UMSL *Physicist*

Department of Physics & Astronomy http://www.umsl.edu/~physics November 2009

Note From Chair

Despite the weak economy, there is good news to report from the past year. After a national search, Dr. Ron Yasbin was hired as Dean of the College of Arts & Sciences. Dr. Yasbin is a research-active microbiologist who previously was the Dean of the UNLV College of Sciences. The Department submitted our five-year strategic plan to the Dean earlier this month with the priority again on replacing retiring faculty. Our own Dr. Sonya Bahar earned tenure and promotion to Associate Professor this year. She was also selected as one of the 2009 Women Trailblazers by the University of Missouri-St. Louis as one of the first female tenure-track (and now tenured) faculty members in the Department of Physics & Astronomy. Our two remaining Assistant Professors, Drs. Erika Gibb and Eric Majzoub, are currently under review for tenure and promotion. We had an excellent crop of undergraduate students graduate at the May commencement with four of the seven graduates now pursuing advanced degrees.

Thanks to stimulus money, the budget cuts required by the University of Missouri were not too severe. However, we did have the suspension of the Benton-Stadler renovation and the budget outlook for next year is not encouraging.

We had a good showing for the second Frank & Elaine Moss Distinguished Lecture in March and for the Alumni Luncheon in May. We are tentatively planning to have next year's Alumni Luncheon on April 16 to coincide with the campus' Alumni Weekend. The College of Arts & Sciences is planning to have a program and reception on April 17 in our planetarium. We hope you will plan to attend one or both events.

Please keep us up to date on your activities as we always enjoy hearing new from our alumni. Let us know of any additional events we could plan that you would enjoy such as a lecture on a particular topic or a night at the Observatory. As always, we thank you for your continued support and encourage you to read the short biographies on our scholarship recipients. We wish you and your family all the best in 2010.

Bruce A. Wilking, Chairperson

Cooperative Ph.D. Program Renewed

A brief signing ceremony on April 2, 2009 at the Missouri University of Science and Technology renewed the Cooperative Ph.D. program in physics between MS&T and UMSL. The degree program was first approved in 1988 and produced the first Ph.D. degree in 1995. This spring, we awarded doctorate degrees to the 19th and 20th students from this program. The program has indeed increased cooperation between the two departments. Ph.D. committees are comprised of physics faculty members from both campuses. Last year, the fourth joint meeting of the two departments was held in Rolla along with a poster session highlighting graduate student research. Under the new agreement, UMSL graduate students will pay reduced fees to MS&T while in the Cooperative Program.

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

Alumni Luncheon Honors

The annual Physics & Astronomy Alumni Awards luncheon was held on May 8, 2009 at the Alumni House. Gábor Balázsi (M.S. 1999, Ph.D. 2001) was the guest of honor. Gábor was recognized as one of the Department's Distinguished Alumni for his accomplishments in cancer research at M. D. Anderson Cancer Center in Houston, Texas (see article which follows). Gábor received his Ph.D. in 2001 working with Frank Moss. At the luncheon, graduating senior Blake Leonard received the Jeffrey Earl Award and a set of the Feynman Lectures. Lauren Stephenson received the Senior Alumni Award ($500) and Scott Stephenson received the Junior Alumni Award ($500). David Peaslee received the Outstanding Graduate Teaching Assistant Award which is a $100 prize and a one-year subscription to the American Journal of Physics. Following the luncheon, we were treated to an excellent talk by Gábor entitled "Engineering precision and memory into living cells".

Awardees at the Alumni Luncheon (from left): Dr. Gábor Balázsi, David Peaslee, Lauren Stephenson, Scott Stephenson, and Blake Leonard.

Gábor Balázsi Receives New Innovator Award from NIH

Alumnus Gábor Balázsi, assistant professor in the Department of Systems Biology at the M.D. Anderson Cancer Center, received a 5-year $1.5M grant from the National Institutes of Health (NIH) to support his research on drug resistance in cells. The grant is part of the New Innovator awards from NIH and is highly competitive. Dr. Balázsi is one of 55 recipients nationwide and the first from M.D. Anderson. By controlling expression of drug-resistant genes in cancer cells, Dr. Balázsi hopes to be able to sustain the effects of chemotherapy.

Meet the Scholarship Recipients

We would like you to meet the scholarship recipients who you help support with your generous contributions. Meredith Ordway, Josh Mann, and Stephen Ordway are receiving Physics & Astronomy Alumni Scholarships and Shane Meyer the Richard D. Schwartz Scholarship. These scholarships provide the students with $1500 annually toward their educational expenses.

Ellie Ordway -- Ellie is a senior, from Jefferson City, Missouri who has been receiving an Alumni Scholarship since entering the University as a freshman in 2006. She is a general physics major and a member of the Pierre Laclede Honors College. She is the vice president of the Physics Club and on the advisory committee for the new Dean of the College of Arts and Sciences. She is happy to be home after spending a year studying abroad in England and is working with MEMC on the NASA Space Grant internship doing X-ray diffraction on silicon wafers. She has played violin for over 11 years and has a second-degree black belt with a state championship in three different divisions. She is set to graduate in May, with Honors, and plans to go to graduate school for her Ph. D.

