PROGRAM IN APPLIED MATHEMATICS

UNIVERSITY OF COLORADO
AT BOULDER

BOULDER, COLORADO 80309-0526
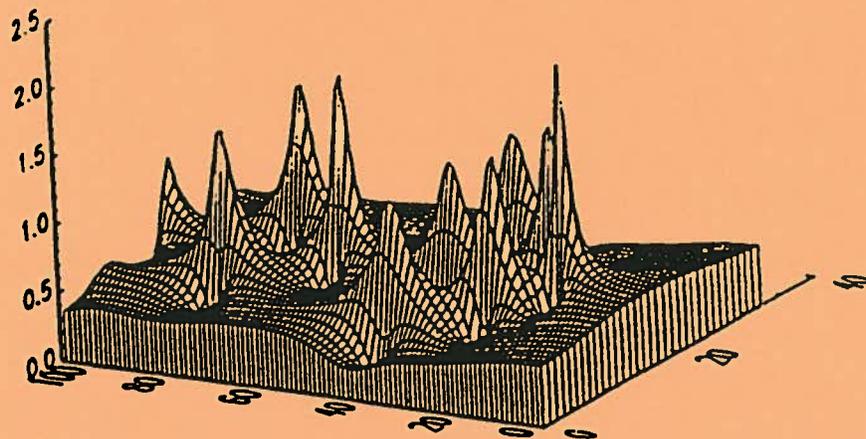
ANNUAL REPORT

1991-92

Mark J. Ablowitz, Director

James D. Meiss, Associate Director

July 1, 1992

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1.   OBJECTIVES

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

a) To provide undergraduate and graduate students with excellent courses and training in applied and computational mathematics. Students will be 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 services 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 and valued by the Program.

2.   ORGANIZATION AND COMMENTS
A. Overview

The Program in Applied Mathematics has a core of 11 faculty members plus two instructors who are responsible for all the teaching and advising of undergraduate students taking applied mathematics courses. (Most engineering majors are required to take four courses in applied mathematics.) In 1991-92 the Program taught a total of 2781 students in 15 undergraduate courses, divided into 29 sections, and 12 graduate courses. The Program also has 23 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 arise frequently in application.

The graduate student population has grown rapidly. The Program currently has 27 graduate students. We have 19 teaching assistantships available and currently support two graduate students with research grants. We expect the number of graduate students supported by research grants to substantially increase via the affiliated faculty program. It is worth remarking that, counter to national trends, we have been very successful recruiting US citizens to study in our graduate program. In 1992, all new students with support will be US citizens from US undergraduate universities. Currently we have 6 foreign graduate students. While we certainly encourage foreign applications, our success in being able to attract high quality American graduate students is noteworthy.

The faculty in the core Program are involved in a variety of research fields including the following: Nonlinear dynamics and chaos theory, integrable nonlinear equations, analysis of nonlinear equations arising in physical phenomena, nonlinear wave theory, computational mathematics including wavelet analysis, matrix algebra, applied probability and statistics.

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.

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

Jerry Dwyer, Instructor; PhD, National University of Ireland. Fracture Mechanics,
    Elasticity, Composites, Hydraulic Fracture.

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

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, Associate Director, Professor; PhD, University of California at Berkeley.
    Dynamical Systems, Hamiltonian Mechanics, Plasma Physics.

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

S.S.Sritharan, Visiting Assistant Professor (from University of Southern California); PhD,
University of Arizona. Control Theory, Analysis, Fluid Dynamics.

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

Leon Takhtajan, Visiting Professor (from Steklov Mathematical Institute, Leningrad); PhD,
    Mathematical Physics, Applied Algebra and Group Theory.

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: Peter Clarkson, Exeter University, U.K. (February - March, 1992); Silvana DeLillo, Perugia University, Italy (April - May, 1992); Barend Herbst, University of the Orange Free State, South Africa (December, 1991 - January, 1992); Yannis Kevrekidis, Princeton University, (September - December, 1991); Javier Villaroel, University of Salamanca, Spain (August - September, 1991); Miki Wadati, University of Tokyo (November, 1991 and March, 1992).

C. Affiliated Faculty - Graduate Program in Applied Mathematics

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

Alberto Bressan (Mathematics), Differential Inclusions, Geometric Control Theory, Conservation Laws and Combustion Theory

Richard Byrd (Computer Science), Optimization, Nonlinear Data Fitting, Parallel Computation

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

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

Fred Glover (Graduate School of Business), Combinatorial Optimization, Heuristic Search, Large Scale Models

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

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

Elizabeth Jessup (Computer Science), Numerical Linear Algebra, Eigenvalue Problems, Parallel Computation

William Jones (Mathematics), Mathematics of Computation, Approximation Theory, Special Functions

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

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

Oliver McBryan (Computer Science), Large Scale Computation, Numerical Partial Differential Equations, Parallel Computations and Algorithms

Tom Mullis (Electrical Engineering), Digital Signal Processing and Linear Systems

Robert Sani (Chemical Engineering), Computational Fluid Mechanics and Transport

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

Robert Schnabel (Computer Science), Parallel Computation, Numerical Optimization, Languages

J. Michael Shull (Astrophysical, Planetary, and Atmospheric Sciences and Physics), Theoretical Astrophysics, Galactic Media, Quasars, Supernovae

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

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Renjeng Su (Electrical Engineering), Systems Theory, Automatic Control, and Robotics

Juri Toomre (Astrophysical, Planetary, and Atmospheric Sciences and Physics), Astrophysics, Mathematical Modelling, Numerical Simulation

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

D. Staff

Middie Morris - Senior Secretary

Janet Glasser - Student Coordinator/Receptionist

Andrea Hennessy - Word Processing Operator

Cheryl Persinger - Part-time Word Processing Operator

E. General Comments

• The program continues to grow. In 1990-91 we taught 2,562 students and in 1991-92 this increased to 2,781. In 90-91 we had 17 graduate students enrolled. In 1991-92 the number of resident graduate students increased to 27. Applied Math had two graduate students receive PhD degrees during the past year: Martha Nesbitt and Fathi Allen - both advised by James Curry.

