

A letter from the department head



We have received a major bequest and gifts that support fellowships for physics gradu-

ate students, scholarships for undergraduate physics majors, and a new endowed lectureship, the Misel Family Lecture. The first Misel Lecturer was the Nobel Laureate, Frank Wilcek of MIT.

The research climate in physics continues to be exciting. As described on these pages, the MINOS program is yielding interesting neutrino oscillation data. At the same time, the next stage of the neutrino program, the Nova project is being developed.

The Materials Research Science and Engineering Center, in which physics is an important and very active participant, had an NSF Site Visit in early November. The report of the committee was extremely positive.

In August Professor John Wygant was awarded a contract that could total \$20M over nine years for the development of the Electric Field/Wave Instrument for NASA's Radiation Belt Storm Probe Mission. On October 25th, the spacecraft developed for the Stereo Program, of which Minnesota has been an active participant, was launched. These activities in space physics will be described in subsequent newsletters.

We are conducting four searches, one each in Condensed Matter Experiment, Astro-particle Experiment, Nuclear Theory, and Condensed Matter Theory. The latter is a chair-level position to replace the late Anatoly Larkin. If all of these positions are filled, then the faculty will number 47. As a consequence of these searches we will have several months of intense interviewing and somewhere between 16 and 20 talks from various candidates.

The Physics Building project is advancing very slowly. Last

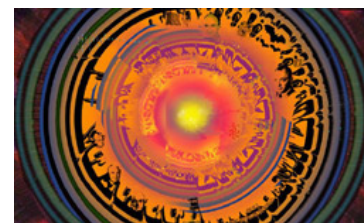
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MINOS results

The Main Injector Neutrino Oscillation Search experiment (MINOS) has been running the equivalent of one full year, or a year and half by the calendar. The MINOS "far" detector is located in a cavern laboratory in an old iron mine in Soudan, Minnesota and detects neutrinos from a beam sent from Fermilab, near Chicago, Illinois.

According to Professor Earl Peterson, preliminary results are "good" in that they support the results of the large

neutrino experiments, Super K and K2K in Japan. The mass difference is a bit higher than found in those two experiments, but is still well within the acceptable range. The difference between MINOS and those experiments is that the former is two to



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Michael
Zudov

New faculty profile: Michael Zudov

Professor Michael Zudov is a condensed matter experimentalist who came to the School of Physics and Astronomy in 2005. He left his native Russia to attend graduate school at the University of Utah in 1994. He is married and has two daughters, ages 5 and 16.

Zudov's research focuses on transport properties of two-dimensional electron systems (2DES) subject to perpendicular magnetic fields and low temperatures. These systems are found in semiconductor devices, known as heterostructures or quantum wells, in which electrons are confined at the interface between two semiconductor crystals. Following the discovery of the quantized Hall effects, high magnetic field transport in such systems has been actively studied over the past few decades and the understanding of 2DES has reached an exceptional level.

As sample quality has steadily improved owing to advances in materials science, many novel phenomena have been discovered in these systems. Some prominent examples include exotic correlated phases in high Landau levels and excitonic Bose condensation in double-layer systems. "It is really amazing that we continue to see surprising new physics in what appears to be a well-studied system," Zudov said.

In his Ph.D. work at Utah, Zudov learned that if a quantum well is irradiated with low-energy microwave photons, its resistance oscillates dramatically with magnetic field. These experiments in microwave-driven 2DES started the emergent area of low-field non-equilibrium magnetotransport. A few years later the Utah group and a Max-Planck group found that if one employs ever cleaner samples the resistance at the oscillation minima can virtually vanish and form, what were named "zero-resistance states". According to Zudov, vanishing resistance is not very common in condensed matter systems and usually signals a new state of matter, as was the case with superconductivity and the quantized Hall effects.

Kakalios featured in commercial

Professor James Kakalios of the School of Physics and Astronomy will be featured in a television commercial for the University of Minnesota's "Driven to Discover" campaign. The national advertising campaign began on October 2nd and the Kakalios' segment on the physics of superheroes, will begin airing this week.

Kakalios "on set" in his office with his co-stars (his collection of comic book action figures) and a crew member from Rent the Sky film.



The commercials were produced by Rent the Sky Film for the Olson Advertising Company. A crew of about 20 people filmed the 60-second spot in Kakalios's office in September. The crew worked around his class schedule arriving for set-up at 8 a.m. and leaving after his class. Kakalios read from a script but was allowed to "ad-lib" some lines in order to sound more natural.

Ann K. Aronson, Director of Marketing at the University of Minnesota said that Kakalios was selected in a University-wide search of faculty because of his innovative teaching techniques. Professor Kaklios teaches a Freshman Seminar on the Physics of Superheroes, which uses examples from comic books to illustrate real-life principals of physics.

Alumni Gifts

Edmond G. Franklin Scholarship and Fellowship

A bequest to Physics will substantially increase the amount of financial support available to undergraduate and graduate students. The late Edmond G. Franklin bequeathed two million dollars to Physics for scholarships and fellowships. Income from one million dollars of the endowment will be made available for need and merit-based scholarships for upper division physics majors. The second million is designated for graduate fellowships. The investment return on the graduate fellowship portion of the endowment will be matched by the Glaxo-Wellcome Fund, effectively doubling the payout. Mr. Franklin's gift is the second largest in the school's history and will significantly impact the amount of financial aid available to students.

Edmond Franklin started his undergraduate career in 1935 at the University of Minnesota. As an engineering student, he worked in Professor Alfred Nier's mass spectroscopy laboratory and was coauthor on some papers on mass spectroscopy. According to the executor of the Franklin estate and long-time family friend, William Rudner, Professor Nier recommended Franklin to the Manhattan Project and he spent the war years working on this project. After the war, Franklin returned to Minnesota and earned a Bachelor of Science in Electrical Engineering in 1947. His wife, Doris, was also an alumnus of the University of Minnesota. She earned a Ph.D. in 1942 and worked for eight years as an editor at the University of Minnesota Press. The Franklins eventually settled in the Akron, Ohio area where he worked at the Hoover Corporation and was granted several patents. Franklin was also a successful real estate developer and made his fortune in the post-war housing boom and stock market. Doris taught English at Kent State University from 1957 until her retirement in the late 1980s. Mrs. Franklin died in 1994 and was followed in death by her husband on February 27, 2005 at the age of 88.

According to Mr. Rudner, Edmond Franklin cred-

ited his education at the University of Minnesota, particularly his research experience in Alfred Nier's laboratory, as being responsible for the success he had in life.

The first awards of the Edmond G Franklin Scholarship and Fellowship funds will be announced in spring of 2007 for use the following fall.

Anatoly Larkin Fellowship



Larkin

A group of 43 donors gave a substantial sum to the University to start a fellowship in memory of the late Professor Anatoly Larkin. The donors included many of Larkin's collaborators and former students who wished to honor his extensive contributions to education and research in theoretical physics. The Fellowship will be awarded to a physics graduate student whose adviser is a member of the Fine Theoretical Physics Institute. Bianca Conti-Fine, widow of the late William I. Fine after whom the Fine Theoretical Physics Institute is named, contributed a substantial gift that brought

the endowment up to the level where the University would provide matching funds.

The first award of the Anatoly Larkin Fellowship will be made in fall of 2007. The gift was announced at the "Frontiers of Condensed Matter Theory" workshop held earlier this year to honor Professor Larkin's contributions to his field. More on this conference can be found on page five of this newsletter.

OUR DEVELOPMENT OFFICER



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Plans and questions regarding making gifts to the department will be kept confidential. In addition, Kim can insure your wishes are carried out and that a plan is in place for your gift today and into the future.

Awards & Announcements

Ken Heller



Professor Ken Heller was installed as President of the American Association of Physics Teachers (AAPT) at the 2006 Winter Meeting.

The annual meeting was held January 21-25 in Anchorage, Alaska. The AAPT was established in 1930 with the fundamental goal of ensuring the “dissemination of knowledge of physics, particularly by way of teaching.” The Association currently has over 11,000 members in 30 countries around the world.

Marshak & Gehrz



Marshak



Gehrz

Top instructor honors went to Professor Marvin Marshak for Physics and Professor Robert Gehrz for Astronomy. An e-mail survey sent to all Institute of Technology undergraduate students requested nominations for the Best Instructor Award for each department in the Institute of Technology. The IT Student Board presented the award to Professors Marshak and Gehrz at an IT Week ceremony this past spring.

Cronin-Hennessy



United States and Canada.

Professor Dan Cronin-Hennessy was selected as an Alfred P. Sloan Research Fellow for 2006-2008. The Sloan Fellowship is an extraordinarily competitive award involving nominations from the very best young scientists from the

John Dombeck



Alumnus, John Dombeck (Aug. 2005 Ph.D) received the 2006 F. L. Scarf Award for outstanding Ph. D. dissertation research by the American Geophysical Union (AGU). Dombeck's thesis was entitled “Properties of Alfvén Waves in the Magnetotail Below 9 R_E and Their Relation to Auroral Acceleration and Major Geomagnetic Storms,” and the work was carried out under the direction of Professor Cynthia A. Cattell.

Dombeck has continued to work in the School in the space physics group as an Information Technology Professional. The F. L. Scarf Award was established in 1989 by the Space Physics and Aeronomy Section to recognize an outstanding dissertation that contributes directly to solar-planetary science. The Awardee is required to deliver an invited paper on his or her dissertation topic at the AGU Spring or Fall Meeting AGU receives nominations from all over the world for this award.

Rudaz



Physics Professor Serge Rudaz has been selected by the College Honors and Awards Committee to receive the 2006 George Taylor Distinguished Teaching Award. Rudaz was recognized formally at the Institute of Technology commencement celebration and ceremony on May 5, 2006.

NuMi Receives Engineering Award

Neutrinos at the Main Injector (NuMi) received the 2006 Society of Civil Engineering Outstanding Civil Engineering Achievement Award of Merit by the American Society of Civil Engineers.

The NuMi beamline runs 435 miles from the Fermi National Accelerator Laboratory in Batavia, Ill., to the Soudan Underground Mine Park in northern Minnesota. The beamline creates the neutrino pulse for the Main Injector Neutrino Oscillation Search (MINOS) experiment. The Society cited the project's integration “historical technology—early 20th-century iron mining—coexisting and flourishing with modern technology, without sacrificing the historical or natural environment.” The Society also cited the educational outreach component of the project as being important to the nomination. The Soudan lab has become a destination for students and teachers of all levels to learn about physics.

FTPI News

Workshop commemorates Anatoly Larkin

As a memorial to the late Anatoly Larkin, The William I. Fine Theoretical Physics Institute (FTPI) held a workshop entitled "Frontiers of Condensed Matter Theory" from May 4-7, 2006. The workshop covered a broad range of subjects in the areas in which Professor Larkin worked. Sixty speakers, all leaders in their sub-fields, spoke at the gathering. Review talks at the start of every plenary session were given by many distinguished speakers including Nobel laureate, Anthony Leggett of the University of Illinois. Many of the speakers were former students of Larkin and according to Professor Leonid Glazman of FTPI, "almost everyone started their lecture with personal recollections and photographs." Glazman said that it had the effect of illuminating unexpected links between people as well as revealing history that many people didn't know.

Professor Larkin's entire family attended the work-

shop dinner at which many of his colleagues spoke about Larkin's influence on Condensed Matter physics and his unusual working style. Konstantin Efetov described how when he was a student of Larkin's at the Landau Institute for Theoretical Physics, Larkin would agree to meet with two students a day. When the first student got tired, the second would come in and take over.

FTPI hosted a related conference in 1997 in celebration of Dr. Larkin's 65th birthday. According to Glazman, the planning of this May's workshop began more than a year before, when one of Larkin's Former students, Paul Wiegmann approached Glazman about planning a celebration for Larkin's 75th birthday. When Larkin died unexpectedly in August of last year the workshop was changed to a memorial celebration.

Misel Lecture Series

FTPI inaugurated an annual lecture series on October 4, 2006. Nobel Laureate Frank Wilczek, the first Edythe and Irving Misel Family Lecturer spoke on "The Origin of Mass and the Feebleness of Gravity."

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three times more accurate and will become even more accurate as it collects additional data. MINOS also has a greater number of events than any neutrino detector yet built.

According to Peterson, there will be a lot more physics coming from the MINOS data. By next summer the collaboration is hoping to have new limits on the probability that muon neutrinos oscillate to electron neutrinos (instead of to tau neutrinos). Another unexplored area is the subject of neutral current reactions. Any reaction under 3 GeV can only be a neutral current reaction. About 30% of the reactions are neutral, where there is no electron, muon or tau produced. These reactions are harder to detect because they don't have a nice high energy signature. Physicists at MINOS would like to pin down whether or not the event rate fits the ν_μ to ν_τ model.

Peterson says that because the MINOS near detector is so relatively close to the beam, it produces three to five interactions per pulse. When all is

said and done MINOS should have generated 100,000 interactions, hundreds of times more neutrino events than have previously been collected. That's good news for the number crunchers, physicists who are awaiting data to plug into Monte Carlo models.

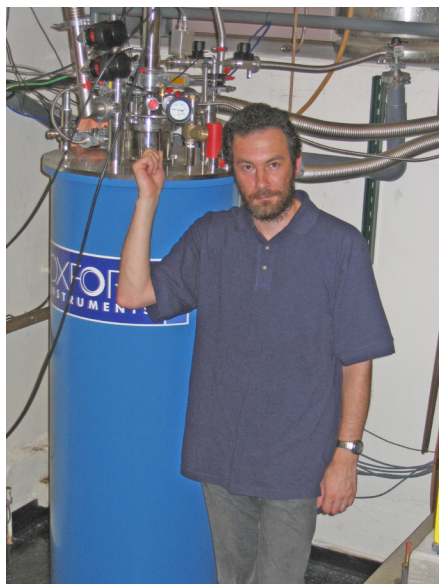
Eventually there will be enough data to tell whether neutrinos and anti-neutrinos oscillate in the same way. "No one's ever looked," Peterson says, "we think they will behave the same way, but the history of neutrino physics has been one of surprises."

SNAPSHOT



Professor Allen Goldman gives a demonstration of a superconductor for a group of school children that visited his lab.

The discovery of microwave-induced zero resistance triggered a surge of both theoretical and experimental activity, but the exact nature of the phenomenon is



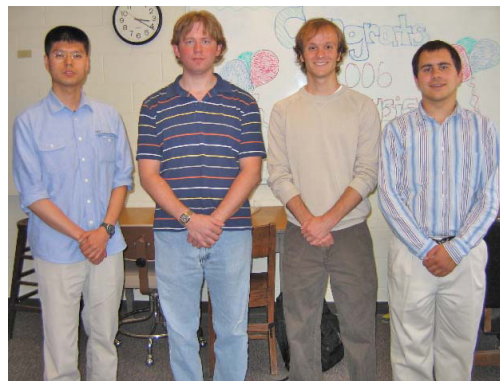
Zudov in his laboratory with his Helium-3 refrigerator.

not known. Theorists have suggested that the microwave radiation in fact tries to drive the system into a negative resistance state, which, however, cannot be sustained because of its instability. Instead, the symmetry is broken and the inhomogeneous pattern of current domains is formed. "One of the major experimental challenges is to test experimentally the concept of negative resistance and the very existence of domains."

