University at Buffalo The State University of New York

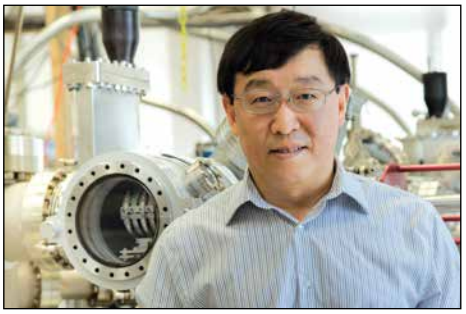
Interactions

The Newsletter of the UB Department of Physics

Volume 8, Fall 2015

It has been an eventful year since I last wrote to you. Once again, our undergraduates are our brightest stars. It is safe to say that our program can only be as good as our students, and our students certainly showed us how far we have gone. Leading the way, Dante Iozzo (physics major), Nigel Michki (physics major), and Andrew Harris (math Major) are the Outstanding Winners of the world-wide Mathematical Contest in Modeling (MCM), one of ten winners among 7636 teams from all over the globe. They presented their work "Turning the tables: modeling the fight against Ebola" in Washington DC in August. This year's academics based Sekula Scholarship had to raise the bar to a minimum GPA of 3.9, so that we can limit the number of recipients to seven, which is unheard of in the history of the scholarship. To adequately recognize their excellence as a group, the Department also awarded additional scholarships to more undergraduates. One of the Sekula Scholarship recipients, Geoffrey Faitin, received a nearly perfect score for the Graduate Record Examinations, again, a first here by a large margin and very rare worldwide. Dante Iozzo received an honorable mention for the 2015 Goldwater Scholarship. Graham P. Lyon was the Recipient of a Woodrow Wilson National Teaching Fellowship. Graduate student Mengyang Xu was awarded the SPIE Optics and Photonics Education Scholarship, and graduate students Ashley Parker and Bahareh Roohzbahani received "Guests and Visitors" grants from the Fermilab LHC Physics Center for summer 2015.

The University is in the process of revamping the General Education Requirement curriculum, an enormous undertaking, intended to bring our curriculum up to date, meeting the needs



of our students. The new curriculum is scheduled to be rolled out during the next academic year. The Department has been doing its part to make this a reality.

In January, our own Professor John Ho returned to the Department after years of being the Dean of Graduate School. One of the first things he did was to donate $154,000 to the Department, to start the endowment for The John Ho and Martha Leung Scholarship. The first round of awards went to three outstanding graduate students.

With fast-changing job markets, there has been a shift in enrollment toward Science, Technology, Engineering and Math (STEM), with corresponding financial challenges for the College of Arts and Sciences (CAS). To provide the right programs for our students, CAS, with help from the Provost Office, went through a productive process of identifying new and improved programs to meet the fast-changing student and market needs. Some of the programs will be ready for students as early as the next academic year.

This year can be considered as one for recognition. Recently, UB has hosted or has been chosen to host numerous international and regional physics meetings. This is a great recognition of the Department. Professor Hu organized the 4th International Workshop on Entanglement, Decoherence and Quantum Control in Oct. 2014. This summer, Professors Krotscheck and Gasparini organized the 2015 International Symposium on Quantum Fluids and Solids and Professors Krotscheck and Han organized the 18th International Conference on Recent Progress in Many-Body Theories. Professors Krotscheck and Gasparini also organized the workshop on Phase Transitions in Low Dimensions in November 2014. Professors Simone Marzani, Doreen Wackeroth and Ciaran Williams organized the QCD Factorization Workshop in October 2015. Professors Dejan Stojkovic and Will Kinney organized the Rust Belt Cosmology and High Energy Physics Meeting in November 2015. The successful Loopfest series of workshops is returning to UB in 2016. Professors Roppaccio and Marzani successfully put forth a bid for BOOST 2017, which will be held at Niagara Falls to be organized mainly by our own high energy physics group. BOOST is a series of successful joint theory/experiment workshops which bring together the world leading experts from theory and the Tevatron/LHC experiments to discuss the latest progress and develop new approaches to discover new physics. This is a list that will be hard to top.

This year's speaker for our Rustgi Lecture was the renowned Prof. Philip Kim from Harvard, whose work on two-dimensional materials has opened many new opportunities .

Stay in touch and share things at work and in life with us!

Best regards,

Hong Luo, Chair
Professor of Physics

Fall 2015 Feature Article

UB Physics Undergraduates leave their Mark in Research, National Competitions, and Outreach

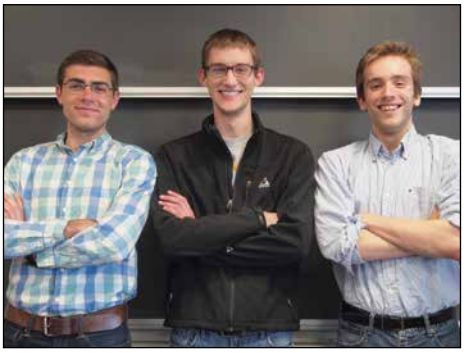
By Dr. Doreen Wackeroth

An integral and important part of majoring in physics at a research university, such as UB, is the participation in cutting-edge research. Our undergraduate students take full advantage of the opportunities offered in both theoretical and experimental research in the Department. They conduct independent studies and undergraduate research with physics faculty and very often present their work at poster sessions organized by the Center for Undergraduate Research & Creative Activities (CURCA), at the UB Celebration of Excellence, and even at national conferences. Some of the research projects result in publications in research journals, which is testimony to the high quality of the research conducted by our students. Here we highlight just a few of the recent achievements of our students in undergraduate research.

UB Senior Michael Benson has been a research student with Dr. Sen's group for the past three years, working on multimillion atom simulations involving collisions of faceted nanoparticles. This work has been in collaboration with Yoichi Takato, a former graduate student in Dr. Sen's group, and has resulted in a forthcoming paper in Physical Review E entitled "Collision dynamics of soft and sticky nanoparticles", with Michael being a co-author. Michael has presented at several poster sessions organized by CURCA. He is now preparing to study patent law.

Brett Blizzard, a mathematical physics major, started working in Dr. Zeng's laboratory in spring 2015 and has won a SUNY 4E (Energy, Environment, Economics, Education) Network of Excellence summer scholar fellowship. He is a co-author on a recently submitted paper on the growth of large area MoS_2 monolayers.

UB Senior Geoffrey Fatin has been working with Dr. Zutic and Visiting Professor Dr. Matos Abiague for the past two years on elusive Majorana fermions (MFs), particles that are their own antiparticle. While the original considerations of MFs were in the context of particle physics, in recent years there was a huge interest in exploring if it would be possible to emulate a similar behavior in solid-state systems using electronic states in materials with



The three-member team consisting of UB undergraduate students Dante Iozzo, Nigel Michki, and Andrew Harris (from left to right) was one of ten Outstanding Winners out of 7636 teams in the 2015 COMAP Mathematical Contest in Modeling.

superconducting order. MFs are neither fermions nor bosons, but instead obey non-Abelian statistics with nontrivial topological properties useful for fault-tolerant quantum computing. Geoffrey is the first author of a paper entitled "Wireless Majorana Fermions: From Magnetic Tunability to Braiding," recently submitted to Physical Review Letters (http://arxiv.org/pdf/1510.08182v1.pdf). Geoffrey was also able to use knowledge acquired in research on theoretical particle physics with Dr. Wackeroth, to show intriguing opportunities for the exchange (braiding) of MFs, the key to revealing their non-Abelian properties and implementing fault-tolerant computing. Goeffrey has excelled in research and academics, so it is not surprising that he recently received a nearly perfect score for the Graduate Record Examinations (GRE). He is now applying to graduate school.

Apart from gaining research experience at UB, our students actively seek out research opportunities outside UB during the summer break, for instance through NSF's Research Experiences for Undergraduates (REU) programs or at the Fermi National Accelerator Laboratory offered by our experimental high-energy physics group (see article on page xy). Luke Lyle (who did independent research projects in Dr. Ganapathy's and Dr. Cerne's labs) did a REU at Clemson University. Luke will present his REU work at the American Physical Society Southeastern Section Meeting in Mobile, Alabama. He studied ion transport in insulating macrocapillaries looking for a way to flexibly transport ions via a self-organizing beam propagation effect that occurs due to charge patch formation inside insulating macrocapillaries.

Sarah Freed (who did an independent research project in our experimental high-energy physics group) did a REU at the University of Arkansas. Sarah presented her work on time evolution of discord in a system of two quantum dots at a poster session at Frontiers in Optics, a conference organized by the APS and The Optical Society in October 2015 in San Jose. Eric Bigenwald, who had worked in Dr. Ganapathy's group in fall 2014 and spring 2015, spent the 10 weeks this summer at Cornell, doing research in the Materials Science and Engineering Department as part of their REU program.

