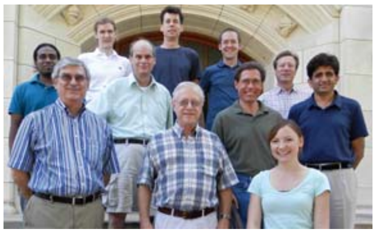
ΦYAST ΦLYER

The Homer L. Dodge Department of Physics and Astronomy
Volume 21, Number 1

The OU-Higgs Connection



l-r: Hasib, Gutierrez, D. Bertsche, Walker, Severini, Skubic, Pearson, Abbott, C. Bertsche, Strauss, Saleem.

Physicists at the University of Oklahoma are members of one of the two experimental collaborations that, on July 4, 2012, announced the discovery of a new particle with properties of a Higgs boson. This groundbreaking discovery confirms the predictions of the standard model of elementary particles and fields and gives direction for future investigations.

In 1964, three independent groups proposed a mechanism that would give mass to certain particles. The current understanding of this "Higgs" mechanism, named after Peter Higgs, a member of one group, is that a scalar field permeates all of space. As a fundamental particle propagates through this Higgs field, its interaction with the field gives mass to the particle, with a mass value that is proportional to the interaction strength. A consequence of this

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Remembering Neil Shafer-Ray

Neil Shafer-Ray

NEIL EVAN SHAFER-RAY, professor of physics and astronomy at OU, passed away Dec. 26, 2012, at the age of 49. Diagnosed with acute myeloid leukemia in July 2011, Neil waged a courageous and spirited battle, continuing to advance his research and advise his graduate students as he fought this disease. Neil's passing leaves a large hole in the department that we will feel for years to come. We all have fond memories of Neil racing off to class or the lab at high speed, or explaining concepts to students on our hallway blackboards, and will greatly miss his indomitable presence in Nielsen Hall.

Neil was born in Boston, graduated from MIT in 1986 and received his doctorate from Columbia in 1990 under Professor Richard Bersohn. He held postdoctoral positions at Hokkaido University in Japan (1990-1991) and at Stanford University (1991-1995) in Richard Zare's group. He joined the OU faculty in 1995 as a member of the Atomic, Molecular and Optical Physics group. Neil's principal areas of research, which he pursued with passion and creativity, included molecular beam studies, reaction dynamics, cold molecules, and most recently, searching for the dipole moment of the electron. In addition to doing physics, Neil enjoyed snow skiing with

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Greg Parker

From The Chair

by Greg Parker

It is unfortunate that Neil Shafer-Ray passed away on Dec. 26, 2012. He loved his family, students, friends, coworkers and physics. We will all miss his enthusiasm and knowledge of physics. Respected by everyone, Neil was a true friend, wonderful teacher and colleague. He was and will remain in our hearts and thoughts forever. His struggle with leukemia was very difficult and painful, but Neil always had a positive outlook. We really appreciate all of the donations for the Neil Shafer-Ray Scholarship Fund, which was established by his family!

We were delighted to have Alberto Marino and John Wisniewski join our department in August. In the past couple of years, we have had seven faculty join and strengthen our department. In addition, our graduate recruiting committee admitted 17 graduate students last August and we expect to have another 15 graduate students join us this year. The A.T. Stair Fellowship for Physics and Astronomy Graduate Students fund raiser is under way. Please consider contributing.

One of our alumni, Neal Lane, received the prestigious 2013 Vannevar Bush Award. Kimball Milton is a Simons Fellows in Theoretical Physics and will spend the 2013-2014 academic year in Paris. Matt Johnson received the VPR Award for Outstanding Research Engagement. Lloyd Bumm and Daminda Dahanayaka were recognized by the Office of Technology for an issued patent. Kieran Mullen received the Student Government Association Award as Outstanding Faculty. Jim Shaffer was awarded the Ted and Cuba Webb Presidential Professorship. Brad Abbott, Chung Kao, Karen Leighly, James Shaffer and Yun Wang were recommended for promotion to full professor, and we expect their promotions to be approved by the Board of Regents this summer. Yun Wang and Michael Santos are now Fellows of the American Physical Society, and Phil Gutierrez, Lloyd Bumm, Matt Johnson, James Shaffer, Yun Wang and Howie Baer received the Carl T. Bush Lectureship award.

Michael Reynolds, a junior majoring in physics, has been awarded a $10,000 scholarship from the Astronaut Scholarship Foundation. In addition to excelling in the classroom, Michael has performed experimental research on gold nanostructures. His research has been conducted at OU with Lloyd Bumm during most of the past two years and as an REU student at Rice University last summer.

What a wonderful year! As always, our faculty, postdoctoral fellows, staff and students continue to excel in research, teaching and service. We are indeed fortunate to have a collegial, prestigious and highly productive department. We really appreciate all of our former alumni who are contributing to the success of our department.

The ΦYAST ΦLYER is the official newsletter of the Homer L. Dodge Department of Physics and Astronomy, College of Arts and Sciences, University of Oklahoma, and is published each spring by OU Printing Services at a cost of $1.70/copy to the taxpayers of the State of Oklahoma. The newsletter staff includes Dick Henry, Kim Milton, Deborah Watson and Bruno Uchoa. The University of Oklahoma is an equal opportunity institution. All photographs are by Robert H. Taylor unless otherwise noted.

Hats Off to Our Students!

Homer L. Dodge Departmental Awards

Dodge Outstanding Sophomore	Dodge Outstanding Junior	Fowler Prize
Tyler Ashley	Michael Reynolds	Stephen Holleman Savannah Logan

Physics and Astronomy Awards

Dodge Scholarship

Bailey Bedford, Catherine Ciampa

J. Clarence Karcher Award

Michael Wilkinson, Caleb Holt

Duane E. Roller Award

Hunter Ash, Christopher Bender, Li Yang

William Schriever Award

Steven Hefner, Sagen Cocklin

Outstanding Graduating Senior

Kramer Harrison, Don Carmichael, Matthew Young

Webb Scholarship

Zachary Eldridge

Karcher Scholarship

Brandon Curd, Adrian Lucy, Neil McGlohon, Taylor Murphy, Catie Raney, Michael Reynolds, Bao Tran, Li Yang, Kyle Yates

Meritorious Scholarship

Joseph Altermatt, Hunter Ash, Nathaniel Beck, Bailey Bedford, Robert Behlen, Christopher Bender, Jodi Berdis, Austin Burkett, Galen Buttitta, Don Carmichael, Catherine Ciampa, Sagen Cocklin, Brandon Curd, Theodore Curtis, Jennifer Davis, Daniel Dobrosky, Constance Elmer, Zachary Eldredge, Jeffrey Gillean, David Graham, Forest Grayson, Kramer Harrison, Steven Hefner, Stephen Holleman, Caleb Holt, Tarryn Kahre, Stephen Lacina, Savannah Logan, Adrian Lucy, Heaven Manning, Neil McGlohon, Jamie Miller, Taylor Murphy, William Parker, Ryan Pentecost, John Pritchard, Josiah Purdum, Catie Raney, Michael Ray, Cody Ray, Michael Reynolds, Vincent Rojas, Matthew Scheffler, Benjamin Strickland, Joseph Tessmer, Jacob Tice, Aaron Wegner, Matthew Wepel, John Wiggins, Michael Wilkinson, Edward Wilkinson, Li Yang, Kyle Yates, Matthew Young

Engineering Physics Awards

J. Clarence Karcher Award

Jeshurun Chisholm

Duane E. Roller Award

Hayden Nunley

William Schriever Award

Eric Holbrook, Paul Hoang

Adams Scholarship

Chase Hennion

Meritorious Scholarship

Tyler Ashley, Dillon Carroll, Olivia Caruthers, Becca Castleberry, Mary Chenot, Jeshurun Chisholm, Timothy Corbley, Daniel Davidson, Daren Davis, Kevin Everly, Alec Forbes, Ryan Griffith, Daniel Grimmer, Trenton Hamm, Joshua Hardisty, Kendall Harper, Jesse Harter, Patrick Helms, Chase Hennion, Paul Hoang, Seth Hodgson, Erik Holbrook, Blake Johnson, Madison Jones, Nicholas Kantack, Hayden Nunley, Jocelyn Roberts, Steven Roberts, Rachel Rogers, Derek, Sealey, Jacob Young

Karcher Scholarship

Mary Chenot, Timothy Corbley, Kevin Everly, Kendall Harper, Seth Hodgson, Erik Holbrook, Jacob Young

Outstanding Graduating Senior

Dillon Carroll and Chase Hennion

2013 student award recipients following the annual awards ceremony. Photo by Greg Parker

Graduate Student Awards

George Kalbfleisch Memorial Award

Ahmed Hasib

Neil Shafer-Ray Memorial Scholarship

James Coker

Nielsen Prize

Jonathan Tallant and Elom Abalo

Dissertation Defenders

Ph.D.:

Elom Abalo (Milton)
Mohamed Razzak Merra Lebbai (Skubic)
Samanatha Gunawardana (Mullen)
Chia-Hsun Chuang (Wang)
Arne Schwettmann (Shaffer)
Parshuram Dahal (Abraham)
Dharshani Bopege (Furneaux)
Abdella Ait Moussa (Mullen)
Dilhani Jayathilaka (Murphy)
Tao Yang (Shafer-Ray)
Roshan Bokalawela (Johnson)
Jeff Crawford (Parker)

M.S.:

Henry Bradsher (Henry)
Leah Morabito (Dai)

Alumni News

Daniel Sinars (BS Engineering Physics, 1996) received the 2011 Presidential Early Career Award for Scientists and Engineers from the Department of Energy. The award was presented during a ceremony at the Smithsonian Natural History Museum on July 31. The awardees met with the president in the White House that same afternoon. The official announcement by the White House Office of Science and Technology Policy can be found at: www.whitehouse.gov/the-press-office/2012/07/23/president-obama-honors-outstanding-early-career-scientists. The Sandia news release can be found at: share.sandia.gov/news/resources/news_releases/pecase/

Dan's official PECASE citation (a mouthful) reads: "For developing innovative techniques to study the properties of instabilities in magnetized-high-energy-density plasma, enabling quantifiable comparison between experiment and simulation needed for validating cutting-edge radiation-hydrodynamics codes, and for demonstrating substantial leadership qualities in high-energy-density-laboratory-plasma physics."

Daniel attended OU from 1992 to 1996, and received his bachelor of science degree in engineering physics along with the Fowler Prize in 1996. Daniel obtained his doctorate in applied physics from Cornell University in 2001, and joined Sandia National Laboratories as a senior member of the technical staff that same year. He has worked at Sandia as an experimental physicist since then in the areas of inertial confinement fusion and high energy density physics. The majority of his research has been on the Sandia "Z" machine, the world's most energetic pulsed power machine. The Z machine is used to deliver more than 80 TW of electrical energy in a ~100 ns, 26 MA current pulse to fusion targets. The resulting Lorentz forces are used to accelerate and converge deuterium fuel to the conditions needed for fusion. Daniel's most recent research has focused on directly measuring the magneto-Rayleigh-Taylor instability in dense plasma liner implosions, for which he received a 2011 Department of Energy Early Career award of $500,000 per year for a five-year period.


Daniel Sinars

Neal Lane, currently the Malcolm Gillis University Professor at Rice University, is the 2013 recipient of the Vannevar Bush Award. The announcement was made on March 26, by the National Science Board. The Vannevar Bush Award honors truly exceptional lifelong leaders in science and technology who have made substantial contributions to the welfare of the nation through public service activities in science, technology and public policy. Established in 1980, the award is in the memory of Vannevar Bush, who served as a science adviser to Franklin Roosevelt during WW II, helped to establish federal funding for science and engineering as a national priority during peacetime, and helped to create of the National Science Foundation.

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ALUMS AND FRIENDS OF THE DEPARTMENT: PLEASE LET US KNOW (rhenry@ou.edu) WHAT YOU'RE UP TO, SO THAT WE CAN INCLUDE THE INFORMATION IN A FUTURE EDITION OF THE NEWSLETTER!

(Alumni News Continued)

Currently, Lane is a Senior Fellow of the James A. Baker III Institute for Public Policy, a member of Rice University's Department of Physics and Astronomy, as well as a member of our distinguished Board of Advisors led by Chun Lin (Neal's Ph.D. adviser at OU). Neal also served as assistant to President Clinton for Science and Technology and director of the White House Office of Science and Technology Policy from August 1998 to January 2001. He was the NSF director from October 1993 to August 1998.

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Shop Talk

by Joel Young

The Department of Physics and Astronomy, as an entity, began around 1907. Sometime before 1920, a German instrument maker, Otto Krause, was hired to maintain lecture demonstration equipment. Krause ran the instrument shop for over 20 years. Since that time, a number of dedicated individuals have supported the physical research needs of the department. Atomic-molecular, solid-state, high-energy physics, and astronomy have all made extensive use of the instrument shop over the years.

The instrument shop at the Department of Physics and Astronomy today is ably staffed by Joel Young, Barry Bergeron and Sean Atteberry. It has a long history of service and support, primarily for the experimental research groups at the physics department; but for the past 30 years the facility has been increasingly involved with supporting a variety of research programs outside the department. As OU has grown, so have the needs of its scientific research community. The HLD instrument shop has designed and fabricated many types of apparatus for other departments: Chemistry, Biochemistry, Geology, Zoology, Mechanical Engineering, Electrical Engineering, Petroleum Engineering, Psychology and the Health Sciences community. Other non-science university units such as Printing Services, and Facilities Management also have utilized the shop and maintain an active working relationship. Outside of the university community, the shop has provided services to the U.S. Air Force, JPL-NASA and the Los Alamos National Lab. Highlights of the past few years include:

Joel Young

Barry Bergeron

•Work on the Higgs detector at CERN (production fixturing for 2,500 pixel detectors) as well as work on D0 in the 1980s (A wide variety of custom detection array equipment)

•Design and fabrication of the monopole detector, which established new energy limits for this very strange theoretical particle.

•Development of numerous high-vacuum apparatus associated with atomic molecular collision work. One such system utilized the first reliable high temperature dissociation device for producing atomic fluorine. JPL requested a number of pieces of the critical and novel

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Faculty Research Programs

Astronomy, Astrophysics and Cosmology

Xinyu Dai continues to research such astronomical objects as gravitational lenses, galaxy clusters, active galactic nuclei and gamma-ray bursts. Since the discovery of the first cosmological gravitational lens in 1979, gravitational lensing has become an important tool in many astrophysical applications. In particular, quasar microlensing provides a novel method to map the quasar accretion disk structure. Utilizing the dependence of microlensing variability on the source size, we are able to resolve the disk structure that is several orders of magnitude smaller than the angular resolution of our current telescopes. Beside quasar microlensing, Xinyu also is interested in probing the interstellar medium of lens galaxies and exploring the embedded lensing model. Galaxy clusters are the largest gravitationally bound objects in the universe. They are ideal sites to constrain cosmological parameters and study structure formation. Xinyu currently is working on the Swift soft X-ray serendipitous cluster survey. The survey has the potential to find one of the largest X-ray selected cluster catalogs to date. Xinyu also is studying the missing Baryon problem in the universe. Active galactic nuclei (AGNs) are very energetic sources in the universe powered by supermassive black holes. Xinyu is interested in the feedback process of AGNs to their host galaxies, in particular, the kinetic feedback carried out by winds. He is working on measuring the intrinsic fractions of broad absorption line quasars of various species and the average absorption column densities of these objects. In addition, he studies the relationships between various AGN parameters such as the broadband spectral index, X-ray spectral index, luminosity, Eddington ratio, and variability with the aim to constrain AGN physics.

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Eddie Baron

Eddie Baron's supernova group has grown and consists of graduate students Brian Friesen, Jeremy Lusk and Malia Jenks. Postdoc Bin Chen works with them on a part-time basis, sharing his time working on lensing projects with professors Dai, Kantowski and David Branch. Brian is working on including the physics of late-time pseudo nebular objects into the PHOENIX code framework. Jeremy passed his specialist exam this semester on peculiar Type II supernovae and will write up that work and then move on to his yet-to-be defined thesis project. Malia has been busy with coursework, but will work on metallicity effects in Type Ia supernovae for her specialist project. Brian and Bin are working on a paper to develop a fully general relativity framework for photon and neutrino transport that would be particularly valuable in core collapse calculations. Eddie will present work on 3D PHOENIX at the conference Fifty One Ergs at North Carolina State University in May 2013.

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Karen Leighly and students have made significant progress in the past year. OU graduate student Erin Cooper is working on HST data from the low-luminosity Seyfert galaxy WPVS 007. Leighly discovered the emergence of a broad absorption line with maximum velocity of 6,000 km/s in FUSE spectra of WPVS 007 taken in 2003. The HST spectrum, taken in 2010, shows that the outflow is still present. However, the maximum velocity is now 11,000 km/s, and the profile suggests that acceleration has occurred. This has never been seen before; generally, absorption line variability is limited to changes in the optical depth with no changes in the velocity. This object also has an anomalously low luminosity for such a high-velocity outflow, and it is an X-ray transient. It is

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possible that the object is undergoing a rare ejection event. This scenario will be tested with two new HST observations scheduled for June and December 2013. OU undergraduate student Adrian Lucy participated in the USRP program at Goddard Space Flight Center last summer. He worked with Bret Lehmer on Chandra X-ray data from a z=2.23 proto-cluster, finding evidence for enhanced AGN activity. He presented a poster at the 221st AAS meeting, and the paper is now published. He will spend this summer participating in an REU program at the National Radio Astronomy Observatory, working on ALMA data from the Orion Nebula. Leighly continues to work on the HeI* sample. HST observations scheduled for June will probe phosphorus absorption in the rest far UV in two objects that are known to have HeI* absorption in the rest frame optical and infrared. These data will be used to investigate the physical origin of partial covering, a poorly understood property ubiquitous in Broad Absorption Line quasars, by taking advantage of expected radial dependence of temperature in the accretion disk.

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Dick Henry's research time has been split roughly evenly among three projects related to abundance measurements in the disks of spiral galaxies. First, he began a new project with Dana Balser at the National Radio Astronomy Observatory to study the distribution of oxygen over the plane of the Milky Way disk. The assumption by galaxy modelers has long been that as massive stars eject newly formed oxygen, it is instantaneously mixed into the local interstellar medium. Dick and Dana are testing that assumption by looking for abundance variations in both the radial and azimuthal (theta) dimensions. A second project, closely related to the first, is the use of integral field spectroscopy to study oxygen distribution in several external spiral galaxies. Data obtained at the McDonald Observatory is being used to do this. The project is being primarily carried out by Tim Miller as part of his dissertation. Tim is close to completing an analysis of NGC 2403 with a paper on that study due out later this year. Finally, Dick is preparing to launch a comprehensive study of abundance patterns in the disk of the Andromeda Galaxy (M31). This galaxy seems to have had an interesting history, in that it may have formed out of the merger of two smaller galaxies and then was later tidally disrupted by a near collision with M33, another spiral galaxy in the Local Group. Detailed chemical evolution models will be used to interpret abundance data for a large fraction of M31's disk.

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John Wisniewski

John Wisniewski continued to investigate a variety of circumstellar disk systems with large teams of international collaborators. He presented a poster at the 2013 AAS meeting reporting the discovery of a B-type emission line star conundrum identified by the SDSS-III/APOGEE project. The star exhibits abnormally large (FWHM ~1400 km/s) velocities, and is now believed to be a sigma Ori-E analog, i.e., a near-critically rotating B-type star with a magnetically confined disk. John's work with the Strategic Exploration of Exoplanets and Disks with Subaru (SEEDS) continued. He analyzed spectra of a large subset of the planet-search target list to age-date each system, and also was part of the team that reported the imaging discovery of a 13 Jupiter-mass "Super Jupiter" around the star kappa Andromeda. John's research group will welcome the addition of two postdocs in the summer and fall of 2013, Jun Hashimoto (National Astronomical Observatory of Japan) and Jamie Lomax (University of Denver).

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Mukremin Kilic's group now consists of postdoctoral fellow Alexandros Gianninas (PhD, U. de Montreal), graduate students Sara Barber and Paul Canton, and undergraduate student Ben Strickland. Ben will start graduate school in physics at Oregon in the fall. Alex and Ben have

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co-authored a paper on limb-darkening coefficients for eclipsing white dwarfs that will be detected by the Large Synoptic Survey Telescope. Alex and Mukremin have used the Keck 10m telescope in February 2013 to observe a 12-min orbital period double white dwarf binary every 30 seconds. Mukremin, Alex and collaborators Hermes (Texas) and Brown (Smithsonian) are using the Gemini 8m and McDonald Observatory telescopes to measure the rate of period change of the same system to indirectly detect gravitational waves and to test Einstein's theory of relativity. Sara used the 6.5m MMT to image two dozen candidate white dwarfs with debris disks. These disks are the tidally disrupted remains of asteroids and small planets, similar to Saturn's rings. Sara also has received Spitzer Space Telescope time in 2013 to image 100 massive white dwarfs to constrain the frequency of disks around them and to constrain the frequency of planets around their progenitor massive stars. Sara and Alex attended the European White Dwarf Workshop in Poland last summer and the AAS meeting in Long Beach in January 2013. Paul, Alex and Mukremin are using the Kitt Peak 4m telescope to identify short period binary white dwarfs in the ELM Survey. The team also has used the Chandra X-ray observatory to search for pulsar companions to several of these binary systems.

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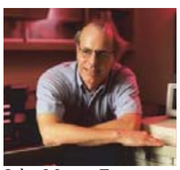
Atomic, Molecular and Optical Physics


John Moore-Furneaux

John Moore-Furneaux is continuing the efforts pioneered by the Neil Shafer-Ray group to measure the electron's Electric Dipole Moment (e-EDM) using a molecular beam of PbF. Neil and his collaborators, Jens Grabow at the University of Hannover and Richard Mawhorter of Pomona College, were able to measure the ground state of PbF to great accuracy, about 100 Hz, which enabled the design of a Ramsey Cavity experiment with the potential to put new limits on the size of the e-EDM. We are now in the process of gathering the resources to actually accomplish Neil's dream. This effort has been facilitated by the generous donations in memory of Neil, especially by Jules and Marcia Shafer, Neil's father and mother. James Cocker, a graduate student working on the e-EDM project, is receiving the first award from this donation.

During this past year, Neil was incredibly productive even while battling acute myeloid leukemia. He in large part authored three papers, wrote two NSF proposals, and completed the design of the Ramsey Cavity experiment to measure the e-EDM in PbF. To complement his efforts, Tao Yang and James Cocker, graduate students in the group, and Jeff Gillian, a physics undergraduate, have been improving the stability of the diode laser system that will accomplish the important quantum state coherence measurements that are at the heart of our e-EDM search. They have been testing this system by measuring precise, saturated absorption spectroscopy of $^{130}Te_2$. This work is important in itself as $^{130}Te_2$ is used as a frequency reference at green and blue visible wavelengths. James has managed to decipher parts of this complicated spectrum and is in the process of establishing new spectroscopic constants for $^{130}Te_2$ with unprecedented precision and accuracy.

Neil's former students are doing well. Chris McRaven continues to work with Trevor Sears at Brookhaven National Laboratory and SUNY Stony Brook. Milinda Rupasinghe completed his post-doc at the Jet Propulsion Laboratory at Cal Tech and is now teaching at Cameron University in Lawton. He also is helping us in the lab. Finally, Tao Yang, who completed his Ph.D. in August 2012, has a post-doctoral position with Rolf Kaiser at the University of Hawaii.

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Jim Shaffer's group has had an exciting year. Harald Kuebler completed a successful year as a postdoc in the group. He is back off to Stuttgart. Jim is sure he will return to visit them again soon. A former undergraduate student, Patrick Zabawa, returned to the group as a postdoc. Santosh Kumar from Jawaharlal Nehru University, India, and Orsay, France, will join the group to take Harald's place. Jonathan Tallant successfully defended his thesis and is now working with Luis Marcassa at the University of

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Sao Paulo in Brazil. Arne Schwettman, now at NIST-Gaithersburg, won the Nielsen Award this past year. Two new graduate students also joined the group this year: Charles Ewel and Jin Yang. They are both off to a good start. Luis Marcassa visited several times to talk about Rydberg atom interactions. Renate Daschner, from Stuttgart, also visited for two months to work on the RF electric field sensing project. It has been a steady stream of new people and ideas flowing through the Shaffer group. Jim's group also had a successful year publishing papers. They had publications in *Physical Review Letters* (editors' choice) and *Nature Physics*. The *PRL* earned them an invited talk at DAMOP this year. The group also has submitted a paper on vector sensing of electric fields with atoms and on a method to count photons using a decoherent process as a fundamental tool for quantum devices. The latter paper also deals with Rydberg atom – surface phonon polariton interactions. As for conferences, the group is giving two talks and three posters at DAMOP this year. They also presented invited talks at the DLS/OSA meeting in Rochester, ITAMP, the University of Wisconsin, University of California-Merced, University of Stuttgart, University of Sao Paulo, and Oklahoma State University this year. They participated in the AMO mini-conference between OU and Oklahoma State, and they are hoping that much valuable collaboration comes out of talks initiated at the conference. In the lab, Don Booth, Patrick and Jin improved the Cs system so that they can do better experiments on Rydberg atom interactions, particularly on anisotropic interactions and trilobite states. Don also is working with Greg Parker on doing accurate scattering calculations on their Rydberg interaction potentials. Jon Sedlacek, Haoquan Fan, Charles and Harald are continuing to work on Rydberg atom surface interactions and electric field sensing with Rydberg atoms. Shaffer's group has made a lot of progress on these projects but it is a little too much to describe here. All in all, it has been a pretty good year. Next year looks to be even better!

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Deborah Watson

Deborah Watson spent her sabbatical year changing research directions from studying systems of cold bosons to studying systems of cold fermions. Fermions are the building blocks of visible matter and comprise a number of important systems in different fields of physics, including nuclei, electrons in metals, superconductors, the quark-gluon plasma in the early universe, and white dwarf and neutron stars. Ultracold fermion systems have provided physicists with new types of large systems to study whose interactions can be controlled with great precision. These systems can be tuned to have strong interactions and thus provide an important testing ground for many-body theories. Previous work by Deborah's group had formulated a many-body perturbation method to handle fully interacting bosons through first-order effects. Reformulating this method to handle fermions requires a major overhaul of the method. Fermions are especially challenging to describe due to the Pauli principle, which forbids two identical fermions from occupying the same quantum state. Enforcing the Pauli principle in a many-body calculation is time-consuming and thus quite expensive. The approach chosen by Watson and her collaborators uses mathematical techniques such as group theory and graphical techniques instead of computers to do the "heavy lifting." The difficulty of describing fully interacting exact quantum wave functions scales exponentially with N, the number of particles "hitting a wall" around N=10 particles, a surprisingly low number. By taking advantage of symmetry, Watson's group successfully has reconstructed this "exponential wall" using analytic building blocks, allowing calculations to be performed for very large systems through low order in the perturbation series. The goal is to acquire insight into the transition from microscopic interactions to macroscopic behavior for these large and technologically important systems.

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Barbara Capogrosso-Sansone

Barbara Capogrosso-Sansone's research interests lie in the field of ultracold atoms and molecules. She has been interested in studying quantum phases of many-body strongly correlated systems by means of large-scale quantum Monte Carlo simulations. Barbara and her collaborator, Arghavan Safavi-Naini from MIT, have been closely working on several extensions of the Worm algorithm for path integral Monte Carlo, which will allow the study of exotic states of dipolar bosonic systems in an accurate and unbiased manner. The dipole-dipole interaction can be tuned and shaped via external static and microwave electric fields. Its long-ranged and anisotropic nature results in more interesting states of matter, compared to what can be realized by contact interaction. Within the theoretical and experimental communities, the importance of unbiased Monte Carlo techniques capable of simulating experimentally realizable models has been widely recognized. To this day, not many groups in the world have access to such powerful techniques. As far as is known, the developments Capogrosso-Sansone and her colleague have made are not yet available to any other group. Experimental realizations of quantum many-body dipolar systems with large induced electric dipole moment, e.g. polar molecules, seem to be imminent. Hence, accurate and unbiased theoretical predictions are timely and crucial to guide experimentalists. Capogrosso-Sansone enjoys collaborations within the United States, Europe and Brazil. She recently has co-organized a successful workshop hosted by ITAMP (Institute for Theoretical Atomic, Molecular and Optical physics) titled "Finite temperature and low energy effects in cold atomic and molecular few- and many-body systems" which brought together top scientists from all over the world.

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Greg Parker: Greg's graduate student Jeff Crawford developed a time-dependent hyperspherical coordinate method and associated numerical software for studying triatomic quantum reactive scattering. The time-dependent method offers an intuitive, physically meaningful picture of the reaction dynamics, as a wave packet can be observed as it propagates along the triatomic potential energy surface. The use of wave packets provides information over a distribution of scattering energies for a single propagation in time, and as the wave packet returns to the product regions of the PES, "snapshots" are taken at each time step to determine constituent final states. Using hyperspherical coordinates increases the computational efficiency. For three identical particles, the triatomic PES becomes symmetric, reducing the amount of coordinate space required to represent the evolving wave packet. Reactive scattering results are important in the areas of combustion chemistry, atmospheric chemistry, ultracold dynamics and trap loss in Bose-Einstein condensates. Jeff admirably defended his dissertation on Jan. 23, and is enjoying his new job at Halliburton in Houston. Undergraduate Research Day is a blue-ribbon event that was held on April 13 at OU. Zachary Eldredge, an undergraduate student working with Greg, won the Roland Lehr Phi Beta Kappa Award for Distinguished Undergraduate Research. Zach currently is incorporating additional capabilities, such as external fields and conical intersections into the time-dependent hyperspherical method developed by Jeff.

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New AMO assistant professor **Alberto Marino** spent the last year building a quantum optics laboratory in Nielsen Hall, which involved a significant renovation of Room 320 on the third floor. The renovations are almost finished, and the initial setup of the apparatus is now taking place. Alberto and graduate student Ailing Deng have been working on characterizing the equipment and setting up the basic experimental apparatus. The apparatus consists of two Ti:Sapphire lasers that are used to implement a four-wave mixing process in an atomic vapor cell. This system will make it possible to generate highly entangled beams of light, known as twin beams, that will be used for applications in quantum information science and quantum

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metrology. The use of an atomic system to generate twin beams makes it possible to obtain a large degree of entanglement without the need of a cavity. This makes the twin beams intrinsically multi-spatial mode, which means that they contain spatial quantum correlations. Once the initial setup is finished, the initial experiments will study the dependence of the spatial correlation on the different experimental parameters to find ways to use this degree of freedom for quantum information applications. Undergraduate student Kramer Harrison has been working on his senior capstone project to develop a temperature stabilization circuit based on the Arduino microprocessor system. This system offers a versatile way of controlling different aspects of the experiment. If all goes well, the first entangled light generated in Nielsen Hall should be produced this summer.

Condensed Matter Physics

Bruno Uchoa

During the past year, **Bruno Uchoa** started his research group with the arrival of the postdoctoral fellow Akbar Jaefari and graduate student Xu Dou. In this period, Bruno published one review article in *Reviews of Modern Physics*, two papers in *Physical Review B* and one article in *Physica Scripta T* for the proceedings of the Nobel Symposium on graphene, held in Stockholm. He was an invited speaker in the 2013 APS March meeting, and presented his work at University of Texas A&M and the University of Indiana. Bruno has been theoretically searching for new exotic quantum states of matter in low-dimensional systems. A typical system of interest is graphene, a flat giant molecule made of carbon atoms that can be hundreds of microns wide and long, but just one atom thick. The electrons in graphene propagate as relativistic massless neutrinos, and show a variety of properties familiar in quantum electrodynamics. One remarkable property of graphene is that when it is stretched in a particular way, the electrons behave as if they were in the presence of an extremely large magnetic field perpendicular to the graphene plane. Unlike in real magnetic fields, in strained graphene there is no net magnetic flux, but nevertheless, the electrons move in circular orbits and show a remarkable quantum property only observed in semiconductors at very large magnetic fields, known as Landau level quantization. In a recent article, Bruno proposed an unprecedented possibility of superconductivity, a state of matter where the electrons propagate without dissipation, being spontaneously generated by Landau level quantization in strained graphene. His proposal opens the possibility for a first-time observation of superconductivity in this material, a discovery that could have a tremendous impact for applications.

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This last year has involved extensive development of the experimental capability in **Ian Sellers**' laboratory here at OU. The equipment currently under construction includes various optical and optoelectronic capabilities, which offer the ability to investigate semiconductor materials from the UV to IR, at low and high temperature, and at magnetic fields to 7 Tesla. The techniques available include photo and electroluminescence, absorption/transmission, photo-modulation spectroscopy, and PLE (among others). The recent delivery of a new optical-access superconducting magnet also allows the investigation of single semiconductor nanostructures. This system is predominantly for the investigation of semiconductor nanorings, and single magnetic quantum dots. In addition to the experiments already described, the laboratory also is fully equipped for solar cell characterization and photovoltaic materials development. These techniques facilitate our research in next generation solar cells. Indeed, in the past year Ian also has continued very fruitful collaborative research programs with partners at University College London, Oxford University and SUNY Buffalo. As a result, articles have been published related to the viability of semiconductor quantum dots for photovoltaics [Applied Physics Letter, Solar Energy Materials & Solar Cells], along with work on the dilute nitrides for multi-

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junction solar cells [*Applied Physics Letters*]. Coupled with all this, Ian also has been very busy writing grant proposal submissions!

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Kieran Mullen

Kieran Mullen has been working on the theory of heat transport in carbon nanotubes and graphene, a single atom thick sheet of carbon. These materials have enormous potential application in plastic composites, if the barrier to getting heat in and out of the molecules can be reduced. In addition he has been doing calculations on the properties of electrons in unusual geometries, specifically rings and shells. These systems are unusual in that the electrons live in a compact yet periodic space, allowing novel behavior.

High-energy Particle Physics

This has been a year of transition for **Mike Strauss,** as he has changed the focus of his research from primarily working with the D0 collaboration at Fermilab to primarily working with the ATLAS collaboration using the Large Hadron Collider at CERN. Of course, ATLAS was one of the two experiments to discover the Higgs Boson as announced in July. Details about the importance of this discovery can be found in another article in this newsletter. In the first half of the year Mike served as the co-convener of the D0 QCD (Quantum Chromodynamics) physics working group at D0, supervising and directing all QCD analysis within the D0 collaboration. He worked with Peter Svoisky, an OU post-doctoral researcher, on measuring the differential production cross section for two photons. A paper from this research has been submitted to *Phys. Lett. B.* During the last half of the year, Mike has been working with two OU graduate students, Ben Pearson and Callie Bertsche, looking at ATLAS data. In particular, they currently are looking for the decay of a Higgs boson to two W bosons, which then decay to two leptons and two quarks. This is a decay mode that has not yet been seen by either detector at the LHC. For a Higgs Boson at 125 GeV, (the mass of the recently discovered particle), this decay mode is quite challenging to see due to extremely large backgrounds and the difficulty of triggering on events with lower momentum particles. However, many theories, like supersymmetry, that extend the standard model of particles and fields, predict that other Higgs bosons should exist and can be discovered at the LHC. We expect that the discovery of the Higgs last summer is just a pre-cursor to the many exciting discoveries that will come from the LHC in the next decades.

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Howie Baer

Howie Baer: The year 2012 was dominated by the discovery of the Higgs boson at the Large Hadron Collider with mass 125 GeV. But still there is no sign of supersymmetric matter. These results exacerbate what has become known as the Little Hierarchy Problem: how can superparticles live above the TeV scale while the Z and Higgs mass sit around 100 GeV? We have created a new scenario known as Radiatively-driven Natural Supersymmetry or RNS (see Phys. Rev. Lett. 109 (2012) 161802 and arXiv:1212.2655) which implements a new measure of naturalness for supersymmetric models. We find that the key feature for natural supersymmetry is a spectrum of light higgsinos (supersymmetric partners to the Higgs boson) with mass similar to that of the Higgs: 100-200 GeV. The higgsinos are very difficult to see at LHC due to their compressed spectrum and low energy release from decays. A linear electron-positron collider is required to fully test this model. For RNS models, we expect dark matter to consist of a higgsino-axion admixture, where the higgsinos ought to be detectable at the Xenon-1-ton WIMP (Weakly Interacting Massive Particle) detector. The RNS model is a key feature of the 2013 Snowmass study on the future of High Energy Physics, since it provides strong motivation for the United States to become a major supporter of the Japanese-led initiative to build an International Linear electron-positron Collider (ILC). In this case, the ILC would be not only a Higgs boson factory, but also likely a higgsino factory as well!

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Kim Milton's group, currently consisting of two postdocs (Elom Abalo and Prachi Parashar), one graduate student (Yifan Zhang), one undergraduate capstone student (Stephen Holleman), and one visiting sabbatical scholar (Fardin Kheirandish, on leave from Isfahan University, Iran), as well as numerous outside collaborators, including Iver Brevik, Steve Fulling, K. V. Shajesh and Klaus Kirsten, has continued to be active, with thrice weekly meetings, 2 to 6 p.m. each MWF. Their work on "PT-Symmetric Quantum Electrodynamics and Unitarity," in which they show that non-Hermitian quantum theories seem to have a fatal problem with unitarity, was published in the world's first science journal, *Philosophical Transactions of the Royal Society*, in April. They continued to explore "Thermal Issues in Casimir Forces Between Conductors and Semiconductors," and concluded that there is a serious conflict between experiment and theory in quantum vacuum physics. In "Electromagnetic semitransparent delta-function plate: Casimir interaction energy between parallel infinitesimally thin plates," they develop the machinery to consistently describe conducting plates of negligible thickness, and in the process show that Bordag's old claim of an anomaly in the interaction of a polarizable atom with a conductor is erroneous. With REU student Giulio Meille, they attempted to demonstrate in "Electromagnetic Angular Momentum and Relativity" the fallacy of Mansuripur's claim of inconsistency between Maxwell's equations and special relativity. In soon to be published work, "Three-body Casimir-Polder interactions and Casimir interaction energies for magneto-electric delta-function plates," they examine the interaction of two atoms with a plate, and extend the thin plate description to magnetic materials, respectively. They currently are completing a paper in which they show how to consistently renormalize the quantum vacuum energy of an annular region between two concentric conducting cylinders, intercut with a conducting wedge. The torque on one wedge surface is indeed the negative derivative of the energy with respect to the wedge angle. They are at present extending this scalar calculation to include full electromagnetism. Kim will continue his studies of the applications of quantum vacuum physics next year while he is on sabbatical at the Laboratoire Kastler Brossel at the Universite Pierre et Marie Curie in Paris, working with Astrid Lambrecht and Serge Reynaud there.

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Phil Gutierrez

During the past year, **Phil Gutierrez** has been working as a member of both the Fermilab D0 and CERN ATLAS collaborations. He is participating in two measurements using D0 data, both studying properties of the top quark. The first is the measurement of the top quark mass in the all hardons final state with OU graduate student Ayesh Jayasinghe, who will defend his dissertation this summer. The second analysis is a collaboration with non-OU D0 collaborators, which is a measurement of the top anti-top production cross section in the tau lepton plus hadrons final state. This mode is not very well measured; therefore, it can be used to improve limits on non Standard Model physics. (OU graduate student Sohrab Hossain and Phil performed the first and only measurement in this final state using Fermilab data.) They have made many improvements to this measurement and hope to finish and publish the results this year. Another analysis that is being carried out with D0 data is the study of multi-parton interactions. The work is being performed with OU post doc Peter Svoisky. They are using two final state channels for this measurement. The first uses two photons plus two hadronic jets (clusters) and the second looks for two J/psi particles. To disentangle single parton from multi-parton interactions, one looks at the angular correlations between the final state particles. This is then compared with theoretical models to extract the fraction of multi-parton interactions that have occurred. Both these analyses are moving toward publication. To make the transition to the ATLAS experiment, Phil decided to pursue the same analysis as on D0, the production cross section of top anti-top quarks in the tau lepton plus hadronic final state. This measurement is at a

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higher energy, so will be a new result. This analysis is using the recently collected data at 8 TeV center of mass energy and is being performed with OU graduate student Ahmed Hasib. In addition, with Ahmed and OU engineer Rusty Boyd, they are performing some tests on the ATLAS silicon pixel detector to improve its performance for future high-intensity data-taking.

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Brad Abbott

Brad Abbott: This past year has been very exciting for high energy physics with the discovery of the Higgs boson at the LHC. Hopefully, more exciting discoveries are in the future. Brad has been focusing more of his research time at CERN with his two graduate students Scarlet Norberg and David Bertsche. Scarlet currently is a resident at CERN, where they have been studying the inclusive photon cross section. This analysis allows them to probe the structure of the proton by allowing the group to extract the momentum distribution of the quarks and gluons within the proton. Using the latest data set collected at ATLAS, they also have recently began searching for new supersymmetric particles by searching for events containing leptons, photons and large missing transverse energy. With this analysis they hope to place the world's most stringent limits on a number of SUSY particles. David Bertsche and Brad have been working on studying QCD backgrounds for two of the analyses that their group has been studying, namely Higgs decaying to two W bosons and top anti-top decays to tau + jets. David is expected to move to CERN, where he will begin working on designing and building the next generation ATLAS detector. Brad also is continuing to work in B physics at the D0 experiment, studying the decays of B mesons decaying to a J/Psi particle + anything. In 2012 two publications on B decaying to J/Psi f0(980) and B decaying to J/Psi K+ K- were published. Brad currently is working on measuring the Bs lifetime of CP odd state Bs decaying to J/Psi f0(980). He will be on sabbatical during the fall 2013 semester and hopes to spend more of his time at CERN working on SUSY analysis and helping build the upgraded ATLAS detector.

Physics Major Awarded Astronaut Scholarship

Michael Reynolds, a junior majoring in physics, has been awarded a $10,000 scholarship from the Astronaut Scholarship Foundation for the 2013-2014 academic year. In addition to excelling in the classroom, Michael has performed experimental research on gold nanostructures. His research has been conducted at OU with Lloyd Bumm during most of the past two years and as an REU student at Rice University last summer. According to the Astronaut Scholarship Foundation, "Ideal candidates will have exhibited motivation, imagination and exceptional performance in their fields, as well as intellectual daring and a genuine desire to positively change the world around them, both in and out of the classroom."

(Alumni News Continued)

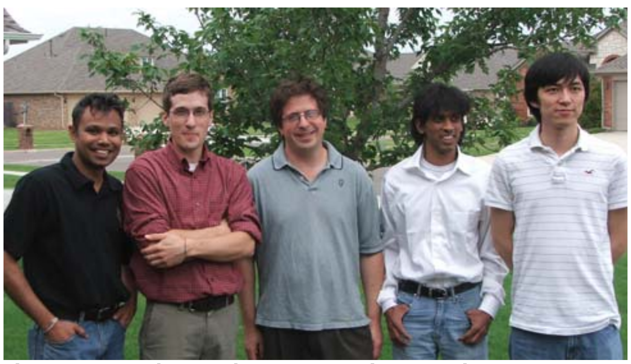
Ian Spielman was elected a fellow of the American Physical Society in 2012. He was nominated by the Division of Atomic, Molecular & Optical Physics "for innovative and pioneering work in quantum phenomena at the intersection of atomic and condensed matter physics." He received a BS in physics and math from OU in 1998 and performed capstone research with Sheena Murphy.

Paul McEuen, who received a BS in engineering physics from OU in 1985, was elected to the OU College of Engineering's Distinguished Graduates Society in May 2013. Selection is based upon prominent and distinguished professional or technical achievement, notable public service, outstanding contribution to and support of education, honors of election in organizations, and other contributions to the engineering profession. Paul is the Goldwin Smith Professor of Physics at Cornell University as well as the director of their Laboratory for Atomic and Solid State Physics and the Kavli Institute at Cornell for Nanoscale Science.

(Neil Shafer-Ray continued from page 1)
friends and family, playing sports with his boys, inventing games to include any age child, and over-engineering home improvement projects.

Neil's death brought an outpouring of thoughts and memories from friends, colleagues and students, many of whom returned for the Jan. 5 memorial service, which overflowed capacity. We have included some excerpts:

"Neil and I had many discussions on his eEDM project and on mine. There's a sense in which Neil was a physicist very much in the tradition of Feynman. He liked to work everything out for himself. He didn't trust the conventional wisdom. For this reason he often had his own idiosyncratic way of describing things. Several times Neil and I disagreed on some point about molecular structure, but then I realized what he was saying made sense - it just wasn't the way I was used to hearing the idea presented. He was a very creative scientist, and I and the rest of the world of molecular physics will miss him." -Eric Cornell, Nobel Laureate, 2001.


l-r: M. Rupasinghe, A. Schwettmann, Neil, S. Poopalasingam, T. Yang

"Perhaps, the most vivid memory I have of him is of us sitting together in a stinking, darkened room staring intently at the bubbles rising in a glass of beer. The glass was being backlit so that we could record photographically a bubble's acceleration and growth in size as it rose from the bottom to the top. A ruler was placed inside the filled beer glass to provide accurate measurements. Enough beer had been carelessly spilled that the room reeked of its presence. This led to one of my favorite scientific publications, "Through a Beer Glass Darkly," Physics Today 44(10), 48 (1991), in which Neil was the first author. It captured the idea that physics and chemistry were all about us and its appreciation could bring great joy. Neil Shafer-Ray will be sorely missed. " -Richard Zare, Marguerite Blake Wilbur Professor in Natural Science, Stanford University

"A particular memory was one time when my car broke down and I was dead broke. He gave me one of his cars and $400. I don't even think he expected me to pay him back. He said he didn't want me to be distracted from research by little things. I paid him back, but was really amazed at how willing he was to help, and with no hesitation at all." -James Coker, current Ph.D. student.

"The last time I saw Neil, I was visiting OU with my then-girlfriend and now wife in September 2009. He was excited to tell me all the new ideas in the EDM project, but was worried that my wife, who does not speak English well and who is not a physicist, would be bored, so we all went to the art museum on campus, where Neil proceeded to tell me about the latest results while my wife could admire the artwork." -Sam Meek, former undergraduate in Neil's group, currently at the Fritz Haber Institute of the Max Planck Society, recipient of the 2010 Otto Hahn Medal

"I would walk along the hallway in Nielsen with Neil coming the other way, greet him, and have him look through me; then 10 minutes later have him interrupt my preparation for class with `I've figured out how to ... make a better widget, make a better measurement, make a better presentation, explain this puzzling set of data, teach this piece of

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(Neil Shafer-Ray continued)

physics more effectively.'" -John Furneaux, OU professor of physics

"Neil was so focused on physics that he was often oblivious to his external environment, especially to the status of his shoe laces." -Ryan Doezema, former chair of the Physics and Astronomy Department

"Neil had a passion for his work. You could tell that he always had something going on in his mind because he was so focused. His shirts were typically wrinkled and only halfway tucked in and his shoelaces. Well they rarely stayed tied and I remember once he came in with two different shoes on. But regardless of his sometimes wayward chalky outside appearance, he was a brilliant scientist. I learned quickly not to be offended if he didn't acknowledge me when I would wish him a good morning. It isn't that he didn't hear me, because he did. At times, yelling back down from the opposite end of the hallway good morning. I am sure he was working on a physics problem in his head and had been in his lab since 3 a.m. or earlier. Later in the day he would come in and apologize, ask me about my children and ask how things are going for me. He was always interested in what was going on in our lives." -Danette Loyd, assistant to the chair

"All the hallway chalkboards in the Neilsen Hall remind me of Neil; not only that, he derived things for us on napkins at restaurants while waiting for food. Besides a great adviser, Neil was one of the greatest human beings I ever met in my life. No doubt that his death is a huge loss for everyone who knew him closely as well as for entire AMO community. I'm still sad when I think about Neil." Melinda Rupasinghe, former Ph.D. student of Neil

Neil's death is a great loss for the Homer L. Dodge Physics and Astronomy Department, OU and the wider scientific community. He was an exceptional human being, the epitome of a dedicated, creative scientist and a superb adviser for his students. He will long be remembered for his zest for physics and for his generosity of spirit, which influenced all his interactions both professional and personal.

Neil is survived by his wife, Kerry Shafer-Ray, his two sons, Reed and Cole; his parents, Jules and Marcia Shafer of Gwynedd Valley, Penn.; his brother Howard Shafer and wife Kate of West Hartford, Conn.; and his sister Toby Petti and husband Michael of Buffalo Grove, Ill.

Contributed by Eric Abraham, John Moore-Furneaux and Deborah Watson

(Shop Talk continued from page 3)


Sean Atteberry

component, a magnesium fluoride tube with an elaborate internal geometry. Other systems incorporate complex magnet geometry and external laser input to produce ultra-cold atoms.

•Assembling a complete hardware and plumbing infrastructure to support a multi-chamber MBE system, including STM and E-Beam analysis.

•Producing a wide variety of low-temperature cryostat hardware.

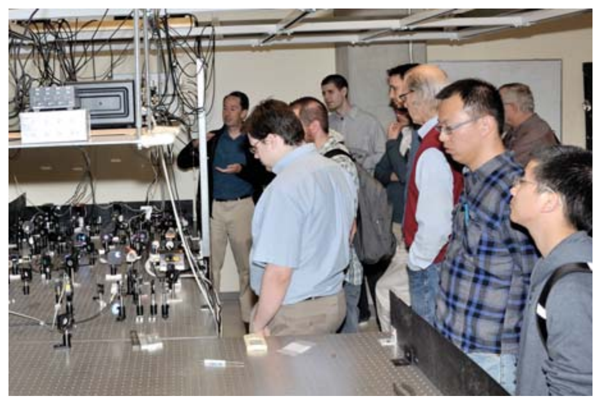
•Finally, around 2008 the shop designed and built an apparatus for a research unit in the OU Department of Geology and Geophysics. This device took more than a year to complete, and produced data that had a significant impact on the associated field of interest. See phys.org/news/2012-10-earthquake-simulator.html and www.popsci.com/technology/article/2013-03/earthquake-machine for more details. Also, see the shop website at www.nhn.ou.edu/shop.

First Oklahoma AMO Research Day

The groups in the field of Atomic, Molecular, and Optical physics from OU and Oklahoma State University organized a research day March 15. The event was hosted by OSU and was attended by professors Eric Abraham, John Furneaux, Alberto Marino, Gregory Parker, James Shaffer and Deborah Watson from OU, and professors Girish Agarwal, Mario Borunda, Bret Danilowicz, Yingmei Liu, John Mintmire, Jacques Perk, Al Rosenberger and Gil Summy from OSU, and more than 20 postdocs, graduate students and undergraduate students. In total, 25 people from OU attended the event which was held in the OSU Student Union. During the one-day meeting, a series of talks, one from each of the AMO groups, was given, primarily by faculty members from both universities. The talks were followed by a poster session, during which the students had the opportunity to present their research. The event also included tours of the labs of rofessors Liu, Rosenberger and Summy and concluded with a catered dinner in which the participants were able to further discuss their research.

The goal of the first Oklahoma AMO research day was to foster collaboration between the two universities. During the event, the different research groups were able to learn about the research conducted by the other groups and explore possible mutual research interests. Due to the considerable overlap between the research done by the AMO groups in both universities, it is expected that this event will lead to significant collaboration that will be highly beneficial for both universities.

We hope that this will be a yearly event and we are looking forward to hosting it on OU's campus next year. The event was supported in part by OU's VPR office, OSU's Women-in-Physics program, and by the physics departments from OU and OSU.



Students and faculty members of both OU and OSU at the AMO Research Day event.

Summer Research for Undergraduates

One dozen students from OU as well as from around the country will be helping to conduct research in the department for two months this summer, thanks to the NSF-sponsored Research for Undergraduates program. The program is run by professor Eric Abraham. The students, home institutions and mentors are: Brent Chappell (Cameron U., Abbott/Strauss), Rita Congdon (Westminster College, Marino), Theodore Curtis (OU, Shaffer), Kenya Davis (U. North Carolina Charlotte, Leighly), Jeffrey Gillean (OU, Furneaux), Seth Hodgson (OU, Johnson), Paul Inman (Ok. Baptist U., Bumm), Meredith McLinn (Minn. St. U. Moorhead, Baron), Rahman Mohd (CUNY, Baron), James O'Deherty (Cameron U., Furneaux), Nick Pellatz (Whitman College, Milton), and Aaron Wegner (OU, Sellers). We welcome these students and wish them success in their summer work.

(OU-Higgs continued from page 1)

prediction is that the Higgs field should manifest itself as individual Higgs particles or bosons, similar to the way a pool of water is made of individual water molecules. The Higgs particle was the one missing piece of the standard model that had not been discovered. The standard model is a comprehensive theory about the fundamental particles and fields of nature that have been confirmed with many experiments over previous decades. If the Higgs was not found, that would be an indication that the standard model was not actually correct or complete.

OU professors Pat Skubic, Phil Gutierrez, Mike Strauss, and Brad Abbott are members of the ATLAS experiment which takes data at the Large Hadron Collider at CERN laboratory in Geneva, Switzerland. ATLAS is a collaboration of about 3,500 physicists from 40 countries. The ATLAS detector is a multipurpose particle detector designed to see what happens when protons collide every 25 ns. A Higgs particle is produced about one out of every 10 billion collisions and almost instantaneously decays to other particles.

The OU High Energy Physics group was responsible for building and testing electronic circuits for the ATLAS pixel detector, a component of the experiment designed to measure the momentum and position of charged particles. In addition, the OU group has searched for the decay of the Higgs particle to two W bosons which, in turn, decay to two leptons and two quarks. Due to high backgrounds, this decay mode has not yet been observed.

Wang and Santos Elected APS Fellows

Two faculty members have recently been elected fellows of the American Physical Society: Yun Wang and Mike Santos.

Yun Wang has extensive experience in exploring dark energy. Yun's nomination as an APS fellow came as a recognition “for her leadership in dark energy research, especially in developing a robust and consistent framework for analysing and interpreting cosmological data to place model-independent constraints on dark energy, and in optimizing the science return of planned space missions to probe dark energy.”
Yun developed the basic framework for extracting dark energy constraints from cosmological data, a framework that is now widely adopted by the cosmology community. She also developed strategies for optimizing future surveys to probe dark energy, and created a mission concept for the Joint Dark Energy Mission, and the Joint Efficient Dark-energy Investigation, where she served as the PI (2004-2006). Yun is a member of the Science Definition Team for the NASA top priority astrophysics mission WFIRST (Wide Field Infrared SurveyTelescope), with a target launch date of 2021, and a founding member of the European Space Agency (with NASA participation) dark energy space mission, EUCLID, which is scheduled for launch in 2019. She also is a member of the Large Synoptic Survey Telescope collaborations on dark energy and supernovae.

Mike Santos made significant contributions to the development of high quality semiconductor materials, which currently are used in such hard core sciences as materials sciences. Some of the materials produced in his lab, such as InAs/GaSb structures and InSb, currently are being used by the Condensed Matter physics community to investigate new quantum states of matter known as topological insulators. Mike was nominated for his work on “growth of compound semiconductor nanostructures and spin transport.” Mike is a Charles L. Blackburn Professor in Engineering Physics and Ted and Cuba Webb Presidential Professor.

2013 Faculty Awards

Matt Johnson

VPR Award, Outstanding Research Engagement

Jim Shaffer

Ted and Cuba Webb Presidential Professor

Kieran Mullen

Student Government Association Award for an Outstanding Faculty Member

Lloyd Bumm

Recognized by Office of Technology for an issued patent

Mike Santos

Fellow, American Physical Society

Yun Wang

Fellow, American Physical Society

Kim Milton

Simons Fellow in Theoretical Physics

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Your donations to our General Fund are used to support such critical departmental activities as physics and astronomy conferences on the OU campus, high-profile colloquium speakers, programs for women and minorities, outreach, alumni reunions, faculty and student research, postdoctoral fellows, graduate research assistants and newsletter publication. What you give to the department stays in the department.

To make a donation, go to www.nhn.ou.edu/donate/

Nielsen Hall, home of the Homer L. Dodge Department of Physics and Astronomy

Foucault pendulum, located in the Nielsen Hall atrium