PROGRAM IN APPLIED MATHEMATICS

UNIVERSITY OF COLORADO
AT BOULDER

BOULDER, COLORADO 80309-0526
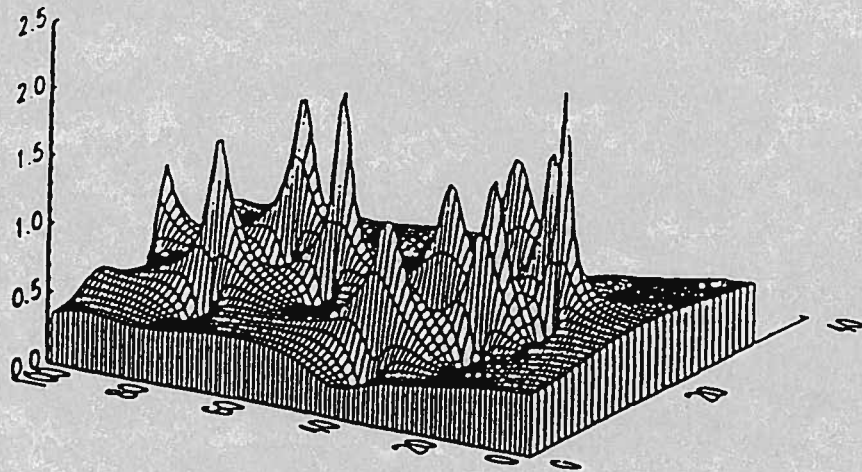
ANNUAL REPORT

1992-93

Mark J. Ablowitz, Director

James H. Curry, Associate Director

July 1, 1993

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1. **OBJECTIVES**

The objectives of the Program in Applied Mathematics at the University of Colorado at Boulder are summarized below:

a) To provide undergraduate and graduate students with excellent courses and training in applied and computational mathematics. Students are given the necessary background to meet the demands of careers in business, industry, R & D laboratories, and academic professions.

b) To offer and develop a broad curriculum that serves the students of all departments and programs of the University.

c) To monitor and maintain excellence in the B.S., M.S. and Ph.D. degrees in Applied Mathematics.

d) To create and nourish an environment in which excitement, creativity and enjoyment of professional activities are of central importance to and valued by the Program.

2. **ORGANIZATION AND COMMENTS**

A. Overview

In 1992-93, the Program in Applied Mathematics had a core of eleven faculty members plus three full-time instructors who are responsible for the teaching and advising of all undergraduate and graduate students taking applied mathematics courses. The program has a large teaching commitment since most undergraduate engineering majors are required to take four courses in applied mathematics. In 1992-93 the Program taught a total of 2797 undergraduate and graduate students in 17 undergraduate courses (divided into 30 sections) and 15 graduate courses. In addition, the Program has 26 affiliated faculty members, each of whom can direct a graduate student towards a Ph.D. in Applied Mathematics. Providing high quality instruction is essential in order that our students learn the fundamental mathematical tools which are frequently required in application.

The graduate student population continues to grow. The Program currently has 28 graduate students and we anticipate nearly 35 students for 1993-94. In 1992-93 we had 20 teaching assistantships, and currently seven graduate students are supported by research grants. The number of graduate students supported by research grants has increased substantially; this is due in part to the success of the affiliated faculty program. It should be noted that, counter to national trends, we have been very successful in recruiting U.S. citizens to study in our graduate program. In 1993 (as in 1992), all new students with support will be U.S. citizens from U.S. undergraduate universities. Currently we have six international graduate students. Although we certainly encourage international applications, our success in being able to attract high quality American graduate students is remarkable.

We are delighted to report that thanks to the tireless efforts of Professor James Meiss, the Program has been awarded $555,000 by the National Science Foundation to fully support six NSF predoctoral students during the upcoming five years. It is undoubtedly a significant

achievement that our program, only in its fourth year of existence, was selected by NSF for this prestigious award.

The research activities of the faculty in the Program are varied and include nonlinear dynamics, chaos theory, solitons and integrable nonlinear evolution equations, nonlinear optics, inverse problems, analysis of nonlinear equations arising in physical phenomena, computational mathematics including wavelet analysis and computational fluid dynamics, matrix algebra, applied probability and statistics. Our affiliated faculty are rostered in a wide range of departments including Aerospace Engineering, APAS, Chemistry and Biochemistry, Civil Engineering, Computer Science, Electrical and Computer Engineering, Geological Sciences, Mathematics, Mechanical Engineering, and the Graduate School of Business.

B. Core Faculty and Long Term Visitors

Mark J. Ablowitz, Director, Professor; PhD, Massachusetts Institute of Technology. Partial Differential Equations, Solitons, Nonlinear Waves.

Jerrold Bebernes, Professor; PhD, University of Nebraska. Differential Equations, Reaction Diffusion Systems, Combustion Theory, Analysis.

Gregory Beylkin, Professor; PhD, New York University. Computational Methods, Wavelets, Geophysical Inverse Scattering.

Mary Brewster, Assistant Professor; PhD, California Institute of Technology. Singular Perturbation Methods, Computational Mathematics, Combustion Theory.

Sarbarish Chakravarty, Lecturer; PhD, University of Pittsburgh. General Relativity, Nonlinear Integrable Systems.

Peter Clarkson, Visiting Associate Professor (from the University of Exeter, UK); D.Phil., Oxford University. Nonlinear Differential Equations, Symmetry Analysis.

James H. Curry, Associate Director, Professor; PhD, University of California at Berkeley. Dynamical Systems, Numerical Methods, Nonlinear Equations.

Robert Easton, Professor; PhD, University of Wisconsin. Dynamical Systems, Hamiltonian Mechanics.

Benno Fuchssteiner, Visiting Professor (from University of Paderborn, Germany); PhD, Technische Hochschule in Darmstadt. Nonlinear Differential Equations, Symmetry Analysis.

Congming Li, Assistant Professor; PhD, New York University. Nonlinear Differential Equations.

Martha Nesbitt Limber, Instructor; PhD, University of Colorado at Boulder. Dynamical Systems, Numerical Methods.

Elizabeth Mansfield, Visiting Research Associate (from the University of Exeter, UK); PhD, University of Sydney. Systems of PDE.

John Maybee, Professor; PhD, University of Minnesota. Applied Combinatorics and Matrix Analysis.

Robert McLachlan, Instructor; PhD, California Institute of Technology. Computational Mathematics, Computational Fluid Dynamics.

James D. Meiss, Professor; PhD, University of California at Berkeley. Dynamical Systems, Hamiltonian Mechanics, Plasma Physics.

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Monika Nitsche, Instructor; PhD, University of Michigan. Computational Numerical Analysis of Fluid Dynamics.

Constance Schober, Instructor; PhD, University of Arizona. Integrable Systems, Computational Methods.

Harvey Segur, Professor; PhD, University of California at Berkeley. Nonlinear Waves, Fluid Dynamics, Asymptotic Methods.

Xiao Wang, Instructor; PhD, New York University. Nonlinear PDE's, Computational Mathematics.

John Williamson, Professor; PhD, University of Minnesota. Statistical Methods in Genetics, Applied Probability, Mathematical Statistics.

SHORT-TERM VISITORS:

Tesuo Daguchi, University of Tokyo (March 1993)

Silvana DeLillo, Perugia University (October 1992)

Boris Dubrovin, SISSA, Italy (May 1993)

Barend Herbst, University of the Orange Free State (January, June 1993)

T. Iizuka, University of Tokyo (September 1992)

Carlangelo Liverani, University of Rome (March 1993)

Taro Nagao, University of Tokyo (March 1993)

K. Nakayama, University of Tokyo (September 1992)

Miki Wadati, University of Tokyo (September 1992)

C. Affiliated Faculty--Graduate Program in Applied Mathematics

William Blumen (Astrophysical, Planetary, and Atmospheric Sciences and Physics), Geophysical Fluid Dynamics in Atmospheric Science

Elizabeth Bradley (Computer Science), Scientific Computation, Artificial Intelligence, Nonlinear Dynamics.

