UNIVERSITY OF WASHINGTON

PHYSICS

VOL. 12, WINTER 2003

HANS DEHMELT RETIRES: END OF AN ERA AND NEW BEGINNINGS

Professor Dehmelt delivers his last lecture at the DehmeltFest, Oct. 14, 2002.

University of Washington Physics Department at a glance:

WWW home page: http://www.phys.washington.edu

Main Office: C121 Physics Astronomy Building
(206) 543-2770, FAX (206) 685-0635

Mailing Address: Department of Physics, University of Washington
Box 351560, Seattle WA 98195-1560 USA

yearly: (typical recent figures)

BS degrees granted…….. 55
MS degrees granted……..14
PhD degrees granted…….15

Undergrad. courses taught …..56
Graduate Courses taught …….50

As of December 2002:

Major research directions:

Astrophysics, Atomic Physics Experiment, Condensed Matter Experiment, Condensed Matter Theory,Gravity Experiment, Nuclear Physics Experiment, Nuclear Physics Theory, Particle Physics Experiment, Particle Physics Theory, Physics Education

Professors ……..…….44
Associate Professors ……9
Assistant Professors …….8
Postdoctoral Associates….. 29

Emeritus faculty ……...…..…..19
Adjunct & Affiliate faculty…..32
Physics Majors …….……..…290
Graduate Students…….…..…..208

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UNIVERSITY OF WASHINGTON

P H Y S I C S

This newsletter is published for alumni and friends of the University of Washington Physics Department. The online version of the Newsletter is maintained at www.phys.washington.edu/news and contains the full text and all pictures (in color!), plus many live WWW links complementing the articles. We invite your comments, complaints, compliments and contributions.

David G. Boulware, Chair
chair@phys.washington.edu 206-543-2770

Vladi Chaloupka, Faculty Editor
vladi@u.washington.edu 206-543-8965

LETTER FROM THE CHAIR

Greetings,

There are few issues in the life of a University Department more important than faculty staffing. A coherent, systematic effort to attract the best possible faculty pays off in attracting good students, attracting more good faculty and postdocs, producing good science, and good teaching. This task is especially important, and difficult, in hard times such as the present financial crisis of our state.

I am pleased to report significant accomplishments in our staffing efforts this year. Our experimental efforts will be enhanced by the presence of Anastasia Chopelas and Alejandro Garcia, and the activities of our Particle Theory group will greatly benefit from the arrival of Matthew Strassler and Mina Aganagic. These staffing successes are described in more detail inside this issue, as is the retirement of Marshall Baker, and of our first Nobel Laureate Hans Dehmelt.

Second only to the quality of faculty is the quality of the graduate students we are able to attract. We were very pleased to be in position to name entering graduate student Iuliana Radu as the second Kenneth Young Fellow. This award continues the tradition of encouraging an outstanding member of the incoming class with the fund established by Christopher Young in memory of Professor Kenneth Young who passed away two years ago.

Last year the Career Development Organization, with the support of the Department, held their first Networking Day. Representatives of industry and laboratories both local and national came to the Department to hear students present their work, and to interview them. A detailed report on the success of this important initiative can be found in this Newsletter. The second Networking Day is being planned for January 30, 2003, and I strongly encourage students, faculty and potential employers to participate — this activity is an important part of our efforts to provide more opportunities for our students.

We granted a record of fourteen degrees in the Evening Master of Science Program this year. This important program serves the community, with many students working on their degrees while working at Boeing, Microsoft and other local companies. The interaction between the University and industry that this program provides help the Department build bridges benefiting us all.

These two activities together with our undergraduate program are the center of our connections with the private employers and the local community. About one-third of our students go to work directly for these groups and we are in the process of strengthening the connections so that we can better serve those students. Any help you can provide in this endeavor will be greatly appreciated.

This past year, the Seattle Repertory Theatre presented the play Copenhagen, a dramatization of the Copenhagen meeting between Niels Bohr and Werner Heisenberg in 1941 in the midst of World War II. The Department, along with the School of Drama, hosted a Forum on October 10, where the Director of the play along with other members of the University Community discussed the play and the historical context. The Physics Department was represented by Emeritus Professor Greg Dash (who knew both Heisenberg and Bohr.)

The achievements of the past year would not have been possible without the support of alumni and friends of the Department. Some of our most notable accomplishments — recruiting extraordinary faculty, rewarding our top faculty, preparing future generations to contribute meaningfully to our society — have been possible because annual funds were available. This year, and for the foreseeable future, support from the friends of the University in general, and from friends of Physics in particular, is and will be even more important.

Sincerely yours,

David G. Boulware

PHYSICS NOBEL PRIZE 2002

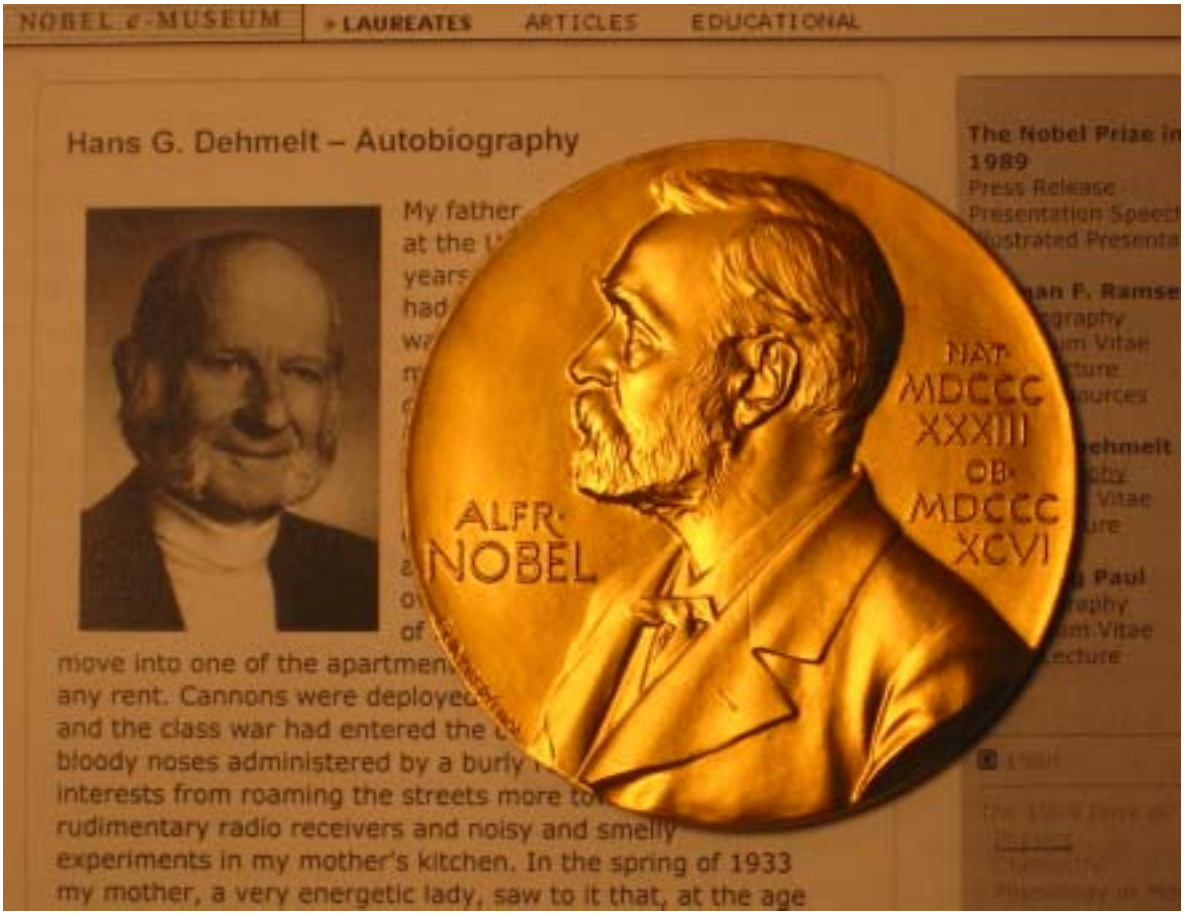
The two halves of the 2002 Physics Nobel prize do have a common theme: "Two New Windows on the Universe", but they recognize what are in fact two rather distinct fields:

Raymond Davis Jr. ((Univ. of Pennsylvania) and **Masatoshi Koshiba** (Univ. of Tokyo) share one half if the prize for their work on neutrino physics. In the 1960's, Davis built a tank with 615 tonnes of tetrachloroethylene (common cleaning fluid) , and was able to extract the handful of Argon atoms created by interactions of solar neutrinos with the chlorine atoms in the tank every months. The Nobel WWW site (www.nobel.se) aptly compares this to "finding a particular grain of sand in the whole of Sahara desert"! Even more exciting than detection of these solar neutrinos was the fact that their number seemed significantly lower than expected from "standard solar model calculations", thus indicating the possibility of new Physics phenomenon. But Davis' experiment could not detect the direction of the incoming neutrinos, and in any case the results needed confirmation. Masatoshi Koshiba is honored for his part in the discovery of that "new Physics phenomenon". He led the team which build a large pure water tank in the Japanese mine called Kamioka - thus the detector became known as Kamiokande. Here the direction of the neutrinos which happened (very rarely) interact in the water could be measured, and so the Solar origin of the effect was established, and the deficiency of the flux was confirmed. The success of this project led, among other developments, to the establishments at Kamioka site of the SuperKamiokande followup experiment, and provided added motivation to building of the Sudbury neutrino Observatory. Both of these experiments have significant UW participation (see the Physics Newsletter Vol. 8, 10 and 11), and we now believe that the reason for the original Davis' flux discrepancy is an oscillation of the neutrinos on their way from Sun to the detectors: a new Physics phenomenon indeed!

The second half of the prize went to **Riccardo Giacconi** (Associated Universities, Inc.) for his development of X-ray detectors, and it really is an Astronomy/Astrophysics prize. X-rays are in fact electromagnetic radiation as is visible light (only the wavelength is about thousand times shorter) so the Giacconi instruments could in fact be called telescopes. Opening up a new wavelength range in which to look at the Universe added immensely to our knowledge of the many diverse and fascinating processes, relevant to double stars, neutron stars, supernova, black holes and other exotica.

To continue in the Nobel spirit, and to provide a link to our cover story (next page), we reproduce below photographs of Hans Dehmelt's Nobel Prize and National Medal of Science. For pictures in full and gloriously yellow color see the online Newsletter at www.phys.washington.edu/news .

HANS DEHMELT RETIRES: END OF AN ERA, AND NEW BEGINNINGS



As of September 16, 2002, our first Nobel Laureate is Professor Emeritus. This event was marked by a full day of Physics talks, reminiscences, celebrations, some jokes and, eventually, food and drink, on Saturday Oct. 14. After a brief introduction recapitulating Hans' life and accomplishments, this article will document the DehmeltFest for the unfortunate people who missed it. For a more formal and complete account of Hans Dehmelt see the Nobel Prize home page at www.nobel.se .

As anyone who heard Hans even briefly can recognize, he was born in Germany. He started tinkering with vacuum tubes at an early age, and after a stint with the Wehrmacht at Stalingrad, and a year in an American (fortunately) POW camp, he finished his studies at Goettingen where he obtained his Doktorat. In his Nobel Institute autobiography Hans reminisces how he attended courses taught by Heisenberg, and went to Colloquia attended by Max Planck! In 1952 Hans moved to America (Duke University), and in 1955 he received an entry level position - a Visiting Assistant Professorship - at the University of Washington. Things went pretty quickly from there: Full Professor 1961, Davisson Germer Prize 1970, elected to the National Academy of Sciences 1978, Nobel prize for Physics 1989, National Medal of Science 1995 ….

Dehmelt's physics can only be called brilliant. With uncanny intuition, supported by surprisingly classical notions and concepts, he performed miracles in the laboratory. Inspired by an off-hand remark by his high-school teacher, who said while pointing on a dot on the blackboard: "Hier ist ein Elektron!", Hans ended up by really trapping a single electron, keeping it in the trap for many seconds, then many weeks, then months, while studying its properties to a precision of 12 decimal digits. Perhaps his most spectacular experiment was the "shelved ion" scheme. In that experiment, random jumps in the quantum state of the ion were made visible to the naked eye by a clever scheme using fluorescence. When Hans first described the proposed setup, a number of papers by learned Quantum Mechanicians were published, in peer-reviewed Physics journals, explaining why this scheme cannot possibly work. Hans was not perturbed, the experiment did work, and another series of theoretical

continued on Page 7

Images from the DehmeltFest.

Toichiro Kinoshita (Cornell Univ. – top left) tells how he spent 25 years calculating the magnetic moment of electron to be 1.001,159,652,133 +- 29 (in some units)

Bob van Dyck (UW – top right) reviewed how Dehmelt's group measured the magnetic moment of electron to be 1.001,159,652,188 +- 4 (in the same units)

Warren Nagourney (UW – bottom left) described some exciting future possibilities with single trapped ions, including experimental test of the possible variations of the fundamental constants with time.

Relaxing over appetizers and drinks (below) at the Faculty Club before dinner.

continued from Page 5

papers was published explaining why the scheme did work. This will be one day an excellent subject for Historians of Science (once they get over the Einstein-Bohr disputes …).

The DehmeltFest on Oct. 20 was a grand affair. The full day of Physics talks brought in lecturers from all over the world, many of them Hans' former students or postdocs. The physics level of presentations was excellent, and some speakers could not resist relating an anecdote or delivering a gentle barb in the direction of the celebrant. The celebration continued at the Faculty Club, where after dinner speaker after speaker recalled various aspects of their interaction with Hans.

In 1989, Professor Dehmelt began his Nobel Lecture with a quote from Albert Einstein:

"You know, it would be sufficient to really understand the electron".

There is no doubt that Professor Dehmelt contributed very significantly to this noble goal. But the story does not end there, and as we marked his retirement, there are new directions and new beginnings in the Physics Department in general, and in his former group in particular. With the help of new faculty, we will continue to be on the forefront of the search for Physics Beyond the Standard Model – more excitement is on the way!

With the celebration concluded, Drs. Diana and Hans G. Dehmelt take their leave.

M.S. Degrees Summer 2001 – Autumn 2002

Tareq Alrefae Oscillations *Bifurcations and Chaos in Nonlinear Colpitts Oscillators* (Prof. Larry Sorensen) Chaotic behavior in electric oscillators is studied (Colpitts oscillator makes use of an amplifier and three complex impedances ...).

Lenore Hernandez (Prof. Paula Heron) *Preparing Teachers To Teach Science as a Process of Inquiry: The Development of Scientific Reasoning Skills* This investigation examined the ability of elementary school teachers enrolled in Physics by Inquiry courses to apply proportional reasoning and to use control of variables. The results from a series of tasks administered before and after instruction showed considerable improvement.

Tim Lowe (Prof. Lillian McDermott) *An investigation of how the web can be used to promote and assess student learning* The use of computer-based homework systems is becoming common in physics courses at university, college and high school levels. This thesis demonstrates in the context of electric circuits that use of such systems may not contribute to student learning.

Brian Kalab (Prof. Larry Sorensen) *Stationary Waves Upstream of a Disturbance* This project originated from observing standing waves when a pencil is inserted into the stream of water from a kitchen faucet. Detailed technical study of the phenomena resulted.

Craig Rivet (Prof. Arnd Junghans)*In Situ Efficiency Calibration of a HP Ge Detector for Gamma Ray Activity Measurements* HP Ge stands for High Purity Germanium, and knowledge of the efficiency of the detector is crucial for proper interpretation of results of the Sudbury Neutrino Detector.

Gerald Whitmarsh (Prof. Joseph Rothberg) *Diffraction Simulation by Phasor Addition with C-Programming Language* Desire to overcome a deeply instilled fear of computers motivated this research. The goal was accomplished, and results are useful for real-time alignment of a muon detector at CERN.

Matthew DePies (Prof. Oscar Vilches) *Adsorption of Hydrogen and Deuterium on Single Walled Carbon Nanotube Bundles* Nanotubes obtained from a lab in Montpellier (France) are studied, and experimental results compared with theoretical models.

Curran Fey (Prof. John Cramer) *Mach's Principle Test* An attempt to look for possible inertial mass fluctuations caused by manipulating energy flow. This is the kind of long-shot experiments which, if an effect is found, result in a handshake with the Swedish king. In this case, effect was not found. ...

Jin Li (Prof. Larry Sorensen) *Investigation of Applications for Surface Plasma Resonance* This project studied a complex quantum optical-electrical phenomenon which influences reflection of light from surfaces. The technique has many chemical and biophysical applications.

Robert Moore (Prof. Larry Sorensen) *Magnetic Phase and Microscopic Return Point Memory in CO:PT Multilayer Thin Films* The alternate title of this work is *"Deep Thoughts on Doughnuts: Do They Really Remember?"*. Advanced Light Source at Lawrence Berkely Laboratory was used to study this question.

Edwin Obune (Prof. Larry Sorensen) *Theoretical Investigations of Eikonal Equation and Its Application To Seismic Tomography* Geophysicists use (sometimes) ordinary rifles and shotguns to disturb the Earth and measure and interpret the produced waves. This work is a study of the Eikonal Equation used to interpret the resulting seismic waves.

Jeremy Cooper (Prof. Larry Sorensen) *Wavelength-Modulated Surface Plasmon Resonance*

Xich Le (Prof. Thompson Burnett) *Web Application for Graphical and Tabular Analysis* The need of High Energy Physics to analyze huge amount of data through the Internet motivated this project (as history of WWW itself demonstrates, this is not the first time High Energy Physics produced a byproduct .....)

Jeremy Thomas (Prof. Robert Holzworth) *In-Situ Measurements of Sprites* Red Sprites are fascinating phenomena of middle atmosphere electrodynamics. This project uses results from long duration baloon experiments to study the processes involved.

Lincoln Webbeking (Prof. Jeffrey Wilkes) *100pc Survey of Low-Mass M Dwarfs: Velocity Dispersion as a Measure of Age* M dwarfs are the most common, yet poorly understood stars in the Universe. This paper analyses the velocities of 600 of the nearest M dwarfs to provide solid data for future studies.

Congratulations to All!

PhD Degrees Summer 2001 – Autumn 2002

Jason Cooke (Prof. Gerald Miller) *Light Front Field Theory Calculation of Deuteron Properties* Light-front dynamics uses a simple mathematical gimmick which turns out to be extraordinarily useful for solving bound state problems in relativistic nuclear physics - the resulting formalism turned out to be anything but simple!

Charles Hoyle (Prof. Eric Adelberger) *Sub-Millimeter Tests of the Gravitational Inverse-Square Law* This work presents the first direct observation of gravitational interaction at distances less than 0.5 mm; no deviations from Newtonian physics were observed.

Cheng-Pang Liu (Prof. Wick Haxton) *Nuclear Anapole Moments: A Manifestation of Nuclear Parity Nonconservation* Symmetry under a mirror-reflection was believed to be a law of Nature until the 1950's. This work studies consequences of parity violations in nuclear physics.

Luanna Ortiz (Profs. Paula Heron and Lillian McDermott) *Identifying and Addressing Student Difficulties with Rigid Body Dynamics* This project focused on student understanding of static equilibrium of rigid bodies and translational and rotational motion resulting from applied forces and torques. Instructional materials developed on the basis of the findings led to significant learning gains by undergraduates and K-12 teachers.

Noam Shoresh (Profs. David Kaplan and Stephen Sharpe) *Applications of Chiral Perturbation Theory* Everyone believes that Quantum Chromodynamics is the correct theory, but testing this belief is not easy, especially at low energies. This Thesis contributes to the progress in this field.

Andrew Boudreaux (Prof. Lillian McDermott) *An Investigation of Student Understanding of Galilean Relativity* The dissertation describes research on student ability to determine and to relate the concepts of displacement, velocity, acceleration, and momentum in multiple frames of reference. There is a description of how results from pretests and post-tests helped guide the design of curriculum.

Li-Jen Chen (Prof. George Parks) *Bernstein-Greene-Kruskal Electron Solitary Waves in Collisionless Plasmas* Recent satellite-based experiments discovered that the broadband electrostatic noise consists in fact of isolated bipolar pulses. This phenomenon is studied theoretically.

Andrew Stachyra (Prof. Jeffrey Wilkes) *A Search for Astrophysical Point Sources of Neutrinos with Super-Kamiokande* This is one of the first PhD Theses to come from The SuperKamiokande experiment. Astrophysical neutrino point sources have not been found yet (but they will be ...).

Travis Norsen (Prof. Wick Haxton) *Strange Phases in Neutron Star Matter* Nuclear matter at high density may exhibit new phases in which kaons (and other, normally unstable subatomic particles) condense. This thesis explores the nature of such mixed phases and their consequences for neutron star properties.

Eric Zager (Prof. Jeffrey Wilkes) *The Impact of TeV Nucleus-Nucleus Simulations on JACEE Results* JACEE is the Japanese American Cooperative Emulsion chamber Experiment which conducted balloon flight exposures of cosmic ray detectors between 1979 and 1994. After participating in Antarctic balloon flight operations and contributing to the ongoing JACEE data analysis effort, Eric Zager implemented a full simulation of the JACEE detectors.

Paul Bedrosian (Prof. Martyn Unsworth) *Electromagnetic Imaging of Active Fault Zones*

Chun-Chung Chen (Prof. Marcel den Nijs) *Understanding Directed Avalanches Through The Underlying Interface Dynamics* This is a highly theoretical study in condensed matter Physics, exploring the concepts of Criticality in Nature.

Chen Shan Chin (Prof. Marcel den Nijs) *Stochastic Fluctuations far from Equilibrium – Statistical mechanics of Surface growth* This is a theoretical study of various types of surface growth, exploring concepts such as fluctuations of topological features, and passive random walker dynamics.

Patrick Fox (Prof. Ann Nelson) *Extra! Extra! Dimensions and Symmetry* The thesis focussed on several new ideas involving extra dimensions and extended supersymmetry of the gauge interactions to address the gauge hierarchy problem (why gravity is so weak).

Karsten Heeger (Prof. Hamish Robertson) *Model-Independent Measurement of the Neutral-Current Interaction Rate of Solar 8B Neutrinos with Deuterium in the Sudbury Neutrino Observato*ry The flux of neutrinos from the sun has been measured with a detector that uses heavy water (deuterium oxide). Previous measurements of the solar neutrino flux have not found the rates expected from astrophysical calculations. It is shown that this is due to conversion of electron flavor neutrinos into other flavors (mu and tau), which indicates that neutrinos have mass.

Congratulations to All!

News from the Department

New Faculty

Research professor **Anastasia Chopelas** comes from the University of Nevada. She is a highly succesful physicist, fellow of the American Mineralogical Society, specializing in the field of measurements of the properties of materials under high pressure and temperature.

Professor **Alejandro Garcia** received his PhD under our very own Eric Adelberger in 1991. He comes back to UW from Notre Dame, where he has been the Grace-Rupley Professor of Physics. He will rejoin Eric, and other members of the Center for Experimental Nuclear and Particle Astrophysics to search for possible extensions of the Standard Model .

Associate Professor **Dam Thanh Son** will also act as Senior Fellow of our Institute for Nuclear Theory. He also is coming back to UW - he has been a Postdoctoral Research Associate here in 1995-97. His awards include the Sloan Fellowship and the Outstanding Junior Investigator.

Associate professor **Matthew Strassler** has broad interests in particle theory, ranging from phenomenology to string theory. He comes to us from the University of Pennsylvania where he has been an Assistant Professor. And just as in the case of Dam Thanh Son above, Matt's awards include the Sloan Fellowship and the Outstanding Junior Investigator. Together with the recently hired professor Andreas Karch, and with Assistant Professor Minda Aganagic (who will be joining us in the Fall of 2003) they will establish a significance presence of our department in the exciting field of the String Theory.

Retirements

Marshall Baker, who has been on our Theory faculty since 1962, retired this year. He has worked on a variety of topics, particularly on the issues of renormalization, and how can it be that nuclei composed of quarks can be observed, but quarks themselves can not be (i.e. the topic of confinment in quantum chromodynamics). A Bakerfest in his honor was organized at UW , with participation of many friends and colleagues from UW and other Universities and laboratories.

Marian Rice has been a helpful and cheerful presence in the Department for twenty years. She was running the Physics Store, and now Marian has retired and the Store is gone. On Nov. 22 there was a large good-bye party at the Faculty Club, where many old timers could talk to Marian and to each other, often after many years …

The retirement of our first Nobel Laureate **Hans Dehmelt** is the subject of our cover story.

Awards and Kudos

Membership in the American Physical Society is open to all, but to be elected a Fellow is quite different matter. Four of our faculty received this honor in 2002:

Peter Doe: For experimental neutrino physics including the demonstration of destructive interference in the charged - and neutral-current scattering of electron neutrinos, and the observation of solar neutrinos in the Sudbury Neutrino Observatory."

Marjorie Olmstead: "For innovative studies of interface formation between dissimilar materials, especially the competition between thermodynamic and kinetic constraints in controlling morphologies and properties of heterostructures."

Martin Savage: "For development of effective field theories for the nucleon and deuteron, for work on parity and CP violation, and for partially quenched chiral perturbation theory in lattice QCD."

Boris Spivak: "For seminal contributions to studies of quantum interference effects in mesoscopic systems and of weak localization in disordered materials."

Congratulations to all!

Graduate Students and Employers: Network!

Back in 2000, it occurred to several far-seeing graduate students at UW Physics and Astronomy Departments that, after graduation, they will need to find a job. Out of this realization grew a new and quite original venture: the Career Development Organization (CDO - see their home page at http://students.washington.edu/cdophys/CAREER/). The mission of CDO, in the broadest sense, is "to assist UW physics and astronomy students in their career advancement." In addition to regular and irregular lectures and seminars, CDO organizes an annual Networking Day, and it might be of interest to our readers to learn more about the first networking day held in 2001.

The event was sponsored by number of well known companies: Boeing, Siemens Medical Solutions, Raytheon, Quinton, and Los Alamos National Laboratory. Additional participating employers included Batelle Pacific, MIT Lincoln Lab., UW Applied Physics Lab., Lawrence Livermore National Lab, Washington Technology Center and ARCH Venture Capital. Ten students presented talks about their research, with subjects ranging from "Data Mining the Early Universe" to "Nanoparticle Formation in Miscrogravity". In addition, 18 students prepared posters describing their research (and their qualification to lure prospective employers …). Just as an example: not many employers have jobs for experts on neutrinos, but a poster on "Object-Oriented Solution to Non-Standard Event Structures in the Sudbury Neutrino Observatory" certainly pointed out to some employers the broad range of skills marketable by our graduates ….

This Networking day was, by all accounts, a great success. Numerous contacts were established, students learned many lessons from exposure to potential employers, and the employers learned a lot, too. CDO is following up on this success by organizing their 2nd Networking Day on Jan. 30, 2003, and we hope that many students, faculty and employers will participate.

Discussions continued during lunchtime on the 1st Networking Day.

Donors of $250 or more to the Department of Physics

from 7/1/2001 through 6/30/2002.

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The Boeing Company
Prof David Boulware & Ms. Susan Veltfort
The Chisholm Foundation
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Physics Department Development Effort

As part of the University's coming development campaign, the Department of Physics is seeking endowed support to help us provide better education for our students and to enhance our research efforts. In particular, we are requesting assistance in obtaining funds for:

- Chairs and Professorships which provide support for faculty and their research
- Predoctoral Fellowships which support our graduate students,
- Undergraduate tuition scholarships to recognize our undergraduates
- a Teaching Prize
- Physics Endowment Fund to provide general support.

Your help in providing funding for these endowments will enable the Department to improve the quality of its teaching and research, and will be of great value in the recruiting of students and faculty.

To inquire about various options of supporting the Department and/or the University, please see http://www.supportuw.washington.edu or call the Department of Physics at 206-543-2770.

DEPARTMENT OF PHYSICS,
UNIVERSITY OF WASHINGTON
BOX 351560
SEATTLE, WA 98195-1560

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