

For alumni, friends, faculty, and staff of the MSM-UMR-Missouri S&T Physics Department

Vojta, Pegasus, and Gryphon Take Flight

Thomas Vojta celebrated the end of a highly productive 2009 by announcing the official opening of the Pegasus II and Gryphon Linux PC clusters during a special departmental colloquium on January 21, 2010. The Pegasus II cluster is a major upgrade of the original Pegasus Cluster built in 2004/2005, and is used by Thomas' research group for computational research in condensed matter and statistical physics. Its construction was supported by the National Science Foundation, the Research Corporation, and by the University of Missouri Research Board.



The Pegasus II cluster consists of a quad-core cluster server, which provides an interface to the Missouri S&T campus network, 64 diskless quad-core compute nodes (for long production runs), 32 older diskless Pentium 4 compute nodes (for test calculations and short runs), and is connected via private Gigabit ethernet. By using inexpensive commodity PC hardware and employing free open-source software whenever possible, the cluster minimizes total cost while providing a high-performance computer system for physics number crunching.

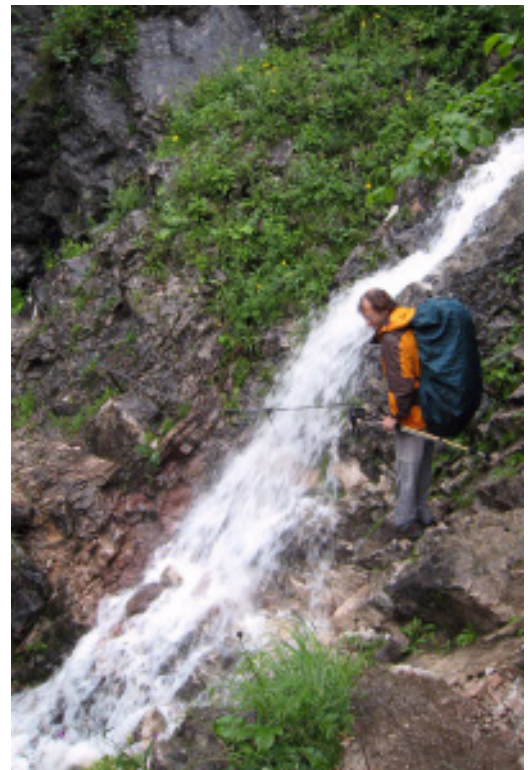
Pegasus has a little sibling, the Gryphon cluster, which was designed for use in computational physics education and student research by students in the Missouri S&T Physics department. Gryphon is built around 32 diskless Pentium 4 compute nodes from the original Pegasus cluster.



Thomas uses his clusters to study quantum and classical phase transitions. Quantum phase transitions occur at zero temperature when some non-thermal parameter such as pressure, chemical composition or magnetic field is changed. They are caused by quantum fluctuations which are a consequence of Heisenberg's uncertainty principle.

In August, 2009, Thomas was awarded \$324,000 by the National Science Foundation to study "*Quantum phase transitions: disorder, dynamics, and frustration.*" In November, Thomas was one of only five Missouri S&T faculty members to receive the prestigious new Faculty Excellence Award. These awards will be given annually to recognize faculty for their overall and sustained excellence in teaching, research, and service. With around 300 tenured/tenure-track professors at Missouri S&T, many of them world-class scientists and outstanding teachers, the chance to get one such award when only five are picked is quite low. Each award winner receives a \$5000 stipend funded by industry and alumni contributions.

Thomas' research on superconducting nanowires is highlighted on page 10 of this newsletter.



Thomas Vojta

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Memo from the Chair

In last year's memo the discussion was dominated by the uncertain economic climate and shrinking state support of higher education. I wish I had better news this year, but the primary concerns at Missouri University of Science & Technology continue to be state support for higher education. For fiscal year 2011, the University of Missouri system has agreed not to raise tuition provided it receives only a 5% reduction in state appropriations. Unfortunately even this requires intervention in the form of federal stimulus funding for the state budget. In fiscal year 2012 federal stimulus dollars will no longer be available, and the state of Missouri will probably begin that year with a deficit of approximately \$1 billion. Historically, higher education in Missouri is subjected to a high percentage of any state budget cuts. It seems clear then, that whatever the details of the near term state budgets are, the university will be challenged to find new ways to continue to offer quality education and maintain world class research programs.

If there is a silver lining to the economic woes it is that there appears to be increased interest in enrollment in the physics program at Missouri University of Science & Technology. We are admitting more undergraduates, and the quality of these students is outstanding. The average ACT score is nearly 30, and over 80% have a high school GPA above 3.5. We look forward to being challenged by these talented students in the future, and your financial assistance can be of help in allowing us to continue to attract highly qualified students with generous physics scholarships.

This past year was a banner year for physics professional degrees. At the May commencement, Drs. **John Daniel Jones** and **Franklin D. Schowengerdt** were awarded professional degrees in physics, and at the December commencement, Dr. **Jonathan H. Waters** was awarded a professional degree in physics. Jon received his B.S. in physics from UMR in 1981 and is currently the Chief of Anesthesia Services at the Magee Women's Hospital at the University of Pittsburgh Medical Center, as well as a visiting Assoc. Prof. at the University of Pittsburgh School of Medicine, and the Medical Director of the University of Pittsburgh Health System Perioperative Blood Management Program. Dan Jones received his M.S. and Ph.D. in physics from UMR in 1971 and 1974 respectively, and he is currently executive vice president of Radiance Technologies. Frank Schowengerdt received his B.S., M.S., and Ph.D. in physics from UMR in 1966, 1967, and 1969 respectively. He is currently president of SpacePartnerships.com, a company specializing in creating and promoting partnerships between industry, academia and government for the purpose of commercializing space. Their visits are detailed elsewhere in this edition of Matter 'n Motion.

Finally, last semester saw the retirement of Professor **Ralph Alexander**. Ralph joined the department as an Assistant Professor in 1970 and served as department chair from 1983-1992. Ralph's dedication to the department was exemplary, and the roles he filled and duties he performed selflessly are far too numerous to

mention. His retirement leaves a tremendous hole for the department to fill, and we already miss his presence and unwavering dedication. As chair, I would like to thank Ralph, on behalf of the department and the Missouri S&T physics community, for his many years of dedicated service and to wish him all the best in his retirement.

In closing, I will repeat the sentiments I expressed in last year's memo. I would like to thank all of you for your continued support. The department remains a vital and thriving unit despite difficult times. This is primarily due to the quality and dedication of our faculty, students, staff, and alumni. I hope that in these troubled financial times we can continue to count on the generous support of our alumni. It is clear that the department's ability to provide a quality education to our students would be hampered without your dedication and support.

