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PHYSICS Newsletter

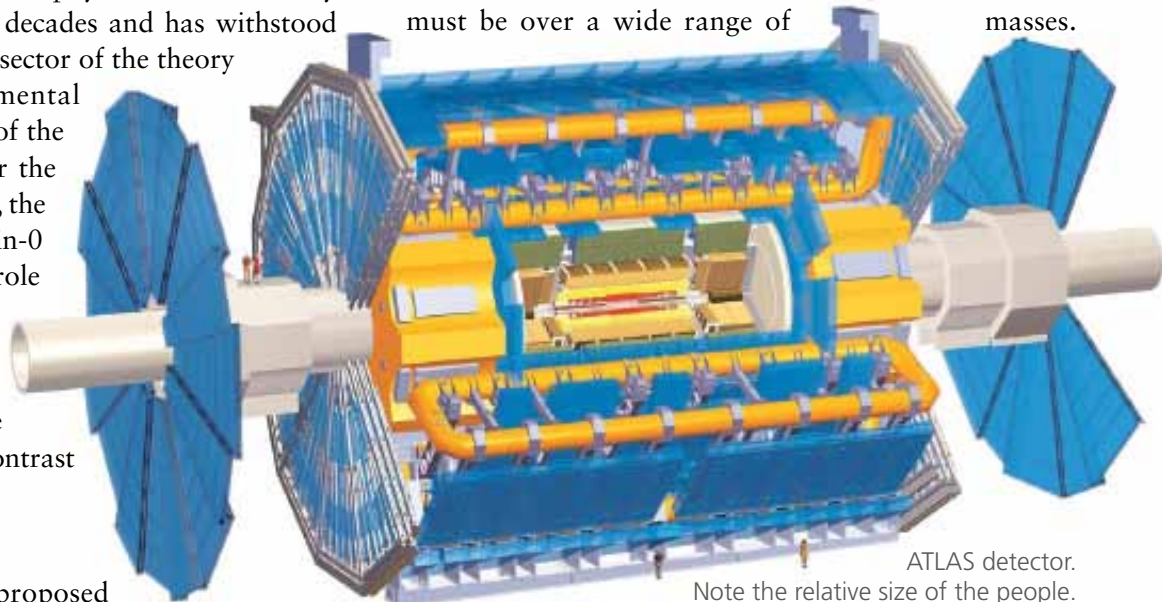
DEPARTMENT OF PHYSICS AT THE UNIVERSITY OF MASSACHUSETTS AMHERST
SPRING 2012 Issue No. 12

The Hunting of the Higgs

The Standard Model of particle physics has been widely tested over the last several decades and has withstood all assaults so far. The last sector of the theory that still requires experimental verification is in the realm of the Higgs boson. Named after the British physicist Peter Higgs, the boson is a hypothetical spin-0 particle that plays a special role in the theory. Without the Higgs boson, the Standard Model would only describe a world in which particles are devoid of mass, in stark contrast with the world we live in.

Higgs, as well as others, proposed a phenomenon known as spontaneous symmetry breaking as the means by which particle masses are introduced in the theory, a process now called the Higgs mechanism. Matter constituents like electrons and quarks, as well as the W and Z bosons that are responsible for nuclear decay and the weak interaction, acquire mass via interactions with the Higgs field that permeates the Universe. The mass of a given particle then depends on the strength of the interaction with the Higgs field, with greater coupling strength resulting

in a heavier particle. Although the Standard Model predicts the existence of the Higgs boson, it does not predict its mass. This means that a search for the Higgs must be over a wide range of masses.



ATLAS detector.
Note the relative size of the people.

The search for the Higgs particle starts with Einstein's equation $E = mc^2$. To produce a particle of mass m we must collide particles with sufficient energy E . By colliding high-energy protons in CERN's Large Hadron Collider (LHC), the world's largest accelerator near Geneva, Switzerland, we may be able to convert the energy of the colliding protons into new particles, including the Higgs, some tiny fraction of the time. The probability of producing the Higgs in any individual collision is very, very small. This means that to produce the Higgs we would need to collide

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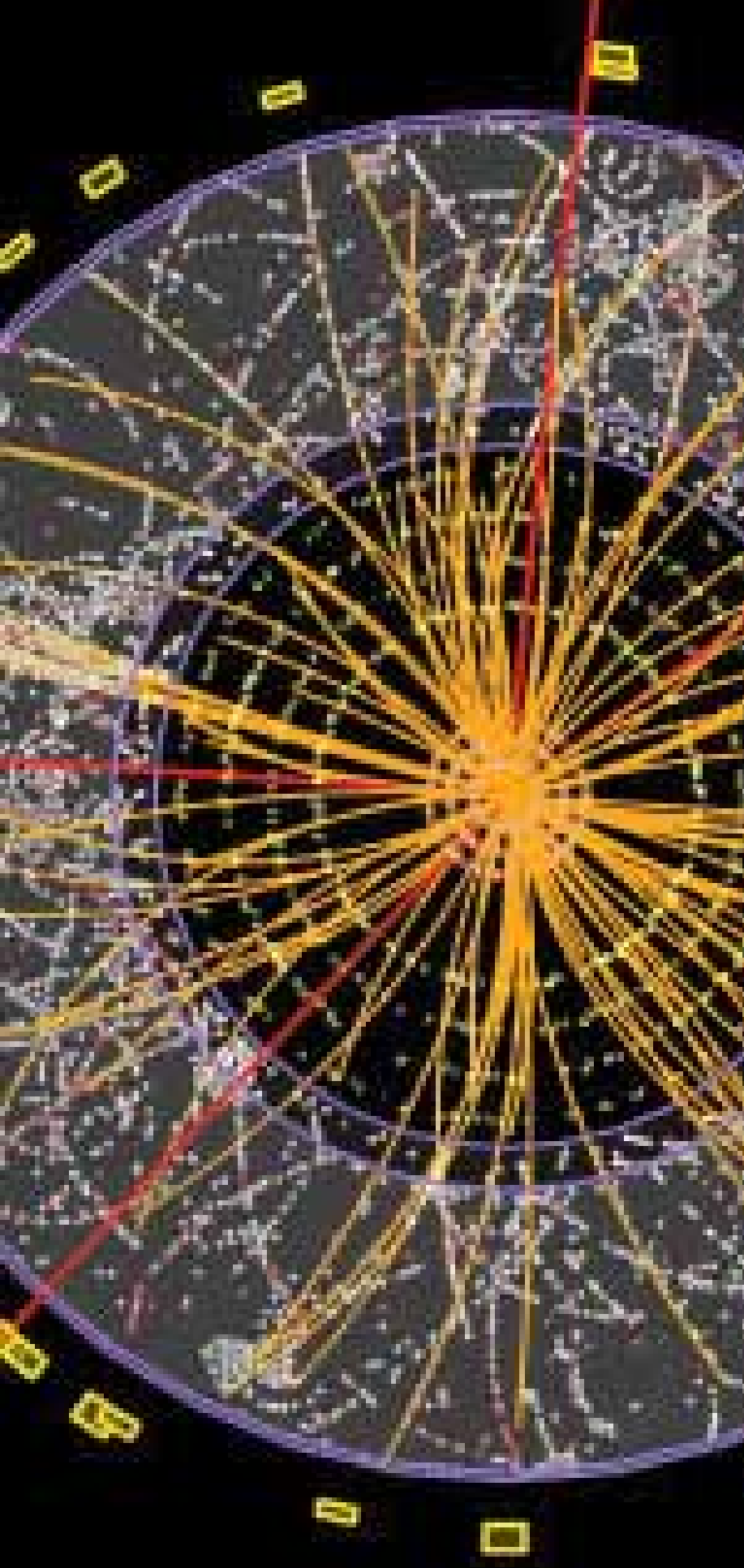


Team Based Learning

A renewed emphasis on Team Based Learning is the incentive for creating renovated teaching space with new facilities. A large well-lit room features lots of white board space and large video screens. Full story: page 10.



UMASS
AMHERST



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Dear Alumni and Friends of the Physics Department,

I have many happy and one sad matter to report to you. The sad item is the passing of our long-time colleague Ed Chang, whom I'm sure many of you remember as a teacher or academic advisor. Recently Ed established an endowed fund specifically to support undergraduate research, which will provide a fitting reminder of Ed's enduring interest in providing academic opportunities for students.

Another long-time member of the Department, Gene Golowich, formally retired at the end of the last academic year. But Gene remains active in his research in particle theory and we are happy to see him around the Department as always. Gene has been one of our finest teachers, and I'm hoping that after a while he will miss teaching enough to pick up the chalk again.

Dr. Paul Bourgeois has joined the Department this year as our new director of teaching laboratories. Most recently Paul has been serving as visiting faculty at Amherst College, but Paul received his PhD working for our nuclear experimental group under the direction of Rory Miskimen, and we are delighted to have him back in the Department on a permanent basis.

As I write we are interviewing candidates for two new faculty positions, one in particle theory and the other in condensed-matter experiment. The candidates are full of exciting ideas for their research and teaching, and I certainly hope that our next newsletter will contain the profiles of our new faculty in one or both of these areas.

