Physics at Brown

News for Alumni and Friends **Issue 2 - Spring 2000**

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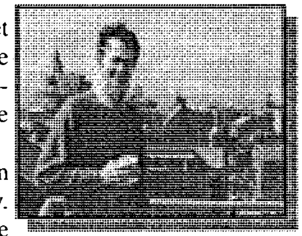
BROWN UNIVERSITY



Welcome to the Brown Physics Newsletter! I'm delighted to greet you again, on behalf of the Department. We've tried to capture in this issue some sense of the excitement shared by our students and faculty, some participation in the celebrations of achievements, and some appreciation of the dynamic changes in the Department.

We have a new faculty member, Ian Dell'Antonio, who joins us from NOAO at Kitt Peak. Ian works in the field of experimental cosmology. He is one of the leaders in using gravitational lensing as a probe of the distribution of dark matter in the universe. His efforts are an excellent complement to Greg Tucker's cosmologically important measurements of the microwave background *(see our previous newsletter)*.

Over the last two centuries, our Department has been a leader in acoustics. Come see the "butter-stamps" (early telephones) here in Barus-Holley! As we enter a new millenium, it's interesting to see how this work has evolved to some very forefront (and practical) research led by Humphrey Maris and others.

Students are our measure of success and we especially want to share with you their accomplishments. Descriptions follow of the research of the Galkin Foundation Fellow, Mihail Mihailescu, of a Brown University Dissertation Fellow, Shan-Wen Tsai and of a Materials Research Society Gold Award winner, Christopher Bowley.

Please join us in celebrating some of the recognition that our faculty has received in recent months: Mike Kosterlitz's Lars Onsager Award, Bob Pelcovits' P.J. Bray Teaching Excellence Award, the 70th birthday of our Nobel Laureate Leon Cooper who was honored by a University-wide Symposium, Bob Beyer's wonderful 80th birthday celebration and Phil Bray's Nucelar Quadrupole Interaction lifetime achievement award.

We honor the long years, 109 years total, of service to Brown of three recently retired staff members, Jack Breetveld, Rose Ouloosian and Margaret Furey. Their skill, dedication and cheer carried and supported us all. We welcome Phyllis Hudek our new Department Manager, and Heather Pickett our new Laboratory Assistant. Finally, thanks once again to Jim Valles, the Executive Officer, and Jane Martin, for making this newsletter happen.

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

Professor Mike Kosterlitz Wins Onsager Prize

In a remarkable paper [J. Phys. C **6**, 1181 (1973)] written when they were both at Birmingham University, Mike Kosterlitz and David Thouless introduced the novel concept of topological order and developed a new way of understanding a wide variety of phase transitions in matter. For this and subsequent work, Kosterlitz, now of Brown, and Thouless were awarded the 2000 Lars Onsager Prize of the American Physical Society. The Onsager prize recognizes outstanding research in theoretical statistical physics. Previous winners of this prize are Michael Fisher, Leo Kadanoff, Robert Kraichnan and C. N. Yang.

One specific example of a Kosterlitz-Thouless transition occurs in the two-dimensional XY model of magnetism (a model with a two-dimensional vector order parameter).

Mike Kosterlitz

It was rigorously proved by Mermin, Hohenberg and Wagner that conventional long-range order cannot exist in this model or any two-dimensional model with a vector order parameter. The XY model has stable point-like topological defects (often called "vortices"), whereas the models with higher dimensionality vector order parameters have no stable defects in two dimensions. In the Kosterlitz-Thouless theory the low temperature phase of the two-dimensional XY model is characterized by tightly bound defect pairs which allow the presence of quasi-long-range order. Using simple physical arguments, Kosterlitz and Thouless showed that a continuous phase transition can occur in the XY model at a temperature where it is favorable for the defects to unbind. The unbinding of the defect pairs leads to the appearance of conventional disorder in the high temperature

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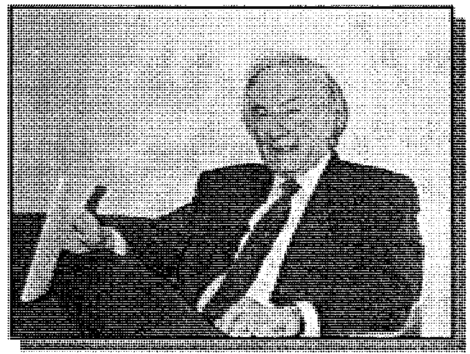
Cooperfest

