ΦYAST ΦLYER

The Homer L. Dodge Department of Physics and Astronomy
Volume 18, Number 1

Homer L. Dodge Department of Physics and Astronomy Celebrates a Century!

In 1909, William P. Haseman was appointed the first chair of the university's Department of Physics and Astronomy. Now, 100 years later, we celebrate the start of the department with a celebration this fall for alumni and friends of the department as well as faculty and students, with two main events planned. The first is a production of Michael Frayn's play *Copenhagen* by the OU School of Drama. The second is a public lecture by the well-known cosmologist Andrei Linde of Stanford University.

The play, presented in OU's Weizenhoffer Theater, concerns the famous 1941 meeting between Niels Bohr, played by New York actor Paul Austin, and Werner Heisenberg, played by Tom Orr, director of OU's School of Drama. The part of Bohr's wife, Margrethe, has yet to be cast. Performances of *Copenhagen* will run the evenings of Thursday through Saturday, Sept. 9, 10 and 11. A special matinee performance on Sunday, Sept. 12, will be followed by a panel discussion featuring faculty from Physics and

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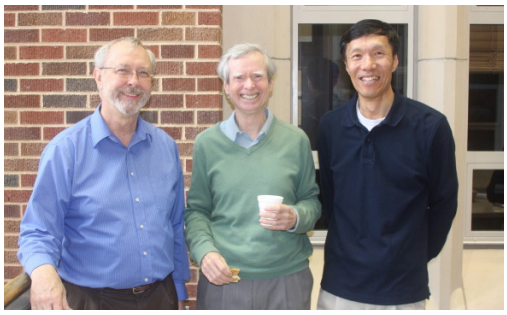
Tom Miller Visits Department

A highlight of the Spring 2010 semester was the visit and colloquium by former faculty member Thomas Miller. Tom came to OU in 1978 as an associate professor and immediately became a highly valued member of our Department—for his internationally known experimental and computational research in chemical physics; for his teaching (while here he won three awards for excellence in teaching, and to date he remains the only physicist the astronomers have allowed to



L to R: Greg Parker, Tom Miller, Xifan Liu.
Photo credit: John Cowan

teach their introductory course for non-majors); and for his service to the department—notably spending many weekends with Michael Morrison and Stu Ryan cleaning out the attic, which contained detritus that apparently pre-dated Isaac Newton, so this space could be turned into offices for graduate students.

In 1990, Tom took a leave of absence to work at the Plasma Chemistry Laboratory at Hanscom Air Force Base, which occupies parts of Lexington, Bedford, and Lincoln, Mass., about a dozen miles northwest of Boston. Much to our regret, Tom ultimately chose to remain at the Hanscom lab,

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From the Chair

The faculty, postdoctoral fellows, staff and students of the Homer L. Dodge Department of Physics and Astronomy continue to pursue excellence in research, teaching and building a productive environment that is collegial, supportive and interactive. Our postdoctoral fellows, graduate and undergraduate students are actively involved in research and teaching. These individuals collaborate with their outstanding faculty mentors to make novel scientific advances, and regularly publish in the most highly recognized scientific journals. Our faculty seeks and obtains funding from the most prestigious national funding agencies.

The future of our discipline, scientific worldwide competitiveness and continued economic growth depends on us and other educators to provide highly educated, exceptionally well-trained students. We are indeed proud of our successful students and alumni. We recognize the need to pursue excellence in research and teaching and our department is noted for its excellence in teaching throughout the state.

We have excellent technicians and staff who monitor budgets, manage our network, provide support and information, machine some of the finest scientific instruments, and engineer electrical circuit boards for faculty and students.

We are delighted to announce the formation of our first Board of Advisors. The Board of Advisors includes Chun Lin (Chair), Neal Lane, Ward Paxton and A. T. Stair. The goal of the Board of Advisors is to advocate for the students, faculty, staff and programs of the Homer L. Dodge Department of Physics and Astronomy. Board members shall personally support the Department through interactions with current students, faculty, staff, alumni and the OU administration and attend regular meetings of the Board in Norman.

We also are happy to announce state matching funds for two and a half of our endowed chairs. These endowed chairs are part of a generous gift from the Avenier Foundation. Paul Bell, dean of the College of Arts and Sciences, invited us to submit paper work to hire two endowed chairs and four junior faculty. Our new Vice President for Research, Kelvin Droegemeier, currently is "lining up support" from the administration.

Finally, it is a pleasure to be a faculty member and current department chair of the Homer L. Dodge Department of Physics and Astronomy. I look forward to many successful years ahead.

—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. The newsletter staff includes Dick Henry, Mike Morrison, Howie Baer and Ryan Doezema and is printed at a cost of $1.70/copy to the taxpayers of the State of Oklahoma. The University of Oklahoma is an equal opportunity institution. All photographs are by Robert Taylor unless otherwise noted.

Centennial Celebration (continued from page 1)
Astronomy (Kim Milton), Religious Studies (Tom Boyd), History of Science (Peter Barker), Philosophy (Zev Trachtenberg) and Drama (Kae Koger). Also during the same September weekend, the first meeting of the department's new Board of Advisors will take place (see From the Chair on page 2). Finally, the Sooners host Florida State in a football game on Saturday, Sept. 11. So mark your calendars!


Andrei Linde

The date for Andrei Linde's lecture is yet to be determined, but will occur later in the fall. Look for more details on both the lecture and the production of *Copenhagen* at our website. We hope you will plan to join us for these exciting events!