Plans are firming up for a new Physical Sciences Building which will provide modern lab space for the Chemistry and Physics Departments. We are lobbying for it to be right next to the north side of Hasbrouck where it could provide handy access for our condensed-matter and other experimental groups. Meanwhile, ground has been broken for the huge New Academic Classroom Building to the south of Hasbrouck (see back cover), which will include Team-Based Learning rooms we will be using for our majors' courses. If you haven't been to campus for a while, please do consider a visit (and stop by the Head's office in Lederle 1126) - I think you will be amazed by the amount of new construction.

In this issue you will find articles contributed by some of our alumni on what they are doing now, and the paths that took them from the UMass Physics Department to their diverse present occupations. We always like to hear from our alumni so please consider contributing your story to the next issue of the newsletter. Please do stay in touch with your old department, which is proud to have started you on your present journey.

Sincerely,



Don Candela

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413-545-1940



research

SEARCHING FOR AN ELECTRIC DIPOLE MOMENT IN THE ELECTRON

Professor David Kawall

Electrons and other particles have magnetic moments that lie along their spin angular momentum vector. In a magnetic field, their precession energies differ depending on whether their spin is parallel or anti-parallel to the field, and is proportional to the sizes of the magnetic moment and the field. In the case of a point-like particle, such as the electron, the magnetic moment can be predicted with very high precision - in fact the magnetic moment of the electron is the most precisely measured quantity in all of science, with theory and experiment agreeing to more than 10 significant figures. Such precision in the theory requires treating the electron not as a bare isolated particles, but as “dressed” - surrounded by a cloud of virtual particles that pop in and out of existence, as permitted (even required) by Heisenberg’s uncertainty principle. Every elementary particle that can interact with an electron appears in these “quantum loop” corrections, and makes contributions to the magnetic moment. These contributions come from all of the interacting particles we know of, *and those we don’t know of*. Deviations between increasingly precise measurements of magnetic moments and theoretical predictions *can indicate indirectly the presence of entirely new, undiscovered fundamental particles*.



A related effort is the search for permanent electric dipole moments (EDMs). EDMs are analogous to magnetic moments, in that any electric dipole would lie along the spin vector, but an EDM would yield a difference in precession energy when the spin is flipped in an electric field, not a magnetic field. Whereas magnetic moments of electrons, muons, etc. are predicted to be non-zero, *EDMs are predicted to be zero* if time-reversal symmetry, T, is not violated. To see this pictorially, look at Figure 1. A particle is shown with an asymmetry in charge D (the EDM) along the spin vector S. If we reverse

the direction of time, we get the picture on the lower right, where the spin vector has reversed, but the EDM remains the same. In the upper part of the picture, the EDM and spin vectors are parallel. In the lower they are anti-parallel. As there is only one kind of electron, only one of these pictures could represent an electron with an EDM as found in nature. If we were watch a movie of an electron interacting with an electric field, we could see whether it corresponds to the upper or lower picture, and we could tell the projectionist whether the movie was running forwards or backwards. By comparison, if we were to record electrons scattering off each other, or almost every other microscopic interaction, we would find them to be reversible and we wouldn’t be able to distinguish the direction of time. In fact, this sensitivity of EDMs to time reversal is only otherwise found in some rare decays of particles known as K and B mesons. Lack of time reversal for these mesons throws light upon the imbalance between matter and antimatter in the universe.

This behavior is important, because it implicates time-reversal violation in one of the greatest mysteries in physics - why the imbalance between matter and antimatter in our universe is so large. The matter-antimatter imbalance we would predict from the properties of meson decays is too small by more than a factor of a million to explain the observed imbalance. There must be other, undiscovered sources of T violation, waiting to be discovered.

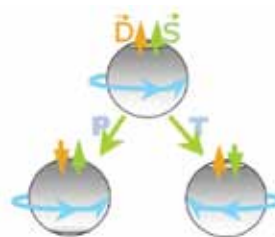


Figure 1: If an elementary particle has an EDM, then parity P and time-reversal T symmetries are violated. The EDM D , effectively an asymmetry in charge, lies along the spin vector S .

If time is reversed (lower right picture), the spin reverses but not the EDM. Their relative direction has changed compared to the top picture, violating time-reversal. If spatial coordinates are reversed (lower left picture), the EDM flips, but the spin is unchanged. Again the relative directions have changed, violating P.

The figure also indicates that parity symmetry, P, (the reversal of all spatial coordinates) is also violated by EDMs. Parity violations are intrinsic in the structure of the weak interactions that govern nuclear decay and

other phenomena. So EDMs can arise from the physics we know about, from the parity and time-reversal violating interactions already observed. Theorists can estimate the magnitude of a Standard Model (SM) EDM by including the quantum loops that incorporate the required P and T interactions. The problem is that the resulting EDMs are far too small to be observed by any current or planned experiment. In fact, a non-zero EDM has not been observed in any system, despite searches dating back more than 50 years.

However, there are many reasons to suspect that EDMs could be much larger. We know there must be other large sources of T violation, and most theories of physics beyond the SM predict many new particles and CP-violating phases (potential sources of T-violation since TCP is conserved¹) that predict dramatically enhanced EDMs, potentially within the detection limits of a new generation of experiments.

How does one search for an EDM? Generically, one places the particle of interest in parallel electric and magnetic fields, and tips the spin over perpendicular to the fields. This causes the spin to precess due to the combined torques of the electric and magnetic fields on the EDM and magnetic moment. If we reverse the electric field, the torques due to the EDM will reverse sign, and the precession rate will be altered. This difference in precession rate is maximized by using the largest external electric field one can make. Statistical sensitivity is increased by maximizing the number of particles observed. Finally, sensitivity to the small change in precession rate is maximized by observing the particles as long as possible. If the difference in precession frequency for external fields parallel and anti-parallel is 1%, then observing the particles for one precession cycle would result in 1% difference out of 2π in the phase, which is hard to detect. If we observe for 100 cycles, then we'd have a 2π phase difference, which is much easier to detect.

The current limit on the electron EDM is 1.0×10^{-27} e·cm, from an experiment by Ed Hinds and collaborators at Imperial College using a beam of YbF molecules.² Using polar molecules with unpaired electron spins is now one of the preferred experimental approaches, as the internal electric fields in such molecules can be tens of gigavolts/cm, five orders of magnitude larger than the strongest electric fields one can make in the lab. This maximizes the size of the EDM effect. The beam technique is limited in part by the observation time: the molecules

fly through the sensitive EDM apparatus in just 1.5 milliseconds. A possible new approach, which we hope to stage at UMass Amherst, is to search for the EDM of the electron in a molecular ion (WN^+) trapped by electric fields in a small storage ring. The technique has the same advantage of the large internal electric field of a heavy polar molecule, but by storing the ions, the observation time can be increased by a factor of 100 to 0.15 seconds. The approach could yield sensitivities at the level of 1×10^{-30} e·cm, three orders of magnitude below the current limit. The results would be interesting no matter what is observed if such sensitivities could be achieved. If an EDM were discovered, it would be definitive proof of new physics. If an EDM were not found, it would imply that all of the theories predicting EDMs at the achieved level of sensitivity would be in serious jeopardy. Figure 2 (adapted from a figure by Dave DeMille at Yale) shows the range of predictions of many theories.

The current limits are shown, as are projected limits from some experiment underway using PbO and ThO by DeMille and collaborators,³ and the projected limits from the storage ring approach. Either way, with a leap in sensitivity we get insight into possible new physics that rivals or even exceeds the reach of the Large Hadron Collider.

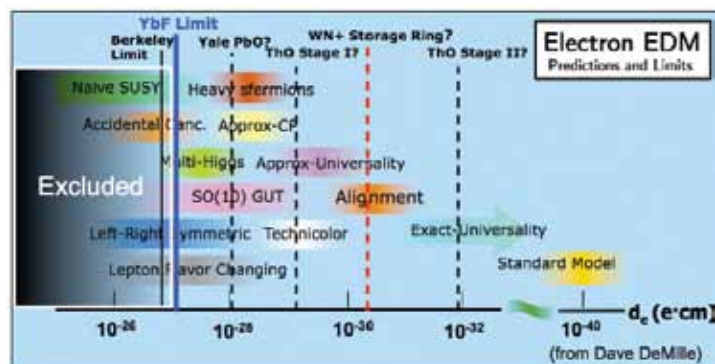


Figure 2: Predictions for the electron EDM from various theories of new physics (adapted from a figure by Dave DeMille). The potential sensitivities of a few new approaches are shown on the plot. Failure to observe an EDM at the projected sensitivities would jeopardize the status of many theories.

¹W. Pauli (ed.) *Neils Bohr and the Development of Physics*, Pergamon Press, London, 1955.

²J.J. Hudson, E.A. Hinds et al., *Nature* 473, 493 (2011).

³A. Vutha et al., *J. Phys. B: At. Mol. Opt. Phys.* 43, 074007 (2010).

