Final Program and Abstracts

SIAM Conference on Nonlinear Waves and Coherent Structures

August 11-14, 2014
Churchill College,
University of Cambridge,
United Kingdom

Sponsored by the SIAM Activity Group on Nonlinear Waves and Coherent Structures.

This conference is being held in cooperation with the Institute of Mathematics and its Applications (IMA).

The Activity Group on Nonlinear Waves & Coherent Structures (NWCS) fosters collaborations among applied mathematicians, physicists, fluid dynamicists, engineers, and biologists in those areas of research related to the theory, development, and use of nonlinear waves and coherent structures. It promotes and facilitates nonlinear waves and coherent structures as an academic discipline; brokers partnerships between academia, industry, and government laboratories; and works with other professional societies to promote NWCS.

The activity group organizes the biennial SIAM Conference on Nonlinear Waves & Coherent Structures; awards The Martin Kruskal Lecture every two years to recognize a notable body of mathematics and contributions in the field of nonlinear waves and coherent structures; and maintains a website, a member directory, and an electronic mailing list.

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SIAM Registration Desk

The SIAM registration desk is located in the Main Foyer - Concourse (Ground Floor). It is open during the following hours:

Sunday, August 10
5:00 PM - 7:00 PM

Monday, August 11
7:00 AM - 5:00 PM

Tuesday, August 12
7:45 AM - 5:00 PM

Wednesday, August 13
7:45 AM - 5:00 PM

Thursday, August 14
7:45 AM - 5:00 PM

Conference Location

All sessions and on-site registration will take place on the main campus of Churchill College. A campus map is located online at *https://www.chu.cam.ac.uk/student-hub/resources/college-map/*, and is also included on the back of this program.

The website for the Churchill College is *https://www.chu.cam.ac.uk/*.

Churchill College Housing Telephone Number

In the event of an emergency, messages may be left for attendees staying in Churchill College housing at 00 44 (0)1223 336000.

Child Care

The childcare office at the University of Cambridge operates the Cambridge Universities Holiday Playscheme for school age children, and delegates are invited to book places on the summer Playscheme. For more information on Playscheme please go to: *www.cam.ac.uk/playscheme*.

Attendees planning to bring their child and book accommodation at Churchill College should have received permission from the Bursar. The Bursar needs to review and consider all requests to bring children to the college. An adult must be with the child at all times, and each child must share a bedroom with an adult. All requests must have been made by July 14, 2014. Child care arrangements may not be made onsite.

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List current June 2014

Funding Agencies

SIAM and the Conference Organizing Committee wish to extend their thanks and appreciation to the U.S. National Science Foundation and the Office of Naval Research Global (ONRG) for their support of this conference.

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Standard Audio/Visual Set-Up in Meeting Rooms

Each meeting room is equipped with an LCD projector, screen, whiteboard and flip chart.

SIAM does not provide computers, however, Wolfson Auditorium is equipped with one PC which will be made available to presenters speaking in this room. **All other speakers must provide their own computers**. Additionally, speakers must provide their own cables/adaptors to connect to the LCD projectors. A VGA input cable is the standard cable required to connect to the data projectors.

SIAM, Churchill College and JRA are not responsible for the safety and security of speakers' computers.

Plenary Sessions Live Streaming

The plenary sessions will be streamed live from Jock Colville Hall, located in the Archives Center. If there is limited seating in Wolfson Hall, attendees are encouraged to view the presentation from Jock Colville Hall.

Internet Access

Complimentary high-speed wireless Internet access is available at Churchill College. To access Churchill College wireless Internet, select the "Churchill College" network. You do not need a password to access the wifi.

Churchill College is planning to have wireless Internet access available in ensuite bedrooms by July 2014. At the time of the publication, Internet access is available in all bedrooms via an Ethernet cable point. Cables are available to purchase from the Porters' Lodge or delegates can bring their own.

Conference Registration Fee Includes

- Admission to all technical sessions
- Business Meeting *(open to SIAG/NWCS members)*
- Internet access
- Morning and afternoon tea, coffee and biscuits daily
- Reception and Poster Session
- Room set-ups and audio/visual equipment

Job Postings

Please check with the SIAM registration desk regarding the availability of job postings or visit *http://jobs.siam.org.*

Important Notice to Poster Presenters

The poster session is scheduled for Tuesday, August 12, 8:00 PM - 10:00 PM. Presenters are requested to put up their posters no later than 8:00 PM on Tuesday, the official start time of the session. Boards will be available to presenters beginning at 9:00 AM on Monday, August 11. Posters must be removed by 5:00 PM on Thursday, August 14.

Poster boards will be 1m wide x 2m high. **Attendees are responsible for providing their own Velcro to adhere to the poster board.**

SIAM Books and Journals

Display copies of books and complimentary copies of journals will be available on site. SIAM books are available at a discounted price during the conference. Titles on Display forms will be available with instructions on how to place a book order.

Name Badges

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Comments?

Comments about SIAM meetings are encouraged! Please send to:

Cynthia Phillips, SIAM Vice President for Programs (*vpp@siam.org*).

Get-togethers

- Reception and Poster Session

  Tuesday, August 12

  8:00 PM - 10:00 PM

- SIAG/NWCS Business Meeting *(open to SIAG/NWCS members)*

  Wednesday, August 13

  8:00 PM - 8:45 PM

  Complimentary beer and wine will be served.

Please Note

SIAM, Churchill College and JRA are not responsible for the safety and security of attendees' computers. Do not leave your laptop computers unattended. Please remember to turn off your cell phones, pagers, etc. during sessions.

Recording of Presentations

Audio and video recording of presentations at SIAM meetings is prohibited without the written permission of the presenter and SIAM.

Social Media

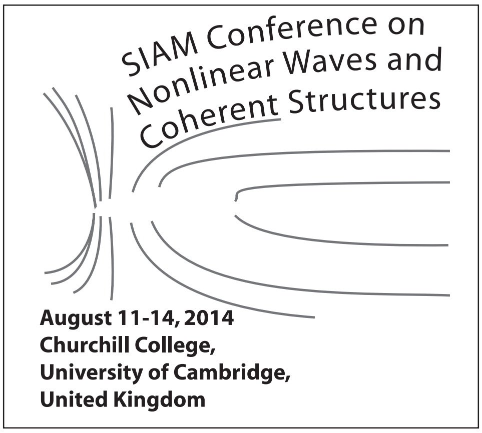
SIAM is promoting the use of social media, such as Facebook and Twitter, in order to enhance scientific discussion at its meetings and enable attendees to connect with each other prior to, during and after conferences. If you are tweeting about a conference, please use the designated hashtag to enable other attendees to keep up with the Twitter conversation and to allow better archiving of our conference discussions. The hashtag for this meeting is #SIAMNW14.

SIAM Activity Group on Nonlinear Waves and Coherent Structure (SIAG/NWCS)

www.siam.org/activity/nwcs

A GREAT WAY TO GET INVOLVED!

Collaborate and interact with mathematicians and applied scientists whose work involves nonlinear waves and coherent structures.



ACTIVITIES INCLUDE:

- Special sessions at SIAM Annual Meetings
- Biennial conference
- Martin D. Kruskal Lecture
- Website

BENEFITS OF SIAG/NWSC membership:

- Listing in the SIAG's online membership directory
- Additional $10 discount on registration at the SIAM Conference on Nonlinear Waves and Coherent Structures (excludes student)
- Electronic communications about recent developments in your specialty
- Eligibility for candidacy for SIAG/NWCS office
- Participation in the selection of SIAG/NWCS officers

ELIGIBILITY:

- Be a current SIAM member.

COST:

- $10 per year
- Student members can join two activity groups for free!

2013-14 SIAG/NWCS OFFICERS

- Chair: Edgar Knobloch, University of California Berkeley
- Vice Chair: Margaret Beck, Boston University
- Program Director: Paul Milewski, University of Bath
- Secretary: Richard Moore, New Jersey Institute of Technology

TO JOIN:

SIAG/NWCS: *my.siam.org/forms/join_siag.htm*

SIAM: *www.siam.org/joinsiam*

Invited Plenary Speakers

*** All Invited Plenary Presentations will take place in Wolfson Auditorium - Wolfson Hall***

Monday, August 11

10:45 AM - 11:30 AM

IP1 Stability and Synchrony in the Kuramoto Model
Jared Bronski, *University of Illinois at Urbana-Champaign, USA*

1:00 PM - 1:45 PM

IP2 Integrability: Initial- Boundary Value Problems in 1+1, and Solitons in 3+1
Thanasis Fokas, *University of Cambridge, United Kingdom*

Tuesday, August 12

10:45 AM - 11:30 AM

IP3 Minimal Models for Precipitating Convection

Leslie Smith, *University of Wisconsin, USA*

1:00 PM - 1:45 PM

IP4 Coherent Structures in 2D Turbulence: Identification and their Use

Rich Kerswell, *University of Bristol, United Kingdom*

Invited Plenary Speakers

*** All Invited Plenary Presentations will take place in Wolfson Auditorium - Wolfson Hall***

Wednesday, August 13

10:45 AM - 11:30 AM

IP5 A Neural Field Model of Binocular Rivalry Waves

Paul C. Bressloff, *University of Utah, USA and University of Oxford, United Kingdom*

1:00 PM - 1:45 PM

IP6 Engineering Extreme Materials with Defects and Nonlinearity

Chiara Daraio, *ETH Zürich, Switzerland and California Institute of Technology, USA*

Thursday, August 14

10:45 AM - 11:30 AM

IP7 Momentum Maps, Shape Analysis and Solitons

Darryl D. Holm, *Imperial College London, United Kingdom and Los Alamos National Laboratory, USA*

1:00 PM - 1:45 PM

IP8 Symmetry, Modulation and Nonlinear Waves

Tom J. Bridges, *University of Surrey, United Kingdom*

Prize Lecture

*** The Prize Lecture will take place in Wolfson Auditorium - Wolfson Hall***

Monday, August 11

8:15 PM - 9:00 PM

SP1: Martin D. Kruskal Prize Lecture -
Nonlinear Waves from Beaches to Photonics

Based on work of Kruskal et al the Korteweg-deVries equation was found to have many remarkable properties. These properties are shared by many other equations including the 2D Kadomtsev-Petvishvili (KP) equation, which arises in the study of shallow water waves. Some solutions of KP and their relation to waves on shallow beaches will be discussed. Nonlinear waves in photonic periodic lattices will also be described; "photonic graphene" is a remarkable case. Since this is an evening lecture, equations and details will be kept to a minimum, and the lecture will be colloquium style.

Mark Ablowitz, *University of Colorado, USA*

NW14 Program

SIAM Conference on
Nonlinear Waves and
Coherent Structures

August 11-14, 2014
Churchill College,
University of Cambridge,
United Kingdom

Sunday, August 10

Registration

5:00 PM-7:00 PM

Room:Main Foyer - Concourse (Ground Floor)

Monday, August 11

Registration

7:00 AM-5:00 PM

Room:Main Foyer - Concourse (Ground Floor)

Monday, August 11

MS1

Boundary-value Problems for Linear and Nonlinear Integrable Problems - Part I of III

8:00 AM-10:00 AM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS9

In the last decade the use of a new method for solving boundary value problems due to Fokas has been expanded by him, his collaborators, and others. This method contains the classical solution methods as special cases and allows for the explicit solution of problems which could not previously be solved. This session will bring together practitioners of the Fokas Method and expose interested parties to the many applications of this technique.

Organizer: Natalie E. Sheils
University of Washington, USA

Organizer: Bernard Deconinck
University of Washington, USA

8:00-8:25 The Fokas Method for Interface Problems

Natalie E. Sheils, University of Washington, USA

8:30-8:55 The Unified Transform for the NLS with t-Periodic Boundary Conditions

Athanassios S. Fokas, University of Cambridge, United Kingdom

9:00-9:25 The Initial Value Problem in Analytic Spaces of Nonlinear Evolution Equations with Traveling Wave Solutions

Alex Himonas, University of Notre Dame, USA

9:30-9:55 On Rigorous Aspects of the Unified Transform Method

Dionyssis Mantzavinos, University of Notre Dame, USA

Monday, August 11

MS2

Novel Challenges in Atomic Gases: Bose-Einstein condensates and Beyond

8:00 AM-10:00 AM

Room:Jock Colville Hall - Archives Center

In recent years, we have witnessed novel developments in the field of ultracold quantum gases. These have spanned a wide range of directions including spin-orbit Bose-Einstein condensates, Dirac-type systems, Bose-Fermi mixtures, and exciton-polariton condensates and their solitary wave excitations (solitons, vortices, vortex rings). This minisymposium touches, via a diverse cohort of experts, upon the current state-of-the-art in this field and the challenges that lie ahead. A balanced perspective encompassing theory, computation and experiment will be sought that should be of value to newcomers, as well as to seasoned researchers in the field.

Organizer: Ricardo Carretero
San Diego State University, USA

Organizer: Panayotis Kevrekidis
University of Massachusetts, Amherst, USA

8:00-8:25 Pattern Formation in Solid State Condensates

Natalia G. Berloff, University of Cambridge, United Kingdom

8:30-8:55 Motion in a Bose-Einstein Condensate: Vortices, Turbulence and Wakes

Carlo F. Barenghi, George Stagg, and Nick G. Parker, Newcastle University, United Kingdom

9:00-9:25 Intrinsic Photoconductivity of Ultracold Fermions in An Optical Lattice

Christoph Becker, Jannes Heinze, Jasper Krauser, Nick Flaeschner, Soeren Goetze, Alexander Itin, Ludwig Mathey, and Klaus Sengstlock, Universitat Hamburg, Germany

9:30-9:55 Quantum Hall Effect and Transport Phenomena in Lossy Photonic Lattices

Tomoki Ozawa, Universita di Trento, Italy

Monday, August 11

MS3

Large Time Behavior in Schrödinger Equations from Different Perspectives - Part I of III

8:00 AM-10:00 AM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS11

Partial differential equations of linear and/or nonlinear Schrödinger type furnish a canonical description of wave propagation in dispersive media. These equations have numerous applications, ranging from quantum mechanics, fiber optics, plasma physics and the description of water waves. One of the most important problems in the mathematical analysis of these equations concerns the precise description of solutions over long times. The proposed minisymposium will bring together experts in the analysis of Schrödinger equations who will give an overview of the current state-of-the art of the mathematical theory invoking several different perspectives, such as stochastics, geometry, and high frequency analysis.

Organizer: Christof Sparber
University of Illinois, Chicago, USA

Organizer: Remi Carles
CNRS & Universite Montpellier 2, France

8:00-8:25 Scattering for Nonlinear Schrödinger Equations under Partial Harmonic Confinement

Remi Carles, CNRS & Universite Montpellier 2, France

8:30-8:55 On the Long-Time Behavior of NLS in the Partially Periodic Setting

Nicola Visciglia, University of Pisa, Italy

9:00-9:25 Asymptotic Stability for Nls with Nonlinear Point Interactions

Riccardo Adami, Politecnico di Torino, Italy

9:30-9:55 Some Collision Problems Related to Nonlinear Schrödinger Equations

Claudio Munoz, University of Paris, Orsay, France

Monday, August 11

MS4

Nonlinear Dynamics of Granular Crystals - Part I of II

8:00 AM-10:00 AM

Room:Recital Room - Music Center

For Part 2 see MS12

Granular crystals are defined as ordered aggregates of elastically interacting particles. They can be assembled as homogeneous, heterogeneous, one-dimensional or even higher dimensional structures and can be tailored to have tunable nonlinear responses. This tunability makes granular crystals relevant for a host of engineering applications, including e.g. shock absorbing layers, acoustic lenses and sound scramblers. In that light, and in connection also to the plenary talk by Professor Chiara Daraio, the aim of this minisymposium is to bring together researchers studying problems in this field with view points from application, experiment, computation and analysis.

Organizer: Christopher Chong
University of Massachusetts, Amherst, USA

Organizer: Miguel Moleron
ETH Zürich, Switzerland

8:00-8:25 Justification of Leading Order Quasicontinuum Approximations of Strongly Nonlinear Lattices

Christopher Chong, University of Massachusetts, Amherst, USA; Panayotis Kevrekidis, University of Massachusetts, Amherst, USA; Guido Schneider, University of Stuttgart, Germany

8:30-8:55 Acoustic Wave Filtering and Breather Formation in Coupled Granular Chains Embedded in Material Matrix

Alexander Vakakis, M. Arif Hasan, Sinhu Cho, D. Michael McFarland, and Waltraud M. Kriven, University of Illinois, USA

continued on next page

Monday, August 11

MS4

Nonlinear Dynamics of Granular Crystals - Part I of II

8:00 AM-10:00 AM

continued

9:00-9:25 An Asymptotic Model for Small Amplitude Solutions to Newton's Cradle

Brigitte Bidegaray-Fesquet, CNRS and Grenoble University, France; Eric Dumas and Guillaume James, Université de Grenoble and CNRS, France

9:30-9:55 Transitions from Energy Entrapment to Energy Transport in the System of N Coupled Granular Chains

Yuli Starosvetsky, Technion - Israel Institute of Technology, Israel

Monday, August 11

MS5

SPDEs and Patterns

8:00 AM-10:00 AM

Room:Club Room - Concourse (1st Floor)

Patterns and waves arise in many physical applications. A wide range of theoretical and numerical approaches have been developed for understanding their formation and dynamics in deterministic spatially extended PDEs. Less is known about the influence of noise on patterns and nonlinear waves. This minisymposium aims to bring together the 'deterministic' and 'stochastic' communities interested in SPDEs, pattern formation and wave dynamics with the goal of identifying common directions and problems.

Organizer: Christian Kuehn
Vienna University of Technology, Austria

Organizer: Bjorn Sandstede
Brown University, USA

8:00-8:25 Noise Induced State Transitions, Intermittency and Universality in the Noisy Kuramoto-Sivashinsky Equation

Greg Pavliotis, Imperial College London, United Kingdom

8:30-8:55 Not Available at Time of Publication

Gabriel J. Lord, Heriot-Watt University, United Kingdom

9:00-9:25 Interfaces in a Random Environment

Nicolas Dirr, Cardiff University, United Kingdom

9:30-9:55 Stability of Traveling Waves in Bistable Reaction-Diffusion Equations

Wilhelm Stannat, Technische Universität Berlin, Germany

Monday, August 11

MS6

Waves in Cell and Developmental Biology

8:00 AM-10:00 AM

Room:Bevin Room - Wolfson Hall

Ever since the seminal work of Hodgkin-Huxley on the axonal propagation of action potentials, cell biology has been a major source of interesting problems in the mathematical modeling and analysis of nonlinear waves. In recent years there has been a growing interest in the functional role of intracellular and intercellular waves, based on variations in the concentration of signaling molecules (calcium, kinases, phosphotases, morphogens) and cytoskeletal structures. Applications include cell polarization, cell motility, cell growth, synaptic plasticity, neuronal development, and embryogenesis. We review some of these applications in this minisymposium.

Organizer: Paul C. Bressloff
University of Utah, USA and University of Oxford, United Kingdom

8:00-8:25 Clock and Wavefront Model of Somitogenesis

Ruth E. Baker, University of Oxford, United Kingdom

8:30-8:55 Actin Polymerization and Subcellular Mechanics Drive Nonlocal Excitable Waves in Living Cells

Jun Allard, University of California, Irvine, USA

9:00-9:25 Actin Nucleation Waves in Motile Cells

William R. Holmes, University of California, Irvine, USA

9:30-9:55 Ca2+/calmodulin-Dependent Protein Kinase Waves in Heterogeneous Spiny Dendrites

Paul C. Bressloff, University of Utah, USA and University of Oxford, United Kingdom

Monday, August 11

MS7

Differential Geometry and Lie Groups in Continuum Modelling

8:00 AM-10:00 AM

Room:Cockcroft Room - Concourse (Ground Floor)

Many continuum field theories such as fluids and solids have differential geometric descriptions. For example, in-viscid in-compressible fluid equations were characterized by V.I. Arnold as right trivialized geodesic equations on the psuedo-Lie group of volume preserving diffeomorphisms. In this minisymposium we will discuss examples of computational and analytical models which benefit from these geometric descriptions.

Organizer: Henry O. Jacobs
Imperial College London, United Kingdom

8:00-8:25 Geometric Theory of Garden Hose Dynamics
Vakhtang Putkaradze, University of Alberta, Canada

8:30-8:55 Using Multi-Moment Vortex Methods to Study Merger
David T. Uminsky, University of San Francisco, USA

9:00-9:25 Structure-preserving Discretization of Fluid Mechanics
Dmitry Pavlov, Imperial College London, United Kingdom

9:30-9:55 Jet-Particle Methods for Incompressible Fluids
Colin Cotter, Imperial College London, United Kingdom; Darryl D. Holm, Imperial College London, United Kingdom and Los Alamos National Laboratory, USA; *Henry Jacobs*, Imperial College London, United Kingdom

Monday, August 11

MS8

Enhanced Dissipation in Fluids

8:00 AM-10:00 AM

Room:JCR Games Room – Concourse (Ground Floor)

Typically, in fluid models, one main source of dissipation is the viscosity. However, there are many examples of fluid models in which temporal decay occurs at a much faster rate than one would expect on the basis of viscous effects alone. Recently mathematical and physical explanations of this enhanced dissipation have been proposed in a number of settings including weakly viscous vortices, strongly sheared flows, and Landau damping. This minisymposium will bring together speakers working on each of these problems to explore similarities and differences between the dissipation mechanism in each of these cases.

Organizer: Margaret Beck
Boston University, USA

Organizer: C. Eugene Wayne
Boston University, USA

8:00-8:25 Inviscid Damping and the Asymptotic Stability of Planar Shear Flows in the 2D Euler Equations
Jacob Bedrossian, Courant Institute of Mathematical Sciences, New York University, USA

8:30-8:55 Large Deviations for Stochastic Partial Differential Equations with Applications in Planetary Atmosphere Dynamics
Freddy Bouchet, ENS Lyon, France

9:00-9:25 Center Manifolds and Taylor Disperson
Osman Chaudhary, Boston University, USA

9:30-9:55 Pseudospectrum for Oseen Vortices Operators
Wen Deng, Lund University, Sweden

Monday, August 11

CP1

Internal Waves and Related Problems

8:00 AM-10:00 AM

Room:Tizard Room - Concourse (1st Floor)

Chair: Paolo Luzzatto-Fegiz, University of Cambridge, United Kingdom

8:00-8:15 Internal Waves Incident Upon An Interface
John P. Mchugh, University of New Hampshire, USA

8:20-8:35 Laboratory Experiments and Simulations for Solitary Internal Waves with Trapped Cores
Paolo Luzzatto-Fegiz, University of Cambridge, United Kingdom; Karl Helfrich, Woods Hole Oceanographic Institute, USA

8:40-8:55 Mcc Type Strongly Nonlinear Internal Wave Models
Tae-Chang Jo, Inha University, Korea

9:00-9:15 Nonlinear Harmonic Generation by Internal Wave Refraction
Scott E. Wunsch, Johns Hopkins University, USA

9:20-9:35 Cylindrical Korteweg-De Vries Type Equation for Internal and Surface Ring Waves on a Shear Flow
Xizheng Zhang and Karima Khusnutdinova, Loughborough University, United Kingdom

9:40-9:55 The Rogue Wave Solutions of the Kpi
Jingsong He, Ningbo University, China

Coffee Break

10:00 AM-10:30 AM

Room:Concourse/Buttery (Ground Floor)

Monday, August 11

Welcoming Remarks

10:30 AM-10:45 AM

Room:Wolfson Auditorium - Wolfson Hall

IP1

Stability and Synchrony in the Kuramoto Model

10:45 AM-11:30 AM

Room:Wolfson Auditorium - Wolfson Hall

Chair:Jianke Yang, University of Vermont, USA

The phenomenon of the synchronization of weakly coupled oscillators is a old one, first been described by Huygens in his 'Horoloquium Oscilatorium.' Some other examples from science and engineering include the cardiac pacemaker, the instability in the Millenium Bridge, and the synchronous flashing of fireflies. A canonical model is the Kuramoto model

$$\frac{d\theta_i}{dt}=\omega_i+\gamma\sum_j \sin(\theta_j-\theta_i)$$

We describe the fully synchronized states of this model together with the dimensions of their unstable manifolds. Along the way we will encounter a high dimensional polytope, a Coxeter group, and a curious combinatorial identity. This leads to a proof of the existence of a phase transition in the case where the frequencies are chosen from as iid Random variables.

Jared Bronski
University of Illinois at Urbana-Champaign, USA

Lunch Break

11:30 AM-1:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Monday, August 11

IP2

Integrability: Initial-Boundary Value Problems in 1+1, and Solitons in 3+1

1:00 PM-1:45 PM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Beatrice Pelloni, Uniersity of Reading, United Kingdom

A review will be presented of the two most challenging problems in the analysis of integrable nonlinear evolution equations: (a) initial- boundary value problems in 1+1, i.e. evolution equations in one spatial variable, and (b) the construction and solution of equations in 3+1. Regarding (a), it will be shown that the so- called unified transform, which provides the proper generalization of the inverse scattering transform, yields effective formulae for the large t- asymptotics of a variety of physically significant problems; this includes problems on the half-line with t-periodic boundary conditions. Regarding (b), an integrable generalization of the Davey-Stewardson equation 4+2, i.e. four spatial and two time variables, will be presented. A reduction of this equation to an equation in 3+1 will also be discussed. Furthermore, one and two soliton solutions for both the 4+2 and 3+1 Davey-Stewardson equations will be presented.

Thanasis Fokas
University of Cambridge, United Kingdom

Intermission

1:45 PM-2:00 PM

Monday, August 11

MS9

Boundary-value Problems for Linear and Nonlinear Integrable Problems - Part II of III

2:00 PM-4:00 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 1 see MS1
For Part 3 see MS17

In the last decade the use of a new method for solving boundary value problems due to Fokas has been expanded by him, his collaborators, and others. This method contains the classical solution methods as special cases and allows for the explicit solution of problems which could not previously be solved. This session will bring together practitioners of the Fokas Method and expose interested parties to the many applications of this technique.

Organizer: Natalie E. Sheils
University of Washington, USA

Organizer: Bernard Deconinck
University of Washington, USA

2:00-2:25 Well-Posedness and Spectral Representation of Linear Initial-Boundary Value Problems

David Smith, University of Crete, Greece

2:30-2:55 A Retrospective Inverse Problem for the Wave Equation

Vishal Vasan, Pennsylvania State University, USA

3:00-3:25 Mixed Boundary Value Problems for Stokes Flows: New Methods and Applications

Darren G. Crowdy, Imperial College London, United Kingdom

3:30-3:55 The Nonlinear Schrödinger Equation with Periodic Boundary Data

Jonatan Lenells, Baylor University, USA

Monday, August 11

MS10

Modeling and Prediction of Geophysical Flows - Part I of II

2:00 PM-4:00 PM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS18

This set of presentations addresses waves, coherent structures, instabilities and turbulence in a variety of geophysical settings. A central goal is to isolate dynamical mechanisms fundamental for modeling and prediction in applications.

Organizer: Leslie Smith
University of Wisconsin, USA

2:00-2:25 A Coupled Model of the Interactions Between Inertial Waves and Turbulence in the Ocean

Jacques Vanneste and Jin-Han Xie, University of Edinburgh, United Kingdom

2:30-2:55 Not Available at Time of Publication

Jean-Marc Chomaz, Ecole Polytechnique, France

3:00-3:25 Centrifugal, Barotropic and Baroclinic Instabilities of Isolated Ageostrophic Anticyclones in the Two-layer Rotating Shallow Water Model and their Nonlinear Saturation

Vladimir Zeitlin, ENS/University of Paris 6, France; Noé Lahaye, University of Paris VI, France

3:30-3:55 Dissection of Boussinesq Non-linear Interactions Using Intermediate Models

Gerardo Hernandez-Duenas, University of Wisconsin, Madison, USA; Leslie Smith, University of Wisconsin, USA; Samuel Stechmann, University of Wisconsin, Madison, USA

Monday, August 11

MS11

Large Time Behavior in Schrödinger Equations from Different Perspectives - Part II of III

2:00 PM-4:00 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 1 see MS3
For Part 3 see MS19

Partial differential equations of linear and/or nonlinear Schrödinger type furnish a canonical description of wave propagation in dispersive media. These equations have numerous applications, ranging from quantum mechanics, fiber optics, plasma physics and the description of water waves. One of the most important problems in the mathematical analysis of these equations concerns the precise description of solutions over long times. The proposed minisymposium will bring together experts in the analysis of Schrödinger equations who will give an overview of the current state-of-the art of the mathematical theory invoking several different perspectives, such as stochastics, geometry, and high frequency analysis.

Organizer: Christof Sparber
University of Illinois, Chicago, USA

Organizer: Remi Carles
CNRS & Universite Montpellier 2, France

2:00-2:25 Selection Principles for Semiclassical Flows over Conical Singularities: Asymptotic and Computational Investigation

Agisilaos Athanassoulis, University of Leicester, United Kingdom

2:30-2:55 Nonlinear Propagation of Coherent States Through Avoided Energy Level Crossing

Lysianne Hari, Universite de Cergy-Pontoise, France

3:00-3:25 Dispersion and Long Time Evolution of Coherent States

Roman Schubert, University of Bristol, United Kingdom

3:30-3:55 Dispersive Estimates for Non-Autonomous Hamiltonians and Applications to Nonlinear Asymptotic Stability of Solitary Waves

Eduard Kirr, University of Illinois at Urbana-Champaign, USA

Monday, August 11

MS12

Nonlinear Dynamics of Granular Crystals - Part II of II

2:00 PM-4:00 PM

Room:Recital Room - Music Center

For Part 1 see MS4

Granular crystals are defined as ordered aggregates of elastically interacting particles. They can be assembled as homogeneous, heterogeneous, one-dimensional or even higher dimensional structures and can be tailored to have tunable nonlinear responses. This tunability makes granular crystals relevant for a host of engineering applications, including e.g. shock absorbing layers, acoustic lenses and sound scramblers. In that light, and in connection also to the plenary talk by Professor Chiara Daraio, the aim of this minisymposium is to bring together researchers studying problems in this field with view points from application, experiment, computation and analysis.

Organizer: Christopher Chong
University of Massachusetts, Amherst, USA

Organizer: Miguel Moleron
ETH Zürich, Switzerland

2:00-2:25 Disordered Granular Chains

Mason A. Porter, University of Oxford, United Kingdom

2:30-2:55 Modulation of Nonlinear Waves in Woodpile Phononic Crystals

Jinkyu Yang and Eunho Kim, University of Washington, USA

3:00-3:25 Granular Crystals at the Microscale

Nicholas Boechler, University of Washington, USA

3:30-3:55 Solitary Waves in a 1D Chain of Repelling Magnets

Miguel Moleron, ETH Zürich, Switzerland; Andrea Leonard, University of Washington, USA; Chiara Daraio, ETH Zürich, Switzerland and California Institute of Technology, USA

Monday, August 11

MS13

Spectral and Geometric Methods in Stability of Waves and Patterns - Part I of V

2:00 PM-4:00 PM

Room:Club Room - Concourse (1st Floor)

For Part 2 see MS21

The purpose of this session is to bring together researchers working on various stability issues for such special solutions of partial differential equations as patterns and waves. All aspects of stability/instability will be discussed, from spectral to nonlinear, with special emphasis on methods of spectral theory. It is expected that the speakers will spend some time of their talks to address possible perspectives in the field of their work as we believe that such a perspective would be not only interesting for the audience but it can also stimulate further discussion and further research in the field.

Organizer: Anna Ghazaryan
Miami University and University of Kansas, USA

Organizer: Yuri Latushkin
University of Missouri, Columbia, USA

2:00-2:25 On the Maslov Index for Periodic and for Multidimensional Problems

Yuri Latushkin, University of Missouri, Columbia, USA

2:30-2:55 Computing the Maslov Index

Simon Malham, Heriot-Watt University, United Kingdom; Margaret Beck, Boston University, USA

3:00-3:25 The Krein Matrix for Quadratic Eigenvalue Problems

Todd Kapitula, Shamuel Auyeung, and Eric Yu, Calvin College, USA

3:30-3:55 Determining Wave Stability Via the Maslov Index

Graham Cox, Chris Jones, and Jeremy L. Marzuola, University of North Carolina, Chapel Hill, USA

Monday, August 11

MS14

Pattern Formation and Evolving Domains

2:00 PM-4:00 PM

Room:Bevin Room - Wolfson Hall

The application of the theory of pattern formation to realistic situations is often constrained by the non-constant nature of the environment, in particular the shape of the domain. However, the pattern formation theory for this context is not yet well developed. In this minisymposium, we bring together researchers with different perspectives on this topic, ranging from modeling, PDE theory and numerics to existence and stability. Evolving domains are seen to be a source of both new, intriguing phenomena and challenging mathematics. Applications cover in particular chemistry (binary gas/liquid mixtures) and biology (evolving tissue, cell motility).

Organizer: Frits Veerman
University of Oxford, United Kingdom

Organizer: Jens Rademacher
University of Bremen, Germany

2:00-2:25 Spatial Patterns on Time-Dependent Domains: Convective and Dilution Effects

Rouslan Krechetnikov, University of California, Santa Barbara, USA; Edgar Knobloch, University of California, Berkeley, USA

2:30-2:55 Recent Advances in Pattern Formation on Growing and Evolving Surfaces: Theory, Numerics and Applications

Anotida Madzvamuse, University of Sussex, United Kingdom

3:00-3:25 Modelling and Simulation of Biological Pattern Formation on Evolving Surfaces

Chandrashekar Venkataraman, University of Sussex, United Kingdom

3:30-3:55 Effect of Dissolution-Driven Convection on the Partial Mixing Between CO2 and Hydrocarbons Or Reactive Solutions

Laurence Rongy, Université Libre de Bruxelles, Belgium

Monday, August 11

MS15

Integrable Systems: Analysis, Geometry, and Applications - Part I of II

2:00 PM-4:00 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 2 see MS23

The minisymposium brings together specialists studying nonlinear waves in integrable evolution equations. The particular emphasis will be given to recent analytical studies of Backlund transformation, inverse scattering, and conserved quantities in the context of global well-posedness of the Cauchy problem, as well as orbital and asymptotic stability of breathers and solitons, including multi-solitons. From another direction, recent work in geometry of integrable systems has led to new sources of analytical problems arising from geodesic flows in circle diffeomorphism groups and inelastic curve flows in Klein geometries. These problems involve the study of periodic peakons and multi-component peakons, as well as multi-component solitons.

Organizer: Stephen Anco
Brock University, Canada

Organizer: Dmitry Pelinovsky
McMaster University, Canada

2:00-2:25 Stability of mKdV Breathers in the Energy Space

Miguel Alejo, IMPA, Brazil

2:30-2:55 On the Interaction of Nonlinear Schödinger Solitary Waves

Claudio Munoz, University of Paris, Orsay, France

3:00-3:25 Stability of Line Standing Waves Near the Bifurcation Point for Nonlinear Schrodinger Equation

Yohei Yamazaki, Kyoto University, Japan

3:30-3:55 On the Dressing Method for Discrete Integrable Systems

Qiao Wang, and Gino Biondini, State University of New York, Buffalo, USA

Monday, August 11

MS16

Coherent Structures in Nonlocal Evolution Equations - Part I of II

2:00 PM-4:00 PM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 2 see MS24

The aim of this minisymposium is to present an overview of some recent and novel analytical techniques developed in the study of coherent structures in nonlocal evolution equations. Talks will range from lattice ODEs over fluid problems to nonlocal reaction-diffusion, all sharing the common feature that nonlocal terms are involved and pose particular mathematical difficulties.

Organizer: Gregory Faye
University of Minnesota, USA

Organizer: Arnd Scheel
University of Minnesota, USA

2:00-2:25 Waves Through Lattices with Impurities

Hermen Jan Hupkes, University of Leiden, The Netherlands; Aaron Hoffman, Franklin W. Olin College of Engineering, USA; Erik Van Vleck, University of Kansas, USA

2:30-2:55 Using Graph Limits for Studying Dynamics of Large Networks

Georgi S. Medvedev, Drexel University, USA

3:00-3:25 Phase Mixing and Hydrodynamic Stability

Jacob Bedrossian, Courant Institute of Mathematical Sciences, New York University, USA

3:30-3:55 Reaction-Diffusion Equations with Spatially Distributed Hysteresis

Pavel Gurevich, Free University of Berlin, Germany

Monday, August 11

CP2

Integrability and Related Problems

2:00 PM-3:20 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Alfredo N. Wetzel, University of Michigan, Ann Arbor, USA

2:00-2:15 Boundary Value Problems for Multidimensional Integrable Nonlinear Pdes

Iasonas Hitzazis, University of Patras, Greece

2:20-2:35 Variable Separation Solutions and Interacting Waves of a Coupled System of the Modified KdV and Potential Blmp Equations

Xiaoyan Tang, East China Normal University, China; Ji Lin, Zhejiang Normal University, China; Zufeng Liang, Hangzhou Normal University, China

2:40-2:55 Explicit Construction of the Direct Scattering Transform for the Benjamin-Ono Equation with Rational Initial Conditions

Alfredo N. Wetzel and Peter D. Miller, University of Michigan, Ann Arbor, USA

3:00-3:15 Model Order Reduction for Coupled Nonlinear Schrödinger Equation

Canan Akkoyunlu, Istanbul Kültür University, Turkey; Murat Uzunca and Bülent Karasözen, Middle East Technical University, Turkey

Coffee Break

4:00 PM-4:30 PM

Room:Concourse/Buttery (Ground Floor)

Monday, August 11

MS17

Boundary-value Problems for Linear and Nonlinear Integrable Problems - Part III of III

4:30 PM-6:00 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS9

In the last decade the use of a new method for solving boundary value problems due to Fokas has been expanded by him, his collaborators, and others. This method contains the classical solution methods as special cases and allows for the explicit solution of problems which could not previously be solved. This session will bring together practitioners of the Fokas Method and expose interested parties to the many applications of this technique.

Organizer: Natalie E. Sheils
University of Washington, USA

Organizer: Bernard Deconinck
University of Washington, USA

4:30-4:55 A New Approach for Linear Elliptic Boundary Value Problems

Anthony Ashton, University of Cambridge, United Kingdom

5:00-5:25 Initial-Boundary-Value Problems for Nonlinear Wave Equations

Jerry Bona, University of Illinois, Chicago, USA

5:30-5:55 The Effect of Boundary Conditions on Linear and Nonlinear Waves

Beatrice Pelloni, University of Reading, United Kingdom

Monday, August 11

MS18

Modeling and Prediction of Geophysical Flows - Part II of II

4:30 PM-6:30 PM

Room:Jock Colville Hall - Archives Center

For Part 1 see MS10

This set of presentations addresses waves, coherent structures, instabilities and turbulence in a variety of geophysical settings. A central goal is to isolate dynamical mechanisms fundamental for modeling and prediction in applications.

Organizer: Leslie Smith
University of Wisconsin, USA

4:30-4:55 On Resurging a Bore-Soliton-Spash
Onno Bokhove, University of Leeds, United Kingdom

5:00-5:25 A Dynamical Scheme for Prescribing Mesoscale Eddy Diffusivity in the Ocean
Scott Bachman, University of Cambridge, United Kingdom; Baylor Fox-Kemper, Brown University, USA

5:30-5:55 Cloud-Edge Dynamics and Mysterious Holes in the Sky
David Muraki, Simon Fraser University, Canada

6:00-6:25 A Strange Gas? Revisiting the Point Vortex Model to Understand the Condensation Process in Two-Dimensional and Quasi-Geostrophic Turbulence
Gavin Esler, University College London, United Kingdom

Monday, August 11

MS19

Large Time Behavior in Schrödinger Equations from Different Perspectives - Part III of III

4:30 PM-6:30 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS11

Partial differential equations of linear and/or nonlinear Schrödinger type furnish a canonical description of wave propagation in dispersive media. These equations have numerous applications, ranging from quantum mechanics, fiber optics, plasma physics and the description of water waves. One of the most important problems in the mathematical analysis of these equations concerns the precise description of solutions over long times. The proposed minisymposium will bring together experts in the analysis of Schrödinger equations who will give an overview of the current state-of-the art of the mathematical theory invoking several different perspectives, such as stochastics, geometry, and high frequency analysis.

Organizer: Christof Sparber
University of Illinois, Chicago, USA

Organizer: Remi Carles
CNRS & Universite Montpellier 2, France

4:30-4:55 Dispersive Blow-Up in Schrödinger Type Equations
Christof Sparber, University of Illinois, Chicago, USA

5:00-5:25 Invariant Gibbs Measures for NLS on the Real Line
Tadahiro Oh, University of Edinburgh, United Kingdom

5:30-5:55 Two-soliton Solutions to a Focusing Cubic Half-wave Equation on R
Oana Pocovnicu, Princeton University, USA

6:00-6:25 Going Beyond the Threshold: Scattering vs. Blow-up Dichotomy in the Focusing NLS Equation
Svetlana Roudenko, George Washington University, USA

Monday, August 11

MS20

Modeling of Optical Combs and Low-Noise Opto-Electronic Sources - Part I of III

4:30 PM-6:30 PM

Room:Recital Room - Music Center

For Part 2 see MS28

In the past decade, new optical devices have been invented and old ones have been refined, leading to a dramatic decrease in the noise floor of time and frequency transfer devices. The devices include opto-electronic oscillators, comb lasers, microresonators, and narrow-linewidth continuous wave lasers. The range of applications is vast and includes astrophysics, telecommunications, medicine, and radio-frequency photonics. The modeling of these devices has not kept pace wit these experimental advances, which have opened up new theoretical problems that are related to solitons and nonlinear dynamics. In this minisymposium, we will highlight recent advances in modeling these devices and point to the new mathematical problems that they have opened.

Organizer: Omri Gat
Hebrew University of Jerusalem, Israel

Organizer: Curtis R. Menyuk
University of Maryland, Baltimore County, USA

Organizer: Stefan Wabnitz
University of Brescia, Italy

4:30-4:55 From Microresonator Combs to Solitons
Michael Gorodetsky, Lomonosov Moscow State University, Russia

5:00-5:25 Kerr Optical Frequency Combs: from Fundamental Theory to Engineering Applications
Yanne Chembo, FEMTO-ST Institute, France

continued on next page

5:30-5:55 Modelocking Quantum Cascade Lasers Using Quantum Coherent Saturable Absorption

Muhammad Talukder, Bangladesh University of Engineering & Technology, Bangladesh; Curtis R. Menyuk, University of Maryland, Baltimore County, USA

6:00-6:25 Pulse Energy Enhancement of Mode Locked Fiber Laser by Cascading Nonlinear Polarization Rotation

Feng Li, Hong Kong Polytechnic University, China; J. Nathan Kutz, University of Washington, USA; P. K. Alex Wai, Hong Kong Polytechnic University, China

Monday, August 11

MS21

Spectral and Geometric Methods in Stability of Waves and Patterns - Part II of V

4:30 PM-6:30 PM

Room:Club Room - Concourse (1st Floor)

For Part 1 see MS13
For Part 3 see MS29

The purpose of this session is to bring together researchers working on various stability issues for such special solutions of partial differential equations as patterns and waves. All aspects of stability/instability will be discussed, from spectral to nonlinear, with special emphasis on methods of spectral theory. It is expected that the speakers will spend some time of their talks to address possible perspectives in the field of their work as we believe that such a perspective would be not only interesting for the audience but it can also stimulate further discussion and further research in the field.

Organizer: Anna Ghazaryan
Miami University and University of Kansas, USA

Organizer: Yuri Latushkin
University of Missouri, Columbia, USA

4:30-4:55 Stability of Fronts in Spatially Inhomogeneous Wave Equations

Gianne Derks and Christopher Knight, University of Surrey, United Kingdom; Arjen Doelman, Leiden University, Netherlands; Hadi Susanto, University of Essex, United Kingdom

5:00-5:25 Spectral Analysis for Transition Front Solutions in Multidimensional Cahn-Hilliard Systems

Peter Howard, Texas A&M University, USA

5:30-5:55 Stability and Computation of Interacting Nonlinear Waves

Wolf-Juergen Beyn, Bielefeld University, Germany

6:00-6:25 A Geometric Approach to Counting Eigenvalues: The Evans Function in Some Cellular Transport Models

Robert Marangell, University of Sydney, Australia

Monday, August 11

MS22

Patterns in Many-body Collective Motion

4:30 PM-6:30 PM

Room:Bevin Room - Wolfson Hall

Patterns in many-body dynamics -- as seen in traffic flow, broadly defined as collections of cars or people, and in aggregation equations, used to model biological “swarms” of bacteria and chemical self-assembly -- are ubiquitous in the natural world. These phenomena are generally studied numerically, but some cases, such as the aggregation equations, have recently become analytically tractable, usually through studying an associated continuum limit of a discrete particle model. This minisymposium brings together researchers from a diverse set of problems all related to the study of patterns arising from many-body interactions on computational, analytical, and experimental levels.

Organizer: Scott McCalla
University of California, Los Angeles, USA

Organizer: Martin Short
Georgia Institute of Technology, USA

4:30-4:55 Contagion Shocks in One Dimension

Martin Short, Georgia Institute of Technology, USA; Andrea L. Bertozzi, Li Wang, and Jesus Rosado, University of California, Los Angeles, USA

5:00-5:25 Agent-Based and Continuum Models for the Formation of Stripes in Zebrafish

Alexandria Volkening and Bjorn Sandstede, Brown University, USA

5:30-5:55 Co-Dimension One Self-Assembly

James von Brecht, University of California, Los Angeles, USA

6:00-6:25 Front Propagation in Bacterial Suspensions

Ray E. Goldstein, University of Cambridge, United Kingdom

Monday, August 11

MS23

Integrable Systems: Analysis, Geometry, and Applications - Part II of II

4:30 PM-6:30 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 1 see MS15

The minisymposium brings together specialists studying nonlinear waves in integrable evolution equations. The particular emphasis will be given to recent analytical studies of Backlund transformation, inverse scattering, and conserved quantities in the context of global well-posedness of the Cauchy problem, as well as orbital and asymptotic stability of breathers and solitons, including multi-solitons. From another direction, recent work in geometry of integrable systems has led to new sources of analytical problems arising from geodesic flows in circle diffeomorphism groups and inelastic curve flows in Klein geometries. These problems involve the study of periodic peakons and multi-component peakons, as well as multi-component solitons.

Organizer: Stephen Anco
Brock University, Canada

Organizer: Dmitry Pelinovsky
McMaster University, Canada

4:30-4:55 The Analysis of a Class of Integrable Evolution Equations
Alex Himonas, University of Notre Dame, USA

5:00-5:25 Integrable Equations in 3D: Deformations of Dispersionless Limits
Vladimir Novikov, Loughborough University, United Kingdom

5:30-5:55 Well Posedness and Breakdown for Cauchy Problems of Integrable Equations
Feride Tiglay, The Ohio State University, USA

6:00-6:25 Geometric Wave Equations with Multi-component Solitons
Stephen Anco, Brock University, Canada

Monday, August 11

MS24

Coherent Structures in Nonlocal Evolution Equations - Part II of II

4:30 PM-6:30 PM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 1 see MS16

The aim of this minisymposium is to present an overview of some recent and novel analytical techniques developed in the study of coherent structures in nonlocal evolution equations. Talks will range from lattice ODEs over fluid problems to nonlocal reaction-diffusion, all sharing the common feature that nonlocal terms are involved and pose particular mathematical difficulties.

Organizer: Gregory Faye
University of Minnesota, USA

Organizer: Arnd Scheel
University of Minnesota, USA

4:30-4:55 From Particle to Kinetic and Hydrodynamic Models of Flocking
Trygve K. Karper, Norwegian University of Science and Technology, Norway

5:00-5:25 A Spectral Theory of Linear Operators on a Gelfand Triplet and Its Application to the Dynamics of Coupled Oscillators
Hayato Chiba, Kyushu University, Japan

5:30-5:55 Pacemakers in a Large Array of Oscillators with Nonlocal Coupling
Gabriela Jaramillo, University of Minnesota, USA

6:00-6:25 A Tale of Two Distributions: from Few to Many Vortices In Quasi-Two-Dimensional Bose-Einstein Condensates
Theodore Kolokolnikov, Dalhousie University, Canada; Panayotis Kevrekidis, University of Massachusetts, Amherst, USA; Ricardo Carretero, San Diego State University, USA

Monday, August 11

CP3

Solitary Waves and Related Problems

4:30 PM-6:30 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: John P. Boyd, University of Michigan, Ann Arbor, USA

4:30-4:45 Resonance, Small Divisors and the Convergence of Newton's Iteration to Solitons
John P. Boyd, University of Michigan, Ann Arbor, USA

4:50-5:05 Solitary Wave Perturbation Theory for Hamiltonian Systems
Lake Bookman and Mark A. Hoefer, North Carolina State University, USA

5:10-5:25 Orbital Stability of Solitary Shallow Water Waves of Moderate Amplitude
Anna Geyer, Universitat Autònoma de Barcelona, Spain; Nilay Duruk Mutlubas, Kemerburgaz University, Istanbul, Turkey

5:30-5:45 Velocity Field in Parametrically Excited Solitary Waves
Leonardo Gordillo, Universite Paris 7-Denis Diderot, France; Nicolas Mujica, Universidad de Chile, Chile

5:50-6:05 Solitary Waves and an *N*-particle Algorithm for a Class of Euler-Poincaré Equations
Long Lee, University of Wyoming, USA; Roberto Camassa, University of North Carolina, Chapel Hill, USA; Dongyang Kuang, University of Wyoming, USA

6:10-6:25 The (1+2)-Dimensional Sine-Gordon Equation: Soliton Solutions and Spatially Extended Relativistic Particles
Yair Zarmi, Ben-Gurion University of the Negev, Israel

Dinner Break

6:30 PM-8:00 PM

Attendees on their own. Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Martin D. Kruskal Prize Presentation

8:00 PM-8:15 PM

Room:Wolfson Auditorium - Wolfson Hall

Monday, August 11

SP1

Martin D. Kruskal Prize Lecture - Nonlinear Waves from Beaches to Photonics

8:15 PM-9:00 PM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Edgar Knobloch, University of California, Berkeley, USA

Based on work of Kruskal et al the Korteweg-deVries equation was found to have many remarkable properties. These properties are shared by many other equations including the 2D Kadomtsev-Petvishvili (KP) equation, which arises in the study of shallow water waves. Some solutions of KP and their relation to waves on shallow beaches will be discussed. Nonlinear waves in photonic periodic lattices will also be described; "photonic graphene" is a remarkable case. Since this is an evening lecture, equations and details will be kept to a minimum, and the lecture will be colloquium style.

Mark Ablowitz, University of Colorado, USA

Tuesday, August 12

Registration

7:45 AM-5:00 PM

Room:Main Foyer - Concourse (Ground Floor)

MS25

Inverse Scattering Transform and Riemann--Hilbert Problems - Part I of III

8:10 AM-10:10 AM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS32

Since the inverse scattering transform was introduced to linearize integrable nonlinear PDEs, a large body of knowledge has been accumulated on these systems. Riemann-Hilbert problems (RHPs) have proven to be a powerful tool for the study of integrable systems [e.g., in the formulation of the inverse problem and for asymptotic analysis of the solutions], and found many connections to other areas of pure and applied mathematics. The session aims at bringing together leading researchers in these areas, and at offering a broad overview of some of the current research activities at the frontier of pure and applied mathematics.

Organizer: Barbara Prinari
University of Colorado, Colorado Springs, USA

Organizer: Gino Biondini
State University of New York, Buffalo, USA

8:10-8:35 The Unified Transform and the Riemann-Hilbert Formalism

Athanassios S. Fokas, University of Cambridge, United Kingdom

continued in next column

8:40-9:05 A Coupling Problem for Entire Functions and Its Application to the Long-Time Asymptotics of Integrable Wave Equations

Gerald Teschl, University of Vienna, Austria; Jonathan Eckhardt, Cardiff University, United Kingdom

9:10-9:35 A Riemann-Hilbert Approach for the Degasperis-Procesi and Ostrovsky-Vakhnenko Equations

Anne Boutet de Monvel, Universite Paris VI, France

9:40-10:05 Long-Time Asymptotics for the Toda Shock Problem

Johanna Michor and Gerald Teschl, University of Vienna, Austria; Iryna Egorova, National Academy of Science, Ukraine

Tuesday, August 12

MS26

Nonlinear Waves in Geophysical Fluid Dynamics - Part I of III

8:10 AM-10:10 AM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS33

Nonlinear waves pervade GFD from classical water waves to internal atmospheric and oceanic waves. The minisymposium brings together some recent modelling and results in this broad field.

Organizer: Paul A. Milewski
University of Bath, United Kingdom

Organizer: Andre Nachbin
Institute of Pure and Applied Mathematics, Brazil

8:10-8:35 Particle Trajectories Beneath Stokes' Waves

Paul A. Milewski, University of Bath, United Kingdom; *Andre Nachbin*, Institute of Pure and Applied Mathematics, Brazil; Roberto Ribeiro-Junior, IMPA, Brazil

8:40-9:05 Diapycnal Mixing and Overturning Circulations

Esteban G. Tabak, Courant Institute of Mathematical Sciences, New York University, USA

9:10-9:35 Effective Boundary Conditions for Semi-Open Dispersive Systems

Rodolfo R. Rosales, Massachusetts Institute of Technology, USA; Lyubov Chumakova, University of Edinburgh, United Kingdom; Esteban G. Tabak, Courant Institute of Mathematical Sciences, New York University, USA

9:40-10:05 Effective Boundary Conditions: An Application to the Atmosphere

Lyubov Chumakova, University of Edinburgh, United Kingdom; Rodolfo R. Rosales, Massachusetts Institute of Technology, USA; Esteban G. Tabak, Courant Institute of Mathematical Sciences, New York University, USA

Tuesday, August 12

MS27

Solitary Waves in Inhomogeneous Structures - Part I of III

8:10 AM-10:10 AM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS34

The goal of the minisymposium is to discuss different aspects of Solitary waves (SW) in inhomogeneous structures, from analytical, numerical as well as applied points of view. On the one hand, there are results on the existence of SW in periodic media, e.g. asymptotics via envelope approximations and ground state solutions, and on wave propagation in media with variable (not necessarily periodic) coefficients. More recently, scattering of SW from strongly localized perturbations, e.g., delta potentials on the line or vertices in graphs has been studied. Important applications include dispersion management, waves at interfaces, in photonic crystals, waveguide arrays, and in networks.

Organizer: Tomas Dohnal
Technische Universität Dortmund, Germany

Organizer: Hannes Uecker
University of Oldenburg, Germany

8:10-8:35 Movement of Gap Solitons across Deep Gratings in the Periodic NLS

Tomas Dohnal, Technische Universität Dortmund, Germany

8:40-9:05 Periodic and Relative Periodic Solutions in a Multiple Waveguide System

Roy Goodman, New Jersey Institute of Technology, USA

9:10-9:35 Solitary Wave Dynamics in Plasmonic Binary Arrays

Alejandro Aceves, Southern Methodist University, USA; Costantino De Angelis, Aldo Auditore, and Matteo Conforti, University of Brescia, Italy

9:40-10:05 Stochasticity and Coherent Structures in Ultra-Long Mode-Locked Lasers

Dmitry Churkin, Aston University, United Kingdom

Tuesday, August 12

MS28

Modeling of Optical Combs and Low-Noise Opto-Electronic Sources - Part II of III

8:10 AM-10:10 AM

Room:Recital Room - Music Center

For Part 1 see MS20
For Part 3 see MS35

In the past decade, new optical devices have been invented and old ones have been refined, leading to a dramatic decrease in the noise floor of time and frequency transfer devices. The devices include opto-electronic oscillators, comb lasers, microresonators, and narrow-linewidth continuous wave lasers. The range of applications is vast and includes astrophysics, telecommunications, medicine, and radio-frequency photonics. The modeling of these devices has not kept pace wit these experimental advances, which have opened up new theoretical problems that are related to solitons and nonlinear dynamics. In this minisymposium, we will highlight recent advances in modeling these devices and point to the new mathematical problems that they have opened.