Zudov's current interests focus on testing these theoretical predictions and elucidating the origin of zero-resistance. In one such experiment, that was recently described by Adam Durst in an article in *Nature* magazine as "clever," Zudov and his collaborators at Utah/Rice/Bell Labs set out to test whether a radiation-formed zero-resistance state is truly "zero-resistance" or if it, in fact, originates from a theorized "negative resistance" state. The results of their experiment supported the concept of a negative resistance state, usually avoided by the system. According to Zudov, the experiment in no way proves, however, that the system chooses to form an unusual current configuration, as theory predicts. A new class of experiments is needed to probe the existence of domains.

Zudov's non-equilibrium magnetotransport laboratory at Minnesota is built around a Helium-3 refrigerator equipped with a large superconducting magnet. The system was modified for microwave measurements via integration of microwave components, mainly consisting of a low-temperature waveguide system, a wide-range tunable microwave radiation source, and attenuators. High quality materials are obtained through collaboration with material scientists at Sandia and Bell Labs. "It's nothing fancy," Zudov said, "just a fridge and a magnet" which are standard tools for measuring resistance. "The only thing we added was microwaves."

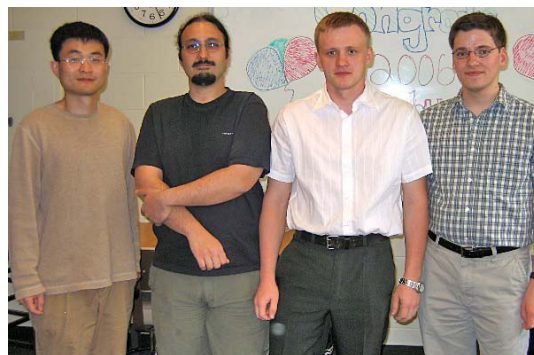
Student Awards



Yeonbae Lee (Jeffrey Basford Award), Michael Ehrlichman (J. Morris Blair Award), David Toyli Alfred O.C. Nier Award), Daniel Ouellette (Harry and Viola St. Cyr Award). Not pictured: Prashant Siva Emani (The Hagstrum Award)



T.A. Award Recipients: (front row) Kimia Ghanbeigi, Heather Greene and Maribel Nunez Valdez. Back row: ??? and Jason Haupt. Not pictured: Matt Fritts, and ???



Jingshan Zhang (Aneesur Rahman Award), Ahmet Gumrukcuoglu, (Hoff Lu Fellowship) Oleksandr Levchenko (Robert O. Pepin Fellowship) and Kevin Parendo, (Aneesur Rahman Award). Not pictured: Rhonald Lua (Aneesur Rahman Award), Chunyong He (Hoff Lu Fellowship).

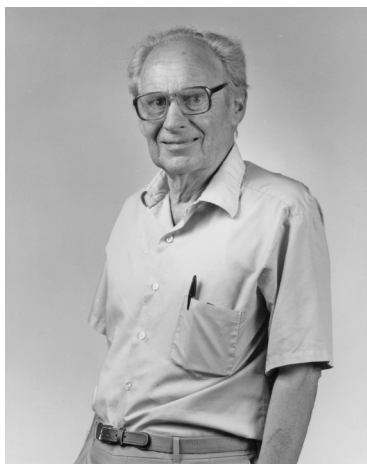
In memoriam:

George Greenlees

George Greenlees, emeritus professor of physics, died March 16, 2006, in Wayzata, Minnesota. He was 83.

An exceptional experimentalist, Greenlees contributed significantly to the understanding of the structure of atomic nuclei through his work on the optical model.

Born in Hartlepool, England, Greenlees entered the University



of Cambridge but interrupted his studies during World War II to work on an assignment from the British government. His task was to improve the cavity magnetron, a high-power vacuum tube that made microwave radar feasible.