Eric studied iridium oxide thin films in Dr. Darrell Schlom's lab. At the end of the program, he wrote and presented a research paper and a research talk about his work.

Fall 2015 Feature Article

Dante Iozzo (right background) and Luke Lyle (right foreground) present physics demonstrations to 7th graders from Westminster Charter School.

Dante Iozzo levitating a superconductor.

Our students not only excel in research but also on the national stage when participating in competitions such as the Consortium for Mathematics and its Applications (COMAP) Mathematical Contest in Modeling (MCM) and prestigious national programs such as the Barry Goldwater Scholarship. In the 2015 MCM competition, 7636 teams representing institutions from seventeen countries participated. The team from UB, advised by Associate Professor of Mathematics John Ringland, was one of ten teams designated as Outstanding Winners and has been selected by the Mathematical Association of America (MAA) to present their work at the MAA conference in Washington, D.C. UB's winning team members are: Andrew Harris, an aerospace engineering major, Dante Iozzo, a mathematics and physics major, and Nigel Michki, a computational physics major. At the start of the contest two real-world problems are given and the teams have 96 hours to design, construct, and test an original mathematical model to find a solution. Andrew, Dante and Nigel competed for UB this past February, developing a mathematical and computational model of the 2014 Ebola Epidemic in West Africa. The teams in the 2015 competition were also tasked with using their model to analyze the effect of the implementation of vaccines or cures. The UB team developed a mathematical model that helped to analyze the spread of Ebola and the effect of medical resource implementation. They developed a highly adjustable computer simulation that illustrated not only the interactions between cities and regions, but also the interactions on the individual level (For more information see the UB News release: www.buffalo.edu/news/releases/2015/04/072.html. In 2014 Nigel was selected a Barry Goldwater Scholar and in 2015 Dante received an Honorable Mention. Goldwater Scholars and Honorable Mentions are selected on the basis of academic merit in STEM fields and are nominated by faculty at colleges and universities nationwide. Both Nigel and Dante have extensive research experience. Nigel did research in Dr. Markelz's lab while Dante worked in Dr. Weinstein's lab and conducted research in theoretical particle physics related to the Higgs boson with Dr. Wackeroth.

We are very proud of our undergraduate student's achievements, not only in academics and research but also in their amazing engagement in outreach activities. The activities featured here are only a few examples where the students took the initiative and leadership in reaching young minds and conveying the excitement of science.

At UB's Science Exploration Day undergraduate students Tyler Barrett (right) and Johnny Hayes (left) explain the physics of sound waves and show how a ringing bell in a vacuum makes no audible noise to an audience of 7th and 8th graders from Buffalo Public Schools.

FEATURE ARTICLE CONTINUED ...

Undergraduate students Tyler Barrett, Ben Cammett, Johnny Hayes, and Dante Iozzo participated in Science Exploration Day in April 2015. Roughly 30 Buffalo Public School students from 7th and 8th grade visited Fronczak Hall and had the opportunity to explore the fields of physics, aerospace and biomedical engineering. The physics team led demonstrations that centered around showcasing physics that is not normally seen in day-to-day life, such as boiling water without heat, silencing a bell with a vacuum, and various examples of the conservation of angular momentum. Eric Borchert from the Aerospace Engineering Department led a presentation on propulsion and space travel, and had the students experiment with balloon rockets. The Biomedical Engineering Society demonstrated that electrolytes carry charge, having the students make a functioning battery from a potato. The various groups of high school students showed great interest in the physics displays in the hallways of Fronczak Hall. They eagerly listened to the explanations and were excitedly asking questions. They were very interested in the Foucault pendulum and the experiments taking place at the Large Hadron Collider at CERN. Overall the middle school students enjoyed themselves and went away with a new perspective on a possible career in the STEM fields that this outreach event was geared towards.

In January 2015, undergraduate students Sean Bearden, Dante Iozzo, Luke Lyle, and Nigel Michki hosted over one hundred 7th graders from Westminster Charter School during the annual Westminster Science Week. A diverse group of departments representing a spectrum of STEM work prepared presentations and activities for the students. The physics team presented two different themes of physics, electricity and magnetism and low temperature physics involving liquid nitrogen. They also ran a large egg drop challenge from the second floor of Davis Hall. The students were very engaged with the egg drop and the wide variety of mechanisms for saving the egg demonstrated their creativity as they explored the concepts of force and air resistance.

Thanks to the enthusiasm and initiative of our undergraduate students as well as that of our graduate students and faculty (see page 18 for more information), our Department continues to create exciting opportunities for young students to experience science.

Alumni News

Dr. Ashok Kaveeshwar, PhD 1969

By Dr. Hong Luo

Dr. Kaveeshwar at the bronze Fermi surface sculpture in our Department. Photo: Hong Luo

Dr. Ashok Kaveeshwar was born in India and received his undergraduate degree in physics from Ujjain University. He initially went to SUNY Fredonia with a scholarship, but there was no graduate program in physics. Advised by one of his professors, he joined our Department and pursued his doctorate in physics. After receiving his Ph.D. in 1969, he worked as a postdoc with Prof. Gregory Breit in the Department at the time.

In 1975, he left academic research and chose a different career path. He joined ST Systems (STX), a private firm, founded by another UB Alumnus, Sharad Tak. Ashok started as a technical project manager for a NASA project, involving satellite remote sensing, and eventually became the chief operating officer of the firm. After Hughes Aircraft acquired STX, Ashok became the president of Hughes STX Corporation. When Hughes was acquired by Raytheon, he became the senior vice president. During his years in industry, he worked with NASA, the National Oceanic and Atmospheric Administration (which was for many years under the leadership of own alumnus Tom Bogdan), the U.S. Geological Survey, Federal Aviation Administration and the Department of Defense, among many other national and international agencies and institutions.

With his vast experience in the private sector, Ashok was nominated by President G.W. Bush (and confirmed by the US Senate), as the first administrator of the Federal Research & Innovative Technology Administration (RITA), where he served until the end of Bush's presidency. Ashok has supported UB and our Department, for many years in various capacities. He served on the CAS Dean's Advisory Council since 1992, chairing it for more than a decade, and helped the college greatly in the area of philanthropy, among others. He joined the UB Foundation Board of Directors in 2004, becoming a UBF Board Trustee in 2011. With his continued support of UB, he received the Samuel P. Capen Award, the highest honor to an alumnus, in 2013. In addition, the gallery at the President's office in Capen Hall is named after him.

Attention to details is important to the level of success that Ashok has been able to achieve. On a lighter note, I had a chance to see a not-so-serious version first-hand. On one of his many trips to UB to attend a board meeting at the UB Foundation, he reserved a small car at the airport, but ended up with a van at the same price. Sounds like a good deal, but he complained to me that he was so embarrassed driving this big car, wasting a few dollars' worth of extra gas. He made sure that he got his small car during the following visit to UB a few months later.

The day after, I received a picture of him from the Development Office that has a

resolution too low for this newsletter. Ashok texted me early in the morning saying that he would be arriving in a few hours for a meeting and would have time to drop by. Rather than looking around for a photo, I took this one him here, in Fronczak!

One of the things Ashok likes about Buffalo is the weather. Don't be surprised to see him wandering in the building in winter time!

Dr. Huicheng Chang, PhD 2000

By Dr. Hong Luo

Dr. Huicheng Chang was born in Taiwan and received his B.S. in Physics from Chung Yuan Christian University in 1989. After 2 years of military service, he joined the booming PC industry as a computer system engineer for 18 months. In fall 1993, he enrolled in our Department to pursue a Ph.D. in physics. Huicheng joined my group and studied Molecular Beam Epitaxy and Optical Properties of II-VI and III-V compounds/heterostructures for lasing applications, and received his PhD degree in Physics in 2000. Whatever Huicheng did in the lab, he did it with great enthusiasm and attention. Several of us still remember him running and screaming in the hallway and down the stairs when he and fellow students observed the lasing modes in Dr. Petrou's lab from the triangular laser that he grew, fabricated and did simulations for. Huicheng was a popular TA, especially for the astronomy course, and was an active participant of many Departmental activities, especially when softball was involved.

