

Radiations

The official publication of Sigma Pi Sigma

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NOBEL PRIZES IN PHYSICS

**SPS Members Help
Power LIGO**

**Nobel Laureate Adam Riess
On Thinking Critically**

Making Waves & Breaking Boundaries

Featuring



Dame Susan Jocelyn Bell Burnell

PhysCon Honorary Chair
Professor of Astrophysics,
University of Oxford
Winner of 2018
Breakthrough Prize



Sandeep Giri

Manager, Advanced Technology
Engineering, Google X



Dr. John C. Mather

Nobel Laureate
Senior Astrophysicist
at NASA Goddard Space Flight
Center

**Photo Courtesy of Christopher
Michael*



Dr. Jami Valentine Miller

Primary Examiner, U.S. Patent and
Trademark Office
Founder, African American Women in
Physics (AAWIP)



Dr. Ellen D. Williams

Distinguished University Professor,
Department of Physics and Institute for Physical
Science & Technology,
University of Maryland



November 14 - 16, 2019
Downtown Providence, RI



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ON THE COVER

Visualization of two black holes colliding and the resulting gravitational waves generated, based on simulations of the event detection from the LIGO experiment announced in February 2015. Credit: Visualization by Carson Brownlee, Intel, using ParaView with OSPRay. GR-Chombo simulation data from Pau Figueras, Markus Kunesch, Saran Tunyasuvunakool, Juha Jäykkä, Stephen Hawking Centre for Theoretical Cosmology.

Spring 2018 Corrections:

Alert readers wrote to us about our “Take a Tour Through the Atomic Age” feature, in which we stated that the Nevada Test Site was the location of the first above-ground test of an atomic device. We, of course, should have said that it was the first test of an atomic device on U.S. soil since the end of World War II. *Radiations* regrets the error.

The Sigma Pi Sigma Chapter Project Award for the University of Maine incorrectly identified the advisor for that chapter. The advisor is Charles Hess.

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EDITOR

Rachel Kaufman

MANAGING EDITOR

Kerry Kidwell-Slak

CONTRIBUTING EDITORS

Kendra Redmond

James Merrick

Rachel Pritchett

COPY EDITOR

Cynthia Freeman

ART DIRECTOR

Hyun-Joo Kim

SIGMA PI SIGMA PRESIDENT

Jim Borgardt,
Juniata College

SPS PRESIDENT

Alina Gearba-Sell,
US Air Force Academy

SIGMA PI SIGMA/SPS DIRECTOR

Brad R. Conrad



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Energizing our Community

by Jim Borgardt, Sigma Pi Sigma President



Jim Borgardt. Photo by Hyun Joo Kim.

One hundred years ago, Max Planck received the 1918 Nobel Prize in Physics “in recognition of the services he rendered to the advancement of Physics by his discovery of energy quanta.” Technically, he received the award in 1919, because the 1918 selection committee concluded none of the nominations offered that year satisfied the criteria Nobel outlined in establishing the awards. The committee opted instead to exercise a rule allowing them to postpone the 1918 award until 1919. Thus in 1919, Planck received the 1918 award in physics, and Johannes Stark received the 1919 award “for his discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields.”

The Nobel laureates represent the most prestigious “honor society” we have in physics. Fortunately, for the many of us who may not rise to such recognition, we also have $\Sigma\Pi\Sigma$! As the national honor society for physics, $\Sigma\Pi\Sigma$ offers unique opportunities to recognize accomplishment, augment your resume, and meet new like-minded people.

I believe there are many ways current $\Sigma\Pi\Sigma$ members can contribute to our community which we haven't fully recognized, just as today we are still unlocking the secrets of Planck's energy quanta. There are latent and underutilized opportunities for $\Sigma\Pi\Sigma$ members to enjoy the benefits of membership beyond the transient induction ceremony, and one of my hopes during my tenure of service is to better leverage these and more effectively engage $\Sigma\Pi\Sigma$ alumni.

While many alumni donate gifts to $\Sigma\Pi\Sigma$ through <http://donate.aip.org> to encourage and support undergraduate physics students with scholarships, career resources, and professional development, I hope to extend the scope of how $\Sigma\Pi\Sigma$ alumni reach back to support and engage with current physics students. The alumni among us could each serve as a “ $\Sigma\Pi\Sigma$ energy quanta” through developing internship opportunities, greater interactions with nearby chapters, or volunteering to be on a speakers list that local $\Sigma\Pi\Sigma$ chapters could query. In regards to the latter, the SPS/ $\Sigma\Pi\Sigma$ National Office has been working on a portal to gather information for willing speakers that will be rolled out in the coming weeks. Check out <http://www.sigmapisigma.org> for more details.

I would be glad to hear your comments on these ideas, as well as any other avenues by which we might strengthen our community and enhance the visibility of $\Sigma\Pi\Sigma$ and its role in this regard.

Finally, I am honored to serve as the incoming Sigma Pi Sigma president and would like to publicly thank Willie Rockward, the outgoing president, who served two terms in this capacity. I look forward to carrying on the initiatives that Willie introduced and leading $\Sigma\Pi\Sigma$ into our next century. You can reach me any time at borgardt@juniata.edu.

Science in general, and physics in particular, has so much to offer our country during these turbulent times. In this spirit, I hope to see you all at PhysCon 2019, November 14–16 in Providence, Rhode Island. This event affords us a wonderful opportunity to strengthen our community and will bring together more than 1,500 physics and astronomy students with mentors, alumni, and distinguished scientists as we meet to “Make Waves & Break Boundaries!” ●

Why I Give

by Samantha Pedek, Sigma Pi Sigma Member, University of Wisconsin, River Falls & Graduate Student in Astrophysics, University of Alabama



SPS and Sigma Pi Sigma have given me a home in the physics community. Not only do these organizations provide a means to connect students to other students and professionals, they also support research, travel to conferences, scholarships, resources for career and personal development, and much more! SPS is a well of opportunity, and more people need to take advantage of all the wonderful things they provide.

In a word, SPS and Sigma Pi Sigma means community. Not only do the organizations create a community of physicists, they also serve as an outlet for involvement in both the local and larger public communities.

One of my favorite memories of SPS was volunteering at the Astronomy on the Mall event on the National Mall with my group of SPS interns in summer 2017. We ran an outreach table with demonstrations ranging from gravity to optics to acoustics, and we saw hundreds of kids and adults who were all very engaged and were eager to learn about science. I see PhysCon 2019 as an extension of this outreach where we can inspire even more students to engage with physics and astronomy and make a difference in their communities.

I decided to become a sustaining donor for the Centennial Campaign because, unlike the vast majority of students, my physics department and alumni completely funded our chapter's expenses to go to PhysCon 2016. It was, and is, an extraordinary opportunity for young physicists to experience a large conference. This is one of the only conferences of this magnitude aimed at physics undergraduates, meaning that they get to hear about the new and exciting happenings of the science community, and most importantly, learn about what kinds of careers they can pursue and meet others that are also interested and involved in those careers and areas of research.

Since my expenses were paid for, I felt that I could help support students who want to attend PhysCon but do not have the means to fund themselves. By helping students attend PhysCon, you are helping them find their home in the physics community. You are helping them find where they belong.

I hope you will join me in making a difference for our community and become a sustaining donor as well. ●



Attendees at PhysCon 2016.
Photos courtesy of SPS.

Becoming a sustaining donor is easy!

Simply visit donate.aip.org and enter the amount you would like to donate along with your payment information. Your credit card will be automatically charged each month. In addition to saving yourself time, your money goes further as a sustaining donor because it reduces administrative expenses related to mailings and paperwork.

Automatic payments can be changed at any time.

The American Institute of Physics is a federation of scientific societies in the physical sciences, representing scientists, engineers, educators, and students. AIP offers authoritative information, services, and expertise in physics education and student programs, science communication, government relations, career services, statistical research in physics employment and education, industrial outreach, and history of the physical sciences. AIP publishes *Physics Today*, the most closely followed magazine of the physical sciences community, and is also home to the Society of Physics Students and the Niels Bohr Library and Archives. AIP owns AIP Publishing LLC, a scholarly publisher in the physical and related sciences. www.aip.org

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Introducing the Newest Sigma Pi Sigma Chapters

by Kendra Redmond, Contributing Editor

High Point University in North Carolina

Although its physics degree program is less than 10 years old, High Point University has an active physics department. “Because we are a new department, we have been very intentional about public outreach, undergraduate research, and developing a strong sense of community among students and faculty,” says advisor Aaron Titus. In their largest outreach event, HPU Universe Day, the department shares physics and astronomy with approximately 1,000 visitors from the community. High Point’s Sigma Pi Sigma installation followed a session of student research presentations, creating a day-long celebration of research, academic achievements, and community service.

Saint Anselm College in New Hampshire

Saint Anselm College hosted its installation on May 4th, because, explains advisor Nicole Gugliucci, “we’re geeks.” It’s been a busy year in the department. “Our students were looking for an opportunity to expand their professional skills and connect with each other outside of classes. So, over this past year, they came together to form our first Society of Physics Students chapter,” she says. “With SPS up and running, there was also a desire to get a Sigma Pi Sigma chapter running as well. We did have to hustle a bit to make sure we got all our inductions in before our seniors graduated!”

University of Nevada, Las Vegas (Renewed)

“Our primary goal as a chapter is to focus on the career development of the undergraduate students,” explains advisor Jason Steffen. Meetings focus on opportunities in internships and scholarships, research, career preparation, and public outreach. “We believe that reintroducing the honor society will provide students with an objective to strive for—motivating them to work hard to achieve their educational goals,” he says. The chapter is planning to explore a number of projects, including talks by potential employers, research presentations, and outreach events, in order to find their niche in the department.

Wofford College in South Carolina

“Our physics department is a close-knit group of dedicated, hardworking students,” says Wofford College’s chapter advisor Carolyn Martsberger. “Many of them are leaders on campus and take initiative on projects both within and outside of our department.” Through its Sigma Pi Sigma chapter, the department plans to increase its community outreach activities to local schools. In addition, says Martsberger, the honor society represents a new level of professionalism. Next fall, members will be participating in an alumni interviewing exercise to learn about the different careers of physics graduates. ●



NEW Alumni Engagement Program

A founding pillar of Sigma Pi Sigma is community fellowship: on campus, off campus, and among students and alumni. A fantastic way to bring together students and alumni is to invite Sigma Pi Sigma members to participate in chapter induction ceremonies and/or department talks. This fall, SPS National will launch a new way for chapters to connect with Sigma Pi Sigma members—the Alumni Engagement Program. Through this program, alumni can volunteer as guest speakers, informational interviewees, job shadow hosts, or Adopt-a-Physicist volunteers. Virtual and in-person opportunities will be available! <http://www.spsnational.org/programs/alumni-engagement>.



TOP LEFT: High Point University physics department chair Dr. Aaron Titus sending off last year’s SPS president, Alan Vasquez. Photo courtesy of the HPU Department of Physics.

TOP RIGHT: Induction materials from the installation of the Saint Anselm College Sigma Pi Sigma chapter. Photo courtesy of Brad Conrad.

BOTTOM LEFT: A group photo of the University of Nevada Sigma Pi Sigma chapter. Photo by Jason Steffen.

BOTTOM RIGHT: The Wofford College SPS chapter participates in the Terrier Play Day event held each spring. The event brings local elementary school children to campus for a safe and fun place to play. In this photo, two SPS members work with attendees to launch air rockets. Photo by Mark Olencki.



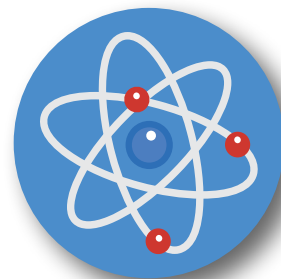
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Elon, SPS Intern 2018, North Carolina State University



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2018 Individual Award and Scholarship Recipients

SPS congratulates this year's recipients and thanks the generous Sigma Pi Sigma and SPS donors whose support makes these awards possible.