– Dan Waddill

What the Easter Bunny Left

Last year the Easter Bunny left some presents for our chairman, **Dan Waddill**. Graduating seniors **Tara Biggers**, **Lori Kennedy**, and **Elizabeth Fiechtner** are shown below investigating the incident.



No, you don't want to know what's inside the translucent plastic box with the reddish-brown handle. Trust us.

Physics Department Awards 2009-2010 Scholarships and Fellowships

The following scholarships have been endowed through the generous gifts of the friends of the Missouri S&T 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 **Jonathan Gigax**, of Marshfield, Missouri and **Jason Mast**, of Kansas City, Missouri. 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 **Kenneth Smith**, of Florissant, Missouri. This \$500 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.

Jesse Hoemann of Washington, Missouri, **Thomas Schmit**, of Naperville, Illinois, and **Christopher Svoboda**, of Kansas City, 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 Missouri S&T.

David Dotson, of Florissant, Missouri received the *Leon E. Woodman Memorial Scholarship*. This \$1000 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.

The *Richard W. Hannum Endowed Development Fund* was established through a bequest by **Richard Hannum** (PhD '66). The fund is currently used to provide scholarships for outstanding students in Physics. **Amanda McBee**, of Kansas City, Missouri received the \$1000 Hannum Scholarship for 2009-2010.

The *Richard Anderson Scholarship Fund* is an endowment established in memory of Dr. **Richard Anderson**. **Adam Farquhar**, of St. Louis, Missouri, and **Nicholas Dennis**, of St. Louis, Missouri received the \$1000 Anderson Scholarship for 2009-2010.

The department also awards *Physics Scholarships for Academic Access*, funded by a group of alumni and faculty donors. These are need-based awards to Missouri resident students in physics. Last year these scholarships were awarded to **Benjamin Knapp**, of Columbia, Missouri, **Kurt Konyalioglu**, of Overland Park, Kansas, **Thanh Nguyen**, of Webb City, Missouri, **Sarah Wiese**, of St. Louis, Missouri, and **Thomas White**, of St. Louis, Missouri.

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 **Matthew Callaway**, of Jefferson City, Missouri, **Brian Derickson** of Farmington, Missouri, **Stephen Lee**, of Butler, Missouri, **Amanda McBee**, of Kansas City, Missouri, **Thanh Nguyen**, of Webb City, Missouri, **Kenneth Smith**, of Florissant, Missouri, and **Thomas White** of St. Louis, Missouri.

Endowments: Gifts that Continue to Give

Many generous donors have found that creating an endowment, a fund established with cash, securities or other assets which provides income in perpetuity, offers a significant, long-term impact on Missouri S&T. Endowments can be unrestricted or restricted for a specific purpose such as scholarships, department programs, faculty support, etc. Endowments can be started with as little as \$15,000 and additional funds can be added at any time in the future.

The Missouri S&T Physics Department has several donors that have been adding to their endowment for several years, including endowments established by **Ed** and **Mary Sue Sickafus**, and by the estate of **Richard Hannum**.

The ongoing nature of an endowment provides a way to support your alma mater and give them the financial strength to do things that might not otherwise be possible. If you want to learn more about the Missouri S&T endowment program and how you can participate, please call 1-800-392-4112, or e-mail giving@mst.edu.

Report from the SPS

The Missouri S&T chapter of the Society of Physics Students had another active year in 2009. Our annual picnic was October 16. We planned for the picnic to be at Schuman Park, but the weather was so crazy (raining off and on) that we moved it to the Fuller Library in the Physics building. The food was still good, and it was a great turnout for SPS. Unfortunately, because of the rain we were not able to experience our annual volleyball defeat at the hands of Dr. **Greg Story**. We could say Dr. Story just used the rain as an excuse and skipped out because he knew he would lose, but that would be a lie.

Our fall highlight was the annual visit to Argonne National Laboratory for the National Undergraduate Symposium. **David Dotson, Jason Mast, Ethan Beck, Sam Stephens, Derek Loveless, Tom Schmit, Dan Franklin, Adam Farquhar, and Winston Carr** all participated. We toured the Advanced Photon Source, which "produces x-ray beams of unprecedented brilliance, providing scientists from around the world with one of their best research tools," and the Argonne Tandem Linear Accelerator System (ATLAS), which "was the world's first superconducting ion accelerator facility and is capable of accelerating ions of all natural elements from hydrogen to uranium."

We all attended the Symposium's keynote address "*Novel H1N1: perplexities in pandemic planning*," by Dr. **Jamie L. Stalker**, Director of the Medical Department at Argonne National Laboratory. The talk discussed pandemics, the initial concern about H5N1 Avian Flu, and the surprise at the novel H1N1 the previous spring. Tom Schmit gave his presentation of "*A signature of new physics: determining missing transverse energy in the ATLAS detector*," and Jason Mast talked on "*Fabrication of suspended nanowire structures*." After the trip concluded, Tom led us to a pizza place, to get some much-enjoyed "authentic Chicago-style pizza."

Another fall highlight was our invitation from the Admissions department to make liquid nitrogen ice cream for visitors at the fall Open House. The ice cream was the hit of the Open House. Freshman **Laura Sisken** showed for the first time her unpatented technique for making dipping dots (center photo right).

In January 2010 we elected a new slate of officers. **Winston Carr** took over **Derek Loveless** as president, **Jesse Hoemann** assumed Winston's vice president position, **Sam Stephens** replaced **Jonathan Gigax** as treasurer, and **Tom Schmit** stepped into **Nathan Glave's** secretary position. Jonathan Gigax was named unofficial webmaster. Maybe some day our web site will have content more recent than April, 2006! (But don't hold your breath.)

--Derek Loveless, President of SPS

upper right: Zach Pittman, Derek Loveless
middle: Laura Sisken, Nathan Glave, Zach Pittman
lower right: Laura Sisken, Erin Davis
page 5: SPS at Argonne



Three Selected as Outstanding GTA's



Tina Dhekial-Phukan, Adam Upshaw, Dan Waddill, Sachin Sharma

This spring the department introduced graduate teaching awards to honor the outstanding accomplishments of our graduate teaching assistants. The awards were for excellence in teaching in the Fall 2009 semester, and were determined by a combination of student evaluations and teaching performance determined by the faculty overseeing the teaching laboratories where most of our graduate teaching assistants teach. Congratulations to the winners: **Tina Dhekial-Phukan, Sachin Sharma, and Adam Upshaw.** We hope this becomes a proud tradition in the department and further reinforces the department's commitment to excellence in teaching.