Richard Byrd (Computer Science), Numerical Computation, Optimization Algorithms

John Cary, (Astrophysical, Planetary, and Atmospheric Sciences and Physics), Nonlinear Dynamics, Plasma Physics, Accelerator and Space Physics

Senarath deAlwis (Physics), Theoretical Physics, String Theory, Quantum Gravity

Thomas DeGrand (Physics), Numerical Methods for Quantum Field Theory

Fred Glover (Graduate School of Business), Large-scale Systems, Applied Artificial Intelligence, Optimization Models

Martin Goldman (Astrophysical, Planetary, and Atmospheric Sciences and Physics), Plasma Physics, Nonlinear Waves, Turbulence

Vijay Gupta (Geological Sciences), Hydrology, Stochastic Processes, Fluid Dynamics

Tissa Illangasekare (Civil Engineering), Mathematical Modeling of Flow and Transport in Porous and Fractured Media, Computational Methods, Numerical Modeling

Elizabeth Jessup (Computer Science), Numerical Computation, Parallel Computation

David Kassoy (Mechanical Engineering), Fluid Dynamics, Combustion Theory, Thermal Science

James Kelly (College of Business), Heuristic Search, Optimization, Artificial Intelligence

Manual Laguna (College of Business), Exact and Heuristic Methods for Combinatorial Optimization Problems, Network Flow Programming, Applied Artificial Intelligence

Michael Lightner (Electrical Engineering), VLSI, Discrete Mathematics, Graph Theory

Oliver McBryan (Computer Science), Parallel Computation, Graphics and Visualization, Computational Fluid Dynamics

Robert Sani (Chemical Engineering), Computational Fluid Dynamics, Free and Moving Boundary Problems, Stability of Systems

Duane Sather (Mathematics), Partial Differential Equations, Fluid Mechanics

Robert Schnabel (Computer Science), Numerical Methods for Optimization, Nonlinear Equations, Parallel Scientific Computation

Richard Seebass (Aerospace Engineering), Aerodynamics, Gas Dynamics, Supersonic and Hypersonic Flows

J. Michael Shull (Astrophysical, Planetary, and Atmospheric Sciences), Theoretical Astrophysics

Rex Skodje (Chemistry and Biochemistry, Joint Institute for Laboratory Astrophysics), Nonlinear Dynamics, Quantum Chaos, Molecular Dynamics

Gary Stormo (Biology), Molecular Structures and Patterns, Dynamics Modeling, Control Robotics

Renjeng Su (Electrical Engineering), Nonlinear Dynamics Modeling, Control, Robotics

Juri Toomre (Astrophysical, Planetary, and Atmospheric Sciences, Joint Institute for Laboratory Astrophysics), Astrophysics, Mathematical Modelling, Numerical Simulation

Ellen Zweibel (Astrophysical, Planetary, and Atmospheric Sciences), Plasma Physics, Astrophysics

D. Staff

Stu Naegele - Administrative Assistant

Janet Glasser - Senior Secretary/Student Coordinator

Margy Lanham - Word Processing Operator

E. General Comments

• The Program continues to teach a very large number of students which is particularly impressive given our relatively small size. We taught 2562 students in 1990-91; 2781 in 1991-92; and 2797 in 1992-93. In 1990-91 we had 17 graduate students enrolled; in 1991-92 there were 27; and in 1992-93 we have 28. We expect significant increases in our graduate student population over the next few years.

• Due to a masterful effort by Professor James Meiss, the program was awarded a $555,000 grant to support six NSF predoctoral trainees during the upcoming five years. The Program is one of only two academic units in the mathematical sciences in the U.S. to receive this grant. Thank you James Meiss!

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- Excellence in teaching is deeply valued by the Program. We are honored and in awe of the achievements of Professor James Curry. This past year he was designated as a President's Teaching Scholar, which is the highest teaching award in the University of Colorado system. In addition to this honor (as if this were not enough!), Curry was also selected as an outstanding advisor in the College of Engineering, was one of the recipients of the SOAR (Student Office for Alumni Relations) award for outstanding teaching, and again won the Tau Beta Pi outstanding teacher award in the College of Engineering. All this comes after James Curry won the Tau Beta Pi outstanding teacher award in 90-91 and the Boulder Faculty Teaching Award in 91-92. How about that for a distinguished record as a teacher and advisor? Bravo James Curry!

- The summer of 1993 brought the advent of a multi-year program featuring visiting scientists from the former Soviet Union. Prestigious lecturers are presenting talks on mathematical and theoretical problems in physics and astrophysics. The program is sponsored by the Program in Applied Mathematics; the Department of Astrophysical, Planetary and Atmospheric Sciences; the Department of Physics; the Dean of the College of Arts and Sciences; the Dean of the Graduate School; the Vice President for Academic Affairs and Research; the Vice Chancellor for Academic Affairs; NCAR; and by a generous grant from the Sloan Foundation. Three members of the Russian Academy of Sciences in Moscow are participating this year. They are I.M. Khalatnikov, L.D. Landau Institute of Theoretical Physics; Andrei Monin, Institute of Oceanology; and Lev Pitaevskii, P.L. Kapitza Institute for Physical Problems. Andrei Illarianov from the P.N. Lebedev Physics Institute is the fourth participant. We are very grateful to all of our contributors and to our colleagues in the former Soviet Union for making this event successful.

- The record of the faculty in research is impressive by national and international standards. The faculty in the program currently are editors of eight leading journals. These include three SIAM (Society for Industrial and Applied Mathematics) journals: *Applied Mathematics, Numerical Analysis,* and *Matrix Analysis*. The other journals are *Studies in Applied Mathematics, Rocky Mountain Journal of Mathematics, Physica D, Journal of Engineering Mathematics and Inverse Problems*. Our faculty members are also members of the advising boards of the following journals: *Chaos, Inverse Problems, Nonlinear Science and Dynamical Systems*. These statistics are even more impressive given that in 1992-93 we are only eleven faculty!

- Thanks to efforts of our faculty in proposals, we have had a multimillion dollar year in new awards. Especially noteworthy is the award of $555,000 (NSF graduate traineeships, J. Meiss, PI) and $450,000 (DARPA, G. Beylkin, PI; M. Brewster, Co-PI). In addition to these large grants, the program faculty received awards of nearly $600,000. Not bad!

- At the end of the 1992-93 academic year, Professor John Maybee will be retiring. In honor of his 65th birthday the Program and the Mathematics Department at the University of Colorado at Denver (special thanks to R. Lundgren) sponsored a two-day conference in John's

honor. Thirty scientists from around the country came and lectured at the conference and 65 attended. A published proceedings of the Conference is planned. John Maybee is a leader in the field of matrix analysis and is an editor of the *SIAM Journal on Matrix Analysis*. He will continue his research and journal activities in the future. We are honored to have John Maybee as our first Professor Emeritus of Applied Mathematics.

• Two of the Program faculty have been awarded CRCW (Committee for Research and Creative Work) fellowships this year. James Meiss has been awarded a faculty fellowship and Congming Li a junior faculty fellowship. These awards are given out by a committee of our peers, and we are extremely gratified that our colleagues have chosen these two members of our faculty for these honors.

