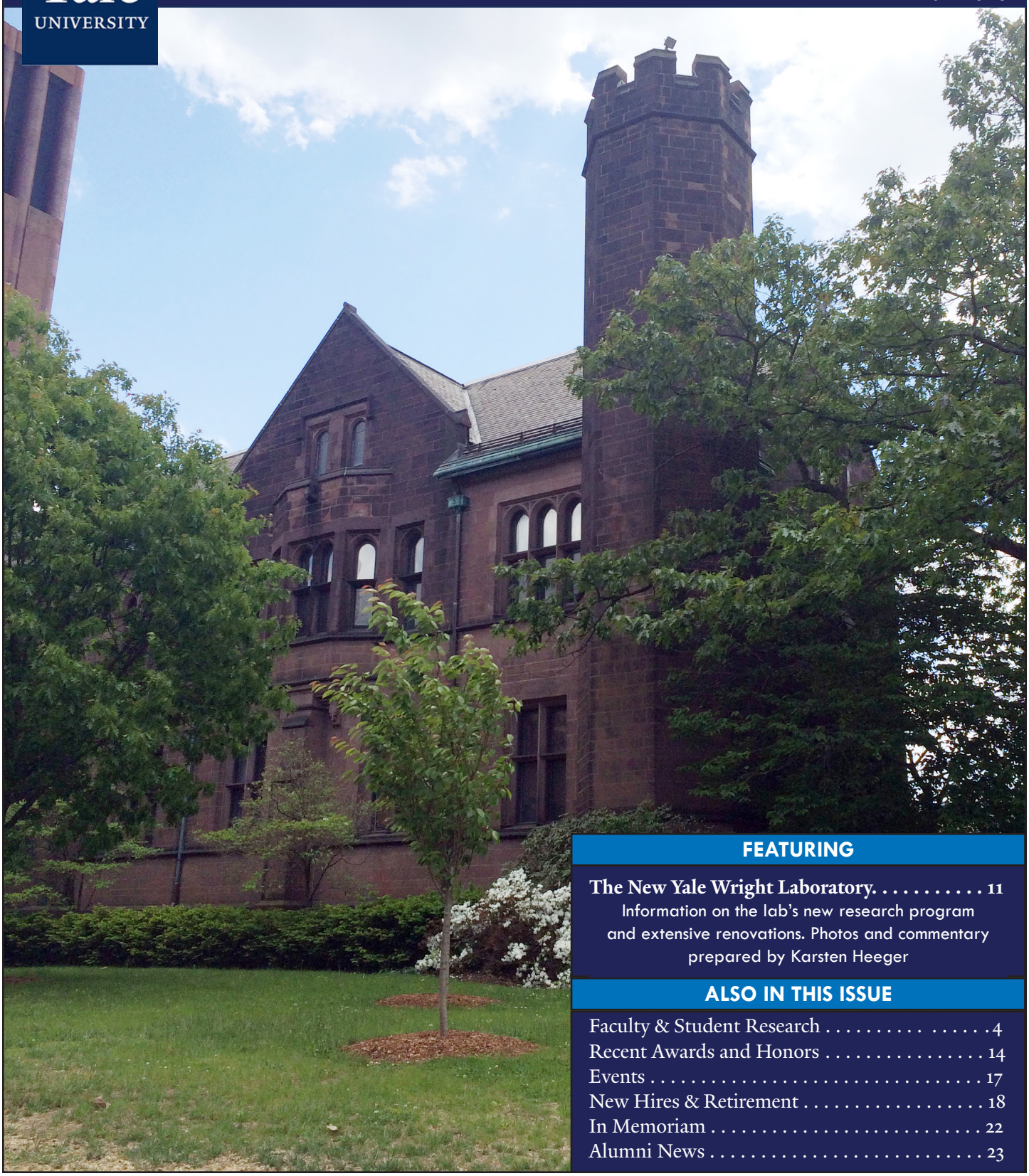
Physics News

Yale UNIVERSITY

Fall 2015



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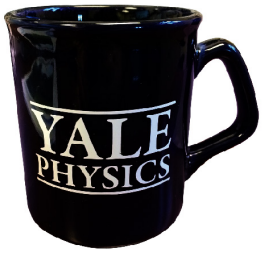
YALE
PHYSICS

A MESSAGE FROM THE CHAIR

Greetings from Paul Tipton

Paul Tipton

It is a pleasure to welcome you to the latest edition of the Physics Newsletter. Our hope is that by gathering news of our research, teaching, and outreach activities, we will help those both near and far catch a glimpse of the exciting advances that are taking place in the Department. You will be able to read about extensive ongoing renovations to Wright Lab that will help its occupants advance the frontiers of nuclear, particle, and astrophysics. You can read about attempts to test quantum gravity in Sloane Physics Lab, and how Yale scientists are leading an effort at Fermilab to understand the mysterious neutrino sector. Still, if you read the Newsletter cover-to-cover, you will learn about just a small fraction of the research activities currently underway in the Department.

Heraclitus was surely right when he wrote, "change is the only constant in life." Two years ago we celebrated the career of Jack Sandweiss on the occasion of his retirement. Jack, who came to Yale as an instructor in 1957, became a member of the National Academy of Sciences in 1987, and for over 25 years served as Senior Editor of Physical Review Letters.

Jack still comes in to his office in the J.W. Gibbs building, which was just 2 years old when Jack arrived at Yale. Many of us know Gibbs as a functional building that has let many do great work; but lately Gibbs has become a bit leaky in wet weather, and it never was a model of energy efficiency. I think it is also safe to say that the Gibbs building never inspired anyone by its beautiful ambiance. In the summer of 2016 we will say goodbye to Gibbs when it will be razed to make room for the new Yale Science Building (YSB), which will house an exciting interdisciplinary mix of biology, chemistry, and physics. In preparation for YSB construction, we are busy planning bedrock low vibration state-of-the art labs for our Atomic, Molecular, and Optical (AMO) group and our growing biological physics group. State-of-the-art physics teaching labs are planned for the newly renovated Sterling Chemistry Building, which will house co-located teaching labs for chemistry, biology, and physics. To complement the beautiful new teaching lab space we have secured generous University funding to leapfrog our peer institutions with new and exciting advanced teaching labs that include magneto-optical traps and liquid argon TPCs.

J.W. Gibbs building

This summer we celebrated the extremely productive career of Rick Casten who is also retiring. In addition to leading WNSL from 1995-2008, Rick collected many awards including the 2011 Tom W. Bonner Prize for outstanding research, and the 2009 Mentoring Award of the APS/DNP. These two top prizes reveal the two strengths of Rick's career: his science and his skill at mentoring young researchers. The Department will miss his excellent classroom teaching, but all who know him fully expect Rick to keep up his busy schedule of research and leadership in nuclear physics.

This past year saw the Physics Department engage in a highly successful long-range strategic planning exercise that led to many constructive departmental recommendations and an exciting new faculty-hiring plan. We have every intention to advance the Department's national standing through strategic growth in the coming years. The plan has us engage in a healthy mix of faculty hiring that both builds on our existing research strengths and ventures into new sub-fields like biological physics. In the upcoming academic year, we will conduct four faculty searches, one each in the sub-fields of particle astrophysics, biological physics, condensed matter theory, and AMO.

In the last several years the Department has gained a well-deserved reputation for its commitment to innovation and excellence in undergraduate and graduate education. Many faculty are employing active learning techniques to reach a wider range of learning styles. Some like Prof. Helen Caines and Simon Mochrie are 'flipping' their classrooms and teaching in a new advanced-technology classroom, to take advantage of teaching techniques that research has shown are very

A MESSAGE FROM THE CHAIR

effective at communicating science. Together with Yale's new Center for Teaching and Learning, we have secured funds from the Helmsley Foundation to support two Teaching Postdoctoral Fellows. They will partner with faculty to further hone their teaching skills while helping us innovate in the classroom and access comprehension and retention among our students.

This year we have added an Alumni News section to this Newsletter in hopes that it will help you keep in touch with your Yale Alumni colleagues. Lastly, let me thank those of you who have given generously to the Department in the last few years. Among other things, your support has helped us recruit a stronger, more diverse graduate student class. With future giving, we hope to establish an endowed Postdoctoral Fellowship program to help us attract the best postdocs to Yale just after their PhDs when young scientists are often the most productive and creative. We thank both friends and alumni of the Department in advance for your generous support.

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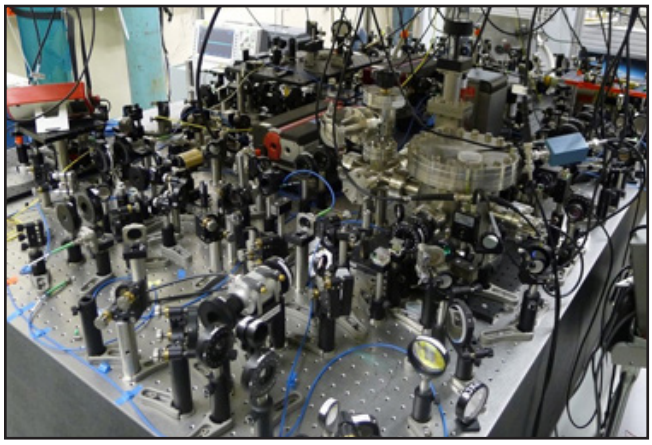
FACULTY RESEARCH

Opening a Window on Quantum Gravity

Jack Harris

Yale University has received a grant from the W.M. Keck Foundation to fund experiments that researchers hope will provide new insights into quantum gravity. Jack Harris, Associate Professor of Physics, will lead a Yale team that aims to address a long-standing question in physics – how the classical behavior of macroscopic objects emerges from microscopic constituents that obey the laws of quantum mechanics.

Very small objects like photons and electrons are known for their odd behavior. Thanks to the laws of quantum mechanics, they can act as particles or waves, appear in multiple places at once, and mysteriously interact over great distances. The question is why these behaviors are not observed in larger objects.



A photograph of the laser setup used in the Harris lab to study quantum behavior of millimeter-sized objects

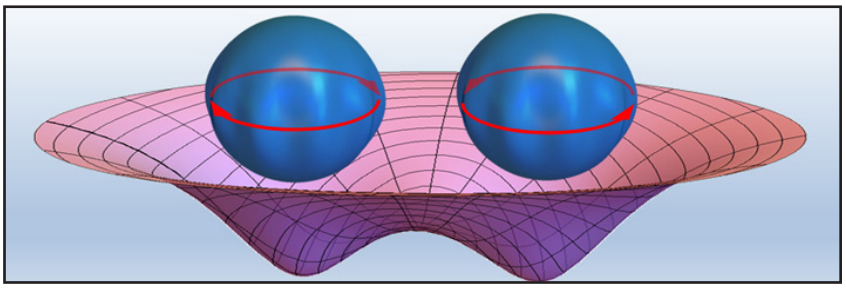
Scientists know that friction plays an important part in producing classical behavior in macroscopic objects, but many suspect that gravity also suppresses quantum effects. Unfortunately, there has been no practical way to test this possibility, and in the absence of a full quantum theory of gravity, it is difficult even to make any quantitative predictions.

FACULTY RESEARCH

To address this problem, Harris will create a novel instrument that will enable a drop of liquid helium to exhibit quantum mechanical effects. "A millimeter across," Harris said, "our droplet will be five orders of magnitude more massive than any other object in which quantum effects have been observed. It will enable us to explore quantum behavior on unprecedentedly macroscopic scales and to provide the first experimental tests of leading models of gravity at the quantum level."

The W.M. Keck Foundation grant will fund five years of activity at the Harris lab. In the first year, Harris and his team will construct their apparatus, and in subsequent years they will use it to perform increasingly sophisticated experiments.

"We are extremely grateful to the W.M. Keck Foundation for this generous support," said Steven Girvin, the Eugene Higgins Professor of Physics and deputy provost for research. "This is a forward-looking grant that will advance truly groundbreaking research."



A cartoon illustration of a levitated drop of superfluid helium. A single photon circulating inside the drop (red arrow) will be used to produce the superposition. The drop's gravitational field (illustrated schematically in the background) may play a role in limiting the lifetime of such a superposition.

Girvin, whose research includes quantum computing, described the Harris project as a possible game changer. "Truly quantum mechanical behaviors have been observed in the flight of molecules through a vacuum and in the flow of electrons through super-conductive circuits, but nothing has been accomplished on this scale. If Jack succeeds, this would be the first time that an object visible to the naked eye has bulk motion that exhibits genuine quantum mechical effects."

Into the whispering gallery

To explain his project, Harris invokes an architectural quirk of St. Paul's cathedral, a London landmark with a famous "whispering gallery." High up in its main dome, a whisper uttered against one wall is easily audible at great distances, as the sound waves skim along the dome's interior. Harris plans to create his own whispering gallery, albeit on a smaller scale, using a droplet of liquid helium suspended in a powerful magnetic field.

Rather than sound waves, Harris' gallery will bounce a single photon. This approach is closely related to an idea proposed by Albert Einstein in the 1920s, but until now, it has remained beyond the technical capabilities of experimentalists. To complete the experiment, Harris will need to combine recent advances in three different areas of physics: the study of optical cavities (objects that can capture photons), magnetic levitation, and the strange, frictionless world of superfluid helium.

"Superfluid liquid helium has particular properties, like absence of viscosity and near-absence of optical absorption," Harris explained. "In our device, a drop of liquid helium will be made to capture a single photon, which will bounce around inside. We expect to see the drop respond to the photon."

"A photon always behaves quantum mechanically," he added. "If you have a macroscopic object - our helium drop - that responds appreciably to a photon, the quantum mechanical behavior can be transferred to the large object. Our device will be ideally suited to studying quantum effects in the drop's motion."

Potential applications for Harris' research include new approaches to computing, cryptography, and communications. But Harris is most excited about the implications for fundamental physics: "Finding a theory of quantum gravity has been an outstanding challenge in physics for several decades, and it has proceeded largely without input from experiments. We hope that our research can provide some empirical data in this arena."

About the W.M. Keck Foundation

The W.M. Keck Foundation was established in 1954 by William Myron Keck, founder of the Superior Oil Company. The foundation supports pioneering research in science, engineering, and medicine and has provided generous funding for numerous research initiatives at Yale University.

In 2014, the Keck Foundation awarded a separate grant to a team of scientists led by Corey O'Hern, Associate Professor of Mechanical Engineering at Yale, to explore the physics of systems composed of macro-sized particles.

– news.yale.edu

FACULTY RESEARCH

Axion Dark Matter eXperiment at High Frequency


Steve Lamoreaux

Yale researchers among those supported by the Heising-Simons Foundation to answer one question to better understand the universe.

When considering what makes up the universe, it's surprising that scientists could focus on just one yes/no question. But that's exactly what a group of researchers supported by the Heising-Simons Foundation is doing.

"Does axion dark matter exist?"

Scientists across the United States are working together to determine if axions - hypothetical subatomic particles are the leading candidate for what makes up dark matter. Although this is a big question about the universe, Heising-Simons Foundation Science Program director Cyndi Atherton said that researchers may be able to answer it in just a few years' time.

"It's a small range of particle masses to investigate, relatively speaking. So we'll look for axion dark matter in that small range, and we'll see it - or not," Atherton said. "Either way, we will know more about the universe."

If the axion does not exist, researchers will consider what other types of theoretical particles could make up our universe. But if it does, Atherton said, "It will basically rewrite physics."

Only 5% of the universe consists of normal matter that we can observe with modern instruments, she explained. The rest of the universe consists of 68% dark energy and 27% dark matter – matter that does not interact with light and that can't be observed by any current technique. If axions were the explanation for all of dark matter, we'd be able to comprehend 27% more - another full quarter - of the universe around us, notes Atherton.

The Heising-Simons Foundation chose to fund this research not only because of its promise for understanding, but also because its investment is substantial enough to allow researchers to move the needle in a major area of scientific discovery. The Heising-Simons Foundation has awarded three-year grants to researchers from institutions including the following:

Lawrence Livermore National Laboratory • National Radio Astronomy Observatory / University of Virginia University of California-Berkeley • University of Colorado-Boulder • University of Florida • University of Washington Stanford University • Yale University

These grants are the first investments that the Heising-Simons Foundation has made in searching for axion dark matter, and Atherton anticipates future collaborations to include more research and scientific symposia.

Yale Project

The project funded at Yale University, Axion Dark Matter eXperiment at High Frequency (ADMX-HF), will overcome technical barriers that until now have presented major obstacles which have hindered the experimental detection of axion dark matter.

Presently, the state-of-the-art devices used to detect axions are based on the conversion of these hypothetical subatomic particles to a weak radio signal within a microwave cavity that is permeated with strong magnetic field. However, existing instruments are sensitive only over a limited range of predicted axion masses which correspond to frequencies between about 0.1 and 100 GHz, with 5 to 20 GHz being favored in some models.

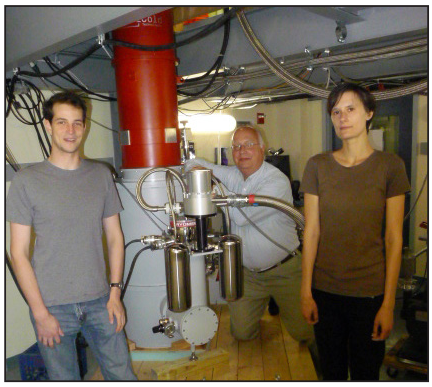
With the support of the Heising-Simons Foundation, Steve Lamoreaux, Professor of Physics, hopes to break new ground in the field by integrating cutting edge technologies, including quantum amplifiers and superconducting cavities, which will enable their team to conduct the first-ever highly sensitive search in the 4-12 GHz frequency range, complementing the efforts of other groups presently searching in the 1 GHz range and below. Collaborating institutions in this work include UC Berkeley, University of Colorado, and Lawrence Livermore National Laboratory.

Lamoreaux states, "More than twenty years ago, when the idea that axions could solve the dark matter problem was first put forward, the technology required to detect them did not exist. New technologies in superconducting quantum and squeezed state amplification will allow us to

FACULTY RESEARCH

attain a theoretically interesting level of sensitivity in the higher mass and hence higher frequency ranges that are theoretically favored. Of course nobody knows what the axion mass is, and in order to perform a complete search, different technologies will be required in different mass ranges.

Support from the Heising-Simons Foundation is already helping to harmonize efforts between multiple collaborative groups focusing on different mass ranges. In this way, the entire range can be searched more rapidly, and hopefully the time to discovery will be years instead of decades."



Yale ADMX-HF team:
Ben Brubaker, Steve Lamoreaux, Yulia Gurevich
Not shown: Sid Cahn, photographer

Heising-Simons Foundation

Mark Heising and Elizabeth Simons established the Heising-Simons Foundation in 2007 to advance sustainable solutions for the environment, enhance the education of young learners, and support ground-breaking research in science.
Learn more at heisingsimons.org.

– news.yale.edu

MicroBooNE Detector Sees First Tracks

Bonnie Fleming

First conclusive evidence that neutrinos oscillate, or change flavor, and therefore have mass occurred only about 15 years ago. The consequences of this seminal discovery include the possibility that neutrinos and their anti-particles could behave differently which could be connected to the matter / anti-matter asymmetry observed in the universe.

In addition, neutrinos may have other unexpected properties. Results from short baseline neutrino oscillation experiments include hints that there could be a fourth neutrino, the so-called sterile neutrino, oscillating amongst the three weakly interacting neutrinos. These hints for new physics come from reactor neutrino experiments, source-based neutrino experiments, and accelerator based neutrino experiments. The accelerator experiments, LSND, and MiniBooNE, saw an excess of electron neutrino events in primarily muon neutrino beams. Explained within the context of all of the other neutrino oscillation results, this excess suggests a new neutrino and therefore new physics!

At Yale, Professor Bonnie Fleming leads a team looking for these hints for new physics and concurrently developing new precision neutrino detectors to accomplish the search. This program includes the MicroBooNE experiment on which Fleming serves as founding and now the current Scientific Co-Spokesperson.

The MicroBooNE experiment designed to address the anomalies seen in accelerator based results, was proposed by Fleming in 2007 as a precision follow-on to MiniBooNE. MicroBooNE sits in the same beamline and nearly the same baseline, and uses a different, high precision detection technique, a Liquid Argon Time Projection Chamber (LArTPC) detector. With this technique, the puzzling excess of events at low energies observed in MiniBooNE is magnified while the backgrounds are reduced.

The principle of the LArTPC is that ionization tracks generated by the passage of charged particles can be transported, practically undistorted, by a uniform electric field over distances of the order of meters in extremely pure Liquid Argon. Imaging is then accomplished using wire planes placed at the end of the drift path, which continuously sense the signals induced by the ionization electrons drifting towards them. In this way, two coordinates of the initial ionization position can be measured, while the third one is given by the measurement of the drift time. The spatial resolution and total absorption calorimetry provided by this technique make them precision neutrino interaction detectors. The technique is so powerful that LArTPCs have been chosen as the technology for the future flagship DUNE experiment, a 40kton LArTPC to be sited deep underground in the SURF lab in South Dakota.

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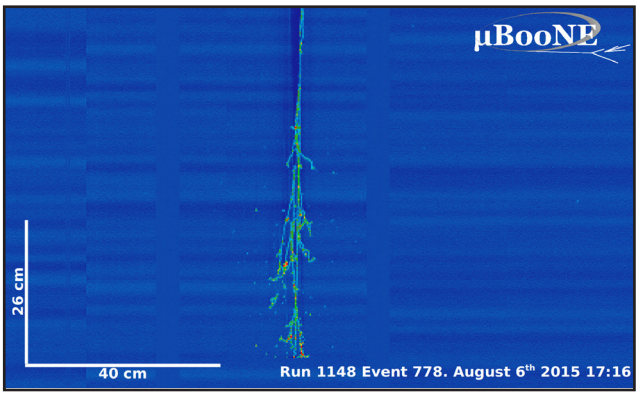
Exposed to a neutrino beam traveling from Fermilab, DUNE will measure the final properties of the 3 neutrino mixing matrix in particular looking for CP Violation in the neutrino sector.

Since 2007, MicroBooNE has completed funding, design, fabrication and installation phases. Yale's contribution came through construction of the inner Time Projection Chamber funded through an NSF MRI for Fleming. Part of this contribution included stringing of 6000 of the 8000 wires on the TPC done by a team of Yale students and Post-docs at Wright Lab in 2012.



One of the first recorded images from the MicroBooNE detector of cosmic rays

This summer, the excitement has really begun as we have finished final assembly, filled the detector and turned on the High Voltage. Running as of this writing at 58kV, MicroBooNE has seen first cosmic ray tracks in the TPC and continues to commission all the systems in the detector. The next step in voltage to about 100kV will have us ready to take neutrino data when the beam comes up on October 12th.

Beyond MicroBooNE, the Fleming team continues to develop LArTPC technology for neutrino physics both in the context of future experiments and through bench top tests in the lab. The Short Baseline Neutrino Detector (SBND) experiment under construction now, will be at a near location on the same beamline as MicroBooNE to enable a near-far comparison of neutrino interactions to look for a length dependent 'smoking gun' signature of neutrino oscillations. Like for MicroBooNE, the Yale team has been funded through an NSF MRI to build the TPC for SBND. Beyond this, Yale's Wright Lab is a candidate site for one of the four worldwide wire stringing factories for the 40kton DUNE experiment.

The Yale team is comprised of Fleming, Adjunct Faculty Flavio Cavanna and Ornella Palamara, Post-docs Serhan Tufanli and Xiao Luo, Graduate students Corey Adams, Ariana Hackenburg, Elena Gramellini, and Brooke Russell, and Undergraduates Elizabeth Himwich, Nicole Pereira, and Will DeRocco.

– Bonnie Fleming

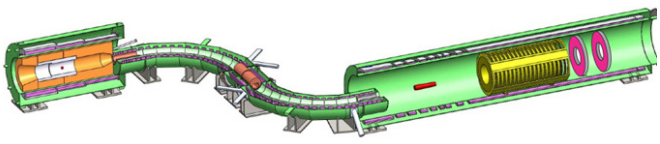
Yale Joins the Mu2e Physics Collaboration

Sarah Demers

A research team led by Sarah Demers, Horace D. Taft Associate Professor, has been accepted into an international collaboration to push the known boundaries of physics.

The Mu2e Collaboration, the muon-to-electron conversion experiment, is based at the Fermilab facility in Illinois and includes 23 universities and 10 domestic and international research laboratories. Its mission is to probe physics questions at energy scales 1,000 times higher than what can be attempted at other experiment sites. In the experiment, a beam of muons will be produced from protons that interact with a tungsten target. The muons, in turn, will convert to electrons. The Demers group will contribute its experience with triggering and data acquisition for the experiment.

The Mu2e experiment is one of several experiments around the world currently probing new areas of physics. In Switzerland, for example, the ATLAS experiment at the Large Hadron Collider will resume in 2015 after upgrades to run at higher energy. Yale physicists Keith Baker, Paul Tipton, and Demers have research groups involved in the ATLAS experiment.



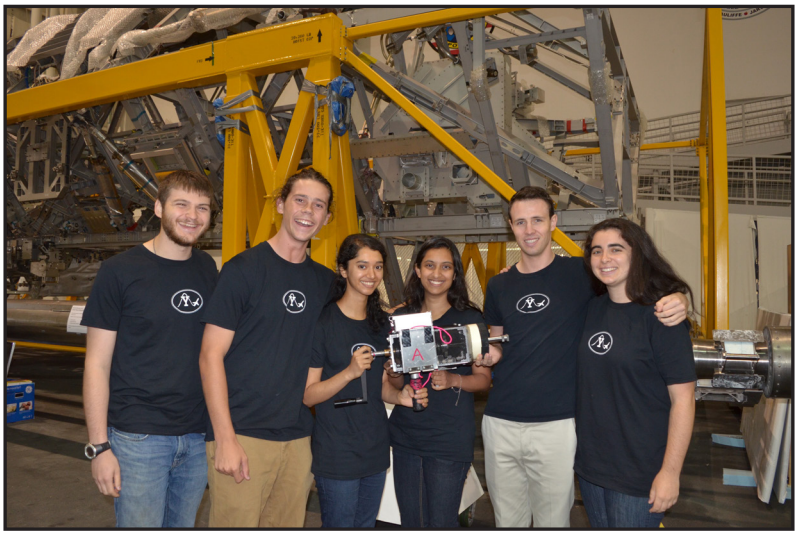
The Mu2e detector is a particle physics detector embedded in a series of superconducting magnets, as shown here.

STUDENT RESEARCH

Yale Drop Team

The Yale Drop Team is an organization of Yale undergraduates who conduct science and engineering-related experiments in microgravity. Founded in 2006 when a group of five students submitted their first proposal to NASA, the Drop Team has successfully completed five projects.

Each year, the Yale Drop Team brings together a diverse group of undergraduates to design an experiment pertinent to current space exploration. The project is then tested in simulated microgravity at the NASA Johnson Space Center facilities in Houston, Texas. This past semester, as part of NASA's new Micro-g Neutral Buoyancy Experiment Design Teams (Micro-g NExT) program for undergraduate groups, the Yale team designed a Trigger Actuated Rock Sampler (TARS) suitable for an astronaut to collect several uncontaminated rock samples from an asteroid. This is a part of NASA's Asteroid Redirect Mission (ARM) which intends to bring an asteroid into lunar orbit and to have astronauts travel to the asteroid and sample its rock.



Photograph of team holding TARS. From left: David Milewicz, Gregory Meyer, Manjari Randeria, Nafeesa Khan, Michael Cruciger, Field Rogers

Human interaction facilitates the collection of much larger rock samples, beneficial for scientific study of these extraterrestrial objects, something robotic drills on rovers have not yet been able to achieve. Since asteroids are not massive enough to have significant gravity, chipping rocks on their surface with a conventional rock hammer would result in the chips flying off at escape velocity. Thus, the team's project of designing a rock hammer for a microgravity environment and integrated rock chip collection system will contribute to the pool of design ideas that NASA's engineers will ultimately use to design the tools that NASA will deploy in the ARM mission. The ARM mission is a test run for many of the technologies NASA intends to use in the upcoming manned Mars mission.

The team, which began working on the project in January, was comprised of six undergraduates: Michael Cruciger, Nafeesa Khan, Gregory Meyer, David Milewicz, Manjari Randeria, and Field Rogers. The final design, TARS, creates rock chips via the action of a linearly actuated spring-driven pick. A containment element collects the rock pieces as soon as the pick chips them off. This prevents any cross-contamination and protects both the astronaut and the samples. The team's final design sought to minimize the movement required of the astronaut, and the mass of the TARS.

The team consulted a diverse group of mentors on technical and design aspects of their device. These mentors include their faculty advisor, Dr. Stephen Irons from the physics department, Tamra George, a NASA hardware manager, Dr. Larry Wilen at the Yale CEID, Dr. David Evans of Yale Geology and Geophysics, and Dr. Glenn Weston-Murphy of Yale Mechanical Engineering.

With the generous support of the physics department and other Yale grants and fellowships, six students on the team and their faculty mentor, Dr. Irons, traveled to Houston earlier in August to see their device tested at NASA's Neutral Buoyancy Lab. The overall experience was fantastic. The students had to present their tool at a formal Engineering and Safety Review board to about fifteen NASA engineers prior to being approved for testing. After making some last minute safety modifications as per the board's suggestions, the Drop Team's tool was tested by NBL divers. TARS was able to create chips off of many rock samples of varying hardnesses and made a large fissure in the NASA boulder sample. The tool was very successful given its ability to safely store a large amount of energy, and the team subsequently had an opportunity to discuss with several NASA engineers interested in its design. The team hopes to continue this project and to hone their design through subsequent iterations of the NASA Micro-g NExT program.

– Manjari Randeria and Field Rogers

STUDENT RESEARCH

High Energy Physics at CERN


Illana Kaufman

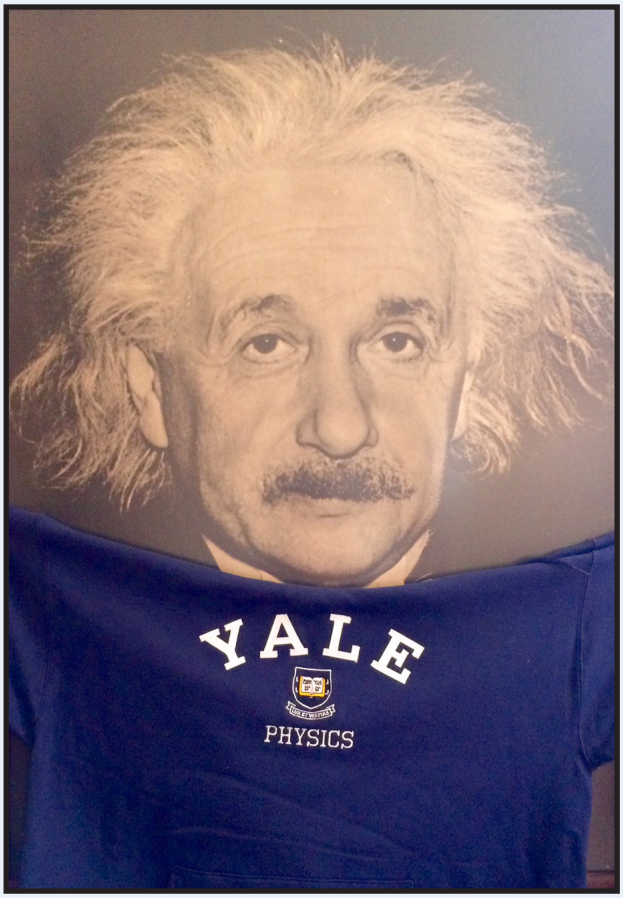
Ilana Kaufman (SM '18) spent the summer in Geneva doing high energy physics research at CERN with Paul Tipton's group. She worked on data analysis for the ATLAS Experiment. Her research focused on particles that decay to Higgs Bosons and then to two b-jets and two photons. Specifically, she investigated the effects of muon corrections to the b-jets.

In semileptonic decay, b-jets are sometimes accompanied by muons, which do not deposit all of their energy in the calorimeter. In these cases, the detector measures the b-jet 4-vector inaccurately. In order to improve the invariant mass resolution of the two b-jets, a muon correction adds the muon's 4-vector to that of the b-jet.

Her research further investigated cases in which only one jet is tagged as a b-jet. In such cases, one must find a second jet to associate with the to-Higgs decay. She tested the existing pairing mechanisms and created new options. She compared the efficiency of the pairing tools and will continue work to optimize one of her mechanisms.

Throughout the summer, she made various presentations to the ATLAS Two-Higgs Working Group. She was also able to attend CERN Summer Student lectures and explore some of Europe's beautiful cities. She thanks the Yale Tetelman Fellowship for providing her with this unique opportunity!

– Ilana Kaufman



Yale Physics Hoodie Order Form

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THE NEW YALE WRIGHT LABORATORY

Rendering of the planned interior space for Wright Lab

For more than 50 years the Wright Nuclear Structure Laboratory, better known as WNSL, on Science Hill led studies and investigations into the structure of nuclear matter.

In 2011 operation of the accelerator ended and planning for future programs of the laboratory began.

Professors Reina Maruyama and Karsten Heeger joined the Yale Physics Department in 2013 and a new research program centered around the study of weak interaction and fundamental symmetries has begun at the Yale Wright Laboratory. The study of neutrinos and dark matter, and the exploration of the invisible Universe are now major thrusts in the laboratory's research program. This complements the Wright Lab activities in relativistic heavy ion physics by Professors Helen Caines and John Harris and the axion searches by Professors Keith Baker and Steve Lamoreaux. Professors Rick Casten and Franco Iachello continue the long-standing program in experimental and theoretical nuclear structure research at Yale. Wright Lab will also support the experimental work of high energy physics faculty Professors Bonnie Fleming, Paul Tipton and Sarah Demers and the cosmological research pursued by Charlie Baltay.

Karsten Heeger, Director

The lab's new research program encompasses a broad portfolio of experiments ranging from table-top efforts like the ADMX-HF axion search (see Axion article on page 5) to world-wide collaborations such as ATLAS at the Large Hadron Collider. Scientists at the Wright Laboratory are pursuing the study of diverse phenomena including the structure of matter in nuclear physics, the interactions and forces between elementary particles, and the observation of galaxies and structures in the Universe at the cosmic scale. Together, these studies form a comprehensive approach to understanding fundamental questions about the nature of matter, its interactions, and its role in the evolution of the Universe. The new scientific program of the Wright Laboratory together with the Yale Center for Astronomy and Astrophysics and the Center for Research Computing put the Yale Physics Department at the fore-front of research in nuclear, particle, and astrophysics.

For many years WSNL was a hub for nuclear research, not only on campus but nationwide. It was host to the US nuclear physics community and many visitors from abroad. Its centerpiece, the Extended Stretched TransUranium (ESTU) tandem accelerator, was designed and commissioned in the 1980's as one of the world's highest-energy nuclear accelerators. It enabled a program of investigations into the structure and properties of nuclei and nuclear reactions in astrophysics. Over 130 graduate students completed their PhD studies at the laboratory and countless postdocs and visitors came to the lab to use the nuclear accelerator, run their experiments, and collaborate with the nuclear structure group in the department.

Scientists at Yale Wright Laboratory continue the tradition of hands-on research on campus by developing instrumentation and technology that define the forefront of nuclear, particle, and astrophysics. Over the last year, Wright Lab scientists have helped create the coldest cubic meter in the Universe, detected nuclear decays with lifetimes much longer than the age of the Universe, and searched for new forms of matter with detectors deep underground.

THE NEW YALE WRIGHT LABORATORY

To support this new research effort, a major transformation of the laboratory is now underway. Over the last couple of years the nuclear accelerator and experimental areas in WNSL were decommissioned and prepared for future use. The Wright Lab technical team consisting of Jeff Ashenfelter, Frank Lopez, and Tom Barker, with support from technicians and specialized support companies, completely disassembled the experimental halls and accelerator systems and arranged for the safe removal of the accelerator systems from WNSL. Equipment was sorted for re-use and disposition and distributed to other research centers and universities around the country. This decommissioning and disposition process was completed in summer 2015 with the removal of the main ESTU tank from the WNSL vault. A big empty hall is now waiting to be filled with new experiments.

After two years of design and planning the Wright Laboratory is currently undergoing extensive renovations to create infrastructure in support of the lab's new scientific research program in fundamental physics. These renovations will provide a complete interior redesign of the Wright Laboratory with state-of-the-art technical facilities as well as interaction spaces and meeting rooms. The new laboratory and office spaces are designed to foster the interaction of scientists, students, and technical personnel and to enable researchers to interact both locally and with collaborators at experimental facilities in Switzerland, China, Italy, and in Antarctica. Cleanrooms, high-bay spaces, and cryogenic facilities will support the new scientific program of the laboratory. Three machine shops, including an advanced prototyping room with CAD-based design capability will allow researchers and students to learn and practice the principles of design and prototyping and support a rapid cycle of innovation. A professional machine shop will support the fabrication of instrumentation for experiments on the Yale campus and facilities worldwide. Renovations of the Wright Lab complex started in 2014 and will be completed in summer 2016.

Decommissioning and disassembly of the accelerator structure (top left and right) and removal of the ESTU tank (bottom) in the WNSL vault

THE NEW YALE WRIGHT LABORATORY

Recently renovated laboratory faciliities in Wright Lab

Plans for the new office area with skylight (top) and machine shop (right) areas

Rendering of the front entrances to Wright Lab after the ongoing renovations. Glass entrances will welcome students and visitors to the new machine shops, laboratories, and office areas (bottom)

Leveraging the newly created infrastructure at the Wright Laboratory, our research groups will be able to build the next generation of instruments that will define the frontiers of fundamental physics for the next decade and beyond. The range of in-house expertise and infrastructure will enable Yale groups to lead experiments at the forefront of the field and train the next-generation of scientists. The Wright Laboratory's location on Yale's Science Hill will foster synergistic activities with the instrumentation and computational needs of interdisciplinary efforts in biology, chemistry, and astronomy.

Our vision is to create a community of researchers, students, and technical experts developing cutting-edge experiments and novel instrumentation to address fundamental questions in nuclear, particle, and astrophysics. The decommissioning of the Yale nuclear accelerator marked the end of a historic era for Yale Physics. With the transformation of the Yale Wright Laboratory, we continue a world-class research facility on campus. I look forward to seeing what discoveries will be made!

For more information, see http://wlab.yale.edu.

– Karsten Heeger

RECENT AWARDS, HONORS, & PROMOTIONS: FACULTY


Damon Clark

Damon Clark, Assistant Professor Molecular, Cellular & Developmental Biology and Physics, was awarded Sloan Research Fellowship. The fellowship honors early-career scientists and scholars whose achievements and potential identify them as rising stars and future leaders of the scientific community. Clark and his lab study how networks of neurons compute, using visual processing and behaviors in fruit flies as a model system.


Sarah Demers

Sarah Demers, newly named as the Horace D. Taft Associate Professor of Physics, focuses her research on using tau leptons to probe for and characterize physics beyond the standard model at CERN's Large Hadron Collider. Demers' current projects include the search for a Higgs Boson that decays to tau pairs and a measure of tau polarization in Z boson decays. In addition, she works on the trigger for the experiment and co-leads the ATLAS Data Quality Group.


Bonnie Fleming

Bonnie Fleming, Professor of Physics, has been named a Fellow of the American Physical Society (APS), in recognition of her leadership in neutrino physics and her role in promoting the liquid argon techniques for neutrino detection. She will also serve as the General Councilor of APS starting January 2016.


Karsten Heeger

Karsten Heeger, Professor of Physics, Director of the Arthur W. Wright Laboratory, has been elected an American Physical Society Fellow for his contributions to the highest impact experiments in neutrino physics, especially for the major roles he played in the Daya Bay and KamLAND experiments.


Francesco Iachello

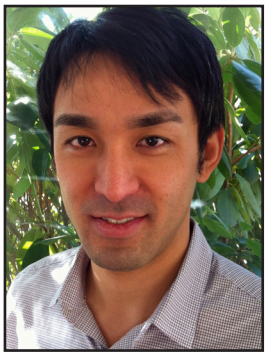
Francesco Iachello, JW Gibbs Professor of Physics, was elected to the Academia Europaea in 2014. With this election Prof. Iachello is now a member of the oldest (Accademia Galileana, Padova, Italy, established 1599) and the youngest (Academia Europaea, London, U.K., established 1988) World Academies.


Corey O'Hern

Corey O'Hern and his collaborators, Profs. Bulbul Chakraborty from Brandeis University and Robert Behringer, were awarded a $1M Science and Engineering Grant in 2014 to develop a theoretical framework for assemblies of macroscopic objects analgous to that provided by quantum and classical statistical mechanics for atomic and molecular systems. O'Hern was also selected as an American Physical Society Outstanding Referee in 2015 for his efforts in peer review.


Reina Maruyama

Reina Maruyama, Assistant Professor, won a 2014 Sloan Research Fellowship. The awards provide $50,000 to early-career scientists and scholars "whose achievements and potential identify them as rising stars," according to the Alfred P. Sloan Foundation, which has sponsored the fellowships since 1955. Reina studies the fundamental properties of neutrinos and dark matter.

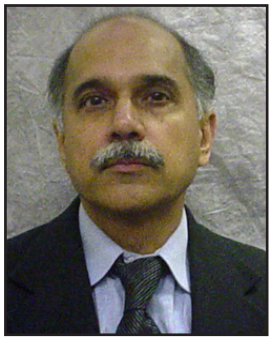

Daisuke Nagai

Daisuke Nagai received a promotion to Associate Professor with tenure. Daisuke is a cosmologist and astrophysicist interested in understanding the origin, composition, and structure formation of the Universe. His current research is in the areas of theoretical and computational cosmology and astrophysics that are closely connected to experiments and observations.

RECENT AWARDS, HONORS, & PROMOTIONS: FACULTY

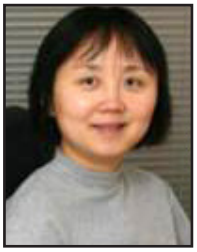

Nikhil Padmanabhan

Nikhil Padmanabhan received a promotion to Associate Professor with tenure. Nikhil's research interests are in observational cosmology with large surveys. His research has recently focused on elucidating the nature of dark energy using the so-called "baryon acoustic oscillation" technique - using sound waves in the early Universe as a ruler to measure the expansion rate of the Universe.


R. Shankar

R. Shankar, John Randolph Huffman Professor of Physics, has been elected to the American Academy of Arts and Sciences. The American Academy serves the nation as a champion of scholarship, civil dialogue, and useful knowledge. As one of the country's oldest learned societies and independent policy research centers, the Academy convenes leaders from the academic, business, and government sectors to respond to the challenges facing the nation and the world.

Hui Cao, Professor of Applied Physics and Physics, and **A. Douglas Stone,** the Carl A. Morse Professor and Chair of Applied Physics, and a Professor of Physics, received Willis E. Lamb awards for laser science and quantum optics at the Physics of Quantum Electronics conference.


Hui Cao

Named for Nobel Prize winning physicist and former Yale faculty member Willis E. Lamb, the awards honor outstanding contributions in the field of laser science and quantum optics.

Doug Stone also received the Phi Beta Kappa Science Book Award, offered for outstanding contributions by scientists to the literature of science, in recognition of his book, Einstein and the Quantum: The Quest of the Valiant Swabian. (Princeton University Press).


A. Douglas Stone


Meg Urry

Meg Urry, Israel Munson Professor of Physics, was selected to receive the Yale Bouchet Leadership Award Medal and delivered the keynote speech at the 12th Annual Yale Bouchet Conference on Diversity and Graduate Education in April 2015. The Bouchet Award is given at the annual meeting of the Bouchet Graduate Honor Society, which was started by Yale and Howard University a decade ago. The award recognizes contributions to increasing diversity in academia.

RECENT AWARDS & HONORS: POST DOCS & STUDENTS


Yulia Gurevich

Yulia Gurevich, Postdoctoral Associate with Professor Steve Lamoreaux, was awarded a Marie Curie Fellowship, to work with Professor Andreas Quirrenbach at the University of Heidelberg.

The project is to develop a calibrator for astronomical spectrographs based on a Fabry-Perot etalon that is actively stabilized to an atomic transition. Her work in Heidelberg will entail developing this prototype into a robust calibration unit suitable for use at an observatory and testing its performance on-sky using the CARMENES spectrograph.

Howard L. Schultz and Deforest Pioneer Prize recipients for Yale College Class of 2015

Congratulations to Aaron Michael Effron (MC 2015), Maya Fishbach (JE 2015), Catherine Lyman Harmer (JE 2015), Robert James Pecoraro (JE 2015), Theodore Papalexopoulos (SM 2015), and Nathan Shridar Sitaraman (PC 2015), for winning the Howard L. Schultz Prize, awarded to outstanding seniors in the physics department.

Congratulations to Christopher Vincent Cappiello (BK 2015), for winning the DeForest Pioneer Prize, in honor of the outstanding scientific achievements of Lee DeForest, Ph.D. 1896. This award is given to a senior physics major for distinguished creative achievement in physics.

RECENT AWARDS & HONORS: STUDENTS

Devin Cody (SM '17, left), Alex Lee (TD '17, middle), and Jacob Marks (PC '17, right)

Three undergraduate students, **Devin Cody** (SM '17), **Alex Lee** (TD '17), and **Jacob Marks** (PC '17), under the guidance of Prof. David Poland participated in the 5th annual University Physics Competition, a 48-hour international contest for teams of undergraduate physics students that focuses on analyzing real-world scenarios using the principles of physics. Their paper, which received a Silver Medal, focused on identifying stable planetary orbits around a binary star system.

Marco Bonett-Matiz

Marco Bonnett-Matiz, Graduate Student with Yoram Alhassid, has been named the recipient of the 2015 D. Allan Bromley Graduate Fellowship in Physics. Bonett-Matiz's thesis research is in nuclear many-body theory. It involves the application of a quantum Monte Carlo approach in the framework of the configuration-interaction shell model. The auxiliary-field quantum Monte Carlo (AFMC) method is among the most powerful computational tools for the study of strongly correlated systems such as nuclei and strongly correlated electron systems (in condensed matter physics). Recently, Marco has been working on an approach using AFMC to calculate excited states, which is an important and challenging goal.

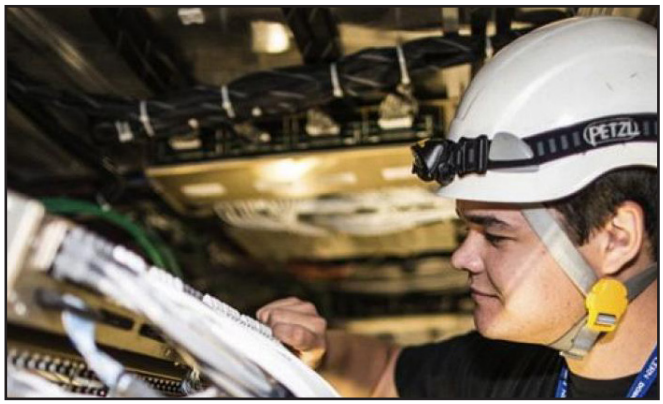
Marco has broad interests beyond physics, focusing on the areas of science education, and community service. Marco taught the PHYS S181 E&M course for four summers in a row, and served as a Physics and Math tutor for the Yale Science & Quantitative Reasoning Program. Marco has volunteered for Integrated Refugee & Immigrant Services (IRIS), helping refugees to get settled in New Haven.

In addition to participation at national conferences dedicated to science outreach and diversity, Marco has mentored, together with other Yale graduate students and postdocs, science projects at the Metropolitan Business Academy Magnet High School in New Haven.

The selection committee faced another tough choice this year, with many highly-qualified applicants. Dr. Bromley would be thrilled to see the many ways that Yale Physics graduate students are making a difference at Yale, and beyond.

Evan Pease

Evan Pease received the DOE Office of Science Graduate Student Research fellowship. The award provides up to a year of funding for graduate students to conduct a year of their dissertation research at one of the DOE National Labs with a collaborating DOE scientist. With this fellowship Evan will be joining collaborators at Lawrence Berkeley National Lab to work on WIMP search data analysis for LUX and liquid xenon detector and high voltage R&D for LZ.



Jared Vasquez

Jared Vazquez, Graduate Student with Paul Tipton, has won a National Science Foundation Graduate Research Fellowship for 2015. As the oldest graduate fellowship of its kind, the program has a strong reputation of selecting recipients who achieve high levels of success in their future academic and professional careers. The ranks of NSF Fellows include numerous individuals who have made transformative breakthrough discoveries, become leaders in their chosen fields, and been honored as Nobel laureates.

EVENTS

Conference for Undergraduate Women in Physics

In January, the 2015 APS Conferences for Undergraduate Women in Physics were held at eight locations around the country with over 1,200 students participating. Starting at a single site in 2006, CUWiP have been running and growing annually. These conferences serve to "help undergraduate women continue in physics by providing them with the opportunity to experience a professional conference, with information about graduate school and professions in physics, and with access to other women in physics of all ages with whom they can share experiences, advice, and ideas."

This year Yale University hosted the conference for the north-eastern region of the US. The 179 participants from 50 institutions across the northeast made the trek to a bitterly cold New Haven, CT. A welcome address from Yale President Peter Salovey followed by a keynote speech by AAS President and former Chair of the Yale Physics Department, Meg Urry, launched the conference on Friday evening. Both Presidents Salovey and Urry addressed the idea of implicit bias. They noted that truly excellent science requires maximizing the available talent pool, which certainly means including women and under-represented minorities. President Salovey also provided a fairly complete history of New Haven cuisine, perhaps doing his part to try to recruit some of these women to future study at Yale through the lure of our excellent pizza.

Eminent scientists such as Yale Professor Bonnie Fleming, SUNY Buffalo Professor Andrea Markelz, and McGill Assistant Professor Lilian Childress presented research talks. However, the topics were not limited to neutrinos, bio-physics, or defects in diamonds. In addition to talking about their work, the speakers discussed their career paths and gave participants advice about being successful physicists. The questions from participants addressed not only science topics but issues related to work-life balance and being a woman in physics.

The participants had an opportunity to present their own work at a poster session and to get to know each other during long coffee breaks and a liquid nitrogen ice cream party. They learned about career options through a graduate student panel and a career panel where both academia and industry were represented. A graduate school fair starred

Undergraduate Organizers & Coordinator Sarah Demers
Back row: Sarah Demers, Elizabeth Himwich, Lauren Chambers, Lucie Tvrznikova (grad student), Maya Fishbach, Aida Behmard. Front row: Nikita Dutta, Megan Phelan, Bárbara Santiago, Mariona Badenas, Grace Pan

intrepid faculty and students from more than a dozen graduate programs who fought through icy conditions to recruit and advise on Sunday afternoon.

The conference was a huge success. The students learned physics and networked with each other and with people who are further along in their careers, both in academia and industry. Thanks to support from APS, the Department of Energy, and the National Science Foundation, their lodging and meals were paid for, and in many cases their home physics departments sponsored their travel. The energy in the halls was palpable all weekend.

The success was only possible due to the team of ten Yale Undergraduate organizers, led by Senior physics major Megan Phelan, who were hard at work for months leading up to the conference and ridiculously hard at work during the conference itself. We bonded over vegan and gluten free meal options and bus schedules and did everything we could to make sure that the participants could focus on physics and each other during the event. Not to mention the strong support of the Yale Physics Department and various administrative offices throughout the university that sponsored us.

The slate of meetings for 2016 has already been set, with Conferences planned for January 15-17 at Black Hills State University, Georgia Institute of Technology, Old Dominion University/Jefferson Lab, Ohio State University, Oregon State University, Syracuse University, University of California San Diego, University of Texas San Antonio, and Wesleyan University. We look forward to many more years of the conference, where the experience of having so many women in physics gathered together becomes less unusual year after year.

– Sarah Demers

EVENTS

Fabiola Giannoti gives Leigh Page Lectures

Fabiola Giannoti, director-general-elect of CERN spoke about the future of particle colliders and the discovery of the Higgs Boson as part of the 2014-2015 Leigh Page Prize Lectures. "With the discovery of Higgs Boson, we have completed the Standard Model," said Gianotti during her second of the two lectures. "Not only is the equation beautiful - it is very condensed and can even fit on the side of a mug - it also works beautifully."

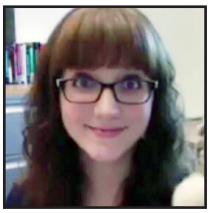
But the work, she argued, is far from over. Physicists have yet to explain phenomena like dark matter and dark energy, and hypotheses like supersymmetry need extensive research beyond even the capacities of CERN's Large Hadron Collider, which, with a 27-mile circumference, is the largest single machine in the world, she said.

As part of Gianotti's visit, the physics department in conjunction with the Whitney Humanities Center offered a screening of "Particle Fever", a documentary about CERN's search for the Higgs Boson. Following the screening, New York Times science columnist Carl Zimmer '87 moderated a discussion with filmmakers Mark Levinson and David Kaplan, film producers Carla Solomon '75 and Andrea Miller '75, and Gianotti, who was featured in the documentary. The panel expressed their hopes that the film would reach a wide audience via word of mouth and, as Levinson put it, "convey the excitement of the scientific community".

NEW ADMINISTRATIVE HIRES

Hannah Carrol, Lead Administrator, joined the Physics Department as a temporary employee working for Vernon Hughes and the AMO group in 1990. She held various jobs in physics, and after 20 years she joined the Career Development Program and was recruited to develop the FRMS' post award group. Hannah is thrilled to be in Physics and Astronomy working with the faculty, students, and staff, and is thankful for this opportunity.

Cynthia Conforte, Financial Assistant, joined Yale in 2001 with 20+ years of accounting experience and spent her first 5 years in the School of Medicine. In 2006, Cindy ventured across campus to join the School of Engineering, where her favorite duty was aiding the multiple undergraduate teams with their projects and competitions, all while overseeing their financing; a task that proudly earned her the nickname "Team Mom". After almost 9 years, she has joined the Physics Department business office. When not at work, Cindy enjoys gardening, boating, hiking and playing with her dog Yoda.



Dani Heller, Supervisor & Assistant to the chair, is celebrating her 7th anniversary at Yale. She began her career with the School of Music, moved on to the Department of Political Science, and was promoted to Physics in October 2014. With a BM in Horn Performance, a soon-to-be MS in Public Policy, and aspirations of an EdD in administration, Dani plans to one day return to her roots in music and arts at Yale. When not at work, in class, or at a gig, Dani can be found taking care of her pet rabbit Harry, or participating in *Future Leaders of Yale* events.

Geriana Van Atta, Senior Administrative Assistant for YCAA, is excited for her new role at Yale. She's joining Yale from her previous position as an administrative assistant at an insurance recruiting office located in Long Island, NY, where she grew up. She received her AAS in Performing Arts-Music from SUNY Nassau Community College. In her free time she enjoys reading, doing anything involving music, catching up on her massive Netflix/Hulu queue, and knitting or crocheting…that is if her cat, Lily, doesn't try to attack the yarn!

NEW ACADEMIC HIRES

Research Development Technician


Paul Noel

Paul Noel received his Bachelor's degree in Physics from Saginaw Valley State University. He went on to receive his Master's in Nuclear Physics at Central Michigan University. Shortly after, Paul went to work for the United States Patent and Trademark Office as a patent examiner. After spending a year at the USPTO, Paul knew he wanted to move into academia and accepted a position at the University of North Dakota as the Physics Laboratory Supervisor. At the University of North Dakota, Paul actively studied physics laboratory pedagogy and developed general and advanced laboratories. He has put together multiple project-based exercises to help bring learning outside of the classroom in a fun and educational way. Additionally, Paul has designed and built many lecture demonstrations to show clearly and concisely a physics concept while still having an awe factor. Paul embraces and uses open-source electronics and software. He is also an avid woodworker. In his spare time, Paul enjoys hiking and visiting parks throughout the country, especially through his home state of Michigan.

Helmsley Postdoctoral Teaching Scholars

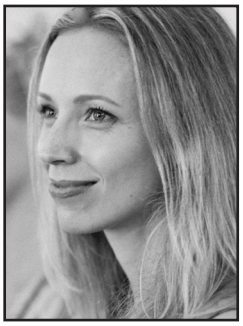
On November 24, 2014 the Helmsley Charitable Trust awarded a grant to the Yale Center for Teaching and Learning, together with the mathematics and physics departments. This grant provides funding to build a cohort of trained STEM instructors who will collaborate on active learning practices in a network of colleges and universities.

The math and physics departments were each invited to search for two postdoctoral teaching scholars. These scholars will organize the Yale Center for Teaching and Learning Science Education Seminar series, attend and support Yale and regional summer institutes, and teach a Yale course each semester. In addition, they will also teach courses at our partner institutions, Housatonic Community College and the University of Bridgeport. Many talented candidates applied, and the department was able to appoint two teaching scholars: Dr. Claudia De Grandi and Dr. Zosia Krusberg.

Claudia De Grandi grew up in Milan, Northern Italy, enjoying both the city life and the proximity to the Alps. After getting her Bachelor's and Master's in Physics from University of Milan, she moved to Boston where she obtained her PhD in theoretical condensed matter physics in 2011 from Boston University. Her thesis focused on out of equilibrium aspects of cold quantum gases. She moved to Yale to work as a postdoc with Professor Steven Girvin. Since then, she has been studying the many-body physics of systems of quantum bits and collaborating with experimental groups at Yale and beyond. With the training and support of the Yale Center for Teaching and Learning, she has been experimenting with several flipped classroom formats for the introductory physics courses. She is committed to finding the optimal recipe to teach physics effectively to a variety of students' backgrounds via active learning methods and in-class engagement.


Claudia De Grandi

Claudia cultivates visual activities such as: discovering modern architecture, photography, drawing, and lego building. She is a four-season cyclist and her favorite sports activities include running, swimming, and yoga.


Zosia Krusberg

Zosia Krusberg is a theoretical cosmologist and particle physicist. From 2011-2015, she was a Visiting Assistant Professor in the Department of Physics and Astronomy at Vassar College. She received her Ph.D. in 2011 in the Department of Physics at the University of Chicago, where she studied dark matter phenomenology with Dr. Edward Kolb. She previously obtained an Ed.M. in Mind, Brain, and Education and Physics Education from Harvard University, and an AB and SM from the Department of Physics and Astronomy at Dartmouth College. She leads an interdisciplinary research program in mind, brain, and education, with particular emphasis on the role of metacognition, intuition, and embodied cognition in physics problem solving. She is committed to promoting the inclusion and retention of women and other underrepresented minorities in physics and other STEM fields.

Dr. Krusberg is also a meditation teacher and practitioner. She teaches embodied meditation in New York City, and spends one to two months of the year in meditation retreat in Crestone, Colorado. The daughter of a Swedish diplomat and an Italian businessman, she grew up across Europe and the Middle East. She continues to travel extensively and is profoundly inspired by the landscapes, cultures, traditions, languages, and individuals she encounters on her travels.

RETIREMENT

Each year at its last meeting, the Yale Faculty pay tribute to their colleagues who will be retiring. Below you will find the Retirement Citations for Jack Sandweiss and Rick Casten, prepared by Professors Charlie Baltay and Franco Iachello, repectively.

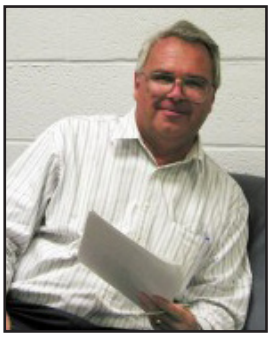
Jack Sandweiss Retires, July 2014

Jack Sandweiss, University of California at Berkeley, B.S. 1952, Ph.D, 1957, faculty member at Yale since 1957: you are an internationally recognized leader in experimental elementary particle physics, a field that epitomizes mankind's search for an understanding of the basic constituents of matter and their fundamental interactions. You pioneered, soon after the discovery of the antiproton at your Alma Mater, in building beams of antiprotons at Brookhaven National Labs to study the properties of that then esoteric new particle. You followed this by equally pioneering beams of the even more esoteric sigma hyperons at Fermilab. You did groundbreaking work on the fundamental symmetries of space and time, by studying time reversal invariance in kaon decays at Argonne Labs and searching for parity violations in heavy ion collisions at Brookhaven. You also pioneered in elucidating and searching for a fundamentally new form of matter, atoms with an unusual quark content called strangelets, both on Earth, in Moon Dust, and later in outer space.

In addition to your pioneering contributions to the science of elementary particles you were a noted leader both nationally and internationally of your chosen field. Your membership, and more often chairmanship, of numerous advisory and decision-making committees made huge impacts on this field. You also served in an exemplary fashion as the editor of The Physical Review Letters, the most prestigious scientific journal in this fundamental field, for a period of 25 years. You also had a huge impact within the Yale community by your chairmanship of many University committees, by serving as Master of Davenport College, and serving as Chair of the Physics Department.

Not least of all, your love of science, and your love of family, left an enduring imprint on your associates and students who had the good fortune of working with you over your distinguished career.

Rick Casten Retires, July 2015



Rick Casten, B.S. College of the Holy Cross, M.S. and Ph.D 1967 Yale University, faculty member at Yale since 1995: Over the span of more than forty years you have been a leading world figure in nuclear physics, first while at the Brookhaven National Laboratory and then while at Yale as Director of the Wright Nuclear Structure Laboratory. Your organizational abilities have made you a sought-after candidate for every National and International Organization in your field. Your vision and advice has been crucial for the future of your field, especially for planning its development in the 21st Century through the construction of large facilities both in the U.S. (Radioactive Isotope Beam Facility, RIBF at Michigan State) and abroad (FAIR facility at GSI n Germany, RIBF at RIKEN, Japan, Rare Isotope Facility RISP in Korea). Your community service has made you one of the most famous nuclear physicists in the World, from South to North America, from Europe to Asia.

Despite the travel involved in your role as a leader of the community, you are also known as a superb mentor. Your students and postdoctoral fellows occupy important positions all over the World, a tribute to your dedication to them and to the time you have spent teaching them both the fundamentals of nuclear physics and its latest applications. Your book, Nuclear Structure from a Simple Perspective, is used as a graduate textbook in many Universities in the Americas, Europe, and Asia.

Last but not least, from 1967 to this day you have published 690 refereed articles and invited conference talks. From the late 1970's to today, your research has been focused on the experimental search for dynamical symmetries in nuclear physics, especially within the framework of the Interacting Boson Model of nuclei. As recent as 2001, you have provided evidence for another type of symmetry, called critical point symmetry, which describes nuclei at the critical point of a phase transition. For this work, you have been awarded the American Physical Society 2011 Tom W. Bonner Prize in Nuclear Physics and, among other prizes and awards, two honorary doctorates.

Today, as you retire from your duties-not from research, your colleagues at Yale and at universities and laboratories all the world-over, wish you many more years of continuing contributions to the field of nuclear physics.

RETIREMENT

Larry Cerrito Retires, June 2015

Larry came to Yale University in 1980 as an Electronics Technician for the Yale Center for Electronics Services (YCES), working there for 16 years. In 1996 the YCES was eliminated and Larry joined a local electronics company.

However, in 1998 his friend Don McDuff considering retirement, thought of Larry. Don was the original operator of our 1 MeV Van der Graaff particle accelerator, which was acquired in 1975 through the DOD. Once at Yale, the device was converted to a proton accelerator and established as an apparatus for undergraduates. On Don's advice, Larry was hired back to keep the machine running. As a result of an incomplete upgrade, the VdG was in pieces when Larry arrived. He expertly rebuilt it.

For the next 17 years Larry cared for the device the way you care for a spirited child: with humor, understanding, dedicated resourcefulness, great patience, and perhaps an occasional bit of frustration. Over these years, during both the fall and spring semesters, the VdG was in near continual operation, giving well over 600 students the rare experience of collecting and analyzing their own nuclear physics data. As a complex apparatus with many subsystems and equipment of varying degrees of age (all old), Larry was indefatigable in ensuring the VdG was operational when it needed to be. Responding to rapid technological advances, he also worked on and implemented a large number of improvements.

In 2001, Larry began maintaining and organizing P205 and P206 lab equipment. In 2010 he took on assisting with providing demonstrations to faculty, as well as becoming a crucial part of the Yale Physics Olympics. Each new responsibility and challenge was accepted with cheerful aplomb. Aside from these contributions, it would be impossible to name all the other areas of the department where his hand has kept things running smoothly.

It continues to be a privilege and delight to know Larry. Not just I but the whole department will miss him.

Tribute by Stephen Irons

John E. Fox Retires, September 2015

In September of this year, the Lead Administrator and Department Business Manager, John Fox will retire. John first joined Yale in 2003, and in 2006 he started his 9 years of service to the physics department. John led the staff during a time of limited resources and falling federal funding for science. John was very loyal to the Department and to the staff, always looking to advance the careers of those who reported to him. After leading the Department through many positive changes, he will surely be missed.

Below are a few quotes gathered from the staff John worked with and supervised over the years.

Always available when I needed guidance or just to let me vent! *– Giselle DeVito*

At staff meetings John was always reminding us of "C I" – Continuous Improvement - I hope he remembers to bring this concept into retirement and that we will hear back from him about all the great ways his life is improving! *– Sandy Tranquilli*

Without you correcting my grammar, I might devolve into a fit of grunts and dramatic hand motions. *– Dani Heller*

John has a memorable sense of humor. My children still remember him from fifteen years ago as the guy who can "break" his thumb and re-attach it. *– Phil Bujalski*

John is always saying to me, "She's in Charge!", "You are spending more money again!?", "See you next month!". He will be so missed by the administrative staff in Physics! *– Linda Ford*

You'll always be on my mind because I'm never going to stop trying to figure out what your middle name is. *– Geriana Van Atta*

"What does the fox say? Ne Ne Ne Ne Ne". He is terrific with the kids and makes them laugh with his floating thumb. *– Daphne Klemme*

IN MEMORIAM

William Lichten (1928–2014)

William Lichten died on November 27, 2014 at Westchester Medical Center in Valhalla, New York, after a short illness. He was 86 years old. His work was characterized by an abiding interest in scientific research, mainly in physics but also in quantitative psychology.

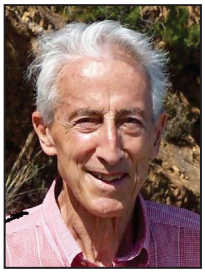
Lichten's undergraduate research was in the psychophysics of perception at Swarthmore College in the laboratories of Hans Wallach and Wolfgang Köhler, and at the Harvard Psychoacoustic laboratory with George Miller. His graduate research was done at the University of Chicago. His Ph.D. thesis was his first experiment on meta-stable molecules and laid the groundwork for his later experimental research.

In 1956, he went to Columbia University as an N.S.F. postdoctoral fellow in the laboratory of Professor P. Kusch and worked with I.I. Rabi. Later he was a research physicist in the Columbia Radiation Laboratory.

William Lichten joined the Physics Department of the University of Chicago as an Assistant Professor. His work at Chicago centered chiefly on metastable hydrogen molecules, involving studies of level crossing spectroscopy of atoms. He also collaborated with Ugo Fano and Michel Barat on the theory of diatomic molecules and atomic collisions. In 1963, he was appointed Associate Professor in the Physics Department of the University of Chicago, with a joint appointment in the Institute for the Study of Metals.

He joined the Department of Physics in the Graduate School of Yale University as a Professor in 1964, where he served until his retirement in 1998. His experimental research at Yale consisted of precise radio frequency and laser measurements of molecular and atomic energy levels. This included a determination of the Rydberg constant to 11 significant figures and the first laser spectroscopy of the electronic states of molecules. In 1968, he was elected a Fellow of the American Physical Society. At the time of his death, he was a Professor Emeritus of Physics and Engineering and Applied Science in Yale College and the Graduate School, and a fellow of the Koerner Institute for Emeritus Faculty at Yale.

William Lichten is survived by Susan Lurie Lichten, his wife and co-author on his first scientific publication (Am J Psychol 63: 280-2, 1950), by Michael, Stephen, and Julia, his children, and by Nathaniel Lichten, Josephine Lichten, Molly Lichten, Adam Geber, and Katharine Geber, his grandchildren.



Martin Charles Gutzwiller (1925–2014)

Martin Charles Gutzwiller passed away on March 3, 2014 in Rio Rancho, New Mexico, where he had spent the last two years of his life in close proximity to one of his daughters. His name will remain graven in the history of theoretical physics, through both his trace formula and his wavefunction. Those who knew him will remember his deep and passionate dedication to science, his lucid mind, and his eagerness to communicate his ideas.

Born on October 12, 1925 in Basel, Switzerland, Martin spent his childhood partly in Fribourg and partly in Heidelberg, Germany. He received his diploma in physics from ETH Zürich in 1950; his thesis, "On the magnetic moment of nucleons in the vector-meson theory," was supervised by Wolfgang Pauli. Several decades later, in a letter to PHYSICS TODAY (August 1994, page 9), Martin recognized having received "a marvelous education in early field theory" but at the same time having been frustrated because the problem posed by Pauli could not be satisfactorily handled. He proceeded to criticize theoretical physicists as having lost any touch with reality. Thus he pleaded for coming back to "down-to-earth physics" instead of "chasing an elusive goal on the basis of abstract models."

After receiving his diploma, Martin spent a year at Brown Boveri (now ABB) in Baden, where he helped set up the first microwave telephone link in Switzerland, between Zürich and Geneva. In 1951 he moved to the US on a scholarship and studied for his PhD at the University of Kansas under the supervision of Max Dresden. Two years later he finished his thesis, "Quantum theory of wave field in spaces of constant negative curvature." He then joined Shell Oil's exploration and production research laboratory in Houston, Texas, to conduct research on plastic flow of rocks under high pressure, sound propagation in solids, and magnetization of sedimentary rocks.

In 1960, Martin returned to Switzerland to be a researcher at the IBM Zürich Research Laboratory. Three years later he moved to New York City to work for the IBM Watson Laboratory at Columbia University, where he also was an adjunct professor in metallurgy. Martin moved with the lab, now the Thomas J. Watson Research Center, to Yorktown Heights in 1970. After retiring from IBM in 1993, he became an adjunct physics professor at Yale University.

ALUMNI NEWS

Alvin M. Saperstein, '56 Ph.D:
Former Chair and Editor of FPS-APS, recently elected to Board of FHP-APS, Professor Emeritus at Wayne State University since 2011. After recovery from severe West Nile Virus, he remains active with ACLU, Fulbright Association, teaching "Politics of Climate" on campus and community, and with WSU Center for Peace and Conflict Studies.

Sam Tanenbaum, '60 Ph.D:
In May, Sam and his wife, Carol, moved into Mt. San Antonio Gardens, a 33 acre, 500 resident retirement community in Claremont, CA. After retiring from full-time teaching at Harvey Mudd College in 2003, he continued to teach part-time at the Claremont Colleges until 2013. Two of his children and their families live in Claremont, so Sam and Carol keep busy with them while enjoying the talks and concerts offered at the colleges.

Russell W. Dreyfus, '60 Ph.D:
After 35 years at IBM Research Center (including Fellow Optical Society of America and Fellow American Physical Society), headed into retirement as visiting Research Professor at: Univ. Aix-Marseille, FR, Univ. of Hull, UK; and, lastly, Dept. Optics, C.S.I.C., Univ. of Madrid, ES. Now enjoying boating, golfing, beaches and family in Sarasota, FL.

William Fickinger, '61 Ph.D:
Now Emeritus prof at Case Western Reserve University, Bill's entire research career was based on the experimental high energy physics work he began with the Bubble Chamber Group at Yale. Since retirement Bill has published the 120 year history of the CWRU physics department and a biography of one of its best known physicists, Dayton Miller. Bill is secretary and editor for Cleveland Peace Action.

Donald J. Williams, '62 Ph.D:
Donald retired in 1999. During his years, he experienced a rewarding research career in the field of space plasma physics, culminated by analyzing data from an experiment, for which he was the Principle Investigator, onboard the NASA Galileo satellite orbiting Jupiter. Since 1999 he has enjoyed a very active and personally productive retirement.

Frank Lin, '57 B.E, '65 Ph.D:
Visiting Professor at Bangkok University doing research in Tsunami applying Remote Sensing. More info at the following link: http://tsunamisociety.org/6thTsuSympCOSTARICA2014Awards.html

Gerald A. Smith, '61 Ph.D:
Currently working on experiements that measure lifetimes of positrons in solids and liquids exposed to weak magnetic fields. The motivation for this work is found in Shertzer et al, Phys. Rev. A58, 1129 (1998), which predicts very long lifetimes under certain conditions. First results should be published soon.

Alan McDonald, '65 Ph.D:
Alan retired from IBM Research in 2005, and moved to Maine, now residing in a recently built house in York. Woodworking and gardening are his current focus. "Come Visit!"

Karl Wetzel, '65 Ph.D:
Prior to arriving at U. Portland in 1969, Karl had post docs at Darmstadt, Germany (electron Linac) and Argonne (CP-5 reactor) doing nuclear structure. At Argonne, he used n-capture γ rays to make the first measurement of Delbruck scattering. He retired from UP in 2001 after teaching and serving as graduate dean and assistant academic VP. Karl has one wife, one house, two sons, and four grandchildren. "Visitors to PDX are welcome to bunk" – wetzelkarl@hotmail.com

John F. Nagle, '65 Ph.D:
Professor Emeritus in the Departments of Physics and Biological Science at Carnegie Mellon University. John entered the Biological Physics subfield in the 1970s during a sabbatical at Yale with Lars Onsager. No longer teaching classes, John spends his time doing research.

James F. Ziegler, '57 B.S, '67 Ph.D:
Recently authored a new book, "The Science of MicroDosimetry". A major problem in radiation dosimetry for health sciences is the very large correction factor from the detected radiation to the equivalent cell dosage. For the first time, radiation detectors have been developed which duplicate corneal epithelial cells which can cause cataracts after even low radiation exposure.

Phil Scott, '69 Ph.D:
Phil started to wind down his Texas practice of ophthalmology in 2006 and fully retired last December, leaving the practice in the capable hands of his three younger associates. His wife, Susan, and he are currently residing in their cabin in northern Minnesota. They anticipate visits from their children, their spouses, and grandchildren later this summer.

Martin Spencer, '70 Ph.D:
Over the past few years, Martin has designed and built a data centre in the heart of downtown Auckland. (www.datacentre.co.nz). It is now full and he is starting to build an extension on the second floor.

Allen Lee Sessoms, '71 M.Ph, '72 Ph.D:
Allen is currently a distinguished professor at Georgetown University. He has recently been elected vice chair of the Forum on Physics and Society of the American Physical Society. He will subsequently serve, one year each, as chair-elect, chair, and past-chair.

ALUMNI NEWS

Elaine Oran, '69 M.Ph, '72 Ph.D:
In 2014, Elaine joined the faculty of the University of Maryland at College Park as the Glenn L. Martin Institute Professor, and Professor of Aerospace Engineering. She is also an affiliate in the Department of Mechanical Engineering, Department of Fire Protection Engineering, and the Institute of Physical Science and Technology. She is also an Adjunct Professor at the University of Michigan, Department of Aerospace Engineering and Visiting Professor of the Institute of Advanced Study at Hong Kong University of Science and Technology.

Alan D. Levine, '73 M.S:
Alan completed his doctorate in Molecular Biophysics and Biochemistry at Yale in 1978. Since 1995, he has been a Professor of Medicine, Molecular Biology, Microbiology, Pathology, and Pharmacology at Case Western Reserve University School of Medicine in Cleveland OH. Along with teaching and service activities, his research focuses the cross talk between the microbiome, intestinal epithelial cells, and mucosal T cells in regulating intestinal permeability.

Subodh R. Shenoy, '73 Ph.D:
After PhD work on fluctuations in superconductors, Subodh returned to India to TIFR-Bombay. After several academic positions, notably the University of Hyderabad, and ICTP, Trieste, he is presently at a new interdisciplinary institute started in Hyderabad by TIFR. A pleasing 2π closure, of a still emerging trajectory.

Martin E. Cobern,'74 Ph.D:
Marty retired in August, 2014 as VP, R&D at APS Technology, Inc. in CT. For the past 35 years he was involved in research in the oilfield services industry. He now devotes his time to volunteer activities - teaching Sunday school, the Cheshire Food Pantry, Trumbull College Fellow, the Masons, and his hobbies – photography and travel. He and Dorie live in Cheshire, CT. Their elder daughter, Susan Chasen, and grandsons Ryan & Zack are also in town. Their younger daughter, Amy Schulenburg lives in Melbourne, Australia.

Mike Lauterbach, '77 Ph.D:
Mike retired two years ago. His wife, the 9th dean of the Yale School of Nursing, is finishing her 10th year as dean. Their plans are to go to Australia and New Zealand for six weeks. "Hello to all Yale Physics grads!"

Peter C. Andersen, '78 Ph.D:
Chief Investment Officer/partner at Congress Wealth Management in Boston. He also writes a monthly column for Forbes, and appears regularly on CNBC. He is on the Board of the Boston Symphony Orchestra. Recently he made a significant contribution to mathematical finance with a new derivation of the Black Scholes equation for options pricing.

Barry Lovett,'79 Ph.D:
Barry uses his math and physics background developing navigation and communication systems at BAE Systems in Wayne, NJ. He lives with his wife Tova, who has a Ph.D. in biology, in Livingston, NJ. They have two grown children, neither one a scientist, one having served time at Harvard.

Thomas Moore, '78 M.Ph, '81 Ph.D:
Thomas has been teaching and doing research on gravitational-wave detection for 28 years at Pomona College. He has published an upper-level undergraduate textbook called "A General Relativity Workbook" (University Science Books, 2013) and is finishing the 3rd edition of his introductory textbook "Six Ideas that Shaped Physics"

Seyyed-Mohsen Maesumi-Fakhaar, '82 M.S/M.Phil: Associate Professor at Lamar University. Mohsen has fond memories of Dr. E. Robert Beringer, Director of G.S. and Sarah Batter, department administrator. He went to NYU-Courant for a Ph.D in Applied Math. He currently lives in Texas with his wife Figen, daughter Parisa, and son Arman.

Kwong-Kit Choi, '84 Ph.D:
Senior Research Scientist at the Army Research Laboratory, performing research on infrared sensors for Army and NASA applications. His recent work includes the design and production of Thermal Infrared Sensor aboard the Landsat-8 satellite, launched in 2013, to monitor Earth's health and resources.

Art Ramirez, '84 Ph.D:
Professor of physics at UC Santa Cruz. He has reestablished the ultra-low temperature capability he had at Bell Labs and is liquefying more than 50 liters of helium per day. His interests are geometrical frustration, topological insulators, and oxide semiconductors.

Steve Axelrod, '85 Ph.D:
Steve is CEO of G-Tech Medical, an early stage medical device startup company developing an "EKG for the gut", a wireless, wearable patch that will help pinpoint the underlying causes of functional gastrointestinal disorders. Steve lives with his wife Kim in Los Altos, CA, and has two college aged daughters.

Suk-Joon Lee, '86 Ph.D:
After serving 23.5 years, Suk-Joon is retiring from Kyung Hee University in Korea this August. He will remain teaching for five more years as Professor Emeritus.

ALUMNI NEWS

Ricardo Piegaia, '88 Ph.D:
Full professor at Universidad de Buenos Aires, Argentina. Ricardo works in high energy physics on experiments at Fermilab (Illinois) and CERN (Geneva, Switzerland), and in experimental astrophysics at the Auger cosmic rays observatory. He is married with one daughter, and big fan of outdoor mountain and underwater activities.

Robert Michaels, '89 Ph.D:
Robert is a staff scientist at Jefferson Lab performing electron scattering experiments. He is a co-spokesperson on PREX, which measures a parity-violating asymmetry for elastic scattering from lead and calcium nuclei that provides new information on neutron distributions.

Steve Kettell, '90 Ph.D:
Senior Scientist and Electronic Detector Group leader at BNL. EDG is pursuing BNL's Intensity Frontier physics program, focusing on neutrino oscillations and rare muon processes. Steve serves as US Chief Scientist for Daya Bay, continuing to produce outstanding science, and has been appointed as International DUNE Project Manager.

Jonathan Gilligan, '91 Ph.D:
Associate Director for Research at the Climate Change Research Network and Associate Professor at Vanderbilt University. His research integrates physical sciences with social and behavioral sciences to understand interactions between changing societies and changing environment, and applies this approach to topics ranging from climate change impacts on rural communities in South Asia to private corporate governance as a tool for reducing greenhouse gas emissions without government regulation.

Doug Bergeman, '98 Ph.D:
Recently granted tenure at the University of Utah. After leaving Yale, Doug worked as a post doc at Rutgers University on the KTeV experiment at FermiLab. Soon after, switched to the field of astroparticle physics, joining the HiRes Experiment. He received an appointment as Assistant Professor at Rutgers in 2005, and in 2009 moved to the University of Utah. He is currently working on the Telescope Array experiment.

Yancey Quinones, '00 M.S:
After 20 years of teaching, the last 6 at the Horace Mann School, Yancey has decided to change careers into the financial field. "I remember some of my physics colleagues going into finance after graduating and wonder what their thoughts might be."

George I. Mias, '01 B.S/M.S, '07 Ph.D:
George completed postdoctoral training in Genetics at Stanford University. He has received an NIH Pathway to Independence (PI) Award (K99/R00) from the NHGRI, and is now Assistant Professor of Biochemistry and Molecular Biology at Michigan State University, conducting research on Personalized Medicine.

Rachel Lewis, '05 Ph.D:
For the past five years Rachel has been working at the Sauder School of Business at UBC. She and her husband live in Vancouver, where they both teach meditation classes.

Adrian Del Maestro, '05 M.S:
Adrian received his Ph.D from Harvard in 2008 and is currently an assistant professor of physics at the University of Vermont where he studies strongly correlated quantum liquids and gases via high performance computer simulations. He is especially interested in low dimensional helium and was recently involved in a collaboration that measured superfluid flow through a channel only a few nanometers across [Science Adv. 1 e1400222 (2005)].

John Murray, '06 B.S, '13 Ph.D:
John has joined the faculty of Yale, after working as a postdoctoral associate at New York University. He is an assistant Professor in the Department of Psychiatry at the Yale School of Medicine. His research is in computational neuroscience at the interface of physics and biology.

Sarah Bickman, '08 Ph.D:
Sarah and her husband, Daniel Farkas (YC '00) are both working at tech startups in Boulder. Daniel is at ColdQuanta, which sells equipment for making ultracold atoms and Sarah is at MBio Diagnostics, which develops a variety of point-of-care medical diagnostic tests. They have two kids, Zeke, 6, and Eliana, 1.

Jack Challis, '09 Ph.D:
Jack sold his startup CliniCast to Elekta, a Swedish cancer care company, in April of this year. CliniCast provides data science tools to help improve the effectiveness of cancer care. In March 2014, Jack and his wife Rachel welcomed the arrival of their daughter Penelope.

Brian Walsh, '13 Ph.D:
Brian lives in Vienna, Austria and works at the International Institute for Applied Systems Analysis (IIASA). He models food, energy, and climate systems to project the impacts of demographics, technologies, and policy shifts on food security and land use. His husband is the US Ambassador to the OSCE, headquartered in Vienna.

Tomas Aronsson, '15 Ph.D:
Researcher at Zurich Financial Services doing exactly the same work he did at CERN, but on financial data. He is working in a newly started research group, working directly under the global executives, developing machine-learning algorithms on large amounts of financial data in order to change the way business is being done.

PHOTO CONTEST

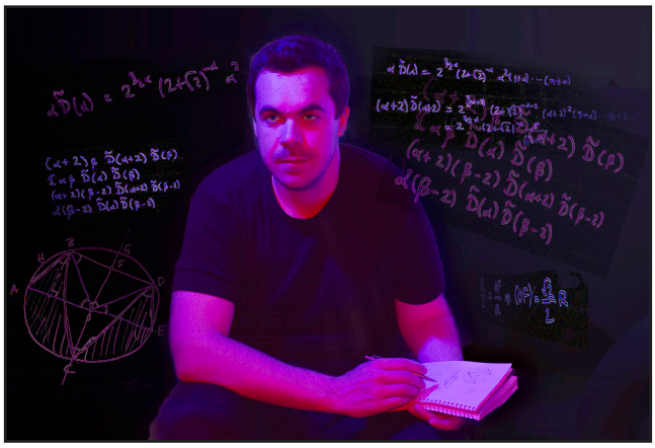
Physics Department Photo Contest of 2015

Selected from about 80 images, the winners of the 3rd Physics Department Photo Contest highlight beautiful scenes from around New Haven, Yale, and inside the physics labs.

About the judge: Michael Doolittle is a freelance photographer who has worked for many publications, including the New York Times, National Geographic Traveler, Time magazine, and the National Geographic World. He took up photography after college and for many years worked in Peru and Malaysia specializing in photographing in the rainforest canopy and helping build canopy walkways for scientists and ecotourists. A highlight of this period was collaborating with scientists at the Cincinatti Zoo Insectarium to collect a large colony of bullet ants, Paraponera clavata. This was the first time that bullet ants, widely considered to have the most painful sting in the insect world, had ever been collected. And they are still on display in Cincinatti.

First Place: Jennifer Stergiou

featuring Andreas Stergiou, Post Doctoral Associate



Second Place: Grace Pan

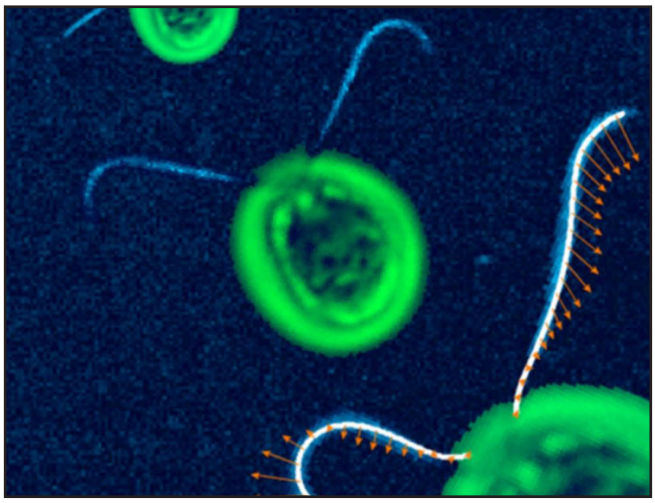
YC'2017 Physics major

Third Place: Anna Kashkanova

Graduate Student

Fourth Place: Veikko Geyer

Post Doctoral Associate



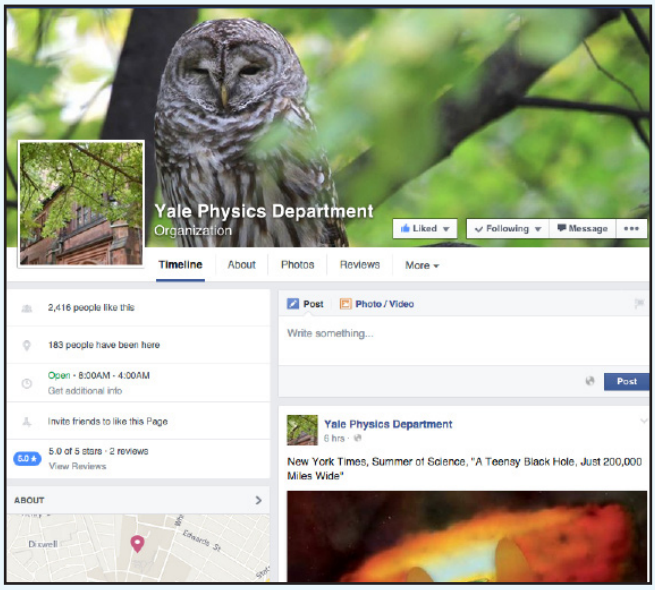


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Photo by Anna Kashkanova