SPS Chapter Report 2020-2021

University of California, Berkeley (Zone 18)
Chapter Advisor: *Zi Qiang Qiu*

Prepared by *Shantanu Kadam, Carter Turnbaugh, Fanghui (Wendy) Wan*

Introduction

"No one can whistle a symphony. It takes a whole orchestra to play it."
—H.E. Luccock

Berkeley SPS has a proud history of providing a welcoming and rich environment to the undergraduate physics community at UC Berkeley, including many members of the National Society of Physics Students. Despite the large-scale disruption caused by COVID-19 throughout the school year, the Berkeley chapter of SPS has made significant progress in adapting and introducing a variety of services to both the undergraduate community in Physics at Berkeley as well as the community.

Table of Contents

Part I: National and Regional SPS

"No one can whistle a symphony. It takes a whole orchestra to play it."
—H.E. Luccock

Having hosted this year's Zone 18 meeting, the Society of Physics Students at UC Berkeley is committed to the mission of the national organization. Furthermore, by engaging in new and wide-reaching competitions, Berkeley SPS further connected with other SPS chapters throughout California and beyond, including UW Seattle.

Hosting SPS Zone 18 Meeting (9-10th April 2021)

Berkeley SPS organized the Zone 18 SPS meeting this year from April 9th to April 10th. Due to COVID regulations, all events happened on a specially designed Gather page. Gather.town is a unique platform that assimilates the "walking around" experience that greatly fosters personal connections between participants. Taking place over two days, events ranged from social to academic, attracting a number of SPS members in Zone 18. Hereby we list the agenda for the zone meeting and descriptions for respective events:

Keynote Speaker Dr. Brad R. Conard (5:30-6:00PM April 9)

Dr. Conrad is the Director of the Society of Physics Students, the Sigma Pi Sigma Physics Honors Society, and a professional lecturer at George Washington University. He completed his PhD in Experimental Condensed Matter Physics at the University of Maryland College Park where he researched organic semiconductors and surface physics. During his undergraduate studies at the Rochester Institute of Technology, he became president of his local SPS chapter as well as an Associate Zone Councilor for Zone 2. Throughout his career he has continued to work with SPS to emphasize the importance of undergraduate education and provide opportunities for early career physicists.

Dr. Conrad talked about his personal journey as a SPS member, and elaborated on potential opportunities and benefits SPS can bring for the physics community. The humorous style of his talk makes the audience burst into laughter and we all learned a lot from his talk.

Intro to Gather.town (6:00-6:30PM April 9)

As we were hosting the Zone 18 meeting on a gather page, we gave all the attendees a brief tutorial on how to navigate around the Gather.town space and some time to familiarize the controls.

Social: Fermi Questions (6:30-7:30PM April 9)

In this event, participants from different universities randomly joined teams to compete and try to answer questions within the closest order-of magnitude. Questions ranged from "How many dumplings can you fit in the Moon?" to the number of snowflakes in a snowman. It was a delight to see students form friendships, and some of them even presented their thought process to the entire audience!

Academic talk by Satcher Hsieh (10:00-11:00AM April 10)

Satcher Hsieh is a sixth year PhD student at the University of California Berkeley studying experimental atomic physics. His current research focuses on sensing platforms to probe matter in extreme conditions. His work has applications in many fields such as alternative energy sources and data storage techniques. Hsieh's work also includes multidisciplinary areas such as the study of diamond anvil cells relevant to physics, chemistry, and geology. His work has been published in such journals as Physical Review Letters, the Bulletin of the American Physical Society, and Physical Review Applied.

Poster Session A (11:00AM-12:00PM April 10)

This is one of the two poster sessions, including research posters in astrophysics, geophysics, and particle physics.

Lunch Break (12:00-12:30PM April 10)

Industry and Grad Panel (12:30-2:00PM April 10)

We invited Berkeley alumni who graduated with physics majors and continued their physics career in industry or academia. Here is a list of panelists:

Nicholas Rui	graduated in 2020 and is currently a graduate student in Astrophysics at Caltech.
Mayia Vranas	graduated in 2019 and is currently a graduate student in condensed matter at UCSD
Jinen (Tim) Guo	graduate in 2020 and is currently a graduate student in Quantum Information/AMO physics at Havard
Chelsea Chen	graduated in 2019 and now works in software engineering at Cisco
Aini Xu	graduated in 2020 and is currently a software developer at Epic
Rahul Malayappa	graduated in 2019 and is now a software engineer at Cognac

Academic talk by Ramamoorthy Ramesh (2:00-3:00PM April 10)

When Intel looks beyond its 10-nanometer silicon-based processor and when quantum computers need a low-temperature alternative, the new oxide electronics device CMOS provides answers. Introducing our next Faculty guest, famous material scientist, Professor Ramamoorthy Ramesh, whose research focuses on correlated oxide thin films and heterostructures. He ranks among the Highly Cited Physicists around the world in the Physics Citation Index. He is also elected as a foreign member of the Royal Society for his “discoveries in complex oxides, from novel fundamental physics, through new materials, to their application in ferroelectric, magnetic and multiferroic devices.”

Professor Ramesh’s talk was a blast! Around 20 people attended his talk and stayed around for more than 30 minutes to ask questions.

Poster Session B (3:00-4:00PM April 10)

This is one of the two poster sessions, including research posters in condensed matter physics, quantum information, and AMO physics.

Resume Workshop (4:00-5:00PM April 10)

Our web-dev manager Carter Turnbaugh hosted the resume workshop and assisted attendees with designing, formating, and writing their resumes.

DE&I Workshop (5:00-6:00PM April 10)

Our Equity and Inclusion Chair Eden McEwen hosted the DE&I workshop. She talked about common obstacles undergraduates might suffer from, including imposter syndrome, as well as how to build an inclusive environment together.

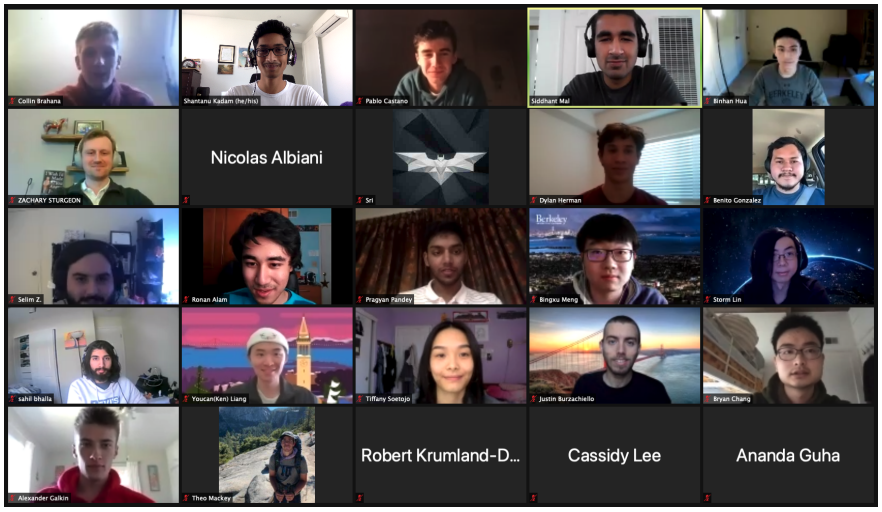
Social (6:00-7:00PM April 10)

People hung out in the main lobby, shared college stories, and exchanged contact information. The process was unexpectedly rewarding and some officers from other SPS chapters reached out for future collaborations!

Closing Remarks (7:00-7:30Pm April 10)

UC Physics Hackathon (5 December 2021)

Coding is an increasingly critical skill in physics research and the professional workplace. To stimulate interest in computational physics and inspire people to learn code, Berkeley SPS hosted the inaugural UC Physics Hackathon for all University of California campuses. SPS chapters from 6 of the 9 undergraduate campuses (Riverside, Los Angeles, Berkeley, Santa Barbara, San Diego, Irvine) participated in a high-octane, 36-hour tournament! Over 60 students formed teams of two across different campuses to teach a Martian how to bake cookies, create a literal logic device, and optimize a cup-telephone. By working together on approachable but complex problems with no barrier to entry, undergraduates learned valuable collaboration skills. During presentations and Q&A sessions, they refined these skills and learned to provide positive feedback through scientific discourse. This event was an immediate hit, with people from many SPS chapters staying long after the tournament ended to share physics puns and connect on social media.



(Above) Hackathon participants share campus stories, puns, and contact info after a weekend of intense problem solving!

American Physicists' Tournament (5 December 2020)

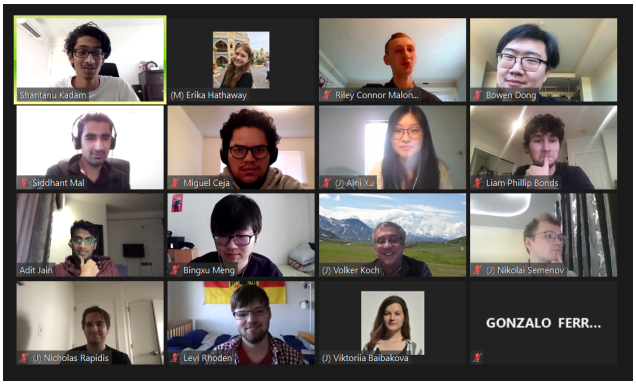
The International Physics Tournament is a world-class event held in Europe. Each country sends one team to compete, and before that, multiple competitions are held in a country at the state or national level to determine qualification. Traditionally, the United States has lacked representation in IPT until the 2018-2019 school year when Berkeley SPS hosted the first national IPT qualifiers which included several Berkeley teams.

