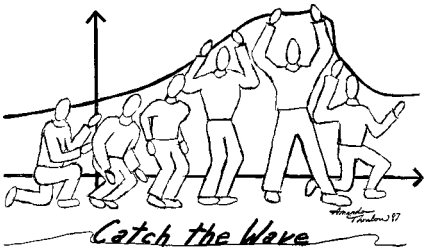

The Wave Packet

The UMD Physics Newsletter

Issue No. 4 ***Spring 1999*** ***http://www.d.umn.edu/physics/newslett/newslett.htm*** ***Editor: J.R. Hiller***

Faces New and Old

When you check the directory of faculty and staff you will see quite a few changes, both major and minor. Lew Oakland has retired after 36 years of service. Now he can stay in Texas until the snow melts in Duluth! The burden of running the introductory labs, which he carried after Gordon Likely retired, has been passed to Jon Maps. As a domino effect, Maps' time as Director of Graduate Studies has come to an end, with Bo Casserberg returning to that role. Both Maps and Casserberg face interesting challenges as we begin the semester-based curriculum this Fall. The instructional load that Oakland carried has been given to Darrin Johnson (MS '90), who was hired as an Instructor in Fall 1997 and will continue in 99-00.

In the staff section of the directory you will find a new name: Don Osterholm. He replaced Todd O'Bey as Lab Services Coordinator after Todd was no longer able to work due to effects of ALS. Todd is certainly missed (He knows where everything is!), but Don is doing a great job. [See the article below.]

That same summer, Nancy Magnuson decided to leave her secretarial position, to have more time for grandchildren and volunteer work. We have somehow managed to cope, with extra work for Lori and everyone else using PCs to do more of their own. A natural evolution, one might suppose; however, it means doing without Nancy's good cheer.

The years to come will bring more changes. We are searching for another new face, the third joint appointment to Physics and the Large Lakes Observatory. With any luck, the next newsletter will carry that person's bio. There may also be retirements and subsequent searches for new faculty in years not too far off.

Osterholm Becomes Lab Services Coordinator

The position of Lab Services Coordinator has been taken by Don Osterholm. Don grew up in Ironwood, on Michigan's western Upper Peninsula, and is a Viet Nam vet. His wife Mary still resides in Ironwood; their two children and three grandchildren live in the Ironwood area. Don currently commutes on weekends.

Don received an associate degree in electrical engineering technology in 1979 from Michigan Technological University and worked with Honeywell Micro Switch in Freeport, Illinois for eight years. He was a senior integrated circuit design technician working with Hall effect magnetics, capacitance sensing, and photo diode arrays. He received the Micro Switch Technological Award in 1986, for his assistance on a CMOS capacitance sensing design.

After a short venture in California, Don and his family moved back to Ironwood where he took a job with the Copper Range Mining Company, White Pine, Michigan, working with industrial electricity and motor control systems. While there, Don also spent three years as electrical supervisor over 18 electricians. In 1995, the mine closed 90% of its operation due to world competition and EPA problems.

At the time Don had a chance to return to school. He pursued a bachelor's degree at Northern Michigan University, again in electrical engineering technology, but eventually added a major in physics and minor in math. His intention was to return to Michigan Tech to graduate school. In May 1998, his school funding ran out leaving Don five physics credits short of his degree. He worked the summer of 1998 with the IBEW (electricians union) in Eau Claire, Wisconsin, and Minneapolis, Minnesota. Now he has the opportunity to finish his NMU physics degree by taking courses at UMD. He wishes all well and hopes you'll stop in to meet him if visiting the campus.

Honors and Awards

Elise Ralph has been awarded a **McKnight Land-Grant Professorship** for the next two years. In large part, this award is recognition of the extensive research program that Ralph has established, focused mainly on Lake Superior. The award will provide additional funds for her research and the option of a one-year leave from teaching duties.

The **Outstanding Graduate Teaching Assistant** for 1997-98 was **Amanda Thralow**. She joined the graduate program immediately after completing her Physics BS at UMD in 1997. Her MS should be completed this year, under the supervision of Professor Sydor. Amanda will then continue at UMD in the Applied and Computational Mathematics graduate program. She and her husband Dan run a successful, Duluth-based Internet store for sunglasses and other vision-related hardware.

Jon Schroden (BS '98) received the 1998 undergraduate **Outstanding Academics Award**. He double majored in Chemistry and has continued his studies in the Chemistry graduate program at Cornell University. This award goes to the graduating Physics senior with the highest GPA. Jon's name has been added to the plaque displayed on the third floor of Marshall W. Alworth Hall. We continue to collect donations to the Development Fund, which when its earnings become large enough, will be used to make monetary awards.

Inside this issue

Catch Up with Past Grads

Christopher Loebner, BS '90

After graduating from UMD in 1990, I enrolled in the masters program at New Mexico State University in Las Cruces, NM (going from extreme cold to extreme hot). At NMSU, I pursued a MSEE degree with an emphasis in telecommunication systems, and received a NASA research grant to work on the TDRS Satellite system at the White Sands area. The TDRS system is made up of two Geo satellites with two back ups that perform all of the relay communications for NASA. The academic highlight while at NMSU was getting my Masters' thesis published in the 1993 International Telemetry Conference (ITC) proceedings, and winning first place in their graduate research paper contest. I also got a free trip to Las Vegas for the conference with some award money to gamble away. I graduated from NMSU in May 1993, and got my first real job at Hughes Aircraft in Aurora, Colorado.

At Hughes I worked on a government satellite project called DCCS as a software developer. I was involved with the Orbital systems of the ground station where I got to use a lot of the physics I learned at UMD. It still amazes me that satellites can really remain in orbit. Also, I got to work on the encryption communications systems, TTC (Telemetry, Tracking, and Communications), and the network hardware systems. I spent three years on the project learning a lot about how a large satellite system works in terms of the software.

A better opportunity (and better pay) became available to me at Lockheed Martin in Boulder, Colorado. This is where I am working, as a software Engineer on a 6-year project called SBIRS (Space Based Infrared Satellite System). For SBIRS I have been laboring on the complete software design and development of the TTC system of the ground station. Mostly I have developed the HMI (Human Machine Interface) displays (using very advanced SGI graphics) which the satellite operator uses to run TTC operations. On this project I am learning a lot on how system engineering works in developing customer requirements into software products.

Even though I thought that I was finally done with school, I am currently working on a degree in Network Engineering, trying to keep updated with the changing technology. I hope very much to apply this degree at work with the Network Installations of the SBIRS satellite ground stations around the world.

When I do have some free time, I enjoy all of the outdoor activities that Colorado has to offer besides skiing. My favorite thing is to go back country packing in the mountains with llamas. Recently I bought my first house in the small town of Berthoud 20 miles north of Boulder, and am looking forward to my upcoming wedding in July.

Richard K. Dumas, BS '62

Having recently taken early retirement from work in the computer industry, I have had some time to reflect on what was, to me, a satisfying career. I was fortunate to get in on the industry in its early stages (late 50s and early 60s) with the advent of the large mainframes, followed by minicomputers, the PC desktop revolution and now, the turn back to the mainframe environment with the high-end multiprocessor servers and sophisticated multi-user operating systems as represented by the evolution of NT and UNIX.

When I look back at what opened this career for me, it was unquestionably the opportunities UMD offered. I grew up across the street from UMD and likely would not have gone to college if the school had not been there. The SPUTNIK revolution caused many of us graduating from high school in the 50s to consider further studies in the sciences. I decided to major in math and physics even though my high school background was deficient in some of the prerequisites. The first two years were a struggle, and I would not have continued in the sciences if it had not been for the ongoing help and encouragement of several teachers in the math and physics departments. I remember the many hours of individual help and conversations with Mrs. Grace Peterson, Dr. Irv Dorff and Dr. Sylvan Burgstahler in the math department and Mr. Don Olson in the physics department. I completed my majors with their help and went on to get my masters in math at UM-Twin Cities. I then went directly into the computer industry in system design and operating system design.

When I look back at the influences of the above professors, I particularly think of the relationship with Don Olson. Don had a research project in conjunction with a professor on the Twin Cities campus, measuring the effects of the earth's magnetic/electric fields. I helped him record and correlate the data in the evenings and weekends. We had many discussions about how individuals can contribute to their chosen field even though they may not be brilliant theorists or researchers. He convinced me, by example, that dedication, perseverance, attention to detail, an open mind and a willingness to let other more creative people consider your findings can lead to satisfaction as well as success in furthering your field of work. Following these guidelines resulted in an extremely satisfying career. I will always be deeply indebted to Don Olson.

I also give UMD credit in fostering an environment where a financially strapped high school student with slightly above average grades could flourish, get to know some professors with a practical understanding of the outside world and, with their help, take away enough confidence, optimism and understanding to succeed. This, in my mind, is what schools like UMD are all about. There is a memorial fund in the physics department named after Don Olson to provide similar opportunities to current students. With the help of the faculty and continued focus of the school on students with backgrounds such as mine, I hope future students are able to leave UMD with the same positive influences that I did.

Daniel Dale, BS '93

I arrived in Ithaca during August 1993, a fresh-faced Cornell physics graduate student eager to finally seriously study astrophysics. I began with only a vague idea of what astronomers do, but I'm happy to say that my route to a PhD in observational cosmology five years later was extremely gratifying.

The transition from Duluth to Ithaca was mild. The universities in both towns sit high on a hill overlooking a large lake, and each region is known for its pleasant summers and snowy winters. However, even upstate New Yorkers respond with quizzical looks when you mention plugging in your car engine, or the snow squeaking when it gets below minus 14 Fahrenheit.

My professional path through graduate school was fairly typical: a full load of coursework during the first two years, and an occasional seminar course thereafter. I

was a teaching assistant for three years, and I was fortunate enough to be awarded the university's highest teaching honor. I also lectured at a local community college for one semester. The real fun began, though, when I started work on my thesis.

My thesis addressed one of the recent hot topics in cosmology, that of large-scale motions in the local Universe. Spurred on by a controversial 1994 claim that the Universe out to a distance of ~200 Megaparsecs (almost a billion light years) was coherently moving at a rate of ~700 km/s, I led an international collaboration that set out to measure the motions of 52 individual clusters of galaxies. In the process I traveled to several observatories throughout the Western Hemisphere. This aspect of my work was doubly rewarding in that it gave me prime opportunities to practice my Spanish. My thesis conclusively showed that a large-scale bulk motion is highly unlikely locally. "Local" here implies anything within ~300 Megaparsecs.

I am currently in my first year of post-graduate work at Caltech. My main thrust now is to use data from recent space-based observatories to develop a unified model for the infrared properties of galaxies.

My wife, Kim, and I live in a sleepy town near Pasadena in the foothills of the San Gabriel Mountains. We are expecting our first child in late June. We appreciate the mild weather of Southern California, but we are determined to return to more northerly climes, hopefully due to a job offer at a liberal arts college.

A Sampling of Student Research

Andrew Wuchter, MS '99

In past years, progress has been made in assembling and testing a new scanning tunneling microscope (STM). My project was to continue this work by adding important and useful capabilities to the instrument.

The STM general operation goes as follows: A voltage applied between a sharp tip and the sample produces a small current. The current, which flows via quantum mechanical tunneling, decreases exponentially with the distance between the tip and the sample. A small current is caused by a large separation between the tip and sample and indicates a "valley" on the surface. Similarly, a large current signifies a "hill." A feedback circuit uses this information to maintain a constant relative position of the tip. The absolute position of the tip in the lab frame provides a record of the surface height. This information can then be manipulated in various ways such as being displayed as a contour map, or converted into a grayscale image. The data is collected as the tip scans back and forth over an area of the sample. The x, y, and z motion of the tip is accomplished by applying the appropriate voltage to the corresponding piezoelectric components.

In the past, a computer was used to produced a discrete scan. The tip would stop at each (x,y) point to take a height (z) reading, which the computer would save as a single data point. The computer would then move the tip to the next point. It would repeat this until it had surveyed a grid of points. This process was relatively slow especially for a large grid. Only after the scan was complete could the data be processed and transformed into an image to "see" the contours and topographical features of the surface.

A dedicated raster generator circuit, built by Qingyan Chen (Wave Pack. **3**, 2 (1998)), was to replace this data collection method by a much faster continuous scan, in which the x-voltage is a rapid triangle wave, while the y- voltage is slowly ramped. The result is a continuous scan that makes a 512 by 512 pixel image. The STM signal goes to a frame-grabber which processes the data as it is collected and displays the image on a TV screen. Images can be displayed in real time as fast as one every few seconds. Also, the images can be acquired consecutively without resetting controls, and the results can be recorded on simple VHS video tape. A clear image of an area of 500 nm square typically takes a couple minutes scan time. In the same amount of time the old computer-controlled scanning method could capture only a low resolution image of 64 by 64 pixels. In addition, small areas on the order of a square nanometer now take only a few seconds.

This is where my job came in. I was to incorporate the raster generator and frame grabber combination into the existing STM. The raster generator had a number of controls, such as starting, stopping, and speed of scan, that ultimately had to be directed by the STM operator and synchronized with the microscope operations. Most of the operations and settings were to be controlled by a data acquisition board that was capable of analog and digital outputs and inputs. Both the frame-grabber and data acquisition boards had their own libraries of programming commands. I wrote the software that enabled the STM user to operate the raster generator and frame-grabber in conjunction with the STM itself. I also built into the software the ability to set the dimensions of the scanning area, to overlay a scale to indicate relative distances, and to save a given image as a image file. The "new and improved" STM was tested using graphite and gold film samples.

The results were very encouraging. Excellent resolution was attained on graphite in particular. I have to say it is quite a thrill to "see" carbon atoms lined up in rows on a TV screen as they are being detected. Further improvements can be made in the future, which may include upgrading the computer hardware and operating system, and possibly connecting a LAN between the computer that controls the STM and the computer that contains the frame-grabber and data acquisition boards.

Cosmin Deciu, MS '99

A number of calculations, including some by Joe Wivoda (BS '90, MS '92) and Professor Hiller, have shown that zero-momentum modes (zero modes) can have a significant impact on the numerical solution of eigenvalue problems in quantum field theory. Retaining such modes in a calculation can improve the numerical convergence. The studied eigenvalue problems take the form of coupled integral equations that mix states of different particle number. The eigenvectors are collections of wave functions, one for each possible number of particles. The numerical method is based on a discretization of the independent particle variables (momenta, actually). The resulting matrix representation of the eigenvalue problem is solved by standard means, such as the subroutines found in the EISPACK and LAPACK libraries. One looks for convergence to the exact answer as

the discretization is refined.

For my thesis I have been working on a systematic study of the effects of zero modes on such numerical calculations. Traditional treatments neglected them entirely, which slowed convergence. Wivoda introduced them in his thesis work, but did not look at all aspects. My study is based on the same model field theory, where bosons of one type interact by exchanging bosons of a second type. I have found that Wivoda's approach, of introducing an effective interaction into the Hamiltonian to represent zero-mode exchange, can be generalized to improve convergence for this theory in important cases not considered previously.

One particular case involves an energy cutoff typically used in more realistic theories to control integration infinities. [Once controlled, such infinities can be absorbed into the definition of the bare parameters of the theory, a process called renormalization.] Zero modes are removed by this cutoff, but I have found that their leading effect can be restored with an effective interaction proportional to a power of the cutoff.

Alumni Visits

Several alumni have stopped by, including Ron Boe (BS '94), Brian Ehret (BS '90), Dale Heikkinen (BA '60), Steve Nicholas (BS '91, MS '93), and John Swenson (BS '93). We also meet up each year with Allen Anway (BA '63) at the judging for the Northeastern MN Regional H.S. Science Fair; this year Dale, who just moved back from California, joined the fun.

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.

Gift Funds

Gifts to the Physics Development Fund and the Donald Olson Memorial Scholarship Fund may be sent to the Development Office, 315 Darland Administration Building, UMD, 10 University Drive, Duluth, MN 55812. If you have questions or would like further information regarding a gift of any type to the Physics Department, including estate planning, please call our Development Officer, Steve Johnston at 218-726-6995.

Electronics Lab Upgraded

With the onslaught of semesters, changes to the laboratory courses for physics majors are imminent. As part of an increase in laboratory experience for our students, new or improved courses in instrumentation and experimental methods will be offered. The existing electronics sequence and its predecessors have long included the use of computers as an important tool in data collection and analysis. The technology and software tools used in these courses have steadily increased in sophistication, and thanks to funds from the College, the next round of upgrades is in progress.

Our old 80386-based machines have been replaced with fast (at least at the time of this writing) 450 MHz Pentium II machines connected to a Novell server in the lab. Each is equipped with a new data acquisition card from National Instruments for high speed A/D and D/A operations and a GPIB interface for operating a wide range of bench instruments, including digital oscilloscopes and multimeters. To take advantage of the new hardware, we have said a tearful farewell to our old software, Asyst, which did not survive the Windows revolution, and adopted LabView, the widely used graphical programming system for laboratory instrumentation from National Instruments.

LabView and HiQ, an associated analysis package, will provide opportunities for carrying out new experiments and data analysis. They contain all the ingredients for the control of the hardware, creation of virtual instruments, graphical display of data in two and three dimensions, and a wide range of analysis tools. These upgrades reflect the amazing evolution that has occurred in the availability of off-the-shelf technology for laboratory purposes over the past decade.

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Spring 99 UMD Physics Newsletter Response Form

Name:_____

Address:_____

Phone:_____

E-mail:_____

Employer:_____

Title:_____

Do you wish to be in the alumni web directory?_____

(The URL is http://www.d.umn.edu/physics/contact/alumni.htm.)

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

(The current list is at http://www.d.umn.edu/physics/career/alum-res.htm.)

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

Tell us about yourself:_____

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Send your reply by one of the following means:

- mail to Department of Physics, 371 MWAH, 10 University Drive, University of Minnesota Duluth, 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!

Lost Addresses

If anyone knows a current address for someone on the list below, please send it in or have the person get in touch. Thanks!

Darrell Anderson, BS '78
James Anderson, BA '50
Mark Bergman, BS '71, MS '73
David Bergum, BS '69
Alfred Bolger, BS '60
Wai Ang Chan, BS '75
Richard Clapper, BS '74
George Clock, BS '73
Samuel Eshete, MS '88
Richard Finstad, BA '70
Angus Gillis, BS '57
Gary Grann, BA '63
Henry Grieser, BA '48
Robert Hayes, BA '58
Charles Hill, BA '55
Robert Hill, BA '52
Judith Holmbeck, BA '68
Lloyd Horton, BA '51
James Johnson, BA '54
McRae Johnson, BA '50
Wallace Johnson, BA '50
Michael Jones, BA '69
John Kennedy, MS '89
Mary Kiiskinen, BS '68
John Koivisto, BS '66
John LaLonde, BA '79
Stephen Lepp, BS '78
Brian Maron, BA '65
Joshua Meyer, BS '96
John Miller, BA '59
Ali Motahamelian, M.S. '82
William Mularie, BA '61
Yaseen Murayed, BS '85
Richard Neenan, BA '50
Charles Nelson, BA '58
Gerald Nelson, BA '60
Wesley O'Brien, BA '56
David O'Connor, BA '61
Timothy Olson, MS '87
Richard Peterson, BA '70
Roger Pilon, BA '63
Mylan Radulovich, BA '61
Steven Sandstrom, BA '72
Steven Saterlie, BA '70
Eric Soderstrom, BA '83
Frederick Stewart, Jr., BA '59
Liqiang Tao, MS '92
Paul Town, BS '49
Charles Turcotte, BA '50
Donald Vivian, BS '51
Dale Wick, BA '59
Stephen Wong, BA '50
Ronald Ylatupa, BS '60