Communiqué

Autumn 2007

UNIVERSITY OF MISSOURI-COLUMBIA DEPARTMENT OF PHYSICS & ASTRONOMY

Physics Faculty Garner Impressive Awards

Assistant Professor **Angela Speck** won a prestigious CAREER Award in the Astronomy and Astrophysics Division of the National Science Foundation (NSF). The award amount pays approximately $500,000 over a period of five years.

Nationally about 200 CAREER awards are given each year in all branches of science and engineering. There are only three to four awards given in the Astronomy Division.

Among the four University of Missouri campuses, there have been only 24 CAREER awards since the program's inception in 1994: 10 in Columbia, three at UMSL, two at UMKC and nine at UMR. Speck has joined the elite group of MU's most successful untenured faculty. Physics faculty member Carsten Ullrich was a winner in 2005.

"The CAREER Award emphasizes an integrated approach to research and teaching," says department Chair H.R. Chandrasekhar. "At the time of her nomination, it was clear in my mind that Angela met that criterion splendidly. It is hard to tell where research stops and teaching begins in her dealings with students — graduate and undergraduate alike. I am not surprised that her application stood out in this tough competition [that has] a funding rate of two to four percent."

Speck will study the precise nature of dust grains around low- and intermediate-mass stars (LIMS) because this is where the dust originates before being expelled into

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Kattesh Katti, professor of radiology and physics and senior research scientist at the MU Research Reactor, received the coveted 2007 Outstanding St. Louis Scientist Fellows Award from the Academy of Science of St. Louis. He was selected to receive this award, in part, because of the international recognition he has received for his contributions to chemistry, physics, nanoscience and radiochemistry.

The academy's literature called it "a rare feat to be distinguished in all of these fields simultaneously" and praised Katti's discoveries in the development of gold and silver nanoparticles for applications in nanomedicine. Katti has written more than 150 publications and is the principal inventor on 14 patents.

"Dr. Katti has achieved international recognition for his contributions to the field of nanoscience. He is truly an interdisciplinary scientist, and we are proud to have such a distinguished professor on the MU faculty," says MU Chancellor Brady Deaton.

Katti's research includes studies of metals and organometallics in the development of cancer diagnostic and therapeutic agents, biomedical optical imaging, new approaches to cancer therapy, new biomaterials for use in surgical and non-surgical wound-healing applications and fundamental aspects of the structure of water and water–alcohol binary mixtures.

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Angela Speck

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the interstellar medium (ISM) and participating in many other astrophysical processes.

The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of the early career-development activities of teacher–scholars who most effectively integrate research and education within the context of the mission of their organization. Such activities should build a firm foundation for a lifetime of integrated contributions to research and education.

Kattesh Katti

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Katti also has been a pioneer in initiating a nanomedicine research program and establishing the Nanoparticles Production Core Facility at MU. He provided leadership in coordinating the nanomedicine research program that led to the establishment of the Cancer Nanotechnology Platform with a $3.2 million grant from the National Cancer Institute.

The Academy of Science of St. Louis, formed in 1856, is one of the oldest academies in the country. Since its inception, the academy has promoted the recognition of internationally renowned scientists of the region as part of its mission to promote the understanding and appreciation of science. The academy has more than 130 fellows who are renowned scientists and engineers; many are also Fellows of the National Academies.

Physics Scholarship Recipients

The following received department scholarship funds either during the 2006–07 academic year or summer '07:

Paul E. Basye Undergraduate Scholarship: Jeffrey Borgeson, Lance Garrison, William Danchus, Caleb Wheeler

Newell S. Gingrich Undergraduate Scholarship: Tyler Litton, Sam Grinter, John Gaddy, Lacy Hardcastle, Kevin Johnson

Eli & Nola Haynes Scholarship: Raina Cepel, Jhuma Das, Michael Gramlich, Jennifer Ortega

Eugene B. Hensley Undergraduate Scholarship: Bogdan Barz, Jacob Burress, Gengsheng Chen

Ernest W. Landen Fellowship in Physics: Michael Forney, Mohammad Arif, Shawn Hayden, Jiexuan He, Lorant Janosi, Mehmet Kahveci, Shunlin Liang, Basil Mchunu

Samuel S. Laws Scholarship: Anthony Smith

Packwood Undergraduate Scholarship: Anthony Smith, Stephen Messenger

Guy Schupp Scholarship: Yvonne Solbrekken

O. M. Stewart Graduate and Undergraduate Scholarship: Jeffrey Owens, Akshaya Swain, Harshani Wijewardane, Mikael Wood, Zhaoyang Yang

Clifford W. Tompson Scholarship: Daniel Hess, Daniel Caputo

If you would like to donate to any of the established scholarships in the Department of Physics & Astronomy, make checks payable to the University of Missouri, with the name of the scholarship in the memo line, and mail to Department of Physics & Astronomy, Attention: Sherry Long, 223 Physics Building, Columbia, MO 65211. Contact Anne Weller at 573-884-2632 or WellerA@missouri.edu to discuss creating your own named endowment.

