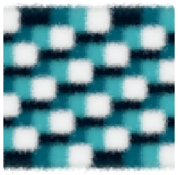

ParticleNews ParticleNews@hub.polari.us

The Global Community of Particle Physics

This account brings you hot items from public particle physics news sources, including CERN, SymmetryMagazine.org, and Interactions.org.

Putting rescue robots to the test, an ancient Scottish village buried in sand, and why costly drugs may have more side effects

4 days ago (2017-10-05T20:28:31Z) (https://hub.polari.us/ParticleNews/note/7AK6erOBSm-oqa3b3AFm0A) via NavierStokesApp To: Public

"Putting rescue robots to the test, an ancient Scottish village buried in sand, and why costly drugs may have more side effects"

This week we hear stories about putting rescue bots to the test after the Mexico earthquake, why a Scottish village was buried in sand during the Little Ice Age, and efforts by the U.S. military to predict posttraumatic stress disorder with Online News Editor David Grimm. Andrew Wagner interviews Alexandra Tinnermann of the University Medical Center of Hamburg, Germany, about the nocebo effect. Unlike the placebo effect, in which you get positive side effects with no treatment, in the nocebo effect you get negative side effects with no treatment. It turns out both nocebo and placebo effects get stronger with a drug perceived as more expensive. Read the research. Listen to previous podcasts. [Image: Chris Burns/Science; Music: Jeffrey Cook]

http://traffic.libsyn.com/sciencemag/SciencePodcast_171006.mp3 (http://traffic.libsyn.com/sciencemag/SciencePodcast_171006.mp3)

(Feed URL: http://www.sciencemag.org/rss/podcast.xml (http://www.sciencemag.org/rss/podcast.xml))

The Nobel Prize in Physics 2017

6 days ago (2017-10-03T10:29:25Z) (https://hub.polari.us/ParticleNews/note/314fwZ41TWmzJARGzeppRA) via NavierStokesApp To: Public

"The Nobel Prize in Physics 2017"

The Nobel Prize in Physics 2017 was divided, one half awarded to Rainer Weiss, the other half jointly to Barry C. Barish and Kip S. Thorne *"for decisive contributions to the LIGO detector and the observation of gravitational waves"*.

Read More ... (https://www.lngs.infn.it/en/news/the-nobel-prize-in-physics-2017)

https://www.lngs.infn.it/en/news/the-nobel-prize-in-physics-2017 (https://www.lngs.infn.it/en/news/the-nobel-prize-in-physics-2017)

(Feed URL: http://www.lngs.infn.it/en/news/rss (http://www.lngs.infn.it/en/news/rss))

Week 38 at the Pole

7 days ago (2017-10-02T19:29:24Z) (https://hub.polari.us/ParticleNews/note/gsHpMC_IRLi8RXDijmCSAg) via NavierStokesApp To: Public

"Week 38 at the Pole"

Last week we saw that someone had pulled up a chair to watch the sunrise, this week there are two. And these two people are actually watching the sun—it has been climbing higher and higher all week and is now officially up.

http://icecube.wisc.edu/news/view/535 (http://icecube.wisc.edu/news/view/535)

(Feed URL: http://icecube.wisc.edu/news/feed (http://icecube.wisc.edu/news/feed))

The IceCube Collaboration meeting begins in Berlin

7 days ago (2017-10-02T16:29:20Z) (https://hub.polari.us/ParticleNews/note/WKA5QzKDQYeWQWDtdRR_4Q) via NavierStokesApp To: Public

"The IceCube Collaboration meeting begins in Berlin"

The fall IceCube Collaboration meeting begins today in Berlin (Germany) hosted by the Humboldt University and DESY. More than 225 IceCube collaborators from around the globe will meet in person.

http://icecube.wisc.edu/news/view/536 (http://icecube.wisc.edu/news/view/536)

(Feed URL: http://icecube.wisc.edu/news/feed (http://icecube.wisc.edu/news/feed))

Stephen Sekula (https://hub.polari.us/steve) likes this.

ATLAS and CMS celebrate their 25th anniversaries

7 days ago (2017-10-02T14:29:15Z) (https://hub.polari.us/ParticleNews/note/QoOd_VdRQNO7flY8AjbrDg) via NavierStokesApp To: Public

"ATLAS and CMS celebrate their 25th anniversaries"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/10/cake-atlas-cms-25_0.jpg)
This special ATLAS and CMS birthday cake, baked and decorated by a member of the ATLAS collaboration, Katharine Leney, represents two event displays, one from each detector, in the icing. (Image: CERN)
ATLAS (http://home.cern/about/experiments/atlas) and CMS (http://home.cern/about/experiments/cms) are like close sisters, the best of friends and competitors all at once. Today they are both celebrating their 25th birthdays. On 1 October 1992, the two collaborations each submitted a letter of intent for the construction of a detector to be installed at the proposed Large Hadron Collider (http://home.cern/topics/large-hadron-collider) (LHC). These two documents, each around one hundred pages long, are considered the birth certificates of the two general-purpose experiments. They each contain fairly precise technical specifications, close to that of the two detectors that were eventually built, and an already long list of institutes and scientists that had joined the collaborations. The letters of intent for ALICE (http://home.cern/about/experiments/alice) and LHCb (http://home.cern/about/experiments/lhcb), the LHC's two other large experiments, followed a few months later.

