



WAKE FOREST

UNIVERSITY

Department of Physics
Office of the Chair

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Dear Physics Alumnae and Alumni,

The Physics faculty and staff would like to invite you to our **Homecoming reception on Saturday, October 15**. We would love to have a chance to see you again. The homecoming reception will be in the foyer of Olin Physical Laboratory, and will be held three hours before the homecoming football game against Virginia Tech. The time is still uncertain because game time will not be set until a week or so before the game; dictated by TV scheduling. As soon as we know, we will post the time on our web page at <http://www.wfu.edu/physics>. If you do not have web access, let me know and I will be happy to give you a call when the time is set.

This past year has been a good year for the Physics Department. We had a record number of graduate students who accepted our offers and came last fall. We continue to have a large number of undergraduate majors. This academic year we have 34 majors in their junior or senior years, 14 of whom are signed up for our newest degree, a Bachelor of Science in Biophysics. Our tradition of undergraduate research continues. Last year 25 undergraduate students engaged in research with our faculty. If you look around Olin, you will see posters and publications in our halls bearing the names of both our undergraduate and graduate students. You can also read about some of the students and their research projects at <http://www.wfu.edu/physics/profiles/profiles.html>. A number of our faculty, graduate students, and undergraduate students have received honors and awards in the past year. Below I describe some of these honors, as well as some other noteworthy events of the past year.

The person whose name has shown up most frequently on the Physics Department website during the past year is Prof. Timo Thonhauser. For excellence in teaching and research he has been awarded the Ranlet and Frank Bell Jr. Fellowship for 2011 – 2013. This is a faculty fellowship which is sponsored through private donors who wish to support faculty members who teach about or conduct research on the environment. The selected faculty members are also known as Environmental Resources Faculty Fellows. For his excellence in teaching, Timo also received the Physics Faculty Excellence in Teaching Award which is given annually to one of the faculty members in our Department. And, because of his excellence in research, Timo has been selected by the Kavli Institute for Theoretical Physics (KITP) to be a KITP Scholar for 2011 - 2013. The KITP is located at the University of California at Santa Barbara and is directed by Nobel laureate David Gross. The KITP has routinely attracted the best scientists not only from the U.S., but also from around the world to participate in its programs. It has, consequently, become the preeminent international center for advancing theory in science. Each year the institute selects approximately 7 scholars nationwide to become KITP Scholars based on their research accomplishments and future research potential.

Timo's research is devoted to the application of condensed-matter theory to currently outstanding problems in physics, biophysics, chemistry, and materials science. His motivation

is the desire to advance the exploration of materials in these fields by developing and applying new electronic-structure approaches, methods, and computational tools. Currently, he is working on an approach to calculate ab-initio NMR chemical shifts, and the description of van der Waals forces within density functional theory. Both research fields have direct applications to nano-, bio-, and energy-related materials. Timo was recently interviewed by ScienceWatch, Thomson Reuters about an important paper he and his collaborators have written which has received a large number of citations. You can read the interview by going to <http://sciencewatch.com/dr/fmf/2011/11jul/fmf/11jul/fmfThon/>.

A second faculty member has also received a faculty fellowship. This summer, Prof. Martin Guthold was named a Wake Forest Faculty Fellow. This is a two year award that recognizes Martin as one of Wake Forest's best teacher-scholars. Martin has previously received both the Wake Forest Excellence in Teaching Award and the Wake Forest Excellence in Research Award. His research interests are at the interface of Biophysics, Molecular Biology and nanotechnology.

Last year I mentioned that Martin, in collaboration with Prof. Jed Macosko, several students, and I, invented a new technology which may dramatically cut the time it takes to develop new drugs. It is called "Lab-on-Bead NanoSelection". Another project Martin is working on involves the mechanical properties of fibrin fibers which form the structural and mechanical backbone of a blood clot. The macroscopic properties of a clot are well known and can be related to clotting disorders. However, the underlying microscopic mechanisms, which determine the behavior of the whole clot are not understood. Clots form when soluble fibrinogen is converted to fibrin monomers that polymerize to form a branched network of fibrin fibers. The mechanical properties of such a branched network depend on the network architecture and the mechanical properties of the individual fibers. These properties are poorly understood. His group has developed an atomic force/fluorescence microscopy technique to study the mechanical properties of single fibrin fibers. They use the tip of the atomic force microscope (AFM) to stretch fibers suspended across 12 μm -wide channels; and the fluorescence microscope is used to image this stretching. This work will help to construct and test good mechanical models of blood clots, and thus advance our understanding of wound healing, heart attacks and strokes.

Prof. Fred Salisbury won the University's Excellence in Research Award. This award is given annually to one or two faculty members who are assistant or associate professors and who have been here for no more than 10 years. Dr. Salisbury's research in computational biophysics is currently focused on applying physics-based methods to the study of the relationship between protein dynamics and protein function and in applying the understanding gained from these studies, along with the methods used, to drug discovery. Specifically, he has two main linked interests in protein dynamics. The first is to understand the free energy surfaces of folded proteins, how these surfaces are perturbed via interactions with other molecules, and how to exploit these perturbations to develop new therapeutics. His second main interest is to understand how proteins communicate as proteins; how does part of a protein "know" that a binding event took place tens of nanometers away? An important example of his research in these areas is the success that Dr. Salisbury and his collaborators have had in studying how specific DNA repair proteins recognize mistakes in DNA as being different from damage, and how to use these differences to discover molecules that exploit these differences. They are hopeful that this work will be the basis for new chemotherapeutics.

Physics graduate student, Yuan Li won the "Chinese Government Award for Outstanding Self-financed Chinese Students Study Abroad". This award was founded by the Chinese government in 2003 with the purpose of rewarding the academic excellence of self-financed Chinese students studying overseas. Only those with outstanding performance in Ph.D. studies are considered by the award selection panel. Yuan works with Prof. David Carroll in the Center for Nanotechnology and Molecular Materials.

Physics graduate student, Jason Bates, applied for and received a grant from the National Science Foundation to study for approximately two months this summer with Professor Hing Tong Cho at Tamking University in Taiwan. Jason works with Prof. Paul Anderson. His research in Taiwan involved computing a two point correlation function which gives information about quantum fluctuations in the stress-energy (energy density, pressure, etc.) of quantum fields in a model in which the universe which is expanding exponentially in time. The work has potential implications for inflationary models, in which the universe undergoes a rapid expansion phase called inflation early in its history.

Physics graduate student, Andrea Belanger, was selected to be a National Research Service Awards predoctoral fellow for the 2011-2012 academic year. This award is part of a training grant from the National Institutes of Health for the Structural and Computational Biophysics Program that is led by Biochemistry professors Leslie Poole and Douglas Lyles. The goal of the program is to broaden the education of students in the biological or physical sciences. Andrea will be using physical methods to help understand the blood storage **lesion** (why old blood goes bad) in the lab of Prof. Dany Kim-Shapiro.

Physics graduate student, Ivan Azarov, earned the Gordon A. Melson Outstanding Doctoral Student Award for 2011. His research with Dany Kim-Shapiro explored how the important signaling molecule nitric oxide is maintained under normal physiological conditions, is compromised in disease, and how it can be restored through therapeutics. His dissertation is entitled "Nitric Oxide Bioavailability Regulation by Hemoglobin". Ivan is now a postdoc in the group of Prof. Mark Gladwin at the University of Pittsburgh.

The Materials Research Society (MRS) awarded Joel Grim, a Physics graduate student, a Silver award for a talk he gave at the MRS Meeting in April. Joel works with Prof. Richard Williams. His talk was entitled "Nonlinear Quenching Rates in SrI_2 , CsI , and NaI Scintillator Hosts".

Claire McLellan, a rising senior in Physics, had an exceptionally successful year. In April she was awarded a prestigious Goldwater Scholarship. These are national scholarships for sophomore and junior students in all areas of science to encourage them to continue their studies in science and to recognize their achievements to date. Then in July, she received a Leadership Award from the Society of Physics Students, a national organization that promotes study in physics and the maintenance of high scholarship expectations for those who pursue physics education. The award is given to students who achieve high scholarship performance both in physics and overall studies, exhibit the potential and intention for continued scholastic development in physics, and who actively participate in SPS programs. This summer Claire worked as a science and technical intern at the Government Accountability Office in Washington, DC as part of the Wake Washington program.

Last December, a team of three undergraduate physics majors: Claire McLellan, C. Wesley Matthews, and Soham Banerjee won a Silver Medal in the first-ever University Physics Competition, an international physics competition for undergraduates sponsored by the American Physical Society and the American Astronomical Society. This competition involved solving one of two problems posed by a committee of professional physicists. They chose the problem entitled "Aerobraking a Space Probe at Neptune". Each participating team had 48 hours to develop a solution to their selected problem, and submit a report explaining their solution. Altogether 58 teams submitted solutions in the 2010 University Physics Competition. Of these, 2 teams (3%) were ranked as Gold Medal Winners, 8 teams (14%) were ranked as Silver Medal Winners, 16 teams (28%) were ranked as Bronze Medal Winners, and 32 teams (55%) were ranked as Accomplished Competitors.

There were also two other awards given by the Physics Department at our last colloquium of the academic year. Jillian M. Bjerke received the award for outstanding teaching assistant, and C. Wesley Matthews received the William E. Speas Memorial Award. Jill just finished her Master's degree in Physics this month (August) and also this month, Wes started graduate studies in Physics at NC State.

Prof. Richard Williams and his group along with collaborators at Fisk University in Nashville, TN have begun working on a research project with important applications to homeland security. Their goal is to discover what fundamentally limits energy resolution of radiation detectors, and to use that knowledge to produce improved material (specifically $\text{SrI}_2\text{:Eu}$) for a next-generation detector with superior capabilities for port and border security screening, nuclear nonproliferation and stewardship, and nuclear medicine. The plan is to keep the cost of these new detectors low enough so that they can serve wide-spread port security applications. They have received a \$900,000 grant from the Office of Nuclear Nonproliferation Research and Development of the National Nuclear Security Administration, within the U.S. Department of Energy. The funds will support this research. The project combines the special measurement and modeling capabilities of Richard's group with the crystal growth and characterization capabilities of the group at Fisk University headed by Professor Arnold Burger. Richard's group includes graduate students Joel Grim and Qi Li along with Research Professor Burak Ulcer. They use ultrafast laser pulses to produce electron-hole excitations at very high density that can be chosen to isolate conditions in specific regions of a particle track, in order to study nonlinear quenching and carrier diffusion properties that are believed to account for loss of energy resolution called "nonproportionality". They conduct numerical modeling of conditions in the particle tracks using the measured data, and this has led to a significant advance in understanding of the relation between nonproportionality and specific material parameters, particularly dipole-dipole transfer rate and carrier mobility. The Fisk University lab is a premier crystal growth facility and was co-discoverer of the superior scintillation properties of $\text{SrI}_2\text{:Eu}$ along with several national laboratories.

Last fall, Physics majors Claire McLellan, Daniel David, and Katelyn Goetz presented their research results at the Plastic Electronics Week conference in Dresden, Germany. This Conference focuses on innovation in electronics, brings together professionals both from academia and industry, and is one of the most prestigious conferences in the field. All three students work with Prof. Oana Jurchescu. Their travel to the conference was supported by the *WFU Undergraduate Student Stipend for Participation in International Conference* and the Physics Endowment Fund.

As well as helping to send students doing research to national and international conferences, the Physics Endowment Fund is used to support other aspects of student research and scholarship. It also supports the annual faculty and student awards and allows us to provide lunches at the career advising events for our undergraduate and graduate students. The Fund is also used to support the students who are members of our local chapter of the Society of Physics Students in their activities and events throughout the academic year. I want to give special thanks to all of you who designated the Physics Endowment Fund as part of your alumni giving. The members of the Physics Department and the university community greatly appreciate the support of our alumni.

Please come by Olin Physical Laboratory and join the fun if you can. We are looking forward to seeing you. If you can't make it to Homecoming, please drop me a note or give me a call and tell me what you're up to. If this letter was forwarded to you, please let us know your current address.

Best Regards,



Keith Bonin
Professor of Physics & Chair