APS Members Elect Homer Neal to Presidential Line

In Society-wide elections in January, new officers for the APS and for the American Physical Society (APS) were elected. Homer Neal of the University of Michigan will be the next president-elect. As the new president-elect, Neal will become APS president in 2016.

The physical review x (PRX) is a broad-scope physics journal by the American Physical Society (APS). It was originally conceived by Ralph Schoen as an “impact factor” ranking for physics journals. The Physical Review X (PRX) received an initial “impact factor” of 6.711, putting it alongside two other APS publications among the ten most influential multidisciplinary physics journals.

Two other measures, in which PRX also ranks in the top ten among broad-scope physics journals, are the Eigenfactor and the immediacy index. The immediacy index is calculated for a given year as the number of citations in a given year to articles published in the journal in the previous two years, divided by the total number of those articles.

Meeting Helps Bridge Programs Interact

The APS Bridge Program (APS-BP) is committed to increasing the number of underrepresented minority students who receive PhDs in physics. In late June, APS-BP hosted a meeting that involved a variety of programs and organizations with similar interests. More than 60 people attended the conference, which took place at the American Center for Physics in College Park, MD. Attendees included representatives from APS, the American Association of Physics Teachers (AAPT), the American Institute of Physics (AIP), bridge programs, and colleges and universities across the US.

Although just getting underway, the APS Bridge Program has been able to facilitate the placement of at least 14 students into physics bridge programs or directly into graduate programs. Seven students were named Bridge Fellows at two newly selected APS Bridge sites, University of South Florida and The Ohio State University.

Executive Officer Kate Kirby Plans Strategically for 2nd Term

In April, the APS Council voted to extend Executive Officer Kate Kirby’s term at the helm of the Society for another five years. Commenting on the vote, APS President Michael Turner said “She’s been a terrific leader of APS. One of the most important things that she’s done is to represent us to the outside world, whether it is working with other societies, or at meetings of young women physicists, or at a National Academy committee. She’s done a tremendous job of being the face of the American Physical Society.”

APS Set to Launch Applied Physics Journal

Following approval by the Executive Board in June, APS is gearing up to launch a new journal of applied physics. Physical Review Applied is slated to debut early in 2014, and will feature high quality applied research articles from all areas of physics.

APS to Participate in Multi-Publisher Open Access Research Clearinghouse

The Clearinghouse for the Open Research of the United States, or CHORUS, is an online platform that links to open access journal articles stored on publishers’ servers. Developed by the American Association of Publishers, it would use publishers’ existing infrastructure to comply with recent federal open access mandates.

In February, the administration’s Office of Science and Technology Policy issued a memo that would ultimately require all scientific papers stemming from federally funded research to be available for free to anyone after an embargo period. The specific form of the policy was not spelled out in the memo, and one of the biggest open questions was whether the papers would be hosted on open access platforms.

The plan was drafted in early 2012, the Executive Board adopted it, and Bob Byer, who was APS President in 2011, was very supportive of devoting considerable time to discussions between the Executive Board and the APS staff, which formed the basis of the Strategic Plan.

What ultimately did you produce?

We produced a ten-page document with four broad goals, which are: serving our members better, serving the physics community better, serving society better, and then an inwardly focused goal, which is to increase our organizational excellence. Under each of these goals are a number of specific objectives.

How do the development of the strategic plan help shape getting the APS Presidential Line and my fellow operating officers on board. Barry Barish, who was APS President in 2011, was very supportive of devoting considerable time to discussions between the Executive Board and the APS staff, which formed the basis of the Strategic Plan.

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“We’re all sitting at the edge of our seats with what’s going to hap- pen there… We expect discovery, but it doesn’t actually work the way you expect.”

Ngoc Loanh, Fermilab’s new director, on the science coming out of the LHC, The Chicago Tribune, June 29, 2013.

“We see a little lump in the data, so we take more data. The bump gets bigger and bigger, until we know that it could no longer be attributed to random chance.”

Paul Tipton, Yale University, de- scribing the LHC bump recently discovered, ABCNews.com, July 4, 2013.

