NEW FACULTY

Bhupal Dev, PhD, joins the physics department as assistant professor. Dev’s research interests include elementary particle physics, particle astrophysics, cosmology, and theoretical physics. His main research goal is to understand the new physics beyond the Standard Model that can explain the outstanding puzzles of our universe, such as the matter-antimatter asymmetry, dark matter, neutrino mass and inflation. He earned his doctorate in physics in 2012 from the University of Maryland, College Park, and has served as a Consortium postdoctoral fellow at the University of Manchester, a University Foundation fellow at the Technical University of Munich, and most recently, as a senior postdoctoral fellow at the Max-Planck-Institute for Nuclear Physics in Heidelberg.

CONSTRUCTION

Both the campus and the department are having a major amount of construction work done this summer. Here are a few scenes of the work in progress in Compton and Crow.

(continued on page 16)
X-CALIBUR RETURNS TO THE SKIES

Professors Henric Krawczynski and Fabian Kislat led a campaign to launch the 8-m focal length X-ray telescope X-Calibur on a stratospheric balloon flight. A balloon filled with 40 million cubic feet of Helium carried the telescope to an altitude of 125,000 feet, where it observed the X-ray emission from two black holes, and two neutron stars in our Milky Way galaxy. The payload was launched on September 17 from NASA’s Columbia Scientific Balloon Facility in Fort Sumner, NM. The X-Calibur polarimeter measures the polarization (the plane in which the electric field of the X-rays oscillates) which holds information about how and where the X-Ray emission originates.

The first flight allowed the team to test the instrumentation and to obtain first science data. The team hopes to use the X-Calibur observations to gain new insights into how black holes in a binary orbit with stars gobble up stellar matter and grow, as well as about the extreme physical conditions close to neutron stars and pulsars, 10-mile-diameter objects with masses exceeding the mass of our sun.

Graduate student Banafsheh Beheshtipour, lead engineer Paul Dowkontt, and Professors Kislat and Krawczynski went to Fort Sumner to assemble the experiment and to align and calibrate the telescope and the focal-plane instrumentation. The team was joined by Dr. Matthias Beilicke.

The Washington University group is collaborating with several other groups on this project: the WASP (Wallops Arc Second Pointer) group of the Wallops Flight Facility, which provided the balloon gondola and the pointing system; the Goddard Space Flight Center group, which contributed the X-ray mirror; and the Brookhaven National Lab group, in charge of the Application Specific Integrated Circuits (ASICs) for the readout of the detectors. Washington University leads the scientific team, and designed and built the 8-m long carbon-fiber telescope truss, and the X-ray polarimeter.

The X-Calibur team includes several science collaborators: M. Baring of Rice University; A. Bodaghee of Georgia College; A. Falcone of Penn State; T. Maccarone of Texas Tech.; and J. Schnittman of Goddard Space Flight Center.

The X-Calibur team chronicled the ballooning campaign on a blog, https://sites.wustl.edu/xcalibur/. The balloon flight lasted 24 hours, and ended with a soft landing of the payload without major damage to the science and pointing equipment. The team is now preparing for a Long Duration Balloon flight launched from McMurdo (Antarctica) in December 2018.

The X-Calibur project is funded by NASA under contract NNX14AD19G. The X-Calibur team thanks the McDonnell Center for the Space Sciences at Washington University for sponsoring the design and fabrication of a prototype polarimeter, and the Columbia Scientific Balloon Facility for supporting the balloon flight.
The National Science Foundation (NSF) has added a newly formed collaboration between Washington University in St. Louis and the University of Pennsylvania to its list of Science and Technology Centers (STC). The center and its collaborative efforts will be supported by a $23.6 million grant from the NSF.

“This award from the National Science Foundation reflects outstanding faculty achievement at Washington University in St. Louis,” Chancellor Mark S. Wrighton said. “As the university advances its commitment to groundbreaking, high-impact research, winning the new Science and Technology Center is a major accomplishment.”

The Science and Technology Center for Engineering MechanoBiology (CEMB) will bring together a consortium of researchers including engineers, biologists and biophysicists. The group’s mission: identify and harness the mechanical functions of both plants and animals at the cellular level. Mechanical force is a critical component of all biological systems, allowing cells to divide, migrate, adapt and differentiate. It is hoped that this deeper dive into how single cells function will transform both medicine and plant science.

“Mechanobiology has incredible potential,” said Guy Genin, professor of mechanical engineering & materials science in the School of Engineering & Applied Science, and principal investigator of Washington University’s portion of the grant. “It could change the way we view many of the world’s most complex questions and issues.

Every plant and animal living today evolved from a single-celled organism. The Washington University-Penn STC will investigate the mechanics at work on the singular cell level, and examine how the cell reacts to electrical and mechanical forces. The hope is that by better understanding the processes in place and at play, cellular “override switches” will be developed that lead to a host of new bio-inspired developments, including disease prevention and more efficient crop practices.

Rounding out the Washington University team are Marcus Foston, assistant professor, and Barbara Pickard, professor emerita of biology, both in the School of Engineering & Applied Science; and Ram Dixit, associate professor of biology; Elizabeth Haswell, associate professor of biology; and Anders Carlsson, professor of physics, all in Arts & Sciences.

In addition to scientists from Washington University and Penn, a diverse group of researchers from Alabama State University, Boston University, Bryn Mawr College, the University of Texas and the New Jersey Institute of Technology will also join in the effort.

The STC also will include a teaching component, with consortium members training students in the field of engineering mechanobiology, and preparing them for careers as innovative leaders, who are ready to collaborate in order to solve society’s biggest problems.

“While we are thrilled to assemble this all-star team to investigate the mechanics of cells, everyone involved in the STC is also very much looking forward to the mentorship piece of this project,” Genin said. “It is of vital importance to instruct and nurture younger scientists as we embark on this complex, far-reaching work.”

