College of Arts and Sciences
University at Buffalo The State University of New York

Interactions

The Newsletter of the UB Department of Physics

Volume 2, Issue 2 Fall 2009

Dear alumni/ae and friends,

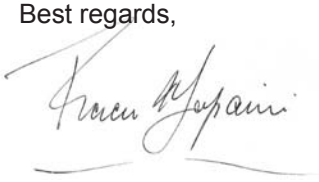
In my last letter I indicated that the Department was about to undergo one of the periodic evaluations of both its graduate and undergraduate programs. I am pleased to say that this went very well with a strong positive recognition on the part of the evaluating team of the quality of our programs, the quality of new faculty hires and the general enthusiasm of both faculty and staff towards common goals. On the other hand there was recognition of some serious deficiencies in the area of staffing and overall faculty count. It seems clear that with the present size of UB enrollments the faculty should be about 35 and the staffing should be doubled when compared to peer institutions. Unfortunately, both of these goals are outside our control and becoming more difficult as we deal with continuing budget cuts.

Keeping the faculty count at high levels is also challenging because of retirements. Most recently Mike Fuda, Shigeji Fujita as mentioned previously, and, after this fall, YC Lee will retire. It seems that a generational change is under way. We will miss our former colleagues. YC in particular has been for many years the conscience of our colloquium, with challenging and insightful questions no matter what the subject matter. Currently YC is finishing up his long tenure by spearheading the development of the Ta-You Wu Lectureship endowment. He views this as his parting gift to the Department.

The success of our young faculty continues with an additional five-year NSF CAREER grant received by Sambandamurthy Ganapathy. His research was featured in the Spring '09 Interactions. This makes the sixth such grant in the Department, an outstanding overall achievement. Also recently of note among the untenured faculty, Dejan Stojkovic has received NSF support, Ia Iashvili and Avto Kharchilava (Interactions Fall '08) have received a substantial increase in their NSF funding and Peihong Zhang has added to his NSF support with a grant from the American Chemical Society. Overall, during the last fiscal year faculty submitted grants totaling over $27M, an all-time high by far.

Our outreach programs continue with the expansion of our Physics and Arts Exhibition to which new sculptures, paintings, and interactive displays have been added. Thanks to Norman Jarosik (Interactions, Fall '08) for providing us with a microwave gradiometer which we have installed on the third floor. It was gratifying to have former student Andy Hope stop by and remark how he liked what we have done to the building. We are doing something right, and we are grateful to all our contributors for their support of the Exhibition. Also, by way of outreach, check out the article in this issue by Will Kinney on the Science and Art Cabaret.

Best regards,



Francis M. Gasparini, Chair
UB Distinguished Professor of Physics

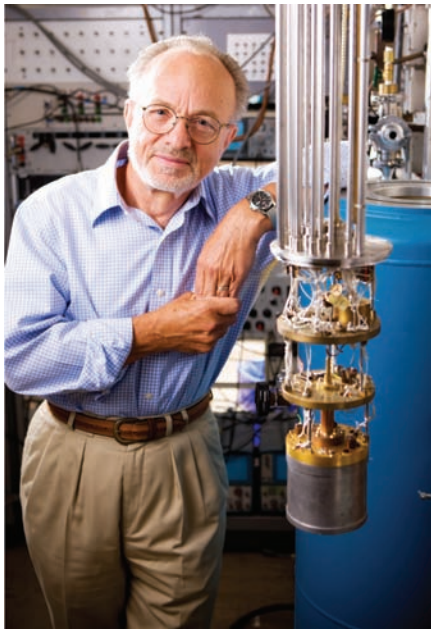
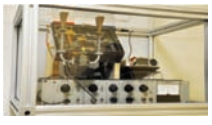


PHOTO: D. Revere, UB Reporter 11/4/2009



Banner: A microwave gradiometer that is closely related to the ones flying on the Wilkinson Microwave Anisotropy Probe satellite and mapping the cosmic microwave background radiation. This working detector is installed on the third floor of Fronczak and can easily pick up the heat from visitors' hands placed above the horns at the top of the detector. PHOTO: F. Gasparini

Undergraduate Education

What's new in undergraduate studies

By Dr. Hong Luo

As most of you know, Dr. Michael Fuda retired about a year ago. He was the Director of Undergraduate Studies for twenty-three years. In fact, he was the only UG Director I knew since joining UB. I assumed the Director's responsibilities in January, 2008, so that I would have some overlap with him before he retired. Boy, wasn't that a bright idea! I don't think I ever asked anyone as many questions on anything as I asked Mike in my first 6 months as Director.

I was on the Undergraduate Studies Committee for many years. However, I didn't quite know everything involved, other than the limited number of things that I was involved in. It was only after I started the job that I really appreciated the work Mike had done, big and small. There was a good reason why our undergraduate program functioned so smoothly for so many years. For example, our Department has several degree programs, some in collaboration with other departments, like B.S. in mathematical physics. Mike managed to design the curriculum so that students could succeed in those challenging programs. There are also many things, day to day things that have to be taken care of, such as approving transfer of courses for students outside our Department. Mike established procedures so that everything can be handled efficiently and smootly.

Looking forward, the Undergraduate Committee is trying to continue the work that Mike started, namely, to strengthen our program and to make adjustments to keep up with changing times. One of the changes recently implemented was to start our intended majors with physics classes right from the first semester, rather than the second semester as in the past. This gives us immediate contact with them as they enter UB. This required a change of the recommended sequence of classes. The committee used this opportunity to restructure the curriculum so that the required mathematics courses can be taken at the earliest possible time. Students typically struggle when moving from introductory classes to upper level classes, mostly because of inadequate math preparation. It is our hope that taking more math classes before the start of upper level physics classes will make this transition easier.

