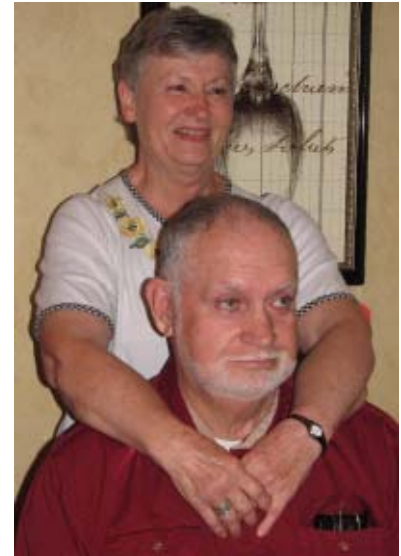


For alumni, friends, faculty, and staff of the MSM-UMR-Missouri S&T Physics Department

Big Changes in the Front Office

Long-time department fixtures **Ellen Kindle** and **Charlie McWhorter** retired during 2012. Ellen joined the department in May 1978 as a senior secretary, and was promoted to administrative assistant in 1991. She served the department for 35 years, and during that time she worked with five different departmental chairmen, dozens of faculty, and hundreds of students. She impacted each in the most positive way, kept the department operating efficiently, and was a major contributor to the department's success. She has retired to Newburg, MO with husband **Bill**, mom **Dorothy**, and all her critters. We wish her the very best, and enjoy those times when she drops in for visits.

Charlie joined the department in June 1976 as a lab mechanic, and worked his way up to Research Engineering Technician II. Charlie was one of the best, if not the best, machinists on campus. He was actively involved in designing, making, and fixing equipment for the research labs in the department, and most faculty and graduate students for the last 37 years are highly indebted to him for the success of their research. In addition, Charlie played a vital role in keeping the equipment in the undergraduate teaching labs functioning. Charlie retired on August 11, 2012, and still resides in Rolla with his wife **Nancy**, and we hope he is enjoying lots of time on his new fishing boat. We wish him all the best in his retirement.



Ellen and Bill Kindle



Ellen, Dan, and Pam

These retirements were the first changes in the departmental staff in over 25 years and as such presented considerable anxiety about the future. We are, however, still in good hands. In the front office, **Pam Crabtree** was promoted from senior secretary to administrative assistant filling Ellen's position, and we hired **Jan Gargus** as a secretary to assist in the office. Pam has been with the department since 1991, and Jan joins us from New Student Programs. Taking over the machine shop is **Ron Woody** who joins the department as a senior lab mechanic. Ron has many years of experience working in machine shops and teaching machining. We are delighted to have both Jan and Ron join the department and we look forward to many years of working with them. Their pictures are on page 7 of this newsletter.

Charlie and Nancy McWhorter



In this issue:

Memo from the Chair	2	Sharma Wins Prize	9
Physics Department Scholarships	3	Michael Schulz Sabbatical	9
Report from the SPS	4	Your Support Acknowledged	10
Three Selected as Outstanding GTAs	5	Corporate Support Acknowledged	10
2012 Physics Degree Recipients	5	S&T Students & Alumni: in Press	11
Modern Physics Homework Database	6	Vojta Teaches in Italy	12
Non-Hermitian Hamiltonians	6	Phonathon 2013	12
A Visit From Santa	7	Frontiers in Physics	13
Alumni Notes	7	Nineteenth Annual Scheerer Prize	14
From Alumnus Louis Anderson	7	Prize Winner Sachin Sharma	14
Physics Department Scores Hat Trick	8	Homecoming 2013	14
Robert G. Fuller Remembered	8	41 st Annual Fuller Research Seminar	15
2012 Physics Academic Scholars	8	Faculty Notes	15

Memo from the Chair

It seems that every year brings significant change to the department and the university. In last year's newsletter I wrote about the change in the upper administration at Missouri S&T. This past year has brought changes closer to home.

After 35 and 37 years respectively, long time administrative assistant **Ellen Kindle** and machinist **Charlie McWhorter** have retired. Most of you reading this letter know one or both of these long time employees, and they likely contributed to your experience and your success at UMR/Missouri S&T. We wish them well in their retirement and hope that they will visit the department frequently. In their absence, the department is still in capable hands. **Pam Crabtree**, long time senior secretary in the department, steps up to fill Ellen's position as administrative assistant, and **Jan Gargus** joins the front office as a secretary. **Ron Woody** takes Charlie's position in the machine shop. You can read more about the changes in the departmental staff on page 1.

State support for higher education continues to trouble universities in the US, and Missouri S&T is no different. Rather than detail the budget woes here I prefer to concentrate on the successes in the department despite the difficult financial situation. Our combined B.S., M.S., and Ph.D. enrollment remains high, and the quality of our students is outstanding. Your generous donations to the department are largely responsible for our ability to attract and retain students of such high quality, and our ability to continue to grow and maintain the quality of our program is dependent on your continued generosity.

Exactly $\frac{3}{4}$ of our graduating majors graduated with honors, and **Laura Sisken** graduated with a perfect 4.0 GPA. **Sachin Sharma**, one of our graduate students working with Prof. **Michael Schulz**, won first place in the Physical Science Division of the 2012 Missouri S&T Council of Graduate Students Research Showcase for his poster "*Effect of coherence on single electron capture of H_2 by 75 keV proton impact.*" Prof. **Thomas Vojta** was one of only five recipients of the Faculty Excellence Award for 2012. Prof. **Julia Medvedeva** won one of seven Faculty Research Awards, and Prof. **Greg Story** won one of seven Faculty Teaching Awards. Greg also won his 10th Outstanding Teaching Award, and Profs. **Paul Parris**, Thomas Vojta, and **Dan Waddill** all received Outstanding Teaching Commendations. These and more stories of student and faculty accomplishments can be found elsewhere in this newsletter.

