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Department of Physics Newsletter: Spring 2004

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UMass Amherst Launches Nanotechnology Center

Small is Beautiful

Many of us thrive on superlatives, such as the biggest and the tallest, but not our condensed matter physicists. They are in pursuit of extreme miniaturization, the smallest. Their effort goes under the name of nanotechnology, where the prefix “nano” means one-billionth. Nanotechnology involves working in the size range of a billionth of a meter, about the distance across ten atoms lined up one after the other, too small to be seen with our best optical microscopes. Nanoscale devices and systems lie between the quantum and classical regimes, and ever more interesting applications are arising from the novel and unexpected properties that they may have. The National Science Foundation predicts that nanotechnology will generate about \$1 trillion per year in new technologies and products by 2015, and will create jobs for about 2 million specialized workers. Technology analysts agree that the coming decades will see nanotechnology fundamentally transform the electronics, medical, chemical, and textile industries, and many others. As Richard Feynman once said, “There is plenty of room at the bottom!”



Mark Tuominen, Tom Russell, and Jim Watkins standing on the image of an array of nano holes in a polymer. (“Honey, I shrunk the investigators!”)

The Department of Physics is playing a major role in the establishment of a nanotechnology center on our campus, to be called **MassNanoTech**. **Professor Mark Tuominen** will serve as a co-director with **Jim Watkins** of Chemical Engineering. **Tom Russell** of Polymer Science and Engineering, current director of the Materials Research Science and Engineering Center, will serve as the associate director.

UMass Amherst is at the forefront of nanotechnology research. Over the last three years we have been seventh in the nation in new nanotechnology funding. Research breakthroughs include polymer self-assembly techniques developed by **Russell** and **Tuominen**, who have used these techniques to create arrays with densities of more than a trillion nanowires per square inch. Such arrays are expected to lead to commercial innovations in magnetic storage of data and other key applications. Mark tells us that “with techniques like this we have the potential to get the contents of 25 DVD movies on a disk the size of a quarter.”

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A Letter from the Department Head

Dear Friends and Alumni,

One of the most exciting developments on campus this year is the creation of the MassNanoTech Center, co-directed by **Mark Tuominen**. The Center is interdisciplinary involving the Physics, Polymer Science, Chemistry, and Chemical Engineering Departments, and represents a major step forward in creating shared instrumentation facilities, partnering with industry, and in attracting new state and federal funding. UMass Amherst is now seventh in the country in Federal funding of nanoscience.

Although budget constraints precluded hiring new faculty last year, we are now in the midst of searches for faculty in high-energy theory, nuclear experiment, nanoscience, and in biophysics, the **Robert L. Gluckstern Professorship**. Though we will not be able to fill all of these positions this year, I am confident that we will be able to do so within the next two years. Because the new hires in biophysics and nanoscience require renovated space, we have major remodeling projects underway on the third floor and in the basement of the Hasbrouck Laboratory.

Last year was a time of transition for our faculty. **Art Swift** retired in September but continues to serve as Associate Department Head. **Fred Byron** retired last fall after many years as Interim Vice Chancellor for Research. **David Scott** and **Ross Hicks** took early retirement effective January 1, 2004. Ross plans to return to his native Australia this summer. **Ed Chang** serves half-time in the department and half-time as Associate Dean for Advising for the College of Natural Sciences and Mathematics (NSM), having replaced **Jim Walker** who retired June 30, 2003. Finally, we are pleased to welcome back **Mike Kreisler** to the faculty after a decade of service to the country at the Lawrence Livermore Laboratory and in Washington at the Department of Energy.

A few of the many achievements of our faculty deserve special mention. **John Donoghue** was the winner of the NSM Outstanding Service Award for 2003 following **Barry Holstein's** receipt of the NSM Outstanding Research Award



for 2002. John and Barry are both on the all-time list of the 260 most cited high-energy theorists along with likes of Richard Feynman and Murray Gell-Mann. Together, their work has been cited more than 10,000 times in the scientific literature. The first results of **Krishna Kumar's** experiment at the Stanford Linear Accelerator Center are in press. Kumar is the lead investigator in this multimillion-dollar experiment with 60 collaborators from 10 institutions. It represents a new level of precision in testing the Standard Model of particle physics and is acknowledged as a technical tour de force.

Our Department hosted two superb public lectures this year (*see the People section for more details*). **Lawrence Krauss**, noted cosmologist from Case Western Reserve University and author of the "Physics of Star Trek," gave an exciting public lecture in October as part of the Five College Undergraduate Physics Colloquium Series. His talk on the cosmological constant and the discovery of a mysterious acceleration in the expansion of the Universe attracted a spellbound audience of over 300. In March, **Douglas Osheroff**, Nobel Laureate in Physics from Stanford and a member of the Space Shuttle inquiry committee, drew an equally large public audience and gave a fascinating talk on the causes of the Columbia shuttle disaster. Osheroff's visit was co-sponsored by the Commonwealth Honors College, and during his stay he discussed a broad range of topics with physics honors students.

Budget issues are much better than they were when I wrote to you last year, thanks to the dynamic leadership of **Chancellor**

John Lombardi, and improvements in the state budget. Nonetheless, it is clear that public funding from state and federal sources and student tuition are but two of three essential pillars of support for the Department. Private gifts from friends and alumni are equally important for maintaining and building on our excellence in teaching and research. This year your gifts were used for everything from purchasing new oscilloscopes for the teaching labs, to supporting the activities of the Society of Physics Students, to sending graduate students to conferences.

We would love to hear from you, and if you are in the vicinity, please stop by to say hello.

Sincerely,

A handwritten signature in cursive that reads "Jon Machta".

Jon Machta
(machta@physics.umass.edu)

University of Massachusetts Amherst
Department of Physics Newsletter

Editors: Bob Krotkov
Gerry Peterson
Monroe Rabin
Hajime Sakai

This fourth issue of our newsletter is being sent to more than 1,200 of our alumni and alumnae who received degrees in physics from the 1930's to the present, and to present and former staff and faculty. For more information about our department, visit our website at <http://www.physics.umass.edu> Comments about the newsletter or information about yourself may be sent to the address on the last page or e-mailed to us at newsletter@physics.umass.edu.

