Physics at Brown

News for Alumni and Friends **2006 Issue**

Greetings! I welcome you back to the 2006 issue of our Physics at Brown newsletter. Two thousand six has been an exciting year. In this issue we highlight some of the events of 2006. We continue to focus on moving aggressively in hiring the next generation of leaders in the frontiers of physics. It is satisfying to note that more than one third of our faculty came to Brown within the last ten years. Four most recent additions to the faculty are Meenakshi Narain, Marcus Spradlin, Derek Stein and Anastasia Volovich. We are also happy to welcome several new staff: Barbara Dailey, Jodie Gill, and Elizabeth Barlow.

Chung-I Tan

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We continue the tradition of highlighting the research of our recent Galkin Foundation Fellow, Dapeng Wang. We would like to congratulate Prof. Ian Dell'Antonio for his promotion to the rank of Associate Professor with tenure, and Prof. Michael Kosterlitz for being named the Farnsworth Professor in Physics. In addition, we highlight the progress in creating the new Center for Nanoscience and Soft Matter and the successful data release from the first three years of the WMAP satellite.

The effort in enriching our undergraduate physics instruction also continues. We highlight our highly successful Instructional laboratory and demonstration team. Many new freshman seminar courses have been developed in recent years; one such course will be described in this issue. It is also worth noting that we have begun a successful Physics Resource Center last September, where our juniors and seniors provide personalized help to students in first and second year physics courses.

This year marks the 50th anniversary of the Bardeen-Cooper-Schrieffer Theory of Superconductivity. A symposium will be held at Brown on April 12-13, 2007, to celebrate this seminal scientific achievement. We wish to remember Professor Kyungsik Kang who passed away last May, after serving Brown for more than forty years. A conference was held last summer in his memory. Lastly, after forty-three years, Ann Thorndike has decided to retire in February 2007 as the Senior Financial Administrator. We will truly miss her.

Chung-I Tan, Chair

Exploring Frontiers in Physics and in Community Outreach

"Exploring the Frontiers of Physics" is the subtitle of the new first-year seminar, Physics 11, *Inner Space Outer Space*. Dave Cutts has created a course which blends the fundamental ideas and challenges of particle physics with the latest discoveries and puzzles in cosmology. Physics 11 aims to develop an appreciation of questions like *What is Dark Matter?* and *What makes mass?* through a non-technical discussions of current ideas in particle physics and cosmology.

The course is designed to be particularly accessible to those outside the physical sciences, with ideas developed through video clips, frequent demonstrations and class discussion. Evening lab sessions include measurements of the varying brightness of several Cepheid variable stars, whose distances are then calculated, and fabrication of working cloud chambers from peanut butter jars, and their use observing cosmic rays. The class visited Greg Tucker's lab, to hear about his CMBR research, Ian Dell'Antonio's lab, to discuss the latest gravitational lensing work, and Rick Gaitskell's lab, for a briefing on laboratory searches for particle dark matter. Several particle physicists also spoke about their work.

The world-wide web serves as an invaluable tool for exploring these ideas and uncovering much useful material. To provide a focus for this exploration, the Physics 11 class uses a tool for developing a web presence which highlights the interconnection between ideas [*see* cristals.brown.edu].

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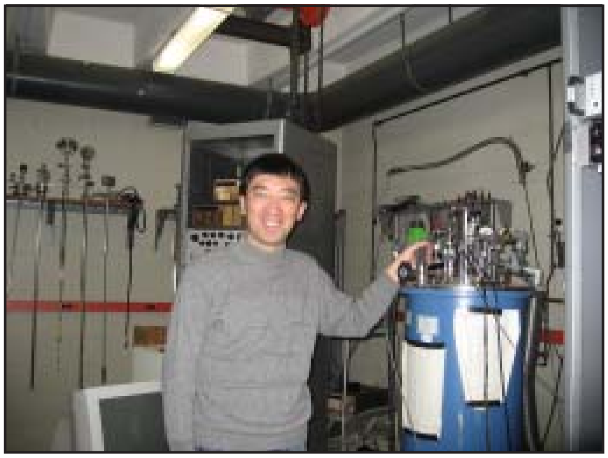
2006 Galkin Fellow - Dapeng Wang



Dapeng Wang, the 2006-2007 Galkin foundation fellow, is completing his Ph.D. dissertation research on transport in granular materials and their applications in microelectronic devices and flexible display interconnects. For the past four years, Dapeng has conducted research at Brown University, with his advisor Prof. Alexander Zaslavsky, in frequent collaboration with other faculty, including Profs. Xu, Crawford, and Feldman.

Dapeng began his Ph.D. research working on carbon nanotubes (CNTs) that have been the focus of intense scrutiny because of their unique and potentially superior electronic properties. He studied the applications of multiwalled CNTs produced by chemical vapor deposition in nanotemplates, a technique developed in Prof. Xu's laboratory to produce CNT Y-junctions. While using CNTs as the conducting material to build field effect transistors has been widely investigated, Dapeng has used the CNT as the controlling gate electrode. In particular, a Y-junction multiwalled CNT was employed as the dual gate to create a lateral electrostatic double-barrier quantum well and to control the conductance in a high mobility GaAs electron channel. The device works as lateral tunneling field effect transistor at low temperature, exhibiting conductance oscillations due to the electrostatic double-barrier potential arising from the Y-junction CNT gate. A three terminal nanotube FET could in principle be realized by using a semiconducting CNT instead of the GaAs as the conducting channel. This work was published in *Applied Physics Letters*.