This year, with the lead of the Projects Coordinators Shantanu Kadam and Siddhant Mal, Berkeley SPS invited multiple SPS chapters from across the United States. Students from the chapter at UW Seattle and UC Berkeley came together during a one-day event where they battled several intriguing physics-based problems. In each round, each team volunteered one person to be either the Presenter or Opposer. The Presenter explained their solution to a problem, while the Opposers presented inconsistencies in the original solution and provided possible improvements to methodology. Judges consisting of a panel of graduate students, professors, and researchers awarded points and provided feedback.

Quarantine and personal matters prevented other interested schools from participating. The tournament format was dramatically altered for virtual flexibility, and communication took place over Instagram, Facebook, and YouTube. Many schools expressed interest in attending an in-person tournament next year, including Rice University, UC Santa Barbara, UC Irvine, Stanford University, and Columbia University. This year, Berkeley SPS created a brand for this now-established event, forming a logo and officially naming it the American Physicists' Tournament (abbreviated as USPT). A permanent problem bank has been established for students to document their efforts and share their discoveries.

In the end, juniors Miguel Ceja and Shantanu Kadam (team captain), sophomore Siddhant Mal, and first years Vivian Guo and Bingxu Meng received the opportunity to represent the United States. The UW Seattle team came in a close second. Students who would not have otherwise met were able to share valuable experiences and learn different thinking styles of physical phenomena, forming lifelong friendships and respect. Efforts such as this closely follow the mission of the national SPS chapter. The international round will be held in June, and we look

forward to the cultural, scientific, and personal exchanges that the UC Berkeley team will experience!



(Above) Berkeley SPS hosted the third annual United States selection round for the International Physicists' Tournament. Here, we see teams from two SPS chapters from across the country using their wit to solve complex physics questions!

(Above) The new logo for the American Physicists' Tournament!

Part II: Local Campus Engagement

"Find a group of people who challenge and inspire you, spend a lot of time with them, and it will change your life!"
—Amy Poehler

The Berkeley SPS forms the official voice of the undergraduate population of the University of California, Berkeley Department of Physics and as such holds a number of regular local events. These events are either social, academic, or professional in nature and help shape the culture of the department by promoting equity and inclusion and good mental health practices. In the 2020-2021 school year, we not only strengthened our presence in the department and students' experiences but unveiled new programs that addressed overlooked problems. In the first part of this section, we will describe traditional Berkeley SPS characteristics that any member of UC Berkeley can enjoy. We then explain collaboration with other student campus groups, as well as with UC Berkeley's physics department. In the last part of this section, we detail several of the new programs led by our student board.

Part A. Traditional Programs

General Meetings

Berkeley SPS held weekly hour-long meetings that were either academic or social in nature. The consistency of these events created a space for community and support, particularly given the virtual nature of this school year. All meetings were held virtually through a mix of engaging platforms, including Zoom and Gather. On average, 15+ students actively participated in general meetings. Below, we highlight select weekly meeting topics.

(Above) Berkeley SPS members gathering at a general meeting at the start of the Spring semester, lost in a maze and "got crazy."

Maze on Gather (14 September 2020)

Berkeley SPS kicked off the 2020-2021 school year with a maze on Gather, customly made by Officer Nathan Helvy for the use of Berkeley SPS. The Gather.town space has most of the room

in the Physics Building (formerly LeConte), serving as a perfect space for new club members to acclimate and virtually experience the physics building. The maze is so confusing that people would randomly end up in the same location, allowing new acquaintances to form and simulating the novelty of a new semester!

Slides Game with Mentorship Groups (30 September 2020)

With everything virtual, it becomes exponentially difficult for new club members to feel the SPS vibe. In the 2020-2021 school year, the mentorship program becomes a vital source for new club members to know and talk to peers and upper classmen. The slides game breaks the ice between new friends by encouraging humor and illogical claims. In this event, each mentorship group (usually consisting of 2 mentors and 4 mentees) gets a set of premade slides that they have never seen before. Their goal is to "be the expert" and present to the other group about their "scientific findings." As our first mentorship inter-group social, the Slides Game offered a space for people to talk (and laugh!) within and between their mentorship groups.

Types of Physics (18 September 2020)

New students are often unsure what physics means and how to pursue meaningful endeavors in the field. Early on in the semester, Berkeley SPS holds this academic general meeting to introduce the subfields of physics to its younger members. Most officers contributed to making slides and presenting about the courses they have taken. They even offered some "insider tips" regarding different professors in the physics department and what courses build off each other. This meeting, before the course selection process officially begins, helps many undergraduates with understanding fields of physics, the physics courses and gives much more information to the prospective physicists!

How to Get Research (7 October 2020)

In the middle of the semester after the first wave of midterms, Berkeley SPS helped introduce its younger members to the amazing variety of topics that are currently researched at UC Berkeley. The meeting covered most fields of physics that are currently research at Berkeley (e.g. Atomic Physics, Condensed Matter Physics, Quantum Information, High Energy Physics, Astro Physics, and the like). Undergraduates from each area of expertise talked about their research, useful skills to perform research in their area, and briefly introduced the relevant coursework. In keeping with Berkeley SPS's emphasis on wellbeing, dealing with failure and healthy student-professor relationships were stressed. This event allows the lowerclassmen to meet and learn from the upperclassmen, and a few lower classmen even stayed around and enjoyed a private talk with the mentors!

Course-Evaluations Party (2 December 2020)

In the second to last general meeting of the fall semester, SPS promoted students to fill out their course evaluations with a special treat. In many ways, SPS is the link between the administration and students of the physics department. Because course evaluations are the primary way students' voices are heard, we dedicate an entire meeting to filling them out over snacks, commentary, and games!

Halloween: Pumpkin Decoration (28 October 2020)

Though the pandemic prevents SPS Members from decorating cookies face-to-face or playing Halloween games in the physics building, Berkeley SPS hosted a pumpkin decoration to make the distance a little sweeter! Just like classes, there are remote and physical pumpkins to decorate! The attendees also submitted a picture of their pumpkin which were later voted on! Below we present the cutest pumpkin, made by president Erika Hathway:

Order-of-Magnitude Games (14 October 2020 and 10 February 2021)

One of our most-loved social events is the order-of-magnitude game, also called "Fermi Questions," which asks groups to try answering seemingly intractable problems. Problems like "How many pianos are there in the United States?" can trigger a lot of interest and laughter. As one of our most popular events, this event was held over both Zoom and Gather. Participants loved the hosts' commentary, tense team discussions, and live updates intermingled with competitive shouts at other teams!

On 14th of October we had a general themed fermi question social while on 10th of February we had a Chinese Lunar New Year themed fermi question + riddle social.

(Above) A fierce competition designed by President Rahul Sahay ensues as teams attempt to answer puzzling Fermi questions! There are also club members testing the new zoom filters!

LaTeX Workshop (31 March 2021)

Web-dev Committee Chair Carter Turnbaugh led this educational LaTeX workshop by introducing some vital skills one might need in the process of writing a research update or an official research paper. He started with the basic functions and proceeded to teach advanced packages for citation and graphing. Member interest in this event has risen rapidly in recent years, and we got very positive feedback from club members. A recording is kept for those who wish to watch it.

Python Workshops (4 November 2020 and 23 February 2021)

Python is one of the most important skills for undergraduate students to get. Fundamental to research in physics, Python has also become a significant feature of weekly homework in courses. In the 2020-2021 school year, we held two Python workshops. In each workshop, we have three levels of difficulty to make sure there is something for everyone. The first workshop focuses on coding in general and covers topics such as numerical integration. In the second workshop, we focus more on graphing, which most physics undergraduates do during their research.

Thanksgiving Scavenger Hunt (18 November 2020)

Though there is no way to have in-person thanksgiving celebration in November 2020, our wonderful gather.town construction team (Kobe and Nathan) initiated a scavenger hunt in the gather.town space that assimilates the physics building! Participants formed groups and talked as they navigated through the building.

Summer Research +Resume Workshop (2 February 2021)

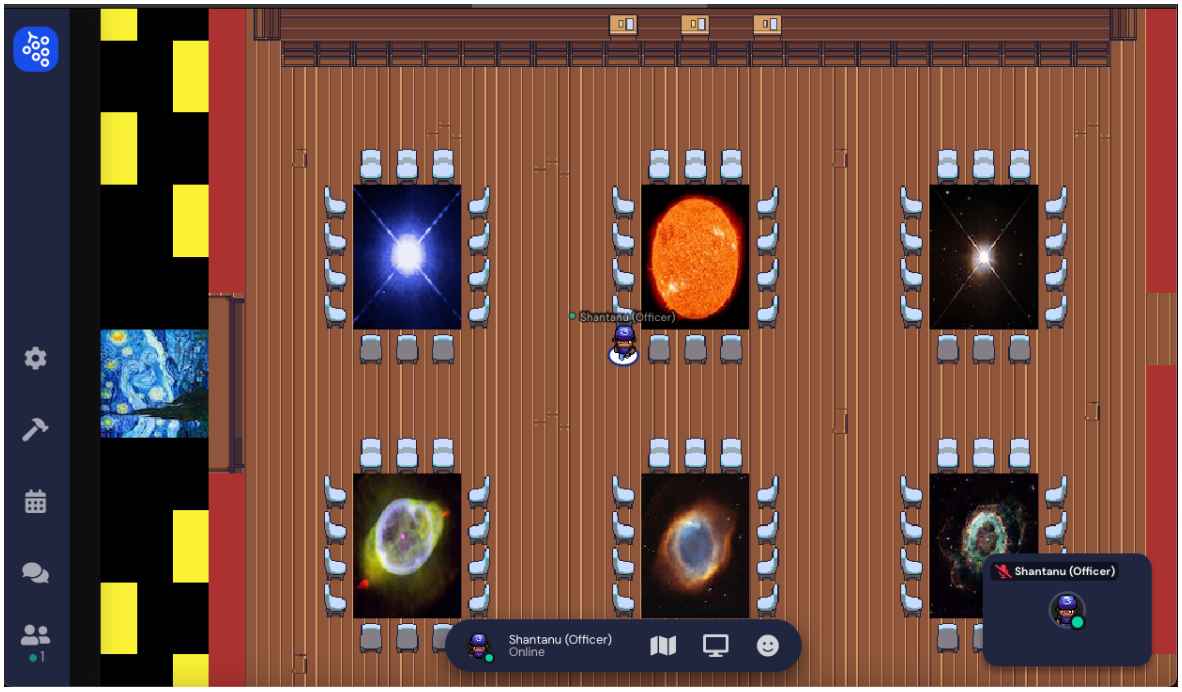
As the deadlines for summer research applications (REU etc) approached, we hosted an event populating possible research opportunities, discussing the application timeline, and helping with resume writing.

