University at Buffalo The State University of New York REACHING OTHERS

Interactions

The Newsletter of the UB Department of Physics Volume 7, Fall 2014

Dear alumni and friends,

Last academic year was a banner year in many ways. I might have appeared overly enthusiastic about our undergraduate program in my letter last year, proudly talking about its growth in great length and detail. But I had my reasons. Our majors have been continuously shattering our expectations. Earlier in the spring, two of our majors, Sean Bearden and Nigel Michki, won the prestigious Goldwater Scholarship. This is an extremely competitive scholarship, with most elite schools, such as Harvard, MIT and Princeton, receiving no more than two as a campus. For one department to receive two, the only two from UB and all SUNY universities, is truly extraordinary. A third student, Paul Glenn, the recipient of the Outstanding Senior Award from the Department and the College, joined UC Berkeley's graduate program with full fellowship. All these majors excelled academically and have contributed greatly in extra curriculum activities, including outreach to the community and disadvantaged kids. None of these recognitions came out of the blue. In fact, all three, among others, were featured in the last issue of our Newsletter for their achievements. Many faculty members contributed to mentoring our majors. In the case of the three mentioned above, Professors Markelz, Zutic and Gasparini, among others, devoted a lot of effort in mentoring them in research. Other awards include Golden Key Outstanding Member of the Year to John Jacangelo and Michael Dugan, MAC's Outstanding Senior Swimmer. Our graduate students also received several prestigious awards, such as Ruifeng Dong receiving the Perimeter Institute Graduate Fellowship under the supervision of Prof. Stojkovic. Yoichi Takato, under the direction of Prof. Sen, received the honor of delivering an invited presentation at the Pan American Science Institute on "Frontiers in Particulate Media," in La Plata, Argentina, with full financial support from NSF. The first winner of the graduate student fellowship established with a generous donation from Prof. McCombe was Hsuan Hao Fan. With Departmental funds, we established a fellowship for outstanding graduate students ($2000/award) earlier in the spring. The first winner is Yoichi Takato. Similarly, the first group of undergraduate scholarships from the Department will be awarded in the fall, in addition to our existing Sekula Scholarship.

Not to be outdone, physics faculty led UB in recognitions for their outstanding achievements. This year, Prof. Krotscheck became a SUNY Distinguished Professor, Prof. Weinstein received the SUNY Chancellor's Award for Excellence in Faculty Service, Prof. Kinney the SUNY Chancellor's Award for Excellence in Teaching, Prof. Markelz UB's Exceptional Scholar and Teaching Innovation Award, and Prof. Cerne the inaugural APT Teaching Award from the College of Arts and Sciences. Congratulations to all our student and faculty awardees, and also to the Committee for External Recognition headed by Prof. Sen for nominating deserving faculty members!

Earlier this year, UB went through an important accreditation process from the Middle States Commission on Higher Education. This was successful, in large part due to the newly implemented assessment programs for graduate and undergraduate programs at UB. Our Department led and continues to lead UB in this area, with great leadership from our Committees of Undergraduate and Graduate Studies.

In January this year, UB had its first winter session with a new academic calendar. Offering courses in a short period of time involved a great deal of planning and preparation, at both the University and Department levels. Our online physics courses with proctored in-person exams clearly set a standard for UB for structuring winter session offerings. Our winter enrollment was more than 22% of the University total, by far the largest among all departments on campus. The retention rate for our courses was over 95%, similar to our regular courses, and student evaluations collected at the end by UB and the Department were extremely positive. This, by any measure, is outstanding. Among others, Prof. Ganapathy contributed greatly to this success. Because of the successes in all these areas, the University and the College allocated significant amount of

Continue on page 2

Continued from page 1

much needed space to the Department to enhance our efforts in research and education.

We had a search for a high energy phenomenologist to join our faculty last year. But the first two choices were equally outstanding, which made the selection difficult. After discussions with the Dean's Office, we were able to give offers to both. I am extremely happy to report that both accepted our offers. Dr. Ciaran Williams from the Niels Bohr Institute at the University of Copenhagen will join us in January, and Dr. Simone Marzani is spending the current year at MIT and will join us this coming fall. This showed the remarkable support from the College, which is always based on the success of the faculty. With the new additions, our high energy phenomenology group will be the largest among universities in the US, which generated a great deal of buzz in this field. We are currently conducting a faculty search in the area of experimental biophysics.

There have been several successful workshops and public lectures. Prof. Kinney organized a multidisciplinary workshop called Origin, and Prof. Ganapathy organized a workshop on oxides, which attracted a large number of well-known experts in the field. Profs. Krotscheck and Gasparini secured a bid for the 2015 International Symposium on Quantum Fluids and Solids and the 18th International Conference on Recent Progress in Many-Body Theory, which is a good reflection of where the Department is on the world stage. This year's speaker for our Rustgi Lecture was the renowned Prof. Helen R. Quinn from Stanford, on a topic close to our hearts: undergraduate education.

What a great year it was! Stay in touch and share things at work and in life with us!

Best regards,

Hong Luo, Chair
Professor of Physics

Physics Majors win Two Goldwater Scholarships!

Vibrations in Proteins

By Dr. Andrea Markelz

The Markelz Group is incredibly proud of Nigel Michki receiving the Goldwater Scholarship. I first met Nigel in the Fall of 2012 when he was asking about physics demonstrations to present to local elementary schools and middle schools. It was impressive that a first semester freshman was organizing such an activity. In May 2013 I had the extreme good fortune of Nigel asking to work in my lab. Nigel's project is to develop an experimental apparatus that allows us to measure the long-range structural vibrations in proteins in the solution phase. Proteins have well defined 3D structure, like a piece of construction equipment. Like construction equipment, proteins are only able to function based on how they can move. Understanding protein motion is a major current research thrust. In my lab we have been working on developing methods to measure these motions with light. This turns out to be a challenging problem because first the color of light we need to use is in the extreme infrared and secondly the light interacts with proteins and the surrounding water and salts in a multitude of ways, making it difficult to isolate the signal coming from just the protein structural motion. Luckily my lab specializes in extreme infrared or terahertz (THz) measurements. As for the large background from all the other signals, we were able to get around this by measuring proteins in crystal form because of the difference in the way light will interact with something that is uniformly oriented (the protein) versus randomly oriented (the water and salts). Unfortunately not all proteins crystallize, and there is some concern about how the protein motions are affected by the crystal structure. Thus it would be preferable to do measurements on proteins in solution. But we would need to somehow orient the protein in solution to still remove the large background and on-

Goldwater Scholarship awardee and computational physics major Nigel Michki discussing his research on microfluidic cells with Nancy Zimpher, Chancellor of SUNY. Photo: Andrea Markelz

ly see the intramolecular protein motions.
Our strategy to orient proteins when they are in solution has been to develop microfluidic cells with electrodes so that we can align the molecules with an electric field, or a voltage. This is precisely how a liquid crystal display works. But we had a few challenges to making these cells. They need to be transparent in the extreme infrared, and in the visible range. Once materials were found that satisfied these criteria, we needed to form electrodes on these materials and produce leak tight cells. The electrodes need to be properly isolated from the solution to prevent any electrochemistry. An additional challenge is to have an AC voltage source that can go to very high biases to ensure maximum alignment. Since measurements on proteins had never been done before using such a technique, we also needed to have a method to determine whether the microfluidic cells were capable of aligning the molecules at all. This is critical to determine if a lack of signal in the optical measurements was coming from the fact that there was truly no signal from the proteins or did it indicate that the cells were not working correctly. We wanted very much to be able to use a standard to characterize the cells. Two standards came to mind: 1) visualization of the electrostatic field with dielectric rods and 2) measurements on liquid crystals.

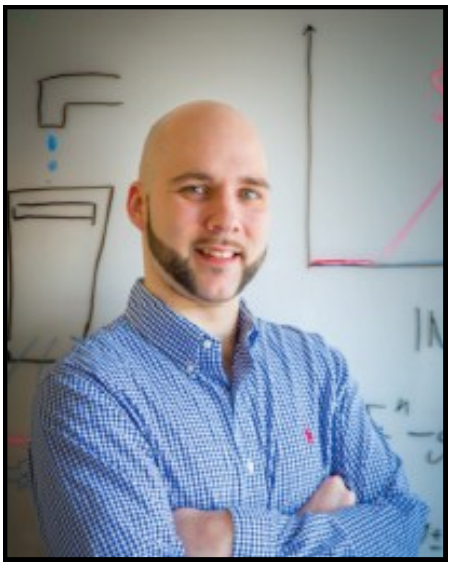
Nigel first fabricated a time varying or AC high voltage source for biasing his large solution cell. He did this in several weeks and with no previous knowledge of semiconductor electronics. Nigel set up the leak tight large electrode spacing cell. After getting both the voltage supply and cell working, Nigel then needed to set up the optical measurement to test if he was getting liquid crystal alignment. He did this, rapidly learning optics and electronics. He then learned how to use the THz optical system and did additional measurements. By week five he was already doing the optical measurements on the liquid crystals.