Upon graduation, Huicheng joined Intel Corporation. From late 1999 to 2005, Huicheng was a Senior Process Engineer at Portland Technology Development of Intel. He worked on the pathfinding project of Si(Ge) epitaxy on 8" Si substrates, which enabled the strained transistor realization onto 12" Si later for 90nm technology node. He also pioneered the Spike anneal technique and developed various silicide approaches from 0.13um to 65nm node. Starting in 2006, he led the Rapid Thermal Anneal A group to support the transistor process evolution in a new era of hi-k dielectric/metal gate replacing traditional SiO2/poly system, and the introduction of multi-gate FETs for continuous transistor scaling. In 2011, he joined R&D of Taiwan Semiconductor Manufacturing Company, where he established the industry-leading R&D fabrication facility for 12" III-V MOCVD related research on new high mobility materials and transistor architectures. Now he is the Deputy Director of the Diffusion Department in the Advanced Technology Module Development division, co-leading the transistor development efforts to extend Moore's law through 7nm technology node and beyond. Huicheng has published over 30 journal and conference articles to date and holds 30 US and international patents related to advanced process technologies and transistor architecture.

Huicheng, his wife Chingyi and two daughters Allison and Julia currently live in Hsinchu, Taiwan. Allison is coming back to the US for college in less than a year, following her dad's footsteps. We look forward to hearing exciting news from Huicheng and the family!

Editor:
Dr. John Cerne

Editorial Assistant:
Tracy Gasinski

Design and Production:
Renee Ruffino and Alex Monterville

Website:
www.physics.buffalo.edu/newsletter

Contact:
Comments about the newsletter, or information about yourself for our Alumni News section, may be sent to Tracy Gasinski via email at

tracygas@buffalo.edu

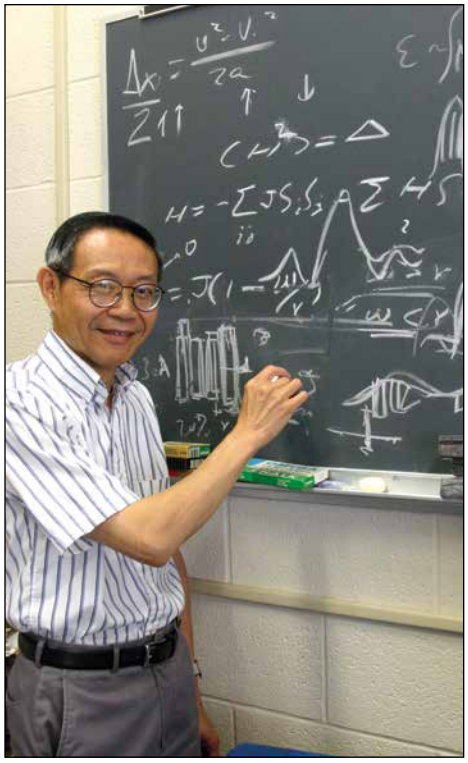
Or mailed to:

Department of Physics
University at Buffalo
239 Fronczak Hall
Buffalo, NY 14260

Faculty News

SUNY Distinguished Professor John Ho

by Drs. Bruce McCombe and Francis Gasparini



Dr. Ho at the chalkboard. Photo: Patty Wallace

After serving UB as Interim Vice-Provost, and then Vice Provost, for Graduate Education (and Dean of the Graduate School) for a total of over nine years, SUNY Distinguished Service Professor John Ho stepped down last summer to return to the Department of Physics. We are very pleased to have him back.

John has been a member of the department since 1975, when he arrived at UB as an Associate Professor in the fall of that year. He was promoted to Full Professor "with continuing appointment" (translation: "with tenure") in 1983, and in 1995 he was promoted into the highest academic ranks in the SUNY system, Distinguished Service Professor. John didn't rest on his laurels. He took this honor to heart and has continued to perform outstanding service to the department, the former Faculty of Natural Sciences and Mathematics and its (much larger) successor, the College of Arts and Sciences, as well as for the Graduate School and other offices in the upper reaches of Capen Hall and the University at large. Here are the administrative positions outside the department that John has held in addition to Vice Provost: Associate Dean of Natural Sciences and Mathematics (1983-98 with one year off in 84-85 for good behavior ☺, during which he was Dean!); Director, Interdisciplinary Natural Science Program (1984-2000); Chairman, Department of Statistics (1987-89); and Associate Dean of Arts and Sciences (1998-2000). John has also served on an astounding number of Decanal-and university-level committees, more than 130 significant committees over the past 40 years.

Last spring John received significant recognition for his continuing service at UB. He won the CISP (Council on International Studies and Programs) award for internationalization for his work in mentoring international students and his close engagement with all the major policy issues affecting international students and programs that have arisen at UB in recent decades. Soon thereafter, he was presented with the President's Medal at commencement, the highest honor the University gives for extraordinary service. Evidencing his characteristic wry sense of humor, when John found out about his nomination and the decision by President Tripathy, he sent an email to one of (what he termed) the "co-conspirators", commenting on the nomination: "…..that led to Satish's ill-advised decision to want to give me the President's Medal, thus forever lowering the standards for that award. In any case, your kindness is much appreciated." John's intelligence and humor is a hallmark of his persona and was always on display in the Department, and in the hallowed halls of the upper administration.

John is also an outstanding scientist and teacher/mentor. His research in the area of phase transitions started with the seminal work on the magnetic ordering transition of $CrBr_3$ and continued with studies of phase transitions in liquid crystals. These display a variety of different phases that can be explored by light scattering utilizing birefringence, Faraday rotation and Raman scattering. One of his outstanding achievements was the ability to study via electron diffraction few-layers of freely-suspended liquid crystals films. Properties could be determined on a layer by layer basis, and in particular, allowed for the study of a new hexatic phase in these films. Also, one of his early research efforts when he joined UB, was in the use of light scattering to study the fusion of phospholipid vesicles, and the role played by calcium atoms. John has trained 14 Masters and 11 PhD students. His research work has been recognized by a Guggenheim Fellowship and election to Fellow of the American Physical Society. As much as John has contributed to UB in his many administrative roles in what one might call a 'second phase' of his academic career, the Department has missed him as one of its outstanding researchers and teachers.

Not everyone is aware of another aspect of John's personality, that is, his breadth of interests and ability to interact personally with a diverse group of individuals. For many years John has been a member of the "Stammtisch" group of faculty (if you're not German or Austrian, you may have to look this up), who met at lunch regularly to discuss politics, philosophy and almost any topic but physics. This group represented many departmental affiliations, from Chemical Engineering to Classics. Such gatherings are an example of the tremendous possibilities for enrichment that exist at a large university like UB, but not all of us take advantage of the opportunity; John does. In spite of these remarkable positives, John has, in the opinion of one of the writers, an annoying habit: legendary

Faculty News

Drs. Martha Leung and John Ho

efficiency and NEVER being late for deadlines. And to top it off, his written documents are always models of clarity and good writing, making the rest of us look like slackers.

During the past year John and his wife, Dr. Martha Leung, have created a $154,000 endowed scholarship fund to be used for supporting graduate students. John and Martha are motivated by their appreciation of their long association with UB that has enhanced their professional and personal lives and their desire to promote further advancement of the graduate programs in Physics at UB. The scholarship with be given out yearly and will recognize outstanding unsupported students and other early-career students who have demonstrated academic excellence since joining UB Physics.

Stephen Dunnett, Vice Provost for International Education, has written, "John's quiet wisdom, innate modesty and essential decency have impressed me from the day I first got to know him nearly forty years ago." As is clear from the preceding, the Department of Physics has benefitted greatly by having a person of John's character, intelligence, breadth, quality, achievements, and unassuming demeanor as a member of the faculty for the past 40 years. His dedication to excellence in the department and at UB has been exemplary, and his presence in the department is greatly valued by all of us.

Two New Faculty Members Make UB a Powerhouse in LHC Phenomenology

By Dr. Doreen Wackeroth

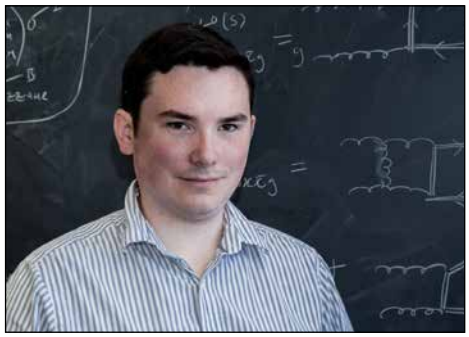
Since the start of the CERN Large Hadron Collider (LHC) in Geneva, Switzerland, in 2010 the particle physics community has already experienced the excitement of the discovery of a new particle. In 2012, the Higgs boson was discovered after decades of searches and we are currently looking forward to an era of exploration at a new energy frontier. Recognizing the unique opportunity of this new era for seminal discoveries in the field of particle physics, the UB Physics Department considerably strengthened its existing high energy physics and cosmology (HEPCOS) group by the addition of two faculty members in the field of LHC phenomenology, Dr. Simone Marzani and Dr. Ciaran Williams. Both already have an outstanding research record and together with the existing theory effort and the excellent experimental effort at UB (UB is a member of the LHC CMS collaboration), the Department is now well positioned to play a leading role in this new era of discovery.

Dr. Williams received his PhD degree in 2010 from Durham University in the U.K., was a postdoctoral researcher at Fermilab from 2010 until 2013, and held an Assistant Professorship at the Niels Bohr Institute in Denmark prior to coming to UB in January 2015. Dr. Marzani joined the UB Physics Department in August 2015. He received his PhD degree in 2008 from the University of Edinburgh in the U.K. He was a postdoctoral researcher at the University of Manchester and Durham University before coming to the U.S. in 2014 to spend one year at MIT as a fellow of the LHC-Theory Initiative. Both Dr. Williams and Dr. Marzani are recipients of this prestigious fellowship, which is funded by the National Science Foundation and awarded to promising young theorists working on LHC-related physics.

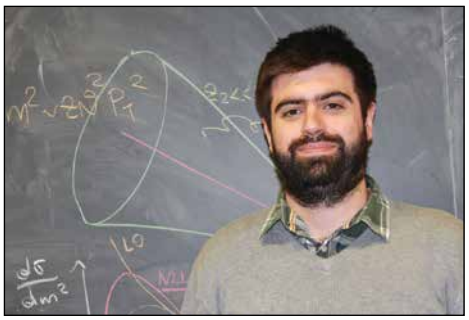
The UB high-energy theory group has a long tradition of providing precise predictions for high-energy colliders, which involves complex calculations in Quantum Field Theory and Monte Carlo generator development. Drs. Marzani's and Williams' research expertise is an excellent fit to these efforts, and provides much needed complementary expertise in this research area. Dr. Marzani is an expert in applying QCD resummation techniques to Higgs, Electroweak and jet physics, and in performing analytic QCD calculations for fundamental validation of new techniques in jet physics. Dr. Williams is an expert in performing fixed higher-order multi-loop calculations in QCD and Electroweak theory and their implementation in the publicly available Monte Carlo program MCFM. Together with the already existing expertise in LHC phenomenology (Dr. Gonsalves in QCD and Dr. Wackeroth in Electroweak theory), we are now one of the most comprehensive university groups in the U.S. in this research area. This wide breath of calculational and Monte Carlo tools as well as fundamental studies in QCD are necessary for precision measurements of Higgs properties, testing the Standard Model (SM), and the search of physics beyond the SM at the LHC. So far the SM has withstood all experimental tests but we know that it is not complete. For instance it does not include an explanation for dark matter or for neutrino masses, to name just a few open questions. The LHC enables a detailed study of the Higgs boson and the search for new particles and interactions in a new high-energy regime, and the research performed here at UB will play an integral part in this endeavor.

Faculty news continued ...

It is exciting to see how the group is growing and attracting young talent to UB to work with Dr. Marzani and Dr. Williams. They were able to hire two outstanding young postdoctoral researchers, Dr. Tobias Neumann from the University of Wuppertal (Germany) and Dr. Vincent Theeuwes from the University of Muenster (Germany), who started at UB in fall 2015. Also Dr. Williams is currently advising a PhD student Roberto Mondini, who received a Masters degree in particle physics from the University of Milan (Italy). All these new developments



Dr. Ciaran Williams, Assistant Professor of Physics, joined the UB Physics Department in January 2015. Photo: Hong Luo



Dr. Simone Marzani, Assistant Professor of Physics, joined the UB Physics Department in August 2015.

in the high-energy theory group at UB have attracted attention from the U.S. particle physics community. This was very apparent at the recent QCD factorization workshop at UB, initiated by Dr. Marzani and generously funded by Dr. Eckhard Krotscheck, the founder of UB's Physics at the Falls series. This workshop gave eleven invited world-leading QCD experts a forum to discuss the consequences of violating a principle that is the foundation of all LHC calculations (for more information see www.physics.buffalo.edu/QCDfactorization).

The LHC Run II is currently well under way and data are collected at the new energy frontier of 13 TeV. The HEPCOS group at UB (see www.physics.buffalo.edu/hepcos) is now well positioned to significantly impact the interpretation of these data.

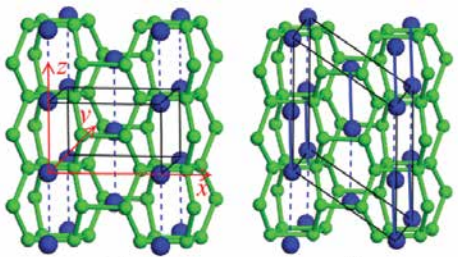
Stay tuned!

Research News

Phonon-Assisted Crossover from a Nonmagnetic Insulator to a Magnetic Metal

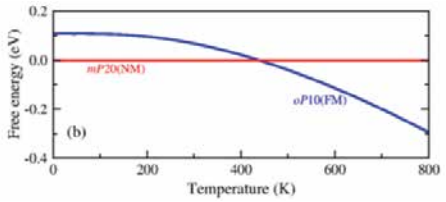
By Dr. Peihong Zhang

Transition-metal borides (TMB) continue to be a focus of intense research owing to their diverse and novel properties ranging from topological Kondo insulator (e.g., SmB6) to the coexistence of metallicity and superhardness (e.g., ReB_2, CrB_4). In the rich family of TMB, MnB_4 has a distinct position not only because of its superhardness, but it also exhibits intriguing magnetostructural behaviors that have puzzled researchers for several decades. In this paper, "Phonon-Assisted Crossover from a Nonmagnetic Peierls Insulator to a Magnetic Stoner Metal" [PRL 113, 176401 (2014)], Y. Liang, X. Yuan, Y. Gao, W. Zhang, and P. Zhang show that MnB_4 undergoes a simultaneous magnetostructural and insulator-metal transition from a nonmagnetic insulating



Crystal structures of othorhombic (left) and monoclinic (right) phases of MnB4. The blue and green spheres represent Mn and B atoms, respectively.

state with the mP20 structure to a magnetic metallic state with the oP10 structure. Such a novel phase transition has never been reported in TMBs. We demonstrate that such a phase transition is a manifestation of a strong competition between Peierls and Stoner mechanisms that governs a crossover from an electron-pairing to an electron-localization scenario in this system. This phase transition is different from a purely Peierls or Stoner picture. The phonon free energy plays an important role that ultimately drives the system toward the phase transition. Therefore, the phase



Calculated relative free energy versus temperature for the oP10 (FM) and mP20 (NM) phases, suggesting a phonon-assisted crossover from a nonmagnetic Peierls insulator to a magnetic stoner metal.

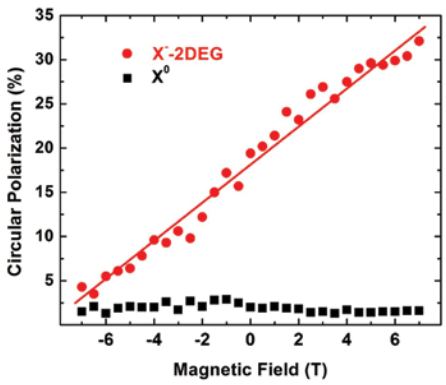
transition in this system is a result of a delicate and unique interplay among three factors, i.e., structural (Peierls) instability, magnetic (Stoner) instability, and temperature (phonon) effects. Our finding not only resolves the long-standing magnetostructural puzzle of a class of TMB but also provides a realistic system for the Peierls-Hubbard model.

Spontaneously spin polarized electrons in WS_2

By Dr. Athos Petrou and Thomas Scrace

WS_2 belongs to a class of materials known as "transition metal dichalcogenides." As bulk crystals they consist of atomic layers that are strongly bonded, while the layers are held together by much weaker van der Waals forces. Thus it is possible to exfoliate flakes composed of a small number of atomic layers. The exact number is determined by recording the vibration frequencies of the flakes using Raman spectroscopy. For our work we

used single-layer flakes because they emit light very efficiently when excited with a laser beam. In general when a material is excited with linearly polarized light at zero magnetic field the emitted light (photoluminescence or PL) is not circularly polarized. To our surprise, we found that the PL from our WS_2 samples was strongly left circularly polarized (degree of circular polarization between 20% and 30%). Furthermore, the circular polarization strongly depends on the magnitude and direction of the magnetic field which is applied normal to the WS_2 layers. This is shown in the figure. The experimental work was carried out at UB in collaboration with Professor George Kioseoglou (University of Crete, Greece). The interpretation was given by Professor Pawel Hawrylak's theory group at the University of Ottawa (Canada). The theory compares the total energy of the electrons in WS_2 for the case in which the electrons are not polarized (equal numbers of spin-up and spin-down electrons) and spin-polarized (all electrons in their spin-down state). The results is that for a range of electron densities the ground state of the system is spin-polarized. When the spin-polarized electrons participate in the recombination process, they emit left circularly polarized light. These results were presented at the 2015 March Meeting of the American Physical Society. A paper on this work has appeared in Nature Nanotechnology : "Magnetoluminescence and valley polarized state of a two-dimensional electron gas in WS_2 monolayers", T. Scrace, Y. Tsai, B. Barman, L. Schweidenback, A. Petrou, G. Kioseoglou, I. Ozfidan, M. Korkusinski, and P. Hawrylak, Nature Nanotechnology 10, 603 (2015). Work at SUNY Buffalo has been supported by Office of Naval Research.