Joshua Mann – Josh is a junior who transferred from the University of Missouri-Columbia last year. He is from Ellisville, MO and graduated from Lafayette Senior High School in Wildwood, MO. Josh is now pursuing the engineering physics option. He is an active mountain biker, artist, and pianist.

Stephen Ordway – Stephen went to high school at Jefferson City High School in Jefferson City, MO. He is a freshman and member of the Pierre Laclede Honors College. Most of his interests outside of school include hanging out with friends and family and fiddling with electronic things. He is especially interested in car-related electronics like installing fog lights, speakers, or a switch for his "Halos". His hope as of now is to focus on the acoustical part of physics, and then get a masters or Ph.D. in engineering so he can design speakers or whole auditoriums.

Shane Meyer – Shane is the third recipient of the Richard D. Schwartz Scholarship. He went to high school at St. John the Baptist in St. Louis by the Bevo Mill. Shane is a junior taking the astrophysics option. Shane's interests outside of school are Japanese culture, some martial arts, and video games. After getting his degree, he plans to go to graduate school in Japan.

Undergraduate Research Symposia

Ten high school, undergraduate and graduate students made presentations at the 18th annual meeting of the NASA/Missouri Space Grant Consortium hosted by the University of Missouri-Columbia on April 17-18, 2009. High school students Mostafa Abel-Hamid (Parkway South) and Rachel Geoffroy (St. Joseph's Academy) presented their

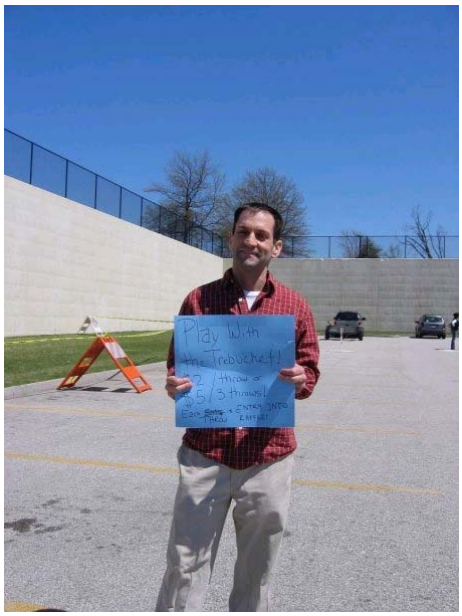
research on neutron star models and metal hydrides for hydrogen storage, respectively (advisors: Drs. Gregory Comer, SLU and Eric Majzoub, UMSL). Undergraduate Jason LaCroix discussed his analysis of photometry of young stars in the Serpens molecular cloud (advisor: Bruce Wilking) and Jamie Williams her research on CO_2 ices around young stars (advisor: Dr. Erika Gibb). Zak Jost presented his results from his summer internship with MEMC Electronics on the analysis of implantation damage of silicon-on-insulator wafers studied using transmission electron microscopy (advisors: Drs. Phil Fraundorf and Jeff Libbert). Graduate student David Coss discussed his computer simulations of gravitational lensing (advisor: Ricardo Flores) and Kristen Erickson her spectroscopic observations of young stars in the Serpens molecular cloud (advisor: Bruce Wilking). Keara Wright and Ashonda Bass described the UMSL Planetarium Program conducted for area 5th grade students and teachers.

Emily Sudholt, Jamie Williams, and Keara Wright made poster presentations at the annual Undergraduate Research Symposium held on the UM-St. Louis campus on May 1 and hosted by the Golden Key International Honour Society and Sigma Xi. All of the students were advised by Erika Gibb. Keara won first prize ($100) in the physical science division for her poster "The Chemistry of Methane and Monodeuterated Methane in Comets".

The Physics Club prepares to prime the trebuchet for firing another water balloon. From left: Keara Wright, Chris Owen, David Peaslee, Kari Wojtkowski, and Emily Sudholt.

Physics Club News

The Physics and Astronomy Club was active this past year with several fundraisers including a chili cook-off and selling firings of water balloons with the Club's trebuchet. The trebuchet, built primarily by David Peaslee, was a big hit at Mirthday but tested the physical strength of the club members to load it. Also at Mirthday, the Club had demonstrations of superconductivity and of electricity with a Van de Graaf Generator. The Physics Club also participated in the International Year of Astronomy by staffing Observatory Open Houses during the 100 Hours of Astronomy (April 4) and Galilean Nights (October 24). This fall, the Club had a potluck dinner followed by telescope viewing at the Observatory. Upon her graduation, Keara Wright stepped down as President after serving several years and passed the torch to Emily Sudholt.



Newly minted Ph.D. Nate Dees at Mirthday. The sign does not say "Will Work for Food".

The Garver Super Beetle

Wayne Garver's converted 1971 Volkwagen beetle was very much in the news. Wayne and his electric car were featured in the Spring 2009 issue of the UM-St. Louis magazine and in the January 16 issue of the St. Louis Beacon. He was also interviewed by KSDK Channel 5 this month and the interview can be found on the KSDK website (http://www.ksdk.com/news/living_green/story.aspx?storyid=189401). The cost of electricity to run the car is only 3 cents per mile but the lead-acid batteries have to be replaced every 15,000 miles. Wayne estimates that, not accounting for the benefits to the planet, he breaks even when gas is at $2.60 a gallon.

Benton-Stadler Renovation Halted

The weak economy has put plans for new science teaching labs and the renovation of Benton/Stadler on hold once again. Architects from HOK completed an initial design that included new introductory physics labs, renovated astronomy and geology labs, and badly needed classroom space. The University received bids and final design plans from five design/build teams and was poised to make a selection when funding for the project was cut from the State budget.

Graduate Program Update

We have awarded two M.S. in Physics degrees and two doctoral degrees in 2009. Adam Scott and Shuang Liu completed their MS degrees. Adam is continuing in our Ph.D. program. Nathan Dees and Roxana Contreras, both advised by Sonya Bahar, successfully defended their dissertations in the Spring. Nathan's dissertation was entitled "*The Role of Stochastic Resonance and Physical Constraints in the Evolution of Foraging Strategy*" and Roxana's was entitled "*Cognitive Levels of Synchrony in the Central Nervous System*". Nathan currently works at the Washington University Genome Center (see more in Alumni Information section).

David Coss, David Peaslee, and Kristen Erickson were supported in part by graduate fellowships from the NASA/Missouri Space Grant Consortium. David and Kristen passed the Ph.D. Qualifying Exam in January. Will Lowes won the 2nd Prize in Physical Sciences at the Annual Meeting of the Microscopy Society of America. We welcomed several new students to our graduate program this year: Nandita Nag (Missouri State), Wael Abueideh (SIUE), Jason LaCroix (UMSL), and Zak Jost (UMSL).

Contributors 2008-2009

Dr. Marsha Allen
Patricia J. Amick
James M. and Janice Baker
Boeing Company
Michael J. Burk and Lynda E. Busse
Christopher R. Dames
Daniel M. and Jo Ann Doerer
Dr. Lu Fei and Dr. Lucy Wenzhong He
William B. and Mary C. Harms
David J. Harris and Margaret A. Diekemper
Dr. Bo He
Hershey Foods Corporation
Richard W. Heuermann and Kathleen P. Price
Charles F. and Carol R. Jones
Mark S. and Cynthia P. Jones
Timothy A. and Dr. Michelle R. Kirchoff
Dr. Jeffrey L. and Linda A. Libbert
Steven L. and Frances C. Lopata
James A. and Laura S. Malke
Klaus M. Malolepszy
Maritz Inc.
Richard J. Melka
Dr. Martin G. and Pamela E. Mlynczak
Dennis J. and Pauline H. Moore
Elenore A. Schewe
James C. Simpson
Duane A. and Deborah Theilen
Dr. Minh Q. and Amanda M. Truong
Dr. Jinfeng Wang
Robert G. Wilking
Don C. and Susan Winter

Note: Please contact us if you made a contribution to the Department from July 1, 2008–November 15, 2009 and your name does not appear. Many thanks to all of you!

Check Out our Web Page!

You can always look at the Department Web page to find our schedule of colloquia, journal clubs, Observatory Open Houses, and up-to-date news. Check it out at and join us at Department events!

http://www.umsl.edu/~physics/

The Faculty:

Sonya Bahar

My research concerns complex dynamics in biological systems. A major branch of my laboratory's research involves synchronization of neural firing during epileptic seizures. The role of synchronization in seizure development can be studied with computational models of coupled neurons or oscillators, and also with experimental imaging of epileptic events. We image seizure onset in the rodent neocortex using various techniques, including the intrinsic optical signal (a drop in light reflectance that correlates with an increase in electrophysiological activity), and voltage sensitive dyes. A central problem is to investigate changes in spatiotemporal synchronization during the course of seizure onset, development, and offset. My group has also recently investigated eye movement synchronization in traumatic brain injured patients, in collaboration with Dr. Minah Suh at the Brain Trauma Foundation and Weill-Cornell Medical College of Cornell University).

In addition to studying synchronization in neural systems, my group uses computational models to investigate patterns of animal search strategies in species ranging from Daphnia ("water fleas") to monkeys. We are also using computer simulations to investigate the role of different parameters in driving evolutionary dynamics, such as the influence of mutation rate on speciation.

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Ta-Pei Cheng

The second edition of my book "*Relativity, Gravitation & Cosmology*" has just been published (November 2009 in UK and two months later in US). In this new edition, presentations on special relativity and black holes are augmented by new chapters. Other parts of the book are updated to include new observation tests of general relativity (e.g., the double pulsar system) and more recent evidence for dark matter and dark energy. As a consequence, almost every chapter has been revised and updated. Although I am officially retired, I still work with some individual students on selected subjects. If any of you are interested in studying some physics topics together with me, you are welcome to send me a message at tpcheng@umsl.edu.

Bernard J. Feldman

During the last year I have continued to develop new materials for physics teachers. *The Physics Teacher* accepted for publication this year two of my papers, "An Introduction to Solar Cells" and "The Collapse of the I35W Bridge in Minneapolis." They will appear in print in early 2010. I am presently working on two manuscripts, an introduction to special relativity and rotational collisions. I also continue to give talks to the public on future automobile technology and science ethics.

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Michael Fix

My research deals with Missouri's only known dinosaur site – the Chronister Site about 30 miles west of Cape Girardeau. I have been working with a group affiliated with the Bollinger County Museum of Natural History, in Marble Hill, Missouri. This group, called the "Missouri Ozark Dinosaur Project (MODEP)," is conducting the first truly scientific excavation of the site, which was accidentally discovered in the early 1940's. The dig is enclosed within a 20 by 36 foot greenhouse in order to keep water out. Inside there is a 60 square meter hanging grid which is used in conjunction with a portable one meter mapping grid with an XY axis sliding cursor equipped with a laser pointer for precision mapping of fossils. Thus far we have found numerous bones of a hadrosaur (duck-bill dinosaur) called *Hypsibema missouriense* (our official state dinosaur), including a partial skull of a juvenile, which according to Dr. John Horner is probably the most complete dinosaur cranial material ever found in the eastern U.S. The site has also yielded fossils from a member of the tyrannosaur family, a possible tooth from a relative of velociraptor, as well as numerous fossils of turtle, crocodile, fishes, and amphibians. We are working on a paper about these finds with Dr. David Parris from the New Jersey State Museum and Dr. Barbara Grandstaff at the University of Pennsylvania, which is intended for publication in the *Journal of Vertebrate Paleontology*.

Ricardo A. Flores

My research interests are astrophysical cosmology and applications of quantum field theory to the physics of elementary particles. Cosmology is now a well established branch of science thanks in great part to the astounding diversification of Astronomy in the last four decades into observations covering a very broad range of the electromagnetic spectrum. It is also a very exciting field of research due to its inherent intellectual appeal, and the rapid progress allowed by a steady flow of observational data. I am currently working with students on gravitational-lensing shear maps of realistic, simulated clusters of galaxies, as well as on making predictions for the expected evolution in maps of the Sunyaev-Zel'dovich effect in clusters. My most recent work was an analysis of large samples of dark matter halos from cosmological simulations to work out their expected properties in concordance with Cold Dark Matter cosmology with dark energy, which is currently favored by a large body of observational evidence. The first work was on the predicted systematics of the shape of DM halos over a wide range in mass, and at different epochs (*MNRAS* 367(2006)1781). The second work was on comparisons to X-ray observations to test the predictions (*MNRAS* 377(2007)883). Other relatively recent work has been on clusters of galaxies (see *ApJ* 532(2000)206 and *ApJ* 538(2000)92) and gravitational lensing (see *ApJ* 533(2000)194 and *ApJ* 535(2000)555). On the particle physics side, my work was on some of the phenomenology expected in supersymmetric quantum field theories (see e.g. *Phys. Lett. B*, 377 (1996) 83). My work has been funded in the past by the National Science Foundation, the University of Missouri System Research Board, and by Research Awards here at UM - St. Louis. Over the years, I have collaborated on a long-term basis with scientists from around the world to carry out my research.

Philip B. Fraundorf

My research involves materials, atomic resolution microscopes, computer simulations, and conceptual strategies for doing both nanoscale detective work and curriculum modernization. For over a decade we've been providing for the region tools not otherwise available in state to examine the nanostructure of a growing variety of specimen types, including for example aerosol catalysts, integrated circuit silicon, carbon nanotubes, extraterrestrial materials, and ferrofluids for drug delivery. We've also put graduates into applied physics internships and jobs with companies that include MEMC, Seagate, Martin-Marietta, Mitsubishi Silicon-America, and Motorola. Of three recent intellectual challenges, one lies at the intersection between single-walled carbon nanostructures in the history of our own atoms, and possible roles for carbon droplets in cool stellar atmospheres. Another involves the study of defects in and on gigascale integrated circuit silicon, a highly-ordered material tightly connected to future technology. A third involves the study of atomic-resolution images using wavelet-versions of long-established optical darkfield techniques. More on recent developments, information on the recently established MissOuri NanoAlliance, and a variety of web-based nanoworld adventures, may be accessed through:

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Thomas George

I am involved in theoretical research in several areas of laser/materials/nanophysics. One area involves molecular clusters and nanostructures, where excitation processes in fullerenes by ultrafast laser pulses are being investigated theoretically by numerically solving the Liouville equation for electron density matrices. Comparisons are then carried out with experiments in regard to the control of vibrational excitations. Nonlinear optical responses are considered, where femtosecond and picosecond degenerate and nondegenerate four-wave mixing and pump-probe techniques are used to investigate ultrafast electron and nuclear dynamics, charge transfer and photoexcitiation in fullerenes. Electroluminescnece enhancement of polymer light-emitting diodes is being examined. Yet another area

involves the analysis of diamondoids as possible materials for nanoelectronic devices. The most recent venture is in nanomedicine, where laser-induced explosion of absorbing gold nanoparticles in selective nanophotothermolysis of cancer is being explored.
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Erika Gibb

I am an astrochemist/astrobiologist studying chemistry in star formation regions and comets. One exciting area of astrobiological research is the search for organic molecules of prebiotic importance in disks of gas and dust around low mass young stars that are thought to be similar to the young solar system. These systems are likely forming planets and may be able to shed insight on what happened in the early solar system. I use infrared spectroscopy to detect molecules and determine the quantity, temperature, and location of each molecule. The observations are usually performed at major telescopes like the 10-meter Keck Observatory and the 3-meter Infrared Telescope Facility on Mauna Kea, HI. I also collaborate with a research group at NASA Goddard Space Flight center to measure abundances of those same molecules in comets, which are thought to have been a source of much of the early Earth's reserve of organics and water. I received an NSF grant to study deuterated methane and water in comets and another NSF grant to search for molecules in disks around forming stars. With these studies, I hope to track the organic chemistry through the star and planet formation process and to be able to infer the role that comets may have played on delivery of organics and water necessary for life on Earth.
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Peter H. Handel

I have found the origin of the fundamental 1/f fluctuations present in most high-tech devices and systems ("Coherent and Conventional Quantum 1/f Effect", *Physica Status Solidi b*, 194, 393 (1996)), including computer chips, infrared detectors, quartz resonators, atomic and laser clocks, submicron electronic devices, FET and HBT transistors, laser gyros, SQUID magnetometers, etc. ("Fundamental Quantum 1/f Noise in Small Semiconductor Devices", *IEEE Trans. on Electr. Devices*, 41, 2023 (1994)). I am using this new effect to optimize these devices ("Incoherence and Negative Entropy in the Quantum 1/f Effect of BAW and SAW Quartz Resonators", *Proc. Frequency Control Symp.*, Orlando, FL, May 1997, pp. 464-69) for the Department of Defense and for civilian applications, such as ultra-low power computers. This research was supported by the Office of Naval Research and by the Air Force Office of Scientific Research. Having also found the origin of Atmospheric Electricity ("Polarization Catastrophe Theory of Cloud Electricity", *J. of Geophys. Research* 90, 5857 (1985)), I use the new law for weather modification and protection against lightning and ball lightning (Handel et al. "Development of the Maser-Caviton Ball Lightning Theory", *J. of Geophys. Research*, 99, 10689 (1994)). In nonlinear Plasma Physics with solitonic MASER interactions, I am developing (Zhil'tsov et. al. "Spatially Localized Microwave Discharge in the Atmosphere", *Zh. Eksp. Teor. Fiz*. 108,1966 (1995) & *JETP* 81, 1072 (1995)) a new type of electric discharge and artificial ball lightning. Finally, I am applying my quantum 1/f formulas to optimize our chemical and bacteriological sensors. I was included into DoD's Ultra-Low Phase Noise MURI #17, together with the University of California, Caltech and Yale University in 2001-2006. Our recent progress in nanotechnology and MEMS applications is shown in *Proc. IEEE* 93, 1784-1814, (2005) and *IEEE Sensors* 8, 1020-1027 (2008). See my web site at www.umsl.edu/~handel/.
handel@jinx.umsl.edu

Bob L. Henson

During this past year, my activities in the Department have been mostly in the areas of instruction at the graduate and undergraduate levels, plus departmental service in matters of curriculum. In addition to my regular teaching load, I developed a course on the topic of plasma physics (Physics 4365) and another on quantum mechanics (Physics 4331). This past year, I taught plasma physics twice by independent study and quantum mechanics once by independent study. This semester, I am developing and teaching a course on fluid dynamics (Physics 4353). These senior-graduate level courses were last taught by me more than twenty years ago for one course and more than thirty-five years ago for the other two. Thus, these courses required me to redevelop my notes for the courses and the materials required substantial updating. These activities took up a great amount of my time. I have been active in mathematical physics research, but at a reduced level of activity. My creative activity in scholarly writing has progressed significantly this past year. My concentration has been on writing up my classroom notes in mathematical methods of physics with applications in atmospheric physics, classical areas of phenomenology and quantum physics. My current goal is to use these written notes to improve my teaching. However, it is possible that these notes might be submitted for publication in text form sometime in the future.

Jacob J. Leventhal

Foundations of Quantum Physics, a textbook written jointly with Charles E. Burkhardt of St. Louis Community College, was published by Springer in October 2008. While it is a textbook for introductory quantum physics courses, the book is intended to be retained by the student as a reference book long after the course has been completed. The book includes topics that are not normally covered in introductory textbooks, topics that will likely be skipped during a first course in quantum physics. Thus, the student may use the book in future years as a source for these subjects.

Foundations of Quantum Physics is the second textbook that we have published with Springer. The first, *Topics in Atomic Physics*, is a graduate textbook that provides a foundation for students that are beginning research in modern atomic physics. It too is intended as a reference as well as a textbook because it contains material that is not

easily located in other sources. A distinguishing feature is the thorough exposition of the quantum mechanical hydrogen atom using both the traditional formulation and an alternative treatment not usually found in other books.
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Jingyue "Jimmy" Liu

My research focuses on two platforms: 1) nanoparticles and nanoparticle systems and 2) advanced nano-characterization techniques. Nanoparticles are defined very broadly here: metal and alloy clusters for catalysis, semiconductor quantum dots for bio-labeling or as bio-markers, oxide nanocrystals as sensor components, as well as proteins, viruses and other nanoscale components of biological systems. Nanoparticle systems include catalysts, displays, nanocomposites, nanosensors, etc. Advanced nanocharacterization techniques include high-resolution microscopy, novel X-ray scattering/diffraction techniques, as well as a variety of spectroscopy and in situ techniques for characterization of nanoscale materials and devices; the goal of this research platform is to develop quantitative and statistically meaningful nanostructural characterization techniques, which is one of the grand challenges in nanoscience and nanotechnology research. All the research activities will have strong component of industrial applications or industry involvement. Our research is conducted in the interdisciplinary Center for Nanoscience, which consists of physicists, chemists, materials scientists, biochemists and biologists.

Current research projects include nanocatalysts for hydrogen production and low temperature fuel cells, nanocomposite polymeric materials for solar cells, metal oxide nanowires/nanobelts and other types of nanostructures for chemical and biological sensors, and nano-containers and capsules for drug delivery.
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Eric Majzoub

The research focus in our group is on the study and design of new materials for energy storage and conversion, as well as sensing technologies. We perform our research using the tools of condensed matter physics for the characterization and modeling of bulk and nano-crystalline materials. We employ a combined experimental and computational approach, utilizing first-principles techniques to understand the electronic, mechanical, and thermodynamic properties of the materials we study.

Currently, our primary research area is hydrogen storage. Materials of current interest for hydrogen storage applications include complex anionic hydrides such as the class of materials known as alanates and borohydrides. Examples include NaAlH4, LiAlH4, Ca(BH4)2, and LiBH4. These materials are generally wide gap insulators, and are very different in their material properties from interstitial metal hydrides. We have developed a suite of Monte Carlo global optimization techniques, using basin-hopping and potential energy smoothing using both Metropolis and non-conventional algorithms, which can predict ground state crystal structures and structures close to the ground state in many of the complex anionic hydrides, as well as prototype structures for electrostatically dominated nano-clusters. This approach allows us to search the space of materials difficult to access experimentally, and to search for new potential hydrogen storage materials. The method we use is called PEGS, for "prototype electrostatic ground states." [Prototype electrostatic ground state approach to predicting crystal structures of ionic compounds: Application to hydrogen storage materials, E.H. Majzoub, V. Ozolins, *Phys. Rev. B*, **77**, 104115, (2008)]

The PEGS method is quite robust. In addition to predicting ground state structures of ionic crystals, it is also able to address the more complicated issue of crystal polymorphs. A polymorph is simply a variation on a crystal structure, and many crystals phase transform into different structures as a function of temperature, or pressure, for example. Several of the polymorphs of calcium borohydride have been predicted using the PEGS method as described in the references below.

Selected Publications

- LiSc(BH4)4 as a Hydrogen Storage Material: Multinuclear High Resolution Solid State NMR and First-Principles Density Functional Theory Studies, S. Hwang,C. Kim, R. Bowman, J. Reiter, J. Zan,J. Kulleck, H. Kabbour, V. Ozolins, E.H. Majzoub. *Journal of Physical Chemistry C*, **113**, 9956-9968 (2009).

1. The crystal structures of calcium borohydride: theory and experiment, E.H. Majzoub, E. Ronnebro, *J. Phys. Chem. C*, **113**, 3352-3358 (2009).

- First-Principles Prediction of Thermodynamically Reversible Hydrogen Storage Reactions in the Li-Mg-Ca-B-H system, V. Ozolins, E.H. Majzoub, and C. Wolverton, *J. Am. Chem. Soc.*, **131**, 230-237 (2009).
- Metastability and crystal structure of the bialkali complex metal borohydride $NaK(BH_4)_2$, L. Seballos, J. Z. Zhang, E. Ronnebro, J.L. Herberg, E.H. Majzoub, J. Al. Comp., **476**, 446-450 (2008).
- First-principles prediction of a ground state crystal structure of magnesium borohydride, V. Ozolins, E.H. Majzoub, C. Wolverton, *Phys. Rev. Lett.*, **100**, 135501, (2008).
- Prototype electrostatic ground state approach to predicting crystal structures of ionic compounds: Application to hydrogen storage materials, E.H. Majzoub, V. Ozolins, *Phys. Rev. B,* **77**, 104115, (2008).

Frank E. Moss

Recently we have been developing a simulation based on Natural Selection in evolution. The simulation uses the simplest and fewest possible hypotheses. It makes predictions about certain distributions (hop lengths and turning angles) used by small aquatic animals during optimum foraging for food. With these results we connect with and criticize current interpretations of optimum foraging strategies using Levy statistics. Collaborating are graduate student Nathan Dees and Sonya Bahar.
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Wilfred H. Sorrell

Main research focus is theoretical astrophysics. Previous research work was focused on models for interstellar solid particles with a special emphasis on the physical and chemical properties of graphitic solid particles producing the interstellar ultraviolet absorption band at wavelength 2175 Angstroms. The research work was published and appears in a peer-review journal as Sorrell (1990, *Monthly Notices Royal Astronomical Society*, 243, 570). Other research works on the chemical properties of hydrogenated amorphous carbon solids in diffuse interstellar clouds appeared as Sorrell (1991, *Monthly Notices Royal Astronomical Society*, 248, 439), and on dust grain processing in the Orion Nebula as Sorrell (1992, *Monthly Notices Royal Astronomical Society*, 255, 594). Research work on the interstellar dust grain alignment problem appeared as Sorrell (1994, *Monthly Notices Royal Astronomical Society*, 268, 40 and 1995, *Monthly Notices Royal Astronomical Society*, 273, 169-200). Research work on the issue about a massive black hole at the center of the Milky-Way galaxy appears in the Bad-Honnef Conference on Cosmic Jets, July 3-7, 1995. Recent research focused on the Origin of Life problem appears in Sorrell (2001, *Astrophysical Journal Letters*, L129-L132). Recent research work on the nature of the T-Tauri binary system appears in Sorrell (2002, *Monthly Notices Royal Astronomical Society*, 334, 705-712). Current research is focused on cosmological models for the universe that have nothing to do with the Big Bang. The cosmological models I am now constructing are based upon my idea that says the Big Bang is a cosmic myth.
swsorre@jinx.umsl.edu

Bruce A. Wilking

Using infrared and optical spectroscopy, I am investigating the ages and masses of young stars in several nearby molecular clouds. A study of young stars in the R Corona Australis cloud using infrared spectroscopy was published in collaboration with alumnus Michael Meyer (2009, *Publications of the Astronomical Society of the Pacific*, v121, 350-358). Work continues on optical spectroscopic surveys of the Ophiuchus and Serpens clouds with the goals of gaining insight into the star-forming history and constructing the distribution of stellar masses for each region. These studies will form the bulk of Kristen Erickson's Ph.D. dissertation. Spectra were obtained in June 2009 using the WIYN 3.5 meter telescope at Kitt Peak (despite poor weather) and in August 2009 at the 6.5 m Magellan telescope at Las Campanas Observatory in Chile. More observations are planned for the summer of 2010. A 30 page review chapter on star formation in the Ophiuchus cloud was published (finally) in December of 2008 in a book entitled "Handbook of Star-Forming Regions, Vol. II" and was co-written with astronomers Marc Gagné (West Chester University) and Lori Allen (Harvard-Smithsonian Center for Astrophysics).
bwilking@umsl.edu

Alumni Information

1972

Paul Koppel (B.S.) is a Systems Manager in the Electronic Radiology Laboratory at the Washington University School of Medicine. Paul will be teaching an evening physics class at UMSL in the spring 2009 semester.

1977

James Malke (B.S.) is the Enterprise Account Manager for Hewlett-Packard in Wildwood, MO.

1981

Marty Mlynczak (B.S.), Senior Research Scientist at NASA's Langley Research Center in Hampton, VA, was featured in the Spring 2009 issue of the UM-St. Louis Magazine. He is currently working to implement NASA's CLARREO mission (Climate Absolute Radiance and Refractivity Observatory). CLARREO, tentatively scheduled to launch in 2017, will make the most accurate measurements of the Earth's climate system to date.

1991

Michael R. Meyer (M.S.) heads up the Star and Planet Formation group at the Institute of Astronomy, at the Federal Institute of Technology in Zurich, Switzerland. He and his wife welcomed a baby daughter, Amelija, into the world this month.

1992

David M. Pierson (B.S.) received a Ph.D. in physics from North Carolina State University in 2004. He is currently on the staff of the Johns Hopkins Applied Physics Lab.

1999

Jennifer (Twitty) Simonotto (B.S.) is a research associate in the School Of Computing Science, Newcastle University, UK.

Minh Truong (B.S., M.S. 2001, Ph.D. 2006) is an assistant professor at Fontbonne University. Minh attended the first school on the Large Hadron Collider in addition to visiting relatives in Vietnam.

2001

Paul Koester (B.S.) is currently a lecturer in mathematics at the University of Kentucky. After receiving his B.S. in physics and mathematics from UMSL, Paul received an A.M. in mathematics in 2002 and a Ph.D. in mathematics in 2007 from Washington University. He conducts research in arithmetic combinatorics.

2002

Vanessa Lauburg (B.S.) received her Ph.D. in astronomy in August from the University of Maryland. Her dissertation was entitled "Black Hole Dynamics and Gravitational Radiation in Galactic Nuclei". She immediately started at

her current position as a Math teacher at Garrison Forest School, which is a girls' school outside of Baltimore. She wants pursue a career in teaching, and reports that she is really enjoying it so far.

Jason Austermann (B.S.) received his doctorate in astronomy from the University of Massachusetts in May. His dissertation was entitled "The AzTEC millimeter-wave camera: Design, integration, performance, and the characterization of the (sub-)millimeter galaxy population". He is currently a postdoctoral research associate the Center for Astrophysics & Space Astronomy at the University of Colorado in Boulder.

2003

Danny Franke (B.S., M.S 2005) is employed as a software engineer with Elekta/CMS for the past three years. He develops software for Radiation Oncology systems.

2004

Joseph Presson (B.S.) is a Financial Analyst II for MetLife in St. Louis.

2005

Doug Brumm (B.S., M.S. 2007) is an online physics instructor for Grantham University and recently finished training to become an online instructor for Grand Canyon University.

Oliver Weihberger (M.S.) is completing his Ph.D. degree at the Bernstein Center for Computational Neuroscience in Freiberg, Germany. He visited UMSL in October and gave a talk about his research entitled "State-dependent stimulus/response relations and interaction with ongoing activity in cortical networks in vitro".

Shaine Joseph (Ph.D.) has joined the University of Petroleum and Energy Studies College of Engineering (www.upes.ac.in) at Dehradun, India as an Assistant Professor in the Department of Physics. He is getting married in December of this year.

2006

Gordon Stangler (B.S.) has a weekly radio show called Musical Universe at Riverfrontradio.com.

2007

Isaac Smith (M.S.) in a doctoral student at the University of Texas in Austin at the Institute for Geophysics.

2008

Tim Maher (B.S.) is living in Portland Oregon working as a Sustainability Coordinator for Clackamas Community College. The position is technically through AmeriCorps and 20% of his time is spent doing other service-based activities in the community. Currently, he is working on a greenhouse gas emissions inventory for the college, and helping to formulate a climate action plan. Tim is applying to grad school in economics here in Portland for the Fall 2010 year.

2009

Kelly Cooley (B.S.) is in the graduate physics program at the University of West Virginia.

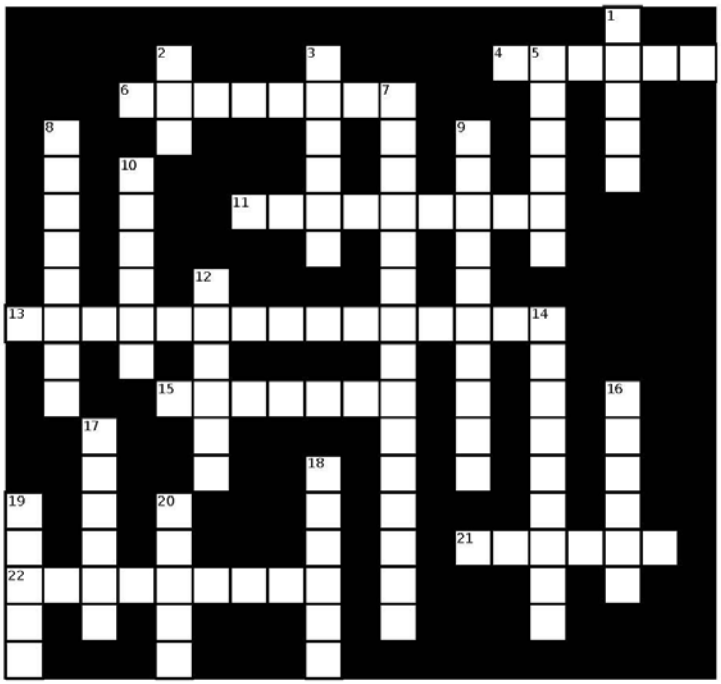
Blake Leonard (B.S.) is in the graduate physics program at Washington University in St. Louis.

Keara Wright (B.S.) is at the Missouri University of Science & Technology pursuing a Master's degree in mathematics.

Nathan Dees (Ph.D.) is now working in the Medical Genomics group in Washington University's Genome Center. He is performing data analysis on sequencing data for various forms of cancer, including gene expression analysis, and is also involved in project management in relation to The Cancer Genome Atlas project (TCGA), funded by the National Cancer Institute (NCI) and the National Human Genome Research Institute (NHGRI).

Roxana Contreras (Ph.D.) is teaching a Science of Light course at the Art Institute of Washington.

Here is a crossword to test your knowledge about Albert Einstein from http://www.armoredpenguin.com/crossword/Data/best/physics



Across

4 Quantum _____.
6 "God does not _____ _____ with the world."
11 Uncertainty _____.
13 Einstein supported two social movements, _____ and _____.
15 Einstein was born in this country.
21 City where Einstein spent much of his youth.
22 President _____ receieved a letter concerning the possible development of an atomic bomb.

Down

1 Einstein won the _____ Prize in Physics in 1921.
2 City of Einstein's birth.
3 Instrument played by Einstein.
5 When _____ came to power, Einstein left Germany for the United States.
7 "On the _____ of Moving Bodies," Einstein's third major paper.
8 Planck's _____.
9 According to Einstein, the only source of knowledge is _____.
10 Location of the Kaiser Wilhelm Institute for Physics.
12 First name of Einstein's first wife.
14 Einstein's chief early patron was _____ _____.
16 Einstein received his doctorate from the University of _____.
17 Brownian _____.
18 A light particle is called a _____.
19 Age at which Einstein began to talk.
20 Unified _____ theory.

Enclosed is my contribution of $_____. _____Yes, I work for a matching gift corporation.

Designation for funds:

Physics Scholarship Fund:_____.
Physics &Astronomy Gift Fund:_____.
Richard D. Schwartz Observatory Gift Fund:_____.
Frank & Elaine Moss Hospitality Fund:_____.

Please make check payable to UM-St. Louis, "Physics & Astronomy Fund" and return to:

Department of Physics & Astronomy
University of Missouri-St. Louis
One University Blvd.
St. Louis, MO 63121-4499

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Alumni Information Form:

Keep in touch! Please let us know what's new with you, both personally and professionally.

Name:_____

Address:_____

City,State,Zip:_____

Company Name:_____

Current Position:_____

e-mail
address:_____

News (to include in our newsletter):

_____

_____

When are you available for campus events? _____

Thank you.

Comments or Questions: canavan@umsl.edu.

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