Battling the Emperor of Maladies

By Gabriel Popkin

2016 APS March Meeting

From modeling the biomechanics of brain development to improving neuroimaging techniques to processing and analyzing the data from studies using those techniques, physics expertise is urgently needed in all areas of neuroscience, presenters at the 2016 APS March Meeting said. They urged physicists to get involved.

The potential reward is a deeper understanding at one of science’s biggest frontiers — the few-pound lump of grey matter that makes us who we are, yet whose function is not accessible in nature, to construct quantum computers. "I think there is a great vista ahead," Rey said. "These atomic systems are offering the possibility to see very exotic behavior."

Xiaowei Zhuang of Harvard University discussed methods for seeing the very small. Her group developed the method of stochastic optical reconstruction microscopy (STORM), which can image structures smaller than the diffraction limit that is set by the wavelength of light.

In traditional optical microscopy, objects smaller than a few hundred nanometers will show up as a blur in standard microscope images, thanks to diffraction. Zhuang and others seized on the possibility to see very exotic behavior.

KAVLI continued on page 7

Physicists, the Brain is Calling You

By Emily Conover

2016 APS March Meeting

The initiative represents a major challenge for neuroscience has been the kind of science that physicists said Fidel Castro Díaz-Balart — the son of Cuban revolutionary Fidel Castro — at a session at the 2016 APS March Meeting on physics in Cuba.

The country is also strong in subjects, from quantum simulation, to constructing quantum computers. "I think there is a great vista ahead," Rey said. "These atomic systems are offering the possibility to see very exotic behavior."

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Physicists Prospects in Cuba

By Emily Conover

2016 APS March Meeting

The historically icy relationship between the U.S. and Cuba has begun to thaw, making scientific collaboration between the U.S. and its southern neighbors more feasible, thanks to eased constraints on travel and the loosening of certain financial restrictions. In December 2014, President Obama announced that the U.S. and Cuba would work to normalize relations, and this March, President Obama visited Cuba — the first visit by a sitting U.S. president in almost 90 years.

The U.S. embargo of Cuba, which has been in place for more than 50 years, has made doing science in the country a challenge, said Fidel Castro-Díaz-Balart, the son of Cuban revolutionary Fidel Castro — at a session at the APS March Meeting on physics in Cuba.

In spite of the conditions, scientists in Cuba have honored the country. Now, Castro-Díaz-Balart said, "The normalization of relations with the United States certainly will provide grounds for improving the conditions in the research in the field of physics, because we had a lot of problems to acquire the newest technology in the labs and to train our undergraduate and postgraduate students."

Cuba is home to around 1800 physicists, said Castro-Díaz-Balart. Around two hundred of those physicists have Ph.D.s — with the majority in solid-state physics and nuclear physics — and around 800 physicists are active in research.

Castro-Díaz-Balart is himself a physicist; he earned his Ph.D. from the Kurchatov Institute in Moscow. He is the vice president of the Cuban Academy of Sciences, and serves as scientific advisor to the state council of Cuba.

Cuba’s scientific strengths lie largely in biotechnology and the medical and pharmaceutical sciences, said Castro-Díaz-Balart. The country boasts six doctors for every thousand inhabitants, and the population has a life expectancy similar to the United States. Cuban scientists have developed vaccines against hepatitis B and meningococcal meningitis B and C, and other drugs, including a treatment for diabetic foot ulcers. And Cuba’s Pedro Kouri Institute of Tropical Medicine has worked on the front lines in efforts against diseases like Zika, dengue and Ebola.

The country is also strong in the nuclear sciences. In the 1980s, the country worked toward establishment of a nuclear power plant. However, the U.S. embargo eventually forced Cuba to abandon these plans. Since then, nuclear research in Cuba began to be redirected to non-energy applications, including medical physics and theoretical nuclear physics.

Cuban physicists are involved in a number of international collaborations, at the ALICE experiment at CERN, with the Joint Institute for Nuclear Research in Dubna, Russia, and the International Kavli Session Speakers Discuss Physics Frontiers

By Emily Conover

2016 APS March Meeting

Each year during its Kavli Symposium, the APS March Meeting features speakers from the forefronts of their fields. The 2016 symposium showcased a broad range of topics, from super-resolution microscopy and its biological applications, to the precise formation of liquid droplets, to the detection of gravitational waves.

Ana Maria Rey of JILA and the University of Colorado Boulder discussed her work with ultra-cold atoms, including atomic clocks that use alkaline earth atoms such as strontium. Rey’s work helped to improve the timing of atomic clocks from formed from atoms trapped in an optical molasses, enabling scientists to understand and control the interactions that occur between atoms in such clocks, which can degrade their precision.

Rey’s research also spans related subjects, from quantum simulation, to forming new materials that are not accessible in nature, to control the interactions of these systems. "I think there is a great vista ahead," Rey said. "These atomic systems are offering the possibility to see very exotic behavior."

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Inside APS
Ken Cole, Corporate Secretary

In this series of articles, APS News sits down with APS employees to learn about their jobs, their goals, and the things that make them tick. This month we chat with Corporate Secretary Ken Cole. He discusses the APS corporate governance and how his role has changed under last year’s corporate reform. We asked the corporate secretary to do?

The corporate secretary basically is responsible for anything governmental in dealing with the various committees—which of course includes the Board of Directors, the Council of Representatives, and most of their subcommittees, most importantly the Board Executive Committee and the Council Steering Committee. And just being the administrative support and the person who helps keep them together and keeps them moving.

This title was created during the APS corporate reform. How is it different from your previous role?

I’ve been telling people 95 per cent of it is old and 5 percent is new. My previous title was special assistant to the executive officer, and most of that transferred over to the corporate secretary. But the Council Steering Committee and the Board Executive Committee are new, so that’s a little bit of additional responsibility.

Why did your title change?

For us to become incorporated, the DC law required us to appoint a secretary as a corporate secretary to do the things that I was already doing, but I just didn’t have the title. So now we’ve fulfilled that requirement.

What kind of things do you do to help the different committees?

That includes working with the chairs—or whoever’s in charge of the meeting—to work out agendas, to record minutes, and to make sure that any action items are followed up on, coordinating closely with the committees.

What work do you do with APS elections?

The general membership election starts with the Nominating Committee. My role includes getting the Nominating Committee together, collecting nominations from the membership, giving the committee historical information so they know who has run, who has been elected, so they’ll have all that background. Once they meet and produce a slate of candidates, their job is pretty much done, and I carry on by contacting the candidates, getting their biographical information, setting up the actual election, and running that. And then afterwards, in conjunction with the CEO, contacting the winners and getting them oriented and ready to do their jobs.

Do you have any resources for members who are interested in APS governance?

All of our governing documents are up on the website. We have meeting minutes that go all the way back to when I first started using the job; they go back to 2000. All of our Board and Council meetings are open to APS members except when the meetings go into executive session.

We have an annual business meeting now, under corporate reform we’re required to have that. We had one last year, and we’re organizing the second one now. It will be at the 2016 April Meeting. People are encouraged to attend in person, but we are also streaming it live, and we are taking live questions. It will be recorded and posted; in fact the 2015 meeting is currently posted and the 2016 meeting will be afterwards.

How long have you been at APS?

I’ve been at APS 21 ½ years. When I came to APS I was the administrator for prizes and awards. I did that for six and a half years, and then I started working for former Executive Officer Judy Franze, in the role I have now.

Have you liked it?

