

# the SPS Observer

Volume LV, Issue 2

FALL 2021

+ Where Will Physics and Astronomy Be in 100 Years?

+ A Medical Physicist's Journey

+ Helping Science and the Public Meet Halfway

+ How to Prepare for a Poster Session

+ Fundraise Your Way to PhysCon

+ The Pull of the Planets



**Editor**

Kendra Redmond

**Managing Editor**

Kayla Stephens

**Contributing Editors**

Korena Di Roma Howley

Brad R. Conrad

Mikayla Cleaver

**Copy Editor**

Cynthia Freeman

**Art Director**

Aaron Hansen

**Layout Designer**

Michael Wernert

**SPS President**

Kiril A. Streletzky,

Cleveland State University

**SPS Director**

Brad R. Conrad



1 Physics Ellipse  
College Park, MD 20740  
301.209.3007 (tel)  
sps@aip.org  
www.spsnational.org



Find SPS National on:



# TABLE OF CONTENTS

FALL 2021 • VOLUME LV, ISSUE 2

## FEATURES

- Let's Celebrate! 100 Years of Momentum . . . . . 16
- Helping Science and the Public Meet Halfway . . . . . 17
- The Pull of the Planets . . . . . 18
- Going Full Circle . . . . . 19
- A Medical Physicist's Journey . . . . . 20
- Where Will Physics and Astronomy Be in 100 Years? . . . . . 21
- 2022 Physics Congress Workshops, Tours, and More . . . . . 22

## SPECIAL FEATURES

- Kicking Ass at Physics . . . . . 24

## DEPARTMENTS

- **IN MEMORIAM**
- Tracy M. Schwab (1967–2021) . . . . . 3
- **LETTER**
- Get Ready—The Physics Congress is Coming! . . . . . 4
- **PATHWAYS**
- Fundraise Your Way to PhysCon . . . . . 5
- **STARS**
- 2021 Individual Award and Scholarship Recipients . . . . . 6
- **PHYSICS PUZZLER**
- Now Let Us Consider... a Herd of Spherical Cows? . . . . . 8
- **INTERACTIONS**
- Coaching West Virginia's Top Science Olympiad Team for Nationals . . . . . 10
- **CROSSWORD PUZZLE**
- Washington, DC, Edition . . . . . 12
- **SINGULARITIES**
- A Bountiful Life: Jim Gates on the Role of Imagination in Physics . . . . . 13
- Time . . . . . 14
- **MEETING NOTES**
- Showcase Your Chapter at the 2022 Physics Congress . . . . . 25
- **PROFESSIONAL DEVELOPMENT**
- How to Prepare for a Poster Session . . . . . 26



**ON THE COVER**

Designed by Brad R. Conrad, the cover image is a photo mosaic of the Crab Nebula composed of 1600 photos from the 2019 Physics Congress and SPS chapter reports going back two years. It was inspired by a similar piece gifted by SPS to Fermi National Accelerator Laboratory in 2008 for hosting a Physics Congress. The gift to Fermi Lab is shown above with its designer, longtime SPS staff member Tracy Schwab. For more on Schwab, see page 3.



The **SPS Observer** (ISSN 2160-1305) is the magazine of the Society of Physics Students, published quarterly by the American Institute of Physics, printed in the USA. Standard postage paid at Freeport, OH. **POSTMASTER:** Send address changes to The SPS Observer, One Physics Ellipse, College Park, MD 20740-3841.

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

**AIP Member Societies:**

- American Association of Physicists in Medicine
- American Association of Physics Teachers
- American Astronomical Society
- American Crystallographic Association
- American Meteorological Society
- American Physical Society
- Acoustical Society of America
- AVS: Science & Technology of Materials, Interfaces, and Processing
- Optica (formerly OSA)
- The Society of Rheology

**Other Member Organizations:**

- Sigma Pi Sigma physics honor society
- Society of Physics Students
- Corporate Associates



**ABOVE:** Tracy Schwab in his office at SPS National. Photo by Liz Dart Caron, AIP.

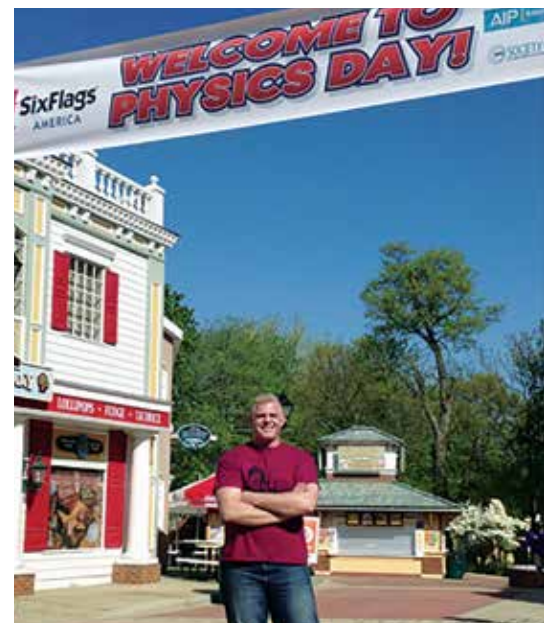
# In Memoriam:

## Tracy M. Schwab (1967–2021)

The SPS National Office is heartbroken to report that Tracy Schwab passed away unexpectedly this spring. You may not have known Tracy by name, but his artistry and expertise are woven into the SPS and  $\Sigma\Pi\Sigma$  website design, issues of *Radiations* and *SPS Observer* going back more than 10 years, and countless SPS brochures, posters, T-shirts, and other special projects. With his endless curiosity, passionate support of students, and quest to make the world more beautiful and inclusive, Tracy truly embodied the ideals of SPS.

Tracy worked at the American Institute of Physics and SPS National Office for 17 years. Hired in 2001 as communications coordinator and webmaster, Tracy brought SPS and  $\Sigma\Pi\Sigma$  into the digital age. He later took on the role of designing the societies' printed publications, transforming them into the visually appealing resources they are today. Tracy was AIP's inaugural director of creative services. During his time with SPS, he helped to guide the organization, inspire students, and support the mission of SPS and  $\Sigma\Pi\Sigma$ .

With an infectious smile and encouraging nature, Tracy was a friend, mentor, and source of support for numerous SPS leaders, staff members, and interns who passed through the National Office. Although he never formally studied physics, Tracy recognized its value and captured it in his designs and artwork. He loved volunteering at physics outreach events, pondering the mysteries of the universe, and creating at the intersection of art and science. The SPS community is grateful for Tracy's lasting contributions to SPS and  $\Sigma\Pi\Sigma$  and honored to have called him friend and colleague for so many years. //



# Get Ready—The Physics Congress is Coming!

by Blane Baker and Samantha Pedek, 2022 Physics Congress Co-Chairs

## DEAR SPS STUDENTS AND MENTORS:

So what is the Physics Congress and why is it important? The Physics Congress (PhysCon) is the largest gathering of undergraduate physics students in the nation. Students from across the US and beyond meet at PhysCon, which takes place every few years, to enjoy outstanding tours, hear from physics luminaries, participate in hands-on workshops, learn about graduate school opportunities, meet potential employers, and make lasting connections with other physics-minded people.

In 2021–22, Sigma Pi Sigma—the physics honor society that resides within SPS—is commemorating its 100th anniversary. This will culminate in a special centennial celebration: The 2022 Physics Congress – 100 Years of Momentum. This event will take place October

6–8, 2022, in Washington, DC, and we want you there! PhysCon is open to all undergraduate students interested in physics and their mentors.

In addition to outstanding tours and workshops, you'll enjoy talks by world-renowned scientists like Dame Jocelyn Bell Burnell and former congressman Rush Holt. You'll have opportunities to present your research, outreach, and science-themed artwork at poster sessions and art exhibits. You'll also enjoy special events from our local hosts, the George Washington University and University of Maryland - College Park. And, perhaps most importantly, you'll experience the energy and potential that comes with an auditorium packed full of physics students. You'll make potentially

lifelong friends and connect with people who might someday become your grad school peers, employers, future collaborators, and mentors.

In anticipation of your attendance, we encourage your SPS chapters and departments to begin fundraising efforts now. Many college and university deans and department chairs will support student travel if it's requested early enough. In addition, many SPS groups raise funds by selling coffee and donuts, doing yard work and other chores for local residents, and accepting donations for tutoring. More fundraising ideas are available on the PhysCon 2022 website. //



*Register Today!*

OCTOBER 6-8, 2022 | WASHINGTON, D.C.

