Conference on Emerging Issues in Mathematics and Computation from the Materials

April 18-20, 1994 Pittsburgh Vista Hotel Pittsburgh, Pennsylvania

> Conducted by the Center for Nonlinear Analysis, Carnegie Mellon University, and SIAM

CONFERENCE THEMES

- Crystal Growth, Solidification, and Interface Motion
- Effective and Optimal Properties of Composite Materials and Ceramics
- Liquid Crystals and other Mesomorphic States of Matter
- Magnetic Materials
- Materials Issues in Nonlinear Optics
- Material Microstructure and Macroscopic Behavior
- Superconductivity and Its Applications

April 18 – 20, 1994

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DEADLINE DATES

Hotel Reservation Monday, March 28, 1994

Conference Preregistration Monday, April 4, 1994

ORGANIZING COMMITTEE

David Kinderlehrer, Chair Department of Mathematics and Center for Nonlinear Analysis, Carnegie Mellon University

John M. Ball Department of Mathematics and International Centre for Mathematical Sciences, Heriot Watt University, Scotland

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Max D. Gunzburger Department of Mathematics, Virginia Polytechnic Institute and State University

Morton E. Gurtin Department of Mathematics and Center for Nonlinear Analysis, Carnegie Mellon University

Robert V. Kohn Courant Institute of Mathematical Sciences, New York University

Mitchell B. Luskin School of Mathematics, University of Minnesota, Minneapolis

Geoffrey B. McFadden Computing and Applied Mathematics Laboratory, National Institute of Standards and Technology

Jerome V. Moloney Department of Mathematics, University of Arizona

Peter Palffy-Muhoray Liquid Crystal Institute, Kent State University

PROGRAM OVÉRVIEW

Following are subject classifications for the sessions. The codes in parentheses designate session type and number. The session types are invited plenary presentations (IP), contributed presentations (CP), and minisymposia (MS). Some of the conference themes have been widely drawn. One may find concurrent sessions related to a particular theme. For the poster session, please refer to page 8 of the program.

Crystal Growth, Solidification, and Interface Motion Interfaces (IP3, page 5) Mathematical Perspectives in Diffusive Processes

and Pattern Formation (MS1, page 4) Pattern Formation During the Motion of Phase Boundaries (IP5, page 7) A Phase-Field Diffuse Interface Solidification Model for Binary Alloys (IP4, page 7) Solidification Modeling and Computation — Parts 1 and 2 (MS8 and MS12, pages 7 and 8) Solidification and Phase Field Methods (CP2, page 6) Stability and Diffusion (CP5, page 8) Topological Transitions (MS16, page 9)

Effective and Optimal Properties of Composites

Bounds and Optimization (CP4, page 7)
Composite Materials and Structural Optimization (MS7, page 6)
Computational Methods for Determining the Effective Properties of Composite Materials (MS22, page 11)
Effective Moduli of Composites (MS2, page 4)
Homogenization (CP6, page 8)
Mathematical Perspectives on Composite Media (IP1, page 4)

Percolation Problems in Materials Science (MS5, page 5)

Liquid Crystals and Other Mesophases of Matter Current Issues in Liquid Crystals — Parts 1 and 2 (MS14 and MS19, pages 9 and 10)

Emerging Issues in Liquid Crystals (IP7, page 9)

Magnetic Materials Electromagnetic Fluids (MS10, page 7) Magnetic Materials (MS6, page 6)

Materials Issues in Nonlinear Optics Materials Issues in Nonlinear Optics

- (MS18, page 10)
- Nonlinear Optical Properties of Bulk, Quantum-Well, Quantum-Wire, and Quantum-Dot Semiconductors (IP9, page 10)

Microstructure and Macroscopic Properties of Materials

- Computation of Crystalline Microstructure (MS4 and MS9, pages 5 and 7) Dynamic Phase Transitions in Elastic Materials
- (MS21, page 11)
- Dynamics of Plasticity and Elasticity (CP3, page 6)
- Electronic Materials Processing: Modeling, Methodology and Challenges (MS17, page 10)
- Failure and Strength Mechanisms (CP7, page 10)
- Magnetic Materials (MS6, page 6)
- Mathematical Issues in Material Microstructure (MS13, page 8)
- Microstructure and Hysteresis (IP2, page 4) Some Statistical Issues in Materials Science
 - (MS3, page 5)
- The Elastic Properties of Heterogeneous Materials (MS11, page 7)
- Variational Methods in Materials Sciences (IP6, page 8)
- Viscoelasticity and Cavitation (CP1, page 5)

Superconductivity

- Modeling, Analysis and Computation for Macroscopic Phenomena in Superconductors (IP8, page 9)
- Recent Trends and Developments in Superconductivity (MS15 and MS20, pages 9 and 11)

FUNDING AGENCY

This conference is conducted with the partial support of the National Science Foundation.

GET-TOGETHER

Welcoming Reception Sunday, April 17, 1994 6:00 PM - 8:00 PM Cambria Room Cash Bar and mini hors d'oeuvres.

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PROGRAM-AT-A-GLANCE

SUNDAY, APRIL 17		MONDAY MORNING, APRIL 18		TUESDAY MORNING, APRIL 19	- v	VEDNESDAY MORNING, APRIL 20
6:00 PM-8:00 PM Registration opens	7:00	Registration opens Allegheny Foyer	7:30	Registration opens Allegheny Foyer	7:30	Registration opens Allegheny Foyer
Allegheny Foyer 6:00 PM-8:00 PM Welcoming	7:45	Opening Remarks David Kinderlehrer Allegheny Room	8:00	IP4 A Phase-Field Diffuse Interface Solidification Model for Binary Alloys	8:00	IP7 Emerging Issues in Liquid Crystals Peter Palffy-Muhoray
Reception Cambria Room	7:55	Welcome Avner Friedman Allegheny Room	8:45	William J. Boettinger Allegheny Room	8:45	Allegheny Room IP8 Modeling, Analysis and Computation for Macroscopic
	8:05	IP1 Mathematical Perspectives on Composite Media Graeme W. Milton		Motion of Phase Boundaries Robert F. Sekerka Allegheny Room		Phenomena in Superconductors Max. D. Gunzburger Allegheny Room
	8:45	Allegheny Room IP2 Microstructure and Hysteresis	9:30	Coffee Allegheny Foyer	9:30	Coffee Allegheny Foyer
		Richard D. James Allegheny Room	10 MS8	:00 AM-12:00 PM Concurrent Sessions Solidification Modeling and	1	:00 AM-12:00 PM Concurrent Sessions Current Issues in Liquid Crystals —
	9:30	Coffee / Allegheny Foyer		Computation — Part 1 of 2 Organizer: Geoffrey B. McFadden Allegheny Room		Part 1 of 2 Organizers: Maria-Carme T. Calderer, Eugene C. Gartland, Jr., Mitchell B.
	10 MS1		MS9	Computation of Crystalline Microstructure — Part 2 of 2		Luskin, and Peter Palffy-Muhoray Somerset Room
	MS2	Processes and Pattern Formation Organizer: Gunduz Caginalp Somerset Room	MS10		MS15	Superconductivity — Part 1 of 2 Organizers: Qiang Du and S. Jonathan
	N152	Effective Moduli of Composites Organizers: Robert V. Kohn and Graeme W. Milton Allegheny Room	M\$11	Organizer: Michael J. Shelley Cambria Room The Elastic Properties of Heterogeneous Materials	MS16	Chapman Allegheny Room Topological Transitions Organizer: Robert V. Kohn
	MS3	Some Statistical Issues in Materials Science Organizer: Alan F. Karr		Organizers: Graeme Milton and David Kinderlehrer Somerset Room	MS17	Crawford Room
	MS4	Crawford Room Computation of Crystalline Microstructure — Part 1 of 2 Organizer: Mitchell B. Luskin	CP4	Bounds and Optimization Chair: Frank Morgan Builer Room	CP7	Organizer: H. Thomas Banks Cambria Room Failure and Strength Mechanisms
	CP1	Cambria Room. Viscoelasticity and Cavitation		JESDAY AFTERNOON, APRIL 19		Chair: Luke E.K. Achenie Butler Room
		Chair: Michael Renardy Butler Room	12:00- 1:30	1:30 Lunch IP6 Variational Methods in		DNESDAY AFTERNOON, APRIL 20 1:30 Lunch
	· · · · · · · · · · · · · · · · · · ·	MONDAY AFTERNOON, APRIL 18		Materials Sciences Irene Fonseca	12:00-	IP9 Nonlinear Optical Properties of
·	12:00- 1:30	1:30 Lunch IP3 Interfaces. Joseph B. Keller	2:15	Allegheny Room Coffee Allegheny Foyer		Bulk, Quantum-Weil,Quantum- Wire, and Quantum-Dot Semiconductors Stephan W. Koch
CP = Contributed Presentations	2:15	Allegheny Room Coffee / Allegheny Foyer	MOID	2:45-4:45 Concurrent Sessions	2:15	Allegheny Room
IP = Invited Presentations			MS12	Solidification Modeling and Computation — Part 2 of 2 Organizer: Geoffrey B. McFadden		Coffee Allegheny Foyer
MS = Minisymposium Contributed presentations are	MS5	2:45-4:45 Concurrent Sessions Percolation Problems in Materials Science	MS13	Allegheny Room Mathematical Issues in Material Microstructure	MS18	2:45-4:45 Concurrent Sessions Materials Issues in Nonlinear Optics Organizer: Jerome V: Moloney
spaced twenty minutes apart, allowing each presenter fifteen	MS6	Organizer: Kenneth M. Golden Crawford Room Magnetic Materials Organizers: David Kinderlehrer, Ling Ma,	CP5	Organizers: John Ball and Irene Fonseca Cambria Room Stability and Diffusion	MS19	Fayette Room Current Issues in Liquid Crystals — Part 2 of 2 Organizers: Maria-Carme T. Calderer,
minutes for presentation and five minutes for	MS7	and Robert Rogers Allegheny Room Composite Materials and Structural	CP6	Chair: Karl Gustafson Somerset Room Homogenization Chair: Michel Artola		Eugene C. Gartland, Jr., Mitchell B. Luskin, and Peter Palffy-Muhoray Butler Room
discussion. Minisymposium presentations are	~~~	Optimization Organizer: Robert V. Kohn Butler Room	Poster	Crawford Room Session Butter Room	MS20	Superconductivity — Part 2 of 2 Organizers: Qiang Du and S. Jonathan
spaced thirty minutes apart, allowing each presenter twenty-five	CP2	Solidification and Phase-Field Methods Chair: Eduardo Socolovsky Somerset Room			MS21	Chapman Crawford Room Dynamic Phase Transitions in Elastic Materials
minutes for presentation and five minutes for	CP3	Dynamics of Plasticity and Elasticity Chair: Timothy J. Burns Cambria Room			MS22	Organizer: Morton E. Gurtin Cambria Room Computational Methods for
discussion. Each plenary talk is forty-						Determining the Effective Properties of Composite Materials Organizer: Leslie F. Greengard
five minutes, including time for						Somerset Room

MONDAY MORNING, APRIL 18

7:00/Allegheny Foyer Registration opens

7:45/Allegheny Room Opening Remarks

David Kinderlehrer, Carnegie Mellon University

7:55/Allegheny Room Welcome

Avner Friedman, University of Minnesota, Minneapolis

8:05/Allegheny Room

IP1/Chair: Robert V. Kohn, Courant Institute of Mathematical Sciences, New York University

Mathematical Perspectives on Composite Media

Colloidal suspensions, polycrystalline materials, porous rocks containing oil or salt water, fiberous materials, foams, slurries, bubbly fluids, cracked solids, granular aggregates, and ceramics are all examples of composites. They are inhomogeneous materials which have the same macroscopic response to applied thermal, electrical, magnetic, or elastic fields as homogeneous materials. The effective coefficients governing this response depend non-linearly on the moduli of the constituent materials and upon the geometry of the composite. Research in the field has been driven by two objectives: the estimation of the effective coefficients of a given material, such as a sample of rock extracted from the earth; and the quest for optimal microstructures that maximise, or come close to maximizing, a given combination of properties. The speaker will present a broad survey of some of the progress that has been made through the development of fast algorithms, application of novel variational techniques, analytic function theory, and Hilbert space methods. He will review the connection with non-convex energy minimization problems.

