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Dear Physics Alumni,

The Physics Department faculty and staff invite you to our **Homecoming reception on Saturday, October 29**. As for the past few years, we are having a joint reception with Chemistry and Biology and a lecture demonstrations show. The show is designed to be of interest to everyone including children. The lecture demonstrations will begin at 10 am on Saturday morning in room 126 of Winston Hall. The demonstrations will be followed at 10:45 by a reception in the lobby of Winston Hall.

I am sad to say that we lost two of our emeritus faculty members last year. George (Jack) Williams passed away on Saturday, November 8th, 2015. He was a great leader and colleague. Jack began his career at Wake Forest in 1958 as an Assistant Professor, and rose to full Professor in 1965. His area of research was condensed matter physics, and he served as Chair of the Physics Department for 16 years (1974-1990). During the 1980's, Jack persistently sought funding from the Olin Foundation to build a new Physics building. He eventually succeeded, and the Physics building (Olin Physical Laboratory) was completed in December 1989. He was instrumental in moving the Department of Physics to a higher level when he got the university to approve the doctoral program in 1986. Jack retired in 1999, after 41 years of excellent service to students, faculty, and the whole community of Wake Forest University. We are both lucky, and proud, to have had Jack as a friend, colleague, and leader.

Robert Brehme passed away on Monday, February 22, 2016. He was a valued colleague and teacher. Bob came to Wake Forest College in 1959 filling an open faculty position created by the retirement of longtime professor William Speas. Shortly before his retirement, Bob received the John Reinhardt Award for Distinguished Teaching, Wake Forest University's highest award for teaching excellence. He retired in 1995 and continued to teach a course without pay for 3 years. Bob was also an active participant in faculty meetings and served on many faculty committees. Two of Bob's research achievements are so useful and important that they have been heavily referenced. One of these is a seminal paper that he wrote with his Ph.D. adviser Bryce DeWitt in 1959 and published in 1960. This paper resolved an apparent paradox concerning the emission of light by charged particles in Einstein's general theory of relativity. It also provided important mathematical tools that are still in use today. The other was a class of diagrams he created (now called Brehme diagrams) to help students to understand how special relativity works. Bob was a member of the Physics faculty at Wake Forest University for 39 years, and we will always remember his quick wit and sharp mind.



Prof. Robert Brehme at Prof. Howard Shields Retirement dinner – 2001.



Prof. Jack Williams – portrait in Olin 101 by Anne Kesler Shields.

The Physics Department continues to do well and our students and faculty continue to win prestigious awards.

Last March Timo Thonhauser, was named a 2016 Simons Fellow in Theoretical Physics. Timo is one of 14 university professors named by the Simons Foundation Division for Mathematics and the Physical Sciences for the fellows program that provides funds to faculty for up to a semester long research leave from classroom teaching and administrative obligations. The Simons Foundation was established by billionaire James H. Simons, a mathematician and philanthropist, to support distinguished scientists. Combined with a sabbatical from the University, Timo is spending the 2016/2017 academic year on research leave at MIT. One of his research goals is to obtain a better understanding of fundamental interactions in materials from a theoretical perspective. He says that "With this newly gained understanding and insight, we hope to improve all kinds of materials for challenges and demands of novel devices in the 21st century — ranging from cell-phones and computers to energy production and storage."

Also in March, Rick Matthews won the WFU Teaching and Learning Center's Teaching Innovation Award. This award recognizes the effort put forth by faculty who have redesigned their courses or introduced new courses with innovative, research-based approaches to the practice of teaching, using new methods and/or technologies, with an intentional emphasis on how these innovations improved or facilitated student learning. Rick has redesigned sections of General Physics I and II in which most lectures are delivered by video while class time is dominated by interactive activities and small group problem solving. Rick discussed this briefly in his contribution to the newsletter last year.

Last November, graduate student Crystal Bolden received a Young Investigator Award at the 22nd Annual Meeting for the Society for Free Radical Biology and Medicine. The Young Investigator Award is presented to students and postdoctoral fellow members based on a submitted research abstract and the presentation of the work at the Society's Annual Meeting as judged by members of SFRBM's Awards–Junior Committee. Crystal is a PhD Candidate in Molecular Medicine and Translational Science at the Wake Forest University School of Medicine and works with Dany Kim–Shapiro.

This spring undergraduate Angela Harper was selected as a Goldwater Scholar for the 2016-2017 academic year. This is a high honor as only 252 Goldwater Scholars were named this year. To quote from the WFU article (<http://news.wfu.edu/2016/04/07/physics-students-win-prestigious-awards/>) “Harper was selected as a Goldwater Scholar on the basis of academic merit from a field of 1,150 mathematics, science, and engineering students who were nominated by the institutional representatives of 415 colleges and universities nationwide.” Angela has worked with Jacque Fetrow and Oana Jurchescu (separately), and spent last summer at Cornell University working with Prof. Paulette Clancy, performing computer simulations on solar cells.

Former graduate student Pete Diemer won the Spring 2016 Materials Research Society Gold Graduate Student Award for the work he did in developing novel deposition techniques for organic semiconductor device layers. His first project of Vibration Assisted Crystallization resulted in a first author publication, including journal cover, highlights in Nature and Nature Materials, as well as US and European patents. Later, he developed the first laser printed organic field-effect transistor using an office laser printer. This invention disclosure was also submitted and a patent is pending. This is the first time that a Wake Forest student received the MRS Gold Award. Pete received his Ph.D. last summer and is currently working as a postdoctoral research associate for Oana Jurchescu.

This year graduate student Ryan Melvin was awarded an NIH NRSA predoctoral fellowship in the Structural and Computational Biophysics Program. The NIH training grant is a National Research Service Award for predoctoral research training in specific shortage areas and will provide up to two years of support. The goal of the training program is to bridge the gap between the biomedical sciences and the more quantitative basic sciences, such as physics, chemistry, and mathematics. Ryan is a member of Fred Salsbury's research group. Last year Ryan was awarded Best Talk at the 2nd Workshop on High-Throughput Molecular Dynamics in Barcelona, Spain, at the Barcelona biomedical research park. The award included a prize of an Nvidia Tesla K40 — a specialized GPU for computer simulations. His talk was titled "Combining Molecular Dynamics and Biopolymer Docking".

Former undergraduate Hannah Smith, who worked in the group of Oana Jurchescu, was awarded a National Science Foundation Graduate Research Fellowship for graduate studies in Electrical Engineering. Hannah graduated last spring and is beginning her graduate career in Electrical Engineering at Princeton University this fall.

At the Physics Department's annual awards ceremony last April Rick Matthews received the Physics Department Excellence in Teaching Award. Graduate students Melissa Pashayan and Maxim Zalutskiy won the Outstanding Teaching Assistant award, postdoc Sabastien Zuluaga won the Outstanding Peer Mentor award, and seniors Harsh Patolia and Hannah Smith received the Speas award.



From left to right: Keith Bonin, Hannah Smith, Rick Matthews, Melissa Pashayan, and Maxim Zalutskiy.

The number of students in our Department remains high. This fall we have 24 juniors, and 27 seniors for a total of 51 majors. There are also 34 graduate students. Our tradition of undergraduate research continues. Last year more than 42 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>.

This past academic year was a successful one for me in multiple ways. Extensive effort went into drafting a plan for an Engineering Department as part of the new Wake Downtown initiative. As co-chair of the committee to propose and plan the new Department, there was substantial committee work in drafting the basic plan, and in overseeing the new facilities that will house the new department in Building 60 at Wake Forest Innovation Quarter in downtown Winston-Salem. In April I was asked to Chair the Search Committee for the new Engineering Department Chair, and I am now chairing the committee to search for the chair, and for two additional engineering faculty members to hire for the launch of the new Department of Engineering next fall (2017). In research, Chad McKell a Master's student, graduated in December 2015, and he is now enrolled in an Acoustics graduate program in Scotland beginning this fall. Currently Dr. Guthold and I jointly work with Hyunsu Lee on the physics of cancer. A visiting Research Scholar from Germany, Lukas Fieber, has also joined the project for the period of August, 2016 to February 2017. Last academic year (2015-2016) several undergraduates, including Daniel Nelli, Tracey Pu, and Josiah Low worked on the same physics of cancer project. In addition, I am working on another cancer project to understand diffusion of double-stranded DNA breaks with the help of undergraduates Preston Levy and Kevin Wang, along with Prof. George Holzwarth. Finally, I also worked with undergraduate Sam Anich on optogenetics last academic year (and this summer) to understand how to modify mammalian addictive behavior using optogenetic approaches in rat brains.

As we did last year, we have a section below where some of our faculty members briefly describe, as I have just done, highlights of the past year about themselves, either professionally or personally or both. This section is presented in alphabetical order.

I want to give special thanks to all of you who designated the Physics Endowment Fund as part of your alumni giving. Many of you hopefully received an email this spring from the Wake Forest Development Office as part of The Source, the title of the current Capital Campaign designed to broaden support for the College's departments. Many of you have generously responded, and we greatly appreciate your kind support. Your gifts have significantly benefited the faculty and students

in the department by enabling us to purchase equipment and supplies for student research, which enhances faculty-student engagement, and for travel of our students to present their work at professional conferences. This enables students to not only network with their peers, but also to develop some of the 'soft' skills needed to be successful professionals throughout their careers. In addition, your funding has allowed us to provide lunches at the career advising events for our undergraduate and graduate students; and the funds also 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. The members of the Physics Department and the university community sincerely appreciate the support of our alumni.

Please come 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.

Go Deacs!



Keith Bonin
Professor of Physics & Chair

STATEMENTS FROM SOME FACULTY MEMBERS

Paul Anderson

This past year has had a good mix of teaching and research. I tried a new teaching technique (for me) last spring called the partially flipped classroom. The year before Fred Salsbury had done this for the undergraduate thermodynamics and statistical mechanics class. Since I was teaching the same class, I thought I would give it a try. Each Friday the class was divided into four groups and each group elected a spokesperson. Then I gave the groups questions and problems to work out and they reported their answers back to the rest of the class. It worked well and most students thought it was worthwhile. I am trying it again this semester for the undergraduate quantum mechanics course.

Last July my graduate student, Ritchie Dudley, and I attended the 21st International Conference on General Relativity and Gravitation which was held at Columbia University. Ritchie gave a talk on his work on Bose-Einstein, BEC, analog black holes. The idea is that under certain conditions a BEC can mimic mathematically some of the properties that a black hole has. The advantage is that, unlike black holes, BEC's can be studied in the laboratory. Also in July, Eric Carlson and I finished writing and submitted a paper for publication which investigates quantum effects in certain models of the universe in which gravity becomes very strong at late times resulting in a final singularity. This work involved three former undergraduates: Jay Einhorn, Bradley Hicks, and Andy Lundeen, who are coauthors on the paper.

Gregory Cook

During the last year, my graduate student, Max Zalutskiy, finished his PhD. His dissertation was titled "Investigations of Black Hole Spectra: Purely-Imaginary Modes and Kerr Ringdown Radiation." We also submitted two papers incorporating some of his work on the purely-imaginary modes of the Kerr geometry. The most exciting event of the year was the first direct observation of gravitational waves, detected by the LIGO observatories in September of 2015 and announced in February of 2016. The gravitational waves were produced by a pair of black holes in an orbit where they spiraled closer together and eventually collided, producing a remnant black hole. This was extremely exciting to me since my own PhD, and much of my subsequent research, was on just such black-hole collisions. In fact, the observed waveform was nearly identical to recent numerical simulations based on my work. I was honored to be invited to talk about the detection of these waves on WUNC Radio's "The State of Things", and also gave a Departmental Colloquium titled "GW150914: The first direct detection of Gravitational Waves. What was seen - How did we see it - What does it mean?"

Martin Guthold

A lot has happened in the Guthold lab in the past year. After three PhD students (Xinyi Guo, Stephen Baker and Wei Li) and one undergraduate students (Mizuki Saito) celebrated their graduation in 2015, the Guthold lab population shrank a bit, and in May 2016 only one undergraduate student, Tommy Lucioni, graduated (with honors). All graduating students found great jobs or will continue their education. Xinyi Guo is getting a Master's degree in Accountancy at Wake Forest University, Stephen Baker and Wei Li got wonderful post-doc positions at the University of Leeds and University of Virginia. Mizuki Saito is attending Dental School at the University of Louisville in Kentucky and Tommy Lucioni is planning to go to Medical School.

In February 2016, Jason Gagliano, who was a technician in the lab, accepted a lab manager position at Forsyth Tech. We are planning to continue working on our drug discovery project using next generation sequencing.

We welcomed new members to the lab. Graduate student Hyunsu Lee and undergraduate students Elizabeth Gianino, Josiah Low and Daniel Nelli joined the lab in 2015. Post-doc Amanda Smelser and undergraduate student Mary Kinney joined in the fall of 2016. We are also hosting a visiting scientist, Lukas Fiber, from Germany.

All the hard work by the students resulted in several publications. In addition to three dissertations and one honors thesis, the Guthold lab published papers in Biophysical Journal, Materials Science & Engineering, Applied Physics Letters, Colloids and Surfaces B: Biointerfaces, Materials, and Biomaterials. One of our previously published papers in Analytical and Bioanalytical Chemistry was among the top ten most downloaded papers in 2015.

Dr. Macosko and Dr. Guthold won a \$250,000 grant from the Discovery Institute to investigate motor-driven vibrations in cells during mitosis.

Dr. Guthold went to conferences in France and South Africa. He received the Outstanding Investigator Award from the International Fibrinogen Research Society at the International Fibrinogen Workshop in South Africa.

Our new state-of-the art combined Asylum MFP-3D-BIO atomic force microscope (AFM) and an Olympus IX73 inverted optical microscope is getting great use by researchers investigating cancer and normal cells, and other biological materials.

Our business collaboration with NanoMedica, LLC is going well; though, finding funding remains a challenge. We were granted on patent and a second patent is pending. We are also having a conversation with Illumina, a large sequencing company, which is interested in our technology.

The Guthold family is doing well. My wife, who is a lawyer for the city of Winston-Salem, is making sure the city is staying out of legal trouble. My son, Felix is working as a PA in a Cardiology unit at a hospital in Stuttgart (Germany). Our daughter, Melissanthi, is starting 8th grade at Jefferson Middle School, and our three-year old son Alexander started Kindergarten at Forsyth Country Day School. We hope to see you at homecoming, or just arrange a visit with us.

Natalie Holzwarth

This year we decided to call ourselves "The Materials Modelers". The biggest milestone of the group was Nicholas Lepley's completion of this Ph. D. Thesis -- "First Principles Investigations of Solid-solid Interfaces in Lithium Battery Materials" before Dec. 2015 and the publication of his work in Physical Review B "Modeling interfaces between solids: Application to Li battery materials", N. D. Lepley and N. A. W. Holzwarth, Phys. Rev. B 92 214201 (2015). Nicholas is now pursuing a career in "Big Data" and keeps in touch from time to time. Graduate students Jason Howard, Ahmad Al-Qawasmeh, and Larry Rush have all been busy with various projects modeling battery materials, attending some of the Electrochemical Society and American Physical Society meetings and completing the publications: "First principles simulations of the porous layered calcogenides $\text{Li}_{2+x}\text{SnO}_3$ and $\text{Li}_{2+x}\text{SnS}_3$ ", Jason Howard and N.A.W. Holzwarth, Phys. Rev. B 94, 064198 (2016); "Computational Study of Li Ion Electrolytes Composed of Li_3AsS_4 Alloyed with Li_4GeS_4 ", Ahmad Al-Qawasmeh and N.A.W. Holzwarth, Journal of the Electrochemical Society 163, A2079-A2088 (2016); and "First principles investigation of the Structural and electrolyte properties of $\text{Na}_4\text{P}_2\text{S}_6$ and $\text{Li}_4\text{P}_2\text{S}_6$ ", Larry E. Rush Jr. and N.A.W. Holzwarth, Solid State Ionics 286, 45-50 (2016). In addition, undergraduate student Yaqi Yang worked with us during the Fall 2015 semester, starting to explore the possibilities of our modeling of X-ray photoemission spectra.

Oana D. Jurchescu

Our group had a successful year. Three students defended their PhD theses and started new jobs: Katelyn Goetz is doing a postdoc at Heidelberg University, in Germany, Yaochuan Mei works in industry and Peter Diemer is now a postdoctoral researcher at Wake Forest University. Several students won awards: undergraduate Angela Harper won a Goldwater scholarship, Hannah Smith won a graduate research fellowship from the National Science Foundation and she started her graduate studies in the Electrical Engineering Department at Princeton University. Graduate student Peter Diemer won a gold award from the Materials Research Society (MRS) for his graduate work on organic devices. This is the first MRS gold at Wake Forest. We welcomed a new graduate student to the group, Andrew Zeidell.

Our research made national newspaper headline when we developed the first hybrid organic-inorganic perovskite transistor. The solar cells based on these materials have recently emerged as one of the most promising contenders for large scale, low-cost photovoltaic energy generation. Our first generation transistors allowed us to directly measure, for the first time, the intrinsic electrical properties of such materials. In addition, the results expanded the use of these hybrid perovskites towards other low-cost thin film electronic circuits, thus widening the spectrum of possible applications of these materials.

Daniel Kim-Shapiro

As in most previous years, stuff happened this year. Several undergraduate students moved on. Andrew Barelli graduated (early) with honors in physics and got job with Bloomberg in NYC in Financial Analytics. Amy Xie graduated and is now a medical student at the Ohio State University. Between 2015 and 2016, the group has about 20 papers accepted or published. For me the stand-out is the Redox Biology paper that Nadeem Wajih (Research Professor in the lab) is first author on. On the homefront, my oldest son Soleil is now a senior. We have been looking at engineering schools that he will apply to. Wake is not on the list as he doesn't want me as a professor. The other two boys are still in middle school. My wife is still working a ton as a pathologist. Hope to see some of you at homecoming – or just come for a visit and arrange to see us.

Jed Macosko

Life in our combined Macosko-Holzwarth lab in Olin 213 has been full of comings and goings in 2015-16. Graduate student Amanda Smelser earned her Ph.D. Undergraduates Adam O'Dell and Scott Smyre graduated after working a combined 9 years in the lab. Both Scott and Amanda will continue to work in the lab for another six months on a research project that examines the affect of cell cycle on any motor-driven whole-cell vibrations, as measured by an AFM cantilever. Adam is pursuing a master's degree at Tokyo University. Undergraduate Manuel Gomez will spend the fall 2016 semester in Copenhagen (not far from where Dr. Macosko lived in the fall of 2013 while he worked on educational research projects at the University of Copenhagen). Manuel will return to his research projects in the spring. Melissa Pashayan, who came to WFU after a successful master's program at the University of Chicago, has been working in the lab since fall 2015 and will continue to investigate the stiffness of breast cancer cells (and non-cancerous breast cells) as a function of cell cycle and cell-cell proximity. She has been aided in her efforts by John Paul Spaventa, a rising freshman at Stanford University who hails from Winston-Salem. As the PI's of the Macosko-Holzwarth lab, we continue our work in the lab. Most recently, one of us (George) worked with Scott and Amanda to build an environmental chamber for long-term live cell imaging on Dr. Guthold's Zeiss microscope. The other of us (Jed) was appointed the Director of Educational Initiatives at an education startup in Bellevue,

WA, which specializes in 3D and virtual reality learning environments. As always, we are both thankful when alumni send news of their latest exploits, and are even more grateful when old friends stop by for a visit. Former graduate student, Todd Fallesen, returned from Europe to attend a conference and made a special trip to visit the lab. It was a happy reunion!

Fred Salsbury

The 2015-16 academic year was a busy one in the Salsbury group. We had three publications come out: our latest review article on molecular dynamics simulations and drug discovery finally came out, and Ryan Godwin and Ryan Melvin both first-authored methods papers. Godwin's paper was on the long-time simulations and rare event sampling, and Melvin's on visualizing ensembles in structural biology. We also had an active year of conferences and workshops. Jiajie and I attended the 2016 Biophysical Society Annual Meeting in Baltimore, whereas Ryan Melvin attended the two workshops in Europe: the Barcelona High-Throughput MD workshop, where he won the Best Talk award and the PyEmma Winter School, the results of which he shared with the rest of the group. Godwin attended the NBCR/TCBG Simulation-Based Drug Discovery Workshop in San Diego and shared the latest results and methods with our group. This was also a good year for awards. Godwin finished up his T32 fellowship, though will be here for one more year. At the end of summer 2016, Ryan Melvin received a T32 NIH fellowship from the Structural and Computational Biophysics training grant. He plans to stay longer to add an MS in statistics; a good fit for our interests in applying statistical methods to simulations. Ryan Godwin also pursued his interest in entrepreneurship by competing in the Triad Startup Weekend in Innovation Quarter, where his team finished in third place. We had some personnel changes: Cenji Yu, a BS Biophysics major, joined our research group and stayed the summer with a WFU Summer Research Fellowship to work on aptamer mutant simulations. TJ Colvin, a part-time graduate student, joined our group at the end of the summer. Meanwhile, Dr. Yan Lu returned to China to take up a new position.

Timo Thonhauser

During this last year, my group continued its research on hydrogen storage materials and metal organic frameworks for the purpose of gas sequestration and storage. For the latter, our research has also moved into the direction of catalysis, which is interesting for many industrial purposes. Our latest research shows that we can use metal organic frameworks much like a storage vessel at the molecular level, being able to add/remove a cap at will. My graduate students David Harrison and Evan Welchman are coming into their last year and are likely to graduate next summer. My post doc Sebastian Zuluaga moved on to another post doc position at Vanderbilt University. On the other hand, we are also welcoming new group members: Stephanie Jensen (post doc), Matt Roveto (graduate student), and Jack Treadwell (undergraduate student) have just recently joined my group. I, myself, have temporarily relocated to Cambridge, MA, to start my sabbatical at MIT. So far it has been very rewarding and I hope to be able to work through the long list of projects I have set up for myself.