

A publication for alumni, friends, faculty, and staff of the MSM-UMR Physics Department

Yamilov Helps Build a Uaser

Alexey Yamilov, research assistant professor at UMR, and his collaborators at the University of Illinois at Urbana-Champaign have built an ultrasound analogue of the laser.

Called a uaser (pronounced WAY-zer) - for ultrasound amplification by stimulated emission of radiation, the instrument produces ultrasonic waves that are coherent and of one frequency, and could be used to study laser dynamics and detect subtle changes, such as phase changes, in modern materials. "We exploit the fact that coherence and stimulated emission are classical concepts and can be applied to build a mechanical device – uaser – a classical analogue to the laser" says Dr. Alexey Yamilov.

To make a uaser, the researchers begin by mounting a number of piezoelectric auto-oscillators to a block of aluminum, which serves as an elastic, acoustic body. When an external acoustic source is applied to the body, like fireflies trapped in a bottle, the oscillators synchronize to the frequency of the source. In the absence of an external source, the tiny ultrasonic transducers become locked to one another by virtue of their mutual access to the same acoustic system.



An aluminum block interacts with electronic auto-oscillator circuits via piezoelectric transducers to form a uaser.

Electronic circuit auto-oscillators interact with the reverberating acoustic cavity via piezoelectric transducers which can emit and absorb acoustic waves. This is similar to how an atom interacts with an optical resonator through emission and absorption of the electromagnetic waves. "Unlike atoms, where the quantum mechanics ensures that the wave emitted by stimulation is always in phase with the incident field, in the classical uaser, we achieve the correct phase with a careful design of the auto-oscillators – electro-mechanical 'atoms,'" says Yamilov.

The uaser more closely resembles a "random laser" than it does a conventional, highly directional laser. In principle, however, it should be possible to design a uaser to generate a narrow, highly directional beam.

Ultrasonic systems with their longer wavelengths and longer time scales can permit probes and controls to a degree not possible in optics. "Similar to how passive acoustic wave experiments allowed a study of the wave-functions of quantum dots and chaotic optical resonators, the ability to experiment with stimulated emission of ultrasound and monitor uasing states of the acoustic cavity will inform the research on lasing in complex media, such as random and chaotic lasers," says Yamilov.

Uasers could also serve as highly sensitive scientific tools for measuring the elastic properties and phase changes of modern materials, such as thin films or high-temperature superconductors.

In this issue:

Memo from the Chair	2	From Alumna Shella Keilholz	9
Class of '57 Reunion	2	Bieniek Named Dean's Teaching Scholar ..	9
Physics Department Scholarships	3	2006 Dean's List	9
Report from the SPS	4	Your Support Acknowledged	10
Thomas Vojta Promoted	4	Fahey to Speak at Homecoming 2007 ..	11
From Alumna Erin Mulanax	5	UMR Students & Alumni in Press	11
2006 Physics Degree Recipients	5	Alumni Notes	12
Vojta Leads Quantum Group	6	From Bob Kronschnabel	12
Faculty Receive Teaching Awards	6	Frontiers in Physics	13
Alumni Joel Brand and Aron Gaus	7	Thirteenth Annual Scheerer Prize	14
Baganoff Interviewed for NOVA	8	Prize Winner Allison Harris	14
New Physics Scholarship	8	37 th Annual Fuller Research Seminar	15
Massimo Bertino Promoted	8	Faculty Notes	15
Slusher Receives Born Award	9	Homecoming 2007	15

Alexey's collaborators are Dr. **Richard Weaver**, professor of theoretical and applied mechanics, and research associate **Oleg Lobkis** at the University of Illinois at Urbana Champaign. For more information, see "UASER: Ultrasound Amplification by Stimulated Emission of Radiation," A. Yamilov, R. Weaver, and O. Lobkis, *Photonic Spectra* pp. 90-94 (August 2006), available online at <http://web.umr.edu/~yamilov/>.

Memo from the Chair

May we all live in interesting times. This certainly is an exciting time of change and opportunity on campus, and sometimes you just have to hold on to your seat to keep from getting bumped off the ride.

As you may have heard from the alumni magazine, alumni surveys, and other sources, the campus is in the process of a major restructuring intended to help it achieve its goal of becoming one of the top five technological research universities in the country. To that end, the campus is implementing a streamlined administrative structure, that eliminates the traditional schools and colleges that have grouped related academic disciplines at UMR in the past. In this new structure, each academic department will report directly to the Provost, the Chief Academic Officer of the campus. This direct access to the top levels of administration should improve efficiency and communication, and will help foster a more entrepreneurial spirit.

And as we go to press, we have just received word of *another* big change—the name of the University itself. I quote from the UMR press release:

“UMR Chancellor **John F. Carney III** today announced that he is asking the University of Missouri Board of Curators to approve changing the institution’s name to **Missouri University of Science and Technology – Missouri S&T**. The board will consider the name-change proposal at its April 5-6 meeting on the Rolla campus. The request follows more than six months of research and discussion with numerous UMR constituents, including alumni, students, prospective students, faculty, staff, corporate recruiters and community leaders. The new name, if approved by the board, would be effective Jan. 1, 2008.

Carney says the name change will help the institution have a stronger identity while remaining a part of the four-campus University of Missouri. “Missouri S&T will better define the university as a leading technological research university,” Carney says. “We believe the new name will help to differentiate this university in a highly competitive university market and provide a national competitive advantage.”

Carney first raised the name change issue during his State of the University Address to the campus community last October. UMR’s current appellation does not distinguish the campus as one focused on engineering, technology and science, he said.

Soon after he joined UMR in September 2005, Carney set a goal of making UMR one of the nation’s top five technological research universities by 2010. While UMR’s marketing materials already carry the tagline of “Missouri’s premier technological research university,” the institution is not as well known as it deserves to be in other parts of the United States, Carney says.

“The University of Missouri-Rolla is unique among the four University of Missouri campuses because of our focus as a technological research university,” Carney says. “We believe a more distinctive name would afford UMR several advantages in recruiting students on a national level.”



The university was founded in 1870 as the University of Missouri School of Mines and Metallurgy. It was informally known as the Missouri School of Mines, or MSM, until 1964, when it was renamed the University of Missouri at Rolla. The campus became known as the University of Missouri-Rolla in 1968.”