Leon Cooper
Watson Professor of Science
Nobel Laureate
A Symposium in Celebration of Leon Cooper's 70th Birthday was held at Brown on March 3, 2000. (see photo, page 8)

Leon Cooper came to Brown University in 1958, just one year after he and Bardeen and Schrieffer published one of the most fundamental papers in 20th century physics: the famous "BCS" theory of superconductivity. This theory built on Cooper's earlier work on the pairing of electrons (the formation of "Cooper pairs"). The symmetry-breaking property involved in "Cooper pairing", which defied the conventional wisdom of those days, became a pillar of many subsequent theories in a wide variety of fields, and thus extended far beyond its original aim of explaining the long standing puzzle of superconductivity. In subsequent years, Leon Cooper continued his research on "many body" (ensembles of large numbers of interacting particles) physics, in which he remained for a long time one of the world's leading experts.

More recently, he turned much of his attention to neural science with a focus on learning, memory and neural development and to the functioning of visual systems. In the mid-1970's he was the driving force in forming the Center for Neural Science at Brown University, which evolved, in time, into the Institute for Brain and Neural Systems. Currently Leon directs



Brown's new Brain Science Program. The program promotes collaborative theoretical and experimental brain study from the molecular to the behavioral and cognitive level. The Program includes many faculty from ten different

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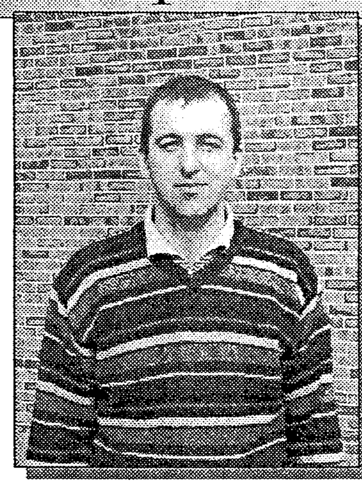
The Galkin Foundation Fellowship

This year's Galkin Fellow, Mihail Mihailescu's Ph.D. thesis, "Investigations of Gravity and Large-N Conformal Field Theory", under the guidance of Professor Antal Jevicki, presents a study of a recently discovered correspondence between a Yang-Mills theory, and the theory of Gravity. This fundamental correspondence, described in a 1997 paper of Juan Maldacena (Harvard), is at the center of all current research in particle theory and quantum gravity.

Efforts to relate the two seemingly very different theories have a long history. Gauge theories have their origin in Maxwell's electrodynamics, whose non-abelian extension was given by Yang and Mills in 1954. They have been successfully used to describe all the fundamental interactions of particle physics: Weak and Electromagnetic, in the form of Weinberg-Salam theory; Strong Interactions in the form Quantum Chromodynamics (QCD) and a unified version called: Grand Unification. Gauge theories have a fundamental virtue of renormalizabilty, giving finite results in any order of (quantum) perturbation theory. Even the typically infinite, bare coupling constant of any field theory is very small (approaching zero), in Yang-Mills theory. This property, called Asymptotic Freedom, is seen as one of the reasons why Yang-Mills theory seems to be a chosen, fundamental theory of nature. Another generalization, in the form of "Super" symmetry, has been introduced. In recent years, many theorists and experimentalists consider the possibility that Super Yang-Mills theory might be a theory of nature.

The one type of interaction that Yang-Mills theory was seemingly not capable of describing was Einstein's Gravity. General Relativity (GR), a generalization of Newton's gravitational theory, possesses not a regular gauge invariance but a much larger symmetry: general covariance. Even though admittedly beautiful



Mihailescu plans to continue with these investigations as he takes up a postdoctoral position at the University of Texas (AM) in September 2000

from an aesthetic point of view, and successful in cosmological applications, GR has suffered from a conflict with another fundamental theory: Quantum Mechanics. The first inconsistency arose upon quantization, where perturbative divergences appear that are not removable by a finite number of counterterms; the theory is unrenormalizable. Steven Hawking uncovered the second type of incon-

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Physics at Brown

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Picosecond Ultrasonics: From the Basement of B & H to the Computer Factory

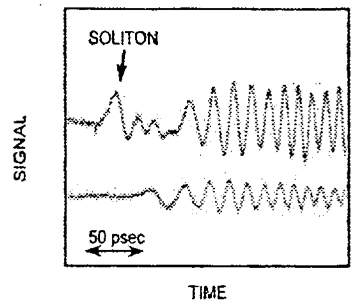
The Brown physics department has had a long history of research in acoustics. Starting in the 1930's, R. Bruce Lindsay performed pioneering studies of sound waves in gases and liquids. Work in this area was continued by Professors Art Williams, Peter Westervelt and Bob Beyer. Bob Beyer, who has just celebrated his 80th birthday is still very active in the affairs of the Acoustical Society of America. Since the early 1950's, there has also been an interest in the acoustic studies of solids. This work was begun by Rohn Truell, and is continued by Charles Elbaum.