LARGE MILLIMETER TELESCOPE ACHIEVES FIRST LIGHT MILESTONE

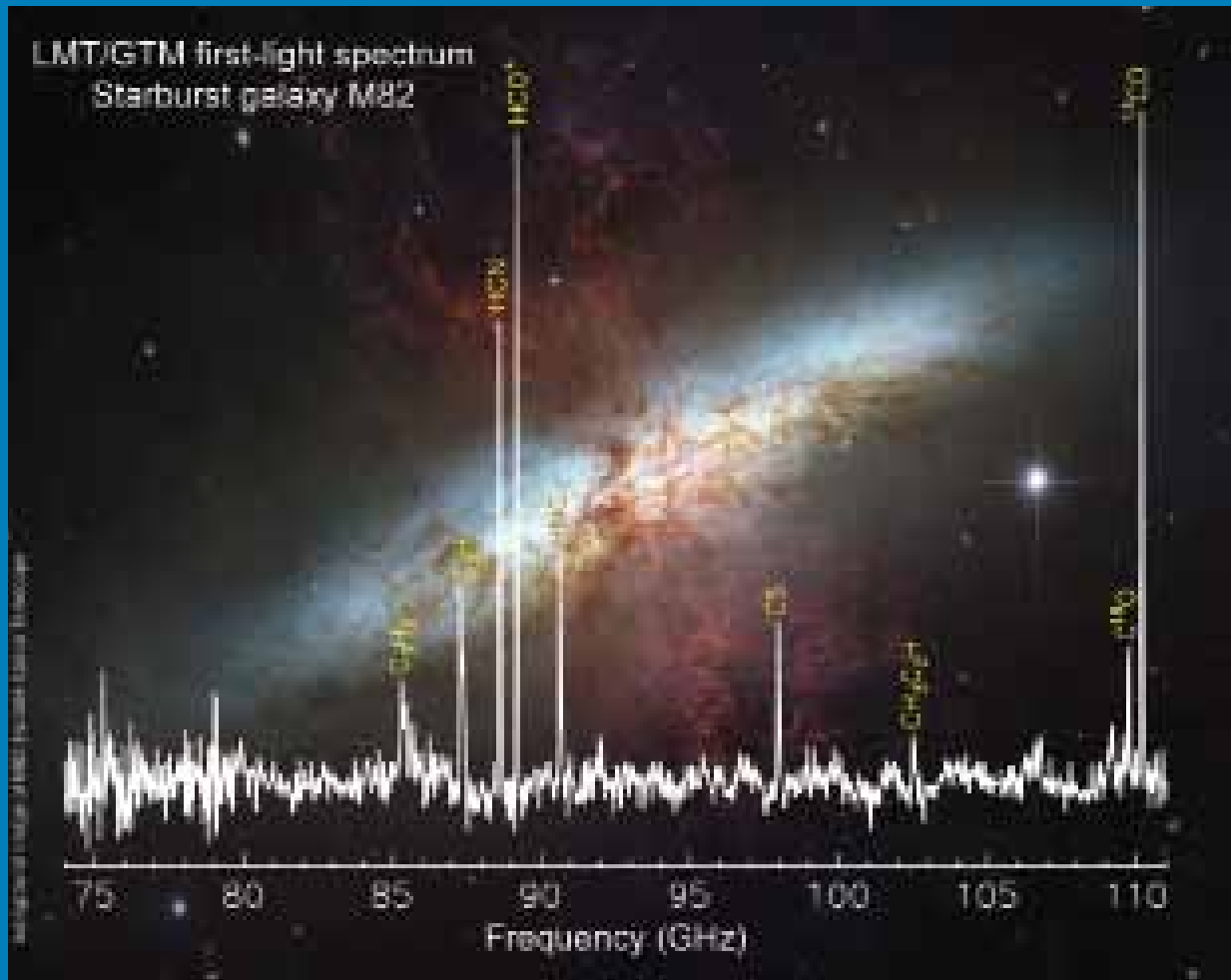
(Editorial Comment: Although the Department of Physics and Astronomy divided into separate departments in 2000, most of our alumni were students here before the division. We therefore thought those alumni would be pleased to learn of a major success story of our astronomer colleagues.)

The Large Millimeter Telescope (LMT) collaboration between UMass Amherst and the Instituto Nacional de Astrofísica Óptica y Electrónica in Mexico is an effort to build and operate a 50 m diameter radiotelescope for millimeter-wave astronomy. The LMT was conceived as an upgrade to the 14 m millimeter-wave telescope built in the Quabbin Reservoir during the 1970s and operated for 30 years as the Five College Radio Astronomy Observatory (FCRAO). 2011 marked the completion of this transition with the achievement of first light on the LMT, and the shutdown and removal of the 14 m radome-enclosed telescope from the Quabbin. The development of FCRAO instrumentation contributed to the discovery of the binary pulsar by Joseph Taylor and Russell Hulse, for which they received the 1993 Nobel Prize in Physics.

The LMT, shown below, was built atop a 15,000-foot peak in the state of Puebla, Mexico, an outstanding

site for millimeter-wave astronomy. During the spring of 2011, the telescope underwent initial tests and first light observations with two instruments built by the FCRAO group at UMass. The first, the Redshift Search Receiver, is an ultra-wideband receiver/spectrometer for the 3 mm spectral window in the Earth's atmosphere. It allows blind searches for highly red-shifted molecular lines in distant galaxies and provides the means to measure the distances to sources discovered through surveys of the millimeter-wave sky. The figure to the right shows the LMT's "first light" spectrum taken with the Redshift Search Receiver. It shows many molecular lines in the well-known "star burst" galaxy M82, whose image, taken with the Hubble Space Telescope, is in the background. The second instrument used for first light work is known as AzTEC, a 144-pixel camera for observations of the 1.1 mm continuum. AzTEC has been used on other telescopes before LMT to survey the sky and discover thousands of new sources, known as "submillimeter galaxies," which are thought to be distant galaxies undergoing star formation at high rates. The LMT, AzTEC, and the Redshift Search Receiver are a potent combination for surveys to find new sources, and then measure their redshift to determine the distance to the source. The sensitivity of these instruments will allow the study of galaxy evolution throughout cosmic time, perhaps even looking back to the very first galaxies that were formed.





First light spectrum of the starburst galaxy M82 obtained on LMT with the redshift search receiver.

(below) Large Millimeter Telescope



Continued/Cover

THE HUNTING OF THE HIGGS

our proton beams for a long time. If we are able to produce the hypothetical Higgs particles, they will very quickly decay into lighter particles, which can be observed in our detectors. The kinds of particles the Higgs decays to depend, to some extent, on the mass of the Higgs. If the mass is large enough, it can decay to two massive W bosons, each of mass about



Ben Brau

85 times that of a proton (whose mass is $0.938 \text{ GeV}/c^2$), which in turn decay to more familiar electrons or muons (elementary particles similar to electrons, but about 207 times more massive). By searching for events that contain two electrons or muons, and identifying and understanding all of the possible ways other events

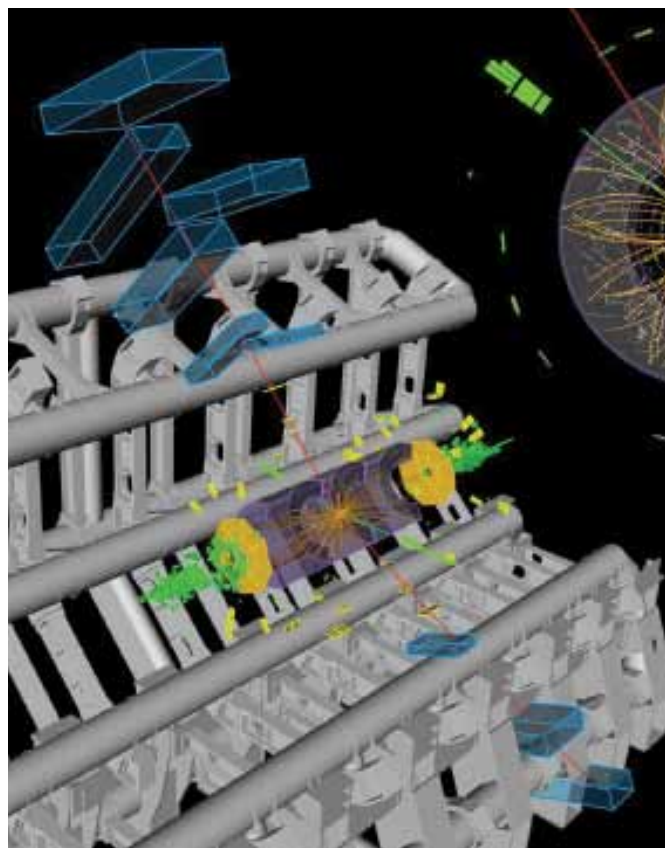
could produce two electrons or muons, we hope to find a signal for the Higgs. On the other hand, if the Higgs is too light to decay to the W boson, it could decay to a pair of bottom quarks, each of mass about four times that of a proton, or a pair of energetic photons. However, for an even heavier Higgs, it could decay to the heaviest known bosons, the Z's, with masses about 97 times that of a proton. The Z boson can also decay to electrons and muons, making their detection especially important in the search for the Higgs.