Tom Miller Visit continued from page 1
where he continues to work under an appointment at the Institute for Scientific Research at Boston College. Tom's current research consists in part of swarm experiments, mostly on electron and ion interactions with molecules in weak plasmas. The U.S. Air Force funds this work because plasmas are important in radiowave communications, including GPS signals traversing the ionosphere, radar signatures of jet and missile exhausts; and communications with hypersonic and re-entry vehicles. Lately, Tom and his colleagues have been studying ion-ion mutual neutralization, in which the collision of a negative and a positive ion causes transfer of an electron that results in neutralization of both ions. This process limits the plasma density possible in any electric discharge at atmospheric pressure or in any situation where free electrons attach rapidly to molecules.

Like his ion-ion research, many of Tom's experiments on electron attachment to molecules use a flowing-afterglow Langmuir-probe (FALP) apparatus that was built at OU during 1978-1990. (In 2005, Tom described much of this research in a review in *Advances in Atomic, Molecular, and Optical Physics*.) During this period, Tom directed five graduate students: Xifan Liu, Jeff Friedman, Steve Lorentz, Bob Fiegel and Rodney Wetterskog. Xifan currently is at the Oklahoma School for Science and Mathematics; Jeff is a professor at the University of Puerto Rico-Mayguez; Steve is at NIST in Gaithersburg, Md, Bob works for the FAA in Oklahoma City and is an owner and coach for Oklahoma Sport Fencing; and Rodney is director of development and alumni relations for the Jonsson School of Engineering and Computer Science at UT-Dallas.

Currently, Tom and his colleagues are preparing an article for *Science* about a newly discovered process. In addition to two-body ion-ion neutralization, they see a three-body process in which the third body is an electron. This observation raises the important question of how the conventional Landau-Zener neutralization is modified by the extra electron. Although several mechanisms could explain the observed increases in the ion-ion neutralization rate, the question of whether any of these mechanisms are sufficiently strong to actually explain the experimental data remains open.

Between 1998 and 2001 Tom and his colleagues also were flying mass spectrometers on NASA aircraft, using chemical ionization (ion-molecule reactions) to detect trace gases in the stratosphere. Knowing the reaction rates from lab work, they could determine from measured ion signals the concentrations of trace gases in the atmosphere. One of these NASA field campaigns focused on the winter arctic ozone hole and resulted in three two-week stays in Kiruna, Sweden, above the arctic circle. —Mike Morrison

Student, Alumni, and Staff News

Hats Off to Our Students!

Many of the Department's students were honored for their achievements during the annual awards ceremony held on May 6. Below are listed the students' names grouped by their scholarships and awards.

Homer L. Dodge Departmental Awards

Dodge Prize (junior)	Robert Free
Dodge Prize (sophomore)	Nils Schlupp
Fowler Prize	Christopher Schroeder
Kalbfleisch Prize (grad. student)	Andre Lessa
Nielsen Prize (PhD Dissertation)	Bin Chen

Physics and Astronomy Awards

J. Clarence Karcher Award	Logan Maingi
J. Clarence Karcher Award	Matthew Whiteway
Duane E. Roller Award	Dustin Clouse
William Schriever Award	Adam Fallon
William Schriever Award	Preston Seaberg

Physics and Astronomy Karcher Scholarships

Adam Fallon	Mallor Getts
Kisa Johnson	Logan Maingi
Neil McGlohon	Preston Seaberg
Daniel Solow	Jacob Stinnett
Matthew Whiteway	

Physics and Astronomy Recognition

Walden Bowen	Austin Burkett
Galen Buttitta	Dustin Clouse
Whitney Costello	Andrew Do
Brandon Doull	Darren Erdman
Andre Goran	Chase Gough
Kramer Harrison	Mary Hogan
Caleb Holt	Jim Hopkins
Spencer James	Stephen Kane
Lena Ramahi	Michael Ray
Christopher Schroeder	Leah Traffor
Amanda Truitt	Michael Wilkinson
Matthew Zarachof	

Engineering Physics Awards

J. Clarence Karcher Award	Andrew Santos
Duane E. Roller Award	Curtis Soiron
Duane E. Roller Award	Zachary Dunn
Duane E. Roller Award	Scott Lowe
Duane E. Roller Award	John Mueller
William Schriever Award	Jody Bringhurst

