University of Minnesota
school of physics & astronomy
Newsletter

Spring 2003 Issue 3

A Letter from the Department Head

These are interesting times at the University of Minnesota. We have a new president, Robert Bruininks, with the former president, Mark Yudof departing for the University of Texas. President Yudof was an excellent leader, who promoted upgrading the physical plant of the University. The remodeled Walter Library with it's new Digital Technology Center is a striking example of Yudof's legacy. For the University, this leadership transition has occurred at a time of uncertainty, which may be followed by rapid change, not all of which will be for the better. The state is currently experiencing major financial problems, which are impacting the University in a very negative manner.

We have introduced a new section devoted to gifts to the department in our newsletter. The support of Alumni and friends of Physics is particularly crucial as the state reduces its financial support of the University. This is a trend that has actually been in place for most of the 38 years I have been a member of the faculty, and it will accelerate over the next biennium, as the Legislature and Governor struggle to balance the budget. We will become increasingly dependent on private support, tuition income, and outside contracts and grants. As tuition increases so will the need for fellowships and scholarships. I am happy to point out that some of our alumni have stepped up to the plate in a most spectacular fashion. In particular, Darrell Rinerson (B.S. Physics, '69, Ph.D. Electrical Engineering '77) has made the largest single commitment ever by an individual to the University.

We also need your support on the political front. If you are a resident of Minnesota and you feel strongly about the future of the School, it is important that you contact your legislators and the governor to affirm your support for the University in the budget wars. Although we look to the future with some apprehension, we carry on with our activities.

In this issue of our newsletter, research in biological physics is highlighted, and the work of two faculty in the field is profiled. Biological physics is a new research area for the department, and given the availability of resources, one which should grow over the next several years. We are currently in the process of searching for an additional experimentalist. The goal is to develop this field as one of the core activities of the department.

We recently celebrated changing the name of the Theoretical Physics Institute (TPI) to the William I. Fine Theoretical Physics Institute (FTPI). This was a bittersweet occasion, as Bill Fine is no longer with us. Bill was the force behind the creation of the Institute through his generous gifts and leadership. Bill's advice and humor, and incredible commitment to the Institute will be missed.

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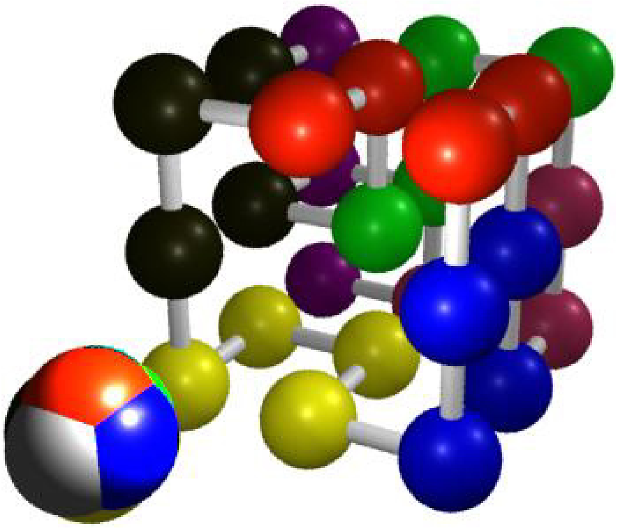
Research Spotlight

Biological Physics



Biological physics is a new sub-field of study at the University of Minnesota. In 1998 Professor Boris Shklovskii began to apply his experience in low temperature electronic semiconductor physics to describe the Coulomb interaction and the formation of complexes of positive objects, for example, positively charged polymers with (negative) DNA. He showed that the polymer can invert the charge of the DNA. This facilitates DNA drug penetration into human cells used for the purposes of gene therapy because surface of human cells is negative. Shklovskii's work is applicable to the improved design of new drugs for gene therapy.

Shklovskii's student Toan Nguyen (currently a postdoctoral fellow at the University of Chicago) was the first to receive his PhD in this sub-field at Minnesota. Another of Shklovskii's students, Alexei Koulakov, began applying to the methods he developed in Minnesota for the Quantum Hall effect to problems in neuroscience. Koulakov is now an Assistant Professor at the University of Utah, researching the short-term memory of the brain.

At the other end of the spectrum, a nuclear experimentalist, John Broadhurst, began to apply his expertise to studying such phenomena as the role of heavy ions in the contractile process of muscle cells, and in the chaotic behavior of stimulated brain tissue.

Since the year 2000 the School of Physics and Astronomy has hired two professors in biological physics, one theorist, Alexander Grosberg and one experimentalist, Joachim Mueller, with the intention of making biological physics a full-fledged program at Minnesota. New classes were added to the curriculum such as Introduction to Biopolymer Physics (Physics 4911), which teaches upper division students about polymers, and biopolymers, such as proteins, their phases and phase transitions. Soft materials such as liquid crystals are also covered in the course as well as single molecule manipulation techniques.

To support this new field of research, the School has added a number of post-docs and graduate students. There are plans to hire one more professor, an experimentalist, which will mean staffing and supplying another complete biological physics laboratory.

