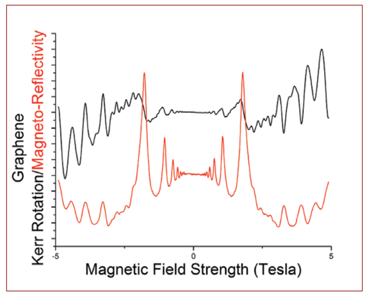
University at Buffalo The State University of New York | REACHING OTHERS

# Interactions

## The Newsletter of the UB Department of Physics




Volume 3, Issue 2 Fall 2010

Dear alumni and friends,

I am writing this letter as the new Department Chair. I am humbled by the support from the Department and the responsibilities the position entails. Although I had doubts before this transition, especially with the difficult budget situation, I am ready to take on this challenge, only because most of the people who brought the Department to where it is are still here. With everyone's effort and cooperation, I am confident we will be able to ride out this difficult situation. I am very grateful to Professor Doreen Wackeroth for agreeing to serve as the Associate Chair and Professor Bernard Weinstein as the Director of Undergraduate Studies, as part of this transition.

As you saw in the last issue of Interactions, Professor Francis Gasparini was stepping down after six years of service as the Department Chair. You are probably also aware of the remarkable growth of the Department under his leadership. During his tenure as Chair, the Department doubled or even tripled several key measures, such as the total number of publications, research expenditure, and the number of majors. A chart illustrating some of these can be found on the back cover of this issue. For me, having an office on the same floor, his leadership has a completely different look. I would like to mention one thing among many I have witnessed over the years. I regularly saw him reading grant proposals, not his own, but from junior faculty members, especially those for the NSF CAREER Awards. It is safe to say there are not many department chairs, at UB or elsewhere, who would take time to read and make comments on as many proposals as he did. Not to take anything away from the outstanding accomplishments of the faculty members, but I could see his day to day contribution to the remarkable growth of the Department. For reasons I no longer recall, I went to his office right after he finished making comments on Professor Peihong Zhang's CAREER proposal. I vividly remember him saying, with excitement, "This guy just keeps on producing great stuff"! This is the level of connection he has had with people in the Department. It is abundantly clear to me that leadership in his book mostly means one thing, namely, service. Although he stepped down as the Chair, his leadership will continue to serve us well.

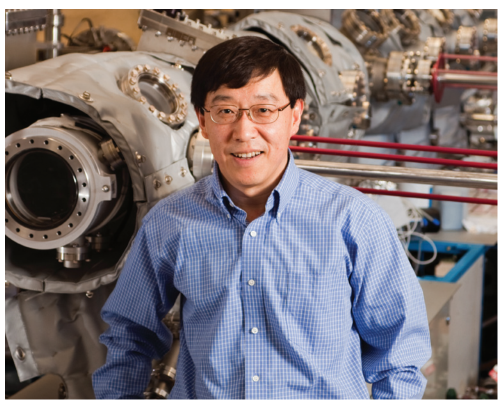
Although many difficult challenges are ahead of us there are areas, especially those where additional financial resources are not critical and there are many, for further growth and improvement. As examples, we need to take advantage of our momentum in consolidating our areas of strength. Much needs to be done to make the outside world aware of where the Department is today, which is important to recruiting students among other things. The increased faculty, majors and overall activities also demand additional office/lab space.

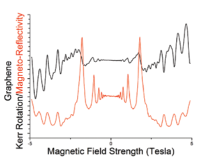
This issue features the accomplishments of our physics majors and a profile of a new faculty member, Professor Steve Durbin, who joined us in Fall 2010.

As always, stay in touch and keep us updated. I am looking forward to working with everyone, here and away, and interacting with you on a regular basis.

