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INSIDE

Guest Editorial: Linking Physics, Innovation, Practical Knowledge, and Diversity

Randall Tagg, University of Colorado Denver and Carol McBride & Judy Bleakly, Aurora Public Schools

In Aurora, Colorado, we have created a home for broadly diverse high school students to work with undergraduate mentors, teachers, and university faculty to use physics to explore and apply new ideas… following paths that the students themselves choose. This home is called the Innovation Hyperlab. It is situated in a 2500 square-foot building originally used for teaching auto shop at Gateway High School, a part of the Aurora Public Schools. Four-star admiral Michelle Howard, the first African-American woman to command a Navy ship and the first woman to achieve four-star rank in the Navy, graduated from Gateway High School in 1978.

The Aurora public school district is highly diverse[1]: 54.7% Hispanic, 17.9% Black, 17.8% White, 4.6% Asian, 0.7% Native American, 0.5% Native Hawaiian / Pacific Islander, and 3.9 % "two or more races". Students come from 130 different countries and speak 120 different languages. The Innovation Hyperlab is diverse in another sense: it is an assembly of resources for 52 different technologies, learning materials, and programs and curricula to engage students in using physics to do scientific research and create innovations. The lab aims to be equally inviting to students who like to make things with their hands and students who enjoy abstract modeling and computation.

Friedrich Amouzou, music-scripted robotics team leader.

The motto of the Innovation Hyperlab is "Omnis Technologia Omnibus," or "All of Technology for Everyone." The guiding philosophy is an exercise in connecting dots. As the first dot, we know that physics is the fundamental science that underlies the other sciences and engineering. Thus physics can be and has been a powerful means to serve human needs. This leads to the next dot: Innovation is the conception, creation, and conveyance of products, processes, and services that people value. So students might see phys-

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Graduate Admissions Bootcamps in California

David Wittman, Mani Tripathi, and Randy Harris

Undergraduates often know too little about graduate school opportunities. Some assume the cost will be prohibitive because they aren't aware that graduate schools fund most students; some assume that an MS is a prerequisite for PhD studies; many aren't aware of the diversity of programs and the need to shop around and match their needs; some don't appreciate how earning a research credential is qualitatively different from simply continuing coursework; and a few don't realize how competitive the admissions process is or how to build a strong application. This information gap particularly affects undergraduates at four-year institutions who do not rub shoulders with graduate students, and for whom the research enterprise may seem like another world. Of course, this is a rough generalization. Many undergrads at PhD-granting institutions could also benefit from more explicit guidance regarding graduate school and admissions. This is, therefore, an area where four-year colleges, terminal Masters programs, and PhD-granting universities could fruitfully collaborate to spread awareness of graduate options to all students.

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ics as a great platform for innovation. Here the third dot appears: Translating "textbook" physics into real use requires an opportunity to gain practical know-how, i.e., the ability to use and design with technologies like mechanical devices, motors, electronics, optics, and computers.

Innovation Academy participants visiting robotics team.

Now the final dot: the capacity to combine fundamental curiosity about the physical universe, an enthusiasm for using knowledge to help people, and a willingness to get hands dirty with practical things is deep within human nature. This capacity spans differences in gender, ethnicity, cultural background, and even aptitudes. Indeed, such diversity is the essential "brew" for bringing innovation to life. The city and student population of Aurora form the perfect microcosm for supporting this endeavor.

One program run by the lab is the Innovation Academy. It is a year-long Saturday program for student teams to engage in university-level research and innovation projects. High school students – typically seniors – are recruited as "principal investigators" to propose projects, which are selected and developed according to their connection with fundamental scientific questions and/or well-defined needs in the community (including the professional community such as biomedicine). Teams are formed from students spanning grades 9-12 and undergraduate mentors are recruited. To date, these mentors have been supported by an NSF-funded Noyce program that encourages college students to consider teaching as a career. Teams are overseen by "Teacher Scientists in Residence" and further technical support is provided by a lab manager. There is also a "university scientist in residence" and the program is overseen by a former school principal. The teams themselves are highly diverse: one team consisted of Black, White, Asian, and Hispanic students. Another team included students who spoke Spanish and who spoke Arabic. Interestingly, the undergraduate mentor was a woman who was also from an Arabic speaking country. The overall program – with 20-30 students per year – is roughly even in representation by female and male participants.

Projects have so far been oriented towards biomedicine because of original funding to foster student interest in medical careers. Here are examples:

- Using music to control robotic motion, ultimately aimed at driving an exoskeleton device used for human rehabilitation;
- Creating methods to use the body's own energy to provide power to biomedical implants;
- Exploring a possible role for quantum coherence of potassium and sodium ions in the function of ion channels of neuron cell membranes;
- Developing strategies to control the spread of infection in the event of an abdominal injury in zero-gravity (e.g. on a mission to Mars);
- Devising low-cost methods to combine electronics, optics, and fluidics into lab-on-a-chip medical diagnostic devices.
- Prototyping a smart bed that monitors and records data about the health of infants or of at-risk patients at home.

In the future, there will be an expansion to include a wider range of "STEM" (science, technology, engineering, and math) topics. Since we want to reach a broad spectrum of potential applications, the aim is also to include students interested in careers in the arts & media, in business, and other fields. While the scope of the projects can be quite advanced, students with many aptitudes and interests make important and meaningful contributions. Indeed, the atmosphere encourages trying out things and even making mistakes.

A challenge that lies ahead is to arrange for this type of experience to reach a much broader proportion of the 43,000 students in the district. We are developing and launching curricula such as a new 9th grade course called "Instruments for Biomedical Discovery" that combines teaching of several of the fundamental technologies in the Innovation Hyperlab with case studies derived from biomedical problems. We also will launch a pilot 7th/8th grade course introducing students to STEM topics, again accentuating the practical knowledge that can be connected with physics – including robotics, sensors, and Python programming. Meanwhile, there has been an amazingly broad interest by physics undergraduates at several of Colorado's universities in participating with the lab and its engagements of diverse high school students. Thus we are profoundly optimistic that physics, innovation, and practical knowledge will indeed enable and encourage youth from many backgrounds to see great opportunities for personal and professional growth. ■

[1] *http://aurorak12.org/about-aps/fast-facts/demographics/*

Think you've nailed down your career path? Think again.

Julia White, INCITE Program Manager

My sister holds the family record for most dramatic career swap: from accountancy at Ernst & Young to teaching geology at a local university. At different stages in her life, priorities changed and opportunities arose that she was positioned to take. I've also taken an unconventional approach to my career. Get a PhD and you do what? Teach or do research, right? Well, as I'll show, not necessarily.

A career in science can be as diverse as you want it to be. You can – and should – explore as many options as possible. Ideally by choice but sometimes through necessity, you can repackage your skills and interests to transition to new roles that you may have never considered when you were launched upon the world with a newly minted degree.

My career has taken me from research to publishing to communications and, now, to program management. Let me describe these roles and what choices and lessons learned were involved in each. This "food for thought" may help you identify some routes for your own career pathway.

A PhD in physical chemistry laid the groundwork for my first position: postdoctoral research associate. I carried out computational simulations on a variety of aluminosilicate materials, exploring the electronic structure of these porous materials used for ion exchange and size-selective catalysis. As important as carrying out research was, the opportunity to meet with other researchers through conferences, national society meetings, and within the large national laboratory environment in which I worked. Many of the individuals I met remain in my professional and personal network today, nearly two decades later. Suggestions for first- or second-time postdocs: look for opportunities whenever you can to engage the broader research community. Attend local and regional meetings of the professional societies related to your area of work; volunteer to give seminars at these meetings; don't hesitate to reach out to senior researchers within your own organization to ask questions or explore common research interests. Don't be a faceless name on a closed office door; reach out to your colleagues and lay the foundation for a network that you'll draw upon again and again.

Faced with several options upon completion of my postdoctoral role, I chose the path less travelled: scientific editor. The idea of being exposed to a wide-range of scientific topics was profoundly compelling to me, and I accepted a position on the editorial staff of the APS's Physical Review B: Condensed Matter and Materials Physics. The posted criterion was a background in physical sciences. The unspoken criterion was a willingness to exit a life of research. The latter was probably the most daunting decision of my career. As my colleagues didn't hesitate to question, "why would you leave science?" What I couldn't articulate then was that, by becoming a scientific editor, my exposure to science became for me, richer and fuller. Editors interact with authors and reviewers around the world and are ultimately responsible for determining which journal manuscripts are accepted for publication. A strong scientific background is critical; however, not in the way you might think. A scientific background provides editors with the basis upon which to extract the intent of the manuscript and identify suitable peer-reviewers. In other words, in many cases it isn't the role of the editor to personally critique the manuscript. Rather, the editor plays the role of mediator between reviewers they've selected and the authors: communicating assessments and responses, and ultimately deciding whether a sufficient case is made to accept a manuscript for publication. As a scientific editor, you'll be rewarded with a place as umpire on the playing field of research.

Julia White

"A career in science can be as diverse as you want it to be. You can —and should— explore as many options as possible."

