ALUMNUS WINS 2014 NOBEL PRIZE IN CHEMISTRY

Washington University in St. Louis alumnus William E. Moerner, PhD, was awarded the Nobel Prize in chemistry in October, 2014. Moerner shares the award with two colleagues, Eric Betzig, of the Howard Hughes Medical Institute, and Stefan W. Hell, of the Max Planck Institute for Biophysical Chemistry, in Germany. The trio received the award for their work on the development of super-resolved fluorescence microscopy.

“...We used ultrasound as a tool to measure the properties of interesting materials, including single crystals and composite materials,” Miller says. This work has brought him into contact with NASA and McDonnell-Douglas (now Boeing), among other major corporations “My work is really the physics of ultrasound, how it interacts with media, and how it can be used to learn about structural integrity or quality. Then growing out of that were applications in medicine, to cardiology and cardiothoracic surgery. All of that was just beginning when Moerner was here. However, his work was more tied to the material side.”

Moerner is the Harry S. Mosher Professor of Chemistry and professor of applied physics at Stanford University. His research focuses on physical chemistry, chemical physics, single-molecule biophysics, super-resolution imaging and nanoparticle trapping.

Moerner earned three bachelor’s degrees, all with honors, from Washington University in 1975. He earned master’s and doctoral degrees in physics from Cornell University.

As an undergraduate at Washington University, Moerner was a physics, mathematics, and electrical engineering major who conducted research primarily with James G. Miller, the Albert Gordon Hill Professor of Physics. He worked in Miller’s laboratory for ultrasonics. At the time of Moerner’s studies in the mid-1970s, Miller said the field was broadly called “physical acoustics.”

James Miller (left) with his wife Judy and W.E. Moerner (right)
Quantum Lines of Desire

There’s a concept in classical physics called the “path of least action.” If you throw a softball to a friend, the ball traces a parabola through space. It doesn’t follow a serpentine path or loop the loop because those paths have higher “actions” than the true path.

For quantum particles, such as atoms or photons, the laws of classical physics cease to apply, and quantum physics and its counterintuitive effects take over.

Quantum particles can exist in a superposition of states, yet as soon as quantum particles are “touched” by the outside world, they lose this quantum strangeness and collapse to a classically permitted state. Because of this evasiveness, it wasn’t possible until recently to observe them in their quantum state.

In the past 20 years, physicists have devised devices that isolate quantum systems from the environment and allow them to be probed so gently that they don’t immediately collapse. With these devices, scientists can at long last follow quantum systems into quantum territory, or state space.

Kater Murch, Assistant Professor of Physics, and collaborators Steven Weber and Irfan Siddiqui of the Quantum Nanoelectronics Laboratory at the University of California, Berkeley, have used a superconducting quantum device to continuously record the tremulous paths a quantum system took between a superposition of states to one of two classically permitted states.

Because even gentle probing makes each quantum trajectory noisy, Murch’s team repeated the experiment a million times and examined which paths were most common. The quantum equivalent of the classical “least action” path — or the quantum device’s path of desire — emerged from the resulting cobweb of many paths.

The experiments, the first continuous measurements of the trajectories of a quantum system between two points, are described in the cover article of the July 31, 2014 issue of Nature.

“We are working with the simplest possible quantum system,” Murch said. “But the understanding of quantum interactions we are gaining might eventually be useful for the quantum control of biological and chemical systems.

The device Murch uses to explore quantum space is a simple superconducting circuit. Because it has quantized energy levels, or states, like an atom, it is sometimes called an artificial atom. Murch’s team uses the bottom two energy levels, the ground state and an excited state, as their model quantum system.

Between these two states, there are an infinite number of quantum states that are superpositions, or combinations, of the ground and excited states. In the
X-Calibur Mission

The astrophysics research group, led by Prof. Henric Krawczynski and Research Assistant Prof. Matthias Beilicke, designed, built, and tested an X-ray polarimeter named X-Calibur. This instrument will be able to study the energetic environments very close to a black hole.

The X-Calibur mission was launched from the Columbia Scientific Balloon Facility in Fort Sumner, New Mexico on September 24. The mission was conducted to flight-test a pointing system and hard X-ray polarimeter for a future long-duration balloon flight. The mission, which lasted seven hours and 40 minutes at 126,000 feet, was a success as the detector functioned properly and the group earned valuable experience with the operating pointing system.

The balloon-borne telescope, which is sensitive to the polarization of high-energy “hard” X rays, ascended to the edge of the atmosphere above Fort Sumner to stare fixedly at black holes and other astronomical objects. It was carried aloft by a 747-jetliner-sized balloon.

When X-Calibur looks to the skies, it will see things that have never been seen before because it is looking at characteristics of high-energy light that astronomers are just beginning to explore.

Only certain objects in the universe are capable of producing high-energy particles and emitting radiation with energy in the X-ray band and above. The regions of interest (black hole vicinities, formation zones of relativistic plasma jets, etc.) are too small to be spatially resolved with purely imaging instruments.

The solution is to perform indirect measurements of those regions using the polarization properties of the emitted radiation - such as the orientation of the electric field vector of the X-ray photons. Such observations are regularly performed at radio and optical wave bands, but sensitive polarization techniques were not yet available for observations at X-ray energies which are needed to study the most extreme objects in the universe.

Asked about the upcoming flights of X-Calibur, Prof. Krawczynski says: “We will return to Fort Sumner for a second balloon flight in Fall 2016. The spectropolarimetric X-ray observations of the black holes Cyg X-1 and GRS 1915+105 should allow us to distinguish between different models of how black holes accrete matter. In particular, we hope to be able to constrain the structure of the inner accretion disk. Most scientists think it is geometrically thin, but some contend that thermal instabilities puff it up and give rise to a spherical section close to the center. We are funded for another flight from McMurdo (Ross Island, Antarctica). The flight will be much longer and will allow us to observe not only stellar mass black holes like Cyg X-1 and GRS 1915+105 but also supermassive black holes.”
PolStar: A Satellite-Borne X-ray Polarimeter to Scrutinize Matter, Radiation, and Spacetime

Professor Krawczynski is leading an international collaboration of 25 scientists which proposed the PolSTAR (Polarimetric Spectroscopic Telescope Array) mission to an announcement of opportunity for NASA's 2014 Small Explorer mission.

The space-borne experiment would study the energy and time dependent polarization of the X-ray emissions from the most extreme objects in the Universe: black holes, neutron stars, magnetars, and relativistic jets from supermassive black holes. The experiment would measure the linear polarization fraction and angle, two properties of photon beams characterizing the uniformity and orientation of the electric field carried by the photons, respectively. These two fundamentally new observables depend on the emission mechanism, scattering angles, and the geometry and properties of the electromagnetic fields and spacetime near the emitting regions. Making use of the new capability of polarization, PolSTAR would be able to study matter, radiation, and spacetime itself very close to the event horizon of black holes. Furthermore, PolSTAR would be able to test predictions of the theory of general relativity in the strong gravity regime by observing the Lense-Thirring precession of the inner accretion flow. PolSTAR's neutron star and magnetar observations would enable a search for the observational signatures of the birefringence of the quantum vacuum. Last but not least, PolSTAR could deliver definitive proof that the jets of supermassive black holes are accelerated to velocities close to the speed of light and collimated by helical magnetic fields.

PolSTAR would be a follow-up experiment to the Washington University led balloon-borne X-Calibur polarimeter (see previous article) and the Caltech and JPL led Nuclear Spectroscopic Telescope Array (NUSTAR) hard X-ray imaging mission launched in 2012. PolSTAR would be built by Washington University in Saint Louis, the Jet Propulsion Laboratory (JPL), the California Institute of Technology (Caltech), UC Berkeley, Livermore National Laboratory, the Goddard Space Flight Center, the Technical University in Denmark, the Agenzia Spaziale Italiana, and industrial partners. NASA's selection will be announced in summer 2015.
Recovery of SuperTIGER

Two years ago, during December 2012 – January 2013, the SuperTIGER cosmic-ray instrument had a record-breaking 55-day flight over Antarctica. The flight ended on February 1, too late in the Antarctic summer for recovery of the instrument, so it remained with plans to recover it the following year.

