

# Department of Applied Mathematics

**1989-1999: The First Decade**



## Annual Report

**1998-99**

University of Colorado  
at Boulder

Boulder, Colorado 80309-0526

Mark J. Ablowitz, Chair

June 30, 1999

**NSF Vertical Integration of Research and Education in the  
Mathematical Sciences (VIGRE): 1999-2004**

**Colorado Commission on Higher Education,  
Program of Excellence: 1999-2004**



$$\int_{1989}^{1999} APPM(t) dt = 10$$



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## OVERVIEW

### From the Chair

The Department of Applied Mathematics (APPM) continues its impressive record of achievement. About one year ago, as noted in our 1998 annual report, the Department was informed that the National Science Foundation selected APPM to be one of the recipients of a major grant (approximately \$2.3 million over 5 years) for Vertical Integration in Research and Education (VIGRE) in the Mathematical Sciences. As part of this effort the Department is forming tetrahedral groups consisting of faculty, postdoctoral instructors/researchers, graduate students, and undergraduate students to interact in the teaching, learning and research activities which fuel successful academic efforts. Four broad fields will be represented as tetrahedral groups. These fields are chaos and dynamics, fast computational algorithms, iterative computational methods, and studies in nonlinear wave propagation. For the upcoming academic year, the Department welcomes Dr. Deborah Alterman from the University of Michigan, Dr. Tobin Driscoll from Cornell University and Dr. Gareth Roberts from Boston University as new members of APPM's tetrahedral postdoctoral program. The VIGRE effort is led by Professor James Meiss (PI) and Co-PI's Mark Ablowitz (Chair of APPM), James Curry (Associate Chair of APPM) and Bengt Fornberg (Chair of the Graduate Committee). The VIGRE grant boosts the Department to a new level of excellence.

We are elated to report that on June 4, 1999, the Governor of Colorado, Bill Owens, announced that the coordinated Applied Mathematics Ph.D. Program of CU-Boulder and CU-Denver was selected as a Colorado Commission on Higher Education (CCHE) Program of Excellence. There were two Program of Excellence awards this year selected from over 30 applicants from across the state. The CU Applied Math units will share approximately \$1 million over the upcoming 5 year period. A CCHE Program of Excellence recognizes the outstanding record of accomplishments that have been made and allows the units to extend their efforts still further. The CCHE award will enhance the tetrahedral program by expanding a hands-on interactive computational math effort involving undergraduate and K-12 levels. New uses of web-based technology are envisioned. All of this is consistent with the theme of *Computation and technology throughout the curriculum*.

The Department is pleased to note that its faculty continue to reap the rewards of the continued excellence of their efforts. Professors Tom Manteuffel and Steve McCormick were awarded a multi-year multi-million dollar DOE grant as part of the DOE ASCI 2 program. Professor Gregory Beylkin gave a major invited lecture at the 1998 International Congress of Mathematics (ICM). This event is convened only quadrennially. Professor Congming Li gave an invited lecture and was asked to Chair a special session at the ICM. The Department is delighted that Professor Manteuffel was awarded a Council on Research and Creative Work (CRCW) faculty fellowship for 1999-2000. This brings to four the number of APPM faculty who have been awarded CRCW fellowships and to two the number of junior CRCW faculty

fellows. We are truly honored that our CU colleagues have chosen to award these prestigious fellowships to our faculty.

The Department was further distinguished when one of its postdoctoral researchers, Dr. Martin Mohlenkamp (Ph.D. Yale), was granted an NSF postdoctoral fellowship. This coveted three year fellowship is awarded by national competition. Dr. Mohlenkamp will be working closely with Professor Gregory Beylkin who serves as the postdoctoral advisor. This is the second NSF fellow at APPM to receive this award. The previous recipient, Dr. Tobin Driscoll (Ph.D. Cornell), won this fellowship three years ago and has worked with Professor Bengt Fornberg. As noted above, Dr. Driscoll is now part of the VIGRE team.

The teaching and research activities of the Department continue at an extraordinarily high level, especially when considering the size of our faculty and that all of the APPM courses are taught at the level of calculus and above. In 1998-99 APPM taught 3566 students which translates to approximately 12,000 student credit hours. Unfortunately, class sizes at the lower division level are large with an average of about 110/class. We note that computational projects have been successfully introduced into our lower division third semester calculus class, APPM 2350 (Calculus III). This means that both of our lower division second year classes, APPM 2350 and APPM 2360 (Introduction to differential equations and linear algebra) have significant computer projects in the curriculum. As an indication of the technological effort within the unit, from June 1998 to May 1999 the Department recorded: 68,798 "hits" on its Web page ([amath-www.colorado.edu/appm/](http://amath-www.colorado.edu/appm/)). The reason for this extraordinary number is, in large part, due to the computer projects in the lower division courses as well as those in upper division APPM courses.

APPM faculty continue their service and lecturing activities at an impressive level. They serve on 15 editorial and advisory boards of international journals and text series and were invited to give 40 lectures at conferences and universities throughout the world. Affiliated faculty increased to 38 in 98-99. Affiliated faculty can direct graduate students in an MS or Ph.D. degree. We are delighted to announce that Dr. Amy Biesterfeld will be joining the Department during upcoming academic year as instructor of Applied math. Amy's expertise is in the field of probability and statistics.

All of this is remarkable when considering that APPM was reorganized as a Program only in 1989. It is fitting as we close the 10 year period 1989-1999 to note some of the developments during the past 10 years.

## 1989 - 1999: A Decade of Achievement

- 1989-90 An independent Program in Applied Mathematics (PAM) is created. M. Ablowitz, J. Curry transfer from CU-Math to become Director and Associate Director of PAM and J. Meiss and H. Segur were appointed as the first core faculty members in the new program. P. Atela was the first full time instructor in PAM's instructor/research program and S. Chakravarty and B. Herbst were appointed as visiting faculty. There were 9 graduate students in the new unit. The affiliated faculty program is established during this year and 22 members joined. The PAM preprint series is begun. The number of undergraduate majors is 37.
- 1990-91 J. Bebernes, R. Easton, J. Maybee transfer to PAM from CU-Math. M. Brewster begins as an assistant professor, Robert MacLachlin is hired as the second full time instructor and Leon Takhtajan is appointed as a visiting faculty member. APPM reorganizes the undergraduate APPM courses and begins offering B.S., M.S., and Ph.D. degrees in Applied Mathematics. The affiliated faculty program expands to 25 members. Fourteen courses in APPM are offered.
- 1991-92 J. Williamson transfers to PAM from CU-Math. G. Beylkin is hired as Professor and X. Wang is appointed Instructor, C. Schober becomes instructor/research associate. There are now 27 graduate students in the unit. The number of PAM preprints stands at 130.
- 1992-93 C. Li begins as assistant professor and Monica Nitsche is appointed as full time instructor. J. Curry is named a President's Teaching Scholar. Enrollment in APPM courses stands at about 10,000 SCH due to large undergraduate service courses. Some 26 courses are now offered by APPM.
- 1993-94 T. Manteuffel and S. McCormick transfer to PAM from the Mathematics Department at CU-Denver. J. Maybee retires to become professor emeritus. Y. Kimura is appointed full time instructor. APPM (PI Meiss) is awarded \$550,000 by NSF to implement a graduate traineeship program in Applied Math. The number of affiliated faculty has grown to 29.
- 1994-95 A. Dougherty is hired as instructor. At this time APPM is teaching 16 undergraduate courses and 12 graduate courses to about 2700 students/year. The number of PAM preprints is 252.
- 1995-96 B. Fornberg is hired as professor. PAM undergoes its first program review and receives excellent evaluations. A report written by a committee chaired by former Dean William Briggs supports the creation of a Department of Applied Mathematics. In April 1996, the Arts and Sciences Council



overwhelmingly votes (31-3-2) to make PAM a Department. The unit receives strong support by the science departments and the administration in this quest. Graduate enrollment now stands at 40. H. Lomeli is hired as instructor. T. Manteuffel accepts a post as Vice President at Large for the Society of Industrial and Applied Mathematics (SIAM).

- 1996-97 After a discussion at the Planning Committee of the Board of Regents, on August 8, 1999, the Regents of the University vote overwhelmingly (5-1) to approve the request to make PAM a Department. The number of affiliated faculty now stands at 35. K. Julien is hired as instructor. T. Driscoll awarded NSF postdoctoral fellowship with B. Fornberg as advisor. The first Henri-James award to the most talented undergraduate proceeding to graduate school is given to Eric Phipps.
- 1997-98 The Department learns that it has been selected as a recipient of the first VIGRE awards - \$2.3m over 5 years. Other units receiving VIGRE awards include Columbia, Harvard, Penn State and University of Washington. K. Julien is promoted to assistant professor. The department introduces computer projects into the lower division course: APPM 2360 (Introduction to differential equations and linear algebra) and makes plans to do the same for the other second year lower division course. A. Dougherty is promoted to Senior Instructor. H. Segur is named a President's Teaching Scholar.
- 1998-99 The joint CU-Boulder, CU-Denver Ph.D. Applied Math program is named a CCHE Program of Excellence. The award is approximately \$1 million over five years. C. Li is promoted to associate professor with tenure. Amy Biesterfeld hired as instructor. M. Molenkamp is awarded an NSF postdoctoral fellowship with G. Beylkin as advisor. Basic statistics are as follows.
- APPM now teaches 23 undergraduate courses and 21 graduate courses.
  - Overall enrollment in APPM courses has grown to 3566 which is equivalent to approximately 12,000 student credit hours.
  - The number of undergraduate majors is 54.
  - The number of graduate students is 49.
  - The number of affiliated faculty is 38.
  - The number of papers written as a PAM preprint now stands at 412.
  - APPM faculty have won 2 Guggenheim fellowships, 1 Sloan fellowship, 4 CRCW fellowships, and 2 CRCW junior fellowships; they serve as editors/ members of 15 boards of journals/texts; 2 have been named President's Teaching Scholars.

## **From the Associate Chair**

The Associate Chair continues to provide coordination and operational support for scheduling, assigning, and implementing the Department's teaching mission. In addition this position is concerned with the development and implementation of current and future plans and goals. Outlined below are a few of the projects and efforts the Associate Chair has been engaged in.