RESEARCH

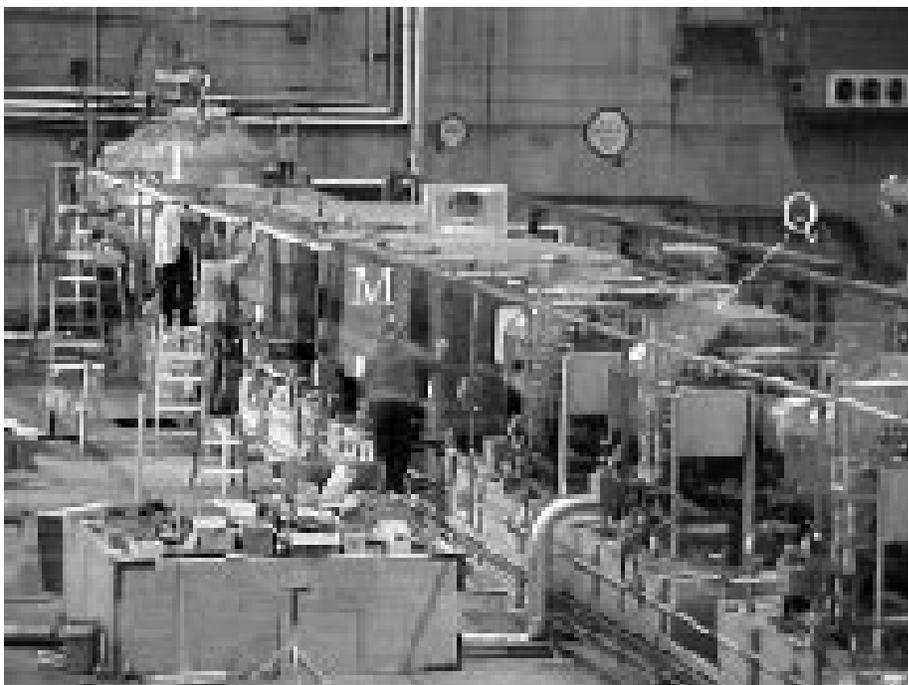
NUCLEAR/HIGH ENERGY PHYSICS

PARITY VIOLATION IN ELECTRON-ELECTRON SCATTERING

Professor Krishna Kumar leads a 60-member collaboration at the Stanford Linear Accelerator Center (SLAC) in a precise experiment that tests the Standard Model of particle physics. His collaborators are from Syracuse, Cal Tech, Princeton, Saclay (France), Berkeley, Virginia, and SLAC, as well as a sizeable contingent from the UMass Amherst Nuclear Physics Group. The experiment used a 50 GeV polarized electron beam that scattered from the electrons in hydrogen atoms contained in a 1.5-meter long liquid hydrogen target. Such electron-electron (e,e) scattering probes parity violation, and thus provides a measure of the weak force between two electrons for the first time. Until the 1950's physicists thought that parity was conserved, i.e., that the universe was mirror symmetric, e.g., a top spinning clockwise (right-handed) would behave the same in the real world as its mirror counterpart, a top spinning counter-clockwise (left-handed). Since then, experiments have shown that the strength of the weak force is different for right- and left-handed electrons. At SLAC the electrons in the beam can be made to have their spins oriented parallel or anti-parallel to their momentum, i.e., they can have either right- or left-handed polarization. But the left-handed electrons are about 10% more likely to exchange a Z boson (a carrier of the weak force) than a right-handed electron, and hence give rise to parity violation. (The electromagnetic, strong, and probably gravitational interactions conserve parity, but not the weak.) However, the electron interacts primarily by exchanging a photon in an electromagnetic interaction by a ratio of about a million to one compared to a Z exchange in a weak interaction. Further, many of the electrons that strike the target involve electromagnetic scattering from the proton (e,p scattering), so it is necessary to distinguish the (e,e) scattering from (e,p) scattering. This is accomplished by using a series of spectrometer magnets and special detectors. In a single beam

pulse consisting of about 500 billion electrons, the detectors see about 10 million electrons that scattered from target electrons. Of these, a left-handed pulse will produce about 11 from Z exchanges compared to about 10 in a right-handed pulse. "In order to measure the difference in Z exchanges accurately (parity violation), we needed to repeat the comparison of left- and right-handed pulses 400 million times to get the desired 10 percent accuracy," said Kumar. Experimentally, this meant measuring the asymmetry in the scattered flux to an accuracy of about 20 parts per billion; the expected value is about 200 parts per billion. This required many months of running at a rate of 120 beam pulses per second.

Data taking was completed this past summer, and data analysis is being led by **Yury Kolomensky** from Berkeley (UMass Amherst Ph.D. '97). A Physical Review Letter will be forthcoming giving the result obtained thus far. The reported result has sufficient accuracy to demonstrate decisively that the electron-electron interaction is not mirror-symmetric. [For those readers familiar with the Standard Model notation, the result is $\sin^2\theta_w = 0.2293 \pm 0.0024$ (statistical) ± 0.0016 (systematic) ± 0.0006 (theory).] (This article borrowed substantially from an article in the "SLAC Beam Line" by **Heather Woods**, Research Professor **Steve Rock's** daughter.)



Some of the equipment used in the parity violation experiment. The electron beam enters the large evacuated chamber (T) in the upper left that contains the liquid hydrogen target. Both the beam and the scattered electrons pass through dipole-magnets (M) followed by quadrupole magnets (Q) in the lower right that separate the scattered from the unscattered electrons.

ASTROPHYSICS

Astrophysicists are always looking for new ways to study the universe. Since the 1980's they've sought to extend the spectrum of observed radiation to very high energies (50 GeV and above), a regime traditionally considered the domain of particle physicists. Very high energy (VHE) gamma rays are of special interest because of their ability to probe some of the most powerful objects in the universe, including distant galactic nuclei, supernovas, and pulsar-powered nebulae. VHE gamma rays can also be used to search for and study fundamental new physics phenomena such as primordial black holes, the effects of quantized space-time on the propagation of light, and the annihilation of heavy new particles in galactic dark matter halos. **Professor Guy Blaylock** and graduate student **Jennifer Joyce** are participating in these astrophysical explorations with their contributions to a Very High Energy Radiation Imaging Telescope Array System (VERITAS), a gamma ray telescope array scheduled to be built in Arizona over the next few years.

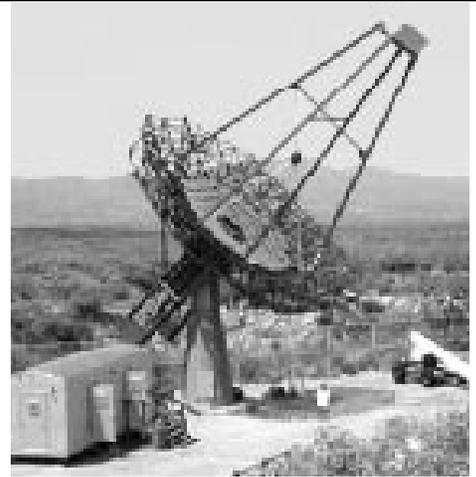
VERITAS is one of a new breed of gamma ray telescopes comprised of an array that looks in the optical range for Cherenkov radiation produced by gamma ray showers in the upper atmosphere. (Cherenkov radiation occurs when a particle is travelling faster than the speed of light *in a medium*. For VERITAS the medium is the atmosphere. See the contribution by **Steve Churchwell** in the Alumni News Section on page 12 for another astrophysics experiment where the medium for the Cherenkov radiation is the Antarctic ice.) At these highest of energies, a gamma ray entering the atmosphere interacts with air molecules at an altitude of 10 to 20 kilometers and produces an electromagnetic shower containing millions of particles and stretching over several kilometers. The charged particles in the shower emit Cherenkov radiation that illuminates tens or hundreds of square kilometers on the ground. Optical telescopes on the ground sample this radiation and form an image of the shower. The intensity, shape, and orientation of the image can be used to

distinguish between gamma-ray-induced showers and other cosmic-ray-induced showers, as well as determine the direction of the primary gamma ray. In this way, the atmosphere is employed as a sampling calorimeter with a very large effective area. Because optical radiation is sampled, a dark and moonless night is preferred for observation.

The atmospheric detection technique has matured significantly since the early 1990's, when the Crab Nebula became the first celestial object identified as a source of VHE gamma rays. Today, eighteen sources of gamma rays have been observed using this technique, including active galactic nuclei, supernova remnants, pulsars, and even previously unidentified sources. VERITAS and its contemporaries hope to detect hundreds of new sources over the next few years, enabling not only detailed studies of astrophysical sources, but also explorations of fundamental new physics.