Circular polarization of the emitted photoluminescence as function of magnetic field at a temperature of 5K.

Department of Physics Programs

Support the Department of Physics Programs

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

Physics 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, out-reach 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 outstanding faculty and 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.

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: 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 Francis Gasparini.

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.

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

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

Physics 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 percent deduction

PHYSICS PROGRAMS CONTINUED ...

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 picnics for new graduate students, activities of the undergraduate Society of Physics Students, awards for our outstanding TA's, and other needs.

Fellowship for Outstanding Graduate Students is established with departmental funds to reward students who have shown significant academic progress since coming to UB. All graduate students who enter the department without a Presidential Fellowship or Dean's Scholarship are eligible for this fellowship. We offer one or two fellowships per year.

Physics Graduate Student Memorial Fellowship is established with a generous endowment from our colleague Bruce D. McCombe, SUNY Distinguished Professor, Emeritus. This Fellowship is in memory of three former UB graduate students, Christian Meining, Yong-Jie Wang and Taeman Yeo, and is used to provide assistance to international graduate students, with preference given to Asian students and first year PhD students, who have demonstrated financial need and academic promise.

This year the Department of Physics established one new scholarship with the generous support of Dr. John Ho and Dr. Martha Leung for our graduate students:

John Ho and Martha Leung Scholarship is established with a generous endowment from our colleague John Ho, SUNY Distinguished Service Professor and his wife, Dr. Martha Leung. This annual scholarship will promote further advancement of the graduate programs in Physics at UB and will recognized outstanding unsupported students and other early-career students who have demonstrated academic excellence.

Events

2015 Rustgi Memorial Lecture

by Dr. Jong Han

The Twenty First Annual Moti Lal Rustgi Memorial Lecture entitled "Relativity, Quantum Physics and Graphene" was presented by Professor Philip Kim from Harvard University on May 8th 2015. Professor Kim, physics Ph D from Harvard University in 1999, is one of the leading researchers in the field of nano-scale low-dimensional materials. His work on quantum transport measurement on the two-dimensional graphene lattice demonstrated novel phenomena arising from the peculiar two-dimensional electron dynamics. With his pioneering works, Kim has been recognized as one of the "Scientific American 50" in 2006, and garnered numerous prestigious awards such as IBM Faculty Award in 2009, the Dresden Barkhausen Award in 2011, and most notably the Oliver E. Buckley Condensed Matter Prize in 2014, given to

Dr. M.L. Rustgi's brother, Dr. Om Rustgi and his wife Meena with Prof. Kim and physics faculty after the lecture. From left to right, Dr. Luo, Mrs. Meena Rustgi, Dr. Om Rustgi,, Dr. Kim, Dr. Han, Dr. Zutic and Dr. Hu. Photo: John Cerne

Professor Kim meeting informally with UB undergraduate and graduate students. Photo: John Cerne

the most outstanding work in the field.

The lecture, given to a full audience of UB students, faculty and the general public in 225 Natural Science Complex on the UB North Campus, entertained with the theme that penetrates modern physics, the theory of relativity and tquantum mechanics. Prof. Kim has taken the audience through the historic path that led Paul Dirac in 1928 to discover anti-particles by combining relativity and quantum theory. Discovered nearly 80 years later, graphene, a two-dimensional honeycomb network of carbon atoms, has since inspired physicists as a concrete physical realization of abstract theoretical concepts. The kinetic energy of electrons in the lattice mimics that of relativistic particles inside particle-like and anti-particle-like bands, leading to an unusually high electron velocity. Furthermore, the lab-made system can be continuously altered to achieve desired materials properties, such as gap-engineering, with the controllability which has made semiconductors one of the cornerstones in modern technology.

Graphene adds another element of fancy in its low-dimensionality. Quantum mechanical properties of many-electron systems stand out due to the heightened fluctuations unmitigated in low dimensions. Electrons swimming through the regular

Prof. Kim during his talk. Photo: John Cerne

Rustgi Lecture-Gio Kharchilava and Professor Kim. Photo : John Cerne

honeycomb-shaped carbon lattice mainly determine the quantum mechanical properties of graphene. Electrons strongly interacting with one another sometimes form collective states such as superconductivity, where electrons behave in unison, aided by quantum mechanical coherence. In three-dimensional systems with a large number of neighboring lattice sites, the quantum coherence gains stability which averages out the fluctuations due to quantum transitions. It is often in two-dimensions that such quantum phases are borderline stable with exotic properties in quantum matter. The graphene system has been a candy store for physicists in over the last decade, in which people can ask deep questions and can verify ideas through experimental facts.

Prof. Kim stressed that the extraordinary properties of graphene can lead to new electronic devices in real life. As a pure, flawless, single-atom-thick crystal, graphene conducts electricity better at room temperature than any other substance. Engineers envision a range of products made of graphene, such as ultrahigh-speed transistors and flat panel displays. Graphene is viewed as a promising next-generation electronics in industry. Prof. Kim wowed the audience by showing a US-letter sized sheet of graphene manufactured by Samsung Electronics.

The Rustgi lecture series has allowed some of the world's premier scientists, like Dr. Kim, (including 8 Nobel laureates) to tell our community about their research. The

Dr. Kim meeting with the audience after the lecture. Photo: John Cerne

Department is grateful to the family of Dr. Moti Lal Rustgi, Professor of Physics at UB 1966- 1992, for funding this public lecture series in his memory.

Two International Conferences hosted by the Physics Department

by Drs. Eckhard Krotscheck and Francis Gasparini

Two international conferences were organized and hosted by the Department of Physics in August, 2015. The International Symposium on Quantum Fluids and Solids (QFS), which was organized by Profs. Francis Gasparini and Eckhard Krotscheck as co-chairs; and, Recent Progress in Many-Body Physics Theory (RPMBT), which was organized by Profs. Eckhard Krotscheck and Jong Han. This is the first time that the Department has hosted these meetings. The conferences took place at the Niagara Falls Convention Center during the second and third weeks in August. Between the end of one conference and the start of the other, eight tutorial lectures were given targeting graduate students and young researchers. These conferences were attended by a total of over 270 scientists from all over the world.

CONTINUED ON PAGE 14 ...

Events of 2015

Undergraduate Commencement, May 2015

Accepted Students Day, March 2015

Left to right: Geoffrey Fatin, Dante Iozzo and Sean Bearden

Supervisor of Instructional Labs - Scott Whitmire

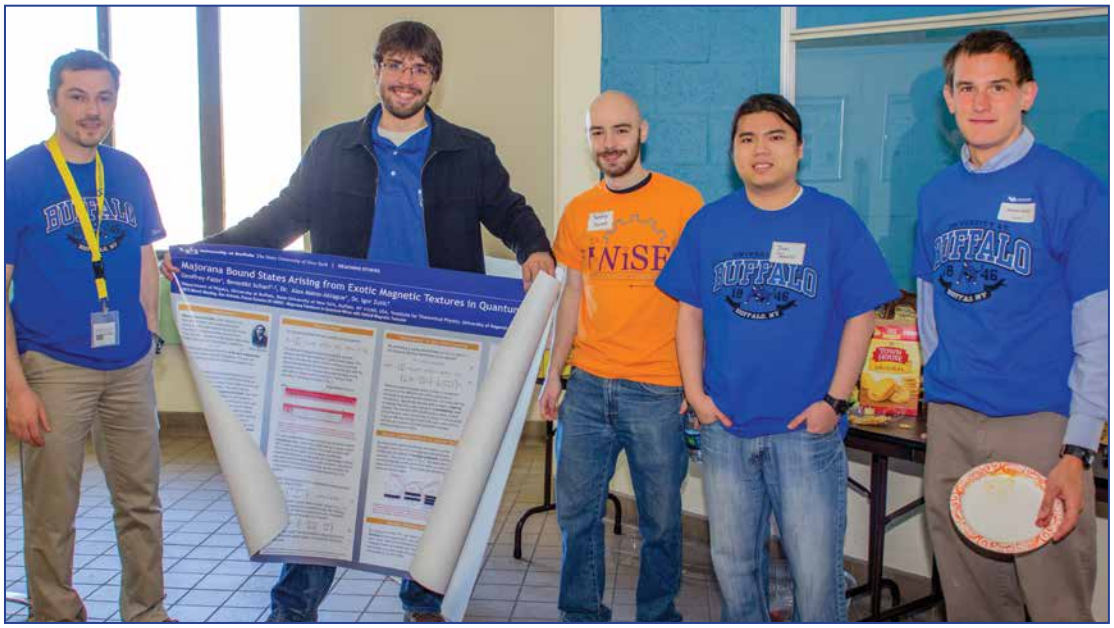
Dr. Rappoccio (left), talking about our undergraduate program

Events of 2015

Dr. Gozpinar giving a tour of the teaching labs

L to R: Anshul Saini, Dr. Rappoccio, Nargess Arabchigavkani, Dr. Wackeroth

Dr. Wackeroth (left) answering questions about physics at UB



Left to right: Dr. Gozpinar, Geoffrey Fatin, Jeremy Baron, John Truong, Nelson Gross

CONTINUED FROM PAGE 11 ...

