

# AIP

American Institute  
of Physics

phys  
con  
an event by the  
American Institute of Physics

# Making Waves & Breaking Boundaries

**2019  
PHYSICS  
CONGRESS**

November 14–16, 2019  
Providence, Rhode Island

[sigmapisigma.com/congress/2019](http://sigmapisigma.com/congress/2019)





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### Brittney Hauke

Graduate Researcher

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## Online Content



### Poster Abstracts

Access the poster abstracts in the PhysCon App or on the PhysCon website at:

[www.sigmapisigma.org/sigmapisigma/congress/2019/poster-presentations](http://www.sigmapisigma.org/sigmapisigma/congress/2019/poster-presentations)

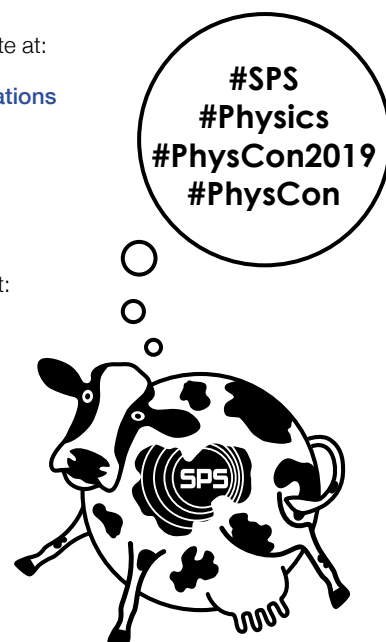


### Art Abstracts

Access the art abstracts in the PhysCon App or on the PhysCon website at:

[www.sigmapisigma.org/sigmapisigma/congress/2019/physics-art#overlay-context=sigmapisigma/congress/2019/physics-art](http://www.sigmapisigma.org/sigmapisigma/congress/2019/physics-art#overlay-context=sigmapisigma/congress/2019/physics-art)

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# WELCOME, 2019 PHYSICS CONGRESS!

## From the Planning Committee Chairs

Welcome! We are delighted that you have joined us at the 2019 Sigma Pi Sigma Physics Congress, also known as PhysCon. This year's theme is "Making Waves & Breaking Boundaries," and we have kept this theme in mind while planning this incredible event for you. PhysCon is the only national meeting whose focus is on undergraduate physics students. We believe it is most appropriate that Sigma Pi Sigma, the national honor society in physics, is the host. The society knows that you hold this event in your hands and are the collective future of physics.

We have spent years planning PhysCon 2019, and we are extremely proud of the program that we've put together. We only have a few days together in Providence, but they promise to be packed with distinguished speakers, incredible breakout sessions, poster presentations, tours and a whole lot more. This year, our speakers include the PhysCon 2019 Honorary Chair, Dame Susan Jocelyn Bell Burnell, as well as Sandeep Giri, Dr. John C. Mather, Dr. Jami Valentine Miller, and Dr. Ellen D. Williams.

There are eight optional tours lined up this year, and we are excited that some of our attendees will get to explore labs, universities and companies that span the physics gamut. Ever wanted to peek inside the Woods Hole Oceanographic Institution? How about a naval submarine base? Are you curious what the Harvard, Brown University, or MIT physics departments are like? Or maybe you'd like to spend an evening at the Ladd Observatory, taking in its breathtaking collection of

astronomical instruments. No matter what your interests are, we have taken great care in developing a tour schedule with you in mind.

Breakout sessions at PhysCon 2019 also have been developed with our amazing attendees in mind, and we want you to carry this year's theme, "Making Waves & Breaking Boundaries," with you as you engage with your peers. In between sessions, don't forget to see the art exhibit, Physics Phine Art, and the hundreds of student posters. See what your colleagues have produced. Probe their work, ask questions; we're sure the contributors will enjoy telling you of their accomplishments.

We also encourage you to participate in a new event for PhysCon 2019, called "Breaking Boundaries." This event is focused on promoting Society of Physics Students chapters from across the country. The goal is for students to visit with and learn from one another, while also finding ways to improve their own chapters. Meet your peers, share ideas on chapter engagement and leadership, and above all, make new friends.

Once again, we are honored that you have chosen to attend PhysCon 2019, and we look forward to providing the best experience possible while you're in Providence.

Welcome again,

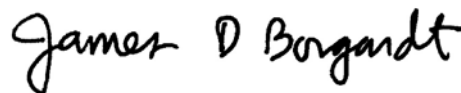


## From the Sigma Pi Sigma President

On behalf of Sigma Pi Sigma and the Society of Physics Students National Council, it is my esteemed HONOR to welcome you to the 2019 Sigma Pi Sigma Physics Congress—PhysCon!

This PhysCon is focused on the theme of "Making Waves and Breaking Boundaries." As the largest meeting of undergraduate students in the US with up to 1500 students in attendance, PhysCon is many students' first professional conference and opportunity to **EXPERIENCE FELLOWSHIP** and **MAKE WAVES** within the larger physics and astronomy community. The Organizing Committee, led by co-chairs Joshua Willis and Steve Feller, has been hard at work putting together the best PhysCon program ever. The speakers, workshops, exhibits, and tours of sites in the surrounding New England area have

been designed to appeal to the **DIVERSITY** of interests, and individuals, and offer **ENCOURAGEMENT** to consider how you will contribute to the larger community. I hope these interactions will inspire you to **BREAK BOUNDARIES** and engage in your own unique and meaningful way in living a professional life of **SERVICE**. Members of this pre-centennial congress will go into many fields seemingly unrelated to your current studies, but through physics, every individual has the opportunity to **MAKE WAVES AND BREAK BOUNDARIES**. I wish each of you a fun and productive PhysCon, and hope to see many of you in two years at the 2021 Centennial Congress in Washington, D.C.





# Download the PhysCon App



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# Letter from the CEO

## Why AIP Supports PhysCon

by Michael H. Moloney, CEO, American Institute of Physics



**When you're an undergraduate student, there are few opportunities to travel to present your work. There are even fewer opportunities to attend a professional conference and network with like-minded people.**

That's why I am so excited about the 2019 Physics Congress, also known as PhysCon, which has been hosted since 1928 by you and your fellow Sigma Pi Sigma members. PhysCon

is the only event of its kind in the United States that is tailored specifically to college students in the physical sciences. PhysCon 2019 will bring together more than 1,500 students of physics and astronomy, along with mentors, alumni, and renowned scientists, for a life-changing experience Nov. 14–16 in Providence, Rhode Island.

Attendees will hear from luminaries in physics and astronomy, go on tours of local research labs and facilities, engage in workshops, and have opportunities to present their research and outreach efforts. The entire event is planned with students in mind, and I see it as an incredibly empowering experience for them.

This will be my first PhysCon as CEO of the American Institute of Physics, and I could not be more enthusiastic about what we have planned. The theme for PhysCon 2019 is Making

Waves and Breaking Boundaries, which is extremely apt for what we will offer in Providence. It is my goal that students who attend PhysCon will go back to their respective universities inspired to continue their studies and excited about the career paths open to them. I truly want them to make waves and continue breaking scientific boundaries.

If you've attended PhysCon in the past, you know how rewarding and inspiring the experience can be for students. I'm hoping that together we can make 2019 the best PhysCon yet.

But despite how excited we all are for PhysCon 2019, we know its success depends on the support of people like you. If you would like to support PhysCon 2021, consider donating your time or money. AIP has established the Congress Student Travel Fund, geared specifically toward supporting student travel to PhysCon. You can find more information at [donate.aip.org](https://donate.aip.org).

We also will be looking for volunteers in the New England region to join us for our Lunch with the Scientists event on Friday, Nov. 15. If you would like to learn more about volunteering, please reach out to [sigmapisigma@aip.org](mailto:sigmapisigma@aip.org).

And if you are an employer or university representative who is looking for interns, employees, or graduate students, consider exhibiting at PhysCon. More information about exhibiting opportunities can be found on the PhysCon website, or you can email Vanessa Bridges at [vbridges@aip.org](mailto:vbridges@aip.org).

I cannot wait to see you and all of the students in Providence, Rhode Island, for PhysCon 2019.

A handwritten signature in black ink that reads "MH Moloney". The signature is fluid and cursive, with a long horizontal line extending from the end.



# Sigma Pi Sigma - A Departmental Legacy of Friendship

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



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

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.<sup>1</sup>*

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.”<sup>1</sup> 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.<sup>1</sup>

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.<sup>2</sup> 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 Appalachian 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 its own, something that supported its 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

The first public symbol of the organization, a pledge badge, was a horseshoe magnet and was adopted<sup>2</sup> 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.”



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!

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.

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# What is MEDICAL PHYSICS?



**MEDICAL PHYSICS IS** an applied branch of physics concerned with the diagnosis and treatment of human disease with applications in the following areas:

- Radiation and particle based cancer treatments
- Medical imaging modalities to identify and track diseases
- Computer simulations of disease treatment/progression and optimization of therapy
- Utilization of data analytics to improve upon current treatment outcomes

THERAPEUTIC MEDICAL PHYSICS

DIAGNOSTIC/IMAGING MEDICAL PHYSICS

MODELING & OPTIMIZATION

DATA ANALYTICS & DECISION SUPPORT

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AMERICAN ASSOCIATION  
of PHYSICISTS IN MEDICINE



## Wednesday, November 13, 2019

### 4:00pm – 8:00pm: Registration

Location: 3<sup>rd</sup> Floor Pre-function – Outside Exhibit Hall A, Convention Center

## Thursday, November 14, 2019

### 6:00am – 5:00pm: Registration

Location: 3<sup>rd</sup> Floor Pre-function – Outside Exhibit Hall A, Convention Center

### 6:15am – 2:00pm: Tour Departures and Arrivals

Meet at Registration at the following times. Tours are 5 hours or less in duration, including travel time.

6:15am . . . . . Optikos Corporation  
7:00am . . . . . Harvard University, Physics Department  
7:15am . . . . . Woods Hole Oceanographic Institute  
7:15am . . . . . Naval Submarine Base New London  
7:30am . . . . . Massachusetts Institute of Technology (MIT), Physics Department  
8:45am . . . . . Lifespan, Rhode Island Hospital  
9:00am . . . . . Brown University, Physics Department

### 10:00am – 3:00pm: Exhibit Hall, Career & Graduate School Fair

Location: Exhibit Hall B, Convention Center

### 12:00pm – 2:00pm: Lunch on your own!

### 2:00pm – 3:00pm: Donor Reception – Invitation Only

Location: Rotunda, Convention Center

### 2:00pm – 3:00pm: Opening Networking Reception

Location: Exhibit Hall B, Convention Center

### 3:15pm – 4:00pm: Welcome and Opening Remarks

Location: Exhibit Hall A, Convention Center

Welcome remarks from...  
Brad Conrad, Director, SPS and Sigma Pi Sigma  
Jim Borgardt, President Sigma Pi Sigma  
Michael Moloney, AIP CEO  
Josh Willis, Executive Program Chair  
Steve Feller, Executive Program Chair  
Brown University Department of Physics

### 4:00pm – 4:45pm: Plenary I – Dame S. Jocelyn Bell-Burnell, Honorary Chair

Location: Exhibit Hall A, Convention Center

Dame S. Jocelyn Bell-Burnell, 2019 Honorary Congress Chair

Title: "Ed and Ein"

Abstract: 100 years ago, in 1919, a solar eclipse expedition gave the first confirmation of Einstein's Theory of General Relativity. I will relate the story of how Eddington came to be involved, and what happened as a consequence.

## **4:45pm – 6:30pm: 2019 Physics Congress Workshop**

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**Location: Exhibit Hall A – Convention Center**

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

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## **7:00pm – 11:00pm: SPS Lounge & Study Room**

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**Location: Omni Hotel – Providence Ballroom**

## **7:30pm: Tour – LADD Observatory**

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**Location: Convention Center – Meet at Rhode Island Convention Center, 1<sup>st</sup> floor**

## **7:30pm: Brown University Demo Show**

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**Location: Brown University Physics Department – Barus & Holley 166**

First come, first served

Bus loop starts at 6:45pm – 10:45pm

# **Friday, November 15, 2019**

## **8:00am – 5:00pm: Registration**

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**Location: 3<sup>rd</sup> Floor Pre-function – Outside Exhibit Hall A, Convention Center**

## **8:45am – 10:00am: Plenary II – Sandeep Giri**

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**Location: Exhibit Hall A**

Sandeep Giri

Title: What the Industry Wants: How Physics Students can Prepare to Thrive in the Private Sector

Abstract: The goal of this talk is to provide a window to physics undergraduates into what industry wants, thus preparing them on what relevant skills to acquire, highlighting the types of experiences that are valued, and how to market themselves (interviewing, resume writing, networking). Physics majors can excel just as well as their engineering peers in the private sector. Professors can also gather insights into how to empower their students for successful transitions out of academia. The talk will also cover exciting projects happening within Silicon Valley.

Additionally, this talk is also a personal journey of a physics major. An immigrant's story through industry & academia—from a small liberal arts college to the tech industry in Silicon Valley. On becoming American & finding well-being.

## **10:00am – 1:00pm: Exhibit Hall, Career & Graduate School Fair**

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**Location: Exhibit Hall B**

## **10:00am – 11:00am: Coffee Break**

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**Location: Exhibit Hall B**

## **10:15am – 11:45am: Poster Session I & Art Exhibit**

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**Location: Exhibit Hall B**

## **12:00pm – 1:00pm: Lunch with Scientists**

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**Location: Exhibit Hall A**

## 1:10pm – 2:40pm: Breakout Sessions – I

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### **Workshop 101: Science Policy for Scientists**

Location: Ballroom B & C

### **Workshop 102: Physics for Humans**

Location: Ballroom A

### **Workshop 103: Making Room in Physics for Everyone**

Location: Junior Ballroom, Room 555/556

### **Workshop 104: The Physics of Climate Change - Putting Numbers to the Issue**

Location: Ballroom D & E

### **Workshop 105: Physics Careers - NOT Just for Academics!**

Location: Room 551 A & B

### **Workshop 106: A Day (or Week, or Few Years) in the Life of a Grad Student**

Location: Room 552 A & B

### **Workshop 107: Faculty Mentors Session - Supporting Leadership and Fostering Research**

Location: Room 550 B

## 2:30pm – 3:00pm: Coffee Break

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**Location: 5<sup>th</sup> Floor Pre-function**

## 3:00pm – 4:30pm: Breakout Sessions – II

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### **Workshop 201: Science Policy for Scientists**

Location: Ballroom B & C

### **Workshop 202: Food Physics – Cooking Up a Global Climate Change Solution**

Location: Ballroom D & E

Sponsored by The Society of Rheology

### **Workshop 203: Taking Your Outreach Game to the Next Level**

Location: Junior Ballroom, Room 555/556

### **Workshop 204: Physics of Jazz**

Location: Ballroom A

Sponsored by the American Acoustical Society

### **Workshop 205: Physics Careers: Education Pathways**

Location: Room 551 A & B

### **Workshop 206: How.to.Grad.School #Success**

Location: Room 552 A & B

### **Workshop 207: Astronomy Outreach for Retention and Recruitment**

Location: Room 550 B

## 4:45pm – 6:00pm: Plenary III – Ellen Williams

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**Location: Exhibit Hall A**

Ellen Williams

Title: The climate is being changed – scientific innovation is part of the solution

Abstract: The impacts of our energy system have grown to the scale of the earth's ecosystem and meteorological processes. The consequences appear dire, as the world's responses to date are far below what is needed to avoid the consequences. Change of the scale needed is possible, and new technologies with lower costs and clear economic benefits will help speed up the response we need to make.