In the last 15 years, the interest in acoustics at Brown has taken a new direction. Techniques have been developed that make it possible to perform ultrasonic experiments on very small structures, such as the thin films that are used in computer chips. These films are typically 100 to 1000 Å thick. To perform ultrasonic experiments on such small objects, it is necessary to find a way to produce and detect very short bursts of sound. In 1984, Humphrey Maris and Jan Tauc used light from a picosecond laser to generate and detect short bursts of sound. The basic idea of these experiments was very simple; a flash of light is absorbed at the surface of a metal film, the temperature of the surface layer rises by a few degrees, the metal expands and a pulse of sound is generated. The frequency of the sound pulses that can be generated in this way extends up to about 700 GHz, i.e., 31 octaves above middle C. With this new technique, we are able to study how very high frequency sound waves travel through different materials and investigate how sound travels across the boundary between one material and another. We can also use a measurement of the time that it takes for sound to travel across a film to make a very accurate measurement of the film thickness.

When these experiments were first performed, lasers that could produce picosecond light pulses were still at an early stage of development. They were usually constructed by toiling graduate students, they occupied a large amount of lab space, consumed vast amounts of electricity and cooling water, and frequently stopped working. However, the technology of ultrafast lasers developed very rapidly, and by 1995 reliable and compact lasers became commercially available. At this point, it became possible to make a version of our laboratory apparatus that could be used in an industrial environment. This machine has now become a standard piece of equipment that is used in semiconductor factories around the world for the testing of the metal films that are components in computer chips. So if you buy a new Pentium computer, you may like to recall the research at Brown that has contributed to its manufacture.

The students currently working on this project are Hsin-Yi Hao, Wadih Homsi, Andy Antonelli and Brian Daly. Some of the experiments that we have performed are described in an article that appeared in the January 1998 issue of Scientific American.

Recently Hsin-Yi Hao used the picosecond technique to make the first observation of acoustic solitons propagating in a crystalline lattice. (See figure) In general solitons occur in the presence of dispersion and nonlinear effects. Because the acoustic pulses contain very short wavelengths, phonon dispersion causes the width of the pulses to increase as they propagate. During the past year Hsin-Yi studied this effect in detail in a number of crystals. She discovered that increases in the pulse amplitude led to non-linear elastic effects that changed the pulse shape. At sufficiently high amplitudes, the combined effects of dispersion and non-linearity resulted in the formation of a soliton.



A soliton has formed at the front of the acoustic pulse of larger amplitude.

Mihailescu

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sistency when he tried to understand the quantum behavior of Black Holes. It appears that both of these problems of GR are presently amenable to solution by String Theory. The first suggestion that the two very distinct theories, GR and Y-M, might be related came from the work of G.'t Hooft. In his effort to solve QCD, 't Hooft introduced, in 1972, the idea of extending the number of "colors" (which label the QCD quanta) from N=3 to N=8. This so-called large-N Yang-Mills theory is then seen to exhibit collective phenomena (here one can bring up an analogy with the BCS theory or with the theory of plasma oscillations in condensed matter physics). The surprising feature of collective oscillations in QCD is that they are not pointlike, rather they appear in the form of closed strings. String theory itself was introduced as a possible theory of strong interactions in 1968, but by 1974 it was shown by T. Yoneya (University of Tokyo) and independently by J. Scherk (ENS, Paris) and J. Schwarz (Caltech) that the lowest nontrivial excitation of a closed string is a spin 2 graviton! (A graviton is to be understood as the carrier of gravitational force, as the photon is the carrier of electromagnetic interactions.)