Editorial Office
Department of Physics & Astronomy
223 Physics Building
Columbia, MO 65211
Phone: 573-882-7997
E-mail: hillsar@missouri.edu
Web site: www.physics.missouri.edu

Editorial Board
Sarah Hill
Meera Chandrasekhar
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Nancy Moen

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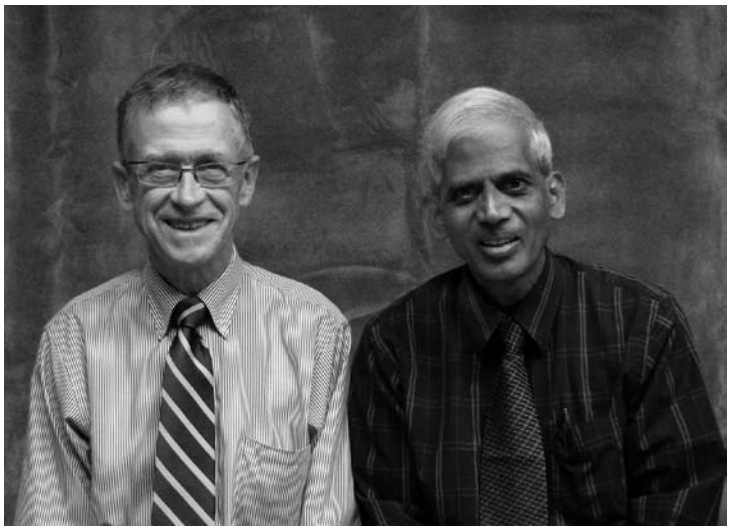
The department appreciates hearing from alumni and friends. Send announcements or milestones to the address listed above.

Chair's Note

By H.R. Chandrasekhar, Department Chair

The 2007–08 academic year begins on a high note with several of our faculty moving on to higher academic ranks with tenure and promotion. Our faculty, staff and students have won several prestigious awards campuswide and externally. I congratulate the winners.

It is hard to believe that three years have passed since I became chair of the department. As I conclude my term at the end of this academic year, Professor Peter Pfeifer will assume that role beginning September 1, 2008. I welcome Peter to take on this challenging task and wish him success. I take this opportunity to thank the students, faculty, staff and alumni for their friendship and kindness during these years. It has been my privilege to work with you.



Department Chair H.R. Chandrasekhar and Peter Pfeifer. Pfeifer will assume responsibility for the department next fall.

The past three years have seen considerable changes. Several top administrators have moved on and some have been replaced. Our faculty size has grown to 30. Five faculty (Carsten Ullrich, Owen Vajk, Maikel Rheinstadter, Xiaoqin Zou and Yun Zhang) were recruited during this period. Carsten has already won the prestigious NSF CAREER award, Provost's Outstanding Junior Faculty Award and tenure with promotion. Maikel is well on his way in establishing a research program on biological membranes using neutrons and X-rays. Owen has fulfilled the long-standing aspiration of the department to establish a material fabrication laboratory. His apparatus has already grown high-quality single crystals of considerable size. Xiaoqin brings her insights into the biological physics program and forms a bridge connecting physics, biochemistry and the Dalton Cardiovascular Research Center. As a teaching faculty member, Yun has been teaching introductory courses and managing our undergraduate laboratories. We are also fortunate to have Professor M. Frederick Hawthorne, co-director of the International Institute for Nano and Molecular Medicine, as a joint faculty member. Fred has been a great supporter in many of my initiatives, and I am grateful to him.

With the numbers of faculty, students and post-doctoral research associates at an all-time high, the intellectual atmosphere of the department has brightened considerably; however, it has also created shortages in space. Various proposals for a new building or another floor to the physics building are being floated. Under the current financial climate these prospects seem remote. I have made modest attempts to improve the quality of our existing space. Three new fume hoods, an asbestos abated duct system and a powerful exhaust fan were installed, making their air-handling system safe and efficient. The library and conference rooms were equipped with ceiling-mounted LCD projectors. It is a delight to watch students using these facilities in the wee hours of the night and on weekends, practicing, with their presentations projected on the screen.

We have also pumped in considerable resources to the Laws Observatory in the form of high-power binoculars, computers and other equipment. Lanika Ruzitskaya's article on Page 8 lists the capabilities in the virtual observatory and the telescope viewing program on the roof of the physics building. In this context I thank Meera Chandrasekhar and Dorina Kosztin, who have been invaluable in terms of ideas and financial support.

One of the dire needs of the faculty has been to obtain some professional assistance in the preparation of grants and contracts. The Physics Leaders have also pushed this idea with the administration to secure help. Our wishes have finally been fulfilled. The article by Sherry Long, our over-worked administrative associate, happily reports that we now have capable staff to help with grant preparation for various departments within the College of Arts and Science. Faculty will be able to provide information concerning new grant proposals via the Web, and this team will process the necessary internal paperwork, assist with budget preparation and also provide monthly reports.

During the past three years, several of our endowment funds have grown considerably, and new ones have been created. These have provided much needed awards and scholarships for our outstanding students and faculty. I cannot thank our alumni enough for their enthusiasm, generosity and kindness.

Once again, I am grateful to have had the opportunity to serve you.

Alumni Corner

Kyle DePew, BS '04, MS '06, has written his first science fiction novel, *The Crusade of the Faithless*. He now resides in Sydney, Australia.

Olexei Motrunich, BS '96, studied at MU in 1994–96 and then moved to a graduate program at Princeton University, completing that in 2001. After five years of postdoctoral work he is an assistant professor of physics at Caltech.

James D. Patterson, AB '56, co-wrote *Solid-State Physics: Introduction to the Theory* in 2007, a revised and expanded version of the first edition. After leaving MU, he earned a master's degree in physics at the University of Chicago and a doctorate at the University of Kansas. Following that he taught at Idaho State University for two years, at South Dakota School of Mines for 21 years and at Florida Institute of Technology (FIT) for 15 years. The past 12 years at Florida he chaired the physics and space sciences department. He had sabbaticals at University of Notre Dame, University of Nebraska and numerous summer appointments at National and Industrial Laboratories. Patterson was also a visiting professor in Brazil. His research and publications have been mainly in magnetism and semiconductors. He retired as professor emeritus from FIT in 1999 and lives in Rapid City, S.D.

Craig Tracy, BS '67, is the 2007 recipient of the Norbert Wiener Prize in Applied Mathematics, along with a colleague, for deep and original work on random matrix theory, a subject that has remarkable applications across the scientific spectrum, from the scattering of neutrons off large nuclei to the behavior of the zeros of the Riemann zeta-function. This prize was established in 1967 in honor of Professor Norbert Wiener and was endowed by a fund from the Massachusetts Institute of Technology Department of Mathematics. The prize is awarded for an outstanding contribution to "applied mathematics in the highest and broadest sense." The award is made jointly by the American Mathematical Society and the Society for Industrial and Applied Mathematics. The recipient must be a member of one of these societies and a resident of the United States, Canada or Mexico. Since 2004, the $5,000 prize will be awarded every three years.

Alan J. Vannevel, MS '93, PhD '96, is a research physicist with the Naval Air Warfare Center Weapons Division in China Lake, Calif. Vanneval's group focuses on developing new mathematical theory as applied to imaging and image processing, pattern recognition and tightly coupling the physics of imaging to the post-processing of the data. He says, "Working here is a unique experience, where you can discuss physics and math in the morning with other researchers, in the afternoon brief an admiral as to why the science is critical and while going home hear a bomb exploding or watch an F/A-18 fighter fly over." Vanneval gives witness to the fact that it really is a dry heat out there. "I will take 110 and 10 percent humidity over a typical 90/90 day in Missouri anytime." Vanneval has been married 11 years, has two children with myriad dogs, cats, birds, lizards, fish, guinea pigs and rabbits overrunning the home zoo. He still plays soccer, tries to play rugby and rock climbs when he can with his daughter.

Recent Physics & Astronomy Graduates

Congratulations to the following physics and astronomy students who earned degrees in the past year:

Doctorates were awarded to Vijayalakshmi Kattumuri, advised by Meera Chandrasekhar and Kattesh Katti; Subodha Mishra, advised by Sashi Satpathy; Mohammad Arif, advised by Suchi Guha; Pavel Korobkhov, advised by Sergei Kopeikin; and Harshani Wijewardane, advised by Carsten Ullrich.

Master's degrees were awarded to Gregory Amenta, Vinay Shimoga, Yvonne Solbrekken, Naresh Kujala Gandhi and Jhuma Das.

The following undergraduates earned bachelor's degrees in physics in May 2007: Zach Childers, Ryan Dickherber, Brandon Fines, John Flavin, Michael Forney, Lance Garrison, Samuel Grinter, Nathaniel Hall, Lacy Hardcastle, Jennifer Ortega, Tyler Sullivan, Trent Twaddle, Christopher Volz and Richard Wharton. Of those, six graduated with high honors, cum laude or magna cum laude. Zach Childers graduated with a triple major (plus English and math), the only one in the College who did so.

Lance Garrison is attending graduate school in physics at Indiana University, Lacy Hardcastle attends Georgia Institute of Technology as a graduate student in mathematics and Christopher Volz attends graduate school at Indiana University.

Physics First Targets Teacher Training

By Sarah Hill

Teachers from Missouri work on lab projects at the 2007 Physics First academy.

A Time for Physics First

Physics First, a national education reform movement spearheaded by Leon Lederman, 1988 Nobel Laureate in physics, focuses on findings that show prior knowledge of physics greatly enhances further learning by high school students in chemistry and biology. In a position statement, the American Association of Physics Teachers "recognizes that (the concept of) Physics First has the potential to foster greater scientific literacy and to help integrate physics, chemistry and biology syllabi."

A Time for Physics First is funded by the Missouri Department of Elementary and Secondary Education through a math–science partnership and a $3 million grant (MU's share is approximately $2 million). This program consists of curriculum development of a yearlong physics course at the ninth-grade level, associated professional development, support for classroom implementation and student evaluation. Meera Chandrasekhar is the lead University principal investigator, and Dorina Kosztin is one of the senior personnel on the grant.

Seventy-two ninth-grade science teachers attended the 2007 Physics First academy, held in the Physics Building in June 2007. Fifty returning participants attended the three-week program; 22 new teachers attended a four-week program. Both groups will return in 2008. In addition, 15 math teachers and 16 school administrators attended for a week and two days, respectively. At present, there are 29 Missouri districts and two non-public schools participating in the Physics First program.

Science teachers met daily for intensive physics content that covered a large swath of mechanics, planetary motion and electrical circuits. The curriculum associated with this content was the culmination of many hours of work by the Physics First writing team during the past two years, headed by Meera Chandrasekhar.

During the academic year, the Physics First program supports participants through access to an informative Web site and their instructors, follow-up meetings, visits by coach mentors (who also attended the summer academy) and a classroom kit loan program. The last Physics First academy is planned for June 2008, once again hosted by the department.

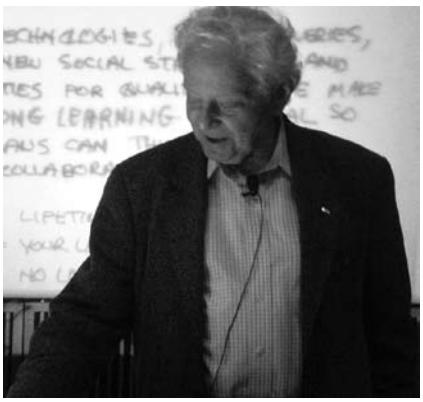
A Special Visit by a Physics First Pioneer

A prominent pioneer of the Physics First concept, Leon Lederman, 1988 Nobel Laureate in physics, spoke to Physics First participants, staff and leadership at their June academy.

Lederman explained the Physics First concept within a historical perspective. In the 20th century, many significant scientific discoveries influenced the logical sequence of the teaching and learning of science in schools. Using a "pyramid" diagram of core disciplines, he illustrated that math and computer science form the foundation for physics and astronomy. In turn, he maintained that chemistry is arguably applied physics and that structural and molecular biology are based on chemical bonding. So, logically the science sequence, in collaboration with mathematics curricula, is physics, chemistry and then biology. However, Lederman says, although there has been massive recognition of the validity of this model, there has been a concurrent failure to implement change in an entrenched system.

Lederman strongly recommends frequent collaborative time among core-discipline teachers, especially during the academic year. "Professional development is crucial to all teaching — not just two weeks in the summer, but regular daily discussion," says Lederman.

The Physics First program seeks to provide just that — not only content and pedagogy instruction in summer academies, but academic year support as well. Besides absolute support from the program itself, participating schools have pledged to supply district-level support to Physics First teachers in many forms.



Physics Nobel Laureate Leon Lederman explains the importance of teaching physics first during his June visit to the Physics First academy.

Faculty Kudos

Meera Chandrasekhar is a member of a team of MU researchers and administrators taking a proactive approach to gender equity in science, technology, engineering and mathematics (STEM). The group has received nearly $500,000 from the National Science Foundation (NSF) to conduct a three-year study aimed at developing a more diverse workplace through the advancement of women in STEM careers.

Paul deBoeij from the theoretical chemistry department at the Rijkuniversiteit in Groningen, the Netherlands, visited the department from June through September. He worked with **Giovanni Vignale, Carsten Ullrich** and their postdoctoral fellows on developing new methods for calculation of the electronic structure and the optical properties of complex materials.

Suchi Guha was chosen as a visiting scholar in summer 2006 at the National Taiwan Normal University (NTNU), Taipei, Taiwan. This is a competitive exchange program between NTNU and several of its sister universities worldwide, MU being one of them. Every year only a handful of scholars from all disciplines are selected. Guha believes she was fortunate to have been chosen for this program. NTNU has a large physics department with an equally large number of physics undergraduate and graduate students. Her host at NTNU was Professor Chita Chia with whom she now has a fruitful collaboration for her research on time-resolved light scattering studies of organic polymers.

Deborah Hanuscin was named 2007 Outstanding Faculty Member by the MU Greek Council. The award is given annually to one member of the MU faculty who has been nominated by a chapter/member of the Greek community. The recipient is to have shown a commitment to the Greek community at the University of Missouri and have made a positive impact in the lives of the members of the Greek community.

Sergei Kopeikin was accepted for inclusion in *Who's Who Among American Teachers and Educators, 2006–07.* He is also included in *Cambridge Blue Book, International Scientist of the Year, 2007.* Kopeikin's paper on the relativistic deflection of light by quadrupolar field of major planets has been published in *Physical Review D* (2007). Results of this work were selected for oral presentation by the organizing committee of Symposium 248 "A Giant Step: From Milli- to Micro-arcsecond Astrometry" of the International Astronomical Union to be held in Shanghai, China, Oct. 15–19, 2007. Kopeikin has received travel support from NSF to attend that symposium. These results have also been included in a new brochure of The American Physical Society for 2008.

Supported by grants from NSF and NASA, **Aigen Li** and his graduate students and postdoctoral and visiting scholars are working on a variety of astrophysical projects ranging from the small angle scattering of X-rays by dust grains in space, gamma-ray bursts (GRBs), the ultraviolet and optical scattering and absorption properties of protoplanetary disks out of which planets are formed, and the photoexcitation and destruction of polycyclic aromatic hydrocarbon molecules in protoplanetary disks and the interstellar medium of the Milky Way and external galaxies. Some of his work is featured in undergraduate textbooks. Since he joined the department in September 2004, Li has been awarded $919,680 by NSF and NASA (he was the principal investigator of 10 NASA grants and one NSF grant). Li participated as one of six lecturers (including D.C. Jewitt, a member of the U.S. National Academy of Sciences) at the 2006 Kobe International School of Planetary Sciences.

Paul Miceli's recent paper, which appeared in *Physical Review Letters* (2006), was selected to be highlighted in the 2006 Advanced Photon Source annual report: "How Quantum Size Effects Regulate Nanocrystalline Islands." That work examined how small nanocrystalline islands of lead grown on silicon substrates evolve in time after the islands are formed. The expectation was that the nanocrystals would "coarsen" in a manner similar to water droplets on a car windshield where larger droplets consume smaller droplets with a universal scaling behavior of the droplet size over time. However, these *in situ* X-ray scattering experiments revealed a breakdown of the classical thermodynamic relations that have been used to describe island coarsening because of quantum mechanical effects that are significant in these very small crystals. The work provides important new insight into the behavior of condensed matter on the nanoscale, which is becoming increasingly relevant to emerging new technologies. Those involved in the mentioned paper were former postdocs Chinkyo Kim (now a physics professor at Kyunghee University in Korea) and Craig Jeffrey (now a research scientist for the National Research Council of Canada in Ottawa). The research was in collaboration with Professor Edward Conrad of Georgia Institute of Technology and his graduate student Rui Feng, as well as with Professor Michael Tringides of Iowa State University and his research associate Myron Hupalo. Miceli's current graduate students **Michael Gramlich** and **Shawn Hayden** are working on subsequent related research.

Wouter Montfrooij was awarded a three-year grant, for $285,000, from the U.S. Department of Energy. The project title is "Designer Phase Transitions in Lithium-based Spinels."

Peter Pfeifer leads a team of researchers, including physics faculty members **Carlos Wexler** and **Frederick Hawthorne**, who will receive a U.S. Department of Energy grant of $880,000 during the next three years. The funding will help build on Pfeifer's previous research on hydrogen fuel storage, an effort they hope will one day revolutionize transportation. Pfeifer and Wexler have received $100,000 funding for their project titled

"Advanced Nanoporous Carbon for Reversible Hydrogen Storage: Fabrication and Demonstration of a Prototype Tank with Capacity of 0.5 kg of Hydrogen — Proof of Concept Study," from the U.S. Department of Defense, Naval Surface Warfare Center. Pfeifer received a 2007 Gold Chalk Award. The Graduate Professional Council Gold Chalk Awards are designed to recognize individuals who have made significant contributions to the education and training of graduate and professional students. One person is recognized from the School of Medicine, the School of Law, the College of Veterinary Medicine and from each of the Graduate School's six academic divisions: behavioral, biological, mathematical, social, and physical sciences and humanities. Awards are presented at the annual Gold Chalk Award banquet. The Gold Chalk Award is open to all MU faculty.

Lou Ross, adjunct instructor and senior electron microscope specialist at the Electron Microscopy Core Facility, reports that a new scanning electron microscope, an FEI Quanta FEG 600, was installed in the Electron Microscopy Core in April 2007. The Quanta brings unique capabilities to the campus such as investigating nonconductive and hydrated samples with little or no sample preparation and electron beam lithography. Ross was recipient of an Arts and Science Alumni Organization award in 2007 to purchase a high-resolution Internet camera for the new scanning electron microscope lab. This microscopy system should be available by the end of the year.

Sashi Satpathy was elected a fellow of the American Association for the Advancement of Science. Election as a fellow is an honor bestowed upon AAAS members for scientifically or socially distinguished efforts to advance science or its applications. Satpathy was recognized for his contribution to science and technology at the Fellows Forum held in February 2007 during the AAAS Annual Meeting in San Francisco. AAAS is the world's largest general scientific society and the publisher of the journal *Science*. During fall 2007, Satpathy is visiting the physics department of the University of Illinois at Urbana-Champaign on research leave with members of his group, **Zoran Popovic, Paul Larson** and **Ranjit Nanda**. They will be working with the condensed matter theory group and, in particular, Professor Richard Martin at UI.

Hak Taub's NSF funding was recently renewed for another three years, making a total of 31 years of continuous NSF funding for his research. In an e-mail message to Taub, James Coleman, departing MU vice president for research, called this a miraculous accomplishment and said that it was fantastic for the neutron scattering program as well as Taub himself. Coleman noted that NSF funding is no easy task to secure. Grant reviewers included numerous laudatory remarks in their report as well.

Carsten Ullrich is the recipient of the Provost's Outstanding Junior Faculty Research and Creative Activity Award, given by MU in special recognition of junior faculty in the early phases of their careers for superior research and creative activity.

Giovanni Vignale's NSF proposal, "Many-body Effects in Electronic Dynamics and Transport," has been recommended for funding, beginning September 2007. Total recommended for this grant is $330,000 for three years. He designed the first "Isaac Newton Physics Challenge," which took place in April 2007. The intent of this problem-solving competition is to demonstrate mastery of mechanics, and it was open to students of Physics 2750. First prize was a set of the coveted *Feynman Lectures on Physics.*

For the past two years, **Ping Yu** has mentored Norman Pai, a student at Hickman High School in Columbia, Mo. Pai was 15 years old when he began working with Yu. Pai placed as a national finalist at Intel International Science and Engineering Fair in 2007 for his work "Simulation of Optical Scattering of Mitochondria after Cell Apoptosis" and was selected for internship at Sandia National Laboratories in New Mexico. Yu also mentors Evan Lin, another Hickman High School student, who has worked in Yu's laboratory for two years. Lin was an Intel Science Talent Search National Semifinalist in 2007 for his work "Detection of Apoptosis by Speckle Imaging." Both Pai and Lin presented their work at the annual meeting of the Missouri Academy of Science.

The University of Missouri Research Board, a University System panel composed of 20 faculty members, announced awards to support research projects across the University's four campuses. Congratulations to those in the department who received funds: In October 2006, **Maikel Rheinstadter** and **Sashi Satpathy** each received $20,100, and in spring 2007 **Wouter Montfrooij** received a $32,360 award.

Future Bright for Laws Observatory

By Lanika Ruzitskaya, Val Germann and Randy Durk
Photo by Val Germann

New equipment and new programs are harbingers of a bright future for Laws Observatory. Recent upgrades to the computer room and observatory instruments have combined with a new weekly film and lecture series to guarantee continuing interest in the facility on the part of students and the general public.

The observatory is open every Wednesday evening from 7:00 to 10:00 p.m. and during special astronomical events such as eclipses. Special thanks to physics Chair H.R. Chandrasekhar and Meera Chandrasekhar for their strong interest in the observatory and the quality of its equipment and programs.

Two of the most recent additions to the observatory's capabilities have been an SSP-3 photometer and a Stellacam3 video imager. The photometer allows students to measure the brightness of stars quickly and accurately using a system of filters and a digital readout. Using the 16-inch Celestron main instrument, users can determine the light curves of even faint variables. The Stellacam3 allows real-time video imaging of the moon and planets, plus "deep sky" photography of galaxies and nebulae, even from the observatory's campus location. The imager is compact, easy to use and can be used to put an eight-foot-wide image of the moon, a planet or other sky object on the screen of the observatory's new projection system. Finally, the observatory features a radio telescope that "listens in" on Milky Way galaxy and other bright radio sources.

Other additions to the observatory's equipment include nine new binoculars, three of them very large, 80-mm-aperture instruments that are carried on fully adjustable tripods and used for the close observation of the moon and many other sky objects. In addition, the observatory has acquired astronomical software and video programming for the film series and for use by visiting students.

Ralph Dumas adjusts the telescope at Laws Observatory.

Volunteers from The Central Missouri Astronomical Association have cooperated in operating the observatory and creating and maintaining the computer and display rooms at Laws. Most interesting is the large collection of signed photographs of NASA flight controllers, many from the time of the original Apollo missions. Also featured are signed photos from Jerry Cobb, one of the original "Mercury 13" women astronauts, and the 10-year-old girl who named the Spirit and Opportunity Mars rovers. Up-to-the minute information and video from current space missions can also be found in the display room, and an astronomical library — the Chandra Library — is maintained there as well.

The observatory will host students from Astronomy 1010 and 1020 courses this fall and will provide a wide range of hands-on astronomical experience for them. Students will be able to step directly from a live view of Jupiter to a computer-driven, 3-D demonstration of the motion of that planet around the sun. Physics majors have the option to use the SSP-3 photometer for a laboratory research project.

The future looks bright for Laws Observatory, both as a vehicle for enhancing the educational experience for students and for public outreach. Hundreds of people from Columbia and surrounding areas visit the observatory every year and should continue to do so for years to come.

Grants and Contract Center Is Here at Last!

By Sherry Long

With the onset of the new academic year, I'm pleased to report the department has received assistance with grant preparation. Our assistance comes as a new initiative provided by the College of Arts and Science, in what has been termed the Arts and Science Grants and Contracts Center (ASGC). ASGC will be headed by Tyeece Little, who has been the grants and contracts administrator for biological sciences for approximately 11 years. She is enthusiastic and extremely knowledgeable in grant preparation at all levels. Tyeece will have two additional staff members who will help with grant preparation for various departments within the College, and she hopes to secure additional staff in the future. Faculty will be able to provide information concerning new grant proposals via the Web, and her team will process the necessary internal paperwork, assist with budget preparation and provide monthly reports. This long-sought solution has finally been realized.

Student Accomplishments

Graduate student **Mohammad Arif,** advised by Suchi Guha, completed a doctorate in physics in summer 2007 and has joined the electrical engineering and physics department at MU as a postdoctoral fellow. Arif completed a master's degree in materials science at Missouri State University and joined the doctoral program at MU in fall 2003. He presented his dissertation research at the 2006 fall Materials Research Society and 2007 American Physical Society meetings. He has co-written more than 12 papers as a doctoral student, most of which appear in prestigious physics journals such as *Physical Review Letters, Physical Review B* and *Applied Physics Letters.* Arif won a first-place plaque and $500 for his poster entered in the research competition of the Nano-alliance meeting held at MU in October 2006.

Sarah Barker, advised by Peter Pfeifer, won the Chancellor's Award for Excellence in Undergraduate Research in the category of physical sciences and engineering, presented April 2007 at the Undergraduate Research and Creative Achievements Forum.

Jacob Burress, advised by Peter Pfeifer, won second prize for best graduate-student presentation at the MU Physics Leaders Meeting in 2006 and second prize for best poster at the third annual MU Missouri Nanotechnology Alliance Conference in 2006.

Lacy Hardcastle, advised by Peter Pfeifer, was selected as a student ambassador at the 2007 University of Missouri Undergraduate Research Day at the Capitol, when students have an opportunity to share their research experiences with state lawmakers. The paper she shared was "Hydrogen Cars from Cornfields." She will be a graduate student in the math department at Georgia Institute of Technology in fall 2007.

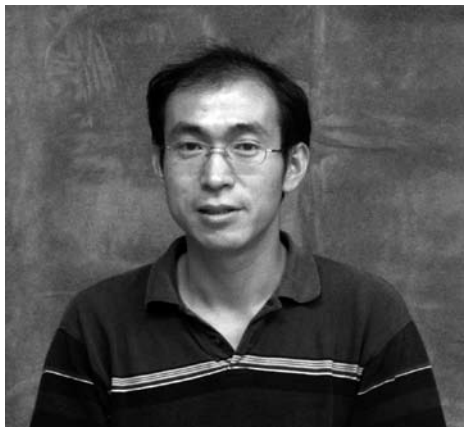
Pavel Korobkov, advised by Sergei Kopeikin, defended his dissertation, "General Relativistic Theory of Light Propagation in the Field of Gravitational Multipoles," with excellence on July 26, 2007. This work has been published in two prestigious international journals: *Classical and Quantum Gravity* and *General Relativity and Gravitation.* Korobkov subsequently returned to Russia to continue his career.

Physics graduate student **Michael Gramlich** attended a 10-day course in Sicily in June 2007 titled "Engineering of Crystalline Materials Properties: State-of-the-Art in Modeling, Design and Applications," the 39th course on crystallography held at Erice, Italy. Gramlich presented a poster titled "The Interfacial Structure of Pb Nanocrystalline Interfaces on Si."

Undergraduate **Christopher Volz**, advised by Suchi Guha, co-wrote "Conformations in Di-octyl Substituted Polyfluorene: A Combined Theoretical and Experimental Raman Scattering Study" with Mohammad Arif and Suchi Guha for the *Journal of Chemical Physics* (2007). He also presented this work as an oral presentation at the 2007 March meeting of the American Physical Society in Denver. Volz is in graduate school at Indiana University.

Mingzai Sun Wins $25,000 Grant from AHA

More than 71 million American adults suffer from one or more types of cardiovascular disease, according to the Centers for Disease Control and Prevention's National Center for Health Statistics. Mingzai Sun, advised by Gabor Forgacs, is working to learn more about cardiovascular disease and was recently awarded a $25,000 grant from the American Heart Association (AHA).



Using an interdisciplinary approach that combines physics and biology, Sun is studying the structure, or biomechanics, of cells. In his AHA-funded research, he plans to study dysfunction of endothelial cells — specialized cells that line blood vessels in the circulatory system, from the heart to the smallest capillary. Endothelial cell dysfunction develops in the early stages of cardiovascular disease and acts as a predictor of the disease. A risk factor of endothelial cell dysfunction is an increase in the levels of low density lipoproteins (LDL) and a decrease in the level of high density lipoproteins (HDL). This is often known in lay-terms as high cholesterol.

It's unusual for a graduate student to receive a grant of this type where he or she is the primary investigator.

Gravity Turned Upside Down

Gravity, as Isaac Newton explained it, is one of the fundamental forces in nature: few people are surprised, for instance, that apples fall to the ground instead of flying into the sky. But research by Professor Bahram Mashhoon, in collaboration with mathematics Professor Carmen Chicone, shows that gravity may not behave the same way when high speeds are involved.

Working with the modern theory of gravity, Einstein's general relativity, the research team discovered a threshold speed that causes particles near a black hole to be affected by gravity in the opposite manner than expected in Newtonian gravity. Black holes, objects with gravitational fields thought to be so strong that nothing, including light, can escape them, are some of the most mysterious objects in the universe.

Bahram Mashhoon has made a startling discovery about gravity.

The study of astrophysical jets, or columns of particles that shoot out at high velocities along the rotational axis of some black holes, led Mashhoon and Chicone to discover a critical speed, which is a threshold speed equal to about 70 percent of the speed of light. If an object is moving faster than the critical speed, the rules of gravity are contrary to expectations based on Newtonian gravity. If an object is moving slower than the critical speed, gravity acts as expected.

"Many people have studied the properties of astrophysical jets, but we looked at the question of why they exist," Mashhoon says. "Black holes typically have what is called an accretion disk of orbiting material around them. We found that the gravitational acceleration of particles moving faster than the critical speed of 70 percent the speed of light may provide an explanation of how relativistic jets (jets of particles moving with speeds close to the speed of light) get started above and below the accretion disk around a rotating black hole."

Mashhoon found the equations of motion used to describe the critical speed of particles approximately 30 years ago.

Mashhoon and Chicone have published 10 scientific papers on this subject, two of them with Brian Punsly of the International Center for Relativistic Astrophysics in Rome. Their most recent paper was in the September 2006 issue of *Physical Review D.*

Ullrich Organizes Gordon Conference

The first Gordon Research Conference on the subject of "Time-dependent Density-functional Theory" took place at Colby College, in Maine, July 15–20, 2007. The conference was organized and chaired by Professor Carsten Ullrich, and co-chaired by Professor Kieron Burke from the University of California, Irvine.

Gordon Research Conferences are among the most prestigious and widely recognized international conferences at the forefront of research in the biological, chemical and physical sciences. They are run by a non-profit institution, which celebrated its 75th anniversary in 2006. Today there are more than 400 active Gordon Research Conferences, and more than 180 were held worldwide in 2007.

Physics Service Champ

Sarah Hill, administrative assistant, was awarded the Staff Advisory Council's Service Champion Award for the month of March 2007. This award is given monthly to recognize outstanding staff members who perform their duties day after day with a work ethic and attitude that makes them stand out.

Postdoctoral Fellows

Postdoctoral fellow **Evelina Hankiewicz,** advised by Giovanni Vignale, has accepted a position as an assistant professor at Fordham College in New York. Hankiewicz also delivered an invited talk at the American Physical Society March meeting in Denver on her work on the spin Hall effect.

Postdoctoral fellow **Jianmin Tao,** advised by Giovanni Vignale, has accepted a prestigious director's postdoctoral position at Los Alamos National Lab.

Promotions

Three faculty members were promoted to the position of associate professor, with tenure: **Suchi Guha, Ioan Kosztin** and **Carsten Ullrich.**

Shi-Jie Chen received a promotion to the rank of full professor.

Leggett Talks Quantum Mechanics

In March 2007, the Department was honored by the visit of Sir Anthony Leggett, the 2003 Nobel Laureate in physics and the John D. and Catherine T. MacArthur Chair Professor at University of Illinois at Urbana-Champaign.

A member of the National Academy of Sciences and recipient of all major international awards in theoretical physics, Leggett is widely recognized as a world leader in theoretical physics in general, and condensed matter and low temperature physics in particular. His seminal work on superfluidity of quantum liquids was recognized by the 2003 Nobel Prize in Physics. Besides his tremendous contribution to theoretical understanding of normal and superfluid helium and other strongly correlated quantum fluids, Leggett has set directions for research in macroscopic quantum tunneling and used condensed matter systems to test the foundations of quantum mechanics.

During his two-day visit at MU, Leggett gave two lectures and had exciting meetings in a friendly and relaxed setting with faculty and students. His O.M. Stewart Physics Colloquium lecture, "Testing the Limits of Quantum Mechanics: Motivation, State of Play, Prospects," provided an original and exciting description of physics experiments for testing the validity of quantum mechanics at the macroscopic scale. Leggett addressed another fascinating topic, the arrow of time, during his public lecture titled "Why Can't Time Run Backwards?" This campuswide event, held in the Monsanto Auditorium of the Life Sciences Building, was a tremendous success. The large auditorium turned out to be too small to accommodate all those who were interested in learning about Leggett's thoughts on one of the deepest questions in physics, namely the origin of the arrow of time. The reception following the public lecture provided a great opportunity for the participants to meet Leggett.

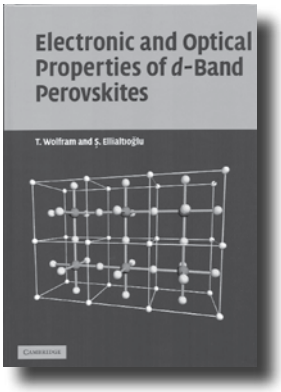
The association of physics students organized a luncheon with Leggett, which offered undergraduate and graduate students the opportunity to meet a Nobel Laureate and discuss with him a variety of topics on and beyond physics.

During his visit, Leggett met with members of the condensed matter physics, optics, biological physics and astrophysics groups. At the meeting he had the opportunity to learn about the broad research activities and accomplishments of the physics faculty.

Leggett's visit at MU was a memorable event that department students and faculty will cherish for years to come.

Physics Chair H.R. Chandrasekhar, in suit, and students listen intently as Sir Anthony Leggett, at left, explains the conundrums in quantum mechanics.

New Book Has MU Connection



Electronic and Optical Properties of d-Band Perovskites by Thomas Wolfram and Sinasi Ellialtioglu is the first textbook devoted to a comprehensive theory of the solid-state properties of these materials. These oxides exhibit fascinating and diverse phenomena, including pseudo two-dimensional electronic energy bands, high-temperature superconductivity, metal-insulator transitions, piezoelectricity, magnetism, and photochromic and catalytic activity.

The text begins with a review of the quantum mechanics of n-electron systems, then discusses various methods of energy band calculations. Applications discussed include optical properties, photoemission, surface states and high temperature superconductivity. The book includes several tables that can be used as references, and each chapter includes problem sets. To write a text that is suitable for science and electrical engineering graduate students and for advanced undergraduate seniors, the authors presented most of the results in analytic form. Many of the results were originally published by the authors in research papers using Green's functions, but they are presented in this text using more rudimentary mathematics.

Wolfram and Ellialtioglu are well known to the department. Wolfram came to MU in September 1974 and served as department chair and professor of physics until he left for Amoco Corporation in 1983. He retired as vice president and general manager, and now lives in California. Ellialtioglu was Wolfram's graduate student at MU. He is a professor and former chair of the Department of Physics at the Middle Eastern Technical University, Ankara, Turkey.

University of Missouri-Columbia
College of Arts and Science
317 Lowry Hall
Columbia, MO 65211

New Faculty Member Holds Joint Appointment

Welcome to Xiaoqin Zou, new assistant professor in the department. Zou will hold a joint faculty appointment with the Department of Biochemistry in the College of Agriculture, Food and Natural Resources and as a research fellow at the Dalton Cardiovascular Research Center. In the spirit of interdisciplinary research, she bridges two colleges and a research center.

Zou earned a bachelor's degree from the Department of Physics at Wuhan University, China, and was one of the top 76 physics students and researchers to enter physics graduate programs in the U.S. through the CUSPEA program (a physics exchange program among the top 100 U.S. and Chinese universities). Zou received a doctorate in physics at the University of California, San Diego. Her graduate research works focused on the nonlinear dynamics and pattern formation in chemical reactions and biological systems. She then moved into the field of computational and theoretical biophysics and worked at Case Western Reserve University as an American Heart Association postdoctoral fellow and at the University of California, San Francisco as a postdoctoral fellow. Zou joined MU in 1999 as a Dalton Investigator at the Dalton Cardiovascular Research Center. Her research lab addresses the following challenging physics problems: How to accurately predict the energetics in protein–small molecule and protein–protein recognition and how to design therapeutic drugs based on rigorous physics principles. Zou is the principle investigator on research grants from the National Institutes of Health, American Heart Association, Cystic Fibrosis Foundation and other funding agencies. Her research group is releasing a software suite named "MDock" for automated molecular docking to be used by academia and the pharmaceutical industry.