• We are pleased to have Dr. Monika Nitsche as an instructor for 1992-94. Dr. Nitsche is an expert in computational fluid dynamics. Our newly designated instructor for 1993-94 is Dr. Yoshi Kimura who is an expert in computational turbulence and fluid dynamics. Dr. Kimura comes to us from NCAR where he was in the Advanced Study Program. We were happy to have Martha Nesbitt Limber as an instructor/research associate for 1992-93.

• The Program's long term visitors for 1992-93 included Dr. Peter Clarkson from Exeter University in England (January-August 1993; expertise: nonlinear differential equations, symmetry analysis) and Prof. Benno Fuchssteiner from Paderborn, Germany (March-July 1993; expertise: integrable nonlinear systems, computer algebra systems). Clarkson was awarded an SERC fellowship and brought four graduate students and a postdoctoral researcher with him. Fuchssteiner was on a semester sabbatical. We were delighted that Peter Clarkson offered a mini-course on Symmetry Analysis of Partial Differential Equations, and Benno Fuchssteiner was able to present several seminars. Thank you gentlemen!

• The Program had a number of exceptional colloquia, sponsored in part by the Centennial of the College of Arts & Sciences. Distinguished speakers included: Peter Lax (NYU-Courant Institute); Joe Keller (Stanford); R.R. Coifman (Yale); I. Krichever (Courant and Landau Institutes); M. Wadati (Tokyo); Jim Keener (Utah); Vladimir Rokhlin (Yale); K. Schmidt (Utah); A.S. Fokas (Clarkson); B. Engquist (UCLA); J. Marsden, (UC, Berkeley). Thank you to our colloquia chair, Gregory Beylkin. The Program also hosted the "Los Alamos Day Meeting" on March 25, 1993 in which we had ten speakers and nine posters. Thank you Harvey Segur, Xiao Wang, Constance Schober, and Warren MacEvoy from Los Alamos for your organizing this meeting. Moreover, the yearly Midwest Dynamical Systems Conference was held in Boulder this year (March 26-27). There were twelve lectures and 80 participants. Thanks to James Meiss, Robert Easton and Robert McLachlan for organizing this conference.

• In January Stu Naegele took over from Middie Morris as administrative assistant for the Program and in March Margy Lanham took over from Andrea Hennessey as Word Processor. We appreciate the invaluable service each of our staff members performs for the Program. Our many thanks to Middie and Andrea and our warm welcome to Stu and Margy.

• We are extremely pleased and honored to announce that as of July 1, 1993, Professors Tom Manteuffel and Steve McCormick will be joining the Program. Tom is a leader in the computational mathematics associated with large scale iterative systems and Steve is one of the pioneers of the multigrid method used by researchers around the world to solve a multiplicity of complex systems. They have been members of the Math Department at the Denver campus of the University of Colorado for many years. Given their interests, this was a natural move for Steve and Tom, and we were pleased to work closely with our colleagues in Denver to make this a reality. We intend to continue collaborations and significant interactions with our Denver colleagues. There is no question that the Program's strength in the vital area of large scale computation has been significantly enhanced. Welcome aboard Tom Manteuffel and Steve McCormick!

F. Applied Mathematics Colloquia and Seminars

Our Applied Mathematics Colloquium series continued this year. The colloquia were held Friday afternoons during the academic year at 3:00 p.m., with coffee and tea preceding at 2:45 p.m. in the PAM conference room, ECOT 2-05. Additionally, the Program maintained the Applied Mathematics Seminar, a weekly seminar series on Thursday afternoons at 4:00 p.m. Each Thursday we used the Physics seminar room G-030 and had coffee and tea on the 11th floor of Duane Physics. We are grateful to the Physics Department for allowing us to use their facilities. A list of visiting speakers and the titles of their talks follows:

Applied Math Colloquium Schedule: 1992-1993

J. Keener, University of Utah, September 11, 1992
"Scroll Wave Dynamics"

S. McCormick, University of Colorado at Denver, September 18, 1992
"Multilevel Projection Methods"

G. Zaslavsky, Courant Institute of Mathematical Science, September 25, 1992
"Hamiltonian Chaos Beyond KAM Theory"

W. Wadati, University of Tokyo, October 2, 1992
"Integrable Quantum Particle Systems with Long-Range Interactions"

B. Alpert, NIST, Boulder, October 9, 1992
"An Algorithm for the Rapid Application of Laplace's Operator on the Sphere"

A.S. Fokas, Clarkson University, October 16, 1992
"Recent Developments in Soliton Theory"

R. Rostamian, NSF, October 23, 1992
"Waves in Stratified Elastic Media"

P.D. Lax, Courant Institute of Mathematical Sciences, NY, October 30, 1992
"Shock Waves, Entropy and Loss of Information"

I. Osman, University of Kent, Canterbury, England, November 6, 1992
"Hybrid Simulated Annealing and Tabu Search Algorithms for the Vehicle Routing Problems"

<u>V. Rokhlin</u>, Yale University, November 13, 1992
    "Rapid Solution of Integral Equations of Scattering Theory"

<u>I. Krichever</u>, Courant Institute of Mathematical Sciences, NY, and Laundau Institute,
        Moscow, November 20, 1992
    "The Tau-Function of the Universal Whitham Hierarchy and Topological Field
        Theories"

<u>A. Larraza</u>, Naval Postgraduate School, Monterey, CA January 15, 1993
    "The Boltzmann Equation: From Particle Kinetics to Nonlinear Random Waves"

<u>R.B. Schnabel</u>, Dept. of Computer-Science, University of Colorado, January 22, 1993
    "Tensor Methods for Nonlinear Equations and Optimization"

<u>A. Wood</u>, Dublin City University, Ireland, January 29, 1993
    "Exponential Asymptotics"

<u>N. Whitaker</u>, University of Amherst, February 5, 1993
    "Numerical Methods for Evolving an Interface in the Hele-Shaw Cell"

<u>R.R. Coifman</u>, Yale University, February 12, 1993
    "Adapted Waveform Analysis as a Tool Kit for Signal Processing and Fast
        Computations"

<u>J. Keller</u>, Stanford University, February 19, 1993
    "The Mathematics of Sports"

<u>T. Deguchi</u>, University of Tokyo, February 26, 1993
    "Topology of Random Knots"

<u>B. Engquist</u>, UCLA, March 5, 1993
    "Numerical Homogenization"

<u>P. Grinevich</u>, Landau Institute of Theoretical Physics, Russia, March 12, 1993
    "Algebra of Conformal Symmetries in Soliton Equations"

<u>B. Fuchssteiner</u>, University of Paderborn, Germany, March 19, 1993
    "Are more powerful computer algebra systems needed for research in nonlinear PDE's?
    --MuPAD, a parallel processing CA-tool"

<u>J. Marsden</u>, Fields Institute, Canada and University of California, Berkeley, April 2, 1993
    "The Euler-Lagrange-Poincare-Hamel Equations and Nonholonomic Mechanics"
    (joint colloquium with Mathematics Department)

<u>K. Schmitt</u>, University of Utah, April 9, 1993
    "The Gelfand and Other Superlinear Problems on Starlike Domains"

<u>R. Kerr</u>, NCAR, Boulder, Colorado, April 16, 1993
    "The Role of Singularities in Hydrodynamic Turbulence"

<u>R. Molzon</u>, University of Kentucky, April 23, 1993
    "Analytic and Geometric Symmetry: Three Methods"

<u>C. Li</u>, University of Colorado, April 30, 1993
    "The Method of Moving Planes"

<u>P. Clarkson</u>, University of Exeter, UK, May 7, 1993
    "Symmetry Analysis for PDEs: A Personal Perspective"

J. Powell, Utah State University, September 17, 1992
    "Singularities and Localized Structures in Fluid Convection and Multi-Photon Lasers"