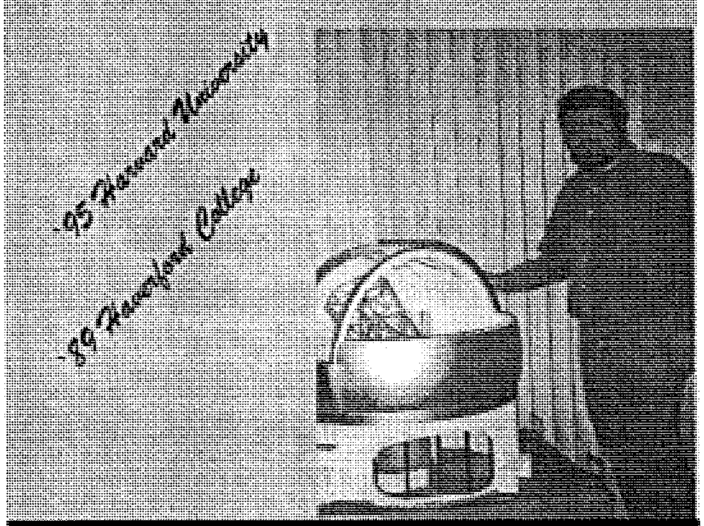
Taken together, the two observations imply that GR can be thought of as a collective, large-N effect in Yang-Mills theory. This fascinating possibility has been a source of interest among field theorists for a number of years. Maldacena's recent conjecture gives a precise correspondence between Super Yang-Mills theory (for example in 4 dimensions) and Supergravity in one higher (5 dimensions). The appearance of extra dimensions is typical of large-N theories; the simplest example was originally demonstrated in the one dimensional (1D) case by S. Das (Tata Institute, Bombay) and A. Jevicki (1990). Mihailescu's thesis concentrates on a particularly elegant case of Maldacena's correspondence, that between 3D Supergravity (SUGRA) and 2D Conformal Field Theory (CFT). In one study done with S. Ramgoolam (Research Assistant Professor at Brown) and Prof. Jevicki, a direct calculation was performed of correlation functions in large-N CFT. In another, Mihailescu performed analogue calculations in SUGRA, and various similarities were investigated. This work provides the basis for a possible, explicit bridge between 2D CFT at large-N and Quantum Gravity.

Our Newest Faculty Member

When light from distant galaxies passes near a massive object (a star, black hole, galaxy or even a cluster of galaxies), the light rays are bent by the gravitational pull of the object. The amount of distortion depends on how much mass is present in the objects. By studying these distortions, one can measure the distribution of mass in very distant objects. This technique, known as gravitational lensing, is the specialty of Ian Dell'Antonio, who joined the faculty in 1999.

In the last two decades, astronomers have discovered that up to 90% of the mass in the Universe is not composed of ordinary baryonic matter, but is some unknown form, commonly referred to as dark matter. The total amount of dark matter, and its distribution in space, are extremely important quantities for understanding the evolution of the Universe. For example, the ultimate fate of the Universe (whether it will keep expanding forever or recollapse on itself) depends on the amount of dark matter. Furthermore, discovering the nature of the dark matter would lead to a better understanding of particle physics.

Ian Dell'Antonio



Ian with a model of the new Gemini telescope on Mauna Kea

Dark matter has proven elusive to study. As its name implies it emits very little or no radiation and thus it is invisible to standard observational techniques. To detect it, one has to rely on gravitational signatures. In nearby galaxies, the rotational speed of the (visible) stars, and in clusters of galaxies, the temperature of the X-ray emitting gas, both point

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Bowley Receives Material Research Society (MRS) Gold Award

Dr. Chris Bowley, Brown '00

Dr. Bowley is currently employed by the 3M Corporation in St. Paul, Minnesota, where he is a Senior Research Physicist in the Optical Systems Division. He is currently working on enhancement films for liquid crystal displays.

At the annual MRS Symposium in San Francisco, Dr. Chris Bowley (Brown '00) recently received the MRS Gold Award for his outstanding research on Holographically-formed Polymer Dispersed Liquid Crystals (H-PDLC). Originally, more than fifty graduate students from the materials community were nominated for the MRS graduate student competition. Dr. Bowley was one of only seven recipients.

This past winter, Dr. Bowley successfully defended his doctoral thesis titled 'Physical Studies of Holographically-formed Polymer Dispersed Liquid Crystals'. During his career at Brown University, Dr. Bowley authored more than fifteen papers, four of which were published in the prestigious journal Applied Physics Letters. He also is the co-inventor on two patent applications currently pending.

