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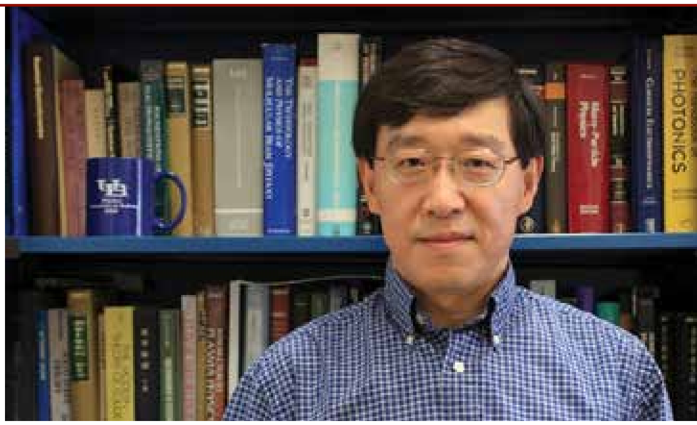
Interactions

The Newsletter of the UB Department of Physics

Volume 6, Fall 2013



Dear alumni and friends,

It has been an exciting year since I last wrote to you. In January this year, the American Physical Society (APS) started what they called APS TV, highlighting some departments to the physics community in the country. APS kicked this off by selecting 15 departments across the country and ours was among them. They produced a 6-minute film featuring our extraordinary growth in recent years. The film was shown at the biggest physics meeting in the country, the APS March Meeting in Baltimore, MD, and posted at the APS homepage and Youtube (a link is posted at the homepage of our Department). It was played throughout the week-long meeting. We have been very proud of this growth seeing it first hand, and it is great to see it recognized by APS.

As many of you may know, this year's Nobel Prize in physics went to two theorists who predicted the Higgs boson. It is very exciting and special to us, because three of our faculty members, Profs. Avto Kharchilava, Ia Iashvili, and Salvatore Rappoccio, made contributions to the CMS Collaboration at CERN, for the discovery of the Higgs boson. In addition, 3 postdocs and about a dozen graduate and undergraduate students participated in various parts of the experiment, and two faculty members, Profs. Ulrich Baur (†2010) and Doreen Wackeroth, contributed with theoretical work.

One of the signs of our growth is dear to our hearts, namely, the number and quality of our incoming majors. This year's class includes fourteen recipients of university scholarships, three of them Presidential Scholarships. This is about 50% of the incoming class, which is by far the highest in the College of Arts and Sciences (CAS).

Our enrollment has also been growing steadily. UB enrolled 14 intended physics majors in 2011, 24 in 2012 and 33 this year. The most impressive number is the ratio of students enrolled to the number of offers made. It grew from 21% in 2011 to 32% in 2012, and to 38% this year. More and more students receiving our offers joined the Department. This again stands out in CAS, and is a testament to the quality of our undergraduate programs and the efforts from the faculty, especially the Undergraduate Studies Committee under the leadership of Prof. Bernard Weinstein. Based on our record, the Department is one of a few used by CAS to establish model procedures for undergraduate recruitment.

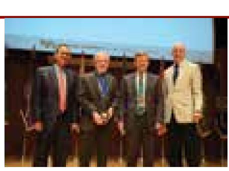
Once again, there are quite a few well-deserved promotions, important awards and recognitions this year. Congratulations to Prof. Francis Gasparini for becoming a SUNY Distinguished Professor, Prof. Igor Zutic for promotion to Full Professor, Profs. Arnd Pralle and Wenjun Zheng to Associate Professor, Prof. Doreen Wackeroth for being elected as a Fellow of APS, Prof. Surajit Sen a Fellow of the American Association for the Advancement of Science and Prof. Bruce McCombe for the Presidential Award for Faculty Excellence. During my first term as the Chair, I witnessed first-hand 15 promotions to all ranks, among them many early promotions, in addition to important awards. As a group, their records/accomplishments have become the envy in CAS and the University.

There have been several successful workshops, public lectures and events. In May, Prof. Jong Han successfully organized the second workshop in the Physics at the Falls series on Recent Progress in Nonequilibrium Quantum Many-Body Theory. The high-energy physics group organized a public event celebrating the discovery of the Higgs boson. Prof. Peihong Zhang organized the inaugural lecture for the Ta-You Wu Memorial Lecture series, featuring Prof. Marvin Cohen from UC Berkeley as the speaker. This year's speaker for our Rustgi Lecture was Prof. Anthony Leggett, a Nobel laureate from UIUC.

Stay in touch!

Best regards,

Hong Luo, Chair
Professor of Physics



Banner: Professor Francis Gasparini with President Sathish Tripathi, Provost Charles Zukoski and CAS Dean Bruce Pitman at the UB Celebration of Faculty & Staff Academic Excellence. Professor Gasparini was named SUNY Distinguished Professor in recognition of his national and international prominence in his research field. Read more in www.buffalo.edu/news/releases/2013/01/003.html. *Photo: Nancy J. Parisi*

UB Physics Plays a Role in the Discovery of the Higgs Boson

By Drs. Avto Kharchilava, Ia Iashvili and Salvatore Rappoccio

On July 4th, 2012, the CMS and ATLAS collaborations at the CERN Large Hadron Collider (LHC) announced the discovery of the Higgs boson, to much worldwide attention and fanfare.

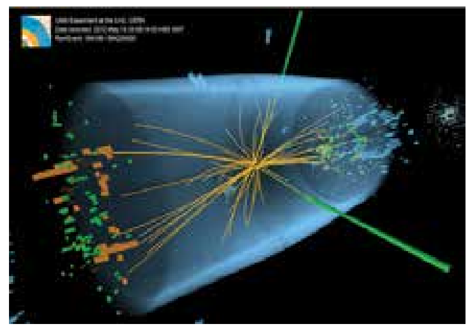
"I think we have it!" proclaims Rolf Heuer, director of CERN, announcing the discovery of the Higgs boson. Photo: CERN

This remarkable discovery is the capstone of a model that explains known interactions of matter to 12 decimals of precision. As such, this model, the so-called "Standard Model" of particle physics, is the best theory there is. As the Higgs boson was predicted in 1964, its discovery was long-anticipated, with a search that took many decades, the combined efforts of thousands of scientists and engineers across the globe, and tireless commitment from governments worldwide. It is a true achievement of the human species, and a model for the wondrous things that can be achieved with global cooperation and a sustained investment in science by all of us. As members of the CMS collaboration, UB physicists played a role in the discovery of the Higgs boson.