I will close as I have the past several years. I 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 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



Dan Waddill

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>.

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 estates of **Richard Anderson** and **Richard Hannum**. Our most recent endowment came from **John** and **Patty Rogers**.

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.

Physics Department Awards 2012-2013 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.

The *Dr. John R. and Patty Rogers Endowed Scholarship* provides scholarships to academically proficient physics majors who demonstrate financial need. The 2012-2013 Rogers scholarship was awarded to **Alexander Mark**, of Saint Louis, Missouri.

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

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

Clayton Craig of Manchester, Missouri, **Nicholas Hugenberg** of Springfield, Missouri, **Alyson Smith** of Belleville, Illinois, **Ryan Gibbs** of Kansas City, Missouri, **Carolyn Johnson** of Lees Summit, Missouri, and **Nathan Morris** of Blue Springs, 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.

Spencer Templeton of Springfield, 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. **Jason Summers** of Rolla, Missouri received the \$1000 Hannum Scholarship for 2012-2013.

The *Richard Anderson Scholarship Fund* is an endowment established in memory of Dr. **Richard Anderson**. **Stephen Kraus** of Jefferson City, Missouri, and **Christian Dzurny** of Sikeston, Missouri received the \$1000 Anderson Scholarship for 2012-2013.

The *Stephen P. Reed Scholarship Fund*, an endowment, provides scholarships to US citizens enrolled in mathematics or physics who are sensitive to a peaceful and humane search for knowledge and solutions to technical problems of mankind. **Jason Summers** of Rolla, Missouri received the \$500 Reed Scholarship for 2012-2013.

The *Charles M. Rice Scholarship* is presented to outstanding juniors or seniors in physics at UMR. The scholarship was established by **Charles M. Rice** (MS '50) to recognize and encourage outstanding effort and achievement in undergraduate physics. The 2012-2013 Rice Scholarship was awarded to **Jason Summers** of Rolla, Missouri.

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 this \$1000 scholarship was awarded to **Brandon Yokeley** of Waynesville, Missouri, **Jason Summers** of Rolla, Missouri, and **Timofey Golubev** of Chesterfield, 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 of \$1000 were awarded to **Derek Anderson** of Blue Springs, Missouri, **Katherine Brinker** of Chesterfield, Missouri, **Alyssa Castro** of Dixon, Missouri, **Andrew Cudd** of Overland Park, Kansas, **Nicholas Hilbert** of Saint Louis, Missouri, **Brock Hinton** of Parkville, Missouri, **Nelson Shreve** of Waynesville, Missouri, **Paul Somers** of Springfield, Missouri, **Spencer Templeton** of Springfield, Missouri, and **Andrew Wilkening** of Glen Carbon, Illinois.

Report from the SPS

2012 may have been the most active SPS year ever, with well-attended weekly meetings and a return of the annual trip to Argonne National Laboratory. The spring semester kicked off with a Welcome Back Bonfire and potluck dinner at the house of one of our members.

Talks by faculty at weekly spring meetings included Professor **Alexey Yamilov**'s presentation on "*Computational physics*," Professor **Barbara Hale**'s talk about "*Elementary particles and our universe*," and Professor **Thomas Vojta**'s discussion of "*Chaos and computational physics*." Departing graduate student **Ben Payne** (Ph.D. '12) shared some of his wisdom in "*Life after getting a bachelor's degree in Physics*." In addition, Materials Science and Engineering Professor **Joseph Newkirk** (a former SPS chapter president) gave a presentation on "*Crystal structures*," and Professor **Chen Hou** of Biological Sciences talked on "*Metabolic scaling theory*."

When they weren't learning about faculty research, SPS members enjoyed several game and movie nights. They also gave departmental tours at open houses on February 20 and April 6, and participated in the Paint the Walk event, where they painted their square on the walk outside the Havener Center. The SPS square contains their favorite "Let there be light" design from their t-shirt, along with the SPS logo in black and gold. After they painted the walk, SPS rewarded themselves with a barbecue.

Officers for the fall 2012 semester were elected at the last spring meeting. **John Igo** was re-elected president, **Dimitar Stoyanov** replaced graduating **Laura Sisken** as vice president, **Frank Marshall** replaced graduating **Madalyn Weston** as secretary, and **Andrew Cudd** was elected treasurer.

The fall semester kicked off with the first annual *Armageddon science-fail competition*. Freshman **Josey Stevens** won the competition by pointing out the most science mistakes while SPS watched the movie. Josey's prize was free dues and some sodas.

Fall meetings included a number of talks by Missouri S&T faculty. Physics professor **Dan Waddill** discussed "*So you think you want to go to graduate school*," Mathematics Professor **David Grow** revealed which mathematics classes (beyond the standard required ones) physics majors should take, and Professor **Greg Story** talked about lasers. In addition, SPS hosted colloquium speaker Dr. **Nhan Tran** of Fermilab at an informal lucheon, where they had a Q&A session about "*The discovery of the Higgs boson (or something like it)*." Dr. Tran was a member of the team that made the discovery.

One of the early fall meetings celebrated the return of classes with liquid nitrogen ice cream, and later SPS made their nearly-annual trek to Argonne National Laboratory for the Undergraduate Research Symposium.



SPS side trip from Argonne to Chicago

Good scores on the Graduate Record Exam are becoming increasingly important for admission to graduate school, so SPS held several GRE review sessions, where they worked sample problems. At one of the sessions the 15 members present split into four competitive teams, with **Mike Christopher**, Andrew Cudd, Frank Marshall, and **Nick Collins** pulling out the win. SPS also gave departmental tours at open houses on October 6 and November 12.

The fall semester concluded with a study night and election of officers. **Nelson Shreve** was elected president, Frank Marshall moved up to Vice President, freshman **Alyssa Castro** was elected secretary, and Andrew Cudd returned as treasurer. SPS also selected **Mike Christopher** to be their StuCo representative.



Nelson Shreve and John Igo

Outstanding GTA's



Tharanga Dissanayaka, Dan Waddill, and Premitha Pansalawatte

This past year we again presented graduate teaching awards to honor the outstanding accomplishments of our graduate teaching assistants. These awards were first initiated for the Fall 2009 semester. In the past the awards were presented every semester, but we have restructured them to an annual award based on two-semester excellence. The awards are determined by a combination of student evaluations and teaching performance assessed by the faculty overseeing the teaching laboratories. The winners for the Spring 2012 semester were **Tharanga Dissanayaka, Nilanka Gurusinghe, and Premitha Pansalawatte**. Congratulations to all the winners for helping to advance the department's commitment to excellence in teaching.



Nilanka Gurusinghe

Congratulations to S&T's 2012 Physics Degree Recipients!

May 2012

Bachelor of Science

- Casey Alan Fischer
- John David Igo
- Stephen Michael Lee
- Amanda Celine McBee
- Johnathan Mulcahy-Stanislawczy
- Laura Jean Sisken
- Aaron D. Viets
- Madalyn Elizabeth Weston

Master of Science

- Sadek Mohamed Fituri Amami
- Hatem Nuri Barghathi
- James Gary Keehn
- James Sly

Doctor of Philosophy

- Glenn Andrew Carlson
- Altynbek Murat
- Benjamin Henry Payne (August)

December 2012

Bachelor of Science

- Patrick Hanners Chipman
- Carolyn Johnson
- Benjamin Patrick Knapp
- Sarah Marie Wiese

Master of Science

- Tharanga Kumara Dissanayaka Mudiyansele
- Jane Dallas Fenech

Doctor of Philosophy

- Prabhavi Kaushalya Premachandra
- Mark Allan Thomason
- Kari Anne Wojtkowski

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.

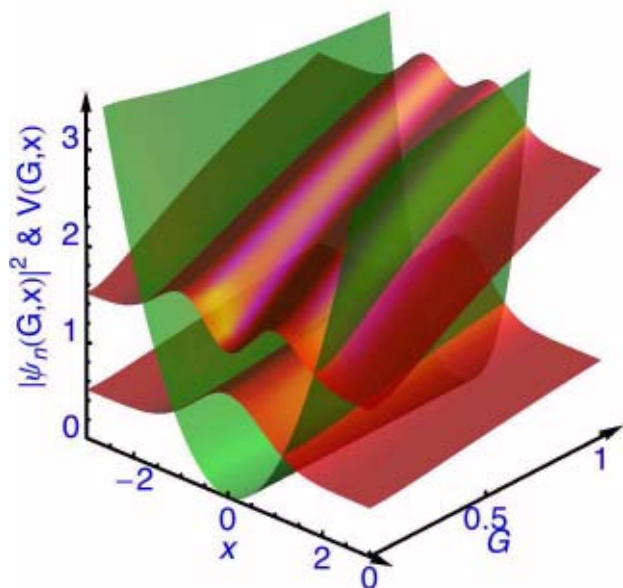
Making a planned gift shows your loyalty to Missouri S&T, an institution that played a significant role in shaping your future. For more information about giving a current or planned gift, contact the Office of Development at 1-800-392-4112 or e-mail giving@mst.edu.

A Modern Physics Homework Database

Greg Story has been awarded one of the 2012-2013 Faculty Educational Mini-Grants by the S&T Office of Academic Affairs and the Center for Educational Research and Teaching Innovation. The \$1700 grant (matched by \$1700 from the Physics Department) is for “*Development of a free database for modern physics homework problems.*” The idea to prepare a modern physics homework database sprang from Greg's realization that solutions to textbook homework problems are readily found on the internet, and that simply copying a homework solution fails to help a student learn.

Supported by this grant, Dr. Story hired five undergraduate students who previously completed his modern physics course to help him write all-new homework problems. He hopes to show that, with these new solution-free homework problems, homework scores will better correlate with test scores and lead to improved student performance. If the project is successful, Greg plans to prepare a large database of modern physics problems that can be used by anyone teaching a similar course.

Greg has noticed an interesting byproduct of this project during the weekly meetings that he holds with the five undergraduate students who are helping write the new homework problems. Greg tells us that for “the first couple of weeks, their problems were basically unusable. At this point, I am actually using a number of their problems each week, some with very minor modifications. I believe this exercise has given the students valuable experience in composing homework problems that are meaningful to other students, and through that process gained a deeper understanding of the course itself.”



Non-Hermitian Hamiltonians

Hamiltonians are extremely useful tools for describing systems in physics. Hamiltonians, which are ideal for calculating the time evolution of a system, are generally assumed to contain no imaginary terms. This property is known as “Hermiticity.” The energy eigenvalues of Hermitian Hamiltonians are real.

It would be boring if this were all there is to the story. We can expand on the concept of Hermiticity by allowing Hamiltonians whose imaginary terms compensate for each other in the time evolution, resulting in real energy eigenvalues. This relaxation of restrictions is known as “pseudo-Hermiticity,” and was introduced in an article in the *Reviews of Modern Physics* by **Wolfgang Pauli** more than 70 years ago. **Carl Bender**, from Washington University in St. Louis, has shown that “pseudo-Hermitian” Hamiltonians can be used to describe quantum systems.

In an effort to help establish pseudo-Hermiticity as a viable extension of Hermiticity, Dr. **Ulrich Jentschura** and his graduate student, **Jonathan Noble**, have shown that both the resulting eigenfunctions and eigenvalues have very “usual” and “intuitively obvious” properties.

They investigated the Hamiltonian for the harmonic oscillator with an imaginary cubic perturbation, i.e., the imaginary cubic oscillator: $H_3 = p^2 + x^2 + iGx^3$. The energy eigenvalues of this Hamiltonian are real, but the corresponding wave functions were found to be complex. While the quantum number of the harmonic oscillator can be enumerated by the number of zeroes in the wave function, this is not the case for the imaginary cubic oscillator. Both the real and imaginary parts of the imaginary cubic oscillator's wave functions have an infinite number of zeroes, which never overlap, and these complex wave functions do not have any zeroes. However, if the modulus squared of these wave functions is examined, familiar shapes that we are used to from quantum mechanics arise, except that instead of zeroes there are local minima. To the left is an illustration of the first two of these wave functions as a function of G and x (red), as well as the confining potential (green). As G increases the potential narrows, restricting the allowed region and the energy (indicated by the base of the function) increases.

While there are no known applications to the H_3 Hamiltonian, there are some more advanced pseudo-Hermitian models that describe down-to-Earth systems, such as waveguides with complex gain and loss terms in the wave equation. Other pseudo-Hermitian models may provide answers to cosmological questions and our understanding of the neutrino. For more details, see the preprint arXiv:1301.5758 (<http://arxiv.org/abs/1301.5758>).

Left: the first two wave functions of the imaginary cubic oscillator (red) imbedded in the confining complex potential (green).

A Visit from Santa

Dan Waddill must have been a really good boy in 2012!



Dan's Office Door



New Physics Staff



Jan Gargus (left) and Ron Woody (right)

Alumni Notes

Emmett Redd (PhD '86) writes "On July 1 I started working on a three-year National Science Foundation grant with Drs. **Steven Younger**, Missouri State University, and **Hava Siegelmann**, University of Massachusetts-Amherst. The grant is entitled *Super-Turing computation and brain-like intelligence*."

Vibhakar Dave (MS '65) informed us "my darling wife Mrs. **Indu V. Dave** passed away on September 28, 2010. I have a new grandson named **Avi**, born to my daughter-in-law **Norma Dave**."

Your editor reports that several alumni notes meant for this newsletter vanished under mysterious circumstances. Perhaps they morphed into dark matter. If the note you sent last year didn't get published, please send it again!

From Alumnus Louis Anderson Jr. (BS '75)

I have been receiving your newsletter for quite some time over my career. So on a whim, I decided to respond with a posting of my status.

I am a former graduate of UMR where I majored in Physics. My interest was focused on E&M theory.

I came to California in 1976, after a year of employment at McDonnell Douglas in St. Louis working in the area of laser communications. I later found my way into microwave/millimeter wave antennas and propagation (while I was in graduate school in California), and have been working in the field for over 30 years. I have been primarily focused on space-based communications and remote sensing payloads. Before coming to my current position in 2000, I worked at Hughes Space and Communications.

I am currently the integrated product team lead (*i.e.* project manager) for the NASA/NOAA Advanced Technology Microwave Sounder (ATMS) instrument antenna subsystem at Northrop-Grumman Corp. ATMS is a low earth orbit remote sensing payload for passive detection of earth atmospheric brightness temperature and humidity profiles. The instrument is part of the Joint Polar Satellite System used by NOAA in civilian weather monitoring and forecasting. The first of these satellites was launched in October of 2012 and is operational.

My other related experiences include photonics and electromagnetic compatibility. I am married with two children and one grandchild. I am a member of Alpha Phi Alpha fraternity, and past member of Sigma Xi and IEEE APS.

Note: Louis received his MS EE in 1983 from California State University, Northridge. If you would like to correspond with Louis, please contact the S&T Physics Department.

Physics Department Scores Awards Hat Trick

The Physics Department scored a hat trick at the Faculty Awards Ceremony held this past February.

Greg Story won one of the seven Faculty Teaching Awards. This award recognizes faculty members who have demonstrated excellence in teaching-related activities.

Julia Medvedeva was one of seven S&T professors to win a Faculty Research Award, which recognizes faculty members who have demonstrated excellence in research and scholarship, both in the last two years and over the long term.

Thomas Vojta was one of only five S&T professors to win a Faculty Excellence Award. This prestigious award is given to faculty members who have demonstrated sustained excellence in all three missions of the institution: teaching, research and service.



no Physics newsletter is complete without a picture of Thomas Vojta somewhere in the mountains

Robert Fuller Remembered

Robert G. Fuller (BS '57), Professor Emeritus of Physics at the University of Nebraska-Lincoln, passed away on April 9, 2012.

Bob was born on June 7, 1935 to **Harold Q** and **Charlotte Mae Fuller**. He graduated from Rolla High School, received his BS in Physics from the Missouri School of Mines and Metallurgy, and his MS and PhD degrees from the University of Illinois.

From 1969 to 2005 Bob was a Professor of Physics at the University of Nebraska-Lincoln. As head of the Research in Physics Education Group at UNL, he was widely known for his expertise in physics education. A more detailed description of Bob's career appeared in *Physics Today* and can be found online at http://www.physicstoday.org/resource/1/phtoad/v65/i7/p62_s1.



Congratulations to 2012 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 2012

Derek Anderson, Katherine Brinker, Clayton Craig, Andrew Cudd, Christian Dzurny, Bradley Farley, Nicholas Few, Ryan Gibbs, Timofey Golubev, Nicholas Hilbert, Brock Hinton, Nicholas Hugenberg, John Igo, Stephen Kraus, Amanda McBee, Shaun Molder, Nathan Morris, Nelson Shreve, Laura

Sisken, Paul Somers, Jason Summers, Spencer Templeton, Aaron Viets, Andrew Wilkening, and Brandon Yokeley.

Fall Semester 2012

Travis Connelly, Clayton Craig, Andrew Cudd, Christian Dzurny, Patricia Falls, Timofey Golubev, Sheldon Harper, Brock Hinton, Patricia Huestis, Benjamin Knapp, Stephen Kraus, Alexander Mark, Rachel McCormick, Shaun Molder, Nathan Morris, Katherine Overend, Matthew Pollard, Yunsheng Qiu, Juan Remolina, Nocona Sanders, David Schmidt, Nelson Shreve, Alyson Smith, Paul Somers, Sam Stephens, Josey Stevens, Dimitar Stoyanov, Andrew Wilkening, David Wilkerson, and Brandon Yokeley.

Sharma Wins Graduate Student Prize

Sachin Sharma took first place in the Physical Science Division of the 2012 Council of Graduate Students Research Showcase for his poster “*Effect of coherence on single electron capture of H_2 by 75 keV proton impact.*”

The Showcase was held on April 12, 2012. About 35 posters were presented in the Physical Science Division by S&T graduate students from all over campus. The posters were judged by S&T faculty.

For his first-place poster, Sachin received a \$500 cash prize and was presented with a certificate of appreciation by Chancellor **Cheryl B. Schrader** at the Council of Graduate Students Excellence Banquet on April 24.

Sachin Sharma and Chancellor Cheryl Schrader



Schulz Spends Sabbatical Year in Germany

Michael Schulz spent a sabbatical year, from June 2011 to August 2012 at the Max-Planck-Institut f. Kernphysik in Heidelberg, Germany. He was sponsored by a scholarship from the Fulbright Foundation and by a Mercator Visiting Professorship by the Deutsche Forschungsgemeinschaft (the German counterpart to NSF). During this time the long-standing research collaboration with his hosts in Heidelberg was further strengthened and resulted in 4 publications in Physical Review Letters, as well as several other publications. The research results were presented in invited talks at international meetings in Serbia, France, Ireland, and Salt Lake City.

Mixing business with pleasure, Michael and his family (including Truffle, a mixture between dog and guinea pig) also did some extensive travelling in Europe, including places like Barcelona and the Pyrenees in Spain, the Bavarian and Austrian Alps, and Croatia. The picture below left shows famous Dubrovnik in Croatia, which was heavily shelled during the Balkan War, and the picture below right shows the old town in Heidelberg. Michael's daughter **Anne-Christine** had a special treat as she experienced (and survived) the German school system for a year.



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

Donations over \$100:

Harro Ackermann
 Kenneth E Arnett
 Mark Jeffery Barnhart
 John S Bosnak
 Laura L Bosnak
 Robert E Caldwell
 Lewis K Cappellari
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 John L Cline
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Physics Department Acknowledges Corporate Support

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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,¹ graduate students,² or alumni³ under the supervision of Missouri S&T faculty.

“Experimental and theoretical investigation of the triple differential cross section for electron impact ionization of pyrimidine molecules,” J. D. Builth-Williams, S. M. Bellm, D. B. Jones, H. Chaluvadi,² D. H. Madison, C. G. Ning, B. Lohmann, and M. J. Brunger, *J. Chem. Phys.* **136**, 024304 (2012).

“Four-body charge transfer processes in proton–helium collisions,” U. Chowdhury,² A. L. Harris,³ J. L. Peacher and D. H. Madison, *J. Phys.* **B45** 035203 (2012).

“Low energy ($e,2e$) measurements of CH_4 and neon in the perpendicular plane,” K. L. Nixon, A. J. Murray, H. Chaluvadi,² S. Amami,² D. H. Madison and C. Ning, *J. Chem. Phys.* **136**, 094302 (2012).

“Dynamical ($e,2e$) studies of tetrahydrofurfuryl alcohol,” S. M. Bellm, J. D. Builth-Williams, D. B. Jones, H. Chaluvadi,² D. H. Madison, C. G. Ning, F. Wang, X. G. Ma, B. Lohmann, and M. J. Brunger, *J. Chem. Phys.* **136**, 244301 (2012).

“Low energy ($e, 2e$) study from the $1t_2$ orbital of CH_4 ,” S. Xu, H. Chaluvadi,² X. Ren, T. Pflüger, A. Senftleben, C. G. Ning, S. Yan, P. Zhang, J. Yang, X. Ma, J. Ullrich, D. H. Madison, and A. Dorn, *J. Chem. Phys.* **137**, 024301 (2012).

“Post collision interactions in fully differential cross sections for four-body charge transfer processes,” U. Chowdhury,² A. L. Harris,³ J. L. Peacher and D. H. Madison, *J. Phys.* **B45**, 175204 (2012).

“Quantum dynamics in atomic-fountain experiments for measuring the electric dipole moment of the electron with improved sensitivity,” B. J. Wundt,³ C. T. Munger and U. D. Jentschura, *Phys. Rev.* **X2**, 041009 (2012).

“Pseudo–Hermitian quantum dynamics of tachyonic spin–1/2 particles,” U. D. Jentschura and B. J. Wundt³, *J. Phys.* **A45**, 444017 (2012).

“Localizability of tachyonic particles and neutrinoless double beta decay,” U. D. Jentschura and B. J. Wundt³, *Eur. Phys. J.* **C72**, 1894 (2012).

“Sources, potentials and fields in lorentz and coulomb hauge: cancellation of instantaneous interactions for moving point charges,” B. J. Wundt³ and U. D. Jentschura, *Ann. Phys. (N.Y.)* **327**, 1217-1230 (2012).

“Projectile coherence effects in single ionization of helium,” X. Wang, K. Schneider, A. LaForge,³ A. Kelkar, M. Grieser, R. Moshhammer, J. Ullrich, M. Schulz, and D. Fischer, *J. Phys.* **B45**, 211001 (2012), Fast Track Communication.

“Ion-lithium collision dynamics studied with an in-ring MOTREMI,” D. Fischer, D. Globig, J. Goullon, R. Hubele, V.J.B. de Jesus, A. Kelkar, A. LaForge,³ H. Lindenblatt, D. Misra, B. Najjari, K. Schneider, M. Schulz, M. Sell, and X. Wang, *Phys. Rev. Lett.* **109**, 113202 (2012).

“Projectile coherence effects in electron capture by protons colliding with H_2 and He ,” S. Sharma,² A. Hasan, K.N. Egodapitiya,³ T. P. Arthanayaka,² and M. Schulz, *Phys. Rev.* **A86**, 022706 (2012).

“Initial-state selective study of ionization dynamics in ion Li collisions,” A. LaForge,³ R. Hubele, J. Goullon, X. Wang, K. Schneider, V.L.B. de Jesus, B. Najjari, A.B. Voitkiv, M. Grieser, M. Schulz, and D. Fischer, *J. Phys.* **B46**, 031001 (2013), Fast Track Communication.

“Artificially disordered birefringent optical fibers,” S. Herath,² N. P. Puente, E.I. Chaikina and A. Yamilov, *Optics Express* **20**, 3620 (2012).

“Effect of evanescent channels on position-dependent diffusion in disordered waveguides,” B. Payne,³ T. Mahler² and A. Yamilov, *Waves in Random and Complex Media* **23**, 43 (2013) .

“Disorder correlations at smeared phase transitions,” C. Svoboda,³ D. Nozadze,² F. Hrahsheh² and T. Vojta, *Europhys. Lett.* **97**, 20007 (2012).

“Disorder promotes ferromagnetism: Rounding of the quantum phase transition in $SrCaRuO_3$,” L. Demko, S. Bordacs, T. Vojta, D. Nozadze,² F. Hrahsheh,² C. Svoboda,³ B. Dora, H. Yamada, M. Kawasaki, Y. Tokura and I. Kezsmarki, *Phys. Rev. Lett.* **108**, 185701 (2012).

“Quantum Griffiths singularities in ferromagnetic metals,” D. Nozadze² and T. Vojta, *Phys. Rev.* **B85**, 174202 (2012), (an *Editor's Suggestion*).

“Percolation transition in quantum Ising and rotor models with sub-Ohmic dissipation,” M. Al-Ali,² J.A. Hoyos and T. Vojta, *Phys. Rev.* **B86**, 075119 (2012).

“Anomalous elasticity in a disordered layered XY model,” F. Hrahsheh² and T. Vojta, *Physica Scripta* **T151**, 014074 (2012).

“Random fields at a nonequilibrium phase transition,” H. Barghathi² and T. Vojta, *Phys. Rev. Lett.* **109**, 170603 (2012).

“Rounding of a first-order quantum phase transition to a strong-coupling critical point,” F. Hrahsheh,² J.A. Hoyos and T. Vojta, *Phys. Rev.* **B86**, 214204 (2012).

“Disordered bosons in one dimension: from weak to strong randomness criticality,” F. Hrahsheh² and T. Vojta, *Phys. Rev. Lett.* **109**, 265303 (2012).

“Composition-dependent oxygen vacancy formation in multicomponent wide-band-gap oxides,” A. Murat² and J. E. Medvedeva, *Phys. Rev.* **B86**, 085123 (2012).

“Electronic properties of layered multicomponent wide-bandgap oxides: a combinatorial approach,” A. Murat² and J. E. Medvedeva, *Phys. Rev.* **B85**, 155101 (2012).

Vojta Teaches in Italy

In October 2012, faculty member **Thomas Vojta** gave a lecture series on “*Phases and phase transitions in disordered quantum systems*” at the XVII Training Course in the Physics of Strongly Correlated Systems in Italy. This course was organized by the University of Salerno. It was part of a series that started in 1996 and promotes research in the field of correlated electron systems by bringing together senior scientists and promising young researchers eager to improve their skills and knowledge.

The two-week-long course combined lectures by four internationally-recognized professors from Europe and the US with training exercises and student presentations. It was attended by 26 students from 12 countries and 4 continents. One of the participants was our own graduate student **David Nozadze** who attended the lectures and gave a short talk on his thesis research.



The training course was held in Vietri sul Mare, a picturesque town located on the scenic Amalfi coast in southern Italy. In addition to the lectures and scientific discussions, the schedule left some time for sightseeing. Thomas visited the world-famous ruins of Pompeii, the Roman city destroyed and buried under ash and pumice in the eruption of Mount Vesuvius in AD 79. After the school, he also went hiking along the Sentiero degli Dei (the path of the gods) in the mountains above the Amalfi coastline.



Above: Pompeii Temple of Apollo
Left: Vietri
Below: Amalfi panorama



Phonathon 2013

Mark your calendars! On April 14-17 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 grow the combined undergraduate and graduate enrollment to nearly 100. 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.

Alumni and other donors committed \$31,674 in donations to the MSM-UMR-Missouri S&T Physics Department last year. Last year's fundraising Phonathon raised \$23,300 with an average gift of \$142 from 164 donors. The department greatly appreciates your generosity, which helps to support scholarships and student activities like the Society of Physics Students.

Frontiers in Physics Colloquium Series

During the 2012 *Frontiers in Physics Colloquium Series* we heard about an incredibly diverse series of topics, including the gross impact of slim chances, non-blinking giant dots, the three faces of electrons, topological insulators and superconductors, thunderstorm electrification, the discovery of the Higgs Boson (or something like that), and how faster-than-light neutrinos are like unicorns.

The colloquium series began in January with a presentation on “A Luttinger liquid core inside helium-4 filled nanopores” by **Adrian Del Maestro** of the University of Vermont. The series continued in February when **Deborah Hanuscin** of the University of Missouri - Columbia discussed “Scientific illiteracy - a gap in our syllabi?” Next, **Jie Gao** of Missouri S&T's Department of Mechanical and Aerospace Engineering described “Chip-scale photonic devices for light-matter interactions and quantum information processing,” followed by **Christian Schubert** of Michoacan University, who spoke about “The first-quantized approach to quantum field theory,” and **Ildar Gabitov** of the University of Arizona, who gave a talk on “Stochastic phenomena in high speed optical fiber communication systems: gross impact of slim chance.”

In March, **Anton Malko** of the University of Texas - Dallas reported on “Spectroscopy of colloidal nanocrystals: multiexcitons, non-blinking giant dots and excitonic energy transfer,” **Raj Narayanan** of the Indian Institute of Technology - Madras lectured on “Effects of disorder and dissipation on quantum phase transitions,” **Sung Ho Salk** of the Korean Institute of Advanced Study reviewed the “Role of antiferromagnetic spin fluctuations in high T_c superconductivity,” and **David Schultz** (PhD '89) of the University of North Texas introduced us to “New explorations of atomic interactions using large scale simulation.”

In April, **Liang Fu** of MIT gave a talk on “Topological insulators and superconductors,” **Itzik Ben-Itzhak** of Kansas State University reported on “Probing molecular-ion beams with intense few-cycle laser pulses – two-color controlled dissociation,” **Taylor Hughes** of the University of Illinois - Urbana-Champaign summarized work on “Time-reversal invariant topological insulators and superconductors,” and **Xinhua Liang** of Missouri S&T's Chemical & Biological Engineering Department spoke on “Ultrathin films coated on ultrafine particles via atomic/molecular layer deposition (ALD/MLD).” Also in April, undergraduate Physics majors presented posters at the Forty-First Annual **Harold Q Fuller** Prize Colloquium. Details of the Fuller competition appear in a separate article on page 15.

The colloquium series resumed in September with a presentation by **Mohsen Asle Zaeem** of Missouri S&T's Materials Science and Engineering Department on “Phase field-finite element models for microstructural evolution.” Next, **Andrew Detwiler** of the

South Dakota School of Mines & Technology summarized “Current problems in thunderstorm electrification and new observing systems for thunderstorm studies,” and **Edward Kinzel** of Missouri S&T's Department of Mechanical & Aerospace Engineering described “Optical antennas for nanolithography, near-field imaging, and energy applications.”

In October, **John Farley** of the University of Nevada, Las Vegas discussed “Going beyond the lecture: what have we learned from physics education research,” our homecoming speaker **Jason Alexander** (PhD '09) told us about “Experiments in cold atom optics at the U.S. Army Research Laboratory,” and **Nhan V. Tran** of Fermilab examined the “Discovery of the Higgs boson or (something like it).”

November began with a presentation by **Robert Ehrlich** of George Mason University on “The superluminal neutrino hypothesis: searching for tachyons or unicorns?” November concluded with talks by S&T Physics faculty and students. **Michael Schulz** reviewed “The overlooked role of projectile coherence in atomic fragmentation processes,” **Thomas Vojta** summarized the research that led to “The 2012 Nobel Prize in physics,” and the Nineteenth Annual **Laird D. Schearer** Prize Colloquium saw four presentations by the finalists. Schearer Prize details are in the article on page 14 of this newsletter.



David Schultz

19th Annual Schearer Prize Competition

The Nineteenth 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 November 29, 2012.

Students submitted applications for the competition. The applications consisted 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 **Barbara Hale**, **Julia Medvedeva**, and committee chair **Ulrich Jentschura**, selected four finalists who gave oral presentations of their work in a departmental colloquium.

The 2012 finalists were **David Nozadze**, advised by Professor **Thomas Vojta**; **Fawaz Hrahsheh**, also advised by Professor Vojta; **Sachin Sharma**, advised by Professor **Michael Schulz**; and **Hari Chaluvadi**, advised by Professors **Don Madison** and **Jerry Peacher**.

During the colloquium on November 29, Mr. Nozadze discussed "*Quantum Griffiths Singularities in Ferromagnetic Metals*," Mr. Hrahsheh talked on "*Rounding of a first-order quantum phase transition to a strong-coupling critical point*," Mr Sharma described "*Projectile coherence effects in electron capture*," and Mr. Chaluvadi presented "*Theoretical M3DW calculations for electron-impact ionization of molecules*." All students gave excellent talks.

After much deliberation the judges awarded first prize and \$600 to Sachin Sharma, second prize and \$400 each to Hari Chaluvadi and David Nozadze, and third and \$300 to Fawaz Hrahsheh. Congratulations to all three speakers, and thanks go to all who participated in this year's competition. The cash awards were made possible by the generous donations of the Schearer family. Following the presentations, the finalists and numerous faculty members had a relaxing dinner at a local restaurant.

From Schearer Prize Winner Sachin Sharma

Being awarded the 19th Annual Schearer Prize is a great honor and motivation. I am thankful to Dr. **Ulrich Jentschura**, Dr. **Julia Medvedeva** and Dr. **Barbara Hale** for providing me an opportunity to participate. I am grateful to my advisor, Dr. **Michael Schulz**, for the time, effort and suggestions he has provided. Also, **Thusitha**, a great friend and colleague, has been very supportive and deserves equal credit.

My work is about understanding few-body systems by atomic and molecular collision processes. My talk was about projectile coherence in collision processes, which has been underestimated by theory for decades. Currently, we are working on fully differential cross section measurements for ionization of H₂ by protons. Working in the accelerator lab is a wonderful opportunity. It is amazing to see in practice things which I have studied during course work. In future, I hope to work in academia and experience from this lab will definitely enhance my prospects.

Come Back for Homecoming

The Missouri S&T Physics Department warmly invites you to return to Rolla for **S&T Homecoming 2013** on **October 11-12, 2013**. On Friday afternoon, October 11, 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 2013 Physics Colloquium at 4 PM. on Friday, October 11. 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!



Sachin Sharma

41st Annual Fuller Research Seminar

The 41st annual **Harold Q Fuller** Undergraduate Research Seminar was held on April 26, 2012. This competition promotes participation of undergraduates in research both in the department and in summer intern projects. The Seminar is presented by finalists selected by their peers, and the Harold Q Fuller Award is given to the student(s) whose project is judged to be the most outstanding on the basis of their accomplishment, their presentation, and their response to the questioning of the judges.

This year's participants were **Laura Sisken** (competing for the third consecutive year), **Carolyn Johnson**, **Kory Kamp**, and **Shaun Molder**, all of whom performed their research at Missouri University of Science and Technology. The four participants presented posters of their work to the entire department. The posters were judged by the Fuller Prize Committee, Dr. **Thomas Vojta**, and Dr. **Yew San Hor**, who were very impressed with both poster presentations and awarded a \$600 cash prize to Laura Sisken, advised by Dr. **Alexey Yamilov**, for her outstanding research in "*Optical wave front shaping*," and a \$400 cash prize to Carolyn Johnson, Kory Kamp, Shaun Molder, advised by Dr. **Greg Story**, for their innovative experiment on "*Variation of double slit experiment using acoustic waves*."



Carolyn Johnson

Faculty Notes

Alexey Yamilov co-authored a book chapter "*Self-optimization of optical confinement and lasing action in disordered photonic crystals*," A. Yamilov and H. Cao, in *Optical properties of photonic structures: interplay between order and disorder*, ed. by M. Limonov and R. De La Rue (Taylor & Francis 2012)

Alexey was also awarded a new three-year NSF grant for "*Anomalous transport and savefront shaping in complex photonic media*." The project aims to uncover unusual optical properties of nano-structures that are neither completely disordered nor perfectly ordered. This research may have a wide range of applications, from biomedical imaging and photodynamic therapy to laser trapping and micro-manipulation.

Gerry Wilemski was again invited to serve as an external expert and to speak at the latest CLOUD Workshop in Konigstein, Germany, 22-24 May 2012. His talk was titled, "*Molecular dynamics simulations of aqueous-organic binary and ternary nanodroplets*," and was co-authored by physics graduate student **Fawaz Hrahsheh**. The Workshop was devoted to reviewing results from the CLOUD (Cosmic Leaving OUtdoor Droplets) project operating at the CERN Proton Synchrotron which studies possible effects of cosmic rays on nucleation as well as on cloud droplet and ice particle formation in the atmosphere.

Ulrich Jentschura was one of six winners of a competition by the Hungarian Academy of Sciences to invite internationally-recognized scientists to join research in Hungary. Called "one of the most prolific scientists in quantum theory" by the Academy, Ulrich will spend eight months at the Academy's Institute of Nuclear Research. Ulrich published two papers in the prestigious journal *Physical Review Letters* in 2012.

Michael Schulz was honored as an Outstanding Referee by the American Physical Society. The award recognizes scientists "who have been exceptionally helpful in assessing manuscripts for publication in APS journals." Only about 150 of the roughly 60,000 currently active referees were selected for this award. He also published two papers in *Physical Review Letters* in 2012.

The paper "*Projectile coherence effects in single ionization of helium*," published in *J. Phys. B* by Michael Schulz and co-authors (see list on page 11 of this newsletter) was chosen by the Editors as an "IOP Select" article and highlighted as an invited LabTalk presentation. Within a few weeks of publication it was downloaded an amazing 2000 times.

Greg Story won his 10th consecutive Missouri S&T Outstanding Teaching Award for 2011-2012. **Paul Parris**, **Thomas Vojta**, and **Dan Waddill** received Missouri S&T Outstanding Teaching Commendations for 2011-12.

Bob Dubois and **David Lay** were nominated for the Freshman Engineering Program "We Love Your Class" award, and **Ron Bieniek** was selected as one of the winners of that award.

Thomas Vojta received a new three-year \$380,000 NSF grant for studies of "*Unconventional quantum phase transitions*." He also gave an invited talk on "*Infinite-randomness criticality in disordered metals and superconductors*" at the 2012 APS March meeting in Boston, taught at a two-week international Training Course in Vietri Sul Mare in Italy (see the article on page 12), and had three papers published in *Physical Review Letters*.

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: _____

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