The Figure shows the technology thrust of Dr. Bowley's thesis, where he develops novel schemes for switchable holograms comprised of liquid crystals and polymers. Also, he develops a diffusion model to describe the underlying physics of formation of the fascinating H-PDLC technology under development here at the Brown University Display Laboratory under the direction of Prof. Gregory Crawford. H-PDLC devices are being researched for use in reflective displays, active color filters, fiber optic switches, and optical strain gauges.

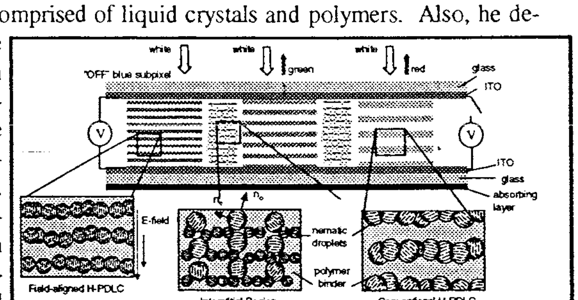


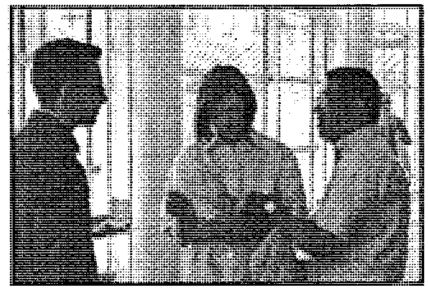
Figure displays novel schemes for switchable holograms comprised of liquid crystals and polymers

High Energy Symposium at Brown

Brown hosted the XXIXth International Symposium on Multiparticle Dynamics, ``QCD and Multiparticle Production", 9-13 August, 1999. More than one hundred physicists from North America, Europe, and Asia, participated in talks and discussions of the latest theoretical and experimental developments in high energy physics.

Brown Professor, Chung-I Tan, seen in the photo at the right discussing the scientific program with Professor Johanna Stachel of Heidelberg, served as director and the members of the Brown High Energy Physics group served on the local organizing committee. All administrative aspects were handled masterfully by Ms. Mary Ann Rotondo. The conference was supported by the U.S. Department of Energy, the National Science Foundation, the Brown Physics Department and the University.

Topics included confinement mechanisms in QCD, Diffractive Production at the Fermi Lab Tevatron, deep-inelastic scattering and small-x phenomena at HERA, jet production at LEP, the soon-to-be on-line Relativistic Heavy Ion Collider (RHIC) at Brookhaven, predictions for the next-generation international Large Hadron Collider (LHC), the interface area between high-energy collisions and cosmic ray/astro-physics, and the connection between Yang-Mills theories and Super-gravity.



PhD Recipients

1999

NOBUHIKO AKINO, "Numerical Study of XY Spin Glass and Gauge Glass Models", *Advisor: Mike Kosterlitz*

CAN AKYUZ, "Resonant Tunneling Measurements of Size-Induced Strain Relaxation", *Advisor: Alex Zaslavsky*

OMER ARTUN, "Implications of Dynamic Synapses on Synaptic Plasticity and Neural Coding", *Advisor: Leon Cooper*

JEFFREY BILLETER, "Computer Simulations of Liquid Crystals: Defects, Deformations and Dynamics", *Advisor: Bob Pelcovits*

SCOTT CARPENTER, "Experimental Adaptive Optimization with Genetic Algorithms: Solving Problems in Mass Spectrometry, Optics, Photoelectron Spectroscopy, and Quantum Control", *Advisor: P. Weber*

KAMIL EKINCI, "Morphology Studies of Quench Condensed Metal and Superconducting Films by Scanning Tunneling Microscopy and Transport Measurements", *Advisor: Jim Valles*

TIMOTHY JOHNSON, "Out of Equilibrium Nucleation in the Solidification of Helium", *Advisor: Charles Elbaum*

GANGPING JU, "Ultrafast Spin Dynamics and Coherent Magnetization Switching in Ferromagnetic Thin Films", *Advisor: Arto Nurmikko*

PEDRAG NESKOVIC, "Feedforward, Feedback Neural Networks with Context Driven Segmentation and Recognition", *Advisor: Leon Cooper*

MATTHEW PARRY, "Topics in Inflationary Preheating", *Advisor: Robert Brandenberger*

ANDREY VERTIKOV, "Near-field Optical Microscopy of Nitride Sermiconductor Heterostructures", *Advisor: Arto Nurmikko*

DWIGHT WHITAKER, "Investigations of Levitated Helium Drops", *Advisor: George Seidel*

1999 Senior Honors Recipients

Our sincere apologies to Claire Cramer whose name we inadvertently omitted in our last newsletter.