Research, development, and deployment of renewable wind and solar power have shown remarkable advances in performance and cost that set the stage for significant changes in the power sector. However, the transportation and industrial sectors lag far behind in readiness for meeting climate mitigation goals, while the feasibility of negative emissions remains unclear.

Examples of high-potential pathways across the power, transportation, industrial, and negative emissions sectors are now arising from targeted innovation in energy technology such as those of ARPA-E, and targeted investment by mission-focused investors such as Breakthrough Energy Ventures (BEV).

## 6:00pm – 8:00pm: Dinner on your own

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## 7:00pm – 11:00pm: SPS Lounge & Study Room

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**Location: Omni Hotel – Providence Ballroom**



## 7:30pm: Tour – LADD Observatory

**Location:** Convention Center – Meet at Rhode Island Convention Center, 1<sup>st</sup> floor

## 8:00pm: High Energy Hot Chocolate & Game Night

**Location:** Brown University – Barus & Holley, ERC

Hosted by Brown University – Department of Physics SPS chapter  
Bus loop runs 7:30pm – 11:30pm

## 8:30pm: Brown University Demo Show

**Location:** Brown University – Barus & Holley 166

With Nobel Prize winner Dr. Bill Phillips  
Bus loop runs 7:30pm – 11:30pm

# Saturday, November 16, 2019

## 7:00am – 6:30pm: Registration

**Location:** 3<sup>rd</sup> Floor Pre-function – Outside Exhibit Hall A, Convention Center

## 7:30am – 9:30am: Visit with Brown University & Jim Gates

**Location:** Brown University – Barus & Holley

S. James Gates  
Title: Using Physics to Become Like Indiana Jones  
Bus loop runs 7:00am – 10:00am

## 9:00am – 12:45pm: Exhibit Hall, Career & Graduate School Fair

**Location:** Exhibit Hall B

## 10:00am – 11:30am: Poster Session II

**Location:** Exhibit Hall B

## 10:00am – 11:00am: Coffee Break

**Location:** Exhibit Hall B

## 11:45am – 12:45pm: Lunch

**Location:** Exhibit Hall A

## 1:00pm – 2:30pm: Breakout Sessions – III

### Workshop 301: ComSciCon

Location: Room 551 A & B

### Workshop 302: Food Physics – Cooking Up a Global Climate Change Solution

Location: Ballroom D & E

### Workshop 303: Taking Your Outreach Game to the Next Level

Location: Junior Ballroom, Room 555/556

### Workshop 304: Do You Know What I See: Visualization Tools for Physics

Location: Ballroom A

### Workshop 305: Physics for Humans

Location: Ballroom B & C

### Workshop 306: The Physics of Climate Change – Putting Numbers to the Issue

Location: Room 552 A & B

### Workshop 307: Thriving Physics Departments: Effective Practices, Tools, and Tips

Location: Room 550 B

## 2:45pm – 4:00pm: Plenary IV – Jami Valentine-Miller

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**Location: Exhibit Hall A**

Jami Valentine-Miller

Title: Intellectual Property and Physics

Abstract: Intellectual property refers to the things that we create with our minds, including artistic works and novel inventions. This talk will be a comprehensive review of the different types of intellectual property along with descriptions of little known career options for someone with a physics degree. The talk will also retrace my trajectory through physics and intellectual property with the goal of encouraging the audience to persevere through the inevitable challenges they will face as young physicists.

## 4:00pm – 4:30pm: Coffee Break

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**Location: Convention Center, 4<sup>th</sup> floor**

## 4:30pm – 6:00pm: Breaking Boundaries – Chapter Event

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**Location: Exhibit Hall B**

## 6:00pm – 6:30pm: Break

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## 6:30pm – 7:45pm: Banquet

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**Location: Exhibit Hall A**

## 7:45pm – 9:00pm: Plenary V – John Mather

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**Location: Exhibit Hall A**

John Mather

Title: From the Big Bang to Intelligent Life and the Future

Abstract: I have a question for you: How did the Big Bang produce humans capable of exploring the universe, and how far might we go? I think you will be working on this question, bit by bit. Physics tells the story of repeated instabilities, from the hypothetical inflation field to spontaneous symmetry breaking, the production of particles, etc. We have cataloged dozens of distinct states of matter, far beyond "earth, air, fire, and water," and almost all the others were experimental surprises. We are living examples of a newly named state, self-organized criticality, with physical and logical structures on all possible scales from the atom to the size of Earth. Life appears to have started on Earth soon after the surface cooled and liquid water arrived, but it took almost 4 billion more years for humans to walk out of Africa with stone tools in their hands. Now as astronomers search for signs of life elsewhere, what should we expect? Is anybody out there? Is Earth really special? Is life a thermodynamic imperative? What governs the time scale for evolution? The time scale for evolutionary growth and the impending phase transition? I will summarize the story of the expanding universe, the multiple phase transitions and catastrophes that led to our existence, show what astronomers are building now, speculate on how far we can go, and ask, how can we contribute to the survival of complex life and society here on Earth and elsewhere?

## 9:00pm – 9:30pm: Closing Remarks & Awards

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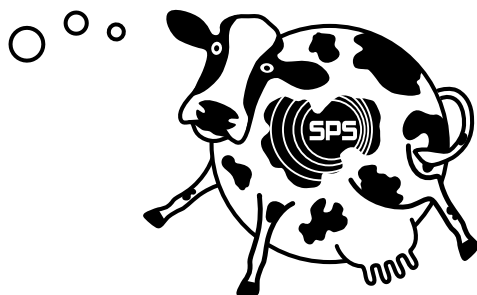
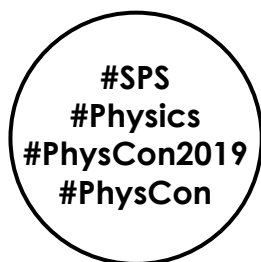
**Location: Exhibit Hall A**

## 9:30pm – 11:30pm: Congress Club – Dance Party

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**Location: Junior Ballroom – Convention Center, Room 555/556**

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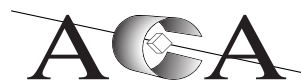
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### 2019 Physics Congress

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## 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. The only requirement for membership is that you be interested in physics. In addition to physics 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; to encourage interest in physics among students at all levels; to promote an attitude of service of its members towards their fellow students, colleagues, and the public; and to provide a fellowship of persons who have excelled in physics. 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, government relations, 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 120,000 scientists, engineers, and educators in the global physical science community.



## Previous Sigma Pi Sigma Congresses

The 2019 Physics Congress is taking place this week in Providence, Rhode Island, and is the latest in a long line of congresses hosted by Sigma Pi Sigma. Congresses have played an integral role in the development of Sigma Pi Sigma as an honor society, and, while the meeting has evolved over the years, one of its core purposes has stayed the same: to provide direction and vision to Sigma Pi Sigma and the Society of Physics Students. The event is used as an opportunity to acknowledge our successes and determine where the community needs to move in the coming years.

The first congress was held in 1928 at Davidson College in North Carolina, and six chapters attended. They elected national officers, including Marsh White, who became a lifelong active participant in Sigma Pi Sigma. In 1934, the third congress was held at the University of Kentucky, attended by nineteen chapters. During this congress Sigma Pi Sigma transitioned from a fraternity to an honor society and set the standard that membership was dependent on academic excellence. In 1967, a special congress saw ninety chapters vote to merge Sigma Pi Sigma with the American Institute of Physics, a move that gave birth to the Society of Physics Students.

In 1992, Sigma Pi Sigma hosted the first congress in 25 years, in Dayton, Ohio—often referred to as the first modern congress. The primary reason that congresses restarted in 1992 was to determine the feasibility of a 75th anniversary celebration in 1996. Based on the success of the 1992 meeting, plans moved forward.

The 1996 "Diamond Jubilee" congress celebrated the 75th anniversary of the founding of Sigma Pi Sigma and addressed the theme "Looking Back, Looking Forward." Held in Atlanta, Georgia, participants heard from exciting speakers such as Dr. Robert Ballard and Dr. Alan Lightman, and the tradition of hosting small group discussions or "breakout sessions" was started.

The 2000 Congress in College Park, Maryland, fully implemented breakout sessions, celebrated the unique creativity of Sigma Pi Sigma members, and featured a large-scale discussion on the state of diversity in physics. Attendees didn't just talk about important issues; they made recommendations to the physics community at large about the state of physics and physics education through the National Task Force on

Undergraduate Physics. The 2004 Congress, held in Albuquerque, New Mexico, set the direction for future congresses. It included tours of the Trinity Test Site in the Jornada del Muerto Desert, and developed ten recommendations related to ethical conduct for Sigma Pi Sigma and the Society of Physics Students. Breakout sessions became full-fledged workshops where attendees discussed important topics such as "Career Choices & Weapons Research" and "Professional Integrity in Research & Authorship," for example.

Four years later at Fermilab in Batavia, Illinois, the 2008 Congress addressed the theme of "Scientific Citizenship: Connecting Physics & Society." Over 600 people attended this congress, setting forth recommendations that led to a renewed commitment by Sigma Pi Sigma and the Society of Physics Students (SPS) to encourage diversity in physics. These recommendations led to the creation of the Future Faces of Physics initiative, which includes a \$500 award for SPS chapters to hold events that cross cultural divides. The 2008 Congress also included an art contest for the first time, where attendees shared connections between art and science.

The 2012 Congress, held in Orlando, Florida, was built around the theme "Connecting Worlds Through Science and Service." More than 800 attendees enjoyed a kick-off tour of the NASA-Kennedy Space Center, and heard from science luminaries including Freeman Dyson and Physics Nobel laureate Dr. John Mather. The meeting also included the first dance party, a standing tradition that will be continued this week. Service has been an integral part of Sigma Pi Sigma since the 1934 Congress, when it was written into the society's mission. Many members and chapters are extremely active in their community, and former president Diane Jacobs said it best: "On the brochure students receive when they are invited to join Sigma Pi Sigma are printed the following words: honor, encouragement, fellowship, and service. These are the cornerstones of our physics honor society." Sigma Pi Sigma members take their responsibility to serve their community to heart, and the 2012 Congress theme was an extension of that dedication.

Each congress has helped to guide the next, with the 2016 Physics Congress, "Unifying Fields: Science Driving Innovation," feeding off the energy and direction of past congresses. The 2019 Physics Congress is no exception, with a theme of "Making Waves & Breaking Boundaries." Sigma Pi Sigma's Physics Congress has become the largest meeting of its kind (known) and a unique meeting targeted at undergraduate physicists in the United States, bringing together nearly 1,200 undergraduate and graduate physics students, faculty, alumni, and others in 2016. The 2019 Physics Congress focuses on how students are not the only future of the field but can and should act now to make waves throughout the community. Only by acting together can we make waves and support everyone who wants to study physics and astronomy. Talks, plenaries, and the congress workshop events help provide an atmosphere for attendees to grow and develop as members of the community, as well as provide important guidance and feedback for Sigma Pi Sigma and SPS. Make this congress your own and impact the future of the field.

*—by Sigma Pi Sigma staff*



RIGHT  
The first Sigma Pi Sigma national convention, held on the campus of the founding chapter, Davidson College, NC. Six chapters were represented, national officers were elected, and life-long leader Marsh White (first row, far left) became Secretary/Treasurer. Photo courtesy of American Institute of Physics.

## SIGMA PI SIGMA PRESIDENTS

**James Douglas**

Davidson College

**Robert Graces**

Davidson College

**Charles Hatley**

Duke University

**Roscoe Young**

College of William & Mary

**Marshall States**

Central Scientific Co.

**Robert Colwell**

University of West Virginia

**Frederic Blacke**

Ohio State University

**Joyce Stearns**

University of Denver

**Homer Dodge**

Norwich University

**Merriam Trytten**

National Research Council

**Vincent Parker**

Oak Ridge Associated Universities

**Stanley Ballard**

University of Florida

**L. Worth Seagondollar**

University of Kansas

**Marsh White**

Pennsylvania State University

**Donald Tendam**

Purdue University

**Cecil Shugart**

Northeast Louisiana State University

**Wallace Hilton**

William Jewel College

**Arnold Strassenburg**

SUNY at Stony Brook

**Richard Waring**

University of Missouri KC

**George Miner**

University of Dayton

**Reuben James**

SUNY College of Oneonta

**Jean Krisch**

University of Michigan Ann Arbor

**Thomas Olsen**

Lewis & Clark College

**Steve Feller**

Coe College

**Ann Viano**

Rhodes College

**Diane Jacobs**

Eastern Michigan University

**William DeGraffenreid**

Sacramento State University

**Willie Rockward**

Morehouse College

**James Borgardt**

Juniata College

## SOCIETY OF PHYSICS STUDENT PRESIDENTS

**Stanley Ballard**

University of Florida

**Leroy Humphries**

McMurry College

**Hla Shwe**

East Stroudsburg State College

**William Eidson**

Drexel University

**Ray Askew**

Auburn University

**Gary Agin**

Michigan Technological University

**Jean Krisch**

University of Michigan Ann Arbor

**Fred Domann**

University of Wisconsin Platteville

**Robert Fenstermacher**

Drew University

**Gary White**

Northwestern State University of  
Louisiana

**Karen Williams**

East Central University

**Earl Blodgett**

University of Wisconsin River Falls

**Toni Sauncy**

Angelo State University

**Dave Donnelly**

Texas State University San Marcos

**DJ Wagner**

Grove City College

**Alina Gerba-Sell**

United States Air Force Academy



# Tour Guidelines

One of many components that makes the 2019 Physics Congress different than a traditional conference is the opportunity to join one of the following Physics Congress tours on Thursday and Friday. Only fully paid PhysCon registrants can go on the tours, which 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 Thursday morning, November 14, 2019. Plan to arrive Wednesday, November 13, due to early bus departures. Tours vary in length but will allow for full conference attendance.

## 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 AT REGISTRATION AT THE LISTED TIME FOR YOUR TOUR.** Roundtrip shuttle service is provided to transport Attendees from the Rhode Island Convention Center 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 alternate 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.

Please tag  
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on your social  
media posts



## T-01: Woods Hole Oceanographic Institution

Woods Hole Oceanographic Institution (WHOI) is a private, nonprofit research and higher education facility dedicated to the study of marine science and engineering. Its scientists and engineers are committed to understanding all facets of the ocean, as well as its complex connections with Earth's atmosphere, land, ice, sea floor, and life—including humanity. Its work touches every aspect of physics: geological activity deep within the earth; plant, animal, and microbial populations and their interactions in the ocean; coastal erosion; ocean circulation; ocean pollution; and global climate change.

Students will hear from field experts, tour WHOI facilities, and potentially tour their research vessel.

Moderate walking.

Additional lunch cost: \$10

### Entrance Requirements:

- You may not enter into unauthorized areas.

## T-02: Naval Submarine Base New London

The Naval Submarine Base New London is the Navy's first submarine base and home of the Submarine Force Library and Museum. A naval yard in 1868, the site is now home to a submarine school, a major submarine construction yard, and home port for several submarines. Come visit the museum, tour an active duty submarine (Los Angeles or Virginia class), and investigate the high stress trainers and sub simulator.

Moderate walking. Wheelchair accessible except on submarine.

Lunch on your own, can be purchased on site.

### Entrance Requirements:

- Must be a US citizen.
- Bring Photo ID.
- You may not enter into 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: Brown University Department of Physics

Dating back to 1772, Brown University's Department of Physics is a leader in the science community. Explore up to six cutting-edge research laboratories, hear from field luminaries, visit with department faculty, and tour the campus with the local SPS chapter. With research specialties including Astrophysics & Cosmology, BioPhysics, Condensed Matter, Particle Experimental, and High Energy Theory, the department has a lot to offer any upcoming physicist.

Extensive walking. You may not enter unauthorized areas.

