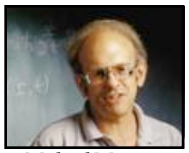
ΦYAST ΦLYER

The Homer L. Dodge Department of Physics and Astronomy
Volume 19, Number 1

The Department Says Farewell To Six Faculty


Michael Morrison

Just as his Ph.D. advisor, Neal Lane, holds the B.S., M.S., and Ph.D. degrees in physics from OU, **Michael Morrison** holds these triple degrees from Rice University. His specialty is theoretical atomic and molecular physics. It was during the time as Lane's advisee that Morrison authored his first book with Thomas Estle and Neal Lane. Book writing became a near constant phenomenon during Morrison's career. After a post-doc at Los Alamos National Laboratory, he arrived at OU in 1977. Besides numerous refereed journal articles, Morrison is author of seven books including those with the titles, "A Dark Night's Dreaming, Contemporary American Gothic Fiction" and "Trajectories of the Fantastic." For his innovative teaching, Morrison was awarded in 1993 OU's highest teaching honor, a David Ross Boyd Professorship, and in 1997 the Medal for Excellence in Teaching from the Oklahoma Foundation for Excellence. He is a Fellow of the American Physical Society. Morrison became David Ross Boyd Professor Emeritus in December, 2010.


Stu Ryan

Stewart Ryan grew up in New York and Indiana. After graduating from Notre Dame, he did his graduate work at the University of Michigan, receiving his Ph.D. in 1971 under Michael

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...And Welcomes Five New Ones

The Homer L. Dodge Department of Physics and Astronomy would like to welcome several new faculty members who will be arriving in fall, 2011. Here are a few words about each of them.


Barbara Capogrosso-Sansone

Barbara Capogrosso-Sansone (AMO group) received her B.S. from the University of Turin (Italy) and her Ph.D. from the University of Massachusetts, Amherst. Currently she is a Postdoctoral Fellow at the Institute for Atomic, Molecular and Optical Physics (ITAMP) at the Harvard-Smithsonian Center for Astrophysics, in Cambridge, MA, where she is finishing her third year. In the past she has worked on biophysics problems, in particular modeling of cancer growth in soft tissues, and non-linear acoustics. Her current research interests include strongly interacting many-body systems and numerical methods. In particular she has been studying ultracold atomic and molecular bosonic gases in optical lattices by means of large scale quantum Monte Carlo simulations. Ultracold atoms have proved to be versatile and highly controllable systems with many interesting applications and with the possibility of simulating condensed

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From the Chair

On Friday, May 20, we honored six of our outstanding faculty who have or will retire within a year: **Professors David Branch**, **Michael Morrison**, **John Cowan**, **Bill Romanishin**, **Stewart Ryan** and **Ryan Doezema**. Not only are these individuals some of our most talented and successful faculty, they are also excellent friends, advisors and teachers. All of us are indebted to them, and we admire their example. Although they are retiring, we know they will continue to be productive researchers and friends of the department. The banquet held in their honor was a huge success, with 179 in attendance. Many of our alumni traveled great distances at their own expense to attend this celebration. I thoroughly enjoyed the event, and it was a pleasure talking with many of you. (See photos on page 19.)

Special thanks go to the czar of the retirement celebration, Professor Deborah K. Watson and Danette Loyd. Both spent many hours organizing and taking care of every detail. I enjoyed listening to Vice President for Research Kelvin Droegemeier give some introductory remarks. His enthusiasm for the future of the university and his support of our department is unequaled. He described our department as one of the most outstanding at OU and announced that the university is committed to its success, describing a new building for research laboratories.

Since all four of our Board of Advisors (Chun Lin, Neal F. Lane, A.T. Stair and G. Ward Paxton) were in attendance for this celebration, they met with Chief Financial Officer Nick Hathaway, Dean Paul Bell, VPR Kelvin Droegemeier, University Research Cabinet Chair Paul Risser, VPR Administrator Melany Dicksons, and Graduate College Dean Lee Williams. This meeting was very productive. We also learned that the Homer L. Dodge Department of Physics and Astronomy is one of the top three departments/priorities at the University of Oklahoma!

The spring semester was exceptionally productive, since we interviewed twenty candidates for five faculty positions. I am delighted to announce that Xinyu Dai, Mukremin Kilic, Barbara Capogrosso-Sansone, Ian Sellers and Bruno Uchoa will join our department as assistant professors in August. These five new faculty members are some of the very best junior scientists in the world. Thanks to all of our administrators, alumni and friends of the department who are contributing their time, expertise, advice and financial support to ensure our success as we make a quantum leap forward.

—Greg Parker

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The ΦYAST ΦLYER is the official newsletter of the Homer L. Dodge Department of Physics & Astronomy, University of Oklahoma, and is published each spring at a cost of $1.70/copy to the taxpayers of the State of Oklahoma. The newsletter staff includes Dick Henry, Deborah Watson, Howie Baer and Ryan Doezema. The University of Oklahoma is an equal opportunity institution. All photographs are by Robert Taylor unless otherwise noted.

Retiring Faculty (continued from page 1)

Sanders. Following his years in Ann Arbor, Ryan had post-doc positions at Yale and the University of Arizona working for Willis Lamb. In 1977 he came to OU. Ryan's research as an experimentalist spanned low temperature, atomic and molecular, and applied accelerator physics. Among the Department's faculty, Ryan is perhaps the best known statewide because of the countless shows he has done as "Dr. Indestructo," teaching thousands of young students the wonders of physics. He also has been a beloved teacher at OU of the many non-majors who take physics by choice, not requirement. As a result, he has garnered nearly every teaching award at OU and also received in 1989 the Medal for Excellence in Teaching from the Oklahoma Foundation for Excellence. Ryan is an enthusiastic participant in the department's Engineering Physics Program and has served as academic advisor to the students in that program for many years. Stu plans to retire in December, 2011.

