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Middle-Schooler Does Rocket Science
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2017 APS President Laura Greene

By Rachel Gaal

On January 1, 2017, Laura Greene became the 103rd president of the American Physical Society. She is currently serving as the chief scientist of the National High Magnetic Field Laboratory (MagLab) and Professor of Physics at Florida State University. APS News *sat down with Greene to discuss her initial plans and expectations for her yearlong term as APS President. This interview has been edited.*

Laura Greene

What are your duties as APS President?

I think my main job is to protect our members and to listen to what their needs are. If members of a unit come to me and want change, we have to listen to them. Another priority is to keep our journals healthy. I'm not sure what will happen with open access. I'm not opposed to it, but we need to figure out the economic model. I'm willing to work with APS Editor in Chief Pierre Meystre and Publisher Matthew Salter to figure out the details. Along with economics, there is the journal content. Pierre working with Matthew will assure the quality of the journals remains intact. We also want to look at a new way to determine impact factor for our journals. And having the APS Director of International Affairs, Amy Flatten, here at APS, who has guided me for years, will be crucial to my presidency. I'm looking forward to doing a lot more work with her.

How do you feel about your physics career thus far?

I never guessed my life would be this fantastic and I've experienced a lot. Firstly, I'm addicted

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Physics in the Big Easy: 2017 APS March Meeting

By Rachel Gaal

The city of jazz, original beignets, and Mardi Gras is hosting this year's APS March Meeting! Held from March 13-17, at the Ernest N. Morial Convention Center, the Society's largest conference will attract over 10,000 physicists, including early career scientists, and students from around the world.

As in past years, the Kavli Foundation Symposium will anchor the conference, with this year's theme being *Quantum Matter & Quantum Information.* The 2016 Nobel Laureates F. Duncan M. Haldane and J. Michael Kosterlitz are among the invited speakers of the symposium, which will also include talks by Kathryn Moler, Dale Van Harlingen, Andrew Cleland, and Michel Devoret.

At least 9,700 abstracts will be presented over the weeklong conference, featuring 1,000 invited speakers and over 350 sessions focused on special topics. Whether it be physics of beams or biophysics, or perhaps the physics of climate or the history of physics, there will be something for everyone in New Orleans.

Feeling a bit nervous presenting in front of record-breaking numbers of attendees? Grad students and postdocs can attend a pre-meeting workshop, *Finding Your Scientific Voice: Improving Your March Meeting Presentation,* to get some last-minute pointers from the Forum for Outreach and Engaging the Public. Each three-hour workshop will focus on communication tips for presenting results to peers and to the lay public. Preregistration is required, and there is a $20 fee.

The APS Division of Polymer Physics is hosting a two-day workshop on Saturday, March 11, and Sunday, March 12 titled *Polymer Colloids: Synthesis, Characterization and Application*. This pre-meeting event will include 15 lectures and two invited seminars that will highlight polymer colloid research and techniques. Preregistration is required and

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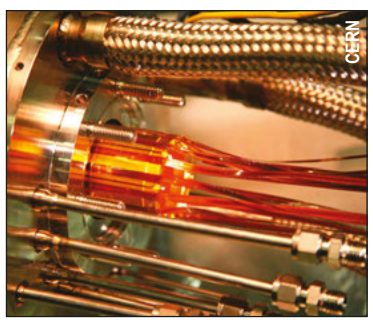
Research News: Editors' Choice

physics.aps.org

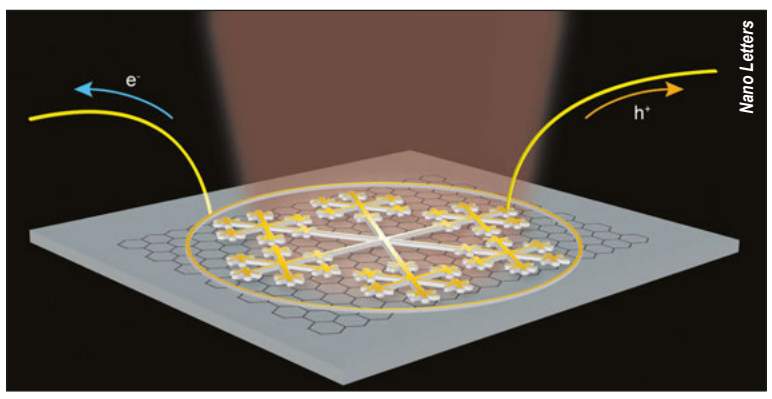
A Monthly Recap of Papers Selected by the Physics Editors

First Spectrum of an Antiatom

Physicists with the ALPHA Collaboration at CERN have measured for the first time how antimatter absorbs light. According to the known laws of physics, matter and antimatter should interact with photons in the same way. Detecting the tiniest deviation from this symmetry could help researchers find ways to revise the standard model of particle physics. But measuring the spectrum of antimatter has so far been impossible, because antimatter annihilates as soon as it comes into contact with ordinary matter. As they report in *Nature* (doi:10.1038/nature21040), the ALPHA Collaboration successfully characterized the optical spectrum of an antihydrogen atom. Exploiting a technology they demonstrated in 2010, the researchers held antihydrogen atoms in a magnetic trap for over 10 minutes. Using a laser, they then observed a transition in antihydrogen and compared it to the same transition in hydrogen, finding that the frequencies of the two transitions are identical to a precision of 0.2 parts in a billion. Next, the researchers hope to carry out more stringent tests of matter–antimatter equivalence by probing other transitions with a broader range of laser energies and by improving the measurement sensitivity.



Antimatter trap at CERN



Gold snowflakes make better photon absorbers

Fractals Help Graphene Detect Photons

Graphene is an attractive material for detecting photons because of its wide optical absorption spectrum and high room-temperature carrier mobility. But being only one atomic layer thick, its photon absorption efficiency is limited. Reporting in *Nano Letters* (DOI: 10.1021/acs.nanolett.6b03202), Fang et al. have now shown that attaching a graphene sheet to a gold fractal structure boosts the detection efficiency by an order of magnitude. The researchers fabricated a 10-micrometer-diameter snowflake-like gold fractal on top of a glass substrate and then characterized its electromagnetic properties both numerically and with a scanning electrode during laser

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APS Council Reinvigorated

By Nan Phinney

In 2014, APS adopted a new governance structure [1], and among the more important changes was a redefinition of the roles of the Board of Directors and the Council of Representatives. The Council is the larger body, like the U.S. House of Representatives, and the Board is smaller. As a result of the change, all voting members of both Board and Council are elected by the members of APS. The Council includes the Presidential Line [2], the Treasurer (a new elected position), four general and four international councilors, and the Chair of the Nominating Committee, all of whom are chosen in Society-wide elections. Another two-dozen councilors represent the divisions, forums, and sections and are chosen in their unit elections. The Board includes the Presidential Line, the Treasurer, the Speaker of the Council (also a new position), and another eight or nine councilors. The Speaker and other councilors on the Board are chosen in Council elections.

In the old APS structure, the Council was officially the final decision-making body, but in practice, the Board always met the day before the Council meetings, and most issues had been discussed and resolved in the Board meetings before they were even brought to the Council. It was also rather tedious to have everything presented first to a smaller group and then repeated for the larger group. In the new APS structure, the Council and Board have distinct roles and responsibilities. The Council has responsibility for most scientific and strategic matters, and the Board has responsibility for financial issues and governance. Of course, there are always areas of overlap, particularly with the APS research journals, which have major scientific and financial impact, but the Council's mandate now includes many of the issues of greatest interest to the membership, such as units, meetings, fellows, prizes, outreach, and educational initiatives. Also, most of the standing committees of APS are Council committees or joint Council and Board committees, so the Council has a broad variety of things to deal with.

Nan Phinney

The Council also gained new leadership with the Speaker of the Council and the Council Steering Committee (CSC). The Speaker-Elect serves one year in that role

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Spotlight on Development

APS Honors and Why Philanthropy Matters

By Irene Lukoff, Director of Development

For over a century, APS has thrived, in part due to the generous philanthropic support of its members. This philanthropy is the main source of support for the APS Honors, which include prizes, awards, fellowships, and lectureships. These Honors have traditionally been the primary vehicles for the 47 APS units (including divisions, forums, sections, and topical groups) to recognize outstanding achievement in research, education, and public service—and in addition to memorialize important physicists. Of the more than 60 APS-wide prizes and awards, and more than 40 unit-level awards, a number of them still require funding to be fully endowed and/or to provide additional benefits to their recipients.

