APS physics™ | FECS FORUM FOR Early Career Scientists

Fall 2019 AMERICAN PHYSICAL SOCIETY aps.org/units/fecs

Message from the Newsletter Editor

Greetings, FECS members! We are excited to present to you our newsletter for Fall 2019. We hope you find it informative and interesting. In these newsletters, in general, we aim to provide you with useful information about basic research in different fields of physics, information about our activities at conferences and elsewhere, opportunities to actively participate in FECS, and helpful guidelines toward furthering your career.

This issue includes an introduction to the newly elected FECS officers, a summary of the FECS activities at the last DFD Meeting, an preview of upcoming FECS sessions and activities at the 2020 March and April Meetings, a Q&A article on submitting grants written by an NSF program director, and an article on the nature of antimatter and its appearance in different fields of physics.

I offer my sincere gratitude to all the contributors for this issue of the FECS newsletter, who worked hard to provide useful and engaging content, and many thanks to all the FECS members for reading. I especially want to thank Dr. Gillaspy from NSF for all his work on his article, which had to go through numerous administrative reviews before it made its way to this newsletter. Suggestions, comments about the newsletter, and article contributions are always very welcome, and you can reach me with these at kludwick@lagrange.edu or on our Facebook group (called "APS Forum for Early Career Scientists"). I hope to connect with you on our Facebook group and at upcoming APS meetings!

Sincerely,

Kevin Ludwick

Kevin obtained his Ph.D. from the University of North Carolina at Chapel Hill. After a two-year postdoc at the University of Virginia, he became an assistant professor at LaGrange College in 2015, and he is the Pre-Engineering Dual Degree advisor there. His research is in theoretical cosmology, pertaining to dark energy and dark matter models.

IN THIS ISSUE:

Views and opinions expressed in articles are those of the author and are not necessarily shared by the editor or the APS/FECS.

As My Year in the Chair Comes to an End

Jason S. Gardner

Jason Gardner

Welcome to the late 2019 FECS newsletter. As my term as chair comes to an end in a few months, I can say the forum has had a very successful year, growing in activities and membership.

We have just held the 2019 elections after a very large and well-qualified list of candidates were put forward. I wish them all the best of luck, and I am sure those who were chosen will enjoy their time on the executive. For those who were not selected, do not be discouraged; apply again. In fact, we are trying to increase the number of executives of the FECS so that more can actively participate and we can do more for our members.

This year, we had very well-attended sessions at both the March and April annual meetings. In no small part due to the efforts of our past chair, Marilena Longobardi, the FECS membership has also blossomed. With these two fantastic achievements, we petitioned the APS for an extra March session, and I am happy to say we will have the equivalent of two sessions from March 2020 onward.

In March 2020, we will hold the first of, I hope, many postdoctoral poster prizes. We recognize that the postdoctoral period in the academic track is very stressful and critical to one's eventual success. In an attempt to address both these issues, FECS has arranged a poster session so that you can present more of your work at the March meeting, and some lucky winners will also go away with a well-deserved certificate and prize money. We will monitor this event closely, and we hope to announce a similar event for the April Meeting participants in the near future.

In January 2019, the American Physical Society announced the creation of the APS Innovation Fund, which encourages collaborative partnerships among APS members, APS Units and Committees, and APS staff to develop new approaches to advancing the interests of the physics community. These grants should align with the APS Strategic Plan, advance the interests of the physics community, be innovative, and have a measurable output within two years. Along with the other units, individuals, and the APS Office of Education and Diversity, we were successful in getting a grant entitled "APS Inclusion, Diversity, and Equity Alliance (APS-IDEA)". Stay tuned for information on activities that result from this grant.

At FECS, we continuously promote and defend the issues important to young scientists. Through programs, travel grants, support, and resources, we hope our members and the APS as a whole recognize this. We welcome suggestions for other activities that will benefit early-career scientists, topics to highlight at our annual meetings, and programs to support or start. We welcome any and all members of the APS to join the Forum for Early Career Scientists, and we believe that we can all learn from each other. In this friendly environment, we can focus on the future leaders of science, helping them to develop their scientific and leadership skills. Finally, I wish Ben Ueland an excellent 2020 as chair of this unit and want to let him know that I will be there to support him as past-chair in all that he does.