Fortunately almost all the important data measuring the abundances of the rare elements heavier than iron had been radioed back during the flight, so failure to recover the instrument has not interfered with analysis of the results. Our graduate student, Ryan Murphy is now completing his PhD thesis based on those results, demonstrating improved evidence for the emerging understanding of clusters of massive stars as the birthplace of most of the cosmic rays.

The year after the flight, recovery turned out to be impossible, mainly because of the federal government shut-down in October which seriously delayed Antarctic operations. All we had from that summer was a plane flight over the instrument, which showed that it was upside down half buried in the snow.

Earlier this year, in January 2015, we were finally able to send to the instrument (about 1000 miles from the McMurdo US Antarctic base) a recovery crew of people from our Washington University group and our collaborating group at NASA’s Goddard Space Flight Center. After two years in “cold storage” the instrument was almost completely buried in snow. The accompanying photo shows the trench around the buried instrument that was dug, mostly by our GSFC colleague who was able to get there first.

Now, after a few months of sea voyage across the Pacific and long truck rides across the US, we have the instrument in our labs – part at GSFC and part here at WU. There is some damage to some of the components, but overall it is in remarkably good condition. Lab tests are underway to assess in detail all components, as we prepare to refurbish and upgrade the instrument in anticipation of another flight to be launched in December 2017.

The SuperTIGER project is under the overall leadership of Principal Investigator Research Professor W. Robert Binns, along with Professor Martin Israel. Other key SuperTIGER people at WU are graduate student Ryan Murphy, Research Assistant Professor Brian Rauch, and members of our technical staff Richard Bose, Dana Braun, Paul Dowkontt, Martin Olevitch, and Garry Simburger. We work closely with collaborators at GSFC, California Institute of Technology, Jet Propulsion Lab, and University of Minnesota.
Flight of ANITA-3

The third flight of the balloon-borne ANtarctic Impulsive Transient Antenna (ANITA-3) from McMurdo Station, Antarctica took place this last Antarctic summer. From an altitude of roughly 37 kilometers, ANITA scans for impulsive radio signals (200-1200 MHz) from the highest-energy cosmic neutrinos interacting in the ice that produce a characteristic vertical polarization and for similar signals from ultra-high energy cosmic-rays (UHECR) interacting in the atmosphere that have a horizontal polarization. ANITA has set the most stringent limits on the highest energy neutrino flux and made the first radio detection of UHECR.

Launched on December 17, 2014 by the NASA Columbia Scientific Balloon Facility (CSBF), ANITA-3 completed roughly one and a third revolutions around Antarctica before the flight was terminated on January 9, 2015 due to concern that the balloon’s trajectory would go off continent. The ANITA-3 payload came down approximately 100 nautical miles from the Australian Davis Base, and a crew from this base was able to mount a partial recovery effort by helicopter that retrieved the principal electronics, including the critical data drives. Further recovery efforts will have to wait until next season, but work has already begun to prepare for a planned 2016-2017 ANITA-4 flight.

ANITA III (the third incarnation of the Antarctic Impulsive Transient Antenna) suspended from its launch vehicle.

The ANITA Collaboration is led by Professor Peter Gorham at the University of Hawaii in Manoa, and is comprised of eleven institutions. Work at Washington University is managed by Institution Principal Investigator Research Professor W. Robert Binns and Professor Martin Israel. The WU effort has focused on the ANITA power system, data telemetry system and gondola structure, which relied on the expertise of our technical staff: Paul Dowkontt (EE), Marty Olevitch (Computer Programmer), Garry Simburger (Elec. Tech.), Dana Braun (Mech. Tech.) and the Physics Machine Shop. Dana Braun and Paul Dowkontt supported the ANITA-3 flight preparations in McMurdo. Research Assistant Professors Viatcheslav Bugaev and Brian Rauch supported flight operations with Martin Israel, W. Robert Binns, Marty Olevitch and Paul Dowkontt. Brian Rauch, Dana Braun and Gary Simburger supported instrument integration at CSBF in Palestine, TX. Viatcheslav Bugaev took a lead role in the UHECR energy reconstruction effort, and Brian Rauch participated in the SLAC T-510 experiment that demonstrated the geomagnetic emission mechanism of UHECR under laboratory conditions.
Hunting for Meteorites

Every austral summer, a group of volunteers heads off to a remote region of Antarctica to set up a field camp on the ice. For the next month, they search the ice and nearby debris piles left by glaciers for dark rocks that might be extraterrestrial in origin. The program is called the Antarctic Search for Meteorites (ANSMET).

ANSMET has been led for the past 20 years by geologist Ralph Harvey of Case Western Reserve University in Cleveland. The National Science Foundation supports field operations, NASA curates the recovered meteorites, and the Smithsonian Institution provides long-term curation facilities for the collection.

Over the years many WU geologists, physicists and astrophysicists have volunteered to help. This year it was the turn of Christine Floss, PhD, Research Professor of Physics.

Meteorites don’t fall more often in Antarctica than in other parts of the world, but in Antarctica those falling on high-altitude ice fields are carried by flowing ice toward the ocean. Some of the ice streams run up against barriers such as the Transantarctic Mountains and are blocked. Wind erosion then slowly brings stones embedded in the ice — sometimes for hundreds of thousands of years — to the surface. It is this concentration mechanism that makes Antarctica a great place to look for meteorites.

The dark stones show up well against the blue ice, but this year the team found more meteorites in moraines than on the ice, even though they’re much harder to find there.

For more information, go to: https://news.wustl.edu/news/Pages/hunting-meteorites.aspx

Excerpted from the WU Ampersand
http://artsci.wustl.edu/articles/2014/science-qa-frisbees-stardust

Stardust

Groopman studies stardust. This is literally material from supernovae and red giant stars that formed before the solar system. At the end of the lives of these stars they expelled a whole bunch of material, and it condensed to form stardust. Some of these grains of presolar stardust actually survived the formation of the solar system. This dust can be found and studied, and therefore the stars that the dust came from can be studied. It’s like doing astrophysics with a microscope instead of a telescope.

When a presolar grain is identified and viewed, the scientist is usually the first and only person to have ever seen this piece of dust — and it’s more than four and a half billion years old. The field is wide open for discoveries. Groopman says, “Everyone I know in the field has made significant discoveries — either discovered a new type of presolar mineral or some new process. I’ve been able to make some discoveries here as a graduate student.”

(Continued on page 20)
CALET

The CALorimetric Electron Telescope (CALET) experiment is a Japanese-Italian-US astroparticle observatory targeted for launch this summer to the International Space Station (ISS) that will be installed on the Japanese Experiment Module - Exposed Facility (JEM-EF). As its name suggests, the principal science aim of CALET is to measure the cosmic ray electron flux to higher energies than previous experiments (~20 TeV) with its deep calorimeter system (~30 radiation lengths). The main calorimeter instrument (CAL) on CALET will also measure gamma-rays to ~10 TeV and cosmic-ray nuclei to ~1,000 TeV, and a Gamma-ray Burst Monitor (CGBM) subsystem will have an energy range between 7 keV and 20 MeV. The CALET Collaboration is led by Professor Shoji Torii at Waseda University in Japan, with Professor Pier Marrocchesi at the University of Sienna leading the Italian effort and Professor John Wefel (PhD WU 1971) at Louisiana State University leading the US effort. Since 2011, the Washington University effort has been led by the Institution Principal Investigator Research Professor W. Robert Binns and Professor Martin Israel, with participation by Professor Henric Krawczynski, Professor James Buckley and Research Assistant Professor Brian Rauch. The US collaboration also includes researchers at NASA’s Goddard Space Flight Center and the University of Denver.