Grad Panel on Grad Life (14 April 2021)

For undergraduate students still pondering between graduate school and industry, there is nothing better than hearing from current graduate students! We collaborated with the Physics Graduate Student Association to host a panel on the lesser-discussed, but equally important, wellness aspects of being a graduate. 7 panelists from the physics department shared meaningful life experiences and actionable ways to maintain mental health in grad school. Around 30 undergraduates came. Between pre-submitted questions, live Q&A, and the panelists' advice, attendees gained real insight into the different ways graduate students manage time, sleep, expectations, and relationships.

SPS Gather.town Prom (05 May 2020)

The UC Berkeley Chapter of SPS traditionally throws a "prom" to celebrate the finale of the Spring Semester. It is typically held before Finals week so that the physics students in our department can say that they "did in fact attend parties in college." Because of the COVID global pandemic, this year's prom was held on gather.town. The theme was space, and Officers Nathaniel Rowe and Nathan Helvy spared no expense on the extravagant, budgetless gather.town decorations on gather.town shows its benefits! Prom kicked off with the handoff of presidential responsibilities from the old presidents, Rahul Sahay and Erika Hathway, to the new presidents, Shantanu Kadam and Fanghui (Wendy) Wan. The crowd enjoyed a Jeopardy-style trivia and casual chat about summer plans afterwards.



(Above) Teams competed in Jeopardy while sitting at these out-of-this-world tables during Prom on Gather!

Record of all General Meetings in the 2020-2021 School Year

Fall Semester Schedule

9 September 2020	Fall Inaugural Meeting
14 September 2020	Maze on Gather
23 September 2020	Types of physics
30 September 2020	Slides Game with Mentorship Groups
7 October 20209	How to Get Research
14 October 2020	Fermi Questions
21 October 2020	Course Scheduling Advice
28 October 2020	Pumpkin Decorating
4 November 2020	Python Workshop
11 November 2020	Social Hour
18 November 2020	Thanksgiving Scavenger Hunt
2 December 2020	Course-Evaluation Party
11 December 2020	SPS Holiday Party

Spring Semester Schedule

27 January 2021	Spring Inaugural Meeting
2 February 2021	Summer Research + Resume Workshop
10 February 2021	Lunar New Year Themed Fermi Questions
23 February 2021	Python/Plotting Workshop

3 March 2021	Peer Resume/CV Editing Workshop
10 March 2021	Becoming an SPS Officer
16 March 2021	Origami Workshop
31 March 2021	LaTeX Workshop
14 April 2021	Grad Panel on Grad Student Life
28 April 2021	Course Eval Party
5 May 2021	SPS Gather.town Prom

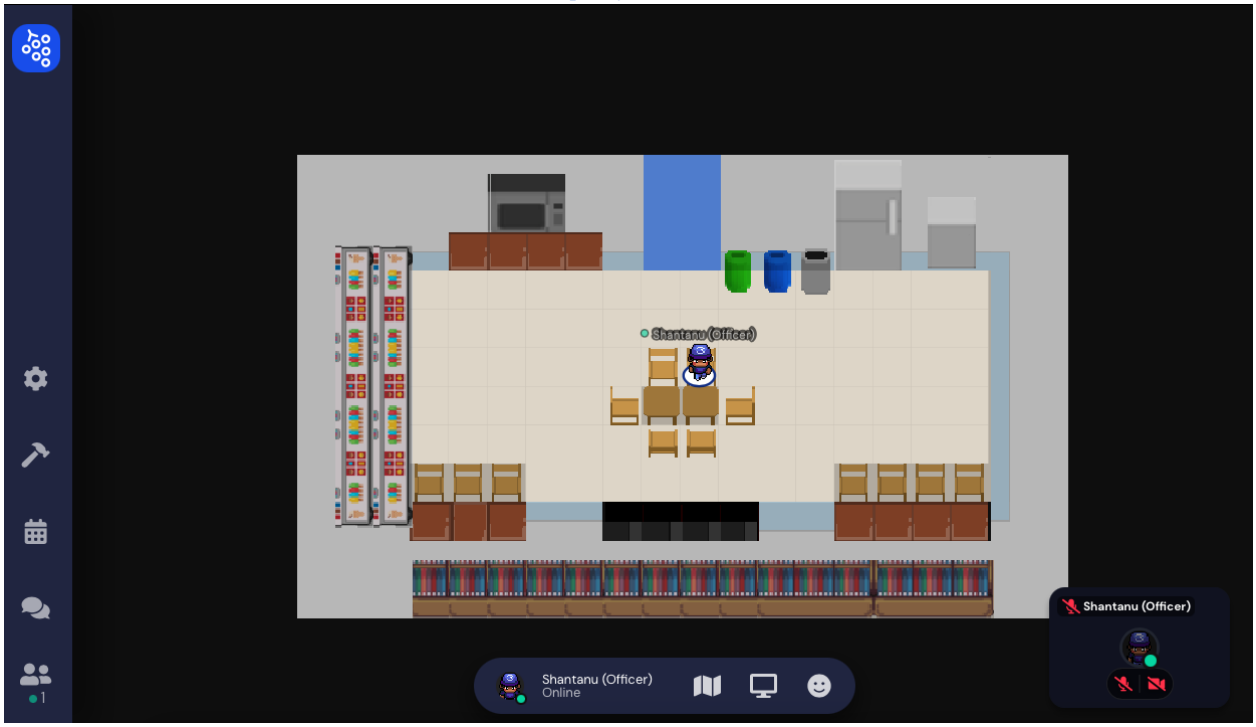
The SPS Room and the Snack Shack

184 Physics North, better known as the "SPS Room", is a small multi-purpose space. Berkeley SPS events are planned in the room, and SPS members and the physics student body can meet to relax or study together, get to know the officers of SPS, and answer the fill-in fun blank question of the week on the whiteboard.

The main highlight of the SPS room is the snack shack, which is a convenient and affordable place for students to find snacks to eat while taking a break from working hard on physics (or any academics). Though virtually no one could enter the sps room due to the COVID global pandemic, we got lots of help from the campus custodians, and they are still buying soda from us! The importance of the Snack Shack in maintaining students' dietary requirements is best exemplified by the Snack Shack food review Instagram account, **@berkeleyspsfoodreview**.

A replica of the SPS Room was made in the Berkeley Physics Gather. Every officer held weekly office hours to facilitate informal study groups, offer course advice, chat about life and quarantine, and play games!

(Above) Berkeley SPS Vice President, Fanghui (Wendy) Wan, drinking her favorite IZZE soda in the SPS room. Of course, she paid for it.



(Above) The SPS Room as replicated in Gather, complete with the always-stocked Snack Shack, comfy couch, communal microwave, and seemingly-endless fridge.

The SPS Barbecue

Providing an excellent opportunity for the physics community--student, staff and faculty alike---to socialize and network, Berkeley SPS hosts triweekly open-air barbecues. These barbecues not only foster community within the department, but also draw in passers-by, enticed by the cheerful atmosphere and delicious scents cooked up by our Grillmasters. These barbecues also serve as excellent fundraising opportunities, providing the club with necessary income for other activities that are not tied directly to the department, enriching the variety of events held for the undergraduate community.

Throughout the 2020-2021 school year, Berkeley SPS missed our barbecues too much! Due to a high demand, our wonderful grill masters, Nathan Helvy and Nathaniel Rowe, hosted two virtual barbecues. Friends gathered in a zoom room and watched the grill masters do their magic. Each event lasted more than 3 hours! Many graduated physics majors came back and enjoyed the silly atmosphere with their friends!

(Above) Nathan Helvy's profile picture on our sps website. He used that same grill for steaks and mushrooms during the virtual barbecue nights!

The Gather

The SPS Grillmasters found themselves with less on their plates with the virtual year. So Nathan Helvey and Nathaniel Rowe turned their attention to another community-building endeavor: the official Berkeley Physics Gather space. Throughout the year, both officers created this space as a model of the physics building on campus, replicating the iconic Reading Room, SPS Room, and other undergraduate spaces. Moreover, professors used this space for office hours, and the department hosted numerous events, such as the trademark Research Fair, in this space. Our Grillmasters adjusted the Gather for each event, from star-lit tables for a space-themed prom to shareable, poster board formats during the Research Fair.

Faculty-Student Lunch

Abbreviated FSL, coordinators Kobe Hassenzahl and Xuyang Yu organize a key event in bringing students and faculty together. Discussions on life and research, career paths, and more are made, and students realize that faculty are intriguing people as well. Throughout the school year, coordinators made use of the virtual format to hold events at different times and host even more FSLs than in previous years. For the first time, FSLs were organized in collaboration with another university: two joint-FSLs were held with UC Riverside's SPS. Students from both campuses had the opportunity to share undergraduate experiences and hear from professors at both universities.

