

A Letter from the Department Head

This fall, thirty-five new graduate students started their careers at Minnesota, approximately half domestic and half international students. They are a very lively bunch. Prospective students from the Chinese mainland were interviewed for both scientific and English skills by Professors Yuichi Kubota and Yong-Zong Qian, who traveled to China last January.

Two new junior faculty members, also joined the School this fall, Vincent Noireaux, from Rockefeller University, in biological physics, and Jeremiah Mans, from the University of Maryland at College Park, in experimental particle physics. Professor Noireaux is the second experimental biological physicist on the faculty. His research is directed at the development of a minimal artificial cell using DNA as a molecular algorithm. The arrival of Professor Mans substantially enhances our research efforts at the Large Hadron Collider at CERN.

This fall we reinstated the department picnic. It had fallen by the wayside with the switch from quarters to semesters. With a change from a spring to a fall picnic, we have created an opportunity for department members to get to know each other at the beginning of the academic year.

Finally we were all greatly saddened by the deaths of Anatoly Larkin, George Freier, and Walter Weyhman. Obituaries for these professors can be found on pages five and seven of this newsletter.

-Allen Goldman

A New Physics Building?

Institute of Technology Dean Steven Crouch met with faculty and staff of the School this summer to discuss developing plans for a new building. Crouch estimated that the new building would cost 100 million dollars, one-sixth of which, or approximately \$17 million, would need to be funded by sources outside the legislature. The University plans to include a proposal for the building in the 2008 bonding bill, with an expectation that construction would be completed by 2010 or 2011.

In the meantime, Crouch has set aside \$500,000 for planning and design. Part of that money will include a modest travel budget for the planning committee to visit recently constructed physics buildings at other universities.

The new building would be located on the current site of the broomball courts, northwest of the Civil Engineering building, "the last available piece of real estate that I.T. can build on." The broomball court has long been looked to for its potential as a building site.

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Faculty Authors

The challenges of writing physics for a general audience

It's not unusual for faculty to write textbooks and monographs on physics for their students and peers, but several faculty members of the School are writing physics books for general audiences.

Alexander Grosberg originally wrote his book *Giant Molecules* when he was living in the former Soviet Union. "There was a great culture of popular scientific books. It was considered the moral duty of every expert in the field," Grosberg said. Officially the book was meant for high school students but its main audience turned out to be professors who wished to keep informed of other fields of physics. Grosberg cited a number of challenges in writing his book. The first was that the subject was in biological physics, which used concepts from both physics and biology. These two fields did not talk to one another so it was a challenge to use terminology that was not only free of jargon but that could be understood by both fields as well as an intelligent, but not technically trained general audience. For example the word "vector" has three different meanings: in physics, mathematics and biology, none of which are related to one another.

When Grosberg decided to translate *Giant Molecules* into English he realized that the publishing process was much more idealistic in the former Soviet Union. The Russian version was inexpensive to produce, and was in a small format, on poor quality paper with black and white figures. It had the advantage of being sold for about 20 cents per copy, which made it available to everyone. The finished product in the U.S. is a much larger book with full color figures and a CD. The success of the English translation among students has inspired Grosberg to create a class on *Giant Molecules* for the Physics curriculum.

In 1989, the late George Freier first published *Weather Proverbs*, a collection of 600 weather related sayings. In the book, Freier discussed the possibility that these "old wives tales" may have some basis in scientific facts. One of the most well-known of his examples was an explanation of the supposed myth of Groundhog Day. Freier noted that the day typically is one of the coldest of the year. Statistically high and low pressure systems that move through a region on that day tend to be followed by similar systems. The days are longer and the sun is higher in the sky so by the time the weather systems move through, winter seems to have mostly passed. Freier's book went through several printings and is still available from Fisher Books.

Professor James Kakalios recently finished a book titled *The Physics of Superheroes*, a, published by Gotham Books. Kakalios' book describes the physics behind the actions of popular comic characters such as Superman, Spiderman and the X-Men. Kakalios, a long-time devotee of comics, began by creating a freshman seminar that addressed physics of the everyday world. He used his particular interest in comics to come up with the examples for the class, which were mostly basic physics problems and concepts taught to a non-physics audience. The Freshman Seminars can be taken by any student and often attract the attention of liberal arts majors interested in learning more about physics, but are intimidated by the math. According to Kakalios this is exactly the audience his book aims for—people who may never have thought about physics outside of their last required high school class. Kakalios was inspired to write for the general public because "the taxpayers, the people we expect to fund our work have a genuine interest in what we do."