Nigel's initial optical measurements demonstrated that the large cells do work for the liquid crystal measurements. He then moved to visualization of the field. In introductory physics classes we demonstrate electric field lines by placing electrodes in a nonpolar liquid with a very large voltage applied. Thin needle-like dielectric material such as thread or wood fibers are then sprinkled on the fluid between the electrodes. The fibers then align along the electric field lines. We wanted to scale this down for the microfluidic cells. Nigel used a research paper that describes the manufacture of these micro rods, and the demonstration of their ability to align along the applied field. The method described in the paper used several pieces of instrumentation that are either no longer commercially available or extremely expensive. Nigel was able to make do with a home drill and a home-made impeller blade. He has had excellent success in making the micro rods with good uniformity and has demonstrated their ability to visualize the electric field lines. Nigel was invited to present this work at the "Innovative Exploration Forum: Undergraduate Research in New York State's Public Higher Education System," in Albany, NY, Spring 2014. There Nigel showcased his work to New York State legislators and SUNY administrators. He is currently attempting to apply these micro rods to determining whether or not the microfluidic cells actually do work for alignment. Nigel has already had considerable success in the development of the microfluidic cells, which ultimately will impact the understanding of protein function.

Putting Spin in Lasers

By Dr. Igor Žutić

Reflecting the Department's strong commitment to undergraduate mentoring and research, the accomplishments of our students have been increasingly recognized by outstanding publications and external awards. This year's recipients of the Barry Goldwater Scholarship awarded to UB were both Physics majors: Sean Rhett-Burke Bearden and Nigel Stephen Michki. This scholarship was established by the US Congress in 1986 and is often considered the most prestigious merit-based undergraduate award in sciences and engineering. It provides a stipend of up to $7,500 per year. Sean's path to this recognition combines academic excellence at UB, after an associate's degree from Ohio University, and impressive service activities. He was a president of the UB Chapter of the Society of Physics Students, a College of Arts and Sciences Ambassador for both the Physics and Mathematics



Goldwater Scholarship awardee Sean Bearden, in front of a bucket model of lasers. Photo: Igor Žutić

Putting Spin in Lasers *continued*

departments, and the public relations officer for UB's Combined Martial Arts Club. I have known Sean since the Fall of 2012 as his instructor for the course PHY 301, Intermediate Mechanics. He was undeterred by a challenging diagnostic test in math, welcoming students in the first class. In fact, he was the only one to solve it without any mistakes. When he expressed interest to join my research group the next semester, I was very excited. Sean has quickly immersed himself in the research on modeling a novel class of semiconductor spin lasers, working together with Jeongsu Lee, a graduate student in my group, who has recently defended his Ph.D. thesis, and Evan Wasner, an outstanding engineering student, Sean's classmate from PHY 301. This topic seemed an excellent fit as Sean is also pursuing a double-major in Applied Mathematics, to directly combine his physics intuition with advanced mathematical methods.

What is needed for semiconductors to lase? A sufficiently large number of electrons and holes should be injected. The excess electrons and holes recombine and emit photons. Under the right conditions, the emitted photons are coherent. Why would semiconductor lasers care about spin? In these processes: carrier generation, recombination, and emission of light, a careful account of the transferred angular momentum takes place. Unlike conventional lasers with an equal number of spin and down carriers, if we create a spin imbalance the net angular momentum from carriers is transferred to light that becomes circularly polarized.

To see lasers in action we use a bucket analogy (visible in the background of Sean's photo), from a recently published work in Applied Physics Letters that Sean has co-authored. Water pumped into the bucket represents the carriers and the water coming out the emitted light. For a low pumping, the water only trickles out, very little light is emitted. Now it is merely an ordinary light source: the emitted photons are incoherent. For a sufficiently strong pumping, there is an onset of an overfilling bucket signaling the lasing threshold and emitting coherent photons. To include spin, the bucket is partitioned: each half for one spin. Lasing in a conventional laser requires filling a full bucket to overflow. In contrast, with a perfect partition and, say, just hot water pouring, filling half of the bucket is enough for lasing. Such a lower pumping required for a spin-laser then gives a desirable lasing threshold reduction. Sean's work has not only explained how this threshold will be modified as a function of carrier spin relaxation, but also described intriguing advantages for a high-frequency operation of spin lasers over the conventional counterparts.

In a bigger picture, Sean's research can be viewed as an important step towards realizing spin lasers as the building blocks for high-performance optical interconnects. Communication among microprocessors will then be realized via transmission of photons, rather than using electricity through metal wires. Considering that the energy dissipation in a computer is increasingly produced not by the operation of its billions of tiny transistors, but rather the information it has to transfer back and forth between different microprocessors, the solution of the interconnects problem will likely become central to microelectronics.

Middle States Commission

By Dr. Bernard Weinstein, Director of the UGSC and *Dr. Xuedong Hu, Director of the GSC*

Every ten years the University at Buffalo is evaluated by the Middle States Commission on Higher Education for academic accreditation of its educational programs. The most recent review has occurred over the past year. The Middle States review covers both undergraduate and graduate programs. The common theme is how we assess whether we have been successful in achieving the Physics Department's goals in the education of our students at the level of the individual courses, and at the level of the overall degree programs that we offer.

Motivated by the requirements of the Middle State Review, the Physics Undergraduate Studies Committee (UGSC) and Graduate Studies Committee (GSC) have undertaken a comprehensive self-review of our academic programs that has provided the Department with an improved infrastructure for educational assessment. We developed mission statements for the degrees offered to undergraduate majors and graduate students, explicitly defined the learning outcomes that our students are expected to achieve at both the course and degree levels, made curriculum changes where necessary to advance those outcomes, and implemented systems to measure student success in achieving the new learning outcomes and completing degree goals. The learning outcomes apply to the subject matter of all program courses, and require student proficiencies that exemplify a high level of *critical thinking*, *scientific communication*, *knowledge of the laws and theory of physics*, *physics problem solving*, and *laboratory skills.* We now have a mandatory assessment by curriculum-embedded rubric questions of all the

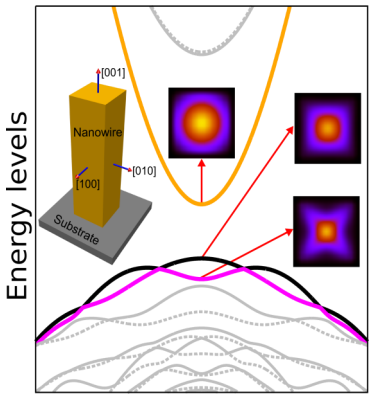
learning outcomes in our formal courses, requiring professors/instructors to quantify their self-evaluation on the effectiveness of their teaching. Based on this assessment, we have formalized an annual review of the undergraduate and graduate academic programs in which recommendations for improvements are made to the faculty when warranted. Increased coverage of scientific communications was implemented in several undergraduate courses, and graduate students beyond the second year undertake a joint annual review with their research advisor to help communicate and clarify mutual expectations and progress.

The academic assessment plan set up by the Physics Department was recognized by UB for its compliance to the high standards of the Middle States Commission and its practicality of implementation. The physics plan was one of a handful of other department plans chosen for presentation at a UB-wide Assessment Workshop prior to the visit of the Middle States Commission review panel on March 31, 2014. This visit and review had a very successful outcome. UB's accreditation was strongly endorsed. The Department of Physics was happy to play a leadership role in this success.

Northern Exposure: Brazilians in Buffalo

By Dr. Igor Žutić

Buffalo is becoming a popular destination for Brazilian physicists. An added benefit is a complementary research expertise at the UB Physics Department. Arriving to UB in 2012, Professor Guilherme Matos Sipahi, from the University of São Paulo (Institute of Physics, São Carlos) spent a two-year sabbatical with the group of Igor Žutić. This fruitful collaboration has also paved the way for the current one-year stay at UB of Paulo Eduardo de Faria Junior, Guilherme's Ph.D. student. Advised by renowned physicists J. R. Leite and R. Enderlein at São Paulo, Guilherme has acquired the expertise in developing computational electronic structure methods for semiconductors. Eager to learn new tools at UB, he has also used *ab-initio* studies and published two articles on graphene spintronics. Desirable spin-dependent properties of graphene may enable seamless integration of memory and logic. Guilherme is now an adjunct faculty at the UB Physics Department.



Nanowire band structure and probability densities.

Trained by Guilherme in developing computational models of semiconductors, Paulo had a smooth transition to UB. With Dr. Jeongsu Lee, who recently graduated in Igor's group, Paulo continued to extend Guilherme's work on microscopic gain calculations in spin lasers. Paulo gave a related invited presentation at the 2014 SPIE conference in San Diego and has just written with Igor News & Views article for Nature Nanotechnology on recent advances in spin lasers.

Left to right: Jeongsu, Benedikt, Guilherme, Paulo, Alex. On the top, Igor. Photo: Igor Žutić

Guilherme's and Paulo's expertise with semiconductor nano-structures of different crystallographic structures makes it possible to consider the following intriguing topics. On one hand, they are exploring desirable optical and spin-dependent properties of nanowires for novel devices. On the other hand, such nanowires are also suitable systems to detect elusive Majorana fermions which are their own antiparticles. This second effort matches well with the current activities of Drs. Alex Matos Abiague and Benedikt Scharf, postdoctoral researchers working with Igor.

Hoping that another winter in Buffalo will not disappoint, more Brazilian physicists are expected. Tiago de Campos, another Ph.D. student from Guilherme's group, may arrive to UB in February. It remains to be seen if he will follow Paulo's approach of growing long beard (obscured by his yellow jacket) to stay warm.

