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FACULTY newsletter

CPMS Physical and Mathematical Sciences

The Solid Facts About Melting Ice

Photo courtesy of Rita Willaert

"Just to orient us," Dr. Eric Steig began, "Arctic means bear. It is the place where there are bears. Antarctica, therefore, means 'No Bears!' Those of you who did not know this, tell people. It drives us crazy to go to Antarctica and come home to 'How were the polar bears?'"

This was the first of many misconceptions about the polar regions that Steig, a visiting geology professor from the University of Washington, cleared up at the Quey Hebrew Memorial Lecture on Thursday, March 21.

Students packed the auditorium to capacity to hear Steig discuss his research on climate change and Steig is no novice on the subject.

In 2009, his research on melting ice sheets in Antarctica made the cover of Nature, raising waves across the scientific community. He is the director of the Quaternary Research Center, an organization dedicated to studying the ice ages and interglacial periods, and he has published over 90 peer-reviewed articles from his research.

Despite his expertise, Steig started his lecture with the basics.

"On the scientific side, the big difference between the Arctic and the Antarctic is that one is ocean and the other is land. The Arctic is covered in sea ice."

Data measuring levels of Arctic sea ice, frozen seawater that floats above the ocean, over the past thirty years reveal that it has been rapidly shrinking along with rising temperatures.

At this rate, according to Steig, "A future with no [summer] sea ice in some of our lifetimes and certainly that of our children is quite likely."

Polar bears, who live on sea ice, will be forced to adapt to their disappearing habitat. Bigger storms, which some recent research suggests is more likely in years with lower sea ice, may also result. And as new sea routes open around the Arctic, shipping routes and politics in the region will change.

On the other side of the world, in

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A Singular Discovery: Geometry Answers Physics Problems

"When people say, 'So what are you working on? Can you explain it?' my wife just laughs. 'No, he can't. Sorry. You'll never know what he does,'" joked mathematics professor Tyler Jarvis.

Jarvis's latest research, which was recently accepted for publication in one of the most prestigious mathematics journals in the world—Annals of Mathematics, is a little complicated, but it's making waves not only in the world of mathematicians but with physicists as well.

For many years, physicists have studied surfaces to try and understand how particles and quantum fields interact, but some aspects of their work lacked a solid mathematical foundation. They

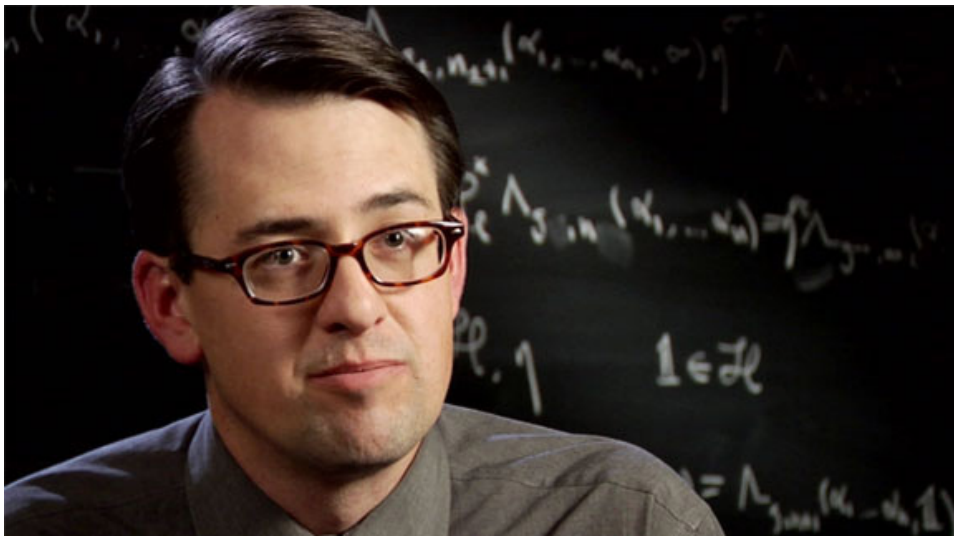

Photo courtesy of BYU Math Department

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Japanese Visitors Welcome Quality Math Instruction

Photo courtesy of Brian Shaw

Many students would agree that math is a tricky subject. Especially in middle and high school, math can seem almost incomprehensible. By figuring out some of the attributes that determine quality mathematics instruction, this problem may have a solution.

Professors from the BYU Department of Mathematics Education and from several universities in Japan have been comparing, contrasting, and learning from each nation's differing styles of teaching.