Not only is this a new field of study at the University of Minnesota, but also it is a young subfield of physics, distinct from biochemistry and biophysics which have been around for years and are well-established. About twenty years ago, theoretical physicists began to look at biological problems such as protein folding, applying the techniques used to study complex lattices to the biomolecule, which is in essence a highly complex dynamic lattice.

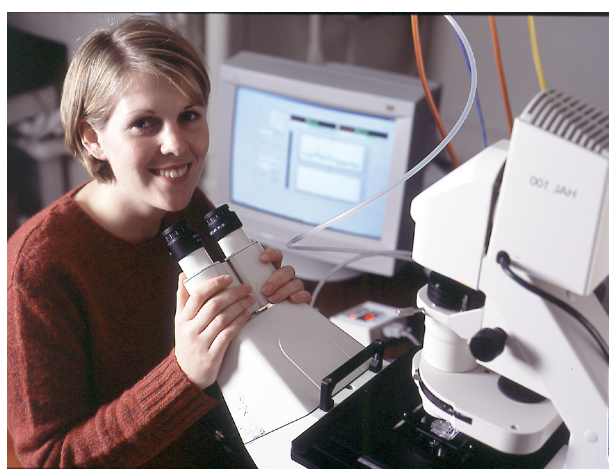


Photo by Jonathan Chapman

Above: Lindsey Hillesheim, a Research Assistant in Professor Mueller's laboratory, uses a microscope to perform fluorescent fluctuation microscopy, a technique which allows physicists to observe proteins on the single-molecule level. Top left: A lattice model of a protein attacking its substrate. Such models are used by theoretical physicists, including Alexander Grosberg and Boris Shklovskii, to calculate the extremely complex movements of proteins.

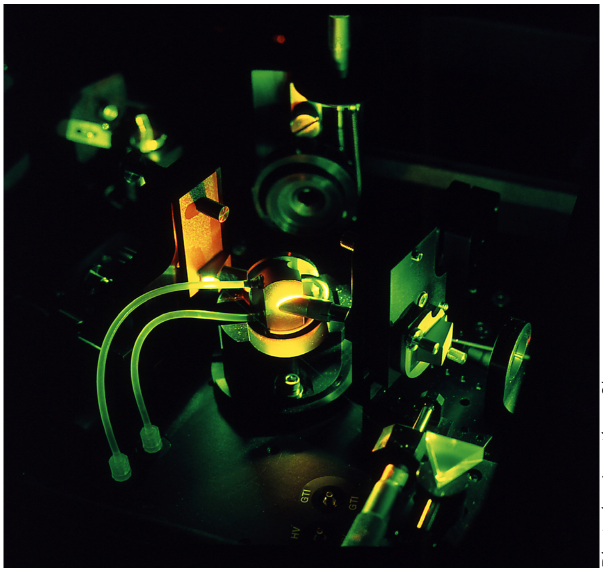


Photo by Jonathan Chapman

A titanium-sapphire laser, like the one used in Mueller's laboratory. The combination of biological microscopes and lasers is one unique to the sub-field of biological physics.

Alexander Grosberg has been active at the forefront of this research and sums up the difficulty as "using a one-dimensional approach for a three-dimensional problem." Proteins, as they are drawn in biochemistry textbooks look relatively simple, but those drawings are cartoons which neglect the density and movement of the biomolecules. The methodology used at the time by theoretical physics was simply overwhelmed by the complexity and dynamism of protein folding. Currently, theoretical physicists like Grosberg use new methodology involving computer modeling and simulation to attack the problem.

In the 1980s, experimental physicists began using simple laboratory techniques to answer questions relating to how biomolecules work. The earliest experiments used a simple table-top approach and as techniques became more sophisticated, physicsts turned toward protein physics. The relationship between structure, function and dynamics is central to protein physics. Again, the common physics techniques were overwhelmed by the complexity of biomolecules. Joachim Mueller was active in this research during this time at the University of Illinois. According to Mueller, proteins are too complex and heterogeneous to study in large numbers. Such experiments only recover averaged properties of the heterogeneous protein population. In the last ten years, a new approach emerged for studying biomolecules. Technological advances allowed, for the first time, experiments at the single molecule level. Mueller's current research uses this technology to address biophysical problems. A titanium-sapphire laser, which produces femtosecond pulses, enters a biological microscope and produces sub-femtoliter excitation volumes. Individual proteins diffusing through the observation volume produce a short burst of signals which are recorded and statistically analyzed.

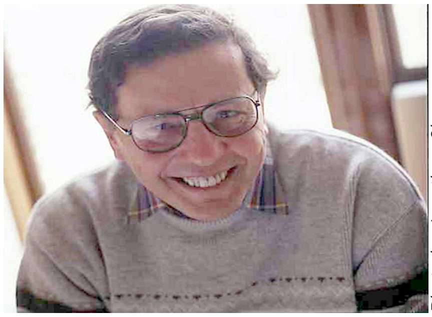
One of the biggest challenges to the young sub-field of biological physics is for physicists to communicate with biologists. There is a difference in the way that these two groups of scientists view the world, which is frequently manifested in a language barrier. One of the reasons for this language barrier is the huge amount of information that biology deals with in comparison to physics.