Kakalios said his biggest challenge for the book was to find the right comic book examples. "There are no answers in the back of a comic book. You have to look at a situation and figure out what questions to ask about it and come up with an equation." The book does contain simple algebra and another challenge for Kakalios was to walk the reader through that as well. But he is confident that the comic book medium in the end will be a help to the reader. "Students rarely remember an equation outside of class, but they always remember a story."

Professor Mikhail Shifman, edited a book that is meant for a general audience and is a unique combination of mathematics and physics called *You Failed Your Math Test, Comrade Einstein*. The book is a collection of essays, both mathematical and memoir, that recount the policy within the former Soviet Union of keeping "undesirables" out of Moscow University by giving them nearly unsolvable problems. Shifman became intrigued with the subject when he ran across a set of the problems and set about trying to solve them for fun. With his years doing calculations as a theoretical physicist, he was surprised to find that some of the problems took him days to solve and others were simply intractable. These were problems given in a timed examination to college freshman so it was no wonder that the university was able to keep its undesirables from joining its student body. A second set of much easier and appropriate prob-

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Marco Peloso



Photo by Jenny Allan

Marco Peloso

particle physics are useful in cosmology.

The first area of Peloso's interest is in the so-called "re-heating phase" of the early Universe. In the first 10^{-35} seconds after the big bang, a very unconventional expansion, named "inflation," occurred. The field that drove this phase had very distinct properties from ordinary matter and radiation. The re-heating phase describes how the constituents of the present universe were created by the decay of this field. Re-heating was surely completed within the first second (and probably much earlier) after the big bang. At this time, nucleosynthesis, or the formation of light nuclei, occurred. Physicists have a clear knowledge of this later "hot big bang phase" because ordinary matter and radiation were driving it, and because the processes that characterize it involve physics which we can test on Earth.

The mysterious force that drove the inflationary phase is conventionally described by a scalar field, named the "inflaton." Although fundamental scalar fields have not yet been observed, they play an important role in particle physics, the most known example being the Higgs field of the Standard Model. The inflaton is required to have a very high mass (about 10^{-13} times greater than the one of the proton, in the simplest models), so there is no hope at present or in the near future to produce it in terrestrial accelerators. The energies required to create such a massive particle could only have occurred in the very early Universe. Consequently physicists look to the skies, where the remnants of the big bang processes are still observable.

For years, theoretical physicists investigated re-heating as a perturbative phase, or one in which single inflaton quanta decayed individually into ordinary matter and radiation. More recent theoretical studies have shown that in many cases the decay occurs through a non-perturbative process, in which the particles behave in an ordered manner. To explain the difference between perturbative and non-perturbative systems, Peloso uses

the example of a laser which, due to its order, behaves completely differently from ordinary light, which is instead disordered and incoherent. Peloso said that the non-perturbative processes involved at re-heating are extremely more efficient than the perturbative ones, and often harder to study. "To me, the model which displays non-perturbative effects is the most natural, but others might disagree," Peloso says, adding, "We don't have a working theory from start to finish."

Another area that Peloso studies is the physics of extra dimensions. Extra dimensions have been predicted by string theory, but Peloso is not a string theorist as such. His main interest is in understanding whether or not extra dimensions can ever be measured. One possibility relies in detecting the dynamical degrees of freedom which are associated with the perturbations of the extra space itself. These studies require theoretical techniques which are very close to the ones developed for cosmological perturbations. It is possible that extra-dimensions have never been observed simply because they are small. This begs the question, why didn't they expand with the rest of the universe? A natural possibility is the presence of a sort of a "rubber band" that prevents the expansion of the additional coordinates, although many different implementations of this idea have been proposed. It is therefore important to study the specific properties of the different realizations with the goal of identifying distinct phenomenological signatures.

Peloso also studies what he calls "the biggest mystery in theoretical physics," the acceleration of the universe. A few years ago it was observed that the expansion of the universe is actually accelerating and theoretical physicists are trying to understand why this is happening, "all of a sudden." Sudden in cosmological terms, can be defined as the last few billion years. There are two schools of thought on the causes of the acceleration. The most conventional one is that there is some sort of vacuum energy, which Peloso termed as "absurdly small" by any conceivable particle physics scale. A second possibility attributes the acceleration to a modified behavior of gravity at the largest observable scales. In the best case scenario, this puzzle may result in a profound change of our understanding of gravity. Peloso admits that this approach to gravity is highly unconventional, but says that the problem is a radical one, which possibly requires an equally radical solution.

Hawking Radiation Revisited

Exploding Microscopic Blackholes!

When School of Physics and Astronomy Professor Joseph Kapusta studied Hawking Radiation for a project in graduate school, he never thought he'd be revisiting the topic nearly thirty years later. "It was a hot topic at the time." Kapusta, spurred on by new papers on the topic, realized that it was time to look at Hawking Radiation again.

The famous British physicist Stephen Hawking theorized that if a black hole were small enough, it would emit matter, as a quantum mechanical effect. This is contrary to what we normally think of black holes—that they absorb all matter in their path, including light.

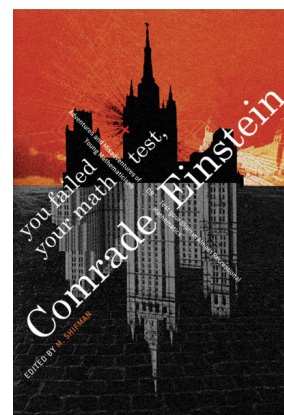
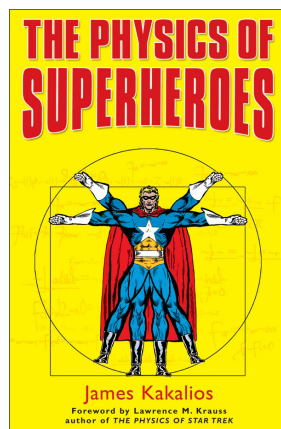
If a particle/anti-particle pair pops up near a black hole the particle is absorbed and the anti-particle escapes and the black hole loses energy. Hawking showed that the black hole is in equilibrium in space by losing and gaining energy. This effect is miniscule in large observable black holes. The scales of observable black holes are enormous, ranging from one star mass to millions of star masses in size. In such a large body the effect of a single anti-particle escaping would be completely unobservable. However, the amount of radiation emitted is in inverse proportion to the mass of the black hole. This means that if a black hole were very small, say the size of an atom, with a density of 1 % of the mass of the earth, it could have observable Hawking Radiation. If the mass gets too small or loses too many particles it will get too hot and explode.

This is where Kapusta and his research group come to the question. Theorists have speculated that Hawking Radiation may scatter and take the form of a "very hot wind." Kapusta has been able to calculate an "equation of state" which has let him determine the possibility of various particles including photons, electrons, positrons and neutrinos emerging from a microscopic black hole within its brief lifespan.

The most promising route for the observation of a microscopic black hole is to search the cosmos for sources emitting gamma rays or neutrinos of ever-increasing energy. If observed, the data may help physicists study new physics at energy scales well above those accessible to accelerators.

"Hawking Radiation is interesting because it deals with conditions beyond what we can observe on Earth." Kapusta added, "It's the link between Quantum Mechanics and General Relativity."

Faculty Authors continued from Page 4



The covers of Kakalios' and Shifman's books. Courtesy of Gotham Books and World Scientific Publishing.

lems were issued to students who were not considered politically dangerous.

Shifman decided to edit the book when he discovered a culture had sprung up around the problems. "There was a professor of mathematics, Sabatovsky, who devoted her life to helping students prepare for these exams, after she learned about the practice of killer problems." Shifman said "She started tutoring them for free in her spare time and got other teachers to help her. She helped over 300 students" Shifman explained that she died under mysterious circumstances and that many of her pupils felt that she had been murdered by the KGB who had previously failed in an attempt to criminalize her.

Half of Shifman's book is devoted to the mathematics problems and the other half is devoted to stories of people who took the exams. One of the essays in the second half of the book, "Intellectual Genocide," was originally published in underground circles within the former Soviet Union. The essay is written by two high school teachers who could not understand why their brightest students failed to gain entrance to the University. They quantitatively proved what was going on by using statistical analysis. Unfortunately for Shifman, the essay was never published in one piece in a single source. "I found pieces of it here and there. Finally I managed to contact the authors. They were very pleased and emotional that it would finally be published as a whole." Shifman said he enjoyed doing the research for the book, "It was like detective work and I got to know a lot of people I otherwise would not have."

Anatoly Larkin



Photo by Tom Foley

Anatoly Larkin, 1932-2005

Professor Anatoly Larkin of the School of Physics and Astronomy died on Thursday August 4, 2005 in Aspen, Colorado. Professor Larkin was 72. Larkin had been attending a physics workshop when he died unexpectedly.