The conferences are part of an ongoing local series of meetings and workshops called "Physics at the Falls" initiated by Eckhard Krotscheck and supported by the State University of New York through the College of Arts and Sciences of the University at Buffalo, http://www.physics.buffalo.edu/physics_at_the_falls.html .

The QFS conference started over 30 years ago and in the present format it is held every year except in years when the Low Temperature conference is held. Recent venues for the QFS were In Matsue, Japan; Lancaster, UK; and Grenoble, France. The conference covers topics of liquid and solid ^{4}He, ^{3}He, ^{3}He-^{4}He mixtures, hydrogen, trapped atomic gases, magnetism and superconductivity, strongly correlated condensed matter systems, quantum fluids as model systems for cosmology, hydrodynamics and high energy physics, and novel experimental techniques developed at low temperatures. These topics were presented in a series of 60 invited talks chosen by an international advisory committee, and a total of 200 posters, which were displayed over a period of four days. External funding for the QFS conference was obtained from the U.S. National Science Foundation, and from the International Union of Pure and Applied Physics. Proceedings of the conference in the form of refereed papers will be published in a special issue of the Journal of Low Temperature Physics with Eckhard Krotscheck, Francis Gasparini, Sambandmurthy Ganapathy and John Cerne as guest editors.

The conference on Recent Progress in Many-Body Theory (RPMBT) started in 1978 and has been held every two years, most recently in Bariloche, Argentina and Rostock, Germany. The series of many-body conferences is the forum for dissemination of new developments in frontier interdisciplinary problems. The conference covers many-body problems in quantum fluids, nuclear physics, correlated electron physics, relativistic many-body theory as well as methodological sessions on new computational techniques. Theory of cold gases has been added more recently and is covered to the extent that interesting many-body physics is involved. These topics and others were covered in a series of 50 invited talks chosen by an international Program Committee. In addition to the scientific program, the outstanding contributions to the field were recognized with two awards. Christopher J. Pethick was awarded The Eugene Feenberg Memorial Medal "for pioneering contributions and profound insights into many-body physics across diverse physical systems, ranging from ultra-cold atoms and quantum liquids to dense nuclear matter in neutron stars and stellar collapse".

Another medal, The Kümmel Early Achievement Award, was given to Dr. Lianyi He "for pioneering work in the many-body theory of QCD at high isospin density and in the simulations of gauge fields in cold atoms". At the conference there were also special sessions to honor John Clark, Washington University, St Louis; and Gordon Baym, University of Illinois, Champagne-Urbana, for their contributions to many-body theory and on occasion of their 80th birthdays. External funding for this conference was also obtained from the National Science Foundation. The proceedings of the MBT conference will be published by the IOP conference proceedings, with Gerardo Ortis (U. of Indiana) and Eckhard Krotscheck as guest editors.

MBT conference participants

The local organizing committee for the QFS conference was comprised of UB's Francis Gasparini, Eckhard Krotscheck, John Cerne, Sambandamurthy Ganapathy, Bruce McCombe, and from Cornell, Jeevak Parpia. For the RPMBT Conference the local committee consisted of Eckhard Krotscheck, Jong Han, Shigeji Fujita, Xuedong Hu, Peihong Zhang and Igor Zutic.

Events Calendar 2015

Oct 10	Open House
Nov 2-3	Physics at the Falls: **Workshop on QCD Factorization**

2016

April 15	Rusti Lecture: Joseph Incandela
May 13	Graduate Commencement
May 15	Undergraduate Commencement
Aug 15-17	Loopfest XV

The University at Buffalo Invades Fermi National Accelerator Laboratory for the summer

By Drs. Ia Iashvili, Avto Kharchilava, Salvatore Rappoccio

The second run of the Large Hadron Collider (LHC) began in the summer of 2015, producing the highest energy proton collisions ever made by humankind, at 13 Tera-electronvolts (TeV) in the center-of-

The UB Invasion of Fermilab: (from left) Prof. Rappoccio, Joshua Kaisen, Maral Alyari, Andrew Godshalk, Matthew Gordon, Joseph Pusztay, Ashley Parker, Anne Fortman, Lisong Chen, Dr. James Dolen.

mass frame. Following the discovery of the Higgs boson in 2012, the LHC experiments will now continue investigating nature at ever-smaller spatial scales to better understand the properties of the only known fundamental scalar particle. Profs. Kharchilava, Iashvili, and Rappoccio are members of the Compact Muon Solenoid (CMS) experiment at the LHC. The CMS detector can measure the trajectories of charged particles within a few dozen micrometers over a distance of 3 meters, and is read out billions of times per second. The innermost detector is a radiation-hard silicon-based pixel tracker, consisting of 66 million channels. This detector must be replaced in spring 2016 to sustain increased radiation and occupancy from higher numbers of LHC interactions in late 2016 and beyond. This provided

Upon arrival, the students were able to attend the LHC restart party at FNAL (until 4 AM). From left, undergraduate student Joseph Pusztay, graduate student Maral Alyari, graduate student Ashley Parker, postdoctoral fellow Dr. James Dolen, and Prof. Rappoccio.

a unique opportunity for graduate and undergraduate students from UB to spend a summer at the Fermi National Accelerator Laboratory (FNAL), funded by the NSF Grant "USCMS Phase 1 Upgrades". Ms. Parker was also awarded a grant from the Fermilab "Guests and Visitors" program for this work. The students assisted in the design, construction, and testing of the new pixel detector. Their responsibilities included designing the CO_2-based cooling system, testing the custom-made printed circuit boards to read out the data from the sensors, testing high-bandwidth flex cables to extract the signals from the inner device to the readout electronics several meters away, and even taking data-quality monitoring shifts from the current 13 TeV collisions at the LHC. They spent much of their time in the clean room at the Silicon Detector Facility at FNAL using cutting-edge equipment that translate directly to

UB postdoctoral fellow Dr. James Dolen (center) explains a testing procedure to undergraduate students Joseph Puzstay, Matthew Gordon, Anne Fortman and Lisong Chen in the clean room at FNAL's Silicon Detector Facility.

technology job skills. They also engaged in the larger educational opportunities at FNAL, including lecture series, conferences, and colloquia. In future summers, the construction will move from FNAL to CERN, so this team of students will continue to work on the detector at CMS in 2016 and beyond.

The students are also learning about the analysis of the data from the CMS detector. The undergraduate students, in particular, are continuing their involvement in CMS over the academic year to make several cutting-edge measurements of the properties of quantum chromodynamics (QCD) in the new 13 TeV collisions at the LHC. These studies will be submitted for publication in 2016.

Undergrad field trip to Fermiliab

by Joseph Pusztay

One of the best parts of going into physics is the fact that you're surrounded by people as motivated and passionate as you are, people who are willing to spend long nights scratching away on a blackboard, diligently working to understand a concept. Last spring, this same passion led a group of students to spend 36 hours awake, driving through the night, to tour a national laboratory. In spring 2015, nine undergraduate UB students, accompanied by Dr. Salvatore Rappoccio, visited the Fermi National Accelerator Laboratory to learn something new about high energy physics. The trip was organized by UB's Society of Physics Students Chapter. Fueled by an excessive amount of caffeine, we all gathered in the Fronczak parking lot around 1 AM to discuss the final seating arrangements in the two rental vans as Jayson Barker, a former U.S. Army Ranger, jokingly discussed how the "convoy" should react in the case of a vehicle rollover, making all involved throw their hands up and scream "rollover rollover rollover." Fast forward eleven hours and we arrived safely at the Fermi National Accelerator Laboratory.