Science on an Epic Scale

Our Universe seems to be governed by four fundamental forces: gravity, electromagnetism, the weak force (which regulates nuclear phenomena like fusion within stars) and the strong force (which manifests on the scale of atomic nuclei). Physicists have long been trying to unify these forces under a single theory. A major breakthrough came nearly five decades ago when physicists realized that the weak and electromagnetic forces can be described by a single, "unified" electroweak theory based on a fundamental symmetry between them. The theory of electroweak interactions and Quantum Chromodynamics (the theory of the strong force) form the basis of the Standard Model. The Standard Model successfully describes all of the elementary particles we know and how they interact with one another. But our understanding of Nature is incomplete. In particular, the Standard Model as originally conceived could not answer one basic question: Why do most of these elementary particles have masses? The symmetry responsible for electroweak unification requires the force-carrying particles be massless. The carrier of the electromagnetic force, the photon, is an example. However, the W and Z bosons, carriers of the weak force, have non-zero masses, and this fact breaks the electroweak symmetry. It also leads to nonsensical predictions such as interactions with probabilities greater than one. As a way out, Higgs, Brout and Englert have proposed a mechanism that explains the broken symmetry. Once incorporated into the equations of the Standard Model, this electroweak-symmetry breaking mechanism would not only allow W and Z bosons to be massive, but all elementary matter particles to have mass, as a bonus! Peter Higgs et al. pointed out that the mechanism required the existence of a new particle with specific properties: it is massive and carries neither electric charge nor spin. And the race for this elusive particle had begun!

Well, many components are vital for the race of these proportions! First, one needs a high energy accelerator such as the Tevatron (Fermilab) and the Large Hadron Collider with its record high energy and luminosity. Next – general-purpose detectors that can handle proton-proton collisions at 10-100 MHz rates. One also needs to design and implement unique and sophisticated event simulation, reconstruction and analysis software that can process petabytes of data daily. Past years – and the Higgs boson discovery in particular – have shown that all is possible through the concerted efforts of world-wide collaboration of thousands of physicists and engineers, which is a miracle on its own and probably a thesis topic for a student in sociology.



A candidate Higgs boson event, decaying into two photons, as recorded by the CMS detector. Photo: CERN

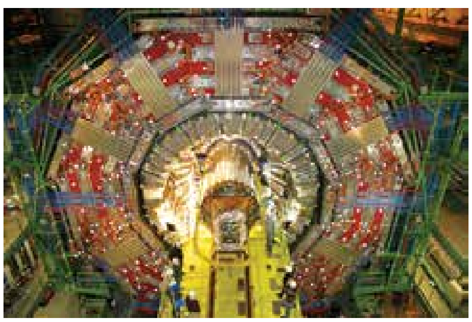
UB physicist Avto Kharchilava and Ia Iashvili, joined the race in the early 90's, when they became members of the CMS Collaboration – one of the two CERN experiments that have announced this discovery. They spent almost 10 years at CERN, until 2000, and contributed to the successful hunt for the Higgs boson in many ways, ranging from CMS detector design optimization studies, tracking detector R&D, construction and commissioning through software validation and physics potential of the CMS/LHC. Here we briefly mention two projects; tracking R&D and searches for a Higgs boson in four lepton final states via the production of two Z bosons. This process is one of the many ways the unstable Higgs boson leaves a trace in

UB Physics and the Higgs Boson Discovery

CONTINUED

the ATLAS and CMS detectors.

Until the late 90's, the CMS Collaboration was considering the MSGC detector – a gaseous tracking device – as a baseline detector for particle tracking. At that time, in collaboration with a research group in Strasburg (France), Profs. Kharchilava and Iashvili studied a new generation of gaseous detectors, the so-called GEM (Gas Electron Multiplier) as a possible replacement for the MSGC. In the meantime, however, the Collaboration had decided to adopt the competing technology of all-Silicon-tracking, which at that time was considered to be "revolutionary." From today's perspective, CMS's decision turned out to be a wise one, even though they "lost the friendly competition".They then joined the Silicon tracking project during its construction phase (in 2005, when they became faculty here at UB) and are now very happy with the excellent performance of the all-Silicon tracking detector of CMS.



The CMS detector during the construction phase. Bright spots/mirrors serve as reference points for a precise laser alignment system. Photo: CERN

Profs. Kharchilava and Iashvili also studied the feasibility of the Higgs boson discovery in four-lepton final states with the CMS detector. In 1996, they pioneered an advanced analysis technique based on Artificial Neural Network event classifiers in combination with the use of spin structure of the Higgs boson and its decay products. They have shown that the separation of the Higgs boson signal from the non-Higgs background can be improved by ~20% compared to traditional search methods, which is a crucial improvement in view of the difficulty to detect this elusive process.

In the late 90s, it was clear that the construction of the LHC and detectors would take many years. Fortunately, in early 2000, the upgraded Tevatron at Fermilab was ready to start its Run II, and Profs. Kharchilava and Iashvili came to the US to contribute to the race for the discovery of the Higgs boson at the Tevatron. They joined the D0 Collaboration, and their expertise and experience from gained at CMS was applied to the Tevatron search for the Higgs boson. In July 2012, the two Tevatron Collaborations, D0 and CDF, jointly announced an evidence for a Higgs-like particle in their data. The significance was at 3 standard deviations, so that the Tevatron collaborations could not claim the observation. However, Tevatron's experience in the search for the Higgs particle was invaluable for the LHC community and essential to the Higgs discovery. As is so often the case in science, discoveries are part of a process, building on previous insights and achievements.

Prof. Kharchilava is now a member of the Higgs Publication Committee Board that oversees the final steps and scrutiny that the CMS collaboration must undertake before results on Higgs particle searches go public. Until recently, Prof. Iashvili was a co-leader of the Jet Energy Calibration group whose work is vital to almost every CMS analysis.

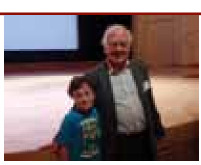
Prof. Rappoccio joined the CMS collaboration in 2007 and the UB Physics Department in 2011. As a member of CMS he is actively involved in jet reconstruction and triggering, advanced techniques for identifying fast-moving heavy particles like top quarks, W, Z and Higgs bosons, and upgrades to the CMS detector in 2013-2015. While the Higgs boson discovery is a capstone of the Standard Model of particle physics, many questions remain unanswered, such as why the mass of the Higgs boson is so far below the Planck energy scale. Prof. Rappoccio leads a team of scientists at CMS looking for physics beyond the Standard Model involving top quarks which could lead to answers to this and other open questions.

UB Physics graduate student Jia Zhou with Prof. Peter Higgs at the poster session of the 69th Scottish Universities Summer School in Physics in St. Andrews. Jia attended the school in 2012 and presented a poster on her work on top quark pair production at the LHC.

What's Next?

We are lucky to have in operation a scientific, technological and engineering marvel such as the LHC at CERN. The particle physics community worldwide can look forward to a sound and cutting-edge research program for many years to come. We have clear goals, such as the precision measurement of properties of the newly discovered particle, and whether it is indeed the Higgs particle as predicted by Higgs, Brout and Englert.

Despite this astonishing success, there are glaring problems with our un-



Banner: Prof. Peter W. Higgs with an Amherst soccer enthusiast, Giorgi Kharchilava. The photo was taken at the European Physical Society Conference in Stockholm, Sweden, July 2013. *Photo: Avto Kharchilava* derstanding of nature. We have, as of now, only accounted for approximately 4% of the known universe with matter and energy that we know about. That means we are completely in the dark about the remaining 96%! We have dubbed these "dark matter and energy," since we are unable to see them in any way at the present time. What constitutes this "dark matter" and "dark energy?" We don't know. The LHC is investigating this pressing question next, along with the ever-present question of "what else is out there that we haven't thought of?" We feel lucky to be part of this endeavor and to have the opportunity to possibly witness even more fundamental discoveries. So, stay tuned for exciting developments from the LHC and other particle physics experiments in the near future, as the second run begins in 2015!