• A team of three applied math undergraduates, Lynne Konecne, Nicholas Hook and Stephen Judd, was considered as providing the best possible solution to a problem in the 1992 mathematical modeling contest. For this achievement the Operations Research Society of America invited the students to present their solutions at the national convention in Orlando, Florida in April. The students were advised by Mary Brewster. The Program is very proud of this achievement. Congratulations to all!

• Gregory Beylkin and John Williamson joined the Program in the Fall semester. They bring valued expertise in computational mathematics and wavelet analysis (Beylkin) and applied probability and statistics (Williamson) and ensure that a wide range of courses in these areas will be taught on a regular basis.

• We are pleased to have Dr. Xiao Wang as an instructor for 1991-93. Dr. Wang is an expert in singularity development associated with nonlinear wave systems. We are also glad to have Dr. Constance Schober join the Program as instructor and research associate, and Dr. Sue Haupt as research associate.

• Jerrold Bebernes spent the year with the National Science Foundation as program director of applied mathematics and Congming Li was a visiting member of the Institute for Advanced Study in Princeton, N.J. where his field of study (analysis of nonlinear systems) was given special attention this year. Dr. Li joins the Program as an assistant professor. We look forward to having both in Boulder for the next academic year.

- The Program has hired Dr. Monika Nitsche as an instructor for the period 1992-94. Dr. Nitsche's research activities center around computational fluid dynamics. Monika comes to us from the University of Michigan where she recently completed her Ph.D.

- Our congratulations to James Curry who won the 1992 Boulder Faculty Teaching Excellence Award. This is a well deserved honor and follows his award as outstanding teacher in the College of Engineering in 1991.

- The Program hosted an active colloquium and seminar series during this past year. As part of our seminar series during the Fall semester Professor Beylkin gave a number of lectures on wavelets and their applications in computational mathematics. Speakers at the colloquium and seminar series included among others: M. Crandall (Santa Barbara), I. Daubechies (Rutgers), V. Matveev (St. Petersburg), A. Newell (Arizona), A. Polyakov (Princeton), H. Rabitz (Princeton), and M. Wadati (Tokyo). In the spring we continued our collaboration with Los Alamos National Laboratory (LANL) and hosted a two day workshop where we had 21 speakers including representatives from the Colorado School of Mines, Colorado State University, the Physics and Astrophysics departments at CU, in addition to members of the Program and LANL. Special thanks to Robert McLachlan of PAM and Roberto Camassa for organizing this year's workshop.

- We are pleased to have had a group of scientists from the Physics Department at the University of Tokyo, led by Professor M. Wadati, visit for short periods of time during the past year. Visitors included T. Deguchi, T. Iizuka, T. Nagao, and T. Yajima. These visits and those made by Professors Ablowitz and Segur to Tokyo were supported by the Japanese government.

- Long term visitors to the Program this year included: L. Takhtajan (Steklov Mathematics Institute, St. Petersburg), S. Sritharan (USC), Y. Kevrekides (Princeton), and J. Dwyer (Massachusetts Institute of Technology). Each of them contributed significantly to our efforts and we appreciate their interest in the program and value their efforts in teaching and research. We wish them well upon their return to their positions - or new positions as the case may be.

- The Program's undergraduate commitee (Chair, R. Easton) recommended a minor in Applied Mathematics in the College of Arts and Sciences, which has been approved by the Program and the College of Arts and Sciences. We are pleased that in addition to students in the College of Engineering , students in the College of Arts and Sciences will have an opportunity to have courses taken in the Program in Applied Mathematics recognized as an official minor. The Undergraduate Committee has reorganized our undergraduate advising system and we look forward to further success in our undergraduate affairs.

- Particular thanks to James Meiss who was interim Associate Director of the Program during 1991-92. As is characteristic of Jim, he did an outstanding job - which was and is greatly appreciated. (Next year James Curry returns to his position as Associate Director.) Jim Meiss also was Chair of the Program's Graduate Committee. The Graduate Program has

grown significantly in the past three years and requires substantial effort on the part of the Graduate Chair. We also are pleased to note that Jim Meiss has been promoted to full professor with tenure. Congratulations Jim!

• In September Middie Morris took over for Janet Horn as senior secretary for the Program. It was quite a change for her - previously being secretary for the Opera program. She has done a remarkable job and we are pleased to have her with the Program (Middie also is a writer and we look forward to seeing her completed "SCI-FI" book in print soon!).