Already being awake for 24 hours, we were driven by pure enthusiasm and excitement to finally see the site of a large collider experiment. All the arguments and frustration that had built up on our way down went to the back of our minds as we entered Wilson Hall to meet up with Dr. Rappoccio. It was here we saw the heart of US Compact Muon Solenoid (CMS). With the Remote Operations Control Center for CMS on the left, and the Control Center for the neutrino experiments on the right, one could easily get lost staring at event displays all day, but our tour guide and Professor Rappoccio ensured this did not happen as we went on to learn about the history of the laboratory.

CONTINUED ON PAGE 16 ...

EVENTS CONTINUED ...

From Left to Right: Giovanni Chiappone, Jayson Barker, Ben Cammett, Yuichi Okugawa, Michael Morse, Justin Mason, Joseph Pusztay, Lisong Chen, Ben Jeff, Professor Salvatore Rappoccio

Beginning on the fifteenth floor of Wilson Hall, we could all look out over the ring of the Tevatron and get a true sense of the size of this accelerator. A video containing music from a Soviet training film then told us about the neutrino experiments at Fermilab. Prior to this trip, none of us really knew anything about the efforts of neutrino physics. Towards the end of the trip, we got to see the Control Room with the event displays for the neutrino detectors, as well as get an explanation for how the detectors at Fermilab work with PVC piping and scintillating fluid. Although we saw many of the latest research efforts in physics, one of the most interesting aspects of our trip was getting to see some of the history as well.

After we ventured from Wilson Hall, we meandered through the lab, seeing much of the interesting architecture as well as the roaming bison, which were a strange and unexpected sight at Fermilab. This venture into the other areas of the lab was most interesting when we reached the building for the Silicon Detector Group. This building, oddly enough, has a strange dome shaped room where the roof is made out of pop cans. This room housed a bubble chamber, one of the early particle detectors, stationed at the end of one of the accelerator's beam lines. The interesting thing, and probably most exciting, was that this fifteen foot bubble chamber is now sitting on the lawn next to the building. As we learned about the pictures that the machine took we all gathered around it, inspecting the components and thinking about how particles used to be analyzed by hand. Here we took a group photo to commemorate our trip, and feel a little cool about the fact we were standing next to a massive particle detector.

Although exhausting, the trip was a huge success. We learned more about a field that isn't strictly taught in the general curriculum and caught a glimpse of new physics research. We spent the night at the lab, and by the time we got home everyone had one thing on their mind: motivation. Seeing such a massive effort all for physics bolstered the already immense passion we all have, and left us thinking "what are going to look into next?"

Faculty Awards

By Dr. John Cerne

Our own Professor John Ho received two UB awards. The first is for "Outstanding Contributions to International Education," which recognizes Dr. Ho's great contributions over many years to international education. Dr. Ho also received the President's Medal for his extraordinary service to UB. For more information on these awards, please check the following websites:

http://www.buffalo.edu/ubreporter/campus/campus-host-page.host.html/content/shared/university/news/ub-reporter-articles/stories/2015/05/ho_cisp_award.detail.html

http://www.buffalo.edu/ubreporter/featured-stories.host.html/content/shared/university/news/ub-reporter-articles/stories/2015/04/wilmers_norton_medal.detail.html

Although the competition for federal funding has become very intense, we are happy to report that several of our faculty have been awarded new grants this year. Dr. Peihong Zhang received an NSF grant titled "Speeding up GW Quasiparticle Calculations to Meet the Challenge of Fast and Accurate Materials Prediction". Awarded in May, 2015

SUNY Distinguished Professor John Ho

with duration of 36 months, this grant supports the development of several new computational techniques that will greatly improve the accuracy and speed of predicting materials' excited states properties from first-principles. Dr. Zhang and his collaborators at Binghamton and Stony Brook received a second round of funding from the SUNY Networks of Excellence – Materials and Advanced

Student Awards

FACULTY AWARDS CONTINUED ...

Manufacturing for their study of complex oxides for electrochemical applications.

Drs. Ia Iashvili and Avto Kharchilava received a 3-year NSF grant entitled High Energy Physics Research at LHC with the CMS Experiment, awarded in June 2015. The goal of this research project is to perform precision measurements of the Standard Model observables and to search for particles predicted by theories beyond the Standard Model at the Compact Muon Solenoid (CMS) experiment at the Large Hadron Collider (LHC). The LHC is a premier energy frontier particle accelerator, operating at the CERN laboratory near Geneva, Switzerland. Drs. Ia Iashvili and Avto Kharchilava also received NSF outreach grants entitled "QuarkNet", awarded October 2015. QuarkNet is a program, which provides hands-on research experience to high school physics teachers and helps them implement basic concepts of high energy physics in their classroom curriculum. Dr. Hong Luo Here received a grant from the Office of Naval Research. The grant is entitled "Synthesis and Characterization of Macromolecules for Mono-Molecular Electronics: A Preliminary Investigation" and covers the period from July 1, 2015 to June 30, 2016,

Dr. Igor Zutic was the principal investigator on "Using Spin-Polarized Carriers in Semiconductor Lasers for Optical Interconnects." The grant was from the National Science Foundation and will go from July 2015 to June 2018.

Student Awards

By Dr. John Cerne

Our undergraduate and graduate students had another successful year in obtaining awards. In addition to the internal awards listed in the table below, our students received numerous external awards.

Ph.D. students Ashley Parker (advisor: Dr. Salvatore Rappocio) and Bahareh Roozbahani (advisor: Dr. Ia Iashvili) received Fermilab LPC (LHC Physics Center) Guest and Visitors awards in spring 2015. The awards support research visits to the LPC for collaboration with other CMS members residing at Fermilab. To receive the award, the students had to write proposals of their research. Ms. Parker's proposal concentrates on searches for new particles in boosted topologies. Ms. Roozbahani's research is centered at jet energy calibrations with new methods.

Our undergraduate students had another banner year in terms of external recognition. For more information on undergraduate awards and accomplishments, please see Dr. Wackeroth's feature article on page two.

Undergraduate Awards

CAS College Ambassadors

Geoffrey Fatin
Dante Iozzo
Nigel Michki
Elizabeth Hunter
Luke Lyle

Outstanding Seniors

Sean R. B. Bearden
Graham P. Lyon

Physics Academic Achievement (undergraduate)

Nigel Michki

Sekula Scholarship Awards

Anne Fortman
Sergio Garcia
Eric Bigenwald
Syed Zain
Dante Iozzo
Ken Budzinski
Matt Gordon

Graduate Awards

Outstanding Graduate Student

Jo-Tzu Hung
Thomas Scrace

Outstanding TA

Colin Kilcoyne
John Truong

Physics Graduate Student Memorial Fellowship

Chenghao Shen
Gaofeng Xu

Presidential Fellowship

John Truong
Ruifeng Dong
Rahul Munshi
Luke Pendo
Roberto Mondini

John Ho & Martha Leung Scholarship

Ashley Parker
Chenghao Shen
Peiyang Zhang

Silvestro Scholarship

Ali Alsaqqa
Maral Alyari
Nargess Arabchigavkani
Yanting Deng
Hsuan Hao Fan
Weiwei Gao
Weixiang Jin
Jiajun Li
Tenzin Norden
Rahul Kashyap
Bahareh Roozbahani
Anshul Saini
Mehedi Hasan Syed
Bilal Tariq
Weiyi Xia
Gaofeng Xu
Xuechen Zhu

Outreach

Impacting our community

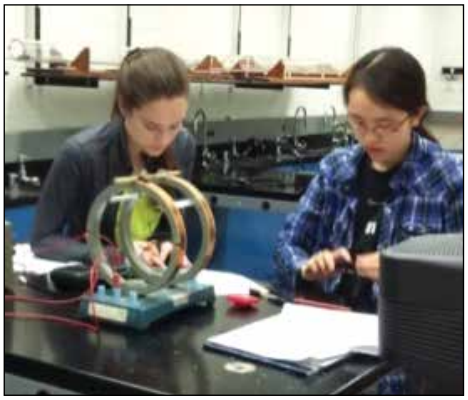
By Dr. John Cerne

Our students and faculty continued their extensive outreach activities. UB has been a member of the nationwide QuarkNet outreach program since early 2006. Mentors of the group are Profs. Iashvili and Kharchilava. The UB QuarkNet center sponsors Summer Workshops and Spring Masterclasses every year. The objective of the program is to bring local high school physics teachers and their students in close contact with the high energy physics (HEP) research. It helps teachers to develop high energy experiment related units for the high school physics curriculum. Two lead teachers, David McClary and Larry Hiller, have been with the UB QuarkNet center since its inception. During the last 9 years, the center has attracted 12 teachers from 11 different schools, including both public and private, as well as girls-only Nardin Academy.