Graeme W. Milton

Courant Institute of Mathematical Sciences, New York University

8:45/Allegheny Room

IP2/Chair: David Kinderlehrer, Carnegie Mellon University

Microstructure and Hysteresis

The presence of hysteresis is often considered to be a defining characteristic of first order phase transformations. The hysteresis observed during heating and cooling can vary from hundreds of degrees centigrade to one or two degrees centigrade in apparently similar materials that undergo first order phase transformations, and the size of the hysteresis does not seem to correlate with any of the standard material properties that are commonly measured for transforming materials. Hence, there is a challenge to understand the origins of hysteresis based on sound mathematical models of transforming materials.

In recent years, there has been increasing interest among applied mathematicians in the prediction of hysteresis, based on direct modeling of the hysteresis loops. The speaker will advocate a different viewpoint, in which the emphasis is on accurate modeling of the material. This approach will be illustrated by a survey of recent research that highlights the importance of microstructure, metastability, relaxation and computational method.

Richard D. James

Department of Aerospace Engineering and Mechanics, University of Minnesota, Minneapolis

9:30/Allegheny Foyer Coffee

10:00 AM-12:00 PM Concurrent Sessions

MS1/Somerset Room Mathematical Perspectives in Diffusive Processes and Pattern Formation

The formation of patterns arising from diffusive processes and shocks has been under study from a number of perspectives. Sharp interface, phase field and statistical approaches are among the modeling techniques used in analytical and numerical study. This minisymposium focuses on the comparative insight and information that can be attained from different approaches.

Michael Cross will discuss coarsening and the persistent dynamics of domain structures. He will also consider reduced descriptions of chaos and compare equilibrium and non-equilibrium. Gunduz Caginalp will also discuss comparisons of static and dynamic as they arise in layer formation in alloys from a phase field perspective. John Chadam will present studies on the stability of the interface using a sharp interface model. John Grove will also discuss sharp interface models as they are used in the numerical computation of shocks.

Organizer: Gunduz Caginalp, University of Pittsburgh, Pittsburgh

- 10:00 Chaotic Domains and Domain Coarsening in Non-equilibrium Systems Michael Cross, California Institute of Technology
- 10:30 Solute Trapping in Binary Alloys Gunduz Caginalp, Organizer
- 11:00 Solidification Interface Instabilities John Chadam, McMaster University, Canada
- 11:30 A Quantitative Numerical Analysis of Shock Accelerated Fluid Interfaces John Grove, State University of New York, Stony Brook

MS2/Allegheny Room

Effective Moduli of Composites

(This session will run until 12:30 PM)

Composite materials arise in many areas of materials science, physics, and engineering. A fundamental issue is to understand the link between microstructure and macroscopic behavior. One type of problem involves microstructures that are either partially or completely known; then the goal is to estimate the effective behavior. A different type of problem is the design of microstructures whose effective behavior is in some sense extremal. A variety of mathematical methods are relevant, including variational principles, compensated compactness, and complex analysis.

Organizers: Robert V. Kohn and Graeme W. Milton

Courant Institute of Mathematical Sciences, New York University

- 10:00 Optimal Bounds Correlating Electric, Magnetic, and Thermal Properties of Two-Phase, Two-Dimensional Composites
- Karen Clark, Stevens Institute of Technology, and Graeme W. Milton, Organizer
 10:30 Viscoelastic Composites: Bounds and Realizable Models James Berryman, Lawrence Livermore National Laboratory; Leonid Gibiansky,
- Princeton University; and Graeme W. Milton, Organizer 11:00 Perturbation Methods in the Study of the Overall Behavior of Composite

Materials Oscar Bruno, Georgia Institute of Technology

11:30 Nonlinear Homogenization: Application to Metal-Matrix Composites and Polycrystals

Pedro Ponte-Castaneda, University of Pennsylvania

12:00 An Optimal Lower Bound on the Elastic Energy of a Composite Made from Two Non Well-Ordered Isotropic Materials

Gregoire Allaire, Commissariat à l'Energie Atomique, France; and Robert V. Kohn, Organizer

MONDAY AFTERNOON, APRIL 18

10:00 AM-12:00 PM Concurrent Sessions

MS3/Crawford Room

Some Statistical Issues in Materials Science

The minisymposium will focus on issues in materials science with important statistical content, on which progress is possible by means of collaboration between materials and statistical scientists. The speakers will focus on materials microstructure and microstructure - property relations. They will discuss important materials issues driven by considerations of data, mathematical modeling and simulation, and with substantive mathematical and computational content.

The minisymposium builds on workshops held at the Catholic University of America in June, 1993, and the National Institute of Standards and Technology in July, 1993, in identifying promising directions of collaborative research between materials scientists and statisticians.

Organizer: Alan F. Karr, National Institute of Statistical Sciences

- 10:00 Mechanical Properties of Strongly Nonhomogeneous Systems Stewart K. Kurtz, Pennsylvania State University
- 10:30 Scalings and Distributions in Lattice Models for Material Failure S. Leigh Phoenix, Cornell University
- 11:00 Some Statistical Issues in Materials Science Related to the Evolution and Inhomogeneity of Microstructure Owen Richmond, Alcoa Technical Center, Pittsburgh
- 11:30 Macroscopic Behavior of Random Media from the Microstructure Salvatore Torquato, Princeton University

MS4/Cambria Room

Computation of Crystalline Microstructure (Part 1 of 2)

The computation of material microstructure is important to the development and control of new materials such as shape memory materials, martensitic crystals, and magnetostrictive crystals. Effective computational methods are essential for comparing the results of new theories and models with experiment.

Material microstructure occurs when twinning occurs on a fine scale or when the deformation gradient oscillates on a fine scale. Theories have been developed which treat this phenomena on an atomic as well as on a continuum scale. This minisymposium will feature some of the important advances which have been made during the past several years in the computation of solutions to these models.

Organizer: Mitchell B. Luskin, University of Minnesota, Minneapolis

- 10:00 Atomistic Structure and Dynamics of a Displacive Transformation Interface *Philip C. Clapp* and Shuangjian Chen, University of Connecticut, Storrs
 10:30 Adaptive Finite Element Analysis of Crystalline Microstructures
- 10:30 Adaptive Finite Element Analysis of Crystalline Microstructures Ellad Tadmor, Rob Phillips and *Michael Ortiz*, Brown University
 11:00 Computational Modeling of the Martensitic Transformation
- Mitchell Luskin, Organizer and Petr Klouček, University of Minnesota, Minneapolis
- 11:30 Tweed Precursors in Martensitic Transformations Sivan Kartha, Institute for Advanced Study; James P. Sethna and James A. Krumhansl, Cornell University

CP1/Butler Room

Viscoelasticity and Cavitation

- Chair: Michael Renardy, Virginia Polytechnic Institute and State University.
- 10:00 Linear Stability of Hyperbolic PDEs and Viscoelastic Flows Michael Renardy, Virginia Polytechnic Institute and State University
- 10:20 About Mathematical Models for Anisotropic n-dimensional Viscoelastic Materials
- Jaime E. Munoz Rivera, Laboratorio Nacional de Computação Científica, Brasil 10:40 Spurt and Instability in a Two-Layer Johnson-Segalman Liquid
- Yuriko Yamamuro Renardy, Virginia Polytechnic Institute and State University
 11:00 Effects of Material Anisotropy and Inhomogeneity on Cavitation for Composite Incompressible Anisotropic Nonlinearly Elastic Spheres Debra A. Polignone, Carnegie Mellon University, and Cornelius O. Horgan, University of Virginia
- 11:20 Numerical Simulation of the Deformation of Viscoelastic Solids S. Shaw, M.K. Warby, and *John R. Whiteman*, Brunel University, United Kingdom
- 11:40 An Algebraic Criteria for Cavitation Pablo V. Negron, University of Puerto Rico, Rio Piedras

12:00-1:30 Lunch

1:30/Allegheny Room

IP3/Chair: Avner Friedman, University of Minnesota, Minneapolis Interfaces

internaces

Interfaces between materials are usually rough or irregular on a microscopic scale, and sometimes they are even rough on a macroscopic scale. Consequently the boundary or interface conditions satisfied by fields (elastic, electro-magnetic, acoustic, thermal, etc.) at such interfaces are complicated. Various methods have been employed to simplify them in order to facilitate their use in analytical and numerical studies of fields. The speaker will review some of these methods, which are based upon the assumed smallness of the height of the roughness elements. He will then present a new method, valid for roughness of any height. This new method is based upon the assumed smallness of the "wavelength" of the roughness.

Joseph B. Keller

Departments of Mathematics and Mechanical Engineering, Stanford University

2:15/Allegheny Foyer Coffee

> 2:45-4:45 Concurrent Sessions

MS5/Crawford Room Percolation Problems in Materials Science

The physical properties of many inhomogeneous materials with highly contrasting phases depend strongly on whether or not one phase "percolates", or forms a connected matrix which spans a sample. Percolation effects on atomic and macroscopic scales dominate the behavior of a broad range of materials, such as semiconductors, cernets, piezoresistors, and porous media. In recent years, there have been a number of mathematical advances in both the pure theory of percolation and in the analysis of discrete and continuous models of transport in percolating systems. However, these advances fall short of providing a comprehensive foundation for understanding the properties of the above rather complex materials. In this minisymposium, the speakers will discribe recent mathematical developments, and a number of actual percolation problems arising in the analysis of materials.

Organizer: Kenneth M. Golden, University of Utah

- 2:45 Percolation Problems Arising in the Analysis of Inhomogeneous Materials Kenneth M. Golden, Organizer
- 3:15 How to Use Percolation Theory for PDE's Describing Transport Through Inhomogeneous Media
 - Serguei M. Kozlov, Université de Provence Aix-Marseille 1, France
- 3:45 Applications of Percolation Theory to Experimental Measurements of the Electrical Properties of Some Binary Media David S. McLachlan, University of Witwatersrand, South Africa
- 4:15 Percolation and Conductivity in Magnetized Heterogeneous Media Michael B. Isichenko, University of Texas, Austin and Kurchatov Institute of Atomic Engineering, Russia

MONDAY AFTERNOON, APRIL 18

2:45-4:45 Concurrent Sessions

MS6/Allegheny Room Magnetic Materials

(This session will run until 5:15 PM)

Magnetic materials have a long and distinguished history and, since the early days of electromagnetic theory, an important technological role. What are the contemporary issues and potential applications associated with these materials? Two areas of rapid progress in recent times are magnetic recording and highly magnetostrictive materials. They will be highlighted here. Moreover, promising new analytical methods are under development. This is an opportune moment to assess the promise of applied mathematics and interdisciplinary research in this agenda.

Organizers: David Kinderlehrer, Carnegie Mellon University Ling Ma, Carnegie Mellon University and Institute for Advanced Study and Robert Rogers, Virginia Polytechnic Institute and State University

- 2:45 Modeling in Magnetic Recording Stanley H. Charap, Carnegie Mellon University
- 3:15 On the Macroscopic Response of Magnetostrictive Materials Antonio De Simone, Carnegie Mellon University and Università di Roma "Tor Vergata", Italy
- 3:45 The Computation of Magnetic Materials: The Thin Film Case Ling Ma, Organizer
- 4:15 New Mathematical Tools for Studying Microstructures Luc Tartar, Carnegie Mellon University
- 4:45 Giant Magnetostrictions and High Power Magnetostrictive Devices Joseph P. Teter, Naval Surface Warfare Center

MS7/Butler Room

Composite Materials and Structural Optimization

(This session will run until 5:15 PM)

The goal of structural optimization is to choose the shape or composition of a structure so as to optimize some aspect of its response. This problem has traditionally been approached by methods based on "front-tracking". In recent years a new approach has emerged, based on the use of composite materials as structural components. As numerical experience has been gained in applying this new approach, many questions have arisen: what types of discretizations avoid undesired instabilities? Is it better to use simple composites, optimal ones, or maybe even "fictitious" ones? Can one design a numerical method that prefers "classical" designs over relaxed ones, other things being equal?

Organizer: Robert V. Kohn, Courant Institute of Mathematical Sciences, New York University

2:45 Proposal for an Integrated Design System Involving Concurrent Design and Manufacturing

Noboru Kikuchi, University of Michigan, Ann Arbor

3:15 Optimal Design of Material Properties and Material Distribution for Single and Multiple Loading Conditions

Martin Bendsoe, Technical University of Denmark, Denmark

- 3:45 Relaxation of Optimal Design Problems: Reduction to the Minimization of a Sum of Energy Densities Andrei Cherkaev, University of Utah
- 4:15 Materials with Prescribed Constitutive Parameters: An Inverse Homogenization Problem

Ole Sigmund, Technical University of Denmark, Denmark

4:45 An Algorithm for Three-Dimensional Shape Optimization Gilles Francfort, Carnegie Mellon University

CP2/Somerset Room

Solidification and Phase Field Methods

(This session will run until 5:05 PM) Chair: Eduardo A. Socolovsky, Hampton University

- 2:45 Phase Field Computational Approaches to Crystal Growth and Propagating Fronts
- Eduardo A. Socolovsky, Hampton University **3:05 Rigorous Asymptotics for a Fully Nonlinear Phase-Field Equation** Robert Jerrard, University of California, Berkeley
- 3:25 Cahn-Hilliard Simulations of Ternary Alloy Separation David J. Eyre, University of Minnesota, Minneapolis
- 3:45 Banded Microstructures in Rapid Solidification Douglas A. Huntley, University of Minnesota, Minneapolis; and Stephen H. Davis, Northwestern University
- 4:05 Tight-Binding Molecular Dynamics Simulations of Liquid Gallium Arsenide Rebecca Mih, University of California, Berkeley; R. Virkkunen, and R. Nieminen, Helsinki University of Technology, Finland
- 4:25 Oscillatory Instabilities in Directionally Solidified Eutectics Brenda A. Diesslin and William T. Grayhack, Iowa State University

CP3/Cambria Room

Dynamics of Plasticity and Elasticity

(This session will run until 5:05 PM)

Chair: Timothy J. Burns, National Institute of Standards and Technology

- 2:45 Singular Poincaré-Andronov-Hopf Bifurcation in a Model of "Discontinuous" Plastic Deformation Timothy J. Burns, National Institute of Standards and Technology
- 3:05 Granular Flow with a Hypoplastic Constitutive Relation E. Bruce Pitman, State University of New York, Buffalo
- 3:25 A Traveling-Wave Analysis in Uniaxial Plastic Flows and Application to Longitudinal Impacts
- Feng Wang, State University of New York, Stony Brook 3:45 Perturbed Scale-Invariant Initial Value Problems in One-Dimensional Dynamic Elastoolasticity

Michael S. Gordon, North Carolina State University

4:05 Wave Propagation and Internal Pressure in Liquid-Filled Elastomeric Composite Tubes CP. Machine and C.I. Bedeliffe, Michigan State University, A.L. Hull, No.

C.R. MacCluer, and C.J. Radcliffe, Michigan State University; A.J. Hull, Naval Undersea Warfare Center; and T.L. Scofield, Michigan State University

- 4:25 Phase Boundary Motion in Elastic Materials: Kineticallym Governed Approach to Equilibrium Thomas J. Pence, Michigan State University
- 4:45 Hyperbolic Equations of Inelastic Media and Their Symmetric Form E.I. Romensky, Institute of Mathematics, Russia

TUESDAY MORNING, APRIL 19

7:30/Allegheny Foyer Registration opens

8:00/Allegheny Room

IP4/Chair: Geoffrey B. McFadden, National Institute of Standards and Technology A Phase-field Diffuse Interface Solidification Model for Binary Alloys

The phase-field method was previously developed for pure materials to treat solid-liquid interface motion with complex (dendritic) shapes. A field variable describes the state (solid or liquid) at different points in the material and the dynamics of this field are governed by the Cahn-Allen equation. The speaker will discuss present work that extends the method to binary alloys using a single free energy function to couple this equation to the Cahn-Hilliard equation. This second equation describes the evolution of the composition field. Physical effects such as capillarity, nonequilibrium interface kinetics and solute trapping are naturally included. Composition segregation patterns that remain after dendritic solidification have been obtained.

William J. Boettinger

Metallurgy Division, Materials Science and Engineering Laboratory, National Institute of Standards and Technology

8:45/Allegheny Room

IP5/Chair: Morton E. Gurtin, Carnegie Mellon University

Pattern Formation During the Motion of Phase Boundaries

The boundaries that separate phases during a first order phase transformation, such as crystallization, can have morphologies that are quite complex. This is due to morphological instabilities, but also to anisotropic capillarity and interface attachment kinetics. Examples are cells and dendrites. The governing free boundary problems are difficult to solve except in special cases.

The speaker will discuss a phase field model in which two coupled PDEs are solved numerically in order to eliminate boundary tracking. He will present results for solution of the phase field model in the context of dendritic growth at high undercoolings and compare dendrite tip radii and growth speeds with the predictions of theoretical principles such as marginal stability, microscopic solvability, and optimum stability. (This work is supported by the National Science Foundation under grant DMR 9211276).

(This work is supported by the National Science Foundation under grant DMR 9211276). Robert F. Sekerka

University Professor of Mathematics and Physics, Carnegie Mellon University

9:30/Allegheny Foyer Coffee

COlle

10:00 AM-12:00 PM Concurrent Sessions

MS8/Allegheny Room

Solidification Modeling and Computation (Part 1 of 2)

The behavior of interfaces separating different phases of a material is a subject of scientific and technological importance, involving interdisciplinary contributions from pure and applied mathematicians, physicists, and materials scientists. Current work in this area includes the derivation and analysis of models of the creation, thickness, stability, shape, and motion of phase boundaries. The speakers will describe problems in solidification and other types of phase transitions and discuss treatments of both sharp and diffuse interfaces will be discussed.

Organizer: Geoffrey B. McFadden, National Institute of Standards and Technology

10:00 Computation of Laplacian Dendrites

Robert Almgren, University of Chicago 10:30 Computational Crystal Growth Using Fully Facetted Interfaces

- A. Roosen, National Institute of Standards and Technology
- 11:00 Studies of Pattern Formation in a Binary Alloy Using a Phase-Field Model James A. Warren, National Institute of Standards and Technology
- 11:30 Monte Carlo Simulation of Growth Patterns in Eutectic Systems J. Iwan D. Alexander, Rong-Fu Xiao, and Franz Rosenberger, University of Alabama, Huntsville

MS9/Crawford Room

Computation of Crystalline Microstructure (Part 2 of 2) For description, see MS4 on page 5

Organizer: Mitchell B. Luskin , University of Minnesota, Minneapolis

10:00 Computations of Twinning in the Two-Well Problem Charles R. Collins, University of Tennessee, Knoxville

- 10:30 Oscillation Problems in the Calculus of Variations Michel Chipot, Université de Metz, France
- 11:00 Algorithms for the Computation of Microstructure Noel J. Walkington, Carnegie Mellon University
- 11:30 The Effects of Mesh Orientation on Computed Microstructures Han Wang and R. A. Nicolaides, Carnegie Mellon University

MS10/Cambria Room Electromagnetic Fluids

Electro-magnetic (EM) fluids are candidates as "Smart Fluids" that can respond to applied electromagnetic fields with changes in their basic fluid rheology and stability properties. Their application to control of fluid flows and devices, or to understanding dipolar fluidic systems, are active areas of research in the engineering and physics communities. EM fluids have a rich phenomenology whose study lies between the fields of materials science and fluid mechanics. Basic questions of such as microscopic and macroscopic formulation, stability, and phase transition, are being pursued. The speakers in this minisymposium will discuss the current state of experimental, theoretical, and computational work.

Organizer: Michael J. Shelley, Courant Institute of Mathematical Sciences, New York University

10:00 Rheological Properties of Ferrofluid Composites

Ronald Rosensweig and J. Popplewell, Exxon Research and Engineering, Annandale, NJ

- 10:30 Ferrofluid Labyrinths: Theory and Experiment Raymond Goldstein, Princeton University
- 11:00 Do Spontaneously Magnetized Liquids Exist? Mike Widom, Carnegie Mellon University
- 11:30 The Leaky Dielectric Model of Electrohydrodynamics Dudley Saville, Princeton University

MS11/Somerset Room

The Elastic Properties of Heterogeneous Materials

(This session will run until 12:30 PM) Heterogeneous solids exhibit a wide range of elastic behaviours, influenced by variations in

material moduli, the presence of cracks, internal stresses arising from the formation of precipitates, or other mechanisms such as ductile fracture. The talks in this minisymposia provide a sampling of problems in this field.

- Organizers: Graeme Milton, Courant Institute of Mathematical Sciences, New York University and David Kinderlehrer, Center for Nonlinear Analysis and Department of Mathematics, Carnegie Mellon University
- 10:00 Small-contrast Perturbation Expansions for the Effective Properties of Nonlinear Composites
 - Pierre M. Suquet, LMA/CNRS, France; and Pedro Ponte-Castaneda, University of Pennsylvania
- 10:30 Frobenius Series Solutions for Materials with Radially-Varying Elastic Moduli Melanie P. Lutz and Mauro Ferrari, University of California, Berkeley
- 11:00 Elastic Equilibrium of Heterophase Solids
- A.L. Roytburd, University of Maryland, College Park 11:30 Issues Concerning Ductile Fracture of Materials
- Warren M. Garrison, Jr., Carnegie Mellon University
- 12:00 The Energy Balance Relations for a Small Crack in a Solid with a Nonlinear Displacement Field

Alexander Movchan, University of Bath, United Kingdom

CP4/Butler Room

Bounds and Optimization

- Chair: Frank Morgan, Williams College
- 10:00 Clusters Minimizing Energy of Interfaces and Singular Curves Frank Morgan, Williams College
- 10:20 Extremal Microstructure for Two Isotropic Phases with Distinct Stress-free Strains in Two Space Dimensions Robert V. Kohn, Courant Institute of Mathematical Sciences, New York University; and Jiangbo Lu, Carnegie Mellon University
- 10:40 Explicit Optimality Conditions for Elastic Energy in a Two Phase Composite with Anisotropic Component Materials in Two Space Dimensions Yury Grabovsky, Courant Institute of Mathematical Sciences, New York University
- 11:00 Composite Plates of Extremal Rigidity Andrei Cherkaev, University of Utah; and *Leonid Gibiansky*, Princeton University
- 11:20 Accurate Phenomenological Models that Agree with Experiments for Ferroelectric-Ferroelastic Crystals: A Semi-infinite Optimization Formulation L. Vu-Quoc and V. Srinivas, University of Florida; and J. Cross, Digital Equipment Corporation
- 11:40 Optimal Control of Phase Transitions
- Matthias Heinkenschloss, Virginia Polytechnic Institute and State University

TUESDAY AFTERNOON, APRIL 19

12:00-1:30 Lunch

1:30/Allegheny Room

IP6/Chair: John Ball, Heriot-Watt University, Scotland Variational Methods in Materials Sciences

The speaker will discuss the study of material instabilities such as phase transitions and the formation of defects and microstructure in crystalline materials from the point of view of the calculus of variations.

She will discuss new mathematical techniques that have been introduced for the treatment of equilibria for nonconvex problems and for models involving interfacial energy contributions and will consider the formation of microstructure and oscillatory behavior using the notion of generalized solutions such as Young measures, H-measures and varifolds.

Irene Fonseca

Department of Mathematics, Carnegie Mellon University

2:15/Allegheny Foyer Coffee

2:45-4:45

Concurrent Sessions

MS12/Allegheny Room

Solidification Modeling and Computation (Part 2 of 2)

(For description, see MS8 on page 7)

Organizer: Geoffrey B. McFadden, National Institute of Standards and Technology

- 2:45 Phase-field Model of Eutectic Growth Alain S. Karma, Northeastern University
- 3:15 Stochastic Eutectic Growth
- Martin Grant, McGill University, Canada
- 3:45 Diffuse-Interface Modeling of Phase Transitions of a Binary Alloy with FCC Crystal Structure Richard J. Braun, William J. Boettinger, John W. Cahn, and Geoffrey B.

McFadden, National Institute of Standards and Technology, and Adam A. Wheeler, National Institute of Standards and Technology and University of Bristol, United Kingdom

4:15 Phase-field Modeling with Nonlocal Free-energies Kirk Brattkus, Southern Methodist University

MS13/Cambria Room

Mathematical Issues in Material Microstructure

(This session will run until 5:15 PM)

In recent years there has been a remarkable progress in the mathematical understanding of the formation of microstructure in crystalline materials. The successful exploitation of smart materials is among its many applications in materials sciences. As older techniques fail to apply, new mathematical tools have been introduced in the theory of partial differential equations and in the calculus of variations. They rely on the concept of generalized solutions and require the handling of new homogenization problems.

This session is directed to applied mathematicians and materials scientists and the agreement between theory and experiments will be discussed.

Organizers: John Ball, Heriot-Watt University, Scotland and Irene Fonseca, Carnegie _ Mellon University

- 2:45 The Behavior of Polycrystalline Shape-Memory Materials Kaushik Bhattacharya, California Institute of Technology and Robert V. Kohn, Courant Institute of Mathematical Sciences, New York University
- 3:15 Transition Between Martensitic Variants Under Biaxial Stress Chun-hwa Chu and Richard D. James, University of Minnesota, Minneapolis
- 3:45 Stress-induced Microstructures in Crystals, and a Necessary and Sufficient Condition for Attainment in the Scalar Calculus of Variations Gero Friesecke, Carnegie Mellon University

4:15 A Model for Twinning in BCC Crystals Phoebus Rosakis and Hungyu Tsai, Cornell University

4:45 Phases and Phase Stability in the Cu-A1-Zn System Marc De Graef, Carnegie Mellon University

CP5/Somerset Room Stability and Diffusion

Chair: Karl Gustafson, University of Colorado, Boulder

- 2:45 Bistability and Multistability Karl Gustafson, University of Colorado, Boulder
 3:05 Stability of Cylindrical Bodies in the Theory of Surfa
 - 05 Stability of Cylindrical Bodies in the Theory of Surface Diffusion Bernard D. Coleman, Richard S. Falk, and Maher Moakher, Rutgers University
- 3:25 Modeling and Simulation of Reaction and Diffusion in a Corrosion Cell Jeffrey H. Dunn, Naval Research Laboratory
- 3:45 Nonlnear Diffusion from a Lattice-Gas Model William T. Grayhack and James W. Evans, Iowa State University
- 4:05 An Advanced Model for Dopant Diffusion in Polysilicon Helmut Puchner and Siegfried Selberherr, Technical University of Vienna, Austria

CP6/Crawford Room

Homogenization

(This session will run until 5:05 PM)

Chair: Michel Artola, Université Bordeaux I, France

- 2:45 Wave Propagation in Some Chiral Composite Materials Michel Artola, Université Bordeaux I, France; and Michel Cessenat, CEA - Centre d'Etudes de Limeil, France
- 3:05 Wave Propagation Along Grain Boundaries *Elliott S. Alber*, Courant Institute of Mathematical Sciences, New York University; and J.L. Bassani, University of Pennsylvania
- 3:25 Effective Moduli and Quasi-Regular Mappings Vincenzo Nesi, University of L'Aquila, Italy
- 3:45 A Homogenized Model for a Molten Carbonate Fuel Cell Joseph D. Fehribach, Worcester Polytechnic Institute
- 4:05 Homogenization of Two Phase Emulsions with Surface Tension Effects Robert Lipton and Bogdan Vernescu, Worcester Polytechnic Institute
- 4:25 Two-point Padé Approximants for Effective Transport Coefficients Stanislaw Tokarzewski and Jerzy Blawzoziewicz, Institute of Fundamental Technological Research, Poland; and Igor Andrianov, Civil Engineering Institute, Ukraine
- 4:45 Flow of Conductive Fluids in Porous Media A. Galka, J.J. Telega and *Richard Wojnar*, IPPT of

A. Galka, J.J. Telega and Richard Wojnar, IPPT of Polish Academy of Sciences, Poland

Butler Room

Poster Session

Ab-initio Total-energy Calculations: Ground State Instability of the Uniform Electron Gas

Yefim Levin, C.D. Wu and Y. Bar-Yam, Boston University

An Algebraic Grid Generation Technique for Tracking Interface Motion Bonita V. Saunders, National Institute of Standards and Technology

Electronic Structure Calculations for Organic Superconductors on High-Performance Architectures

A. Smith, University of Washington; *Michael Minkoff* and R. Benedek, Argonne National Laboratory; and L.H. Yang, Lawrence Livermore National Laboratory

Propose of Basic Idea for Mathematically Composing and Simple Calculations for Liquid-Glass- Encapsulation Growth GaAs Crystal Stoichiometric Deviations Yasuyuki Saito, Toshiba Corporation, Japan

Coupled Fields in Heterogeneous Solids and Homogenization

S. Bytner, B. Gambin, A. Galka, J.J. Telega, and Richard Wojnar, IPPT of Polish Academy of Sciences, Poland

WEDNESDAY MORNING, APRIL 20

7:30/Allegheny Foyer Registration opens

8:00/Allegheny Room

IP7/Chair: Maria-Carme T. Calderer, Pennsylvania State University Emerging Issues in Liquid Crystals

Liquid crystalline materials play key technological roles in information display and structural applications. Many recent advances in modeling their behavior are the result of relaxing restrictive assumptions of earlier descriptions. Characterizing orientational order by a tensor rather than a vector field, for example, has lead to qualitatively new features in both static configurations and in dynamic response, in agreement with experimental observations. The increased complexity of the models gives rise to challenging mathematical and numerical problems. The speaker will present some illustrative examples, involving equilibrium structures, steady state configurations in the presence of shear and other fields, and interfacial instabilities.

Peter Palffy-Muhoray

Liquid Crystal Institute and Department of Physics, Kent State University

8:45/Allegheny Room

IP8/Chair: Mitchell B. Luskin, University of Minnesota, Minneapolis Modeling, Analysis and Computation for Macroscopic Phenomena in Superconductors

Superconductivity has become of subject of renewed interest since the recent discovery of materials that retain superconductive properties at temperatures above the boiling point of nitrogen. A brief history of superconductivity will be presented, along with a brief description of some applications in which superconducting materials are used. Various mathematical models for superconductivity will be discussed, including some that are thought to apply to the "high critical temperature" materials. A sample of the analyses and computations that have been performed based on these models is then presented. The speaker will close with a brief discussion of the possible roles that mathematicians can play in the further development of the science and technology of superconductivity.

Max D. Gunzburger

Department of Mathematics and Interdisciplinary Center for Applied Mathematics, Virginia Polytechnic Institute and State University

9:30/Allegheny Foyer Coffee

10:00 AM-12:00 PM Concurrent Sessions

MS14/Somerset Room

Current Issues in Liquid Crystals (Part 1 of 2)

Liquid crystals are orientationally ordered fluids with anisotropic bulk properties. The speakers will discuss problems in pure liquid crystals and liquid crystal composites which are materials with great promise for information displays; orientational order also plays a key role in polymers in structural applications, the understanding of equilibrium configurations, the response to applied fields, and instabilities in non-equilibrium situations. They will consider the description and determination of equilibrium configurations, the dynamics of the approach to equilibrium, hydrodynamics, convective and interfacial instabilities, and intensity dependent optical nonlinearities.

Organizers: Maria-Carme T. Calderer, Pennsylvania State University, University Park, Eugene C. Gartland Jr., Kent State University, Mitchell Luskin, University of Minnesota, Minneapolis, and Peter Palffy-Muhoray, Kent State University

- 10:00 On the Topology of Defects in Nematics and the Changes of Defect Structures at Uniaxial-Biaxial Phase Transitions Alfred Saupe, Max-Planck-Gesellschaft, Germany
- 10:30 Numerical Minimization of a Landau-deGennes Free Energy for Liquid Crystals

Eugene C. Gartland Jr., Timothy A. Davis, and Peter Palffy-Muhoray, Kent State University

- 11:00 Defect Structures in Nematic Solutions of a Rodlike Polymer Guy C. Berry, Carnegie Mellon University
- 11:30 Flow Instabilities and Dynamics of Defects in Liquid Crystals Maria-Carme T. Calderer, Pennsylvania State University

MS15/Allegheny Room

Recent Trends and Developments in Superconductivity (Part 1 of 2) The theory of Type-II superconductors is a rapidly changing and exciting area, which has

a key role in the continuing development of high-Tc materials. Of particular importance is the understanding of the so-called "vortices" which are characteristic of Type-II superconductors.

There are two sessions, which have been designed to highlight the mathematical stimulation that has resulted from some complementary theoretical and computational approaches to vortex modeling.

The talks in the first session will feature (i) a rigorous mathematical analysis of a certain boundary-value problem, which sheds light on the problem of vortex nucleation, (ii) more formal methods of matched asymptotic expansions that are needed to understand vortex dynamics, the key mechanism for losses in superconducting materials, and (iii) formal averaging to produce a model for the vortex density analogous to the Euler equations for an inviscid rotational fluid.

The talks in the second session will feature (i) discussions of simplified dynamical equations for vortices, vortex liquids and vortex lattices, (ii) analytical and computational studies of vortex motion and vortex pinning, simulations in various geometrical regions, analysis of different discretization techniques.

Organizers: Qiang Du, Michigan State University and S. Jonathan Chapman, University of Oxford, United Kingdom

- 10:00 Creation, Motion and Homogenization of Vortices in Type-II Superconductor S. Jonathan Chapman, Organizer
- 10:30 A Semi-Elliptic System for a Superconductor Model Henri Berestycki, Université Pierre et Marie Curie, France; Alexis Bonnet, CERMICS, ENPC and École Normale Supérieure (DMI), France; and S. Jonathan Chapman, Organizer
- 11:00 Magnetic Flux Dynamics in Superconductors Alan T. Dorsey, University of Virginia
- 11:30 Vortex Dynamics in Superconductors Jacob Rubinstein, Indiana University, Bloomington

MS16/Crawford Room

Topological Transitions

This minisymposium brings together two related themes: (i) Weak solutions of interface motion laws, even after singularity formation or change of topological type; these are so far understood primarily for "local" models of interface motion. (ii) Problems in which diffusion plays an essential role, for example Hele-Shaw flow, which represents a quasistatic limit of solidification dynamics; here singularities can form, but there is not yet much theory for what happens afterward. The hope, of course, is that by focusing on both themes at once we might discover some points in common.

Organizer: Robert V. Kohn, Courant Institute of Mathematical Sciences, New York University

- 10:00 Singularity Formation in Hele-Shaw Flow and in the Motion of Vortex Sheets Michael Shelley, Courant Institute of Mathematical Sciences, New York University
- 10:30 Interface Motion with Triple Junctions H. Mete Soner, Carnegie Mellon University
- 11:00 Interface Evolutions with Boundary Conditions Yoshikazu Giga, Hokkaido University, Japan
- 11:30 Topological Transitions and Singularities in Nonlinear Diffusion Equations Andrea Bertozzi, Michael Brenner, Leo Kadanoff and Todd Dupont, University of Chicago

WEDNESDAY AFTERNOON, APRIL 20

10:00 AM-12:00 PM **Concurrent Sessions**

MS17/Cambria Room

Electronic Materials Processing: Modeling, Methodology and Challenges

In recent years, the modeling of fluid flow and mass transport processes in physical vapor transport and chemical vapor deposition reactors has provided significant insights into the phenomena controlling the performance of the processes such as reactor geometry, flow patterns, and temperature.

This minisymposium will focus on the modeling and control of transport phenomena in crystal growth processes. The speakers will describe mathematical models that can be used to predict and control the process outcome and their influence on the experimental implementation of these processes. They will also discuss computational issues related to flow simulations and validation of the mathematical models. The multidisciplinary scope of both experimental design and mathematical modeling will be emphasized in order to stimulate exchange of ideas.

Organizer: H. Thomas Banks, Center for Research in Scientific Computation, North Carolina State University

10:00 Modeling of Transport in Crystallization from Vapors Franz Rosenberger, University of Alabama, Huntsville

- 10:30 Thermal Diffusion Effects in Chemical Vapor Deposition Ivan O. Clark, NASA Langley Research Center
- 11:00 Modeling and Optimal Control of Transport Process in High Pressure Vapor Deposition of Optoelectronic Devices Klaus J. Bachmann, H. Thomas Banks, Kuzufumi Ito, Hien T. Tran, and Jeffrey S. Scroggs, North Carolina State University
- 11:30 Effect of Radiation Heat Transfer on the CVD Process for Materials Mohammed Kassemi and S.A. Gokoglu, NASA Lewis Research Center

CP7/Butler Room

Failure and Strength Mechanisms

(This session will run until 12:20 PM)

Chair: Luke E.K. Achenie, University of Connecticut

- 10:00 Thermomechanical Behavior of a Porous Material and its Failure During Combustion
- N.J. Salamon and Sun-pyo Lee, Pennsylvania State University, University Park 10:20 Interface Failure Analysis of Multilayered Ceramic Composites
- Jose F. Magalhaes and Ashley F. Emery, University of Washington
- 10:40 Computational Analysis of Failure Mechanisms in Synthetic Membrane Laminates
- Luke E.K. Achenie and Robert J. Fisher, University of Connecticut 11:00 Stress-Strength Reliability for Braced Systems
- Hossein Arsham, University of Baltimore; Darush Davani, Towson State University; and Arthur B. Kahn, University of Baltimore
- 11:20 Long Time Behaviour of an Evolutionary Ginzberg-Landau System Q. Tang, University of Sussex, United Kingdom
- 11:40 Discontinuous Deformation Gradients and the Onset of Fracture in **Nonlinear Elasticity**

Salim M. Haidar, Grand Valley State University

12:00 A Quasi-Steady Approximation to an Integro-Differential Model of Interface Motion

Piotr Rybka, Warsaw University, Poland

12:00-1:30 Lunch

1:30/Allegheny Room

IP9/Chair: Jerome V. Moloney, University of Arizona Nonlinear Optical Properties of Bulk, Quantum-Well, Quantum-Wire, and Quantum-Dot Semiconductors

Strong optical excitation may change the insulating characteristics of semiconductors all the way to quasi-metallic behavior. These changes are the source of large optical nonlinearities which are interesting not only because of their intrinsic quantum mechanical nature, physical complexity, and richness of dynamic phenomena, but also because of their substantial device application potential. The nonlinear optical response can be manipulated by material design, e.g. by changing the effective dimensionality of the structure from three-dimensional bulk material to quasi-two-dimensional quantum wells, to quasi-one-dimensional quantum wires, or to quasi-zero-dimensional quantum dots. The speaker will review the mathematical modeling of light - matter interaction effects in semiconductor media. He will discuss important physical mechanisms underlying the nonlinear optical response and provide examples of results for different systems.

Stephan W. Koch

Fachbereich Physik, Philipps Universität, Germany

2:15/Allegheny Foyer Coffee

> 2:45-4:45 **Concurrent Sessions**

MS18/Fayette Room

Materials Issues in Nonlinear Optics

The search for suitable materials with large nonlinear optical coefficients is of paramount importance in telecommunications and industrial applications. There is a critical need for all-optical, ultrafast large bandwidth network switches which circumvent the speed limitations of currently used electronic systems. The current state of materials research in nonlinear optics provides great scope for innovative ideas on mathematical modeling and the exploration of scaling laws for nonlinear optical coefficients.

In discussing materials issues in nonlinear optics, the focus is usually on determining the nonlinear optical response for the material in question. This reflects the fact the electromagnetic wave and material property are inseparable entities. A proper description of the optical response function is extremely complicated, requiring full scale microscopic quantum mechanical calculations. Perhaps the greatest limitation to date in the technological implementation of a host of nonlinear optical effects, is the lack of suitable materials. The speakers in this minisymposium will highlight a subset of problems relating to materials that show most promise, namely semiconductors, organics and photorefractives.

Organizer: Jerome V. Moloney, University of Arizona

2:45 Nonlinear Optical Response of Semiconductors

John E. Sipe, University of Toronto, and Ontario Laser and Lightwave Research Center, Canada

- 3:15 **Optics of Fractals**
 - Mark I. Stockman, Washington State University
- 3:45 Anharmonic Oscillator Modeling of Nonlinear Susceptibilities in Molecular Nanostructures and Conjugated Polyenes

Shaul Mukamel, Akira Takahashi and Michael Hartmann, University of Rochester 4:15 **Photorefractive Nonlinear Optics**

Alex Zozulya and Dana Z. Anderson, University of Colorado, Boulder

MS19/Butler Room

Current Issues in Liquid Crystals (Part 2 of 2)

(For description, see MS14 on page 9)

Organizers: Maria-Carme T. Calderer, Pennsylvania State University, University Park Eugene C. Gartland Jr., Kent State University, Mitchell Luskin, University of Minnesota, Minneapolis, and Peter Palffy-Muhoray, Kent State University

2:45 Filamentation and Undulation of a Self-Focused Laser Beam in a Nematic Liquid Crystal

Luc P. Faucheux, Princeton University 3:15 Light Interacting with Liquid Crystals

- David W. McLaughlin, Princeton University 3:45 Convection Instabilities in Liquid Crystals
- Lorenz Kramer and Werner Pesch, Universität Bayreuth, Germany

WEDNESDAY AFTERNOON, APRIL 20

4:15 Pattern Formation at Travelling Chiral Liquid Crystal Phase Boundaries Patricia E. Cladis, AT&T Bell Laboratories, H.R. Brand University of Bayreuth, Germany, and J.T. Gleeson, University of Calgary, Canada, and P.L. Finn, AT&T Bell Laboratories

MS20/Crawford Room

Recent Trends and Developments in Superconductivity (Part 2 of 2) (For description, see MS15 on page 9)

Organizers: Qiang Du, Michigan State University and S. Jonathan Chapman, University of Oxford, United Kingdom

- 2:45 Analyses and Simulations of Ginzburg-Landau Type Equations Qiang Du, Organizer
- 3:15 Dynamics of Vortices in Ginzburg-Landau Theories with Application to Superconductivity
- Weinan E, Institute for Advanced Study 3:45 Title to be determined
- Karl-Heinz Hoffmann, Techniche Universität Munich, Germany 4:15 Numerical Simulation of the Time Dependent GL Equations
- Man Kam Kwong, Argonne National Laboratory

MS21/Cambria Room

Dynamic Phase Transitions in Elastic Materials

For a large class of two-phase problems discussed by materials scientists the material is presumed to be *rigid*, but there are situations in which deformation is important. The speakers in this minisymposium will address four areas of current research in dynamic phase transitions in elastic materials: highly nonequilibrium phase transitions with interface kinetics; dynamic phase transitions in elastic materials with phase characterized by an order parameter, emphasizing the modeling of nucleation; dynamical balance laws for magnetostrictive solids; computational solutions for the dynamics and energetics of particle evolution in stressed elastic solids.

Organizer: Morton E. Gurtin, Carnegie Mellon University

- 2:45 Dynamics of Phase Transitions in Thermoelastic Solids James K. Knowles, Massachusetts Institute of Technology
- 3:15 The Dynamics and Energetics of Particle Evolution in Elastically Stressed Solids
- C.H. Su, M.E. Thompson, and *Peter W. Voorhees*, Northwestern University 3:45 Nucleation and Growth in the Solid State
- Eliot Fried, Pennsylvania State University 4:15 On the Dynamics of Magnetostrictive Solids
 - A. DeSimone and P. Podio-Guidugli, Università di Roma "Tor Vergata", Italy

MS22/Somerset Room

Computational Methods for Determining the Effective Properties of Composite Materials

(This session will run until 5:15 PM)

The focus of this minisymposium is on recently developed numerical methods for the solution of partial differential equations in heterogeneous media and for the determination of the effective properties of such materials. The speakers will discuss finite element and integral equation approaches to the solution of the governing equations, from which the effective properties can be computed, as well as variational methods for the calculation of bounds on the effective properties. The first class of methods yields more information than the second but requires more computational effort. The speakers will also discuss future directions for research.

Organizer: Leslie F. Greengard, Courant Institute of Mathematical Sciences, New York University

- 2:45 Unified Methodology to Characterize the Microstructure and Properties of Composite Media
 - Salvatore Torquato, Princeton University
- 3:15 A Study of the Singularity Structure of the Conductivity of a Sheet with Polygonal Inclusions
- J.H. Hetherington and M. F. Thorpe, Michigan State University
 3:45 Fast Computation of Structural Parameters Leslie F. Greengard, Organizer and J. Helsing, Courant Institute of Mathematical
- Sciences, New York University 4:15 A Voronoi Cell Finite Element Model for Microstructural Analysis of
- 4:15 A Voronol Cell Finite Element Model for Microstructural Analysis of Random Heterogeneous Media Somnath Ghosh, Ohio State University
- 4:45 On the Evaluation of Electrostatic Fields in Composite Media Leslie F. Greengard, Organizer and M. Moura, Instituto Superior Tecnico, Portugal

5:00 Conference Adjourns

SIAM Conferences, Meetings, Symposia, Tutorials, and Workshops

Sponsored by the Society for Industrial and Applied Mathematics

1994

June 15–18, 1994 Fifth SIAM Conference on Applied Linear Algebra Snowbird Ski and Summer Resort, Snowbird, Utah Sponsored by SIAM Activity Group on Linear Algebra Organizer: Beresford N. Parlett, University of California, Berkeley

June 22-25, 1994

Seventh SIAM Conference on Discrete Mathematics Ramada Classic Hotel, Albuquerque, NM Sponsored by SIAM Activity Group on Discrete Mathematics Organizer: William T. Trotter, Bellcore

July 22–23, 1994

Symposium on Control Problems in Industry Holiday Inn on the Bay, San Diego, CA Conducted with the cooperation of INRIA Organizers: Irena Lasiecka, University of Virginia, Blaise Morton, Honeywell Corporation, and Jacque Henry, INRIA

> July 25–29, 1994 **1994 SIAM Annual Meeting** Sheraton Harbor Island East, San Diego, CA Organizer; Barbara L. Keyfitz, University of Houston

December 12–14, 1994 Symposium on Inverse Problems: Geophysical Applications Tenaya Lodge at Yosemite, Fish Camp, CA Sponsored by GAMM and SIAM Abstract deadline: 4/25/94 Organizer: William Rundell, Texas A&M University, College Station

1995

January 22–24, 1995 Sixth ACM/SIAM Symposium on Discrete Algorithms The Nikko Hotel, San Francisco, CA Sponsored by ACM Special Interest Group on Automata and Compatibility Theory and SIAM Activity Group on Discrete Mathematics Abstract deadline: 7/5/94

> February 8–10, 1995 SIAM Conference on Geosciences San Antonio, TX Sponsored by SIAM Activity Group on Geosciences Abstract Deadline: 8/8/94

February 15–17, 1995 Seventh SIAM Conference on Parallel Processing for Scientific Computing The Nikko Hotel, San Francisco, CA Sponsored by SIAM Activity Group on Supercomputing Abstract Deadline: 5/16/94 Organizer: Robert S. Schreiber, RIACS, NASA, Ames Research Center

> April 27–29, 1995 Third SIAM Conference on Control and Its Applications Adams Mark Hotel, St. Louis, MO Sponsored by SIAM Activity Group on Control and Systems Theory Abstract Deadline: 10/7/94 Organizer: John E. Lagnese, Georgetown University

> > October 16–19, 1995 1995 SIAM Annual Meeting The Galt House Hotel, Louisville, KY Abstract Deadline: 4/24/95

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Bitstinglarger, M. J. MS13 Tue 2.45 8 Juffin, G.W. Pf Mass 800 Borniger, M. J. MS15 Wei 1030 9 Morgan, Et. CP4 Tue 2.45 Branting, K. MS12 Tue 3.45 8 Morgan, Et. CP4 Tue 2.45 Branting, K. MS12 Tue 3.45 8 Morgan, Et. MS1 Tue 2.45 Branting, G. MS1 MS12 Tue 3.45 8 Morgan, Et. MS1 Med 3.45 Branting, G. MS1 Men 10:00 4 Morgan, Et. MS1 Med 3.45 Cagninal, G. C. MS1 Men 10:00 4 Mass 70 Morgan, St.4 Men 11:00 Pace, T1.4 MS18 Weid 3.45 Chadran, J. MS1 Weid 10:00 9 Oriz, M. MS4 Men 12:30 Tue 3.25 Chadran, J. MS19 Weid 3.45 6 Pace, T1.4 MS19 Weid 3.45 Chadran, J. MS1 Weid 3.45 6 Pace, T1.4 MS19 Weid	10
Benner, S. S. M15 Weil (0.30 7 Miskoff, M. F. France Tue 2:26 S Boner, S. S. M512 Tue 3:45 8 Mourn, M. ² M222 Weil 4:35 Bunn, D. J. M512 Tue 3:45 8 Mourn, M. ² M222 Weil 4:35 Bunn, D. J. M52 M02455, 6 Makmel, S., MS11 Weil 3:35 Mourn, M. ² Main 1:40 Caparan, S.J. M51 M02455, 6 Makmel, S., MS18 Weil 3:35 Weil 3:35 Caparan, S.J. M514 Weil 1:30 9 Near, C. C.P.I Mon 11:40 Checkner, A. M51 M61 M6120 Oriz, M. M84 Mon 10:30 Checkner, A. M57 M63:35 6 Dathy Mohaner, A. P17 Weil 8:00 Checkner, A. M57 M63:35 6 Dathy Mohaner, A. M53 Weil 3:60 Checkner, A. M57 M63:35 7 Phote, Y. CP1 Mon 10:30 Checkner, A. M57 M63:35 6	6
Bonnet, S. MS15 Weil (0:30) 9 Morgan, E.J. CP4 The (10:3) Brattus, K. MS12 Tue 4:15 8 Morgan, E.J. CP4 Tue 1:0:0 Brans, O.J. MS12 Tue 3:35 8 Morean, M.* MS12 Weil 4:45 Brans, O.J. MS2 Mon 11:00 4 Morean, M.* MS11 Tue 12:00 Caginalp, O.L. MS1 Mon 10:30 4 Morean, M.* MS11 Tue 12:00 Caginalp, O.L. MS1 Mon 10:30 4 Morean, M.* MS11 Tue 12:00 Cadaran, J. MS1 MS1 Weil 4:00 9 Oriz, M. MS4 Mon 10:30 Chapman, S.J. MS12 Tue 10:30 7 Perform, Manorean, B. Profile Mon 10:30 Chapman, S.J. MS12 Tue 10:30 7 Perform, Manorean, B. Profile Mon 10:30 Chapman, M.A. MS5 Tue 10:30 7 Perform, Manorean, M.* MS19 Weid 4:35 Chapman, S.J.	4
Definition No.12 1 are 343 8 Morr. M. ³ MS22 Weid 445 Brann, O. M. MS12 Tare 345 8 Morr. M. ³ MS22 Weid 445 Brann, O. M. MS12 Mon 2455 6 Mon 2455 Mon 1400 Brann, O. M. MS1 Mon 1030 4 Ms18 Weid 345 Dems, D. M. MS1 Mon 1100 4 Mon 1140 Non 1140 Chadnan, J. MS1 Mon 1100 4 Non 1140 Non 1140 Chadnan, J. MS1 Mon 1245 6 Definition 1400 9 Oriz, M. MS4 Mon 1030 Chadnan, J. MS1 Mon 1245 6 Definition 1400 9 Oriz, M. MS4 Mon 1030 Chadar, P.E. MS10 Tae 315 8 Poech, W. MS19 Weid 345 Chap, P.C. MS17 Mon 1030 10 Poech, W. MS19 Weid 345 Chap, P.C. MS17 Mon 1030 10 Poech, W.	- 8. 7
Brun, 0.4 MS12 Tue 3:45 8 Movelanized Sc. Mill Tue 1:200 Brun, 0.4 MS2 Mon 11:00 4 MS18 Weid 3:45 Caginalp, G. 6 MS1 Mon 11:00 4 Mono:River, I. CP1 Mon 11:40 Caginalp, G. 6 MS1 Weid 11:30 9 Negron, P.V. CP1 Mon 11:40 Chapman, S. J. MS1 Won 11:00 4 Negron, P.V. CP1 Mon 11:40 Chapman, S. J. MS1 Won 11:00 4 Negron, P.V. CP1 Mon 10:30 Chapman, S. J. MS1 Weid 4:15 6 Partify Mukory, P. Prot. MS4 Mon 10:30 Chap, P.C. MS4 Mon 10:00 5 Prot. MS19 Weid 3:45 Mon 3:05 Claik, R. MS17 Weid 4:15 10 Prot. MS1 Mon 10:30 Prot. MS1 Mon 10:30 Mon 11:30 Mon 3:30 Mon 11:30 Mon 3:30 Mon 11:30 Mon 3:30 Mon 11:30 Mon 11:30	11
Burns, T.J. CP3 Mon. 2:45, 6 Munoz-Rivera, J. CP1 Mon. 10:20 Caginalp, G. A. MS1 Mon. 10:30 4 Negron, P. V. CP1 Mon. 10:40 Cadatan, J. MS1 Mon. 10:30 4 Negron, P. V. CP1 Mon. 10:30 Chadran, J. MS1 Mon. 10:00 4 Ortiz, M. MS4 Mon 10:30 Charp, S.H. MS6 Mon. 24:5 6 Defr. M. Units, M. MS4 Mon 10:30 Cherkaw, A. MS7 Mon. 34:5 6 Defr. M. Units, M. MS19 Wed 3:65 Chu, C.H. MS13 Tu 0:30 7 Bernik, M. MS19 Wed 3:45 Char, LO. MS17 Wed 10:50 10 Defr. M. MS13 Mon 10:30 Char, LO. MS17 Wed 10:50 10 Defr. M. MS13 Mon 10:30 Char, L. M. MS12 Mon 10:60 4 Deforein, M. MS13 Mon 10:30 Calar, L. M. MS1 Mon 10:60 4 Deforein, M. MS13	7
Caginalp, G. C. MS1 Mon 10:30 4 Nearant, C. T. Mon 11:40 Caditarr, MC.T. MS14 Weil 11:30 9 Nearant, S. W. CP1 Mon 11:40 Chapman, S. M. MS15 Weil 10:00 9 Ortiz, M. MS4 Mon 10:30 Chapman, S. M. MS15 Weil 10:00 9 Ortiz, M. MS4 Mon 10:30 Chapman, S. M. MS15 Weil 10:00 9 Ortiz, M. MS4 Mon 10:30 Chapman, S. M. MS7 Mon 3:43 6 Party Michaever, M. (27) Weil 3:00 Chap, P. C. M. MS1 MS1 Transport Transport MS3 Mon 10:30 Chap, P. C. M. MS4 MS1 Transport MS1 Mon 10:30 Party Michaever, MS3 Mon 10:30 Chap, P. C. M. MS4 MS1 Mon 10:30 10 Porte-Chaptaever, MS2 Mon 11:30 Chap, P. C. M. MS1 Mon 10:30 10 Porte-Chaptaever, MS2 Mon 11:30 Chap, A. MS1 Mon 10:30	10
Catchere, M. C17. MS14 Wed 11:30 9 The state of the state	5
Chadam, J. MS1 Mon 11:00 4 Frank Frank Mon 10:30 Chapman, S.J. MS15 Wei (1000) 9 Orit, M. MS4 Mon 10:30 Charpe, S.H. MS6 Mon 24:5 6 Oritz, M. MS4 Mon 10:30 Charder, J. M. MS9 Tue 10:30 7 Pech, R. J. M. MS19 Wei 3:45 Charder, J.L. MS19 Wei 4:15 8 Phech, S. L. MS19 Wei 3:45 Char, K. MS17 Wei 10:30 10 Phinan, E.B. CP3 Mon 11:00 Colars, K. MS2 Mon 10:00 4 Pontic, S.L. MS21 Wei 4:15 Colars, C.R. MS2 Mon 10:00 4 Pontic, H. (CP3 Mon 11:00 Colars, C.R. MS3 Tue 10:00 7 Puchner, H. (CP5 Tue 4:05 Colars, C.R. MS3 Tue 10:00 7 Puchner, H. (CP1 Mon 10:00 De Sim, B.A. CP2 Mon 4:25 6 Roarder, Y, Y CP1 <td< td=""><td>5</td></td<>	5
Chapman, S.J. Mis1s Weil (10:00 9 Oriz, M. Mis4 Mon 10:30 Chapp, S.J. Mis5 Weil (10:00 9 Oriz, M. Mis4 Mon 10:30 Chipot, M. MS9 Tur 10:30 7 Perce, T.J.4 CP3 Mon 4:23 Chipot, M. MS19 Weid 3:43 10 Phoenix, S.L. MS3 Mon 10:30 Chap, P.C.H. MS13 Tur 3:15 8 Phoenix, S.L. MS3 Mon 10:30 Char, L.O. MS17 Weid 10:00 5 Phoenix, S.L. MS3 Mon 10:30 Clark, K. MS2 Mon 10:00 10 Phoine-Castanedger MS2 Mon 11:30 Coleman, B.D. CP5 Tur 3:00 8 Ponther, H. & CP1 Mon 10:00 Cross, M. MS1 Mon 10:00 4 Remarky, Y.Y. CP1 Mon 10:40 De Graef, M. MS13 Tur 4:45 8 Richmond, O. 1 MS3 Mon 11:00 De Simon, A.1 MS6 Mon 3:15 <td< td=""><td>8</td></td<>	8
Charap, S.H.I. MS6 Mon 2-45 6 Cherkaev, A. MS7 Mon 3-45 6 Cherkaev, A. MS9 Tue 10-30 7 Chu, C.H., MS13 Tue 315 8 Chark, K. MS19 Wed 4;15 10 Chark, I.O. MS17 Wed 4;15 10 Chark, I.O. MS17 Wed 10:30 10 Clark, K. MS2 Mon 10:00 5 Colins, C.R. MS2 Mon 10:00 4 Colins, C.R. MS2 Mon 10:00 4 Colins, C.R. MS9 Tue 10:00 7 Custer, A. MS9 Tue 10:00 7 Colsen, A. MS9 Tue 10:00 7 Costs, M. MS13 Tue 4:45 8 Renardy, M. De Graef, M.H. MS13 Tue 4:45 8 Renardy, M. De sinne, A. MS0 Mon 12:50 6 Buestin, P. Dissin, B.A. CP2 Mon 3:25 6 Buestin, P. </td <td>5</td>	5
Outstand, Y. M31 M00.3-03 O Penci, T.1.4. CP3 Mon.4-25 Chipot, M. MS19 Tue 0:030 7 Penci, T.1.4. CP3 Mon.4-25 Chai, C.H. MS19 Wed 3:45 10 Phoenix, S.L. MS19 Wed 3:45 Clark, I.O. MS17 Wed 3:45 10 Penci, T.1.4. MS3 Mon.10:30 Clark, I.O. MS17 Wed 3:45 10 Penci, T.1.4. MS3 Mon.10:30 Clark, I.O. MS17 Wed 1:0:30 10 Penci, T.1.4. MS2 Mon.10:30 Columa, B.D. CP5 Tue 3:0:5 8 Point-Castanciarty MS2 Mon.10:00 Cross, M. MS11 Tue 4:4:5 8 Remardy, Y.Y. CP1 Mon.10:00 De Graef, M. MS15 Tue 4:4:5 8 Remardy, Y.Y. CP1 Mon.10:00 De simone, A. MS6 Mon 3:15 6 Robumetky, E.L. CP3 Mon.4:45 Dosey, A.T. MS13 Tue 4:2:5	9
Chinol, N. H. Diab Ture 10:30 Participation Chu, C.H. MS13 Ture 3:15 8 Cladis, P.E. MS19 Wed 4:15 10 Clark, I.O. MS17 Wed 4:15 10 Clark, I.O. MS17 Wed 10:30 10 Clark, K. MS2 Mon 10:30 CP3 Clark, K. MS2 Mon 10:00 4 Colina, G. C.R. MS2 Mon 10:00 4 Colina, G. C.R. MS1 Mon 10:00 4 Poilgrone, J.A. Colina, G. C.R. MS1 Mon 10:00 4 Renardy, M. CP1 Mon 10:00 De Graef, M. MS1 Tue 4:45 8 Renardy, M. CP1 Mon 10:00 De Simone, A. MS2 Mon 4:25 6 Board, S.P. MS13 Tue 4:45 Dia, Q. MS13 Tue 4:45 8 Renardy, M. CP1 Mon 10:40 De Simone, A. MS13 Tue 4:45 8 Roosen.A MS33 Mon 4:45	9. 6.
Chais, P.E.MailWeil 4:15NoChais, P.E.MS1Weil 4:1510Chais, P.E.MS1Weil 4:1510Chais, P.E.MS1Weil 4:1510Clark, L.O.MS1Weil 0:3010Clark, L.O.MS2Mon 10:004Poligone, D.A.CP1Mon 11:30Columa, B.D.CP5Tue 3:058Columa, B.D.CP5Tue 3:058Columa, B.D.CP5Tue 3:058Columa, B.D.CP5Tue 3:058Columa, B.D.CP2Mon 10:007Public Castancian TimeMS2Mon 10:00De Graef, M.MS13Tue 4:458De Simone, A.MS6Mon 3:156Dissim, B.A.CP2Mon 4:256Dorsey, A.T.MS15Weil 11:009Du, Q.MS20Weil 2:4511Dun, J.H.CP5Tue 3:258Biger, D.J.CP2Mon 3:256Faucheux, L.P.MS19Weil 2:4511Rubinstein, J.D.CP6Tue 3:458Faucheux, L.P.MS19Weil 2:4511Rubinstein, J.D.CP6Tue 3:458Friezeke, G.MS21Weil 3:4511Rubinstein, J.D.CP6Tue 3:458Silonon, N.J.CP7Weil 1:00Rearchy, R.M.MS11Tue 1:130Rearchy, R.M.MS14Weil 2:00Friezeke, G.MS13<	10
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Collinal, D.L. Cl3 Tue 303 a Collins, C.R. MS9 Tue 10:00 4 Renardy, M. CP5 Tue 4:05 Cross, M. MS1 Mon 10:00 4 Renardy, M. CP1 Mon 10:00 De Graef, M.4 MS13 Tue 4:45 8 Renardy, Y.Y. CP1 Mon 10:00 De Simone, A. MS6 Mon 3:15 6 Richmond, O. 4 MS3 Mon 10:00 De Simone, A. MS6 Mon 3:15 6 Richmond, O. 4 MS3 Mon 10:00 Dersey, A.T. MS15 Wed 12:25 6 Rosetti, P. MS13 Tue 4:15 Dun, J.H. CP5 Tue 3:25 8 Rosettiberger, F. MS17 Wed 10:00 Fancheux, L.P. MS19 Wed 2:45 11 Robitstein, J. MS15 Wed 10:00 Fancheux, L.P. MS19 Wed 2:45 11 Robitstein, J. MS15 Wed 10:00 Franctori, G. MS7 Mon 4:25 8 Saito, Y. Poster <t< td=""><td>4</td></t<>	4
Cross, M. MS1 Mon 10:00 4 Renardy, M. CP1 Mon 10:00 De Graef, M./ MS13 Tue 4:45 8 Renardy, Y.Y. CP1 Mon 10:00 De Simone, A. MS6 Mon 31:5 6 Renardy, Y.Y. CP1 Mon 10:00 De Simone, A. MS6 Mon 425 6 Rosen, A. MS3 Mon 10:00 Diressin, B.A. CP2 Mon 425 6 Rosen, A. MS8 Tue 10:30 Du, Q. MS20 Wed 11:00 9 Rosen, K. MS13 Tue 4:15 Dun, J.H. CP5 Tue 3:25 8 Rosenswig, R. MS10 Tue 10:00 Eyre, D.J. CP2 Mon 3:25 6 Roythurd, A.L. MS11 Tue 4:15 Duacteux, L.P. MS19 Wed 2:45 11 Rosenswig, R.P. MS15 Wed 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rosenswig, R.P. MS15 Wed 10:00 Franchor, G. (f. MS7 Mon 4:45 6	8
De Graef, M. J. MS13 Tue 4:45 8 Renardy, Y,Y. CP1 Mon 10:40 De Simone, A. J. MS6 Mon 31:5 6 Richmond, O. MS3 Mon 10:40 Dessimone, A. J. MS6 Mon 31:5 6 Richmond, O. MS3 Mon 10:40 Direstin, B.A. CP2 Mon 31:25 6 Rosensity, P. J. CP3 Mon 4:45 Dung, J.H. CP5 Tue 3:25 8 Rosensity, P. MS13 Tue 4:15 Dung, J.H. CP2 Mon 3:25 6 Rosensity, P. MS17 Wel 0:00 Faucheux, L.P. MS19 Wel 2:45 11 Rosensweig, R. MS10 Tue 10:00 Faucheux, L.P. MS19 Wel 2:45 11 Rubinstein, J. MS15 Wel 11:30 Faucheux, L.P. MS19 Wel 2:45 11 Rubinstein, J. MS15 Wel 11:30 Francfort, G. MS7 Mon 4:45 6 Salamon, N.J. CP7 Wel 10:00 Francfort, G. MS13 Tue 3:45 8	5
De State, R. 1 Mills Mon 3:15 6 Richmond, O. 4 MS3 Mon 11:00 Diesslin, B.A. CP2 Mon 4:25 6 Bauerfsty, E.I. CP3 Mon 4:45 Dorsey, A.T. MS15 Wed 11:00 9 Rosen, A. MS8 Tue 10:30 Du, Q. MS20 Wed 2:45 11 Rosen, A. MS13 Tue 4:15 Dunn, J.H. CP5 Tue 3:25 8 Rosen, A. MS10 Tue 10:00 Fyre, D.J. CP2 Mon 3:25 6 Rosenberger, F. MS11 Tue 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rubinstein, J. MS15 Wed 11:30 Faucheux, L.P. MS17 Mon 4:45 6 Saito, Y. V Poster Tue 2:45 Franctort, G. MS13 Tue 3:45 8 Saito, Y. V Poster Tue 2:45 Friesecke, G. MS11 Tue 1:30 7 Sauders, B. MS10 Tue 1:45 Garison, W.M. MS11 Tue 1:30 7 Sauders, B. <td>5</td>	5
Diesslin, B.A.CP2Mon 4:256CP3Mon 4:45Dorsey, A.T.MS15Wed 11:009Roosen, A.T.MS8Tue 10:30Du, Q.MS20Wed 2:4511Rosenberger, F.MS13Tue 4:15Dunn, J.H.CP5Tue 3:258Rosenberger, F.MS10Tue 4:15Eyre, D.J.CP2Mon 3:256Rosenberger, F.MS11Tue 10:00Faucheux, L.P.MS19Wed 2:4511Rubinstein, J.MS15Wed 11:30Fenceca, I.T.IP6Tue 3:458Rybka, P.CP7Wed 12:00Fonceca, I.T.IP6Tue 1:308Saito, Y.PosterTue 2:45Francfort, G.MS13Tue 3:458Saimon, N.J.CP7Wed 10:00Friesecke, G.MS13Tue 3:458Saimon, N.J.CP7Wed 10:00Garrison, W.M.MS11Tue 11:307Saunders, R.P.MS14Wed 10:00Gartand, E.O.MS14Wed 10:309Scröggs, J.S.MS16Wed 11:00Globa, S. C.MS22Wed 4:1511Saunders, R.P.PS7Tue 8:45Gibiansky, LLCP4Tue 11:007Shelley, M.MS16Wed 10:00Gibiansky, Y.L.CP4Tue 10:407Sociolovsky, E.M.MS16Wed 3:15Gordon, M.S.Y.CP5Tue 3:458Sociolovsky, E.M.MS16Wed 3:15Gordon, M.S.Y.CP4Tue 10:407Sociolovsky, E.M. <td>5</td>	5
Dur, Q. MS20 Wed 2:45 11 Rosakis. P MS13 Tue 4:15 Dun, J.H. CP5 Tue 3:25 8 Rosakis. P MS17 Wed 10:00 Eyre, D.J. CP2 Mon 3:25 6 Rosamberger, F, MS17 Wed 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rubinstein, J. MS10 Tue 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rubinstein, J. MS11 Tue 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rubinstein, J. MS15 Wed 11:30 Faucheux, L.P. MS17 Mon 4:45 6 Saito, Y. Poster Tue 2:45 Francfort, G. MS21 Wed 3:45 11 Saito, Y. Poster Tue 2:45 Friede, E. MS13 Tue 3:45 8 Saito, Y. Poster Tue 2:45 Gartison, W.M. MS11 Tue 11:30 7 Saupe, A. MS14 Wed 10:00 Goldastin, R.P. MS14 Wed 10:30 9	6
Dum, J.H. CP5 Tud 2.4.5 11 Rosenberger, F. MS17 Wed 10:00 Byre, D.J. CP2 Mon 3:25 6 Rosensweig, R. MS10 Tue 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rosensweig, R. MS11 Tue 10:00 Faucheux, L.P. MS19 Wed 2:45 11 Rosensweig, R. MS15 Wed 11:30 Febribach, J.D.M. CP6 Tue 3:45 8 Rybka, P. CP7 Wed 12:00 Francfort, G. MS7 Mon 4:45 6 Salamon, NJ. CP7 Wed 10:00 Fried, E. MS21 Wed 3:45 11 Saudors, B.V. Poster Tue 2:45 Friesecke, G. MS13 Tue 3:45 8 Saupe, A. MS14 Wed 10:00 Gartiand, E.G. MS14 Wed 10:30 9 Sorrogs, J.S. MS17 Wed 11:00 Gartiand, E.G. MS14 Wed 10:30 9 Sorrogs, J.S. MS16 Wed 10:00 Gartiand, E.G. MS14 Wed	7
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Febribach, J.D./ CP6 Tue 3:45 8 Febribach, J.D./ CP6 Tue 3:45 8 Francfort, G. MS7 Mon 4:45 6 Saito, Y. Poster Tue 2:45 Fried, E. MS21 Wed 3:45 11 Saito, Y. Poster Tue 2:45 Garrison, W.M. MS11 Tue 11:30 7 Gartiand, E.G. MS14 Wed 10:00 9 Gartiand, E.G. MS14 Wed 10:30 9 Gordinsky, L1 CP4 Tue 11:00 7 Gibiansky, L1 CP4 Tue 11:00 7 Gibiansky, L1 CP4 Tue 11:00 7 Gibiansky, L1 CP4 Tue 10:30 7 Golden, K.M. MS16 Wed 10:00 9 Golden, K.M. MS10 Tue 10:30 7 Gordon, M.S.Y. CP3 Mon 3:45 5 Golden, K.M. MS10 Tue 10:30 7 Sociolovsky, E.A. CP2 Golder, K.M. MS12 Tue 3:15 8 Sociolovsky, E.A. CP2 M	7
Forecta, 17 IP6 Tue 1:30 8 Francfort, G. MS7 Mon 4:45 6 Fried, E. MS21 Wed 3:45 11 Priesecke, G. MS13 Tue 3:45 8 Garrison, W.M. MS11 Tue 11:30 7 Gartiand, E.G. MS14 Wed 10:30 9 Gartison, S. L MS22 Wed 4:15 11 Gibiansky, L1 CP4 Tue 1:100 7 Sauge, A. Gibiansky, L1 CP4 Tue 1:100 7 Shelley, M. Giden, K.M. MS16 Wed 11:00 7 Shelley, M. Golden, K.M. MS16 Wed 11:00 7 Shelley, M. MS16 Wed 10:00 Gidiansky, L1 CP4 Tue 1:00 7 Shelley, M. MS16 Wed 10:00 Gidiansky, L1 CP4 Tue 1:00 7 Shelley, M. MS16 Wed 10:00 Gidiansky, L1 CP4 Tue 10:00 7 Socolovsky, E.M. MS18 Wed 2:45 Goldstein, R.M. MS10 Tue 10:30 7 Socolovsky, E.M. <	9
Francfort, G. MS7 Mon 4:45 6 Salamon, N.J. CP7 Wed 10:00 Fried, E. MS21 Wed 3:45 11 Salamon, N.J. CP7 Wed 10:00 Gartison, W.M. MS11 Tue 11:30 7 Salamon, N.J. CP7 Wed 10:00 Gartison, W.M. MS11 Tue 11:30 7 Saunders, B.V. Poster Tue 2:45 Gartiand, E.G. MS14 Wed 10:30 9 Scroggs, J.S. MS10 Tue 11:30 Gartiand, E.G. MS14 Wed 10:30 9 Scroggs, J.S. MS17 Wed 11:00 Ghosh, S. L MS22 Wed 4:15 11 Gertkerka, R.F. PF5 Tue 8:45 Gibiansky, L1 CP4 Tue 11:00 7 Shelley, M. MS16 Wed 10:00 Giga, Y. MS16 Wed 11:00 9 Sigmund, O. MS7 Mon 4:15 Golden, K.M. MS5 Mon 2:45 5 Socolovsky, E.A. CP2 Mon 2:45 Goldstein, R.Y. MS10 Tue 10:30 7 Socolovsky, E.A. MS18 Wed 2:45 Gordstein, M.Y.	10
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Haluar, S.W. V CP7 Well 11:40 10 Tokarawski S. A. CD6 The 4:25	8
Halikenschildss, M. Cr4 Heilitäu / Torquato, S. MS3 Mon 11:30	5
Helsing, J. MS22 Wed 3:45 11 Hoffmann, KH. MS20 Wed 3:45 11 Hoffmann, KH. MS20 Wed 3:45 11 Torquato, S. MS22 Wed 2:45	11
Huntley, D.A. CP2 Mon 3:45 6 Voorhees, P.W. MS21 Wed 3:15	11
Isichenko, M.B. 1 MS5 Mon 4:15 5 Vu-Quoc, L. CP4 Tue 11:20	7
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Wong F 2 (DD) Man 2.05	6
Wang, H. / MS9 Tue 11:30	7
Karma, A.S. MS12 Tue 2:45 8 Warren, J.A. MS8 Tue 11:00	7
Kartha, S. MS4 Mon 11:30 5 Weinan E MS20 Wed 3:15 Kassemi, M. MS17 Wed 11:30 10 Whiteman, J.R. 4 CP1 Mon 11:20	11
Kassemi, M. MS17 Wed 11:30 10 Whiteman, J.R. CP1 Mon 11:20 Keller, J.B. IP3 Mon 1:30 5 Widom, M. MS10 Tue 11:00	5
Kikuchi, N. / MS7 Mon 2:45 6 Woinar, R. / CP6 Tue 4:45	8
Knowles, J.K. MS21 Wed 2:45 11 Wojnar, R. Poster Tue 2:45	8
Koch, S.W. IP9 Wed 1:30 10	10
V doubort Sinth V	**
Kramer, L. MS19 Wed 3:45 10 Kurtz, S.K. MS3 Mon 10:00 5	
Kina, S.K. Miss Midi 10:00 S Kwong, M. MS20 Wed 4:15 11	