The Royal Swedish Academy of Sciences awarded the 2013 Nobel Prize in physics to two theorists, Peter W. Higgs and François Englert, "for the theoretical discovery of a mechanism that contributes to our understanding of the origin of mass of subatomic particles, and which recently was confirmed through the discovery of the predicted fundamental particle, by the ATLAS and CMS experiments at CERN's Large Hadron Collider."

The Advanced Laboratory

By Dr. Serdar Gozpinar

The advanced lab consists of a series of experiments that are aimed at seniors and graduate students. As the name of the lab suggests, the experiments are quite involved and usually take several weeks to complete. A wide spectrum of physics topics are addressed, from condensed matter physics, to optics, quantum physics and particle physics. The primary purpose of the lab is to introduce students to hands-on research, data and error analysis, to improve laboratory skills and also presentation skills. After working on the experiments, students are expected to present their results to their fellow students and instructors, in a fashion similar to a talk in a conference setting. Providing this kind of hands-on experience and opportunity to practice communication skills is an invaluable and crucial part of our student's education at UB.

Undergraduate student Sean Rosney and graduate student Ruifeng Dong taking data with the cosmic ray detector. Photo: Serdar Gozpinar

In the lab, students learn to use instruments that are commonplace in physics laboratories, such as Lock-in amplifiers, power supplies, electromagnets, electronic interfaces, spectrometers, lasers and various optical equipment. Techniques and safety procedures related to the usage of cryogens, vacuum equipment, high magnetic fields and lasers are also taught. The advanced lab is one of the few courses in the physics curriculum that requires the simultaneous development of advanced theoretical knowledge and experimental skills, and serves to prepare students towards work and research in leading edge areas of physics.

The advanced lab is taught by Dr. Serdar Gozpinar. He received his PhD at Brandeis University, where he was a member of the experimental high energy physics group. He completed his PhD thesis working on the ATLAS experiment at CERN, under the advisement of Dr. Craig Blocker. He joined the physics department at UB as an Instructional Assistant Professor in 2013.

Dr. Gozpinar in the advanced laboratory.

First Physics Boot Camp for Incoming Freshman

By Dr. John Cerne and Scott Whitmire

In June 2013, the Department offered its first three-day workshop geared toward strengthening the preparation of incoming freshmen for our introductory physics courses. The workshop helped prepare participants by identifying strengths and weaknesses in their knowledge of college physics, teaching them how to better utilize lectures, improving their laboratory skills, familiarizing them with on-line homework, building their problem-solving skills, and developing their preparation strategies for examinations and quizzes.

Twenty-eight students registered for the workshop and many of them had also taken the Chemistry workshop immediately before our workshop began. The students were first taken on a tour of the Department, including research labs and the Physics and Arts exhibits. The tour ended with a garbage can launch/explosion using liquid nitrogen, which really got their attention! Participants experienced lectures very similar to those given in Physics 101 and 107 (Introductory Mechanics) on topics of high importance. They used classroom

response systems in lecture. They also attended recitations and completed a physics laboratory. The lectures were taught by John Cerne and the labs were run by Scott Whitmire. Teaching assistants Katherine Niessen and YuTsung (Rem) Tsai led the recitations and labs. At the end of the intensive workshop, Cerne and Whitmire met with each student to go over his/her performance in the workshop, answer questions, and recommend personalized strategies for success in our introductory courses. This is the first time that we offered this workshop and we are looking forward to offering it every summer from now on. For more information, please check out: www.physics.buffalo.edu/Physics_Workshop_description.pdf

Boot Camp students and instructors after three days of intensive physics.

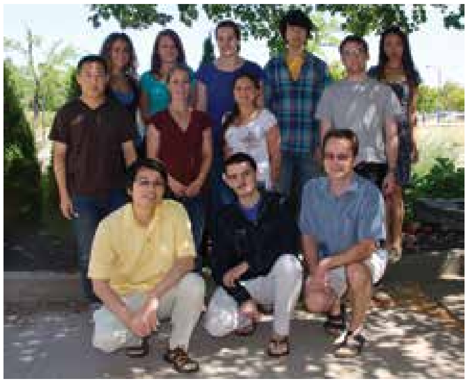
The Value of Undergraduate Research

By Dr. And Pralle

Recent studies emphasized the importance of hands-on research experience during the undergraduate years for the training of our future scientists. As consequence, funding and accreditation agencies request undergraduate involvement. We at UB Physics have been traditionally very welcoming to undergraduate research. In this article we will feature undergraduate research experience in the Physics department, starting with Dr. Pralle and his biophysics research group.

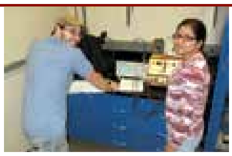
The Pralle group studies how cells communicate and what role the nanoscale structure of the cell membrane plays. This requires a very interdisciplinary approach including growing cells, developing and building physical instrumentation, and writing computer code for data analysis and simulation. In the past 6 years, we had 15 undergraduate students join our efforts of which about half were physics majors, while the others were biomedical engineers, pre-pharmacy or pre-medical majors. These students with diverse backgrounds bring diversity and fresh input to the lab of physics graduate students and post-docs. The students in-turn benefit from the chance to work on their own independent project, and to develop and present their ideas in group meetings. They hone their laboratory skills of good book-keeping and communication, and realize that the team's success depends on everyone's work. When possible, we take the students to the Annual Biophysics conference where they experience the communication between 6,000 biophysicists, from around the world, which is usually a highlight of their time with us. The graduate students gain valuable experience in training and leading these students. Training undergraduates costs extra time for the group-leader and the graduate students, and we have lost some expensive equipment. But overall the benefits to the students and the group greatly outweigh these. The vast majority of our students have gone on to graduate or professional school. Here, I like to paraphrase some of the reflections of the last two students in my group: Katie Spoth, BS 2012, now graduate student at Cornell University; and Junhong Choi, BS 2013, now graduate student at Stanford University.

Katie reflects that working in the lab allowed her to gain skills and experience that she would never have been exposed to in a class setting, including the chance to really dive in and learn a lot about a particular problem. During the time she realized the value of other students' knowledge and support, and got a good idea what graduate school would really be like. She greatly enjoyed the opportunity to travel to the Biophysical Society conference with the group. The research experience made her confident about attending graduate school and she feels it was certainly a positive factor in her applications! Doing research in biophysics also led her to her current research in cryo-electron microscopy of biological samples at Cornell.