The Washington University group has provided technical expertise in the fabrication and operation of scintillation detectors and scintillating optical fiber trackers based on its experience from experiments like SuperTIGER and ACE-CRIS. In addition, WU has supported the CALET modeling and simulation validation efforts, studied CALET’s expected ability to measure heavy and ultra-heavy cosmic-ray nuclei and distinct cosmic-ray electron and positron spectra using the Earth’s geomagnetic field. Brian Rauch has also participated in CALET engineering model beam tests at CERN in 2012, 2013 and 2015.

Retirement

Prof. Ernst Zinner retired in January, 2015. On January 30, the department held a retirement party in his honor. He came to Washington University in 1965 as a graduate student, received his PhD in 1972 and started working on the 4th floor in the Laboratory for Space Physics where he can still be found a lot of the time. The picture is with his wife Brigitte Wopenka who retired two years ago from the Earth and Planetary Sciences Department.
Graphene

A low temperature sample stage (*image at right*) used in Assistant Professor Erik Henriksen’s lab to investigate spin-orbit physics in graphene, viewed from below. A small purplish square at center is a silicon wafer with a small graphene device, which faces down toward an integrated thermal evaporator for depositing dilute coatings of atoms on the graphene surface at cryogenic temperatures. The sample stage is bolted on to the ‘mixing chamber’ plate of a dilution refrigerator with a base temperature of < 10 mK, and fits in a 14 T superconducting magnet.

Innovative Physics Course

Large lecture courses notoriously discourage students from going into the sciences, but an innovative physics course helps to prevent this first-year slide.

Many students harbor an inner conviction that they are bad at science. That attitude is one of the toughest obstacles science teachers face. It gathers speed in high school, when students often are defined as smart if they get the right answer quickly — by any means possible. In many cases, an introductory college science class is the last chance educators have to fix the perception that getting the answer is everything. Unfortunately, these are often large lecture classes that, research shows, drive steep attitudinal declines toward learning and problem solving in the sciences.

A three-year evaluation of an innovative Washington University in St. Louis course suggests the attitudinal decline is not inevitable. Offered by the Department of Physics, “Active Physics” incorporates active-learning techniques, but still is taught to large classes.

The results, published in the July 2 issue of *Physical Review Special Topics*, show that the course has the expected benefits in conceptual learning and retains some, although not all, of the attitudinal benefits of small, inquiry-based courses.

Although results were mixed, “Active Physics” consistently outperformed traditional lecture courses in conceptual learning and in attitudes toward learning and problem solving, said Regina F. Frey, PhD, the Florence E. Moog Professor of STEM Education, who co-led the evaluation team.

“What’s more, ‘Active Physics’ eliminates what is typically a big gender gap in attitudinal declines in traditional introductory physics courses,” said Frey, who also is executive director of the university’s Teaching Center and associate professor of chemistry in Arts & Sciences. “Women’s attitudinal scores still decline in ‘Active Physics,’ but much less than they do in traditional lecture courses.”

Read more at: [https://news.wustl.edu/news/Pages/27183.aspx](https://news.wustl.edu/news/Pages/27183.aspx)
wavelength of light, called a diffraction limit, with an optical microscope. This took them down to the level of the mitochondrion, an organelle in the cell that kicks out energy for cellular processes, but still left them unable to see proteins, which carry out most of the cell’s work.

The Nobel Committee said this was like being able to see the buildings of a city without being able to track what any of its citizens were doing.

Moerner and his colleagues discovered that fluorescent molecules allowed them to bypass the diffraction limit. In 1989, Moerner became the first scientist in the world to measure the light absorption of a single molecule with the first published report of single-molecule detection and spectroscopy in condensed phases.

Eight years later, he discovered that the fluorescence of a variant form of a green protein isolated from a fluorescent jellyfish could be turned on and off at will by exciting it with light of different wavelengths.

He dispersed the excitable proteins in a gel separating each of them by more than the diffraction limit. They were like tiny lamps with switches, the Nobel Committee said, and dispersed in this way they could be seen with a regular optical microscope.

Research as Art

An inaugural art exhibit about scientific research titled “Research as Art” was hosted by the Department of Earth and Planetary Sciences on April 3.

Andreas Windisch, a postdoctoral research associate, was awarded first prize in physics for his image of a double vortex in a superfluid.

The People’s Choice Award went to Frank Gyngard, a research scientist in physics, for an anaglyph (red/green stereoscopic image) of a mote of dust propelled into space by a supernova.

“Research as Art” was supported by the Departments of Physics and Earth and Planetary Sciences, and the McDonnell Center for the Space Sciences, and the GIS office, which printed the images. Although this year it was open to members of those departments and the center, the organizers plan to invite more departments to join in next year’s exhibit.

Donation

The physics department has received a generous gift from Dr. Randall and Mrs. Sally Knight. They have pledged $10,000 per year for 5 years to support undergraduate students in research experience projects.

The Knights visited the department earlier this year, and we are grateful to all those who made their visit a success, especially Profs. Carlsson and Schilling, Mairin Hynes, Scott Handley, and Daniel Flanagan.
Quantum Lines

(Continued from page 2)

past, these states would have been invisible to physicists because attempts to measure them would have caused the system to immediately collapse.

But Murch’s device allows the system’s state to be probed many times before it becomes an effectively classical system. The quantum state of the circuit is detected by putting it inside a microwave box. A very small number of microwave photons are sent into the box where their quantum fields interact with the superconducting circuit.

The microwaves are so far off resonance with the circuit that they cannot drive it between its ground and its excited state. So instead of being absorbed, they leave the box bearing information about the quantum system in the form of a phase shift (the position of the troughs and peaks of the photons’ wavefunctions).

Murch is in essence able to observe millions of these matches, and from all the matches where one path is chosen, he can determine the most likely way that path will develop.

So what is the most likely path for a quantum system slowly collapsing from a superposition of states to one of two final states?

“Before we started this experiment,” Murch said, “I asked everybody in the lab what they thought the most likely path between quantum states would be. I drew a couple of options on the board: a straight line, a convex curve, a concave curve, a squiggly line . . . I took a poll, and we all guessed different options. Here we were, a bunch of quantum experts, and we had absolutely no intuition about the most likely path.”

Andrew N. Jordan of the University of Rochester and his students Areeya Chantasri and Justin Dressel inspired the study by devising a theory to predict the likely path. Their theory predicted that a convex curve Murch had drawn on the white board would be the correct path.

“When we looked at the data, we saw that the theorists were right. Our very clever collaborators had devised a ‘principle of least action’ that works in the quantum case,” Murch said.

They had found the quantum system’s line of desire mathematically and by calculation before many microwave photons trampled out the path in Murch’s lab.

But as the famous physicist Richard Feynman once said, “It doesn’t matter how beautiful your theory is, it doesn’t matter how smart you are. If it doesn’t agree with experiment, it’s wrong.” And he was a theoretician.

Based on articles from WU Record by Diana Lutz, compiled by Alison Verbeck.
Clarkfest 15

On April 27 and 28, 2015, a conference in honor of Prof. John Clark’s 80th birthday and retirement was organized by Prof. Carl Bender, Sarah Akin, Kate Whitaker, and Scott Handley.

The two day conference included a dinner at Whittemore house with an after-dinner talk by Prof. Jim Miller ("Fond memories of 50 years with John Clark at Washington University") and other contributed remarks and comments.

The meeting was opened by welcome talks from Chancellor Mark Wrighton and the Chair of the Physics Department, Prof. Mark Alford.