G. Zaslavsky, Courant Institute, September 24, 1992
    "Anomalous Transport of Passive Particles"

Lectures on Computational Fluid Dynamics, October 1 - December 10, 1992:

R. McLachlan, University of Colorado, Boulder, October 1, 1992
    "Finite Difference Solutions of the Navier Stokes Equations"

R. McLachlan, University of Colorado, Boulder, October 8, 1992
    "Spectral and Pseudo-Spectral Methods"

R. McLachlan, University of Colorado, Boulder, October 15, 1992
    "Miscellaneous Methods and Problems"

M. Nitsche, University of Colorado, Boulder, October 22, 1992
    "Vortex Methods in 2-d for Inviscid Flows"

M. Nitsche, University of Colorado, Boulder, October 29, 1992
    "Inclusion of Viscous Effects"

M. Nitsche, University of Colorado, Boulder, November 5, 1992
    "Vortex Methods in 3-d"

Y. Kimura, NCAR, Boulder, Colorado, November 12, 1992
    "Introduction to Turbulence Simulation"

Y. Kimura, NCAR, Boulder, Colorado, November 19, 1992
    "Mathematical Tools for Turbulence Simulation"

Y. Kimura, NCAR, Boulder, Colorado, December 10, 1992
    "Advanced Topics on Turbulence and Turbulence Simulation"

A. Larraza, Naval Postgraduate School, Monterey, California, January 14, 1993
    "Wave Turbulence and Collective Modes in Open Systems of Nonlinear Random
    Waves"

M. Brewster, University of Colorado, Boulder, January 21, 1993
    "Interface Models of Flames"

C. Liverani, University of Rome, January 28, 1993
    "Ergodicity in Hamiltonian Systems"

Y. Kimura, NCAR, Boulder, Colorado, February 4, 1993
    "Intermittency and Scaling Properties of Turbulence"

J. Dreitlein, University of Colorado, Boulder, February 11, 1993
    "Topological Integrators"

J. Jenkins, National Science Foundation, Washington DC, February 18, 1993
    "The State of Affairs at NSF" (joint seminar with the Mathematics Department)

J. Dreitlein, Physics Dept., University of Colorado, Boulder, February 25, 1993
    "Topological Integrators, Part II"

J. Liandrat, CNRS, University of Aix-Marseille, France, March 4, 1993
    "On Solutions of Partial Differential Equations Using Wavelets"

P. Grinevich, Landau Institute of Theoretical Physics, Russia, March 11, 1993
    "Decaying Potentials on a Finite-gap Background and the d-bar Problem on Riemann
    Surfaces"

J.E. Howard, UC Santa Cruz, March 18, 1993
    "Kepler Meets Kolmogorov: Chaos in the Hydrogen Atom"

E. D'yakanov, Moscow State University, April 1, 1993
    "Asymptotically Optimal Algorithms for Elliptic Problems"

J. Dreitlein, Physics Dept., University of Colorado, Boulder, April 8, 1993
    "Topological Integrators, Part III"

B. Fuchssteiner, University of Paderborn, Germany, April 15, 1993
    "Some Tricks from the Symmetry-Toolbox Applied to Nonlinear Equations"

B. Fuchssteiner, University of Paderborn, Germany, April 29 & May 6, 1993
    "Symplectic Ideals and Group Theory Reductions of Integrable Systems"

B. Dubrovin, SISSA, Italy, June 9, 1993
    "Chazy Equation Revisited"

In addition, we had several special lectures throughout the year:

Rocky Mountain Experience II, a mini-workshop, was held August 17, 1992, and featured
    talks by B. Dubrovin, S. Chakravarty, J. Villarroel, T. Yajima, P. Clarkson, X. Wang,
    C. Schober, M. Nitsche, and T. Takagi.

Peter Clarkson gave nine seminars on "Symmetry Analysis for Partial Differential Equations"
    at 4:00 pm on Thursdays from February 11, 1993 to May 6, 1993.

Elizabeth Mansfield gave two seminars on Differential Gröbner Bases, April 1 and April 8,
    1993.

W. Chen, Southwest Missouri State University, March 15, 1993
    "Variational Problems Arising from Differential Geometry"

V. Tkachenko, Institute for Low Temperature Physics, Ukraine, May 4, 1993
    "Spectral Theory of Periodic Nonselfadjoint Differential Operators"

3. COMMITTEES

A. Undergraduate Committee--Robert Easton, Chair

The Program Undergraduate Committee consisted of Robert Easton (chair), Mary
Brewster, and John Williamson. The Program in Applied Mathematics currently has 47
majors. Fifteen students graduated this year. Laura Mather was awarded a Goldwater
Fellowship for next year, and plans to graduate in 1994. Laura will be the first such
Goldwater Fellow at CU. Sean Carver won a prestigious NSF graduate fellowship, and will
attend Cornell University as a graduate student in Applied Mathematics. Congratulations Laura
and Sean!

A new advising procedure was instituted this year and is working well. Students in
each entering class are assigned advisors who will work with them through graduation.
Currently, the freshman class is advised by Professor Curry, the sophomore class is advised
by Professor Williamson, the junior class is advised by Professor Brewster, and the senior
class is advised by Professor Easton.

The Program in Applied Mathematics offers a Bachelor of Science degree in the College
of Engineering. In addition, a new minor in Applied Mathematics is offered for the first time

this year through the College of Arts and Sciences. This allows undergraduate students on the Boulder campus to receive in-depth training in Applied Mathematics. The Program currently has two students enrolled for our minor degree. We expect that number to grow significantly as we bring more courses online.

There will be a major change in the way we teach calculus beginning Fall 1993. A new text by Thomas and Finney will be used together with a supplementary text by Beckmann and Sundstrom titled *Exploring Calculus with a Graphing Calculator*. Students will be required to purchase a graphing calculator such as the TI-81, TI-82, or the Casio 7700. This new technology will help students to visualize concepts, and to numerically explore limits and algorithms. New courses are planned for next year. APPM 3050 will introduce students to advanced software including Maple and Mathematica used to perform symbolic mathematical calculations. APPM 3010 will also be introduced, providing a calculus based introduction to chaos and dynamical systems.

B. Graduate Committee--James Meiss, Chair

The Program Graduate Committee consists of James Meiss (chair), Gregory Beylkin, John Maybee and Harvey Segur. The main business of the committee is administering the preliminary exams, advising the current graduate students, and processing graduate applications. Currently the Program has 28 graduate students, of whom six began last fall. Three students are on track to complete their PhD by the end of the calendar year and eleven received the MS degree so far this year.

The Program was awarded a Graduate Traineeship Grant from the National Science Foundation. This grant will fully fund six graduate students each for five years. In the fall of 1993 we will have two trainees. We expect to offer four more for the fall of 1994.

There were 58 applicants for the fall semester of 1993, of whom we chose seven for TA positions. In addition, one of our incoming students was awarded the Boulder Campus Chancellor's Fellowship as well as an NSF graduate fellowship. Several of the students visited the campus, supported by funds from the graduate school.

In addition to the preliminary exams in Applied Analysis, Computational Analysis, and Partial Differential Equations, we are now offering an exam in Probability and Statistics. These exams are administered before classes begin in the Fall and Spring.

C. Faculty Search Committees

During this academic year we received over 250 applications in response to our advertisement for an instructor position. Our first candidate, Yoshi Kimura, accepted our offer and will join the Program in the upcoming fall semester. Members of the search committee were M. Ablowitz, G. Beylkin, J. Curry, and H. Segur. For the year 1994-95 we anticipate filling one instructorship.

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D. Faculty Service to the University, College and Societies

<u>Mark Ablowitz</u>: Program Director; Member of Chairs Committee in the College of Arts and Sciences; Member of CRCW Committee; Member of Joint CU Denver-Boulder Applied Mathematics Committee.