Members of the Pralle group summer 2012 Back row: Becky Testa, Kelly Wyrough, Katie Spoth, Junhong Choi, Heng Huang; Middle row: Jin Weixiang, Sara Parker, Maral Alyari, Zach van Zant; Front row: Yunhsiang Hsu, Muhammed Simsek, Arnd Pralle

For Choi, the research experience at Pralle Lab was the beginning of a career as a scientist, as he was just deciding to pursue a graduate degree, abandoning his former plan to be in health-related fields. In general students in the sciences change majors more than in other subjects, so the real lab experience can be a great guidance. Choi feels that by getting hands-on experience in a research lab and having opportunities to present his work, he got a strong conviction that graduate school is right for him, and more importantly that he wanted to pursue science as a life-long career. Moreover, this became an even greater



Banner: Undergraduate student Chris Smith and graduate student Sushree Tripathy working on the optical pumping experiment. Photo: Serdar Gozpinar indicator of his potential for schools and labs that he wanted to be admitted to and join. Without this experience as an undergraduate researcher, Choi doubts that he would now be at Stanford in the Applied Physics program or be this strongly convinced to pursue a scientific career.

Cynthia Rudin, BS 1999

By Dr. Cynthia Rudin

Dr. Cynthia Rudin graduated Summa Cum Laude from UB in 1999, with a B.S. in mathematical physics, a B.A. in music theory, and a minor in computer science. Cynthia earned her Ph.D. degree in applied and computational mathematics at Princeton University in 2004, specializing in machine learning. While at UB, Cynthia was in the UB Honors Program (now called the UB Honors College) and received outstanding senior awards from the departments of physics, mathematics, and music, and the outstanding senior award in the natural sciences.

After receiving her Ph.D., Cynthia worked at New York University as a NSF Postdoctoral Research Fellow, and then at the Center for Computational Learning Systems at Columbia University. At Columbia, Cynthia led a team of scientists in a joint project with Con Edison, New York City's power utility company to help maintain the energy grid using machine learning and data mining. Their project used historical data from NYC's power grid to predict power failures such as manhole fires, manhole explosions, and smoking manholes. This project was extremely challenging, and used diverse historical power grid data, some of which were 120 years old, dating from the time of Thomas Edison. Her team's work on electrical grid maintenance recently earned them the 2013 Innovative Applications in Analytics Award, given by the Institute for Operations Research and the Management Sciences (INFORMS).

Currently, Cynthia is an associate professor at MIT, studying a range of different topics related to data mining and machine learning. One of her current core interests is to design "interpretable" machine learning models that can be automatically generated but are understandable to a human expert. She and her collaborators used these techniques to design interpretable models for predicting stroke in medical patients.

Another one of her projects aims to design a next-generation Internet search engine where the user puts in a few examples of something (e.g., colors), and the search engine gathers information from the Internet to generate more examples.

Cynthia is working with the Cambridge Police Department on a project that uses machine learning to detect patterns of crime committed by the same offender(s). This work on predictive policing was recently featured in the Boston Globe, Times of London, and on Radio Boston.

She has also worked on topics related to analysis of meetings (appearing in the Wall Street Journal), and reverse-engineering quality rating systems (in Businessweek: www.businessweek.com/articles/2012-03-09/b-school-research-briefs).

Michael Skvarch, BS 2010

By Dr. Frank Gasparini

Michael Skvarch in Mozambique, Sofala Province, Mangunde, at the opening of a community center he helped build.

Michael Skvarch received a BS degree in Physics from the University at Buffalo before he joined the Peace Corps. The photo shows Michael at the opening of a local community center that he and some local health workers organized and helped build. The school is known as the "School of Peace" and its inauguration was held on October 4th 2013. October 4th is the national day of peace in Mozambique and commemorates the day that the General Peace Accords were signed, and the 20 year civil war was brought to an end in 1992. The school was built for a group of orphaned children who live with local community members and whose lives have been affected by the HIV/AIDS pandemic. Michael is now returning to the US to get a masters degree in Teaching Physics.

Physics Programs

Support the Department of Physics Programs

The Physics Department is grateful to all our alumni and friends for their financial contributions. As is the case at many public universities, the state portion of the operating budget has shrunk substantially over the years. At UB, this portion is now only about one-quarter of the total budget. Thus, private donations, either restricted or unrestricted, have become the margin which distinguishes outstanding departments from good departments. The Physics Department has grown by 50 percent over the last few years. We have received a number of donations and endowments from friends and alumni in support of our academic mission. Some of these are listed below. We seek additional contributions to either enhance our existing endowments or other targeted contributions as the donor prefers.

To contribute electronically, please visit http://www.physics.buffalo.edu/support_physics/endowments.html or contact Christine Gleason in the Physics Department at 716.645.3629 or via e-mail cg57@buffalo.edu. You may also contact the Development Office at 716.645.0839 with any questions.

Physic Department Funds:

Physics Excellence Endowment:

The Physics Excellence Endowment is of paramount importance in achieving overall excellence in the broad mission of the Physics Department. These expendable, undesignated funds support recruitment of outstanding graduate and undergraduate students, outreach efforts to the community, upper level experimental laboratories, undergraduate research projects, and activities of The Society for Physics Students. In addition, the Physics Excellence Endowment funds provide partial support for the Department's colloquium and seminars series, and for the tangible recognition of our students.

Frank B. Silvestro Endowment Fund:

This endowment, established in 2000, and funded by donations of Mr. Frank Silvestro, BA 1962, MA 1968 is used to support physics students who show academic promise and demonstrate financial need. Currently, the available endowment funds are used for the support of graduate students.

Physics International Graduate Student Assistance Fund:

Established in January 2010 by Dr. Bruce D. McCombe, Physics, at the time he was Dean of the College of Arts and Sciences to provide support for critical financial assistance to international graduate students in the Department of Physics, with a preference given to international students and 1st year Ph.D. candidates, at the University at Buffalo.

Dr. Stanley T. Sekula Memorial Scholarship Fund:

This endowment, established in 1990 by Mrs. Anne H. Sekula, honors the memory of Dr. Stanley T. Sekula, BA 1951. The endowment income is used to recognize outstanding undergraduates who show academic promise and demonstrate financial need.

Moti Lal Rustgi Professorship in Physics:

The Professorship was endowed by the Rustgi family in 2006 to honor and remember our former colleague Professor Moti Lal Rustgi. The endowment provides support for the Rustgi Professor, a title held by one of the Department's tenured professors, currently Professor Frank Gasparini. Income from the endowment supports research and other scholarly pursuits.

Moti Lal Rustgi Memorial Lectureship Fund:

Endowment for this lectureship was established in 1993 by the Rustgi family and friends in remembrance of our former colleague Professor Moti Lal Rustgi. The lecture is given annually by distinguished researchers in a broad area of physics research.

Ta-You Wu Lectureship Fund:

An endowment has been established in remembrance of our former colleague Professor Ta-You Wu. He was a member of our Department from 1966 to 1978. He served as chairman from 1966 to 1969. The lectureship is being supported by former colleagues, friends, and students who wish to remember the strong influence Professor Wu had on their careers and lives.

Physics and Arts Exhibition Fund:

The Physics and Arts Exhibition opened on May 5th, 2006. It was made possible through the contribution of many of our alumni. This Exhibition is a permanent installation in Fronczak Hall. It involves a series of displays, many interactive. The displays have added a welcoming atmosphere to the building and have provided the multitude of students who frequent the building with a quick graphical exposure to physics. This has been, and will continue to be, an excellent source for University and community outreach. The Exhibition involves a unique presentation of physics at interactive, conceptual and artistic, and historical levels. Donations to this Exhibit will support the continued evolution, development, and upgrade of the Exhibition.