Several months earlier, 600 physicists and engineers from 250 institutes around the world had met in Évian-les-Bains to discuss the physics and detectors of the LHC. Design proposals for various experiments were then made public. Carlo Rubbia, the Director-General of CERN at the time, proposed a schedule for selecting which experiments would go ahead, with letters of intent to be submitted for evaluation by a peer review committee. This resulted in the creation of the LHC Committee (LHCC), which began evaluating the proposals that autumn.

In June 1993, the LHCC gave the green light to the two general-purpose experiments, which then had to develop detailed technical proposals. This marked the start of a long and difficult journey that pushed the boundaries of technology and human endeavour, but which eventually led to a major discovery, that of the Higgs boson, and many other important results, the list of which keeps on growing.

- **Visit the ATLAS (https://atlas.cern/atlas25) and CMS (https://cms25.web.cern.ch/) websites to find out more about the events of the last 25 years.**
- **ATLAS has been organising a series of Facebook Live events today, with a Q&A session at 6pm CEST. Visit the ATLAS Facebook page (https://www.facebook.com/ATLASexperiment/).**
- **You can also read the ATLAS letter of intent (https://cds.cern.ch/record/291061/files/cm-p00043027.pdf) and the CMS letter of intent (https://cds.cern.ch/record/290808/files/cern-lhcc-92-003.pdf).**

http://home.cern/about/updates/2017/10/atlas-and-cms-celebrate-their-25th-anniversaries (http://home.cern/about/updates/2017/10/atlas-and-cms-celebrate-their-25th-anniversaries)

(Feed URL: http://home.web.cern.ch/about/updates/feed (http://home.web.cern.ch/about/updates/feed))

Tonight: Researchers' Night at CERN

1 week ago (2017-09-29T11:29:32Z) (https://hub.polari.us/ParticleNews/note/XAUtJHg4T1uxQqHDxvzKbA) via NavierStokesApp To: Public

"Tonight: Researchers' Night at CERN"

Laurianne Trimoulla (http://home.cern/authors/laurianne-trimoulla)

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/21951030_1461674847253189_1513623669460138645_o.jpg)
What do bioluminescence, body tech, robotics, liquid nitrogen and space have in common?

Researchers' Night at CERN. Tonight, CERN will be open to the general public to celebrate science, for the eighth year.

From 5 p.m. to 11 p.m. at the Globe of Science and Innovation (http://visit.cern/get-to-cern), visitors can program their own robot and be amazed by bioluminescence, watch science documentaries and prize-winning short films, and visit different parts of CERN.

Matthias Maurer, European Space Agency astronaut, and Mercedes Paniccia, Senior Research Associate for the AMS space experiment will debate "Why do science in space?" (in French, with English interpretation).

For those unable to travel to CERN, there will be virtual tours of experiments (http://cern.ch/go/RtN9) via Facebook Live (https://www.facebook.com/cern/) (available in several languages):

- 6 p.m. - CERN Data Centre, where all the data from all the experiments are stored and shared using the world's biggest computing grid for science. Tour in Finnish
- 7 p.m. - ALICE, the experiment that studies quark-gluon plasma, a state of matter thought to have existed just after the Big Bang. Tour in English
- 8 p.m. - CERN Control Centre, the nerve centre from which all of CERN's accelerators are controlled. Tour in English.
- 9 p.m. - LHCb, the experiment that seeks to understand why we live in a universe that appears to be composed of matter but no antimatter. Tour in Serbian.
- 10 p.m. - CMS, the experiment that, like ATLAS, is exploring the great issues of particle physics and co-discovered the Higgs boson in 2012. Tour in Lithuanian.

Full programme available at: http://cern.ch/nuit (https://l.facebook.com/l.php?u=http%3A%2F%2Fcern.ch%2Fnuit&h=ATMtyj57C3g7LTS-6lVL5CnUEP5Bh67PurXlc8y0FeDk9dgdgrHvc41vjnqg7gaDhQgjF5CC_fHgjgFrTq0ffWczZLJngqZt0ekVIPqu6zTWZyvYPpG3c35LPwVq1yjy2VbL2-h-5GVsJldZ7_ZcWlj4Vvy53Tm5Y_Xo9Cyrv1FeAfL4rlMw).

http://home.cern/about/updates/2017/09/tonight-researchers-night-cern (http://home.cern/about/updates/2017/09/tonight-researchers-night-cern)

(Feed URL: http://home.web.cern.ch/about/updates/feed (http://home.web.cern.ch/about/updates/feed))