[sigmapisigma.org/congress/2022](https://sigmapisigma.org/congress/2022)



### ABOUT BLANE BAKER

As an undergraduate student in the 1980s I made one of the most impactful decisions of my life. At the encouragement of my academic advisor, I joined the Society of Physics Students (SPS) chapter at my undergraduate institution, William Jewell College. For nearly 40 years now, I have been an active member of SPS National and my local SPS and Sigma Pi Sigma chapters—as an undergraduate, graduate student, and faculty member.



### ABOUT SAMANTHA PEDEK

I joined my local SPS chapter when I was a student at University of Wisconsin - River Falls. I attended my first PhysCon in 2016 and was introduced to all the opportunities that SPS and Sigma Pi Sigma have to offer undergraduate students. I then served as an SPS intern and as the SPS Zone 9 associate zone councilor for the 2017–18 academic year. Even after receiving my bachelors in physics, I have stayed involved with SPS and Sigma Pi Sigma.



# Fundraise Your Way to PhysCon

by Brittney Hauke, 2022 Physics Congress Planning Committee Member; PhD Candidate, The Pennsylvania State University

The 2022 Physics Congress will be epic, as it will be celebrating the centennial of Sigma Pi Sigma, the physics honor society. With a roster of inspiring plenary and centennial speakers, an amazing location in the nation's capital, poster and art sessions, a dance party, and a centennial festival, this is a must-attend event for all undergraduates interested in physics.

SPS recognizes that for many chapters, bringing members to Washington, DC, for the weekend is an expensive endeavor. For those planning to attend, now is the time to raise money for the trip. Below are suggestions on how to get started.

## 1 ASK!

Ask your student government, dean, and department if they can help fund your trip. After all, it's good for your school and department to be represented at this national gathering, and it's a great way to showcase your chapter's research and outreach efforts. Ask research supervisors if their grants can support travel funds for students to present posters at professional meetings like PhysCon. Many grants include money for this purpose, and some organizations give awards for traveling to present research.

## 2 EVERYONE'S FAVORITE: SELL STUFF.

My SPS chapter is very good at creating a fun T-shirt for PhysCon, which all the members buy to wear to the event. We market to alumni, who sometimes pay more than what the shirt costs as a way of providing support for student travel. Other ideas: Make stickers, buttons, hats, or polo shirts; sell coffee or soda; or have a bake sale!

## 3 ASK YOUR GREEK LIFE CHAPTERS HOW THEY FUNDRAISE FOR PHILANTHROPIES.

Consider working with an already established organization, Greek or otherwise, and cohost a fundraising event.

## 4 APPROACH ALUMNI FOR TRAVEL SUPPORT.

First, clear the idea with your advancement office. They can help you find contact information for alumni if needed.

## 5 SEEK SPONSORSHIPS WITH LOCAL BUSINESSES THAT STUDENTS FREQUENT.

Examples include restaurants, coffee shops, and technical companies, but make sure this is allowed by your college! Again, Greek life or other campus groups may have experience with this and can give you pointers. Check out the PhysCon fundraising page for a sample letter to use.

## 6 LOOK FOR WAYS TO SAVE ON TRAVEL.

For PhysCon 2012, my chapter approached United Airlines for a group rate that saved a few thousand dollars and made it easy to secure passage for the whole group on the same plane.

## 7 IF DRIVING, ASK IF YOUR UNIVERSITY OR COLLEGE HAS DISCOUNTED VAN RENTALS.

An athletic team office may be a great resource, as they usually rent or own vans.

## 8 APPLY FOR FUNDING FROM SPS NATIONAL!

SPS National has a variety of opportunities to get funding for travel. There are chapter and individual travel awards for presenting research and art, and for meeting reporters. //



**ABOVE:** Brad Conrad, director of SPS and Sigma Pi Sigma, demonstrates the concept of a "Pi a Professor" fundraiser—no costume necessary. Photo by SPS National.

**BELOW:** This T-shirt, designed by Texas Lutheran University SPS members as a fundraiser, pays homage to the scientists who won the 2020 Physics Nobel Prize for work on black holes. Image courtesy of the chapter.



For even more fundraising ideas, sponsor letter templates, and a spreadsheet to help calculate travel costs, visit [sigmapisigma.org/sigmapisigma/congress/2022/fundraising](https://sigmapisigma.org/sigmapisigma/congress/2022/fundraising).

# 2021 Individual Award and Scholarship Recipients

The Society of Physics Students congratulates this year's recipients and thanks the generous ΣΠΣ and SPS donors whose support makes these awards possible.

## 2021 SPS SUMMER INTERNS

The SPS summer internship program offers 10-week positions for undergraduate physics students in science research, education, and policy with organizations in the greater Washington, DC, area. Students are placed in organizations that use the interns' energy and viewpoints to engage with the community and promote the advancement of physics and astronomy. Due to COVID-19, the 2021 internship program was virtual. Learn more about the SPS internship program at [spsnational.org/programs/internships](https://spsnational.org/programs/internships).



**Julia Bauer**  
Davidson College  
*AIP FYI Science Policy Communications Intern*



**Madison Brewer**  
University of Pittsburgh  
*Physics Today Science Writing Intern*



**Guido Dominguez**  
Pomona College  
*US House of Representatives - AIP Mather Public Policy Intern*



**Roberto Gauna**  
Massachusetts Institute of Technology  
*NIST Research Intern*



**Noah Johnson**  
New York University  
*SPS Science Outreach Catalyst Kit Intern*



**Kirk Kleinsasser**  
Lycoming College  
*APS Career Programs Intern*



**Gina Pantano**  
University of Tampa  
*NASA Goddard Space Center Intern*



**Karthik Rao**  
Texas A&M University  
*NIST Research Intern*



**Casey Roepke**  
Mt. Holyoke College  
*NIST-AIP Mather Public Policy Intern*



**Maura Shapiro**  
University of Pittsburgh  
*AIP Center for History of Physics/Niels Bohr Library & Archives Intern*



**Zeynep Tuna**  
Bowdoin College  
*APS Education & Diversity Intern*



**Joseph Watson**  
McMurry University  
*NASA Goddard Space Center Intern*



**Hannah Wistrand**  
Colorado School of Mines  
*APS Public Engagement Intern*



**Alan Wright**  
Purdue University  
*AAPT Teacher Professional Development Intern*



**Jesse Zeldes**  
Haverford College  
*Society of Rheology/Soft Matter Kitchen Intern*

Photos courtesy of the 2021 SPS interns.

## SCHOLARSHIPS

Multiple awards are given by SPS and  $\Sigma\Pi\Sigma$  each year, ranging in value from \$2,000 to \$5,000, to individuals showing excellence in academics, SPS participation, and additional criteria. Learn more and see photos and bios of the recipients at [spsnational.org/awards/scholarships](https://spsnational.org/awards/scholarships).

### SPS Outstanding Leadership Scholarship

**Giuliana Hofheins**

Rhodes College

### SPS Leadership Scholarships

**Sophie Koh**

Amherst College

**Giovani Leone**

University of North Carolina at Chapel Hill

**Alden MacKenzie**

Grove City College

**Zachary Miller**

Missouri University of Science and Technology

**Joseph Milligan**

Wheaton College

**Andrew Scherer**

Cleveland State University

**Ian Slagle**

Coe College

**Carol Stover**

University of Central Arkansas

**Joseph Tanguay**

Juniata College

**Rahaf Youssef**

St. Olaf College

### LLNL-AIP Leadership Scholarships

**Natalie Douglass**

University of Dayton

**Elyzabeth Graham**

Juniata College

**Emma Moreland**

Juniata College

### SPS Future Teacher Scholarship

**Ian Carter**

University of Wisconsin - River Falls

### Peggy Dixon Two-Year Scholarship

**Sophie Roberts**

University of Northern Iowa

### Herbert Levy Memorial Scholarship

**Collins Kariuki**

Pomona College

### AWIS Kirsten R. Lorentzen Award

**Makyla Boyd**

Coe College

### Aysen Tunca Memorial Scholarship

**Riley Havel**

University of Central Florida

### Science Systems and Applications, Inc. (SSAI) Academic Scholarship

**Kirk Kleinsasser**

Lycoming College

### Science Systems and Applications, Inc. (SSAI) Underrepresented Student Scholarship

**Priktish Rao Suntoo**

Lycoming College

### 2021 SPS and AAPT Mary Beth Monroe Memorial Scholarship

**Emily Thorne**

Northern Virginia Community College

## SPS AWARD FOR OUTSTANDING UNDERGRADUATE RESEARCH

Awards are made to individuals for outstanding research conducted as an undergraduate. Winners are awarded \$1,800 to present their research at an AIP Member Society meeting and receive \$500 for themselves and \$500 for their SPS chapter. The runner-up receives \$400 to present their research at an AIP Member Society meeting. Learn more at [spsnational.org/awards/outstanding-undergraduate-research](https://spsnational.org/awards/outstanding-undergraduate-research).

