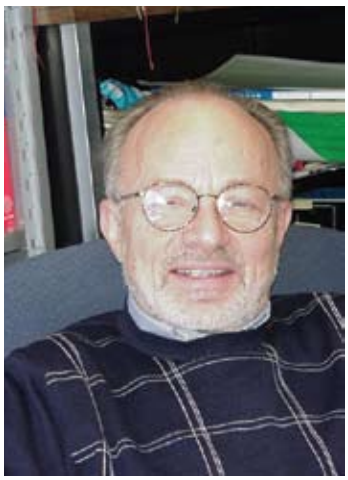
College of Arts and Sciences
University at Buffalo The State University of New York

Interactions

The Newsletter of the UB Department of Physics

Volume 1, Issue 2 Fall 2008



Dear alumni/ae and friends,

Change. It seems to be a very topical word. The Department is indeed undergoing substantial changes. On the negative side, Karl Ecklund has left the Department to take an appointment at Rice University. He was an immediate contributor to our department since his appointment in 2006. We wish him well. We also have two retirements which will be effective during this academic year: Mike Fuda and Shigeji Fujita. They have both served the department and UB well over their long academic careers. We will miss them. On the positive side, we are searching this year to fill a faculty position with a senior theorist. There is also a new buzz of activities on the first floor of Fronczak with three new research laboratories beginning to function: Arnd Pralle in biophysics, Sambandamurthy Ganapathy with facilities for ultra-low temperature transport studies and Gottfried Strasser with a new Molecular Beam Epitaxy system. There is also great excitement in the High Energy/Cosmology group with the start up of the LHC. On the outreach front, the Physics and Arts Exhibition is continuing to be expanded with some major additions to be made this fall. These were made possible with a grant from the "Robert and Carol Morris Fund for Artistic Expression and Performing Arts."

As promised in the first Interactions, we are beginning to feature some of our alumni in the present issue. It is very gratifying to see so many of you doing so well. It seems only yesterday that you were taking courses and exams. Tempus fugit!

We are currently going through what seems to be a periodic time of budget upheavals in New York. This is mirrored in many other states throughout the country. UB is better placed than in the past to weather this difficult period. Currently, less than 30% of the University budget comes from the State. The remainder is from tuition, research grants, fees and private donations. There has been a great momentum built up with President Simpson and Provost Tripathi with UB2020: a plan to strengthen certain areas of creativity and research at UB. Check www.buffalo.edu/ub2020. There is every hope that this initiative will not wither due to budget constraints. However, there is no doubt that we are in for some challenging years.

Best regards,

Francis M. Gasparini, Chair
UB Distinguished Professor of Physics

Magnetic Excitations in Semiconductors – Bridges to the Next Decade

Fest-Symposium and Public Lecture honoring Dr. Bruce D. McCombe

By Dr. Bernard A. Weinstein

Leading physicists and young investigators from around the world gathered at UB on March 6-8, 2008 for the fest-symposium *Magnetic Excitations in Semiconductors – Bridges to the Next Decade*, celebrating the eminent career in research and education of Dr. Bruce D. McCombe, SUNY Distinguished Professor, and Dean of the College of Arts and Sciences.

Article continued on page 2

UB President John B. Simpson, Dr. Bernard Weinstein, Professor of Physics and fest-symposium chair, Dr. Bruce McCombe, SUNY Distinguished Professor, and Dean of the College of Arts and Sciences, and UB Provost Satish K. Tripathi, at the reception honoring Dr. McCombe on the occasion of the fest-symposium "Magnetic Excitations in Semiconductors: Bridges to the Next Decade". PHOTO: Nancy J. Parisi

Article continued from page 1: Magnetic Excitations...

By Dr. Bernard A. Weinstein

Dr. McCombe is one of the foremost international scholars in the field of magnetic excitations in semiconductors. His research over the past four decades is noted for many pioneering advances that have helped to shape the understanding of this scientifically and technologically important area of condensed matter physics. A number of the graduate students that Dr. McCombe has mentored are presently among the field's most active contributors.

Professor Klaus von Klitzing (left), Nobel Prize in Physics 1985, takes questions after his presentation at the fest-symposium. Professor Gasparini (right) chaired the session. PHOTO: Mark Kimball

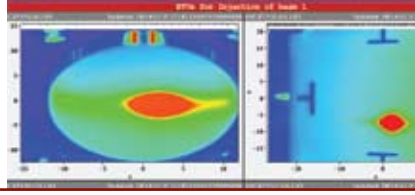
The scientific program of the Fest-Symposium featured 23 plenary lectures and over 40 poster presentations, selected to promote discussion at the highest level on key past advances and new long-term research directions. The lecture and poster sessions were conducted in an informal atmosphere to maximize the intellectual exchange between senior researchers and young investigators. An open access Web Proceedings has been created to make the Fest-Symposium lectures available to the general scientific community. Please see the '*Proceedings*' link at http://mccombe.physics.buffalo.edu/magex-festsymp/index.htm.

The Fest-Symposium also featured the public outreach lecture "Putting Spin into Electronics", presented to foster learning in an area of magnetic excitations in semiconductors that has high potential for societal impact. Some 380 people from the Buffalo community and the UB student body enjoyed the entertaining talk, demonstration of superconductivity, and lively questions at this free lecture, given by UB physics professor Dr. Igor Žutić. The public lecture was preceded by a gala reception hosted by UB's President John Simpson.

The idea for this Fest-Symposium was initiated by several of Dr. McCombe's former graduate students, who worked very hard to bring the event to fruition. The Fest-Symposium was organized by these students with the help of its Chair Dr. B. Weinstein, Co-Chair Dr. A. Cartwright, Program Chair Dr. J. Kono, and several other faculty members in the Department of Physics. External financial support was received from the National Science Foundation, the Office of Naval Research, the National High Magnetic Field Laboratory, as well as several industry sponsors. Many University sources also assisted including the Office of the Provost, the Office of the Vice President for Research, the College of Arts and Sciences, the School of Engineering and Applied Sciences, and the Physics Department. Please see the URL given above, under the 'Committees' and the 'Sponsors' links, for a full listing of all the organizers and sources of financial support. All who attended Magnetic Excitations in Semiconductors – Bridges to the Next Decade were treated to an exceptional conference and an enjoyable stay in Buffalo, undaunted even by a March snow storm. The excellence of the physics and the warm fellowship of the gathering were a fitting tribute to Dr. McCombe's outstanding career achievements.

Dr. Alexander Efros (Naval Research Laboratory), Professor Bruce McCombe, and Dr. Michael Sheridan, UB Distinguished Professor of Geology, at the gala reception. PHOTO: Nancy J. Parisi

Professor Bruce McCombe among his present and former students and postdocs, who attended the meeting. PHOTO: Nancy J. Parisi



Faculty in Focus

Experimental High Energy Physics Research at UB

By Dr. Ia Iashvili

The experimental high energy physics group at UB consists of two faculty members, Dr. Avto Kharchilava and Dr. Ia Iashvili, both Assistant Professor of Physics, a postdoctoral research associate Dr. Michael Strang and a graduate student, Kenneth Smith, who are both located at Fermilab near Chicago, and Dr. Ashish Kumar, a postdoctoral research associate located at CERN, the European Organization for Nuclear Research, in Geneva, Switzerland. We study the elementary constituents of matter and the interactions between them. This research field is called High Energy Physics, because many elementary particles do not occur under normal circumstances in nature, but can be created and detected during very energetic collisions of other particles.

The Tevatron collider at the Fermi National Accelerator Laboratory (Fermilab) is currently the world's most energetic machine which collides protons and anti-protons circulating along 4-mile orbits with a speed close to the speed of light. Our group studies these collisions which are recorded by sophisticated detectors that have the ability to precisely measure the properties of microscopic particles. So far, a wealth of new information has been extracted from the Tevatron data. One of many examples is the mass of the top quark which has been measured with an unprecedented precision of 0.8%. The top quark is one of six types of quarks and is by far the heaviest observed elementary particle. It is this property which makes the top quark of special interest since it may hold secrets of fundamental question about the origin of mass. We have also observed very rare processes, such as the production of a pair of Z bosons. This process provides an additional and so far missing test of the Standard Model -- a theory that describes elementary particles and three (electromagnetic, weak and strong) out of four fundamental interactions.

Soon the Large Hadron Collider (LHC) will become fully operational at the CERN laboratory. It will deliver proton-proton collisions at energies seven times higher than that at the Tevatron. Our group has been working on the construction and testing of the silicon sensor detector which will measure with high precision trajectories of elementary particles emerging from these collisions.

We have also developed software simulations that predict, under certain assumptions, the outcome of collisions at these super high energies. Data from the LHC is expected to change our knowledge about everything from the Big Bang and black holes to the ever-elusive Higgs boson and the most fundamental building blocks of matter.

For more information about our group please visit www.physics.buffalo.edu/hepcos and read the UB Reporter article at www.buffalo.edu/ubreporter/2008_09_10/physics.

Dr. Avto Kharchilava (left) and Dr. Ia Iashvili, both Assistant Professors of Physics, joined the Physics Department in 2005. They are members of the international group of scientists that planned and built one of the LHC's four detectors, the Compact Muon Solenoid (CMS) pictured behind them. PHOTO: Douglas Levere

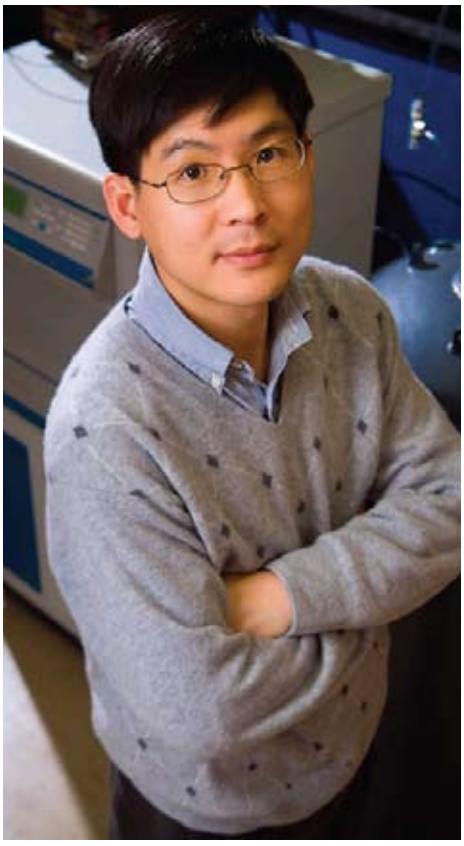
Banner: On September 10, 2008 a beam of protons has been successfully circulated in the CERN Large Hadron Collider (LHC) ring (the red dot shows the beam). The UB Department of Physics celebrated the LHC start-up by showing live streaming video of this event on a large screen in the third floor foyer of Fronczak Hall and by videoconferencing with UB postdocs and students stationed at CERN in Geneva and Fermilab in Chicago. UB physicists, Dr. Kharchilava and Dr. Iashvili, have been involved in the planning and design of the CMS experiment at the LHC. Read more in the UB Reporter: www.buffalo.edu/ubreporter/2008_09_10/physics.

Faculty in Focus
CONTINUED

Spin Effects and Magnetism in Nanostructures

By Dr. Hao Zeng

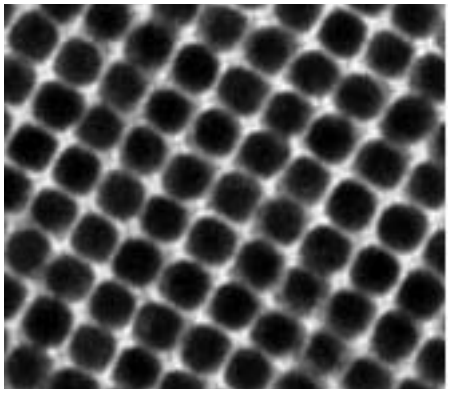
Magnetism is one of the oldest sciences dating back to the discovery of lodestone some 2,500 years ago. Ancient Chinese invented South Pointers using lodestone for navigation. Today, magnetic materials are widely used in computers, communication equipments, sensors, electric motors and generators.



Dr. Hao Zeng, Assistant Professor of Physics, joined the Physics Department in 2004. In 2006 he has received a prestigious National Science Foundation CAREER award for studying nanoscale materials and devices, and to educate students in the interdisciplinary fields of nanoscience and nanotechnology.

The continuous demand for higher density data storage and faster data access triggered a tremendous development in magnetic thin films and nanostructures. The 2007 Nobel Prize in physics was awarded to Albert Fert and Peter Grünberg for their discovery of Giant Magnetoresistance (GMR), a quantum mechanical effect due to spin polarized charge transport in thin films containing alternating ferromagnetic and nonmagnetic layers. GMR has been used extensively in the read heads in modern hard drives and magnetic sensors, making it possible to store thousands of songs and videos in iPods. The discovery of GMR is considered the birth of a new field in condensed matter physics called “spintronics”. Spintronics exploits both the spin and charge properties of electrons, which promises faster operations with lower power consumption, and the possibility of integrating logic and memory functions.

My research is part of the ongoing spintronics research effort at UB. I am interested in fundamental understanding of the origin of magnetism in materials. This is very important if we want to perform logic functions using spins in semiconductors. We are also interested in magnetism and spin dependent charge transport at the nanoscale. We use nanoparticles that contain only a few thousand atoms for such studies. At such small dimensions, the nanoparticles show some unusual properties that are different from those of bulk materials. For example, the magnetism of these nanoparticles is dominated by size and surface effects because a large fraction of the atoms are surface atoms and have different interactions from those in the bulk. Like an atom, the energy levels of the electrons in the nanoparticle become discrete; and adding or removing an electron from the particle costs a lot of energy. The interplay among quantum confinement, Coulomb blockade, and spin



Dr. Zeng’s research group uses self-assembly to fabricate nanoparticle charge transport devices as shown in the picture. Self-assembly is the spontaneous formation of spatially ordered patterns without human intervention, due to specific, local interactions. In other words, the nanoscale device builds itself.

dependent charge transport promises interesting new physics. The possibility of discovering new phenomena and the potential applications of these discoveries make this field very exciting.

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Alumni in Focus

Shao-Tang Sun, Ph.D., 1978 and Jean-Hsien Ho, M.S., 1979

By Dr. Shao-Tang Sun

Shao-Tang Sun received his Ph.D. degree under the guidance of Professor John T. Ho in 1978. He is President and Co-Founder of Elsicon, Inc. located in Newark, Delaware. Elsicon specializes in developing specialty optical materials for flat panel display applications. Previously he was manager of the Aerospace Division at Hercules Research Center. He built and managed an interdisciplinary team developing photonics technology at Hercules and led the team in a successful buyout to launch Elsicon in 1997.

Dr. Shao-Tang Sun (left) and his wife Jean-Hsien Ho are both alumni of the Department of Physics.

Prior to joining Hercules in 1983, Dr. Sun was a Research Associate at Massachusetts Institute of Technology. He has been happily married to another UB physics alumnus, Jean-Hsien Ho for 30 years. Jean-Hsien received an M.S. degree under the supervision of Professor Y. C. Lee in 1979. She moved to Boston with Shao-Tang and subsequently earned a Master Degree in Electrical Engineering with focus in Computer Sciences from Northeastern University. She is currently a computer architect at a pharmaceutical company, AstraZeneca. They have two grown children.

Junichiro Kono, Ph.D., 1995

By Dr. Junichiro Kono

Dr. Junichiro Kono is currently an Associate Professor in the Department of Electrical and Computer Engineering at Rice University in Houston, Texas. He obtained his Ph.D. from the UB Physics Department in 1995, for which he conducted a far-infrared magneto-optical study of spatially-separated two-dimensional electrons and holes in semiconductor quantum wells at low temperatures and high magnetic fields in search for Bose condensation of excitons. His advisor was Professor McCombe, from whom he learned a great deal about semiconductor physics as well as various spectroscopic techniques that he has been using to date.

After graduation, he was a post-doctoral research associate, 1995-1997, at the University of California, Santa Barbara, working at the Center for Terahertz Science and Technology under Professor Jim Allen. There, he performed some pioneering optical spectroscopy experiments on quantum confined semiconductor structures that are driven far from equilibrium by intense terahertz radiation from the UCSB Free Electron Lasers. During 1997-2000, he was the W. W. Hansen Experimental Physics Laboratory Fellow in the Department of Physics at Stanford University, conducting independent research on ultrafast and nonlinear infrared phenomena in solids as well as teaching a classical mechanics course to undergraduate physics majors for three quarters.

Dr. Kono has been a faculty member at Rice University since 2000, obtaining tenure in 2005. His research group at Rice University currently consists of 10 graduate students and a few undergraduate students, and they are performing optical studies of nanostructures and nanomaterials. Current research topics range from fundamental phenomena such as the Aharonov-Bohm effect in single-walled carbon nanotubes and strong-field physics in semiconductors to device applications such as terahertz generation from quantum confined carriers as well as electro-optical modulators using coherent non-perturbative effects. In addition, Dr. Kono's group has a significant research effort to study the optical manipulation of ferromagnetism in magnetic semiconductors for opto-spintronic applications in information technology. Dr. Kono's work is supported by various federal and state agencies.

Dr. Kono presented a talk on High-Field Magneto-Spectroscopy at the fest-symposium "Magnetic Excitations in Semiconductors—Bridges to the Next Decade" honoring Dr. McCombe. PHOTO: Mark Kimball

Banner: The LORAS (Linear Omnidirectional Airspeed System) display in Fronczak Hall is the first display in the newly created Alumni Gallery. Jack Bielman, Physics Major class of 1962, invented this unique airspeed system while working on the Flight Research Department of the Cornell Aeronautical Laboratory (CAC) at the Buffalo International airport. It found its first patent application in 1966. Between 1968 and 1978 additional 12 patents were awarded, 5 U.S. and 7 foreign patents.

Alumni in Focus
CONTINUED

Alumni News

Dr. Norman Jarosik, Senior Research Physicist at Princeton University, received the 2008 Pioneers of Science Award. Dr. Jarosik is a leader of one section of the WMAP (Wilkinson Microwave Anisotropy Probe) Mission of NASA that has revealed conditions as they existed in the early universe. Dr. Jarosik received both his B.S. (1979) and Ph.D. (1985) degree from the UB Department of Physics.

Dr. Kristan Corwin, Associate Professor of Physics at the Kansas State University, has received a National Science Foundation CAREER award in 2005. Dr. Corwin received a Bachelor of Science degree in physics from UB in 1993.

We congratulate our 2007/2008 Physics Bachelor recipients:
Q.Anx, M.Gerfin, A.Kitt, J.Mcmillan, C.Romaszko, M.Rumpf, T.Szczykutowicz, J.Zennamo

Master's recipients:
T.Beringer, N.Demez, M.Hira, R.Kuells, V.Kurz, F.Lipps, T.Loedding, M.Schmitter, C.Sikdar, R.Yang

Doctorate recipients:
J.Chen (Washington State Univ.), S.Jang (Stevens Inst. of Technology), J.Knab (Delft Univ. of Technology), M.Oh (Mercy Health Center, Oklahoma), R.Thapa (Univ. of Texas), S. Wang (Arizona State Univ.), G.Yadava (GE Medical System, Milwaukee)

Support the Department of Physics Programs

By Dr. Frank Gasparini

The Department continues to rely on its alumni and friends to support a broad spectrum of activities. These range from targeted scholarships to lectureships, exhibits and a general endowment fund. These contributions truly make the difference in the quality of our academic endeavors both at the undergraduate and graduate level. Your contributions to any of these activities are much appreciated.

To contribute your support electronically, visit www.physics.buffalo.edu and click the Support Physics button on the top right. Please contact Chris Gleason in the Physics Department at 716.645.2017, ext. 112 or via e-mail cg57@buffalo.edu or you may contact Deborah McKinzie in the Development Office at (716) 645-6000, ext. 1503, or via email at mckinzie@buffalo.edu with any questions.

Physics Department Funds

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

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

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

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

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

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

Year of Physics Exhibition:
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 initiative. Support will allow continued evolution, development, and upgrade.

Physics & Arts

2008 Morris Fellowship for Artistic Expression awarded to Art & Physics

By Dr. Doreen Wackeroth

The 2008 Morris Fellowship for Artistic Expression in the amount of $18,000 was awarded for a new Art & Physics installation in Fronczak Hall. The proposal was based upon the successful permanent Physics & Arts exhibition in Fronczak Hall that was initially created on the occasion of the 2005 World Year of Physics celebrating Albert Einstein's annus mirabilis. That installation saw the construction of a series of interactive physics displays, unique sculptures and artistic graphics intended to both instruct and lend a sense of the excitement of discovery that physics offers. Gary Nickard, UB Assistant Professor of Visual Studies, Reinhard Reitzenstein, UB Associate Professor of Visual Studies, Patty Wallace, a Williamsville artist, and UB physicists, Dr. John Cerne, Dr. Jong Han and Dr. Doreen Wackeroth, are presently working on the new Carol and Robert Morris Art & Physics installation which will include a number of entirely new permanent installations:

"The Music of the Spheres" created by artist Gary Nickard as part of the Carol and Robert Morris Art & Physics installation will be heard in the entrance foyer to Fronczak Hall.