CLAIRECRAMER, "Nucleation of Bubbles in Liquid Helium-3: Preliminary Results ", *Advisor: Humphrey Maris*

DAVID BAGHDADI, "Investigations of Phase Transitions in Superheated Metallic Crystals", *Advisor: Sean Ling*

BARRETT BREADY, "Cardiac Chaos: Application of Nonlinear Analysis to Electrocardiogram Data", *Advisor: Jim Valles*

SUVI GEZARI, "A Study of Supersonic Turbulence Probed by Water Vapor Masers in Five Galactic Sources", *Advisor: Greg Tucker*

JOSHUA BLOUSTINE, "Assessment of DO Detector Electronics", *Advisor: Richard Partridge*

RAVI PILLARISILLY, "Reverse Tunneling in Si/SiGe Backward Diodes for Multi Emitter Heterojunction Bipolar Transistor Applications", *Advisor: Alex Zaslavsky*

Mike Kosterlitz

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phase with exponential decay of order parameter correlations. Mike later supplemented these arguments with quantitative predictions derived from ingenious applications of the renomalization group [J. Phys. C **7**, 1046 (1974)].

The original theory of Kosterlitz and Thouless, describes the magnetic transition in the XY model, the superfluid transition in helium films as well as transitions in related models of thin superconducting films and two-dimensional solids. However, their striking results have led to an explosion of interest in "defect mediated phase transitions" beyond these two-dimensional systems. Transitions driven by defect unbinding have been discovered in many other condensed matter systems of higher dimensionalities (such as smectic liquid crystals) as well as in models of interest to particle physicists and cosmologists.

Shan Wen Tsai - Recipient of Dissertation Fellowship

Between the realm of perfect regularity as described by the microscopic laws of atomic, nuclear and particle physics and the realm of complexity, life for instance, lies the field of science known as condensed matter physics. Condensed matter physicists find their research exciting because they are uniquely positioned to understand how myriad diverse properties of matter emerge from simple physical laws.

One young condensed matter physicist, Ms. Shan-Wen Tsai, was awarded a competitive Graduate Dissertation Fellowship from Brown University in recognition of her cutting-edge theoretical research on the "quantum Hall effect," (a catch-all name for the rich variety of behaviors exhibited by electrons confined to two dimensions and subjected to strong magnetic fields). Under the direction of her advisor, Professor Brad Marston, Shan-Wen combined analytical calculations with numerical results obtained using the Department's powerful Cray supercomputers to understand the role of disorder in quantum Hall transitions. Some of their results recently appeared in the prestigious journal Physical Review Letters. An overview can be found at the Department of Physics website at www.physics.brown.edu/cmt/whatis/qcp.pdf.

Shan Wen Tsai

Shan-Wen is devoting her final year of Ph.D. research to a new project: investigating how interactions between electrons lead to superconductivity. She is applying the "renormalization-group" method to a model of electrons hopping between sites on a triangular lattice. This model should provide insight into the two-dimensional layered organic superconductors κ-$(BEDT\text{-}TTF)_2 X$. One question to be answered is whether or not d-wave superconductivity, the type found in the famous high-temperature superconductors, occurs in this model. Shan-Wen will present her latest results at the APS Meeting in Minneapolis this March.

Dell'Antonio

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to deep gravitational potentials that are attributed to dark matter. These detection techniques, however, require some form of luminous matter to be mixed with the dark matter, and thus amount to "looking under a lamp-post", *i.e.* looking where there are already baryons.

In contrast gravitational lensing detection of dark matter only requires a background source of light. Furthermore, because the strength of the lensing distortion depends only on the mass of the lensing object and on the distance between the source, the observer, and the lens, extracting the mass information is relatively simple. The measurements of the positions and shapes of the distant galaxies that are used as probes of the intervening mass distribution must be made with high precision. Dell'Antonio and coworkers have achieved such precision using the Hubble Space Telescope.

Professor Dell'Antonio focuses his efforts on determining the distribution of mass on large scales (larger than 100,000 light years), and on the evolution of the clumping of matter. To this end, he, as the co-PI, and a team of scientists from ten different institutions have begun an ambitious program to map portions of the sky-- the Deep Lens Survey. They are attempting to measure the positions and shapes of millions of faint galaxies in seven patches of the sky, each about 20 times the size of the full moon (the faintest just one ten-billionth of the brightness of the faintest stars visible to the naked eye). In order to achieve this goal, the survey uses the wide-field cameras mounted on the twin 4-meter telescopes at Kitt Peak in Arizona and Cerro Tololo in Chile. The survey, which began in the fall of 1999, will occupy roughly ten percent of the total dark time available at these telescopes over the next four years. With this vast amount of data, Professor Dell'Antonio hopes to measure the evolution of the clumping of mass over the last ten billion years and form an accurate picture of where the Universe is heading.

Long Time Colleagues Retire

Over the past ten months, Physics has lost the benefit of the experience and talent represented by three devoted staff members who have entered a well-deserved retirement. Together, Jack Breetveld, Margaret Furey and Rose Ouloosian contributed 109 years of service to Brown.

Jack served the Department in many roles, far more than indicated by his title as Manager of the Instructional Labs. Many of us who were students in the labs remember his support and training, ever present good humor and sense of perspective. All who worked in the building benefited from his delight in helping with equipment, labs and offices, and the fine points of soccer.

As Assistant to the Chair, Margaret Furey was responsible for a wide range of matters, from faculty appointments through student records and foreign visas. She provided the essential link to the University administration for faculty, students and visitors. We depended heavily on her wisdom and advice, and ever-cheerful help in working within the system.

Rose Ouloosian, our long-time Academic Office Manager, oversaw the secretarial staff and many important department matters, including the assembly of the Qualifying Exam and the Graduate Brochure. Faculty will remember that she would always cheerfully help to find solutions to their needs; and staff, that she was always available and understanding.

The warmth, friendliness and support of Jack, Margaret, and Rose will ever be present in the minds of many who remember the Physics department.

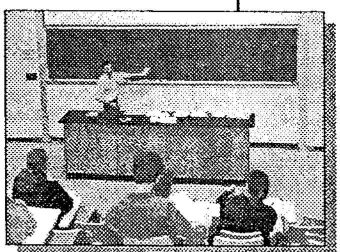
BEYER BIRTHDAY

On January 30, Professor Emeritus Robert Beyer's family surprised him with an 80th birthday party at the Faculty Club. Ellen, his wife, his children and grandchildren, past students and friends from physics and elsewhere joined in the celebration of his life and his service to others.

P.J. Bray NQI Award Recipient

Philip J. Bray was presented the Nuclear Quadrupole Interaction Award at the XVth International Symposium on NQI at the University of Leipzig this past July. The award was presented in recognition of his pioneering and outstanding contributions to the field of Nuclear Quadrupole Resonance and his continuing effort to develop and strengthen the NQI community. One person is selected for the award every two years from the international scientific community. Presentation is made at the international meetings sponsored by the Committee in various international locations. Professor Bray was the host and Chairman of the Organizing Committee for the 1995 meeting which was held at Brown University.

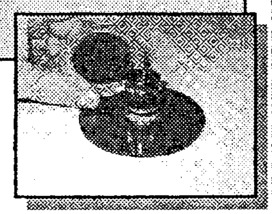
Pelcovits awarded the Philip J. Bray Award for Teaching Excellence in the Physical Sciences



In recognition of years of superb work in the classroom, Bob Pelcovits received the prestigious Philip J. Bray Award for Teaching Excellence in the Physical Sciences. Most recently, Bob Pelcovits shined while teaching the introductory physics class for premedical students. His very clear and organized style, compassion for students, and love of physics are also well known to many of our past concentrators who may have had him for physics 5, 6, 8, 47, 79, or 151 and our past graduate students whom he may have taught in 208, 214, 241, 242, or 243.

Stargazing. . .

Senior physics concentrator Aaron Schweiger and his advisor, Professor Hendrik Gerritsen, were awarded a patent for a device that literally puts a new look on star gazing. Motivated by the uncertainty and the cumbersome nature of traditional star maps Schweiger and Gerritsen created an optical device that seamlessly incorporates our knowledge of the constellations with one's view of the celestial vault. Their prototype consists of a flat and locally undistorted map that is presented before one eye. This map coincides with the unobstructed eye's view of the stars. The fusion of the two images in the brain, results in an undistorted labeled view of the night sky.