John Cowan

Growing up in the Washington, D.C., area, **John Cowan** received his B.A. degree from nearby George Washington University. Following a brief foray into solid state physics at Case Institute of Technology in Cleveland, where he received his M.S. degree, Cowan went to the University of Maryland, where he received his Ph.D. in astronomy under Michael A'Hearn in 1976. After a post-doc at Harvard, Cowan came to OU in 1979. An expert in stellar evolution, Cowan has published well over 200 refereed papers. He built up and attracted many students into OU's introductory course for non-majors in astronomy and in 2002 was made David Ross Boyd Professor. John is retiring in August, 2011.

Bill Romanishin received his A.B. degree from Harvard and his Ph.D. from the University of Arizona in 1980. Following post-doc positions at NASA/Goddard and Arizona State University, Romanishin came to OU in early 1989. An observational astronomer, Romanishin is an expert in the photometry and spectrometry of outer solar system objects. He modernized OU's observatory with the introduction of CCD spectrometry and acquired the current telescope with an OU-matched NSF grant. Romanishin plans to retire in December, 2011.

Bill Romanishin

Ryan Doezema

After growing up in California, the Netherlands and Michigan, **Ryan Doezema** received his B.S. degree from Calvin College in Grand Rapids, Mich. He did his graduate work at the University of Maryland and received his Ph.D. under Fred Koch in 1971. After a post-doc with Dennis Drew, also at Maryland, Doezema followed Koch, who took a chaired position, to the Technical University of Munich in Germany, remaining for nearly seven years. In 1979 he came to OU. As a solid state experimentalist, he worked both in metal physics and semiconductor physics and taught courses ranging from "pre-med" physics to graduate courses. In 1990 he became chair of the department, a position he held until 2009. In 2004 he was awarded a Regents' Professorship. Doezema plans to retire in May, 2012.

David Branch

David Branch was raised in Pennsylvania, became a physics major at Rennselaer, and received his Ph.D. in astronomy from Maryland in 1969 with thesis advisor Roger Bell. It was as a post-doc at Cal Tech that he became interested in supernova spectra, later a life-long passion. Following a year at Cal Tech, he held a post-doc with Bernard Pagel at the

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Retiring Faculty (continued from page 3)

Royal Greenwich Observatory. It was in 1973 that Branch arrived at OU to begin his 37-year career in the Department. Specializing in supernovae, stellar spectroscopy and cosmology, Branch has authored around 250 refereed publications and taught courses ranging from introductory astronomy for non-majors to graduate courses geared toward experts. Branch was department chair from 1985 to 1990, a crucial and formative time in the Department's history. In 1987 he was made George Lynn Cross Research Professor, OU's highest research honor. Branch retired in May, 2010.

Hats Off to Our Students!

Many of the Department's students were honored for their achievements during the annual awards ceremony held on May 5. Below are listed the students' names grouped by their scholarships and awards.

Homer L. Dodge Departmental Awards

Dodge Prize
Scott Lowe (Junior) & Thanh-Nhan Do (Sophomore)

Fowler Prize
John Mueller & Matthew Whiteway

Babb Award
Mary Catherine Hogan

Outstanding Senior
Bruce Bacon, Zachary Dunn & Cale Gentry

Kalbfleisch Prize
Iroko K Abalo

Nielsen Award
Jeffrey Wagner & Christopher McRaven

Physics and Astronomy Awards

Webb Scholarship

David Findley

Dodge Scholarship

Jocelyn Roberts

J. Clarence Karcher Award

Preston Seaburg

Duane E. Roller Award

Jacob Stinnett

William Schriever Award

Stephen Holleman, Caleb Holt & Michael Wilkinson

Karcher Scholarship

Dillon Carroll, Jeshurun Chisholm, Thanh-Nhan Do, Zachary Eldredge, Adam Fallon, Robert Free, Mallory Getts, Joshua Hardisty, Seth Hodgson, Stephen Holleman, Scott Lowe, Adrian Lucy, Logan Maingi, Neil McGlohon, Cody Piersall, Michael Ray, & Jacob Young

Meritorious Scholarship

Nathaniel Beck, Bailey Bedford, Don Carmichael, Sara Chilson, Dustin Clouse, Whitney Costello, Thanh-Nhan Do, Brandon Doull, Zachary Eldredge, Darren Erdman, Adam Fallon, Mallory Getts, Jeffrey Gillean, Andre Goran, Kramer Harrison, Mary Catherine Hogan, Stephen Holleman, Caleb Holt, Jim Hopkins, Stephen Kane, Virginia Lambert, Adrian Lucy, Logan Maingi, Neil McGlohon, William Parker, Michael Ray, Michael Reynolds, Preston Seaberg, Daniel Solow, Jacob Stinnett, Amanda Truitt, Aaron Wegner, John Weis, Matthew Whiteway, & Michael Wilkinson

Engineering Physics Awards

J. Clarence Karcher Award

Curtis Doiron

Duane E. Roller Award

Dillon Carroll

William Schriever Award

Jeshurun Chisholm, Chase Hennion, Rachel Rogers

Meritorious Scholarship

Bruce Bacon, Nathan Barry, Jody Bringhurst, Aaron Browder, Dillin Carroll, Jeshurun Chisholm, Curtis Doiron, Zachary Dunn, David Findley, Robert Free, Cale Gentry, Joshua Hardisty, Kendall Harper, Chase Hennion, Seth Hodgson, Cale Kennedy, Scott Lowe, John Mueller, Cody Piersall, Jocelyn Roberts, Rachel, Rogers, Nils Schlupp, Derek Sealey, Seth Strout, Peter Tower, Jacob Young, & Brendon Watts

2011 student award recipients, pictured here following the annual awards ceremony. Photo by Sheena Murphy

Danette Loyd: BBQ Restauratrice

Danette Loyd, assistant to the department chair, spends many of her evening and weekend hours serving up highly-praised KC-style barbeque cuisine at Loyd's Blueline BBQ, a business owned by Danette and husband-chef Robert. Their restaurant, which seats 17-18 customers at a time, is located inside the Conoco Purcell Plaza convenience store, 1731 N. Green Ave., Purcell, OK.