### Winners

**Ian Slagle**

Coe College

**Abdullah Al Maruf**

South Dakota State University

## AIP-SPS FUNDING OPPORTUNITIES FOR STUDENTS IN NEED

The Society of Physics Students (SPS) has launched two new funding opportunities that will support academic department food cabinets and provide educational assistance scholarships for undergraduate students that are in need due to persisting impacts of the COVID-19 pandemic.

### Food for Hungry Students

To alleviate food insecurity concerns for students, the Society of Physics Students, through the support of the American Institute of Physics, will provide \$300 in financial support for chapters to start **food cabinets for hungry physics students** in their departments. Chapters are to use the funds for items that are freely accessible to all department undergraduates and are encouraged to fundraise to restock and maintain food cabinets beyond the seed funding. Grants are available on a first come, first serve basis. **For more information and to apply, visit [spsnational.org/scholarships/FHPS](https://spsnational.org/scholarships/FHPS).**



### AIP-SPS Undergraduate Student Emergency Assistance

To provide immediate support to students who are negatively impacted by COVID-19, through the support of the American Institute of Physics, SPS will grant up to **\$1000 scholarships** to students who need assistance with costs directly related to their education, such as tuition, fees, housing, and books, due to the financial effects of COVID-19. Grants are available on a first come, first serve basis. For program requirements and to apply, visit [spsnational.org/scholarships/AIPSPSUSEA](https://spsnational.org/scholarships/AIPSPSUSEA).



# Now Let Us Consider . . . a Herd of Spherical Cows?

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

During a planning session for our upcoming Centennial Physics Congress in Washington, DC (October 6–8, 2022), an immensely important puzzle came up:

## THEORETICALLY, HOW MANY SPHERICAL COWS COULD FIT INTO WASHINGTON, DC?

**A ridiculous question?** Definitely. Although you never know when you might need ridiculous information at your fingertips, and this definitely isn't something you can look up.

**An answerable question?** Totally.

First things first—What would we need to know to make a good estimate?

How big is a spherical cow?

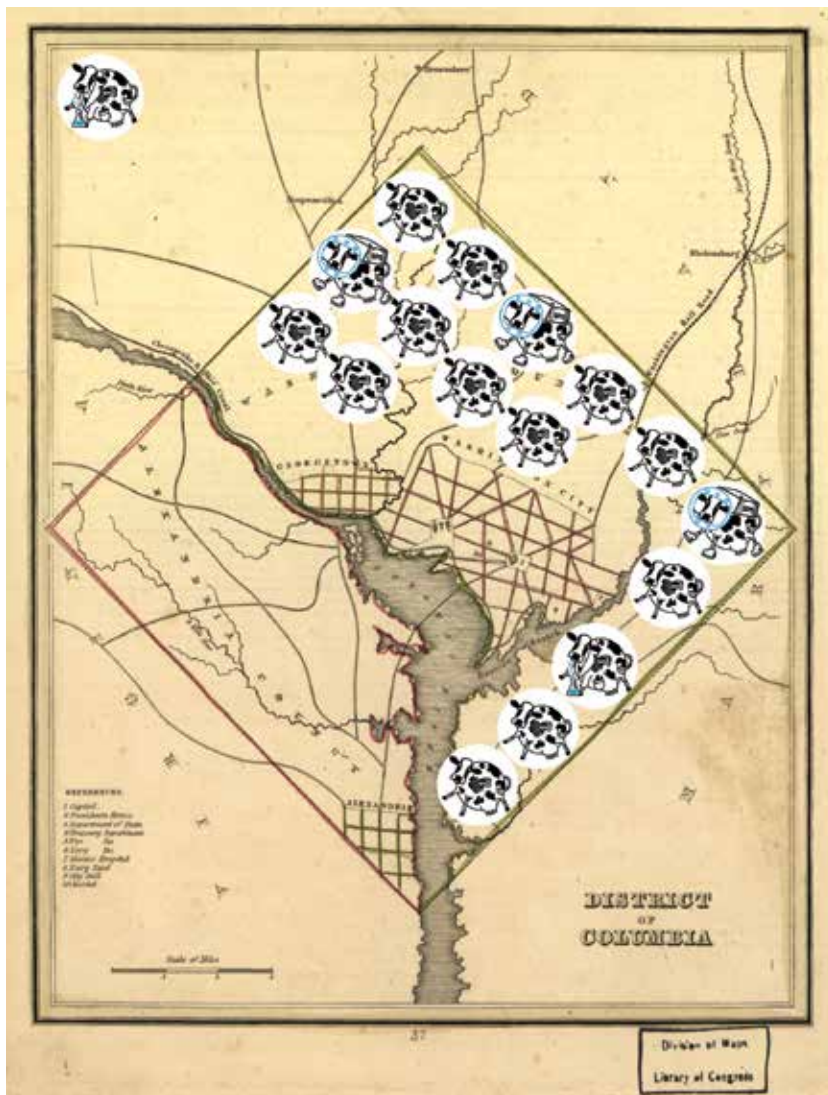
How do we pack them in DC?

## PUZZLE 1: HOW BIG IS A SPHERICAL COW?

You probably won't find this in many physics textbooks (but possibly in a theoretical animal science or quantum farming course...). I'll assume we're talking about dairy cows. I have seen them in person, and these cows are way bigger than me but also smaller than a standard US car. I'll estimate they weigh 450 kg (which is about 1000 lb in the imperial system). THAT. IS. HUGE. We're talking several football/soccer players big.

I'll assume cows are mostly water (since humans are), and one of the few facts I've memorized is the density of water at STP: 1000 kg/m<sup>3</sup>. This is helpful because volume is mass divided by density, as you might remember from middle school. We also know that the volume of a sphere is  $\frac{4\pi r^3}{3}$ , where  $r$  is the radius of a sphere. Combining those equations for volume yields the following:

$$\text{Volume} = 450 \text{ kg} \cdot \frac{\text{m}^3}{1000 \text{ kg}} = \frac{4\pi r^3}{3}$$



**Figure 1.** A modified map of the District of Columbia in 1835, which was prior to the ceding of Alexandria County back to Virginia. Map courtesy of the Library of Congress, Geography and Maps Division, public domain.

Solving for the radius  $r$ , we arrive at about 0.475 m as the radius of our *spherical cow*.

Now we just need to know how many spheres of radius 0.475 m fit into Washington, DC. From Fig. 1 we can see that Washington, DC, is roughly a diamond shape. I'm guessing it's about 10 miles per side, or 100 square miles, minus the land given back to Virginia (on the west side of the Potomac River).<sup>1</sup> If we take out the water and now-Virginia part of the diamond, we can estimate the land to be about 67 square miles, or 173 km<sup>2</sup>.





Figure 2. Identical circular cows forming a hexagonal packing arrangement, which is the densest packing possible for spheres. The hexagon can be repeated to fill an area. Image modified from Wiki: Inductiveload.

### PUZZLE 2: HOW DO WE PACK THEM IN DC?

If we really packed our spherical cows in there, they'd be touching each other. Just how tight could we pack them? Gauss and Lagrange determined the maximum packing of spheres in a 3D volume and on a flat 2D surface<sup>2</sup>—in fact, it's a common calculation in condensed matter physics because it directly relates to crystal structures! If we put in as many cows as possible without stacking them, they'll naturally form a hexagonal pattern, as shown in Fig. 2.

From this image we can see that for circles of radius  $r$  and a hexagon of side length  $2r$ , the spheres fill this fraction of the space:

$$\frac{\text{Area of circles}}{\text{Area of hexagon}} = \frac{3 \cdot \pi r^2}{6\sqrt{3}r^2} = \frac{\pi\sqrt{3}}{6} \cong 0.907.$$

This is independent of sphere radius (which is super cool) and means that when we pack the cows in, we are left with about 9% empty space.