During the spring and summer of 2003 the prototype telescope for VERITAS was assembled and installed at the base of Mount Hopkins, about 30 miles south of Tucson, Arizona. The VERITAS proposal was fully approved on Sept. 26, 2003 as a joint funding effort between the National Science Foundation and the Department of Energy. This decision followed three years of funding negotiations and was none too soon: first light on the prototype telescope, that will become the first telescope in the array, had already been seen two days earlier. Complete commissioning of the telescope and development of the data acquisition system continues throughout 2004. UMass Amherst contributions to the experiment so far focus on software development, including database and software repository management.

Over the next few years the VERITAS collaboration will construct an additional three telescopes. The complete four-telescope array will be installed at the top of Kitt Peak, and will be fully operational by 2006 to reconstruct stereoscopic images of gamma ray showers. In the not too distant future, data from this experiment



VERITAS prototype telescope for observing Cherenkov radiation

will form the basis of a new field of particle physics research in the sky.

UNDERGRADUATE RESEARCH

Undergraduates may undertake faculty supervised research projects. As an example, **Ryan McGorty**, a junior, guided by **Professor Tony Dinsmore**, is attempting to encapsulate living bacteria in a water droplet surrounded by a shell of other particles. The procedure Ryan developed starts with oil containing microscopic particles in suspension. He then adds some water containing bacteria so as to make droplets. The particles completely coat the droplets and form a shell around them. They are then pulled through the oil by using a centrifuge to move the denser water through the less dense oil, resulting in coated droplets suspended in water. In practice the water has various salts and nutrients added to it for benefit of the bacteria, as advised by collaborator Professor Mark Goulian of the University of Pennsylvania, who also provides the bacteria. Preliminary results in keeping the bacteria alive in the droplets look promising. Such encapsulation of bacteria could be potentially useful in various biological processes, and if mammalian cells could be encapsulated, there could be many clinically useful applications.

Continued on page 5

Continued/Undergraduate Research

Ryan started the project in the summer after his freshman year by using paramagnetic particles in order to find their response to a uniform magnetic field. Since such particles are confined to a spherical surface, they cannot form linear chains as they would in bulk, leading to novel statistical mechanical properties.

Continued from Nanotech front page

The center will build upon currently existing on-campus research and development efforts in nanotechnology, and facilitate the creation of new ones, particularly those involving industrial partners. State-of-the-art fabrication facilities will be provided that will enable new basic research and technology-based economic development. It will be possible to build systems atom by atom to create larger structures with fundamentally new properties and functions.

Besides cooperative programs with Massachusetts industry, a significant thrust will also be made in education, training, and outreach through programs such as “Research Experience for Undergraduates” and “Research Experience for Teachers,” both sponsored by the National Science Foundation.

The development of the center will require tens of millions of dollars in funding from the university, the state, the federal government, industry, and private donors. The MassNanoTech program will be a very cooperative, coordinated effort with the Massachusetts Technology Collaborative, Mass Insight, and other programs to promote the state’s science and technology strengths in nanotechnology.

Other physics professors active in nanophysics are **Tony Dinsmore**, **Alex Levine**, **Nikolay Prokofiev**, and **Don Candela**. For example, **Tony Dinsmore**, who joined us in 2001 (*Spring 2002 issue of this Newsletter*), made a membrane composed of 5 nm CdSe nanoparticles (“quantum dots”) whose macroscopic lateral size is of the order of 1 cm^2 but whose thickness is only 5 nm, one nanoparticle thick! The membrane



One nanoparticle thick self-assembled membrane of CdSe.

was formed by self-assembly of the nanoparticles at the interface between water and oil. This composite membrane is a model system for studying the crumpling of thin sheets. These membranes can be made from a mixture of particles with distinct properties, leading to the potential for new materials for encapsulation and stimulated release of drugs. The research has been carried out in collaboration with faculty and students in the Departments of Physics and of Polymer Science and Engineering. It is an example of the collaborative and interdisciplinary nature of current nanoscience research.

The past decade has seen rapid advances in two initially unrelated areas: nanotechnology and molecular biology. **Alex Levine** is currently exploring the mechanics of nature’s smallest nanomachines – proteins, that at the scale of microns (1000 nanometers), form super-molecular aggregates such as the filaments that make up the scaffolding of the cell – the cytoskeleton. This complex network of filaments is the site of cellular force sensing, and generation, and it establishes the mechanical integrity of the cell. Perhaps a better understanding of biological nanomachinery can play a role in the design and engineering of useful nanodevices based on, or mimicking, biomolecules. Elucidating the underlying machinery of life at the molecular level already depends on our growing ability to manipulate nanoscale matter. Alex has been doing theoretical work on the response of simulated cellular networks

to applied stresses. He finds that dense networks tend to store elastic energy by stretching, while in less dense networks it is stored in bent filaments.

Theorist **Nikolay Prokofiev** is working in another exciting area of nanophysics: quantum computers. In such a computer the single bit (0 or 1) of classical computers would be replaced by a *qubit* that in principle can be used to store much more information. In the computer on your desk, a single bit lives for years (memory is not forgotten). A problem to be overcome in proposed quantum computers is that of *decoherence*: in practical realizations of qubits, a superposition of qubit states lasts for only a very small fraction of a second. For example, for qubits realized as magnetic macromolecules, the measured decoherence time is about a nanosecond. Nikolay has been studying the interactions of such magnetic molecules with neighboring spins and finds that these interactions can quantitatively explain the short decoherence time. He finds similar results for “flux qubits,” in which an electrical current goes around a nanoloop in two directions at once. (It seems strange, but that’s quantum mechanics!)

Don Candela and his students are using nuclear magnetic resonance to study the crystal structure of magnetic nanowires that are being grown by students in Mark Tuominen’s group. The cobalt wires are tens of nanometers in diameter, of controllable length, and are electrodeposited in the pores of membranes made of diblock co-polymers (like the “floor” in the picture on page 1). The magnetic properties of such nanowire arrays are interesting both from a fundamental point of view and also from the viewpoint of magnetic memory for computers.

The campus’ nanotechnology program will be further strengthened when the **Robert L. Gluckstern Professorship** is filled by an experimental biophysicist. The combination of nanotechnology and biophysics is very promising.

TEACHING

Undergraduate Program

Undergraduate Laboratories

Laboratory courses play important roles throughout our undergraduate program. For the first-year students and sophomores, there are three laboratory courses in classical physics, followed by one in modern physics. For the juniors and seniors, intermediate level laboratory courses provide for future research activities. In these latter courses, groups of students do various table top experiments ranging from classical gravity measurements to up-to-date experiments on the nano-contacts formed between two conducting wires. Before carrying out their experiments, students first make a presentation before the class and instructors about the proposed measurements and procedures. Typically this involves intense scrutiny and discussion. When the experiment is completed, the results are presented in a form similar to that of a paper given at an American Physical Society meeting. Finally one of the students in the group writes a paper on the experiment, again with the scrutiny of his/her colleagues. These procedures involve extended interactions amongst students and instructors. Their success can be judged by the remarkable student progress that is observed as the course proceeds. In parallel with these formally structured courses, there is a senior thesis/undergraduate research program that is described in this newsletter in the section on research.