In an effort to attract more students to our programs, the Committee redsigned PHY117 and PHY118 (honors mechanics and E&M), the first classes that many of our intended majors take. These first classes are pivotal in communicating the excitement of our field. The classes are now more suitable for advanced students, by leaving out some introductory materials that these students already know from high school physics classes, and adding advanced topics. The goal is to teach them the material and to convey the excitement that the subject richly deserves. This semester is the first time we are using this approach. Dr. Dejan Stojkovic is giving it a great start by adding topics from his own research, relativity and cosmology, and having more interactive instruction.

The Committee is also trying to have more contact with majors, from recruiting new students to join the programs to having exit interviews for graduating seniors. All majors are encouraged to join the Society of Physics Students under the guidance of Dr. John Cerne. The percentage of high school students taking physics classes has been increasing steadily in the last 30 years, from below 20% in the 1980s to above 30% now. We need to take advantage

Drs. Strasser and Luo enjoying the picnic with undergraduate students at the Society of Physics Students Cookout on 9/18/09. PHOTO: F. Gasparini

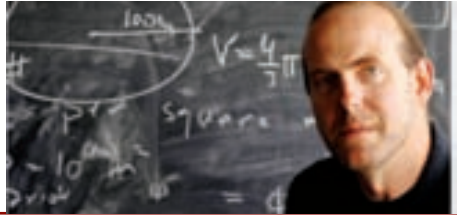
of this growth and attract the brightest students to our programs. Some of this is already reflected in our current enrollment. As of this semester, there are 70 approved majors across all years and 55 intended majors. We need everyone's support to retain our majors and help them succeed. Equally important, we need everyone's ideas and support to continue to improve our programs.

New technology improves teaching (and learning)

By Dr. Sambandamurthy Ganapathy and Dr. Arnd Pralle

In today's world of instant messaging, handling a large introductory class of close to a thousand students can be a communication and email nightmare. Instructors are swamped by questions via email and students get annoyed when responses to their messages are not immediate. Therefore in fall 2007, we set up a central discussion board for the introductory algebra-based physics course on which students post general class questions and homework questions and other students may provide assistance. The board is moderated by one of the instructors and the students receive a qualified answer within 24 hours. The students have quickly accepted the discussion board as a place to ask for help with physics problems and concepts. They appreciate the quick feedback from an instructor but also are actively answer-

Banner: Undergraduate students and Dr. Cerne at the Society of Physics Students (SPS) cookout discussing plans for the new SPS robot that will literally destroy the competition at the 2010 UB Bot Wars. PHOTO: F. Gasparini.



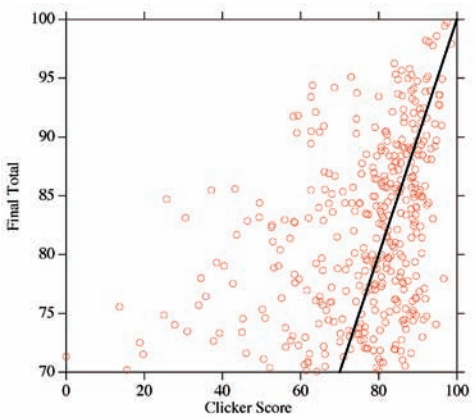
Undergraduate Education, CONTINUED

ing each other's questions, reaping the benefits of learning by explaining. The number of users and messages has risen continuously in the last four semesters since offering the discussion board. Half way through this currentsemester 80 students have posted more than 350 messages.

Undergraduate students, especially first year students who take the College Physics course, are juggling a lot of activities and classes causing many of them to come underprepared to lecture. As a result basic definitions have to be repeated, taking away from the time to explain complex concepts. Last year we experimented with assigning simple conceptual questions to be completed online before the lecture, which required reading the introduction of the chapter to be taught in class that week. As a result the students were better prepared for class. The answers from those pre-lecture concept questions provide valuable feedback to the instructors about which ideas the students struggle on, allowing for adaptation of the lecture content. In the late 1990s, this Just-in-Time-Teaching concept had been scientifically proven to help students learn and is slowly being adopted country wide. Certainly we feel our students are more prepared now and we can tailor the lectures better to their needs.

Solving end-of-chapter problems helps the students understand the application of the physics concepts learned in various situations and is one of the essential parts of introductory physics learning. With student enrollments in introductory courses increasing every year, it puts a heavier load on the TAs and instructors to grade homework problems in a timely manner and provide feedback. Online homework systems, available as part of the publishers' resources, help ease this load enormously. Students register online and purchase an access code to use the problems from the book for a limited period and homework problems are assigned online every week by the instructors. Problems are a mixture of multiple choice and numerical problems and students get instant feedback for the answers.

Use of personal response systems (commonly known as clickers) in large class rooms had been one of the exciting new tools in higher education circles. We would like to share some of our experience of using the clickers in introductory physics courses for the last four years. Clickers serve two major purposes: one to increase the class attendance which makes it easier for students to grasp the concepts involved and two, to increase class room interaction and peer instruction. In the graph above, we plot the final course total for the top 50% of the students of an introductory algebra-based physics class (total enrollment of 800) against their clicker scores. Clicker scores contain both credit for attending the class and answering correctly several multiple-choice conceptual questions in class. The majority of the students who have scored 70% or above in the course have scored high on clickers too. It is clear that there are a very few students who ended up in the top 50% of the class after skipping several classes. Our experience is based on the use of clickers in the introductory algebra-based courses, but clickers are also being increasingly used in other introductory courses (PHY 107-207) in the Department and we believe they bring a positive experience to the student learning as we see from the end-of-semester student evaluations.



Correlation between clicker and final scores in an undergraduate physics course at UB.

These trends towards electronic tools have been recognized by the textbook publishers as well, and several groups are developing new completely integrated systems. Some of these will include drawing and writing tools for more complex and conceptual exercises and assignments. We both have been asked to consult in the development of an integrated electronic book, homework, discussion board and conceptual questions system. It hands the flexibility back to the instructor to adapt the course content to his students' requirements and the students will obtain a large palette of study tools from connecting notes to book chapters and homework questions to receiving better feedback on their learning progress.