In the course of studying CNT Y-junctions, the granular character of these materials became evident, leading Dapeng to study the transport properties of the CNT material itself as a function of temperature, applied electric and magnetic fields, and the granularity itself (which can be altered by annealing the CNT material at high temperatures). In close collaboration with Prof. Feldman, the observed transport characteristics were analyzed in terms of variable range hopping in the unusual geometry of a pseudo-two-dimensional granular material wrapped into a cylinder.

Simultaneously with his granular CNT transport research, Dapeng embarked on a project involving granular metal interconnects for flexible display applications, in collaboration with Prof. Crawford's group. Compared to planar electronic technologies on rigid silicon or glass substrates, flexible electronic applications like flexible displays, sensitive skin sensors, electronic textiles and electronic paper displays, are currently underdeveloped, and the same is true for other large area applications (wearable electronics, electrically active sensor arrays large enough to cover macroscopic irregularly shaped objects, large solar cell arrays, etc.) In all of these applications, active electrical devices – transistors, LCDs, light emitting diodes (LEDs), lasers – must be integrated on large-area flexible substrates and must withstand significant and repeated mechanical strains, both tensile and compressive, without losing functionality. Most high-performance active devices are built from stiff materials – e.g. amorphous or nanocrystalline Si thin film transistors (TFTs), indium-tin-oxide (ITO) LCD cells, etc. In order to integrate such devices onto a flexible substrate, they must be fabricated on small islands and connected with robust and stretchable interconnects. Therefore in recent years, much research effort has focused on understanding the basic phenomena responsible for failure of thin metal or conducting oxide layers on stretchable substrates.

In collaboration with Prof. Crawford's group, Dapeng has investigated a robust granular metallization scheme ideal for interconnects required in flexible display applications. Multi-layered metal interconnects including a granular discontinuous ductile indium layer were deposited on a variety of compliant substrates. Experimental results demonstrate that the multi-layered films maintain a continuous electrical path through the interconnect lines via a bridging mechanism observed in the specimen after a mechanical loading force is applied`. There is a minimal change in resistance even when subjected to large mechanical strains and repeated low-strain fatigue loading. Initial analysis of deformed films also suggests there is a possibility for a self-healing process, due to local heating when the current is passed through the high-resistance bridging links. A finite element analysis (FEA) model of the thin-metal film/polymer substrate structure, also confirms the stretchability of the granular indium islands observed to be bridging the cracked regions in the underlying stiff conductive layers. This work has been published in *J. of Applied Physics* and presented at the *Society for Information Display* international conference.

During his Ph.D. studies, Dapeng participated in a number of international scientific conferences and has authored seven papers (five as first author). He is also a co-author on a patent filed on the flexible conductor work.

The Galkin Foundation Fellowships are funded through a generous donation by Mr. Warren Galkin, Class of 1951. Each year the Fellowship recognizes exceptional promise and achievement in physics by a senior graduate student.

Professor Kyungsik Kang Memorial


Kyunsik Kang

Prof. Kyungsik Kang came to Brown in 1964, and, for more than forty years, he served Brown faithfully as a member of the Physics Department. He retired from teaching in 2005. Prof. Kang passed away last May 8th at the age of 67. He leaves behind his wife, Hailanne, three sons, Peter, Michael, and David, and two grandchildren.

Kyungsik graduated from Seoul National University in 1959, and obtained his Ph.D. from Indiana University in 1964. He was an active researcher in the field of theoretical particle physics, with more than two hundred refereed journal publications and articles. He was elected a Fellow of the American Physical Society, the Korean Academy of Science and Technology, and the Korean Physical Society. Kyungsik was also a dedicated teacher at Brown. He set a high standard for all his students, a practice which was much appreciated. He was also active in his service to the University. He served on Advisory Committee on University Planning and was also a former Chair of the Nominating Committee.

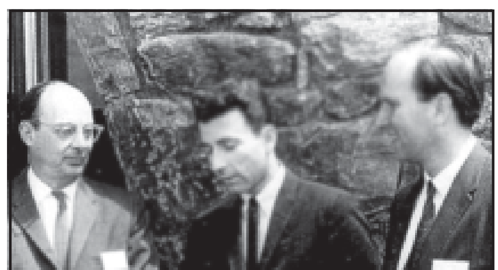
Kyungsik was among the first generation of Korean scientists who had the opportunity to come to America to study. He remembered to pay back his good fortune, like an honorable son, by helping generations of young Korean graduate students come to Brown. His legacies will include his contribution in bringing all things Korean to Brown, and in introducing the development of modern theoretical physics to Korea.

Kyungsik was proud of his heritage and would take advantage of every opportunity to educate and introduce Korean culture to the un-initiated. He was equipped with a near photographic memory, and he was a world traveler. He knew all the good Korean restaurants in every corner of the world. During any International physics conference, we could always count on Kyungsik to recommend a delicious Korean meal, whether it was in Hamburg, Tokyo, Singapore, Melbourne, or Paris.

A Physics Conference was held at Brown on July 6th in his memory, with speakers coming from as far away as Australia. A memorial service was held on July 7th. It was said during this service: Through Kyungsik, we have all been brought together, as members of a global family. By bringing us together, with all our different backgrounds, our likes and dislikes, he has enriched us all. For us at Brown, this singular achievement is Kyungsik's personal legacy.

BCS THEORY

The Physics Department is sponsoring the Symposium, "50 Years of the BCS Theory of Superconductivity" to be held April 12th and 13th , 2007 at Brown. The symposium will highlight and celebrate the 50th anniversary of the formulation of the theory of superconductivity. The theory, formulated in 1957 by J. Bardeen, L. Cooper and J. R. Schrieffer, has had a major impact on physics and modern science. It represents a most important pillar of scientific thought, enjoying major applications and considerable theoretical influence. It has been investigated from many perspectives, and has fruitfully been applied to solve open fundamental problems. It stands as an outstanding achievement in the development of twentieth century knowledge with far reaching applications in science and technology.


J. Bardeen, L. Cooper and J. R. Schrieffer

Brown physics celebrates this major scientific accomplishment with its colleague Leon Cooper. Prof. Cooper was a central contributor to the theory, first providing a discovery of a novel phenomenon (known as "Cooper pairing") and then formulating the full theory in collaboration with John Bardeen and J. R. Schrieffer at the University of Illinois. The Nobel Prize given for this work (to Bardeen, Cooper and Schriefer) represents one of the glowing successes of US science.

The two-day Symposium will feature talks by outstanding experts that bring out the range of fields the theory has impacted through the years: from Applied Physics to Particle Physics and Cosmology. This meeting will be a gathering of an international group of scientists, each of whom has left his mark on the developments of physics, allowing them to highlight new discoveries from their own unique perspectives. It is planned to be a most handsome tribute of both historical and current interest. The lectures are planned to be of broad scope and relevance. They will be accessible to general faculty and graduate and undergraduate students in all disciplines.

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New Center for Nanoscience and Soft Matter

Physicist Richard Feynman anticipated the rise of a new field of science called "nanoscience" in a 1959 lecture entitled "There's Plenty of Room at the Bottom." A proposal from the departments of physics and chemistry and the division of engineering for a new Center for Nanscience and Soft Matter (CNSSM) that would conduct studies in this emerging field is now advancing towards approval by the full Brown faculty.

Materials science is one of the most exciting and broad fields of research involving cross-disciplinary collaborations. As research and development has moved to the nanometer (one billionth of a meter) length scale, the field has actually grown broader because of the need to incorporate chemistry, physics and engineering into the mix of disciplines that need to be used together to make further progress. The Intel chips found in new laptop computers have features etched into silicon as small as 65 nanometers, but the next major advances in materials science may come in the area of "soft materials" such as colloid suspensions, liquid crystals, and membranes as these are explored at the nanoscale. The primary aim of CNSSM is to promote frontier research in such nanoscience. CNSSM will foster the development of collaborations and intellectual exchanges between faculty in chemistry, engineering, physics, and other departments such as biology, something now viewed as essential for making rapid and prominent progress.

Brown chemistry, engineering, and physics faculty have already begun to expand their research efforts in the nanoscience direction. Recent faculty hires in the area of nanoscale soft condensed matter include Professors Shouheng Sun in chemistry, Thomas Webster in engineering, and Derek Stein in physics. These new faculty have substantially increased opportunities for on-campus collaborations among Brown chemists, engineers and physicists. Together with anticipated future faculty hires, and an emerging partnership with Oak Ridge National Laboratory in Tennessee, Brown's CNSSM is expected to become one of the most exciting centers for materials research in the nation. It will also be a key component of a larger scale Institute for Molecular and Nanoscale Innovation (IMNI) being proposed at Brown. One immediate impact will be a substantially expanded graduate program in this area. A new joint seminar series already started last fall. Development of new graduate courses will follow, and these courses will provide the means for regular intellectual exchange that bring parties together and also attracts new members to the center.

The center will also foster the development of undergraduate programs in nanoscale studies, along the line of existing Engineering-Physics and Chemical-Physics programs. It is anticipated that new concentrations in nanoscience will emerge from the CNSSM initiative. Each participating department plans to offer new courses in the area of nanoscience and soft matter. Current offerings include CH0156, "Nanomaterials: Synthesis and Applications," PH0161, "Biological Physics," and EN292/BI284 "Small Wonders: Science, Technology, and Human Health Impacts of Nanomaterials." First year seminars and courses designed for the proposed Brown Science Cohort program are also being planned.

Exploring Physics and Community Outreach
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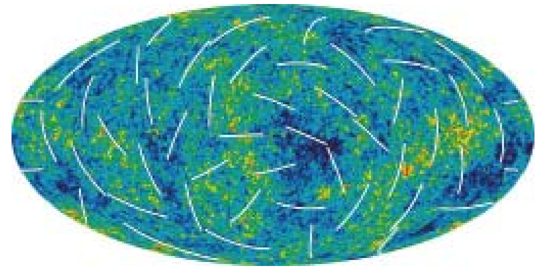
Community outreach is a central component of Physics 11. Students formed four groups, and each gave class presentations on specific topics of their chosing at three Providence high schools: Hope High, Lincoln, and the Met School. Outreach serves as an important capstone for the semester, as students learn the effectiveness of explaining ideas in developing their own understanding. They also are enriched by the high school students' enthusiasm, interest and appreciation of their efforts. Graphic demonstrations and hands-on involvement were really effective. To mention one such, the Dark Matter group contrasted a bursting balloon filled with water with one filled with a dense mixture of chocolate pudding, which illustrates indelibly the role of dark matter in restraining the Big Bang sufficiently to allow the formation of galaxies.

Hope High students helping with a Physics 11 demonstration showing how mass curves space

A Physics 11 team explaining the expansion of the universe to Hope High students.

CMB POLARIZATION



Polarization of the cosmic microwave background (CMB) as measured by WMAP. The colors indicate intensity variations in the CMB. (Credit: NASA/WMAP Science Team).

On March 16, 2006, the Wilkinson Microwave Anistropy Probe (WMAP) team released the data from the first three years of the WMAP satellite. Professor Greg Tucker is a member of the WMAP team and worked on building the WMAP satellite.

This data provides the first full-sky polarization maps of the cosmic microwave background (CMB). The CMB is the remnant afterglow from the beginning of the universe 13.7 billion years ago. The polarization information provides a window on the universe during its first trillionth of a second, during the periods of inflation when the universe grew from submicroscopic size to astronomical size in the wink of an eye.

In 2003, NASA announced that the WMAP satellite had produced a detailed picture of the infant universe by measuring fluctuations in temperature of the afterglow — answering many longstanding questions about the universe's age, composition and development. The WMAP team has built upon those results with a new measurement of the faint glare from the afterglow to obtain clues about the universe's first moments, when the seeds were sown for the formation of the first stars 400 million years after the beginning of the Big Bang. The WMAP results have been accepted for publication in the Astrophysical Journal Supplement and are posted online at http://wmap.gsfc.nasa.gov/results.

The newly detected pattern, or polarization signal, in the glare of the afterglow is the weakest cosmological signal ever detected – less than a hundredth of the strength of the temperature signal reported three years ago. The new WMAP data, combined with other cosmology data, also support established theories on what has happened to matter and energy over the past 13.7 billion years since its inflation, according to the WMAP researchers. The result is a tightly constrained and consistent picture of how our universe grew from microscopic quantum fluctuations to enable the formation of stars, planets and life.

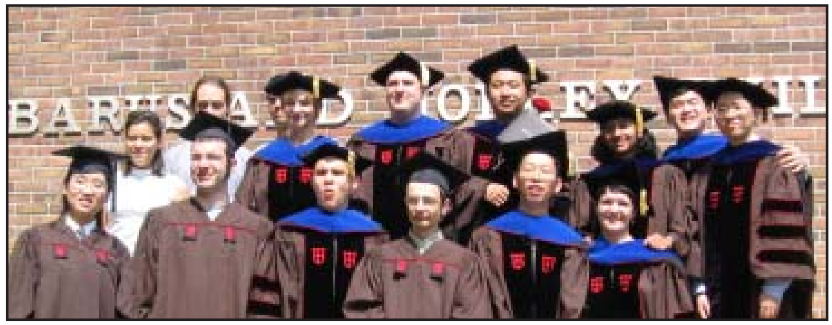
According to this picture, only 4 percent of the universe is ordinary familiar atoms; another 22 percent is an as yet unidentified dark matter, and 74 percent is a mysterious dark energy. That dark energy is now causing another growth spurt for the universe, fortunately, more gentle than the one 13.7 billion years ago

BCS Theory - continued from page 3

Invited speakers: Anthony J. Leggett, John D. and Catherine T. MacArthur Professor and Center for Advanced Study Professor of Physics at the University of Illinois, is the recipient of the 2003 Nobel Prize in Physics for his pioneering work on superfluidity. Frank Wilczek, Herman Feshbach Professor of Physics (MIT), together with H. David Politzer and David Gross, is a recipient of the 2004 Nobel Prize in Physics for the discovery of asymptotic freedom in the theory of the strong interaction. Wolfgang Ketterle, John D. MacArthur Professor of Physics (MIT) is the recipient of the 2001 Nobel Prize in Physics, together with Eric Cornell and Carl Wieman, for the achievement of Bose-Einstein condensation in dilute gases of alkali atoms, and for early fundamental studies of the properties of the condensates. Leon Cooper, Henry Ledyard Goddard University Professor (Brown Univ) and Director of Brown University's Center for Neural Science is the recipient of the 1972 Nobel Prize in Physics, together with John Bardeen and John Schrieffer, for the theory of superconductivity, usually called the BCS-theory. Alexis P. Malozemoff, Exec. V. P. and Chief Technical Officer, American Superconductor Corporation, is recognized for his work in the field of superconductivity. He was awarded the superconductivity person of the year in 2004 and IEEE Distinguished Lecturer on Superconductivity.

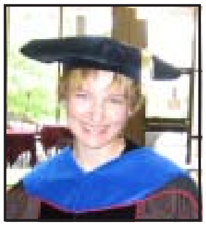
The second day will feature new scientific developments and breakthroughs with talks by Eugene Demler (Harvard), Alexei Kitaev (Caltech), Robert Schoelkopf (Yale), J.S.Tsai (NEC Research, Tokyo), Matthew Fisher (KITP) and contributions from Profs. Sean Ling, Gang Xiao and Brad Marston. We look forward to two days of exceptional talks on both experimental and theoretical physics on our campus.

2006 PhD Recipients



Artur Adib
"Exact Results in Nonequilibrium Statistical Mechanics: Formalism and Applications in Chemical Kinetics and Single-Molecule Free Energy Estimation"

Anastasia Anishchenko
"Two Alternative Models of Neuronal Connectivity: Committed Complex Cells and Small World Networks"



Michael Attisha
"Cryogenic Dark Matter Search (CDMS II)- Application of Neural Networks and Wavelets to Event Analysis"

Andrew Callan-Jones
"Topological Defects in Liquid Crystalline Matter: Strain Transitions, Simulations, and Visualization of Core Structure and Fluctuations"

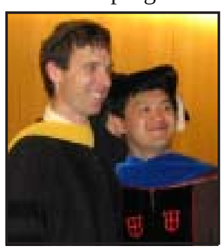
Sera Cremonini
"Interactions in Anti-DeSitter Space"

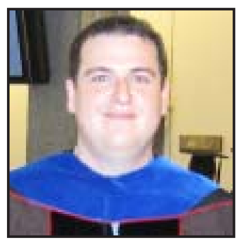
Karine Guevorkian
"Experimental Studies of Protozoan Response to Intense Magnetic Fields and Forces"

Yiping He
"Physics of Novel Nitride Semiconductor Light Emitters"

Jaiseung Kim
"The Millimeter-wave Bolometric Interferometer (MBI) for Observing the Cosmic Microwave Background Polarization"

Kyung-Taek Lim
"Chiral Extension of Lattice Field Theory with Ginsparg-Wilson Fermions"





Guo-Xing Miao
"Influences of Electron Spin Ordering on Spin Dependent Transport"

Sowmya Venkataramani
"Compact Semiconductor Light-Emitting Diodes for Dynamic Imaging of Neuronal Circuitry"

Jorge Viamontes
"Isotropic to Nematic Liquid Crystalline Phase Transition of F-Actin"

Guohua Wang
"The Physics of Inhomogeneous Strain-induced SiGe Quantun Rings and Ellipses"

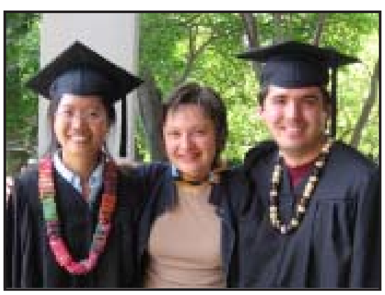
Jigang Wang
"Statistical Pattern Recognition"

Lei Wang
"Structural and Functional Characterization of Synapse-Associated Protein-97"

Gary Scott Watson
"String Gases in the Early Universe"

Peter Zannitto
"Generation and Detection of Surface Acoustic Waves in Al"

2006 Senior Honors Recipients



Emily M. Conover, "Nonequilibrium Statistical Mechanics of a Geophysical Jet" Advisor: Prof. Marston

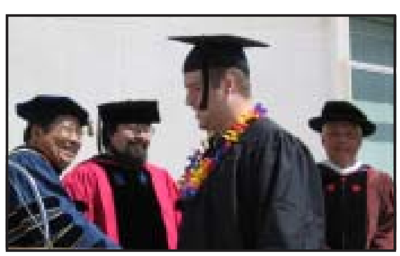
Alison L. Errico, "Defects in Liquid Crystals" Advisor Prof. Pelcovits

Worasom Kundhikanjana, "NMR Study of FeSb2" Advisor: Prof. Mitrovic

Stefan W. Leichenauer, "Nonperturbative Effects in the Dynamics of Fermi Liquids" Advisor: Prof. Jevicki

Benjamin B. Machta, "Attractor Array Dynamaics" Advisor: Prof. Guralnik, Prof. Anderson

John D. Murray, "Black Holes, Topological Strings, AdS/CFT, and Anomalies: New Methods in Black Hole Entropy Counting" Advisor: Prof. Lowe



Eric J. Perlmutter, "The Average Null Energy Condition and Vector Perturbations in Randall-Sundrum Brane-Worlds" Advisor: Prof. Lowe

Etienne D. Reyes, "Classifying n-Back EEG Data Using Mutual Information and Neive Bayes Classifier" Advisor: Prof. Nescovic

Adam A. Straub, "Low Temperature NMR Probe Design" Advisor: Prof. Mitrovic

Jennifer L. Swearingen, "Basic String Theory" Advisor: Prof. Jevicki

Robert Charles M. Rosenthal, Trustee, Awarded Diplomas

Kosterlitz Named Farnsworth Professor

Mike Kosterlitz

In recognition of his major contributions to theoretical physics, Professor J.M. Kosterlitz was named to a Farnsworth Professorship in Physics this past July. Mike, who has been at Brown since 1982, has received multiple accolades from the scientific community. He was named a Fellow of the American Physical Society, received the Maxwell Medal from the U.K. Institute of Physics in 1981 and, in 2000 was awarded the Onsager Prize by the American Physical Society.

Professor Kosterlitz's first and most famous efforts in condensed matter physics sorted out an apparently impossible contradiction that existed between theory and experiment. Rigorous theorems seemed to eliminate the possibility that liquids confined to two dimensions could become superfluids or crystalline solids. Experiments on thin films of Helium, however, indicated a phase transition to a zero viscosity superfluid state. Having been trained as a high energy theorist and consequently, "not being burdened with the conventional wisdom about phase transitions, or being completely ignorant" in the words of Mike — he, along with David Thouless, developed the theory of topological phase transitions. Two publications in the Journal of Physics in 1973-74 laid the foundation of this field, solved the conundrum and have since been cited over 6,600 times. The Onsager prize citation read, *"For the introduction with David J. Thouless of the theory of topological phase transitions, as well as his subsequent quantitative predictions by means of early and ingenious applications of the renormalization group."*

Currently, Professor Kosterlitz attacks the "even more difficult problem" of describing how a system, driven out of equilibrium, evolves to its final stationary state. An everyday example of this is a pot of water on a hot stove which, despite being a very common example, is actually not well understood. Another example is an adult animal which can be regarded as a driven out of equilibrium system in a steady state. This path deviates from most of his previous research, which centered on the behavior of systems in a state of thermal and mechanical equilibrium. His recent numerical simulations of simple, yet mathematically insoluble, models that he developed have yielded results that appear sensible. Encouraged, he intends to unleash these models on a range of physical systems including convecting fluids and perhaps, his colleagues.

Ian Dell'Antonio Promoted to Associate Professor

Ian received his Sc. B. in Physics from Haverford College in 1989 and his Ph.D. from Harvard University in 1995. Prior to joining the faculty in September of 1999, he was a postdoctoral researcher at Bell Laboratories in Murray Hill from 1995 to 1998 and an Institute Fellow at the National Optical Astronomy Observatories in Tucson. His research focuses on the dark matter and dark energy distribution in the universe. He is one of the leaders in the field of gravitational lensing, using the space-time distortions around massive objects to measure the dark matter content and the growth of structure in the universe. He is co-PI of the Deep Lens Survey, an important ground-based gravitational lensing survey, and he has recently become the team leader of the gravitational lensing experiment on the DESTINY experiment, one of the final candidates for a NASA-DOE Joint Dark Energy Mission (JDEM). For the past few years, Professor Dell'Antonio has taught the undergraduate astronomy and cosmology courses; this spring he will be inaugurating the graduate course in cosmology.

Ian Dell'Antonio

Physics at Brown

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We welcome your comments and contributions!

Staff News

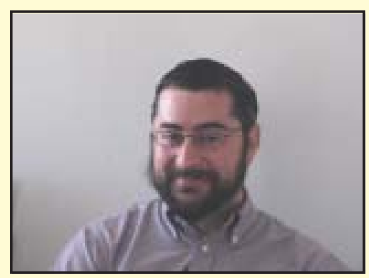
Barbara Dailey

Barbara Dailey has recently joined the Department of Physics staff as the Administrative Assistant, Facilities. Barbara began with us on the Limited Duration Payroll in August while we were in transition. Happily, both she and the Department were eager to continue working together, and we are pleased to have retained her in this position.Barbara came to Rhode Island from "the Jersey Shore" in the late 70's as an undergraduate at Brown and now resides in Foster. She feels right at home in the Physics Department and can hardly believe that she joined us but a few short months ago. Barbara's diverse background has prepared her well for the lively pace and dynamic atmosphere she has found here and she is glad to contribute her efforts to the smooth functioning of the Physics Department.

Jodie Gill

One of our newest additions to Physics is **Jodie Gill**, Student Affairs Coordinator, a native of the City of Providence. Upon graduating from the University of Rhode Island with a BA in Education and Psychology she joined Urban League of Rhode Island to coordinate and implement a computer skills training program. With her clear understanding of the correlation between program outcomes and recruitment, she was sought out by the Operation March Program to retain student involvement with the program as the Retention Specialist. She was rapidly promoted to manage the employment training program, until funding was no longer available in 2004. Jodie is currently collaborating with Physics' faculty and students to provide support in a vigorous, productive manner. This includes broadening the relationship between our graduate and undergrad students and the Department.

Conan Kelly joined the department as an IT and financial support team member, January 2004. The following year he added acting System Administrator to his job title. The new title was made official in July of 2005. Conan spent the previous nine years at a Knox College, in Galesburg, IL. He was first associated with Knox College as an undergraduate student and then stayed to work as a full-time staff member with the Computer Center. After a brief visit to the world of internal banking support, during the fall of 2003, Conan is happy to be back in an academic environment. Though he came to enjoy cornfields and open spaces, he's excited by the new coastal scenery.



Conan Kelly

Carol Lacroix, DCC/Administrative, joined the Physics Department in September 2005 and quickly acclimated herself to its workings. Her background is in Computer Information Technologies and she enjoys looking for new areas to apply this knowledge in Physics through ways to streamline existing processes in the department to expedite the work of faculty and staff. Carol enjoys working on the Physic's web pages and always appreciates feed back from the website's visitors. Her close work with Conan Kelly, the system administrator has added strength to the department's computing support services. One of Carol's favorite parts of her position is conversing with a student, faculty or staff member and then designing something needed which will bring an improvement of some type their way.

Carol Lacroix

New Faculty

Meenakshi Narain

Meenakshi Narain

Meenakshi Narain, who will join the Department of Physics in January, played an important role in the discovery of the top quark. She's still on the prowl for new discoveries.Attracting her interest are things like technicolor models – theories that go beyond the Standard Model of particle physics. "We haven't observed anything yet," she said, "but it is fun to keep on looking."

Some form of technicolor may be discovered at the Large Hadron Collider (LHC), the world's largest particle accelerator, near Geneva, Switzerland. Narain is expected to play a central role once the facility begins operating in the coming year. In preparation, she is conducting a research project – "Development of Techniques to Identify the Signatures of Little Higgs Models at the Large Hadron Collider with the ATLAS Detector" – this fall as a fellow at the Radcliffe Institute for Advanced Study.

The possibility of discovering new models ... is so large that there's great excitement among experimental physicists," Narain said. "We may find something that defines the future of particle physics. Nobody really knows what may be there"

In addition to conducting research at the LHC, Narain's work at Fermilab, where she has been a key player in the D–Zero Collaboration, will continue. "Fermilab will collect a lot more data – it's a more improved accelerator," she said. "Data accumulated there may give us ... a new energy regime – something we have never explored before. It will be fun to see something absolutely new. That's what keeps us going."

Narain, who received her doctorate in physics from State University of New York–Stony Brook, comes to Brown from Boston University, where she has taught since 1998. As an educator and researcher, Narain considers it part of her mission to encourage minorities and women to consider a career in the physical sciences. At Boston University, Narain was active in creating programs that helped build science skills and interests in youngsters beginning at an early age.

Marcus Spradlin

Marcut Spradlin

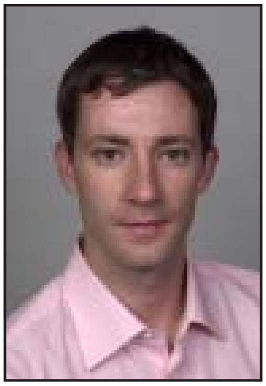
Marcus Spradlin, the new Manning Assistant Professor of Physics, received his A.B. from Princeton University in 1996 and his Ph.D. from Harvard University in 2001. He joins Brown following postdoctoral work at Princeton University, a research appointment at the Kavli Institute for Theoretical Physics in Santa Barbara, and a sabbatical year at the Institute for Advanced Study in Princeton.