Robert and Danette Loyd at Centennial 2010

A few years ago Robert, a Purcell police officer, began inviting his co-workers to the Loyd house for lunch-time BBQ prepared on his backyard grill. Enthusiastic about the fare, his colleagues suggested that he and Danette open their own BBQ restaurant. The now-successful eatery opened in January, 2010, with Robert performing the cooking duties and Danette waiting on the 150-200 enthusiastic diners who come in each

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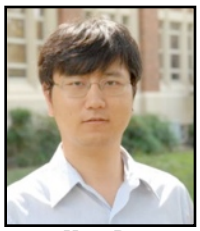
New Faculty (continued from page 1)

matter models. They allow studying of ultracold collisions and few-body physics, and realize many-body quantum phases. Ultracold polar molecules have only recently become experimentally available and they promise to open exciting new research directions due to their more complex structure and to the long-range, anisotropic dipole-dipole interaction. Monte Carlo techniques provide an excellent tool for exactly solving quantum hamiltonians (free of sign problem), therefore allowing the calculation of accurate phase diagrams, and provide experimentalists with precise information and guidance for the realization of quantum phases of interest. Capogrosso-Sansone has a strong interest in developing new Monte Carlo algorithms to solve difficult problems analytically. She likes being physically active, using her bike as the main means of transportation. In the past couple of years, she has been practicing boxing and kick-boxing. Since she has moved to Boston, she has become a big fan of the Boston Celtics, but is planning to support the Oklahoma City Thunder as her second team! Capogrosso-Sansone also likes traveling, visiting new places and enjoying the diversity of the world.

Mukremin Kilic

Mukremin Kilic (Astrophysics group), a native of Turkey, received his bachelors degree in physics from Bogazici (Bosphorus) University in Istanbul. In 2006, he received his Ph.D. in astronomy from the University of Texas at Austin. His thesis, entitled "Cool White Dwarfs and the Age of the Galaxy," was chosen for the university-wide Outstanding Dissertation Award at UT in 2007. Kilic has been a Spitzer Fellow in the Solar, Stellar, and Planetary Sciences Division at the Harvard-Smithsonian Center for Astrophysics between 2008 and 2011. From 2006 to 2008, he was a Columbus Prize Postdoctoral Fellow at the Ohio State University. Using several different observatories, including telescopes in Arizona, Chile and Hawaii, Kilic has continued studying white dwarfs. His work focuses on the searches for the progenitors of supernova explosions, constraining the age of our galaxy and the formation and the fate of planetary systems around Sun-like stars. Kilic has published close to 50 articles in refereed journals, including 26 as the first author.



Xinyu Dai

Xinyu Dai (Astrophysics group) obtained his B.S. degree in 1998 at Beijing University and Ph.D. degree in 2004 at the Pennsylvania State University. He then held postdoc positions at the Ohio State University and University of Michigan. He came to OU in 2009 as a research scientist and became an assistant professor in the Department in 2011. Xinyu's research interests lie in understanding astronomical objects such as gravitational lenses, galaxy clusters, active galactic nuclei and gamma-ray bursts. In particular, he is interested in using the quasar microlensing technique to map the quasar accretion disk structure that is several orders of magnitude smaller than the angular resolution of our current telescopes. He also is currently working on the Swift soft X-ray serendipitous cluster survey. The survey has the potential to produce one of the largest X-ray selected cluster catalogs to date, enabling the study of the evolution of galaxy clusters and constraining cosmological parameters.

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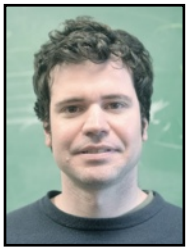
New Faculty (continued from page 6)

Ian Sellers

Ian Sellers (Solid State group) gained a BEng (Hons) in Medical Electronics & Instrumentation at the University of Liverpool (UK) in 1999 and an MSc (with Distinction) in Semiconductor Science and Technology from Imperial College London (UK) in 2000. After his undergraduate studies, Sellers earned his Ph.D. in 2004 at the University of Sheffield (UK) under Professor Maurice Skolnick. Following his graduate studies he moved to France, where he spent two years as a Marie Curie Fellow at CRHEA-CNRS in Valbonne, working in the area of strong coupling in GaN microcavities before moving to SUNY-Buffalo in 2006. At SUNY-Buffalo, his work focused on the magneto-optical properties of semiconductor quantum dots and spin-injection into semiconductor devices. Since 2008, Sellers has held the position of Senior Research Scientist at Sharp Laboratories of Europe, working in the area of third generation photovoltaics while also holding a Senior Visiting Research Fellowship in the Department of Materials at the University of Oxford. His current research interests include the magneto-optical properties of semiconductor quantum dots and their applications in 3rd generation photovoltaics.



Bruno Uchoa

Bruno Uchoa's (Solid State group) primary research interests are low dimensional quantum critical systems. This is the case of superconductors with nodal gaps, such as cuprates, and includes a broad class of materials with Dirac-like electronic excitations known as Dirac materials. The two most popular examples of Dirac systems in Condensed Matter today are graphene and topological insulators and superconductors. Graphene, one of Uchao's current research topics, is a new alotropic form of carbon formed by a single atomic layer of graphite. The quantum numbers provided by the honeycomb lattice structure in graphene offer a rich playground for the emergence of new quantum phenomena at room temperature. As a Dirac material, its elementary electronic excitations behave as massless Dirac fermions and mimic properties known as relativistic fermions in quantum electrodynamics. His current interests range from new electronic instabilities in Dirac materials, such as superconductivity, magnetism and spontaneous mass generation, to problems involving disorder and electron-electron interactions in the perturbative and non-perturbative regimes. He also is interested in mesoscopic systems in general, since they provide an interesting window for the observation of new quantum phenomena such as zero energy modes and zero bias anomalies.

Alumni Report

Alum Joe Allen of Denton, Texas, writes: "I graduated from OU in 1961 with a B.S. in Physics. Depending on how I chose my last year of courses, I could have had a B.S. in Math (not unusual, I suppose) or a B.A. in Political Science or German. Most of my optional courses were in history and political science. I was probably one of the most undistinguished Physics undergraduates to pass through OU, but I did acquire operational knowledge of digital computers (Prof. Andre), a certificate as a nuclear reactor operator, and was a participant in the first OU Honors Program (Political Science). All of these experiences were important to me in a career in government science and in graduate work in mathematics at Oklahoma City University, at American University, and in getting a MSci in Engineering Geosciences at U.C. Berkeley while working for the government.

"Immediately after graduation I taught maths at The Casady School in Oklahoma City. I then moved to Washington, D.C. to begin working for the U.S. Coast & Geodetic Survey (C&GS) as a Geophysicist. After moving around the country (Washington, D.C.; Fredericksburg, Va; Berkeley, Ca; and Boulder, Co) I retired from my final government positions as chief of the Solar-Terrestrial Physics (STP) Division and director of World Data Center-A for STP."

Summer Research Experience for Undergraduates

Once again this summer, the department will host numerous undergraduates as they team up with faculty in their labs and offices to gain research experience. This year, we welcome 15 students, six from outside the department: **Alicia Gomez** from Florida State U. (AMO, Shaffer), **Jesse Rivera** from UT Brownsville (AMO, Abraham), **Leslie Bicknell** from U. Oregon (AP, Dai), **Corey Kownacki** from Notre Dame (HEP, Milton), **Joey Hambleton** from Cornell College (HEP, Strauss), and **Mitchell Yothers** (CM, Bumm); and nine from within: **Stephen Holleman** (AMO, Shaffer), **Andre Goran** (CM, Santos), **Rachel Rogers** (HEP, Abbott), **Michael Reynolds** (CM, Bumm), **Kramer Harrison** (CM, Johnson), **Maingi Logan** (HEP, Kao), **Don Carmichael** (AP, Dai), **Adrian Lucy** (AP, Leighly), and **Michael Ray** (AMO, Abraham).

Bits From Nielsen Hall Network

by Andy Feldt

A perusal of our archive of newsletters shows that it has been three years since I last wrote about our computing environment. So, it is time for a brief update. That last report indicated that we were beginning to support Intel architecture systems running Red Hat Enterprise Linux. This has now become our predominant platform, gradually replacing our remaining Sun workstations. We have now also nearly completed the complete overhaul of our network infrastructure from the old 100 Mbs to 1 Gbs hardware. Additionally, we have doubled the bandwidth for connecting out of our building. And, we finally have wireless access even in the old part of Nielsen Hall. For those who like numbers, a few are given here:

- 23 - RHEL workstations on NHN
- 43 - total workstations on NHN
- 110 - total cores in our workstations
- 327 - IP addresses assigned on our subnet
- 1.7 - terabytes of backed up data
- 3800 - e-mails/day initiating connection
- 1000 - e-mails/day actually delivered after filtering
- 35000 - hits/day to our web server
- 6 - gigabytes/day served by our web server

Dissertation Defenders

Spring 2010

Daminda Liyanage Dahanayaka (PhD, Bumm)

Summer 2010

Jeff Wagner (PhD, Milton)

Shivakumar Rajagopalen PhD, Baer)

Fall 2010

Christopher McRaven (PhD, Shafer-Ray)

Julie Dalhed (MS, Cowan)

Michele Benesh (MS, Branch)

Faculty Awards

Eddie Baron

George Lynn Cross Award

Brad Abbott

Regents Award for Superior Teaching

Kim Milton

Royal Norwegian Society of Science and Letters, Foreign Member Inductee

White Buffalo Mask Drama Award

Research Programs

Astronomy, Astrophysics and Cosmology

Xinyu Dai explains that 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, Dai's group has been able to resolve the disk structure that is several orders of magnitude smaller than the angular resolution of our current telescopes. Beside quasar microlensing, he 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. Dai is currently 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. He 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 is also studing 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 has been working on several related projects this past year. With former OU student Bin Chen he has been extending his general purpose 3D radiative transfer code to the case of arbitrary velocity fields. The first phase of this work is nearly finished. With OU graduate student Soma De, he has been working on the effects of time-dependent recombination in Type II supernovae. They have published two papers on this work. An extension of this project is to calculate full, time-dependent radiative transfer in the cosmological recombination epoch. De received her Ph.D. in May, 2010, and now is a postdoctoral fellow at Arizona State University. With OU undergraduate Spencer James, Baron has been working on determining the mass of the hydrogen envelope surrounding Type Ib supernovae. They have found that Type Ib supernovae commonly have hydrogen envelopes of about 1/1000 of the mass of the sun. This points to the origin of Type Ib as low mass helium cores in binary systems that have undergone a common envelope evolution. Their published paper also formed James's capstone thesis. James currently is a graduate student working on resistive magneto-hydrodynamics at the University of Tulsa. With OU undergraduate Brandon Doull, Baron has been re-examining the

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class of "cool" Type Ia supernovae. These objects are known to be dim, not to produce much radioactive nickel and to have lower temperatures than "core normal" Type Ia. They have a submitted a paper on this work, which also will form Doull's capstone thesis. With Cosimo Inserra, a student visiting OU for a year from the University of Catania in Italy, Baron has modeled the spectra of the Type II supernova SN 2007od and the paper is ready for publication. They also are working on classifying the extent that Type II supernovae interact with their own "circumstellar" environment (material that was lost from the exploding star, during the life of the star). Finally, with his collaborators, Baron has been working on a physical model of the very slowly declining Type Ia SN 2001ay. Slowly declining Type Ia are supposed to be bright, but this one is not. A physical model that does more expansion work in the interior due to more available explosion energy seems to do a reasonable job of fitting the light curve and spectra, although Baron's group still is working to model the spectra in detail.

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Karen Leighly

For **Karen Leighly** this year saw publication of her group's paper describing the discovery of the first HeI*10830 absorption line quasar, and as such they have been energetically following up that discovery with six separate accepted observing proposals. Along the way, they have added two more members to the team: Don Terndrup, from Ohio State University and the NSF, to help with the optical observations, and Sarah Gallagher from University of Western Ontario, who is an expert in all aspects of broad absorption line quasars. These two individuals join Matthias Dietrich from Ohio State University, an expert in infrared observations, and Sara Barber, an OU graduate student. The first project involves looking for HeI* absorption lines in the handful of known low-redshift BALQSOs. They made the infrared observations in April 2010 using the SpeX on IRTF, observing remotely from Leighly's office, and obtaining data on all three nights. They discovered that most of the these objects do not have IR HeI* absorption lines. This is a valuable result. A big problem in BALQSO studies is that partial covering gives only upper limits on the absorption column density. The lack of HeI* absorption will yield the first lower limits on the absorption column density. The second project is much more ambitious. Leighly's group identified 18 SDSS quasars with redshifts between 0.5 and 0.6 with evidence for HeI*3889 absorption. These objects were fainter, so they needed a bigger aperture. They obtained observing time in the infrared for 10 of them on the 8-meter LBT telescope through the OSU collaboration, and for an additional eight on the Gemini 8-meter telescope through UWO collaboration. These infrared observations mostly are queue scheduled, and most have been done to date. Follow-up optical spectroscopy was obtained in February on the MDM Hilter 2.4 meter telescope using the CCDS.

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Dick Henry has continued his studies of abundance patterns in spiral galaxies using emission line objects as chemical abundance probes. The unifying goal of the projects is to understand the formation history of both the galaxy and the stars within it. Along with collaborators Karen Kwitter (Williams College), Bruce Balick (U. Washington), and Jackie Milingo (Gettysburg College), Henry completed

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Research Programs (continued from page 10)

a detailed study of the oxygen abundance gradient in the Milky Way disk using planetary nebulae as the probe. Over the years his group has compiled a comparatively large sample of PN abundances for which they have acquired, reduced and measured the data, and carried out the abundance computations of roughly a dozen elements, producing a highly homogeneous set of chemical abundances for objects located primarily in the disk of the MWG. Along with Michael Morrison, Henry performed a detailed data-fitting regression exercise to understand the results. In the process he uncovered clear evidence of real abundance scatter, suggesting that PN progenitor stars actually alter their oxygen abundances through nuclear processes during their lifetimes. The PN group also is completing their first paper on chemical patterns in M31, the Andromeda Galaxy. Using the Gemini North telescope, they have found evidence for a decidedly shallower slope for oxygen across its disk than what they see in the Milky Way, indicating that matter accreted more uniformly during the formation process of M31's disk. Henry also is working with Reggie Dufour (Rice U.) and Steve Hawley (KU) on a study of metal-rich H II regions in external spirals in an effort to test the assumption that alpha elements such as O, Ne and S are synthesized in lockstep. The group enjoyed a productive run at McDonald Observatory in March, and it is hoped that the analysis of the results over the next year will yield some insight into the posed question. Henry continues to labor away on the interpretation of the PN group's discovery several years ago that sulfur abundances in these objects are systematically lower than expected from nucleosynthesis theory by factors of 2-3. Together with collaborators Angela Speck (U. Missouri), Amanda Karakas (Mt. Stromlo Obs., Australia), Gary Ferland (U. Kentucky) and OU undergrad Mason Maguire, he is testing various hypotheses involving atomic processes such as dielectronic recombination, stellar nucleosynthesis, and chemical processes such as sulfide dust formation. Finally, Henry's graduate student Henry Bradsher is deriving and interpreting PN abundances in the Small Magellanic Cloud for his masters thesis.

Dick Henry

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John Cowan continues his focus on the origin of the elements. He has been working on several observational and theoretical projects involved with abundances. First, working with Dick Henry and Jennifer Sobeck (U. Chicago) he explored Galactic chemical evolution abundance trends of the Fe-peak elements. Working with Ian Roederer (Carnegie Observatories), Chris Sneden (Texas) and James Lawler (Wisconsin), he utilized both HST and Keck spectra of the star BD +17 3248 to detect Os II, Cd I and Lu II. These were the first detections of these species in any Galactic halo stars. The group, along with their German collaborators (K.-L. Kratz and K. Farouqi), also made large scale studies of the halo stars spanning a large range in metallicities. These studies indicated the widespread nature of the rapid neutron capture synthesis process early in the history of our Galaxy. Led by Sobeck, and including Robert Kraft, Chris Sneden, George Preston, Ian Thompson and Steve Shectman, Cowan and associates also completed a very long study of the abundances of neutron-capture species in the globular cluster M15. This was a followup to an earlier study that they (led by Sneden) had undertaken on this same globular in 2000. In addition to the astrophysics elements, Cowan has been working with experimental atomic physicists led by Lawler and his group in Wisconsin. They have spent decades measuring

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atomic transition probabilities in all of the rare earth elements, which we utilized to make very precise stellar abundance determinations of these elements. New work in the last year has extended that to the Fe-peak elements with one paper so far on improved transition probabilities for lines in Mn I and II for abundance determinations in dwarf and giant stars. As a result of Cowan's work in employing new experimental data for abundance determinations, he has been a member for about five years of the Working Group in Laboratory Astrophysics, which has just succeeded in adding Laboratory Astrophysics as a new Division in the American Astronomical Society. They also have collaborated on a recently submitted review article to *Reports on Progress in Physics* entitled "The Impact of Recent Advances in Laboratory Astrophysics on our Understanding of the Cosmos."

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Yun Wang is a cosmologist whose current research interests are focused on dark energy. She supervises two graduate students, Chia-Hsun Chuang and Maddumage Don P. Hemantha, whose Ph.D. dissertation research aims to develop robust and efficient methods for analyzing cosmic large-scale structure data to probe dark energy. Wang's book, "Dark Energy" (Wiley, 2010), is a technical monograph and graduate textbook, and has been adopted by the Scientific American Book Club. Wang is a member of the Science Definition Team of the proposed NASA space mission to explore dark energy and discover new exoplanets, Wide-Field Infrared Survey Telescope (WFIRST). She also is a key participant of the proposed ESA dark energy space mission, Euclid, as well as an active member of the Large Synoptic Survey Telescope (LSST) supernova science collaboration.

Atomic, Molecular and Optical Physics

Over the last year, the Shaffer group has been busy. **Jim Shaffer** co-chaired two successful conferences, the DLS/OSA annual meeting in Rochester, N.Y., and a workshop on Cold Rydberg Gases that was held in Recife, Brazil. The group also hosted several visitors: Luis Marcassa, a Fulbright fellow at OU and longtime collaborator along with some of his students from Recife, Brazil; and Harald Kubler, a visitor from Tilman Pfau's research group in Stuttgart, Germany. In addition to their scientific contributions, both collaborators cooked for the group: Kubler made spatzle and Marcassa cooked picana. This year saw significant progress by both graduate students and undergraduates in the lab. Cale Gentry, an undergraduate student, successfully completed his capstone research in the group making atom chips in collaboration with Matt Johnson's research group. Graduate students Don Booth and Jonathan Tallant have been doing experiments in a crossed dipole trap and have detected Cs Rydberg atom molecules formed when an electron scatters off a ground state atom and attracts it to the Rydberg atom. Arne Schwettmann and Jon Sedlacek characterized their Rb atom chip trap and also developed a new laser system to excite Rydberg atoms in their apparatus. They are setting up experiments to look at Rydberg atom dynamics in their experiment. They also worked on obtaining state-to-state differential cross-sections for 3 body recombination and made progress in determining the best detection methods for these difficult experiments. They have two new graduate students joining us this summer, Hasan Serce and Malia Jenks. The Shaffer group had a successful year publishing

Jim Shaffer

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papers with publications in *Physical Review Letters*, *Physical Review A*, *New Journal of Physics*, and *Journal of Physics B*. Presentations on this work were made at the DLS/OSA meeting in Rochester, the meeting in Recife, and the Cold Rydberg Atom workshop at the Max Planck Institute in Dresden, Germany. Two talks at the Dresden workshop and one at the DLS/OSA meeting were invited talks. Shaffer also gave invited talks at the University of Sao Paulo and at OU-Tulsa and was invited to give a talk at the ETH in Zurich. The group plans to give two talks and two posters at DAMOP this year. They also managed to land a $1.18 million dollar grant from DARPA for a new project to use atoms as interferometers to construct a traceable detector for small electric fields. Although the group had a busy and successful year, they are looking forward to another one next year!

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Eric Abraham's group is working on two projects. The first concerns production of cold, trapped nitric oxide (NO). Abraham and graduate student Parshuram Dahal, in collaboration with John Furneaux, developed a new laserless source of molecules for cold molecule experiments. The results are being prepared for publication and especially will be useful for researchers that use dilution refrigerators that have little optical access. Abraham and Dahal, in collaboration with Neil Shafer-Ray, are attempting to trap NO in a new, permanent magnetic trap through optical pumping. In June, Dahal will be presenting their latest results and progress at the 2011 meeting of the Division of Atomic, Molecular, and Optical Physics (DAMOP) of the American Physical Society. The second project, involving graduate students Thomas Akin and Sean Krzyzewski, Abraham is studying collisions between ultracold (temperatures below 0.001 degrees of absolute zero) rubidium atoms. Specifically, two atoms collide under resonant conditions and are promoted to a bound excited state molecule. This is used to further understanding of atomic and molecular interactions, which in turn is significant to atomic clocks, quantum computers, and quantum simulators (atomic gases which are used to simulate condensed matter systems). Toward this goal, they are in close collaboration with theorist Michael Morrison and his graduate student, James Dizikes. Abraham and his students will present these results and latest progress at the 2011 DAMOP meeting. In the future, they hope to test recent theoretical advances in the theory of quantum degenerate gases by Deborah Watson. Akin and Krzyzewski have designed a new type of laser-cooled atom slower to load ultracold atom traps that uses permanent magnets for the spatially varying magnetic field profile. Akin, for his specialist exam, has worked out how to calculate BEC transition characteristics in multiply-connected trap configurations. This was recently submitted for publication.

Eric Abraham

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Greg Parker's group has developed a method for properly treating collinear conical intersections in triatomic systems. They used a general vector potential (gauge theory) approach to treat the geometrical significance of the electronic sign change associated with a conical intersection between two potential energy surfaces. This conical intersection gives rise to a geometrical or Berry phase which should be

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included for a proper treatment of scattering and bound state calculations on triatomic systems. They showed that the collinear curved seams of conical intersections can be mapped onto a straight line using an appropriate diffeomorphism. To their knowledge this is the first explicit derivation of the associated vector potential for collinear conical intersections.

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Since receiving NSF funding in 2006, the **Neal Shafer-Ray** group has made steady progress toward measurement of a property of the electron known as the electron dipole moment (e-EDM). Recently **John Moore-Furneaux** has joined the e-EDM project, bringing to the group sorely needed expertise in metrology and instrumentation techniques. The e-EDM, first predicted in 1950 by Purcell and Ramsey, is of central importance to our fundamental understanding of the laws of nature and bears on such central questions of our time as "What is dark matter?" and "Why do we live in a universe dominated by matter and not antimatter?" Despite its importance and six decades of searching, this property of the electron has yet to be measured. At the same time, all widely considered theories of physics indicate that the electron has this property if only we look carefully enough. In fact, most theories say the property should have already been observed. Some molecules (heavy diatomic radicals) have a spectroscopy that is extraordinarily sensitive to the e-EDM. Several groups around the world are in fierce competition to exploit this sensitivity in order to enter a new age of precision e-EDM measurement. Efforts in the United States include our own here at OU as well as efforts at Yale, Harvard, NIST, Sandia National Laboratories, the University of Michigan and Penn State. The ability to search for an e-EDM depends on how accurately we are able to measure a tiny shift in the energy of a PbF molecule for the case that it's angular momentum is aligned parallel to and anti-parallel to an electric field. In order to measure such a shift, an optical quantum beat experiment will be carried out. This beat experiment requires a high-power extremely stable laser that has just been acquired taking advantage of funding from the Vice President for Research's office. The group hopes to use this new laser system to reach a new experimental sensitivity to the e-EDM in the near future.

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Deborah Watson has continued her work describing large systems of bosons using a perturbation method that takes advantage of the symmetry of high dimensional spaces. Her most recent *Physical Review Letter* with postdoc Martin Dunn outlines the challenge of describing fully-interacting quantum wave functions for which the effort scales exponentially with N, the number of particles. Typically, this requires doubling the resources for every particle added. With current numerical resources, this problem "hits a wall" around N=10 particles, a surprisingly low number. By taking advantage of the symmetry at high dimensions, Watson's group has successfully constructed analytical building blocks to rearrange this exponential wall. The exponential complexity has been shown to reappear in the order of the perturbation series, allowing calculations for very large N (a million or higher) through low order. Currently the perturbation series can be determined analytically through first order, and

Deborah Watson

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an application to a Bose-Einstein condensate of rubidium atoms is in progress. A second-order term in the series is being pursued to obtain density profiles that remain positive for all radial distances. This term involves determining Clebsch-Gordan coefficients for the symmetric group that connect four irreducible representations, a formidable challenge. This work on bosons is being supported by the Army Office of Research. A second project, an extension to large systems of identical fermions also has been started involving a major overhaul of the many-body formalism. This extension is motivated by the relevance of the physics of large systems of fermions to many fields of physics from superconductors to neutron stars. Watson has given two invited talks on this work, one at a "Novel Quantum Methods" workshop in Casper, Wyo., last July and another at Wesleyan University in October. She and is planning to give an invited talk at an American Chemical Society meeting in Denver this coming August.

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During summer 2010, **Michael A. Morrison** began a new collaborative research project with Eric Abraham. The intrepid pair are investigating a core issue related to the atomic-clock transition in the Rb_2 molecule. Morrison is also collaborating with Abraham and his students on a long-term experimental/theoretical project designed around Abraham's idea of a way to use laser-induced transformations of pairs of Rb atoms at preposterously cold temperatures (below about 10^{-3}K) into *excited-state* Rb_2 molecules to gain hitherto unprecedented quantitative knowledge of the potential energy of such molecular excited states. This idea hinges on the "ultracold" atoms initially being in a special type of scattering state called a Feshbach state; this aspect of the project constitutes the doctoral research of James Dizikes, a grad student in Morrison's group. In another collaboration, with Jim Shaffer and Greg Parker, Stephane Valladier, the other grad student in Morrison's group, is pursuing his dissertation research. This entails exploration of an idea Valladier concocted to use a "chirped laser," which produces a pulsed laser field whose center frequency depends on time, in a procedure that will transform pairs of colliding Na and Cs atoms at ultracold temperatures into NaCs molecules in their lowest-energy bound state.

None of this research was affected by Morrison's decision to retire in December 2010 into the leisurely, salary-free life of a Professor Emeritus. In addition to continuing these projects, he is finalizing a book called *Effective Scientific Writing: Recipes and Strategies for Students of Physics and Other Sciences* he developed out of a course taught during his last teaching semester, Fall, 2010; grudgingly slogging through the endless chores required to prepare his quantum tome *The Joy of Quantum Physics* to go into production at Oxford University Press, which aspires to publish in in~2012; and continuing work on the monograph *Low-energy Charged Particles in Atomic and Molecular Gases* he is co-writing with Australian colleagues Rob Robson and Ron White for publication by Princeton University Press. While he will miss teaching---to say nothing of writing and grading qualifier problems, attending faculty meetings, and doing other administrative chores--Morrison is eagerly looking forward to many more years of research and writing in the department.

Condensed Matter Physics

During a busy academic year with faculty recruiting in both experiment and theory, the condensed matter group has had an overarching, time-consuming goal: renewal of the NSF-MRSEC (Materials Research Science and

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Engineering Center) grant held jointly between OU and the University of Arkansas. The center, called C-SPIN (Center for Semiconductor Physics in Nanostructures), was first funded in 2000 at $4.8M for five years and renewed in 2005 at $9.8M for six years. With director **Matthew Johnson**, C-SPIN (now with 21 faculty researchers on both campuses) has flourished, producing copious research results, interdisciplinary initiatives, and both graduate and undergraduate student projects. The renewal effort is in its final stage. It began with a pre-proposal that was due last September. Of the 49 pre-proposals submitted across the country, 19 were selected to compete with full proposals, C-SPIN among them. Then in April, 14 of the 19 were invited to "reverse site visits" at NSF in Washington, D.C. In C-SPIN's June 1, 2011, reverse site visit, five faculty from OU and Arkansas made presentations and responded to questions by a panel of experts. As one member who has participated in the previous reverse site visits has noted, "it feels like an oral qualifying exam all over again." The process is expected to result in eight to ten finalist MRSECs for funding. C-SPIN is requesting $11M for an additional six years of funding.

High-energy Particle Physics

On the D0 experiment, **Brad Abbott** has been studying the decay B_s -> J/Psi f_0(980). This decay mode is interesting, since it is a CP eigenstate and allows the measurement of the CP-violating phase phi_s. On ATLAS, he recently released the world's best limits for the SO(10) SUSY GUTS model. Additionally, his graduate student Scarlet Norberg won a fellowship to study at Argonne National Lab for a year.

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During the past year, **Howie Baer** co-led an eight week workshop on Dark Matter at the Galileo Galilei Institute for Theoretical Physics in Florence, Italy, April 26 to June 19, 2010. His student Shibi Rajagopalan defended his thesis and moved on to Grenoble/Torino to pursue post-doctoral studies. Baer has published numerous papers on the possibility of mixed axion/SUSY particle dark matter with his student Andre Lessa and postdoc Warintorn Sreethawong.

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During the past year, **Phil Gutierrez** gave an invited talk at "Prospects for Charged Higgs Discovery at Colliders" meeting in Uppsala Sweden; published results of ttbar->tau+jets in PRD (results of his student Sorhab Hossain's dissertation); and worked on the measurement of top quark properties, using data from the D0 experiment at Fermilab.

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Ron Kantowski is continuing to work with the astrophysics group on making fundamental corrections to gravitational lensing theory caused by the failure of current homogeneous cosmological models to properly account for the optical effects of mass inhomogeneities. A tractable theory is in the works.

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Chung Kao, his postdoc and students are working on a series of studies to search for new physics at the LHC. The first paper on coloron search will be published in *Physical Review D* as a rapid communication.

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Kim Milton: Perhaps the most noteworthy papers written during the past year were "Casimir Energies of Cylinders: Universal Function" (E. K. Abalo, K. A. Milton and L. Kaplan), and "Casimir-Polder repulsion near edges: Wedge apex and a screen with an aperture" (K. A. Milton, E. K. Abalo, Prachi Parashar, Nima Pourtolami, Iver Brevik, and Simen A. Ellingsen). The former mostly was worked out by Milton's student Elom Abalo, and shows that Casimir energies for cylinders with triangular cross-section can be computed unambiguously, and for special cases can be computed in closed form. Elom is extending the work to tetrahedra, and to higher than three dimensions. The second work, also still in progress, is to compute analytically, repulsive Casimir forces between anisotropic atoms and half-planes, wedges, and now cylinders (both circular and parabolic) and spheres. Repulsive Casimir forces might have important technological applications.

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Pat Skubic has been on sabbatical since fall 2010, spending the majority of his time at CERN. His first high energy proton-proton collision data were taken with the ATLAS detector during 2010. The run is continuing this year and will end in late 2012. While at CERN he has had the

Pat Skubic

opportunity to be shift-leader in the ATLAS control room during data-taking. His group is analyzing ATLAS data in collaboration with colleagues from Oklahoma State University and UTA. They presented results on the measurement of the top-quark pair production cross section at a recent conference: Rencontres de Moriond conference, March 13 through 20. They have also submitted a paper on a search for SUSY particles that sets lower limits on the masses such particles can have. These results are based on data taken during 2010. They plan to present updated results as more data are taken during 2011-2012.

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In September **Mike Strauss** was appointed co-convener of the QCD Physics working group on D0, overseeing and coordinating all QCD results for the collaboration. He gave a talk on Recent QCD Measurements at the Tevatron at the Recontres de Blois conference in Blois, France in July. Also, his graduate student's research (Mandy Rominsky) was published in *Physics Letters B*, "Measurement of the dijet invariant mass cross section in p pbar collisions at sqrt(s) = 1.96 TeV."

OU HEP and the CERN Large Hadron Collider

by Howie Baer

At the end of March, 2010, the CERN Large Hadron Collider (LHC) finally turned on, and began delivering proton-proton collisions at a world record center-of-mass energy 7 trillion electron volts. The run continued with fits and starts, and by the end of 2010 the CMS and Atlas experiments had collected around 50 pb^-1 of data. OU Professors Skubic, Gutierrez, Abbott and Strauss are members of the Atlas collaboration. The 2010 LHC data set was sufficient for the experiments to see many familiar Standard Model processes--dijet production, production of W and Z bosons, and production of top quark pairs--all at expected levels. The data set was also sufficient to set the world's best limits on production of supersymmetric matter: in this case, experiments probed gluino and squark masses up to 800 GeV under optimal circumstances!

Bas-relief Sculptures in Nielsen Hall Foyer

by Stu Ryan

The entrance foyer of Nielsen Hall is graced with two Art Deco bas-relief stone panels that we all have passed many times, pausing occasionally perhaps to examine their story of the history of science - primarily physics. The panel on the foyer's east wall illustrates the progression of scientific knowledge starting with the cave man "Homo" busily crafting a stone tool, followed by Euclid, Archimedes, Galileo and Newton. These figures are illuminated by the sun, which filters through the scientific aphorism "*Experience is the Foundation of Theory and the Test Thereof.*" In the west panel, the sun illuminates a line from Shakespeare's Anthony and Cleopatra: "*In Nature's Infinite Book of Secrecy A Little Can I Read.*" Faraday, Mme. Curie and Pasteur are featured along with two unnamed scientists, who are obviously Lise Meitner and Otto Hahn.

Construction of Nielsen Hall, originally known as the Research Institute Building, started in 1946 and was completed by Christmas of 1948 although the Physics Department had moved into the second floor in March of that year. [The Research Institute occupied the first floor.] The bas-relief panels in the foyer were sculpted by the artist and sculptor Louis Terebesy, in his Tulsa studio and most likely installed in 1949 or 1950 according to his grandson Allen Terebesy.

Born in Transylvania in 1893, Louis Terebesy was a painter, sculptor, and architect, who immigrated to the U.S. in 1921 and settled in Chicago. He was a WPA artist during the Depression and sculpted the stonework on famous Art Deco buildings in Chicago some including the WGN studio at the Tribune Tower. He was a friend of the Tribune owner, Col. McCormick, architects Frank Lloyd Wright and Louis Sullivan, as well as physicists Enrico Fermi and fellow Hungarian émigré Edward Teller. He also designed props for movie sets, and taught at the prestigious School of Design in Chicago.

During WWII, Terebesy worked for the U.S. Corps of Engineers in Tulsa and settled there after the war, working on many of Tulsa's Art Deco buildings, including St. John's Hospital, the Blue Cross building, the Daniel and Kewanee building and Memorial Park Cemetery. His work also can be found at the Arkansas State Capitol complex, and the universities of Chicago, Illinois, Northwestern, Oklahoma State and Purdue, as well as Mundelein College in Chicago. Terebesy died in Chicago in 1959.

Loyd's BBQ (continued from page 5)

day. Danette also develops recipes such as the dry rub and sweet sauce used to flavor the meats. Besides their standard BBQ beef and pork, Loyd's also features beans, potato salad, cole slaw, french fries and smoked bologne.

Loyd's Blueline BBQ is open for lunch and dinner Wednesday through Friday as well as for Sunday lunch. Most customers live in Purcell, but several members of the physics department, including last summer's entire REU class, have traveled to Purcell to sample the fare. And folks from as far away as OKC have begun stopping in as the good word travels up I-35. Loyd's menu is available on Facebook.

Jeannie and Greg Parker

Bob Petry and Tom Miller

Deborah Watson, Xifan Liu, and Jingling Zhou

Joni and Neal Lane

RETIREMENT BANQUET
MAY 20, 2011
photos by Xifan Liu

Stu Ryan and Greg Parker

Bob St. John, Steve Whitmore, and Neal Huffaker

71.3% of Banquet Attendees

Linda Christie and Bob St. John

Ryan Doezema

Greg Parker and David Branch

Mike Morrison, Bob Crompton, and Kieran Mullen

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

Foucault pendulum, located in the Nielsen Hall atrium

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