Physics Department Resource Fund:

The Resource fund is not an endowment fund. Contributions to this fund are available immediately to the Department less a minimum of five per-

Banner: Chase Ellis (PhD 2013) with his wife Erin at their wedding. From left to right: Dr. Tyler Nordgren, Chase's undergraduate advisor, Dr. Julie Rathbun (UB Physics BS 1994), Erin, Chase, Dr. Andrea Markelz, and his graduate advisor Dr. John Cerne.

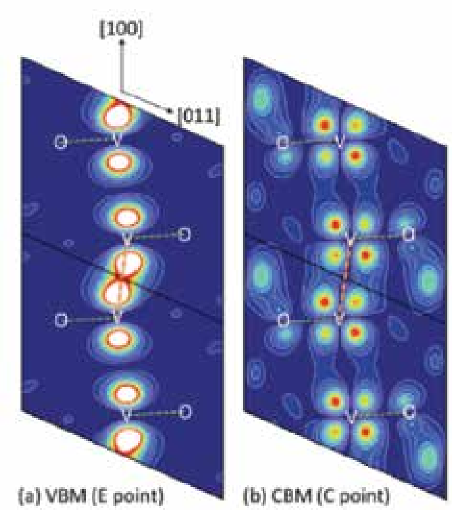
cent deduction by the UB Foundation. These funds from our donors are used to give partial support to activities such as graduation receptions for our physics majors, welcoming picnic for new graduate students, activities of the undergraduate Society of Physics Students, awards for our outstanding TA's, and other needs.

Hole-lattice Coupling and Photoinduced Insulator-metal Transition in VO2

By Xun Yuan, Wenqing Zhang, and Dr. Peihong Zhang

Vanadium dioxide (VO_2) undergoes a metal-insulator transition (MIT) at 340 K. The electronic phase transition is accompanied by a seemingly "simultaneous" structural change from a low-temperature monoclinic (M1) to a high-temperature rutile (R) structure. Despite decades of intensive research, the physics behind the MIT in VO_2 remains a subject of unabated debate. Recently, it was found that the phase transition in VO_2 can be induced by photo-excitation. Ultrafast spectroscopy also reveals a multi-timescale structural evolution ranging from subpicoseconds to nanoseconds in VO2 upon photo-excitation.

In a recent paper [PHYSICAL REVIEW B 88, 035119 (2013)], we propose a unified theory that is able to explain the ultrafast photoinduced insulator-metal transition and the multi-timescale structural dynamics associated with photoexcitations. Our theory is based on results from first-principles electronic structure calculations. We show that holes created by photoexcitation weaken the V-V bonds and eventually break V-V dimers in the M1 phase when the laser fluence reaches a critical value. The breaking of the V-V bonds in turn leads to an immediate electronic phase transition from an insulating to a metallic state while the crystal lattice remains monoclinic in shape. Our results suggest that it is the strong coupling between the lattice and the excited holes is responsible for the observed rapid separation of V-V pairs after photoexcitation. The coupling between excited electrons and the 6.0-THz phonon mode is found to be responsible for the observed zigzag motion of V atoms upon photoexcitation and is consistent with coherent phonon experiments. This work was carried out in collaboration with Shanghai Ceramics Institute, Chinese Academy of Sciences. The work at UB was supported by the US Department of Energy, Office of Basic Energy Sciences, Division of Materials Sciences and Engineering under Award No.DESC0002623.



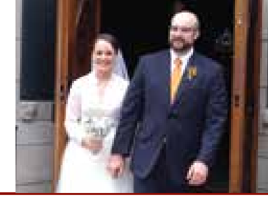
Charge density contour plot of the VBM (a) and CBM (b) states which helps to explain the lattice dynamics of VO_2 upon photo-excitation.

Research Collaborations and Visitors at UB Physics

By Dr. Eckhard Krotscheck

The UB Department of Physics has a vibrant visitors' program, which is beneficial to collaborative research and international visibility of the Department. In the following we feature two recent visitors, Drs. Siu A Chin and Eric Serauld.

Dr. Siu A. Chin got his B.S. in Physics from M.I.T in 1971 and his Ph.D. in Physics from Stanford University in 1975. He has been a Professor of Physics at Texas A&M University since 1993. He is a Fellow of the American Physical Society, Division of Computational Physics and was named APS's Outstanding Referee in 2011. His research interest began in theoretical nuclear physics where his one paper on relativistic many-body field theory garnered over 500 citations since publication. His early interest in high-density nuclear, neutron and quark matters resulted in collaborative works with Dirk Walecka, Gordon Baym and Arthur Kerman. His interest in the Diffusion Monte Carlo methods originated with his joint work on Hamiltonian Lattice Gauge Theory with John Negele and Steve Koonin and continued with Eckhard Krotscheck, UB Professor of Physics, on solving the statics and dynamical properties of Helium-4 droplets. In the past decade he has been a proponent of developing forward high-order symplectic integrators for solving classical dynamical problems as well as higher order Diffusion Monte Carlo and Path-Integral Monte Carlo methods for solving quantum many-body systems. These methods are also heavily used



in the calculations of the properties of metallic clusters by Krotscheck and his group.

Eric Seraud, a Distinguished Professor at the University Paul Sabatier Toulouse 3, brings expertise in the dynamics of finite fermion systems to the metallic cluster research of Krotscheck. His main research area is irradiation dynamics on small Fermi systems, which is a key issue in physics, chemistry and biology. It provides a remarkable tool of investigation of static and dynamical properties of atoms, molecules and bulk material. It also plays a central role in radiation damage, both in materials and in living tissues. Laser irradiation is especially fashionable because of the easy access to lasers and their-ever growing tuning capabilities, in terms of intensity, frequency and pulse shaping, to mention only a few recent hot spots. The primary response mechanisms to an irradiation proceeds via electrons, in particular in terms of electronic emission, as soon as the deposited energy is large enough. Ongoing experimental progress is now allowing access to properties of electronic emission at a remarkably detailed level, in particular in an energy, angle and sometimes time resolved manner. The key measured observables are Photo Electron Spectra (PES, providing an energy resolved analysis of electron emission) and Photo Angular Distributions (PAD, providing the angular distribution of emitted electrons).

It is thus crucial to develop theoretical tools to understand the dynamics of electronic emission from irradiated species and a natural issue here is to consider PES and PAD. Dr. Suraud has developed for more than a decade a robust body of methods and computer codes to deal with these questions. The theoretical basis is Density Functional Theory (DFT) in its time dependent version solved in real time. In its standard, Local Density Approximation (LDA), version, this mean-field theory provides a robust and versatile tool. It also requires some developments to include unaccounted effects such as self interaction problems (one electron spuriously interacts with itself) and dissipative features (beyond mean field), in particular.

One of our most recent achievements concerns the analysis of the irradiation dynamics of fullerenes in terms of PES and PAD, following recent measurements. Such a complete analysis is a "first" at the highly microscopic level of description we have achieved and thus allows a better and "direct" understanding of the underlying physical mechanisms.

Among other recent results, let us mention the reformulation of the self interaction problem in a fully dynamical context and new developments of DFT beyond LDA in order to include dissipative features. Both these questions are still under active investigation, both from the formal and computational viewpoints.