Enrollments continue to increase, adding significant additional stress to an already over-extended unit. The Associate Chair was able to make a compelling argument for needed resources this past year. As the Department becomes more data driven, however, it is easier to let the numbers make the argument for additional resources.

The Associate Chair helped to coordinate the new undergraduate computing facility, with 28 PC workstations, that was brought on-line at the beginning of the Fall 1998 semester. During the Fall and Spring semester, the computer laboratory witnessed heavy usage and, at times, significant demand beyond its capacity. As mentioned in a previous report, the undergraduate computing lab is a part of the major changes that are taking place in the undergraduate curriculum. The most visible aspect of the curriculum evolution for the Department is hands-on interactive computer assisted projects. This is part of our sophomore lower division offerings as well as our upper division curriculum.

Several new professional development activities for undergraduate students were organized by the Department during the past year. The Department developed an undergraduate version of the successful Graduate Teaching and Learning Seminar. A consequence of this is that the Department now has a group of well trained undergraduate students who can provide assistance in the computing lab. This has led to an increased sense of community among the undergrads and has proved to be a valuable learning experience because it helps participants to further enhance their mathematical, computing and communication skills. The Department has high hopes for continued successes in this direction.

Additionally, the Associate Chair has been working with local companies, most notably Sun Microsystems and Lockheed-Martin, to establish partnerships leading to internships for Applied Mathematics majors. We have had successes and believe the Department now has an adequate foundation to build on.

The National Science Foundation (NSF) funded a research computing equipment grant to the Department. The Associate Chair was able to work with Sun Microsystems to leverage the NSF grant into a major equipment grant from Sun. The final configuration awarded to the Department by Sun included a large Sun Enterprise multiprocessing server and 15 super-graphics workstations. This takes the Department's computing infrastructure to the next level of performance.

The Associate Chair was also successful in obtaining both internal and external resources for the upgrade of the Department's internal network.

The Associate Chair was able to facilitate a strong partnership with Information Technology Services (ITS) that is extremely beneficial to the Department. This has brought needed stability to our entire computing effort.

All of the efforts mentioned above were carried out with the help of faculty and an increasing group of postdoctoral associates, students and especially staff.

It has truly been a year of excellence.

## **1. ROLE AND MISSION**

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

- a) Provide undergraduate and graduate students with high quality education and training in applied mathematics and prepare them for careers in industry, laboratories and the academic professions;
- b) Offer and monitor degree programs leading to a BS, MS and PhD degrees in Applied Mathematics;
- c) Nourish and maintain a professional environment in which excellence in teaching, learning, scholarship and creativity are of central importance;
- d) Assure teaching and research expertise in a number of key areas of applied mathematics including the methodology of applied mathematics, computational mathematics and algorithms, industrial applications, applied probability and statistics.

## **2. DEPARTMENTAL ACTIVITIES**

### **A. Undergraduate Education**

In 1998-99, the Department of Applied Mathematics had a core of thirteen tenure track faculty members plus two instructors responsible for the teaching and advising of all undergraduate and graduate students taking applied mathematics courses. The Department has a large teaching commitment since most undergraduate engineering majors are required to take four courses in applied mathematics. The Department taught a total of 3,566 undergraduate and graduate students in 23 undergraduate courses (divided into 64 sections) and 21 graduate courses. We had 54 undergraduate majors with 12 receiving their baccalaureate degrees. We are very proud that 21 made the Dean's List for academic achievement with grade point averages of 3.5 or better. There are also 24 students pursuing a minor in Applied Mathematics in the College of Arts and Sciences.

In the coming years, the VIGRE Grant that the department received from the National Science Foundation, will undoubtedly change the character of our undergraduate major. Undergraduates will have many new opportunities to participate in "tetrahedra" consisting of undergrads, grads, postdocs and faculty working together on many parts of a common research theme. The art of creating and testing mathematical models of important aspects of the world will be increasingly emphasized as part of the undergraduate training. Participation in research seminars and group discussions will broaden the undergraduate experience, making our majors even more competitive when they enter the job market.

Professor Curry was successful in obtaining from Dean Spear support for an undergraduate computer laboratory for students enrolled in Applied Math courses. Labs were introduced in courses APPM 2350 and continued in APPM 2360 and APPM 2380. The labs are designed to teach students to write about mathematics, to analyze multi-step problems, to use computer technology, and to work in teams.

At the May graduation ceremony Miguel Alvarez received the Henrie-James award for outstanding scholarship and service by a student continuing to graduate school. Emily Hagn was honored as the outstanding senior with a 3.9 grade-point average, and Leda Schwartz was honored for outstanding service.

The undergraduate student chapter of SIAM (the Society for Industrial and Applied Mathematics) continued its active tradition. Events this past year included several student presentations, a technical presentation by an invited speaker from SUN, a resume-writing workshop, a tour of the local SUN facilities in Broomfield and several mentor lunches. Leda Schwartz served as Chapter President. She was assisted by Alia Oster, Jillian Redfern, Christy Stecher, Rebecca Picotte and Mike Rempe. The officers for the 1999-00 academic year will be Jillian Redfern (President), Willie Heuett, Mark Snyder, Anna Segurson, Elaine Spiller and Thuha Nygen. Anne Dougherty was the faculty advisor for 1998-99 and will continue in that capacity for 1999-00.

The Department of Applied Mathematics, with assistance from the undergraduate SIAM chapter, entered its first team in the 4th Undergraduate Data Analysis Contest, held during the Fall 1998 semester. The team members were Leda Schwartz and Mike Rempe. They tied for second place in this national statistics contest. The Department also entered a 3-person team in the 1999 Mathematical Contest in Modeling. This international contest, sponsored by COMAP (The Consortium for Mathematics and its Applications), ran from 12:01 am February 5, 1999 until 5:00 p.m. February 8, 1999 and drew 478 entries from around the world. The CU-Boulder team of Mark Snyder, Mike Rempe and Thuha Nguyen was designated as Honorable Mention. Anne Dougherty was the faculty advisor for both teams.

## **B. Graduate Education**

The graduate student population continues to prosper. In 1998-99, the Department had 49 graduate students represented by eighteen teaching and laboratory assistantships, seven graduate students on fellowships and traineeships, twelve research assistantships and twelve providing their own support. The number of graduate students supported by research grants is substantial; this is due in part to the success of our faculty in obtaining research support and to the affiliated faculty program. The Department has 38 affiliated faculty members, each of whom can direct a graduate student towards a PhD in Applied Mathematics. It should be noted that, counter to national trends, we continue to be very successful in recruiting U.S. citizens to study in our graduate program. In 1998-99, 72% of the incoming students with support were U.S. citizens from U.S. undergraduate universities. Among the graduate students in 1998-99, ten were foreign graduate students and five more will be starting in the fall. Although we certainly encourage international applications, our success in being able to attract high quality American graduate students continues to be remarkable.

This year, 19 students were supported partially or fully by fellowships or grants. The National Science Foundation graduate traineeships supported five students: Travis Austin, Brian Bloechle, Ken Jarman, David Sterling, and David Trubatch. Michelle Ghrist received partial support from the traineeship grant, complementing her award from the National Physical Science Consortium. The \$555,000 NSF traineeship grant provides full support for six predoctoral students over a five-year period. Allison Baker was in her second year of support on a University of Colorado Chancellor's Fellowship. An additional twelve students were supported by faculty or affiliated faculty grants (AFOSR, DARPA, DOE, and NSF).

### C. Enrollment Statistics

Enrollment in the courses offered by the Department continues at extremely high levels. It is particularly noteworthy, given the faculty's small size that the Department teaches so many students. The statistics over the past few years are as follows:

Year	total enrollment in courses	graduate students	undergraduate majors	undergraduate minors
1990-91	2562	17	45	—
1991-92	2781	27	50	—
1992-93	2797	28	47	2
1993-94	2809	33	47	8
1994-95	2670	39	51	11
1995-96	2734	40	54	18
1996-97	2973	46	52	23
1997-98	<b>3108/3323*</b>	51	44	23
1998-99	<b>3172/3566*</b>	49	54	24

\* The totals in bold include all Calculus I & II Work Study Groups, as well as Calculus III Labs & Differential Equations Labs.

Enrollment in our upper division courses has continued to increase. With projected increases in undergraduate enrollment we foresee further enrollment increases in applied mathematics courses.

### D. Teaching Awards

Faculty in the Department have been honored with distinguished teaching awards. We are extremely pleased to note that Professor Harvey Segur has been named a President's Teaching Scholar in 1998, the highest honor awarded within the university.

In May 1999, Professor John Williamson was awarded a Distinguished Citizen Citation by the Alumni Association of his alma mater, Macalester College.

## E. Graduates

We would like to congratulate our students who graduated this past year with a degree in Applied Mathematics. They are:

### *PhD degree*

August 1998: Laurie Heyer, Peter Staab

May 1999: Markus Berndt, David Sterling

### *Master's degree*

December 1998: Travis Austin\*, Grant Hillman, Anna Karplus

May 1999: Allison Baker\*, Tim Layman, Jennifer Pearce, Emily Rudd, Eric Wright\*

\*Continuing with PhD

### *Bachelor's degree*

August 1998: Brandi McCarty, Robert Pacheco†

December 1998: Erik Jasiak, Sean Rhoades

May 1999: Miguel Alvarez\*, Emily Hagn\*\*, Andrew Hartman, Alyssa Lebner, Alia Oster, Michael Rempe, Leda Schwartz, Ann Windnagel

\*With Distinction

\*\*With High Distinction

† Outstanding Student in the College of Engineering

## F. Research

The research activities of the core faculty in the Department are varied. They include nonlinear dynamics, chaos theory, nonlinear waves, solitons and integrable nonlinear evolution equations, nonlinear optics, inverse problems, analysis of nonlinear equations arising in physical phenomena, computational mathematics including wavelet analysis, multigrid, iterative methods and computational fluid dynamics, applied and computational linear algebra, applied probability and statistics. Our affiliated faculty are rostered in a wide range of departments and nearby institutions, including Aerospace Engineering; Astrophysical and Planetary Sciences; Chemistry and Biochemistry; Civil Engineering; Colorado School of Mines; Computer Science; Electrical and Computer Engineering; Geological Sciences; Mathematics; Mechanical Engineering; CIRES (Cooperative Institute for Research in Environmental Sciences); INSTAAR (Institute for Arctic and Alpine Research); and the Graduate School of Business.