The UMass group of Professors **Ben Brau**, **Carlo Dallapiccola**, **Stephane Willocq** and their graduate students has made significant contributions in the area of muon identification and reconstruction for the LHC's ATLAS detector.

Members of the group have written large portions of the code currently used to reconstruct the trajectories of muons in the ATLAS Muon Spectrometer. They are responsible for the maintenance and development of the muon event data classes, as well as substantial parts of the reconstruction software. Since joining the ATLAS



Carlo Dallapiccola



Cutaway view of ATLAS showing a two-muon event passing through muon detectors shown in blue.

collaboration in 2004, they have held coordinator positions for software, reconstruction, combined data quality, and combined performance for events containing muons. Graduate students have also played a significant role in the commissioning and continued operation of the end-cap Muon Spectrometer System, as well as muon data acquisition.

By simultaneously searching the data for all of the possible ways the Higgs might decay, we can explore the full range of masses the Higgs might have. The data are analyzed separately for each of the different ways the Higgs can decay, and then these results are combined together into a single result for each

possible Higgs mass. Limits on the probabilities are presented normalized to the theoretical probabilities. Currently, for the data collected up to now, a Higgs mass in the range between 122 and $128 \text{ GeV}/c^2$ is possible.



Stephane Willocq

This year will be particularly interesting in the Higgs hunt as the data sets acquired at the LHC are expected to grow to the extent that the Higgs boson could either be discovered or excluded. Stay tuned!

NANOTECHNOLOGY LEADERSHIP

The University continues to be a leader in the area of nanotechnology. Professor of Physics **Mark Tuominen** and Professor of Polymer Science and Engineering (PS&E) **James Watkins** together direct the UMass Center for Hierarchical Manufacturing (CHM). Most recently CHM has been awarded a \$20 million five-year grant from the NSF. At the time of its creation in 2006 the Center received a \$16 million federal grant and \$7 million from the Commonwealth of Massachusetts.

The core technology has been the assembly of precisely designed nanostructures of hybrid materials out of polymers by chemical methods. This process, pioneered by Professor Tom Russell of PS&E, has the remarkable property of self-assembly whereby the nanostructure is organized spontaneously out of a coating of the polymer solution. The result is the manufacture of devices important in energy generation and storage, chemical separations, flexible electronics and sensors. Examples include solar cells, cell phone displays and batteries.

A major concern is to keep the production cost down for these devices. With this in mind the Center, in cooperation with Massachusetts industry, is developing the so-called roll-to-roll manufacturing technique analogous to newspaper printing. But here physical and chemical processes take place on a moving web of the flexible substrate. The expectation is the production of low-cost devices that outperform those made by more conventional methods.

DIAGRAMMATIC MONTE CARLO METHODS

Combining known factors in a new way, Professors **Boris Svistunov** and **Nikolai Prokof'ev**, together with three former post-docs, Kris Van Houcke, Felix Werner and Evgeny Kozik, have solved an intractable 50-year-old problem: how to simulate strongly interacting quantum systems to allow accurate predictions of their properties. Their result could open the door to practical

superconductor applications, as well as to solving difficult manybody problems in high-energy physics, condensed matter and ultracold atoms.

In a 1981 seminal lecture, Richard Feynman argued that an arbitrary quantum system cannot be efficiently simulated with a classical universal computer, because



Boris Svistunov

generally, quantum statistics can only be imitated with a classical theory if probabilities are replaced with negative (or complex) weighting factors. For the majority of many-particle models this indeed leads to the so-called sign problem, which has remained an insurmountable obstacle. Somewhat ironically, Feynman's arguments, which led him to the idea of emulators, may be defied by a theoretical method that he himself devised, namely Feynman diagrams.

This technique organizes the calculation of a given physical quantity as a series of diagrams representing all the possible ways particles can propagate and interact. Evaluating and summing all the corresponding integrals has been thought to be prohibitively difficult. But the UMass Amherst team now has found a way to do this.



Nikolai Prokof'ev

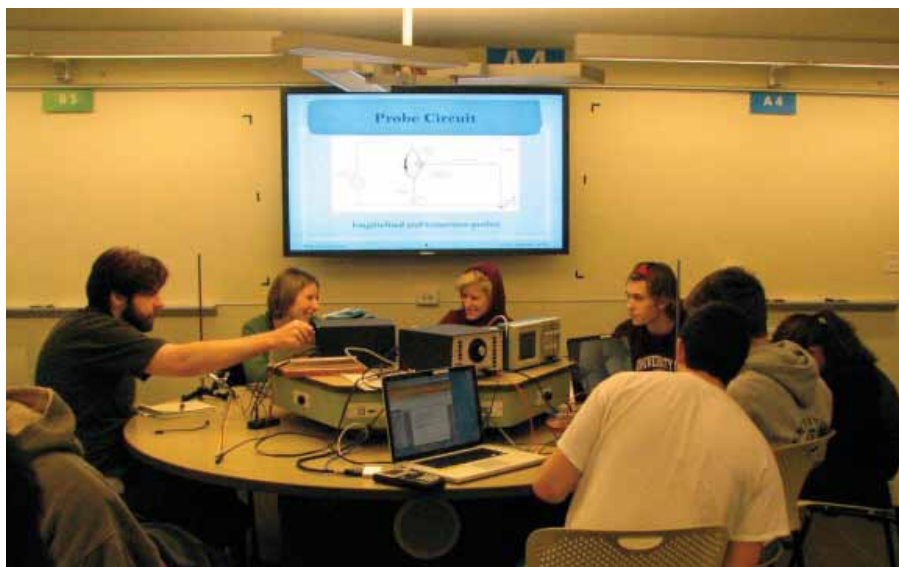
What they discovered is a trick called Diagrammatic Monte Carlo. Thinking of each integrand as a probability distribution (over many variables), one may use statistical techniques to sample and effectively sum the series without explicitly performing integrations over the internal variables in each particular term.

The paper includes crucial results of an experimental validation using ultracold atomic Fermi clouds with controlled population imbalances conducted by Martin Zwierlein and colleagues at MIT. Agreement between theory and experiment is excellent.

teaching

TEAM BASED LEARNING

New facilities and stepped up interest are resulting in a new emphasis on team based learning (TBL) in the Physics Department. A good example is the changed atmosphere of the Physics 182 E&M lab. The recently created teaching space in the Goodell Building (formerly the library) is a large well-lit room with walls that are lined with huge video screens alternating with white board writing space. Eight students surround each of large round tables on which the lab apparatus is placed on a raised area in the center



of the table. Video cameras are everywhere, enabling the instructors to display on the video screens a page of explanatory material, notes written on one of the white boards, a diagram of the experiment, a close-up of the apparatus zoomed in to almost microscopic detail, a web page from the instructors laptop, or just about anything else one might want the class to see.

Students work together in groups of three or four, dividing up the tasks necessary to complete the lab assignment and collaborating with each other to figure out the details of what to do next and how to do it. The instructors, **Narayanan Menon** and **Krishna Kumar**, circulate freely among the tables providing help, asking questions, and provoking discussion about the physics of the experiments. If the instructors want to involve the whole class in a short discussion or explanation, it is easy to put the relevant material on the video screens where everyone can see it, and briefly turn the laboratory into a lecture, a demonstration, or a group interchange. The apparatus for the experiments has to be carted over

from Hasbrouck each week because of heavy scheduling of the specially equipped room by many departments.

A different implementation of TBL is used in the weather course taught by **Heath Hatch**. In addition to learning the physics of weather, the class is divided into two teams, each having the task of sending aloft an instrument package capable of collecting weather related data. The flight package is limited to three pounds because of FAA regulations. The team has complete responsibility for deciding what is to be measured, what instrumentation is to be used, how the data are recovered, and the design and construction of the apparatus. Some enterprising students have enlisted design help from their engineering buddies.

The concepts and principles of TBL are not new; textbooks have been around since the 1980s and the eleventh annual conference of the TBL Collaborative was held in March 2012. TBL was pioneered in the fields of medicine and later business management, where much of the learning is based on a team being assigned a specific task, for example, to make a diagnosis and recommend a treatment, or to find a solution to a business problem. Some guiding principles are: each team must remain together for the duration of the exercise, the grading system must require individual accountability for out-of-class work and contribution to the team effort, there must be some form of readiness evaluation before the team exercise is begun, and there must be application-focused assignments reported and evaluated in class.

The obvious questions are: Does it work? Is TBL an improvement over traditional methods? It is NOT easier. Is the extra effort worth it? The response from the instructors is that they are freer to give individual attention, and most significantly, the level of student interest and engagement is MUCH higher.