Alumni News

Dr. Joseph D. Szustakowski, B.S. Physics 1995

By Drs. Joseph D. Szustakowski and Hong Luo

Dr. Joseph D. Szustakowski graduated Magna Cum Laude from UB in 1995, with a B.S. in Physics and a minor in Mathematics as a member of the UB Honors Program. After UB, Joseph went on to study Biomedical Engineering at Boston University (BU) as a Dean's Fellow. While at BU, Joseph worked in the emerging field of Bioinformatics, with an emphasis on the study and comparison of three-dimensional protein structures. Dr. Szustakowski completed his Ph.D. in Biomedical Engineering in 2003.

During his graduate studies, Joseph also worked as a consultant for Compaq Computer Corporation's Cambridge Research Laboratory (CRL), where he served as a member of the Genome Analysis Group responsible for the annotation and analysis of the first draft of the Human Genome. Joseph is especially proud of this work, as the sequencing of the Human Genome has catalyzed significant advances in genetics, molecular biology, and medicine in the decade since its completion. The Human Genome was first reported in the journal Nature[1] where – true to form – his last name was mis-spelled!

In 2003 Joseph joined the research division of the Swiss-based multinational pharmaceutical company Novartis. His initial research efforts were directed toward mining the human genome and high throughput molecular biology datasets to discover and characterize novel drug targets. Since 2003, Dr. Szustakowski has held positions of increasing responsibility and led several global project teams.

Joseph began working in early clinical trials for Novartis in 2008, and is currently the Associate Director for Marker Data Sciences in the Translational Medicine Department. He leads an international team of nine Ph.D. scientists that applies Next Generation Sequencing (NGS) technologies to understand the genetic causes and mechanisms of disease, and to help identify patients most likely to benefit from specific therapies. The team recently discovered a novel genetic mutation that causes Focal Segmental GlomeruloSclerosis (FSGS) – a rare, inherited renal disorder[2]. This discovery sheds new light on the molecular pathology of FSGS and will aid diagnosis.

Since his time at UB, Joseph has authored more than twenty peer-reviewed papers and two book chapters. He currently lives with his wife Dr. Renee Lansley (B.S. History and Women's Studies, UB 1996; Ph.D. Women's History, Ohio State University 2004) and two boys in the suburbs of Boston.

1. The International Human Genome Sequencing Consortium. Initial sequencing and analysis of the human genome. Nature, 409 (6822):860– 921, Feb 15 2001.
2. Boyer, S. Woerner, F. Yang, E. J. Oakeley, B. Linghu, O. Gribouval, M.-J. Tete, J. S. Duca, L. Klickstein, A. J. Damask, J. D. Szustakowski, F. Heibel, M. Matignon, V. Baudouin, F. Chantrel, J. Champigneulle, L. Martin, P. Nitschke, M.-C. Gubler, K. J. Johnson, S.-D. Chibout, and C. Antignac. Lmx1b mutations cause hereditary fsgs without extrarenal involvement. J Am Soc Nephrol, May 2013.

Tim Ritter, Ph.D. 1997

By Dr. Bernard Weinstein

Among the many notable alumni of the University at Buffalo Department of Physics, Tim Ritter stands out for the scope of his achievements in education, in research involving undergraduates, and in his service as an officer in the US Navy Reserve. Tim is a Professor in the Department of Chemistry and Physics at the University of North Carolina Pembroke (UNCP). He was both an undergraduate and graduate student at UB, earning the B.S. (1989), M.A. (1996), and Ph.D. (1997) degrees from our Physics Department. He did his Ph.D. research in Dr. Weinstein's group, studying the effects of high pressure on deep levels and band offsets in optoelectronic materials. Tim was appointed to the UNCP faculty in 1996; he rose through the ranks in his department to Full Professor in 2007. During 1997-99 Tim worked as a NASA Summer Faculty Fellow at the Marshall Space Flight Center. As a result of

Alumni News

Dr. Tim Ritter – UNC professor, award winning educator, Navy Reserve Commander.

this interaction, he developed and now directs a unique NASA-sponsored STEM education program at UNCP. In this program, undergraduate teams, "The Weightless Lumbees", carry out microgravity experiments of their own design while flying in parabolic (near zero-gravity) trajectories on a NASA KC-135A aircraft. Tim has so far directed seven teams of Lumbees in this highly successful program. Recent team projects include studies of enzyme reaction rates and of fluid kinematics in microgravity. Tim's outstanding achievements in education, inside the classroom as well as outside, have been recognized both state wide and at his university. He received the UNC Board of Governors Award for Excellence in Teaching in 2013, and won the UNC Pembroke Outstanding Teacher Award in 2004 and 2009.

But, the scope of Tim's achievements extends far beyond the limits of the UNCP campus. Since 1998, Tim has served in the United States Navy reserve as an Intelligence Officer and a Federal Law Enforcement Officer. He is a veteran of Operation Enduring Freedom, stationed overseas in Iraq

Dr. Tim Ritter during his graduate student days.

Photo: Bernhard Weinstein

in 2009-10. He currently holds the rank of Commander. Tim's successes in all these endeavors reflect our recollections of him as a graduate student. He was known as one of our best teaching assistants, excelled in his research, and was a leader in many graduate student activities that enriched the esprit de corps in our Department. The photograph of Tim above is from his graduate student days. The UB Physics Department is rightly proud of Dr. Tim Ritter. We celebrate his outstanding achievements, and wish him continued success in the future.

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Alumni News

In Memoriam: Dr. Christian D. Gøthgen, Ph. D. 2010

By Dr. Igor Žutić

Dr. Christian D. Gøthgen, employed at Buffalo Pharmacies, and a former PhD student in the Department of Physics, died at the age of 49 on August 19, 2014 after a tragic accident while sailing in Lake Ontario, near Olcott Harbor. Christian was a very experienced sailor, but in windy conditions his high-performance single-man sailboat flipped over and struck him. He is survived by his parents Alice and Dr. Svend Gøthgen, and two younger brothers Niels and Peter.

Christian was born on May 20, 1965, in Aarhus, Denmark. He moved to Buffalo in 1978 when his father accepted a position as a neurologist. After undergraduate studies in Physics at UB, Christian completed a B. Eng. at the renowned Aarhus University in Denmark in 2004. The next year he enrolled in PhD studies at UB, obtaining PhD in 2010. He was the first student in the group of Professor Igor Žutić in the Department of Physics, working on a novel class of semiconductor spin lasers. While conventional lasers are ubiquitous devices used in DVDs, optical communication, medicine, art, and military, they are oblivious to spin. In his research, which combined his skills and curiosity as a physicist, as well as an engineer, Christian systematically elucidated how spin degrees of freedom can improve the performance of lasers, as compared to their conventional (spin-unpolarized) counterparts. His findings have provided an important foundation for the subsequent work on spin lasers in the group of Professor Žutić, including the research of Sean Bearden, 2014 recipient of the prestigious Goldwater Scholarship. Christian's PhD dissertation entitled "Steady-State Analysis of Semiconductor Spin Lasers," combines traditional research in lasers and the emerging field of spintronics, recognized by the 2007 Nobel Award in Physics. However, unlike commercial spintronic applications, such as magnetic read heads in computer hard drives, and magnetic RAM, the principles of operation of spin laser offer novel opportunities that are not limited to magnetoresistive effects. Following his PhD defense, Christian remained connected to UB and joined the experimental group of Professor Bernie Weinstein, working on semiconductors. Christian continued to publish articles on spin-lasers, including an influential 2012 Physical Review B article on the mapping between quantum dot and quantum well lasers, chosen as the Editors Suggestion and highlighted in a Viewpoint article for the online journal Physics.

Christian enjoyed challenges and was eager to overcome the usual boundaries between theoretical and experimental research. Working on theoretical models of spin lasers he had a keen interest to envision what it would take to implement them in practice. His remarkable engineering skills brought some other peoples' dreams within his grasp; close to the top of his to do list was making an airplane. A job interview took him to the 4,200 meter high summit of Mauna Kea in Hawaii, housing one of the world's largest astronomical observatories.

He will be remembered by those who worked and interacted with him, not only as a dedicated researcher with unwavering curiosity, but also as a caring and supportive friend, disarmingly honest, seldom seen in today's competitive world. We will miss him.

Staff News

Retiring Staff: Christine Gleason

In spring 2014 Christine Gleason retired after joining the Physics Department in the fall of 2007. Christine will probably be most thought of for her successful preparation of the Department's annual events and

important markers. These include the Welcome BBQ for graduate students and their guests, the Holiday Party, the Moti Lai Rustgi Lecture, the Qualifier Examination, scientific workshops and the Open House to name a few. She played a vital role in the planning of retirement parties and any other special event the Department had to organize.

In 2013 she became the liaison for the UB State Employees Federated Appeal (SEFA) Campaign for the Community and took the initiative to plan a bake sale on Halloween to raise funds. This was the first fundraiser our Department had hosted in the 35+ year history of the Campaign and provided a way to make a meaningful contribution to charitable organizations. Faculty, graduate students and staff participated by baking and buying baked goods and the Department plans to make this an annual fundraiser. Since retiring, Christine has enjoyed spending time with her grandchildren, remodeling and redecorating her home, and traveling.

New Staff: Tracy Gasinski

The Physics Department welcomed a new staff member in summer of 2014. Tracy Gasinski is the Department's new Research Foundation Secretary and Special Events Coordinator. She filled the position vacated by Christine Gleason's retirement. Tracy is a 1995

graduate of Buffalo State College where she received a Bachelor of Arts in Elementary Education and a 1992 graduate of Niagara Community College where she received an Associate of Arts in Liberal Arts.

After graduating, Tracy worked as an Administrative Assistant for 17 years at the Double Tree by Hilton in Amherst, New York. She managed daily office operations, oversaw the reception area, composed reports, and handled all incoming and outgoing correspondences. She planned and executed corporate meetings, luncheons, and special events and negotiated contracts with vendors. Tracy also started an Adopt a Highway program to help showcase Double Tree's involvement in the community. Tracy will be assisting with the Department's special events, newsletter, dossiers, and teaching evaluations.

Tracy loves traveling, especially cruises. She also enjoys reading, spending time at the family cabin in Cuba, New York, and being "Aunt Tracy" to her nieces and nephews.

Research News

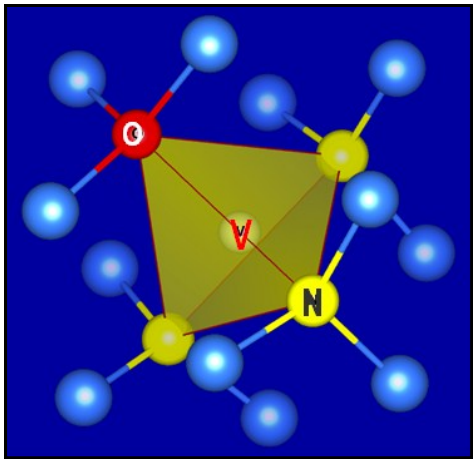
Theory of Oxygen-Boron Vacancy Defect in Cubic Boron Nitride: A Diamond NV^- Isoelectronic Center

By Dr. T. A. Abtew, W. Gao, X. Gao, Y. Y. Sun, S. B. Zhang, and Dr. P. Zhang

A successful transition from a transistor-based computing paradigm to quantum computing requires identifying systems with desired properties such as having a long quantum coherence time and being scalable. In this regard, the negatively charged nitrogen-vacancy (NV^-) center in diamond, with its unique spin and optical properties, has emerged as a promising solid system for quantum information applications. The promises of the NV^- center have inspired unprecedented research interests in optical manipulations of defect states, and have fostered the search for alternative isoelectronic defect systems.

Using density functional theory based first-principles electronic methods, we predict a diamond NV^--like color center in c-BN. This defect center consists of a substitutional oxygen and an adjacent boron vacancy, $O_N - V_B$ (shown in the figure), and displays most of the interesting properties found in the NV^- center, thus providing a potentially low-cost alternative to the diamond NV^- center. This work has been published in Physical Review Letters [PRL 113, 136401 (2014)].

This work is supported by the U.S. Department of Energy under Grant No. DE-SC0002623 (Modeling of defects for electronics applications) and by the National Science Foundation under Grant No. DMR-0946404 (Excited states of materials).



Structure of an $O_N - V_B$ center in c-BN.

Tuning Magnetic Order by Doping

By Dr. Hao Zeng and Hongwang Zhang

Magnetic order arises from regular arrangement of magnetic moments. The quantum mechanical origin of such spontaneous arrangement is the exchange interactions between electron spins. The simplest magnetic order is ferromagnetism, in which all electron spins are aligned parallel to each other. We owe many of the modern technologies to ferromagnets. For example, the continuous improvement in magnetic properties of thin films has helped to keep the increase of data storage density in hard disk drives for over fifty years. The increase in energy density in permanent magnets has enabled lighter and more powerful motors and generators used in, e.g., electric cars and wind turbines. Most of the strong permanent magnets contain rare earth elements (try removing the NdFeB magnets from my office door). Presently, rare-earth-free permanent magnet is a hot area of research due to the potential disrupted supply of rare earth materials and the huge environmental cost associated with mining.

Magnetic order is by no means simple: the often competing interactions can lead to many different types of spin arrangement. Antiferromagnetism (antiparallel or canted alignment of spins), ferrimagnetism (antiparallel or canted alignment of spins with different magnitudes), helimagnetism (spins arranging themselves in a spiral pattern) and spin ice (the spin arrangement having no single minimum due to geometrical constraints). While antiferromagnetic order is less useful in permanent magnets, it is very important in data storage. In the read head of a hard disk drive, an antiferromagnetic layer is used to stabilize the domains in the ferromagnetic layer against thermal fluctuations.

Therefore for broader understanding of magnetism and for development of novel magnetic materials, it is interesting to investigate if the magnetic order can be tuned by engineering the material composition. In a recent paper [NANO LETTERS 14, 3914 (2014)], we reported the synthesis of a new magnetic nanomaterial by substitutional doping of an antiferromagnetic material called ferroferriborate (Fe_3BO_5). Fe_3BO_5 is known to be antiferromagnetic with an ordering temperature of about 110 K. We used high temperature organic solution phase technique to synthesize highly crystalline, cobalt doped ferroferriborate ($(Fe_{1-x}Co_x)_3BO_5$) (x = 0–0.2) nanorods. These nanorods form due to the anisotropic growth along twin boundaries of the multiply twinned na-

noparticle nuclei. We demonstrated that incorporation of a moderate concentration of Co cations into the antiferromagnetic host nanoparticle greatly enhanced the magnetic properties, changing its behavior from antiferromagnetic to ferrimagnetic. Figure c shows that $(Fe_{0.9}Co_{0.1})_3BO_5$ nanorods exhibit magnetic hysteresis at room temperature. Moreover, the magnetic ordering temperature of $(Fe_{0.9}Co_{0.1})_3BO_5$ nanorods is determined to be 560 K, as measured from the magnetic moment *vs* temperature curve (Fig. c inset). This value is 400% higher than that of Fe_3BO_5 and is the highest ordering temperature ever reported in any magnetic ludwigite system.

Our work suggests that doping in nanoscale materials can modify the magnetic interactions dramatically. This is not only scientifically interesting, but may also provide an attractive avenue to develop novel nanomaterials for magnetic applications. The material system we developed is among the rare examples of anisotropic nanomaterials demonstrating above room temperature magnetism. A potential application is to use these nanorods as labels for the study of mechanical properties of biomolecules, by exerting a force or torque via the application of a magnetic field. Our system should have greater advantages over existing isotropic, micron-sized magnetic beads by having a stronger response to the external field without distorting the intrinsic behavior of biological systems. The coauthors of this paper are Shuli He, Hongfei Cui, Chenguang Yang, Kai Li from Capital Normal University in China, Hong Wang Zhang, Hui Xing and Hao Zeng from the University at Buffalo, and Shouheng Sun from Brown University. The work at UB was supported by NSF DMR1104994 and the SUNY Energy, Environment, Education and Economics (4E) Network of Excellence grant.

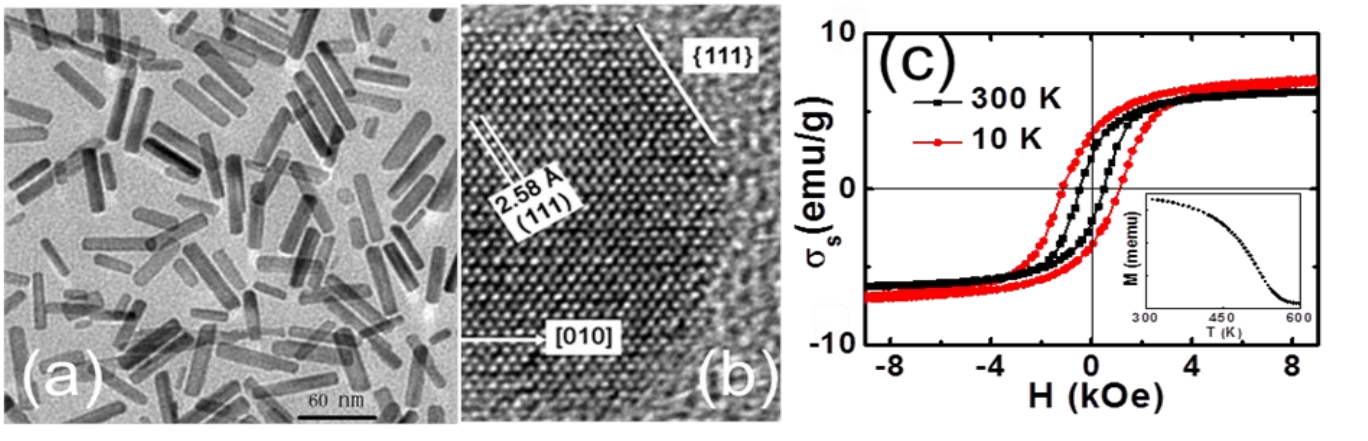
Strong Push for Electrons

By Dr. Jong Han

When a quantum particle is pushed by a force and navigates a channel filled with fellow particles, how will it behave? Such questions are among the central questions of materials physics from the time even before quantum mechanics. Conventional solid-state description tells us that, with help from band structure theory and the Pauli exclusion principle, physicists could explain the electronic behavior in solids for the last century. It was because that usual physical external electric-field in solids is much weaker than that an electron feels from the atomic environment, and an extrapolation of zero-field properties (i.e, equilibrium) of the materials were sufficient to predict electron transport. In the last decades, the situation has changed significantly with nanotechnology – the external fields can now create electronic energy comparable to other energy scales in solids, and the previous extrapolated reasoning from equilibrium (i.e., linear response theory) is no longer reliable.

Dr. Jong Han and his collaborator, Dr. Jonathan Bird (Electric Engineering at UB), tested the question in quantum point-contact (QPC) devices, one of the most basic elements in quantum electronics. The device is made of AlGaAs/GaAs hetero-structure with the interfacial two-dimensional electron gas (2DEG) with the electrons made to pass through a nanoscale constriction -- an analog of the single-slit experiment for electrons (see the inset figure for illustration of the device). The nanoscale constriction creates quantized modes inside the channel and the famous conductance quantization occurs. Dr. Bird's group applied a voltage bias much greater than the other electronic energies such as the 2DEG's Fermi energy and the energy splitting of the bands.

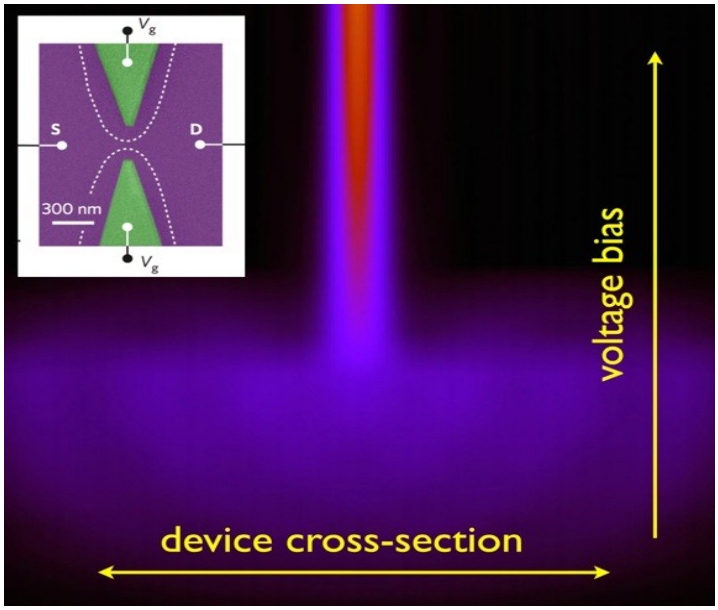
Continued on page 12



Physics Programs

Research News *continued*

Electron transport in such extreme nonequilibrium is poorly known. To everyone's surprise, the conductance approached the universal limit, $G_0 = 2e^2/h = (13.7\ \text{kOhm})^{-1}$, as if electrons pass the constriction only through a single quantized mode although there are seemingly hundreds of modes available inside the bias window. The team published the finding and a theoretical scenario in Nature Nanotechnology, vol. 9 101 (2014).



The puzzling electronic behavior can be reconciled by assuming an attractive electron-electron interaction mediated by lattice vibrations. When electrons are put through the constriction they tend to attract each other strongly, and the calculations show that, after a critical value of the bias, the electrons abruptly form a filamentary path. The width of the filament can be much narrower than the nominal constriction and the quantization gap becomes much wider, therefore, exceeding the applied bias. (See the figure. As the bias grows the calculations show the electron density spontaneously form a narrow path after a certain bias.) In a rough human analogy, imagine a room packed with random people, and suddenly they are pushed to exit through a door. What is the best strategy for the most efficient exit? One might say the solution is to form a single line, avoid unnecessary collision and get out in an orderly manner. Well, electrons might have a similar idea.

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, 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 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.

Physics Programs

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 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.

This year the Department of Physics established the following two new fellowships for our graduate students:

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 E. McCombe, SUNY Distinguished Professor. This Fellowship is in memory of two former UB graduate students, Yong-Jie Wang and Taeman Yeo, and will be 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.

The second annual Ta-You Wu lecture on September 25th, 2014 was presented by Professor Gordon Baym, (University of Illinois at Urbana-Champaign) titled "Quarks and cold atoms: From the hottest to the coldest places in the Universe." This annual lecture was free and open to the public.

Events

Organizers of the WiSE orientation event. Pictured from left to right in the first row-Matthew Westley, Yanting Deng and Tom Scrace. 2nd row -Dr. Andrea Markelz, Dr. Doreen Wackeroth, Dr. Ia Iashvili and Dr. Surajit Sen.

Photo: Tracy Gasinski

Women in Science and Engineering Orientation

By Drs. I. Iashvili, A. Markelz, D. Wackeroth

WiSE (Women in Science and Engineering) is a new program launched by the College of Arts and Sciences and the School of Engineering and Applied Sciences in Fall 2014. The program aims to attract female students to STEM (Science, Technology Engineering and Mathematics) fields, and to enhance and support their professional development and persistence towards becoming scientists and engineers.

An inaugural WiSE activity took place a week before the beginning of the Fall 2014 semester. Participating female freshmen and their parents were welcomed by the deans of the CAS and SEAS at a dedicated orientation meeting. This was followed by various activity sessions throughout the campus laboratories. The activities were meant to share the excitement of scientific research, give a glimpse in a typical day of a scientist's life, and present the wide range of research opportunities available at both undergraduate and graduate levels in the STEM fields at UB. Students were divided in small groups to participate in several assigned lab tours, selected from a total of 16 activities offered, which were carried out during two days.

The Physics Department was represented by four sessions: "Light Emission from Nanostructures" by Dr. Petrou's graduate student, Thomas Scrace; "Biophysics lab demo" by Dr. Markelz's graduate student, Yanting Deng; "The Pleasure of Finding Things Out - The Discovery of the Higgs Particle" by Dr. Iashvili and Dr. Wackeroth; and "Foucault Pendulum" demo by Dr. Sen's student, Matt Westley. Each of these activities were presented to two groups of 5-10 female students. Based on their feedback, students found the activities useful in providing information about academic and research opportunities, and in facilitating connections with their peers.

The WiSE program has several planned upcoming events with more research-oriented components, group projects, seminars, and outreach events planned throughout the year in which the Physics Department will play an integral part. More information about the program can be found at www.cas.buffalo.edu/students/student-programs/wise/. We hope that by adding this program to our outreach activities, we will increase the diversity of our undergraduate majors, as well as encourage young women to pursue careers in STEM fields.

Events Calendar

2014

Sept 25	Inaugural Ta–You Wu Lecture
Oct 18	Open House
Oct 22-24	Physics at the Falls: The 4th International Workshop on Entanglement, Decoherence and Quantum Control
Nov 12-14	Physics at the Falls: Phase Transitions in Low Dimensions
Dec 6	Holiday Party

2015

May 15	Graduate Commencement
May 17	Undergraduate Commencement
Aug 9-15	International Symposium on Quantum Fluids and Solids: QFS
Aug 16-21	International Conference on Recent Progress in Many-Body Theories

Events

Moti Lal Rustgi Memorial Lecture

By Dr. R. Gonsalves

The Twentieth Annual Moti Lal Rustgi Memorial Lecture entitled "What is changing in Science Education, and what does that mean for you and your children?" was presented by Professor Helen R. Quinn from the SLAC National Accelerator Laboratory on April 25, 2014 to a packed audience of UB students, faculty, and the general public in the Woldman Theater auditorium. Helen Quinn is a theoretical high energy physicist, a member of the National Academy of Sciences, and past President of the American Physical Society. She has received many awards for her research contributions, including the prestigious Dirac and Klein medals. Her lecture capped an eventful academic year focused on educational issues at UB, with President Obama's address on August 23 on College Affordability, the Middle States Review of UB's accreditation, and new UB 2020 Signature Initiatives on Curricular Distinction and Communities of Excellence. Dr. Quinn has served on numerous National Research Council committees and has contributed at the national and state levels to science curriculum and standards, and continuing education of science teachers. She chaired the NAS-NRC Committee on a Conceptual Framework for New K-12 Science Education Standards, and wrote its final report A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas (NAP 2012). Her Rustgi Lecture explained the essential ideas in this report in a physics context. To update traditional STEM education for global competitiveness and the internet era, her committee outlined a roadmap of traditional and new categories and initiatives. As examples she emphasized "Obtaining, evaluating, and communicating information" as one of 8 Scientific and Engineering Practices essential in this age of Wikipedia, "Systems and system models" as one of 7 Crosscutting Concepts to train students to compete in our increasingly interdisciplinary and job-mobile society, and "Waves and their applications in technologies for information transfer" as one of 4 Disciplinary Core Ideas in the Physical Sciences. She went on to describe progress and challenges, both disciplinary and political, in implementing this Framework nationally and at the state and local levels, and there were numerous questions and lively discussion on the nuts and bolts of implementing these new ideas in the classroom and laboratory, especially from the numerous school teachers in the audience.

Dr. Helen R. Quinn

Dr. Quinn met earlier in the day with physics majors for an informal discussion on her research and educational initiatives. She explained her renowned work with Roberto Peccei on an elegant mechanism to resolve the famous problem of strong-CP violation, for which they were awarded the 2013 J.J. Sakurai prize in theoretical physics. This work led to the invention of axions, a subject of intense experimental and theoretical work for more than three decades. Axions are currently a leading candidate for the mysterious dark matter that constitutes almost 27% of the observable universe. She also described her fundamental work with Georgi and Weinberg on a general formalism for calculating the renormalization effects which make strong interactions strong in simple gauge theories of strong, electromagnetic, and weak intetions. There was lively discussion on current developments in physics, the future of the discipline, and especially on career opportunities in science education. Dr. Quinn met with faculty members in the Department and the Graduate School of Education during her visit. A recurring theme in these meetings was the need to integrate research in the curriculum in a coherent way from K-12 through college and graduate school.

The 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.

Dr. Moti Lal Rustgi

We Congratulate Our Graduates!

Fall 2013

Physics Bachelors

Alec Cheney Ralston

Christopher William Smith

Physics Masters

Robert Allen Makin

Advisor: **Steven Durbin**

Physics Ph.D.

Che Jin Bae

Advisor: **Andrea Markelz**

Thesis Title**:** *A Turntable Terahertz Detector Based on Self Assembled Plasmonic Structure on a 3-Dimensional Electron Gas*

Ratchanok Somohonsane

Advisor: **Jonathan Bird**

Thesis Title**:** *Fast Energy Relaxation of Hot Carriers Near the Dirac Point of Graphene*

Joseph Anthony Zennamo III

Advisor: **Avto Kharchilava**

Thesis Title: *Z Boston Production in Association with Quark Jets at DO*

Spring 2014

Physics Bachelors

Francisco Cabrera

Michael Dugan

Paul Glenn

John Julian Jacangelo

Andrew Michael Kopanon

Samsun Nahar

Zachary Joseph Pace

Katherine Pierce

Sean Rosney

Benjamin Burton Siegel

Physics Ph.D.

John B. Hatch

Advisor: **Hong Luo**

Thesis Title: *Scanning Tunneling Spectroscopy Studies of Transition Metal Oxides and Spin Light Emitting Diode Studies*

Summer 2014

Physics Masters

David Elliott Allen

Advisor: **Hu Xuedong**

Ali M.A. Alsaqqa

Advisor:

Sambandamurthy Ganapathy

Maral Alyari

Advisor: **Salvatore Rappoccio**

Han-Yu Chia

Advisor: **Dejan Stojkovic**

Thesis Title**:** *A General Glance at Theoretical Black Holes*

David Wilson

Advisor:

Sambandamurthy Ganapathy

Physics Ph.D.

William Falls

Advisor: **Surajit Sen**

Thesis Title**:** *Characterization of Solitary Waves in Fermi-Pasta-Ulam-Tsingou Systems*

Jeongsu Lee

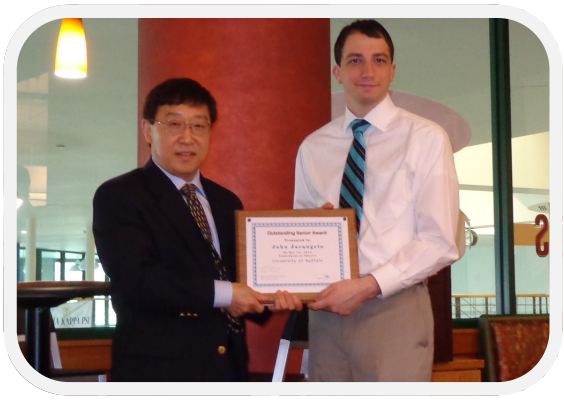
Advisor: **Igor Zutic**

Thesis Title**:** *Semiconductor Nanostructures: From Spin Lasers to Nodal Ground States.*

We Congratulate Our Graduates!

2014 Commencement

Zachary Pace (above left), Paul Glenn (above right) and John Jacangelo (right) received the Departmental Outstanding Senior Awards. Paul also received the CAS Outstanding Senior Award. Photos: John Cerne



Events

Dr. Bruce McCombe and Frank Silvestro at the CAS Scholarships & Alumni Awards Reception.

Photo: Ariel Namoca

October 2014 Department Open House

The fall open house is the best way for students accepted into the university to learn all about what UB has to offer. Graduate students and faculty shown above and below conducted lab tours and performed a range of physics demonstrations.

Students and alumni during the get together at Denver, CO during the APS March meeting (March 2014) (above and below)

Photos: Renee Bush

Student Awards

Undergraduate Awards

Outstanding Seniors

John Jacangelo

Paul Glenn

Zachary Pace

Sekula Scholarship Awards

Luke Bodmer

Geoffrey Fatin

Nigel Michki

Dante Iozzo

Syed Zain

Matthew Gordon

Goldwater Scholarships

Nigel Michki

Sean Bearden

CAS College Ambassadors

Sean Bearden

Geoffrey Fatin

Dante Iozzo

Nigel Michki

Physics Academic Achievement (undergraduate)

Eric Bigenwald

Stephen Muehlemann

Richard Bisson

Arielle Balthazard

Graduate Awards

Outstanding TA

Yoichi Takato

Outstanding Graduate Student

Yoichi Takato

Presidential Fellowship

John Truong

Ruifeng Dong

Rahul Munshi

Luke Pendo

Matthew Westley

Cambi Fellowship

Maral Alyari

Han Wen

Silvestro Scholarship

Ali Alsaqqa

Maral Alyari

N. Arabchigavkani

Jaba Chelidze

Ruifeng Dong

Hsuan-Hao Fan

Weiwei Gao

Jimin George

Nelson Gross

Jiajun Li

Alok Mukherjee

Anshul Saini

Sujay Singh

Bilal Tariq

Sushree Tripathy

Yutsung Tsai

Gaofeng Xu

Xuechen Zhu

Physics Graduate Student Memorial Fellowship

Hsuan-Hao Fan

Faculty Awards

Dr. Krotscheck Receives SUNY Distinguished Professorship

By Dr. Frank Gaspirini

Professor Eckhard Krotschek was promoted to SUNY Distinguished Professor effective November of 2013. Eckhard joined our Department in 2011 as a full professor. His previous academic appointments were at Texas A&M University and the Johannes Kepler University of Linz, Austria. Eckhard's outstanding theoretical research has been recognized throughout his career: he received a Heisenberg Fellowship in 1980, was named Fellow of the American Physical Society in 1995 and, more recently, received the Eugene Feenberg Memorial Medal in 2007. He was cited for his pioneering work in developing *ab initio* methods to calculate properties of strongly correlated quantum systems. Eckhard's nomination for SUNY Distinguished Professor was supported by a list of prominent scientists, including two Nobel Prize winners, four recipients of the Feenberg Memorial Medal, three winners of the London Prize and five members of the National Academy of Sciences and its international equivalents.

Eckhard's presence in the Department has had a great impact in a very short time. He has established a series of workshops "Physics at the Falls" which have attracted distinguished national and international speakers to UB. Seven workshops with different research emphasis have already been organized as part of this series. Most recent ones include "Recent Progress in Nonequilibrium Many-Body Theories", "Structural and Electronic Instabilities in Oxide Nanostructures", "Entanglement, Decoherence and Quantum Control" and "Phase transitions in Low Dimensions". These have been organized by our own faculty, Professors John Han, Sambandamurthy Ganapathy, Xuedong Hu and Eckhard and Gasparini, respectively. For a description of these workshops see http://www.physics.buffalo.edu/Physics-at-the-falls-workshops/index.html. Also, in collaboration with Francis Gasparini and Jong Han, Eckhard is organizing two international conferences to be held at the Niagara Falls Convention Center in August of 2015, the International Symposium on Quantum Fluids and Solids, and the 18th International Conference on Recent Progress in Many–Body Theories. In addition to all this, Eckhard has brought distinguished visitors to the Department for more extended stays to foster collaboration and interactions. Among these are Eric Suraud from Toulouse University, Sui Chin from Texas A&M, Chuck Campbell from U. of Minnesota and Henri Godfrin from the CNRS-Institute Neel in Grenoble. Eckhard has taught so far the introductory non-calculus physics sequence and is currently teaching the two-semester graduate course in quantum mechanics.

Professor Krotscheck with this year's other SUNY Distinguished Professors, the President and the Provost. Photo: Nancy J. Parisi

Prof. Krotscheck with President Tripathi (left) and Provost Zukoski (right) at the annual Celebration of Faculty and Staff Excellence. Photo: Nancy J. Parisi

Attendees of the Physics at the Falls workshop organized by Dr. Krotscheck in 2013 made a visit to the famous Niagara Falls. Pictured here with the Statue of Nikola Tesla, inventor of AC electricity. Photo: Eckhard Krotscheck

Faculty Awards

Professors Kinney, Markelz and Weinstein win Prestigious Awards in 2014

By Dr. Surajit Sen

Professor William Kinney was awarded the *SUNY Chancellor's Award for Excellence in Teaching* this year. Will got his PhD from the University of Colorado, Boulder in 1996 and then postdoced at the Fermilab, University of Florida and Columbia University. He is a prominent cosmologist who joined UB Physics in 2003, was promoted to Associate Professorship in 2009 and to full professorship in 2014. In addition, Will was a long term visitor at the Perimeter Institute of Theoretical Physics, University of Waterloo, Canada and at Yale University. A charismatic classroom teacher with superb communication skills, he has been remarkably successful in teaching across the levels, from mechanics in General Physics I (PHY 101) to Intermediate Mechanics (PHY 301) and the graduate level Classical Dynamics (PHY 509) and from the Descriptive Astronomy sequence to graduate courses in Cosmology. Will is also well known for his generosity with personal time in attending to the individual student's needs regardless of the student's level and has distinguished himself as a highly sought after research advisor with an enviable track record of student placements. Not surprisingly, Will was a recipient of the 2011 Milton Plesur Award which is a recognition bestowed by the Student Association of UB.

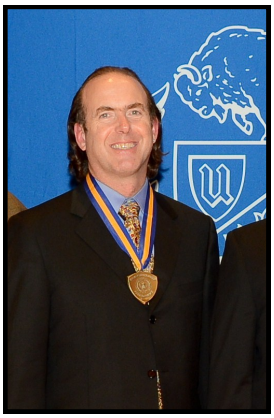


Photo: Nancy J. Parisi

Passionate about the importance of public awareness of science, Will has pioneered the Buffalo region's version of the Cafe Scientifique movement by introducing the Science and Art Cabaret program. This program involves a mash-up of prominent scientists, artists and musicians of the region and has a loyal following with packed halls in every one of their events. The purpose of this effort is to not only foster a dialog in an informal setting between the academic communities involved but also to make this dialog accessible to all who care to come. This collaborative effort is a rich partnership and enjoys the support of the College of Arts and Sciences, Hallwall's Contemporary Arts Center, Buffalo Museum of Science, the Physics Department, and the Buffalo State College. *Congratulations Will!!!*

Professor Andrea Markelz received the *UB Exceptional Scholar: Sustained Achievement Award* earlier this year. Andrea, a 1995 PhD from the University of California at Santa Barbara, post-doc'd at the National Institute of Standards and Technology and then jointly at the Bell Labs and the University of Maryland, College Park before coming to UB in 1999. She was promoted to associate professorship in 2006 and to full professorship in 2011. She works mainly on the modeling and measurement of dynamic properties of proteins; on studies of terahertz (THz) plasmonic devices; on the development of THz instrumentation for studying molecular systems and nanomaterials. She has successfully combined her expertise in THz techniques and in biophysics to make significant contributions in our understanding of the motion of proteins. Among her latest achievements is a THz microscopy technique that beats the fundamental diffraction limit by some 1,000. The difficulty with THz microscopy is that the THz waves are long wavelength (~ 1 mm) and hence not suitable for probing biological systems where length scales are often in the micrometer range. However, many fundamental processes in biological systems have resonances in the THz range. Andrea has developed a way to effectively operate a THz microscope for studying biological systems.

Photo: Nancy J. Parisi

She has been the first in many ways for UB Physics. She became our first woman faculty, the first recipient of the NSF CAREER award in Physics leading the way for seven others to follow and the first to receive an NSF instrumentation development grant ($1,001,046, 2010-2013). She has received grants totaling over $3.6 million as a Principal Investigator and has been a Co-PI or participant in other grants totaling over $19 million. Andrea remains an active mentor having graduated 5 PhDs, 10 Masters and 17 undergraduate students. She has been engaged with local schools and has mentored students from these institutions over the years. In addition, she has been generous with her time and has been active in academic service within the University, nationally and internationally, serving as the Editor of the Virtual Journal of Terahertz Science and Technology since 2008 and a former Associate Editor of the Journal of IR, Millimeter and THz Waves (Springer). *Congratulations Andrea!!!*

Continued on page 22

Faculty and Student Awards

Continued from page 21

Professor Bernard A. Weinstein won the *SUNY Chancellor's Award for Excellence in Faculty Service* this year. Bernie obtained his PhD from Brown University in 1974 and was an NRC Postdoctoral Research Associate at the National Institute of Standards between 1973 and 1975. He came to UB as a Professor in 1987 after having spent three years on the faculty at Purdue University and nearly a decade at the Xerox Corporation in Rochester, NY. He is a highly accomplished experimental condensed matter physicist with interests in the high pressure physics of semiconductors. He is a winner of the Alfred P. Sloan Foundation Fellowship (1976-1978), a Fellow of the American Physical Society (1997), a winner of the SUNY Chancellor's Award for Excellence in Teaching (2000), and a winner of the Milton Plesur Award (2003).

Photo: Nancy J. Parisi

Bernie's service as a faculty member to his profession, the Department, College and the University has been exemplary. For three decades he has served as an organizing committee member of the International Conference on High Pressure Semiconductor Physics, which is held in different countries every other year and he has organized or co-organized numerous other major conferences and Fest workshops including several in this region. He has served for three terms as an elected member of the College of Arts and Sciences Appointments, Promotions and Tenure Committee including one term as the Chair and his role in this regard is well known to all. His efforts within the Department as the Director of Undergraduate Studies since 2010 have helped raise the standards of our program and have brought tremendous national visibility. It is not an accident that two of our undergraduates won the highly competitive Goldwater Scholarship, a feat even Harvard could not match! Thanks to Bernie's insights and leadership, the Department has been at the forefront of implementing the Middle States Assessment program. His list of contributions continues in every aspect of the Department's functioning. This is more than a well-deserved award.

Congratulations Bernie!!!

APT Teaching Award

By Dr. Hong Luo

The College of Arts and Sciences established a teaching award during the last academic year to recognize faculty members who have made significant contributions toward the educational goal of the University. It is called the APT Teaching Award. APT is a committee at the Dean's level to consider all awards, promotion and tenure cases in the college. This award does not involve nominations from individual departments. Instead, the committee looks at the dossiers of faculty members who are going through the promotion and/or tenure process.

Based primarily on the teaching part of the dossiers, the committee will identify one faculty member who best exemplifies the aspirations of the college in terms of education of our students. The first award was made this year, and Prof. John Cerne, who was promoted to full professor this year, was chosen as the winner. For those who know John and how he teaches his students, this did not come as a surprise. In fact, he received the SUNY Chancellor's Award for Excellence in Teaching two years ago for exactly the same reason. Congratulations and thanks to Prof. Cerne, for his outstanding ability and effort in teaching our students and for setting a standard for this particular award!

A Record Number of Physics Majors Appointed to Be College Ambassadors

By Dr. Bernard Weinstein

Four of our undergraduate physics majors, *Sean Bearden*, *Nigel Michki*, *Geoffrey Fatin*, and *Dante Iozzo*, were recently appointed to be College Ambassadors by the Dean of the College of Arts and Sciences. This is a distinguished honor that recognizes the outstanding academic and leadership achievements of these students, and their active roles in campus life. For Sean Bearden, who served as a College Ambassador last year, it is the second such recognition, and both Sean and Nigel Michki are recent winners of the prestigious Barry M. Goldwater Scholarship. College Ambassadors act as representatives of the Physics Department and the College of Arts and Sciences in outreach activities to prospective new students, their parents, and the general Western New York community. Four College Ambassadors chosen from a single department is a record that speaks to the extremely high caliber of these students, and the success of the UB physics undergraduate program.

Faculty and Student Awards

The students selected to be College Ambassadors meet elite criteria. They must be undergraduates pursuing a major within the College of Arts and Sciences who have excelled academically and are involved in campus and community groups. These student volunteers are nominated by faculty and staff to represent the College at a variety of university-sponsored events. Ambassadors serve as liaisons between the Dean's Office and the student body and provide insights and information to prospective students and their parents at activities such as the UB Open House and Discovery Day events. Throughout the year, the College Ambassadors receive unique professional development opportunities, including leadership training, access to community engagement activities, and networking events with faculty and alumni. The UB Physics Department is fortunate to have many fine undergraduate students. The four College Ambassadors selected this year are among the most outstanding, and we anticipate that they will continue to demonstrate leadership as they pursue their future physics careers.

Recent Research Grant Awards

Ph.D. student Alok Mukherjee (advisor: Dr. John Cerne) won a UB/GSA Mark Diamond Research Fund award in fall 2013. To get this award he had to write a proposal on his research and he received funds to carry out that research. The title of his proposal was: Magneto-optical studies of iron superconductors. More information about this award can be found at http://gsa.buffalo.edu/mdrf/.

Dr. John Cerne received a 3-year research grant entitled *Resolving competing orders and symmetry-breaking in cuprate and iron pnictide high temperature superconductors using infrared Hall measurements*, awarded in July 2014 by the National Science Foundation (NSF). This award supports research on new materials that superconduct at significantly higher temperatures and have challenged our understanding of superconductivity.

Drs. Will Kinney, Dejan Stojkovic and Doreen Wackeroth received an NSF award entitled *Physics at the Frontier: Collider and Cosmology*, a 3-year grant with start date of July 2014. The goal of this research project is to make important progress in providing answers to key open questions at the frontier of particle physics, cosmology and gravity research.