Congratulations to S&T's 2009 Physics Degree Recipients!

May 2009

Bachelor of Science

- Tara Elizabeth Biggers
- Joshua Vincent Cardenzana
- Elizabeth Ann Fiechtner
- Lori Elizabeth Kennedy
- David Michael Kimzey
- Melissa Ann Ray
- Ciaran Ryan-Anderson
- Christopher Evan Stolte
- Jake Patrick Walker

Master of Science for Teachers

- Mark Allen Peckham

Master of Science

- Thomas Franklin Creel, Jr.

Doctor of Philosophy

- Jason S. Alexander
- Nathan Daniel Dees
- Jared Martin Gavin

December 2009

Bachelor of Science

- Jason Edward Mast
- Joshua Ramon Whitaker

Doctor of Philosophy

- Roxana Patricia Contreras (August)
- Allison Lynn Harris

Planned Giving:

Leaving a Legacy to Missouri S&T

Many alumni and friends have realized that a future gift – one arranged through their will or trust – allows them to give back to their alma mater more than they ever thought possible. With careful planning, charitable estate giving can reduce your estate tax liability or transfer assets to your family at a lower gift tax cost.

Making a planned gift shows your loyalty to Missouri S&T, an institution that played a significant role in shaping your future. For more information about giving a current or planned gift, contact the Office of Development at 1-800-392-4112 or e-mail giving@mst.edu.

Ralph Alexander Retires

Ralph Alexander retired in December 2009 after 40 years of service to UMR/Missouri S&T.

Ralph received his BA in Physics from Wesleyan University in 1963, and his PhD in Physics from Cornell University in 1968. After a postdoc at the University of Freiburg in Germany, he began his career at UMR/S&T in 1970 as an assistant professor. He was appointed associate professor in 1975, and became a full professor in 1983.

Ralph's specialized in research on far infrared spectroscopy and optical properties of materials. He supervised nine PhD students, and was PI or Co-PI on grants from the US Army, McDonnell Douglas, Science Matrics, the Air Force Office of Scientific Research, the National Science Foundation, and the Research Corporation. He published more than 30 refereed papers and several book chapters.



From 1983-1992 Ralph was Chairman of the Physics Department. He served as President of the Missouri Chapter of the American Association of Physics Teachers from 2000-2001 and was Chairman of the Missouri Academy of Science in 2000.

While at Missouri S&T, Ralph developed the Advanced Laboratory Teaching Methods course (Physics 404), created the Physics Honors Labs, and rewrote the introductory physics lab manuals. He received the Arts & Sciences Excellence in Teaching Award for 2005-2006, a campuswide Teaching Excellence Award for 2008-2009, and numerous campuswide Outstanding Teaching Commendations. Ralph was PRO advisor, organized departmental Open Houses, and served as chairman of the department's Undergraduate Recruitment Committee. His contributions to the department will be missed, but we wish Ralph the best in his retirement.



Physics Department Acknowledges Corporate Support

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

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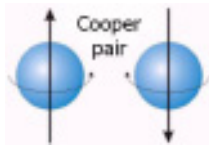
Student Notes

Graduate student **Aaron LaForge** has been selected to attend the 2010 annual Nobel Laureates meeting in Lindau, Germany. Only a few selected young researchers from around the world are invited to this special week-long meeting with Nobel Laureates in medicine, chemistry, and physics. Aaron's advisor is **Michael Schulz**.

Graduate student **Ola Al-Hagan** and her advisor **Don Madison** had their paper "*Deep interference minima in non-coplanar triple differential cross sections for the electron-impact ionization of small atoms and molecules*" selected by the Journal of Physics B as one of the journal's 2009 Highlights, which showcases the most exciting research published in the journal.

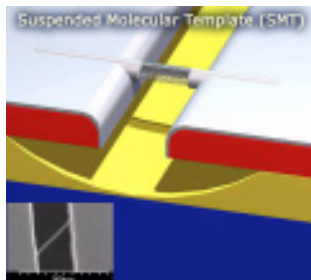
Don't Be Too Thin If...

Don't be too thin if you want to be super(conducting)! Superconductivity is one of the most fascinating phenomena in physics. It occurs in metals at very low temperatures when the electrons form Cooper pairs. These pairs move through the material without any scattering, leading to a complete vanishing of the electrical resistance.



In recent years, advances in nanotechnology have made it possible to produce nanoscale superconductors. Offering unprecedented control over system parameters, these devices provide a “laboratory” for testing fundamentals of quantum mechanics. They are also at the heart of the quantum information revolution since small superconductors are among the most promising candidates for the qubits in future quantum computers.

Superconducting nanowires with widths of about 10 nanometers can be produced by means of the ingenious molecular templating technique (see the figure to the right). Measuring their electrical resistance reveals that only sufficiently wide wires actually become superconducting while the narrower ones do not lose their resistance to the lowest temperatures. This is caused by magnetic impurity atoms on the surface of the wire that tend to break up the Cooper pairs responsible for superconductivity.



Faculty member **Thomas Vojta**, graduate student **Chetan Kotabage** and postdoc **Jose Hoyos** (now at Duke University) developed a theory for this phenomenon. A short version was published in the prestigious *Physical Review Letters* 99, 230601 (2007) and a complete account just appeared in *Physical Review B* 79, 024401 (2009). The latter article has been prominently showcased by the American Physical Society in the journal “Physics” which is a publication dedicated to spotlighting exceptional research to help physicists and physics students learn about exciting new developments outside of their own subfields. The Viewpoint Commentary on this paper, written by **Gil Refael** from Caltech, can be found at <http://physics.aps.org/articles/v2/1>.

To Contact S&T 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@mst.edu. You might also be interested in checking out our web page, <http://physics.mst.edu>.

Alumni Notes

Emilio Nanni (BS '07) is working on his PhD at MIT. Emilio will be marrying Sarah Wilson on October 9, 2010 in Boston, where they both reside.

Andrew Walters (BS '07) graduated from the University of Oklahoma Health Sciences Center with a MS in Medical Physics in the summer of 2008. He is currently working with a medical physics group in Omaha, NE.

Ryan Kinney (BS '06) married **Amanda Chasteen** (BS '06, Chem. E.). Ryan is close to finishing his Masters of Engineering in Nuclear Engineering from Penn State. Ryan is a US Navy officer working in the Naval Nuclear Propulsion Program. He is currently on the Admiral's staff at headquarters located in the Washington Navy Yard, Washington DC..

Dustin Spieker (BS '08) is working on his PhD at Georgia Tech.

Kevin Johnson (BS '06) writes "finished masters degree in physics last year, went to work at the Naval Air Warfare Center - Weapons Division in China Lake, CA. Bought a house and outside of work I fly sailplanes around the Sierra for fun."

Sara Whitbeck (BS '07) lives in Utah and teaches math and physics at Wasatch Academy, a small international boarding school.

Mark Dickison (BS '05) is finishing his PhD at Boston University.

Junfang Gao (PhD '05) is a Medical Physics Resident at Scott & White Memorial Hospital in Temple, TX. He works with Dr. Andrew Boyer, a well-known medical physicist. His wife is still at Missouri S&T finishing her degree, and his son is in high school.

Caleb Klapp (MS '08) is working as an algorithms engineer at Clean Earth Technologies, LLC.

Allison Harris (PhD '09) is a postdoc at Kansas State University in Manhattan KS.

Jared Gavin (PhD '09) is an algebra instructor for the University of Arkansas-Monticello.

Muzaffer Tabanli (PhD '02) tells us he works on TV production and documentaries, and is producing a TV program "*Matter and Beyond*" for Ebru Televison. His wife, **Sule**, is working at a nearby high school. **Latif** is still growing. It is amazing to see how many little things Latif has learned - things that we normally think that we are born with.

Hugh Duguid (MS '69, <http://www.duguid.org/>) writes "after forty years at Hopkinsville Community College, Hopkinsville, KY, we retired at the end of the academic year, 30 June 2009. We will go fishing."

Rastko Sknepnek (PhD '04) is a Research Associate at the Materials Science & Engineering Department of Northwestern University working with Prof. **Monica Olvera de la Cruz**.

Medvedeva Receives Faculty Research Award

Julia Medvedeva was one of only ten Missouri S&T faculty members to receive a Faculty Research Award.

This new award was established to recognize faculty who have demonstrated excellence in research. Selection criteria include peer-reviewed publications, book chapters, and patents; national and international awards; research funding; supervision of graduate and undergraduate students supervised; and presentation of invited and contributed conference papers.

During 2009, Julia was PI or co-PI on four major research grants, and supervised a group consisting of one postdoctoral fellow, two graduate students, and one undergraduate. She is a recognized expert in computational physics and transparent conductors. Congratulations, Julia!



Julia Medvedeva receiving faculty research award from Provost Kent Wray

Magnus, Johnson Come Back for Homecoming

Sandra Magnus (BS '86, MS EE '90) and **John Johnson** (BS '99) visited the department for homecoming 2009.

Magnus returned to Earth in March, 2009, after 4.5 months and 50,304,000 miles aboard the International Space Station. In contrast, Johnson only had to travel from Honolulu, Hawaii, for his visit to Rolla.

During their visit, Sandra (center, top picture) and John (center, bottom picture) spent a lunch hour with undergraduate and graduate students. The hour was far too short for all the lively discussions that needed to take place. Later, Magnus gave a Homecoming keynote speech (see http://news.mst.edu/2009/10/nasa_astronaut_sandra_magnus_t.html) and Johnson presented the department's Homecoming Colloquium (see page 13).



Congratulations to 2009 Physics Academic Scholars

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 Academic Scholars.

Spring Semester 2009

Tara Biggers, Matthew Callaway, Joshua Cardenzana, Winston Carr, Nicholas Dennis, Brian Derickson, David Dotson, Adam Farquhar, Elizabeth Fiechtner, Jonathan Gigax, Jesse Hoemann, Lori Kennedy, David Kimzey,

Benjamin Knapp, Kurt Konyalioglu, Jason Mast, Amanda McBee, Thomas Schmit, David Skinner, Christopher Svoboda, Thomas White, and Sarah Wiese.

Fall Semester 2009

Tara Biggers, Matthew Callaway, Joshua Cardenzana, Brian Derickson, David Dotson, Adam Farquhar, Elizabeth Fiechtner, Jonathan Gigax, Jesse Hoemann, Micah Johnston, Lori Kennedy, David Kimzey, Benjamin Knapp, Kurt Konyalioglu, Stephen Lee, Lane Martin, Jason Mast, Andrea McBee, Melissa Ray, Lauren Rich, Ciaran Ryan-Anderson, Thomas Schmit, Christopher Svoboda, Jake Walker, Thomas White, and Stephen Yeo.

S&T-UMSL Cooperative Agreement Renewed

On April 2, 2009, the cooperative Ph.D. program in physics between Missouri S&T and the University of Missouri-St. Louis was renewed at a brief signing ceremony attended by representatives of both departments and both campuses. The joint degree program was initially approved in 1988, and the first Ph.D. degree was awarded in 1995. In spring 2009, the 20th Ph.D. from the program was awarded. Under the program, Ph.D. students from UMSL have faculty from Missouri S&T physics faculty on their Ph.D. committees. The departments also trade hosting a joint meeting of the departments every third semester that is highlighted by a graduate student research competition. The results of these meetings have been featured in past newsletters. The renewal was needed to reflect changes in administrative structure at Missouri S&T, additions in graduate course offerings, and to introduce reduced fees for UMSL students in the program.



*Front Row: UMSL Provost Glen Cope, UMSL Chancellor Tom George, S&T Chancellor Jack Carney, S&T Provost Kent Wray
Back Row: UMSL Chair Bruce Wilking, Professor Sonya Bahar, UMSL Vice Provost Judith Walker de Felix, Dan Waddill, Ron Bieniek*

"He Did Good"

It is with great pleasure that I inform you that **John Johnson**, one of our former physics majors (BS Dec '99) has "done good." He was recently offered tenure-track assistant professorships at two institutions: Princeton University and California Institute of Technology. Although an understandably tough choice, John has decided to take the position in Cal Tech's Department of Physics, Mathematics & Astronomy, where he is currently an Assistant Professor of Astronomy.

I will remember when John came into my office while he was taking Physics 23 to discuss the results of his first test. He was a mechanical engineering major at the time. After many subsequent dialogs in my office and in the Physics Learning Center, John switched to being a physics major. Let us just say he took off in his new academic milieu. He did REUs at Duke and Cal Tech. He was also one of the best Peer Learning Assistants we have ever had in the PLC. And his personality was (and continues to be) robust.

After graduating from Rolla, John went to graduate school at Berkeley in astronomy. He received campus awards for his teaching and for establishing The Astronomy Learning Center (TALC, "for that itchy, scratchy feeling in astronomy"), inspired by our Physics Learning Center. John and I even had a joint poster at an APS meeting on success of the learning centers.



John received a personal NSF postdoctoral fellowship to pursue his research in exoplanet observational astronomy at Hawaii's Institute of Astronomy and premier Mauna Kea Observatory. He subsequently was the winner of a NASA Sagan Postdoctoral Fellowship. Besides his research publications in the *Astrophysical Journal*, John continues to display his outreach skills through several articles in popular astronomy magazines and journals.

John is married to lovely wife Erin and has two sons: Owen and Marcus. I urge you to visit his homepage at <http://www.ifa.hawaii.edu/~johnjohn/>. His current email address is johnjohn@ifa.hawaii.edu.

Like I said, John's done good. We influenced him along the way.

– Ron Bieniek



John, Owen, and Marcus

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

Donations over \$100:

Harro Ackermann
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 Dr. John C. Carstens
 Charles H. Church
 Patrick L. Cole
 Richard L. Dalrymple
 Suzanna Jo Edwards
 Robert A. Fletcher
 Robert M. Flick
 Roger Keith Foehrweiser
 Matthew Christopher Fritts
 Alexandre Frohlich
 Julie Anne Gamble
 Charles W. Haggans
 Carol V. Hanrahan
 Stanley S. Hansen, II
 William E. Haymes
 Carol E. Henderson-Kuhn
 Wayne E. Holland
 Theodore C. Huff
 William M. Hughes
 Dr. Jerry G. Johnson
 Harris C. Jones
 Dr. J. Daniel Jones
 Mark A. Jones
 Jessica Joy Kerr
 John V. Knopp
 Kurt Thomas Koch
 Franklin W. Kone
 Dr. Danny J. Krebs
 Terrence A. Leigh
 DeAnn Lewis
 Robert Wells Lowe
 Rex A. Mann
 Dr. Gaya Kanishka
 Marasinghe
 Jon D. Mastin
 John L. McDaniels

John W. McGuire
 Dr. Thomas J. McMahon
 David L. Meier
 Dr. Luzheng Meng
 Steven A. Mezines
 Dr. Sanjay Ramnaresh
 Mishra
 William F. Munson
 Jon R. Nance
 Emilio Alessandro Nanni
 Lawrence A. Newquist
 Eric J. Norman
 Dr. Robert R. Nothdurft
 Larry D. Oppliger
 Dr. Raymond E. Paul
 Larry J. Peery
 Daniel H. Perkins
 Charles C. Polly
 Matthew Nathan Pritzker
 Kathy A. Rages
 Rodney O. Randall
 Nancy L. Ranek
 Donald G. Rathbun
 Dr. Emmett R. Redd
 Arthur J. Reetz
 Carl T. Reichert
 John R. Reiter
 Lauren E. Rich
 Michael R. Ruhland
 Gary S. Sammelmann
 Richard S. Schwentker
 Carl B. Sigler, III
 Dr. Gerald K. Sirotiak
 Dr. James G. Smith
 Steven Lee Smith
 Gary E. Staats
 Kenneth M. Stephens
 Robert M. Stovall
 John Lester Tappmeyer
 Richard D. Thom
 John L. Thompson
 Dr. Robert E. Thurman
 Terry R. Tucker
 Zu-En Wang
 James T. Willcutt
 David J. Wolters
 F Matthew Woodward
 Gary K. Woodward
 Gary G. Wooley

Phonathon 2010

Mark your calendars! On April 8, 11, 12, 13, and 14 this year a dedicated group of our students will be calling to ask for your assistance. With new scholarships made possible by past phonathon donations the department has been able to more than double undergraduate enrollment since Spring 2005. This year we continue to work towards our goal of 100 undergraduate and graduate majors. Every dollar you can give for scholarships and graduate fellowships will greatly assist the department in its aggressive recruitment plan, and will be greatly appreciated. In addition, in this time of shrinking state support for higher education our department, along with all academic units, are more reliant than ever upon the generosity of our alumni to continue to provide the outstanding education we are known for. Your continued support will also allow us to maintain instructional supplies and resources in our classes, and support the efforts of our outstanding faculty and students.

A total of 202 alumni and other donors committed \$167,896 in donations to the MSM-UMR-Missouri S&T Physics Department last year. Last year's fundraising Phonathon raised \$17,535 with an average gift of \$104 from 168 donors. The department greatly appreciates your generosity, which helps to support scholarships and student activities like the Society of Physics Students.

An Untimely Demise?

It is rumored that Professor **Ron Bieniek** met with an untimely demise at the hands of an ex-Physics 23 student during the Theatre department's production of *Sweeney Todd: the Demon Barber of Fleet Street*.

Although the production took place during the Spring, 2009 semester, at the current time we are unable to either confirm or disprove this rumor. If any of our readers has further information, please contact the department at physics@mst.edu.



Missouri University of Science and Technology Students & Alumni: In Press

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

"Dual-periodic photonic crystal structures," A. Yamilov and M. Herrera,³ in **Recent Optical and Photonic Technologies**, Ed. K. Y. Kim, INTEH, (2010).

"Three-body dynamics in single ionization of atomic hydrogen by 75 keV proton impact," A. C. LaForge,² K. N. Egodapitiya,² J. S. Alexander,³ A. Hasan, M. F. Ciappina, M. A. Khakoo, and M. Schulz, *Phys. Rev. Lett.* **103**, 053201 (2009).

"Infinite-randomness quantum critical points induced by dissipation," T. Vojta, C. Kotabage,² and J. A. Hoyos, *Phys. Rev. B* **79**, 024401 (2009). Selected as an Editor's Suggestion and featured in a Viewpoint Commentary by **G. Refael**, *Physics* **2**, 1 (2009).

"Infinite-randomness critical point in the two-dimensional disordered contact process," T. Vojta, A. Farquhar,¹ and J. Mast,¹ *Phys. Rev. E* **79**, 011111 (2009).

"Absorbing-state phase transitions on percolating lattices," M. Y. Lee² and T. Vojta, *Phys. Rev. E* **79**, 041112 (2009).

"Tuning the properties of complex transparent conducting oxides: role of crystal symmetry, chemical composition, and carrier generation," J. E. Medvedeva and C. L. Hettiarachchi,³ *Phys. Rev. B* **81**, 125116 (2010).

"Atomic and molecular signatures for charged particle ionization," O. Al-Hagan,² C. Kaiser, D. H. Madison and A. Murray, *Nature Physics* **5**, 59 (2009).

"Treatment of ion-atom collisions using a partial-wave expansion of the projectile wavefunction," T. G. Wong, M. Foster,³ J. Colgan and D. H. Madison, *Eur. J. Phys.* **30**, 447 (2009).

"Triple differential cross sections for the electron-impact ionization of H_2 molecules for equal and unequal outgoing electron energies," J. Colgan, O. Al-Hagan,² D. H. Madison, C. Kaiser, A. J. Murray, and M. S. Pindzola, *Phys. Rev. A* **79**, 052704 (2009).

"Deep interference minima in non-coplanar triple differential cross sections for the electron-impact ionization of small atoms and molecules," J. Colgan, O. Al-Hagan,² D. H. Madison, A. J. Murray and M. S. Pindzola, *J. Phys. B: At. Mol. Opt. Phys.* **42**, 171001 (2009). Selected for inclusion in Journal of Physics B 2009 Highlights of the Year, which showcases the most exciting research published in the journal.

"Dynamical ($e, 2e$) studies of formic acid," C. J. Colyer, M. A. Stevenson, O. Al-Hagan,² D. H. Madison, C. G. Ning and B. Lohmann, *J. Phys. B.* **42**, 235207 (2009).

"($e, 2e$) study of two-center interference effects in the ionization of N_2 ," L. R. Hargreaves, C. Colyer, M. A. Stevenson, B. Lohmann, O. Al-Hagan,² D. H. Madison, and C. G. Ning, *Phys. Rev. A* **80**, 062704 (2009).

"Four-body model for transfer excitation," A. L. Harris,³ J. L. Peacher, D. H. Madison, and J. Colgan, *Phys. Rev. A* **80**, 062707 (2009).

"Low-energy symmetric coplanar and symmetric non-coplanar ($e, 2e$) studies from the $3a_1$ state of H_2O ," K. L. Nixon, A. Murray, O. Al-Hagan,² D. H. Madison, and C. Ning, *J. Phys. B.* **43**, 035201 (2010).

Three Awarded Professional Degrees

The department awarded three professional degrees in 2009. At the May commencement, Drs. **John Daniel Jones** and **Franklin D. Schowengerdt** were awarded professional degrees in physics.

Dan Jones received his BS in physics from North Georgia College, his MS and PhD in physics from UMR in 1971 and 1974 respectively. He began his professional career as a member of the technical staff at Teledyne Brown Engineering. He moved to General Research Corporation and then Nichols Research Corporation before joining Radiance Technologies in 2006. He is currently executive vice president of Radiance Technologies.



Dan Jones

Dr. Jones has nationally recognized, expert knowledge in Strategic Defense Systems as demonstrated through his selection as a key panel member for a number of USASMDC/BMDO(MDA) studies.

Dan was director and lead Principal Investigator for the USASMDC Joint Center for Technology Integration's Robust Enhanced Decoy Elimination and Mitigation Study. The study defined candidate counter-counter measure system concepts and provided technical assessments of system elements. The Mini Kill Vehicle Concept was further refined and quantified through this study.

Dan also served as the technical director for the Exoatmospheric Discrimination Simulation. The program objective was to develop simulations for system level discrimination assessments of multiple optical sensors, high-density threats, multiple pen aid types, and tens of thousands of objects.

Frank Schowengerdt received his BS, MS, and PhD in physics from UMR in 1966, 1967, and 1969 respectively. After a short stay at the University of Nebraska-Lincoln, Frank joined the physics faculty at Colorado School of Mines in 1973. At Colorado School of Mines he served in many capacities including as Head of the Physics Department, Vice President for Academic Affairs and Dean of Faculty, Chairman of the Board, Colorado Advanced Materials Institute, and Director, Center for Commercial Applications of Combustion in Space.



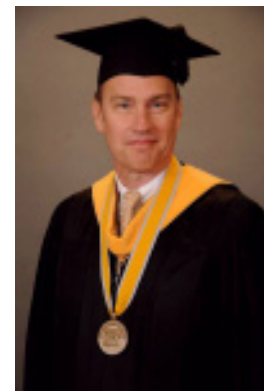
Frank Schowengerdt

In 2003 Frank became Program Executive of Space Product Development for NASA. He was responsible for the Space Product Development program that oversees the Research Partnership Centers (RPCs), which are cooperative research and development centers located at universities around the U.S. Research sponsored in these centers includes advanced materials, biotechnology, communications, electronics, energy conversion and storage, imaging, pharmaceutical development, space medicine, space power, spacecraft technology and thermal control. As of 2005, the RPCs' total operating budgets were in excess of \$80 million.

Frank founded and directed CCACS, which is an RPC specializing in applied research and development in combustion-related phenomena and processes, including fundamental combustion, catalytic combustion, flame synthesis of powders, fire suppression and combustion synthesis of advanced materials. This center grew from a small seed grant to a \$5 million enterprise over the course of six years.

Frank is currently president of SpacePartnerships.com, a company specializing in creating and promoting partnerships between industry, academia and government for the purpose of commercializing space.

At the December commencement, Dr. **Jonathan H. Waters** was awarded a professional degree in physics. Jon received his BS in physics from UMR in 1981 and an MD from George Washington University. Dr. Waters has had a highly successful career in the medical profession.



Jonathan Waters

Waters has held numerous academic and non-academic positions and is currently the Chief of Anesthesia Services at the Magee Women's Hospital at the University of Pittsburgh Medical Center, as well as a visiting Assoc. Prof. at the University of Pittsburgh School of Medicine, and the Medical Director of the University of Pittsburgh Health System Perioperative Blood Management Program.

Jonathan developed the first American Association of Blood Banks accredited autotransfusion program in the U.S, and he is the President for the Society of Blood Management. He has held offices in numerous professional and scientific societies, published 36 refereed papers, 4 book chapters, 4 invited papers, and edited 2 books. He is actively involved in medical education and research, and served as a medical officer in Operation Desert Shield/Storm.

Frontiers in Physics Colloquium Series

The 2009 *Frontiers in Physics Colloquium Series* began in January with Dr. **Andrea Markelz** of SUNY Buffalo, who spoke on “*Correlated motion and protein dynamics: what terahertz spectroscopy tells us.*” She was followed by Dr. **Timothy Gay** of the University of Nebraska, who gave his famous talk on “*Football physics.*” Tim’s talk was just in time for Super Bowl week. Next up was Dr. **James Colgan** of the Los Alamos National Laboratory, who discussed “*Atomic physics using high-performance computing.*” In February we were visited by Dr. **Carl M. Bender** of Washington University in St. Louis who talked about non-Hermitian quantum mechanics in “*Making sense of non-Hermitian hamiltonians.*”

In March, we hosted Dr. **Mariana Bertoni** of MIT, who spoke about “*Defect engineering of solar cell materials.*” She was followed by Missouri S&T’s Dr. **Amitava Choudhury** who told us of the “*Many virtues of transition metal phosphates: magnetic porous solids to Li-ion batteries.*”

April brought four visitors to our department, starting with Dr. **John Tanis**, of Western Michigan University, who spoke on “*Fast electron and ion transmission through insulating nano- and microcapillaries.*” Dr. **Ray Arvidson** of Washington University in St. Louis then gave a fascinating presentation on the search for water on Mars in “*The Phoenix lander mission: a trip to the frozen arctic of Mars.*” April concluded with Dr. **Peter J. Mohr** of the National Institute of Standards and Technology in Gaithersburg, Maryland, who enlightened us on how fundamental the fundamental constants really are in “*The status and future of fundamental constants,*” and Dr. **Vasily Astratov**, of the University of North Carolina-Charlotte, who spoke on “*Optical Transport Phenomena in Coupled Spherical Cavities.*”



Ray Arvidson

The busy April of our spring series concluded with the Thirty Eighth Annual Harold Q Fuller Prize Colloquium, which was run again as a poster competition. Details of the Fuller competition appear in a separate article on page 15.

The colloquium series resumed in the fall with 11 colloquia in a variety of subfields of physics. First up in September was Dr. **Maarten DeKieviet**, Heidelberg University, Germany, with a talk titled “*From Newton to Casimir and back: fundamental physics using atomic beam spin echo.*” Dr. **Klaus Woelk** from the Chemistry department at Missouri S&T talked about “*Novel toroid cavity techniques for in situ NMR spectroscopy and imaging studies.*”

During a busy month of October, Dr. **Jeffrey Catalano** from Washington University in St. Louis, reported on “*Interfacial Water Ordering, Complex Ion Adsorption, and Redox-Driven Nanoscale Transformations at Mineral-Water Interfaces.*” He was followed by Dr. **Stephan DeBievre**, Universite des Science et Technologie de Lille, who told us about “*The Unruh effect revisited.*” Dr. **Sergey Skipetrov**, of France’s Centre National de la Recherche Scientifique talked about “*Anderson localization of classical waves.*” Alumnus Dr. **John Johnson** (BS ’9), who received his PhD from UC Berkeley and is currently an NSF Postdoctoral Fellow at the University of Hawaii Institute for Astronomy, talked about his career and his search for planets orbiting other stars during an invited homecoming colloquium “*The Golden Age of exoplanet spin-orbit measurements.*” October concluded with a colloquium by Dr. **Gregory Stewart**, of the University of Florida who gave us an insider’s view on the race to synthesize novel high- T_c superconductors in “*The new iron age - superconductivity in an odd place.*”

The November schedule included two visitors and one homegrown colloquium. Dr. **Gavin King**, University of Missouri-Columbia, told us about, “*A precision force microscope for biophysics.*” We learned about precision measurements of the magnetic moment of the electron in “*Tests of fundamental symmetries at low energies,*” by Dr. **Gerald Gabrielse** of Harvard University. Continuing a new tradition, the department celebrated the awarding of the 2009 Nobel Prizes with lectures by our own **Alexey Yamilov** and **Thomas Vojta**, on “*The 2009 Nobel prize in physics.*”

In December our colloquium series concluded with the Sixteenth Annual **Laird D. Schearer** Prize Colloquium, which saw four presentations by the finalists (see page 14).



John Johnson

16th Annual Schearer Prize Competition

The Sixteenth 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, was held on December 3, 2009. Seven students submitted applications for the competition, consisting of a short description of their research, copies and lists of any publications and presentations they have made, plus a résumé. Based on these applications, the judges, professors **Greg Story**, **Gerry Wilemski**, and committee chair **Paul Parris**, selected four finalists who gave oral presentations of their work in departmental colloquium.

The 2009 finalists were **Ola Al-Hagan**, advised by Professor **Don Madison**, **Tina Dhekial-Phukan**, advised by Professor **Dan Waddill**, **Aaron LaForge**, advised by Professor **Michael Schulz**, and **Ben Payne**, advised by Professor **Alexey Yamilov**. During

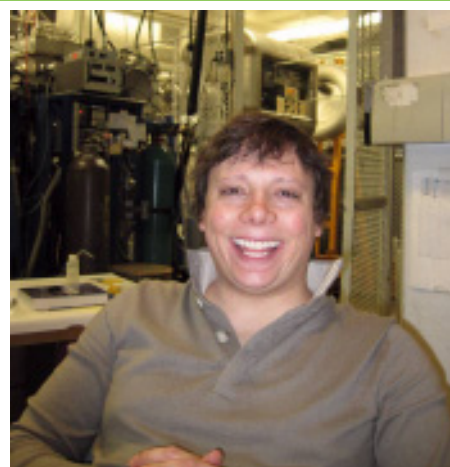
the colloquium on December 3, Ms. Al-Hagan spoke about “*Electron impact ionization cross sections of H_2 for low outgoing electron energies from 1eV to 10 eV*,” Ms. Dhekial-Phukan discussed “*Surface structure determination of ultrathin iron-oxide films using x-ray photoelectron spectroscopy, x-ray photoelectron diffraction, and low energy electron diffraction*,” Mr. LaForge talked on “*Three-body dynamics in single ionization of atomic hydrogen by 75keV proton impact*,” and Mr. Payne presented “*Effect of evanescent modes on conductance distribution in disordered waveguides*.” All students gave excellent talks. First place and a \$500 prize was awarded to Mr. LaForge, while Mr. Payne took second place and a \$200 prize, and Ms. Al-Hagan and Ms. Dhekial-Phukan shared third place and received \$100 each.

From Schearer Prize Winner Aaron LaForge

I consider it an honor to be selected as a finalist and eventually to win the 16th Annual Schearer Prize. I would like to first thank my advisor, Dr. **Michael Schulz**, for guiding me in my research and giving me a great appreciation for my area of research, AMO physics. Second, I would like to thank the unsung hero and my partner in crime in the lab, **Kisra Egodapitiya**, who was an invaluable help in running the experiment. Third, I would like to thank the judges, Drs. **Paul Parris**, **Greg Story**, and **Gerald Wilemski**, for selecting me as the winner of the Schearer Prize. Their decision had to be a difficult one as my competition was stiff. I consider the three other finalists in this year’s Schearer Prize, **Ola Al-Hagan**, **Ben Payne**, and **Tina Dhekial-Phukan**, to be my friends and their research to be top notch.

As my time in Rolla is drawing to a close, it is nice to look back at how I got to this point. At the time of entering the Physics department, I had no idea what type of research I would like to pursue and even if physics was the right choice for me. Luckily, I soon realized that this was the right department for me and soon after found an area of research that greatly interested me which I hope to work in for the remainder of my career.

My presentation was over my research in the single ionization of atomic hydrogen by proton impact. This fundamentally important, yet unsolvable, collision system is an important benchmark in understanding the three body problem. We found that even a state-of-the-art quantum mechanical model was not able to accurately describe the dynamics of this most simple system. This proves that there is still much work to do on both the theoretical and experimental side to better understand this most fundamental atomic process.



Aaron
LaForge

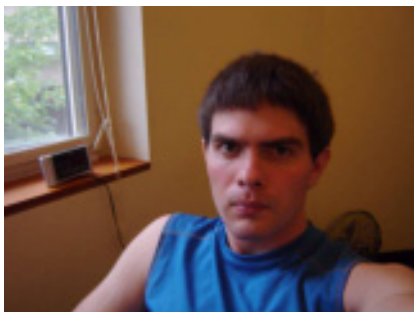
Come Back for Homecoming

The Missouri S&T Physics Department warmly invites you to return to Rolla for **S&T Homecoming 2010** on **October 1-2, 2010**. On Friday afternoon, October 1, 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 Missouri S&T physics students. Come see what we have done since you received your degree.

In keeping with a long-standing tradition, an S&T alum will deliver the Homecoming 2010 Physics Colloquium at 4 PM. on Friday, October 1. Later that evening, Professors **Ed** and **Barbara Hale** will host a homecoming reception in their lovely home. Contact us at physics@mst.edu for specific information about physics department activities, or alumni@mst.edu for general homecoming information. Come home to your college roots, and help us celebrate our past as UMR, even as we work to shape our future as Missouri S&T!

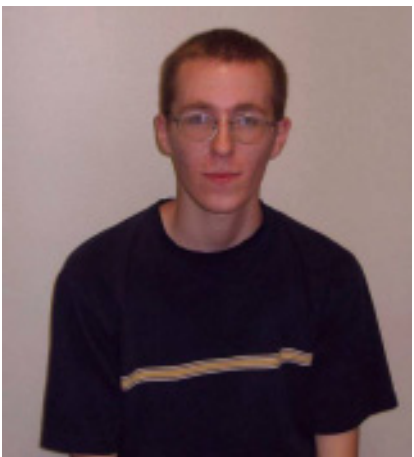
38th Annual Fuller Research Seminar

The 38th annual **Harold Q Fuller** Undergraduate Research Seminar was held on April 28, 2009. This competition promotes participation of undergraduates in research both in the department and in summer intern projects. This year's participants were **Jason Mast** and **Adam Farquhar**, "A study the nonequilibrium phase transition," advised by Dr. **Thomas Vojta**; **Spencer Garr**, "Guiding of molecular ions by a capillary insulator," advised by Dr. **Bob DuBois**; and **Ciaran Ryan-Anderson**, "Differential cross section for electron-impact ionization of atomic helium and molecular hydrogen for both coplanar and perpendicular plane scattering," advised by Dr. **Don Madison**.



Jason Mast

The four participants presented posters of their work to the entire department. The posters were judged by Dr. **Alexey Yamilov** (competition chairman), Dr. **Ralph Alexander**, and Dr. **Ulrich Jentschura**. First place and a \$300 prize was shared by Jason Mast and Adam Farquhar, second place and a \$200 prize went to Ciaran Ryan-Anderson, and Spencer Garr placed third and received a \$100 prize. The committee of judges was impressed by the scientific level of the research projects and the degree of involvement of each of the contestants.



Adam Farquhar

Faculty Notes

Don Madison's NSF grant "*Theoretical study of few-body processes*" was extended for another year.

Julia Medvedeva was awarded a new research grant from Goodrich Corporation on "*Electronic structure and properties of transparent conducting GaN*" and her NSF grant "*Electronic band structure investigations of complex multi-component oxides for photovoltaic applications*" has been extended. Her book chapter "*Combining optical transparency with electrical conductivity: challenges and prospects*," has been selected to be the first chapter in **Transparent Electronics: From Synthesis to Applications**, to be published in July by John Wiley & Sons. Julia also received a Missouri S&T Faculty Research Award for 2009.

Greg Story received an Outstanding Teaching Award for 2007-2008 (the award was announced in April, 2009).

Thomas Vojta visited the Indian Institute of Technology (IIT) in Chennai in October 2009. There he started a collaboration with Dr. **Rajesh Narayanan** on layered magnets while being keenly watched by the monkeys that roam the IIT's campus.

New faculty member **Ulrich Jentschura** received a new National Science Foundation grant to study "*Quantum electrodynamics in fundamental physics and applications*" and was awarded a National Institute for Standards and Technology Precision Measurement Grant for "*Nonperturbative quantum electrodynamics, numerical methods and fundamental constants*." This is a highly competitive program with only two awards made every calendar year! He also received a University of Missouri Research Board award for work "*From computational field theory to practical applications*." Ulrich was selected by the editors of the journals *Physical Review* and *Physical Review Letters* as one of their Outstanding Referees for 2010. Only about 0.3% of active referees receive this honor. Not a bad first year for Ulrich!

Ralph Alexander and **Greg Story** received Outstanding Teaching Awards for 2008-2009, and **Paul Parris** and **Gerry Wilemski** received letters of commendation from the campus Committee on Effective teaching.

Alexey Yamilov received a Missouri Research Board grant for new studies of "*Electromagnetic wave transport through disordered amplifying optical fibers*." In addition, his National Science Foundation grant "*Collaborative research: mesoscopic transport and localization in active random media*" has been extended.

Ron Bieniek and **Allan Pringle** are co-PI's on "*Science education and quantitative literacy: an integrated, inquiry-based approach*," funded for the seventh year in a row by the Missouri Department of Higher Education.

Don Hagen is co-PI on four major Department of Transportation grants which involve the study of various aircraft emissions.

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 Missouri S&T, 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: **Physics Department, Missouri University of Science and Technology, 1315 N. Pine St., Rolla MO 65409-0640**. Or, if you would prefer, you can e-mail us your comments at **physics@mst.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: _____

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