

A Letter from the Department Head

The months since the last newsletter have been quite eventful with some good news as well as sadness, with the death of Emeritus Professor Morton Hamermesh in late fall.

Mort was Department Head in Physics from 1965 until 1975 and during his tenure he hired approximately 29 faculty members. Although not all of these individuals remained at Minnesota, it was a period of substantial growth and development, a truly a golden period for the School of Physics and Astronomy. In early December we held a celebration of Mort's life, attended by his family, friends and colleagues. Although long retired, Mort was a regular in the School, up to the time of his death. He will be missed for his wry humor and profound insights into all aspects of human activity.

In September the Editor and Chief of the Physical Review, Dr. Martin Blume, on the occasion of his colloquium, dedicated a plaque in Room 143 that commemorates John Tate's 25-year long editorship of the Physical Review. A major section of this newsletter is dedicated to the discussion of Tate's role in the development of the major physics journals published by the American Physical Society. It is clear that Tate, after whom our building is named, had a major impact on the way physics is done in the United States and in the world.

This has been a banner year for recognition of faculty, postdocs and students through prizes and awards. I would like to take this opportunity to congratulate the many award recipients whose accomplishments are described in detail in this newsletter.

We hope that you enjoy reading this newsletter. If you have specific questions, please do not hesitate to contact me either by telephone (612) 624-6062, or by e-mail at <goldman@physics.umn.edu>.

Steven Chu Delivers 2004 Van Vleck Lectures



Chu

Steven Chu, Theodore and Frances Geballe Professor of Physics and Applied Physics, Stanford University delivered the 2004 Abigail and John Van Vleck Lectures. The public lecture, "Holding on to Atoms and Molecules with Lasers: From Atomic Clocks to Watching Biomolecules Move," dealt with the method he developed to cool and slow atoms using laser light. The colloquium, "What Can Physics Say About Life" focused on Chu's forays into biological physics. The techniques discussed in the Public Lecture were examined in detail for their applications in such problems as protein-folding at the single molecule level.

Professor Chu is an experimental physicist specializing in the areas of Atomic, Biological and Polymer Physics. Since joining Stanford in 1987 his studies have included the theory of laser cooling for real (multi-level)

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Tate Plaque Dedication

The School of Physics and Astronomy took the occasion of Dr. Martin Blume's colloquium to officially dedicate a plaque in Room 143 of the Tate Laboratory of Physics. The plaque commemorates John Tate's contribution as editor of the *Physical Review*. It is known that Tate used Room 143 as an editorial office during at least part of the time he edited the journal. Blume, who is Editor in Chief of the American Physical Society, delivered the colloquium, "The Physical Review and Physics Publishing, Past and Future (with particular mention of the Minneapolis years of the *Physical Review*)."

Professor Tate became Managing Editor of the American Physical Society and editor of the *Physical Review* in 1926. Under his editorship the *Physical Review* became the foremost physics journal in the world, quadrupling in annual number of pages, and tripling in circulation over the next quarter century. In 1929 Tate founded the *Reviews of Modern Physics* and edited it for more than two decades. In 1931, he started a new journal, *Physics* (now called the *Journal of Applied Physics*) and edited it for six years.

Blume's talk covered the history of the Physical Review. In the early years the publication was headquartered at Cornell University. It was created as the first American peer review journal exclusively devoted to physics. "The U.S. was a scientific backwater in 1894 (the year the journal was founded) and that was reflected in the early years of the journal," Blume said. According to Blume, there were many great scientific discoveries at the time in Europe such as the discovery of X-rays, radium, Planck's work on quantum mechanics and Einstein's Theory of Relativity, but these discoveries were first published in European journals. The leading scientists in America were Thomas Edison and Alexander Graham Bell, whose work was in applied physics. That's why there was a particular emphasis on creating a journal for fundamental physics research.