Exciting changes are happening in the way we teach the introductory physics courses, and more lie ahead!

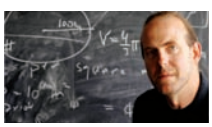
Editor: Dr. John Cerne

Design and Production: Renee Ruffino and Mike Massett

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
Buffalo, NY 14260



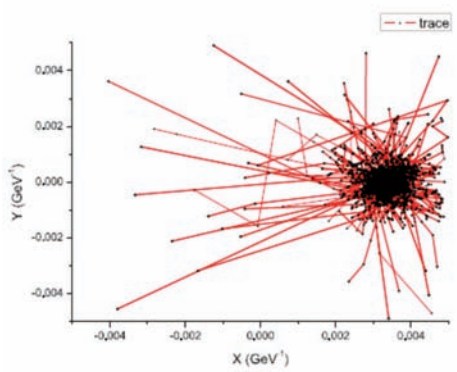
Banner: Dr. Will Kinney was interviewed for a May 18, 2009 article in the New York Times, "Psst! Need the Answer to No. 7? Click Here." PHOTO: D. Benz for The NY Times.

Faculty in Focus

Cosmology – looking beyond the boundaries

By Dr. Dejan Stojkovic

The study of the origin, structure and evolution of the Universe is one of the most exciting research fields in modern physics. In the last twenty years, technological advances have made possible an array of observations which strongly constrain the properties of the Universe we live in. A huge amount of observational data allowed us for the first time to formulate "The Standard Model of Cosmology" in analogy with the Standard Model of particle physics. While the evidence supporting it



Calculation by the Stojkovic group (including post-doc De Chang Dai) representing the motion of mini black holes that could perhaps be produced at the LHC. Black holes emit particles due to Hawking radiation and recoil in the opposite direction. This recoil motion is random, as the plot shows.

is enormous, the model is not without problems. The most important puzzle is that 96% of the content of our Universe seems to be missing. This missing content is often labeled as Dark Matter (the missing mass) and Dark Energy (a mysterious ingredient which drives the accelerated expansion of the Universe). The solution to these puzzles will take the concerted effort of many researchers over a span of a decade or more. Still, for the first time, these answers seem to be within our reach. The general feeling is that modern cosmology stands on the brink of

Dr. Stojkovic at a conference.

major discoveries that will strongly impact all of physics. The nature of the problems treated is such that its resolution will inevitably involve different concepts from cosmology, gravity and particle physics.

My research includes various topics on the interface of cosmology, gravity and particle physics. In particular, with my postdoc and graduate students, we explore possible solutions to dark energy, dark matter and other cosmological problems like horizon and flatness, we study theory and phenomenology of classical and quantum black holes, and try to understand the properties and evolution of various interesting cosmological objects like magnetic monopoles, cosmic strings and domain walls. Among other things, in collaboration with our colleagues from Oxford University, CERN, and Case Western Reserve University we recently built a black hole event generator called BlackMax which will be the main tool for excluding (or confirming!) the creation of mini black holes at the Large Hadron Collider at CERN.

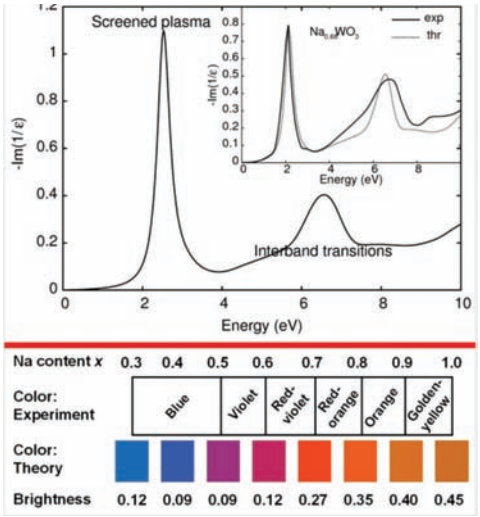
My research is embedded in a wider high quality research environment of the high energy physics/cosmology group, whose members have similar interests. Together, we discuss and actively work on several joint projects.

As a part of the dissemination of our research results, we also work on the popularization of science, especially in the Buffalo area. I gave two public talks "The Standard Model of Cosmology" and "Black Holes" at the Buffalo Museum of Science in April 2009, as a part of the celebration of the year 2009 as the International Year of Astronomy.

Computational Materials Research

By Dr. Peihong Zhang

In the past few decades we have witnessed great advances in our ability to calculate various properties of materials knowing only the identities of their constituent atoms. This progress has been driven mainly by two important factors, namely, the availability of the ever-increasing computer speed and advances in theoretical/computational methods. Using massively parallel computers as a primary tool, a wide spectrum of materials and material properties can be studied by applying



Dr. Zhang's group employs first-principles electronic structure theory to understand the mechanism of electrochromism in WO_3. Top panel: Comparison of electron energy loss spectra between theory and experiment. Bottom panel: Comparison between theoretically calculated colors of Na_xWO_3 and experiment. This work has been published in Phys. Rev. B.

Banner: As part of our new Beauty of Equations exhibit, Einstein's famous equation in neon lights in Fronczak Hall. By artist G. Nickard. PHOTO: J. Cerne.

Faculty in Focus

CONTINUED

state-of-the-art electronic structure techniques.

The long term research objectives of my group are unified around the theme of understanding and predicting materials properties from first principles, with emphasis on nanostructures and other novel materials, computational materials design, and development of new theoretical and computational techniques.

Dr. Zhang's group uses massively parallel computers to model properties of materials.

Current research projects in my group include designing novel boron based hydrogen storage materials for fuel cell applications, investigating unconventional magnetism in semiconductors and nanostructures, and developing new theoretical methods for better understanding localized electronic states and excitations in solids. My research is supported by National Science Foundation, Department of Energy, and Petroleum Research Fund.