The invited speakers were:
- Sonya Bahar (University of Missouri at St. Louis)
- Mark Byrd (Southern Illinois University)
- John Clark (Washington University)
- Adam Eggebrecht (Washington University)
- Robert Flake (UT Austin)
- Morten Hjorth-Jensen (UIO, Norway)
- Victor Khodel (Washington University)
- Eckhard Krotscheck (University of Buffalo SUNY)
- Manuel de Llano (UNAM, Mexico)
- Michael Miller (Washington State University)
- Gerardo Ortiz (Indiana University)
- Robert Panoff (Shodor Education Foundation)
- Jan Rafelski (University of Arizona)
- Armen Sedrakian (University of Frankfurt)
- Ralf Wessel (Washington University)

A film crew from NHK, the Japan Broadcasting Corp., visited the Danforth Campus of Washington University in St. Louis on Sept. 18 to film for a series called "Cosmic Front HOTLINK," about the wonders of the universe. Here, they interview Ernst Zinner, PhD (left), research professor of physics in Arts & Sciences. Zinner pioneered techniques to study tiny bits of matter from stars that died before the solar system was born and were carried to Earth in meteorites. Sachiko Amari, PhD, a research scientist and colleague of Zinner’s who also works with stardust, hosted the visit.

Joe Angeles/WUSTL Photos
SATURDAY SCIENCE

Originally conceived in 1964 as a one-time set of lectures to explore what physicists don’t know, the Saturday Morning Physics Lecture Series has become a staple of the University’s intellectual life outside of the classroom. Michael Friedlander, professor emeritus of physics, has been organizing the series since its conception. It became the series we know it to be three decades later, in 1994.

FALL 2014: A Cocktail of Physics

This past fall, the lecture series rounded up a fascinating set of talks. From the physics of baseball to the archaeoastronomy of Stonehenge and Cahokia, WUSTL physicists discussed topics that personally interest them. Friedlander admits, “I ran out of ideas for themes, so I spoke to my colleagues and discovered these four talks that might not fit together into one theme, but are fascinating nonetheless.”

Kasey Wagoner: Baseball Physics (at least some of it)

Michael Friedlander: Archaeoastronomy: Stonehenge and Cahokia

John Rigden: Kepler and the Beginning of Modern Science

Michael Ogilvie: Crazy ideas of science: right, wrong and maybe?

SPRING 2015: Radioactivity: its sources and its uses

It is just over one hundred years since the phenomenon of radioactivity was discovered, well before the structure of atoms was understood. The Saturday lectures in the spring semester described the scientific understanding of the behavior of radioactive atoms and some of their many uses.

John S. Rigden: The Consequential Discovery of Radioactivity

Lee Sobotka: The Chart of the Nuclides

Henric Krawczynski: Using radioactive sources to calibrate the space telescope X-Calibur

Ramanath Cowsik: Radioactive Beta Decay - How it changed our worldview

Physics Family Fun Days

This year, the department held two Physics Family Fun Days. The first one, held in November, had a theme of “Hot & Cold: Physics of Temperature. It included demonstrations with liquid nitrogen, can crushing with pressure, and levitating superconductors. Hands-on activities included making a hot air balloon, experimenting with dry ice and making liquid nitrogen ice cream.

The second Physics Family Fun Day was held in April. The spring theme was “The Science of Sports!” Demonstrations and hands-on activities explained the science behind baseball, football, golf and martial arts.
FACULTY AWARDS & RECOGNITION

Kater Murch, Assistant Professor, was awarded a 2015 Sloan Research Fellowship. He is among 126 outstanding U.S. and Canadian researchers selected as fellowship recipients this year. Awarded annually since 1955, the fellowships are given to early-career scientists and scholars whose achievements and potential identify them as rising stars, the next generation of scientific leaders.

Charles M. Hohenberg, Professor Emeritus, has been awarded the James B. Eads Award by the St. Louis Academy of Science, for his construction of a unique noble gas mass spectrometer which continues to be the most sensitive magnetic sector instrument in the world, capable of single atom detection and of analyzing the isotopic structures of micro-samples of noble gases.

Christine Floss, Research Professor, has been named as one of the recipients of the 2015 outstanding faculty mentor awards, honoring faculty members whose dedication to PhD students and commitment to excellence in graduate training have made a significant contribution to the quality of life and professional development of graduate students in Arts & Sciences at Washington University in St. Louis.

Li Yang, Associate Professor, received a Faculty Early Career Development Award (CAREER) from the National Science Foundation. The five-year proposal is about many-electron interactions and excited-state properties in two-dimensional van der Waals interfaces.

Henric Krawczynski, Professor, has become a member of the executive committee of the NASA Physics of the Cosmos Program Analysis Group (PhysPAG).

At this year’s Freshman Finale, Mairin Hynes, Instructor, was selected to receive a two-year CIRCLE fellowship from the University’s AAU grant on Improving STEM Education. As a CIRCLE fellow, Mairin will continue and expand her work with The Teaching Center and CIRCLE to incorporate more interactive learning activities into General Physics.

Kasey Wagoner, Instructor, was awarded the Outstanding Faculty Member Award. This honor is given to the Washington University faculty member who has had the largest impact on the year’s Freshman class.

Kasey Wagoner between two of his undergraduate students.

Sai Iyer, Adjunct Faculty in University College, was awarded the Dean’s Faculty Award for 2015.

FACULTY NEWS

Prof. Wim Dickhoff gave invited talks at the Topical Meeting “Understanding Nuclear Structure and Reactions Microscopically, including the continuum”, March 18, 2014, GANIL, Caen, France entitled, “Forging the link between nuclear reactions and nuclear structure”, and at NMP14, the Fourth Conference on “NUCLEI and MESOSCOPIC PHYSICS” at the NSCL/MSU, East Lansing, Michigan, May 5 entitled “Pairing in Bulk Nuclear Matter Beyond BCS”.

From March 2-13, 2015 he co-organized together with Prof. Charlotte Elster (Ohio U) and Prof. Ian Thompson (LLNL) an Institute for Nuclear Theory Workshop INT-15-58W entitled “Reactions and Structure of Exotic Nuclei”. The first week of the workshop was attended by about 35 scientists, both theorists and experimentalists, who presented their latest results. The second week a smaller group of about 15 continued digesting and discussing this information with only one presentation per day. Prof. Dickhoff gave a talk entitled “Reactions and Structure employing the Dispersive Optical Model in a broader context”. Graduate student Hossein Mahzoon presented his work also giving a talk entitled “Nonlocal Dispersive Optical Model”. Hossein also gave an invited talk at the workshop “International Collaborations in Nuclear Theory: Theory for open-shell nuclei near the limits of stability” organized in May 2015 at the FRIB facility at MSU.

This coming Summer Prof. Dickhoff will organize and teach Course 2: Many-body methods for nuclear physics, GANIL, Caen, France, July 5-25 2015 as part of the TALENT initiative: TALENT: Training in Advanced Low Energy Nuclear Theory. The TALENT initiative aims at providing an advanced and comprehensive training to graduate students and young researchers in low-energy nuclear theory. The network aims at developing a broad curriculum that will provide the platform for a cutting-edge theory for understanding nuclei and nuclear reactions. These objectives are being met by offering a series of lectures, commissioned from experienced teachers in nuclear theory.

The other teachers of the course are Carlo Barbieri (former WashU grad student), University of Surrey; Gaute Hagen, Oak Ridge National Laboratory; Morten Hjorth-Jensen, Michigan State University.
and University of Oslo; and Arturo Polls, University of Barcelona. The website for the course is https://groups.nscl.msu.edu/jina/talent/wiki/Course_2. Both graduate students Dong Ding and Mack Atkinson have been accepted to this course and will attend.

Prof. Dickhoff has also been invited to speak at the International Symposium on Nuclear Symmetry Energy (NuSYM15) that will take place in Kraków (Cracow, Poland) within June 29 - July 2, 2015. He will also give an invited talk at the 5th International Workshop on Compound Nuclear Reactions and Related Topics, CNR*15, during October 19-23, 2015 at Tokyo Institute of Technology (Tokyo Tech.), Japan.

Prof. Emeritus Pat Gibbons co-taught two interesting and fun courses in the fall of 2014. Physics 597, Supervised Teaching of Physics, has a name that is not entirely descriptive. In it, first-semester graduate students do work as apprentice TAs in our general physics labs, supervised by experienced lab TAs. They also read articles from the science education literature that are relevant to physics teaching, submit written reflections on the articles, and discuss them in the 50-minute weekly class meeting. The discussions sometimes stray from the article, but are always about teaching and learning. Pat and co-teacher Dr. Mairin Hynes usually learn new, useful things from the discussions.

Education 6012, Hands-On Science K-8: Earth and Planetary Systems, was astronomy and astronomy pedagogy for teachers of grades 4-9. Pat co-taught with Jack Wiegert of the Institute for School Partnership, which sponsored the course financially. Two students earned graduate credit, 3 units for the course, and others preferred not to pay tuition and received certificates of participation in 40 hours of professional development. We made models out of paper, people, and balls of different sizes of the Sun, Earth, Moon, and constellations of the ecliptic. Many of the teachers used the activities in their classrooms. Teachers make the best students!

Pat presented workshops at Interface 2015, a meeting for K-8 science teachers sponsored by the Missouri Department of Elementary and Secondary Education, with co-presenter Erin Nolan, PhD student in Education with an undergraduate physics major. Erin was a TA in the fall astronomy course. Pat and Erin presented many of the course activities and gave participants materials to take and use in their classrooms with the activities.

Prof. Jim Schilling gave a Plenary Talk on the topic “Contrasting Effects of Extreme Pressure on Highly Correlated Electron Behavior” at the International Workshop “Pressure and Strain effects in Correlated Electron Materials”, October 6-10, 2014 at the Max-Planck-Institute for Physics of Complex Systems in Dresden, Germany.

Pat working with middle- and high-school teachers at Interface.

Tanmay Vachaspati, Professor and director of the Cosmology Initiative at ASU, was the Clark Way Harrison visiting Professor this Spring. He taught a widely popular graduate course on Topological Defects, and he collaborated with Jim Buckley, Manel Errando, Wenlei Chen (grad student) and Francesc Ferrer on understanding the origin of cosmological magnetic fields.

Wenlei and Ferrer wrote two papers this year together with Tanmay and Tashiro (Nagoya University) on measurements of parity violation caused by primordial magnetic fields (produced in the early universe at the time of baryogenesis) in the gamma-ray sky. And Jim Buckley, Wenlei and Ferrer wrote another paper showing the presence of pair halos around AGNs due to intergalactic magnetic fields.

(Continued on page 16)
An urban (Brooklyn/Manhattan) electromagnetic environment: the total power in the cellphone band. The daily and weekly cycle is evident—peaks during the working day and when people are awake, less on weekends, on a few days there is evidence for separate morning and afternoon rush hour peaks, people stay up later (or at least use their cell phones later) on weekends. The minimum power is partly attributable to cell phones “handshaking” with base towers when not in use. Data from Profs. Jonathan Katz and Mike Know (NYU-Polytechnic), analysis by L. Canel-Katz.

Prof. Jonathan Katz spent the 2015-2016 academic year on sabbatical at the NYU Center for Urban Studies and Progress, studying the application of physical methods to urban problems. For example, crowds of people are luminous in cell-phone radiation, and it is possible to follow the movement of crowds with this radiation. Diurnal and weekday flows of people into Midtown Manhattan are clearly observed. Another example is the use of interferometric synthetic aperture radar, a technique developed and widely used in the Earth sciences to study the motion of glaciers, volcanoes and earthquakes, to study the subsidence of streets undermined by water leaks, or raised in frost heaves.

In addition, Prof. Katz, undergraduate Justin Finkel and WU Physics PhD Lilly Canel-Katz have been studying historic trends of drought and storminess to answer the questions of whether climate change has led (and may be expected to lead) to increasing or decreasing storminess and drought.

From one database that goes back to 1893 they found a systematic reduction in average drought in the 48 contiguous United States. This may be correlated with increasing temperature because warmer air can contain more water vapor. There are regional differences, however, with some Western sites showing increasing drought but rapidly decreasing drought in much of the Midwest and Northeast.

Using another database containing rainfall data from 1948 to 2009 at 5995 sites, they found a statistically significant increase in a statistical measure of storminess (see figure). An unexpected surprise was a striking increase in storminess in the Los Angeles basin that they speculate may be correlated with decreasing air pollution.

Matthias Beilicke left Washington University after almost eight years of working in the Physics Department (the last 3 1/2 as Assistant Research Professor) to go back to Germany. He says he will miss the department and the time in St.Louis.

Kasey Wagoner, Lecturer, originally came here as a graduate student in August of 2004. He is leaving this summer for the position of Assistant Professor of Physics at Philadelphia University.
STAFF NEWS

Major changes took place in the staff this year. After over 45 years of service, Julia Hamilton, Graduate Student Secretary, retired at the end of December. She was the department mother to many graduate students over the years and will be greatly missed.

With Julia’s departure, Sarah Akin moved into her new position as Assistant to the Chair, Graduate Secretary, and Undergraduate Secretary.

Kate Whitaker has recently joined the Physics Department as the Administrative Assistant. She is here to help people with whatever they need, whether it is making copies, booking hotels, or planning events. She is very excited to be a member of the department and looks forward to what this opportunity will bring.

Stan Crone, Demonstration Technician, retired in May after nearly 30 years with WU. Stan set up, maintained, and developed demonstrations for a wide range of physics courses and was an invaluable aide to the teaching faculty, providing demonstrations that greatly enhanced their lectures. Students often cited Stan’s demonstrations as their favorite part of the course and remembered the demonstrations long after forgetting the related equations.

Christine Tilley, Grants and Accounting Supervisor, left the Physics Department in June to become the Department Administrator in Energy, Environmental and Chemical Engineering. She had worked in the accounting office for 15 years, working with grants, contracts and departmental funds; and overseeing payroll, purchasing and reimbursements to the faculty, staff and students.

At the May 2015 Staff Day Service Award Ceremony, the following staff members were honored:

Eric Inazaki - 26 years
Sai Iyer - 15 years
Richard Bose - 10 years

MCDONNELL CENTER FOR THE SPACE SCIENCES Distinguished Lecture Series

2015 McDonnell Lecture

The 2015 McDonnell Distinguished Lecturer was Roger J. Phillips, Institute Scientist, Southwest Research Institute, Boulder CO; Director Emeritus, McDonnell Center for the Space Sciences and Professor Emeritus, Department of Earth and Planetary Sciences, Washington University in St. Louis. Phillips delivered a public lecture on April 15, “No Denying Climate Change on Mars” and a colloquium on April 16, “Mercury ain’t the Moon: Results from the MESSENGER mission.”

Robert M. Walker Lecture

Professor Ramesh Narayan, FRS, Thomas Dudley Cabot Professor of the Natural Sciences, Harvard University delivered a colloquium on October 22, “Astrophysical Black Holes” and a public lecture on Thursday, October 23rd, “Black Holes.”

Feenberg Lecture

Professor Hans Weidenmueller, Heidelberg University Director Emeritus Max-Planck-Institut für Kernphysik, Heidelberg, delivered the Feenberg Lecture colloquium on April 22, 2015, “Random Hamiltonians in Quantum Physics.”
The following students have received their PhD degrees. Their thesis titles, faculty advisors and current position (if known) are listed as well.

**Dimitrios Manolidis**, “Neutron Star Models in Alternative Theories of Gravity”, May 8, 2014 (Professor Will), Army in Greece

**Daniel Hunter**, “Phase-Space Distributions of Galactic Dark Matter Halos and Implications for Detection”, May 13, 2014 (Professor Ferrer) Software Developer at ARINC Direct

**Adam Vogt**, “Studies of Structural and Chemical Ordering in Metallic Liquids and Glasses Using Electrostatic Levitation”, May 20, 2014 (Professor Kelton) Oak Ridge National Laboratory, Post-doc Research Associate, Instrument & Source Division

**Yuefeng Liang**, “Quasiparticle Energy and Excitons in Two-Dimensional Structures”, June 6, 2014 (Professor Yang) Lawrence Berkeley National Laboratory, (Post-doc)

**Jason Snyder**, “Shape and Structure of Neutron-Rich Nuclei from 252Cf Fission Fragments”, June 10, 2014 (Professor Sarantites) U.S. Navy (Nuclear Power Training Unit), Naval Officer

**Fletcher Werner**, “Investigation and optimization of extraordinary electroconductance (EEC) sensors & The role of magnetic disorder in the formation of spin glasses”, June 26, 2014 (Professor Solin) Cutting Edge Optronics (Semiconductor Equipment Engineer)

**Sina Mossahebi**, “Kinematic Characterization of Left Ventricular Chamber Stiffness and Relaxation”, August 26, 2014 (Professor Kovacs) Medical Physics Certificate Program at University of Chicago

**Qingwen Guo**, “X-Ray Polarimetry with X-Calibur”, September 11, 2014 (Professor Krawczynski) Halliburton, Houston, (Scientist-Physics, Sr)

**Gilberto Fabbris**, “Tuning Electronic Correlation with Pressure”, November 7, 2014 (Professor Schilling) Research Associate-Materials Science, at the Condensed Matter Physics & Materials Science Department of the Brookhaven National Laboratory

**Evan Groopman**, “NanoSIMS, TEM, and XANES Studies of Presolar Grains”, November 14, 2014 (Professor Bernatowicz) Department of Physics, Washington University (Post-Doc)

**Amber Groopman**, “Comparison of Conventional and Bayesian Analysis for the Ultrasonic Characterization of Cancellous Bone”, November 17, 2014 (Professor Miller) Washington University, (Post-doc) Dr. Miller’s group


**Jeffrey Pobst**, “Neural Processing in the Three Layer Turtle Visual Cortex”, February 26, 2015 (Professor Wessel) Actuary Analyst, Towers Watson, St. Louis, Missouri

**Javad Komijani**, “Topics in Gauge Theory and Theoretical Physics”, April 24, 2015 (Professors Bernard/Bender) Technische Universität München (TUM) Germany, Post-doc

**Jinhyuk Lim**, “Enhanced Magnetism in Dy and Tb at Extreme Pressure”, April 30, 2015 (Professor Schilling) Washington State University, Post-doc

**New Graduate Students**

For the 2015-2016 academic year, the department admitted 11 new graduate students:

**Quincy Abbar**
**John Cavin**
**Pin-Hui Chen**
**Steven Patrick Harris**
**Jared Lalmansingh**
**Xiaobo Lu**

**Mark Sellers**
**Jufri Setianegara**
**Nima Tatari**
**Daniel Van Hoesen**
**Ji Xia**
Josiah Lewis, a fifth-year graduate student, works in the department’s Laboratory for Space Sciences. Lewis is currently working with Research Professor Christine Floss to analyze nanodiamonds found in meteorites.

The crystal structure and the elements that go into nanodiamonds, primarily carbon, is what identifies them as diamond. In that sense they are like diamonds that you can see, just much smaller.

One fun size comparison: the two most-studied types of presolar grains – presolar graphite or silicon carbide – are about the size of a bacterium. A presolar nanodiamond would be just about the right size to be a wedding ring on one of those bacteria. They’re about a thousand times smaller than the other grains that we study, and that’s why we don’t know that much about them.

Scientists are trying to determine if the carbon ratios within these diamonds are the kind that you’d find if they formed in the early solar system, or if they are the ratios that you’d find in a supernova explosion or floating through the interstellar medium.

The problem is that when the nanodiamonds are analyzed, they give conflicting clues. If you take a whole bunch of these nanodiamonds – billions of them at once – and you do stepped heating, they release some trace elements like xenon that have been embedded in the diamonds.

The xenon has a stable isotope signature that only comes from supernova explosions. But then if you measure the carbon ratios of this big group of nanodiamonds, that carbon ratio comes back and indicates that it is from the solar system.

To resolve this conflict, scientists measure the carbon ratio of individual diamonds to see if some of them came from outside the solar system and the rest formed after the solar system formed. They’ve had to develop some novel techniques to do that, because they’re so small, and the counts are very small, so normal techniques don’t work.

Lewis came to graduate school with some background in thin films and condensed matter type physics, as well as one summer doing astrophysics. He thought he was going into condensed matter physics, but instead got really interested in the astrophysics group. They are doing astrophysics, but mostly with a condensed matter toolkit. They’re looking at materials, they’re just materials from outside the solar system.

Most astrophysics is done with photons, and there’s a lot of information you can get from them. Instead of looking at light that came from a supernova explosion, Lewis is actually looking at a piece of material that came from that supernova. If NASA could run a sample return mission to a supernova, have it survive, and have it get back in a time scale where we could actually look at it – the price tag is unthinkable, and the science would be really amazing – well, we have that. It just literally fell out of the sky on us.

Lewis says, “I’m an experimentalist, so using really amazing pieces of equipment that I’m learning about and learning to work on and fix gives me a lot of satisfaction. Having that connect to what goes on in the universe on time scales longer than recorded history – it’s an amazing scope, right? And I feel like while I’m not conversant in the arts, I get to go look at this amazing artistry of the natural world, and enjoy it, and wonder at it. That’s probably what gets me out of bed in the morning, in addition to my alarm clock.”
STUDENT NEWS

Putnam Competition & Missouri Collegiate Mathematics Competition

Washington University teams scored 16th in the famously brutal Putnam Math Competition and took first and second place in the Missouri Collegiate Mathematics Competition.

The William Lowell Putnam Mathematical Competition consists of two three-hour sessions, during each of which competitors work on only six problems, each worth 10 points, for a total of 120 possible points. The problems are so difficult that in 2006, 2,279 of 3,640 participants registered scores of zero and it typically has a median score of less than one.

This year, the Washington University team, consisting of junior physics major Anthony Grebe, senior Alan Talmage and sophomore Jongwhan Park, placed 16th out of 500 teams.

Students prepare for the Putnam during Friday afternoon practice sessions in the fall semester. This year the coaches were Carl Bender, PhD, professor of physics; and Renato Feres, PhD, professor of mathematics, both in Arts & Sciences.

WU students also did well in the 20th annual Missouri Collegiate Mathematics Competition held in March. The two Washington University teams took first and second place in this competition. A team consisting of Anthony Grebe, Alan Talmage and junior Fangzhou Xiao, was first. The second-place team consisted of sophomore Ted Meador, freshman physics major Stella Schindler and sophomore physics major Yu Tao Li.

Stardust  (Continued from page 7)

“I discovered that certain grains contain subgrains that have isotopic signatures of a very specific region of a pre-supernova star. We can really pinpoint within the supernova where this material came from. That was very exciting.”

Most of these grains are isolated from very primitive meteorites that formed at the beginning of the solar system. The isotopic composition of the grains shows that they’re completely different than what’s in the solar system.

These grains are from individual stars, and the stars have a very different signature than the isotopic composition of the solar system. This is done by dissolving away 99.99% of the meteorite, and what’s left over are some very hardy minerals like silicon carbide and graphite.

Then the NanoSIMS, a high spatial resolution mass spectrometer, is used to measure the isotopic composition of individual grains.

It would be very interesting to be able to date these grains and know their absolute ages. They are at least as old as the solar system, or 4.5 billion years old. But between that and the age of the galaxy – that’s around 13 billion years old – there’s a wide window. We’re unsure how long these grains survived in the interstellar medium before becoming incorporated into the solar system.
2014 Fall Undergraduate Research Symposium

On October 11, the Office of Undergraduate Research hosted the annual Fall Undergraduate Research Symposium, where 174 undergraduates presented their research at a poster session open to the public. Chancellor Mark Wrighton and Dean Joy Kiefer, the director of the Office of Undergraduate Research, kicked off the event. A few students briefly discussed their work, including physics major Satcher Hsieh who presented his talk, “High Sensitivity Microwave Power Detection via Dissipative Coherence of a Driven Superconducting Qubit” before all were invited to wander through the poster presentations in Olin Library. Eleven physics undergrads presented posters at the session.