Best regards,

Hong Luo, Chair
Professor of Physics





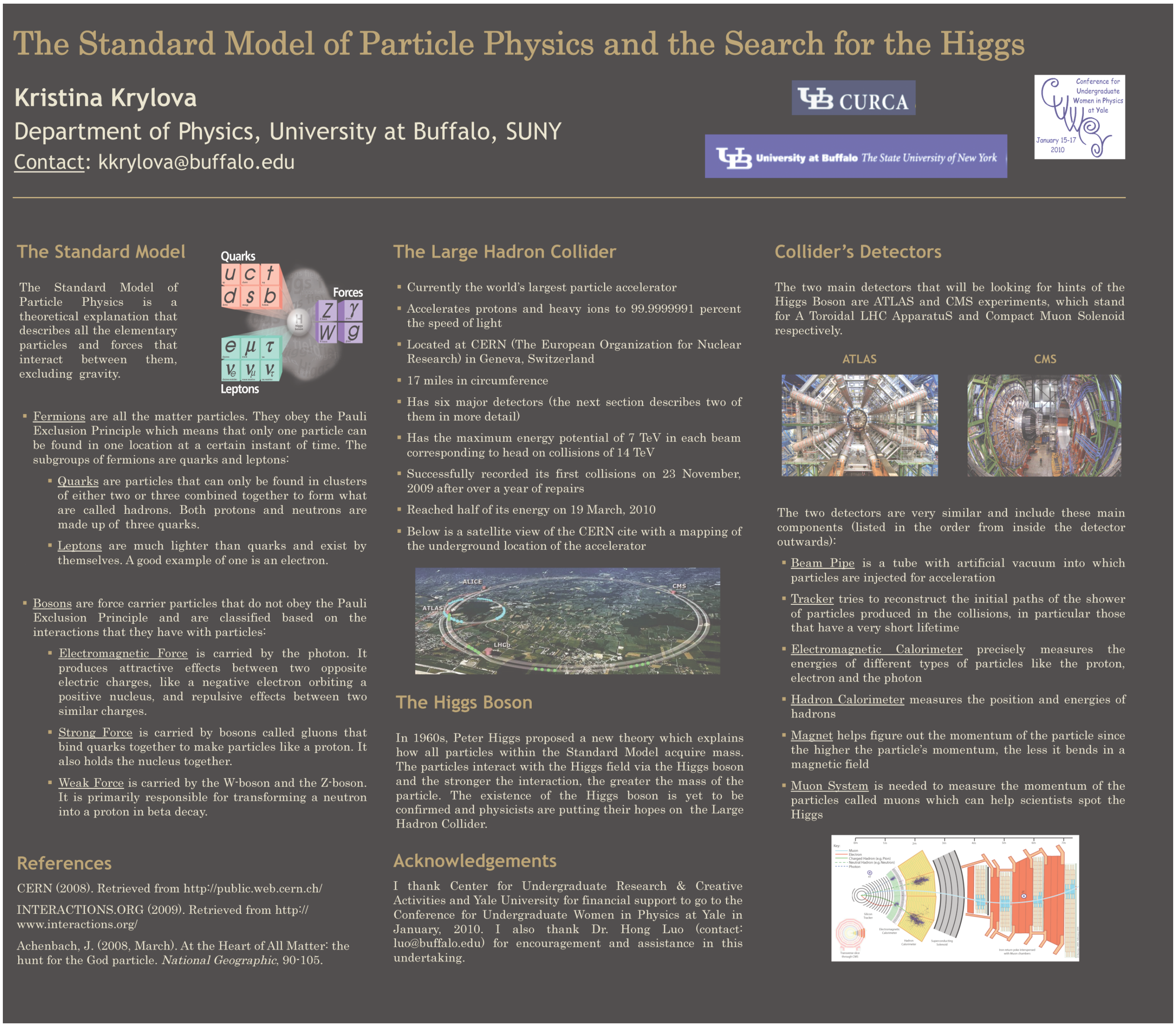

Banner: Infrared Kerr and reflection data showing the rich structure of graphene (a single atomic layer of carbon atoms). This novel measurement on graphene was made by UB graduate student Chase Ellis in the Cerne lab using samples provided by UB physics alumnus Joseph Tischler (Naval Research Labs). More information on this research can be found on page 9. Graphene has made a huge impact in physics research and the 2010 Nobel Prize in Physics was awarded to Andre Geim and Konstantin Novoselov "for groundbreaking experiments regarding the two-dimensional material graphene."

## Undergraduate Physics on the Rise at UB

*By Dr. Bernard Weinstein and Dr. Hong Luo*

The undergraduate physics program at UB is enjoying an exciting period of growth. The number of physics majors has increased by almost a factor of three over the last decade, from 33 in 2000 to 89 in 2010. Last May 27 seniors from our department graduated with B.S. or B.A. degrees as majors in physics, or in one of our four related programs focusing on the mathematical, computational, engineering, or educational aspects of physics. The achievements of our majors, and their potential to pursue modern careers in physics, have also increased as the Department continually strives to improve the educational quality and relevance of its undergraduate programs.

Working with the UB College of Arts and Sciences (CAS) student advising office and the UB Honors College, we have been able to attract many top notch students to our programs. As part of our outreach activities, we invite




The poster describes some basic ideas in the field of High Energy Physics and illustrates the importance of the Large Hadron Collider, the world's largest HEP experiment to date. The poster was created and presented by undergraduate student Kristina Krylova at Universityat Buffalo's Celebration of Academic Excellence in April 2010 as a result of getting funded by the CURCA Undergraduate Research Award to attend the Conference for Undergraduate Women in Physics at Yale University in January 2010.

# Undergraduate Physics, CONTINUED

area high-school science classes to our fall and spring open-houses, where laboratory tours, hands-on demonstrations, and presentations highlight the educational and research excellence of the UB Physics Department.

In our introductory physics courses, there is increased use and upgrades of lecture demonstrations that teach basic physics in concrete and memorable ways. Among the most effective of these are the “Electrostatic Motor” using pop-bottle-armatures, and the “Shoot the Monkey” and “Bowling Ball of Death” teaching constant gravitational acceleration and conservation of energy, respectively -- non-living subjects only! We have made changes in the curriculum so that we better attract and retain the brightest students into the Department’s majors programs. For example, our entry-level honors-physics courses (PHY 117/118) have been switched to a fall-spring sequence in order to better support the academic schedule of our majors. The physics undergraduate studies committee is also exploring ways to offer expanded physics electives to our majors.

The increased research activities of the physics faculty (see the back cover of this issue for more information) has given our majors more choices for undergraduate research. At last count, there are currently 17 undergraduate students engaged in research projects with 8 of the physics faculty (see text-box). Many of the projects are supported by funding from the NSF and other major sources. The names and project titles are too many for a short article. However, the studies range across our Department’s specialties, including exotic topics such as: simulation of dark matter; 2-diregular Feynman diagrams; spintronic light-emitting devices; visualizing ab-initio solid-state calculations; electronic transport in graphene; high velocity nanoparticle collisions; and Higgs boson searches. The findings of several of these students have been (or soon will be) presented at national or state meetings, e.g., the American Physical Society (Dallas), the American Mathematical Society (San Francisco), and the St. Lawrence Valley Symposium (Clarkson University) In some cases the projects have also contributed to articles for the Physical Review, Applied Physics Letters, and other major physics journals.

Most of the undergraduates involved in research are planning to pursue graduate degrees and future careers in physics or related fields. Their research is an important – often formative – career experience, and they carry out their projects while maintaining academic excellence. Our students’ research posters are prominent at the annual Celebration of Academic Excellence sponsored by the UB Center for Undergraduate Research and Creative Activity (CURCA). CURCA also provided over $400 each to two physics students, Kristina Krylova and Melissa Judson, to attend the Conference for Undergraduate Women in Physics at Yale University in January 2011.

We are rightly proud of the achievements of our undergraduate physics students. Again the list is longer than this article will allow, but here is a short list of highlights. In September we were pleased to award 7 of our brightest juniors and seniors with 2010-11 Sekula Scholarships of $1300 -$2000 each. The lowest GPA of these winners was 3.775. Earlier this year, one of our seniors Chun Pui Kwan won the prestigious UB Grace W. Capen Award. Andrew Tamchyna, a 2010 Engineering-Physics graduate, was nominated by Prof. Luo for the SUNY Chancellor’s Scholar-Athlete Award. He received the award in April of 2010 in recognition of his outstanding academic performance and athletic achievements as captain of the UB swim team. Indeed it would seem that undergraduate physics is on the rise at UB.

Our undergraduate students are involved in a wide range of research projects, mentored by UB physics faculty:

Richard Gonsalves - mentor for Robert Dygert, Matthew Heavner, Devanshu Pandey, and Michael Skvarch

Dejan Stojkovic - mentor for Alex Kitt and Alexander Piaseczny

Athos Petrou - mentor for David Elasaesser and Nathaniel Feldberg

Peihong Zhang - mentor for Dean Kirby

Murthy Ganapathy - mentor for Rich Brosius and Jeff Kwan

Surajit Sen - mentor for Matt Westley, Nicholas De Meglio, and Yoichi Takato

Avto Kharchilava - mentor for Rich Brosius, Alexander Piaseczny, Olga Nelioubov, Chun Pui Kwan