It’s been wonderful. I have had the chance to work in any aspect of the society. I’ve been involved in all the different committees, all aspects of the society, and I have been happily surprised with the possibilities that this job offered me—inspired young Peter to pursue similar scientific interests. He proved an apt pupil, ranking at the top of his class for all six years he studied at the Edinburgh Academy, with a strong proficiency in mathematics. Among his classmates was James Clerk Maxwell; their paths would continue to cross for the rest of their lives. After a period teaching at Queen’s College, Tait went on to study at the University of Edinburgh, although he transferred to Trinity College, Cambridge, the following year. He graduated with top honors and received a college fellowship, becoming a Peterhouse Fellow, coaching undergraduates and writing a textbook, Dynamics of a Particle, with his colleague William Steele. In 1854, he became a professor at Queen’s College, but he did not take his new job; they go back to 2000. All of our Board and Council meetings are open to APS members except when the meetings go into executive session.

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Inside the Beltway

Mandatory Science Spending: What’s That?

By Michael S. Lubell, APS Director of Public Affairs

A week before President Obama released his budget request for the coming fiscal year, the White House leaked word that his plan would include mandatory science spending. My first reaction was, "Huh?" By the time the Administration rolled out the budget on February 9, I was well aware that the plan that the White House considered was pretty much a gimmick. Boxed in by the two-year budget ceiling, the plan was designed to last to fall last with congressional Republicans, the president wanted to make a statement about urgent need for science funding.

He knew that Congress would never agree to put any portion of science spending on a par with mandatory programs, such as Social Security and Medicare. These programs are funded by the payroll tax and untouchable by the normal annual appropriations process. He was simply setting down a marker and laying the groundwork for future discussions over science spending for a future president at a future date.

The science budget rollout, in which the White House held the headquarters of the American Association for the Advancement of Science, confirmed my suspicion. In response to a question from Science journalist Jeffrey Mervis, the President’s science adviser, John Holdren, and OSTP analyst Kei Koizumi indicated that the president tried to circumvent the need for a consensus on science spending by adding mandatory spending for science – and that was the same answer Jeff had received the same moment earlier.

The principal purpose of the announcement was to make a point: that science is the underpinning of our national security. It is a serious rationale for assigning a higher priority to science. The president tried to circumvent the special interest-lobbying-gimmick. Boxed in by the two-year budget ceiling, the plan was designed to last to fall last with congressional Republicans, the president wanted to make a statement about urgent need for science funding.

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BRAIN continued from page 1

gather images from more than a millimeter deep in a mouse brain. Since the announcement of the initiative, federal investment has increased severalfold, with the National Science Foundation and the National Institutes of Health each contributing about $150 million in 2016, and other agencies putting in smaller amounts. "It is not that our federal private foundations are partnering with the federal agencies, collectively contributing more than $300 million in 2015, according to data Chum showed. With the influx of funding, Chum said, "I think the physics community is taking the opportunity for really solving these complex questions."

States of mind

Molecular biologist David Tank of Princeton University, who early in his career helped Hopfield develop neural network theories, described the meeting as "a gimmick, but in reality he has opened the door to a discussion on something far more substantive."

When plasma physicist Andrew Zwickler ran for a seat in the New Jersey legislature last fall, he was fighting the incumbent, Donna Simon, 16,308 to 16,230.

In 2012, the Obama campaign successfully ran a similar strategy on a larger scale. The technique, known as micro-targeting, aims a candidate’s messages at narrowly defined segments of the population, even tailoring communication to individual voters. Until recently, such modeling has been out of the reach of all but the largest campaigns, but now small, well-funded, experiments, are gaining traction.

Zwickler was facing an uphill battle, running as a Democrat in New Jersey’s 16th district, which had voted Republican in 2012 and 2010.

The model that was used was a “turnout” score representing the probability that a person would show up at the polls on election day.

To most effectively reach out to the district, the campaign tailored its communications effect according to these scores. Voters with a high support score and a low turnout score might be contacted by a volunteer encouraging them to vote, while voters that the model predicted would not vote on election day were not on the fence about whom to vote.

The emphasis on neuroscience at this year’s March Meeting resulted partly from organic growth in the field, but also from the recent election of Ilya Nemenman, a biophysicist at Emory University, who as incoming Division of Biological Physics chair oversaw the division’s meeting programming. "Computational neuroscience in some sense started here," said Zwicker, "and then people migrated out to neurosciences," he said. "We made the decision a couple years ago to make this meeting about bringing physical scientists back."

"I think of one impact this has will be to have us get to know what is still unknown about how the brain works," he added, "and actually tell them that now you can use that sort of training to solve the brain.”
A Medley of Metamaterials

By Emily Conover

Metamaterials — specially designed, structured materials with counterintuitive properties — can do things that are the most dramatic are “invisibility cloaks” that hide objects by steering light around them. Another kind of such material, known as a mechanical metamaterial, is structured to tweak mechanical behavior rather than optical properties, producing results that are clear, albeit, Younger, for example.

The weird substances were the topic of several sessions at the 2016 APS March Meeting. Researchers drew inspiration for Ahmed Elbanna of the University of Illinois Urbana–Champaign. He designed a material, thanks to destructive vibrations within certain frequency band gaps, changed the origin shape once they are stretched, and allows waves through without being disturbed. How the system could be toward creating one-dimensional waveguides, Naseh said. And, since these types of optical properties are more well known in quantum dimensional material, but as a two-dimensional material you can create surface roughness that’s variable as a function of the stretch.” Such structures could be formed from a variety of materials and in a range of sizes, and the corruga- tion can be tuned by modifying the ratio of the stiffness between the two different materials. The material can also be layered, using different patterns of stiff reinforcements to obtain different results, including creating small channels in the material, or corrugation shaped like egg cartons. These metamaterials, inspired by patterns in Islamic art, expand in both directions when stretched, and stay locked in their stretched position.

By layering graphene with a polymer, it is possible to make a material that becomes corrugated when it gets thinner — it shrinks in the spinning direction of the gyroscope, which interacts with one dimensional material, but as a two-dimensional material you can create surface roughness that’s variable as a function of the stretch.” Such structures could be formed from a variety of materials and in a range of sizes, and the corruga- tion can be tuned by modifying the ratio of the stiffness between the two different materials. The material can also be layered, using different patterns of stiff reinforcements to obtain different results, including creating small channels in the material, or corrugation shaped like egg cartons. These metamaterials, inspired by patterns in Islamic art, expand in both directions when stretched, and stay locked in their stretched position.

So what’s the next frontier in metamaterials? It’s probably the most familiar, according to Icai Cohen of the Technion. “The principle of origami metamaterials, which are folded and unfold in complex patterns. “You can make very com- plicated patterns with origami,” said Cohen. And importantly, he noted, it is scalable, so the rules of origami remain the same on the smallest scales. So Cohen focused on the thinnest sheets available: gra- phene — a one-layer-thick sheet of carbon atoms.

“We want to start thinking about graphene not just as a two- dimensional material, but as a two-dimensional material that you can build things out of in 3D,” said Marc Miskin, a member of Cohen’s research group at the Institute for Advanced Study.

By layering graphene with a thin sheet of glass, Miskin created a material that bends when heated, for example, as the glass and graphene expand and contract in different amounts in response to changing conditions. When Miskin heats up the glass/graphene sheet, it curls up into a tiny helix. “We are interested in the ultimate limit of this technol- ogy,” Miskin said.

vote for, might merit an in-person visit from Zwicker himself. We sent out, every phone call we made, and every door we knocked on was successful, every poll we conducted, which took two weeks. In fact, Zwicker says, he was at the 2015 APS Division of Plasma Physics Meeting in Savannah, Ga., when Celli called to inform him that he won. Zwicker says that the model alone wasn’t enough to tip the outcome; “We worked them to that election — that’s the only reason why I won,” he claims. “All together, we knocked on 22,000 doors; we made 78,000 phone calls; and we sent out many pieces of mail. So the model just guided it.” Zwicker campaigned with the promise that he would use evi- dence to make decisions. When he knocked on doors of vot- ers with this line, Zwicker says, “They would laugh sort of cyni- cally, like ‘good luck with that.’” But, Zwicker says, they voted, although they didn’t necessarily promise to vote for him, said they were intrigued. “That happened over and over again.”

Now, in his first months on the job, Zwicker is sticking with the job. “If I don’t agree with your perspective, I don’t have any one and I have to do what I promised to do — what any good scientist would do,” Zwicker added. “I’d like to stick to our ideology,” Zwicker says. “People respond to that, because they say to me, ‘We may not agree but at least I understand where your position comes from.’”

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Save the date!

The 2017 APS Bridge Program Conference will be held in conjunction with the American Association of Physicists in Education Conference Education College Park, Md., on February 10-12, 2017. More details coming soon.

NMC Conference — October 21 - 23, 2016; Registration Open April 6

The annual National Mentoring Community Conference will be held on October 21-23 at the University of Houston, and will highlight the importance of mentoring and research experiences for undergraduate students. The agenda will include a research experience for undergraduates and a grand mentor conference, workshops for both students and faculty, plenary talks on supporting underrepresented students in physics, a research poster session, NASA tours, and more. NMC mentors and mentees receive special discounted rates and are eligible for travel funding to attend. Visit go.aps.org/nmc-conference to register and learn more.

Industrial Physicists Mentor Young Scientists

When Edward Chen entered graduate school at the Massachusetts Institute of Technology, he planned to go into academia, like many of his peers. By his third year, near the end of his education, he learned that an academic postdoc was far from the only option for a Ph.D. physicist. “The possibilities are enormous,” he says — from working in government to doing research in industry. But, Chen says, the job market is difficult to navigate for students who consider venturing beyond the familiar halls of academia, and he was unsure whether he should start a postdoc, or dive into the private sector. “I’ve sort of been grappling with it since the beginning,” he says, “trying to make sense of what a Ph.D. means, and what you can do with a PhD, and what I wanted to do for the next 5 or 10 years of my professional career.”

Fewer than 20 percent of physics Ph.D.s end up in academic physics, says APS Career Program Manager Crystal Bailey, and more than half of physics Ph.D.s eventually end up in the private sector. Despite that, many students struggle with lack of access to information about industrial careers, says APS Industrial Physics Fellow Steven Lambert, because “they’re surrounded by academicians.”

To address this knowledge gap, APS has created a new program, called Industry Mentoring for Physicists (IMPact). “Students are aware that they won’t all get academic jobs, and many of them don’t want academic jobs,” Lambert says, but “they have no example of what it’s like to work in industry.”

Once connected, the mentor and mentee can proceed however they like — IMPact program guidelines recommend four discussions over three months, followed by phone or video conference. Students can have up to two mentors at a time, and mentors can have up to two mentees.

Since November 2015, APS has gradually rolled out the program to more students. Lambert, a postdoc in the IMPact program by proposing the 2014 APS Workshop on National Issues in Industrial Physics. Thompson is now particularly interested in mentoring.

“When a student connected you asked the question, answered by a fictional teacher who considered venturing beyond the familiar the fictional student. The student’s academic focus was also randomly assigned.

For newbies at the beginning, “I think it’s pretty straightforward,” Hofer says. “Most of the time you needed serious advice, the students needed to have the opportunity to talk to a fellow student who had gone through the process.”

The only exception to this pattern was male German teachers, who graded boys and girls equally. The study’s author, the students, had a statistically significant advantage over the fictional girl, while the boy got a 5.5 for her answer. This bias was selectively decreased with the help of a postdoc who had already worked with teachers who had taught for at least ten years. The students’ academic focus had no influence on the students’ grades. The students’ gender was not known to the grader.

The choice of such an open-ended question, answered by a fictional teacher who won the same answer. “It makes sense that as teachers become more experienced, the bias decreases when their gender bias in student evaluation goes away,” Dasgupta says.

The researchers asked 780 physics students to answer a question, answered by a fictional student. The question was a conceptual Newtonian mechanics problem, which asked students to explain in words what would happen to two skateboarders, each holding one end of a rope, when one skateboarder pulled on the rope.

The choice of such an open-ended question was intentional, says research poster session, NASA tours, and more.

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The cancer swamp

Pienta said the cancer cell can construct a temporary, metastatic barrier resembling a miniature silicone sponge, in which the cancer cells can hide from the immune system. "It is a膜brane that promotes evasion and immune suppression," he said. "That's not something cancer biologists have thought about until very recently, and even then, few experimental approaches have been developed to target this issue."

The cancer swamp idea also makes sense in terms of physics, according to physicist Michael Lesnick, a program director in the NCI's division of cancer biology. "We need physicists to help us understand the physics of this system," he said. "We need to understand how the cancer cell moves through the body and how it interacts with the immune system." The cancer swamp concept could also be important in understanding the behavior of cancer cells in the presence of immunotherapies, he said. The cancer cells might be able to "migrate through the body and escape the immune system," he said. "We need to understand how these cells are able to do that."

In the end, progress will come from the interaction of both fields, he said. "We need to work together to understand the physics of cancer and to develop new treatments."
possibility of beating the diffraction limit by tagging individual molecules and pinpointing the center of a single molecule's blur. Zhuang tagged molecules with fluorescent dyes that can be switched on with light. By turning on a small subset of the dye molecules at a time, she can determine the positions of individual molecules.

“We can not only use the super-resolution approaches to get prettier and sharper pictures, we can actually use that to discover novel cellular structures people didn’t even know existed before,” Zhuang said. Using this method, her group discovered a skeleton-like structure in neurons, made of actin.

David Weitz of Harvard University spoke about his method for making extremely regular liquid droplets. Using new microfluidics techniques, Weitz and his group created precisely sized drops of liquid by forcing them through nozzles and letting them break up into droplets of a selected size. Weitz said.

Duncan Brown of Syracuse University discussed the recent observation of gravitational waves by the LIGO experiment. 1.3 billion years ago, two black holes spiraled around one another, orbiting closer and closer until they violently merged, emitting three solar-mass-worth of energy in gravitational waves. LIGO detected these gravitational waves last September, Brown recalled, just after the upgraded version of the experiment, Advanced LIGO, turned on for the first time. The signal was “absolutely beautiful,” Brown said, and it was easily visible above LIGO’s ever-present background noise. “I did not expect this,” he said.

When one eager physicist asked when to expect a second detection, Brown pointed to the second strongest event reported in the detection paper — a 2-sigma result, which was not significant enough to report as a detection — saying that it “quacks like a duck,” and added, “If you ask me, this little guy here looks like a weak black hole merger.” Either way, Brown said, LIGO is currently analyzing two more months of data, and should have results soon. And LIGO will begin taking more data in late summer or fall. “We won’t have to wait too long,” he predicted.
In the Matter of Minority Physics Students v. Chief Justice Roberts

By Chandradeka Singh

On December 9, 2015, Chief Justice Roberts asked the question “What unique perspective does a minority student bring to a physics class?” during the discussion of a case on affirmative action at the university level. It appears that he chose a physics class because he felt that this discipline definitely does not need diverse perspectives. As a female physicist who has been teaching at the University of Pittsburgh for two decades, I feel that the Chief Justice’s question suggests a lack of familiarity with urgent issues in education that must be addressed by U.S. policymakers.

The question first implies that it is the perspective of the minority student that is the critical feature rather than the presence of the minority student in the physics class. We need to attract minority students to disciplines that need their talents. Currently, approximately 20 percent of undergraduates and Ph.D. students in physics programs across the U.S. are females, which is significantly lower than the percentage in many European and Asian countries. What is perhaps more alarming is that only about 9 percent of physics undergraduates and Ph.D. degrees are awarded to students from underrepresented races and ethnicities. According to the AIP Statistical Research Center, while the number of students obtaining a bachelor’s degree in physics increased by 58 percent from 2003-2013, the decrease for the African-American students was only 1 percent [1].

In addition, the minority population is projected to become the majority in the U.S. in a few decades. The students from the first generation are often from economically disadvantaged families, who are often denied the opportunities to get ahead that children from families without economic concerns typically receive. Moreover, there are other barriers due to societal stereotypes and implicit bias that impact the advancement of various underrepresented groups in physics including women and those from underrepresented races and ethnicities. There is an urgent need to engage and increase the participation of these traditionally underrepresented students, whose talents in physics have largely been untapped. These students will be attracted to the beauty of physics if they are supported and encouraged early and often, and have role models.

In response to the Chief Justice’s question, the APS President Sam Aronson released a statement on diversity which notes, “One physics student from a minority community disparaged and feared at the time – the Jews of 19th century Germany – was Albert Einstein, whose unique perspective transformed the world.” One of my colleagues, who was a Ph.D. student of Manhattan Project leader J. Robert Oppenheimer, told me that he had wanted to major in math but the chairman of the math department at the time told him that no one on either the white and Jewish students majoring in math would not find decent math related jobs. Therefore, he majored in physics! Although one may feel relieved now that we do not have this level of explicit discrimination against underrepresented groups, it is important to understand that stereotypes and implicit biases persist and can negatively impact the advancement of underrepresented groups.

My two children attended a high school in which half of the students were African American, Hispanic, or multi-racial and the other half were white. This school appeared to be “well-integrated” in terms of providing equal education to students with ethnically and racially diverse backgrounds. The reality was different. While my children and many white students took advanced classes in the gifted or honors track, a large number of minority students were in the lower tier called “main stream.” A main reason for the difference is that some children were privileged and had the resources to succeed. Talented minority students with less than optimal resources and support from various societal stakeholders (including school counselors) are unlikely to perform as well as privileged children in seemingly “integrated” schools. They are less likely to get into top colleges and pursue graduate potential unless we give them adequate opportunities and support.

Now let’s go back to the question of the “unique” perspective. I don’t believe that the Chief Justice is assuming that all physics instructors must be a “sage on a stage,” and that students have nothing to contribute to the classroom dynamic. Research in physics education, including my own work, shows that teaching by telling does not work for a majority of students; rather the physics instructor must actively engage students in the learning process in order to be meaningful.

The photos above show students at Chicago State University, a minority serving institution on Chicago’s South Side, engaged in active learning environments that have been shown to aid diverse groups of students develop a deep understanding of physics. In top photo Ebony Spells, Angela Moore, and Sharif Onihale work on a physics lab experiment. In middle photo Mike Tyler, Ruth Osborne, and Louis Isaac tackle a classroom exercise. CSU is one of the larger producers of African American physics graduates. It is projected to graduate six black physics majors this year (Fall 15 & Spring 16). According to APS, only two of the roughly 750 colleges and universities that grant this type of degree graduate more than six African American physics majors. Illinois is currently in its eighth month without a budget and universities in the state will need to make some very difficult decisions about program cuts and elimination. Physics programs, such as the one at CSU, which the state classifies as low producing, are in danger.

The chart on the left shows pre-instruction (Pre) and post-instruction (Post) Matched Force Concept Inventory (FCI) scores for Modeling Instruction and lecture classes at Florida International University, a diversity serving institution. The raw gains from Modeling Instruction are substantially higher compared with traditional lecture techniques. Reprinted from Brews et al. [3].

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Few decades, a majority of physics Ph.D. (approximately 70 percent) have found employment outside academia. The enriching perspectives that diverse groups of students bring to physics classes shape the thought processes of all students who go into varied careers and impact innovation and progress in every walk of life [3, 6, 7].

We should all focus our effort on providing greater opportunities to students from underrepresented groups. Without broadening our perspective to include the talents of talented students, we risk losing our competitive edge.

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