So what do UMR physics alums think of the new name? Let us know, and we will try and run a special report in our next newsletter with your reaction to the new name. In the meantime, with your help and support, we will keep trying to provide the quality education, and performing the quality research that are at the core of our institutional values, either as UMR, or under our soon-to-be new banner, MS&T. – Paul Parris

Special Event for MSM/UMR Class of '57

Congratulations to the MSM class of 1957, which is holding its 50th reunion this summer on the UMR campus, from May 21-23. As part of the event, the UMR Physics department will host a special opportunity for Physics graduates of that class to meet, to recall their school days, and to describe their careers after leaving UMR.

The idea for the event came from MSM Physics alum **Robert Fuller** (BS '57), who is currently Professor Emeritus of Physics at the University of Nebraska Lincoln, and who is nationally known for his leading role in Physics education. According to Fuller, who is the son of the late **Harold Q Fuller**, Physics Department Chair from 1948-70, “The class of '57 was pretty strong. As I recall there were seven physics majors in the class and six of us were selected to be Phi Kappa Phi honorees.” The department is pleased to invite the members of the Physics class of 1957 to join the department from 3:30-4:30 on Tuesday, May 22, to take part in this historical event.

Physics Department Awards 2006-2007 Scholarships and Fellowships

The following scholarships have been endowed through the generous gifts of the friends of the UMR Physics Department. Please contact the Physics Department if you would like to add to the endowment fund of these scholarships or would like to establish a new one.

Recipients of the *Harold Q Fuller Scholarship-Loan* were **Brett Sweeney** of St. Charles, Missouri, **Zachary Stegen** of St. Peters, Missouri, and **Quinn Looker** of Hensley, Arkansas. The \$1,300 scholarship-loan was endowed by the late Dr. **Harold Q Fuller**, chair of the Physics Department from 1948 to 1970 and former Dean of the College of Arts and Sciences, to recognize outstanding achievements among juniors and seniors in physics. One quarter of the scholarship is an interest-free loan that students begin to repay when they start their first jobs.

The recipient of the *Burke H. Miller Memorial Scholarship* was **Lori Kennedy** of Belleville, Illinois. This \$1000 endowed scholarship was established by the Miller family to commemorate the academic achievements of their son, Burke, who graduated with a bachelor's degree in physics in 1969 and later died during the Vietnam War. The award is for promising and dedicated students in physics.

Michael Hoffman, of Russellville, Missouri, **Mark Herrera**, of Kansas City, Missouri, **Shellie Huether**, of St. Louis, Missouri, and **Joshua Carey**, of Fredricktown, Missouri, were awarded the \$1000 *Ed and Mary Sue Sickafus Endowed Scholarship/Fellowship*, established by **Ed** (BS '55, MS '56) and **Mary Sue Sickafus** in conjunction with the Ford Motor Company and awarded to physics students on the basis of their performance at UMR.

Ryan Hupe of Troy, Missouri and **Joshua Whitaker** Kansas City, Missouri received the *Leon E. Woodman Memorial Scholarship*. This scholarship was established by the Woodman family in honor of Dr. **L. E. Woodman**, Chair of the Physics Department from 1919 to 1948. It is offered to students in physics who are of good moral character, maintain a satisfactory grade point average, and are in financial need.

During the 2005-2006 school year, the department was pleased to endow a major new scholarship, funded by donations from seven physics faculty members who matched a major gift made by **Ed and Mary Sue Sickafus**. Their \$15,000 donation was matched by the University of Missouri System, providing a \$30,000 endowment for need-based scholarships. **Jonathan Reinagel** of Florissant Missouri, was the first recipient of the *Physics Scholarship for Academic Access*.

In addition to endowed scholarships, which are usually awarded to juniors and seniors, the department awards special *Physics Department Scholarships*, funded from the annual phonathon, to students who earn a grade point average of 3.5 or higher. This past year, department scholarships ranging from \$500 to \$1000 were awarded to **Benjamin Bethge**, of St. Louis, Missouri, **Tara Biggers**, of Marshfield, Missouri, **Joshua Cardenzana** of Reeds Springs, Missouri, **Tyler Fears** of Poplar Bluff, Missouri, **Elizabeth Fiechtner**, of Sioux Falls, South Dakota, **David Kimzey**, of Arnold, Missouri, **Lane Martin**, of Rogersville, Missouri, **Ryan Ohs**, of Lincoln, Nebraska, **Samuel Petersen**, of Rolla, Missouri, **Lauren Rich**, of St. Joseph, Missouri, **Ciaran Ryan-Anderson**, of Ellsinore, Missouri, **Dustin Spieker**, of Shawnee, Kansas, **Bradley Towery**, of St. Charles, Missouri, **Christopher Van de Riet**, of Eureka, Missouri, **Jake Walker**, of Kansas City, Missouri, and **Benjamin Williams** of Florissant, Missouri.

Endowments: Gifts that Keep on Giving

Through the generosity of friends and alumni, the Department of Physics has been very successful in raising annual support for scholarships, student travel funds, and program enrichment. As you make your annual commitment to the department, however, you might want to consider starting an endowment in your name or in the name of a loved one, so that your gift will still be making a difference when your great-grandchildren enroll at UMR. An endowment to the university will bear the name that you designate *in perpetuity*.

Consider the impact of leaving an endowed scholarship or lecture series in your name. With an initial gift of \$10,000 (which may be started with \$2,000 and a pledge of \$2,000 annually over the next five years) you can start a fund from which generations of students will benefit. The fund will generate approximately \$500 per year initially,

and will continue to grow as the principal increases each year. The UMR physics department has several donors that have been adding to their endowment for several years, including endowments recently established by **Ed and Mary Sue Sickafus**, the estate of **Richard Hannum**, and by the family of late Professor **Richard Anderson**.

Endowments may be established with cash or readily marketable securities. Regardless of the amount of the endowment you wish to establish or the methods used to establish it, your investment will have a significant and long-term impact on the Physics Department and on the University of Missouri-Rolla. Please call **Donald Keeny** at 1-800-392-4112 or e-mail him at keenyd@umr.edu if you have any questions or wish to discuss options available to you for giving to the department.

Report from the SPS

From Mark Herrera, President of SPS

The Society of Physics Students (SPS) is alive and well! Membership exploded over the past couple of years, and the enthusiasm in SPS has never been higher. Sometimes the SPS room is so full that it's standing room only. Currently our students are applying for (and getting accepted into) Research Experiences for Undergraduates (REU's) all across the country. Our undergraduates have received REU offers from places such as Princeton, MIT, Los Alamos, Toledo, Purdue, University of Central Florida, Indiana, Wisconsin, and many places in between. Who knows, you may run into a UMR undergraduate physics major this summer!

The junior physicists have been traveling everywhere to present the research they've done at UMR. **Shellie Huether** recently presented her work at the APS March meeting in Denver, Colorado. **Michael Hoffman, Lane Martin, Lauren Rich**, and I all presented our various projects at the recently-held joint UMR-UMSL meeting in St. Louis. In addition, SPS made its annual trip to Argonne National Lab and a number of us, including **Emilio Nanni, Ryan Kinney, Shellie Huether, Chris Stole**, and me, got to present our research projects.

Thomas Vojta Promoted

Dr. Thomas Vojta was promoted to Associate Professor of Physics in 2006.

Dr. Vojta received a Diploma in physics (comparable to our MS) from the University of Dresden (Germany) in 1991 and a PhD degree from Chemnitz University of Technology (Germany) in 1994. Vojta joined the UMR Physics Department in 2002 after postdocs at the University of Oregon and Chemnitz University of Technology as well as a Heisenberg Fellowship at the University of Oxford in England. While at UMR Dr. Vojta has received two Faculty Excellence Awards, and two Teaching Effectiveness Commendations.

Dr. Vojta's research interests are at the boundary between condensed matter theory and statistical physics. He uses quantum field theory and large-scale Monte-Carlo simulations to study phase transitions in quantum magnets, superconductors, and also in chemical reactions.

His work has been supported by a National Science Foundation CAREER award and by a Cottrell Scholar award from Research Corporation.

Since coming to UMR in 2002, Dr. Vojta has published 24 refereed papers including five prestigious Physical Review Letters and two invited review articles. He has also organized an international workshop on Quantum Phase Transitions in 2003 and a working group at the Aspen Center for Physics in 2006.

And we're still not done! A number of our students are gearing up to participate in the Missouri Academy of Science Meeting, the Undergraduate Research Day at the state Capital, and the UMR Research Symposium. We intend to do well and demonstrate just how strong the physics program at UMR really is.

Outside of academics, SPS has also been very active. We set up a display at the UMR block party and the Halloween Fright Night. There was even an unofficial float trip and plans are in order for the Spring Student-Faculty Picnic. It's time to have that long overdue biannual "students versus Dr. Story" volleyball game.

Of course we have our mixed feelings as we say goodbye to some of our active members as they graduate and begin their careers. Though **Micah Burgdorf, Zack Christensen, Ryan Kinney, Zac Stegen**, and **Andrew Walters** are leaving us, they and any alumni always have a warm welcome waiting for them here at SPS. We've also had the pleasure of welcoming in a new batch of enthusiastic, bright students into SPS. SPS is alive and well, and expect to hear more from us in the future!



above: typical day in the SPS room

right: SPS favorite, liquid nitrogen ice cream



From Alumna...

Erin Mulanax

Since graduating in 1993, I have been teaching high school physics at various places.

The first job I had was an all girls high school in South Central Los Angeles. Unfortunately, that school was closed after my year there. Then, I was hired at Rolla High School where I taught physics and coached cheerleading for four years. I decided to follow a dream and joined the Peace Corps. What an experience it was to teach physics at a high school in a small town in Ghana, West Africa. English might be the official language of Ghana, but it certainly wasn't the native language. There I developed lessons and labs using very few resources: my brain and whatever I could find lying around!

After returning from Ghana, I was hired at my alma mater, Pattonville High School, to replace my own physics teacher. At first, it was strange to be a colleague of teachers that I had when I went to school there. At PHS, I have been teaching Physics I and AP Physics (a second-year more advanced class) for six years. I gave up coaching poms and cheerleading after five years to become the Pep Club sponsor. Now, I'm completely in charge of Homecoming, including the dance, parade, and coronation! Most recently, I've been active in our district's professional development and teacher evaluation committees. I've never envisioned myself as a teacher when I first came to UMR, but now I can't imagine myself doing anything else. Teaching is tough and thankless sometimes, but never boring! I really do love my job!



Erin Mulanax, Pattonville High School, Maryland Heights, Missouri 63043

Congratulations to UMR's 2006 Physics Degree Recipients!

May 2006

Bachelor of Science

Jeffrey Jau
Kevin Johnson
Zechariah Thraikill
Clayton Weidinger
Charles Williams

Doctor of Philosophy

Matt Foster
Junfang Gao
Minseob Kim
Alexander Silvius
Minh Quang Truong

December 2006

Bachelor of Science

Stephen Berkley
Ryan Kinney

Master of Science

Brian Heckman
Brian Tooke
Cameron Johnson
Mark Thomason
Andrew Drago

Doctor of Philosophy

Ryan Feeler

Leaving a Legacy Through Your Will

A planned gift makes a perpetual statement about your dedication to MSM-UMR. While many may not be able to establish an endowment today, they find that they are able to leave a significant legacy to the university through a planned gift, such as a bequest, life income gift, or life insurance. By making a planned gift, you show your loyalty to an institution that has played a significant role in shaping your future. For more information about giving a planned gift, contact **Lynn Bennett** at 573-341-4508 or e-mail her at lbennett@umr.edu.

Vojta Leads Quantum Phase Transitions Group

Professor **Thomas Vojta** was selected to lead the “Quantum Phase Transition” working group at the Aspen Center of Physics during the summer of 2006.

The town of Aspen in the Colorado Rocky Mountains may be best known for its great skiing and luxury resorts, but every summer it also becomes a focal point for scientific research and discovery as leading physicists from all over the world gather at the Aspen Center for Physics.



The Center was founded in 1962 as a division of the renowned Aspen Institute for Humanistic Studies to provide an unstructured environment, free from distractions, where physicists can work unfettered by their normal responsibilities. It quickly gained a worldwide reputation as a unique environment for the pursuit of basic scientific knowledge; and in 1968, it became an independent non-profit corporation. Today, more than 400 physicists attend the 15-week summer session, mainly from three major areas of forefront theoretical physics research:

astrophysics, elementary particle physics, and condensed matter physics.

In summer 2006, UMR physics faculty member Thomas Vojta spent three weeks at the Aspen Center for Physics. He was leading a working group on “Quantum Phase Transitions” that brought together leading theorists from all over the nation working in the areas of quantum magnetism, superconductivity, and strongly correlated electron systems.

During informal talks and individual discussions, the group attacked problems such as metallic quantum ferromagnets, high-temperature superconductivity, and the Kondo lattice problem. As is usual in the stimulating atmosphere of the Center, many new ideas were born and collaborations started. One of the new projects has already led to a publication.

In addition to his scientific work, Thomas, who is an avid hiker and mountaineer, climbed Mt. Yale and Mt. Massive, two of the fourteeners (peaks higher than 14,000 feet above sea level) surrounding Aspen.



Physics Department Acknowledges Corporate Support

The Physics Department gratefully acknowledges the support of the following corporations:

3M Foundation
Boeing/McDonnell Douglas Foundation
Chevron Corporation
ConocoPhillips
Ford Motor Company
Honeywell International Foundation
IBM
Motorola Foundation
Shell Oil Company Foundation

Greg Story, Ralph Alexander Receive Teaching Awards

This past year, physics faculty member **Greg Story** received the UMR *Outstanding Teaching Award*, which honors the top 10 percent of teachers campus-wide.

In addition, Greg Story and **Ralph Alexander** received the College of Arts and Sciences *Excellence in Teaching Awards* for their outstanding effectiveness in large-enrollment and laboratory courses. According to Dean **Paula Lutz**, “we wanted to recognize those faculty who teach well to a large number of students (more than 100 per year) and those who teach labs.”

Alumni Joel Brand and Aron Gaus

Joel Brand (PhD '94) and his wife, **Ann**, are proud parents of their first child, **Tabetha Ting Brand**. The Brands adopted Tabetha when she was fifteen months old in May 2006 in Hefei, China, and have settled back home to life as a family of three in Colorado Springs. Tabetha is now 2 years old and doing great. Ann is now working part-time to have more time to stay home with Tabetha.



Ann, Tabetha, and Joel Brand

Aron Gaus (PhD '94) and his wife **Jennifer** live in Texas with their two children **Katelyn** (6 yrs old) and **Nicolas** (born in June 2006).



Jennifer, Nicolas, Katelyn, and Aron Gaus

Joel & Aron have owned a business, Brand-Gaus LLC, since 1999. The business is located in Cedar Park, TX. Brand-Gaus was formed to provide cost-effective, high-quality, easy to use instrumentation products in a professional, customer-friendly

manner. Joel and Aron identified these needs throughout their industrial careers, first as technical contributors, later as managers, and finally as directors of industrial equipment manufacturing companies. Brand-Gaus, LLC is dedicated to fulfilling their vision.

At Brand-Gaus LLC they develop and manufacture industrial gas monitoring equipment, primarily for combustion sources (e.g. power plant emissions). These systems rely on an interdisciplinary mix of engineering and science, generally, exploiting some aspect of molecular/optical physics for detection of the species of interest. More information can be obtained at their website <http://www.brandgaus.com/>.

Who Was That (Unmasked) Man?

Graduate student **Andrew Drago** disguised himself as Physics Department Chair **Paul Parris** for Halloween 2006.

Can you identify Paul and his imposter in the picture below?



To Contact UMR Physics

If you would like to contact us for any reason, you can reach us by phone at (573) 341-4781 and by e-mail at physics@umr.edu. You might also be interested in checking out our web page, <http://www.umr.edu/~physics>.

Baganoff Interviewed for NOVA Program

We were pleased to see that **Fred Baganoff** (BS '85) was interviewed for the NOVA program "Monster of the Milky Way," which was telecast on October 31, 2006, on the PBS network. Fred was a team leader in the discovery of x-ray emissions from the 2.6-million solar-mass blackhole at the center of our galaxy, using the orbiting Chandra Observatory. Fred is an astrophysicist at MIT's Kavli Institute for Astrophysics and Space Research.

Fred uses the Chandra x-ray telescope because the "Milky Way, our galaxy, is a spiral galaxy, and that means it has this sort of frisbee-shaped disk, and then a bulge in the center. And in the disk are lots of dust-clouds. Because our sun is in the disk, we have to look through these dust-clouds to see towards the center of our galaxy, and the dust acts like smog and it blocks our view. So we actually can't see the center of our own galaxy in optical light, or ultraviolet light. We can only look at longer wavelengths like radio and infrared, or the shorter wavelengths like X-rays and gamma rays."



*x-ray image of the center of our galaxy,
by Fred Baganoff and Mike Muno*

Massimo Bertino Promoted

Dr. Max Bertino was promoted to Associate Professor of Physics on September 1, 2006.

Max received his PhD from the University of Gottingen in 1996. His research focuses on a variety of nanomaterials, including the synthesis of metal nanoparticles and nanowires, polyaniline nanofibers, and aerogel-metal cluster composites, as well as the patterning of sol-gel materials with metal and semiconductor nanoparticles. He has developed the technique of embedding quantum dots into aerogel surfaces using photolithography, a technique commonly used by microchip makers to print circuitry on silicon wafers. Bertino and co-workers use lasers and other forms of electromagnetic radiation to "write" quantum dots into the aerogel.

Physics Scholarship for Academic Access

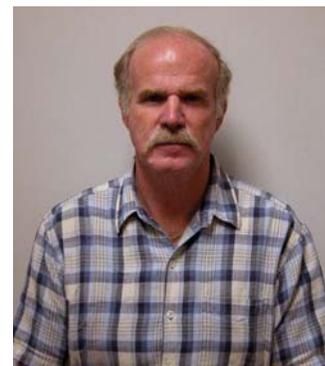
This past year, the department was pleased to endow a major new scholarship, funded by donations from seven physics faculty members who matched a major gift made by **Ed and Mary Sue Sickafus**. Their \$15,000 donation was matched by the University of Missouri System, providing a \$30,000 endowment for need-based scholarships. The Physics Department is grateful to all who made this scholarship possible.

Crabtree, McWhorter Honored for Service

Senior Secretary **Pam Crabtree** and Research Maintenance Technician **Charlie McWhorter** were honored by UMR in 2006 and received gifts for their years of service. Pam received a 15 year award, and Charlie received a 30 year award.



Pam Crabtree



Charlie McWhorter

Slusher Receives Max Born Award

Richard Slusher (BS '60) received the 2006 Max Born Award, presented by the Optical Society of America. The award honors Max Born, and is presented to a person "who has made outstanding contributions to physical optics, theoretical or experimental." The award was established in 1982, the centenary of Born's birth.

Slusher is the director of Quantum Information Research at Bell Labs in Murray Hill, New Jersey. His work at Bell Labs included the first observation of squeezed light in 1985, and the application of squeezed light to precision measurements and quantum non-

demolition measurements. Recently, his work has focused on quantum information and the application of quantum effects to information science.

Slusher is a fellow of Bell Labs, the American Physical Society, and the Optical Society of America. His other awards include the 1989 Einstein Award for Laser Science and the 1995 Arthur Schawlow prize in laser spectroscopy from the American Physical Society.

From Alumna...

Shella Keilholz

My lab focuses on developing techniques to image and characterize functional networks in the brain, primarily with magnetic resonance imaging (MRI). MRI is an amazing research tool because, depending on how you manipulate the parameters, you can produce images that show exquisite anatomical structure, how much blood is flowing through the brain, how much oxygen is being used, or which direction the nerve fibers run. By looking at changes in these physiological parameters, areas of the brain that become active during a certain task (such as looking at a picture) can be identified.

The scanner that we use is a high-performance machine optimized for imaging mice and rats. Typical hospital MRI machines have a magnetic field of 1.5T and can detect regions that are about one millimeter in diameter; our 9.4 T system can detect regions that are only one tenth of a millimeter in diameter, comparable to the size of a human hair.

My students and I use MR physics to develop imaging sequences that can detect activity throughout the brain, and collaborate with neuroscientists and psychologists to examine changes in these circuits caused by learning and development. We are currently trying to detect altered network activity in fear-conditioned mice, which has implications for post-traumatic stress disorder in humans.

Shella Keilholz (BS '97), Assistant Professor, Wallace H. Coulter Dept. of Biomedical Engineering at Georgia Tech and Emory University School of Medicine, Atlanta, GA 30322



Ron Bieniek Named Dean's Teaching Scholar

A big round of congratulations to **Ron Bieniek**, who has been chosen to be Dean's Teaching Scholar for the College of Arts and Sciences for 2006-07.

The appointment, which recognizes sustained contributions to educational excellence over a number of years, comes with a three-year appointment, and a \$2000 stipend. Award winners are selected by the dean of each school or college based on student course evaluations, department chair recommendations, and evidence of good teaching practices. Congratulations, Ron!

Congratulations to 2006 Physics Dean's List Recipients

Students who maintain at least a 3.50 GPA for twelve hours or more of coursework are honored for their outstanding accomplishment by being named to the Dean's List.

Tara Biggers, Joshua Cardenzana, Joshua Carey, Tyler Fears, Elizabeth Fiechtner, Mark Herrera, Michael Hoffman, Shellie Huether, Ryan Hupe, Jeffrey Jau, David Kimzey, Ryan Kinney, Quinn Looker, Tom Maher, Samuel Petersen, Jonathon Reinagel, Ciaran Ryan-Anderson, Dustin Spieker, Zechariah Thrailkill, Bradley Towery, Steven Underwood, Christopher Van de Riet, Jake Walker, Clayton Weidinger, Joshua Whitaker, Sara Whitbeck, Benjamin Williams.

The Physics Department gratefully acknowledges the support of the following alumni and friends.

Dr. Dharmalatha Abayarathna
Harro Ackermann
Leroy H. Alt
Bryce Lyle Anson
Daniel J. Arbini
Kenneth E. Arnett
Mark Jeffery Barnhart
Laura L. Bosnak
Dr. Christopher Brannon
Mack A. Breazeale
Dr. Howard L. Brooks
David K. Bross
Dr. James P. Canner
Lewis K. Cappellari
James H. Carlson
Dwight E. Carmichael
Ross O. Carnes
Dr. John C. Carstens
Dr. Stephen D. Christiansen
Charles H. Church
Alan R. Cobb
Ludmilla B. Cole
Patrick L. Cole
Matthew Henry Commens
David C. Davisson
Ronald C. Epps
Courtney Ryan Feeler
Robert A. Fletcher
Dennis M. Frederick
Matthew Christopher Fritts
Alexandre Frohlich
Thomas K. Gaylord
Robert Gerson
Glen R. Gettemeyer
Dr. John R. Glaese
Dr. Andreas K. Goroch
Edward B. Hale
Carol V. Hanrahan
Stanley S. Hansen, II
Harry E. Hardebeck
Terrance Rich Harrison
Daryl C. Hatfield
John L. Hedrick
Dr. Lionel D. Hewett
Jon Mark Holdman
Wayne E. Holland
Thomas K. Holley
James W. Jensen
Dr. J. Daniel Jones
Timothy H. Kaiser
Dr. Jerry Kiefer
John V. Knopp
Franklin W. Kone
Dr. James I. Latham
James E. Lawler
Jalon R. Leach
Charles C. Limbaugh
William A. Lindgren
Arthur R. Loepp
Suzanna Maupin Long
Robert Wells Lowe
Hulen H. Luetjen
Don Madison
Dr. Sandra H. Magnus
Joseph E. Marischen
Dr. Daniel B. Marsh
Roger E. May
John L. McDaniels
John W. McGuire
Dr. Thomas J. McMahon
Donald I. Meyer
William Vernon Meyer
Brian G. Millburn
Michael J. Mochel
Dr. David Patrick Moore
Rebecca Erin Mulanax
Jon R. Nance
Charles J. Neumann, Jr.
Lawrence A. Newquist
Charles S. Nichols
Arthur L. Nickless
Eric J. Norman
Dr. Robert R. Nothdurft
Ronald E. Olson
Larry D. Oppliger
David L. Pannone
William F. Parks
Paul E. Parris
Dr. Raymond E. Paul
Dr. Daniel N. Payton, III
Larry J. Peery
Jay A. Peterson
Kathryn Masterman Pimmel
Charles C. Polly
Norman H. Pond
Wayne Kevin Portwine
Nickey L. Prater
John S. Price
Donnie W. Priest
Kathy A. Rages
Dr. Frederick H. K. Rambow
Nancy L. Ranek
Donald G. Rathbun
Paul Frank Reichert

Charles M. Rice
Dr. John R. Rogers
Frank E. Salter
Gary S. Sammelmann
Dr. Franklin D. Schowengerdt
Jeffrey Paul Schroeder
Dr. David Robert Schultz
Richard S. Schwentker
David Gene Seely
Dr. Richard H. Shields
James Shiells
Dale R. Shull
Carl B. Sigler, III
Richard E. Slusher
Bart Wayne Smith
Dr. Robert T. Smith
Arthur M. Soellner
Mrs. Leslie E. Spanel
Michael S. Stein
Dr. Edward F. Stephens, IV
Dr. Edward E. Stepp
Robert M. Stovall
Chiu-Ying Tai
John Lester Tappmeyer
Richard D. Thom
Lorie E. Thompson
Dr. Robert E. Thurman
Carolyn M. Toburen
Terry R. Tucker
Kari Anne Van Brunt
Lee Gordon Van Pelt
Dr. Michael A. Vietti
Terrence R. Ward
Jonathan Hale Waters
David W. Webster
Jerry Doug West
Dr. Gerald Wilemski
James T. Willcutt
Raymond L. Wills
David J. Wolters
F Matthew Woodward
Gary K. Woodward
Gary G. Wooley
Paul C. Yue



Phonathon 2007

More than 145 alumni and other donors gave \$17,640 in donations to the MSM-UMR Physics Department last year. Last year's fund-raising Phonathon raised \$12,225 with an average gift of \$77. The department greatly appreciates your generosity, which helps to support scholarships and student activities like the Society of Physics Students.

"With help from last year's phonathon the department made a major effort to increase undergraduate physics enrollment." says Dr. **Paul Parris**, Chair of Physics, "With new scholarships made possible by phonathon dollars, the department was able to increase its undergraduate enrollment from 50 to 60 majors, a seven-year high. This year we are continuing to work towards our goal of 100 undergraduate and graduate majors. We greatly appreciate every additional scholarship dollar you can give that would help the department carry out its aggressive recruitment plan."

This year, we will be calling our alumni April 11-12 and April 15-17. When the phone rings, please take a moment to share some of your Rolla experiences with a current UMR student, and say, "Yes," when asked for a pledge.

Taxpayer support accounts for only one-third of the university's revenue, so your contribution makes up an important part of the department's total income. Private funding also helps distinguish UMR from other universities, increasing the value of your education. Any amount you give will be appreciated. It will help make UMR a leader in alumni giving among public universities, and will help the Physics Department fulfill its educational mission.

David Fahey to Speak at Homecoming 2007

David Fahey (PhD '79) will be the Physics Department's Homecoming Speaker for 2007.

Fahey is a Research Physicist for the National Oceanographic and Atmospheric Administration (NOAA), and a member of the Chemical Sciences Division of NOAA's Earth System Research Laboratory. His division conducts research aimed at discovering, understanding, and quantifying the processes that govern the chemical reactions of Earth's atmosphere, in order to improve our capability to predict its behavior.



Fahey is also a Fellow of the Cooperative Institute for Research in Environmental Sciences (CIRES). The CIRES Council of Fellows is composed of individuals with an outstanding record of achievement and ability in environmental sciences. CIRES pursues interdisciplinary research in earth system science, and communicates its findings to the scientific community, decision-makers, and the public.

Fahey's current research projects include measurement of nitric acid uptake on cirrus and contrail particles, and the measurement of hydrochloric acid as a tracer of stratospheric ozone in the upper troposphere.

UMR Students & Alumni: In Press

The following journal articles which appeared over the last year feature work by UMR undergraduate students,¹ graduate students,² or UMR alumni³ under the supervision of UMR faculty.

"Nonequilibrium phase transition on a randomly diluted lattice," T. Vojta and M.Y. Lee,² Phys. Rev. Lett. **96**, 035701 (2006).

"Quantum phase transitions of the diluted O(3) rotor model," T. Vojta and R. Sknepnek,³ Phys. Rev. B **74**, 094415 (2006).

"Slow dynamics at the smeared phase transition of randomly layered magnets," S. Huether,¹ R. Kinney³ and T. Vojta: Phys. Rev. B **74**, 094425 (2006).

"Gradient theory of nucleation in polar fluids," A. Obeidat³ and G. Wilemski, Atmos. Res. **82**, 481 (2006).

"Adiabatic-Nonadiabatic transition in the diffusive Hamiltonian dynamics of a classical Holstein polaron." A. Silvius,³ P.E. Parris, and S. De Bièvre, Phys. Rev. B **73**, 014304 (2006).

Medvedeva Receives International Attention

Prof. Julia Medvedeva's research on novel transparent conducting materials for photovoltaic applications has attracted world-wide attention. Recently, she gave several invited talks on the topic:

"Designing novel materials from first principles: transparent conductors and beyond," at Toyota Central R&D Laboratories (Nagoya, Japan).

"Future of nanoporous TCO: what we have learned from C12A7," at the International Symposium on C12A7 and Nanoporous Materials (Tokyo Institute of Technology, Yokohama, Japan).

"Density functional theory: from conventional to novel transparent conductors," at the 1st International Symposium on Transparent Conducting Oxides (Hersonissos, Crete, Greece).

"Origin of isotropic transport properties in layered transparent conductors," at the Workshop on Transparent and Conducting Oxides (Microsystems Technology Office, DARPA, Arlington, VA).

Alumni Notes

Dan Storey (MS '98) was promoted to Chief Technology Officer for both Ionic Fusion and its medical subsidiary, Nexxion Corp.

Jerry Kiefer (MS '65, PhD '79) was recognized for 25 years of teaching at St. Bonaventure University in New York.

Sam (PhD '93) and **Debbie Bross** were married in the Jewel Box in Forest Park, St. Louis, on March 26, 2006.



Debbie and Sam Bross

John W. "Jack" McGuire (MST '69) retired from Bellarmine University. He and his wife, **Mary Ann**, are "looking forward to life after math."

Allen R. Cobb (BS '69) earned master of divinity and doctorate of ministry degrees from Midwestern Baptist Theological Seminary in Kansas City, Missouri.

Richart E. Slusher (BS '60) was awarded the 2006 Max Born Award by the Optical Society of America.

Bob Kelly (BS '52) writes "Life post Rolla ('52): Army (drafted!), PhD ('59), Professor of Theoretical Physics at the University of Mississippi for 30 years, research in France with the French Atomic Energy Commission for 15 months, 16 years at the Los Alamos National Lab mainly with nuclear weapon diagnostics, now consulting on electromagnetic theory topics associated with mining. Otherwise, lots of music performing, amateur radio, plus some softball."

Keith R. Honey (BS '63) reports "retired 30 June 2006 after 34 years in higher education - 30 years at West Virginia University Institute of Technology (WVUIT); served as Chair of Physics Department at WVUIT from 1978 to 2000. Will now spend more time with my three children and 14 (!) grandchildren."

Jon Fox (BS '93) and his wife **Audrey (Linville)** (BS '93 Chem.) had a boy, **Calvin**, on August 4, 2005. Calvin joins brothers **Louis** and **Maxwell**.

Layne Mills (MS '93) married **Julie Flowers** on August 19, 2006. Layne lives in California, where he works for Intel. Layne and Julie are expecting their first child in late June.



Julie and Layne Mills

If you wish to get in touch with any of these alumni, or any others, please contact the Physics Department at (573) 341-4781 or at physics@umr.edu. We can generally give you current phone numbers, along with postal and e-mail addresses. We would be grateful if you would take the time to fill out and return the alumni information on both sides of the last page of this newsletter.

From Bob Kronschnabel

Bob Kronschnabel, (MS Engr. Mgt. '91) writes: I came to UMR from Gustavus Adolphus College with **Scott Sehlin** (PhD '94). I worked in the physics department from 1988-1989, and then transferred to the Engineering Management department and got my MS there in 1991, but I still consider myself a physicist (*aka* problem solver) at heart. I last had contact with UMR a few years ago when I asked Dr. **Pringle** about physics day at an amusement park. I am actually a high school math teacher, but our physics department wasn't going, so I took my Algebra 2 kids to the park.

I am Irondale High School's Robotics team advisor. I can only dream of what our team could do with UMR's resources for programming, machining and welding. Our robotics website is www.team2052.com and there are links to videos of our team in action there.

I plug UMR with our kids that are interested in engineering. I tried to get the captain of my robotics team to consider, but his heart was set on Stanford.

Robert Kronschnabel, Irondale High School, 2425 Long Lake Rd., New Brighton, MN 55112

Bob may not be a Physics alum, but we still consider him part of our family, and are happy to see that he is a physicist at heart.

Frontiers in Physics Colloquium Series

The 2006 *Frontiers in Physics Colloquium Series* started with a talk on “*Quantum spin chains*,” given by Dr. **Jose Hoyos**, who is a postdoc working with **Thomas Vojta**. The series continued with “*Intermediate symmetries and dimensional reduction in electronic systems*” by Dr. **Zohar Nussinov** of Washington University, St. Louis, “*The thermal- and radiation-induced interactions of water with UO_2 surfaces*” by Dr. **Steve Joyce** of Los Alamos National Laboratory, and “*Theory of the spread of epidemics: simple statistical mechanical considerations*” by Dr. **V.M. Kenkre** of the University of New Mexico.

The first speaker in March was Dr. **Michael Romalis**, of Princeton University, who talked on “*Atomic spin magnetometers for tests of fundamental symmetries and other applications*.” He was followed by Dr. **Murtadha Khakoo**, once a postdoc at UMR and now with California State University - Fullerton, who gave a talk entitled “*Low energy electron impact excitation of the Rydberg-valence levels of molecular nitrogen*.”

The spring semester concluded with “*Cubic $Ba_2YRu_{1-x}Cu_xO_6$ - a possible strong-coupled spin-density-wave superconductor*,” by Dr. **H. A. Blackstead** of the University of Notre Dame, and “*Electron-atom/molecule collisions: understanding electron-driven processes*,” by Dr. **Julian Lower** from the Australian National University.

The fall semester brought a change of colloquium organizer with faculty member **Gerry Wilemski** taking over the duties as colloquium chair from **Michael Schulz**, who had been colloquium chair for the spring semester.

The fall colloquium series started with a talk entitled “*Exchange bias and magnetic properties of cobalt ferrite nanoparticles*” by Prof. **Arif Mumtaz** of Quaid-i-Azam University, Islamabad. He was followed by Dr. **Tom Kirchner** of the Technische Universitaet Claustal-Zellerfeld who spoke on “*Non-perturbative calculations in ion-atom collisions*.” Then, Dr. **Arshad Saleem Bhatti** of the COMSATS Institute of Information Technology, Islamabad lectured on “*Growth kinematics of nanostructures in buffer - layer - assisted growth*.”

The next two colloquia featured speakers from our own department. First, Prof. **Thomas Vojta** gave us an overview of his current research with a talk entitled “*Phase transitions and disorder: how rare events can dominate a macroscopic system*.” The following week three current Physics undergraduates, **Ryan Kinney**, **Shellie Huether**, and **Mark Herrera** each gave a short talk describing his or her off-site summer research project.

The first speaker in October was Prof. **Erika Gibb** of the University of Missouri - St. Louis, whose talk was entitled, “*Organics in comets and star-forming regions*.” Our undergraduates enjoyed

learning about prospects for graduate work in astronomy during an extended lunch period with Prof. Gibb. Our next speaker, also from St. Louis, was Prof. **Ken Kelton**, the Arthur Holly Compton Professor in Arts and Sciences at Washington University, spoke about the “*Role of coupled nucleation in metallic glass formation and nanocrystallization*.” Next up was Homecoming Weekend, and we were fortunate to have Prof. **Sanjay Mishra**, a UMR Physics Ph.D now at the University of Memphis, give a talk on “*Magnetic nanocomposites*.” October was capped off by computational physics expert, Prof. **David Landau** from the University of Georgia, who explained “*A new approach to Monte Carlo simulations in science*.”

November brought three speakers to campus. First, Prof. **Milton Cole** of Penn State University talked on “*Novel 1, 2 and 4 dimensional phases of matter in carbon nanotubes*.” Prof. **Brad Marston** of Brown University then informed us about “*The quantum mechanics of global warming*.” Finally, Prof. **Bin Chen** (of Louisiana State University) gave us a detailed look at “*Probing the nucleation mechanism of multi-component systems with atomistic simulations*.” Following the Thanksgiving break, November finished with the Thirteenth Annual Laird D. Schearer Prize Colloquium. This year’s graduate student contestants were **Allison Harris** and **Jared Gavin**. The fall program closed with a talk in December by Dr. **Robert McGraw** (of Brookhaven National Laboratory) on the subject of “*Kinetic potential and barrier crossing: A new model for drizzle formation*.”



Sanjay Mishra

13th Annual Schearer Prize Competition

The Thirteenth Annual *Laird D. Schearer Competition for Graduate Research*, established by the family of Dr. **Laird D. Schearer** to recognize research performed by a graduate student, took place in November, 2006. Applications based on a brief description of research projects and publications or presentations resulting from the work were solicited from graduate students. **Allison Harris** and **Jared Gavin** were selected to act as our colloquium speakers on November 30. Following the presentations, in which Allison and Jared described their current research efforts and findings, they eagerly answered questions from the panel of judges, Drs. **Allan Pringle**, **Dan Waddill**, and **Gerry Wilemski**, and also from the audience. Dr. **Bob DuBois** acted as chair of the Committee this year.

The title of Miss Harris' talk was "*Effects of final state electron exchange in heavy particle impact ionization.*" This work described theoretical calculations of the interaction dynamics associated with ionization by heavy particle impact. Based on a Three Distorted Wave (3DW) model, three dimensional fully differential cross sections are calculated. Miss Harris' work is supervised by Drs. **Don Madison** and **Jerry Peacher**.

Mr. Gavin's talk was titled "*Triply differential cross sections for single ionization of argon by 500 eV positron impact on argon.*" He described his experimental work where triply differential cross sections for single ionization of argon by positrons and electrons are being measured. Mr. Gavin's work is supervised by Dr. DuBois.

Based upon the talks and application packet, Miss Harris was awarded first place in this year's competition and Mr. Gavin was awarded second place. Cash awards were presented to both candidates.

Because of the generous donations of the Schearer family, cash prizes were awarded to the finalists. Following the presentations, the finalists and numerous faculty members had a relaxing dinner at a local restaurant. Due to snow and ice on the day of the competition, the dinner was delayed until the following week.

Jared Gavin



From Schearer Prize Winner Allison Harris

Some people say that the number 13 is unlucky, but in this case I would have to disagree! It was certainly an honor for me to be selected as the winner of the 13th Annual *Schearer Prize Competition*, and just one of the many wonderful experiences I've had since I arrived in Rolla. I can't wait to see what lies ahead! There are many people I would like to thank for helping me with various aspects of the competition. My family and friends have always supported me in all my endeavors, and for that I am grateful. The faculty here at Rolla are excellent, as well, and in particular thanks to my advisors Dr. **Madison** and Dr. **Peacher** for all of their help.

As far as my journey to Rolla goes, I came here in January of 2005, after completing my undergraduate physics degree at Drury University. My research here is in theoretical atomic physics, and my presentation at the competition dealt specifically with heavy particle impact ionization. The Three-Body Distorted Wave theory developed by our group had failed to accurately predict experimental results outside of the scattering plane. I had investigated the possibility that exchange between the bound and ionized electrons might be the missing piece of the puzzle. It turns out that this exchange didn't account for the discrepancy between experiment and theory, so there is more work to be done.

All in all, I found the Schearer Prize Competition to be more than just a competition. It was a learning experience, and one that I am grateful is available. So, thanks to the Schearer family and everyone else involved for providing this opportunity, and I look forward to participating again in the future..

Allison Harris



37th Annual Fuller Research Seminar

The Physics Department encourages undergraduates to participate in research through courses, projects with UMR faculty, and summer research internships at other institutions. The **Harold Q Fuller** Undergraduate research seminar is presented by finalists selected by their peers, and the Harold Q Fuller Award is given to the student(s) whose project is judged to be most outstanding on the basis of their accomplishment, their presentation, and their response to the questioning of the judges.

The 35th Annual Harold Q Fuller Undergraduate Research Seminar was held on April 25, 2006. The 2006 Seminar Chairman was Dr. **Ralph Alexander** and the judges were Drs. **Jerry Peacher** and **Dan Waddill**.

For the 2006 competition, students presented posters about their research. The competitors were **Mark Herrera**, "*Light propagation through a dual-periodic one-dimensional photonic crystal*," **Charles Williams**, "*Focused laser beam*

quality determination using indirect object scanning technique," and **Jeffrey Jau**, "*Numerical simulation of wave propagation through quasi-1D random scattering medium*."

Mark was awarded first place, Charles took second place, and Jeffrey received third place. The winning students names were engraved on the Harold Q Fuller Award Plaque. The first place project received \$300, second place received \$200, and third place received \$100.



Mark Herrera

Faculty Notes

Gerry Wilemski's paper, "*Experimental evidence for internal structure in aqueous-organic nanodroplets*," by **Barbara E. Wyslouzil**, Gerald Wilemski, **Reinhard Strey**, **Christopher H. Heath** and **Uta Dieregswiler**, *Phys. Chem. Chem. Phys.* 8, 54 (2006), ranked in the top 2% of all *Phys. Chem. Chem. Phys.* (PCCP) papers published in 2006, based on the number of times it was cited. It was also one of the most-downloaded PCCP papers, and was accessed over 1000 times. PCCP is an international journal for the fastest publication of high-quality original work in physical chemistry, chemical physics and biophysical chemistry. Gerry's paper was also honored on the journal's web site as an example of how to write a good-quality letter.

The Gaseous Electronics Conference (GEC) annually selects one member from the community to be given the honor of "Foundation Speaker." The GEC Foundation Talk is a plenary talk at each GEC. Its aim is to present a cogent overview of a topical area and to put it into context for the very cross-disciplinary audience that attends the GEC. The talk covers both introductory material to guide students and newcomers, as well as cutting edge work from the speaker's own experience to engage the expert. The honor of Foundation Speaker is given to an individual who has made significant and sustained contributions to the field. The GEC Foundation Speaker at the 60th GEC meeting to be held in Washington, DC October 2-5, 2007 will be **Don Madison**.

Max Bertino's student, **Lane Martin**, took 2nd place honors in the Natural Sciences Division of the 2006 UMR Undergraduate Research Conference for his talk on "*Quantum dot photolithography*."

Come Back for Homecoming

The UMR Physics Department warmly invites you to return to Rolla for **UMR Homecoming 2007** on **October 19-20, 2007**. On Friday afternoon, October 19, the department will hold an open house and special programs for its alumni and friends. Tours of laboratories and educational facilities will be offered and there will be opportunities for interaction with current UMR physics students. Come see what we have done since you received your degree.

In keeping with a long-standing tradition, a UMR alum will deliver the Homecoming 2007 Physics Colloquium at 4 PM. on Friday, October 19. Later that evening, professors **Ed** and **Barbara Hale** will host a homecoming reception in their lovely home. Contact us at physics@umr.edu for specific information about physics department activities, or alumni@umr.edu for general homecoming information. Come home to your college roots, and help us celebrate UMR's past, even as we work to shape its future!

So What's News with You?

We hope you enjoyed this year's edition of **Matter 'n Motion**. We enjoy keeping you informed about what is going on at UMR, but we'd also like to know what's new with you, both personally and professionally. Any information you send will be circulated in the department and, if appropriate, inserted in the next physics newsletter unless you request otherwise.

Please print or type your information, and include your mailing address so that we can update our records. Mail to: **UMR Physics Department, University of Missouri-Rolla, 65409-0640**. Or, if you would prefer, you can e-mail us your comments at **physics@umr.edu**. Thanks for keeping in touch. It's always good to hear from old friends.

Name: _____ Phone: _____ E-mail: _____

Mailing Address: _____

Job Title (if appropriate): _____

Business Phone: _____

Business Address: _____

News or Comments: _____

Department of Physics
University of Missouri-Rolla
Rolla, MO 65409-0640