Innovation in the Lecture Room

Last year **Professor Bill Gerace** and **Dr. Ian Beatty** of the Physics Education Research Group were awarded grants from the Hewlett-Packard and Microsoft corporations for a project to design and implement a new generation of a classroom communication system (CCS) that incorporates all of the latest wireless communication technology. UMass Amherst has been a world leader in the use of CCS systems. Hard evidence and ten years of experience demonstrates that



Students use Tablet PCs in state of the art classroom

CCS technology coupled with appropriate pedagogy broadly enhances learning.

“We have reached the limit of what existing CCS’s can do for us,” said Ian. “No existing system is fully satisfactory. More seriously, none offers a forward path for research-driven exploration of the possibilities created by in-class mobile computing technology. The conjunction of mobile computing technology, computer science research, and pedagogic innovation has created a grand opportunity for educational advancement.”

The project is expected to take several years, and additional support is currently being sought from industry and the National Science Foundation. Besides designing and implementing software, explorations of the functionality and limitations of existing and planned wireless systems on campus will be undertaken. To this end, tablet PCs acquired as part of the Hewlett-Packard grant have been used in class and distributed to students in selected classes.

Graduate Program

Changes in the Graduate Program

You would think that after more than 35 years we would know how to do it, but the Department is still in the process of revising the philosophy behind and details of both the Comprehensive and Qualifying Exams.

Until now, a student was required to pass the Comprehensive Exam, based on undergraduate physics, before being

allowed to take the Ph.D. Qualifying Exam. If a student had not succeeded in passing the Comprehensive Exam after two attempts, he/she could not continue in the program. For the last few years, this exam was also used as a diagnostic tool to determine whether a student was deficient in undergraduate physics and should start their graduate career by taking one or more upper division undergraduate physics courses before embarking on the usual graduate program.

The Qualifying Exam was usually given in January of the second year of a student’s graduate career, although over the years, a number of foreign students who had entered the graduate program with superior undergraduate preparation had succeeded in taking and passing the exam during their first year. Each student was given two tries at passing the exam. Recently, we have allowed a second try at the exam during the spring, so that a student who had not passed the exam would not have to wait a full year to retake it. Furthermore, we have allowed students to pass (and not have to retake) only a part of the exam, either in Classical or Quantum physics.

Beginning with 2004-2005 academic year, we will consider the Comprehensive Exam to be diagnostic only, with no requirement that a student pass it in order to remain in the graduate program. The Qualifying Exam will then be the only filter determining whether a student can pursue a Ph.D. degree in physics.

Graduating 1983



Others (1983):

Fred Ellis (Ph.D.)

Harald Gomm (Ph.D.)

Bai-Sig Park (MS)

Yu-Zhang Chen (MS),

James M.Liebl (MS),

Michael F. McGurrin (MS),

Jie Piao (MS), Dong Lu Shi (MS)

Entering 2003



Front row (left to right): Jennifer Joyce, Laura Sparks, Rui Kong (Kerry), Vasileios Zarkos, Matthias Frager, Xiangdong Gu, Hongqiang Wang

Middle row: Peter Laviolette, Robin Plachy, Chris Jones, Wolfgang Unger, Dan Koehler, Kirsten Fuoti, Neil Naik, Amaresh Datta

Back row: Stefan Meyer, Colin Fredericks, Jacob Usinowicz, Robert Wagner, Mike Ray, Jake Ferguson, Josef Wenzler (Andi)

PEOPLE

DISTINGUISHED VISITORS

LAWRENCE KRAUSS

On October 22, 2003, **Lawrence Krauss**, an internationally known theoretical physicist, Professor of Physics and Astronomy, and Chairman of the Department of Physics at Case Western Reserve University, spoke to an audience of over 300 on *Einstein's Biggest Blunder* in the Five College Colloquium Series "What's New in Physics." The blunder involved the so-called "Cosmological Constant," invented and later repudiated by Einstein, but whose existence seems to have been validated by recent cosmological observations. The Cosmological Constant predicts a kind of anti-gravity force that is causing the expansion of the universe to accelerate. This implies that about 73% of the energy in the universe is



Lawrence Krauss

contained in empty space, so-called dark energy, whereas atoms have only 4% and mysterious cold dark matter 23%. If dark energy really exists, it is one of the biggest mysteries of physics.

On the next day Professor Krauss gave the William E. Mahoney Annual Lecture in Chemistry on *Scientific Ignorance as a Way of Life* that was also well

received by a large audience. This lecture reviewed some of the problems involved in trying to acquaint lay audiences with scientific advances and also illustrated the difficulties in confronting those who try to present creationist and other non-scientific notions as alternate science.

Professor Krauss is the author of several critically acclaimed books, including *The Physics of Star Trek* (1995), *The Fifth Essence: the Search for Dark Matter in the Universe* (1989), and his most recent one, *Atom: An Odyssey from the Big Bang to Life on Earth, and Beyond* (2001).

DOUGLAS OSHEROFF

On March 26, about 250 people attended a special Physics Colloquium co-sponsored by the Commonwealth Honors College, given by Douglas Osheroff, Chairperson of Physics at Stanford University, and recipient of the 1996 Nobel Prize in Physics. He spoke about the destruction of the Columbia space shuttle as it re-entered the atmosphere after a successful mission, and the work of the Columbia Accident Investigation Board, of which he was a member.

The cause of the accident occurred during the shuttle's ascent at the beginning of the mission. A piece of foam insulation had detached from the external fuel tank and impacted the underside of the left wing with a speed in excess of that of a rifle bullet.

Foam had detached during previous missions, including many flown by the Columbia shuttle, without obvious harmful effects. NASA engineers worried that this problem could eventually have disastrous consequences in shuttle missions, but the NASA management chose to minimize the problem. Osheroff pointed to defects in NASA's management structure that contributed to the Columbia disaster and



Douglas Osheroff

indicated that these problems still exist in the agency.

Outstanding Service Award

JOHN DONOGHUE was presented the College of Natural Sciences and Mathematics (NSM) Outstanding Service Award at the fall 2003 College Convocation. John served as Department Head from 1996-2002, and in this capacity guided both the Department and the College through some challenging times. He helped find a solution to the shortage of start-up funds for newly arrived faculty to build up their laboratories on campus. He guided the Department of Physics and Astronomy through a division into separate Departments of Physics and of Astronomy—this was not something he initiated but something he executed gracefully once he became convinced that it was in the best interest to form separate departments. He served on the administrative team that negotiated the Graduate Employees Organization contract. He was pivotal in the process that helped select the new head of the Department of Mathematics at a time when that department was going through a difficult period due to the retirement of 25% of its faculty. Finally he played a leading role in organizing the NSM Heads to advocate issues important to the College administration.



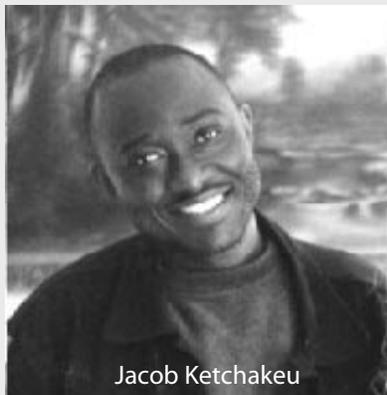
Here is Professor **Arthur Swift** at our annual holiday party holding a piece of **Mary Ann Ryan's** birthday cake. Art has been Associate Department Head for many years and has been responsible for course scheduling as well as countless other contributions to the Department. Although he retired effective September 1, 2003, and has relinquished his teaching duties, he continues to serve as Associate Head. Mary Ann's birthday came the same day as the party, but she won't tell which birthday. She has been our very competent and tireless business manager for over ten years. For the views of a past business manager, see the article on page 11 by Al Mathieson.