Choosing to return to a national laboratory environment that would enhance my ties to the research community, I next became a group leader for a high-performance computing facility's user assistance and outreach efforts. While as a postdoctoral research assistant I executed research programs, and as a scientific editor I adjudicated manuscripts of research outcomes, in this new role I was responsible for communicating science topics and goals to a broad, layperson audience. Quite literally, I became a science translator. A degree in science or engineering not only fosters critical thinking, it immerses the practitioner in a specialized vocabulary peculiar to their domain. Proficiency in this language is necessary but often earns a deer-in-the-headlights response when launched upon the unindoctrinated. A great anecdote was shared by a colleague years ago: a senior-ranking member of the federal government visited the lab and the laboratory management pulled out all the stops. The visitor was introduced to all department heads and toured the major facilities. Each individual who met with him provided a thirty-minute overview of their work. At the end of the day the laboratory director escorted the visitor to the airport and asked how the visit went, fully anticipating a positive reply. The director was stunned by the visitor's pithy comment that the trip was a waste of time. In his words, he felt like his head had been held under a fire hose of information! The visitor had been willing to act as an advocate; he left not knowing what the laboratory's priorities were.

I have encountered countless researchers who simply cannot bridge the gap and effectively convey to a general audience the excitement and ultimately the impact of their work. Even when capable of doing so, some individuals view this as a trite, frivolous exercise beneath their interest or one that trivializes the work they've spent years, even decades, upon. Savvy researchers (or their management) will recognize that

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Think Again *continued from page 3*

funding has become increasingly hard fought-over and a significant advantage is given to a research campaign that a sponsor can readily understand and communicate with enthusiasm to granting agencies. Sponsors and agency representatives don't have time to pore over page after page of white papers or manuscripts, however carefully crafted. Science writers, grant proposal directors, and, in my case, leaders of outreach, play a role in the lifecycle of science research by ensuring that the appropriate target audience – general public, sponsors, funding agencies, and so on – understand the importance and relevance of the work being carried out, so that it can continue to be supported. If this role sounds interesting to you, then look for opportunities to write. Find your organization's newsletter (or start one) and contribute stories about not just your work but things you've read about or R&D topics important to your workplace. Your input will be welcomed: rare is the individual who can weave a compelling account of research being carried out.

Finally, let me transition to my current role of program manager which, for me, blends well the experiences and skills gained from my previous roles. I manage the Innovative and Novel Computational Impact on Theory and Experiment or, INCITE, program. Through an annual call for proposals I invite scientists around the world to submit challenging, high-impact proposals of research that require some of the most powerful supercomputers on the planet. Once again, I play the role of umpire and select expert peer-reviewers to assess the relative merits of the proposed work. As a science translator I facilitate communication of the award decisions to the funding agencies providing the supercomputer resources. The breadth of domains supported by the INCITE program is immense, from computational biology to nuclear physics. A strong foundation in science and a rich network of authors, reviewers, and colleagues allows me to effectively guide and oversee a diverse portfolio of applicants. If you think you might be interested in a program management role, several options are available to you. You might consider managing programs within your organization. This involves interacting with colleagues, identifying potential funding sources, and networking with the relevant grant agencies. Another track is to work in the agency itself – soliciting proposals, making and tracking awards. In both cases, employers are looking for individuals with a solid research background and a very broad perspective on the state-of-the art in your community. A wide network will be important to you.

"Don't fall into the trap of defining yourself by a job title; opportunities are out there that you may not have yet considered but which are equally or more fulfilling."

My career in science has taken me from the role of individual researcher to manager of a proposal process granting computer resources to scientists around the world. The transition was sometimes dramatic, sometimes more gradual, but at each step I periodically looked around at people whose work I admired and assessed what I wanted to accomplish next and the skills that would be needed. Some of the steps I actively pursued, while other opportunities came unexpectedly.

Don't fall into the trap of defining yourself by a job title; opportunities are out there that you may not have yet considered but which are equally or more fulfilling. I've mentioned several possibilities here: researcher, scientific editor, program manager. Other possibilities include science writer, patent attorney, grant writer, technology transfer specialist, and so on. In your current job and the next one, and the next one, look for opportunities not only to deepen your skill set, but to broaden them. Volunteer in your society's local chapter; ask that your name be included in the invitees to meet a visiting science dignitary; start an article-reading group in your organization, where each member takes turns discussing a recently published work in their field; take a proposal-writing course.

All of this takes time, but you'll be recognized as a go-to person and more opportunities will come your way (which leads to 'how to say no' but that's a topic for another day). Keep your mind open and explore the possibilities that a career in science can lead to. ■

NOMINATE SOMEONE FOR WOMAN PHYSICIST OF THE MONTH

The APS Committee on the Status of Women in Physics (CSWP) began a program to highlight exceptional female physicists in January 2012. Since then, a new woman is the face of ***www.WomenInPhysics.org*** each month and a short bio is featured on the website showcasing the amazing talents of female physicists.

The CSWP Woman Physicist of the Month award recognizes female physicists who have positively impacted other individuals' lives and careers. The award is not restricted to just research physicists, but open to students, teachers or any woman doing physics-related work. Nominations are accepting on a rolling basis.

To nominate someone, the name, institution/facility/company, and email of both the nominee and nominator should be emailed to women@aps.org. The nominee's CV and a nomination statement up to three paragraphs should also be included in the email as attachments.

APS IBM Research Internships for Undergraduate Women and Underrepresented Minorities

Arlene Modeste Knowles

For the past 14 years, APS has co-sponsored the APS/IBM Research Internships for Undergraduate Women, which was co-founded by long time IBM scientist and APS member, Dr. Barbara Jones. She also co-founded the IBM Research Internships for Underrepresented Minorities around that time. Jones, who had participated in the undergraduate research programs for women and minorities at Bell Labs as an undergraduate, and then later as a graduate student in their Graduate Research Program for Women, credits those experiences as important in her career. "I found the encouragement and advice of my Bell Labs mentors during my undergraduate years to be invaluable, and crucial to my success in graduate school. I wondered why IBM could not have such a program as well," said Jones of her motivation to start the IBM Research Programs. So she and her colleagues went to work designing programs aimed at keeping talented technical women and minorities on track to pursue graduate studies in science and engineering and have successful careers. They convinced IBM Almaden to support the programs for undergraduates in their sophomore and junior years, and for a few years the program did well with 4-8 interns per year.

It was Jones' stint as chair of the APS Committee on the Status of Women in Physics (CSWP) during the time of the IBM program's founding that paved the way for APS' co-sponsorship of the women's program. Jones noted that they needed help advertising the program and handling some of the administration of the women's program, and the APS' joint sponsorship made a huge difference in the scope of the program, attracting over 200 applicants.

As mentioned, IBM also had an internship program for underrepresented minorities that began around the same time as the women's program, but had no affiliation with the APS. A couple of years ago, APS began sponsoring the APS/IBM Research Internships of Underrepresented Minorities, again thanks to Jones and her leadership. Although Jones started these programs at IBM, she says, "It would be wonderful if other industries that do research could start similar programs: there are plenty of truly excellent URM and women undergraduates out there, who would welcome doing worthwhile projects, getting career advice, and making long-term contacts."

For the APS, these programs are a wonderful way to encourage women and minorities to pursue their degrees. It gives students an opportunity to conduct research in an industrial setting and gain exposure to scientists working on both fundamental science as well as on developing scientific technologies. Further, it broadens their view of what can be done with a STEM degree, allows them to make connections they might otherwise never make, and affords them the opportunity to work across disciplines to solve real problems.

Elisa Yang and other IBM interns.

Each year, Jones and her colleagues at IBM painstakingly read each and every application and select young women and underrepresented minority STEM sophomores and juniors for the program. They also take tremendous care to optimize the placement of students in various research and mentorship projects. Eligible students must be majoring in physics, chemistry, materials science and engineering, computer science and engineering, chemical, electrical, or mechanical engineering, or interdisciplinary biology, and must have a 3.0 GPA or higher.

Three physics students (2 women and 1 URM) were selected for the 2014 summer internships out of 200 applications for the women's program and ~70 applications for the minority program. Those IBM interns are eagerly working on their projects for this summer. However, Jones stresses that she would still like to see many more applications from underrepresented minorities and she encourages eligible African Americans, Hispanics Americans, and Native Americans to apply.

Why spend all the time that she does administering this program? Jones herself says it best, "The biggest rewards are the interns: the excitement and joy of the interns as they learn they have been accepted, and as they start their internship. And then at the end of the summer, to see all the accomplished posters, really is tremendous. Then when I hear of them going to graduate school, and in some cases, eventually becoming IBM employees, the rewards are great."

In 2013, four interns were selected for the APS/IBM Research Internships. On the following pages, two of them, Elisa Yang and Rodrigo Tellez have shared their accounts of their experiences working in industrial labs.