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: 1991-1992

M. Crandall, University of California, Santa Barbara, Sept. 13, 1991
    "Viscosity solutions of fully nonlinear elliptic PDEs"

T. Deguchi, University of Tokyo, Japan, Sept. 20, 1991
    "Knots in physics"

S.S. Sritharan, University of Colorado, Sept. 27, 1991
    "Optimal control theory of viscous flow"

M. Barber, Australian National University, Oct. 4, 1991
    "Phase Field Models of Solidification"

G. Beylkin, University of Colorado, Oct. 11, 1991
    "The Mathematics of Seismic Exploration"

P. Hagan, Los Alamos National Lab, Oct. 18, 1991
    "Strong-field Semiconductor Equations"

K. Uhlenbeck, University of Texas, Nov. 1, 1991
    "Poisson-Lie group actions and nonlinear sigma models"

P. Swarztrauber, NCAR, Nov. 8, 1991
    "A Fast Parallel Algorithm to Compute the Eigenvalues
    of a Symmetric Tridiagonal Matrix"

M. Wadati, University of Tokyo, Japan, Nov. 15, 1991
    "Random matrices and statistical mechanics"

M. Longuet-Higgins, University of California, San Diego, Nov. 22, 1991
    "Parasitic Capillary Waves"

C. Cioffi-Revilla, Political Science Department, University of Colorado, Dec. 6, 1991

"Probability Methods in the Analysis of War"

J. McWilliams, NCAR, Jan. 24, 1992

"Scaling Behaviour and the Punctuated Hamiltonian Dynamics
of Structured Turbulence"

S. Chakravarty, University of Colorado, Jan. 31, 1992

"Cosmology, Integrability, and Modular Forms"

N. Murray, Caltech, Feb. 7, 1992

"Dynamical History of the Neptunian Satellites"

F. Glover, J. Kelly & M. Laguna, University of Colorado, Feb. 14, 1992

"Mathematical Optimization and Artificial Intelligence in Real
World Problem Solving"

M. Allen, University of Wyoming, Feb. 21, 1992

"Collocation Methods for Solving Underground Contaminant
Transport"

I. Daubechies, Rutgers University & Bell Labs, Feb. 28, 1992

"Wavelets on the Interval"

B. Dubrovin, Moscow State University, Mar. 6, 1992

"Topological Field Theory and Integrable Systems"

M. Wadati, University of Tokyo, Japan, Mar. 13, 1992

"Exactly Solvable Models and Finite Size Corrections"

A. Polyakov, Princeton University & Landau Institute, Moscow, Mar. 20, 1992

"Quantum Geometry and Physics"

A. Newell, University of Arizona, Apr. 3, 1992

"Dynamics of Patterns"

H. Rabitz, Princeton University, Apr. 17, 1992

"Optimal Control of Quantum Mechanical Systems and the
Occurence of Coupled Nonlinear Schroedinger Equations"

G. Doolen, Los Alamos National Lab, Apr. 24, 1992

"Lattice Gas Dynamics"

H. Fattorini, UCLA, May 1, 1992

"Modern Developments in the Optimal Control of PDEs"

Seminar in Applied Mathematics

T. Yajima, University of Tokyo, Sept. 19, 1991

"Nonlinear Equations in Unstable Media

Y. Kevrekides, University of Colorado and Princeton University, Sept. 26, 1991

"Noninvertibility and the Dynamics of Adaptive Control Systems"

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M. Barber, Australian National University, Canberra, Australia, Oct. 3, 1991
 "Travelling Waves in Phase Field Models of Solidification"
R. Easton, University of Colorado, Oct. 10, 1991
 "Capture Orbits and Melnikov Integrals in the Planar Body Problem"
R. Easton, University of Colorado, Oct. 17, 1991
 "Discrete Dynamical Systems and Isolating Blocks"
S.S. Sritharan, University of Colorado, Oct. 24, 1991
 "An Introduction to Hamilton-Jacobi Theory and Nonsmooth Analysis"
Y. Kimura, NCAR, Oct. 31, 1991
 "Intermittency Growth in 3D Turbulence"
N. Bleistein, Center for Wave Phenomena, Colorado School of Mines, Nov. 7, 1991
 "The Cagniard Method in Complex Time Revisited"
T. Iizuka, Deptartment of Physics, University of Tokyo, Japan, Nov. 14, 1991
 "Waves in the Raleigh-Taylor Problem"
G.E. Karniadakis, Mech. and Aerospace Engineering, Princeton University, Dec. 5, 1991
 "Turbulence Simulations on Parallel Supercomputers"
B. Herbst, University of the Orange Free State, South Africa, Jan. 23, 1992
 "Exponentially small splitting distances in symplectic discretizations of integrable
 Hamiltonian systems"
S.S. Sritharan, University of Colorado, Jan. 30, 1992
 "Young Measures"
N. Murray, Caltech, Feb. 6, 1992
 "Magnetic Fields and p-mode Frequency Shifts"
M. Nitsche, University of Michigan, Feb. 13, 1992
 "Axisymmetric Vortex Sheet Roll-up"
M. Mineev, Courant Institute, NYU, Feb. 13, 1992
 "Exact Solutions of 2-dimensional Interface Dynamics"
E. Stone, Colorado State University, Feb. 20, 1992
 "Models of Intermittent Bursting in a Turbulent Boundary Layer"
R. Dewar, Australian National University, Feb. 27, 1992
 "Flux Minimizing Curves and the Arrow of Time"
V. Wickerhauser, Washington University, St. Louis, Mar. 5, 1992
 "Wavelets and 2D-Computed Turbulence"
B. Dubrovin, Moscow State University, Mar. 5, 1992
 "Geometry and Integrability of topological-antitopological fusion"
J. Hietarinta, Los Alamos National Laboratory, Mar. 12, 1992
 "The Complete Solution of the Constant Quantum Yang-Baxter"
C. Chow, APAS, Apr. 2, 1992
 "Spatio-Temporal Chaos in a Nonconservative Three Wave Interaction"