Lunch on your own, can be purchased on site.

## T-04: Harvard University Department of Physics

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The Department of Physics at Harvard is large and diverse in its research interests. With 10 Nobel Prize winners to its credit, the distinguished faculty of today engage in teaching and research that span the discipline and define its borders. Accordingly, Harvard is consistently one of the top-ranked physics departments in the nation. Visit research laboratories (Center for Nanoscale Systems, BioPhysics, Robotics, and more), hear from Harvard faculty, learn about their graduate program, and explore their cutting-edge research through a poster session.

Extensive walking. You may not enter into unauthorized areas.

Lunch on your own, can be purchased on site.

## T-05: MIT Department of Physics

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The highly acclaimed MIT Physics Department's mission is excellence in physics research and teaching. The department also aims for inclusion—to tell the story of the physical universe to the world means having all the world's voices as part of the community.

Come visit this center of research that strives to be at the forefront of many areas where new physics can be found. The local SPS chapter will guide the tour to visit research laboratories (up to ten options), the campus facilities, and to hear from leaders in the field.

Extensive walking. You may not enter into unauthorized areas.

Lunch on your own, can be purchased on site.

## T-06: Rhode Island Hospital

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Interested in medical physics as a career? This tour is for you! Visit the Rhode Island Hospital, located in the Federal Hill neighborhood of Providence.

This interactive tour will let you see what it's really like to be a medical physicist! The tour includes a talk by two recently graduated medical physicists, detailed information about career pathways for medical physicists, advice on graduate school options, and a clinical tour featuring dosimeters, CTE scanner, patient immobilization, and much more.

Moderate walking.

Lunch on your own, can be purchased on site.

### Entrance Requirements:

- Bring photo ID.
- Tour occurs in medical hospital.
- You may not enter into unauthorized areas.

## T-07: Optikos Corporation

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Interested in a career in industry? Want to know where your physics undergraduate degree could take you? Optikos Corporation is known worldwide for its products and systems used in the measurement of optical image quality, and for expert optical product design and manufacturing in life sciences, defense, consumer products, automotive, and other industries and applications. Located just north of Boston, see what industrial physicists do, visit research and development laboratories, hear from industry leaders including Stephen Fantone, 2020 president of The Optical Society (OSA), and explore how you can use your physics degree after graduation.

Moderate walking.

Accessibility: Not advised for the severely visually impaired.

Additional lunch cost: \$10

### Entrance Requirements:

- US Citizens and Permanent Residents bring photo ID; non-US citizens bring passport.
- No photography without express permission.
- You may not enter into unauthorized areas.

## T-08a: LADD Observatory (Thurs. evening tour)

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Night tour! The historic LADD Observatory dates back to 1891 and houses the original 12" refracting telescope with a lens made by John A. Brashear of Pittsburgh following the lens design of Prof. Charles S. Hastings. Come see this feat of engineering along with a breathtaking collection of astronomical instruments. Tour the historic observatory, learn about observational astronomy, and (weather permitting) join us for an evening of observing. Bring warm clothes!

There are two tours of LADD Observatory available.

Moderate walking.

Accessibility: Not advised for the severely visually impaired.

## T-08b: LADD Observatory (Fri. evening tour)

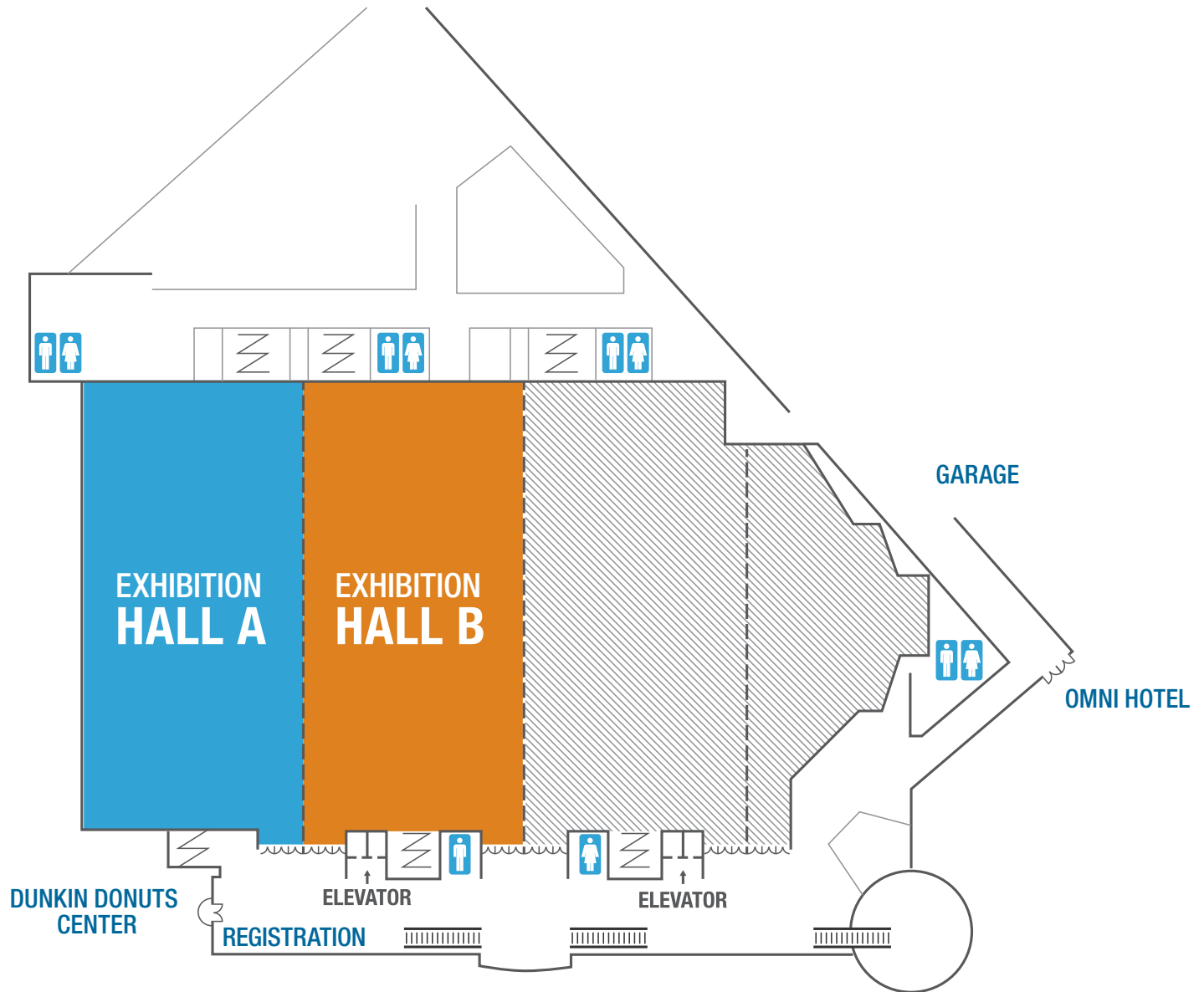
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Night tour! The historic LADD Observatory dates back to 1891 and houses the original 12" refracting telescope with a lens made by John A. Brashear of Pittsburgh, following the lens design of Prof. Charles S. Hastings. Come see this feat of engineering along with a breathtaking collection of astronomical instruments. Tour the historic observatory, learn about observational astronomy, and (weather permitting) join us for an evening of observing. Bring warm clothes!

There are two tours of LADD Observatory available.

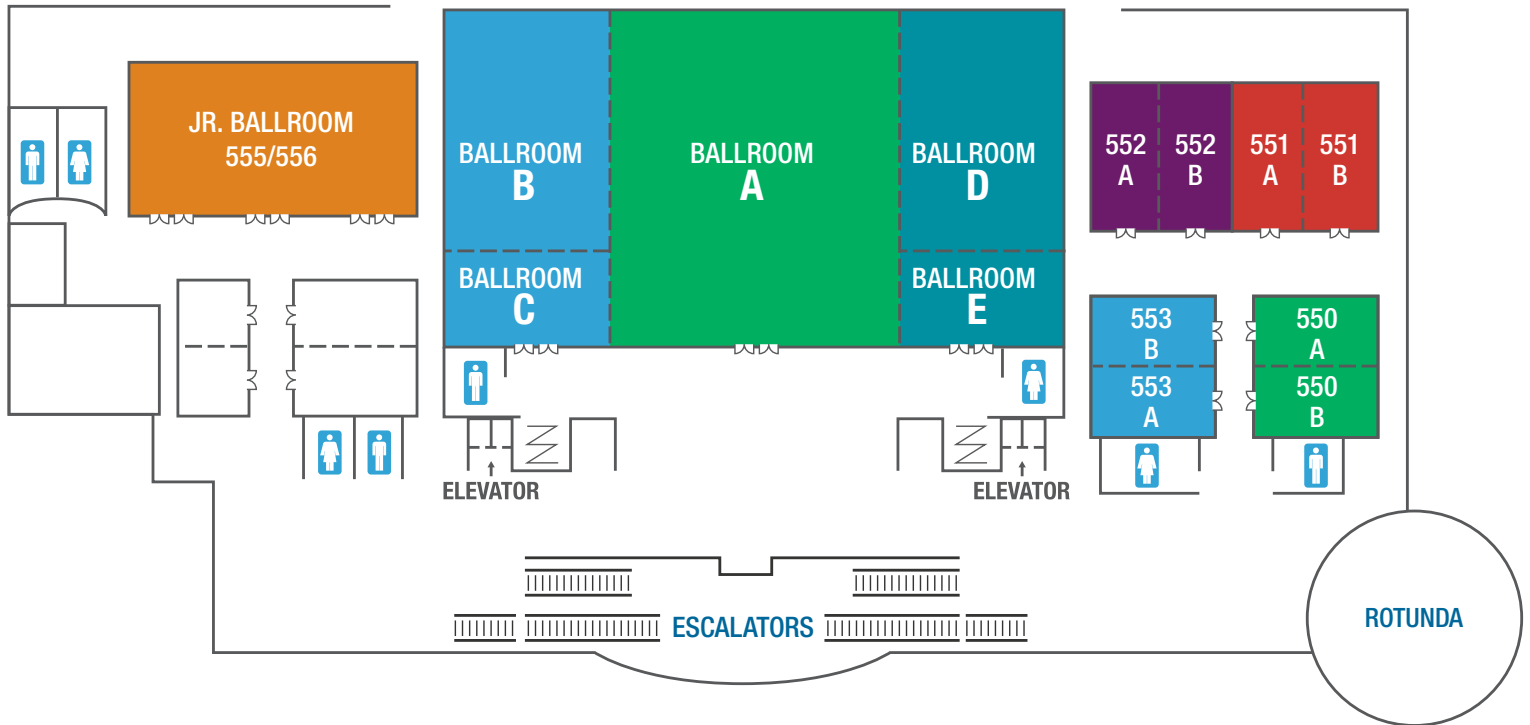
Moderate walking.

Accessibility: Not advised for the severely visually impaired.



## 3rd FLOOR





## 5th FLOOR

Please tag @SPSNational on your social media posts



#SPS  
#Physics  
#PhysCon2019  
#PhysCon

### DAME S. JOCELYN BELL-BURNELL, HONORARY CHAIR

#### Plenary I – Jocelyn Bell-Burnell Returns to PhysCon



Photo courtesy of Dame S. Jocelyn Bell-Burnell.

One of the most famous female astronomers will return to speak at PhysCon for the fourth time. Dame S. Jocelyn Bell-Burnell, known both for her discovery of pulsars in 1967 and her scientific leadership in the decades since, will serve as honorary chair and provide the opening talk as well as scientific context for our other speakers.

Bell-Burnell was a graduate student at Cambridge—one of the very few women in the program—searching for quasars when she noticed the “scruff” on the paper charts produced by a new radio telescope. That “scruff” was the first detected pulsar.

Pulsars are rapidly rotating neutron stars, and beyond being interesting in their own right, they have been used to study the “stuff” in space outside of any solar system and indirectly detect gravitational waves.

Many students know what happened after Bell-Burnell’s landmark discovery. Bell-Burnell’s advisor, Antony Hewish, and another astronomer, Martin Ryle, were nominated for, and subsequently won, the Nobel Prize for their role in pulsar discovery in 1974. Bell-Burnell has said that she understands the logic of rewarding supervisors rather than students; she also told this magazine in 2012 that not winning the Nobel meant she was “carried on a great wave of sympathy and a great wave of feminism.... It’s a waste of energy worrying about that kind of thing.”

Afterward, Bell-Burnell had a wide-ranging career in astronomy, studying stars in almost every band of the electromagnetic spectrum. She has headed the Royal Astronomical Society and served as the first female president of both the Institute of Physics and the Royal Society of Edinburgh.

The accolades are still coming. Earlier this year, she was awarded a Special Breakthrough Prize in Fundamental Physics, a recognition that comes with a \$3 million award. The prize was awarded “for fundamental contributions to the discovery of pulsars, and a lifetime of inspiring leadership in the scientific community,” prize organizers said.

Bell-Burnell told Space.com earlier this year that she plans to spend the \$3 million to fund graduate students from underrepresented groups in physics through the Institute of Physics.

“I feel that I made my contribution in part because I felt an outsider,” she told the outlet. “I was one of very few women, and I wasn’t from the southeast of England, the affluent part of the country. So, I think increasing diversity of the workforce actually allows all sorts of things to develop.”

At the Breakthrough Prize awards ceremony in November, she added in a brief speech that “One of the most delightful things is that some people have... been in touch, saying, ‘How can we also contribute and add to this fund?’ So hey, Breakthrough, we might have a breakthrough.”

For more about Bell-Burnell’s career, check out “Resolved: Noted Scientist Shares Her Journey” in The SPS Observer, Winter 2012 issue.

— by Rachel Kaufman, Editor

### SANDEEP GIRI

#### Plenary II – Such Great Heights on building products, quitting academia, and putting internet in the sky



Photo courtesy of Sandeep Giri.

Sandeep Giri spent years developing manufacturing facilities in Puerto Rico to enable the building of giant balloons and their payloads that X (an Alphabet company; formerly Google X) needs to run Project Loon, an ambitious project to bring the internet to remote and rural areas using a network of stratosphere-based balloons.

Hurricane Maria destroyed the facility in two hours.

Undeterred, Giri (at the time Loon’s manufacturing engineering manager) and his team leapt into action. Within a few weeks, they had steered an adequate number of balloons into the skies above Puerto Rico, restoring connectivity for text-messaging and email to 200,000 Puerto Ricans. The newly built facilities sustained this service for months. This was an important milestone for the Loon project, which had never provided internet service at this rapid pace or scale before.

Born to a blue-collar family in India, Giri says he’s grateful for the emphasis his parents placed on education. By chance, at a forum for Indian students interested in getting student visas to study in the United States, he met a professor from Coe College (Iowa) in the lobby of a Calcutta hotel. “Coe was not even on my radar, I hadn’t even heard of the college or Iowa. But the professor insisted, ‘Why don’t you apply?’” Giri applied right in the lobby, and was subsequently accepted and offered a generous scholarship (for which he is still grateful).

At Coe, initially, Giri was aiming for a computer science major. Then, by chance, he met physics professor Steve Feller, who invited Giri to his lab to work on glass research. “I had never done research,” Giri says. “I had never really done experiments on fundamental science... That’s what got me—it was totally new to me.” He went on to earn his undergraduate degree in computer science and physics, and a master’s in materials science; he then went on to pursue a PhD.

As Giri has related in the Fall 2018 issue of the SPS Observer, his PhD was going well when he met a friend of a friend in industry. “[The employees there] were using the same vacuum deposition technique I was using in my grad school lab... It seemed like a direct application of what I had been doing. I was like, I can use my skills to actually build a product?” He considered dropping out of school and getting to work.