Shuoying (Elisa) Yang

2013 Intern, APS/IBM Research Internship for Undergraduate Women
Bryn Mawr College

Elisa Yang

I am from Chengdu, China. After finishing high school in China, I came to Bryn Mawr College, an all-women's college in the U.S. Taking advantage of the liberal arts education, I took a wide variety of courses. Among all, I was especially captivated by the beauty of physics – how a handful of basic principles work together to explain the complexity of the world. Yet, maybe there was too much awe for me to take in at that stage to realize that physics is not just about theoretical neatness. It was not until I came across a paper about giant magnetoresistance that I truly began to appreciate the even more exciting practicalities of physics. I was astonished by how the spins dance in the spin valve device to extend memory capacity, and how novel materials play a key role in solving the problems of such big practical importance. Since then, I began making a conscious effort to apply physics concepts to solve real-world problems. This is also why I plan to pursue graduate study in applied physics at Columbia University.

I first learned about the APS/IBM Research Internships for Undergraduate Women through the Bryn Mawr physics department summer internship website. I found it particularly interesting because firstly, IBM is one of the pioneers in condensed matter physics research, including, but not limited to its ability to position individual atoms, racetrack memory, and innovative data storage technology, which are exactly the areas I am interested in. The specific target of undergraduate women made the program even more attractive. As a girl who puts significant value on one's pursuit of knowledge, I was very glad to find out that APS and IBM set up this special program to encourage undergraduate women to pursue their interests in physics.

The problem that I worked on was to understand the mechanism of the spin Hall Effect. The spin Hall Effect describes the accumulation of spin-up and spin-down electrons on the lateral surface of a non-magnetic material due to the spin-orbit interaction. It is an interesting phenomenon to study because it provides a way of transforming charge current into spin current. It has been of great interest recently due to its potential use in future spintronic memory and logic devices. A solid understanding of the detailed mechanisms behind the spin Hall effect is key to effectively utilizing and enhancing this effect. The goal of my research was to use temperature to quantitatively separate these two extrinsic mechanisms – skew-scattering and side jump mechanism.

As part of my experimental work, I deposited multi-layered perpendicularly magnetized magnetic samples using the magnetron-sputtering system, and patterned devices using optical lithography and ion milling. I characterized magnetic properties of the samples using vibrating sample magnetometer and polar-MOKE. Furthermore, I performed my low noise transport experiments on measuring the current induced switching of perpendicularly magnetized magnetic layers using spin torque from the spin Hall effect under different temperatures. In the end, we were able to quantitatively separate the contribution of the skew scattering and side jump mechanisms due to the spin Hall effect.

The magnetoelectronics and spintronics lab that I interned in is a very well-equipped lab. When I was working at Bryn Mawr, we would sometimes go to other schools to seek collaborations. At IBM, all the experiments could be done in the same lab, which made our work more efficient. In addition, because it is an industrial lab, the research is more applied. Most of the research is aimed at delivering products or making a more direct real-world impact, instead of fundamental physics research.

One of things that I really liked about this lab was its diversity. Our team was made up of people with diverse backgrounds, such as material science, physics, electrical engineering, and chemistry. The interdisciplinary discussions and collaborations brought me a lot of inspiration. I was very glad to work with a group of talented people, including my advisor, Dr. Stuart S.P. Parkin, a world renowned pioneer in the science and application of spintronic material, the research staff members at IBM and the graduate students. Doing research with them has brought me new insights on not only the new physics, but also how they come up with research ideas, how to deal with specific problems while doing the experiment, and how to capture a phenomenon and interpret it with physical meanings. I also enjoyed the coffee hour every afternoon where everyone working at Almaden is free to come to the cafeteria, eat popcorn and discuss their recent research. During the coffee hour I was able to get to know a lot of people outside my field.

> **"This challenging but rewarding internship not only gave me a chance to participate in real scientific research, but also let me experience the daily work of researchers."**

This challenging but rewarding internship not only gave me a chance to participate in real scientific research, but also let me experience the daily work of researchers. As if the ups and downs, surprises and unknowns were not challenging enough, the grinding work and long hours of tactical considerations imposed further demands on my intellectual and physical capacities. I learned to question when there were anomalous phenomena and persevere when there were no results. The happiness when I got a little breakthrough on my research was all I could ever ask for.

In the future, I want to work on expanding the scientific tool kit for making discoveries that will improve people's living standards. This desire intensified after interning at IBM. I will never forget one afternoon, at the coffee hour after a whole-day experiment, the researchers told me about the journey of successfully synthesizing materials with perpendicular magnetic anisotropy. I found myself sharing the same excitement with them. I understand that many people had to dedicate years to come to a breakthrough like this, which has brought the realization of high-density non-volatile memory to a new horizon. I know that my best career option is to be part of such a collective effort: working with these intelligent and passionate people to add value to the existing scientific inventory. ■

Rodrigo Tellez

2013, APS/IBM Research Internships for Underrepresented Minorities
University of California Berkeley, Chemical Engineering & Materials Science, B.S.

My family moved to a migrant camp in the rural city of Tracy, CA in the agricultural central valley when I was eight months old. My entire family works, in some capacity, as migrant farm laborers for local farm owners. My father works nonstop – sometimes not coming home for weeks, to provide for our family. Because of my father's occupation, we do not have the financial means that most students take for granted. However, my socio-economic circumstances have never deterred me from furthering my education, rather it has been a major component in helping to keep me motivated to one day finally leave this line of harsh manual labor work that my family has endured for so long throughout their generation and fulfill my dream as the very first person in my family to graduate from college and become a chemical engineer.

Currently I am a rising senior at the University of California, Berkeley after being at San Joaquin Delta College for my first two years of undergrad. I've always had an affinity towards science and engineering but after having completed my organic chemistry course I knew that chemical engineering would be the perfect major for me. It would allow me to combine my passion for engineering and chemistry to develop new technological advances for our society.

I found out about the APS/IBM Research Internship for Underrepresented Minority Students program through the Mathematics Engineering Science Achievement (MESA) program director at San Joaquin Delta College.

During my time at IBM Almaden Research Center I worked under the supervision of Alshakim Nelson. There I worked on the synthesis, characterization, and thermal nanoimprinting of biodegradable hydrogels. The objective of my research was to successfully synthesize the triblock copolymers via a controlled ring opening polymerization, demonstrate the formation of hydrogel films, and demonstrate imprinting of the triblock copolymer. Based on my research, we concluded that these triblock copolymer films were in fact able to function as hydrogels and were also able to maintain their nano-imprinted features.

Having the opportunity to work at IBM allowed me to see firsthand what a job in industry is like and how the work that you do as a researcher can directly influence our society. The part I enjoyed the most was being able to work side by side with amazing researchers and other college students. This was a completely new experience in which I was able to share ideas and be an active participant in technological innovation. I appreciated the group atmosphere and learned a lot from my peers. Finally my experience at IBM not only expanded my knowledge in science and engineering but also provided the space to hone my leadership and team work skills.

My immediate goal after graduating from UC Berkeley is to apply to and pursue a PhD in Chemical Engineering. My long-term academic goal is to be a professor and an applied researcher at a university. My ultimate goal is to serve as a mentor and resource for young, Latino students to encourage their interest in the sciences. This internship was my first opportunity to conduct research. Therefore this opportunity has solidified my interest in chemical engineering and has provided me with the confidence to conduct laboratory research. ■

Applications for the APS/IBM Summer Research Internships open in December and close February 1, 2015.

Diversity in APS Prizes and Awards

Monica Plisch, APS Associate Director of Education and Diversity

Monica Plisch

Introduction

In Fall 2013, APS Executive Officer Kate Kirby formed the Diversity Working Group (APS-DWG), composed of nine staff members, to look at issues of equity and inclusiveness from a perspective internal to the organization. APS-DWG co-chairs are Arlene Modeste Knowles (APS Diversity Programs Administrator) and Monica Plisch (author of this article). Among other things, the charge for the group includes gathering statistics on the participation of different demographic groups in the activities of the APS, and making recommendations to improve equity and inclusiveness. The APS-DWG is complementary to the Committee on Minorities (COM) and Committee on the Status of Women in Physics (CSWP), and in the first year we found a number of opportunities to work together to advance the goals of all three committees.

This article, focusing on diversity in prizes and awards, is a first report on what we are calling the "diversity census."[1] The diversity census is a look at the demographics of who is participating in various activities of the APS, including honors, meetings, membership, publications, and leadership of the society. To our knowledge, this is the first time APS has done such a comprehensive analysis, and preliminary results have already generated a number of productive conversations on diversity-related issues. The Joint Diversity Statement passed by the APS Council in 2008 states, "We call upon the physics community as a whole to work collectively to bring greater diversity wherever physicists are educated or employed." To respond effectively to this charge, we need to know our current status regarding diversity, including where APS as a society is doing well and where there are indications that things could be improved. Diversity and inclusiveness are also highlighted in the APS Strategic Plan for 2013-17.

Women

We focus here on demographic data for APS prizes and awards over the last five years to get a sense of the current status regarding diversity. Data on gender were more readily available than on race and ethnicity. As indicated in Table 1, about 7% of recent prize recipients, and about 14% of recent award recipients, are women. In terms of actual numbers of women, this corresponds to 12 prize recipients (of 170 total) and 19 award recipients (of 141 total) over the last five years.