The New Academic Classroom Building under construction (see the back cover) will have classrooms equipped for TBL so that the next generation of students will have the opportunities to experience these new methods of learning.

graduate students, new and old

GRADUATED IN 1991



Peter Hessling



Robert Higley



Charles Mayo



Michael McGovern



Yee Ling Ong



Carlos Ramirez



K.S. Sateesh



Li-Juan Wei

1991 MS and PhD graduates not pictured: Siu-Kau Chan, Edward Kling, David Olivieri, Antonio Perez, Peter Sheldon, Thomas Sotirelis, Peter Temple

ENTERED IN 2011



From Left to Right: Kieran Ramos, Oshri Oz, Sebastian Fachs, Wei Hong, Qingyou Meng, Thomas Korosik, Zhanlong Qui, Dan Wang, Salem Al Mosleh, Chenxi Wang, Nathan Bernard, Jinhua Mu, Zhiyuan Yao, Brian Hildebrandt, Jiyue, Wei He, Brian Griffin, Yiwei Sun, Florian Weiser, Ramesh Adhikari, Kun Wang

student awards

UNDERGRADUATE AWARDS MAY 2011

- Chang Freshman Award
Alexander Chippendale
- Chang Transfer Student Award
Vinay Shah
- LeRoy F. Cook Jr. Memorial Scholarship
Colin Jermain
Kyle Lafata
- Kandula Sastry Book Award
Vinay Shafi
- Hasbrouck Scholarship Award
Alexander Nemtzow
Zachary Nemtzow
Russell Smith
- Morton & Helen Sternheim Award
Thomas Brewer

GRADUATE AWARDS MAY 2011

- Quinton Teaching Assistant Award
Nerangika Sadeera Bandara
Benjamin Ett
Aditya Gokhale
- Kandula Sastry Thesis Award
Mohamed Anber
- Dandamudi Rao Scholarship
Pekar Milas

COLLEGE/NATIONAL AWARDS MAY 2011

- William F. Field Alumni Scholarship
Colleen Treado

AWARD RECIPIENTS, PHYSICS DEPARTMENT, MAY 2011



Back row (L to R) Benjamin Ett, Negarangika Bandara, Alexander Neutzow, Vinay Shah, Pekar Milas,
Thomas Brewer, Colin Jermain, Colleen Treado
Front row (L to R) Kartikeya Nagendra, Kyle Lafata, Alexander Clipperdale, Russell Smith

COLLEGE OUTSTANDING STAFF AWARD



Steve Goodwin (Dean of Natural Sciences), Kris Ropell, and Don Candela, our Department Head.

Each year the College of Natural Sciences holds an award ceremony to recognize excellence and honor faculty and staff who have made important contributions to their discipline, department, college, and university. Each recipient receives a \$1,000 honorarium. This year, one of the College Outstanding Faculty and Staff Awards was presented to Physics staff member **Kris Reopell**.

Kris is the Department's Academic Scheduling Officer. She routinely goes above and beyond, making sure that all students are placed into the classes and labs that they require for their track toward graduation. It is a common sight at the beginning of each semester to see a stream of students winding its way down the hall to Kris' office.

This is just one of the many jobs that Kris is responsible for. She performs all of her tasks with diligence, integrity, and always a smile. The Physics Department is very fortunate to have Kris as one of our staff members, and we greatly appreciate all that she does.

MACHTA AND TUOMINEN NAMED AMERICAN PHYSICAL SOCIETY FELLOWS

Professor **Jon Machta** and Professor **Mark Tuominen** of the Physics Department have been named Fellows of the American Physical Society (APS). Machta's selection came for his many contributions to understanding the statistical physics of disordered and complex systems and for the development, analysis and application of algorithms for simulating these systems. He was nominated by the APS's Topical Group of Statistical and Nonlinear Physics.



Jon Machta



Mark Tuominen

Tuominen was nominated for contributions to nanoscale science and technology. He was nominated by the Division of Condensed Matter.

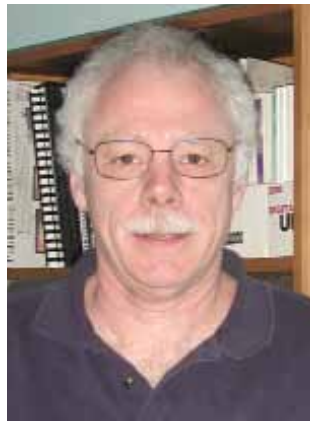
DISTINGUISHED PROFESSOR DONOGHUE



John Donoghue has been appointed Distinguished Professor, a title conferred on a selected few faculty at UMass. John's impressive research record ranges from his seminal work on the use of quantum field theoretical methods in gravity, to his contributions to the study of the physics of quarks and to the idea of "multiverse" in cosmology. This honor recognizes the highest levels of achievement in service, teaching, and research. Congratulations John!

new faculty

DR. JOSEPH GALLANT



Joe Gallant (BS '86, MS '88, PhD '96) recently returned to us as a Lecturer and is now teaching Physics 152, the large introductory physics course for engineering undergraduates.

Joe's PhD thesis was on the nuclear shell model and Prof. John Dubach was his advisor. (Dubach is now Chief Information Officer and Special Assistant to the Chancellor.) The Alumni News section of the spring 2006 Newsletter, page 16, has a note from alumnus John Desjarlais about "goofing around a little too much during class with my cohorts Joe Gallant and Gary Kolnicki..." hmm...

From 1993 to 2007 Joe was at Kent State in Ohio where he became a tenured associate professor. After a few years at Hiram College in Ohio, he returned to the Pioneer Valley in 2011.

He has recently published a book, *Doing Physics with Scientific Notebook*, a software package that makes it easy to create documents combining text and mathematics, and to carry out mathematical calculations (Wiley, May 2012). He uses it in the Physics 152 course.

Joe and his wife Patti have a daughter, Lisa. From his earlier days at UMass, he remembers Professors Brehm, Cook, Donoghue, Peterson, and Golowich. They are all no longer on the faculty except for John Donoghue. Some of our alumni readers may remember them too! Joe says it is good to be back. Joe: it's good to have you back! gallant@physics.umass.edu

ZACHARY WISSMAN

Zach Wissman came to us as a Teaching Lab Assistant in 2010. He was an undergraduate at Trinity College in Hartford where he majored in Environmental Science, and in addition played hockey. In our physics teaching labs he sets up experiments, takes them down, and makes sure they will run. In the latter capacity he interacts with students who are having trouble – and likes that interaction!

His long-term goal is to go to a medical school. He says that his job at UMass Amherst keeps him in touch with academia – and also helps him to pay off student loans!

new lab director

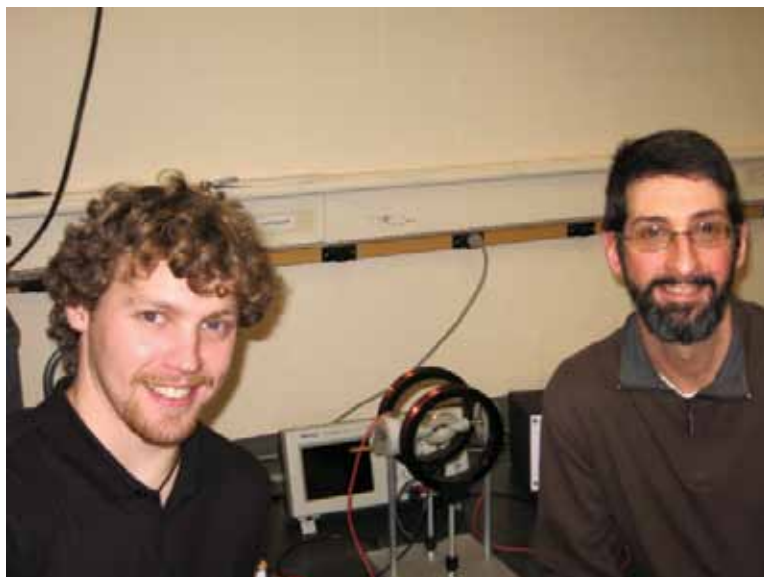
DR. PAUL BOURGEOIS

Paul Bourgeois (PhD '05) has a long connection with UMass: he was an undergraduate here, graduating in 1991 with a major in Astronomy when our department was still a Department of Physics and Astronomy. In 1993 he got a second bachelor's degree (this time in Physics) from UMass Boston and stayed on teaching labs. In 1997 he came back to UMass Amherst as a graduate student, receiving his PhD in 2005 based on a virtual Compton scattering experiment involving the scattering of electrons on the proton.

In succeeding years he was a teaching fellow at Amherst College and later a postdoc at Brookhaven National Laboratory. In 2008 Paul returned to Amherst College as a visiting Assistant Professor, and in 2011 he came back to us to in a new faculty position: Director of Physics Teaching Laboratories.

Over the years, physics labs at UMass Amherst have been run in various ways. At one time an undergraduate physics course would have a lab associated with it as part of the course. Later the lab was split off as a separate course. Now the lab is again part of the course. From the Director's viewpoint, a lab has two components: an "operational" component (setting up the experiments, making sure they run) and an "academic" component: what is the student supposed to learn? In his role as Director, Paul is planning to review both components, but especially the academic content of all the experiments.

Good luck Paul!



Zach Wissman (left) and Paul Bourgeois (right)

IN MEMORIAM

Edward Shih-Tou Chang died in his home on Wednesday, February 15, 2012. He recently endowed a program to fund undergraduate research, and on February 15 there was to have been a luncheon in his honor at the Campus Center. He was ill, the venue was changed to be at his home, but he died early that morning. The “luncheon” became a remembrance in his honor.



Natalie and Ed doing their thing.

