# Physics at Brown

**News for Alumni and Friends** **2003 Issue**

Greetings! I welcome you back to the 2003 issue of our Physics at Brown newsletter. Foremost of all we wish to honor the memory of Professor Anthony Houghton, who passed away in July 2003 at the age of 67. Tony was a close friend and mentor to many of us, a widely respected physicist and a determined champion of the Department and the University. Tony provided inspired leadership through his work in theoretical condensed matter physics and as Physics Chair, from 1992-1998. We miss his deep knowledge of physics, his keen-edged sense of humor and his devotion to scholarship and service.

**Table of Contents**

*Greetings from the Chair............1*
*Beautiful Theories of Physics .....1*
*Galkin Foundation Fellowship...2*
*Tony Houghton..........................3*
*Watching the Flow of Electricity..4*
*Breakthrough of the Year............5*
*Biophysics.................................6*
*New Faculty...............................7*
*PhD's & Honors Recipients........8*
*Awards and Promotions..............9*
*Laboratory Instruction............. 10*
*What's New in Physics..............11*

In remembering Tony Houghton we recognize again the central role of our faculty, in defining the Department. In this issue, we are delighted to welcome Assistant Professor Jay Tang, who joined us in January 2003. Jay comes to us from Indiana University, where he established a thriving effort in biological physics as well as a prize-winning teaching program. Jay arrived in Providence January 1st with a truckload of equipment, and during the spring a new "wet lab" (a first in Physics) blossomed in space on the 4th floor of Barus-Holley. Retired Professor Phil Bray expressed delight in his old lab's rejuvenation. Sharing in this renewal, Professor Gang Xiao's lab next door is the site of new developments in spintronics, described on page 4.

Dave Cutts

I'm delighted to announce that two other new replacement hires in condensed matter physics are joining the faculty: Assistant Professors Dima Feldman arrives September 2003 and Vesna Mitrovic, in January 2004. They are introduced on page 7; their work will be covered more fully in the next issue of Physics at Brown.

We highlight again the research of our Galkin Foundation Fellow, who this year is Sang Ryul Park. Working with advisor Professor Sean Ling, as well as undergraduate Brigit McClain and collaborators at NIST, Sang Ryul carried out widely acclaimed experiments pointing to a new phase transition in type-II superconductors. The research, described on page 2, has intellectual roots in the work of Nobelist Leon Cooper and Onsager winner Mike Kosterlitz.

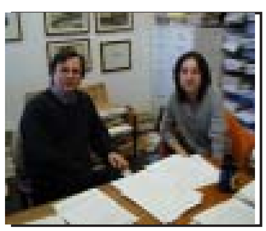
Other highlights of 2003 include Assistant Professor Greg Tucker's contribution to the epoch results of the WMAP satellite team, whose measurements formed the core of the "Breakthrough of the Year" as announced by Science. One of our new areas of research, cosmology at Brown is linked closely with related work in experimental and theoretical particle physics. This area is especially fertile ground for inventing and testing "beautiful theories", an overview of which is covered in Professor Antal Jevicki's new course.

Finally, I am delighted to introduce Beverly Travers, our new Department Manager, who joined us in December 2002. Beverly brings much experience in education and administration with the Bristol R.I. school district; after resolving problems of 350 teachers, supporting a rather smaller number of physics faculty and staff must seem like duck soup to her.

Dave Cutts, Chair, *cutts@physics.brown.edu*

## Beautiful Theories of Physics: From Harmony of the Spheres to Superstrings

Professor Antal Jevicki has designed a new course to highlight the most significant ideas and theories of physics. Given in the Freshman Seminar series for the first time in Spring, 2003, the course, listed as Physics 12, ranges from Kepler's "Harmony of the Spheres" through Einstein's General Theory of Relativity, and culminates in String Theory as a theory of "everything". Great successes and some colossal failures are discussed in the class.



**Professor Jevicki and graduate student Sera Cremonini**

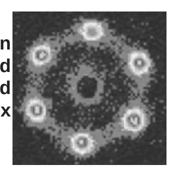
The course concentrates on the hidden, underlying mathematical beauty of physical equations. In his book, "It Must Be Beautiful: Great Equations of Modern Science", Graham Farmelo of London's Museum of Science says about Einstein's gravitational equation: "You can write it on the palm of your hand yet it shapes the Universe". He compares the feeling of understanding such an equation to the experience in taking possession of a great painting or a poem.

In the course, the elegance of physical laws is shown to relate to the high degree of symmetry that they exhibit. Professor Jevicki introduces a beautiful and far reaching theorem of Emmy Noether, which provides a connection between symmetries and conservation laws in physics, and discusses the revolutionary role of Quantum Mechanics and

***Continued on page 3***

# Research Highlights of 2002-2003 Galkin Fellow Sang Ryul Park

One of the greatest achievements in modern physics is the understanding that under certain conditions, a large group of interacting particles can exhibit emergent properties that were absent in the individual particles. The most familiar example in nature is the existence of three phases of water: vapor phase in a sauna, liquid phase in our water bottle, and solid ice on which we skate. Water in each phase is made of the same molecule, yet ice exhibits a new property of rigidity against shear force that liquid water (and steam) does not have. A triumph of condensed matter physics is the development of a symmetry principle for understanding phase transitions such as freezing and melting. Upon freezing, atoms or molecules rearrange themselves in an orderly fashion and form beautiful crystals. In this process, it is said that symmetries have been broken and new orders have emerged. By identifying the "order parameters", detailed theories can be written to describe these phase transitions with great success. Physicists are also painfully aware of the facts that many systems may not conform to this simple-minded view. One such system is that of type-II superconductors, familiar to condensed matter physicists, consisting of the materials such as niobium and its alloys; another is that of the newly discovered oxide superconductors. When these materials are cooled in a magnetic field, the electrons form Cooper-pairs (also a phase transition and understanding of which earned Professor Leon Cooper and his colleagues a Nobel Prize in physics in 1974), and the Cooper-pairs move in circles to form vortices. These vortices are themselves new objects in that they interact with each other and can be said to form "vortex matter". Ideally, these vortices should form a vortex crystal just as water molecules form ice. But they can't crystallize because vortices live inside an imperfect atomic lattice. For many years, it was an unresolved problem as to whether a true phase transition can still happen in the vortex matter since the "long-range order" of a vortex crystal would not have survived at low temperatures. In the early part of the past decade, a German theorist Thomas Nattermann at Cologne, and two young French theorists Thierry Giamarchi and Piere le Doussal in Paris proposed that unlike in an ice crystal, the vortex matter may possess "topological long-range order" (a concept invented by Professor Mike Kosterlitz and his collaborator which earned them an Onsager Prize). Nattermann et al predicted that a new form of matter "Bragg glass" should exist in type-II superconductors. This bold suggestion sparked an international race for the search for the phase transition into this "topologically ordered" Bragg glass state. The team which first found the key evidence for this phase transition consisted of Sang Ryul Park, this year's Galkin Foundation Fellow, his advisor Professor Sean Ling, and undergraduate assistant Bridget McClain at Brown University, and scientists at National Institute of Standards and Technology, Dr. Sungmin Choi, Dr. Daniel Dender, and Dr. Jeff Lynn. Their paper was published in Physical Review Letters in January 2003 and was considered a "milestone contribution" by the experts in their field. Immediately, two groups attempted to reproduce their results; the first team from Oak Ridge National Lab led by Dr. David Christen found similar results, but another team from Birmingham and Grenoble led by Professor Ted Forgan could not observe the effects reported by the Brown-NIST team. These puzzling results suggest either a trivial technical error in one of these teams' experiments, or something fundamental about the nature of the phase transition. During the past 12 months, Sang Ryul Park and his coworkers carried out an exhaustive study of their sample in which the first evidence of a Bragg-glass transition was detected. They carefully repeated their previous experiments to be certain that no errors were made and then expanded their study to investigate the Birmingham-Grenoble result. Park and coworkers found that in part of the "phase diagram" of the vortex matter, the first-order phase transition they discovered disappears and turns into a continuous one such as the Birmingham-Grenoble team observed. This means that the previous conflicting results are likely due to the existence of a "multi-criticality" point on the phase diagram, namely that the different experiments had explored different parts of the phase space. Sang Ryul Park is the first author of a paper to appear in Physical Review Letters reporting these latest exciting findings.



**Neutron diffraction patterns produced by a vortex liquid (left) and by a vortex solid (right)**

**The Galkin Foundtation 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.**

# In Memory of Tony Houghton



A memorial service for Anthony Houghton, Professor Emeritus of Physics and Professor of Physics (Research) who died in July, 2003, at the age of 67, was held at Brown in October.

Professor Houghton retired from regular teaching at Brown in July 2002 but remained actively involved in physics research until his death. He came to Rhode Island in 1963 when he joined the Brown faculty as an Assistant Professor of Physics. He was promoted to the rank of Associate Professor of Physics in 1967 and to Professor of Physics in 1971. He served as chair of the Department of Physics from 1992 to 1998.

Professor Houghton wrote more than 90 papers on a diverse range of condensed matter physics problems including superconductivity, interacting electrons, disorder, and critical phenomena. In a famous collaboration with Franz Wegner, he made a very important early contribution to renormalization group theory. A Fellow of the American Physical Society and a Humboldt Fellow, Professor Houghton was a visiting professor at many European and American institutions, including Oxford University, the Norges Tekniske Hogskole, the University of Sussex, the University of Manchester, the University of Heidelberg, Imperial College, London, and the University of California at San Diego. He held Science Research Council Fellowships at the Universities of Manchester and Sussex and at Imperial College London, as well as an Alexander von Humboldt Senior Scientist Award at the University of Heidelberg.

Professor Houghton taught courses ranging from pre-med physics to specialized graduate classes in advanced statistical mechanics and quantum many-body theory. His many Ph.D. students have gone on to productive careers in condensed matter physics.

As his colleague Professor Leon Cooper, recalled: “Tony made many contributions to physics and to the Brown University Physics Department, to which he was enormously devoted. Tony did not seek headlines, and avoided publicity. He was a physicist’s physicist whose work was best appreciated by his colleagues for its craftsmanship and great originality. He loved doing and talking about physics; he also loved good food, good wine and good conversation as well as the light of the setting sun on the water. He was a stimulating companion and fun to be with. We miss him.”

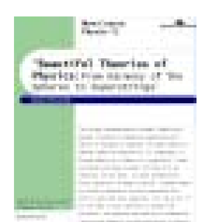
Professor Houghton brought to the department strength as a scientist and dedication as a teacher, along with a commitment of service to the University, said Professor David Cutts, current chair of the department. “Tony was in many ways the backbone of the department. The leader of the condensed matter physics group, Tony was devoted to physics, as is evident through both his important contributions to the field and his outstanding qualities as a committed teacher and mentor. Junior physics faculty flourished, thanks to his advice, guidance and friendship. Frequently exhibiting a wry, British sense of humor, Tony could still be as fiercely passionate about issues important to the department and to the University as he was about physics. He took seriously the call to service, and devoted much time in leadership positions and University committees.”

He is survived by his wife, Patricia, a sister and two nephews.

---

***Continued from page 1***

the concept of broken symmetry. Finally, he describes the most exciting recent unification achieved by modern String Theory. String Theory not only brings together the physical theories (Relativity, Gravity, Quantum Mechanics) but as a Nobel prize winner Gerard ‘t Hooft put it, “it unifies knowledge”. Its success in revealing the origin of Gravity and at the same time complying with Quantum Mechanics uniquely singles it out as the theory of the world. It’s implications on quantum existence of black holes and cosmology is far reaching. Yet, as Professor Jevicki emphasizes, the theory has a simple origin. It can be described as a statistical ensemble of ‘partons’ originating in an even more fundamental theory called M-theory. Altogether, the course’s goal is to introduce these fascinating theories, to reveal the elegant structure behind the laws of physics and to exhibit the symmetries that govern them. Particular emphasis is given to a set of demonstrations accompanying the course and on the possibility of one-on-one study with the professor.



# Watching the flow of electricity

Gang Xiao

**A new scanning microscope developed at Brown University can uncover defects in the smallest and most complex integrated circuits at a resolution 1,000 times greater than current technology.**

Professor Gang Xiao and recent PhD Ben Schrag have created a magnetic-sensing microscope that allows them to watch electricity flow through the world's tiniest components. They are using the device to find defects in integrated circuits and micromachinery. The design opens the door to wider application of magnetic-sensing technology for imaging electrical current flow. The microscope is described in the May 12, 2003, issue of *Applied Physics Letters*.

"This microscope will allow manufacturers to find defects in each embedded wire in ever-tinier circuits," said Brown University Professor Gang Xiao.

The microscope's magnetic-scanning technology suggests a new small, non-invasive form of remote detection, said the researchers, who envision a "pass-over and detect" magnetic-sensor-tipped pen, for use in finding internal cracks within aircraft, sensing biological agents in the environment or body, or recognizing counterfeit bills or other objects.

Although magnetic sensing is used extensively, it is not applied widely for imaging electrical current flow, said Schrag. The only method that uses magnetic imaging to see current flow is restricted to extremely low temperatures, employing cryogenic aids such as liquid nitrogen. However, the Brown device works at room temperature. This design opens the way to greater use of magnetic sensing technology, he said.

"The factor of 1,000 improvement in spatial resolution is how much better we can do than this cryogenic technology," Schrag said. "We are just scratching the surface of potential applications."

Xiao and Schrag are using the technology to pinpoint how electrical current can form pinholes in state-of-the-art devices called magnetic tunnel junctions. These tiny sandwiches of ferromagnetic layers and insulating material are candidate memory storage cells to replace standard cells used in computer memory chips.

The researchers have "imaged" current flow in electrical components as small as 50 nanometers, the smallest commercially available components, half the size of conventional chips.

Until now, little or no technology existed for actually "watching" electrical current flow, said Schrag. Whenever current runs through wires, such as those embedded within the semiconducting material of an integrated circuit, it creates a magnetic field. By measuring spatial changes in that magnetic field, the microscope visualizes electrical current, even within wires buried under layers of advanced materials, he said.

"The device allows us to see the evolution of hot spots on each wire in a circuit and how each defect moves down the wire in the form of electrons moving atoms," said Xiao. "To see a collection of atoms moving as a function of time is a capability that did not exist until now. We are witnessing the flow of electricity."

About the size of a refrigerator, the microscope is being reduced to the size of a desktop computer. "The new design will allow a technician to sit in front of a monitoring screen, as integrated circuits pass through a small open door, under a scanner and out the door," Xiao said. Currently, the microscope takes a few minutes to scan a circuit. The researchers are working to reduce that time to as little as 30 seconds.

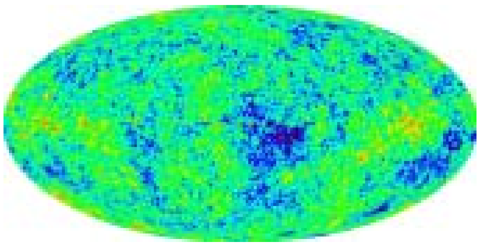
Xiao and Schrag have filed patent applications on several aspects of the technology, which has been transferred to Micro Magnetics, a Fall River, Mass., company that makes scanning devices for manufacturers of integrated circuits (computer chips). Images produced by the microscope may be viewed at http://www.micromagnetics.com/.

***The National Science Foundation funded this work.***

***For further details of Professor Xiao's work see:***
***http://www.physics.brown.edu/Users/faculty/xiao/xiao.htm***

# Breakthrough of the Year

Science magazine **Breakthrough of the Year**: *Cosmic convergence*. The WMAP satellite data, combined with results from many different lines of inquiry, greatly improved our knowledge of the most important parameters governing the evolution of the universe.



**A map of the sky showing the cosmic microwave background as measured by WMAP. This is a map of the universe as it appeared 379,000 years after the Big Bang. The intensity differences have been greatly enhanced to be visible.**

Professor Greg Tucker's observational cosmology group studies the early universe by measuring the cosmic microwave background (CMB) and by looking at the very earliest galaxies to have formed in the universe. The group designs and builds special purpose instruments for these measurements and then uses them and analyzes the results.

**THE COSMIC MICROWAVE BACKGROUND.** The CMB is light which is "left over" from the Big Bang. This light is brightest at millimeter wavelengths. The technologies to carry out precision measurements at these wavelengths are relatively new and are evolving rapidly, so many measurements have become possible only during the past several years.

By observing the CMB Professor Tucker's group looks at the universe as it appeared only 379,000 years after the Big Bang, which occurred 13.7 billion years ago. The CMB appears to be uniform to better than 1 part in 100,000, so the early universe was very smooth. The brightness of the CMB can be characterized by a temperature of $2.7^\circ$ K. To measure variations in the CMB requires measuring temperatures with an accuracy of a micro-K or better.

**Launch of the WMAP satellite**

In contrast to the early universe, the present day universe is very clumpy. Part of what they are trying to understand is how the universe evolved to its present state.

The age of the universe stated above represents an extraordinary leap in our understanding. A year ago, the best one could say was that the universe was roughly 10 - 15 billion years old, rather than rather precisely13.7±0.2 billion years. This great advance has been possible by measuring the intensity differences of the CMB with exquisite accuracy. These measurements were made by one instrument that Greg Tucker's observational cosmology group at Brown helped to design and build - the Wilkinson Microwave Anisotropy Probe (WMAP) satellite, which was launched on 30 June 2001. It now appears that not only will the universe expand forever but that the rate of expansion is currently accelerating. WMAP has also determined that the universe is composed of 4.4% ordinary matter, 23% dark matter and 72% dark energy - the energy which is causing the expansion rate to accelerate. The cosmology group is now working on a novel new instrument to measure the polarization of the CMB; imprints from the first $10^{-35}$ s

**Graduate student Matt Truch working on the BLAST cryostat outside in Fort Sumner, New Mexico**

**Professor Greg Tucker**

of the universe should appear in the polarization. Polarization measurements will require measuring temperatures with an accuracy of nano-K.

**THE FIRST GALAXIES.** This fall Professor Tucker's group flew a new instrument called BLAST – the Balloon-borne Large Aperture Submillimeter Telescope. They are now preparing this experiment for a long duration balloon flight from the Antarctic. During the austral summer, the winds are circumpolar, so it is possible to fly a balloon for a couple of weeks and land near the original launch site. BLAST observes the very earliest galaxies to have formed. Very little is known about these galaxies, which were only discovered a few years ago. Most of them are not visible at optical wavelengths, and they appear to be enshrouded by dust. By observing at several different wavelengths BLAST will be able to determine the distance to these galaxies.

**Preparing the Balloon-borne Large Aperture Submillemeter Telescope (BLAST) for its first flight from the National Scientific Balloon Facility site in Fort Sumner, New Mexico**

# Biophysics: Unraveling the Physical Principles Behind Life


Biophysics is an interdisciplinary science that has developed into a broad research field in the post genome era. Biophysicists seek to understand the basic processes of life by applying fundamental physical principles and experimental methods to biological systems. Understanding these biological systems and their complex processes requires exquisitely detailed knowledge of molecular structures and molecular functions. To investigate life at this most basic level, biophysicists use some of the most powerful tools available - optical, atomic force, and electron microscopy,laser optics, X-ray crystallography, nuclear magnetic resonance (NMR) spectroscopy and advanced computational science.

An active contributor in this expanding field, Assistant Professor Jay X. Tang was recruited recently from Indiana University. Professor Tang arrived in January 2003 to occupy a newly renovated research space on the 4th floor of the Barus-Holley building. At the present time a biological physics laboratory is fully operational in space once devoted to Phil Bray's illustrious research activities.

Professor Tang brings to Brown a new research program of molecular biophysics. The main goal of his research effort is to understand the mechanisms and properties of protein assemblies. In particular, the Tang lab studies the assembly of the so-called cytoskeletal proteins, such as proteins called actin and tubulin. By forming an intertwined nest of filaments inside practically every cell of our body, these proteins build the backbones of the cells and provide dynamic scaffolds for many molecular events so crucial for biological functions.

Professor Tang's research group studies the biophysical properties of these proteins with several levels of approach. Basic biochemical and molecular biology techniques are employed for preparation and characterization of proteins and live cells of interest. Modern microscopy techniques are used to infer the structure and functions of protein filaments and various aggregates. The newest tool recently added to the biological physics lab is an atomic force microscope (AFM) thanks to the National Science Foundation under a Major Research Instrumentation award to Professors Jay Tang, Sean Ling, Tom Powers (Div of Eng), Gang Xiao, and Jim Valles. Other physical techniques include light scattering, micro-rheology, X-ray and neutron scattering.

**Graduate Students Jorge Viamontes and Qi Wen examining protein samples**

The new biophysics lab was kick-started with the assistance of three energetic associates who transferred with Professor Tang from Indiana University, including graduate students Jorge Viamontes and Qi Wen and postdoctoral fellow Dr. Gunaglai Li. By the summer of 2003, a new graduate student Ms Hyeran Kang and several undergraduate students have joined the troop. The lab has quickly become a place of fun experiments and thought provoking discussions.

Professor Tang has teamed up with other faculty colleagues to make a concerted effort to foster learning activities in the new research area. For instance, Professor Tang has joined with Professor Leon Cooper to establish a seminar series called "Frontier of the Interactions between Physics and Biology". The goal of the series is to provide a forum for lectures by experts at the forefront of interdisciplinary areas of biological physics, neural biophysics and physiology, modern molecular and cell biology, as well as computational biology. In addition, Professor Tang and Professor Valles jointly established an informal weekly biophysics journal club in the summer of 2003, which continues through the academic year.

**Graduate Students Jorge Viamontes and Hyeran Kang preparing a column chromatography run**

# New Physics Faculty

## Vesna Mitrovic

Assistant Professor of Physics

Vesna Mitrovic arrives at Brown in January 2004 after two years as a post-doctoral fellow at the Grenoble High Magnetic Field Laboratory in France. Mitrovic's research is in condensed matter physics, using nuclear magnetic resonance (NMR) techniques to study microscopically highly correlated electronic systems in novel materials. "New, truly revolutionary industrial applications of materials are necessarily based on exploiting their remarkable quantum properties," says Mitrovic, who in 2001 received a Ph.D. in physics from Northwestern University. Working at the National High Magnetic Field Lab facility at Florida State University in 2001, Mitrovic and other scientists were for the first time able to examine the behavior of a high-temperature superconducting material – observing the electrical and physical properties of the superconductor at extremely high resolution. The research and its findings may have implications for medical usage, potentially improving magnetic resonance imaging (MRI) technologies.

"Such an application is just one example of the vibrant interplay between fundamental physics and developments in applied areas," says David Cutts, chair of the Physics Department. "Condensed matter physics has a multitude of strong interconnections with engineering, biology, chemistry and other fields. Professor Mitrovic brings exceptional skills in experimental physics, especially with the important area of NMR studies, which strengthens efforts at Brown in fundamental physics, such as understanding the physics of high temperature superconductivity, while at the same time enhancing related efforts in materials science, biophysics, nanotechnology and applied physics."

## Dmitri Feldman

Assistant Professor of Physics

Dmitri "Dima" Feldman comes to Brown after nearly two years as a postdoctoral appointee in the materials science division at Argonne National Laboratory. As a member of Argonne's Material Theory Institute, Feldman took part in theoretical and experimental research efforts in condensed matter physics – the study of matter at larger-than-atomic scales.

"Intellectually, condensed matter physics lies between mathematics and chemistry," says Feldman, who is a native of Chernogoloka, a Moscow suburb that is the center of chemistry studies for the Russian Academy of Science. Feldman's physics research focus areas, which include soft condensed matter, strongly correlated electrons, quantum and classical phase transitions, and disordered systems, neatly match this early environment and an interest in mathematics. As a teen, Feldman won the All-Union Mathematical Olympiad of the then-Soviet Union.

Professor Feldman has bachelor and master of science degrees in the combined field of physics and mathematics from the Moscow Institute of Physics and Technology. In 1998, he received his Ph.D. in physics from the Landau Institute of Theoretical Physics, also in Russia. He has held postdoctoral or research positions at Landau and Israel's Weizmann Institute of Science, where he received a distinguished Koshland postdoctoral fellowship. At Brown, Feldman will join other faculty (from chemistry and engineering, as well as physics) engaged in condensed matter research and this fall will teach a graduate-level course on quantum mechanics. Among Feldman's current research interests is an investigation of how electrical current works at the nanoscale. By applying sound to narrow channels called quantum wires, scientists have been able to drag single electrons through the wires. In theory, this technique, one of several methods of producing current in quantum wires, could power a generation of functional nanoscale machines. "We can do this in the physics laboratory," says Feldman. "We need at least several years before engineers can join physicists in developing devices that can utilize quantum wires."

* Story line provided by Ricardo Howell, PAUR

## 2003 PhD Recipients

**Alexandre Anguelouch**
"Spin-Polarized Transport and Magnetization Reversal Behavior of Transition Metal and Half Metallic Cr02 Thin Films and Multilayers"

**Stefan C. Badescu**
"Dynamics of Hydrogen Atoms Adsorbed on Metallic Surfaces"

**Brian C. Daly**
"Studies of the Thermal Conductivity of Thin films by Optical Pump and Probe Measurements and Molecular Dynamics Simulations"

Profesor Greg Crawford and Adam Fontecchio

**Adam K. Fontecchio**
"Multiplexing Studies of Holographically-formed Polymer Dispersed Liquid Crystals: Morphology, Structure, and Device Applications"
*NASA Fellowship*

**Antonio C.C. Guimaraes Jr.**
"Cosmological Information from Weak Gravitational Lensing"

**Pavel Kossyrev**
"Tailored Molecular Order in Reactive Mesogens"

**Jun Liu**
"Strain-induced quantization in Si/SiGe Vertical Quantum Dots and Rings"

**Alexandros Pertsinidis**
"Experimental Studies of Two-Dimensional Colloidal Crystals: Defects, Pinning and Driven Dynamics"
*Wunderlich Dissertation Fellow*

Antonio Guimaraes and Alexandros Pertsinidis

**Jun Qi**
"Holographic Polymer-Dispersed Liquid Crystals: Physics and Applications"

**Benaiah D. Schrag**
"Scanning Magnetoresistive Microscopy and Spintronics-based Sensing"
*Wunderlich Dissertatrion Fellow*

## 2003 Senior Honors Recipients

**Amandine Cagnioncle**, "Melt migration and interaction with the mantle at subduction zones"
*Advisor: Marc Parmentier*

**Andres Morey**, "Quantum Mechanics and Determinism: An Investigation into Gerard 't Hooft's Recent Theories"
*Advisor: Antal Jevicki*

**Rachel Rosen**, "Supersymmetries and Giant Gravitons"
*Advisor: Antal Jevicki*

**Ellen Syracuse**, "Determining crustal parameters along the FLED (Florida to Edmonton, Alberta Seismic Stations) *Array*"
*Advisor: Karen Fischer*

President Hornig awarded diplomas

Professor Valles and Rachel Rosen

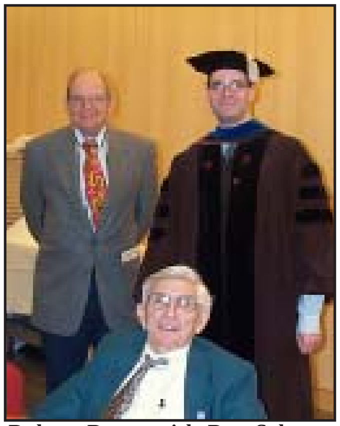
**Tyler Wellman**, "An Introduction to Supersymmetry in Quantum Mechanical Systems"
*Advisor: Antal Jevicki*