<u>Jerrold Bebernes</u>: Member of Program Graduate Committee; Calculus Textbook Selection Committee

<u>Gregory Beylkin</u>: Member of Program Graduate Committee; Member of the Program Faculty Recruiting Committee

<u>Mary Brewster</u>: Member of Program Undergraduate Committee; Member of Engineering Safety Committee; Member of Honors Committee; Faculty Member of Center for Combustion Research; Faculty Advisor for SIAM Chapter

<u>James Curry</u>: Program Associate Director; Member of Program Faculty Recruiting Committee; Member of Vice Chancellor's Advisory Committee; Member of Campus Policy Board on Information Technology

<u>Robert Easton</u>: Chair, Program Undergraduate Committee; Chair, Educational Policy and Planning Committee (Engineering); Member of Administrative Council (Engineering)

<u>John Maybee</u>: Member of Program Graduate Committee

<u>James Meiss</u>: Chair, Program Graduate Committee; Member of Campus-wide Scholarship Committee; Chair, Goldwater Scholarship Committee; Member of Physics-Math-Astronomy Library Committee

<u>Harvey Segur</u>: Member of Program Graduate Committee; Member of Faculty Advisory Committee for Minority Engineering Program; Member of Ad Hoc Committee on Teaching Effectiveness

<u>John Williamson</u>: Member of Program Undergraduate Committee; Member of College of Engineering Scholarship Committee; Member of Engineering Undergraduate Academic Affairs Committee

4. TEACHING ACTIVITIES

A. Courses Taught by Program Faculty During Academic Year 1992-93

(i) UNDERGRADUATE COURSES

<u>APPM 1340</u> *Easton*, Intensive Calculus.

<u>APPM 1350</u> *Bebernes, Easton, Limber, Nitsche*, Calculus 1 for Engineers.

<u>APPM 1360</u> *Ablowitz, Bebernes, Limber*, Calculus 2 for Engineers.

<u>APPM 2350</u> *Nitsche, Schober, Segur, Wang*, Calculus 3 for Engineers.

<u>APPM 2360</u> *Chakravarty, McLachlan, Meiss*, Linear Algebra and Differential Equations.

<u>APPM 3170</u> *Maybee*, Discrete Applied Mathematics.

<u>APPM 3310</u> *Maybee*, Matrix Methods and Applications.

<u>APPM 3570</u> *Williamson*, Applied Probability.

<u>APPM 4350</u> *Meiss*, Methods in Applied Mathematics 1.

<u>APPM 4360</u> *Meiss*, Methods in Applied Mathematics 2.

<u>APPM 4570/5570</u> *Williamson*, Statistical Methods.

APPM 4650 *Curry*, Numerical Analysis 1.

APPM 4660 *Curry*, Intermediate Numerical Analysis.

<div align="center">(ii) GRADUATE COURSES</div>

APAS 5520 *Meiss*, co-taught, Nonlinear Dynamics.

APPM 5440 *Li*, Applied Analysis 1.

APPM 5450 *Li*, Applied Analysis 2.

APPM 5470 (MATH 5470) *Segur*, Methods in Applied Mathematics 3.

APPM 5480 *Brewster*, Methods of Applied Mathematics 4.

APPM 5600 (MATH 5600) *Beylkin*, Numerical Analysis 1.

APPM 5610 (MATH 5610) *Beylkin*, Numerical Analysis 2.

APPM 6580 *Williamson*, Statistical Methods.

APPM 7400 *Brewster, Curry*, Topics in Applied Mathematics.

APPM 8100 Seminar--Dynamical Systems.

APPM 8200 Seminar--Nonlinear Waves.

B. Summer Courses, 1993

APPM 1350 *Sundbye*, Calculus 1 for Engineers.

APPM 1360 *Martha Limber*, Calculus 2 for Engineers.

APPM 2350 *Chakravarty*, Calculus 3 for Engineers.

APPM 2360 *Schober, Mark Limber*, Intro. to Linear Algebra and Differential Equations.

APPM 8000 Seminar in Applied Mathematics

5. RESEARCH ACTIVITIES FOR CALENDAR YEAR 1992

A. Research Publications for Calendar Year 1992

Mark Ablowitz:

Solitons, Nonlinear Evolution Equations and Inverse Scattering, by M.J. Ablowitz and P.A. Clarkson, London Mathematical Society Lecture Note Series #149, Cambridge University Press, NY, 1992.

"One Dimensional Reductions of Self-Dual Yang-Mills Fields and Classical Equations" by S. Chakravarty, M.J. Ablowitz and P.A. Clarkson, *Recent Advances in Relativity--Essays in Honor of Ted Newman"* Eds. Allan I. Janis and John R. Porter (1992), 60-71, Parker and Birkhauser Press.

"On Reductions of Self-Dual Yang Mills Equations" by S. Chakravarty and M.J. Ablowitz, *Painlevé Transcendants*, Eds. D. Levi and P. Winternitz (1992), 331-343, Plenum Press, New York.

"On the Method of Solution to the 2+1 Toda Equation" by J. Villarroel and M.J. Ablowitz, *Phys. Lett. A* **163** (1992), 293-296.

"A New Hamiltonian Amplitude Equation Governing Modulated Wave Instabilities" by M. Wadati, H. Segur and M.J. Ablowitz, *Journal of the Physical Society of Japan* **61** (1992), 1187-1193.

"Self Dual Yang-Mills Equation and New Special Functions in Integrable Systems" by S. Chakravarty, M.J. Ablowitz and L.A. Takhtajan, *Nonlinear Equations and Dynamical*

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Systems, Eds. M. Boiti, L. Martina and F. Pempinelli, World Scientific, Singapore (1992), 3-11.

"Integrable Systems, Self-Dual Yang-Mills Equations and Connections with Modular Forms" by M.J. Ablowitz, S. Chakravarty and L.A. Takhtajan, *Nonlinear Problems in Engineering and Science*, Science Press, eds. S. Xiao and X.C. Hu, Beijing, China (1992), 1-15.

"Numerical Homoclinic Instabilities in the Sine-Gordon Equation" by B.M. Herbst and M.J. Ablowitz, *Questiones Math.* 15 (1992), 345-363.

"Stable, Multi-State, Time-Reversible Cellular Automata with Rich Particle Content" by M.J. Ablowitz, J.M. Keiser and L.A. Takhtajan, *Questiones Math.* 15 (1992), 325-343.

Jerrold Bebernes:

"Finite time blowup for semilinear reactive-diffusive systems" by J. Bebernes and A. Lacey, *Journal of Differential Equations* 95 (1992), 105-129.

"Final time blowup profiles for semilinear parabolic equations via center manifold theory" by J. Bebernes and S. Bricher, *SIAM J. Math. Analysis* 23 (1992), 852-869.

Gregory Beylkin:

Co-Editor, *Wavelets and Their Applications* (1992), Jones and Bartlett.

"On the representation of operators in bases of compactly supported wavelets" by G. Beylkin, *SIAM Journal on Numerical Analysis* 29 (6) (1992), 1716-1740.

"Wavelets in Numerical Analysis" by J. Beylkin, R.R. Coifman and V. Rokhlin in *Wavelets and Their Applications* (1992), Jones and Bartlett.

Mary Brewster

"Stationary Premixed Flames in a Dual-source System," *Comb. Flame* 91 (1992), 99-105.

Sarbarish Chakravarty:

"On Reductions of Self-Dual Yang Mills Equations" by S. Chakravarty and M.J. Ablowitz, *Painlevé Transcendants*, Eds. D. Levi and P. Winternitz (1992), 331-343, Plenum Press, New York.