Ed was born in Swatow, Kwangtung, China, to Jessie and Thomas TK Chang on July 6, 1940. He earned his doctorate in theoretical atomic physics at the University of California Riverside and came us in 1970, at which time we had an active atomic physics research group. He collaborated extensively with local experimentalists, as well as with physicists at NASA and elsewhere in the analysis of spectroscopic measurements and of electron-molecule scattering.

Ed was very active in our undergraduate program, particularly in advising undergraduate students. For many years he was head of our Undergraduate Studies Committee. In 2003 he became Associate Dean for Advising in the College of Natural Sciences and Mathematics. He went from helping about 100 physics majors to helping 2000 students. He has also funded awards to help freshmen and transfer students. Ed loved to dance and every week went

to contra dances and to English country dances. He also liked to hike, to cook, and to travel. He leaves his wife Natalie and three sons.

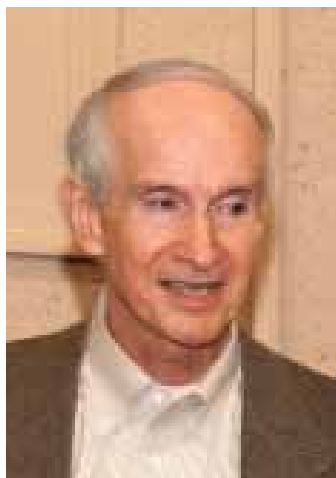
ENDOWMENT FOR UNDERGRADUATE RESEARCH

Ed Chang always had a special interest in undergraduate teaching and advising. As our Head Advisor and Undergraduate Program Director, and later as Associate Dean for Advising for the College of Natural Sciences, he improved on the recruitment of physics majors, an improvement that greatly increased the number of physics graduates and continues to this day. He also created two undergraduate awards for majors, one for an outstanding freshman and one for a transfer student. In his retirement, he established a generous endowment to provide funds in perpetuity to support small grants to undergraduate physics majors pursuing research projects: The Edward S. Chang Endowed Fund for Undergraduate Research. Undoubtedly, it will have a long-term impact on our undergraduate program. Thank you Ed!



GENE GOLOWICH RETIRES

Gene Golowich, who received his PhD from Cornell in 1965, retired in June 2011 after almost 44 years in the Physics Department. He was a key member of the High Energy Physics Theory Group and had published 124



papers in various areas of that field. Gene provided us with a detailed description of his research career in an article in the 2009 Newsletter, entitled *A Life in Physics*, which is recommended reading at any stage of a physics career.

Gene has always been rated by the students in his classes as being one of the best teachers in the department. No doubt that his quiet but penetrating sense of humor contributed greatly to this. In departmental meetings, he was not the loudest person speaking, but was one of the people to whom the other faculty paid the most attention.

Although retired, Gene has continued his involvement with high energy theory. Currently, he is working on a new edition of the well-known book *Dynamics of the Standard Model* written with John Donoghue and Barry Holstein.

ANTHONY PAPIRIO

Anthony Papirio came to us in 1979 to work in our introductory physics labs. He retired as Faculty Lecturer in 2011. We asked him to tell us about some of his memories and here is what he wrote:

In 1979 enrollments were growing and lab prep was an extremely busy place. My boss, Fritz Tidlund, encouraged me to master the skills helpful to the labs, provided me with tools and space to learn, and we constructed lab apparatus together. Fritz retired in August 1984. That fall I launched into the semester on my own. It was a very intense experience, having to take responsibility for every aspect of lab operations with only some temporary part time help. With Prof. Ben Crooker providing oversight, I made it through to the 1985 spring semester, when after a drawn out hiring process, Jeff Kmetz became my assistant. He was the right choice, and was a dependable coworker for the next 23 years.

In 1987 Prof. Kandula Sastry and I created a lab course for non-science majors (Physics 103), which was a popular success. Through these years I began developing new lab experiments with many of the faculty. That process was always my favorite part of the job.

In June 1988, at Cornell, I attended my first of over 20 AAPT summer meetings. This was one of the most

Al Mathieson Celebrated his 94th Birthday



On July 6, 2011, Professor Emeritus Alfred Mathieson celebrated his 94th birthday with family and friends at his Amherst home. Matty graduated from Columbia University in 1939, and with WWII on the horizon, he enlisted in the Marine Corps in June of 1940, serving first as an instrument flight instructor, and later as a commanding officer of a squadron in the French West Hebrides. At the war's end he was discharged as a Major, and came to Amherst to teach physics to the returning GI's who were attending college under the GI bill. From the late 1960s to 1978, he served as Department Business Manager, and then until 1984 he worked for Fred Byron, who had been our Department Head and later Dean of the School of Natural Sciences and Mathematics (NSM). Finally until 1990 Matty worked as liaison to the Physical Plant on NSM building modifications. At his birthday party, Matty reflected on the many changes he saw during his long tenure on our campus. We wish him well indeed!

exciting parts of my career; I personally got to meet and learn from lab and demo experts from all across the US, and met the manufacturers of the lab equipment that



was my daily stock and trade. Energized to start updating and innovating my own labs at UMass, I began suggesting and demonstrating to the faculty new apparatus for the lab courses. My attention was

shifted at the beginning of the 1990's to helping faculty members who got grants to support summer programs. Profs. Mort Sternheim, Roy Cook of Physics, and Don Saint Mary of Math, all set up summer programs with lab components. Summers became as busy as the fall and spring semesters. I introduced the first computers into the labs in the middle 1990's. I also developed an improved version of the Millikan Oil Drop experiment with Profs. Jimmy Sakai and Claude Penchina, and had an article published in *The Physics Teacher* in January 2000.

In March of 2000, I was deeply honored to accept an offer to join the faculty as Lecturer. Working for 33 years with our graduate students lab instructors from practically every place on the planet, I was given one of the greatest privileges of my job. It's a thrill to realize that there are hundreds of physicists and astronomers all over the world who worked with me in the labs when they were grad students here.

Note added by the newsletter committee:

Tony first came to UMass as a student in electrical engineering. He now lives in nearby Belchertown with his wife; they have two grown sons and two grandchildren. He played and still plays a mean saxophone with local bands.

papirio@physics.umass.edu

DAVID V. WEBB

David Webb, Australian trained, joined Gerry Peterson's Nuclear Physics Group in 1972 as a post doc to do some fun electron scattering physics experiments using the National Bureau of Standards (NBS) and MIT electron linear accelerators. He later became an assistant professor. His wife Liz, a PhD molecular biologist, worked in the labs of Skip Fournier of the Biochemistry and Molecular Biology Department while they were here. When they returned to Australia in the late 70s, Dave briefly did some atomic scattering work at Melbourne University before joining the Australian Radiation Laboratory, which has become the Australian Radiation Protection & Nuclear Safety Agency (ARPANSA), a government regulatory agency. Dave developed a high dose rate irradiation facility for ARPANSA. Ironically when he became a radiation metrologist some 20 years later, he was involved with a new generation of people from NBS, now called the National Institute of Standards



Liz and Dave Webb

and Technology (NIST). In February 2012 he returned to the USA to give a talk at NIST in Gaithersburg, Maryland, on international comparison of absorbed-dose standards that will be developed in Australia using their new medical radiotherapy linear accelerator. Then he and Liz took the Amtrak train from Washington to Amherst to be feted by their former colleagues before flying to London to visit their sons and grandchildren. Although officially retired, ARPANSA hired David back part-time to support the medical application of these radiation standards.

alumni news

Christine DeRunk (BS '00) writes: When I was a student at UMass preparing for a career as a high school physics teacher, I was supported particularly by Bill Gerace. It was in his class that I learned to own my education. I doubt that Professor Gerace even remembers the extra help session in which we were learning that Lagrange's and Newton's equations are equivalent, but that session was a life-changing experience for me. My peers and I were sitting around the table with Professor Gerace and none of us were asking questions. He said that if there were no questions, he was going back to his office and that we could find him there. Desperate for him to stay in the room, I asked a question. It was probably more of a muttered statement of confusion but he went with it. We talked for a few minutes about the problem and then he extended his hand offering me a piece of chalk. He said simply, "You're ready." I was thinking, "Ready for what?" and only when he answered did I realize that I had spoken aloud. "To go to the board," he replied as though it were obvious. I went to the board, so scared that all I could do was draw a picture of the problem. He guided me through the process in his I'll-answer-your-question-with-a-question style. I still recall that the answer was $g/2$. I also remember laughing at the answer because it was *obviously* $g/2$. Professor Gerace laughed as well and said, "It's okay. We're constructivists around here." Since graduating in 2000, I taught at the high school level for six years where no fewer than a dozen of my former students have gone on to study physics as undergraduates. It is always rewarding to get an email from a former student saying that she or he enjoyed my class so much that it was an inspiration to study physics in college. There was always a part of me that felt I "should" go to grad school for physics, but I have made my peace with not doing so because I see that my talent is with the high school crowd. I have also earned a master's degree from Antioch University in Peace Education, served as the Physics Lab Director at Mount Holyoke College, and given birth to a beautiful baby boy. My family and I now live in Leverett, MA. derunk@yahoo.com