After obtaining his Ph.D. at Warwick University in the UK, Jason worked for several national laboratories in North America before moving to Sydney, Australia in 2013. He is currently a research Professor at Songshan Lake Material Laboratory, a new research laboratory in China. His scientific interests are primarily in frustrated magnets, but he's also performed research in many areas of condensed matter over thirty years of research. He has published over 150 papers and 4 book chapters. He was made a fellow of the Institute of Physics (UK) in 2008 and the APS in 2019.

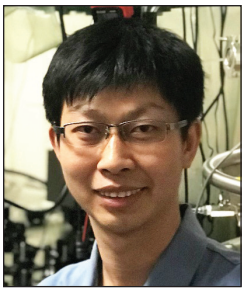
NEWS

FECS Election Results

Kevin Ludwick, Newsletter Editor and Secretary/Treasurer

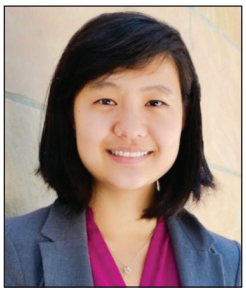
FECS recently held an election for three executive committee positions for next year: two Members-at-Large and the Chair-Elect. Many exceptional candidates applied for these positions, and we thank them all for their willingness to apply and serve. We encourage those who were not selected this year to apply next year as well!

The selected officers will start their positions next year after the March and April Meetings, and we look forward to working with them, as they are eager to serve. Thank you for voting, and please welcome these well-qualified officers. Below is some more information about them.



Shaowei Li (Chair-Elect) is a Heising-Simons Postdoctoral Fellow in the Physics Department, University of California Berkeley. His research focuses on developing a novel imaging technique combining laser and a scanning tunneling microscope (STM) to shatter the diffraction limit and probe the inhomogeneous properties in low dimensional materials. The desire for observing finer details using optical microscopy particularly in bio-science and material-science is pushing technology developments beyond the diffraction limit. The coupling of photon excitation with electron tunneling at the junction of a scanning tunneling microscope combines the femtosecond sensitivity of a laser and the Angstrom resolution of tunneling electrons. The joint fs-A resolution will provide a new window for viewing the unique ultafast dynamics of individual nano-scale objects.

Shaowei received his Ph.D. in physics from UC Irvine in 2017. Prior to that, he received his bachelor's degree in physics from Nankai University in 2010. He spent a year as a postdoctoral fellow at Northwestern University before joining UC Berkeley. His past work involves probing the physcial and chemical properties of single molecules and low-dimensional materials with optical techniques and STM.



Wennie Wang (Member-at-Large) is a computational materials scientist and currently a postdoctoral scholar at the Pritzker Institute for Molecular Engineering at the University of Chicago. She earned her B.S. in Materials Science and Engineering at MIT in 2013 and her PhD in the Materials Department from UC Santa Barbara (UCSB) in 2018. Her research interests include first-principles methods for energy applications and currently encompass the study of complex oxides for water-splitting applications.

Daniel Borrero (Member-at-Large) is originally from Bogotá, Colombia, and he holds a BS in Physics from the University of Texas at Austin and an MS and a PhD in Physics from Georgia Tech. Since 2016, Prof. Borrero has been a member of the Physics faculty at Willamette University, a small liberal arts college in Salem, Oregon. At Willamette, Prof. Borrero's group focuses on studying fluid systems with complex spatiotemporal dynamics, including studies of the transition to turbulence in linearly-stable shear flows and self-organization in bouncing drop systems. Prof. Borrero has taught courses across the Physics major and has recently been involved with departmental efforts to incorporate scientific computation and promote career readiness throughout the curriculum, especially through laboratory and hands-on undergraduate research experiences. Prof. Borrero is currently a member of the Executive Board of the Advanced Laboratory Physics Association (ALPhA) and a member of the Organizing Committee for the 72nd Annual Meeting of the APS Division of Fluid Dynamics. He is also a member of the American Association of Physics Teachers (AAPT) and the Society for Industrial and Applied Mathematics (SIAM) and has previously organized faculty development workshops on the instruction of workplace-ready skills in the undergraduate curriculum through ALPhA and the Partnership for Integration of Computation in Undergraduate Physics (PICUP).