“What they have done is a major step, because they have been able to provide a much more complete de- scription of what really happens near the black hole singularity using loop quantum gravity… We still don’t have a clear picture of the details of what happens. So it is opening a new door that other people will follow.”


“We don’t often connect what goes on in particle physics laboratories to what goes on in our everyday lives… But that connection is there, and I try to tell my students that it is a very human one, of people doing their best, working their hardest, taking risks and dis- covering something really amazing.”

Volker Rose, Argonne National Laboratory, on using his lab’s par- ticle accelerator to save old du- guewater. The Chicago Tribune, July 15, 2013.

“If the four-quark explanation is confirmed, our entire particle physics zoo will need to be enlarged to include new species… And our understanding of quark taxonomy will have ex- panded into a new paradigm.”

Eric Swanson, University of Pittsburgh, on an unusual particle that was part of an experiment in Ja- pan, and BESIII in China, FoxNews.com, June 19, 2013.

“This is a process that particle physicists have been trying to find for 25 years… It’s a rare process involving a particle with a mass that is roughly 1000 times smaller than the masses of the heaviest particles we are searching for now.”


“As I read the idea of a functioning warp drive remains far-fetched, but the real take-away is in that other part: not so much in re-thinking it—reminding all of us that the urge to explore continues to run deep in our species.”


“So you have vanilla ice cream, you throw it into space—some time later, it turns into chocolate ice cream, or strawberry ice cream… This is a very, very weird phenom- enon.”

Chung Kee Jung, State Univer- sity of New York at Stony Brook, describing how neutrinos change flavors, Los Angeles Times, July 24, 2013.

“We need different people in Congress… Congress is a place that’s filled with lawyers. Now the law is an honorable profession, but professors are trained to argue and trained to dispute facts. What we need are people who work with facts.”


This Month in Physics History

Lord Rayleigh and the Discovery of Argon: August 13, 1894

“A searcher obedient to truth,” he found a truth he was not searching for.

Ed. Note: This column has been contributed by guest columnists. For Names: Williams, John William Strutt, Ronald Williams, John Strutt, Robert William Strutt; for Sources: The Chicago Tribune, Los Angeles Times, The Associated Press, ABCNews.com. Enjoy.

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Stamatis Krimigis, John Hopkins University, on recent unexpected readings from the Voyager 1. The Los Angeles Times, June 27, 2013.

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Abhay Ashtekar, Pennsylvania State University, on making new developments in using loop quantum gravity. NBCNews.com, July 12, 2013.

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“A searcher obedient to truth,” he found a truth he was not searching for.
As a physics PhD candidate at North Carolina State University specializing in physics education, I love to see how people teach and learn science, especially in other countries and cultures. The US-Brazil student exchange program—sponsored by APS and the Sociedade Brasileira de Física—immersed me in an exploration of Brazilian education at the secondary and university level, while I shared information about American educational innovations.

In May of 2011, another APS travel grant sponsored my trip to India to survey and interview women about studying and working in science. I enjoyed talking to students, women and high school teachers so much that I sought out the opportunity to collect similar data upon my return to North Carolina. There were remarkable similarities in the stories I heard, but the differences were intriguing. I decided to go to Brazil to add another dimension to the Senate resolution data, not assume continuation of sequestration and provide a total of $1,058B for discretionary spending, $552B for Defense and $506B for Non-Defense, both slightly above the BCa caps.

I have also compiled a small portion of the student's data upon my return to North Carolina.

As in the US, Brazilian women are dramatically outnumbered in the natural sciences. Recently, a couple of professors have been volunteering to develop programs to interest women in these fields, despite minimal outside support. At UnB, I also met with the relatively new physics education group. They develop teacher-training programs, connect schools to community resources and engage students in research projects, mostly at the secondary level. They have also compiled over a hundred hand-made experiments and demonstrations as a physics-learning lab for visitors. BRAZIL continued on page 6

Disagreement over the budget resolution, which by law Congress must pass, highlights the ideological divides. The Resolution is supposed to establish spending priorities by government function and provide a top-line overall budget number that dictates total appropriations for the coming year. Unable to agree on a common Resolution this year, the House and Senate have adopted dramatically different budget plans. The House Resolution provides a total of $966B for discretionary spending, consistent with the 2010 Budget Control Act (BCa), assuming continuation of across-the-board sequestrations for FY14. But the House Resolution provides more money for Defense ($552B) and less for Non-Defense ($414B) than the BCa stipulates. By contrast, the Senate Resolution does not assume continuation of sequestration and provides a total of $1,058B for discretionary spending, $552B for Defense and $506B for Non-Defense, both slightly above the BCa caps.