“This new center will link together the research and teaching efforts at Washington University with those at the partner institutions in innovative ways that we have never tried before, including opening up the university’s cutting-edge facilities and graduate catalog to the CEMB’s faculty and students at all partner institutions,” said Provost Holden Thorp. “CEMB will be a vital part of our university’s innovation ecosystem, and will lengthen the leverage of many of our key international strengths in engineering and life sciences.”

FLIGHT OF ANITA-IV

The fourth flight of the balloon-borne ANtarctic Impulsive Transient Antenna (ANITA-IV) from McMurdo Station, Antarctica took place this last Antarctic summer. Flying on a stratospheric balloon at an altitude of approximately 37 kilometers, ANITA scans the 200-1200 MHz radio band for impulsive signals from electromagnetic particle showers. The highest-energy cosmic neutrinos interacting in the ice are expected to produce a characteristic, predominately vertical polarization, while the signals from ultra-high energy cosmic-rays (UHECR) interacting in the atmosphere have a mostly horizontal polarization that is modulated by the particle shower angle relative to the geomagnetic field. ANITA has set the most stringent limits on the highest energy neutrino flux and made the first radio detection of UHECR.

In a record early season for Antarctic ballooning, ANITA-IV was launched on December 2, 2016 by the NASA Columbia Scientific Balloon Facility (CSBF), and completed just over two revolutions around Antarctica before the flight was terminated on December 30, 2016. The ANITA-IV payload landed approximately 100 nautical miles off the South Pole, and a limited recovery effort retrieved the critical data drives and the more accessible electronics components. Further recovery efforts will have to wait until next season, but a fifth ANITA flight has already been proposed.

The ANITA Collaboration is led by Professor Peter Gorham at the University of Hawaii in Manoa, and is comprised of eleven institutions. Work at Washington University is managed by Institution Principal Investigator Research Professor W. Robert Binns and Professor Martin Israel. The WU effort has focused on the ANITA power system, data telemetry system and gondola structure, which relied on the expertise of our technical staff: Paul Dowkontt (EE), Richard Bose (EE), Marty Olevitch (Computer Programmer), Garry Simburger (Elec. Tech.), Dana Braun (Mech. Tech.) and the Physics Machine Shop. Dana Braun, Garry Simburger and Research Assistant Professor Brian Rauch supported the ANITA-IV flight preparations at McMurdo. Research Assistant Professor Viatcheslav Bugaev, Martin Israel and W. Robert Binns participated in flight operations with support from Marty Olevitch, Richard Bose, Paul Dowkontt and Brian Rauch. Instrument integration at CSBF in Palestine, TX was supported by Dana Braun, Gary Simburger, Richard Bose, and Brian Rauch, and Richard Bose completed testing of the telemetry system in Hawaii. Viatcheslav Bugaev leads the ANITA data analysis and simulations efforts at Washington University.

ANITA-IV at full inflation as seen through telescope after launch
MISSING NANODIAMONDS

Institute of Materials Science and Engineering research scientist **Tyrone Daulton** was studying stardust, tiny specks of heat-resistant minerals thought to have condensed from the gases exhaled by dying stars. Among the minerals that make up stardust are tiny diamonds.

In 2007, science writer Richard Kerr, knowing Daulton’s expertise, called to ask about an article in *Science* that claimed nanodiamonds found in sediments were evidence of an ancient impact.

Daulton said it was possible the heat and pressure of such a cataclysm could convert carbon in Earth’s crust to diamond.

The *Science* paper argued that a shower of exploding comet fragments over the North American ice sheet had triggered a sudden climate reversal called the Younger Dryas. Daulton told the reporter, “There’s not enough information in this paper to say whether they found diamonds.”

Since then, Daulton has periodically been asked to evaluate Younger Dryas sediments for nanodiamonds. In the issue of the *Journal of Quaternary Science* released online December 19, he reviewed the accumulated evidence and reported on his own analysis of new samples from California and Belgium.

For the second time in 10 years, Daulton has carefully reviewed the evidence, and found no evidence for a spike in nanodiamond concentration in Younger Dryas sediments. Because nanodiamonds are the strongest piece of evidence for the impact hypothesis, their absence effectively discredits it.

Nanodiamonds are tiny — smaller than bacteria. Impact supporters often claim to find them inside small spheres of carbon, and those spheres are about the size of the period at the end of this sentence.

Even so, how is it possible for some scientists to find diamonds in samples and others to find none? One answer is that carbon atoms can arrange themselves in many different configurations. These arrangements, which make the difference between pencil lead and diamond, can be confused with one another.

(continued on page 11)

GRADUATE COLLOQUIUM

Prof. Subir Sachdev, Herchel Smith Professor of Physics, Harvard University, gave the graduate student colloquium on Wednesday, March 22. The subject of his talk was “Quantum Entanglement, Strange Metals, and Black Holes.” Prof. Sachdev was invited and hosted by Physics Department graduate students; the event was chaired this year by **Jordan Russell** and **Sumanta Bandyopadhyay**, who are the graduate student members of the departmental colloquium committee. Prof. Sachdev is a member of the National Academy of Sciences, a Fellow of the American Physical Society, and a Guggenheim and Sloan Fellow. In 2015, he was awarded the Dirac Medal by the Australian Institute of Physics.
MEET A SCIENTIST

The Record recently featured 10 Washington University scientists in short videos speaking about moments in their lives that have much to do with why they are scientists. Included in the group of scientists are physics professors Mairin Hynes and Mark Alford. You can view their videos at: https://www.thinglink.com/scene/913090369514635265

NOWRUZ CELEBRATION

In March, Iranian students put together a potluck lunch in celebration of the Persian New Year, Nowruz. Nowruz is an ancient celebration of the spring equinox and Iranian new year. It has been celebrated for over 3000 years. It is celebrated at the exact moment that the length of the night and day becomes equal. To celebrate Nowruz, people set a table, called a Haft Sin table, with seven major items that start with the letter “S” in Persian and each are a symbol of prosperity in life. The Nowruz celebration ends 13 days after the moment it begins and during this period people typically visit their relatives. The celebration is ended by going to a picnic on the 13th day.

SCANNING ELECTRON MICROSCOPE

The Laboratory for Space Sciences acquired a new scanning electron microscope. It is a Tescan field-emission scanning electron microscope and will be used to study extraterrestrial samples.
Professor **Kater Murch** hosted the Physics Department picnic at his home this spring. Graduate student **Siera Stoen** coordinated the picnic. It was a beautiful day with a great turnout. Numerous pizzas were served and activities included swimming and “boat” races.
ASTRONOMY NIGHT OUTREACH

In March, the Outreach Committee participated in the inaugural Astronomy Night at Mark Twain Elementary School in Brentwood. Close to 50 children were in attendance as well as many of their parents. WU helped them learn a little bit about the solar system and some constellations. The kids drew constellation creations and then went outside to see some stars.

ENERGIZING DEBATE

The department took part in the excitement of the Trump-Clinton debate on campus this year. The Society of Physics Students received Presidential Debate funding to host “Energizing Debate: The Science Behind Energy and Environmental Policy.”

Pictured are (left to right): Moderator Tyler Satchel Orden, sophomore, and panel members Profs. Jonathan Katz and Mike Ogilvie (Physics), as well as Michael Wyssession (EPS).
PHYSICS FAMILY
FUN DAY 1

In early April, the Outreach Committee hosted a Physics Family Fun Day, and it was a great success. The event was themed Thermal Physics, and immediately followed Dr. Krawczynski’s Saturday Science Lecture on Black Holes and Gravitational Lenses.

Approximately 25-30 people attended, comprised of parents and their children (who were in the kindergarten to middle school age range). They were privy to learning about the physical principles underlying demonstrations on: Stirling engines, hot air balloons, air pressure can crushing, fire tornadoes, balloons in liquid nitrogen, and superconducting magnets. The event culminated with the last demonstration, liquid nitrogen ice cream.

Using a fog machine, Jared Lalmansingh (right), shows how to create a propane derived fire-tornado using two halves of a hollow tube and also how to visualize the biased air current feeding it.

After an initial discussion of the physical principles underlying how hot air balloons work, Daniel Van Hoesen (right), assists audience members in creating and testing their own hot air balloons made of kite paper, masking tape, and glue.

Following an explanation of the physical processes used to create it, Natalia Calleya (right), helps Kelsey Meinerz (off-screen) prepare liquid nitrogen ice cream for the audience by mixing liquid nitrogen into a mixture of cream, sugar, and vanilla extract.
On May 20th, the Outreach Committee hosted another Physics Family Fun Day covering topics in optics. They showed attendees some fun examples of total internal reflection and Schlieren photography. They also had attendees create their own kaleidoscopes and refracting telescopes using very simple, household materials. The event ended with a very nice presentation by Jared Lalmansingh about the upcoming solar eclipse and how to view it safely. A special thank you to Dr. Israel for providing the group with plenty of solar eclipse glasses to be able to provide one to everyone in attendance and to Sean Ehle and Dr. Gibbons for their help in designing some of the demonstrations. Participating students included Gus Medeiros, Kelsey Meinerz, Jared Lalmansingh, Matt Reisman, Natalia Calleya & Zach Hughes.
**PRESOLAR GRAIN WORKSHOP**

Through the weekend of October 21-23, 2016, the McDonnell Center for the Space Sciences and members of the Laboratory for Space Sciences hosted the annual Presolar Grain Workshop in the Physics Department. Over 40 participants attended two days of presentations, and we were fortunate to have twenty in-depth talks, focusing on nucleosynthesis in stars and isotopic anomalies in extraterrestrial materials. This workshop was founded by Professor Donald Clayton of Clemson University and late Professor Ernst Zinner of Washington University, and rotates annually between four institutions: Washington University, Clemson University, the University of Chicago, and the Carnegie Institution of Washington, D.C.

For over two decades, this informal, collegial workshop has been a bastion of collaboration in the ongoing field of presolar grain research, of which Washington University has been a pioneer.

Impact supporters often claim to have found lonsdaleite, a rare form of diamond that has a hexagonal rather than the common, cubic atomic structure. “Lonsdaleite is usually reported in the literature associated with impact sites or in meteorites that were shock processed,” Daulton said. “It can also be formed by detonation in the laboratory, so the presence of lonsdaleite to me would be a strong suggestion of an impact.”

As the Younger Dryas impact hypothesis has lost scientific credibility, it has captured the imagination of the general public, in part because the climate reversal may — or may not — be linked to extinction of Ice Age megafauna like the mammoths and the disappearance of the paleo-Indian Clovis culture.

But when he examined Younger Dryas samples reported to contain lonsdaleite, Daulton couldn’t find it. Instead, he found aggregates of single-atom-thick sheets of carbon atoms (graphene) and sheets of carbon atoms with attached hydrogen atoms (graphane) that looked “very, very similar to lonsdaleite.” So the claim of lonsdaleite was based on a misidentification.

In 2014, a group of researchers reported that they had found a nanodiamond-rich sediment layer that spanned three continents. While claiming to have found cubic and hexagonal diamond, they also claimed to have found much more abundant n-diamond, a controversial form of diamond characterized by electron diffraction patterns similar to diamond, but with extra “forbidden” reflections that diamond does not exhibit.

Pulled back into the controversy, Daulton again found no diamond or n-diamond in the samples from the Younger Dryas horizon. What he found instead was nanocrystalline copper, which produces diffraction patterns just like the controversial n-diamond. Daulton also attempted to reproduce the analyses that found a spike in the concentration of nanodiamonds at the Younger Dryas, but he found flaws in the methodology that invalidated the result. Paradoxically, it was Daulton’s experience finding nanodiamonds in stardust that prepared him not to find them in sediments.

Excerpted from: https://source.wustl.edu/2016/12/case-missing-diamonds/
FALL 2016: The Strange World of Quantum Physics

The quantum revolution did more than add to our knowledge of the physical world. It fundamentally changed how scientists and philosophers view the world, and continues to drive change in all of our technologies.

Michael Ogilvie: Unsung Heroes of Quantum Physics
Kater Murch: Quantum Measurement and the Emergence of an Arrow of Time
Carl Bender: Black Holes and Quantum Mechanics
Mark Alford: Spooky Action at a Distance: the EPR Experiment and the Weirdness of Nature
Alexander Seidel: Quantum Meets Classical: The Superconducting State

SPRING 2017: Connecting the Large and the Small

Today’s physics connects the history of the universe, and the stars and planets in it, to the smallest parts of our universe: to rocks, cosmic dust, atoms, elementary particles, dark matter and dark energy.

Michael Ogilvie: Dark Energy: Is Quantum Physics Making the Universe Fall Apart?
Henric Krawczynski: Exploring the Spacetime Around Supermassive Black Holes with Gravitational Lenses
Francesc Ferrer: In the wake of the Higgs, what could be the next breakthrough at the LHC?
Ryan Ogliore: From Stardust to the Solar System
FACULTY AWARDS & RECOGNITION

Prof. Carl Bender was awarded the 2017 Dannie Heineman Prize for Mathematical Physics by the American Physical Society and the American Institute of Physics “for developing the theory of PT symmetry in quantum systems and sustained seminal contributions that have generated profound and creative new mathematics, impacted broad areas of experimental physics, and inspired generations of mathematical physicists.”

With this prize Bender joins the illustrious company of Stephen Hawking, Freeman Dyson, Murray Gell-Mann, Roger Penrose, Steven Weinberg, and Edward Witten, among others.

Prof. Kater Murch has received the St. Louis Academy of Science 2017 Innovation Award. This award recognizes a scientist or engineer, age 40 or under, who has demonstrated exceptional potential for future accomplishments in science, engineering or technology. Murch has made significant discoveries in understanding and controlling quantum systems, revealing how quantum systems evolve during the process of measurement. He has surmounted the most challenging hurdle to controlling quantum systems and discovered how they evolve under measurement, a subject of intense debate since the formulation of quantum mechanics. Murch’s approach focuses on using weak measurements to slowly accumulate information about the quantum state and thereby “look inside” wave function collapse. Murch has applied this novel ability to track quantum systems through their complex-valued state space to examine fundamental processes.

Prof. James G. Miller was named the recipient of the 2016 Rayleigh Award. This ultrasonics award is the highest given by the Ultrasone, Ferroelectrics, and Frequency Control (UFFC) Society of the Institute of Electrical and Electronic Engineers (IEEE). The award is named in honor of British Nobel Prize winning physicist John William Strutt, recognized as one of the fathers of the physics of sound. The citation for Professor Miller’s award reads “For pioneering sustained and high impact research in ultrasonic tissue characterization and quantitative echocardiography”.

Bob Binns (3rd from left) and Brian Rauch (center) on the swamp tour that was part of the CALET Technical Interchange Meeting (TIM) at LSU in Baton Rouge in March that they attended after a LIGO visit.
Prof. Erik Henriksen gave a Science on Tap talk titled “Graphene: Particle Physics in Pencil Lead” on January 25. Science On Tap is a place where, for the price of a beverage, anyone can come to explore the latest ideas in science and technology. Meetings take place outside a traditional academic context, at the Kirkwood Station Brewing Co. in Kirkwood, MO and Erik says it is the first time he’s given a talk while drinking a beer.

Henriksen also gave the same talk at Maplewood-Richmond Heights High School as the keynote speaker for their Science Honors Symposium. The Symposium was for students who had conducted independent research projects and were showing their results, like a mini science fair.

Prof. Ken Kelton and Daan Frenkel, Cambridge University, were guest co-editors for an issue of the Journal of Chemical Physics. The issue was a Special Topic on Nucleation: New Concepts and Discoveries.

The issue was a Special Topic on Nucleation: New Concepts and Discoveries.

Prof. Carl Bender originated the research area known as PT symmetry. This has led to scores of papers reporting experimental work -- these papers have been published in PRL, Nature, and Science. His original paper in PRL with graduate student Stefan Boettcher now has over 2000 citations. This work is highly interdisciplinary and it has had an impact in chemistry, biology and even in financial mathematics. The biggest interdisciplinary impact has been in mathematics.

A recent application is in complex analysis. Physicists have been searching since 1999 for a quantum system whose energy levels correspond to the zeros of the zeta function. In a paper published on March 30 in Physical Review Letters, Bender, Dorje Brody of Brunel University London and Markus Müller of the University of Western Ontario proposed just such a candidate system. This paper in PRL is an Editor’s recommendation: “Hamiltonian for the zeros of the Riemann zeta function” C. M. Bender, D. C. Brody, and M. P. Muller Physical Review Letters 118, 130201 (2017) [arXiv: quant-phys/1608.03679]

In the past few months, Bender has given invited talks (colloquia) on his research at: Brookhaven National Laboratory, Princeton, University of Toronto, University of Heidelberg and he gave the opening plenary talk at a meeting on PT symmetry in Germany [PHHQP XVII -- 17th International Workshop on “Pseudo-Hermitian Hamiltonians in Quantum Physics” Bonn, Germany at Bad-Honnef]

Previous talks in the last academic year were at meetings in Prague, Crete, Kyoto, and London. He also gave a Saturday Science talk last fall.

Bender continues to be a Visiting Professor, Mathematics Department, Imperial College, London; an International Professor of Physics, University of Heidelberg and a Visiting Professor, King’s College, London.

(Continued on page 15)
Prof. Jonathan Katz has been working on Fast Radio Bursts, a recently discovered astronomical phenomenon consisting of brief (millisecond) bursts of radio radiation that are detected from far across the Universe. These bursts are remarkable because they are faster (briefer) than almost anything else in astronomy; for example, they are five to fifty times shorter than the shortest gamma ray bursts. The two most popular hypotheses to explain fast radio bursts are that they are radio counterparts of “soft gamma repeaters”, an energetic phenomenon emitting gamma or X-rays and known in our Galaxy (where they are not observed to emit radio waves, casting some doubt on this hypothesis), and that they are supergiant pulses of pulsars.

Prof. Katz published the first review article about Fast Radio Bursts in 2016, and has investigated both the leading hypotheses as to their sources, soft gamma repeaters and pulsars. In particular, he has considered the possibility that rather than being sources of brief bursts, they are more like lighthouses, radiating steady narrow beams that sweep across the sky, only infrequently pointing in our direction. That hypothesis would reduce the peak powers we infer they are radiating, making them easier to understand. He has also asked if they may be the results of the collapse of stars to neutron stars without making supernovae. Many neutron stars are known to be formed in supernovae, a process that has never been satisfactorily calculated, but independent arguments have suggested that there may be neutron stars formed without a supernova.

Prof. Katz has also continued his work, in collaboration with undergraduate Justin Finkel, on climate change. They found that in the United States the gradual warming trend has (unsurprisingly) reduced the rate of all-time record minimum temperatures, but has not (perhaps more surprisingly) increased the rate of all-time record maximum temperatures. In contrast, in Australia the rate of all-time record maximum temperatures has increased in the last few decades. Climate change is a very regionally varying process.

Indices of (a) minimum temperature records (t) and (b) maximum temperature records (t) computed over all 1218 sites and all 365 calendar days, showing means and 1.
Long-time Physics Department professor Tom Bernatowicz retired in December 2016, following a year-long terminal sabbatical. Tom’s career at Washington University began as a graduate student in the Department of Earth and Planetary Sciences in 1975. After receiving his PhD in 1980, he joined the Laboratory for Space Sciences where he remained for the rest of his career. As Professor in Physics, Tom was responsible for the establishment of an innovative approach to the teaching of the department’s Introductory Physics (197/198) course, based on Thomas A. Moore’s textbook, *Six Ideas That Shaped Physics*. In 2004, when Tom first started teaching with *Six Ideas*, it was with one section of 62 students. Now there are six sections taught every year, with over 750 students per semester. Tom imparted a love of knowledge, and of physics in particular, to the many students and colleagues with whom he interacted during his years in the department (https://source.wustl.edu/2011/03/physics-according-to-bernatowicz). In 2009, he won the inaugural David Hadas Teaching Award in acknowledgement of his commitment to teaching.

*Construction* (Continued from page 1)

Scenes from Crow & Compton, early June 2017.
The 5th Joint Meeting of the Acoustical Society of America and the Acoustical Society of Japan was held in Honolulu, Hawaii, in November, 2016. As was the case for the 4th Joint Meeting, which took place at the same venue ten years earlier, Dr. James Miller, in partnership with Professor Mami Matsukawa of Doshisha University in Kyoto, Japan, organized an all-day session on the physics and engineering underpinning the use of ultrasound to characterize bone.

An all-invited-talk program brought together world leaders in this highly competitive field. Talks from the Laboratory for Ultrasonics and from the United States Food and Drug Administration brought together novel research from Laboratory for Ultrasonics alumni Keith Wear and Amber Nelson Groopman, and Professors Jonathan Katz and Jim Miller.

The 42nd annual International Symposium on Ultrasonic Imaging and Tissue Characterization was held in greater Washington, D.C. in June, 2017. Jim Miller, who has served as Co-Chairman of that meeting for many years, delivered a presentation co-authored with Connie James and Jonathan Katz on role of the causality-imposed Kramers-Kronig relations in ultrasonic tissue characterization.

(Continued from page 15)

More scenes from Compton and Crow, late June 2017. Construction is scheduled to be complete in time for the fall semester. The second floor hallway, lecture halls, and third floor labs are all being updated.
Tony Biondo retired on February 3, 2017 after 42 years in the Physics Department machine shop. He managed the shop for 5 years and taught the machine shop course. He says one of the best things he ever did was to hire Todd Hardt to manage the shop. Tony plans to enjoy his retirement by reading, gardening, visiting Civil War battlefields, and even doing some machining.

Nathan Lundak, Machinist, joined the shop on July 3, 2017 to fill the vacancy left by Tony. Nathan has a degree from Ranken Technical College in Precision Machining Technologies.

Shirley McTigue joined the department on May 15, 2017 as the Grants & Budgets Administrator, replacing Andrew Hampton who took a position at the Medical Campus. Shirley came to Physics from the Medical School campus where she was the Data and Grants Manager for Biology & Biomedical Sciences (DBBS); she worked in the Department of Surgery (Vascular Division) prior to that implementing a database to track surgical details for research/reporting purposes. Although this is only the third department she’s worked in during her 31 years with the university, she’s changed roles within each department always trying to learn something new. Shirley has always enjoyed working with people and looks forward to getting to know everyone.

Drew Osterhout, Faculty Assistant, is a singer with The Ambassadors of Harmony. In 2016, they brought home the gold medal as the best chorus of 2016 when they won an international A Cappella Competition.

Even though Patricia “Patty” Kofron joined the Department of Physics as Departmental Administrative Assistant in December 2016, she is no stranger to Washington University having been an administrative secretary to the former Chairman of the Department of Surgery, Samuel A. Wells, Jr., M.D.

A native St. Louisan and mezzo-soprano, Patty attended the London College of Music in London, England where she was awarded Fellow of the London College of Music, F.L.C.M. in vocal performance. She sings regularly with the St. Louis Symphony Orchestra and Chorus, and performed with them in March 2017 at New York’s Carnegie Hall.

When she is not working in the Physics Department or singing, she enjoys hiking, travel, cooking international cuisine, and gardening. Patty is the proud mother of two Washington University graduates.

Denny Huelsman was recognized at the Staff Awards ceremony in May for his 26 years of employment at Washington University.

Merita Haxhia joined the department on August 17, 2016 as an Intro Physics Lab Manager, replacing Dan Flanagan.

She and her family moved to the US in August 2001 from a small European country, Albania. She graduated from Tirana University and held different educational positions including teacher, curriculum coach, and principal.

The challenge of facing a different culture from her native one did not stop her eagerness to teach physics. She came to the department after working as a Physics and Advanced Placement Physics teacher and Science Department Head at Gateway STEM High School in St. Louis Public School District for 11 years. During that time, she received several awards.
STUDENT NEWS

Graduate student Siera Stoen recently completed the Associate level of the CIRTL program.

In 2011, Washington University became a member of the Center for the Integration of Research, Teaching, and Learning (CIRTL). CIRTL is a network of 43 universities dedicated to preparing future faculty who will be equipped to meet the challenges of improving learning and increasing diversity in STEM.

Our local program, WU-CIRTL, is designed to be the starting point for a faculty career that includes the practice of scholarly teaching, which involves: Reflecting on and assessing one’s own teaching, Developing knowledge of, and implementing, evidence-based pedagogy by drawing on research from the cognitive and learning sciences, the Scholarship of Teaching and Learning (SoTL) and discipline-based education research, and Developing knowledge of research methods that may be applied to evaluate teaching and learning.

The program is designed with multiple levels (Community Member, Associate, Practitioner, and Scholar) to enable participants to build on introductory-level TA-training to increase their expertise in evidence-based, active-learning pedagogies.

Mark Sellers has received a 2017 NSF Graduate Research Fellowship. Mark is doing research on metallic liquids in Prof. Ken Kelton’s group. The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based Master’s and doctoral degrees at accredited United States institutions.

Undergraduate student Ryan Wahidi is this year’s recipient of the Arts & Sciences Florence Moog Scholarship.

On 3/14/17, the staff celebrated Pi Day with individual π pies.

Staff News (Continued from page 18)

for excellence in teaching such as STEM Teacher of the Year and Science Teacher of the Year. Also, while teaching, she received her Master’s Degree in Physics from Southern Illinois University in Edwardsville. In addition to her devotion to working with the students, Merita still enjoys traveling, cooking and the company of her friends and colleagues.
STUDENT NEWS

The following students received their PhD degrees this year. Their thesis titles, faculty advisors and current position (if known) are listed as well.

Janie K. Hoormann, “Using Simulations of Black Holes to Study General Relativity and the Properties of Inner Accretion Flow,” June 29, 2016 (Krawczynski) University of Queensland in Brisbane, Australia, Postdoc

Dong Ding, “Green’s Function Application for Pairing Correlations and the Optical Potential,” July 7, 2016 (Dickhoff)

Amila Weerasinghe, “Spectral Properties of Fractional Quantum Hall Hamiltonians,” August 9, 2016 (Seidel) McDonnell Genome institute, Washington University, Postdoc

Wenlei Chen, “Probing Intergalactic Magnetic Fields from γ-Ray Observations,” August 22, 2016 (Buckley) Washington University, Postdoc

Christopher Pueblo, “Ground and Flight Based Studies of Nucleation and Thermophysical Properties in Metallic Glass Forming Systems,” September 21, 2016 (Kelton) Washington University Physics, Postdoc

Rashied Amini, “Modern Assessment of the High-Energy Background Environment at Small Atmospheric Depths Using the X-Calibur X-Ray Polarimeter and Its Implications,” October 29, 2016 (Krawczynski) NASA Jet Propulsion Lab, Systems Engineer

Li Chen, “The Second Quantized Approach to the Study of Model Hamiltonians in Quantum Hall Regime,” November 18, 2016 (Seidel) National High Magnetic Field Laboratory, Postdoc


Jinbang Guo, “New Techniques and Optimizations of Short Echo-Time 1H MRI with Applications in Murine Lung,” December 14, 2016 (Conradi/Woods) Cincinnati Children’s Hospital Center for Pulmonary Imaging Research, Postdoc

Nathan (Caleb) Wright, “Ongoing and Visually-Evoked Cortical Activity Measured Across Multiple Spatial Scales,” December 14, 2016 (Wessel) Georgia Institute of Technology, Department of Biomedical Engineering, Postdoc


Josiah Lewis, “Stellar and Interstellar Origins of Meteoritic Nanodiamonds,” April 12, 2017 (Bernatowicz) MCSS, Washington University, Postdoc

Avery Archer, “A Study of the Effects of Pair Production and Axionlike Particle Oscillations on Very High Energy Gamma Rays from the Crab Pulsar,” August 19, 2016 (Buckley) Purdue University, Postdoc

Tyler Harmon, “Excluded Volumes of Disordered Linkers Modulates the Phase Behavior of Multivalent Proteins,” April 19, 2017 (Pappu) MPI-PKS and MPI-CBG, Dresden, Post-doc
STUDENT NEWS

Graduating Seniors

16 seniors graduated in May 2017:

Patrick Boyle
Bobbie Brown
Patrick Chao
Fan Chen
Tommy Dvergsten
Justin Finkel
Samuel Jolinger
Dennis Kelly

James Lung
Dominic Maley
Vera Schulte
Michael Seitanakis
Jeremy Sorel
Spencer Stanley
Eugene Tsao
Daniel Wasserman

New Graduate Students

For the 2017-2018 academic year, the department admitted 15 new graduate students:

Maryam Abbasi
Hamed Aliakbariyan
Nathaniel Conway
Matheus De Oliveira Schossler
Md. Arman Hossen
Dawson Huth
Yashika Kapoor
Taeho Lee

Chen-Hao Lin
Luis Perez
Lindsey Rodgers
Shixang Wang
Andrew West
Fang Xu
Linghan Zhu
Wolfgang Zober

2017 Seniors

Front Row: Sam Jolinger, Eugene Tsao, Michael Seitanakis, Spencer Stanley, Dominic Maley, Justin Finkel

Back Row: Fan Chen, James Lung, Vera Schulte, Tom Dvergsten, Patrick Chao, Bobbie Brown, Jeremy Sorel, Dennis Kelly, Daniel Wasserman
STUDENT NEWS

Missouri Collegiate Mathematics Competition

The 22nd Missouri Collegiate Mathematics Competition was held in March in Joplin. Washington University teams placed 1st and 3rd. Physics minor Alex Mason competed with the first place team.

Eliot Society Dinner

In April, the WU Eliot Society hosted Neil deGrasse Tyson and the Society generously donated tickets to allow some students to attend the dinner with him. After dinner, Dr. Tyson personally invited and talked to members of the Society of Physics Students privately.

Undergraduate Research Symposia

Twice yearly, the Office of Undergraduate Research sponsors the Undergraduate Research Symposium. It is a forum for students to present their research findings and a celebration of the diversity of research that takes place at Wash U.

The following students participated in the October 2016 symposium: Ryan Chang, Christian Fogerty, Nathan Gartlan, Arman Guerra, Michael Keim, Heather Lee, Bohan Lu, Michael Seitanakis, David Shaw, Caroline Sullivan, Eugene Tsao, Ryan Wahidi, and Zack Weinstein.

Sophomore Caroline Sullivan, senior Michael Seitanakis, and junior Arman Guerra show off edible accoutrements while presenting posters at the Undergraduate Research Symposium in Fall 2016.
STUDENT NEWS

SPS Outstanding Chapter Award

In 2016, the Washington University Chapter of the Society of Physics Students was recognized as an Outstanding SPS Chapter. Some of the criteria for this award include:

- The chapter’s involvement in local, zone and national SPS meetings and other professional meetings
- Participation in SPS programs
- Outreach efforts to grades K-12 or the general public
- Participation in community service
- Contributions to student recruitment and retention
- Participation in social events
- Interactions with the department’s alumni

Sigma Pi Sigma Inductees

Join us in congratulating the newest members of the Washington University in St. Louis Chapter of Sigma Pi Sigma, the national physics honor society.

Patrick Chao  Dennis Kelly
Fan Chen        Michael Seitanakis
Tommy Dvergsten Daniel Wasserman
Justin Finkel

SPS students hosted a Liquid Nitrogen Ice Cream Night in March.

SPS Officers elected for 2017-2018

Back row: Prajwal Keranahalli (Member-at-large), Ryan Wahidi (Treasurer), Bohan Lu (Webmaster), Jon Huster (Secretary), Stella Schindler (President)
Front row: Julia Cohen (Historian), Tyler Orden (Vice President), Jason Tang and Kos Sarfo (Public Relations), Prajwal Keranahalli (Member-at-large), Isabella Pastrana (Workplace Climate and Diversity Committee Representative)
STUDENT AWARDS

Departmental Awards to Students

Each year, the department awards prizes for outstanding performance.

Graduate Students

Shull Prize
Awarded to the top graduate teaching assistant partially endowed in memory of Franklin Shull. Frank Shull was the senior faculty instructor in introductory courses for many years, and the prize takes note of both his interest and the importance that the Department attaches to the quality of teaching assistantships. This year, we had three awardees and three honorable mentions.

Nima Hassanpour
Ghady was nominated by Carl Bender and Craig Lincoln for his work in Physics 501 and 504. Lincoln said, “Nima is currently my TA for Physics 502 and is, by far, the best TA I’ve had while adjunct teaching at WU Physics since the 1990’s.” Bender added, “Nima is doing an excellent job. The problem sets are always graded accurately and finished on time. Nima has TAed for me in 501, 502, and 503 in the past and has always done fantastic work. However, I have now had reports from graduate students that he is also doing a marvelous job in Physics 502 … the students say that he is the best TA that they have ever had.”

Daniel Van Hoesen
was nominated by Scott Handley for his work in Physics 322. Handley said, “Dan is currently doing his second year of TAing the Physical Measurements lab. He is a natural teacher and hands-on experimenter. He thoroughly enjoys interacting with the students and is very helpful in guiding the students to a better understanding of the physics as well as the practical aspects of performing the experiment.”

Jufri Setianegara was nominated by Mairin Hynes for his work in 197 Labs. Hynes said, “Jufri would regularly hold 3-5 hour long help sessions each week, instead of his required 1 hour office hour. His office hours regularly had an attendance 3-4 times the number of students usually at Physics 197 office hours, despite them being Friday afternoon. During these office hours, Jufri would use a number of excellent active-learning strategies to help the students learn the material. He would go out of his way to respond to every student email, which included helping them solve extra problems and derivations, something not required of him as a TA. Jufri was nominated to me by several of his students who wrote me emails and letters about how fantastic and helpful he was. Out of the ~15 TAs I oversee in Intro Physics each semester, I have never had a student contact me about how wonderful a TA was, much less several students.

Honorable Mentions:

Augusto Medeiros da Rosa: by Martin Israel for Physics 118
Kamal Pangeni: nominated by Mark Conradi for Physics 463
Mark Sellers: nominated by James Miller for Physics 314

Dean’s Award for Teaching Excellence

This award recognizes superb performance by a graduate teaching assistant in the instruction of Arts & Sciences undergraduates. Each Graduate Arts & Sciences department is invited to nominate its best teaching assistant for the award.

Nathan Brown was an outstanding lecturer in the summer Physics 117 (General Physics) course in 2016, and served as a teaching assistant for introductory Physics 197-198 for several semesters. He was also the Teaching Assistant for introductory thermodynamics Physics 463, and graduate electricity and magnetism Physics 505.

In these courses, Nathan demonstrated his commitment to active learning approaches, his ability to make complex topics approachable to students, and a knack for getting students to ask questions that further their understanding. His ability to tailor his teaching to individual students’ abilities makes him especially effective and appreciated as a teacher.
STUDENT AWARDS

Undergraduate Students

Nishi Luthra Senior Prize

Awarded to the outstanding senior Physics Majors. Selection is based on performance in physics courses and is made by the department’s major advisors. The donors Chaman and Adarsh Luthra made this gift in memory of their daughter Nishi Luthra who died in 1984 while she was a student at WashU.

May 2016 - Tommy Dvergsten & Justin Finkel

Varney Prize

Awarded to the best students in the introductory courses. Professor Robert Varney was a member of the faculty for many years. This prize was established to commemorate his deep and long-time interest in physics instruction.

2015-2016 - Nate Ballintyn & Pooja Jairam

Honorable Mentions: Jiachen Deng, Thomas van Horn, Jordan Pack

Summer 2017 - Mark Alford and Tommy Dvergsten

Undergraduate Summer Research Fellowship

The Fellowship is for ten weeks in the upcoming summer. The purpose is to provide a gateway for summer research in an on-campus laboratory with an appropriate faculty mentor. Nomination for this fellowship is made by a faculty member.

Summer 2017 - Ryan Chang, Blake Bordelon, Isabella Solaro, Elizabeth Montesano, Hannah McCall, Caroline Smith, Tyler Spink, Caroline Sullivan, Julia Cohen

(Continued on page 27)
Graduate Research Symposium

The 22nd annual Graduate Research Symposium was held in February. Eleven graduate students from the Physics Department participated: Kelsey Meinerz, Shiyan Gao, Ruixiang Fei, Nima Hassanpour, Arefeh Sherafati, Sumanta Bandyopadhyay, Fowad Motahari, Jing Son, Yuhang Deng, Jonah Scher-Zagier, and Wenshen Song.

ALUMNI NEWS

LinkedIn Group

Alumni of the Physics Department have a LinkedIn group, “Washington University in Saint Louis, Physics Department Alumni” (https://www.linkedin.com/groups/8516994)
All current and former physics majors, minors, graduate students, and faculty can create a free account and take advantage of the group resources. Members are encouraged to invite connections to join and increase the representation of mid-career members.

The group is an information source on career path types (industry, government, and academic) for physics students and a networking tool for established alumni. While physicists can use their skills in many job areas, the group provides a contextual dataset of specific careers achieved by those with a WashU education and credentials. Helpful information for students and soon-to-be graduates includes field-specific job titles, an inventory of skills necessary for success in various job types, as well as networking and contact information.
IN MEMORIAM

Stanley Crone, Demonstration Technician for nearly 30 years until his retirement in May 2015, died on Sunday, March 26, 2017.

Ken Kelton, Professor, worked with Stan in the intro physics class and enjoyed doing so. A real passion that Stan and Ken shared was woodworking. Stan was a master and Ken says that he benefited many times from conversations as varied as discussions of tools to bandsaw techniques. When Ken was chair, he asked Stan to take a large old table that was in Crow 205 and cut it down in size. He went way beyond the mark, preparing a beautiful table with very nice inlaying on the side.

Pat Gibbons, Professor Emeritus, writes, “I worked with Stan Crone for many of his years in Physics, teaching introductory physics frequently and making heavy use of his demonstrations. He kept them in impeccable order and made them work perfectly for us instructors. He created one new demonstration that no one asked for, when he saw videos on the internet and knew we would want it. That was the can crusher, using magnetic pressure on a soda can to tear it apart with a gratifyingly loud noise. His first try was a failure, but those that followed worked better and better. It still tends to tear its electromagnet coil apart, but now a coil will last through quite a few uses. We did want it, indeed, and it is one of the students’ favorites. I would, too frequently, ask Stan in the last 10 minutes before a class, “Can we do something like this?,” showing a picture in a textbook. He always answered either “Yes” or “Not exactly, but how about this?” showing me a piece of equipment or a picture of his own. These spur-of-the-moment demonstrations also worked well. I treated him brutally with these requests, but he remained cheerful and produced what was needed almost every time.”

“I was Stan’s supervisor for a few years, but he hardly needed watching. Instead I negotiated time he needed off for him, or just approved it and apologized to the department later. Stan was the best curator of our demonstration equipment we ever had.”

Philip Moore, Electronics Engineer, passed away Saturday, May 20, 2017, at the age of 64.

Philip earned his Bachelors and Masters degree in Technology at Indiana State University. Phil worked for McDonnell Douglas and then Boeing from 1976 to 2006 when he retired. After retirement, he worked with a group of scientists at Washington University to help create the Super-TIGER, a balloon developed to study cosmic rays.

In his spare time, Philip enjoyed radio controlled airplanes and riding his motorcycle. Phil was also an avid St. Louis Blues Hockey fan. Above all else, Phil loved his family, and he will be missed dearly by all who knew and loved him.

Student Awards (Continued from page 25)

Greg Delos Summer Research Fellowship

Greg Delos was an excellent student who died during his junior year. In his memory, the Delos family has generously set up the fund that supports the award, each year, of a prize that takes the form of a stipend to support a student working with one of the research groups during the summer. The winner is selected by the department’s advisors from among the applicants, with selection based on performance in the physics courses (and possibly research) thus far.

May 2017 - Michael Keim & Jordan Pack
During the year, refer to our website: www.physics.wustl.edu for up-to-date news.