J. Dwyer, University of Colorado, Apr. 16, 1992

"Edge Function Methods-- Powerful Alternative for Linear Boundary Value Problems"

P. Grinevich, Landau Inst. for Theoretical Physics, Moscow and Univ. of Maryland at College Park, Apr. 23, 1992

"d-bar Problem Method and the Fixed-energy Scattering Problems for the Two-dimensional Schrodinger Operator"

L. Armi, Scripps Oceanographic Institute, UCSD, Apr. 30, 1992

"Hydraulics of a Stratified Fluid Flow"

V. Matveev, Leningrad State University, May 7, 1992

"Deformations of Algebraic Curves and Integrable Nonlinear Evolution Equations"

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

A. Wheeler, University of Bristol, U.K., October 1,1991

"Phase Field Models of Crystal Growth"

V. Korepin, Institute for Theoretical Physics, SUNY, Oct. 10, 1991

"Differential Equations for Quantum Correlation Functions"

Y. Kurylev, Steklov Institute of Mathematical Sciences, Russia, Dec. 5, 1991

"Inverse Problems and Riemannian Geometry"

Vitaly Ginsberg, Russian Academy of Sciences, June 22,1992

"Lev Landau"

Michael Spector, Tel-Aviv University, June 23,1992

"Stability of Nonlinear Waves in Integrable Models"

3. COMMITTEES

A. Undergraduate Committee - Robert Easton, Chair

The Program in Applied Mathematics currently has fifty undergraduate majors. Seven students graduated this year.

Honors: Laura Mather won the Ellison Onizuka Outstanding Freshman award as the outstanding undergraduate in the College of Engineering.

A team of three applied mathematics undergraduates ranked in the top five teams in a 290 team competition sponsored by the Consortium for Mathematics and its Applications. The members were Lynn Konecne, Nicholas Hook, and Stephen Judd. Mary Brewster was the team's faculty advisor.

A new advising procedure is being instituted. Students in each entering class will be assigned a faculty advisor who will work with them until they graduate.

A new Minor in Applied Mathematics was prepared and submitted to the Dean of the College of Arts and Sciences and was approved. The minor will allow undergraduate students on the Boulder Campus to receive systematic training in applied mathematics, and will appear as a minor on their transcripts.

A policy on course coordination was developed by the committee and approved by the faculty. Multi-section courses will have one professor designated to coordinate common exams, grading policy, and other administrative duties.

B. Graduate Committee - James Meiss, Chair

The Program Graduate Commmittee 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 for next fall. Currently the Program has 27 graduate students, of whom 13 began last fall. Two students received the PhD degree this year, and three received the MS.

There were 45 applicants for the fall semester of 1992, of whom we chose six for TA positions. The choice was difficult since the applicants had a remarkable average GPA of 3.5 and quantitative GRE scores of 728. We were awarded $9000 from the graduate school for fellowships, and in addition some funds for financial aid. The entering graduate class appears to be a remarkable group--with an average GPA of 3.7. Several of the students visited the campus, supported by funds from the graduate school, and one of our new students is "learning the ropes" of the program as a secretary during the summer.

The committee revised the syllabi for the preliminary examinations, of which there are currently three: in Applied Analysis, Computational Analysis, and Partial Differential Equations. These exams are administered before classes begin in the Fall and Spring.

C. Faculty Search Committees

During this academic year we received nearly 200 applications in response to our advertisement for an instructor postion. Our first candidate, Monika Nitsche, 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. In the year 1993-94 we anticipate filling one faculty position and one instructorship.

D. Faculty Service to the University, College and Societies

Mark Ablowitz: Program Director; Member of Council on Research and Creative Work of The Graduate School; Organized the Applied Mathematics Seminar on Nonlinear Waves and Integrable Systems

Gregory Beylkin: Member of the PAM Graduate Committee; Member of the PAM 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

James Curry: Member of Program Faculty Recruiting Committee; Member of Salary Equity Committee; Chancellor's Information Technology Committee, Arts and Sciences

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Personnel Committee; Member of the Review Committee for the Center for Combustion Research

    Robert Easton: Chair, Undergraduate Committee; Member of Educational Policy and Planning Committee (Engineering); Member of Undergraduate Academic Affairs Committee (Engineering)

    John Maybee: Member of Program Graduate Committee

    James Meiss: Associate Director of Program; Chair of Graduate Committee; Member of Graduate Chairs Commitee; Graduate school; Member, Program Graduate Committee; Member, Program Faculty Recruiting Committee; APAS Committee on Plasma Physics at CU

    Harvey Segur: Chairman, Colloquium Committee; Graduate Commitee; Member, Faculty Search Committee; Member, Faculty Advisory Committee for Minority Engineering Program; Applied Mathematics Committee for University of Colorado

    John Williamson: Member of Undergraduate Committee; Contributed to the coordination of UCD and Program offerings in the area of probability and statistics; Led a 6 week series of help sessions for students preparing to take the second actuary exam in May 1992; Member, College of Engineering Scholarship Committee

4. TEACHING ACTIVITIES

A. Courses Taught by Program Faculty During Academic Year 1991-92

(i) UNDERGRADUATE COURSES

APPM 1350. *Dwyer, Maybee, McLachlan, Easton,* Calculus 1 for Engineers.