According to Mueller, his experiments are highly dependent on collaboration with biologists. "They have studied specific biomolecules for years whereas our lab is relatively new to them. They are experts and know all kinds of information about sample preparation that we would have to find out by trial and error." According to Mueller, such errors would be disastrous, possibly tainting years of work. "We have learned to listen very carefully to what biologists have to say."

Grosberg puts it this way, "Physics is an information-poor science and biology is an information-rich science. For example, in physics we derive the equations of motion and analyze all the consequences. We prove that Newton's equation of motion in central gravitational potential allows only hyperbolic, parabolic or elliptic orbits. By contrast in biology the number of possibilities is much greater than the number of actually existing systems." Grosberg continues his analogy by comparing biological organisms to literature where the number of possible books is much larger than the number of books written.

The challenge for biological physicists then is to develop some methodology that is consistent with the physics tradition and useful for the information-rich subject of biology. Many of the techniques are examined in greater detail in the profiles of Grosberg and Mueller which also appear in this issue.

Alexander Grosberg



Professor Alexander Grosberg specializes in polymer physics and biological physics. Grosberg and his collaborators recently published an article in the *Reviews of Modern Physics* on heteropolymers that examines protein folding, one of the most exciting issues in present day biological physics.

Grosberg described the folding process as similar to reading a book. A random sequence polymer won't fold in a meaningful way, just as a randomly written book wouldn't attract much readership. The sequence is designed to fold in a meaningful way and is fixed or quenched when it's chemically synthesized. Grosberg compares this to a parallel situation with spin-glass materials, in which the magnetic atoms are frozen in random places in a matrix, forming a complicated pattern. Normally, physicists would examine "dirty" systems by freezing the sample, expecting the disorder to change after every melting-freezing cycle. However, this method doesn't work on proteins.

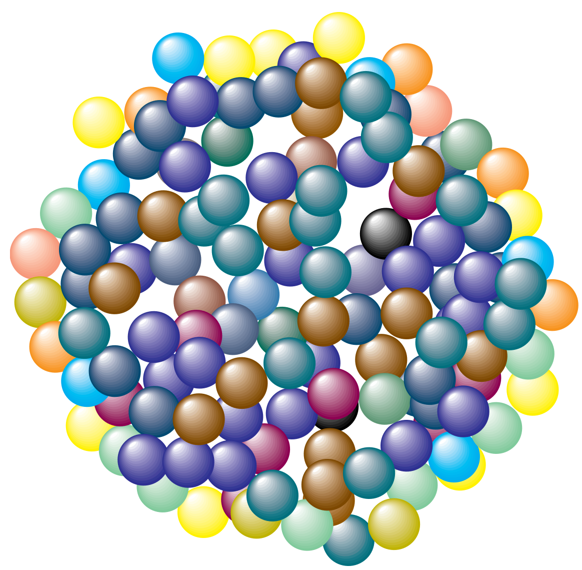
When proteins are synthesized, the sequences are quenched in some intelligent way and one gets many identical copies of each protein. Computer modeling shows that sequences exist (though improbable) which have a combination of interesting properties: 1) The ground state has very low energy, much lower than random sequences. 2) Sequence folding is similar to first-order phase transitions. It is cooperative, accompanied by latent heat and goes through bimodaly-distributed state, (two extremes with no middle state). 3) The sequence is stable against mutations.

While biologists have much information about the behavior of protein folding, they still do not know how proteins do this. Some analytic methods have been borrowed from the physics of disordered systems. "Unfortunately these methods are rather cumbersome,"
Grosberg says, "One particularly famous example, the Wheeler Principle, is recommended that if you don't know the answer to begin with, you shouldn't even start." These methods work with infinite systems, but proteins though large, are far from infinite, making computer simulations necessary. "The beauty of using computer simulations is that you can create and study simplified systems, capturing only the key features of proteins."

In the case of proteins, one simplification is made by placing molecules on a lattice which simplifies their geometries but doesn't alter their most interesting features—the relations between sequence, design and folding. "Presently computers are so fast people study all atomic models without a lattice, but there's still a long way to go because even the most powerful computers can simulate a protein for only as short a period of time as 10^{-11} seconds, while protein folding takes 10^{-3} seconds."

New and interesting studies of these structures involve interaction between different protein molecules. "It wouldn't be an exaggeration to say that such an interaction is life itself," Grosberg said. Some interactions are necessary for our well being, others are responsible for illnesses, and both analytical and computational methods are being developed to study these interactions.

Apart from his teaching, research, and extensive academic publishing, Professor Grosberg has also co-written a popular science book called "Giant Molecules." Grosberg said he wanted to do a general interest science book because "it's an interesting challenge to be able to explain things in a way more people can understand.



A computer model created by Grosberg's research group depicting a water-soluble heteropolymer. This model is one frame out of long simulation that may contain millions of such images. These simulations help theoretical physicists understand the complexities of protein folding.