Engineering Physics Scholarships

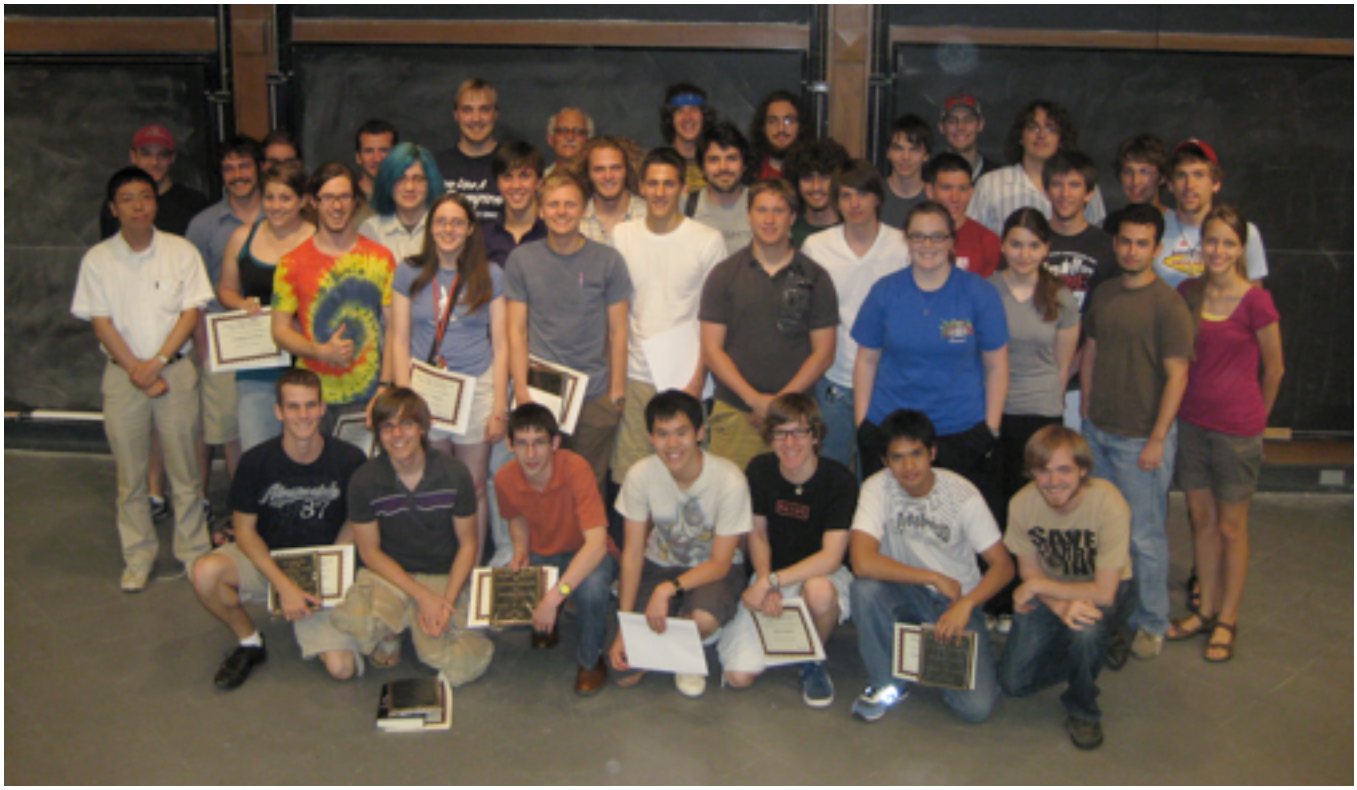
Roy B. Adams Scholarship — Jody Bringhurst
Roy B. Adams Scholarship — Joshua Reid
Cuba and Ted Webb Scholarship — Scott Lowe
Homer L. Dodge Scholarship — Curtis Doiron

J. Clarence Karcher Scholarships

Dillon Carroll — Zachary Dunn
Robert Free — Cale Gentry
Joshua Hardisty — Kendall Harper
Stephen Holleman — Mason Maguire
Seth Strout — Peter Tower

Engineering Physics Recognition

Benjamin Abner — Bruce Bacon Jr.
Aaron Browder — Bryce Callies
Jeshurun Chisholm — Chase Hennon
Thomas Mcquaid — Richard Mihelic
John Mueller — Kelly O'Roke
Cody Piersall — Rachel Rogers
Andrew Santos — Nils Schlupp
Derek Sealey — Jared Seay
Chase Stevens — Brendon Watts



2010 student award recipients, pictured here following the annual awards ceremony. Photo by Matt Johnson.

Alumni News

Bob Coleman (B.S. 1960) lives in Williamsburg, Ohio, and has had a long career in the U.S. space program. He recalls attending the 1957 Bohr lecture at OU and notes a reference to J. Rud Nielsen in Richard Rhodes 1986 book *The Making of the Atomic Bomb*.

Eldon Ferguson (B.S. 1949, Ph.D. 1953) is the retired director of the NOAA environmental lab in Boulder, Colo., and splits his time between homes in Boulder and France. Eldon is known for developing the Flowing Afterglow method for ion-molecule studies that still is extensively used, as we heard in a recent colloquium by former faculty member Tom Miller. He is also co-author of a recent publication in *Science* (January 15, 2010) describing some new experimental results in ionosphere physics.

We'd like to hear news from more alumni! We invite you to visit the alumni section on our website to make sure that your name is listed among our alumni and to update your information! Check out the alumni photo gallery while you are there. If you can identify people in the photos that we haven't been able to figure out, please let us know!

Staff News

Two members of our staff were honored with Distinguished Performance Awards this spring.

Debbie Barnhill received a Distinguished Performance Award, from the Hourly Employee's Council. From the time she was hired, Debbie's co-workers knew that she would become indispensable in the department. From her experience with campus procedures and policies to her calming influence in a hectic academic world, Debbie's greatest value to us is her ability to interact with all, greeting them with a smile and a willingness to listen when challenges seem overwhelming.

L to R: Linda Smith, president of the Hourly Employees Council, Debbie Barnhill; and OU President David Boren.

Andy Feldt received a Distinguished Performance Award from the Informational Staff Association. Andy has been a fantastic asset to the department for many years. He maintains all of the departmental computers with multiple operating systems, manages the department's networks, and interfaces with OU's IT group. He is knowledgeable, supportive, friendly and easy to work with. Both of these awards carry a stipend of $500. Congratulations, Debbie and Andy, for your outstanding contributions to the Department of Physics and Astronomy!