Here is, in his own words, what inspired APS Fellow and Life Member Herbert L. Berk of the University of Texas at Austin to recently establish a $50,000 endowment:

I am about to retire from a 53-year career in research and teaching of physics. One of the most interesting tasks I participated in was being as a member of the committees that formulated the concept and sought permanent funding for the Nicholson Medal, named in honor of Dwight Nicholson, of the University of Iowa, who was killed by an irate student for no sensible reason. Dwight was chairman of the physics department, and had warm encouraging relations with many of his colleagues and particularly with students and young research scientists. To honor this trait in him, the Nicholson Medal for Humanitarian Service was created in 1993, renamed the Nicholson Medal for Human Outreach in the early 2000's when a permanent travel endowment was established; it is now named the Nicholson Medal for Outreach. One of the principal bases for the medal is the recognition of mentoring that an experienced physicist can give to young emerging scientists. I believe that mentorship, in addition to awards for scientific advancement, is an important trait that our Society should recognize, and this recognition will be enhanced if the awardee would receive a monetary prize in addition to the Medal. Hence, I have donated $50,000 to establish a permanent endowment to supply an annual monetary award of $2000 to the Nicholson recipient. It is my hope that my gift will encourage others who knew Dwight and appreciate the role of mentorship, to donate additional funds to enhance the monetary component and prestige of this award.

Herbert L. Berk

APS is extremely grateful to Herbert Berk for his vision and generosity, and encourages others to follow his lead.

There are a number of existing Honors that need additional funding to be fully endowed—as well as Honors pending establishment—that could use your support. If you wish to learn more about giving opportunities related to our Honors or other APS-led programs (Education & Diversity, Public Outreach, International Affairs, Industrial Physics, Public Affairs, Matching Membership) please contact Irene I. Lukoff, Director of Development at 301-209-3224 or lukoff@aps.org.

This Month in Physics History

February 6, 1971: Alan Shepard Hits a Golf Ball on the Moon

NASA's lunar missions in the 1960s and 1970s were designed for serious science, but that didn't stop its astronauts from finding creative ways to let off steam. One astronaut became the first man to experimentally investigate the ballistic properties of textured polymer spheres in non-terrestrial gravitational fields. In other words, he hit a golf ball on the moon.

Alan Shepard, Jr. was born in New Hampshire in 1923, part of a long line of descendants dating back to the Mayflower. He was bright enough to skip two grades before graduating from Pinkerton Academy. And he loved airplanes, taking informal flying lessons in exchange for doing various chores at nearby Manchester Airport. The onset of World War II prompted him to enter the military. He passed the U.S. Naval Academy entrance exam at just 16—too young to be enrolled until the following year. (He spent the interim at a naval prep school.)

Shepard was first assigned to the USS *Cogswell*, and found himself weathering typhoons and attacks by Japanese submarines and kamikaze pilots—including rescuing over a hundred sailors from a torpedoed cruiser. He eventually served as a gunnery officer as the war came to an end. After Japan surrendered in September 1945, Shepard began basic flight training in Corpus Christi, Texas. He initially struggled in the program, resorting to private flying lessons and earning a civilian's license to improve his skills. It wasn't the typical approach for an aspiring Navy pilot, but it worked: He was approved for advanced training, and soon earned his wings.

Astronaut Alan Shepard practices his golf swing on the moon.

Shepard spent the next couple of years piloting a F4U Corsair, including a nine-month stint in the Caribbean. Also, he served as a test pilot at the Naval Air Station Patuxent River, in Maryland, where his daredevil nature nearly led to a court-martial after he cheekily looped the Chesapeake Bay Bridge during a test flight. He escaped that fate due to timely intervention by his superiors. He forged a very respectable naval career in the ensuring years, logging over 3600 hours of flight time.

By 1959, President Dwight D. Eisenhower had established a fledgling federal space agency, and NASA began recruiting military pilots as potential astronauts for the planned fleet of Project Mercury spacecraft. Shepard was one of the 32 preliminary candidates selected, and once he'd received assurance that volunteering for the program would not damage his military career, he agreed to participate. After an exhaustive battery of tests, he became one of the seven Mercury astronauts, along with Scott Carpenter, Gordon Cooper, John Glenn, Gus Grissom, Wally Schirra, and Deke Slayton.

Project Mercury did not have a smooth beginning. Just a few weeks after astronaut selection, an unmanned Project Mercury rocket launched at Cape Canaveral failed spectacularly, exploding after liftoff as the astronauts watched. Shepard's response: "Well, I'm glad they got that out of the way."

After a fierce competition, Shepard was chosen for the first American manned mission into space.

The goal of Project Mercury was to beat the Russians to the punch, but the mission kept getting postponed. So on April 25, 1961, Russian cosmonaut Yuri Gagarin became the first man to travel to space. Shepard followed suit less than one month later, on May 5, and his flight was broadcast live to millions of television viewers. Asked by reporters what he was thinking while waiting for liftoff, Shepard quipped, "the fact that every part of this ship was built by the lowest bidder."

His successful flight made him a national hero, and he remained active in Project Mercury until it was shuttered in June, 1963—just before Shepard was slated to go into space again as part of the Mercury-Atlas 10 mission. The silver lining: He was chosen as command pilot of the first manned mission of the new Project Gemini. But then he started having severe dizziness episodes with a loud ringing in his left ear. NASA's doctors discovered he had Ménière's disease—an abnormal volume of fluid in the inner ear—and attempts to drain it proved ineffective. They also found he had glaucoma, and a lump on his thyroid.

Shepard found himself grounded, having to watch fellow astronauts Grissom and John Young fly his Gemini mission instead. He assumed administrative oversight of the NASA astronaut program as Gemini gave way to the Apollo mission—during which the U.S. sent the first astronauts to the moon. Four years later, a colleague put him in touch with a Los Angeles otologist who could cure the inner ear disease with surgery, draining the fluid by way of a small tube.

The procedure worked, and Shepard was cleared for flight in May 1969—just in time for the Apollo 13 moon mission. But Shepard and his relatively inexperienced crew (their colleagues dubbed them "the three rookies") were ultimately turned down for the mission, in order to give them more time to prepare. Jim Lovell famously replaced him as

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Focus on Advocacy

APS Member Advocacy Helps Score Win on American Innovation and Competitiveness Act

By Tawanda W. Johnson, APS Press Secretary

Mina Hanna

Mina Hanna was eager to make a difference in science advocacy last year. So he took the initiative by introducing himself to Greg Mack, APS government relations specialist, during the 2016 APS April Meeting in Salt Lake City, Utah.

"I was excited to learn how I could effectively bring to my congressional representatives' attention the importance of reauthorizing the America COMPETES Act and keeping politics out of the science process," said Hanna, a physicist, senior applications consultant at Synopsys Inc., and chief operating officer at Wholesplit, LLC, in Austin, Texas. "Science has continuously striven to provide us with practical answers to the most perilous challenges of our human existence. And I believe it will continue to do so, but only if legislation is made to promote objective, inquisitive, evidence-based, robust science."

The APS Office of Public Affairs (OPA) worked with Hanna in developing the most effective way to reach out to his congressional representatives. On August 23, 2016, Hanna published an op-ed in the *Houston Chronicle*.

In the piece titled, "Federal research funds caught in political vise," Hanna urged two key Texas representatives—Rep. John Culberson, chair of the House Subcommittee on Commerce, Justice, Science and Related Agencies, and Rep. Lamar Smith, chair of the House Science, Space, and Technology Committee—to drop some controversial provisions in their version of COMPETES legislation and instead follow the Senate's approach. He wrote, "The state's ability to attract, educate, and retain qualified, high-tech workers is crucial to its ability to keep American companies from relocating overseas. And that is why it is imperative that our lawmakers support the right piece of legislation that strengthens scientific research and the U.S. innovation enterprise."

The OPA alerted APS members in Texas to the publication of the op-ed and encouraged them to contact congressional offices and share their views.

Hanna then arranged a direct meeting with a key House Science Committee staffer who works for Representative Smith. By the time of the meeting, the House and Senate had compromised on a revised version of COMPETES, consistent with suggestions Hanna made in his op-ed. During the meeting, which Mack also attended, Hanna, Mack, and the House science staffer discussed the revised bill, giving Hanna the opportunity to thank them for their work.