In the early years, Blume said there were few significant papers, but coinciding with Tate's editorship of the journal, "a torrent of spectacular papers (began) in the 1930s." Among the discoveries reported in *Physical Review* during the Tate years were Oppenheimer's theoretical work predicting Black Holes and the discovery of the technology behind lasers. Blume mentioned that the most cited paper of that era was by A. Einstein, B. Podolsky, and N. Rosen which attempted to prove that the quantum mechanical description of reality was impossible and put forward a hypothetical experiment to



Photo by Jenny Allan

Dr. Martin Blume and Professor Allan Goldman stand next to the plaque that was dedicated on the occasion of Blume's colloquium.

show the preposterousness of certain quantum mechanical behavior. These experiments were later performed successfully and helped demonstrate that quantum mechanics was indeed a reality. Blume noted that this paper is a good example of why "peer review doesn't necessarily mean a paper is right, but that it's worthy of scientific attention."

After Tate's death and a subsequent interim year, the *Physical Review* moved to Brookhaven National Laboratory, its present home. In the last twenty years, according to Blume, the biggest change has been the increase in submissions from Western Europe and the rest of the world; and internet technology. Blume gave a demonstration of PROLA, the *Physical Review* Online Archives which have linked and indexed all of the articles in every APS journals going back to 1894. "The information in journal form would stretch from one end of a football field to the other, and hang out over the end zones." The search engine allows physicists to track papers and citations, so that a literature review on a topic can be assembled in minutes rather than in hours spent at a library. Blume said that within five years, all the APS journals will be distributed only online and will cease to be published in paper journal format.

At the end of his talk, Blume presented the School with a specially inscribed copy of the book and CD-Rom "The Physical Review: The First 100 Years."

Mort Hamermesh Remembered



Photo courtesy of Madeline Hamermesh

Morton Hamermesh

Morton Hamermesh's family, friends and colleagues gathered in Coffman Union in December to remember his career and unique perspective on life. Born in 1915 in Brooklyn, NY, Hamermesh received a bachelor's degree from City College of New York (CCNY) in 1936 and a Ph.D. from New York University (NYU) in 1940. He taught at CCNY, Stanford University, and NYU, before serving as director of the Physics Division of Argonne National Laboratory.

In 1965, Hamermesh joined the University of Minnesota as professor and head of School of Physics and Astronomy, a post he manned until 1975, with the exception of one year spent at the State University of New York at Stony Brook. He retired from the University in December 1985. Morton Hamermesh died on November 14, 2003. Hamermesh's most significant contribution to physics research was his measurement of the magnetic properties of the neutron and electron neutron interactions.

The memorial program consisted of remarks from family and colleagues who were close to Mort, including Professor Steven Gasiorowicz from the University of Minnesota. Gasiorowicz talked about Hamermesh's influence on him as a graduate student in theoretical physics. At the time, Gasiorowicz was familiar with Hamermesh's work with Julien Schwinger on neutron scattering, and his work on no-go theorems, "but for me, the most important contribution was Mort's wonderful book on group theory. This came at a time when one could no longer go by the lazy man's dictum: anything you can do with group theory, you can do without it."

Gasiorowicz also talked about another valuable contribution Hamermesh made to physics, which was to translate many important physics works written in Russian into English. "Mort's translation of the Landau-Lifschitz Classical Theory of Fields made us aware of the treasures hidden in the books by these authors." Hamermesh's knowledge of Russian made him a sought

after translator and was fluent enough to allow him to attend Arkady Vainshtein's (now currently a Professor of Physics at the School of Physics and Astronomy) thesis defense in the former Soviet Union.

Professors Benjamin Bayman and Allen Goldman related Hamermesh's contributions as department head. Bayman talked about being on the search committee to replace Hamermesh after he left for Stony Brook, but the search committee learned that Hamermesh wanted to return to Minnesota. "As soon as we heard that Mort wanted to return," Bayman said, "we told the Dean that as far as we were concerned, the search was over – we wanted Mort back. I think that this story demonstrates very clearly the high value placed on Mort's leadership, both nationally and locally."

John Schiffer of Argonne National Laboratory, said that Hamermesh's leadership style is still felt to this day at the Laboratory. "Mort, with Lou Turner, literally founded the Physics Division at the Laboratory. His judgment of what was good science and what was nonsense allowed no room for compromise. He established the style that the prime responsibility of a scientist was to do first-rate science, and that it was the role of the Division's management to protect scientists from bureaucratic distractions."