In addition, Danette Loyd and Bill See were recognized for 20 years of service to the university. Way to go!

Finally, our librarian, Kathryn Caldwell, has joined the Peace Corps and has traveled to the

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L to R: Chris Cook, president of the Informational Staff Association., Andy Feldt; and President David Boren.

Staff News (continued from page 6)

Republic of Georgia to teach English. This is an excellent opportunity for Kathryn; however, we have lost a wonderful librarian. We extend a warm welcome to our new librarian, Peggy Eby!

The Defenders

The following students have successfully defended their dissertations during the past year.

Master's: Daniel Habchi (5-09), Richard Walcott (12-09), and Chau Dang (5-10).

Ph.D.: Madhavie Edirisooriya (8-09), Aruna Dedigama (8-09), Bin Chen (8-09), Melissa Brucker (8-09), Mandy Rominsky (10-09), Shorab Hossain (12-09), Mark Curtis (12-09), Poopalasingam Sivakumar (12-09), Soma De (5-10), and Daniel Brue (5-10).

Astronomer David Branch Retires

David Branch can be considered one of the founders of Physics and Astronomy at OU. The department's first astronomer, Tibor Herczeg, retired in the spring of 1999, and now Dave will retire this May. Without their presence astronomy could not have grown to include eight tenure positions, as it now does. Dave came in September of 1973 after a three-year postdoc in England. We were wise to offer him a position, and we were lucky to get him to come. He started his science education in physics at Rensselaer Polytechnic Institute and did his graduate work in astronomy at Maryland (where he met his wife, Sheila). Details of his route from Pennsylvania to Oklahoma can be found in Richard Fowler's book *Late Start, Fast Finish*. Dave has made a name for himself and the department because of the work he has done on supernovae. He first became interested in their strange spectra while a postdoc at Caltech, and shortly thereafter pioneered the use of Type Ia supernovae to determine the expansion rate of the universe, the Hubble constant. He even had the audacity to suggest measuring the change in the expansion rate. Thirty-five years later, as the number and distances of observed supernovae has increased, it is now possible to measure that change; the expansion is accelerating. These measurements would have been far in the future without David's research and his advocacy of the use of Type Ia supernovae as cosmological probes. In his efforts to understand these strange exploding stars, he has become the world's leading authority on the spectra and classification of supernova types. In retirement, he will finish a book already begun on the subject.

Dave's contribution to science is widely recognized—he was awarded a George Lynn Cross Research Professorship in 1987—but his contribution to the development of the department has been equally important. David was responsible for developing the introductory astronomy class at OU and many thousands of students have passed through that class—their

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David Branch Retires (continued from page 7)
only science exposure at OU—since his arrival. David is one of the few, if not the only, GLC professor who has continued to teach a non-major introductory course at OU. The faculty has elected David many times to serve on the executive committee of the department (Committee A), and the department's turbulent decade that started in 1975 ended when he was chosen as chair in 1985. Branch led more by example than dictate, and under his leadership the department pulled itself together and grew into four collegial research groups.

— Ron Kantowski, Eddie Baron and John Cowan

George Lynn Cross Professor David Branch has been a member of the department since 1973.

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 a dozen students, eight from outside the department and four from within it. Students from the first group (along with their supervising professors) include Arvon Amisial(Mullen, Jacob Teffs (Leighly), Steven Armour (Milton), Thomas Rembert (Johnson), Sushant Sabnis (Abraham), Timothy Wolfe (Abraham), James Sloan (Abbott), and Michael Jones (Shafer-Ray). Those students from OU include Adam Fallon (Shaffer), Darven Erdman (Johnson), Mason Maguire (Henry), and Mallory Getts (Cowan). We wish all of these undergrads and their professors a productive summer!

OU HEP and the CERN Large Hadron Collider

The CERN Large Hadron Collider, which has been under construction these past 15 years, has finally begun to operate. CERN is the European Laboratory for Particle Physics, located in Geneva, Switzerland. The LHC is a 17 mile circumference accelerator designed to collide one beam of protons against another proton beam at center-of-mass energies ranging from 7 to 14 TeV (trillion electron volts).

On March 30, the first proton-proton collisions at 7 TeV were recorded. Since that time, there have been numerous data-taking runs, albeit at extremely low luminosity. LHC operators are engaged in learning how the machine runs, and how to create and maintain stable beams suitable for data taking at the various detectors.

The High Energy Physics world is abuzz with excitement over the long-awaited LHC turn-on! The reason is that the LHC was designed to be a "discovery machine." The laws of physics as we

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Research Programs

Astronomy, Astrophysics and Cosmology

During the past year, Yun Wang, whose main research area is dark energy, was selected to be a member of the NASA/ESA Joint Dark Energy Mission Science Coordination Group. She also remained actively involved in the proposed ESA-led dark energy space mission Euclid, for which she is a science topics coordinator for Baryon Acoustic Oscillations and the U.S. representative on the Science Advisory Team for EUCLID Near-IR Spectroscopy Consortium.

In summer 2009, after two years of intensive work, Wang completed an invited technical monograph on dark energy. Published in both the U.S. and Germany by Wiley, this book can be used either as a technical reference or a graduate textbook. Both of Wang's graduate students are making excellent progress on their doctoral thesis research projects on key aspects of Baryon Acoustic Oscillations as probes of dark energy.

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Eddie Baron has been working on four related projects. First, with former OU student Bin Chen he has nearly finished the first phase of the extension of his general purpose three-dimensional radiative transfer code to the case of arbitrary velocity fields. Second, Eddie's research with OU graduate student Soma De on the effects of time-dependent recombination in Type II supernovae has yielded one published paper, with a second under review. The next phase of this project will entail calculating full, time-dependent radiative transfer in the cosmological recombination epoch. Soma defended her thesis in May. Third, with OU undergraduate Spencer James, Eddie has been working to determine 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 finding points to the origin of Type Ib as low-mass helium cores in binary systems that have undergone a common envelope evolution. This research constitutes Spencer's Capstone Thesis and will be the topic of a soon-to-be-submitted paper. Last but not least, Eddie and collaborators have been looking for second parameters in the light curves of Type Ia supernovae that are directly associated with the progenitor system.

Eddie Baron

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From 2004 through 2008, David Branch's main research activity was to produce a series of five papers for the *Publications of the Astronomical Society of the Pacific* on comparative analysis of the spectra of thermonuclear (Type Ia) supernovae. For David, the most satisfying aspect of the project was the participation of students, including Darrin Casebeer, Leeann Chau Dang, Nicholas Hall, Joshua Harrison, Kazuhito Hatano, Melissa Keithley, Wesley Ketchum, Mercy Melakayil, Jerod Parrent and Michael Troxel (all at OU); Christopher Bruner

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(a summer visitor from Wesleyan); and Miriam Musco (a summer visitor from the University of Indiana).

Since early 2009, David also has been working on a book, *Supernova Explosions*, for advanced students of physics and astronomy and for physicists and astronomers conducting research on topics related to supernovae. He is enjoying the attempt but, of course, cannot know whether he'll ever finish——although his retirement from OU at the end of the spring 2010 semester can only help.

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Karen Leighly

Karen Leighly has been researching broad absorption lines observed in about 20 percent of quasars. These lines appear blueward of the transition's rest wavelength, indicating absorption in winds emerging from the quasar. These winds can have speeds as high as one tenth the speed of light. Observations suggest that these winds occur in all quasars but are in the line of sight only 20 percent of the time. Outflows are an important part of the AGN phenomenon. Among other things, they may carry kinetic energy to the host galaxy, influencing its evolution. They also may contribute to the coevolution of black holes and galaxies implied by the observed correlation between the black-hole and galactic-bulge masses. Unfortunately, the nature and origin of AGN outflows remain largely mysterious due to the difficulty of measuring basic parameters of the outflows. Karen and colleague Matthias Deitrich (Ohio State University) were awarded time in April on NASA's Infrared Telescope Facility and in May on the Michigan-Dartmouth-MIT telescope to observe a sample of nearby broad absorption line quasars. OU graduate student Sara Barber will participate in both observing runs. Karen and Matthias also were awarded time on the Large Binocular Telescope, where they will use the new infrared instrument Lucifer.

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Dick Henry, in collaboration with Bruce Balick (U. Washington), Karen Kwitter (Williams), Jackie Milingo (Gettysburg) and John Cowan (OU), has continued research on the abundances of planetary nebula and galactic chemical evolution. In three successful nights of observing on the Gemini North 10-meter telescope in Hawaii, Karen Kwitter, Bruce Balick and Dick obtained spectrophotometric observations of several planetary nebulae located in the halo of the galaxy M31. They hope these data contain clues to the formation and evolution of galaxy halos in general. The same group along with Jackie Milingo, a former OU doctoral student now teaching at Gettysburg College, also is completing research on the oxygen abundance gradient of the Milky Way disk. Dick's graduate student Henry Bradsher has been using photoionization models to study aspects of the routine that the group uses to determine nebular oxygen abundance. His results will be distilled and prepared for publication during summer 2010. Henry currently is reducing spectral data, obtained at Cerro Tololo Interamerican Observatory in 2007, of several planetary nebulae located in the Small Magellanic Cloud, a nearby irregular galaxy. The results will be the basis of his master's thesis. Early in 2010, Dick was coauthor with John Cowan and Jennifer Sobeck (Chicago) on a published report of theoretical production rates of Fe-peak elements in massive stars.

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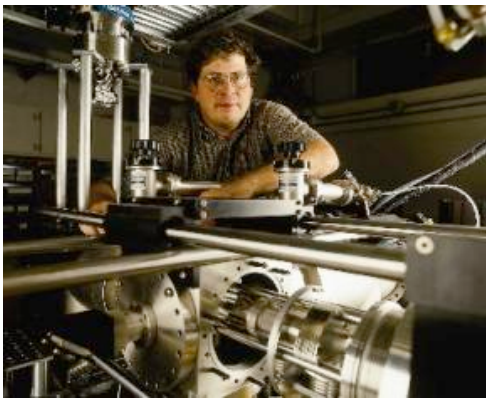
Continuing his studies of stellar abundances, John Cowan and collaborators last year completed a large-scale, decade-long project to obtain abundances for all of the rare-earth elements (Nd, Ba, Ce, and so forth) in a number of old, metal-poor Galactic halo stars. This research will aid understanding the formation of heavy elements in the "First Stars" in our Galaxy. John and his colleagues also were awarded observing time on the recently refurbished Hubble Space Telescope. This will allow them to use the Space Telescope Integrated Spectrograph on HST during summer 2010 to determine the abundances of heavy elements, including radioactive elements, in one of the oldest stars in the universe. Using the resulting data, they hope to determine the age of this star and thereby put a lower limit on the age of our Galaxy and of the universe.

Last fall, John taught almost 400 students in introductory astronomy. He also mentored capstone student Amy Rogers on studies in stellar abundances. She now has become a grad student in the OU History of Science program.

Atomic, Molecular, Optical and Chemical Physics

Neil Shafer-Ray and OU students P. Sivakumar, C. P. McRaven, P. M. Rupasinghe and T. Zh. Yang recently submitted a paper to *Molecular Physics* that demonstrates their achievement of the world record for resolution in a resonance-enhanced multiphoton ionization experiment. They used this detection scheme to determine hyperfine splittings from spectra in PbF, the molecule Neil and his collaborators are using to



Neil Shafer-Ray

measure the electric dipole moment of the electr on. Several students have graduated or will soon graduate from the Shafer-Ray laboratory. Sivakumar Poopalasigam is beginning his first postdoctoral appointment at Delaware State University, and Christopher McRaven, who will soon defend his thesis, is choosing from several postdoctoral opportunities, including ones at Stony Brook and Wisconsin.

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Eric Abraham's group is working on two projects on the production of cold, trapped nitric oxide (NO). Eric and graduate student Parshuram Dahal, in collaboration with John Furneaux of the condensed-matter group, have developed a new laserless source of molecules to be used in cold-molecule experiments. This source will be especially useful for researchers who have dilution refrigerators but little optical access. In collaboration with Neil Shafer-Ray, Eric's group also is attempting to trap NO in a new, permanent magnetic trap by optical pumping. They recently brought online a new pulsed dye-laser system with which they have measured the rotational spectrum of NO. They plan to use this system to characterize the new NO source and to detect the resulting trapped molecules. In May 2010, Parshuram presented results from this project at the 2010 meeting of the Division of

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Atomic, Molecular, and Optical Physics of the American Physical Society.

Working with new graduate students Thomas Akin and Sean Krzyzewski, Eric is re-constituting his research on laser cooling and trapping rubidium. They seek to study effects beyond the mean-field approximation in Bose-Einstein condensation and to test recent advances by Deborah Watson in the theory of these effects. In this project, Eric also is collaborating with Michael Morrison on the theory Feshbach-resonance-enhanced photoassociation spectroscopy, a new tool that may probe beyond-mean-field effects in BEC. Tom and Sean have designed a new type of laser-cooled atom slower that can load ultracold-atom traps by using permanent magnets to generate a spatially varying magnetic field profile. Tom, for his specialist exam, has worked out how to calculate the characteristics of a BEC transition in multiply-connected trap configurations. Eric and his students will present both of these results at the 2010 DAMOP meeting.

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In fall 2009 Jim Shaffer returned from a sabbatical at the University of Stuttgart in Germany. He was named a Fellow of the Alexander von Humboldt Society. Prior to his return in summer 2009, undergraduates Chris Schroeder and Leah Trafford worked in Stuttgart. Chris was a DAAD fellow and won the Grand Prize at Oklahoma Research Day for his research in Jim's group. Chris also was an honorable mention for a Goldwater Fellowship and won the department's Fowler Prize. Leah was invited to present her research at the University of Nebraska Conference on Women in Science, where she was the only undergraduate who gave a talk. Jim is returning to Stuttgart for June and July of 2010 to continue research initiated during his sabbatical. Overall, the Shaffer group had a highly successful year. They published papers on ultracold Rydberg-atom physics in *Nature*, *Nature Physics, Nature Photonics* and *Physical Review Letters*. Additional papers have been submitted to *Physical Review Letters* and to *New Journal of Physics*. In the lab, they have made great progress constructing new experiments. Graduate students Don Booth and Jonathan Tallant have upgraded the group's cesium Rydberg-atom experiment so it can capture more cold atoms at larger densities in a dipole trap. They currently are measuring lifetimes of Rydberg atoms in this trap and using the new apparatus to look for Rydberg molecules. In another advance, the group's new atom chip experiment is coming online. With this apparatus, graduate students Arne Schwettmann and Jon Sedlacek have magnetically trapped Rb atoms and will be collecting data for the first paper generated by this machine. The group is presenting two talks and three posters at this year's DAMOP conference. As of May 2010, Jim has given invited talks about his group's research at the University of Heidelberg, the University of Durham (UK) and the University of Connecticut. Last year, he gave invited talks at DAMOP, ITAMP (Harvard), and the Workshop on Control of Tailored Matter in Germany. The

Jim Shaffer

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group has several invitations to give talks in the near future at the University of Ulm and at a workshop on cold Rydberg atoms at the MPI for Complex systems in Dresden, Germany. Jim's group hosted students from Stuttgart and the University of Sao Paulo, Brazil. Professor Luis Marcassa of the University of Sao Paulo also visited for two weeks, intends to return for four months, and has applied for a Fulbright Fellowship to join the group next year. Jim is co-chairing the LS/DLS meeting and a workshop on cold Rydberg atoms to be held in Recife, Brazil, next year. These plans are almost complete, and he is looking forward to a year free of planning meetings! With a little bit of luck, his group will have another great year!

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Deborah Watson and her postdoc Martin Dunn recently submitted a paper to *Physical Review Letters* that describes their masonry work "rearranging the exponential wall" for systems with a large number of particles *N*. This wall refers to the exponential scaling in the amount of work and/or resources required to exactly solve large-*N* systems. Due to the complexity of quantum wave functions, this wall has long been considered insurmountable because the required work scales *exponentially* with *N*, often doubling for every particle added. With current numerical resources, this problem "hits a wall" around $N = 10$. To circumvent this scaling, Watson's group has been sharpening up their skills at group theory and graph theory to construct analytical blocks formed from irreducible representations of the symmetric group. With these blocks they can reconstruct the same wall but shift the "heavy lifting" from the computer to paper. The rearranged wall does not depend on *N*. Instead, the exponential complexity appears in the order of the perturbation series. This reformulation potentially allows exact calculations of large *N* systems through low order. Deborah and Martin currently are applying this approach to a Bose-Einstein condensate of rubidium atoms.

Deborah Watson

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Juan Blandon, a postdoctoral fellow in Greg Parker's group, has been collaborating with one of Parker's former graduate students, Xuan Li (who is now a postdoc at the University of British Columbia), on calculating potential energy surfaces of Li_3 molecules exposed to a constant external magnetic field. These potential energies manifest so-called "diabolical conical intersections" as well as two-body magnetic Feshbach resonances. Blandon plans to use these potentials to calculate *ab initio* three-body recombination rates for an ultracold atomic gas of ^6Li atoms. This research is relevant to the fundamental topic of universality in few-body systems, which was recently observed in ultracold atomic gases of alkali metals. Last year, Juan presented this research at a 2009 Gordon Research Conference on Quantum Control of Light and Matter. In May 2010, he will present further results at this year's DAMOP meeting.

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Michael A. Morrison continues research with students and faculty at OU on the physics of ultracold molecules, with collaborators in China on electron-molecule scattering, and with colleagues in Australia on a new transport theory for charged particles in molecular gases. During summer 2009, he worked on transport theory

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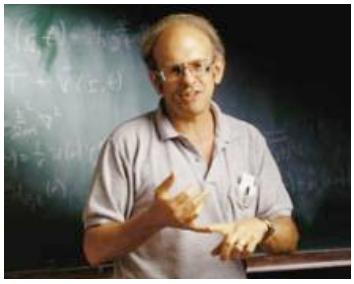
with collaborators Rob Robson and Ron White at James Cook University in Townsville, Australia. (Morrison, Robson, and White are writing the monograph *Low-energy Charged Particles in Atomic and Molecular Gases* for publication by Princeton University Press.) He then visited the Australian National University in Canberra to consult on possible future collaborations at the newly formed Centre for Research on Positron and Anti-matter, a part of the ANU's Institute for Advanced Studies. In electron-molecule scattering, Mike's ongoing collaboration with Andy Feldt (at OU), and with Chinese colleagues Hao-Feng and Weiguo Sun led to the publication this year in *Journal of Physics B* of state-of-the-art calculations of



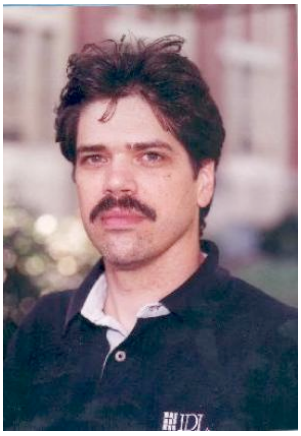
Mike Morrison

vibrational excitation cross sections for low-energy e-N_2 scattering. The ultracold research, a collaboration with Greg Parker and Jim Shaffer and former graduate student Xuan Li, seeks to devise practical schemes for creating large samples of molecular dimers in very low-lying vibrational states of the ground electronic state. In particular, the group is testing the hypothesis that one can use shaped ultrashort laser pulses used to efficiently change the state of translationally cold sodium and cesium atoms confined in a trap into NaCs molecules in deeply bound vibrational states. The formation of ultracold molecules is a primary current emphasis in AMO research because of its potential contributions to femtosecond chemistry, to precision measurement of physical constants, to the creation of a molecular laser, to the study of molecular Bose-Einstein condensates of dipolar molecules and to the search for electric dipole moments of elementary particles such as the electron, which currently is a goal of Shafer-Ray's experimental program.

Under Mike's supervision, two OU graduate students soon will begin complementary doctoral research on ultracold molecular formation: Stephane Valladier will explore schemes involving two (or more) pulsed lasers, while James Dizikes will explore schemes in which the initial quantum state of the atoms is enhanced by using an external magnetic field to create a resonant state. The latter topic also is the focus of ongoing discussions by Mike and Eric Abraham aimed at developing a proposal for joint experimental/theoretical study of resonance-enhanced photoassociation of homonuclear rubidium dimers. Finally, having finished his decades-in-the-making textbook *The Joy of Quantum Physics*, Mike hopes to complete a few more (much shorter!) writing projects before he finally retires.

Condensed Matter Physics

All faculty in this group—Lloyd Bumm, Ryan Doezema, Matt Johnson, Kieran Mullen, Sheena Murphy and Mike Santos—continue to benefit from their participation in the Center for Semiconductor Physics in Nanostructures (C-SPIN). Held jointly with the University of Arkansas, C-SPIN is funded by NSF under the Materials Research Science and Engineering Center program. Now in its ninth year of funding, the Center will be up for renewal next year. Matt is the Center's director, and Mike and Greg Salamo (at Arkansas) head two Interdisciplinary Research



Lloyd Bumm

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Groups. IRG1 focuses on a variety of ways to create nanoscale structures such as quantum dots and wires. IRG2 focuses on mesoscopic structures made from narrow-gap semiconductors. Individual faculty and smaller groups of faculty also hold several smaller grants. Contributing to their research are four post-doctoral fellows, staff and seven graduate students.

High-energy Particle Physics

For Pat Skubic, Howie Baer and Brad Abbott (as for almost everyone else in the global high-energy physics community) *the* event of the year was the successful startup of the large-hadron collider. Brad has been studying the top-quark cross section and searching for supersymmetry at the ATLAS detector at CERN. He also has been using the large data set of the D0 detector at Fermilab to determine the strong phase, ϕ_s, in B_s decays. Howie is co-leader of an eight-week workshop (April 26 through June 18) titled "Dark Matter: Its Origin, Nature and Prospects for Detection" at the Galileo Galilei Institute for Theoretical Physics in Florence, Italy. Among the many hot topics discussed at this workshop is "What light can the LHC Atlas and CMS experiments shed on the identity of the dark-matter particle(s)?"

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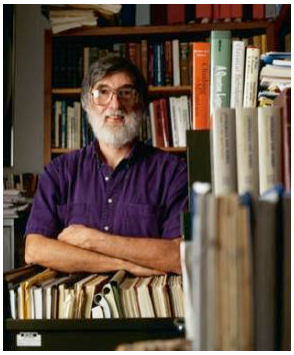
For Kim Milton, two conferences were among the highlights of 2009-2010. Held in September 2009, the Ninth Conference on Quantum Field Theory Under the Influence of External Conditions involved 100 participants from 25 countries. Its proceedings will be published by *World Scientific* in June. Then, in April 2010, OU hosted the "MiltonFest" (under the more formal title "Nonperturbative Quantum Field"). On this occasion, some 40 participants representing seven countries and four continents came to OU to honor Kim on his 65th birthday. During this academic year, Kim, his students and collaborators have written 10 papers, with several more far advanced in the pipeline.



Kim Milton

The awarding of a Ph.D. is a major Departmental event, and in 2009 Mike Strauss's graduate student Mandy Rominsky earned hers for analysis on "A Measurement of the Inclusive Dijet Cross Section as a function of Dijet Invariant Mass and Rapidity at D0." During fall 2009, Phil Gutierrez's graduate student Sohrab Hossain finished his dissertation. A paper reporting this work is currently under review by the D0 collaboration for publication in *Physical Review.* In addition, Phil was a lead author, along with OU postdoc Supriya Jain, on a D0 paper published in *Physical Review D* that set limits on the top quark decaying to charged Higgs bosons. During summer 2009, Gutierrez presented D0 results at the European Physical Society meeting in Krakow Poland.

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Ron Kantowski has been working to correct the widely used theory of gravitational lensing theory that he, Bourassa, Norton and Cooke developed in the early 1970's. Chung Kao published "Discovering the Higgs Bosons of Minimal Supersymmetry with Bottom Quarks," a paper with his student Shankar Sachithanandam, who is now on the faculty of Anna University in India, and with former and present OU postdoctoral fellows Yili Wang and Josh Sayre, in *Physics Letters*.

Large Hadron Collider (continued from page 8)

know them today are contained within the Standard Model of particle physics. The Standard Model provides a relativistic-quantum mechanical description of the strong and weak nuclear forces, along with electromagnetism. In fact, it unifies these seemingly disparate forces into a single coherent theory. All the fundamental particles contained within the SM have been discovered except one: the Higgs boson, a hypothetical particle necessary for the breakdown of electroweak symmetry, and for providing mass to the SM particles. One goal of the LHC is to discover or rule out the existence of the Higgs boson.

Site of the Large Hadron Collider near Geneva

The LHC will have two general purpose detectors—Atlas and CMS—along with two smaller, more specialized detectors. The OU HEP experimental group (Pat Skubic, Phil Gutierrez, Brad Abbott and Mike Strauss) is deeply involved with the Atlas detector. They have been engaged in constructing the inner-most elements: the semi-conductor pixel detector. This detector will aid in identifying the long-lived bottom-quarks, which are the decay products of the putative Higgs boson. They also are involved in analysis efforts ranging from quantum chromodynamics and supersymmetry, to Higgs boson searches. In addition, HEP theorist Chung Kao is involved in calculating Higgs boson production and decay processes, and Howie Baer is involved in calculating the consequences of supersymmetry for LHC experiments. With LHC up and running, the next decade promises to be the "discovery decade" for High Energy Physics, and the OU HEP group will be playing a major role in these efforts!

—Howie Baer

Yun Wang: Poetry from a Cosmologist

OU cosmologist Yun Wang is also a poet. Her poetry book, *The Book of Jade* from Story Line Press, was published in 2002 and is available from Amazon.com. The following is a selection from her book.

Yun Wang joined the department in 2000.

Written in Stars

A great wall stretches
three hundred million lightyears
We are not certain of its existence

The black mirrors are embroidered
They speak to us in waves
As we breathe our thoughts are read
A cold sensation

These faint blossoms emerge
out of darkness
As we gaze they grow brighter

In the celestial ocean of dust
there are lumps that glow
there are lumps that are dark
there are voids that grow