This report provides data which show that the faculty in the Department are extremely active in their research and scholarly work (a list of publications, invited lectures and Department Preprints is included at the end of this report). However, another very important aspect of the faculty's role in the national and international scholarly effort in applied mathematics is service as editors and advisory board members of archival journals and textbook series. In fact, during 1998-99, the faculty in the Department currently serve in 14 such capacities on 11 journals/periodicals which include:

*Applied and Computational Harmonic Analysis* (Beylkin)  
Cambridge University Press Texts in Applied Mathematics (Ablowitz)  
*Communications on Applied Nonlinear Analysis* (Bebernes, Easton)  
*Journal of Engineering Mathematics* (Ablowitz)  
*Journal of Numerical Linear Algebra and Applications* (Manteuffel)  
*Physica D* (Meiss)  
*Rocky Mountain Journal of Mathematics* (Bebernes)  
*Springer-Verlag Series in Integrable Systems and Solitons*, (Ablowitz)  
*SIAM Journal of Numerical Analysis* (Manteuffel, Beylkin, McCormick)  
*SIAM Journal on Scientific Computation* (McCormick)  
*Studies in Applied Mathematics* (Ablowitz)

In addition, Jim Curry is a member of the board of governors of The Geometry Center at the University of Minnesota, and Tom Manteuffel is Vice President of the Society of Industrial and Applied Mathematics (SIAM).

## **G. Conferences**

### **Copper Mountain**

The Copper Mountain Conference on Multigrid Methods was held April 11-16, 1999. Over 100 mathematicians from all over the world attended the meeting. The conference had two major themes: algebraic multigrid and parallel multigrid. The quality and diversity of the talks was superb. During the five day meeting, 69 talks on current research topics were presented. The program also included three tutorials. Late evening sessions included a circus and an informal open discussion session. The conference also held a Student Paper Competition that provided travel support for the four winners. About 25 other students also attended the conference.

### **Los Alamos Days**

The department of Applied Mathematics has a tradition of holding a small annual conference on complex systems and nonlinear phenomena jointly with the Center for Nonlinear Studies (CNLS) at Los Alamos National Laboratory, New Mexico. The venue alternates annually between Los Alamos and Boulder.

The purpose of the meeting is to give our graduate students, instructors, postdocs and visitors an opportunity to meet other young scientists in related fields and allow them to present their work before a scientific audience in a less formal setting. Since 1998, the Colorado Center for Chaos and Complexity (C4) is also a participating institution.

This year the conference was held in Los Alamos on May 17-18. Attendance for the conference was approximately 50, including researchers from both Los Alamos and Colorado.

## **H. Remarks**

Assistant Professor Congming Li successfully navigated through the tenure process. Congming has been awarded tenure and promoted to Associate Professor.

The Department conducted a favorable search for instructor for AY 1999/2000. We welcome Dr. Amy Biesterfeld. Amy's field of expertise is statistics and stochastic processes.

The Department is indebted to all of its staff - Lynn Randolph, Tiana Baenziger, Margy Lanham and Stu Naegele - for their fine efforts in keeping the unit running smoothly. We extend our sincerest thanks to them. And finally, we bid farewell to Tiana Baenziger who is leaving Applied Math and moving to northern Colorado. Our best wishes go with her.



### 3. FACULTY, RESEARCH ASSOCIATES AND STAFF

#### A. Core Faculty and Long Term Visitors

- Mark J. Ablowitz**, Chair, 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.
- Gino Biondini**, Instructor, Postdoctoral Research Associate; PhD, Universita de Perugia, Italy. Nonlinear Waves, Nonlinear Optics.
- Marian Brezina**, Postdoctoral Research Associate; PhD, University of Colorado at Denver. Algebraic Multilevel Methods.
- Sarbarish Chakravarty**, Visiting Assistant Professor, University of New South Wales, Sydney, Australia. Partial Differential Equations, Solitons, Nonlinear Waves
- Robert Cramer**, Postdoctoral Research Associate; PhD, University of Colorado at Boulder. Numerical Analysis, Wavelets, Potential Theory
- James H. Curry**, Professor; PhD, University of California at Berkeley. Dynamical Systems, Numerical Methods, Nonlinear Equations.
- David Dean**, Postdoctoral Research Associate; PhD, University of Colorado at Denver. Computational Math, Multigrid Analysis.
- Anne Dougherty**, Senior Instructor; PhD; University of Wisconsin, Madison. Applied Probability, Stochastic Processes.
- Tobin Driscoll**, Postdoctoral Research Associate; PhD, Cornell University. Numerical Analysis, Numerical Methods for PDEs and Conformal Mapping.
- Holger Dullin**, Instructor; PhD, Universitaet Bremen, Germany. Hamiltonian Systems, Integrable Systems, Semiclassical Quantization.
- Robert Easton**, Professor; PhD, University of Wisconsin. Dynamical Systems, Hamiltonian Mechanics.
- Bengt Fornberg**, Professor, Postdoctoral Research Associate; PhD, Uppsala University, Uppsala, Sweden. Numerical Analysis, Computations of Wave Phenomena.
- David Gines**, Postdoctoral Research Associate; PhD, University of Colorado at Boulder. Wavelets and Multilevel Methods, Biomedical Engineering.
- Rod Halburd**, Instructor, Postdoctoral Research Associate; PhD, University of New South Wales. Integrable Systems, Darboux-Halphen System.
- Keith Julien**, Assistant Professor; PhD, Cambridge University. Mathematical and Computational Fluid Dynamics, Dynamical Systems Theory.
- Congming Li**, Assistant Professor; PhD, New York University. Elliptic Partial Differential Equations.

**Tom Manteuffel**, Professor; PhD, University of Illinois, Urbana. Computational Math; Numerical Linear Algebra, Iterative Mathematics, Numerical Solution of PDE's.

**Steve McCormick**, Professor; PhD, University of Southern California. Computational Math, Numerical Partial Differential Equations, Multigrid Methods, Parallel Computation, Computational Fluids, Tomography, Electromagnetics.

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

**Martin Mohlenkamp**, Postdoctoral Research Associate; PhD, Yale University. Computational Harmonic Analysis, Non-linear PDEs and Cryptography.

**Lucas Monzón**, Postdoctoral Research Associate; PhD, Yale University. Harmonic Analysis, Wavelets.

**J. Adam Norris**, Part-time Instructor; PhD, University of Colorado, Boulder. Phase Change Kinetics, Perturbation Methods, Numerical Methods.

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

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

## **B. Affiliated Faculty - Graduate Department**

**Steve C. Arendt** (Colorado Research Associates), Theoretical Fluid Dynamics

**Norm Bleistein** (Mathematics, Colorado School of Mines), Direct & Inverse Scattering, Asymptotic Methods, Wave Phenomena

**William Blumen** (Program in Atmospheric and Oceanographic Sciences--PAOS), 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** (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** (Physics), Plasma Physics, Nonlinear Waves, Turbulence

**Vijay Gupta** (Geological Sciences; Cooperative Institute for Research and Environmental Sciences), Hydrology, Stochastic Processes, Fluid Dynamics

**Ute Christina Herzfeld** (INSTAAR, Geomathematics), Geostatistical Analysis of Remote Sensing Data, Applications in Glaciology, Marine Geophysics and Global Change Research

**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

**Shankar Mahalingam** (Mechanical Engineering) Turbulent Combustion, Direct Simulations

**Andrew Moore** (Atmospheric and Oceanic Sciences), Ocean-Atmosphere Modeling

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

**Lev Ostrovsky** (CIRES/NOAA Environmental Technology Laboratory), Nonlinear Waves, Fluid Dynamics, Oceanography, Acoustics

**K.C. Park** (Aerospace Engineering) Parallel computation, Structural vibrations

**Harihar Rajaram** (Civil, Environmental and Architectural Engineering), Fluid Flow, Transport Phenomena and Reactive Processes in Geologic/Geochemical Phenomena

**John Rundle** (Geological Sciences; Cooperative Institute for Research in Environmental Sciences), Statistical Mechanics Applied to Earth Sciences, Complex Systems, Simulations of Nonlinear Systems, Earthquakes, Transport Processes in the Geological Sciences

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

**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 and Planetary Sciences), Theoretical Astrophysics

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

**Gary Stormo** (Molecular, Cellular and Developmental Biology--MCDB), Molecular Structures and Patterns, Computer Sequence Analysis, Splicing Algorithms

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

**Juri Toomre** (Astrophysical and Planetary Sciences; Joint Institute for Laboratory Astrophysics), Astrophysics, Mathematical Modeling, Numerical Simulation

**Patrick Weidman** (Mechanical Engineering), Hydrodynamic stability, solitary waves and their interaction, counter-rotating vortex rings, Stokes flow on dendrite models, similarity flows in natural convection, fluid sloshing in freely suspended containers

**Jeffrey B. Weiss** (Astrophysical and Planetary Sciences; Atmospheric and Oceanic Sciences), Geophysical Fluid Mechanics, Turbulence, and Climate predictability

**Thomas Warner** (Atmospheric and Oceanic Sciences) Numerical modeling of mesoscale atmospheric phenomena; Marine meteorology

**Joseph Werne** (Colorado Research Associates), Fluid dynamics

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

### **C. Short Term Visitors, 1998-99**

Peter Clarkson, Kent University, Canterbury, September 17-20  
Silvana Delillo, Università de Perugia, Italy, September 10-24, 1998  
Fritz Gesztesy, University of Missouri, Columbia, April 21, 22, 1999  
Ben Herbst, University of Stellenbosch, South Africa, January 2 – February 27, 1999  
Takeshi Iizuka, University of Tokyo, Japan, February 8-21, 1999  
Yasumasa Kajinaga, University of Tokyo, Japan, February 8-21, 1999  
Sang Dong Kim, Kyungpook National University, Korea, February 1- 28, 1999  
Laura and Martin Kruskal, Rutgers University and Princeton, N.J., March 3-15, 1999  
Chang-Ock Lee, Inha University, Korea, January 24-February 23, 1999  
Akinori Nishino, University of Tokyo, Japan, February 27-March 10, 1999  
Constance Schober, Old Dominion University, Norfolk, VA, July 12-31, 1999  
Michael Shub, T.J. Watson Research Center, Yorktown Heights, NY, April 22-24, 1999  
Alex Shvartsburg, Chalmers University of Technology, February 10-February 19, 1999  
Gerhard Starke, University of Karlsruhe, Germany, March 11-March 24, 1999  
Hideaki Ujino, University of Tokyo, Japan, February 8-21, 1999  
Yukiko Umeno, University of Tokyo, Japan, February 27-March 10, 1999  
Tetsu Yajima, University of Tokyo, Japan, February 8-21, 1999  
Miki Wadati, University of Tokyo, Japan, February 27-March 10, 1999  
Stephen Wirkus, Cornell University, April 14-18, 1999  
Marta Mazzocco, MSRI, Berkeley, June 11-June 16, 1999

### **D. Staff**

Stuart Naegele	Professional Research Assistant
Margy Lanham	Professional Research Assistant
Lynn Randolph	Student Services Coordinator
Tiana Baenziger	Faculty Services Coordinator

## 4. COLLOQUIA AND SEMINARS, 1998-99

### A. Applied Mathematics Colloquium Schedule, 1998-99

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 2:30 p.m. in the APPM conference room, ECOT 226.