The annual UB QuarkNet workshops are held at the Physics Department. The workshops include: presentations by the mentors; Compact Muon Solenoid (CMS) data analyses by the teachers with the help from mentors; Data taking sessions using cosmic muon detector at the Physics Department Cosmic lab and e-lab data uploads; and discussion sessions to exchange ideas about high school physics curriculum developments.

The annual Masterclass sessions take place at the Nichols High School. UB mentors introduce participating high school students to HEP and CMS. After the introduction sessions, students are divided into several groups to analyze different sets of CMS data and compare their findings. This year, students had an opportunity to study $Z \rightarrow ee$, $Z \rightarrow \mu\mu$, $W \rightarrow e\nu$ and $W \rightarrow \mu\nu$ events using the CMS event display. At the end of the data analysis session, students combined their results to measure the relative cross-section of Z/W production, the ratio of W^+/W^-, and to check lepton universality. Students, also "discovered" the Higgs boson and low mass resonances, J/Ψ and Υ. Finally, the students shared their findings and participated in discussions over a videoconference with other participating Masterclass groups from Boston and Detroit. Students found the Masterclass experience very informative about HEP and about the collaborative nature of the HEP experimental research.

Summer 2015 QuarkNet Workshop participants at the UB Physics Department.



The magnetization experiment with high school students Mychaela Navel and Sonia Chung during Dr. Petrou's "Introduction to magnetism" workshop

Dr. Dejan Stojkovic, who is able to take the most abstract theoretical concepts and make them understandable to non-experts, was asked by the Huffington post to write an article about Pluto. His article can be found at: http://www.huffingtonpost.com/dejan-stojkovic/why-pluto-will-remain-a-dwarf-planet_b_7832384.html

In November, Dr. Will Kinney organized the Science & Art Cabaret 16.0: Improvisation. This cabaret brought scientists, educators, artists, musicians and poets (among others) together to explore improvisation in freewheeling discussions and performances. This is the 21st Science & Art Cabaret to have been held to packed crowds at Hallwall's Contemporary Arts Center and other venues around downtown Buffalo since Dr. Kinney started this series in 2009 in collaboration with UB's College of Arts and Sciences, Hallwall's Contemporary Arts Center, UB's Techne Institute, and the Buffalo Museum of Science. Two more events are planned for spring 2016. For more information, visit:

http://www.hallwalls.org/science-art.php

Dr. Athos Petrou continued his outreach efforts to promote knowledge of magnetism by organizing an "Introduction to Magnetism" workshop supported by his NSF grant. The workshop was offered between July 6-10, 2015 to high school

Outreach

students of the Buffalo area. The workshop was supervised by Ms. Sandra George, who is a science teacher at the Frontier Central High School. The workshop offered an introduction to magnetic effects with a series of demos, a tutorial on the use of EXCEL for data analysis and the following experiments: a) Measurement of the horizontal and vertical components of the earth's magnetic field; b) The hysteresis on the magnetization of iron; c) The magnetic force on electrons; d) Measurement of the magnetization of a permanent magnet. In the photo we show two students measuring the magnetization of a permanent magnet. The teaching materials for the workshop are available to the high school teachers of the Buffalo area. More information can be found at:

www.physics.buffalo.edu/faculty/APetrou_outreach_2015.html

On their own initiative, our undergraduate students helped run two major outreach events, the annual Science Exploration Day and Westminster Science Week. For more information on undergraduate outreach activities, please see Dr. Wackeroth's feature article on p.2.

Workshop participants analyze data taken to simulate a mechanical analog of the Rutherford scattering experiment

UB QuarkNet teachers diagnose a CMRD counter that registers low muon flux.

ALS Ice Bucket Challenge at the 2015 Kickoff Barbeque

by Dr. Bernard Weinstein

Each August the Department of Physics hosts a kick-off barbecue picnic to welcome our new graduate students, and welcome back from summer activities our current students, faculty and staff. It is a festive event held on the Friday before the first week of classes. There is plenty of good food and beverage to enjoy, and lively conversation among the students and faculty on our expectations and hopes for what the year might bring in learning and research. The winners of several student merit awards are also announced.

The 2015 picnic took place on August 28, but this year the customary activities had a new addition. The new event might loosely be described as an experiment in thermal physics and fluid dynamics, but this would be a very loose description, indeed, and would hide its true purpose. Prior to the awards announcements, about 15 physics faculty and graduate students stood facing the gathering in the bright sunlight of the day. After a short explanation of what was to happen, they then proceeded in unison to dump buckets of ice water over their heads, completing the ALS Challenge to great fanfare of all present. This self-inflicted drenching can be seen on YouTube at:

www.youtube.com/watch?v=Y35sEFOeL5U&feature=em-share_video_user .

ALS, or amyotrophic lateral sclerosis, is a progressive degenerative disease affecting the brain and spinal cord cells that control voluntary muscle movement. There is no known cure for this ultimately paralyzing and usually fatal disease, unfortunately shared by so many including the famous physicist Stephen Hawking. The UB Physics Department, like so many other groups and individuals over the last two years, decided to take up the "Ice Bucket Challenge" in support of ALS research and care. It was done for the first time this year in honor of one of our physics Alumni who recently contracted this debilitating disease. Under different circumstances, this person would have been the first to stand in our ice bucket line. In that spirit we wish comfort in the days ahead to all who suffer from ALS, and we continue to hope for a breakthrough in the research for a cure. Perhaps next year the challenge can be extended by involving other UB departments.

Before...

…and after. Photos: Murat Mumtaz Arik

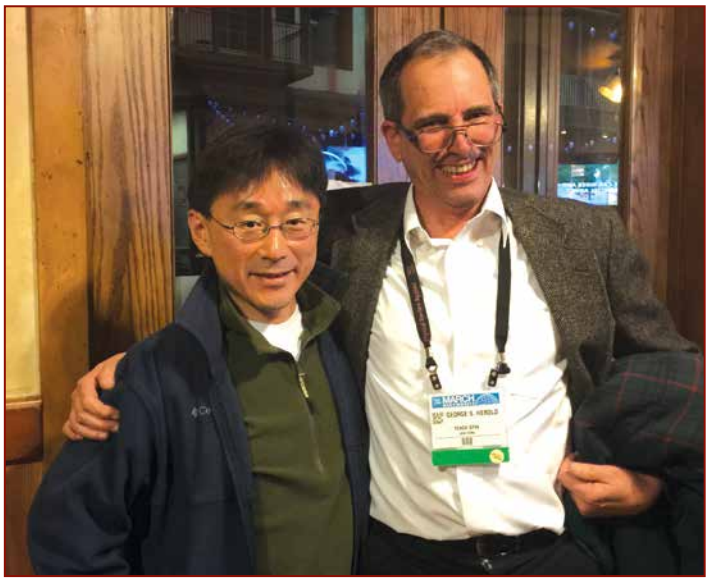
Dr. Rappoccio threatening the crowd with ice water. Photo Murat Mumtaz Arik

Drs. Ganapathy (left) and Weinstein after their ice bucket refreshment. Photo: Doreen Wackeroth

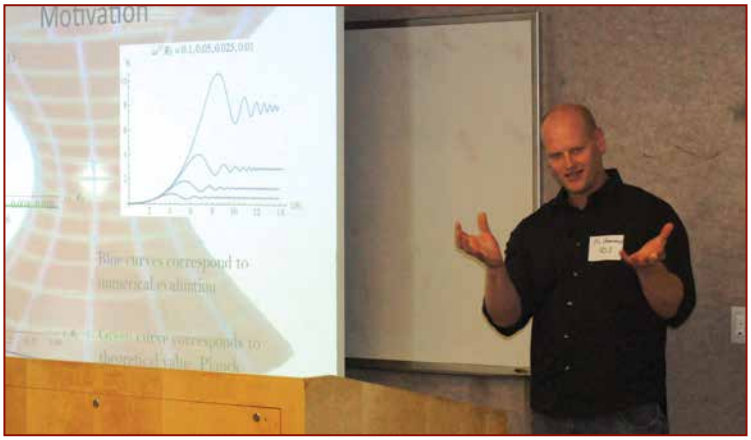
March Meeting reunion –

We thank Renee Bush for all the great photos!

March Meeting Reunion *continued*



Rust Belt Cosmology and High Energy Physics Workshop



Dr. Eric Greenwood (UB graduate, Ph.D. 2010)

UB graduate student Jia Zhou

www.physics.buffalo.edu

The University at Buffalo Department of Physics Newsletter

International Symposium on Quantum Fluids and Solids in Niagara Falls, August 2015.

INTERACTIONS

The Newsletter of the UB Department of Physics

University at Buffalo The State University of New York

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

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