After the war he earned a Ph.D. from Cambridge and accepted a position at the University of Birmingham, where

he became a leading researcher in nuclear physics. Dissatisfied with the accelerator at Birmingham, Greenlees designed a more

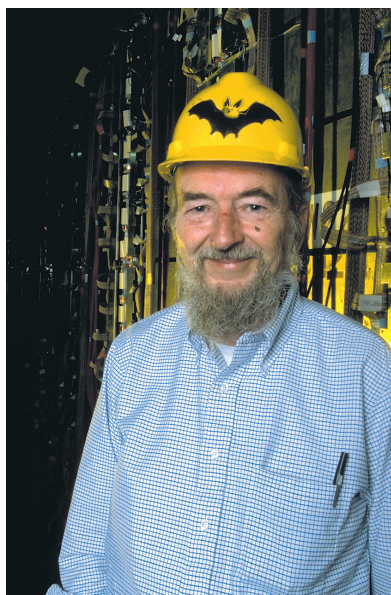
sophisticated accelerator using new technology. But when the British government transferred the majority of nuclear research to National Laboratories, where the new accelerator was not implemented, he began looking for new opportunities.

In 1964 he joined the physics faculty at the University of Minnesota, where he had access to a new accelerator ideally suited to his field. His research flourished, and Greenlees established a world reputation for his work which contributed to the development of the optical model of the atomic nucleus. He continued experimental work until his retirement in 1993.

Earl Peterson retires

Professor Earl Peterson marked his retirement from teaching last Spring. Though now a Professor Emeritus, Peterson will still retain his position as Principal Investigator for several important experimental efforts including the MINOS far detector and the Soudan Underground Research Laboratory. Peterson said he plans to remain with MINOS for the rest of its run, and connect to the Soudan operation for "as long as it makes sense" to do so.

Peterson is also actively involved in the planning stages of the NuMI Off-Axis ν_e Appearance (NOvA) experiment. NOvA is a proposed experiment which will use a 20000 metric ton detector, to be located three miles south of Voyageurs National Park in Ash River, Minnesota. It is



designed to measure the probability that the muon neutrino will undergo a transition to an electron neutrino.

As the Principal Investigator for Soudan laboratory operations, Peterson has worked with a small business that makes high purity and low radioactivity copper. Jim Reeves, a retired Research from Pacific Northwest Laboratories is in charge of the effort, which brings copper sulfate down to the mine and produces copper under conditions shielded from cosmic rays. According to Peterson, the business operates in a small scientific niche market for highly pure copper to be used in detector experiments such as CDMS.

Peterson is also the P.I. for a small grant for educational outreach at the Soudan facility.

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Frank Wilczek is the Herman Feshbach Professor of Physics at the Massachusetts Institute of Technology. He was awarded the Nobel Prize with his former advisor David Gross and with David Politzer (who worked independently) "for the discovery of asymptotic freedom in the theory of the strong interaction." This research led to a whole new direction in physics called quantum chromodynamics.

Wilczek's lecture focused on how mass arises, explaining it in terms of more basic concepts. He also discussed the reasons for the weakness of gravity and discussed possible new physical phenomena that may be found with the large hadron collider.

The Misel lecture was very well attended with a standing room only crowd in Physics 150. Wilczek signed copies of his book, "Fantastic Realities: 49 Mind Journeys and A Trip to Stockholm," after the lecture.

The Irving and Edythe Misel Family Lecture series was made possible by a gift from Irving and Edythe Misel, honoring their family's life-long friendship with William and Bianca Fine.

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summer a statement of need was developed and submitted by the Dean to the Central Administration. Rough estimates suggest that the building could cost \$75,000,000. Hopefully the new building will be part of the 2008 request and will not be delayed until 2010. We are working hard, together with the Dean and the IT Development Office, to secure the College's share of the funds needed for the building.

On a sad note, Emeritus Professor George Greenlees, the well-known experimental nuclear physicist passed away last March. An obituary is also found on these pages.

–Allen Goldman



Newsletter

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