Ia Iashvilli - mentor for Kristina Krylova

John Cerne - mentor for Zelu Xu and Jungryeol Seo

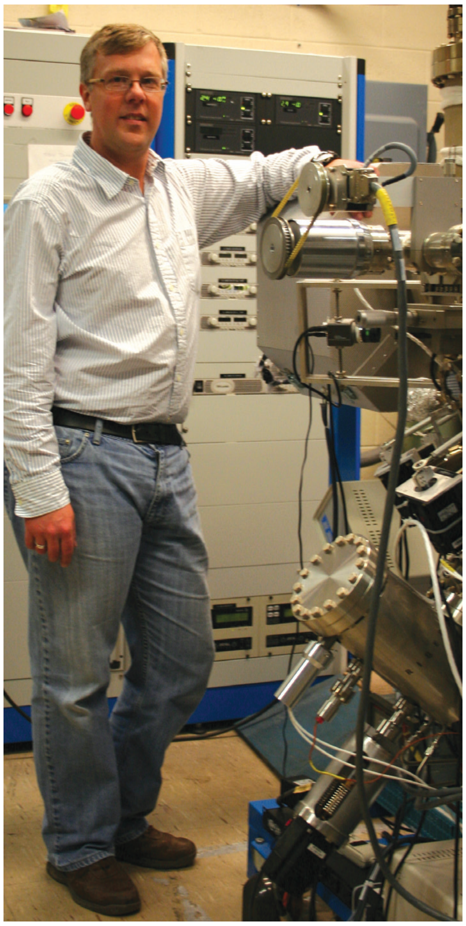


Banner: Undergraduate students from UB’s Society of Physics Students (SPS) and Prof. John Cerne after a get-to-know-the-faculty meeting. These meetings allow the students to informally discuss a large variety of topics ranging from graduate school to research to careers in physics with faculty and visitors. UB’s SPS Chapter organizes many scientific and social activities, including free tutoring, picnics, science lectures, and building robots for the UB Botwars competition. PHOTO: S. Whitmire

## Doping Novel Semiconductors

*By Dr. Steve Durbin*

Semiconductor-based electronics have transformed virtually every aspect of our daily lives, and this trend will only continue. From high-speed communications and computing, to displays and energy conversion, economical solutions to the needs of various applications are increasingly being developed through new compound semiconductors, many of which are based on either nitrogen or oxygen. My interests currently focus on two specific members of these families, namely indium nitride (InN) and zinc oxide (ZnO). At first glance, two semiconductor materials could hardly seem more different. InN has an infrared bandgap energy (~0.6 eV, corresponding to 2 microns), is rather rare, and has no native substrate to use as a crystal growth template (Fig. 1a). Optical emission spectra typically consist of one or more rather broad features, with no evidence of excitonic transitions. In contrast, ZnO is a ubiquitous material, used for a range of commercial products including skin creams, breakfast cereals, and gas sensors. It has an ultraviolet bandgap (~3.4 eV, or roughly 0.3 microns), and the highest quality material available is in the form of bulk crystals well-suited to homoepitaxial thin film growth. Photoluminescence spectra of even comparatively poor crystal specimens are dominated by numerous donor-bound exciton features, and the material is an efficient light emitter.



Originally from Indiana, Steve Durbin joined UB in August 2010 after 10 years in New Zealand, where he was with the University of Canterbury and a founding member of the MacDiarmid Institute for Advanced Materials and Nanotechnology. He holds a joint appointment between the Department of Physics and the Department of Electrical Engineering. In this article, he shares some of his current research interests.

As my group began to study these materials, it rapidly became clear that their similarities were much more striking than their differences. Both are best grown by plasma-assisted molecular beam epitaxy (MBE), a technique we used extensively in New Zealand and my group is installing at UB to complement the existing solid-source MBE facilities run by Dr. Hong Luo and his research group. Both materials suffer from a significant surface electron accumulation layer and are inherently n-type as grown. Consequently, efforts to create and measure p-type material and pn junctions for device applications have been fraught with difficulties and more than their fair share of controversy. For InN, in-situ doping using Mg, Mn and Zn introduced during MBE growth is being evaluated using magneto-transport (in collaboration with Tom Myers at Texas State University), high-resolution x-ray diffraction and transmission electron microscopy (with Masakazu Kobayashi at Waseda University), photoluminescence (with Roger Reeves at the University of Canterbury), and time-resolved differential absorption (with Alex Cartwright at UB). We are also studying surface passivation and surface electronic properties in collaboration with Tim Veal and Chris McConville at the University of Warwick. For ZnO, in addition to these techniques we have also made considerable progress in employing Schottky contacts to study defects and doping in a range of samples (in collaboration with my former student Dr. Martin Allen). In particular, we have shown that various estimates of the branch point energy (derived, for example, from x-ray photoelectron spectroscopy or Schottky barrier heights) do not agree. The branch point energy is a key parameter in determining how easily a material can be doped, and the lack of agreement indicates we as yet do not have a comprehensive predictive model or robust means of evaluating this material constant (Fig. 1b).

My group and I are also interested in other materials including GaN nanostructures (Fig. 1c), rare-earth nitrides, and metal-semiconductor metamaterials, but these might have to wait for a future article.

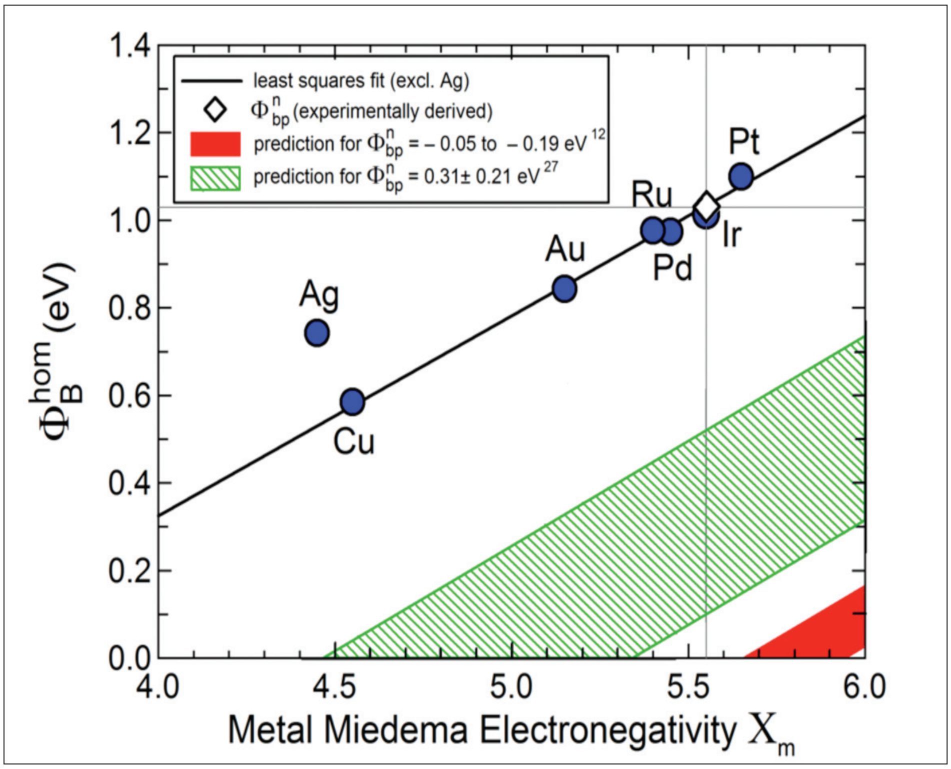



Fig.1(b)

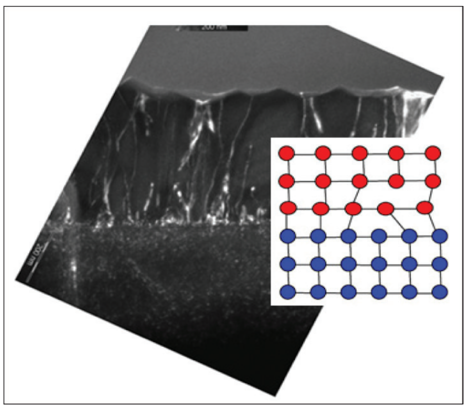


Fig.1(a)

Figure 1(a) Transmission electron micrograph of an InN film (middle region) grown on (111) yttrium-stabilized zirconia (bottom of image), showing high threading dislocation density that arises from lattice mismatch (illustration, inset). (b) Fitting of the barrier heights of a range of metals deposited onto hydrothermal ZnO, showing agreement with theory but also indicating a branch point energy in the gap, in conflict with other measurements. (c) False-color image of GaN nanowires grown by catalyst-free vapor-liquid-solid MBE.

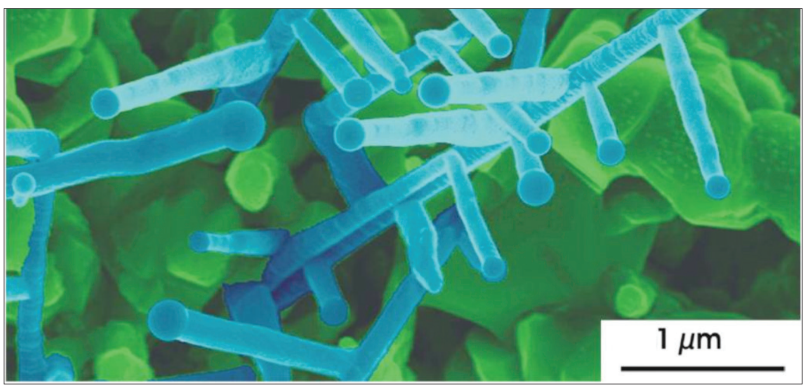



Fig.1(c)

## Professor Ulrich J. Baur 1957-2010

Our friend and colleague Professor Ulrich Baur died on November 25th, 2010, while on vacation with his wife Yvonne in the U.S. Virgin Islands. He was 53 years old. Professor Baur was a UB faculty member since 1994 and a world-renowned expert in Theoretical High-Energy Physics. He will be sorely missed.

A memorial website has been set up by his wife at www.forevermissed.com/ulrich-baur/ and obituaries are published in the UB Reporter, www.buffalo.edu/news/12075, and in Fermilab Today, www.fnal.gov/pub/today/archive_2010/today10-12-14.html.

Please also see the Spring 2011 issue of Interactions, which will be dedicated to Prof. Baur's memory.

## Dr. Christian Meining 1973-2010

Dr. Christian Meining died in a tragic accident on November 26th, 2010, while hiking in the Sierra Nevada Range. He was 37 years old. Dr. Meining received his PhD from the UB Department of Physics in 2006 working in Prof. Bruce McCombe's lab. He was a close friend to many in the Department and will be very much missed. Watch for the obituary in the Spring 2011 issue of Interactions.



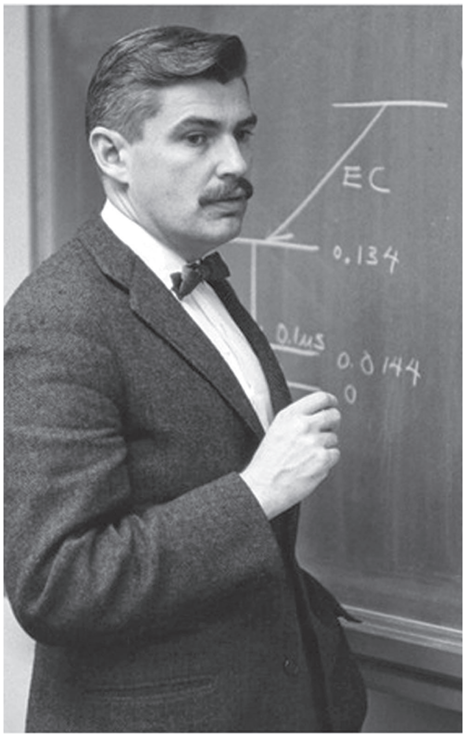
Banner: We welcome Dr. Alexander Khaetskii who has joined the Physics Department as a Visiting Professor for the 2010-2011 academic year. Dr. Khaetskii is a world renowned condensed matter theorist and has made important contributions to the understandings of spin relaxation and decoherence. His current research interests are in spin Hall effect and hole spin dynamics. His presence will surely inject some excitement into the condensed matter physics groups in the Department.

## In Memory of Distinguished Alumnus Robert Pound, BA 1941

*By Dr. John T. Ho*

Renowned physicist Robert Pound, whose only formal degree was a BA in Physics from UB in 1941, passed away on April 21, 2010. Pound was born in Ridgeway, Ontario in 1919. He moved to Buffalo at the age of 4 when his father became a faculty member in mathematics at UB, and attended Amherst Central High School before enrolling at UB as a scholarship student. After graduation, he joined the MIT Radiation Laboratory and made key contributions to the design of the microwave radar during the war. In 1945, he was elected to the Harvard Society of Fellows and on that basis became a faculty member at Harvard, where he remained until his retirement in 1989 as Mallinckrodt Prfessor of Physics. Pound was a first-class theorist and a brilliant experimentalist, an old-style scientist who designed and built his own apparatus. Among his many contributions, he was a co-discoverer, together with E.M. Purcell and H.C. Torrey, of nuclear magnetic resonance in condensed matter. His most significant breakthrough was the first empirical confirmation of Einstein's general theory of relativity, by measuring the gravitational red shift of gamma rays from iron-57 of less than a trillionth of a percent over a height of 75 feet.

Pound was a recipient of numerous awards and recognitions, including the Eddington Medal of the Royal Astronomical Society in 1965 and the National Medal of Science in 1990. He also received an honorary doctorate from UB in 1994.




## We Congratulate our Recent Graduates

Bachelors:
Brian M. Bove, Gordon W. Church, Aaron T. Festinger, Joseph W. Bodnarchuk, Jonah Dayan, Nathaniel A. Feldberg, Anna Kuehn, Seth C. Levy, Katherine A. Niessen, Dante G. Quirnale, Stephen S. Raiman, and Jason Skrzypeck

Masters:
Narpinder S. Chahil, Sandesh K. Gupta, Dooyoung Kim, Fu-Chang Sun, Aleh Haramykin, Joseph A. Zennamo, Willmert Pereyra, James P. Steinman, and Ian R. Swanson

Ph.D.:
Mustafa Eginligil, Erhan Erdemir, Eric S. Greenwood, Andrew T. Kuhls-Gilcrist, Diankang Sun, Robert P. Simion, Christian D. Gothgen, Shridhar N. Hegde, Chia-Wei Huang, and Amit Jain

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**Design and Production:**
Renee Ruffino and Diana Popescu

**Website:**
www.physics.buffalo.edu/newsletter

**Contact:** Comments about the newsletter, or information about yourself for our Alumni News section, may be sent to Christine Gleason via e-mail cg57@buffalo.edu or mailed to:

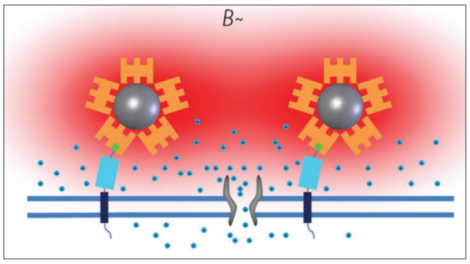
**Christine Gleason**
Department of Physics
University at Buffalo
239 Fronczak Hall

# Research News and Awards

**"Remote control of ion channels and neurons through magnetic-field heating of nanoparticles" H. Huang, S. Delikanli, H. Zeng, D.M. Ferkey and A. Pralle, Nature Nanotech. 5, 602–606 (2010).**

*By Dr. Arnd Pralle*

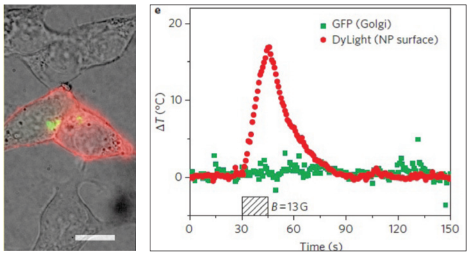
A major goal in the study of the brain is to understand how brain circuits regulate animal behavior. Not only is understanding how the brain works fundamentally interesting, but it can help




Schematic of ion channel stimulation using nanoparticle heating and local temperature sensing (drawn to scale): Superparamagnetic nanoparticles (grey) are coated with a protein (streptavidin–DyLight549, orange) which anchors them to cell membrane (horizontal blue double line) via the interaction with another protein (AP-CFP-TM, cyan). A radio-frequency magnetic field (B~) causes the nanoparticles to heat up (red) which induces opening of the nearby temperature sensitive ion-channel TRPV1 to let calcium ions flow into the cell.

develop new treatments for neurological diseases. However, analyzing the complex neuronal networks in animals requires the ability to interfere with the circuitry. In particular, this requires controlling the activity of individual neurons. This is conventionally done by inserting electrodes into the brain which is a very invasive method prohibiting many studies. This leaves many scientists studying the brain wishing for a remote and non-invasive method to control neuronal activity.

We have developed an innovative concept using alternating magnetic fields, instead of electricity or light, to reach a local actuator on the cell. The physical basis of the idea is that magnetic fields penetrate biological tissue with little attenuation, but at specific sites deep in the brain membrane targeted super-paramagnetic nanoparticles transform magnetic field energy into local heat, which in turn activates local heat-sensitive ion channels. Graduate student Savas Delikanli in Dr. Hao Zeng's group has synthesized six-nanometer manganese ferrite nanoparticles which are too small to be ferro-magnetic, but instead are super-paramagentic. When such particles are placed into radio-frequency (RF) magnetic fields, similar to field use in magnetic resonance imaging (MRI), these particles heat up. Heng Huang, a graduate student in my lab, has made the super-paramagentic nanoparticles biocompatible and targeted them to specific proteins on the membranes of cells genetically engineered to express the temperature-sensitive transient receptor potential V1 (TRPV1) ion channel. Because thermal effects are highly localized at the nanoscale in an aqueous environment, the nanoparticles heat up locally when exposed to an alternating magnetic field that continuously flips the




Local heating of the cell and local temperature sensing. (left) Microscopy images showing a group of cells (grey), two of which are expressing a green fluorescent marker internally and are labeled with red fluorescence nanoparticles (scale bar, 20 μm). (right) Application of the RF magnetic field (indicated by the hatched box) increases the local temperature at the plasma membrane (red, measured at the nanoparticle), yet remained constant inside the cell (green).

magnetization of the particles. Heat generated in this way was sufficient to open and close the nearby heat sensitive ion channel, yet the temperature inside the cell changed very little. The opening of these ion channels excites the cell by raising the membrane potential through an influx of cations which then causes the neuronal cell to 'fire' an electrical stimulation to the next cell, thereby triggering activation of a specific brain circuit.

Besides creating a new tool for neuroscience, this study was innovative in several ways: This is the first study to use the geometry of nanoparticle distribution to limit heating to a single surface, the plane of the membrane. Previously, nanoparticles had been only used to heat the entire solution volume. To show the heat distribution, we used the temperature dependence of the fluorescence to obtain a microscopic picture of the heating in the cell with unprecedented resolution.

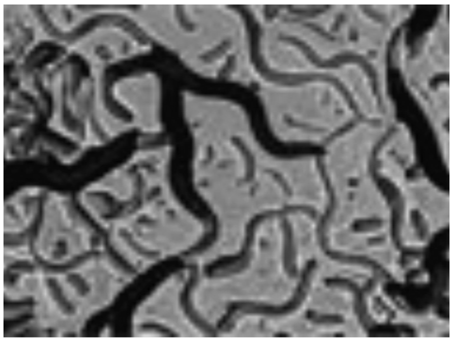


Image of C. elegans worms. A video of the response of the worms to the magnetic stimulation can be found at http://www.youtube.com/watch?v=u9MqrLcLaCk

To apply our method in a living organism, we collaborated with Denis Ferkey from the Biology Department and labeled the thermosensory neurons in Caenorhabditis elegans (a worm commonly used as a model animal in biological studies) with nanoparticles, and applied a magnetic field. Heating of the nanoparticles targeted to the head region initiated the worm's thermal avoidance reflex causing them to stop or reverse their motion. Animals without nanoparticles did not display such a reflex. One advantage of us-



Banner: The Science & Art Cabaret No. 2.5 organized by Prof. Will Kinney and supported by Hallwalls, the Buffalo Museum of Science, and the UB College of Arts & Science took place on August 18th, 2010, on the roof of the Buffalo Museum of Science. Dr. Kinney gave a presentation on The End of the Universe and the Future of Life and the Long Winters String Quartet performed Gustav Holst's The Planets. See also www.hallwalls.org/visual/4863.html for more information.

ing magnetic fields is that large groups of animals or cells within an organism can be stimulated simultaneously while the experimental subjects are free to move within the range of the field 'with no strings attached'. Our experiments show that magnetic fields are promising for controlling neuronal function, and encourage further experimentation in more complex neuronal circuits such as the mouse brain. If experimentally confirmed in the mouse brain, this new technique will facilitate the analysis of circuits in deeper brain structures that are currently inaccessible by optics. This research was supported by the National Science Foundation, UB 2020 Interdisciplinary Research Development Fund and start-up funds from the Departments of Physics and Biological Sciences.

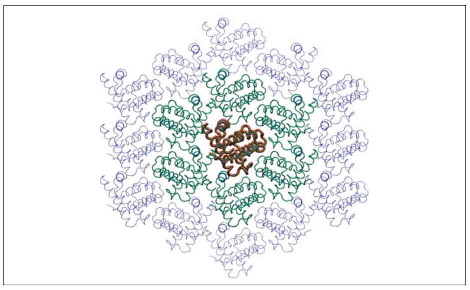
**"Optimal modeling of atomic fluctuations in protein crystal structures for weak crystal contact interactions," J. Hafner and W. Zheng, J. Chem. Phys. 132, 014111 (2010).**

*By Dr. Wenjun Zheng*

My computational biophysics group seeks to explore the dynamics of protein molecules relevant to their biological functions. To this end, we have been developing novel computer modeling techniques based on a synthesis of a simple spring model and more sophisticated all-atom protein models.

A prime source of protein dynamics information is X-ray crystallography which measures the atomic fluctuations of a protein living in a crystal. A long-standing question in structural biology is how the crystalline environment affects the dynamics of a protein whose physiological environment is in solution instead of a crystal. Thanks to ever-increasing resolution of X-ray crystallography, structural biologists can now measure both magnitude and direction of atomic fluctuations, which produces a fast-growing set of experimental data for evaluating and refining computer models of protein dynamics.

Working with graduate student Jeffrey P. Hafner, we have employed both a simplified spring model and all-atom models to simulate the atomic fluctuations of a list of more than 80 protein crystal structures. In our models, a main protein molecule interacts with its neighboring molecules with a single parameter that tunes the strength of inter-protein interactions to optimize the fitting with atomic fluctuation data. Interestingly, we have found that the optimal fitting is achieved by significantly weaker protein-environment interactions as compared to internal interactions within a protein molecule. This finding implies that the internal dynamics of a protein is only weakly perturbed by the crystalline environment, which justifies the use of dynamics data of proteins in crystals to interpret their dynamics in solution. Another encouraging finding is that the accuracy of modeling is fairly comparable between simple models and all-atom models. Therefore, our use of simple models to simulate protein dynamics is well justified, which allow us to explore dynamics of large protein complexes with much lower computing cost without compromising accuracy. This study was published in the Journal of Chemical Physics.

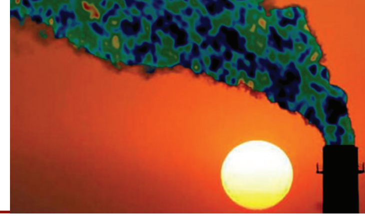


A protein crystal of oxy-myoglobin (PDB code: 1a6m) with the main protein in red, the nearest neighbors in green, and the next nearest neighbors in blue. We simulate the dynamics of the main protein with the nearest neighbors unconstrained while the next nearest neighbors are fixed.

**New Spectroscopic Characterization Facility**

*By Dr. Andrea Markelz*

We have recently added a new user facility to Physics, a Fourier Transform Interferometer (FTIR). This high end Vertex 70 Bruker system allows for transmission spectroscopy from 10 $cm^{-1}$ to 7000 $cm^{-1}$, or wavelengths from 1 micron to 1 mm. This energy range covers phonon modes in semiconductors and molecular crystals, as well as molecular vibrational modes in solid state and solution phase. The system is distinctly different than that available through the Chemistry Instrumentation Facility, which is a simple system that does not allow for this broad range, or much variation in samples. In addition to a Helium cooled bolometer for 5 $cm^{-1}$ to 200 $cm^{-1}$, LaDGTS, DGTS and MCT detectors, two beamsplitters for switching wavelength ranges, the system also has a cryostat for measuring transmission of samples down to 4.2 K. The facility, run through the integrated nano systems instrument facility (INSIF) is overseen by Prof. Markelz. Currently the facility has users from electrical engineering and physics covering topics from detector development, metamaterials development and protein spectroscopy. The facility is also capable of using external detectors and sources allowing, for example, for the characterization of the emission from quantum cascade lasers fabricated at UB. Even more exciting is the step scan capabilities of this system that can allow for high sensitivity detection through external modulation of sample parameters such as gate bias on semiconductor devices. The step scan utilities also allow for time resolved measurements. As some of you may remember from your advanced lab days, the mid infrared range suffers from large absorption from atmospheric water. To combat this we have added a purge system using a dry gas generator so the system is under continuous





purge allowing for fast sample change time and high sensitivity even in regions of large water absorption. Hopefully in the future we will be able to add additional capabilities: such as reflectivity, microscopy and attenuated total internal reflection (ATR). Scheduling of the facility is through an online calendar, (www.sens.buffalo.edu/cgi-bin/Calcium40.pl). Interested users should contact Prof. Markelz, amarkelz@buffalo.edu.

### Research Awards

**Drs. J. Cerne, S. Ganapathy, A. Markelz and B.D. McCombe** were awarded $375,000 from the National Science Foundation to study graphene. Graphene, which consists of a single atomic layer of carbon atoms, has produced dramatic new physical phenomena, such as massles Dirac quasiparticles, and has potential for exciting technological applications, such as high speed room temperature ballistic transistors and tunable infrared detectors/sources. This three-year project will explore graphene in new ways by using polarized infrared light in magnetic fields up to 10 T to probe the Hall effect of this chiral material (see banner on title page). The changes in the polarization of the reflected and transmitted light will help to resolve questions that have been left unanswered by other techniques as well as test new theoretical predictions.

**Congratulations to our recent student award recipients:**

**John Hatch** won the 2010 Outstanding Teaching Award.

**The Dr. Stanley T. Sekula Memorial Scholarship 2010/2011** has been awarded to: Grady Gambrel, Daniel Filipski, Katherine Spoth, Michael Skvarch, Matthew Westley, Michael Collins, and Jenna Curry.

**The Frank B. Silvestro Scholarship 2010** has been awarded to: Tariq Ali, Philip Cheung, Jae Kyu Choi, Azadeh Moradinezhad Dizgah, Everett Fraser, Evan Halstead, Jaesuk Kwon, Jeongsu Lee, Gen Long, James Pientka, and Tom Scrace.

**Seth Levy** won the Outstanding Senior Award.

**Benjamin Keen** received a CAMBI fellowship.

**Andrew Tamchyna** won the SUNY Chancellor's Scholar-Athlete Award for 2009-2010.

### Support the Department of Physics Programs

The Physics department is grateful to all our alumni and friends for their contributions. These contributions provide the margin, which makes UB Physics an excellent Department. In today's environment of decreasing government support the contributions to any of these funds are instrumental in the quality of our academic endeavors every year. To contribute electronically, please visit www.physics.buffalo.edu and click the Support Physics button on the top right or contact Chris Gleason in the Physics Department at 716-645-3629 or via e-mail cg57@buffalo.edu. You may also contact Deborah McKinzie in the Development Office at 716-645-0839, or via email at mckinzie@buffalo.edu with any questions.

## Physics Department Funds:

**Physics Excellence Endowment:** Supports recruitment and recognition of outstanding students, outreach to the community, upper level experimental laboratories, undergraduate research projects, and activities of The Society of Physics Students.

**Frank B. Silvestro Endowment Fund:** Established in 2000 by Mr. Frank Silvestro, BA 1962, MA 1968, the fund supports outstanding students with financial need. Currently used to support graduate students.

**Dr. Stanley T. Sekula Memorial Scholarship Fund:** Established in 1990 by Mrs. Anne H. Sekula, honoring the memory of Dr. Stanley T. Sekula, BA 1951, and used to recognize outstanding undergraduates with financial need.

**Moti Lal Rustgi Professorship in Physics:** Endowed by the Rustgi family in 2006 to honor the late Professor Moti Lal Rustgi. Provides support for the Rustgi Professor, currently held by Professor Athos Petrou.

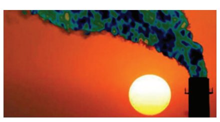
**Moti Lal Rustgi Memorial Lectureship Fund:** Established in 1993 by the Rustgi family, the fund supports an anual lecture by distinguished researchers.

**Ta-You Wu Lectureship Fund:** Established in 2008 by Professor Yung-Chang Lee in remembrance of the late Professor Ta-You Wu, who was a key member of the Department from 1966 to 1978.

**Physics & Arts Exhibition Fund:** This interactive permanent exhibition in Fronczak Hall opened in 2006, and was funded by alumni. It is one of the Department's most effective outreach initiatives. Support will allow continued evolution and development.

**Physics International Graduate Student Assistance Fund:** Established in 2010 by Professor Bruce D. McCombe to provide support for critical financial assistance to international graduate students in the Department of Physics, with a preference given to Asian students and 1st year Ph.D. candidates, at the University at Buffalo.





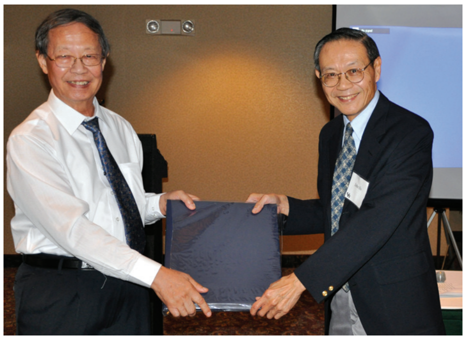
Banner: The Rust Belt Cosmology Workshop 2011 is an informal, student-centered workshop bringing together researchers in cosmology and astroparticle physics from the New York / Ohio / Ontario / Pennsylvania region. The conference is organized by Profs. Will Kinney and Dejan Stojkovic and was held at UB on January 15-17, 2011. Conference support is provided through a National Science Foundation Grant. For more information visit www.physics.buffalo.edu/whkinney/RustBelt/Conference.htm.

### Retirement Festivities Honoring Professor Y.C. Lee

*By Dr. John T. Ho*

Professor Y.C. Lee retired from the Department in the beginning of 2010 after a remarkable 43-year career of teaching and research at UB. On August 28, 2010, a Mini-Symposium on Condensed Matter Physics and a dinner reception were organized in his honor. The afternoon symposium at UB was very well attended, and featured talks by two of Y.C.'s former PhD students, Wai-Ning Mei of the University of Nebraska at Omaha and Sergio Ulloa of Ohio University. At the dinner held at the Ramada Hotel and Conference Center, over 60 people came to pay tribute to Y.C., including his family, current and retired Department colleagues, and an unusually large number of former students. The after-dinner speakers included Professors John Ho, Bruce McCombe, Frank Gasparini and Hong Luo, former students Yi-Kuo Yu, Ophelia Tsui, Norman Jarosik, Shao-Tang Sun, Jiping Cheng, Wei-Ning Mei, Sergio Ulloa and Andras Sablauer, and Y.C.'s daughters Tienshun and Tienyi. The indelible influence that Y.C. had on the lives of his family, colleagues and so many of his students was obvious from the heartfelt testimonials. The evening concluded with a talk by the Guest of Honor reminiscing on his days at UB. Instead of a gift, Y.C. requested his well-wishers to make a donation to the Ta-You Wu Lectureship Fund. Over $6,300 was collected as a fitting tribute to Y.C.

Professors Y.C Lee and Ophelia Tsui at the dinner reception organized in honor of Prof. Lee. PHOTO: F. Gasparini



Professors Y.C. Lee (left) and John T. Ho (right) at the Mini-Symposium organized in honor of Professor Lee.
PHOTO: F. Gasparini

### Retirement Events in Honor of Professor Shigeji Fujita

*by Dr. Bernard Weinstein*

The Department of Physics recently celebrated the career of Professor Shigeji Fujita who retired last year. A Fest-symposium and dinner were held in Shigeji's honor on October 9, 2010. Over 65 colleagues, former students, family, and friends attended the dinner from as far away as California, Houston, Mexico and Japan. The Fest-symposium speakers reviewed developments on several topics: quantized damped oscillators – Akira Suzuki (Tokyo Univ.), electron-microscopy – Seiichi Watanabe (Hokkaido Univ.), Fermi- and Bose- gasses – Manuel De Llano (UNA, Mexico), high-Tc superconductors – Ruihua He (Stanford Univ.), airborne nano-contaminants – John Baker (ICU Corp., Houston) and changing physics-careers – T. K. Srinivas (Avaya Labs., NJ). Shigeji has been a member of the UB Physics Dept. for 43 years – a long and rich career with many proud achievements, and warm human interactions. He came to UB as an Associate Professor in 1966, after obtaining his degree from Elliot Montroll in Md., and working with I. Prigogine (Brussels) and Gregory Wannier (Oregon) -- an impressive array of the notable physicists of that day. Shigeji has contributed to the fields of theoretical equilibrium and non-equilibrium statistical mechanics, and condensed matter physics. After working with Montroll on the development of fundamental diagrammatic methods for treating pair-distribution functions, he went on to studies in the kinetic theory of plasmas and solids, cyclotron resonance, relaxation of polymers, and treatments of problems in superconductivity and the Quantum Hall effect. In the course of this work he mentored a total of 37 PhD and Master students, published over 200 articles (at last count), and wrote 15 books that include monographs, texts, and translations. Among these books is the Ta-You Wu Festschrift proceedings on the "Science of Matter", which was edited by Shigeji, with the help of two other UB physics emeriti, Y. C. Lee and Bob Hurst. Many of the

Professor Shigeji Fujita and participants of the Fest-symposium in Prof. Fujita's honor. PHOTO: K. Roth

Professor Shigeji Fujita (right) and participants of the Fest-symposium. PHOTO: K. Roth



the participants at Shigeji's celebration made donations in his honor to the Physics Department's Ta-Yu Wu Lectureship fund, a cause very dear to Shigeji. Professor Shigeji Fujita has had an illustrious career at UB. For 43 years he has touched many of our lives as a teacher, a mentor, a colleague, and a friend. In all things, we wish him well in the future.

### Fall Physics Fun

*By Dr. Andrea Markelz*

This fall saw two very exciting outreach events at the Department: Family Weekend and Fall Open House. Family weekend Oct. 8-10 invites student's families to see what UB life is like. Various athletic events, artistic performances and food festivals are scheduled. This is the first year that the Physics Department was asked to participate, so we had no idea what

With many lookers-on watching Graduate Student Lars Sweidenback loads the "monkey" in our "shoot-the-monkey" demo during Fall open house. PHOTO: A. Markelz

to expect. We planned Lab tours by Profs. Durbin, Ganapathy and Markelz, Physics and Art exhibit tours by Prof. Wackeroth and a Cosmology lecture by Prof. Stojkovic. A video crew came from the Center for the Arts, somewhat unexpectantly. We tried to prepare the video team for a low turn out, as we really didn't think we could compete with all the other activities on campus. However 60 people came to our welcome in beloved 219 Fronczak!! These families paid close attention to tours of ultrafast lasers, nanoelectronics, and molecular beam epitaxy labs. They then had fun with the hands on exhibits and posed many provocative questions at the end of Prof. Stojkovic's lecture. Their curiosity made the tours and talk fun for everyone. Saturday October 16 was this year's annual Fall open house. This is traditionally an opportunity for undergraduate perspective students to see the department and Prof. Weinstein went all out to organize a very fun event. Graduate student Justin Perron and Prof. Cerne put together a catalog of *EXPLOSIVE* demonstrations. Please go to the Department website to see more pictures of the event. Many of the demonstrations were inspired by Professor and Nobel Laureate William Phillips' Rustgi lecture last year. The night before open house saw many trash cans destroyed as Justin and a number of graduate and undergraduate students tried to perfect the demonstrations involving exploding liquid nitrogen containers. Prof. Weinstein's demonstration on high pressure studies allowed visitors to freeze water at room temperature. Kids were attracted to the solar cell and nanoparticle demonstrations by Prof. Zeng. Visitors made their own solar cells and got to see the superior performance of the materials fabricated by Prof. Zeng's students. We strongly encourage all alumni to come out for these events when possible to get together with old friends and have some physics fun.

### Quantum Mechanics for high-school students

*By Dr. Athos Petrou*

In an effort to promote knowledge of the application of quantum mechanics in nano-devices at the secondary education level, a workshop with the theme of "Introduction to Quantum Mechanics" was offered during the week of July 12, 2010 to 11 high school students from the Buffalo area. This workshop was funded by the National Science Foundation. The students were supervised by Ms. Sandra George and Mr. Richard Hubbard, who are science teachers at the Frontier Central High School, and the Western New York Maritime High School, respectively. The workshop offered an introduction to wave mechanics, a tutorial on the use of EXCEL for data analysis and the following experiments: Uncertainty in measurement, standing sound waves, Balmer lines

Participants of the summer workshop organized by Prof. Athos Petrou (left, seated) and conducted with the help of two high-school teachers, Sandra George and Richard Hubbard, and two of Prof. Petrou's graduate students, Andreas Russ and Lars Schweidenback.

of the hydrogen atom, emission and absorption spectra from InP nanocrystals, and diffraction of light from one and two dimensional arrays; diffraction of electrons from graphite. The teaching materials for the workshop can be found at: http://www.physics.buffalo.edu/faculty/APetrou.html

## Events Calendar

**November 3, 2010,** 7 pm:
Science & Art Cabaret 'Illuminating Nano' in the Ninth Ward @Babeville

**December 11, 2010,** 5 pm:
Holiday Party at Pistachios

**January 15-17, 2011:**
Rust Belt Cosmology workshop 2011, www.physics.buffalo.edu/whkinney/RustBelt/Conference.htm

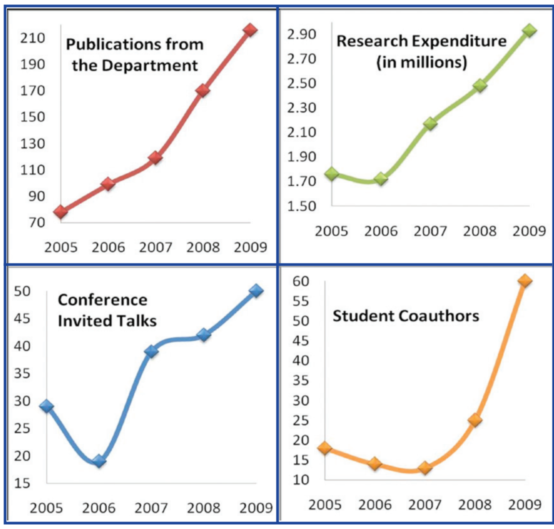
**March 26, 2011:**
Physics Open House

**April 2011:**
Rustgi Lecture



Banner: Participants of the Physics & Arts Summer Institute 2010 (PASI) at an one-day excursion to the Fermi National Accelerator Laboratory (Fermilab) near Chicago. The Summer Institute is organized by Prof. Doreen Wackeroth and high-school science teacher Craig Uhrich and supported by the National Science Foundation. At the PASI 2010 the students devolped and gave a performance of a high-energy particle collision, using light effects and fun toys representing the subatomic particles in the Standard Model of particles physics. Audience members were then guided through simple instructions by the students at computer stations to try and figure out which particles were produced in the 'collision' and represented in the performance. For more information please see the press release www.buffalo.edu/news/11650 and the PASI website www.physics.buffalo.edu/pasi.

# The University at Buffalo Department of Physics Newsletter




## In this issue:

- Undergraduate Physics on the Rise at UB
- Faculty in Focus
- Alumni News
- Research News and Awards
- Outreach and Events

During the tenure of Professor Gasparini as Chair, the Physics Department doubled or even tripled several key measures, such as the total number of publications, research expenditure, and the number of majors.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