Table 1. Female recipients of APS prizes & awards

	Recipients (2010-14)	Nominations (April 2013)	Expected (APS membership)
Prizes	12/170 = 7%	7%	7%
Awards*	19/141 = 14%	11%	13%

** Data on awards excludes the Maria Goeppert Mayer Award (since the recipient must be a woman) and includes dissertation awards.*

According to a recent "snapshot" of the nominations database (April 2013), about 7% of the prize nominations, and 11% of the award nominations, were women. In comparison with the percentages of female prize and award recipients, this suggests that overall women tend to do just as well or slightly better than men in the selection process. It also suggests that nominations are a limiting factor in increasing the diversity of prize and award recipients, or put another way, increasing nominations of women could be key to increasing diversity in APS honors. Figure 1 shows the distribution of the number of female nominations for APS prizes. The number of nominations ranged from 0 to 4; for example, there were zero nominations of women for 12 different APS prizes. The average number of women nominated for a particular prize or award was 1.0 and 1.1, respectively. Many prizes and awards had 0 female nominees, as would be expected from Poisson statistics. These low numbers indicate that a single nomination for a woman is likely to significantly increase the diversity of the selection pool, and several competitive nominations could well be expected to make a difference in the overall diversity of prize and award recipients.

Overall, the percentages of female recipients of prizes and awards are small, particularly for prizes, which are seen as the most prestigious APS honor. It appears that these low percentages can largely be explained by the age distribution of recipients. Figure 2 shows the distributions of ages for both prize and

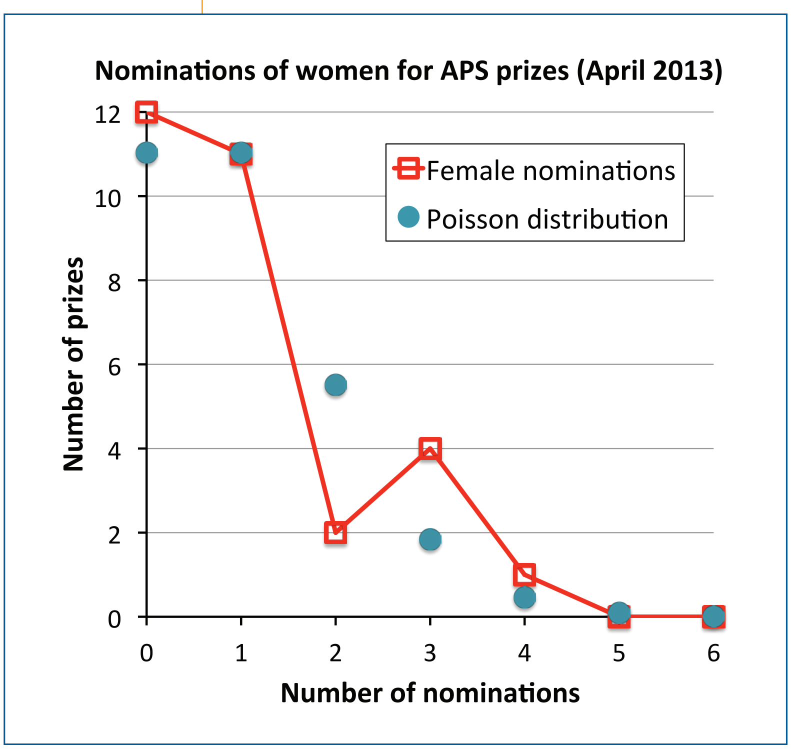

Figure 1. The histogram shows the distribution of the number of female nominations for APS prizes in April 2013. The number of female candidates ranged from 0 to 4 with an average of 1.0, and the distribution approximately followed the Poisson distribution with an expected value of 1.

award recipients. The average age of prize winners is quite high, 64 years, with a standard deviation of 10 years. Prizes are typically awarded to senior physicists in recognition of outstanding lifetime achievements. For award winners the average age is much lower at 44 years, and the distribution is broader. This reflects a mix of early career and dissertation awards, other awards for physics research, and recognition for activities in the physics community not directly related to research.

The star-shaped markers in Figure 2 show the percentages of women in APS membership as a function of age bracket. While prize and award recipients are not required to be APS members, many are, and we use the demographics of APS members as an approximate description of the pool of potential prize and award recipients. Note there is a sharp drop in the percentage of women with age, reflecting in part the smaller numbers of women entering the field in earlier years. When the age distribution for women is multiplied with the age distributions for prize and award recipients, the expected percentages of women for prizes and awards are 7% and 13%, respectively, as listed in Table 1. Since the expected percentages are very close to the actual percentages, this indicates that age distribution is likely the dominant factor in the overall participation of women in APS prizes and awards. This suggests another strategy for APS units seeking to increase the diversity of members who receive recognition, which is to grow the parts of the APS honors portfolio aimed at early- and mid-career members. In addition, winning an honor at an early stage can help to boost a physics career at a critical time.

Table 2. URM recipients of APS prizes & awards (2010-14)

	Hispanic (all)	Hispanic (US)	African American
Prizes	3	1	0
Awards*	3	1	2

** Data on awards excludes the Edward A. Bouchet award since the recipient must be an underrepresented minority (URM).*

While it is difficult to do meaningful statistical analysis on individual prizes and awards due to small numbers, it is worth noting that 12 of 31 prizes and 11 of 28 awards have never been won by a woman. Some of these honors were initiated recently, although some have been in existence for many years. There are a number of potential benefits to units that actively seek to increase the ranks of women receiving honors, including promoting female role models for younger physicists, as well as building confidence in an equitable process for recognition.

Underrepresented Minorities (URM)

Gathering data on race and ethnicity of prize and award recipients was a more difficult task than gathering data on gender. The APS member database has

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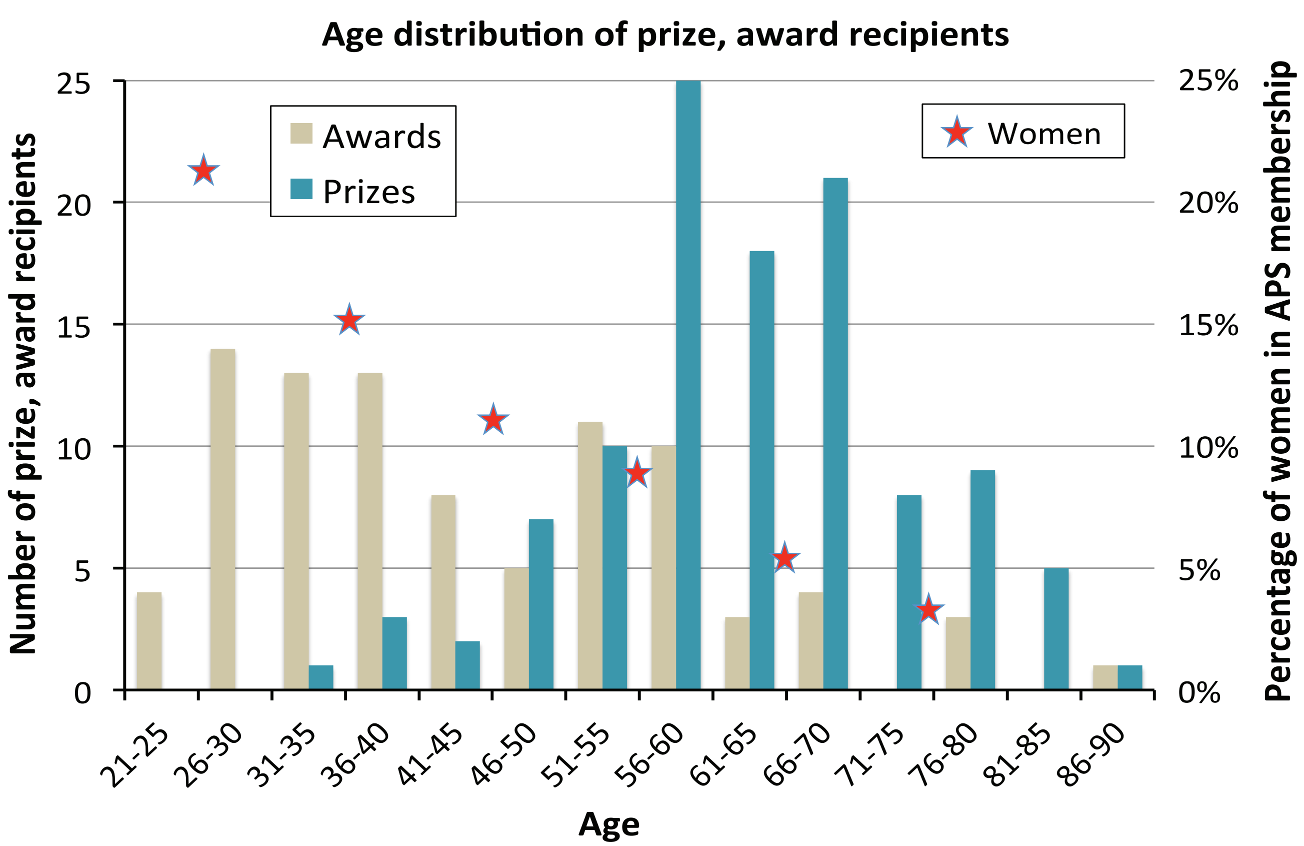
Figure 2. Two histograms show the distributions of ages for both prize and award recipients, with data from 2009-2014. Overlaid is the percentage of women in APS membership with respect to age bracket. The sharp drop in the percentage of women with increasing age bracket, combined with the high average age of prize recipients, appears to largely explain the low percentage of women who receive prizes.



APS Forms Ad Hoc Committee on Lesbian, Gay, Bisexual, Transgender Issues

Arlene Modeste Knowles, Diversity Programs Administrator

Arlene Modeste Knowles

In June 2014, a group of Lesbian, Gay, Bisexual, Transgender (LGBT)[1] and ally physicist leaders met at APS headquarters to set a course forward for a brand new APS ad hoc Committee on LGBT Issues (C-LGBT). This planning meeting was the latest development in a five-year alliance between APS and the LGBT physics community.

Five years ago, a transgender graduate student, who is a strong advocate for the LGBT community, initiated a relationship with APS and worked with APS staff to organize the first meeting for LGBT members to meet and network at the 2009 APS April Meeting. The idea was for LGBT physicists to discuss their experiences within physics departments and throughout their careers. That first meeting had about 10 participants, ranging from undergraduates to senior faculty, and although they were at different professional levels, the sense was that it was a relief to finally be talking about these issues with people who understood. Since that initial meeting, the network of LGBT physicists and allies has grown. They have formed an organization called *LGBT+ Physicists*, and they have continued to organize discussion/mentoring sessions at each APS March and April Meeting.

The LGBT+ Physicists group has been incredibly active in many other ways too. They have created a website (lgbtphysicists.org) with an array of resources, including the *Supporting LGBT+ Physicists and Astronomers: Best Practices Guide for Academic Departments*, the Out List of LGBT+ physicists and allies who pledge to build discrimination free scientific environments and provide safe zones for those needing support, and a host of informative articles written by people inside and outside of the community. The group also organized an invited session on "Sexual and Gender Diversity Issues in Physics"[2] (thanks to the generosity of COM and CSWP donating a half session each) at the 2012 APS March Meeting, which was very well attended and showed that there is interest in these topics within the APS community.

A natural outgrowth of this informal relationship with APS was a request by the LGBT+ Physicists to have a more formal relationship with the APS. In response, and in keeping with APS' commitment to diversity, APS Executive Officer, Kate Kirby, proposed the new ad hoc committee, which will exist for the purpose of carrying out its charge and making recommendations to APS leadership about how APS can support this community of members.

At the June meeting, the planning group met to draft a charge for the new ad hoc committee, nominate members, draft a general outline of the scope of work, and develop suggested outcomes for the C-LGBT. The expectation is that the ad hoc committee of nine members will exist for 12-18 months and will produce a report summarizing their work and providing recommendations.

Having safe places to learn and work where LGBT individuals will not be subject to overt discrimination or micro-aggressions is a constant consideration for members of the LGBT community.

One important component of the draft charge is for the committee to investigate LGBT representation in physics and assess the educational and professional climate for those who identify as LGBT in physics. LGBT scientist demographic data is not currently accessible, and this work will be important in understanding the number of people who identify as LGBT in the physics community. However, as with women and minorities, climate issues within academic departments, labs, and other places where physicists learn and work can have an even greater impact on the ability for people to be successful in physics. Some of these climate issues were highlighted during the LGBT networking discussions at APS meetings.

To those unfamiliar with LGBT communities, there may be a question as to how being an LGBT person impacts their physics education or professional work life at all. After all, some still hold the belief that race, gender, sexual orientation or identity, and disability have no bearing whatsoever on one's ability to succeed in physics, and that the only factor that matters is being smart. This has not been the general experience of women and minorities. For example, it is widely known that unconscious biases may have negative effects on the education and careers of women and minorities; but how do beliefs about members of the LGBT community held by colleagues, peers, and even LGBT physicists themselves have an impact?

The APS meeting discussion sessions revealed that having safe places to learn and work where LGBT individuals will not be subject to overt discrimination or micro-aggressions is a constant consideration for members of the LGBT community. Consider a lesbian student, who naively applies, and excitedly learns that she has been accepted to the perfect summer research experience working in the field she is most interested in pursuing further. The one catch; it is at a conservative religious university, where she would not only be unable to be "out," but could quite possibly have to endure hostile comments and acts against gays on campus, if not within the physics department. How might she have been advised differently, if there was open communication between her and her advisors? What about a gay physicist, who is interviewing for a faculty position and who is asked several times during the interview what his wife does or if she will be looking for a position too? If he is not "out," might revealing that he is gay put him out of the running or jeopardize his reputation within his field? What if he has a partner who will indeed be looking for a faculty position? How does he navigate this situation? What about a transgender man or woman, who would like to travel to another country for his or her research collaboration,

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Bootcamp *continued from page 1*

In California—and, we suspect, across the nation—-underrepresented minorities (URM) are more strongly concentrated at four-year, rather than PhD-granting institutions. Thus, spreading awareness of graduate options through partnerships between these institutions has the potential to increase URM representation in PhD programs, and thus, ultimately in the ranks of faculty who will influence the next generation of students. Admissions committees at PhD programs who wish to see more and stronger URM applications also have an interest in spreading the word on how to build a strong application.

For all these reasons, in 2010 we began running a Graduate Admissions Boot Camp at UC Davis to serve college seniors and juniors from across California. The bootcamp is a single weekend packed with a full physics GRE practice exam taken under realistic test conditions; group work on GRE physics problems; panels on grad student life and the admissions process; a few short research talks by current PhD students; individualized advising; and half of a physics GRE as an exit exam, with prizes given to the most improved students (a full schedule of activities appears at the end of this article). We feature the physics GRE prominently because it is one of the few things students can improve between late August (when the camp is held) and the applications deadline. The camp aims not to substantially improve GRE scores in a single weekend, but to serve as a wake-up call for many students to study, and to get students to interact on the common pursuit of solving physics problems (see below).

The camp has been very well received by students, who rate the overall experience as 4.8 out of 5. Students report that they particularly value the wake-up call provided by the practice exam under realistic conditions and the opportunity to work with peers from a range of institutions to increase their understanding of physics. The camp was quickly replicated to better serve students across California: CSU Long Beach (thanks to Andreas Bill) runs an annual camp in southern California, and the annual northern California camp rotates between host institutions, with UC Davis hosting it in 2010-12 and UC Santa Cruz (thanks to Bruce Schumm) hosting it in 2013-14. We thank the UC Davis Office of Graduate Studies for generously funding the camps in southern California as well as at UC Davis, and we thank UC Santa Cruz for funding the Santa Cruz camps. We also thank Damien Martin of Whittier College, who obtained his PhD at UC Davis, for providing a crucial link between the northern and southern camps. Damien has served as coach and inspiration to students at every camp.

Attendance has been running at about 75-80 students in each camp. We welcome students of all races, backgrounds, and educational stages, but we particularly try to recruit URM and female students through the California Professoriate for Access to Physics Careers (www.physics.ucdavis.edu/cpapc/), a loose network of CSU and UC faculty dedicated to increasing the representation of minorities and women in physics and astronomy. Anecdotally, the experience of work-

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Students working in groups on GRE problems. CSU-Long Beach, August 2013.

Spreading awareness of graduate options through partnerships between these [four-year, terminal Masters and PhD] institutions has the potential to increase URM representation in PhD programs.

A WORD ON USING PHYSICS GRE SCORES

While we aim to prepare students, admissions committees should also brush up on best practices for using physics GRE scores. The GRE measures preparation rather than potential, and is predictive of first-year grades but not long-term research performance. Preparation in pencil-and-paper physics is an important factor, but should not dominate admissions decisions for a PhD program, which is primarily a research apprenticeship.

Because URMs have systematically lower scores, imposing a cutoff score is likely to screen out most URMs, even those with a great deal of research potential. Thus, ***ETS itself states in no uncertain terms that GRE scores should never be used as cutoffs, but many admissions committees continue to make this mistake***.

Furthermore, there is research showing that women tend to underperform on timed tests compared to untimed tests, and that women show greater hesitation than men to answer a question unless they are absolutely certain of the answer. Each of these factors will work against women on the physics GRE: time pressure is intense (100 physics questions in 170 minutes!), and guessing does tend to increase the score if a student can eliminate at least one of the options presented.

Therefore, faculty should be aware that the physics GRE may underestimate a female applicant's preparation in pencil-and-paper physics.

See Miller & Stassun 2014, Nature 510, 303 for more on the use of GRE scores.

Bootcamp *continued from page 11*

Profs Susan Lea (San Francisco State) and Dave Whitman (UC-Davis) give advice on graduate school prep and admissions.

Anecdotally, the experience of working with peers to meet a common challenge seems to go some way toward alleviating the 'I don't belong' feeling, which many students experience at points in their physics studies.

ing with peers to meet a common challenge seems to go some way toward alleviating the "I don't belong" feeling, which many students experience at points in their physics studies. However, we do not have hard data on this or on any other long-term impact.

Nevertheless, students report a positive experience and the camps seem to fill a need. The budget is modest: $5-6k, with half going to food and teaching assistants, and the other half to lodging, so that students pay nothing other than their transportation. We facilitate carpools. This budget may not sound modest for your department, but it is modest on the scale of what graduate deans spend on outreach and retention, so consider asking yours for funding. He or she may be pleasantly surprised that a physicist is willing to contribute time and ideas to address this issue. Graduate studies offices conduct substantial recruitment and retention efforts but often diffusely, across a vast array of disciplines, so they are often happy to hear more about specific needs in specific fields.

The camp becomes even more feasible if faculty at multiple institutions in a geographical area team up. Teaming up like this is key to providing students with advice from a range of faculty perspectives (for example, those at terminal Masters as well as PhD-granting institutions). We have found that it also benefits faculty to make new connections, and continued faculty-to-faculty contact facilitates the flow of students from minority-serving institutions to PhD-granting institutions.

The 2014 bootcamps will take place August 22-23 at California State University, Long Beach and August 23-24 at University of California, Santa Cruz. ■

SAMPLE BOOTCAMP AGENDA

Saturday

0830	donuts and coffee
0900	take full GRE exam under realistic exam conditions
1200	lunch
1300	self-score the exam
1330	introduce TAs and form groups
1340	group work I
1510	break
1530	group work II (first meet in Roessler 55 to form new groups)
1700	discussion panel: the life of a PhD student
1800	dinner
1900	grad student research talks:
	Will Dawson: Dark Matter in Colliding Galaxy Clusters
	Adam Dioguardi: Nuclear Magnetic Resonance in High Temperature Superconductors
2000	adjourn

Sunday

0830	donuts and coffee
0900	TA analysis of group work; form new groups
1000	group work III
1130	lunch
1230	applying to physics graduate programs: types of programs, admissions process, and question-and-answer session with Susan Lea, chair, SFSU Physics Dept., and David Wittman, chair, UC Davis Physics Graduate Admissions Committee
1330	break (faculty available for individualized advice)
1400	exit exam: 50 GRE questions
1530	score exit exam
1600	Awards ceremony.
	Evaluations.
	Faculty available for individualized advice.

Goeppert-Mayer Awardee Loved High School Physics

Michael Lucibella, APS Staff Writer

This year, APS presented its Maria Goeppert-Mayer Award to Ana Maria Rey of the University of Colorado. The award recognizes outstanding achievement by a woman physicist in the early years of her career. The award is named after German-American physicist Maria Goeppert-Mayer, the second woman to win a Nobel prize in physics (after Marie Curie).

In addition to a certificate honoring her achievement, Rey will receive a $2,500 stipend plus $4,000 in travel allowances to be used towards speaking at up to four U.S. universities and at an APS meeting.

Rey is an atomic, molecular, and optical physicist working at JILA and the University of Colorado. Her research focuses on optically trapping alkaline atoms and polar molecules. This work could serve as the basis for future atomic clocks, as well as quantum simulators, which are possible stepping-stones to quantum computers.

She was born in Bogota, Colombia and has enjoyed physics since she was young. "I love to be able to write an equation, and nature behaves as I predicted," Rey said. She liked solving these kinds of equations so much that in her teen years, she found herself needing more from her physics class.

"I was in high school, I loved physics and I asked the high school teacher to give me more problems," Rey said. "He borrowed a physics book for me that I used to do more problems besides the ones assigned from the class."

She attended the Universidad de los Andes in Bogota and majored in physics. It was there also she met her husband, Juan. After finishing, she decided to travel abroad to continue her education. "I wanted to come to the United States to learn more," Rey said. "At that time there was no graduate program in Colombia."

She set her sights on the University of Maryland and as luck would have it both she and her husband were accepted into the school. The two moved to the US in 1999. However, at that time, the university had limited options for the field she wanted to go into. "When I graduated the formal program started in atomic, molecular and optical physics." Rey said.

To compensate, Rey took a job at NIST in nearby Gaithersburg, Maryland to get experience in this field. There she worked on the theory of optical lattices and ultra-cold atoms. She received her PhD in 2004.

She did her postdoc work at the Harvard-Smithsonian Center for Astrophysics. After three years there, she left for Colorado and is now a fellow at JILA and an associate professor in the University of Colorado's physics department. Rey was named a MacArthur Fellow in 2013.

As a theorist, she is noted for her willingness to work closely with the experimentalists. "The groups are downstairs so you can just go into the basement and talk to them," Rey said. "This collaboration has been stronger in the last couple of years." In addition to her work, she also spends time raising her four-year-old son Nicholas.

Rey said that she was honored by the recognition of her work, and was looking forward to using the Maria Goeppert-Mayer Award to help advance her research. "There are collaborators around the world, in Europe especially, that are doing experiments with alkaline atoms and collaborating more closely with them could be very interesting," Rey said. ■

This article was previously published in APS News.

Ana Maria Rey

Dr. Rey was also awarded a 2013 MacArthur Fellowship and was named a CSWP Woman Physicist of the Month in 2012.

C-LGBT Committee *continued from page 10*

but the country has strict laws against gays and transgender people punishable by incarceration or worse? These are just a few examples of safety considerations that exist for LGBT physicists in the normal course of pursuing their physics careers. Prevalent in all of the discussions was the sense of isolation that many LGBT physicists and students face, particularly when they have not identified any other LGBT physicists around them.

Safety issues, discrimination, climate problems, lack of necessary physical accommodations, legal considerations, and many other issues were raised in the discussion sessions at the APS meetings that point to a need for an organized group of physicists to begin formally addressing them. The C-LGBT ad hoc committee will indeed examine many of these issues, as well as other important questions and will advise the APS on how best to support LGBT members. Another likely outcome will be to educate the physics community about these issues and encourage actions that increase and support inclusion. ■

For More Information

Arlene Modeste Knowles, APS Diversity Programs Administrator, and Dr. Monica Plisch, APS Associate Director of Education & Diversity will serve as staff liaisons to the C-LGBT. For more information or to send comments, please contact knowles@aps.org.

1 *In this document, the term "LGBT" refers to lesbian, gay, bisexual, transgender, queer, questioning, intersex, and asexual persons, as well as other sexual and gender minorities.*

2 *N. Ackerman, T. Atherton, W. Deconinck, M. Falk, S. Garmon, E. Henry, E. Long,* Gender and Sexual Diversity Issues in Physics: The Audience Speaks, ***arXiv:1206.4112****, June 19, 2012.*

Prizes and Awards Diversity *continued from page 9*

race and ethnicity information for only about one-third of US members, and demographic information is not requested from prize and award recipients. Given the lack of available data, we brought together an ad hoc group of African American and Hispanic physicists to review lists of recipients of APS honors; the goal was to identify members of these communities, and come up with an estimate of the total number of underrepresented minority (URM) recipients. Members of the ad hoc group included J.D. Garcia (University of Arizona, emeritus), Jorge Lopez (University of Texas at El Paso), Sekazi Mtingwa (MIT, emeritus), and Jim Stith (AIP, retired).

No one could identify a single African American who had received an APS prize in any year, not just the last five years.

Table 2 lists the number of Hispanic and African American physicists identified by the ad hoc group who received a prize or award in the last five years. "Hispanic (all)" is a broader category that includes those who may have originated in another country in Central or South America and emigrated to the US. "Hispanic (US)" is restricted to those who were born in the US, and is a subset of "Hispanic (all)." The overall numbers of URM physicists receiving prizes and awards appears to be quite small. In fact, no one could identify a single African American who had received an APS prize in any year, not just the last five years.

Comparison data on the pool of URM physicists eligible for prizes and awards is also somewhat difficult to come by. Figure 3 shows an estimate of the percentages of URM physicists in the US by age bracket, based on physics doctoral degrees awarded in past years to US citizens and permanent residents who identified as African American, Hispanic or Native American.[2] According to AIP, the average age at which doctoral degrees are granted is 30,[3] which in combination with the physics PhD data allows an estimate of URM physicists by age bracket. The estimated percentages of URM are likely to be low in that they do not account for physicists who immigrate from other nations in Central and South America or Africa and become US citizens after their PhD. As a check on the estimated percentages, AIP reports that 5.3% of all physics faculty are URM (this includes 3.9% of faculty at PhD granting physics departments likely to have highly active research programs).[4] The AIP statistic is somewhat higher than most of the percentages in Figure 3; this is not inconsistent given the likely underestimate noted above. While we hesitate to report an expected percentage for URM recipients of APS prizes and awards given the uncertainties, we can state that according to the available data, URM physicists appear to be underrepresented in APS prizes and awards.[5] More complete data is needed, as well as a closer look at the nomination and selection process, as discussed in the following section.

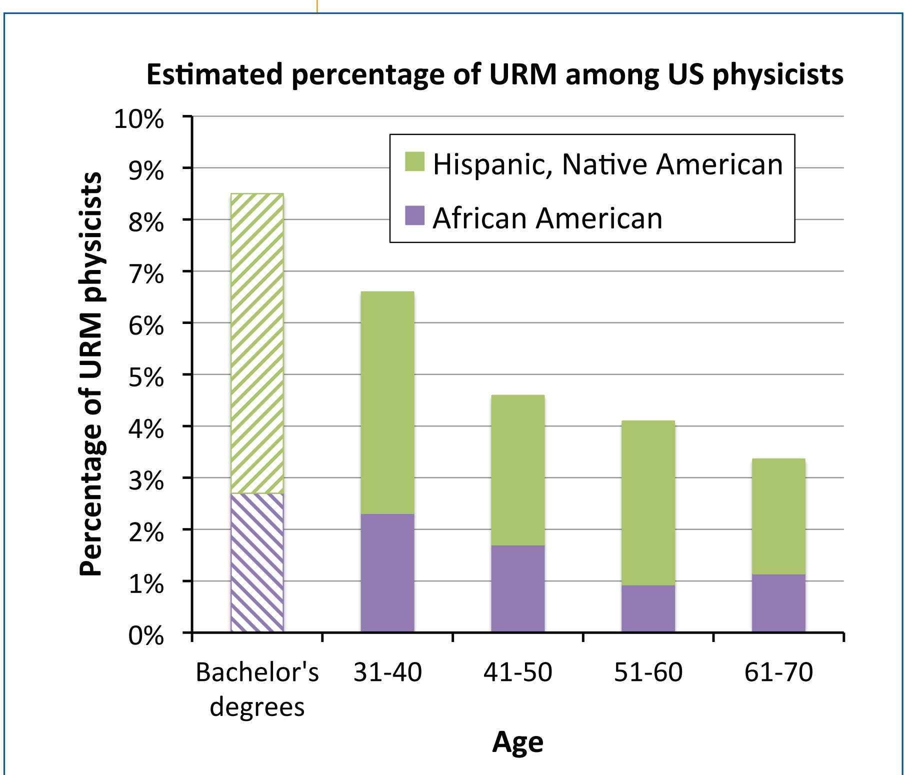

Figure 3. The percentage of URM physicists in the US as a function of age bracket is estimated based on physics doctoral degrees awarded in past years to US citizens and permanent residents who identified as African American, Hispanic or Native American. Data on physics bachelor's degrees provides an indication of percentages of URM among younger physicists. The percentages of Native American physicists are a few tenths of one percent, and this is grouped with Hispanic physicists.

APS Response

APS is working to more systematically include considerations of diversity in the nomination and selection process for honors. There are inherent challenges to doing so, including reaching the many dozens of selection committees involved in the process, with membership that changes on an annual basis. In the last year, new guidelines for selection committees were developed that emphasize the role of the committee in fostering nominations "including foreign, minority and woman candidates." In addition, a new section on demographics was added to the recommendation form to be filled out by selection committees. To back this up, the APS Executive Board passed a resolution stating that incomplete forms may be returned to the selection committee and cause a delay in the award process. In coordination with these efforts, CSWP and COM produced a set of guidelines on promoting equity that is sent on an annual basis to selection committees. Additional steps are being considered to further improve the nomination and selection process, with the goal of ensuring quality and equity throughout. Many of these changes will be fully implemented for the 2015 award cycle.

Our attempt to put together a picture of URM participation in APS prizes and awards shows that better demographic information is needed. The APS Membership Department is in the process of emailing all members with a request to update the demographic information in their member profile.[6] In addition, there have been discussions about requesting demographic information from prize and award recipients. Even with somewhat incomplete data, indications are that more attention is needed toward the nomination of URM physicists for APS honors. The Committee on Minorities (COM) has already responded by establishing a subcommittee on nominations. Changes to selection committee procedures described above also have potential to help in this regard. In addition, APS is looking to other societies, such as the ACS, which has a canvassing committee to look after nominations.

There are a number of actions that APS members can take to promote equity and inclusiveness in APS honors. First, consider nominating women and minorities for prizes, awards and fellowship; a single nomination can be significant, especially if you get yourself nominated. A second opportunity is to participate in a selection committee and be a voice for diversity considerations; such participation can also be useful in learning how the process actually works. Third, if APS members collectively check the completeness of the demographic information in their member profile,[7] this will help to provide better data on the participation of underrepresented groups in a number of APS activities.

Looking to the Future

One of the stated objectives in the APS Strategic Plan is to "broaden the APS membership to be more inclusive and diverse." An important aspect of this is making opportunities for recognition available to members from underrepresented groups; such opportunities can help to advance careers, promote role models, and build confidence in the inclusiveness of the organization. Given the substantially higher percentages of women, minorities, and international members[8] among early career (and mid-career) physicists, this naturally suggests a strategy of increasing recognition for the achievements of younger members. The future of physics depends on attracting and retaining the best and brightest. As diversity is increasing dramatically in younger generations, it will become all the more important to promote the full spectrum of diversity and foster a broadly inclusive climate.

Author's Acknowledgements

I gratefully acknowledge contributions from following people in putting together this article: Alan Chodos, Jim Egan, Pahola Elder, J.D. Garcia, Ted Hodapp, Rachel Ivie, Arlene Modeste Knowles, Trish Lettieri, Jorge Lopez, Sekazi Mtingwa, Kathy Prestridge, Bill Reinhart, Pam Stebbins, Jim Stith, Xiaoyan Weng, and Delong Yang. In addition, I thank members of the APS-DWG, CSWP, and COM for helpful discussions. ■

1 *The full report of the diversity census will be made available on aps.org in fall 2014.*

2 *Physics degree data by race and ethnicity are from the IPEDS Completions Survey by Race.*

3 *P.J. Mulvey and S. Nicholson, Trends in Physics PhDs, (AIP Statistical Research Center, College Park, MD, February 2014).*

4 *R. Ivie, G. Anderson, and S. White, African Americans & Hispanics among Physics & Astronomy Faculty, (AIP Statistical Research Center, College Park, MD, July 2014).*

5 *To calculate the percentage of URM physicists who receive prizes and awards, it is necessary to remove the 19% of prize and award recipients at institutions outside the U.S. When this is taken into account, it still appears that URM physicists are underrepresented in prizes and awards.*

6 *Demographic information is only used to report statistics in aggregate and is not provided to third parties.*

7 *You can access your APS member profile from www.aps.org by going to the Membership tab and selecting My Member Profile on the drop-down menu. If you have difficulties, contact the membership department by emailing membership@aps.org.*

8 *In addition, indications are that APS members who identify as lesbian, gay, bisexual and transgender (LGBT) are much more likely to be younger in age. This is based on attendance at LGBT roundtable discussions held at recent APS March and April Meetings, organized by the group LGBT+ Physicists (lgbtphysicists.org).*

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- **Scroll over 'Membership'**
- **Click 'My Member Profile'**
- **Click 'Edit'**

Questions? Contact membership@aps.org

Do you need an inspiring speaker?

APS offers travel grants to physics departments at U.S. institutions to host minority speakers!

The Minorities Speakers Program is intended to expand the opportunity for physics departments to invite minority colloquium/seminar speakers who can serve as role models for undergraduates, graduate students and faculty. The program also recognizes the scientific accomplishments and contributions of these physicists.

For more information and to complete an application, please visit: Minority Speakers Program Travel Grants: **go.aps.org/minoritytravelgrants**

BOOK REVIEW: Research Methods for Science by Dr. Michael P. Marder, 2011

Reviewed by Linda M. Alviti, B.A. in English, California State University, Los Angeles

Linda M. Alviti

From ground-breaking theories to innovative experimental design, science invites us to dream big while trying to understand nature and improve our world. To reach fruition and effect change, however, professional scientific efforts need to be grounded by precision, attention to detail, and a thorough knowledge of both the history and the methods of science. *Research Methods for Science* conveys this message well. It is the result of years of collaboration between physicist Dr. Michael P. Marder and many colleagues to create original, inquiry-based classes that help prepare undergraduates to become scientists or secondary school science and math teachers.

Marder's enthusiasm for science is evident in the textbook's interesting, detailed examples, drawn from fields ranging from astronomy to zoology, which capture a reader's attention: Newton, Kepler, earthquakes and freshwater fish are all referred to in its pages. Although the text's raison d'être is not specifically physics education, every topic covered in the book, from hypothesis testing to the presentation of research findings, is essential knowledge for undergraduate physics students. The thoughtful use of varied perspectives to illustrate concepts takes readers' diverse learning styles into account.

Despite their call for a high standard of scientific excellence, the book's chapters have a conversational, down-to-earth tone, like a set of extended letters from a mentor to a beginning scientist. Because of this combination of style and content, its nontraditional "how-to" approach, and its relative conciseness, many undergraduates contemplating a career in science would benefit from reading Marder's practical "insider guide" to the world and mindset of science early in their academic careers. Instructors can learn more about the UTeach inquiry-based, non-lecture classes involving scientific research which led to the textbook's development at: www.cambridge.org/Marder. General information about the UTeach program is available at www.uteach-institute.org.

Every chapter of the textbook includes indispensable information about its specific topic, whether it be experimental design or mathematical modeling. Do's, don'ts, advice and strategies are rapidly and logically presented, culminating in imaginative assignments at the end of each chapter. Students can learn about everything from systematic errors to dimensional analysis to the ISI Web of Knowledge. However, it would be useful for each chapter to begin with a brief topic outline of the chapter's contents, thus providing a roadmap for what will follow. A glossary of key terms at the end of the book would also be a valuable feature.

Using concrete examples, the teaching rubrics in Appendix D succinctly convey expectations for undergraduates' own practice of good science and mathematics, such as attention to safety and ethics, the need for careful planning in experimental design, the role of statistical analysis and good communication skills, and the need for proper research, attribution and documentation. Capable of standing on its own as a quick reference guide, Appendix D is an excellent summary and resource for student, teacher and scientist alike.

One other section of the book should be mentioned here. Chapter Three, which is about statistics, eagerly dives into the quantitative analysis of data, an increasingly important domain in all branches of modern science. While the chapter's scope is extensive (it is the longest chapter in the book, covering statistical concepts from means to normal distributions to chi-squared tests), it contains some mathematical expressions and notation that may be unfamiliar to lower-division undergraduate math and science students. Including more explanations of the statistical notation that is used in the equations (either within the text itself or in nearby text boxes), along with more detailed presentations of the equations themselves, would reduce the need for readers to consult outside references for full understanding while reading the chapter.

All in all, *Research Methods for Science* paints a remarkably clear picture of how to be a scientist. While looking back to one of Galileo's Dialogues for guidance (a substantial excerpt appears in Appendix B), Marder effectively shares his own sound wisdom about modern science with future scientists, math and science teachers—advice that will help them follow in the footsteps of people like James Clerk Maxwell, Marie Curie and Gregor Mendel. ■

Want to contribute to the Gazette? We are always seeking guest articles and book reviewers. Contact *women@aps.org* for more info.

BOOK REVIEW: Women in Physics: A Collection of Reprints in Honor of Melba Newell Phillips

Reviewed by Dr. Kathy Prestridge, Chair of the Committee on the Status of Women in Physics

Women in Physics, edited by Jill Marshall, is an important collection of articles that physics educators, mentors, scientists, and those interested in the evolving role of women in science will want to read. The articles in the first half of the book provide an excellent synopsis of gender issues in education and leading factors in retention of women in physics. Several biographical articles provide a more complete picture of the spectrum of women involved in physics and the variety of their contributions to science.

The biographies illustrate, in very personal detail, some of the struggles and triumphs of women physicists, highlighting some lesser-known women in nuclear physics. While Marie Curie is often presented as a role model for women because of her awesome achievements, it can seem challenging, if not impossible, for young women to feel that they will have similar success in physics.

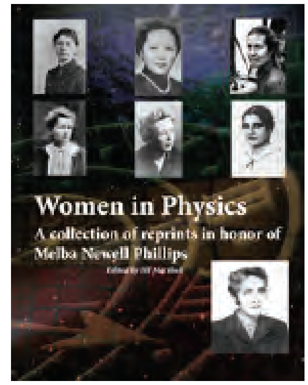
The article "Pioneer women in nuclear science" highlights the lives many other historical female physicists who had active, successful, inspiring research careers. By also including historical pictures of the roles of women in translating science books, the importance of women in the Manhattan Project, and other non-traditional careers, "Women in Physics" presents and inspiring world of possibilities for girls considering careers in science and for educators and researchers interested in helping them achieve those goals.

The American Association of Physics Teachers published *Women in Physics: A collection of reprints in honor of Melba Newell Phillips*. The collection includes eighteen articles on women in physics, presented in four parts:

1. Gender Issues in Physics and Physics Education
2. Gender-related Physics Education Research
3. Biographical Articles
4. Analysis of the Role of Women in Science

This volume fills a need for scholarship specifically focused on women in physics and comprehensive in scope, from practical recommendations and recent research to archival and historical analyses.

Articles are reprinted from the *American Journal of Physics*, T*he Physics Teacher*, *Physics Today*, and *Physical Review Special Topics*. Proceeds from the sales will support the endowment of the Melba Newell Phillips Medal. A complete Table of Contents listing is available at http://www.aapt.org/Store/images/TOC_Women-1.pdf. ■



Order online at The Physics Store: http://bit.ly/1evPVzE

2015 APS CUWiP SITES ANNOUNCED

The 2015 APS Conferences for Undergraduate Women in Physics (CUWiP) will be held Friday, January 16 through Sunday afternoon, January 18, 2015 at the following locations:

North Carolina Research Triangle
Purdue University
Rutgers, the State University of New Jersey
University of California, Santa Cruz
University of Michigan
University of Mississippi
University of Texas at Brownsville
Yale University

The APS CUWiP goal is to help undergraduate women continue in physics by providing them with the opportunity to experience a professional conference, information about graduate school and professions in physics, and access to other women in physics of all ages with whom they can share experiences, advice, and ideas. Learn more at: http://www.aps.org/programs/women/workshops/cuwip.cfm.

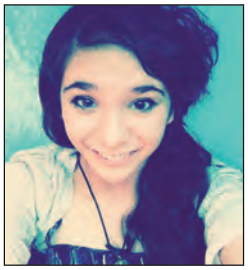
Student applications are accepted starting in September, and acceptance notifications are sent by December 1. Stay tuned to www.WomenInPhysics.org for updates on the application process!

APS Announces the 2014-15 Minority Scholars

The APS Committee on Minorities is happy to announce that 36 students were selected this year to receive the APS Scholarships for Minority Undergraduate Physics Majors: 16 renewals and 20 new recipients. The goal of this minority scholarship is to increase the number of under-represented minorities obtaining degrees in physics. It provides funding and mentoring to minority physics students to enhance their education and help them prepare for success in various careers.

New Recipients


Jessica Abrolat

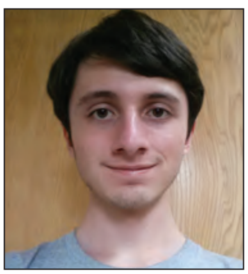

Nicole Banales

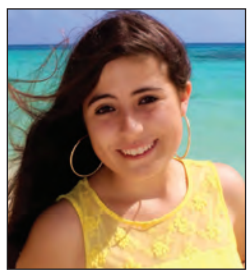

Sarah Caballero

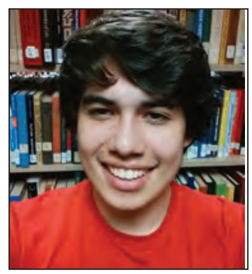

Christopher Compton

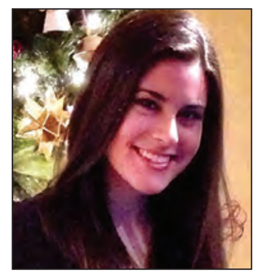

Andrew Edoimioya


Cristian Garcia

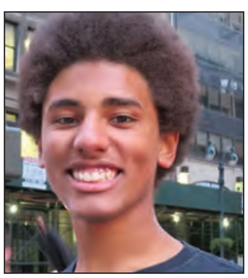

Jeremias Gonzalez


Maddy Greene


Ian Prado


Maria Prado


Gabriel Oman


XhiDae Otam


Jorge Gabe Otero


Andres Rios Tascon


Jamie Rodriguez


Wesley Runnels


Saquann Seadrow


Steven Smith


Sebastian Wagner-Carena

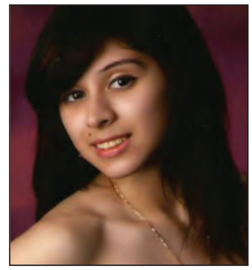
Not pictured:
Alex Pacheco

Renewals


Bryan Anenberg


Alaric Bryant

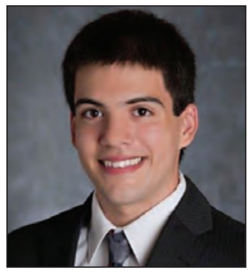

Kendall Cole


Consuelo Cuevas

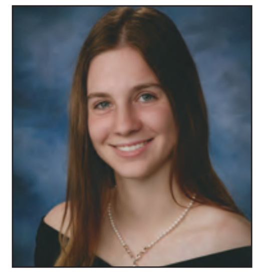

Patricia Dominguez


Erin Flowers


Tewa Kpulun


Antonio Martinez

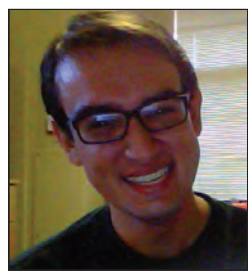

Jordan Melendez

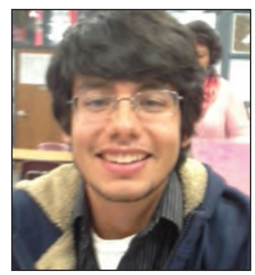

Katelyn Neese


Olumakinde Ogunnaike


Christopher Tiller


Stephanie Torres


Gabriel Vasquez


Jorge Zetina


Daniela Zuniga Sacks

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College Park, MD 20740-3844

Request to join the
APS Minorities in Physics Facebook group
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Minorities in Physics
Conferences for Undergraduate Women in Physics

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