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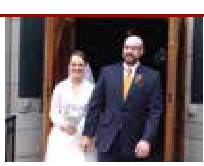
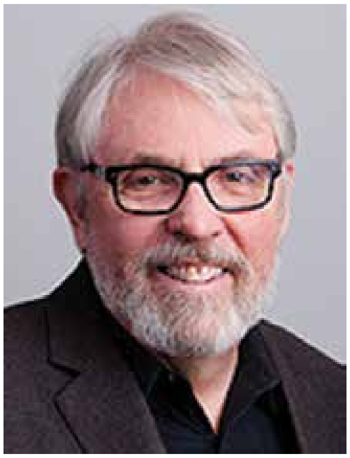


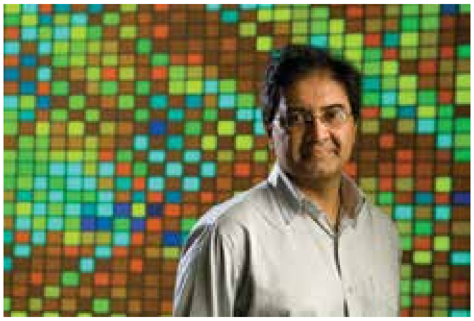
Banner: Graduate student Tom Scrace and his wife Sarah after their wedding ceremony at Notre Dame's Basilica.

Faculty and Student Awards
Volume 6

Faculty Awards
By Dr. Doreen Wackeroth



SUNY Distinguished Professor Bruce McCombe has been awarded the UB President's Medal. The UB President's Medal, first presented in 1990, recognizes "outstanding scholarly or artistic achievements, humanitarian acts, contributions of time or treasure, exemplary leadership or any other major contribution to the development of the University at Buffalo and the quality of life in the UB community." Professor Bruce McCombe has served the university in numerous academic and administrative leadership roles. He was director of the Center for Advanced Photonic and Electronic Materials, as well as the Center for Spin Effects and Quantum Information in Nanostructures. He has served as associate chair and chair of the Physics Department, as associate dean for research and sponsored programs in the College of Arts and Sciences, vice provost for graduate education and dean of the Graduate School, and dean of the College of Arts and Sciences. After stepping down as dean to focus on scholarship, he agreed to serve as interim provost during a critical period of leadership transition for the university. Read more in www.buffalo.edu/ubreporter/archive/2012_04_26/commencement.html.



Professor Surajit Sen has been elected a fellow of the American Association for the Advancement of Science (AAAS) for "pioneering research on solitary waves and their collisions in granular media and for sustained outstanding service and leadership in international physics." Read more in www.buffalo.edu/news/releases/2012/12/13832.html

Professor Doreen Wackeroth has been elected a fellow of the American Physical Society (APS) for "careful contributions to electroweak and Higgs physics, especially the computation and phenomenology of electroweak and QCD corrections to W, Z and Higgs boson production at hadron colliders, and for service to high-energy physics especially co-organizing a decade of annual LoopFest Workshops."

Undergraduate Awards

Outstanding Senior:

Junhong Choi

Sekula Scholarship Awards:

Sean Bearden, Michael Benson, Geoffrey Fatin, Sarah Freed, Paul Glenn, John Jacangelo, John Nord

Graduate Awards

Outstanding TA's:

George Lindberg, Katherine Niessen

Silvestro Scholarship:

Ali Alsaqqa, Maral Alyari, Jaba Chelidze, Ruifeng Dong, Jimin George, Alok Mukherjee, Samanthe Perera, James Pientka, Sujay Singh, Payem Taherirostami, Sushree Tripathy, Xuechen Zhu

Presidential Fellowship:

Ruifeng Dong, Rahul Munshi, Luke Pendo, John Truong, Matthew Westley

Cambi Fellowship:

Rahul Munshi

Fermilab Graduate Student Fellowship:

Jia Zhou

We Congratulate Our Graduates

FALL 2012

Physics Ph.D.

Heng Huang
Advisor: **Arnd Pralle**
Thesis Title: *Magnetic Stimulation of Neurons and Study of Membrane Structures*

Gen Long
Advisor: **Hao Zeng**
Thesis Title: *Carrier Spin Polarization in Quantum Confined System*

Andreas Hans Russ
Advisor: **Athos Petrou**
Thesis Title: Magneto-optical Studies of Quantum Dots

SPRING 2013

Physics Bachelors

Jeremy Franklin Baron
Alexander Jacob Carson
Junhong Choi
Matthew Charles Gorfien
Connor Gorman
Melissa Marie Judson
Colin P. Kilcoyne
Kristina Krylova
William Robert Louden
Jessica Jean Ralabate
John Truong
Cory Joseph Zorsch

Mathematical Physics Bachelors

Joshua Andrew Buli
Laura Hanzly
Aaron Francis Kirby
Joshua Puzio Lauzier

Physics Masters

Qi Qian
Advisor**: Hong Luo**
Thesis Title**:** *Band Gap Study of Titanium Dioxide with Scanning Tunneling Microscopy and Scanning Tunneling Spectroscopy*

Yizhi Qiu
Advisor**: Hao Zeng**
Thesis Title**:** *Self-organized Porous Template for Super Absorber Material*

Physics Ph.D.

Jae Kyu Choi
Advisor**: Vladimir Mitin**
Thesis Title**:** *Design, Growth, Characterization of Mid Infrared and Terahertz Detectors Based on Nanostructures*

Chase T. Ellis
Advisor**: John Cerne**
Thesis Title**:** *Probing cyclotron resonant signatures and the AC quantum Hall effect in monolayer and heterogeneous graphene multilayers through mid-infrared, magneto-optical, polarization sensitive spectroscopy.*

Azadeh Moradinezhad Dizgah
Advisor**: William Kinney**
Thesis Title**:** *Scale-invariant Perturbations Model-independent Analysis of Alternatives to Inflation*

Alexander Moreno Briceno
Advisor: **Doreen Wackeroth**
Thesis Title: *Top Quark Phenomenology in CP-Violating Supersymmetric Models*

Rohit Singh
Advisor: **Andrea Markelz**
Thesis Title: *Modulated Orientation Sensitive Terahertz Spectroscopy*

SUMMER 2013

Physics Ph.D.

Deepu K. George
Advisor: **Andrea Markelz**
Thesis Title: *Polarization Sensitive THz TDS and Fabrication of Alignment Cells for Solution Phase THz Spectroscopy*

Yun-Hsiang Hsu
Advisor: **Arnd Pralle**
Thesis Title: *High Resolution Map Of Cell Membrane Stiffness, Proteins Diffusion And Concentration Characterized By Thermal Noise Imaging*

Jaesuk Kwon
Advisor: **Hong Luo**
Thesis Title: *Magnetization of Ferromagnetic MnAs/GaAs Heterostructure and Optical Studies on MnAs/InAs Spin LEDs*

Lars Schweidenback
Advisor: **Athos Petrou**
Thesis Title: *Efficient injection of spin-polarized electrons from MnAs contacts into AlGaAs/GaAs Spin LEDs*

Zhenzhong Shi
Advisor:
Sambandamurthy Ganapathy
Thesis Title: *Noise Spectroscopy Near Phase Transitions In Nanoscale Systems*

Banner: Professor Michio Kaku with Prof. Avto Kharchilava and his son Giorgi at a reception at his recent visit at UB. Read more on page 14.