**Sam Wurzel**, "Prospects for studying negative gravitaxis in Paramecia using magnetic field gradient levitation"
*Advisor: James Valles*

## Awards and Promotions

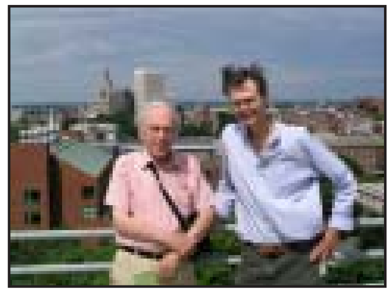
### Robert Beyer Award

Thanks to a thoughtful gift from Warren Galkin ’51 which recognizes his former professor, Robert Beyer, the Physics Department presented an award in 2003 to the graduating Ph.D. student who best combined scholarship and service. We are delighted to recognize Benaiah D. Schrag as the recipient of the Robert Beyer Award.



**Robert Beyer with Ben Schrag, recipient of the award in Professor Beyer’s Honor, and Warren Galkin.**

**Our Lecture in honor of Professor Arthur O. Williams was given in 2003 by Bernard Sadoulet, U.C. Berkeley**

**Hervey Gauvin, Brown Physics '47, enjoying the view of Brown and Providence from the roof of the Barus-Holley Physics/Engineering building, with Professor Cutts.**

## Faculty Awards and Promotions

Awards:

**Sean Ling** - *Named a fellow of the John Simon Guggenheim Memorial Foundation 2002-2003*

**Greg S. Tucker** - *Received a National Research Council senior fellowship for 2002-2003*

Promotions:

**Brad Marston** - *Professor of Physics*

**Jim Valles** - *Professor of Physics*

**Greg Landsberg** - *Associate Professor of Physics*

**David Lowe** - *Associate Professor of Physics*

## New Grant Awards
### to junior (or just promoted) faculty

**Ian Dell’Antonio**
*NSF Early Career Development Program*

**Rick Gaitskell**
*DOE Outstanding Junior Investigator*

**Greg Landsberg**
*NSF Early Career Development Program*

**Greg Tucker**
*NASA Space Astrophysics Research & Analysis*

**Co-editors**: *Dave Cutts*, *Beverly Travers*

**Layout Editors**: *Jane Martin*, *Conan Kelly*

**Contributors**: *Jane Martin*, *Dave Cutts*, *Beverly Travers*, *Dean Hudek*, *Jay Tang*, *Antal Jevicki*, *Greg Tucker*, *Sean Ling*, *Gang Xiao*

**Correspondence**: newsletter@physics.brown.edu

*We welcome your comments and contributions!*

Physics at Brown
Box 1843, Physics Dept.
Brown University
Providence RI, 02912
Phone: (401) 863-2644
Fax: (401) 863-2024

# Lecture Demonstrations and Teaching Labs Receive National Attention

Dean Hudek

Dean Hudek is the Physics Department's Laboratory Physicist and Director of the Instructional Laboratories. Under his leadership, Brown's physics instruction has earned a prominent role nationally. In the fall of 2002 Dean was appointed Chair of the American Association of Physics Teachers' (AAPT) Committee on Apparatus. He took office in Jan '03 and in August of this year was asked to stay on for a second term. Dean is ex officio a member of the Programs Committee, and thus also helps plan the biannual AAPT meetings.

The nine members of the Apparatus Committee along with "several friends of the committee" sponsor presentations, workshops, poster-sessions and apparatus competitions at national AAPT meetings. The Apparatus Committee also sponsors the Physics Instructional Resource Association (PIRA), an organization of instructional support professionals from academic institutions all across the USA and Canada with a few members from Europe. The mission of the Apparatus Committee is to:

1) Seek new and forgotten techniques for presentation of ideas in physics through lecture and laboratory demonstrations and experiments,
2) Aid in keeping the AAPT membership informed of techniques of apparatus construction, maintenance and utilization,
3) Conduct apparatus competitions, as authorized by the Executive Board, to recognize, reward and publicize worthwhile contributions to physics teaching through demonstration and experiment.

Dean has been an active member of the AAPT and PIRA for 13 years. Before joining the Apparatus Committee he served three years on the Committee for Professional Concerns, and remains an active friend of this committee. Over the years he created, and now annually coordinates for the national AAPT meetings, Workshops and Crackerbarrel Sessions. The Workshops on Introductory Instructional Labs, and on Advanced and Intermediate Labs, each involve six co-presenters from universities across the country. The Crackerbarrels are grouped under the titles Professional Concerns of Instructional Resource Specialists and Instructional Laboratory Apparatus.

Dean Hudek came to Brown in June of 1989 as Laboratory Physicist and co-Director of Lecture Demonstrations with Jack Breetveld. Following Jack's retirement Dean has taken on full responsibility over all Departmental support in this area. As is clear from the national recognition, Dean has overseen rather significant improvements to our demonstration facility and instructional labs. He would give much credit to the three staff whom he hired and trained:

**Physics Instructional Lab and Lecture Demonstration Personnel: Ken Silva, Jerry Zani, Dean Hudek and Bob Horton**

Gerald Zani - Manager of Lecture Demonstrations: Jerry has been with the Physics Department for 10 years. He is infectiously enthusiastic about lecture demonstrations and endlessly inventive, stimulating students and faculty alike. Jerry is an active member of Physics Instructional Resource Association (and past President) and for many years has been a co-presenter of the very popular "Demonstrations Workshop I & II" that are offered annually at the national summer AAPT meeting.

Kenneth Silva - Laboratory Manager, in charge of introductory labs: Ken is fairly new to Brown but arrived in 2001 with a solid knowledge of instructional labs and the associated equipment. He hit the ground running and is doing a great job. Ken is active in PIRA and annually co-presents in both of previously mentioned instructional labs workshops at the national summer AAPT meeting.

Robert Horton – Laboratory Manager, in charge of astronomy labs and assistant to the advanced labs: Bob has provided superb assistance to the Department's astronomy program for years but became a regular staff member only in 2001. Bob is an avid amateur astronomer and astro-photographer, and has taught in the Brown Learning community for many years. He is active in national astronomy conventions and now assists at AAPT meetings as well.

Dean, Jerry, Bob and Ken enjoy their work, and share their enthusiasm for tangible physics by reaching out to others, beyond the Brown classroom. Both Dean and Jerry are well known on campus for their popular physics demonstration show, a fixture now on Brown Staff Development Day. They also fill halls with enthralled kids from neighborhood schools. Bob supports public viewing at Ladd Observatory and is active in the Skyscrapers amateur astronomy club. In many ways the Department's instructional staff spread the joy of physics to all.

# Meet Beverly Travers our New Department Manager

Our new Department Manager, Beverly Travers, started in December 2002. Beverly has over 25 years of experience in public education both in the classroom and central office administration. She earned a Bachelor of Science in Physical Education & Biology, and a Master's degree in Education at the University of Wisconsin-Superior and a Certificate of Advanced Graduate Studies (C.A.G.S.) in Curriculum at Rhode Island College. Beverly was employed in the Office of Training and Development here at Brown for the past two years as Manager of Training Programs. In that capacity she directed training programs for 2200 employees and coordinated major programs for manager development. She also did departmental consultation and training program design. As the Physics Department Manager, Beverly has been involved with lab renovations, technology enhancements, upgrading office spaces and building a team with the eleven staff reporting to her that is most supportive of the faculty and department goals. Beverly can be reached at (401)863-3574 or travers@physics.brown.edu

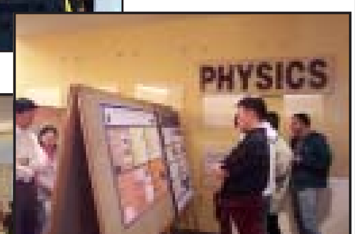
**Beverly Travers**

# A New Look for the Barus & Holley Lobby

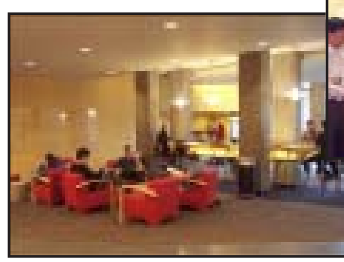
Recently an anonymous donor provided funds to be used specifically for the renovation of the Barus & Holley lobby. The work was completed in January of 2003 and the change is remarkable. A central marble table with underlighting provides a beautiful as well as functional place for studying. A flat panel TV is mounted high on two of the columns so that matters of great importance can be viewed. Directory kiosks are computerized with touch screens. Enhanced lighting, small tables, and carpeting add to the warmth of comfortable and colorful seating groups. Another much appreciated feature is an area where snacks and coffee can be purchased.

The new lobby is a popular gathering place

**Graduation 2003**




**A poster presentation**



**Students studying**

# Our New Website

The Physics Department has launched a new website! During the later part of 2003, Brad Marston, Dave Cutts, Eric Scantlebury, Jane Martin, Beverly Travers and Mark Howison (student/consultant) formed a committee of the computing committee to investigate, design and then implement a new web design. Thanks to Brad's initiative in refusing to accept the status quo, to the committee for the new design ideas, and to Mark's technical prowess in implementing them, the site is up! Your comments are welcome. It can be viewed at http://www.physics.brown.edu

# Physics at Brown

**Physics at Brown Newsletter**
**Department of Physics**
**Box 1843**
**Brown University**
**Providence, RI 02912**

---

**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**



## New Courses for the 2003-2004 Academic Year