APPM 1360. *Ablowitz, Curry, Segur,* Calculus 2 for Engineers.

APPM 2350. *Brewster, Chakravarty,* Calculus 3 for Engineers.

APPM 2360. *Takhtajan, Schober, Brewster, Wang,* Linear Algebra and Differential Equations.

APPM 3310. *Maybee,* Matrix Methods and Applications. Linear algebra and matrices with emphasis on applications, methods to solve systems of linear algebraic and linear ordinary differential equations and computational algorithms.

APPM 4350.*Meiss,* Methods in Applied Mathematics 1. Review of ODE's, series methods, Sturm-Liouville problems, special functions, boundary value problems.

APPM 4360. *Meiss,* Methods in Applied Mathematics 2. Introduction to and methods of complex variables. PDE's, Fourier and Laplace transforms, and conformal mapping.

 APPM 4520/5520. *Williamson,* Introduction to Mathematical Statistics. Point and confidence interval estimation. Principles of maximum likelihood sufficiency, and completeness; tests of simple and composite hypotheses, linear models, and multiple regression analysis. Analysis of variance distribution-free methods.

APPM 4650. *Easton*, Numerical Analysis 1. Solution of algebraic and transcendental equations, linear and nonlinear systems of equations, interpolation, numerical integration, sources of error and error analysis.

(ii) GRADUATE COURSES

APPM 5440. *Sritharan*, Applied Analysis 1. Elements of basic real and complex analysis, Banach spaces, L^p spaces, and relevant inequalities. Applications to existence and uniqueness of solutions to various types of ordinary differential equations, partial differential equations and integral equations.

APPM 5450. *Sritharan*, Applied Analysis 2. Continuation of 5440.

APPM 5470. *Segur*, Methods in Applied Mathematics 3. Properties and solutions of partial differential and integral equations. Methods of characteristics for partial differential equations, well-posed problems, main results for the well-known equations, Green's functions, and related integral equations.

APPM 5480. *Segur*, Methods of Applied Mathematics 4. Asymptotic evaluation of integrals, perturbation methods, multiple scale methods and applications to differential/integral equations.

APPM 5600. *Beylkin*, Numerical Analysis 1. Solution of linear systems, least squares approximations, nonlinear algebraic equations, interpolation, and quadrature.

APPM 5610. *Beylkin*, Numerical Analysis 2. Solution of ordinary and partial diferential equations.

APPM 6550. *Fox*, Introduction for Stochastic Processes, Systematic study of Markov processes including renewal theory, limit theorems for Markov chains, branching processes, queuing theory, and birth and death processes.

APPM 6620. *Wang*, Numerical Computation in Applied Math 1: Ordinary Differential Equations. Numerical solution of ordinary differential equations, initial and boundary value problems.

APPM 6630. *Wang*, Numerical Computation in Applied Math 2: Partial Differential Equations. Numerical solution of ordinary and partial differential equations, initial and boundary value problems, stability and convergence of difference schemes.

APPM 7100. *Easton*, Mathematics Methods in Dynamical Systems. Dynamical systems, mappings and differential equations, period doubling route to chaos, Hamiltonian mechanics, action-angle variables, KAM and bifurcation theory, phase plane analysis, Melnikov theory, strange attractors.

APPM 7300. *Takhtajan*, Mathematical Methods in Nonlinear Waves & Integrable Equations. Basic results associated with linear dispersive wave systems, first order nonlinear wave equations, nonlinear dispersive wave equations, solitons and methods of the inverse scattering transform.

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APPM 6520, *Williamson*, Mathematical Statistics. Mathematical theory of statistics. Topics include distribution theory, estimation and testing of hypotheses, multivariate analysis, and non-parametric inference.

In addition, some of our faculty taught classes through the Department of Mathematics:

MATH 4510, *Williamson*, Introduction to Probability Theory. Axioms, combinatorial analysis, independence and conditional probability, discrete and absolutely continuous distributions, expectation and distribution of functions of random variables, laws of large numbers, central limit theorems, simple Markov chains.

MATH 4520/5520, *Williamson*, Introduction to Mathematical Statistics. (same as APPM 4520/5520).

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

B. Summer Courses, 1992

APPM 1350, *Wang*, Calculus I for Engineers.

APPM 1360, *Werckman*, Calculus II for Engineers.

APPM 2350, *Chakravarty*, Calculus III for Engineers.

APPM 2360, *Sundbye*, Intro. to Linear Algebra and Differential Equations.

APPM 4650, *Schober*, Intermediate Numerical Analysis I.

5. RESEARCH ACTIVITIES (1991-92)

A. Research Publications

Mark Ablowitz:

Solitons, Nonlinear Evolution Equations and Inverse Scattering, M.J. Ablowitz and P. Clarkson, London Math. Society Lecture Note Series, 516 p., Cambridge Univesity Press, 1991.

"On the Kadomtsev Petviashvili Equation and Associated Constraints" by M.J. Ablowitz and J. Villaroel, Studies in Applied Mathematics 85 (1991): 195-213.