Alumni News

Madalina Furis, PhD 2004

By Dr. Madalina Furis

Dr. Madalina Furis is an assistant professor at the University of Vermont (UVM) since the Fall of 2006. Her research group explores the quantum realm of novel nanostructured materials where the intrinsic spin of the electrons shapes the materials' properties. The team is currently conducting optical spectroscopy experiments to probe properties of electrons in nitride semiconductor nanostructures and crystalline organic semiconductor films. With support from the National Science Foundation, Dr. Furis has been building UVM's first magneto-microscopy facility that integrates the latest generation of ultrafast lasers with superconducting magnet technology and top of the line polarization optics into spectroscopy experiments that map electron spin dynamics at micron resolution in high magnetic fields. The facility will be used by faculty in physics, chemistry and engineering to conduct high magnetic field studies of electrons in a variety of materials systems, including semiconductor nanostructures, proteins and polymers. As a member of the National High Magnetic Field Laboratory (NHMFL) Users' Executive Committee, Madalina is currently involved in the planning of experimental infrastructure around the upcoming Florida split coil helix 25 Tesla magnet, ground-breaking magnet technology that will enable research in electron spin physics and ultrafast phenomena never accessible until now. She has also been featured as one of the promising young high magnetic field scientists in the recent "Science Starts Here" profile series of the NHMFL.

Dr. Furis, working on a Kerr effect magnetization measurement in her spectroscopy lab at the University of Vermont.

During her graduate studies at UB Madalina worked in collaboration with many professors and students from physics, electrical engineering and chemistry on spin and time-resolved spectroscopy studies of semiconductor nanostructures. The knowledge of ultrafast and high magnetic field techniques earned her a postdoctoral position at the Los Alamos National Laboratory pulsed field facility after her graduation in February of 2004.

Chingping Chen, PhD 1995

By Dr. Francis Gasparini

Chingping Chen obtained his PhD in 1995 working on the sorption properties of fullerite crystals of C_{60} and C_{70}. Subsequently, he spent time as a postdoc in Taiwan and in France. He is currently Associate Professor at Peking University in Beijing. He is working on the physics of nanomagnetism and on superconducting properties of MgB_2. He informs us that he would be happy to show people around if they are visiting Beijing. His exact coordinates can be found on our alumni list at the Department's web site.

Banner: Is it art or is it the second zone of the Fermi surface for a divalent hexagonal close-packed metal? Perhaps it's both! By artist R. Reitzenstein. PHOTO: J. Cerne.

Alumni News

CONTINUED

Brian Powell, PhD 2008

By Dr. William Kinney

Brian Powell obtained his PhD in cosmology under the supervision of Dr. William Kinney. His area of focus was on the observational signatures of inflation, a period of ultra-rapid expansion in the early universe. Using the latest cosmological data-sets, Brian employed statistical techniques to constrain theories of the early universe. Upon graduation from UB, Brian accepted a position with the newly formed Institute for the Physics and Mathematics of the Universe, at the University of Tokyo, Japan. Brian was one of around five early universe cosmologists within a larger, diversified group of mathematicians, string theorists, and particle physicists. In Tokyo, Brian collaborated on several projects related to the observational predictions of string theory–inspired models of inflation. In October 2009, Brian joined the Institute for Defense Analyses in Alexandria, VA., where he works on computer network defense and other problems related to national security.

Alexander Kitt, BS 2008

By Dr. Francis Gasparini

Alex is starting his second year as a PhD student in physics at Boston University and will be supported as a Photonics Fellow for the upcoming year. He is currently involved in several projects as a member of the Optical Characterization and Nanophotonics Laboratory, working with Professors Goldberg and Swan. In the biophysics world, he has designed and is now building the prototype of a low cost CD4 detection assay for use in sub-Saharan Africa. In the condensed matter world, he is using

Raman spectroscopy to study the effects of strain on graphene. He is enjoying life in Boston, but has remained true to his Buffalo sports heritage.

We Congratulate our Recent Graduates

Bachelors: Michael BIERNAT, William FALLS, Robert FLANAGAN, Mary GLASS, Andrew GODSHALK, George LINDBERG, Stephen MUELLER, Daniel MUFFOLETTO, Justin MULLEN, and Chris PENEPENT

Masters: Peng-Jen CHEN, Lili CHU, Pei-I KU, Mark LAURRI, Yichen LI, Shuo -Fang TSAO,Tianyi YU, Daniel BAILEY, Rohit SINGH, Jonathan SCHMITT, and Jen-Chieh WANG

PhD: Elena BREWER, Kwangwoo PARK, Brian POWELL, Gheorghe ACBAS, Fatih BULUT, Imran KHAN, Pratibha DEV, Andreea DOHATCU, Yunfen HE, Konstantinos TZIRAKIS, Vikas PATEL, Robert TALLMAN

Support the Department of Physics Programs

The Department continues to rely on its alumni and friends to support a broad spectrum of activities. Contributions truly make the difference in the quality of our academic endeavors. Your contributions to any of these funds are appreciated. 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 716-645-2017x112 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 annual 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.

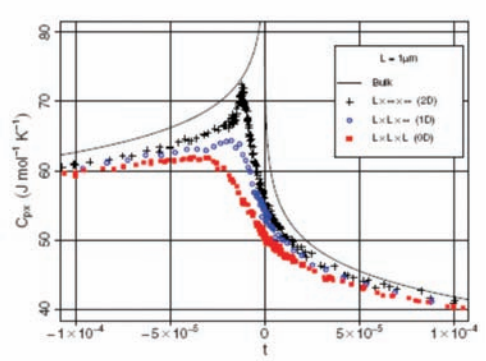
Physics & Arts Exhibition Fund: This interactive permanent exhibition in Fronczak Hall opened in 2006, and was funded by alumni. It is one of the Department's most effective outreach initiatives. Support will allow continued evolution and development.

Banner: A bronze Mexican hat representing spontaneous symmetry breaking, which is fundamental to many fields of physics. By artist R. Reitzenstein. PHOTO: J. Cerne.