If we ignored buildings, elevation changes, small rivers, and everything else already in Washington, DC, we'd be able to fit about 349 million spherical cows! That's a lot of  $\mu$ -ing (bad joke).

Next, I challenge you to think outside the two-dimensional world: What if we could stack the cows? **How many spherical cows could we stack inside Washington, DC?**

**Hints:** The final shape would probably be something like a pyramid. Check out the awesome Fall 2017 Puzzler written by Gary White for some useful insights.<sup>3</sup> //

References:

1. It turns out this was a very good guess, as it originally was 10 miles per side. The actual area is about 68.3 mi<sup>2</sup>.
2. Zamponi, F., "Packings Close and Loose," *Nature* 453 (2008): 606–607, <https://doi.org/10.1038/453606a>.
3. G. White, "Consider a Circular Cow," *The SPS Observer*, Fall 2017, <http://www.spsnational.org/the-sps-observer/fall/2017>.

Willing to share your answer? Please email [SPS-Programs@aip.org](mailto:SPS-Programs@aip.org) with a one-page PDF showing how you solved the above question. Submissions have a chance to be highlighted on SPS National social media pages, and participants may receive some SPS swag!



# Coaching West Virginia's Top Science Olympiad Team for Nationals

Photo by Sachiko McBride.

by Jacquelyn Sizemore, SPS Chapter President 2020–21, Marshall University

**After winning West Virginia's Science Olympiad tournament early in 2021, the Cabell Midland High School team was looking ahead to the national tournament. To help them prepare, Marshall University's SPS chapter partnered with the Science Olympiad student organization on campus in a new effort—to offer coaching for the competition.**

The national tournament consists of 23 events that span the sciences. I coached team members participating in two events: Sounds of Music and Codebusters. In Sounds of Music, team members typically construct a unique musical instrument in advance, apply the fundamentals of acoustics and music theory, and present their work in front of a judge. Students also take a written test on acoustics and music theory, which is what we focused on during our sessions.

Codebusters challenges teams with an exam that includes a variety of ciphers, from simple substitution to Morse code. To break many of the codes, students must use algebraic techniques such as matrices. It's an interesting event to study for, as it combines math and language. At least one cipher is in Spanish.

I didn't know what coaching a high school Science Olympiad team would be like. During my first meeting with the students, we discussed their backgrounds and the topics they needed to concentrate on. It didn't take me long to be impressed with their talent—they were quick learners and made some very clever connections.

After that first meeting, I met with the students once a week via Zoom. Each meeting focused on a particular topic and included opportunities for students to practice what they were learning. Fortunately, many previous tests are posted online, so we could practice questions similar to those they would see at nationals.

We held coaching sessions in the spring, as the state competition was in February and nationals were in May. This was at the height of Advanced Placement (AP) exams and, for the seniors on the team, college decision making. All of the students had extracurricular activities and were still navigating COVID-19. Still, they met with me each week and practiced for nationals on their own. I was really impressed by their work ethic. One student even attended a coaching session while on vacation. He said he preferred learning something new over relaxing.

There are so many talented and hard-working students who want to learn and hone their science skills. Coaching was a great way for our chapter to invest in them and in our community. As we look to the future, we hope this becomes an ongoing effort and helps establish a legacy of Science Olympiad participation and success among West Virginia high school students. //

*This opportunity for Science Olympiad coaching was made possible by the NASA West Virginia Space Grant Consortium, Grant No. 80NSSC20M0055.*





Photo by Carver Eller.

■ **ALL PHOTOS:** High school students take part in the West Virginia Science Olympiad in 2019 and 2020. The 2021 competition was virtual.



Photo by Carver Eller.

## ABOUT THE SCIENCE OLYMPIAD

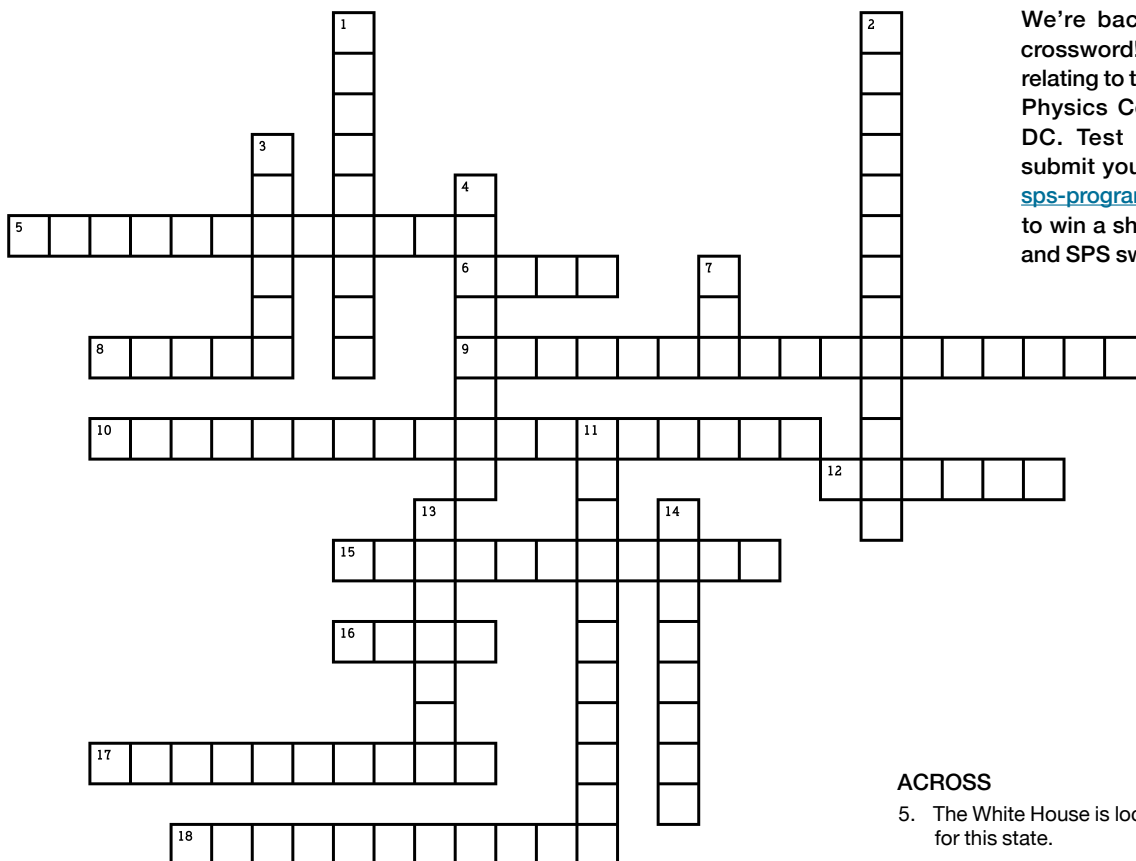
The Science Olympiad is one of the top science competitions for middle and high school students in the United States. Each year, teams compete to represent their school and their state in a national tournament. Last year, about 5,000 teams participated in the Science Olympiad's 375 live and remote tournaments covering all 50 states. To qualify for nationals, teams must first win their state tournament.

For many years West Virginia didn't have a state tournament; to go to nationals, teams had to compete in a neighboring state's tournament. That changed in 2015, when Dr. John Winfrey, then a physics professor at Marshall University, revived the West Virginia tournament. Marshall's College of Science has hosted and managed the tournament ever since. With the exception of last year (due to COVID-19), high school participation has grown steadily over the past few years under the leadership of physics professor Dr. Sachiko McBride. McBride also advises the Science Olympiad student organization on campus that plays an active role in hosting the event and, now, coaching for nationals. The coaching effort was devised in an effort to boost West Virginia's state ranking in the tournament.

For details on the Science Olympiad and to find out about your state tournament, visit [www.soinc.org](http://www.soinc.org).

# 2022 Physics Congress Crossword Puzzle Washington, DC, Edition

by Mikayla Cleaver, SPS Programs Coordinator



We're back again with another crossword! This puzzle has clues relating to the host city for the 2022 Physics Congress—Washington, DC. Test your knowledge and submit your completed puzzle to [sps-programs@aip.org](mailto:sps-programs@aip.org) for a chance to win a shoutout on social media and SPS swag!

## DOWN

- John Quincy Adams and Herbert Hoover both had these reptiles, native to Florida and the American South, as pets in the White House.
- This tree, namesake of a popular festival in Washington, DC, was gifted as a sign of friendship from Japan to the United States in 1912.
- There is a second, lesser known branch of the Smithsonian Air and Space Museum near this airport just outside of Washington, DC.
- Washington, DC's, original territory was taken from Virginia and this other state.
- This letter is rumored to be missing from the Washington, DC, street system because of a disagreement with the first chief justice of the United States.
- The area that is Washington, DC, today was originally inhabited by an Algonquian-speaking people known as the \_\_\_\_\_.
- This TV personality, known for making science parodies of popular songs from the '80s on his hit kid's show, is from Washington, DC.
- A statue of this physics Nobel Prize winner can be found (and climbed on) near the National Academy of Sciences.

## ACROSS

- The White House is located on an avenue named for this state.
- On average, Washington, DC, gets more of this type of precipitation every year than Seattle.
- The first president to live in the White House wasn't Washington; it was \_\_\_\_\_.
- This DC landmark has over 40 million cataloged books.
- This structure is currently the tallest structure in Washington, DC.
- This HBCU, located in northeast Washington, DC, has notable alumni such as Vice President Kamala Harris and Taraji P. Henson.
- There are nearly 30 million visitors annually to this group of 19 museums in Washington, DC.
- The ceiling of Union Station is covered in this element.
- This Star Wars character makes an appearance alongside the gargoyles carved into the northwest tower of the Washington National Cathedral.
- The American Institute of Physics (AIP) is located in this nearby town, home to the University of Maryland.



# A Bountiful Life:

## Jim Gates on the Role of Imagination in Physics

by Korena Di Roma Howley, Contributing Editor

**The first hint that Jim Gates isn't your average scientist—or even your average theoretical physicist, if such a person exists—is his characterization of physics not strictly as a field capable of answering the riddle of our universe but as one that also adds to our ability to live a bountiful life, in part by challenging us to exercise our minds as we do our bodies.**

As Gates speaks about his work, the power of the intuitive mind—its capacity for creativity and imagination—comes up frequently. He is quick to quote Albert Einstein, who famously said that imagination is more important than knowledge. And he expresses wonder at the role the subconscious mind plays in the eureka moments that have become ingrained in our collective vision of scientific breakthrough.

“When you're a person like me who works in mathematics—the way that I know that it's my imagination at work is because we have these so-called flashes of insight or intuition,” he says. “That is clearly coming to me from my subconscious.”

Born in Tampa, Florida, on December 15, 1950, Sylvester James Gates Jr. was only four when he saw a science fiction movie and sensed that science could provide a doorway to adventure. That perception proved true. Today, Gates is known for many things—his groundbreaking work in particle and mathematical physics, his appearances on the PBS series *Nova*, and his many accolades, including a National Medal of Science awarded by President Barack Obama in 2013.

But throughout his distinguished career, Gates has also remained a committed teacher, first at MIT, then at the University of Maryland, Howard University, and Brown University, among other institutions. He is also the current president of the American Physical Society. Along the way he has

become a friend to SPS, participating in numerous events with SPS summer interns, graciously making time for student interviews, and speaking at the 2016 and 2019 Physics Congresses. After decades of working with students in both formal and informal roles, he continues to marvel at their capacity to offer fresh insights when looking at problems. For Gates, this ability among individuals demonstrates why the field of physics needs diversity—of background, of experience, of perspective. And, of course, it needs imagination. “Wider, more innovative, and robust forms come about when you allow the largest number of people to exercise their imagination,” he says.

His own career provides an example. Gates has spent more than 40 years working on supersymmetry—the theory that for every particle in the standard model, a partner particle exists. He first stumbled on the idea as a graduate student in the early 1970s, when the theory was only a few years old. He went on to author the first doctoral dissertation on the subject to be submitted at MIT. He now recalls how a willingness to explore a little-known topic more deeply enabled a single graduate student to stand out among the brilliant minds of the day. Many may credit personality, he says, “but my personality is formed out of culture, out of experience.”

Importantly in a field such as theoretical physics, Gates excels at presentations aimed at public understanding, at spinning narratives that elicit enthusiasm for and curiosity about concepts that often defy comprehension among nonphysicists. He frequently taps into the humanistic side of the discipline and illustrates his work in such a way that his audiences—whether students, conference goers, or television viewers—are left struck by the possibilities inherent in the field.



ABOVE: Sylvester James "Jim" Gates Jr. Photo courtesy of Gates.

Gates believes that mathematicians and theoretical physicists should become proficient at using the language of mathematics to tell stories, transforming signs and symbols into narratives as novelists do words and sentences. “We don't want to dazzle people with our ability to juggle arcane, strange symbols,” he says. “What we want to dazzle them with and invite them to be a part of—or at least understand the excitement of—is the stories behind the symbols.”

In recognition of his distinctive contributions to the field, the American Institute of Physics recently announced Gates as the recipient of its 2021 Andrew Gemant Award, bestowed for accomplishments related to the cultural, artistic, or humanistic dimension of physics. The award committee praised Gates for “instilling a deep and humanistic love of physics in generations of students, being a steadfast ambassador of science policy and the history of physics, and his persistent dedication to communicating the wonders of the field.”

When discussing the role of physics in history and culture, Gates goes again to Einstein. “If you look outside of his science, you'll find that he had this enormous capacity to help others,” Gates says. It's an ability he can surely relate to. //

## JORDAN SANCHEZ

### On climate denial



# Time

by Jordan Sanchez, Physics Undergrad, Harvard University

I've spent my entire life trying to make time stop. I've got a terrible memory, and to cope I try to record every detail of my life. This was how I got into writing. In elementary school, I attempted to keep diaries so I wouldn't forget what happened each day, no matter how mundane the details, because someone might find it insightful—whether a historian in 500 years or myself in 10. I wrote with the intention of my words being read. Somewhere, hidden in old school notebooks, there are entries that document my life and the progression of it. Sometimes I recounted my day in full detail; other times I stuck to the bare minimum.

**Monday, November 7, 2011. Jordan A. Sanchez. I am 9 years old. I feel good today.**

It wasn't until middle school that I started writing for my present self rather than a

distant Future Jordan. The world was getting a lot bigger than my immediate family, and the thought of a version of myself that didn't currently exist was too much to think about. I learned words and phrases I could use to describe the world I saw: racism, sexism, big bang, gravity. In addition to helping me remember the new things I learned or wanted to learn, writing became a creative outlet.

**Wednesday, September 20, 2017. Jordan A. Sanchez. I am 15 years old. I really like my physics class. It makes me feel like I know everything and nothing at the same time.**

What attracted me to physics was everything you get to study after learning the basics, but what I grew to love about the subject is how it gave me the power to better understand and explain the space I existed in. Instead of asking you to sort new knowledge into



**TOP:** Sanchez performs her poem "On Climate Denial" onstage at the Apollo Theater.

**ABOVE:** Jordan Sanchez. Photos courtesy of the author.



old buckets of things you've learned in the past, physics forces you to create entirely new buckets of information. The more I learned, the more I was able to see the world in new ways. Sometimes it was the backdrop to an algebra problem with accelerations and masses, and other times it was a giant jumble of all the "-isms" I could think of. Both ways of seeing the world were correct, even if it felt like I was looking at two different things.

**Friday, June 14, 2019. Jordan Sanchez. I am 17 years old. I performed at the Apollo Theater today. I want to write about climate change more.**

One of my writing mentors used to say, "Through art, change hearts, and change minds." That's what makes poetry such a powerful tool. At our core, most people want the same thing: for us and those we love to be safe. Actively choosing to see this commonality while searching for others is how I found my footing as a poet. When it comes to problems we may not yet know how to solve, the same emotions overcome us: fear, confusion, frustration, hopelessness. So when I wrote and performed "On Climate Denial," and later "Reimagine, Recreate, Restore," the goal was always the same: Write something that reminds people that this is their world and they have the power to change it.

**Monday, June 21, 2021. Jordan Sanchez. I am 19 years old. It's been about a month since the UNEP poem launched. Over 150 million people have seen it. What is my life?**

As I navigate college and consider potential avenues for my future, I'm forced to think about Future Jordan as a real person with a life that I have the power to affect. I've thought about choosing one interest over the other: poetry or physics, activism or academics. But I don't have to. They're two different ways of achieving the same goal of understanding the world so it can be made better. The root of your work, no matter what field or industry you're in, should always be helping people or society in some way—that is our obligation as humans. But if you can't communicate with the people you're trying to help, if you can't resonate and connect with people outside of the lab or the office, then what is it all for?

So when I ask, "Have you ever seen time fly?" in "Reimagine, Recreate, Restore," I have no choice but to say, "I must have." I've witnessed it through my writing, through the knowledge I acquire, and through the forever changing ways I see the world. The more hats I wear, the more lenses I'm able to see the world through, the more there is for me to document and work to improve. This is something I intend to do for the rest of my life.

**Someday. Jordan Sanchez. I am today years old. Wherever I am, whatever I'm doing, I'm looking at the same world I've always looked at, and I'm trying to make it better. //**

## ABOUT THE AUTHOR

Jordan Sanchez studies physics and education at Harvard University. She also writes, performs original spoken word poetry, and mentors high school students through the college application process. As a finalist in the Climate Museum's 2019 Climate Speaks competition, Sanchez performed onstage at the iconic Apollo Theater in Harlem. The United Nations Environment Programme (UNEP) commissioned her to write a piece for World Environment Day 2021, resulting in "Reimagine, Recreate, Restore." To see her perform the poem, visit [thejordansanchez.com/reimagine-recreate-restore/](https://thejordansanchez.com/reimagine-recreate-restore/).

# REIMAGINE, RECREATE, RESTORE.

by Jordan Sanchez

Tick. Tick. Tick. Tick.

Have you ever seen time fly?

Watch it slip through your fingers like a cloud passing by . . .

Too slow to notice it leaving,

Too fast to make it stop

All we've known is to destroy like it's breathing.

The pitter patter of raindrops

Match the sounds of clocks

Counting down.

Tick. Tick. Tick. Tick.

How lucky we are to live.

We are a fraction of a second

In earth's lifetime

Yet she is our only lifeline

Resilient, we stand on our own two feet

I'll tell you, reimagining the future has never tasted so sweet.

Like nectar to a bee, Honey to a home.

We're trying to recover ours, but

No one can do this alone

Tick. Tick. Tick. Tick.

The promise of restoration lives within us.

We see her in the hues of the youth

And she's asking you

What will you stand for?

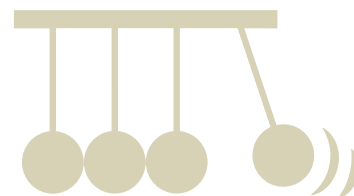
Now is the time for our re-generation

Reimagine. Recreate. Restore.



**ABOVE:** Thumbs up for physics! A closing photo from the 2019 Physics Congress. Photo courtesy of SPS National.

# LET'S CELEBRATE! 100 YEARS OF MOMENTUM



by Kayla D. Stephens, SPS Assistant Director

**A**lbert Einstein once said, “Nothing happens until something moves.” This could have been a reference to Newton’s first law, a physics equation, or a more general statement about life. The 2022 Physics Congress is a very special event—not only will it be the largest gathering of undergraduate students in physics and astronomy—it will be a celebration! This year marks the 100th anniversary of Sigma Pi Sigma, the physics honor society housed within SPS.

For SPS and Sigma Pi Sigma to be where they are today, someone had to move. Someone had to move to make society realize the value of having a professional organization catered to physics students. Someone had to move within this group for it to understand the importance of honor, encouragement, service, and fellowship. It was someone moving within the society that led SPS to take official actions supporting mental health, and diversity and inclusion within the physics community.

Once you start moving, momentum carries you forward—just like momentum has carried us into our 100th year. Take a moment to learn more about how we’ll be celebrating *100 Years of Momentum* at the 2022 Physics Congress through plenary speakers, special centennial speakers, panels, workshops, tours, and more. We hope you’ll be there to celebrate the last 100 years and help us move into the next 100 years! //



# HELPING SCIENCE AND THE PUBLIC MEET HALFWAY

## Introducing Rush Holt Jr. 2022 Physics Congress Plenary Speaker

by Korena Di Roma Howley, Contributing Editor



**LEFT:** SPS student leaders with then US Representative Rush Holt (D-NJ), third from left, during a 2014 visit to Capitol Hill. Photo by SPS National.

**G**rowing 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 the *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 the *SPS 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.

While he was head of AAS, 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 friend of SPS internship programs, which includes the American Institute of Physics Mather Public Policy Internship, a summer program during which physics majors work on Capitol Hill. //



# THE PULL OF THE PLANETS

## Introducing Sarah Hörst 2022 Physics Congress Plenary Speaker

by Kendra Redmond, Editor

**W**alk 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."

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.

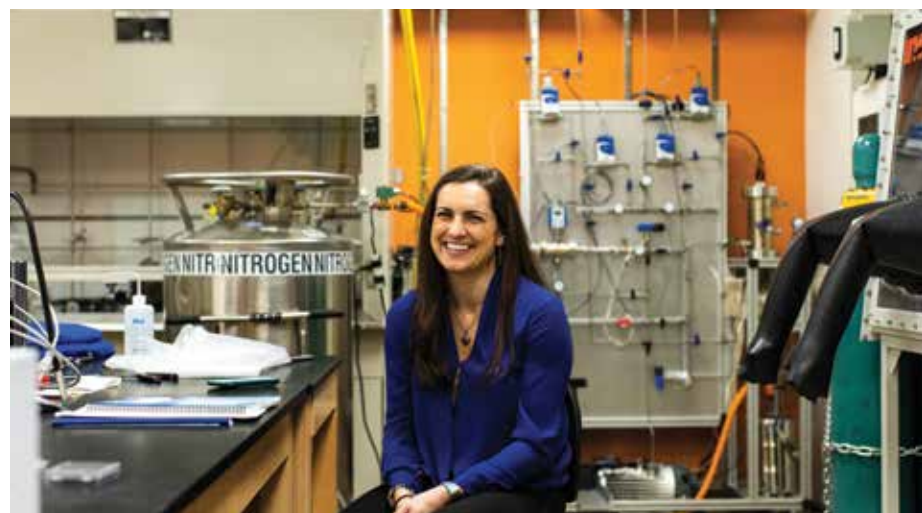
Over the years Hörst has thought a lot about how the atmospheric and planetary

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." //



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



# GOING FULL CIRCLE

## Introducing K. Renee Horton 2022 Physics Congress Plenary Speaker

by Kendra Redmond, Editor



**W**hen 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.

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 implications 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.” //



**TOP:** Dr. H, the main character from Horton’s children’s book series *Dr. H Explores*. Image courtesy of Horton.

**ABOVE:** Renee Horton. Photo by Pep Holman.

# A MEDICAL PHYSICIST'S JOURNEY

## Introducing Julianne Pollard-Larkin 2022 Physics Congress Plenary Speaker

by Korena Di Roma Howley, Contributing Editor



**W**hen 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. Julianne 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



**ABOVE:** Julianne Pollard-Larkin. Photo courtesy of Pollard-Larkin.

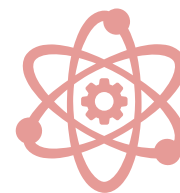
your potential outside of yourself and your own family, because that's the person who's going to remind you that this is possible."

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." //



# WHERE WILL PHYSICS AND ASTRONOMY BE IN 100 YEARS?



## Meet the 2022 Physics Congress centennial session speakers

by Mikayla Cleaver, SPS Programs Coordinator

**T**o 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 Jr.** 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. //

## 2022 Physics Congress WORKSHOPS, TOURS, AND MORE



**TOP:** The Robert C. Byrd Green Bank Telescope, or GBT, is the world's premiere single-dish radio telescope operating at meter-to-millimeter wavelengths. Photo courtesy of the Green Bank Observatory.

**MIDDLE:** NIST Gaithersburg's Newton apple tree on a spring morning. Like its more famous ancestor, the tree continues to produce apples, although they taste terrible. The deer don't seem to mind, though. Photo by Stoughton/NIST.

**BOTTOM:** 2019 PhysCon attendees hear about the physics of moorings and oceanic research at Woods Hole Oceanographic Institution. Photo courtesy of Jessi Valdez, Texas Lutheran University.

**W**hile in the midst of hearing from luminaries in physics and astronomy, presenting your research or outreach projects, and networking with physicists from across the US, at PhysCon you'll have opportunities to engage in workshops, panels, and tours catered to physicists like you.

### WORKSHOPS

#### Physics Phine Art

Led by Geraldine Cox, an artist, physicist, and winner of the 2020 Andrew Gemant Award for her contributions to the artistic dimension of physics, this workshop will focus on conducting outreach at the intersection of art and physics.

#### Physics for Humans: Using Physics to Improve the Human Condition

Led by Randy Tagg from the University of Colorado Denver, this workshop will explore entrepreneurship, inventive thinking, and how your physics and astronomy skills could make life better for humans.

#### Stellar Astronomy Outreach

Led by Nicole Gugliucci of Saint Anselm College and Riley Troyer of the University of Iowa, this workshop is for those who want to step up an astronomy-themed outreach program on a budget, take pictures of the night sky with a cell phone, or find fun new ways to interest their communities in physics and astronomy.

#### Little Shops of Physics: Take Your Outreach Game to the Next Level

Led by Heather Michalak and Sheila Ferguson from Colorado State University, this workshop is for those who want to learn to present physics concepts to a wide variety of audiences with engagement, showmanship, and pizzazz.

#### Faculty Workshops

PhysCon faculty workshops will focus on the physics and astronomy SEA Change Initiative to help departments improve diversity, equity, and inclusion; preparing students for the workforce; and best practices for cultivating student research and leadership.



## TOURS

### Overnight Tour of the Green Bank Observatory (GBO)

The first trailblazers of American radio astronomy called Green Bank Observatory home more than 60 years ago. Today their legacy is alive and well in the observatory's seven telescopes, ranging from 14 to 100 meters in diameter. Nestled in the mountain ranges of West Virginia, within the National Quiet Zone, GBO is now home to radio astronomers listening to the remote whispers of the universe in order to discover answers to our most astounding astronomical questions. This overnight tour will include talks by GBO staff and researchers, a nighttime tour of the facilities, and a visit up to the enormous Robert C. Byrd Green Bank Telescope.



### National Institute of Standards and Technology (NIST) Gaithersburg

Founded in 1901, NIST is one of the nation's oldest physical science laboratories—but don't let that fool you. In the last 25 years NIST scientists have won five Nobel Prizes, four in physics. NIST's headquarters, in Gaithersburg, Maryland, sits on a 579-acre campus just outside of Washington, DC. Inside its 62 structures, researchers and engineers push the boundaries of science and technology to their limits in areas such as energy and climate research, physical measurements, materials, nanotechnology, and advanced communications. While visiting NIST, be sure to keep an eye out for a direct descendant of Newton's apple tree!



### NASA Goddard Space Flight Center (GSFC)

GSFC in Greenbelt, Maryland, is home to some of the most famous NASA projects—the James Webb Space Telescope (led by John C. Mather, physics Nobel laureate and good friend to SPS) and the groundbreaking Hubble Space Telescope. GSFC is also home to the International Space Station mission control, maintaining communications between astronauts on the station and Earth. The campus features several unique facilities for testing spacecraft components and payloads, including what may be the world's largest clean room, a nearly 13-meter-tall acoustic test chamber, a space environment simulator, and a centrifuge that can accelerate a 2.5-ton payload up to 30 Gs.



### University of Maryland (UMD) - Department of Physics

Housed within a large, diverse research university just outside of Washington, DC, the physics department at UMD is one of the largest in the nation (and it has a great SPS chapter!). The department's faculty and students do cutting-edge research in more than 30 subfields of physics, including quantum computers, quantum theory, biophysics, chemical physics, high-energy physics, nuclear physics, and astrophysics. During this tour you'll hear about the department's research, tour labs, talk to current graduate students, and check out this world-class campus.



### Behind-the-Scenes Tour of the Smithsonian Institution

The Smithsonian Institution is the world's largest museum, education, and research complex. Its 19 museums, galleries, gardens, and the National Zoo boasted a combined 28 to 30 million visitors annually prior to the start of COVID-19. The National Air and Space Museum and its annex are among the favorites of space and science enthusiasts. The Smithsonian is also one of the world's foremost research centers, conducting studies on astrophysics, environmental changes, and how modern technology can aid our interpretation of historical objects, among many other areas of science, the arts, and the humanities. You don't need to attend the 2022 Physics Congress to visit the museums, but you won't get this behind-the-scenes tour anywhere else! //



“Going to MIT’s physics department and touring the condensed matter experiments during the 2019 PhysCon was a SOLID experience. Part of the tour consisted of a graduate student explaining his research to us regarding single-layer atoms and using optical techniques to better understand topological behaviors. It was an incredible experience hearing someone who was just a few years older than us talk about his physics research and current endeavors. It was an eye-opening experience and such a fun time to be in a room with people who also found this to be interesting.”

- Student from Abilene Christian University

“During PhysCon 2019, we had the chance to engage in workshops and tours that were centered around the idea of how physics can be beneficial and affect human life. Each experience was interactive, and some even involved group work to get us engaging with our peers. One of the commonalities between these experiences was their focus on climate change and how we as physicists can help lead in this change. . . .”

- Student from Juniata College

Watch for details this fall on more PhysCon events: panel discussions on careers and graduate school, a history of physics and astronomy Wiki-thon, how to be a shark with physics, and more!

# Kicking A\*\* at Physics

## Opportunities for SPS students in the international physics student community

by Molly McDonough, Associate Research Physicist, PhD Student, The Pennsylvania State University

**The *Physics League Across Numerous Countries for Kick-ass Students (PLANCKS)* is an annual event hosted by a member committee of the International Association of Physics Students (IAPS). During the event, teams of three or four undergraduate and master's students representing their home countries compete to solve high-level physics problems. The problems, written and graded by a panel of professors, span all varieties of physics, including glaciers, particle physics, graphene, astrophysics, skyrmions, and more.**

The top three teams receive prize money in denominations of Planck's constant,  $\hbar/2$ ,  $\hbar/3$ , and  $\hbar/4$  times  $10^{37}$  euros, respectively. Typically, each country hosts a preliminary competition between December and February to determine the team that will go to the finals in late spring, May or June. Preliminary competitions are conducted in the same spirit as the finals: a university hosts, professors write and grade the problems, and a winning team is selected.

Typically, the finals are hosted at a university in an IAPS member country. Every year

during the International Conference for Physics Students (ICPS), member countries turn in proposals and place bids to be the following year's host. The schedule may include three to four days of tours, lectures, workshops, laboratory tours, social events, cultural excursions, and, of course, the competition.

Due to COVID-19, PLANCKS 2020 and 2021 went virtual with 36-hour, nonstop competitions that accounted for the various time zones of IAPS members from over 45 countries.

Whether conducted in person or virtually, PLANCKS provides an opportunity to interact and network with physics students across the globe. Members of SPS are also members of IAPS, meaning they are welcome to participate in any of the association's events, including ICPS and PLANCKS. The other annual event IAPS hosts is IAP2CERN, which takes place in April and gives 20 students the opportunity to spend four days in Switzerland touring CERN and immersing themselves in local cultural activities. Students are welcome to submit

applications to attend, and the applications are reviewed by the Executive Committee.

Similarly to SPS, IAPS is deeply rooted in giving back to the greater community, holding global service events. For example, on the International Day of Light (May 16th of each year), IAPS member countries simultaneously (time zones permitting) conduct physics demonstrations themed around light with support from the Institute of Physics (IOP). Additionally, IAPS hosts an annual School Day, where member countries organize physics demonstrations around a particular theme for K through 12 students. //

For more information on PLANCKS, ICPS, IAPS2CERN, and other opportunities to engage with the International Association of Physics Students, visit [iaps.info](https://iaps.info).





# Showcase Your Chapter

## at the 2022 Physics Congress

by Payton Arber, Magen Bright, Joseph Schuster, and Sarah Vue, SPS Members, and Shannon Clardy, SPS Chapter Advisor, Henderson State University

**The Chapter Showcase event at PhysCon enables SPS members from all over the country to meet one another and exchange ideas. Chapters that sign up for a booth can use posters, photos, and interesting demos to highlight some of the fun and engaging activities they've organized. During the showcase, chapters get new ideas from each other and have an opportunity to swap shirts, stickers, and pins.**

At the 2019 Physics Congress, our SPS chapter brought shirts, demos, and our favorite chapter tradition—the aluminati. These small triangles of aluminum are decorated with the image of an eye and have a strong magnet on the back. On campus, our chapter hides the aluminati throughout the physics department. They must be hidden in plain sight, and anyone who finds one hides it again for someone else to find. The game has been part of our tradition for so long that the triangle design has become the chapter logo. During the 2019 Chapter Showcase event, we hid eight aluminati around the exhibit hall for other chapters to find and take home with them to engage people to interact, and we also brought stickers, pins, and magnets featuring the logo to share with other chapters.

Packing physics demos to bring was no easy task. Not many of our demos fit in suitcases or transport well by plane. Others raise eyebrows as they go through airport security. We ultimately chose small demos that wouldn't raise suspicions about our luggage, like a gravity sling. Looking ahead to the 2022 Physics Congress, we plan to explore shipping options to see if we can send our demos in advance.

In addition to putting on our own demos during the showcase, we enjoyed viewing those presented by other chapters as we browsed the exhibits. Another fun way to participate in the event, celebrate our physics community, and pick up some awesome new swag is to enter the shirt design contest and swap shirts with other chapters. If your chapter is particularly proud of its logo or looking for a reason to design a new one, this is the perfect challenge.

We hope to see you at the 2022 Chapter Showcase—whether it's to show off a shirt design, stickers, demos, or something else! //

**TOP:** Members of the Rhodes College chapter from Memphis, TN.

**MIDDLE:** Chapter members show an aluminati sign at the Henderson State University (HSU) Chapter Showcase booth. Front row (L-R): Jeremy Brents, Sammy Dobson, and Dallas Crumley. Back row (L-R): Payton Arber, Calvin Clardy, Sarah Vue (seated), Joseph Schuster, and Becca Voss.

**BOTTOM LEFT:** HSU's SPS chapter displays pins and stickers with their unique logo.

**BOTTOM RIGHT:** HSU SPS member Becca Voss presents the gravity sling demo, while fellow member Payton Arber looks on. Photos courtesy of the chapter.

To join in the excitement at the 2022 Physics Congress, sign up to receive more information about the Congress at [spsnational.org/sigmapi sigma/congress/2022](https://spsnational.org/sigmapi sigma/congress/2022), and register to attend at [physcon2022.completereg.com/default.aspx](https://physcon2022.completereg.com/default.aspx).

# How to Prepare for a Poster Session

by Noura Ibrahim, 2019 SPS SOCK Intern

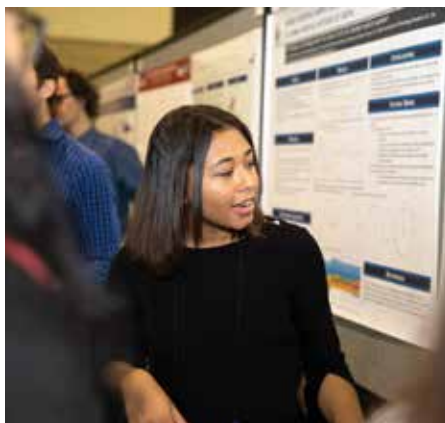
Presenting a poster at a professional conference such as PhysCon is a great way to develop your communication skills, share your work with other students and professionals, and network! Preparing for your first poster session can feel overwhelming, but if you take your time and go step-by-step, you should have a great experience.

## STEP 1

### REGISTER AND SUBMIT YOUR POSTER INFORMATION

As soon as you decide to present, register for the meeting and indicate that you will be presenting a poster. You'll probably need to identify the category most relevant to your topic and submit a title and abstract. Depending on the event, you may need to submit this information during registration, or you may have more time. Check the deadlines and requirements early so you don't miss anything.

Your poster should have a short, descriptive title—no more than ten words. An abstract is a concise summary of your work, including results. It's meant to give attendees a glimpse into your work and results, not an in-depth summary—**aim for 100 words or less.**



## STEP 2

### CREATE THE POSTER

It's a good idea to give yourself at least three weeks to work on the poster. SPS recommends using PowerPoint to design and lay out your poster, but there are other options. Before you start designing, check the poster dimensions specified by the conference and scale the poster accordingly. It is typical to do a 42-inch by 42-inch poster.

**The top section** of the poster is your identifier. Include the title, the authors' names and affiliations, the logo of your institution, and sources of funding, if applicable. You can include a headshot, but it's not necessary.

It's important for the body of your poster to have a clear flow and distinct sections. Most experimental and computational research presentations follow **a uniform format: introduction, methodology, data/results, discussion, conclusion, and acknowledgments.** Posters on theoretical research usually focus on derivations instead of data. You might also include your abstract, the next steps or future direction of the project (helpful for works in progress), and a references section. You don't need to label each section as such, but you can.

**Your poster is more of a visual guide than a script,** so use many relevant graphs, tables, photographs, and figures when possible (with clear labels). Cite any figures or information you don't own in the references section. Also, try to use phrases and bullet points instead of whole sentences when possible.

Be consistent with fonts and constrain your **font size to 32 pt** or larger. A helpful trick is to lay your poster on the ground, and if you can't read it while standing up, the font size is too small. Posters don't have to be dull—be creative but mindful of your readers. Clear and simple is a winning combination.

Once you are satisfied with the content and layout, it's time to **seek feedback from mentors, peers, and co-authors.** Ask them to note jargon that should be replaced or defined, points of confusion, how easily they could follow the flow of sections, any typos or errors, and the bottom line of the poster. Consider their feedback carefully. Did the main point come across? Are there sections you need to rewrite? Information to add or subtract? **Then revise your poster accordingly.** Remember that your audience may be fellow physicists, but that doesn't mean they are experts in your field.

**Printing is the last step of the design process.** Before you spend money on a full-scale version, print a small version of your poster and check the layout, then triple check your text for typos and errors. Don't forget captions and graph labels!

There are multiple options for printing a full-scale poster, so discuss what will work best for you with your mentor or advisor. Keep in mind the budget, how quickly you need the poster, mode of travel, ease of transportation around the conference, quality, and durability.





**ALL PHOTOS:** Students take advantage of the poster sessions at PhysCon 2019. Photos by SPS National.

### STEP 3

#### PRACTICE, PRACTICE, PRACTICE!

Rehearse how you would walk through your poster with an attendee. After doing this a few times, you might record yourself. It can feel a little awkward at first, but this allows you to be the first to critique your performance and adjust your presentation accordingly. Be prepared to explain every element of your poster and how it relates to the central thesis.

Next, practice for an audience, such as a group of peers, family, friends, or mentors. They don't need to be in physics or astronomy to give helpful feedback. At the conference you'll interact with attendees from a wide range of expertise; tailor your explanations to fit the audience.

Remember that a poster presentation isn't a talk. The goal is to have *conversations* with attendees about your work, not present a memorized monologue. Some listeners will only have a few minutes to spare while others will prefer a lengthier discussion, so you'll need to adapt.

### STEP 4

#### IT'S PRESENTATION TIME!

Presentation day has finally arrived! Double-check the location and time, and aim to arrive early so you can find your spot and tack up your poster. It's a good idea to dress professionally and have business or contact cards to give to potential collaborators or others interested in your work.

Once the poster session starts, stay near your poster. This is your chance to share your work and connect with potential collaborators, graduate advisors, and employers. Speak with confidence, maintain eye contact, be flexible, and be open to discussions and opportunities. Remember that you know your work best, so have pride in sharing it with the world. **You've got this! //**



### PHYSICS CONGRESS TRAVEL AWARDS

If you're presenting a poster (or art project) at the 2022 Physics Congress, apply for a PhysCon Travel Award! There are chapter Travel Awards for groups and a limited number of individual Travel Awards for those attending by themselves. Apply today!

[sigmapisigma.org/sigmapisigma/congress/2022/awards](https://sigmapisigma.org/sigmapisigma/congress/2022/awards)



phys  
con  
2022 Physics Congress

# 100 YEARS OF MOMENTUM

OCTOBER 6–8, 2022 | WASHINGTON, DC



**Start Celebrating 100 Years of Momentum with Sigma Pi Sigma!**



The 2022 Physics Congress is coming up fast. Stay in the know by joining the SPS Discord server. In the new PhysCon Hype channel, you'll find PhysCon updates, behind-the-scenes information, and fellow physics majors preparing for the 100<sup>th</sup> anniversary celebration of Sigma Pi Sigma! This meeting is specifically for you!

Registration is now open: [www.sigmapisigma.org/congress/2022](http://www.sigmapisigma.org/congress/2022)

