

Radiations

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in the Physics Community**

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MEMBER NOTES



Letter to the Editor

May 2020

Dear Editor,

I found the article by Dwight E. Neuenschwander entitled “Discoveries, Unintended Consequences, and the Values of Science” (published in the Spring 2020 issue of *Radiations*) both informative and insightful, and if I were not long retired, I would have my students read it, particularly the students I had in my course Introduction to the History and Philosophy of Science. On the other hand, I believe that in his list of unintended consequences, in which he says, “In December 1938 when Otto Hahn and Fritz Strassmann stumbled across nuclear fission and their data was correctly interpreted by Lise Meitner,” there is a serious historical omission that fails to do justice to the work of Ida Noddack that was published in 1934. I am attaching a copy of a letter I wrote about her contributions that appeared in the June 2012 issue of APS News which, in view of the current interest in the accomplishments of women in science that are frequently overlooked, I am sure both you and Prof. Neuenschwander will be interested in reading. With best regards.

Sincerely,

Frank R. Tangherlini
Associate Professor of Physics, Emeritus
ΣΠΣ, College of the Holy Cross Chapter

Editor’s Note: Frank Tangherlini’s 2012 letter is available through the APS News archives at www.aps.org/publications/apsnews/201206/letters.cfm.

Congratulations Andrea Ghez, ΣΠΣ, MIT Chapter!

Ghez was awarded the 2020 Nobel Prize in Physics “for the discovery of a supermassive compact object at the centre of our galaxy.” She is the Lauren B. Leichtman and Arthur E. Levine Professor of Astrophysics at UCLA and director of the UCLA Galactic Center Group. Ghez is the fourth woman to receive the Nobel Prize in Physics, following Marie Curie (1903), Maria Goeppert Mayer (1963), and Donna Strickland (2018). Ghez shared one half of the 2020 prize with Reinhard Genzel. The other half was awarded to Roger Penrose.

Editor’s Notes:

Thank you to William Dorrity (ΣΠΣ, University of Maine chapter) for sharing that he took the picture of Dr. Worth Seagondollar at the Trinity site that appeared in the Fall 2013 issue of *Radiations*! Dorrity is 95 years young and was a friend of Worth’s.



We appreciate all corrections, feedback, and notes from *Radiations* readers! You can share your thoughts with us at sps@aip.org.

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Rhodes College SPS shares dry ice filled “Boo Bubbles” with event attendees at their annual Pumpkin Drop outreach event. Photo courtesy of Rhodes College SPS.

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Equity and Inclusion Matters

by Earl Blodgett, SPS & ΣΠΣ Historian, Worth Seagondollar Service Awardee ('19), ΣΠΣ Honorary Member ('16), Professor of Physics, Director of STEMteach, Director of Undergraduate Research, Scholarly & Creative Activity at University of Wisconsin – River Falls



Photo courtesy of UW-River Falls.

When I was first approached about writing this opening letter, I experienced a touch of panic as I am no expert on equity and inclusion. I try to avoid the stereotypical hubris of physicists who seem to believe that being an expert in physics entitles them to be an expert on *anything*. I am a physicist, not a sociologist!

Perhaps you feel the same way? Discussing issues like equity or racism may make you uncomfortable, and you might feel out of your depth. Interpersonal topics in general may be something you try to avoid (“Please don’t make us put our chairs in a circle!”).

But digging into a challenge is something that we are good at—after all, we are physicists! The key is that we *enjoy* the challenge of physics. It is in our personal comfort zone. I would submit for consideration the idea that we can make equity and inclusion something that can be enjoyable and mutually beneficial.

When you look around your own physics department, realize that everyone there brings a different background, experiences, and perspectives, some that are advantageous and some that are not. Inclusion means that we acknowledge and welcome those differences, not that we ignore them. Equity is the process of mutually providing each other with the support to remedy disadvantages by sharing from our advantages. I firmly believe that *everyone* has something of value to share in this process, because we *all* have gaps in our background and experiences. It is about being adaptable, respectful, and mutually supportive.

When I teach first-semester calculus-based physics, my students work in groups of three. I tell them that they are not competing for grades, that instead they are working together to improve *everyone’s understanding*. I remind them over and over that I don’t care what level of knowledge of physics they came into the class with. I care that they leave the class with a better understanding. This requires that students feel comfortable exposing their weaknesses and strengths so that everyone in the group leaves with a higher level of understanding. I think that this is an example of equity in action—providing a path to success for everyone by acknowledging and addressing the differing backgrounds and skills each student has coming into the class.

When schools focus on providing resources to fit individual needs, the entire classroom environment improves.¹ I observe this in my classroom, my SPS chapter, and my community. We all benefit from recognizing our uniqueness and working together from that uniqueness. We can enjoy the process of learning from each other and supporting each other! Yes, equity and inclusion may be topics that you are not comfortable discussing, but continuing consideration of these issues is necessary to uphold the values we committed to as ΣΠΣ members. This is not something we, as a community, have done well in the past.

In March 2019, the National Council added to the existing SPS Statement on Diversity, Inclusion, Ethics, and Responsibility, emphasizing that we must actively correct for past exclusion in our community. Actually working together toward equity and inclusion can help address these historical injustices, can help us better understand one another, can be enlightening, and can be mutually beneficial! ●

1. OECD Observer Staff. *Ten Steps to Equity in Education*. Organization for Economic Co-operation and Development, January 2008, pp. 1–8.

Sigma Pi Sigma and the American Institute of Physics Step Up: AIP-SPS Emergency Scholarships

by Brad R. Conrad PhD, Director of the Society of Physics Students and Sigma Pi Sigma

It's hard for me to imagine what it would be like to be removed from the department and university environments I grew into and loved as a junior or senior. Moving into the COVID reality, what many students are facing today is, frankly, daunting. These challenges must be even harder for those just starting their college education. The courses, extracurriculars, and living experiences for tens of thousands of physics majors have been affected in a myriad of ways, often putting students in situations where their safety nets are impaired or removed.¹ Experimental physics looks a lot different when laboratory access is limited and lab partners are not allowed. I've asked myself, How would I have even finished my homework if I couldn't spend late nights in the SPS lounge or the library, face to face with my classmates? Quantum was hard enough with only a handful of classmates (two, to be exact). In fact, very few aspects of what we often consider the college experience have not been impacted by this virus: on-campus housing, dining options, intramural sports, in-person lectures, summer research experiences, and even course availability have been altered or indefinitely postponed. These changes can place students, especially those who lack a strong external support network, in danger of not finishing their degree.

Even more poignant is the realization that the social and professional networks that help students establish their sense of what it means to be a physicist are vastly different from even just one year ago. Most national physics and astronomy conferences were virtual this year and likely will be for at least part of 2021. Physics club meetings for many SPS chapters across the country are set to be virtual-only events for many months to come. Even office hours, which for some of us were a lifeline in the sea of new terms, symbols, and math we had to navigate, are video-only for many. For most students, the sudden rise in campus food pantry use is well understood: times are tough and employment is hard to come by.² Collectively, these changes can work to impede students from accessing

resources, advice, and a community on which they can rely.

These educational stresses became quite apparent at the beginning of the pandemic. Each spring the Society of Physics Students, which shares governance with Sigma Pi Sigma, offers merit- and need-based scholarships to its members to support their educational progress. In 2020, the number of student applications almost doubled compared to the same time last year. In fact, the number of applications we have received has far outpaced our ability to fund every student in need.

Responding to this urgent need, the American Institute of Physics (AIP) partnered with the Society of Physics Students and Sigma Pi Sigma to establish a fund to support students in need of assistance to stay on track in completing their education. This temporary fund was named the AIP-SPS Emergency Scholarship Fund and was formed to extend emergency lifeline grants to students whose lives have been upended by the pandemic. Through the generous support of Sigma Pi Sigma donors, friends of SPS, and the American Institute of Physics, we have been able to award a total of \$100,000 in the form of emergency scholarships to current undergraduate students in need of assistance.

Whereas traditional scholarships are limited to use for tuition, the Emergency Scholarship Fund was specifically designed in response to the pandemic. SPS was able to offer support in other ways, whether through underwriting unanticipated travel expenses, food and housing costs, or materials needed for distance learning. The versatility of our support allowed us to respond to the specific challenges of each student. For some this meant support for course materials and tuition because of lost on-campus employment. Other students whose classes migrated online needed help securing a new place to live and internet access as campus housing became unavailable. Many students reported needing



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YOUR DOLLARS AT WORK

help with essentials, including books, food, and course fees, because they lost summer jobs and the income that would ordinarily support them throughout the year.

In total, SPS provided support to 73 students who otherwise might not have been able to complete their degrees. Applications came from students at colleges and universities across North America, about a third of which were minority-serving institutions or historically Black institutions. The average funding amount per award was \$1,370, and each student who received funding shared with us what the support meant to them. Here is a sample of what recipients said.

"I am driven to combine medical and research training to provide health care and conduct clinical research as a physician-scientist. I hope to forge a connection between nanoengineering and medicine, so I am pursuing an MD-PhD...I find research empowering...I would like to sincerely thank you for supporting my academics. I know that many of the SPS programs, such as the scholarship program, would not be possible without the generosity and dedication of donors like you."

"Once again, your support in my academic endeavors means the world to me, and I can't thank you enough for allowing me this opportunity."

"I can sleep better knowing I can complete my degree."

"I have been a part of the Society of Physics Students and the... Quidditch team since my first semester at school. (I got a concussion from one of those groups in my first semester, I'll leave it up to you to guess which.) I was inducted into $\Sigma\Pi\Sigma$ this past spring before we left school for remote learning. I hope to pursue a PhD in particle physics, quantum field theory, general relativity, or most of all a topic that is in the intersection of those such as quantum gravity or neutrino related cosmology. I'd like to reiterate my gratitude for your support. The programs that have been so beneficial to me in many ways would not be possible without the support of you and many others like you. I am particularly thankful for the help in finishing my undergraduate degree that your donation will provide this coming year."

"Thanks to the generosity of your donations I will be able to submit a first author publication as an undergrad this year."

"I always dreamed of being a scientist...Now, thanks to you, I can continue with this dream."

These quotes illustrate the impact of what we must do as a society—help students realize their dreams through supporting their education. As advocates for the most vulnerable within our community and as stewards of SPS and Sigma Pi Sigma, it is up to us to do what we can to assist students at risk. Supporting the next generation speaks to the four pillars of Sigma Pi Sigma, which we agreed to uphold upon entering the society: honor excellence and scholarship in physics, encourage interest in physics, promote service to the community, and provide fellowship to our colleagues.

The pressures students face will likely remain for years to come, but Sigma Pi Sigma will continue to aid undergraduates in realizing their full potential. For example, we have begun planning for our centennial celebration, the 2022 Physics Congress, which will be hosted by Sigma

Pi Sigma and sponsored by the American Institute of Physics. Over the next two years, we will be inviting you to consider a gift toward travel to this event, which will be used to underwrite student and chapter travel, as well as lodging expenses related to attending. While the meeting will not occur until October 6–8, 2022, most students have to conduct fundraising for years to make this once-in-a-lifetime trip. Fundraisers and departments can help, but many students are not able to come to this event without donor support. As COVID-19 will only further stress the means of students who hope to attend the meeting, our goal is to help every student who wants to attend be a part of our 100-year anniversary celebration.

Without support from our community, countless students simply will not have the resources needed to attend gatherings like the Physics Congress. These events are important not only for networking but also for developing support structures that help them throughout their professional careers. In 2019, Sigma Pi Sigma provided over 300 students with awards in support of their travel to the Physics Congress, and we anticipate even more will require assistance in 2022. Thank you for everything you have done and continue to do to bolster the next generation.

On behalf of the students who have benefited from the AIP-SPS Emergency Scholarship Fund, I thank the hundreds of Sigma Pi Sigma donors and friends of SPS who helped us meet our goal of raising emergency support for students in need. The pandemic brought with it displacement, upheaval, and loss, but the commitment of AIP and donors like you has allowed SPS to award \$100,000 to students in need. I leave you with the words of one of our students:

"It is through SPS that I have found companionship and guidance in school...[This] would not be possible without the generosity and dedication of donors like you." ●

www.aip.org/helpstudents

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Student recipients of the Emergency Scholarship Fund. Images courtesy of SPS National.

Virtual Sigma Pi Sigma Inductions: Where Tradition Meets Opportunity

by Kendra Redmond, Editor

When I signed my name in the red book, becoming an inaugural member of the Carthage College Sigma Pi Sigma chapter in 2007, the feeling of comradery was visceral. I thought of all those who had signed their names in red books before me and all of those who would sign after me. So many physicists that I would never meet—could never meet—but that I was now connected to through this fellowship.

Ritual and tradition are woven into the fabric of Sigma Pi Sigma. In its first decade of existence, Sigma Pi Sigma was a fraternity. Symbolism and secrets were important parts of its identity. In 1931 the society dropped the secret elements and transitioned to an honor society, but traditions like the red books live on. Many chapters have cultivated and passed down their own traditions.

This year, due to the COVID-19 pandemic, the $\Sigma\Pi\Sigma$ National Office is encouraging chapters to honor student achievement safely by moving induction ceremonies online. The move has inherent losses: inductees can't physically sign their chapter's red book during the ceremony, feel the weight of honor cords as they are bestowed, shake hands with school administrators, or participate in their local traditions.

But Sigma Pi Sigma is not a collection of red books—it's a fellowship of people. Inductions aren't a collection of traditions—they're an opportunity to embrace new members who love physics and share the same commitment to academic achievement, service, and outreach. Physicists excel at identifying the essence of a situation and applying the same principles to a new environment. Virtual inductions are an opportunity to do just that—examine the essence of $\Sigma\Pi\Sigma$ traditions and apply them in a virtual setting. By doing so we have the opportunity to strengthen and engage our long-standing community in new ways, even as we celebrate the hope and promise of our newest members. ●

Seize the Opportunity

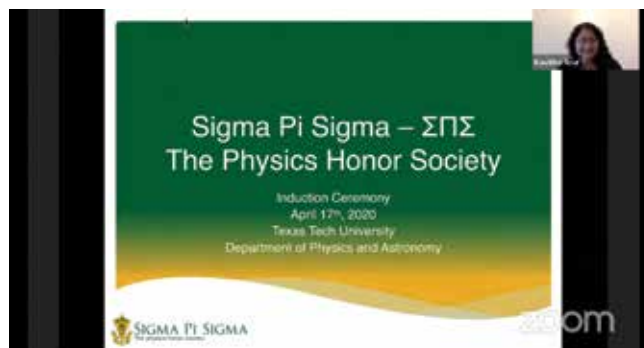
Get resources for planning a virtual induction, request a personalized message from Sigma Pi Sigma leadership for your ceremony, and invite chapter alumni at www.sigmapisigma.org/sigmapisigma/virtual_inductions.

Join the Alumni Engagement Program at www.sigmapisigma.org/programs/alumni-engagement.

Share your ideas for virtual community building by emailing us at sps@aip.org.



Attendees pose for a group “photo” during the University of Washington Bothell’s 2020 Sigma Pi Sigma induction. Image courtesy of Joey Shapiro Key.



Chapter president Kavitha Arur opens Texas Tech University’s 2020 Sigma Pi Sigma induction. Image courtesy of Andrew Whitbeck.



Attendees show off the right-hand rule during the 2020 Sigma Pi Sigma induction at the University of the Sciences in Philadelphia. Image courtesy of Roberto Ramos.



Physics Nobel laureate William Phillips gives a talk during the University of the Sciences virtual induction last spring. Image courtesy of Roberto Ramos.

2020 Individual Award and Scholarship Recipients

The Society of Physics Students 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 \$2,000 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 www.spsnational.org/awards/scholarships.

SPS OUTSTANDING LEADERSHIP SCHOLARSHIP:

Anshu Sharma
Randolph-Macon College

Tristen White
Juniata College

SPS LEADERSHIP SCHOLARSHIP:

Abdullah Al Maruf
South Dakota State University

Carol Stover
University of Central Arkansas

Chris Matsumura
University of Southern California

David Nguyen
University of Southern California

Georgia Votta
Augustana College

Kameron Gould

University of Utah
Matthew Macasadia
Texas Lutheran University

Ryan Pindale
University of Maryland – College Park

Tyler Price
University of Tulsa

HERBERT LEVY MEMORIAL SCHOLARSHIP

Kirk Kleinsasser
Lycoming College

SPS FUTURE TEACHER SCHOLARSHIP

Carissa Giuliano
Adelphi University

AWIS KIRSTEN R. LORENTZEN AWARD SCHOLARSHIP

Sophie Weiss
Coe College

PEGGY DIXON TWO-YEAR SCHOLARSHIP

Joseph Watson
McMurry University

2020 SCIENCE SYSTEMS AND APPLICATIONS INC., ACADEMIC SCHOLARSHIP

Sophie Roberts
University of Northern Iowa

2020 SCIENCE SYSTEMS AND APPLICATIONS INC., UNDERREPRESENTED STUDENT SCHOLARSHIP

Anna Murphree
Rhodes College

2020 AYSEN TUNCA MEMORIAL SCHOLARSHIP

Amy Zingsheim
University of Wisconsin-River Falls

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 chapter.

Learn more at www.spsnational.org/awards/outstanding-undergraduate-research.

WINNERS

Kevin Fernando
University of Central Florida

Parsa Zareiesfandabadi
North Carolina State University

2020 SPS SUMMER INTERNS

The SPS summer internship program offers 10-week positions for undergraduate physics students in science research, education, and policy with organizations in the greater Washington, DC, area. Students are placed in organizations that use the interns' energy and viewpoints to engage with the community and promote the advancement of physics and astronomy. This year all internships took place virtually.



Abigail Ambrose
The College of Wooster
AIP/SOR History Intern



Holly Fortener
Marquette University
SOCK (Science Outreach Catalyst Kit) Intern



Benjamin Petkie
Worcester Polytechnic Institute
AAPT Teacher Professional Development Intern



Kyle Blasinsky
John Carroll University
AIP Mather Policy Intern – Representative Bill Foster's Office (D-IL 11)



Paul McKinley
Pomona College
AIP Mather Policy Intern: US House Committee on Science, Space, and Technology



Abdul Qadeer Rehan
University of Richmond
NIST Research Intern



Billy "Trey" Cole
West Virginia University
NIST Research Intern



Alex Mikulich
Colorado School of Mines
NASA Goddard Space Center Intern



Maria Stokes
University of Utah
AIP Center for History of Physics Intern



Samantha Creech
University of North Carolina – Asheville
Physics Today Science Writing Intern



Jack Moody
University of Massachusetts – Amherst
APS Career Programs Intern



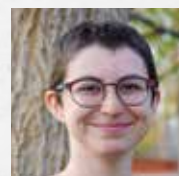
Hale Stolberg
American University
AIP FYI Science Policy Communications Intern



Joseph Dees
Henderson State University
APS Bridge Program Intern



Anna Murphree
Rhodes College
NASA Goddard Space Center Intern



Madison Swirtz
Colorado School of Mines
APS Education & Diversity Intern



Max Dornfest
University of California – Berkeley
AIP Mather Policy Intern – NIST

2021 SPS Internship applications open November 1.
For more information, visit
spsnational.org/programs/internships.

This program is supported by Sigma Pi Sigma members. Donations can be made at foundation.aip.org/student-programs.html.



Diversity Isn't Going to Cut It

by *K. Renee Horton, PhD,*
Founder of Unapologetically Being, Inc.

Diversity is easy to achieve. Inclusion is the hard part.

Diversity within an organization refers to intentionally employing and/or engaging individuals of varying genders, religions, races, ages, ethnicities, political ideologies, sexual orientations, education levels, and physical abilities. Some organizations go further and include life experiences and cognitive approaches toward problem solving as well. All of these variables characterize us as individuals.

When you think about your team at work, at school, or even in your network, you likely see some diversity, maybe in race and gender. But this categorical approach doesn't really hit the essence of what it means to be a richly diverse organization. Such an organization looks beyond race and gender data to inclusion. Embracing and valuing diversity is key to the success of the organization and, by extension, the success of its individuals.

In 1961, President John F. Kennedy signed an executive order (EO) known as Affirmative Action that stated that US government employers could not discriminate against employees or job applicants on the basis of race, creed, color, or national origin. This was an attempt to eliminate the unfair, unequal treatment of minority ethnic groups who had historically faced discrimination. If this EO had not been signed into law, Katherine Johnson and the other "human computers" of color that played a key role in getting us to the moon may not have even been hired. Thankfully, they were hired, and, well, the rest is history.

Affirmative Action and subsequent laws to prohibit discrimination on the basis of sex, ability, and veteran status force us to confront a painful reality at the core of our history. The country in which we live was not built on the principle that all races or genders are equal, nor were many of our personal worldviews. Affirmative Action is a measure against organizational practices based on a fundamental belief system that one race or gender is superior to another.

Even if you support the law and bring in people who are different, it can be hard to include them simply because they are different from you and you don't know how to process those differences.

In my first research position as a new PhD, I was not readily accepted. I tried hard to gain acceptance from several places—the



Photo by Pep Holman.

engineering group to which I was assigned, the tech group in charge of training me, and even a group of minority employees. The latter worked to influence the ability of minority employees to excel at their positions, but only if they considered you part of their group.

I knew I had a lot to offer the company, but the stress of trying to be included, to fit in, was draining. My colleagues constantly told me, "It's not rocket science," implying that I was just too smart for this position and they didn't need me. My guard was up, and I was in defense mode.

I didn't understand it then, but my brain was having a physiological response to the exclusion. When you experience pain from exclusion, a part of your brain called the dorsal anterior cingulate cortex (dACC) lights up. The dACC is also known to activate when we experience aversive feelings of physical pain. This suggests that social and

physical injuries are similarly processed by the brain, which leads us to the understanding that pain from exclusion and physical pain can have an identical effect.¹ Now I know why I was exhausted back then. Within 90 days of starting, I was let go because the company deemed I wasn't a good fit. I was relieved – I never saw myself being included or valued.

Inclusion is the hard part. It's a state of being valued, respected, and supported. It is about focusing on the needs of every individual and ensuring the right conditions are in place for each person to achieve their potential. Inclusion is about making sure the climate and the culture of the organization are willing to accept diversity and value the differences presented by each individual. Inclusion pushes each of us to examine our values and our biases. It challenges us to consider that there are some things we may need to change or be intentional about when it comes to our colleagues.

Our brains have a tendency to categorize things—a useful function in a world of infinite stimuli—but this can lead to discrimination, baseless assumptions, and worse, particularly in times of hurry or stress. Psychologist Jennifer Eberhardt states that same-race recognition isn't inborn, "It's a matter of experience, acting on biology: If you grew up among white people, you learned to make fine distinctions among whites. Those are the faces our brain is getting trained on."² I think this holds true for gender and other aspects of diversity as well.

To make inclusion work, we have to be willing to accept differences, value what each person brings to the table, and believe that they belong at the table. We have to be intentional about changing and correcting our unconscious biases with factual data about individuals, let our guard down, and be open to the perspectives and opinions of others. Just think: the answer to your problem, the key to your team's success, could be locked away in the brain of the person you exclude, whether it's done consciously or unconsciously.

Being truly inclusive may put you in situations that are uncomfortable. Including someone who is different may go against the culture of your company, your team's ideology, or your own belief system. It's easy to seek out comfortable situations, but to be an agent of change and ensure that diversity and inclusion coexist, you have to prepare yourself to be comfortable in the uncomfortable. ●

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Disclaimer: This article is written in my personal capacity as the founder of Unapologetically Being, Inc., a nonprofit that advocates for changing the face of STEM. The opinions expressed in this article are mine and do not reflect the view of the National Aeronautics and Space Administration, referred to as NASA, or the United States Government.



A Problem with Physics

by Kendra Redmond, Editor

In the past 20 years, the number of physics and astronomy bachelor's degrees awarded in the United States has more than doubled.

Over the same time period, the number of African American students earning bachelor's degrees in all fields has grown much faster than can be accounted for by population growth. This holds true for the subset of those earning degrees in all physical science fields.¹

Interest in physics is rising. The percentage of African American students earning bachelor's degrees in the US is rising. Yet the percentage of physics and astronomy bachelor's degrees earned by African American students has been persistently and inexcusably low—in the 2%–5% range.

Decades of efforts to increase diversity in physics have met with varying levels of success, but none have visibly shifted the national picture for African American students² in physics and astronomy.



The Time is Now: Systemic Changes to Increase African Americans with Bachelor's Degrees in Physics and Astronomy

www.aip.org/teamup

The Time is Now

In 2017 the American Institute of Physics³ convened TEAM-UP⁴, a task force of physicists, astronomers, and education researchers. The group was charged with studying the experience of African American undergraduates and identifying how the physics and astronomy culture impacts their persistence in the field.

Through student focus group sessions, site visits, student surveys, and departmental surveys, TEAM-UP identified a number of systemic changes urgently needed in physics and astronomy departments and institutions at large. Some of these are highlighted here, and the complete findings and corresponding recommendations are detailed in the TEAM-UP report, “The Time is Now: Systemic Changes to Increase African Americans with Bachelor’s Degrees in Physics and Astronomy.”

TEAM-UP Findings and Recommendations

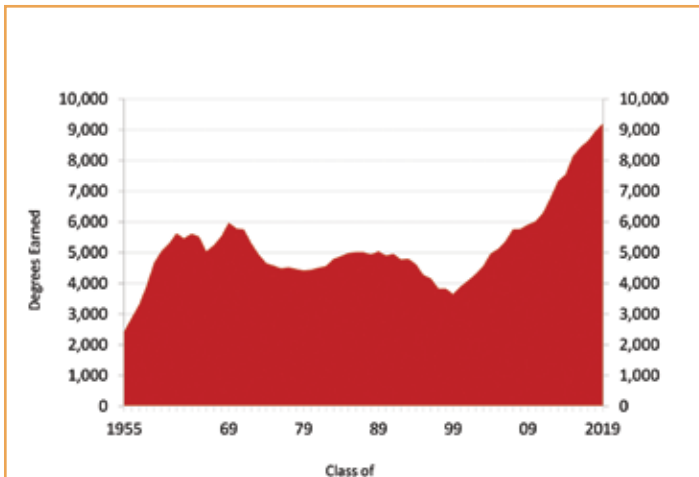
Key factors that affect the success or failure of African American students in physics and astronomy include belonging, physics identity, academic support, personal support, and leadership and structures. Most of the TEAM-UP findings and recommendations are categorized according to these five factors. Below are selected examples; to read the full report, which includes 20 key findings and 30 recommendations, visit the AIP website at www.aip.org/teamup.

Belonging

A sense of being a welcomed and contributing part of the physics and astronomy community.

Key finding: Faculty interactions have a powerful effect on student retention in, or departure from, the major. Students’ sense of belonging increases with the number of faculty who get to know them as individuals and demonstrate support for their success.

Recommendation: Faculty who teach or advise undergraduates should become aware that counterspaces (e.g., family, churches, Black student organizations) are important for African American students and should assist students in finding the support they need inside and outside the department.



Number of bachelor’s degrees earned in physics in the US, 1955–2019. Credit: AIP Statistical Research Center.

Physics Identity

Perceiving oneself and being perceived by others as a future physicist or astronomer.

Key finding: The connection of physics to activities that improve society or benefit one’s community is especially important to African American students.

Recommendation: Departments should communicate the ways in which a physics degree empowers graduates to improve society and benefit their communities, for example, by inviting alumni to speak to students about these issues.

Academic Support

Effective teaching that builds on strengths rather than focuses on presumed deficits.

Key finding: Faculty who teach well and demonstrate commitment to students by affirming their academic abilities, encouraging their success, and helping them find additional resources are critically important in fostering student success.

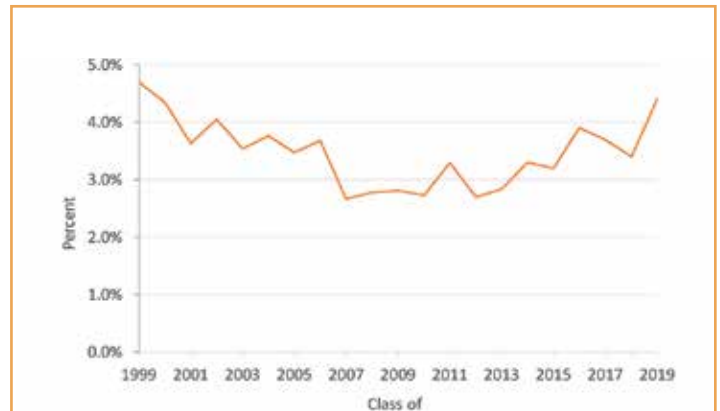
Recommendation: Departments should adopt policies and practices that encourage multiple faculty, including those who are not members of marginalized groups, to engage in formal and informal mentoring of students, and they should recognize and reward these efforts.

Personal Support

Easy and destigmatized access to support for nonacademic needs.

Key finding: Financial stress is particularly high for many African American students given the documented enormous racial wealth disparities in the US. Colleges and universities improve student retention and graduation by providing emergency support.

Recommendation: Departments should identify campus resources for emergency financial aid, conference travel, and other unmet needs and help students take advantage of them.



Typically between 5% and 8% of physics bachelors are awarded to non-US citizens. The percent of degrees awarded to African-Americans is based on US citizens only.

Percent of physics bachelor’s degrees earned by African American students in the US. Credit: AIP Statistical Research Center.

Leadership and Structures

Department leaders designing environments, policies, and structures that maximize success.

Key finding: Lone champions [within the department] can make a big difference for students, but their effort is unsustainable, making this an ineffective long-term strategy. In the most successful departments, a significant fraction of the faculty consistently values and supports underrepresented students.

Recommendation: Departmental administrators should become familiar with and encourage students to utilize campus resources, including student affairs offices, dual-degree programs, research funding programs, multicultural centers, tutoring centers, etc.

What will it take?

To catalyze real change and at least double the number of bachelor's degrees in physics and astronomy awarded to African American students by 2030, TEAM-UP is calling on the physics and astronomy community to provide

- Supportive departments in which the faculty is deeply engaged in improving outcomes for African American students, and
- Significant financial support for African American students and historically Black colleges and universities that relieves some of the unjust burden of racial wealth disparities, ideally in the form of a \$50 million endowment.

Help solve the problem

- Read the TEAM-UP report, "The Time is Now," available at www.aip.org/teamup.

- Consider the climates you help foster, on campus and otherwise, and how you can implement any relevant recommendations.
- If you're a faculty member, administrator, or member of a professional society, consider participating in an upcoming TEAM-UP implementation workshop. For details see www.aip.org/teamupworkshops.
- If you're an alumnus, reach out to your home or local SPS chapter (<https://www.spsnational.org/about/governance/zones>) to offer support in line with these recommendations.
- Connect with SPS chapters and members by joining the SPS Alumni Engagement Program, www.spsnational.org/programs/alumni-engagement.
- Financially support physics undergraduates in need of emergency funding due to negative impacts of the COVID-19 pandemic through the SPS Emergency Scholarship Fund, <https://foundation.aip.org/student-programs.html>. ●

References:

1. The percentage of African American students earning physical science degrees has increased by 36%, compared with a 23% population growth rate.
2. For consistency with previous data collection efforts and the wording of its charge, TEAM-UP used "African American" to refer to Black students earning physics bachelor's degrees in the United States.
3. AIP is the parent organization of Sigma Pi Sigma.
4. The Task Force to Elevate African American Representation in Undergraduate Physics and Astronomy.

TEAM-UP Voices

"For so long, efforts to increase the numbers of African American students in physics have focused on 'fixing' these students. An important message from the TEAM-UP study is that they don't need fixing . . . Departments have to do the work to break down harmful structures and rebuild those that will truly support African American students and ultimately all."

- Arlene Modeste Knowles, AIP Diversity Task Force Project Manager, TEAM-UP

"The biggest barrier for me was finance. It was really hard to succeed and make the most of my undergraduate experience when I was constantly worrying about feeding myself and paying for rent."

- Student comment during a TEAM-UP focus group session

"We physicists are so steeped in the community, and also in looking at specific science problems, that [when we tackle issues like diversity and inclusion] we're not looking at the whole community, we're not taking a holistic view. Because of [the sociologists on the team] we had a robust survey and we were able to hear student voices directly."

- Tabbetha Dobbins, Interim VP for Research and Dean of the Graduate School, Division of University Research and Associate Professor, Department of Physics & Astronomy, Rowan University; TEAM-UP task force member

"Sometimes you feel like you can do it, and then it's like, what if you can't? . . . You go into a class and you're the only [Black] person there. There's already the pressure of 'I have to be top notch. I have to do what I got to do.' I feel like sometimes that can get in the way of personal success."

- Student comment during a TEAM-UP focus group session

"At this point there is really no excuse. We have all seen the data over and over, heard the stories, and have clear recommendations to address each finding. The only thing left to do is to act upon them."

- Brian Beckford, Physicist and Program Manager, Office of High Energy Physics, Office of Science, Department of Energy, TEAM-UP Task Force member

The views and opinions expressed here are personal and not intended to reflect the views of any organization or employer.



Solving for Inclusivity in Physics

by Molly McDonough, 2019–20 Associate Zone Councilor
Representative, SPS National Council
Executive Committee



Photo courtesy
of SPS National.

The AIP National Task Force to Elevate African American Representation in Undergraduate Physics & Astronomy (TEAM-UP) recently published its study of the reasons behind and recommendations to address the persistent underrepresentation of African American students in our field. As the honor society of the physics field, Sigma Pi Sigma has a unique obligation to not only support the efforts of the TEAM-UP report but also to work within our community to implement its recommendations to combat the related issues that have plagued our community. While some conclusions in the TEAM-UP report are not new, the collection as a whole serves as a beacon to guide us to a better place. The student voices from the report serve as an honest reflection of many of the issues that stop students from moving forward with their education, whether for advanced or undergraduate study.

As Sigma Pi Sigma members, we all promised to not just encourage others to study physics but to strive to help them succeed. Fellowship takes many forms, and part of our promise includes making the recommendations of the TEAM-UP report work for students, faculty, and undergraduate departments. We are 76,000 physicists strong, and collectively we can serve future generations by ending the persistent underrepresentation of African American people in physics and astronomy.

“There was one teacher that really, honestly, I was going to give up on physics and she changed everything... She just kept checking in on me.”

- Student comment during a TEAM-UP focus group session

While the physics and astronomy community acknowledges there is a need for a significant increase in diversity and inclusion of people of all gender identities, races, ethnicities, sexual identities, socioeconomic statuses, and ability statuses, the number of bachelor's degrees awarded to African American students in physics and astronomy remains appallingly low. The total number of physics undergraduate degrees earned in the US has more than

doubled in the last two decades¹. While the number of African American students earning an undergraduate physics degree has increased over this period, the percentage of African American physics grads has remained well below the 13% of the US population composed of African American people.^{1,2}

Physics and astronomy (and science as a whole) is a team sport. Science works best and leads to more innovation when groups of people with differing perspectives come together and work towards a common goal. A study of over 2.5 million scientific papers conducted by Freeman and Huang at Harvard University found that while authors of similar ethnicities (as suggested by their last names) published together more frequently, publications written by authors with diverse ethnic backgrounds were more likely to be published in higher-impact journals and receive more citations.³ This serves as empirical evidence that diversity and inclusion in physics and astronomy is not just important as a social cause but also as a scientific one. Including broader perspectives and people from diverse backgrounds is critical to innovation in science and speaks directly to the mission of Sigma Pi Sigma.

In 21st-century physics and astronomy, there is no place for institutionalized racism. As the primary student organization for students of physics and astronomy and an honor society that strives to support and encourage interest in physics at all levels, we must take it upon ourselves to support and educate our chapters, students, faculty, and departments on the value of inclusivity and diversity in physics and astronomy. Sigma Pi Sigma, and in turn each of us, would do well to use the TEAM-UP report as a tool to help us step up and solve for inclusion in physics. ●

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We're Past Due for a SEA Change

by Alexis Knaub, Project Manager for Physics
and Astronomy - SEA Change, American
Association of Physics Teachers



Photo courtesy of Alexis Knaub.

While it's no secret that we in physics and astronomy still have much progress to make, our field has begun the journey of addressing the disproportionate challenges faced by our colleagues from groups underrepresented in physics, including those who are Black,¹ Latin American,² Indigenous,³ Asian,⁴ female,⁵ LGBT+,⁶ and/or are disabled.⁷

A major issue we must confront is that many of our learning and work environments aren't set up for all of us to thrive as our whole, authentic selves. There are many reasons for this, ranging from systemic barriers to individual actions. There are people in physics who blatantly promote harmful beliefs or actions. There are also many people who mean well but subconsciously cause harm.

All of us have unconscious biases, beliefs, or preferences of which we are unaware and for which we lack supporting evidence.⁸ For example, the editor-in-chief of *Physics World* noted a time he assumed two astronomers in a story were middle-aged white men when, in fact, they were young women.⁹ As the author points out, his unconscious

bias—assuming an astronomer is a middle-aged white man—can have other impacts, such as whom he selects for different jobs. Because they are not deliberate, unconscious biases are hard to unseat. Becoming aware of them and actively working on them are important first steps.

To provide the best possible environment for everyone in our departments, those who witness or learn of problematic situations have a responsibility to ensure harm doesn't continue. We must dismantle barriers rooted in racism, sexism, homophobia, biphobia, transphobia, ableism, and more. These barriers have nothing to do with learning or working in physics and are detrimental to the progress of the field. To do so, departments must work together internally and with support from the broader community.

Encouragingly, the scientific community has been making efforts to understand and improve the experience of marginalized students, faculty, and staff. The AIP TEAM-UP project is a prominent example of such an effort, focusing specifically on African American students in physics, and is described in greater detail elsewhere in this issue.¹ Additionally, site visits from professional society committees can provide information on how a department is faring, where they can find additional resources, and what they can do to improve. Most recently, members of the physics and astronomy community have begun a pilot project that involves a self-assessment and action plan process to help spur change at the department level.

SEA Change

The American Association for the Advancement of Science (AAAS), inspired by the United Kingdom Athena SWAN project, aimed at improving gender equity, launched an initiative to address bias, marginalization, and exclusion on the basis of gender, race, ethnicity, ability, socioeconomic status, sexual orientation, age, and the intersections between these identities in science, technology, engineering, mathematics, and medicine (STEMM).^{10,11} This initiative is the STEMM Equity Achievement (SEA) Change project.

The Physics and Astronomy SEA Change project is a pilot project to support physics and astronomy departments in changing their cultures to support those who are marginalized and cultivate an equitable and inclusive community for everyone.

The AAAS SEA Change initiative began at the institutional level. Universities and colleges embarking on the SEA Change process first undergo a self-assessment to better understand how effectively their institution is serving underrepresented students, faculty, and staff. The self-assessment, which entails data gathering and

reflection, can reveal what might not be apparent to university and college leaders. This process aims to establish a baseline set of facts for comparison. This looks different for each institution. From there, institutional leaders develop a five-year plan to address aspects of their institution that aren't equitable. Their plans must be rooted in the data from the self-assessment and provide ways to track how their plans are addressing the issue(s) identified.

These plans and the rationale behind them are reviewed by a committee which awards distinction to institutions with solid plans for progress. After five years, institutions are encouraged to revisit their self-assessment and reapply to renew their award. So far, three institutions have received awards. Their plans include steps such as implementing bystander intervention trainings and creating policies that ensure members of underrepresented groups are not asked to serve on too many committees, which is a common issue.¹²

The Physics and Astronomy SEA Change pilot project is analogous to the AAAS SEA Change institutional-level project in that it includes a self-assessment and award structure but functions at the departmental level. Participating departments will build a baseline for their processes and evaluate historical trends and statistics. Through this process they can evaluate their standing on a wide variety of issues that impact those that they wish to educate and serve. This pilot project is guided by representatives from physics and astronomy professional societies, including the American Association of Physics Teachers (AAPT), American Astronomical Society (AAS), American Institute of Physics (AIP), American Physical Society (APS), the National Society of Black Physicists (NSBP), the National Society of Hispanic Physicists (NSHP), the Optical Society of America (OSA), and SPS and ΣΠΣ.

Why create a departmental self-assessment and award system if an institutional program already exists? Departments in postsecondary educational institutions have considerable autonomy, ranging from what is taught (and how) to graduate admissions to faculty hires. Thus, although not completely removed from institutional constraints, departments have a lot of agency over day-to-day realities and, ultimately, the culture and climate of the department.

This academic year, the Physics and Astronomy pilot program hopes to support a few departments as they work through the self-assessment. In this way, we can test drive the program and determine its feasibility for physics and astronomy departments. If successful, we plan to scale up and support more departments in their work to remove barriers and create conditions for *everyone* to thrive.

Let's get to work

The act of creating a truly equitable environment for all students and faculty can feel overwhelming. There is a vast gray area between active discrimination and inclusivity. Where a department lies on this spectrum can profoundly impact people, especially those from historically underrepresented groups. The SEA Change approach focuses on self-assessment and data, but the goal isn't just having a representative number of individuals with various identities in a program. People spend considerable time working, learning, and socializing in their departments. Creating environments where all individuals can thrive is the goal. Reaching that goal entails confronting harsh realities and making meaningful efforts to change the culture. This is not a trivial undertaking, and we must rise to the occasion.

Through actions we take as individuals and collectively in departments, we can implement the changes necessary to establish a diverse, inclusive, and equitable field. Together, we can make sure everyone is welcome in the physics and astronomy community. ●

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The Ten

Most Popular *Physics Today* Articles of the Spring and Summer Quarantine

by Mikayla Cleaver, SPS Programs Coordinator

1. “Graduate Departments Move Away from GREs,” by Dalmeet Singh Chawla, July 9, 2020

The general Graduate Record Examinations (GREs) and GRE subject tests in physics have slowly been disappearing from the requirements of physics and astronomy graduate programs. With the COVID-19 pandemic, additional departments are joining this trend for the short term, and some are considering making the change permanent. Research has highlighted issues with using these standardized tests—notably, their inability to predict student success in graduate programs and their tendency to introduce inequities in the admissions process. The cost of testing, access to testing locations, and other factors can serve as barriers for very capable students, making it hard for them to do well or even take the test. Students can take the test at home during the pandemic but may still struggle with the cost, finding a quiet place to take the test, and having reliable internet access, among other concerns. Eliminating these tests may result in physics and astronomy departments seeing a more diverse and better-quality graduate student class.

2. “Helium Shortage has Ended, for Now,” by David Kramer, June 5, 2020

In addition to birthday parties, helium is a key element in medical research, scientific research, industrial processes, and medical treatments, among other applications. Since June 2017, helium suppliers have had draw limits on the amount of helium one could purchase because of a supply shortage. Due to social distancing measures resulting from the COVID-19 pandemic, many birthday parties have been canceled and the demand for party balloons has dropped immensely. Prior to the pandemic, balloons were responsible for at least 10% of the helium usage. The decrease in demand seems to have ended the helium shortage for now. However, some scientists have noticed price hikes when ordering helium for their experiments. So while there may not be need to worry about supply in the near future, prices may be a source of concern if the trend continues.

3. “World’s Physics Instruments Turn Their Focus to COVID-19,” by David Kramer, May 1, 2020

Science facilities around the world have reopened their doors post shutdown and focused their instruments on research into the COVID-19 virus. For example, the Advanced Photon Source at Argonne National Laboratory can use multiple beamlines to study the proteins encoded

by the virus. At the UK’s Diamond Light Source, researchers are working from home to analyze how potential drug components interact with the virus through a process called fragment screening. Some groups, including a team at the University of Texas at Austin, are using cryoelectron microscopy to examine the structure of proteins that resist crystallization. The path to a drug-based treatment or vaccine that can slow or even stop the current pandemic is long, but as Kramer demonstrates in this article, physics instruments are likely to play an important role in the process.

4. “Commentary: Disentangling Anti-Blackness from Physics,” by Charles D. Brown II, July 20, 2020

Charles D. Brown II, postdoctoral researcher in the Ultracold Atomic Physics Group at the University of California, Berkeley, shares a frightening experience he had with police that occurred in Chicago during one of his nightly runs as an undergraduate. He was aggressively approached and physically assaulted. He ties this experience into his life in academia, stating, “Black scholars experience widespread bias and discrimination and are subjected to both interpersonal and systemic anti-Black racism.” In 2017, Black students were awarded only 3% of physics bachelor’s degrees. In this article, Brown shares numerous examples of how racism pushed him away from physics and academia, and he notes that these experiences aren’t unique—Black students still face these challenges in academia. The article includes a call to action and concrete steps that faculty, students, and departments can take to help create a more successful and inclusive community, such as educating yourself and listening to Black students and scientists, and acknowledging your biases and working to correct them.

The Advanced Photon Source (APS) at Argonne National Laboratory (ANL). Photo courtesy of aps.anl.gov.





Galaxy NGC 2442 imaged by the Hubble Space Telescope. Photo courtesy of ESA/Hubble & NASA, S. Smartt et al.

5. “An Atomic Physics Perspective on the Kilogram’s New Definition,” by Wolfgang Ketterle and Alan Jamison, May 1, 2020

The kilogram, previously defined by a physical weight in Paris, has recently been redefined in terms of Planck’s constant, or more plainly, atomic frequency. Similarly, other standard units of measure have been redefined in terms of constants of nature, such as the meter, which is now defined in terms of the speed of light. In this article, Ketterle and Jamison explore the new definition and what it means physically to have the kilogram defined in terms of Planck’s constant. The main benefit of this redefinition is that unlike physical artifacts, it is not subject to decay over time.

6. “Hubble’s 30-Year Legacy,” by Nadieh Bremer and Andrew Grant, April 1, 2020

In April 1990, *Physics Today* ran an article about the Hubble Space Telescope set to launch later that month. Thirty years later, Hubble has dramatically changed how we view the universe. By looking more closely and deeply at the universe than humanity ever has before, the telescope has revolutionized our understanding of the cosmos and our place within it. Included in the article is a four-page visual highlighting some of Hubble’s accomplishments over the past three decades, such as the Ultra Deep Field image and imaging of nebulae and galaxies. The Hubble Telescope is still making new discoveries and is predicted to keep observing the universe until at least 2025.

7. “Academics to Stage Strike for Black Lives, ShutDownSTEM on 10 June,” by Andrew Grant, June 8, 2020

On Wednesday, June 10, 2020, many physicists and other STEM communities shut down all of their normal academic activities to instead educate themselves and reflect on how they can take action to aid in the fight for justice. The idea was conceived by Chanda Prescod-Weinstein, a particle cosmology theorist and feminist theorist at the University of New Hampshire, and Brian Nord, cosmologist and Fermilab physicist, and coordinated in conjunction with #ShutDownSTEM and a diverse group of physicists known as Particles for Justice. The idea for the strike came about amidst the protests against systemic racism and police violence during the spring of 2020. Non-Black academics were

encouraged to use the day “to educate themselves and advocate for change in their communities.” The day also encouraged academics to rethink the way they perform their normal duties and challenged them to combat anti-Blackness in the world at large.

8. “Gravitational-Lensing Measurements Push Hubble-Constant Discrepancy Past 5σ,” by Johanna L. Miller, March 1, 2020

The Hubble constant (H_0) tells us how fast the universe is expanding. Two prominent methods of measuring H_0 are the Λ CDM model and the distance–velocity method utilizing cosmic events such as supernovae. The Λ CDM model measures H_0 to be 67.4 ± 0.5 km/s/Mpc and the distance–velocity method measures it to be 74.0 ± 1.4 km/s/Mpc. The difference between these two magnitudes could be explained by systemic uncertainty in methodology. A new measurement by the HOLICOW collaboration using gravitationally lensed quasars, however, measures H_0 to be $73.3 + 1.7 - 1.8$ km/s/Mpc. The article explains the discrepancy in these measurements and how it affects our view of the universe.

9. “COVID-19 Pandemic Modeling Is Fraught with Uncertainties,” by David Kramer, June 1, 2020

Modeling of the COVID-19 pandemic spread over time in Georgia showed that even if lockdowns had been extended through mid-May instead of lifting May 1, infections would have climbed extremely quickly. This article notes that different models from groups around the country predicted a peak in cases that has already been surpassed. Kramer uses what happened in Georgia to demonstrate that the uncertainties surrounding the virus lead to large error bars in predictions, and there are many models to choose from that change and evolve every day. Alison Hill, a research fellow at Harvard University, says one factor to look for in a model is the education and skill level of the people involved. While these models can change and disagree with one another, as they are continuously fine-tuned they can be used to interpret and benefit decision-making for the future.

10. “Does New Physics Lurk inside Living Matter?,” by Paul Davies, August 1, 2020

Without being able to explain life, it is very hard to look for it in other places. Paul Davies writes, “Asked whether physics can explain life, most physicists would answer yes. The more pertinent question, however, is whether known physics is up to the job or whether something fundamentally new is required.” Davies dives deep into examining how different fields of physics may be able to explain life but argues that there may be a new field of physics waiting to be discovered that’s necessary to explain what life is. ●

To read the articles, visit [physicstoday.org](https://www.physicstoday.org).

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The Prophet, the Physicist, and Activism

by Dwight E. Neuenschwander, Southern Nazarene University

A young man asked Frederick Douglass, “What should I do with my life?”
Douglass replied, “Agitate, agitate, agitate.”

When Dr. Martin Luther King was assassinated, I was attending high school in Wichita, Kansas. Back then, Wichita was sharply segregated. My school sat on the boundary between the White and Black neighborhoods. The morning after Dr. King's murder, the halls of the high school were filled with simmering frustration. My typing teacher closed the door to block the noise. Going to lunch, I suddenly found myself surrounded by an angry mob. Someone had me around the neck, but he suddenly dropped his grip as 7-ft.-tall Coach Wessel approached us, the mob parting before him like the Red Sea before Moses. Shortly thereafter the hallways were lined with helmeted police. I had had enough school for that day and went home. That evening I talked by telephone with a Black classmate named Marvin. He helped me, a White student, understand the enormous despair that had just crashed down onto the Black community. I am grateful to Marvin for his friendship and our conversation at that moment. On a day when his family needed solace, Brother Marvin was there for me, replacing potential resentment with the desire to understand. That day Marvin practiced a calming and effective form of personal activism.

Forty years later I visited the Lorraine Motel in Memphis, the site of the assassination. The Lorraine is now part of the National Civil Rights Museum. I was moved and mourned the sins of my country, the sufferings of the oppressed, and the foolish arrogance that keeps us from seeing everyone as brothers and sisters in the human family. What can one person do?

The 2020 March on Washington commemorated the 57th anniversary of the August 28, 1963, civil rights March on Washington. On that day in 1963, Freeman Dyson took a half-day off from his work at the Arms Control and Disarmament Agency to join the marchers:

Black people from all over the United States were marching. A quarter of a million people were marching. It was quiet... I walked to the end of the avenue where the marchers were assembling and marched with them to the Lincoln Memorial... They sang their freedom songs... and they looked like the hope of the future as they danced and sang with their bright faces and sparkling eyes.

From two til four, the leaders of the black people spoke at the memorial, with the huge figure of Lincoln towering over their heads... Martin Luther King spoke like an Old Testament prophet. I was quite close to him, and I was not the only one listening who was in tears. “I have a dream,” he said, over and over again, as he described to us his visions of peace and justice. In my letter to my family that night I wrote, “I would be ready to go to jail for him any time.” I did not know then that I had heard one of the most famous speeches in the history

*of mankind. I only knew that I had heard one of the greatest.*¹

The 1963 march was followed by the 1964 Civil Rights Act, the 1965 Voting Rights Act, and the 1968 Fair Housing Act. But these promises on paper remain unfulfilled in practice. Fifty-seven years later, drawing strength from more tragedy², the Black Lives Matter movement has gained long-overdue traction. But voting rights for people of color are still suppressed. They still endure unequal access to education, health care, jobs, and secure housing. The arc of history bends toward justice with excruciating slowness. In his letter to fellow clergy from the Birmingham jail, Dr. King wrote, “We know through painful experience that freedom is never voluntarily given by the oppressor; it must be demanded by the oppressed”³.

In his final Sunday morning sermon, delivered at Washington National Cathedral on March 31, 1968, Dr. King proclaimed,

*Through our scientific and technological genius, we have made of this world a neighborhood and yet... we have not had the ethical commitment to make of it a brotherhood... We must all learn to live together as brothers. Or we will all perish together as fools...Whatever affects one directly affects all indirectly.*⁴

From quantum electrodynamics to adaptive optics, Freeman Dyson greatly advanced mankind's scientific and technological genius. He spoke out for making our world a brotherhood. Thirty-two years after Dr. King's final Sunday sermon, Professor Dyson stood in the same cathedral to deliver another powerful sermon, his acceptance speech for the 2000 Templeton Award:

The great question of our time is, how to make sure that the continuing scientific revolution brings benefits to everybody, rather than widening the gap between rich and poor...

*Technology must be guided and driven by ethics if it is to do more than provide new toys for the rich...Science and religion should work together to abolish the gross inequalities that prevail in the modern world.*⁵

The prophet and the physicist preached similar messages. They understood that the end never justifies the means. In a 1967 Christmas sermon, Dr. King emphasized, “We will never have peace in the world until men everywhere recognize that ends are not cut off from means ...destructive means cannot bring about constructive ends”⁶. As an operations analyst studying the Allied bombing of German cities during World War II, Professor Dyson grimly concluded, “A good cause can become bad if we fight for it with means that are indiscriminately murderous... In the end it is how you fight, as much as why you fight, that makes your cause good or bad”⁷.

The prophet and the physicist desired similar ends: justice for the oppressed and redemption of the entire society, because oppression also dehumanizes the oppressors. Dr. King sought the moral high ground, as he explained in a 1956 speech at the end of the year-long Montgomery bus boycott: “We must remember . . . that a boycott is not an end within itself . . . The end is reconciliation; the end is redemption; the end is the creation of the beloved community”⁸. Dr. King’s principle of nonviolent resistance was effective. John Griffin, a White man who in 1959 medically darkened his skin to experience life as a Black man in the Jim Crow South, recorded,

*In Montgomery . . . I encountered a new atmosphere. The Negro’s feeling of utter hopelessness is here replaced by a determined spirit of passive resistance. The Reverend Martin Luther King, Jr.’s influence, like an echo of Gandhi’s, prevails . . . Here the Negro has committed himself to a definite stand. He will go to jail, suffer any humiliation, but he will not back down. . . . The white race is bewildered and angered by such an attitude, because the dignity of the Negro’s course of action emphasizes the indignity of his own.*⁹

Professor Dyson shared with my students his personal experience of this principle. Our class quoted in a letter to him his statement about *how* you fight makes your cause good or bad, and we asked his thoughts on the 9/11 terrorists who hijacked passenger-laden airliners. His answer recalled his teenage emotions during the Blitz—hearing in the crash of buildings the collapse of the British Empire, which had ransacked other cultures. Many young people abroad might have been thinking similar thoughts about the United States during 9/11:

*The only wisdom that I can extract from this memory is that the problem of terrorism is not a military problem. It is a problem of people’s hearts and minds. Attempts to solve it by military means will only make it worse. . . . We must treat our enemies with respect so that we do not appear to be trampling on their cultures and traditions. The ultimate goal must always be not to destroy our enemies but to convert them into friends.*¹⁰

In his 1991 Oersted Medal speech, Professor Dyson described “subversion of authority” as one of the “beautiful faces of science”¹¹. Physicists have an obligation to activism^{12,13}, which we have expressed collectively through professional societies by showing whom we honor, causes we support, and stands we articulate. Whom we honor finds illustration in the Andrei Sakharov Prize, which recognizes “outstanding leadership and/or achievements of scientists in upholding human rights”¹⁴. Causes we support are expressed in organizations like the Union of Concerned Scientists¹⁵ and APS Forums on Physics & Society¹⁶ and Diversity & Inclusion¹⁷. Our public stands are articulated through official statements such as the APS Statements on Nuclear Testing¹⁸.

But ultimately, activism must be personal. Recall the exemplary activism of Albert Einstein¹⁹⁻²¹, from his first political manifesto in 1915 urging intellectuals to transcend nationalism, to the 1955 Einstein–Russell Manifesto urging nations to eschew hydrogen bombs; from renouncing ties with Hitler’s Germany in 1933, to cochairing with Paul Robeson the American Crusade to End Lynching; from publicly defending in 1931 Heidelberg professor E.J. Gumbel, who had exposed political assassinations by Nazis, to offering himself, during the McCarthyism hysteria, as a character witness for NAACP founder W.E.B. du Bois²⁰; from helping Jewish refugees find wartime sanctuary in America, to taking walks in Princeton’s Black neighborhoods that

included lingering conversations on family porches, a quiet defiance of the town’s segregation.

While living in America, Einstein accepted only one honorary doctorate, from Lincoln University, America’s oldest Black university²⁰. There, on May 3, 1946, Einstein declared, “Segregation is a disease not of colored people but of White people, and I do not intend to remain quiet about it.” He had published four months earlier an article condemning racism in America²¹. Recalling the mythology that “In the United States everyone feels assured of his worth as an individual,” Einstein pointed out an inconsistency:

There is, however, a somber point in the social outlook of Americans. Their sense of equality and human dignity is mainly limited to men of white skins. . . . The more I feel an American, the more this situation pains me. I can escape the feeling of complicity only by speaking out.

In the Birmingham jail letter, Dr. King wrote, “We will have to repent in this generation not merely for the vitriolic words and actions of the bad people, but for the appalling silence of the good people. We must come to see that human progress never rolls in on wheels of inevitability”²². Professor Dyson affirmed, “We are scientists second, human beings first. We become politically involved because knowledge implies responsibility”²³. In the presence of injustice, silence is complicity. I am proud to be a member of the community of physicist agitators who respect reality and speak truth to power. The arc of history urgently needs further bending toward justice for all. Let us not be quiet about it.



Professor Dyson at the 2012 Sigma Pi Sigma Congress, conversing with a student. Photo courtesy of Dwight Neuenschwander.



Martin Luther King Jr. at the 1963 Civil Rights March on Washington, D.C. Photo courtesy of Central Press/Getty Images.

POSTSCRIPT

Professor Dyson passed away on February 28, 2020. Everyone knows of his accomplishments in physics, mathematics, engineering, and writing. My students and I also came to know him as a wise grandfather figure. He put other people first²⁴.

* When a theologian said Professor Dyson was “trying to impose his set of rules on God,” Professor Dyson responded, “Maybe I impose my rules on God, but that is not as bad as imposing them on my neighbors”²⁵.

* In a hand-written letter Professor Dyson wrote, “Now I am a busy grandfather with our three little grandsons living here in Princeton. . . . I spend more time babysitting and less time writing books. You never know which job will turn out to be more important!”²⁶.

* When asking about energy sustainability, we quoted his comment, “Sanity is, in its essence, nothing more than the ability to live within nature’s laws”²⁷. We suggested that by plundering our planet, society is insane. Professor Dyson’s response surprised us: “I disagree

particularly with your last sentence, where you say our society is insane. On the contrary, I think we are handling the energy problem much better than we are handling other problems such as poverty and inequality and gun violence and education and public health. The obsession with energy is distracting attention from these more serious problems”²⁸. Here was food for thought. In a peaceful, healthy, just society, energy problems would be easy to solve.

* At the 2012 Sigma Pi Sigma Congress in Orlando, attended mostly by students, Professor Dyson was scheduled to speak on Saturday morning, but he arrived Thursday evening as the conference began. He was immediately surrounded by a crowd, students and Nobel Laureates together. He participated in every activity of the Congress. During every break, long lines formed about Professor Dyson. He turned no one away. The meeting ended on Saturday evening. Near midnight, as the staff disassembled the registration booth in the deserted convention center, Professor Dyson still patiently conversed with lingering students who had waited for a word with him. He was a wise, beloved grandfather to us all. We are blessed to call him mentor and friend. ●

Acknowledgment

Thanks to Doug Forsberg, colleague and activist, for reviewing a draft of this article.

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4. *Ibid.*, p. 269.
5. D.E. Neuenchwander, Ed., *Dear Professor Dyson: Twenty Years of Correspondence Between Freeman Dyson and Undergraduate Students on Science, Technology, Society, and Life* (World Scientific, 2016), p. 347.
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22. Ref. 3, p. 296.
23. Ref. 1, p. 6.
24. “Freeman Dyson Remembered by People Who Knew Him: ‘An Unusual Visionary,’” *MIT Technology Review* (3/2/2020).
25. Ref. 5, pp. 361–362.
26. *Ibid.*, p. 374.
27. Ref. 1, p. 237.
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Remembering Freeman Dyson

Creative and passionate theorist, brilliant mathematician, prolific author. Physicist and polymath Freeman J. Dyson, who passed away in February at age 96, was as outspoken as he was gifted. Dyson made important scientific achievements, including in quantum electrodynamics, while being vocal about such issues as nuclear war and the environment. During his long career, he challenged conventional thinking with bold—and often controversial—ideas about the climate, humanity’s future in space, the role of science and technology in economic development, and other complex topics. After teaching briefly at Cornell, he became a scholar at the Institute for Advanced Study in Princeton, New Jersey, and remained a fixture there for more than 60 years, despite never earning a PhD. Dyson was inducted as an honorary member of Sigma Pi Sigma in 2012 and spoke at that year’s Physics Congress about the four knowledge revolutions that changed history. Attendees especially appreciated his brutally honest take on the graduate school system. He will be greatly missed.

“When [Dyson] signed a PhysCon T-shirt for us, I felt like I was in the presence of a rock star.”

~ 2012 PhysCon student attendee



SPS Zone 9 associate zone councilor Brandon Clary (left) inducts Freeman Dyson (right) as an honorary member of Sigma Pi Sigma in 2012. Photo courtesy of SPS National.

Sigma Pi Sigma — A Departmental Legacy of Fellowship Part 3: Developing Community (1930s & '40s)

by Brad R. Conrad, Director of SPS and Sigma Pi Sigma, and Earl Blodgett, Historian of SPS and Sigma Pi Sigma

“The objectives of the fraternity shall be to serve as a means of awarding distinction to those of high scholarship and service in physics, to promote interest in the advanced study of the subject, to stimulate and encourage a spirit of cooperation and friendship among those who have displayed marked ability in this study.”

– Original mission of Sigma Pi Sigma,¹ as recorded in the *Radiations of Sigma Pi Sigma*.

As the fields of physics and astronomy expanded in the first half of the 20th century, so too did the set of activities necessary for Sigma Pi Sigma to achieve its mission. We still honor that same mission today as a linked set of distinct societies, namely, Sigma Pi Sigma and the Society of Physics Students. The original mission statement of the organization, as printed in the 1932 issue of *Radiations*, is a modified phrasing of the same mission we adhere to today.

While it began as a fraternity, it is well established from histories of the founders of the organization that the intent extended beyond that of a traditional fraternity and, instead, focused on community building within physics and service to the broader public.²⁻⁴ During a major expansion before World War II, when the society increased from 20 chapters to 43 chapters, Sigma Pi Sigma leaders specifically self-identified as a society. They found that the newly formed Association of College Honor Societies (ACHS) most closely represented who they wished to become—part of a collection of societies that recognized skill and leadership that promoted “desirable standards and useful functions in higher education.”⁴ Joining would require removing all elements of secrecy, including a secret handshake, and strategically developing strong connections between physics and astronomy departments and their alumni. These core concepts, which we perpetuate by welcoming everyone and that physicists need to support one another, drove the evolution of the organization over the following decades.

As membership in Sigma Pi Sigma expanded to span generations and spread to an ever-growing fraction of departments, the activities and interests of the society expanded as well. Events were regularly scheduled to bring members from different chapters together. For example, yearly luncheons were held at the annual meetings of the American Physical Society as far back as 1932 to encourage members to network (the entrance fee was \$1.00).¹ On the local level, chapters worked to improve the environment for current and potential undergraduate students by promoting student lounges, which supported retention and recruitment efforts (we can all thank the University of Kentucky’s chapter for the idea).^{1,5} At the Eta chapter of Chattanooga, students pioneered undergraduate science communication by writing about recent scientific developments for the local school paper.¹ Wheaton College offered awards for the best student papers (Ms. Ella Horness was the first reported winner), and Park

College kept a “a unique type of bulletin board situated in the hall of the physics building... [which] kept a number of clippings and other scientific reports...[that] have attracted much interest.”¹ It’s noteworthy that hallway boards with jobs and news articles were new developments within the community at that time. As early as 1933, Sigma Pi Sigma encouraged chapters to do many of the things that SPS promotes today: hold regular meetings, keep in touch with alumni, donate to scholastic awards, schedule unique department events, and capture an annual chapter picture. Sigma Pi Sigma was a leader in developing best practices for undergraduate physics departments as we know them today.

During this period before WWII, it became commonplace for Sigma Pi Sigma chapters to serve not just their members but also to work toward the improvement of the entire department. Efforts tended to focus specifically on undergraduates and the general public, as there were organizations for professionals and graduate students but no national student organization specifically for undergraduates. The chapters acted as instruments to improve department health and as a network for alumni. Sigma Pi Sigma spread internationally quite early, as the first group chartered outside the continental United States occurred at The University of the Philippines on July 6, 1932, because of a “yearning for a broader field of physics” and connection to a national body.⁶ These developments were recognized early on by the Sigma Pi Sigma Council, and delegates agreed in 1933 to begin discussions of affiliation with the newly formed “Institute of Physics,” which references the American Institute of Physics (AIP), which published *The American Physics Teacher* (American Journal of Physics) and *The Review of Scientific Instruments with Physics News and Views*.⁶ Meeting notes touch on the desire of the Council to connect students to additional resources and develop professional connections among all students of physics. This began a relationship between the executive secretary of Sigma Pi Sigma, Marsh White, and AIP that ultimately lead to the formation of AIP’s student chapters after World War II and the creation of the Society of Physics Students in 1968.^{6,7}

One of the first collaborations between Sigma Pi Sigma, AIP, and the American Association for the Advancement of Science (AAAS), dating back to 1936, offered recent graduates discounted membership in AIP’s member societies or AAAS.⁸ It was described as “having as its aim the installation of a more professional spirit among our members” by Marsh

White, editor of *Radiations* at the time.⁶ This desire to collaborate with the professional physics and astronomy member societies was key to the development of the organization as we know it today. Early on, Sigma Pi Sigma established a custom of working with physics and astronomy Member Society leaders to invite distinguished researchers to give plenary “open meeting” talks at the Physics Congresses. These notable physicists and astronomers, identified by the community, received honorary membership, and many would become active within the society. The history of Sigma Pi Sigma includes many such distinguished researchers, including Arthur H. Compton (cosmic rays), Arthur Haas (Bohr radius), and Edward Teller (fusion), who went on a 3500 mile tour to visit eight chapters and several potential chapters on behalf of Sigma Pi Sigma in 1937.^{9,10} These types of interactions brought departments and Sigma Pi Sigma closer to the professional societies of the time.

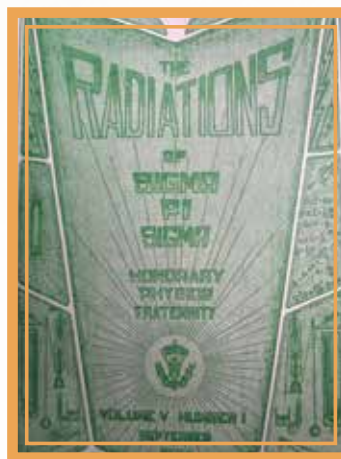
Most professional activities slowed or stopped in the period around World War II, but as soldiers and service people returned from the war, they brought with them a desire to study the technologies which had such an impact on the war's outcome. Paired with their interest was a large influx of students to universities, fueled, in part, by recent legislation commonly known as the G.I. Bill. This resulted in a huge change for American universities in terms of size, student population, and scope. The new students needed new resources, and the leadership of both Sigma Pi Sigma and many physics departments realized this, which led to a doubling of the organization in four years.⁷ Around this same time, the formation of the National Science Foundation in 1950, with its mission to promote the progress of science, led to a focus beyond physics research to physics education. The late 1940s and early 1950s became a time of experimentation with student support services, and discussions about how Sigma Pi Sigma and AIP could more effectively work together began in earnest.^{2,7} ●

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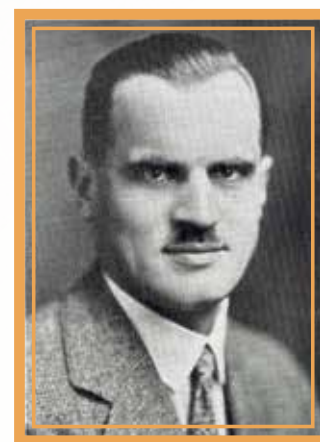
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Photograph of the Charter Sigma Pi Sigma group of the University of the Philippines, July 6, 1932. Image courtesy of *Radiations*, Volume III.



Colorful cover art of *The Radiations of Sigma Pi Sigma*, Volume V, 1934. Image courtesy of SPS National.



Honorary Sigma Pi Sigma member and Nobel Laureate Arthur H. Compton. Image reproduction from *Radiations*, Volume I, 1931 courtesy of SPS National.



Illustration of the Sigma Pi Sigma Key. Image reproduction from *Radiations*, Volume III, 1933 courtesy of SPS National.

Read More

Sigma Pi Sigma – A Departmental Legacy of Fellowship

Part I: Formation and the Early Years www.sigmapisigma.org/sigmapisigma/radiations/issues/fall-2019

Part 2: A Phase Change in the Late 1920s www.sigmapisigma.org/sigmapisigma/radiations/spring/2020/References

The Oceanographer

Jackie Veatch

PhD Student in Physical Oceanography,
Department of Marine and Coastal Science, Rutgers University



Photo courtesy of Jackie Veatch.

Scrolling through a seemingly endless dropdown menu of potential majors on a college application, I came across “biophysics.” Having never seen this word before, I thought to myself, “That sounds awesome,” and just rolled with it. Flash forward a year and I’m in my first semester of college at The George Washington University, exploring properties of light, the mechanics of a frog leg, and everything in between. Simply put: I was hooked.

I had always enjoyed math and science and, in high school, found that I might even be good at it. As I began college, I was enthralled by the idea of using physics to study complex biological systems. I tried my hand at immunology research, exploring the microscopic biophysics behind infectious disease. After a few years, I knew that it was time for something new. I was determined to combine my love for the outdoors with my interest in physics and, more urgently, to get out of the mouse room. I began working in Dr. Keryn Gedan’s coastal ecology lab and quickly discovered that my interests coupled the physical and biological mechanisms of Earth systems. At the time, I had never heard of someone using a background in physics to study the environment. And Dr. Gedan’s lab had never had a physics student before. Nevertheless, I was convinced that physics was everywhere, even in the marshy coastline of the Chesapeake Bay.

As my graduation approached, I was a little overwhelmed by all of the different ways I could use my physics degree. I was inspired by scientific discovery but knew that the more traditional applications of biophysics that

undergraduate professors studied weren’t for me. I began researching schools that took interdisciplinary approaches to making sense of Earth systems. It turns out that a lot of scientists use physics to tackle complex environmental problems. And there is a lot of physics in the ocean! I accepted a position at Rutgers University, where I’m currently pursuing a PhD in oceanography.

My research examines the physical mechanisms of the marine food web, focusing on Palmer Deep, Antarctica. In my current position I’m able to use physics to study the biological world, with applications to a cause that I’m very passionate about—the environment.

I really enjoy the distribution of my work. Between observed data and simulated experiments, field work and office time, I get a good mix of experiences. The biggest highlight of my graduate studies thus far has definitely been my field research trip to Palmer Deep. Researching in Antarctica felt like being deployed to the front line of climate change. Seeing firsthand the effects of a warming climate, such as a retreating glacier or shifting plankton ecology, makes global warming feel a lot closer than it ever has and gives my research a sense of urgency.

I’m thankful for my strong background in physics, which has given me a sense of academic fearlessness and, in my opinion, an advantage when tackling intricate oceanic problems.

I encourage the next generation of physics students to look for physics in unconventional places. Your scientific breadth need not be bound by traditional definitions of what a physicist looks like! ●

The Baker

Sam Montgomery

Sigma Pi Sigma, New Mexico Institute of Mining and Technology Chapter, 2016



Sam Montgomery. Photo by Elliot Esquivel.

I didn't gravitate toward physics until slightly later in my academic life. In fact, the first physics class I ever took was in college! My initial scholarly hopes and dreams lay in the Earth sciences, which tempted me with their flashy rocks and field-trip-heavy curricula. However, what physics presented was an opportunity to participate in cutting-edge research in fields like astronomy, atmospheric science, materials engineering, and Earth science. Physics opened up a Safari Zone of exciting possibilities, and I just had to get in on the action.

Being active in research during my time as an undergraduate at New Mexico Tech kept me enthusiastic about completing the grueling coursework. Over the years I was involved in research projects ranging from imaging ionized hydrogen near supermassive black holes to modeling brain rhythms present in Alzheimer's disease. One summer I interned with the American Physical Society's education and diversity department. The colorful plumage of possibilities I had hoped to achieve in physics seemed to be doable.

After graduating with my bachelor's degree, I got a job as a technician at a smell-recognition lab in Duke University's Department of Neurobiology. The scholastic adaptability I had inherited as a physicist equipped me with the confidence and skill set to integrate into my new laboratory setting. Coming to work every day where I was part of a productive scientific community was fantastic, and it really filled me with a sense of accomplishment. However, over time I realized that even with this achievement I was missing that feeling of fulfillment. I was very satisfied with what I had accomplished as a scientist, and it was time to start exploring the other dimensions of myself.

My passion for baking developed at home. From an early age, I remember helping my mom bake scones for breakfast on the weekends. Today I'm in charge of baking Duffeyrolls at Duffeyroll Cafe and Bakery in Denver. Duffeyrolls are flakey and extravagant cinnamon rolls that are renowned across Colorado. Each morning I bake hundreds of Duffeyrolls. I've been an at-home baker for so long that I'm excited to be working in a real bakery! It's very fulfilling to spend a morning preparing delicious treats that you know will make other people happy.

Similarities between physicists and bakers may seem scarce at first glance, but I've found that the professions use some similar skills. As a physicist, I honed my eye for detail and developed an aptitude for quantitative reasoning, both of which are needed to be a strong baker. Bakers make precise measurements, exercise problem solving, and are awake at all hours of the night, so having a physics degree in my repertoire prepared me beautifully. Rolling pins, dough pullers, and buckets of flour now fill a workspace that had previously been cluttered with circuit boards, voltmeters, and mice brains.

The biggest challenge of becoming a baker has been completely revamping my sleep schedule. Most shifts start at 2 a.m., and the next several hours are spent doing very physically demanding work. It's a small space, so when the store is busy and all of my coworkers are running around tending to orders, things can get a little hectic. While this can cause a bit of stress, it also gives me the opportunity to adapt to the fast-paced habitat of the culinary world. Of course, COVID-19 arrived with its own entourage of challenges this year. At work its imprint is undeniable, with everyone wearing masks, social distancing, and dealing with the current unpredictable business climate.

Now on any given day if you were to come to my home you would likely find me baking some baguettes or maybe one of my signature dessert tarts! As I move forward with my career as a professional baker, I'm excited to start the next chapter of my story. Although I've exchanged my lab coat for an apron, I will always continue to draw upon my background as a physicist.

My advice to aspiring physicists: Strive for multidimensionality in your research and in your life. The universe is unapologetically interdisciplinary, so make sure you have more than just physics in your intellectual tool belt. ●



Duffeyrolls on display at the Duffeyroll Cafe and Bakery in Denver. Photo by Sam Montgomery.



Montgomery's orange tart. Photo by Sam Montgomery.

Congratulations

to the newest members of Sigma Pi Sigma 2019-2020 Inductees

Abilene Christian University

Alyssa L. Borquez
Benjamin W. Edwards
Marshall Beard
Michael Arrasmith
Olive Tuyishimire
Roy Salinas
Zachary Moses

Adelphi University

Brendan McDougal
Carissa Giuliano
Charanpreet Singh
Christian Chong
Elias M. Goldman
Gabriela Vidad
Hamid Jalili
James Haddad
Katherine M. Gifford
Ken Kidangalil
Nicola Brancato
Ryan Kennedy
Thomas Gerard Gric
Thomas V. Danza

Andrews University

Jonathan Homan

Angelo State University

Andrew Joseph Russell
Chelsea Lenae Green
Chevy Robertson
Christian James Dempsey
Eduardo Aguirre Serrata
Kara Mckenzie Naegeli
Michaela Beth Allen
Parker J. Adamson
Rebeca Eliana Soto
Armandariz
Troy Allen Long
Wyatt Campbell

Appalachian State University

Kaleb Brookshire
Lucian Philip Murray
Robert Evan Martin Barnes
Ryan James Chicosky
Stewart C. Fasolak

Auburn University

Alex K. Edwards
Brady Unzicker
Davis Arthur
Grant R. Wilkinson
Logan Ridings
Mason S. Sake
Pearson Hall
Pierce Masters Jackson
Samantha Rizzuto
William Leonardo Alexander
Burdett

Augsburg College

Benjamin Stark
Brent William La Muro
Javier Francisco Perez
Lukes
Lidiya Ahmed
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