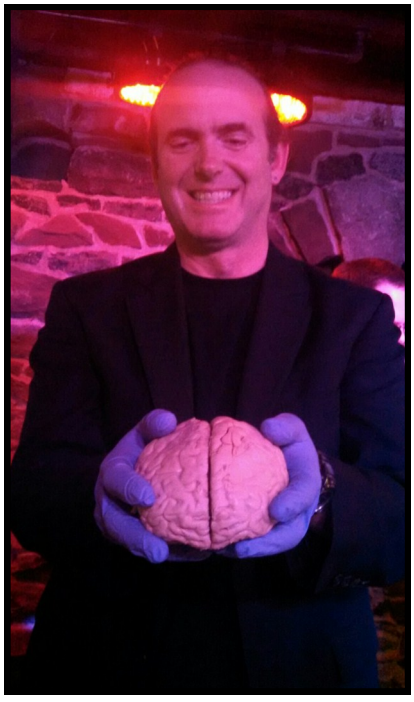
Dr. Salvatore Rappaccio received an NSF grant entitled *High Energy Physics Research at the CMS Experiment,* awarded in April 2014 with a 36 months duration. In this project new analysis techniques will be applied in the search for "Beyond the Standard Model" new physics using data collected at the Compact 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, Avto Kharchilava, and Salvatore Rappoccio received an NSF research grant entitled *US CMS Phase-1 Upgrades,* with starting date of January 2014 and a duration of 60 months.

Drs. Ia Iashvili and Avto Kharchilava received a continuation of their NSF research grant entitled *US CMS Operation Program/Phase 2 Upgrade R&D Subsystem* and NSF outreach grant entitled *QuarkNet*. These grants have been awarded in 2007 and 2006, respectively. QuarkNet is a program, which provides valuable research experience to teachers enabling them to teach the basic concepts of introductory physics in a context that students find exciting.

Dr. Wenjun Zheng received a 3-year grant from the American Heart Association entitled *Multi-scale molecular simulations of cardiac muscle regulation.* The grant was awarded in December 2013.

More information about the NSF awards can be found at http://www.nsf.gov/awardsearch/.



Dr. Will Kinney at the Science and Art Cabaret, "Love Yer Brain" holding a real brain (October 22, 2014). For more information, visit: www.buffalo.edu/~whkinney/Cabaret
Photo: Jeanette Sperhac

Student Awards

UB Physics Graduate Student Takes Top prize at International Conference

By Dr. Andrea Markelz

Katherine Niessen, a fifth year grad student in the Markelz Lab, won first place in the Best Student Paper/Presentation Award for the 39th International Conference on Infrared, Millimeter, and THz Waves, September 14-19, 2014 at The University of Arizona, Tucson, AZ. Ms. Niessen received her award for the invited paper entitled, "Measurements and Calculations of Protein Intramolecular Vibrations in the THz Range.". This long established conference had 564 participants this year. Katherine is a coauthor of a recent Nature Communications article, "Optical measurements of long-range protein vibrations" and is currently writing up several papers on her work to understand how the new technique of crystal anisotropy terahertz microscopy (CATM) can be optimized for the study of intramolecular vibrations in proteins. Ms. Niessen has been using the CATM technique and molecular modeling calculations to study the natural antibiotic, lysozyme. Lysozyme cleaves bacterial cell walls by breaking up carbohydrates within the walls. She has found that while the density of states is nearly independent of the binding state, the CATM spectrum changes dramatically with binding. Her further modeling has revealed that the large change is likely due to a change in the direction of internal motions changing with binding.

Katherine Niessen receiving the first place Student Paper Award from Nuria Llombart, International Organizing Committee member and chair of the Student Award committee. Photo: Andrea Markelz

The directionality of the vibrations will change the dipole coupling to the motion, which then results in the large contrast in the measurement. Since the directionality of motion is precisely what is of interest with regards to these motions actually promoting function, this information from the optical measurements is extremely valuable to understanding the optimization of the biological system and system regulation. Ms. Niessen expects to finish her thesis Spring 2015.

Sekula Scholarship Awards for 2014-15

By Dr. Bernard Weinstein

Luke J. Bodmer, Geoffrey L. Fatin, Nigel S. Michki, Dante A. Iozzo, Syed M. Zain, and *Matthew A. Gordon* are this year's Sekula Scholarship Award winners. These outstanding Physics seniors have consistently demonstrated the highest level of academic achievement, and potential to excel in future careers as Physicists. We wish them much deserved congratulations!

The Sekula endowment fund was established in December of 1990 by Mrs. Anne H. Sekula in memory of her husband, Dr. Stanley T. Sekula, who received his B. A. in Physics from the University of Buffalo in 1951. The Scholarships are awarded to undergraduate students pursuing a degree in the Department of Physics who show academic promise and demonstrate financial need.

New Award for Undergraduate Majors Inaugurated by the Physics Department

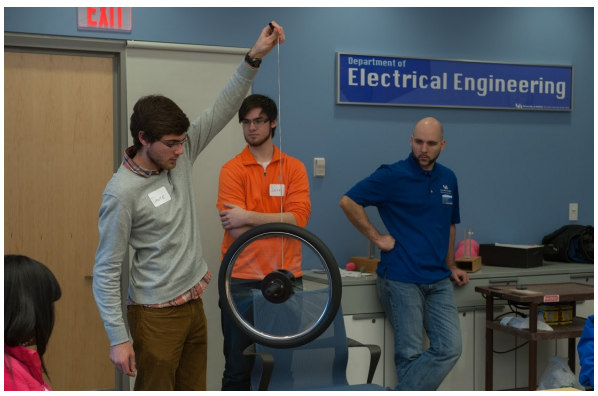
In order to recognize students who, early on, demonstrate outstanding achievement in their Physics courses, and the potential for continuing excellence as Physics majors, our department has instituted the "Physics Academic Achievement Award". The Award carries a monetary prize, which this year is $700. The inaugural winners for 2014-15 are *Eric Bigenwald, Stephen Muehlemann, Richard Bisson, and Arielle Balthazard*. Congratulations all!

Outreach Activities

Last March Graduate Student Outreach Team went to the King Center Charter School to do a series of interactive experiments with kids in grades K-7.

Pictured to the left and below.

Nigel Michki and Dante Iozzo performed demos with the theme “Unusual physics of everyday life” for two classes of 7th graders in PS19 in Oct. 2014. They opened by showing how different things behave in vacuum. They showed how a ringing alarm produces no sound in a vacuum and also show how one can boil water without adding any heat. Since the class just started a chapter on forces and motion, they brought in a bike wheel and a spinning stool to demonstrate torque and the angular momentum conservation. Nigel and Dante were apprehensive about how well the students would be able to grasp this material, but the students were intrigued the entire time and were very active about making hypotheses and asking questions. At the end, they were asking the students questions about the demos performed and surprisingly found that the students grasped the material quite well. Overall, it was a very successful event and they look forward to doing similar events in the near future.

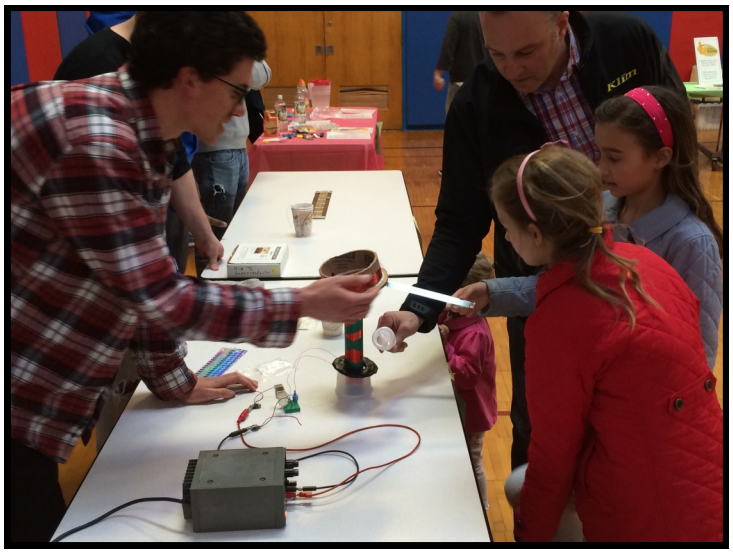


Outreach Activities

In January 2014, UB ran a STEM outreach day for over 100 middle school students from Westminster Community Charter School, providing interactive exploration into the fields of physics, biology, chemistry, geology, mathematics, and engineering. Sean Bearden, Nigel Michki, and Dante Iozzo, along with colleagues Jake Oddy from Buffalo State University and Sarah Chamberlain from Fredonia State University, performed demonstrations and led hands-on physics-related activities. The event began with a presentation from each field. Sean, Nigel and Dante performed a few demonstrations involving some intriguing properties of liquid nitrogen. The students then broke into smaller groups and went to the different stations set up in Davis Hall where they participated in hands-on exploration. Nigel and Sarah led an activity exploring unusual properties of non-Newtonian fluids using cornstarch and water, while Sean, Jake and Dante led another group exploring angular momentum along with how objects from balloons to alarm clocks behave in vacuum. At the end of the event the students enjoyed some pizza before leaving. The students were all very enthusiastic about the activities and had a lot of fun going through all the activities. Our students are looking forward to another STEM outreach day next month!

Outreach Activities

Our undergraduates were invited to the Ellicott Road Elementary School Science Night by Lia Hallet from Student Advising Services at UB. The event was May 1st, 2014.The students who attended were: Sean Bearden, Luke Bodmer, Luke Lyle, Ifechukwu Ononye, and Joe Pusztay.



Pictured from left to right -Dr. Bruce McCombe, Geoffrey Fatin, Dante Iozzo, Nigel Michki, Mrs. Sekula, Matthew Gordon, Luke Bodmer, Syed Zain, Dr. Hong Luo, at the CAS Scholarships & Alumni Awards Reception.

Photo: Ariel Namoca