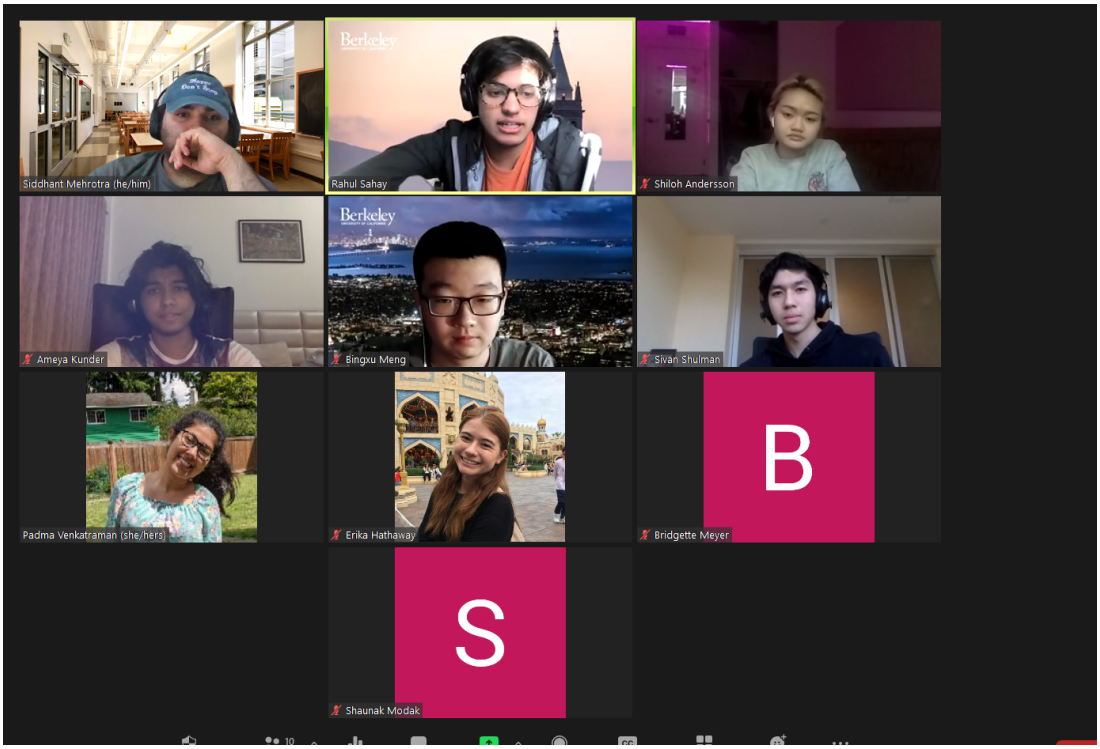
Faculty-Student Lunch Schedule

17 September 2020	Yury Kolomensky
24 September 2020	Heather Gray
13 October 2020	Achilles Speliotopoulos
22 October 2020	Jeffrey Neaton
18 November 2020	Liang Dai
23 November 2020	Robert Littlejohn
5 March 2021	Kam Biu Luk
25 March 2021	Barry Barish (joint)
30 March 2021	Hitoshi Murayama (joint)
6 April 2021	Ramamoorthy Ramesh

(Above) UC Berkeley Professor Heather Gray talks to students about her life experiences, research, and passions during Berkeley SPS' Faculty-Student Lunch.

Destress with SPS

Continuing the initiative from last year, Berkeley SPS is fully aware of zoom fatigues and tries to construct a space for students to safely express their anxieties as well as stay connected with friends. The Project Committee Chairs, Yonna Kim and Siddant Mehrotra, never stopped trying to come up with new events with the committee members. Continuing the great initiative last year, DeStress events include game nights, movie nights, wholesome crafts, discussion about managing through classes, and even movement classes. The movement classes are particularly special since they were held by a committee member, Venrena Lee, who is passionate about SPS and dancing. Her movement class asked club members to "stand up and move," which constantly reminds everyone of how important occasional exercise is!



(Above) DeStress discussion regarding managing though classes. At the end of spring 2021, it becomes increasingly difficult for students to accommodate remote learning as the pressure grows as the semester comes to an end.

Undergraduate Seminars

Berkeley SPS organized the Physics Department's third installment of **Undergraduate Seminar** evening talks which gives undergraduate physics and astronomy students a platform to present their research (or general topic of interest). These seminars were founded with (and delivered on) the intention of making research-level physics **more accessible** to younger students and further increasing **communication** between upperclassmen and lowerclassmen. The seminars were also a fruitful networking avenue through which lowerclassmen were able to seek out upperclassmen mentors, with more than ten lowerclassmen joining research groups as a direct consequence. This year, Harvard and UC Santa Barbara students also spoke, learning key communication skills and developing inter-collegiate connections.

Seminar Schedule

17 September 2020	Rahul Sahay *From Thermalization to Localization*
30 September 2020	Charlie Cummings *What Happened "Before" the Big Bang*
14 October 2020	Anasuya Lyons *The Beautiful Structure of Chaos*

5 November 2020	Miguel Ceja *A New Way to Measure Gravity.. and Maybe Even Dark Energy*
12 November 2020	Rahul Sahay *From Basic Quantum to the Prediction of Real Materials*
1 February 2021	Rahul Sahay *Probing Dipolar Fluctuations via the Decay of Quantum Information*
21 November 2019	Joshua Z. Lin *Searching for Supersymmetry*
11 February 2021	Carter Turnbraugh *Keeping the World's Brightest Point Lit*
18 February 2021	Xuyang Yu *The Song of Fire and Ice - Classical Spin Models*
25 February 2021	Nathaniel Rowe *A Particle Physicist's Handbook*
1 March 2021	Pablo Castano *Simulating Neutrino Oscillations on a Quantum Computer*
11 March 2021	Aditya Sengupta *Effective Real World Scientific Programming*
1 April 2021	Luca Scharrer (UC Santa Barbara) *Topological Defects in Active Matter*
8 April 2021	Binhan Hua *Physics Engines and Speedrunning*
15 April 2021	Sambuddha Chattopadhyay (Harvard) *Pictures at Disordered Exhibition: Strong Disorder Renormalization and Random Singlet Coupling*
22 April 2021	Christian Ramos *A Survey of the Exciting World of Cryptography*
29 April 2021	Shantanu Kadam *Why You Should Care About 112 (Statistical Mechanics)*

Part B. Collaborations with other clubs

Math and Physics Joint Lecture Series

Seeking to serve students whose interests lie at the intersection of mathematics and physics, Berkeley SPS partnered up with the MUSA to create a lecture series in Mathematical Physics presented in a manner accessible for undergraduates: *The Mathematics and Physics Joint Lecture Series* (MaPJLS). The lecture series was kicked off with a lecture given by Mathematics Professor Lin Lin entitled "Grassmann manifolds, gauges, and quantum chemistry." The kick-off lecture was quite successful with over 50 participants. Mathematics Professor Nikhil Srivastava spoke next on physical metaphors for graphs.

Berkeley Integration Bee

Taking inspiration from the famous Integration Bee at the Massachusetts Institute of Technology, Berkeley SPS reached out to the Math Undergraduate Student Association (MUSA) and Society of Engineering Sciences (SES) to jointly organize UC Berkeley's second integration competition. Berkeley SPS contributed in both the organization logistics of the event, as well as providing a large amount of the integrals used in the competition. With over 200 attendants and over 70 participants, the competition was wildly successful and very competitive. In order to break down the participant pool, a preliminary round was held that narrowed down the competition to just 15 people who showcased their skills in a live Grand Finale over Zoom. Math, physics, and engineering communities came together for a day of extraordinary excitement and support! The final rounds can be found under the Berkeley SPS Youtube at https://youtube.com/playlist?list=PLa4PS945pJPdI6h0W5RjZMRpGjhncMnLx.

Part C. Collaborations with Physics Department

Meetings with Physics Advisors

Due to the fact that Berkeley's SPS chapter takes the role of "the official voice of the undergraduate community," Co-presidents Erika Hathaway and Rahul Sahay and Vice President Wendy Wan regularly met with the undergraduate advisors of the UC Berkeley Department of Physics Kathleen Anna Cooney. During these meetings, Berkeley SPS typically was charged with communicating the grievances of the undergraduate physics community. For example, SPS has helped lead the effort to get an equal number of men's and women's bathrooms in the physics building. Furthermore, Berkeley SPS officers have been key players in most of the conversations regarding equity and inclusion in the physics department.

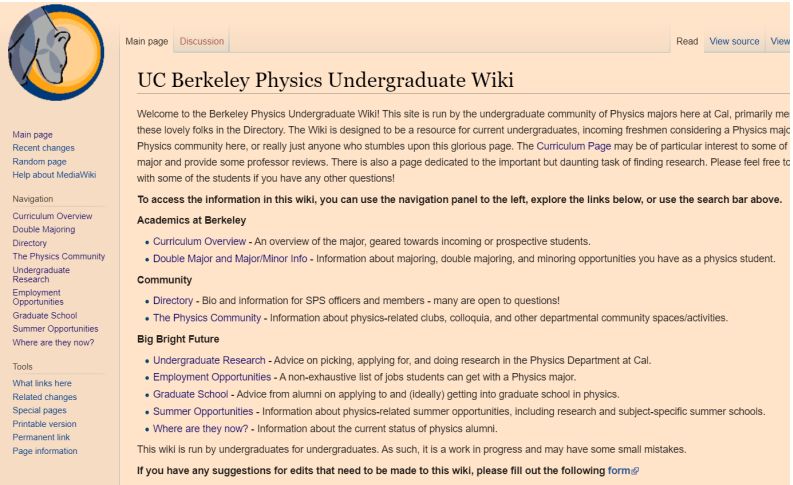
Establishment of Department Piazza Page

Berkeley SPS has been a major proponent for increasing communication throughout the physics department. Namely, in order to facilitate conversation between fellow undergraduates, the faculty, and department advising, Berkeley SPS put forward a formal proposal to the department for the establishment of a department-wide Piazza page. The purpose of Piazza would be to allow students to 1. ask anonymously about a variety of department resources (e.g. mental health resources), 2. engage with the faculty via department held AMA's (ask me anything), 3. search for a study group, etc. The department has recently agreed to the establishment of this Piazza

page and we believe that it will allow for younger students to better situate themselves within Berkeley physics, thereby improving retention rates in the department.