"Numerical Homoclinic Instabilities and the Complex Modified Korteweg-De Vries Equation" by B.M. Herbst, M.J. Ablowitz and E. Ryan, Computer Phys. Commun. 65 (1991): 137-142.

"Forced and Semiline Solutions of Burger's Equation" by M.J. Ablowitz and S. De Lillo, Phys. Lett. A. 156 (1991): 483-487.

"A Class of Stable Multistate Time-Reversible Cellular Automata with Rich Particle Content" by M.J. Ablowitz, J.M. Keiser and L.A. Takhtajan, Phys.Rev. A. 44, no. 10, Nov. 15. 1991: 6909-6912.

"One-Dimensional Reductions of Self-Dual Yang-Mills Fields and Classical Equations" by S. Chakravarty, M.J. Ablowitz and P. Clarkson, <u>Recent Advances in General Relativity,</u> (1992): 60-71, Parker & Birkhauser Press.

"On the Method of Solution to the 2+1 Toda Equation" by J. Villaroel and M.J. Ablowitz, <u>Phys. Lett. A,</u> 163, No. 4 (1992): 293-296.

"Dynamics of Semi-Discretization of the Defocusing Nonlinear Schrodinger Equation" by M.J. Ablowitz, B.M. Herbst and J.A. Weidman, <u>IMA Journal of Numerical Analysis II</u> (1991): 539-552.

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

Jerrold Bebernes:

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

Gregory Beylkin:

"Multiresolution representatives using the auto-correlation functions of compactly supported wavelets" by N. Saito and G. Beylkin, <u>Proceedings of ICASSP 92</u> IV (March 1992): 381-384.

"Wavelets in Numerical Analysis" by G. Beylkin, R.R. Coifman and V. Rokhlin, in <u>Wavelets and their Applications,</u> Jones and Bartlett, 1992.

Mary Brewster:

"Thin Plates and Compressive Membrane Solutions I: Global Breakdown." <u>SIAM Journal of Applied Mathematics</u> 51 No. 5 (October 1991): 1255-1283.

Sarbarish Chakravarty:

"One-Dimensional Reductions of Self-Dual Yang-Mills Fields and Classical Equations" by S. Chakravarty, M.J. Ablowitz and P. Clarkson, <u>Recent Advances in General Relativity,</u> (1992): 60-71, Parker & Birkhauser Press.

On Reductions of Self-Dual Yang-Mills Equations, S. Chakravarty and M.J. Ablowitz, in Proceedings of NATO Advanced Research Workshop, Montreal, eds. D. Levi and P. Winternitz (Plenum Press, New York, 1992).

Diffeomorphism Algebras and The Nahm and Ward Equations, S. Chakravarty, S.L. Kent, and E.T. Newman, J. Math. Phys., 33, No. 1, (1992)

Self-Dual Yang-Mills Equation and New Special Functions in Integrable Systems, S. Chakravarty, M.J. Ablowitz, and L.A.Takhtajan, in Proceedings of the Nonlinear Evolution Equations and Dynamical Systems, Gallipoli, ed M. Boiti, (World Scientific, Singapore, 1991).

Integrable Systems, Self-Dual Yang-Mills Equations and Connections with Modular Forms, Mark J. Ablowitz, S. Chakravarty, and Leon Takhtajan, in Proceedings of the Symposium

on Nonlinear Problems in Engineering and Science, Tsinghua University, Beijing, ed X.
Hu, (Beijing, 1992).

Robert Easton:

"Transport through Chaos." Nonlinearity 4 (1991): 583-590.

"Capture Orbits and Melnikov Integrals in the Planar Three-Body Problem." Celestial
Mechanics and Dynamical Astronomy 50 (1991): 283-297.

John Maybee:

"Algebraic Multiplicity of the Eigenvalues of a Tournament Matrix," with D. deCaen, D.
· Gregory, S. Kirkland, and N. Pullman, in Linear Algebra and Its Applications 169 (1992):
179-193.

Robert McLachlan:

"The accuracy of symplectic integrators" by McLachlan, R. and Atela, P. Nonlinearity 5
(1992): 541-562.

James Meiss:

Plasma Confinement, R.D. Hazeltine and J.D. Meiss, (Addison Wesley, Sept 1, 1991), 394
pp., ISBN 0201-53353-5.

"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, Vol 2(2) (1992): 12-18.

"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.

Harvey Segur:

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

"Who cares about integrability?", Physica D 51 (1991): 343-359.

"An asymptotic symmetry of the rapidly forced pendulum." with Chang Y.-H., Physica D 51
(1991): 109-118.

"Asymptotics Beyond All Orders in a Model of Crystal Growth." with M.D. Kruskal, Stud.
App. Math. 85 (1991): 129-182.

"Periodic Waves in Shallow Water." Proc. of Int.School of Physics "Enrico Fermi", Course
CIX (1988), ed. by A.R. Osborne, North Holland, Amsterdam, with J. Hammack & N.
Scheffner (1991): 891-914.

"An overview of the geometric model." Asympotics Beyond All All Orders, ed. by 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,
Asympotics Beyond All Orders, ed. by 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, <u>Journal of The Physical Society of Japan</u> 61 (1992): 1187-1193.

S.S. Sritharan:

"Analysis of Regularized Navier Stokes Equations -- I", co-Author Y.R. Ou, Quarterly of Applied Mathematics 49 No. 4 (1991): 651-685.