FECS Made a Splash at the APS Division of Fluid Dynamics Conference

Mark Owkes, Member-at-Large

Mark Owkes

This year, FECS was active at the APS Division of Fluid Dynamics (DFD) meeting, sharing information to early-career scientists and recruiting new members. With our bright FECS t-shirts, many people learned about the forum.

Our largest activity was sponsoring a panel session on applying to postdoc and faculty positions. The six panelists, consisting of department heads and deans, shared insights from their many years being involved in hiring. Here are a few quotes from the session:

- "First paragraph of cover letter needs to 1) grab attention, 2) demonstrate confidence and knowledge, 3) describe fit and new skills bringing to department, and 4) ability to communicate"
- "Tune application to each university you are applying to: identify potential collaborators and talk about how your skills and equipment compliment current department members and resources"
- "9 out of 10 recent faculty hires completed a postdoc"
- "Publish in top journals - quality vs. quantity"
- "Build research network: talk with people at conferences, meet with visitors to current university, etc."
- "Get teaching experience"
- "Do your homework for the interview: research whom you will be meeting with, the department, the university, etc."
- Top ways faculty members fail in first five years: "not finding success with grant funding - not teaching effectively - focusing on perfection - not getting to know leaders in area - not getting to know peers in department."

FECS t-shirt at a table at DFD. IMAGE: MARK OWKES

- Don't get discouraged: "many very successful faculty members have had to go through many searches"

Overall, involvement at the meeting exposed FECS to many people, and our activities shared very useful information that will help early career scientists.

Mark is an assistant professor at Montana State University in the department of Mechanical and Industrial Engineering. His research interests include developing numerical methods to study gas-liquid multiphase flows such as the atomization of a liquid fuel

Upcoming 2020 March and April Meeting Activities

Ben Ueland, Chair-Elect

Ben Ueland

Dear FECS Members,

As program committee chair for the 2020 APS March and April Meetings, I am excited to inform you about the meetings' FECS sponsored sessions. FECS executive committee members contributing to organizing the program include Chair Jason Gardner, Past-Chair Maria Longobardi, Secretary and Treasurer Kevin Ludwick, and Member-at-Large Adam Iaizzi.

The 2020 March Meeting will feature the first solely FECS-sponsored invited session which will cover topics in diversity, inclusion, and wellness for early-career scientists. Subjects that will be covered include issues facing minority groups in science, creating an inclusive and welcoming atmosphere, and mental-health wellness challenges facing young researchers. In addition to this session, we are once again cosponsoring sessions with the Forum on International Physics and the Forum on Industrial & Applied Physics. The former session will feature talks by early-career scientists from Europe who have been recognized for their cutting-edge work. The latter session will have a selection of speakers highlighting research careers in industry, national laboratories, and academia, as well as the return of a great presentation from last year about pursuing a career in science communication. At the 2020 April meeting, FECS is solely sponsoring an invited session featuring talks about careers in academia, in science policy, and at government-sponsored laboratories.

Finally, for the 2020 March Meeting, FECS chair Jason Gardner has created a post-doctoral poster competition that features a $500 best poster prize as well as several $100 runner-up prizes. The competition will give young researchers an opportunity to show off their work while networking with their peers. We hope that this will become an annual event, and, depending on interest, we may host a similar contest at the April Meeting in subsequent years.

We are excited for the upcoming meetings and hope that you will find the time to attend the FECS sponsored sessions. Please look for members of the executive committee while traversing the convention center and feel free to stop us to offer feedback, ideas, or just to say hi. See you in March and April!

Ben Ueland is an experimental condensed-matter physicist specializing in neutron and x-ray scattering studies of magnetic correlated-electron materials. He earned a Ph.D. in Physics from the Pennsylvania State University in 2007 for his work examining cooperative magnetic-relaxation effects in geometrically-frustrated magnetic oxides using various very-low-temperature thermodynamic measurements. He joined the NIST Center for Neutron Research in 2007 as an NRC Postdoctoral Associate to learn neutron scattering techniques and became a G. T. Seaborg Institute Postdoctoral Associate at Los Alamos National Laboratory in 2010. In 2012, he joined the Correlations & Competition between the Lattice, Electrons, & Magnetism group at Ames Laboratory located at Iowa State University and is currently a staff scientist there. Some of his recent work includes identifying emergent itinerant ferromagnetism in hole-doped $BaMn_2As_2$, examining magnetostructural coupling and itinerant magnetic excitations in various 122 pnictide superconductors and related compounds, and characterizing fragile antiferromagnetism in the heavy-fermion YbBiPt.

Grants Q&A with an NSF Program Director

John D. Gilliaspy, Program Director for Atomic, Molecular, and Optical Experimental Physics at the National Science Foundation

John D. Gilliaspy

The advice offered below is based on my experience as the Program Director for Atomic, Molecular, and Optical Experimental Physics at NSF, since 2014. I've tried to include some of the most common, but difficult to answer, questions that I've seen over this period. Other Program Directors might have a different perspective, so it is always best to consult the person who is running the Program to which you are considering applying. Definitive answers to most procedural questions can be found in the most recent version of the NSF Proposal & Award Policies & Procedures Guide (PAPPG), which is published online annually.

Q1: How do I figure out which NSF Program will give me the best chance of getting a grant?

A1: Applying to the Program with the largest budget or the highest "success ratio" (fraction of applicants that are funded) is not the best strategy to get an NSF grant. A better strategy is to find the Program with the right "intellectual match" to your research topic and expertise. In fact, I would say that one of the first things you should do after getting your PhD (or even possibly before) is to send your CV to relevant Program Directors and offer to serve as a reviewer. Serving as a reviewer can give you a lot of insight into how to write a highly competitive NSF proposal. Another thing I often recommend is to download a spreadsheet of all of the awards that are currently active in a particular Program, and look over the PI names, proposal titles, and award abstracts to help you decide whether the community supported by that program is likely to embrace your research. The Program or Solicitation webpages may have a "What has been funded" link, or you can use the NSF Advanced Award Search page and search on your Program Director's name, keywords related to your research, and/or the Program Element Code (you can find this 4 digit code by using the NSF "Element Code Lookup" web page to search for words in the program title, such as "*atomic*"). You can always ask a Program Director for advice or help.

Q2: Someone told me that I should contact NSF and ask whether or not they are interested in funding the sort of research that I would like to do. Is that good advice?

A2: If you have questions about whether or not a particular NSF Program is the best fit to your research idea, then it is a good idea to consult the Program Director. Typically, however, that is not necessary–with very few exceptions, we don't "pre-screen" research ideas to make sure that they are "of interest" to NSF. The range of our interests is extremely wide. Our mission is to "Advance the Progress of Science", and we are interested in having you send us proposals that contain your best ideas to further that very broad mission. As discussed in the first Q&A above, however, it is very important to apply to the right Program within NSF. Every year, NSF evaluates approximately 50,000 proposals using an extensive merit review process that is considered by many to be the "gold standard" among funding agencies (for more information, see: nsf.gov/news/mmg/mmg_disp.jsp?med_id=76467). We have about 800 Program Directors managing programs in virtually every topical area of study, except medical research that is focused on specific diseases. There is likely a place for your idea somewhere at NSF, and Program Directors will generally not make a decision about what to fund until after they take into consideration advice from peer review.

Q3: How close to the deadline should I submit my proposal?

A3: Don't wait until the last minute. University Sponsored Research Offices are often flooded with last-minute submissions, and having yours be one of them can put you at a disadvantage. NSF is increasingly automating compliance checking, and proposals are being immediately returned without review because of compliance issues (not following the rules in the PAPPG such as page limits, a description of the "Broader Impacts", etc.). If a proposal is submitted 10 minutes before the deadline and is automatically returned because of a compliance issue, there may not be time to revise and resubmit by the deadline, in which case you may find yourself having to wait nearly a full year before you can submit again. Many people don't know that they can submit a proposal early and then continue to revise and resubmit it (without NSF permission), right up until the deadline. On the other end of the spectrum, don't succumb to pressure to submit a proposal before you are ready, just because there is a deadline looming. It is better to wait a full year than to submit a proposal that is not polished. Your first try may be your best chance to impress.

Q4: How can I best improve my declined proposal in order to get funded next year?

A4: Read the reviews very carefully and with an open mind, and then revise your proposal *substantially* to address every weakness stated in the reviews. Reach out to some leaders in the community and ask them for frank advice. Consider offering to give them a copy of your proposal to read. Better yet, if you have an entirely different idea that you are similarly

passionate about, write an entirely new proposal on that idea instead. In my experience, tweaking up your proposal here or there and then resubmitting it next year usually doesn't change the outcome, and might even result in having your proposal returned without review (RWR) as not having been substantially altered from a proposal that had already been reviewed and declined. The fact that we have an acronym for that tells you that it is a real risk. Many people don't know that Program Directors have a button that they can click that will send the proposal back immediately, before even sending it out for review. You don't want that to happen to you.

Q5: The reviewers gave me really high letter grades, but I still didn't get funded. Why?

A5: Reviewers don't make funding decisions; Program Directors do. The advice of the reviewers is taken into consideration, but the Program Director has to look at this in light of all of the other proposals, the available Program budget, and other factors such as portfolio balance. Moreover, the letter grades are less important than the text that the reviewers write–this is something that I think is not widely appreciated and is good to keep in mind both when reading and writing reviews. If you really want to understand the answer to this question, come serve with us for a year as a "rotator"! Ask a current Program Director or see: beta.nsf.gov/careers/temporaryrotator-programs.

John Gillaspy is the Program Director for Atomic, Molecular, and Optical Experimental Physics at the National Science Foundation (NSF). He received his Ph.D. from Harvard University and his B.A. from Stanford University. Prior to coming to NSF, he was a physicist at the National Institute of Standards and Technology (NIST). He has published over 130 papers, and is a fellow of the American Physical Society. His honors include awards from the Director of NSF, the Director of NIST, and Sigma X

SCIENCE

The Problem with Antimatter

Eric Sorte, Member-at-Large

Eric Sorte

Despite being prevalent in science fiction stories for generation, antimatter is real, and its existence is firmly rooted in modern scientific theory. Its existence was confirmed in 1955 by scientists at the University of California, Berkeley, for which they were awarded the Noble prize in physics just 4 years later (nobelprize.org/nobel_prizes/physics/laureates/). When exposed to regular matter, antimatter annihilates, releasing energy that can in principle be harnessed to do work – power a lightbulb, or a city. While potential applications for harnessing such energy abound, none has ever fully materialized. The reasons for this reveal one of the largest unsolved problems in physics today.

Antimatter refers to particles very similar to the ordinary matter with which we are all familiar. Such anti-particles have the same mass as their normal-particle counterparts, but are their opposites in some respects. For example, an anti-electron, commonly called a positron, has the same mass as a normal electron but has a positive charge opposite to that of the electron's normal electric charge. Antimatter is routinely produced in particle accelerators and in collisions of high-energy particles in the earth's atmosphere. The mystery of antimatter lies in its marked absence. As best as we can tell, the universe around us is composed almost entirely of regular matter, with no antimatter in sight. To understand why we should expect to find antimatter at all, it helps to think back to the beginning of the universe and the big bang.

The big bang theory was developed in the early part of the 20th century to explain observations by Slipher, Lemaitre, and Hubble that the visible galaxies are moving away from Earth in all directions. Two interpretations are possible: Either the earth is at the center of a cosmic explosion of galaxies, or space itself is everywhere expanding. The latter explanation is of course much more tenable, and has been the consensus view ever since. The effect is like that of blowing up a balloon or stretching a rubber band. Two marks on the surface of the rubber will move apart, not

because of relative motion of the dots along the rubber, but because the space in which they exist is stretching apart.

Naturally, upon observing the continual expansion of space, one is forced to imagine what things looked like a million or a billion years ago. Things then must have been much closer together, more dense, and hotter. In fact, it's relatively simple to figure out when everything must have been at one point: around 13.8 billion years ago by modern estimates. Around that time, as the theory goes, all of space and matter (and time) exploded out from that point, cooling as it expanded. Quantum fluctuations of photons in this plasma continually created pairs of particles, electrons and positrons, particles and antiparticles. These particles were created and annihilated almost immediately. As the plasma continued to expand and cool, some of the particles and antiparticles were created but did not annihilate, and the particles eventually agglomerated to form the atoms, stars, planets, and everything we see around us today.

But what of the anti-particles? Where did they go? We know the processes that created all the matter we see, and we know that an equal amount of antimatter must have been simultaneously created. But where is it? This is one of the largest unanswered questions in modern cosmology, and many scientists are hard at work trying to solve the puzzle. One of them is Hui Chen, who lead a team at Lawrence Livermore in 2008 to produce more antimatter than had ever before been produced in a lab (llnl.gov/news/newsreleases/2008/NR-08-11-03.html). She and her team used high-energy lasers to illuminate gold targets, many times thicker than previous targets. The laser photons ionize the gold atoms, creating high-energy electrons that traverse the gold target, losing energy as they go. Some of this energy transforms (via Einstein's famous mass-energy equality) into positrons and electrons. Optimization of the process allowed Chen and her team to create far more antimatter particles than ever before, opening up the possibility of new research into the enigmatic asymmetry of matter and antimatter in the universe.

Will we find other planets, solar systems, and galaxies made of antimatter? NASA is betting we just might. nasa.gov/mission_pages/chandra/news/08-160.html). If so, such a find would rank as one of the amazing discoveries of mankind. If not, then perhaps there is new physics awaiting us that we don't yet understand, and that would be an equally exciting discovery.

Eric Sorte graduated from the University of Utah with a B.S. in Finance in 2002. He spent 4 years working with various business consulting firms and investor groups in South America and the Eastern United States. After deciding to pursue science as a career, he attended Columbia University in New York City, pursuing a graduate degree in physics. He worked with the High Energy Cosmic Ray group developing software for the Telescope Array Project and received his Ph.D. in experimental condensed matter physics in 2011 studying manifestations of quantum chaos under the advisement of Dr. Brian Saam at the University of Utah. He then did postdocs at Washington University in St. Louis and Georgetown University before starting a job at Sandia National Lab where he is today. As a member of the Graduate School Advisory Committee (GSAC), Eric was instrumental in raising the levels of communication between graduate schools in the College of Science by spearheading interdepartmental activities. Eric has been very active in APS organizations, holding positions on the Executive Committees of the Forum on Graduate Student Affairs and of the Four Corners Section before becoming an APS Councilor. After leaving the Council. Eric worked with the Committee on Committees and more recently on the Committee on Informing the Public. As an active member of the APS, Eric has served on various panels both as panel member and host, including several APS webinars. He loves serving in the APS and looks forward to the next opportunity.

FECS 2019 Executive Committee on the Forum for Early Career Scientists

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Past Chair: Maria Longobardi
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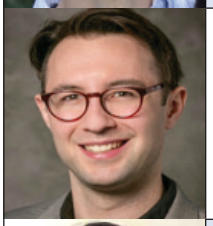

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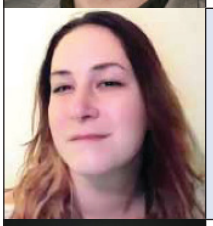

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