

Dear Physics Alumni,

The Physics Department faculty and staff invite you to our **Homecoming reception on Saturday, September 16th**. As in the past few years, we are having a joint reception with Chemistry and Biology and a lecture demonstration 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. This will be followed at 10:45 am by a reception in the lobby of Winston Hall.

This year we are implementing a new alumni award. The award will be given out to a Physics Department alumnus for exceptional achievements and/or service. If you can think of someone to nominate, please send me a letter or email (shapiro@wfu.edu) describing why that person is a good candidate for this award. Note that the award will have a modest monetary component. If we do not have enough nominations this year, we will make the first award in 2018.

This newsletter is from Dany Kim-Shapiro this year rather than Keith Bonin because Keith stepped down as Department Chair on June 30th. He served in that position for 10 years and was an excellent chair, receiving the Academic Leadership award as described below. During his tenure, Keith oversaw the amazing growth of our undergraduate and graduate physics programs. Keith has now resumed his duties as a regular faculty member in the Physics Department.

Richard Williams retired in June. Richard joined the Physics Faculty in 1985 as a Reynolds Professor. He is also one of our alumni and was the first recipient of the Speas award in 1968. Richard has a very active research program with two graduate students, one postdoc, and three active grants on the topic of scintillators. As a result, he is going to keep his laboratory space for the next two years in order to give the graduate students a chance to graduate and to fulfill the obligations of his grants. We wish Richard well in his retirement and are happy that he will continue to be active in research at WFU.



I am very sad to report that we lost our Administrative Assistant, Karen Logan. Karen passed away on July 1, 2017, as the result of a tragic accident in which she and her husband Aaron were hit by a vehicle while crossing a street in Winston-Salem. Aaron survived the accident with minor injuries but unfortunately Karen died several days after the accident. Karen joined the Department of Physics in December 2013. This is an extremely important position in the Department as it is the central staff position with responsibility for running the main Departmental Office and for overseeing all aspects of Departmental affairs. Karen had a strong desire for personal improvement and was taking classes at Salem College to earn her bachelor's degree and also participated in the WFU Thrive Program. She was a

model citizen of the Physics Department and a good example to others. In addition, Karen was a gentle soul with an easygoing personality who always made strangers feel welcome, and who did so much to calm stressed out students, staff, and faculty when issues arose that might cause some tension.

We will long remember the many kindnesses and concerns she expressed when family members got sick or needed medical care, and we will miss her sweet demeanor and friendly smile.

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

Last April, Keith Bonin received the Academic Leadership Award from the College Board of Visitors. Keith is the first recipient of this award. The Dean's Office Digest says "This award recognizes Keith as a leader who embodies the best qualities of academic leadership, not only of managerial skills, but of institutional vision and an abiding commitment to academic excellence, diversity, and inclusion, classroom innovation, and commitment to students and the Wake Forest community." When he presented the award, John Cooper, chair of the College Board of Visitors, said in part, "Tonight, the College Board of Visitors honors Dr. Keith Bonin, professor and chair of the Department of Physics, for your outstanding leadership of a vital and thriving department, your advocacy for students, your work to develop a climate where faculty do their best work, and for your visionary leadership and its impact on the college and its future." Keith has been heavily involved in the effort to start an engineering program at Wake Forest and chaired the search committee that hired four faculty members in engineering including the new department chair. In this context, Cooper remarked to Keith that "Your fingerprints are all over Wake Downtown including the long-term vision to create an engineering department."

In February, Oana Jurchescu received the Kulynych Family Omicron Delta Kappa Award at the Wake Forest University Founders' Day Convocation. The Kulynych Family Omicron Delta Kappa Award was established in 1982 by the Wake Forest Circle of Omicron Delta Kappa to recognize an outstanding faculty member who bridges the gap between the classroom and student life. The recipient must contribute beyond the expected duties of teaching and research. The award is named to honor the life and contributions of Wake Forest University Lifetime Trustee, Petro Kulynych, and his family.

This past winter, undergraduate Angela Harper was named a Churchill Scholar. As a result, she will be studying at the University of Cambridge during the next academic year. Angela is the first WFU student to receive this honor and one of only 15 recipients this year. She was also awarded an NSF Graduate Research Fellowship. This program recognizes and supports outstanding graduate students. Fellows benefit from a three-year annual stipend of \$34,000 along with a \$12,000 cost of education allowance for tuition and fees (paid to the institution), and opportunities for international research and professional development. Angela has worked with Jacque Fetrow and Oana Jurchescu (separately), and spent the summer of 2016 at Cornell University working with Prof. Paulette Clancy, performing computer simulations on solar cells.

At the Physics Department's annual awards ceremony last April, a new award called the Outstanding Service Award, which honors a Physics faculty member for distinguished service, was given to Keith Bonin for the incredible service he has provided to the Department over the past ten years as chair. Eric Carlson received the Physics Department Excellence in Teaching Award. Graduate student Ryan Godwin won the Outstanding Teaching Assistant Award, and senior Angela Harper received the Speas Award.

The number of students in our Department remains high. This fall we have 17 juniors, and 26 seniors for a total of 53 majors. There are also 29 graduate students. Our tradition of undergraduate research continues. Last year, more than 30 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> .

As mentioned above, I took over as Chair of the Physics Department on July 1st of this year. When I came to Wake Forest in 1996, Jack Williams had stepped down as Chair several years before and Howard Shields was serving as the Chair of Physics. I remember thinking that nobody could be as good or a better Chair than Howard. Well, Rick Matthews and Keith Bonin both proved me wrong. They all leave big shoes to fill. It is an honor to have this position.

My research has been going well. Two more of my graduate students received their PhD: Xiaohua Liu and Crystal Bolden-Rush. A few undergraduate students also graduated: Emily Kim, Sam Brashears, Daniel Griffin, and Julien-Fabrice Momo. This past summer, Amber Dewitt continued to work in the lab along with Emily Kim (before she leaves for a postbac program) and Aryatara Shakya. Together we published about 10 papers in the past year.

My oldest son, Soleil, is starting the Engineering program at NC State this fall. My other two boys are in 9th and 8th grade. My wife continues to work hard as a pathologist at the medical school. As usual, we are all busy, but enjoyed a great vacation in Oahu.

As we have done for the past couple of years, 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.

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.

Again, we hope to see you on September 16th. 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!

Daniel Kim-Shapiro
Professor of Physics & Chair

STATEMENTS FROM SOME FACULTY MEMBERS

Paul Anderson

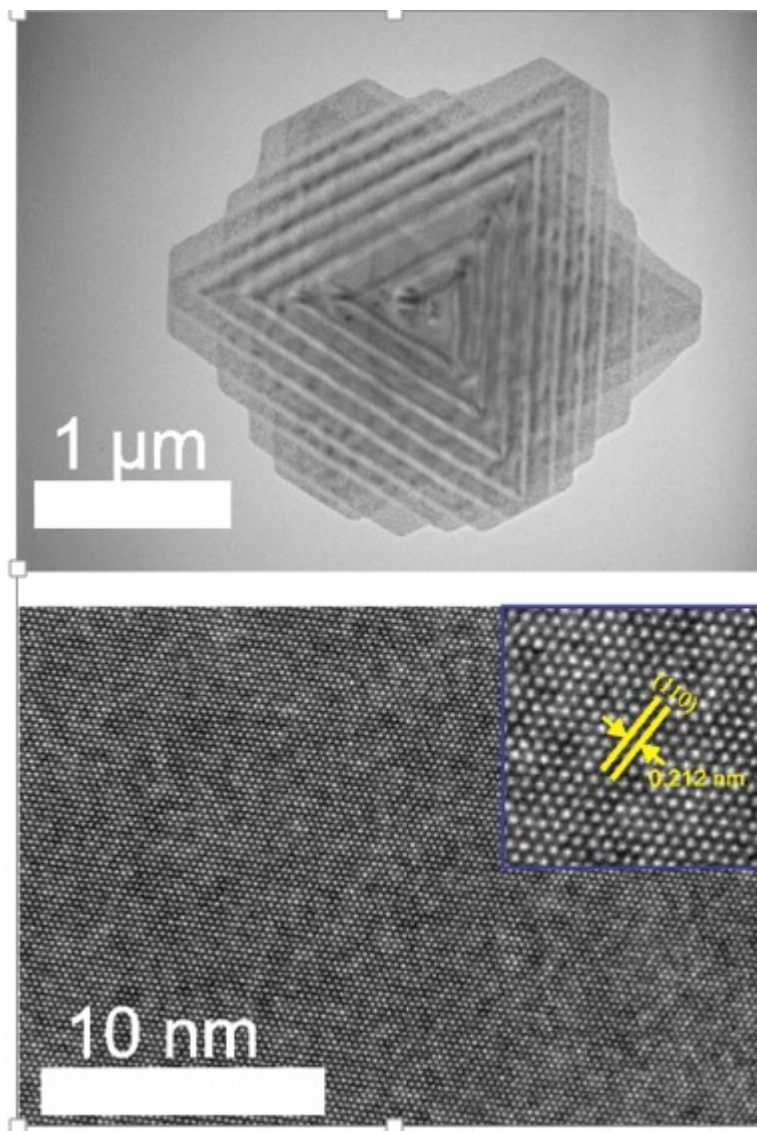
This past year has had a good mix of teaching and research. I adapted the technique of the partially flipped classroom to an upper level course in quantum mechanics that I taught last fall. Inspired by Fred Salsbury, I had previously tried it the semester before in the undergraduate thermodynamics and statistical mechanics class. Most Fridays, 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.

Last winter, undergraduate Ray Clark joined our small research group. He is working with me on a project involving the computation of the energy density and pressure outside of a black hole that forms from collapse. He applied for and received one of WFU's summer Undergraduate Research and Creative Activities grants which allowed him to spend most of the summer doing research. Ritchie Dudley is continuing to do interesting research 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, although the work Ritchie is doing is theoretical, not experimental. And, in February, a paper involving Eric Carlson, myself, and three former undergraduates: Jay Einhorn, Bradley Hicks, and Andy Lundeen, was published in Physical Review D. It involves a detailed study of possible consequences of quantum effects on the fate of the universe for various types of dark energy in many cases where classical general relativity predicts there should be some type of final singularity.

Keith Bonin

On June 30th I completed my last year (of 10) as Chair of the Department. Several significant tasks were completed during this final year. The conversion of Olin 105 into a novel format for teaching classes that are much more interactive was completed with the installation of a new laser projector and a new Google Jamboard for that room. I also chaired an important university committee that selected 4 new faculty members as the founding members of Wake Forest's new Engineering Department. The new Engineering Department will start offering their first classes this fall at Wake Downtown. On the research side, I was issued my first patent (along with fellow Physics Professors Martin Guthold and Jed Macosko) for a new method to do high-throughput drug discovery using next-generation sequencing chips. Dr. Guthold and I also received a small internal grant this year to pursue this drug discovery idea in a different NGS platform, made by Illumina Corporation, the largest supplier of such machines. In addition, I submitted a paper on a new method for studying diffusion of DNA in cell nuclei that utilizes so-called structured illumination of cells, and this method enables measurement of the movement of DNA at a large matrix of points within the nucleus. This work is focused on developing techniques to better understand how to treat cancers without having the treatments themselves produce additional cancers. This coming academic year, I will be on academic leave to pursue research in several areas including the cancer and drug discovery research already mentioned, as well as research in optogenetics and also on cellular structural mechanics.

Carroll Research Group:



The research team of Prof. Carroll continues to push the boundaries in light emitting devices. With several new publications on AC magnto-transport in light emitting polymers, the group has been asked to present their work at several international forums. In the area of organic hybrid thermoelectrics, the Carroll team has also published significant new results. The group's announcement of a fully flexible, textile, composite that exhibits a ZT quality factor of 0.97 (a world record), means that clothes made from such composite textiles would be capable of generating several Watts/m² from just a light stroll. However, among the biggest moves made by the Nanotech group this year is setting its course into areas of quantum information processing. The team's newest path has taken them into the world of two-dimensional dichalcogenides and the creation of the first gradient-doped topological insulators. Such materials have conductive surface states that are protected by fundamental symmetries such as charge and parity in their wavefunction. This is thought to allow for the entanglement of electronic states on topologically complex nano-objects

such as shown in the image above. If the team is right, this means that electronically gated and fully integrate-able Qbits, operating at room temperature, are just around the corner! This work was carried out at the Wake Forest University Center for Nanotechnology and Molecular Materials.

Gregory Cook

The detection of new gravitational wave by the LIGO observatories continues. After two observations during the 2015-16 academic year, a third binary black hole coalescence detection was made this year, not long after the detector sensitivity was upgraded. This is quite an exciting time for gravitational physics. While I don't participate directly in the observations, my work modeling black-hole binaries has played an important role. I was gratified to be invited to the Physics Department at Ole Miss University to give a talk on the history of binary black hole simulations and detections. This was the first year in a very long time that I haven't had a graduate student working with me. Two undergraduates have just started working on research projects that will carry through to next year. But, what I enjoyed most about this last year was getting to teach an advanced course in Computational Physics.

Eric Carlson

During 2016-'17, Eric Carlson has continued his research in semi-classical gravity. He published one paper with Paul Anderson and with former students Jay Einhorn, Bradley Hicks and Andrew Lundeen on "Future singularities if the universe underwent Starobinsky inflation in the past." [Phys. Rev. D 95, 044012 (2017)]

He has also continued to serve as the advisor for the Society of Physics Students. SPS had a lot of activities, including an overnight at Fancy Gap, participating in Hit the Bricks, a hike at Fancy Gap with SPS from Guilford College, and a year-end SPS picnic and Fermi contest. The honor society Sigma Pi Sigma inducted twelve new members, and Brian Conrad, the national head of SPS and Sigma Pi Sigma, was able to be present and participate in the induction ceremony



Brad Conrad,
national director
of SPS and Sigma
Pi Sigma,
wearing a WFU
SPS t-shirt,
inducts members
into Sigma Pi
Sigma
(4/19/2017)



The year-end SPS picnic and Fermi Contest
(04/21/2017)



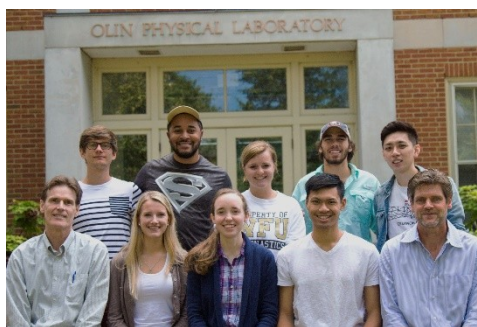
Wake Forest has an SPS outing at Hanging
Rock State Park (03/19/2017)



Taylor Ordines (in red) plays his part raising
money to fight cancer as part of the SPS "Hit
the Bricks" team (10/6/2016)

Martin Guthold

There is quite a bit of exciting news from the Guthold lab, and its current, and recently graduated members. Xinyi Guo (PhD, 2015; Master of Accountancy, 2017) landed a job as consultant at Deloitte in New York; Wei Li (PhD, 2015), who is now a post-doc in the Barker lab (UVA), got married this year (congratulations!), Stephen Baker (PhD, 2015) landed a great post-doc position in the Ariens lab at the University of Leeds, and Tommy Lucioni (BS, 2016) is attending medical school at Wake Forest University. Justin



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Sigley (PhD, 2014), visited the department in Sept. 2016 to give the Physics Colloquium. Elizabeth Gianino (BS, 2017), who wrote her Honors thesis about a permeability assay for blood clots, will be attending graduate school at Clemson University. Charlotte Antoni (BS 2017), who developed an assay to determine fibrinogen concentration, is planning to go to medical school, and Daniel Nelli (BS, 2017), who worked on several projects was accepted at Stanford University, though he is first taking a gap year in Utah visiting with his brother Patrick (BS, 2009). In March 2017, Amanda Smelser, who was a post-doc in the lab, accepted a post-doc position with Pierre Vidi at Wake Forest University. In June 2017, Scott Smyre, who was a technician in the lab, started a Master's program at the WFU Medical School. In their research, Amanda and Scott found that a small force applied to a cell before metaphase reverses mitosis. This a very interesting finding, as aberrant mitosis is implicated in many diseases.

This past year we welcomed several new members to the lab. Post-doc Amanda Smelser, technician Scott Smyre, graduate students Ali Daraei, Melissa Pashayan, and undergraduate student Mary Kinney joined in fall 2016. Undergraduate student Jacquelyn Sharpe and John Diaz-Silveira joined the lab in the spring of 2017. The new members had an immediate strong impact on research productivity, with some work already resulting in publications. We were also hosting a visiting scientist, Lukas Fiber from Germany. The new members joined continuing lab members Hyunsu Lee, Elizabeth Gianino, Josiah Low and Daniel Nelli.

All the hard work by the lab members resulted in several publications. The Guthold lab published papers in *Scientific Reports*, *PLOS One*, *ACS Applied Materials & Interfaces*, and *Acta Biomaterialia*. 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 numerous researchers. In our drug screening project - a collaboration with NanoMedica, LLC - we got a third patent, and we are having a conversation with Illumina, a large sequencing company that is interested in our technology.

The Guthold family is doing well. My wife, a lawyer for the city of Winston-Salem, is keeping the city out of legal trouble. Our daughter, Melissanthi, is starting high school, and our son, Alexander, started Kindergarten at Forsyth Country Day School. My son, Felix, is working as a PA in a Cardiology unit at a hospital in Stuttgart (Germany).

We hope to see you at homecoming, or just arrange a visit with us.

George Holzwarth

I continue to do research and work with undergraduate and graduate students in Olin. Particle tracking has been a unifying theme in my recent research. For example, we tracked endogenous particles (peroxisomes) in live mammary epithelial cells and analyzed the motions by Mason's Generalized Stokes-Einstein theory to determine the viscous and elastic moduli of the cytoplasm, a method called "passive microrheology" because the particle motion is thermally driven (Amanda Smelser, PhD 2017). Current research is directed at learning whether chromatin near double-strand breaks in DNA is more mobile than chromatin which has not been damaged (collaborators: Pierre-Alexandre Vidi, Cancer Biology, and Keith Bonin, Physics). My role is to determine mobility from the motions in live cells of photoactivated GFP fused to histone 2A. Another current project aims at determining how VSV (vesicular stomatitis virus) nucleocapsids move from the point of synthesis near the nucleus to the periphery of the cell (collaborators: Doug Lyles, Biochemistry, David Ornelles, Microbiology, Jed Macosko, Physics). The motions can be Brownian diffusion in random directions or motor-driven along microtubules or fibrous actin. We'll use Bayesian statistics to segment the tracks into Brownian and motor-driven intervals. We're currently seeking undergraduate students to work with us on these new projects.

Oana D. Jurchescu

The Jurchescu Research Group welcomed two new graduate students (Hamna Haneef and Colin Tyznik), and three undergraduate students (Laura Jennings, Ben Scharmann and Shengcheng Chen). Two undergraduate students defended their honor theses and graduated in May 2017. Jacori Hayes is now playing professional soccer at UC Dallas, and Angela Harper will start her master studies at Cambridge University in UK. Angela also won the first Churchill fellowship awarded to a Wake Forest student, and this fellowship will support her stay in UK. In addition, she won a graduate research fellowship from the National Science Foundation that will support her PhD studies at UC Berkeley upon returning from Cambridge. Graduate student Andrew Zeidell received a WFU Richter fellowship to travel to University of Bordeaux, France, where he was a visiting scientist in the lab of Prof Wantz, working on perovskite transistors.

Jed Macosko

In the Macosko/Holzwarth lab, we said goodbye to Amanda Smelser who successfully completed her Ph.D. in the summer of 2016 and was hooded this May. We also said farewell to Scott Smyre, who started in a master's program on the medical campus. We are working hard on AFM-cell projects in collaboration with Dr. Guthold and a joint Ph.D. student (Melissa Pashayan) who is really great. We are also hoping to get some new undergraduates this fall and perhaps even a high school student (Dr. Macosko's oldest child is finally in high school!) Our latest lab mascot is 11-month-old Bree Macosko, part Golden Retriever and part Spaniel. We are thankful for Kara Libby helping in the lab this summer and even taking time to give Bree some "good citizen" lessons, as she is otherwise pretty wild.

Fred Salsbury

The 2016-17 academic year was a busy one in the Salsbury group. The biggest news is that Ryan Godwin defended his dissertation and was also awarded the Outstanding TA award. He will be a visiting instructor in the Physics Department for 2016-17 and has started his own company. The past year was also a good year for publications and awards. We had eight publications come out with two more accepted including our first co-author paper with Dr. Berenhaut in statistics, thus lowering most of the group's Erodős number to 4. Ryan Melvin had his T32 NIH fellowship from the Structural and Computational Biophysics training grant competitively renewed. Jiajie Xiao was awarded a fellowship from the Center for Molecular Signaling. A former undergraduate research student, William Thompson, won an NSF graduate fellowship to support his PhD work at Yale; he was a co-author on two of those eight publications. In other news, Dr. Salsbury attended a workshop on integrating computation into the undergraduate physics curriculum, and looks forward to applying some of the lessons learned there.

Timo Thonhauser

I was on sabbatical for the academic year 2016/2017, which was made possible through a generous fellowship from the Simons Foundation. During this sabbatical I spent time at MIT and collaborated with local experts on improving the theoretical description of modeling materials on the computer. I also used the time to submit research proposals to national funding agencies, one of which meanwhile has been funded by NSF. In addition, I worked with three other WFU faculty to submit a Center Planning Grant to the provost, which has also been awarded. As a result, for the academic year 2017/2018, I am the planning director of the *Center for Functional Materials*, and will work with my collaborators to investigate the feasibility of fully establishing this center at WFU.