The debate over federal spending is about both top-line numbers and how those numbers are distributed. For example, President Obama requested and Senate appropriators have proposed $5,152B for the Department of Energy Office of Science. The full House has approved only $4,853B, a difference of almost $500B, which alone would make it difficult to confront the bills. But House spending for Fusion is $50B higher than the Senate, while the Senate plan includes $300M more for Basic Energy Sciences than the House has approved. Furthermore, the House would eviscerate ARPA-E, reducing it to only $56B as compared to the Senate which would fund ARPA-E at $379M. The House would also reduce funding significantly to Energy Efficiency and Renewable Energy (EERE), cutting it back to $826M whereas the Senate would fund EERE at $2,280M.

Congress pushes back against STEM-Ed realignment

The House Appropriations Committee’s realignment of STEM-Ed programs. Both chambers of Congress have included language in appropriations that severely limits the STEM-Ed realignment, and in some cases, forbids parts of it. The Senate explained, “The President’s budget was based on the administration’s proposal to reauthorize the ESEA [Elementary and Secondary Education Act, more recently known as The No Child Left Behind Act], but no such bill has passed the Senate. As a result, programs in this account are based generally on current law, as authorized under the ESEA.” The result is significant confusion. Many programs slated for cancellation or consolidation under the President’s Budget request stopped taking grant proposals at the direction of the administration. Congress is now directing those programs to continue as before, while giving some leeway to internal reorganization. An unfortunate result may be that at year’s end, there will be a lot of unspent STEM-Ed money that will be returned to federal coffers and applied to deficit reduction.
Physics History and the Department of Terrestrial Magnetism

I was pleased to see the headline “APS Honors Vera Rubin and Kent Ford at Carnegie Institution” in the July APS News. On more than one occasion, I have the pleasure of meeting Vera Rubin, who represents astrophysics in a fashion all can aspire to. Michael Turner’s presence at a place where the existence of dark matter got an early nod makes perfect sense both in his role as APS President and as a distinguished astrophysicist and cosmologist.

Turner contributed some remarks on pp. 8-9 of the September 2008 issue of Physics Today about the work of my father, Ralph A. Alpher, together with Robert C. Herman, and George A. Gamow in the 1940s. The article bore the catch title “From abg to Precision Cosmology: The Amazing Legacy of a Wrong Paper,” but in fact it recognized the beginning of modern precision cosmology on April 1, 1948 with the first publication emerging from Alpher’s dissertation on nucleosynthesis. Few citing the Alpher-Bethe-Gamow letter to Physical Review recognize just what it is, or where it came from. In the addition of Hans Bethe’s own words to his treatise “De Mutu Corporum in gyrum,” and the rest is history.

Incidentally, Mordechai Feingold in “The Neutronium Moment” (Oxford University Press, Oxford 2004), pp. 29-30 writes that it was “probably” Hooke’s suggestion to Halley. Newton, as Hooke had already told Hooke some three years earlier that he knew that the shape of the orbit in an inverse-square force field was an ellipse. It appears that Newton could have won Sir Christopher Wren his prize almost over three years before it was proposed!

Lior Burko
Huntsville, AL

I hope to make a bridge among physics teachers, and many other citizens and cosmologists. This is noted by prominent historians of physics including Helge Kragh and Stephen G. Brush, among others. I urge anyone interested in this history to read Turner’s short article, Alpher and Herman’s accounts, or one of my recent publications (e.g., V.S. Alpher, “Ralph A. Alpher, Robert C. Herman, and the Cosmic Microwave Background Radiation,” Physics in Perspective, 2012, 14, 300-334). Ralph Alpher published, along with colleagues at the Johns Hopkins University Applied Physics Laboratory (JHUAPL), the first estimates of the temperature of the Cosmic Microwave Blackbody Radiation (Nature, 1948, 162, 774; Physical Review, 1949, 75, 1089).