For a full list of of research abstracts from the Fall symposium, check out the program at:


2014 University Physics Competition

The University Physics Competition is an international contest for undergraduate students, who work in teams of up to three students at their home colleges and universities all over the world, spend 48 hours analyzing an applied scenario using the principles of physics, and write a formal paper describing their work. In this year’s competition 131 teams submitted papers for judging. 93 teams selected “Problem A - Circumbinary Planets” and 38 teams selected “Problem B – A Water Fountain.” This year Washington University had three teams in the competition and two of them earned silver and the third one earned bronze.

Anthony Grebe, Stella Schindler and Beth Bollinger chose the first problem and were awarded a Silver Medal.

The other two teams worked on the second problem. Zhengdao Chen, Fan Chen and Pengning Chao were awarded a Silver Medal; Alexander J. Lu, Tyler Ellison and Arian Jadbabaie were awarded a Bronze Medal.

Graduate Student Research Symposium

The 20th Annual Graduate Research Symposium was held in February. The Physics Department was represented by Avery Archer, Mahlega Hassanpour, Seyedhadi Hosseini, S. Kumar Mallavarapu, and Tahereh Mazaheri.

Congratulations to Avery Archer who finished in 3rd place in the Sciences category.
STUDENT NEWS

Sigma Pi Sigma Inductees

Join us in congratulating the newest members of the Washington University in St. Louis Chapter of Sigma Pi Sigma, the national physics honor society.

Marie Draper
Michael Driscoll
Tyler Ellison
Ryan Endsley
Declan Gruber
Christina Kreisch
Pratik Sachdeva

SPS Outstanding Chapter Award

In 2014, the Washington University Chapter of the Society of Physics Students was recognized as an Outstanding SPS Chapter. Some of the criteria for this award include:

• The chapter’s involvement in local, zone and national SPS meetings and other professional meetings
• Participation in SPS programs
• Outreach efforts to the grades K-12 or the general public
• Participation in community service
• Contributions to student recruitment and retention
• Participation in social events
• Interactions with the department’s alumni

Society of Physics Students

The Society of Physics Students had another year full of activities: liquid nitrogen ice cream, physics jeopardy, lab tours, a summer research info session, and movie nights (we showed Particle Fever in the Fall).

But, this year the Washington University Chapter also organized the Zone 12 meeting. (http://wustlsp.s.weebly.com/details.html).

This took place on April 3-4, and roughly forty students from other parts of Missouri and as far away as Memphis, visited our campus. Highlights of the conference were a talk by Kater Murch and a career fair.
STUDENT AWARDS
Departmental Awards to Students

Each year, the department awards prizes for outstanding performance.

Graduate Students

Shull Prize
Awarded to the top graduate teaching assistant wholly endowed in memory of Franklin Shull. Frank Shull was the senior faculty instructor in introductory courses for many years, and the prize takes note of both his interest and the importance that the Department attaches to the quality of teaching assistantships.

Robert Ashcraft was nominated by Jim Schilling for his work in Physics 471 - Quantum Mechanics. Robert did an excellent job of grading the 11 weekly homework assignments during the semester. He also finished correcting all assignments on time. Not a single complaint came from any of the students during the entire semester. His overall grade in the teaching evaluations was 5.71 out of 7 which is above the departmental average. His willingness to give two lectures in the professor’s absence was impressive. His lectures were well received. He clearly stands out from the majority of teaching assistants.

Dean’s Award for Teaching Excellence
This award recognizes superb performance by a graduate teaching assistant in the instruction of Arts & Sciences undergraduates. Each Graduate Arts & Sciences department is invited to nominate its best teaching assistant for the award.

Ryan Soklaski is a fifth-year student in the PhD program in Physics. His physics research embodies the quest to calculate detailed electronic properties of solids starting from only the charges on the atomic nuclei. Ryan’s teaching skills are illustrated by his work as an instructor in the summer introductory Physics 118/198 course. He first approached topics in a way that promotes conceptual understanding, and only then introduced mathematical concepts, using mature, innovative approaches. He held the attention of students by incorporating a variety of active-learning techniques, including group work and clicker-type questions, while interspersing short lectures throughout the class. One student stated that “Ryan is a born physics professor. He’s good at everything a physics instructor should be: explaining concepts vividly and dynamically, public speaking, maintaining students’ attention, being responsible and caring about students, fair grading, and his exceptional skills of connecting all the dots and presenting a clear big picture.”

First year graduate student Kevin Seltzer is a recipient of the American Physical Society’s 2014 LeRoy Apker award recognizing outstanding undergraduate physics achievement. This is based on research he did in quantum field theory as an undergraduate at Loyola University Maryland.

Josiah Lewis, a graduate student in physics, has received a NASA Earth and Space Sciences Fellowship for 2014–15. The fellowship is for research titled “Atom-Probe Studies of the Origins of Meteoritic Nanodiamonds and Silicon Carbide.”
STUDENT AWARDS

Undergraduate Students

Senior Prize

Awarded to the outstanding senior Physics Majors. Selection is based on performance in physics courses and is made by the department’s major advisors.

May 2015 - Christina Kreisch

Varney Prize

Awarded to the best student in the introductory courses. Professor Robert Varney was a member of the faculty for many years. This prize was established to commemorate his deep and long-time interest in physics instruction.

2013-2014 - Nathan Wolf

Honorable Mentions: Justin Finkel, Thomas Dvergsten, Caryn Devaney, Derreko Ricketts, Zhengdao Chen, Pengning Chao

Greg Delos Summer Research Fellowship

Greg Delos was an excellent student who died during his junior year. In his memory, the Delos family has generously set up the fund that supports the award, each year, of a prize that takes the form of a stipend to support a student working with one of the research groups during the summer. The availability of this prize is publicized each spring semester and the winner is selected, by the department’s advisors, from among the applicants, with selection based on performance in the physics courses (and possibly research) thus far.

May 2015 - Christopher Munley & Tansel Baran Yasar

Undergraduate Summer Research Fellowship

The Fellowship is for ten weeks in the upcoming summer. The purpose is to provide a gateway for summer research in an on-campus laboratory with an appropriate faculty mentor. Nomination for this fellowship is made by a faculty member.

Summer 2015 - Deveon Berwick, Claire Heuckeroth, Pengning Chao, Fan Chen, Rohit Unni, Annie Pitkin
James Ely Shrauner (1933-2015) died June 1, 2015 in hospice care at Brooking Park, Chesterfield, Missouri from complications of Parkinson's disease. He was born March 10, 1933 in Dodge City, Kansas and graduated from Cimarron High School in 1951. He attended the University of Kansas, where he worked his way through college, lived in Scholarship Houses and graduated in 1956 with a BS in biophysics as a pre-med. In high school and college he held a variety of jobs including working on farm harvests, writing insurance contracts, and working on the railroad. He enjoyed relating his early work experiences which were uncommon for a college professor.

Ely received an MA in physics from Columbia University in New York in 1960 and his PhD in theoretical physics in 1963 from the University of Chicago with Professor Y. Nambu, a winner of the Nobel Prize in physics. His thesis work made early contributions to the role of chirality in hadronic physics. While in Chicago he also sang in the chorus of Gilbert and Sullivan productions. He held a postdoctoral appointment at Stanford University from 1963 to 1965.

Ely joined the faculty at the Physics Department at Washington University in 1965 and retired as an Emeritus Professor in 2001. His encyclopedic knowledge of many subfields of physics enabled him to teach a broad range of physics courses including all the standard graduate courses and the advanced courses as well. He had the knack for simplifying difficult physics and making it seem obvious, an important gift. He especially enjoyed meeting with students in the Council of Masters of the South Forty. He served on various Departmental Committees including the Colloquium Committee for which he invited a wide variety of speakers for a number of years.

Ely was a co-founder of the High Energy Theory Group in the Physics Department. His research was in many areas of particle physics and field theory. His path-breaking research on the pion form factor and in multi-quark scattering analysis flourished in the late 1960s, independently and in collaboration with his PhD students Les Benofy and D. W. Cho. He collaborated with a number of physicists as evidenced by his Visiting Scientist Research appointments at SLAC in 1968, at Fermilab in 1974, and at Los Alamos National Laboratory in 1975-76 and 1978. He was a Visiting Research Scientist and Consultant at Ames Laboratory 1978-1988 where he worked with Professor Charles Hammer of Iowa State University and Professor Brian DeFacio of the University of Missouri, Columbia. Their work demonstrated new insights involving vacuum and path-integral representations of the S-matrix and on the statistical mechanics, dynamic structure and renormalization of iconic “φ⁴” theories. He was a Visiting Research Scientist and Consultant at Lawrence Berkeley Laboratory and the Universities Research Association Superconducting Supercollider Central Design Group 1985-1990 at which he investigated magnet technology. He attended the Aspen Center of Physics in the summer for many years.

Ely served as a Trustee of the Universities Research Association Panel, the consortium of 54 universities that managed Fermilab from 1979-1985. He was a Fellow of the American Physical Society (APS) and served on several national panels including the Executive Committee of the APS Division of Particles and Fields.

His family, friends and colleagues enjoyed his wry sense of humor. Ely was a welcoming person who was genuinely interested in others’ ideas. He had wide interests besides physics: he enjoyed poems by Robert Frost and especially liked music by Brahms or Mahler. He looked forward to concerts of the St. Louis Symphony, the Arianna String Quartet and the Studio plays at the Repertory Theatre. He was an avid runner and nature lover and enjoyed skiing and hiking, which made it that much harder when he was diagnosed with Parkinson’s disease. He attended student basketball and volleyball games at Washington University. Travels included varied Elderhostel programs in bird watching, art museums and music. In retirement he served as President of the Professors Emeriti and enjoyed taking German and French courses with undergraduates.

Patrick Swan (1941-2015) passed away on Thursday, May 21, 2015. He was a Space Science Engineer who worked with the Space Science group on the fourth floor of Compton Hall from 1969 - 2010.

(Continued on page 26)
James Keith de Pagter (1927-2014) (GR 58) passed away in New Orleans on September 29, 2014.

Jim’s research centered on neutrons that were produced in the interaction of cosmic ray particles in heavy metals. The experiments were carried out at ground level, in contrast to the use of balloons and satellites used in later years.

As a member of Bob Sard’s cosmic ray research group. Jim’s dissertation had the title ‘A Study of Low Energy Transfer Interactions By Fast Mu-Mesons,’ and was submitted in April 1958.

Jim was born in Kenosha, Wisconsin on August 22, 1927. His BS degree came from the University of Arkansas. After graduating from WU, Jim was a Research Fellow at Harvard until 1965 when he accepted a faculty position at Southwestern Massachusetts University (now the University of Massachusetts - Dartmouth). Jim was promoted to the rank of professor in 1969, and started a term as department chair in 1971.

John Foote (1934-2015) passed away at St. Anthony’s Medical Center in St. Louis on January 8, 2015, at age 80. From 1982 to 1997, John had worked on the 4th floor of Compton lab. A long-time resident of Crestwood, a St. Louis suburb, John earned his BS degree from WU, then worked for the Brown Shoe Co., where he became general manager of warehousing and systems. He was a volunteer at the St. Louis Science Center. Ten years after retiring from WU, John was elected to the Crestwood Board of Aldermen and served three two-year terms. On the occasion of his retirement, the Mayor and the Board of Aldermen adopted a Resolution to “express their thanks and great appreciation and extend to him their heartfelt, sincere and kindest wishes in all his undertakings.”

Ernst Zinner shared the following reminiscences. “There are many happy memories from the years John and I worked together. John worked on a satellite experiment which was in Earth’s orbit on the Long Duration Exposure Facility (LDEF) from 1984 to 1990 and he was an essential member of our research team. John also was in charge of the maintenance of our Cameca IMS 3f ion microprobe. This involved not only keeping the instrument in running order and included repairs on the electronics and vacuum systems, but also new designs to improve the instrument.

“John was the most meticulous and reliable person who has ever worked in the Laboratory for the Space Sciences. His contributions solved many technical problems. Even when working on boring tasks he never tired but strove for perfection. He also fulfilled the role of a “psychiatrist” for our group. Many students and collaborators talked to him about their problems and he always listened patiently. Another thing I really appreciated was that he took care of visiting scientists, some of whom came from far-away places. He helped them with their local problems and showed them around St. Louis. Many remarked that his help made their visits easier and more enjoyable. John will live forever in our memories.”

Lawrence Killion (1925-2015) (GR 55) passed away February 7, 2015, at age 89. Larry was born in 1924 in Ross, Texas. He obtained his BS in 1948 at Baylor University and then served as an intelligence officer in the Pacific and in post-war Japan. He continued his education at Indiana University, where he received his MS, then came to Washington University. He completed his PhD in 1955, with a dissertation “Beta Spectra of Vanadium-48 and Rubidium-86”.

Larry was an important member of the United States’ weapons program; at the Department of Energy his focus was laser fusion and he served as the Director of Fusion Systems Division. He was an adviser in the negotiations of the START Treaties in Geneva. He retired as a member of the Senior Executive Service where he assisted in managing the weapons programs that ultimately played such a key role in ending the Cold War. Larry held numerous senior administrative positions. After retiring from government service, he started another career with United Technologies Incorporated as the Vice President of the Optics Division.
Wilifred Konneker (GR 50) was named a Dean’s Medalist in the 2015 Washington University Distinguished Alumni Awards. He holds degrees in chemistry, math, and nuclear physics and was a pioneer in nuclear medicine and radiopharmaceuticals. Throughout his career, he founded or co-founded ten successful high-tech companies and ran the pharmaceutical division of Mallinckrodt. He is an emeritus Trustee and one of the original members of the Arts & Sciences National Council as well as a supporter of professorships and scholarships.

Larry Altman (LA 73) was appointed by the Missouri Bar to serve as the Chair of a Task Force to organize existing resources and find new resources to assist attorneys who have significant mental health issues. Additionally, the Missouri Bar appointed him as the Co-Chair of its Lawyers’ Assistance Committee where he was appointed as Chair to the Task Force and the Committee.

His son, Michael, has his PhD in Medical Physics and works for Washington University’s Siteman Cancer Center.

Craig Looney (GR 73)’s talk on February 27, 2015 on “Schrödinger’s Cat: Wanted Dead AND Alive”.


Craig Looney, James Hamlin, and Shanti Deemyad at the Gordon Conference on “Research at High Pressure”, June 22-27, 2014, at the University of New England, Biddeford, Maine. Shanti was elected Chair of the next Gordon Conference in June 2016. She is currently an Assistant Professor in the Physics Department at the University of Utah in Salt Lake City. Craig Looney is an Associate Professor of Physics at Merrimack College in North Andover, Massachusetts. James Hamlin is Assistant Professor in the Physics Department of the University of Florida in Gainesville.

45th Reunion – class of 1970

Members of the class of ’70 enjoyed being on campus again and renewing friendships in April.

From left : Emily Plachy, Sandra Hoffmann (Joe Hoffmann’s wife; Joe died last year), Tony Plachy, Chong (Moon Nahm’s wife), Dennis Dietz, Moon Nahm, and Peggy Dietz (Dennis Dietz’s wife).
During the year, refer to our website: www.physics.wustl.edu for up-to-date news.

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