Larkin was a leader of a renowned Russian school of theoretical physics. Many of his former students hold leading academic positions at universities and institutes both in Russia and the Western world. He was a recipient of many awards, including the Hewlett Packard Europhysics Prize, A Humboldt Award, the London Prize in Low Temperature Physics, the Lars Onsager Prize in Theoretical Statistical Physics and the Bardeen Prize for Superconductivity.

Larkin published more than 50 papers during his 10 years at the School, as well as the 600-page "Theory of Fluctuations in Superconductors. "Anatoly Larkin was a giant in the field of condensed matter theory and a great teacher of theoretical physicists," said Allen Goldman, head of the School of Physics and Astronomy.

Larkin was born Oct. 14, 1932, near Moscow. He started his career as a researcher at the Moscow Physical Engineering Institute, and went on to positions at the Landau Institute for Theoretical Physics and Moscow State University.

Larkin is survived by his wife Tatiana; his sons Victor and Ivan; his daughters-in-law Marina and Victoria; his grandchildren Alexander, Maria, Ilia, Anatoly and Timothy; and great-grandchildren Sofia and George. Larkin was cremated and his ashes taken by his family back for funeral services in Russia, which were held on Friday, August 19, 2005. FTPI plans to dedicate its spring workshop in condensed matter physics to the memory and research of Professor Larkin.

George Freier

Contributed by Prof. C. J. Waddington



Photo by ?

George Freier, 1915-2005

George Freier, Professor Emeritus of Physics, died on Friday May 18th, 2005, at the age of 90. George was born in Ellsworth, Wisconsin on the family farm and frequently described the harsh life on a farm in the early days of the last century. He graduated from River Falls State Teachers College in 1938 and taught in White Lake, Wisconsin until WW II. He received a Master of Arts degree from the University of Minnesota in 1941 and then worked in the Naval Ordnance Laboratory from 1942 to 1944, developing torpedoes. Returning to the University he was awarded a Ph.D. in nuclear physics in 1949, and was appointed an assistant professor in the same year. His studies with the nuclear physics group led to a number of important discoveries about the behavior of nuclear interactions at low energies. In particular he was the first to demonstrate the production of polarized beams of nucleons. He was promoted to full professor in 1958 at about the time that his interests switched to atmospheric physics.

His work with the high voltages of the University Van de Graaff accelerator led to his interest in thunderstorms and the electrical discharges that produced lightning. He switched his research work from nuclear physics to meteorology and this remained the main topic of his research for the rest of his career. After discovering that rain drops were often radioactive he developed a theory of rain drop formation in which the radioactive atoms lead to the nucleation of water vapor to form drops. Using simple but clever instruments he monitored every thunderstorm that occurred in the area, rushing to the roof of the Physics building every time a storm approached. He made a point of collecting all the folk weather lore that he could find and wrote a popular book, *Weather Proverbs* that discussed the basis and validity of all of the proverbs and weather related sayings he had found. He also had a lifelong interest in the theory and practice of music, building a number of string instruments and studying Newton's work on musical theory.

George was deeply committed to teaching and believed that the concepts and ideas of physics were best communicated by hands-on demonstrations. His "Demonstration Handbook for Physics" co-written with F. J. Anderson, was used in many universities. In 2002, the

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Awards and Announcements

Vainshtein to Receive Pomeranchuk Prize



John Lind Photography

Vainshtein

School of Physics and Astronomy Professor and member of the Fine Theoretical Physics Institute Arkady Vainshtein will receive the 2005 Pomeranchuk Prize in theoretical physics. Vainshtein will share the prize with his collaborator, Iosif Khriplovich of the Budker Institute for Nuclear Physics in Novosibirsk, Russia. The prize committee cited Vainshtein and Khriplovich for their “outstanding contribution to understanding the properties of the standard model, especially for illuminating work on weak and strong interaction of quarks.”

This prize, awarded by the Institute of Theoretical and Experimental Physics (ITEP), is intended to perpetuate the memory of Isaak Yakovlevich Pomeranchuk, the famous theoretical physicist known for work in many fields. Previous winners of the Pomeranchuk Prize, awarded annually since 1998, include S. Drell, J. D. Bjorken, T. Regge, and F. Dyson.

Rudnick Receives Outstanding Community Service



Courtesy of Rudnick

Rudnick

Professor Larry Rudnick of the School of Physics and Astronomy received a 2005 University of Minnesota Outstanding Community Service Award. Rudnick received the award in part for contributions to the Science Works! Program, the Minneapolis Planetarium and DragonflyTV.

Dahlberg Receives George Taylor Award



Courtesy of Physics Force

Dahlberg

Professor Dan Dahlberg of the School of Physics and Astronomy received the George Taylor Distinguished Service Award. Dahlberg and Larry Rudnick (see previous article) were recognized formally at the Institute of Technology Pre-Commencement celebration.

Peloso Receives Best Instructor Award

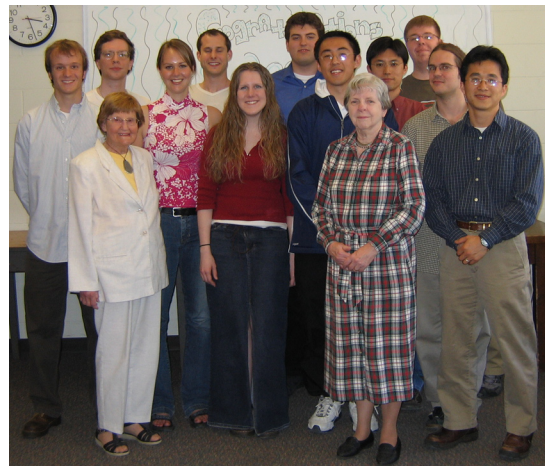


Photo by J. Allan

Peloso

School of Physics and Astronomy Professor Marco Peloso received a 2005 Institute of Technology (IT) Best Professor Award at an IT Week award ceremony. Peloso was chosen by an e-mail survey of all Institute of Technology undergraduates as the Best Instructor in the Physics Department.

2004 Student Awards



Left to right front row: Ardis Nier, Jennifer Dockter, Kay Blair, Jooho Park. Second row: David Toyli, Elizabeth Barnes, Yousi Ma, Tomo Matsumura, Peanut McCoy. Back row: Derek Lee, Greg McKusky, Kyle Zilic, Erik Aver.

Mrs. Ardis Nier presented the Alfred O. C. Nier Award and Mrs. Kay Blair attended on behalf of the J. Morris Blair Award.

Recipient

Elizabeth A. Barnes
David M. Toyli
Paul R. Shearer
Kyle T. Zilic
Yousi Ma
Tomotake Matsumura
Jooho Park
Erik J. Aver
Jennifer L. Docktor
Derek M. Lee
Bradley “Peanut” McCoy
Gregory M. McKusky
Xiaoxia Peng

Award

Alfred O.C. Nier
Harry & Viola St. Cyr
J. Morris Blair
Jeffrey Basford
The Hagstrum Award
Aneesur Rahman Award
Aneesur Rahman Award
Outstanding TA Award
Outstanding TA Award
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Outstanding TA Award
Outstanding TA Award
Outstanding TA Award

Our Development Officer



Photo by Tom Foley

Jennifer Payne Pogatchnik

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

Walter Weyhmann Class Notes



Weyhmann

Professor Emeritus Walter V. Weyhmann, 69, died on Saturday, September 24, 2005.

Professor Weyhmann, a graduate of Duke University, Class of '57, received his Ph.D. from Harvard University in 1963. He came to the University in 1964 as an Assistant Professor.

Professor Weyhmann made important contributions to the area of experimental low temperature physics including pioneering techniques in nuclear cooling which enabled the study of the properties of real materials in mK and sub-mK temperature range and the discovery of nuclear magnetic ordering PrCu_6 . The latter was the first observation of nuclear magnetic ordering in a metallic system. PrCu_6 is unusual, characterized by very weak coupling of its nuclear and electronic spin systems. Its magnetic ordering is dominated by the nuclear spin system. Professor Weyhmann's breakthrough with this material opened the door for much research in this and similar directions.

Professor Allen Goldman, praised Weyhmann's abilities as a teacher saying that his lectures were known for their clarity and completeness. He called him a pioneer at Minnesota in the way in which he taught thermal and statistical physics using more physical and understandable examples than had been traditionally used in those subjects.

Professor Weyhmann was promoted quickly to Associate Professor in 1968 and Full Professor in 1975. He served as Head of the School for 7 years (1975-82) and Acting Head for one year (1973-74). He was appointed Associate Dean of the Graduate School for Research in 1989 and continued in this position until 1993. He also served as Acting Dean of the Graduate School for two quarters during this period. Professor Weyhmann retired in 2001, but continued his research activities in his sub-basement laboratory until about a year ago.