One of the themes that came up frequently was Mort's unique approach to problem solving and learning. One of Hamermesh's lifelong loves was chess and he achieved world-class status, coming in 6th in the U.S. Chess Open in 1945. Hamermesh's love of the game also was apparent in his physics career where strategy came in handy solving complex problems. Hamermesh's brother, Bernard remembered that "Mort would do his calculations on butcher paper, pulling out a long sheet that covered the whole table," so that he could view a problem in one long take rather than having it broken up into pages. Bernard compared that to Mort's chess strategy which was to encompass the whole game rather than just segments of it.

Hamermesh's children and grandchildren talked about the fact that Mort kept the learning process going his entire life. He took classes in various languages including Mandarin up to his last years of life, spending a year teaching in China with his wife, Madeline, after he retired in the 1980s.

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New Faculty Profile:

Alex Kamenev



Photo by Jenny Allan

Alex Kamenev

Alex Kamenev is a theoretical physicist, whose principal area of study is condensed matter with an emphasis on the quantum physics of metals, semiconductors and

superconductors. His research examines the electrical and magnetic properties of these materials under various conditions, work which has application in miniaturization of electronics. At a certain size these properties change. The onset of quantum effects is extremely significant, since, for example, transistors are already at a submicron level and as they get significantly smaller they begin to show quantum effects.

Of particular interest to Kamenev's research is the mesoscopic or "in-between" scale, which describes devices containing thousands or even millions of electrons, yet which are sufficiently small that quantum coherence and interference effects play a major role in a system's behavior. For example, in the macro world, the conductance of a wire increases continuously with its diameter, but in the meso world the wire's conductance is quantized - i.e., the increases occur in steps. "The problem with the mesoscopic scale is that physical phenomena are very complex," Kamenev said, "and you can't calculate the behavior of millions of electrons with a computer." The well-developed theory of bulk materials is not applicable, either, so an entirely new framework needed to be developed which was based on many-body quantum field theory, not dissimilar to the approach used in high energy physics.

An additional complication arises from the fact that quantum interference patterns are extremely sensitive to impurities or disorder. This is why semiconductors are manufactured in clean rooms under extremely controlled conditions. Despite every effort taken in manufacturing, any real semiconductor will have some "dirt." Since the dirt has a large effect on the electrical properties and there is no control over where it will be, theorists attempt to predict device characteristics using statistical analysis. Quantum field theory in the presence of random disorder is a new and exciting area of theoretical physics and according to Kamenev even it's most basic principals are still the subject of hot debates.

Physics on the mesoscopic scale is further complicated due to the major role played by interactions between electrons. Kamenev uses a metaphor to explain strongly interacting versus weakly interacting systems. He compares a mesoscopic system to a small village, where one is forced to be dependent on one's neighbors to strongly interact with them in order to survive. A bulk system is like a big city, where one may go about one's business without even knowing one's neighbors names.

One type of strongly interacting mesoscopic system is the quantum dot. This is a small grain of metal or semiconductor, isolated from the outside world, so that electron transport to and from it is possible through quantum tunneling only. Quantum dots show an amazing sensitivity to the arrival or departure of a single electron. Besides being prominent candidates for device applications, quantum dots are ideal playgrounds for theorists and experimentalists to study various fundamental effects. In recent years quantum dots were used to study quantum chaos, the Kondo effect, mesoscopic superconductivity and host of other phenomena. Kamenev and his coauthors are currently working on a theory of large arrays of quantum dots also known as granular metals.

An essential feature of mesoscopic systems is that they are frequently far from equilibrium. Even a relatively small external voltage or a weak radiation field may drive a system into a nonequilibrium state. Due to its intrinsic disorder it may then take an extremely long time to equilibrate back. The theory of disordered nonequilibrium systems started to shape up only very recently. Physicists have been surprised to learn that electronic systems, chemical reactions and even biological populations are governed by very similar mathematical structures. "It is a great experience," Kamenev said, "when your expertise with solid state theory allows you to address problems in mathematical biology or even sociology."

"What I like about condensed matter theory," Kamenev said, "is its complexity and intellectual challenge on the one hand, and its connection to and dependence on real experiments, on the other. That link is sometimes weakened in other areas of physics. Condensed matter seems to be a most suitable background for quantum computing, theoretical biophysics, sociophysics and other novel areas. "I am sure," he said, "we are about to see an explosive grow in the diversity of applications for condensed matter theory."

Alumni Gifts Update



Photo by Tom Foley

Jennifer Payne Pogatchnik

financially significant gift than would have been possible during life.

If you have made a provision in your estate plans or would like to discuss a current gift to the department please call Jennifer Payne Pogatchnik at 612-626-9501 or jpogatchnik@it.umn.edu. Your plans and questions 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 future.

Providing for the School of Physics and Astronomy in your estate plan is a simple way to make a profound impact. There are many ways to make such a provision. Among the easiest is placing a bequest to the department in your will. Such a gift does not deplete needed income for living expenses, and often allows you to make a more

Class Notes

Derek Sturges (MS '60) After receiving his Ph.D. in Engineering from the University of Minnesota in 1965, Sturges worked for three years in England on an ionospheric physics research program, as a staff member at Birmingham University. Sturges joined General Electric (GE) in Lynn, MA, with responsibilities in glow-discharge casehardening of steel, and Non-Destructive Testing. In 1979, he moved to GE's aircraft engine business, with full-time concentration on NDT. Sturges retired in 2000, after 20 years in Cincinnati, specializing in the statistics of flaw detection processes. He is married with 5 children and 3 grandchildren and currently splitting his time between Ohio and Michigan.

Jeong-Sun Hwang (M.S. '02) married Soo-Hyeon Nam on August 10, 2002. Her husband, Nam, is a fourth year graduate student in physics at the University of Minnesota.

Tom Wald (B.S. 1997) is a computer programmer at the College of Communication at the University of Texas at Austin and runs a side-business as a photographer: < <http://photoecho.com> > .

Dark Matter Experiment Narrows Search for WIMPs

The first results are in from the CDMS II (Cryogenic Dark Matter Search) experiment in Soudan which is looking for WIMPs, postulated Dark Matter particles. So far, the experiment has found no WIMPs, but neither has it found contamination from stray neutrons. CDMS II member Professor Priscilla Cushman, of the School of Physics and Astronomy, is delighted. "It is actually very satisfying to see nothing on our first run because it establishes the degree of background rejection we have been able to achieve," said Cushman. "We hope the next run will reveal the elusive dark matter particle."

The experiment seeks to catch the extremely unso- ciable WIMPs interacting with matter—specifically, the nuclei of germanium or silicon atoms. The germanium and silicon detectors, which resemble hockey pucks, are stacked inside a detection chamber 2,341 feet below the surface of the Earth. The Earth's filters out cosmic rays and other stray particles. An interaction between a WIMP and a germanium or silicon atom would produce a movement of electric charge and the generation of heat, but so little of both that the detection chamber must be cooled to a tenth of a degree above absolute zero to achieve appropriate sensitivity. But neutrons generated under- ground could pass through the apparatus and produce a signal similar to that expected for a WIMP. The first data, however, show no neutrons sneaking through, meaning the background is low enough to give the experiment a very good shot at detecting WIMPs.

University of Minnesota physicists have supplied theoretical underpinnings for CDMS II. Physics profes- sor Keith Olive and his colleagues have applied data from other experiments and observations of the cosmos to predict what the CDMS II detection system will find and how sensitive it must be. "We're shaping expectations," said Olive. "For example, we know about how much dark matter there is. That, combined with accelerator searches, translates to limits on the WIMP mass and the rate of its interactions with ordinary matter."

The presence of dark matter in the universe is detected through its gravitational effects on all cosmic scales, from the growth of structure in the early universe to the stabil- ity of galaxies today. Most astrophysicists believe that this unseen "dark matter" cannot be made of the ordinary matter forming the stars, planets and other objects in the visible universe. WIMPs produced in the early universe are a major contender for this mysterious component.

More information can be found online at < cdms.berkeley.edu/index.html > .

Awards and Announcements

Larkin Receives Bardeen Prize

Professor Anatoly I. Larkin was a co-recipient of the 2003 Bardeen Prize for “work on the Theory of Vortex Matter.” This prize is “awarded for theoretical works which have provided significant insights on the nature of superconductivity and have led to verifiable predictions.” The prize was awarded in 2003, at the 7th International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors in Rio de Janeiro, Brazil. Professor Larkin shared the prize with Professor David Nelson of Harvard University and Dr. Valerii Vinokur of Argonne National Laboratory. The Bardeen Prize is given by the International Conference on Materials and Mechanisms of Superconductivity and High Temperature Superconductors and is named for Nobel Laureate, John Bardeen, who was an assistant professor of physics at the University of Minnesota from 1938-41.

Kakalios Receives Charles E. Bowers Faculty Teaching Award

Professor James Kakalios received the Charles E. Bowers Faculty Teaching Award, which honors exceptional interest and commitment to teaching. Kakalios was formally recognized at the Institute of Technology Pre-Commencement in 2003. The Charles E. Bowers Award was established by a graduate of the Physics program, John E. Bowers in honor of his father Charles “Ed” Bowers who was a professor of Civil Engineering at the University of Minnesota for fifty years.

Dahlberg Receives University Outstanding Community Service Award

Professor Dan Dahlberg was among five sets of recipients of the 2003 Outstanding Community Service Award. The award recognizes outstanding contributions and accomplishments of University community members who have worked to improve public life and the well-being of society. Dahlberg was honored for his leadership of the Physics Force, an outreach program that has demonstrated physics principles to thousands of young people.

Kapusta Elected AAAS Fellow

Professor Joseph Kapusta was recently elected a fellow of American Association for the Advanced Science for the physics section.

Olive Elected APS Fellow

Professor Keith Olive has been elected as a Fellow of the American Physical Society (APS). The APS cited his “contributions toward the development of astroparticle physics. In particular, for work done on early universe cosmology, including pioneering efforts in big bang nucleosynthesis and supersymmetric dark matter.”

Mueller Named McKnight Professor

Professor Joachim Mueller was named a McKnight Land-Grant Professor for 2004-2006. In 1987, the University of Minnesota Graduate School established the McKnight Land-Grant Professorship, a program of career development awards for junior faculty. The McKnight Land-Grant Professorship was named for a significant endowment gift from the McKnight Foundation that was then combined with a share of the Permanent University Fund (PUF). This Fund, released to the University by the legislature in 1985, came from the original Land Grant to the University. The name of the Professorship emphasizes this public-private partnership.

Steiner Wins APS Award

Dr. Andrew Steiner, Research Associate, received the APS, Division of Nuclear Theory 2004 Dissertation Award. Steiner’s dissertation which was done at SUNY, Stony Brook under the direction of Madappa Prakash. He was given the award “For his in depth studies of the phase structure of dense matter containing quarks, neutrino-quark interactions, superconductivity in quark matter, and in particular for the delineation of the neutrino signals which are likely to reveal the structural components of dense matter.”

Kamenev Receives Sloan Fellowship

Professor Alex Kamenev has been selected as an Alfred P. Sloan Fellow. The Sloan Fellowship is an extraordinarily competitive award involving nominations for most of the very best young scientists from around the country. The Sloan Research Fellowship carries with it a grant of \$40,000, to be used in support of Professor Kamenev’s research.

Marshak Appointed IT Distinguished Professor

Professor Marvin Marshak was appointed as an Institute of Technology Distinguished Professor on May 7, 2004. The appointment is in recognition of his unusual efforts in, and contribution to teaching; his reputation as a scholar; and his genuine commitment to the Institute of Technology and its activities. The appointment includes a one-time grant of \$15,000 from the George W. Taylor Trust Fund to be used at Marshak's discretion.

Voloshin to Receive Humboldt Award

Professor Mikhail Voloshin will receive the Humboldt Research Award for Senior U.S. Scientists. The award, includes a grant to do collaborative study at the University of Bonn in Germany is in recognition of Voloshin's "past accomplishments in research and teaching." The Alexander von Humboldt Foundation was established in 1860 originally with the aim of sponsoring research travel abroad by German Scholars. Since 1925, the Foundation's primary aim has been to assist non-German scholars in undertaking research in Germany.

Kellogg selected as AGU Fellow

Emeritus Professor Paul Kellogg of the School of Physics and Astronomy has been made a Fellow of the American Geophysical Union (AGU). Kellogg was cited "in recognition of his theoretical contributions that defined the emerging field of space plasma physics. In particular, for his predictions of the collisionless bow shock, the structure of the natural and artificial radiation belts, and the physics of plasma waves in the earth's foreshock and from the sun."

Heller elected VP of AAPT

Professor Ken Heller was elected to be Vice President of the American Association of Physics Teachers (AAPT) for the year 2004. 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.

Maier Received 2004 President's Student Leadership and Service Award

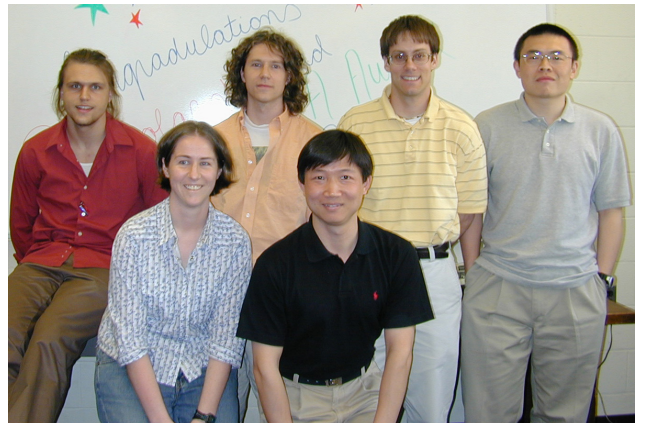
Emily Maier, Research Assistant, has been selected to receive the 2004 President's Student Leadership and Service Award. Maier was selected from a pool of 100 nominees for the award which recognizes outstanding student leaders at the University of Minnesota. Maier received the award at a banquet at Coffman Memorial Union on May 3, 2004.

School of Physics and Astronomy Scholarship Awards



From Left to Right: David Molitor (St. Cyr Scholarship), Kyle Zilic (Nier Scholarship), Ardis Nier, Elizabeths Barnes (St. Cyr Scholarship), Kay Blair, Derek Lee (Hagstrum Award), Arthur Obiadazie (Marquit Grieser Scholarship), Jonathan Strand (Aneesur Rahman Award). Missing from photo are: Bradley Froehle (Nier Scholarship), Yousi Ma (Blair Scholarship) Jacob Haqq-Misra (Bastford Scholarship), Mathew Steuck (Hagstrum Award) & Selina Li (Aneesur Rahman Award).

Teaching Assistant Awards



From Left to Right: Aaron Martell, Beth Masimore, Johannes Hubmayr, Tao Qian, James Reichling, Rui Zhang

atoms, the first atomic fountain and cesium frequency source and atom interferometers based on optical pulses of light. In 1989, he introduced optical tweezers methods to simultaneously visualize and manipulate individual bio-molecules. Chu and his group have also applied fluorescence microscopy in single molecule studies of protein and RNA folding, translation and proofreading by the ribosome, and vesicle fusion.

Chu has been recognized for his outstanding research with many awards including the 1997 Nobel Prize in Physics, which he shared with William Phillips and Claude Cohen-Tannoudji “for the development of methods to cool and trap atoms with laser light.” Chu’s Nobel-cited work included the first laser spectroscopy of positronium and muonium, faster-than-light pulse propagation, the laser cooling of atoms (optical molasses), the optical trap (optical tweezers) for atoms and particles and the magneto-optic trap (MOT).

Physics Force a Hit at the State Fair

Physics Force, the Original Force was awarded a contract to perform at the public bandstand at the Minnesota State Fair in 2003. In previous years, the group has performed at the University of Minnesota exhibit, but the larger venue and publicity provided by the State Fair, allowed the group to perform to a much larger crowd of people. Force member, Professor Dan Dahlberg estimated that the group played before thousands of people during its three shows. Since the group was contracted performers they were paid for their efforts. Proceeds from the show were donated by members back to the group so that they can continue their outreach efforts to schools around Minnesota. The Physics Force has been invited to perform at the 2004 State Fair.

Hamermesh continued from Page 3

Madeline Hamermesh said she will always remember her husband as the “skinny, nervous graduate student,” she met in 1938 at NYU.

Hamermesh is survived by his wife, daughter, Deborah White; sons Daniel and Lawrence; six grandchildren, and seven great-grandchildren.



Newsletter

Allen M. Goldman
Head, School of Physics & Astronomy

Send article suggestions and additions/deletions for the newsletter mailing list to:

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To: