

LABORATORY FOR EXPERIMENTAL ASTROPHYSICS (LEXAS) GROUP STUDIES HIGH-ENERGY NEUTRINOS IN ANTARCTICA

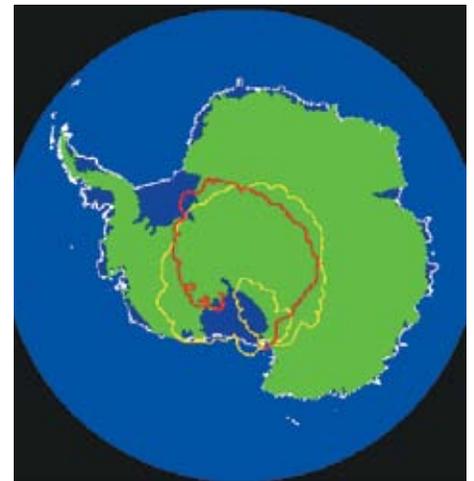
For many years, the Cosmic Ray Group in the Laboratory for Experimental Astrophysics (LEXAS) has used balloons and satellites as vehicles to investigate the cosmic ray nuclei that bombard the Earth. The Antarctic Impulsive Transient Antenna (ANITA) experiment, however, is designed to detect ultra-high-energy neutrinos (threshold energy $\sim 10^{18}$ eV) that are almost certainly produced in the interactions of ultra-high-energy cosmic rays with the cosmic microwave background (CMB) that permeates the universe. For cosmic rays with energy 10^{19} eV and higher, the interaction cross-section with CMB photons is large enough so that the universe is optically thick. Before reaching the Earth, the cosmic rays will collide and produce neutrinos. This interaction process is known as the GZK effect (named after its discoverers Greisen, Zatsepin, and Kuzmin). The product is a cosmogenic neutrino flux. So far none of these neutrinos has been detected. Confusing the picture are high-energy neutrinos that may also be produced in a variety of other astrophysical processes.



↑ Garry Simburger and Dana Braun with ANITA gondola

In order to detect these rare, high-energy neutrinos, a giant detector is required because of the low-interaction cross-sections. The ANITA experiment utilizes the Antarctic ice cap as its primary detector. The ANITA instrument consists of a radio antenna array that is flown on a high-altitude balloon and is designed to detect radio frequency (RF) (0.2 to 1.2 GHz) pulses resulting from the interactions of the GZK neutrinos in the upper layer of the Antarctic ice cap, with a typical thickness of 1 to 4 km. At any given time, for a balloon float altitude of 37 km, the antennas view an area of order of 1 million square km; with the attenuation length of RF emission about 1 km in ice, the detector volume will be about 1 million km^3 .

The production of RF emission starts with the interaction of the neutrinos in the ice, producing a shower of charged particles which move faster than the speed of light in the ice. By the familiar Cherenkov effect, RF emission by the particles then occurs. In 1962, G. Askaryan, a Russian theorist (1962, *JETP* 21, 658), was the first to recognize that in very high-energy interactions, strong coherent RF emission should occur. If the interactions occur in a medium transparent to RF such as ice, salt, or the lunar regolith, these events could be observed by the detection of the RF pulse. The number of particles (electrons and positrons) in these showers is about equal to the energy of the original neutrino in GeV. So for a neutrino energy of, e.g., 10^{19} eV, there are approximately 10^{10} electrons and positrons in the shower. Very quickly a net negative charge of about 20% builds up due to the combination of positron annihilation and the Compton effect, which produces electrons but not positrons. The longitudinal dimension of the charged particle shower moving through the ice (in the direction of particle traversal) is



↑ ANITA was launched near the McMurdo station on the edge of the Ross Ice Shelf. The winds first carried the balloon on a small circle, not far from the launch site; then the winds carried it twice around the South Pole. The instrument was brought down after 30 days, near the edge of the Ice Shelf, about 300 miles from McMurdo.

just a few centimeters and the lateral dimension is comparable. As a result, for wavelengths that are ~ 0.25 to 1.5 meters for ANITA (long compared with the shower dimensions), the RF emission is coherent. Thus, the tiny component of radio Cherenkov from a single particle is multiplied by the excess negative charge (effective charge) of $\sim 2 \times 10^9$ squared, resulting in a large RF Cherenkov pulse that can, in principle, be detected at distances as far as the horizon, ~ 700 km.

Washington University physicists Robert Binns and Martin Israel are co-investigators on the ANITA experiment. The principal investigator is Peter Gorham from the University of Hawaii, Manoa. Other co-investigator institutions are UCLA, The Ohio State University, University of Delaware/Bartol, UC London, SLAC, JPL, and the University of Minnesota.

(continued on page 6)

ALUMNI FROM THE LABORATORY FOR ULTRASONICS

Ultrasonics research in the department started when Dan Bolef joined the faculty in the early 1960s. His early colleague was Ron Sundfors, and **Jim Miller (GR 69)** has been the director for many years, as well as advisor to more than 25 graduate students. Updates on some of the lab's alumni follow.

Among the lab's early alumni are: **Robert Leisure (GR 67)** who went on to become the chairman of the physics department at Colorado State University in Fort Collins; **Robert Melcher (GR 68)** who had a very distinguished career as a scientist and later as a high-level manager at IBM Laboratories in the United States and Europe; and **Willis Smith (GR 70)** who served on the professional staff of Senator Henry "Scoop" Jackson and later as a vice president of Boeing.

Eric Madaras (GR 81) and **Patrick Johnston (GR 85)** continue to work at NASA Langley Research Center.

Mark Holland (GR 89) was recently elected to the Board of Governors of the American Institute of Ultrasound in Medicine. He had previously served terms as secretary, vice chairman, and chairman of the Basic Sciences and Instrumentation Section of that organization, which is the nation's largest and most influential ultrasound organization. In collaboration with colleagues from Pediatric Cardiology at the Washington University School of Medicine,

Mark continues research associated with the measurement of the ultrasonic properties of the developing heart and their subsequent effects on echocardiographic imaging. He was invited to present a paper titled "Ultrasonic Characterization of the Fetal Heart" at the 2008 American Institute of Ultrasound in Medicine Annual Convention in San Diego. Additional aspects of this work were reported at the 33rd International Symposium on Ultrasonic Imaging and Tissue Characterization in Washington, D.C.

S. Lori Bridal (GR 94) has received numerous awards and recognition for her work and now

holds a CNRS (National Center for Scientific Research) position at the University of Paris VI.

Russell Fedewa (GR 97) left his position at the ultrasound company Focus-Surgery in Indianapolis to join Volcano's research facility in Cleveland.

Before returning to the United States to take a position with the intravascular ultrasonic imaging company Volcano, **Kendall Waters (GR 00)** conducted research in the Laboratoire d'Imagerie Paramétrique. He recently joined an exciting new San Francisco Bay-area medical imaging startup company.

PHYSICS ALUMNUS ELECTED CHAIRMAN OF BANK OF AMERICA

Walter Massey (GR 66) has been elected chairman of the board of directors at Bank of America. After obtaining his undergraduate degree at Morehouse College, Walter came to Washington University as a graduate student. His faculty advisor was Gene Feenberg and the title of his dissertation was "Ground State of Liquid Helium-Boson Solutions for Mass 3 and 4." Other faculty on his examining committee were John Clark and Ed Jaynes.

Walter has had a very distinguished career. He was a member of the Brown University Department of Physics, becoming a full professor in 1975. He served as director of Argonne National Laboratory from the late 1970s through the middle 1980s during a period of severe budget constraints. He then served as vice president for research at the University of Chicago with Argonne National Laboratory being under his supervision. Subsequently, he served as the director of the National Science Foundation under President George H.W. Bush. His next position was senior vice president and provost of the University of California System. Walter's last academic appointment was as president of Morehouse College in Atlanta, Georgia, during 1995–2007.

WASHINGTON UNIVERSITY, PHYSICS, AND THE CIVIL WAR

The name of **John M. Schofield** is well known in Civil War history. Schofield served in the Union army under Sherman during the March to the Sea. Schofield later served as secretary of war (1868–69) and as superintendent of West Point (1876–81). However, his connection with our Department of Physics is not otherwise widely known. During 1860–61, Schofield was the Eliot Professor of Physics and Civil Engineering at Washington University.

Schofield was a graduate of the U.S. Military Academy at West Point. He was appointed assistant professor of natural philosophy at West Point and held that position for four years. By 1860 he had written a textbook on physics, but, with the war starting, this was never published. Since he did not see any prospects for promotion, he decided to change careers. He was advised to take leave from the army rather than resign his commission. By being on leave, he would not lose seniority if he resumed his commission.

The Eliot professorship was the first named professorship at Washington University and had been endowed by a donation from Wayman Crow. In 1862, the chair's title was changed to the William Greenleaf Eliot Professor of Chemistry. The current Eliot Professor is Joe Ackerman, chairman of the Department of Chemistry. Our Wayman Crow Chair of Physics was created in 1875, and the present holder of this chair is John Clark.

The Washington University course catalog for 1860–61 shows the physics courses offered:

Freshman and sophomore years: no physics

Junior year: "Physics–Natural Philosophy (Mechanics, Hydrostatics, Hydraulics, Pneumatics, and Acoustics)"

Senior year: "Physics–Natural Philosophy (Optics, Electricity, and Magnetism)"

In his autobiography, Schofield described his military service in St. Louis: "Upon President Lincoln's first call for volunteers, I was detailed to muster in the troops required of the State of Missouri...." [Editor's Note: Missouri was deeply divided politically and the troops did not quickly emerge.] "Fortunately, a large number of the loyal citizens of St. Louis had, in anticipation of a call to take up arms in support of the government, organized themselves into companies, and received some instruction in tactics at their places of secret nightly meetings in the city. On the other hand, the organized militia of the State, mostly disloyal, were in the city of St. Louis near the arsenal...there was a great danger that the arsenal would follow the fate of the public arsenals in the more Southern States...the successful defense of the arsenal was secured."

(Thanks to Jim Buckley, a Civil War enthusiast, for discovering Schofield's Washington University connection, and to Miranda Rectenwald of the University Archives for additional help.)

A NEW INTRODUCTORY PHYSICS COURSE

In 2004, **Tom Bernatowicz** introduced Physics 197/198, a new, calculus-based physics sequence based on the teaching methodology introduced by Thomas A. Moore of Pomona College. Moore's textbook, *Six Ideas That Shaped*

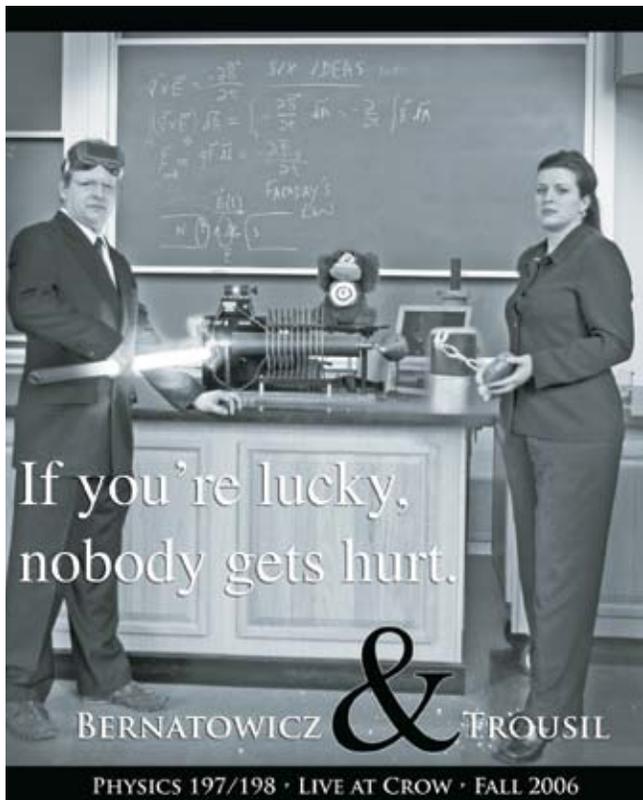
Physics, was developed under the auspices of NSF's Introductory University Physics Project (1987–1995). The initiative for this curriculum review came from John S. Rigden, then at the American Institute of Physics and now an honorary professor in our department.

Many alumni will remember our long-running, first-year sequence, Physics 117/118. These courses were introduced over 40 years ago, in the post-Sputnik period when federally funded curriculum revision was in vogue and included high-school courses in physics (PSSC), math, chemistry, and biology.

Tom's new course is based on active learning in the classroom and daily exercises in solving realistic homework problems in both modern and classic physics. The course is designed, in part, to take into account modern studies of how students learn and adapt to

quantitative analysis in both group and private settings. Students are required to read and solve problems from each textbook chapter before these are considered in the classroom, to prepare their thinking for the discussions, problem-solving exercises, and demonstrations that will be conducted in class. Homework grades form a significant part of course credit, and students are rewarded with improved scores for correcting their errors. The course focuses on conceptual understanding, as opposed to formula-hunting, and is implemented by the "two-minute problems" in class that allow students to formulate answers and discuss them with classmates. Students seem to greatly appreciate the opportunity to break the monotony of the conventional passive learning. In many ways, the course structure is similar to that used in language and literature classes.

The course has become so favorably regarded by students, faculty, and deans, that it was necessary to open a new section, taught in 2006 by **Becky Trousil**, senior lecturer. Representative student reactions have been "this class is by far my favorite," "very interactive with the class, casual and humorous atmosphere," and "pay this [teacher] more money." In fall 2009, another section will be added.



↑ Tom Bernatowicz and Becky Trousil

W.E. MOERNER AWARDED WOLF PRIZE IN CHEMISTRY

It is our great pleasure to take note of **W.E. Moerner's** being awarded the Wolf Prize in Chemistry. W.E. (as we have always known him) graduated from Washington University in 1975 with three degrees: A.B. in Mathematics in Arts & Sciences, and B.S. and M.S. in Engineering. His graduate work was carried out at Cornell where he received his Ph.D. in 1982. He then worked in the IBM Research Lab until 1995, when he was appointed to a distinguished chair in physical chemistry, University of California–San Diego. In 1998, he moved to Stanford University as the Harry S. Mosher Professor in the Chemistry Department, with a courtesy appointment in Applied Physics. He was elected to the National Academy of Sciences in 2007.

The Wolf Foundation began its activities in 1976, with an initial endowment fund of \$10 million donated by the Wolf family. The Foundation's founders and major donors were Dr. Ricardo Subirana y Lobo Wolf and his wife, Francisca. Five awards are made each year "to promote science and art for the benefit of mankind."

W.E. shared his prize with Allen J. Bard of the University of Texas "for the ingenious creation of a new field of science, single molecule spectroscopy and electrochemistry, with impact at the nanoscopic regime, from the molecular and cellular domain to complex material systems." W.E.'s award citation noted that he was "the first person to perform optical detection and spectroscopy of a single individual molecule in condensed matter."

You can find detail of W.E.'s research at his group's Web site:

stanford.edu/group/moerner/members.html



↑ W.E. Moerner

MCDONNELL DISTINGUISHED LECTURE SERIES

Each year, the McDonnell Center for the Space Sciences invites a distinguished scientist to visit and deliver the McDonnell Lecture. These lectures honor the memory of James S. McDonnell, a generous donor to the Center.

This year's distinguished lecturer was **P. James E. Peebles**, Albert Einstein Professor Emeritus at Princeton University. On April 15 at the department's weekly colloquium, Professor Peebles



↑ James Peebles

addressed a full house in the Hughes Lecture Room in Crow Hall with his topic, "Establishing the Big Bang." The following evening he spoke to a general audience on "Finding the Big Bang." Jim Peebles (as he is widely known) is a theoretical physicist who has been a major participant in the study of the structure and evolution of the universe. In the science of modern cosmology, his work has been central in setting the theory of the Big Bang on a firm basis. The McDonnell Lectures began in 2002, with the objective of providing the University and its wider community an opportunity to hear from

a distinguished scientist about forefront space science research. The lecturers, with the titles of their popular lectures, have been:

2002: Bruce Jakosky, educator and researcher at the University of Colorado, Laboratory for Atmospheric and Space Physics, and director of the University of Colorado Center for Astrobiology, "What Do Scientists Now Know About Extraterrestrial Life...and What Would It Mean to Find It?"

2003: Michael S. Turner, Bruce V. and Diana M. Rauner Distinguished Service Professor, departments of Astronomy & Astrophysics and Physics, and chair, Department of Astronomy & Astrophysics, University of Chicago, "Outer Space Is Our Window on the Earliest Moments of Creation. 'In the Beginning'..."

2004: Donald Brownlee, professor of astronomy, University of Washington, and principal investigator, NASA's Stardust Mission, "The Stardust Mission"

2005: (no lecture)

2006: Robert P. Kirshner, Harvard College Professor of Astronomy and Clowes Professor of Sciences, Harvard University; president, American Astronomical Society, "The Accelerating Universe: Einstein's Blunder Undone"

2007: Sean C. Solomon, director, Department of Terrestrial Magnetism, Carnegie Institution of Washington, principal investigator, MESSENGER Mission, "The MESSENGER Mission to Mercury"

2008: Kathryn Flanagan, senior scientist and head of the James Webb Space Telescope Mission Office, Space Telescope Science Institute, Baltimore, "The James Webb Space Telescope: A Window to the Past"

In addition to the McDonnell Lectures, the Center for the Space Sciences has started the **Robert M. Walker Distinguished Lecture Series** to honor the memory of Bob Walker, the founding director of the McDonnell Center in 1975, who was the driving force behind the Center's success and growth. Succeeding directors have been Roger Phillips (1999–2007) and Ramanath Cowsik (2007–present).

The initial Robert M. Walker Lecture was given in 2009 by Raymond E. Arvidson, James S. McDonnell Distinguished University Professor, Washington University, who is a co-principal investigator on the Mars Mission. His lecture topic was "Mars: Environments, Habitability, and Life."

GALACTIC COSMIC RAYS

The Department of Physics Laboratory for Experimental High-Energy Astrophysics (LEXAS) has received a new NASA grant to undertake an experimental study of the elemental abundances of the so-called ultra-heavy nuclei, those with atomic numbers $Z \geq 30$, in the galactic cosmic rays. Most cosmic ray particles are nuclei of hydrogen and helium. Within the remaining 3%, the relative abundances of the particles carry important information about their sources.

The primary objective of the new study is to measure the abundances of all nuclei from Zinc to Molybdenum ($30 \leq Z \leq 42$). The NASA grant will support the development of a larger version of the Trans-Iron Galactic Element Recorder (TIGER) that has been flown twice over Antarctica. The measurements will test the suggestion that the origin of galactic cosmic rays lies in OB associations that consist of many hot, blue giant stars. This attribution has been strongly indicated by isotopic abundances measured by the lab's Cosmic Ray Isotope Spectrometer (CRIS), currently in space aboard the NASA Advanced Composition Explorer (ACE) satellite, and by elemental abundances measured by TIGER.

The experiment will be performed by a collaboration of scientists, engineers, technicians, and graduate students from NASA Goddard Space Flight Center (GSFC), Caltech, the Jet Propulsion Laboratory (JPL), and Washington University. Washington University is the PI institution, with faculty investigators Bob Binns, Jim Buckley, Marty Israel, and Henric Krawczynski. Technical staff members are Richard Bose, Dana Braun, Paul Dowkontt, Marty Olevitch, and Garry Simburger. Graduate students and shop personnel will also play key roles. The grant is for a five-year program to develop and fly the instrument, followed by data analysis. The first flight is planned for December 2012 over Antarctica. Washington University alumni are also involved at collaborating institutions: Richard Mewaldt (1971, Caltech), Georgia DeNolfo (1997, GSFC), and Jason Link (2003, GSFC). Antarctica, though remote, is the preferred flight location because very long-duration flights are possible with better payload recovery.

FROM THE CHAIRPERSON

Last year, I gave my letter the title, *The Times They Are a-Changin'*, taken from an old Bob Dylan song. My choice reflected changes that I saw coming—changes in departmental leadership as I tried to follow in the footsteps of John Clark as the new chair of Physics, changes in the departmental staff, changes in the layout and look of the departmental office, and other far-reaching changes to the University. Over the past year, there indeed have been many changes, and we have witnessed many accomplishments.

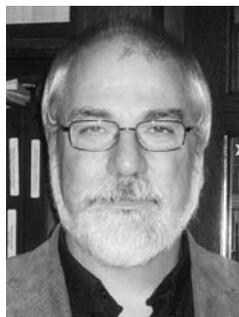
New faces have appeared. Alex Seidel joined the faculty in early 2008. His research centers on quantum many-body physics, in particular strongly correlated electron systems. Francesc Ferrer, who joined the faculty in August 2008, has research interests that are focused at the interface of astrophysics, particle physics, and cosmology, overlapping with the strong astrophysics experimental and high-energy theory groups. David Hall joined the department as the new administrative officer, following Cary McConnell's retirement in March 2008.

New things are happening in our undergraduate programs. Becky Trousil, Ph.D., senior lecturer and the new chair of the Undergraduate Studies Committee, is helping to revitalize the Society of Physics Students (SPS) by working to recruit new members (60 in spring 2008) and improving the sense of community among the undergraduates. Renovation of an undergraduate space has started; it will provide a place for students to study and socialize. An SPS Zone meeting was hosted in April 2008, in conjunction with the APS April meeting held in St. Louis last year. Four undergraduate female physics majors attended the 2nd Annual Midwest Conference for Undergraduate Women, held at the University of Illinois in mid-January 2009. Jason Woods, Ph.D., senior research scientist and assistant dean of Arts & Sciences, has worked with others to provide more opportunities for summer undergraduate research. In addition to external research grants, there are several internal fellowships that provide support: the Delos Fellowship, which has received continuous support from the parents of Greg Delos, and four to seven Undergraduate Research Fellowships, which Jason was instrumental in obtaining in collaboration with the Undergraduate Research Office. This explosion of activity in

our undergraduate program has led to the selection of the Washington University SPS chapter as an Outstanding SPS Chapter for the 2007–2008 school year. We are now working to establish a Sigma Pi Sigma

(the national physics honor society) chapter this spring (2009). Our undergraduate classes are also changing to meet student needs and are introducing new teaching paradigms. This is most evident in our introductory calculus-based course. Started only five years ago as an experiment in new ways to teach physics, Physics 197/198 has become so popular that it is the dominant introductory course. We have opened up a third section this year to try to meet the student demand. We are working with colleagues in the other science departments and in the School of Engineering & Applied Science to explore options for carrying these changes further, creating new courses and possibly new majors.

The graduate program in Physics also has seen its share of change. Washington University has a new dean of the Graduate School of Arts & Sciences, Dean Richard Smith, professor of anthropology and formerly dean of the School of Dental Medicine, and the Department of Physics has a new chair of Graduate Studies, Professor Mark Alford. We are working closely with the new dean to find ways to expand and improve our graduate program. A critical aspect of this is graduate student recruitment. As one example, Professor Henric Krawczynski has conducted a review of the on-site visits that the department offers to prospective graduate students in late March of each year; he is making several improvements to the agenda. Professor Alford, Dr. Trousil, and several senior graduate students are working on ways to improve the visibility of our graduate program. They plan to send senior students and professors to meet with SPS chapters in selected undergraduate institutions, and to describe the research and quality of student life at Washington University. In summer 2008, we instituted new Summer



↑ Ken Kelton

Teaching Fellowships to give graduate students who were interested in teaching careers the opportunity to teach their own introductory physics courses during the summer. These are competitive fellowships that are awarded by a committee chaired by Dr. Trousil, who worked closely with the recipients to learn all the ins and outs of being in charge of a class. Vicky Lee and Kasey Wagoner were the first recipients of this fellowship and did an outstanding job. We are now beginning the selection process of the two recipients for summer 2009.

Some things old received new attention. On December 4, 2007, a plaque was unveiled at a ceremony commemorating the 1859 gift from James Yeatman of the telescope that is housed in the Crow Observatory. Members of the family, including James Carr, a great-great-great grandson of Yeatman, were present at the ceremony.

It has been a year of accomplishments, with new grants and high-profile publications from faculty and students. The second edition of Professor Willem Dickhoff's book, *Many-Body Theory Exposed!*, has appeared in print. This is a comprehensive text on the quantum mechanics of identical particles and also includes a wealth of experimental data. One of our former graduate students, Rob Phillips (GR 89), also had a book published, *Physical Biology of the Cell*. Presenting a quantitative treatment that has been lacking in cell biology books, this publication has received praise for defining a new paradigm in quantitative biology.

The high quality of the faculty, students, and staff in the Department of Physics continues to be recognized. This past year Carl Bender, internationally renowned for his work in mathematical physics, was installed as the first Wilfred R. and Ann Lee Konneker Distinguished Professor in Arts & Sciences. Last April, Marty Israel was given the Fellows Award from the Academy of Science of St. Louis and John Rigden was given the Science Educator Award. Only a little over a year ago, in spring 2007, Cliff Will was inducted into the National Academy of Sciences, joining Ram Cowsik as the second member of our current faculty to join that distinguished body. One of our graduate students, Allyson Gibson, received the prestigious P.E.O.

(continued on page 10)

NEW FACULTY

Professor

Francesc Ferrer

is one of two recent additions to the Department of Physics faculty.

Professor Ferrer is an expert in the new field of astroparticle physics, an interdisciplinary field that sits at the

intersection of particle physics, astrophysics, and cosmology. His research interests are very broad and include dark matter and dark energy, superconducting cosmic strings, and the origin of ultra-high-energy cosmic rays. Dark matter is the “missing mass” of the universe that we cannot detect directly but whose existence we infer from its gravitational effects on visible matter. Dark energy is the most popular way to explain recent observations indicating that the expansion of the universe is accelerating. Dark matter and dark energy are now thought to account for the vast majority of the mass in the observable universe, but their properties constitute a very active area of research. Cosmic strings are hypothetical relics of phase transitions in the very early universe, very shortly after the Big Bang. Professor Ferrer has also done research on ultra-high-energy cosmic rays as a collaborator of the Pierre Auger Observatory (auger.org), a new international facility built on the Argentinean prairie. Professor Ferrer received his bachelor's degree and Ph.D. from the Universitat Autònoma de Barcelona. After completing his Ph.D., he was a postdoctoral fellow at Oxford University. Most recently, he was



↑ Francesc Ferrer

a postdoctoral fellow at Case Western University, working with Professor Lawrence Krauss, a well-known theoretical physicist and the author of several best-selling books. Washington University has a long-standing history of excellence in astrophysics and space sciences. The Department of Physics is very happy to welcome Professor Ferrer as a part of that ongoing tradition.

Professor Alexander Seidel is the other new member of our department faculty. He is working on the theory of quantum many-body systems in condensed matter physics. His main interests lie in strongly correlated systems, where new phenomena emerge that cannot be understood even at a crude level without properly taking into account the interactions between particles. Examples include quantum Hall states, quantum magnets, and nearby phases of matter such as high-temperature superconductors.



↑ Alexander Seidel

One of the primary goals of research into strongly correlated matter is to understand and predict new paradigms according to which matter can behave. This is well exemplified by fractional quantum Hall states which are host to a set of remarkable phenomena such as “fractional charge” and exotic braiding statistics. These properties are interesting both from a fundamental physics viewpoint, as well as for their potential use in building a fault-tolerant topological quantum computer.

Recently, Professor Seidel has developed a new language to discuss the fundamental properties of fractional quantum Hall states. In this language, different types of states and their elementary excitations are represented via simple strings of integers. These strings can be shown to encode the fundamental properties of these states with remarkable efficiency. While they have deep connections to certain conformal field theories, which traditionally play a pivotal role in the description of quantum Hall states, the integer strings can be directly extracted from variational wave function. In some cases of interest, this further bridges the gap between wave functions and effective field theories, as the method developed by Seidel allows the derivation of non-abelian braiding statistics independent of field theoretic assumptions.

Other current interests of Professor Seidel include the theory of frustrated and disordered quantum magnets. In particular, he is aiming to identify conditions under which a magnet will refuse to order even at the lowest temperatures, owing to quantum fluctuations and frustrated geometry. This question has been of primary interest since the advent of high-temperature superconductivity, which is found in certain cuprate-based compounds that feature magnetism in close proximity to superconductivity.

Professor Seidel obtained his Vordiplom from the University of Bayreuth in 1997 and his Ph.D. at the Massachusetts Institute of Technology in 2003. Before joining our faculty, he was a postdoctoral fellow, Lawrence Berkeley National Laboratory (2003–06), and postdoctoral associate, National High Magnetic Field Laboratory at Florida State University (2006–07).

LEXAS GROUP STUDIES HIGH-ENERGY NEUTRINOS IN ANTARCTICA — *continued from page 1*

ANITA was flown for the first time from McMurdo, Antarctica, in December 2006. It flew for 35 days but recorded only about 15 days of good data, owing in large part to an unusually poor balloon trajectory which bypassed much of the deepest ice on the high East Antarctic plateau. No neutrinos have been identified from data taken in this first flight. The ANITA instrument had a second, very successful flight over Antarctica, which was launched in December 2008 and lasted for 30 days. Analysis of data from that flight is under way.

A large effort to support ANITA has been put forth by the LEXAS technical staff members in our department: Paul Dowkontt (electrical engineer), Marty Olevitch (computer programmer), Garry Simburger (electrical tech-

nician), Dana Braun (mechanical technician), and Richard Bose (electrical engineer). Garry and Dana each spent several weeks in Antarctica this past November and December, participating in integration and testing of the ANITA instrument in preparation for its second flight. Garry was responsible for integration of the photovoltaic power system that powers the instrument in flight, and Dana was responsible for gondola assembly and mechanical integration of the instrument into the gondola. The remainder of the Washington University ANITA group provided support remotely from St. Louis.

To read more about the ANITA experiment, go to cosray.wustl.edu and click on ANITA.

AMERICAN PHYSICAL SOCIETY SPRING MEETING: ST. LOUIS, APRIL 2008

The American Physical Society meeting in April was one of the major APS meetings and had not been held in St. Louis for many years. The Department was well represented through contributions by faculty, students, and alumni, most in fundamental research and a few in adjacent topics.

Invited papers were presented by faculty members James Buckley, Charles Hohenberg, Ramanath Cowsik, Carl Bender, and Claude Bernard.

In addition, Ramanath Cowsik chaired two sessions.

Contributed papers came from:

- faculty Martin Israel, Bob Binns, and Henric Krawczynski
- research faculty Alex Meshik and Olga Pravdivtseva
- postdoctoral research associates Viatcheslav Bugayov, Emanuele Berti, and Trey Garson
- graduate students (some of whom have since graduated) Brian Rauch, Lauren Scott, Jason Link, Adamantios Stavridis, Qiang Li, James Shifflett, Kasey Wagoner, and Amit Sircar

Alumni presenters were Dick Mewaldt (GR 71), Scott Barthelmy (GR 78), and Georgia de Nolfo (GR 97).

The Department has considerable interest in physics education. Pat Gibbons co-organized a session for the forum on physics education, with Jack Wiegiers as chairman.

Rebecca Trousil gave an invited talk: “Active Learning in a Large General Physics Classroom.” This paper described a new calculus-based, introductory physics sequence that was started in 2004 with the primary objectives of actively engaging students in the learning process, significantly strengthening students’ conceptual reasoning skills, helping students develop higher-level quantitative problem-solving skills necessary for analyzing “real world” problems,

and integrating modern physics into the curriculum. This two-semester course has been a resounding success. (See separate news story on Physics 197/198 on page 3.)

Somewhat different was the paper presented by Michael Friedlander in the History of Physics session: “From Alamogordo to the Nuclear Test-Ban Treaty.” This spring marked the 50th anniversary of the formation of the Committee for Nuclear Information (CNI) in which several physics faculty were involved. The objective of CNI was to publicize to the general public information about the effects of radioactive fallout from nuclear weapons tests.

LATE-BREAKING NEWS

As we approach press time, the latest APS NEWS has arrived, with good news about three of our alumni. We send them our hearty congratulations.

W.E. Moerner (LA 75, EN 75, MS 75) has been awarded the Irving Langmuir Prize “for making major contributions to the chemical physics of biological systems and non-biological materials through the application of single-molecule spectroscopy.”

Two of our alumni have been elected Fellows of the APS:

Rob Caldwell (LA 87) was cited “for his numerous contributions to theoretical cosmology, particularly those on pioneering ideas for dark energy.” Rob is on the faculty at Dartmouth College.

For **Marc Kamionkowski (LA 87)**, the citation reads, “For pioneering contributions to theoretical cosmology, including investigations of supersymmetry-inspired candidates for dark matter and of the use of precise measurements of the cosmic microwave background and gravitational waves to test cosmological models.” Marc is a member of the faculty at Caltech.

SATURDAY SCIENCE

Our Saturday Science lectures for the general public continue to be so well received that we now have lectures in both the fall and spring semesters. The Hughes Lecture Room in Crow Hall (capacity 195) is almost full each week.

In April 2008, the theme was *Concepts in Physics*. The lectures were given by John Rigden, “What Do the Laws of Thermodynamics Tell Us?”; Mark Alford, “What Does Quantum Mechanics Tell Us About the Universe?”; Michael Ogilvie, “Are There More Than Four Dimensions?”; and Carl Bender, “Turbulence.”

For the 2008 fall semester, the theme was suggested by Cliff Will—that we take note of the election season and cover some topics in science and technology that are important for the United States and that should be (but aren’t being) discussed.

Accordingly, we presented a *Science and the Next U.S. President* theme. Lecturers were John Rigden, “Sputnik, Global Warming, and Science Education”; Michael Ogilvie, “Energy—The Challenge of the 21st Century?”; Michael Friedlander, “Advising the President: What Scientific Advice Does the President Get?”; and Carl Bender, “Global Warming.”

In honor of the 400th anniversary of Galileo’s first astronomical discoveries, the International Astronomical Union designated 2009 as the International Year of Astronomy.

Our theme for spring 2009 was *Galileo Galilei—A 17th-Century Scientific Giant*. Speakers and their topics were Michael Friedlander, “The Scientific Background in 1609”; Patrick Gibbons, “Galileo’s Astronomical Discoveries”; John Rigden, “Galileo: A Founder of Modern Physics”; and Michael Friedlander, “Galileo’s Trial.”

FACULTY NEWS

Each year, the Academy of Science of St. Louis recognizes outstanding local scientists for their achievements in a variety of areas. For 2008, two members of the Department's faculty have been honored:

Martin H. Israel received the **Fellows Award** which recognizes a distinguished professional in the fields of science, engineering, or technology, with a record of excellence in communicating to and mentoring colleagues.



↑ Martin Israel

John Rigden shared the **Science Educator Award**, being selected as a distinguished individual for his outstanding contributions to science education and to the public understanding of science, engineering, and technology.



↑ John Rigden

He has also spoken in the Saint Louis Science Center's public lecture series. His subject was "The Simplest Atom Offers Evidence for the Big Bang." This is based on his award-winning book, *Hydrogen: The Essential Element*.

As 2007 was the 50th anniversary of the discovery of the theory of superconductivity, there were two major anniversary conferences at which **Mark Alford** was invited to present: the Gordon Conference at Les Diablerets, Switzerland, and the BCS@50 conference at the University of Illinois at Urbana-Champaign. At both venues, he described to an audience consisting mostly of condensed-matter physicists how the methods and ideas of superconductivity theory have been successfully applied to quark matter at very high densities.

Professor Alford was also invited to several other international meetings during the year. The most exotic was in Armenia, where he spent a week in September 2008. The conference was in the capital, Yerevan, but Professor Alford's hosts provided him with guided

travel around the surrounding countryside, including the Armenian Orthodox cathedral at Etchmiadzin, the Khor Virap monastery with its extraordinary views of Mt. Ararat, the ruins of Zvartnots Cathedral, the Greco-Roman temple at Garni, and the monastery of Geghard. Professor Alford was very impressed by the hospitality of the Armenian people, who truly live up to their motto, "The guest is king."

Professor Alford gave two lectures in St. Louis for the general public. One was in the *Science on Tap* series at the Schlafly Bottleworks (scienceontap.wustl.edu). It drew an audience of over 100 people, who listened while Professor Alford described his research and then peppered him with insightful questions. The other lecture was in the Department of Physics *Saturday Science* series where Professor Alford described the mysteries of quantum mechanics to an audience of over 200 people.

In July 2008, Professor Alford's work on superfluid superconductors, performed with part-time student (and full-time Boeing employee) Gerald Good, was published in *Physical Review B*, and was chosen by the American Physical Society to be featured in *Physical Review Focus* (focus.aps.org/story/v22/st3).

Professor Alford's first graduate student at Washington University, Matt Braby, graduated in May 2008 with a Ph.D. The title of his thesis was "Phenomenology of High-Density Quark Matter." Professor Alford has recruited a new student, Simin Mahmoodifar, who is from Iran. She started working with Matt before he graduated and is working on the project that they began together.



↑ Carl Bender with Professor Gregory Salamo and members of his nonlinear optics group at the University of Arkansas

Carl Bender considers the most exciting thing for him is that the nonlinear optics group at the University of Arkansas has just verified some theoretical predictions of his work on PT quantum mechanics by using optical wave guides. The photo shows Professor Salamo (head of the group), two of the people in his group, and Bender, with some of their experimental equipment.

During the past year, Professor Bender has visited a number of universities around the world to present mini-courses and a series of lectures:

1. University of Heidelberg, Germany (where he has been appointed a professor): a series of four lectures (April) and another series of three (November).
2. A five-lecture M.Sc. course at Imperial College, London (June); two students then wrote M.Sc. theses which were then submitted for their degrees.
3. A series of five lectures at the University of Valladolid, Spain (July).

Professor Bender has also given invited talks:

1. Three-day workshop in Paris (May).
2. Two-week workshop on his work on PT quantum mechanics at the Benasque Centre for Science, Spain (July).

Invited seminars and colloquia include:

University of California-Irvine (May); University of Ulm, Germany (June); Emory University (September); Indiana University/Purdue University, Indianapolis (October); McGill University, Montreal (October); William and Mary (October); University of Arkansas (November); a conference in Mumbai, India, which is devoted to his work on PT quantum mechanics (January); the annual High-Energy Conference in Florida (December); and the University of Oklahoma and University of Washington, Seattle (The Boeing Lecture).

This has been a very busy year for **Ramanath Cowsik**. In addition to his contributions to the April APS meeting (see separate news story on that meeting), he has given several lectures at Kansas State University; the Tata Institute of Fundamental Research (TIFR), Mumbai; the Raman Research Institute, Bangalore; the Third World Academy of Sciences (TWAS) Silver Jubilee meeting in Mexico City; and the

University of Missouri–Columbia. In addition, he delivered the JRD Tata Memorial Lecture at TIFR, where his topic was “Journey from Quarks to the Cosmos and Back.”

His research program is primarily directed towards building an extremely sensitive torsion balance to probe possible violations of the inverse square law at sub-millimeter scales that are predicted by ‘string-motivated’ theories. This work follows a long-standing interest in constructing sensitive torsion balances and using them to study Einstein’s equivalence principle and to search for new fundamental forces. A new design for direct detection of dark matter, based on triggered cavitation in acoustic fields, is being developed and experimentally investigated. His other interests include several problems in high-energy astrophysics, dark matter, and cosmology.

In his capacity as director of the McDonnell Center for the Space Sciences, Cowsik is seeking to improve the visibility of the Center. As part of this program, he arranged for a poster display in January 2009. A total of 55 posters on different topics was set up by the various groups affiliated with the Center. With each poster being about 4 ft x 3 ft, the display covered most of the wall space on the first floor in the Earth & Planetary Sciences building. It was an impressive demonstration of the extent and quality of research activities within the Center.

Cowsik continues as a member of the American Board of Advisors to the John Templeton Foundation.

Willem Dickhoff and Professor Dimitri Van Neck from the University of Ghent have published the second edition of their textbook, *Many-Body Theory Exposed!*, with World Scientific, Singapore, in 2008. Unlike the first edition, there also is a softcover version available. Since the last Newsletter, Professor Dickhoff has given seminars at Michigan State University (MSU), Kent State, and Texas A&M. Invited talks were presented at the Institute of Nuclear Theory in Seattle during the workshop on “New Approaches in Nuclear Many-Body Theory”; at the ECT, Trento, Italy, during the 1st International Workshop on “Quasifree Scattering with Radioactive Ion Beams”; at Colby-Sawyer College, New Hampshire, during the Gordon Research Conference on Nuclear Chemistry; at the 5th FRIB Workshop on “Bulk Nuclear Properties”; and the NSCL at MSU. In addition, he gave the keynote address at

the mini-workshop at the Free University in Amsterdam on the occasion of the retirement of Dr. Klaas Allaart.

In 1958, several members of the Department’s faculty, including **Michael Friedlander**, were among the founding members of the Committee for Nuclear Information. This was the time of increasing public awareness and concern over the widespread distribution of radioactive debris (‘fallout’) from nuclear weapons tests. CNI’s purpose was to disseminate information about fallout in terms that were understandable to the general public.

To take note of the 50th anniversary of CNI’s creation, Friedlander gave two lectures with the title, “From Alamogordo to the Nuclear Test-Ban Treaty.” The first was at the April meeting of the American Physical Society in St. Louis. The lecture was presented in a special session, “The Manhattan Project and Beyond.” The second lecture was the opening colloquium of the Department’s 2008–2009 series.

Friedlander continues to be the organizer of the very successful *Saturday Science* lecture series (see separate news story). The audience is both loyal and enthusiastic, and, as a result, members of our faculty continue to be most willing to participate. Friedlander continues to chair the committee that selects the Arthur H. Compton and William C. Ferguson lecturers. These lectures, supported by the endowed Ferguson Fund, bring distinguished scientists to the campus each year to speak in the Wednesday Assembly Series lectures and also meet informally with students in the appropriate departments.

Martin Israel is chair of the NASA Scientific Ballooning Assessment Group. This is a panel of scientists who use high-altitude balloons in their research, charged with assessing the status of the NASA Balloon Program and setting out a roadmap for ballooning in the coming years. A report of the work of this group over the past two years is scheduled to be published in early 2009.

He is also a member of a newly formed Committee on the Role and Scope of Mission-Enabling Activities in NASA’s Space and Earth Science Mission. This is a National Research Council committee formed under the auspices of the National Academy of Science’s (NAS) Space Science Board. The committee has been created in response to a congressional request to NAS to evaluate how NASA balances its

resources between major space missions and smaller programs, for example, the Balloon Program.

Zohar Nussinov

was chosen by the Graduate Student Senate as one of the Special Recognition Recipients for 2008–2009. This award is especially notable—the selection of faculty recipients is made by graduate



↑ Zohar Nussinov

students, and it indicates recognition of his excellence in mentoring. The awards were presented at a special reception in the Danforth University Center in April 2009.

Jim Schilling has given invited talks on the topic, “Recent Studies in Superconductivity at Extreme Pressures,” at two large meetings: the 2008 Annual Meeting & Exhibition of the Minerals, Metals, and Materials Society (MTS) in March in New Orleans, Louisiana; and the 16th International Conference on Ternary and Multinary Compounds (ICTMC-16), Technical University Berlin, Germany, in September.

One paper, “Comparison of the Pressure Dependences of T_c in the Trivalent d-Electron Superconductors Sc, Y, La, and Lu up to Megabar Pressures,” by M. Debessai, J.J. Hamlin and J.S. Schilling, was published in *Physical Review B*. It was selected by the editors as an “Editors’ Suggestion” paper which is listed prominently on prb.aps.org and marked with a special icon in various search engines. The editors do this as a service to both readers and authors by listing a small number of PRB papers that the editors and referees find to be “of particular interest, importance, or clarity.”

James Hamlin finished his Ph.D. thesis work in Professor Schilling’s group on the topic “Superconductivity Studies Under Extreme Pressure” in December 2007. Hamlin joined the world-renowned research group of Professor Brian Maple at UC San Diego in January 2008 as a postdoctoral research associate.

Brian Maple’s group is interested in exotic forms of superconductivity and magnetism at both ambient and high pressures. Brian is the successor to the famous Bernd Matthias who passed away in 1980.

Wai-Mo Suen studies the coalescence of neutron star binaries using Einstein's general theory of relativity. The orbit of a binary system shrinks due to gravitational radiation; the eventual coalescence of a binary consisting of two neutron stars is one of the most violent events in the universe. It gives a huge burst of gravitational waves detectable at distances of tens of millions of light years away by a gravitational wave observatory like LIGO, the Laser Interferometer Gravitational Wave Observatory, presently in operation in Livingston, Louisiana, and Hanford, Washington. The coalescence of neutron stars is also the leading candidate of the soft gamma ray bursts. Gamma ray bursts, the flashes of high-energy radiation that last a few seconds to a few hundred seconds with a luminosity that out-shines all stars and galaxies in the universe combined, are among the biggest mysteries of modern astronomy.

Two students graduated from Professor Suen's group last year working on the neutron star coalescence research. Randy Wolfmeyer's thesis is on the construction of initial data for the numerical simulations of neutron star binary systems. He developed mathematical formulations as well as numerical tools to determine the accuracy of initial data sets and gave necessary conditions that a data set has to satisfy in order for it to describe a realistic neutron star system in the astrophysics environment. One set of tools he developed based on null geode-

sics enables the determination of the properties of the strongly gravitating system directly in terms of observations at a large distance will be of great use in the numerical studies of black holes and neutron stars. Randy is continuing his research now as a postdoctoral fellow at the University of Wisconsin at Milwaukee.

Jian Tao also graduated last year from Suen's group. His thesis research is on the dynamics of inspiral of neutron star binaries. In particular, he disproved a conjecture in the literature that the neutron stars in a binary system would collapse before they merge due to the tidal force they exert on one another. The conjecture was based on a set of seemingly reasonable approximations to the Einstein equations. Mark Miller, a former postdoc in Suen's group, now a research scientist at the Jet Propulsion Lab of Caltech, showed that such collapse could not occur before merge if the neutron stars were co-rotational. However, one may argue that realistic neutron star binaries in the astrophysical environment are not co-rotational. Jian picked up on this research and showed that the "premature collapse" will not happen in a realistic rotational state. Jian is now a research scientist at the Center for Computation & Technology of Louisiana State University.

Two other graduate students in Suen's group, Ke-Jian Jin and Mew Bing Wan, are studying the critical collapse phenomenon in neutron

star systems, an interesting phenomenon that the group discovered in 2007. Critical phenomena in gravitational systems, with scaling, universality, and critical exponents analogous to critical phenomena in phase transitions of ordinary material systems, were discovered in the 1990s and generated a lot of excitement, although the critical collapse phenomenon was found only with exotic matter sources and with fine tuning. Suen's group found that the gravitational collapse of an object formed in a neutron star merger could exhibit such critical behavior, opening the possibility that such phenomena may be observable. Professor Suen gave a plenary talk at the International Conference on Astrophysics of Compact Objects in Huangshan, China, last summer on the subject.

Jason Woods, senior research scientist and assistant dean of Arts & Sciences, has been awarded a \$1.6 million NIH grant for new imaging research involving a collaboration between the departments of physics, radiology, and surgery. The aim of the grant is to use new ³He MRI and CT techniques (developed largely in the Department of Physics) to identify and better understand gas trapping and collateral connectivity in human lungs. There is hope that these new techniques will help predict the effectiveness of new surgical remedies for end-stage lung disease.

FROM THE CHAIRPERSON — *continued from page 5*

Scholar Award for the 2008–09 academic year. She was one of 85 recipients selected from 640 applicants from the United States and Canada (record.wustl.edu/news/page/normal/12159.html). In the past two years, two members of our staff have been selected for the Outstanding Staff Award given by Washington University: Sarah Hedley in 2007 and Christine Monteith in 2008.

There are many challenges that go outside the University boundaries, beyond our undergraduate and graduate programs. Why are fewer students interested in physics as a career? Why are the percentages of women and particularly minorities in our discipline so low? How can we educate the public on the importance of physics and science in general to maintain a healthy and productive society? For years, Professor Michael Friedlander has organized a very successful set of public lectures on topics spanning the entire spectrum of physics activities. The *Saturday Science* lecture series is immensely popular, always drawing a packed house. This year, supported by enthusiastic interest among the faculty, graduate students, and administration, we formed a new committee, the Outreach Committee, chaired by Professor Pat Gibbons. This committee is working with local schools, sending volunteers into classrooms, help-

ing students with science fair projects, and assisting with workshops and camps that are organized on the campus of Washington University.

Of course, we all know that the past year has brought new challenges. The rapid deterioration of the economy has had an impact on us all. Private universities have been hit by a loss in the value of their endowment and an uncertain tuition income. How this will impact our plans for the immediate future is as yet unclear. However, with new challenges come new opportunities, and we are confident that the department will not only weather the storm but emerge stronger.

I know that the accomplishments listed in this newsletter will strengthen your pride in your association with the Department of Physics at Washington University. The past year has certainly made me aware of the honor of chairing this department.

— **Ken Kelton**

Arthur Holly Compton Professor in Arts & Sciences
Chair, Department of Physics
kfk@wustl.edu

STUDENT NEWS

GRADUATE STUDENTS

Since the last Newsletter, 19 of our students have received their Ph.D. degrees. They are listed below, along with their thesis titles, faculty advisors, and current positions. There are now 79 graduate students in the Department of Physics, of whom one third are women.

Matthew L. Braby, “Phenomenological Properties of High-Density Quark Matter,” April 24, 2008 (Professor Alford), North Carolina State University (postdoc)

Sebastian Brandt, “On the Dynamics of Delayed Neural Feedback Loops,” December 11, 2007 (Professor Wessel), Washington University, Department of Physics (postdoc, Wessel’s group) and Goldman Sachs and Company, London, England (financial analyst)

Frank Brooks, “Dynamics of Nonequilibrium Actin Polymerization,” July 31, 2008 (Professor Carlsson), Washington University, Department of Physics (postdoc)

Christopher P. Favazza, “Self-Organized Nanopattern Formation through Laser Induced Hydrodynamic Flow in Ultrathin Metal Films,” July 29, 2008 (Professor Kalyanaraman), Washington University, Department of Biomedical Engineering (postdoc)

James Hamlin, “Superconductivity Studies Under Extreme Pressure,” December 6, 2007 (Professor Schilling), University of California, San Diego, Department of Physics (postdoc)

Kuen Lee, “Gamma-Ray and Optical Variability of the TeV Blazars,” April 24, 2008 (Professor Buckley), Washington University (teaching Physics 117/118 in summer 2008)

Yu Li, “Measurements of Molecular Clustering in 2D Systems by Fluorescence Fluctuation Spectroscopy: Application to EGF Receptors on Living Cells,” October 24, 2008 (Professors Elson and Wessel), (current position unknown)

Joyce Carol Meyer, “The Effect of Massive Fermions in Different Representations of the Phase Diagram of $SU(N)$ Gauge Theories,” August 19, 2008 (Professor Ogilvie), Swansea University (postdoc/research fellow)

Olga L. Pechenaya, “Far From Stability: Investigations in Mass ~ 90 Nuclei,” June 27, 2008 (Professor Sarantites), Washington University School of Medicine (postdoc in radiation oncology)

Brian F. Rauch, “Measurement of the Relative Abundances of the Ultra-Heavy Galactic Cosmic Rays ($30 < Z < 40$) with the Trans-Iron Galactic Element Recorder (TIGER) Instrument,” April

28, 2008 (Professor Israel), HyperTech Systems, Irvine, California (physicist)

Lasitha Senadheera, “Proton NMR Studies of Hydrogen Clathrate Hydrates,” June 20, 2008 (Professor Conradi), Stanford University School of Medicine (postdoc)

James A. Shifflett, “Extensions of the Einstein-Schrodinger Non-Symmetric Theory of Gravity,” April 22, 2008 (Professor Will), Boeing Aircraft (lead engineer/scientist)

Jian Tao, “General Relativistic Numerical Simulations with Adaptive Mesh Refinement: Construction of Tools and Applications to Neutron Star Processes,” December 7, 2007 (Professor Suen), Louisiana State University, Center for Computation & Technology (postdoc)

Justin R. Trice, “Theory and Dynamical Simulations of Fast Laser-Induced Self-Organization and Design of Plasmonic Nanocomposites for Applications in Energy Harvesting,” July 25, 2008 (Professor Kalyanaraman), Raytheon, El Segundo, California (senior systems engineer)

Yun Wang, “Extraordinary Electroconductance in III-V Metal Semiconductor Hybrid Structures,” August 18, 2008 (Professor Solin), University of Connecticut, Department of Math (graduate school)

Randy W. Wolfmeyer, “Validity of Initial Data for Binary Neutron Star Inspiral,” November 30, 2007 (Professor Suen), University of Wisconsin–Milwaukee (postdoc/research associate)

Yue Wu, “Frequency-Based Analysis of Diastolic Function,” December 5, 2007 (Professor Kovacs), Argonne and the University of Chicago (BIASE), (postdoc)

Jing Zeng, “Application of Energy and Angular Momentum Balance to Gravitational Radiation Reaction for Binary Systems with Spinning Bodies,” March 31, 2008 (Professor Will), (current position unknown)

Jie Zhu, “Force Generation by Actin Polymerization: Nanoscale to Microscale,” April 29, 2008 (Professor Carlsson), University of California–Davis, Math Department (postdoc)

2008 Seniors

Nineteen seniors graduated in May 2008. Many have entered physics graduate programs, while some have switched to other disciplines:

Rashied Amini—Caltech: Mechanical Engineering

Erin Beck—Santa Clara University: M.S. Mechanical Engineering

Andrew Beresky—Schlumberger: Field Engineer

John Cheairs—The Ohio State University

Robin Chisnell—MIT

Alex Drlinca-Wagner—Stanford: Astrophysics

Pongsakorn Kanjanaboos—University of Chicago

David Katz—Mercer Human Resources Consulting: Actuarial Work

Kenneth Kline—Bank of America: Quantitative Analyst

Jacob Leemaster—Georgia Tech: Electrical and Computer Engineering

Thomas Loh—Saint Louis University: Medicine

Kevin Mercurio—Harvard

Nozomi Nemoto—University of Tennessee: Material Science & Engineering

Christopher Weaver—University of Wisconsin

At press time, we had no information on the plans of the following students:

Justin Bajah

David Eby

Gregory Gilbert

David Li

Aubrey Scott

New Graduate Students

For the 2008–09 academic year, the department admitted 14 new graduate students:

James Bender (Kettering University, Michigan)

Lauren Edge (University of Saint Thomas, Minnesota)

Daniel Flanagan (University of Tulsa, Oklahoma)

Lingzhi Hu (University of Science & Technology of China)

Daniel Hunter (University of Maryland, Baltimore County)

Tsen Hsuan Lin (Tamkang University, Taiwan)

Saeed Mirshekari (University of Tehran, Iran)

Sina Mossahebi (University of Wisconsin–Milwaukee)

Niraj Pant (Whittier College, California)

Charlie Pye (University of Kansas)

Laleh Sadeghian (University of Tehran, Iran)

Xiaoqi Wang (Nanjing University, China)

Julia Wildeboer (Technische Universität-Dresden)

Xiaoxian Yin (University of Science & Technology of China)

UNDERGRADUATE STUDENTS

One of the strong features of our physics major program is that opportunities are available for physics majors to work with a research group.

Erin Beck (EN) and **Rashied Amini (EN)**, two members of the Class of 2008, participated in this way and were featured in the summer 2008 issue of *Washington University in St. Louis Magazine*.

Erin worked with Professor Michael Swarthout (mechanical engineering) in the nanosatellites program—designing satellites of less than 50 kg—where she served as project manager of the team. Rashied, majoring in both physics and mechanical engineering, also worked with Swarthout and with Professors James Buckley and Henric Krawczynski (in physics).

Erin had a summer internship with the Monterey Bay Aquarium Research Institute (MBARI), where she was involved in the development and use of submersible robotic vehicles for marine science. She is presently a graduate student at Santa Clara University in their Robotic Systems Laboratory (M.S. in Mechanical Engineering), where she has a research appointment through NASA Ames Research Center. Her research work is related to spacecraft autonomy, and she is involved with the imminent launch of NASA's PharmaSat-1 mission.

In addition, Erin was the project manager for our student-built spacecraft mission, Bandit, leaving an enormous hole upon her departure. It has taken three students to patch the hole as she did everything, from project management to public relations to electronics assembly.

Rashied is currently working at NASA/JPL as a system engineer and is part of the team that has developed and implemented Interplanetary Internet. He plans to continue his studies in a graduate program in astronomy.

Jonathan Mueller (EN 09) has been part of a scientific collaboration with colleagues from our Department of Chemistry (Professors Lee Sobotka and Robert Charity) and Professor Wim Dickhoff. This work clarifies the relationship between nucleon elastic scattering data off nuclei and the nucleon self-energy as a function of nucleon asymmetry and has been published in *Physical Review C*. Jonathan is currently

involved in analyzing elastic neutron scattering data off ^{48}Ca that were taken last summer at the Triangle Universities Nuclear Laboratory (TUNL) in Durham, North Carolina.

During the summers of 2007 and 2008, Professor Mark Alford supervised **David Eby**, calculating the thickness of the strangelet-crystal crust of a strange star. This work has been described in a paper in *Physical Review C*.

Professor Jim Schilling's student, **Hunter Banks**, is now in his junior year and has been working in this group since the beginning of summer 2008. His excellent experimental talents have enabled him to take over the responsibility for experimentation on our He-gas high-pressure system to 10,000 atm pressure involving studies of superconductivity and magnetism.

James Ahn has worked with Professor Robert Binns on the photovoltaic array testing for the ANITA collaborative experiment (see front page story).

The ANITA experiment, which is designed to detect ultra-high-energy neutrinos using impulsive radio detection techniques, was flown successfully for the second time over Antarctica in December 2008 using these PV arrays as the power source. Since that time, James also has performed tests on scintillating optical fibers coupled to ultra-high quantum efficiency multi-anode PMTs measuring the numbers of photoelectrons produced as a function of distance. These are being studied for possible use in a large-area gamma-ray telescope. The results that he has obtained are very encouraging.

Michael Wang worked for Professor Mark Conradi and Dr. Jason Woods the summer just before his freshman year investigating an NMR method to measure the magnetic susceptibilities of red and blue (de-oxy) blood. He worked during the summer of 2008 on computer simulations of diffusion in a lung. Those simulations will be his focus this spring and summer. The simulations will be used to compare to their theoretical model; they hope to finally convince the field of helium-3 lung MR imaging that our model contains all the essential features necessary to explain the data.

Charlie McIntosh returns this summer from the University of Colorado-Boulder, where he is an engineering student. He worked with Professor Conradi's group between his high school junior and senior years and did a great job of building radio-frequency coils for MR imaging of mouse brains at 200 MHz. Conradi tells us that he was most impressed with the talk Charlie delivered to Professor Joe Ackerman's imaging group in Chemistry.

Laura Rayhel is a sophomore working with Professor Conradi's group this summer. She is building an elegant rf coil to allow us to MR image human brains removed at autopsy. Some of the brains come from head-trauma suffered in Iraq. The coil is a periodic structure, so it is an extended lesson in coupled resonators. She will be supported as a Hoopes Fellow during the summer.

Two undergraduates are working with Dr. Jason Woods at the interface between imaging physics and molecular biology: **Lucy Liu** and **Ruth Lewit**. They are working with Woods and with Dr. Rich Pierce (Pulmonary Division, Internal Medicine). Last year, Lucy was highlighted in *Washington University in St. Louis Magazine* and is going to do an honors project on her research (in Biology). Ruth is a freshman and is taking to immunohistochemistry rather well.

STUDENT AWARDS

Allyson Gibson has received a prestigious P.E.O. Scholar Award for the 2008–09 academic year. She was one of 85 recipients selected from more than 640 applicants from the United States and Canada. The mission of P.E.O. (Philanthropic Educational Organization) is to promote educational opportunities for women.



↑ Allyson Gibson

Allyson has been working in the department's Laboratory for Ultrasonics under Jim Miller and Mark Holland. The laboratory studies the physics of ultrasound in materials such as heart and bone, and Allyson's research has

focused on quantitative cardiovascular tissue characterization on fetal hearts and the hearts of type 2 diabetics. She has collaborated with several School of Medicine physicians and spent four months at the U.S. Food and Drug Administration.

A 2003 summa cum laude graduate of Wofford College in Spartanburg, South Carolina, Allyson is the recipient of numerous other awards and scholarships, including the Department of Physics' 2008 Shull Prize for Outstanding Teaching Assistant. Her numerous volunteer activities include working with Habitat for Humanity, Meals on Wheels, and abused women and children.

Leo Shmuylovich (a Ph.D./M.D. student in our department) was a member of a winning team in the 2008 Olin Cup competition for entrepreneurs presented by the Olin Business School and the Skandalaris Center for Entrepreneurial Studies. The prize carries a \$70,000 investment award.

Leo's idea derived from his experience in tutoring students: he wanted to create an interactive, multimedia tutorial Web site to help students in math and science. He also wanted to make the tutoring affordable and responsive to the students' questions and answers.

The Olin Cup was inaugurated in the Olin School in October 1988, and, since 2001, has been supported by the Skandalaris family through the Skandalaris Entrepreneurship Program.

Putnam Competition

Each year, there is the national Putnam Mathematics Competition for undergraduate students, and Washington University has a remarkable record. This is a team contest, and **Carl Bender** has been the enthusiastic coach for over 20 years. In 2007, the University's team placed 12th. The team included **Huajia Wang** (physics and math, LA 09).

In the Missouri Collegiate Mathematics Competition, the University's team placed first and also included Huajia Wang.

Departmental Awards to Students: May 2008

Each year, the Department awards prizes for outstanding performance.

Undergraduate Students

Varney Prize: Named to honor Robert Varney, a member of our faculty for many years. Varney and Dick Norberg taught an introductory course, then named *Engineering Physics*, Physics 211/212.

Awarded to one or more outstanding students in introductory physics courses:

Caitlin L. Chicoine and **Robert J. Perkins**.

Senior Prize:

Awarded to the outstanding senior physics majors: **Alex Drlica-Wagner**, **Pongsakorn Kanjanaboos**, and **Kevin Mercurio**.

Greg Delos Summer Research Fellowship:

Endowed by his family in memory



↑ Alex Drlica-Wagner (right) with Chair Ken Kelton



↑ Pongsakorn Kanjanaboos



↑ Kevin Mercurio

of Greg Delos, an undergraduate who passed away during his junior year. Awarded to an outstanding undergraduate for summer research in physics: **Jonathan Mueller**.

Hoopes Undergraduate Research

Awards in Physics: Awarded to undergraduate students with proposed outstanding summer research projects: **Puneet Kollipara**, **Laura Soderberg**, **Huajia Wang**, and **Michael Wang**.

Graduate Students

During the 2007–08 academic year, two physics graduate students were recognized for their exemplary teaching skills. **Nick Mauro** was the recipient of a University-wide **Dean's Award for Teaching Excellence** based on his outstanding performance as an introductory physics teaching assistant. As a first-year graduate student, Nick volunteered to teach in the introductory physics labs and in his second year, he served as the head lab teaching assistant for introductory physics. **Allyson Gibson** was the 2007–08 recipient of the **Franklin B. Shull Prize**. This departmental award, in memory of Franklin Shull, longtime member of our faculty, recognizes outstanding teaching by graduate students in the physics department. Allyson has served as a teaching assistant in the introductory physics labs, *Physics of the Heart*, and *From Stars to Galaxies to the Universe*.

STAFF NEWS

In our Staff News last year, we took note of the retirements of **Pranoat Suntharotok-Preiesmeyer** and **Dave Tanner**. We have received an approving comment from an alumnus:

"I enjoyed reading the retirement announcements about Pranoat and Dave Tanner. Re Pranoat: I really appreciated the carefully worded description of how she was never reluctant to point out a problem with the department when she saw one :-). Dave Tanner was great helping with the freshmen labs. He did an excellent job with both the equipment and the people."

Physics Department Machine Shop

This shop is central to much of the experimental work in the department. Head of the shop is now **Todd Hardt**. Older alumni will remember **Otto Retzloff**, who was in charge of the shop from 1945 until he retired in 1969. His long service overlapped with that of **Len Sylvester** (glassblower, 1945–1975) and **Larry Vossel** (1958–1977; cryogenics). Otto was followed by **Bill Beswick** (until 1983) and then by **Tony Biondo** (1983–1988). Tony is still with us, together with **Denny Huelsman** who joined the department in 1990. For many years, individual research groups also have had their own engineers, and we will mention them in the next Newsletter.

Todd tells us that in 2001, the department purchased a Bridgeport EZ TRAK mill which has CNC capabilities, and it has been an important piece of equipment for some of our research groups. The shop still does sheet metal work;



↑ Otto Retzloff

welding of aluminum, steel, and stainless steel; and soldering (soft & hard) with copper, brass, and stainless steel. They also still do woodwork (although the need has diminished greatly) along with

normal machine shop work. And the shop still maintains and teaches a Faculty/Student Shop course in Crow 103 which was totally refurbished during the process. The shop is responsible for liquid helium requests, liquid helium recovery, liquid nitrogen maintenance and upkeep, truck usage and maintenance, and moving and storage at Tyson and North Campus.

Demonstration Equipment

A strength of our lower-level courses is the number, variety, and quality of the lecture demonstrations, many of which have been designed and constructed in the department.

John Brooks

(1958–1973) was in charge when the current introductory sequence (Physics 117/118) was introduced some 50 years ago.

For the past 22 years, the demonstrations have been the responsibility of **Stan Crone** who continues John's fine tradition.



↑ John Brooks

Introductory Lab

Bob Poli joined the Department of Physics in July 2008 as the introductory physics lab coordinator. He succeeds Dan LaBrier, who left Washington University to pursue a Ph.D. in nuclear engineering at Idaho State University. Continuing a family business, Bob worked as a watchmaker from 1975–1986 and then received an A.A.S. degree in Robotics Technology from Forest Park Community College in 1986. He began his career at Washington University in 1990 as a petrographic thin section specialist in the Department of Earth & Planetary Sciences (EPSc). While working at Washington University, he earned his B.S. degree in Engineering Physics at the University of Missouri–St. Louis in 1999. During 2002–08, Bob managed the Planetary Atmosphere Laboratory in the EPSc department. Since joining the physics department, Bob has been overseeing the day-to-day operations of the introductory physics labs, modernizing existing experiments, developing new labs, and maintaining the introductory physics lab manual. Bob is an avid reader and trout fisherman, and

he spends much of his free time cooking gourmet meals for his wife, Laura, and enjoying the company of their two cats, Mac and Gordita.

Departmental Office

Several new faces have appeared in the departmental office. In February 2008, **David Hall** joined the business office as administrative officer. David has attended school on both coasts, earning his B.A. in Chemistry and Mathematics at Linfield College in Oregon and his Ph.D. in Physical Chemistry at Brown University. Since graduation, David has worked in the pharmaceutical/chemical industry, including 10 years as director of R&D at Mallinckrodt, Inc. David lives in Ballwin with his wife, Denise, a Rockwood School District Parent Educator. His son, Brian, is a 2nd Lieutenant in the Marine Corps Flight Program now stationed in Pensacola, Florida. His daughter, Renee, is a junior at Baylor University studying business and marketing.

Debra Barco joined the Department of Physics this March as our newest grants and contracts coordinator. Debbie transferred from the Center for Inquiry in Science Teaching and Learning (CISTL), which is a part of the Department of Education at Washington University. Debbie was the project coordinator for the National Science Foundation grant, which funded research into science education and supported the center. For over five years, she managed the administrative and fiscal components of the grant, including both formal and informal partner institutions (University of Missouri–St. Louis, St. Louis Community College, Tyson Research Center, Saint Louis Science Center, Saint Louis Zoo, and Missouri Botanical Garden). Prior to coming to Washington University, Debbie was the director of public programs at the Saint Louis Science Center. Debbie received her B.A. with Honors in Russian Language and Literatures from the University of Missouri–Columbia. She has completed graduate work toward an M.A. in Slavic Languages and Literatures at The Ohio State University and an MBA at Saint Louis University. Debbie's interests include spending time with family and friends, movies, and coffee. She is looking forward to expanding her knowledge of physics!

Linda Coffin joined the Physics staff in July 2007. She was born in Indiana and in her youth studied opera at Indiana University in

Bloomington. Linda and her husband have four children. They settled in St. Charles after many years living the gypsy life of the military family. She has worked in a variety of jobs over the years, including legal and executive secretary, newspaper reporter, and photographer. She received her bachelor's degree from Washington University in 2003. Linda began her career in the Department of Electrical and Systems Engineering, where she performed secretarial duties for the professors in the Electronic Systems and Signals Research Laboratory. Her position in Physics is a dual one: in the mornings, she assists the research scientists and professors on the fourth floor in the Laboratory for Space Sciences, and, in the afternoons, she works in the departmental office, where her duties include processing procard transactions, developing TEM films, proofreading, and assisting with the Newsletter. Linda writes in her spare time. She is currently working on her master's degree through University College.

Arts & Sciences: Outstanding Staff Awards for 2007–2008

Christine Monteith is the grants and accounting supervisor in the Department of Physics and is the central contact point for any accounting issue in the department.

The faculty has been impressed with Christine's ability in grant submission, budget preparation, and her efficiency in meeting short deadlines. She



↑ Christine Monteith

knows the rules—both federal and university—or, on the rare occasions when she doesn't, she knows whom to contact to find out. Christine is always calm and smiling, always can-do, never complaining. She is a model employee who sets a high standard for all around her.

IN MEMORIAM

Roberta ‘Pudge’ Landau died at her home in Clayton on July 22, 2008. Pudge, as she was known to all of her many friends, traced her interest in space and astronomical subjects to reading about meteorites in the *National Geographic*. Her bachelor’s degree in physics came from the University of Chicago and her M.S. from Washington University in 1948. Her graduate dissertation described behavior of positive ions and was carried out under the direction of Rob Varney.

For many years, Pudge was associated with the Saint Louis Science Center and the McDonnell Planetarium, which opened in 1963. It was her suggestion that the new Science Center be placed across Highway 40 from the Planetarium, connected by an enclosed pedestrian overpass. She was one of the first operators of the planetarium and was the first education director of the Science Center. From 1975 to 1998, Pudge was on the faculty of the St. Louis Community College at Forest Park—teaching astronomy, of course.

These days, women students in physics are no rarity—among our current graduate students, about one in three is a woman. But in Pudge’s days, it was very different. Our alumni records show that our oldest living alumnus graduated in 1937. Pudge was the first woman in our list; then there were two in 1951 and one in 1955. Beyond academic ability, what was needed was great determination, which Pudge exemplified. Pudge was married to Dr. William Landau, professor of neurology at Washington University, who was head of the department for many years. She is also survived by three sons and a daughter, and was especially fond of each of nine grandchildren. The eldest granddaughter is a CPA, undergraduate and graduate Washington University alumna. Her sister, an undergraduate math major, is now a graduate architecture student at Washington University. Two of their male cousins are ardent undergraduate physics majors elsewhere.

We are saddened to report that the incomparable **William Yen (GR 62)** passed away in January 2008. Bill was a student of Dick Norberg, and the title of his dissertation was “Nuclear Magnetic Resonance of Xe 129 in Liquid and Solid Natural Xenon.” In those days, dissertation committees had only three members; the others were E.U. Condon and Jack Townsend.

Bill was born in 1935 in Nanjing, China, but grew up in Mexico City where his father was the Chinese Ambassador. In 1948, the family left China, as Bill’s father became a diplomat for the government of Taiwan. Bill went to school in Indonesia and then, with his older brother, moved to Redlands, California. Bill received his B.S. degree from the University of Redlands in 1956.

From Washington University, Bill went directly to Stanford for a three-year postdoc with Nobelist Arthur Schawlow. In 1965, he joined the faculty of the University of Wisconsin and remained there until 1986, when he moved to the University of Georgia as the first incumbent of the Graham Perdue Chair of Physics. Bill had many doctoral students: 20 in Wisconsin and nine in Georgia.

Bill’s distinguished career included numerous fellowships and visiting professorships: University of Tokyo, University of Taipei in summer 1972, Lawrence Livermore Laboratory, Université Paris-Sud, Harvard, Australian National University, Universidade Federal de Pernambuco, University of California–Santa Barbara, Chinese Academy of Sciences in Changchun, Johan Goethe University in Frankfurt/Main, and the Chinese University of Science and Technology. Of special note, Bill was the first Edwin T. Jaynes Visiting Professor in our department during the fall semester of 2004. He was a Fellow of the American Physical Society, of the Electrochemical Society, of the AAAS, and of the Optical Society of America. He was a Fulbright Senior Scholar (Australia) 1965–66 and a Guggenheim Fellow (1979–80). He was an editor of the *Journal of Luminescence*, of *Chinese Physics*, and of the *Journal of Material Sciences*. In December 2005, he was awarded the Lamar Dodd Award in recognition of research at the University of Georgia.

Bill had 275 refereed publications, covering his wide range of research interests: phonon effects in the optical spectra of solids; magnon effects in the optical spectra of solids; utilization of synchrotron radiation for the study of optical properties of solids; laser and time-resolved laser spectroscopy of crystals and glasses; and photo acoustic spectroscopy of solids. He co-edited *The Phosphors Handbook*, a technical manual of phosphor properties and uses. It is the standard reference book for the field.



↑ Bill Yen with fellow graduate students (clockwise from right): Jim Gaines, Manny Paxhia, Tom Hughes, Jim Opfer; (behind): Len Sylvester, glassblower.

Bill loved to reminisce. His style can be gauged from a note that we included in the 2005–06 Newsletter:

Reading the obituary for Melba Phillips, I could not but remember a number of incidents which involved this fine lady and which I thought are worthy of retelling for the Newsletter, concerning the classic text she co-authored with Wolfgang Panofsky (Classical Electricity and Magnetism, Addison-Wesley, 1955); this was the book of choice until Jackson displaced it.

In the mid-fifties also there was a sizable trade in pirated technical books from Taiwan and it was customary for a number of graduate students who had contacts to engage in this trade to some extent...many years later, Melba won the Oersted Medal of the American Association of Physics Teachers in 1974 and the Prize was bestowed on her during the Chicago meeting of that year. Following her acceptance speech, I went up to congratulate her on her very well deserved honor... she looked at me in her inimitable way, thanked me for my good wishes, and said: “Yes, I remember you from Washington University; in fact, the reason I remember you is because you are the only person that had the cheek to ask me to autograph one of those pirated copies of my book from Taiwan!”

Darn! I didn’t have the heart to set her straight on this. She likely would not have believed me anyway. Well, it wasn’t me, it [was] probably ----.

Bill was a “devoted Cardinals fan, Dixieland and modern jazz enthusiast, and a terrible golfer” (as he described his ability). He enjoyed his correspondence with Norberg, all letters starting with the salutation ‘Dear Boss...’.

Bill was one-of-a-kind. He is survived by his wife, Laurel Yen, and daughter, Jane.

ALUMNI NEWS

It is always good to read your letters and e-mails. Please continue to send us your news. We continue to find that there are some errors and gaps in our master list of alumni addresses. This is where you can help us: obviously, if you read this, then you have received the Newsletter. But ask your alumni friends, and let us know of any whom we appear to have missed. Send us their e-mail and mailing addresses, and we'll be happy to add them to our list. Contact: Michael Friedlander (mwf@wuphys.wustl.edu) or Patrick Gibbons (pcg@wuphys.wustl.edu).

Late last year, we had a long and most interesting letter from **Jim de Pagter (GR 58)**. Jim was a student of Bob Sard, studying cosmic ray muon interactions in a cloud chamber in a trailer parked behind Crow Hall (long before Compton Lab went up). Jim writes that, after leaving Washington University, he was a Research Fellow at Harvard at the Cambridge Electron Accelerator, working on beam monitoring and shielding. He then joined Jerome Friedman and Henry Kendall of MIT, in electron-deuteron scattering measurements.

In 1965, a new institution was started and Jim was one of the founding faculty in the Southeastern Massachusetts Technological Institute, setting up a high-energy research group. (After some transformations, SMTI is now University of Massachusetts–Dartmouth, one of the five U. Mass campuses.) For more than 20 years, Jim served as department chairman, holding that position until he retired in 1995. Jim's wife passed away in 2002, and he is now settled in New Orleans. Jim is not idle: he writes that he “spends a large amount of time messing with two antique automobiles.”

Safia Wasi (GR 60) sent us the announcement for the *International Conference on Physics and the World of Today & Careers through Physics*, held at the University of Karachi in Pakistan, during December 2008. Safia was on the conference Advisory Board.

This year, **Jonathan Reichert (GR 62)** and Barbara Wolff-Reichert were awarded a Distinguished Service Citation by the American Association of Physics Teachers. The AAPT has a long-standing interest in many aspects of physics teaching, and this award recognizes the major contributions made by the Reicherts and their company TeachSpin that Jonathan started in 1992 when he decided to retire from SUNY-Buffalo where he had been for more than 30 years (see teachspin.com).

TeachSpin is dedicated to creating rugged, reliable, and affordable hands-on instruments that any physicist, no matter what his or her area of expertise, can incorporate into an advanced laboratory program.

Torrence Johnson (EN 66) is co-editor of the 1,000-page *Encyclopedia of the Solar System* and also contributed a chapter on two of Jupiter's moons, Ganymede and Callisto. In this Encyclopedia, Washington University is also represented by **Bill McKinnon** (Department of Earth & Planetary Sciences) who has written on another moon, Triton, and by **Jack Brandt (LA 56)** writing on the physics and chemistry of comets.

Peter Gary (GR 67), who is at the Los Alamos National Laboratory, has been elected a Fellow of the American Physical Society.

Professor Marty Israel told us that, at the NAS-NRC committee meeting, he met **Conilee Kirkpatrick (EN 69)**, vice president of HRL Laboratories, Malibu, California. (HRL was formerly Hughes Research Lab). Conilee obtained her M.A. from our department in 1970, and her Ph.D. in Electrical Engineering from the University of Illinois at Urbana-Champaign. Since then, her career has been in industrial laboratories.

HRL—owned by General Motors, Boeing, and Raytheon—is researching solid state hydrogen storage to power hydrogen fuel cell cars that are expected to be developed by 2010. Conilee notes that the exciting part about working on fuel cell research is that there is a constant pull by those who want the technology.

It was good to resume contact with **George Hagnar (EN 71)** through one of his students who visited Washington University and is applying for admission for the fall. George received his Ph.D. from the University of Missouri at Rolla, which is where he met his wife Carol. He taught physics, math, and electronics at a junior college in Illinois before taking a position in the semiconductor industry, developing and manufacturing IC components. While working in the industry, he published articles on processes, developed several patents, and even had an IC process that he had developed named after him. But, as George notes, “although I found it a challenging and rewarding field of research, I had always intended to return to teaching and finally made the decision to do so in 2003 when I began teaching several different math courses online for the University of Phoenix to get my foot back in the door...I have been teaching physics at the Oklahoma

School of Science and Mathematics–Muskogee Regional Center for the last four years and really enjoy it.”

The Oklahoma School of Science and Mathematics (OSSM) is a prestigious two-year residential public high school located in Oklahoma City. OSSM has an extremely rigorous program. Established by the Oklahoma legislature in 1983, the school was designed to educate academically gifted high school students in advanced mathematics and science. It is a member of the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology.

George has wide interests: “One of my most memorable adventures, and one I'm asked about often because of the Crater of Diamonds hat I wear, was a visit to Crater of Diamonds State Park where I was lucky enough to find (and keep) a 0.82-carat diamond.”

Larry Altman (EN 73) has described his interesting career path. He graduated from the Saint Louis University School of Law in 1976 and then ran a general law practice for almost 25 years. At that stage, he made a major change, shifting to representing disabled children who are attempting to obtain special educational services in the public schools. His work has been widely recognized, and, in 2007, he received a special award from the Annie Malone Society.

In his letter, Larry has commented in a way that we have heard from many other alumni: “My years of study in physics taught me discipline and study habits...I am required to sift through scientific data presented by school personnel and health care experts...I am not overwhelmed by the data...my science training has taught me to ask the correct questions when challenging data presented by schools...none of this would have been possible without my four years of training in the Department of Physics.”

It is several years since we last heard from **Spiro Apostolou (GR 76)** and then we got a lengthy e-mail. He had visited Washington University some months ago, but we missed connections. Spiro tells us that he “did see Julia...and I was nostalgic and reminiscent of the past. The past that we always see with the special lenses of a bygone era.”

Spiro has many interests and activities. He spends a few months every year visiting the United States. He is the scientific advisor for Radius Ventures LLC, “one of the most successful companies for embryonic research in medical technologies, on Madison Ave. in the heart

of Manhattan.” He also consults with PMDI (Princeton Management Development Institute). He is on the Board of the MDDI (Medical Device Diagnostic Industry) Magazine and also on the Engineering Council Board of Bradley University in Peoria.

Steve Dierker (AS 77, EN 77) went on to get his Ph.D. at the University of Illinois at Urbana-Champaign in 1983. From there, he went to the Research Department at AT&T Bell Laboratories (now Lucent Technologies). In 1990, he took up a faculty position in Physics and Applied Physics at the University of Michigan. Steve moved to Brookhaven in May 2001 to become chair of the National Synchrotron Light Source (NSLS).

Since 1996, Steve has been a member of the Advanced Photon Source (APS) Users Organization at Argonne National Laboratory, and he chaired that organization from 1998–2000. In December of 2005, Steve was also named Project Director of NSLS-II. There is a major report in the March 2009 issue of *Physics Today* (pp. 24–26). There are ambitious objectives for NSLS: improvements in technology and applications in many areas, such as the life sciences, materials and chemical sciences, nanoscience, geoscience, and environmental science.

The careers of our alumni often go in directions apparently far from their dissertation topics.

For **Suzanne Gronemeyer (GR 79)**, graduate research was in low-energy nuclear physics, with experimental work carried out at the Argonne National Laboratory. Then, after three years at Fermilab as a radiation physicist and six years with Siemens Medical Systems as their first MR applications scientist, Suzanne joined Diagnostic Imaging at St. Jude in 1988, becoming the first MRI physicist in Memphis. Since 1997, Suzanne has been the director of the Pediatric Oncology Education (POE) Program at the St. Jude Children’s Research Hospital. A primary goal of the program is to encourage students to pursue a career in cancer research, either as a laboratory-based scientist or a physician scientist. The program is funded by the NIH/NCI and AHA. (See, also, stjude.org/Gronemeyer.)

Eric Mjolsness (LA 80) visited our department this fall, gave a colloquium, and worked with Carl Bender. Eric was one of our many physics/math majors and he has put this foundation to great and varied uses. He now holds joint appointments at the University of California–Irvine in the departments of Information and Computer Science, and of Mathematics. Since 2002, he has had a visiting appointment at Caltech in Biology.

Eric tells us that he “studied physics, neural networks, computer science, and a little biology at Caltech, obtaining a Ph.D. from the physics department in 1985 under John Hopfield.” He points to a number of Washington University influences on his career: his interest in neural networks was piqued by John Clark’s work, and his interest in pattern recognition was catalyzed by Ed Jaynes’ work in maximum entropy and Bayesian methods. At Caltech, he continued his work in computer algebra, begun in St. Louis under Carl Bender, resulting in early contributions to the power series package of the immediate forerunner of the *Mathematica* commercial computer algebra system. Eric also notes “the mathematical skills learned under Robert McDowell and the Washington University mathematics department.”

Eric mentioned something special: being a teaching assistant for Richard Feynman and contributing in a minor way to the Feynman Lectures on Computation. (Editor’s Note: Our colleague, Marty Israel, when he was a grad student, tape recorded the lectures for the famous introductory course. He also took photographs of the blackboards. This material went into volumes 2 and 3.)

From Caltech, Eric went on to spend nine years at Yale (neural networks, optimization, computer vision, and developmental biology); then to UC San Diego (more of the same); then to the Jet Propulsion Laboratory (machine learning for science onboard spacecraft, in part with Ray Arvidson and computational biology); and since 2002 in computer science at UC Irvine (modeling biological cells and development using physics, and creating mathematical and computational methods to do that better).

Eric’s comments: “Along the way I learned a lot of biology, and found it to be a very rich area for applying the kinds of quantitative thinking and mathematical tools that physicists learn.” (Editor’s Note: We have had many of our alumni making this sort of comment.) Other activities: spending time with his family and “sometimes tinkering with amateur telescopes.”

Yves Idzerda (LA 81, EN 81) received his M.S. at the University of Washington in 1983 and then moved to the University of Maryland in College Park, where he graduated with his Ph.D. in 1986. He was at the Naval Research Laboratory in Washington D.C. until 2000, then moved to Montana State University (MSU) in Bozeman where he is now a professor. His work has been well recognized through awards at Montana State: the Charles and Nora L. Wiley Award for Meritorious Research (2003); the Deans’ Award for Meritorious Research, Letters and Science (2004); and the Cox Family Fund for Excellence Award (2007). Yves was

elected a Fellow of the American Physical Society in 2008.

Yves’ current research interests are in the physics of reduced dimensionality systems, especially in their interfacial and nanostructured behavior. This includes oxide materials and ultra-thin film and interface magnetism of itinerant electron magnetic systems. Part of his research includes magnetic nanoclusters developed in protein cages and exploiting polarized X-rays to obtain unique knowledge of the behavior of magnetic thin films and surfaces. Some of this research is performed at the MSU Nano-Materials X-Ray Characterization Facility located at beamline U4B of the National Synchrotron Light Source, where he has been the spokesperson for this effort since its beginning.

When we last heard from **Clayton Handleman (LA 84)**, he was with Heliotronics, Inc. (heliotronics.com) which he started and where he is now president. This is a company dedicated to teaching about renewable energy with hands-on tools. He writes that his experience has shown him that “there is a whole class of highly capable people out there that are underserved by traditional education. They have the ability to go beyond auto mechanics, but the path is not there for them. They need to be in the realm of the hands-on.” Clayton tells us that he found our optics lab course “such a wonderful confidence builder for me.”

His company has systems at major universities such as Harvard, MIT, RPI, Texas A&M, and North Carolina State University. (See, for example, sunviewer.net/portals/Harvard.) They also have systems in more than one hundred K–12 schools. More than that, they recently had one of their systems installed for a display at the first LEED platinum museum (sunviewer.net/portals/dvlake).

This year, they will be “working with RPI and SUNY ESF to put in side-by-side PV fixed and tracking arrays. The data will be available on the Internet and will provide a real source of data for people around the world to learn about fixed and tracking arrays.”

Jack Mottley (GR 85) has been on the faculty of the Department of Electrical and Computer Engineering at the University of Rochester since 1986, and has won several awards and been recognized for teaching, most recently with the Edward Peck Curtis Award for Excellence in Undergraduate Teaching in 2005. He has served in many department and university positions, including a nine-year stint as associate dean for undergraduate programs of the School of Engineering and Applied Sciences (1996–2004).

After several years working as a scientific programmer for NASA, **Brad Dalton (EN 87)** returned to graduate school at the University of Colorado in Boulder and completed his Ph.D. in geophysics in 2000. He was awarded a National Research Council Fellowship at NASA's Ames Research Center in Mountain View, California, and, in 2003, became a principal investigator for the SETI Institute (also in Mountain View). He specializes in spacecraft infrared remote sensing of planetary surfaces and laboratory studies of planetary surface materials. His main interest is in imaging spectroscopy.

Brad made special note of the education he received at Washington University (where he majored separately in computer science and physics) that enables him to develop algorithms to process these high-dimensionality data sets and produce false-color images which are maps of surface composition. As he put it, "Everybody told me I was crazy to major in both CS and physics, but every time I would walk down the halls of Compton, I would see a computer in every lab, manned by somebody with no formal computer science background whatsoever."

In 2007, he accepted a position as research scientist at the Jet Propulsion Laboratory in Pasadena, California. He is developing a cryogenic laboratory facility for simulation of surfaces of the icy moons of Jupiter and Saturn. Recently, he was awarded a grant to work with the Cassini mission presently orbiting Saturn. In 2008, he was asked to serve on the Science Definition Team for a proposed mission to Jupiter's moon, Europa. Launch would be in the 2015–2020 timeframe, with arrival in 2024 to 2028. Brad is always looking on the bright side and tells us, "That's okay, since my student loans won't be paid off until 2030!"

Among our alumni who have switched to medicine is **Michael Robb (LA 88)**. He received his medical degree from the University of Santo Tomas in Manila, with subsequent training including residencies and fellowships at the University of Wisconsin, Michigan State University, and the Barrow Neurological Institute. His specialty covers neurology, otoneurology, and medical neuro-otology. For the past few years, he has been at the Barrow Neurological Institute in St. Joseph's Hospital in Phoenix. For the past two years, Michael has been listed among America's Top Physicians, and he is the president of the Phoenix Chapter of the Association of American Physicians and Surgeons.

Natalie Mahowald (LA 88) is currently an associate professor in the Department of Earth and Atmospheric Sciences at Cornell University, where she is working on climate change issues.

Natalie received a master's degree in resource policy management from the University of Michigan and then her Ph.D. from MIT in 1996. Before coming to Cornell, she had a postdoc year in the Department of Meteorology, Stockholm University, and was then at the Bren School of Environmental Science and Management, University of California, Santa Barbara.

Her work uses models and observational data to better understand natural feedbacks on the system, as humans perturb climate and biogeochemistry. Much of her research has focused on characterizing and understanding global and regional variability of desert dust (mineral aerosols) during the last 20,000 years and also human impacts on desert dust.

Natalie tells us that, "I am married to another faculty member and have two little boys (three-and-a-half and five) who keep me busy!"

Mike Meyer (AB 89) also sent us a brief e-mail. "I have recently accepted a chair in Star and Planet Formation in the Institute of Astronomy, Department of Physics, E.T.H., Zurich. This will mean great change for my wife and me (and our dog Luna, who is coming with us on the transatlantic ocean voyage!). We are looking forward to new challenges and new opportunities both personally and professionally." Mike is the vice chair of a Gordon Conference on the Origin of Solar Systems to be held at Mount Holyoke College this summer.



↑ Class of 1989. Please let us know if you would like to get a copy of this photo.

Joe Ganem (GR 89) was a student of Dick Norberg, with his dissertation on deuteron magnetic resonance studies. Since 1994, Joe has been on the faculty at Loyola College in Maryland, where his teaching has included courses in mathematical methods and he has published on magnetic resonance and laser development.

Joe is the author of a book on how a physicist looks at the numbers in everyday financial decisions. The title is: *The Two-Headed Quarter: How to See Through Deceptive Numbers and Save Money on Everything You Buy*. Intended for a popular audience, the book shows how con-

sumers are fooled by the numbers presented to them when they make a wide variety of financial decisions, for example, shopping, investing, borrowing, and risk-taking. It is a practical guide for consumers, although some Wall Street CEOs who appear to have no understanding of numbers might find it useful reading. The book has received positive reviews in the press and garnered a gold medal in the 2008 Independent Publisher Awards and was also a finalist in the 2007 National Best Books Awards. Readers can learn about the book online at TheTwoHeadedQuarter.com and obtain signed copies at a discount. (See, also, magazine.wustl.edu/Fall08/AlumniProfiles.html.)

Among his other interests is chess. Joe is an expert at correspondence chess and since 1991 has been the editor of *The Chess Correspondent*, a magazine that is published by The Correspondence Chess League of America. He writes that in his spare time, he enjoys playing a wide variety of music on the piano. Currently he resides in Baltimore County, Maryland, with his wife and three children.

We have heard from **Alan Wiseman (GR 92)** who is currently an associate professor at the University of Wisconsin–Milwaukee and member of their Center for Gravitation and Cosmology. In a lapse of judgment (as he describes it), his colleagues have elected him as department chair. Before joining the faculty in Milwaukee, he was a postdoc at Northwestern, Caltech, and the University of Chicago. He has been active in the LIGO Scientific Collaboration, an organization dedicated to analyzing the data from the LIGO gravitational wave detectors. In May 2007, he and his wife, Marilyn, adopted a 10-month-old baby girl (Eleanor Goris Wiseman) in China. In addition, Eleanor now has an 11-month-old baby brother (Wesley Goris Wiseman).

Robert Behnken (EN 92) graduated with degrees in both physics and mechanical engineering, an appropriate combination that led to his successful voyage on the NASA shuttle to the International Space Station. During his student years, Bob was in the Air Force ROTC and later attained the rank of major. He received his Ph.D. in mechanical engineering from Caltech. While at Washington University, Bob was a student and advisee of Sal Sutera, professor of mechanical engineering at the time, who remembers him as "a low-maintenance student" with an outstanding record.

Bob started in the NASA astronaut training program in 2000, and his mission in the spacecraft *Endeavor* was launched from Cape Canaveral in March 2008. The task of the mission was to deliver the Japanese Logistics Module and

the Canadian Special Purpose Dexterous Manipulator. You will find a full news report in the summer 2008 issue of the *Washington University in St. Louis Magazine* (magazine.wustl.edu/Summer08/AlumniProfiles.html).

We heard from **Aziz Ulug (GR 93)** last summer. He tells us that after receiving his degree (working in Mark Conradi's group), he went to the Department of Radiology at Johns Hopkins University. He stayed as a postdoc for four years doing *in vivo* MR diffusion tensor imaging. In 1997, he moved to the Weill Medical College of Cornell University as an assistant professor in the Department of Radiology. In 2003, he was promoted to associate professor. Most recently (July 2008), he moved to the Feinstein Institute for Medical Research at Long Island, becoming director of MRI Core and associate investigator. Aziz still keeps an academic appointment in the Cornell University Department of Radiology. His research interest is mainly about MR diffusion tensor imaging applications. In addition to his many reviewed papers, Aziz holds a U.S. patent. He now has three children.

Mike Westphal (GR 95) sent us an e-mail to tell us that "after a nearly 15-year break, he will be getting back into the experimental astrophysics game." In April, he joined the Space Astronomy Laboratory at the University of Wisconsin to take on the Far Ultraviolet SpectroPolarimeter (FUSP) project. This is a sounding rocket payload that will obtain the first high-precision spectropolarimetry from 1050–1500 Angstroms, the first astronomical polarimetry of any kind below 1300 Angstroms. The end goal is to measure magnetic fields, e.g., around stars and galaxies.

Word from **David Lawrence (GR 96)** is that he has moved from Los Alamos to Maryland where he has taken a position in the Space Department at Johns Hopkins Applied Physics Laboratory. David has joined a group of about 20 planetary scientists that help to both design spaceflight instrumentation as well as do science with the data returned from these instruments. Currently, his main work is analyzing data from the Neutron Spectrometer on the MESSENGER spacecraft, which is slated to go into Mercury orbit in 2011. He continues to be involved in lunar science as well as a variety of other instruments (mostly neutron and gamma-ray instruments) and mission development projects.

David tells us that his most important news is the arrival of Abigail Christine, born on December 9, 2008. She joins her two brothers (Noah, age nine, and Benjamin, age four) and two sisters (Molly, age seven, and Lilly, age two). David comments that "this of course

makes for a very busy Lawrence household, which we enjoy very much."

Malcolm Tobias (GR 97) tells us that for the last three years, he has been working at Washington University's Center for Computational Biology (CCB) doing computer support. The CCB provides computational resources for three departments (Biochemistry and Molecular Biophysics, Biomedical Engineering, and Genetics), mainly focused on computational molecular dynamics. Malcolm was initially "apprehensive about being surrounded by biologists but is now happy to report that most have a strong background in physics." Malcolm works with Anders Carlsson, professor of physics, who is also an adjunct faculty member of the CCB. Malcolm also does some work at the Cortex center at the medical school, where he often encounters some of the members of the ultrasound group

After graduating from Washington University, **Erika Eggers (LA 97)** received her Ph.D. in physiology and biophysics from the University of Washington in 2003. She returned to Washington University for a postdoctoral fellowship with Dr. Peter Lukasiewicz in the Department of Ophthalmology and Visual Sciences in the School of Medicine. Erika was a postdoc there for five years and then a senior scientist for one year. She is now an assistant professor in the Department of Physiology at the University of Arizona, with a joint appointment in Bioengineering. Her lab focuses on studying the neurophysiology of the retina using electrical recording techniques.

After completing her master's degree and further graduate work in Jim Miller's group, **Stephanie Posdamer (GR 00)** decided to change course. She tells us that she moved to Virginia last year and has been teaching astronomy at the Northern Virginia Community College, as well as teaching physical science labs at Marymount University in Arlington, Virginia. Her interest in astronomy dates back to her undergraduate days in Washington, D.C. when she worked at the Laboratory for Astrophysics at the National Air and Space Museum. She makes special mention of "so many good local astronomy resources here. My students visit the scale model solar system on the National Mall during the semester and can attend great astronomy lectures at the Carnegie Institution."

Eric Majzoub (GR 00) sent a brief e-mail. "After working at Sandia National Laboratories as a staff scientist for seven years, I decided to try academics and take the opportunity to return to St. Louis. I accepted a faculty position in the physics and astronomy department at UMSL in fall 2008 and now have a group con-

sisting of two postdocs, three graduate students, and a few undergraduates. We are located in the Center for Nanoscience at UMSL, and the group's research focuses on energy storage and conversion materials, with funding through research grants from the U.S. Department of Energy."

Aaron Mertz (LA 06) started his graduate program at Yale and then was awarded a Rhodes Scholarship. As we go to press, he is in his second year at the University of Oxford, where he is completing his M.Phil. in the History of Science, Medicine, and Technology. His thesis will be on the public understanding of science in the United Kingdom after World War II. In the fall of 2009, Aaron will return to Yale on an NSF Graduate Research Fellowship to continue his Ph.D.

During his time away from the United States, Aaron has traveled extensively in Europe, the Middle East, and Southeast Asia including India (but he was nowhere near the terrorist attacks in Mumbai). Aaron's interests are wide. He has not yet decided just what he wants to do when he returns to Yale, but he is considering biophysics or astrophysics.

Aaron is a co-author of a paper that has appeared in *Physical Review C*, (77, 014307 (2008). "First Experimental Test of X(5) Critical-Point Symmetry in the A~130 Mass Region: Low-Spin States and the Collective Structure of ¹³⁰Ce."

Ji Shen (GR 06) spent two years as a postdoc at the Technology Enhanced Learning Science Center at the University of California–Berkeley, and then moved to the University of Georgia–Athens as an assistant professor in the Department of Mathematics and Science Education. Ji writes that, for the past three years, he has been investigating the effect of technology-enhanced science education environments. He is particularly interested in developing modeling-based approaches to help students learn complex and abstract science concepts. In 2007, Ji and Yu Tang were married. She got her Ph.D. in 2008 from the Olin Business School and is now an assistant professor at the University of Miami, Florida.

Brian F. Rauch (GR 08) received his Ph.D. with a thesis on ultra-heavy galactic cosmic rays. He is now a Research Physicist at HyperTech Systems in Irvine, California.

Compiled by:
Michael Friedlander
mwf@wuphys.wustl.edu
Patrick Gibbons
pcg@wuphys.wustl.edu

DEPARTMENT OF PHYSICS NEWSLETTER / SPRING 2009



↑ Members of the Department of Physics, spring 2008

Newsletter Editors

Michael Friedlander
mwf@wuphys.wustl.edu
(314) 935-6279

Debbie Barco
dbarco@physics.wustl.edu
(314) 935-6491

During the year, refer to our Web site
(physics.wustl.edu) for up-to-date news.