Hydrodynamic Forces to Blame for Glacial Earthquakes?

By Calla Cofield

APS March Meeting, Denver

Massive icebergs that break off from their parent glaciers might be responsible for earthquakes detectable from thousands of miles away, sometimes reaching 5 on the Rich-ter scale. How this happens could depend on the way the icebergs slosh around in seawater and release energy against the glacier wall.

At the March Meeting, Justin Burton presented results from his laboratory at Stanford University, where he and his colleagues are looking at icebergs calving events. Burton added evidence to the case that hydrodynamics is a crucial part of how the icebergs are able to create significant seismic events in their parent glaciers.

In the early 2000s, Douglas MacAyeal at the University of Chicago and colleagues made the connection between glacial calving and earthquakes. Several studies have been performed that events are well correlated, and scientists want to use the seismic data to keep track of calving activity and track details about the icebergs, like their size. But to do that, they need to work out the mechanisms causing the seismic activity.

Icebergs break off from glaciers are often (but not always) gravitationally unstable: They are tall and skinny and occasionally break off so that the taller side is pointing down into the ocean (imagin- ing a book-shaped iceberg tending to float with its cover vertical). An iceberg with this arrangement will fling 90-degrees (so the cover of the “book” goes from vertical to hori-zontal).

In a particular fjord on the west coast of Greenland where this phenomenon has been extensively stud-ied, Meisner said, adding that NASA

Applied Physics at the APS March Meeting

By Michael Lucibella

APS March Meeting, Denver

This year’s March Meeting of the American Physical Society was packed with topics ranging from hydrodynamics to neutrino astronomy. Here are a few highlights:

Neutrinos and National Security

By Michael Lucibella

APS March Meeting, Denver

The Department of Energy (DOE) is funding WAter Teller (WATCH MAN), a prototype neutrino detector that can monitor whether a nuclear reactor 400 kilometers away is enriching the raw material for nuclear weapons. If successful, the WATCHMAN Collaboration’s search could make it nearly impossible for countries to hide their illicit nuclear enrichment. It also marks the start of the neutrino’s transformation into a practical tool for uses outside of basic research.

“Would be the first really applied use of neutrinos,” said Mark Vagins of the University of California Irvine and member of the collaboration. All nuclear reactors emit radiation and antineutrinos. While radiation can be blocked with a few feet of soil or concrete, antineutrinos pass unimpeded through hundreds of miles of solid Earth.

“That’s the beauty of this signal—you won’t be able to stop it or shield it,” said Adam Bernstein of Lawrence Livermore National Labs and head of the WATCHMAN Col-laboration. Neutrinos pass unimpeded through hundreds of miles of solid Earth.

Wisconsin Synchrotron Center Goes Dark

By Michael Lucibella

In mid-March one of the country’s remaining synchrotron light sources switched off for the last time. The Synchrotron Research Center (SRC) at the University of Wisconsin-Madison shut down after thirty years of use when funding for its continued operation failed to emerge.

“It’s not that we’re a sleepy little institution waiting to be turned off. We were producing real world-class science here,” said Joseph Blug-sano, the director of the synchrotron center.

The 5.5 million center is home to the Aladdin storage ring with twenty-one attached beamlines. The compact machine’s specialty was ultraviolet and soft X-ray research and recently the facility installed an infrared beamline.

Berkeley’s Advanced Light Source is the only other major source of soft X-rays in the United States. The closure of the SRC represents the shuttering of roughly 40 percent of the nation’s soft X-ray and ultraviolet beamlines.

Following a review panel’s recommendations, the National Sci-ence Foundation (NSF) announced in 2011 that it would soon stop funding the center. NSF provided about two years worth of bridge funding for the university to operate the machine while searching for new revenue sources. The SRC was ultimately put on the sidelines. This was a competitive process and the decision was made to give an award to a competitor,” said Mary Galvin, NSF’s director of the Division of Materials Research. Bisognano said that he felt that the decision was influenced by political pressure for NSF to reduce its budget. He said that the lab was being shut down despite having received several excellent NSF reviews in recent years.

“We’re large enough to count [for closing] but small enough to not create a lot of political repercussions,” Bisognano said. “That’s all I can figure because it was a very cost-effective facility at 5 million a year.”

Galvin disagreed. “They really are science decisions; trying to op-timize the science that we can get,” Galvin said. “We have a lot of pro-posals that get very positive assessments that we don’t fund.”

The synchrotron’s last run was on March 7. The university will

For more from the APS March Meeting, see pages 3 and 5.
"A lot of people think we need scientists to deal with the science issues—funding for NASA and things like that. That’s not the case about that. It is the countless other things that come before that us scientific components that are ignored.”


“If we build three east-west great walls in the American Mid-west....one in North Dakota, one across the border between Kansas and Oklahoma to the east, and the third one in south Texas and Loui-siana, we will diminish the tornados threat in the Tornado Alley for- ever.”


“It could mean that we have to close quantum theory, the funda-mental theory governing matter. Or it could mean that we could be weird activity in the very earliest moments of the Big Bang.”

David Kaiser, Massachusetts Institute of Technology, on testing the quantum implications of loop-holes in Bell’s theorem, NBC-News.com, March 5, 2014.

“The idea was just to trust that nature has designed a good way to do this.”

Kerstin Nordstrom, University of Maryland, on designing the Ro-boClam, a smart anchor that burrows like a clam, The Los Angeles Times, March 5, 2014.

“Elastic threads are everywhere in our daily lives—from hair and textile yarns to DNA and underwater broadband cables. Even the honey you pour on your toast.”

Pierre-Thomas Brun. École polytechnique fédérale de Lausanne, describing his work on the physics of latex, BBCNews.com, March 6, 2014.

“Our first suspicion was that this has to be a mistake… We did many tests to try to rule out these spurious effects, and so far we have failed.”

Troy Shinbrot, Rutgers, on his team’s discovery that fraticles in granular material can generate voltages. The Washington Post, March 6, 2014.

“I don’t actually constrain myself personally with the practical applications at this point…. We don’t have to get a home run here.”


“Inflation—the idea of a very big burst of inflation very early on—is the most important idea in cosmology since the big bang itself... If correct, this burst is the dynamic behind our big bang.”


“Yeah, I ordered it 30 years ago... It finally arrived.”

Andre Linde, Stanford, one of the theorists behind cosmic inflation, when asked if he had ordered something after being surprised at his future door with the news of the find-ings from the South Pole, The Los Angeles Times, March 18, 2014.

“Certainly everything in the universe that we see now, at one time before inflation, was smaller than an electron... And then it ex- panded during inflation at faster than the speed of light.”

Kent Irwin, Stanford, CNN Tech, on his team’s discovery of evidence for cosmic inflation, March 18, 2014.

“The most prized component we can have here is a failed part [so future parts won’t fail].”


“...to provide the power needed to guide space vehicles and com-municate with them. An invention from the 1960s made it possible to provide this power for space missions for the first time—to be a significant fac-tor in the success of these space voyages. It is the radioisotope thermoelectric gener-ator, or RTG, which provides electrical power needed for guidance, communications, and all the other power needs of the space vehicles. The RTG contains a radioactive source, plutonium 238, which emits primarily ~5 MeV α particles and has a half-life of 87.7 years. The α particles are absorbed within a short distance inside the radioactive plu-tonium oxide, heated up to as high as 1000°C. The RTG design places this heat source in contact with two side-by-side semiconductor elements, one N-type and one P-type. These must be stable at 1000°C, have high electrical conductivity and, especially important, low thermal conductivity. The only read-ily available material that satisfied all these require-ments was an alloy of silicon and germanium. Fifty years later, no better material has yet been found.”

Physicists George Cody and Ben Abeles discov-ered the unique properties of this material in the early 1960s. Working as part of a research team at RCA Laboratories in New Jersey, they attacked the problem of designing a semiconductor material for nuclear applications. Andrei Linde, Stanford, one of the theorists behind cosmic inflation, when asked if he had ordered something after being surprised at his future door with the news of the findings from the South Pole, The Los Angeles Times, March 18, 2014.

“In the important signals with the crucial information needed to land safely with all their equipment intact. The most prized component we can have here is a failed part [so future parts won’t fail].”


“For Nuclear Auxiliary Power).”

Later vehicles included the Voyager I and II unmanned spacecraft launched in 1977 for their rendezvous with the giant outer planets, and the Galileo spacecraft mission to Jupiter launched in 1989. In 1996, Elvis Minin, the Jet Propulsion Laboratory noted that “when future generations look back, Voyager’s epic journey to the four giant gas planets [Jupiter, Saturn, Uranus, and Neptune] and in deep space, solar radia-tion are too weak for solar cells to provide the power needed to guide space vehicles and com-municate with them.”

Cody and Abeles then went on to the silicon-germani-um alloys, which were available at RCA Laboratories, and known to be stable at 1000°C in vacuum, to measure their use in a range of alloy compositions. At the optimum composition, 60% at. silicon, the thermal conductivity was unexpectedly low, lower than that for other metals. More than 50 years later, the high thermal conductivity of metals and musical earphones of different materials is being accumulated good electrical contact.

This appears to be just too good physics research, made possible by institutional patience with solid work, and it is. But it re-sults in the key invention that has made all the planetary and deep-space missions possible. Cody and Abeles applied for a patent in October 1962, which was granted on October 18, 1966: US 3,279,954, Thermoelectric Device Having Silicon-Germanium Alloy Thermoele-

cmentary theory governing matter. Or it could mean that we could be weird activity in the very earliest moments of the Big Bang.”

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Graphene, Paper, Scissors

By Cala Cofield

APS March Meeting, Denver
Melina Blees, a graduate student at Cornell University, is dabbling in kirigami, a form of origami that mostly involves cutting rather than folding it. Through specially placed cuts, a sheet of paper becomes a spring, a pyramid, a net, or any number of other shapes. But Blees is working with 10 micron squares of graphene, which is a single layer of carbon atoms. At the APS March Meeting in Denver, Blees showed videos of the structures she has created. They flex, bend, twist and stretch almost exactly the way they would if they were cut from paper.

“I know, just from the numbers, that graphene should behave like this,” said Blees. “But to actually feel you are pulling it and playing with it, and it’s resilient—it’s kind of incredible.”

The use of origami in physics is not new—and another meeting session focused on its many applications. And the idea that changing the physical structure of a material can also alter its properties is of course familiar in mechanical engineering and metamaterials. But applying these concepts to graphene has been nearly impossible: it tends to stick to substrates and to itself, and tears easily when pushed or pulled, almost like wet tissue paper.

A few years ago, Blees and other researchers in Paul McEuen’s lab at Cornell found they could apply gold tabs as “handles” to grab the graphene. They first transferred the graphene to an aluminum film on glass, then use a photolithography process to deposit the gold tabs, and at the same time make the kirigami cuts. The aluminum is then removed with a mild hydrochloric acid etch. Blees remarks that she can pick up and manipulate these “cantilevers,” but only if they are suspended in water. She and her colleagues assume that as the aluminum is removed, the water gets between the graphene and the glass substrate, preventing sticking. In most cases, graphene sticks to the resting surface so well that trying to pick it up with the gold tabs would only cause it to tear.

This allowed the researchers to measure the bending stiffness of the graphene directly. “It’s not an easy thing to measure because usually graphene is suspended and under tension, and then that changes what you’re measuring,” said Blees. “So it’s a different situation when you can pick it up and it’s fairly free.”

Blees can cut a spring pattern out of the graphene, allowing it to stretch to nearly twice its resting length. For this reason, graphene could find its way into touch-screen technology, which is one place that this kind of flexibility might be useful.

Biophysics applications are attractive. In a group of connected cells, like a network of neurons, the graphene could serve to probe the cells individually.

“These [graphene nets] are really very good looking, but they’re bio-friendly. You could just drape a net over a cell, measure some electrical properties, and get real time read-outs of exactly what kind of neural firing is going on in a specific location within an entire network,” said Blees. “We’re just starting to think about going in that direction.”

APS to form ad hoc committee on LGBT issues

In response to a formal request from the LGBT+ Physicists, APS held a special session at the 2012 APS March Meeting to investigate the status of physicists who identify as Lesbian, Gay, Bisexual, Transgender (LGBT), and other sexual and gender minorities. Little is known about the numbers of LGBT+ physicists and there has been no systematic study of the issues they face. The LGBT+ Physicists have organized networking events and roundtable discussions at APS meetings, and held an invited session on Sexual and Gender Diversity Issues in Physics at the 2012 APS March Meeting. They have also put together a best practices guide for physics departments, which is available along with other resources at http://lgbtphysicists.org

APS Bridge Summer Meeting

June 25-27, 2014 - College Park, MD
http://www.apsbridgeprogram.org/conferences/summer14/index.html

The APS Bridge Program Summer Meeting will bring together experts to discuss efforts to increase the number of under-represented minorities (URMs) who receive PhDs in physics. This year’s conference will focus on exploring and understanding the MS degree in promoting URMs in physics. Workshops, panel discussions, and presentations will address topics including:

• Establishing relationships among MS-granting and PhD-granting institutions
• Role of master’s degrees for URMs
• Barriers to student advancement to the PhD
• Mentoring
• Non-cognitive admissions measures

Who should attend: faculty, students, and administrators interested in increasing the number of underrepresented students pursing PhDs in physics. Registration is now open.

APS CSWP Climate for Women in Physics Site Visit Program

Inspires Astronomy Community

At the American Astronomical Society (AAS) meeting in Indianapolis in June 2013, the AAS Council approved a proposal by the committee on the Status of Women in Astronomy to implement Climate Site visits for astronomy departments. These site visits are modeled on the highly successful visits that are done by the APS Committee on the Status of Women in Physics (CSWP) for physics departments. More details are available at: http://www.aas.org/astrophysics/cswa-climate-site-visit-program-for.html

PhysTEC Conference Offers Travel Support for Minority-Serving Institutions

Registration is now open for the PhysTEC Conference in Austin, Texas on May 19-20, held in conjunction with the UTeach Conference. The registration rate for PhysTEC member institutions is $150 and the non-member rate is $295; registration closes on May 1, 2014. Travel stipends of up to $800 are available to a limited number of minority-serving institutions.

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The PhysTEC Conference is the nation’s largest meeting dedicated to physics teacher education. This year’s conference theme is “Building Leadership” and the conference features workshops, panel discussions, presentations by national leaders, and a contributed poster session. There will be a PhysTEC-UTeach joint plenary session by Arthur Levine, Woodrow Wilson Foundation. Other plenary speakers include Nicole Gillespie, Knowles Science Teaching Foundation; David E. Memmott, the University at Albany; and Susan Singer, National Science Foundation. Additional conference information can be found here at: http://www.physetec.org/conferences/2014

References


Editor’s Note: This column was written by guest author Richard Williams.
We were gratified to see the IceCube Neutrino Observatory lauded as a "Physics Newsmaker for 2013" (APS News, February 2014, page 1).

However, we were confused by the second half of the discussion, "In August, researchers using data from IceCube’s surface detectors, IceTop, confirmed that, as scientists had long suspected, supernovae are the main sources of the high-energy protons known as cosmic rays." IceCube has not made any conclusions about the sites of cosmic-ray acceleration.

Women and the Nobel Prize

Congratulations for recognizing the gender imbalance in Nobel Laureates in Physics since their inception in 1901 ("This Month in Physics History," APS News, December 2013). As of now, the Nobel Prize in Physics has been awarded to two women and 193 men.

In honor of the three women mentioned, Lise Meitner, Chien-Shiung Wu, and Vera Rubin, whose contributions to science we acknowledge, there are others. For example, Marjatta Blau, who pioneered the development of a digital signal as one that is "expressed as a series of the digits 0 and 1."

UNDOCUMENTED STUDENTS ELIGIBLE TO RECEIVE APS SUPPORT

By Bishroura Khatib

In June 2012, the U.S. Department of Homeland Security announced that it would consider deferring deportation proceedings for a subset of undocumented youth brought to the U.S. as children, assuming they meet specific requirements. This classification, called "Deferred Action," allows APS to provide support for students who might otherwise be ineligible, and who typically have few resources to attend college.

In a 2012 press release, then-Secretary of Homeland Security Janet Napolitano stated that the program was designed to encourage underrepresented minority students to pursue careers in physics.

Successful applicants to the federal program will receive deferred-action status for two years, which can be renewed, and will be eligible to apply for work authorization.

Some of these individuals have come to the U.S. under the age of sixteen; have continuously lived in the U.S. for at least 5 years prior to June 12, 2012; currently be in school, graduated from high school, or have obtained their GED; and

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support continued from page 6

Unless you’re a political junkie or have nothing better to do with your time than watch Fox News or MSNBC, you probably haven’t heard the name David Jolly before. But you should be concerned about the impact his March 11 special election victory could have on science.

Jolly, a Republican lobbyist with no campaign experience, poor name recognition, and little early campaign cash, upended Alex Sink, a well-funded, well-known Democrat who had narrowly lost Florida’s last gubernatorial election.

Jolly, helped by a flood of outside money, portioned his narrow victory by running hard against big government programs in general and Obamacare in particular.

Although Republican Bill Young had represented Florida’s 13th district for 42 years until his death in 2013, the area anchored by Tampa-St. Petersburg has prompted candidates to label the special election a bellwether for the upcoming 2014 congressional elections. If they’re right, Jolly’s successful campaign could have national ramifications for both political parties. But that’s not all.

In a previous APS News column (October 2013), I wrote about the "bipartisan campaign theme that suggests a further, existential threat to federal science programs. Although the turnaround demographics in a special election may not mimic the demographics in a general election, Jolly’s message that Washington is not to be trusted seems to have resonated well in a region that is especially among independent voters."

Based on the Florida 13th result, Republicans undoubtedly will continue to use the limited-government message in the 2014 congressional campaigns. Democrats will be on the defensive, and if the Jolly-Sink contest is a reliable predictor, their attempt to defend government may well be a losing proposition.

If shrinking government really does become a winning populist theme in November, the Tea Party will have a much larger choice singing its anti-Washington refrain.

Should that happen, science budgets would be faced with a very challenging landscape, beginning as early as next year.

Last December’s Ryan-Murray budget deal restored most sequestration cuts in fiscal years 2014 and 2015, but unless Congress strikes a new bargain after the November elections, the across-the-board reductions will kick in once again in fiscal year 2016.

Despite its general bipartisan nature, the legislation reasonably could then become the exemplar of collateral damage in a fight between Democrats focused on preserving the social safety net and Republic ans fixated on reducing the scope and budget of the federal government.

Making the case for science will be difficult but not impossible. There are several arguments that could resonate with both sides of the aisle. Here are just a few.

Fact One: The National Science Board’s recently released “Science and Engineering Indicators 2014” shows the following attention grabber. Between 2001 and 2012, our nation’s worldwide share of research and development fell from 37 percent to 30 percent. Message Two: In an era of increasing global high-tech competition, we cannot afford to cede any further ground.

Fact Two: As the economy continues to recover, the Congressional Budget Office predicts that deficits will continue to shrink as long as corporate profits grow and corporate income taxes increase. Message Three: Science and technology are the acknowledged primary drivers of the 21st century American economy, and federal support of long-term research has proven to be a major catalyst of innovation and entrepreneurial ventures.

Fact Three: The workforce of the 21st century will have to be more science and tech-savvy than today, and we have far too few well-prepared science teachers to educate our students. Message Three: Investing in science education at both the federal and state level is essential for developing a 21st century science teacher corps.
Preservationists hope this is the year for the Manhattan Project Historic Park

By Michael Lucibella

An arduous effort to preserve the history of the Manhattan Project in the form of a National Park (at several different locations) may be close to fruition, said the head organizer at a recent session of the APS March Meeting in Denver.

Cynthia Kelly, founder of the Atomic Heritage Foundation, remarked that legislation this year might clear the way for the National Park Service (NPS) to take over the birthplace of the atomic bomb.

“These buildings embody this history in a way that nothing else does,” Kelly said. “The Park Service will do what they do best. They’re America’s storytellers.”

The Obama administration must formally transfer control of the land from the Department of Energy (DOE) to NPS before the park can move forward. A bill authorizing the transfer got through the House in 2013, but was dropped in the Senate. It would have transferred sites in Hanford Washington, Los Alamos, New Mexico and Oak Ridge, Tennessee to NPS.

“It’s been almost five years since any park legislation has passed,” Kelly said. “It’s been very difficult in this congress to get the votes we need.”

Facilities picked include the “V-site,” a cluster of buildings at Los Alamos where physicists assembled the first atomic bomb, the reactor and its control room at Hanford, which produced the first plutonium, and one of the calutrons at Oak Ridge for separating uranium.

But in a setback, the giant-mile-long K-25 plant which produced marks how resistant a ferromagnetic material is to having its magnetic orientation changed by a nearby magnetic field. In most materials, the hotter they are, the easier it is to change their magnetic directions, and the lower their coercivity.

“Is the control of magnetism without a magnetic field,” said Schuller, speaking at the APS March Meeting. “We can control it just by changing the temperature.”

Coercivity is the quantity that marks how resistant a ferromagnetic material is to having its magnetic orientation changed by a nearby magnetic field. In most materials, the hotter they are, the easier it is to change their magnetic directions, and the lower their coercivity.

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studies in this country. His preference is that the funds be used to help undocumented students, and may help deferred-action action students in the future.


References


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cilitate the use of quantified evi- dence for decision-making” in fund- ing, he adds. “That’s another programmatic opportunity within the agency. To that end, “we are examining innova- tive sources of data we haven’t harnessed to date in our engagement processes before,” explains Abraham.

Social media is at the top of the list of new tools to help the Office and its partners to better understand conditions that might affect populations,” she says, “We need to improve the deployment of resources to those in need and to parts. For example, the team is con- sidering how twitter could be used to be known as a hegemony,” such as a tsunami or an earthquake, or Google searches about flu-like symptoms could pinpoint where an outbreak might be occurring.

Ali Douraghy, another AASAS S & T Policy Fellow, came to a ca- reer in international development through his work with the Palestinian Authority. While an undergraduate in bio- medical engineering at UC San Diego, he worked in the Middle East and the Arab-American at the American University in Cairo. “This changed every- thing,” he says, recounting how he taught himself to read Arabic and worked even into Pakistan. When he re- turned stateside, he pursued a PhD in biomedical physics at UCLA while working with IBM to improve their medical imaging ca- pabilities by adopting technology such as PET scans. “I was itching to get back to the Middle East,” he says.

“Even though you are speaking about the Middle East,” he says, “you need to understand the local context, and you need to learn about the other cultural and religious beliefs of the people you are trying to reach.”

His work with the Palestinian Authority has been heavily focused on health and development issues, and he has been involved in a number of projects, including a project to improve water supply and sanitation in the West Bank and Gaza Strip.

“For scientists interested in pursu- ing careers in international develop- ment and science diplomacy, Abra- ham suggests getting involved with organizations like the AASAS and Engineers Without Borders, which she participated in as a grad- uate student at the University of Texas. “It’s important to get involved with organizations and scientists and engineers and communities and in international development,” she says. “My career path has been to start with science and go on to diplomacy.”

“I think it’s really important to build upon one’s existing network,” Abraham says. “If you’re working in the STEM fields, try to get involved with organizations and scientists and engineers and communities and in international development.”

ANNOUNCEMENTS

Distinguished Traveling Lecturer Program (DTL)
Laser Science
Help convey the excitement of laser science to undergraduate students

For a list of lecturers for 2014/2015, see www.physics.sdsu.edu/~anderson/DTLlecturers.html

http://physics.sdsu.edu/~anderson/DTL

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ied, the largest of these icebergs may be up to about one kilometer tall, two kilometers wide, and 500 meters thick as they break off from the glacier. According to work published in 2012 in the Journal of Geophysical Research: Earth Surface, Burton et al. show that the iceberg takes a few minutes to make the 90 degree adjustment, but in that time it will release the energy equivalent to two Hiroshima nuclear bombs, or 40 kilotons of TNT. There are multiple forces at work when an iceberg forms. As the bottom half swings up, the top half exerts a contact force against the glacier. But Burton and his collaborators have shown that the contact force on the glacier is larger when hydrodynamic forces are included in the calculation. This is due to various effects of the water on the system. For example, the iceberg’s rotation away from the glacier creates suction between the two surfaces, creating a force in the opposite direction from the contact force.

Other scenarios may be involved. A group at Harvard University, led by James R. Rice, showed that it is possible to replicate the seismic signals without hydrodynamic forces, but it requires that the iceberg push off of other icebergs, which must lie directly in front of it. Burton is now investigating how the sea waves created by this violent rotation may also contribute to seismic activity. In work he is preparing for publication, Burton says his laboratory experiments suggest that the period of the waves created by a calving iceberg could match the period of the seismic data. While the calving of a large iceberg may last a few minutes, seismic events often continue long after that. This longer time period could be explained by the waves.

Minor seismic activity can be detected as a result of waves pounding on shorelines, so the idea is not unfounded. In addition, the setting is unique. The glacier is a straight cliff face, stretching roughly a kilometer down into the ocean. Waves striking the vertical face could potentially transfer their energy directly into the glacier, as opposed to a horizontally inclined shore, where the wave would be broken up and the energy would be more dispersed. “I guess it’s just really surprising if an ocean wave like this can produce seismic waves that are detected globally,” said Jason Amundson, a glaciologist at the University of Alaska Southeast and an occasional collaborator with Burton. “On the other hand, this is a wave hitting a vertical face, so it’s a different type of problem than seismologists usually think about.”

If Burton’s hypothesis proves correct, it would be a situation where water waves cause seismic waves. “Which is weird,” he says, “because it’s usually the other way around.” The scientists studying iceberg calving are primarily glaciologists and geophysicists. For that reason, a discussion of the hydrodynamics involved in this process has to come from outside sources, such as physicists like Burton. “Nobody knew how to think about [the hydrodynamics] and it really took these experiments to figure out where they were important,” said Burton in an interview. “In fact we didn’t know that they were important until we couldn’t modell the data without turbulent forces in the water. So most people would agree that they’re important.”

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soon start to disassemble the machine after workers finish cataloging and locating buyers for some of the more valuable parts.

“There are a few instruments that we hope to send to a happy home,” said Mary Saffaon, the center’s beam manager.

Many of the center’s technicians like Severson are staying on to help the decommissioning process. However in a few months everyone employed by the center will have to start looking for new jobs.

“Closure of the facility was a possibility but not a certain thing until this month,” said Ken Jacobs, the head of the accelerator development division and a 12-year vet eran of the lab. He’s been looking around for somewhere in the Midwest to go next, but there’s a limited number of places where he can apply his expertise.

“It’s sort of a highly specialized field and there aren’t very many accelerators around,” Jacobs added.

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12 kilometers up the road offers the nation’s reactors.

Giants neutrino detectors could be built within the borders of a country to keep tabs on the reactors of a nearby nation hostile to inspections. Based on the detected neutrino signature, monitors can discern what is happening inside of that nation’s reactors.

“If an unfriendly nation is producing plutonium, they will typically run their reactor in a specific cycle,” Vagins said. “What we want to really determine is how well we can see this on-off cycle.”

Because neutrinos only weakly interact with matter, nonproliferation monitors will need massive water detectors to analyze reactors at long distances. When an antineutrino strikes an atomic nucleus, it emits a tiny flash of light, which propagates through the clear water and can be picked up by sensitive photodetectors. But this is rare, so large volumes of water are needed to see the effect at all.

The prototype the collaboration hopes to complete by 2016 will use a few thousand tons of water spliced with gadolinium to observe reactors a dozen kilometers away. They predict that detectors engaged in nonproliferation monitoring would need about a million tons of water to observe reactors 400 kilometers away.

The collaboration hopes to build the prototype at the Fairfield Salt Mine outside of Cleveland, Ohio, once the home to the world’s first water neutrino detector.

“The mine is still active. The area used by scientists, the instrumented cavern, has remained unused for many years,” Vagins said. The Perry Nuclear Power Plant

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their home communities. Message Four: We must make graduate education more attractive to American students by providing the funds required for world-class university research programs and science instrumentation.

Having the messages is essential, but convincing students and scientists who can communicate them is just as important. Unfortunately, all too often, scientists who are at the top of their game in the laboratory are woefully lacking in basic communication skills. But there is hope.

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When we think of large-scale international scientific facilities, CERN comes to mind as a prime example. The discovery of the Higgs boson captured the imagination of the general public worldwide. However, it is this particular success of CERN may over-shadow the success and importance of many other national or international large-scale facilities, which are changing the scientific practice and discourse in a fundamental way. Several examples come to mind, including established photon and neutron sources in Europe, and notably the first synchrotron light source in the Middle East, SESAME in Amman, Jordan. Furthermore, many of the national facilities, such as the one we work at in the US, have considerable international participation and collaborations that make them truly international facilities. All have been responsible for big changes in the way science is done and how to do it. Oftentimes, this may even include the roles and responsibilities of international scientists, which it takes a decade or two from the original idea to operation, but these projects are always very successful, despite initial difficulties. Another common aspect of these facilities is that they exceed the performance of their predecessors by several orders of magnitude in terms of number of photons, neutrons, protons, or ions on the sample, in terms of their frequency range, and in terms of other aspects like spatial and temporal coherence, pulse duration, and polarization.

Several factors play a role in the success or failure of these facilities. Each new generation machine has to be built quickly enough so that there is continuity between the young and the old researchers, and yet late enough to capture substantial technological advancements that have taken place. There is a need to have a wide and competent scientific user community to invent new techniques and explain the scientific and societal needs for a new generation machine. Along the way, old rivalries, perceived national competition, and the sheer ambition and determination of a few individuals all influence the process.

Research and development work about international facilities

The need for new-generation synchrotron radiation and neutron sources has been articulated several times in recent years in scientific case reports [1-4], as well as in national strategic documents. If there is given sufficient time and proper resources are provided, a healthy mix of parameters emerge, ensuring the future success of the project in terms of its scientific impact and potential reach of the targeted user community. Significant research and development funds should be made available to explore the outer boundaries of several key experimental methods and accelerator components, with strong international participation. As far as SESAME is concerned, the situation was far more “interesting” because the collaborating countries had and continued to have distinctly different foreign policy priorities. To mention the countries of Iran, Israel, Palestine, Turkey, Egypt and Jordan in one breath explains why the characterization “interesting” is an understatement. The ebbs and flows between 1999 and 2013 have left many participants who wanted to return. In fact, some of the best practices learned in these facilities migrate back to other countries. For example, the Super Photon Ring-8 (SPRing-8) facility has adopted an international scientific advisory board, a first in Japan. Facilities like Advanced Photo Source (APS) in the USA, Electron Synchrotron Radiation Facility (ESRF) in France, SPring-8, and Positron-Electron Todd Ring Accelerator (PETRA III) in Germany hold regular annual meetings to exchange ideas, and develop joint projects.

The instruments evolve and change, sometimes completely; the seeds of the new-generation machines are sowed.

International scientific activities promote understanding and friendship among people from different countries, religions, races, and even peace, as well as science. Scientists trained in these facilities become leaders of their own countries after their return. In fact, some of the best practices learned in these facilities migrate back to other countries. For example, the Super Photon Ring-8 (SPRing-8) facility has adopted an international scientific advisory board, a first in Japan. Facilities like Advanced Photo Source (APS) in the USA, Electron Synchrotron Radiation Facility (ESRF) in France, SPring-8, and Positron-Electron Todd Ring Accelerator (PETRA III) in Germany hold regular annual meetings to exchange ideas, and develop joint projects.

What I learned working at a large scientific facility is that one needs a constant flow of well-trained scientists, engineers, and technical support, an engaged scientific user community that has a vested interest in the design and operation of the instruments, and efficient managers who are well versed in the field of practice. Equally important is the public support at the level of local mayors, congressmen, business leaders, and at the national and international level, support of funding managers and law makers. This cannot be done by only national means. We need strong international participation to sustain these magnificent facilities of discovery and learning.

Esen Ercan Alp is a senior scientist at the Advanced Photon Source Argonne National Laboratory. He will be chairing the Forum on International Physics in 2014. The photo was shot by Esen Ercan Alp.

References
2. A series of conceptual and technical design reports on EuroXFEL can be found at http://www.eu XFEL.eu/documents/technical_documents
5. Accelerators for America’s Future: http://www.acceleratorsamerica.org/reports
6. ESRF upgrade program for 2009-2018 is described at http://www.esrf.eu/about/upgrade

APS News welcomes and encourages letters and submissions from its members responding to these and other issues. Responses may be sent to: letters@aps.org

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International Science Changes the Scientific Discourse

By Esen Ercan Alp

Technical Director Dieter Einfeld (left) and Esen Ercan Alp (right) inside SESAME in Amman, Jordan. Photo courtesy of Esen Ercan Alp.

There are also benefits to the culture of science. On the experimental floor, the most valuable contributors are the ones who actually know what to do and how to do it. Offentimes, this may even include individuals from different fields and different generations. The culture of science is changing and sometimes completely; the seeds of the new-generation machines are sowed.

International activities promote understanding and friendship among people from different countries, religions, races, and even peace, as well as science. Scientists trained in these facilities become leaders of their own countries after their return. In fact, some of the best practices learned in these facilities migrate back to other countries. For example, the Super Photon Ring-8 (SPRing-8) facility has adopted an international scientific advisory board, a first in Japan. Facilities like Advanced Photo Source (APS) in the USA, Electron Synchrotron Radiation Facility (ESRF) in France, SPring-8, and Positron-Electron Todd Ring Accelerator (PETRA III) in Germany hold regular annual meetings to exchange ideas, and develop joint projects.

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