Spradlin is a theoretical physicist whose research, funded by the National Science Foundation, focuses on string theory and its applications to various problems in particle and gravitational physics.

One of the most exciting developments in string theory in the last decade has been the discovery of dualities relating various string theories to each other or to ordinary quantum field theories. These dualities provide new ways of thinking about important problems in theoretical physics, such as the problem of quark confinement in QCD or the problem of understanding the quantum microscopic degrees of freedom of black holes.

These two examples are actually not unrelated, as they might seem at first. In fact duality implies a mathematical relation between QCD, which describes the strong nuclear interaction that binds together elementary particles inside protons and neutrons, and quantum gravity, including the formation and evaporation of black holes.
This mathematical relation is widely viewed as being the most promising road towards the formulation of a mathematical solution of gauge theories such as QCD.

Derek Stein



Derek Stein

Biomolecules such as DNA, RNA, and proteins are the fundamental machinery of life. Despite their importance, biomolecules remain difficult to study in detail because they are so extremely small and operate under water. Derek Stein, who joined the Physics Department this fall, is working on new ways to study these fascinating molecules up close and personal and one at a time.

Professor Stein takes advantage of techniques used to make the smallest features of modern computer chips to build nano-scale devices so tiny that they can manipulate and study an individual molecule. For example, a small hole or "nanopore" whose diameter is comparable to that of DNA (only 2.5nm wide) can be used to electrically detect individual molecules in their native, aqueous environment. Electric fields pull the DNA molecule through the pore like sucking up a piece of spaghetti, a process that can rapidly measure a molecule's length, conformation, and perhaps one day even the sequence of bases that encodes genetic information.

Derek arrived at Brown after completing his Ph.D. at Harvard University, followed by postdoctoral research at the Delft University of Technology in the Netherlands. But it was as an undergraduate at McGill University that an encounter with Nobel Laureate Heinrich Rohrer set Derek off on a course to explore the nanoworld. Rohrer, who co-invented the scanning tunneling microscope, "had an inspiring approach to science," says Stein. "Their research on quantum mechanical tunneling resulted in an instrument that can image individual atoms – something that had seemed like pure fantasy. It happened because the inventors asked 'why not?' The laws of physics allow it, and the technical challenges didn't intimidate them. I think there's a lesson to be learned by people who want to study biology at its fundamental scale."

The "nano-bio" approach appeals to Derek for several reasons: A physicist can bring sensitive new experimental tools to bear on biology. Second, the nano-scale of biology is often dominated by fascinating physical effects that are not perceptible at larger scales. Finally, single-molecule research has the potential to deliver truly revolutionary biomedical applications.

To do all this, Derek looks forward to collaborating with researchers from a diversity of disciplines. "Brown seems like a great place to do this. I've been impressed by how interested and supportive people are of one another."

Anastasia Volovich

Anastasia Volovich

Anastasia Volovich, the new Richard and Edna Salomon Assistant Professor of Physics is working on the frontier of string theory. Her research in that realm, a world of particle physics, general relativity, mathematics, gauge/string dualities, black holes, de Sitter space, noncommutative geometry, and string field theory has earned national and international recognition. The author of more than 35 scientific publications, Volovich has been an invited speaker at string theory conferences and workshops around the world.

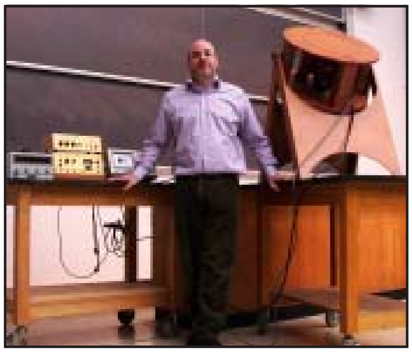
These days, Volovich finds herself exploring the gauge theory and quantum gravity. She is using the insights coming from and inspired by string theory to address long-standing problems in gauge theories with the eventual goal to solve QCD. One direction of her research is the study of nonperturbative Yang-Mills and \$AdS_5\$ string theory with the aim to make theoretical predictions for the experimentaly observed spectrum of strongly interacting particles. Another direction is concerned with the application of methods inspired by twistor string theory to the calculation of perturbative QCD scattering amplitudes. Improvement in this area of QCD is especially urgent since QCD processes will be the dominant physics at the Large Hadron Collider experiment which is coming online in the near future.

Anastasia grew up in Moscow, Russia and studied physics at Moscow State University, where she received her Masters degree in 1999. She moved to the US in 1998, and in 2002 received a Ph.D from Harvard University. More recently, she conducted postdoctoral research at the Kavli Institute for Theoretical Physics at the University of California, Santa Barbara and at the Princeton Institute for Advanced Study. Volovich has won several awards and honors, including a Soros Foundation fellowship (1996-1998), the Khoklov Prize at Moscow State University for the best masters degree thesis (1999), and the Van Vleck Award presented to an outstanding prospective student by Harvard University (1998).

Highlights from the Instructional Labs and Lecture Demonstrations

Ken Silva, manager of the introductory and intermediate labs, has his hands full and he is very happy to have the Semester Startup sheets, the new WIKI website and his 14 new computers. Already the new computers have been connected to lab interfaces and interfaced to digital video cameras to create powerful data collection tools for our signature labs PH 5, 6, 7 & 8 where our undergraduates design their own topic specific experiments. In the intermediate labs, the computers and digital video cameras have also made a dramatic improvement to the data collection and processing of our newly renovated Zeeman Effect experiment, which was presented at the 2006 summer AAPT meeting in Syracuse, NY.

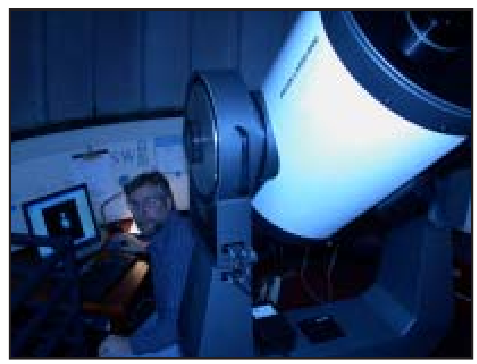
Ken Silva with our improved and digitized Zeeman apparatus. Using computer interfaced video cameras students can now collect and process their data digitally.



Jerry Zani with our newly acquired Earth's Field NMR device. With this apparatus students can observe the basic principles of NMR in the classroom.

Thanks to Jerry Zani, manager of lecture demonstrations our demonstration area continues to grow in popularity. In addition to the many and frequent demonstrations used by the introductory and intermediate courses, graduate courses now routinely request demonstrations. Since our collection includes Single Photon Double Slit Interference, Super Fluid Helium, STM and our recently acquired Earth's Field NMR, you can see why.

Bob Horton, manager of the astronomy labs & supervisor of the Ladd Observatory staff has been working hard with the faculty making major and significant improvements to the Astronomy labs. With a new and remarkable astronomical CCD camera coupled to our 16" telescope and 6 new computers our students can take great images from our roof top observatory and process them in B&H 218. While we still heavily promote direct telescope use, we can now offer interesting and challenging indoor labs, such as examining the properties of variable stars and calculating the positions of asteroids with astrometry, for those, all too frequent, cloudy nights.



Bob Horton with our new astronomical CCD camera (not shown) coupled to our 16 inch Mead telescope. With this new imaging system, students can take excellent images of faint astronomical objects, such as the Horsehead Nebula, from the roof of Barus & Holley.

Dean Hudek with graduate students Paul Huwe and Helen Hanson Holding the S-N-I thin film junction they created this fall in PH201. Though students routinely make N-I-S junctions in PH20, this is our first successful S-N-I-S junction.

Though Dean Hudek, Laboratory Physicist and Director of Instructional Labs, is involved with all of the instructional labs and the demonstration area, much of his time is spent in the advanced labs PH 156 & PH 201, which continue to run smoothly. All existing computers were upgraded and interfacing them with some of the older hardware provided quite a challenge, major improvements were made to our CW NMR lab and graduate students Helen Hanson and Paul E. Huwe created our first S-N-I-S thin film junction. Apparently, the junction was the result of contamination in the evaporator caused by a previous user. PH 201 Professor Sean Ling explained the strange oscilloscope traces and verified his theory with a simple horseshoe magnet. Helen and Paul proved up to the challenge and gave an excellent power point presentation on the phenomena. It was all very exciting! Life is never dull in the instructional labs.

Physics at Brown

Physics at Brown Newsletter
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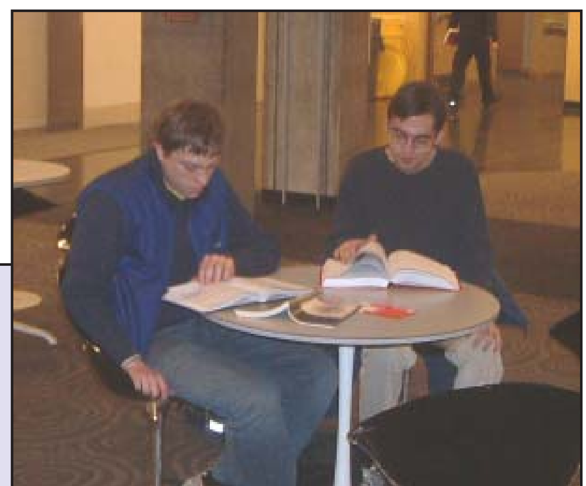
ALUMNI, WE'D LIKE TO HEAR FROM YOU!
News? Comments?
Please write to the above address or e-mail us at newsletter@physics.brown.edu

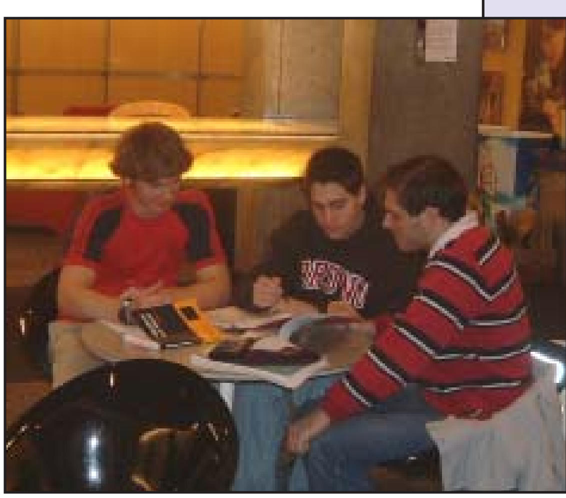
Undergrad Resource Center

On Wednesday evenings, the lobby of Barus&Holley hums with activity.

The Physics Resource Center, organized by the Department Undergraduate Group (DUG) and staffed by upperclassmen volunteers led by DUG president Andrew Potter, provides a popular place for students to meet and discuss the material of the first and second year physics courses.



Students catching up on studies at our new Resource Center



Upperclassman Ted Baker helping Physics 8 students

This opportunity for peer-learning, generously supported by a donation from Professor Theodore D. Foster ('50), has helped generate a sense of community for the students in the department and provides a vital link between the lower- and upper-classmen.