Furiously beating bat hearts, giant migrating wombats, and puzzling out preprint publishing

1 week ago (2017-09-28T21:29:37Z) (https://hub.polari.us/ParticleNews/note/tlz--LUmTmilXl01iTYehQ) via NavierStokesApp To: Public

"Furiously beating bat hearts, giant migrating wombats, and puzzling out preprint publishing"

This week we hear stories on how a bat varies its heart rate to avoid starving, giant wombatlike creatures that once migrated across Australia, and the downsides of bedbugs' preference for dirty laundry with Online News Editor David Grimm. Sarah Crespi talks Jocelyn Kaiser about her guide to preprint servers for biologists—what they are, how they are used, and why some people are worried about preprint publishing's rising popularity. For our monthly book segment, Jen Golbeck talks to author Sandra Postel about her book, Replenish: The Virtuous Cycle of Water and Prosperity. Listen to previous podcasts. [Image: tap10/iStockphoto; Music: Jeffrey Cook]

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Conjuring ghost trains for safety

2 weeks ago (2017-09-28T18:29:29Z) (https://hub.polari.us/ParticleNews/note/mbANicocQ56AVuAWevKGjA) via NavierStokesApp To: Public

"Conjuring ghost trains for safety"

A Fermilab technical specialist recently invented a device that could help alert oncoming trains to large vehicles stuck on the tracks.

Browsing YouTube late at night, Fermilab Technical Specialist Derek Plant stumbled on a series of videos that all begin the same way: a large vehicle—a bus, semi or other low-clearance vehicle—is stuck on a railroad crossing. In the end, the train crashes into the stuck vehicle, destroying it and sometimes even derailing the train. According to the Federal Railroad Administration, every year hundreds of vehicles meet this fate by trains, which can take over a mile to stop.

"I was just surprised at the number of these that I found," Plant says. "For every accident that's videotaped, there are probably many more."

Inspired by a workplace safety class that preached a principle of minimizing the impact of accidents, Derek set about looking for solutions to the problem of trains hitting stuck vehicles.

Railroad tracks are elevated for proper drainage, and the humped profile of many crossings can cause a vehicle to bottom out. "Theoretically, we could lower all the crossings so that they're no longer a hump. But there are 200,000 crossings in the United States," Plant says. "Railroads and local governments are trying hard to minimize the number of these crossings by creating overpasses, or elevating roadways. That's cost-prohibitive, and it's not going to happen soon."

Other solutions, such as re-engineering the suspension on vehicles likely to get stuck, seemed equally improbable.

After studying how railroad signaling systems work, Plant came up with an idea: to fake the presence of a train. His invention was developed in his spare time using techniques and principles he learned over his almost two decades at Fermilab. It is currently in the patent application process and being prosecuted by Fermilab’s Office of Technology Transfer.

“If you cross over a railroad track and you look down the tracks, you’ll see red or yellow or green lights,” he says. “Trains have traffic signals too.”

These signals are tied to signal blocks—segments of the tracks that range from a mile to several miles in length. When a train is on the tracks, its metal wheels and axle connect both rails, forming an electric circuit through the tracks to trigger the signals. These signals inform other trains not to proceed while one train occupies a block, avoiding pileups.

Plant thought, “What if other vehicles could trigger the same signal in an emergency?” By faking the presence of a train, a vehicle stuck on the tracks could give advanced warning for oncoming trains to stop and stall for time. Hence the name of Plant’s invention: the Ghost Train Generator.

To replicate the train’s presence, Plant knew he had to create a very strong electric current between the rails. The most straightforward way to do this is with massive amounts of metal, as a train does. But for the Ghost Train Generator to be useful in a pinch, it needs to be small, portable and easily applied. The answer to achieving these features lies in strong magnets and special wire.

“Put one magnet on one rail and one magnet on the other and the device itself mimics—electrically—what a train would look like to the signaling system,” he says. “In theory, this could be carried in vehicles that are at high risk for getting stuck on a crossing: semis, tour buses and first-response vehicles,” Plant says. “Keep it just like you would a fire extinguisher—just behind the seat or in an emergency compartment.”

Once the device is deployed, the train would receive the signal that the tracks were obstructed and stop. Then the driver of the stuck vehicle could call for emergency help using the hotline posted on all crossings.

Plant compares the invention to a seatbelt.

“Is it going to save your life 100 percent of the time? Nope, but smart people wear them,” he says. “It’s designed to prevent a collision when a train is more than two minutes from the crossing.”

And like a seatbelt, part of what makes Plant’s invention so appealing is its simplicity.

“The first thing I thought was that this is a clever invention,” says Aaron Sauers from Fermilab’s technology transfer office, who works with lab staff to develop new technologies for market. “It’s an elegant solution to an existing problem. I thought, ‘This technology could have legs.’”

The organizers of the National Innovation Summit seem to agree. In May, Fermilab received an Innovation Award from TechConnect for the Ghost Train Generator. The invention will also be featured as a showcase technology in the upcoming Defense Innovation Summit in October.