Joachim Mueller

Photo by Jenny Allan

Joachim Mueller is an experimental biophysicist who came to the School of Physics and Astronomy in 2000. His research focuses mainly on proteins, which he calls "the executive branch of biomolecules because they do things." Proteins perform many tasks in the body, for example, hemoglobin absorbs oxygen into the blood and collagen aggregates in such a way as to give your skin elasticity.

Biologists, or more specifically biochemists, have rich and extensive knowledge of proteins as far as being able to tell you what they do, and how they react with other proteins, as well as very specific information about the conditions under which they perform. "What they lack," Mueller says, "is the fundamental understanding of how proteins do their jobs."

Mueller points out that what is typically studied is static models of a protein, cartoons that show a schematic picture of a complex molecule in order to make it understandable to students. However these types of models, which fill biochemistry textbooks, cannot explain the complex dynamic movement and action of the protein, such as the way in which proteins pack DNA into the nucleus or how a protein might enter the nucleus.

Proteins are designed to have biological purpose, yet each one is unique and therefore very difficult to learn from. "A single protein is enormously complex with thousands of components that come together and act in a non-trivial way," Mueller says.

Mueller's research attempts to study the dynamics and association of proteins on a single-biomolecule level. "Physicists," Mueller says, "are used to studying the structure and dynamics of phenomena. However, biomolecules all have a function, a role to play in the body, and this is not something physicists normally address." Biomolecule behavior is not random, but has been tuned to do something in particular. How the structure, function and dynamics come together essentially answers how a biomolecule such as a protein works. "We are very much at the observation stage of learning how proteins do their jobs."

The dynamic qualities of proteins present many obstacles to experimentation. To begin with proteins are not synchronized. That is, you can not count on them to all behave exactly the same way at the same time to a certain stimuli. Conventional spectroscopic techniques average over a whole protein population, but the average is often not good enough. In the last five to ten years, biological physicists have been employing stable lasers and sensitive detectors in order to capture a sample on the single molecule level.

One technique developed in Mueller's laboratory is called photon counting histogram (PCH) analysis. It calculates intensity statistics and determines the brightness of fluorescent dye. The statistics can be used to detect the aggregation state of proteins down to the single molecule level.

Another novel technique created and used by Mueller's group is a high-pressure instrument with single molecule sensitivity. Hydrostatic pressure is used for inducing dissociation or unfolding of protein complexes. The technique employs a tiny capillary tube, about the size of a human hair, which serves as the high-pressure cell.

According to Mueller one of the biggest challenges is to see proteins in their natural environment. Biological cells are far more complex than anything replicated in a test tube. In addition, the possibilities of manipulating a cell, by adding dyes or changing environmental parameters, are very limited. Mueller's group uses green fluorescent protein (GFP) to "paint" cells for spectroscopic observation. Mueller has been working with Professor Li-Na Wei from the Department of Pharmacology to observe the aggregation state of nuclear receptors, which is important for the activation of genes. A variant of PCH analysis has been developed for use in cells and allowed to follow the changes of the aggregation state over a wide concentration range.

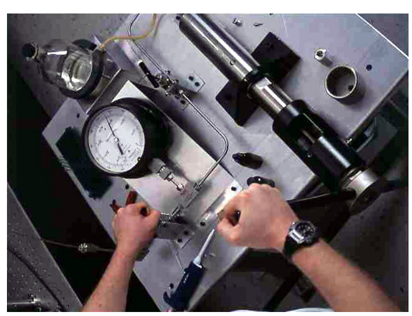


Photo by Jonathan Chapman

A simple high-pressure generator is used for the dissociation and unfolding of proteins in Mueller's laboratory.

Mueller is originally from Germany and has lived in Minnesota since the fall of 2000. He is married has two children, a two-year-old son and a four-month-old daughter.

A Fine Celebration

On Saturday December 7th Professor Bianca Conti-Fine, widow of William I. Fine, hosted a dinner to celebrate the renaming of the Theoretical Physics Institute as the William I. Fine Theoretical Physics Institute (FTPI). William Fine, a Minneapolis businessman, was instrumental in the creation of the Institute not only by his generous monetary donation, but his persistent commitment to the project.

Over one hundred friends of William Fine, including faculty members and University administrators, gathered at the McNamara Alumni Center to remember Fine and the creation of the Theoretical Physics Institute. Conti-Fine spoke of her late husband's love of physics and the University of Minnesota. "He was tremendously proud of his Russian Jewish roots and he felt that since so many Jewish people had contributed to theoretical physics and since so many of them were from Russia, his support of theoretical physics was a way to connect to his culture and his past."

The FTPI oversight committee met the same weekend and Professor of Physics Steve Gasiorowicz spoke on that topic. "This was the first oversight committee meeting without Bill and we missed his leadership, his clarity and his good humor." Gasiorowicz explained that although FTPI is fifteen years old, Fine's involvement goes back much further to the early 1980s. "We first met at a cocktail party. Bill expressed interest in what was going on in theoretical physics, and asked many searching questions. I realized that this was not going to be typical cocktail party chit-chat. His interest was very real, and this led to our getting together to discuss new developments. At some point he asked what he could do as a layman to contribute to theoretical physics." Gasiorowicz said that after the idea of an institute at the University of Minnesota came up, Fine took it on as his project.

The idea of setting up the Institute was initially met with indifference by the dean of the college, as the University was in the midst of a funding crisis and had been asked by then Governor Rudy Perpich to contract its programs. Fine then attempted to raise additional money from private sources outside the University, but found little interest in the esoteric topic of theoretical physics. "There's a tradition in America for wealthy people to fund hospitals and libraries, but to do something that's so far removed from the practical things—that took a very special person. The fact that this theory institute is really thriving is a monument to Bill and his past efforts," Gasiorowicz said.

Ken Keller, who was University president at the time, also reflected on Fine's efforts on behalf of the Institute in the mid 1980s. "It's a lot easier to lose quality than to build quality." Keller explained that budget cuts at the University had caused him to think small when it came to attracting new people and expanding fields of study. "I hadn't counted on Bill Fine to come to us with something like this."

Keller explained that usually the University was put in the position of seeking donors and then dealing with their personal agendas. "Bill's agenda had nothing to do with his profession. We honor Bill with the name, but he never asked for that," Keller continued "what mattered to him was the physics that was done here." The renaming had been planned for the fifteenth anniversary of the official inauguration of the Institute. Sadly, this coincided with the last year of Bill's life.

About FTPI

The FTPI is a major international center for research in theoretical physics. Current members of FTPI are Leonid Glazman, Anatoly Larkin, Keith Olive, Mikhail Shifman, Boris Shklovskii, Arkady Vainshtein, and Mikhail Voloshin. Its seven members are major contributors to elementary particle, astro-particle, condensed matter and biological physics research as well as concurrent members of the School.

Professor Bianca Conti-Fine has replaced Fine as co-chair of the FTPI oversight committee. She shares the post with Gloria Lubkin, who is a member of the editorial staff of *Physics Today*. The other external members of the committee are Frank Wilczek (MIT), Bertrand Halperin (Harvard) and Roald Sagdeev (Maryland). Members from the University are Kenneth Keller from the Humphrey Institute and Chemical Engineering and Materials Science; and C. C. Huang and Stephen Gasiorowicz from the School. Keith Olive as director of the Institute, and Allen Goldman as head of the School, serve as ex-officio members. Frank Wilcek has recently stepped down from the committee, and will be replaced by Dr. Helen Quinn, from the Stanford Linear Accelerator Center. Dr. Quinn is president-elect of the American Physical Society and was a co-winner of

Research Experience for Undergraduates

The Research Opportunities for Undergraduates (REU) is a NSF-sponsored summer program for support of active research participation by undergraduate students. The REU program seeks to expand student participation in all kinds of research–whether disciplinary, interdisciplinary, or educational in focus. REU students at the University of Minnesota work in research laboratories alongside graduate students, post-docs and professors to get hands-on experience. Some students choose to do research in theoretical physics and are paired with a professor to work on a set of problems in their area of interest.

Every summer about 15 students from around the country come to Minnesota for the ten week program. In addition to research, the program also features a course on the physics portion of the Graduate Record Exam (GRE) and weekly seminars on topics such as planetary exploration and experimental condensed matter physics. This is meant to help train an engaged scientific and engineering work force and does so by emmersing students in real-life work settings. The REU students visit the University of Minnesota's Soudan Underground Laboratory that is now the site for a new large collaborative experiment on neutrino oscillations. The Soudan visit introduces the students to the scale of experiments done in the large collaborative projects of high-energy physics. Students also take a field trip to the School's O'Brien Observatory where they are shown a selection of astronomical objects using the 36-inch telescope as well as details of the cryogenic detector used for observations in the infrared part of the spectrum.

Students' laboratory work culminates in a poster session, where results are presented in a format similar to that used at scientific conferences and meetings. Students stay either at the dormitories or in local residences. Within a day or so after arrival, each student is paired with a faculty mentor in an area of common interest and immediately begins work in a research setting. Though separated into individual laboratories, they get a chance to know each other and their professors through field trips and daily lunches taken as a group.

Crystal Austin, a senior in physics at the University of Minnesota worked with Professor Priscilla Cushman during the summer of 2002. Her project involved testing the effects of radiation on hybrid photo diodes, the light detectors used in the Compact Muon Solenoid Collaboration (CMS). Minnesota is responsible for more than 10,000 channels of new hybrid photodiode readout.

Austin said she was attracted to the REU program because she sought a summer job that would be relevant to her coursework in school. Her project was not completed during the summer and since Austin was a local student, she was able to continue the project during spring semester of this year. While the REU program allowed Austin to explore career opportunities and to become better acquainted with faculty, she found the work environment to be the most rewarding part. "The most fun part was having access to the Tandem Lab (a former accelerator laboratory which has been retrofitted to accommodate recent high energy physics experiments)." Austin, whose project required her to complete radiation safety training prior to work in the laboratory, gave a tour of the Tandem Facility to visiting inspectors from the (NRC) Nuclear Regulatory Commission.

Continued on page 12

Photo by Ashley Wiren

Thongphanh Phanthavady checks out the telescope at the O'Brien Observatory.

Photo courtesy of Ashley Wiren

Aneel Damle and Ashley Wiren ride the mine cars at Soudan Mine State Park in Tower, Minnesota.

Alumni Gifts Update

Photo by Tom Foley

Jennifer Payne Pogatchnik

Jennifer Payne Pogatchnik recently joined IT as a Development Officer charged specifically to work with Physics alumni. Pogatchnik is willing and available to assist alumni with their charitable giving questions, thoughts and ideas. Her expertise ranges from maximizing tax benefits on outright giving to estate gift planning. She can be reached by calling 612-626-9501 or at < jpogatchnik@ it.umn.edu >. Her Alumni Gifts Update is a new feature that will appear regularly in the Newsletter.

Campaign Minnesota Update

The University launched Campaign Minnesota, its largest fund-raising effort ever, in October 1999. Thanks in part to the generous support of Physics alumni and friends, the Institute of Technology is just $10 million shy of its $160 million Campaign Minnesota goal.

Physics is using donations to increase its scholarship support to undergraduate and graduate students, recruit more undergraduate students, enhance research infrastructure, and invest in high quality faculty and teaching.

Recent Gifts of Note

Kristine M. Black (BS '75) pledged $25,000 to begin a Physics Library Collection. Science-Physics books will be purchased from the fund for use in the University of Minnesota Library System. The books will be available for student and faculty use. Black's motivation for establishing the Physics Library Fund was to provide students continued access to resources in their pursuit of academic excellence.

Bob Kempe, (BSCheE '43) recently made a $15,000 contribution utilizing a Charitable Gift Annuity to the Alfred O. C. Nier Scholarship fund. Kemp's motivation for making the gift was extreme admiration and respect for Dr. Nier. The Alfred O.C. Nier Scholarship fund is a tremendous source of undergraduate scholarship support for physics students awarded annually based on need and merit.

Darrell Rinerson (BS '69) recently pledged a historic **$30 million dollar** bequest to the University of which $20 million would be to Physics for use in faculty and student support. Rinerson's motivation for establishing the bequest was in gratitude and appreciation for the excellent education he received in the department.

Class Notes

Class Notes is effort to update classmates and friends as to your news and whereabouts. We are asking you to send us any information you wish about births, marriages, jobs, promotions, wedding anniversaries, trips etc. for this section of the newsletter. We also welcome photos to go along with your news. Please send your news to the address on our masthead or by e-mail to <jenny@physics.umn.edu>. We look forward to hearing your news!

Stanley Brodsky (B. S. '61, Ph.D Physics '64) is currently a Distinguished Fellow at Jefferson Laboratory, Newport News, Virginia during his sabbatical from the Stanford Linear Accelerator Center, Stanford University.

Arnold Dahm (Ph. D. '65) Would like to announce his promotion to Emeritus status after 33 years teaching at Case Western Reserve University. Dahm will continue doing full-time physics research with a major portion of his time spent doing background research necessary for realizing a quantum computer. He and his wife, Susan have two daughters, one is an interior designer

Photo by Daniel Pogatchnik

Ardis Nier at the display in the McNamara Alumni Center featuring her late-husband, Professor A. O. C. (Al) Nier which highlights his career in Physics at Minnesota. On February 29,1940, Nier was the first to isolate a detectable quantity of Uranium-235. Parts of the display are on loan from the

Announcements

Bahcall to Deliver Van Vleck Lectures

John N. Bahcall

John N. Bahcall, Richard Black Professor of Natural Sciences at the Institute for Advanced Study, delivered the 2003 Van Vleck Lectures.

The subject of Bahcall's public lecture was "How does the Sun Shine?" and was held on Wednesday, April 9th. A reception followed the lecture in Room 216. He also delivered a School of Physics and Astronomy Colloquium on "Solar Neutrinos" the following day. Both Van Vleck Lectures were held in Room 150 Tate Laboratory of Physics.

Professor Bahcall's expertise is in theoretical studies of solar neutrinos, models of the Galaxy, dark matter, atomic and nuclear physics applied to astronomical systems, stellar evolution, and quasar emission and absorption lines. Professor Bahcall was honored with the 1998 Presidential Medal of Science in recognition of his theoretical work on solar neutrinos and for his role in the development of the Hubble Space Telescope. NASA recognized his achievements with the 1992 Distinguished Public Service Medal, citing his observations and leadership with the Hubble Telescope.

Professor Bahcall received his Ph.D. degree from Harvard University in 1961 and spent eight years at CalTech (1962-70) prior to being appointed to the Institute for Advanced Study in 1971. While at CalTech (1964) Bahcall and Raymond Davis, Jr. proposed that neutrinos from the sun could be detected via a practical chlorine detector. In the subsequent three and a half decades, Bahcall has refined theoretical predictions and interpretations of data from solar neutrino detectors.

The Van Vleck Lecture Series is made possible by a gift to the Institute of Technology from Abigail Pearson Van Vleck, the wife of John Hasbrouck Van Vleck.

John Van Vleck, who died in 1980, served for thirty-five years as Professor and later as Hollis Professor of Mathematics and Natural Philosophy at Harvard University until his retirement in 1969. Early in his career, he was a member of the physics faculty at the University. Van Vleck is universally recognized as the father of modern magnetism.

Physics site visit

The School of Physics and Astronomy was visited on March 11 and 12 by members of the Committee on the Status of Women in Physics (CSWP) of the American Physical Society. The CSWP has a long-standing interest in improving the climate in physics departments for women. The purpose of this particular visit was to provide the site visit team with quantitative and qualitative information they need to assess the climate in the School. Members of the committee met with women adminstrators, faculty, graduate and undergraduate students of the School. The site-visit team will write a follow-up report to the department head, detailing the findings of the visit and offer simple, practical suggestions on improving the climate for minorities or women.

Class Notes continued from page 8

and the other works in art conservation at the Art Institute of Chicago. Dahm's hobbies remain skiing and tennis.

Andrew K. McMahan (Ph.D., '71) was recently named a fellow of the American Physical Society, at the 2003 March Meeting. McMahan is a Staff Scientist in the Condensed Matter division at Lawrence Livermore National Laboratory.

Chung Ngoc Leung (Ph.D., '83) is currently Professor of Physics at the University of Delaware.

Heinrich Jaeger (Ph.D., '87) was recently named a fellow of the American Physical Society at the 2003 March Meeting. Jaeger is a Professor at the University of Chicago, Director of the University of Chicago Materials Research Center, 2001 and Co-Director of UC - Argonne Consortium for nanoscience Research, 2001.

Chip Hart (B. S. '92). After working as a manager at Deloitte & Touche from 1996-2000, Hart is now the owner of Quantrobe, Inc. He and his wife Lucy, an Associate Professor at the University of Minnesota, have two children, Damyan and Gabriel.

Inside Tate Lab:
School of Physics and Astronomy Machine Shop

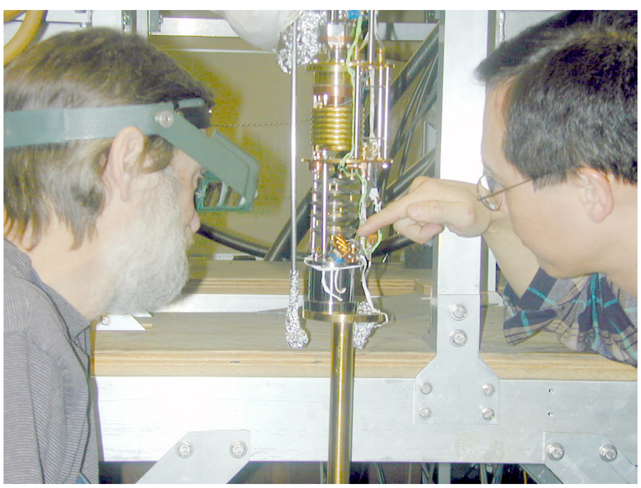
The School of Physics and Astronomy maintains the largest machine shop at the University of Minnesota. The shop has changed a lot over the years and has expanded its role to include designing and building equipment for other departments, facilities management and the hospital. The shop also does work for the teaching labs, building demo apparatus, repairing equipment, giving advice about hardware purchasing and supply sources. One of the shop employees, Roger Olson, works part time in the student shop, assisting and training students.

The majority of the shop's clients are physics graduate students who frequently come in with an idea sketched on paper. Shop staff work with the students to turn the sketch into a Computer Aided Drawing or CAD design and then to mill and build the equipment. Nearly every graduate student in experimental physics goes through some version of this process at some point in his or her tenure at Minnesota. "It's fun to interact with the faculty and students on these projects," shop manager Jon Kilgore said.

Most of the equipment the shop helps create are unique, one-of-a-kind items designed specifically for a particular experiment, "People in the shop like working here because it's challenging work, sometimes difficult. Every job is different which is not always the case in other work environments," Kilgore said. Any given project might present an opportunity to work with some material, such as welding an exotic metal like tantalum, which would never be seen in most machine shops.

According to Kilgore, the biggest change in the last ten years has been the effect that computers have had on the shop. All the design work previously done by hand is now completed with the help of CAD systems. Machines such as the manual lathe have been replaced by computer controlled lathes that are more accurate and can fabricate certain shapes and sizes that were previously impossible.

Kilgore cited as example, the new Mitsubishi FX10 Wire Electrical Discharge Machine (EDM) that the shop recently purchased. Wire EDM uses electricity to remove metal by means of spark erosion. Rapid electrical pulses are generated between the wire electrode and the work piece with the aid of deionized water. A shield of water flows between the wire and work piece. When sufficient voltage is applied, a spark melts and vaporizes a tiny portion of the metal. These pulses are repeated



Above: Machinist, Carl Johnson (left) discusses changes in a piece of equipment with Sarwa Tan, a graduate student in Professor Allen Goldman's superconductivity laboratory. Tan needed to modify the cylinder that holds the samples in his apparatus. At right: Johnson modifies the cylinder in the machine shop, according to the student's requirements. This collaboration between machinist and student is part of the process that allows the shop to repair and upgrade scientific apparatus.