- a sound art installation
- bronze sculptures, canvas paintings, a neon sign, all presenting artistic expressions of equations
- a Cosmic Ray Spark Chamber and a Linear Electron Accelerator.

The installation is expected to be finalized by January 2009, which will be celebrated with an opening reception in Fronczak Hall. The Physics & Arts exhibition is open to the public and guided tours can be arranged by sending email to ubexpo@gmail.com.

Physics and Art

By Prof. Gary Nickard

50 years have passed since physicist and novelist C.P. Snow delivered his infamous "two cultures" lecture at Cambridge University that cited a "gulf of mutual incomprehension" and "mutual dislike" that he felt separated "natural scientists" from "literary intellectuals." While to some today it may seem that there remains little to be shared between such apparently disparate human endeavors as physics and art, I would maintain that the "truism" of "two cultures" is actually one of those "persistent illusions" that Einstein warned us constitute "reality" as we only seem to know it. If as Richard A. Feynman quipped, "philosophers are tourists and physicists are explorers," then I would like to suggest, artists are "imagineers" (to borrow a term from Disney).

A powerful case-in-point of "consilience" between art and science occurred during the first decade after the discovery of Quantum physics as Niels Bohr struggled to re-imagine the structure of matter. 19th century positivism imagined a "classically" deterministic universe with atoms appearing as tiny but concrete objects arrayed like little solar systems. With the realization that what was actually going on in the micro-world was so bizarre as to defy conventional explanation, Bohr saw that physics needed a new metaphor, ordinary language was completely incapable of describing the new physics: "When it comes to atoms, language can only be used as in poetry."

Bohr was fascinated by cubist art because he felt that it shattered the "common sense" certainty of the object. He filled his study with cubist paintings and delighted in interpreting them for visitors as illustrations of a blurring of the illusion of solid matter. He was suggesting that the micro-world might be conceived as similar to a cubist world. To Bohr, the paintings echoed the fundamental instability of everything and by 1923 Louis de Broglie demonstrated that matter could be "pictured" as either waves or particles. Bohr maintained that how they appeared depended upon how you looked at them, implying that much like a Picasso painting, quantum theory depicted a non-Euclidean world that only made sense with an understanding of how the "picture" was structured.

What artists share with physicists is the unceasing questioning of anything imaginable. It is just this adventurousness of the spirit and excitement at possible new vistas unfolding before the senses that these two disciplines share most intimately. In fact I get a sense that there are more similarities than differences between physics and art.

"Ma Jolie" by Pablo Picasso (Paris, winter 1911-12). On view at MoMA. For more information please visit MoMA.org.

Banner: The PASI 2008 participants (please see article on page 8) created an artistic illustration of Broken Symmetry now on view as part of the Physics and Arts exhibition on the third floor of Fronczak Hall. Symmetry breaking is an important concept in physics. The 2008 Nobel Prize in physics was awarded to Yoichiro Nambu, Makoto Kobayashi, and Toshihide Maskawa for the discovery of spontaneous symmetry breaking in particle physics and the discovery of the origin of broken symmetry that predicts three families of quarks (see http://nobelprize.org/nobel_prizes/physics/laureates/2008/). For more information about PASI please visit www.physics.buffalo.edu/pasi.

Outreach

Summer workshop on LEDs for high school students

by Dr. Athos Petrou

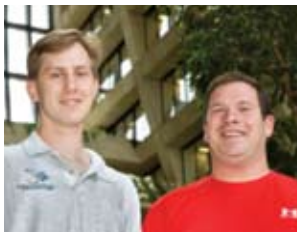
A workshop with the theme of "light emitting diodes" was offered by the Physics Department during the week of July 23, 2007 to area high school students, with the participation of Ms. Jennifer Partyka, a teacher at Cattaraugus Little Valley High School (first from the left in front row in the picture below). The workshop offered a survey of the history of science and on the operation of LEDs, a tutorial on the use of EXCEL for data analysis, and the following experiments: Uncertainty in measurement, I/V curves of LEDs, Emission spectra of LEDs, Linearly polarized light—Malus' law, and dispersion of light using a diffraction grating. The teaching materials used for the workshop can be found at www.physics.buffalo.edu/faculty/APetrou_outreach.html.

The participants of the summer 2007 workshop on LEDs for high school students of the Buffalo area.

UB QuarkNet Center

by Dr. Avto Kharchilava and Dr. Ia Iashvili

QuarkNet is an outreach program that provides an opportunity for high school physics teachers and their students to come in close contact with fundamental research in particle physics. The QuarkNet has more than 45 university centers nationwide and is supported by the National Science Foundation (NSF) and the US Department of Energy (DOE). The UB High Energy Physics group joined QuarkNet in 2006 with Dr. A. Kharchilava and Dr. I. Iashvili, both Assistant Professor of Physics, becoming mentors of the center. North Tonawanda High School physics teachers, Mr. D. McClary and Mr. L. Hiller, are lead teachers of the center. After initial training at the Physics Department, the teachers spent three weeks at Fermi National Accelerator Laboratory (Fermilab), in Batavia (Illinois) in summer 2006, where they took part in the construction of a Silicon Pixel Detector, a tracking devise for the CMS detector which will study fundamental interactions in proton-proton collisions at the LHC. Participation in the project has provided a unique opportunity for the teachers to gain hands-on experience with the state-of-the-art device commonly used for elementary particle detection. Their contribution was highlighted in a Fermilab Today article, www.fnal.gov/pub/today/archive_2006/today06-08-16.html. In 2007, Mr. McClary and Mr. Hiller were invited to Washington to participate in a NSF/DOE review meeting where they presented a poster on their work on the Forward Pixel Detector construction.



North Tonawanda High School teachers, Larry Hiller (left) and David McClary, in Wilson Hall at Fermilab. Mr. Hiller and Mr. McClary are lead teachers of the UB QuarkNet center.

Physics & Arts Summer Institute 2008

By Dr. Doreen Wackeroth

At the three-week long Physics and Arts Summer Institute (PASI) eight high-school students created artistic and interactive displays, along with a web page (www.physics.buffalo.edu/ubexpo) as well as voice recordings for a self-guided tour, featuring the concept of Symmetry and Symmetry breaking. The display has been built and installed by the CAS machine shop on the third floor of Fronczak Hall as part of the Physics and Arts exhibition. It illustrates how symmetry breaking is responsible for mass generation in the Standard Model of particle physics, which as a consequence of symmetry breaking predicts the existence of the elusive Higgs particle. The high school students visited Fermilab where they learned first hand from UB postdoc Dr. Michael Strang, about the search for the Higgs particle at the Tevatron proton anti-proton collider. PASI is funded by the National Science Foundation. The PASI 2008 team consisted of Gary Nickard, UB Assistant Professor of Visual Studies, Depew High School teacher Craig Uhrich, UB student James O'Leary, Dr. Dejan Stojkovic, Assistant Professor of Physics, Patty Wallace, a Williamsville artist, Kevin Cullinan (CAS machine shop), and Dr. Doreen Wackeroth, Associate Professor of Physics. See also the news release at www.buffalo.edu/news/9568.

Participants of PASI 2008 in front of Wilson Hall at Fermilab. PHOTO: Doreen Wackeroth

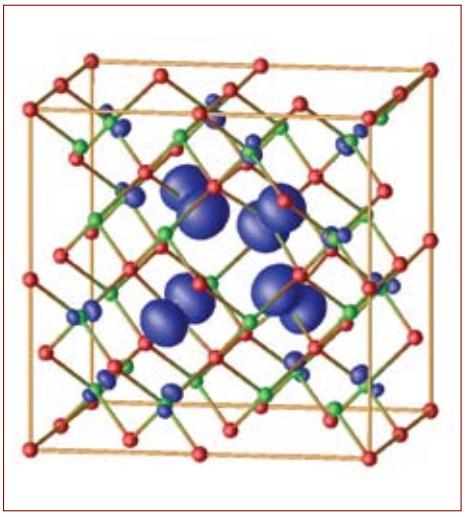
Banner: Dr. Gasparini presents a demonstration to high school students at UB's Science Exploration Day that targets WNY high school students interested in science. PHOTO: Mark Kimball

Research News & Awards

Unconventional Magnetism in GaN and ZnO

By Dr. Peihong Zhang

Magnetism is one of the oldest condensed matter phenomena known to mankind, yet the microscopic theory of magnetic moment formation and magnetic interaction remains one of the least well developed areas of condensed matter physics. Traditionally,



An isosurface of spin-polarization density associated with a neutral Ga vacancy in GaN, showing the localized nature of the defect states.

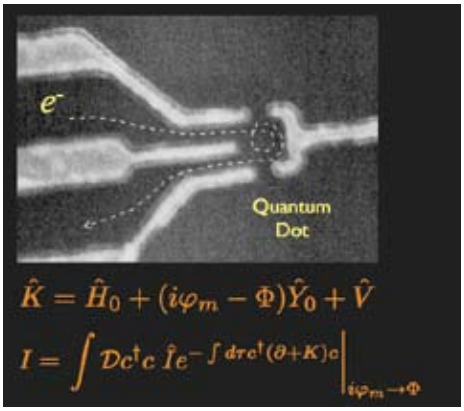
local magnetic moment formation in solids has been associated with transition metals or rare-earth elements. However, we showed in a recent paper [Physical Review Letters 100, 117204 (2008)] that certain defect states in wide gap semiconductors such as GaN and ZnO may also give rise to the formation of local magnetic moments. More surprisingly, we found that the magnetic coupling between these defect-induced magnetic moments could be extremely long-ranged. These results open a new-route towards manipulating the magnetic properties of "nonmagnetic" semiconductors through defect-engineering.

Splitting an Electron by many electrons in nanoscale devices

By Dr. Jong Han

Nano-scale electronic systems provide us with a unique window for exploring the quantum nature of many-particle dynamics. With the electronics technology pushed to the quantum limit where an electron is strongly affected by the presence of other electrons via wave-function overlap, quantum mechanics is not only a subject of fundamental science but assumes the central role in the engineering of future electronics. The key to the new framework for novel electronics design in such small scales lies in how we can control the quantum numbers of elementary particles, namely the charge and the spin. One cannot separate the charge and spin degrees of freedom of a free electron. However, quantum states through collective motion of many-electrons sometimes exhibit quanta of charge and spin at very different energy scales, enabling us to control the two properties independently – one of the truly remarkable properties of quantum many-particle systems. Now with nano-technology, we are at a very exciting stage of manipulating the quantum properties at the smallest scale and putting that into a practical use.

Dr. Han's group at UB studies the quantum statistics theory of many electron systems, in particular the electron transport in quantum dots and molecular junction systems under strong bias in electron potential. This research will provide a fundamental understanding of nano-scale electronics. Dr. Han's group has recently developed a formalism for quantum simulation [Physical Review Letters 99, 236808 (2007)] and is working on nonequilibrium transport in strongly correlated electron nanostructures.



Strong interaction among electrons confined in nanoscale devices manifests in exotic quantum states which have spin or charge characters separated. Illustrated is the electron transport in a quantum dot device.

Banner: The inside view of the dilution refrigerator, recently installed in Dr. Ganapathy's laboratory. Dr. Ganapathy, Assistant Professor of Physics, joined the department in 2006. This cryogenic device uses a mixture of two isotopes of helium: helium-3 and helium-4 to achieve ultra low temperatures that are essential to study electron transport in nanodevices. The temperature controller (pictured at the left) for the dilution refrigerator displaying the lowest temperature achieved: 8.9 mK! This cryogenic system also has a superconducting magnet capable of reaching 16 T or 300000 times earth's magnetic field.

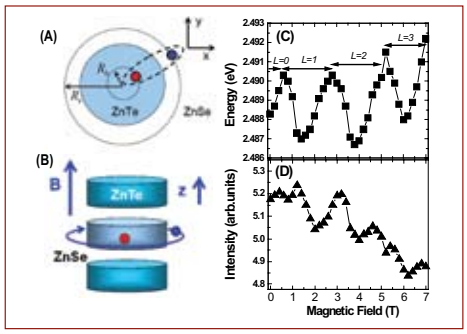
Research News & Awards

CONTINUED

The Aharonov-Bohm effect in type-II Quantum Dots

By Dr. Ian Sellers

The Aharonov-Bohm (AB) effect describes a phase shift induced upon a charged carrier as it orbits a magnetic flux in a closed trajectory (shown schematically in Figure A). Recently, Dr. Sellers and coworkers from Professor Bruce McCombe's group at UB have demonstrated that this effect is remarkably robust in columns of so-called type-II Quantum Dots (QDs), persisting up to a temperature of 180K [Physical Review Letters 100, 136405 (2008)]. In these structures the positively charged hole is confined within the central ZnTe QD by the discontinuity in the valence bands, while the negatively charged electron is located in the ZnSe barrier material, bound to the central ZnTe QD only through its Coulomb attraction to the positive hole. When a magnetic field is applied parallel to the columns of QDs (Figure B), the electron orbits the dot with a phase that is periodic with the flux penetrating the trajectory of the rotating electron and confined hole. The spatial charge separation of the carriers in type-II systems is directly responsible for the large optical AB effects in neutral excitonic systems. Since the photon emission from the QDs is directly related to the recombination of the Coulomb correlated electrons and holes (excitons), the relative phase of the electron and hole wavefunction strongly affects the energy (Figure C) and intensity of the optical emission. This produces oscillations that represent changes in the ground state total angular momentum of the neutral exciton. This modulation of the intensity occurs because the difference in relative phase of the carriers changes the quantum selection rules that 'allow' a photon to be emitted. This experimental study paves the way for further exploration of quantum coherent dynamics in semiconductor nanostructures, and may have potential implications in quantum information processing and future generation electronic/spintronic devices.



(A) Schematic of the symmetry and spatial separation of carriers in type-II QDs. (B) View of columns of type-II QDs stacked along the direction the applied magnetic field (z). (C) Energy and (D) intensity of the peak of the observed QD magneto-photoluminescence. Strong oscillations in both energy and intensity with magnetic field are observed, corresponding to oscillations in total orbital angular momentum in the presence of a magnetic field (L).

Congratulations to our recent award recipients:

Diankang Sun and Konstantinos Tzirakis won the 2008 Outstanding Teaching Assistant in Physics (OTAP) award.

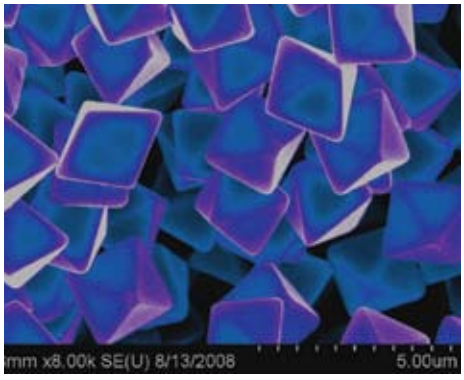
The Dr. Stanley T. Sekula Memorial Scholarship 2008/09 has been awarded to: Jonah Dayan, William Falls, Aaron Festinger, Seth Levy, Katherine Niessen, Michael Skvarch, and Andrew Tamchyna.

The Frank B. Silvestro Scholarship 2008 has been awarded to: Tariq Ali, Che-Jin Bae, Philip Cheung, Jae-Kyu Choi, Lili Chu, John Hatch, Yunfen He, Ryan Heary, Jaesuk Kwon, Yichen Li, Justin Perron, Bi-Ching Shih, Kenneth Smith, and Robert Tallman.

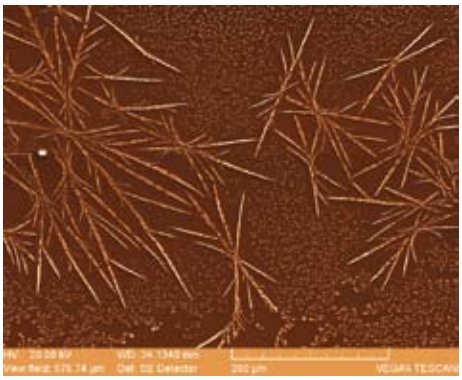
Vijay Rana received a CAMBI Fellowship (2008).

Prathiba Dev received a CAS Dissertation Fellowship (2008-2009).

Dr. Doreen Wackeroth won the UB Research Foundation Rising Star Award (2008).



First place winner of the Image competition: "Blue Diamonds" by Gen Long. See article on the UB Open House.



Second place winner of the Image competition: "Leaves of Grass" by Hui Xing. See article on the UB Open House.

Events

Second Physics Open House at UB

By Dr. Arnd Pralle

Inspired by an exciting first open house held at the Physics Department in the fall of 2007, a group of faculty got together to organize the second physics open house at UB on Saturday Oct. 18, 2008. A large group of prospective undergrads and incoming students mingled with current undergraduate and graduate students and faculty at the open house. After a general orientation presentation and tours of the research labs, the students discussed studies

The six highest ranked images entered by UB Physics students have been displayed at the second Physics Open House and the winning pictures have been presented by Dr. Wackeroth. First, second and third place winners are Gen Long (Dr. Zeng's lab), Hui Xing (Dr. Zeng's lab), and Heng Huang (Dr. Pralle's lab).

and life at UB over refreshments in the midst of aisles of research posters. One poster stood out among these: it displayed the winning photos of the first UB Physics science image competition. Current graduate students and postdocs had been invited to enter photos or images about their work in the department. The six images ranked most beautiful by a committee were displayed during the event. Creators of the top two images received attractive cash prizes. If you missed to enter your images this year, begin collecting them for next year's competition. Also, you may want to enter the science video competition, calling for short entertaining videos about UB physics research projects, which still can be submitted until the Holiday party.

LoopFest VII at UB

By Dr. Doreen Wackeroth

In May 2008, 47 particle physicists from around the world came to UB to participate in LoopFest VII, an international workshop on Radiative Corrections for the LHC and ILC. The participants of LoopFest VII exchanged and discussed scientific results that are important to fully exploit the potential of particle accelerators, such as the CERN LHC and the future International Linear Collider (ILC) , to answer some of the most fundamental questions in particle physics such as: Why do particles have mass?

LoopFest VII participants in front of UB's Clemens Hall. PHOTO: Ulrich Baur

Is there new physics beyond the Standard Model and how will it manifest itself? With the start of the LHC particle physics is at the brink of new discoveries, and the theoretical work needed for these discoveries were the topic of LoopFest VII. UB Physicists, Dr. Baur, Dr. Gonsalves, Dr. Wackeroth and Dr. Weber (now at the Max-Planck-Institut Munich), and Dr. Sally Dawson from Brookhaven National Laboratory organized this workshop, which was supported in part by NSF and DOE. Dr. Baur and Dr. Wackeroth are presently co-organizing LoopFest VIII to be held in May 2009 at the University of Wisconsin in Madison. See www.physics.buffalo.edu/loopfest7 for the slides of the presentations and more pictures of LoopFest VII.

Events Calendar

December 7th, 2008, 5:00 p.m., Pistachios: Holiday party
January 2009, Fronczak Hall: Opening reception for the Robert and Carol Morris Physics & Arts installation
March 28th, 2009: Spring Open House (Preview Day), guided tours of the Physics and Arts Exhibition in Fronczak Hall are available by request (please send email to ubexpo@gmail.com)
April 3rd, 2009 : Moti Lal Rustgi Memorial Lecture
April 4th, 2009: Retirement party for Professor Michael Fuda

UB Physicists ride for Roswell

By Dr. Mark Kimball

Twelve riders, eleven bicycles, and $2696 raised. This sums up the 2008 UB_Physics Ride for Roswell bicycle team. The Ride for Roswell is an annual event in Western New York that allows the community to support the Roswell Park Cancer Institute by pledging riders who will pedal along bicycle routes which vary from 8 to 62.5 miles. Now in its second year, the UB_Physics team had 3 riders who completed the 62.5 mile route, one who completed the 44 mile route, and the rest completing the 33, 30, and 20 mile routes. Not bad for a collection of people known more for their brains than brawn.

The UB_Physics bicycle team at the 2008 Ride for Roswell (from left to right): Chase Ellis, Mark Kimball, Jeffrey Hafner, Vincent and Sarahrose Whiteside. Not shown are: Minsoo Kim, Wolf Mosle and Doreen Wackeroth, Carol and Austin Nottingham, Andreas Stier and Laura Hovind. PHOTO: Minsoo Kim

Banner: Dr. Igor Zutic, Assistant Professot of Physics, presented a public lecture, "Putting Spin into Electronics: Vision for the Future," as part of the fest-symposium "Magnetic Excitations in Semiconductors: Bridges to the Next Decade," honoring the career of Dr. Bruce D. McCombe, SUNY Distinguished Professor and Dean of the College of Arts and Sciences. For more information about the lecture read the UB Reporter article at: www.buffalo.edu/ubreporter/archives/vol39/vol39n23/articles/SpintronicsLecture.html

The University at Buffalo Department of Physics Newsletter

In this Issue:

Graduate student Azadeh Moradinezhad cuts the cake at the welcome barbeque for newly arrived graduate students. In Fall 2008, 9 graduate students from China, India, Iran, Korea, Saudi Arabia, and the U.S., started their graduate studies at the UB Department of Physics.

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