Jim Ledwell (MS '74) Senior Scientist, Woods Hole Oceanographic Institution. Forty years have passed since I started the best academic experience of my life, studying basic graduate physics courses at UMass Amherst with Fred Byron, Jim Walker, and David Inglis. Unable to settle down to a research project after finishing the usual menu of courses, I left with an MS to try something more applied at Harvard's Center for Earth and Planetary Physics. I hit my stride, such as it was, only after

finishing a PhD there and becoming an oceanographer, mentored by Wally Broecker at Lamont-Doherty Earth Observatory. Wally got me started studying mixing and stirring in the ocean by releasing tracers and watching their distributions evolve, sometimes for period of many years. I have been at that sort of work ever since. These studies inform us about the subtle dynamics of stratified turbulent fluids, driven by winds, tidal forces and air-sea-ice-heat and moisture exchanges, on a rotating planet. To appreciate the elegance of this field, see Joseph Pedlosky's *Geophysical Fluid Dynamics*, a most clear and tightly written physics text. By the way, the partly phenomenological text that first caught my interest in ocean dynamics was Henry Stommel's charming book, *The Gulf Stream*. It is great to receive and read the Physics Newsletter, even if it reminds us of how swiftly time passes. Thanks very much for your efforts, and thanks to the faculty that guided my faltering steps in the early 70's. jledwell@whoi.edu

Jack Lareau (BS Physics, '72) After graduating from UMass, I started in the newly formed Non-Destructive Testing Development Laboratory at the Westinghouse facility supporting the naval reactors program. I stayed in this field and now have completed 40 years of R&D in this field, working on a variety of problems in



nuclear plants. These technologies were also transferable to aerospace and petrochemical applications. One of the most demanding efforts was developing the solid rocket motor inspection system after the Challenger explosion in 1986. Our group also developed inspection

systems for the Alaska pipeline and the first deep water off shore oil platforms. I drew the short straw and had to install the system in Prudhoe Bay in February (-60F!). We even had the opportunity to retrofit old Titan II rockets (the original ICBMs) with ultrasonic fuel level sensors and launched transducers into space.

In 2011, I was the recipient of the George Westinghouse Lifetime Achievement Award for Technology Development recognizing the body of work that helped to solve a number of critical safety inspection

issues in nuclear plants around the world. Working on a Russian designed reactor in China presented many unique challenges, the least of which was the dual simultaneous translation for all the meetings.

In 2012, I was elected to Connecticut Academy of Sciences and Engineering. This group of academics and industry professionals assist the state government on an ad hoc basis by serving on technology panels.

Through the years, I have maintained considerable contact with UMass through football and basketball season tickets. It is fun to see the basketball team winning again. After all, our class had Julius Erving!

Undoubtedly, my single largest accomplishment during college was successfully presenting the coed dorm proposal to the Board of Trustees. UMass was the first state university with undergraduate coed dorms. jacklareau@cox.net

From Big Detectors at Jefferson Lab to Small Ones Detecting Cancer

Pjerin Luli (BS '05) writes us: When I arrived at UMass the world was big with many opportunities. Walking in Southwest area felt like being in a city. There was always something to do, go to class, finish



a lab report in Hasbrouck, study at the library, go back to Southwest, get into a riot because Patriots won or lost, go to the frats, and take an exam the

next day. Physics is a fascinating subject because you always ask the question WHY, and you may get into discovering something, even if it is how to solve a problem differently from everyone else in class. Working at the Bluewall, on the other hand, taught me to fight hard to get what I came for at UMass in the first place.

One of the best decisions I made while at UMass was to jump into undergraduate research early in my sophomore year. My research focused in nuclear physics at Jefferson lab (JLab) in the Primex project. The goal of the project was to test the low energy QCD theory by performing a precise measurement of the neutral pion lifetime. We built a large square detector, more than 4 feet tall, with hundreds of crystals to detect gamma rays. In physics graduate school I realized that I wanted to go beyond experiments and theory and wanted to do something different. But, is there anything out there besides Physics, and most importantly, am I able to do anything else besides Physics? Another problem with a big WHY... Business school was like a boot camp. How is it possible that one with no knowledge of physics can engage and convince people so magnificently?! I remembered the importance of early research/internships, and went to work for a high tech company called Dilon Technologies. The most revealing moment was during a tour at their manufacturing lab when I saw a tiny detector made of many small crystals. It resembled the gigantic detector from Jlab but instead of detecting gamma rays coming from an experimental target it detected gamma rays from a “hot” lesion in the human body, indicating a possible cancer.

One in eight women will have breast cancer in their lifetime. Mammography misses more than 10% of cancers and a lot more in women with dense breasts. The gamma detector, the Dilon 6800 Gamma Camera, is used when a mammogram is inconclusive. Dilon is the world leader in gamma cameras for breast imaging. The gamma camera looks into the functionality of the cancer rather than its structure, and can help in early diagnosis of breast cancer. Early detection of cancer saves your life! My initial work in the company consisted of analyzing different markets. Suddenly, I was in the Marketing department, although I kept asking the same WHY! I am currently leading the marketing efforts at Dilon and closely working with the physicists in the company to bring the ideas of the future to reality today, now, at this moment. I live in Williamsburg, Virginia with my wife Klaudia Luli (BS '06). pjerluli@gmail.com

Nancy Missert (BS '83) My undergraduate years at UMass, working in Kreisler's high-energy physics group, instilled in me a love of experimental physics that continues to guide my career. I was lucky enough to participate in the high-Tc superconductor revolution starting with my PhD work (with the KGB group) at Stanford, and continuing on during my post-docs at Berkeley and NIST.



I've now been at Sandia National Laboratories for the past 18 years, where I've had the opportunity to explore quite a variety of material science problems, from diamond-like carbon field emission, to phosphors, to semiconductor defects, to corrosion, and now Li ion battery materials. Being at Sandia has allowed me to work on so many really interesting projects with some of the best people and facilities in the world. I also feel truly blessed to be able raise my two boys, Lyle and Clayton, with my husband Dave in New Mexico, one of the most amazing spots on this planet. namisse@sandia.gov

We, the editors, thank everyone for their input. With a readership of over 1700, we look forward to your hearing from you, too.

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For more information about our department, visit our website at www.physics.umass.edu

Brigette McKenna, Designer
bridgettemckenna@gmail.com

Satish C. Prasad (PhD '72) retired from the SUNY Upstate Medical University in 2010. He sent us this summary of his career: I arrived in Amherst in August 1966 as a graduate student from India with about ten dollars and a suitcase full of physics books used in Indian schools. I was initially helped by a friend, another UMass graduate student. My need for money was critical and any income from my teaching assistantship was months away. Professor Morton Sternheim was kind enough to sign my application for a loan, which led to cash from the Bursar's Office. In the summer of 1967, the Department Head Robert Gluckstern invited me to work with him as a research assistant. This partnership resulted in a paper on proton accelerator beam blowup, published in the Proceedings of the Brookhaven National Laboratory. I was proud of my name on my first paper. The Masters Degree was awarded in 1968 and then a Fellowship toward my PhD. I started under John Brehm in theoretical elementary particle physics with the group consisting of John Brehm, LeRoy Cook, Gene Golowich, Barry Holstein, and Arthur Swift. My thesis work was on "Pion-Pion Scattering based on Current Algebra and Unitarity" and was based on work done by Brehm and Golowich on the pion's form factor. During the defense, I answered a question posed by Robert Krotkov about the application of Current Algebra to fermions. I started to answer that question with an assumption that was untenable, as was pointed out to me. Bob was kind enough to ignore my blunder.

In 1972 I finished my degree and started postdoctoral work in particle physics at the University of Rochester. After two years it became difficult to secure a job in this field. Peter Carruthers, a theoretical physicist at Los Alamos offered me a postdoc position. On the advice of a friend, I enrolled in a training program for medical physics in Denver CO in 1974 and finished with a MS in Radiological Medical Physics. I then joined Washington University's School of Medicine as a faculty member in the Radiology Department. In 1981 I moved to the SUNY Upstate Medical University in Syracuse. In 1992 I was promoted to the rank of Professor and have written a review book on the physics of radiation oncology for medical residents. In 2010 I retired from active work to shuttle with my wife between New York City and Seattle where our children and grandchildren live.

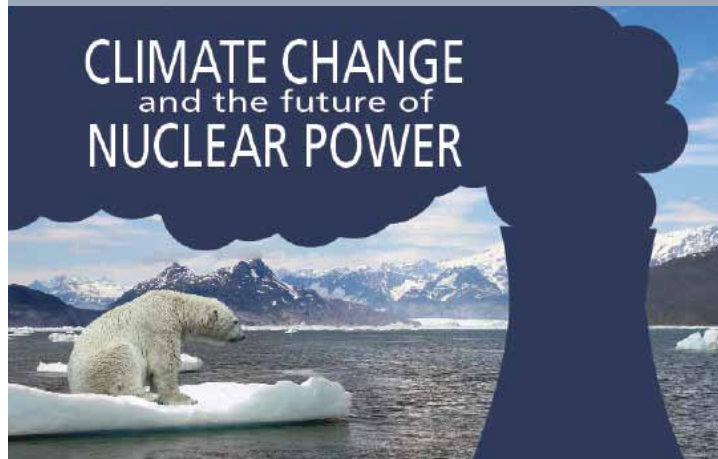
prasads1954@yahoo.com

NEW CHANCELLOR THE CHANGING OF THE GUARD

In mid-March the Board of Trustees announced that we will have a new Chancellor on July 31, 2012. Provost **Kumble Subbaswamy** of the University of Kentucky will, on that date, take over from Robert Holub who has held the office for the past three years. Provost Subbaswamy was an undergraduate at Bangalore University in India. He came to the United States for his graduate studies and was awarded his PhD from Indiana University in 1976. His research interest has been in the optical properties of novel materials and in nonlinear excitations. Yes! He is a physicist.