In December, the Senate and the House both passed the new version of COMPETES, called the American Innovation and Competitiveness Act—one that satisfied both chambers of Congress while softening the political polarization of the previous bills. The legislation calls for boosting the nation's investment in research, creating jobs, and spurring new businesses and industries. President Obama signed the bill into law on January 6.

Hanna's success is just one example of how OPA has assisted APS members.

"The APS Office of Public Affairs has worked with thousands of APS members to help them effectively communicate with their elected representatives," said Francis Slakey, interim director of OPA.

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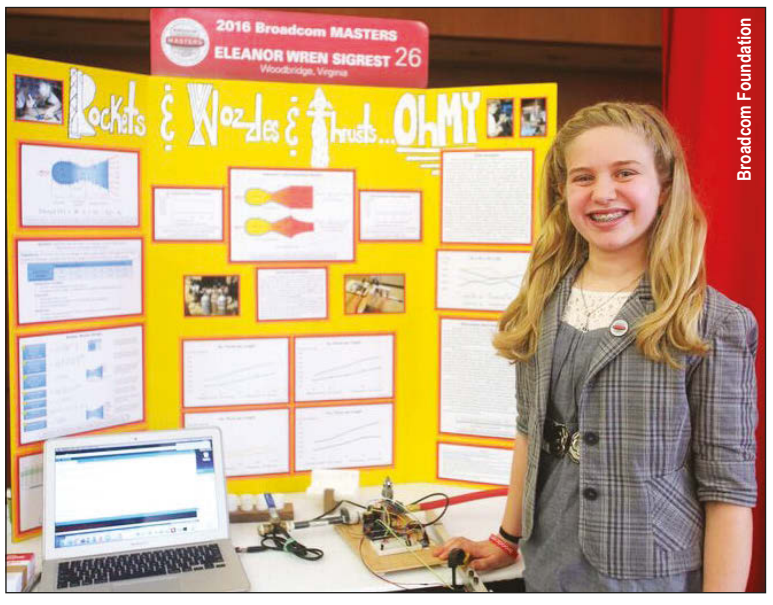
Physics at the Broadcom MASTERS Competition

By Rachel Gaal



Eleanor Wren Sigrest, winner of the $25,000 Samueli Foundation prize at the Broadcom MASTERS competition.

For the past six years, the annual Broadcom MASTERS (Math, Applied Science, Technology and Engineering for Rising Stars) competition has encouraged middle school students to explore the world around them. The 2016 finalists tinkered and toyed with their experiments to create the ultimate science fair projects. A program of the Society for Science & the Public and the Broadcom Foundation, the 30 finalists had a one-of-a-kind competition, full of STEM challenges to demonstrate their skills (like coding Raspberry Pi minicomputers and building robotic crab arms).

Among the finalists (15 girls and 15 boys) were some students who pursued their passion in physics. *APS News* got a chance to sit down and chat with four of the finalists to figure out what inspired them, and the different physics challenges they faced along the way. We feature one of the winners here, and for the interviews with all four finalists, see *APS News* online.

Elenor Wren Sigrest, Woodbridge, VA, Age: 13

Her project: "Rockets and Nozzles, and Thrusts, Oh My"

Sigrest was awarded the Samueli Foundation Prize for her mastery of STEM principles and team leadership. As the top prize-winner, she received $25,000 from the Samueli Foundation for her work on cold gas rocket nozzles.

What inspired you to pursue this project?

When I saw SpaceX attempt the first landing of the Falcon 9, I was amazed watching the rocket tip and seeing a burst of exhaust explode from the side. It was fighting a losing battle—[but] I was inspired. How could I keep the first stage from tipping? … I wanted to do a project related to the real world, and I've always loved rockets and space. I was lucky to meet a couple of SpaceX engineers out in California who helped me brain-

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International News

International Physics Graduate Student Conference Comes to the Nation's Capital

By Krista Freeman

Krista Freeman

As a physics Ph.D. candidate and the past chair of the APS Forum on Graduate Student Affairs (FGSA), I am delighted to invite my fellow graduate students to an upcoming international scientific meeting planned by, and exclusively for, physics graduate students. I am pleased to announce the call for abstracts for the 2017 Canadian-American-Mexican Graduate Student Physics Conference (CAM2017). This unique meeting will be held August 17-19, 2017 in Washington, D.C., and graduate students may submit abstracts and travel award applications from February 8 through April 28.

So what makes this meeting so special? Imagine a general physics conference that fulfills all your expectations—an intimate and collegiate atmosphere with a broad array of interesting, accessible talks. International attendees enjoying each other's company both professionally and socially. The promise of an attentive audience for your talk, and a feeling of unlimited possibilities for future collaborations. Welcome to CAM, North America's premier conference series planned by and for physics graduate students! Past CAM attendees have reviewed their experience with comments such as "excellent conference, with interested and interesting student attendees" and "I was impressed at the choice of the program, the quality of the student presentations, and the high degree of interactivity among all participants." The success of the CAM series is the product of more than two decades of collaboration among APS, the Canadian Association of Physicists (CAP), and the Sociedad Méxicana de Física (SMF).

CAM2017 is expected to attract more than 100 student researchers from the U.S., Canada, Mexico, and (for the first time in CAM history) Cuba. The three-day meeting has a busy schedule of plenary talks, parallel student presentation sessions, a poster session, panels, a banquet on Capitol Hill, and more! Senior scientists from each of the four participating countries will serve as plenary speakers and panelists, and will be available throughout the meeting to interact with student participants. The atmosphere, program, and attendees of the conference add up to many opportunities for international networking and, most importantly, the sharing of science.

The meeting is, above all, a platform for graduate students to share their scientific research achievements and learn about those of their international peers. Each student participant will present his or her research through either a contributed talk or a poster presentation. The student research topics covered in past meetings are as diverse as the researchers: CAM conferences have hosted physicists studying everything from gluons to galaxies and at all the length scales in between. This rich variety of research topics (and subsequently low average audience familiarity with each topic) requires student speakers to tailor their talks for a general physics audience. This is good scientific communication practice for the presenters, and it also provides the audience a rare opportunity to learn a topic outside their own subdiscipline from another graduate student.

Some participants may be presenting their research publicly for the first time at the meeting, and we hope that an audience of peers will make this process less intimidating. For other presenters, CAM may be their last conference before a final thesis defense and will serve as a platform to summarize their graduate research achievements. For these students, we hope that a presentation experience with an audience of international peer scientists will help them segue into the next step of their education and/or careers.

Regardless of the stage of a student's career, however, we believe that CAM will be a unique opportunity for concrete feedback for students to develop their scientific communication skills. For the first time in CAM history, all presenters will be invited to participate in a voluntary peer feedback program. Participating students will write

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commander, and Apollo 13 would go down in history as NASA's most successful failure. Shepard commanded the successful Apollo 14 mission, becoming the fifth man to walk on the moon, as well as the oldest at 47.

The mischievous Shepard, a golf enthusiast, had planned a surprise for the millions of Americans watching the televised broadcast of his final moonwalk. He smuggled a collapsible golf club and golf balls aboard the spacecraft, and just before returning to the lunar module, he hit two balls with the club. The first plunked down into a crater, but according to Shepard the second flew for "miles and miles." That was likely an exaggeration, but astrophysicist and blogger Ethan Siegel has calculated that a perfect shot on the moon could easily travel 2.5 miles.

Shepard resumed his administrative position at NASA, eventually retiring from both the agency and the Navy in 1974. A leukemia diagnosis in 1996 grounded him once and for all; he succumbed to complications from the disease on August 25, 1998. His wife Louise survived him by just five weeks, dying of a heart attack. A Navy helicopter scattered their ashes together in a cove near their home in Pebble Beach, California.

Recommended Reading:

Burgess, Colin. *Freedom 7: The Historic Flight of Alan B. Shepard, Jr.* New York/London: Springer-Praxis, 2014.

Thompson, Neal. *Light This Candle: The Life and Times of Alan Shepard, America's First Spaceman*. New York: Crown Publishers, 2004.

Profiles in Versatility

Physicist Tackles Voynich Manuscript with Statistical Methods

By Sophia Chen

Marcelo Montemurro insists that he isn't obsessed with the Voynich manuscript.

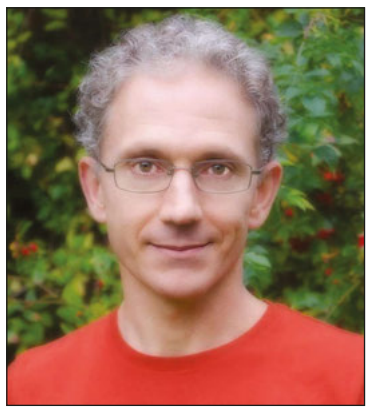
The UK-based physicist has never held its calfskin pages in his hands. He has never been to the Yale Library stacks where the codex is kept. He doesn't know what the manuscript says, and he doesn't know if anyone ever will.

He just likes a good puzzle — and the Voynich manuscript is the king of them all.

No one knows who wrote its 200-something pages, nor the alphabet that was used. One passage, transliterated to Latin letters, reads: "qokedydy qokoloky qokeedy qokedy shedy." Its pages feature illustrations of unidentified plants, astronomical bodies—and naked women bathing in green liquid.

What experts do know: The calfskin has been carbon-dated to the 15th century. At the turn of the following century, Rudolf II, Holy Roman Emperor, paid 600 gold ducats for it, about $40,000 in today's dollars. For about 200 years, no records about the manuscript exist. In 1912, a Polish book dealer named Wilfrid Voynich found it stashed in the summer villa of a Renaissance pope. He asked approximately twenty of the best World War I cryptologists to make sense of the unknown script. They failed to decode a single word.

Academics languished over it for decades. From the sparse Latin scrawled on some of the pages, they argued whether the author could be Roger Bacon, a medieval philosopher. Researchers transcribed the document into computer-readable scripts. In 2014, botanists claimed one of the images resembled a soap plant from Mexico. They suggested the manuscript was tied to the Aztecs.



Marcelo Montemurro

Enter Montemurro. In 2006, he stumbled upon an article about the Voynich in a two-year-old issue of *Scientific American*. In the article, Gordon Rugg, a British computer scientist and psychologist, argued that the manuscript was meaningless. He'd overlaid a card with holes cut in it over a grid of random syllables—a Renaissance-era cryptography technique—and claimed he could produce Voynich-like words. Rugg thought that it could be a forger's attempt to con a customer into buying a fake manuscript.

"I became absolutely interested in it," Montemurro says.

At the time, he was a relatively fresh hire at the University of Manchester's department of neuroscience and psychology, where he still works today, studying neural networks.

But he had also researched linguistics for about five years, beginning when he was a physics Ph.D. student studying disordered magnets at Argentina's National University of Córdoba. He set aside time from his Ph.D. work to dig through Shakespeare's plays. With colleagues, he analyzed how the playwright distributed different types of speech throughout his work and searched for empirical laws that roughly predicted how sentences were strung together.

He thought about how to categorize language. Should he tally sentence by sentence or paragraph by paragraph? How do the statistics differ as sampling size changes?

The work, which he eventually published, wasn't so different from physics, Montemurro says. To a physicist, a sentence is just a signal transmitted between two nodes in a network—where each node is a human brain. "I see language as

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there is a registration fee.

Soft matter physics buffs can also attend a short course on Sunday, March 12, to review the fundamental concepts and tools used in more computational research. A daylong survey of different models, common theories, and tools will be covered over several lectures. This pre-meeting event is limited to 40 participants, and a registration fee is required.

Keep an eye out for additional pre-meeting tutorials, hosted in the morning and afternoon hours of Sunday, March 12. These half-day workshops, organized by the March Meeting Program Chairs, will cover a variety of topics: Quantum Photonics, Electron-Phonon Interactions, Topological Insulators, Current Research in Many Body Localization, Weyl Semimetals, Computation in the Undergraduate Curriculum, Topological Physics with Cold Atoms, and Active Matter. Check the tutorials timetable on the March Meeting Events & Activities page to learn more about the content and invited speakers. Register now or onsite at the New Orleans Convention Center (but be warned, space is limited and tutorials will fill up!).

To kick off the week festivities, an official Tweetup will be held on Sunday evening for those who plan to converse throughout the meeting over Twitter. Gather with your online friends and learn about using social media to communicate science! You can also have your picture taken with the Flat Physicists at the Tweetup; in case you miss them, they will be around all week at the APS Village, where attendees can also pick up APS giveaways and stylish physics gear from the Member Store.

Amid the scientific sessions throughout the week, a number of panels, receptions, and awards ceremonies will take place.

Those interested in learning about career options outside of academia are encouraged to attend an interactive panel on Monday, March 13. Hosted by the Forum on Industrial and Applied Physics, the *Meet Your Future: An Interactive Panel on Industry Careers* session will give advice on how to start and succeed in an industrial career path. An overview of federal career programs related to condensed matter physics will be given at the session *Enabling Careers in Condensed Matter Physics: Federal Programs,* also on Monday.

Undergraduates who are keen to learn how to land a job post-graduation should attend the *Building your Undergraduate Physics Career* session on Monday, March 13. The Society of Physics Students will hold an interactive workshop to teach students how to polish resumes, practice interviews, and more. The Graduate School Fair and Reception, along with the Student Reception and Awards Ceremony, will be held on Tuesday, March 14.

For those wondering how to take the next step into the job market, a workshop hosted by Peter Fiske on Wednesday, March 15, will provide advice and strategies for taking your physics job search to the next level. This *Careers in Physics: Putting Your Science to Work* session is free and open to all meeting attendees. Space is limited, and sending an RSVP is encouraged.

Prospective authors and referees can attend a short tutorial on Wednesday, March 15, led by editors from *Physical Review Letters* and the *Physical Review* journals, to guide anyone looking to submit to or review for any of the APS journals. If you're more interested in chatting with journal editors, make sure to stop by one (or both) of the Meet the APS Editors Receptions, held on Tuesday, March 14, and Wednesday, March 15.

A number of meetups will be held on Wednesday, March 15, for LGBTQ+ Physicists, the National Society of Black Physicists, and the National Society of Hispanic Physicists. To learn more about the APS diversity initiatives and to get involved in the dissemination of opportunities for women and underrepresented minorities, attend the Diversity Reception on Wednesday evening.

The 2017 APS Annual Business Meeting will also be held during the March Meeting on Thursday afternoon. It can be attended in person, on the web, or online after the meeting. APS Leadership will provide members with information about the Society, and the opportunity to ask questions and share comments.

We hope you can join us in New Orleans to take part in this Mardi-Gras-sized meeting!

COUNCIL continued from page 1

and then serves as Speaker during her/his final year on Council. In addition to the Speaker, Speaker-Elect, and President-Elect, the CSC includes four other councilors who have two-year terms. As the first ever Speaker of Council, I had the opportunity to occupy a new role for the last two years. This was a really exciting and fun time when the new Council leadership had to figure out how things should work in the new structure. We were especially committed to making the Council much more interesting and interactive, and I think we were successful. Also, the Council now meets before the Board, so any topic on both agendas is first presented to everyone and need not be repeated the second day.

Starting in January 2015, all of the members of the newly minted CSC attended the Leadership Convocation, which is the annual gathering of all Unit leaders, and we organized a facilitated small group discussion with the Unit leaders to find out how they wanted to interact with Council. We learned that the units wanted to know more about what Council was doing and that those units not having their own councilor wanted more representation. To provide more information, we agreed to give the Unit leaders access to the agenda and briefing materials about a week before each Council meeting. We also distributed a year-end and mid-year report on Council activities.

The representation issue required more thought, as the Council has already almost forty members, and meetings also include APS staff, guests, and speakers. At the first meeting of the new Council in April 2015, the councilors brainstormed how to provide more representation without making the Council so large as to be unwieldy. The unanimous agreement was to designate existing councilors as representatives for the other units. The topical groups and small forums identified a division or forum most closely aligned with their interests for their Council Representative. The two section councilors were each asked to represent four additional sections. All representatives are identified on the Council webpage and the Unit Executive Committee webpages.

Publications are an extremely important part of what APS provides to the physics community. Both the Board and Council hear regular reports from both the Editor in Chief and the Publisher, and both discussed at length the proposals for new journals and approved the creation of *Physical Review Fluids* in 2016.

Meetings are another important service to the community. There has been concern for some time about the health of the APS April Meeting: An earlier task force had recommended moving the meeting to the fall, but this proved impossible. Council formed a new April Meeting Task Force that included councilors from all of the units that have significant participation. The Task Force recommended the formation of a chair-line for the April Meeting Steering Committee, with a four-year rotation among the major units. While this really goes into effect only in 2017, the 2017 April Meeting organizers already see a significant improvement in terms of coordination and continuity.

Prizes, awards, and fellowships are another responsibility of Council, and we have had to hold a third virtual Council meeting in September each year to approve awards. In early 2015, we formed a new committee to select awardees for the new APS Medal and the Lilienfeld and Valley prizes, all of which are Society-wide. For broad representation, the committee includes all division councilors. We also requested the Committee on Prizes and Awards to conduct a review of the program, which was long overdue. Their very thorough report was discussed at the November 2016 Council meeting, and their recommendations sent to APS honors staff for implementation.

The Fellowship Committee also conducted a review of its program and recommended changes to the allocation algorithms. APS has actively recruited student members, and students are now almost a third of APS members. This means that the number of fellowship nominations per year has increased by almost 50% without any corresponding increase in the number of eligible candidates. After a very thoughtful discussion, the Council approved a change such that the number of new fellows per year cannot exceed 0.5% of non-student members, beginning in 2017.

Council has covered many more topics over the last two years than can possibly be discussed here, but the new leadership seems able to support a much more active role for Council in the Society. I was fortunate to have a terrific group of people serving on the first Council steering committees to get the new Council off to a good start. We leave Council in the capable hands of Dan Kleppner, Speaker of the Council in 2017, and Tim Gay, Speaker in 2018.

The author is an accelerator physicist at the SLAC National Accelerator Laboratory. She led the world's first linear collider project, the Stanford Linear Collider, in the 1990s and has been a leader in subsequent linear collider design efforts. She was the Councilor for the Far West Section in 2013-2016 and served as Speaker of the APS Council of Representatives in 2015 and 2016.

Footnotes

1. *APS News Special Edition*, Fall 2014, aps.org/publications/apsnews/201408/index.cfm and *APS News*, December 2014, aps.org/publications/apsnews/201412/vote.cfm
2. The APS Presidential Line consists of the President, President-Elect, Vice President, and Past President. Each year in a general election, APS members elect the Vice President, who becomes President-Elect the following year, and President the year after that. For additional information about APS governance, see aps.org/about/governance/

Education & Diversity Update

Woman Physicist of the Month

Chuhee Kwon

Chuhee Kwon is a professor and past chair in the Department of Physics and Astronomy at California State University Long Beach (CSULB). She strongly believes that education is the key to upward mobility and advocates for making a level playing field for everyone in physics. As a P.I. and co-P.I., she has received over $2.4 million in external grants, half of which was for outreach and diversity-enhancing programs, including the Physics Teacher Education Coalition (PhysTEC), National Science Foundation Scholarships in Science, Technology, Engineering, and Mathematics, and the APS Bridge Program. Under her leadership, the department has more than tripled the number of undergraduate majors and eliminated the achievement gap in gender/ethnicity. Kwon received the 2010 Advancement of Women Award from the President's Commission on the Status of Women, as well as the 2013 Faculty Award for Excellence by the College of Natural Sciences and Mathematics at CSULB. Her research specialty is condensed matter experiment, and she has over 90 peer-reviewed publications in superconducting and magnetic thin films. More than 10 of these papers have undergraduate and master's student co-authors. She received her B.S. and M.S. in physics from the Seoul National University and the Pohang Institute of Science and Technology, respectively, and her Ph.D. in physics from the University of Maryland, College Park.

Nominate the next Woman Physicist of the Month at womeninphysics.org

Sites Announced for 2018 Conferences for Undergraduate Women in Physics (CUWiP)

Arizona State University

Cal Poly Pomona/Pomona College/Harvey Mudd College

Columbia University

George Washington University

Iowa State University

Queen's University (Canada)

Rochester Institute of Technology

University of Kansas

University of North Florida

University of Oregon

University of Toledo

University of Virginia

Interested in hosting an Undergraduate Women in Physics conference in 2019? Fill out an expression of interest form at aps.org/programs/women/workshops/cuwip-host.cfm

NMC Conversations Now Online

The 2017 edition of *Conversations*, the newsletter of the APS National Mentoring Community (NMC), is now available online at aps.org/nmc. Read highlights from the recent NMC Conference, meet an NMC mentor and mentee pair, and learn about how to prepare students for diverse careers, including careers in industry.

2017 Conferences for Undergraduate Women in Physics

This past January, over 1500 female undergraduates traveled to the 11th annual Conference for Undergraduate Women in Physics (CUWiP). But this wasn't a single-site spectacle—10 different institutions hosted scores of attendees to make this year's CUWiP the largest to date. The photos show participants at the CUWiP meeting at Princeton University on January 13-15, 2017. CUWiP started in 2006, with just one university host site at the University of Southern California. Over the past decade, other institutions have joined the effort to reshape the gender statistics of physics majors—including support from the National Science Foundation, and the U.S. Department of Energy. For more information, visit aps.org/programs/women/workshops/cuwip.cfm

BROADCOM continued from page 3

storm ideas. Later they spent hours with me in their rocket lab back at MIT, explaining and sharing, and more explaining, and giving me tours—I was hooked! I've devoured rocketry books and thermodynamics lessons they've sent me, and they poured their hearts out into teaching me. I've learned so much. I learned cold gas rockets are used as stabilizers for the first stage, but little engineering data is available; engineers rely on rules-of-thumb.

When you first started your investigation, what did you think the outcome was going to be?

I believed the engineering rule of thumb was going to be correct. Engineers generally use a half-angle [of the rocket nozzle] between 12° and 18°. When I first started my experiment, I thought 15° would be the best compromise for the length and thrust of the nozzle. My hypothesis was actually disproven … 20° is the best compromise for the length and thrust, not 15°. This surprised me because 20° is outside the range of the rule-of-thumb.

What was the hardest challenge you faced while carrying out your research?

My initial comparison of theoretical predictions and experimental results showed a large difference, and I didn't understand why. My compressor wasn't able to produce the chamber pressure I was expecting, and there was still a huge difference between my predictions and results. I reviewed my sources and realized that I had designed my nozzles based on an optimum expansion ratio, meaning the pressure at the nozzle exit equals atmospheric pressure. But with a reduced chamber pressure [in my experiments], my nozzle pressure was less than the atmospheric pressure. My nozzles were over-expanded, causing them to produce significantly less thrust … I had to recalculate my predictions, which was a much more difficult thrust equation to solve.

What resources did you use if you were confused with a problem?

If I was having a hard time understanding something, I would read the literature. If I still didn't understand, I would talk to my dad. But even after talking to my dad, I might need a different explanation, so I would call my mentors at MIT. They were almost always able to explain the concept in terms that I could understand. On the rare occasion, I would let my mind sit and come back to the problem later. Giving myself a chance to take a break allowed me to think of information or some experience from my past that I could compare to, then the lightbulb would go off in my head!

When you get older, what do you want to do as a career?

I am going to be an astronaut … more specifically, a mission specialist in computer science. I am going to send my research paper to SpaceX, get my pilot's license, and I AM going to be the first person on Mars!

VOYNICH continued from page 4

a natural phenomenon on top of a social phenomenon," he says.

The Voynich was "the ideal system" to test his linguistic hypotheses. Since no one knew whether Voynichese is a language in the first place, he thought he could approach with it with fewer preconceptions. So he downloaded the digital version of the manuscript.

To study the manuscript, he uses the concept of linguistic entropy, first proposed by Claude Shannon in 1950. It describes the level of predictability in a text. A sequence of repeating letters like "aaaaaaaa" has zero entropy because each letter can be predicted from its previous one. A random sequence of letters, however, has high entropy.

Language, of course, is neither ordered nor random. Grammar provides a repeating structure, but content words differ between sections. By analyzing the entropy of a word, you can guess its purpose: Is it a proper noun that shows up in bursts, or an evenly distributed conjunction like "and"? Montemurro uses entropy to quantify information in a text without having to understand it at all.

The work doesn't fit in a conventional academic field, says Mirko Degli Esposti, a University of Bologna mathematician who collaborates with Montemurro. Some humanities experts distrust statistical methods. "They think that using these quantitative methods on a piece of poetry somehow kills all the creativity inside," Degli Esposti says.

Quantitative experts doubt the work, too. Math purists, for example, think humanities problems "contaminate" the field. But these "contaminations" keep math relevant, Degli Esposti says.

"A century ago [the contamination] was physics," he says. "Now it is medicine, language, and the humanities."

More physicists and mathematicians are studying humanities problems, Degli Esposti says. The problems can be practical, too: For example, he researches plagiarism detection.

Montemurro doesn't care which box academics place him in. He doesn't get funding to study the Voynich, anyway. He considers himself a physicist because of how he approaches a problem. Inspired by statistical physics, he wants to develop statistical theory to describe how individual words create language, like the way individual particles create magnetism.

With a colleague, Montemurro published a paper in 2013 that compares Voynich statistics to English, Chinese, Latin, and even Fortran. The manuscript's statistics resemble those of real languages too much to be fake, they wrote.

Their next step, Montemurro says, is to correlate the manuscript's words with its images. "It is likely that some of the language written close to the figures refers to the figures," he says.

Some of his fascination with the manuscript is, of course, its Da Vinci Code factor. Can it reveal something new about the culture of the Middle Ages?

"People speculate that the Voynich contains forbidden medicinal information or alchemy, or something that could not be disseminated freely at the time," he says. "It would be significant for a historian to learn."

But whenever the excitement builds in his voice, he steadies himself.

"The Voynich has a problem," he says. "Some people become obsessed with it and really start feeling very personal about their theories. … For me, I'm quite open. I'm not defending a particular theory about it."

What if the botanists' Aztec hypothesis is correct? What if someone confirms that a con man faked it? "If they come with substantial evidence, I won't feel personally betrayed," he says. "That would be fantastic."

The author is a freelance science writer based in Tucson, Arizona.

CAM2017 continued from page 3

and submit objective and respectful observations about each presentation they attend. In return, they will each receive at the end of the conference a written collection of detailed peer feedback. This feedback will be a great resource for students hoping to improve their presentation skills.

Participants will also enjoy international networking opportunities with their peers and invited senior scientists. Leaders of APS, CAP, SMF, and the Cuban Physical Society will attend the meeting, giving students an excellent opportunity to network within these physical societies. These networking opportunities at CAM meetings are designed to strengthen the scientific infrastructure of North America by promoting partnerships among young physicists. In line with this, student participants will also learn about international research collaborations available through APS, CAP, and SMF, and will be encouraged to maintain their newly-developed international networks through participation in an exclusive CAM2017 Facebook group. The meeting theme this year, "Physicists of the Future: Transcending Boundaries," will embody this spirit of collaboration by highlighting the disciplinary and geographical boundaries increasingly crossed in pursuit of physics research. The theme will be explored with two panel discussions ("Transcending Boundaries: Geographical, Disciplinary & Career" and "Transcending Boundaries: Personal & Societal) exploring the boundaries—both literal and figurative—that physicists encounter.

"Transcending Boundaries" is an intentionally broad phrase, since each physicist has his or her own personal boundaries that are overcome in pursuit of science. This could be as literal as crossing a geographical border for a new experiment or as abstract as starting to explore a new discipline as research results lead outside the realms of "traditional" physics. For some, the most important crossing may be of the unconscious societal boundary that has historically prevented many women and minorities from excelling in physics. For others it might be making a leap into a new and unfamiliar career outside of academia. Common to all, transcending a boundary in pursuit of science is an exciting signifier of a next great step. We hope you will join us in sharing your plans for that next step!

APS and FGSA hope to offer travel awards to many students at U.S. universities, and similar opportunities may be available for Canadian and Mexican students through their physical societies. For more information on CAM2017, and to apply, please visit our website at go.aps.org/2017cam

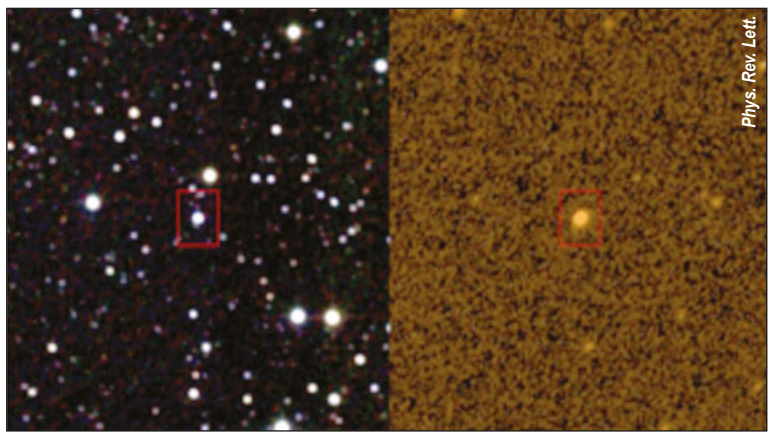
The author is the immediate Past-Chair of the APS Forum on Graduate Student Affairs and is a Ph.D. student at Carnegie Mellon University.

RESEARCH continued from page 1

illumination. This revealed strong enhancements of the near-field electromagnetic field strength that were produced by electron plasma resonances. Then they placed the gold snowflake on top of a graphene sheet and tested the combined photoresponse with laser illumination at several visible wavelengths. The researchers observed enhancement factors between 8 and 13 due to the plasmonic response of the gold. They suggest that the use of fractal snowflakes for broadband detection enhancement may be extended to other materials.

The Mysterious Dimming of Boyajian's Star

For over a full year, the brightness fluctuations of star KIC 8462852 (named Boyajian) have dumbfounded astronomers, but now they may be closer to solving the puzzle. In September 2015, a citizen scientist group analyzing NASA's Kepler mission data drew attention to this star because of its decreased light flux for long periods. While speculations from scientists included transiting planets, large orbiting objects, or even alien energy-harvesting solar panels, none of these hypotheses matched the data. But a more plausible piece of evidence might shed light on this mystifying stellar behavior. Sheikh et al. from the University of Illinois at Urbana–Champaign recently published their results in *Physical Review Letters,* (DOI: 10.1103/PhysRevLett.117.261101) which suggests that the pronounced dimming episodes might be linked to internal phenomenon rather than external orbiting structures. Over four years, the team studied Boyajian's star, and found that its spectrum of fluctuations is consistent with that given by an "avalanche model"—where a small perturbation can set off a sudden change in a system. In this type of model, an internal stellar process (which is still unknown) would reach a tipping point, and cause a steady decrease in light flux for a period of time. (For more, see the Viewpoint in *Physics* "New Clues as to Why Boyajian's Star is Dimming" by Steinn Sigurðsson at physics.aps.org/articles/v9/150)



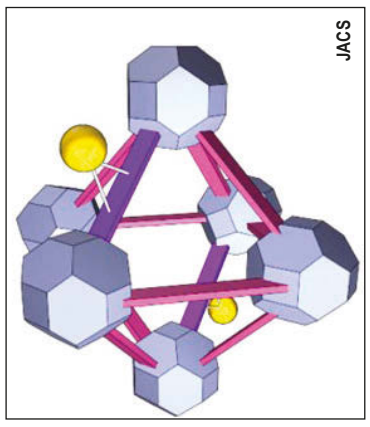
Boyajian's Star (KIC 8462852)

Laser Tech for When the Fog Rolls In

Fog can be a killer for technologies that involve sending intense lasers through the air, such as remote sensing and free-space communication. In *Applied Physics Letters* (DOI: 10.1063/1.4972954), de la Cruz et al. offer a simple solution to this problem for near-infrared lasers: Re-send the signal every 100 microseconds. The idea uses the fact that an intense laser traveling through a region with water droplets or other small particles will drill out a low-density "hole" as it propagates. The hole lasts for just fractions of a second, but that's long enough to pass another pulse of light through the cleared space. The team tested this approach by sending an ultrashort pulse from a 1030-nanometer-wavelength laser through a chamber filled with dense fog. Pulses delivered at a slow rate were almost fully blocked, but those sent at a faster clip (1000 Hz) were able to transmit 32% of their light through the meter-long chamber.

Metal-Based "Engines" Increase Mobility in Micromotors

Invisible to the naked eye, biomolecular motors can chug along inside living cells without leaving a mark. These tiny messengers could be used for a variety of tasks, such as drug delivery and virus isolation. Scientists have hardwired these engines to convert chemical energy into mechanical work; the micrometer-sized motors use hydrogen peroxide as their fuel source by breaking down the chemical into its constituent parts (water and oxygen) and using the oxygen bubbles to launch forward. These "engines" have a mind of their own however, and it's difficult to control their speed or halt them at will. Li et al. took these engines into the shop and revamped their designs to fix this flaw. As described in the *Journal of the American Chemical Society* (DOI: 10.1021/jacs.6b11899), the team used metal-organic frameworks (MOFs) in their self-propelled micromotors.



Micromotor control

They selected different metal ions (cobalt and manganese salts) in the MOF framework, which provided customizable options. The motors achieved different top speeds with different metals, giving the fine-tuner a way to adjust an engine's performance. There was also an optional "braking system" for the motors—by adding molecules called chelating ligands, the ions would "bite" onto the metal framework and slow down the engines.

ADVOCACY continued from page 3

"Mina is a terrific physicist to work with, and I look forward to working with many more physicists who also want to be advocates," added Mack.

Hanna said advocacy is crucial to the effective operation of the nation's government.

"It's vital to remember that we live in a democracy that urges us to take an effective part in lawmaking by reaching out to our representatives. It is our moral and professional duty to protect the neutrality of evidence-based science," said Hanna.

He added, "My experience meeting with staff in Capitol Hill has been a very positive one. I found the staff amenable to hearing my concerns, and I've learned that understanding the challenging nature of science policy is crucial to guiding my advocacy efforts. I greatly appreciate the resources and coaching I received from APS to help me accomplish my advocacy goal."

Read Hanna's op-ed: chron.com/opinion/outlook/article/Hanna-Federal-research-funds-caught-in-political-9180444.php

For more information about getting involved in grassroots activities, contact Greg Mack, APS government relations specialist, at mack@aps.org.

GREENE continued from page 1

to physics and I'm so lucky to be in it. I've always called it "seductive and consuming." Not thinking I could ever get a job doing it, I thought that after grad school I was going to be a machinist because I really liked machining. And I thought that if I could ever get a job teaching physics, and maybe every few years go to a conference, I would've considered myself extraordinarily lucky.

What is your current area of physics research?

The physics keeps getting better; I'm so captivated by correlated electrons. I like to compare correlated electrons to dark energy. So that's my latest colloquium, because it's such a fundamental concept. But how do you get that across to others? It's a really hard, complex problem and I'm really drawn to it.

As you start your new presidency, what do you aim to accomplish?

My theme this year is science diplomacy. I learned that science is completely international and, during science discussions, no one gives a hoot what your background is. Then discussions can go beyond science—maybe to family or music—and that leads to broad friendships beyond borders. Let's just sit at the same table and talk to each other. If we know how to communicate through science, we can branch out into other areas... It doesn't matter what the line or subject of communication is, but there needs to be a starting place.

Also, human rights, diversity, outreach, and public engagement—these are things I put a lot of time into it and that I really care about. You can't have science diplomacy without all of these things, and you can't do good science without them. When you have people from different countries, different genders, different outlooks, we can look at problems differently, and the diversity of approach helps you solve problems. Even diversity between fields: I would like to see high energy physics and cosmology connect even more with condensed matter. Those are the kinds of things that can be very exciting—and that I try to promote.

What makes you feel so strongly about communication?

So many answers! When I made some discovery about 20 years ago, it wasn't expected, and I would basically have people just not believe even the experimental results. They really attacked me and I would get angry … but mostly at myself. I was wondering what I was doing wrong, thinking, "How do I communicate this with people to get them to understand?" It was my charge to find the mode of communication—a challenge that was worth it. Also, communicating the beauty and importance of science to the general public is not only fun, but it helps us stay strong as a field.

Do you see any parallels with the importance of communication in the new presidency under Donald Trump?

After the latest election, I've realized that science diplomacy, which is by definition, using the language and actions of science to create a better world, and to understand each other's philosophies … to see the world out of each other's eyes … that idea has to be applied within our borders.

I know there are people in APS who did not vote the way I did, and I honestly don't know how to communicate with them. They are probably a minority, and as a minority, I have to protect and learn how to interact with them. I want the members to tell me what is the best way to do that, and I'm not doing my job unless I'm really trying.

This is unknown territory—we have a president that doesn't have a political background, and many are looking at worst-case scenarios. Let's just make sure both sides know what the other is thinking. In most areas of science and technology research, the U.S. is number one in the world, and we don't want to lose that status. I think if we can start and keep the conversation going across the political boundary, we will come to an understanding of the importance of funding fundamental and applied science—maybe it won't look like the model we have now, but we will figure it out … together. And remember, people can heatedly disagree with each other on physics questions, but they still are colleagues and have many things in common—especially their love of science!. So I want APS members to come to me… let's use the language of science to converse. Hey—I've even started a Twitter account: @laurahgreene—let's follow each other!

ANNOUNCEMENTS

APS/IBM Research Internships

10-week paid internships for undergraduate women and underrepresented minority students.

APPLICATIONS ARE DUE FEBRUARY 15

APS physics **Apply now:** aps.org/programs/women/scholarships/ibm

Reviews of Modern Physics

Dynamics of non-Markovian open quantum systems
Inés de Vega and Daniel Alonso

This review gives a summary of the many techniques that are used in the analysis of open quantum systems. Emphasis is on those cases where it is unsuitable to use a memoryless or Markovian point of view, generally because there is no large separation of time scales between system and environment dynamics. The approaches reviewed include master equations, Heisenberg equations of motion, chain mapping representations, and various stochastic methods such as path integral Monte Carlo and stochastic equations. Guidance is given on how to evaluate the suitability of each of these methods for application in different physical problems.

doi.org/10.1103/RevModPhys.89.015001

journals.aps.org/rmp

ACTUALIZATION OF THE INTERNET OF THINGS

APS physics

FIAP 2017 CONFERENCE • APRIL 17-19 • MONTEREY, CA

Registration & Abstract Submission Deadline: March 25, 2017

Learn more at go.aps.org/fiap-iot

INDUSTRY DAY

Physics at Work for You

WEDNESDAY, MARCH 15

MARCH MEETING 2017

Join industry R&D leaders, entrepreneurs, and senior scientists from both academic and national labs to hear about cutting edge developments and well-established projects that are already a part of your everyday life.

Satellite sessions on

TUESDAY, MARCH 15
AND
THURSDAY, MARCH 16

go.aps.org/mm17-industry-day

APS BRIDGE PROGRAM

APS physics

Student Applications Now Open

Deadline: March 20, 2017

The **APS Bridge Program** is an effort to increase the number of physics Ph.D.s awarded to underrepresented minority students.

African American, Hispanic American, and Native American students interested in pursuing a Ph.D. in physics are encouraged to apply.

apsbridgeprogram.org

APS Annual Business Meeting

Thursday, March 16 • 5:45 p.m. CT
At the APS March Meeting
in New Orleans

APS leaders will provide an overview of the Society and answer questions from members. All members are invited to attend in person or watch live online.

APS physics

www.aps.org/about/governance/meeting.cfm

APS Webinars

Preparing for the Physics GRE: Tips & Strategies

TUESDAY, MARCH 7 at 3:00 p.m. EST

In this interactive webinar, you will learn:

- Test taking strategies
- Practical study skills
- And how to apply them to practice questions

Space is limited. REGISTER NOW!

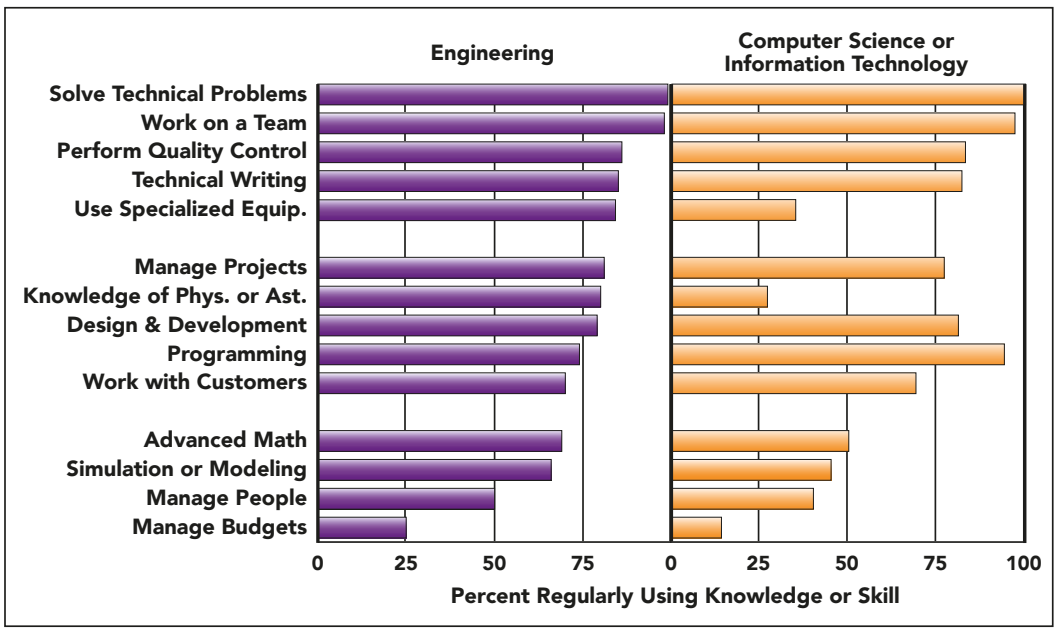
aps.org/careers/guidance/webinars/gre-strategies.cfm

The Back Page

Phys21 — Physics Education for the 21st Century

By Douglas Arion and Lawrence Woolf

Are you one of the 5 percent or the 95 percent? No, we're not talking politics or economics. We're talking physics careers. If you are one of the roughly 5 percent of undergraduate physics majors who ultimately became a faculty member, congratulations! Congratulations, too, to the 95 percent who are contributing to all sorts of industries and professions, using their physics background to create products, services, and processes of value to society. In general, the undergraduate physics curriculum was designed to best serve the 5 percent. With greater demand on higher education to demonstrate economic value to students, combined with greater international economic competition and the changing demographics of incoming students, the education we provide to physics majors requires a critical re-examination.



AIP Statistical Research Center

Skills and Knowledge used by Physics Bachelors in the Private Sector **Source: aip.org/statistics/data-graphics/knowledge-and-skills-regularly-used-physics-bachelor's-employed-private-0**

The *Phys21: Preparing Physics Students for 21st Century Careers* report, summarized below, examined these issues. It is the outcome of the Joint Task Force on Undergraduate Physics Programs (J-TUPP), which was convened by the American Physical Society and the American Association of Physics Teachers to answer the following question: *What skills and knowledge should the next generation of undergraduate physics degree holders possess to be well prepared for a diverse set of careers?* J-TUPP was also asked to provide guidance to physics faculty on how to revise their department's undergraduate curriculum to better prepare students for diverse careers, and to include relevant recommendations on content, pedagogy, professional skills, and student engagement.

This study was seen as a necessary follow-on to the *SPIN-UP* report [1] (an outcome of the physics revitalization effort begun in the '90s), trends in innovation and entrepreneurship education, and the aforementioned issues of economic competitiveness, student demographics, and economic pressures on colleges and universities [2]. Other nations are making significant efforts to enhance economic competitiveness by linking physics, innovation, entrepreneurship, and career development [3]. It was the goal of this project to encourage the physics community to be pro-active, rather than re-active, to the coming changes in physics education, and to be the leading discipline in adapting to this changing educational landscape.

The task force consisted of leaders in academic physics, physics education, industry, national labs, and professional societies who brought with them knowledge and insight from a variety of perspectives including career development, innovation and entrepreneurship, physics education research, and systemic change in education [4]. The panel conducted a comprehensive study to identify the skills, knowledge, and attitudes that physics graduates will need in order to be prepared for diverse careers and to generate a set of learning goals and recommend methods to achieve these goals in academic settings.

The task force reviewed reports and learning goals generated by panels in physics and other STEM disciplines, National Academy reports, employment data, recommendations from think-tanks and economic development organizations, surveys of employers, the STEM competency literature, data from the American Institute of Physics Career Pathways Project and Statistical Research Center (see the figure), and interviews with a range of industry and education experts. In addition, J-TUPP commissioned studies of hiring managers and recent physics graduates employed outside of academia, and conducted case studies of physics departments to better understand how to develop innovative programs that support the career preparation of their students. A number of external reviewers also provided insight that was incorporated into the report. The two-year study resulted in *Phys21*, which was published in October 2016. A supplementary document summarizes the supporting research used in *Phys21* [4].

The *Phys21* report is intended to help physics programs better prepare students for today's careers and those of the future. It provides information about the skills and knowledge that employers of physics graduates are seeking, and describes ways in which physics departments can help students acquire those skills and that knowledge. Not only will departments that take up this challenge better serve all of their current students, they are also likely to attract a more diverse set of students with a broader range of career interests. The potential for greater funding resources, new and interesting research projects, and creating a greater sense of relevance for physics among students are all valuable outcomes.

Phys21's Major Findings

- There is broad consensus regarding the skills, knowledge, and attitudes needed by college graduates to prepare them for 21st century careers.
- Colleges and universities are increasingly scrutinized regarding the value and the return on investment that an undergraduate degree provides.
- Many students expect their intellectual work to have relevance, often resulting in a social good, authenticity, and application; they seek out disciplines and programs that they perceive to have these characteristics.
- Students who plan to obtain graduate degrees will also benefit from developing skills and knowledge that are valued outside the academic community.

Learning Goals that Promote Career Readiness

- *Physics-specific knowledge:* Use fundamental cross-cutting themes in physics, apply basic laws of physics, represent physics in multiple ways, solve problems that involve multiple areas of physics, engage in multidisciplinary problems that link physics with other disciplines, and investigate how physics concepts are used in modern technology.
- *Scientific and technical skills:* Solve ill-posed problems through experiments, simulations, and models; determine follow-on investigations; and identify resource needs. Competencies required include instrumentation, computational and industry-standard software, coding, and data analytics.
- *Communication skills:* Communicate orally and in writing with audiences that have a wide range of technical and non-technical backgrounds. Competencies include listening, discussing, persuading, assessing understanding, and teaching.
- *Professional and workplace skills:* Work in diverse teams and generate new ideas; demonstrate familiarity with workplace concepts such as project management, budgeting, intellectual property, and legal and regulatory issues; demonstrate awareness of career opportunities and pathways for physics degree holders; and life skills such as responsibility, time management, perseverance, and ethical behavior.

Phys21's Recommendations

- Use the findings of *Phys21* to guide strategic planning for program improvement and enhanced student recruitment through faculty development, course modifications, changes in program requirements, and co-curricular activities that include fostering contact between students and physicists outside of academia, and exposing students to physics as applied in non-academic settings.
- Incorporate application-related topics and industry-standard software and tools into courses, exercises and assignments, and laboratory activities.
- Utilize co-curricular activities, such as co-ops and student internships, community resources such as chambers of commerce and economic development organizations, and industry speakers and guests to expose students to opportunities as well as to business and professional skills..
- Collaborate with other academic departments and campus offices (such as career services) to bring workplace relevant topical content and experience to physics students.
- Direct students, through advising, to general education courses and programs that can support their career objectives while meeting graduation requirements.
- Expand written and oral communications content and activities to address diverse, non-technical audiences.
- Build industry partnerships, add industrial projects to the research enterprise, and utilize sabbaticals and other opportunities to provide faculty with opportunities to become familiar with the needs and opportunities presented by non-academic organizations.
- Develop interdisciplinary research and teaching opportunities, and leverage existing capabilities on campus.
- Promote a departmental and faculty culture that values non-academic careers and the students who pursue them, and which emphasizes innovation and the entrepreneurial mindset.

Additional Resources

There are groups within the physics community that are developing resources, implementation methods, and curricular approaches for achieving goals such as those recommended in *Phys21*. Primary in this effort is the development of the *PIPELINE Network* [5], an APS-led, NSF-funded project engaging a consortium of colleges and universities to develop and test a variety of implementation methods to achieve learning goals such as those recommended in *Phys21*. As documented in the J-TUPP Supplement [4] there are other academic disciplines working to achieve similar goals, and the methods developed across these areas can be applied to physics. In addition, there are national organizations, such as VentureWell, that offer financial support, conferences, and other resources [6]. You are not alone.

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References

1. aps.org/programs/education/undergrad/faculty/spinup/spinup-report.cfm
2. D. N. Arion, "Things Your Advisor Never Told You: Entrepreneurship's Role In Physics Education." *Physics Today*, August 2013, Pg. 42.
3. iop.org/about/international/development/entrepreneurship/page_44527.html. See also aip.org/industry/ipf/2014/capacity-building-industrial-physics-developing-emerging-economies
4. compadre.org/jtupp/
5. aps.org/programs/education/innovation/pipeline/
6. venturewell.org