In Memoriam

Stella M. Rewa, 78, died June 29, 2003 in Greenfield. For twenty years she was the departmental bookkeeper in the Physics and Civil Engineering Departments before she retired in 1990. She had been a resident of South Deerfield for many years, and before coming to UMass Amherst, had held a variety of jobs in Franklin County. She will be remembered for her careful bookkeeping, but she was also a baker par excellence who would often generously share her goodies with an appreciative office staff.

David Erik Laus (B.S. '94) died unexpectedly June 26, 2003, in Portland, Oregon at age 31. In 1994 he received a B.S. in physics from this department with minors in music and mathematics. In 1996 he received an M.S. in computational science from the University of California at Davis where he worked at the Lawrence Livermore Laboratories. He grew up in Amherst, he became an Eagle Scout, and received the Rensselaer Science Medal upon graduation from high school. He leaves his wife of seven years, Melinda (Neal) Laus, and two sons, Jonathan Michael and Brendan Avery. Memorial gifts may be made to trust funds established for his sons, in care of MFS Service Center Inc., P.O. Box 2281, Boston, 02107-9906.

Jacob Ketchakeu (M.S. '00) died December 22 following an automobile accident in Cameroon, West Africa, where he had returned for the funeral of his mother. He grew up in Cameroon and attended schools there and in France. In 1994 he came to the U.S. as a goalie on the Cameroon World Cup Soccer Team. He did not return with the team, but enrolled in our Department to continue his studies in physics. He published several articles on nonlinear phenomena and became a dedicated and popular instructor in physics and mathematics at Holyoke Community College. He leaves his wife Laura (Differfer) Ketchakeu, three daughters, and two sons. Memorial gifts may be made to the Jacob Ketchakeu Memorial Fund, c/o Fleet Bank, Triangle Street, Amherst, 01002.



Jacob Ketchakeu

STAFF NEWS

Demonstrations

You probably remember the lecture demonstrations (demos) if you were here as an undergraduate. For many years they were very efficiently managed by **Bill Bates**, who came to us from the Audio-Visual Department on campus. Bill set up the demos with their accompanying support electronics, such as TV's, or what-ever else was needed. Bill retired a few years ago and was replaced by **Heath Hatch** who came from Alberta, Canada on August 28, 2000 - with classes about to start in just a couple of days with a full slate of demos. It was quite a first semester of learning for Heath! Bill Bates was very helpful, Heath survived, and now the operation is running smoothly again.

How have the demos changed in the past 30 or more years? For the most part they haven't. We still use a lot of the same demos that even 30 years ago looked like they were 100 years old. (*See the "Looking Back" article on page 10.*) They just don't make them like they used to. We have added some new demos as new classes are added - for example, a new course called "Seeing the Light" requires an extensive list of optical demos. The real change has been in the added component of technology in the classroom. As technology changes we have changed with it. We now use a wireless camera for small demos, and computers in almost every classroom to project Power Point slide presentations, web sites, and to show various computer animations. The web has almost eliminated the good old slide projector. The old-fashioned blackboard is only rarely used in large lectures. We have also implemented interactive classroom technologies such as the Personal Response System. Through the use of these technologies the professor is able to get instant feedback from the students in a way that allows for improved teaching and learning. All of these changes have fallen in the lap of the Heath Hatch.

Whenever Bill comes in to visit he laughs at what has happened and says, "There is still no time to sit down and rest; it is a good thing that there are only 24 hours in a day." As the world has changed, demonstrations, computers, and whatever

else is needed continue to be provided in supporting the teaching mission of department.

Outreach Demonstrations

Heath Hatch not only runs lecture demonstrations, but is also active in outreach. This past year saw some good opportunities for outreach to the local communities as well as the greater Massachusetts area. We were invited to many local schools where some of our undergraduates gave physics demonstrations to the classes. The demonstrations were very well received and the classes are looking forward to return engagements. There were so many visits to schools, as well as on-campus demonstrations, that we had to do some time juggling to make sure that the participating undergraduates did not shirk their studies. All in all it was a good year with many great experiences for both our students as well as the recipients.



Heath Hatch and some of his apparatus

LOOKING BACK

The Department in the 1930's

[As described by **Emeritus Professor Raymond Wyman** (B.S. '37)]

In the depths of the Great Depression in 1934 I was a sophomore at Massachusetts State College that became the University of Massachusetts Amherst in 1947. I elected to take an introductory course in

physics taught by a new instructor, Dr. William Ross. This was a course such as I had never dreamed of. About twenty of my classmates and I were exposed to a dazzling display of phenomena in mechanics, sound, heat, light, and electricity that paralleled our text and made everything exciting and clear. We came to class each week wondering what would come next. I decided then and there that physics and teaching would be a good combination to pursue.

Our courses were taught in the small, old, three-story, wooden physics building across from the Durfee Conservatory below the President's House. (I shudder to think of the things done in that building with only one stairway and no rules about smoking or safety.) My courses included:

Physics 25 & 26: Mechanics, Sound, Heat, Light, E & M

Physics 51 & 52: E & M, taught by Dr. Wallace F. Powers

Physics 53: Optics, by George Alderman in the basement

Mechanical Drawing 26

Agricultural Engineering: Motors

Physics 75&76: Advanced Experiments in Electricity, Dr. Powers

Astronomy 58

During my junior and senior years I elected nearly all of the courses offered in the three-man Department. Note that there were no courses in quantum mechanics.

Electricity and particularly vacuum tubes fascinated me. I spent many delightful hours in the second floor lab. Dr. Powers became my friend and mentor. (He drove a Buick "straight eight" that I thought was made in heaven.) We kept in touch until his death. My senior project was to construct a cathode ray oscilloscope, the first in Western Massachusetts. We had a Nipkow spinning disc mechanical television receiver, but no source of a program. My friend Rod Bliss ('36) built a 1000-watt short wave transmitter for his project.

I have nothing but admiration for the three professors who determined my career path. Dr. Powers, the Department

Head, commanded respect from all of us. George Alderman was a more practical man who ruled the basement of the physics building. Bill Ross' teaching was his full time occupation. Nearly every night Bill's office would be lit well into the night. When we chided him about marriage, he would say, "Any woman foolish enough to marry me is too foolish for me to marry." [See the back page for more about Bill Ross.]

Upon graduation I had a choice of working on television at RCA in Camden, or teaching science at Westfield High School. RCA would pay \$30 per week, but Westfield would pay \$45. I started high school science teaching in 1937. I tried to emulate Bill Ross' demonstrations.

Audiovisual Aids were new then, and I did some pioneering with disc recording, slides, filmstrips, silent movies, sound movies, and radio. I became the first Audio-Visual Director in Westfield, then in Holyoke, and then at UMass (1949). I obtained a first class FCC Radiotelephone License and did part time engineering on WHYN and WHMP. I was the required engineer for WMUA and WFCR.

I think that I made good use of the wonderful education that I received. I retired from UMass Amherst twenty-five years ago, and I still have a small electronics shop in my garage for experimentation and repairs.

[Dr. Wyman received a D. Ed. in 1956 and became a professor and chairman in the



Raymond Wyman

School of Education. He was a sought-after lecturer at U.S. and European universities, and because of his expertise in audio-visual technology, he chaired many national and international committees, including those for audiovisual standards. At UMass Amherst he chaired the University Master Planning Committee from 1966 through 1969, the period of our greatest growth. (In 1945, there were 725 students, in 1962, 10,000, and in 1972, 25,000) The Society of Motion Picture and Television Engineers awarded him the Kodak Gold Medal for contributions to education in 1996.]

The Department after WWII

[**Alfred Mathieson** was our business manager for many years as well as one of our more perky physics professors. Matty's physics career was interrupted by World War II. Here are some of his memories.]

I got my degree at Columbia University in 1939 during the Great Depression and my first teaching position at Springfield College at \$600 per year. Since WWII was on the horizon, I enlisted in the Marine Corps in June of 1940, was commissioned a 2nd Lt., received my Navy Wings in May of 1941, and served as an instrument flight instructor for several years. Later I saw action as a pilot and commanding officer of a squadron in the French West Hebrides. Upon discharge as a major after six years of active duty, I came to the University of Massachusetts Amherst and taught the returning GI's who were given the opportunity to go to college under the GI bill. They were very serious and excellent students, but they did have their fun as well. One time they played the university football team, and beat the pants off of them. As the Department grew in the 60's, I served as business manager until 1978, when I joined **Fred Byron**, who had stepped down as Department Head to become Dean of the School of Natural Sciences and Mathematics (NSM).

I retired the first time in 1984, but worked for six more years as a liaison to Physical Plant Engineers on building modifications for NSM. Now I am enjoying my second retirement.

UPDATE ON THE UNIVERSITY OF MASSACHUSETTS SYSTEM

Last spring the fate of the five-campus University of Massachusetts system hung in the balance. In a cost-cutting effort, Gov. Mitt Romney had moved to dismantle the system by eliminating the President's Office and the Board of Trustees. The flagship Amherst campus would have become an independent research university that would have retained tuition monies instead of their being reverted to the Massachusetts General Fund. Other campuses would have been realigned regionally with state and community colleges. We promised to update you on this matter.

Here's what happened. The five-campus system was not eliminated, tuition monies were retained only for out-of-state students, **William Bulger** stepped down as President, and **Dr. Jack Wilson**, CEO of UMassOnLine, Vice President for Academic Affairs, and Acting President became President on March 17.

Dr. Wilson helped build the UMassOnLine program into one of the largest externally directed online programs in the United States with 39 graduate and undergraduate degree and certificate programs serving 11,239 enrollees in 2003.

Before his association with UMass, Wilson had served as *Professor of Physics*, of Engineering Science, Information Technology, and Management, Dean, and interim Provost at the Rensselaer Polytechnic Institute.

UNDERGRADUATE AWARDS

Kandula Book Award

Karl Henriksen '05
Megan Juskiewicz '05
Teresa Liberatore '05
Yutaka Maki '05

Hasbrouck Scholarship

Robert Lychev '05
Ryan McGorty '05
Jennifer Misuraca '05
Katherine Whitaker '05

Field Alumni Scholars

Jennifer Misuraca '05
Katherine Whitaker '05

Millman Scholarship

Megan Juskiewicz '05

Chang Freshman Award

James Barber '07
Nicholas Botchan '07
Ashley Dasilva '07

Chang Transfer Student Award

David Bloore
Matthew Maiberger

Barry M. Goldwater Scholarship

Ryan McGorty, a junior honors physics and journalism major was awarded the national **Barry M. Goldwater Scholarship** for academic excellence, and for his undergraduate research and effective communication thereof.

Annual Mathematics Prize

Edward J. Slavich, a sophomore honors physics and astronomy major received third place in the university-wide **19th Annual Mathematics Prize Competition**. (Editor's note: Through the years our undergraduate physics majors have consistently done well in this competition.)

GRADUATE STUDENT AWARDS

Arthur Quinton Awards

As this goes to press, the decisions are still pending. In next year's Newsletter the awards will be listed.

ALUMNI NEWS

Richard Carson (B.S. '56) writes: "I just received the 2003 Spring edition of the Physics Newsletter. It was wonderful to receive the update on the department. I was sorry to learn of the passing of Ben Crooker. It seems hard for me to believe that that so many years have elapsed since 1953 when Mr. Crooker was my physics instructor. I graduated in 1956 and stayed on as an Instructor in 1957. I surely miss Mr. Alderman and Dr. Ross and the rest of the Physics Department. Dr. Powers was head after 1957. I moved on to USN-USL in New London, retiring several years ago. I am looking forward to the next newsletter."

(unkdick@Juno.com)

Steve Churchwell (Ph.D. '98) writes from the South Pole where he is working on two experiments that use the Antarctic ice as the detector medium in looking for Ultra High-Energy (UHE) neutrinos ($\approx 10^{20}$ eV). "In one experiment called "Ice Cube," 80 strings of phototubes will be placed at depths between 1.4 and 2.4 km in one cubic kilometer of ice to look for Cherenkov light from muons produced by neutrino interactions in the ice. To distinguish those muons from atmospheric muons, we look for muons coming up from below, and use the earth as a shield. The other experiment called RICE (Radio Ice Cherenkov Experiment) is based on

the fact that when an electromagnetic shower develops, a net negative charge propagates in the core of the shower since atomic electrons are swept into the shower, and the positrons tend to be annihilated. This "blob" of negative charge moves relativistically, and therefore emits Cherenkov radiation. Since the core of the shower has dimensions of 10-15 cm, we can get coherent radiation from the particles in the core (typically, large showers have millions of particles) at wavelengths longer than the size of the object. So we are looking for radio signals between 200 and 1000 MHz. We have 16 dipole antennas buried several hundred meters below the surface, and are still trying to find our first UHE neutrino signal. We probably shouldn't have seen one yet, since the counting rates are quite low, $\approx 1/100$ km²/ year. But we can now set upper limits on the neutrino flux based on the past couple of years of data. I am working on a high-speed digitizer system to transmit the data. It isn't too cold now in December (-25 C with wind chills closer to -40 C). The picture shows me beside one of our vehicles on a warmer day. By mid-February when they close the station for the winter, it will be below -50 C. In midwinter it is so cold (below -80 C) that planes can't land because

their hydraulics get stiff when the engines aren't running at full speed. Even now, the supply planes never turn their engines off when they land. They are here for about 30 minutes, propellers spinning, and take off again. When I am not at the South Pole, I am at the University of Canterbury, in Christchurch, New Zealand where I have a lectureship. My family and I all love New Zealand and I love the pole. It is somewhat addictive they say, once you've been here, you want to keep coming back. We'll see how I feel about it next year." (Steve worked at MIT-Bates and at SLAC when he was with our Nuclear Physics Group.)

(steven.churchwell@canterbury.ac.nz)

Jimmy Leas (M.S. '75) is a prolific inventor with over 30 patents for IBM. One classical physics-related experiment with his then four-month old daughter Zoe sparked a career change. "At that age our baby could first grasp things between her thumb and fingers, and she wanted to use that skill on everything she could. As we held her, Zoe took hold of a ring on a mobile hanging from a string over her bassinet. I stepped back a few steps, the string of the mobile now slanted. After less than a minute Zoe let go of her hold and the mobile swung pendulum fashion away. Her face turned so sad as it departed. But then, back it came swinging, to her delight, coming to a momentary stop just where she released it next to her little hand. As it stood stopped, Zoe made the catch! A scheme for infant throwing and catching was born. It became my first patent application, and Zoe became the youngest inventor to receive a US patent (5,135,233 "Pendulum Toy"). I went on to become a patent lawyer, writing patent applications in IBM's microelectronics invention factory in Burlington, Vermont for nine more years. Zoe just finished her freshman year in high school, where she did respectably well in physics. I left IBM last August and opened my own patent law firm in Vermont. Best wishes to Bob Krotkov, my research advisor."



Steve Churchwell beside his snow tractor in Antarctica

(jimmy@vermontpatentlawyer.com)

Robert K. Mohr (Ph. D. '72) writes: "After earning my Ph.D. from the University of Massachusetts Amherst I went directly to the physics department at Catholic University of America. I joined a research group in the Vitreous State Laboratory (VSL), which is a multidisciplinary group doing basic and applied research in vitreous materials (glass). For the past 30-odd years I have been doing mostly material science and engineering. My basic physics education and experience as an experimentalist at UMass Amherst prepared me well for such a career. Particular credit goes to Professors Langley and Ford for that education. Somehow I missed the photo of our 1966 entering class when it appeared in the 2002 newsletter. I noticed with interest the alumni notes from Breck Hitz and Justus Koch in the 2003 edition, and went back to the 2002 issue on the website and found the picture and the note from Satish Prasad. Paul Elterman and Tom Olson, who were a year or two behind our group, joined me at Catholic University for a short time. I don't remember where Paul went after CUA, but Tom went on to several fiber optics companies as a result of work in our lab. Tom and I are still in touch from time to time."

(robertm@vsl.cua.edu)

Paul Nakroshis (Ph.D. '94) writes: "I just received tenure at the University of Southern Maine this past fall, and my wife, daughter and I have moved from Peaks Island to Freeport, where we bought a small saltbox and barn. My wife teaches part time at the Merriconeag Waldorf School in addition to her full time job with our daughter. In my spare time, I have been turning the barn into a woodworking shop, and have been practicing Aikido for the last several years. I have been studying the physics of granular materials, specifically, the statistics of stick-slip events in a model 2-d granular array. As an offshoot of this work, my students and I applied our image recognition routines to track the motion of Brownian particles, and turned this into an article for *Am. J. Phys.* **71**, 568 (2003)." (pauln@maine.edu)

Richard E. Piazza (Ph.D. '69) writes: "Though it is of little import, except perhaps for "bragging rights," I think I was the first to receive a Ph.D. in Physics from UMass. If I recall correctly, degrees were presented in alphabetical order and Robert Amadori was unable to be present at the ceremonies (his degree was to be mailed to him following the ceremonies). Consequently, I, and then David Wei received our degrees on May 31, 1969. In any event, the degree from UMass has served me very well throughout my career. The first few years in industry were spent in the development of state-of-the-art very high-speed devices such as CRT's and scan-converters at Tektronix, Inc., a world class powerhouse in laboratory instrumentation. Initially an individual investigator, I later managed a group I assembled, "The High Frequency Devices Group," dedicated to pushing the boundaries of this technology. One of the highlights of this experience was a visit to the AEC's Los Alamos facilities which helped set the stage for sale of ultra fast devices which we were working on for high-end laboratory instrumentation. My understanding was that this was the first (and perhaps only) time that components, rather than complete instruments, were sold by the company. While still at Tektronix, as the industry and opportunities evolved, I made a move to the fledgling Medical Devices Group. Efforts there included developing and evaluating new techniques for the acquisition and display of physiological measurements such as cardiac output and other patient monitoring devices. At the advice of outside consultants, Tektronix eventually decided to sell off the medical unit but my career continued to develop along the same lines in several other medical equipment companies including General Manager of Engineering at Ohmeda (parent company British Oxygen Co.), Manager of Monitoring Products at Physio Control Inc. (parent company Eli Lilly Corp.) and, finally, V.P. of New Product Development for Datascope Medical Products. I retired from this very satisfying career about 10 years ago and have reflected, on many occasions, on how my years at UMass have been the key to my progress throughout the ensuing years. Though it did not impact



Our first Ph. D. graduate, Richard Piazza, daughter Millicent, and wife Yu-ling. (May 1969)

me significantly, I continue to be amazed that the research I did at UMass and earlier at Emory University in NMR and ENDOR were part of the precursors to the substantial medical applications of MRI. In retirement it seems I continue to be as busy as ever, but now I get to include more of what I would like to pursue, such as travel with my wife and two daughters, as well as my renewed interest in motorcycling." (rich@piazza.name)

George Schmiedeshoff (Ph.D. '85) writes: "It was great getting my first copy of the newsletter, it really brought back memories. I especially enjoyed reading about my old Low Temperature Physics research group (with Bob Hallock at the helm) and seeing the pictures of my contemporaries from 1982. After leaving UMass Amherst I did a postdoc at the old magnet lab at MIT with Jim Brooks (another former member of Hallock's group), taught at Tufts University and Bowdoin College, and have been at Occidental College in Los Angeles for about 12 years now. Lately I have been probing the interplay between magnetism and superconductivity in nickel borocarbide compounds with thermal expansion and magnetostriction measurements supported by the NSF. Three of my research students have gone on to get Ph.D.s in physics at Tufts, Indiana, and Cambridge Universities, while another two are "in the pipeline" at Stanford and Boston College. I live in Pasadena, California where we have a big parade every New Year's Day!" (gms@oxy.edu)

Jim Valles (Ph.D. '88) After many happy years in Hallock's lab at UMass Amherst and a couple of months sleeping on Rob Dionne's porch, Jean Mandell and I moved to New Jersey so that I could take a postdoc

at Bell Labs to learn about electronic condensed matter systems and more low temperature physics. Ever since I have pursued research in superconductivity through two and half years on the faculty at the University of Oregon and now at Brown University. We unexpectedly developed a second research thrust in biological physics after we used intense, inhomogeneous magnetic fields to levitate living frog embryos to simulate a low gravity for them. Jean and I have been married for more than 15 years and have two boys who are a constant source of pride and amusement.
(valles@physics.brown.edu)



Jim Valles in his lab

NEW ALUMNI

B.S. Graduates

Kevin Ann	Phillippe Martel
Peter Chikov	Ian Mast
Kristen Cote	Meghan McGovern
Jonathan Dick	Stephen Mirigian
Daniel Dufour	David Ryan
Kazem Edmond	Adam Sannicandro
Daryn Firicano	Maureen Schoenmann
Kiran Garimella	Diwakar Turaga
Alden Johnson	Jeffrey Ulbrandt
Russ Juskalian	
Can Kayatekin	
Randal Leiter	

M.S. Graduates

Chao Huan
Edgardo Ortiz
Jamie Winterton

M.S. Graduates with Thesis

Bernhard Fischer, "Phase Separation of Polyelectrolytes in Salt Solution"
Christian Guertin, "Universal Elastic Properties of Soft, Disordered Solids"
Karsten Koeneke, "Measurement of the Branching Fraction for the Decay $B^{\pm} \rightarrow K^{\pm} K^{*0} + \gamma$, $K^{\pm} \rightarrow K^{\pm} K^{*0} + \pi^0$ with the BaBar Detector"
Andreas Ross, "Applications and Techniques of Long Distance Regularization in Chiral Perturbation Theory"

Ph.D. Graduates and Thesis Titles

Hyunji Cho, "Topics in Gravity and Supergravity" Dissertation adviser: Profs. Traschen and Kastor
Juan Pablo Fernandez, "Bose-Einstein Condensation In Two-Dimensional Traps" Dissertation adviser: Prof. Mullen
Justin Herrmann, "Localization in Two Dimensional Third Sound Systems" Dissertation adviser: Prof. Hallock
Shuhui Kang, "Fundamentals of Poly (Lactic Acid) Microstructure, Crystallization Behavior, and Properties" Dissertation adviser: Prof. Hsu
Shulan Liu, "Counterion Distribution and Conformational Properties of Polyelectrolytes" Dissertation adviser: Prof. M. Muthukumar
Xiaoyu Yang, "NMR Studies Of Granular Media and Two-Phase Flow in Porous Media" Dissertation adviser: Prof. Candela
Kevin Flood, "Search for Charm Mixing Using the Semileptonic Decays $D^0 \rightarrow K^+ K^+ e^- \nu$, $D^0 \rightarrow K^+ K^+ \nu$." Dissertation adviser: Prof. Hertzbach

GIFTS

THANKS FROM TEACHING LAB DIRECTOR TONY PAPIRIO

With This
spring,

the electricity and magnetism laboratory for physics majors and honors students. We now have ten brand new versatile Tektronix TDS 2002 fast digital oscilloscopes. (Editor's note: See page 13 for alumnus Richard Piazza's creative career at Tektronix). By purchasing

life

increasingly difficult to find. Your donations help us to continue to provide an up-to-date first-rate laboratory experience for our students. We are very grateful for your help in obtaining these cutting edge instruments.

MONEY MATTERS

A perusal of this newsletter gives a flavor of the continued dynamic character of our Department and of the outstanding success of our graduates. But we truly believe the best may be yet to come! There is a tremendous potential for our Department within this university that aspires to and is poised to achieve excellence. Many of the ingredients are here: talent, desire, and a positive “can do” attitude. But money does matter, and your past support has helped tremendously. You may continue to help our Department to extend its mission of teaching, research, and public service across the Commonwealth and beyond by making a tax-deductible donation. If you wish, you may contribute directly to the Department of Physics by making your check out to the University of Massachusetts Amherst, and mailing it to

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University of Massachusetts Amherst
710 North Pleasant St.
Amherst, MA 01003-9337

Please state that your gift is for the *Department of Physics*. If its use is not specified, allocations may be made where they are most needed to support the wide variety of educational and research activities such as are reported in this newsletter. On the other hand, if you wish to specify how your gift is to be used, we will honor your request. Furthermore, if you give to the Annual Fund, you may indicate that your support is for the Department of Physics. For your convenience, you may also make your gift on-line by visiting www.umass.edu/development, choosing “**Make a Gift Now,**” and selecting **Physics** Department from the gift allocation menu. Every gift, no matter how small, will be greatly appreciated.

HONOR ROLL

The following “Honor Roll” lists those who contributed since last year’s Newsletter. We apologize for any omissions and request that you bring them to our attention.

Amurgis, Victor & Patricia
Azure, Dr. Michael T.
Bears, Walter & Elaine
Bell, Ms. Mary
Bonanno, Mr. Richard A.
Bonn, Mr. Matthew A
Brackett, Ms. Elizabeth.
Brody, Mr. Herbert
Case, Mr. James A.
Catagnus, Mr. Phillip C.
Celli, Mary
Chase, Mr. Scott B.
Chang, Prof. Edward
Contrada, Mr. Anthony A.
Crooker, Dr. Benjamin C.
Davis, Mr. Christopher A.
Demski, Mr. Edward F.
Dutton, Mr. Laurence R.
Eckhardt, Mr. Ronald
Edmond, Massoudeh
Ekholm, Mr. David T.
Fisher, Donald & Diane
Flescher, Donald & Diane
Gabbiani, Fabrizio
Gardner, Mr. Paul C.
Gluckstern, Dr. Robert L.
Gorczyca, Ms. Vicki L.
Hallock, Robert & Nancy
Harding, Mr. Leroy W.
Haupt, Ms. Marion
Heller, Mr. Evan K
Hollman, Mr. Richard F.
Houmère, Miss Pamela D.
Huffman, Robert & Kristina
Hulse, Dr. Russell A.
Juszkiewicz, Daniel & Maureen
Kinard, Mr. Joseph R., Jr.
Koh, Mr. Christopher T.
Latimer, Ms. Margaret W.
Leas, Mr. James M.
Ledin, Phillip E.
Legere, Mr. Roger
Leuschner, Mr. Mark B.
Libby, Haddon & Lynn
Long, Dr. David G.
Loring, Miss Margaret

Lundquist, Mr. Theodore R.
Mann, Dr. William Anthony
Mayo, Dr. Charles S.
McAllaster, Mr. Donald R.
McGovern, John & Anne
Mertes, Mr. Kevin M.
Merrill, Ms. Barbara
Messier, Dr. Mark N.
Parsons, Mr. David H.
Parker, Mrs. Susan L.
Pavlin, Dr. Igor
Pribram, Dr. John K.
Reed, Nancy
Reynolds, Mr. William N.
Roig, Francesc & Kathleen
Ryan, Mary Ann and Tom
Schmiedeshoff, Dr. George M.
Shu, Mr. Ker-Li
Shurtleff, Mr. Richard
Silvia, Mr. Thomas R.
Skinner, Mrs. Mary
Slavkovsky, Mr. Thomas J.
Smith, Peter & Kathryn
Smith, Mr. Luther W. Jr.
Tinney, Harold & Suzann
Taylor, Mark and Carol
Walker, James and Elaine
Weinberg, Edward D.
Wise, Jeremy & Janet Klausner-Wise
Wittlin, Jodi
Yeslow Finn, John & Lynn
Zakashansky, Mrs. Elena

We want to particularly thank

Elizabeth Brackett for her especially generous gift. Elizabeth graduated from UMass in 1980 and now lives in Vernon, Connecticut, where she works for the MJW Corporation.

Our former head and provost, Professor Robert L. Gluckstern, who started the modern era in our Department. We are grateful to him for his continued generous contributions.

Springfield Neurology Associates who gave the Department a \$4900 infrared imaging camera that can be used in lecture demonstrations and in the advanced laboratories.



Professor William Ross leads the 1968 commencement ceremony. He received the first Distinguished Teaching Award in 1962 and was one of the university's best and most colorful professors from 1933 until his death in 1975. To his students he was not only a teacher, but also a friend, advisor, and sometimes "father-confessor." In Bill's time, there were fewer courses offered, so the professor had to appeal to a mix of students, from engineering and science freshmen, to seniors who had procrastinated to take the course. Students in Bill's classes never knew what to expect beyond the usual physics fare. For example, there were his famous cartwheels, in one door of the lecture room, across the room between the demonstration table and the first row of seats, and out the prep room door. This had little to do with physics, but the students were never bored. The following illustrates Bill's attitude about teaching: "I feel that there is no one answer. A competent professor turned loose to do his best is probably far more important than a specific curriculum."

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