Organizer: Omri Gat
Hebrew University of Jerusalem, Israel

Organizer: Curtis R. Menyuk
University of Maryland, Baltimore County, USA

Organizer: Stefan Wabnitz
University of Brescia, Italy

8:10-8:35 Tunable Photonic Oscillators

Vassilios Kovanis, Virginia Tech, USA

8:40-9:05 Dynamics of Frequency Comb Generation and Design of Planar Microring Resonators

Tobias Hansson, Daniele Modotto, and Stefan Wabnitz, University of Brescia, Italy

9:10-9:35 Azimuthal Dissipative Structures in Whispering-Gallery Mode Resonators

Aurelien Coillet, FEMTO-ST Institute, France

9:40-10:05 Injection Locking of Frequency Combs in Mode Locked Lasers

Omri Gat, Hebrew University of Jerusalem, Israel; David Kielpinski, Griffith University, Brisbane, Australia

Tuesday, August 12

MS29

Spectral and Geometric Methods in Stability of Waves and Patterns - Part III of V

8:10 AM-10:10 AM

Room:Club Room - Concourse (1st Floor)

For Part 2 see MS21
For Part 4 see MS36

The purpose of this session is to bring together researchers working on various stability issues for such special solutions of partial differential equations as patterns and waves. All aspects of stability/instability will be discussed, from spectral to nonlinear, with special emphasis on methods of spectral theory. It is expected that the speakers will spend some time of their talks to address possible perspectives in the field of their work as we believe that such a perspective would be not only interesting for the audience but it can also stimulate further discussion and further research in the field.

Organizer: Anna Ghazaryan
Miami University and University of Kansas, USA

Organizer: Yuri Latushkin
University of Missouri, Columbia, USA

8:10-8:35 Transverse Dynamics of Periodic Gravity-Capillary Water Waves

Mariana Haragus, Université de Franche-Comté, France; Erik Wahlen, Lund University, Sweden

8:40-9:05 Orbital Stability of Periodic Waves and Black Solitons in the Cubic Defocusing NLS Equation

Dmitry Pelinovsky, McMaster University, Canada

9:10-9:35 Stability of Traveling Waves on Vortex Filaments

Stephane Lafortune, Annalisa M. Calini, and Scotty Keith, College of Charleston, USA

9:40-10:05 Stability of Viscous Roll-Waves

Mat Johnson, University of Kansas, USA; Pascal Noble, University of Toulouse, France; Miguel Rodrigues, University of Lyon 1, France; Kevin Zumbrun and Blake Barker, Indiana University, USA

Tuesday, August 12

MS30

Liquid Crystals: Beyond Display Applications

8:10 AM-10:10 AM

Room:Bevin Room - Wolfson Hall

Liquid crystals (LCs) are intermediate or mesogenic phases of matter which combine liquid fluidity with crystalline solid properties. In recent years, LCs have revolutionized the display industry. LCs now have fundamentally new applications beyond displays, in materials science and biology. This minisymposium comprises four talks: Kralj will speak about novel defect-stabilized LC structures; Vitelli will address questions related to defects and curvature; Sengupta will describe exciting experimental work on LC microfluidics and Dawes will talk about smectic liquid crystals. Between themselves, the speakers cover a range of emerging interdisciplinary research fields with ample scope for new developments.

Organizer: Apala Majumdar
University of Bath, United Kingdom

8:10-8:35 Shear-induced Instability of a Smectic A Liquid Crystal

Jonathan Dawes, University of Bath, United Kingdom; Iain W. Stewart, University of Strathclyde, United Kingdom

8:40-9:05 Frustrated Nematic Order in Spherical Geometries

Vincenzo Vitelli, Universiteit Leiden, The Netherlands

9:10-9:35 Imry-Ma-Larkin Clusters in Random Nematics

Samo Kralj, University of Maribor, Slovenia

9:40-10:05 Harnessing Topological Defects via Liquid Crystal Microfluidics

Anupam Sengupta, Massachusetts Institute of Technology, USA; Stephan Herminghaus and Christian Bahr, Max Planck Institute for Dynamics and Self-Organization, Germany

Tuesday, August 12

MS31

Vortex Dynamics of Superfluids

8:10 AM-10:40 AM

Room:Cockcroft Room - Concourse (Ground Floor)

The session focuses on quantized superfluid vortices with a focus on the superfluid phase of liquid Helium. Consideration of the dynamics of vortices turns out to be crucial for a fundamental understanding of turbulent flows in the superfluid regime. The session will feature a range of talks describing numerical simulations based on vortex filament models as well as mean-field models based on the nonlinear Schrodinger equation. This is complemented by talks on analytical studies of soliton excitations on quantised vortices and experimental studies of vortex dynamics in liquid Helium providing a broad overview of the key developments in the field.

Organizer: Hayder Salman
University of East Anglia, United Kingdom

8:10-8:35 Vortex Reconnections and Implications for Inverse Energy Transfer in Turbulent Superfluid Helium

Carlo F. Barenghi, Newcastle University, United Kingdom; Andrew Baggaley, University of Glasgow, Scotland, United Kingdom; Yuri Sergeev, Newcastle University, United Kingdom

8:40-9:05 Breathers on Quantized Superfluid Vortices

Hayder Salman, University of East Anglia, United Kingdom

9:10-9:35 Reconnections of Vortex Rings in Superfluid Helium

Paul Walmsley, P.M. Tompsett, D.E. Zmeev, and A.I. Golov, University of Manchester, United Kingdom

9:40-10:05 Thermal Counterflow in a Periodic Channel with Solid Boundaries

Andrew Baggaley, University of Glasgow, Scotland, United Kingdom; Jason Laurie, Weizmann Institute of Science, Israel

10:10-10:35 Local and Nonlocal Effects in Quantum Turbulence

Lucy Sherwin, Newcastle University, United Kingdom

Tuesday, August 12

CP4

Nonlinear Schrodinger Equations and Related Problems

8:10 AM-9:30 AM

Room:JCR Games Room – Concourse (Ground Floor)

Chair: Justin Cole, Florida State University, USA

8:10-8:25 Spectral Band Gaps and Lattice Solitons for the Fourth Order Dispersive Nonlinear Schrödinger Equation with Time Periodic Potential

Justin Cole and Ziad Musslimani, Florida State University, USA

8:30-8:45 Long-Time Asymptotics for the Defocusing Integrable Discrete Nonlinear Schrödinger Equation

Hideshi Yamane, Kwansei Gakuin University, Japan

8:50-9:05 Transverse Instability of a Soliton Solution to Quadratic Nonlinear Schrödinger Equation

Sarun Phibanchon, Mahidol University and Burapha University, Thailand; Michael Allen, Mahidol University, Thailand

9:10-9:25 On Rational Solutions to Multicomponent Nonlinear Derivative Schrödinger Equation

Tihomir I. Valchev, Dublin Institute of Technology, Ireland

Tuesday, August 12

CP5

Mathematical Biology and Related Problems

8:10 AM-10:10 AM

Room:Tizard Room - Concourse (1st Floor)

Chair: Sofia Piltz, University of Oxford, United Kingdom

8:10-8:25 Pipes and Neurons

Dwight Barkley, University of Warwick, United Kingdom; Baofang Song and Mukund Vasudevan, Institute of Science and Technology, Austria; Marc Avila, University of Erlangen-Nuremberg, Germany; Bjoern Hof, Institute of Science and Technology, Austria

8:30-8:45 Localized Structures and Their Dynamics in Bioconvection of *Euglena Gracilis*

Makoto Iima, Erika Shoji, Akinori Awazu, Hiraku Nishimori, and Shunsuke Izumi, Hiroshima University, Japan

8:50-9:05 Models for Adaptive Feeding and Plankton Populations

Sofia Piltz, Mason A. Porter, and Philip K. Maini, University of Oxford, United Kingdom

9:10-9:25 Self-Organisation in a Reaction-Diffusion System with a Non-Diffusing Component

Peter Rashkov, Philipps-Universität, Marburg, Germany

9:30-9:45 On a Volume-Surface Reaction-Diffusion System with Nonlinear Boundary Coupling: Well-Posedness and Exponential Convergence to Equilibrium

Bao Q. Tang, Klemens Fellner, and Evangelos Latos, University of Graz, Austria

9:50-10:05 Optimal Control in a Mathematical Model of Low Grade Glioma

Juan Belmonte-Beitia, Universidad de Castilla-La Mancha, Spain

Coffee Break

10:10 AM-10:40 AM

Room:Concourse/Buttery (Ground Floor)

Tuesday, August 12

Remarks

10:40 AM-10:45 AM

Room:Wolfson Auditorium - Wolfson Hall

IP3

Minimal Models for Precipitating Convection

10:45 AM-11:30 AM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Paul A. Milewski, University of Bath, United Kingdom

Despite the importance of organized convection (e.g. squall lines and hurricanes), numerical simulations remain a challenge. Comprehensive cloud resolving models would include water vapor, liquid water and ice, and liquid water would be separated into cloud water and rain water. Here we take a minimalist approach to cloud microphysics by incorporating fast auto-conversion from cloud to rain water, and fast condensation and evaporation. Numerical and analytical results will be discussed, e.g., saturated regions have a linear stability boundary associated with parcel (finite-amplitude) stability in unsaturated regions.

Leslie Smith
University of Wisconsin, USA

Lunch Break

11:30 AM-1:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Tuesday, August 12

IP4

Coherent Structures in 2D Turbulence: Identification and their Use

1:00 PM-1:45 PM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Margaret Beck, Boston University, USA

Ideas from dynamical systems have recently provided fresh insight into transitional fluid flows. Viewing such flows as a trajectory through a phase space littered with coherent structures (meaning 'exact' solutions here) and their stable and unstable manifolds has proved a fruitful way of understanding such flows. Motivated by the challenge of extending this success to turbulent flows, I will discuss how coherent structures can be extracted directly from long-time simulations of body-forced turbulence on a 2D torus. These will then be used to 'postdict' certain statistics of the turbulence.

Rich Kerswell
University of Bristol, United Kingdom

Intermission

1:45 PM-2:00 PM

Tuesday, August 12

MS32

Inverse Scattering Transform and Riemann--Hilbert Problems - Part II of III

2:00 PM-4:00 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 1 see MS25
For Part 3 see MS40

Since the inverse scattering transform was introduced to linearize integrable nonlinear PDEs, a large body of knowledge has been accumulated on these systems. Riemann-Hilbert problems (RHPs) have proven to be a powerful tool for the study of integrable systems [e.g., in the formulation of the inverse problem and for asymptotic analysis of the solutions], and found many connections to other areas of pure and applied mathematics. The session aims at bringing together leading researchers in these areas, and at offering a broad overview of some of the current research activities at the frontier of pure and applied mathematics.

Organizer: Barbara Prinari
University of Colorado, Colorado Springs, USA

Organizer: Gino Biondini
State University of New York, Buffalo, USA

2:00-2:25 The Semiclassical Sine-Gordon and Rational Solutions of PainlevéII

Peter D. Miller, University of Michigan, Ann Arbor, USA

2:30-2:55 A Spectral Approach to Dbar Problems

Christian Klein, Institut de Mathématiques de Bourgogne, France

3:00-3:25 Numerical Inverse Scattering for the Benjamin–Ono Equation

Sheehan Olver, University of Sydney, Australia

3:30-3:55 Oscillatory Integrals and Integrable Systems

Thomas Trogdon, Courant Institute of Mathematical Sciences, New York University, USA

Tuesday, August 12

MS33

Nonlinear Waves in Geophysical Fluid Dynamics - Part II of III

2:00 PM-3:30 PM

Room:Jock Colville Hall - Archives Center

For Part 1 see MS26
For Part 3 see MS41

Nonlinear waves pervade GFD from classical water waves to internal atmospheric and oceanic waves. The minisymposium brings together some recent modelling and results in this broad field.

Organizer: Paul A. Milewski
University of Bath, United Kingdom

Organizer: Andre Nachbin
Institute of Pure and Applied Mathematics, Brazil

2:00-2:25 Breaking of Interfacial Waves Induced by Background Rotation

Ted Johnson, University College London, United Kingdom

2:30-2:55 Pure Gravity Generalised Solitary Waves

Jean-Marc Vanden-Broeck, University College London, United Kingdom

3:00-3:25 The Effect of Rotation on Shoaling Internal Solitary Waves

Roger Grimshaw, Loughborough University, United Kingdom

Tuesday, August 12

MS34

Solitary Waves in Inhomogeneous Structures - Part II of III

2:00 PM-4:00 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 1 see MS27
For Part 3 see MS42

The goal of the minisymposium is to discuss different aspects of Solitary waves (SW) in inhomogeneous structures, from analytical, numerical as well as applied points of view. On the one hand, there are results on the existence of SW in periodic media, e.g. asymptotics via envelope approximations and ground state solutions, and on wave propagation in media with variable (not necessarily periodic) coefficients. More recently, scattering of SW from strongly localized perturbations, e.g., delta potentials on the line or vertices in graphs has been studied. Important applications include dispersion management, waves at interfaces, in photonic crystals, waveguide arrays, and in networks.

Organizer: Tomas Dohnal
Technische Universität Dortmund, Germany

Organizer: Hannes Uecker
University of Oldenburg, Germany

2:00-2:25 On the Existence of Breathers in Periodic Media: An Approach Via Inverse Spectral Theory

Martina Chirilus-Bruckner, University of Sydney, Australia; C. E. Wayne, Boston University, USA

continued in next column

2:30-2:55 Ground States of a Nonlinear Curl-Curl Problem

Thomas Bartsch, University of Giessen, Germany; Tomas Dohnal, Technische Universität Dortmund, Germany; Michael Plum, Karlsruhe University, Germany; *Wolfgang Reichel*, Karlsruhe Institute of Technology, Germany

3:00-3:25 Analysis of Dispersion Managed Solitary Waves

Dirk Hundertmark, Karlsruhe Institute of Technology, Germany

3:30-3:55 Reflection of an Incoming NLS Soliton by an Attractive Delta Potential

Justin Holmer and Quanhui Lin, Brown University, USA

Tuesday, August 12

MS35

Modeling of Optical Combs and Low-Noise Opto-Electronic Sources - Part III of III

2:00 PM-4:00 PM

Room:Recital Room - Music Center

For Part 2 see MS28

In the past decade, new optical devices have been invented and old ones have been refined, leading to a dramatic decrease in the noise floor of time and frequency transfer devices. The devices include opto-electronic oscillators, comb lasers, microresonators, and narrow-linewidth continuous wave lasers. The range of applications is vast and includes astrophysics, telecommunications, medicine, and radio-frequency photonics. The modeling of these devices has not kept pace wit these experimental advances, which have opened up new theoretical problems that are related to solitons and nonlinear dynamics. In this minisymposium, we will highlight recent advances in modeling these devices and point to the new mathematical problems that they have opened.

Organizer: Omri Gat
Hebrew University of Jerusalem, Israel

Organizer: Curtis R. Menyuk
University of Maryland, Baltimore County, USA

Organizer: Stefan Wabnitz
University of Brescia, Italy

2:00-2:25 Stability of Modelocked Lasers With Slow Saturable Absorbers

Shaokang Wang and Curtis R. Menyuk, University of Maryland, Baltimore County, USA

2:30-2:55 Terabit Communications Using Optical Frequency Combs

Christian Koos, Karlsruhe Institute of Technology, Germany

3:00-3:25 Noise of Frequency Combs Based on Yb Fiber Lasers with Self-Similar Pulse Evolution

William Renninger, Yale University, USA

3:30-3:55 Novel Phenomena in WGM Resonators with Vertical Evanescent Coupling to Bus Waveguides

Mher Ghulinyan, Fondazione Kessler, Italy

Tuesday, August 12

MS36

Spectral and Geometric Methods in Stability of Waves and Patterns - Part IV of V

2:00 PM-4:00 PM

Room:Club Room - Concourse (1st Floor)

For Part 3 see MS29
For Part 5 see MS44

The purpose of this session is to bring together researchers working on various stability issues for such special solutions of partial differential equations as patterns and waves. All aspects of stability/instability will be discussed, from spectral to nonlinear, with special emphasis on methods of spectral theory. It is expected that the speakers will spend some time of their talks to address possible perspectives in the field of their work as we believe that such a perspective would be not only interesting for the audience but it can also stimulate further discussion and further research in the field.

Organizer: Anna Ghazaryan
Miami University and University of Kansas, USA

Organizer: Yuri Latushkin
University of Missouri, Columbia, USA

2:00-2:25 Approximation of Traveling Waves on Finite Intervals
Jens Rottmann-Matthes, Karlsruhe Institute of Technology, Germany

2:30-2:55 Concatenated Traveling Waves
Stephen Schecter and Xiao-Biao Lin, North Carolina State University, USA

3:00-3:25 Stability of Traveling Standing Waves for the Klein-Gordon Equation
Milena Stanislavova, University of Kansas, Lawrence, USA

3:30-3:55 Stability of Solitary Waves in Nonlinear Dirac Equation
Andrew Comech, Texas A&M University, USA and IITP, Moscow, Russia

Tuesday, August 12

MS37

Solitons, Vortices, Domain Walls, Their Dynamics and Their Progenitors - Part I of III

2:00 PM-4:00 PM

Room:Bevin Room - Wolfson Hall

For Part 2 see MS45

Understanding building blocks of solutions of key nonlinear partial differential equations, appearing in physics, material sciences, biology and other sciences, is of great current interest. These building blocks are highly symmetric (technically, equivariant), special solutions with high energy concentration and spatial localization. Examples of such solutions, which we will call ‘lumps’, are solitons, vortices, monopoles, domain walls (known also as interfaces or fronts), etc. Typically, a general solution can be represented as a collection of moving lumps interacting with each other and emitting radiation or dissipating. The dynamics of lumps and their relation to the underlying ‘microscopic’ dynamics will be the focus of the minisymposium.

Organizer: Israel Michael Sigal
University of Toronto, Canada

Organizer: Avy Soffer
Rutgers University, USA

2:00-2:25 Vortices and Vortex Lattices in the Ginzburg-Landau and Bcs Theories
Israel Michael Sigal, University of Toronto, Canada

2:30-2:55 Two Component Condensates: Spin Orbit Coupling and Defects
Amandine Aftalion, CNRS and University of Versailles, France

3:00-3:25 Convergence to an Equilibrium for Wave Maps on a Curved Manifold
Piotr Bizon, Jagiellonian University, Poland

3:30-3:55 A Gradient Flow Approach to the Keller-Segel Systems
Adrien Blanchet, TSE/IAST, GREMAQ, Université de Toulouse, France

Tuesday, August 12

MS38

Nonlocal Wave Equations - Part I of II

2:00 PM-4:00 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 2 see MS46

This session focuses on nonlocal model equations for wave problems in fluids and solids. Particular attention will be paid to equations in which the nonlocal character plays a crucial role in the behaviour of the solutions and in the analysis of the equations. Examples are the Benjamin-Ono equation which features algebraically decaying solutions, the Whitham equation which features a nonlocal operator of negative order, and the intermediate long wave equation. The topics under discussion include existence and stability of traveling waves and solitary waves, well posedness of the Cauchy problem, and singularity formation, as well as boundary value problems on finite and semi-infinite domains.

Organizer: Henrik Kalisch
University of Bergen, Norway

Organizer: Mats Ehrnstrom
Norwegian University of Science and Technology, Norway

2:00-2:25 Dispersive Perturbations of Burgers and Hyperbolic Equations
Felipe Linares, Instituto de Matemática Pura e Aplicada, Brazil; Didier Pilod, UFRJ, Brazil; Jean-Claude Saut, Universite de Paris-Sud, France

2:30-2:55 Three-Dimensional Solitary Water Waves with Weak Surface Tension
Boris Buffoni, EPFL, France; Mark D. Groves, Universität des Saarlandes, Germany; *Erik Wahlen*, Lund University, Sweden

3:00-3:25 Stability of Periodic Traveling Waves for Nonlocal Dispersive PDE
Mat Johnson, University of Kansas, USA; Vera Hur, University of Illinois at Urbana-Champaign, USA

3:30-3:55 Local Well-posedness for a Class of Nonlocal Evolution Equations of Whitham Type
Long Pei, NTNU, Norway

Tuesday, August 12

MS39

Dynamics of Spiral and Scroll Waves in Cardiac Tissue

2:00 PM-4:00 PM

Room:JCR Games Room – Concourse (Ground Floor)

Spiral and scroll waves are nonlinear dissipative patterns occurring in 2- and 3-dimensional excitable media, respectively, where they act as (desired or undesired) organizing centers. Important example is excitation re-entry in the cardiac tissue where they underlie dangerous arrhythmias and fibrillation. Study of spiral and scroll dynamics by experimental, numerical and analytical approaches goes back nearly forty years. Recent advances in experimental, theoretical and computer simulation techniques brought the studies closer to practical applications than ever before. This minisymposium provides a sampling of the current state of experimental and theoretical research in this field.

Organizer: Irina Biktasheva
University of Liverpool, United Kingdom

2:00-2:25 Anatomy Induced Drift of Spiral Waves in Human Atrium
Irina Biktasheva, University of Liverpool, United Kingdom; Sanjay R. Kharche, University of Exeter, United Kingdom; Gunnar Seemann, Karlsruhe Institute of Technology, Germany; Henggui Zhang, The University of Manchester, UK; Vadim N. Biktashev, University of Exeter, United Kingdom

2:30-2:55 Optogenetic Control of Cardiac Electrical Activity: Experimental Insights
Emilia Entcheva, Stony Brook University, USA

3:00-3:25 Spatiotemporal Dynamics of Obstacle-Induced Spiral Wave Initiation
Thomas D. Quail, McGill University, Canada

3:30-3:55 Exact Coherent Structures and Dynamics of Cardiac Tissue
Greg A. Byrne, Chris Marcotte, and Roman Grigoriev, Georgia Institute of Technology, USA

Tuesday, August 12

CP6

Fluid Dynamics and Related Problems I

2:00 PM-4:00 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Mark A. Hoefer, North Carolina State University, USA

2:00-2:15 Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids: Experimental Investigation
Mark A. Hoefer and Nicholas K. Lowman, North Carolina State University, USA

2:20-2:35 Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids: Model Derivation and Modulation Theory
Nicholas K. Lowman and Mark A. Hoefer, North Carolina State University, USA

2:40-2:55 Coherent Structures Inhibition and Destruction in the Taylor-Couette System
Oualli Hamid and Mekadem Mahmoud, EMP, Algiers; Bouabdallah Ahcene, USTHB University, Algeria

3:00-3:15 Interaction of a Weak Discontinuity Wave with Elementary Waves of the Riemann Problem for Euler Equations of Gasdynamics
Vishnu D. Sharma, Indian Institute of Technology-Bombay, India

3:20-3:35 On the Unified Wave Model (uwm) for Smooth and Peaked/cusped Solitary Waves
Shijun Liao, Shanghai Jiao Tong University, China

3:40-3:55 Controlling the Position of Traveling Waves in Reaction-Diffusion Systems
Jakob Löber and Harald Engel, Technical University Berlin, Germany

Coffee Break

4:00 PM-4:30 PM

Room:Concourse/Buttery (Ground Floor)

Tuesday, August 12

MS40

Inverse Scattering Transform and Riemann--Hilbert Problems - Part III of III

4:30 PM-6:30 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS32

Since the inverse scattering transform was introduced to linearize integrable nonlinear PDEs, a large body of knowledge has been accumulated on these systems. Riemann-Hilbert problems (RHPs) have proven to be a powerful tool for the study of integrable systems [e.g., in the formulation of the inverse problem and for asymptotic analysis of the solutions], and found many connections to other areas of pure and applied mathematics. The session aims at bringing together leading researchers in these areas, and at offering a broad overview of some of the current research activities at the frontier of pure and applied mathematics.

Organizer: Barbara Prinari
University of Colorado, Colorado Springs, USA

Organizer: Gino Biondini
State University of New York, Buffalo, USA

4:30-4:55 On the Scattering Matrix for AKNS Systems with Matrix-Valued Potentials
Martin Klaus, Virginia Tech, USA

5:00-5:25 Large-degree Asymptotics of Generalised Hermite Polynomials and Poles of Rational Painlevé-IV Functions
Robert Buckingham, University of Cincinnati, USA

continued on next page

5:30-5:55 Inverse Scattering Transform for the Defocusing Nonlinear Schrödinger Equation with Asymmetric Nonzero Boundary Conditions

Gino Biondini and *Emily Fagerstrom*, State University of New York, Buffalo, USA; Barbara Prinari, University of Colorado, Colorado Springs, USA

6:00-6:25 Inverse Scattering Transform for the Focusing NLS Equation with Fully Asymmetric Boundary Conditions

Francesco Demontis, Universita di Cagliari, Italy; Barbara Prinari, University of Colorado, Colorado Springs, USA; Cornelis Van der Mee, Universita di Cagliari, Italy; *Federica Vitale*, Università del Salento, Italy

Tuesday, August 12

MS41

Nonlinear Waves in Geophysical Fluid Dynamics - Part III of III

4:30 PM-6:30 PM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS33

Nonlinear waves in the atmosphere and in the ocean bring together researchers from many different, but related, fields with a wide range of applications together with interesting mathematical developments.

Organizer: Paul A. Milewski

University of Bath, United Kingdom

Organizer: Andre Nachbin

Institute of Pure and Applied Mathematics, Brazil

4:30-4:55 Tropical-Extratropical Wave Interactions in a Moist 2-Layer Model

Juliana F. Dias, NOAA Earth System Research Laboratory

5:00-5:25 The Influence of Fast Waves and Fluctuations on the Evolution Three Slow Limits of the Boussinesq Equations

Beth Wingate, University of Exeter, United Kingdom; Jared Whitehead, Brigham Young University, USA; Terry Haut, Los Alamos National Laboratory, USA

5:30-5:55 Nonlinear Wave Interactions in Global Nonhydrostatic Models

Carlos Raupp and Andre Teruya, University of Sao Paulo, Brazil

6:00-6:25 Pilot Wave Dynamics in a Rotating Frame: Orbital Quantization and Multimodal Statistics

Anand Oza, Massachusetts Institute of Technology, USA

Tuesday, August 12

MS42

Solitary Waves in Inhomogeneous Structures - Part III of III

4:30 PM-6:30 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS34

The goal of the minisymposium is to discuss different aspects of Solitary waves (SW) in inhomogeneous structures, from analytical, numerical as well as applied points of view. On the one hand, there are results on the existence of SW in periodic media, e.g. asymptotics via envelope approximations and ground state solutions, and on wave propagation in media with variable (not necessarily periodic) coefficients. More recently, scattering of SW from strongly localized perturbations, e.g., delta potentials on the line or vertices in graphs has been studied. Important applications include dispersion management, waves at interfaces, in photonic crystals, waveguide arrays, and in networks.

Organizer: Tomas Dohnal

Technische Universität Dortmund, Germany

Organizer: Hannes Uecker

University of Oldenburg, Germany

4:30-4:55 The NLS on Fat Graphs and the Metric Graph Limit

Hannes Uecker, University of Oldenburg, Germany; Zarif A. Sobirov, Tashkent State University, Uzbekistan

5:00-5:25 Minimizing the NLS Energy on General Graphs

Riccardo Adami, Enrico Serra, and Paolo Tilli, Politecnico di Torino, Italy

5:30-5:55 Micro/macroscopic Models for Fluid Flow in Networks of Elastic Tubes

Radu C. Cascaval, University of Colorado, Colorado Springs, USA

6:00-6:25 Solution Formulas for the Linearized KdV Equation on Graphs

Zarif A. Sobirov, Tashkent State University, Uzbekistan; Hannes Uecker, University of Oldenburg, Germany; Maksad Akhmedov, Tashkent State University, Uzbekistan

Tuesday, August 12

MS43

Nonlinear Waves in Systems with PT Symmetry - Part I of III

4:30 PM-7:00 PM

Room:Recital Room - Music Center

For Part 2 see MS51

Interest in the so-call parity-time (PT)–symmetric systems, i.e., systems described by non-Hermitian Hamiltonians with real spectra, is rapidly growing during the last fifteen years. Recently, studies of nonlinear PT-symmetric systems became particularly intensive, since the respective models were shown to be of great relevance for many branches of physics such as optics, Bose-Einstein condensates, electronics, and so on. The purpose of this minisymposium is to highlight effects due to the interplay between nonlinearity and PT-symmetry and overview their physical applications.

Organizer: Vladimir V. Konotop
University of Lisbon, Portugal

Organizer: Jianke Yang
University of Vermont, USA

4:30-4:55 Coupled PT-Symmetric Systems
Carl M. Bender, Washington University in St. Louis, USA

5:00-5:25 New Aspects of Nonlinear PT-Symmetric Plaquettes
Uwe Guenther, Helmholtz-Center Dresden-Rossendorf, Germany

5:30-5:55 One $\mathcal{AC}$ and Two $\mathcal{PT}$ Nonlinear Schrödinger Dimers
Igor Barashenkov, University of Cape Town, South Africa

6:00-6:25 Linear and Nonlinear Properties of PT-symmetric Optical Systems
Demetrios Christodoulides, University of Central Florida, USA

6:30-6:55 Pt-Symmetric Synthetic Materials
Konstantinos Makris, Princeton University, USA; Stefan Rotter, Vienna University of Technology, Austria; Demetrios Christodoulides, University of Central Florida, USA

Tuesday, August 12

MS44

Spectral and Geometric Methods in Stability of Waves and Patterns - Part V of V

4:30 PM-6:30 PM

Room:Club Room - Concourse (1st Floor)

For Part 4 see MS36

The purpose of this session is to bring together researchers working on various stability issues for such special solutions of partial differential equations as patterns and waves. All aspects of stability/instability will be discussed, from spectral to nonlinear, with special emphasis on methods of spectral theory. It is expected that the speakers will spend some time of their talks to address possible perspectives in the field of their work as we believe that such a perspective would be not only interesting for the audience but it can also stimulate further discussion and further research in the field.

Organizer: Anna Ghazaryan
Miami University and University of Kansas, USA

Organizer: Yuri Latushkin
University of Missouri, Columbia, USA

4:30-4:55 Evans Function Analysis of Viscous Multidimensional Shock Layers
Jeffrey Humpherys, Brigham Young University, USA; Greg Lyng, University of Wyoming, USA; Kevin Zumbrun, Indiana University, USA

5:00-5:25 Computing the Refined Stability Condition for Shock Waves
Gregory Lyng, University of Wyoming, USA

5:30-5:55 The Evolution of Traveling Waves in a Simple Isothermal Chemical System
Je-Chiang Tsai, National Chung Cheng University, Taiwan

6:00-6:25 Linear and Spectral Stability of Solitary Gravity Waves
Shu-Ming Sun, Virginia Tech, USA

Tuesday, August 12

MS45

Solitons, Vortices, Domain Walls, Their Dynamics and Their Progenitors - Part II of III

4:30 PM-5:30 PM

Room:Bevin Room - Wolfson Hall

For Part 1 see MS37
For Part 3 see MS53

Understanding building blocks of solutions of key nonlinear partial differential equations, appearing in physics, material sciences, biology and other sciences, is of great current interest. These building blocks are highly symmetric (technically, equivariant), special solutions with high energy concentration and spatial localization. Examples of such solutions, which we will call ‘lumps’, are solitons, vortices, monopoles, domain walls (known also as interfaces or fronts), etc. Typically, a general solution can be represented as a collection of moving lumps interacting with each other and emitting radiation or dissipating. The dynamics of lumps and their relation to the underlying ‘microscopic’ dynamics will be the focus of the minisymposium.

Organizer: Israel Michael Sigal
University of Toronto, Canada

Organizer: Avy Soffer
Rutgers University, USA

4:30-4:55 Regularity and Stability of Landau-Lifshitz Flows
Stephen Gustafson, University of British Columbia, Canada

5:00-5:25 Dynamics of Bec of Fermion Pairs in the Low Density Limit of Bcs Theory
Christian Hainzl, University of Tuebingen, Germany

Tuesday, August 12

MS46

Nonlocal Wave Equations - Part II of II

4:30 PM-6:30 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 1 see MS38

This session focuses on nonlocal model equations for wave problems in fluids and solids. Particular attention will be paid to equations in which the nonlocal character plays a crucial role in the behaviour of the solutions and in the analysis of the equations. Examples are the Benjamin-Ono equation which features algebraically decaying solutions, the Whitham equation which features a nonlocal operator of negative order, and the intermediate long wave equation. The topics under discussion include existence and stability of traveling waves and solitary waves, well posedness of the Cauchy problem, and singularity formation, as well as boundary value problems on finite and semi-infinite domains.

Organizer: Henrik Kalisch
University of Bergen, Norway

Organizer: Mats Ehrnstrom
Norwegian University of Science and Technology, Norway

4:30-4:55 Pseudodifferential Operators on a Half-line and the Riemann-Hilbert Problem
Elena Kaikina, National Autonomous University of Mexico, Mexico

5:00-5:25 Stability of Solitary Waves for the Doubly Dispersive Nonlinear Wave Equation
Husnu Ata Erbay and Saadet Erbay, Ozyegin University, Turkey; Albert Erkip, Sabanci University, Turkey

5:30-5:55 Dissipation and Dispersion in Shallow Water
John Carter, Seattle University, USA; Harvey Segur, University of Colorado, USA; David L. George, U.S. Geological Survey, USA

6:00-6:25 A Numerical Method for Computing Traveling Waves of Nonlinear Dispersive Equations
Daulet Moldabayev, University of Bergen, Norway

Tuesday, August 12

MS47

Theoretical Aspects of Spiral and Scroll Waves Dynamics

4:30 PM-7:00 PM

Room:JCR Games Room – Concourse (Ground Floor)

Spiral and scroll waves are nonlinear dissipative patterns occurring in 2- and 3-dimensional excitable media, respectively, where they act as (desired or undesired) organizing centers. Recent experimental studies of biological and chemical excitable systems help to form novel views on spiral and scroll waves dynamics, interaction of scroll wave filaments and spiral tips with each other, with gradients, boundaries and local inhomogeneities. The minisymposium provides a sampling of the current state of theoretical and experimental research in the field and related numerical modeling.

Organizer: Roman Grigoriev
Georgia Institute of Technology, USA

4:30-4:55 Dynamics of Spiral Cores: the Effect of Boundaries and Heterogeneities
Roman Grigoriev, Christopher Marcotte, and Greg Byrne, Georgia Institute of Technology, USA

5:00-5:25 Spiral Pinballs
Jacob Langham and Dwight Barkley, University of Warwick, United Kingdom

5:30-5:55 Measuring Scroll Filament Rigidity
Vadim N. Biktashev, University of Exeter, United Kingdom; Elias Nakouzi, Zulma Jimenez, and Oliver Steinbock, Florida State University, USA

6:00-6:25 Effective Dynamics of Twisted and Curved Scroll Waves Using Virtual Filaments
Hans Dierckx, Ghent University, Belgium

6:30-6:55 Kinematic Theory of Spirals and Wave Segments
Vladimir Zykov and Eberhard Bodenschatz, Max-Planck-Institute for Dynamics and Self-Organization, Germany

Tuesday, August 12

CP7

Patterns and Related Problems

4:30 PM-6:30 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Alastair M. Rucklidge, University of Leeds, United Kingdom

4:30-4:45 Hopf Bifurcation from Fronts in the Cahn-Hilliard Equation
Ryan Goh and Arnd Scheel, University of Minnesota, USA

4:50-5:05 New Exact Solution for Nonlinear Interaction of Two Pulsatory Waves of the Korteweg – De Vries Equation in An Invariant Zigzag Structure
Victor A. Miroshnikov, College of Mount Saint Vincent, USA

5:10-5:25 Inertial Waves and Pattern Formation Inside a Rotating Cylinder Partially Filled with Liquid
Denis A. Polezhaev, Victor Kozlov, and Veronika Dyakova, Perm State Humanitarian Pedagogical University, Perm, Russia

5:30-5:45 Quasipatterns in Coupled Reaction-Diffusion Problems
Alastair M. Rucklidge, University of Leeds, United Kingdom

5:50-6:05 Vibrational Hydrodynamic Top Wave Instability and Pattern Formation
Stanislav Subbotin, Victor Kozlov, and Nikolay Kozlov, Perm State Humanitarian Pedagogical University, Perm, Russia

6:10-6:25 Oscillons in a Parametrically Forced PDE
Alastair M. Rucklidge, *Abeer Al-Nahdi*, and Jitse Niesen, University of Leeds, United Kingdom

Dinner Break

6:30 PM-8:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Room or Buttery snack bar.

Tuesday, August 12

PP1

Reception and Poster Session

8:00 PM-10:00 PM

Room:Buttery - Concourse (Ground Floor)

Bifurcation of Travelling Waves in Nonlinear Magnetic Metamaterials

Makrina Agaoglou, Makrina Agaoglou, and Vassilis M. Rothos, Aristotle University of Thessaloniki, Greece; Hadi Susanto, University of Essex, United Kingdom; Giorgos P. Veldes, University of Athens, Greece

The Dual-Weighted Residual Method Applied to a Discontinuous Galerkin Discretization for the Shallow Water Wave Equations

Susanne Beckers, University of Hamburg, Germany; Jörn Behrens, KlimaCampus - University of Hamburg, Germany; Winnifried Wollner, University of Hamburg, Germany

Dipolar Bose-Einstein Condensates

Roberto I. Ben, Universidad Nacional de General Sarmiento, Argentina

Oscillatory Pulses in the Fitzhugh-Nagumo Equation

Paul A. Carter and Bjorn Sandstede, Brown University, USA

Stability of Spatially Periodic Pulse Solutions in General Singularly Perturbed Reaction-Diffusion Systems

Björn De Rijk and Arjen Doelman, Leiden University, Netherlands; Jens Rademacher, University of Bremen, Germany; Frits Veerman, Oxford University, United Kingdom

Stochastic Mode-Reduction in Models with Conservative Fast Sub-Systems

Ankita Jain, University of Notre Dame, USA

Stochastic Analysis of Turbulent Mixing

Hyeonseong Jin, Jeju National University, South Korea

continued in next column

Abundant Soliton Solutions of the General Nonlocal Nonlinear Schrodinger System with the External Field

Ji Lin, Zhejiang Normal University, China; Xiaoyan Tang, East China Normal University, China

Elastic Nonlineal Model for a Unidimensional Chain with Clustering Zones

Francisco J. Martinez, Universidad Nacional Autónoma de México, Mexico

Scattering from a Large Cylinder with a Cluster of Eccentrically Embedded Cores

Brittany Mccollom, Colorado School of Mines, USA; Alex Yuffa, U.S. Army Research Laboratory, USA

Oscillons Near Hopf Bifurcations of Planar Reaction Diffusion Equations

Kelly Mcquighan and Bjorn Sandstede, Brown University, USA

Stability of Morphodynamical Equilibria in Tidal Basins

Corine J. Meerman and Vivi Rottschäfer, Leiden University, Netherlands; Henk Schuttelaars, Delft University of Technology, Netherlands

Hydrodynamic Rogue Waves

Daniel Ratliff, University of Surrey, United Kingdom

Bifurcation of Travelling Waves in Nonlinear Magnetic Meta-Materials

Vassilis M. Rothos, Aristotle University of Thessaloniki, Greece; Hadi Sussanto, University of Essex, United Kingdom; G.P Veldes, Technological Institution of Lamia, Greece

Tracking Pattern Evolution Beyond Center Manifold Reductions with Singular Perturbations

Lotte Sewalt, Arjen Doelman, and Vivi Rottschäfer, Leiden University, Netherlands; Antonios Zagaris, University of Twente, Netherlands

Robust Pulse Generators in An Excitable Medium with Jump-Type Heterogeneity

Takashi Teramoto, Asahikawa Medical University, Japan

continued in next column

On the Statistics of Localized Rogue Wave Structures in Spontaneous Modulation Instability

John Dudley, Université de Franche-Comté, France; *Shanti Toenger*, FEMTO-ST Institute, France; Goery Genty, Tampere University of Technology, Finland; Frederic Dias, University College Dublin, Ireland

Evolution Equations for Weakly Nonlinear Internal Ocean Waves

Eric J. Tovar, Daqi Xin, and Zhijun Qiao, University of Texas - Pan American, USA

Reflection and Transmission of Plane Quasi Longitudinal Waves at Semiconductor Elastic Solid Interface

Amit Sharma, National Institute of Technology Hamirpur, India

Soliton Interactions in the Sasa-Satsuma Equation on Nonzero Backgrounds

Tao Xu, China University of Petroleum, China; Min Li, North China Electric Power University, China

Wednesday, August 13

Registration

7:45 AM-5:00 PM

Room:Main Foyer - Concourse (Ground Floor)

MS48

Nonlinear Waves, Singularities, and Collapses in Water Waves, Optics and Plasmas - Part I of IV

8:10 AM-10:10 AM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS56

Waves dynamics is one of the most interesting and appealing problems in applied mathematics and physics. In wast majority of interesting cases the problem of wave propagation can be solved not only in the linear approximation but also with nonlinear effects taken into account, due to powerful tools of modern applied mathematics and theoretical physics. Common approaches stimulate intensive interchange of ideas in the field which accelerates the development of the wave dynamics even further. Our minisymposium is devoted to new advances in the theory of waves and demonstrates vividly the similarity of approaches in a broad spectrum of important applications.

Organizer: Alexander O. Korotkevich
University of New Mexico, USA

Organizer: Pavel M. Lushnikov
University of New Mexico, USA

continued in next column

8:10-8:35 Nondecaying Solutions of KdV Equation

Vladimir E. Zakharov, University of Arizona, Tucson and Lebedev Physical Institute, Moscow, Russia; Dmitry Zakharov, Courant Institute of Mathematical Sciences, New York University, USA

8:40-9:05 Surface Waves in Graded Index Meta-materials

Ildar R. Gabitov, University of Arizona and Los Alamos National Laboratory, USA; Andrei Maimistov, Moscow Engineering Physics Institute, Russia

9:10-9:35 Channel Capacity and Nonlinear Fourier Transform in Coherent Fibre-Optic Communications

Sergei Turitsyn, Aston University, United Kingdom

9:40-10:05 Models for Laser-Driven Generation of THz Radiation

Pedro Gonzalez de Alaiza and Luc Berge, CEA, France

Wednesday, August 13

MS49

Existence, Stability and Evolution of Coherent Structures in Coupled Systems - Part I of II

8:10 AM-10:10 AM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS57

This special session will bring together researchers who study fronts, pulses, wave trains and patterns of complex structures, which occur in natural and experimentally built systems. In mathematics, these objects are realized as solutions of nonlinear partial differential equations. The speakers in this special session will present their results on the existence, stability, dynamical properties, and bifurcations of these solutions in coupled systems obtained using analytical and numerical techniques.

Organizer: Stephane Lafortune
College of Charleston, USA

Organizer: Vahagn Manukian
Miami University, USA

8:10-8:35 Spatially Periodic Patterns, Busse Balloons, and the Hopf Dance

Arjen Doelman and Björn De Rijk, Leiden University, Netherlands; Jens Rademacher, University of Bremen, Germany; Frits Veerman, Oxford University, United Kingdom

8:40-9:05 Pattern Formation in a Class of Landau-Lifschitz-Gilbert-Slonczewski Equations for Spintronic Devices

Jens Rademacher, University of Bremen, Germany

9:10-9:35 Modulation Equations for Interacting Localized Structures

Martina Chirilus-Bruckner, University of Sydney, Australia

9:40-10:05 Coherent Structures in a Population Model for Mussel-Algae Interaction

Anna Ghazaryan, Miami University and University of Kansas, USA; Vahagn Manukian, Miami University, USA

Wednesday, August 13

MS50

Water Waves with Surface Tension - Part I of II

8:10 AM-10:10 AM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS58

Water waves have been studied for over 200 years, but many fundamental questions remain about their behaviour. One of these questions is about the role of surface tension in various models. In this session, we will explore this and similar questions analytically and numerically.

Organizer: Olga Trichtchenko
University of Washington, USA

Organizer: Bernard Deconinck
University of Washington, USA

8:10-8:35 Lasers and Ripples

Paul A. Milewski, University of Bath, United Kingdom; Zhan Wang, University College London, United Kingdom

8:40-9:05 Stability of Near-Resonant Gravity-Capillary Waves

Olga Trichtchenko and Bernard Deconinck, University of Washington, USA

9:10-9:35 The Influence of Surface Tension Upon Trapped Waves and Hydraulic Falls

Emilian I. Parau and Charlotte Page, University of East Anglia, United Kingdom

9:40-10:05 Dimension-Breaking Phenomena for Solitary Gravity-Capillary Water Waves

Mark D. Groves, Universität des Saarlandes, Germany; Shu-Ming Sun, Virginia Tech, USA; Erik Wahlen, Lund University, Sweden

Wednesday, August 13

MS51

Nonlinear Waves in Systems with PT Symmetry - Part II of III

8:10 AM-10:10 AM

Room:Recital Room - Music Center

For Part 1 see MS43
For Part 3 see MS59

Interest in the so-call parity-time (PT)–symmetric systems, i.e., systems described by non-Hermitian Hamiltonians with real spectra, is rapidly growing during the last fifteen years. Recently, studies of nonlinear PT-symmetric systems became particularly intensive, since the respective models were shown to be of great relevance for many branches of physics such as optics, Bose-Einstein condensates, electronics, and so on. The purpose of this minisymposium is to highlight effects due to the interplay between nonlinearity and PT-symmetry and overview their physical applications.

Organizer: Vladimir V. Konotop
University of Lisbon, Portugal

Organizer: Jianke Yang
University of Vermont, USA

8:10-8:35 CPT-symmetric Spin-orbit-coupled Condensate

Yaroslav Kartashov, Institut de Ciències Fotòniques, Spain; *Vladimir V. Konotop*, University of Lisbon, Portugal; Dmitry Zezyulin, Universidade de Lisboa, Portugal

8:40-9:05 Nonlinear Dynamics in PT-Symmetric Lattices

Dmitry Pelinovsky, McMaster University, Canada

9:10-9:35 Asymmetric Transport in Non-Linear Systems with Parity-Time Symmetry

Tsampikos Kottos, Wesleyan University, USA

9:40-10:05 Interactions of Bright and Dark Solitons with Localized *PT*-Symmetric Potentials

Boris Malomed, Tel Aviv University, Israel; *Hadi Susanto*, University of Essex, United Kingdom

Wednesday, August 13

MS52

Algebraic Aspects of Integrable Systems and Applications - Part I of IV

8:10 AM-10:10 AM

Room:Club Room - Concourse (1st Floor)

For Part 2 see MS60

Integrable system has been studied extensively in related to many fields in both pure mathematics and applied mathematics. Meanwhile, the integrable system also promises applications ranging from water waves, nonlinear optics to numerical algorithms. The purpose of this special session is to bring together researchers from integrable system in both continuous and discrete integrable system to discuss recent advances on algebraic aspects of integrable systems and their applications.

Organizer: Bao-Feng Feng
University of Texas - Pan American, USA

Organizer: Xing-Biao Hu
Chinese Academy of Sciences, China

Organizer: Kenichi Maruno
University of Texas - Pan American, USA

Organizer: Jonathan Nimmo
University of Glasgow, Scotland, United Kingdom

8:10-8:35 On Jost Solutions for the Discrete and Ultradiscrete KdV Equation

Jonathan Nimmo, University of Glasgow, Scotland, United Kingdom

8:40-9:05 Classification of Tau-symmetric Hamiltonian Evolutionary PDEs

Youjin Zhang, Tsinghua University, P. R. China

9:10-9:35 Quasi-Determinants and Non Commutative Equations with Pfaffian Type Solutions

Claire Gilson, University of Glasgow, Scotland, United Kingdom

9:40-10:05 A Four-component Camassa-Holm Type Hierarchy

Qingping Liu, China University of Mining and Technology, China

Wednesday, August 13

MS53

Solitons, Vortices, Domain Walls, Their Dynamics and Their Progenitors - Part III of III

8:10 AM-10:10 AM

Room:Bevin Room - Wolfson Hall

For Part 2 see MS45

Understanding building blocks of solutions of key nonlinear partial differential equations, appearing in physics, material sciences, biology and other sciences, is of great current interest. These building blocks are highly symmetric (technically, equivariant), special solutions with high energy concentration and spatial localization. Examples of such solutions, which we will call 'lumps', are solitons, vortices, monopoles, domain walls (known also as interfaces or fronts), etc. Typically, a general solution can be represented as a collection of moving lumps interacting with each other and emitting radiation or dissipating. The dynamics of lumps and their relation to the underlying 'microscopic' dynamics will be the focus of the minisymposium.

Organizer: Israel Michael Sigal
University of Toronto, Canada

Organizer: Avy Soffer
Rutgers University, USA

8:10-8:35 Vorticity Models in Condensed Matter Physics and Gradient Flows of 1-Homogeneous Functionals

Giandomenico Orlandi, University of Verona, Italy

8:40-9:05 Coherent Motion in Hamiltonian Lattices with Next-to-nearest Neighbour Interactions

Johannes Zimmer and Christine Venney, University of Bath, United Kingdom

9:10-9:35 Skyrmions as Models of Nuclei

Nicholas Manton, University of Cambridge, United Kingdom

9:40-10:05 Long Range Scattering for the Klein-Gordon Equation with Nonhomogeneous Nonlinearities

Avy Soffer, Rutgers University, USA

Wednesday, August 13

MS54

Connections Between Nonlinear Wave Equations and Geometry - Part I of III

8:10 AM-10:10 AM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 2 see MS62

This minisymposium will discuss some of the many facets of the interplay between geometry and nonlinear wave equations, and its increasingly important role in the study of nonlinear PDE and integrable systems, as well as differential and Poisson geometry. Topics will include geometric evolution equations---both continuous and discrete---arising in physical or geometric settings, geometric aspects of nonlinear wave equations (such as recursion operators and Poisson structures), and existence and construction of special solutions and coherent structures through geometric methods (e.g. Inverse Scattering Transform, Bäcklund transformations, algebro-geometric tools, Hirota method, etc.).

Organizer: Annalisa M. Calini
College of Charleston, USA

Organizer: Francesco Demontis
Universita di Cagliari, Italy

Organizer: Giovanni Ortenzi
University of Milan, Italy

8:10-8:35 Discrete Geometry of Polygons and Hamiltonian Structures

Gloria Mari Beffa, University of Wisconsin, Madison, USA

8:40-9:05 Discrete Moving Frames and Discrete Integrable Systems

Jin-Ping Wang, University of Kent, United Kingdom

9:10-9:35 Discrete KP Equation with Self-Consistent Sources

Adam Doliwa, University of Warmia and Mazury, Poland; Runliang Lin, Tsinghua University, P. R. China

9:40-10:05 Geometric Aspects of Integrable Self-adaptive Moving Mesh Schemes

Kenichi Maruno, University of Texas - Pan American, USA

Wednesday, August 13

MS55

Nonlinear Waves in Metamaterials: Theory and Applications - Part I of II

8:10 AM-9:40 AM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 2 see MS63

Recently, artificially constructed metamaterials have attracted considerable interests because of their nontrivial and peculiar electromagnetic properties. Understanding nonlinear wave propagations in the systems are of importance, not only from the application, but also from the mathematical point of view. The minisymposium aims to bring together experts from the field of metamaterials and related areas, including but not limited to the creations and characteristics of localised structures in the systems. The target of the minisymposium is to present recent contributions to this subject, both theoretically and experimentally.

Organizer: Vassilis M. Rothos
Aristotle University of Thessaloniki, Greece

Organizer: Hadi Susanto
University of Essex, United Kingdom

8:10-8:35 Nonlinear Waves in a Homogenized Two-Phase Particulate Composite Medium

Nikolaos L. Tsitsas, Aristotle University of Thessaloniki, Greece; Akhlesh Lakhtakia, Pennsylvania State University, USA; Dimitri Frantzeskakis, University of Athens, Greece

8:40-9:05 Nonlinear Wave Propagation and Localization in Squid Metamaterials

Nikos Lazarides and George Tsironis, University of Crete, Greece

9:10-9:35 Dynamical Properties of Parity-Time Symmetric Metamaterials

George Tsironis, University of Crete, Greece

Wednesday, August 13

CP8

Dynamical Systems and Related Problems

8:10 AM-9:50 AM

Room:Tizard Room - Concourse (1st Floor)

Chair: Richard Kollar, Comenius University, Bratislava, Slovakia

8:10-8:25 Pullback Attractor for the Non-Autonomous Stochastic Damped Wave Equations on Bounded and Unbounded Domains

Hongyan Li, Shanghai University of Engineering Science, China

8:30-8:45 Persistence Results for Nonlocal Perturbations on Unbounded Domains

Christian Kuehn and Franz Achleitner, Vienna University of Technology, Austria

8:50-9:05 New Criteria Preventing Hamiltonian-Hopf Bifurcations Using Graphical Krein Signature

Richard Kollar, Comenius University, Bratislava, Slovakia; Peter Miller, University of Michigan, USA

9:10-9:25 Complex Mode Dynamics of Coupled Wave Oscillators

Tristram J. Alexander, University of New South Wales, Australia; Dong Yan and P. Kevrekidis, University of Massachusetts, USA

9:30-9:45 Modulation Theory for the Fkdvb Equation Constructing Periodic Solutions

Laura Hattam, Monash University, Australia

Coffee Break

10:10 AM-10:40 AM

Room:Concourse/Buttery (Ground Floor)

Remarks

10:40 AM-10:45 AM

Room:Wolfson Auditorium - Wolfson Hall

Wednesday, August 13

IP5

A Neural Field Model of Binocular Rivalry Waves

10:45 AM-11:30 AM

Room:Wolfson Auditorium - Wolfson Hall

Chair:Alina Chertock, North Carolina State University, USA

Binocular rivalry is the phenomenon where perception switches back and forth between different images presented to the two eyes. The resulting fluctuations in perceptual dominance and suppression provide a basis for non-invasive studies of the human visual system and the identification of possible neural mechanisms underlying conscious visual awareness. In this talk we present a neural field model of binocular rivalry waves in visual cortex – continuum neural fields are integro-differential equations that describe the large-scale spatiotemporal dynamics of neuronal populations. We derive an analytical expression for the speed of a binocular rivalry wave as a function of various neurophysiological parameters, and show how properties of the wave are consistent with the wave-like propagation of perceptual dominance observed in recent psychophysical experiments. We then analyze the effects of extrinsic noise on wave propagation in a stochastic version of the neural field model. We end by describing recent work on rotating rivalry stimuli and direction selectivity.

Paul C. Bressloff

University of Utah, USA and University of Oxford, United Kingdom

Lunch Break

11:30 AM-1:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Wednesday, August 13

IP6

Engineering Extreme Materials with Defects and Nonlinearity

1:00 PM-1:45 PM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Apala Majumdar, University of Bath, United Kingdom

We study the fundamental dynamic response of discrete nonlinear systems and study the effects of defects in the energy localization and propagation. We exploit this understanding to create experimentally novel materials and devices at different scales (for example, for application in energy absorption, acoustic imaging and energy harvesting). We use granular systems as a basic platform for testing, and control the constitutive behavior of the new materials selecting the particles' geometry, their arrangement and materials properties. Ordered arrangements of particles exhibit a highly nonlinear dynamic response, which has opened the door to exciting fundamental physical observations (i.e., compact solitary waves, energy trapping phenomena, and acoustic rectification). This talk will focus on energy localization and redirection in one- and two-dimensional systems.

Chiara Daraio

ETH Zürich, Switzerland and California Institute of Technology, USA

Intermission

1:45 PM-2:00 PM

Wednesday, August 13

MS56

Nonlinear Waves, Singularities, and Collapses in Water Waves, Optics and Plasmas - Part II of IV

2:00 PM-4:00 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 1 see MS48
For Part 3 see MS64

Waves dynamics is one of the most interesting and appealing problems in applied mathematics and physics. In wast majority of interesting cases the problem of wave propagation can be solved not only in the linear approximation but also with nonlinear effects taken into account, due to powerful tools of modern applied mathematics and theoretical physics. Common approaches stimulate intensive interchange of ideas in the field which accelerates the development of the wave dynamics even further. Our minisymposium is devoted to new advances in the theory of waves and demonstrates vividly the similarity of approaches in a broad spectrum of important applications.

Organizer: Alexander O. Korotkevich
University of New Mexico, USA

Organizer: Pavel M. Lushnikov
University of New Mexico, USA

2:00-2:25 Blowup Dynamics in the Keller-Segel Model of Chemotaxis

Israel Michael Sigal, University of Toronto, Canada

2:30-2:55 Modeling Combined UV/IR Filamentation

Alejandro Aceves, Southern Methodist University, USA

continued in next column

3:00-3:25 Instabilities of Gravity and Capillary Waves on the Surface of the Fluid

Alexander O. Korotkevich, University of New Mexico, USA; Alexander Dyachenko, Landau Institute for Theoretical Physics, Russia; Vladimir E. Zakharov, University of Arizona, Tucson and Lebedev Physical Institute, Moscow, Russia

3:30-3:55 Some Fundamental Issues in Internal Wave Dynamics

Roberto Camassa, University of North Carolina, Chapel Hill, USA

Wednesday, August 13

MS57

Existence, Stability and Evolution of Coherent Structures in Coupled Systems - Part II of II

2:00 PM-4:00 PM

Room:Jock Colville Hall - Archives Center

For Part 1 see MS49

This special session will bring together researchers who study fronts, pulses, wave trains and patterns of complex structures, which occur in natural and experimentally built systems. In mathematics, these objects are realized as solutions of nonlinear partial differential equations. The speakers in this special session will present their results on the existence, stability, dynamical properties, and bifurcations of these solutions in coupled systems obtained using analytical and numerical techniques.

Organizer: Stephane Lafortune
College of Charleston, USA

Organizer: Vahagn Manukian
Miami University, USA

2:00-2:25 Vortex Dynamics in Bose-Einstein Condensates: Bifurcations, Chaotic Dynamics and Experimental Observations

Panayotis Kevrekidis, University of Massachusetts, Amherst, USA

2:30-2:55 Traveling Waves in Holling-Tanner Model with Diffusion

Vahagn Manukian and Anna Ghazaryan, Miami University, USA

3:00-3:25 Semi-strong Multipulse Interaction in Reaction Diffusion Systems: The Case of Asymptotically Weak Dissipation

Keith Promislow, Michigan State University, USA; Arjen Doelman, Leiden University, Netherlands; Tom Bellsky, Arizona State University, USA

3:30-3:55 Dynamics of Vortex Filaments and their Stability

Annalisa M. Calini, College of Charleston, USA

Wednesday, August 13

MS58

Water Waves with Surface Tension - Part II of II

2:00 PM-4:00 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 1 see MS50

Water waves have been studied for over 200 years, but many fundamental questions remain about their behaviour. One of these questions is about the role of surface tension in various models. In this session, we will explore this and similar questions analytically and numerically.

Organizer: Olga Trichtchenko
University of Washington, USA

Organizer: Bernard Deconinck
University of Washington, USA

2:00-2:25 Gravity Capillary Waves and Related Problems

Jean-Marc Vanden-Broeck, University College London, United Kingdom

2:30-2:55 A Quasi-Planar Model for Gravity-Capillary Interfacial Waves in Deep Water

Zhan Wang, University College London, United Kingdom

3:00-3:25 An Efficient Boundary Integral Method for 3D Interfacial Flow with Surface Tension: Numerical Results and Numerical Analysis

David Ambrose, Drexel University, USA

3:30-3:55 A Reduction of the Euler Equations to a Single Time-Dependent Equation

Katie Oliveras, Seattle University, USA; Vishal Vasan, Pennsylvania State University, USA

Wednesday, August 13

MS59

Nonlinear Waves in Systems with PT Symmetry - Part III of III

2:00 PM-4:00 PM

Room:Recital Room - Music Center

For Part 2 see MS51

Interest in the so-call parity-time (PT)–symmetric systems, i.e., systems described by non-Hermitian Hamiltonians with real spectra, is rapidly growing during the last fifteen years. Recently, studies of nonlinear PT-symmetric systems became particularly intensive, since the respective models were shown to be of great relevance for many branches of physics such as optics, Bose-Einstein condensates, electronics, and so on. The purpose of this minisymposium is to highlight effects due to the interplay between nonlinearity and PT-symmetry and overview their physical applications.

Organizer: Vladimir V. Konotop
University of Lisbon, Portugal

Organizer: Jianke Yang
University of Vermont, USA

2:00-2:25 Partially- *PT* -symmetric Potentials with All-real Spectra and Soliton Families

Jianke Yang, University of Vermont, USA

2:30-2:55 Solitons in Quadratically Nonlinear Media with *PT*-Symmetric Potentials

Fatkhulla Abdullaev and Bakhram Umarov, International Islamic University of Malaysia, Malaysia

3:00-3:25 Dynamical Theory of Scattering for Complex Potentials, Inverse Scattering, and Confined Nonlinearities

Ali Mostafazadeh, Koc University, Turkey

3:30-3:55 Nonlinear Quantum Dynamics of a BEC in a *PT*-symmetric Double-well Trap

Holger Cartarius, Daniel Haag, Dennis Dast, Andreas Löhle, Jörg Main, and Günter Wunner, Universität Stuttgart, Germany

Wednesday, August 13

MS60

Algebraic Aspects of Integrable Systems and Applications - Part II of IV

2:00 PM-4:00 PM

Room:Club Room - Concourse (1st Floor)

For Part 1 see MS52
For Part 3 see MS68

Integrable system has been studied extensively in related to many fields in both pure mathematics and applied mathematics. Meanwhile, the integrable system also promises applications ranging from water waves, nonlinear optics to numerical algorithms. The purpose of this special session is to bring together researchers from integrable system in both continuous and discrete integrable system to discuss recent advances on algebraic aspects of integrable systems and their applications.

Organizer: Bao-Feng Feng
University of Texas - Pan American, USA

Organizer: Xing-Biao Hu
Chinese Academy of Sciences, China

Organizer: Kenichi Maruno
University of Texas - Pan American, USA

Organizer: Jonathan Nimmo
University of Glasgow, Scotland, United Kingdom

2:00-2:25 On Exact Solutions to Lattice Equations

Daisuke Takahashi, Waseda University, Japan

2:30-2:55 Constructing Probabilistic Particle Cellular Automata from Fundamental Diagrams

Junta Matsukidaira, Ryukoku University, Japan

3:00-3:25 Soliton Solutions to an Extended Box and Ball System Equation

Hidetomo Nagai, Tokai University, Japan

3:30-3:55 Lattice Boussinesq Equation and Convergence Acceleration Algorithms

Yi He, Chinese Academy of Sciences, China

Wednesday, August 13

MS61

Recent Advances in Numerical Methods for Shallow Water Equations and Related Models - Part I of II

2:00 PM-4:00 PM

Room:Bevin Room - Wolfson Hall

For Part 2 see MS69

This minisymposium focuses on numerical methods for hyperbolic systems of conservation and balance laws used to model shallow water and related geophysical flows. Specific numerical difficulties different shallow water models have in common are due to the presence of(possibly singular) geometric source terms and/or nonconservative exchange terms. These may lead to the loss of hyperbolicity, nonlinear resonance, very complicated wave structures and, as a result, to appearance of spurious oscillations and slow convergence of numerical methods.Therefore development of highly accurate and efficient numerical methods for these systems is a very important and challenging task.

Organizer: Alina Chertock
North Carolina State University, USA

Organizer: Alexander Kurganov
Tulane University, USA

2:00-2:25 Well-Balanced Positivity Preserving Central-Upwind Scheme for the Shallow Water System with Friction Terms
Alina Chertock, North Carolina State University, USA

2:30-2:55 Well-Balanced Fully Coupled Central-Upwind Scheme for Shallow Water Flows over Erodible Bed
Abdolmajid Mohammadian and *Xin Liu*, University of Ottawa, Canada

3:00-3:25 High Order Discontinuous Galerkin Methods for the Shallow Water Equations
Yulong Xing, University of Tennessee and Oak Ridge National Laboratory, USA

3:30-3:55 MLMC-FVM for Shallow Water Equations with Uncertain Bottom Topography
Jonas Sukys, ETH Zürich, Switzerland

Wednesday, August 13

MS62

Connections Between Nonlinear Wave Equations and Geometry - Part II of III

2:00 PM-4:00 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 1 see MS54
For Part 3 see MS70

This minisymposium will discuss some of the many facets of the interplay between geometry and nonlinear wave equations, and its increasingly important role in the study of nonlinear PDE and integrable systems, as well as differential and Poisson geometry. Topics will include geometric evolution equations---both continuous and discrete---arising in physical or geometric settings, geometric aspects of nonlinear wave equations (such as recursion operators and Poisson structures), and existence and construction of special solutions and coherent structures through geometric methods (e.g. Inverse Scattering Transform, Bäcklund transformations, algebro-geometric tools, Hirota method, etc.).

Organizer: Annalisa M. Calini
College of Charleston, USA

Organizer: Francesco Demontis
Universita di Cagliari, Italy

Organizer: Giovanni Ortenzi
University of Milan, Italy

2:00-2:25 A Finite Dimensional Integrable System Arising in Shock Clustering
Luen-Chau Li, Pennsylvania State University, USA

2:30-2:55 Multi-Component Integrable Wave Equations and Geometric Moving Frames
Stephen Anco, Brock University, Canada

3:00-3:25 Some Novel Geometric Realizations of Integrable Hierarchies
Thomas Ivey, College of Charleston, USA

3:30-3:55 Integrable Systems and Invariant Geometric Flows in Similarity Symplectic Geometry
Changzheng Qu, Ningbo University, China

Wednesday, August 13

MS63

Nonlinear Waves in Metamaterials: Theory and Applications - Part II of II

2:00 PM-3:30 PM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 1 see MS55

Recently, artificially constructed metamaterials have attracted considerable interests because of their nontrivial and peculiar electromagnetic properties. Understanding nonlinear wave propagations in the systems are of importance, not only from the application, but also from the mathematical point of view. The minisymposium aims to bring together experts from the field of metamaterials and related areas, including but not limited to the creations and characteristics of localised structures in the systems. The target of the minisymposium is to present recent contributions to this subject, both theoretically and experimentally.

Organizer: Vassilis M. Rothos
Aristotle University of Thessaloniki, Greece

Organizer: Hadi Susanto
University of Essex, United Kingdom

2:00-2:25 Pt-Symmetry and Embedded Modes in the Continuum for Magnetic Metamaterials
Mario Molina, Universidad de Chile, Chile

2:30-2:55 Quasi-Discrete Solitons in Nonlinear Transmission Line Metamaterials
D.J. Frantzeskakis, University of Athens, Greece

3:00-3:25 Amplitude Modulation and Envelope Mode Formation in Left-Handed Media: a Survey of Recent Results
Ioannis Kourakis, Queen's University, Belfast, United Kingdom

Wednesday, August 13

CP9

Geophysical Fluid Dynamics and Related Problems

2:00 PM-4:00 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Bin Cheng, University of Surrey, United Kingdom

2:00-2:15 Time-Averaging and Error Estimates for Reduced Fluid Models.

Bin Cheng, University of Surrey, United Kingdom

2:20-2:35 Atmospheric Moisture Transport: Stochastic Dynamics of the Advection-Condensation Equation

Yue-Kin Tsang and Jacques Vanneste, University of Edinburgh, United Kingdom

2:40-2:55 On the Asymptotics of Nonlinear Wall-Localized Thermal Convection Waves

Geoffrey M. Vasil, University of Sydney, Australia; Keaton Burns, Massachusetts Institute of Technology, USA

3:00-3:15 Optimal High-Order Diagonally-Implicit Runge-Kutta Schemes for Nonlinear Diffusive Systems on Atmospheric Boundary Layer

Farshid Nazari and Abdolmajid Mohammadian, University of Ottawa, Canada; Martin Charron and Ayrton Zadra, Environment Canada, Canada

3:20-3:35 Interaction of Atmospheric Vortex with A Land

Olga S. Rozanova, Moscow State University, Russia

3:40-3:55 Simulating Wall-Mode Convection: Numerical Techniques and First Results

Keaton Burns, Massachusetts Institute of Technology, USA; Geoffrey M. Vasil, University of Sydney, Australia

Coffee Break

4:00 PM-4:30 PM

Room:Concourse/Buttery (Ground Floor)

Wednesday, August 13

MS64

Nonlinear Waves, Singularities, and Collapses in Water Waves, Optics and Plasmas - Part III of IV

4:30 PM-6:30 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS56
For Part 4 see MS72

Waves dynamics is one of the most interesting and appealing problems in applied mathematics and physics. In wast majority of interesting cases the problem of wave propagation can be solved not only in the linear approximation but also with nonlinear effects taken into account, due to powerful tools of modern applied mathematics and theoretical physics. Common approaches stimulate intensive interchange of ideas in the field which accelerates the development of the wave dynamics even further. Our minisymposium is devoted to new advances in the theory of waves and demonstrates vividly the similarity of approaches in a broad spectrum of important applications.

Organizer: Alexander O. Korotkevich
University of New Mexico, USA

Organizer: Pavel M. Lushnikov
University of New Mexico, USA

4:30-4:55 Wave Turbulence: A Story Far from Over

Alan Newell, University of Arizona, USA

5:00-5:25 High-Frequency Instabilities of Small-Amplitude Solutions of Hamiltonian PDEs

Bernard Deconinck, University of Washington, USA

5:30-5:55 Energy Growth in Switching Hamiltonian Systems of Fermi-Ulam Type

Vadim Zharnitsky, University of Illinois, USA; Maxim Arnold, University of Illinois at Urbana-Champaign, USA

continued in next column

6:00-6:25 Multipole and Half-vortex Gap-solitons in Spin-orbit Coupled Bose-Einstein Condensates

Yaroslav Kartashov, Institut de Ciències Fotòniques, Spain; *Vladimir V. Konotop*, University of Lisbon, Portugal; Valery Lobanov, Institut de Ciències Fotòniques, Spain

Wednesday, August 13

MS65

Spatial Localization: Recent Progress in Theory and Applications - Part I of II

4:30 PM-6:30 PM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS73

Spatially localized structures occur in many continuous dissipative systems and play an important role in their dynamics. They typically take the form of bound states of stationary or time-dependent fronts and have been observed in optics, biology and fluids. They are relevant to understanding the edge separating two stable states, such as laminar and turbulent shear flows. This minisymposium brings worldwide experts together to discuss and provide a summary of the recent progress in this area. The minisymposium is also of interest from a technical point of view as the investigation of spatial localization involves cutting-edge mathematical techniques.

Organizer: Cedric Beaume
University of California, Berkeley, USA

4:30-4:55 Stability Properties of Localized Structures Near Snaking

Elizabeth J. Makrides and *Bjorn Sandstede*, Brown University, USA

5:00-5:25 Dynamics of Cavity Solitons and Optical Frequency Combs in the Lugiato-Lefever Equation

Lendert Gelens, Stanford University, USA; Pedro Parra-Rivas, Vrije Universiteit Brussel, Belgium; Damia Gomila, Universitat de les Illes Balears, Spain; François Leo, Ghent University, Belgium; Stéphane Coen, University of Auckland, New Zealand

5:30-5:55 Localised Hexagon Patches on the Surface of a Magnetic Fluid

David Lloyd, University of Surrey, United Kingdom; Reinhard Richter, University of Bayreuth, Germany

6:00-6:25 Localized Solutions in Plane Couette Flow with Rotation

Matthew Salewski and Tobias Schneider, Max Planck Institute for Dynamics and Self-Organization, Germany

Wednesday, August 13

MS66

Analysis and Applications of Pattern-Forming Systems - Part I of II

4:30 PM-6:30 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS74

This minisymposium will bring together eight researchers working on the underlying mathematical mechanisms which drive complexity in physical and biological systems. The significant applications to be addressed are crime modeling, elastic patterning and biological growth. A unifying feature in studies of these disparate applications is the need to apply and develop analytical tools for predicting the possible states of the underlying mathematical models. Significant challenges arise due to the highly non-linear and non-local nature of these models. Numerical simulations must also be carefully designed in order to preserve mathematical structures of the model.

Organizer: Alan E. Lindsay
University of Notre Dame, USA

Organizer: Matthew Pennybacker
University of New Mexico, USA

4:30-4:55 The Stability and Evolution of Curved Domains Arising from One Dimensional Localized Patterns

Alan E. Lindsay, University of Notre Dame, USA

5:00-5:25 Slowly Varying Control Parameters, Delayed Bifurcations, and the Stability of Spikes in Reaction-diffusion Systems

Justin C. Tzou, Dalhousie University, Canada; Michael Ward, University of British Columbia, Canada; Theodore Kolokolnikov, Dalhousie University, Canada

continued in next column

5:30-5:55 Hotspots in a Non-Local Crime Model

Scott McCalla, University of California, Los Angeles, USA; Jonah Breslau, Pomona College, USA; Sorathan Chaturapruek, Harvey Mudd College, USA; Theodore Kolokolnikov, Dalhousie University, Canada; Daniel Yazdi, University of California, Los Angeles, USA

6:00-6:25 Modeling Capillary Origami

Nicholas D. Brubaker, University of Arizona, USA

Wednesday, August 13

MS67

Nonlinear Coherent Structures in Photonics - Part I of III

4:30 PM-6:30 PM

Room:Recital Room - Music Center

For Part 2 see MS75

Nature provides numerous examples of coherent nonlinear structures and waves. Often, physical systems sharing the same underlying nonlinear phenomenon can be modelled by similar equations, allowing for cross- disciplinary exchange of ideas and methods. This minisymposium, focused on coherent structures in photonics, brings together a number of leading experts in various aspects of nonlinear optical waves. The minisymposium scope covers both fundamental and applied nonlinear photonics with topics including temporal and spatial nonlinear effects, ultrafast processes, solitons and rogue waves, pulse shaping and generation, nonlinearity in nanophotonics, wave propagation and localization in disordered media, and fibre lasers.

Organizer: Sonia Boscolo
Aston University, United Kingdom

Organizer: Sergei Turitsyn
Aston University, United Kingdom

4:30-4:55 In-Cavity Transformations for New Nonlinear Regimes of Pulse Generation in Mode-Locked Fibre Lasers

Sonia Boscolo and Sergei K. Turitsyn, Aston University, United Kingdom; Christophe Finot, Université de Bourgogne, France

5:00-5:25 Nonlinear Pulse Shaping in Normally Dispersive Fibres: Experimental Examples

Kamal Hammani, Julien Fatome, and Guy Millot, Université de Bourgogne, France; Sonia Boscolo, Aston University, United Kingdom; Hervé Rigneault, Institut Fresnel, France; Stefano Wabnitz, University of Brescia, Italy; *Christophe Finot*, Université de Bourgogne, France

continued in next column

5:30-5:55 Time Domain Nonlinear Structures and Substructures for Ultrafast Photonics

Levon Mouradian, Aram Zeytunyan, Hrach Toneyan, and Garegin Yesayan, Yerevan State University, Armenia; Ruben Zadoyan, Newport Corporation, USA; Frédéric Louradour and Alain Barthélémy, Université de Limoges, France

6:00-6:25 Mechanisms and Definitions of Rogue Waves in Nonlinear Systems

John Dudley, Université de Franche-Comté, France; Goery Genty, Tampere University of Technology, Finland; Frederic Dias, University College Dublin, Ireland

Wednesday, August 13

MS68

Algebraic Aspects of Integrable Systems and Applications - Part III of IV

4:30 PM-6:30 PM

Room:Club Room - Concourse (1st Floor)

For Part 2 see MS60
For Part 4 see MS76

Integrable system has been studied extensively in related to many fields in both pure mathematics and applied mathematics. Meanwhile, the integrable system also promises applications ranging from water waves, nonlinear optics to numerical algorithms. The purpose of this special session is to bring together researchers from integrable system in both continuous and discrete integrable system to discuss recent advances on algebraic aspects of integrable systems and their applications.

Organizer: Bao-Feng Feng
University of Texas - Pan American, USA

Organizer: Xing-Biao Hu
Chinese Academy of Sciences, China

Organizer: Kenichi Maruno
University of Texas - Pan American, USA

Organizer: Jonathan Nimmo
University of Glasgow, Scotland, United Kingdom

4:30-4:55 A New Procedure to Approach Integrable Discretization

Xing-Biao Hu, Chinese Academy of Sciences, China

5:00-5:25 Rogue Waves for Some Soliton Equations

Yasuhiro Ohta, Kobe University, Japan

5:30-5:55 Complex and Coupled Complex Short Pulse Equations: Integrability, Discretization and Numerical Simulations

Bao-Feng Feng, University of Texas - Pan American, USA

6:00-6:25 New Results on the Explicit Monge-Taylor Forms for Submanifolds Under Group Actions Using Equivariant Moving Frame Method

Ruoxia Yao, Shaanxi Normal University, China

Wednesday, August 13

MS69

Recent Advances in Numerical Methods for Shallow Water Equations and Related Models - Part II of II

4:30 PM-6:30 PM

Room:Bevin Room - Wolfson Hall

For Part 1 see MS61

This minisymposium focuses on numerical methods for hyperbolic systems of conservation and balance laws used to model shallow water and related geophysical flows. Specific numerical difficulties different shallow water models have in common are due to the presence of(possibly singular) geometric source terms and/or nonconservative exchange terms. These may lead to the loss of hyperbolicity, nonlinear resonance, very complicated wave structures and, as a result, to appearance of spurious oscillations and slow convergence of numerical methods.Therefore development of highly accurate and efficient numerical methods for these systems is a very important and challenging task.

Organizer: Alina Chertock
North Carolina State University, USA

Organizer: Alexander Kurganov
Tulane University, USA

4:30-4:55 RVM Finite Volume Methods: Applications to Multilayer Shallow Flows

Jose M. Gallardo and Manuel Castro, University of Malaga, Spain; Antonio Marquina, University of Valencia, Spain

5:00-5:25 Well-Balanced Ale: a Dynamic Mesh Adaptation Strategy for Shallow Water Flows

Mario Ricchiuto, INRIA, France

5:30-5:55 Well-Balanced Positivity Preserving Cell-Vertex Central-Upwind Scheme for Shallow Water Flows

Abdelaziz Beljadid, University of Ottawa, Canada

6:00-6:25 Path-Conservative Central-Upwind Schemes for Nonconservative Hyperbolic Systems

Alexander Kurganov, Tulane University, USA

Wednesday, August 13

MS70

Connections Between Nonlinear Wave Equations and Geometry - Part III of III

4:30 PM-6:30 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 2 see MS62

This minisymposium will discuss some of the many facets of the interplay between geometry and nonlinear wave equations, and its increasingly important role in the study of nonlinear PDE and integrable systems, as well as differential and Poisson geometry. Topics will include geometric evolution equations---both continuous and discrete---arising in physical or geometric settings, geometric aspects of nonlinear wave equations (such as recursion operators and Poisson structures), and existence and construction of special solutions and coherent structures through geometric methods (e.g. Inverse Scattering Transform, Bäcklund transformations, algebro-geometric tools, Hirota method, etc.).

Organizer: Annalisa M. Calini
College of Charleston, USA

Organizer: Francesco Demontis
Universita di Cagliari, Italy

Organizer: Giovanni Ortenzi
University of Milan, Italy

4:30-4:55 Closed Form Solutions of the Hirota Equation

Cornelis Van der Mee, Universita di Cagliari, Italy

5:00-5:25 Integrable Nature of Modulational Instability

Gino Biondini and Emily Fagerstrom, State University of New York, Buffalo, USA

5:30-5:55 On the Spectrum of the Defocusing NLS Equation with Non-zero Boundary Conditions

Barbara Prinari, University of Colorado, Colorado Springs, USA; Gino Biondini, State University of New York, Buffalo, USA

6:00-6:25 Rational Solitons of Wave Resonant-Interaction Models

Sara Lombardo, Northumbria University, United Kingdom; Antonio Degasperis, Università La Sapienza, Rome, Italy

Wednesday, August 13

MS71

Coherent Structures in Nonlinear Hamiltonian Lattices: OPEN PROBLEMS

4:30 PM-6:30 PM

Room:JCR Games Room – Concourse (Ground Floor)

Hamiltonian lattices are ubiquitous in many branches of physics and materials science, and the standard equations (FPU-type chains, Klein-Gordon lattices, discrete nonlinear Schroedinger equations) have attracted a lot of interest in different communities. The last decades have seen a dramatic progress in the mathematical analysis of coherent structures in such systems but many fundamental problems remain unsolved. Moreover, new questions and problems constantly arise from the ongoing research activities. This minisymposium focuses on open problems and intends to provide a forum for discussing the current state and the future development of the research field.

Organizer: Ioannis Giannoulis
University of Ioannina, Greece

Organizer: Michael Herrmann
Saarland University, Germany

4:30-4:55 Localized Waves in Fully Nonlinear Media

Guillaume James, Université de Grenoble and CNRS, France

5:00-5:25 Breathers in Two-dimensional Fermi-Pasta-Ulam Lattices

Jonathan Wattis, University of Nottingham, United Kingdom

5:30-5:55 New Solutions for Slow Moving Kinks in a Forced Frenkel-Kontorova Chain

Phoebus Rosakis, University of Crete, Greece

6:00-6:25 On the Travelling Wave Problem for Phase Transitions in the Fermi-Pasta-Ulam Chain

Hartmut Schwetlick, University of Bath, United Kingdom

Wednesday, August 13

CP10

Fluid Dynamics and Related Problems II

4:30 PM-6:10 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Matthew R. Turner, University of Surrey, United Kingdom

4:30-4:45 Fluid Ratcheting by Oscillating Channel Walls with Sawteeth

Jie Yu, North Carolina State University, USA

4:50-5:05 Diffraction and Reflection of a Weak Shock at a Right-Angled Wedge in Real Fluids

Neelam Gupta, Indian Institute of Technology-Bombay, India

5:10-5:25 Nonlinear Energy Transfer Between Fluid Sloshing and Vessel Motion

Matthew R. Turner, Tom J. Bridges, and Hamid Alemi Ardakani, University of Surrey, United Kingdom

5:30-5:45 A Theory of Weakly Non-Linear Detonations

Luiz Faria and Aslan R. Kasimov, King Abdullah University of Science & Technology (KAUST), Saudi Arabia; Rodolfo R. Rosales, Massachusetts Institute of Technology, USA

5:50-6:05 Pattern Formation in a Circular Hydraulic Jump

Aslan R. Kasimov, King Abdullah University of Science & Technology (KAUST), Saudi Arabia

Dinner Break

6:30 PM-8:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Wednesday, August 13

SIAG/NWCS Business Meeting

8:00 PM-8:45 PM

Room:Wolfson Auditorium - Wolfson Hall

(Open to SIAG/NWCS members)

Complimentary beer and wine will be served.

Thursday, August 14

Registration

7:45 AM-5:00 PM

Room:Main Foyer - Concourse (Ground Floor)

Thursday, August 14

MS72

Nonlinear Waves, Singularities, and Collapses in Water Waves, Optics and Plasmas - Part IV of IV

8:10 AM-10:10 AM

Room:Wolfson Auditorium - Wolfson Hall

For Part 3 see MS64

Waves dynamics is one of the most interesting and appealing problems in applied mathematics and physics. In wast majority of interesting cases the problem of wave propagation can be solved not only in the linear approximation but also with nonlinear effects taken into account, due to powerful tools of modern applied mathematics and theoretical physics. Common approaches stimulate intensive interchange of ideas in the field which accelerates the development of the wave dynamics even further.
Our minisymposium is devoted to new advances in the theory of waves and demonstrates vividly the similarity of approaches in a broad spectrum of important applications.

Organizer: Alexander O. Korotkevich
University of New Mexico, USA

Organizer: Pavel M. Lushnikov
University of New Mexico, USA

continued on next page

8:10-8:35 Solitons, Self-Induced Transparency, and Quantum Cascade Lasers

Curtis R. Menyuk, University of Maryland, Baltimore County, USA; Muhammad Talukder, Bangladesh University of Engineering & Technology, Bangladesh

8:40-9:05 Thresholds and Blow-up Dynamics in the Nonlinear Dispersive Equations

Svetlana Roudenko, George Washington University, USA

9:10-9:35 On Multi-Dimensional Compact Patterns

Philip Rosenau, Tel Aviv University, Israel

9:40-10:05 Branch Cut Singularity of Stokes Wave

Pavel M. Lushnikov, University of New Mexico, USA

Thursday, August 14

MS73

Spatial Localization: Recent Progress in Theory and Applications - Part II of II

8:10 AM-10:10 AM

Room:Jock Colville Hall - Archives Center

For Part 1 see MS65

Spatially localized structures occur in many continuous dissipative systems and play an important role in their dynamics. They typically take the form of bound states of stationary or time-dependent fronts and have been observed in optics, biology and fluids. They are relevant to understanding the edge separating two stable states, such as laminar and turbulent shear flows. This minisymposium brings worldwide experts together to discuss and provide a summary of the recent progress in this area. The minisymposium is also of interest from a technical point of view as the investigation of spatial localization involves cutting-edge mathematical techniques.

Organizer: Cedric Beaume

University of California, Berkeley, USA

8:10-8:35 Localised Solutions in Integral Neural Field Equations

Daniele Avitabile, University of Nottingham, United Kingdom

8:40-9:05 Localized Convection in a Rotating Fluid Layer

Cedric Beaume, University of California, Berkeley, USA

9:10-9:35 Steady and Oscillatory Localised States in Boussinesq Magnetoconvection

Paul J. Bushby and Matthew Buckley, Newcastle University, United Kingdom

9:40-10:05 Moving Localized Structures in a Doubly Diffusive System

David Lo Jacono and Alain Bergeon, Universite de Toulouse, France; Edgar Knobloch, University of California, Berkeley, USA

Thursday, August 14

MS74

Analysis and Applications of Pattern-Forming Systems - Part II of II

8:10 AM-9:40 AM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 1 see MS66

This minisymposium will bring together eight researchers working on the underlying mathematical mechanisms which drive complexity in physical and biological systems. The significant applications to be addressed are crime modeling, elastic patterning and biological growth. A unifying feature in studies of these disparate applications is the need to apply and develop analytical tools for predicting the possible states of the underlying mathematical models. Significant challenges arise due to the highly non-linear and non-local nature of these models. Numerical simulations must also be carefully designed in order to preserve mathematical structures of the model.

Organizer: Alan E. Lindsay

University of Notre Dame, USA

Organizer: Matthew Pennybacker

University of New Mexico, USA

8:10-8:35 Pattern-Forming Fronts in Phyllotaxis

Matthew Pennybacker, University of New Mexico, USA

8:40-9:05 Isometric Immersions and Pattern Formation in Non-Euclidean Elastic Sheets

John A. Gemmer, Brown University, USA; Shankar C. Venkataramani, University of Arizona, USA

9:10-9:35 Nanoscale Pattern Formation by Ion Bombardment of Binary Compounds

Patrick Shipman, Colorado State University, USA

Thursday, August 14

MS75

Nonlinear Coherent Structures in Photonics - Part II of III

8:10 AM-10:10 AM

Room:Recital Room - Music Center

For Part 1 see MS67
For Part 3 see MS83

Nature provides numerous examples of coherent nonlinear structures and waves. Often, physical systems sharing the same underlying nonlinear phenomenon can be modelled by similar equations, allowing for cross- disciplinary exchange of ideas and methods. This minisymposium, focused on coherent structures in photonics, brings together a number of leading experts in various aspects of nonlinear optical waves. The minisymposium scope covers both fundamental and applied nonlinear photonics with topics including temporal and spatial nonlinear effects, ultrafast processes, solitons and rogue waves, pulse shaping and generation, nonlinearity in nanophotonics, wave propagation and localization in disordered media, and fibre lasers.

Organizer: Sonia Boscolo
Aston University, United Kingdom

Organizer: Sergei Turitsyn
Aston University, United Kingdom

8:10-8:35 Relative Intensity Noise Transfer in Second-Order Raman Amplification with Random Distributed Feedback Ultra-Long Fibre Lasers

Javier Nuno, CSIC, Madrid, Spain; *Juan Diego Ania Castañón*, Instituto de Óptica (CSIC), Madrid, Spain

8:40-9:05 Order and Chaos in Fibre Lasers

Stefan Wabnitz, University of Brescia, Italy

continued in next column

9:10-9:35 Transverse Disorder-Induced Localizations in Nonlocal Nonlinear Media: Theory and Experiments

Claudio Conti, Università degli Studi di Roma, La Sapienza, Italy; Viola Folli, Universita di Roma “La Sapienza,” Italy; Marco Leonetti, Università degli Studi di Roma, La Sapienza, Italy; Salman Karbasi and Arash Mafi, University of Wisconsin, Milwaukee, USA

9:40-10:05 Optical Wave Turbulence: Toward a Unified Non-Equilibrium Thermodynamic Description of Statistical Nonlinear Optics

Gang Xu, University of Burgundy, France; Josselin Garnier, Universite Paris 7-Denis Diderot, France; Stefano Trillo, University of Ferrara, Italy; *Antonio Picozzi*, Université de Bourgogne, France

Thursday, August 14

MS76

Algebraic Aspects of Integrable Systems and Applications - Part IV of IV

8:10 AM-10:10 AM

Room:Club Room - Concourse (1st Floor)

For Part 3 see MS68

Integrable system has been studied extensively in related to many fields in both pure mathematics and applied mathematics. Meanwhile, the integrable system also promises applications ranging from water waves, nonlinear optics to numerical algorithms. The purpose of this special session is to bring together researchers from integrable system in both continuous and discrete integrable system to discuss recent advances on algebraic aspects of integrable systems and theirs applications.

Organizer: Bao-Feng Feng
University of Texas - Pan American, USA

Organizer: Xing-Biao Hu
Chinese Academy of Sciences, China

Organizer: Kenichi Maruno
University of Texas - Pan American, USA

Organizer: Jonathan Nimmo
University of Glasgow, Scotland, United Kingdom

8:10-8:35 General Solutions of Arbitraray First Order Autonomous PDEs

Senyue Lou, Ningbo University, China

8:40-9:05 On Nonintegrable Semidiscrete Hirota Equation: Gauge Equivalent Structures and Dynamical Properties

Zuonong Zhu, Shanghai Jiao Tong University, China

9:10-9:35 Invariant Manifold of the KdV Equation

Yong Chen and Yuqi Li, Eastern China Normal University, China; Senyue Lou, Ningbo University, China

9:40-10:05 KP Web-solitons from Wave Patterns

Sarbarish Chakravarty, University of Colorado, Colorado Springs, USA

Thursday, August 14

MS77

Discrete and Continuous Nonlocal Wave Equations and Applications - Part I of III

8:10 AM-10:10 AM

Room:Bevin Room - Wolfson Hall

For Part 2 see MS85

The session focuses on recent results on nonlinear wave equations with nonlocal terms, including dispersive wave equations coupled with elliptic or parabolic equations. Applications include nonlinear optics in thermal media, water wave models, and coupled nonlinear lattice models. The inclusion of nonlocal terms can produce subtle and physically important effects in the properties of coherent structures, and requires more general analytical and numerical tools. The session will include works motivated by recent experimental studies, as well as more theoretical results on the relevant models.

Organizer: Panayotis Panayotaros
IIMAS-UNAM, Mexico

Organizer: Richard O. Moore
New Jersey Institute of Technology, USA

8:10-8:35 Dynamics of Localized Solution in Nonlocal NLS Equation with Double Well Potential

Vassilis M. Rothos, Aristotle University of Thessaloniki, Greece

8:40-9:05 Surface Signature of Internal Waves

Philippe Guyenne, University of Delaware, USA

9:10-9:35 The Role of Radiation Loss in the Evolution of Elliptic Solitons in Nonlocal Soft Media

Luke Sciberras, Universidad Nacional Autónoma de México, Mexico

9:40-10:05 Mobile Localized Solutions for An Electron in Lattices with Dispersive and Non-Dispersive Phonons

Luis Cisneros, Instituto Politécnico Nacional, Mexico

Thursday, August 14

MS78

Nonlinear Waves and Patterns Generated by Instabilities - Part I of II

8:10 AM-10:10 AM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 2 see MS86

The phenomenon of the pattern formation has been extensively studied during several decades. The major success has been achieved in the exploration of patterns governed by some versions of the Ginzburg-Landau equation. However, there exists a variety of problems where the Ginzburg-Landau equation is not efficient. The present minisymposium exposes recent achievements in the field of nonlinear waves and patterns created by instabilities, which need diverse tools for their description. The list of problems includes instabilities developed under the action of vibration and modulation of parameters, waves generated by rotation, different aspects of the nonlinear film dynamics, and the dynamics of coherent structures in dissipative turbulence.

Organizer: Alexander Nepomnyashchy
Technion - Israel Institute of Technology, Israel

Organizer: Sergey Shklyaev
Institute of Continuous Media Mechanics, Perm, Russia

8:10-8:35 Symmetries and Parametric Instabilities in Vibrating Containers

Jose Manuel Vega, Universidad Politécnica de Madrid, Spain

8:40-9:05 Modulation of a Heat Flux in a Layer of Binary Mixture

Irina Fayzrakhmanova, Perm State Humanitarian Pedagogical University, Perm, Russia; Sergey Shklyaev, Institute of Continuous Media Mechanics, Perm, Russia; *Alexander Nepomnyashchy*, Technion Israel Institute of Technology, Israel

continued in next column

9:10-9:35 Coherent Structures Interaction and Self-Organization in Dissipative Turbulence

Serafim Kalliadasis and Marc Pradas, Imperial College London, United Kingdom; Te-Sheng Lin and Dmitri Tseluiko, Loughborough University, United Kingdom

9:40-10:05 Waves on the Interface of Two-Layer Liquid System Subject to Longitudinal Vibrations: Stability and Collision of Solitons

Denis S. Goldobin, Russian Academy of Sciences, Russia; Kseniya Kovalevskaya, Pennsylvania State University, USA

Thursday, August 14

MS79

Model Reduction for Complex Systems Exhibiting Wave Phenomena

8:10 AM-10:10 AM

Room:JCR Games Room – Concourse (Ground Floor)

The study of complex systems equations and large systems of ordinary differential equations is important in many problems from fluid mechanics, climate, nonlinear optics, molecular dynamics, etc. The complexity can come from the number of fields involved or the underlying geometry. An example is the propagation of waves on networks. For this study, it is important to be able to reduce the complexity and obtain simpler equations that can be studied analytically. This reduction can be done by projecting on coherent structures or on linear modes. We present works that use both approaches and compare them on large systems of coupled differential equations and of coupled partial differential equations.

Organizer: Brenton J. LeMesurier
College of Charleston, USA

Organizer: Alejandro Aceves
Southern Methodist University, USA

Organizer: Jean-Guy Caputo
Universite de Rouen, France

8:10-8:35 Model Reduction in Optics and Traffic Modeling
Mads Sørensen, Technical University of Denmark, Denmark

8:40-9:05 Model Reduction for Waves in Networks
Jean-Guy Caputo, Universite de Rouen, France

9:10-9:35 Disorder in One-Dimensional Granular Crystals
Alejandro J. Martinez, University of Oxford, United Kingdom

9:40-10:05 Partial Continuum Limits for Exciton Pulses in Large Molecules
Brenton J. LeMesurier, College of Charleston, USA

Thursday, August 14

CP11

Surface Waves and Related Problems

8:10 AM-10:10 AM

Room:Tizard Room - Concourse (1st Floor)

Chair: David I. Ketcheson, King Abdullah University of Science & Technology (KAUST), Saudi Arabia

8:10-8:25 On Periodic Solutions of a Model Equation for Surface Waves of Moderate Amplitude in Shallow Water
Nilay Duruk Mutlubas, Istanbul Kemerburgaz University, Turkey

8:30-8:45 Solitary Waves Without Dispersive Terms: the Shallow Water Equations over a Periodic Bottom
David I. Ketcheson, King Abdullah University of Science & Technology (KAUST), Saudi Arabia; Manuel Quezada De Luna, Texas A&M University, USA

8:50-9:05 High Order Hamiltonian Water Wave Models with Wave-Breaking Mechanism
Ruddy Kurnia and E. Van Groesen, University of Twente, The Netherlands

9:10-9:25 Interaction of Strongly Nonlinear Waves on the Free Surface of Non-Conducting Fluid under the Action of Horizontal Electric Field
Evgeny Kochurin and Nikolay Zubarev, Russian Academy of Sciences, Russia

9:30-9:45 The Higher-Order Boussinesq Equation with Periodic Boundary Conditions: Analytical and Numerical Results
Goksu Topkarci and Gulcin M. Muslu, Istanbul Technical University, Turkey; Handan Borluk, Isik University, Turkey

9:50-10:05 Ocean Wave Energy Potential and Microseisms
Paul Christodoulides, Cyprus University of Technology, Cyprus; Lauranne Pellet, École Centrale de Marseille, France; Frédéric Dias, University College Dublin, Ireland and Ecole Normale Supérieure de Cachan, France

Coffee Break

10:10 AM-10:40 AM

Room:Concourse/Buttery (Ground Floor)

Thursday, August 14

Remarks

10:40 AM-10:45 AM

Room:Wolfson Auditorium - Wolfson Hall

IP7

Momentum Maps, Shape Analysis and Solitons

10:45 AM-11:30 AM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Sheehan Olver, University of Sydney, Australia

Much of this talk is based on work done with Jerry Marsden (1942 - 2010) on shared geometric properties in the analysis of fluid flow and shape transformations. The talk will discuss uses of geometric mechanics in the problem of registration of images, primarily in the example of planar closed curves. Many types of mathematics apply in this problem, including soliton theory and momentum maps. Some trade secrets will be revealed.

Darryl D. Holm
Imperial College London, United Kingdom and Los Alamos National Laboratory, USA

Lunch Break

11:30 AM-1:00 PM

Attendees on their own.

Meals will be available for purchase in the Dining Hall or Buttery snack bar.

Thursday, August 14

IP8

Symmetry, Modulation and Nonlinear Waves

1:00 PM-1:45 PM

Room:Wolfson Auditorium - Wolfson Hall

Chair: Barbara Prinari, University of Colorado, Colorado Springs, USA

Modulation underpins many facets of the analysis of nonlinear waves and patterns. A new perspective on modulation combined with symmetry and conservation laws will be presented, which leads to a mechanism for the emergence of model wave PDEs such as KdV, KP, Boussinesq and others. This combination results in simple geometric formulae for the coefficients. Generalizations to multi-phase wavetrains, systems of conservation laws, Whitham equations with dispersion, and a mechanism for the formation of multi-pulse planforms in pattern formation will also be presented.

Tom J. Bridges
University of Surrey, United Kingdom

Intermission

1:45 PM-2:00 PM

Thursday, August 14

MS80

The Hamiltonian and Symplectic Methods in the Theory of Non-Linear Waves - Part I of II

2:00 PM-4:00 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 2 see MS88

Hamitonian structures have played a central role in the theory of nonlinear waves. Historically they played an abstract role, but increasingly they are viewed as practical tools for solving open problems in the theory of nonlinear waves. The subject is ever expanding, and the purpose of this minisymposium is to present a snapshot of recent developments. Topics include Hamiltonian structures of nonlinear dispersive wave equations, theory of Hamiltonian PDEs, Krein signature, the Maslov index, stability of solitary waves (symplectic Evans function, the energy-momentum method), multi-symplectic structures, averaged Lagrangians, Whitham modulation theory, and numerical methods for all of the above.

Organizer: Frederic Chardard
Universite Jean Monnet, France

Organizer: Tom J. Bridges
University of Surrey, United Kingdom

2:00-2:25 Transversality of Solitary Waves and Their Stability

Frederic Chardard, Universite Jean Monnet, France

2:30-2:55 An Application of Maslov Index to the Stability Analysis for Standing Pulses

Chiao-Nen Chen, National Changhua University of Education, Taiwan

3:00-3:25 Stability of Periodic Waves in Hamiltonian Pdes

Miguel Rodrigues, University of Lyon 1, France

3:30-3:55 Sloshing Dynamics with the Hamiltonian Particle-mesh Method

Hamid Alemi Ardakani, Tom J. Bridges, and Matthew R. Turner, University of Surrey, United Kingdom

Thursday, August 14

MS81

Nonlinear Waves in Fluid Flows and Their Interaction with Structures - Part I of II

2:00 PM-4:00 PM

Room:Jock Colville Hall - Archives Center

For Part 2 see MS89

This session focuses on nonlinear waves in fluid flows and their interaction with structures. Examples include internal and surface waves in the ocean, flexural-gravity waves in floating ice sheets, and hydroelastic waves in industrial or biological fluid systems. Such problems are typically described by nonlinear dispersive PDEs with coupling terms, which require sophisticated analytical techniques and accurate numerical methods to calculate such solutions as solitary waves, breaking waves or waves with a multivalued profile. This session will feature a wide range of talks on the mathematical modeling, numerical simulation and laboratory experiment of such waves.

Organizer: Philippe Guyenne
University of Delaware, USA

Organizer: Emilian I. Parau
University of East Anglia, United Kingdom

2:00-2:25 Experimental Observation of Unstable Mode 2 Internal Waves

Magda Carr, University of St. Andrews, United Kingdom; Peter A Davies, University of Dundee, Scotland; Ruud Hoebers, Eindhoven University of Technology, Netherlands

2:30-2:55 Comparing Stokes Drift for Internal and Surface Gravity Wave Packets

Ton van den Bremer and Paul Taylor, University of Oxford, United Kingdom; Bruce Sutherland, University of Alberta, Canada

3:00-3:25 Analysis and Computations of the Initial Value Problem for Hydroelastic Waves

Michael Siegel, New Jersey Institute of Technology, USA

3:30-3:55 Hydraulic Falls Under a Floating Ice Plate

Charlotte Page and Emilian I. Parau, University of East Anglia, United Kingdom

Thursday, August 14

MS82

Dynamical Systems and Climate - Part I of II

2:00 PM-4:00 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 2 see MS90

Over the past few decades it has become apparent that the Earth's climate is a rich source of applied mathematical problems, particularly in the fields of dynamical systems and data assimilation. The rigorous study of conceptual models has provided new insight into climate dynamics, along the way necessitating the development of exciting new mathematical tools. This minisymposium will focus on the application of dynamical methods to problems in such diverse areas as data assimilation, desertification, and ocean circulation, with an emphasis on the unique mathematical challenges arising in such studies.

Organizer: Graham Cox
University of North Carolina, Chapel Hill, USA

Organizer: Thomas Bellsky
Arizona State University, USA

2:00-2:25 Stablility of Localized Structure for a Semi-Arid Climate Model

Thomas Bellsky, Arizona State University, USA

2:30-2:55 Semi-Strong Desertification Dynamics with a Slowly Changing Parameter

Eric Siero and Arjen Doelman, Leiden University, Netherlands; Thomas Bellsky, Arizona State University, USA

3:00-3:25 Tipping and Warning Signs for Patterns and Propagation Failure in SPDEs

Karna V. Gowda, Northwestern University, USA; *Christian Kuehn*, Vienna University of Technology, Austria

3:30-3:55 Model Reduction and Response for Two-Timescale Systems Using Fluctuation-Dissipation

Marc Kjerland, University of Illinois, Chicago, USA

Thursday, August 14

MS83

Nonlinear Coherent Structures in Photonics - Part III of III

2:00 PM-4:00 PM

Room:Recital Room - Music Center

For Part 2 see MS75

Nature provides numerous examples of coherent nonlinear structures and waves. Often, physical systems sharing the same underlying nonlinear phenomenon can be modelled by similar equations, allowing for cross- disciplinary exchange of ideas and methods. This minisymposium, focused on coherent structures in photonics, brings together a number of leading experts in various aspects of nonlinear optical waves. The minisymposium scope covers both fundamental and applied nonlinear photonics with topics including temporal and spatial nonlinear effects, ultrafast processes, solitons and rogue waves, pulse shaping and generation, nonlinearity in nanophotonics, wave propagation and localization in disordered media, and fibre lasers.

Organizer: Sonia Boscolo
Aston University, United Kingdom

Organizer: Sergei Turitsyn
Aston University, United Kingdom

2:00-2:25 Tuning of Surface Plasmon Polaritons Beat Length in Graphene Directional Couplers

Costantino De Angelis, Aldo Auditore, and Andrea Locatelli, University of Brescia, Italy; Alejandro Aceves, Southern Methodist University, USA

2:30-2:55 Ultrafast Spatial and Temporal Soliton Dynamics in Gas-Filled Hollow-Core Photonic Crystal Fibres

John Travers, Francesco Tani, Ka Fai Mak, Philipp Hölzer, Alexey Ermolov, and Philip Russell, Max Planck Institute for the Science of Light, Germany

continued in next column

3:00-3:25 Self-Tuning Nonlinear Optical Systems

J. Nathan Kutz, Steven Bruton, and Xing Fu, University of Washington, USA

3:30-3:55 Thermo-Optical Effects and Mode Instabilities in Large Mode Area Photonic Crystal Fibers

Annamaria Cucinotta, Universita degli Studi di Parma, Italy; Enrico Coscelli, Federica Poli, and Stefano Selleri, University of Parma, Italy

Thursday, August 14

MS84

Coherent Structures Driven by Coulombic and Other Long Range Interactions - Part I of II

2:00 PM-4:00 PM

Room:Club Room - Concourse (1st Floor)

For Part 2 see MS92

Coherent structures (CSs) are fundamental in pattern forming systems, e.g., reaction-diffusion systems, convection, and periodically forced media. Recently, evidences of CSs are also being emerged in systems related to renewable energy devices, e.g., membranes in fuel cells, batteries, and ionic liquids. Such systems extend the reaction-diffusion type systems to incorporate effects like Coulombic interactions and global conservations. The minisymposium goals: (1) to survey the development of models and analysis methods that give rise to CSs and (2) to scrutinize the connections between models and their impacts to real life applications, e.g. renewable energy devices, polymer based media and vegetation.

Organizer: Arik Yochelis
Ben Gurion University Negev, Israel

Organizer: Nir Gavish
Technion - Israel Institute of Technology, Israel

2:00-2:25 On Electrical Diffuse Layers in Ionic Liquids and Heteroclinic-Type Connections

Arik Yochelis, Ben Gurion University Negev, Israel

2:30-2:55 Bifurcations in the Langmuir-Blodgett Transfer Problem

Michael H. Koepf, Ecole Normale Supérieure, France; Uwe Thiele, University of Muenster, Germany

continued in next column

3:00-3:25 Standing Waves and Heteroclinic Networks in the Nonlocal Complex Ginzburg-Landau Equation for Electrochemical Systems

Vladimir Garcia-Morales, Technische Universität München, Germany

3:30-3:55 Coherent Structures in Confined Swarming Flows

Franck Plouraboue, CNRS, France; Adama Creppy and Olivier Praud, Toulouse University, France; Pierre Degond, Imperial College London, United Kingdom; Hui Yu, Universite de Toulouse, France; Nan Wang, National University of Singapore, Singapore

Thursday, August 14

MS85

Discrete and Continuous Nonlocal Wave Equations and Applications - Part II of III

2:00 PM-3:30 PM

Room:Bevin Room - Wolfson Hall

For Part 1 see MS77
For Part 3 see MS93

The session focuses on recent results on nonlinear wave equations with nonlocal terms, including dispersive wave equations coupled with elliptic or parabolic equations. Applications include nonlinear optics in thermal media, water wave models, and coupled nonlinear lattice models. The inclusion of nonlocal terms can produce subtle and physically important effects in the properties of coherent structures, and requires more general analytical and numerical tools. The session will include works motivated by recent experimental studies, as well as more theoretical results on the relevant models.

Organizer: Panayotis Panayotaros
IIMAS-UNAM, Mexico

Organizer: Richard O. Moore
New Jersey Institute of Technology, USA

2:00-2:25 Exact and Approximate Solutions for Solitary Waves in Nematic Liquid Crystals

Michael MacNeil, University of Edinburgh, United Kingdom

2:30-2:55 Controlability of Schroedinger Equation with a Hartree Type Nonlinearity

Mariano De Leo, Universidad Nacional General Sarmiento, Argentina

3:00-3:25 Localized Solutions and Traveling Waves in a Nonlocal Parametrically Forced Nonlinear Schroedinger Equation

Richard O. Moore, New Jersey Institute of Technology, USA

Thursday, August 14

MS86

Nonlinear Waves and Patterns Generated by Instabilities - Part II of II

2:00 PM-4:00 PM

Room:Cockcroft Room - Concourse (Ground Floor)

For Part 1 see MS78

The phenomenon of the pattern formation has been extensively studied during several decades. The major success has been achieved in the exploration of patterns governed by some versions of the Ginzburg-Landau equation. However, there exists a variety of problems where the Ginzburg-Landau equation is not efficient. The present minisymposium exposes recent achievements in the field of nonlinear waves and patterns created by instabilities, which need diverse tools for their description. The list of problems includes instabilities developed under the action of vibration and modulation of parameters, waves generated by rotation, different aspects of the nonlinear film dynamics, and the dynamics of coherent structures in dissipative turbulence.

Organizer: Alexander Nepomnyashchy
Technion - Israel Institute of Technology, Israel

Organizer: Sergey Shklyaev
Institute of Continuous Media Mechanics, Perm, Russia

2:00-2:25 Thin Film Flows over Spinning Discs: Numerical Simulation of Three-Dimensional Waves

Omar K. Matar, Imperial College London, United Kingdom

2:30-2:55 Wave Instability of a Rotating Liquid-Liquid Interface

Nikolay Kozlov, Anastasiia Kozlova, and Darya Shuvalova, Perm State Humanitarian Pedagogical University, Perm, Russia

continued in next column

3:00-3:25 Continuously Quenched Pattern Dynamics in Drying Liquid Films

Pierre Colinet, Université Libre de Bruxelles, Belgium

3:30-3:55 Compactons Induced by Nonconvex Advection

Alex Oron, Technion - Israel Institute of Technology, Israel; Philip Rosenau, Tel Aviv University, Israel

Thursday, August 14

MS87

Stratified Fluids, Coherent Structures, and Their Interactions - Part I of II

2:00 PM-4:00 PM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 2 see MS94

Fluid-structure interactions are ubiquitous in fluid mechanics. The presence of ambient fluid stratification can increase the level of complexity and provide a rich parametric space with new and interesting effects. In this minisymposium, presenters will discuss the dynamics of fluid-structure interactions and multiphase flow in homogeneous and stratified settings. They will explore the resulting fluid flow and emergence of coherent structures in physically relevant problems which pose challenging mathematical questions, including handling varying boundary conditions in the flow. Studies will draw from all aspects of scientific investigations in this area, from experimental, to analytical and numerical results.

Organizer: Shilpa Khatri
University of North Carolina, Chapel Hill, USA

Organizer: Roberto Camassa
University of North Carolina, Chapel Hill, USA

Organizer: Richard McLaughlin
University of North Carolina, Chapel Hill, USA

2:00-2:25 Experiments and Theory for Porous Spheres Settling in Sharply Stratified Fluids

Shilpa Khatri, Roberto Camassa, Richard McLaughlin, Jennifer Prairie, Brian White, and Sungduk Yu, University of North Carolina, Chapel Hill, USA

continued on next page

2:30-2:55 Solute Dynamics Within Settling Marine Snow at Density Discontinuities

Morten Iversen, University of Bremen, Germany

3:00-3:25 Settling and Rising in Density Stratified Fluids: Analysis and Experiments

Roberto Camassa, University of North Carolina, Chapel Hill, USA

3:30-3:55 Transcritical Flow of a Stratified Fluid Over Topography and Non-classical Dispersive Shock Waves

Gennady El, Loughborough University, United Kingdom

Thursday, August 14

CP12

Bose-Einstein, Nonlinear Optics and Related Problems

2:00 PM-4:00 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Dmitri Tseluiko, Loughborough University, United Kingdom

2:00-2:15 A Multiscale Continuation Algorithm for Binary Rydberg-Dressed Bose-Einstein Condensates

Cheng-Sheng Chien, Chien Hsin University of Science and Technology, Taiwan; Sirilak Sriburadet, National Chung-Hsing University, Taiwan; Yun-Shih Wang, Chien Hsin University of Science and Technology, Taiwan

2:20-2:35 Vortex Clustering and Negative Temperature States in a 2D Bose-Einstein Condensate

Hayder Salman and *Davide Maestrini*, University of East Anglia, United Kingdom

2:40-2:55 The Structure of the Equilibrium Field Distribution in a Discrete Optical Waveguide System with Four-Wave Mixing

Stanislav Derevyanko, Weizmann Institute of Science, Israel

3:00-3:15 Ground State Solutions of Coupled IR/UV Stationary Filaments

Danhua Wang, University of Vermont, USA; Alejandro Aceves, Southern Methodist University, USA

3:20-3:35 Dynamics of Bright-Dark Solitons and Their Collisions in the General Multi-Component Yajima-Oikawa System

Sakkaravarthi Karuppaiya and Kanna Thambithurai, Bishop Heber College, India

3:40-3:55 Pulse Interactions and Bound-State Formation in Non-Local Active-Dissipative Equations

Dmitri Tseluiko and Te-Sheng Lin, Loughborough University, United Kingdom; Marc Pradas, Serafim Kalliadasis, and Demetrios Papageorgiou, Imperial College London, United Kingdom

Coffee Break

4:00 PM-4:30 PM

Room:Concourse/Buttery (Ground Floor)

Thursday, August 14

MS88

The Hamiltonian and Symplectic Methods in the Theory of Non-Linear Waves - Part II of II

4:30 PM-6:30 PM

Room:Wolfson Auditorium - Wolfson Hall

For Part 1 see MS80

Hamitonian structures have played a central role in the theory of nonlinear waves. Historically they played an abstract role, but increasingly they are viewed as practical tools for solving open problems in the theory of nonlinear waves. The subject is ever expanding, and the purpose of this minisymposium is to present a snapshot of recent developments. Topics include Hamiltonian structures of nonlinear dispersive wave equations, theory of Hamiltonian PDEs, Krein signature, the Maslov index, stability of solitary waves (symplectic Evans function, the energy-momentum method), multi-symplectic structures, averaged Lagrangians, Whitham modulation theory, and numerical methods for all of the above.

Organizer: Frederic Chardard
Universite Jean Monnet, France

Organizer: Tom J. Bridges
University of Surrey, United Kingdom

4:30-4:55 A Hamiltonian Analogue of the Meandering Transition

Claudia Wulff, University of Surrey, United Kingdom

5:00-5:25 Dispersive Shear Shallow Water Flows

Sergey Gavrilyuk, University of Aix-Marseille, France

5:30-5:55 Standing Pulse Solution of Fitzhugh-Nagumo Equations

Yung-Sze Choi, University of Connecticut, USA

6:00-6:25 Multisymplectic Structure and the Stability of Solitary Waves

Tom J. Bridges, University of Surrey, United Kingdom

Thursday, August 14

MS89

Nonlinear Waves in Fluid Flows and Their Interaction with Structures - Part II of II

4:30 PM-6:30 PM

Room:Jock Colville Hall - Archives Center

For Part 1 see MS81

This session focuses on nonlinear waves in fluid flows and their interaction with structures. Examples include internal and surface waves in the ocean, flexural-gravity waves in floating ice sheets, and hydroelastic waves in industrial or biological fluid systems. Such problems are typically described by nonlinear dispersive PDEs with coupling terms, which require sophisticated analytical techniques and accurate numerical methods to calculate such solutions as solitary waves, breaking waves or waves with a multivalued profile. This session will feature a wide range of talks on the mathematical modeling, numerical simulation and laboratory experiment of such waves.

Organizer: Philippe Guyenne
University of Delaware, USA

Organizer: Emilian I. Parau
University of East Anglia, United Kingdom

4:30-4:55 On the Interaction Between Surface and Internal Waves

Wooyoung Choi, New Jersey Institute of Technology, USA

5:00-5:25 Computing the Pressure in Fully Nonlinear Long-Wave Models for Surface Water Waves

Henrik Kalisch, University of Bergen, Norway

5:30-5:55 Davies Approximation of Levi-Civita's Surface Condition for Water Waves in the Complex Domain

Sunao Murashige, Ibaraki University, Japan; Wooyoung Choi, New Jersey Institute of Technology, USA

6:00-6:25 Axisymmetric Solitary Waves on a Ferrofluid Jet

Mark Blyth, University of East Anglia, United Kingdom

Thursday, August 14

MS90

Dynamical Systems and Climate - Part II of II

4:30 PM-6:30 PM

Room:Fellows Dining Room - Concourse (1st Floor)

For Part 1 see MS82

Over the past few decades it has become apparent that the Earth's climate is a rich source of applied mathematical problems, particularly in the fields of dynamical systems and data assimilation. The rigorous study of conceptual models has provided new insight into climate dynamics, along the way necessitating the development of exciting new mathematical tools. This minisymposium will focus on the application of dynamical methods to problems in such diverse areas as data assimilation, desertification, and ocean circulation, with an emphasis on the unique mathematical challenges arising in such studies.

Organizer: Graham Cox
University of North Carolina, Chapel Hill, USA

Organizer: Thomas Bellsky
Arizona State University, USA

4:30-4:55 Mixed Mode Oscillations in Conceptual Climate Models: A General Perspective

Esther Widiasih, University of Hawaii, USA

5:00-5:25 Mixed Mode Oscillations in Conceptual Climate Models: An In-depth Discussion

Andrew Roberts, University of North Carolina, Chapel Hill, USA; Esther Widiasih, University of Hawaii, USA; Chris Jones, University of North Carolina, Chapel Hill, USA; Martin Wechselberger, University of Sydney, Australia

5:30-5:55 Data Assimilation for Quadratic Dissipative Dynamical Systems

Kody Law, King Abdullah University of Science & Technology (KAUST), Saudi Arabia

6:00-6:25 Automatic Recognition and Tagging of Topologically Different Regimes in Dynamical Systems

Jesse Berwald, University of Minnesota, USA

Thursday, August 14

MS91

Nonlinear Dispersive Wave Equations

4:30 PM-6:30 PM

Room:Recital Room - Music Center

Wave equations take an important place in the literature since they point out important aspects of some physical phenomena which arise, for example, from water wave theory, fiber optics or plasma dynamics. Since linear equations are insufficient to explain nonlinear behaviours like solitary waves, nonlinear wave equations have been proposed to fulfil this need. In this minisymposium, the essential aim is to feature a blend of analytical and numerical studies on various nonlinear dispersive wave equations. The topics include well-posedness, existence of travelling wave solutions, orbital stability of solitary waves and some numerical results.

Organizer: Nilay Duruk Mutlubas
Istanbul Kemerburgaz University, Turkey

Organizer: Handan Borluk
Isik University, Turkey

4:30-4:55 Local Well-posedness for a Class of Nonlocal Evolution Equations of Whitham Type

Mats Ehrnstrom, Norwegian University of Science and Technology, Norway

5:00-5:25 Traveling Surface Waves of Moderate Amplitude in Shallow Water

Anna Geyer and Armengol Gasull, Universitat Autònoma de Barcelona, Spain

5:30-5:55 Orbital Stability of Solitary Waves of Moderate Amplitude in Shallow Water

Nilay Duruk Mutlubas, Istanbul Kemerburgaz University, Turkey; Anna Geyer, Universitat Autònoma de Barcelona, Spain

6:00-6:25 The Nonlocal Nonlinear Wave Equation with Periodic Boundary Conditions: Analytical and Numerical Results

Handan Borluk, Isik University, Turkey; Gulcin M. Muslu, Istanbul Technical University, Turkey

Thursday, August 14

MS92

Coherent Structures Driven by Coulombic and Other Long Range Interactions - Part II of II

4:30 PM-6:30 PM

Room:Club Room - Concourse (1st Floor)

For Part 1 see MS84

Coherent structures (CSs) are fundamental in pattern forming systems, e.g., reaction-diffusion systems, convection, and periodically forced media. Recently, evidences of CSs are also being emerged in systems related to renewable energy devices, e.g., membranes in fuel cells, batteries, and ionic liquids. Such systems extend the reaction-diffusion type systems to incorporate effects like Coulombic interactions and global conservations. The minisymposium goals: (1) to survey the development of models and analysis methods that give rise to CSs and (2) to scrutinize the connections between models and their impacts to real life applications, e.g. renewable energy devices, polymer based media and vegetation.

Organizer: Arik Yochelis
Ben Gurion University Negev, Israel

Organizer: Nir Gavish
Technion - Israel Institute of Technology, Israel

4:30-4:55 A Generalized Otha-Kawasaki Model with Asymmetric Long Range Interactions
Nir Gavish, Technion - Israel Institute of Technology, Israel

5:00-5:25 Variational Models and Energy Landscapes Associated with Self-Assembly
Rustum Choksi, McGill University, Canada

continued in next column

5:30-5:55 Competitive Geometric Evolution of Network Morphologies
Keith Promislow, Michigan State University, USA; Shibin Dai, New Mexico State University, USA; Greg Hayrapetyan, Carnegie Mellon University, USA

6:00-6:25 Multiple Water-Vegetation Feedback Loops Lead to Complex Vegetation Diversity Through Competing Turing Mechanisms
Shai Kinast, *Yuval R. Zelnik*, and Golan Bel, Ben Gurion University, Israel; Ehud Meron, Ben Gurion University Negev, Israel

Thursday, August 14

MS93

Discrete and Continuous Nonlocal Wave Equations and Applications - Part III of III

4:30 PM-6:00 PM

Room:Bevin Room - Wolfson Hall

For Part 2 see MS85

The session focuses on recent results on nonlinear wave equations with nonlocal terms, including dispersive wave equations coupled with elliptic or parabolic equations. Applications include nonlinear optics in thermal media, water wave models, and coupled nonlinear lattice models. The inclusion of nonlocal terms can produce subtle and physically important effects in the properties of coherent structures, and requires more general analytical and numerical tools. The session will include works motivated by recent experimental studies, as well as more theoretical results on the relevant models.

Organizer: Richard O. Moore
New Jersey Institute of Technology, USA

Organizer: Panayotis Panayotaros
IIMAS-UNAM, Mexico

4:30-4:55 Interaction of Dark Nonlocal Solitons
W. Krolikowski, Australian National University, Australia

5:00-5:25 Some Results About the Relativistic NLS Equation
Juan Pablo Borgna, Universidad Nacional General Sarmiento, Argentina

5:30-5:55 Optical Solitons in Nematic Liquid Crystals: Continuous and Discrete Models
Panayotis Panayotaros, IIMAS-UNAM, Mexico

Thursday, August 14

MS94

Stratified Fluids, Coherent Structures, and Their Interactions - Part II of II

4:30 PM-6:30 PM

Room:JCR Games Room – Concourse (Ground Floor)

For Part 1 see MS87

Fluid-structure interactions are ubiquitous in fluid mechanics. The presence of ambient fluid stratification can increase the level of complexity and provide a rich parametric space with new and interesting effects. In this minisymposium, presenters will discuss the dynamics of fluid-structure interactions and multiphase flow in homogeneous and stratified settings. They will explore the resulting fluid flow and emergence of coherent structures in physically relevant problems which pose challenging mathematical questions, including handling varying boundary conditions in the flow. Studies will draw from all aspects of scientific investigations in this area, from experimental, to analytical and numerical results.

Organizer: Shilpa Khatri
University of North Carolina, Chapel Hill, USA

Organizer: Roberto Camassa
University of North Carolina, Chapel Hill, USA

Organizer: Richard McLaughlin
University of North Carolina, Chapel Hill, USA

4:30-4:55 Buoyant Jets and Vortex Rings in Stratification

Richard McLaughlin, University of North Carolina, Chapel Hill, USA

5:00-5:25 On the Extreme Runup of Long Surface Waves on a Vertical Barrier

Claudio Viotti, University College Dublin, Ireland

5:30-5:55 Mixing in Stratified Shear Flows: The Central Role of Coherent Structures

Colm-cille Caulfield, University of Cambridge, United Kingdom; Ali Mashayek, Massachusetts Institute of Technology, USA; W. Richard Peltier, University of Toronto, Canada

6:00-6:25 Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids

Mark A. Hoefer and Nicholas K. Lowman, North Carolina State University, USA; Gennady El, Loughborough University, United Kingdom

Thursday, August 14

CP13

Mathematical Physics, Materials and Related Problems

4:30 PM-6:30 PM

Room:Tizard Room - Concourse (1st Floor)

Chair: Stefan Mancas, Embry-Riddle Aeronautical University, USA

4:30-4:45 Transmission and Reflection of Airy Beams at An Interface of Dielectric Media

Rajah P. Varatharajah, North Carolina A&T State University, USA

4:50-5:05 Ultrashort Pulse Propagation in Periodic Media - Analysis and Novel Applications

Yonatan Sivan, Ben Gurion University Negev, Israel

5:10-5:25 Chiral Solitary Waves in Galilean Covariant Fermi Field Theories with Self-Interaction

Fuad Saradzhev, Athabasca University, Canada

5:30-5:45 Absolute Stabilization for the Axially Moving Kirchhoff String with Nonlinear Boundary Feedback Control

Yuhu Wu and Tielong Shen, Sophia University, Japan

5:50-6:05 Phase Wave Equation

Takashi Odagaki, Tokyo Denki University, Japan

6:10-6:25 Weierstrass Traveling Wave Solutions for Dissipative Equations

Stefan C. Mancas, Embry-Riddle Aeronautical University, USA

NW14 Abstracts

SIAM Conference on
Nonlinear Waves and
Coherent Structures

August 11-14, 2014
Churchill College,
University of Cambridge,
United Kingdom

Abstracts are printed as submitted.

IP1
Stability and Synchrony in the Kuramoto Model

The phenomenon of the synchronization of weakly coupled oscillators is a old one, first been described by Huygens in his "Horoloquium Oscilatorium.' Some other examples from science and engineering include the cardiac pacemaker, the instability in the Millenium Bridge, and the synchronous flashing of fireflies. A canonical model is the Kuramoto model

$$\frac{d\theta_i}{dt} = \omega_i + \gamma \sum_j \sin(\theta_j - \theta_i)$$

We describe the fully synchronized states of this model together with the dimensions of their unstable manifolds. Along the way we will encounter a high dimensional polytope, a Coxeter group, and a curious combinatorial identity. This leads to a proof of the existence of a phase transition in the case where the frequencies are chosen from as iid Random variables.

Jared Bronski
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IP2
Integrability: Initial- Boundary Value Problems in 1+1, and Solitons in 3+1

A review will be presented of the two most challenging problems in the analysis of integrable nonlinear evolution equations: (a) initial- boundary value problems in 1+1, i.e. evolution equations in one spatial variable, and (b) the construction and solution of equations in 3+1. Regarding (a), it will be shown that the so- called unified transform, which provides the proper generalization of the inverse scattering transform, yields effective formulae for the large t- asymptotics of a variety of physically significant problems; this includes problems on the half-line with t-periodic boundary conditions. Regarding (b), an integrable generalization of the Davey-Stewardson equation 4+2, i.e. four spatial and two time variables, will be presented. A reduction of this equation to an equation in 3+1 will also be discussed. Furthermore, one and two soliton solutions for both the 4+2 and 3+1 Davey-Stewardson equations will be presented.

Thanasis Fokas
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IP3
Minimal Models for Precipitating Convection

Despite the importance of organized convection (e.g. squall lines and hurricanes), numerical simulations remain a challenge. Comprehensive cloud resolving models would include water vapor, liquid water and ice, and liquid water would be separated into cloud water and rain water. Here we take a minimalist approach to cloud microphysics by incorporating fast auto-conversion from cloud to rain water, and fast condensation and evaporation. Numerical and analytical results will be discussed, e.g., saturated regions have a linear stability boundary associated with parcel (finite-amplitude) stability in unsaturated regions.

Leslie Smith
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IP4
Coherent Structures in 2D Turbulence: Identification and their Use

Ideas from dynamical systems have recently provided fresh insight into transitional fluid flows. Viewing such flows as a trajectory through a phase space littered with coherent structures (meaning 'exact' solutions here) and their stable and unstable manifolds has proved a fruitful way of understanding such flows. Motivated by the challenge of extending this success to turbulent flows, I will discuss how coherent structures can be extracted directly from long-time simulations of body-forced turbulence on a 2D torus. These will then be used to 'postdict' certain statistics of the turbulence.

Rich Kerswell
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IP5
A Neural Field Model of Binocular Rivalry Waves

Binocular rivalry is the phenomenon where perception switches back and forth between different images presented to the two eyes. The resulting fluctuations in perceptual dominance and suppression provide a basis for non-invasive studies of the human visual system and the identification of possible neural mechanisms underlying conscious visual awareness. In this talk we present a neural field model of binocular rivalry waves in visual cortex continuum neural fields are integro-differential equations that describe the large-scale spatiotemporal dynamics of neuronal populations. We derive an analytical expression for the speed of a binocular rivalry wave as a function of various neurophysiological parameters, and show how properties of the wave are consistent with the wave-like propagation of perceptual dominance observed in recent psychophysical experiments. We then analyze the effects of extrinsic noise on wave propagation in a stochastic version of the neural field model. We end by describing recent work on rotating rivalry stimuli and direction selectivity.

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IP6
Engineering Extreme Materials with Defects and Nonlinearity

We study the fundamental dynamic response of discrete nonlinear systems and study the effects of defects in the energy localization and propagation. We exploit this understanding to create experimentally novel materials and devices at different scales (for example, for application in energy absorption, acoustic imaging and energy harvesting). We use granular systems as a basic platform for testing, and control the constitutive behavior of the new materials selecting the particles geometry, their arrangement and materials properties. Ordered arrangements of particles exhibit a highly nonlinear dynamic response, which has opened the door to exciting fundamental physical observations (i.e., compact solitary waves, energy trapping phenomena, and acoustic rectification). This talk will focus on energy localization and redirection in one- and two-dimensional systems.

Chiara Daraio
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IP7

Momentum Maps, Shape Analysis and Solitons

Much of this talk is based on work done with Jerry Marsden (1942 - 2010) on shared geometric properties in the analysis of fluid flow and shape transformations. The talk will discuss uses of geometric mechanics in the problem of registration of images, primarily in the example of planar closed curves. Many types of mathematics apply in this problem, including soliton theory and momentum maps. Some trade secrets will be revealed.

Darryl D. Holm
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IP8

Symmetry, Modulation and Nonlinear Waves

Modulation underpins many facets of the analysis of nonlinear waves and patterns. A new perspective on modulation combined with symmetry and conservation laws will be presented, which leads to a mechanism for the emergence of model wave PDEs such as KdV, KP, Boussinesq and others. This combination results in simple geometric formulae for the coefficients. Generalizations to multiphase wavetrains, systems of conservation laws, Whitham equations with dispersion, and a mechanism for the formation of multi-pulse planforms in pattern formation will also be presented.

Tom J. Bridges
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SP1

Martin D. Kruskal Prize Lecture - Nonlinear Waves from Beaches to Photonics

Based on work of Kruskal et al the Korteweg-deVries equation was found to have many remarkable properties. These properties are shared by many other equations including the 2D Kadomtsev-Petvishvili (KP) equation, which arises in the study of shallow water waves. Some solutions of KP and their relation to waves on shallow beaches will be discussed. Nonlinear waves in photonic periodic lattices will also be described; photonic graphene is a remarkable case. Since this is an evening lecture, equations and details will be kept to a minimum, and the lecture will be colloquium style.

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CP1

The Rogue Wave Solutions of the Kpi

Rogue wave solutions of integrable partial differential equations are one kind of large-amplitude doubly localized rational solutions. Recently, the first-order rogue wave solution of the NLS has been observed in water tanks and optical fibers. In this talk, we shall provide new rogue wave solutions of a well-known (2+1)- dimensional equation: the KPI, from the solutions two (1+1)-dimensional equations: NLS and complex mKdV. The main technique is the Darboux transformation.

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CP1

Mcc Type Strongly Nonlinear Internal Wave Models

We discuss MCC type strongly nonlinear internal long wave models in two- and three-layer fluid systems in detail. Their dispersion relations and stability properties comparing to coupled Euler equations will be presented. In addition, generalized strongly nonlinear models are also considered. Non-stationary time evolution for their performance tests will be presented as well.

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CP1

Laboratory Experiments and Simulations for Solitary Internal Waves with Trapped Cores

Under appropriate conditions, solitary internal waves in the ocean and atmosphere can develop recirculating regions, known as “trapped cores’. Fundamental properties, essential for constructing and testing theoretical models, remain to be quantified experimentally. These include core circulation and density, as well as mass and energy transport, and Richardson number. By using a new technique, we measure these properties in detail. To examine larger waves, we perform simulations. The corresponding theory agrees closely with our experiments.

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Karl Helfrich
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CP1

Internal Waves Incident Upon An Interface

Recent results have shown that a vertical packet of internal waves that are horizontally periodic will develop a discontinuous mean flow at an interface. Here we consider a similar configuration where the waves are not horizontally periodic, but instead exist within a wave packet that is limited both horizontally and vertically. The basic state has constant stability N in two layers without a shear flow.

The horizontal limit of the wavepacket results in a much different wave-induced mean flow than the periodic case, as the mean flow is confined to the wavepacket and therefore must have a zero net flow across any vertical surface. The net effect is that gradients of the mean flow at the interface are stronger than the periodic case. Waves are treated with the nonlinear Schrodinger equations that are solved numerically.

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CP1

Nonlinear Harmonic Generation by Internal Wave Refraction

Weakly nonlinear analysis is used to show how internal wave refraction through variable stratification generates harmonics. Refraction into a strongly stratified pycnocline layer will be analyzed, as ocurs for oceanic internal tides and topographically-generated beams. For large incidence angles, the lowest harmonic is trapped, and its wavenumber selected by a resonance with the natural modes of the pycnocline. Analytic methods are used to calculate this resonance condition, and the results compared to simulation and experiment.

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CP1

Cylindrical Korteweg-De Vries Type Equation for Internal and Surface Ring Waves on a Shear Flow

We study the ring waves in a stratified fluid over a prescribed shear flow. A weakly-nonlinear 2+1-dimensional long wave model is derived from the full set of Euler equations with background stratification and shear flow, written in cylindrical coordinates, subject to the boundary conditions typical for the oceanographic applications. In the absence of the shear flow and stratification, the derived equation reduces to the cylindrical Korteweg -de Vries type equations obtained by V.D. Lipovskii and R.S. Johnson. The features of the ring waves are then studied numerically using a finite-difference code for the derived model.

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CP2

Model Order Reduction for Coupled Nonlinear Schr?dinger Equation

Proper orthogonal decomposition (POD) method is used to get numerical solution for coupled nonlinear Schrdinger (CNLS) equation in Hamiltonian form. The CNLS equation is discretized in space by finite differences and is solved in time by midpoint method. Numerical results for CNLS equation with different parameters indicate that the low-dimensional approximations obtained by POD is effective and reproduce very well the characteristic dynamics of the system, such as preservation of energy and phase space structure of the CNLS equation.

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CP2

Boundary Value Problems for Multidimensional Integrable Nonlinear Pdes

The Fokas method, or Unified Transform method, is a significant novel generalization of the classical inverse scattering method, rendering it applicable to initial-boundary value problems (IBVPs) for integrable nonlinear PDEs. We present the implementation of the Fokas method to certain IBVPs for multidimensional integrable nonlinear PDEs. In particular, we study the Davey-Stewartson equation (i) on the half-plane in the case of a time-periodic boundary condition, (ii) on the quarter-plane, and (iii) on bounded domains.

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CP2

Variable Separation Solutions and Interacting Waves of a Coupled System of the Modified KdV and Potential Blmp Equations

The multilinear variable separation approach (MLVSA) is applied to a coupled modified Korteweg de-Vries and potential Boiti-Leon-Manna-Pempinelli equations, as a result, the potential fields u_y and v_y are exactly the universal quantity applicable to all multilinear variable separable systems. The generalized MLVSA is also applied, and it is found u_y (v_y) is rightly the subtraction (addition) of two universal quantities with different parameters. Then interactions between periodic waves are discussed, for instance, the elastic interaction between two semi-periodic waves and non-elastic interaction between two periodic instantons. An attractive phenomenon is observed that a domion moves along a semi-periodic wave.

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CP2

Explicit Construction of the Direct Scattering Transform for the Benjamin-Ono Equation with Rational Initial Conditions

We propose a construction for the scattering data of the Benjamin-Ono equation with a rational initial condition, under mild restrictions. The construction procedure consists in building the Jost function solutions explicitly and use their analyticity properties to recover the reflection coefficient, eigenvalues, and phase constants. We finish by showing that this procedure validates certain well-known formal results obtained in the zero-dispersion limit by Y. Matsuno.

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CP3

Solitary Wave Perturbation Theory for Hamiltonian Systems

Solitary waves in Hamiltonian systems can be parameterized by conserved quantities and parameters associated with the system's symmetries. When such systems are perturbed, it is natural to consider slow dynamics constrained to the solitary wave solution manifold. A standard way to derive the modulation equations involves direct calculations of the perturbed conserved quantities. However, the evolution of the symmetry parameters containing higher order, but often important, information is not as readily obtained. In this talk, singular perturbation theory is employed to obtain the solitary wave modulation equations for a general class of Hamiltonian systems. This methodology is applied to a six-parameter solitary wave solution for the (2+1)D Landau-Lifshitz equation that models the magnetization of a thin, ferromagnetic material. Results are provided for recent experimental observations of solitary waves in a magnetic layer where both damping and localized forcing are present.

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CP3

Resonance, Small Divisors and the Convergence of Newton's Iteration to Solitons

Resonances create the small divisor problem for Stokes/Poincare-Lindstedt series. We show through the Fifth-Orde KdV equation how the same cause makes Newton's iteration stall at small residuals, and how to fix this to converge to a soliton or periodic traveling wave.

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CP3

Orbital Stability of Solitary Shallow Water Waves of Moderate Amplitude

We study the orbital stability of solitary traveling wave solutions of an equation for surface water waves of moderate amplitude in the shallow water regime. Our approach is based on a method proposed by Grillakis, Shatah and Strauss in 1987, and relies on a reformulation of the evolution equation in Hamiltonian form. We deduce stability of solitary waves by proving the convexity of a scalar function, which is based on two nonlinear functionals that are preserved under the flow.

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CP3

Velocity Field in Parametrically Excited Solitary Waves

Parametrically excited solitary waves are localized structures in high-aspect-ratio free surfaces subject to vertical vibrations. In this talk, we present the first experimental characterization of the hydrodynamics of these waves using Particle Image Velocimetry. Our results confirm the accuracy of Hamiltonian models with added dissipation in describing these structures. Our measurements also uncover the onset of a streaming velocity field which is shown to be as important as other nonlinear terms in the current theory.

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CP3

Solitary Waves and an N-particle Algorithm for a Class of Euler-Poincaré Equations

Nonlinearity arises generically in mathematical models of physical phenomena, and the interplay between nonlinearity and dispersion is thought to be responsible for many of these phenomena, such as the existence of traveling waves. We explore the relation between nonlinearity and dispersion by studying the N-particle system of the Euler-Poincaré differential equations, or the EPDiff equations. In particular, we illustrate the existence and dynamics of traveling wave solutions of the EPDiff equations. Solitary waves for this class of equations can be made to correspond to interacting particles of a finite-degree-of-freedom Hamiltonian system. We analyze the dynamics of two-solitary wave interaction and show that two solitons can either scatter or capture each other. The scattering or capture orbits depend on the singularity level of the solitons, while singularity of a soliton is determined by the power of the linear elliptic operator associated with the EPDiff equations.

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CP3

The (1+2)-Dimensional Sine-Gordon Equation: Soliton Solutions and Spatially Extended Relativistic Particles

The (non-integrable) (1+2)-dimensional Sine-Gordon equation does have N-soliton solutions for all N = 1. Multi-soliton solutions propagate rigidly at constant velocities that are higher than or lower than the speed of light. A first integral of the equation vanishes on single-soliton solutions and maps multi-soliton solutions onto structures that are localized around soliton junctions. The slower-than-light structures emulate spatially extended relativistic particles, whose mass density obeys a source-driven wave equation.

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CP4

Spectral Band Gaps and Lattice Solitons for the Fourth Order Dispersive Nonlinear Schrödinger Equation with Time Periodic Potential

Localization and dynamics of the one-dimensional biharmonic nonlinear Schrödinger equation in the presence of an external periodic potential is studied. The band gap structure is determined using the Floquet-Bloch theory and the shape of its dispersion/diffraction curves as a function of the fourth order dispersion/diffraction coupling constant β is discussed. Contrary to the classical nonlinear Schrödinger equation (with an external periodic potential) here it is found that for a fixed negative value of β, there exists a nonzero threshold value of potential strength below which there is no first band gap. For increasing values of potential amplitudes, the dispersion bands reorient themselves leading to different soliton forms. Lattice solitons corresponding to spectral eigenvalues lying the the semi-infinite and first band gap are constructed. Stability properties of various localized lattice modes are analyzed and contrasted against direct numerical simulations.

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CP4

Transverse Instability of a Soliton Solution to Quadratic Nonlinear Schrödinger Equation

Madelungs fluid picture is applied to the quadratic nonlinear Schrödinger equation. This gives the travelling wave equation that describes ion acoustic wave in plasma with non-isothermal electrons. The variational method is applied to determine the growth rate of instabilities of a soliton which is perturbed perpendicular to its direction of propagation. This gives us the Lagrangian density of the coupled differential equations. The growth rate can be obtained by maximizing the Lagrangian density. By using the spectral methods, the unstable planed soliton will be shown a transformation to two-dimensional soliton-like solution.

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CP4

On Rational Solutions to Multicomponent Nonlinear Derivative Schrödinger Equation

We consider multicomponent derivative nonlinear Schrödinger equations (DNLS) related to Hermitian symmetric spaces. DNLS were firstly proposed by A. Fordy as generalizations of Kaup-Newell's equation. We present rational type solutions to DNLS. To do this we make use of Zakharov-Shabat's dressing technique adapted for quadratic bundles.

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CP4

Long-Time Asymptotics for the Defocusing Integrable Discrete Nonlinear Schrödinger Equation

We investigate the long-time asymptotics for the defocusing integrable discrete nonlinear Schrödinger equation $\mathrm{i}dR_n/\mathrm{d}t + (R_{n+1} - 2R_n + R_{n-1}) - |R_n|^2(R_{n+1} + R_{n-1}) = 0$ introduced by Ablowitz-Ladik. We employ the inverse scattering transform and the Deift-Zhou nonlinear steepest descent method. The leading part is a sum of two oscillatory terms with decay of order $t^{-1/2}$. Details will appear in Journal of the Mathematical Society of Japan.

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CP5

Pipes and Neurons

We exploit a surprising analogy between the subcritical transition to turbulence and the dynamics action potentials in order to understand the onset of turbulence in pipe flow. The focus here is the transition from localized to expanding turbulence. Analysis of fronts connecting laminar flow (quiescent state) to turbulent flow (excited state) gives the speeds of turbulent-laminar fronts. Combining with experiments and simulations we explain the various stages in the transition to turbulence.

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CP5

Optimal Control in a Mathematical Model of Low Grade Glioma

We address this research to a mathematical model for low-grade glioma treated with chemotherapy. We analyze the dynamics of the model and study the stability of the solutions. Besides, we characterize the optimal controls related to drug therapy, using different strategies, including a quadratic control and a linear control. We establish the existence of the optimal control, and solve for the control in both the quadratic and linear case. Finally, from numerical simulations, we discuss the optimal strategies from the clinical point of view

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CP5

Localized Structures and Their Dynamics in Bioconvection of *Euglena Gracilis*

We experimentally study localized patterns of suspension of a phototactic microorganism, *Euglena gracilis*, illuminated from the bottom. By using annular container, two basic types of localized patterns were isolated. They are similar to those observed in thermal convection of binary fluid mixtures, although the governing equations for this system is not known. We will also report their dynamics and statistical analysis related to the bistability and phototactic responses of the microorganism.

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CP5

Models for Adaptive Feeding and Plankton Populations

In this presentation, we develop (1) a piecewise-smooth dynamical system and (2) reformulate it as a fast-slow dynamical system to account for prey preference, flexible feeding behaviour or rapid evolution, and an ecological trade-off (all of which have been observed in plankton). We discuss connections between Filippov and fast-slow systems, and compare our model predictions with data on protozoan predator and two different phytoplankton prey groups collected from Lake Constance.

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CP5

Self-Organisation in a Reaction-Diffusion System with a Non-Diffusing Component

Motivated by the regulation mechanism behind positioning of flagellar basal bodies in bacteria, we study a model system where a diffusion-driven instability leads to pattern formation. The model includes three species and its dynamics is described by a pair of reaction-diffusion equations coupled to an ODE. We study how the presence of a non-diffusing species impacts the analytical properties of the solution and the resulting pattern.

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CP5

On a Volume-Surface Reaction-Diffusion System with Nonlinear Boundary Coupling: Well-Posedness and Exponential Convergence to Equilibrium

We consider a model system consisting of two reaction-diffusion equations, where one specie diffuses in a volume while the other specie diffuses on the surface which surrounds the volume. The two equations are coupled via nonlinear reversible Robin-type boundary conditions for the volume specie and a matching reversible source term for the boundary specie. As a consequence the total mass of the species is conserved. The considered system is motivated by models for asymmetric stem cell division. We first prove the existence of a unique weak solution via an iterative method of converging upper and lower solutions to overcome the difficulties of the nonlinear boundary terms. Secondly, we show explicit exponential convergence to equilibrium via an entropy method after deriving a suitable entropy entropy-dissipation estimate.

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CP6

Coherent Structures Inhibition and Destruction in

the Taylor-Couette System

TaylorCouette flow remains one of the most widely studied problems. This is certainly due to the various impacting fundamental and applied applications instilled by such archetype flow.The Taylor vortices are coherent structures known to be omnipresent whatever is the flow regime. Suppression of these coherent structures is searched for several industrial processes such as crystal growth and osmotic/photonic water purification. A control strategy is suggested to obliterate or inhibit the coherent structures in a TaylorCouette flow. It consists in effecting minute radial pulsatile motion of the inner cylinder cross-section. The superimposed modulations combined with the free surface dynamics suppress both the Ekman and Taylor coherent structures. When eliminated, fluid particles are no longer trapped within the Ekman or Taylor vortices. This yields significant increase in the axial and azimuthal velocity fluctuations, which results in enhanced flow mixing.

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CP6

Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids: Experimental Investigation

The evolution of the interface separating a buoyant conduit of viscous fluid rising through a more viscous, exterior fluid is governed, counterintuitively, by the interplay between nonlinearity and dispersion, given sufficiently high viscosity contrast. Here, we present the results of quantitative, experimental investigations into large amplitude solitary wave interactions and dispersive shock waves (DSWs). Overtaking interactions of large amplitude solitary waves are shown to exhibit nearly elastic collisions and universal interaction geometries according to the Lax categories for KdV solitons. Further, we conduct experiments on well-developed DSWs and demonstrate favorable comparison with Whitham-El modulation theory. We also report observations of novel interaction experiments. Viscous liquid conduits provide a well-understood, controlled, table-top environment in which to study universal properties of dispersive hydrodynamics.

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CP6

On the Unified Wave Model (uwm) for Smooth and Peaked/cusped Solitary Waves

Based on the symmetry and fully nonlinear wave equations, a unified wave model (UWM) based on the symmetry and the fully nonlinear wave equations is put forward for progressive waves with permanent form in finite water depth. The UWM admits not only all smooth waves but also the peaked/cusped solitary waves. So, the UWM unifies the smooth and peaked/cusped solitary waves in finite water depth, for the first time. Some unusual characteristics of the peaked waves are found. For example, unlike smooth waves, the phase speed of peaked solitary waves has nothing to do with the wave height. Besides, it is found that a cusped solitary wave is consist of an infinite number of peaked ones: this reveals the close relationship between the peaked and cusped solitary waves. The UWM deepens and enriches our understandings about the smooth and peaked/cusped waves as a whole.

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CP6

Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids: Model Derivation and Modulation Theory

The evolution of the interface separating a buoyant conduit of viscous fluid rising through a more viscous, exterior fluid is governed, counterintuitively, by the interplay between nonlinearity and dispersion, given sufficiently high viscosity contrast. In this talk, a derivation of the scalar interfacial equation via an asymptotic, multiple scales procedure is presented. Perturbations about a state of vertically uniform pipe flow are considered in the context of the coupled fluid equations. The approximate model is shown to be valid for long times and large amplitudes under modest physical assumptions. We then apply Whitham-El modulation theory to derive analytical predictions for key properties of dispersive shock wave solutions, as well as demonstrate novel multiphase behavior which results from a turning point in the dispersion relation. This talk establishes the theoretical background for quantitative experiments on solitons and DSWs in this simple, table-top fluid setting.

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CP6

Controlling the Position of Traveling Waves in Reaction-Diffusion Systems

We present a method to control the position as a function of time of one-dimensional traveling wave solutions to reaction-diffusion systems according to a pre-specified protocol of motion. Given this protocol, the control function is found as the solution of a perturbatively derived integral equation. We derive an analytical expression for the space and time dependent control function $f(x,t)$ that is valid for arbitrary protocols and many reaction-diffusion systems. These results are close to numerically computed optimal controls. The control can be expressed in terms of the uncontrolled wave profile and its propagation velocity, rendering detailed knowledge of the reaction kinetics unnecessary. An extension to two higher dimensions allows a precise control of the shape of patterns of reaction-diffusion systems.

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CP6

Interaction of a Weak Discontinuity Wave with Elementary Waves of the Riemann Problem for Euler Equations of Gasdynamics

We investigate the effects of initial states and the shock strength on the jumps in shock acceleration, and the amplitudes of reflected and transmitted waves. The test-data are considered for the three Riemann problems to analyze the situation when the initial discontinuity breaks up into two shocks and a characteristic shock. It is noticed that for a weak shock, the jump in its acceleration due to an interaction with a weak discontinuity wave can be zero only when the incident wave belongs to the same family as the shock.

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CP7

Oscillons in a Parametrically Forced PDE

Spatially localized, time-periodic structures are common in pattern-forming systems, appearing in fluid mechanics, chemical reactions, and granular media. We examine the existence of oscillatory localized states in a PDE model with single frequency time dependent forcing, where the primary pattern appears with non-zero wavenumber.

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CP7

Hopf Bifurcation from Fronts in the Cahn-Hilliard Equation

We study Hopf bifurcation from traveling-front solutions in the Cahn-Hilliard equation. Models of this form have been used to study numerous physical phenomena, including pattern formation in chemical deposition and precipitation processes. Technically we contribute a simple and direct functional analytic method to study bifurcation in the presence of essential spectrum. Our approach uses exponential weights to recover Fredholm properties, spectral flow ideas to compute Fredholm indices, and mass conservation to account for negative index.

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CP7

New Exact Solution for Nonlinear Interaction of Two Pulsatory Waves of the Korteweg De Vries Equation in An Invariant Zigzag Structure

Interaction of two pulsatory waves of the KdV equation is treated by a novel method of solving nonlinear PDEs by invariant structures, which continues classical methods of undetermined coefficients and separation of variables by developing experimental and theoretical computing. Using this approach a new solution for pulsatory waves, which includes the two-solitons solution, is developed experimentally and proved theoretically by employing a zigzag, hyperbolic-tangent structure. Convergence, tolerance, and summation of the structural approximation are discussed.

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CP7

Inertial Waves and Pattern Formation Inside a Rotating Cylinder Partially Filled with Liquid

We consider a rapidly rotating horizontal cylinder partially filled with granular medium and/or fluid under gravity or vibration. In the rotating frame gravity oscillates and induces fluid oscillations, which take the form of inertial waves under resonance conditions. Dependently on the experimental conditions waves with different azimuthal and axial wavenumbers are excited. The inertial waves generate averaged fluid flows in the direction of propagation and bring to growth of regular patterns on the fluid-sand interface.

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CP7

Quasipatterns in Coupled Reaction-Diffusion Problems

The nonlinear interaction between waves of different wavelengths is a mechanism that can stabilise 12-fold quasipatterns (two-dimensional patterns that are quasiperiodic in all directions but that have 30° rotation symmetry on average). Here, we investigate how coupling two pattern-forming Turing systems can lead to these quasipatterns being formed.

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CP7

Vibrational Hydrodynamic Top Wave Instability and Pattern Formation

Flows excited by light free sphere in cavity with liquid rotating around horizontal axis are experimentally investigated. Sphere commits differential rotation caused by

oscillating external force (vibrational hydrodynamic top). Main flow has shape of 2D column. New instability is found azimuthal wave at column boundary and two-dimensional vortex system inside it. Stability threshold is one order of magnitude lower compare to differential rotation of sphere fixed on axis. Supercritical flows and transition sequences are studied.

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CP8

Complex Mode Dynamics of Coupled Wave Oscillators

We show how nonlinear coherent waves localized in a few wells of a periodic potential can act analogously to a chain of coupled oscillators. We identify the small-amplitude oscillation modes of this system, demonstrate their extension to the large amplitude regime and reveal complex behavior such as the breakdown of Josephson-like oscillations, the destabilization of fundamental oscillation modes and the emergence of chaotic dynamics.

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CP8

Modulation Theory for the Fkdvb Equation Constructing Periodic Solutions

We present a multiple-scale perturbation technique for obtaining solutions to the forced Korteweg de Vries-Burgers equation. The first order solution in the perturbation hierarchy is the modulated cnoidal wave equation. From the second order equation in the hierarchy, we find a system of odes governing the slow variation of the properties of the cnoidal wave. This is achieved by imposing an extra condition at second order. We then construct periodic solutions and examine their stability.

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CP8

New Criteria Preventing Hamiltonian-Hopf Bifurcations Using Graphical Krein Signature

Linear stability of equilibria in Hamiltonian systems is characterized by a restriction of the spectrum of the linearized problem to the imaginary axis. If the Hamiltonian is indefinite a stable equilibria under a parameter change in a system may be subject to instability through a Hamiltonian-Hopf (HH) bifurcation. HH bifurcations are generic if two purely imaginary eigenvalues of opposite Krein signature are close to each other. But it is possible that under a particular perturbation eigenvalues pass each other and do not bifurcate; it happens when the perturbation is definite [Krein & Ljubarski] or if the system has an additional symmetry [Melbourne et al.]. Using the graphical Krein signature we present a new type of mechanism that prevents HH bifurcations. Although such a mechanism is non generic it may commonly appear in applications. Surprisingly the conditions appear to use information that may not be visible if one considers only the typical form of the eigenvalue problem.

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CP8

Persistence Results for Nonlocal Perturbations on Unbounded Domains

The main focus of this talk will be to outline a, quite general, method to show persistence of coherent structures for sufficiently small non-locality in spatially-extended PDEs. As an example, the existence of stationary solutions for a nonlocal version of the Fisher-Kolmogorov-Petrovsky-Piskounov (FKPP) equation on the unbounded domain $\mathbb{R}^d$ will be considered. It will be shown that only two bounded non-negative stationary solutions of the nonlocal FKPP equation can exist for sufficiently small nonlocality.

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CP8

Pullback Attractor for the Non-Autonomous Stochastic Damped Wave Equations on Bounded and Unbounded Domains

This paper is devoted to dierential equations of the damped wave equations with both non-autonomous deterministic and random forcing terms. On unbounded domain, we show the sufficient and necessary condition for existence of pullback attractors for the non-autonomous stochastic damped wave equations on unbounded domain by establishing pullback absorbing set and pullback asymptotic compactness of the cocycle in a certain parameter region, where the uniform estimates on the tails of solutions are employed to overcome the non-compactness embeddings. On bounded domain, we prove the existence of pullback attractors for the non-autonomous stochastic damped wave equations by establishing pullback absorbing set and pullback condition in a certain parameter region. At the same time, when the deterministic forcing terms is periodic, we obtain the pullback attractor is also periodic.

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CP9

Simulating Wall-Mode Convection: Numerical Techniques and First Results

We present simulations of strongly nonlinear wall-mode convection in a rapidly rotating container. Using the asymptotically reduced model by Vasil et al., we examine the development of the wall-mode instability and subsequent pattern formation in isolation from bulk convection. This system includes nonlocal and nonlinear bounary conditions, and separate prognostic equations for the barotropic and baroclinic components of the flow, which we implement using Dedalus, a new open-source pseudospectral code.

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CP9

Time-Averaging and Error Estimates for Reduced Fluid Models.

I will discuss the application of time-averaging in getting rigorous error estimates of some reduced fluid models, including the quasi-geostrophic approximation, incompressible approximation and zonal flows. The spatial boundary can be present as a non-penetrable solid wall. I will show a very recent (and somewhat surprising) result on the ϵ^2 accuracy of incompressible approximation of Euler equations, thanks to several decoupling properties.

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CP9

Optimal High-Order Diagonally-Implicit Runge-Kutta Schemes for Nonlinear Diffusive Systems on Atmospheric Boundary Layer

Nonlinear diffusion equations are extensively applicable in diverse fields of science and engineering. Numerical stability is a common concern in this class of equations. In the present study, a three-stage third-order diagonally-implicit Runge-Kutta (DIRK) scheme is introduced by optimizing the error and linear stability analysis for a commonly used nonlinear diffusive system in atmospheric boundary layer. The proposed scheme is stable for a wide range of time steps and able to resolve different diffusive systems with diagnostic turbulence closures, or prognostic ones with a diagnostic length scale, with enhanced accuracy and stability compared to current schemes. It maintains A-stability, which makes it appropriate for the solution of stiff problems. The procedure implemented in this study is quite general and can be used in other diffusive systems as well.

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CP9

Interaction of Atmospheric Vortex with A Land

We show that the complex behavior of the tropical cyclone making landfall can be explained in the frame of two dimensional barotropic model obtained by averaging over the hight of the primitive system of equations of the atmosphere dynamics. In particular, this behavior includes a significant track deflection, sudden decay and intensification. In contrast to other model, where first the additional physically reasonable simplifications are made, we deal with special classes of solutions to the full system. This allows us not to lose the symmetries of the model and to catch the complicated features of the full model. Our theoretical considerations are confirmed by numerics made within a two dimensional barotropic model and are in a good compliance with experimental data. In particular, our method is able to explain the phenomenon of attraction of the cyclone to the land and interaction of the cyclone with an island.

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CP9

Atmospheric Moisture Transport: Stochastic Dynamics of the Advection-Condensation Equation

Transport of atmospheric moisture is studied using a stochastic advection-condensation model. Water vapor is advected by a prescribed velocity field and condensation occurs as fluid parcels enter regions of low saturation humidity. In contrast to previous studies, we focus on two velocity models with spatial correlation: single-vortex stirring and the random sine flow. We predict the total moisture decay rate in the initial value problem and investigate the spatial moisture distribution for the steady-state problem.

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CP9

On the Asymptotics of Nonlinear Wall-Localized Thermal Convection Waves

We describe an asymptotically reduced model of multiscale wall-mode convection in a rapidly rotating container. The bulk-interior dynamics drives small-scale flow within sidewall boundary layers, and the boundary layers feed back onto the interior via a nonlinear and non-local boundary conditions. These new PDE's contain the results from previous linear theory but in an elementary fashion and also provide a new avenue for investigating several interesting phenomena in a strongly nonlinear regime.

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CP10

A Theory of Weakly Non-Linear Detonations

We derive a new weakly non-linear asymptotic model of detonation waves that captures the rich dynamics observed in solutions of the reactive Euler equations. We investigate the traveling wave solutions of the asymptotic model and their linear stability. The non-linear dynamics of the model are investigated by direct numerical simulations. Predictions of the asymptotic equations are compared quantitatively with the full reactive Euler equations.

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CP10

Diffraction and Reflection of a Weak Shock at a Right-Angled Wedge in Real Fluids

Shock reflection-diffraction problem is one of the most challenging problems for the mathematical theory of multidimensional conservation law. Since at high pressure or low temperature, the behavior of gases deviates from the ideal gas law and follows the van der Waals gas, we study here the reflection-diffraction phenomenon of a weak shock at a right-angled wedge for the two-dimensional compressible Euler system, modeled by the van der Waals equation of state. Using asymptotic expansions,some basic features of the phenomenon and the nature of flow pattern are explored within the context of a real gas. In this talk, we discuss how the real gas effects influence the nature of the self-similar flow patterns, relative to what it would have been in the ideal gas case.

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CP10

Pattern Formation in a Circular Hydraulic Jump

When a vertical jet of viscous fluid strikes a horizontal plate, a circular hydraulic jump occurs at some distance from the jet impact point. Under certain conditions, the circular symmetry of the jump can break to give rise to stationary or rotating polygonal patterns. The talk describes experimental observations of the symmetry breaking and a model for the polygonal pattern formation.

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CP10

Nonlinear Energy Transfer Between Fluid Sloshing and Vessel Motion

This talk identifies a mechanism leading to an energy exchange between a sloshing fluid and the vessel containing the fluid. The theory is developed for Cooker's pendulous sloshing experiment where a rectangular vessel is partially filled with fluid and suspended by two cables. Close to an internal 1 : 1 resonance, the energy transfer is manifested by a heteroclinic connection which connects the purely symmetric sloshing modes to the purely anti-symmetric sloshing modes leading to slosh-induced destabilization.

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CP10

Fluid Ratcheting by Oscillating Channel Walls with Sawteeth

Motions rectified by symmetry-breaking mechanisms in oscillating flows have been of great interest in biological locomotion and engineering applications. Inspired by an experiment that demonstrates that fluid can be pumped from one end to the other in a narrow channel using the vibrational motions of the sawtooth channel walls, we put forward here a theory describing the ratcheting effect of fluid. In a conformally transformed plane, the Stokes boundary layer flow is analysed, revealing the nonlinear effects driving the rectified flow and its complex spatial structure. Whereas the wall sawtooth shape is a source of asymmetry, the difference in entrance and exit flow conditions due to the geometries at the channel ends is found to be a second source to break the left-right symmetry of the system.

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CP11

Ocean Wave Energy Potential and Microseisms

Ocean gravity waves driven by wind and atmospheric pressure can generate pressure variations on the sea floor that are at the origin of microseisms. We will be concerned with secondary microseisms with a frequency twice that of the causative wave and amplitude independent of the depth. We need to know the sea states that allow pressure variations large enough to generate microseisms and we need to understand how pressure variations vary in space and time and how they are linked to the sea floor. We will show the conditions on different parameters to obtain pressure variation able to generate microseisms and we will study the pressure with respect to different parameters in order to illustrate our theoretical results.

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CP11

On Periodic Solutions of a Model Equation for Surface Waves of Moderate Amplitude in Shallow Water

The work which will be presented is mainly on a nonlinear evolution equation for surface waves of moderate amplitude in shallow water given below:

$$u_t + u_x + \frac{3}{2}\varepsilon u u_x - \frac{3}{8}\varepsilon^2 u^2 u_x + \frac{3}{16}\varepsilon^3 u^3 u_x + \frac{\mu}{12}(u_{xxx} - u_{xxt}) + \frac{7\varepsilon}{24}\mu(u u_{xxx} + 2u_x u_{xx}) = 0, \quad x \in R, \ t > 0. \tag{1}$$

Here $u(x,t)$ is the free surface elevation and ε and μ represent the amplitude and shallowness parameters, respectively. Solutions of the Cauchy problem corresponding to (1) which are spatially periodic of period 1 are investigated. Local well-posedness is attained by an approach due to Kato which is based on semigroup theory for quasilinear equations. Moreover, it is shown that singularities for the model equation can occur only in the form of wave breaking.

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CP11

Solitary Waves Without Dispersive Terms: the Shallow Water Equations over a Periodic Bottom

The shallow water equations are a non-dispersive hyperbolic system and their solutions typically involve shock waves. We show by computational experiment that in the presence of periodic bathymetry, solutions may be characterized instead by solitary wave formation. Unlike solitary wave solutions of the KdV or Boussinesq equations, these waves arise in the absence of any dispersive terms. Instead, they result from effective dispersion caused by wave diffraction and reflection.

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CP11

Interaction of Strongly Nonlinear Waves on the Free Surface of Non-Conducting Fluid under the Action of Horizontal Electric Field

In the present work we consider the problem of free surface motion of the fluid with high dielectric constant in the strong horizontal electric field. It is shown that nonlinear surface waves can propagate nondispersively in the direction of electric field . Moreover, the counter-propagating solitary weakly nonlinear waves preserve the initial form after collision. The question arises as to whether the same tendency is observed for strongly nonlinear waves. We have shown that collisions of strongly nonlinear waves are elastic, i.e., the energy of solitary wave does not change. However, results of our numerical simulations indicate that, in general case, the interaction of strongly nonlinear waves leads to the shape distortion and formation of regions with high surface steepness.

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CP11

High Order Hamiltonian Water Wave Models with Wave-Breaking Mechanism

Based on the Hamiltonian formulation of water waves, we derive higher order Hamiltonian equations by Taylor expansions of the potential and the vertical velocity around the still water level. The polynomial expansion in wave height is mixed with pseudo-differential operators that preserve the exact dispersion relation. The consistent approximate equations have inherited the Hamiltonian structure and give exact conservation of the approximate energy. In order to deal with breaking waves, we designed an eddy viscosity model that is applicable for fully dispersive equations. As breaking trigger mechanism we use a kinematic criterion based on the quotient of horizontal fluid velocity at the crest and the crest speed. The performance is illustrated by comparing simulations with experimental data obtained at hydrodynamic laboratory. The comparison shows that the higher order models perform quite well; the extension with the breaking wave mechanism improves the simulations.

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CP11

The Higher-Order Boussinesq Equation with Periodic Boundary Conditions: Analytical and Numerical Results

We consider the higher-order Boussinesq (HBQ) equation proposed in [P. Rosenau, "Dynamics of dense discrete systems", Prog. Theor. Phys. 79, 1028-1042, (1988)], [G. Schneider, C. E. Wayne, "Kawahara dynamics in dispersive media", Physica D 152-153, 384-394, (2001)], [N. Duruk, A. Erkip, H. A. Erbay, "A higher-order Boussinesq equation in locally non-linear theory of one-dimensional nonlocal elasticity", IMA Journal of Applied Mathematics 74, 97-106, (2009)]. We propose a Fourier pseudo-spectral numerical method for the HBQ equation. We then prove the convergence of numerical scheme in the energy space. We consider three test problems concerning the propagation of a single solitary wave, the interaction of two solitary waves and a solution that blows up in finite time. The numerical results show that the Fourier pseudo-spectral method provides highly accurate results. This work has been supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under the project MFAG-113F114.

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CP12

A Multiscale Continuation Algorithm for Binary Rydberg-Dressed Bose-Einstein Condensates

We study a multiscale continuation algorithm for binary Rydberg-dressed Bose-Einstein condensates which is governed by a system of the Gross-Pitaevskii equations (GPEs). The proposed four-parameter continuation algorithm has the advantage that we can obtain the contours of the wave functions ψ_1 and ψ_2 for various values of $\mu_{11} = \mu_{22} \in [0, \mu_1^*]$ and $\mu_{12} \in [0, \mu_2^*]$, where we only need to trace the ground state solution curve once. Our numerical experiments show that the proposed algorithm outperforms the classical continuation algorithm, and is very competitive compared to other numerical methods.

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CP12

The Structure of the Equilibrium Field Distribution in a Discrete Optical Waveguide System with Four-Wave Mixing

Statistical mechanics of two coupled vector fields is studied within the framework of the tight-binding model that describes propagation of polarized light in discrete waveguides in the presence of the four-wave mixing. The equilibrium properties of the polarization state are described in terms of the Gibbs measure with positive temperature. The transition line $T = \infty$ is established beyond which the discrete vector solitons are created. In the limit of the large nonlinearity an analytical expression for the distribution of Stokes parameters is obtained which is found to be dependent only on the statistical properties of the initial polarization state and not on the strength of the nonlinearity. The evolution of the system to the final equilibrium state is shown to pass through the intermediate stage when the energy exchange between the waveveguides is still negligible.

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CP12

Dynamics of Bright-Dark Solitons and Their Collisions in the General Multi-Component Yajima-Oikawa System

We consider a general multi-component Yajima-Oikawa system governing the dynamics of nonlinear resonance interaction of multiple short waves with a long wave in one dimension. We construct the exact bright-dark (mixed) soliton solution by using the Hirota's bilinearization method. By performing an asymptotic analysis, we unravel two types of fascinating energy sharing collisions and also the standard elastic collision of bright-dark solitons. The dynamics of soliton bound states is also explored.

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CP12

Vortex Clustering and Negative Temperature States in a 2D Bose-Einstein Condensate

In this work we investigate the question of clustering of like signed vortices in a two-dimensional Bose-Einstein condensate. Such clustering can be understood in terms of negative temperature states of a vortex gas. Due to the long-range nature of the Coloumb-like interactions in point vortex flows, these negative temperature states strongly depend on the shape of the geometry in which this clustering phenomena is considered. We analyze the problem of clustering of point vortices in a number of different regions. We present a theory to uncover the regimes for which clustering of like signed vortices can occur and compare our predictions with numerical simulations of a point vortex gas. We also extend our results to the Gross-Pitaevskii model of a Bose gas by performing numerical simulations for a range of vortex configurations using parameters that are relevant to current experiments.

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CP12

Pulse Interactions and Bound-State Formation in Non-Local Active-Dissipative Equations

We analyse coherent structures in active-dissipative equations that in addition contain non-local contributions in the form of pseudo-differential operators. Such equations arise e.g. in the modelling of a liquid film flow in the presence of various external effects. We develop a weak-interaction theory of pulses in such equations and demonstrate that pulse interactions and bound-state formation are strongly influenced by non-locality and are characterised by several features that are not present in local equations.

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CP12

Ground State Solutions of Coupled IR/UV Stationary Filaments

The ground state solutions of coupled infrared (IR) / ultraviolet (UV) stationary filaments have been studied both analytically and numerically. The UV pulse have exact Townes solition power for the small IR pulse. And the eigenstates of the UV Townes branch where the IR filament is no longer small are also found numerically.

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CP13

Weierstrass Traveling Wave Solutions for Dissipative Equations

In this talk the effect of a small dissipation on waves is included to find exact solutions to the modified BBM equation. We will use a general formalism based on Ince's transformation to write the general solution in terms of Weierstrass $\wp$ functions, from which all the other known solutions can be obtained via simplifying assumptions. This method can be applied to other similar dissipative equations.

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CP13

Phase Wave Equation

I consider coupled oscillators which exhibit frequency synchronization without phase synchronization. The separation of frequency and phase synchronizations leads to a new wave equation which can be called a phase wave equation. I first explain the basic properties of the phase wave equation. Then I demonstrate that the phase wave equation is generic and can support various kinds of wave which include barbers pole, solitary wave, crawling motion etc.

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CP13

Chiral Solitary Waves in Galilean Covariant Fermi Field Theories with Self-Interaction

A generalization of the Levy-Leblond equations for a $(3+1)$-dimensional non-relativistic Fermi field for the case of the non-zero rest energy is considered. The self-interaction of the field is included and its rest mass is assumed to differ from the inertial one. A positive chirality solitary wave solution with space oscillations in the x^3-coordinate is constructed, the amplitude of the solution depending on the rest energy. The wave's energy and mass transferred through the unit area in the (x^1, x^2)-plane are calculated. Stability of the solution is discussed.

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CP13

Ultrashort Pulse Propagation in Periodic Media - Analysis and Novel Applications

We present a novel technique for manipulating short pulses in periodically modulated media. Specifically, we show how to perform time-reversal, extreme pulse compression, ultrafast switching and slow light. Our study includes an unusually sophisticated multiple-scales analysis which is corroborated numerically with a full electrodynamic model and a simplified coupled mode theory. The technique can find applications in any wave systems, especially in optics and acoustics. Finally, we review experimental tests of these ideas.

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CP13

Transmission and Reflection of Airy Beams at An Interface of Dielectric Media

Transmission and Reflection of Airy beams at an interface between two diffusive linear-nonlinear dielectric media are

studied numerically and analytically. The beam dynamics is simulated by the beam propagation method. In this study, the interesting cases of critical incidence of Brewster and total-internal-reflection angels are considered. It is observed that the reflected beam nearly unaffected but shifted. Some interesting results will be presented in this talk.

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CP13

Absolute Stabilization for the Axially Moving Kirchhoff String with Nonlinear Boundary Feedback Control

In this work, we consider the stabilization problem of the nonlinear axially moving Kirchhoff string using nonlinear boundary control. The nonlinear boundary control is the negative feedback of the transverse velocity of the string at one end, which satisfies a polynomial type sector constrain. Employing the multiplier method, we establish explicit exponential and polynomial stability for the Kirchhoff string. Simulation examples are presented based on finite element method with Lagrange hat basis.

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MS1

The Unified Transform for the NLS with t-Periodic Boundary Conditions

The most challenging problem in the implementation of the so-called unified transform to the analysis of the nonlinear Schrödinger equation on the half-line is the characterization of the unknown boundary value in terms of the given initial and boundary conditions. For the so-called linearizable boundary conditions, this problem can be solved explicitly. Furthermore, for non-linearizable boundary conditions which decay for large t, this problem can be largely bypassed in the sense that the unified transform yields useful asymptotic information for the large t behavior of the solution. However, for the physically important case of periodic boundary conditions, it is necessary to characterize the unknown boundary value. Recent progress towards the solution of this problem will be presented.

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MS1

The Initial Value Problem in Analytic Spaces of Nonlinear Evolution Equations with Traveling Wave Solutions

We shall consider dispersive and weakly dispersive evolution equations, which in addition to being integrable they all have interesting traveling wave solutions and discuss their Cauchy problem when the initial data are analytic. For dispersive equations, like KdV and cubic NLS, the solution to the initial value problem with analytic initial data is analytic in the space variable and Gevrey in the time variable. However, for weakly dispersive equations, like Camassa-Holm type equations, the solution is analytic in both variables.

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MS1

On Rigorous Aspects of the Unified Transform Method

The unified transform method, introduced by Fokas in 1997, produces novel solution formulae to boundary value problems for linear as well as integrable nonlinear equations. For linear problems, in particular, this method can be employed even for non-separable or non-self-adjoint problems, where the classical solution techniques fail. We will discuss some rigorous aspects of these novel formulae in the case that the prescribed initial and boundary data belong to appropriate Sobolev spaces.

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MS1

The Fokas Method for Interface Problems

Problems related to interfaces in different media arise frequently in applications and often are not solvable analytically using classical approaches. In my talk I will show that by adapting and expanding the Method of Fokas, solving many types of interface problems for the heat equation is now possible. I will also show how to use these methods for an interface problem involving the linear Schrödinger equation and expand to mixed interface problems where different sides of the interface are governed by differing equations.

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MS2

Motion in a Bose-Einstein Condensate: Vortices, Turbulence and Wakes

We show that an elliptical obstacle moving in a 2-dimensional Bose-Einstein condensate induces a wake resembling that seen in ordinary classical flows past a cylinder. The wake consists of clusters of like-signed quantum vortices which are nucleated at the boundary of the obstacle. Vortex singularities in the inviscid superfluid thus mimic classical vortex patterns typical of viscous flows. Transitions from symmetric wake to time dependent Karman vortex street to turbulent wake are observed. Finally, we discuss these effects in view of current experiments in which oscillating wires, forks and grids are used to generate turbulence in superfluid helium.

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MS2

Intrinsic Photoconductivity of Ultracold Fermions in An Optical Lattice

We report on the experimental observation of an analog to a persistent alternating photocurrent in an ultracold gas of fermionic atoms in an optical lattice. The dynamics is induced and sustained by an external harmonic confinement. While particles in the excited band exhibit long-lived oscillations with a momentum-dependent frequency, a strikingly different behavior is observed for holes in the lowest band. An initial fast collapse is followed by subsequent periodic revivals. Both observations are fully explained by mapping the system onto a nonlinear pendulum.

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MS2

Pattern Formation in Solid State Condensates

In my talk I will discuss the phenomena observed in, and properties of, microcavity excitonpolariton condensates. These are condensates of mixed light and matter, consisting of superpositions of photons in semiconductor microcavities and excitons in quantum wells. Because of the imperfect confinement of the photon component, excitonpolaritons have a finite lifetime, and have to be continuously re-populated. Therefore, excitonpolariton condensates lie somewhere between equilibrium BoseEinstein condensates and lasers. I discuss the coherence properties of excitonpolariton condensates predicted theoretically and studied experimentally, and the wide variety of spatial structures including quantised vortices, trapped states, states of a quantum harmonic oscillator, ring condensates and other coherent structures. These patterns and their dynamics can be reproduced through the solution of the complex Ginzburg-Landau or the complex Swift-Hohenberg equations. I will discuss to which extent these macroscopic quantum states can be understood as linear or nonlinear phenomena and what criteria can be applied to make such a separation.

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MS2

Quantum Hall Effect and Transport Phenomena in Lossy Photonic Lattices

We discuss properties of photonic cavities aligned in a form of a lattice. Because of the inherent loss of photons, the steady-state configuration is achieved as a result of continuous gain and loss, which can theoretically be obtained through solving an equation similar to the Schrödinger equation but with an imaginary term representing loss. We discuss how some transport properties, such as the quantum Hall effect, show themselves in such driven-dissipative systems.

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MS3

Asymptotic Stability for Nls with Nonlinear Point Interactions

We report on recent results concerning a Schrödinger Equation with an attractive nonlinearity concentrated at a point. In particular, we focus on the problem of the asymptotic stability of the Ground States. We treat both cases of a linearized evolution with or without bound states. This is a joint work with D. Noja (Milan) and C. Ortoleva (Milan).

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MS3

Scattering for Nonlinear Schrdinger Equations under Partial Harmonic Confinement

We consider the nonlinear Schrödinger equation under a partial quadratic confinement. We show that the global dispersion corresponding to the direction(s) with no potential is enough to prove global in time Strichartz estimates. We infer the existence of wave operators. Asymptotic completeness stems from suitable Morawetz estimates, which in turn follow from the latest approach, applied to a marginal of the position density. This is a joint work with Paolo Antonelli and Jorge Drumond Silva.

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MS3

Some Collision Problems Related to Nonlinear Schrdinger Equations

In this talk I will discuss a more qualitative lack of stability of several structures of solitary wave type. I will focus this description on the nonlinear Schrdinger model, although the proposed account of the dynamics can be adapted to several other models with unstable solitons.

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MS3

On the Long-Time Behavior of NLS in the Partially Periodic Setting

We present results on the Nonlinear Schroedinger equation posed in the partially periodic setting $\mathbf{R}^d \times \mathbf{T}$ and we look at the long-time behavior of the solutions. In particular we shall study the H^1 scattering in the regime of nonlinearities which are both L^2-supercritical and energy subcritical. We also present results related to the modified scattering for the cubic NLS in the partially periodic setting $\mathbf{R} \times \mathbf{T}^d$.

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MS4

An Asymptotic Model for Small Amplitude Solutions to Newton's Cradle

We study the dynamics of a one-dimensional lattice of nonlinearly coupled oscillators. The class of problems addressed include Newton's cradle with Hertzian contact interactions. The Cauchy problem is studied yielding lower bounds for the existence time. We then derive an asymptotic model for small amplitude solutions over large times. This allows to prove the existence of breather-like solutions to the initial model. We also estimate the maximal dispersion of localized initial data.

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MS4

Justification of Leading Order Quasicontinuum Approximations of Strongly Nonlinear Lattices

After giving a brief introduction to the topic of granular crystals, I will consider the leading order quasicontinuum limits of a one-dimensional granular chain governed by the Hertz contact law under precompression. The approximate model, a so-called p-system, which is derived in this limit is justified by establishing asymptotic bounds for the error with the help of energy estimates. The continuum model predicts the development of shock waves, which we investigate with the aid of numerical simulations.

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MS4

Transitions from Energy Entrapment to Energy Transport in the System of N Coupled Granular Chains

In the present study we analyze the governing mechanisms of transition from energy entrapment to energy transport in the system of N coupled, granular chains. Two distinct mechanisms leading to the breakdown of energy localization on the first and the second chains have been revealed and analyzed in the study. Using the regular multi-scale asymptotic analysis along with the non-smooth temporal transformation method (NSTT) we formulate the analytic criteria for the formation of the inter-chain energy transport. Results of the analytical approximation are in a very good correspondence with the results of numerical simulations of the full model.

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MS4

Acoustic Wave Filtering and Breather Formation in Coupled Granular Chains Embedded in Material Matrix

We present an experimental study of primary pulse transmission in coupled ordered granular chains embedded in elastic matrix under harmonic excitation. We find that depending on the magnitude and frequency of the applied excitation these strongly nonlinear dynamical systems may either support propagating pulses (in pass bands), or may attenuate higher frequency harmonic components (in stop bands). Hence, these media act as tunable nonlinear acoustic filters. In the transition between pass and stop bands these systems support breathers, in the form of weakly modulated oscillating waves. These results are confirmed theoretically and experimentally.

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MS5

Interfaces in a Random Environment

We review results on the qualitative behaviour of parabolic evolution equations with random coefficients which model the evolution of an interface which moves in a random environment. The typical examples are randomly forced mean curvature flow (with a forcing which depends on space onlu) and related semi-linear models (random obstacle model).

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MS5

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MS5

Noise Induced State Transitions, Intermit-

tency and Universality in the Noisy Kuramoto-Sivashinsky Equation

We analyze the effect of pure additive noise on the long-time dynamics of the noisy Kuramoto-Sivashinsky (KS) equation in a regime close to the instability onset. We show that when the noise is highly degenerate, in the sense that it acts only on the first stable mode, the solution of the KS equation undergoes several transitions between different states, including a critical on-off intermittent state that is eventually stabilized as the noise strength is increased. Such noise-induced transitions can be completely characterized through critical exponents, obtaining that both the KS and the noisy Burgers equation belong to the same universality class. The results of our numerical investigations are explained rigorously using multiscale techniques.

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MS5
Stability of Traveling Waves in Bistable Reaction-Diffusion Equations

Stability of traveling waves in stochastic bistable reaction-diffusion equations with both additive and multiplicative noise is proven, using a variational approach based on functional inequalities. Explicit estimates on the rate of stability are derived that can be shown to be optimal in the special case of stochastic Nagumo equations. Our analysis allows to derive a stochastic differential equation for the motion of the wave front and a mathematical rigorous decomposition of the full dynamics into the phase-shifted traveling wave and non-Gaussian fluctuations.

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MS6
Actin Polymerization and Subcellular Mechanics Drive Nonlocal Excitable Waves in Living Cells

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MS6
Clock and Wavefront Model of Somitogenesis

The currently accepted interpretation of the clock and wavefront model of somitogenesis is that a posteriorly moving molecular gradient sequentially slows the rate of clock oscillations, resulting in a spatial readout of temporal oscillations. However, while molecular components of the clocks and wavefronts have now been identified in the presomitic mesoderm (PSM), there is not yet conclusive evidence demonstrating that the observed molecular wavefronts act to slow clock oscillations. Here we present an alternative formulation of the clock and wavefront model in which oscillator coupling, already known to play a key role in oscillator synchronisation, plays a fundamentally important role in the slowing of oscillations along the anteriorposterior (AP) axis. Our model has three parameters that can be determined, in any given species, by the measurement of three quantities: the clock period in the posterior PSM, somite length and the length of the PSM. A travelling wavefront, which slows oscillations along the AP axis, is an emergent feature of the model.

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MS6
Ca2+/calmodulin-Dependent Protein Kinase Waves in Heterogeneous Spiny Dendrites

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MS6
Actin Nucleation Waves in Motile Cells

Not Available at Time of Publication

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MS7
Jet-Particle Methods for Incompressible Fluids

A Lagrangian model of ideal incompressible fluid flow is introduced in which a kth order deformation is attached to each particle. The data associated to the deformation gradient is formally represented as an internal degree of freedom within each particle. In particular, it is a gauge associated to the kth order jet-group of a point, and we refer to the particle as a k-jet particle. Through an infinite-dimensional reduction by symmetry, solutions may be obtained to the fluid equation by solving a finite dimensional ODE. The resulting ODE is then solvable using standard integration schemes. Interesting behavior occurs when we consider particle collisions. We find that collisions of a k-jet particles and an ℓ-jet particles yield (in infinite time) a $(k+\ell)$-jet particle. This can be interpreted as a model of the energy cascade of an ideal incompressible fluid.

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MS7
Structure-preserving Discretization of Fluid Mechanics

In this talk we will geometrically derive discrete equations of motion for fluid dynamics from first principles. Our approach uses a finite-dimensional Lie group to discretize the group of volume-preserving diffeomorphisms, and the discrete Euler equations are derived from a variational principle with non-holonomic constraints. The resulting discrete equations of motion induce a structure-preserving time integrator with good long-term energy behavior, for which an exact discrete Kelvin circulation theorem holds. Our methods can be used to derive structure-preserving integrators for many systems, such as equations of magnetohydrodynamics, complex fluids etc.

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MS7

Geometric Theory of Garden Hose Dynamics

Instability of flexible tubes conducting fluid, or "garden hose instability", is a phenomenon both familiar from everyday life and important for applications, and therefore has been actively studied. In spite of its long history, many unanswered questions remain, in particular, how to address a dynamically changing cross-section. We construct a fully three dimensional, exact geometric theory of this phenomenon by coupling the dynamics of the elastic tube (left-invariant) with the motion of the fluid (right-invariant) with additional volume constraint. We also discuss the boundary conditions through an appropriate, Lagrange-d'Alembert's like modification of the critical action principle. We show that the change of the cross-section affects the stability properties, derive a class of exact, fully nonlinear solutions of traveling wave type and (time permitting), discuss the results of experiments elucidating some important aspects of the dynamics.

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MS7

Using Multi-Moment Vortex Methods to Study Merger

We use a low order model to understand how two co-rotating vortices transition from a quasi-steady distance from each other to the rapid convective merger that occurs after diffusion causes the vortex core size to exceed some critical fraction of the separation distance. This model was derived from the recently developed Multi-Moment Vortex Method and provides several physical insights as well as pins down precisely what causes the very initial onset of convective merger.

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MS8

Inviscid Damping and the Asymptotic Stability of Planar Shear Flows in the 2D Euler Equations

We prove the asymptotic stability of shear flows close to the planar, periodic Couette flow in the 2D incompressible Euler equations. Specifically: given an initial perturbation of the Couette flow small in a suitable regularity class, the velocity converges strongly in L2 to a shear flow as t-¿infinity. The vorticity is mixed to small scales and in general enstrophy is lost in the weak limit. Joint work with Nader Masmoudi.

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MS8

Large Deviations for Stochastic Partial Differential Equations with Applications in Planetary Atmosphere Dynamics

We will discuss several recent result for the computation of large deviation rate function for stochastic differential equations, including the stochastic two-dimensional Euler and Navier-Stokes equations, and quasi-geostrophic models that describe planetary atmospheres. Both explicit results for the quasi-potential expression and numerical computations will be discussed. From those computations, we predict non-equilibrium phase transitions and bistable situations.

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MS8

Center Manifolds and Taylor Disperson

Taylor dispersion, first described by G. Taylor in 1953, occurs when the diffusion of a solute in a long channel or pipe is enhanced by the background flow, in that the solute asymptotically approaches a form that solves a different diffusion equation (with larger diffusion coefficient, in an appropriate moving frame). By introducing scaling variables, I'll show how one can obtain this asymptotic form via a center manifold reduction. This is joint work with Margaret Beck and C.E. Wayne.

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MS8

Pseudospectrum for Oseen Vortices Operators

Oseen vortices are self-similar solutions to the vorticity equation in $\mathbf{R}^2$. T.Gallay and C.E.Wayne proved in 2005 that these solutions are stable for any value of the circulation Reynolds number. The linearization of the system around an Oseen vortex naturally gives rise to a non-self-adjoint operator. We shall discuss spectral and pseudospectral properties of the linearized operator in the fast rotation limit. In particular, we give some (optimal) resolvent estimates along the imaginary axis.

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MS9

Mixed Boundary Value Problems for Stokes Flows: New Methods and Applications

Motivated by microfluidics applications where it is required to manipulate viscous fluids at small scales we present some novel mathematical approaches to a variety of mixed boundary value problems for biharmonic fields arising therein. The methods, which are based on a formulation originally presented by Crowdy & Fokas [Proc. Roy. Soc. A, 460, (2004)], are general and have much wider applicability in other areas.

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MS9

The Nonlinear Schrdinger Equation with Periodic Boundary Data

I will present some new results related to the initial-boundary value problem for the nonlinear Schrdinger equation on the half-line with an asymptotically periodic boundary condition.

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MS9

Well-Posedness and Spectral Representation of Linear Initial-Boundary Value Problems

We study initial-boundary value problems for linear constant-coefficient evolution equations on a finite 1-space, 1-time domain. Classical separation of variables and Fourier transform methods fail for all problems except those of second order or those with very special boundary conditions whereas the method of Fokas solves any such well-posed problem. We describe the well-posedness criteria and provide a functional-analytic view of the failure of classical methods and the success of Fokas' method.

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MS9

A Retrospective Inverse Problem for the Wave Equation

A typical retrospective inverse problem is one where we attempt to recover the full solution to the heat equation, say on the whole line, given time series data at a specific location i.e. Dirichlet data. In this talk, I shall consider this problem for the wave equation: given time-series data at fixed spatial locations, can one recover the full solution to the problem posed on the whole line? By using simple arguments based on Fokas' method we shall obtain necessary conditions to recover the solution. Further employing the global relations for the associated boundary-value problems we obtain a system of equations to solve for the initial condition everywhere.

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MS10

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MS10

Dissection of Boussinesq Non-linear Interactions Using Intermediate Models

Nonlinear coupling among wave modes and vortical modes is dissected in order to probe the question: Can we distinguish the wave-vortical interactions largely responsible for formation versus evolution of coherent, balanced structures? It is well known that the quasi-geostrophic (QG) equations can be derived from the Boussinesq system in a non-perturbative way by ignoring wave interactions and considering vortical modes only. One qualitative difference between those two models is the lack of skewness in the QG dynamics. In this talk, non-perturbative intermediate models that include more and more classes of non-linear interactions will be used to identify their role in different qualitative properties of the Boussinesq system. Numerical results will be shown to describe the effect of each class in the transfer of energy between vortical modes and waves, transfer of energy (or the lack of it) between scales, formation of vortices and skewness.

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MS10

A Coupled Model of the Interactions Between Inertial Waves and Turbulence in the Ocean

We derive a new model of the interactions between near-inertial waves (NIWs) and balanced motion in the ocean using Generalised Lagrangian Mean theory and Whitham averaging. In its simplest form, the model couples the well-known Young-Ben Jelloul model of NIWs with a quasi-geostrophic model of the balanced motion. The model is Hamiltonian and conserves both energy and wave action. Analytic arguments and numerical simulations of the model shed light on mechanisms of NIW-mean flow interactions in the ocean.

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MS10

Centrifugal, Barotropic and Baroclinic Instabilities of Isolated Ageostrophic Anticyclones in the Two-layer Rotating Shallow Water Model and their Nonlinear Saturation

Instabilities of the isolated anticyclonic vortices in the 2-layer rotating shallow water model are studied at Rossby numbers up to 2, with the main goal to understand the interplay between the classical centrifugal instability and other possible ageostrophic instabilities. We find that different types of instabilities with low azimuthal wavenumbers exist, and may compete. In a wide range of parameters an asymmetric version of the standard centrifugal instability has larger growth rate than this latter. The dependence of the instabilities on the parameters of the flow: Rossby and Burger numbers, vertical shear, and the ratios of the layers' thicknesses and densities is investigated. The zones of dominance of each instability are determined in the parameter space. Nonlinear saturation of these instabilities is then studied with the help of a high-resolution finite-volume numerical scheme, by using the unstable modes identified from the linear stability analysis as initial conditions. Differences in nonlinear development of the competing centrifugal and ageostrophic barotropic instabilities are exposed.

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MS11

Selection Principles for Semiclassical Flows over Conical Singularities: Asymptotic and Computational Investigation

When a pure state interacts strongly with conical singularities, there are several possible classical evolutions. Based on recent rigorous results, we propose a selection principle for the regularization of semiclassical asymptotics for Schroedinger equations with Lipschitz potentials. Employing a solver with a posteriori error control, we generate rigorous upper bounds for the error in our asymptotic approximation. For 1-dimensional problems without interference, we obtain compelling agreement between the regularized asymptotics and the full solution. This allows the formulation of a conjecture for the validity of the regularized asymptotics. Both the selection principle, and the computation with a posteriori error control to check it, can be extended to the 1D Schroedinger-Poisson equation, where the non-linearity is also generated by a conical singularity. Existing work in the same spirit, and implications of our approach in that problem are briefly discussed.

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MS11

Nonlinear Propagation of Coherent States Through Avoided Energy Level Crossing

We study the propagation of a coherent state for a one-dimensional system of two coupled Schrdinger equations in the semi-classical limit. Couplings are induced by a cubic nonlinearity and a matrix-valued potential, whose eigenvalues present an "avoided crossing" : at one given point, the gap between them reduces as the semi-classical parameter becomes smaller. We show that when an initial coherent state polarized along an eigenvector of the potential propagates through the avoided crossing point, there are transitions between the modes at leading order. In the regime we consider, we observe a nonlinear propagation far from the crossing region while the transition probability can be computed with the linear Landau-Zener formula.

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MS11

Dispersive Estimates for Non-Autonomous Hamiltonians and Applications to Nonlinear Asymptotic Stability of Solitary Waves

The pioneering work of Soffer and Weinstein in the '90 introduced the method of controlling the nonlinearity by dispersive estimates of the linearized operator at a frozen time. It has now become a classical method to study asymptotic stability of nonlinear waves and has shown that the actual dynamics shadows different solitary waves before collapsing to one. What is less known is that the method can be significantly improved if one obtains and uses dispersive estimates for the time dependent linearized dynamics, i.e. the linearization is at the solitary wave shadowed at that moment and changes as the dynamics moves from one solitary wave to another. I will discuss how this new perspective has allowed us to tackle, for the first time, subcritical nonlinearities in Schrodinger equations and to significantly reduce smoothness assumptions in nonlinear Dirac equations. This is joint work with A. Zarnescu (U. Sussex, England), O. Mizrak (Mersin U., Turkey), R. Skulkhu (Mahidol U., Thailand) and N. Boussaid (U. Franche-Comte, France).

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MS11

Dispersion and Long Time Evolution of Coherent States

We consider the the semiclassical limit of solutions of the time dependent Schrödinger equation with potential, and with initial conditions given by coherent states. The evolution of the shape of a coherent state depends strongly on the classical dynamics which emerges in the semiclassical limit, and we use this dynamics to give precise estimates on how a coherent state disperses for large times and eventually becomes a Lagrangian state. This can then be used to transform a nonlinear Schrödinger equation into a new form in which the nonlinearity decays in time.

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MS12

Granular Crystals at the Microscale

The nonlinear dynamics of a two-dimensional granular crystal composed of 1 μm silica microspheres assembled on an elastic substrate are studied. The dynamics of the

system are shown to differ significantly from macroscale granular media due to effects such as interparticle and particle-substrate adhesion. High amplitude surface acoustic waves are excited and measured in the coupled system via the laser-induced transient grating technique. The photoacoustic measurements are compared with our analytical model and numerical simulations.

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MS12

Solitary Waves in a 1D Chain of Repelling Magnets

We study experimentally, numerically and theoretically the dynamics of a 1D discrete nonlinear lattice composed of repelling magnets. We demonstrate that such lattice supports solitary waves with profile and propagation speed depending on the amplitude. The system belongs to the kind of nonlinear lattices studied in [Friesecke and Matthies, Physica D, 171(2002) 211-220] and exhibits sech^2 profile in the low energy regime and atomic scale localization in the high energy regime. Such systems may find potential applications in the design of novel devices for shock absorption, energy localization and focusing. Furthermore, due to the similarity of the magnetic potential with the potentials governing atomic forces, the system could be used for a better understanding of important problems in physics and chemistry.

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MS12

Disordered Granular Chains

I investigate the propagation and scattering of highly nonlinear waves in disordered granular chains composed of spheres that interact via Hertzian contact. Experiments and numerical simulations both reveal the existence of two different mechanisms of wave propagation. In low-disorder chains, one observes a decaying solitary pulse; beyond a critical level of disorder, the decay is faster and the wave transmission becomes insensitive to the level of disorder. I will also compare results from different families of disordered arrangements.

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MS12

Modulation of Nonlinear Waves in Woodpile Phononic Crystals

We present experimental and numerical studies on the modulational effect of nonlinear waves in woodpile phononic crystals composed of slender, cylindrical elements. We find that various patterns of wave modulation and attenuation can be achieved in woodpile architectures associated with their natural bending modes. The numerical results based on finite element and discrete element methods corroborate experimental results well. Woodpile phononic crystals can offer new testbed for manipulating nonlinear wave propagation.

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MS13

Determining Wave Stability Via the Maslov Index

The Maslov index is a symplecto-geometric invariant that counts signed intersections of Lagrangian subspaces. It was recently shown that the Maslov index can be used to compute Morse indices of selfadjoint, elliptic boundary value problems on star-shaped domains. We extend these results to bounded domains with arbitrary geometry, and discuss some applications to the stability of nonlinear waves.

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MS13

The Krein Matrix for Quadratic Eigenvalue Problems

In order to understand spectral stability for Hamiltonian systems, there are two types of eigenvalues that need to be found: those with positive real part, and those purely imaginary ones with negative Krein signature. The former can be easily identified visually; however, the latter cannot. Knowing the signature of an eigenvalue is necessary in order to determine which eigenvalues can contribute to a Hamiltonian-Hopf bifurcation. The Krein matrix is a meromorphic matrix which can be used to not only find eigenvalues, but it can be used to graphically determine the Krein signature of purely imaginary eigenvalues. We will discuss its construction, and how it can be used in conjunction with the Hamiltonian-Krein instability index theory in order to study Hamiltonian eigenvalue problems.

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MS13

On the Maslov Index for Periodic and for Multidimensional Problems

In this talk we discuss some recent results on connections between the Maslov and the Morse indices for differential operators. The Morse index is a spectral quantity defined as the number of negative eigenvalues counting multiplicities while the Maslov index is a geometric characteristic defined as the signed number of intersections of a path in the space of Lagrangian planes with the train of a given plane. The problem of relating these two quantities is rooted in Sturm's Theory and has a long history going back to the classical work by Arnold, Bott, Duistermaat, Smale, and to a more recent paper by Deng and Jones. Two situations will be addressed: First, the case when the differential operator is a Schroedinger operator equipped with theta-periodic boundary conditions, and second, when the Schroedinger operators are acting on a family of multidimensional domains obtained by shrinking a star-shaped domain to a point and are equipped with either Dirichlet or quite general Robbin boundary conditions. This is a joint work with G. Cox, C. Jones, R. Marangell, A. Sukhtayev, and S. Sukhtaiev.

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MS13

Computing the Maslov Index

We address the problem of computing the Maslov index for large linear symplectic systems on the real line. The Maslov index measures the signed intersections (with a given reference plane) of a path of Lagrangian planes. The natural chart parameterization for the Grassmannian of Lagrangian planes is the space of real symmetric matrices. Linear system evolution induces a Riccati evolution in the chart. For large order systems this is a practical approach as the computational complexity is quadratic in the order. The Riccati solutions, however, also exhibit singularites (which are traversed by changing charts). Our new results involve characterizing these Riccati singularities and two trace formulae for the Maslov index. We demonstrate the effectiveness of these approaches by applying them to a large eigenvalue problem. We also discuss the extension of the Maslov index to the infinite dimensional case.

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MS14

Spatial Patterns on Time-Dependent Domains: Convective and Dilution Effects

We explore the key differences in the near-critical behavior between extended systems on time-fixed and time-dependent spatial domains, with particular emphasis on the effects of convection and dilution. As a paradigm, we take the Swift-Hohenberg equation, which is the simplest nonlinear model with a finite critical wavenumber, and use it to study dynamic pattern formation and evolution on time-dependent spatial domains. In particular, we discuss the effects of a time-dependent domain on the stability of spatially homogeneous and spatially periodic base states, and explore the effects of convection and dilution on the Eckhaus instability of periodic states. We show that this instability is repeatedly triggered as the domain grows and that it leads to phase slips that are responsible for the insertion of additional wavelengths required to maintain a preferred wavenumber. This behavior is captured by an evolution equation for the pattern wavenumber that can be derived from a generalized complex Ginzburg-Landau equation describing the nonlinear evolution of the pattern amplitude on time-dependent domains in the presence of convection and dilution. The results are compared with those on fixed domains.

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MS14

Recent Advances in Pattern Formation on Growing and Evolving Surfaces: Theory, Numerics and Applications

In this talk I will present theoretical results on the stability analysis of reaction-diffusion systems on evolving domains. There are two fundamental biological differences between the Turing conditions on fixed and growing domains, namely: (i) we need not enforce cross nor pure kinetic conditions and (ii) the restriction to activator-inhibitor kinetics to induce pattern formation on a growing biological system is no longer a requirement. Our theoretical findings are confirmed and reinforced by numerical simulations for the special cases of isotropic linear, exponential and logistic growth profiles. In particular we illustrate an example of a reaction-diffusion system which cannot exhibit a diffusively-driven instability on a fixed domain but is unstable in the presence of slow growth. Generalisations to reaction-diffusion systems with cross-diffusion as well as results on evolving surfaces will be presented.

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MS14

Effect of Dissolution-Driven Convection on the Partial Mixing Between CO2 and Hydrocarbons Or Reactive Solutions

Reducing greenhouse gas emissions to mitigate climate change is one of the most timely and important challenges in environmental and energy-related issues. Subsurface carbon sequestration has emerged as a promising solution to the problem of rising atmospheric carbon dioxide (CO2) levels. However, the question remains as to how the efficiency and safety of such a sequestration process depend on the physical and chemical characteristics of the storage site.

This question is emblematic of the need to better understand the dynamics of CO2 in subsurface formations where it is known to dissolve into the pre-existing fluid (hydrocarbons in depleted oil fields and brine in saline aquifers). This dissolution, known to improve the safety of the sequestration by reducing the risks of leaks of CO2 to the atmosphere, leads to an increase of the density of the liquid phase in the gravity field, thereby leading to natural convection. We aim to describe the mass transport between the non-equilibrium gas and liquid phases of a binary mixture. Our model accounts for the motion of the interface, diffusion and convective mass transport due to compressibility, non ideality, and natural convection. We show that natural convection influences the mixing time drastically. On the basis of a linear stability analysis of a simplified model, we also show that a chemical reaction of CO2 with a dissolved chemical species can either enhance or decrease the amplitude of the convective dissolution compared to the non reactive case. On this basis, we classify the various possible cases and identify the parameters that could influence the dissolution-driven convection in the subsurface formations, and thus impact the safety of carbon sequestration.

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MS14

Modelling and Simulation of Biological Pattern Formation on Evolving Surfaces

We investigate models for biological pattern formation via reaction-diffusion systems posed on evolving surfaces. The nonlinear reaction kinetics inherent in the models and the evolution of the surface mean that analytical solutions are generally unavailable and numerical simulations are necessary. We discuss numerical simulation of the model equations by finite elements and focus on applications to cell motility, chemotaxis and skin pigment pattern formation.

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MS15

Stability of mKdV Breathers in the Energy Space

In this talk I will show some recent results about the H^1 stability of breather solutions of mKdV. I will also present Bäcklund transformations for the mKdV and I will explain how we use them as a technical tool to get stability at the level of H^1 regularity.

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MS15

On the Interaction of Nonlinear Schrödinger Solitary Waves

The aim of this talk is go give a brief account of some interaction problems involving nonlinear solitary waves for the Schrödinger equation, where the nonlinearity is either integrable or non integrable. We will give a qualitative description of the involved dynamics.

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MS15

On the Dressing Method for Discrete Integrable Systems

This talk will discuss the discrete analogue of the dressing method for continuous and discrete integrable systems. We will show how, starting from appropriate matrix Riemann-Hilbert problems, one can derive a number of completely integrable nonlinear differential-difference systems of equations, together with their associated Lax pairs.

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MS15

Stability of Line Standing Waves Near the Bifurcation Point for Nonlinear Schrodinger Equation

We consider the transverse instability for nonlinear Schrodinger equation. One dimensional nonlinear Schrödinger equation has a stable soliton. Here, we regard this soliton as a line soliton of two dimensional nonlinear Schrodinger equation on the periodic boundary condition in the transverse direction with the period $2\pi L$. Rousset and Tzvetkov showed that there exists the critical period $2\pi L_*$ such that the line soliton is stable for $L < L_*$ and the line soliton is unstable for $L > L_*$. In this talk, we will present the transverse instability in the degenerate case $L = L_*$ and the relation between the stability and the bifurcation.

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MS16

Phase Mixing and Hydrodynamic Stability

Phase mixing is thought to play an important role in the stability of certain coherent structures in inviscid fluid dynamics and collisionless kinetic theory. However, mathematically rigorous nonlinear stability results have been somewhat elusive. We will discuss some recent advances on this topic including a simplified proof of nonlinear Landau damping in the Vlasov equations joint with Nader Masmoudi and Clement Mouhot and the asymptotic stability of shear flows in 2D ideal fluids joint with Nader Masmoudi.

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MS16

Reaction-Diffusion Equations with Spatially Distributed Hysteresis

We consider continuous and discrete reaction-diffusion equations with hysteresis which is given at every spatial point. Such equations arise when one describes hysteretic interaction between several diffusive and nondiffusive substances. In the talk, we will discuss mechanisms of appearing global and local spatio-temporal patterns due to hysteresis as well as their interconnection. This is a joint work with Sergey Tikhomirov.

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MS16

Waves Through Lattices with Impurities

We consider scalar lattice differential equations posed on square lattices in two space dimensions. Under certain natural conditions we show that wave-like solutions exist when obstacles (characterized by "holes') are present in the lattice. Our work generalizes to the discrete spatial setting the results obtained by Berestycki, Hamel and Matano for the propagation of waves around obstacles in continuous spatial domains.

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MS16

Using Graph Limits for Studying Dynamics of Large Networks

The theory of graph limits uses analytical methods for describing structural properties of large graphs. We discuss some applications of this theory to constructing and justifying continuum limits and to studying stability of spatial patterns of nonlocally coupled dynamical systems.

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MS17

A New Approach for Linear Elliptic Boundary Value Problems

We will discuss the functional analytic foundations that underline Fokas' unified approach to elliptic boundary value problems. It will be demonstrated that the global relation completely characterizes the Dirichlet-Neumann map for a large class of elliptic boundary value problems. A detailed treatment of linear elliptic boundary value problems on convex polygons will be presented and we will discuss the numerical implementation of the unified method in this case.

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MS17

Initial-Boundary-Value Problems for Nonlinear Wave Equations

The lecture will focus upon both the motivation and some of the recent analysis of boundary-value problems for nonlinear, dispersive wave equations.

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MS17

The Effect of Boundary Conditions on Linear and Nonlinear Waves

In this talk, I will discuss the effect of boundary conditions on the solvability of PDEs that have formally an integrable structure, in the sense of possessing a Lax pair. Many of these PDEs arise in wave propagation phenomena, and boundary value problems for these models are very important in applications. I will discuss the extent to which general approaches that are successful for solving the initial value problem extend to the solution of boundary value problem. I will survey the solution of specific examples of integrable PDE, linear and nonlinear. The linear theory is joint work with David Smith. For the nonlinear case, I will discuss boundary conditions that yield boundary value problems that are fully integrable, in particular recent joint results with Thanasis Fokas and Jonatan Lenells on the solution of boundary value problems for the elliptic sine-Gordon equation.

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MS18

A Dynamical Scheme for Prescribing Mesoscale Eddy Diffusivity in the Ocean

The resolution of the oceanic component of climate models will soon enter a regime where quasigeostrophic dynamics dominate. This talk will introduce a numerical scheme for dynamically adjusting the eddy diffusivity and viscosity of these models in a way that is appropriate for quasigeostrophic motion at the gridscale. This scheme is inspired by subgrid modeling techniques that are common in 3D Large Eddy Simulation (e.g. Smagorinsky), but which are not appropriate for climate-scale flows.

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MS18

On Resurging a Bore-Soliton-Spash

We were able to create an anomalously high rogue wave splash in a water wave channel with a convergence involving a bore and solitons, and we could control it. Unexpectedly, this man-made extreme or rogue wave is related to rogue waves in multidirectional seas, solutions of the KP-equation, tsunami run-up into coastal valleys, and certain wave-energy devices, as we will show. Some steps towards the mathematical and numerical modeling of this bore-soliton-splash will be discussed, including accurate conservative discretizations of water waves, and a single-phase mixture theory for air- and water in an approximate model for intermittent wave breaking.

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MS18

A Strange Gas? Revisiting the Point Vortex Model to Understand the Condensation Process in Two-Dimensional and Quasi-Geostrophic Turbulence

The statistical mechanics of a system of point vortices interacting in a bounded two-dimensional domain is revisited. It is shown that the familiar sinh-Poisson theory is incomplete, and describes the behaviour only for inverse temperatures below a critical value ($\beta < \beta_c$), when the 'gas' of point vortices has 'condensed' generating a mean circulation. For $\beta > \beta_c$ a theory of fluctuations, recently generalised by the authors, is shown to describe the 'uncondensed' state. Behaviour near the critical value is investigated using statistical sampling and DNS. The implications for the behavior of unforced two-dimensional Navier-Stokes turbulence, magnetized plasmas, and superfluids are discussed, and it is shown that the theory extends easily to related problem of quasi-geostrophic vorticity dynamics.

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MS18

Cloud-Edge Dynamics and Mysterious Holes in the Sky

A holepunch cloud is a curious atmospheric phenomenon where a disturbance in a thin cloud layer, as can be caused by an ascending aircraft, leaves behind a growing circular hole of clear air. Observed since the dawn of aviation, only very recently has the holepunch feature been simulated in a full-physics numerical weather model. Although the initiation process has been clearly attributed to ice crystal formation, we explain that the continued expansion of the hole is a travelling front between two phases of moist air — unsaturated and weakly-stratified (clear) intruding into saturated and moist-neutral (cloudy). Furthermore our fluid model, a non-hyperbolic conservation law system, illustrates an unusual example of a travelling discontinuity that satisfies the Rankine-Hugoniot conditions, yet exists despite the absence of underlying characteristics.

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MS19

Invariant Gibbs Measures for NLS on the Real Line

We discuss invariant Gibbs measures for NLS on the real line. Previously, Bourgain '00 considered this problem and proved uniqueness of solutions to (sub-)cubic NLS with the Gibbs measure as initial data. By viewing such initial data as a diffusion process in x, we extend this result to (sub-)quintic NLS. Moreover, we identify the limiting Gibbs measure on the real line and show its invariance.

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MS19

Two-soliton Solutions to a Focusing Cubic Half-wave Equation on R

In this talk we discuss work in progress regarding a nonlocal focusing cubic half-wave equation. Evolution problems with nonlocal dispersion naturally arise in physics as models for wave turbulence and gravitational collapse. The goal of the present work is to construct asymptotic global-in-time two-soliton solutions and to discuss their behaviour in terms of growth of high Sobolev norms. The talk is based on joint work with P. Gérard (Orsay, France), E. Lenzmann (Basel, Switzerland), and P. Raphaël (Nice, France).

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MS19

Going Beyond the Threshold: Scattering vs. Blow-up Dichotomy in the Focusing NLS Equation

We study the focusing nonlinear Schrodinger equation in R^N, in the L^2-supercritical regime with finite energy and finite variance initial data and investigate solutions above the energy (or mass-energy) threshold. We extend the known scattering versus blow-up dichotomy above the mass-energy threshold for finite variance solutions in the energy-subcritical and energy-critical regimes, obtaining scattering and blow-up criteria for solutions with arbitrary large mass and energy. This is a joint work with T. Duyckaerts.

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MS19

Dispersive Blow-Up in Schrdinger Type Equations

We review results from a recent joint paper together with J. Bona, J. C. Saut, and G. Ponce on the possibility of finite-time, dispersive blow up for nonlinear equations of Schroedinger type. This mathematical phenomena is one of the conceivable explanations for oceanic and optical rogue waves. We extend the existing results in the literature in several aspects. In one direction, the theory is broadened to include the Davey-Stewartson and Gross-Pitaevskii equations. In another, dispersive blow up is shown to obtain for nonlinear Schroedinger equations in spatial dimensions larger than one and for more general power-law nonlinearities. As a by-product of our analysis, a sharp global smoothing estimate for the integral term appearing in Duhamels formula is obtained.

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MS20

Kerr Optical Frequency Combs: from Fundamental Theory to Engineering Applications

We present the recent developments on the topic of Kerr optical frequency comb generation using whispering gallery mode resonators. These combs have are expected to provide optical signals with exceptional amplitude and phase stability. We discuss recent theoretical developments which are compared with numerical simulations and experimental measurements. The technological interest of these combs for various microwave photonics applications is also reviewed.

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MS20

From Microresonator Combs to Solitons

Microresonator based Kerr combs open the way for novel compact photonic devices. This promise is supported by predicted and recently experimentally demonstrated controlled transition from chaotic to phase locked combs associated with temporal solitons. We studied experimentally and in systematic numerical simulation the correlation between mode structure and comb dynamics. We found that solitons may appear in presence of mode coupling induced avoided crossings, only if affected modes are sufficiently far from the pump frequency.

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MS20

Pulse Energy Enhancement of Mode Locked Fiber Laser by Cascading Nonlinear Polarization Rotation

The periodic response curve of mode locked fiber laser with nonlinear polarization rotation limits the single pulse energy in the laser cavity by triggering multi-pulse lasing. We propose to engineer the effective response curve of the fiber cavity by cascading multiple stages of nonlinear polarization rotation schemes in fiber cavity which can enhance the single pulse energy in the cavity by improving the threshold of multi-pulsing with the combination of the multiple response curves.

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MS20

Modelocking Quantum Cascade Lasers Using Quantum Coherent Saturable Absorption

Experimental efforts to create short, stable mid-infrared pulses using quantum cascade lasers (QCLs) have not been successful to date. Time-evolving, strong spatial hole-burning due to very fast gain recovery hinders modelocking. We show that two-section quantum cascade lasers can be designed in which one of the sections acts as a quantum coherent absorbing medium, so that spatial hole-burning is suppressed and ultra-short pulses on the order of 100 fs can be obtained.

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MS21

Stability and Computation of Interacting Nonlinear Waves

We consider solutions of nonlinear reaction diffusion equations composed of several localized waves which interact strongly or weakly. We propose an extension of the freezing method which generates multiple coordinate frames. In these frames single waves stabilize independently while still keeping their nonlinear interaction. Asymptotic stability of the decomposition system is shown in one space dimension and numerical experiments are provided for both weakly and strongly interacting waves in dimensions one and higher.

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MS21

Stability of Fronts in Spatially Inhomogeneous Wave Equations

Model equations describing waves in anisotropic media or media with imperfections usually have inhomogeneous terms. This talk considers the effects of (non-local) inhomogeneities on fronts and solitary waves in nonlinear wave equations. Inhomogeneities break the translational symmetry and travelling waves are no longer natural solutions. Instead, the travelling waves tend to interact with the inhomogeneity and get trapped, reflected, or slowed down. The underlying Hamiltonian structure of the wave equation allows for a rich family of stationary front solutions and the energy densities inside the inhomogeneities provide s natural parametrization for these solutions. In this talk, we will show that changes of stability can only occur at critical points of the length of the inhomogeneity as a function of these energy densities and we give a necessary and sufficient criterion for the change of stability. We will illustrate the results with an example related to a Josephson junction system with a finite length inhomogeneity associated with variations in the Josephson tunneling critical current.

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MS21

Spectral Analysis for Transition Front Solutions in Multidimensional Cahn-Hilliard Systems

We consider the spectrum associated with the linear operator obtained when a Cahn-Hilliard system on $\mathbb{R}^n$ is linearized about a planar transition front solution. In the case of single Cahn-Hilliard equations on $\mathbb{R}^n$, it's known that under general physical conditions the leading eigenvalue moves into the negative real half plane at a rate $|\xi|^3$, where ξ is the Fourier transform variable corresponding with components transverse to the wave. Moveover, it has recently been verified that for single equations this spectral behavior implies nonlinear stability. In this talk, I'll discuss recent results in which it is shown that this cubic rate law continues to hold for a broad range of multidimensional Cahn-Hilliard systems.

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MS21

A Geometric Approach to Counting Eigenvalues: The Evans Function in Some Cellular Transport Models

This talk will focus on some geometric techniques in Evans function computations. The aim is to show how such methods can 1) facilitate spectral calculations, and 2) describe dynamical properties via said spectral calculations. The application in mind is for systems of travelling fronts in cellular transport models, specifically those describing tumour invasion and wound healing.

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MS22

Front Propagation in Bacterial Suspensions

Not Available at Time of Publication

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MS22

Contagion Shocks in One Dimension

We consider an agent-based model of emotional contagion coupled with motion in one dimension that has recently been studied in the computer science community. The model involves movement with speed proportional to a "fear' variable that undergoes a temporal consensus averaging with other nearby agents. We study the effect of Riemann initial data for this problem, leading to shock dynamics that are studied both within the agent-based model as well as in a continuum limit. We examine the model under distinguished limits as the characteristic contagion interaction distance and the interaction timescale both approach zero. Here, we observe a threshold for the interaction distance vs. interaction timescale that produces qualitatively different behavior for the system - in one case particle paths do not cross and there is a natural Eulerian limit involving nonlocal interactions and in the other case particle paths can cross and one may consider only a kinetic model in the continuum limit.

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MS22

Agent-Based and Continuum Models for the Formation of Stripes in Zebrafish

Zebrafish (Danio rerio), a small fish with black and yellow stripes, has the ability to regenerate its stripes in response to growth or artificial disturbance. We simulate past laser ablation experiments using discrete (agent-based) and continuum (nonlocal conservation law) models. Both models consider two cell types diffusing and reacting based on rules of short range attraction and long range repulsion. Our results suggest that the radius of interaction is a key determinant of stripe formation.

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MS22

Co-Dimension One Self-Assembly

Not Available at Time of Publication

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MS23

Geometric Wave Equations with Multi-component Solitons

I will survey some recent work deriving integrable geometric wave equations that are generalizations of Schrodinger map equations and their KdV analogs, as well as a geometric map version of integrable Camassa-Holm type equations. Through a generalized Hasimoto transformation, these geometric map equations are related to multi-component integrable systems which have soliton or peakon solutions.

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MS23

The Analysis of a Class of Integrable Evolution Equations

We shall consider a class of nonlinearevolution equations that are integrable and discuss their analytic properties,including the existence of peakon traveling wave solutions, well-posedness, ill-posedness and the stability of their data-to-solution map. This class includes the Camassa-Holm equation, the Degasperis-Procesiequation, the Novikovequation,and the Fokas-Olver-Rosenau-Qiao equation.The integrabilityof these equations has beenstudied in a unified way by V. Novikov.

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MS23

Integrable Equations in 3D: Deformations of Dispersionless Limits

Classification of integrable systems remains as a topic of active research from the beginning of soliton theory. Numerous classification results are obtained in 1 + 1 dimensions by means of the symmetry approach. Although the symmetry approach is also applicable to 2 + 1-dimensional systems, one encounters additional difficulties due to the appearance of nonlocal variables. There are several techniques to tackle the problem (e.g. the perturbative symmetry approach). In the perturbative symmetry approach one starts with a linear equation having a degenerate dispersion law and reconstructs the allowed nonlinearity. In this talk we present a novel perturbative approach to the classification problem. Based on the method hydrodynamic reductions, we first classify integrable quasilinear systems which may potentially occur as dispersionless limits of integrable 2 + 1-dimensional soliton equations. Subsequently we construct dispersive deformations preserving integrability deforming the hyrdrodynamic reductions by dispersive deformations and requiring that all hydrodynamic reductions of the dispersionless limit will be inherited by the corresponding dispersive counterpart. The method also allows to effectively reconstruct Lax representations of the deformed systems. We present various classification results obtained in the frame of the new approach, e.g. the classification of scalar 2+1-dimensional equations generalizing KP, BKP/CKP, the classification of Davey-Stewartson type systems as well as various classifications of 2 + 1-dimensional differential-difference equations. The talk is based on joint work with E. Ferapontov, A. Moro, B. Huard and I. Roustemoglou.

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MS23

Well Posedness and Breakdown for Cauchy Problems of Integrable Equations

We will discuss well posedness and breakdown results for some integrable equations that can be derived as Euler-Arnold equations.

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MS24

A Spectral Theory of Linear Operators on a Gelfand Triplet and Its Application to the Dynamics of Coupled Oscillators

The Kuramoto model is a system of ordinary differential equations for describing synchronization phenomena defined as a coupled phase oscillators. In this talk, an infinite dimensional Kuramoto model is considered. Kuramoto's conjecture on a bifurcation diagram of the system will be proved with the aid of a new spectral theory of linear operators based on Gelfand triplets.

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MS24

Pacemakers in a Large Array of Oscillators with Nonlocal Coupling

We model pacemaker effects in a 1 dimensional array of oscillators with nonlocal coupling via an algebraically localized heterogeneity. We assume the oscillators obey simple phase dynamics and that the array is large enough so that it can be approximated by a continuous nonlocal evolution equation. We concentrate on the case of heterogeneities with negative average and show that steady solutions to the nonlocal problem exist. In particular, we show that these heterogeneities act as a wave source, sending out waves in the far field. This effect is not possible in 3 dimensional systems, such as the complex Ginzburg-Landau equation, where the wavenumber of weak sources decays at infinity. To obtain our results we use a series of isomorphisms to relate the nonlocal problem to the viscous eikonal equation. The linearization about the constant solution results in an operator, L, which is not Fredholm in regular Sobolev spaces. We show that when viewed in the setting of Kondratiev spaces the operator, L, is Fredholm. These spaces can be described as Sobolev spaces with algebraic weights that increase in degree with each derivative.

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MS24

From Particle to Kinetic and Hydrodynamic Models of Flocking

In nature, one can find many species who's combined interaction give rise to large scale coherent structures without any force or leader guiding the interaction. The typical examples of such dynamics are flocking of birds, schools of fish, or insect swarms. In this talk, we will consider some of the models proposed to capture such interaction. We shall start at the level of particles and from there derive kinetic and hydrodynamic models. The main novelty of the talk is that all passages will be made using rigorous arguments. From particles to kinetic models, convergence is measured in Wasserstein distance, while from kinetic to hydrodynamic models, convergence is measured using relative entropy. We shall also consider flocking in an incompressible fluid governed by the Navier-Stokes equations. (Collaborators: Jose A. Carrillo, Young-Pil Choi, Antoine Mellet, and Konstantina Trivisa)

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MS24

A Tale of Two Distributions: from Few to Many Vortices In Quasi-Two-Dimensional Bose-Einstein Condensates

Motivated by the recent successes of particle models in capturing the precession and interactions of vortex structures in quasi-two-dimensional Bose-Einstein condensates, we revisit the relevant systems of ordinary differential equations. We consider the number of vortices as a parameter and explore the prototypical configurations ("ground states') that arise in the case of few or many vortices. In the case of few vortices, we modify the classical result of Havelock [Phil. Mag. **11**, 617 (1931)] illustrating that vortex polygons in the form of a ring are unstable for $N \geq 7$. Additionally, we reconcile this modification with the recent identification of symmetry breaking bifurcations for the cases of $N = 2, \ldots, 5$. We then examine the opposite limit of large N and illustrate how a coarse-graining, continuum approach enables the accurate identification of the radial distribution of vortices in that limit.

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MS25

A Riemann-Hilbert Approach for the Degasperis-Procesi and Ostrovsky-Vakhnenko Equations

I will present an inverse scattering transform approach, based on Riemann-Hilbert problems, for the Degasperis-Procesi and Ostrovsky-Vakhnenko equations on the line. The formulation of the initial value problem in terms of associated (3×3) matrix Riemann-Hilbert problems allows us to get the principal term of the long time asymptotics of its solution, and also to find soliton solutions. Work with D. Shepelsky.

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MS25

The Unified Transform and the Riemann-Hilbert Formalism

The Unified Transform provides a novel method for analysing boundary value problems for linear and for integrable nonlinear PDEs. The relationship of this method with the Riemann-Hilbert formalism for both scalar and matrix problems will be elucidated.

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MS25

Long-Time Asymptotics for the Toda Shock Problem

Consider the doubly infinite Toda lattice with steplike initial data and non-overlapping background spectra. We apply the method of nonlinear steepest descent to compute the leading term of the long-time asymptotics of the Toda shock problem in all principal regions of the space-time half plane under the assumption that no discrete spectrum is present.

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MS25

A Coupling Problem for Entire Functions and Its Application to the Long-Time Asymptotics of Integrable Wave Equations

We propose a novel technique for analyzing the long-time asymptotics of integrable wave equations in the case where the underlying isospectral problem has purely discrete spectrum. To this end we introduce a natural coupling problem for entire functions which serves as a replacement for the usual Riemann-Hilbert approach, which does not work for these kind of problems. As a prototypical example we investigate the long-time asymptotics of the dispersionless Camassa-Holm equation improving the currently known results.

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MS26

Effective Boundary Conditions: An Application to the Atmosphere

In this talk we present an application of the theory in the previous talk to the dry atmosphere. While the atmosphere does not have a definite top, it can be modeled as finite because the buoyancy frequency has a jump at the tropopause. This, effectively, acts as a “leaky” lid on the lower atmosphere. The leakage of gravity waves from the troposphere to the stratosphere is a significant physical effect that cannot be ignored — as happens when a rigid lid is added at the tropopause. In this talk we show how to develop effective boundary conditions at the tropopause, using the theory in the previous talk and transform methods.

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MS26

Particle Trajectories Beneath Stokes' Waves

We study particle trajectories beneath a Stokes' wave in the following regimes: (a) in the presence of a current, (b) in the presence of a submerged structure, and (c) in the presence of constant vorticity, where the particle phase-space and related pressure distribution are described in detail.

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MS26

Effective Boundary Conditions for Semi-Open Dispersive Systems

In the classical linear dispersive wave theory it is shown that sinusoidal waves (i.e., $\propto e^{i(kx-\omega t)}$) carry energy with the group speed $c_g = d\omega/dk$. This concept is limited to the case where both the frequency $\omega(k)$ and the wavenumber k must be real. On the other hand, semi-open dispersive systems allow more than just sinusoidal solutions: they can have exponentially blowing up and/or decaying solutions as well. In these cases the concept of an energy propagation speed looses meaning, but direction of propagation does not. Equations to determine the direction of propagation can then be implemented by considering the flux of energy. In this first talk (out of two) we show how this can be implemented to develop radiation boundary conditions for semi-open dispersive systems. We also show that there is a connection between this concept and the branch cuts of the dispersion relation in the complex plane.

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MS26

Diapycnal Mixing and Overturning Circulations

This talk explores a framework to quantify the large-scale effects of fluid mixing without resolving the associated small scale motion. The equations of motion for hydrostatic flows adopt the form of a hyperbolic system of nonlinear equations, which typically yield breaking waves. In order to model the shock waves that ensue, one needs to involve integral conserved quantities, such as mass and momentum. Yet in a system composed of layers that may mix, first physical principles do not provide a set of conserved quantities large enough to completely determine the flow. Our proposal is to replace the conventional conservations laws of each layer's mass and momentum, invalid after shocks form, by others, such as energy, in a way that provides a natural description of the mixing process. This closure is then applied to modeling overturning circulations, such as the Hadley cells of tropical convection.

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MS27

Solitary Wave Dynamics in Plasmonic Binary Arrays

Novel photonic devices provide the possibility of being more efficient, smaller and richer in their functionality. At the same time they are an excellent platform in the ongoing general study of nonlinear light propagation dynamics. Our work represents efforts in the study of photonic binary systems that are discrete in nature. Results will be presented on the existence and properties of localized modes and on the natural extension of the model to a continuum approximation leading to systems of coupled PDEs. this is a joint effort with Prof. C. De Angelis, Drs. A. Auditore and M. Conforti from U. Brescia in Italy

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MS27

Stochasticity and Coherent Structures in Ultra-Long Mode-Locked Lasers

Ultra-long mode-locked lasers are known to be strongly influenced by nonlinear interactions in long cavities that results in noise-like stochastic pulses. Here, by using an advanced technique of real-time measurements of both temporal and spatial (over round-trips) intensity evolution, we reveal an existence of wide range of generation regimes. Different kinds of coherent structures including dark and grey solitons and rogue-like bright coherent structures are observed as well as interaction between them are revealed.

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MS27

Movement of Gap Solitons across Deep Gratings in the Periodic NLS

Moving pulses in nonlinear periodic media can be applied, e.g., as information carriers in photonic crystals. We consider the 1D periodic nonlinear Schroedinger equation as a prototype model. For asymptotically small contrasts of the periodic structure the equation has moving pulses approximated by gap solitons of the coupled mode equations [Aceves, Wabnitz, Phys. Lett. A, 1989]. These gap solitons have a wide range of velocities $v \in (-c_g, c_g)$. We show that analogous moving pulses exist also in large contrast structures described by perturbed finite band potentials due to the opening of spectral gaps from a transversal intersection of band functions.

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MS27

Periodic and Relative Periodic Solutions in a Multiple Waveguide System

We describe the propagation of light in multi-waveguide systems modeled by the nonlinear Schrodinger and discrete nonlinear Schrodinger equations using normal form methods and other ideas from Hamiltonian systems. We report on new families of relative periodic orbits that coexist with the familiar nonlinear normal modes in these systems.

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MS28

Azimuthal Dissipative Structures in Whispering-Gallery Mode Resonators

Different regimes of Kerr optical frequency combs can be generated in ultra-high Q resonators pumped by a continuous wave laser. We use a 1-dimension Lugiato-Lefever equation to theoretically describe their dynamics. In particular, we show that these combs correspond to different spatio-temporal structures such as Turing patterns, bright and dark solitons. We discuss the parameter ranges for the generation of such combs, and relate them to our experimental results obtained in crystalline resonators.

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MS28

Injection Locking of Frequency Combs in Mode Locked Lasers

Injection locking of mode locked laser to an external pulse train entails the entrainment of two frequencies, the pulse to pulse timing and overall phase shift, synchronizing the source and target frequency combs. For a given injection strength, we demonstrate the domain of stable synchronization in the plane of comb spacing and offset mismatches. The shape of the synchronization domain depends on the pulse shape and chirp, and it is bounded by a line of saddle-node and higher co-dimension bifurcations.

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MS28

Dynamics of Frequency Comb Generation and Design of Planar Microring Resonators

We study the generation of optical frequency combs from microresonators and show that a truncated dynamical model can capture the essential nonlinear dynamics of both stable and chaotic patterns. We also present an analytical approach for obtaining linear and nonlinear design parameters of planar microring resonators. Closed form approximations for the eigenmode/eigenfrequency problem are derived for resonators possessing a large radius to width ratio and examples are presented for silicon microrings.

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MS28

Tunable Photonic Oscillators

Limit cycle oscillators are used to model a broad range of periodic nonlinear phenomena. Using the optically injected semiconductor oscillator as key Paradigm architecture we will demonstrate that at specific islands in the optical detuning and injection level map, the Period one limit frequency is simultaneously insensitive to multiple perturbation sources. In our system these include the temperature fluctuations experienced by the master and slave lasers as well as fluctuations in the bias current applied to the slave laser. Tuning of the oscillation frequency then depends only on the injected optical field amplitude. Experimental measurements are in good quantitative agreement with numerical modeling and analysis based on reduced generalized Adler phase equations. These special operating regions should prove valuable for developing ultrastable nonlinear oscillators, such as sharp linewidth, frequency tunable photonic microwave oscillators. Finally the concept of an Isochron originally developed in mathematical biology will be reviewed and placed on context for efficient design of stable frequency sources via systems of coupled limit cycles oscillators. Time permitting a few new theoretical results on injecting monothematic signals into quantum cascade laser gain media will be outlined.

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MS29

Transverse Dynamics of Periodic Gravity-Capillary Water Waves

We study the transverse dynamics of two-dimensional gravity-capillary periodic water waves in the case of critical surface tension. We show that, as solutions of the full water-wave equations, the periodic traveling waves are linearly unstable under three-dimensional perturbations which are periodic in the direction transverse to the direction of propagation. Then we discuss the nonlinear bifurcation problem near these transversely unstable two-dimensional periodic waves. We show that a one-parameter family of three-dimensional doubly periodic waves is generated in a dimension-breaking bifurcation.

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MS29

Stability of Viscous Roll-Waves

Roll-waves are a well observed hydrodynamic instability occurring in inclined thin film flow, mathematically described as periodic traveling wave solutions of the St. Venant system. In this talk, I will discuss recent progress concerning the stability of viscous roll-waves in a variety of asymptotic regimes, including near the onset of hydrodynamic instability and in the inviscid limit. Our analysis relies on Evans function calculations, geometric singular perturbation theory, Whitham theory, and spectral perturbation theory.

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MS29

Stability of Traveling Waves on Vortex Filaments

We develop a framework for studying the linear stability solutions of the Vortex Filament Equation (VFE), based on the correspondence between the VFE and the NLS provided by the Hasimoto map. This framework is applied to vortex filaments associated with periodic NLS solutions. We focus on a class of torus knots VFE solutions and show that they are stable only in the unknotted case. We also establish the spectral stability of soliton solutions.

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MS29

Orbital Stability of Periodic Waves and Black Solitons in the Cubic Defocusing NLS Equation

Standing periodic waves of the cubic defocusing NLS equation are considered. Using tools from integrability of the cubic NLS equation, these waves have been shown to be linearly stable by computing the Floquet–Bloch spectrum explicitly. We combine the first four conserved quantities of the cubic NLS equation to give a direct proof that the waves are also orbitally stable with respect to the subharmonic periodic perturbations in the $H^2_{\rm per}$ topology. We also develop a new proof of the orbital stability of the black solitons in $H^2(\mathbb{R})$. This is a joint work with Thierry Gallay (University of Grenoble).

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MS30

Shear-induced Instability of a Smectic A Liquid Crystal

A smectic A liquid crystal is usually described as being composed of rod-like molecules arranged in reasonably well-defined equidistance layers. Recent models describing the microscopic organisation of smectic A allow the average molecular orientation to evolve away from the layer normal direction, see for example I.W. Stewart, *Contin. Mech. Thermodyn.* **18**:343-360 (2007). In this presentation we will summarise this continuum theory and apply it to investigate the undulation instability of the smectic A phase in the presence of an imposed linear shear flow.

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MS30

Imry-Ma-Larkin Clusters in Random Nematics

Not Available at Time of Publication

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MS30

Harnessing Topological Defects via Liquid Crystal Microfluidics

Harnessing interactions between flow, and molecular ordering in complex anisotropic fluids like liquid crystals provides a novel pathway to engineer flow and topology templates. The interactions emerge due the anisotropic coupling between flow and molecular orientation. In microfluidic parlance, the nature of surface anchoring, channel aspect ratios, and strength of the flow provide a rich assortment of accessible experimental parameters. The emerging field of Topological Microfluidics promises physics and potential applications beyond the conventional isotropic case.

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MS30

Frustrated Nematic Order in Spherical Geometries

Not Available at Time of Publication

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MS31

Thermal Counterflow in a Periodic Channel with Solid Boundaries

We perform numerical simulations of finite temperature quantum turbulence produced through thermal counterflow in superfluid ^{4}He, using the vortex filament model. We investigate the effects of solid boundaries along one of the cartesian directions, whilst assuming a laminar normal fluid with a Poiseuille profile, whilst varying the temperature and the normal fluid velocity. We analyze the distribution of quantized vortices as a function of the wall-normal direction and find that the vortex line density is concentrated close to the solid boundaries. Furthermore, we find that the vortex line density profile is independent of the counterflow velocity, and offer an explanation as to why the peak of vortex line density tends towards the solid boundaries with increasing mutual friction. Finally we offer evidence that upon the transition to a turbulent normal fluid, there is a dramatic increase in the homogeneity of the tangle, which could be used as an indirect measure of the transition to turbulence in the normal fluid component in experiments.

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MS31

Vortex Reconnections and Implications for Inverse Energy Transfer in Turbulent Superfluid Helium

In superfluid helium vorticity takes the form of discrete vortex filaments of fixed circulation and atomic thickness. We present numerical evidence of three-dimensional inverse energy transfer from small length scales to large length scales in turbulence generated by a flow of vortex rings. We argue that the effect arises from the anisotropy of the flow, which favors vortex reconnections of vortex loops of the same polarity, and that it has been indirectly observed in the laboratory. The effect opens questions about analogies with related processes in ordinary turbulence.

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MS31

Breathers on Quantized Superfluid Vortices

We consider the propagation of breathers along quantised superfluid vortices. Using the correspondence between the local induction approximation (LIA) and the nonlinear Schrödinger equation, we identify a set of initial conditions corresponding to breather solutions of vortex motion governed by the LIA. These initial conditions, which give rise to a long-wavelength modulational instability, result in the emergence of large amplitude perturbations that are localised in both space and time. The emergent structures on the vortex filament are analogous to loop solitons. Although the breather solutions we study are exact solutions of the LIA equations, we demonstrate through full numerical simulations that their key emergent attributes carry over to vortex dynamics governed by the Biot-Savart law and to quantized vortices described by the Gross-Pitaevskii equation. In these cases, the breather excitations either decay or in some cases can lead to self-reconnections, a mechanism that can play an important role within the cross-over range of scales in superfluid turbulence. Moreover, the observation of breather solutions on vortices in a field model suggests that these solutions are expected to arise in a wide range of other physical contexts from classical vortices to cosmological strings.

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MS31

Local and Nonlocal Effects in Quantum Turbulence

Quantum turbulence consists of an apparently random tangle of quantised vortex lines which move under the influence of each others' velocity field. We ask the natural question of the relative importance of local and nonlocal effects on the turbulent velocity at a point, which is determined by the instantaneous distribution of vorticity via the Biot-Savart law. The answer is related to the existence of (or the lack of) coherent vortex structures in the turbulence tangle: the more random the vortex lines are, the more cancellation of far-field effects there will be. We shall present numerical results which address and answer this question.

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MS31

Reconnections of Vortex Rings in Superfluid Helium

Quantized vortex rings in superfluid helium provide an ideal model system for investigating the interactions and collisions occurring within a cloud of unidirectional vortex rings with almost identical radii. We present evidence for small vortex rings emitted upon vortex reconnections in superfluid 4He at very low temperatures. In one experiment, pairs of charged vortex rings collided resulting in creation of both smaller and larger vortex rings, highlighting how energy can be redistributed to both smaller and larger length scales. In a second experiment, small vortex rings with large mean free path were frequently generated when much larger vortex rings are injected into vortex tangles of known density. This only occurred at temperatures below 0.7 K where small wavelength Kelvin waves occur due to the lack of damping provided by mutual friction. All our observations can be explained using simple models based on vortex reconnections and self-reconnections and provide new insight into the quantum regime of superfluid turbulence.

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MS32

A Spectral Approach to Dbar Problems

We present a fully spectral approach to the numerical solution of dbar problems for smooth rapidly decreasing initial data. As an example we will discuss the Davey-Stewartson equations.

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MS32

The Semiclassical Sine-Gordon and Rational Solutions of Painlevé-II

We formulate and study a class of initial-value problem for the sine-Gordon equation in the semiclassical limit. The initial data parametrizes a curve in the phase portrait of the simple pendulum, and near points where the curve crosses the separatrix a double-scaling limit reveals a universal wave pattern constructed of superluminal kinks located in the space-time along the real graphs of all of the rational solutions of the inhomogeneous Painlevé-II equation. The kinks collide at the real poles, and there the solution is locally described in terms of certain double-kink exact solutions of sine-Gordon. This study naturally leads to the question of the large-degree asymptotics of the rational solutions of Painlevé-II themselves. In the time remaining we will describe recent results in this direction, including a formula for the boundary of the pole-free region, strong asymptotics valid also near poles, a weak limit formula, and planar and linear densities of complex and real poles. This is joint work with Robert Buckingham (Cincinnati).

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MS32

Numerical Inverse Scattering for the BenjaminOno Equation

We investigate the numerical implementation of the forward and inverse scattering transform for the BenjaminOno equation. Unlike previous numerical inverse scattering problems, the transform involves a nonlocal spectral problem, requiring new numerical techniques to be developed. Joint work with Peter Miller and Tom Trog-

don.

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MS32

Oscillatory Integrals and Integrable Systems

High oscillation is an important conservative phenomenon in the theory of integrable systems. For integrable PDEs, two competing forces are in balance. First, the flow regularizes and prevents the formation of discontinuities. Second, an infinite number of quantities are conserved. In the necessary absence of dissipation, oscillations must be responsible for regularization. These oscillations are seen to be a direct consequence of oscillatory Fourier symbols. Furthermore, properties of these symbols are used for detailed asymptotic and numerical studies of many problems. In this talk, I will discuss recent asymptotic and numerical progress on integrable PDEs that exploits the structure of oscillatory integrals.

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MS33

The Effect of Rotation on Shoaling Internal Solitary Waves

In the weakly nonlinear long wave regime, internal oceanic solitary waves are often modeled by the Korteweg-de Vries equation, which is well-known to support solitary waves. However, when the effect of background rotation is taken into account, the resulting relevant nonlinear wave equation is the Ostrovsky equation, which does not support an exact solitary wave solution. Instead an initial solitary-like disturbance decays into radiating oscillatory waves with the long-time outcome being the generation of a nonlinear wave packet, whose carrier wavenumber is determined by an extremum in the group velocity. When variable bottom topography is also taken into account, although this process may still take place, some new features emerge such as the formation of secondary undular bores.

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MS33

Breaking of Interfacial Waves Induced by Background Rotation

The amplitudes of vertical modes in weakly-nonlinear, weakly rotating, horizontally-extended stratified flows are governed by the reduced Ostrovsky (RO) equation where dispersion arises from a non-local integral term. This equation is integrable provided a certain curvature constraint is satisfied. We demonstrate, through theoretical analysis and numerical simulations, that when this curvature constraint is not satisfied at the initial time, then wave breaking inevitably occurs. Similar results are obtained for the modified (cubic) RO.

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MS33

Pure Gravity Generalised Solitary Waves

Steep waves travelling at a constant velocity at the surface of an incompressible and inviscid fluid of infinite depth are considered. The flow is assumed to be irrotational and gravity is taken into account. The effect of surface tension is neglected. It is shown that in addition to the classical periodic Stokes waves, there are also non periodic waves. These waves are generalised solitary waves in the sense that they are characterised by a periodic train of waves in the far field. Numerical evidence for the existence of new types of periodic waves is also presented.

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MS34

On the Existence of Breathers in Periodic Media: An Approach Via Inverse Spectral Theory

Breathers are considered a rare phenomenon for constant coefficient nonlinear wave equations. Recently, a nonlinear wave equation with spatially periodic step potentials has been found to support breathers by using a combination of spatial dynamics, center manifold reduction and bifurcation theory. Via inverse spectral theory for weighted Sturm-Liouville equations, we characterize a surprisingly large class of potentials that allow breathers. The research is motivated by the quest of using photonic crystals as optical storage.

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MS34

Reflection of an Incoming NLS Soliton by an Attractive Delta Potential

We consider the dynamics of a single soliton launched from spatial infinity with velocity v toward a delta-potential defect, evolving according to the 1D cubic NLS equation $i\partial_t u + \frac{1}{2}\partial_x^2 u + |u|^2 u - q\delta u = 0$, where $q \in \mathbb{R}$ is the coupling constant and δ is the delta function at $x = 0$. The case of $|q| \sim |v| \gg 1$ was previously studied and quantum splitting of the incoming soliton was observed and quantified. In the case of $|q| \ll 1$, the soliton was shown to remain intact and obey classical motion. In this paper, we study the case of intermediate interaction strength $|q| \sim 1$, and slow incoming velocity $|v| \ll 1$. We show that this is neither a classical nor quantum regime – a small eigenstate emerges on top of the delta potential with phase structure incompatible with the incoming soliton, resulting in reflection of the incoming soliton. Interestingly, this occurs even for *attractive* potentials $q \sim -1$.

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MS34

Analysis of Dispersion Managed Solitary Waves

We study pulses in optical glass fiber cables which have a periodically varying dispersion along the cable. This so-called dispersion management leads to interesting effects in those cables. Mathematically, these pulses are described by a non-local version of the non-linear Schrödinger equation which was derived first by Gabitov and Turitsyn (1996), and and later by Ablowitz and Biondini (1998). The non-local nature of the non-linearity makes the rigorous analysis hard. In the talk, we will focus on existence of solitary pulses in these cables and show that they are very well-localized.

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MS34

Ground States of a Nonlinear Curl-Curl Problem

In this talk I will report on recent joint work with Thomas Bartsch, Tomas Dohnal and Michael Plum. We are interested in ground states for the nonlinear curl-curl equation

$$\nabla\times\nabla\times U+V(x)U=\Gamma(x)|U|^{p-1}U \text{ in } \mathbb{R}^3, \quad U:\mathbb{R}^3\to\mathbb{R}^3.$$

A basic requirement is to find scenarios, where 0 does not belong to the spectrum of the operator

$$\mathcal{L}=\nabla\times\nabla\times+V(x).$$

Under suitable assumptions on V,Γ we construct ground states both for the defocusing case ($\Gamma\leq 0$) and the focusing case ($\Gamma\geq 0$). The main tools are variational methods and the use of symmetries.

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MS35

Novel Phenomena in WGM Resonators with Vertical Evanescent Coupling to Bus Waveguides

We will report on novel optical phenomena which manifest in a vertically coupled Whispering-gallery resonator and a dielectric waveguide. In particular, theoretical predictions of (a) the oscillatory vertical coupling, characterized by multiple critical coupling conditions at different gaps, and (b) the non-diagonal analogue of the Lamb shift for classical photons will be presented. Supporting experimental observations of these novel optical phenomena confirm the unique characteristics of the evanescent vertical coupling in an integrated photonic platform.

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MS35

Terabit Communications Using Optical Frequency Combs

Terabit/s optical interconnects rely on advanced wavelength-division multiplexing (WDM) schemes, where information is transmitted by a multitude optical channels of different wavelengths. In this context, frequency combs are a particularly attractive option for generating the associated optical carriers. In this paper, we give an overview on our recent demonstrations of terabit/s communications using optical frequency combs. Our experiments exploit different comb generation schemes relying, e.g., on electro-optic modulation and on Kerr-nonlinear interaction in high-Q microcavities.

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MS35

Noise of Frequency Combs Based on Yb Fiber Lasers with Self-Similar Pulse Evolution

Measurements of the free running carrier envelope offset frequency linewidth of a similariton based optical frequency comb show that the frequency noise of the laser is independent of net cavity dispersion. The experimental results are consistent with simulations of the quantum-limited timing noise. The resultant possibilities for low-noise, high-performance fiber sources will be discussed.

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MS35

Stability of Modelocked Lasers With Slow Saturable Absorbers

Lasers that are modelocked with semiconductor saturable absorbers are of great practical interest because they can be more environmentally stable than other modelocked lasers. However, the slow saturable absorber opens a gain window that can lead to instability in the wake of modelocked soliton pulse. In this paper, we characterize the spectrum of this instability and its evolution.

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MS36

Stability of Solitary Waves in Nonlinear Dirac

Equation

We study the linear instability of solitary wave solutions $\phi(x)e^{-i\omega t}$ to the nonlinear Dirac equation. That is, we linearize the equation at a solitary wave and examine the presence of eigenvalues with positive real part. We describe recent analytic and numerical results. In particular, we show that small amplitude solitary waves in the Soler model are linearly unstable in three spatial dimensions, but are generically stable in one dimension. We use the limiting absorption principle and the Carleman-type estimates of Berthier–Georgescu to locate the part of the continuous spectrum of the linearized system, from which point eigenvalues can bifurcate (leading to linear instability). We also show that the border of the linear instability region is described not only by the Vakhitov-Kolokolov condition $Q'(\omega) = 0$, obtained in the NLS context, but also by the energy vanishing condition, $E(\omega) = 0$. Here E, Q are the energy and the charge of a solitary wave with frequency ω. Some of the results are obtained in collaboration with Nabile Boussaid, Université de Franche-Comté, David Stuart, University of Cambridge, Stephen Gustafson, University of British Columbia, Gregory Berkolaiko and Alim Sukhtayev, Texas A&M University.

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MS36

Approximation of Traveling Waves on Finite Intervals

Usually, traveling waves are not a meaningfull object for partial differential equations posed on finite intervals. But by using the method of freezing, proposed by Beyn and Thümmler in 2004, one is able to calculate a suitable co-moving frame on the fly so that in this new system a stable traveling wave of the original system becomes a stable standing wave in the new system. More precisely, in the method of freezing one rewrites the original problem as a partial differential algebraic equation that includes the velocity of a suitable co-moving frame as an additional unknown. For this new system it does make sense to restrict to a finite interval. To obtain a well-posed problem, one then has to impose artificial boundary conditions. We consider this procedure in the case of semilinear hyperbolic problems and show how the new system on a finite interval approximates the original problem and can be used in numerical computations.

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MS36

Concatenated Traveling Waves

We consider concatenated traveling wave solutions of reaction-diffusion systems. These are solutions that look like a sequence of traveling waves with increasing velocity, with the right state of each wave equal to the left state of the next. I will present an approach to the stability theory of such solutions that does not rely on treating them as a sum of traveling waves. It is based instead on exponential dichotomies and Laplace transform.

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MS36

Stability of Traveling Standing Waves for the Klein-Gordon Equation

For the Klein-Gordon equation, the stability of the traveling standing waves is considered and the exact ranges of the wave speeds and the frequencies needed for stability are derived. This is done in both the whole line case and the periodic case.

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MS37

Two Component Condensates: Spin Orbit Coupling and Defects

Two component condensates emerge from the physics of artificial gauge potentials and can describe a single isotope in two different hyperfine spin states, two different isotopes of the same atom or isotopes of two different atoms. I will describe both numerical and theoretical results concerning spin orbit coupled two component condensates. I will explain how some segregation cases can be analyzed through a Gamma limit leading to a phase separation problem of de Giorgi type. In the coexistence cases, we try to obtain an asymptotic expansion of the energy taking into account the various types of defects. The first term in the expansion is related to the Thomas Fermi limit of the profile and relies on singular perturbation techniques, while the next ones require a more precise analysis of the defects: vortex sheets, vortices or skyrmions

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MS37

Convergence to an Equilibrium for Wave Maps on a Curved Manifold

We consider equivariant wave maps from a wormhole-type spacetime into the three-sphere. This is a toy-model for gaining insight into the dissipation-by-dispersion phenomena, in particular the soliton resolution conjecture. Using the hyperboloidal formulation of the initial value problem, we show that, for a given topological degree of the map, all solutions starting from smooth initial data converge to the unique stationary solution as time goes to infinity. The asymptotics of this relaxation process is described in detail.

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MS37

A Gradient Flow Approach to the Keller-Segel Systems

Not Available at Time of Publication

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MS37

Vortices and Vortex Lattices in the Ginzburg-Landau and Bcs Theories

The Ginzburg-Landau theory gives a fairly good macroscopic description of superconductors and the effect of magnetic fields on them. This theory is based on the Ginzburg-Landau equations, a pair of coupled nonlinear equations for the macroscopic wave function (order parameter) and magnetic potential. (These equations appear also in abelean Higgs model with unknowns called the Higgs and gauge fields and, in general, serve as a paradigm for the description of a large class of phenomena in physics, material science and biology.) In this talk I will review recent rigorous results on the key solutions of these equations - the magnetic vortices and magnetic vortex lattices, their existence and stability. I will also discuss relation of the Ginzburg-Landau theory to the microscopic BCS theories and the description of vortices and vortex lattices in the latter.

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MS38

Stability of Periodic Traveling Waves for Nonlocal Dispersive PDE

We discuss recent work on the stability of periodic traveling wave solutions to nonlinear PDE of KdV-type, allowing for nonlocal phase speeds. Specific examples include fractional KdV with phase speed $|\xi|^\alpha$ for some $\alpha > 1/2$, and Whitham's water wave equation with the exact (unidirectional) phase speed from the Euler equations. We demonstrate the existence of an explicit stability index, computable entirely from the linear phase speed, which determines the modulational stability of small amplitude waves.

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MS38

Dispersive Perturbations of Burgers and Hyperbolic Equations

The aim of this talk is to show how a weakly dispersive perturbation of the inviscid Burgers equation improve (enlarge) the space of resolution of the local Cauchy problem. We will also review several problems arising from weak dispersive perturbations of nonlinear hyperbolic equations or systems.

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MS38

Local Well-posedness for a Class of Nonlocal Evolution Equations of Whitham Type

For a class of pseudodifferential evolution equations of the form

$$u_t + (n(u) + Lu)_x = 0,$$

we prove local well-posedness for initial data in the Sobolev space H^s, $s > 3/2$. Here L is a linear Fourier multiplier with a real, even and bounded symbol m, and n is a real measurable function with $n'' \in H^s_{\text{loc}}(\mathbb{R})$, $s > 3/2$. The proof, which combines Kato's approach to quasilinear equations with recent results for Nemytskii operators on general function spaces, applies equally well to the Cauchy problem on the line, and to the initial-value problem with periodic boundary conditions.

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MS38

Three-Dimensional Solitary Water Waves with Weak Surface Tension

I will discuss a variational existence theory for three-dimensional fully localised solitary water waves with weak surface tension. The water is modelled as a perfect fluid of finite depth, undergoing irrotational flow. The surface tension is assumed to be weak in the sense that $0 < \beta < 1/3$, where β is the Bond number. A fully localised solitary wave is a travelling wave which decays to the undisturbed state of the water in every horizontal direction. Such solutions are constructed by minimising a certain nonlocal functional on its natural constraint. A key ingredient is a variational reduction method, which reduces the problem to a perturbation of the Davey-Stewartson equation.

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MS39

Anatomy Induced Drift of Spiral Waves in Human Atrium

In biophysically and anatomically realistic model of human atrium, we demonstrate functional effects of atrial anatomical structures on spiral waves spontaneous drift. Spiral

waves drift from thicker to thinner regions, along ridge-like structures of pectinate muscules (PM) and cristae terminalis, anchor to PM-atrial wall junctions or to some locations with no obvious anatomical features. The insight can be used to improve low-voltage de-fibrillation protocols, and predict atrial arrhythmia evolution given a patient specific atrial anatomy.

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MS39

Exact Coherent Structures and Dynamics of Cardiac Tissue

High dimensional spatiotemporal chaos underpins the dynamics associated with life threatening cardiac arrhythmias. Our research seeks to suppress these arrhythmias and restore normal heart rhythms by using low-energy transfers between unstable solutions underlying the chaotic dynamics of cardiac tissue. We describe the search for unstable solutions of nonlinear reaction diffusion models of cardiac tissue and discuss recent efforts to understand local symmetries in terms of pairwise interactions between spiral cores.

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MS39

Optogenetic Control of Cardiac Electrical Activity: Experimental Insights

Optogenetics, in the broader sense, refers to the use of genetically-encoded molecules serving as optical actuators or optical sensors for the active interrogation and imaging of biological processes and systems with high specificity and high spatiotemporal resolution. We will report the application of these genetic tools to cardiac tissue and will demonstrate all-optical remote actuation and sensing to study wave propagation and termination by light.

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MS39

Spatiotemporal Dynamics of Obstacle-Induced Spiral Wave Initiation

Inexcitable obstacles in the heart can act as substrates for the initiation of spiral waves. We introduced obstacles of varying sizes (1-8 mm) into cardiac monolayers with side pacemakers, demonstrating that smaller obstacles (<5 mm) are correlated with spiral wave generation. Using a computational model of the experiments, we showed that the location of the obstacle sensitively governed the spatiotemporal dynamics of the initiated spiral waves.

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MS40

Large-degree Asymptotics of Generalised Hermite Polynomials and Poles of Rational Painlevé-IV Functions

The Painlevé-IV equation admits a family of rational solutions, indexed by two integers, that can be expressed in terms of certain generalised Hermite polynomials. In the large-degree limit the zeros of these polynomials form remarkable patterns in the complex plane resembling rectangles with arbitrary aspect ratios depending on how the indexing integers grow. Using Riemann-Hilbert analysis we compute the large-degree asymptotic behavior of the generalised Hermite polynomials and analytically determine the boundary of the elliptic (i.e. zero/pole) region for the associated rational Painlevé-IV functions. We also obtain asymptotic behavior in terms of Painlevé-I functions at the corners of the elliptic region.

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MS40

Inverse Scattering Transform for the Defocusing Nonlinear Schrödinger Equation with Asymmetric Nonzero Boundary Conditions

We develop the inverse scattering transform (IST) for the defocusing nonlinear Schrödinger (NLS) equation with asymmetric nonzero boundary conditions $q(x, 0) \to q_\pm$ as $x \to \pm\infty$, where $|q_-| \neq |q_+|$. The direct problem is formulated without using a uniformization variable, taking into account the square root discontinuities of the eigenvalues of the asymptotic scattering problems. The inverse problem is formulated in terms of a discontinuous Riemann-Hilbert problem (RHP).

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MS40

On the Scattering Matrix for AKNS Systems with Matrix-Valued Potentials

We discuss spectral properties and analytic properties of the scattering matrix associated with matrix AKNS systems under suitable assumptions on the potentials. Special attention will be paid to spectral singularities and embedded eigenvalues. We present results on the analytic behavior of the scattering matrix near such points and study how the spectrum changes if the system is perturbed.

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MS40

Inverse Scattering Transform for the Focusing NLS Equation with Fully Asymmetric Boundary Conditions

We present the inverse scattering transform (IST) for the focusing nonlinear Schrödinger equation: $iq_t = q_{xx}+2|q|^2q$, with non-zero boundary conditions $q(x,t) \sim q_{l/r}(t) = A_{l/r}e^{i\theta_{l/r}(t)}$ as $x \to \mp\infty$ in the fully asymmetric case. The direct problem is shown to be well-posed for NLS solutions $q(x,t)$ such that $q(x,t) - q_{l/r}(t) \in L^{1,1}(\mathbb{R}^{\mp})$ with respect to x for all $t \geq 0$, for which analyticity properties of eigenfunctions and scattering data are established. The inverse scattering problem is formulated both via (left and right) Marchenko integral equations, and as a Riemann-Hilbert problem on a single sheet of the scattering variables $\lambda_{l/r} = \sqrt{k^2 + A_{l/r}^2}$, where k is the usual complex scattering parameter in the IST. The time evolution of the scattering coefficients is then derived, showing that, unlike the case of solutions with the same amplitude as $x \to \pm\infty$, here both reflection and transmission coefficients have a nontrivial time dependence.

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MS41

Tropical-Extratropical Wave Interactions in a Moist 2-Layer Model

The coupling between moist convective processes and large-scale circulation is at the core of tropical-extratropical atmospheric interactions, which, in turn, are known to strongly modulate rainfall at low latitudes. For example, within the tropical Eastern Pacific, observations suggest that poleward transport of moisture and energy is particularly dependent upon intrusion of large-scale transient Rossby waves from the extratropics towards the equator, particularly during northern winter. Theories for the relationship between low latitude moist convection and extratropical waves have emphasized the role of upper level potential vorticity (PV) intrusions associated with Rossby wave breaking. In this talk, two major drawbacks of this approach are discussed: the limitations of PV inversion at low latitudes and the neglect of latent heating feedbacks. To address these limitations, an alternative reduced model is proposed that is based on a barotropic-baroclinic shallow water system coupled to a water vapor equation. The water vapor equation is coupled to the dynamical variables through a simple parametrization for precipitation, allowing for a two-way feedback between precipitation and waves. This model is used to investigate modulations of equatorial rainfall, in particular, the relative roles of zonal moisture transport by tropical waves and meridional moisture advection by extratropical waves. By integrating the model using initial conditions consistent with the northern winter basic state, we demonstrate the key role of advection of moisture towards the equator due to extratropical Rossby waves. The transient response and tropical rainfall sensitivity to precipitation parametrization and extratropical wave amplitude and scales are discussed, as well as the model predictions overall agreement with observations and more complex models.

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MS41

Pilot Wave Dynamics in a Rotating Frame: Orbital Quantization and Multimodal Statistics

We present the results of a theoretical investigation of droplets walking on a rotating vibrating fluid bath. The droplet's trajectory is described in terms of an integro-differential equation that incorporates the influence of its propulsive wave force. Predictions for the dependence of the orbital radius on the bath's rotation rate compare favorably with experimental data and capture the progression from continuous to quantized orbits as the vibrational acceleration is increased. The orbital quantization is rationalized by assessing the stability of the orbital solutions, and may be understood as resulting directly from the dynamic constraint imposed on the drop by its monochromatic guiding wave. The stability analysis also predicts the existence of wobbling orbital states reported in recent experiments, and the virtual absence of stable orbits in the limit of large vibrational forcing. The droplet's trajectory is numerically simulated in this limit, revealing a chaotic dynamics whose statistical properties reflect the persistent influence of the unstable orbital solutions.

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MS41

Nonlinear Wave Interactions in Global Nonhydrostatic Models

In previous works we have analyzed the nonlinear wave interactions in a shallow global non-hydrostatic model. Here this analysis has been extended for the case where the full Coriolis force terms are considered. The full Corilis force terms include those proportional to $2\Omega cos\Phi w$ and $2\Omega cos\Phi u$ in the zonal and vertical momentum equations, respectively, which are disregarded in hydrostatic models for energetics consistence. For simplicity we have considered the mid-latitude beta-plane approximation.

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MS41

The Influence of Fast Waves and Fluctuations on the Evolution Three Slow Limits of the Boussinesq Equations

We present results from a study of the impact of the non-slow (typically fast) components of a rotating, stratified flow on its slow dynamics. In order to understand how the flow approaches and interacts with the slow dynamics we decompose the full solution, where $\mathbf{u}$ is a vector of all the unknowns, as $\mathbf{u} = \mathbf{u}^{\alpha} + \mathbf{u}'_{\alpha}$where α represents the $Ro \to 0$, $Fr \to 0$ or the simultaneous limit of both (QG for quasi-geostrophy), with $P_{\alpha}\mathbf{u}^{\alpha} = \mathbf{u}^{\alpha}$, $P_{\alpha}\mathbf{u}'_{\alpha} = 0$, and where $P_{\alpha}\mathbf{u}$ represents the projection of the full solution onto the null space of the fast operator. Numerical simulations indicate that for the geometry considered (triply periodic) and the type of forcing applied, the fast waves act as a conduit, moving energy onto or off of the slow 'manifold'.

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MS42

Minimizing the NLS Energy on General Graphs

We treat the problem of finding the ground state for a system driven by the Nonlinear Schroedinger Equation and evolving on a ramified structure (graph). We prove two results: first, if the graph is made of at least two half lines meeting in an arbitrary compact graph, then there is non minimizer. Second, if the graph is a star graph with two infinite edges and a finite one, then there exists a minimizer, whose shape can be quite explicitly decsribed.

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MS42

Micro/macroscopic Models for Fluid Flow in Networks of Elastic Tubes

We describe a Boussinesq-type system for modeling the dynamics of pressure-flow in arterial networks, considered as a 1d spatial network of elastic tubes. Numerical solutions of the system of PDEs are compared with simplified microscopic models based on particle-tracking arguments, and are used to study flow optimization task, depending on the geometry and size of the network. Physiologically realistic control mechanisms are tested in the context of these simplified models.

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MS42

Solution Formulas for the Linearized KdV Equation on Graphs

We investigated linearized KdV equation on metric star graphs with at least three semi-infinite bonds. Under some assumption on the coefficients of the vertex conditions uniqueness of solution are proven. It is known that theory of potentials for linearized KdV equation are well studied. Using this theory we reduced the considered problem to the equivalent system of linear algebraic equations. It is shown that the obtained system of equations is uniquely solvable under conditions of the uniqueness theorem. By using of derived formulas for the solutions we proved the existence theorems in the classes of Schwartz functions decreasing at infinity and in Sobolev classes.

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MS42

The NLS on Fat Graphs and the Metric Graph Limit

The description of the propagation of waves through networks is often based on metric graphs, consisting of 1D bonds joined at vertices. However, real waveguides are not 1D, and networks are not constructed of 1D bonds connected at 0D vertices, but rather the bonds and the vertex regions have a certain thickness ϵ. These structures are often refered as “fat graphs’. Here we compare numerical solutions of Nonlinear Schrödinger equations (NLS) on fat graphs with solutions of the formally derived NLS on the metric graph, in the limit $\epsilon \to 0$. In particular, we show that an interesting transmission formula for the metric graph limit lifts to the fat graph with small errors.

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MS43

One $\mathcal{AC}$ and Two $\mathcal{PT}$ Nonlinear Schrödinger Dimers

We compare nonlinear dynamics and phase space geometry of the standard $\mathcal{PT}$-symmetric nonlinear Schrödinger dimer to those of its two modifications. One observation is that the addition of the nonlinear coupling softens the $\mathcal{PT}$-symmetry breaking transition in the standard dimer: stable periodic and quasiperiodic states persist for any value of the gain-loss coefficient. Another result is that the introduction of active coupling ($\mathcal{AC}$) changes the nonlinearity from the promotor to a suppressor of blowup regimes.

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MS43

Coupled PT-Symmetric Systems

Inspired by recent experiments on a PT-symmetric system of coupled optical whispering galleries, we study a model of two coupled oscillators with loss and gain. There are two PT transitions: PT symmetry is broken for small and very large coupling, but unbroken for intermediate coupling. The classical and the quantized systems transition at the same couplings. An oscillating charged particle backreacting with its own electromagnetic field is also a PT-symmetric system.

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MS43

Linear and Nonlinear Properties of PT-symmetric Optical Systems

Not Available at Time of Publication

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MS43

New Aspects of Nonlinear PT-Symmetric Plaquettes

Nonlinear Schrödinger equations for PT-symmetric plaquette type setups are used as toy models for investigations of general geometric structures connected with the bifurcation dynamics in the vicinity of PT phase transition points. The presentation extends earlier results obtained in collaboration with Panayotis Kevrekidis, Boris Malomed and Kai Li in (J. Phys. A 45, 444021 (2012)).

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MS43

Pt-Symmetric Synthetic Materials

In this talk we will introduce a new class of optical structures that rely on the recently developed notion of parity-time (PT) symmetry. These PT synthetic materials can exhibit a number of unique characteristics provided that the optical processes of gain, loss, and index guiding are judiciously designed. In particular, we examine the scattering properties of PT-symmetric optical Fabry-Perot cavities. Multiple phase transitions and unidirectional invisibility for both polarizations are systematically examined.

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MS44

Evans Function Analysis of Viscous Multidimensional Shock Layers

We give an overview of our recent work on the stability of multidimensional shock layers in multi-dimensional compressible fluid flow, in particular the Navier-Stokes equations. Our work involves a careful combination of asymptotic ODE and Evans function methods. We discuss the substantial challenges observed when computing the Evans function in Eulerian coordinates at high frequencies. We show how to overcome these problems by transforming into canonical and somewhat general coordinates. The results are surprising.

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MS44

Computing the Refined Stability Condition for Shock Waves

The classical (inviscid) stability analysis of shock waves is based on the Lopatinskiĭ determinant, Δ—a function of frequencies whose zeros determine the stability of the underlying shock. A careful analysis of Δ shows that in some cases the stable and unstable regions of parameter space are separated by an open set of parameters. Zumbrun and Serre [*Indiana Univ. Math. J.*, **48** (1999) 937–992] have shown that, by taking account of viscous effects not present in the definition of Δ, it is possible to determine the precise location in the open, neutral set of parameter space at which stability is lost. In particular, they show that the transition to instability under suitably localized perturbations is determined by an "effective viscosity' coefficient given in terms of the second derivative of the associated Evans function, the viscous analogue of Δ. Here, we describe the practical computation of this coefficient.

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MS44

Linear and Spectral Stability of Solitary Gravity Waves

The talk will discuss linear and spectral stability of two-dimensional solitary waves on water of finite depth. It is assumed that the fluid is bounded by a free surface and a rigid horizontal bottom. The solitary wave is moving under the gravity (no surface tension). It was known that the fully nonlinear Euler equations have a solitary-wave solution. In this talk, we will show that the linear operator arising from linearizing the Euler equations around the solitary-wave solution has no spectrum points lying on the right half of the complex plane, which implies the spectral stability of the solitary waves. Moreover, under the norm with exponential weight, the solitary waves are linearly stable. (This is a joint work with R. Pego)

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MS44

The Evolution of Traveling Waves in a Simple Isothermal Chemical System

We study a reaction-diffusion system for an isothermal chemical reaction scheme governed by a quadratic autocatalytic step and a decay step. Note that this system does not enjoy the comparison principle. Previous numerical studies and experimental evidences demonstrate that if the autocatalyst is introduced locally into this autocatalytic reaction system where the reactant initially distributes uniformly in the whole space, then a pair of waves will be generated and will propagate outwards from the initial reaction zone. We will analytically study this phenomena.

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MS45

Regularity and Stability of Landau-Lifshitz Flows

The Landau-Lifshitz equations of ferromagnetism are geometric PDE for maps into the 2-sphere, which include as special cases the harmonic map heat flow and the Schroedinger flow. While flows of topological degree 1 which form singularities are known, we present results showing that symmetric flows of higher degree, even with large energy, remain regular, and flow toward harmonic maps.

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MS45

Dynamics of Bec of Fermion Pairs in the Low Density Limit of Bcs Theory

We show that the time-evolution of the wave function describing the macroscopic variations of the pair density in BCS theory can be approximated, in the dilute limit, by a time-dependent Gross-Pitaevskii equation. For the static case we can as well include direct and exchange energies in order to obtain a similar result.

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MS46

Dissipation and Dispersion in Shallow Water

In a series of physical experiments of surface water waves, dissipation and dispersion appear to play important roles in the evolution of waves of depression. This suggests that the (conservative, nondispersive) shallow-water wave equations miss some important features of the evolution. In this talk we compare measurements from a series of shallow-water experiments with numerical simulations of dispersive and dissipative shallow-water wave models.

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MS46

Stability of Solitary Waves for the Doubly Dispersive Nonlinear Wave Equation

The general class of nonlocal nonlinear wave equations

$u_{tt} - Lu_{xx} = B(g(u))_{xx}$ involves two sources of dispersion, characterized by two pseudo-differential operators L and B. Erbay, Erbay and Erkip (2014) established thresholds for global existence versus blow-up in the case of power-type nonlinearities. In a recent study of Erbay, Erbay and Erkip (submitted), the existence and stability/instability properties of solitary waves for the above class of nonlocal nonlinear wave equations have been established using the concentration-compactness method of Lions. In this talk, we consider the double-dispersion equation with power-type nonlinearities, which is a member of the above class, and discuss recent analytical and numerical results on the stability interval of solitary waves.

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MS46

Pseudodifferential Operators on a Half-line and the Riemann-Hilbert Problem

Consider the initial-boundary value problem on a half-line for the evolution equation

$$\partial_t u + F(D)\, u = f(x,t), t > 0,\ x > 0,$$

where $F(D) = \sum_1^{m_1} c_k \partial_x^k + \sum_1^{m_2} b_k \partial_x^{\beta_k} + \sum_1^{m_3} a_k |\partial_x|^{\alpha_k}$ is a linear combination of the usual derivative ∂_x, the Caputo derivative ∂_x^β and the module-fractional derivative $|\partial_x|^\alpha$ on half-line, α_k, $\beta_k \in R$, k is integer. Here $|\partial_x|^\alpha$ is a module-fractional derivative

$$|\partial_x|^\alpha u = \mathcal{R}^{1-\alpha+[\alpha]} \partial_x^{[\alpha]+1} u,$$

where

$$\mathcal{R}^\alpha u = \int_0^{+\infty} \frac{sign(x-y)u(y)}{|x-y|^{1-\alpha}} dy$$

is the modified Riesz potential. The fractional Caputo derivative ∂_x^β is defined as

$$\partial_x^\beta u = \mathcal{I}^{1-\beta+[\beta]} \partial_x^{[\beta]+1} u,$$

where

$$\mathcal{I}^\beta u = \int_0^x \frac{u(y)}{(x-y)^{1-\beta}} dy$$

is Riemann-Liouville fractional derivative. We prove the existence and the uniquness of the solution. We propose a new method to construct solutions to the initial-boundary value problem. These results could be applied to the study of a wide class of nonlinear nonlocal equations on half-line by using the techniques of nonlinear analysis. We give some examples: nonlinear Schrodinger equation, Benjamin-Ono equation, intermediate long wave equation, and nonlinear Klein-Gordon equation.

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MS46

A Numerical Method for Computing Traveling Waves of Nonlinear Dispersive Equations

We present an automated Python-powered solver for nonlinear nonlocal wave equations such as the Whitham equation, KdV, Benjamin-Ono and alike. The solver is based on the cosine collocation method. A user supplies the programme with a nonlinear flux, linear dispersion operator and some parametres. Given that the input satisfies required conditions, a traveling-wave solution is computed and tested with an evolution integrator. Dynamic simulation results are provided for the Whitham and square-root Whitham equations.

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MS47

Measuring Scroll Filament Rigidity

Spherical glass beads can pin three-dimensional scroll waves in the Belousov-Zhabotinsky reaction. Three pinning sites cause initially circular scroll filaments to approach equilateral triangles. The resulting stationary shapes show convex deviations that increase with anchor radii. We describe the shapes of the filament segments analytically using an asymptotic theory, that takes into account filament tension and rigidity. Fitting the theoretical shapes to experimental data, with knowledge of filament tension, allows experimental measurement of filament rigidity.

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MS47

Effective Dynamics of Twisted and Curved Scroll Waves Using Virtual Filaments

Scroll waves are three-dimensional excitation patterns that rotate around a central filament curve. Starting from the reaction-diffusion equations, I will show that the detailed, instantaneous equations of filament motion heavily depend on the scroll wave's rotation phase. However, by filtering out epicycle motion we obtain simpler dynamics for a previously unseen companion of the classical filament, which we call the 'virtual filament'. [See H. Dierckx and H. Verschelde, Phys. Rev. E 88 0629072013 or arXiv:1311.2782.]

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MS47

Dynamics of Spiral Cores: the Effect of Boundaries and Heterogeneities

While reaction-diffusion PDEs used to model cardiac tissue respect continuous translational and rotational symmetries, the cardiac tissue and the spatially discretized numerical models based on these PDEs do not. The dynamics are modified due to both boundary conditions and heterogeneities associated, for instance, with the cellular structure of the tissue or the computational mesh. This talk will discuss the effect of such heterogeneities on the dynamics of stable and unstable spiral wave solutions.

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MS47

Spiral Pinballs

Macroscopic systems exhibiting both wave-like and particle-like properties have received much attention in recent years. One case is excitable media, for which spiral waves have core regions that behave like particles. Under resonant stimulation, spiral cores drift in straight lines and may reflect from boundaries in interesting ways. In this talk, the 'pinball' dynamics of these reflections are studied, via numerical simulations and asymptotic theory.

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MS47

Kinematic Theory of Spirals and Wave Segments

Spiral waves and wave segments represent typical examples of self-organized patterns observed in excitable media. We demonstrate that at least two dimensionless mediums parameters should be measured to predict the spatio-temporal characteristics of these patterns. The findings should be applicable to a wide class of media due to the generality of the free boundary approach used. The predictions of this approach are in good quantitative agreement with the results from numerical reaction-diffusion simulations.

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MS48

Surface Waves in Graded Index Meta-materials

We have studied the properties of electromagnetic surface waves in graded index meta-materials. It is known that in transient layers, where index of refraction changes sign, these surface waves are associated with field enhancement which leads to the anomalous absorption. We have studied the nonlinear parametric processes due to such field enhancement in case of non collinear incident fields.

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MS48

Models for Laser-Driven Generation of THz Radiation

We discuss the generation of THz radiation by two-color ultrashort optical pulses interacting in a nonlinear medium. Photocurrents driven by tunnel ionization in gases are shown to be responsible for the emission of broadband THz pulses with field amplitude above the GV/m level. Associated spectra, which can be evaluated semi-analytically, result from constructive interferences of discrete plasma radiation bursts occurring at the field maxima. Technological solutions for optimizing THz emission and links with plasma physics are addressed.

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MS48

Channel Capacity and Nonlinear Fourier Transform in Coherent Fibre-Optic Communications

I will overview recent progress in studies of the Shannon capacity of nonlinear fibre channels and new opportunities offered by resurrection of the idea of eigenvalue communications in the new context of non-soliton coherent communications. Application of the well-known nonlinear analogue of the Fourier transform to digital signal processing in coherent optical transmission leads to radically novel approaches to coding, transmission and processing of information using specific nonlinear properties of the optical

fibre communication channel.

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MS48

Nondecaying Solutions of KdV Equation

We develop the algebraic procedure that makes possible to construct the exact bounded but not vanishing at infinity solutions of integrable nonlinear systems. Multizone solutions of the KdV equation are used as a test bed for the method.

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MS49

Modulation Equations for Interacting Localized Structures

Employing modulation equations for the approximate description of nonlinear waves is a widespread technique which allows to reduce the analysis of complicated systems to universal models such as the KdV or the NLS equation. Recently, the interaction of localized structures was analyzed by deriving a set of modulation equations giving a separate description of internal and interaction dynamics. We briefly review the procedure for PDEs and display the full analysis for a polyatomic FPU system.

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MS49

Spatially Periodic Patterns, Busse Balloons, and the Hopf Dance

The Busse balloon is the region in (wavenumber, parameter)-space for which stable spatially periodic patterns exist. In the class of singularly perturbed reaction-diffusion systems, the Busse balloon typically has a non-smooth edge where it borders on a family of homoclinic patterns. Near this edge, the boundary of the Busse balloon has a fine-structure of intertwining curves that represent various kinds of Hopf bifucations – as will be explained and discussed in this talk.

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MS49

Coherent Structures in a Population Model for Mussel-Algae Interaction

We consider a model that describes the interaction of mussel biomass with algae in the water layer overlying the mussel bed. The model consists of a system of two coupled pdes where both the diffusion and the advection matrices in are singular. We use the Geometric Singular Perturbation Theory to capture nonlinear mechanisms of pattern and wave formation in this system.

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MS49

Pattern Formation in a Class of Landau-Lifschitz-Gilbert-Slonczewski Equations for Spintronic Devices

The Landau-Lifshitz-Gilbert-Slonczewski equation describes magnetization dynamics in the presence of an applied ?eld and a spin polarized current. In the case of axial symmetry and with focus on one space dimension, we investigate the emergence of space- time patterns in the form of coherent structures, whose pro?les asymptote to wavetrains. In particular, we give a complete existence and stability analysis of wavetrains and prove existence of various coherent structures, including soliton- and domain wall-type solutions. Decisive for the solution structure is the size of anisotropy compared with the di?erence of ?eld intensity and current intensity normalized by the damping. This is joint work with Christof Melcher (RWTH).

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MS50

Dimension-Breaking Phenomena for Solitary Gravity-Capillary Water Waves

The water-wave problem has small-amplitude line solitary-wave solutions which to leading order are described by the Korteweg-deVries equation (for strong surface tension) or nonlinear Schrödinger equation (for weak surface tension). We present an existence theory for three-dimensional *periodically modulated solitary-wave solutions* to the water-wave problem which have a solitary-wave profile in the direction of propagation and are periodic in the transverse direction. They emanate from the line solitary waves in a dimension-breaking bifurcation and are described to leading order by the Kadomtsev-Petviashvili equation (for strong surface tension) or Davey-Stewartson equation (for weak surface tension). The term *dimension-breaking phe-*

nomenon describes the spontaneous emergence of a spatially inhomogeneous solution of a partial differential equation from a solution which is homogeneous in one or more spatial dimensions.

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MS50

Lasers and Ripples

Three dimensional capillary-gravity waves behave very much like strong laser pulses propagating through a Kerr medium. We describe the reasons for this similarity and how the evolution in the two cases differ past the collapse time.

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MS50

The Influence of Surface Tension Upon Trapped Waves and Hydraulic Falls

Steady two-dimensional free-surface flows past submerged obstructions on the bottom of a channel are presented. Both the effects of gravity and surface tension are considered. Critical flow solutions with subcritical flow upstream and supercritical flow downstream are sought using fully nonlinear boundary integral equation techniques based on the Cauchy integral formula. When a second submerged obstruction is included further upstream in the flow configuration trapped wave solutions are found for small values of the Bond number, for some values of the Froude number. Other types of trapped waves are found for stronger tension when the second obstruction is placed downstream of the hydraulic fall generated by the first obstacle.

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MS50

Stability of Near-Resonant Gravity-Capillary Waves

I will present results on the computation and stability of periodic surface gravity-capillary waves that are in a near-resonant regime. In the zero amplitude limit, the parameters defining these solutions almost satisfy the resonance condition that leads to Wilton ripples. This manifests itself as a small divisor problem in the Stokes expansion for these solutions. We compute such solutions and investigate their stability using Hills method.

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MS51

CPT-symmetric Spin-orbit-coupled Condensate

We introduce a meanfield model of a spin-orbit-coupled atomic system accounting for pumping and removal of atoms from the two states, i.e. giving origin to an open spin-orbit-coupled Bose–Einstein condensate. The system possess charge-parity-time (CPT) symmetry and obeys such properties as control of the stability by the external trap, singular CPT symmetry phase breaking, the existence of stable nonlinear modes with nonzero currents in repulsive and attractive condensates, multiple re-entering the CPT-symmetric phase, splitting of nonlinear modes into sets of solitons (wave-packets) moving with different velocities and in different directions in the condensate released from the trap.

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MS51

Asymmetric Transport in Non-Linear Systems with Parity-Time Symmetry

We will introduce the notion of Parity-Time (PT) symmetry and present its implications in classical wave propagation. Using integrated optics and electronics as playfields we show how one can construct new circuitry designs that allow for asymmetric transport due to interplay of the novel properties of PT-symmetry and non-linearity or gyrotropic elements.

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MS51

Nonlinear Dynamics in PT-Symmetric Lattices

We consider nonlinear dynamics in a finite parity-time-symmetric chain of the discrete nonlinear Schrodinger (dNLS) type. For arbitrary values of the gain and loss parameter, we prove that the solutions of the dNLS equation do not blow up in a finite time but nevertheless, there exist trajectories starting with large initial data that grow exponentially fast for larger times with a rate that is rigorously identified. In the range of the gain and loss parameter, where the zero equilibrium state is neutrally stable, we prove that the trajectories starting with small initial data remain bounded for all times. We also discover a new integrable configuration of a PT-symmetric dimer and classify existence and stability of large-amplitude stationary PT-symmetric nonlinear states. The results to be reported in this talk were obtained in collaboration with P. Kevrekidis, V. Konotop, and D. Zezyulin.

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MS51

Interactions of Bright and Dark Solitons with Localized $\mathcal{PT}$-Symmetric Potentials

We study collisions of moving nonlinear-Schrödinger solitons with a $\mathcal{PT}$-symmetric dipole embedded into the one-dimensional self-focusing or defocusing medium. Analytical approximations are developed for both bright and dark solitons. In the former case, an essential aspect of the approximation is that it must take into regard the intrinsic chirp of the soliton, thus going beyond the bounds of the simplest quasi-particle description of the soliton's dynamics. The analytical results are verified by comparison with numerical simulations. Collisions result in partial reflection and transmission of incident solitons. Critical velocities separating these outcomes are found by means of numerical simulations, and in the approximate analytical form. Exact solutions for the dark soliton pinned by the complex $\mathcal{PT}$-symmetric dipole are produced too.

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MS52

Quasi-Determinants and Non Commutative Equations with Pfaffian Type Solutions

For some time, quasi-determinants of wronskian and grammian type have been known to provide solutions to some non-commutative equations, the most famous of which is the non-commutative KP equation. In this talk we shall use some of the ideas developed for the non-commutative KP equation to look at a possible construction for a non-commutative pfaffian which we shall call a 'quasi-pfaffian' and consider its properties.

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MS52

A Four-component Camassa-Holm Type Hierarchy

We consider a 3×3 spectral problem which generates four-component CH type systems. The bi-Hamiltonian structure and infinitely many conserved quantities are constructed for the associated hierarchy. Some possible reductions are also studied.

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MS52

On Jost Solutions for the Discrete and Ultradiscrete KdV Equation

Explicit expressions for the Jost solutions of the discrete Schrödinger equation for compact support solution of the discrete KdV are described. These expressions have ultradiscrete limits and applications of these results to solving arbitrary initial value problems for the ultra discrete KdV equation using the inverse scattering proposed by Willox et al (J. Phys. A: Math. Theor. 43 (2010) 482003) are considered.

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MS52

Classification of Tau-symmetric Hamiltonian Evolutionary PDEs

We consider the classification of deformations of the dispersionless KdV hierarchy which possess a Hamiltonian structure and satisfy the so called tau-symmetry property. We conjecture that such deformations are characterized by an infinite series of constant parameters, and provide evidences to support this conjecture. We also consider the classification problem of tau-symmetric deformations of Hamiltonian integrable hierarchies of hydrodynamic type.

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MS53

Skyrmions as Models of Nuclei

Skyrmions in 3-dimensions are compact soliton solutions in a nonlinear theory of pions. They have interesting shapes, and several have Platonic symmetry. There is a conserved topological charge B which is identified with baryon number. Skyrmions are proposed to model protons, neutrons and larger nuclei. I will discuss progress in constructing Skyrmion solutions up to baryon number 108 and beyond, and finding the properties of their quantised states, including their spin.

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MS53

Vorticity Models in Condensed Matter Physics and Gradient Flows of 1-Homogeneous Functionals

We illustrate some recent results on variational and evolution problems concerning a certain class of convex 1-homogeneous functionals for vector-valued maps, related to vortex density in 3-d superconductors and superfuids, that arise as limiting cases of the classical Ginzburg-Landau and Gross-Pitaevskii energies. Minimizers and gradient flows of such functionals may be characterized as solutions of suitable non-local vectorial generalizations of the classical obstacle problem.

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MS53

Long Range Scattering for the Klein-Gordon Equation with Nonhomogeneous Nonlinearities

The asymptotic stability of coherent states , like kinks in one dimension poses new great challenges. This is due to the long range nature of the dispersive equation. This talk will focus on one such problem. We study the 1D Klein-Gordon equation with quadratic and variable coefficient cubic nonlinearity. This problem exhibits a striking resonant interaction between the spatial frequencies of the nonlinear coefficients and the temporal oscillations of the solutions. We prove global existence and (in L-infinity) scattering as well as a certain kind of strong smoothness for the solution at time-like infinity with the help of several new classes of normal-forms transformations. The analysis also shows the limited smoothness of the solution, in the presence of the resonances.

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MS53

Coherent Motion in Hamiltonian Lattices with Next-to-nearest Neighbour Interactions

We consider an infinite chain of particles with nearest neighbour (NN) and next to nearest neighbours (NNN) being coupled by nonlinear springs. To mimic the Lennard-Jones potential, the NN and NNN springs act against each other. The existence of supersonic periodic solutions is discussed, as well as the existence of subsonic waves homoclinic to exponentially small periodic oscillations. The contrast to the theory for chains with NN interaction alone is discussed.

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MS54

Discrete KP Equation with Self-Consistent Sources

We show that the discrete Kadomtsev–Petviashvili (KP) equation with sources, obtained recently by the ”source generalization” method, can be incorporated into the squared eigenfunctions symmetry extension procedure. Moreover, using the known correspondence between Darboux-type transformations and additional independent variables, we demonstrate that the equation with sources can be derived from Hirota's discrete KP system of equations (without sources) in a space of bigger dimension. In this way we uncover the origin of the source terms as coming from multidimensional consistency of the Hirota system itself.

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MS54

Discrete Geometry of Polygons and Hamiltonian Structures

In this talk I will describe how a discrete moving frame describing the discrete geometry of polygons in projective $\mathbf{RP}^n$ and other parabolic manifolds describes a Hamiltonian structure on the space of discrete curvatures. The structure is associated to some differential-difference completely integrable systems. In the projective case the systems are integrable discretizations of generalized KdV equations or AGD flows, systems that posses a realization as flows of polygons in $\mathbf{RP}^n$. This is joint work with Jing Ping Wang.

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MS54

Geometric Aspects of Integrable Self-adaptive Moving Mesh Schemes

We will explain how to construct integrable self-adaptive moving mesh schemes of some nonlinear wave equations such as the short pulse equation and the Camassa-Holm equation. We also show various properties of self-adaptive moving mesh schemes.

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MS54

Discrete Moving Frames and Discrete Integrable Systems

Discrete moving frame offers significant computational advantages for our study of discrete integrable systems. We demonstrate that the discrete analogues of some curvature flows lead naturally to Hamiltonian pairs, which generate integrable differential-difference systems. In this talk, we concentrate on the projective space and the integrable equations obtained. This is joined work with Elizabeth Mansfield and Gloria Mar Beffa.

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MS55

Solitonic and Vortex Behaviour in Exciting Nonlinear Hyperbolic Metamaterials

Not Available at Time of Publication

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MS55

Nonlinear Wave Propagation and Localization in Squid Metamaterials

rf SQUIDs are strongly nonlinear oscillators exhibiting several fascinating properties. Metamaterials comprising SQUIDs reveal rich electromagnetic behavior, manifested by tuneability, switching, and multistability. SQUID metamaterials support flux waves, whose nonlinear propagation generates subharmonic pass-bands. They also support localized excitations in the form of dissipative breathers, investigated with respect to their generation conditions and their evolution. Tetragonal and honeycomb lattices are considered, and features of nonlinearity peculiar to each array type are identified and discussed.

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MS55

Dynamical Properties of Parity-Time Symmetric Metamaterials

Synthetic systems with matched gain and loss may be realized through parity-time ($\mathcal{PT}$)-symmetric metamaterials consisted of split-ring resonator (SRR) dimers, one with loss and the other with equal amount of gain, coupled magnetically while nonlinearity and gain are introduced through tunnel Esaki diodes. In the absense of nonlinearity a $\mathcal{PT}-$ phase transition occurs with an accompanying band modification. The presense of noninearity may induce nonlinearly localized modes in the form of discrete breathers with the largest part of the total energy concentrated in two neighboring sites belonging to the same gain/loss dimer. Time-varying gain/loss parameters introduce additional control possibilities including reentrant $\mathcal{PT}-$ transitions.

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MS55

Nonlinear Waves in a Homogenized Two-Phase Particulate Composite Medium

We consider a two-phase, isotropic, nonlinear, particulate composite medium whose effective linear permittivity and nonlinear susceptibility are determined by the strong permittivity fluctuation theory. Soliton propagation in the homogenized composite medium is found to obey the complex Ginzburg-Landau (CGL) equation. When linear loss is counterbalanced by nonlinear gain, the propagation of chirped solitons is permitted. These solitons are classified as Pereira-Stenflo bright solitons or Nozaki-Bekki dark solitons. Their propagation regime depends on the volume fraction of the component phases and on the correlation length of the spatial fluctuation of the dielectric properties in the medium. In the absence of linear and nonlinear dissipation, the CGL equation reduces to the nonlinear Schrödinger (NLS) equation, and both types of solitons simplify to the usual NLS bright and dark solitons. The exhibited possibility of localization of electromagnetic energy may pave the way for interesting applications employing such composite media in planar multilayered structures similar to the ones utilizing temporal solitons and beams in nonlinear optical media.

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MS56

Modeling Combined UV/IR Filamentation

Advances in laser technology allows the creation of intense light filaments, in particular in the infrared(IR) and ultraviolet(UV) regimes. A prevailing challenge is to determine conditions on the filament that enhance the possibility of long (kilometer) distance propagation in the atmosphere. This requires theoretical studies on filament formation and stability that parallel experimental efforts. This work presents our recent results on the existence and stability properties of multi-colored (UV/IR) filament/filament and filament/vortex states. This work is join with D. Wang (U. Vermont), A. Sukhinin, J-C Diels and A. Rasoulof (U. New Mexico. Work is supported by a DOD-MURI grant.

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MS56

Some Fundamental Issues in Internal Wave Dynamics

One of the simplest physical setups supporting internal wave motion is that of a stratified incompressible Euler fluid in a channel. This talk will discuss asymptotic models capable of describing large amplitude wave propagation in this environment, and in particular of predicting the occurrence of self-induced shear instability in the waves' dynamics for continuously stratified fluids. Some curious properties of the Euler setup revealed by the models will be presented.

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MS56

Instabilities of Gravity and Capillary Waves on the Surface of the Fluid

We observed numerically and investigated analytically resonant interactions on the discrete greed of wave vectors, where resonances are never fulfilled exactly. In this report we shall concentrate on an interesting and useful case of four wave resonances for standing wave. Standing wave is relatively easy to generate in experiment. We have shown that with time such a wave will generate isotropic wave field, which is important for experiments on wave turbulence.

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MS56

Blowup Dynamics in the Keller-Segel Model of Chemotaxis

The Keller-Segel equations model chemotaxis of bio-organisms. It is relatively easy to show that in the critical dimension 2 and for mass of the initial condition greater than the critical one, the solutions 'blowup' (or 'collapse') in finite time. However, understanding the mechanism of blowup turned out to be a very subtle problem defying solution for the long time. This blowup is supposed to describe the chemotactic aggregation of the organisms and understanding its mechanism would allow to compare theoretical results with experimental observations. In this talk I discuss recent results on dynamics of solutions of the (reduced) Keller-Segel equations in the critical dimension 2 which include a formal derivation and partial rigorous results of the blowup dynamics of solutions of these equations. Our results are confirmed by numerical simulations and agrees with the formula of Herrero and Velázquez for specially constructed solutions. The talk is based on the joint work with S. I. Dejak, D. Egli and P.M. Lushnikov.

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MS57

Dynamics of Vortex Filaments and their Stability

I will discuss some progress in determining the nonlinear (orbital) stability type of certain closed solutions of the Vortex Filament Equation (VFE), such as finite-gap filaments and periodic breathers. The approach is based on the correspondence between the VFE and the Nonlinear Schrödinger equation (NLS), and on the representation of a natural sequence of constants of motion in terms of NLS squared eigenfunctions.

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MS57

Vortex Dynamics in Bose-Einstein Condensates: Bifurcations, Chaotic Dynamics and Experimental Observations

In this talk, we will revisit the topic of N-vortices in Bose-Einstein condensates (BECs). We will review recent experiments including ones of remarkable symmetry-breaking phenomena in cases of co-rotating vortices, as well as explore steady states and configurations of counter-rotating vortices. Particle models of such systems will give rise to a considerable wealth of: (a) chaotic dynamics; (b) exotic states and bifurcation phenomena; (c) connections to classical polynomials (e.g. Hermite); (d) coarse graining features (for large N). We will briefly discuss (a)-(d) and provide some future perspectives.

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MS57

Traveling Waves in Holling-Tanner Model with Diffusion

We study diffusive Holling Tanner model for wide range of parameters from the point of view of existence of traveling waves. We geometrically construct qualitatively different traveling waves that include fronts, periodic wave-trains and solutions that asymptotically connect wave-trains to a constant state.

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MS57

Semi-strong Multipulse Interaction in Reaction Diffusion Systems: The Case of Asymptotically Weak Dissipation

We demonstrate the asymptotic stability of semi-strong N-pulse solutions for a class of singularly perturbed reaction-diffusion equations for which the essential spectrum is asymptotically close to the origin. The key step to both the existence and stability is the semi-group analysis of a weakly time-dependent family of non-self adjoint operators. We derive a nonlinear normal hyperbolicity condition that balances the time dependence of the linear operators against the rate of dissipation of the essential spectrum.

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MS58

An Efficient Boundary Integral Method for 3D Interfacial Flow with Surface Tension: Numerical Results and Numerical Analysis

We introduce an efficient boundary integral method for the initial value problem for 3D interfacial flow with surface tension. The method uses a generalized isothermal parameterization of the free surface, and requires a fast method for evaluation of the Birkhoff-Rott integral. We will also discuss a proof of convergence of the method. This is joint work with Yang Liu, Michael Siegel, and Svetlana Tlupova.

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MS58

A Reduction of the Euler Equations to a Single Time-Dependent Equation

In this talk, a new single equation for the time-dependent free-surface of a water-wave under the influence of gravity and surface tension is derived. This new equation is derived without approximation from Euler's Equations for an invicid, irrotational fluid and is valid in two spatial dimensions (one-dimensional wave surface). Using this single equation, various asymptotic models are derived. Classical reduced models such as KdV are found with ease, and new asymptotic models are presented.

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MS58

Gravity Capillary Waves and Related Problems

Nonliinear waves propagating under an elastic membrane are considered. Results for periodic waves, solitary waves with decaying oscillatory tails and generalised solitary waves are presented. The results are compared to the classical theory of gravity-capillary waves and new types of waves are found and discussed.

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MS58

A Quasi-Planar Model for Gravity-Capillary Interfacial Waves in Deep Water

We propose a quasi-planar model for gravity-capillary waves between two semi-infinite, immiscible fluids. Our analysis and numerics show that there exists a critical density ratio, below which the interfacial solitary waves and the bifurcation diagram are qualitatively similar to those of the free-surface gravity-capillary waves on deep water. However, the bifurcation mechanism near the minimum of the phase speed is essentially similar to that of the hydroelastic waves on deep water, when the density ratio is in the supercritical regime.

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MS59

Solitons in Quadratically Nonlinear Media with PT-Symmetric Potentials

The system of equations for waves in quadratically nonlinear media with a parity-time(PT) symmetric modulation of refractive indices for fundamental and second harmonics are studied. Exact bright and dark solitary solutions for corresponding forms of the PT-symmetric potentials are found. Their stability and dynamics are investigated.

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MS59

Nonlinear Quantum Dynamics of a BEC in a $\mathcal{PT}$-symmetric Double-well Trap

The dynamics of a Bose-Einstein condensate in a non-Hermitian $\mathcal{PT}$-symmetric double-well potential modelling a coherent in- and outflux of particles is investigated in the mean-field limit. The time-dependent Gross-Pitaevskii equation is solved and it is shown that it exhibits stable stationary states, however, the dynamical properties are very comprehensive. Elliptically stable and hyperbolically unstable stationary solutions are found. The complicated dynamical properties can be related to the subtle interplay of the nonlinearity and the non-Hermiticity.

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MS59

Dynamical Theory of Scattering for Complex Potentials, Inverse Scattering, and Confined Nonlinearities

For a given possibly complex scattering potential v(x) in one dimension, we construct a two-level non-Hermitian Hamiltonian whose S-matrix coincides with the transfer matrix of v(x). We use this approach to develop a dynamical theory of scattering where the reflection and transmission amplitudes are given as solutions of a set of dynamical equations and offer an inverse scattering scheme for construction of scattering potentials with desirable properties at a prescribed wavelength. We will also outline an extension of some of our results to situations where a confined nonlinearity is present.

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MS59

Partially- $\mathcal{PT}$ -symmetric Potentials with All-real Spectra and Soliton Families

Multi-dimensional complex potentials with partial parity-time ($\mathcal{PPT}$) symmetry are proposed. The usual parity-time ($\mathcal{PT}$) symmetry requires that the potential is invariant under complex conjugation and simultaneous reflection in all spatial directions. However, we show that if the potential is only partially $\mathcal{PT}$ -symmetric, i.e., it is invariant under complex conjugation and reflection in a *single* spatial direction, then it can also possess all-real spectra and continuous families of solitons. These results are established analytically and corroborated numerically. Symmetry breaking of solitons in $\mathcal{PPT}$ -symmetric potentials will also be discussed.

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MS60

Lattice Boussinesq Equation and Convergence Acceleration Algorithms

In this talk, we will give the molecule solution of an equation related to the lattice Boussinesq equation with the help of determinantal identities. It is shown that this equation can for certain sequences be used as a numerical convergence acceleration algorithm. Reciprocally, we will derive a non-autonomous form of the integrable equation related to the lattice Boussinesq equation by a new algebraic method. This method starts from constructing generalizations of convergence acceleration algorithms related to discrete integrable systems. Then the non-autonomous version of the corresponding integrable systems are derived. The new operator generalizing the usual forward difference operator in this method was first proposed by C. Brezinski when studying generalizations of the epsilon algorithm.

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MS60

Constructing Probabilistic Particle Cellular Automata from Fundamental Diagrams

We propose a probabilistic neighborfood-five particle cellular automata (CA) which includes fifteen deterministic particle CA. The probabilistic particle CA is constructed from evolution equations of max-min form obtained from ultradiscrete Cole-Hopf transformation. We also show a fundamental diagram of the probabilistic particle CA obtained by numerical simulations. Finally we discuss about future plans.

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MS60

Soliton Solutions to an Extended Box and Ball System Equation

We consider an extended Box and Ball system equation. It has two type of ultradiscrete soliton solutions. One is a solution of the ultradiscrete KdV type and the other is a solution of the ultradiscrete Toda type. We propose a solution which includes both of them.

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MS60

On Exact Solutions to Lattice Equations

We propose dynamical systems defined on algebra of lattices, which we call lattice equations. We give exact solutions to a class of lattice equations of which complexity of solutions are of polynomial order. Moreover we discuss the relationship between those equations and binary cellular automata.

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MS61

Well-Balanced Positivity Preserving Central-Upwind Scheme for the Shallow Water System with Friction Terms

Shallow water models are widely used to describe and study free-surface water flow. While in some practical applications the bottom friction does not have much influence on the solutions, there are still many applications, where the bottom friction is important. In particular, the friction terms will play a significant role when the depth of the water is very small. In this talk, I will discuss shallow water equations with friction terms and their approximation by a well-balanced central-upwind scheme that is capable of exactly preserving physically relevant steady states. The scheme also preserves the positivity of the water depth. We test the designed scheme on a number of one- and two-dimensional examples that demonstrate robustness and high resolution of the proposed numerical approach. The data in the last numerical example correspond to the laboratory experiments, designed to mimic the rain water drainage in urban areas containing houses. Since the rain water depth is typically several orders of magnitude smaller than the height of the houses, we develop a special technique, which helps to achieve a remarkable agreement between the numerical and experimental results.

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MS61

Well-Balanced Fully Coupled Central-Upwind Scheme for Shallow Water Flows over Erodible Bed

Intense sediment transport and rapid bed evolution are frequently observed under highly-energetic flows, and bed erosion sometimes is of the same magnitude as the flow itself. Simultaneous simulation of multiple physical processes requires a fully coupled system to achieve an accurate hydraulic and morphodynamical prediction. In this talk, I will present a high-order well-balanced finite-volume method for a new fully coupled two-dimensional hyperbolic system consisting of the shallow water equations with friction terms coupled with the equations modeling the sediment transport and bed evolution. The nonequilibrium sediment transport equation is used to predict the sediment concentration variation. Since both bed-load, sediment entrainment and deposition have significant effects on the bed evolution, an Exner-based equation is adopted together with the Grass bed-load formula and sediment entrainment and deposition models to calculate the morphological process. The resulting 5 by 5 hyperbolic system of balance laws is numerically solved using a Godunov-type central-upwind scheme on a triangular grid. A computationally expensive process of finding all of the eigenvalues of the Jacobian matrices is avoided: The upper/lower bounds on the largest/smallest local speeds of propagation are estimated using the Lagrange theorem. A special discretization of the source term is proposed to guarantee the well-balanced property of the designed scheme. The proposed fully coupled model is verified on a number of numerical experiments.

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MS61

MLMC-FVM for Shallow Water Equations with Uncertain Bottom Topography

The initial data and bottom topography, used as inputs in shallow water models, are prone to uncertainty due to measurement errors. We model this uncertainty statistically in terms of random shallow water equations. We extend the Multi-Level Monte Carlo (MLMC) algorithm to numerically approximate the random shallow water equations efficiently. The MLMC algorithm is suitably modified to deal with uncertain (and possibly uncorrelated) data on each node of the underlying topography grid by the use of a hierarchical topography representation. Numerical experiments in one and two space dimensions are presented to demonstrate the efficiency of the MLMC algorithm.

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MS61

High Order Discontinuous Galerkin Methods for the Shallow Water Equations

Shallow water equations (SWEs) with a non-flat bottom topography have been widely used to model flows in rivers and coastal areas. Since the SWEs admit non-trivial equilibrium solutions, extra care need to be paid to approximate the source term numerically. To capture this balance and near-equilibrium solutions, well-balanced methods have been introduced and performed well in many numerical tests. In this presentation, we will talk about recently developed high-order discontinuous Galerkin (DG) finite element methods, which can capture the general moving steady state well, and at the same time are positivity preserving without loss of mass conservation. Some numerical tests are performed to verify the positivity, well-balanced property, high-order accuracy, and good resolution for smooth and discontinuous solutions.

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MS62

Multi-Component Integrable Wave Equations and Geometric Moving Frames

I will survey some recent work giving a geometric approach to deriving group-invariant nonlinear wave equations. The approach is based on applying moving-frame methods to curve flows in geometric spaces, where the differential covariants of the curve naturally satisfy a multi-component nonlinear wave equation which has an internal symmetry group given by the equivalence group of the moving frame. In this setting there are natural classes of integrable flows, which give rise to group-invariant integrable wave equations with a Lax pair, a bi-Hamiltonian structure, and a symmetry recursion operator.

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MS62

Some Novel Geometric Realizations of Integrable Hierarchies

We discuss geometric evolution equations for generic curves in centroaffine 3-space and for Legendrian curves in the 3-sphere. In the centroaffine case, we construct a double hierarchy of mutually commuting curve flows, whose curvature evolution equations realize the two-component Boussinesq hierarchy. The passage from the velocity components (with respect to a Frenet-type frame) to invariant evolutions gives a Poisson operator for the hierarchy. Within the hierarchy of curve flows there is a sub-family of geometric evolution equations that preserves curves on a cone through the origin, and realize the Kaup-Kuperschmidt hierarchy. In the Legendrian case, we can also realize the Kaup-Kuperschmidt equations via a sequence of geometric flows.

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MS62

A Finite Dimensional Integrable System Arising in Shock Clustering

In previous work, Menon and Srinivasan studied scalar conservation laws with convex flux and initial datum given by spectrally negative Feller processes. For the special case in which the initial condition is stationary, it was shown that the generator of the Feller process evolves according to a Lax equation. Subsequently, Menon introduced a finite dimensional version of this problem, associated with the Markov group. In this talk, we will explain how to solve this finite dimensional system explicitly.

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MS62

Integrable Systems and Invariant Geometric Flows in Similarity Symplectic Geometry

In this talk, differential invariants and invariant geometric flows in similarity symplectic geometry are studied. Explicit formulae of symplectic invariants and Frenet formulae for curves in the similarity symplectic geometry are obtained by the moving frame method. The relationship between the of Euclidean symplectic invariants and similarity symplectic invariants is also identified. As a result, we show that the matrix mKdV equation and the matrix Burgers equation arise from invariant nonstreching curve flows in the similarity symplectic geometry.

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MS63

Quasi-Discrete Solitons in Nonlinear Transmission Line Metamaterials

Not Available at Time of Publication

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MS63

Amplitude Modulation and Envelope Mode Formation in Left-Handed Media: a Survey of Recent Results

Not Available at Time of Publication

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MS63

Pt-Symmetry and Embedded Modes in the Continuum for Magnetic Metamaterials

First, we examine the PT-symmetry breaking transition for a magnetic metamaterial of a ?nite extent, modeled as an array of coupled split-ring resonators in the equivalent circuit model approximation. Small-size arrays are solved completely in closed form, while for arrays larger than N = 5 results were computed numerically for several gain/loss spatial distributions. In all cases, it is found that the parameter stability window decreases rapidly with the size of the array, until at N = 20 approximately, it is not possible to support a stable PT-symmetric phase. A simple explanation of this behavior is given. Next, we consider the problem of building a surface localized mode embedded in the continuous band of a semi-infinite one- dimensional array of split-ring resonators. We suggest an efficient method for creating such surface mode and the local bounded potential necessary to support this mode.

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MS64

High-Frequency Instabilities of Small-Amplitude Solutions of Hamiltonian PDEs

Generalizing ideas of MacKay, and MacKay and Saffman, a necessary condition for the presence of high-frequency (i.e., not modulational) instabilities of small-amplitude solutions of Hamiltonian partial differential equations is presented, entirely in terms of the Hamiltonian of the linearized problem. The entire theory with the exception of a Krein signature calculation can be phrazed in terms of the dispersion relation of the linear problem. The general theory changes as the Poisson structure of the Hamiltonian PDE is changed. Two important cases are worked out and different examples are presented.

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MS64

Multipole and Half-vortex Gap-solitons in Spin-orbit Coupled Bose-Einstein Condensates

Using the parity and time reversal symmetries of a two-dimensional spin-orbit coupled Bose-Einstein condensate in a Zeeman lattice, we found numerically various families of localized solutions, including multipole and half-vortex solitons. The obtained solutions may exist at any direction of the gauge field with respect to the lattice and can be found either in finite gaps. The existence of half-vortices requires higher symmetry. Stability of these modes makes them feasible for experimental observation.

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MS64

Wave Turbulence: A Story Far from Over

Despite some successes, there are still many open questions as to the validity of the wave turbulence closure and the relevance of Kolmogorov-Zakharov finite flux solutions. In some cases, such as gravity driven water waves, the KZ spectrum has to be augmented with the Phillips' spectrum at high wavenumbers. Why? In others, such as the the MMT equation, the KZ spectrum and indeed the whole closure does not obtain at any scale at all. Why? Further we ask: might it be possible to give a priori conditions on weakly nonlinear systems so that one is guaranteed that at least the natural asymptotic closure holds? I look forward to addressing and discussing these challenges.

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MS64

Energy Growth in Switching Hamiltonian Systems of Fermi-Ulam Type

A natural example of a switching Hamiltonian system of Fermi-Ulam type (a particle bouncing between two oscillating walls) is considered. A corresponding smooth in time system would possess invariant KAM tori which would prevent energy growth. Numerical simulations suggest that energy does not grow even in the discontinuous case. We explain this phenomenon using relation with another problem considered earlier by Kesten.

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MS65

Dynamics of Cavity Solitons and Optical Frequency Combs in the Lugiato-Lefever Equation

Kerr frequency combs can be modeled in a similar way as temporal cavity solitons (CSs) in nonlinear cavities, using the Lugiato-Lefever equation describing pattern formation in optical systems. Here, we first characterize different dynamical regimes of CSs, such as time-periodic oscillations and various chaotic dynamics. Secondly, the effect of third order dispersion on the stability and snaking structure of CSs is studied. Finally, we discuss how the dynamics change as the cavity size decreases.

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MS65

Localised Hexagon Patches on the Surface of a Magnetic Fluid

We present experimental results showing the existence of a patches involving different numbers cellular hexagons on the surface of a magnetic fluid under the influence of a vertical magnetic field. These patches are spontaneously generated by jumping into the neighborhood of the unstable branch of the domain covering hexagons and are found to co-exist in the same parameter region. Using numerical continuation techniques, we investigate the existence of localized hexagons in the full equations determining the free-surface of magnetic fluid and describing the experiment. We find that cellular hexagons possess a Maxwell point where the energy of a single hexagon is equal to the energy of the flat state providing an energetic explanation for the multitude of various different hexagon patches observed in experiments. Furthermore, it is found that planar hexagon fronts and hexagon patches undergo homoclinic snaking.

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MS65

Localized Solutions in Plane Couette Flow with Rotation

Localized solutions of plane Couette flow (PCF) bifurcate from the subcritical 3D periodic state at infinite parameter; forcing the system through rotation changes this. The 3D periodic state now emerges secondarily from a 2D periodic state, making the localized solution a 3D patch embedded in a 2D patterned background. The nontrivial background has some effect, however much of the scenario seen in other

systems remains, such as the snakes-and-ladders structure already found in non-rotating PCF.

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MS65

Stability Properties of Localized Structures Near Snaking

Snaking refers to the existence of localized roll structures in spatially extended, reversible 1D partial differential equations, that exist along a vertical sine-shaped bifurcation curve so that the width of the underlying periodic roll pattern increases along the bifurcation curve. Localized rolls undergo a series of bifurcations along the branch, and this talk is concerned with analytical and numerical aspects of their PDE stability spectra.

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MS66

Modeling Capillary Origami

To continue the move towards miniaturization in technology, developing new methods for fabricating micro- and nanoscale objects has become increasingly important. One potential method, called capillary origami, consists of placing a small drop of liquid on a thin, inextensible sheet. In this state the system minimizes its total energy, pulling the planar sheet upward. Under appropriate conditions the sheet will fully encapsulate the liquid, creating a three-dimensional structure. In this talk, we discuss recent work on modeling a two-dimensional version of this system.

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MS66

The Stability and Evolution of Curved Domains Arising from One Dimensional Localized Patterns

In many pattern forming systems, narrow two dimensional domains can arise whose cross sections are roughly one dimensional localized solutions. This talk will present an investigation of this phenomenon for the variational Swift-Hohenberg equation. Stability of straight line solutions is analyzed, leading to criteria for either curve buckling or curve disintegration. A high order matched asymptotic expansion reveals a two-term expression for the geometric motion of curved domains which includes both elastic and surface diffusion-type regularizations of curve motion. This leads to novel equilibrium curves and space-filling pattern proliferation. A key ingredient in the generation of the labyrinthine patterns formed, is the non-local interaction of the curved domain with its distal segments. Numerical tests are used to confirm and illustrate these phenomena. document or other high-level commands.

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MS66

Hotspots in a Non-Local Crime Model

We extend the Short et al. burglary hotspot model to allow for a larger class of criminal movement. Specifically, we allow criminals to travel according to a Lévy flight rather than Brownian motion. This leads to a non-local system of differential equations. The stability of the homogeneous state is studied both numerically and through a Turing-type analysis. The hotspot profiles are then constructed to leading order in a singular regime.

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MS66

Slowly Varying Control Parameters, Delayed Bifurcations, and the Stability of Spikes in Reaction-diffusion Systems

We present three examples of delayed bifurcations for spike solutions of reaction-diffusion systems. The delay effect results as the system passes slowly from a stable to unstable regime, and was previously analysed in the context of ODE's in [P.Mandel and T.Erneux, J.Stat.Phys 48(5-6) pp.1059-1070, 1987]. Analysis of explicitly solvable nonlocal eigenvalue problems allows for analytic predictions of the magnitude of delay. Asymptotic results are compared favorably to numerical computations.

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MS67

In-Cavity Transformations for New Nonlinear Regimes of Pulse Generation in Mode-Locked Fibre Lasers

We review recent progress in the research on nonlinear mechanisms of pulse generation in passively mode-locked fibre lasers. These include parabolic self-similar pulse mode-locking, a mode-locking regime featuring pulses with a triangular distribution of the intensity, and spectral compression arising from nonlinear pulse propagation. We also report on the possibility of achieving various regimes of advanced temporal waveform generation in a mode-locked fibre laser by inclusion of a spectral filter into the laser cavity.

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MS67

Mechanisms and Definitions of Rogue Waves in Nonlinear Systems

Optical rogue waves are rare yet extreme fluctuations in an optical field. First used to describe an analogy between wave propagation in optical fibre and on deep water, the terminology has since been generalized to many other optical processes. We present here an overview of recent research in this field, and although statistical features are often considered defining feature of rogue waves, we emphasize the underlying physical mechanisms driving the appearance of extreme events.

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MS67

Nonlinear Pulse Shaping in Normally Dispersive Fibres: Experimental Examples

While the combination of Kerr nonlinearity with dispersion in optical fibers can seriously impair high speed optical transmissions, it also provides an attractive solution to generate new temporal and spectral waveforms. We explain in this talk how to take advantage of the progressive temporal and spectral reshapings that occur upon propagation in a normally dispersive fiber. We base our discussion on several experimental results obtained at telecommunication wavelengths.

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MS67

Time Domain Nonlinear Structures and Substructures for Ultrafast Photonics

Applications of the time domain amplitude and phase structures and substructures, induced by self- and cross-phase modulation, phase addition and CARS type processes, are presented based on our numerical and experimental studies. The report is focused on the techniques of temporal lensing- spectral compression, Fourier conversion-spectrotemporal imaging and frequency tuning, the specificity of Newton rings in a similariton-induced time lens, as well as on nonlinear-optic applications of the trains periodically substructured by similaritons superposition.

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MS68

Complex and Coupled Complex Short Pulse Equations: Integrability, Discretization and Numerical

Simulations

We propose a complex and a coupled complex short pulse equations which describe the ultra-short pulse propagation in optical-fibers. After showing the integrability of these equations by Lax pairs, we derive the multi-soliton solutions expressed in pfaffians by Hirotas bilinear method. In the second partod the talk, the integrable semi-discretizations are constructed and are successfully used as self-adaptive moving methods for the numerical simulations of these equations. This is a collaborative work with K. Maruno and Y. Ohta.

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MS68

A New Procedure to Approach Integrable Discretization

In this talk, we present a new procedure to derive discrete analogues of integrable PDEs in Hirota's bilinear formalism. This new approach is mainly based on introdution of suitable auxiliary equations with additional discrete independent variables such that there is integrable compatibility between the integrable system under consideration and the new introduced equations while keeping the discrete independent variables converging to original ones. We apply this procedure to several equations, including the Korteweg-de-Vries (KdV) equation, the Kadomtsev-Petviashvili (KP) equation, the Boussinesq equation, the Sawada- Kotera (SK) equation, the Ito equation and etc., and obtain their associated semi-discrete or fully discrete analogues. In the continuum limit, these discrete analogues converge to their corresponding smooth equations.

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MS68

Rogue Waves for Some Soliton Equations

For some soliton equations, the rogue wave solutions are studied and their algebraic structures are analyzed based on the bilinear technique of soliton theory.

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MS68

New Results on the Explicit Monge-Taylor Forms for Submanifolds Under Group Actions Using Equivariant Moving Frame Method

Motivated by the widely used equivariant moving frame method and starting from the relations between the infinitesimal generators of transformation groups and the universal recurrence formulae for differential invariants, we elaborate important propositions which indicate the procedure to construct more higher order fundamental normalized differential invariants such that we can derive the explicit Monge-Taylor forms extensively for submanifolds under group actions. At the same time, a complete set of syzygies on the generating set of differential invariants are obtained.

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MS69

Well-Balanced Positivity Preserving Cell-Vertex Central-Upwind Scheme for Shallow Water Flows

I will present a novel two-dimensional central-upwind scheme on cell-vertex grids for shallow water equations with source terms due to bottom topography. This type of computational cells has the advantage of using more cell interfaces which provide more information on the waves propagating in different directions. We prove that the proposed method is well-balanced and guarantees the positivity of the computed water depth. Our numerical experiments confirm stability, well-balanced and positivity preserving properties of the proposed method. This scheme can be applied to shallow water models when the bed topography is discontinuous and/or highly oscillatory, and on complicated domains where the use of unstructured grids is advantageous.

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MS69

RVM Finite Volume Methods: Applications to Multilayer Shallow Flows

A new class of incomplete Riemann solvers for the numerical approximation of conservative and nonconservative hyperbolic systems is proposed. They are based on viscosity matrices obtained by rational approximations to the Jacobian of the flux evaluated at some average state, and only require the knowledge of the maximal characteristic speed. The proposed schemes are applied to nonconservative multilayer shallow water systems, where it has been observed that intermediate waves can be properly captured for an appropriate degree of approximation of the generating rational function used. The numerical tests indicate that the schemes are robust, running stable and accurate with a satisfactory time step restriction, and the computational cost is more advantageous with respect to schemes using a complete spectral decomposition of the Jacobians.

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MS69

Path-Conservative Central-Upwind Schemes for Nonconservative Hyperbolic Systems

I will present a new path-conservative central-upwind scheme for noncoservative hyperbolic systems of PDEs. Such systems arise in a variety of applications and the most challenging part of their numerical discretization is a robust treatment of nonconservative product terms. Godunov-type central-upwind schemes were developed as an efficient, highly accurate and robust "black-box' solver for hyperbolic systems of conservation laws. They were successfully applied to a large number of hyperbolic systems including such nonconservative systems as two-layer shallow water equations, compressible two-phase flow models, Savage-Hutter type system modelling submarine underwater slides. To overcome the difficulties related to the presence of nonconservative product terms, several special techniques were proposed. However, none of these techniques was sufficiently robust and thus the applicability of the original central-upwind scheme was quite limited. We have recently realized that the main drawback of the original approach was the fact that the jump of the nonconservative product terms across cell interfaces has never been taken into account. Rewriting central-upwind schemes in the form of path-conservative schemes has helped to understand how the nonconservative products should be discretized so that their influence on the numerical solution is accurately taken into account. The resulting path-conservative central-upwind scheme is a new robust tool for both conservative and nonconservative hyperbolic systems. The new scheme has been applied to the Saint-Venant system with discontinuous bottom topography, two-layer shallow water system, and the two-mode shallow water equations which was recently derived as a simplified model tat describes nonlinear dynamics of waves with different vertical profiles. Our numerical results illustrate a superb performance of the new path-conservative central-upwind scheme, its robustness and ability to achieve very high resolution.

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MS69

Well-Balanced Ale: a Dynamic Mesh Adaptation Strategy for Shallow Water Flows

We discuss an efficient and cost effective strategy toward dynamic unstructured mesh adaptation for shallow water flows. The method combines a mesh movement strategy based on a solution dependent Lapacian operator with an ALE formulation. The first provides nodal displacements dependent on the smoothness of the solution, while the second allows to follow these solution adaptive displacements without the need of any interpolation. We will discuss the conditions allowing the ALE formulation to remain well balanced, and show validation on both smooth and discontinuous shallow water flows.

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MS70

Integrable Nature of Modulational Instability

The modulational instability (MI), known as Benjamin-Feir instability in water waves, is one of the most widespread phenomena in nonlinear science. In many cases, the underlying dynamics is governed by the nonlinear Schrodinger (NLS) equation. The initial stage of MI can therefore be described by linearizing the NLS equation around a constant background. Once the perturbations have grown to O(1), however, the linearization ceases to be valid. On the other hand, the NLS equation is a completely integrable infinite-dimensional Hamiltonian system, and the initial-value problem is therefore amenable to solution via the inverse scattering transform (IST). In this talk we will describe how the recently-developed IST for the focusing NLS equation with non-zero boundary conditions can be used to elucidate the nonlinear stage of the MI.

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MS70

Rational Solitons of Wave Resonant-Interaction Models

Integrable models which describe the resonant interaction of two or more waves in $1 + 1$ dimensions are known to be of applicative interest in many fields. We consider a system of three coupled wave equations which includes as special cases the vector Nonlinear Schroedinger equations (or Manakov System) and the equations describing the resonant interaction of three waves. The Darboux-Dressing construction of soliton solutions is applied under the condition that the solutions have rational, or mixed rational-exponential, dependence on coordinates. Our algebraic construction relies on nilpotent matrices and their Jordan form. We systematically search for all bounded rational (mixed rational-exponential) solutions. Rogue waves of the three-wave resonant interaction equations belog to this class.

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MS70

On the Spectrum of the Defocusing NLS Equation with Non-zero Boundary Conditions

We revisit the scattering problem for the defocusing nonlinear Schrödinger equation with constant, non-zero boundary conditions at infinity. After reviewing some aspects of the general theory, we consider a specific kind of piecewise constant potentials to address and clarify two issues, concerning: (i) the (non)existence of an area theorem relating the presence/absence of discrete eigenvalues to an appropriate measure of the initial condition; and (ii) the existence of a contribution to the asymptotic phase difference of the potential from the continuous spectrum.

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MS70

Closed Form Solutions of the Hirota Equation

By using the Inverse Scattering Transform we construct an explicit multisoliton solution formula for the Hirota equation. The formula obtained allows one to get, as particular cases, the N-soliton solution, the breather solution and, most relevantly, a new class of solutions called multipole soliton solutions. By adapting the Sym-Pohlmeyer reconstruction formula to the Hirota equation, we use these exact solutions to study the motion of a vortex filament in an incompressible Euler fluid with nonzero axial velocity. The results are obtained in collaboration with G. Ortenzi (University of Milano Bicocca) and F. Demontis (University of Cagliari)

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MS71

Localized Waves in Fully Nonlinear Media

We discuss properties of localized waves in a class of Hamiltonian lattices involving fully nonlinear interactions. This problem arises for the study of impact propagation in granular chains, where the Hertz contact force introduces a fully nonlinear coupling. In this context, new types of strongly nonlinear modulation equations such as the logarithmic KdV and discrete p-Schrödinger equations can be introduced. We review open problems concerning localized waves in these systems and the original lattice.

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MS71

New Solutions for Slow Moving Kinks in a Forced Frenkel-Kontorova Chain

In order to study effects of discreteness on dislocation motion, we construct new traveling wave solutions of moving kink type for a modified, driven, dynamic Frenkel-Kontorova model, representing dislocation motion under stress. Formal solutions known so far are inadmissible for velocities below a threshold value. The new solutions fill the gap left by this loss of admissibility. Analytical and numerical evidence is presented for their existence; however, dynamic simulations suggest that they are probably unstable. We discuss ramifications of this result for slow dislocation motion.

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MS71

On the Travelling Wave Problem for Phase Transitions in the Fermi-Pasta-Ulam Chain

We want to present established and recent results on the analyse of travelling waves for a lattice model of phase transitions. In particular we consider a bistable model with a piece-wise quadratic interaction potential and a smoothed variant with small spinodal region. Various authors have been able to prove in both cases the existence of families of subsonic travelling waves, so that special interest is focusing on relevant selection criteria to identify meaningful solutions. Following ideas from vanishing viscosity approach to conservation laws we present ideas to analyse the stabilisation of waves in the model with dissipation and discuss how this might help to set up a framework for the interpretation of the various types of wave solutions existing for the lattice problem. This is joint work with M Herrmann, K Matthies, J Zimmer

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MS71

Breathers in Two-dimensional Fermi-Pasta-Ulam Lattices

Motivated by the observations of Marin et al [Phys Lett A, 281, 21, (2001)], we use asymptotic analysis to approximate breathers in a square, triangular and honeycomb Fermi-Pasta-Ulam lattices. In scalar two-dimensional systems we obtain perturbed 2D NLS equations and conditions on the existence of breathers. We discuss the open problems of breathers' stability (or decay rate), and interaction properties.

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MS72

Branch Cut Singularity of Stokes Wave

Stokes wave is the fully nonlinear gravity wave propagating with the constant velocity. We consider Stokes wave in the conformal variables which maps the domain occupied by fluid into the lower complex half-plane. Then Stokes wave can be described through the position and the type of complex singularities in the upper complex half-plane.We identified that this singularity is the square-root branch point. We reformulated Stokes wave equation through the integral over jump at the branch cut which provides the efficient way for finding of the explicit form of Stokes wave.

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MS72

Solitons, Self-Induced Transparency, and Quantum

Cascade Lasers

Self-induced transparency is a phenomenon in which an optical pulse passes through a resonant medium without being absorbed because of quantum coherence. This phenomenon is modeled mathematically using the Maxwell-Bloch equations, and these equations have exact soliton solutions in the limit that the quantum coherence times become infinite. In this talk, we show that it is possible to use this phenomenon to modelock a quantum cascade laser by creating dissipative solitons.

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MS72

On Multi-Dimensional Compact Patterns

Solitons, kinks or breathers, are manifestations of weakly nonlinear excitations in dispersive media like mass-particle lattices. In a strongly anharmonic chains, the tails of the solitary patterns rather than exponentially, decay at a doubly-exponential rate which in the continuum limit collapse into a singular surface with the resulting waves becoming strictly compact,hence their name: compactons. Using the Z-K, the sub-linear Complex Klein-Gordon and the sub-linear NLS eqs. as examples, we shall demonstrate how N-dimensional compactons emergence and interact. In general, for compact, and hence non-analytical, structures to emerge, the underlying system has to undergo a local loss of uniqueness due to, for instance, a degeneracy of the highest order operator or other, singularity inducing, mechanisms. For a basic introduction see: What is a Compacton, Notices of the AMS, Vol. 52, #7, pp 738, 2005.

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MS72

Thresholds and Blow-up Dynamics in the Nonlinear Dispersive Equations

We consider the focusing nonlinear Schrödinger equation with finite energy initial data in the mass-supercritical regime. We discuss the contracting sphere blow-up dynamics (joint work with Justin Holmer and Galina Perelman), then present a new dichotomy for scattering and collapse solutions with finite variance (joint work with Thomas Duyckaerts). In both results solutions can have an arbitrary L^2-norm (mass). Generalization to other nonlinear dispersive equations will be considered.

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MS73

Localised Solutions in Integral Neural Field Equations

I will discuss the formation of stationary localised solutions in integral neural field models with inhomogeneous synaptic kernels and Heaviside firing rate functions. We consider a simple periodic modulation in the synaptic kernel, apply interface methods to the resulting integral problem and show how to construct localised bumps with a finite activity region and two threshold crossings. Localised solutions are arranged in a "snake and ladder" bifurcation diagram. However, in this context, interface methods allow for the explicit construction of a bifurcation equation for localised steady states, so that analytical expressions for snakes and ladders can be derived. Similarly, eigenvalue computations can be carried out analytically to determine the stability of the solution profiles. In addition, we find regions of parameter space where the trivial homogeneous state coexists with two other stable solutions, an above-threshold periodic state and a cross-threshold periodic state. We show how the multiple stability affects the corresponding bifurcation diagram and examine models in which the firing rate is a steep sigmoid as opposed to the Heaviside step function. This is joint work with Helmut Schmidt (Exeter)

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MS73

Localized Convection in a Rotating Fluid Layer

We study stationary convection in a two-dimensional fluid layer rotating around the vertical and heated from below. With stress-free boundary conditions, spatially localized states are embedded in a self-generated background shear zone and lie on a pair of intertwined solution branches exhibiting "slanted snaking". Similar solutions with no-slip boundary conditions are computed. They are not embedded in a background shear and the solution branches exhibit snaking without a slant. Homotopic continuation from free-slip to no-slip boundary conditions is used to track the changes in the properties of the solutions and the associated bifurcation diagrams.

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MS73

Steady and Oscillatory Localised States in Boussinesq Magnetoconvection

Previous studies have shown that it is possible to find steady, localised convective cells in two-dimensional Boussinesq magnetoconvection. Building on earlier work, we demonstrate the existence of oscillatory localised convective states in this system. We discuss the properties of these solutions as well as the effects of changing the horizontal boundary conditions. In particular, we show that the inclusion of impermeable sidewalls can lead to formation of localised "wall" modes.

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MS73

Moving Localized Structures in a Doubly Diffusive System

In this talk we will describe the origin and properties of moving spatially localized structures in natural doubly-diffusive convection in a vertically extended cavity. These solutions arise through secondary parity breaking bifurcations. Both single pulse and multipulse states of this type will be described. The numerical results will be related to the phenomenon of homoclinic snaking in spatially reversible systems.

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MS74

Isometric Immersions and Pattern Formation in Non-Euclidean Elastic Sheets

Swelling thin elastic sheets are archetypical examples of pattern forming systems which are often modeled as the minimum an elastic energy which is the sum of a strong stretching energy which penalizes deviations from a growth induced geometry and a weak bending energy. A fundamental question is whether we can deduce the three dimensional configuration of the sheet given exact knowledge of the imposed geometry. Using a combination of rigorous analysis and numerical conjectures on I will argue that the periodic patterns observed in nature correspond to low energy isometric immersions of the imposed geometry.

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MS74

Pattern-Forming Fronts in Phyllotaxis

Some of the most spectacular patterns in the natural world can be found on members of the plant kingdom. Furthermore, the regular configurations of organs on plants, collectively called phyllotaxis, exhibit a remarkable predisposition for Fibonacci and Fibonacci-like progressions. Starting from a biochemical and mechanical growth model similar to the classic Swift-Hohenberg equation, we discuss the ways in which nearly every property of phyllotaxis can be explained as the propagation of a pushed pattern-forming front.

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MS74

Nanoscale Pattern Formation by Ion Bombardment of Binary Compounds

When a solid surface is bombarded with a broad ion beam, a plethora of self-assembled nanoscale patterns can emerge, including nanodots arranged in hexagonal arrays of remarkable regularity. We discuss a theory that explains the genesis of the strikingly regular hexagonal arrays of nanodots that can form when binary materials are bombarded. In our theory, the coupling between a surface layer of altered stoichiometry and the topography of the surface is the key to the observed pattern formation. We analyze how a soft mode related to the mean sputter yield can facilitate defect formation and give rise to less ordered patterns.

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MS75

Relative Intensity Noise Transfer in Second-Order Raman Amplification with Random Distributed Feedback Ultra-Long Fibre Lasers

The predicted RIN transfer function for second-order distributed amplification based on different configurations of Random distributed feedback ultralong Raman fiber lasers (RDFLs) is found and studied over a broad range of possible lengths and signal powers, showing that the values of the RIN transfer function and the RIN cut-off frequencies are dependent upon both parameters. RIN performance is compared to that of a typical cavity ultralong Raman fiber laser pumped from the extremes.

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MS75

Transverse Disorder-Induced Localizations in Nonlocal Nonlinear Media: Theory and Experiments

We review our theoretical approach about the way localized states due to disorder are affected by the presence of nonlinearity. We outline the link between Anderson localization and solitons, and study local and nonlocal responses. We also report on experimental results on two-dimensional disorder-induced localization in optical fibres, and the observation of action at a distance and collective dynamics involving localized states in nonlocal media.

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MS75

Optical Wave Turbulence: Toward a Unified Non-Equilibrium Thermodynamic Description of Statistical Nonlinear Optics

We review a unified theoretical formulation of statistical nonlinear optics on the basis of the wave turbulence theory, which provides a nonequilibrium thermodynamic description of incoherent nonlinear waves. On the basis of the generalized NLS equation, we discuss the wave turbulence kinetic equation in analogy with kinetic gas theory, the long-range Vlasov equation in analogy with Gravitational dynamics, and the nonequilibrium description of noninstantaneous (Raman-like) nonlinearities in analogy with weak Langmuir turbulence in plasma.

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MS75

Order and Chaos in Fibre Lasers

We analyse the nonlinear stage of modulation instability in passively mode locked fiber lasers, leading to either stable or chaotic or noise-like emission. We present the diagram of phase transitions among stable temporal patterns and different regimes of chaotic emission in terms of the key cavity parameters such as dispersion and nonlinearity: amplitude or phase turbulence, and spatio-temporal intermittency. Whenever the polarizer is removed from the cavity, stabilization of the chaotic emission may occur via spatio-temporal synchronisation induced by the nonlinear coupling among two the orthogonal polarization modes.

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MS76

KP Web-solitons from Wave Patterns

Nonlinear interactions among small amplitude, long wavelength, obliquely propagating waves on the surface of shallow water often generate web-like patterns. In this talk, we discuss how line-soliton solutions of the Kadomtsev-Petviashvili (KP) equation can approximate such web-pattern in shallow water wave. We describe an "inverse problem" which maps a certain set of measurable data from the solitary waves in the given pattern to the parameters required to construct an exact KP soliton that describes the non-stationary dynamics of the pattern. We illustrate the inverse problem using explicit examples of shallow water wave pattern.

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MS76

Invariant Manifold of the KdV Equation

The solution structure of the KdV equation is studied in light of invariant manifold (IM). According to the definition of IM, the first order IM of the KdV equation is obtained, which turns to describe the traveling wave solution . The relationship is recovered between the second order group-invariant IM and the group-invariant solutions of the KdV. The concept of linear IM is presented to study the higher order IM and the two sets of linear IMs concerning soliton and algebraic geometric solutions are investigated. The direct method for seeking the linear IM of a given PDE system is presented and the existence of rich linear IMs is a strong indication that the given PDE is integrable. We find that the first integrals of the reduced ordinary differential equation can be obtained by the inner symmetry of the IMs. It is conjectured that the new (2+1)-dimensional differential-difference system is an integrable system including the well-known KdV reduction.

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MS76

General Solutions of Arbitraray First Order Autonomous PDEs

Using general symmetry approach, it is proved that ALL solutions of arbitrary autonomous first order partial different equations (PDEs) can be obtained. In other words, a first order autonomous PDE in any dimensions is C-integrable. Especially, for arbitrary two dimensional first order autonoumous PDEs, the recursion operators, group invariant operators, Lax pairs, higer order general local and nonlocal symmetries and group invariant functions are explicitly given.