"Analysis of Regularized Navier Stokes Equations -- II", co-Author Y.R. Ou, Quarterly of Applied Mathematics 49 No. 4 (1991): 687-728.

"Theory of Harmonic Grid Generations--II", Applicable Analysis 44 No. 1/2 (1992): 127-149.

Leon Takhtajan:

"Class of stable multistate time-reversible cellular automata with rich particle content," with M.J. Ablowitz and J.M. Keiser, <u>Phys. Rev. A</u> 44 (1991): 6909.

John Williamson:

"Linkage Analysis in Quantitative Traits: Increased Power by Using Selected Samples." with G. Carey, <u>American Journal of Human Genetics</u> 49 (1991): 786-796.

B.   Invited Lectures and Meetings Attended

Mark Ablowitz:

NATO Advanced Scientific Workshop, Patras, Greece, "Solitons, Computation and Chaos," July 9-18, 1991.

Symposium on Nonlinear Problems in Science and Engineering, Tsinghua University, Beijing, China, "Self-Dual Yang-Mills, Solitons and Connections with Modular Forms". Oct. 16-20, 1991.

Kao Corporation, Tokyo, Japan, "Solitons, Chaos and Cellular Automata," Oct. 22, 1991.

University of Tokyo, Japan, Physics Department, "Reductions of Self-Dual Yang-Mills Equations and Connections with Modular Forms," Oct. 23, 1991.

Ryukoku University, Seta, Japan, Applied Mathematics Dept., "Numerical Chaos and Cellular Automata," Oct. 28, 1991.

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

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.

Jerrold Bebernes:

Georgetown University, "Final Time Profiles," November 1991.

Gregory Beylkin:

A series of lectures at INRIA, France, 1991.

ICIAM-91, "Representations of Differential Operators and Fast Numerical Algorithms," July, 1991.

ONR Workshop, USC, "Preliminary results on computing F(u) in the Wavelet Bases," Sept. 13-14, 1991.

C.U. Physics Dept., "Wavelets and their Applications," Sept. 4, 1991.

Series of seven lectures at CU Boulder, Seminar in Applied Mathematics, Fall 1991.

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

Wavelets and Applications, Toulouse '92, Toulouse, France, "On Computing F(u) in the Wavelet Bases," June, 1992.

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

Mary Brewster:

AWM workshop, ICIAM '91,"Stationary Premixed Flames in a Dual-Source System," July 7, 1991.

ICIAM '91, Washington DC, "Dean Vortices in Spiral Channel Membrane Systems," July 9, 1991.

UC Denver, "Stationary Flames in a Dual-Source System," October 9, 1991.

Applied Mathematics Seminar at University of Arizona, "Wrinkled Flames Induced by Transverse Nonuniformity," October, 1991.

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.

Sarbarish Chakravarty:

Meeting on Similarity Solutions of Differential Equations, University of Pittsburgh, Pittsburgh, PA, April 26-28, 1991.

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

Midwest Geometry Conference, Kansas State University, Manhattan, Kansas, " 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 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 Days, "Symplectic Integration of Hamiltonian wave equations," April, 1992.

John Maybee:

Conference on Qualitative Matrix Analysis - Georgia State University, Atlanta, August 1991.
Fourth SIAM Conference on Applied Linear Algebra, Minneapolis, September, 1991.
Organized a minisymposium on tournament matrices. Lecture: "Inverses of L-matrices"
Invited participant at an IMA workshop on combinatorial matrix analysis at the University of
    Minnesota. Contributed two conjectures about sign-nonsingular matrices to the
    proceedings.
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.)
Workshop on introducing computing into the undergraduate matrix theory course. University
    of Wyoming, Laramie, June,1992 (3 day workshop).
SIAM Conference on Combinatorics in Vancouver B.C., "Chordal, interval, and 2-step
    graphs," June, 1992.

James Meiss:

Dynamics Systems Meeting, Euler Institute of Mathematics, Leningrad, Russia, "Resonances,
    Escape and Transport", November 1992.
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.

Harvey Segur:

NATO Advanced Studies Institute on Chaotic Dynamics: Theory and Practice, at Patras,
    GREECE, "Periodic Waves in Shallow Water", July 11-20, 1991.
Meeting of AMS, held in Fargo, N.D., "Periodic Waves in Shallow Water", October 25-26,
    1991.
Slow Pitch Seminar of Math. Dep't, CU,"What is integrability and why should I care?", Sept
    11, 1991.
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.

S. Sritharan:

Math Colloquium, University of California - Santa Barbara, "Optimal Control of Viscous Flow," October, 1991.

Applied Math Colloquium, University of Southern California, "Young Measures and Optimal Control of Viscous Flow," October, 1991.

Slow Pitch Seminar, University of Colorado Mathematics Department, "Viscosity Solutions for Nonlinear PDE's," March, 1992.

Probability Seminar, University of Colorado Mathematics Department, "Young Measures - I," April, 1992.

Probability Seminar, University of Colorado Mathematics Department, "Young Measures - II," April, 1992.

John Williamson:

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

C.   Research Grants *

Mark Ablowitz:

NSF, Mathematics Division: 1991-94

AFOSR, Mathematics: 1991-94

ONR, Mathematics: 1990-92, 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

James Curry

ONR, Physics/Oceanography Division: 1992-94

Robert Easton

Council for the Enhancement of Undergraduate Education:

John Maybee

ONR, Mathematics Division: 1990-93

CRCW: Support for further computing of maximal L-matrices.