Establishment of Department Wiki Page

This semester we launched our UC Berkeley Physics Undergraduate Wiki, hosted at sps.berkeley.edu/wiki. It serves as an all-in-one place for physics undergrads to find a multitude of information about studying physics here at Cal, including curriculum overview, major/minor information, potential double majors, directory of people in the community, finding research, employment opportunities, grad school, etc. It has been written and will be maintained by SPS members, accurate to the best of our fact-checking abilities. Our goal for the wiki is to consolidate information and make it easier for the physics community to find what they seek.



(Above) A snippet previews the landing page of the newly created wiki!

Assistance in planning department events

Berkeley SPS has been the primary source for volunteers for department events. A few of the most notable events that Berkeley SPS assisted with are briefly described below.
talk for the community.

Career & Graduate School Panels

Berkeley SPS helped promote the Berkeley physics departments' annual career and graduate panel. Panelists included SPS members and members of the officer board, and although through Zoom, was well populated.

Physics 5A Study Hall

Physics 5A, the first college physics course taken by many physics majors at Berkeley, is notorious for its difficulty. Many of the challenges students face in 5A are not merely academic, but stem from a lack of community within the class because freshmen have not had time to interact and form study groups. In Fall 2019, outreach officer Charlie Cummings founded the

Physics 5A Study Hall program, where Charlie tutored 5A for two hours a week, and provided a space for study groups to naturally form within the class. Although Charlie was (hopefully) a valuable resource to students in the class, the main benefit was the collaboration between the students themselves.

The 5A study halls were extremely successful in their pilot run in the 2019-2020 academic year. The Physics Department officially took on the organization and planning for the 5A study halls during the 2020-2021 school year. With the support of SPS, a 5B study hall was also implemented, with mentors for both programs coming from the undergraduate study body. One student had even said they "wouldn't still be in the major" if it weren't for the program. Another benefit of the program is that by working with others, it becomes much clearer that physics is hard for everyone! It can be difficult to appreciate that it is natural to struggle through problem sets when there is a false narrative that you are the only one struggling, which is exposed as a lie when working with others. It is our hope that this program will not only improve the mental health of the students entering the department, but also improve diversity as well. The success of the program has led the Physics department to potentially expand into even more classes in the future. Stay tuned!

Part D. New Initiatives

Equity & Inclusion Coordinator

In response to a growing movement in the undergraduate study body and ongoing discussions with the graduate body and physics department, Berkeley SPS introduced the Equity & Inclusion Coordinator as a new officer position. In the first person in this role, Eden McEwen served as an official representative on the department's Equity & Inclusion working group, conceived undergraduate town halls on diversity and inclusion, made resources more available on the Berkeley SPS website, and organized mentorship. Her actions played a key role in facilitating communication between undergraduates and the department while lifting voices into the spotlight.

Mentorship Program

In the 2019-2020 year, SPS revitalized its mentorship program with goals including introducing underclassmen and incoming transfers to the undergraduate physics community, providing resources (e.g. research, tutoring), and encouraging a balanced and healthy lifestyle. Based on the reflection, new ideas were planned and implemented in the 2020-2021 school year, including a weekly challenge program, activity and participation rewards system, and inter-family events.

The mentorship program was in a "family", or group, format, with 2-3 mentors to 4-6 mentees in each family. Each family was grouped together based on availability and interests of each member. To give mentors some guidelines and ideas of how to maintain an active and inclusive mentorship group, a manual was created. The manual covered expectations, logistics, and tips and tricks. Each mentorship group was expected to meet at least once a month, either through SPS events or on their own time. The mentors and organizers met about twice a semester to check in and chat about progress, share tips, and give feedback. Additionally, all mentors and

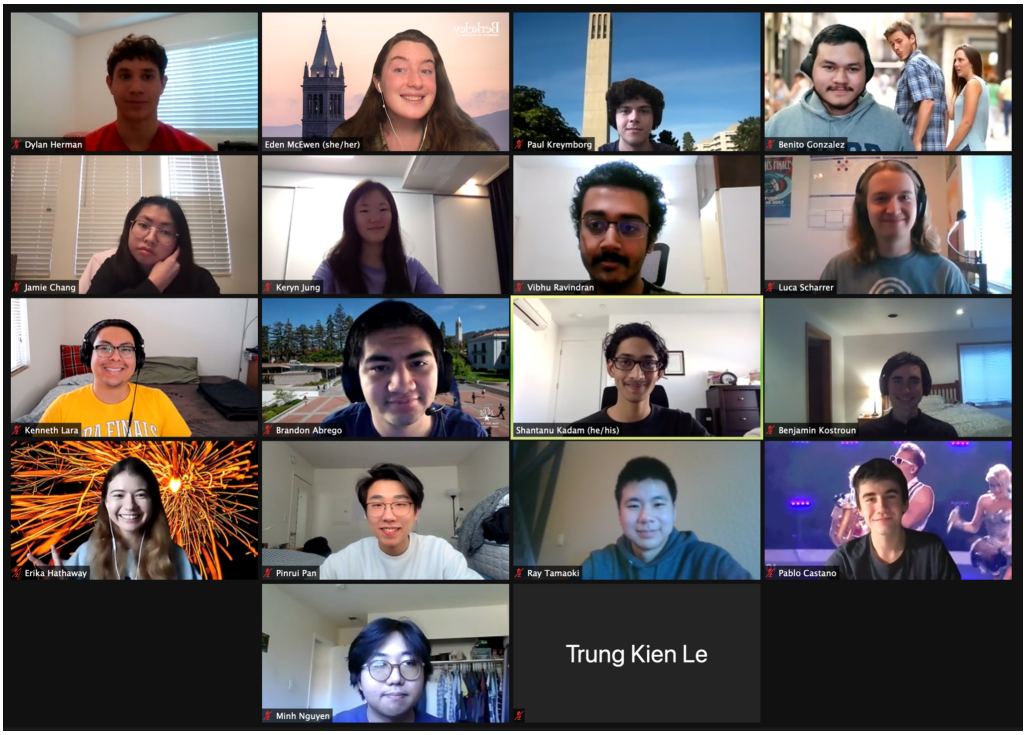
organizers belong in the same online chat so they could share ideas and experiences. The mentors also served as emotional support on many occasions, since imposter syndrome is a common experience for all students. These families served as some of the first real friendships in physics for mentees, even providing some members the resolve and motivation to continue pursuing physics despite unfortunate, alienating classroom experiences.

Officer Eden McEwen implemented a Family Cup system this year, assigning point values to family get-togethers, SPS event attendance, and special events. In this way, emphasis was placed on spending quality time together, both academically and socially. Moreover, town halls and intercollegiate events were given highest priority in the point system, embedding civic engagement into the mentorship experience. The competitive nature of the cup also encouraged mentorship families to come together for a common cause.

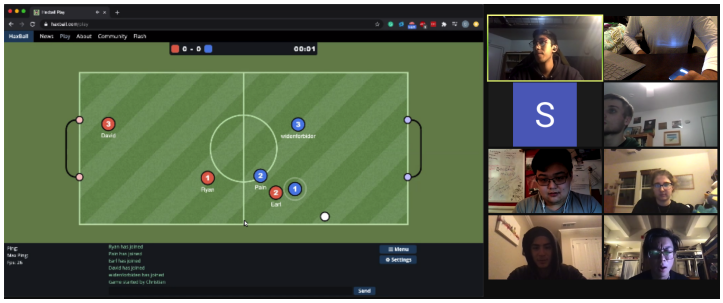
Inter-family meetups were strongly encouraged and incentivized. This was a massive success for mentorship organizers and mentees. A meeting forum was created for mentors to reach out to other mentors and schedule events together, while check-ins focused on facilitating advice between mentors. Through inter-family events, mentees of differing backgrounds got to meet even more people, make connections with fellow classmates, and form their own communities based on background, current coursework, and interests. Particularly during the quarantined year, mentees (and mentors) found this improvement a welcome way to maintain the social aspect of physics.

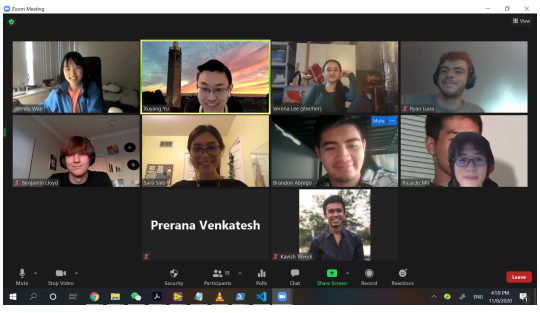
This year, a new joint mentorship event was organized between Bekeley and Santa Barbara by Officers Eden McEwen and Shantanu Kadam. Mentorship groups from both chapters got together for a lighthearted Slides Game, with a great deal of improvising and much ado about “quantum kumquats!”

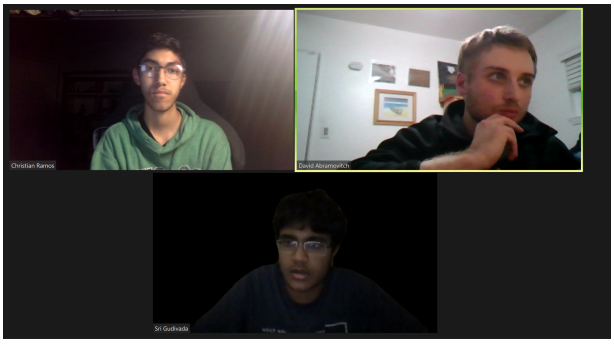
SPS deeply cares about mentorship and the inclusivity it brings, and we look forward to further making the mentorship program fun and meaningful.

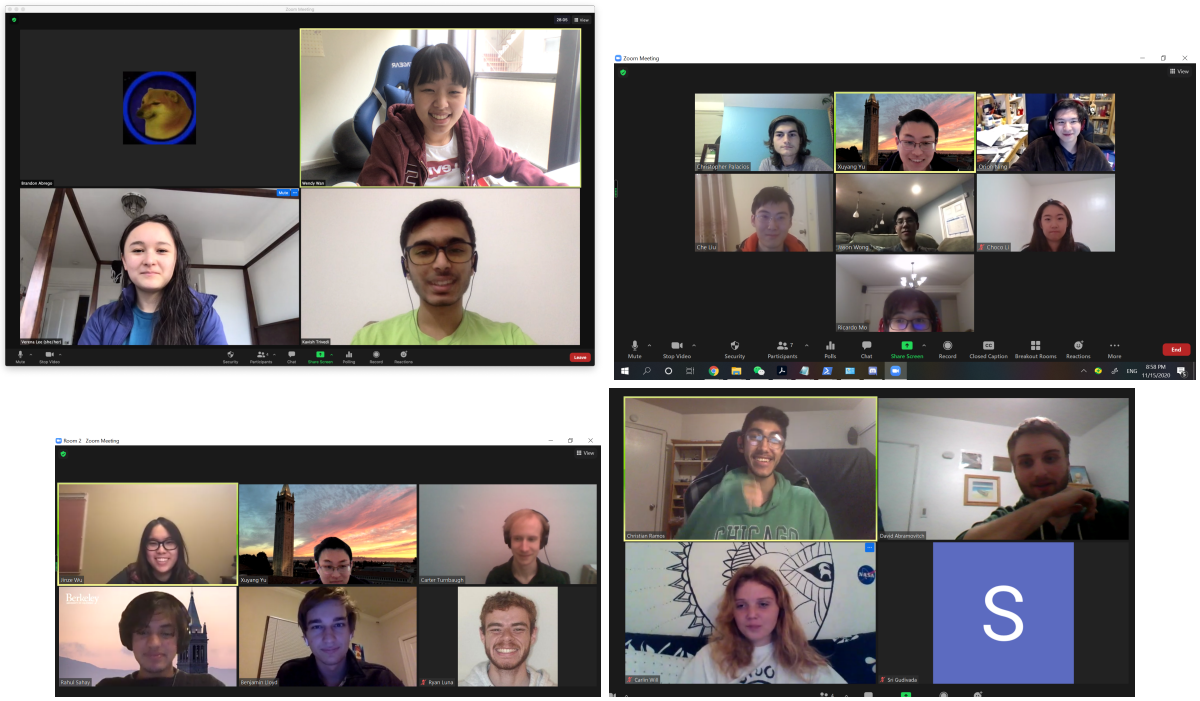


(Above) UC Berkeley and UC Santa Barbara SPS mentorship groups meet and mingle during a joint Slides Game event. New friendships were made that have carried over into the new year!









(Above) Some of the many smiles during mentorships meetings throughout the 2020-2021 school year!

Website Improvements

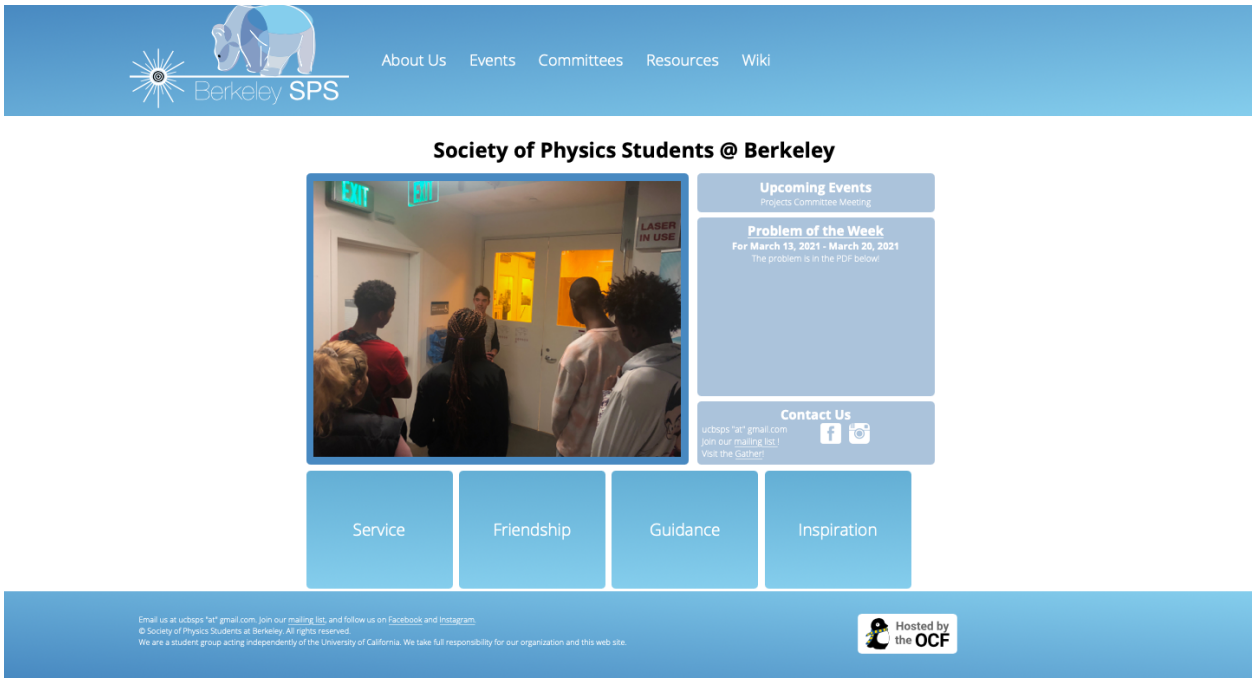
The Berkeley SPS website is an important tool **for** informing members about events, providing the Berkeley **physics** community with resources, and making people **aware** of what we offer. In the past, many of the services offered by our website were updated manually. As our initiatives have become solidified, the advantages of automating the **pipeline** from the officers running the project to the club members have become clear. In order to provide this automation, Web Master Carter Turnbaugh embarked on a full rewrite of our website this year, which can be found at https://sps.berkeley.edu.

Events are an essential part of what Berkeley SPS does, so the website must provide members with information about upcoming and past events. Our improved website reads data from our Google Calendar in order to automatically generate sorted groups of events. We now also list upcoming events on our homepage, allowing physics community members to easily see events they may take part in in the near future.

Last year, the Problem Of The Week (POTW) initiative began, providing fun extracurricular physics problems for members of the Berkeley physics community to work on. Previously, each problem was transcribed for the website by the Web Master and then uploaded at the beginning of the week. With the new website, POTW problem web pages are generated from a Google Spreadsheet managed by the Competitions Coordinators. Problems can also be written ahead of time, then only made visible during the relevant time (allowing Competitions Coordinators to write a semester's worth of problems when they have free time over the summer). Finally, the website can now provide a way for problem solvers to give feedback on the problems so that the Competitions Coordinators can find problems of interest to the physics community.

The new website also automatically appends a common header and footer to each page, ensuring a uniform, professional, style across the website and reducing the time needed to add new links to our navigation bar. This change has made adding pages for specific events, such as the American Physicists' Tournament, Berkeley Physics Tournament, and the UC Hackathon, more convenient.

Finally, it is important that we continue to update the website to serve the needs of our community. In order to understand these needs, the new website adds an analytics system. The analytics system makes an anonymous record of the activities of each visitor on the website, allowing us to see which links people click as they search for information on it. With only a single (unusual) year of data, drawing conclusions from this information would be premature, but we hope to leverage it in the future to improve our website further.



(Above) The newly redesigned and easily navigable Berkeley SPS website!

Web Development Committee

Software development has become an important part of physics. Recognizing this, Berkeley SPS has made an effort to provide opportunities for our members to learn programming skills. One prong of this effort has been the creation of the Web Development Committee. The Web Development Committee is a group of Berkeley SPS members who are given access to the website source code, then guided to add new pages to the website, improve the website automation systems, and manage the UC Berkeley Physics Undergraduate Wiki. The committee had some success in its first year, with six non-officer Berkeley SPS members making contributions to the website rewrite towards the beginning of the semester. We hope that with the return of in-person meetings in the coming years it will be possible to further expand this initiative.

Competitions Coordinators

By creating spaces to try, fail, and share together, competitions provide casual environments to develop community and technical interests. Trial-and-error experiments help undergraduates learn to think in novel ways with "can-do" attitudes and understand that a problem without a full answer can still be meaningfully answered through a thoughtful approach. SPS at Berkeley created a new officer position to explore this dynamic and create more opportunities for physics undergraduates. In addition to adapting traditional events to virtual formats (Integration Bee, US selection for IPT, Problem of the Week), Shantanu Kadam and Siddhant Mal initiated new events designed to create community in flexible ways during the pandemic, including the Berkeley Physics Tournament and inter-UC Physics Hackathon. Through our first Competition Chairs' efforts, new friendships with UC Riverside and UC Santa Barbara SPS chapters have formed, paving the way for the development of a larger and more diverse community. Many people have found their first Berkeley friends through a Berkeley SPS competition. Older students have become mentors for younger ones, with several first and second year competition participants choosing to become involved as SPS officers for the upcoming school year!

Berkeley Physics Tournament

Through experiences at the International Physicists' Tournament, Competitions Chairs Shantanu Kadam and Siddhant Mal realized that there were few opportunities to try, fail, and reassess outside the classroom in the Berkeley undergraduate physics community. To provide a casual, collaboration-focused introduction to competitions and the experimental approach, they created the Berkeley Physics Tournament. Students meet other Berkeley physics undergraduates through the pairing process, choose an interesting everyday physical phenomenon, and develop a theoretical and experimental explanation over the course of two weeks. At the end of two weeks, teams present to each other, discuss solutions, and engage in peer grading.

There is no minimum time requirement and problems have no barrier to entry. This allows students to feel comfortable approaching a new, unanswered question. Along the way, support is offered by the Competitions Officers through office hours and example approaches, helping participants rebound from initial failures or confusion. Scientific critique is incorporated into the grading scheme, pushing all teams to learn and utilize collaborative discourse with a focus on applicable suggestions. In this way, the competition serves to introduce undergraduates to the experimental side of physics often ignored in introductory classes but ever present in research and actual problem solving. By design, the collaborative nature of this tournament ties participants' individual, technical development with motivating social interactions, thereby increasing the appeal of physics to students whose interests lie beyond the blackboard.

(Above) From China to Brazil, these Berkeley students had amazing solutions!

Problem of the Week

Problem of the Week (POTW) is another endeavour to satisfy members of the community who were craving creative puzzles and the excitement of interesting problems. However, unlike competition problems, these are more sublime, technical situations with unique mathematical and physical foundations. Problems are released on a weekly basis, with interested students submitting solutions by the following weekend. The strength of POTW is in maintaining a regular relationship with the few but passionate solvers from the community who would race to the solutions each week. This close relationship allowed for more structure in the sequence of problems and the development of an arc in the ideas being developed through the problems. There is an exciting possibility for growth of POTW in the coming year, to cultivate a community similar to math/physics circles in various academic settings.

In the 2020-2021 school year, Competition Coordinator Siddhant Mal revitalized POTW, focusing on consistency in problem release and, for the first time, securing funding for prize money! According to the SPS website database, POTW is the most viewed page of our website, with thousands of views in total.

Merchandise

A growing number of physics undergraduates expressed interest in having mementos of the physics community and their time in it, so this year Treasurers Max Pan and Shaunak Modak secured funds for subsidized merchandise. Media Officers Benjamin Loyd and Shishir Dholakia created wonderful designs which SPS members voted on. In the end, the following designs came out on top and are waiting for proud members in the SPS Room!

(Above) The first ever UC Berkeley SPS merchandise, featuring our spiffy bear logo!

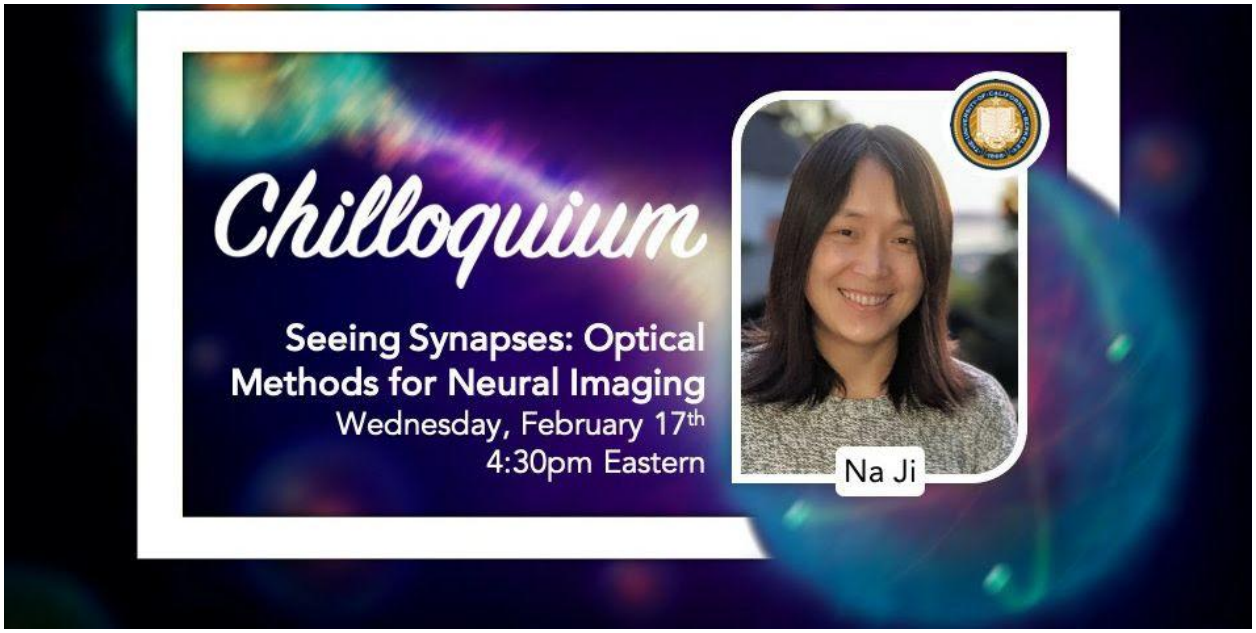
Chilloquiums

Over the past year, UC Berkeley collaborated with Harvard and MIT SPS chapters to host casual talks with up-and-coming professors in unique fields. Talks covered a wide variety of topics and allowed students to make new connections with faculty and other undergraduates. Some students even got research through these talks! The Chilloquium is an opportunity to meet famous physicists from across the country and hear about their research and their stories. Furthermore, it is an opportunity to form lifelong connections with our friends from Harvard and MIT SPS!

Chilloquium Schedule

10 August 2020	Pablo Jarillo-Herrero
17 August 2020	Monika Aidelsburger
24 August 2020	Phiala Shanahan
18 September 2020	Chris Laumann
2 October 2020	Carlos Argüelles
16 October 2020	Tongyan Lin
30 October 2020	Matteo Mitrano
26 January 2021	Ard Louis
2 February 2021	Alexey Gorshkov
17 February 2021	Na Ji
23 February 2021	Karin Öberg
2 March 2021	Lisa Manning
9 March 2021	Sylvester James Gates
16 March 2021	Geoff Pennington
30 March 2021	Shep Doeleman
6 April 2021	David Hu

29 April 2021 | Dr. Gavin E. Crooks



(Above) Advertisement graphics made by Harvard SPS featuring Na Ji, a biophysics professor in UC Berkeley Physics Department. The event was well attended by students and many are charmed by Professor Ji's personality!

Part III: Interaction with Professional Physics Community

"It's a lot easier to do good work when you have good words to say and work with good people."
—Mark Harmon

Combining a **rigorous major curriculum** with **excellent research facilities**, Berkeley's physics program consistently provides pathways for undergraduate students to participate in **cutting-edge science**. This past year, Berkeley's undergraduates have left **deep footprints** in the academic landscapes of physics and astronomy, upholding the school's long history of **pushing the frontier of human knowledge**. This year, due to COVID global pandemic, most events are canceled or postponed. As most of our club members work in a lab, the closure of campuses puts a huge obstacle on the publications and conference attendance for undergraduates. With campuses opening up in fall 2021, we believe undergraduates in Berkeley SPS will thrive in the professional physics community.

Other Academic Conferences

Please note that the following list is not all-inclusive.

(1) **Fanghui Wan** et al. *Magnetoresistance of Doped CeCoIn5*. APS March Meeting 2021, Denver, CO, March 18 2021. (contributed talk)

Part IV: Off-Campus Engagement

"Teach love, generosity, good manners and some of that will drift from the classroom to the home and who knows, the children will be educating the parents."

—Roger Moore

The Berkeley chapter of SPS is proud and thankful to have a population of students invested in public outreach and service to the community. We realize the impact of outreach on future generations of students in Berkeley's Department of Physics, and look at public outreach as a way to help shape the environment in the way we dreamed we could have. Under the management of the Outreach Officer, Charlie Cummings, a newly formed 'Outreach Committee' consisting of enthusiastic SPS general members were able to organize returns to events held the previous school year as well as new programs in reaction to event cancellations due to wildfires and COVID 19. The Berkeley chapter of SPS was able to reach and inspire a large number of young scientists around California.

Bay Area Science Festival(October 2020)

As an SPS outreach classic, a large number of students typically participate in the Bay Area Science Festival hosted in Oracle Park. This year, participation was restricted but several students volunteered to read astronomy books and teach young children just how large our solar system is.

Bay Area Scientists Inspiring Students (BASIS)

The Berkeley chapter of SPS worked to cement our relationship with BASIS this year, after having begun volunteering in the 2019-2020 school year to collaborate with BASIS. Outreach Officer Charlie Cummings brought safe and fun demonstrations to the classroom setting online, while also recruiting fellow undergraduates who share his passion for outreach. With effort, we were able to adapt the demonstration to an interactive online presentation, and visited several classrooms online to promote STEM via play-doh circuits.

SPS YouTube Channel

With things going remote, SPS started to utilize the YouTube channel to its full potential. A link to the Youtube channel is here.

The uploads range from faculty student lunch recordings to lessons recorded for AP students. The Projects Committee, headed by Projects Coordinators Siddhant Mehrotra and Yonna Kim, contributed to most of the editing and uploading.

In late January, Kavish Trivedi, Bingxu Meng, and Shanuak Modak, a few of the Projects Committee members, recorded several review videos on Mechanics: Forces , Rotational Mechanics and Energy. Students were guided through a number of topics including kinematics, momentum, and rotation, with generally positive reception from students, parents, and teachers. These videos received very positive feedback from students in the introductory physics courses. Due to privacy reasons, we uploaded some videos as unlisted so it is not visible unless a link is sent.

Part V: The SPS Mission

"The SPS exists to help students 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."

—SPS's mission statement

Who We Are

With the University of California, Berkeley as a backdrop, Berkeley's Society of Physics Students upholds the mission of the national organization. Namely, Berkeley SPS aims to supplant the high-quality academics of our parent campus by helping our members become model citizens and leaders of the professional community at large.
In an inclusive and diverse setting, our local chapter promotes the academic success and professional development of our student body.

Academically, we host a number of programs aimed at encouraging collaboration throughout the undergraduate population. In particular, our Physics 5A Study Halls target students at the earliest stage of their academic development and bolsters a cooperative approach to problem solving. Furthermore, as the academic paths of our student body naturally diverge based on interest, we offer a number of programs that help ensure the spread of ideas, our most regular of which are the Undergraduate Seminars and the Homework Parties. The former directly allows for the proliferation of conceptual ideas amongst members by providing a platform for novel physics and mathematics to be shared and the latter allows for individuals to enhance their technical abilities by approaching UC Berkeley's challenging problem sets in a relaxed group setting.

Professionally, Berkeley SPS helps our members access the necessary doors to get them onto the path of their choice, whether they are interested in pursuing a career in academia or industry. For those interested in a research career in either path, we offer a number of "How to get research" events wherein we detail the best ways to approach a potential research advisor. Furthermore, our active involvement in promoting career panels and graduate panels, allow members to engage with their preferred potential career option. In any case, the skill-based workshops that we offer (e.g. the LaTeX workshop and Python workshop), help members learn professional tools that make them an appealing candidate in any job market. Moreover, the forgoing Undergraduate seminar provides a much-needed platform for public speech and communication, needed in any industry.

All of these are done in the inclusive setting that Berkeley SPS provides. Our local chapter is committed to providing our members with a safe and accepting social environment that promotes good mental health practices. This social environment is built by programs that Berkeley SPS hosts (e.g. our Mentorship program), conversations our chapter engages in (e.g. our several mental health and sexual harassment workshops), and the casual day-to-day events that establish a friendly zeitgeist to the department (e.g. the Berkeley SPS Instagram, the Integration Bee, "Order-of-Magnitude Game", etc.).

In addition to establishing the aforementioned inclusive setting within the walls of our department, Berkeley SPS seeks to do its part to establish it in the broader community.

To this end, Berkeley SPS is unequivocally devoted to community service and outreach, seeking both to spread a love of physics and to create numerous opportunities for the upcoming generation of future scientists. This is evidenced by the numerous outreach events (e.g. the Bay Area Science Fest, Bay Area Scientists in Schools, etc.) that our chapter supports and the dozens of volunteers that we get for such events. All-in-all, SPS acknowledges that good physics requires an educated society with the opportunities that it needs to flourish.

Hence a conclusion left unstated most days of the year, the Society of Physics Students chapter at the University California, Berkeley stands as a proud representative of the values outlined in the national organization's mission statement. The message described therein is one to which our local chapter has been and will for many years continue to be unapologetically committed.

Getting out the Word

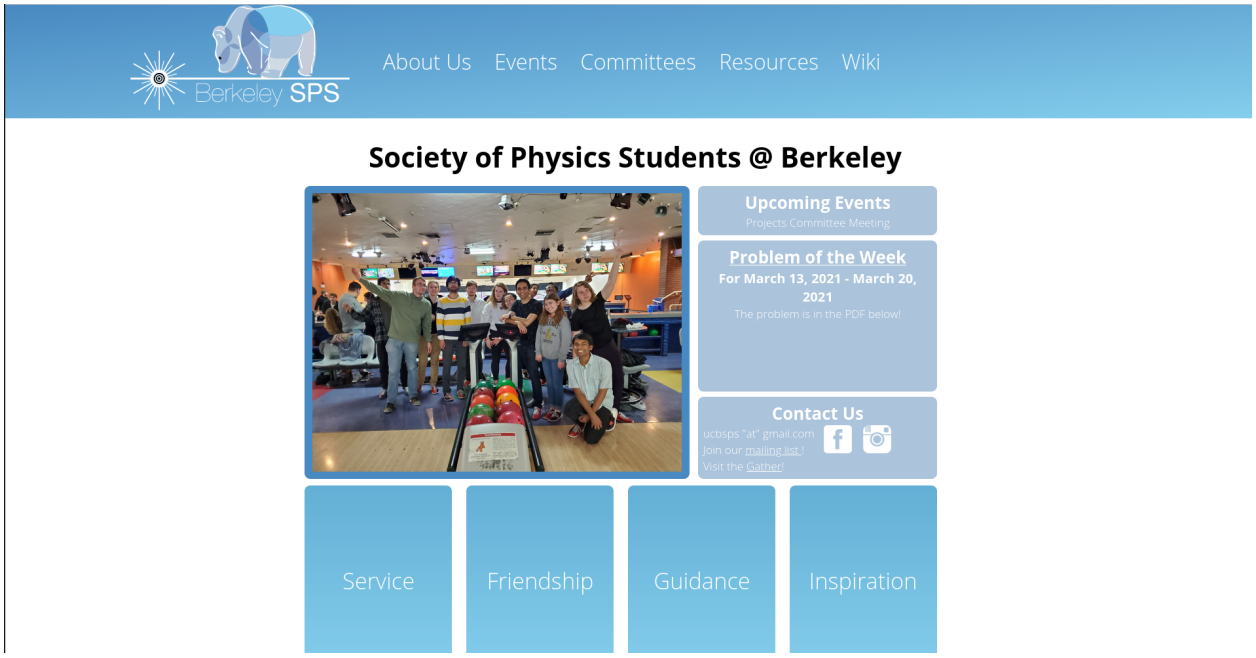
Throughout this past academic year, Berkeley SPS has extensively utilized **technology** and **social media** to **get the word** out on the club's **numerous activities** and **community activism**. When it comes to all things "happening" at Berkeley's Department of Physics, Berkeley SPS wants everyone to know!

Email Newsletter

To keep its members in the loop, SPS at Berkeley sends out a quirky newsletter detailing SPS **events, departmental resources, and professional opportunities**. The newsletter is typically dispersed on Monday mornings from our official email, **ucbsps@gmail.com**, to over 600 subscribers. The newsletter is usually the first time most members hear about the general meeting topic, undergraduate seminar, DeStress with SPS, competitions, and outreach/projects events.

Website: sps.berkeley.edu/

Berkeley SPS's website provides information for Berkeley SPS members, current and prospective Berkeley students, and the broader undergraduate physics community. The website coordinates and archives Berkeley SPS events, provides resources to Berkeley students (especially through the UC Berkeley Physics Undergraduate Wiki), and informs others about the club. In the past academic year, the Berkeley SPS website has had 48±14 visitors per day, suggesting that it is a popular resource for our members.



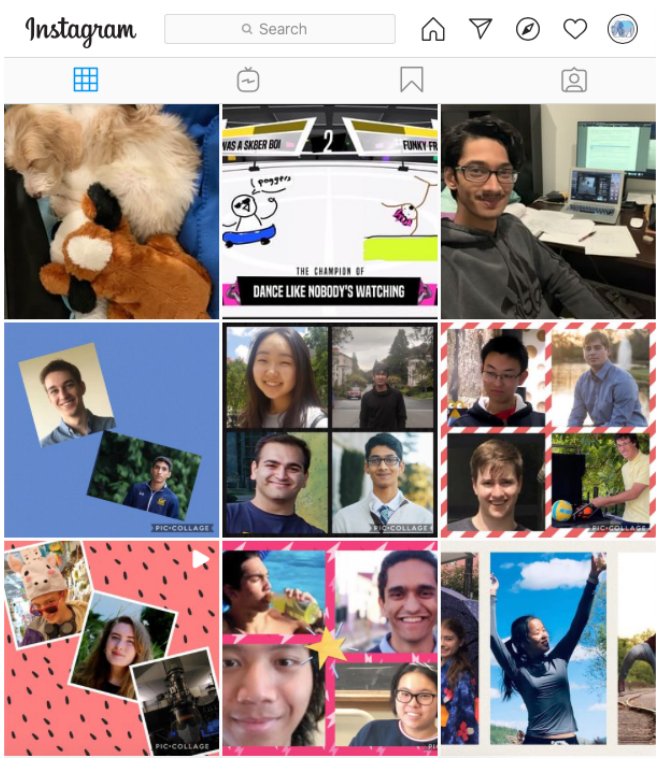
(Above) A screenshot of the new homepage of the Berkeley SPS website. The continuously updated website allows Berkeley SPS to get the word out on new and exciting things happening in the department.

SPS Instagram: @sps_berkeley & Facebook Group

Headed by Media Chair Benjamin Lloyd, SPS utilizes various social media platforms to promote SPS events. The Berkeley SPS Facebook is managed by the media chair, who publishes events, resources, and reminders of social, professional, and outreach events the day of. Sometimes, SPS members will take to the official Berkeley SPS Instagram account to be 'influencers', highlighting a glimpse into their day-to-day lives. It helps **encourage balanced lifestyles** and **increase friendship** as members discover similar interests that did not happen to come up in academic conversations, shortening the distance between quarantined students. This year, new students put names with faces through officer introductions on Instagram and Facebook.

SPS Instagram Schedule

(Week of) 7.6.2020	Jinze Wu
11.9.2019	Shantanu Kadam



(Above) A screenshot of some pictures featured on the SPS Instagram. While Media officer Ben Lloyd made sure that the posted content was appropriate and safe, the freedom of student 'influences' allows an unfiltered view into the day-to-day life of a physics student.