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MS76

On Nonintegrable Semidiscrete Hirota Equation: Gauge Equivalent Structures and Dynamical Properties

In this talk, we investigate nonintegrable semidiscrete Hirota equations including nonintegrable semidiscrete Hirota I equation and nonintegrable semidiscrete Hirota II equation. We focus on the topics on gauge equivalent structures and dynamical behaviours for the two nonintegrable semidiscrete equations. By using the concept of the prescribed discrete curvature, we show that under the discrete gauge transformations, nonintegrable semidiscrete Hirota I and II equations are respectively gauge equivalent to the nonintegrable generalized semidiscrete modified Heisenberg ferromagnet equation and the nonintegrable generalized semidiscrete Heisenberg ferromagnet equation. We prove that the two discrete gauge transformations are reversible. We study the dynamical properties for the two nonintegrable semidiscrete Hirota equations. The exact spatial period solutions of the two nonintegrable semidiscrete Hirota equations are obtained through the constructions of period orbits of the stationary discrete Hirota equations. We discuss the topic that the spatial period property of the solution to nonintegrable semidiscrete Hirota equation is whether preserved to that of the corresponding gauge equivalent nonintegrable semidiscrete equations or not under the action of discrete gauge transformation. We also give the numerical simulations for the stationary discrete Hirota equations. We find that their dynamics are much richer than the ones of stationary discrete nonlinear Schrodinger equations. This is a joint work with Li-yuan Ma.

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MS77

Mobile Localized Solutions for An Electron in Lattices with Dispersive and Non-Dispersive Phonons

We consider a one dimensional lattice in which an electron can interact both with on-site non- dispersive (Einstein) phonons and with longitudinal dispersive acoustic (Debye) phonons and provide existence conditions for mobile localized electron excitations in the long wave limit. The role of both types of phonon modes on localization is also assessed, together with a discussion of differences existing between the discrete and the continuum approaches. A striking result is that, under certain conditions localized states can only be stable if they have a non-zero velocity.

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MS77

Surface Signature of Internal Waves

Based on a Hamiltonian formulation of a two-layer ocean, we derive an asymptotic model for surface-internal wave interactions, where the nonlinear internal waves evolve according to a KdV equation, while the smaller-amplitude surface waves are described by a linear Schrodinger equation. For internal solitons of depression, the Schrodinger equation is shown to be in the semi-classical regime and thus admits localized bound states. This leads to the phenomenon of trapped surface modes which propagate as the signature of the internal waves. Numerical simulations taking oceanic parameters into account are performed to illustrate this phenomenon. This is joint work with Walter Craig and Catherine Sulem.

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MS77

Dynamics of Localized Solution in Nonlocal NLS Equation with Double Well Potential

In this talk, we examine the combined effects of cubic and quintic terms of the long range type in the dynamics of a double well potential. Employing a two-mode approximation, we systematically develop two cubic-quintic ordinary differential equations and assess the contributions of the long-range interactions in each of the relevant prefactors, gauging how to simplify the ensuing dynamical system. Finally, we obtain a reduced canonical description for the conjugate variables of relative population imbalance and relative phase between the two wells and proceed to a dynamical systems analysis of the resulting pair of ordinary differential equations. The relevant bifurcations, the stability of the branches and their dynamical implications are examined both in the reduced (ODE) and in the full (PDE) setting.

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MS77

The Role of Radiation Loss in the Evolution of Elliptic Solitons in Nonlocal Soft Media

Optical solitary waves can propagate in a nematic liquid crystal, which exhibits an intensity dependent refractive index change, balancing beam diffraction and self-focusing. The evolution of an elliptical nematicon with orbital angular momentum is investigated. Modulation theory and numerical solutions show that shed diffractive radiation is critical to this evolution, which occurs in two phases. First, angular momentum is shed via spiral waves, reshaping the beam. Secondly, diffractive radiation loss drives the beam towards its steady state.

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MS78

Waves on the Interface of Two-Layer Liquid System Subject to Longitudinal Vibrations: Stability and Collision of Solitons

We consider dynamics of the internal interface in two-layer liquid system subject to longitudinal vibrations. We derive the equations of average dynamics of large-scale patterns

on the interface, reveal a one-parametric family of solitons and show that the persisting system dynamics is merely the kinetics of a set of these solitons. Collisions of solitons are comprehensively studied. Class of collisions leading to explosive layer rupture is revealed; formation of the rupture is both observed numerically and described analytically.

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MS78

Coherent Structures Interaction and Self-Organization in Dissipative Turbulence

We study interactions of coherent structures in a falling film as a generic prototype of dissipative turbulence. Our analysis is based on a low-dimensional formulation and direct numerical simulations (DNS). A rich and complex dynamics is observed, with monotonic, underdamped or self-sustained oscillations, finding excellent DNS-theory agreement. We also consider a shear-thinning falling film that yields hysteresis on the coherent structures as the Reynolds number increases which we quantify with appropriate stability analysis.

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MS78

Modulation of a Heat Flux in a Layer of Binary Mixture

We consider nonlinear dynamics of a longwave Marangoni convection in a binary liquid layer subject to a modulated heat flux at the bottom. It is shown that nonlinear evolution for synchronous and subharmonic modes is governed by the same set of standard Landau equations with the coefficients calculated numerically. For both modes the transition to the case of no modulation is nontrivial and the corresponding intermediate asymptotics are developed.

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MS78

Symmetries and Parametric Instabilities in Vibrating Containers

Symmetries, either exact or approximate, play an essential role in pattern forming systems, in particular under oscillatory excitation, suppressing some of the resonances expected in the generic case and enhancing others. This will be illustrated considering parametric excitation of surface waves in finite containers in several distinguished regimes, including single-mode and modulated patterns, horizontal and vertical excitation, and various excitation mechanisms such as vibration of the whole container and immersed wave makers.

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MS79

Model Reduction for Waves in Networks

The propagation of localized waves in nonlinear networks is an ubiquitous problem. Examples are fluxon motion in arrays of Josephson junctions, pulse propagation in the circulatory system. Modeling such problems is difficult and it is helpful to simplify the equation and the geometry. We will illustrate these issues with the analysis of the propagation of sine-Gordon waves through Y junctions.

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MS79

Partial Continuum Limits for Exciton Pulses in Large Molecules

Numerical solutions of ODEs related to the discrete NLS equation often develop propagating pulses with slow spatial variation, which has motivated the search for approximations by PDEs. In this talk, it is observed that these patterns are substantially different from previously-considered NLS approximations, and several new PDE approximations are presented: systems related to the Airy PDE, and a quite different system describing oscillations near endpoints. Numerical solutions and linear analysis show good agreement with the long-wave phenomena in the ODEs.

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MS79
Disorder in One-Dimensional Granular Crystals

We study the effects of multiple types of disorder — both correlated and uncorrelated — and nonlinearities on the evolution of an initially localized excitation in a one-dimensional granular crystal. In the linear limit, we examine various regimes of subdiffusivity, superdiffusivity, and absence of diffusion. These regimes depend on the strength and type of disorder as well as on the normal modes of the linear spectrum. When we introduce nonlinearity, we observe a gradual delocalization.

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MS79
Model Reduction in Optics and Traffic Modeling

This talk introduces some recurring ideas and methods in model reduction by describing two apparently diverse problems where similar reduction techniques are useful and related wave phenomena arise. The first is the Zeno effect for soliton type pulses in a nonlinear directional coupler with dissipation. The effect consists in increase of the coupler transparency with increase of the dissipative losses in one of the arms (joint work with F. Abdullaev et al). The second is traffic modeling, and methods for reducing traffic jams through modulations of parameters, such as stochastic modulation of the safety distance (joint work with Yuri Gaididei et al).

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MS80
Sloshing Dynamics with the Hamiltonian Particle-mesh Method

The Hamiltonian Particle-Mesh (HPM) method of [J. Frank, G. Gottwald & S. Reich. A Hamiltonian particle-mesh method for the rotating shallow-water equations, Meshfree Methods for Partial Differential Equations,Lecture Notes in Computational Science and Engineering, Springer 26 131142 (2002).] is used to develop a symplectic integrator in Eulerian-Lagrangian coordinate systems for the problem of dynamic coupling between shallow-water sloshing and horizontal vehicle motion. A simple and fast numerical algorithm with excellent energy conservation over long times, based on the Störmer-Verlet method is implemented. Numerical simulations of the coupled dynamics are presented and compared to the results of [H. Alemi Ardakani & T.J. Bridges. Dynamic coupling between shallow-water sloshing and horizontal vehicle motion, European Journal of Applied Mathematics 21 479517 (2010).] where the coupled fluid-vehicle problem is analysed in the pure Lagrangian Particle-Path (LPP) setting.

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MS80
Transversality of Solitary Waves and Their Stability

Variationnal partial differential equations like the Swift-Hohenberg equation or the Kawahara equation have an Hamiltonian steady part. This steady part can have an homoclinic tangle, a phenomenon which implies the existence of an infinity of isolated waves or solitary waves for the PDE. In this talk, we will describe how the Lazutkin invariant, a quantity originally introduced to study the steady part, can be related to the stability problem.

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MS80
An Application of Maslov Index to the Stability Analysis for Standing Pulses

For the FitzHugh-Nagumo equations, a standing pulse solution is a homoclinic orbit of a second order Hamiltonian system. We employ the Maslov index theory to give certain criteria for the stability of standing pulse. Related results are also applicable to more general skew-gradient systems.

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MS80
Stability of Periodic Waves in Hamiltonian Pdes

Many partial differential equations endowed with a Hamiltonian structure are known to admit rich families of periodic traveling waves. The stability theory for these waves is by many respects still in its infancy though. The main purpose of this talk is to point out a few results, for KdV-like equations and systems, that make the connection between three kind of approaches: spectral, variational, and modulational.

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MS81
Experimental Observation of Unstable Mode 2 Internal Waves

The structure and stability of mode 2 internal solitary-like waves were investigated. The amplitude of the wave and the offset of the pycnocline (with regard to the mid-depth of the water) were varied. In non-zero offset cases, it was found that the critical amplitude required for instability was less than in the zero offset counterpart case. It was also found that increasing the offset value led to increases in the asymmetry of the wave.

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MS81

Hydraulic Falls Under a Floating Ice Plate

Steady two-dimensional nonlinear flexural-gravity hydraulic falls past a submerged obstruction on the channel bottom are considered. The fluid is assumed to be ideal and is covered above by a thin ice plate. Cosserat theory is used to model the ice plate as a thin elastic shell, and boundary integral equation techniques are employed to find critical flow solutions. By utilising a second obstruction, solutions with a train of waves trapped between the obstructions are investigated.

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MS81

Analysis and Computations of the Initial Value Problem for Hydroelastic Waves

First, we summarize a new existence and uniqueness proof for the initial value problem for hydroelastic waves in 2D flow. The proof uses energy methods, following earlier work by Ambrose on vortex sheets with surface tension. Second, an efficient, nonstiff boundary integral method for 3D hydroelastic waves is presented. The stiffness is removed by developing a small-scale decomposition, in the spirit of prior work on 2D vortex sheets with surface tension by Hou, Lowengrub and Shelley. The existence theory and numerical method both rely on a formulation of the problem using a generalized isothermal parameterization of the interface. This is joint work with David Ambrose.

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MS81

Comparing Stokes Drift for Internal and Surface Gravity Wave Packets

We compare and contrast existing and new results for the Stokes drift and associated return flow for surface gravity wave packets on an unstratified fluid to new results for the Stokes drift and its "return flow' for Boussinesq internal gravity wave packets on a linearly stratified fluid. We do so by exploring a perturbation expansion in two small parameters, the steepness and the bandwidth of the packet, and provide a numerical validation.

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MS82

Stablility of Localized Structure for a Semi-Arid Climate Model

This talk will give a brief overview of dynamical systems and climate. We will also detail recent stability results and multi-pulse interaction laws for N-pulse semi-strong solutions to the Gray-Scott model. This model has recently been used to describe vegetative pattern formation in a semi-arid ecosystem.

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MS82

Model Reduction and Response for Two-Timescale Systems Using Fluctuation-Dissipation

Direct numerical simulation of a large multiscale system is typically cost prohibitive. We present a method to generate reduced models for the slow variables of two-timescale ODE systems using an averaging method combined with the fluctuation-dissipation theorem to obtain a linear response correction term for the averaged fast dynamics. We apply this method to a two-scale Lorenz '96 model and analyze the statistics and perturbation response of the resulting reduced system.

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MS82

Tipping and Warning Signs for Patterns and Propagation Failure in SPDEs

In this talk, I shall report on recent results on early- warning signs for pattern formation in stochastic partial differential equations. In particular, it will be shown that classical scaling laws from stochastic ordinary differential equations can be carried over to the SPDE case. This is illustrated in the context of the Swift- Hohenberg equation, analytically and numerically. Furthermore, I shall discuss numerical results for warning signs for the stochastic Fisher- KPP equation in the case of noisy invasion front travelling waves near positive absorption probability events

leading to propagation failure.

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MS82

Semi-Strong Desertification Dynamics with a Slowly Changing Parameter

We introduce a slowly changing parameter in the framework of semi-strong interaction of pulses in reaction diffusion systems, which appear as models for vegetation in (semi-)arid regions. Geometric singular perturbation theory yields laws of motion for the pulses and spectral (in)stability of the configuration. Crucial is understanding the interplay between the inherent slow dynamics of the pulse interactions and the rate of change of the changing parameter: will ecosystem response be fast enough to postpone destabilization by a changing parameter?

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MS83

Thermo-Optical Effects and Mode Instabilities in Large Mode Area Photonic Crystal Fibers

In recent years fiber laser systems have shown a rapid evolution in terms of beam quality and power. High pulse energies and peak power require large effective area and new photonic crystal fiber designs are proposed. Thermo-optical effects can lead to transverse mode instability (TMI), a nonlinear effect that sets in at a threshold power level. The numerical models of TMI for understanding the origin and mechanism behind, and for future mitigation strategies are discussed.

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MS83

Tuning of Surface Plasmon Polaritons Beat Length in Graphene Directional Couplers

We investigate the tuning of the coupling of surface plasmon polaritons between two spatially separated graphene layers. We demonstrate that the coupling coefficient in such structures can be easily controlled by means of an applied electrical signal. We prove theoretically and numerically that by slightly changing the chemical potential, a graphene coupler can switch from the bar to the cross state.

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MS83

Self-Tuning Nonlinear Optical Systems

We demonstrate that the integration of data-driven machine learning strategies with adaptive control produce an efficient and optimal self-tuning algorithm for mode-locked fiber lasers. The adaptive controller is capable of obtaining and maintaining high-energy, single-pulse states in a mode-locked fiber laser while the machine learning characterizes the cavity itself for rapid state identification and improved optimization. The theory developed is demonstrated on a nonlinear polarization rotation (NPR) based laser using waveplate and polarizer angles to achieve optimal passive mode-locking despite large disturbances to the system. The physically realizable objective function introduced divides the energy output by the fourth moment of the pulse spectrum, thus balancing the total energy with the time duration of the mode-locked solution. The methods demonstrated can be implemented broadly to optical systems, or more generally to any self-tuning complex systems.

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MS83

Ultrafast Spatial and Temporal Soliton Dynamics in Gas-Filled Hollow-Core Photonic Crystal Fibres

Optical solitons form the core of the many of the most exciting nonlinear phenomena in nonlinear fibre optics for example, they are the basis of a plethora of supercontinuum mechanisms. Next generation photonic-crystal fibres filled with gas provide new opportunities and regimes to explore soliton physics, ranging from the influence of soliton-induced plasma, to the possibility of guiding and generating sub-cycle and vacuum-UV optical fields. A range of theoretical and experimental results will be discussed.

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MS84
Standing Waves and Heteroclinic Networks in the Nonlocal Complex Ginzburg-Landau Equation for Electrochemical Systems

The nonlocal complex Ginzburg-Landau equation [V. Garcia-Morales and K. Krischer, Phys. Rev. Lett. 100, 054101 (2008)] describes the interaction between the electrostatic potential and the oscillatory nonlinear kinetics of spatially extended electrochemical systems. This equation is shown to exhibit heteroclinic netwroks and standing waves (under global coupling). The latter lead to complex interference patterns, with active subharmonic modes. Linear stability and symmetry analysis allow detailed features of these coherent structures to be elucidated.

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MS84
Bifurcations in the Langmuir-Blodgett Transfer Problem

Spontaneous pattern formation in deposition processes at receding contact lines has become a versatile tool to coat substrates with well controlled micro- and nanostructures. As a paradigmatic example, the coating of substrates with periodically structured monolayers has in recent years been investigated by theoreticians and experimentalists [Köpf et al, *New J. Phys.* **14** (2012) 02316 and *Langmuir* **26** (2010) 10444, Li et al, *Small* **8** (2012) 488] alike. Here, we present recent progress, allowing for the first time to understand the intricate bifurcation diagram of the system that exhibits a snaking branch of stationary solutions. Each nose of the snake is connected to a branch of time periodic solutions. Using numerical continuation, we detect various local and global bifurcations and investigate how the solution structure depends on the system size. These results are of wide interest for the theoretical description of pattern formation in systems with nontrivial boundary conditions.

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MS84
Coherent Structures in Confined Swarming Flows

Swarming flows display new interesting behaviours associated with the collective dynamics of interacting active swimmers. We report new observations of collective motion of concentrated semen arising inside an annulus through spontaneous symmetry breaking. The resulting self-sustained dynamics shows various interesting regimes such as constant rotation, oscillating rotation, and damped oscillations. A similar configuration is analyzed through a linear instability analysis of the Viksek model which display a rich variety of modes with similar behaviour.

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MS84
On Electrical Diffuse Layers in Ionic Liquids and Heteroclinic-Type Connections

Studies of room temperature ionic liquids, showed that electrical diffuse layers can be thick and exhibit spatially extended non-monotonic (oscillatory) and monotonic decays. These unconventional properties are fundamentally different from traditional (dilute) electrolytes and demonstrate the limited mechanistic understanding of highly concentrated electrolytes. To advance the understanding of electrical diffuse layers in ionic liquids we use a semi-phenomenological modified Poisson-Nernst-Planck equations and regulate weak dilutions. Using spatial dynamics and numerical methods, we analyze distinct diffuse layer characteristics and provide for each type the analytic conditions and the validity limits in terms of applied voltage, domain size, molecular packing, and short range electrostatic correlations. We also discuss the qualitative generality of the results via global heteroclinic-type connections.

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MS85
Controlability of Schroedinger Equation with a Hartree Type Nonlinearity

We are concerned with the control problem for

$$i\,u_t = -u_{xx} + \alpha(x)\,u + \left(\int (|x-y| - |x|)|u(y,t)|^2 dy\right) u,$$

where the Hartree nonlinearity stems from the coupling with the 1D Poisson equation, and $\alpha(x) \in C^\infty$ has linear growth at infinity, including constant electric fields. We shall show that for both small initial and target states, and for distributed controls supported outside of a fixed compact interval, the model equation is controllable. We shall also give non controllability results for distributed controls with compact support

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MS85

Exact and Approximate Solutions for Solitary Waves in Nematic Liquid Crystals

The system described solitary waves in nematic liquid crystals (NLC) is general, arising in many other areas of physics.. Isolated exact solutions and general variational approximations are found for solitary waves in NLC's. These approximate solutions are compared with numerical solutions and the relative merits of different ansatze are discussed. Physically, we find a type of bistability in the system and a minimum power for solitary waves to exist.

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MS85

Localized Solutions and Traveling Waves in a Nonlocal Parametrically Forced Nonlinear Schroedinger Equation

The parametrically forced nonlinear Schroedinger equation is a model for nonlinear dissipative systems, including detuned operation of optical parametric oscillators. It has been shown to support a rich variety of localized solutions, including standing, periodic and (unstable) traveling waves. We show how coupling this equation to a heat equation produces stable traveling waves whose dynamics can be understood through a simple reduction to collective coordinates, and we discuss their connection to solutions of the uncoupled equation.

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MS86

Continuously Quenched Pattern Dynamics in Drying Liquid Films

The nonlinear dynamics of Bnard-like surface-tension-driven patterns in thin liquid films evaporating into ambient air is analyzed experimentally and theoretically. Due to the layer thickness decrease, the average size of convection cells continuously decreases by a fast mitosis process, which results in highly disordered structures. Their characteristics are studied using a long-wave convection model, which compares qualitatively well with experiments. A simple fitting-parameter-free model is also proposed for the threshold thickness below which patterns disappear.

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MS86

Wave Instability of a Rotating Liquid-Liquid Interface

Experimental study is performed of rotating system of two immiscible liquids of different density. Inertial waves, excited on the centrifuged interface under external periodic force action perpendicular to rotation axis, are considered. Excitation of interface differential rotation is observed. With an increase of external forcing, an azimuthal wave, characterized by pronounced two-dimensional crests parallel to rotation axis, is excited on the interface accompanied with interface differential rotation velocity increase. Thresholds of interface stability are studied.

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MS86

Thin Film Flows over Spinning Discs: Numerical Simulation of Three-Dimensional Waves

We model the flow of a thin film over a rotating disc using the integral method coupled to the method of weighted residuals to derive a set of evolution equations for the interface, and the radial and azimuthal flow rates. These equations account for centrifugal, inertial, and capillary forces and the transition from two-dimensional to three-dimensional waves as these waves travel towards the disc periphery. We compare our results with those from full Navier-Stokes simulations.

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MS86

Compactons Induced by Nonconvex Advection

Using the model equation $u_t \pm (u^3 - u^2)_x + (u^3)_{xxx} = 0$ we study the impact of a non-convex convection on formation of compactons. In the ositive version, both traveling and stationary compactons are observed, whereas in the negative branch, compactons may form only for a bounded range of velocities. Depending on their relative speed, interaction of compactons may be close to being elastic or a fission process wherein the collision gives rise to additional compactons.

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MS87

Settling and Rising in Density Stratified Fluids: Analysis and Experiments

Not Available at Time of Publication

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MS87

Transcritical Flow of a Stratified Fluid Over Topography and Non-classical Dispersive Shock Waves

We study transcritical flow of a stratified fluid past a broad localised topographic obstacle using the recent development of the nonlinear modulation theory for the forced Gardner equation. We identify some of the wave structures generated by the transcritical flow as dispersive counterparts of non-classical shocks and double waves occurring in the regularisation of non-convex hyperbolic conservation laws. The talk is based on joint works with R. Grimshaw, A. Kamchatnov and M. Hoefer.

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MS87

Solute Dynamics Within Settling Marine Snow at Density Discontinuities

Not Available at Time of Publication

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MS87

Experiments and Theory for Porous Spheres Settling in Sharply Stratified Fluids

Marine snow, aggregates composed of organic and inorganic matter, play a major role in the carbon cycle. Most of these particles are extremely porous, allowing diffusion of a stratifying agent from the ambient fluid to affect the density and therefore the settling dynamics. We study the case of a single spherical particle settling in water stratified by salt, focusing on effects of porosity and diffusion. A parametric study of the settling behaviors and comparisons between modeling and experiments will be presented.

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MS88

Multisymplectic Structure and the Stability of Solitary Waves

A challenge in the stability analysis of solitary waves is to find general conditions for stability or instability. In this talk it is shown how multi-symplectic structures leads to a general instability condition for a large class of solitary waves of Hamiltonian PDEs. It generalizes theory of Pego & Weinstein (1992) and Bridges & Derks (2001), and uses new results of Bridges & Chardard (2014) on transversality. It is shown that the product of the the Lazutkin-Treschev invariant, and dI/dc, the derivative of the momentum with respect to the speed, generates a sufficient condition for linear instability of solitary waves.

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MS88

Standing Pulse Solution of Fitzhugh-Nagumo Equations

Using a variational formulation, we study standing pulse solutions of the FitzHugh-Nagumo equations when the activator diffusion coefficient is small compared to that of the inhibitor. There is no global minimizer in this case, we therefore look for local minimizer by imposing appropriate topological constraints on the solution space. Interesting techniques are developed to deal with such classes of topological constraints.

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MS88

Dispersive Shear Shallow Water Flows

We derive a new dispersive model of shear shallow water flows through the Hamilton principle. The model generalizes the well-known Green-Naghdi model.

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MS88

A Hamiltonian Analogue of the Meandering Transition

A Hamiltonian analogue of the meandering transition from rotating waves to modulated traveling waves (TWs) in systems with Euclidean symmetry is presented. In dissipative systems this transition is associated with a Hopf bifurcation. In the Hamiltonian case, for example in models of point vortex dynamics, the conserved quantities of the system are bifurcation parameters. Depending on symmetry, it is shown that either modulated TWs do not occur, or modulated TWs are the typical scenario near rotating waves.

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MS89

Axisymmetric Solitary Waves on a Ferrofluid Jet

The propagation of axisymmetric solitary waves on the surface of a cylindrical ferrofluid jet subjected to a magnetic field is investigated. A numerical method is used to compute fully-nonlinear travelling solitary waves and predictions of elevation waves and depression waves by Rannacher & Engel (2006) using a weakly-nonlinear theory are confirmed in the appropriate ranges of the magnetic Bond number. New nonlinear branches of solitary wave solutions are identified. As the Bond number is varied, the solitary wave profiles may approach a limiting configuration with a trapped toroidal-shaped bubble, or they may approach a static wave if the wave speed approaches zero. For a sufficiently large axial rod, the limiting profile may exhibit a cusp.

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MS89

On the Interaction Between Surface and Internal Waves

We consider a system of two fluids of different densities bounded above by a free surface. The propagation of surface and internal waves generated by an external forcing and their interaction are studied both theoretically and experimentally.

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MS89

Computing the Pressure in Fully Nonlinear Long-Wave Models for Surface Water Waves

The effect of a linear background shear flow on the pressure beneath steady long gravity waves at the surface of a fluid is investigated. Using an asymptotic expansion for the streamfunction, we derive a model equation given in terms of the background vorticity, the volume flux, the total head and the momentum flux. It is shown that a strongly sheared flow leads to nonmonotonicity of the fluid pressure in the sense that the maximum pressure is not located under the wave crest, and the pressure just beneath the wavecrest can be below atmospheric pressure.

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MS89

Davies Approximation of Levi-Civita's Surface Condition for Water Waves in the Complex Domain

Levi-Civita's surface condition is the free surface condition for an irrotational plane flow using the logarithmic hodograph variable. This condition allows us to apply Davies' approximation to the problem of steady water waves, and discuss all waves, from small-amplitude waves to the highest one with a corner flow at the crest. This work investigates singularity structure of this approximate solution, and compares the high-order Davies approximations with some other standard methods including long wave approximation.

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MS90

Automatic Recognition and Tagging of Topologically Different Regimes in Dynamical Systems

We discuss robust methods to characterize and detect sudden shifts, eg. critical transitions, between different regimes in stochastic dynamical systems, with examples from classical dynamics as well as real world climatological data. We develop techniques for the detection of such critical transitions from sparse observations contaminated by noise. We present a machine learning framework which accurately tags different regimes of a dynamical systems based on topologically persistent features near an attractor. In particular, our methodology performs well in the context of periodic orbits and saddle-type bifurcations.

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MS90

Data Assimilation for Quadratic Dissipative Dynamical Systems

Data assimilation refers to the incorporation of a model of a system together with data in the form of noisy observations of that system in order to infer the underlying state and/or parameters of the system. In the case in which the data is received online and incorporated sequentially, it is referred to as filtering. We present accuracy and well-posedness results for two prototypical filters, 3DVAR and EnKF, for a broad class of quadratic dissipative dynamical systems, including Navier-Stokes, Lorenz '96, and Lorenz '63.

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MS90

Mixed Mode Oscillations in Conceptual Climate Models: An In-depth Discussion

This talk analyzes a fast/slow system with one fast and two slow variables. Geometric singular perturbation theory is used to demonstrate the existence of a folded node singularity. A parameter regime is found in which the folded node leads to a stable MMO orbit through a generalized canard phenomenon.

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MS90

Mixed Mode Oscillations in Conceptual Climate Models: A General Perspective

Much work has been done on relaxation oscillations and other simple oscillators in conceptual climate models. The oscillatory patterns frequently found in climate data however are often more complicated than what can be described by such mechanisms. In this talk, I will present some recent work incorporating ideas from the study of mixed mode oscillations into conceptual modeling of climate systems.

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MS91

The Nonlocal Nonlinear Wave Equation with Periodic Boundary Conditions: Analytical and Numerical Results

We consider a general class of nonlinear nonlocal wave equation arising in one-dimensional nonlocal elasticity [N. Duruk, H. A. Erbay, A. Erkip, "Global existence and blow-up for a class of nonlocal nonlinear Cauchy problems arising in elasticity", Nonlinearity, 23, 107-118, (2010)]. The model involves a convolution operator with a general kernel function whose Fourier transform is nonnegative. We focus on well-posedness and blow-up results for the nonlocal wave equation with periodic boundary conditions. We then propose a Fourier pseudo-spectral numerical method. To understand the structural properties of the solutions, we present some numerical results illustrating the effects of both the smoothness of the kernel function and the strength of the nonlinear term on the solutions. This work has been supported by the Scientific and Technological Research Council of Turkey (TUBITAK) under the project MFAG-113F114.

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MS91

Orbital Stability of Solitary Waves of Moderate Amplitude in Shallow Water

We study the orbital stability of solitary traveling wave solutions of the following equation for surface water waves of moderate amplitude in the shallow water regime:

$$u_t+u_x+6uu_x-6u^2u_x+12u^3u_x+u_{xxx}-u_{xxt}+14uu_{xxx}+28u_xu_{xx}=0.$$

Our approach is based on a method proposed by Grillakis, Shatah and Strauss in 1987, and relies on a reformulation of the evolution equation in Hamiltonian form. We deduce stability of solitary waves by proving the convexity of a scalar function, which is based on two nonlinear functionals that are preserved under the flow.

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MS91

Local Well-posedness for a Class of Nonlocal Evolution Equations of Whitham Type

For a class of pseudodifferential evolution equations of the form

$$u_t+(n(u)+Lu)_x=0,$$

we prove local well-posedness for initial data in the Sobolev space H^s, $s>3/2$. Here L is a linear Fourier multiplier with a real, even and bounded symbol m, and n is a real measurable function with $n'' \in H^s_{loc}(\mathbb{R})$, $s>3/2$. The proof, which combines Kato's approach to quasilinear equations with recent results for Nemytskii operators on general function spaces, applies equally well to the solitary and periodic cases.

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MS91

Traveling Surface Waves of Moderate Amplitude in Shallow Water

We study traveling wave solutions of an equation for surface waves of moderate amplitude arising as a shallow water approximation of the Euler equations for inviscid, incompressible and homogenous fluids. We obtain solitary waves of elevation and depression, including a family of solitary waves with compact support, where the amplitude may increase or decrease with respect to the wave speed. Our approach is based on techniques from dynamical systems and relies on a reformulation of the evolution equation as an autonomous Hamiltonian system which facilitates an explicit expression for bounded orbits in the phase plane to establish existence of the corresponding periodic and solitary traveling wave solutions.

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MS92

Variational Models and Energy Landscapes Associated with Self-Assembly

In this talk, I will address two paradigms for self-assembly. The first is via phase-field, energy-driven pattern formation induced by competing short and long-range interactions. A nonlocal perturbation (of Coulombic-type) to the well-known Ginzburg-Landau/Cahn-Hilliard free energy gives rise to a mathematical paradigm with a rich and complex energy landscape. I will discuss some recent work (with Dave Shirokoff and J.C. Nave at McGill) on developing methods for (i) assessing whether or not a particular metastable state is a global minimizer and (ii) navigating from metastable states to states of lower energy. The second paradigm is purely geometric and finite-dimensional: Centroidal Voronoi tessellations (CVT) of rigid bodies. I will introduce a new fast algorithm for simulations of CVTs of rigid bodies in 2D and 3D and focus on the CVT energy landscape. This is joint work with Lisa Larsson and J.C. Nave at McGill.

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MS92

A Generalized Otha-Kawasaki Model with Asymmetric Long Range Interactions

Energy-driven pattern formation induced by interactions on various scales is common in many physical systems. The Ohta-Kawasaki model is a classic nonlocal Cahn-Hilliard model which gives rise to pattern formation driven by the competition between short and long range interactions between phases A and B. The interactions described in the Otha-Kawasaki model are symmetric, i.e., phase A interacts with phase B in the same way phase B interacts with phase A. Therefore, the only way to break symmetry is by introducing mass asymmetry between phase A and phase B, a parameter which is not directly related to long range interactions. In this talk, I will present a Generalized Otha-Kawasaki Model with asymmetric long range interactions, whose derivation is motivated from a model of a binary mixture of charged phases. Of particular interest is the mass symmetric case, as in this case, any asymmetry between the two phases is directly related to the nature of long-range interaction. I will present a systematic analysis of the equation. In particular, I will demonstrate that proper tuning of the long range interaction gives rise to patterns which cannot exist in the Otha-Kawasaki model, and show that it is possible to attain isolated structures.

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MS92

Competitive Geometric Evolution of Network Morphologies

Abstract: Functionalized polymer membranes have a strong affinity for solvent, imbibing it to form charge-lined networks which serve as charge-selective ion conductions in a host of energy conversion applications. We present a continuum model, based upon a reformulation of the Cahn-Hilliard free energy, which incorporates solvation energy and counter-ion entropy to stabilize a host of network morphologies. We derive geometric evolution for co-dimension 1 bilayers and co-dimension two pore morphologies and show that the system possesses a simple mechanism for competitive evolution and bifurcation of co-existing networks through the common far-field chemical potential.

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MS92

Multiple Water-Vegetation Feedback Loops Lead to Complex Vegetation Diversity Through Competing Turing Mechanisms

In my presentation I will use the context of dryland vegetation to study a general problem of complex pattern forming systems - multiple pattern-forming instabilities that are driven by distinct mechanisms but share the same spectral properties. This study shows that the co-occurrence of two Turing instabilities, when the driving mechanisms counteract each other in some region of the parameter space, results in the growth of a single mode rather than two interacting modes. The interplay between the two mechanisms compensates for the simpler dynamics of a single mode by inducing a wider variety of patterns, which implies higher biodiversity in dryland ecosystems.

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MS93

Some Results About the Relativistic NLS Equation

We study the existence of ground states of the non linear pseudo-relativistic Schrödinger equation $i\psi_t = \left(\sqrt{m^2 - \partial_x^2} - m\right)\psi - |\psi|^2\psi$, by using a suitable adaptation of the concentration-compactness principle. We prove existence of the boosted ground states with profile $\varphi_v \in H^{1/2}(\mathbb{R})$. Also, we present results on the regularity of the ground states and on the weak orbital stability of the flow of the equation. In addition we present an efficient numerical method to compute the profile φ_v of the boosted ground state solution.

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MS93
Interaction of Dark Nonlocal Solitons

In typical nonlinear media the response to the propagating wave in a particular point is determined by the intensity of the wave in the same point. On the other hand, in media with nonlocal nonlinearity the nonlinear response in a particular location depends on the strength of the wave in a certain neighbourhood of this location. Nonlocality appears to be a generic feature of various nonlinear systems ranging from optical beams to matter waves. It may result from certain transport processes such as, atom diffusion, heat transfer or the long range of the inter-particle interaction as in the case of nematic liquid crystals. Such a spatially nonlocal nonlinear response is also inherent to coherent excitations of Bose-Einstein condensates where it is due to the finite range of the inter-particle interaction potential. Propagation of waves in nonlocal media has been extensively studied both theoretically and experimentally in last decade. It turns out that nonlocality may dramatically affect propagation of waves, their localization and stability. In particular, it has been shown that while nonlocality generally slows down modulational instability it may actually promote it in defocusing media if the nonlocal response function is sufficiently flat. Moreover, nonlocality has been shown to arrest collapse of finite beams and stabilize spatial solitons, including vortex and rotating solitons. In addition nonlocal response of the medium drastically affects soliton interaction. In this talk we will discuss propagation of dark spatial solitons in spatially nonlocal media. I will show how nonlocality affects properties of individual dark solitons and their interaction. In particular we demonstrate that nonlocality introduces attractive force between normally repelling dark solitons and ultimately lead to the formation of their bound states. Our analytical and numerical results are confirmed by experiments with spatial dark solitons in weakly absorbing liquids.

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MS93
Optical Solitons in Nematic Liquid Crystals: Continuous and Discrete Models

We present some results on optical solitons in nematic liquid crystals, and in waveguide arrays built from liquid crystals. The corresponding models are continuous and discrete cubic NLS equations with Hartee-type nonlinearities that involve Bessel potentials. We first review results on energy minimizing solitary wave solutions for the continuous 2-D case. We show the existence of smooth, radial, and monotonic (up to symmetries) sollitons, and we also show that these solutions can only exist above a power threshold. This is joint work with T. Marchant, U. Wollongong, Australia. We also report on more recent work on the discrete 1-D problem, where we discuss existence and stability of various types of breather solutions.

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MS94
Mixing in Stratified Shear Flows: The Central Role of Coherent Structures

Stratified shear flow instabilities can modulate, and in some circumstances significantly accelerate, the transition to turbulence in stratified fluids, which are very common in the environment. We demonstrate that the life-cycles of such coherent vortical primary and secondary instabilities play a central role in the commonly observed non-monotonic dependence of turbulent mixing on overall stratification, leading, through a classical physical mechanism first identified by Phillips, to the inevitable, generic development of layers in stratified fluids.

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MS94
Large Amplitude Solitary Waves and Dispersive Shock Waves in Conduits of Viscous Liquids

A dispersive shock wave (DSW) represents the combination of solitary and linear dispersive wave phenomena into one coherent structure. DSWs are therefore fundamental nonlinear structures that can occur in any conservative hydrodynamic setting, e.g., superfluids and "optical fluids". Experimental studies of DSWs in all media have been restricted by inherent physical limitations such as multi-dimensional instabilities, difficulties in capturing dynamical information, and, eventually, dissipation. These limit DSW amplitudes, evolution time, and spatial extent. In this talk, a new medium is proposed in which to study DSWs that overcomes all of these difficulties, allowing for the detailed, visual investigation of dispersive hydrodynamic phenomena. The vertical evolution of the interface between a buoyant, viscous liquid conduit surrounded by a miscible, much more viscous fluid exhibits nonlinear self-steepening (wave breaking), dispersion, and no measurable dissipation. First, it will be shown experimentally and theoretically that the three Lax categories of KdV two-soliton interaction geometries extend into the strongly nonlinear regime. Then, DSW experiments and novel DSW-soliton interaction behaviors will be presented and compared with modulation theory. The talk will cover multiple scales, from the microscopic (Navier-Stokes), mesoscopic (interfacial conduit equation), and macroscopic (Whitham modulation equations), to the truth (experiments).

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MS94

Buoyant Jets and Vortex Rings in Stratification

We present theoretical, computational, and experimental studies of the motion of buoyant fluid through a stratified background density field focusing on the evolution of jets and vortex rings impinging upon sharp stratification. Both cases depict an interesting critical phenomena in which the buoyant fluid may escape or be trapped as the propagation distance is varied. For the case of jets, an exact solution is derived for the Morton-Taylor-Turner closure hierarchy which yields a simple formula for this critical distance, both with and without a nonlinear "entropy" condition. These formulae will be compared directly to experimental measurements. Additionally, analysis will be shown demonstrating that the sharp two-layer background is the optimal stably stratified mixer. For the case of the buoyant vortex ring, full DNS simulations of the evolving ring impinging upon sharp stratification will compared directly with experimental measurements of the critical length.

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MS94

On the Extreme Runup of Long Surface Waves on a Vertical Barrier

The runup of long, strongly nonlinear waves impinging on a vertical barrier can result in a remarkable amplification (beyond 6 times) of the far-field amplitude of incoming waves. Such an extreme runup is the result of an evolution process in which long waves experience strong amplification under the combined action of nonlinear steepening and dispersion, followed by the formation of undular bores. In this work we study and discuss the conditions that result optimal for producing vertical runup, as well as some of its consequences, by means of numerical simulations of the free-surface Euler equations. In particular, we analyze the pressure fluctuations on the wall during strong runup cycles. We show that non-hydrostatic effects can strongly affect the dynamic loads exerted on the wall, and that, as a consequence, the high-frequency component of the pressure loads is significantly enhanced with respect to that of the wave spectrum itself. This observation suggests that also long oceanic waves can act as a source of seismic noise.

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PP1

Bifurcation of Travelling Waves in Nonlinear Magnetic Metamaterials

We consider a model of one-dimensional metamaterial formed by a discrete array of nonlinear split-ring resonators where each ring interacts with its nearest neighbors. At first we study this problem without taking into account the normalized electro-motive force and the loss coefficient. The existence and uniqueness results of periodic and asymptotic travelling waves of the system are presented, using dynamical system methods. We compare our analytical results with numerical simulation.

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PP1

The Dual-Weighted Residual Method Applied to a Discontinuous Galerkin Discretization for the Shallow Water Wave Equations

The dual-weighted residual (DWR) method provides an error estimator which can be used as a mesh refinement criterion for adaptive methods.Our aim is to use the DWR scheme for goal oriented mesh refinement applied to a discontinuous Galerkin (DG) discretization of the shallow water equations. Since the DG method allows discontinuous solutions the dual equations have discontinuous coefficients. We solve the dual equations also by the DG method, using a Riemann solver designed to handle discontinuous coefficients.

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PP1

Dipolar Bose-Einstein Condensates

In this poster we analyze the Gross-Pitaevskii equation modeling the dynamics of dipolar Bose-Einstein condensates:

$$\begin{aligned} i\psi_t(x,t) &= -\frac{1}{2}\Delta\psi(x,t) + V(x)\psi(x,t) \\ &\quad +\alpha\,|\psi(x,t)|^2\,\psi(x,t) + \beta(W * |\psi|^2)\psi(x,t), \\ &\quad t \in \mathbb{R}_{>0}, x \in \mathbb{R}^3. \end{aligned}$$

where $V(x) = \omega_1 x_1^2 + \omega_2 x_2^2 + \omega_3 x_3^2$ states for a double-well harmonic trap potential (with ω_k being the trap frecuency in x_k direction) and $W(x) = \frac{1-3(x\cdot n)^2}{|x|^3}$ is the kernel of the dipolar interaction potential (with $n \in \mathbb{R}^3$, $|n| = 1$, being the dipole axis).

We show some known facts concerning the existence of solutions and well-posedness and present a time-splitting method for computing the dynamics.

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PP1

Oscillatory Pulses in the Fitzhugh-Nagumo Equation

It is well known that the FitzHugh-Nagumo system exhibits stable, spatially monotone traveling pulses. Also, there is numerical evidence for the existence of spatially oscillatory pulses, which would allow for the construction of multi-pulses. Here, we show the existence of oscillatory pulses rigorously, using geometric blow-up techniques and singular perturbation theory.

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PP1

Stability of Spatially Periodic Pulse Solutions in General Singularly Perturbed Reaction-Diffusion Systems

The spectral stability of spatially periodic pulse solutions is studied in a general class of singularly perturbed reaction-diffusion systems that significantly extends the theory for slowly non-linear equations of Gierer-Meinhardt/Gray-Scott type. The Evans function is approximated by a product of an analytic 'fast' component D_f and a meromorphic 'slow' component D_s, corresponding to singular limits of the stability problem. Stability is determined by D_f, D_s and 'small' spectrum around 0. Each of these aspects are analyzed in full asymptotic detail.

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PP1

Stochastic Mode-Reduction in Models with Conservative Fast Sub-Systems

We will consider application of the stochastic mode reduction to multi-scale models with deterministic energy-conserving fast sub-system. Since there is energy exchange between the fast conservative sub-system and the slow variables, it is necessary to explicitly keep track of the energy of the fast sub-system. Therefore, we develop a new stochastic mode reduction process in this case by introducing energy of the fast subsystem as an additional hidden slow variable. We use several prototype models to illustrate the approach.

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PP1

Stochastic Analysis of Turbulent Mixing

We study fluid mixing layers which grow out of acceleration driven instabilities, including the classical cases of Rayleigh-Taylor instability, driven by a steady acceleration and Richtmyer-Meshkov instability, driven by an impulsive acceleration. Numerical simulations of the microphysical equations of fluid mixing are validated through comparison to laboratory experiments. We mathematically analyze properties of fluid mixing and averaged equations.

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PP1

Abundant Soliton Solutions of the General Nonlocal Nonlinear Schrodinger System with the External Field

Periodic and quasi-periodic breather multi-solitons solutions, dipole-type breather soliton solution, the rogue wave solution and the fission soliton solution of the general nonlocal Schrodinger equation are derived by using the similarity transformation and manipulating the external potential function. And the stability of the exact solitary wave solutions with the white noise perturbation is investigated numerically..

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PP1

Elastic Nonlineal Model for a Unidimensional Chain with Clustering Zones

We study weakly nonlineal localized oscillations in an quartic elastic network model. Elastic network models describe sets of particles interacting through pairwise elastic potentials of finite range, We use a small displacement assumption to derive a quartic FPU-type model in which the number of interacting neighbours depends on the site. The spatial inhomogeneity of the interaction, specifically the presence of clusters of particles that interact with many neighbours, leads to the existence localized linear modes. Additionally we show examples where the properties of the linear spectrum, and the nonlinear mode interaction coefficients allow us to bring the system into a normal form that

has invariant subspaces with additional symmetries and periodic orbits that represent spatially localized motions.

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PP1

Scattering from a Large Cylinder with a Cluster of Eccentrically Embedded Cores

The onset of Anderson localization at millimeter/sub-millimeter wavelengths is experimentally studied by examining a scale model of cylindrical scatterers embedded into a large host cylinder. Analytic methods are developed to compare the laboratory measurements with the theoretical predictions. A numerical implementation of these methods allows us to gain physical insight into the onset of Anderson localization in two and three dimensions.

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PP1

Oscillons Near Hopf Bifurcations of Planar Reaction Diffusion Equations

Oscillons are planar, spatially localized, temporally oscillating, radially symmetric structures. They have been observed in several experimental media, including fluids, granular particles, and chemical reactions. Oscillons often arise near forced Hopf bifurcations. Such systems are modeled mathematically by the forced complex Ginzburg-Landau equation (CGL). We present a proof of the existence of oscillons CGL through a geometric blow-up analysis. Our analysis is complemented by a numerical continuation study of oscillons using Matlab and AUTO.

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PP1

Stability of Morphodynamical Equilibria in Tidal Basins

Interesting patterns are observed in the tidal basins in The Wadden Sea. To get a better understanding of these patterns, a morphodynamical model is constructed. This model describes the interaction between water motion, sediment transport and bed evolution. The goal is to find the morphodynamic equilibria, to investigate their sensitivity to parameter variations, and to understand the physical mechanisms resulting in these equilibria.

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PP1

Hydrodynamic Rogue Waves

The poster primarily discusses the hierarchy of rogue wave structures generated by the Peregrine soliton in envelope equations. This covers how to generate higher order solutions from those known and how these behave in higher order models, such as the Dysthe equation. The poster also touches on the stability of the Peregrine soliton to different kinds of disturbances and how these can be generalised to other rational solutions of the Nonlinear Schrodinger equation.

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PP1

Bifurcation of Travelling Waves in Nonlinear Magnetic Meta-Materials

We consider a model of one-dimensional meta-material formed by a discrete array of nonlinear split-ring resonators where each ring interacts with its nearest neighbors. At first we study this problem without taking into account the normalized electro-motive force and the loss coefficient. The existence and uniqueness results of periodic and asymptotic travelling waves of the system are presented, using dynamical system methods. We compare our analytical results with numerical simulation.

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PP1

Tracking Pattern Evolution Beyond Center Manifold Reductions with Singular Perturbations

We consider 2-component, singularly perturbed PDE-systems with a known stability spectrum, close to a bifurcation. A method which reduces them to 2D systems of ODEs governing the flow on an exponentially attracting 2D manifold, is presented. Other than center manifold reduction, this method remains robust even if the primary eigenvalue is of the same asymptotic magnitude as other eigenvalues. We also show explicit systems for which the reduction is 3D or 5D, and contains chaos.

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PP1

Reflection and Transmission of Plane Quasi Longitudinal Waves at Semiconductor Elastic Solid Interface

This paper deals with the study of reflection and transmission characteristics of acoustic waves at the interface of a semiconductor half-space and elastic solid.

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PP1

Robust Pulse Generators in An Excitable Medium with Jump-Type Heterogeneity

We study a spontaneous pulse-generating mechanism occurred in an excitable medium with jump type heterogeneity. We investigate firstly the conditions for the onset of robust-type PGs, and secondly, we show the organizing center of their complex ordered sequence of pulse generation manners. To explore the global bifurcation structure of heterogeneity-induced ordered patterns (HIOPs) including PGs, we devise numerical frameworks to trace the long-term behaviors of PGs as periodic solutions, and we detect the associated terminal homoclinic orbits that are homoclinic to a special type of HIOPs with a hyperbolic saddle.

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PP1

On the Statistics of Localized Rogue Wave Structures in Spontaneous Modulation Instability

We use numerical simulations of the stochastic NLSE to investigate the statistics of emergent intensity peaks in the chaotic field generated from spontaneous modulation instability. We show that these emergent structures display time and space properties well-described by analytic NLSE solutions including Akhmediev breather, Peregrine Soliton and Kuznetsov-Ma soliton forms. Examining the statistics of these structures allows us to associate the highest intensity rogue wave peaks as due to higher-order breather superpositions.

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PP1

Evolution Equations for Weakly Nonlinear Internal Ocean Waves

We follow a perturbation approach to derive an evolution equation from the equations of momentum for long, weakly nonlinear internal ocean waves for a two-layer system. At the second order of the momentum equations, the extended Kortewegde Vries equation was derived in the literature. For this work, we will attempt to rewrite the momentum equations at the third order and higher order.

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PP1

Soliton Interactions in the Sasa-Satsuma Equation on Nonzero Backgrounds

In this poster, we obtain two families of anti-dark soliton solutions of the Sasa-Satsuma equation on nonzero backgrounds, one of which can the W-shaped solitary structure. The anti-dark solitons admit both the elastic collisions and resonant interactions, which has been first reported in a one-dimensional nonlinear dispersive equation with only one field. In general, the solutions can exhibit more complicated phenomena which are combined of elastic and resonant interactions.

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NW14 Speaker and Organizer Index

SIAM Conference on Nonlinear Waves and Coherent Structures

August 11-14, 2014
Churchill College,
University of Cambridge,
United Kingdom

Italicized names indicate session organizers.

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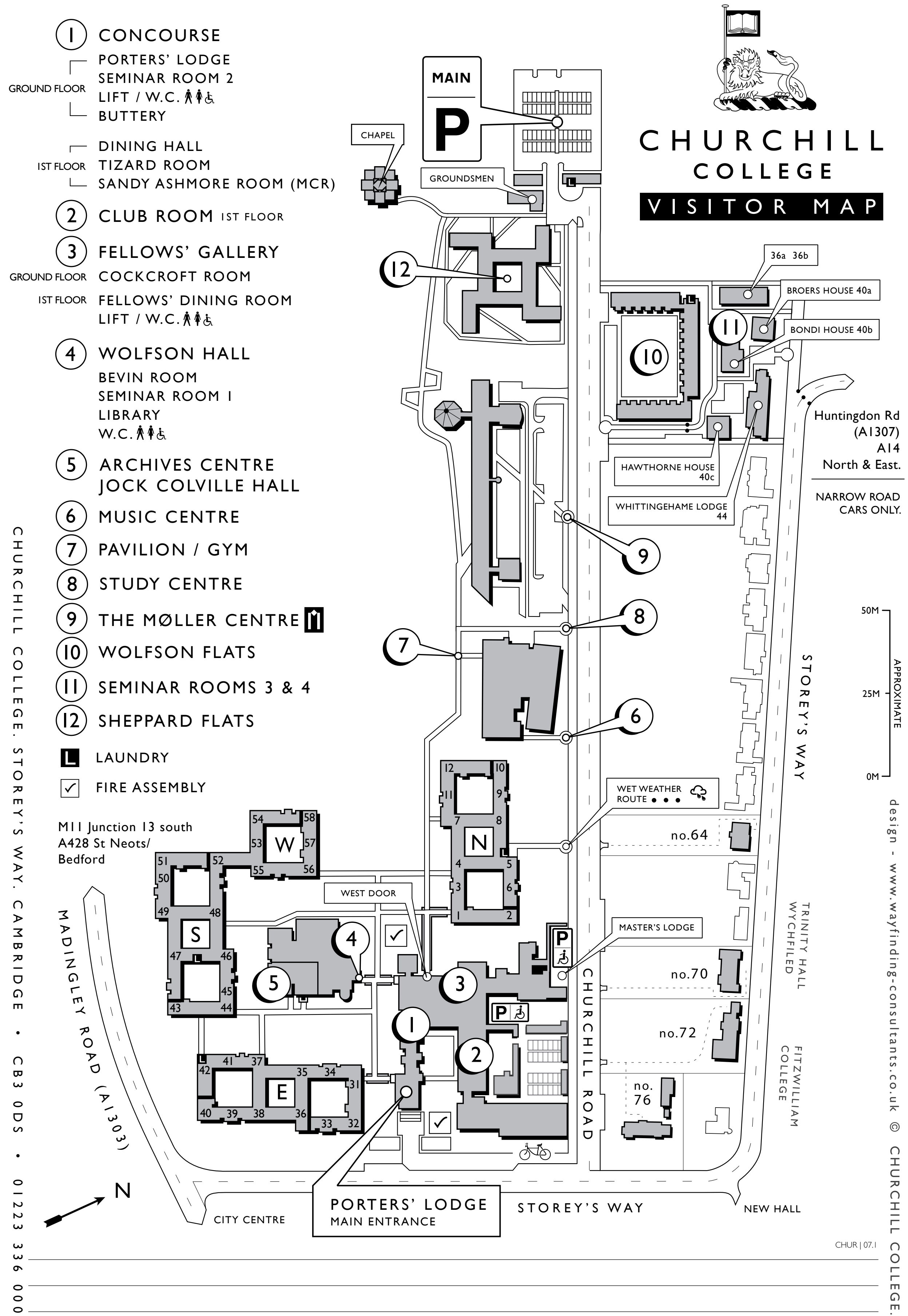
Notes

NW14 Budget

Conference Budget
SIAM Conference on Nonlinear Waves and Coherent Structures (NW14)
August 11-14, 2014
Churchill College, Cambridge, UK

Expected Paid Attendance	350	
Revenue		
Registration Income		$121,240
Grant to Surrey University from ONRG		$7,000
	Total	$128,240
Expenses		
Printing		$2,970
Organizing Committee		$2,880
Invited Speakers		$7,900
Food and Beverage		$2,178
AV Equipment and Telecommunication		$14,744
Advertising		$5,000
Professional Services		$64,114
Conference Labor (including benefits)		$24,027
Other (supplies, staff travel, freight, misc.)		$3,036
Administrative		$11,749
Accounting/Distribution & Shipping		$5,768
Information Systems		$10,316
Customer Service		$3,821
Marketing		$5,933
Office Space (Building)		$3,239
Other SIAM Services		$3,672
	Total	$171,347
Net Conference Expense		-$43,107
Support Provided by SIAM		$43,107
		$0
Estimated Support for Travel Awards not included above:		
Early Career / Students	30	$24,450


CHURCHILL
COLLEGE
VISITOR MAP
1 CONCOURSE
GROUND FLOOR
PORTERS' LODGE
SEMINAR ROOM 2
LIFT / W.C.
BUTTERY
1ST FLOOR
DINING HALL
TIZARD ROOM
SANDY ASHMORE ROOM (MCR)
2 CLUB ROOM 1ST FLOOR
3 FELLOWS' GALLERY
GROUND FLOOR COCKCROFT ROOM
1ST FLOOR FELLOWS' DINING ROOM
LIFT / W.C.
4 WOLFSON HALL
BEVIN ROOM
SEMINAR ROOM 1
LIBRARY
W.C.
5 ARCHIVES CENTRE
JOCK COLVILLE HALL
6 MUSIC CENTRE
7 PAVILION / GYM
8 STUDY CENTRE
9 THE MØLLER CENTRE
10 WOLFSON FLATS
11 SEMINAR ROOMS 3 & 4
12 SHEPPARD FLATS
L LAUNDRY
FIRE ASSEMBLY
MAIN P
CHAPEL
GROUNDSMEN
36a 36b
BROERS HOUSE 40a
BONDI HOUSE 40b
HAWTHORNE HOUSE 40c
WHITTINGEHAME LODGE 44
Huntingdon Rd
(A1307)
A14
North & East.
NARROW ROAD
CARS ONLY.
50M
25M
0M
APPROXIMATE
STOREY'S WAY
WET WEATHER ROUTE
no.64
MASTER'S LODGE
no.70
no.72
no.76
TRINITY HALL WYCHFILED
FITZWILLIAM COLLEGE
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M11 Junction 13 south
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Bedford
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MAIN ENTRANCE
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