Many of these Japanese professors spent a week in Utah visiting various schools and discussing with the Department of Mathematics Education how they could collaborate and help each other master math teaching.

One of the visitors, Professor Hiro Ninomiya from Hokkaido University of Education said, "Some things that seem natural, or obvious, to Americans are new and different to Japanese," said Professor Ninomiya, "and what is natural to a Japanese person is new to an American."

Professor Blake Peterson, from the BYU math education department, agreed:

"One of the big benefits of looking at math education in other countries is that it gives us a different lens with which to look at math education in the U.S.," he said.

Not surprisingly, there are many differences between the two countries, but not in the ways you might think.

Professor Kazuhiko Souma, who is well known in Japan for being an advocate of teaching math through problem-solving, said that he was impressed with another key difference: teacher and student interaction, especially at higher levels of education.

"In Japan, high school classes are largely lecture-based, yet in America, even at the university level, students are still asking many questions."

Professor Souma thinks this might be related to the separation of students in Japan into different types of high schools based on entrance exam scores. This practice differs from the U.S., where students are all taught together, for the most part, regardless of their individual strengths at school.

There was also much to learn from the Japanese mathematics teachers. According to Professor Peterson, "Their board work is impeccable. All of the key points that come out in the lesson... are carefully written on the board."

The Japanese professors related a mathematics lesson to a journey up a mountain. The teacher should walk with the students to the summit, but too often teachers put the students on a lift to the top and shortcut the process by just telling the students what steps to follow. As a result, students may reach a different goal at the top.

Even from these few insights however, the professors felt that as they said goodbye and sayonara, they were one step closer to bidding farewell to some of the difficulty in math education.

The research and collaboration is still far from over and the Japanese professors look forward to additional visits.

by Brian Shaw

Students Learn the Art of Presentation at SRC 2013

Hundreds of students gathered to the Jesse Knight Building on Saturday March 9 for the 27th annual Student Research Conference (SRC) sponsored by the College of Physical & Mathematical Sciences. While there, students had the opportunity to present their undergraduate and graduate research and learn from their peers.

The SRC, which began twenty-seven years ago as a small gathering of students and professors in only two classrooms, has now expanded to occupy an entire building. This year, the conference hosted 373 student presentations on everything from kidney cancer to forgery detection.

One of the key purposes of the SRC is to give students valuable experience presenting in a professional atmosphere to their professors, peers, visitors and members of the CVLC (College Volunteer Leadership Council), who participated in the conference as session chairs.

Presentations can be a challenge. Students are given only 12 minutes to present, which requires them to carefully select points from their research and hone their presentation skills.

According to Kerissa Poulson, who presented on LDS pioneer mortality, presenting was a great opportunity to assess the progress of her research and share her excitement for the project.

"I have a strong enthusiasm for my research, and I want others to not just understand what I've been working on but hopefully spark their interest so they can share my excitement. The SRC provided a perfect venue to practice and develop those essential skills of communication."

Brittany Spencer presented research on classifying supernovas, but for her, the best part of the SRC was listening to her classmate's presentations.

"It was extremely interesting to hear what everyone else had been working on and to see the innovative ways they were approaching difficult problems."

From the hundreds of students who presented their research, 49 papers were selected as the "2013 SRC Session Winners."

Among these winners was William Rankin, who presented his research on the "Formation of Zinc Oxide Nanostructures into Hexagonal Prisms."

Said Rankin, "Last year I presented on a project that I had only worked on for a few months. This year I was able to present on a project that I have been working on for over a year. I helped start this project, and I personally contributed to most of the research. I am really passionate about it, and I loved

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Dates to Note

Commencement
Thursday, April 25
4 p.m., Marriott Center
Faculty should line up in the parking lot north of the ASB at 3:15 p.m.

Convocation
Friday, April 26
8 a.m., WSC Ballroom
Faculty should line up in the Garden court at 7:30 a.m.

Chemistry Open Lab Day
Saturday, May 11 and May 18
10 a.m.-1 p.m.
Orientation: W140 BNSN

Astrofest
Saturday, May 18
10 a.m.-4 p.m., ESC

College Grants

Not yet available

Information will be added once it is received later in the week.

Research Development

NSF Grants Conference and Proposal Preparation Webinars

The NSF Grant Conference held in March and October provides the most up-to-date information about NSF funding programs and priorities, policy updates, procedures for submitting grants and detailed information about each directorate. Notes about the March 2013 conference, as well as, conference briefings are available on the ResDev website *here*.

Also, NSF Interactive Webinars on proposal preparation topics will be broadcast to the ESC Conference Room, N181D - Goals and Expected Outcomes, April 18 (1-3 pm); Proposal Strategy, April 23 (11 am -1 pm); Project Evaluation, April 24 (1-3 pm); Broader Impacts, April 30, 2013 (1-3 pm); and Impact and Transportability, May 1 (3-5 pm). Those interested in submitting NSF proposals should consider attending.

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Antarctica, ice sheets are thinning, especially in regions around the coast. And the rate at which these sheets are thinning is quite fast.

Steig notes that this rapid melting is connected to global warming not because increased CO2 levels have made things warmer, but because of the way in which it has influenced air pressure in the atmosphere. This change in pressure and air circulation has brought warm air onto the Antarctic continent. It also affects ocean circulation, which brings warm water to the margin of the ice sheet.

Though this has been apparent for the past twenty years, Steig cautions that this may not be a trend. According to Steig, there simply isn't enough data to tell whether this will continue. It will take another twenty years of data to better see if this is long-term.

As the lecture ended, Steig noted that much remains unknown in this interesting area of study. In fact, he concluded that in the future economics and politics in the Arctic will play as big a role or an even bigger one than climate, at least for the next few decades.

"I was in a meeting with some oil executives, and I asked this guy, 'Are you going into the Arctic because the sea ice is melting?' And he said, 'Absolutely not. The sea ice is melting, but it is economics that are driving our activities. The sea ice loss changes our operations, but it doesn't motivate our operations."

by Carly Huchendorf

Tyler Jarvis continued from page 1

made rough arguments for why things should behave a certain way, but the mathematical tools to confirm whether their ideas were correct didn't exist.

"Theoretical physicists conjectured that there should be four different ways of thinking about these interactions. Two of these theories are well known, like Gromov-Witten Theory and the Landau-Ginzberg 'B-model.' The other two, they postulated, should exist, but until recently, no one had any idea how to fill them in," said Jarvis.

From 2001 to 2008, Jarvis and a team of mathematicians and physicists built the mathematical groundwork to change that. Their extensive research filled in one of these unknown theories with what is now called the Fan-Jarvis-Ruan-Witten Theory.

By establishing their theory, Jarvis and his collaborators formed the mathematical foundation necessary to begin studying the physics of singularities—defined by Stephen Hawking as "a point in space-time at which the space-time curvature becomes infinite," much like the tip of a cone. This, in turn, will help physicists to further understand particle interaction.

"The hope is that [this] theory provides a simpler way of understanding aspects of quantum interactions. By clarifying how singularities and symmetries work, we made it easier to understand how particles and fields interact, which ultimately tells us something about a fundamental aspect of physics."

This isn't the first time that Jarvis has crossed disciplines to solve a problem. In fact, he has always enjoyed using geometry to find solutions to questions in physics. For Jarvis, part of the joy in math comes through applying it to other realms.

"I like the fact that mathematical tools aren't just something to be used in the abstract. Yes, they are beautiful in their own right, but they can also be used to solve problems that many other people are interested in. They can tell us something deep about the nature of the universe."

by Carly Huchendorf

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the opportunity to share."

Associate Dean Thomas Sederberg believed this year's conference was successful in offering students a professional sphere to present their work.

"I was personally able to attend a few talks from each of the seven departments, and was very impressed by the quality of the research, and the professionalism of the presentations. The scientific training and communication skills on display will serve these students very well in their future careers."

by Carly Huchendorf

College Publications

Chemistry and Biochemistry

J. L. Andersen, S. Kornbluth, "The Tangled Circuitry of Metabolism and Apoptosis", *Molecular Cell*, 2013, volume 49/issue 3, pp. 399-410

J.A. Contreras, A.L. Rockwood, H.D. Tolley, M.L. Lee, "Peak Sweeping and Gating Using Thermal Gradient Gas Chromatography", Journal of Chromatography A, 2013, volume 1278, pp. 160-165

A. Wang, H.D. Tolley, M.L. Lee, "Gas Chromatography Using Resistive Heating Technology", Journal of Chromatography A, 2012, volume 1261, pp. 46-57

A.C. Pearson, S. Jamieson, M.R. Linford, B.M. Lunt, R.C. Davis, "Oxidation of Grapheme 'Bow Tie' Nanofuses for Permanent, Write-Once-Read-Many Data Storage Device", Nanotechnology, 2013, volume 24/issue 13, pp. 1-7

R.K. Watt, "A Unified Model for Ferritin Iron Loading by the Catalytic Center: Implications for Controlling "Free Iron: during Oxidative Stress", Chembiochem, 2013, volume 14/issue 4, pp. 415-419

Y. Geng, A.C. Pearson, E.P. Gates, B. Uprety, R.C. Davis, J.N. Harb, A.T. Woolley, "Electrically Conductive Gold- and Copper-Metallized DNA Origami Nanostructures", Langmuir, 2013, volume 29/issue 10, pp. 3482-3490

S.J. Ness, R.R. Anderson, W. Hu, D.C. Richards, J. Oxborrow, T. Gustafson, B. Tsai, S. Kim, B. Mazzeo, A.T. Woolley, G.P. Nordin, "Weak Adsorption-Induced Surface Stress for Streptavidin Binding to Biotin Tethered to Silicon Microcantilever Arrays", Sensors Journal, IEEE, 2013, volume 13/issue 3, pp. 959-968

C.J. Woolstenhulme, S. Parajuli, D.W. Healey, D.P. Valverde, E.N. Petersen, A.L. Starosta, N.R. Guydosh, W.E. Johnson, D.N. Wilson, A.R. Buskirk, "Nascent Peptides that Block Protein Synthesis in Bacteria", PNAS, 2013, volume 110/issue 10, pp. E878-E887

D. N. Mortensen, D.V. Dearden, "Influence of Charge Repulsion on Binding Strengths: Experimental and Computational Characterization of Mixed Alkali Metal Complexes of Decamethylcucurbit[5]uril in the Gas Phase", Chemical Communications, 2011, volume 47, pp. 6081-6083

J.P. Wright, M.S. Heywood, G.K. Thurston, P.B. Farnsworth, "The Effects of Added Hydrogen on a Helium Atomspheric-Pressure Plasma Jet Ambient Desorption/Ionization Source", J. Am. Soc. Mass Spectrom. 2013, volume 24/issue 3, pp. 335-340

J.D. Kerby, R.T. Daly, D.E. Austin, "A Novel Particle Source Based on Electrospray Charging for Dust Accelerators and its Significance for Cosmic Dust Studies", Earth Planets Space, 2013, volume 65/issue 3, pp. 157-165

V. Gupta, N. Madaan, D.S. Jensen, S.C. Kunzler, M.R. Linford, "Hydrogen Plasma Treatment of Silicon Dioxide for Improved Silane Deposition", Langmuir, 2013, volume 29/issue 11, pp. 3604-3609

Mathematics Education

P.J. Rich, K.R. Leatham, G.A. Wright, "Convergent Cognition", Instructional Science, 2013, volume 41/issue 2, pp. 431-453

Physics and Astronomy

A.C. Pearson, S. Jamieson, M.R. Linford, B.M. Lunt, R.C. Davis, "Oxidation of Grapheme 'Bow Tie' Nanofuses for Permanent, Write-Once-Read-Many Data Storage Device", Nanotechnology, 2013, volume 24/issue 13, pp. 1-7

Y. Geng, A.C. Pearson, E.P. Gates, B. Uprety, R.C. Davis, J.N. Harb, A.T. Woolley, "Electrically Conductive Gold- and Copper-Metallized DNA Origami Nanostructures", Langmuir, 2013, volume 29/issue 10, pp. 3482-3490

Statistics

R. Day, H. Joo, A.C. Chavan, Y.A. Chen, D.B. Dahl, M. Vannucci, J.W. Tsai, "Understanding the General Packing Rearrangements Required for Successful Template Based Modeling of Protein Structure from a CASP Experiment", Computational Biology and Chemistry, 2013, volume 42, pp. 40-48

G.W. Fellingham, L.J. Hinkle, I. Hunter, "Importance of Attack Speed in Volleyball", Journal of Quantitative Analysis in Sports, 2013, volume 0/issue 0, pp. 1-10

J.A. Contreras, A.L. Rockwood, H.D. Tolley, M.L. Lee, "Peak Sweeping and Gating Using Thermal Gradient Gas Chromatography", Journal of Chromatography A, 2013, volume 1278, pp. 160-165

A. Wang, H.D. Tolley, M.L. Lee, "Gas Chromatography Using Resistive Heating Technology", Journal of Chromatography A, 2012, volume 1261, pp. 46-57

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