It was a tough decision. His PhD results were actually “looking super interesting,” and he’d just passed his qualifying exams at Stanford, which had a low pass rate. “Mentors were telling me, ‘Are you sure? You’re quitting a prestigious PhD at Stanford?’ But I went with my instinct that I wanted to build products.”

Giri landed a job at Qualcomm, working on microelectronics devices for displays in consumer electronics, and learned “all the phases of product development.” He even helped develop patents for anti-stiction coatings for microelectronics that he eventually helped incorporate into their products while living in Taiwan.

After a few years, a friend recruited him to Google, where his product development experience came in handy for working on the ill-fated smart

glasses known as Glass. “From our end, we did good work,” he says. “It was a solid product.”

After Glass wound down, Giri joined Loon. “I never thought I would work on balloons—this was an audacious idea Google was behind,” he said. He developed the manufacturing engineering branch, bringing it up from scratch and launching manufacturing facilities in Nevada and Puerto Rico. The launch of balloon-based internet service to Puerto Rico after Maria was “a big win” for the project. Google is still working on further developing Loon, using the manufacturing facilities Giri helped build (and rebuild).

Now, surprisingly, Giri has come almost full circle to his early physics days, working on building the next generation of processors for Google’s machine learning and artificial intelligence.

“These are extremely fast—some of the fastest computers in the world. I’m part of the team that helps design and build them. “We are kind of approaching the end of Moore’s law,” he adds, referring to the observation that the number of transistors in a circuit doubles every two years but that the laws of physics dictate that transistors can only be miniaturized so far. “This is something I studied back in high school physics, and now I am living it,” he says.

— by Rachel Kaufman, Editor

## DR. ELLEN WILLIAMS

### Plenary III – Energizing Change



Photo courtesy of Ellen Williams.

Ellen D. Williams has a storied career in surface statistical mechanics, nanoscience, and energy technology.

Now, the former head of the Advanced Research Projects Agency-Energy (ARPA-E) is bringing her wisdom, experience, and climate optimism to PhysCon to inspire the next generation to use their physics knowledge to solve the world’s most pressing energy problems.

Climate change “is very scary, [but] I have to be optimistic. We can do it—and we just have to do it,” Williams says.

In a way, coming back to energy innovation—both at ARPA-E and in her post-ARPA-E career—is coming full circle for Williams, who was very excited about environmental issues way back in high school. But as an undergraduate, she became “more oriented toward physical chemistry,” and eventually, surface science. Her research at the University of Maryland focused on studying the growth of materials used in semiconductors.

For decades she did this work, racking up numerous publications, awards, and honors along the way. Then in 2010, BP came knocking.

“I was invited to apply for the position of chief scientist at BP, and I thought, ‘How could I possibly do that?’ And then I thought, ‘Maybe I could.’” Williams was still interested in energy and climate change, and, at that time, BP was investing in solar and biofuels, so it seemed like a match. During her tenure at BP, Williams ran a sustainability initiative at the company and led the creation of reference publications on oil and gas’s impact on the environment, specifically on water, land, and scarce materials, in addition to climate change.

In 2014, she was tapped by Ernest Moniz, then the US secretary of energy, to head up ARPA-E, the DOE’s agency focused on identifying

and funding cutting-edge energy technologies. “It’s a great agency, it was a wonderful job. I had an incredibly productive time there,” she says. When asked for examples of the types of innovative technologies that ARPA-E supports, Williams says there are so many that it’s hard to select just a few. She describes radiative cooling—the development of materials that emit waste heat to outer space and create passive cooling. She also is enthusiastic about developing plant-based photosynthesis to extract carbon dioxide from the air and store it as solid materials in the soil. She offers other examples in energy storage, low-energy materials processing techniques, high-power lasers for accessing geothermal energy, energy implications of vehicle automation, and pauses to say, “Obviously I could talk about this all day.”

With the change of administration in 2016 came another job change, and Williams found herself back at UMD, teaching, researching, and consulting on energy technology innovation. “It was actually a bit of a surprise [to be back in the energy field],” after all these years, she says. “I went away from that path [but] it never left me. But the skills I developed through my life made it possible for me to make that transition,” she says. Williams adds that undergraduates should also focus on developing their “skills.... Find the things that excite you and that you can do well, and get really good at them. And then you can take those skills and go out and find the problems where you can have an impact.”

— by Rachel Kaufman, Editor

## DR. JAMI VALENTINE MILLER

### Plenary IV – Dr. First: Jami Valentine Miller

It can be lonely being the first. But Jami Valentine Miller—the first African American woman to get a physics degree from Brown University and the first African American woman to get a PhD in physics from Johns Hopkins University—is used to being the first.

Thanks to her work founding African American Women in Physics, other “firsts” may feel a little less lonely.

Miller was born in Philadelphia, where she realized her aptitude for math at an early age. This led her to a middle school magnet school for math and to a high school program that gave her college prep over the summer.

After those experiences, “I knew I was going to major in a science or engineering field,” Miller said. “It felt completely natural. It didn’t feel at all odd to be a black girl in Philadelphia who wanted to [do that].”

At a college fair at her high school, she was recruited to a historically black college and university (HBCU), Florida A&M University, where she earned a BS in physics. At the time, FAMU didn’t have a graduate program in physics, so she went to Brown for her master’s, then Johns Hopkins for her PhD.

“One of the things HBCUs do is they prepare you for life in the real world,” Miller said. “In the real world, you’re not going to be in a situation that’s 95% minority. [At Brown], I made friends, I socialized. It was definitely a culture shock because Tallahassee is not Providence... It was different, but I was prepared.”

Fast-forward 7 years, and Miller was just finishing her dissertation in materials for spintronic applications when her advisor insisted she get



Photo courtesy of Jami Valentine.

a job lined up before defending. She applied to as many positions as possible and heard back from the US Patent and Trademark Office.

"It was 8 months of paid training. I was like, 'I'll take this job while I wait to hear back from my true passion—a postdoctoral position.'" But patent examining turned out to be Miller's dream job, and she's still there. "I enjoy the work, [and] it's related to my dissertation."

At the same time she was finishing her dissertation, Miller became acutely aware of how few other black women she knew in physics, and she started an Excel sheet to track the few she knew of.

"At the time there were less than 50. I'd meet these women at different conferences [and track] who they were, what were their careers. I posted it on my website at Hopkins." That Excel sheet eventually grew into African American Women in Physics (<http://aawip.com/>), a site to celebrate African American women "who are doing amazing things," Miller says.

"It's also a safe space where people can discuss their concerns or any situations they might be in, because most people are going to be the only African American woman—possibly the only African American or the only woman [in their program]."

The women trade advice on navigating their careers and "talk about what it's like to be the first" African American woman in their program. "If you didn't go to Stanford or Howard, you were probably going to be the first," Miller says.

Now, Miller is celebrating the accomplishments of these women while also showing that physics is central to everything. At PhysCon, when she returns to the city where she got her master's, she'll discuss how physics and intellectual property are related.

"I'm biased," she says, "but everything is physics. If you want to be an electrical engineer, all you have to do is figure out the vocabulary ...because they're still doing physics, they're just calling it something slightly different.... Even if you're just [building a] table, a table has to be balanced. There's physics in there. If you're interested in it, go for it."

— by Rachel Kaufman, Editor

## DR. JOHN MATHER

### Plenary V – A Nobel's Next Move



Photo courtesy of NASA.

How do you look back at the earliest days of the universe? John Mather knows. As the scientific leader of the Cosmic Background Explorer (COBE), John Mather kept a team of 1,500 focused on the prize: looking back at the earliest days of the universe, at light that no one had seen before.

And he's going to do it again, looking back to within 200 million years of the big bang as the senior project scientist for the James Webb Space Telescope (JWST).

"We're looking for those rare things that are at the earliest times in the universe—that's something that I'm really excited about," he told Space.com in a 2011 interview. Mather will bring the excitement of JWST and its potential to answer unanswered questions to PhysCon as a plenary speaker.

Born in Roanoke, Virginia, in 1946 and raised in New Jersey, Mather grew up interested in math and science. He wrote in 2006 that his

earliest school memory, from age 6, was "realizing that one could fill an entire page with digits and never come to the largest possible number, so I saw what was meant by infinity." A voracious reader, he hid books under his desk and read rather than pay attention to lessons.

By fourth grade, given a radio kit for Christmas, he quickly was entranced and saved his allowance for a better one to listen to broadcasts from around the world.

He majored in physics as an undergraduate at Swarthmore and moved to Berkeley for graduate research. There, he worked on a project to measure the cosmic microwave background (CMB). Arno Penzias and Robert Wilson had discovered the CMB in 1964 when their new radio telescope picked up a low but steady signal, even after they had eliminated every imaginable source of interference (including pigeon droppings in the antenna). The cosmic microwave background is the earliest electromagnetic radiation in the universe, and its structure is some of the best evidence we have for the big bang.

"I started right in," Mather wrote. The project was to build a far-infrared spectrometer that would be taken to a mountain in California and pointed at the sky. The spectrometer yielded some "interesting" data, so the next step was to attach a spectrometer to a balloon that would raise it above the Earth's atmosphere to get a better picture of the CMB. This half of the project did not go quite as well. As Mather recalled:

"I'm afraid that my skill was stronger in understanding than it was in implementation, and it's a true story that the antenna on the balloon payload fell off while it was on the launch pad. It was my solder joint that failed. Fortunately, this fault was noticed, and the payload was launched successfully. However, it also was true that we had gotten tired of testing, and our instrument did not work, for three different reasons. It was an awful feeling—one that stayed with me for the rest of my life."

Luckily Mather was still able to finish his thesis, writing about the ground-based observations and the design for the balloon instrument. After graduating, he went on to new adventures—but quickly turned back to the cosmic microwave background and began working on what would become COBE. In 1989, the instrument was launched; in 1992, the spacecraft's measurements of the "wrinkles" in the CMB made the front page of the New York Times. In 2006, he and collaborator George Smoot were awarded a Nobel Prize for their work.

Mather says JWST is now his "major passion." James Webb, scheduled to launch in 2021, represents "the hopes and ambitions of the 10,000 astronomers who have already used the Hubble," he told Space.com in 2011. Immensely more powerful than Hubble, JWST will be able to see further back in time to see the earliest galaxies in the universe. "I'm pretty confident there will be surprises out there," he said, "things that will be worth all this work."

— by Rachel Kaufman, Editor

## S. JAMES GATES

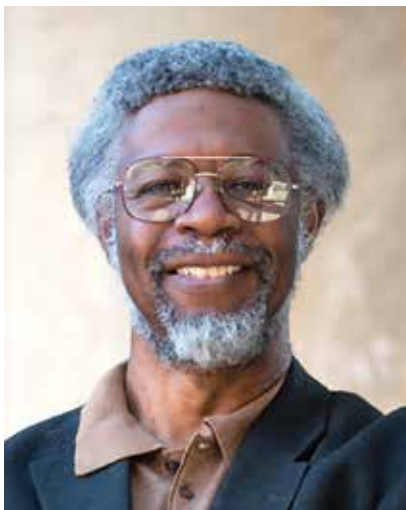
### Special Speaker – The Universe According to Jim Gates

Supersymmetry expert S. James Gates, distinguished professor and Center for String & Particle Theory director at the University of Maryland, will be featured as one of the keynote speakers at PhysCon.

If we are living in the Matrix, Jim Gates will probably be the first one to figure it out.

The theoretical physicist, who will give one of the plenary talks at PhysCon this year, has spent his entire career looking for supersymmetry. It's a concept tough for many to wrap their heads around, but it proposes that all particles have partners (that we haven't discovered yet).





S. James Gates. Photo by Sarah L. Voisin/  
The Washington Post via Getty Images.

Along the way, Dr. Gates has gotten attention for discovering what he says is computer code in the math of supersymmetry. Specifically, he said he has found an error-correcting mechanism; others have analogized this code to the checksums that make the Internet work by ensuring that transmitted information is accurate. This find has led him to speculate—in a mostly joking way—that we might be living in a giant computer simulation.

What this would mean for our universe is not yet clear. But Gates is content to keep looking until he finds out.

Sylvester James Gates, born December 15, 1950, in Tampa, Florida, was fascinated by science at an early age. He cites books on space travel that his father bought him at age eight as sparking his interest. “A world exploded in my head,” he said in 2013, “because I could see from these books that these tiny points of light in the sky at night were places you could go. And somehow in my young mind I knew that mathematics and science had something to do with going to those places.”<sup>1</sup>

A bit character in an episode of the sitcom *Make Room for Daddy* inspired him to set his sights on MIT. Gates told NOVA that seeing a smart kid who attended MIT on that show was “how I found out that there’s a place you can go to college where they only make you study the good stuff,” the good stuff being math, science, and engineering.<sup>2</sup>

But as he grew older, Gates, who is African American, faced racial biases on the road to college. “I had to learn to be black,” he said in a 2013 speech.

A few years prior to Gates discovering MIT, his father left the US Army and moved to Orlando, Florida. At that time, the army had integrated schools, but Orlando did not.

“Segregation is an interesting phenomenon to experience,” he said. “The people that are the minority come to believe the things that are said about them... One day on the playground... another African American said, ‘You’re pretty good at school.’ And I said, ‘Thank you.’ And he said, ‘But you can’t be as smart as a white guy.’”

When it came time to apply to college a few years later, “I understood lots of things about the rules of how our society worked in those days, and I thought there’s no way in the world that I would have the opportunity to go to such a place.” He would have stopped himself from applying, but his father “literally forced me to fill out the application form.”<sup>3</sup>

Gates was accepted. At MIT he earned two degrees, one bachelor’s in math and another in physics, and went on to earn his PhD there four years later. His dissertation was the first written about supersymmetry at MIT, and no professors there could help him. Undaunted, he taught himself, earned his degree, and moved on to Harvard.

After a number of prestigious research and teaching positions, Gates landed at the University of Maryland in 1984.

Since then, Gates has been plugging away at supersymmetry and string theory. His research has been recognized with the National Medal of Science and the Mendel Medal, as well as an appointment to the President’s Council of Advisors on Science and Technology.

We do not yet know whether string theory or supersymmetry is true. The first round of experiments at CERN’s Large Hadron Collider found no evidence of supersymmetry. But that’s just a push to keep going, Gates says.

“String theory is often criticized as having had no experimental input or output, so the analogy to a religion has been noted by a number of people,” Gates told NOVA. “In a sense that’s right; it is kind of a church to which I belong. We have our own popes and House of Cardinals. But ultimately, science is also an act of faith—faith that we will be capable of understanding the way the universe is put together.”<sup>4</sup>

And if string theory is correct, so what? Well, Gates admits he doesn’t know. But think of scientists like James Maxwell who unified electricity and magnetism. “One can imagine saying, ‘Professor Maxwell, what do your equations mean?’ He would struggle for answers. He would say, ‘Well, you know, the electric and magnetic phenomena are not separate, they’re part of a unity.’ But beyond that I think he would be rather hard-pressed to tell you what it means. One hundred and fifty years later we can answer this question very easily. A large fraction of our technological basis rests on his work.”<sup>5</sup>

“So if string theory is correct, what does it mean? Well, one can imagine 150 or 200 years from now some marvelous piece of technology that’s beyond my imagining. Maybe it’s a transporter from *Star Trek*, perhaps it’s warp drive, maybe our species finally is released from ... being contained in a single solar system.”<sup>6</sup>

Until then, Gates will keep looking.