Physics Majors Get Children Excited About Science

By Luke Bodmer, undergraduate student

Three sophomore physics majors, Dante Iozzo, Nigel Michki, and I organized two physics education outreach events in spring 2013. Our goals were to engage the minds of young children and to get them excited about science. Kids want to see physics hands on. They want to get that glimpse of how our universe works. And if we can give them that, maybe we can give them that one spark that will lead them down a life of discovering, educating and advancing our world.

It was this idea that drove us to create an outreach program. With the help of a couple very supportive professors, Dr. Markelz and Dr. Cerne, and the resources of the UB physics department we had more than we needed to get kids excited about science. After meeting with a representative, Betsy Vazquez, from the Buffalo Museum of Science we decided to get involved in their Physics Week. This is a weeklong camp for kids age eight to eleven, aimed at showing them the exciting world of science. We jumped at the opportunity and planned our first class.

Nigel Michki, Dante Iozzo and Luke Bodmer in blue UB Physics shirts from left to right, showing a levitating high temperature superconductor to children at the Buffalo Museum of Science's Physics Week.

On the day of the class we set up an array of demos in a class with roughly twenty five kids. The energy from the start was incredible. Each kid was so excited to get involved they were literally hanging on the edge of their seats. It was wonderful to see these young minds eager to learn. We worked our way through six or seven demos ranging from superconductors to an interactive Lenz's law race. Each demonstration showed the kids that physics doesn't have to be a boring subject. Behind the introductory textbooks lies a whole world of exotic, fascinating material to be learned.

Our efforts at the museum ended up attracting a bit of publicity. Soon after, we were contacted by the UB Child Care Center asking us to do a similar class for their five to eight year olds. With a bit of experience on our side we planned a presentation that started right below the Foucault pendulum. Demonstrations such as Levitrons and Van de Graaff Generators captivated the kids for about an hour. Once we had worked our way through the whole lesson it was time for the finale. We took the kids outside where Dr. Kinney used liquid nitrogen and a plastic bottle to launch a garbage can twenty feet in the air.

Dante Iozzo, Nigel Michki and Luke Bodmer talking about magnetism to children from the UB Childcare Center at their UB Children and Physics presentation. Photo: John Cerne

We can only hope that these children grow up to be the pioneers and leaders of the future. However, I think we can safely say that without experiences like this many of the contributors to physics right now may have never found their love for science. So we encourage you to engage someone today. All someone needs is a little spark of insight to set them down a path of discovery. You never know who you might inspire.

Thanks to everyone who helped. We look forward to continuing with more outreach programs in the future.

Graduate Student Outreach Program

By George Lindberg, PhD student

Another year has gone by and the graduate student outreach program is still going strong. Our second event took place on Halloween 2012 at UB with another group of 7th and 8th grade students, from Dr. Charles R. Drew Science Magnet School. We presented the structure and results of our program at the American Physical Society (APS) March Meeting in March 2013 and at the New York State Section of the American Physical Society (NYSSAPS) spring meeting, the organizations responsible for the initial funding of our program.

The Halloween event was as successful as our first event, which was in June 2012. We added some new attractions added to the mix. The physics group did some demonstrations of BOOOOOO Bubbles, hot water mixed with dry ice, produced a white vapor that filled soap bubbles, making a spooky mist when popped.

Because of the cold weather, the biology group was unable to bring their snakes again, but entertained the students with some non-Newtonian fluid. Did you know that blood is a non-Newtonian fluid? The chemistry group had everyone jumping back with their geyser-like Elephant Toothpaste!

Since we re-invited the same school as the first event, we were able to find out that word had gotten around about how

awesome the event was, and we had a parent come as a chaperone for the field trip.

Boo Bubbles! Photo: Chase Ellis

Reactions about our program at the APS meetings were positive, especially at the NYSSAPS meeting. They were ecstatic that the money they provided went to such a great program.

With that money, we have been able to purchase new equipment for the program. We now have some cool microscopic critters for the biology station to study under the microscope; some of them will even eat each other. We bought new colorful paints for the chemistry group so we can keep doing the oil and water art. And for physics we have some new emission lamps for the spectroscopy experiment, some awesome low temperature demonstrations, and a ringing bell inside of a vacuum jar!

We are gearing up for another event to be held after Thanksgiving this year. Now that all of the meetings are completed we hope to get in some more events. Dante Iozzo, honor college and physics undergraduate is aiding me in setting up this event. I am also looking for another graduate student to take over the program as I prepare to step away. This is an entirely student-run event. So, I would like to thank all of the past volunteers from biology, chemistry, and physics and welcome any new students to volunteer for the next event. Hopefully this program can really get ready to take off and we can continue having the great results we have seen. For more information please drop me an email or stop by, gpl2@buffalo.edu

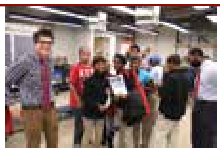
Elephant tooth paste eruption! We had to wipe the ceiling shortly after this picture was taken. Photo: Chase Ellis

College Ambassador Program

By Sean Bearden, undergraduate student and president of SPS

The new College Ambassador Program at UB was created by the College of Arts and Sciences (CAS) as part of its centennial celebration (www.cas.buffalo.edu/about/college-centennial/). The College Ambassadors are undergraduate student volunteers who serve as a liaison between the CAS Dean's Office and the community at large. Ambassadors are nominated by their departments based on academic performance and involvement in campus activities. Twenty-three Ambassadors will represent their respective departments at university events throughout this academic year. Paul Glenn and I have been selected to represent the Physics and Mathematics Departments. We hope to attract students to the Department and answer any questions they or their parents might have. We will participate in numerous events, including student recruitment, alumni and donor events, and community outreach activities. The program is led by CAS Dean Bruce Pitman and coordinated by Caitlin Barone. For more information on the Ambassador Program, please see: www.cas.buffalo.edu/students/current-undergraduate/student-ambassadors/

Physics Ambassadors Sean Bearden (left) and Paul Glenn. Photo: Jessica Smith



Banner: Joshua Kaisen, PhD student, with some of the students and a parent at the graduate student outreach event.

Famous Physicist Talks to Our Students

By Sean Bearden, undergraduate student

If I were to test friends who are not physics majors to see which living physicists they could identify by photo, I am sure Dr. Stephen Hawking and Dr. Neil Degrasse Tyson would be the top two results. But, in a close third, would be Dr. Michio Kaku. I know of him not by his work in physics, but his appearances on various programs aired on the History Channel and the Discovery Channel. He speaks with such enthusiasm on all matters of physics that it is difficult for the viewer to forget him (and his hair). I was excited to find out Dr. Kaku had been selected as the Graduate Student Choice Speaker for the Distinguished Speaker Series at UB.