The Ghost Train Generator is currently in the pipeline to receive a patent with help from Fermilab, and its prospects are promising, according to Sauers. It is a nonprovisional patent, which has specific claims and can be licensed. After that, if the generator passes muster and is granted a patent, Plant will receive a portion of the royalties that it generates for Fermilab.

Fermilab encourages a culture of scientific innovation and exploration beyond the field of particle physics, according to Sauers, who noted that Plant’s invention is just one of a number of technology transfer initiatives at the lab.

Plant agrees—Fermilab’s environment helped motivate his efforts to find a solution for railroad crossing accidents.

“It’s just a general problem-solving state of mind,” he says. “That’s the philosophy we have here at the lab.”

Editor's note: A version of this article was originally published by Fermilab (http://news.fnal.gov/2017/09/invention-help-avert-disaster-railroad-crossings/).

http://www.symmetrymagazine.org/article/conjuring-ghost-trains-for-safety?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/conjuring-ghost-trains-for-safety?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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Fermilab on display

2 weeks ago (2017-09-28T18:29:29Z) (https://hub.polari.us/ParticleNews/note/suOOTH_rRSuZDy09SUhiZg) via NavierStokesApp To: Public

"Fermilab on display"

The national laboratory opened usually inaccessible areas of its campus to thousands of visitors to celebrate 50 years of discovery.

Children at Fermilab open house learning more about science
Fermi National Accelerator Laboratory’s yearlong 50th anniversary celebration culminated on Saturday with an Open House that drew thousands of visitors despite the unseasonable heat.

On display were areas of the lab not normally open to guests, including neutrino and muon experiments, a portion of the accelerator complex, lab spaces and magnet and accelerator fabrication and testing areas, to name a few. There were also live links to labs around the world, including CERN, a mountaintop observatory in Chile, and the mile-deep Sanford Underground Research Facility that will house the international neutrino experiment, DUNE.

But it wasn’t all physics. In addition to hands-on demos and a STEM fair, visitors could also learn about Fermilab’s art and history, walk the prairie trails or hang out with the ever-popular bison. In all, some 10,000 visitors got to go behind-the-scenes at Fermilab, shuttled around on 80 buses and welcomed by 900 Fermilab workers eager to explain their roles at the lab. Below, see a few of the photos captured as Fermilab celebrated 50 years of discovery.

Fermilab employees Jemila Adetunji and Joel Kofron arrive on site excited to welcome thousands of visitors.
Fermilab photo archives

http://www.symmetrymagazine.org/article/fermilab-on-display?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/fermilab-on-display?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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Shining with possibility

2 weeks ago (2017-09-26T16:29:51Z) (https://hub.polari.us/ParticleNews/note/c48qcRlFTNmtkByYDZdu5Q) via NavierStokesApp To: Public

"Shining with possibility"

As Jordan-based SESAME nears its first experiments, member nations are connecting in new ways.

Early in the morning, physicist Roy Beck Barkai boards a bus in Tel Aviv bound for Jordan. By 10:30 a.m., he is on site at SESAME, a new scientific facility where scientists plan to use light to study everything from biology to archaeology. He is back home by 7 p.m., in time to have dinner with his children.

Before SESAME opened, the closest facility like it was in Italy. Beck Barkai often traveled for two days by airplane, train and taxi for a day or two of work—an inefficient and expensive process that limited his ability to work with specialized equipment from his home lab and required him to spend days away from his family.