Research News and Awards

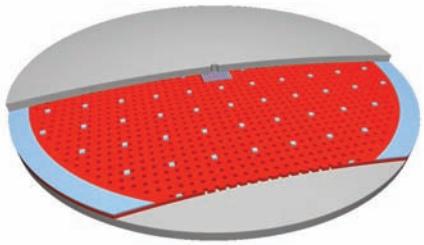
"Finite-size scaling of ^{4}He at the superfluid transition," F.M. Gasparini, M.O. Kimball, K.P. Mooney, and M. Diaz-Avila, Reviews of Modern Physics 80, 1009-1059 (2008).

The description of a system not in the thermodynamic limit is complicated because of the role that boundary conditions play and the importance of surface topology and overall sample shape. All of these variables become irrelevant in the thermodynamic limit as the volume becomes large at constant density. The situation near a continuous phase transition is still more complicated by a temperature-dependent



Comparison of the crossover from three dimensions to two, one, and zero dimensions where the smallest spatial length in each confinement is 1 μm. The data show the expected behavior: As more spatial dimensions are made finite, the greater the heat capacity is suppressed and the specific-heat maximum shifts to lower temperatures.

length, the correlation length ξ. This diverges at a continuous transition in the thermodynamic limit. The fact that real samples, with dimensions of say millimeters, are not infinite is not really an issue since ξ never becomes comparable to this size with typical temperature resolution. Taking a different point of view, one may ask how does a finite system approach the thermodynamic limit near a continuous transition. Theoretically this question has been answered a long time ago via the conjecture of finite-size scaling; however, there are very few experiments which have tried to verify this prediction. We have been working on this problem for many years. The system on which we have focused is ^{4}He at the superfluid transition. Helium has many advantages for such a study, but perhaps the most important is the fact that we believe we understand the boundary conditions between the order parameter, a wavefunction, and the confining walls. To confine helium we use a combination of silicon lithography and direct wafer bonding to achieve confining geometries corresponding to films, lines and boxes. These represent crossover to two, one, and zero dimensions, respectively, as the growth of fluctuations is progressively limited in more directions. It is a feature of finite systems that their shape defines a unique thermodynamic response. The characteristic small dimension of our samples is in the range of 0.01-3 μm. An example of a recent design for an experimental cell to study collective and proximity effects is shown in the figure below. The resulting geometry for this cell is an array of $34x10^6$ boxes of $(2\ \mu m)^3$ volume in equilibrium with a 37.1 nm film of helium.



Cut-away view (not to scale) of an experimental cell to study coupling and proximity effects in superfluid ^{4}He. The cell consists of an array of $(2\ \mu m)^3$ connected by a 31.7 nm planar region. The confinement is formed between the two wafers using direct wafer bonding.

The RMP paper is a review of the work of several generations of graduate students in the Gasparini lab, and relevant work at other institutions. This work, which tests theories of finite-size scaling, is almost unique in helium with very few counterparts in other critical systems. Some of the most interesting results are the striking difference in thermodynamic response for crossover to different dimensionalities, the identification of surface and edge effects, universal behavior as function of ^{3}He impurity concentration and with pressure, and, in some cases, remarkable agreement with theory. On the other hand, there are significant results which do not agree with theory and remain a puzzle to this day. The work presented in the RMP also shows most obviously where future experiments would be of interest in order to address questions of lack of scaling, universality, and coupling and proximity effects.

"Importance of the Terrestrial Cosmic Ray Flux for Climate," M. Ram, M. Stolz, and B. Tinsley, EOS, Transactions, American Geophysical Union, 90, 397-398 (2009).

The above titled paper was published as an invited feature article in the November 3rd issue of EOS, Transactions, American Geophysical Union. This is a weekly journal that can best be characterized as the Geophysical equivalent of Physics Today and hence, has an enormous circulation.

It has long been assumed that the changes in the radiative solar flux reaching earth over a solar cycle (the well known eleven year period of solar activity) are too small to result in significant changes in earth climate. That is the argument that anthropogenic global warming alarmists have advanced in their claim that the sun cannot be the instigator of significant climate change, and have used incomplete (as an example, but this is not the only one, they completely ignore the effects of cosmic rays on climate) computer models to show that anthropogenic greenhouse

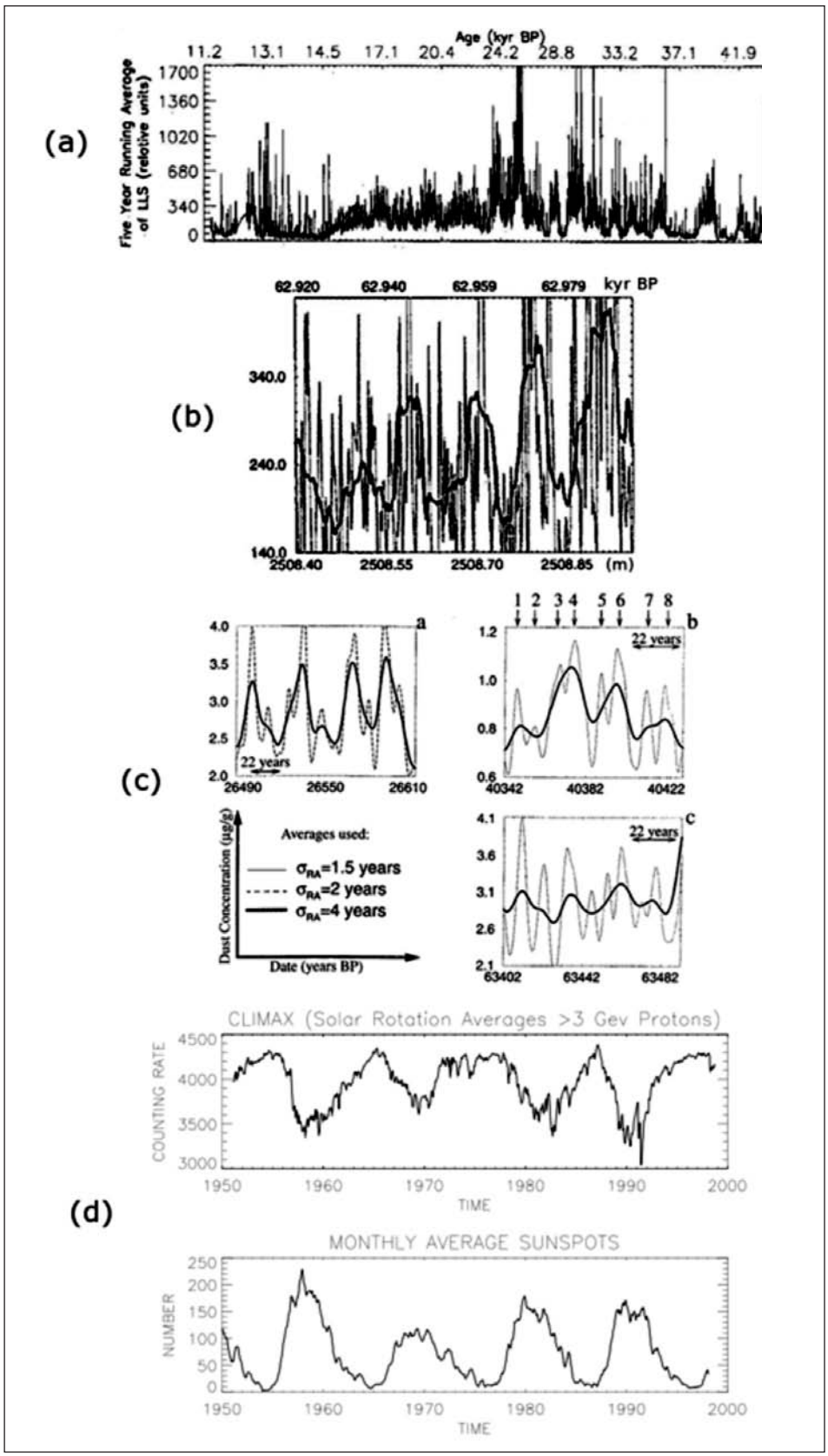
Banner: Graduate student Justin Perron describes research in the Gasparini lab to visitors at the Fall Open House. PHOTO: F. Gasparini.

Research News and Awards

CONTINUED

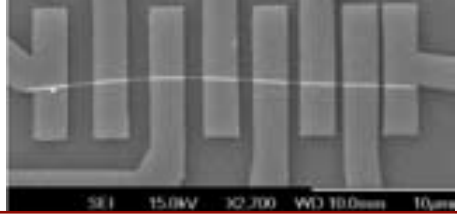
emissions can have a more significant impact on climate change than solar changes. As everyone is aware, this is a topic of great contention and has led to numerous initiatives to cap Greenhouse gas emissions. Clearly, it's a "hot" topic and one on which enormous resources have been, and will continue to be, expended.

Our article shows that the influence of the sun on earth climate is not limited to its radiative output, and a strong amplifying mechanism (over an order of magnitude) is provided by the solar-modulated terrestrial cosmic ray flux which, through ionization of the atmosphere, can strongly affect precipitation. This conclusion is a result of extensive research by Ram and coworkers on the impact of the solar cycle on climate, and by Tinsley and his collaborators on the mechanisms of precipitation by clouds.



(a) Dust profile of glacial ice from GISP2 ice core (Ram and Koenig, 1997), (b) Dust profile of short section of GISP2 glacial ice. Rapidly oscillating fine line is raw data showing sharp annual maxima. Heavy line is 5 year running average of raw data showing very large 11 year dust modulations, (c) Generation of 22 year cycle from two 11 year cycles (Ram and Stolz, 1999), (d) Neutron counting rate (top) and Sunspot number (bottom) courtesy R.I. Jokopii).

Banner: Large Hadron Collider Theory Initiative Fellow and UB graduate student Cathy Bernaciak (left) attends a coffee break and poster session at the LHC TI Fellows meeting at Fermilab October 29, 2009. Bernaciak presented a summary of her research and networked with other fellows performing LHC theory work. From a featured article in Fermilab Today, 11/11/09.



Research News and Awards, CONTINUED

Research Awards

By Dr. Sambandamurthy Ganapathy

Research activities at the Department are growing significantly with several of the faculty obtaining new grants for their research from federal funding agencies in recent months. We report here the latest awards and a short description of the research activities planned.

Dr. Arnd Pralle, together with Dr. Berry from the Department of Biological Sciences, has recently received a Major Research Instrumentation (MRI) award from the a National Science Foundation (NSF) for the "Acquisition of a Confocal Microscopy System for Research and Education" (2009-2011). The NSF award, together with matching funds from the UB, allows the purchase and operation of a state-of-the-art high resolution optical microscope system which will be unique to Buffalo by providing fast time-resolved measurements using freely tunable visible laser light. The facility will be available to any researcher at UB and greatly enhances the infrastructure of biophysical research at UB.

Dr. Jong Han recently received a NSF award (2009-2012) in the Division of Materials Research for the project titled, "Strongly Correlated Nonequilibrium Transport Simulation in Complex Quantum Dot and Bulk Systems." The goal of this project is to theoretically study the dynamics of strongly interacting electrons under strong voltage bias in nanoscale devices.

Dr. Gottfried Strasser recently received NSF's at ub (MRI) award (2009-2010) for the project titled "Acquisition of a Dual Beam Electron Beam/Focused Ion Beam System for Research and Education." This instrument will allow interdisciplinary groups at UB to expand their research activities into a broad range of new applications like novel electronic, photonic and fluidic devices.

Dr. Gottfried Strasser also recently received NSF's Course Curriculum and Laboratory Improvement (CCLI) award (2009-2011) for the project titled "First Course in Nanoelectronics for Engineers." This project will allow him to train engineers and provide them with a deeper understanding of nanostructures and their implementation into real world applications.

Dr. Sambandamurthy Ganapathy recently received NSF's Faculty Early Career Development (CAREER) award (2009-2014) for the project titled, "Collective transport near quantum critical points in superconducting nanostructures." The goal of this project is to effectively integrate multidisciplinary research work on nanometer scale superconducting devices with education and outreach programs to train a new generation of students.

Dr. Dejan Stojkovic recently received a NSF (Astrophysics and Cosmology Theory Program) grant for the project titled, "Gravity, cosmology and collider physics." The duration of the award is three years (2009-2012). This project will explore phenomena on the interface of cosmology, gravity and particle physics.

Drs. Ia Iashvili (PI) and Avto Kharchilava (Co-PI) received a grant from NSF to fund their proposal on "High Energy Physics Research at CMS and D-Zero Collider Experiments." This three-years long project is a continuation of their earlier NSF grant funded since 2006. The goal of the proposal is to conduct research at energy frontiers and scrutinize the Standard Model of Particle Physics. Another aspect of the project is to work with local high school teachers and their students by engaging them in the nationwide outreach program called QuarkNet.

Dr. X. Hu recently received a grant from the US Army Research Office (2009-2012) for the project titled, "Theoretical Study of Solid State Quantum Information Processing". The goal of this project is to study quantum coherence and manipulation of spin qubits and spin environments in solid state nanostructures.

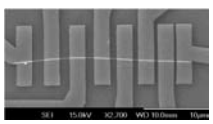
Congratulations to our recent award recipients:

James Pientka and Robert Paul Simion won the 2009 Outstanding Teaching Assistant in Physics award.

The Dr. Stanley T. Sekula Memorial Scholarship 2009/10 has been awarded to: Nicholas De Meglio, Brian Frey, Pierre Gautreau, Seth Levy, Mary Mohr, Katherine Niessen, Stephen Raiman, Katherine Spoth, and Yoichi Takato

The Frank B. Silvestro Scholarship 2009 has been awarded to: Tariq Ali, Yiu Him Cheung, Jae Kyu Choi, Chase Ellis, William Falls, Everett Fraser, Andrew Godshalk, Chia-Wei Huang, Chaehyun Kim, Minsoo Kim, Jaesuk Kwon, Jeongsu Lee, Gen Long, Justin Perron, Muhammed Simsek, Hemachander Subramanian, Yu Tsung Tsai, Tailung Wu, and Jia Zhou.

Muhammed Simsek received a CAMBI fellowship (2009).



Banner: Dr. S. Ganapathy, has recently received the prestigious National Science Foundation's CAREER award (2009-2014) to study the novel transport properties of superconducting nanomaterials and devices, such as the one shown in this picture, when they undergo quantum phase transitions. PHOTO: S. Ganapathy

Outreach/Events

Summer and fall 2009 were active times for educational outreach at the Department. Dr. Doreen Wackeroth organized the Physics and Arts Summer Institute (PASI), which is now in its fourth year. Inspired by New Physics ideas and Gary Nickard's artwork, eight local high-school students created a Wonder Room at this year's PASI. The Wonder Room is designed as a walk-in display case with several interactive exhibit pieces that are related to extra dimensions and supersymmetry, two new physics concepts, which will be tested at the CERN Large Hadron Collider. The exhibit includes "illusions" such as magic eye pictures and a hologram, and a black box, inspired by Carl Sagan's Cosmos presentation on extra dimensions, as well as a video produced by the high-school students on the UB campus. The display has been built and installed by the CAS Instrument Machine Shop on the second floor of Fronczak Hall as part of the permanent Physics and Arts exhibition. During the three-week long program the high school students visited Fermilab where they learned first hand from UB graduate students, Joseph Zennamo and Andrew Godshalk, about research at the Tevatron proton anti-proton collider. PASI is funded by the National Science Foundation. The PASI 2009 team consisted of Prof. Gary Nickard, (Media Studies), Depew High School teacher Craig Uhrich, Derek Robins, Prof. Dejan Stojkovic (Physics), Patty Wallace, a Williamsville artist, Kevin Cullinan (CAS Machine Shop), and Prof. Doreen Wackeroth (Physics).

Dr. Dejan Stojkovic, who worked on PASI and I featured on page 4 of this Newsletter, actively participated in the "Scientists in Residence" program at the Buffalo Museum of Science. This program connects scientists and educators to the Buffalo Museum of Science's school and the public to share current research and interdisciplinary approaches to science.

PASI 2009 participants and team.

Four centuries ago the first detailed observations of the heavens were made by Galileo Galilei. During 2009 the UB Physics Department is participating in the International Year of Astronomy (IYA), a global commemoration of Galileo's breakthrough sponsored by the International Astronomical Union and UNESCO. Drs. Bernard Weinstein and John Cerne organized a week of lectures and activities to celebrate the IYA during October 13-16. The first speaker, Jason Kendall (NASA Jet Propulsion Laboratory Solar System Ambassador) gave a seminar on the "Wild Universe! Black Holes and Gamma-Ray Bursts, Quasars and Neutron Stars" that was aimed at the general public. After the talk, Mr. Kendall led a star party on the roof of Fronczak Hall using the Department's 10" reflecting telescope (much superior to Galileo's instrument). Over fifty people attended, and we are grateful to four of our teaching assistants: Robert Poltis, Ian Swanson, William Falls, and Alexander Moreno for volunteering to run the telescope. The skies were clear and visitors could clearly see the Ring Nebula and the moons of Jupiter. Two days later, Prof. David Hogg from the New York University Center for Cosmology and Particle Physics gave a colloquium to the Department entitled "What if the Milky Way Isn't Integrable?" Prof. Hogg is an observational astronomer well known for his work with the Sloan Digital Sky Survey. His colloquium dealt with recent progress in measuring the actual distribution of dark matter in our galaxy. On Friday evening, Prof. Hogg also gave a public talk exploring "What Happened Before the Big Bang? And How Could We Know that, Anyway?" Over 250 students, faculty, and community members heard Prof. Hogg discuss the latest ideas on this fascinating topic in an understandable and exciting fashion. Those present showed their approval with lively questions after the talk that continued until Prof. Hogg had to hurry off to the airport.

Drs. Ia Iashvilli and Avto Kharchilava from our high energy experimental physics group have sponsored the 4th annual QuarkNet Summer Workshop at UB during July 27-29. Participants this year included two mentors from the Department, Ia Iashvili and Avto Kharchilava, working with 7 teachers from the local high schools and one from New Jersey. A representative from the Fermilab Education Office, Robert Peterson, has also participated in the workshop. One of the main goals of the workshop was to discuss the origins of cosmic rays and their detection techniques, and to have the participants take data with cosmic ray detectors. Participants formed three independent experimental groups and by the end of the workshop they had prepared posters analyzing the data obtained at UB and other QuarkNet centers.

In reaching out to our younger generations, Drs. Andrea Markelz and John Cerne gave a presentation on lasers for about 120 students from the 4th grade class at Dodge elementary school on June 18. New laser and optical/audio interference demonstrations were presented, but it seemed that burning holes in paper with lasers captivated the students best!

Banner: Visitors at the Fall Open House look at a light bulb and arc lamps through a 100-year-old spectroscope.
PHOTO: F. Gasparini

Open House
By Dr. Andrea. Markelz

The third annual Physics Department Open House was held on Saturday October 17. The Open House included a welcome and graduate program overview by Dr. Stojkovic and undergraduate program overview by Dr. Gasparini. Eight labs opened their doors to tours by the general public and prospective students. Dr. Sen provided multimedia presentations and Drs. Cerne and Kharchilava, as well as grad student E. Greenwood, were available for tours of the Physics and Arts interactive exhibits. The day culminated in the graduate student research poster presentations and a traditional Buffalo pizza and wings reception. Please come join us for future Open House festivities!

UB Physicists and Artists Aim to Entertain with the First Science and Art Cabaret
By Dr. William Kinney

Whether you're a total non-science person or the next Einstein, the Science and Art Cabaret is made for you. The first of an ongoing series of science-as-never-seen-before cabarets took place in the Ninth Ward at Babeville's Asbury Hall in Buffalo on October 20. The Science & Art Cabaret is an entertaining mash-up of cutting-edge science and technology with art, music, poetry and performance. The October 20 topic was "Taking Nature Apart," and UB's scientists and artists weighed in. Now Buffalo has its own place for artists and scientists to connect, created by UB's physicists and visual artists who have collaborated on such local successes as the UB Physics and Arts Summer Institute and the permanent "Physics and Arts Exhibition" at UB. Order a drink at the bar and hear top university researchers discuss their work in context with creative minds from the arts and humanities. We pick a topic and look at it from all angles. Physicists, biologists, musicians, and poets at the October event riffed on reductionism, that peculiar scientific notion of learning about the world by breaking it into component parts. What do we learn by taking an organism apart? What do we learn by taking matter itself apart? What don't we learn? Should we feel alienated or illuminated by the creative destruction of scientific inquiry?

In addition to Kinney, who organized the cabaret, the panel featured these faculty from UB's College of Arts and Sciences: Ulrich Baur, physics professor and particle physicist, Katharina Dittmar de la Cruz, assistant professor of biological sciences and Gary Nickard, clinical assistant professor of visual studies. Local artist Patty Wallace performed a reading and live music was provided by The Vores, (unplugged), Buffalo's late 70's alternative band whose music is described as punk rock and surfer and which features UB artists Gary Nickard and Biff Henrich and UB grant writer Catherine Carfagna. To provide the critical connection to the world of quarks and questions about our place in the universe, particle physicist and UB assistant professor of physics Avto Kharchilava hosted a video link to the control room at Fermi National Accelerator Laboratory.

Welcome Barbecue
By Christine Gleason

At our annual welcome barbeque the Physics Department greeted seventeen new graduate students. In fall 2009, the new students are from Canada, China, India, Iran, Taiwan, Turkey and the USA. The students started their graduate studies at the Department with a morning orientation followed by a barbeque.

Ride for Roswell
By Chase Ellis

Unlike last year, the Department cycling team was blessed with a beautiful sunny day for this year's Ride for Roswell. This was the third year that the Department has participated in the annual bike ride which helps raise money for cancer research at the Roswell Park Cancer Institute. The 6 team members were able to raise over $1300, which places them as one of the top 100 fundraising teams out of the 535 registered. In total Roswell Park's 6,400+ riders were able to scrounge together $2.3 million dollars. The UB Physics cycling team would like to thank all of those who helped support our ride, and we look forward to having another successful ride this coming summer. If you are interested in riding on the team or supporting a member please contact Chase Ellis (ctellis@buffalo.edu) to get put on the UB Physics cycling team email list.

Events Calendar

Holiday Party – Saturday, December 5th 5-9:00 p.m. in Pistachios.

Rustgi Lecture – April 23, 2010. Nobel Prize winner W. D. Phillips will present a public lecture on "Time, Einstein and the coolest stuff in the universe."

Banner: The 2009 Physics Department Ride for Roswell Team, left to right, Chase Ellis, Marty Zanolli, Vincent Whiteside, Sarah-Rose Whiteside, James Parry, and Jeffrey Hafner. PHOTO: M. Kim

College of Arts and Sciences
University at Buffalo The State University of New York

Department of Physics
239 Fronzcak Hall
Buffalo, NY 14260
Tel: (716) 645 - 2017
Email: cg57@buffalo.edu

Non Profit Org.
U.S. POSTAGE
PAID
Buffalo, NY
Permit No. 311

The University at Buffalo Department of Physics Newsletter

Students and faculty at the fall Open House. PHOTO: F. Gasparini.

In this issue:

Undergraduate Education

Faculty in Focus

Alumni News

Research News and Awards

Outreach/Events