Professor Michio Kaku interacting with students at his recent visit at UB. Photo: John Cerne

Dr. Kaku is the co-founder of string field theory. He also has a reputation as a futurist, authoring books such as Physics of the Future. At the Distinguished Speaker event, the subject of his talk was the technology of the near future. He believes computers will become so integrated into our daily lives that we will view them as we currently view electricity; it is everywhere around us, in the walls, under our feet, in our pockets, but we think nothing of it, virtually forgetting its existence. The computer will invade every aspect of our lives, that is, if it has not already. Dr. Kaku went so far as to suggest that all of the knowledge of mankind will literally be accessed in the blink of an eye, as we will have contact lenses which access the Internet.

Thanks to efforts spearheaded by our Society of Physics Students (SPS) Chapter and our own Nicole Mercer, a special informal meeting between Dr. Kaku and UB students was arranged. Approximately 50 students, mainly from the Physics Department, attended an hour-long Q&A session with Dr. Kaku before his Distinguished Speaker Series lecture. It was at this smaller event that more physics-related matters were discussed. Many students wanted to know more about Dr. Kaku's opinions on aspects of string theory, particle physics, and a theory of everything. I used the opportunity to ask how string theory can be tested, because its greatest criticism is that it lacks a way to be verified. He gave three suggestions: look for deviations of the inverse square law for gravity on very small length scales; search for dark matter at the Large Hadron Collider and, in the future, the International Linear Collider in Japan; and examine the Big Bang for a pre-Big-Bang era. Another student asked when will we get a true theory of everything that will not lead to another theory. Dr. Kaku admitted that this may never happen, but we should continue searching. String theory has its critics, Dr. Kaku said, but we cannot just attack a theory without providing an alternative. His challenge to the critics: If you don't like string theory, come up with something better.

Anthony J. Leggett is the Nineteenth Moti Lal Rustgi Lecturer

By Dr. Frank Gasparini

This year's Rustgi Lecture was given by Nobel Prize winner Anthony Leggett from the University of Illinois at Urbana Champaign. The title of his talk was, "What can we do with a Quantum Fluid?" Professor Leggett is recognized as a world leader in the theory of phenomena occurring at low temperature. His research spans a wide range of phenomena: superfluidity of 3He and 4He, cuprate superconductivity, superfluidity in atomic gases, amorphous solids at low temperature, topological quantum computation and the foundations of quantum mechanics. His work in these areas has been recognized in a number of international prizes in addition to the Nobel, such as the Paul Dirac medal, the Wolf Prize and the Eugene Feenberg Medal for many-body theory. He was appointed Knight Commander of the Order of the British Empire in 2004. Professor Leggett met with a number of faculty during his visit to discuss their research, and had an informal meeting with undergraduate physics majors. The lecture itself, which focused on the unusual properties of superfluids, was well attended and was followed by a lively discussion period. The department is grateful for the continued support of the Rustgi family for this lecture.

Nobel Prize winner Anthony Leggett meets with our physics students. Photo: John Cerne

Events
CONTINUED

HiggsFest
By Dr. Salvatore Rappoccio

To celebrate the wondrous discovery of the Higgs boson by the CMS and ATLAS collaborations at the CERN Large Hadron Collider (LHC), several UB physicists presented a "plain English" summary of the results to a wide audience, from small children to high-school students, from other scientists to poets to interested members of the community. This was dubbed the "HiggsFest!"

Here, the audience learned about this exciting discovery from a theoretical standpoint, and looked at the actual data collected by the CMS experiment in hands-on demonstrations. There were also demonstration stations of how particles are detected by these colossal devices, and even crafts for the younger (and sometimes even the older!) audience members.

HiggsFest draws a big crowd!

Inaugural Ta-You Wu Lecture
By Dr. Francis Gasparini

On September 30, 2013, Prof. Marvin L.Cohen presented the inaugural lecture of the newly established Ta-You Wu Lectureship fund. This lectureship was established by Prof. Y. C. Lee, a long-time colleague and close friend of Dr. Wu, and has received contributions from over 70 donors. Prof. Cohen's lecture on Condensed Matter Physics (CMP): The Goldilocks Science was well attended by members of the department, students and the public. The focus in CMP is on energies, sizes, and time scales that are not extremely big or extremely small, but somewhere we loosely call the "middle", it is an area of science that reminds us of Goldilocks. It can be argued that because of its "Goldilocks nature", CMP has many links to other branches of physics and more generally other areas of science and engineering. These collaborations with fields like electrical engineering, computer science, material science, medical science, and chemistry have led to applications that have had an extremely large influence on our everyday life. The transistor, solar battery, MRI, and other solid-state devices such as lasers, are a few of the many applications associated with this field. So it can be said that physics is the central science, and CMP, which is the largest branch of physics, is in the center of physics.

Physics at the Falls
By Drs. Jong Han and Eckhard Krotscheck

The Workshop series "Physics at the Falls", supported by the College of Arts and Sciences of UB, has been bringing exciting physics to the UB campus and raising our department's visibility as one of the leading institutions in physics research.

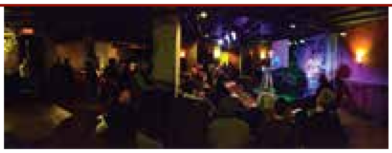
In its latest installment, the workshop "Recent Progress in Nonequilibrium Quantum Many-Body Theory", held at Davis Hall (May 16-18, 2013), had 20 invited lectures from eminent researchers in the upcoming field of nonequilibrium quantum statistics. (see http://www.physics.buffalo.edu/noneq_workshop for details) The nonequilibrium quantum many-body theory, as one of the leading research areas, investigates electron transport under strong external field with largely unexplored novel electron correlation effects. The focus was on basic formulations of far-from-equilibrium systems, fast time-resolved spectroscopy, dissipation and steady-state nonequilibrium, and realistic nanoscale device modeling.

The next workshop was held November 6-9 (2013) on "Common Challenges in Finite Fermion Systems" (see http://www.physics.buffalo.edu/Cluster_Workshop). It brought both theorists and experimentalists from nuclear physics and metal cluster physics together. 22 invited speakers from mostly the US and Europe discussed theoretical, computational, and experimental aspects of the subject matter.

Future workshops are planned on "Origins" in Dec. 2013, and "Quantum Coherent Nanostructures" and "Physics of Adsorption" in 2014. Proposals for other workshops are invited.

Events Calendar

Sept 20	Inaugural Ta-You Wu Lecture
Oct 26	Open House
Nov 6-9	Physics at the Falls: "Common Challenges in Finite Fermion Systems"
Dec 7	Holiday Party
Dec 16	Physics at the Falls: "Origins"
April 25	Annual Rustgi Lecture: SLAC Prof. Emeritus Helen Quinn
May 16	Undergraduate Commencement



Banner: The Science & Art Cabaret is already celebrating its 5th season. Created by Prof. Will Kinney it offers a unique opportunity for artists and scientists to interact with the audience in an informal setting. Visit Prof. Kinney's website at www.buffalo.edu/~whkinney/Cabaret for information about upcoming Science & Art Cabarets. Read more in www.tinyurl.com/m2lhcce.

The University at Buffalo Department of Physics Newsletter

Professor Michio Kaku with UB students after an informal discussion on physics and the future.
Photo: John Cerne

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University at Buffalo The State University of New York

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