Professor Weyhmann is survived by his wife, Rose; daughter, Elizabeth (Brian) Freeberg; grandchildren, Michael, Anna, Darryl and Peter; sister, Anita (Victor) Brugh; brother-in-law, Chester (Mona Jean) Fossee; several nieces and nephews.

Hassib Amini (Ph.D. '03) is currently working as a Senior Engineer at Seagate Technology in Bloomington, Minnesota.

Jennifer Anderson (B.S. '98) recently completed a Ph.D. in Geology at Brown University and returned to Minnesota with her husband, fellow alumnus Jeremy Anderson, for a fellowship at Carleton College.

Jennifer Blue (Ph.D. '97) is starting a tenure-track position at Miami University in Oxford, Ohio this fall.

Heather Brown (Ph. D. '03) and **Steve Wilkins** (B.S. '96) were married in October 2004. Brown is working at General Atomics in San Diego and Wilkins is working at the Genomics Institute of the Novartis Research Foundation in San Diego.

Luke Corwin (B.S. '03) is currently a graduate student at The Ohio State University. Corwin is working in the OSU BaBar group under Prof. Klaus Honscheid. This fall he will move to Stanford Linear Accelerator Center, which houses BaBar, to continue pursuing his Ph.D..

Phil Dudero (B.S. 1985) has returned to the department to pursue a Ph.D. in Physics. He married recently and he and his wife live in married housing on campus.

Jesse Johnson (B.S. '94) is currently an Assistant Professor of Computer Science at the University of Montana at Missoula. After completing his Bachelors at Minnesota he spent three years in Malawi as a Peace Corps Volunteer. He received a Ph.D. in Physics and a Masters in Computer Science from the University of Maine. He is married with two children.

David Kleinjan (B.S. '04) works designing fire sprinklers for Viking Automatic Sprinkler Company in St. Paul. He is planning to go to graduate school in 2006.

Earl Kyle (B. S. '61) currently a consultant and volunteer for NASA's Solar System Ambassador Program. Kyle is a former military/aerospace engineer/physicist whose designs have flown on Apollo manned moon missions, Skylab, Orbiting Solar Observatory, Delta rockets, and the SR-71 Blackbird. He has also served as a consultant for numerous aerospace corporations as well as on the Senate Space Shuttle Advisory Committee.

Dave Madland (Ph.D. '70) recently retired from 30 years in the nuclear physics group in the Theoretical Division at Los Alamos. His work included fission stud-

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ies, optical potentials, Hauser-Feshbach calculations, and the use of the Dirac equation in scattering and nuclear structure (relativistic mean field) studies. He was named an APS Fellow in 2003.

Christian Minor (B.A. '94) currently a Senior Staff Scientist for Nova Research, Inc. of Alexandria, Virginia and works as an in-house contractor for the Naval Research Laboratory, Washington, D.C.

James McLinn (M.S. '74) is a Senior Reliability Engineer at Teradyne Instruments. McLinn is a Fellow of the American Society for Quality and was named Distinguished Engineer in Minnesota in 2000 by the Minnesota Federation of Engineering Societies.

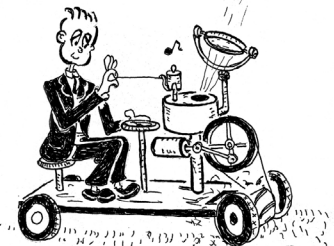
Jeff Nelson (Ph.D. '94) is an Assistant Professor at The College of William & Mary in Williamsburg, VA.

Elwood Nestvold (Ph.D. '62) retired from Shell Group in 1992. Since his retirement he has formed a consulting company in Oil and Gas Exploration and Production whose clients have included Schlumberger, IBM, YPF (Argentina), and Japex (Japan).

University named the demonstration room in the Tate Laboratory of Physics as the George D. Freier Lecture Demonstration Room in recognition of his work. He was honored by a Distinguished Service Citation from the American Association of Physics Teachers for his services to undergraduate teaching.

George retired from the University in 1985, when he reached the mandatory retirement age of 70. He was preceded in death by his wife, Phyllis, who was also a Professor of Physics at the University. He is survived by his son, David and daughter Susan, as well as three grand children.

Demonstration News



Cover Illustration from Demonstration News, a newsletter which Freier started to keep faculty abreast of the latest demonstrations. Freier did all the illustrations for the newsletter as well as his Handbook. This whimsical character often appeared in his drawings.



Newsletter

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Head, School of Physics & Astronomy

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To: