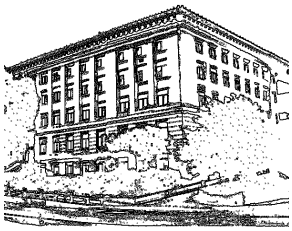

Sterling Hall
on the University of Wisconsin Campus

THE WISCONSIN PHYSICIST

Vol. 4, No. 1 *A Newsletter for University of Wisconsin Physics Alumni* *Fall, 1997-98*

• Hi, Physics alumni and friends:

Hello again from the University of Wisconsin – Madison campus. First of all, I would like to thank you for your continuing support for this newsletter project. I like the fact that you say good things about our efforts to stay connected. This is our fourth issue of **THE WISCONSIN PHYSICIST** *and, I hope, our best!*

Many exciting activities continue to happen here. New and continuing faculty alike continue to initiate exciting research projects. Our Web presence is growing. Physics labs are really becoming computerized. New faculty hires are joining the staff. We actually compiled the first undergraduate major handbook. We established three outstanding student awards thanks to generous gifts from Lily and Jeff Chen, Faye Ajzenberg Selove and the Dillinger family. Undergraduate peer tutoring is actually becoming a reality. And, because of your continuing strong financial and institutional support, we are confident that the size of our incoming graduate student classes will continue to increase.

*On a personal and professional note, I recently led a campus committee to establish a mentoring pilot program for all academic staff on the Madison campus. We currently have about 50 pairs of senior and junior people connected. If you check out the physics web site (*http://www.physics.wisc.edu*), you'll find more information.*

Stay in touch, Jean Meyer Buehlman, Editor

Pondrom Elected Chair

Professor **Lee Pondrom** began his chairship of the Department of Physics on July 1, 1997. Pondrom, who received his Ph.D. from the University of Chicago, has been a faculty member in the High Energy Physics group at UW Madison since 1963. His specialty area includes experimental studies in elementary physics using electronic techniques and general instrumentation problems in elementary particle physics. Professor Robert Joynt has joined Pondrom's administration as Associate Chair. Joynt is from the Condensed Matter group and has been a member of the department since 1986.

Thoughts on a New Chairship

By Lee G. Pondrom

I agreed to assume the responsibilities of Department Chair during the summer of 1997. The Physics Department is in good shape, with no really major crises on the immediate horizon. We have been fortunate in hiring new staff in the past few years, who have strengthened the department for the future. Thanks to vigorous recruiting efforts on the part of alumni and others the incoming fall graduate class enrollment will be back up to the level of two years ago, thus easing the threat on graduate class size. Innovative teaching techniques are attracting local attention, and

Lee Pondrom, Chair

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Inside Features:

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may help in encouraging undergraduates to major in physics, which will increase the undergraduate upper division class sizes. Larger classes will mean that we can offer more courses, and have a stronger teaching program.

Bob Joynt, Associate Chair

I believe that the job picture for people with undergraduate or advanced degrees in physics is improving. US industry, under intense competition, is interested in hiring people who can think. Federal grant support for research in the physical sciences shows signs of stabilizing after a period of uncertainty. So the situation is easing a bit, although there is still a shortage of privately funded research, and pressures on the federal budget will continue for the next several years.

A periodic external review of the Physics Department is planned for this fall. While the Department is basically sound, there is always room for improvement. State support has been squeezed by the property tax relief initiative and the many other demands on state funds. As a result, Madison campus salaries have fallen behind those of peer institutions. Indeed the decline in the overall ranking of the Department, partly because of the salary picture, is a cause for concern. The external review committee could make positive recommendations which would, in due course, strengthen the position of the Department as a whole.

The duties of the faculty include research, teaching, and service. The strength of the Department depends on the faculty, staff, and students. For the next few years it will be my job to maintain the qualities that we now have, and improve them wherever possible. I will have lots of competent help. It will be interesting to read what I have to say this time next year. Look for it. ❑

Lee G Pondrom

Lee Pondrom
Professor of Physics
Chair of the Physics Department

Looking Back Over Three Years As Physics Department Chair

by J. E. Lawler

This is my letter as outgoing Physics Department Chair. A three-year term is standard in our Department. It has been a valuable and rewarding experience for me to serve as Department Chair. I have learned a great deal about the administration of the University and about Wisconsin's strong traditions of Faculty Governance. We have made progress toward solving a few of the problems facing the Physics Department, but a few new problems have surfaced.

The highly competitive environment of the Physics Department sometimes makes it difficult for faculty members to fully appreciate the excellence which exists in the Department and to maintain good morale. Morale also tends to suffer when raise money is very limited as it has been for the last two years. Although this is not the best of times, we should take great pride in the recognitions received by our faculty and staff. A partial list of these recognitions received during the last three years includes: Prof. Anderson's election to the UW Teaching Academy; Prof. Balantekin's American Physical Society (APS) Fellowship, Humboldt Research Award, and Mid Career Award; Prof. Bruch's APS Fellowship; Prof. Chubukov's Sloan Fellowship; Prof. Cox's election to the UW Teaching Academy; Prof. Randy Durand's Distinguished Teaching Award; Prof. Haeberli's Hilldale Award; Prof. Himpsel's election to the New York Academy of Sciences; Prof. Joynt's Nordic Institute Visiting Professorship; Prof. Lagally's APS Davisson Germer Prize; my International Penning Award; Prof. Lin's APS Allis Prize; Prof. McCammon's Vilas Associateship; Prof. Olsson's APS Fellowship; Prof. Onellion's Vilas Associateship; Prof. Prager's University Houses and Hilldale Professorships; Prof. Reeder's University Houses Professorship; Prof. Smith's Vilas Associateship and APS Fellowship; Prof. Sprott's Van Hise Outreach Teaching Award; Prof. Walker's Romnes Fellowship; Prof. Wu's European Physical Society High Energy Physics Prize and election to the American Academy of Arts and Sciences; and Prof. Zeppenfeld's Romnes Fellowship. Physics Department Scientist Dr. Robert Morse won the Chancellor's Award for Excellence in Research. There have also been numerous promotions of faculty and staff members during the last three years. I have an uneasy feeling that I may have missed something important, but it is nevertheless an impressive list for three years.

Faculty and staff recruiting has been quite successful over the last three years. The list of successes in recruiting includes: Prof. Franz Himpsel in experimental condensed

matter physics, Asst. Prof. Cary Forest in experimental plasma physics, Assoc. Prof. Tao Han in phenomenology/theoretical physics, Assoc. Prof. Peter Timbie in astrophysics, Mr. Steve Narf as the lecture demonstration manager, and Mr. Bill Grogan as our computer support person to help with the instructional laboratory modernization. In addition, many research groups have successfully recruited both scientists and support staff. There are numerous retirements anticipated in the next few years, and continued success in recruiting excellent faculty and staff will be vital to the Physics Department. The Department established a Long Range Planning Committee during my first year as Chair. The Long Range Planning Committee finished and released a multi-year recruiting plan during the last 12 months. The plan won unanimous Department support and was well received by the College Administration.

The Department has been very successful in University-wide competitions for lab modernization funding. We have won about $400,000 during the last three years to help computerize our large instructional labs for freshman Physics. We are behind other schools in computerizing our instructional labs, but we are committed to the computerization while preserving the best features of the labs. Labs for freshman physics courses should help students learn or reinforce: (1) physical concepts from the lectures, (2) rudimentary laboratory techniques, and most importantly, (3) the Scientific Method. I am especially grateful to Prof. Willy Haeberli and Prof. Ugo Camerini for providing substantial leadership in our lab modernization effort. Many other people have been doing an outstanding job in the Physics Department, but I am mentioning two faculty who have been working on the lab modernization because it is a major and important task which requires a great deal of faculty input.

Jim Lawler, outgoing Chair

This year was a better year for recruiting graduate students. The Department initiated a new appointment to supplement graduate students' stipends. The Incremental Tuition Reimbursement (ITR)-Research Assistantship provides a student with additional income during the first three years of graduate study. The new graduate students must find a research group and major professor to be eligible for an ITR appointment. Graduate students' stipends during the first three years have been a problem because of the high cost of in-state graduate tuition. The initiation of the ITR appointments and somewhat more generous partial fellowship awards to prospective graduate students helped recruiting this year. Unfortunately, we may have made partial fellowship awards this year at a higher level than we can sustain. We are very grateful to those of you who have helped with our Fund Raising Drive to endow Graduate Fellowships. We need help from the rest of you at any level you can afford. We need help from all of you in encouraging talented young people to choose a career in science. I remain concerned about recruiting graduate students. I regard recruiting graduate students as the most serious challenge facing our Department. To close, I want to thank my key support people who made it possible for me to serve as Chair while maintaining my research. I am especially grateful to Instructional Program Manager Jean Buehlman, Assoc. Chair-Prof. Al Erwin, Chair's Secretary Chris Lynch, Research Program Manager Ed Slotten, and all other Physics Department Support Staff who have provided excellent help to me and to the Department during the last three years. ❑

James E Lawler

Jim Lawler
Professor of Physics
Outgoing Chair of the Physics Department

Faculty & Staff Research Awards

Several Physics faculty and staff were once again honored with a variety of national and local awards, ranging from the Hilldale Award to a Chancellor's Award for Research Excellence.

Sabbaticals

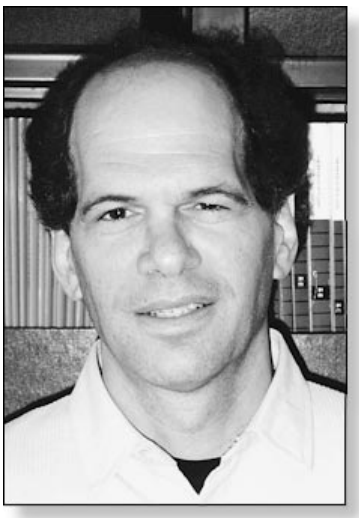
Congratulations to Professors **Balantekin**, **Onellion** and **Ögelman** for winning sabbaticals during the 1997–98 academic year. Professors Balantekin and Ögelman will be on sabbatical for the complete academic year, while Professor Onellion will be on leave for the fall 1997 semester.

Other awards include:

Hilldale Professorship

Professor **Stewart Prager**, UW-Madison, Department of Physics, became a Hilldale Professor on July 1, 1997.

Hilldale Professorships are given to faculty who excel in scholarly activity and have records of outstanding research and show promise of continued productivity. Hilldale Professors each receive $25,000 per year for five years, and normally will be renewed so long as the holder maintains the level of appointment under which the professorship was awarded.



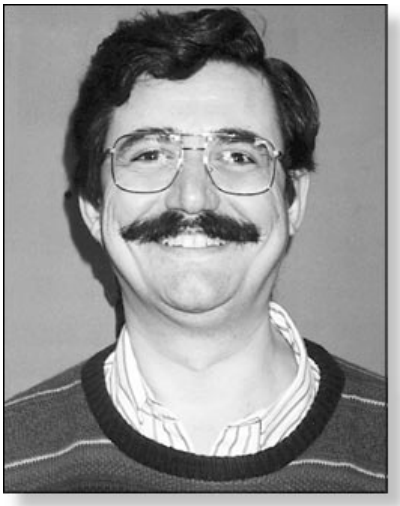
Stewart Prager

Stewart Prager received his Ph.D. in plasma physics in 1975 from Columbia University. Following two years at General Atomics in California, in 1977 he joined the faculty of the University of Wisconsin–Madison, where he is now the R. N. Dexter Professor of Physics. His research in plasma physics focuses on basic plasma problems related to fusion energy.

Professor Prager has made fundamental contributions to the understanding of plasma turbulence, anomalous transport in plasmas, reconnection of magnetic fields, and dynamo effects (spontaneous generation of magnetic fields). He presently directs the MST (Madison Symmetric Torus) experiment, which in addition to basic plasma studies, is developing an approach to fusion energy different than the mainline tokamak. He has just completed a term as Chair of the Division of Plasma Physics of the American Physical Society. Other recent national service activities include membership on the President's Committee of Advisors on Science and Technology fusion review panel, and presidency of the University Fusion Association. He is an Associate Editor for *Reviews of Modern Physics*, and has served as Associate Editor of *Physical Review Letters*. About twenty students have received their Ph.D. degrees under his supervision.

Mid-Career Award

Baha Balantekin was one of nine UW professors who received a boost to their research at mid-career. Wisconsin Alumni Research Foundation and the Graduate School created the Mid-Career Awards in 1995 to provide support to faculty during what is often their most productive phase. The $60,000 awards are given to faculty who are between five and twenty years past tenure, and are nominated by colleagues. The Graduate School Research Committee selected winners based on distinguished research achievements and quality of teaching and service contributions.



Baha Balantekin

Balantekin works at the interface of nuclear physics, particle physics and astrophysics. His current research is focused on theoretical neutrino astrophysics. In particular, he is interested in the study of solar neutrinos, the role of neutrinos in the dynamics of core-collapse supernovae and the Early Universe, neutrino probes of gravitationally-driven stellar oscillations, using astrophysical settings to probe neutrino properties, and the development of new mathematical techniques to address physics questions arising in these studies.

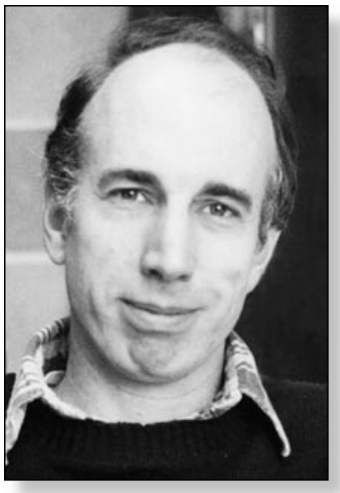
Balantekin is a Fellow of the American Physical Society. He currently serves on the Editorial Board of *Physical Review* and the Fellowship Committee of the Division of Nuclear Physics of the American Physical Society. His previous awards include an Alexander von Humboldt Research Award for Senior U.S. Scientists, a Japan Society of Promotion of Science Senior Fellowship, a Presidential

Young Investigator Award from the National Science Foundation, and a Jefferson Award from the Martin Marietta Corporation. Before joining the UW faculty in 1986, he was a Eugene P. Wigner Fellow at Oak Ridge National Laboratory and a research staff member at Massachusetts Institute of Technology.

Vilas Associate

Congratulations go to **Dan McCammon** on his selection as a Vilas Associate. The Vilas Trustees have made possible this form of recognition for tenured faculty in the Physical Sciences. This appointment provides for 2/9 summer salary for two summers and $5,000 in flexible research funding for two years.

Professor McCammon's research work has led in the development of a new class of X-ray detectors. These detectors are actually microscopic, low temperature calorimeters. He is now proposing to combine these calorimeters with new and more sensitive thermometers based Superconducting Quantum Interference Devices (SQUIDS). This development could have a major impact on X-ray Astronomy and other areas including Particle Physics, Medicine, Spectroscopy, and Cosmology. McCammon's earlier research in the area of X-ray Astronomy using sounding rockets is also held in high regard by the community.



Dan McCammon

Dan McCammon joined the faculty as an Assistant Professor in 1980, following prior appointments as Research Assistant, Research Associate, Assistant and Associate Scientist. He received his Ph.D. from UW-Madison in 1971.

Emeritus Professor McVoy Honored

Kirk McVoy has been elected as a Corresponding Member of the Academia Mexicana de Ciencias. This nonprofit, non-government association was established in 1959. Its membership includes distinguished members of the scientific community, and one of its main objectives is to promote science research in Mexico, as well as to foster communication and interaction among the scientists.

Dr. McVoy tells us, "The University of Mexico in Mexico City has a Physics Department which has long had Nuclear Physics as one of its specialties — you may recall that Marcos Moshinsky, one of Wigner's early students, is their star performer. I happened to meet Moshinsky when we both were lecturers at a 'winter school' in nuclear physics held in Trieste in 1968. He invited me down to Mexico for a visit the following year, and since I discovered several kindred souls in his Department who were interested in nuclear theory questions which also interested me, I began a collaboration with the group which has lasted to the present day."

Kirk McVoy

"It has been an exceptionally stimulating group to work with, and my many visits there — and theirs here, including a sabbatical year here by Pier Mello — have not only led to a string of joint publications, but have also provided me with something of an education in the problems faced by scientists working in third-world countries. And, this in turn led to various efforts I've made to help some of their projects along."

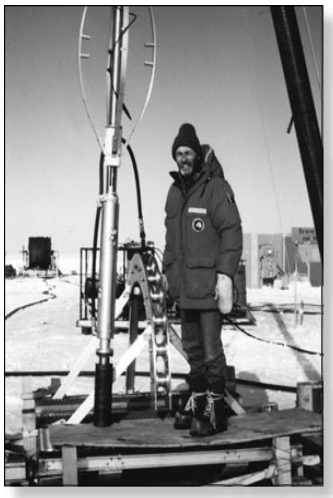
"To my surprise and delight, they reciprocated last fall by electing me, on October 4, to Corresponding Membership in their Academia Mexicana de Ciencias. As near as I can tell, this is their equivalent of our National Academy of Sciences...It was a generous gesture on their part, and one which I greatly appreciated. I am also pleased to report that, in recent years, my principal collaborator there has been Maria Ester Brandan, who obtained her degree at the University of Wisconsin-Madison and is now a professor at the University of Mexico."

Chancellor's Award for Excellence in Research

(See related story by Bob Morse in Research Section)

Department of Physics Scientist, **Robert Morse**, was awarded the Chancellor's Award for Excellence in Research at a ceremony held at the home of Judith and David Ward on May 1, 1997. This award, established to give recognition to individual academic staff who have

had outstanding university careers, was one of seven excellence awards presented annually on the UW-Madison campus. Morse was also recognized on May 12, 1997 in a ceremony held as part of the Academic Staff Assembly. (Parts of the following article are reprinted from *Wisconsin Week*, May 14, 1997, by Terry Devitt, UW News Service)



Bob Morse

Robert Morse is in quest of a ghostlike particle. His quarry is the cosmic neutrino, a subatomic particle so elusive that it can pass through the entire earth without interacting. But if, by a one-in-a-billion chance it does collide with a nucleus and leave a fleeting trail of Cherenkov light, there's a good chance Morse will be there to record it.

For more than 20 years, Morse has been what former Physics Department Chair James Lawler described as "a good citizen of the High Energy Physics Group." But it is Morse's dedicated efforts to help detect one of the most wanted particles in the realm of physics that inspired the unanimous decision of the Physics Department to nominate Morse for the Chancellor's Award for Excellence in Research.

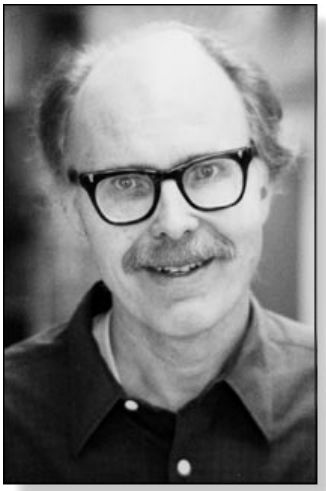
Since 1990, Morse has busied himself — and others — with the construction of AMANDA, the Antarctic Muon and Neutrino Detector Array at the South Pole. AMANDA is, in essence, a telescope designed to detect in the deep, clear Antarctic ice the fleeting light signature of the elusive neutrino. Once detected, it is hoped that the trail of the neutrino can be traced back to its cosmic origin, possibly a black hole, active galactic nuclei (AGNS) or other violent source in the heart of a distant galaxy.

And, who knows, it's just possible that we may get an extra-galactic source of cosmic neutrinos in the bargain.

APS Fellows

Professor **Martin Olsson** was recently elected as an American Physical Society Fellow. He was cited by the Division of Particles and Fields as follows:

"For highly significant contributions in hadron phenomenology, especially tests of current algebra and QCD, the properties of quarkonium bound states, and the mechanism of quark confinement."



Martin Olsson

He received a Ph.D. from the University of Maryland in 1964 and joined the faculty of the University of Wisconsin Madison in 1966. Olsson was awarded the Chancellor's Teaching Award in 1989 and served as Department Chair from 1988–1991. He has co-authored (with Vernon Barger) intermediate level textbooks in Mechanics and in Electricity and Magnetism. His current research interests are in B factory physics and the dynamics of quarks bound into mesons.

Wes Smith is also to be congratulated for his recent election to Fellowship in the American Physical Society. He is the 25th Physics Department member to be elected as an APS Fellow. He was cited by the Division of Particles and Fields as follows:

"For systematic investigation of the structure of hadrons using muon, neutrino and electron deep inelastic scattering and for electronic innovations to detector design."

Wes Smith

Professor Smith's research in high energy physics is centered on the physics analysis of lepton-hadron interactions and the construction of a new detector to observe hadron-hadron collisions at the energy frontier. (See article in Research Section for update to research progress.)

Smith joined the faculty in 1988. His prior awards include a Vilas Associateship, a Presidential Young Investigator Award, an Exxon Education Foundation Award, and an Outstanding Junior Investigator Award from the Department of Energy. ❑

PHYSICS RESEARCH

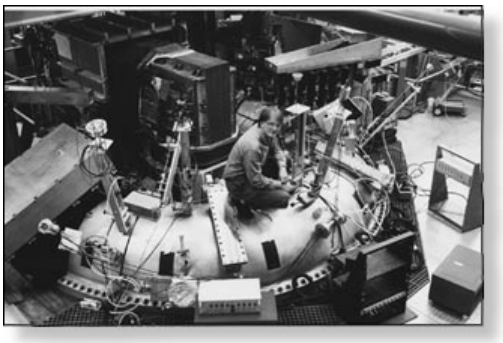
Plasma Physics Research in the MST Experiment

by Stewart Prager, Hilldale & R. N. Dexter Professor of Physics

The Madison Symmetric Torus (MST) experiment is dedicated to research in basic plasma physics problems, most of which have relevance to the fusion energy quest and to the evolution of a plasma confinement concept with the unfortunate appellation of reversed field pinch (RFP). Housed in Chamberlin Hall, MST began operation in 1988.

The focus of MST research has been the understanding of magnetic field turbulence, its consequences, and its control. The RFP is a wonderful vehicle to study magnetic turbulence since it spontaneously generates one-percent fluctuations in the confining magnetic field. The fluctuations, including their nonlinear properties, are fairly well understood as being driven by the free energy contained in the plasma current. MST has recently made unique contributions to understanding the consequences of the turbulence. One percent fluctuations may sound small, but they have a powerful effect on the macroscopic behavior of the plasma in two ways.

First, the fluctuations cause energy and particles to escape the confines of the magnetic field. If not heated, the several million degree plasma will lose all its energy in one-thousandth of a second. How does this happen? The tiny fluctuations cause the magnetic field lines to wander chaotically about the plasma. Charged particles follow the chaotic field lines and are transported across the plasma. MST researchers have devised a technique to measure the plasma energy flux specifically caused by the magnetic turbulence. This task required measurement of the correlation between the fluctuating electron energy flux (measured with a specially designed fast bolometer) and the fluctuating magnetic field. The measurement proved that magnetic turbulence can cause energy transport in the RFP configuration, and provided the first measurement of transport from chaotic magnetic fields.



Madison Symmetric Torus (MST)

The second consequence of the magnetic turbulence is the production of a dynamo effect: the spontaneous generation of plasma current and magnetic field. A remarkable property of the RFP is that its magnetic field is partly self-generated by a mechanism which has some similarity to magnetic field generation in the Earth and stars. Measurements in the outer region of MST have shown that the dynamo mechanism is in agreement with the standard model of magnetohydrodynamics.

This evolving understanding of magnetic turbulence has led to techniques to control the turbulence. The free energy source can be reduced by controlling the spatial structure of the plasma current. In MST, this has led to a halving of the turbulence. It is notable that a reduction in the magnetic field fluctuation from about 1% to about 0.5% causes the electron temperature to increase by 50% (from about four million to six million degrees) and the input power required to maintain the plasma to decrease by a factor of three. Tiny changes in magnetic field "noise" cause power flow within the plasma to change by millions of watts.

These control experiments offer a fine tool to study the properties of turbulence, dynamo, and transport. Moreover, they suggest a new path to improve confinement in the RFP. The advantage of an RFP as a fusion energy source is that the confining magnetic field is relatively weak (and thereby inexpensive). A disadvantage has been that the weakness in the confining field makes it vulnerable to plasma induced fluctuations which cause strong transport. The MST result offers a solution to this problem and has caused a re-evaluation of the reactor promise of the RFP.

MST research is led by a group of faculty and scientists consisting of Daniel Den Hartog, Gennady Fiksel, Cary Forest, Stewart Prager, John Sarff, and Clint Sprott. Theoretical work by Professor Paul Terry, Dr. Chris Hegna and co-workers complements the experimental activity. Tom Lovell heads the MST engineering staff, and John Laufenberg heads the technical operations of MST. John recently entered an active "retirement" after several decades of service, but still oversees MST technical operation with a 60% appointment. About twelve enterprising graduate students perform thesis research on MST, and about fifteen undergraduate workers complete the staff. ❑

The Oldest Photons in the Universe

by Associate Professor Peter Timbie

A new research group joined the Physics Department in January, bringing me and my associates from Brown University to the Department of Physics in sunny and friendly Madison.

Our goal is to measure the cosmic microwave background radiation (CMB) that fills the sky with a glow left over from the "Big Bang." Measurements of the CMB promise to answer many of the open questions in cosmology today: Is the universe open or closed? What makes up the "missing mass" in the universe — is it normal baryonic matter or is it some more exotic form like neutrinos? What is the expansion rate of the universe (Hubble constant)? What is the origin of the large-scale structures that we see around us — the galaxies, clusters of galaxies, great voids, etc.?

The CMB is made of photons that have traveled across the universe for some 10 billion years, most of the age of the universe. The radiation reveals the temperature and structure of the universe at a time far earlier than can be seen in visible light with any telescope. In 1992 the COBE (Cosmic Background Explorer) satellite confirmed that the radiation has the spectrum of a 2.7 K blackbody source, with a peak wavelength around 1 mm. COBE also discovered that the intensity of this glow varies across the sky. COBE compiled a map of the whole sky mottled with "hot" and "cold" spots. The variations from uniformity are small, just a few parts in 100,000 of the general glow, but they are an imprint of the structure of the universe on the largest scales.

Our telescope gondola on the launch pad, ready for a balloon flight to observe the 2.7 K cosmic microwave background radiation. A scientific helium balloon is filling in the background. The truck ("Tiny Tim") holds the gondola until launch.

Let's take a speedy trip through the universe's history. In the 1920's astronomers began to realize that the universe was not just filled with stars, but rather was composed of galaxies similar to our own Milky Way galaxy. Around 1930, Edwin Hubble and others found that most of these galaxies are speeding away from each other (and from us) in a flow that is called the Hubble expansion. The most distant galaxies recede nearly at the speed of light and have strongly redshifted spectra. Presumably, at some time in the past, all these galaxies were piled on top of each other, during an epoch of enormous density and temperature when matter would have been in close thermal contact with radiation. The discovery of the CMB itself, in 1965, provided the key missing evidence that the universe was once much hotter and denser than it is today.

In this "Big Bang" model, the universe was once a hot fluid made mainly of ionized hydrogen and helium in close contact with thermal radiation. These elements formed from protons and neutrons in the first few minutes of the universe in a process called nucleosynthesis. The thermal photons are strongly scattered by the free electrons; it's opaque, like the surface of the Sun. As the universe expanded, it cooled. About 200,000 years after the "Bang" the universe cooled to about 5000 K (the temperature of the solar photosphere), cool enough that the plasma combined to form neutral atoms. With the scattering electrons tied up in atoms, the universe rapidly became transparent to light. Before landing on our detectors, the last contact the CMB photons had with matter was during this era of recombination. These photons provide a "snapshot" of the universe at the earliest times accessible with light.

What we see in COBE's full-sky map is often called the "cosmic photosphere." It is almost perfectly uniform, with faint features caused by density variations in the universe. As the CMB photons traveled across the universe to us, their wavelengths were red-shifted and blue-shifted by the gravitational potentials of these regions. Photons emitted from high density regions of the universe lost energy while climbing out of the potential wells and were red-shifted compared to light from low-density regions. This effect is clearly visible in COBE's coarse map which has pixels about 7 degrees in diameter, or 14 times the size of the full moon. But with finer resolution, even more dramatic features should be visible.

On smaller angular scales than COBE could resolve, we expect to see the distant precursors to galaxies and clusters. Before recombination, gravity caused the denser regions of the plasma to collapse and heat up. The photons, moving fast and tightly coupled to matter, opposed this

collapse, causing oscillations in the matter flow. At recombination these oscillations presumably left a distinctive imprint on the temperature distribution in the CMB across the sky. If we could measure these imprints on all angular scales down to about 0.1 degrees, we could see patterns that depend sensitively on key cosmological parameters that specify the details of the Big Bang model: the expansion rate (Hubble Constant), the density of the universe (tells us if the universe will expand forever or whether it will ultimately collapse in a "Big Crunch"), and whether this model for the formation of structures really makes any sense. After recombination, photons could no longer prevent gravitational collapse, and large scale structures formed.

Research groups from around the world are working feverishly to map out these fine "anisotropies," as they are known, from exotic observing locations with microwave-transparent skies like the South Pole, Tenerife, scientific balloons, space probes, and even Madison, Wisconsin. At UW-Madison, a team of graduate students (Sean Cordone, Khurram Farooqui, Brian Keating, Slade Klawikowski, Chris O'Dell, and Grant Wilson), undergraduates (Karen Lewis, Nathan Stebor), a postdoctoral research assistant (Josh Gundersen), a visiting faculty member (Lucio Piccirillo), and I are pursuing schemes to view this radiation.

We are working on the Medium-Scale Anisotropy Measurement (MSAM), which will map out a section of the microwave sky with an overnight flight of a balloon-borne telescope provided by NASA/GSFC. In a few years a project called TopHat will survey a larger fraction of the sky than MSAM, using an infrared telescope mounted on top of a scientific balloon flown for two weeks in Antarctica. Both of these measurements will be capable of detecting and characterizing the expected fine spatial features of the CMB anisotropy.

The CMB may also be polarized. In principle, when the CMB photons scattered from matter in the early universe, they became polarized at a low level – approximately 1 part in 1,000,000 of the total intensity. The amount of polarization and the polarization patterns on the sky depend on the same cosmological parameters that define the intensity variations. But the polarization is sensitive to an additional unknown — did the CMB really come to us directly from the early universe, or did it scatter again from matter on the way? We are assembling an instrument, called POLAR, that we hope will detect this polarization. POLAR will operate initially from the roof of the Van Hise building in Madison. Later we plan to move to Antarctica, where the atmosphere may be more transparent. All of these measurements rely on the development of new sensitive detectors of microwave and infrared radiation. In one approach, we are developing cooled monolithic silicon bolometers. These devices are made of micromachined silicon that is patterned into small islands suspended at the ends of 4 tiny silicon legs. The island has an implanted semiconductor resistance thermometer, which is monitored through electrical leads that run down the legs. When cooled to low temperatures (0.1 K) and coupled to an antenna or telescope, the island warms and cools as we scan across the ripples in the CMB sky. Afterwards we can reconstruct a map. In another approach, we use new high-electron mobility transistors in low-noise amplifiers that now operate up to frequencies of 100 GHz.

Over the last fifteen years, cosmology has undergone a renaissance, fueled by a confluence of new theoretical ideas based on fundamental physics and a wealth of new data coming from observational astronomy and experimental astrophysics. In recent years, observational cosmology has generated an explosion of information on the large-scale clustering of galaxies, the spatial distribution of dark matter, and anisotropies in the cosmic microwave background. As a consequence of these observational advances, we can now confront cosmological models of the early universe with an impressive and growing array of observations. We are thus entering what one might call the "scientific" age of cosmology: those theories which are sufficiently predictive are becoming increasingly falsifiable and will stand or fall in the coming years. To read further, see "A Tour of CMB Physics" at http://www.sns.ias.edu/~whu/physics/tour.html. ❑

Members of Timbie's research group take a first look at the data during the flight.

Studies of Lepton-Hadron Interactions Continue

by Professor Wes Smith

Prof. Smith's research is centered on the physics analysis of lepton-hadron interactions and the construction of a new detector to observe hadron-hadron collisions at the energy frontier.

Prof. Smith is spokesman of the US group on the ZEUS experiment, which observes interactions of 27 GeV electrons with 820 GeV protons at the HERA collider at the DESY laboratory in Hamburg, Germany. He collaborates on this effort with Prof. Don Reeder, a previous US spokesman, and Wisconsin scientists Costas Foudas, Bill Badgett, Sridhara Dasu, Richard Loveless and students. The ZEUS experiment has made the first photoproduction measurements at high energy, the first observation of the direct photon and resolved photon contributions, and the first analysis of the properties of the photon remnant (Wisconsin thesis). There have been significant searches for new exotic physics states in heretofore unexplored regions (Wisconsin thesis).

In deep inelastic scattering ZEUS has extended the measurements of the charged and neutral current cross sections to the highest momentum transfer (Wisconsin thesis), measured the proton structure function F_2 (Wisconsin thesis) and extracted the gluon density of the proton (Wisconsin thesis). These latter measurements have discovered a striking rise at low fraction of the proton momentum of the structure function and the gluon density. Prof. Smith and his colleagues are eagerly pursuing this effect to more fully understand its nature and consequences.

Extracting physics out of the ZEUS detector at HERA posed significant instrumental challenges. In order to select the few Hz event rate from the 10 MHz beam crossing rate in a large detector collider detector, Prof. Smith, Wisconsin Engineer Joe Lackey and their colleagues in the Physics Department and Physical Sciences Lab built the ZEUS Calorimeter First Level trigger, which uses over a thousand high-speed electronics boards processing sums from 13,000 phototubes to collect physics events while reducing background from hundreds of kHz to a few hundred Hz by analyzing 14 kbits of information from each interaction occurring every 96 nsec. This innovative and successful system has been widely recognized as the model for future High Energy Physics detectors.

Prof. Smith, along with Profs. Duncan Carlsmith and Don Reeder, Senior Scientist Richard Loveless and Assistant Scientist Sridhara Dasu are working on the Compact Muon Solenoid (CMS) experiment being built to study the collisions of protons at a center of mass energy of 14 TeV at the Large Hadron Collider (LHC) at CERN. The physics program includes the study of electroweak symmetry breaking, investigating the properties of the top quark, a search for new heavy gauge bosons, probing quark and lepton substructure, looking for supersymmetry, and exploring for other new phenomena.

Prof. Smith has been appointed project manager of the trigger for the CMS detector. The trigger is required to reduce the input rate of 10^9 interactions every second by a factor of at least 10^7 to 100 Hz. The trigger system reduces the rate in 2 levels. The first level reduces the input rate to less than 100 kHz in a processing time of less than 3 microseconds. Prof. Smith and his group have a specific task to build the calorimeter level 1 trigger. This system will process 3 Terabits/second of electromagnetic and hadronic trigger tower sums from the calorimeter front end electronics and produce information on electrons, photons, jets, and energy sums in about 300 nsec.

Both the CMS detector and the LHC project are making good progress and DOE support of US participation is strong. Prof. Smith and his colleagues are looking forward to first physics from this program in 2005. In the meanwhile, they continue to pursue an active program of lepton-hadron physics at ZEUS that promises to continue with luminosity, polarization and other beam upgrades well into the next decade. ❑

Wanted — A Few Really Good Neutrinos

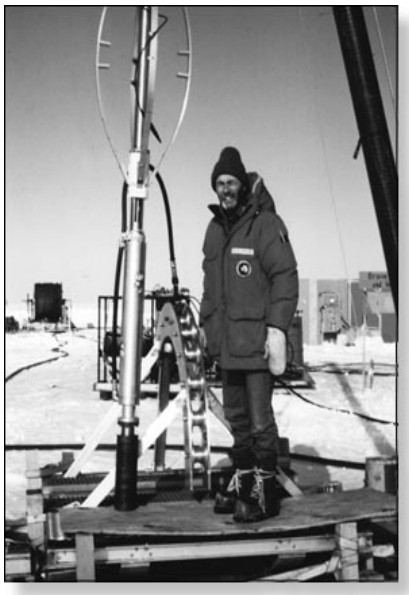
by Robert Morse, Senior Scientist

Unlike the Marines, we don't choose the neutrinos, but they choose us. This becomes obvious when you consider that only one in a thousand high-energy neutrinos would be detected in an apparatus the size of the earth. The odds get even worse — like about one in ten-million — when you talk about realistic sized detectors like the AMANDA detector at the South Pole. AMANDA, or the Antarctic Muon and Neutrino Detector Array, uses the clear ice of the two mile thick South Pole Icecap to do just that — detect neutrinos.

Bob Morse and Francis Halzen (yes, a theorist brazen enough to face the crushing disappointments and frustrations routinely faced every day by experimentalists) are co-principal investigators in this Wisconsin-led NSF supported project that is a collaborative effort that also involves UC-Berkeley, UC-Irvine, Pennsylvania, Bartol Research at Delaware, two universities in Sweden —

Stockholm and Uppsala and the DESY laboratory in Zeuthen (Berlin).

We are often asked, why are we trying to detect these most elusive of particles, and of all places, why the South Pole? Well first, the primary objective of AMANDA is to discover sources of very high-energy neutrinos from galactic and extra-galactic sources. These neutrinos could be of diffuse origin coming from the contributions of many active galactic nuclei (AGNs), or they could be point sources of neutrinos coming from supernova remnants (SNRs) and rapidly rotating pulsars or neutron stars.



Bob Morse standing next to hot water drill used to make 2 km deep holes in the ice at the South Pole.

Neutrinos — with energies of about a billion times that of visible light — could be the "ultimate messenger particle" bringing us information on cataclysmic processes occurring in our own galaxy and neighboring galaxies. Because they have no charge or mass, they travel in straight lines at the speed of light. They rarely interact with other matter, and are unaffected by inter-galactic magnetic fields, so they carry reliable messages through clouds of intergalactic dust to us from potentially interesting sources of neutrinos or "hot-spots" in the universe.

Recently, new sources of high-energy gamma rays have been discovered, like the sources Mrk-421, and Mrk-501 discovered by the Compton Gamma Ray Observatory satellite, and the Mt. Hopkins Observatory. Sources like Mrk-421 are also believed to be copious emitters of high-energy neutrinos, and it is objects like this that AMANDA has been designed to study.

On those rare occasions when neutrinos do interact with matter, the collision that occurs often creates a muon, or daughter particle. When these muons travel through matter they emit Cerenkov light. This emitted light is like the bow wave from a boat going through the water, and as such, measurement of this "bow-wave" of light allows us to detect the muon and reconstruct the original neutrino direction and its origin in the sky. See Figure 1.

AMANDA consists of photomultiplier tubes that have been imbedded in a regularly shaped grid between one to two kilometers deep in ice whose primary function is to detect high-energy neutrinos of astrophysical origin that have passed through the earth. Why South Pole ice you ask? Well, with detections probabilities of 10^{-36} per nucleon, you have to continually interrogate about 10^{36} nucleons — about 2 million tons of ice — to see one event per week for neutrino fluxes of about $10^{-1}/cm^2$ per day.

To be effective, the detectors must be placed in a medium that is cheap, plentiful and transparent, in a location with a scientific infrastructure to support the experiment. The ice at the south pole is ideal, and it is the only place on earth that meets all the criteria. If you need to instrument 2 million tons of anything, then it had better be cheap, so rather than choose water, we chose ice, because as we will show it turns out to be much easier to work with.

At depths of 1 km, we discovered ice from which the bubbles had all been squeezed out — ice of almost glass-like quality — extending downward to depths of possible 2.4 km or greater. We drilled and installed the first detectors at the South Pole in 1993, and each year since then we've enlarged the grid.

The present AMANDA detector (it is continually growing) instruments about 5 million tons of ice, or a volume

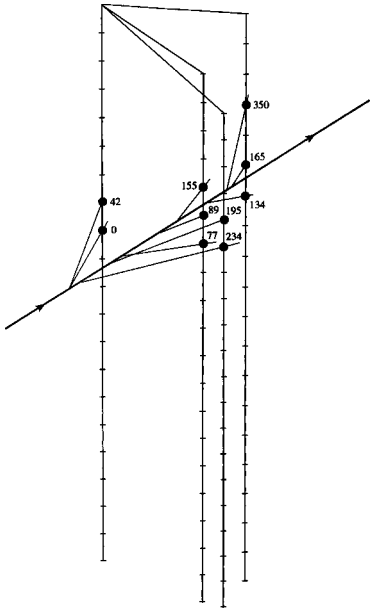


Fig. 1: A muon passes through the detector emitting Cerenkov light. Shown are the PMTs struck by the light, and the time when they were hit. From this information the track shown is reconstructed. Since the angle between the neutrino and muon is usually less that a degree, the muon points back fairly accurately to the origin of the neutrino.

equivalent to a cylinder 120 meters in diameter and 400 meters in height. About 300 photomultiplier devices are buried in this volume between 1500 to 2000 meters below the ice surface at the South Pole. This season, 1997–98, we plan to drill to depths of 2.5 km and install detectors to depths of about 2.4 km. See Figure 2.

The neutrinos we're interested in are the ones traveling up through the earth. We get a lot of cosmic ray muons (junk) coming down on us from space, so by only analyzing the upward traveling muons (hence neutrinos) we are using the whole earth as a filter. Only neutrinos can travel through the earth without interacting and being absorbed. To date we have logged millions of particles, but of these only a very few are candidates for high-energy neutrinos. The data are now being analyzed to determine where the neutrinos originate...from a few select hot-spots in the sky or from a diffuse background, or both?

To date, neutrino astronomy has been limited to the detection of solar neutrinos and one brief burst from the supernova that appeared in the Large Magellanic cloud in February 1987 (SN-1987a). If we see "hot-spots," then we are seeing neutrino-emitting objects in the universe for the first time, and a whole new type of astronomy has been born. Only now is it becoming technically feasible to build large neutrino telescopes and, as one of the first generation detectors, AMANDA promises to be a large contributor to this new science of High-Energy Neutrino Astronomy. If the concept succeeds, future AMANDAs will search many cubic miles of ice looking for neutrino signatures of the black holes currently believed to be the birthplace of galaxies. ❑

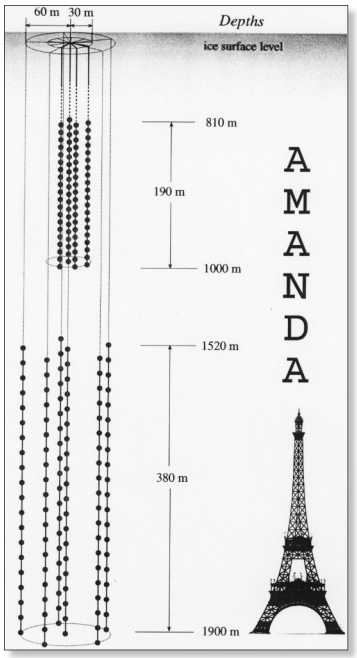


Fig. 2: The size and construction of the detector compared to the Eiffel Tower.

Hale-Bopp Provides Scherb & Roesler Research Bonanza

by Frank Scherb

When comet Hale-Bopp passed through our solar system neighborhood in March and April, 1997, it became everything a community of astronomers and physicists had hoped for; a brilliant object whose brightness and size enabled scientists to analyze a comet as never before.

The opportunity to study this great comet was a once in a lifetime event since it will be about 2400 years before it returns to the inner regions of the solar system near the sun.

With new observational technologies and enough forewarning to deploy them, astronomers worldwide engaged in a variety of observational campaigns that together promise to reveal new insights about comets that, like time capsules, provide a time-stamped record of the composition and conditions of the interstellar medium at the time of the formation of the solar system. During the relatively brief time comets spend in the inner solar system, they become a laboratory for photochemistry, charged particle collision processes, and solar wind/magnetic field interactions.

No fewer than six UW observational programs gathered data from the comet, making the effort here one of the most diverse and concentrated on the planet. In addition to a rocket experiment launched April 8 at the White Sands Missile Range in New Mexico, and an imaging and spectroscopy program using the 3.5 meter WIYN telescope on Kitt Peak, Wisconsin physicists Frederick Roesler and Frank Scherb observed the comet with a trio of Fabry-Perot spectrometers located also on Kitt Peak. Two of the Fabry-Perot instruments were used at the McMath-Pierce telescope, where one was coupled to the 0.8 meter west auxiliary telescope and was used to obtain high spectral resolution images of light emitted by ionized water (H_2O^+). The other Fabry-Perot was coupled to the McMath-Pierce 1.5 meter main telescope and was used for spectroscopic studies of emissions from atomic oxygen, hydrogen, and carbon. The third Fabry-Perot, called the Wisconsin H-Alpha Mapper (WHAM), is installed at Kitt Peak for a several-year program of observations unrelated to the comet, and was occasionally diverted from its official observations to obtain spectra and map the distribution and velocities of H_2O^+ ions and atomic oxygen.

As a comet approaches the sun, sunlight heats the surface of the solid nucleus, and the cometary ices begin to evaporate to form the extended coma of molecules (mostly water) and dust around the comet. From the interaction of the coma with sunlight and the solar wind, two tails are formed. The dust tail is the result of sunlight radiation pressure, and it trails the comet along its orbital path. The ion tail is pro-

duced by a few percent of cometary molecules being ionized by solar ultraviolet and the interaction of the ions with the solar wind and its magnetic field which rapidly transport the ions outward away from the sun in an almost radial direction, as a kind of 'windsock.'

Since water (H_2O) is the main volatile component (up to 85%) in comets, overall comet activity (gaseous output or production rate) is usually described in terms of the number of water molecules per second flowing out from the comet. Because water is difficult to observe spectroscopically, most observations are usually carried out on the atoms and molecules (H_2, OH, H, O) produced when solar ultraviolet causes the water to break up (photodissociation). We determine the water production rate as a function of time by measuring the emission line strengths of the two atomic fragments, oxygen and hydrogen. These observations are used with theoretical models of the cometary coma and information on the solar ultraviolet radiation to determine the water production rate.

Our H_2O^+ images provide maps of the spatial and velocity distributions of the ions in the coma and allow detailed comparison with magnetohydrodynamic calculations recently carried out to model the solar wind interaction with the ionized cometary atmosphere. This will help us to better understand how to use future comets as remote scientific "spacecraft probes" of the solar wind in regions of interplanetary space that are usually inaccessible to earth-launched spacecraft.

Although H_2O is the dominant molecule in comets, there are many other species, including organic molecules such as CO, CO_2, CH_4, and many other more complex organic (and inorganic) molecules. Atomic carbon is a dissociation by-product of organic molecules in the coma. Carbon is an astrophysically important element, as it is a primary component of interstellar matter and serves as a tracer of heavier elements. It serves the same function in comets, which condensed out of interstellar gas at the time of the solar system's formation. ❑

UW-Madison Physicists Present Explanation for Gamma-Ray Bursts

by Ron Seely, Science Notebook from Wisconsin State Journal, September 25, 1997

Scientists at UW-Madison have offered an explanation for one of space science's great mysteries — the massive explosions known as gamma-ray bursts.

Physicists **Wlodzimierz Kluzniak** and **William Lee** have used computer simulations to show the explosions may be stars that are being torn apart by black holes.

The scientists presented their findings last week at the Fourth Huntsville Gamma-Ray Burst Symposium. The enormous bursts of high-energy radiation known as gamma rays have puzzled scientists for 30 years. The explosions happen an average of once a day and last anywhere from a fraction of a second to minutes. They are so intense they briefly outshine entire galaxies and their billions of stars.

The theory proposed by Kluzniak and Lee is one of several that have been offered as explanations for the phenomenon; others believe the explosions are caused by colliding neutron stars or by massive black holes at the center of quasars.

But Kluzniak and Lee sketch this picture: A neutron star, a shrunken but very dense star, spirals toward a black hole. As it approaches, it is nearly torn apart by the powerful gravitational pull of the black hole, but it is not completely ripped apart. Instead, the star is stripped of mass, each time releasing energy in the form of gamma rays.

This transfer of mass could happen many times until the star finally becomes unstable and explodes, according to Kluzniak and Lee. ❑

Comet Hale-Bopp

Faculty News

New Physics Faculty

Cary B. Forest joined the Physics Department in April 1997 as an Assistant Professor. Forest is an experimental plasma physicist who comes from General Atomics. He received his Ph.D. from Princeton University in 1992. His undergraduate work was in Applied Math, Engineering and Physics at UW-Madison. His substantial research background includes university-level laboratory experiments, including his thesis work on the CDX-U tokamak at Princeton, and large scale tokamak fusion experiments from collaborative work on ASDEX, T-10 and Tore Supra, and as a scientist on the DIII-D tokamak at General Atomics. His primary interest is in current generation in plasmas and other magnetohydrodynamic systems. He is looking forward to working with the MST reversed field pinch experiment in the Physics Department, and pioneering a new physics experiment to simulate solar and planetary magnetism using liquid sodium.

His office is 3277 Chamberlin Hall, 1150 University Avenue, Madison, WI 53706. Phone: 608-263-0486; Fax: 608-262-7205.

Tao Han officially joined the Physics Department as Associate Professor in August 1997. Han comes to Wisconsin from the Institute for High Energy Physics, University of California-Davis, where he had recently been promoted to an associate professor. Professor Han is considered a leading physicist of his generation in particle physics phenomenology. His research focuses on the most fundamental questions in physics: the origin of mass, the symmetries in nature, and the unification of all forces. He has taught General Physics, Elementary Particle Physics, High Energy Collider Physics and Special Topics at Davis.

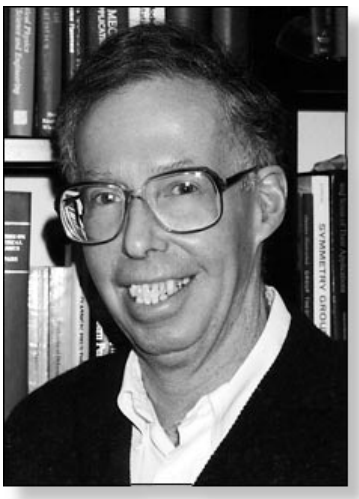
Han received his Ph.D. at the University of Wisconsin-Madison in 1990. His undergraduate work was completed at Nankai University, the People's Republic of China, where he also completed his Master's degree. Han had previously been a Research Assistant and a postdoctoral Research Associate in the Phenomenology Institute at the University of Wisconsin-Madison and a postdoctoral Research Associate in the Theory Group at Fermi National Accelerator Laboratory.

Han is expected to begin his teaching at UW-Madison in the Spring 1997–98 semester. ❑

Physics Instruction

Chancellor Recognizes Excellence In Teaching

The Elvehjem Museum of Art was the setting for Chancellor David Ward to present the Chancellor's 1997 Distinguished Teaching Award to Professor **Loyal Durand** of the Physics Department. April 29, 1997 was the date chosen for this ceremony to provide special recognition to faculty for their distinctive contributions to excellent teaching.



Loyal Durand

Loyal Durand, whose research specialty is Theoretical Particle Physics, has taught on the Madison campus for over 31 years. He is a frequent instructor of Physics graduate core courses, 715 (Statistical Mechanics), 731 (Quantum Mechanics), 711 (Theoretical Physics-Dynamics), 722 (Advanced Classical Theoretical Physics) & 715 (Statistical Mechanics). Most recently, in Spring 1997, Professor Durand taught Advanced Particle Physics. He also has been chairing the Physics Graduate Program Committee during 1996–97.

❑

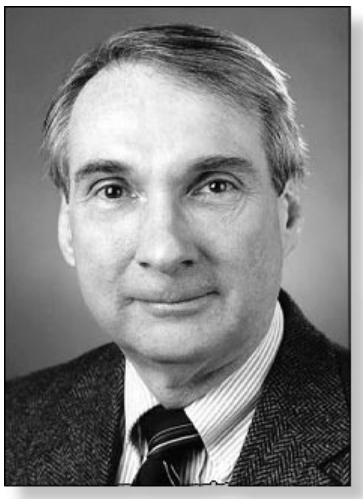
Sprott Receives Van Hise Outreach Teaching Award

In February, 1997, for the fourteenth year, Prof. **Clint Sprott** put on his lecture/demonstration, "The Wonders of Physics," six times — to capacity crowds of 2,250. These entertaining presentations are enjoyed by everyone, from preschool children to emeritus faculty. This year's theme of "The Physics of Flying" featured a flying entrance, surprise visits by the Wright Brothers, Albert Einstein and his little-known much younger twin brother, and a very agitated bee. Many of those who attended the presentations toured the Department laboratories as part of the yearly open house.

Prof. Sprott has now done 119 of these presentations to a total audience of over 30,000, and his 14 hours of videotapes have been distributed to hundreds of schools and cable television stations around the country. He was recently awarded the Van Hise Outreach Award for Excellence in Teaching for these activities. This is a relatively

new award given to only one recipient at UW-Madison each year. It reflects the University's renewed commitment to outreach as an activity equal in importance to classroom teaching and research.

In addition to these presentations, the Physics Department sponsors a traveling version of "The Wonders of Physics" that has visited over 200 schools and other settings throughout Wisconsin, neighboring states, and as far away as Connecticut and Colorado. These presentations are given mostly by physics graduate students, and by Roger Feeley who administers the program. Thirty-nine such presentations were made this academic year. In addition to the videotapes, the Department also produces a Lecture Kit for teachers and scientists who want to start similar programs, computer demonstration software, and educational materials for teachers and children. Except for the sale of these materials, "The Wonders of Physics" is supported almost entirely by donations from those to whom we make presentations and from others who believe in the importance of such outreach activities.



Clint Sprott

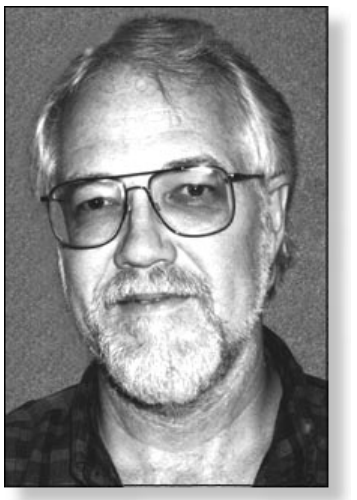
You can get more information about "The Wonders of Physics," from *http://sprott.physics.wisc.edu/wop.htm* or by calling 608-262-2927. ❑

Don Cox Selected As Member Of Teaching Academy

The Physics Department nominated **Don Cox** for membership in the Teaching Academy by unanimous vote. His nomination was accepted and he joined the Academy at an induction ceremony for new Fellows on April 15 at the Wisconsin Center. Nominator Professor Dan McCammon says, "Cox is an outstanding example of someone who maintains an international renown in his research field while making the quality of the undergraduate education in the department his primary responsibility."

"Don's continuing efforts with classroom innovation and experiments of new teaching methods are well known, and are best judged by the letters and comments from current and former students and colleagues. He has been dedicated to fostering a climate within the department where good teaching is valued and nurtured, and where our students, particularly the undergraduates, can feel comfortable."

Some of Cox's initiatives in the past few years have included instituting a Mentor Program where any undergraduate who declares physics as a major can choose a faculty member in the department to be a mentor; organizing an undergraduate "Find Our People" meeting each year, where faculty members come to talk about their research work and about traditional and non-traditional careers in physics; organizing brown bag luncheons where physics faculty and staff with an interest in innovations in teaching methodology meet and discuss things they are trying in their classes, and creating an undergraduate majors guidebook.



Don Cox

Cox has served as the Coordinator of Undergraduate Programs and adviser to the University Physical Society group for many years. Cox is the third Physics Department faculty member to be inducted into the University Teaching Academy. Others include Loyal Durand (1995–96) and Wilmer Anderson (1994–95). ❑

Promotions

*Congratulations to **Andrey Chubukov** who recently was promoted to Associate Professor. Chubukov joined the Physics staff in 1993. He received his Ph.D. in physics from Moscow State University, Moscow, USSR.*

*Also congratulations are in order for **Thad Walker** who has now become a full professor. Walker received his Ph.D. from Princeton University in 1988 and was a post doc at Princeton and the Joint Institute for Laboratory Astrophysics (University of Colorado) before joining us in 1990. He received his tenure in 1993.*

Initiative Development Continues

by Michael Winokur

The Physics Department is now undertaking an ambitious program to revitalize and update the introductory physics laboratories. In support of this modernization effort, the department has received significant financial commitments by the University in combination with the concerted efforts of numerous faculty (**U. Camerini**, **W. Haeberli**, **F. Halzen**, **P. Quin**, **M. Thompson**, and **M. Winokur**) and technical support staff (**J. Sylvester** and **B. Grogan**). This initiative covers all aspects of the student's laboratory experience including both upgrades in the experimental instrumentation and changes in the instructional methodology.

While thousands of students have been introduced to the nature of physics and the scientific method through these introductory laboratories, it has become all too evident that much of this instrumentation has become outdated and that a major overhaul was needed. In particular, the rapid introduction of the computer into the educational arena has drastically and irreversibly changed the way in which information is acquired, analyzed and disseminated. To reflect these changes in our introductory laboratories we have endeavored to create an educational setting which utilizes this technology to its fullest extent; hopefully while enhancing the learning process and the understanding of physics principles. Thus, when fully implemented, these laboratories will utilize computer-aided data acquisition and analysis in combination with access to interactive Web-based learning tools.

One scenario that is currently under investigation is the development of a new laboratory manual which is available both in a hardcopy form and, simultaneously, as a fully integrated Web document so that the manual itself has become an interactive tool in the laboratory environment. Thus, the student will find a wealth of learning resources available while the laboratory is being performed. Not only can the computer-based laboratories be "launched" from a browser, but references to secondary information sources can be easily accessed either before, during, or after the laboratory period. One major goal in this endeavor is to employ interactive links to on-line data analysis and laboratory "quizzes." By providing direct and immediate feedback to our students we hope to better track those students who find understanding physics an insurmountable barrier. The first on-line demonstration of this package will, hopefully, be available to our Physics 207 students during the Fall 1997 semester. Access to this link will be provided from the Physics Department Webpage (http://www.physics.wisc.edu/) when it becomes available. ❑

Peer Tutoring Becomes a Reality

Remember your first semester in physics? Chances are it was pretty awesome. It can be even more imposing if you are not planning to become a physics major. What do students do if they cannot keep up or if they just don't understand physics? They can, of course, talk with the course instructor or the teaching assistant in charge of their course. They can go the University Physical Society and make use of their free tutoring service. They can hire a private tutor. Or, they can go to GUTS-HASH general tutoring sessions.

This fall semester, however, the Department of Physics is participating in a new Peer Tutoring Program. This program has four peer tutors, selected mainly from highly qualified physics or AMEP majors. These four students have been assigned up to five "at risk" students from Physics 103, General Physics, to work with for the whole semester. Tutors and students meet twice a week as a group. Tutors will also stay connected with the course instructors and TA's. In addition, the Physics Department peer tutors and the Chemistry Department peer tutors meet once a week to learn more about effective teaching techniques. Peer tutors will receive a stipend of $500 per semester for participating in this activity. During the 1997–98 academic year, the overall coordinator of this program will be Dr. Tony Jacobs of Chemistry, who has worked with Dr. Cathy Middlecamp (Director of the Chemistry Learning Center) to develop the Chemistry Peer Tutoring Program.

Professors **Paul Quin** and **Duncan Carlsmith**, who are the co-instructors of Physics 103 in Fall 1997–98, have agreed to be responsible for this initiative in their course.

❑

No Quantum Leaps For Women in Science, Math…But With Help, Gradual Progress is Being Made

(by Shannon Henson, selected parts reprinted from the Capital Times, Madison Wisconsin, April 3, 1997, supplemented by Jean Buehlman)

When **Bernice Durand** studied physics at Radcliffe, she was one of a tiny minority of women in her math and physics classes. She is now a professor of physics at the University of Wisconsin-Madison, but says it was a hard row to hoe. She dropped out of Radcliffe twice.

"The support system was zero for women in science majors at the Ivy League schools," says Durand. One striking feature was the lack of place to study between morning lectures and afternoon labs. Women were excluded

from the Harvard undergraduate library and had a single study table in the basement restroom of Memorial Church.

Today women find fewer obstacles in trying to break the science barrier, but progress has been slow. Some schools, such as the College of Engineering at the UW-Madison, have tried to improve by actively recruiting women, while other schools such as the School of Pharmacy now have more women than men.

But the fact remains that women are still outnumbered in the math and science fields.

Dr. Margaret R. Meyer, an education professor at the UW-Madison, says women such as Durand are in the minority in the math and science fields because of stereotypes. Meyer says she does believe, however, that the stereotypes are changing.

"I believe the stereotypes are being broken down," she says. "When I was a girl in school, it was strongly abnormal for a woman to go into engineering, but now there is a significant number of women who do go into engineering."

At UW-Madison, 18 percent of pre-engineering freshmen and sophomores are women, and 16.5 percent of general engineering seniors are women.

(In Physics, there are currently 31 declared majors. As you will recall, physics majors often don't declare until they are seniors. The result is that we often don't really know our actual count of majors in progress until very late in undergraduates academic careers. On our roster of 31 majors in Spring 1997, there were 24 men and seven women, or 22% women. At the graduate level, in Fall 1997, there are a total of 132 students, with 14 women or 10.6 %.)

People like Bernice Durand are trying to show other women how they can succeed in science. Programs for elementary through high school girls, plus a 75-year-old Graduate Women in Science organization at UW-Madison give her and other senior women a chance to give information and support to younger women interested in science.

On a personal level, Durand has established a research scholarship for undergraduate women or minority physics or astronomy majors at Iowa State University (her alma mater). She did this in appreciation of the research jobs she had there as a student, which let her know someone was taking her seriously as a future colleague. She tries to get to know the recipients of her scholarship through email and occasional visits.

"I'm doing what no one did for me," says Durand. "I want women to see there are successful women physicists. I never got to even meet another woman physicist until well into graduate school, and she wasn't at all cordial!"

❑

GRADUATE STUDENT REPORT

New Graduate Students — It Was A Very Good Year

by Barb Schutz, Graduate Secretary

Our added recruitment efforts certainly paid off this year, some of which included personal contact by faculty members, contacting alumni for prospective graduate student referrals, reimbursement of total travel expenses for visitors, and a $2,000 Van Vleck Fellowship for all Teaching Assistants and Research Assistants. We had a third more prospective graduate students visit this year and couldn't be more pleased with the yield. A total of 86 offers (60 domestic, 26 international) were made to 254 applicants (86 domestic, 168 international), resulting in 28 acceptances — double last year's class! Twenty of the incoming students are domestic (including five fellowships: 2 WARF and 3 AOF), and eight are international.

Another major change was the redevelopment of the Master's Degrees in Physics, allowing students to be admitted directly to one of two Master's programs. Both programs are designed to strengthen the student's physics background, and enhance his or her opportunities for employment as a physicist or in physics education. The Professional Master of Science degree is a terminal professional program which should normally be completed in two years or less by full-time Master's students and includes a Master's Thesis written at a professional level together with an oral presentation of the project. The Academic Master of Arts degree is an academic, course-based program which should be completed in two years by full-time Master's students and includes a course in Scientific Presentation. Students admitted initially only to a Master's program must reapply if they wish to enter the Ph.D. program.

The Graduate School has also initiated several changes to streamline the Ph.D. degree granting process by abolishing the two full-time semesters requirement, replacing the residency requirement with a minimum number of graduate level course credits requirement, and granting the departments approval authority for the Ph.D. minor program. These changes should allow Ph.D. candidates to achieve dissertator status and complete their graduate work in a shorter period of time.

As current graduate students complete their programs and move into the work force more quickly, the demand for new graduate students is ever increasing. Several faculty members in the fields of high energy physics (experimental and theoretical), condensed matter physics, atomic physics, plasma physics, and nuclear physics are actively seeking graduate students to work with their research groups. We appreciate your past efforts in assisting with our student recruitment and thank you in advance for your help in the future. ❑

New L&S Teaching Fellow (Woman)

Rellen Hardtke, in her second year in the Physics Graduate Program, was selected by the L&S Teaching Assistant Instructional Development Program Committee as an L&S Teaching Fellow for 1997.

Rellen was a presenter at an all-day workshop held on August 28, 1997 for all L&S Teaching Assistants. This award recognized the high quality of her performance as a teaching assistant in physics during the fall semester 1996 and, in addition, provided a payment of $500.

All new Teaching Fellows were welcomed at a reception at the University Club on March 10, 1997. Chairman Jim Lawler and Instructional Program Manager, Jean Buehlman, attended in Rellen's honor.

Rellen has also been an active member of the Physics Department Graduate Program Committee during 1996-97 Beginning her undergraduate work here at the University of Wisconsin, she studied math and physics. She won the Physics Department's Ingersoll Prize for outstanding academic achievement in Physics 208 at that time. She transferred to MIT at the end of her sophomore year, graduated, and then did consulting in Washington, D.C. for three years. Rellen began to take graduate courses at Indiana University-Purdue University in Indiana, during which time she served as a teaching assistant for undergraduate physics courses.

When asked what information she could share about being a successful teaching assistant, Rellen replied that she did everything possible to make students comfortable, broke overwhelming problems into comprehensible pieces, asked for feedback early in the semester, worked at being proactive in getting students to ask questions, and displayed enthusiasm for the subject she was teaching.

Physics is pleased to have another enthusiastic L&S Teaching Fellow added to the list of outstanding teaching assistants from our department. Last year's Teaching Fellow, **Chris Greiveldinger**, graduated in Spring 1997. ❑

1997 Piore Prize Winner

Rob Haslinger received a B.S. in Physics and Mathematics from Union College in New York in 1995. Rob's research interest is in solid state physics, and he is currently working with Professor Bob Joynt. As an undergraduate, Rob won prizes as the outstanding physics student and also as the outstanding student of German literature. As this year's Piore Prize winner, Rob is continuing that academic excellence in graduate school. Outside Physics, Rob also has an interest in sports and music. He was a violinist in the Union College orchestra and was a member of the college crew team for three years.

The Piore Prize is presented annually, at a May departmental colloquium, for academic excellence in the first year of graduate study. Our continuing thanks to the Piore family for creating this inspiration to excellence. ❑

Department Names Second Dillinger Award Winner

The **Joseph R. Dillinger Award**, initiated in April of 1996, was made possible by the family of Joseph Dillinger in honor of their father. The purpose of the award was to provide recognition to an outstanding teaching assistant in the Department of Physics. Professor Dillinger was a faculty member of the department with a special interest in improving undergraduate education. He came to the department in 1947 and specialized in photoelectric and thermionic emission, development of power pulse generators, gas discharge tubes and low temperature physics.

Tim Kinnel, winner of this year's Dillinger Award, attributes his success to the outstanding example set by his parents. His dad teaches chemistry at Hamilton College, and he took high school chemistry from his mother. Says Tim, "I try to emulate the perfect atmosphere of caring, respect, and terror that they generate in the classroom." When not TAing, Tim studies neutrino-nucleon interactions with his advisor, Wesley Smith. He would like to thank Wesley, Ludwig Bruch, and Paul Terry for their guidance and assistance.

Tim most recently taught students in Physics 244, Modern Physics (for ECE majors). ❑

Other Awardees:

One of our 1997 graduates, **John Beacom**, was named a Sherman Fairchild Fellow in Physics at Caltech. John just completed his dissertation under the supervision of Professor Baha Balantekin working at the intersection of nuclear physics, particle physics, and astrophysics. His

thesis was on the analytic study of the equations that govern matter-enhanced neutrino oscillations, and application of these results in astrophysical situations.

This three-year fellowship is awarded in an international competition. At Caltech, John will be working with Steve Koonin and Petr Vogel in the area of nuclear and neutrino physics, with an emphasis on astrophysical applications.

As a precondition to graduation, John returned to the Physics Library all 6,597 books and journals that he had checked out while here.

John was born in Lincoln, and grew up in St. Paul, Portland, Seattle, and Kansas City. He received a B.S. Physics and a B.S. Mathematics from the University of Kansas in 1991. As an undergraduate, he spent summers working at Argonne, Fermilab, and the Institut Laue-Langevin (Grenoble, France). He came to Madison as both a WARF Fellow and a National Science Foundation Graduate Fellow.

As a precondition to graduation, John returned to the Physics Library all 6,597 books and journals that he had checked out while here. Kerry Kresse has revoked the warrant for his arrest, and he has been pardoned for stealing paper from the photocopiers.

John and his wife Jenna moved out to Pasadena in August. She will be looking for a job teaching deaf children. They will miss the snow, but perhaps not all six months of it. ❑

GRADUATE DEGREES

Ph.D. Degrees/Updated October 8, 1997

• Summer 1996

(continued from last year's alumni newsletter)

Karabulut, Hasan
"Distributed gaussian discrete variable representation" (Balantekin)

Shelton, Robin
"The interstellar medium in our galaxy: A new interpretation of the distribution of hot/cool gas boundaries in the disk, and models of super nova remnants in the halo" (Cox)
National Research Council Fellow, NASA, Lab for High Energy Astrophysics, Goddard Space Flight Center, Greenbelt MD

Veseli, Sinisa
"Heavy quark symmetry and hadronic models" (Olsson)
Research Associate, Fermilab, Batavia IL

Zhou, Zi-Lu
"A study of the spin dependence of electron scattering from a tensor polarized internal deuterium target" (van den Brand)
Postdoc, MIT Laboratory for Nuclear Science, Cambridge MA

• *Fall 1996*

Al-Omari, Awny
"Field ionization as a technique to determine electronic properties of fluids" (Huber/Reininger)
Faculty Assistant, UW-Madison Physics Department, Madison WI

Jacobsen, John
"Simulating the detection of muons and neutrinos in deep Antarctic ice" (Halzen)
Postdoctoral Research Associate, UW-Madison Physics Department, Madison WI

Kadyrov, Ernest
"Critical currents in superconducting thin films and multilayers" (Larbalestier)
Manufacturing Development Engineer, Hewlett-Packard Company, Corvallis OR

Singh, Sangeet
"X-ray photoemission spectromicroscopy and its application to the study of patterned titanium silicide" (Huber/Cerrina)
Postdoctoral Research Associate, UW-Madison Electrical and Computer Engineering Department, Madison WI

Zhao, Dai
"Theoretical investigation of magnetic X-ray dichroism in ferromagnetic metals" (Huber)
Research Associate, UW-Madison Physics Department, Madison WI

• *Spring 1997*

Greiveldinger, Christopher
"X-ray emission from young isolated neutron stars" (Ögelman)
Max-Planck-Institut Fellow, Max-Planck-Institut für Extraterrestrische Physik, Garching, Germany

Tufte, Stephen
"The WHAM spectrometer: Design, performance characteristics, and first results" (Reynolds)
Postdoctoral Research Associate, UW-Madison Astronomy Department, Madison WI

• *Summer 1997*

Balman, Solen
"X-ray emission from classical novae in outburst: Noracypru 1992 and other ROSAT detections of novae" (Ögelman)
Post-doc, Fizik Bolumu ODTU, Ankara, Turkey

Beacom, John
"Semiclassical density inversion of solar neutrino data" (Balantekin)
Sherman Fairchild Postdoctoral Fellow, Caltech, Pasadena CA

Betouras, Joseph
"Superconductivity with mixed gap symmetry" (Joynt)
Returned to Crete, Greece

Fernandez Garcia, Eduardo
"Decorrelation dynamics and spectra in drift alfven turbulence" (Terry)
Postdoc, Center for Turbulence Research, Stanford University

Hinaus, Bradley
"Intrinsic and extrinsic transport properties of high temperature superconductor Josephson Junctions" (Rzchowski)
Allegheny College Dept. of Physics, Meadville PA

Liubarsky, Igor
"Simulacrum or corporeal manifestations in Antarctic muon and neutrino detector array" (Halzen)
Researcher, RAL Chilton, Didcot, Oxfordshire, United Kingdom

Markwardt, Craig
"The pulsar wind interactions of the vela pulsar" (Ögelman)
Research Associate NRC Postdoc, NASA, Goddard Space Flight Center, Greenbelt MD

Morr, Dirk
"Electronic and magnetic properties of underdoped and slightly doped high-T_c materials" (Chubukov)
Postdoctoral Research Associate, Univ. of Illinois, Dept. of Physics, Urbana IL

Narita, Tomohiko
"Multi-wavelength observations of supernova 1987A" (March)
Center for Astrophysics, Cambridge MA

O'Donnell, Jim
"Magnetism and colossal magnet resistance in the perouskite manganite transition-metal oxides" (Rzchowski)
Assistant Researcher, UW-Madison Physics Department

Safi-Harb, Samar
"An X-ray study of unusual composites" (Ögelman)
Research Associate NRC Postdoc, NASA, Goddard Space Flight Center, Greenbelt MD

Serbo, Victor
"Measurement of the polarized forward-backward asymmetry of b quarks at SLD" (Prepost)
Santa Cruz CA 95064

Williamson, Robert
"Magneto-optical trapping of potassium isotopes" (Walker, T.)
Opto-Mechanical Designer, Focused Research Inc., Madison WI

• *Masters Degrees, 1996-97*

Balman, Solen
Barnes, Bryan
Biewer, Theodore
Cooper, John Charles
Fetter, Jonathan
Frandy, John
Gorsuch, Susan
Kelly, John IV
Nelson, Ian
Nesnidal, Renee
Oeckl, Robert
Sakai, Motohiro
Watchorn, Steve
Zhou, Young ❑

UNDERGRADS

Undergraduate Report

by Don Cox

From the Desk of the Alleged Coordinator of Undergraduate Programs (ACUP)

Omigosh, time for another alumni newsletter again? And here I've once again sandwiched writing it into the day before flying off to Mexico to work with Marco Martos, Jose (Pepe) Franco (Loco), and John Raymond, all UW Physics Ph.D.s.

What, pray tell, has happened on the undergrad front in the last year or so? Apart from the fact that most things are pretty much the same, people meeting their classes and trying to clarify the intricacies of our various mathematical models of the physical world, there are a few things which are different.

But I will save myself some typing by telling you about something else first. Two big things struck this year. The first was the arrival of an authoritative dictum to the effect that we should have an annual assessment of our programs, and we were obliged to submit a document describing our plans for this event. Guess who is the designated compiler of the annual tome on the undergrad program? (It is actually supposed to be a very condensed report of the gathering of lots of information, varying in emphasis from year to year.) The second was the arrival of our department's turn for a major general review, commencing with a self study of all aspects of our activities. Such reviews are supposed to happen to each department about once every ten years. It had been seventeen years since our last one. Guess who got to assess the undergrad program. Having done these, however, I can dig around in them for things you might find interesting, rather than trying to amuse you on the fly.

But before that I should tell you that I got some interesting replies to what respondent emeritus professor John Cameron described as my "harrumph" article in the last of these newsletters. So, this is Cameron:

15-Feb-1997

Don,

I found your article interesting but as you can guess not much new! One small idea is to increase the use of e-mail for communication with students, especially since this allows an undergrad major to ask questions of retired faculty as well without having the feeling they are "bothering" them. For example, in your introductory courses you could alert the students that I am interested in the physics of the body and the applications of physics in medicine. I expect that most physics students at any level spend little time thinking about the physics of the body.

I'll bet most physics faculty don't have much feeling for the wattage of their own body. If any students (or faculty) have questions or are curious about these areas, they can send me a query by e-mail. I try to answer all messages. John Cameron

To get information about medical physics and medical physicists in other countries try looking in the new Electronic Medical Physics World (EMPW) web page http://www.biostat.wisc.edu/medphys/empw/empw.html

• • •

Back to Cox here. I got another fascinating message from Nicolle Zellner, who later said I could quote her, so I will, editing out one or two sensitive bits about what textbooks we use. So, here is Nicolle:

15-Jan-1997

Hi Dr. Cox,

I've just completed my first semester of graduate school at Rensselaer Polytechnic Institute (RPI), and while I was working through the pages of homework problems over the past few months, I came to the conclusion that my undergraduate physics text books…(obviously left something to be desired).

You may want to check (December 1996) Physics Today — they surveyed colleges around the country and came up with the top 20 or so books used in undergrad physics courses. None of the ones I used (except B&M) were mentioned. All of the ones listed as my recommendations were.

Your article in Wisconsin Physicist was pretty interesting. I don't know how to keep the students from getting too bored, but I can tell you that there seems to be a general feeling of apathy and unconcernedness — I see the same thing in my students here at RPI. Perhaps you need to change your style of teaching. Rather than lecturing in front of a chalkboard (if you still do that), an interactive approach or peer instruction could be implemented. Both of these are encouraged and practiced in classes here. If a student is expected to participate, he/she may become more interested in what is being taught and the mind may not wander as much. I took Physics Today; I think we had 13 students in the class — the perfect size for either of these teaching methods.

As for approachability, I've always found the Astronomy profs. far more friendly and willing to chat than any of

my Physics profs. The former had always open doors and smiles; the latter were nervous and always seemed to me to be pushing me out the door — there were exceptions, of course, but for the most part, I found this to be the case. Perhaps this difference has to do with department and class size; perhaps it's just the nature of the field. My clearest memory of a conversation with you — and one that made me nervous to approach you afterwards — occurred during the spring of my sophomore year (you were teaching 208) and I wanted to talk to you about my future. Your words to me were something like "You'll never make it in Astronomy if you can't get A's in physics." That broke my heart and temporarily shattered my dreams: Astronomy was my passion and I was getting B's in physics. Good for me, I didn't listen to you and graduated with honors in Astronomy and Physics and spent the three most exciting years of my life so far working with WUPPE and PBO and some of the most wonderful people I've ever known. I'm now in graduate school, pursuing a degree in Physics, teaching, speaking to school groups about Astronomy, and planning on a co-op tour at JPL for the summer and fall. I'll be working in the laser communications group, developing technology to transfer satellite data via laser beams to tracking stations on Earth. I'll also do some data analysis. Hopefully, this will lead me to another mission experience.

The advice I give my students, especially the "grade weasels," is that grades don't really matter in the real world or even on grad school applications. It's the work experience and extra-curricular activities that matter if choosing to work, or research experience and GRE scores if choosing to go to grad school. Given the variety of grad schools, the student will be accepted somewhere; he/she just has to know that there are options besides Caltech, Princeton, Cornell, and the other "big names." Grad school is what you make of it — the name itself won't get you a job.

Finally, students should be encouraged to pursue interests outside of Physics and Astronomy, especially given the current lack of academic positions. Knowing they can get jobs outside of academia may brighten their outlook, when, by their junior year they realize they've chosen a somewhat "dead-end" career field and it's too late to start over in a more practical field such as engineering or business. Physics Today seems like the perfect place to bring in speakers with Physics/Astronomy BS's, Masters, or Ph.D.'s who are doing something else (not working in academia).

Wow. This got long — I hope it kept your interest. I've wanted to tell you these things for awhile, and your article was the perfect opener. Thank you for letting me express my opinions. Nicolle Zellner

• • •

Back to Don. So, I was going to tell you about some of the changes, some of the plans, stuff like that. But I'm running short of time and the need to prepare for tomorrow's trip is looming. So, I think I'll just do two more small things.

1. Part of the annual assessment is to do a survey of alumni. The idea is to ask people who have gotten bachelor's degrees here what they are doing now, and at various stages of their lives since graduation. I'm supposed to think up a good set of questions that we can put in a postcard (short questionnaire) and send to some of you folks. What do you think would be useful questions?

2. One of the things the current crop of potential majors wants to know is what the prospects are for someone doing a physics major. Think about the sorts of people who might be asking that question, given the rather visible discussion of the low state of the employment in the field. Some are folks who could study almost anything, but have some interest in physics from prior reading or a high school course — they might go to med. school or business school, or law school, or become molecular biologists or whatever. Another is a group who just flat out think they love physics, but are not going to excel — you'd think I'd never mention this possibility after the mistake I made with Nicolle, but I am a slow learner. What are the prospects for someone who can muddle through an undergrad physics degree but would not go on to grad school? Others are both. They could do anything but physics is their first and burning choice. These folks, like Nicolle, I don't have to worry about, but they do need some encouragement, if for no other reason than to have something to tell their parents. What are the truths? How will I learn them from the questions in 1 above? ❑

Undergraduate Stats.

Below are statistics of undergraduate majors in the Physics Department for the past academic year:

In the fall semester of 1996–97, there were 33 declared physics undergraduate majors. This group consisted of 27 males and six females. In addition, there were fifteen declared AMEP majors, fourteen of whom were male and one female.

In the spring semester of 1996–97, there were 31 declared physics undergraduate majors. Of this group, there were 24 males and seven female students. Twenty-four were seniors. Six were juniors and one was a sophomore. There were sixteen declared AMEP majors, including fourteen males and two females. ❑

Celebration of Commencement

Commencement took place on Saturday, May 17, 1997 at Camp Randall Stadium. This year the May commencement schedule was changed so that BA, BS, MA , and MS graduates in a single major all attended the same ceremony. Physics majors graduated at 4:30 p.m., following a 3:30 P.M. celebration of commencement sponsored by the College of Letters and Science and the Wisconsin Alumni Association.

Congratulations to the following new Physics alumni:

Physics

3/96 (BS)

William Keller

1/97 (BS)

Kimberlee Chestnut

2/97 (BS)

Michael Andresen
Thomas Friedrich
Peter Lepeska
Wade Lutgen
John Peck
Kathy Prem
Daniel Steiner

AMEP

3/96 (BS)

James Hansen

1/97 (BS)

Dana Muchow
Ted Tuttle

Astronomy-Physics

1/97 (BS)

Kimberlee Chestnut
Mary Putnam
Eric Spears
Yoji Natori
(with honors) ❑

Undergrad Awards

Our Physics undergraduates were the recipients of many honors during the 1996–97 school year. Some honors came directly from the Department of Physics. Others were awarded in L&S or campus-wide competitions.

Physics Department Awards

Karen Lewis

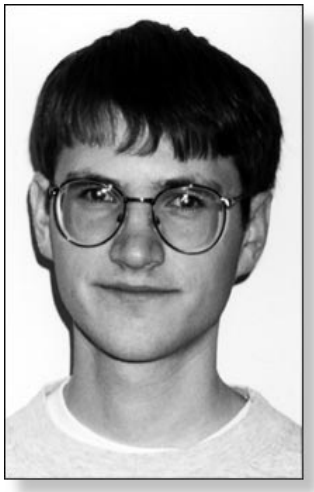
The **Radtke Award** is given each spring to the outstanding junior or senior undergraduate major. This award was made possible by a bequest of the late Mrs. Elizabeth S. Radtke in honor of her husband, who received a degree from UW-Madison in 1900. The winners of the 1997 Radtke Awards are Karen Lewis and Andrew Pawl.

Karen Lewis *by Karen Lewis*

I was born and raised in Milwaukee, Wisconsin, the youngest of seven children. I have wanted to be a scientist for as long as I can remember, but I decided upon physics after taking the first year course at Rufus King High School. I have just completed my second year as a math and physics major and plan to continue with physics in graduate school. The areas of physics I am most interested in are cosmology and astrophysics.

Andrew Pawl *by Andrew Pawl*

Andrew Pawl is a wild and crazy guy. He enjoys surfing (the net), shooting (the breeze), and skydiving (from his loft every morning.) When not engaged in these extracurricular activities, he goes about the business ordinarily associated with being a third-year (soon to be fourth) physics major. In particular, next year he will be working on a senior thesis under the supervision of Professor Don Cox of Space Physics. Oh yeah, and he's fond of parentheses (could you tell?). By the way, just for the record, he attended high school in Beaver Dam, Wisconsin, and after graduation, he plans to attend grad school…somewhere.



Andrew Pawl

A new award, the **Faye Ajzenberg-Selove Scholarship**, was given to **Nicole Hausen**. This scholarship is based on merit for undergraduate women majoring, or planning to major in Physics, Astrophysics, or Astronomy. A scholarship committee with representation from Physics and Astronomy chose the winner of this award. (Editor's Note: For complete story on initiation of this award, see page 27.)

The 1996–97 academic year marked Hausen's fourth year at U. W. Madison in pursuit of a B.S. degree. She came to the University of Wisconsin after graduating from Fort Atkinson High School, Fort Atkinson, Wisconsin. In addition to her academic work, Nicole has been involved in undergraduate research activities through Astronomy Professor Ron Reynolds (who also holds a "joint governance" appointment in Physics). The research project Hausen worked on under Reynolds was WHAM or "Wisconsin H-alpha Mapper."

Another honor which Physics students can attain is the **L. R. Ingersoll Prize** for outstanding work in introduc-

tory physics courses. This prize is underwritten by a fund established by the family and friends of the late Professor Ingersoll, a distinguished physicist and teacher at the University who served as Department Chair for many years. All Ingersoll Prize winners are listed on a plaque in the Physics Museum.

The Ingersoll Prize winners for the Fall 1996–97 semester were: **Wei Ching Lee** (103-104), **Yuliana Kuswandi** (201-202) and **Jesse Potash** (207-208). Back in Spring 1996, the Ingersoll Prize winners were: **Ryan Kehoe** (103-104), **Effendi Rusli** (201-202), **Kyle Heckler** and **Robert Kotloski** (207-208). ❑

College & Campus Awards

Five students received **Hilldale Undergraduate Research Awards**. This allowed faculty members to receive a stipend of $l,000, available for expenses related to working with each undergraduate research student. Those faculty-student pairs were:

L. W. Anderson — Greg Piefer
Don Cox — Andrew Pawl
J. E. Lawler — Jeffrey MacDonagh-Dumler
Marshall Onellion — Shashank Misra
Thad Walker — Jennifer Tate

Two Physics undergraduate students were the recipients of **Sophomore Summer Honors Grants**. Both students are working in cooperation with Professor Marshall Onellion. **Scott Christensen's** summer research grant is on "The Exchange Boson in High-Temperature Superconductors." **Robert Sundling** is working on "Fabricating Thin Films of New High-Temperature Superconductors."

Nicole Hausen also was honored through the **Florence Brooks Usher Scholarship** created by annual gifts from **Gretchen Usher**, Florence's daughter. This was the first awarding of this scholarship to support undergraduate women pursuing degrees in the sciences. Gretchen, a graduate of graduate of UW, was originally from Madison. ❑

UNIVERSITY PHYSICAL SOCIETY

Report on the Undergraduate Physics Club

by Jennifer Tate (President for 1997–98)

The University Physical Society (better known as the Physics Club) got off to a great start for the 1996–97 year by holding its third annual ice cream social, where the officers (Wade Lutgen, Shashank Misra, Jennifer Tate, and Maggie Turnbull) demonstrated how to make ice cream using liquid nitrogen (generously supplied by Professor Dan McCammon). In fact, club members and invited faculty enjoyed this event so much that, in Fall 1996, the Physics Club sponsored two such ice cream socials!

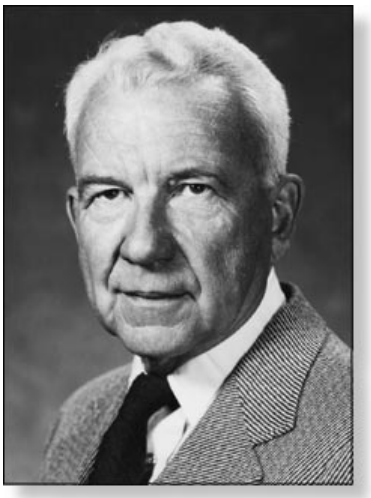
Another popular event during the fall was a trip to Fermilab, where club members were treated to a tour conducted by Jim Olsen, a UW-Madison grad student. As always, during the 1996–97 year Physics Club members offered free, drop-in physics tutoring to any student in need. The club room, 2321 Sterling Hall, offers the same benefits that it has for years: club magazine subscriptions (*Scientific American*, *Astronomy* and *Physics Today*), a microwave, a refrigerator, a NeXT computer, and simply a place to go between classes. It remains a popular hangout for physics students, both majors and non-majors, to socialize and/or study. Plans for next year include continuing ongoing projects, such as tutoring and improving the club room, hosting more speakers, taking a trip to Yerkes Observatory, and perhaps attending an SPS Zone Meeting, wherever that might be. ❑

OBITUARIES

Henry H. Barschall, 81; Experimented with Neutrons

(Parts reprinted from the New York Times, February 6, 1997 by Ford Burkhart)

Dr. Henry H. Barschall, a nuclear physicist who carried out early experiments with neutrons, helped develop the atomic bomb in World War II and then saw his laboratory destroyed by a bomb in Vietnam War protests, died on Tuesday at his home in Madison, Wisconsin. He was 81.


Heinz Barschall

The cause was liver cancer, family members said.

Dr. Barschall contributed to the understanding of neutron physics and its applications to medical radiotherapy and fusion technology. He began using particle accelerators at the University of Wisconsin in the 1940's to test the scatter-

ing of fast neutrons by atomic nuclei. The patterns he found were useful in understanding neutron-nuclear interactions.

"His work marked the first time that the neutron data could be understood in a simple way," said Dr. Hugh T. Richards, a retired physics professor at the University of Wisconsin.

In World War II, Dr. Barschall joined the team at Los Alamos, NM, that developed the atomic bomb. On July 16, 1945, he helped monitor the shock wave from the first nuclear test, near White Sands.

More than 20 years after he came to Wisconsin, campus protests against the Vietnam War became violent. On August 24, 1970, a bomb exploded before dawn at the university building that housed Dr. Barschall's laboratory and the United States Army Math Research Center. One post doc was killed, several were injured, and the work of several professors was destroyed.

"He was very shaken up, very perturbed" said Dr. Richards. "He never got back into nuclear physics."

Dr. Barschall worked instead in medical physics and nuclear engineering for the rest of his career, turning to the use of fast neutrons in the treatment of malignancies.

Born Heinrich Barschall in Berlin, he studied at the University of Berlin and Marburg University. He accepted a fellowship at Princeton University and received a doctorate in 1940.

He taught at Kansas University and at Wisconsin, where he was the Bascom Professor of Physics and Nuclear Energy and the chairman of the Physics Department. He was elected to the National Academy of Sciences in 1972 and was awarded the first T. W. Bonner Prize by the American Physical Society.

He is survived by his wife, Eleanor; a son, Peter H., of Gloucester, Mass., and a daughter, Anne E. Barschall of Tarrytown, NY. ❑

Former Physics Department Secretary Passes Away

(reprinted in part from the Wisconsin State Journal*, March 11, 1997)*

Marilyn L. Balke, age 67, died suddenly on Monday, March 10, 1997 at a local hospital. She was born on January 5, 1930 in Beaver Dam, Wisconsin, the daughter of Carl and Erma Backhaus. She married Donald Balke on May 7, 1960 in Beaver Dam. He preceded her in death on December 23, 1994.

After graduation from Beaver Dam High School in 1948, Marilyn moved to Madison to complete a year of secretarial skills at the Madison Vocational School (MATC).

Marilyn Balke

She remained in Madison and started her career at The Wisconsin State Board of Health in May of 1949. In February of 1953 she joined the Department of Physics at the University of Wisconsin and remained there until her retirement in 1985. During those 32 years she acquired many life-long friends and could talk endlessly of the many experiences with students, secretaries and professors, all in different walks of life. She also became a very good listener when needed. Because of health complications she retired from the Physics Dept. and State service.