Gerhard Starke, University of Essen, September 4, 1998, "Least-Squares Mixed Finite Element Solution of Variably Saturated Subsurface Flow."

Martin Mohlenkamp, Department of Applied Mathematics, University of Colorado at Boulder, September 11, 1998, "A Fast Transform for Spherical Harmonics."

Gary Stormo, Department of MCD Biology, University of Colorado at Boulder, September 18, 1998. "Discovering Genetic Networks."

Yuri Kivshar, Department of Applied Mathematics, Australian National University, September 25, 1998, "Spatial Optical Solitons and their Interactions."

Robert Mc Lachlan, MSRI, University of California at Berkeley, October 2, 1998, "Linear-Gradient Systems and Geometric Integration."

Gerhard Dangelmayr, Department of Mathematics, Colorado State University, Ft. Collins, October 9, 1998, "Synchronized Oscillations in Two-dimensional Arrays of Coupled Cells."

Dmitry Pelinovsky, University of Toronto, October 16, 1998, "Normal Forms for Soliton Instabilities."

Erik Bollt, Department of Mathematics, U.S. Naval Academy, October 23, 1998, "Asymptotic Localization for Moser-Calogero Potentials and Super Symmetric Yang-Mills Theory."

Kirill Vaninsky, Kansas State University, October 30, 1998, "Asymptotic Localization for Moser-Calogero Potentials and Super Symmetric Yang-Mills Theory."

Peter J. Olver, School of Mathematics, University of Minnesota, Twin Cities, November 6, 1998, "Applications of Lie Groups to Computer Vision."

Yuji Kodama, Department of Mathematics, Ohio State University, November 13, 1998, "Integrable Foundation of Ultra-Fast Optical Communications."

Professor Thomas T. Warner, Program in Atmospheric and Ocean Sciences, University of Colorado at Boulder, and National Center for Atmospheric Research, November 20, 1998, "Numerical Models of Atmospheric Dynamics: Recent Growth in their Range of Applications."

Doug Roble, Computer Graphics Software Engineer, Digital Domain, December 4, 1998, "Mathematics and Visual Effects."

Jishan Hu with Min Yan, Hong Kong University of Science and Technology, January 22, 1999, "Justification of Painlevé Analysis."

Nalini Joshi with Pilar Gordo and Andrew Pickering, University of Adelaide, Australia, January 29, 1999, "Symmetries and Singularities of Nonlinear Differential Equations."

Jean-Luc Thiffeault, Institute for Fusion Studies, University of Texas at Austin, February 5, 1999, "Hamiltonian Structure of Fluids and Plasmas."

Alex Shvartsburg, Chalmers University of Technology, Sweden, February 12, 1999, "Time-Domain Electromagnetics of Ultrashort Single-Cycle Pulses in continuous Media."

Samantha MaWhinney, Health Sciences Center, University of Colorado at Denver, February 19, 1999, "How Now Mad Cow."

Linda Petzold, University of California at Santa Barbara, February 26, 1999, "Model Reduction for Nonlinear Dynamical Systems from Chemical Kinetics."

Martin Kruskal, Department of Mathematics, Rutgers University, March 5, 1999, "In Search of Elementary Euclidean Geometry."

Isom Herron, Department of Mathematical Sciences, Rensselaer Polytechnic University, March 12, 1999, "Mathematical Issues from the Onset of Fluid Instabilities."

C. Eugene Wayne, Department of Mathematics, Boston University, April 2, 1999, "Coherent Behavior for Large Systems of Coupled, Chaotic Oscillators."

Charbel Farhat, Aerospace Engineering Sciences and the Center for Aerospace Structure, University of Colorado at Boulder, April 9, 1999, "Conservation Laws for the Discretization and Solution of Coupled Fluid/Structure PDEs on Moving Grids."

Catherine Weinberger, Department of Economics and Institute for Social, Behavioral and Economic Research, University of California at Santa Barbara, April 16, 1999, "Staying at 'No': Using Game Theory to Understand Inefficient Outcomes of Bargaining."

Michael Shub, T.J. Watson Research Center, Yorktown Heights, NY, April 23, 1999, "Newton's Method and Complexity."

Dick Kautz, NIST, Boulder, CO, April 30, 1999, "Quasipotentials and Josephson Junctions."

## **B. Seminars in Applied Mathematics, 1998-99**

The Department 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-031 and had coffee and tea on the 11<sup>th</sup> 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:

Rodney Halburd, Department of Applied Mathematics, University of Colorado at Boulder, September 3, 1998, "On the Extension of the Painlevé Property to Difference Equations."

Tobin A. Driscoll and Bengt Fornberg, Department of Applied Mathematics, University of Colorado at Boulder., September 10, 1998, "Spectrally Accurate Reconstruction of Piecewise Analytic Functions Using Fourier or Collection Data."

Peter A. Clarkson, Institute of Mathematics and Statistics, University of Kent, September 17, 1998, "Bäcklund Transformations and exact Solutions for the Discrete Painlevé Equations."

Gerhard Dangelmayr, Department of Mathematics, Colorado State University, September 24, 1998, "Synchronized Oscillations in Two-dimensional Arrays of Coupled Cells."

Robert Easton, Department of Applied Mathematics, University of Colorado at Boulder, October 1, 1998, "Stability of Levitrons."

Yuri Kivshar, Optical Sciences Centre, Australian National University, October 8, 1998, "Spatial Optical Solitons and their Interactions."

Dmitry Pelinovsky, Department of Mathematics, University of Toronto, October 15, 1998, "Bifurcations of new Eigenvalues for the Benjamin-Ono Equation."

Dana Z. Anderson, Department of Physics and JILA, University of Colorado at Boulder, October 22, 1998, "Information Dynamics of Photoreactive Two-beam Coupling."

Kirill Vaninsky, Department of Mathematics, Kansas State University, October 29, 1998, "Gibbs' State for the Cubic Schrödinger Equation."

Martin J. Mohlenkamp, Department of Applied Mathematics, University of Colorado at Boulder, November 5, 1998, "NTRU: A New Public Key Cryptosystem."

Yuji Kodama, Department of Mathematics, Ohio State University, November 12, 1998, "Isospectral Manifolds of the Set of Tri-diagonal Matrices and Toda Lattice Equations with Indefinite Metric."

Steve Maxson, Physics Department, University of Colorado at Boulder, November 19, 1998, "Generalized Wavefunctions for Coherent Combinations of Quantum Oscillators and Hamiltonian Chaos."

Min Yan, Hong Kong University of Science and Technology, January 21, 1999, "An Analytical Algorithm for Integrable Systems."

Nalini Joshi and Clio Creswell, University of Adelaide, Australia, February 4, 1999 "The Discrete Painlevé Equations: A Survey with some New Results."

Alex Shvartsburg, Chalmers University of Technology, February 11, 1999. "Non-Stationary Electromagnetics of Unharmonic Waves in Dispersive and Conducting Media (Exactly Solvable Models)."

Alex Shvartsburg, Chalmers University of Technology, February 18, 1999. "Terahertz Optics of Non-Stationary Media."

Alexander Bobenko, Technical University of Berlin, February 25, 1999. "A Discrete Time Lagrange Top, Discrete Elastic Curves and Discrete Time Lagrangian Mechanics on Lie Groups."

Martin Kruskal, Rutgers University, March 4, 1998. "The Simplest Proof of the Painléve Property."

Martin Kruskal, Rutgers University, March 11, 1998. "A Simple Introduction to Modern Asymptotics Beyond all Orders."

Steven Cundiff, Jila, April 8, 1998. "Vector Solitons in Modelocked Fiber Lasers."

Fritz Gesztesy, University of Missouri, April 22, 1999. "A Characterization of all Elliptic Algebro-Geometric Solutions of the KdV and AKNS Hierarchies."

David Trubatch, University of Colorado, April 29, 1999. "Discretization of the Vector Nonlinear Schrödinger Equation."

### **C. University of Colorado at Denver - University of Colorado at Boulder Joint Seminars in Computational Mathematics, 1998-99**

The Joint CU Denver - CU Boulder Computational Math Seminar continued the expanded form of last year, with the regular lecture on Tuesdays at 12:00 preceded by three hours of open discussion, with the location alternating between Denver and Boulder. There were typically 20 or more faculty, students, and visitors from the two campuses attending the open discussions and regular lectures. A partial list of speakers and the titles of their talks follows:

Christine Henya, Department of Chemical Engineering, University of Colorado at Boulder, September 8, 1998. "On the Effects of Particle-Phase Turbulence in Dense Gas-Solid Flows."

Junping Wang, Department of Mathematics, University of Wyoming, October 6, 1998. "Mathematics of Fluid Flow and Compaction in Sedimentary Basins."

Robbie Robertson, TRW, Inc., November 3, 1999. "Tracking Data and Air Traffic Control Software."

Keith Julien, Department of Applied Mathematics, University of Colorado at Boulder, February 1, 1999. "A Numerical Investigation of Rapidly Rotating Thermal Convection."

Victor H. Barocas, Department of Chemical Engineering, University of Colorado at Boulder, February 2. "Fluid-Solid Interactions in the Eye" or "Applied Applied Math."