This work was done independent of Gamow, who opposed the concept theoretically but did publish an estimate himself in 1953. JHUAPL had been the administrative arm of DTM from 1942 through 1945. DTM helped Alpher get his start in applied physics. Herman joined JHUAPL in 1942, Gamow, a consultant to the Navy’s Bureau of Ordnance during the war, as was Alpher, passed through the doors at DTM and JHUAPL many a time.

The Department of Terrestrial Magnetism (DTM) deserves much broader recognition. In 1940 President Roosevelt authorized the establishment of the National Defense Research Committee (NDRC), headed by Vannevar Bush. Ralph A. Alpher was at the time working at the Carnegie Institution of Washington (CIW) and assigned to the Department of Terrestrial Magnetism under Scott Forbes. They were analyzing geomagnetic data gathered from around the globe. Suddenly, everyone was working for the NDRC under the Office of Scientific Research and Development, which had the task of bringing applied technology up to the level of eventual adversaries Germany and Japan.

There was not a moment to lose in this effort, and DTM, with its wartime development efforts headed by the late, the epicenter not only of recruiting and hiring the best scientific and technologists from across the country under the cloak of secrecy, but also of the early development of new methods in naval degrading and one of the first “smart bomb” known as the proximity fuze, which made its debut in January, 1943 in the USS Helena’s anti-aircraft guns. After deployment, it neutralized most kamikaze attack on naval vessels. Deployed finally by the Army in the Ardennes, the proximity fuse helped turn back Hitler’s last, desperate offensive.

The work at DTM made a decisive difference in the outcome of the war as recognized by the plaudits given the work done there by Secretary of the Navy the James Forrestal, General George S. Patton, Admiral George Hussey, Jr. and others.

The DTM has often been at the forefront of scientific work, whether it be pure science, science in the public interest, or science applied to national defense. The Department itself maintains a finding aid of more than a century of magnifi cent achievements that would rival any academic research university (Department of Terrestrial Magnetism General Files, 1904-Present, Carnegie Institution of Washington, D.C.) and as a distinguished astrophysicist, history, but also of the early development of new methods in naval degrading and one of the first “smart bomb” known as the proximity fuze, which made its debut in January, 1943 in the USS Helena’s anti-aircraft guns. After deployment, it neutralized most kamikaze attack on naval vessels. Deployed finally by the Army in the Ardennes, the proximity fuse helped turn back Hitler’s last, desperate offensive.

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Physics History and the Department of Terrestrial Magnetism
In late July, 22 physicists convened at APS headquarters in College Park to sort abstracts for the upcoming meeting of the Division of Plasma Physics. In the photo, Nikolai Gureenko from Princeton Plasma Physics Laboratory (left) converses with Mark Koepke of West Virginia University (center) and colleague Igor Kagarov from PPPL. The DPP meeting will take place in Denver, November 11-15.

Photo by Michael Lubella

Winners Selected in APS-Middle School Science Program

APS has announced the winners of this contest. The Physics Quest competition for middle school students. Taking the grand prize is Robert Capanna’s fourth-period class at the Kenton Area Intermediate School in Vandergriff, Pennsylvania. The class won an assortment of physics gear from APS, and a $500 gift certificate. The class, which is described as the school’s scientific education, has increased their knowledge in their ability to teach physics concepts as well as enthusiasm on the part of their students.

By Michael Lubella

The APS Committee on Education, in a new effort to promote a set of science standards aimed at bringing some uniformity to the patchwork of standards adopted by states, has been working to develop national standards. The committee is made up of representatives from 26 state boards of education across the country. The committee has been working on the physics content of the Next Generation Science Standards (NGSS), and voted to encourage states to adopt them.

The standards were in part inspired by the Common Core set of standards in mathematics and language arts, which have been adopted by more than 40 states. The science standards were first released in April and so far three states have adopted them while others are in the process of considering them.

“My guess is more than half of the states will have adopted the standards in a couple of years,” said Louis N. Butts, who chaired the National Research Council’s Board on Science Education which helped author the standards.

“Expectations” that students should be able to achieve. Such expectations “standards are and what they are not,” Quimby said.