Brown hosts Thin Films Workshop

Workshop participants enjoying Brown's Faculty Club including Peng Xiong '94, sixth from left, now an Assistant professor at Florida State University

About 40 physicists attended a two day, international workshop, "Physics of Ultrathin Films near the Metal-Insulator Transition" on the Brown campus. More than 20 talks reviewed recent progress and results in superconductivity, localization, quantum critical and mesoscopic phenomena that occur in quasi-two-dimensional systems near the metal to insulator transition. Myron Strongin (Brookhaven National Laboratory), Allen Goldman (University of Minnesota) and Jim Valles (Brown University) coorganized the US Department of Energy sponsored event. Jane Martin's careful coordination of the logistics ensured that the workshop ran smoothly.

Arthur O. Williams Lecture

STEVEN CHU

NOBEL LAUREATE IN PHYSICS - STANFORD UNIVERSITY

"Holding onto atoms and molecules with laser light"

Monday, February 7, 2000
4:30 p.m.- Barus & Holley 166

Special Additional Lecture:

"Watching enzymes work, unfold and refold, one molecule at a time"
Tuesday, February 8, 2000
2:30 p.m. - Barus & Holley 166

Physics Department - Brown University

Physics at Brown

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Symposium to Honor Leon Cooper

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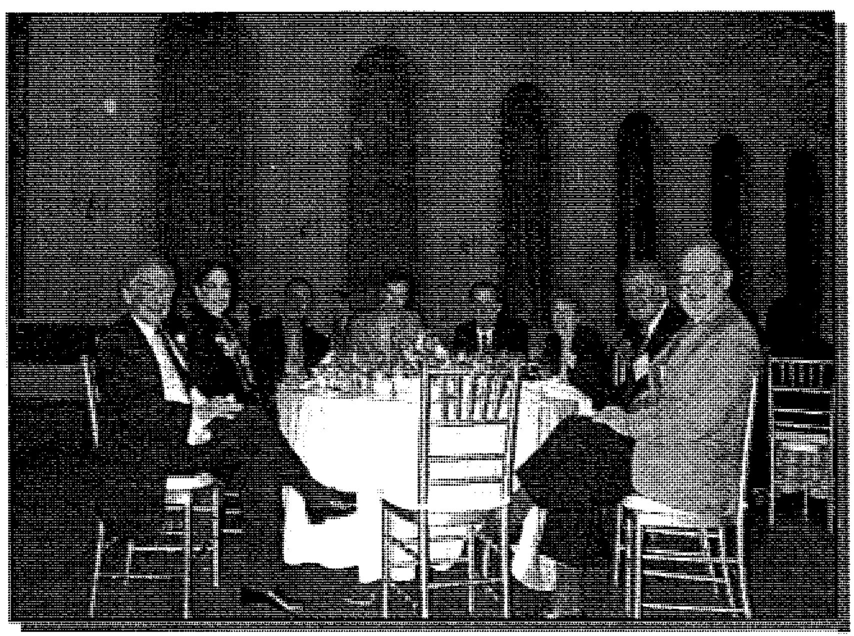
departments and attracts students, post-docs and senior scientists from all areas of the globe.

Leon Cooper is a very enthusiastic and inspiring teacher at all levels. Together with his many scholarly and research activities, he has been extensively involved, throughout his career at Brown, in teaching our undergraduate and graduate students. His courses span the range from advanced quantum mechanics to introductory physics for undergraduates majoring in the humanities. The latter course was based on Leon's book, "The Structure and Meaning of Physics". This book has been of great interest to both scientists and non-scientists.

Recently, Leon and colleagues in art, biomed, classics, computer science and philosophy, initiated a well-received cross-disciplinary course that bridges and integrates the various outlooks under a common umbrella.

Charles Elbaum organized a University Symposium to celebrate Leon Cooper's accomplishments on the occasion of his 70th birthday. Speaking at the Symposium were Interim President Sheila Blumstein, Robert Schrieffer, T.D. Lee, Andrew Sessler, and Mark Bear. (see photo of birthday dinner above).



Seated left to right, Leon Cooper, Kay Cooper, T.D. Lee, Dave Cutts, Mark Bear, Interim President Sheila Blumstein, Robert Schrieffer and Andrew Sessler