It is interesting to note that for the past forty years physicists have frequently played an important part in the upper levels of the UMass Administration. It all started with Randolph Bromery, a geophysicist who was Chancellor in the period 1971-79. He was a great admirer of our own Department Head, Robert Gluckstern, a theoretical physicist, and convinced him to join his Administration. As a result Robert was Provost from 1970 until 1975 before becoming the Chancellor at the University of Maryland. In 1993 nuclear physicist David Scott from Oxford and Berkeley became Chancellor. Since 2001 he has been Professor of Physics, now Emeritus. In recent years Jack Wilson has been President of the UMass five-campus system. He was in Boston from 2003 until 2011. At one stage of his career he was Professor of Physics at RPI. Meanwhile Professor John Dubach of our department has been in Whitmore acting as advisor to the past four Chancellors, especially in the area of Information Technology. And now Kumble Subbaswamy takes over.



MEETING OF THE NEW ENGLAND SECTIONS OF THE APS, AAPT, AND SPS

On Friday and Saturday, November 18 and 19, our department hosted a joint meeting for more than 270 members of the New England Sections of the American Physical Society, the American Association of Physics Teachers, and the Society of Physics Students. The meeting's theme "Climate Change and the Future of Nuclear Power" resulted in many lively sessions of invited and contributed papers, poster sessions, workshops, and a debate on climate change. Also participants could visit our award winning cogeneration power plant that provides both heat and electricity to the campus. Plenary sessions were held in the Campus Center Auditorium, a Friday night banquet in the Student Union Ballroom, and a savory Saturday breakfast in the 10th floor Amherst Room with a view of the Holyoke Range.

The meeting marked the 100th anniversary of Rutherford's discovery of the nucleus. Although he did not hold much hope that we would ever be able to extract energy from nuclei, today nuclear plants provide 18% of the world's electrical energy without emitting climate-changing greenhouse gases as do fossil-fuel fired plants. However in March 2011, doubt was cast on the future of nuclear power as a result of a disastrous earthquake and tsunami in Japan that crippled the Fukushima Daiichi nuclear facility and caused releases of radioactivity. That event was discussed, as well as new nuclear power plant designs, evidence for climate change, and means of mitigating climate change by extracting carbon dioxide from the atmosphere. The meeting's program may be found at <http://scholarworks.umass.edu/>.

Financial support for the meeting came in part from the Department of Physics, the College of Natural Sciences, the Five College Corporation, Professor Arthur Quinton, and anonymous donors.

new alumni

Degrees awarded since the Spring 2011 Newsletter

BS and BA Degrees

Michael Batakis	Christian Geneus	Sera Kelemencky	Patrick Rogan
Ashley Benis	Christopher Gunderson	Kyle Lafata	Eric Saunders
Thomas Brewer	Andrew Hall	James Lanzafane	Daniel Schulman
Adam Cohen	Brandon Hoover	Alexander Lombardi	Christopher Tabis
Tyler DeMarco	Jonathan Hoyt	Peter Panka	Joshua Wagner
Daniel Doherty	Colin Jermain	Karthik Prakhya	Shanka Wijesundara
Joseph Fox	Max Jiusto	John Quirk	VireakYim

MS Degrees

Yiming Chen	Jonathan Wexler
-------------	-----------------

PhD Degrees

PhD Degrees	Thesis Title	Advisor
Xuan Ding	Toward the "bijel" Structure: Light Scattering and Morphology Studies of Spinodal Decomposition in Polymer Blends Mixed with Nanoparticle	Russell (PSE)/ Dinsmore
Kevin Facto	Measurements of Gravity Driven Granular Channel Flows	Candela
Emily Thompson	Search for Contact Interactions with Dmuons at the ATLAS Detector	Willocq
Tianyu Yang	Manipulation of Magnetization States of Ferromagnetic Nanorings	Tuominen
Chuan Zeng	Capillary Interactions among Microparticles and Nanoparticles at Fluid Interfaces	Dinsmore Russell

THANK YOU!

Your generous contributions to the Department are greatly appreciated and are vital to our success. The days are long past when we could carry out our mission by relying only on state and federal funding.

USE OF YOUR GIFTS

We have had several enquiries about the use of your gifts. For the year 2011 your gifts supported this newsletter, the NES/AAPT/APS/ SPS Meeting, scholarships and other student awards, electronic postings of physics news in the Hasbrouck Lobby, employee recognition events, science outreach, SPS Meetings, and Junior Faculty Teaching Workshops. No monies are given to the Alumni Association.

YOUR MAILING ADDRESS

The University Development Office pays for mailings to alumni, but not for anyone else, including faculty who are not alums. If you are an alumnus/alumna, please keep your address current through that office in order to continue to receive copies of the Physics Newsletter by going to <http://www.umass.edu/giving/contact/contactform/> and filling out the change of address form. In addition contact Ann Cairl at cairl@physics.umass.edu with your new address. If you are not an alumnus/alumna of UMass Amherst, just contact Ann Cairl at cairl@physics.umass.edu or phone 413-545-2545 to update your mailing address.

This lists represents those who contributed to the Department of Physics from January 1, 2011, to December 31, 2011. We apologize for any omissions and kindly ask that you bring them to our attention.

Richard Anderson
Anonymous
Karen Armstrong
Michael Azure
Robert Baraldi
James Barber
Kenneth & Betsy Barrows
Michael Belanger
David Bloore
Michael Bonn
Paul Bourgeois
Hazen & Marcella Boyd
Elizabeth Brackett & Thomas Radcliff
Joanne & Nelson Burke
Francis Canning
Roderic Casali
Joan Centrella
Shu-Kau Chan
Edward Chang
Scott Chase
Theodore Coletta
Raymond Connors
Christopher Coyle
Benjamin Crooker
Christopher Davis
Edward Demski
Christine DeRunk
Aimin Ding
John Donoghue
Laurence Dutton
Jon Eisenberg
George Estrella
Frederic Fahey
Keith Fratus
Stephen Fuqua
Fabrizio Gabbiani
Robert & Rebecca Galkiewicz
Robert Gamache
John Golden
Eugene & Joan Golowich
Philip Gregor
Robert & Nancy Hallock
Leroy Harding
Harold Hatch
Evan Heller
Pamela Houmere
Roger & Donna Howell
Robert & Kristina Huffman
Russell Hulse
Thomas Ierardi
David Jagodowski
Julie Johnson
Phillips & Ereda Jones
Philip Kan
Donald Kaplan
Lisa Kaufman
Paul Kendra
Per & Linda Kirstein
John Knapton
Yury Kolomensky
Donald Kuhn

Margaret Latimer
Jack & Margaret Lareau
David G. B. Lawrence
James Leas
Phillip Ledin
Roger Legare
Margaret Loring & Suzanne Clewley
Theodore Lundquist
Jonathan Maps
Alfred Mathieson
Donald McAllaster
Katherine McCall
John McColgan
Margaret McCarthy
Evelyn McCoy
Michael McGurrian & Gena Cadieux
Leonard Mellberg
Barbara Merrill
Caleb Mills
Edward & Claire Montgomery
Medha & Abhay Nadgir
Andre Nasr
Steven Newton
Angela Niu
Mark Noble
Elizabeth Nuss
Moshe Oren
Ramona Osborne
Elizabeth & Peter Ouellette
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V. Adrian Parsegian
Igor Pavlin
Gerald & Doris Peterson
Marti Peltola
Alexey Petrov
John Polo
Satish Prasad
John Pribram
Stanley Pulchtopek
Brooke Purinton
Keith Quinton & Barbara Fildes
John Rahn & Dorota Nowak Rahn
Nadia & Steven Richman
Francesc & Kathleen Roig
Frederick Rowland
Mary Ann & Thomas Ryan
Phillip Rynes
Hajime & Sachiko Sakai
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Ker-Li Shu
Scott Simenas
Thomas & Martha Slavkovsky
Luther Smith
Peter & Kathryn Smith
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George Theofilos
Jorge Uribe
Robert & Judith Vokes
Leslie & Charles Walseman
Jarius Warner
Anna & David Wei
Sharon Woods
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Susan & Frederick Zucker

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The New Academic Classroom Building (NACB) as it will look after construction is completed. The picture was drawn as the NACB will be seen by an observer standing at the northern end of the campus pond, which is to the right in the picture. Hasbrouck is invisible – it is behind the NACB. (See the article on Teaching on page 10)