"Self Dual Yang-Mills Equation and New Special Functions in Integrable Systems" by S. Chakravarty, M.J. Ablowitz and L.A. Takhtajan, *Nonlinear Equations and Dynamical Systems*, Eds. M. Boiti, L. Martina and F. Pempinelli, World Scientific, Singapore (1992), 3-11.

"Integrable Systems, Self-Dual Yang-Mills Equations and Connections with Modular Forms" by M.J. Ablowitz, S. Chakravarty and L.A. Takhtajan, *Nonlinear Problems in Engineering and Science*, Science Press, Beijing, China (1992), 1-15.

John Maybee:

"Some properties of a class of recursively defined digraphs" by J. Lundgren and J. Maybee, *J. of Combinatorics, Information and System Sciences* 16 (1991), 29-36

"Algebraic multiplicity of the eigenvalues of a tournament matrix" by J. Maybee, D. de Caen, D. Gregory, S. Kirkland and N. Pullman, *Linear Algebra and its Applications* 169 (1992), 170-193 .

"Real rank as a bound for nonnegative integer rank" by J. Maybee, R. Lundgren, D. de Caen, D. Gregory and T. Henson, *J. of Combinatorial Mathematics and Combinatorial Computing* 11 (1992), 47-53.

"Biclique covers and partitions of unipathic digraphs" by J. Maybee , R. Lundgren and K. Hefner, in *Graphs, Matrices and Designs*, S. Rees, editor, Marcel Dekker, Inc. (1992), 213-224.

"Combinatorial eigenvalues of matrices" by J. Maybee, D. Olesky, M. Tsatsomeros and P. van den Driessche, *Linear Algebra and its Applications* **175** (1992), 213-24.

Robert McLachlan:

"The Accuracy of Symplectic Integrators" by R. McLachlan, and P. Atela, *Nonlinearity* **5** (1992), 541-562.

James Meiss:

"Cantori for Symplectic Maps Near the Anti-integrable Limit" by R.S. MacKay and J.D. Meiss, *Nonlinearity* **5** (1992), 149-160 .

"Cantori for the Stadium Billiard," Chaos, **2** (1992), 267-272.

"Phenomenology of Area Preserving Twist Maps" in *Nonlinear Dynamics and Chaos*, R. L. Dewar and B. I. Henry (eds.), (World Scientific Press, 1992), 15-40.

"Symplectic Maps, Variational Principles and Transport" by J.D. Meiss, *Reviews of Modern Physics* **64** (1992), 795-848.

"Flux-Minimizing Curves for Reversible Area-Preserving Maps" by R.L. Dewar and J.D. Meiss, *Physica D* **57** (1992), 476-502.

Connie Schober:

"Chaotic and Homoclinic Behavior for Numerical Discretizations of the Nonlinear Shcrödinger Equation" by D.W. McLaughlin and C.M. Schober, *Physica D*, **57** (1992).

Harvey Segur:

Asymptotics Beyond All Orders, edited by H. Segur, S. Tanveer, & H. Levine, Plenum Press, NY, 389 pp., 1992.

"An overview of the geometric model" by H. Segur in *Asymptotics Beyond All Orders*, Eds. H. Segur, S. Tanveer, & H. Levine, Plenum Press (1992), 29-36.

"A new formulation for dendritic crystal growth in two dimensions" with E.A. Coutsias, *Asymptotics Beyond All Orders*, Eds. H. Segur, S. Tanveer, & H. Levine, Plenum Press (1992), 87-104.

"A New Hamiltonian Amplitude Equation Governing Modulated Wave Instabilities" by M. Wadati, H. Segur, and M.J. Ablowitz, *Journal of The Physical Society of Japan* **61** (1992), 1187-1193.

"Integrability and the Motion of Curves" by K. Nakayama, M.H. Segur and M. Wadati, *Phys. Rev. Lett.* **69** (1992), 2603-2606.

Xiao Wang:

"Stability of isotropic self-similar dynamics for scalar wave collapse," by X. Wang, M. Landman, G. Papanicolaou, C. Sulem and P.L. Sulem, *Phys. Rev. A* **46** (1992), 7869-7876.

John Williamson:

"Robustness of the maximum likelihood (LOD) method for detecting linkage" by J. Williamson, *American Journal of Human Genetics* 52 (1993), 213-214.

B. Invited Lectures and Meetings Attended for Calendar Year 1992

Mark Ablowitz:

University of Kansas, Mathematics Department, "Chaos in the Nonlinear Schrödinger Equation: Real or Fake," Jan. 30, 1992; "On Reductions of the Self-dual Yang-Mills Equations," Jan. 31, 1992.

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Carlton University, Department of Mathematics, Ottawa, Canada, "Solitons, Computation and Chaos," April 11, 1992.

Kansas State University, Midwest Geometry Conference, "Reductions of the Self-dual Yang-Mills Equations and New Integrable Systems," May 1-3, 1992.

SIAM Forum on Applied Mathematics, Moderator of Panel: "Training in Applied Mathematics/Preparation for Academic Careers," May 15-17, 1992.

University of Alberta, Edmonton, Canada, Conference on Wave Phenomena, Canadian Applied Math. Society, "Nonlinear Waves, Integrable Systems and Modular Forms," June 15-18, 1992.

University of Minnesota, "Reductions of the Self-dual Yang-Mills System and Modular Forms," Oct. 8-9, 1992.

NATO Advanced Research Workshop, Exeter University, Exeter U.K.: "Chaos in the Nonlinear Schrödinger Equation--Can it be Avoided?" July 14-18, 1992.

SUNY Stony Brook, Department of Mathematics, "Nonlinear Waves, Integrable Systems and a Novel Class of ODE's", December 3, 1992.

Jerrold Bebernes:

University of Pittsburgh, Dept. Math. Colloquium, "Final Time Blowup," February 7, 1992.

University of Utah, Dept. Math Colloquium, "Blowup Asymptotics,"February 19, 1992.

University of Central Oklahoma, Edmonds, OK, Math. Conference, "Thermal Runaway," March 27, 1992.

University of Maryland, Dept. Math Colloquium, "Blowup Profiles," April 23, 1992.

NSF, U.S. Olympiad Team, "Why so Many Solutions?", May 19, 1992.

Universitá di Padova, Italy, Dept. Mat. Appl., "Blowup for Quasilinear Parabolic Equations," July 7, 1992.

SIAM Annual Meeting, Los Angeles, Special Session on Blowup, Invited Lecture, "Blowup for Quasilinear Parabolic Equations," July 24, 1992.

University of Nebraska, Dept. Applied Math. Colloquium, "Asymptotics of Blowup," November 13, 1992.

Gregory Beylkin:

Colorado School of Mines, Carl Meiland Lecture, "Wavelets and their Applications," January 27, 1992.

AAAS Meeting, Chicago, "Wavelets in Numerical Analysis," February 7, 1992.

Wright Paterson Air Force Base, Air Force Institute of Technology Workshop: The Role of Wavelets in Signal Processing Applications, Talk: "Multiresolution Representation Using Auto-Correlation Functions of Compactly Supported Wavelets"

Universite de Paris IX (CEREMADE, Dauphine) Conference, Paris,"Wavelet Based Algorithms for Solving Partial Differential Equations," June, 1992.

International Conference on Wavelets and Applications, Toulouse '92, Toulouse, France, "On the Fast Algorithm for Multiplication of Functions of Compactly Supported Wavelets," June, 1992.

1992 AMS-IM-SIAM Summer Research Conference, Mt. Holyoke, Mass.,"Wavelet Based Algorithms for Solving Partial Differential Equations," June, 1992.

Vienna, Austria, Conference on 75 Years of Radon Transform, "Inversion and Applications of the Generalized Radon Transform," August 30 - September 5, 1992.

National Academy of Science, Fourth Annual Symposium on Frontiers of Science, "Wavelets and Fast Numerical Algorithms," November 5 - 7, 1992.

SPIE, Boston, "Wavelets, Their Autocorrelation Functions, and Multiresolution Representation of Signals," November 15-November 20, 1992.

Mary Brewster:

Dow Chemical Co., Midland, Mi., "Dean Vortices in Spiral Channel Membrane Systems," presentation of final progress report, January, 1992.

UCB Combustion Center, "Numerical Wavelet Methods for Combustion?" February, 1992.

"Show-N-Tell" colloquium for PAM, April, 1992.

UCD, 1992 Meeting of the Western States Section of the Combustion Institute, "Stationary Flames in a Dual Source System," November 1992.

AIChE Annual Meeting, Miami Beach, FL, "Weakly Nonlinear Analysis of Dean Vortex Flow in Spiral Porous Channels," November, 1992.

Sarbarish Chakravarty:

Colorado School of Mines, Department of Mathematics and Computer Science, "Universal Integrable Hierarchy," April 20, 1992

Kansas State University, Manhattan, Kansas, Midwest Geometry Conference, " ASD Yang-Mills Equations Associated with Volume Preserving Diffeomorphisms," May 1-3, 1992.

NATO Advanced Research Workshop on "Applications of Analytic and Geometric Methods to Nonlinear Differential Equations," University of Exeter, England, "SDYM Hierarchies and Classical Soliton Systems," July 14-19, 1992.

Robert Easton:

SIAM Conference on Applications of Dynamical Systems, Oct. 15-19, 1992.

Congming Li:

Institute of Advanced Study, School of Math., "On the Method of Moving Planes"

University of Minnesota, School of Math., "Apriori Estimates of Solutions to Certain PDE's"

American Mathematical Society 873rd meeting, Springfield, MO "Classifications of Solutions to Nonlinear Elliptic Equations"

Robert McLachlan:

The Geometry Center, Minneapolis, Workshop on visualization of invariant sets of symplectic maps in dimension 4, "The Four-dimensional Rigid Body," March, 1992.

Los Alamos Day, "Symplectic Integration of Hamiltonian Wave Equations," April, 1992.

Center for Nonlinear Studies, Los Alamos, Visiting Scholar, June, 1992.

Summer Dynamics Institute, Boston University, July 1992.

AMS-SIAM conference on Exploiting Symmetry in Applied Mathematics, Colorado State University, "Explicit Symplectic Splitting Methods Applied to PDE's," July, 1992.

International Workshop on Dynamical Systems, Oporto, Portugal, "Symplectic Integration of Hamiltonian Partial Differential Equations," August, 1992.

John Maybee:

21st Southeastern International Conference on Graph Theory, Computing, and Combinatorics. Boca Raton, Florida, February 1992. Discussed future research in the theory of tournament matrices (with Professor N. Pullman of Queens University.)

University of Wyoming, Laramie, Workshop on introducing computing into the undergraduate matrix theory course, June, 1992 (3 day workshop).

SIAM Conference on Combinatorics in Vancouver B.C., "Chordal, interval, and 2-step graphs," June, 1992.

Queens University, Kingston, Ontario, "Nearly sign-nonsingular matrices," October 1992.

James Meiss:

Dynamics Days 1992, Austin TX, "Resonances and Escape in Symplectic Maps," Jan 8-11, 1992.

Midwest Dynamical Systems Meeting, University of Minnesota, "Escape in Four Dimensions," March 18-22, 1992.

SIAM Dynamical Systems Meeting, Snowbird, "Chaotic Transport in Symplectic Maps," October, 1992.

American Physical Society Division of Plasma Physics, Seattle, "Generalized Action-Angle Representation for Resonances," November, 1992.

Monika Nitsche:

NATO Advanced Research Workshop on Vortex Flows and Related Numerical Methods, Grenoble, France, "Axisymmetric Vortex Sheet Roll-up," June 17, 1992.

Rocky Mountain Experience II, University of Colorado, Boulder, "Axisymmetric Vortex Sheet Roll-up," August 17, 1992.

Colorado State University, Fort Collins, Mathematics Colloquium, "Vortex Sheet Roll-up and the Formation of Vortex Rings," October 1992.

45th Annual Meeting of the Division of Fluid Dynamics, American Physical Society, Florida State University, Tallahassee, "Vortex Ring Formation at the Edge of a Circular Tube," November 25, 1992.

University of Colorado, Boulder, Computational Fluid Dynamics lecture series, "Vortex Methods in 2-d for Inviscid Flows," "Inclusion of Viscuous Effects," "Vortex Methods in 3-d," November 1992.

University of Wyoming, Laramie, Mathematics Colloquium, "Axisymmetric Vortex Sheet Roll-up," December 3, 1992.

Connie Schober:

University of Colorado, Boulder, Rocky Mountain Experience II, August 1992.

Harvey Segur:

University of Tokyo, Japan, "Periodic Waves in Shallow Water," May 14, 1992.

University of Tokyo, Japan, "Asymptotics Beyond All Orders - A Survey," May 20, 1992.

Research Institute for Mathematics Sciences, Kyoto, Japan, "Periodic Waves in Shallow Water," May 22, 1992.

Research Institute for Mathematics Sciences, Kyoto, Japan, "Asymptotics Beyond All Orders - A Survey," May 25, 1992.

ONR Contractors' meeting, Alexandria, VA, "Progress on periodic wave in shallow water," October 15, 1992.

Xiao Wang:

NATO Advanced Research Workshop on the Singularities in Fluids, Plasmas and Optics, Crete, Greece, "Stability of isotropic self-similar dynamics for the Zakharov equations", June 5-10, 1992

John Williamson:

Medical Statistics Unit of Paris V, René Descartes University, France, "Limit Distribution of the LOD Score under Various Maximization Schemes," July, 1992.

C.   Research Grants for Calendar Year 1992*

Mark Ablowitz:

NSF, Mathematics Division: 1991-94

AFOSR, Mathematics: 1991-94

ONR, Mathematics: 1992-94

Jerrold Bebernes

NSF, Mathematics Division: 1991-94

U.S. Army Research Office,
    Mathematics Division: 1991-92

Gregory Beylkin

Chevron Oil: unrestricted grant

ONR, Mathematics Division: 1991-1993

AASERT - ONR - Mathematics Division: 1992-95

Mary Brewster

CRCW: 1991-92

NSF: 1992-93

James Curry

ONR, Physics/Oceanography Division: 1992-94

John Maybee

ONR, Mathematics Division: 1990-93

James Meiss:

NSF, Mathematics Division: 1990-92

Harvey Segur:

NSF, Mathematics Division: 1990-92

ONR, Physics/Oceanography Division: 1992-94

*NSF:	National Science Foundation
AFOSR	Air Force Office of Scientific Research
ONR:	Office of Naval Research
CRCW:	Committee on Research and Creative Work, University of Colorado

D. Miscellaneous

Mark Ablowitz:

Editorial boards: *SIAM Journal of Applied Mathematics, Studies in Applied Mathematics, Journal of Engineering Mathematics*

Reviewer: NSF, AFOSR, DOE grants; Australian and Canadian Research Grants; *SIAM Journal on Applied Mathematics, Physics Letters, Physical Review Letters, Physica D, Communications in Mathematical Physics, Studies in Applied Mathematics, Cambridge University Press.*

Member Chairs Council of Joint Policy Board for Mathematical Sciences

Jerrold Bebernes

Program Director of Applied Mathematics for Division of Mathematical Sciences, National Science Foundation, January - August 1992.

Editor, *Rocky Mountain Journal of Mathematics*

Gregory Beylkin

Member of the Editorial Board for: *Inverse Problems, SIAM Journal on Numerical Analysis, Applied and Computational Harmonic Analysis*

Referee for: NSF proposals; *Duke Mathematical Journal; IEEE Transactions on Image Processing; IEEE Transactions on DSP*

Member of Translation Committee of the Society of Exploration Geophysicists

Mary Brewster

Coach of two mathematical modelling teams

Reviewer for *SIAM Journal in Applied Mathematics*

Initiated the SIAM University Chapter

Sarbarish Chakravarty

Refereed *Journal of Mathematical Phyics* and *Physics Letters A*

James Curry

Designated President's Teaching Scholar, 1993

Recipient of SOAR Award for Outstanding Teaching for 1992-93

Recipient of Tau Beta Pi Outstanding Teacher Award in College of Engineering for 1992-93

Recipient of Outstanding Advisor Award of College of Engineering for 1992-93

Member AMS Committee on Communications

Robert Easton

Reviewer for NSF

Co-organizer Midwest Dynamical Systems Conference held here in March 1993

Robert McLachlan

Co-organizer Midwest Dynamical Systems Conference held here in March 1993

John Maybee

Member, Board of Editors, *SIAM J. on Matrix Analysis and Applications*

Referee for *Linear Algebra and its Applications*

James Meiss:

Recruited next year's graduate class (13 new students--six received University fellowships, two received NSF Graduate Traineeships, and one received the prestigious Chancellor's fellowship)

Reviewer for book proposals: Cambridge University Press.

Reviewer for numerous journals

Co-organizer Midwest Dynamical Systems Conference held March 1993

Associate Editor of Physica D

Constance Schober:

Co-organizer for Los Alamos Day, held here in March, 1993

Harvey Segur:

Reviewed grant proposals for the following: NSF, Applied Mathematics; NSF, Classical Analysis; Army Research Office.

Reviewed papers for the following: *Journal of Fluid Mechanics, Physica D, Physical Review Letters, Physics Letters A, Fluid Dynamics Research, IEEE Transactions, Journal of Mathematical Physics, Wave Motion.*

Xiao Wang:

Co-organizer of Los Alamos Day, held here in March, 1993

John Williamson:

Contributed to book writing project meetings in Lyon, France, and Washington, D.C. with co-authors; Book title: Statistical Methods in Genetic Epidemiology.

6. PREPRINTS OF THE PROGRAM: 1992-93

Following is a list of preprints developed by Program faculty and visitors during this academic year. If you would like a copy of any preprint, please request a copy in writing from Margy Lanham, Program in Applied Mathematics, Campus Box 526, University of Colorado, Boulder, CO 80309-0526.

No.

131. *Minimum-Energy Surface Profile of Solder Joints for Non-Circular Pads,* S.K. Patra, S.S. Sritharan and Y.C. Lee., July 1992.

132. *A Self-Dual Yang-Mills Hierarchy and Its Reductions to Integrable Systems in 1 + 1 and 2 + 1 Dimensions,* M.J. Ablowitz, S. Chakravarty and L.A. Takhtajan.

133. *SDYM Hierarchies and Classical Soliton Systems,* by S. Chakravarty, October 1992.

134. *Breakup of Invariant Tori for the Four Dimensional Semi-Standard Map,* E.M. Bollt and J.D. Meiss, October 1992.

135. *Low Order Models, Initialization, and the Slow Manifold,* J.H. Curry, S.E. Haupt and M.N. Limber, October 1992.

136. *Rapidly Forced Burgers Equation,* M.J. Ablowitz and S. DeLillo, October 1992.

137. *Stable, Multi-State, Time-Reversible Cellular Automata with Rich Particle Content,* M.J. Ablowitz, J.M. Keiser and L.A. Takhtajan, October 1992.

138. *On Visualizing the Four-Dimensional Rigid Body*, Robert McLachlan, November 1992.

139. *Exit Times and Transport for Symplectic Twist Maps*, R.W. Easton, J.D. Meiss and S. Carver, November 1992.

140. *On the Elliptic 2 + 1 Toda Equation*, J. Villarroel and M.J. Ablowitz, November 1992.

141. *Integrable Four-Dimensional Symplectic Maps of Standard Type*, R.I. McLachlan, December 1992.

142. *On the Dynamics of Shooting Methods for Solving Regular Sturm-Liouville Problems*, M.N. Limber and J.H. Curry, January 1993.

143. *Topology of Closed Random Polygons*, T. Deguchi and K. Tsurusaki, February 1993.

144. *Self-Consistent Chaos in the Beam-Plasma Instability*, J.L. Tennyson, J.D. Meiss and P.J. Morrison, February 1993.

145. *Symmetries of the Nonlinear Heat Equation*, P.A. Clarkson and E.L. Mansfield, February 1993.

146. *Wave Collapse and Instability of Solitary Waves of a Generalized Nonlinear Kadomtsev-Petviashvili Equation*, X.P. Wang, M.J. Ablowitz and H. Segur, March 1993.

147. *Numerical Chaos, Roundoff Errors and Unstable Wave Processes*, M.J. Ablowitz, C. Schober and B.M. Herbst, March 1993.

148. *New Symmetry Reductions and Exact Solutions of the Davey Stewartson System. I. Reductions to Ordinary Differential Equations*, P.A. Clarkson and S. Hood, March 1993.

149. *Symmetry Reductions, Exact Solutions and Painlevé Analysis for a Generalized Boussinesq Equation*, P.A. Clarkson and D.K. Ludlow, March 1993.

150. *Focusing Singularities of Davey-Stewartson Equations for Gravity-Capillary Waves*, G.C. Papanicolau, C. Sulem, P.L. Sulem, and X.P. Wang, January 1993.

151. *A Simple Criterion for Involutivity*, by E. Mansfield, March 1993.

152. *On the Fast Algorithm for Multiplication of Functions in the Wavelet Bases*, G. Beylkin, August 1992.

153. *On Wavelet-Based Algorithms for Solving Differential Equations*, G. Beylkin, December 1992.

154. *Inversion and Applications of the Generalized Radon Transform*, G. Beylkin, January 1993.

155. *Symmetry Reductions and Exact Solutions of a Class of Nonlinear Heat Equations* P.A. Clarkson and E.L. Mansfield, March 1993.

156. *Explicit Lie-Poisson Integration and the Euler Equations*, R.I. McLachlan, April 1993.

157. *Parametric Forcing, Bound States and Solutions of a Nonlinear Schrödinger Type Equation*, M.J. Ablowitz and S. DeLillo, May 1993.

158. *A Class of Integrable Conformally Self Dual Metrics*, S. Chakravarty, November 1992.

159. *Integrable Nonlinear Evolution Equations with Time-Dependent Coefficients*, B. Fuchssteiner, May 1993.

160. *Some Tricks from the Symmetry-Toolbox for Nonlinear Equations: The Camassa-Holm Equation*, B. Fuchssteiner, May 1993.

161. *Stationary Self-Propagating Fronts in Potential Flow*; M.E. Brewster, June 1993.

162. *A Note on the Motion of Surfaces*; R.I. McLachlan and H.Segur, June 1993.

163. *A. Gallery of Constant-Negative-Curvature Surfaces*; R. McLachlan, June 1993.

161. Stationary Self-Propagating Fronts in Potential Flow. M.E. Brewster. June 1993.

162. A Note on the Motion of Surfaces. R.I. McLachlan and H.Segur, June 1993.

163. A Gallery of Constant-Negative-Curvature Surfaces. R. McLachlan. June 1993.