## References

1. World Science Festival. “The Moth: Go Tell It on the Mountain - Jim Gates”. YouTube video, 21:17. December 5, 2013, <https://youtu.be/gDCbBWfhJ1o>.
2. Gates, Jim. Interview with Joe McMaster. NOVA, Public Broadcasting Service, July 2003.
3. World Science Festival, 2013.
4. McMaster, NOVA, 2003.
5. Ibid.
6. Ibid.

— by Rachel Kaufman, Editor



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## WORKSHOP 101: SCIENCE POLICY FOR SCIENTISTS

### Leaders:

Anna Quider, Northern Illinois University  
John Mather, NASA

Abstract: 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. Co-led by a seasoned science policy professional and a Nobel Prize winning scientist working on a large government funded project, the 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.

## WORKSHOP 102: PHYSICS FOR HUMANS

### Leaders:

Randy Tagg, University of Colorado Denver  
John Andersen, Rochester Institute of Technology

Abstract: In this hands-on, maker/thinker/problem solver workshop, learn and experience how physicists are at the forefront of solving problems that profoundly affect human life. Armed with a broad understanding of the interactions that drive the natural world and knowledge of the function of a vast array of technologies, the problem solving power of physicists will be used to impact life as we know it. This workshop is for the curious and the inspired!

## WORKSHOP 103: MAKING ROOM IN PHYSICS FOR EVERYONE

### Leaders:

Jackie Chini, University of Central Florida  
Geraldine Cochran, Rutgers University

Creating inclusive environments that support diverse populations is a rewarding, though at times challenging, endeavor. Furthermore, without preparation we may find ourselves ill-equipped to address in-the-moment threats to inclusive and welcoming environments.

In this workshop, participants will engage in activities designed to help them think about how to create inclusive environments in a variety of settings, including local SPS meetings, active learning or collaborative group work in class, academic settings outside of the classroom, and their local communities. Workshop facilitators will utilize think-pair-share activities, practice scenarios, and modeling to walk participants through strategies to mitigate the impact of bias.

## WORKSHOP 104: THE PHYSICS OF CLIMATE CHANGE – PUTTING NUMBERS TO THE ISSUE

### Leaders:

Ellen Williams, University of Maryland  
Earl Blodgett, University of Wisconsin – River Falls

Abstract: In this workshop, learn how to apply physics thinking to solving climate change through Fermi problems. What are the facts? What is the role of the individual, a community, a region, a nation, or the

whole human population of the planet? If you have ever wondered how to get to the heart of what really matters - what will impact the future - this is the workshop for you!

## WORKSHOP 105: PHYSICS CAREERS – NOT JUST FOR ACADEMICS!

### Leaders:

Katherine Zaunbrecher, Ridgeview Classical School  
Kirtley Watts, Puratos Corporation

Abstract: Learn about exciting career options! During this concurrent two-panel session, you will hear from physical scientists working in careers outside academia. Careers in industrial physics, Woods Hole Oceanographic Institute, NASA, and medical physics will be highlighted. Seating is limited to allow an in-depth conversation between panelists and attendees. These professionals will help you focus your career objectives and consider pathways you've never thought of.

## WORKSHOP 106: A DAY (OR A WEEK, OR A FEW YEARS) IN THE LIFE OF A GRAD STUDENT

### Leaders:

Sam Pedek, Physicist  
Brittney Hauke, Penn State University

Abstract: Considering grad school? Curious about the realities of grad school? Wondering about the quality of life and how you might fit in?

### Interested in student opportunities at the American Physical Society?



APS develops and implements a range of programs for undergraduate students to promote the recruitment, inclusion, and support of underrepresented minorities in physics and provide the tools necessary for the retention and career development of women physicists.



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This dual-panel session offers a glimpse of life in grad school through the eyes of current students. Pick the brains of grad students in the first three years of their programs. Come experience what life is really like in that advanced degree program. Walk between two separate panels to explore all your options (45 minutes for each panel). One panel will focus on Physics and Astronomy programs while the second panel will feature students studying Engineering and Materials Science.

## WORKSHOP 107: FACULTY MENTORS – SUPPORTING LEADERSHIP AND FOSTERING RESEARCH

### Leaders:

Blane Baker, William Jewell College  
Steve Feller, Coe College

Abstract: Advisors! This session is intended for faculty/staff mentors who aspire to promote the best possible environments for developing strong student leaders and providing meaningful research opportunities. The session is led by experienced advisors/mentors, with plenty of time for sharing, idea exchange, and collaborative conversation. Bring questions and walk away with effective practices!

## WORKSHOP 201: SCIENCE POLICY FOR SCIENTISTS

### Leaders:

Anna Quider, Northern Illinois University  
John Mather, NASA

Abstract: 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. Co-led by a seasoned science policy professional and a Nobel Prize winning scientist working on a large government funded project, the 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.

## WORKSHOP 202: COOKING AS A CONTEXT FOR PHYSICS AND POLITICS

### Leaders:

Carla Ramsdell, Appalachian State University  
Megan Anderson, George Washington University

Abstract: In this workshop, experience a dynamic conversation that explores the intersection of cooking, climate change, and physics, all with the backdrop of energy efficiency. Engage in learning about kitchen thermodynamics and rheology WHILE cooking spaghetti and from-scratch tomato sauce. Learn more about FOOD – one of our most critical energy resources.

*Sponsored by The Society of Rheology.*

## WORKSHOP 203: TAKING YOUR OUTREACH GAME TO THE NEXT LEVEL

### Leaders:

Sheila Ferguson, Little Shop of Physics, Colorado State University  
Heather Michalak, Little Shop of Physics, Colorado State University

Abstract: SPS Chapters around the country are noted for creative and impactful outreach programs. This workshop is for those who want to learn how to create and present physics concepts to a wide variety of audiences with showmanship, pizzazz and engaging education. You will learn pro tips and secrets from a world-renowned physics demonstration. Come see the Little Shop of Physics for an interactive experience! We help people realize that they can do physics. Science is something that anyone can do anytime, anywhere, with anything.

## WORKSHOP 204: PHYSICS OF JAZZ

### Leader:

Stephon Alexander, Brown University

Abstract: John Coltrane was inspired by Einstein to put physics and geometry at the core of his music. Physicist and jazz musician Stephon Alexander follows suit, using jazz to answer physics' most vexing questions about the past and future of the universe. Following the great minds that first drew the links between them, come learn about music, physics, and the world around us.

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## WORKSHOP 205: PHYSICS CAREERS: EDUCATION PATHWAYS

### Leaders:

Katherine Zaunbrecher, Ridgeview Classical School  
Geraldine Cochran, Rutgers University

Abstract: In this concurrent two-panel session, you will hear from physicists working in education careers. Seating is limited to allow an in-depth conversation between panelists and attendees. Choose between two sets of professionals to focus your career pathway. One panel features physicists working to educate younger students, while the other panel spotlights physicists working at colleges and universities.

## WORKSHOP 206: HOW.TO.GRAD. SCHOOL #SUCCESS

### Leaders:

Sam Pedek, Physicist  
Brittney Hauke, Penn State University

Abstract: If you think grad school is in your future, but you are not sure how to get in, and once you get in, just how to succeed, be sure to sign up for this interactive panel where you can get advice, ask questions, and get the DL on making grad school work for you.

## WORKSHOP 207: ASTRONOMY OUTREACH FOR RETENTION AND RECRUITMENT

### Leaders:

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

Abstract: Advisors! This session is for advisors and outreach leaders who want to step up an astronomy-themed outreach program on a budget, take pictures of the night sky with a cell phone, or work with student leadership teams to find new and fun ways to interest their communities in physics and astronomy.

## WORKSHOP 301: COMSCICON

### Leader:

Nathan Sanders, ComSciCon

Abstract: ComSciCon is a series of workshops focused on the communication of complex and technical concepts organized by students for students. In a partnership with ComSciCon, you will meet and interact with professional communicators and learn how to effectively conceive, write, and communicate the science you are passionate about.

## WORKSHOP 302: COOKING AS A CONTEXT FOR PHYSICS AND POLITICS

### Leaders:

Carla Ramsdell, Appalachian State University  
Megan Anderson, George Washington University

Abstract: In this workshop, experience a dynamic conversation that explores the intersection of cooking, climate change and physics, all with the backdrop of energy efficiency. Engage in learning about kitchen thermodynamics and rheology WHILE cooking spaghetti and from-scratch tomato sauce. Learn more about FOOD – one of our most critical energy resources.

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### Leader:

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Heather Michalak, Little Shop of Physics, Colorado State University

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## WORKSHOP 304: DO YOU KNOW WHAT I SEE: VISUALIZATION TOOLS FOR PHYSICS

### Leader:

Rebecca Vieyra, American Association of Physics Teachers

Abstract: One of the most important and intriguing aspects of communicating science is visualization. In physics, there are a number of new tools that can be used in formal settings for education and informal settings for spurring interest in physics. In this workshop take a hands on tour through some cool and easily accessible visualization tools for physics.

## WORKSHOP 305: PHYSICS FOR HUMANS

### Leaders:

Randy Tagg, University of Colorado Denver  
John Andersen, Rochester Institute of Technology

Abstract: In this hands-on, maker/thinker/problem solver workshop, learn and experience how physicists are at the forefront of solving problems that profoundly affect human life. Armed with a broad understanding of the interactions that drive the natural world and knowledge of the function of a vast array of technologies, the problem-solving power of physicists will be used to impact life as we know it. This workshop is for the curious and the inspired!



## WORKSHOP 306: THE PHYSICS OF CLIMATE CHANGE – PUTTING NUMBERS TO THE ISSUE

### Leaders:

Ellen Williams, University of Maryland

Earl Blodgett, University of Wisconsin – River Falls

Abstract: In this workshop, learn how to apply physics thinking to solving climate change through Fermi problems. What are the facts? What is the role of the individual, a community, a region, a nation, or the whole human population of the planet? If you have ever wondered how to get to the heart of what really matters - what will impact the future - this is the workshop for you!

## WORKSHOP 307: THRIVING PHYSICS DEPARTMENTS: EFFECTIVE PRACTICE TOOLS AND TIPS

### Leaders:

Michael Jackson, Millersville University

Toni Sauncy, Texas Lutheran University

Abstract: For advisors! This interactive session is for faculty and staff who are interested in learning more about physics community endorsed resources for helping to make their department the best it can be.

# STEP UP

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## Exhibits Located in Exhibit Hall B

### AMERICAN ASSOCIATION OF PHYSICISTS IN MEDICINE

#### Booth 108

Contact: Rachel Smirolido, [rachel@aapm.org](mailto:rachel@aapm.org)

The American Association of Physicists in Medicine is a professional membership organization of more than 8,000 members. The mission of AAPM is to advance the science, education, and professional practice of Medical Physics: a broad-based scientific & professional discipline encompassing physical principles with applications in biology & medicine.

### AAVSO

#### Booth 207

Contact: Kristine Larsen, [larsen@ccsu.edu](mailto:larsen@ccsu.edu)

The American Association of Variable Star Observers (AAVSO) is an international non-profit organization of variable star observers whose mission is to enable anyone, anywhere, to participate in scientific discovery through variable star astronomy. We accomplish our mission by carrying out the following activities:

- observation and analysis of variable stars
- collecting and archiving observations for worldwide access
- forging strong collaborations between amateur and professional astronomers
- promoting scientific research, education, and public outreach using variable star data.

As an independent, private research organization in Cambridge, Massachusetts, with active participants in more than 100 countries, and an archive of over 34 million variable star observations. It is the world's largest association of variable star observers. Membership in the AAVSO is open to anyone—professionals, amateurs, and educators alike—interested in variable stars and in contributing to the support of valuable research.

### ACOUSTICAL SOCIETY OF AMERICA

#### Booth 204

Contact: Keeta Jones, [kjones@acousticalsociety.org](mailto:kjones@acousticalsociety.org)

The Acoustical Society of America (ASA) is the premier international scientific society in acoustics. Its mission is to generate, disseminate, and promote the knowledge and practical applications of acoustics, which is achieved through its publications, meetings, and outreach activities. The Society's technical activities include a variety of fields related to acoustics such as physics, oceanography, architecture, music, speech and hearing, noise control, and many more. ASA attracts interest and participation by academics, consultants, government and industry professionals, and students from around the world, creating a vibrant organization dedicated to the science of sound.

### AMERICAN INSTITUTE OF PHYSICS

#### Booth 304

Contact: David Reinbold, [dreinbold@aip.org](mailto:dreinbold@aip.org)

The American Institute of Physics advances, promotes, and serves the physical sciences for the benefit of humanity. AIP programs advance the physical sciences through our commitment to the preservation of physics for future generations, the success of physics students, and the promotion of a more scientifically literate society.

### AMERICAN ASSOCIATION OF PHYSICS TEACHERS

#### Booth 104

Contact: Jerri Anderson, [janderson@aapt.org](mailto:janderson@aapt.org)

The American Association of Physics Teachers (AAPT®) was established in 1930 with the fundamental goal of ensuring the "dissemination of knowledge

of physics, particularly by way of teaching." Founders Homer L. Dodge, Paul E. Klopsteg, and William S. Webb led the effort to organize the first association dedicated to improving physics education. Today that vision is supported by members around the world.

### AMERICAN PHYSICAL SOCIETY

#### Booth 303

Contact: Jamie Liu, [liu@aps.org](mailto:liu@aps.org)

The American Physical Society is the professional society for physicists. With over 50,000 members, APS works to advance and disseminate the knowledge of physics worldwide. Through meetings, journals and other publications, APS delivers the latest physics information and works to create a stronger and more diverse physics community. In addition to its services for members, APS provides career information for those interested in pursuing all types of physics as a career path.

### BROWN UNIVERSITY DEPARTMENT OF PHYSICS

#### Booth 410

Contact: Ida Alarcon, [idalina\\_alarcon@brown.edu](mailto:idalina_alarcon@brown.edu)

Physics has been in the Brown curriculum since 1772, back when the discipline was called "natural philosophy" and Wolfram Alpha was not around to solve our problems. Today, we have a vibrant department with 29 faculty members and 12 joint and affiliated faculty members, all pursuing the frontiers of physics. Some members are developing advanced theories to explain phenomena as grand as the origin of our universe and the nature of matter. Others are pushing the limits of physics to detect new fundamental particles and dark matter, as well as building incredibly sensitive devices based on quantum physics. Fear not if you are a beginner with a sense of curiosity; Brown physics will build you from the ground up. Our research is distinguished across the discipline – high energy, cosmology/astrophysics, condensed matter, and biophysics.

### CARNEY, SANDOE & ASSOCIATES

#### Booth 209

Contact: Diana Zito, [connor.rooney@carneysandoe.com](mailto:connor.rooney@carneysandoe.com)

Carney, Sandoe & Associates is an educational recruitment firm that places teachers and administrators in private, independent and like-kind (charter, magnet, pilot and merit) schools across the nation. We have placed over 32,000 teachers and administrators in independent schools since 1977. CS&A works to fill thousands of teaching and administrative openings at hundreds of K-12 college preparatory schools each year. Services are free for the job-seeking candidate, and teacher certification is not required in most positions open at these great schools.

### DIGITALIS EDUCATION

#### Booth 206

Contact: Kerrie Berglund, [karrie@digitaliseducation.com](mailto:karrie@digitaliseducation.com)

Digitalis Education Solutions, Inc. is the leading provider of digital planetarium systems worldwide, with nearly 800 customers around the globe. Our goal is to offer the most cost effective, easy to use, and practical astronomy education tools. Several of our staff have real world experience working in or even running planetariums. We offer planetarium systems for portable or fixed domes, and we build our own inflatable domes at our company headquarters near Seattle. We develop the planetarium software our Digitalis systems run, Nightshade Next Generation. Our interfaces (developed in house) facilitate live, interactive programs, enabling our customers to target each program to that specific audience's interests. Please visit our planetarium at PhysCon 2019 to learn more about Digitalis. We'll be happy to take you on a tour of the universe and to discuss astronomy visualization and education with you.

