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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.

Sarbargh 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.
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:

Tetsuo 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

Manuel 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 Naegle - 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!
- 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 Illarionov 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 Midge 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 Midge 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:


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

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

A. Larrazá, Naval Postgraduate School, Monterey, CA January 15, 1993
"The Boltzmann Equation: From Particle Kinetics to Nonlinear Random Waves"

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

A. Wood, Dublin City University, Ireland, January 29, 1993
"Exponential Asymptotics"

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

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

J. Keller, Stanford University, February 19, 1993
"The Mathematics of Sports"

T. Deguchi, University of Tokyo, February 26, 1993
"Topology of Random Knots"

B. Enquist, UCLA, March 5, 1993
"Numerical Homogenization"

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

B. Fuchssteiner, 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"

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

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

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

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

C. Li, University of Colorado, April 30, 1993
"The Method of Moving Planes"

P. Clarkson, University of Exeter, UK, May 7, 1993
"Symmetry Analysis for PDEs: A Personal Perspective"
Seminars in Applied Mathematics

I. 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. Larrazá, 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"

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

E. D'yakonov, 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.
D. Faculty Service to the University, College and Societies

Mark Ablowitz: 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.

Jerrold Bebernes: Member of Program Graduate Committee; Calculus Textbook Selection Committee.

Gregory Beylkin: Member of Program Graduate Committee; Member of the Program Faculty Recruiting Committee.

Mary Brewster: 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.

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

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

John Maybee: Member of Program Graduate Committee.

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

Harvey Segur: Member of Program Graduate Committee; Member of Faculty Advisory Committee for Minority Engineering Program; Member of Ad Hoc Committee on Teaching Effectiveness.

John Williamson: 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

APP M 1340 Easton, Intensive Calculus.

APP M 1350 Bebernes, Easton, Limber, Nitsche, Calculus 1 for Engineers.

APP M 1360 Ablowitz, Bebernes, Limber, Calculus 2 for Engineers.

APP M 2350 Nitsche, Schober, Segur, Wang, Calculus 3 for Engineers.

APP M 2360 Chakravarty, McLachlan, Meiss, Linear Algebra and Differential Equations.

APP M 3170 Maybee, Discrete Applied Mathematics.

APP M 3310 Maybee, Matrix Methods and Applications.

APP M 3570 Williamson, Applied Probability.


APP M 4360 Meiss, Methods in Applied Mathematics 2.

APP M 4570/5570 Williamson, Statistical Methods.
APPM 4650  Curry, Numerical Analysis 1.
APPM 4660  Curry, Intermediate Numerical Analysis.

(ii) GRADUATE COURSES
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:


"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


**Jerrold Bebernes:**

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


**Gregory Beylkin:**

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


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

**Mary Brewster:**


**Sarbarish Chakravarty:**


**John Maybee:**


**Robert McLachlan:**


**James Meiss:**


**Connie Schober:**


**Harvey Segur:**


**Xiao Wang:**


**John Williamson:**


**B. Invited Lectures and Meetings Attended for Calendar Year 1992**

**Mark Ablowitz:**

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


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

**Jerrold Bebernes:**


**Gregory Beylkin:**


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


Mary Brewster:

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


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


Robert Easton:

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:


Summer Dynamics Institute, Boston University, July 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).


**James Meiss:**


**Monika Nitsche:**


**Connie Schober:**


**Harvey Segur:**


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:

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

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:


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 Physics* 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.

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.

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.

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


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