



The Wave Packet

The UMD Physics Newsletter

Issue No. 2

Spring 1997

Editor: J.R. Hiller

Elise Ralph Joins Faculty

The newest member of the physics faculty is Elise Ralph, who came to Duluth in January from La Jolla, California. She is an oceanographer by training and is the first of three new physics faculty members who will hold joint appointments in the physics department and the Large Lakes Observatory, where she will conduct research in the circulation of large lakes, in particular Lake Superior. Ralph was raised on the southern shore of Lake Superior, in Michigan's Upper Peninsula, so she has a long-term interest in large lakes and their role in the local climate.

Ralph received her bachelor's degree in Physics from the University of Chicago. An Honor's project in nonlinear dynamics began an interest in nonlinear fluid dynamics which led her to graduate school in the MIT/Woods Hole Oceanographic Institution Joint Program. There she pursued theoretical and numerical studies of the dynamics of coherent structures such as jets (like the Gulf Stream, or the atmospheric jet stream) and eddies. Her master's thesis concerned meandering jets and eddy detachment from them (the mechanism is qualitatively similar to the formation of oxbow lakes). The study resulted in an analytical method to predict eddy detachment from a jet based on inverse scattering methods of soliton theory. Her doctoral thesis explored the dynamics of how jets branch (resulting in atmospheric blocking, or the breakdown of the Gulf Stream near Newfoundland) and established a link between hydraulics and instability theory, based on ideas of resonance.

While in graduate school, Ralph also participated in several oceanographic cruises in the Gulf Stream and the south Pacific (which included stops on Easter Island and New Zealand). This stirred an interest in more traditional, observational oceanogra-

phy, which she pursued as a postgraduate researcher at Scripps Oceanographic Institution. While there she worked on wind-driven circulation of the tropical Pacific using "drifters," which are designed to accurately follow the near-surface water's movement while reporting their positions and ambient water temperature to a satellite. This data led to a new interpretation of how heat is transported within the western equatorial Pacific, the birthplace of El Nino events. In addition, she used the drifters to carry out the first basin-wide test of Ekman's 1903 theory of how momentum from the winds is stirred into the water column.

Since joining the faculty at UMD, Ralph has submitted several proposals to examine the circulation dynamics of large lakes. She is interested in pursuing studies of convection in lakes, including a process study of how mid-latitude lakes "turn over." She will also be involved in long-term monitoring of the physical aspects of the ecosystem in the western Lake Superior. This summer will include repeated measurements of temperature from the LLO boat, to observe the seasonal transition. With a physics department graduate student, Yabo Peng, she will also establish a mooring to measure a time series of temperatures and currents with depth during the summer months. In addition, Ralph will spend three weeks on Kyrgyzstan's Issyk-Kul, the world's fifth deepest lake, to study deep water renewal mechanisms.

A search for someone to fill a second Physics/LLO appointment is underway.

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Shaffer Outstanding TA of 95-96

Daniel Shaffer was selected as the Outstanding Graduate Teaching Assistant of the 1995-96 academic year. He completed his M.S. soon thereafter and is now a mathematics instructor at the LaLumiere School in LaPorte, Indiana.

A Name for the Newsletter

Several alumni sent in suggestions for the name of the newsletter. *The Wave Packet* was suggested by Prof. Jim Rohlf (BA '73), Boston University. The added graphic was drawn by Amanda Thralow (BS '97). Thanks for all the ideas!

Now that the newsletter has a name, it can be cited easily. For citations in *The Physical Review*, the correct form is: Wave Pack. **issue #**, page # (year).

Edgar Wins New Awards

Brian Edgar (BS '96) won both of the two new awards for undergraduates, the Outstanding Academics Award and the Outstanding Research Award. This was the first year for these awards, which are based on academic achievement and quality of a research project. The academic award goes to the graduating senior with the highest GPA. For now, the nature of each award is permanent entry of the name on a plaque. The plaques were purchased with funds from the department's Development Fund and are displayed on the third floor of Marshall W. Alworth Hall. When the Fund becomes large enough, its earnings will be used to make monetary awards.

These were not the first awards to Brian. Earlier in his undergraduate career he received an Olson Memorial Research Scholarship. Several such awards have been made over the past ten years, made possible by the many generous contributors to the Olson Memorial Fund.

After graduation, Brian accepted a position with Seagate in the Twin Cities.

Catch Up with Past Grads

Editor's note: The large number of badgers here is purely coincidental

Dan Lennartson, BS '93

I graduated with a B.S. in Physics from UMD in the spring of 1993. Since then, I took two years off before furthering my education at the University of Wisconsin-Madison. Here, I am working to earn a master's degree in meteorology. I have found meteorology to be a very rewarding and fascinating way to apply the physics I previously learned while going to UMD, largely due to the dynamic weather I grew up with living in Duluth. I suppose this is why my area of research has to do with air/lake interaction such as the lake effect snowstorms Duluth receives in the late fall and winter and lake breeze circulations that sometimes seems to add a few weeks to winter during the spring. Anyway, great things are happening for me in Madison and I thank the folks at UMD that helped me develop the tools I've needed to reach my goals.

James Olson, BS '94

After graduating in May 1994 from UMD with a double major in physics and mathematics, I decided to pursue a master's degree in physics. After applying to several grad schools, I chose South Dakota State University in Brookings, South Dakota. Initially, my interests in physics were in astrophysics and astronomy. During my first year at SDSU, I took mostly graduate courses in physics and was a teaching assistant for introductory physics courses in electricity and magnetism. During this time I also began to do research for Dr. Steven Schiller, an assistant professor in the department whose interests included astronomy, astrophysics, and remote sensing.

Although initially interested in astronomy, I soon began to work more in remote sensing. Specifically, I worked with the Portable Ground-Based Atmospheric Monitoring System (PGAMS), a portable system consisting of a spectrometer and diffusor capable of making measurements of several atmospheric parameters. In the

fall of 1995, I began working on my thesis, which focused on the research I had done under Dr. Schiller and the NSF Epscor program as well as incorporating aspects of radiative transfer. Specifically, my thesis focused on the contributions of multiple scattering occurring between the atmosphere and a target of known reflectance and how this multiple scattering influenced the total downwelling radiance measured by PGAMS.

After completing my master's degree at SDSU in August of 1996, I began work on my Ph.D. in atmospheric sciences at the University of Wisconsin-Madison in fall of 1996. While the approach in the department is a little different than in physics, I hope to continue with my research in the field of remote sensing and its applications in understanding global climate patterns. I do maintain ties with the physics department here in Madison by working as a teaching assistant for an introductory physics course.

In my spare time, I like to read, listen to music, and go for runs around Lake Mendota, which is pretty but no Lake Superior!

Robert Mitchell, MS '90

In the fall of 1988 I arrived at UMD with a B.S. in geology, an M.S. in geophysics, and one year of university teaching experience. Initially, my objective was to strengthen my physics background and teach at a community college. However, I left UMD with the desire of not only being a teacher, but also a researcher. So, I accepted a Department of Education Fellowship and enrolled in the Environmental Engineering Ph.D. program at Michigan Technological University. I was eager to apply my physics and geology background to environmental problem solving in this interdisciplinary field.

I attribute my ambition to earn a Ph.D. to my experiences at UMD. My coursework and research strengthened my understanding of the physical world, which stimulated my desire to learn even more science. In addition, I gained a strong foundation of the critical thinking skills necessary to conduct research. And, teaching statics, dynamics, and deformable body mechanics for a year at UMD secured my enthusiasm for the teach-

ing profession.

Three UMD physics courses had a direct impact on my dissertation research, and thus career. They were the courses in Prof. Hiller's Computational Physics and Modeling sequence. These courses served as the foundation for the two-dimensional finite-element flow and Eulerian-Lagrangian transport model that I developed for my dissertation research (soon to be published in the Journal of Contaminant Hydrology). I used this model to investigate the importance of nonideal fluid flow processes and porous media heterogeneity on solute transport in unsaturated porous media. In other words, I investigated how contaminants are transported in the subsurface.

After completing my dissertation in 1996, I accepted an assistant professorship in the Geology Department at Western Washington University in Bellingham, WA where I serve as the resident hydrogeologist and engineering geologist. I continue to enjoy teaching and am actively pursuing my research in contaminant transport and groundwater studies. Who knows, maybe I'll even get the opportunity to get back to my M.S. roots and collaborate with a geophysicist or physicist in the future.

Peter Trost, BS '82

After UMD, I attended the University of Wisconsin-Madison where I studied plasma physics and controlled nuclear fusion in the Electrical Engineering Department. I received my M.S.E.E. in 1984 and my Ph.D. in 1988. My research topic for my Ph.D. involved electron cyclotron resonance heating in a stellarator fusion device. As a large part of my Ph.D. research, I built a laser-based system which measured electron energy and density of a high temperature plasma by means of Thomson scattering (the scattering of photons by free electrons).

After graduating from UW, I was hired by General Atomics in San Diego. At GA I continued working on Thomson scattering devices for use on the DIII-D Tokamak. After a couple of years of this, I transferred to the Advanced Technologies group at GA and worked in a small group that built a high resolution, intensified CCD camera for LLNL for their Brilliant pebbles and Clementine moon probe projects. The camera flew on the Clementine probe in early 1994 and took high resolution, sequential color images of nearly all of the moon's

surface.

In fall of 1993, I took a position at Laser Power Research, which is a R & D group which is funded mostly by SBIR grants. I was primarily involved with a group which developed countermeasure systems for laser guided weapons. At Laser Power, I was awarded a SBIR grant for developing a lightweight, wide dynamic range CCD camera for use on hand-launched Unmanned Aerial Vehicles. Using technology learned from LLNL's Clementine program, I delivered to our customer a camera which produced good images from scenes as dark as a cloudy moonless night, to bright sunny days.

This was in a package which was 2.5" x 3.0" x 4.0" (including lens).

In April of 1996, I changed employers again, and am working for a Biotech firm called Gentic BioSystems. We are developing a low cost DNA sequencer which uses infrared fluorescence instead of radioactive tagging. I am doing optical/laser/detector/signal processing engineering. (One must wear many hats at a small firm.) I now have a patent pending on a fiber-optic based system for detection of DNA fragments. This will make patent number three for me.

In my spare time, I keep in shape by running up and down the hills around north

county San Diego. It has been a long time since I have done any cross country skiing, as I had done almost every winter day when I was in Duluth.

I have revived my interest in aviation since I finished school. I have built and flown several home-built aircraft. I just sold a Sonerai II. Last August I took my first flight in a Vari-eze that I built. I presently have a commercial pilot's license with instrument and multiengine ratings. I am now working on my Flight Instructor's rating (CFI) and will have it in April.

A Sampling of Student Research Projects

Bill Wolz, MS '97

In the summer of 1996, I worked with Prof. Sydor, Amanda Thralow and Brent Barnstuble on building an apparatus to study light scattering off particles suspended in water. The purpose of this apparatus was to study the ratio between forward and backward scattering intensities. The particles that we are interested in are polystyrene spheres, red clay and organic particles. We want to see if light scattering by natural particle distributions can be modeled using spheres. We are studying the backward to forward scattering ratios by varying different parameters, such as laser intensity, particle concentration, and particle size, shape and type.

The apparatus that I built consisted of mirrors, lenses, apertures, lasers, and photodetectors. The photodetectors and hardware for the apparatus were built by hand. The summer was spent building and testing the components for the apparatus. Prototypes were first built and tested and then refined and rebuilt until confidence in the quality of the components was realized.

The center of the apparatus has the bottle holding the suspended particles mounted on a tilt table gimbal so that the bottle can be adjusted for level. On either side of the bottle are two concave mirrors placed so that the middle of the bottle is at the focal length of the mirrors. Each mirror has a small hole drilled in the center so that the primary laser beam can pass through without being picked up by the photodetec-

tors. Two tiny apertures are placed out side of the mirrors so that the lasers can be pointed through the exact middle of the bottle. To the outside of the apertures are holders for the lasers, one on each side, so that the bottle can be illuminated from the left and the right sides. The mirrors are angled slightly to send the scattered light to two photodetectors, one measuring forward scattered light and the other back scattered light. Each side of the bottle is illuminated in turn so that an average value of the back to front scattering ratio, going both ways through the bottle, can be taken.

There are many difficulties in aligning the system. The bottles have to be in the exact center of the apparatus and the lasers have to shine straight through. Even when this is done correctly, there are problems with the apparatus. One consideration is the asymmetric shape of the bottles themselves. Internal reflections off the surfaces of the bottles have to be taken into account as well as dust particles clinging to the sides of the bottles. Every effort is made in cleaning the bottles thoroughly and readings are taken with clean water in the bottles to get zero readings before any particles are added. These are just a few of the difficulties involved with getting good data. There are many other problems too numerous to print in a short article.

This project was very interesting and fun as well as being at times frustrating. A real appreciation of the difficulties involved with building experimental apparatus that give wanted results without adding sys-

temic noise and false readings was learned. All in all, I found the summer project to be very rewarding and would encourage others to take on such projects. Practical experience in a lab setting is very valuable to anyone pursuing a career in Physics.

Amanda Thralow, BS '97

I conducted a UROP (Undergraduate Research Opportunities Program) project, titled Optical Detection of Submicron Particulates in Water, as part of a collaboration with other students supervised by Prof. Sydor. [See related article by Wolz.] My contributions were the preparation of water samples with known concentrations of sized particulates and to some extent the building of photodetectors. Samples with spheres of 10, 5, 3, 2 and 1 micron diameters were prepared. Preparation of samples with submicron spheres proved to be too difficult given the equipment at hand; the bottles could not be made and kept clean enough. Even the micron-sized spheres were a challenge. If care was not taken, organic contaminants would bloom rapidly and ruin the sample.

Since the end of the UROP support in the summer of 1996, I have continued to work on the project. Bill Wolz and I are currently taking data for the forward to backward scattering ratio for the micron particulate spheres. We hope that these measurements will be successful and that definite conclusions can be made by the end of summer 1997.

Lost Addresses

Several alumni did not get the previous newsletter, because we no longer have a current address. If anyone knows a current address for someone on the list below, please send it in or have the person get in touch. Thanks!

Lance Amundsen, BS '85
Darrell Anderson, BS '78
Mark Bergman, BS '71, MS '73
Richard Clapper, BS '74
George Clock, BS '73
William Drew, BA '63
Samuel Eshete, MS '88
Richard Finstad, BA '70
Judith Holmbeck, BA '68
Wallace Jamsa, BA '62
James Johnson, BA '54
Wallace Johnson, BA '50
Christopher Loebner, BS '90
John Kennedy, MS '89
Mary Kiiskinen, BS '68
John Koivisto, BS '66
Gregory Kuhlmeier, BA '70
Brian Maron, BA '65
John Miller, BA '59
Ali Motahamelian, M.S. '82
Yaseen Murayed, BS '85
Gerald Nelson, BA '60
Donald Novak, BA '68
Timothy Olson, MS '87
Mylan Radulovich, BA '61
Steven Sandstrom, BA '72
Eric Soderstrom, BA '83
Paul Town, BS '49

Alumni Visits

Several alumni attended the all-class reunion on July 26 and 27, 1996. They included Dale Heikkinen (BA '60), Peggy Davis Chun (BS '69), Jeffrey Stein (BA '76), Dave Gibbens (BA '67), Don McLish (BS '68), and Matt Evans (MS '92). Profs. Howard Hanson and Gordon Likely also joined in. That same summer Dale Heikkinen (See Wave Pack. 1, 2 (1996).) gave a colloquium on August 20 entitled "Accelerator Mass Spectrometry and Ion Beam Analysis." This spring, another alum, Darrin Johnson (MS '90) gave a colloquium on "Sparking Interest in Physics at the High School Level." Darrin is currently the physics instructor at Marshall School, a local private prep school.

If you're ever in the area, please stop in. With some advance planning, we can arrange a chance for you to speak about your work, or other topic of interest.

Web Directory

Several alumni have asked for a directory they could use in contacting other alumni. We plan to put a directory on the UMD web server, linked to the department home page at <http://www.d.umn.edu/physics>. We won't include anyone without permission. Please send a short e-mail note or include an answer to the directory question on the response form.

Career Contacts

Our graduates have found a variety of careers. For current students trying to find the right niche the information that alumni possess could be quite valuable. If you are willing to be a resource for career information, please indicate this on the response form or send e-mail to jhillier@d.umn.edu. A list of career contacts will be provided to physics B.S. and M.S. students.

Directory of Faculty ...

Bo R. Casserberg

Associate Professor and Assistant Head
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John R. Hiller

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Michael Sydor

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and Staff

Lori Johnson

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Nancy Magnuson

Senior Secretary
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Todd O'bey

Laboratory Services Coordinator
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In Memory of ...

Professor John Gergen, a former faculty member, who passed away in 1995.

Gift Funds

If you are able to make a gift to the Development Fund or the Donald Olson Memorial Scholarship Fund, please send it to the Development Office, 315 Darland Administration Building, UMD, 10 University Drive, Duluth, MN 55812 earmarked "Physics Development Fund" or "Olson Memorial Fund."

Spring 97 UMD Physics Newsletter Response Form

Name: _____

Address: _____

Phone: _____

E-mail: _____

Employer: _____

Title: _____

Do you wish to be in the web directory? _____

Are you willing to serve as a career resource for physics students? _____

Would you like to be featured in the next newsletter? _____

Tell us about yourself: _____

Send your reply by one of the following means:

- mail to Department of Physics, UMD, Duluth, MN 55812 .
- fax to 218-726-6942.
- e-mail to jhiller@d.umn.edu.
- web page form at the URL <http://www.d.umn.edu/physics/response.html>.

Thanks!! We'll enjoy hearing from you!