James Meiss:

NSF, Mathematics Division: 1990-92

Harvey Segur:

NSF, Mathematics Division: 1990-92

NSF, Special Projects: 1991

NATO, Scientific Affairs Division: 1991

ONR, Physics/Oceanography Division: 1992-94.

S.S. Sritharan:

ONR, Mathematics Division: 1991-94

    *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

Reviewer: NSF, AFOSR, DOE grants; Physical Review Letters, Physics Letters, Studies in
    Applied Mathematics, Inverse Problems

Jerrold Bebernes

Program Director of Applied Mathematics, Division of Mathematical Sciences, National
    Science Foundation

Editor, Rocky Mountain Journal of Mathematics

Gregory Beylkin

Member of the Editorial Board for "Inverse Problems"

Organized Minisymposium "Wavelets and Fast Numerical Algorithms" at the Second
    International Conference on Industrial and Applied Mathematics, ICIAM, Wash. D.C.,
    July 1991.

Mary Brewster

Coach of two mathematical modelling teams, one winning

Helped create requirements for minor in Applied Mathematics

Created advising guide for BA degree

Reviewer for SIAM Journal in Applied Mathematics

Organized minisymposium presented at ICIAM 91

Consultant for a cooperative research project headed by Prof. G. Belfort of Rensselaer
    Polytechnic Institute

Consultant to Los Alamos National Laboratories

James Curry

Recipient of BFA Teaching Excellence Award, April 1992

Member of AMS/NSF postdoctoral Review Panel

Member of AMS Committee on Communications

Participated in Faculty Research Seminar April 1992

Robert Easton

Coordinated formulation of the new degree requirement for the BS Applied Math degree and
  minor in Applied Mathematics

Reviewer for NSF

Robert McLachlan

Organized "Los Alamos Days", Boulder, April, 1992.

John Maybee

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

Eight papers accepted for publication, three more currently in process.

James Meiss:

Organizer of Applied Mathematics Seminars

Recruited next years graduate class (6 new TA's, all received Fellowships, 2 received Non-
  resident Tuition waivers, two of our students received Stibic fellowships)

Helped set up, organize and purchase computers for the undergraduate computing lab

Awarded Tenure and promotion to full Professor.

Organizer of Aspen Center for Physics Workshop, June '92.

Reviewer for Mathematical Reviews: Approximately 10 reviews in the past year: NSF,
  Australian Research grants

Reviewer for Book proposals: Cambridge University Press.

Harvey Segur:

Reviewed grant proposals for the following: NSF, Applied Mathematics; NSF, Classical
  Analysis; Petroleum Research Fund, Department of Energy; UROP, U of Colorado .

Reviewed papers for the following: Communications in Mathematical Physics, Journal of
  Fluid Mechanics, Journal of Nonlinear Science, Physica D, Physical Review, A,
  Physical Review Letters, Physics Letters, A, SIAM Journal for Mathematical Analysis,
  Studies in Applied Mathematics.

S.S. Sritharan:

Reviewed grant proposal for NSF

Reviewed papers for the following: Journal of Applicable Analysis, Nonlinearity, SIAM
  Journal of Mathematical Analysis

John Williamson:

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

6. PREPRINTS OF THE PROGRAM: 1991-92

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 Andrea Hennessy, Program in Applied Mathematics, Campus Box 526, University of Colorado, Boulder, CO 80309-0526.

No.

99. *Maintaining Dean Vortex Flow in a Spiral Porous Channel: A New Approach to Membrane Module Design* by M.E. Brewster, Kun-Yong Chung and G. Belfort.

100. *Regular Orbits for the Stadium Billiard* by J.D. Meiss.

101. *Symplectic Maps, Variational Principles, and Transport* by J.D. Meiss.

102. *Asymptotics of Blowup for Weakly Quasilinear Parabolic Problems* by J. Bebernes, S. Bricher and V.A. Galaktionov.

103. *An Introduction to Infinite-Dimensional Dynamical Systems and Inertial Manifolds* by Linda Sunbye.

104. *Wrinkled Premixed Flames Induced by Transverse Nonuniformity* by M.E. Brewster.

105. *Exponentially Small Splitting Distances in Leapfrog Discretizations of Nonlinear Dynamical Systems* by B.M. Herbst, M.J. Ablowitz and J.M. Keiser.

106. *Stationary Premixed Flames in a Dual-Source System* by M.E. Brewster.

107. *On the Method of Solution to the 2+1 Toda Equation* by J. Villaroel and M.J. Ablowitz.

108. *Self-dual Yang-Mills Equation and New Special Functions in Integrable Systems* by S. Chakravarty, M.J. Ablowitz and L.A. Takhtajan.

109. *Semi-Classical Liouville Theory, Complex Geometry of Moduli Spaces, and Uniformization of Riemann Surfaces* by Leon Takhtajan.

110. *Solitons and Computation* by M.J. Ablowitz and B.M. Herbst.

111. *Flux-Minimizing Curves for Reversible Area-Preserving Maps* by R.L. Dewar and J.D. Meiss.

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

113. *Integrable Systems, Self-Dual Yang-Mills Equations and Connections with Modular Forms* by M.J. Ablowitz, S. Chakaravary and L. Takhtajan.

114. *A New Hamiltonian Amplitude Equation Governing Modulated Wave Instabilities* by M. Wadati, H. Segur and M.J. Ablowitz.

2.5