SCHOLARSHIPS

Multiple awards, ranging in value from \$200 to \$5,000, are made each year to individuals showing excellence in academics, SPS participation, and additional criteria. Learn more and see photos and bios of the recipients at <http://www.spsnational.org/awards/scholarships>.

SPS LEADERSHIP SCHOLARSHIP:

Mitchell Ahlswede

University of Wisconsin - River Falls

Brandon Barker

University of Tennessee - Knoxville

Aaron Coe

Bethel University

Dylan Frikken

University of Wisconsin - River Falls

Siddhartha Harmalkar

University of Maryland - College Park

Aman Kar

University of Wyoming

Camden Kasik

Juniata College

Connor Murphy

Grove City College

Jesus Perez

California State University - San Marcos

Samantha Smiley

DePaul University

SPS OUTSTANDING LEADERSHIP SCHOLARSHIP:

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Texas Lutheran University

AYSAN TUNCA MEMORIAL SCHOLARSHIP:

Brittney Contreras

University of Tennessee - Knoxville

HERBERT LEVY MEMORIAL SCHOLARSHIP:

Daniel Morales

Texas Lutheran University

AWIS KIRSTEN R. LORENTZEN AWARD SCHOLARSHIP:

Sophia Sanchez-Maes

Yale University

SCIENCE SYSTEMS AND APPLICATIONS, INC., UNDERREPRESENTED STUDENT SCHOLARSHIP:

Erin Brady

High Point University

SCIENCE SYSTEMS AND APPLICATIONS, INC. ACADEMIC SCHOLARSHIP:

Shae Machlus

Florida State University

PEGGY DIXON TWO-YEAR SCHOLARSHIP:

Vincent Thompson

Indiana University of Pennsylvania

SPS AWARD FOR OUTSTANDING UNDERGRADUATE RESEARCH

Awards are made to individuals for outstanding research conducted as an undergraduate. Winners are awarded \$1,800 to present their research at an AIP Member Society meeting and receive \$500 for themselves and \$500 for their SPS chapters. The runner-up receives \$250 for their chapter. Learn more at <http://www.spsnational.org/awards/outstanding-undergraduate-research>.

WINNERS

Luciano Manfredi Console

Loyola Marymount University

Sophia Sanchez-Maes

Yale University

RUNNER-UP

Collin Wilkinson

Coe College

HONORABLE MENTION

Brandon Barker

University of Tennessee - Knoxville

Coe College Recognizes Two Alumni with Sigma Pi Sigma Outstanding Service Awards



Steve Feller and DaNel Hogan. Photo courtesy of Steve Feller.

Sandeep Giri '04 and DaNel Hogan '99 were recognized June 30, 2018, at the Coe College Physics Reunion in Cedar Rapids, Iowa. Dr. Steve Feller recognized these two individuals for their steadfast commitment to the physics department at Coe and the undergraduate physics community as a whole. Giri will also be one of the keynote speakers at PhysCon 2019.

All Sigma Pi Sigma chapters are invited and encouraged to nominate their members and alumni for Outstanding Service Awards. Winners will receive a plaque from the National Office and recognition on the Sigma Pi Sigma website and in a future issue of *Radiations*. Please contact sigmapisigma@aip.org for more details.

2018 SPS SUMMER INTERNS

The SPS summer internship program offers 10-week positions for undergraduate physics students in science research, education, and policy with various organizations in the Washington, DC, area. Students are placed in organizations that use the interns' energy and diversity to engage in meaningful assignments relevant to their host organization and promote advancement of physics and astronomy.



Samuel Borer
University of Maine
AIP Mather Policy
Intern



Mikayla Cleaver
Gettysburg College
AIP/Society of
Rheology History
Intern



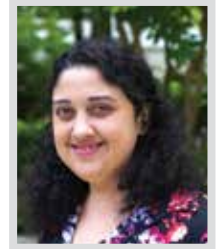
Collin Flynn
Coe College
NASA Goddard
Space Center Intern



Nathan Foster
Tufts University
AIP FYI
Science Policy
Communications
Intern



Kristen Larson
University of Illinois -
Chicago
AIP Niels Bohr
Library & Archives
Intern



Sarah Monk
University of
Maryland - College
Park
AIP Mather Policy
Intern



Daniel Morales
Texas Lutheran
University
NASA Goddard
Space Center Intern



Jesus Perez
California State
University - San
Marcos
NIST Research Intern



Elon Price
North Carolina State
University
APS Career
Programs Intern



Phoebe Sharp
Rhodes College
APS Public Outreach
Intern



Brigette Smith
Coe College
The Optical Society
Intern



Michael Welter
High Point University
SPS Communications
and Web
Development Intern



Amanda Williams
Weber State
University
SPS SOCK (Science
Outreach Catalyst
Kit) Intern



Stephanie Williams
University of
Maryland - College
Park
AIP Center for History
of Physics Intern



Krystina Williamson
Columbia University
Barnard College
AAPT Teacher
Professional
Development Intern

NEW WAY to Apply for Awards

It's now even easier for you or your chapter to apply for awards, scholarships, and internships from SPS National!

Effective August 2017, $\Sigma\Pi\Sigma$ and SPS members can now access the online awards portal via a single sign-on through their SPS membership account. Simply visit <http://membership.spsnational.org>, click "SPS Awards Application" at the top menu bar, and log in using your SPS membership username and password.

Please note that you must have an active, individual, dues-paying SPS membership to access the SPS Awards Application system. Chapter accounts are not eligible to apply. Contact us at 301.209.3007 or sps-programs@aip.org with any questions.

Nobel Knowledge Quiz

So you think you know your Nobel history? You may think again after taking our quiz.
Do you recognize these images of Nobel laureates?



1

While this laureate (shown here as a wee tyke) may be best known for the limit named after him, he also has a telescope, number, and observatory named in his honor.



2

This physicist's Nobel was awarded for peace in 1975 for his efforts to oppose nuclear proliferation.



3

Sexism and rules regarding nepotism meant that this laureate wasn't paid to do research until 11 years after receiving her PhD.



4

In addition to his contributions to the electroweak unification theory, this laureate also advocated for the expansion of scientific resources in the developing world.



5

Despite his impressive work in laser cooling and trapping atoms, this laureate is probably better known for his second career as US Secretary of Energy from 2009–2013.



6

A special friend of the Society of Physics Students, this laureate's commitment to connecting scientists with policy has helped 18 undergraduate students over 9 years spend their summers in Washington, DC, serving in hands-on roles with the US Congress.

These images all come from the Emile Segrè Visual Archives (ESVA) within AIP's Niels Bohr Library & Archives. This collection features over 30,000 historical digital images, photographs, slides, lithographs, engravings, drawings, and other visual materials. The ESVA is fully searchable online at <http://photos.aip.org> or, if you find yourself in the Washington, DC, area, we encourage you to stop by the archives to check out these materials in person.

1. Subrahmanyan Chandrasekhar, 2. Andrei Sakharov, 3. Maria Goeppert-Mayer, 4. Abdus Salam, 5. Steven Chu, 6. John Mather

Lindau Nobel Laureate Meeting Bridges Generations of Scientists

by Rachel Pritchett, Contributing Writer



Nobel laureates are the rock stars of the physics world, often idolized by aspiring scientists. The Lindau Nobel Laureates Meetings are an effort to bridge the gap between these honored scientists and promising young scientists with the ultimate networking event.

Each meeting brings together approximately 30 Nobel laureates and 500 young researchers for a week in Lindau, Germany, for a once-in-a-lifetime experience. Not only do young physicists meet Nobel laureates, but also like-minded, motivated young researchers from across the world. This collective feeling of exuberance towards physics, often referred to as the “Lindau spirit,” is one of the things that sets this meeting apart from other top research conferences.

Much like other conferences, attendees participate in tours, small group discussions, panel discussions, poster sessions, and plenary talks. Unlike its counterparts, Lindau is open only to undergraduates, PhD students, and postdoctoral researchers under the age of 35. The theme alternates between chemistry, physiology and medicine, and physics. The next physics Lindau meeting is happening in the summer of 2019, and this is the time to apply.

Biophysicist Charlotta Lorenz attended the meeting in 2016. She describes the meeting as the “most scientifically inspiring week of my life.”

According to Lorenz, talking science wasn't the only life-changing aspect of the meeting; instead, personal conversations with Nobel laureates offered some of the most memorable moments of the week. At one of the dinners, Lorenz sat next to Johann Deisenhofer, winner of the 1988 Nobel Prize in Chemistry, and talked with him about life within and outside the realm of science. Lorenz encourages all young physicists to apply for Lindau 2019, because “you'll get to know many Nobel laureates directly and can connect with other young inspiring scientists. It's also a nice add-on for your resume.”

The Lindau Nobel Laureate Meetings began in 1951 with the goal of fostering an exchange among scientists across different generations, cultures, and disciplines. The conference is organized by two organizations, the Council for the Lindau Nobel Laureate Meetings and the Foundation Lindau Nobel Laureate Meetings; together they plan, fund, and oversee the meetings. As a global event, the Lindau council and foundation partner with over 200 distinguished science and research institutions around the world. These academic partners are tasked with identifying the most qualified candidates from their country and nominating them to the second part of the application process.

If you're interested in attending next year's physics-focused meeting, the journey to Lindau starts with your country's academic partners. For those in the United States this would be Oak Ridge Associated Universities (ORAU), a nonprofit organization that promotes building relationships between different generations of scientists. Although the Lindau organization allows undergraduate participants, ORAU requires applicants to be enrolled in a graduate program. Qualified students should apply through ORAU's website, <http://www.orau.org/lindau/>, by the end of September. If nominated, you will then apply directly through the Lindau association at <http://www.lindau-nobel.org/meeting/>. Interested people in other countries should visit the Lindau website at <http://www.lindau-nobel.org/academic-partners/> to find their country's academic partner. The process is extremely competitive, so reviewers look for candidates that exhibit outstanding qualities or experiences, such as studying outside of the country.

The application process is involved, but attendees say that in the end, walking into a room with 530 of the brightest minds in the physics community is well worth the effort. ●



TOP LEFT: Nobel laureates Brian Schmidt, Dan Shechtman, and Carl Wieman discuss the future of science education with SPS member Tamas Vami. Photo credit: Christian Flemming, Lindau Nobel Laureate Meetings.

RIGHT: David Wineland, 2012 Nobel Prize in Physics awardee, speaks with some young physicists at one of the social events at Lindau. Photo credit: Christian Flemming, Lindau Nobel Laureate Meetings.

AIP provides comprehensive coverage of the Nobel Prize in Physics announcements. Be sure to visit www.aip.org for 2018's expected announcement on October 2!

Reflections on the 2017 Nobel, From Students Who Helped Make it Possible

by Kendra Redmond, Contributing Editor

In 2017, the Nobel Prize in Physics was awarded to Rainer Weiss, Barry C. Barish, and Kip S. Thorne from the LIGO/MIRGO Collaboration for their contributions to the Laser Interferometer Gravitational-Wave Observatory (LIGO) and the historic first detection of gravitational waves. Scientists around the world celebrated, including then-undergraduate physics students Hunter Gabbard, Jasmine Gill, and Jonathan Wheeler, who were among the more than 1,000 scientists working on LIGO at the time of the discovery. Here, they share their thoughts on what it was like to be part of this monumental achievement.

Hunter Gabbard

Undergrad institution: University of Mississippi, class of 2016

LIGO involvement: Studied the detection of noise/glitches and analyzed data at the University of Mississippi, Laboratoire de l'Accélérateur Linéaire, and at the University of Texas Rio Grande Valley.

Current position: Astrophysics PhD candidate at the University of Glasgow in Scotland studying how machine learning can be applied to the LIGO search for black holes, neutron stars, and supernovae.

My interest in LIGO research began the first week of my freshman year. I remember casually walking by a LIGO poster in the hallway of the physics department and thinking to myself, "Wow, that sounds like an incredibly audacious experiment." I went to Dr. Marco Cavaglia, the person who would eventually become my undergraduate research advisor, and asked how I could get involved.

My experience working in the collaboration was, and continues to be, a major driving force in my career. The experience yielded many benefits that I didn't anticipate. Given that LIGO is such a large collaboration, with over 1,000 scientists and engineers, I have had the opportunity to work with people from diverse backgrounds. I've found that the connections I fostered early on gave way to many interesting research projects later in my career, most recently to a Fulbright Fellowship at the Max Planck Institute for Gravitational Research in Hanover, Germany.

Kiranjyot (Jasmine) Gill

Undergrad institution: Embry Riddle Aeronautical University, class of 2018

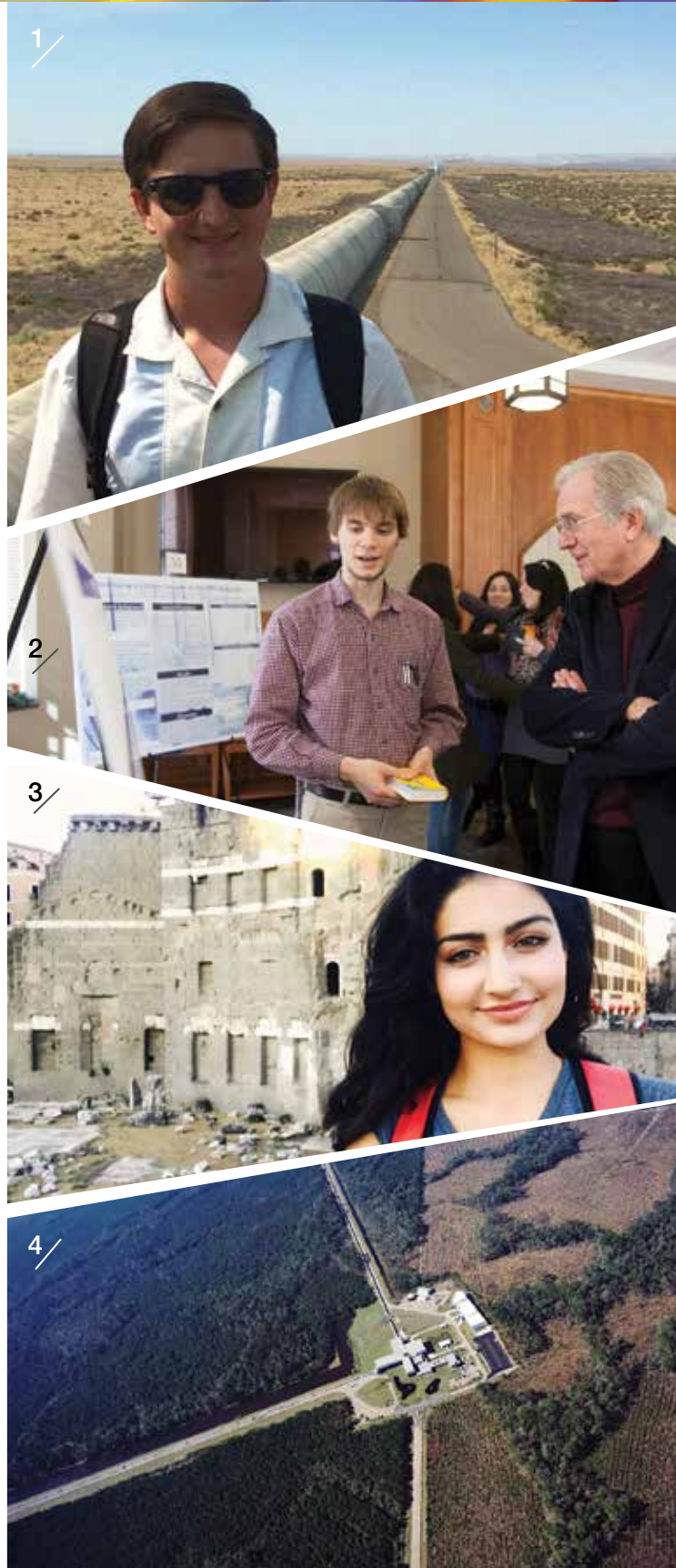
LIGO involvement: Studied the gravitational waves from core-collapse supernovae at Embry Riddle Aeronautical University, California Institute of Technology, Massachusetts Institute of Technology, and Carnegie Observatories.

Current position: Astrophysics PhD student at Harvard University.

Being involved in LIGO presented fruitful opportunities I could never have dreamed of. I became a bridge between the LIGO astrophysics and the astronomy communities, introduced my own supernova waveform at the age of 20, and helped provide the supernova science case for third-generation detector networks, which will be even more sensitive to gravitational waves than LIGO. I was the youngest author on the initial discovery paper. LIGO has been an integral part of my growth as a scientist and I am happy to have found a home in this scientific community.

When I heard that the collaboration had detected gravitational waves, simply put, I felt blessed. I couldn't believe what I was reading. I didn't feel the full impact of being part of the discovery until the pioneers who dared to dream this dream were awarded the Nobel prize. I was a young scientist standing on the shoulders of giants.

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Jonathan Wheeler

Undergrad institution: Andrews University, class of 2016

LIGO involvement: Developed educational games for use in science fairs and elementary and high schools at Andrews University.

Current position: PhD student at Stanford University, researching laser-driven fiber optic gyroscopes.

It was really exciting to contribute to such a massive project. As an undergraduate, I knew that I was supporting a mission that was perhaps one of the most ambitious scientific feats ever attempted by the human race. In 2015, I remember being told that we might have discovered the first gravitational waves but that we needed to be absolutely hush-hush until it was formally announced. I was warned, "Not even your teddy bear can know."

On the day of the big announcement, the labs of our general physics classes were cancelled so we could all witness the event. We had root beer floats to hand out if the LIGO Scientific Collaboration formally announced the discovery of gravitational waves. Everyone was taking bets on whether they would announce the discovery right off the bat, tease the audience a little bit, or not announce anything at all.

I remember texting my friends during the live stream saying, "ARE YOU WATCHING THE MOST HISTORIC SCIENTIFIC ANNOUNCEMENT OF THE DECADE??"

I was thrilled as everyone cheered when David Reitze, the executive director of LIGO, announced simply and plainly, "Ladies and gentlemen, we have detected gravitational waves! We did it!" It was a fulfilling experience to be part of a Nobel-prize-winning discovery. ●

LEFT TOP: Visualization of two black holes colliding and the resulting gravitational waves generated, based on simulations of the event detection from the LIGO experiment announced in February 2015. Credit: Visualization by Carson Brownlee, Intel, using ParaView with OSPRay. GR-Chombo simulation data from Pau Figueras, Markus Kunesch, Saran Tunyasuvunakool, Juha Jäykkä, Stephen Hawking Centre for Theoretical Cosmology.

1: Hunter Gabbard visits the LIGO observatory in Hanford, Washington, during a 2015 summer internship at the University of Texas Rio Grande Valley. Photo courtesy of Hunter Gabbard.

2: Jonathan Wheeler explains his research to then-president of Andrews University, Niels-Erik Andreasen, at a poster session in 2013. Photo by Christa McConnell.

3: Jasmine Gill visits Rome while traveling to the Gran Sasso Science Institute in L'Aquila, Italy, to do LIGO-related research earlier this year. Photo courtesy of Jasmine Gill.

4: An aerial view of the LIGO detector in Livingston, Louisiana. LIGO has two detectors: one in Livingston and the other in Hanford, Washington. LIGO is funded by NSF; Caltech and MIT conceived, built, and operate the laboratories. Photo courtesy of the LIGO Laboratory.

Nobel Intent

by Rachel Kaufman, Editor

Over the nearly 120-year history of the Nobel Prizes, only two of the prizes in physics have ever gone to a woman. None have gone to people of African heritage.

Looking at the data, as many have over the years,¹ it's easy to see that the vast majority of Physics Prize recipients have been white men. (There were not even any scientists nominated from countries in Africa for the first 65 years of the prize, according to the most recent data made available by the Royal Swedish Academy of Sciences.)

The Nobel Foundation, which manages the prize money and represents the institution, said at a press announcement last fall that they were concerned about the lack of women's representation in the prizes.²

"[W]e are disappointed looking at the larger perspective that more women have not been awarded. Part of it is that we go back in time to identify discoveries. We have to wait until they have been verified and validated before we can award the prize. There was an even larger bias against women then. There were far fewer women scientists if you go back 20 or 30 years," Goran Hansson, vice chair of the Board of Directors of the Nobel Foundation, said. "...We will, starting next year, indicate in our invitation to nominate women scientists and consider ethnic and geographic diversity. ...[W]e are concerned, and we are taking measures. I hope that in five years or ten years, we will see a very different situation."

The steps the committees are taking to rectify the gender imbalance are noble but are likely not the whole story. The standard explanation—that it takes a long time for a discovery's usefulness to be apparent, and there just weren't enough women scientists (or scientists of color) doing important work 2–3 decades ago—doesn't hold up under scrutiny, according to data from AIP's own Statistical Research Center. In an article published in the Huffington Post,³ Rachel Ivie and Susan White write that in 1980, 7 percent of the people receiving PhDs in physics in the United States were women. (The Nobel Prize is, of course, an international institution, but around one-third of its winners are US citizens.) Since 1990, 57 men have won the Nobel Prize in Physics (and no women). Using the 7 percent figure as a baseline, the authors write, if the pool of Nobel nominees was 7 percent female, the probability of 57 men winning the prize is less than two percent. Rather, the authors say, it's likely a combination of factors are at play, both of which trace their root causes to sexism.

"Even if they follow similar career paths, perhaps something happens along the way that makes men more likely to do the type of research that leads to a Nobel Prize," they write. "Results from our survey of nearly 15,000 physicists from around the world suggest that women do not have the same access to opportunities and resources to advance their careers as do men." This could result in fewer women being nominated—and since nominees are secret for 50 years, we won't know if this is the case for some time. Finally, they say, even if women are nominated in equal numbers as men, sexism could be at play, resulting in men winning.

Given that unconscious bias is well supported in the literature, the authors conclude that it is the most likely explanation for the gender disparity.

The Society of Physics Students is committed to making physics more accessible to everyone. That's a start, but it's going to take hard work to upend the power structures that lead to these gender and racial disparities and replace them with ones that lead to a more diverse and inclusive future for the prize. ●

1. <https://physicstoday.scitation.org/doi/10.1063/PT.6.4.20170925a/full/>.

2. <https://qz.com/1097888/the-nobel-prize-committee-explains-why-women-win-so-few-prizes/>.

3. http://www.huffingtonpost.com/susan-white/blind-ambition_2_b_4039523.html.

Staying Curious: Adam Riess's Nobel Journey

by Diva Parekh, SPS Member, Johns Hopkins
University



Author Diva Parekh. Photo courtesy of Diva Parekh.

Walking into Adam Riess's office, I was immediately struck by the number of books. There were books everywhere: in a ceiling-high bookshelf, all over the desk, and on the chairs. I assumed they were all related to physics, but I couldn't have been more wrong.

Riess, who shared the 2011 Nobel Prize in Physics for discovering that the expansion of the universe is accelerating, has incredibly diverse interests. This became apparent

when I asked him when he realized he wanted to do physics.

"I always had these questions of how or why something is," he said. "What is fundamental? What is the basic law here from which everything derives? That approach, as I asked more questions, led naturally to physics."

As an undergraduate at MIT, he majored in physics and minored in history. When I asked Riess if history is still a part of his life today, his eyes lit up.

"As scientists, we will really only confront a handful of research problems. When you seek wisdom or intuition, you may not have enough experiences to really gather that wisdom or intuition, so it's wonderful to study the history of science," he said.

He continued, explaining how scientists today can gain much-needed perspective from historical examples. Astronomers in the early 1800s observed that Uranus was not always where it was supposed to be, he said, which led to the discovery of Neptune. Mercury was not where astronomers initially believed it to be, which led to a confirmation of Einstein's general relativity.

"Right now we're seeing the expansion of the universe is faster than we expect. Is it a problem with the theory, or is it a problem with the components of the universe?" he said. "History, if anything, teaches you in science that you have to think critically."

Thinking critically during his undergraduate labs helped lead Riess to where he is today. "I particularly gravitated towards data analysis as applied to physics hypotheses," he said. "How is it that we collect a pile of numbers and we infer truth or reality from that?"

Riess's Nobel-winning research was a natural extension of what he had been working on since graduate school.



2011 Nobel laureate Adam Riess. Riess was inducted into $\Sigma\Pi\Sigma$ in 1991 at the MIT Chapter. Photo courtesy of Adam Riess.

"In my thesis, I had worked on tools involved in measuring the distances to exploding stars, supernovae. I began working with close collaborators on measuring even more distant supernovae," he said. "There was an expectation that the expansion of the universe would be slowing or decelerating."

He reinforced, however, that what earned him and his co-winners, Saul Perlmutter and Brian P. Schmidt, the Nobel Prize was not a sudden idea or a "Eureka" moment. Instead, it was persistence.

"It wasn't an idea so much as it was a measurement. It was an observation that the expansion is actually accelerating or speeding up, not decelerating," he said. "It came as a great surprise, and it came as a direct consequence of

continuing to work on these tools for measuring distances to supernovae and data analysis."

At the end of our meeting, I asked Riess if he had any advice for students like me.

"A passion for understanding is the best guide that you will have," he said. "The best privilege you could get in your life is to have a job that you actually like, that you find interesting, that doesn't feel like work." ●

TOP: This image, the Hubble Ultra Deep Field 2014, is a composite of separate exposures taken by the Hubble Space Telescope in light ranging from ultraviolet to near-infrared over many years. Credit: NASA, ESA, H. Teplitz and M. Rafelski (IPAC/Caltech), A. Koekemoer (STScI), R. Windhorst (Arizona State University), and Z. Levay (STScI).

NOBELS BY THE NUMBERS

49

Years between Peter Higgs and Francois Englert proposing the Higgs boson and being awarded the Nobel Prize, among the longest waits between discovery and recognition in the Physics Nobel's history. On average, the time between discovery and winning the prize is rising, according to data published in *Physics Today*,¹ and, if trends continue, most physicists will die before winning a Nobel.

1

Year between Chen Ning Yang and T. D. Lee's publication of "Question of Parity Conservation in Weak Interactions" in *Physical Review* in 1956 and their being awarded the Nobel in 1957. This is the fastest time from discovery to prize.

25

Age of William Lawrence Bragg when he won the Nobel in Physics in 1915, the youngest ever Physics laureate.

88

Age of Raymond Davis, Jr., when he was awarded the Nobel in Physics in 2002, the oldest person ever to win the Physics Nobel.

31

Paul Dirac's age when he won the Nobel. He may have wished he could take back a poem he had recited, according to biographer Helge Kragh, a few years earlier: "Age is, of course, a fever chill / that every physicist must fear / He is better dead than living still / when once he is past his thirtieth year."

2

The number of women who have won the Nobel Prize in Physics. Marie Curie shared the 1903 prize with her husband and Henri Becquerel for their discovery of radiation, and Maria Goeppert Mayer shared the 1963 prize with Hans D. Jensen and Eugene Wigner for important discoveries about the structure of the nucleus.

150,782

The amount in Swedish krona that Wilhelm Conrad Röntgen, the first Physics laureate, received as his prize. SEK 150,782 in 1901 is equivalent to about 7.7 million kronor today, which is not dissimilar to the values of today's awards, which have fluctuated at around 9 million SEK as of late. Nine million SEK is about \$1 million.

20

Percent of Physics laureates who wore beards; the other 80 percent apparently shaved regularly. According to tongue-in-cheek analysis by the Information is Beautiful Studio,² the most likely demographic group to win a Nobel in any category would be a 61-year-old married man who was born in the spring, lives in America, and studies or works at Harvard.

7

Children of Nobel Prize winners who have gone on to win the prize themselves (though not always in physics). Irene Curie, daughter of Marie and Pierre, won the Chemistry Prize in 1935. William Lawrence Bragg shared the 1915 Physics Prize with his father. Kai Siegbahn and his father, Manne Siegbahn, each won Nobels in Physics. Clearly, it pays to be related to a Nobel laureate.

1

Number of people who have won the Nobel Prize in Physics twice. That honor goes to John Bardeen. (Marie Curie was the first person to win two Nobels, but her first was in chemistry.) Bardeen, who co-won the 1956 prize for helping develop the transistor, attended the awards ceremony without his family in tow. King Gustav scolded Bardeen about leaving his family behind on the occasion of the Nobel ceremony, and he promised to bring them "next time." So far, he is the only person in history who has been able to keep such a promise.

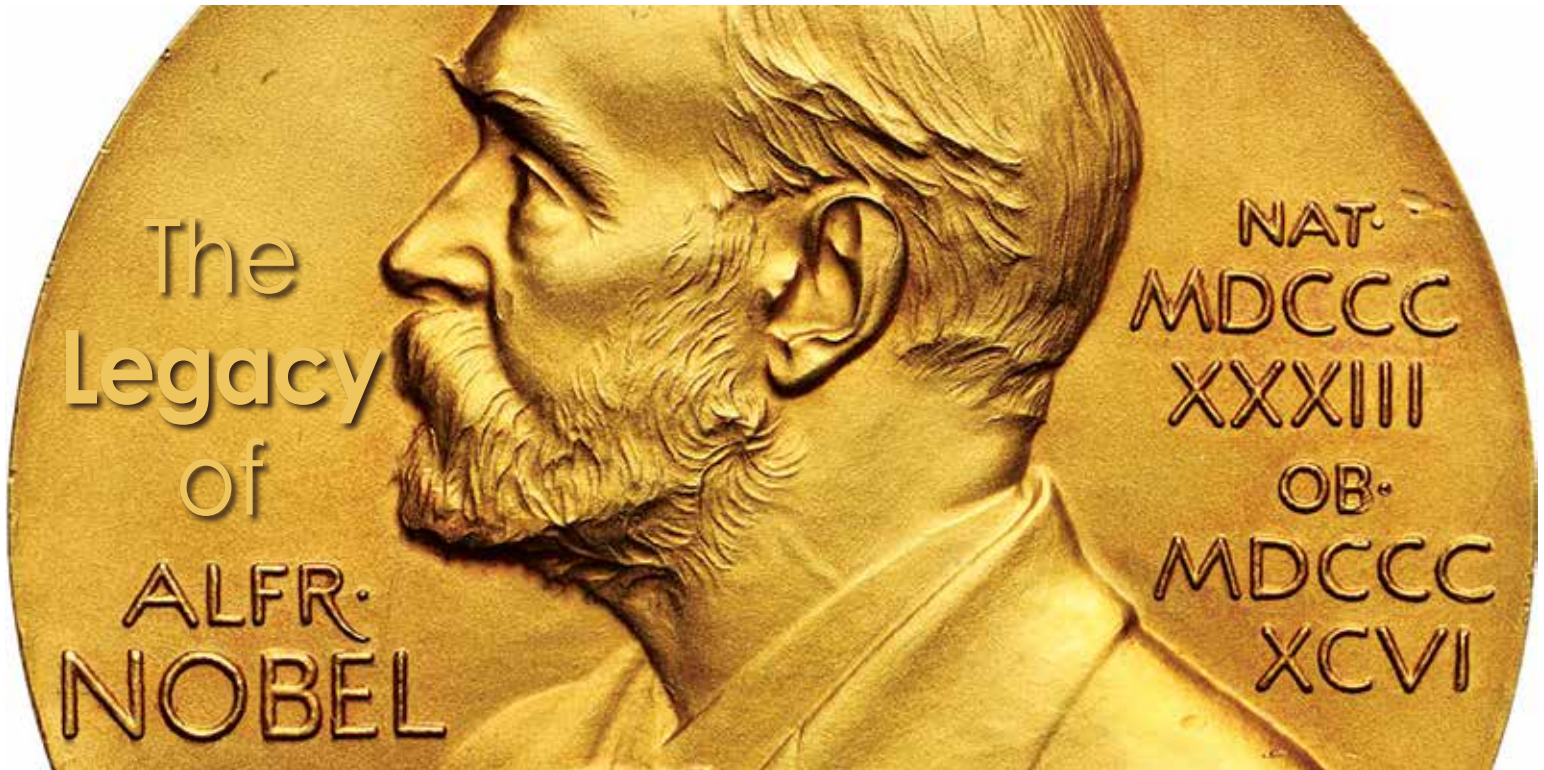
55

The percentage of Physics laureates in their 40s: More people in their 40s have won the Physics Prize than any other age group.³

1. <http://physicstoday.scitation.org/doi/10.1063/PT.5.2012/full/>.

2. <http://www.vox.com/xpress/2014/10/14/6966291/nobel-prize-winners-youngest-chart-graphic-age-demographics-facial-hair>.

3. <http://www.vocativ.com/366734/how-long-does-it-take-to-win-a-nobel-prize/index.html>.



by Dwight E. Neuenschwander, Southern Nazarene University

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When you are selected to win the Nobel Prize in Physics, you are informed (so I have heard) by a telephone call from the Royal Swedish Academy of Sciences. The following December in Stockholm, before a distinguished audience, you are presented the Nobel Prize medal by the king of Sweden. After the grand ceremony the laureates and dignitaries repair to a great hall for a formal banquet. You make an acceptance speech, which is published.

Of course, most of us will never win a Nobel Prize. But no matter who wins, all are uplifted because, as I have noted in another context, it takes three people to make music: the composer, the performer, and the appreciator.¹ As physicists we are well-informed appreciators. Nobel Prizes recognize visionary individuals, but they also commemorate the journey of a community.

Amid the international publicity surrounding the annual Nobel Prize announcements, little is said about the person behind them: Alfred Nobel (1833–1896), a 19th-century Swedish chemist, engineer, and industrialist. Like all interesting human beings, his life contained ironies and inconsistencies. He never earned a university degree but was a gifted inventor and chemist, highly skilled in science and engineering, well read and fluent in five languages. He lived in cosmopolitan cities but preferred solitude. As an entrepreneur, he managed multinational technology corporations but found time to write novels and poetry. His

business was the manufacture of explosives and armaments, but he actively supported pacifism. He amassed great wealth but left almost all of it to people he would never meet.

Alfred Nobel was born in Sweden in 1833, into a family of engineers.² In 1838 his father, Immanuel Nobel, immigrated to St. Petersburg for a fresh start after a bankruptcy. In Russia he founded a company that manufactured furnaces, steam engines, and machines for making wagon wheels. The company's fortunes brightened when Immanuel demonstrated in the Tsar's presence the effectiveness of sea mines against shipping vessels, winning a contract with the Russian government. The enhanced prosperity enabled Immanuel's wife Carolina (née Ahlsell) and their three sons, Robert, Ludvig, and Alfred, to join him in Russia in 1842. A fourth son, Emil, was born in St. Petersburg.³ The lads were taught at home by university professors. From a Swedish tutor, Lars Santesson, they learned the Swedish language and history, world literature, and philosophy. They were taught mathematics, chemistry, and physics by a Russian tutor, Ivan Peterov. In cosmopolitan St. Petersburg the pupils became fluent in five languages: Swedish, Russian, French, German, and English.

1. D.E. Neuenschwander, "Composers, Performers, and Appreciators," *Radiations* (Spring 1998), 6–7.

2. Biographical notes about Alfred Nobel are from articles on the Nobel Prize website, www.nobelprize.org/alfred_nobel/biographical/articles: Birgitta Lemmel, "Alfred Nobel-St. Petersburg, 1842–1863"; Tore Frängsmyr, "Alfred Nobel – Life and Philosophy"; Sven Tägil (ref. 6); and Åke Erlandsson (ref. 7).

3. The family had eight children; four did not survive beyond childhood, two (a son and a daughter) were born after Emil.

Chemist, Engineer, Entrepreneur

The teenage Alfred studied abroad in 1850–1852. In Paris he met the Italian chemist Ascanio Sobrero, who had synthesized the sensitive, highly explosive nitroglycerin.⁴ Alfred returned to St. Petersburg in 1852 during the Crimean War to find the family business manufacturing war materiel for the Russian army. But when the war ended in 1856 the Russian army orders abruptly stopped, plunging the Nobel factory into bankruptcy. The parents and Emil returned to Sweden, while Robert, Ludvig, and Alfred remained in St. Petersburg to start anew. They formed the Brothers Nobel oil company with prospects near the Caspian Sea. A tireless inventor, Alfred soon had several patents to his credit. The first one, issued in 1857, was for an improved gas meter. A patent for an improved pressure gauge followed in 1859.⁵

Steering himself back into the family business of explosives, which Immanuel had resumed in Sweden, Alfred was issued patents in 1863 for improvements in gunpowder production. Recalling the potential of nitroglycerin, he turned to the problems that prevented this unstable liquid from being usefully controlled. The first problem—whose solution required many dangerous experiments—was to synthesize nitroglycerin in quantity without premature detonation. The second challenge was to devise a way to explode nitroglycerin deliberately and reliably. Into a zinc can packed with gunpowder he placed a stoppered test tube filled with nitroglycerin. To initiate a purposeful explosion he invented the blasting cap, a hollow plug filled with gunpowder and lit with a fuse. When he threw the prototype into a canal, the huge explosion resulted in a spectacular waterspout. Returning to Stockholm, Alfred found his father trying with less success to solve the same problems—which resulted in a priority dispute between father and son. After Alfred described the technical details in a letter to his father, Immanuel backed off and helped his son apply for the patent under Alfred's name, which was awarded in 1864. The first large-scale use of this new “blasting oil” came in 1864 when the Swedish State Railway built Stockholm's Söder Tunnel. The Nobels set up factories in Sweden, Germany, and America.



Alfred Nobel as a young man. (PDM).

Tragically, in September 1864 an explosion at the Stockholm factory killed Emil and four others. In 1866 another explosion occurred at the Nobel factory in Germany. Reflecting over two devastating accidents in two years, Nobel pondered nitroglycerin's instability. He realized this touchy liquid might be mechanically stabilized if it were absorbed into a porous matrix. In the German moorlands lay a diatomaceous earth called *kieselguhr* that Nobel mixed with nitroglycerin. The

resulting puttylike material could be shaped into cylinders that conveniently fit into drilling holes. It could be jarred in transport and touched by a lit match without exploding, but Nobel's blasting cap produced an ignition sufficiently hot and fast to sweep through the entire putty stick and explode it. Alfred named his invention “dynamite” after the Greek word for power, *dynamis*. Patents were granted in 1867. Orders for dynamite poured in for large

civil engineering projects, such as constructing the St. Gotthard tunnel through the Swiss Alps in the 1870s.

In 1868, Alfred and Immanuel were recognized by the Swedish Academy of Sciences with the Letterstedt Prize for “important discoveries of practical value to humanity.” The citation's wording would be echoed 30 years later when Alfred established the prizes that bear his name. In 1884 Alfred Nobel was elected a member of the Royal Swedish Academy of Science, which would later administer some of the Nobel Prizes.

Over his busy career Alfred Nobel was granted 355 different patents in several countries.⁵ Most of the patents were for explosives and armaments, including gelnite (1875), more powerful than dynamite, and ballistite (1887), the forerunner of cordite. Even in the final years of his life Nobel was still active in weapons design, patenting firearm silencers and recoil inhibitors (1894), fuses and smokeless gunpowder for explosive projectiles (1896), and rocket-powered projectiles with timed ignition (1896). One could argue that Alfred Nobel's companies formed a 19th-century military-industrial complex, because weapons industries inevitably overlap politics. For instance, in 1891 while living in Paris, Nobel was accused of “high treason against France” for selling ballistite to Italy. Quitting the French residence, he made San Remo, Italy, along with his native Sweden, his homes for the rest of his days.

A Man of Letters

Alfred Nobel's “second home” after inventions and manufacturing was literature and writing.⁷ In his student days he translated Voltaire from French into Swedish, then from Swedish back into French, and compared his second translation to the original. His personal library ultimately held over 1500 volumes in several languages, including elegantly bound collections of classics such as Shakespeare, Goethe, and Schiller; philosophy and history works including Comte, Voltaire, and Rousseau; and his engineering and science books, including a copy of Charles Darwin's recently published *Origin of Species*.

When he moved to Paris in 1873, Nobel met Countess Bertha von Suttner of Austria, a well-known pacifist, organizer of peace conferences, and author of a famous antiwar novel *Lay Down Your Arms*.⁶ She and Nobel maintained a lifelong friendship through correspondence. The countess was impressed by Nobel's “well-stocked library, capable of satisfying the most divergent wishes.” In Paris Juliette Adam Lambert, the publisher of a literary review magazine, introduced Nobel to Victor Hugo. On Hugo's 83rd birthday Nobel wrote in French to the author of *Les Misérables*, “Great Master, long may you live to charm the world and propagate your ideas about universal charity.”

Nobel wrote extensively. His literary works included *In Brightest Africa*, a novel of social criticism written while he lived in St. Petersburg, where he also drafted a novel called *The Sisters* about faith and free-thinking. In 1895 he produced a satirical draft called *The Patent Bacillus*, “based on the dogmatism and bureaucracy he experienced.” He wrote numerous poems, and essays on the origin of the universe and on human evolution. His correspondence was extensive, sometimes

6. Sven Tägil, “Alfred Nobel's Thoughts about War and Peace,” www.nobelprize.org/alfred-nobel/alfred-nobels-thoughts-about-war-and-peace/.

7. Åke Erlandsson, “Alfred Nobel and His Interest in Literature,” www.nobelprize.org/alfred-nobel/alfred-nobel-and-his-interest-in-literature/.

4. The original name of nitroglycerin was pyroglycerin.

5. “List of Alfred Nobel's Patents,” www.nobelprize.org/alfred-nobel/list-of-alfred-nobels-patents/.

twenty letters a day.

A biographer notes that Nobel had “a solidly grounded belief in progress. Technological inventions and scientific conquests would lead humanity forwards, and he seems to have believed that good literature could play a dynamic role in an ‘ideal direction.’”⁷ Works “in the ideal direction” would appear in his criteria for the Nobel Prize in Literature, with the meaning of “ideal direction” left open to interpretation.⁸

The Society of Physics Students has offered a wonderful lapel button that proclaimed “Physics is the Poetry of Nature.” How inspiring to find that the person who established prestigious prizes for outstanding accomplishments in physics, chemistry, medicine, and world peace would include literature in that class! The Nobel Prizes commemorate outstanding creativity, and creativity, as Jacob Bronowski describes it, is the search for unity in hidden likenesses.⁹ The inner fire that drives searches for unified field theories, or seeks common ground between nations, or expresses transcendent human experience through novels and poetry is sparked by the same passion for harmonious understanding.

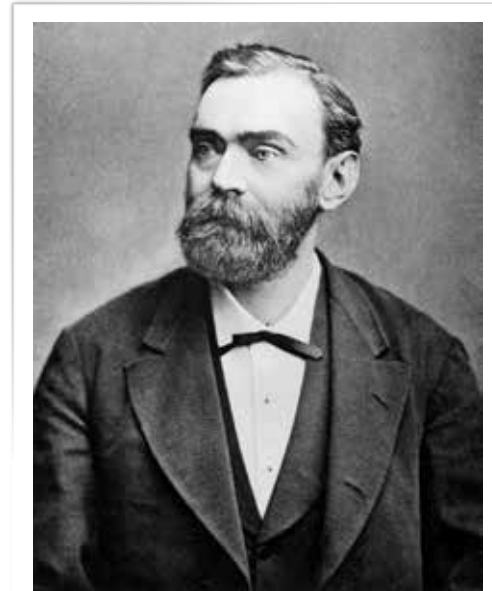
A Pacifist Weapons Merchant

Imagine having a Tom Sawyer experience, when you are mistakenly presumed to be dead and secretly attend your funeral to learn how you are remembered.¹⁰ A similar experience happened to Alfred Nobel in 1888. His brother Ludvig died, but a Paris newspaper mistakenly produced an obituary about Alfred, announcing “The merchant of death is dead.”

“Alfred Nobel,” the obituary reported, “who became rich by finding ways to kill more people faster than ever before, died yesterday.” Nobel was probably stung by this criticism because, however unlikely it may seem, he had pacifist leanings.⁶

When developing dynamite, he envisioned its use for infrastructure, not in war. Of course, using dynamite on the battlefield quickly proved irresistible. Only three years after it was patented, dynamite was used by both sides in the Franco-Prussian War. Encouraged by Countess von Suttner, Nobel joined the Austrian Peace Association and was a financial donor. But he insisted that a realistic strategy was more important than funding. He cautioned the countess that “Good wishes alone will not ensure peace.”

Nobel saw no contradiction between his armament industries and the cause of peace. Decades before the doctrine of mutually assured destruction became dogma, he saw powerful weapons as war deterrents. When Nobel and Suttner met in 1876 he told the countess, “Perhaps my factories will put an end to war sooner than your congresses. On the day that two army corps can mutually annihilate each other in a second, all civilized nations will surely recoil with horror and disband their troops.”⁶ More than a century has passed since Nobel's death. Although subsequent decades have seen two world wars, the atomic bomb, the Cold War, and aircraft and missiles that can murder millions within seconds, the nations have not disbanded their troops. By Nobel's definition, they are not yet civilized.



Portrait of Alfred Nobel. (PDM).

The Nobel Prizes

Even though he maintained a fast pace of armament development into the very last years of his life, one may surmise that Alfred Nobel's premature obituary may have caused him to ponder his legacy. On November 27, 1895, at the Swedish-Norwegian Club in Paris, he signed the final version of his will, a document of scarcely one page.¹¹ Having no wife or children, he left 6 percent of his vast wealth to various relatives. With the remaining 94 percent he established five¹² prizes to be awarded each year:

“

The whole of my remaining realizable estate...shall constitute a fund, the interest on which shall be annually distributed in the form of prizes to those who, during the preceding year, shall have conferred the greatest benefit to mankind.

”

The interest earned for the five prizes would be apportioned equally between physics, chemistry, physiology or medicine, literature, and peace. The Physics Prize would go to “the person who shall have made the most important discovery or invention within the field of physics” as determined by the Royal Swedish Academy of Sciences. This criteria allows discoveries of fundamental principles (e.g., quantum electrodynamics) or applications (e.g., the transistor). The Peace Prize would go “to the person who shall have done the most or the best work for fraternity between nations, for the abolition or reduction of standing armies, and for the holding and promotion of peace congresses.” The Nobel Peace Prize recipient would be selected by a committee of

8. Bob Dylan fans (including the author) are glad the Nobel committee for the Literature Prize did not take a narrow definition of poetry. Dylan won the 2016 Nobel Prize in Literature.

9. Jacob Bronowski, *Science and Human Values* (Harper & Row, New York, 1956, 1965), 13.

10. Chapter 17 of *The Adventures of Tom Sawyer* by Mark Twain.

11. “Alfred Nobel's Will,” www.nobelprize.org/alfred_nobel/will/.

12. A sixth prize for economics came about in 1968, when at the request of Alfred's great-great-nephew, Peter Nobel, the Bank of Sweden (Sveriges Riksbank) initiated the Riksbank Prize for Economic Science in Memory of Alfred Nobel. The winners are selected by the Royal Swedish Academy of Sciences.

five persons “to be elected by the Norwegian Storting,” or parliament.¹³ Nobel closed his will with a requirement of inclusivity: “It is my express wish that in awarding the prizes no consideration be given to the nationality of the candidates, but that the most worthy shall receive the prize, whether he be Scandinavian or not.”

A year after writing his will, Alfred Nobel passed away on December 10, 1896, in San Remo. The first Nobel Prize ceremony was held at the Royal Academy of Music in Stockholm in 1901. The first Nobel Prize in Physics went to Wilhelm Röntgen for his 1895 discovery of X-rays.

Not having attended a Nobel ceremony myself, I will borrow a description of one from a Paul Dirac biographer, who described the festivities of December 1933 when Dirac and Erwin Schrödinger shared the Nobel Prize in Physics:

“Early on Sunday evening, hundreds of coiffed men and women packed the galleries at the Stockholm Concert Hall to witness the King’s presentation of the prizes. At 5 p.m. sharp, a blazing chorus of trumpets silenced the crowd before the opening of the two huge doors into the room where the prizes would be awarded. Each of the laureates, escorted by one of the Swedish hosts, marched to their separate armchairs on the platform, covered in red velvet and decorated with banks of pink cyclamen, maidenhair ferns and palms. The national flags of the laureates hung alongside Sweden’s. The prize-winners were in the customary starched white shirt and bow tie, and all of them wore dinner suits, except Dirac... He bowed low to the King before accepting his medal and certificate and then bowed several times to the crowd amid tumultuous applause...”

“After the ceremony, the laureates were driven back to the Grand Hotel to attend the Nordic midwinter feast of the Nobel Banquet, in the winter garden of the Royal Salon. Even by the standards of Cambridge this was a spectacular setting for a dinner: the tables, lit with hundreds of bright-red candles in silver holders, were arranged in a horseshoe shape around the water fountain in the centre of the room. There were three hundred guests, every woman in her most scintillating gown, every man in a dinner jacket, except Dirac... On a balcony above, liveried musicians played, in competition with canaries chirruping in their cages near the glass roof.

“After the speeches, a silent toast to the memory of Alfred Nobel and the singing of the Swedish national anthem, a fleet of waiters began to deliver the first course from a menu that featured game consommé, sole fillet with

13. The Nobel Peace Prize ceremony takes place in the beautiful City Hall of Oslo, Norway. In 1905 the Norwegian Storting selected Bertha von Suttner as that year’s Nobel Peace Prize recipient.

clams and shrimps... The climax was the chef’s pièce de résistance dessert: ice-cream bombes that shone in the dark after they had been doused in alcohol and set alight. Afterwards, each laureate was expected to make a short speech, customarily a few pieties of gratitude and reflection, laced with self-deprecating wit...¹⁴

The prestige of the Nobel Prize stands as the pinnacle accolade in each discipline recognized by Nobel’s will. We have all witnessed how, when a conference or colloquium features a Nobel laureate (or someone everyone knows should have been a laureate),¹⁵ the auditorium is packed. Even so, Richard Feynman once observed that winning the Nobel Prize “is a pain in the neck.”¹⁶ Because of the celebrity, he felt he could not move about in everyday life with the freedom that an ordinary person enjoys. Be that as it may, as in any demanding discipline, one’s best work results when it is done joyfully, giving it one’s all for the love of the game.¹⁷ When one of our colleagues wins a Nobel Prize, we share their joy and realize with gratitude that we form a deep bench of knowledgeable appreciators. Most of us are in no danger of receiving the life-changing telephone call from Sweden. But if we aren’t enough without it, we won’t be enough with it, for whether our task is directing searches for gravitational waves, or grading weekly lab reports, or repairing the vacuum pumps, there are no unimportant roles in the physics community. Few win a Nobel, but whatsoever is rightly done, however humble, is noble.

The accomplishments of the Nobel laureates, against the backdrop of Alfred Nobel’s source of wealth that makes the prizes possible, illustrates the dilemma that places science at the intersection of intellectual discipline for its own sake and its applications with consequences good and bad. Nobel “gave expression to the prevalent 19th-century understanding which maintained that the scientist was not responsible for how his findings were used. Each scholarly discovery is neutral in itself, but can be used for both good and bad objectives.”¹⁶ The distinctions between scientific discoveries and the societal responsibilities of scientists are not as sharp in our 21st century as they were in Alfred Nobel’s 19th century. But each annual Nobel Prize in Physics offers an opportunity for thoughtful reflection on the relationships between physics as an intellectual discipline and the societal responsibilities of physicists. Such reflective thinking would be a legacy of which Alfred Nobel would be proud. ●

14. Graham Farmelo, *The Strangest Man: The Hidden Life of Paul Dirac, Mystic of the Atom* (Basic Books, New York, 2009), 240–241.

15. E.g., as everyone in the physics community knows, Freeman Dyson should have shared the 1965 Nobel Prize in Physics for developing quantum electrodynamics, Jocelyn Bell Burnell, should have shared the 1974 Nobel Prize for the discovery of pulsars, Ralph Alpher and Robert Herman for the prediction of cosmic background radiation—one could go on. Professor Dyson graciously observes, “It’s better for people to ask why you didn’t win the Nobel Prize than for them to ask why you did” [Phillip Schewe, *Maverick Genius: The Pioneering Odyssey of Freeman Dyson* (St. Martin’s Press, New York, 2013), 179–180]. To this list of should-be Nobel laureates we must add George Sudarshan, who passed away as this article was being written. He developed (with Robert Marshak) the $V-A$ theory of the weak interaction, which opened the door to the electroweak interaction and the Sudarshan-Glauber quantum theory of coherent light (Roy Glauber shared the 2005 Nobel Prize).

16. Richard Feynman, interview in the NOVA documentary “Richard Feynman: Last Journey of a Genius” (broadcast on PBS); see also Richard Feynman, *The Pleasure of Finding Things Out* (Perseus Books, Cambridge, MA, 1999), 12.

17. D.E. Neuenschwander, “For the Love of the Game: It’s Not About the Prize,” *SPS Observer* (Fall 2010), 2–4.

The Management Consultant and Musician

Nick Sneed

Sigma Pi Sigma, Howard University, 2013

by Nick Sneed as told to Kendra Redmond, Contributing Editor



I'm used to surprising people. A physicist by education, musician by night, and management consultant by day, some people struggle to see the threads holding my interests together. But for me, it's simple: creativity and problem-solving.

At age eight I arranged my bedroom into a recording studio. Today, I produce, manage, and release my own music. Music is a benefactor of all of the other experiences that I've had, like earning a physics bachelor's degree at Howard University, working as a patent examiner, and becoming a consultant.

I didn't start out with this career path in mind. In my last year of college, everyone—my parents to professors—were on me about making a plan. I could almost hear my department chair sigh, "Here comes Nick again, let's try to get him to do something besides that music..." I eventually settled on the idea of medical school and got a job working part time for the Society of Physics Students while studying for the MCAT.

At SPS, I helped assemble the Careers Toolbox (<http://www.spsnational.org/sites/all/careerstoolbox/>), a resource for undergraduate physics students interested in entering the workforce after graduation. As part of this project, I saw a list of common job titles held by physics bachelor's degree recipients. The list included things like analyst and patent examiner and, for the first time, I realized it might be possible to get a career-track job without an advanced degree.

Inspired, I applied for a job as a patent examiner and was hired by the US Patent and Trademark Office to examine digital signal processing patent applications. "What the heck is digital signal processing?" I wondered, worried I was in over my head. My first patent, for a pair of headphones, put me at ease. My physics and music experience helped me learn quickly, and I was able to focus on understanding the legal side of the job rather than being distracted by the technical side.

Have an open mind.

Physicists are not only smart, we are trained at solving an array of problems that exist in the natural world. And problem-solvers are what the world runs on.

A few years into life as a patent examiner, I met a recruiter from a major consulting firm. At the time I didn't know much about consulting firms, much less that one might be interested in hiring me. To my surprise, when I told her I was a physics major, she looked at me like I had a golden ticket. I interviewed and was hired.

As a consultant, I work with government agencies to creatively solve business-related problems. My goal is to help agencies improve the employee experience. I help unite a workforce along a mission or vision or purpose, in order to increase retention. Consulting requires creative problem-solving, just like physics. Instead of solving the Schrödinger equation, I tackle problems like how to provide job training in formats that engage diverse employees.

One of my personal goals is to let physics students know what I didn't—that physics graduates aren't limited to jobs that require an advanced degree. Have an open mind. Physicists are not only smart, we are trained at solving an array of problems that exist in the natural world. And problem-solvers are what the world runs on. ●



Photos by Jon C Media Group.

The Psychiatrist

Louis Littman, MD, PhD

Sigma Pi Sigma, Temple University, 1987

Bright, nerdy, and awkward — three adjectives that described me as a child that most would say still describe me today. I hated school as a child. I was frequently picked on for having a speech impediment. In first grade, I once got in trouble for talking out of turn and was told by my teacher to “leave the class.” She meant for me to go to the principal’s office, but instead I left the school building. My science teacher found me down the street and brought me back to the school. She told me that if I focused on understanding the world through science I could have fun and accomplish something great. I was hooked.

My love of science never wavered from that moment but continued to expand over the last 40 years. As an adolescent in the 1970s, my focus was space satellites, computers, and dinosaurs. I started my freshman year at Temple University in the engineering department but after one year switched my major to chemistry and then later to physics. However, after realizing that I had a mild form of dyscalculia, occasionally flipping numbers in my head, I concluded that this might hinder my becoming a top-level physicist. Thus, I switched my major in my senior year to biology. I graduated with a major in biology and a minor in physics, one class shy of a double major. I attended the University of Pennsylvania to obtain a PhD in pharmacology (I specialized in neuropharmacology, the study of how molecules interact with the brain), which allowed me to combine aspects of all the scientific fields that I had studied.

One day, as I was finishing my dissertation, I complained to my roommate that many clinical medical doctors did not seem to understand pharmacology, and she said, “Well, if you’re so smart, why don’t you go back to school and become a medical doctor?” I thought about it and shortly after applied to medical school. I wanted to take my knowledge of how medications work in people out of the laboratory and into the clinical world to help people directly. I started medical school shortly after finishing my PhD. I quickly discovered that I did not like dealing with blood (I actually passed out in surgery and obstetrics). That is partly why I ended up in my current career—psychiatry. No blood! In addition, I now get to use my knowledge of neuropharmacology from graduate school to help people.



Photo courtesy of Louis Littman.

I have been a psychiatrist for the past 15 years and have treated several thousands of patients. Many have conditions such as depression, bipolar disorder, ADHD, and anxiety. The majority of my patients are on combinations of medicines because they only get a partial response to a single medicine. Complex thought goes into managing the delicate balance between providing maximal benefit while minimizing side effects from treatment. I enjoy educating my patients about why I am making these choices for them. They seem to appreciate that I explain the “why” rather than just saying “take these pills.”

I recently ran into my PhD mentor, and he asked me if I “missed science.” While it is true that I no longer do experiments with cells or on rats, I still use the scientific method with each of my patients. I observe the patient, come up with a hypothesis about what is likely to help, perform a trial treatment, observe the

results, and generate a new hypothesis. I offer a unique perspective to psychiatry because I practice medicine as a scientist as well as a clinician.

I have recently expanded my practice to offer a new non-pharmacological treatment called repetitive transcranial magnetic stimulation (rTMS). It utilizes a rapidly alternating magnetic field to generate an electric field inside the brain, causing neurons to fire in specific targeted areas. (Sound familiar? I have come full circle back to physics and Faraday’s law.) By targeting areas that are underactive in depression we can alleviate symptoms for some patients without the side effects of medication. So far, I have treated a number of my most severely depressed patients with rTMS and have had amazing success. This technology is at the cutting edge of where psychiatry is heading over the next decade.

Physics extends into my personal life as well. When I am not treating patients, I enjoy spending time with my family and training together in Shotokan Karate. As a 4th-degree black belt, I use my knowledge of physics to teach other students proper application of force, energy, and momentum in self-defense techniques. The students appreciate the explanations, and it enhances their training experience.

My favorite branch of science is still physics, as it is an integral part of both my personal and professional lives. The advice my first-grade science teacher gave 45 years ago has carried me to where I am today—having fun and accomplishing great things! ●



LUNCH with a Side of *Physics*

Jocelyn Bell-Burnell

discovered the first radio pulsars in 1967, for which her thesis superiors were awarded the Nobel Prize in Physics. Despite her exclusion from the Nobel Prize, she has had an extremely successful career in physics research and academia.

- Tori Eng Inducted 2017, Coe College
- Photo: Jocelyn Bell-Burnell



Satyendra Nath Bose

was self-taught and a polymath. I would ask him about his work on the Bose-Einstein condensate. I heard that he was giving a lecture to students, went on a tangent, and just arrived at the conclusion, which he then sent to Einstein and Einstein published in his name.

- Sam Borer, Inducted, 2015, University of Maine
- Photo: PDM



Richard Feynman

's famous three-volume set of lectures on physics was a big part of my formative years as an advanced high school and early college physics student in the early 1980s—they helped cement my desire to pursue a career in physics.

- Jean Quashnock, Inducted 2007, Carthage College
- Photo: Caltech Archives



Emmy Noether

and I are both goofy mathematical physicists who like to teach. I really hope she would think my senior thesis on crystallographic group representations and the photorefractive effect was interesting; she might even have some ideas on it I hadn't considered.

- Natalie Nuessle, Inducted, 2016, Rose-Hulman Institute of Technology
- Photo: Bryn Mawr College Archives



We asked ΣΠΣ members what famous physicists they would want to invite to lunch and why. Here are some of your answers, slightly edited for length and clarity.



Millie Dresselhaus was a pioneering woman who quietly and courageously changed the pathways for women in physics. Not only is she a remarkable scientist, but she also took on a personal responsibility to transform the culture of science on behalf of all women.

- Toni Sauncy, Inducted, 1993, Angelo State University
- Photo: Bryce Vickmark



Carl Sagan's enthusiasm for communicating science was as genuine as it comes. He was not only a scientist, but also a great poet and philosopher. The way he articulated his ideas, thoughts, and knowledge was deeply invigorating!

- Ashish Patel, Inducted, 2014, Georgia State University
- Photo: Michael Okoniewski

James Clerk Maxwell's theory of color vision helped me understand light. I also deeply admire him for the way he wanted to make science available to everyone by teaching small community groups.

- Will Vance, Inducted, 2014, Marietta College
- Photo: Trinity College, University of Cambridge



I couldn't pass up an opportunity to have lunch with **Sir Isaac Newton**, arguably the most intelligent and determined person that physics and mathematics has ever seen.

- Scott Bakkila, Inducted 2014, Lawrence Technological University
- Photo: Godfrey Kneller

Neil deGrasse Tyson has an infectious enthusiasm for science and a way of inspiring nonscientists to care about science that I envy.

- Kendra Redmond, Inducted, 2007, Carthage College
- Photo: Andrew Toth - Getty Images





How Studying Physics Prepared Me for **Life Abroad**

by Hannah Pell, *Sigma Pi Sigma Member at Lebanon Valley College & Graduate Student in Music Theory, University of Oregon*



It was a beautiful autumn day in late October, and I was on a train traveling across Austria. Six weeks prior I had moved to Graz to pursue a Fulbright Combined Grant to teach English as a foreign language and study systematic musicology, a discipline that uses science to better understand music. I wasn't yet fully immersed in my new home, and on this particular train ride, I found myself wondering, in what ways are my own observations of the expansive, mountainous Austrian landscape different than observations made by those around me?

As I pondered this question, I recalled a transportation-appropriate thought experiment in physics. Two observers—a passenger at the midpoint of a train and another standing on a platform as the train moves past—see a simultaneous flash of light at the center of the train. According to the observer on the train, the light reaches both ends of the train at the same time. The observer on the platform, however, perceives the light as reaching the front and back ends of the train at different times. This thought experiment demonstrates Einstein's concept of the relativity of simultaneity.

Studying physics has given me the tools to reorient my thinking within various reference frames. As I navigated a new culture, they allowed me to recognize limitations of my individual worldview—my own unique reference frame. In recognizing these limitations, I began to expand the breadth of my worldview by solo traveling, language learning, and practicing Austrian cultural norms and traditions.

An important aim of studying physics is to develop a deeper

understanding of how nature operates independently of us. After my experience living abroad, though, I became fascinated with subjectivity and wonder to what extent my biases and experiences affect my ability to make observations about the world and thus change the inferences I draw from them. Physics is inherently a discipline about understanding and describing behavior, and I found this aspect of the field especially useful as I learned to adopt a new culture.

Science is an incredibly valuable catalyst for intercultural cooperation and exchange. In his book *Astrophysics for People in a Hurry*, Neil deGrasse Tyson writes: "The universality of physical laws tells us that if we land on another planet with a thriving alien civilization, they will be running on the same laws that we have discovered and tested here on Earth—even if the aliens harbor different social and political beliefs. Furthermore, if you wanted to talk to the aliens, you can bet that they don't speak English or French or even Mandarin. [...] Your best hope is to find a way to communicate using the language of science" (pp. 38–39).

The universal power of scientific laws is a triumph of our collective curiosity about the world and our place in it. By using my physics toolbox when immersed in an unfamiliar place, I gained a much deeper appreciation for cultural differences, as well as what we all have in common. ●

TOP LEFT: The author looking out over the red roofs of Graz, Austria.
MIDDLE LEFT: Reaching Alpine heights to gain new perspective.

BOTTOM LEFT: Life abroad is a surprising way to learn about the relativity of time and space.

TOP RIGHT: Physics encourages many opportunities to explore our world. All photos courtesy of Hannah Pell.

Congratulations

to the newest members of Sigma Pi Sigma

Abilene Christian University

Jared Barker
Steven Carrizal
Paul Carstens
Samuel Denmark
Tad Kile
Shannon McNease
Bradley Mitchell
Samuel Mulderpoint
Lauren Selensky

Adelphi University

Michelle Borovskoy
Daniel Lee
Brian Lei
Zoya Shafique

American University

Shams El-Adawy
Maya Kinley-Hanlon
Weston Millar
Danielle Montecalvo

Andrews University

Joel Paea
Jesse Snelling
Greg Zdor

Angelo State University

Zachary Cabrera
Cody Larsen
Gabriel Maldonado
Christopher McKowen
Luis Romo Villa
Michael Rooks
Taylor Spoo
C Watts
Clay Wegner

Appalachian State University

Brandon Adams
Garrett Boher
Mary Clements
Taylor Foote
David Gribble
Ian Krintz
John Mackall
Jeffrey Miller
Faith Montgomery
Raimie Neibaur
Ravikumar Patel
Benjamin Perez
Caroline Piephoff
Steven Poche
Ellie Prim
Dustin Roten
Kyle Schwendiman
Nathaniel Scott

Auburn University

Joseph Bahder

William Bowers
Robert Glennon
Geoffrey Harrison
Ayden Kish

Augsburg College

Nyssa Capman
Chloe Gintner
Khoi Nguyen Hoang
Elise Linna

Augustana College

Patrick Crompton
Adam Gronewold
Hayden Karrick
Allison Pease

Augustana College - Sioux Falls

Darwin Garcia
Joshua Jatton
Abel Solomon
Shitong Zhao

Austin College

Austin Andrie
Rosemary Fasullo
Wenhao Li
Connor Luckett
Eva Natinsky
Emma Page
Carlos Reyes-Leon
Callin Schone
Thomas Yuan

Austin Peay State University

Jared Averitt
Cord Beck
Austin Harnage
Zachary Hill
Margaret Seage
Kenneth Shipley
Joseph Spear

Ball State University

Cameron Gray
Paul Hettinger
Sarah Vise
Kenzie Worsham

Baylor University

Catherine Arndt
Beau Brooks
Naoki Ellis
Nesta Lenhert Scholer
Brynna Neff
Garrett Williams

Berry College

Audrey Burch
William Newman
Parker Roberts

Bethel University

Thomas Berglund
Blake Burgstahler
Noel Dittbenner
Kallai Hokanson
John McCauley
Ammanuel Robinson
Ryan Spies
Zachary Tebow

Binghamton University

Dennis Dempsey
Pravini Fernando
Joel Friedman
Mo Li
Peter Malinverni
Sara Mohamed
Robert Shepard

Bloomsburg University of Pennsylvania

Ian Birdwell
Charles Brochus
Vrunda Desai
Zhipeng Li
Jarret Willis

Boston College

Amelia Culp
Matthew Fernbach
Marisa Romanelli
Nicholas Stubblefield
Cole Tamburri
Chun-An Wang

Bridgewater College

Thomas Argiro
Parker Cline
Charles German
Jeremy Hardy
Austin Lane
Jason Moughon
Stephen Pincus

Bucknell University

Zilin Ma
Matt O'Donnell
Laura Owens
Jeanine Shea

Buffalo State College

Allison Torsey

Butler University

Alexander Glickfield
James Weislogel

California Lutheran University

Johann Dias
Hend Kordy
Blair Martin
Johanna Paine
Jamie Shultz

California Polytechnic State University - San Luis Obispo

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Mackenzie Duce
Nolan Elauria
Anders Johnson
Benjamin Kauffman
Madeline Larkin
Andre Li
Teresa Netro

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William Mixer
Charles Payne
Aria Radick
Kyle Rocha-Brownell
Logan Storm

California State University - Northridge

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Mark Dettenmaier
Sohee Kwon
Mac Lee
Garrett Limon
Thomas Look
Patrick Mcmillin
Fernando Ramirez
Jeffrey Valdez
Dylan Walsh

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Miguel Hernandez Cuevas
Tyler Jarrett

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Natividad Pestana
Jillian Robinson
Daniel Sanchez
Jared Sutton
Hila Swindell
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Carnegie Mellon University

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Naren Bhandari
Vineetha Bheemarasetty
Can Bostanci
Katja Brackelmanns-Puig
Doyee Byun
Ziheng "George" Cai
Minghan Chen
Nathan Drucker
Alex Fernez

Zoé Haskell-Craig
Rongzheng He
Ian Holst
Julianne Igbokwe
Sicong "Crystear" Liu
Valene Mezmin
Diamond Moody
Roshan Sajjad
Nicholas Speeney
Alexandru Stanescu
Dylan Steele
Yue Xu
Andrew Ye

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Monica Kasper
Bradley Krueger
Nathaniel Lee
Benjamin Tillema
Jackson Wehr

Catholic University of America

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Central Michigan University

Kazi Ahmed
Jayani Dissanayake
Ashton Falduto
Jose Galicia-Hernandez
Kerim Gulyuz
Christian Hannah
Ashlie Hinkle
Madhawa Horana Gamage
Tristan Howard
Reed Kolany
Jake Larson
Zachary Purcell
Kai Treppe
Jorge Vargas Tellez
Junjie Yang
Mitchell Zubich

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Nicole Johnson
Rory McFarland

Centre College

Frank Marx

Christian Brothers University

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George Eason
Barbara Schmitz
Lucas Wade
Piper Ziebarth

Cleveland State University

Justin Flaherty
Krista Freeman
David Spelic

Coe College

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Nathan Dvorak
Mareena Franke
Marissa Hedlund
Evgeny Pakhomenko
Gregory Palmer
Zackery Thune

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Hannah Bossi
Tianzeng Chen
Mirco Dinelli
Gabriel Forest
Abigail Johnson
Madeline Placik
Samantha Turbeville
Yuewei Wen
Jianing Yang
Minjing Yang
Joshua Young

Colgate University

Christina Bowers
Logan Conran
Brendan Corrodi
Anthony D'Addario
Julia Dottinger
Zachary Frohock
Kelly Haberl
Katherine Kelleher
Ed Liu
Stephen Paolini
Derek Sherry
Nolan Smyth
Michael Williams

College of the Holy Cross

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Mitchell Collett
Patrick Connolly
Abby Corrigan
Yihui Jin
Jessica Stietzel

Colorado Mesa University

Bret Brouse
Scott Jackson

Colorado School of Mines

Madi Clark
Chasen Henderson
Ryan Hooker
Jonathan Kim
Ashley Piccone
Alison Tucker

Concordia College

Travis Deegan
Zachary Doerring
Isak Johnson

Connecticut College

Patrick Davis

Weston DeLomba
Doug Fitzgerald
Jianbin Guan

Creighton University

Laura Aumen
Hannah Durant
David Kasper
Bong Lee
Caitlyn Ward
Jeffrey Wong
Thomas Wong

Davidson College

Ella Brewer-Jensen
Henry Brooks
Christina Chen
Esteban Leon
Joseph Martin
Nancy Pruett
Noah Rickolt

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Danish Siddiquie
Angela Sommerer

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Erin Wynne

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Tiereny Wiggins

Drew University

Mack Fox
Andrew Goldstein
Ji Hoon Kim
Natalya Shcherban

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John Franklin Crenshaw
Juan Pablo Gonzalez
Stuart Ki
Newton Kwan
Eric Segerberg
Kya Sorli
David Wang

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Robert Behary
Spencer Graves
Jake Kline
Mathew Knauss
Collin Mccauley
Connor Pecar
Canyon Pratt

East Carolina University

Erik Carr
Andrew Fuquay
Nicholas Kowalski
Alicia Kwon
Casey Lohner
Noah MacKay
Ryan Mezera
Robert Moller

East Central University

Trevor Berg
Breecia Crawford
Daniel Creech

Matthew Henry
Sean Jesse
Reid Kinder
Chaz Pelas
Caleb Stallcup

Eastern Illinois University

Benjamin Karpus
Jenalee Reardon

Eastern Kentucky University

Spencer Hall
Abigail Kalany
Jacob Riley
Alexander Rose
Evan Stelter
Zachary Stewart

Eastern Michigan University

Hunter Cox
Jonah Pollens-Dempsey
Andrew Richardson
Kyle Wilhelm

Elizabethtown College

Muntabir Choudhury
Nathan Copros
Zachary Daly
Erich Holtzer
Paul Lecurieux-Lafayette
Derek Manning
Otis Statham
Catherine Stencler

Elon University

Samuel Jenkins
Glen Kleinschmidt
Eleanor Macklin
Alexander Maggioni

Embry - Riddle Aeronautical University

Cynthia De La Rosa
Ethan Gregory
William Hosea
Nour Ibrahim
Danica Lenge
Hunter McCraw
David PeQueen
Ryan Sitler
Michael Vroom
Daniel Weber

Emory University

Joshua Chen
Karl Fenzl
Cristin Hendrickson
Greer Howard
Hyun Bin (Peter) Kim
Meiran (Eva) Liu
Jonathan (Jack) Lothrop
Zhiyin (Steven) Lu
Peter Oliveira Soens
Zijian Qiu
Rachel Tao

Fairfield University

Catharine Brady
Samantha Cooper
Ryan Fishbaugh
Nicole Kwasnaza

Matthew Lee
Run Li
Matthew Mark
Stacy Mendez
John Nikas
Jonathan Stott

Florida International University

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Aitor Bracho
Jeremy Buergo
Analis Lawrence
Chris Lopez
Kathryn Mendez
Joseph Moscoso
Stephen Revesz
Jennifer Russo
Lemise Saleh
Alejandro Villalobos
Katherine Wild

Florida State University

Stanley Denny
Jessica Koros

Fort Hays State University

Braden Allmond
Holden Eisiminger
Elizabeth Penner-Hiebert
Caleb Quay

Fort Lewis College

Christopher Flynn
Ryan Ruzycki

Franklin & Marshall College

Benjamin Akers
Md Faisal Alam
Victoria Bonidie
Sandra Chilson
Reed Kienzle
Noah Lamb
Thomas Lehman-Borer
Gabriella Sallai
Jonathon Sinton
Menglin Sun
Chenchen Wei
Xuan Zhang

Frostburg State University

Sean Black
Glenn Herb
Brandon Tichnell

Furman University

Robert Anderson
Trenton Duncan
Haley Eckert
William Fravel
Graciela Garcia Ponte
Thomas Gaudin
Madeline Leaman
Jameson Roberts
Michael Rose
Matthew Rosenberg
Thomas Trankle
Sara Vanovac

Georgia College and State University

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Georgia Institute of Technology

Aaron Aizenman
Alexander Buser
Joseph Colosimo
Thomas Dellaert
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Mary Elizabeth Lee
Kate Napier
Andrew Shumway
Nathaniel Wilson

Georgia Southern University

Reed Hodges

Georgia State University

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Saif Ali
Megan Connors
Wyatt Flynn
Stuart Jefferies
David Martin
Francisco Martinez

Gettysburg College

Julia Giannini
Lawson Gillespie
Maria Mazza
Adrián Navarro
Ross Silver
Peter Yergeau

Grand Valley State University

David Bronicki
Brett Clark
Kenneth David
David Hill



The College of Charleston celebrates their new Sigma Pi Sigma inductees. Photo courtesy of College of Charleston.

Samantha Koch
Ross Kunzi
Kimberly Suran
Matthew Underhill
Nikhil Watsa
Tyler Wheeler

Grove City College
Michael Thompson

Gustavus Adolphus College

Clark Hickman
Elise Le Boulicaut
Matthew Mehrkens
Hailey Nelson
Kelly Neubauer
Ryan O'Neil
Eli Sontag
Ryan Sullivan
Kevin Treb

High Point University

Spencer Ader
Thomas Boudreaux
Erin Brady
Kyle Corcoran
Zackary Hutchens
Jordan McClung
Noah Novembre
Nolan Roth
Alan Vasquez-Soto
Noah Worley

Hofstra University

Alexandre Dangay
Ali Hyder
Robert Watson

Hope College

Else Amanda Rensmo
Yong Chul Yoon

Houston Baptist University

Metha Chea
Katherine Chu
Trent Clark
Amanda Johnson
Elnora Nguyen
Jonathan Nguyen

Howard University

Odunayo Ayegbajeje
Naomi Haddock
Tell Lott
Viet Tran

Idaho State University

Patrick Bond
Legacy DeShazo
Tony Lemos
Alec Lepisto

Illinois Institute of Technology

Daniel Bafia
Alexandra Detweiler
Ian Gustafson
Bryan Hendricks
Emma Kaufman
Noah Samuelson
Varrick Suezaki

Illinois State University

Manuela Burek
Michael Giocolo
Tyler Jenkins
Phillip Kovarik
Alex Mraz
Richard Pelphrey
Torrey Saxton
Courtney Sunday
Zachary Temple
Jonathan Unger
Brandon White

Indiana University of Pennsylvania

Collin Adamson
Thane Bonnett
Nicholas Dzuricky
Esteban Garcia
Brenden Glover
Kathryn Hagood
Matthew Lees
Brandon MacGregor
Sky Semone
Brandon Vought

Indiana University Purdue University - Fort Wayne

Zachary Agnew
Anderson Miles
Skyler Mills
Lewis Ostermeyer
Panayioti Panayi
Andrew VonGunten

Indiana University - South Bend

Christopher Freitag
Johnathan Leece
Erin Saunders
Alexandria Weesner
Tanner Wesp
Jeffrey Yoder

Ithaca College

Alex Bredikin
Annie Cooney
Colleen Countryman
Megan Holman
Thy Doan Mai Le
Jacob O'Brien
James VanDeventer

Jacksonville University

Sergio Aponte
Courtney Purcell
Magyanis Ruiz

James Madison University

Robert Given
Rodney Hodges
Patrick Maxwell
Jessica Mayer
K P
Michael Padgett
Kaitlyn Porter
Aaron Swecker

John Carroll University

Taylor Clark
Ricardo Monge Neria

Troy Nemeth
Cameron White

Juniata College

Laura Early
Alison Earnhart
Marcus Lee
John Maclay

Kent State University

Mona Alshehri
Andre Antoine
Kelsey Bittinger
Thomas Cook

Kenyon College

Matthew Carney
Ian George
Austin Hulse
Frank Peiris
Caroline Popiel
Jordan Potter
Kyle Rose
Patrick Shaw
Bryce Wedig

Kettering University

Nomin Batkhuyag
Noah Beauchamp
John Bonhomme
Dylan Brewer
Megan Harlow
Melissa Mikolowski
Josephina Wright
Joshua Wylie
Tyler Yuzwalk

Kutztown University

Cayley Eppler
Jack Hovanec
Adam Saybolt
Colton Sterner
Bethany Tirrell
Elizabeth Touchstone
Jason Turdo
Ethan Wallace

Lafayette College

Ethan Garvey

Lamar University

Carlos Caballero
Alek Hutson
Nicolas Nikoloutsos
Benjamin Ofiel
Suzanne Wheeler

Lawrence Technological University

Patrick Carzon
Mary Cody
Mark Kocherovsky
Kylie LeBlanc
Karlene Robich
Shane Storks

Lawrence University

John Mangian
Lucas Myers
Julian Garrido Tomasini
Benjamin Tomhave

Lebanon Valley College

Eric Alleman
Leah Boyer

Alexander Heilman

Lewis University

Stephen Hiller
Jackson Waters

Linfield College

Renjie Kang
Ryan O'Dowd
James Seeley
William Shannon
Troy Taylor

Louisiana State University - Baton Rouge

Manon Bart
Margaret Carey
Justin Champagne
Rebecca DiTusa
Edward Facundus
Kyle Hamer
Ivan Hidrovo
Benjamin Lane
Adam Majoria
Khang Pham
Vaibhav Rajora
Richard Tuminello

Louisiana Tech University

Joshua Joffrion
Darrian Mills
Evan Norris
Sarah Pazos
Jaron Williams

Loyola Marymount University

Kabir Buxani
Angela Cardamone
Luciano Manfredi Console
Daniel Dijamco
Jingyuan Du
Shane Farley
Ryan Taus

Loyola University - New Orleans

Abigail Alton
Andrew Brinsko
Victoria Cinnater
Sandrine Ferrans
Coleman Green
Ariel Hall
Anna Smith

Loyola University Maryland

Kylee Sullivan

Luther College

Benjamin Davidson
Nicholas Hentges
Jacob Schulz
Colin Weber

Lycoming College

Gaelen Brown
Shannon Coriddi
Michael Elkins
Melissa Shea
Lucas Wilkins
Nathaniel Wilston

Manchester University

Christopher Jacobs

Manhattan College

Linh Nguyen
Michael Pryor

Marietta College

Xuan Zhu

Marquette University

Dominic Battaglia
Sophia Cieslicki
Andres Damian
John Kempf
Gabriel Dias Duarte Machado
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New graduates from The College of New Jersey celebrate walking across the stage. Photo courtesy of Zvacanti Teschuh.

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