## FERMI NATIONAL ACCELERATOR LAB

### Booth 110

Contact: Kathleen Venn Bowers, [kvb@fnal.gov](mailto:kvb@fnal.gov)

Fermilab is America's premier laboratory for particle physics and accelerator research, funded by the U.S. Department of Energy. We support discovery science experiments in Illinois and at locations around the world, including deep underground mines in South Dakota and Canada, mountaintops in Arizona and Chile, and the South Pole. We are strategic risk takers, innovators, and collaborators. We are engineers, scientists, technicians, administrative professionals. We are 1,800 employees advancing knowledge for the benefit of humankind. Fermilab has been at the forefront of particle physics for more than 40 years. We build world-leading accelerators and detectors to conduct some of the most advanced particle physics experiments possible. We collect and analyze the data from those experiments with some of the most powerful computers in the world. We conduct this research on a 6,800-acre prairie, 35 miles outside Chicago, a treasure that has been designated a National Environmental Research Park.

## GRAD SCHOOL SHOPPER

### Booth 306

Contact: Paolo Sian, [psian@aip.org](mailto:psian@aip.org)

GradSchoolShopper.com is the most comprehensive directory of graduate programs in the physical sciences. The website, along with the printed book, helps students compare grad schools by sorting hard-to-find data such as department size, research specialties, acceptance rates, location, department culture, and much more. Students can sign up for a FREE account on the GradSchoolShopper site and get the printed book for FREE as well!

## IBM (IBM T.J. WATSON RESEARCH CENTER)

### Booth 101

Contact: Mark Ritter, [mritter@us.ibm.com](mailto:mritter@us.ibm.com)

Come to booth 101 to discuss physics with IBM researchers, see demonstrations of quantum concepts, and program a real quantum computer! We'd be glad to discuss how research is conducted in an industrial setting. Please drop by to talk about IBM Research's rich history of physical science!

## JEFFERSON SCIENCE ASSOCIATION

### Booth 201

Contact: Cassandra Andrews, [candrews@jlab.org](mailto:candrews@jlab.org)

JSA, LLC, is the managing and operating contractor of the Thomas Jefferson National Accelerator Facility (Jefferson Lab) for the U.S. Department of Energy's Office of Science. This nuclear physics user facility enables the international user community to conduct outstanding scientific research. JSA is a partnership between the Southeastern Universities Research Association, Inc., (SURA) and PAE Applied Technologies.

## MARSHALL UNIVERSITY

### Booth 308

Contact: Jon Saken, [saken@marshall.edu](mailto:saken@marshall.edu)

Stop by Booth 308 to learn about graduate opportunities in The Marshall University Department of Physics. As a smaller school we can offer a personalized education designed to meet the needs of every individual student. Research areas include solid state physics, nanoparticles, astrophysics and gravitational physics. You can also find out more about us on our Facebook page, [www.facebook.com/MUPhysicsDept](http://www.facebook.com/MUPhysicsDept), or on Instagram at [www.instagram.com/muphysics/](http://www.instagram.com/muphysics/).

## MIT PRESS

### Booth 102

Contact: David Ryman, [dryman@mit.edu](mailto:dryman@mit.edu)

Established in 1962, the MIT Press is a not for profit, university-based publisher aligned with the values and mission of the Massachusetts Institute of Technology. With offices in Cambridge, MA and London, the Press is one of the largest and most distinguished university presses in the world and a leading publisher of books and journals at the intersection of science, technology, art, social science, and design. MIT Press books and journals are known for their intellectual daring, scholarly standards, interdisciplinary focus, and distinctive design.

## NATIONAL SOCIETY OF BLACK PHYSICISTS

### Booth 406

Contact: Monique Howard, [mhoward@nsbp.org](mailto:mhoward@nsbp.org)

Founded in 1977 at Morgan State University, the mission of the National Society of Black Physicists is to promote the professional well-being of African American physicists and physics students within the international scientific community and within society at large.

## OAK RIDGE NATIONAL LABORATORY

### Booth 106

Contact: Rachel McNutt, [mcnuttrd@ornl.gov](mailto:mcnuttrd@ornl.gov)

Oak Ridge National Laboratory is the largest US Department of Energy science and energy laboratory, conducting basic and applied research to deliver transformative solutions to compelling problems in energy and security. ORNL's diverse capabilities span a broad range of scientific and engineering disciplines, enabling the Laboratory to explore fundamental science challenges and to carry out the research needed to accelerate the delivery of solutions to the marketplace. ORNL supports DOE's national missions of Scientific Discovery, Clean Energy, and Security. ORNL supports these missions through leadership in four major areas of science and technology: Neutrons, Computing, Materials, and Nuclear.

## SOCIETY OF RHEOLOGY

### Booth 203

Contact: Gareth McKinley, [gareth@mit.edu](mailto:gareth@mit.edu)

The Society of Rheology is composed of physicists, chemists, biologists, engineers, and mathematicians interested in advancing and applying rheology, which is defined as the science of deformation and flow of matter. Our Vision: An international community of rheologists working towards common goals as articulated in our founding Constitution. Values: We are the nexus of excellence in the theory and practice of rheology. We are committed to advancement and promotion of the rheological sciences and practice of rheology broadly across diverse groups of individuals, disciplines and industries. Mission: We aim to expand the knowledge and practice of rheology through education, partnership and collaboration with associated fields, industries, and organizations, as well as to disseminate to diverse communities what rheology is, and how it impacts humanity and the world.

## SPS PUBLICATIONS

### Booth 408

Contact: Kendra Redmond, [KRedmondStories@gmail.com](mailto:KRedmondStories@gmail.com)

Meet and share your ideas with some of the people behind the Society of Physics Students and Sigma Pi Sigma's three publications: The SPS Observer, JURP, and Radiations.



## TEACHSPIN

### Booth 401

Contact: Barbara Wolff-Reichert, [bwr@teachspin.com](mailto:bwr@teachspin.com)

One visitor called it "a bounce house for physicists." We call it the Food Truck for the Physics Mind—a 44-foot trailer housing all our TeachSpin instruments up and running and ready to take data. We're parking it on the exhibit floor and inviting you in. Come see what could be coming your way!

## THORLABS

### Booth 202

Contact: Jamie LaCouture, [jlacouture@thorlabs.com](mailto:jlacouture@thorlabs.com)

Thorlabs has been proud to serve the photonics industry for 30 years. We manufacture a broad portfolio of mechanics, motion control, light sources, electronics, optics, optical fiber, and instrumentation building blocks. These building blocks are used in industries such as medical devices, defense, and manufacturing. Our tools can be found in leading research labs in physics, optics, photonics, life sciences, as well as other emerging fields. We have an expanding selection of educational kits, with experiments including spectroscopy, optical tweezers, Fourier optics, polarization, and microscopy, with each experiment including detailed setup instructions and extensive teaching materials. With offices in nine countries, we are focused on providing same-day shipping of stocked components and fast response to customer inquiries.

## US LHC USERS ASSOCIATION

### Booth 301

Contact: Harvey Newman, [newman@hep.caltech.edu](mailto:newman@hep.caltech.edu)

The US LHC Users Association (USLUA) is composed of high energy physicists, engineers and students located at universities and laboratories throughout the nation and overseas. Its members carry out high-energy particle physics research exploring the nature of the fundamental particles and forces that govern our universe, using the Large Hadron Collider (LHC) experiments and accelerator systems at the CERN laboratory outside of Geneva, Switzerland. USLUA includes both people based at CERN and those working from their home institutions. The purpose of USLUA is to provide a forum for discussions of the US participation in the worldwide LHC research program, with a focus on how best to enhance scientific participation in the discoveries expected from this research. USLUA helps members of the US LHC community work effectively with their colleagues at CERN while physically located in the US, and also adapt to work at and live in the environs of CERN. In addition, USLUA provides communication channels between scientists working on the LHC experiments, the US agencies supporting this research and the US Congress. Learn more about us at <http://www.uslua.org>, and about our science, the goals of our research, and the associated innovations that help improve our daily lives at <http://usparticlephysics.org>.

## Universities & Colleges

## AUBURN UNIVERSITY

### Booth 319

Contact: Allen Landers, [landeal@auburn.edu](mailto:landeal@auburn.edu)

Though the Auburn campus is large, the Physics Department maintains a surprisingly high ratio of faculty members to our physics majors and graduate students. There are more than 20 full-time faculty and approximately 60 undergraduate majors and 50 graduate students. This means that each student receives the sort of individual attention that is usually only available at much smaller schools. Research projects are currently underway in plasma physics including magnetic fusion and dusty plasmas, condensed matter physics with an emphasis on wide band-gap semiconductors for microelectronic devices and calculation of transport properties, atomic physics probing the fundamental properties of atoms, molecules and ions, and space physics exploring the Earth's magnetosphere. The research is done in teams that include faculty, postdoctoral students, graduate and undergraduate students.

## BOSTON UNIVERSITY

### Booth 314

Contact: Mirtha Cabello, [cabello@bu.edu](mailto:cabello@bu.edu)

The Boston University, Physics Department offers a PhD in Physics with an optional MA degree. Our research specialties include experimental particle physics, particle astrophysics, theoretical particle physics and cosmology, molecular biophysics, experimental biophysics, experimental condensed matter physics, theoretical quantum condensed matter physics, statistical physics, polymer physics and computational physics. There are numerous interdisciplinary opportunities, particularly with the College of Engineering, the Materials Science and Engineering Division, and the Center for Photonics Research. Major resources include the Scientific Instrument Facility, the Electronics Design Facility, and the supercomputer clusters in the Center for Computational Science. We have approximately 100 graduate students, with a typical incoming class of 15-25 students. The department provides full tuition scholarships, stipends, and student medical insurance for essentially all graduate students through a combination of teaching fellowships, research assistantships and university fellowships.

## BROWN UNIVERSITY MEDICAL PHYSICS

### Booth 312

Contact: Eric Klein, [eric.klein@lifespan.org](mailto:eric.klein@lifespan.org)

Medical physics (MP) is a specialty recognized by the American Board of Medical Specialties. Medical physicists contribute to improving quality and safety by acceptance testing, commissioning, and optimized clinical use of medical devices such as CT and MRI scanners, linear accelerators, and treatment planning systems. Activities are based on current best evidence or the medical physicists' own knowledge and skills. The path leads to acceptance into a residency program, and Board certification. The MP program is 2 years, with 5-8 new students annually. Our program assures incoming students a relevant, comprehensive, and satisfying educational experience. Students will write a publishable thesis. There is currently a void of quality MP programs. Brown University offers an excellent and distinctive academic experience in MP, and will matriculate strong and diverse students. In turn, a rich learning environment will instill energy and creativity in the fields of radiation oncology and radiology.

## CITY UNIVERSITY OF NEW YORK

### Booth 320

Contact: Daniel Moy, [dmoy@gc.cuny.edu](mailto:dmoy@gc.cuny.edu)

Our Ph.D. Program in Physics is part of The Graduate Center, a school within the City University of New York (CUNY). The Graduate Center is the principal doctorate-granting institution of the CUNY. As one of the largest physics graduate programs in the United States, we have faculty doing research in almost all fields of physics; - including astrophysics and cosmology; biophysics & neuroscience; computational, statistical & mathematical physics, condensed matter & semiconductor physics; nanotechnology, particle & high-energy physics; photonics; string theory; quantum information and optics. All of our students are awarded a 5-year CUNY Science Scholarship. The support includes \$30,000 per annum in cash financial aid, full tuition waiver, affordable individual and family health-care insurance, and family leave benefits.

## CLARK UNIVERSITY

### Booth 414

Contact: Jerry Czub, [jczub@clarku.edu](mailto:jczub@clarku.edu)

With Albert A. Michelson, the first American Nobel Laureate in physics, and Robert H. Goddard, the Father of Modern Rocketry, as part of our distinguished history, Clark University's world-renowned physics doctoral program continues to offer unique opportunities to our graduate students. Our program, which offers a Ph.D. in experimental, theoretical, and computational condensed matter physics and biophysics, emphasizes active learning with research beginning in a student's first semester. This style, our intimate size, and the access our students have to cutting-edge equipment, builds independence in a supportive, collaborative environment. As a result of this ex-



ploration, self-reliance, and mentorship, our Ph.D. recipients regularly obtain attractive positions in academia and industry. Graduate students receive full tuition remission and a 12-month graduate assistant stipend. Our graduate students, along with our undergraduate SPS members, actively participate in several annual outreach events.

### CLEMSON UNIVERSITY

#### Booth 219

Contact: Sean Brittain, [sbritt@clemson.edu](mailto:sbritt@clemson.edu)

Clemson University is a top-25 public research university nestled in the foothills of the Blue Ridge Mountains. Our Department of Physics & Astronomy (<http://www.clemson.edu/science/departments/physics-astro/>) seeks to provide an outstanding and innovative education to our undergraduate and graduate students, while also maintaining a robust research program as we attempt to answer some of the most fundamental questions in nature. The faculty and students in our department pursue research in a number of exciting areas including atomic physics, astrophysics, biophysics, condensed matter physics, and atmospheric and space physics.

### CORNELL UNIVERSITY

#### Booth 411

Contact: Anitra Douglas, [amd78@cornell.edu](mailto:amd78@cornell.edu)

With 5200 graduate and professional students in nearly 100 fields of study, applied physics, physics and materials science, the Cornell University Graduate School offers the broadest range of programs in the Ivy League. Our world-renowned faculty and world-class research facilities combined with our interdisciplinary approach to graduate education and research make us unique. Please stop by our booth and talk with one of our representatives to learn more about our graduate programs, research centers, fellowships, summer research internships for undergraduates and much more. Visit our website @ [www.gradschool.cornell.edu](http://www.gradschool.cornell.edu).

### EMORY UNIVERSITY

#### Booth 422

Contact: Barbara Conner, [barbara.conner@emory.edu](mailto:barbara.conner@emory.edu)

The graduate program in physics at Emory University offers students a comprehensive graduate education and the opportunity to engage in cutting-edge research with internationally-recognized groups. We offer a fully-funded Ph.D. in physics and a combined Physics Ph.D./Computational Science M.S. degree. The size of our program engenders collegial interactions among students, faculty and staff. We are located in the Mathematics & Science Center (built in 2002), where state-of-the-art research, teaching, and support facilities augment our strong commitment to graduate education. Graduate students are the engine of university research and the heart of the physics department, providing a vital link between undergraduates, post-docs, faculty, and staff. In the Department of Physics there are currently 53 graduate students and 21 regular faculty members. Frequent seminars and weekly colloquia attracts many distinguished scientists and stimulates informal discussions. Students have access to conference travel funds and other networking opportunities involving research and education. Emory University is a fully-accredited, comprehensive R1 research university. It was founded in 1836 and now enrolls close to 15,451 students. Of this total, about 46 percent are graduate students. Nestled among old forests overlooking Atlanta, the university provides a diverse student body with access to shopping, nightlife, a world-class airport, and numerous outdoor activities.

### FLORIDA INTERNATIONAL UNIVERSITY

#### Booth 214

Contact: Wenzhi Li, [liwenzhi@fiu.edu](mailto:liwenzhi@fiu.edu)

Florida International University (FIU) is Miami's public research university and in less than five decades has become a top 100 public university, according to U.S. News and World Report's Best Colleges. FIU is focused on student success and research excellence, with nearly \$200 million in annual research expenditures. The Department of Physics is dedicated to excellence in

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## Exhibitors

research, teaching and service to the scientific, university and local communities. We offer opportunities for students to participate in research across a variety of fields. Our faculty are committed to innovative teaching and scholarship in areas such as astrophysics, atomic and molecular physics, fusion energy, medical and biophysics, nanoscience and nanotechnology, nuclear and particle physics, plasma physics and quantum optics. The department also houses the Center for Imaging Science, a research-dedicated MRI facility supporting an integrated community of national investigators at the forefront of neuroimaging science.

### FLORIDA POLYTECHNIC UNIVERSITY

#### Booth 421

Contact: Michelle Powell, [mpowell@floridapoly.edu](mailto:mpowell@floridapoly.edu)

Florida Polytechnic University is Florida's newest and most innovative university, engineered from the ground up to push the boundaries of education in science, technology, engineering, and math (STEM). Located in Lakeland, the heart of Florida's High-Tech Corridor, Florida Poly provides cutting-edge degree programs that prepare graduates to take on today's fastest-growing fields.

### FLORIDA STATE UNIVERSITY

#### Booth 420

Contact: Volker Crede, [vcrede@fsu.edu](mailto:vcrede@fsu.edu)

The FSU Physics Department offers research programs that are well-funded, diverse, and provide a breadth of learning and teaching experience to over 300 graduate and undergraduate students. Ranked in the top five by the Joint Task Force on Undergraduate Physics Programs and named among the best in the nation for graduate physics by U.S. News and World Report, the department is comprised of over 60 faculty members specializing in condensed matter, nuclear, high-energy, atomic, bio-, and astrophysics. The physics department also houses unique experimental facilities such as the John D. Fox Nuclear Accelerator Laboratory and the National High Magnetic Field Laboratory, which is the largest and highest powered magnet lab in the world.

### GEORGE MASON UNIVERSITY

#### Booth 121

Contact: Brooke Vaughn, [bvaughn4@gmu.edu](mailto:bvaughn4@gmu.edu)

The Department of Physics and Astronomy at George Mason University is located in Fairfax, VA, just west of Washington, DC. Our goal is to advance knowledge and promote scientific literacy through instruction, research, and outreach. We are a leading physics and astronomy research and education center whose members and graduates, through their work and work-related activities, make positive contributions to science, the economy, and society. Our degree programs provide our students with opportunities and resources to gain the knowledge and develop the skills necessary to pursue further education or obtain productive employment. Our advanced degrees prepare our students for careers in academia, research, or industry. Many of our faculty and students collaborate with local and national research institutions, including the Naval Research Laboratory, National Institute of Standards and Technology, NASA, the Jefferson Laboratory, and many others to push the boundaries of physics and astronomy research. On our department website, [physics.gmu.edu](http://physics.gmu.edu), you can find a wealth of information regarding our faculty and their research interests, upcoming events, contact information, and department news.

### JOHNS HOPKINS UNIVERSITY

#### Booth 116

Contact: Kelley Key, [kkey@jhu.edu](mailto:kkey@jhu.edu)

Graduate programs in physics and astronomy at Johns Hopkins University are among the top programs in the field. Students engage in original research starting in their first semester and have flexibility in choosing their course of research and designing their path through the program. A wide range of research projects—both theoretical and experimental—are available

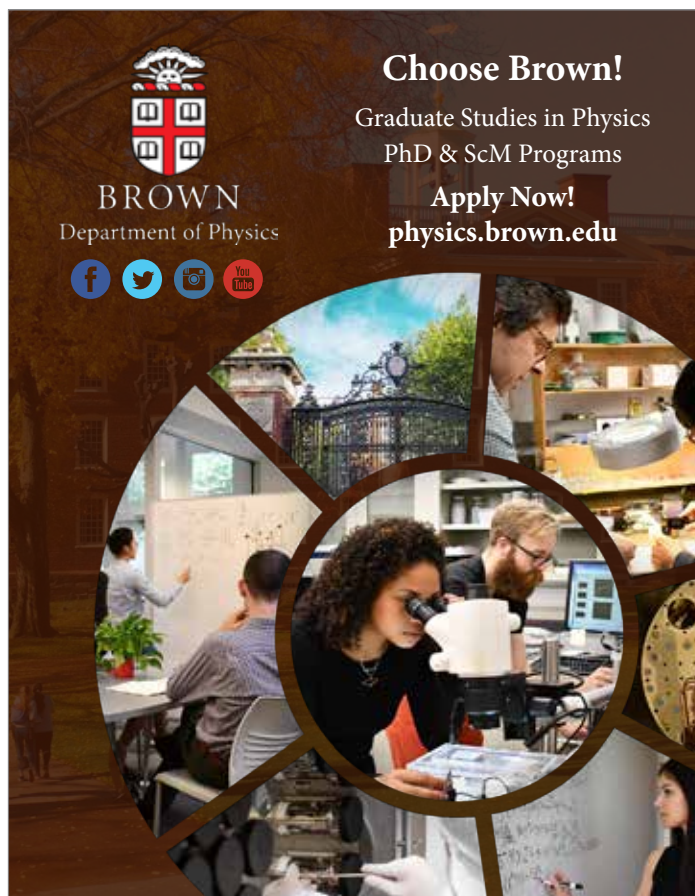
in astrophysics, condensed matter physics, particle physics, and plasma spectroscopy. Graduate students can work toward a PhD in either physics or astronomy and astrophysics. Our doctoral students are prepared for careers in physics and astronomy research, teaching, or in applications such as biophysics, space physics, and industrial research. Graduate students at Johns Hopkins study and work in close collaboration with a world-renowned, award-winning physics and astronomy faculty, whose research is truly global. Students have access to state-of-the-art laboratories, and they are full participants in the vibrant intellectual life of the department. Research leading to the dissertation can be carried out not only within the Department of Physics and Astronomy, but also in collaboration with other research centers. Recent dissertation research has been conducted with members of the Johns Hopkins Applied Physics Laboratory, Space Telescope Science Institute, and the Goddard Space Flight Center.

### MAX PLANCK SCHOOL OF PHOTONICS

#### Booth 216

Contact: Reinhard Geiss, [reinhard.geiss@uni-jena.de](mailto:reinhard.geiss@uni-jena.de)

The Max Planck School of Photonics (MPSP) provides an integrated program for the photonics education of graduate and doctoral students in a network of excellence of German universities and research institutions. Students can start the program with a qualification-phase to obtain a Master of Photonics degree at one of three teaching universities. The subsequent PhD-phase is conducted under the supervision of one of 45 MPSP-Fellows in eight locations in Germany. Students already holding a master's degree can directly enter the PhD-phase. Apart from an excellent network of renowned scientists, the MPSP offers generous financial support and a curriculum to strengthen the research network and to advance personal and professional skills. The MPSP is an ideal basis to immerse oneself into European culture while being part of an international network of likeminded peers. Applications for admission to the MPSP in 2020 can be submitted until December 2019. For more information visit [www.photonics.school](http://www.photonics.school).



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## OLD DOMINION UNIVERSITY

### Booth 113

Contact: Charles Sukenik, [csukenik@odu.edu](mailto:csukenik@odu.edu)

Old Dominion University (ODU) is a state-supported institution located in Norfolk, Virginia, at the mouth of the Chesapeake Bay. It is classified as a Carnegie Research Institution with "high research activity." The ODU Physics Department ([www.odu.edu/physics](http://www.odu.edu/physics)) has more than 30 regular and special appointment faculty, 60 graduate students and 80 undergraduate majors and minors. Faculty are committed to student success in a friendly, supportive environment with small classes where student-faculty interaction is promoted. Research areas include experimental and theoretical programs in: nuclear and hadronic physics, atomic and few-body physics, accelerator science and condensed matter physics as well as experimental programs in materials science and atmospheric science. In addition to on-campus research in state-of-the-art labs, students can join major ODU-led research programs at the nearby Thomas Jefferson National Accelerator Facility. The Hampton Roads region, of which Norfolk is a part, is a thriving, metropolitan coastal area with many cultural and recreational amenities.

## PROVIDENCE COLLEGE

### Booth 120

Contact: Thesera Moreau, [tmoreau@providence.edu](mailto:tmoreau@providence.edu)

Providence College is a primarily undergraduate Catholic and Dominican liberal arts institution in Providence, RI. The Department of Engineering and Physics provides a four-year undergraduate physics degree and also offers a dual-degree engineering program through affiliations with Columbia University and Washington University. All department faculty are physicists, and areas of research specialization include condensed matter experiment, condensed matter theory, atomic molecular and optical experiment, high energy theory and observational astronomy. The college is in the process of a multi-million dollar science complex renovation that will boast state-of-the-art research facilities and augment a new wing with classrooms designed to facilitate inclusive excellence and high-impact teaching practices.

## SIENA COLLEGE

### Booth 122

Contact: John Moustakas, [jmoustakas@siena.edu](mailto:jmoustakas@siena.edu)

Siena College is a private liberal arts college located in upstate New York serving approximately 3000 undergraduate students. The Department of Physics & Astronomy is a vibrant and close-knit department with an active and externally well-funded research profile which provides cutting-edge research opportunities in astrophysics, computational physics, physics education research, and particle physics, among other areas, to the approximately 100 students in our department. The Breyo Observatory, an 0.7-meter research-grade optical telescope located on campus is particularly noteworthy for a college of this size. In addition, in 2019 Siena College was recognized by the American Institute of Physics for granting more than 40% of its bachelor's degrees to women between 2013-2017, one of only 21 institutions in the country, and our Society of Physics Students has been nationally recognized as a Distinguished or Outstanding Chapter for the past five years.

## THE GEORGE WASHINGTON UNIVERSITY

### Booth 212

Contact: William Briscoe, [briscoe@gwu.edu](mailto:briscoe@gwu.edu)

At the GW Department of Physics, faculty and students are at the forefront of transformative, interdisciplinary scholarship, as they seek answers to fundamental questions about matter, motion and the mysteries of the universe. The department engages in collaborative research with some of the Washington, D.C., area's world-renowned centers and institutes, including the National Institutes of Standards and Technology, the U.S. Naval Research Laboratory, NASA and the Thomas Jefferson Electron Accelerator Facility. Through in-depth research, faculty mentorship and unique learning environments, physics students are exploring the countless applications of physics to the working world.

## THE UNIVERSITY OF MISSISSIPPI

### Booth 321

Contact: Jake Bennett, [jbennett@phy.olemiss.edu](mailto:jbennett@phy.olemiss.edu)

The University of Mississippi Department of Physics and Astronomy offers Master's and PhD programs in Physics. All students admitted to our graduate program receive full financial support, including a tuition waiver and a generous living stipend. The primary areas of research in the department include Atmospheric Physics, Condensed Matter Physics, Gravity, High Energy Physics, and Physical Acoustics. Several faculty members in our department are cross appointed at the National Center for Physical Acoustics, a unique facility located on The University of Mississippi campus. Other faculty members in Gravity and High Energy Physics are affiliated with the newly created Center for Multi-messenger Astronomy. The University of Mississippi carries the R1 Carnegie designation reserved for Doctoral Universities with the highest level of research activity.

## UNIVERSITY OF CALIFORNIA, MERCED

### Booth 221

Contact: David Strubbe, [dstrubbe@ucmerced.edu](mailto:dstrubbe@ucmerced.edu)

Located in the heart of California's Central Valley, UC Merced is the 10th and newest campus of the University of California system. We are a rapidly growing department, with 17 faculty members and 64 PhD students, who come from California, across the country, and around the world. Physics at UC Merced offers forefront research opportunities in biological and soft matter physics, condensed matter and materials physics, and atomic, molecular and optical physics, plus astrophysics starting in 2020, and fosters synergistic and interdisciplinary collaborations. We have access to major research facilities on campus, across the UC system, and through collaborations at other universities and national laboratories in northern California. Our graduate students pursue their degrees while working on a broad range of cutting-edge research topics in one of the most diverse departments in the country. All admitted students are guaranteed five years of financial support. We welcome your application!

## UNIVERSITY OF NORTH TEXAS

### Booth 222

Contact: Duncan Weathers, [duncan.weathers@unt.edu](mailto:duncan.weathers@unt.edu)

Examples of physics research at the University of North Texas include seeking better understanding of how systems of only a few atoms, electrons, and photons behave, exploration of the properties of meso-scale objects such as nanoparticles and polymers, and observing and interpreting the light from distant galaxies. This research also makes connections to diverse applications, which at UNT include, for example, new materials for energy storage, nanotechnology for sensors and novel photonic devices, and mathematical models of the working of networks of neurons.

## UNIVERSITY OF UTAH

### Booth 413

Contact: Tamara Young, [tamara@physics.utah.edu](mailto:tamara@physics.utah.edu)

The University of Utah (the "U"), located in Salt Lake City, is the flagship public research university in the state of Utah. The university has nearly 25,000 undergraduate and more than 8,000 graduate students enrolled annually. The Department of Physics & Astronomy at the University of Utah engages in excellent theoretical and experimental research that spans the broad spectrum of modern physics and astronomy. Our commitment to excellence and success in research is reflected in the strong international reputation of our faculty and programs. Research areas include:

- Astronomy and Astrophysics
- Biophysics
- Cosmic Rays
- Education
- Experimental Condensed Matter Physics
- Particle Physics
- Theoretical Condensed Matter Physics



## UNIVERSITY OF WISCONSIN-MADISON

### Booth 412

Contact: Michelle Holland, [michelle.holland@wisc.edu](mailto:michelle.holland@wisc.edu)

The Department of Physics at the University of Wisconsin-Madison has a strong tradition of graduate study and research in astrophysics; atomic, molecular, and optical physics; condensed matter physics; high energy and particle physics; plasma physics; quantum computing; and string theory. There are many facilities for carrying out world-class research. We have a large professional staff: 45 full-time faculty members; 11 faculty members holding joint appointments with other departments; 34 assistant, associate, and senior scientists; and 46 postdocs. In addition, there are over 180 PhD students and about 15 MS in physics-quantum computing students in our graduate programs.

## UTAH STATE UNIVERSITY

### Booth 115

Contact: Vanessa Chambers, [vanessa.chambers@usu.edu](mailto:vanessa.chambers@usu.edu)

At USU, all students participate in faculty-mentored research, gaining valuable experience in campus research centers and laboratories. This makes USU students better prepared for entrance into either the workforce or graduate school. Beyond the experimental facilities at USU, many students are involved in theoretical work, data analysis, and computer simulations in general relativity and field theory, space weather forecasting, surface science, and complex system applications. There is also a Physics Learning Center available for undergraduate physics students where physics graduate students provide individualized help with homework concerns. The physics department is home to an active, national-award-winning chapter of the Society of Physics Students. Its students and faculty have also been recipients of prestigious national awards, including a Rhodes Scholar, two Carnegie Professors, Goldwater Scholars, and more.

## VIRGINIA TECH PHYSICS DEPARTMENT

### Booth 213

Contact: Betty Wilkins, [bewilki2@vt.edu](mailto:bewilki2@vt.edu)

The Department of Physics at Virginia Tech, located in beautiful southwest Virginia, offers both master's and Ph.D. degrees in physics. The department is comprised of 34 full-time faculty members, 75 graduate students, and about 350 undergraduate physics majors. Research areas include: astrophysics, condensed matter, high energy, soft matter and biological physics, and string theory. We are currently accepting applications for Fall 2020 through January 5th, so please stop by our booth to learn more about the graduate education opportunities that await you at Virginia Tech!

## WAYNE STATE UNIVERSITY

### Booth 311

Contact: Dawn Niedermiller, [dniedermiller@wayne.edu](mailto:dniedermiller@wayne.edu)

The Department of Physics and Astronomy is devoted to both teaching and research. Our mission is to educate and train students while advancing the frontiers of knowledge. We offer undergraduate degrees that prepare students for a career in a technical field, to go on to a professional school, or to go on to graduate school. Our graduate program offers both master's and Ph.D. degrees. Our professors are both teachers and researchers, thus giving students opportunities to participate in cutting-edge research projects in astrophysics, biophysics, high energy particle physics, nuclear physics, and solid state physics. Our research is federally funded by the National Science Foundation, the Department of Energy, and the National Institute of Health. We are located in the hub of the Cultural Center just a short walk to the Detroit Central Library, Detroit Institute of Arts, Detroit Science Center, Museum of African-American History, New Center, many restaurants, and other fine attractions. We have national collaborations across the country with numerous other universities, National Labs, and international collaborations at CERN in Europe, KEK in Japan, and with many universities across the world.

## WILLIAM AND MARY

### Booth 322

Contact: Irina Novikova, [inovikova@physics.wm.edu](mailto:inovikova@physics.wm.edu)

The William & Mary physics department offers a world-class program, with tracks that cater to generalists, pre-meds, and students interested in engineering and design. Our twenty-nine core faculty provide cutting-edge research opportunities for both undergraduate and Ph.D. students in a wide range of research specialties. The department is housed in the recently-expanded William Small Physical Laboratory, set in a beautiful, personal-scale, liberal-arts campus. In addition to the facilities available on our historic campus, the research program extends to nearby NASA Langley, Jefferson Lab, and beyond.

## WYANT SCHOOL OF OPTICAL SCIENCE

### Booth 114

Contact: John Koshel, [jkoshel@optics.arizona.edu](mailto:jkoshel@optics.arizona.edu)

The University of Arizona's James C. Wyant College of Optical Sciences is a world-renowned educational and research institution dedicated to optics – the field of science and engineering that focuses on the nature, generation, detection, manipulation, and applications of light. We offer classes and research opportunities across the full range of optics, from quantum technologies and optical physics, to photonics, optical engineering, and imaging. Our PhD and MS programs provide scientific training and highly competitive technical skills through cutting-edge research projects and an expanding array of courses, including online courses and distance-learning programs. Our graduates become professors, scientists, engineers and entrepreneurs, working in academia, government, and businesses around the globe. Visit our website, [www.optics.arizona.edu](http://www.optics.arizona.edu), or attend our annual Optics and Photonics Winter School in January to learn about the field of optics. Then join one of our academic programs in Tucson or online to embark on an illuminating career in optics!

**Saturday Only**

## BOSTON COLLEGE

### Booth 118

Contact: Jane Carter, [chevry@bc.edu](mailto:chevry@bc.edu)

The Department of Physics at Boston College is a community of approximately 150, including faculty, staff, postdocs, visiting scientists, graduate students and undergraduate majors. Our research program is focused in condensed matter physics. We have a highly collaborative and interdisciplinary research environment, with experimental and theoretical research carried out on a wide range of topics, from topological materials to novel magnetism to quantum biosensors. Boston College recently founded the Schiller Institute for Integrated Science and Society, and our department is now further expanding its interdisciplinary research efforts in areas such as quantum materials and information, nanophotonics, plasmonics, materials science, nonlinear optics and biological physics. We provide a wide range of research opportunities for motivated graduate students, and typically admit 8 or so each year into our Ph.D. program. Our graduates have been very successful in obtaining jobs in both academia and industry.

## ECOLOGICAL SOCIETY OF AMERICA

### Booth 218

Contact: Jonathan Miller, [jon@esa.org](mailto:jon@esa.org)

The Ecological Society of America (ESA) is a nonpartisan, nonprofit organization of scientists founded in 1915 to promote ecological science by improving communication among ecologists, raise the public's level of awareness of the importance of ecological science, increase the resources available for the conduct of ecological science, and ensure the appropriate use of ecological science in environmental decision-making by enhancing communication between the ecological community and policymakers. ESA's over 9,000 members conduct research, teach, and use ecological science



to address environmental issues that include biotechnology, natural resource management, ecological restoration, ecosystem management, species extinction and loss of biological diversity, habitat alteration and destruction, and sustainable ecological systems.

## KENT STATE UNIVERSITY/CPIP

### Booth 417

Contact: Mary Ann, mkopcak@kent.edu

Our focus covers the foundational principles that underlie our universe and extends to several areas of applied physics. Physics programs range from physics minors to bachelor's and master's physics degrees to the PhD physics program. Are you interested in physics degrees or physics programs? Are you seeking undergraduate physics programs, PhD physics programs, or master's-level physics degrees? The Department of Physics at Kent State University focuses on providing students with a quality education in the field of physics. Our undergraduate offerings include courses and studies for physics majors and minors, and interdisciplinary options are also available. The Kent State Physics Department continues to develop new coursework, and our physics programs offer stimulating and informative classes, labs and research training.

## OHIO UNIVERSITY

### Booth 415

Contact: Gang Chen, cheng3@ohio.edu

Founded in 1804, Ohio University is one of the first universities in the Midwest Territory. The Department of Physics & Astronomy at Ohio University hosts the 2nd largest physics and astronomy programs in the state of Ohio. Graduate students study with internationally renowned faculty and take advantage of distinctive facilities at Ohio University. Research areas include astrophysics, biophysics, condensed matter and surface science, nanoscience, nuclear physics, and particle physics. Both experimental and theoretical studies are in progress in these areas. Interdisciplinary and inter-departmental programs of study also are possible. The John E. Edwards Accelerator Laboratory, the MDM Observatory, and scanning tunneling microscopes are just a few of the specialized labs available to graduate students.

## QUEENS COLLEGE

### Booth 315

Contact: Phillip Gould, phillip.gould@uconn.edu

The University of Connecticut is consistently ranked the Number 1 public university in New England. The University's first Physical Review article was published in 1899, and the first physics course was taught in 1918. The Department of Physics granted its first Ph.D. in 1954. One (so far) of the Department's Graduate Students, David M. Lee, went to receive a Nobel Prize in Physics. The Department of Physics offers a wide range of graduate and undergraduate courses, as well as a vibrant research program with 29 full-time faculty.

## SOUTHERN CONNECTICUT STATE UNIVERSITY

### Booth 416

Contact: Evan Finch, finchl3@southernct.edu

The applied physics master's degree program at Southern Connecticut State University is a Professional Science Master's (PSM) program that includes training in physics and physical sciences, computer science, and business management. The program is designed both to provide students with a broad set of skills that equip them for Connecticut's high-tech workforce and also to be a stepping stone (particularly through the research opportunities offered) for those students wanting to pursue a PhD. Areas of concentration are optics and nanoscience, with research opportunities that also include astronomy, materials, and biophysics.

## UNIVERSITY OF MARYLAND

### Booth 318

Contact: Donna Hammer, dhammer@umd.edu

Housed within a large, diverse research university, Maryland Physics is one of the largest departments in the nation. Exploring more than 30 fields of physics, our faculty and students work together on some of today's most cutting edge physics research. Along with a rigorous academic curriculum and an ideal Washington, D.C. location, this productive research program forms the foundation of a first-class educational experience. Our undergraduates are sought after by premier graduate schools and a competitive marketplace; and our graduate students advance to challenging careers in government, industry and academia.

## UNIVERSITY OF WASHINGTON

### Booth 217

Contact: Marjorie Olmstead, olmstd@uw.edu

The University of Washington Department of Physics graduate program provides wide ranging opportunities in both experiment and theory. Particular strengths include a strong combined experimental and theoretical effort in quantum matter, with special expertise in 2-dimensional materials and development of model qubits, a broad experimental program in fundamental symmetries and particles, including searches for dark matter as well as strong ties to CERN, and a long-standing program in physics education research. The department has strong overlap with the Institute for Nuclear Theory and UW's Department of Astronomy, with whom it shares a building. The department maintains strong interdisciplinary efforts across campus, including several faculty with joint appointments in engineering as well as adjunct faculty in related departments who supervise physics doctoral students. The department provides a well-established mentoring program for first-year students and an active physics graduate student council and career development organization.

## UNIVERSITY OF WYOMING

### Booth 117

Contact: Hannah Jang-Condell, hjangcon@uwyo.edu

Our program offers a welcoming, personalized educational experience that broadly prepares students for challenging careers in space sciences, nanotechnology, quantitative finance, engineering, environmental sciences, optics, computer technology, energy policy, science law, and many other fields. Our research efforts are broadly focused on condensed matter physics, materials science, and astronomy. Our physics faculty and students carry out interdisciplinary, collaborative, and hands-on research in multiple cutting-edge laboratories. Our astronomy faculty and students have exceptional access to observing opportunities at Apache Point Observatory, the Wyoming Infrared Observatory, and Red Buttes Observatory. Our researchers also use the NCAR Wyoming supercomputer and the Mount Moran cluster for their theoretical computational work. We offer three undergraduate and three graduate degree programs: Physics BS, Physics BA, Astronomy BS, Physics MS, Physics Teaching MS, and Physics Ph.D.

## WESTERN MICHIGAN UNIVERSITY

### Booth 418

Contact: Kirk Korista, kirk.korista@wmich.edu

Integral to the liberal arts environment, the study of physics is fundamentally important to thousands of students at Western Michigan University. Students majoring in physics are in demand for careers in industry, government or teaching. Many go on to graduate study in physics, astronomy, education, engineering—even medicine and law. The intellectual challenges presented by this exciting field of study are significant, and the accomplishments of its students are widely recognized by professional schools. Many other majors, including engineering, chemistry and mathematics, require physics coursework. In fact, enrollment in our classes tops 3,400 each year. Our Master of Arts and Doctor of Philosophy programs prepare student researchers for careers in industry, academia and national laboratories, with concentrations in atomic and nuclear physics, with potential applications in astrophysics;

condensed matter physics and material physics; physics education (M.A. level only); and applied work in conjunction with the College of Engineering. For students at all levels, our goals are to nurture an enthusiasm for learning and to convey the limitlessness of our modern world's need and capacity for scientific discovery. In concert with this commitment to teaching, our faculty are involved in diverse areas of research—both on campus and at leading national and international laboratories. WMU is a premier, comprehensive, public research university. The faculty within our department receive more than \$1.7 million annually in external research funding. Today, as in the times of Newton and Einstein, the study of physics lies at the forefront of human understanding. The students and faculty of the Department of Physics will continue to play an important role in solving the mysteries presented by our physical universe.

### WORCESTER POLYTECHNIC INSTITUTE

#### Booth 317

Contact: Doug Petkie, [dtpetkie@wpi.edu](mailto:dtpetkie@wpi.edu)

Graduate students are an integral part of Worcester Polytechnic Institute's (WPI) research fabric in fields across science, engineering, and business, and benefit from WPI's intimate size, strategic location, and a community of researchers with open labs, doors, and minds. We have designed the WPI physics graduate program to give you a solid background in the fundamentals while working with a research group when you first join the PhD program. Research opportunities are available in experimental and theoretical/computational studies in biophysics, nanoscience, electromagnetics, materials science and photonics. Professional development opportunities for career pathways in industry and academia are available in the Physics Department and offered by the WPI Graduate Studies office. Visit [www.wpi.edu/+physics](http://www.wpi.edu/+physics) to find out more.



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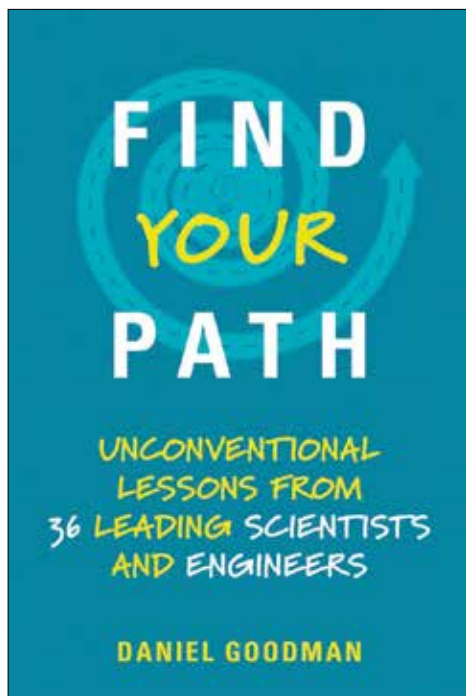
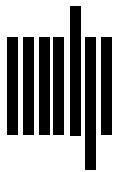
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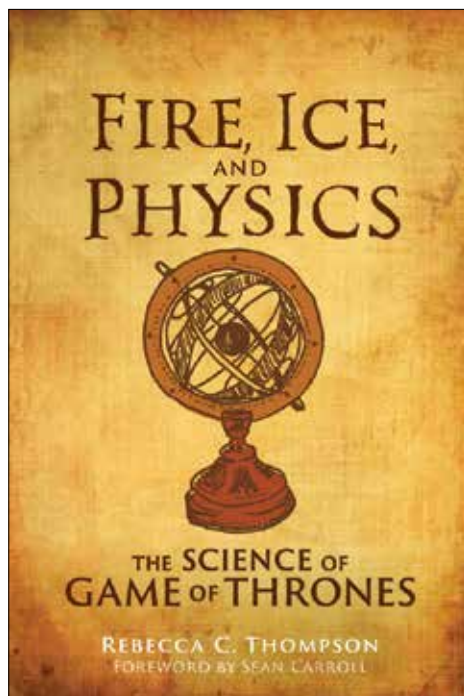
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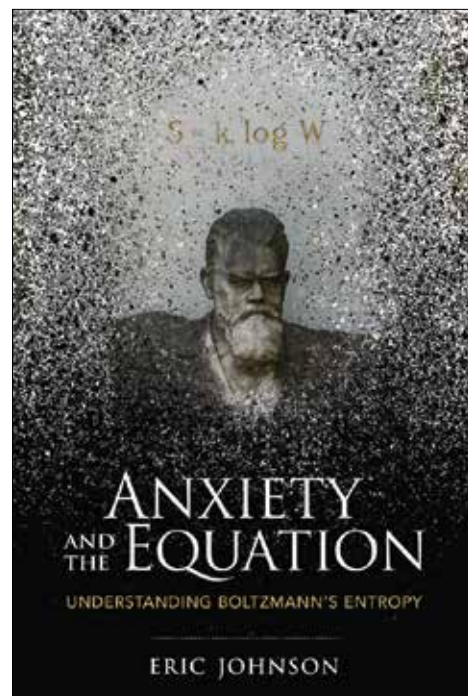
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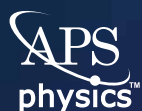
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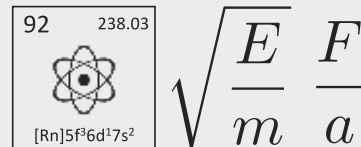
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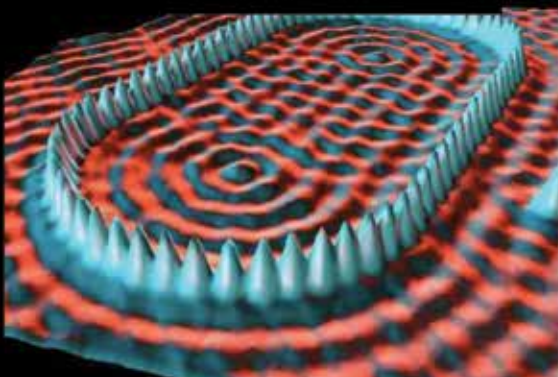
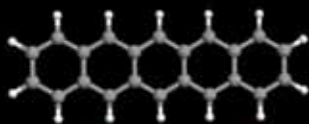
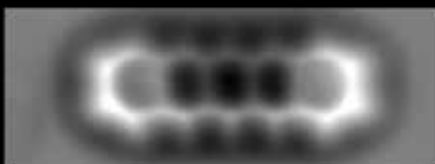
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