The aim of the standards is to set a minimum bar for students to understand the scientific process after graduating from high school. The standards are not for students who have taken a physics-specific course, as many students don’t have the resources to study two or more years of basic science.

Textbook manufacturers in particular have been supportive of the effort because it is easier to print textbooks that conform to a broad standard than to the amalgam of disparate state standards that exists today.

There are many ways in which scientists working with teachers helped the implementation phase,” Quinn said, adding that the APS involvement in teacher training is one way that the Society can help states adopt the standards. “Adoption is one step; implementation doesn’t happen overnight.”

The new standards have historically been a controversial idea. Oftentimes state boards of education object to the idea of having a federal authority involved in their curriculum.

“We’re not trying to preach to students, we’re asking them to evaluate the evidence.”

Though the physics community has generally supported towards the standards, some Concerns have been raised within the physics community. “We don’t have the experience to be a ‘punch bag for conservatives’ even as they use the resources for political purposes such as public polling.

For more information, log on to the APS Public Affairs website: http://www.aps.org/policy/
What I saw at UNB made me re‐ alize the ingenuity of individuals who wanted to share their love of science without many resources or opportunities. What I observed is that improving education is only starting to become a priority for the Brazilians.

I visited the private American School of Brasilia to see the “best‐case” scenario of high school education. Students, complete with uniforms, felt like a SCALE‐UP classroom. Students worked in groups to collaborate, consider problems on whiteboards, and present results to classmates. Unfortunately, active and collaborative learning is not as common in Brazil, especially in public schools, because financial resources are tight and often, teachers are not trained in methods that are true even back in 1950, when Richard Feynman complained about the shallowness of education. Therefore, foreign students could only recall facts, not apply information.

Kids have to do more than memorize informa‐ tion to be innovative, productive members of today’s workforce, perhaps needless to say anymore. The University of Sao Paulo (USP, South America’s biggest university) ap‐ proached us to implement SCALE‐UP’s minimal lecture, technology-rich, highly collabora‐ tive approach. I wanted to make sure we could implement it and also use this reformed pedagogy and classroom design. SCALE‐UP has been spreading rapidly (cur‐ rently serving over 200,000 students worldwide) and Andre Vieira had been inspired to try it at USP after talking to a collaborator at Duke University.

Sao Paulo’s 12 million resi‐ dents make it the biggest city in Brazil and one of the most di‐ verse, blending indigenous, Af‐ rican, European and Asian heri‐ tages. Sao Paulo actually contains a larger population of Japanese people outside of Japan. I asked if ethnic diversity provided moti‐ vation for adopting SCALE‐UP, since at NC State it significantly reduced failure rates for women and other traditionally underrep‐resented groups. But Brazilians are more concerned with handling differences in economic back‐ grounds. I was assured that they knew especially after recent affirmative action efforts. Universities are re‐ quired to accept a certain percent of students from public schools, which historically pro‐ vide a notoriously poor education; thus the preparation of students.

My last meeting was with the Chemistry Education Group at Brazil’s largest federal University in Rio de Janeiro (UFRJ). The disparity between rich and poor is especially apparent in Rio, a city notorious for its criminal enterprises. Educating these students is a chal‐ lenge, since many struggle with drugs, gangs, and lack of food and housing. The Chemistry Education Group has rapidly expanded its facilities to include computer labs and science labs for students whose schools can not afford these supplies, and their outreach efforts keep growing.

Overall, Brazil and the United States face similar challenges as large, diverse countries trying to stay competitive in an increasing global economy. The opportunity to share dialogue with Brazilians in a variety of po‐ sitions about educating the next generation of scientists and en‐ gineers. I expect these collabora‐ tions to last a lifetime—I am work‐ ing with my UNB host on a paper and Andre Vieira from USP came to visit my University to see SCALE‐UP in action. Every time I said goodbye to someone in Brazil, they wanted me to promise to come back. I hope I will be able to return.

Kathleen Foote is a physics PhD candidate in the Physics Education Research Group at North Carolina State University.

BRAZIL continued from page 3

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I visited the private American School of Brasilia to see the “best‐case” scenario of high school education. Students, complete with uniforms, felt like a SCALE‐UP classroom. Students worked in groups to collaborate, consider problems on whiteboards, and present results to classmates. Unfortunately, active and collaborative learning is not as common in Brazil, especially in public schools, because financial resources are tight and often, teachers are not trained in methods that are true even back in 1950, when Richard Feynman complained about the shallowness of education. Therefore, foreign students could only recall facts, not apply information.

Kids have to do more than memorize informa‐ tion to be innovative, productive members of today’s workforce, perhaps needless to say anymore. The University of Sao Paulo (USP, South America’s biggest university) ap‐ proached us to implement SCALE‐UP’s minimal lecture, technology-rich, highly cooper‐ ative approach. I wanted to make sure we could implement it and also use this reformed pedagogy and classroom design. SCALE‐UP has been spreading rapidly (cur‐ rently serving over 200,000 students worldwide) and Andre Vieira had been inspired to try it at USP after talking to a collaborator at Duke University.

Sao Paulo’s 12 million resi‐ dents make it the biggest city in Brazil and one of the most di‐ verse, blending indigenous, Af‐ rican, European and Asian heri‐ tages. Sao Paulo actually contains a larger population of Japanese people outside of Japan. I asked if ethnic diversity provided moti‐ vation for adopting SCALE‐UP, since at NC State it significantly reduced failure rates for women and other traditionally underrep‐ resentated groups. But Brazilians are more concerned with handling differences in economic back‐ grounds. I was assured that they knew especially after recent affirmative action efforts. Universities are re‐ quired to accept a certain percent of students from public schools, which historically pro‐ vide a notoriously poor education; thus the preparation of students.

My last meeting was with the Chemistry Education Group at Brazil’s largest federal University in Rio de Janeiro (UFRJ). The disparity between rich and poor is especially apparent in Rio, a city notorious for its criminal enterprises. Educating these students is a chal‐ lenge, since many struggle with drugs, gangs, and lack of food and housing. The Chemistry Education Group has rapidly expanded its facilities to include computer labs and science labs for students whose schools can not afford these supplies, and their outreach efforts keep growing.

Overall, Brazil and the United States face similar challenges as large, diverse countries trying to stay competitive in an increasing global economy. The opportunity to share dialogue with Brazilians in a variety of po‐ sitions about educating the next generation of scientists and en‐ gineers. I expect these collabora‐ tions to last a lifetime—I am work‐ ing with my UNB host on a paper and Andre Vieira from USP came to visit my University to see SCALE‐UP in action. Every time I said goodbye to someone in Brazil, they wanted me to promise to come back. I hope I will be able to return.

Kathleen Foote is a physics PhD candidate in the Physics Education Research Group at North Carolina State University.
We would prefer people to find - question is how,” said APS Treasurer and a government server akin to non-governmental repositories the publishers’ websites, other OPEN ACCESS continued from page 1 similar to those already main had two parts. The first dealt with Researchers from the Niels Bohr ed that he particularly liked the experimental physicist in the nice to think that I’m the best students were given solar identical phenomena. Rayleigh’s diligence chemistry brought all to light. Let Newton be! and all was light.” “energy,” as in the “erg” of physics. Rayleigh and Ramsay each received the Nobel Prize in 1904, for Physics and Ramsay for Chemistry.

OLYMPIANS continued from page 3 of the High Technology High School in Linwood, New Jersey. This was his second time competing at the Olympiad, and he placed fifth overall. “The test is not the big emphasis.” The students were treated to trips to local museums and historial sites around Copenhagen. Researchers from the Niels Bohr institute came to speak and the Olympiad participants.

Calvin Huang from Gunn High School in Palo Alto, Califor- nia, placed first overall in the experimental competition, which had two parts. The first dealt with the speed of light, and in the sec- ond, students were given solar cells and a related series of questions. “I feel quite good about it. It’s nice to think that I’m the best experimental physicist in the world,” Huang quipped. He add- ed that he particularly liked the last question dealing with solar cells, which asked the students to determine water’s index of re- flection by measuring the change in current when a container of water is placed between the solar cell and the light source.

Stanley said he felt that over the last five years Olympic questions had gotten more cre- or, indeed, “atom.” The “ergon” is, as in the “erg” of physics.

Through the Brazil-U.S. Physics Graduate Student and Postdoc Visitation Program, U.S. and Indian graduate students and postdocs may apply for travel grants to pursue a breadth of opportunities in physics.

This program is sponsored by the Sociiedade Brasileira de Física (SBF) and APS.

The deadline for U.S. applicants traveling to Brazil is Friday, 11 November 2013. http://www.aps.org/international/programs/brazil.cfm

Information for Brazilian applicants: www.sbfisica.org.br/v1/
The Role of Physics Departments in High School Teacher Education

By David E. Metzler, Monica S. Storch, and Stanislaw Volk

Physics departments with a physics teacher education (PTE) program

1. The impact of pre-college science education on the physics community

The US physics community has become habituated—perhaps unconscious—to pre-college science education system that is relatively weak by international standards. Several studies have confirmed that, when comparing equivalent student populations, US science students rank no better than middle-of-the-pack in terms of subject performance, and indications are that physics students rank even lower. There is no great mystery regarding the cause: pre-college students in the US are not as well prepared in physics as are many of their foreign counterparts. Data show that students who elect to major in physics have been shrinking: the number of physics bachelor’s degrees awarded in 2010 was virtually identical to that in 1970, even though the overall number of bachelor’s degrees had more than doubled. Among the consequences of this shrinking proportion are that physics graduates receive less effective training as science educators to eliminate the physics major from “lower producing” departments. While there are many factors behind the low and declining proportion of physics majors, there can be little doubt that pre-college science education has a significant influence. Several studies have shown that students’ decisions to major in science fields, including physics, are usually made well before their departure from high school. Moreover, college students who receive inadequate physics preparation in high school are at a disadvantage when trying to complete a standard physics major at the university level. Studies have also shown that US students beginning undergraduate work are not as well prepared in physics as are many of their foreign counterparts.

Many physics faculty are aware that, among US physics PhD graduates, US citizens are outnumbered by foreign citizens. An important contributing factor is that the number of US citizens who go on to physics graduate studies tends to follow trends in the number of physics majors; fewer majors mean a smaller pool to fill openings for graduate students. One might argue that there is no problem so long as foreign citizens are available to fill gaps left by domestic students. However, the supply of foreign graduate students is not as well prepared in physics as are many of their foreign counterparts.

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2. The role of physics departments

Physicists tend to regard the situation of weak pre-college science education in the US with some resignation, believing it is not their job to deal with this situation directly, nor that it has any significant impact on the effectiveness of their own work or on the physics community. To the contrary, we argue, it does have an impact, and—while it may not be their “job”—university physics faculty bear some responsibility for the causes of and the potential remedies for this unsatisfactory state of affairs. For one thing, university physics departments must ensure that the physics major is a suitable place to prepare students for teaching careers, and this requires physics faculty to provide special preparation for physics teachers, nor provides specialized preparation for physicists teaching courses from inspirational, knowledgeable teachers before they even began university study. Moreover, at the high school level, the need for more, better prepared STEM teachers, a physics department that aligns itself with such institutional and national priorities is likely to upgrade its perceived value both within the university, and within society as a whole.

We believe that physicists and physics departments are capable of addressing the problem of high-quality physics teacher education quite effectively. Indeed, there are physics departments that graduate relatively large numbers of teachers from excellent programs; some of these are indicated by the outliers in the histogram distribution (see figure). The T-TEP recommendations for physics departments center on (i) developing strong pre-university programs for cultivating early physics teaching experiences under expert mentorship, and (ii) developing special courses focused specifically on physics pedagogy. We envision a very different situation, one in which many physics faculty are actively engaged in the education of future teachers. Many of these physics departments would partner with expert practicing teachers to provide students with diverse role models of high-quality physics teaching, and together they would mentor bright students who sought careers as physics teachers. As a consequence, increasing proportions of high-quality physics teachers would be preparing physics courses from inspirational, knowledgeable teachers before they even began university study. Moreover, at the high school level, the need for more, better prepared STEM teachers, a physics department that aligns itself with such institutional and national priorities is likely to upgrade its perceived value both within the university, and within society as a whole.

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