Edward F. Kuester, Department of Electrical and Computer Engineering, University of Colorado at Boulder, March 2, 1999. "Numerical Modeling of Electromagnetic Fields for Microwave Engineering Applications."

Shannon Wynne, Department of Mathematics, University of California at Irvine, March 9, 1999, "Efficient Methods Using High Accuracy Approximate Inertial Manifolds."

Kristina Bogar, Department of Mathematics, University of Utah, March 11, 1999. "A Semi-Implicit Method for the Bidomain Model in Cardiac Tissue."

Tom Russell, Department of Mathematics, University of Colorado at Denver March 16, 1999. "Finite Volume Methods for Groundwater Flow and Transport Equations" (at Denver campus).



## D. Other Seminars, 1998-99

### Dynamical Systems Seminars

The weekly Dynamical Systems seminar is a research working group led by James Meiss and Robert Easton. Following is a list of the speakers and the titles of their talks:

K. Zyczkowski, September 10, 1998, "Entropy computing and Integration over Fractal Measures."

James Meiss, Department of Applied Mathematics, University of Colorado at Boulder, September 17, 1998, "Stable and Unstable Manifolds for Volume-Preserving Maps."

Thomas Peacock, Department of Computer Science, University of Colorado at Boulder, September 24, 1998, "Bifurcation Phenomena in a Fluid Experiment."

Chris Hoge, Department of Applied Mathematics, University of Colorado at Boulder, October 1, 1998, "Understanding the dynamics of Undulatory Swimming: A Model of Fluid-Body Interactions."

David Sterling, Department of Applied Mathematics, University of Colorado at Boulder, October 8, 1998, "The Mysterious Henon Period 3 Orbit: A Tale without a Twist."

Holger Dullin, Department of Applied Mathematics, University of Colorado at Boulder, October 15, 1998, "Vanishing Twist Near 3 Tupling Bifurcations."

James Curry, Department of Applied Mathematics, University of Colorado at Boulder, October 22, 1998, "There is Something about Newton's Method."

Erik Bollt, U.S. Naval Academy, October 23, 1998, "Symbolic Dynamics and Control."

Bill Briggs Jr., Department of Mathematics, University of Colorado at Denver, October 29, 1998, "Circle Maps: The Mathematics of Rhythms."

Discussion, November 5, 1998, "The Future of Dynamics."

Vanessa Robins, Department of Applied Mathematics, University of Colorado at Boulder, November 12, 1998, "Alpha Shapes for Computational Topology."

Joe Iwanski, Department of Applied Mathematics, University of Colorado at Boulder, November 19, 1998, "Recurrence Plots of Data: A Survey."

Keith Julien, Department of Applied Mathematics, University of Colorado at Boulder, December 3, 1998, "A Derivation and Investigation of Reduced PDE's for Rotating Convection."

David Sterling, Department of Applied Mathematics, University of Colorado at Boulder, January 21, 1999, "Chaotic Communication Strategies."

Holger Dullin, Department of Applied Mathematics, University of Colorado at Boulder, January 28, 1999, "Cubic, Area-Preserving Maps."

Jim Howard, Department of Applied Mathematics, University of Colorado at Boulder, February 4, 1999, "Planetary Dust Rings."

Vanessa Robins, Department of Applied Mathematics, University of Colorado at Boulder, February 11, 1999, "If a Donut had Infinitely many Holes, would there be anything left to eat?"

Gareth Roberts, Department of Mathematics, Boston University, February 18, 1999, "Existence and Stability of Relative Equilibria in the N-Body Problem."

Chris Moore, Santa Fe Institute, March 4, 1999, "Three- and Four-Color Models in the Plane."

Adrienne Allen, Department of Physics, University of Colorado at Boulder, March 11, 1999, "Scattering from Fractal Grains."

David Sterling, Department of Applied Mathematics, University of Colorado at Boulder, April 8, 1999, "Thesis Defense."

Stephen Wirkus, Center for Applied Mathematics, Cornell University, April 15, 1999, "Dynamics of Two Coupled van der Pol Oscillators with Delay Coupling."

Hector Lomeli, Technological Institute of Mexico, April 22, 1999, "Principal Homoclinic Orbits in 3D Maps."

Roy Adler, IBM, Watson, April 29, 1999, "Symbolic Dynamics and Information Theory."

### **SIAM Undergraduate Seminars**

The following Seminars were sponsored by the SIAM Undergraduate chapter:

Erik Jasiak, Applied Mathematics senior, November 19, 1998. "Acoustic Fields and Solid Rocket Motors."

Alia Oster and Miguel Alvarez, Applied Mathematics seniors, December 2, 1998. "Wavelets and Computer Graphics."

Professor Bengt Fornberg, Department of Applied Mathematics, January 20, 1999. "Resume Writing Workshop."

Matias Elgart, SUN Microsystems, February 24, 1999. "Computer Graphics on the O2s."

Emily Hagn, Applied Mathematics senior, April 15, 1999. "A look at Simulation and Variances in Time Series Analysis."

Math Modeling Contest and Data Analysis Contest discussion by participants, April 19, 1999.

## **5. COMMITTEES**

### **A. Undergraduate Committee - Robert Easton, Chair**

The members of the Undergraduate Committee were Gregory Beylkin, Jim Curry (ex officio), Anne Dougherty, Bob Easton (Chair) and Keith Julien. In addition, Anne Dougherty was Faculty Advisor to SIAM, an undergraduate Applied Math organization.

The Department of Applied Mathematics had 54 undergraduate majors this year. During the academic year 21 of our majors were on the Dean's list with a grade point average of 3.5 or better during either the fall or spring semester. Miguel Alvarez won the 1999 Henrie-James Award as the outstanding applied mathematics major who is going on to graduate school. Twelve students graduated this year with bachelor of science degrees in applied mathematics. Four of these students graduated with a cumulative grade point average of 3.5 or better. Finally, one of our students graduated high distinction (GPA of 3.9 or better).

The minor in Applied Mathematics, available to students in the College of Arts and Sciences or in Engineering, is growing. There are now 24 students who are pursuing a minor in Applied Mathematics or who have graduated with the minor during the past year.

### **B. Graduate Committee - Bengt Fornberg, Chair**

The graduate committee for 1998-99 consisted of Bengt Fornberg (Chair), Congming Li, Tom Manteuffel and Jim Meiss.

The main business of the committee is to advise the current graduate students, process graduate applications, decide on admission to the graduate program and administer the preliminary exams. These exams are given twice each year, in four areas: Applied Analysis, Computational Analysis, Partial Differential Equations and Probability/Statistics.

The program had 49 graduate students during 1998-99, of whom nine began in the fall of 1998 and two in the spring of 1999. During the year, four students received PhDs and nine received MS degrees. For the fall semester of 1999, there were 60 applicants, of whom nine were awarded teaching assistantships.

The number of funded teaching assistantships has remained at about 17-19 for the past seven years. Now a majority of our graduate students are supported on research contracts. The percentage of American students has fluctuated between 70-80%, while the percentage of female students fluctuated between 21-41%. For minority students, the recent percentage range has been 6-15%.

The NSF VIGRE grant begins in the fall of 1999. We have awarded three graduate traineeships to our current students, and used the enticement of VIGRE traineeships to recruit an excellent group of beginning students for the fall. A number of these students will be awarded traineeships as they start their research programs in their second year.

In summary, the graduate program of the Department has come of age. While we have improvements to make, we believe it has developed remarkably well during its ten years of existence, and that it is continuing to enhance its ability to produce highly qualified and marketable applied mathematicians.

## 6. FACULTY SERVICE TO THE UNIVERSITY, DEPARTMENT AND SOCIETIES, CALENDAR YEAR 1998

**Mark Ablowitz:** Department Chair; Member of College of Arts & Sciences Council of Chairs; Member of American Mathematical Society Short Course Committee.

**Jerrold Bebernes:** Member of Department of Applied Mathematics Executive Committee, Member of Post Tenure Review Committee, Member of Promotion Committee for Congming Li.

**Gregory Beylkin:** Organized a mini-symposium at SIAM Wave Propagation 1998 Meeting, June '98; Consulted for Fast Mathematical Algorithms and Hardware Corp.

**James Curry:** Department Associate Chair; Candidate for SIAM Office; Sigma Chi Distinguished Lecturer; Established a partnership with Sun Microsystems that provides internships for as many as 36 students and am working on a similar relationship with Lockheed-Martin; Co-PI with Connect: the Colorado Statewide Systemic Initiative.

**Anne Dougherty:** Consultant for the Boulder Police Department on a case requiring Probability and Statistics, March 1998 -present. Member Probability and Statistics Preliminary Committee; Faculty Advisor for the SIAM, (Society for Industrial and Applied Mathematics) Undergraduate Chapter, Prepared Undergraduate Brochure for Applied Mathematics departmental mailings; Department of Applied Mathematics Undergraduate Committee member; Search Committee member for Department of Applied Mathematics instructor position; Boulder Campus Actuarial Certificate Committee Member; Faculty participant in several Engineering College programs: Engineering Open House activities, Spring 1998; Engineering Orientation Program, August 21, 1998; Presentations at the Women in Engineering Career Days programs, March 7, 1998 and April 4, 1998.

**Robert Easton:** Chair, Department Undergraduate Committee; Chair, Department Diversity Committee; Department Transfer Credit Evaluator; Helped organize the Applied Math Dynamical Systems Seminar in collaboration with Jim Meiss, and gave several lectures at the seminar; Department Representative at the Council of Chairs meetings; Department Representative, Arts and Sciences Council Chair; Department Representative, Planning Committee of the Arts and Sciences Council; Member of the Arts and Sciences Council Executive Committee; Member College Educational Policy and Planning Committee, College of Engineering; Member Undergraduate Academic Affairs Committee, College of Engineering; Member of Center for Chaos and Complexity.

**Bengt Fornberg:** Chairman of the Applied Mathematics Graduate Committee; Member of the Applied Mathematics Budget Committee; Consultant to Division of Applied Mathematics, Brown University, on DARPA/AFOSR project on time-domain computational electromagnetics; Consultant to Weidlinger Associates, Los Gatos, CA, on numerical techniques for wave propagation; Member of CRCW - Council on Research and Creative work, Boulder, CO; Scientific mentor for a team of juniors from La Quinta High School (near Palm Springs, CA) in their participation in national competition "Adventures in Supercomputing."

**Keith Julien:** Member of the Peer Review Panel for NASA 1999 SecTP Grant Proposals, November, 1998; Reviewer for six Grant Proposals to Sun-Earth Connection Program, August 1998; Member of the Applied Mathematics Undergraduate Committee, 1998; Member of the Engineering and Excellence Fund Committee, 1998.

**Congming Li:** Member of Department Graduate Committee; Member of Diversity Committee; Chair, Session of Short Communications on Partial Differential Equations From Differential geometry, International Congress of Mathematicians, 1998.

**Tom Manteuffel:** Society of Industrial and Applied Mathematics: Vice-President, Chair of Science Policy Committee, Member Master Program Committee, Chair of Major Awards Committee; Consultant, Lawrence Livermore National Laboratory; Science Advisory Committee, SquareOne Technologies; Department of Applied Mathematics: Graduate Committee, Computing Committee, Budget Committee; Arts and Science Council, ASC Grievance Committee (Spring 1998); Co-Chair: Copper Mountain Conference on Multigrid Methods, Copper Mountain, CO., March 30-April 3, 1998.

**Steve McCormick:** Consultant, Lawrence Livermore National Laboratory; Co-Chair Copper Mountain Conference on Multigrid Methods, Copper Mountain, March 30-April 3, 1998.

**James Meiss:** Chair, ad hoc Computer Committee, Graduate Committee, Textbook Selection Subcommittee for APPM 2360, Jan 98 and Aug 98; Write and grade the PDE preliminary exam for MS and Ph.D. students; Created, and Edited the first issue of the Applied Mathematics Alumni Newsletter (See it at <[http://amath/appm/alumni/newsletter\\_1.pdf](http://amath/appm/alumni/newsletter_1.pdf)>); Aerospace Engineering Graduate Mathematics Committee, Fall 1998; Faculty Teaching Excellence Program, Computer Technology Liaison; Boulder Campus Goldwater Scholarship Representative; Member, International Education Scholarship Committee; Graduate School Subcommittee on Technology in the Humanities, Center for Integrated Plasma Studies; Fellow, Colorado Center for Chaos and Complexity, Created and maintained the "Frequently asked questions" document for the sci.nonlinear usenet newsgroup. See <http://amath/appm/faculty/jdm/faq.html>;

**Harvey Segur:** Member of Department Graduate Committee, Gave lecture on "Does Class Size Affect FCQ Scores?" at Presidential Teaching Scholars' fall retreat, Keystone, CO October 3, 1998.

**John Williamson:** Member of Undergraduate Committee, Member of College of Engineering Scholarship Committee, Member of Executive Committee for the Certificate Program in Actuarial Studies, Coordinator for Statistics Coordinating Committee.

## 7. TEACHING ACTIVITIES

### A. Courses Taught by Department Faculty, Academic Year 1998-99

#### (I) Undergraduate Courses

- APPM 1350 *Chakravarty, Dullin, Li, McCormick*, Calculus 1 for Engineers.
- APPM 1360 *Biondini, Halburd, Meiss, Segur*, Calculus 2 for Engineers.
- APPM 2350 *Chakravarty, Halburd, Herod, Manteuffel*, Calculus 3 for Engineers.
- APPM 2360 *Bebernes, Easton, Julien*, Linear Algebra and Differential. Equations.
- APPM 2380 *Meiss*, Introduction to Ordinary Differential Equations.
- APPM 2450 *Wright*, Calculus 3 Lab.
- APPM 2460 *Edgin, Tearle*, Differential Equations Lab.
- APPM 3010 *Julien*, An Introduction to Nonlinear Systems: Chaos.
- APPM 3310 *Chakravarty, Curry*, Matrix Methods and Applications.
- APPM 3570 *Dougherty*, Applied Probability.
- APPM 4350 *Segur*, Methods in Applied Mathematics: Boundary Value Problems.
- APPM 4360 *Ablowitz*, Methods in Applied Mathematics: Complex Variables.
- APPM 4380 *Fornberg*, Modeling in Applied Mathematics.
- APPM 4560 *Dougherty*, Markov Processes, Queueing Theory and Simulation.
- APPM 4570 *Dougherty*, Statistical Methods.
- APPM 4580 *Luftig*, Statistical Methods Data.
- APPM 4650 *Driscoll*, Introduction to Numerical Analysis.
- APPM 4660 *Driscoll*, Intermediate Numerical Analysis 2.
- APPM 4720 *Curry*, Wavelets.
- APPM 4955 *Curry, Dougherty*, Seminar--Applied Mathematics.

## (ii) Graduate Courses

APPM 5350 *Segur*, Methods in Applied Mathematics: Boundary Value Problems.

APPM 5360 *Ablowitz*, Methods in Applied Mathematics: Complex Variables.

APPM 5430 *Ablowitz*, Advanced Complex Variables.

APPM 5440 *Li*, Applied Analysis 1.

APPM 5450 *Li*, Applied Analysis 2.

APPM 5460 *Bebernes*, Dynamical Systems.

APPM 5470 *Meiss*, Methods in Applied Mathematics: Partial Differential Equations.

APPM 5480 *Segur*, Methods 4.

APPM 5560 *Dougherty*, Markov Processes, Queueing Theory and Simulation.

APPM 5570 *Dougherty*, Statistical Methods.

APPM 5580 *Luftig*, Statistical Methods Data.

APPM 5600 *Fornberg*, Numerical Analysis 1.

APPM 5610 *Fornberg*, Numerical Analysis 2.

APPM 5720 *Curry*, Wavelets.

APPM 6630 *Beylkin*, Numerical Computation 2.

APPM 7100 *Easton*, Dynamical Systems.

APPM 7400 *Curry*, Seminar—Teaching and Learning.

APPM 7400 *Beylkin*, Numerical Computation 2.

APPM 8000 *Segur*, Colloquium.

APPM 8100 *Ablowitz*, Seminar--Nonlinear Equations.

APPM 8100 *Meiss*, Seminar--Dynamical Systems.

APPM 8200 *Manteuffel, McCormick*, Seminar--Computational Mathematics.

## B. Summer Courses, 1999

APPM 1350 *Tenford*, Calculus I.

APPM 1360 *Cotae, Nelson*, Calculus II.

APPM 2350 *Robins*, Calculus III.

APPM 2360 *Akmaev*, Intro. Linear Algebra and Differential Equations

APPM 2450 *Wright*, Calculus III Lab.

APPM 2460 *Edgin*, Differential Equations Lab.

APPM 4650 *Norris*, Intro. to Numerical Analysis I

## 8. RESEARCH ACTIVITIES FOR CALENDAR YEAR 1998

### A. Research Publications for Calendar Year 1998

#### Mark Ablowitz

- "On Timing Jitter in Wavelength-Division Multiplexed Soliton Systems," M.J. Ablowitz, G. Biondini, S. Chakravarty and Rudy L. Horne, *Optics Communications*, **150**, 305-318 (1998).
- "Multiscale Pulse Dynamics in Communication Systems with Strong Dispersion Management," M.J. Ablowitz and G. Biondini, *Optics Letters*, **23** 1668-1670 (1998).
- "The Darboux-Halphen System and the Singularity Structure of its Solutions," M.J. Ablowitz, S. Chakravarty, and R. Halburd, in *Mathematical and Numerical Aspects of Wave Propagation*, Ed. John A. DeSanto, Society for Industrial and Applied Mathematics, Philadelphia, PA, 408-412, (1998).
- "Collision Induced Timing Jitter in Dispersion-Managed Soliton Systems," M.J. Ablowitz, G. Biondini, S. Chakravarty and R.L. Horne, in *Nonlinear Guided Waves and Their Applications*, Technical Digest Series, Volume 5, Conference Edition, Optical Society of America, Washington, DC, 181-183, (1998).
- "Soliton Communications and Wavelength-Division Multiplexing," M.J. Ablowitz, G. Biondini, and S. Chakravarty, in *Mathematical and Numerical Aspects of Wave Propagation*, Ed. John A. DeSanto, Society for Industrial and Applied Mathematics, Philadelphia, PA, 145-149, (1998).

#### Jerrold Bebernes

- "Nonlocal Problems Modeling the Formation of Shear Bands," *Proceedings of Eighth International Colloquium on Differential Equations*, D. Bainov, Editor, VSP, 67-71, (1998).

#### Gregory Beylkin:

- "A New Class of Time Discretization Schemes for the Solution of Nonlinear PDEs," (with James Keiser and L. Vozovoi), *Journal of Computational Physics*, **147**, 362-387, '98.
- "A Multiresolution Strategy for Reduction of Elliptic PDE's and Eigenvalue Problems," (with N. Coult), *Applied and Computational Harmonic Analysis*, **5**, 129-155, (1998).
- "LU Factorization of Non-Standard Forms and Direct Multiresolution Solvers," (with David L. Gines and J. Dunn), *Applied and Computational Harmonic Analysis*, **5**, 126-201, (1998).
- "A Multiresolution Method for Numerical Reduction and Homogenization of Nonlinear ODEs," (with M. Brewster and A. Gilbert), *Applied and Computational Harmonic Analysis*, **5**, 450-486, (1998).
- "On Multiresolution Methods in Numerical Analysis," *Documenta Mathematica*, Extra Volume ICM 1998, **III**, 481-490, (1998).
- "Multiscale Inversion of Elliptic Operators," (with A. Averbuch, R.R. Coifman, and M. Israeli), Chapter in *Signal and Image Representations in Combined Spaces*, 1-16, **7**, Wavelet Analysis and Applications series, Academic Press, (1998).
- "Fast Radon Transform for Multiple Attenuation," (with A. Vassiliou), *Proceedings of SEG*, (1998)
- "On applications of Unequally Spaced Fast Fourier Transforms," *Proceedings of SIAM WP98*, (1998).



**James H. Curry:**

“Symmetric Functions and Exact Lyapunov Exponents,” *Physica D*, (1998).

**Ann Dougherty:**

“Extreme Value Theory - Applications to Design Wind Prediction,” with Wei Xu and R. Corotis, *Proceedings of the Third International Conference on Computational Stochastic Mechanics*, Santorini, (1998).

“Human Perceptual Thresholds of Friction in Haptic Interfaces,” with D. Lawrence, L. Pao, Y. Pavlou, S. Brown, and S. Wallace, *Proceedings of the ASME Dynamic Systems and Control Division, DSC, 64*, 287-294, ASME Int. Mech. Engr. Conf. & Expo., Anaheim, CA, (1998).

**Bob Easton:**

“Stability of Levitrons,” with Holger Dullin, *Physica D*, **126**, 1-17, (1998).

“Geometric Methods for Discrete Dynamical Systems,” **50**, *Oxford Engineering Science Series*, Oxford University Press, (1998).

**Bengt Fornberg:**

“A Practical Guide to Pseudospectral Methods,” *Cambridge University Press*, first paperback edition, (1998).

“A Block Pseudospectral Method for Maxwell's Equations: I. One-Dimensional Case,” with Tobin Driscoll, *Journal of Computational Physics*, **140**, 47-65, (1998).

“Calculation of Weights in Finite Difference Formulas,” *Siam Review*, **40**, 685-691, (1998).

“On the Chance of Freak Waves at Sea,” with B.S. White, *Journal of Fluid Mechanics*, **355**, 113-138, (1998).

**Keith Julien:**

“A Reduced Description of Rapidly Rotating Turbulent Convection,” with E. Knobloch and J. Werne, *Advances in Turbulence VII*, Kluwer Academic Publishers, 479-482, (1998).

“Strongly Nonlinear Convection Cells in a Rotating Fluid Layer: the Tilted Plane,” With E. Knobloch 1998, *Journal of Fluid Mech.* **360**, p.141, (1998).

“A New Class of Equation for Rotationally Constrained flows,” with E. Knobloch and J. Werne, *J. Theor. Comp. Fluid Mechanics*, **11**, P. 251, (1998).

“Thermohaline Convection with Nonlinear Salt Profiles Balmforth, N.J.,” with A.R.R. Casti, *Phys. Fluids*, **10**, P. 819, (1998).

“Fully Nonlinear Three-dimensional Convection in a Rapidly Rotating Layer,” with E. Knobloch, *Physics of Fluids*, **11**, no. 6, 1469-1483, (1999).

“Strongly Nonlinear Magnetoconvection in Three Dimensions,” with E. Knobloch and S. Tobias, *Physica D*, **128**, 105-129, (1999).

“Plumes in Rotating Convection, Part 1,” with S. Legg, J. Mc.williams and J. Werne, *Journal of Fluid Mechanics*, **388**, (1999).

**Congming Li:**

“Some new Approaches in Prescribing Gaussian and Scalar Curvatures,” *Proceedings of the International Conference in Dynamical Systems and Differential Equations*, 148-159, (1998).

“Indefinite Elliptic Problems with Critical Exponent,” *Proceedings of the International Conference in Partial Differential Equations*, World Scientific, (1998).

**Tom Manteuffel:**

“First-order System Least-squares for the Pure Traction Problem in Planar Linear Elasticity,” Z. Cai, T.A. Manteuffel, S.F. McCormick, S. V. Parter, *SIAM J. Numer. Anal.*, **35**, pp.320-335. (1998).

“First-order System Least Squares (FOSLS) for Convection-diffusion Problems: Numerical Results,” J.-M. Fiard, T.A. Manteuffel, S. McCormick, *SIAM J. Sci. Comp.*, **19** pp. 1958-1979, (1998).

“Analysis of Velocity-flux Least-squares Principles for the Navier-Stokes Equations: Part I” I. Bochev, Z. Cai, T.A. Manteuffel, S. McCormick, *SIAM J. Numer. Anal.*, **35**, 990-1009, (1998).

“Local Error Estimates and Adaptive Refinement for First-order System Least Squares (FOSLS),” E M. Berndt, T.A. Manteuffel, S. McCormick, *E.T.N.A.* **6**, pp. 35-43, (1998).

“Least-squares Finite-element Solution of Neutron Transport Equations in Diffusive Regimes,” T.A. Manteuffel and Klaus Ressel, *SIAM J. Numer. Anal.*, **35**, No. 2, (1998).

**Steve McCormick:**

“First-order System Least-squares for the Pure Traction Problem in Planar Linear Elasticity,” Z. Cai, T.A. Manteuffel, S.F. McCormick, S. V. Parter, *SIAM J. Numer. Anal.*, **35**, pp.320-335. (1998).

“First-order System Least Squares (FOSLS) for Convection-diffusion Problems: Numerical Results,” J.-M. Fiard, T.A. Manteuffel, S. McCormick, *SIAM J. Sci. Comp.*, **19** pp. 1958-1979, (1998).

“Analysis of Velocity-flux Least-squares Principles for the Navier-Stokes Equations: Part I” I. Bochev, Z. Cai, T.A. Manteuffel, S. McCormick, *SIAM J. Numer. Anal.*, **35**, 990-1009, (1998).

“Local Error Estimates and Adaptive Refinement for First-order System Least Squares (FOSLS),” E M. Berndt, T.A. Manteuffel, S. McCormick, *E.T.N.A.* **6**, pp. 35-43, (1998).

**James Meiss:**

“Computing Periodic Orbits using the Anti-Integrable Limit,” D. Sterling and J.D. Meiss, *Physics Letters A* , **241**, 46-52, (1998).

“Quadratic Volume-Preserving Maps,” H.E. Lomeli and J.D. Meiss, *Nonlinearity* **11**, 557-574, (1998).

“Computing Connectedness: an Exercise in Computational Topology,” V. Robins, J.D. Meiss and E. Bradley, *Nonlinearity* , **11**, 913-922, (1998).

“Stability of Minimal Periodic Orbits,” H. Dullin and J.D. Meiss, *Phys. Lett. A* **247**, 227-324, (1998).

“Homoclinic Bifurcations for the Hénon Map,” D. Sterling, H. R. Dullin and J.D. Meiss, *Physica D* (1998).

“Quadratic Volume Preserving Maps: an Extension of a Result of Moser,” K.E. Lenz, H. E. Lomeli and J.D. Meiss, *Regular and Chaotic Motion* (1998).

**Harvey Segur:**

“The KP Equation with Quasiperiodic Initial Data,” with B. Deconinck, *Physica D*, **123**, pp. 123-152, (1998).

## B. Invited Lectures and Meetings Attended for Calendar Year 1998

### Mark Ablowitz

Invited Lecture, First Pacific Rim Conference on Mathematics, Hong Kong, "On Solutions to the Nonstationary Schrödinger Equation and the Kadomtsev-Petviashvili Equation," January 21, 1998.

Invited Lecture, Mathematical Association of America Meeting, New Orleans, LA, "Solitons: from Water Waves to Telecommunications," February 28, 1998.

Invited Lecture, Meeting on *Novel Solitons: Nonlinear Guided Waves*, Victoria, Canada, "Four Wave Mixing," March 29, 1998.

Colloquium Speaker, Department of Applied Mathematics, University of Colorado, Boulder, "Solitons: from Water Waves to Communication and Encryption," April 3, 1998.

Invited Lecture, Pennsylvania State University, State College, PA, "Computational Chaos in the Nonlinear Schrödinger Equation," April 24, 1998.

Invited Lecture, International Conference on *Solitons, Geometry and Topology: On the Crossroads*, Moscow, Russia, "On Darboux-Halphen (DH) Systems," May 25, 1998.

Invited Lecture, International Meeting on *Integrable Systems: Solutions and Transformations*, Guardamar, Spain, "On Darboux-Halphen (DH) Systems," June 15, 1998.

Workshop in Nonlinear Optics, Mathematics Department, University of Arizona, Tucson, AZ, "Multidimensional Optical Pulses in Chi-2 Materials," September 23-26, 1998.

### Gregory Beylkin:

Invited Lecture, "On Multiresolution Methods in Numerical Analysis," ICM, Aug. 1998.

Invited Lecture, Integral Methods in Science and Engineering, MTU, "On Multiresolution Methods for Integral and Differential Equations," August, 1998.

Invited Lecture, Mathematical Geophysics Summer School at Stanford, "On applications of Unequally Spaced Fast Fourier Transforms," August, 1998.

Invited Lecture, SIAM WP98, "On applications of Unequally Spaced Fast Fourier Transforms," June, 1998.

Invited Lecture, Mathematical Geophysics Summer School at Stanford, "Wavelet Transforms and Compression of Seismic Data," August 1998.

National Radio Science Meeting, "On Factored FIR Approximations of IIR Filters," Boulder, CO, Jan. 1998.

DARPA Workshop, "On Factored FIR Approximations of IIR filters," June 22, 1998.

DARPA Workshop, "Efficient Representation of Earth's Gravitational Field," June, 1998.

DARPA Workshop, "Towards Fast Spectral Projection Methods," June 24, 1998.

DARPA Workshop, "Towards Fast Spectral Projection Algorithms for Density Matrix Computations in 3D," October, 1998.

SEG, "Fast Radon Transform for Multiple Attenuation" (with A. Vassiliou), 1998.

SWC "Local Models for Gravitational Fields," Colorado Springs, Nov. 1998.

### James H. Curry:

Presented Paper, CAARMS 4, Rice University, "Newton's Method," (1998).

### Bob Easton:

Invited Lecture, Midwest Dynamical Systems Conference, University of Cincinnati, "Stability of Levitrons," March 25-29, 1998.

Invited Lecture, University of Colorado at Boulder, Department of Applied Mathematics, "Stability of Levitrons," September 1, 1998.

**Bengt Fornberg:**

Presentations given at CU Boulder, Uppsala University (Sweden), University of Strathclyde (Scotland), and University of Stellenbosch (South Africa).

**Keith Julien:**

Invited Lecture, "Laminar to Turbulent Rapidly Rotating Convection," APPM Numerical Colloquium, University of Colorado at Boulder, November, 1998.

Invited Lecture, "Nonlinear Dynamics of Rotationally Constrained Flows," APPM Dynamical Systems Group, University of Colorado at Boulder, December, 1998.

**Congming Li:**

Invited Lecture, "Geometric Questions in Partial Differential Equations," conference at the Mathematisches Forschungsinstitut in Oberwolfach, Germany, 1998.

Invited Lecture at the 933<sup>rd</sup> Meeting of American Mathematics Society at Temple University, Philadelphia, PA, 1998.

Invited Lecture at the Session of Short Communications on Partial Differential Equations From Differential Geometry, International Congress of Mathematicians, 1998.

Colloquium Talk at the Department of Mathematics, University of Wyoming, Laramie, March 26, 1998.

**Tom Manteuffel:**

Speaker, Copper Mountain Conference on Iterative Methods, Copper Mountain, CO, March 30-April 3, 1998.

Invited Lecture, DOE Workshop on Linear System Solvers, Sandia National Laboratories, Albuquerque, NM, October 12, 1998.

**Steve McCormick:**

Speaker, Copper Mountain, CO, Copper Mountain Conference on Multigrid Methods, March 30-April 3, 1998.

**James Meiss:**

Invited Lecture, "Controlling Hamiltonian Dynamics: Chaotic Orbits to the Moon," University of California at San Diego, Inst. Nonlinear science, May 8, 1998.

Invited Lecture, "Normal Forms for Quadratic Maps," Dynamics in Astrophysics, Gainesville Florida, February, 1998.

Invited Lecture, "Continuation from an Anti-Integrable Limit," Southeast Dynamical Systems, College Park, Maryland, March, 1998.

Invited Lecture, "Destruction of Horseshoes for the Hénon Map," International Hamiltonian Systems Conference, Patzcuaro, Mexico, February, 1998.

**Harvey Segur:**

Invited Lecture, "The KP Equation with Quasiperiodic Initial Data," American Mathematical Society Meeting, Manhattan, Kansas, March 28, 1998.

Invited Lecture, "The KP Equation and Water Waves," IUTAM Conference on Air-Sea Interactions, Nice, France, May 19, 1998.

**John Williamson:**

Participated in International Genetic Epidemiology Society meeting in Arcachon, France, Fall, 1998.

## C. Research Grants for Calendar Year 1998

	Amount for 1998
<b>Mark Ablowitz</b>	
NSF, Mathematics Division, 1997-2000	\$37,000
AFOSR, Mathematics, 1997-99	\$65,000
NSF, Engineering Communications, 1998-2001	\$70,800
<b>Gregory Beylkin</b>	
DARPA/AFOSR, 1998-2000	\$227,900
DARPA/Univ. of Va., 1996-99	\$130,300
DARPA/USC, 1998-2001	\$66,000
DARPA/Raytheon, 1998-2001	\$43,800
<b>James Curry</b>	
NSF SCREMS (with matching funds), 1998-99	\$79,000
Silicon Grail, 1998-99	\$17,500
NSF Statewide Systemic Initiative, 1993-98	\$20,000
Sun Microsystems Equipment Donation, 1998-99	\$111,000
<b>Bengt Fornberg</b>	
NSF, Mathematics Division, 1997-00	\$27,000
<b>Keith Julien</b>	
NASA, 1997-00	\$78,100
<b>Congming Li</b>	
NSF, 1996-99	\$22,900
<b>Tom Manteuffel</b>	
DOE, Applied Mathematics, 1996-99	\$100,000
IBM, SUR, 12-node IBM SP parallel processor, 1998	\$893,000
NIH, 1998-2000	\$9,400
<b>Steve McCormick</b>	
NSF, Mathematics Division, 1997-2000	\$142,500
NIH, 1998-2000	\$9,400
<b>James Meiss</b>	
NSF, Mathematics Division, 1996-99	\$21,900
NSF, Graduate Traineeship, 1993-99	\$111,000
<b>Harvey Segur</b>	
NSF, Mathematics Division, 1998-2001	\$29,600
<b>John Williamson</b>	
NIMH, 1995-99	\$48,200

## D. Miscellaneous for Calendar Year 1998

### **Mark Ablowitz:**

Editorial boards: *Journal of Engineering Mathematics*; *Studies in Applied Mathematics*,  
Cambridge University Press Texts in Applied Mathematics

Advisory boards: *Springer Verlag Series in Integrable Systems & Solitons*

Reviewer: NSF Grants; Air Force Grants; Australian, Canadian, South African, Hong Kong  
and Air Force Research Grants; *Physics Letters A*; *Physical Review Letters*; *SIAM Journal  
on Applied Mathematics*; *Journal of Engineering Math*; *Physical Review E*; Cambridge  
University Press

NSF Panel Member:

Mathematics Division (VIGRE Panel), Oct. 1998

Electrical Communications Division (ARREER Panel), Nov. 1998

### **Jerrold Bebernes:**

Editor: *Rocky Mountain Journal of Mathematics*; *Communications on Applied Nonlinear  
Analysis*

### **Gregory Beylkin:**

Editorial boards: *SIAM Journal on Numerical Analysis*; Editorial and Advisory Board,  
*Applied and Computational Harmonic Analysis*.

Refereed Journal Articles or Chapters: *Journal of the Atmospheric Sciences*

### **Robert Easton:**

Editorial Board: *Communications on Applied Nonlinear Analysis*

Reviewed an undergraduate applied linear algebra text for Prentice Hall publishers.

### **Bengt Fornberg:**

Refereed proposals for NSF and its counterparts in Canada and South Africa; Refereed about a  
dozen articles for seven journals.

### **Keith Julien:**

Refereed a paper for: Refereed two papers for the *Journal of Fluid Dynamics* in 1998

### **Tom Manteuffel:**

Editor-in-Chief, *SIAM Journal of Numerical Analysis*; Associate Editor, *Journal of Numerical  
Linear Algebra and Applications*

### **Steve McCormick:**

Associate Editor: *SIAM Journal on Numerical Analysis*

Editor: *SIAM Journal on Scientific Computation*

### **James Meiss:**

Editor: *Physica D*

Reviewer: *Physics Letters*; *Physical Review Letters*; *Journal of Fluid Mechanics*; *Journal of  
Physics A*; *Chaos*; *Physics of Plasmas*; *Physica D*, *Nature*; *Nonlinearity*, NSF Proposals

### **Harvey Segur:**

Reviewer: *Advances in Geophysical Turbulence* (3 papers), *European Journal of Mechanics*  
(2 papers), *European Journal of Fluid Mechanics* (2 papers), *Physics Letters A*, *Physical  
Review E*, *Physical Review Letters*, *Proceedings of the Royal Society of London*, *SIAM J.  
on Applied Mathematics*, *SIAM J. on Sci. Computing*, *Studies in Applied Mathematics* (2  
papers), Reviewer for NSF, (2 proposals)

## 9. PREPRINTS OF THE DEPARTMENT: 1998-99

The following is a list of preprints developed by Department 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, Department of Applied Mathematics, Campus Box 526, University of Colorado, Boulder, CO 80309-0526.

389. *Novel Potentials of the Nonstationary Schrödinger Equation and Solutions of the Kadomtsev-Petviashvili I Equation*, by M.J. Ablowitz, S. Chakravarty, A.D. Trubatch and J. Villarroel, July 1998.
390. *On the Discrete Spectrum of the Nonstationary Schrödinger Equation and Multipole Lumps of the Kadomtsev-Petviashvili I Equation*, J. Villarroel and M. J. Ablowitz, July 1998.
391. *A New Class of Equations for Rotationally Constrained Flows*, K. Julien, E. Knobloch and J. Werne, January 4, 1998.
392. *Fast Spectral Projection algorithms for Density-Matrix Computations*, by G. Beylkin, N. Coult and Martin Mohlenkamp, August 12, 1998.
393. *A Comparison of High-order and Spectral Time Stepping Methods for Maxwell's Equations*, by T. Driscoll, B. Fornberg, and M. Ghrist, September 30, 1998.
394. *Staggered Time Integrators for Wave Equations*, by M. Ghrist, B. Fornberg, and T. Driscoll, September 30, 1998.
395. *Localized Multidimensional Optical Pulses in Non-resonant Quadratic Materials*, M.J. Ablowitz, G. Biondini, and S. Blair, October 4, 1998.
396. *Improved Discretization Error Estimates for First-Order System Least Squares (FOSLS)*, Tom Manteuffel, Steve McCormick, and Christoph Pflaum, October 1998.
397. *Perturbation Theories for Nonlinear Waves*, Lev Ostrovsky and Konstantin Gorshkov, November 1998.
398. *Wavelets & Chalice: A Student Perspective*, Alia Oster, Miguel Alvarez and Tony Edgin, November 1998.
399. *Solitons and Symmetries*, M.J. Ablowitz and P.A. Clarkson, December 1998.
400. *The Generalized Chazy Equation and Schwarzian Triangle Functions*, M.J. Ablowitz, S. Chakravarty and R. Halburd, December 1998.
401. *The Generalized Chazy Equation from the Self-duality Equations*, M.J. Ablowitz, S. Chakravarty and R. Halburd, December 1998.
402. *Computing Connectedness: Disconnectedness and Discreteness*, Vaness Robins, J.D. Meiss and Eric Bradley, February 1999.
403. *On the Extension of the Painlevé Property to Difference Equations*, M.J. Ablowitz, R. Halburd and B. Herbst, February 1999.
404. *Integrable Relativistic Models and the Generalized Chazy Equation*, R. Halburd, February 1999.
405. *Lumped and Distributed Filter Models in Wavelength-Division Multiplexed Soliton Systems*, M.J. Ablowitz, G. Biondini, S. Chakravarty and R. Horne, April 1999.

406. *Homoclinic Bifurcations for the Hénon Map*, D. Sterling, H.R. Dullin & J.D. Meiss, April 1999.
407. *A Fast Spectral Algorithm for Nonlinear Wave Equations*, B. Fornberg and T.A. Driscoll, April 1999.
408. *Strongly Nonlinear Magnetoconvection in Three Dimensions*, K. Julien, E. Knobloch and S. Tobias, April 1999.
409. *Adaptive Solution of Partial Differential Equations in Multiwavelet Bases*, B. Alpert, G. Beylkin, D. Gines and L. Vozovoi, June 1999.
410. *Strongly Nonlinear Magnetoconvection in the Presence of Oblique Fields*, Keith Julien, Edgar Knobloch, and Steve Tobias, June 1999.
411. *Highly Supercritical Convection in Strong Magnetic Fields*, Keith Julien, Edgar Knobloch and Steve Tobias, June 1999.
412. *Reduced Equations for Rotationally Constrained Convection*, Keith Julien, Edgar Knobloch and Joseph Werne: Conference Proceedings: First International Symposium on Turbulence and Shear Flow Phenomena, June 1999.