Photos at left by Jenny Allan

thousands of times per second, creating a finished product that can be extremely thin and accurate, in a short amount of time. Wire EDM is a good example of how computer-controlled machines have expanded the range of possibilities for fabrication, and in turn, the types of experimental equipment that can be built with them.

The shop has come a long way since it's original home was in one small room in the basement of Tate Laboratory of Physics. As other departments have been forced to close their shops (Mechanical Engineering, Electrical Engineering and Computer Science, Chemical Engineering and Materials Science and Geology still maintain shops) the physics machine shop has expanded its list of clients to include national laboratories and many of the departments in the Institute of Technology. Appropriately, the original shop room is now home to a CAD drawing computer laboratory. University of Minnesota Professor Al Nier wrote in his "History of the School of Physics and Astronomy" that "the experimental work in the department was characterized by the sophisticated apparatus employed. The heart of the equipment was almost invariably some departmentally constructed unit of ingenious design which required machinists with unusual competency and capabilities."

Barney Glynn Remembered

Byron E. "Barney" Glynn

Some alumni might remember Barney Glynn as the fellow who helped fabricate a vital piece of equipment, others might remember him as a guy who helped them fix their car when they were broke.

Byron "Barney" Glynn worked in the machine shop from 1968 until his retirement in 1986. During his time at the School, Glynn worked on numerous projects, including helping to build cryostats for Professors Allen Goldman and Dan Dahlberg. Glynn, who died in August 2001, will also be remembered by generations of physics graduates students as someone whose love of tinkering went beyond his profession. Glynn's home garage was a place many students visited over years. Jon Kilgore remembers that Glynn would help students fix their cars, lending them plenty of tools and guidance along the way.

Glynn was also known as a motorcycle enthusiast who, apart from enjoying motorcycle touring and racing, used his mechanical abilities to repair and maintain his own bikes. Glynn is survived by his wife Mildred, daughters Jean and Betty, and three grandchildren.

Dept. Head Letter from page 1

Also featured in this newsletter is a look at the NSF-supported Research Experience for Undergraduates Program. The 2002 program was particularly positive for the student participants, who were from all parts of the country. Hopefully we will see some of them as future applicants to our graduate program.

This year's Van Vleck Lectures was given by Professor John Bahcall. His visit to the university was particularly timely given the excitement over Nobel Prizes for research on neutrinos, and the plethora of new results on neutrinos, and in the broad area of cosmology, which are areas of his expertise. Some faculty in the School are working hard to develop the Soudan Mine facility as a national underground research facility with an emphasis on neutrino research.

We have included a feature on our Machine Shop, which is one of the premier facilities of its type in the country. On a personal note, the scientific accomplishments of my research group over the years have been enhanced and facilitated by the shop. I am truly grateful for the ingenuity, dedication and skill with which the machinists and shop managers were able to translate often very primitive ideas into sophisticated apparatus. In particular Barney Glynn, who is remembered in this newsletter, played a major role in our success.

We hope that you enjoy this newsletter. We have added an alumni news section entitled Class Notes. We ask you to send us any information that you wish for this section of the newsletter either by contacting the editor at the address on our masthead or by e-mail at <jenny@physics.umn.edu>. We look forward to hearing from you.

REU continued from page 7

Beyond research experience, REU provides students with a chance to explore different areas of research interest and decide whether or not they want to pursue the subfield in graduate school. Many REU students have gone on to distinguished academic careers. One such student, Matthew Landreman, who was a part of the 1999 REU Program, was recently awarded a Rhodes Fellowship to study at Oxford University in England.

The School is finalizing applications for the 2003 REU program. Information is available online at <www.physics.umn.edu/outreach/reu>.

Physics Force

April 29, 2003 (The Original Force)
Eden Prarie High School,
7:30 p.m., Public Show

May 2, 2003 (The Next Generation)
Chaska High School.
Time TBA, Public Show

Grosberg Profile, continued from page 4

As a reader I like things about other fields that don't use jargon, and don't cover up the difficulties."

Grosberg began his career of research in polymer physics at Moscow State University. He was interested in biology, during a period in which no biology was taught for two years in the former Soviet Union. This anecdotal circumstance was in fact a delayed consequence of one of the great crimes of Stalinism, the persecution of members of the profession of biology.

Grosberg's interest in biology led him to study biological problems from a theoretical physics standpoint. Grosberg observed, "Many physicists begin working on biological problems and move into a biology field, but there are only a few examples of a counter movement toward physics. "Thus" he says, "we should encourage students to learn physics in order to keep all doors open for their future careers." Grosberg moved to Minnesota in 1999. He is married and has a son and a daughter.

University of Minnesota
school of physics & astronomy
116 Church Street S.E.
Minneapolis, MN 55455
www.physics.umn.edu

Newsletter

Allen M. Goldman
Head, School of Physics & Astronomy

Send article suggestions and additions/deletions for the newsletter mailing list to:
Jenny Allan
Editor
School of Physics & Astronomy
University of Minnesota
116 Church Street S.E.
Minneapolis, MN 55455
jenny@physics.umn.edu

To: