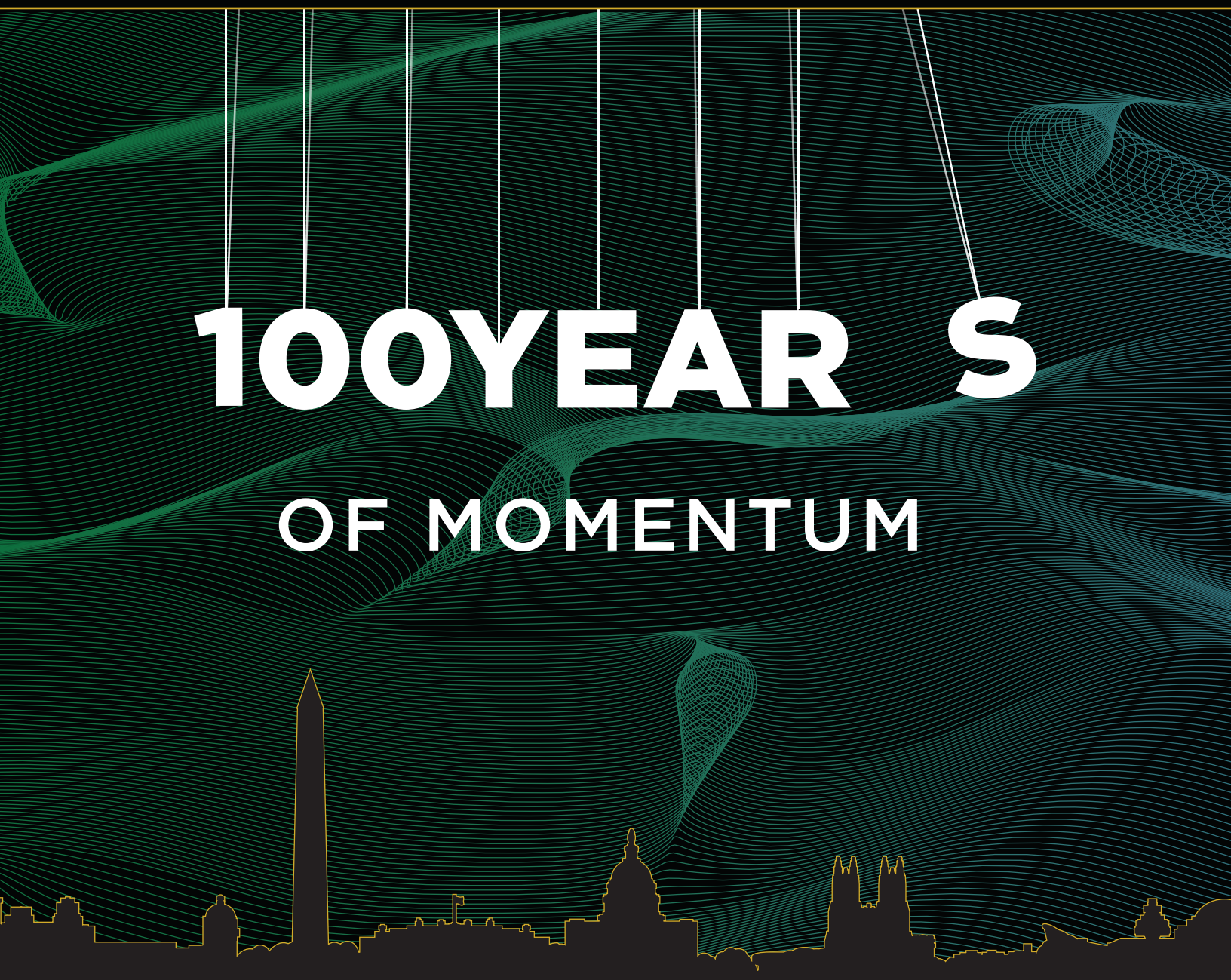
AIP
American Institute of Physics

physcon
2022 Physics Congress



100YEAR S

OF MOMENTUM

2022 PHYSICS CONGRESS

October 6-8, 2022
Washington, DC
sigmapisigma.org/congress/2022

SPS

UTA
Department of Physics
COLLEGE OF SCIENCE

PHYSICS DEPARTMENT

UTA offers world-class educational and research opportunities with small class sizes and outstanding faculty mentorship. Our department is large enough to be comprehensive and to give students a wide choice of research topics from the major areas of current physics research. Internationally recognized research in nanomaterials, particle physics, astrophysics, space physics.

- Student to faculty ratio of **2:1**
- Typical graduate assistantship: **$27,600** per academic year
- Highly diverse student body Ph.D. program: **24%** women

Phone: 817-272-2266 • Email: physics@uta.edu
502 Yates Street, Box 19059, Arlington, TX 76019

www.uta.edu/physics

Department of Medical Physics
UNIVERSITY OF WISCONSIN
SCHOOL OF MEDICINE AND PUBLIC HEALTH

Madison, Wisconsin
www.medphysics.wisc.edu/graduate-program

MEDICAL PHYSICS

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Apply: https://bit.ly/20t1olL

Degree(s): PhD, MS

Fields offered include: Nanotech, US, PET,MRI, CT, AI, X-ray, MRR

Questions: caaspinwall@wisc.edu

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Georgia Tech College of Sciences
School of Physics

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The School of Physics at Georgia Tech focuses on six areas of research: Astrophysics, Atomic, Molecular and Optical Physics, Condensed Matter and Material Sciences, Non-linear Systems, Physics of Living Systems and Soft Matter. The graduate curriculum in the School of Physics provides the background and training needed to conduct and complete high quality, world-recognized research, allowing graduate students from diverse backgrounds to develop into creative physicists who can function effectively in educational, industrial or government laboratory settings.

physics.gatech.edu
Phone: 404-894-5201 • Email: gradinfo@physics.gatech.edu
School of Physics, Georgia Institute of Technology. 837 State Street. Atlanta, GA 30332

2022 Physics Congress Program Guide

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Letter from the 2022 Physics Congress Co-Chairs and Sigma Pi Sigma President

Blane Baker
Sigma Pi Sigma President and 2022 Physics Congress Co-Chair

Samantha Pedek
2022 Physics Congress Co-Chair

Welcome !

We are delighted that you have chosen to attend the 2022 Physics Congress in Washington, DC, commemorating 100 years since the founding of ΣΠΣ. Over the next few days, your participation will result in lifelong friendships and opportunities to experience physics in incredible ways.

As many of you know, this congress was originally scheduled for 2021 but was delayed until 2022 due to the ongoing effects of the COVID-19 pandemic. Our theme of "100 Years of Momentum" is reflected throughout the congress, and we are excited to showcase the growth and impact of physics over the past century. As part of our celebration, we are pleased to host special centennial speakers Dame Jocelyn Bell Burnell, John Mather, Jim Gates, and Eric Cornell. These speakers are well known in their fields and truly enjoy interacting with the next generation of scientists.

The 2022 Physics Congress Planning Committee has enjoyed organizing events for this year's congress. We encourage you to participate by attending the plenary talks and other sessions, presenting your work at the poster sessions, and meeting new people at social gatherings. Plenary speakers represent a variety of disciplines and perspectives and include Julianne Pollard-Larkin, K. Renee Horton, Rush Holt Jr., and Sarah Hörst. They are very excited to be here and interact with you.

This 2022 Centennial Congress features several optional tours, ranging from an overnight stay at the Green Bank Observatory to a more local setting in Georgetown where you can learn more about the field of medical physics. The University of Maryland tour highlights research in biophysics, quantum physics, astrophysics, and chemical physics. For those interested in astronomy, NASA's Goddard Space Flight Center is the home of the Hubble and James Webb Space Telescope operations. Other opportunities for tours include the Smithsonian National Air and Space Museum Steven F. Udvar-Hazy Center and NIST.

The cornerstone of the congress is to highlight the work of young physicists and to foster connections between future leaders in the field. As such, there are plenty of opportunities to exhibit the wonderful things that make each chapter unique. Students will have opportunities to present their research and participate in a poster competition, showcase their creativity in an art competition, and participate in the Chapter Showcase. This popular event, which debuted at the 2019 Physics Congress, is an opportunity to bring and display anything that represents your chapter—pictures, demos, displays, swag, or anything else that makes your chapter special.

Once again, we are very honored that you have joined us for the 2022 Centennial Physics Congress. We are looking forward to meeting many of you and providing the best possible experience while you are in Washington, DC.

Congress Participants,

One hundred years in existence and Sigma Pi Sigma is still making waves and breaking boundaries. It is my great privilege to welcome you to the 2022 Physics Congress, an occasion that not only marks SPS's centennial, but also celebrates the organization's evolution, diversity, and inclusivity.

We have experienced many impacts of the COVID-19 pandemic on our community. Disrupted learning, lack of connection, and economic hardships have all taken their toll—especially on undergraduates struggling to find their way in a demanding curriculum with compromised support systems for hands-on learning, social connection, internships, and research opportunities. COVID has also stunted opportunities to perform broader community outreach—efforts that we know can be so energizing and motivating for scientists and scientists in training.

Notwithstanding all these challenges, throughout 2021 and 2022 our community has been working to recapture what had been lost since the pandemic started. Many of you have been a part of that movement. Thank you. This congress is your time to celebrate your hard work and to create bonds that will lead to a lifetime of connectivity with the physics and astronomy community.

Now, as SPS looks forward to its second century, we have found powerful and meaningful ways to grow. I am especially pleased that SPS and ΣΠΣ formally expanded their scope with the inclusion of astronomy alongside physics. I applaud the intentionality behind this inclusion.

AIP is committed to taking action to cultivate diversity, equity, inclusion, belonging, and accessibility in the physical sciences. We are poised to create waves of change that will have lasting impacts on our science. I trust you, too, will feel a sense of pride in knowing that SPS is a lead partner in TEAM-UP Together, working with AAPT, AAS, AIP, and APS to provide direct financial support to students and physics and astronomy departments in pursuit of the systemic change required to double the number of African American undergraduate physics and astronomy bachelors by 2030. As a community, we have embraced this goal, and together we can get there.

Looking to the future, it will take the full force of our collective efforts to engender belonging for everyone who seeks to practice, teach, and support science. I know you will join me in a call to action to be welcoming, inclusive, open listeners, and committed allies here at PhysCon, in our SPS–ΣΠΣ community, and broader afield. As change agents, the future is in our hands.

Michael H. Moloney, PhD
Chief Executive Officer
American Institute of Physics

About

the Society of Physics Students, Sigma Pi Sigma, and the American Institute of Physics

The Society of Physics Students (SPS) is a professional association explicitly designed for students. Membership, through collegiate chapters, is open to anyone interested in physics and astronomy. The only requirement for membership is that you be interested in physics or astronomy. In addition to physics and astronomy majors, our members include majors in chemistry, computer science, engineering, geology, mathematics, medicine, and a range of other fields.

SPS exists to help students, particularly undergraduates, transform themselves into contributing members of the professional community. Course work develops only one range of skills. Other skills needed to flourish professionally include effective communication and personal interactions, leadership experience, establishing a personal network of contacts, presenting scholarly work in professional meetings and journals, and outreach services to the campus and local communities. Locally, regionally, nationally, and internationally, SPS offers the opportunity for these important enrichments to the student's experience.

Within SPS is housed Sigma Pi Sigma, the national physics honor society, which elects members on the basis of outstanding academic achievement and service. Sigma Pi Sigma exists to honor outstanding scholarship in physics and astronomy; to encourage interest in physics and astronomy among students at all levels; to promote an attitude of service of its members toward their fellow students, colleagues, and the public; and to provide a fellowship of persons who have excelled in physics and astronomy. Sigma Pi Sigma's mission is not fulfilled by the induction ceremony, which recognizes academic accomplishment. In the four dimensions of Honor, Encouragement, Fellowship, and Service, the mission of Sigma Pi Sigma spans a lifetime.

Founded in 1921, Sigma Pi Sigma is a member honor society of the Association of College Honor Societies. Our society has more than 100,000 historical members. Election to Sigma Pi Sigma is a lifetime membership.

This unique two-in-one society operates within the American Institute of Physics (AIP), a federation of physical science societies that advances, promotes, and serves the physical sciences for the benefit of humanity. AIP offers authoritative information, services, and expertise in physics education and student programs, science communication, breaking news about science policy, career services for science and engineering professionals, statistical research in physics employment and education, industrial outreach, and the history of physics and allied fields. AIP also publishes the flagship magazine Physics Today and is home to the Niels Bohr Library & Archives. AIP owns AIP Publishing LLC, a scholarly publisher in the physical and related sciences.

The ten Member Societies supported by AIP collectively represent a broad cross-section of more than 105,000 scientists, engineers, and educators in the global physical science community.

Executive Program Committee

Blane Baker, William Jewell College (Congress Co-Chair, ΣΠΣ President)
Samantha Pedek, University of Iowa (Congress Co-Chair)
DJ Wagner, Grove City College
Katherine Zaunbrecher, Educator and Physicist
Amandeep Gill, University of Nevada, Reno
Brad Conrad, Director, Sigma Pi Sigma & Society of Physics Students

ΣΠΣ/SPS Office Staff

Brad Conrad, Director, Sigma Pi Sigma & Society of Physics Students
Andrew Zeidell, Assistant Director, Sigma Pi Sigma
Kayla Stephens, Assistant Director, Society of Physics Students
Mikayla Cleaver, SPS Programs Coordinator
Sacha Purnell, Administrative Assistant
Lydia Quijada, Membership Coordinator
Vanessa Bridges, Meeting Planner
Aaron Hansen, Creative Services Manager
Hyun-Joo Kim, Web and Graphics Designer

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Sigma Pi Sigma—
A Departmental Legacy of Friendship, Part 1

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

What we know today as Sigma Pi Sigma and the Society of Physics Students began back in 1920 at Davidson College, North Carolina, when four students and five physics department faculty members formed an organization to

> *. . . reward high scholarship and promote interest in the advanced study of Physics, to stimulate individual research, to enable its members to keep pace with the progress of the science, and to encourage a spirit of co-operation and friendship among those who have displayed marked ability in this study.*[1]

In 1920, the field of physics was still being defined, but it was clear to the founders that something was needed to facilitate student cooperation, friendship, and intradepartment collaboration.

A formal decision to create such a fraternity was finalized on December 21, 1921, but it was immediately apparent to the founding members that they were different than a "social fraternity of the conventional kind."[1] The organization immediately became a vehicle for change within the department, gave opportunities for individual student and faculty expression, and let its members "talk shop" informally and freely through seminars and friendly gatherings outside the department. While there was a social component to the fraternity, as was customary at the time, the primary focus was on forming a physics-related professional community through shared meals, scholarship, and development of the department. Discussion topics ranged from social to science—from physics, to astronomy, to what would become several different physical sciences as we know them today. The group aimed to be "an active factor in the life" of its members.[1]

The first public symbol of the organization, a pledge badge, was a horseshoe magnet and was adopted[2] on February 22, 1922. Excellence in physics was stressed from the beginning, as members of the first class to be inducted into Sigma Pi Sigma "were expected to prepare some paper on a physics topic."

While it may seem that physics departments, and indeed, physics students, must be vastly different today than they were in 1921, an article from the December 1931 issue of *The Radiations of Sigma Pi Sigma* suggests otherwise.[2] That issue highlighted the 10th anniversary of the organization and gave an intimate view into the first meetings of the first Sigma Pi Sigma chapter, or the alpha chapter. L. M. Curie, a founding member, tells *Radiations* readers,

> *From such a modest beginning, the present organization of Sigma Pi Sigma has grown. From this beginning, however, interest in physics at Davidson has shown a steady increase. The most serious subject for consideration at the first business meeting after organization was a discussion by Price, Brice, and Dew (founding members) as to how much voltage could be applied to "Wooly" Grey (a member of the first group initiated into the chapter in 1922) without doing him any permanent injury. A moderate voltage was decided upon and applied at a later date.*

I don't know if your classmates were anything like mine, but this would have fit right in with discussions we had at my chapter at the Rochester Institute of Technology almost 80 years later. In fact, the last time I hosted an induction at Appala-

chian State University, we made a pun in this vein about giving "the charge" to new Sigma Pi Sigma members.

Curie goes on to write,

> *It seems somewhat the irony of fate that among my first efforts for the good of the cause should have been a paper which I presented to the group sometime during the first year. This paper dealt with dry cells and primary batteries in general. As a punishment for that effort, I have spent the last six years finding out that two-thirds of what I said in my first paper was not true—and I have as yet been unable to find out the reason for the truth of the 33-1/3 percent.*

More than any words I could write, this quote gets at the heart of what Sigma Pi Sigma is—not just to individual students and faculty but to a department's sense of identity. Each chapter is a reflection of that department and who they strive to be. The Davidson College members began something that was distinctly their own, something that supported their members and promoted excellence but also could be shared with the broader community of physicists. They saw Sigma Pi Sigma as an agent of change.

It was decided that Sigma Pi Sigma should become a national organization, and on April 12, 1925, a modest expansion program began. A second chapter of Sigma Pi Sigma was chartered at Duke University that spring and a third chapter at the Pennsylvania State University the following academic year. The first national convention of the society was held in 1928, with all six chapters participating. During this period of time, questions of governance, the constitution, and requirements were adjusted to more closely resemble what we know today. Of great debate were the requirements for chapter activity. Ultimately, it was decided that while no formal requirement for regular meetings or activities needed to be specified, chapters should be ingrained within the department culture, faculty and students alike. Early discussions stressed that membership within the society was regarded as an honor to strive for, yet it was well understood that the chapter should benefit the entire department, so much so that it was decided by the 1928 convention to actively promote the concept and vision of Sigma Pi Sigma to colleagues and other institutions. This resulted in rapid expansion, and by June 2, 1930, there were 19 chapters, with 9 of the chapters being installed in 19 days!

Sigma Pi Sigma leadership from 1928.
Picture from M. White personal records.

Over the following decades, Sigma Pi Sigma continued to grow and respond to the needs of new generations of physical scientists. Through the early support of Marsh White and several other societies, including the American Association for the Advancement of Science, the American Association of Physics Teachers, and the American Institute of Physics, Sigma Pi Sigma has grown to represent hundreds of departments and continues to serve the needs of students, faculty, and the broader community.

1. *"Nine Years of Lusty Growth: Visions of Founders of Local Honorary at Davidson College far Surpassed by Substantial Development of Recent Years — A Story of Achievement,"* The Radiations of Sigma Pi Sigma, *October 1930.*

2. *L. M. Curie, "Letter from Our Founders," reprinted from the December 1931 issue of* The Radiations of Sigma Pi Sigma, *p. 1.*

Daily Schedule s

WEDNESDAY, OCTOBER 5, 2022

3:00 pm – 8:00 pm **Registration**

Location: Lobby Level Registration near Executive Room

1:30 pm **Greenbank Tour (only Wednesday tour)**

Note: Meet at Registration for this overnight tour

THURSDAY, OCTOBER 6, 2022

6:45 am – 5:00 pm **Registration**

Location: Lobby Level Registration near Executive Room

7:00 am – 8:45 am **Tours (optional):**

- NASA Goddard Space Flight Center
- University of Maryland - College Park Physics Department
- Georgetown University Medical Center
- National Air and Space Museum Steven F. Udvar-Hazy Center
- National Institute of Standards and Technology

12:00 pm – 1:45 pm **Expo & Career Fair**

Sponsored by Grad School Shopper

12:30 pm – 1:30 pm **Coffee Break**

Location: Exhibit Hall – Lower Level of Omni Shoreham Hotel

2:00 pm – 2:30 pm **Opening Events and Awards**

- Director of SPS and Sigma Pi Sigma, Brad R. Conrad
- AIP CEO, Michael H. Moloney
- Davidson College
- 2022 Congress Chairs, Blane Baker and Samantha Pedek
- Special Guests including: Blane Baker, President of Sigma Pi Sigma; Earl Blodgett, Historian of Sigma Pi Sigma; Paul Wahlbeck, GWU Dean of the Columbian College of Arts & Sciences, and others

2:30 pm – 2:45 pm	**Honorary Chair Dame Jocelyn Bell Burnell**
2:45 pm – 4:30 pm	**Centennial Plenary** – Each speaker will answer the question "Where will physics and astronomy go over the next 100 years?" » Dame Jocelyn Bell Burnell » Dr. John Mather » Dr. Jim Gates » Dr. Eric Cornell Location: Regency Ballroom, Lower Level
4:30 pm – 4:45 pm	**Break**
4:45 pm – 6:30 pm	**2022 Physics and Astronomy Congress Workshop** Location: Regency Ballroom, Lower Level
6:30 pm – 8:00 pm	**Dinner On Your Own**
8:00 pm – 12:00 am	**(Optional) SPS Lounge, Study Room, and Game Room** Location: Omni Shoreham Hotel – Congressional Room, Executive Room, and Palladian Room

FRIDAY, OCTOBER 7, 2022

8:00 am – 5:00 pm	**Registration** Location: Lobby Level Registration near Executive Room
8:30 am – 10:00 am	**Plenary: Dr. Julianne Pollard-Larkin** Sponsored by the American Association of Physicists in Medicine (AAPM) Location: Regency Ballroom, Lower Level
10:00 am – 1:00 pm	**Expo & Career Fair** Sponsored by GradSchoolShopper and Physics Today
10:00 am – 11:00 am	**Coffee Break**
10:15 am – 11:45 am	**Poster Session I and Art Exhibit** Location: Exhibit Hall – Lower Level of Omni Shoreham Hotel

Daily Schedules

11:45 am – 1:00 pm **Lunch**

Location: Regency Ballroom, Lower Level

1:00 pm – 2:30 pm **Plenary: Dr. K. Renee Horton**

Location: Regency Ballroom, Lower Level

2:45 pm – 4:15 pm **Breakout Session I**

» **Physics for Humans: Entrepreneurship with Physics and Astronomy Workshop**

Location: Palladian Room

» **Life as a Physics & Astronomy Grad Student (Panel)**

Location: Diplomat Room

» **Reaching for the Stars, Literally: Easy, cheap, and meaningful ways to bring astronomy to your SPS chapter**

Location: Empire Room

» **Becoming a Change Agent for Diversity, Equity, and Inclusion**

Location: Ambassador Room

» **Careers in Physics and Astronomy (Panel)**

Location: Congressional A/B Room

» **Wikipedia Edit-a-Thon – Improving Visibility of Physicists and Astronomers**

Location: Forum Room

» **Faculty Session – Fostering Leadership in Your SPS Chapter**

Sponsored by the American Association of Physics Teachers (AAPT)
Location: Senate Room

» **#SPSSplat: Art, Physics, and Outreach Workshop**

Location: Executive Room

4:30 pm – 6:00 pm **Breakout Session II**

» **Physics for Humans: Entrepreneurship with Physics and Astronomy Workshop**

Location: Palladian Room

» **Careers in Physics and Astronomy (Panel)**

Location: Diplomat Room

» **Do You Know What I See: Visualization Tools for Physics Workshop**

Location: Empire Room

- **Becoming a Change Agent for Diversity, Equity, and Inclusion**
  Location: Ambassador Room
- **Grad School in the Physical Sciences (Panel)**
  Location: Congressional A/B Room
- **Wikipedia Edit-a-Thon – Improving Visibility of Physicists and Astronomers**
  Location: Forum Room
- **Faculty Session – Building Strong Undergraduate Departments**
  Sponsored by the American Association of Physics Teachers (AAPT)
  Location: Senate Room
- **Be a Shark**
  Location: Executive Room

6:30 pm – 8:00 pm **Dinner on your own**

8:00 pm – 12:00 am **(Optional) SPS Lounge, Study Room, and Trivia/Game Room**
Location: Omni Shoreham Hotel – Congressional Room, Executive Room, and Palladian Room

8:30 pm – 11:00 pm **(Optional) High Energy Hot Chocolate and Game Night at GWU**
Location: George Washington University – Corcoran Hall, 725 21st St. NW, Washington, DC

SATURDAY, OCTOBER 8, 2022

8:00 am – 8:00 pm **Registration**
Location: Lobby Level Registration near Executive Room

8:30 am – 10:00 am **Plenary: Dr. Sarah Hörst**
Location: Regency Ballroom, Lower Level

10:00 am – 12:00 pm **Expo & Career Fair**
Sponsored by GradSchoolShopper

10:00 am – 11:00 am **Coffee Break**

Daily Schedules

10:00 am – 11:30 am **Poster Session II and Art Exhibit**

Location: Exhibit Hall – Lower Level of Omni Shoreham Hotel

11:30 am – 12:45 pm **Lunch with Scientists**

Location: Regency Ballroom, Lower Level

12:45 pm – 2:15 pm **Plenary: Dr. Rush Holt Jr.**

Sponsored by Optica

2:15 pm – 2:30 pm **Awards and Acknowledgments**

Location: Regency Ballroom, Lower Level

2:45 pm – 4:15 pm **Breakout Session III**

- **Science Policy for Scientists**

  Location: Palladian Room

- **Careers in National Labs and Industry**

  Location: Diplomat Room

- **Reaching for the Stars, Literally: Easy, cheap, and meaningful ways to bring astronomy to your SPS chapter**

  Location: Empire Room

- **Iron Chef Science – Science is something that anyone can cook up!**

  Location: Ambassador Room

- **Do You Know What I See: Visualization Tools for Physics Workshop**

  Location: Congressional Room

- **Wikipedia Edit-a-Thon – Improving Visibility of Physicists and Astronomers**

  Location: Forum Room

- **Faculty Session – Undergraduate Research and Your SPS Chapter**

  Location: Senate Room

- **#SPSSplat: Art, Physics, and Outreach**

  Location: Executive Room

2:45 pm – 4:15 pm	**Sigma Pi Sigma and Donor Appreciation Reception** Hosted by AIP Foundation Location: Lower Level – Bird Cage
4:30 pm – 5:45 pm	**Breaking Boundaries Event** Location: Exhibit Hall – Lower Level of Omni Shoreham Hotel
5:45 pm – 6:15 pm	**Break** – To dress up as your favorite physics and astronomy equation, concept, or person (or as yourself).
6:15 pm – 7:15 pm	**Dinner**
7:10 pm – 7:15 pm	**Closing remarks by Centennial Chairs** Location: Palladian Room, Diplomat Room, and Empire Room
7:15 pm – 8:45 pm	**Physics & Astronomy Centennial Festival** Location: Regency and Ambassador Ballrooms, Lower Level
8:45 pm – 12:00 am	**(Optional) SPS Lounge, Study Room, and Trivia/Game room** Location: Omni Shoreham Hotel – Congressional Room, Executive Room, and Palladian Room
8:45 pm – 12:00 am	**Dance Party** Sponsored by the American Physical Society (APS) Location: Regency Ballroom, Lower Level

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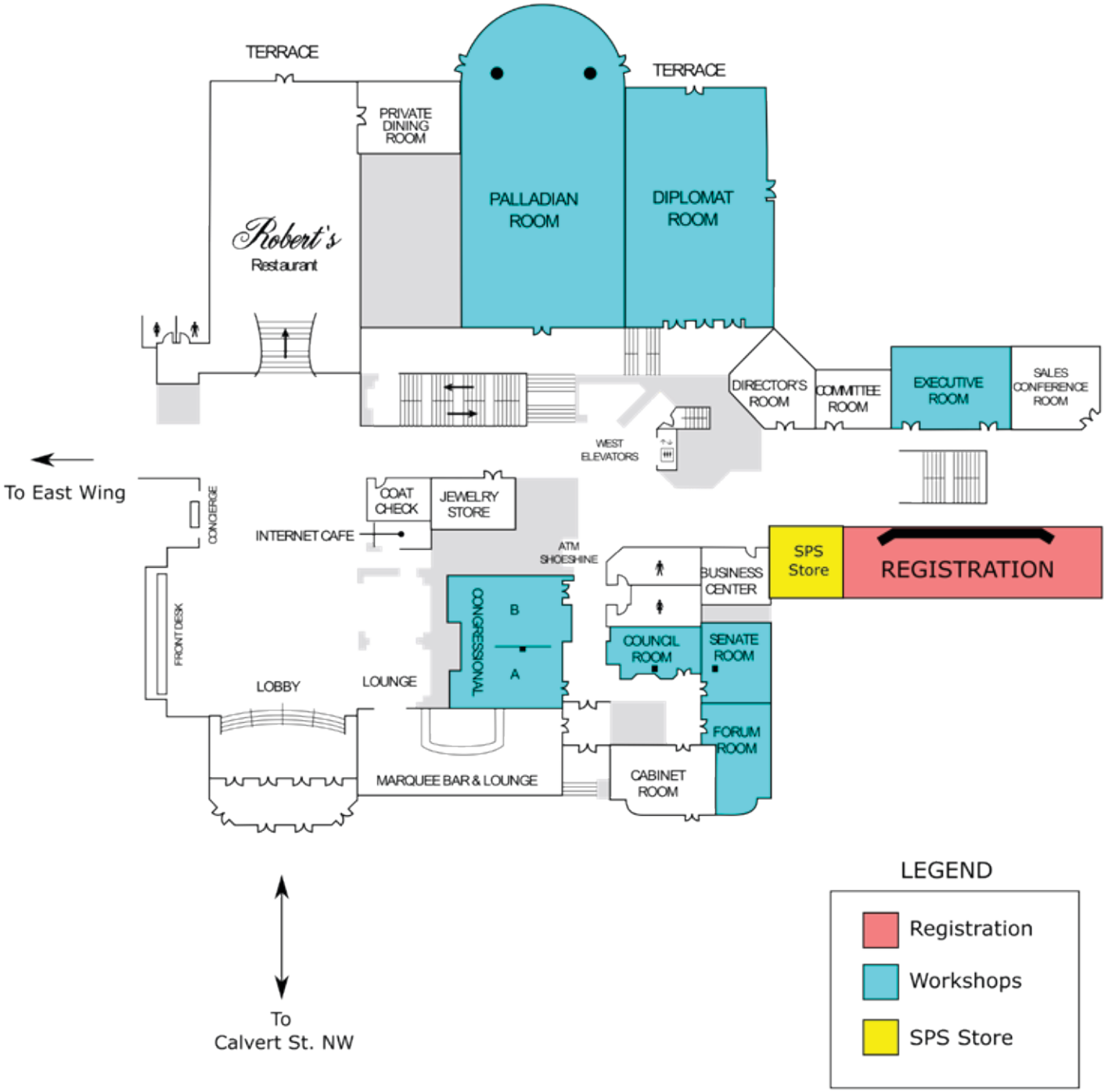
Lobby Level


TERRACE
TERRACE
PRIVATE DINING ROOM
PALLADIAN ROOM
DIPLOMAT ROOM
Robert's Restaurant
DIRECTOR'S ROOM
COMMITTEE ROOM
EXECUTIVE ROOM
SALES CONFERENCE ROOM
WEST ELEVATORS
To East Wing
CONCIERGE
COAT CHECK
JEWELRY STORE
INTERNET CAFE
ATM
SHOESHINE
BUSINESS CENTER
SPS Store
REGISTRATION
FRONT DESK
CONGRESSIONAL
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COUNCIL ROOM
SENATE ROOM
LOBBY
LOUNGE
FORUM ROOM
MARQUEE BAR & LOUNGE
CABINET ROOM
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LEGEND
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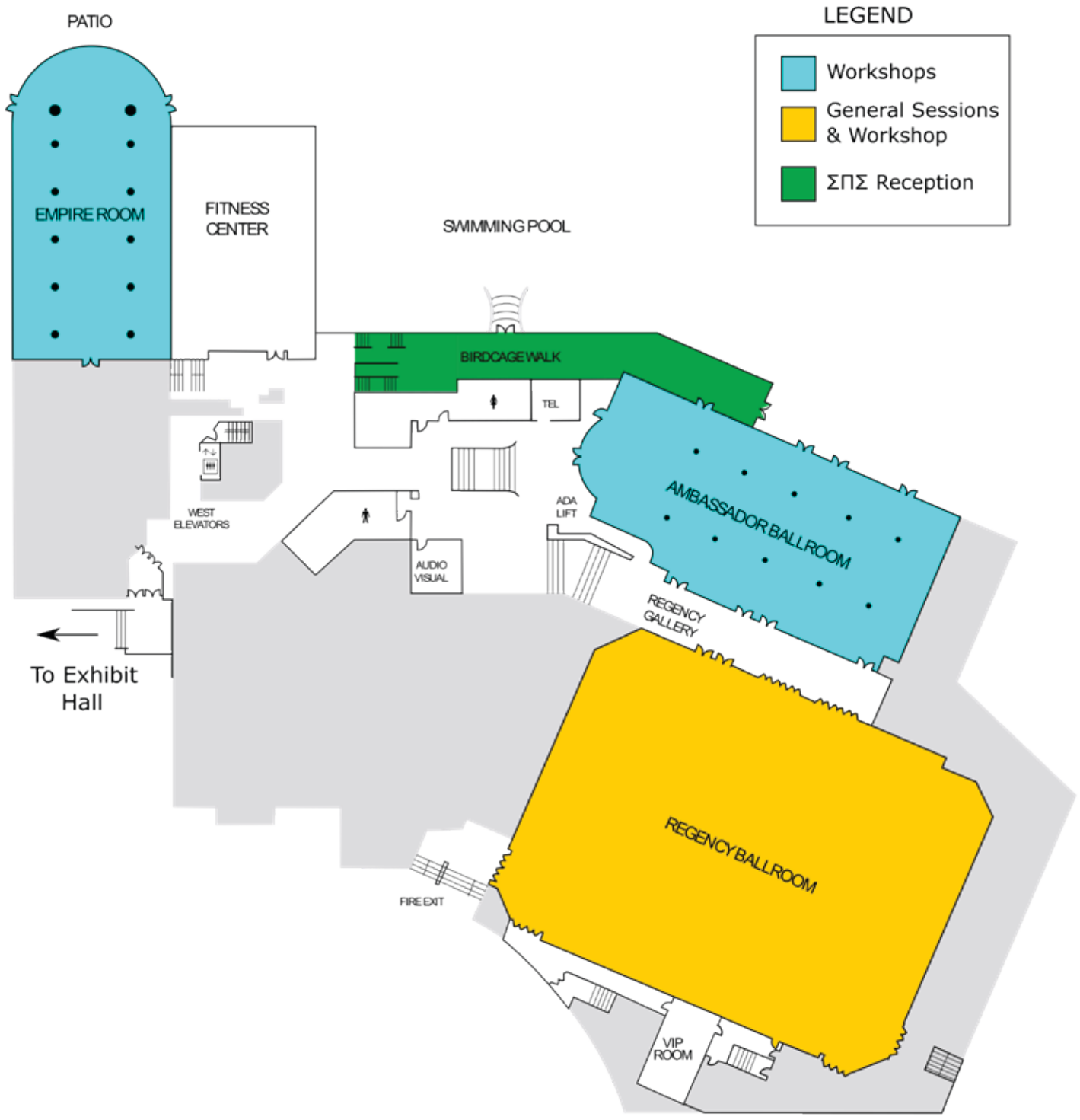
Workshops
SPS Store

Lower Level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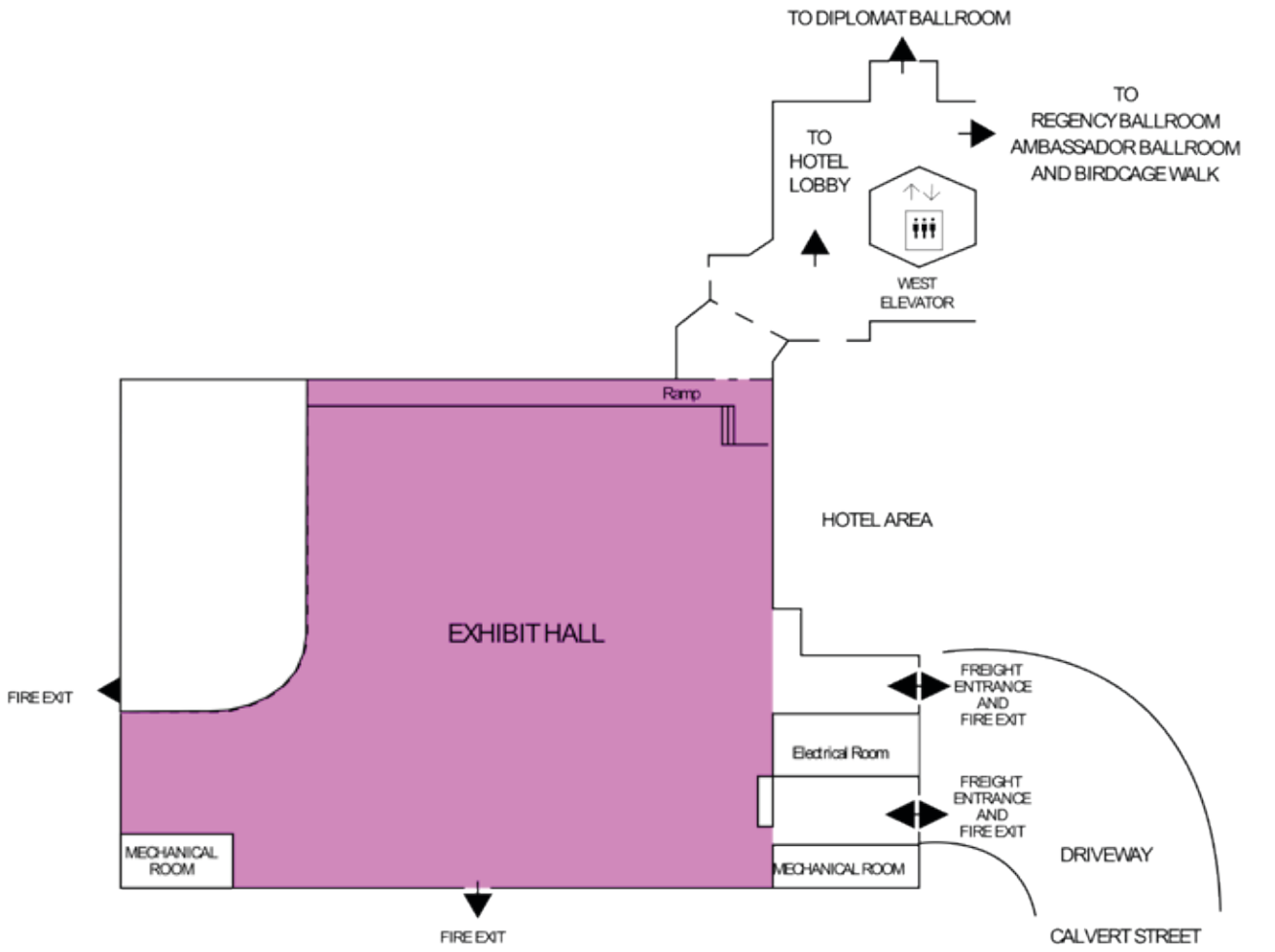
LEGEND
Workshops
General Sessions & Workshop
ΣΠΣ Reception
EMPIRE ROOM
FITNESS CENTER
SWIMMING POOL
BIRDCAGE WALK
TEL
WEST ELEVATORS
ADA LIFT
AMBASSADOR BALLROOM
AUDIO VISUAL
REGENCY GALLERY
To Exhibit Hall
REGENCY BALLROOM
FIRE EXIT
VIP ROOM

Exhibit Hall - Lower Level



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Syracuse University

DEPARTMENT OF PHYSICS

Application due: December 9, 2022

Apply: https://bit.ly/3PQkHvA

Degree(s): PhD

Fields offered include: Biophysics, Quantum, GW, Particles

Questions: phyacademics@syr.edu

- Total grad students: **100**
- Years to completion: **6**
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Syracuse, New York
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FUTURE OF PHYSICS DAYS

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Future of Physics Days (FPD) events help undergraduate students have valuable professional experiences at APS scientific meetings. Join us at an APS March or April Meeting to present your research, explore career options, and meet new colleagues.

APS physics SPS

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- **100+** grad students

Orlando, Florida

sciences.ucf.edu/physics

Tour Description s

for Sigma Pi Sigma Physics Congress 2022

PhysCon registrants have the opportunity to join one of the off-site tours on Thursday, October 6th, 2022. Only fully paid PhysCon registrants can go on the tours. Tours are limited to one per Attendee. Attendees may not be able to get their first choice of tour, as space is limited. All tours are opt-in and require registration before attendance.

Most tours occur on the morning of Thursday, October 6th. Plan to arrive Wednesday, October 5th due to early bus departures.

FEES:

Tour registration cost is $10 (early bird) / $20 (general registration) for each tour. No on-site registration is available for tours. Only one tour per Attendee. Bottled water is provided on each bus. Additional fees for lunch are indicated for each tour. Tour fees are not refundable.

The tours have entry requirements, as outlined below, which will be enforced, especially those related to citizenship and ID requirements. Failure to comply with the requirements could mean forfeiting your participation. Photo ID is required for all tours.

MEET IN THE DESIGNATED STAGING AREA AT THE LISTED TIME FOR YOUR TOUR. Roundtrip shuttle service is provided to transport Attendees from the Omni Shoreham Hotel to the tour sites. For most tours, there is only one pick-up and drop-off time. Tour buses will not wait for missing Attendees. Do not miss the provided transportation or you must find an alternative method to return to the conference hotel.

IMPORTANT:

Due to circumstances beyond our control, some last-minute changes, including cancellations, to tour schedules/destinations are possible. Please verify your tour meeting time upon check-in. Tour fees are not refundable. **All attendees going on tours must arrive 30 minutes before the scheduled departure.** Failure to arrive 30 minutes early could result in you missing the tour.

T-01: Green Bank Observatory Tour

Capacity: 60
Note: This is an overnight tour. Registrants must plan to arrive for the tour Wednesday, October 5th.
Time: Wednesday, October 5th at 2 p.m. to Thursday, October 6th, 4 p.m.
Member price: $25 Early bird, $30 Regular registration
Meals: Included
Location: Off-site

The Green Bank Observatory (GBO) is a cutting-edge research and education facility which hosts the world's largest fully steerable radio telescope, the 100m Green Bank Telescope, as well as many other research-class instruments, a forefront engineering research and development laboratory, and a highly successful series of STEM education and training programs. The Green Bank facility has been a resource for students, engineers, scientists, and educators for more than 50 years.

The first day of the tour includes a visit to the 40 ft radio telescope and the opportunity to point the dish and collect data. Weather permitting, there will be a star party and the opportunity to analyze data captured using the telescope. The second day includes a tour of the Green Bank Telescope, and other telescopes on-site, as well as analysis of data captured Wednesday evening. Meals are included in the price of registration.

Note: There is no cell phone service at this location, though internet access will be available within a Faraday-caged room off of the Visitor Center. Rooming is in bunkhouses on-site. Use of digital and cell phone cameras near the instruments is not permitted. Most film cameras, including single use, are allowed. Attendees may miss part of the first plenary session on Thursday, October 6th.

Entrance Requirements:

» Registrants must register through GBO prior to visiting the site.
» You may not enter unauthorized areas.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.
» Cell phone photography is forbidden near radio telescopes.

T-02: NASA's Goddard Space Flight Center

Capacity: 200
Time: 7:30 a.m. – 1:45 p.m. Thursday, October 6th
Member price: $10 Early bird, $20 Regular registration
Lunch: Lunch provided
Location: Off-site

NASA's Goddard Space Flight Center, home to Hubble and James Webb Space Telescope operations, hosts the nation's largest organization of scientists, engineers, and technologists who build spacecraft, instruments, and new technology to study Earth, the sun, our solar system, and the universe. Come visit and tour the four research centers—Heliophysics, Space Weather Research Lab, Hubble Missions Operations Center, Planetary and Lunar Science—and more! A panel of scientists will talk to you about the work done at Goddard, and staff scientists will lead the tours. Lunch will be available for purchase on-site.

Entrance Requirements:

» Foreign visitors must complete the "Foreign Visitor Information Sheet" three weeks in advance.
» All visitors must sign a COVID-19 Vaccine Attestation Form.
» U.S. Citizens: Bring photo ID.
» Foreign Visitors: Bring passport/visa & photo ID.
» You may not enter unauthorized areas.
» Must stay with escort the entire time.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.

T-03: University of Maryland Physics Department

Capacity: 50
Time: 9:00 a.m. – 12:00 p.m. Thursday, October 6th
Member price: $10 Early bird, $20 Regular registration
Lunch: Provided
Location: Off-site

The University of Maryland (UMD) has several research groups which apply physics techniques to various problems and fields. Within the UMD physics department are groups researching biophysics, quantum physics, astrophysics, and chemical physics! Research areas span a large breadth of disciplines and include both theoretical and experimental work focusing on exciting problems which are often found along the boundaries and intersections of traditional fields. Come explore these areas on guided tours through different facilities! Each UMD tour includes a general address in the demo lecture hall by faculty and grad students before groups split for different tours.

Entrance Requirements:

» You may not enter unauthorized areas.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.

T-04: Georgetown University: A Day of Medical Physics

Capacity: 20
Time: 9:00 a.m. – 12:00 p.m. Thursday, October 6th
Member price: $10 Early bird, $20 Regular registration
Lunch: Not provided
Location: Off-site

Interested in medical physics as a potential career? This tour is for you! Come visit Georgetown University Hospital's Radiology & Radiation Therapy Departments for a day of medical physics! The tour begins with a special lecture, "Exciting Careers of Medical Physicists" by Stanley Fricke, director of medical physics, Georgetown University, and is followed by a tour of Georgetown University Hospital's Radiology and Radiation Therapy Departments by board-certified medical physicist Matthew Williams.

Entrance Requirements:

» You may not enter unauthorized areas.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.

T-05: Smithsonian National Air and Space Museum Steven F. Udvar-Hazy Center

Capacity: 200
Time: 9:00 a.m. – 12:00 p.m. Thursday, October 6th
Member price: $10 Early bird, $20 Regular registration
Lunch: Not provided
Location: Off-site

Want to see the Space Shuttle Discovery and the Concorde, the first supersonic airliner? The Steven F. Udvar-Hazy Center displays these and thousands of aviation and space artifacts spanning the history of human terrestrial and space flight! Included in the tour is a visit to the Mary Baker Engen Restoration Hangar and science demonstrations after the tour.

Entrance Requirements:

» You may not enter unauthorized areas.
» Outside food and drink are not permitted inside the museum; only bottled water is permitted inside the museum.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.

T-06: National Institute of Standards and Technology - Gaithersburg

Capacity: 32
Time: 9:00 a.m. – 12:00 p.m. Thursday, October 6th
Member price: $10 Early bird, $20 Regular registration
Lunch: Not provided
Location: Off-site

The National Institute of Standards and Technology (NIST), founded in 1901, is the nation's oldest physical science laboratory. Headquartered in Gaithersburg, MD, this campus houses five major laboratories spread throughout 62 different buildings. This tour includes visits to the Physical Measurement Laboratory and the Materials Measurement Laboratory, and a short talk by staff scientists.

Entrance Requirements:

» You may not enter unauthorized areas.
» Food and drink are not permitted.
» There is only one pick-up and drop-off time. Do not miss the provided transportation or you must get yourself back to the conference hotel.

UNIVERSITY OF CALIFORNIA
MERCED

Merced, California
physics.ucmerced.edu

PHYSICS

Application due: January 15, 2023

Apply: https://bit.ly/39pZJ7u

Degree(s): PhD

Fields offered include: astro, AMO, biophys, cond mat, soft matter

Questions: mscheibner@ucmerced.edu

- Total graduate students: **68**
- Graduate students who are women: **13**
- University founded: **2005**

SMU
DEPARTMENT OF PHYSICS

SOUTHERN METHODIST UNIVERSITY PHYSICS

Application due: Dec 15, 2022

Apply: https://bit.ly/2W00hFr

Degree(s): PhD, MS

Fields offered include: Experimental Particle Physics, Theoretical Physics, Astrophysics

GRE Subject Test Required

Questions: smugrad@smu.edu

- **4-5** first year students
- **4-5** years to completion
- **100%** of grad students are receiving assistantship support

Dallas, Texas
exampleschoolname.edu/department

Washington University in St. Louis

PHYSICS

Application due: Dec 15, 2022

Apply: https://bit.ly/3Stk5hG

Degree(s): PhD, MS

Fields offered include: astrophysics, quantum information and quantum materials, biophysics

GRE Subject Test: Optional

Questions: gradinfo@physics.wustl.edu

- **$29,152** average stipend per academic year
- **5.63** years to completion on average
- **2:1** student to faculty ratio

St. Louis, Missouri
physics.wustl.edu

LSA APPLIED PHYSICS PROGRAM
UNIVERSITY OF MICHIGAN

Ann Arbor, Michigan
lsa.umich.edu/appliedphysics

APPLIED PHYSICS

Application due: January 5, 2023

Apply: https://bit.ly/2NschKo

Degree(s): PhD, MS

Fields offered include: Research in all areas of physics

Questions: appliedphysics@umich.edu

- ***80*** graduate students total
- ***35%*** of graduate students are women
- ***177*** faculty members

Workshops

2022 Physics and Astronomy Congress Workshop



Brad Conrad, Director of SPS and Sigma Pi Sigma
Shannon Clardy, Henderson State University
Bill DeGraffenreid, CSU Channel Islands

Attendees will gather together to form the 2022 Sigma Pi Sigma Physics and Astronomy Congress. In this congress, students and faculty from across the world will examine the current status of our community, debate issues, identify paths forward, and provide input on where we need to go in the future as a collective. In this session, you'll impact the future of both SPS and Sigma Pi Sigma and make a few friends along the way. Together we'll develop a plan on how you'll support and bring change to others that were not able to join us. We can make each department and chapter a vibrant place where everyone can explore, tinker, and discover.

Physics for Humans: Entrepreneurship with Physics and Astronomy Workshop

Randy Tagg, University of Colorado Denver

Come see how physics and practical knowledge rise to the challenge of inventing new ways to address human needs and aspirations. In areas such as energy, health care, agriculture, manufacturing, construction, and communications—and even music, sports, and retail—you and your student colleagues will conceive of fascinating new approaches to improve human well-being. This will even stimulate your desire to advance the frontiers and methods of physics and astronomy as you draw upon fields like optics, nanotechnology, sensing and detection, materials physics, etc. Begin a journey of physics and innovation that may last well beyond the conference!

Life as a Physics & Astronomy Grad Student (Panel)

Sam Pedek, University of Iowa
Molly McDonough, Pennsylvania State University

It's never too early to start planning for the future, and one of the many paths to follow after receiving an undergraduate degree is to pursue either a master's degree or a PhD. In this workshop, hear from current graduate students in physics and astronomy about their lived experiences. Bring your questions and have an honest discussion about life as a grad student in physics and astronomy.

Becoming a Change Agent for Diversity, Equity, and Inclusion

Kayla Stephens, Assistant Director of SPS
Jovonni Spinner, AIP
Arlene Modeste Knowles, AIP
Elon Price, Auburn University
Deanna Marshall, Northwest Earth and Space Sciences Pathways

This workshop is designed to introduce undergraduate students to resources and concepts that will empower them to be departmental change agents toward the implementation and realization of the AIP TEAM-UP report goals.

Reaching for the Stars, Literally: Easy, cheap, and meaningful ways to bring astronomy to your SPS chapter

Nicole Gugliucci, Saint Anselm College
Riley Troyer, University of Iowa

Space telescope images, radio observations of black holes, and exoplanet surveys can make astronomy seem intimidating and out of reach. In this workshop we will explore ways that you and your chapter can enjoy and share the wonders of the night sky, even if you don't have a huge observatory. Astronomy is one of the oldest sciences for a reason. If scholars thousands of years ago could partake in this fascinating field, so can you. During this session, you will construct your own planisphere, learn how to organize star parties, discover the astrophotography potential of your phone's camera, and more.

Careers in Physics and Astronomy (Panel)

Alina Gearba-Sell, United States Air Force Academy
James "Jim" Borgardt, Juniata College

Are you interested in learning about exciting career opportunities in the field of physics and beyond? Are you wondering how to make the most of your physics degree? Then come to the Careers in Physics and Astronomy Workshop, where a diverse group of professionals will guide you on your journey of becoming a "contributing member of the professional community." Traditional as well as nontraditional career pathways for physics and astronomy graduates will be discussed.

Wikipedia Edit-a-Thon –Improving Visibility of Physicists and Astronomers

Joanna Bergman, AIP

Wikipedia is the world's largest online encyclopedia, and it is often the first stop when people want to learn about the lives of historical and current scientists. Unfortunately, women, people of color, and LGBTQ+ individuals are underrepresented among Wikipedia's biographies of scientists. In this Wikithon, attendees will come together to create and edit scientists' biographies. This Wikithon will help correct Wikipedia's bias and improve the visibility of a diverse array of scientists. All levels of experience with editing Wikipedia are welcome.

Faculty Session – Fostering Leadership in Your SPS Chapter

Steve Feller, Coe College
Shannon Clardy, Henderson State University

Leadership skills and experience are among the most sought-after qualities when interviewing for jobs or graduate school. But how do students obtain those skills before they begin their careers? Have you wondered how to establish a foundation of leadership in your SPS chapter? In this interactive workshop, you will identify desirable qualities of leaders, share ideas, and develop strategies to encourage the growth of student leaders.

#SPSSplat: Art, Physics, and Outreach

Deanna Marshall, Central Washington University
Katherine Zaunbrecher, Educator and Physicist

Interested in the intersection of art, physics & astronomy, and outreach? Want to know how you can host a pumpkin drop event at your institution effectively, safely, and with the most science possible? Then this workshop is a must!

Do You Know What I See: Visualization Tools for Physics Workshops

Rebecca Vieyra, Vieyra Software
Chrystian Vieyra Cortés, Vieyra Software

How many ways can you visualize physics with your smartphone? Come engage in a series of fun physics challenges in teams with your own—or a borrowed—smartphone as you visualize environmental data in multiple ways. Use motion, light, pressure, sound, and magnetic field sensors, combined with AR and LiDAR, to uncover and explore the physics around you!

Grad School in the Physical Sciences (Panel)

Molly McDonough, Pennsylvania State University
Sam Pedek, University of Iowa

Are you interested in pursuing either a master's degree or PhD in physical science? In this workshop a panel of current graduate students in physical science will answer your questions about life as a graduate student by sharing their own experiences. The panelists will give their insights into the application process, choosing a program, daily life, and much more.

Faculty Session – Building Strong Undergraduate Departments

James "Jim" Borgardt, Juniata College

Physics and astronomy departments are under immense pressure in 2022. Come hear about the resources available to you and what you can do to help your students and department thrive.

Workshops

Be a Shark

Matthew J. Wright, Adelphi University

The Be a Shark Workshop is an opportunity to work on changing your mindset toward being professionally successful and forward-thinking. There will be a discussion, and we will play a super fun game that will help you improve your "sharkiness"—the ability to think big, quick, and get your thoughts out quickly.

Participants will:

» Learn about how to effectively look for internships and jobs
» Learn about the SHARK mindset (e.g., Sharks eat things that get in their way)
» Learn about opportunities at Adelphi to mix business and science

Science Policy for Scientists

Anna Quider, Northern Illinois University
James "Jim" Borgardt, Juniata College

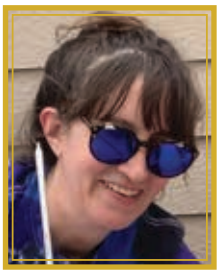
Want to know more about how science policy influences science research, and how scientists can be influential in science policy? If so, this workshop is a must. Led by a seasoned science policy professional, this workshop will engage you in the process of real decision-making that impacts science and scientists. Come ready to learn how to prioritize and make tough choices.

Careers in National Labs and Industry

Molly McDonough, Pennsylvania State University
Sam Pedek, University of Iowa

In a society that is dependent on innovation and technology, careers in national labs and industry are in high demand. In this workshop you will have the opportunity to learn what it's like working at national labs and industry from a panel of local professionals. They will share their experiences and answer your questions.

Iron Chef Science – Science is something that anyone can cook up!



Heather Michalak, Little Shop of Physics, Colorado State University
Debra Dandaneau, Physics Department, Colorado State University

Would you like to do outreach and engagement but don't have a budget for materials? Join the Little Shop of Physics for ideas and tips on low-cost, everyday items to use for hands-on exploration. With 31 years of momentum and experience teaching around the world, we will share how to teach science to a wide variety of audiences in an interactive way! We will hand out engaging ingredients and challenge you to cook up spicy activities. Science is something that anyone can do anytime, anywhere, with anything.

Faculty Session – Undergraduate Research and Your SPS Chapter

Steve Feller, Coe College
Shannon Clardy, Henderson State University

Undergraduate research gives students valuable opportunities to apply the science they learn every day in class while increasing hire-ability or acceptance to graduate school. Involving students in research has been shown to grow departmental enrollment while improving retention. Though the value of participation in undergraduate research is well documented, establishing and maintaining a vibrant year-round program of undergraduate research can be a challenge. This workshop for faculty and SPS advisors will provide you with ideas and resources toward this end. In this session you will share experiences, challenges, and ideas to grow and maintain your own undergraduate research program. This will include the idea that a successful research program should be collaborative with the administration of your college. Ways that this can be done will be emphasized.

Sigma Pi Sigma—
A Departmental Legacy of Friendship, Part 2

by Brad R. Conrad, Director of SPS & ΣΠΣ

What is in a name? Sigma Pi Sigma was founded in 1921 at Davidson College as a department-centered group that rewarded "high aim," encouraged service to the community, and improved departmental fellowship. The benefits of this new society were quite apparent to those that visited Davidson, and the 1920s ended with a rapid expansion of the society which continues to this day.1 Beyond merely adding additional chapters, this period was a phase transition of sorts, as the composition of the society began to shift from a few schools in close communication with each other to a much wider-reaching initiative spanning graduating cohorts. There became a need for society discussion and member news to be spread across dozens of schools with hundreds of members, past and present. Many of those graduating needed a mechanism to remain connected to not just their alma mater but each other, which is still the case today.[2] To answer the question of how to connect members spanning institutions and generations, the Sigma Pi Sigma Executive Council chose a freely available, member-focused publication which would contain letters from society leaders, community information, and chapter updates.

Below is an excerpt of an editorial from the first issue of the *Radiations of Sigma Pi Sigma*, which was published in October of 1930[3] and written by Dr. Marsh White himself[4]:

> *"Our selection of the name the* Radiations of Sigma Pi Sigma *for this magazine is purely provisional and subject to change. It seemed appropriate to us. What is your reaction? One of our prominent and greatly interested members wrote some time ago concerning this designation: 'No more happy title was ever chosen for a journal. Only a physicist can realize the significance of the symbolism. Yet it is obvious that from such an organization as Sigma Pi Sigma there are always these intimate penetrating rays that pervade our entire being and our laboratories. They are invisible; they may be unnoticed by an outsider, but they affect every moment of our life. They arise from electronic encounters from sparks within ourselves and between the members of the fraternity. A laboratory in which the fraternity is organized is never inactive and never at a low potential but is alive at the core. The attendant phenomena are numberless; the production and consumption of energy is tremendous and from those transformations of energy arise new theories, new concepts and new vigor. But most striking is the fact that we all live and breathe in an atmosphere which is vibrating at a high frequency and in which we all have luminous fluorescent faces activated by the radiations of Sigma Pi Sigma. Such an atmosphere is the most precious asset of any university.'"*

Map of Sigma Pi Sigma chapters, reprint from page 24, September 1935, *Radiations*.

The field has changed greatly since this was written in 1930, but the atmosphere in which physics departments flourish largely remains the same. Our undergraduate studies affect us deeply, forever changing how we approach the world; however, it is our interactions with each other, our "luminous fluorescent faces" that often have the longest impact.

If SPS and Sigma Pi Sigma were not created when they were, they would

have been reinvented to fulfill a fundamental need within physics and astronomy departments: a desire to academically excel, aim high, and share in the pleasure of discovery with colleagues. This speaks to the unique place our organization occupies within departments and for students across a century, as SPS is for many students their first support network and their entry into the broader physical sciences.

The field has changed through the decades, and the work of Sigma Pi Sigma chapters has developed with the times. There is evidence of the first SPS/ΣΠΣ lounge, a closely guarded tradition for many departments, as far back as 1930 at the University of Kentucky.[5] To quote the chapter historian, "All are rightfully proud of this 'social center' in the department. It serves a purpose which is very essential to the lives of all, even the physicists."[5] And, knowing how student spaces go, the couch featured in the Lambda chapter photo might have been repurposed and is still in use in an SPS lounge somewhere else to this day.

As the membership became more diverse, so too did its founding principles. While some groups did not induct women at the time of the founding, Radiations of Sigma Pi Sigma provides us with many examples of Sigma Pi Sigma chapters doing just that, spanning back to our first chapters.[6] Additionally, the first female editor of the publication, Vivian Johnson of Purdue University, was announced in the October 1937 issue.[7] Through deliberation with the broader collection of chapters, induction criteria for service were strengthened and the pillars of our society became to honor outstanding scholarship in physics, to encourage interest in physics among students at all levels, to promote an attitude of service of its members toward their fellow students, colleagues, and the public, and to provide a fellowship of persons who have excelled in physics. As Sigma Pi Sigma grew, it strived to represent the living ideals and needs of our entire community.

As our understanding of the physical world and the structure of the universe has become more specialized, our need for cooperation and collaboration with each other is stronger than ever. After World War II, the explosion of students at American universities created new challenges and a wealth of opportunities for the honor society that ultimately resulted in the formation of the Society of Physics Students and its intrinsic linkage to the physics honors society. Today, the Society of Physics Students is a home to everyone with an interest in physics and astronomy, while Sigma Pi Sigma continues to honor excellence, service, and fellowship across the generations. It's the combination of societies that allows us to rely on each other more than ever to collaborate, communicate, and form the communities that will propel each other toward another 100 years of momentum.

Charter Members and Installing Party at the Upsilon Chapter, Wheaton College, June 3, 1931, reprinted from H. O. Taylor, A History of Wheaton College, December 1931, *Radiations*.

Lambda's clubroom, a feature other chapters may well emulate

First known SPS/ Sigma Pi Sigma student lounge at the University of Kentucky, reprinted from H. M. Sullivan, Sigma Pi Sigma Club Room at Lambda Chapter, December 1931, *Radiations*.

1. *Sigma Pi Sigma, the Physics Honors Society Information Booklet, 3rd ed. (1946).*

2. *J. Pold and P. Mulvey, Physics Bachelor's One Year After Degree (College Park, MD: AIP Statistical Research Center, 2016), 3.*

3. *Marsh White, "Editorial: What's in a Name?"* Radiations of Sigma Pi Sigma *1, no. 1 (Oct 1930): 20.*

4. *Video Interview of Sigma Pi Sigma icon March White, www.youtube. com/watch?v=4eyRu_QrRXg.*

5. *H. M. Sullivan, "Sigma Pi Sigma Club Chapter Room at Lambda Chapter,"* Radiations of Sigma Pi Sigma *1, no. 2 (Dec 1930).*

6. *Alphabetical Membership Directory, Sigma Pi Sigma Bulletin,* Radiations of Sigma Pi Sigma *1, no. 1 (Oct 1930).*

7. *"Editor of the Radiations of Sigma Pi Sigma by Executive Committee,"* Radiations of Sigma Pi Sigma *8, no. 1 (Oct 1937): 53.*

PhysCon Sponsor s

Thank you to the 2022 Physics Congress Sponsors!

A special thank you National Institute of Standards and Technology (NIST) Gaithersburg, National Aeronautics and Space Administration (NASA) Greenbelt, Green Bank Observatory, Georgetown Medical Center, Smithsonian Institution, University of Maryland - College Park, and the George Washington University.

And a very special thank you to The George Washington University and the University of Maryland - College Park for being our 2022 Congress local hosts!

SPS Presidents

Vincent E. Parker	Cal Poly Pomona	1968–1971
Stanley Ballard	University of Florida	1971–1973
Leroy Humphries	McMurry College	1973–1977
Hla Shwe	East Stroudsburg State College	1977–1981
William Eidson	Drexel University	1981–1985
Ray Askew	Auburn University	1985–1989
Gary Agin	Michigan Technological University	1989–1991
Jean Krisch	University of Michigan - Ann Arbor	1991–1993
Fred Domann	University of Wisconsin - Platteville	1993–1995
Robert Fenstermacher	Drew University	1995–1999
Gary White	Northwestern State University of Louisiana	1999–2001
Karen Williams	East Central University	2001–2005
Earl Blodgett	University of Wisconsin - River Falls	2005–2009
Toni Sauncy	Angelo State University	2009–2012
Dave Donnelly	Texas State University - San Marcos	2012–2013
DJ Wagner	Grove City College	2013–2017
Alina Gearba-Sell	US Air Force Academy	2017–2021
Kiril Streletzky	Cleveland State University	2021–Current

Sigma Pi Sigma Presidents

J.K. Price	Davidson College	1922–1922
R. M. Brice	Davidson College	1923–1923
James Douglas	Davidson College	1925–1951
Robert Graces	Davidson College	1925–1928
Charles Hatley	Duke University	1928–1931
Roscoe Young	College of William & Mary	1931–1931
Marshall States	Central Scientific Co.	1931–1934
Robert Colwell	University of West Virginia	1934–1939
Frederic Blacke	Ohio State University	1939–1943
Joyce Stearns	University of Denver	1943–1947
Homer Dodge	Norwich University	1947–1950
Merriam Trytten	National Research Council	1950–1955
Vincent Parker	Oak Ridge Associated Universities	1955–1959
Stanley Ballard	University of Florida	1959–1962
L. Worth Seagondollar	University of Kansas	1962–1967
Marsh White	Pennsylvania State University	1967–1970
Donald Tendam	Purdue University	1970–1972
Cecil Shugart	Northeast Louisiana State University	1972–1976
Wallace Hilton	William Jewell College	1976–1978
Arnold Strassenburg	SUNY at Stony Brook	1978–1982
Richard Waring	University of Missouri - Kansas City	1982–1986
George Miner	University of Dayton	1986–1990
Reuben James	SUNY College of Onesta	1990–1994
Jean Krisch	University of Michigan - Ann Arbor	1994–1998
Thomas Olsen	Lewis & Clark College	1998–2002
Steve Feller	Coe College	2002–2006
Ann Viano	Rhodes College	2006–2010
Diane Jacobs	Eastern Michigan University	2010–2012
William DeGraffenreid	Cal State Sacramento	2012–2014
Willie Rockward	Morehouse College	2014–2018
James Borgardt	Juniata College	2018–2022
Blane Baker	William Jewell College	2022–Current

Helping Science and the Public Meet Halfway

Introducing Rush Holt Jr. 2022 Physics Congress Plenary Speaker

by Korena Di Roma Howley, Contributing Editor

Growing up in West Virginia, Rush Holt Jr. was fascinated by both science and politics. Over the course of his career he has worked to bridge the gap between the two, most notably serving as US representative for New Jersey's 12th congressional district from 1999 to 2015 and as CEO of the American Association for the Advancement of Science (AAAS) from 2015 to 2019. Prior to entering politics, Holt, a PhD physicist, taught physics and public policy at Swarthmore College, helped to establish the science education program at the Princeton Plasma Physics Laboratory while serving as its assistant director, and headed the Nuclear and Scientific Division of the Office of Strategic Forces at the US State Department.

Holt comes from a family of teachers and politicians. His father, Rush Holt Sr., taught school and later served as a US senator and West Virginia state legislator. His mother, Helen Holt, a biology teacher, was West Virginia's first female secretary of state. "I realized you could combine science and politics and there was nothing wrong with it," Holt said in an interview for the Spring 2021 issue of SPS Observer.

He got his first direct experience with politics when, in the midst of his teaching career, he spent a year on Capitol Hill as part of a science and technology policy fellowship sponsored by AAAS and the American Physical Society. Though he returned to teaching at the end of the program, he ultimately made his way back to Washington—and to the work of science-minded policymaking.

As a congressman, Holt advocated for science education and investment in scientific research and development, founding the Congressional Research and Development Caucus and co-chairing the Biomedical Research Caucus. He also served on the National Commission on Mathematics and Science Teaching for the 21st Century, chaired by former astronaut and US senator John Glenn, which produced a report in 2000 that urged a strengthening of math and science education.

In his recent interview with Observer, Holt noted that, in some areas, science education is still falling short. "Most of the emphasis in schools is on teaching science through specific disciplines—biology, chemistry, physics—rather than being taught as science," he said. "As a result, you don't get to see the role of one in the other, and cross-disciplinary questions are overlooked."

Holt is also troubled by the state of public engagement with science and the disconnect that's most recently been brought to the fore by the COVID-19 pandemic. According to Holt, this disconnect has demonstrated in particular that scientists and the public must meet each other halfway. "Scientists will do better science if they think more broadly about what science is, how science works, and how it fits into the world," he said.

According to the AAAS, while head of the organization Holt worked to make scientific expertise more accessible to science communicators, policymakers, and the public. He has served as an SPS advisor and is a longtime supporter of SPS internship programs, including the American Institute of Physics Mather Public Policy Internship, a summer program during which physics majors provide support to congressional representatives and their staff on Capitol Hill. He will serve as a special centennial speaker at the 2022 Physics Congress.

US Representative Rush Holt (D-NJ) with AZCs, from the left - Joseph Charnawskas, Kelsey Buggelli, Allison Whale, Phil Lundgreen, and Richard Prince, during Congressional Visits Day, March 26, 2014. Photo courtesy of SPS National.

Introducing Sarah Hörst
2022 Physics Congress Plenary Speaker

The Pull of the Planets

by Kendra Redmond, Editor

Walk into Sarah Hörst's lab at Johns Hopkins University and you might find researchers simulating the haze surrounding exoplanets, experimentally recreating Titan's atmosphere, digging through Hubble Space Telescope data for clues about Europa's surface, or measuring wind speeds in Saturn's atmosphere. The subjects of her work are every young scientist's dream—exoplanets, planets, and planetary moons.

"It's pretty common for kids to be into space, dinosaurs, and robots, and I guess I just never really grew out of that," Hörst laughs. "My group is interested, big picture, in understanding the role that planetary atmospheres might play in the origin of life, or the evolution of life, those kinds of things. We do a lot of atmospheric chemistry and we use a number of different tools."

Sarah M. Hörst sits in front of the planetary atmospheric simulation chamber in her lab. Photo by Justin Tsucalas, Plaid Photo.

As much as she loved space as a kid, Hörst never planned to pursue it as a career. "It's funny because on my CV, it looks like I just decided I wanted to be a planetary scientist at 18 years old and that's what I did. But that's not what happened," she says.

Hörst went to Caltech for college, intending to major in chemistry. When it was time to declare a major, she casually asked a classmate what she was planning to major in. When the classmate said planetary science, Hörst asked, "What is that?!" They talked and, as Hörst tells it, "I basically marched over to the registrar's office and said, 'I'm going to do planetary science.'"

Graduate school visits were another turning point. After double majoring in planetary science and literature, Hörst applied primarily to earth science graduate programs, planning to work on climate change—an area where she thought she could have a greater impact on the world. But when she visited earth science programs, things changed. "I knew [climate change] was important and I wanted to make a contribution, but I just wasn't as scientifically interested as I was in planetary science," she says. She had applied to a few planetary science programs as a backup plan and chose one of those instead.

Over the years Hörst has thought a lot about how the atmospheric and planetary sciences fit in with her drive to contribute to the greater good. She's realized that all fundamental research has merit, even if it doesn't seem immediately useful—that the value of increasing human knowledge has been proven over and over again.

In addition, she's found planetary science to be a great way to spark kids' interest in STEM. As a postdoc, Hörst revived a program in the American Astronomical Society's Division of Planetary Sciences that helps K–12 teachers harness this excitement among their students when teaching math, reading, and other skills. Hörst has stayed involved in the program throughout her career, working to make it sustainable and even more useful to teachers.

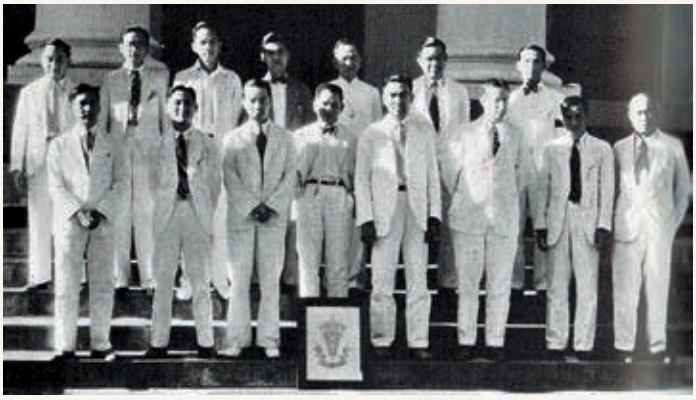
The other thing she's realized is that it's really important for a person to be happy. Hörst notes that society often tries to devalue happiness—to make it seem like if you're happy, you haven't sacrificed enough of yourself for the greater good. In contrast, she believes that personal happiness contributes to the greater good. "Choosing a career in which you are happy has a positive impact on humankind in general," she says.

Reflecting on her own internal conflict between a career in climate change or planetary science, Hörst advises students to "find a life that makes you happy." She continues, "There are so many outside pressures trying to convince us to prioritize certain things or make certain choices. But at the end of the day, the person who has to live with those decisions is you. Figuring out what you need and want from life is one of the most important things that you can do."

Sigma Pi Sigma—
A Departmental Legacy of Friendship, 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

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.



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

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.

> *"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 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.

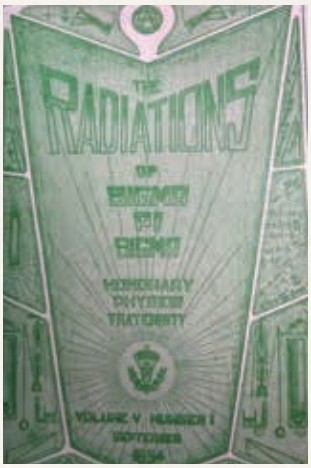
During this period before WWII, it became commonplace for Sigma Pi Sigma chapters to serve not just their members but also to work toward the improvement of the entire department. Efforts tended to focus specifically on undergraduates and the general public, as there were organizations for professionals 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]

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



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

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

1. *Marsh W. White,* The Radiations of Sigma Pi Sigma *3, no. 1 (1932).*

2. *Marsh W. White autobiographical account, circa 1955, Niels Bohr Library and Archives.*

3. *P. Dixon, The History of Sigma Pi Sigma (Oct 1996), accessed October 12, 2020, https://www.sigmapisigma.org/sigmapisigma/about/history.*

4. *Homer L. Dodge papers, 1852–1994, Niels Bohr Library & Archives.*

5. *H. M. Sullivan, "Sigma Pi Sigma Club Chapter Room at Lambda Chapter,"* The Radiations of Sigma Pi Sigma *1, no. 2 (Dec 1930).*

6. *Marsh W. White,* The Radiations of Sigma Pi Sigma *IV, no. 1 (1933).*

7. *D. Cunningham, L. W. Seagondollar, C. G. Shugart, A. A. Strassenburg, and Marsh White, "The New Organization of Physics Students,"* Physics Today *21, no. 9 (1968): 59, DOI: 10.1063/1.3035154.*

8. *Marsh W. White,* The Radiations of Sigma Pi Sigma *7, no. 1 (1936).*

9. *Sanford C. Gladden, "New Honorary Members: Biographical Sketches of our New Honorary Members,"* The Radiations of Sigma Pi Sigma *2, no. 1 (1932): 31.*

10. *Sigma Pi Sigma Information Booklet (1939).*

Going Full Circle

Introducing K. Renee Horton 2022 Physics Congress Plenary Speaker

by Korena Di Roma Howley, Contributing Editor

Renee Horton. Photos courtesy of Horton.

When Renee Horton found out she was hearing impaired, she was crushed. Not because of the physical impairment—so far, she had navigated life fine by reading lips—but because the disability meant she could never be an astronaut. On the verge of turning 18 and already in college, she dropped out and abandoned her dream of working for NASA.

Her dream had been ignited at nine years old by a telescope from her dad. "That telescope opened up the chasm to my intellect. It opened up my curiosity to the rest of existence—not just the Earth, but the universe…I wanted to know," Horton says.

With the birth of her daughter 10 years later, Horton reconsidered her options. "I realized then that I wanted the world to be different for her. I wanted her to be able to pick and choose where she walked, which meant that I needed to get my stuff together," she says. With three kids at home, Horton went back to college on a vocational rehabilitation scholarship. She earned a bachelor's degree in electronics and engineering in two years, because that was the term of the scholarship.

Dr. H, the main character from Horton's children's book series, Dr. H Explores.

Next came graduate studies in materials science, where Horton was supported by NASA fellowships. "That's where I realized that life could be what I wanted it to be," she explains. She could still work for NASA. She wouldn't be going to space, but maybe she would get lucky and help send someone else.

After earning her PhD, Horton did go to work for NASA. Her first project involved testing the *Orion* space capsule. She was on one of the welding projects that made the adapter connecting the capsule to its launch vehicle. When the capsule reached space for the first time, in December 2014, it had Horton's name on it, along with the names of her kids, parents, and sister. "I realized that my life had gone full circle, because I got launched into space. And that was my moment," she says.

Life took off after that. Horton is now a quality engineer for NASA's Space Launch System—the Artemis Mission—which, she says, "will put the first woman and the next man back on the moon." She's currently on a nine-month leadership detail to the Low-Boom Flight Demonstrator program, which aims to demonstrate the feasibility of flying at supersonic speed over land without generating an ear-splitting sonic boom.

In addition to her NASA responsibilities, Horton founded Unapologetically Being, a nonprofit organization that mentors cohorts of students and teaches them to go from surviving to thriving in STEM. She's also written a series of children's books about a character who represents herself—Dr. H is a bald, black woman with a PhD in physics and a hearing disability who flies around exploring space. When "the cutest little white boy" walked up to Horton at a book event and said, "I want to be you when I grow up," she chuckled. Then she realized the seriousness of the project. Dr. H spanned so many different intersections that she was bringing people together. The books get kids having fun and learning about the universe and, as Horton puts it, "They're okay with it being from a black woman who's bald and flying around in a VW Beetle."

In addition to working, mentoring, and writing, Horton gives invited talks around the United States and beyond on topics ranging from NASA's Space Launch System to diversity and inclusion in STEM, getting girls interested in science, dealing with imposter syndrome, and overcoming disabilities. "When I think of all of those things, I think of an umbrella with me at the top, at the point," Horton says. "All of those little spokes off the umbrella are different layers of me, [things] that I need to change in this world—or that I need to be changed in this world—for those that are going to follow behind me."

Julianne Pollard-Larkin. Photo courtesy of Pollard-Larkin.

A Medical Physicist's Journey

by Korena Di Roma Howley, Contributing Editor

When a cancer patient undergoes radiation therapy, among the team of specialists involved in planning and executing treatment is a clinically trained medical physicist.

If you were unaware that physicists have a key role in radiation oncology, you're not alone. Juliana Pollard-Larkin was a rising senior at the University of Miami studying physics and math when her mother was diagnosed with breast cancer. On day one of radiation therapy, the medical physicist on her mother's treatment team introduced himself to Pollard-Larkin. "Once I realized that we could use our physics skills to save lives, I was set for life," she says.

Already drawn to STEM while growing up, Pollard-Larkin recalls the moment it became clear that physics was the particular path she needed to pursue: seeing Mae Jemison on the cover of a magazine in 1993, the year after Jemison became the first black woman to travel to space. "I decided if I ever wanted to be as awesome as [Jemison], I had to go for the hardest specialty," she says. "And physics is the hardest field there is."

In high school, Pollard-Larkin got her first lesson in just how hard physics can be, not because the concepts can be difficult to grasp but because her ability to grasp them was deeply underestimated. "My physics teacher did not see a whole bunch of potential in a young group of Miami high school students," she says. "[It] was the first time in my life that I ever had any type of instructor, teacher, or professional in education look at me and be quite open about their bias."

Pollard-Larkin's response was to double down on the subject. "It just made me even more excited about it," she says. After graduating from the University of Miami, she went on to receive a PhD in biomedical physics from the University of California, Los Angeles. Today she's an associate professor of medical physics at the MD Anderson Cancer Center at the University of Texas, where she's engaged in both clinical work and academic research. She also volunteers much of her time, leading diversity and inclusion efforts for the American Association of Physicists in Medicine (AAPM) and being involved in outreach activities at conferences and other events.

Since Pollard-Larkin began her career, she's seen diversity in the field evolve. Over the past two decades, for instance, the percentage of women in medical physics graduate programs has grown. "I love being part of that whole generation," she says. "Seeing that happen just on the gender scale really changed things for me." Now Pollard-Larkin and others are continuing this effort by working to expand racial and ethnic diversity in the field as well.

Still, racial and gender biases continue to present hurdles for students from underrepresented groups. "The idea that you would just have to get over not feeling comfortable, not feeling welcome, not being asked to provide your input, not being taken seriously when you have a question or even a remark—that takes a lot out of you," Pollard-Larkin says. "The reason I decided to persist in spite of that was because [I knew] just how exciting my future could be if I were to continue on."

For Pollard-Larkin, finding a mentor was key to overcoming some of the more insidious issues that can close doors for underrepresented students. "Every person needs not just a mentor but also an ally—somebody who will actually put their own skin in the game for you," she says. "You need someone to see your potential outside of yourself and your own family, because that's the person who's going to remind you that this is possible."

A lot of the effort, Pollard-Larkin says, must come from students themselves. She emphasizes the importance of attending conferences, ensuring that a particular passion is well articulated, and finding community, even if it's necessary to look beyond one's immediate environment to locate it. "Use the internet to its full capacity," she says. "There are so many ways to get connected right now."

Most importantly, Pollard-Larkin encourages students to find people who help provide strength, rejuvenation, and encouragement, and to put a spotlight on their backgrounds, achievements, and unique qualities. "When it comes to your future," she says, "leave nothing on the table."

1. *https://aapm.onlinelibrary.wiley.com/doi/pdf/10.1002/mp.14035.*

Sigma Pi Sigma— A Departmental Legacy of Friendship, Part 4: A Society for All

by Brad R. Conrad, Director of SPS & ΣΠΣ

Well before the 1968 creation of the Society of Physics Students from the merging of Sigma Pi Sigma (ΣΠΣ) chapters and American Institute of Physics (AIP) local student sections, physics departments from across the country knew that ΣΠΣ could do more. While ΣΠΣ was bringing together students from different class years (within individual departments) and helping to increase interactions with some alumni, not everyone could meet the high academic bar set by the honor society. As a member of the Association of College Honor Societies (ACHS), ΣΠΣ adhered to rules that standardized membership requirements for academic honors societies. Before the formation of SPS, correspondence between advisers and Marsh White, the administrative executive of ΣΠΣ, discussed ways to broaden the base of people who could benefit from the organization. For example, the Syracuse University chapter created an associate membership class for students who completed their first course in physics.[1] This general observation—that all physics students within the department had need of something like ΣΠΣ—was also observed by the leadership of AIP.

Informal meetings during the early 1940s led Marsh White to formally approach Dr. Henry Barton, then AIP director, in 1948.[2] White originally proposed that ΣΠΣ join AIP as a full membership society. Realizing the importance of helping students become professional physicists and astronomers, Dr. Barton created a special committee (consisting of AIP board members) to explore the idea and report back to the Board of Directors with recommendations. Through several meetings in 1948, AIP's Policy Committee recommended that AIP should form a "special relationship" with ΣΠΣ, different from its relationships with the existing five Member Societies.[3] In response, a joint ΣΠΣ/AIP committee comprised of active members from both societies was formed to investigate "other ways in which ΣΠΣ could satisfactorily be incorporated into AIP."[3] Discussions proceeded for several years, with progress shared regularly with ΣΠΣ membership through public and confidential correspondence. Much of the conversation focused on how to best serve departments and students "to develop spirit and also the beginnings of a professional society" among students. A primary concern for ΣΠΣ was how to preserve the pursuit of excellence on which ΣΠΣ was founded.

It's important to note that ΣΠΣ's regular correspondence with departments about these developments generated a large number of suggestions and public discussion. Publicly shared feedback tended to focus on the need for departmental and Member Society interactions, technical sessions (professional development) for students, and a need to increase alumni interactions across the sciences. Above all, the need to support "all students with an interest in physics" drove the conversation. In addition, the small society's highly variable budget and financial instability hampered its ability to provide consistent student support in a shifting educational landscape. For example, early ΣΠΣ initiatives included graduate fellowships. A 1936 ΣΠΣ newsletter notes the fellowship value, $450 at the time, as less than ideal given that a $500 salary constituted comfortable living.[4] ΣΠΣ also offered emergency student loans to students experiencing financial need (repayable, as they could afford), when it was financially able.

Figure 1: (L-R) Marsh White, Vincent Parker, Walter French, Lewis Seagondollar, and Stanley Ballard at a 1965 Sigma Pi Sigma Executive Committee Meeting at Oak Ridge National Labs. Photo courtesy of Oak Ridge Institute of Nuclear Studies Inc., courtesy of AIP Emilio Segrè Visual Archives, Physics Today Collection.

The joint ΣΠΣ/AIP committee, comprised of active ΣΠΣ and AIP Member Society members, ultimately recommended that AIP and ΣΠΣ work together to establish one home for physics students. To begin this complicated and long process, the committee recommended the formation of local student sections of AIP with a governance structure based on that of ΣΠΣ. This meant that a new organization could begin to take shape even as AIP and ΣΠΣ worked out the details of the formal agreement. A core tenet of the recommendation was that two separate societies for physics students would be a disservice to both the departments and the Member Societies. The formation of AIP chapters was not without considerable discussion, as at least four different versions of the local sections were developed before a consensus was reached. Participation in ΣΠΣ was to be actively encouraged in AIP chapters, and ΣΠΣ agreed to help support individual Member Society initiatives such as AAPT meetings, AIP careers services, and Physics Today. In the same spirit, ΣΠΣ petitioned APS leadership to create a membership category for graduate students.[5]

The collaboration continued to develop, as is evident by Marsh White's 1947 Statistical Survey of PhD Physicists in Training.[6] Data from the creation of ΣΠΣ chapters and local sections was then used by AIP to produce reports on enrollment and employment. Similar reports are still produced today through AIP's Statistical Research Center. As a sign of good faith and a token of future collaboration, ΣπΣ also financially supported AIP, as much as a small student society could, through a $500 donation to the building fund of AIP.[7] As the magnitude of the en-

deavor to create what would become SPS was not wasted on the organizations, AIP, each of its five Member Societies, and ΣΠΣ ratified the creation of the AIP local student sections.

A model constitution for the local sections was developed by AIP in conjunction with ΣΠΣ through society leaders Homer Dodge, R. C. Gibbs, F. Wheeler Loomis, and Marsh White. That model is the basis of the constitution we use today.[8] The term "local sections of AIP" was used as a temporary name to avoid any confusion around the two separate student organizations and to provide a "flexible plan" so that an agreement between ΣΠΣ and AIP could be found without rushing forward. As a first step toward a formal agreement, ΣΠΣ was accepted as an AIP Affiliate in 1951.

Conversations about how to best combine ΣΠΣ and the AIP local student sections continued through the 1950s and were driven by how to most effectively educate the growing number of future physicists, how to incorporate graduating students into Member Societies, and how to effectively govern a large chapter-based society while maintaining membership oversight. A large part of the delay between inception of the merger and full implementation came from eight years of negotiations with ACHS about how ΣΠΣ could remain a recognized honor society while sharing a constitution with a society that welcomes all. White's desire to retire after 30 years accelerated the issue, resulting in the three-year process of voting to merge the societies. In August of 1966 the AIP Governing Board gave its unanimous approval to the merger plan. The same plan went for a final vote by 200 delegates representing 90 chapters at the 1967 Physics Congress and was approved by a one-vote margin![8] While the two societies were already intertwined, delegates were concerned about oversight and maintaining the spirit of ΣΠΣ. The final agreement required AIP to provide financial support for a full-time director, a fund to support Sigma Pi Sigma in perpetuity, and conditions under which Sigma Pi Sigma could withdraw from the new organization "if things did not work well."[9] Ultimately, society leaders within ΣΠΣ, the AIP student sections, and department chairs from around the country helped to form the key concepts that would guide the formation of SPS:

1. We must do what "best serves the need of the students."[2]
2. We must form the widest possible umbrella—everyone with an interest in physics is welcome.
3. Competing societies are hurtful to both departments and future physicists and astronomers.

A key result of the 1967 Congress was that the two organizations should remain linked in purpose but held as distinct entities in character. One of the most important aspects of any organization, especially a Member Society, is how it chooses to acknowledge itself publicly. The emerging society made two such public declarations to convey its identity: its name and its symbol. Names were discussed at great length, even when being compared to a standard department meeting. Ultimately, the Society of Physics Students was selected as the most inclusive name. This name reflects the society's support of all physics students, no matter what they might wish to do upon graduation. Undergraduates unsure of their future, career ambitions, and even their major may be wary of joining professional organizations tied to one track, but as the adopted name implies, they can find a home in SPS.

Figure 2: Earliest known use of the SPS logo, dated May 1970. Image courtesy of SPS National.

Figure 3: The student-designed seal of SPS and Sigma Pi Sigma. Image courtesy of SPS National.

In the same vein, one of the first actions of the newly formed 1968 Executive Committee and National Council of the Society of Physics Students and Sigma Pi Sigma was to have chapters decide on both an insignia and symbol for this new student-focused organization. Marsh White and AIP director Ed Koch requested no change to the ΣΠΣ logo but advocated for students to determine a new logo for the Society of Physics Students. One of the first actions of the newly formed National Council was to hold a student competition to determine the SPS logo and seal.

With over one-quarter of all chapters submitting a design, the logo and seal were selected by vote of the Executive Committee and National Council from over 66 finalists. The SPS logo was submitted by Craig B. Shumaker of the Purdue University chapter, and the basic design for the seal was submitted by Bruce Bushman of the Seattle University chapter[10] (see Figs. 2 and 3, respectively). Each student received a $100 prize (over $700 in today's US dollars). While the insignia is used in official communications from the national organization, chapters often use the SPS logo in unique ways to express themselves and what they are passionate about: at carved pumpkin art competitions, on physics-themed T-shirts, and prominently displayed on SPS lounge walls in hundreds of configurations. Just like the symbol, SPS is whatever it needs to be to best serve its student members. To this day, the SPS logo and insignia are a reminder of the organization's commitment to student leadership and self-determination.

1. *W. R. Fredrickson, Department head of University of Syracuse, Private correspondence, April 2, 1948.*

2. *M. White, Sigma Pi Sigma general letter to the Executive Committee, December 16, 1948.*

3. The Radiations, *1949, vol. XIV, no. 4.*

4. The Bulletin of Sigma Pi Sigma, *May 14, 1936, vol. 5.*

5. Radiations, *1949, vol. XIV, no. 2.*

6. *M. W. White, "Statistical Survey of Number of Physicists in Training," Rev. Sci. Instrum. 18, no. 4 (1947).*

7. *M. White, Sigma Pi Sigma general letter to chapters, January 30, 1945.*

8. *Executive Committee of the American Institute of Physics, April 1, 1950.*

9. *P. Dixon, "The History of Sigma Pi Sigma," https://www.sigmapisigma.org/sigmapisigma/about/history.*

10. Society of Physics Students Newsletter, *January 22, 1969.*

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Where Will Physics and Astronomy Be in 100 Years?

by Mikayla Cleaver, SPS Programs Coordinator

To celebrate 100 years of momentum with Sigma Pi Sigma, a special centennial session at the 2022 Physics Congress will feature four giants in the fields of physics and astronomy who are great friends of SPS, each responding to the same question: Where will physics and astronomy be in 100 years?

DAME JOCELYN BELL BURNELL is perhaps best known for her 1967 discovery of radio pulsars. In 2018 she was awarded the Special Breakthrough Prize in Fundamental Physics for her discovery. She donated the award money to fund women, underrepresented, and refugee students to become physics researchers through the Institute of Physics. Bell Burnell received her bachelor's degree in natural philosophy (physics) in 1965 from the University of Glasgow and earned a PhD from the University of Cambridge in 1969. She served as president of the Institute of Physics in 2008 and 2010 and is currently an astrophysics professor at the University of Oxford and a fellow at Mansfield College.

DR. ERIC CORNELL was awarded the Physics Nobel Prize in 2001, alongside Wolfgang Ketterle and Carl Wieman, for his role in synthesizing the first Bose-Einstein condensate (BEC). He graduated from Stanford University in 1985 and went on to earn a PhD at MIT. After completing his degree, Cornell joined Carl Wieman's lab at the University of Colorado Boulder as a postdoc on a small laser-cooling experiment. This started him on the path that led to his Nobel Prize work. Cornell is currently a professor at CU Boulder and a physicist at the National Institute of Standards and Technology Boulder campus.

DR. SYLVESTER JAMES "JIM" GATES is a theoretical physicist studying supersymmetry, supergravity, and superstring theory. Gates received two bachelor's degrees from MIT, one in math and one in physics, in 1973. He continued his education at MIT, receiving his PhD in 1977 for work on supersymmetry. He released the first comprehensive book on the topic in 1984. Gates is currently a physics and math professor at Brown University and director of the Brown Theoretical Physics Center. He is also serving as president of the American Physical Society.

DR. JOHN MATHER was awarded the Physics Nobel Prize in 2006, alongside George Smoot, for his work on the Cosmic Background Explorer satellite (COBE). Mather received a bachelor's degree in physics in 1968 from Swarthmore College, after which he attended the University of California, Berkeley, receiving his PhD in physics in 1974. He is currently a senior astrophysicist at NASA Goddard Space Flight Center, where he serves as head of the James Webb Space Telescope project. He is also an adjunct physics professor at the University of Maryland. Through the John and Jane Mather Foundation for Science and the Arts, Mather and his wife support SPS summer internships on Capitol Hill for physics undergraduates interested in science policy.

Sigma Pi Sigma—A Departmental Legacy of Friendship, Part 5: The Contribution of Federal Science Policy to SPS and Sigma Pi Sigma

by Jack Hehn, Senior Fellow, American Association of Physics Teachers and Director of Education (Retired), American Institute of Physics, and Brad R. Conrad, Director of SPS and Sigma Pi Sigma

The development of federal science policy in the United States after World War II spurred not only the physics and astronomy curriculum as we know it today, but also the decades-long growth of both university research and the undergraduate ecosystem of SPS and Sigma Pi Sigma chapters. From 1945 to 1965 there was significant interest in and support for science in the United States, particularly for academic science. At the same time, the United States undertook a great deal of infrastructure improvement projects and supported more and broader education.

Part of the reason was that, coming out of World War II, the United States had the resources and pent-up demand to release a consumer economy that had been destroyed in so much of Europe. The United States was suddenly recognized as a "great world power." These factors influenced government support for science and technology and their wide recognition in national media, which led to the popularization of science and technology in general.

America started to become a world resource in scientific fields, creating the necessity of a much larger scientific workforce. This prompted a significant increase in federal investment in science and engineering education. And, in turn, to a rapid rise in Sigma Pi Sigma membership.

Much of this systematic and consistent government support was influenced by the Vannevar Bush report, "Science, the Endless Frontier." Bush was director of the US Office of Scientific Research and Development. In November of 1944, President Roosevelt sent a letter to Bush requesting recommendations on how to proceed with the nation's science efforts now that the war was over. In closing he wrote, "New frontiers of the mind are before us, and if they are pioneered with the same vision, boldness, and drive with which we have waged this war we can create a fuller and more fruitful employment and a fuller and more fruitful life."[1]

Bush responded in July of 1945 to Truman, who became president when Roosevelt died in April. Bush's document became the guiding narrative for the US scientific enterprise for decades to come. The report included appendices from distinguished committees: the Medical Advisory Committee, the Committee on Science and the Public Welfare, and the Committee on Discovery and Development of Scientific Talent.[2]

The mobilization of American industry in response to the war and the resulting new development of scientific knowledge and processes led to new advances against disease, in strategic defense, and in recognition of the public welfare and an improving quality of life for every citizen. The Bush report opines that these advances could only have been built on the knowledge provided by basic scientific research.

Most of the physics done during the war was applied science, largely carried out by academic faculty and students working as industrial or military personnel under federal contracts. Before the 1940s, most academic work in science, engineering, and medicine had been supported by endowments, foundation support, and private donations. The Bush report recognized a fundamental change in perception—the quality of life of the average citizen could and should be enhanced by government support of basic research. In short, basic science ought to be financially supported for long-term gains.

The federal government was ready to accept the responsibility for developing scientific knowledge and a scientifically talented labor pool among young Americans. One of the first policy recognitions was a dramatic need for all people to be educated in science, including physics and "space-oriented" subfields. A second policy recognition was the need to support basic research principally con-

ducted on university and college campuses as an integral part of undergraduate and graduate programs. The Bush report advocated for the formation of a new federal agency, which became the National Science Foundation (NSF) in 1950. An important factor in these policies was that the decisions about federal support of basic science must be based on the advice of academic scientists more than that of federal bureaucrats.[2]

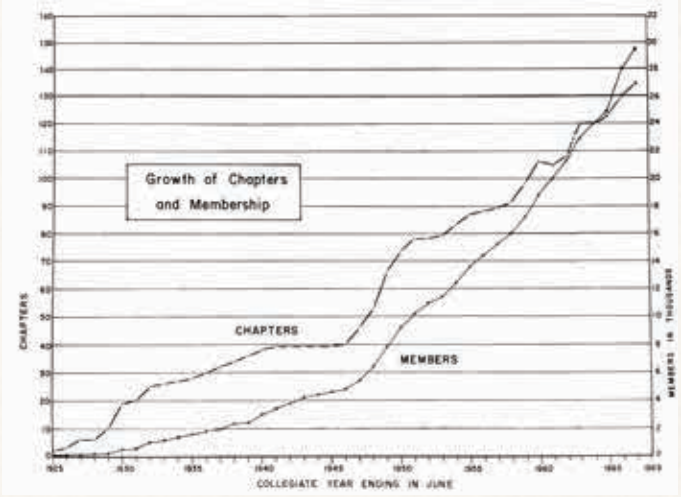
In the years following World War II, there was both a baby boom and a large number of men in uniform that were mustered out into the transitional economy. For many years the government had wisely supported academic institutions through the Morrill Act (1862) and the development of the Land Grant Colleges system. Building on this premise of federal support to universities, a federal program called the Servicemen's Readjustment Act of 1944, better known as the GI Bill, was created for World War II veterans. This bill funded the construction of additional VA hospitals, made mortgages more accessible, and established funds to cover tuition for veterans attending college. There developed in many universities larger and broader colleges of science and engineering to meet this student and labor demand. Physics departments were an important part of this growth. As far back as at least 1966, statistics on physics and astronomy departments were sent to chapters within Sigma Pi Sigma.

There followed a recognition at the NSF in 1956 that science education should be dramatically increased in the public schools so that an interest in science could be developed within families and the science talent pool could be developed at an earlier age. To review and implement improvements to introductory physics education, the Physical Science Study Committee (PSSC) was created at a 1956 conference at MIT. This led to the production of an entire series of instructional movies, textbooks, and laboratory materials widely used in high school classrooms around the world for the following decades.

NSF continued supporting a number of science curriculum development programs (abbreviated as BSSC, Chem Studies, ECCP, ISIS) that emphasized summer institutes on college campuses, providing more in-depth science education for teachers. The teachers took information from these summer institutes directly back into their classes. The NSF also supported summer activities on college campuses for high school students to develop their interests and career aspirations in science and technology.

In 1958, the National Aeronautics and Space Administration (NASA) was established when President Eisenhower signed the National Aeronautics and Space Act. This new civilian agency was tasked with institutionalizing America's efforts in space exploration.

NASA was created to respond to the launch of the Soviet Union's *Sputnik I* on October 4, 1957, the first artificial



The number of Sigma Pi Sigma chapters and members from 1925 to 1965. Image courtesy of the SPS National Office, reproduced from the 11th Sigma Pi Sigma Physics Information Handbook (1967).

The number of Sigma Pi Sigma chapters and members from 1925 to 1965. Image courtesy of the SPS National Office, reproduced from the 11th Sigma Pi Sigma Physics Information Handbook (1967).

satellite successfully placed into orbit. This launch caught everyday Americans by surprise and signaled the beginning of the US–Soviet "Space Race," as the White House saw a clear need to demonstrate technological superiority. While embarrassing for officials, this also began an era of rapid technological development and continued investment in science and engineering.

Public information and public understanding have been a fundamental undertaking for NASA, particularly through the Apollo project in the 1960s. NASA estimates that a total of 400,000 people across the United States were involved in the Apollo program. These developments and an influx of both funding and interest in physics can be seen in publications at the time. The November 1963 issue of *Radiations* states, "The National Aeronautics and Space

Agency plans to increase sixfold the number of graduate students subsidized to study 'space-oriented' subjects. The goal is to double the number of PhD graduates by 1970, as compared with present productions. These expanded enrollments will materially increase the number of potential members for the chapters of the Society."[3]

Sigma Pi Sigma started in 1921 and grew steadily before WWII. It would be remiss to not mention that well before World War II, historians and sociologists documented Americans as a "nation of joiners," particularly before 1940.[4] After WWII (1946–1967) there was huge growth in the number of Sigma Pi Sigma chapters, so much so that the number of zones the chapters are divided into jumped from 10 to 19.[3] Some of this growth may have been driven by federal science policy and national support for science. After the glow of the space race faded, NASA continued to make a significant impact on many college campuses, primarily through the National Space Grant College and Fellowship Project, also known as the Space Grant, created in 1989. Space Grant is a national network of colleges and universities. In addition to doing research, many Space Grant colleges administer pre-college and public service education projects in their states.

Many of us who grew up in the 1950s and 1960s remember an era and an environment when science offered many exciting new and rapidly expanding opportunities. We saw science nightly in the national TV news, in popular magazines and newspaper headlines, and even newspaper sections, heard our teachers' excitement about new opportunities to teach science, and experienced summer opportunities to attend NSF workshops for students and teachers. It is no surprise that so many people in that cohort have lived careers in science and education. It has been a great adventure for us, and federal support has been essential.

The authors wish to thank Rachel Ivie, AIP senior research fellow, for valuable contributions and discussions.

1. *"President Roosevelt's Letter," in* Science, the Endless Frontier: A Report to the President *(July 1945), www.nsf.gov/od/lpa/nsf50/vbush1945.htm#letter.*

2. *Vannevar Bush, Science,* The Endless Frontier *(Princeton, NJ: Princeton University Press, 2021).*

3. Radiations of Sigma Pi Sigma, *XXV, no.1, November 1963.*

4. *Gerald Gamm and Robert Putnam, "The Growth of Voluntary Associations in America 1840-1940," J.* Interdiscip. History, *XXIX, no. 4 (Spring 1999): 511–577.*

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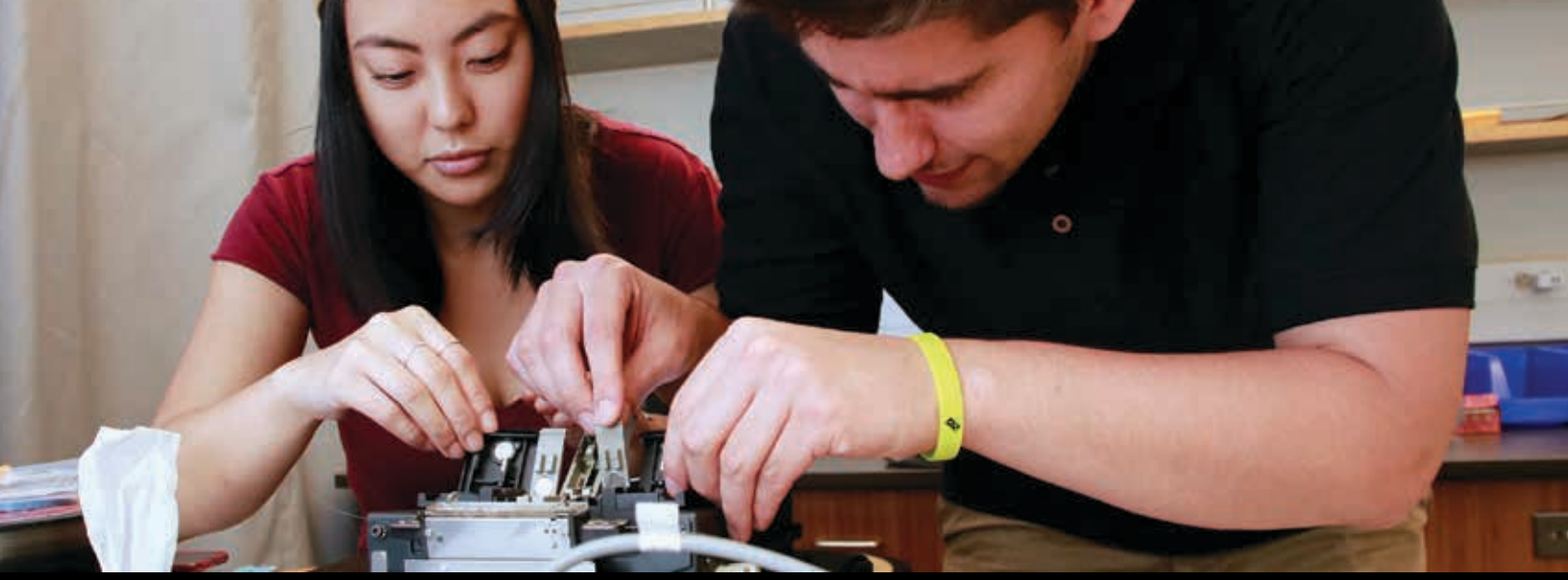

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