[Editor's Note on Physics Trivia: The Physics Department office is the home of a clock made by Professor E. M. Terry, 1911. There is a sign on the bottom of the clock that reads "This clock watched Marilyn Balke's 32 years of distinguished service to the Physics Department (1953–1985). It always makes me chuckle.] ❑

1996 Honorary Degree Alumnus, Robert Serber, Dies

Robert Serber, Physics alumnus who aided the birth of the A-bomb, passed away on June 1, 1997 at his home in Manhattan. He was 88. Born on March 14, 1909, in Philadelphia, Robert Serber earned a bachelor's degree from Lehigh University in Bethlehem, PA, in 1930 and his Ph.D. in physics at the University of Wisconsin in 1934 during the Depression. He received an honorary Degree at the 1996 University of Wisconsin commencement exercise. To learn more about this interesting physicist, you may want to read "Peaceful Pastimes 1930–1950" in the *Annu. Rev. Nucl. Part. Sci.*, 1994, 44:1-26.

Dr. Serber is survived by the former Fiona St. Clair, whom he married in 1979, and by two sons, Zachariah and William, who are both studying at Edinburgh. ❑

ALUMNI CORNER

(Editor's Note: Thanks to all of you who responded. I have included some of the messages below.)

Jeffrey J. Sundquist (MS, 1981) I earned my MS in solid state physics under Professor Chun Lin. I am now a college faculty member (tenured 4 years ago now! finally!) in the Physics Department of Palm Beach Community College in Boca Raton, Florida. My main duties are teaching undergraduate liberal arts, pre-professional, physics, and engineering majors. I also supervise the physics labs and all adjunct instructors in the physical science department, conduct regular sky viewings, and teach regularly using multimedia and the World Wide Web. My faculty web page at PBCC is *http://www.pbcc.cc.fl.us/southweb/sundquis/sundquis.htm* and my E-mail address is *sundquj@mail.firn.edu*. I'd love to be included among the list of alumni.

Rod Milbrandt (Ph.D. 1997) Just thought I'd let you know that I was offered and accepted a job at Loras College in Dubuque Iowa (a liberal arts college). So, I'll be a Visiting Assistant Professor of Physics (one-year position, possibly more) in the fall. I'll try to keep in touch.

Kurt Riesselmann (Ph.D. 1994) Kurt wrote to tell us that he has moved from Munich to Berlin. When last heard from he was applying for tenure track positions in the U.S. and establishing a teaching portfolio. He can be found on the WWW at *http://www.ifh.de/~kurtr/*.

William (Willie) Keller (B.S. 1996) Willie describes himself as a government employee working for the DOD in Washington, D.C. He invites others to check out his WWW page at *http://www.cae.wisc.edu/~kellerw/*. His E-mail is *kellerw@cae.wisc.edu*.

Larry Rothenberg (Ph.D. 1969) A nuclear physics graduate, Larry was elected President of the American Association of Physicists in Medicine (AAPM). He will serve as President-Elect in 1997 and as President in 1998. In the same election Paul DeLuca, Chair of the Department of Medical Physics and Professor of Physics, was elected to the Board of Directors of AAPM.

Scott Price (Ph.D. 1985) sent the following unofficial news update in Dec. 1996:

Dave Pearson is a permanent staff member at JPL in Pasadena. **Stan Kurtz** just wrote to me from Mexico City, where he is a post-doc (maybe something else) with the Autonomic University there. **Bob Fletcher** is with GE, I just heard. **Tao Han** is at the University of California-Davis working with Gunion. (Editor's note: not for long, as we have hired him.) **Dan Lacourse** is at Bethany College, Lindsborg, KS as an instructor in physics. **Scott Schappe** is in Mississippi — I think. **Dave Weber** is at GE, Milwaukee, last I heard, in Medical Physics. **Tim Sommerer** is at GE in lighting (gas discharge) research. **Alex Converse** runs his own firm in Madison, WI, Physica. **Brad Edwards** is permanent staff at Los Alamos and is married to Karla who graduated with a B.S. from Wisconsin. **Dave Cinabro** was at Harvard working on one of their experiments at Cornell, last I heard. (Too many Daves! So little time!) **Pamela Sandler** was at Lawrence Livermore or LBL, I can't remember which one.

David C. Kocher (Ph.D. 1970) Dave is currently employed at the Oak Ridge National Laboratory. He responded that the thought that the single most valuable experience he had at UW-Madison was the opportunity to do good work with first-class faculty and students. Thanks for your donation to the newsletter fund too, David.

Willard J. Pearce (Ph.D. 1950) Willard is retired and sent us a new home address in Mt. Airy, GA.

Walt Howard (M.D. 1994) Physics Major in 1987. Walt planned to finish his residency at Michigan State University in June of 1997. He will then begin to practice pediatrics at the LaSalle Clinic in Oshkosh, Wisconsin. He is willing to be a part of the informal physics network in his area. He can be found at 1855 S. Koeller Street, Oshkosh, WI 54901. He says, "Physics is an excellent background for Medical School!!!"

Adam Duff (Ph.D. 1993) A Zeppenfeld student, Adam can currently be found working for Morgan Stanley & Co. International, London, England.

Mark Skinner (Ph.D. 1991) After 5 years at Penn State, I have taken a position at Ball Aerospace & Technologies Corp., Boulder, Colorado, working on AXAF and other X-ray missions. My wife, Alison (UW-Madison BS, 1985) and I live up in Nederland, Colorado, at 8,500 feet, 17 miles west of Boulder. Anyone coming through town, please look me up, and we will go out for a microbrew.

Sally Laurent-Muehleisen (B.S. 1988) Received her Ph.D. in Astronomy and Astrophysics from Penn State in December 1996. She is currently a postdoctoral researcher at Lawrence Livermore National Lab working on the FIRST survey (*http://sundog.stsci.edu*). Her new mail address is *slauren@igpp.llnl.gov*. Her new home page address is *http://www-igpp.llnl.gov/people/slauren.html*.

Ralph Muehleisen (B.S. 1989) Ralph received his Ph.D. in Acoustics from Penn State in May 1996. He is cur-

rently an ASEE/ONR postdoctoral fellow in the Physics Department at the Naval Postgraduate School in Monterey, CA. He is doing research on thermoacoustic refrigeration. He will be joining the Civil, Environmental, and Architectural Engineering Department at the University of Colorado as an Assistant Professor in January of 1998. His new E-mail address is *muehleis@physics.nps.navy.mil*.

Francis G. Eparvier (B.S. 1985) After leaving the UW with my B.S., I went to graduate school at the University of Colorado-Boulder and received my Ph.D. in Astrophysical, Planetary, and Atmospheric Sciences in 1991. After a series of post-docs in the Boulder area, I currently work as research faculty at the Laboratory for Atmospheric and Space Physics at the University of Colorado. My research involves the study of the upper atmosphere and solar-terrestrial interactions using both sounding rocket and satellite instrumentation, and theoretical modeling efforts. My E-mail is *eparvier@colorado.edu*. My home page is *http://stripe.colorado.edu/~eparvier*.

Paul Burstein (Ph.D. 1976) Paul was kind enough to write a letter to the department chair discussing the current undergraduate's outlook, needed changes in the curriculum and a professional marketing thrust. We appreciated his sharing his professional view from a "real world perspective." He is currently in Winchester, MA.

G. Truman Hunter (Ph.D. 1949) Currently Adjunct Professor in the Physics Department at the University of Miami (Ohio).

Janet Seger (Ph.D. 1991) Janet Seger has been recently tenured and is now an Associate Professor of Physics at Creighton University, Omaha, Nebraska. Prof. Seger received her Ph.D. degree in 1991 from the University of Wisconsin-Madison. Her Ph.D. thesis were completed under the supervision of Prof. Balantekin.

Prof. Seger started her career as a theorist and still carries out research in theoretical nuclear physics. After joining Creighton University she started working on experimental projects as well. Her current research interests are in the area of nuclear and particle physics, particularly Relativistic Heavy Ion Physics. She is a member of the STAR Collaboration, which is building a detector at Brookhaven National Laboratory to search for the Quark Gluon Plasma.

Brian S. Swartzentruber, (Ph.D., 1992) will receive the Peter Mark Memorial Award for "pioneering studies of atomic-scale, kinetic and thermodynamic aspects of the morphology of Si (silicon) surfaces, and significant innovations in scanning tunneling microscopy that made such measurements possible." Swartzentruber is a senior member of the technical staff in the interface science department at Sandia National Laboratories. ❑

Fund Raising Report

More Alumni Invest in Physics Futures

The Department of Physics extends a sincere "thank you" to alumna, **Faye Ajzenberg-Selove**, for her donation of $100,000 to establish an award for an outstanding undergraduate woman. Dr. Ajzenberg-Selove came to Wisconsin on December 6, 1996 to make the first award to undergraduate winner, Nicole Hausen. A plaque commemorating this annual award and specifying each year's winner will become a permanent addition in the Sterling Hall lobby.

Alumna Dr. Faye Ajzenberg-Selove (l) and undergraduate Nicole Hausen (r) at reception in honor of first winner of Ajzenberg-Selove Award.

Faye Ajzenberg-Selove, an active faculty member at the University of Pennsylvania, also presented the Physics Colloquium on the topic of "Why Are There So Few Women Physicists?" [Editor's Note: You may be interested in rereading the last issue of *The Wisconsin Physicist* (Fall 1995–96) which contained an in-depth article regarding Ajzenberg-Selove and selected "clips" from her autobiography, "A Matter of Choices."] ❑

In last year's **The Wisconsin Physicist**, *Jim Lawler mentioned the need for a major fund raising drive to provide more generous fellowship stipends for all of our graduate students. The Van Vleck Fellowship fund was used to supplement the stipends for all of the teaching and research assistants entering in the fall of 1997. We need to continue this supplement in future years in order to remain competitive in attracting good graduate students, and we need your help in this regard, as the base level of the fund is not adequate to sustain these supplements over time. You may send your Physics Department donations directly to:*

UW Foundation
1848 University Avenue
PO Box 8860
Madison, WI 53706-8860

Please specify that the donation is for the Physics Department General Fund. Thank You!

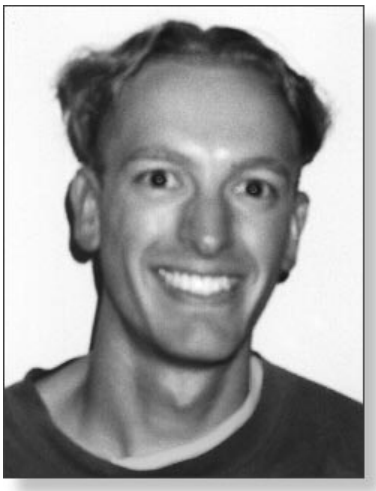
Lee Pondrom, Chair

Jeff and Lily Chen Establish Scholarship to Attract Top Graduate Students

The Department also wishes to extend a huge "thank you" to **Jeff and Lily Chen** for the establishment of a new ongoing scholarship fund to assist in the recruitment of top graduate students. Jeff and Lily were honored by a reception at the department in November of 1996. Dr. Jeff Chen presented a special colloquium entitled, "From Scientist to Businessman." Dr. Lily Chen gave an informal presentation to the graduate and undergraduate women on her views of women in science. Both presentations were enjoyed by physics graduate students and faculty.

Lily and Jeff Chen

During their visit, the Chens were interested in learning what type of assistance the department required to attract top graduate prospects. Our answer was a scholarship of several thousand dollars. The Chens acted quickly and decided to provide such a scholarship in the upcoming 1997-98 year. This scholarship was to be awarded to a student from National Taiwan University, a woman, or other top contender for a graduate offer.



John Peck, an incoming grad student from Beaver Dam, Wisconsin, was the grateful recipient of the first Chen Award.

We are pleased to announce that, as we go to press, the Chens have announced plans for a $135,000 endowment to fund future scholarships. Thanks again, Lily and Jeff, for your timely assistance. ❑

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We invite you to visit us at our Web site:
http://www.physics.wisc.edu

•Talk to Us

Address Correction and Alumni News

Please use this form if you are writing to us hard copy. We are more than happy to hear your news and publish it in next year's issue of **The Wisconsin Physicist**. This is also the way to update your address. Send this hard copy to:

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❒ Please check here if your address is different from last year.

Name: _____

UW-Madison Degree(s) and Year(s): _____

Employment: _____

Change in Home Address: _____

Phone: _____

City, State and Zip _____

_____

Change in Work Address: _____

Phone: _____

City, State and Zip _____

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My E-mail address is: _____

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- I would be willing to be a part of an informal informational Physics network in my area for Physics graduates.

  ❒ yes ❒ no

- Do you have access to the World Wide Web?

  ❒ yes ❒ no

- Have you found us on the World Wide Web at: http://www.physics.wisc.edu/ ? ❒ yes ❒ no

- I would be interested in being included in a UW-Physics alumni database available on WWW.

  ❒ yes ❒ no

- Contact me about linking my WWW home page to the Physics Dept. homepage. ❒ yes ❒ no

Feel free to include the following information in the next issue of Alumni News:

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Tell Us More

Survey question:

What's your best advice to physics graduate students?

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