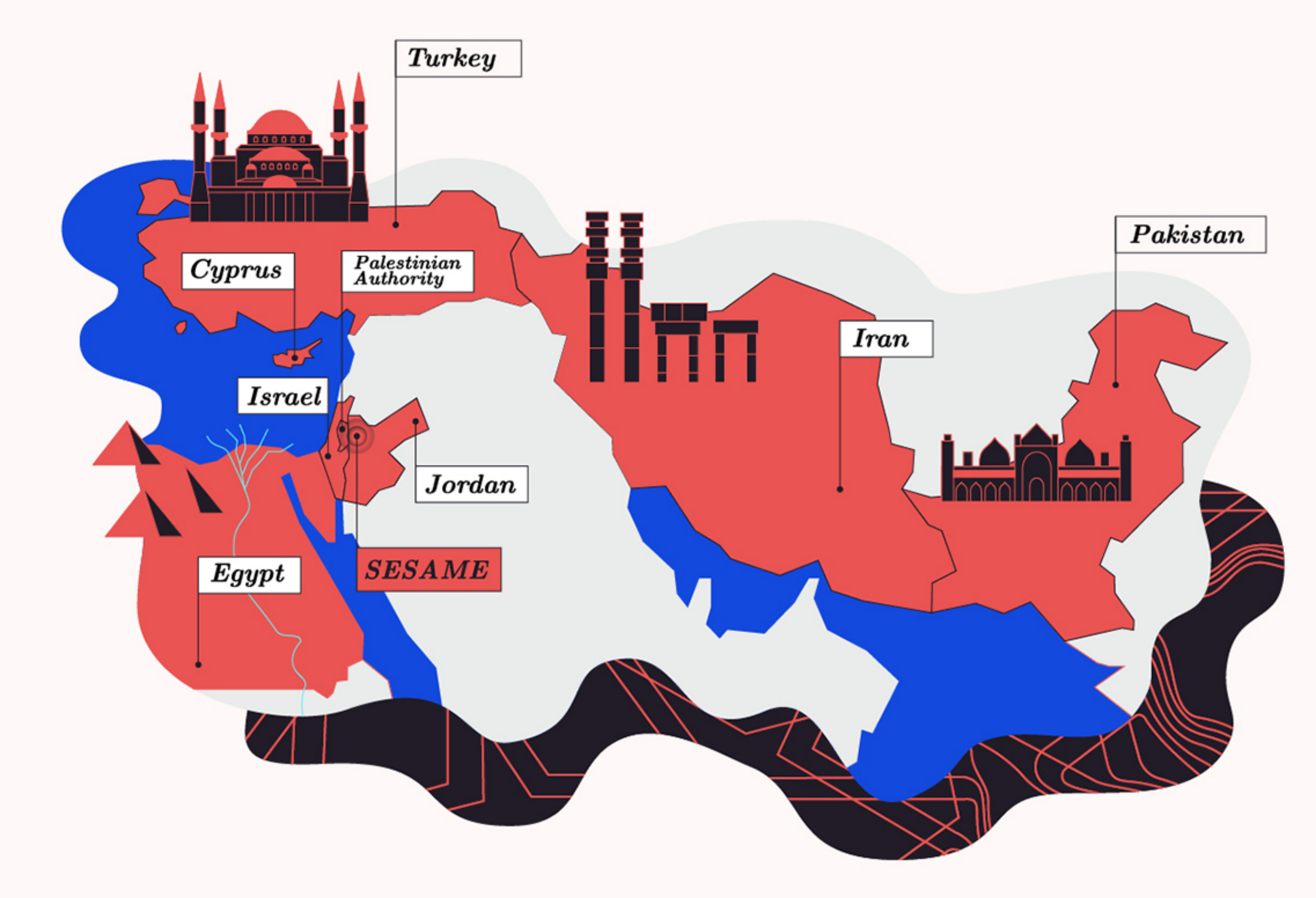
“For me, having the ability to kiss them goodbye in the morning and just before they went to sleep at night is a miracle,” Beck Barkai says. “It felt like a dream come true. Having SESAME at our doorstep is a big plus."

SESAME, also known as the International Centre for Synchrotron-Light for Experimental Science and Applications in the Middle East, opened its doors in May and is expected to host its first beams of particles this year. Scientists from around the world will be able to apply for time to use the facility’s powerful light source for their experiments. It’s the first synchrotron in the region and the first international research center in the Middle East.

Beck Barkai says SESAME provides a welcome dose of convenience, as scientists in the region can now drive to a research center instead of flying with sensitive equipment to another country. It’s also more cost-effective.

Located in Jordan to the northwest of the city of Amman, SESAME was built by a collaboration made up of the countries of Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Turkey and the Palestinian Authority—a partnership members hope will improve relations among the eight neighbors.

“SESAME is a very important step in the region,” says SESAME Scientific Advisory Committee Chair Zehra Sayers. “The language of science is objective. It’s based on curiosity. It doesn’t need to be affected by the differences in cultural and social backgrounds in these countries. I hope it is something that we will leave the next generations as a positive step toward stability.”



(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_1_A%20new%20light.jpg)
Artwork by Ana Kova
Protein researcher and a University of Jordan professor Areej Abuhammad says she hopes SESAME will provide an environment that encourages collaboration.

“I think through having the chance to interact, the scientists from around this region will learn to trust and respect each other,” she says. “I don’t think that this will result in solving all the problems in the region from one day to the next, but it will be a big step forward.”

The $100 million center is a state-of-the-art research facility that should provide some relief to scientists seeking time at other, overbooked facilities. SESAME plans to eventually host 100 to 200 users at a time.

SESAME’s first two beamlines will open later this year. About twice per year, SESAME will announce calls for research proposals, the next of which is expected for this fall. Sayers says proposals will be evaluated for originality, preparedness and scientific quality.

Groups of researchers hoping to join the first round of experiments submitted more than 50 applications. Once the lab is at full operation, Sayers says, the selection committee expects to receive four to five times more than that.

Opening up a synchrotron in the Middle East means that more people will learn about these facilities and have a chance to use them. Because some scientists in the region are new to using synchrotrons or writing the style of applications SESAME requires, Sayers asked the selection committee to provide feedback with any rejections.

Abuhammad is excited for the learning opportunity SESAME presents for her students—and for the possibility that experiences at SESAME will spark future careers in science.

She plans to apply for beam time at SESAME to conduct protein crystallography, a field that involves peering inside proteins to learn about their function and aid in pharmaceutical drug discovery.

Another scientist vying for a spot at SESAME is Iranian chemist Maedeh Darzi, who studies the materials of ancient manuscripts and how they degrade. Synchrotrons are of great value to archaeologists because they minimize the damage to irreplaceable artifacts. Instead of cutting them apart, scientists can take a less damaging approach by probing them with particles.

Darzi sees SESAME as a chance to collaborate with scientists from other Middle Eastern countries and promote science, peace and friendship. For her and others, SESAME could be a place where particles put things back together.

http://www.symmetrymagazine.org/article/shining-with-possibility?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click
(http://www.symmetrymagazine.org/article/shining-with-possibility?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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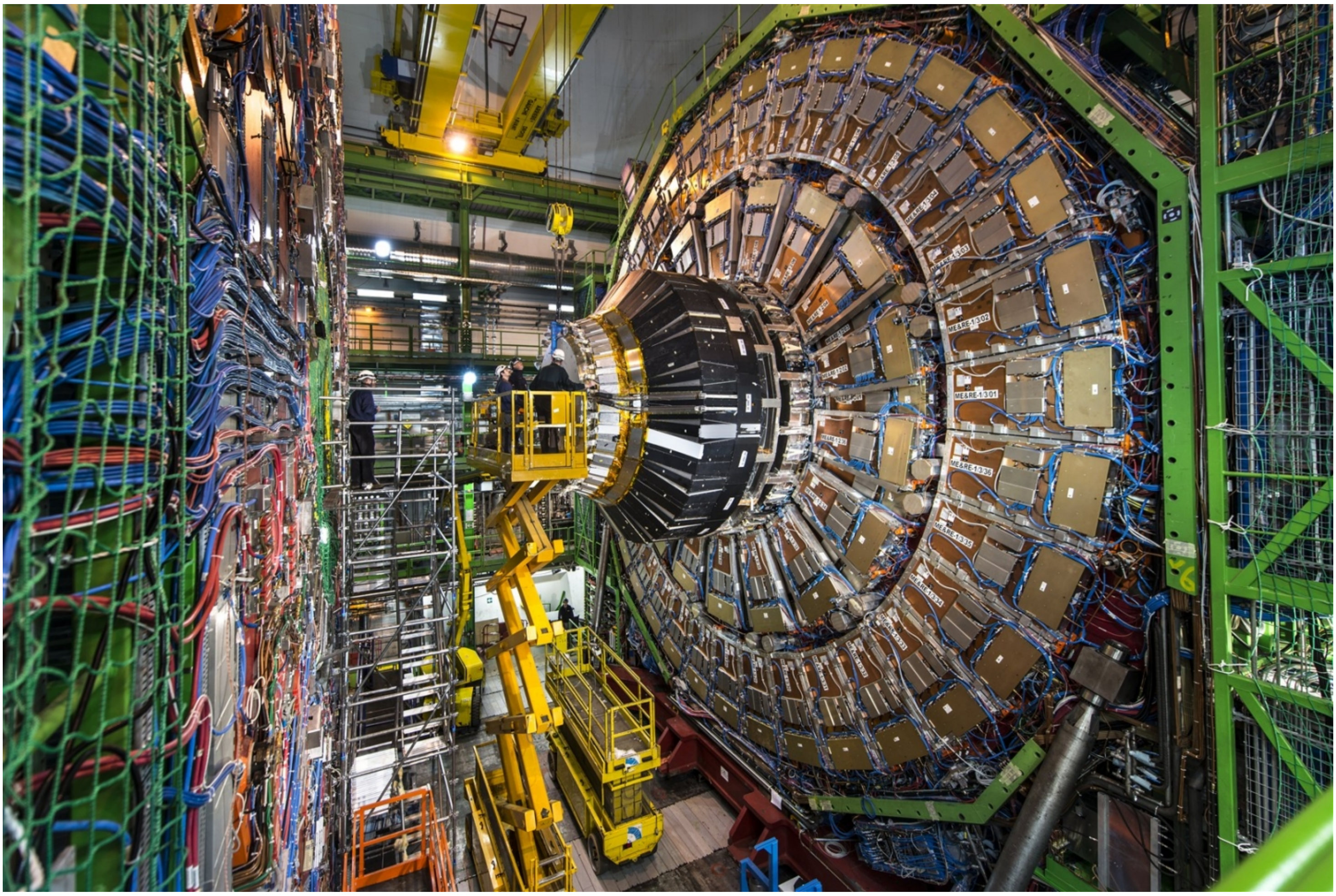
LHC rocks the seesaw model

2 weeks ago (2017-09-26T09:29:43Z) (https://hub.polari.us/ParticleNews/note/honEi_qOSBmz0q5ePY1pOA) via NavierStokesApp To: Public

"LHC rocks the seesaw model"

Matthew Chalmers (http://home.cern/authors/matthew-chalmers)



(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/1311292_01-a4-at-144-dpi.jpg)
Members of the CMS collaboration removing the preshower from ECAL detector in the CMS cavern. (Image: M Brice/CERN)
For most of us, seesaws are the stuff of childhood memories. For theoretical physicists, they could explain one of the biggest mysteries in the field: why are neutrinos so incredibly light?
Experiments at CERN's Large Hadron Collider (http://home.cern/topics/large-hadron-collider) have now put the unlikely sounding "seesaw model" through one of its most stringent tests.

Discovered 60 years ago, the neutrino was long thought to weigh nothing at all. But experiments in the late 1990s showed that neutrinos change type as they travel, implying that they have a small but non-zero mass. The mystery is why their masses are so small and yet not zero, as assumed by the Standard Model (http://home.cern/about/physics/standard-model) of particle physics. Most other elementary particles acquire their masses by interacting with Higgs bosons (https://home.cern/topics/higgs-boson): the stronger the interaction the heavier the particle. But many physicists think it a stretch – "unnatural" even – that the Higgs boson interacts so feebly with the neutrino as to leave it at least a million times lighter than the already waif-like electron.

The seesaw model, dreamed up in the 1980s, is an abstract ratio that connects normal neutrinos to an unseen breed of super-heavy particles with weird properties: the neutrinos we know on one end are pivoted up by heavier particles on the other end of the "seesaw". Were these mathematical gymnastics shown to be responsible for the neutrino's tiny mass, it would lead physicists to a rich landscape of new particles and phenomena beyond the Standard Model, perhaps even a unified theory of the fundamental forces.

Researchers on the CMS (https://home.cern/about/experiments/cms) experiment have been searching for signs of the neutrino's weightier partners among billions of proton-proton collisions produced by the LHC at an energy of 13 TeV. Specifically, they tested a version of the seesaw mechanism (called Type-III) that involves a triplet of two heavy charged particles and an additional neutral particle, which would reveal themselves in the CMS detector via their decays into more familiar objects such as Higgs bosons and electrons. Studies at the LHC have also probed the original Type-I seesaw mechanism, which requires a heavy "sterile" neutrino that does not interact at all with known matter.Such particles are the quarry of several dedicated neutrino experiments worldwide.

Building on previous search results obtained by CMS and its sister experiment ATLAS (https://home.cern/about/experiments/atlas) at lower collision energies, CMS reports no sign of heavy charged particles associated with the seesaw model and has ruled out their existence below a mass of 840 GeV. According to the team, these are the strongest constraints to date on the mass of Type-III seesaw particles. "We have now looked at all 27 relevant decay channels in a single multimodal analysis," explains CMS member Sunil Somalwar from Rutgers University in the US. "With the seesaw, the higher you set the masses of the new particles the smaller the neutrino mass – which is good. We are now getting into seesaw exclusions at the LHC."

CMS and ATLAS will subject the seesaw, and many other models of physics beyond the Standard Model, to further scrutiny as the LHC continues to amass data at a record-breaking energy of 13 TeV.

> Immerse yourself into the CMS detector and observe the installation of the new Pixel Tracker from within the underground experimental cavern with this interactive 360º photograph. (Image: Max Brice/CERN)

http://home.cern/about/updates/2017/09/lhc-rocks-seesaw-model (http://home.cern/about/updates/2017/09/lhc-rocks-seesaw-model)

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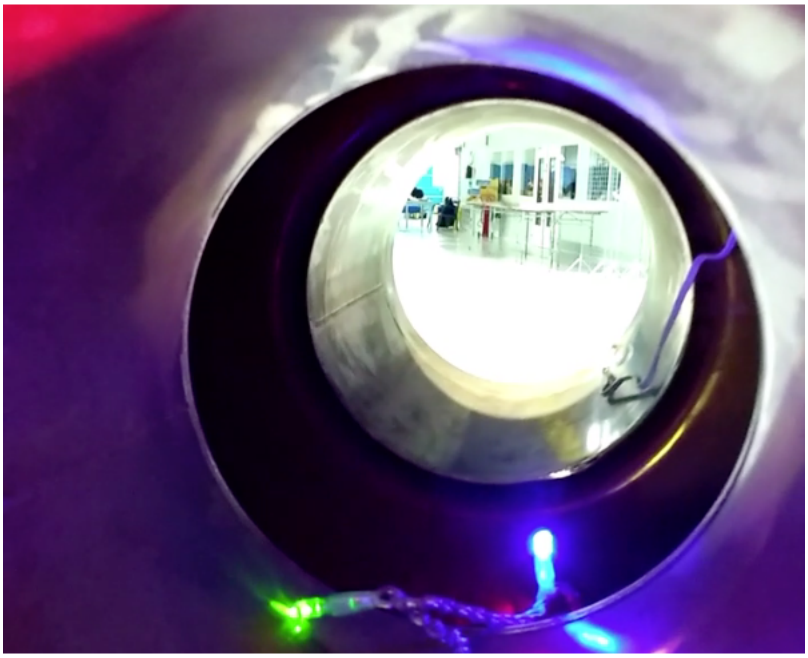
The melody of magnets

2 weeks ago (2017-09-25T15:29:43Z) (https://hub.polari.us/ParticleNews/note/v9H153SETOCBvp5cHQp0wg) via NavierStokesApp To: Public

"The melody of magnets"

Paola Catapano (http://home.cern/authors/paola-catapano)


(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/musical-cavity_0.png)
A superconducting cavity transformed into a musical instrument thanks to a sonification system. Mechanic transducers are placed in the cavity, making it vibrate at audible frequencies. (Image: Domenico Vicinanza/Anglia Ruskin University)
Have you ever listened to a superconducting magnet sing?

Superconducting magnets became part of the entertainment programme at CERN organized for the EUCAS 2017 conference (http://home.cern/about/updates/2017/09/magic-superconductors-spotlight) last week. Magnets that have made the history of superconductivity, from Tevatron's very first dipole to the very latest additions to the family (FRESCA 2 (http://home.cern/about/updates/2017/09/next-stop-superconducting-magnets-future) and the High Temperature Superconductor (http://home.cern/about/updates/2017/09/20-tesla-and-beyond-high-temperature-superconductors)) were on display in the huge magnet-testing facility and turned into musical instruments for the night.

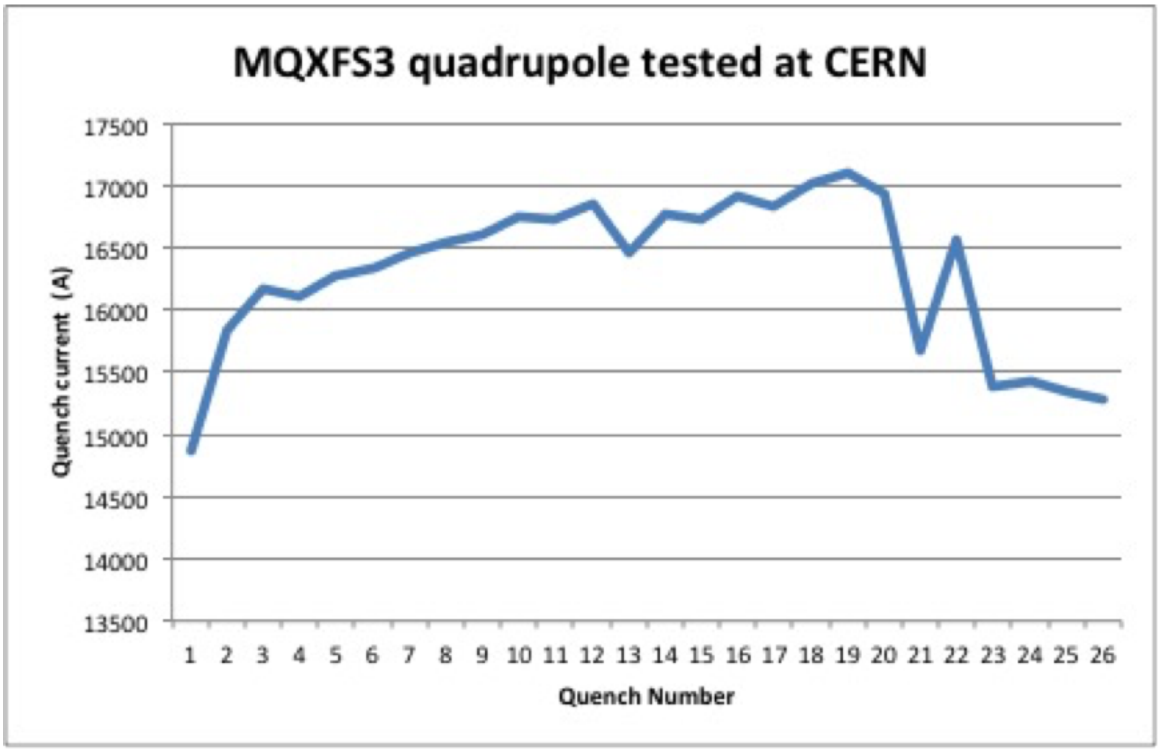
Sonification experts and scientists Domenico Vicinanza (Anglia Ruskin University, Cambridge) and Genevieve Williams (University of Exeter) placed mechanic transducers on superconducting magnets and cavities, making them vibrate at audible frequencies. The geometry, size and material of the magnets and cavities shaped these vibrations into unique sounds melodies that provided the ambient music for the evening.

Domenico also orchestrated a “Field Polyphony” by mapping graphs of superconducting magnet trainings to a music scale. The same sequence of notes was then used as the score for the closing concert of the event, played live with a cello, flute and clarinet.

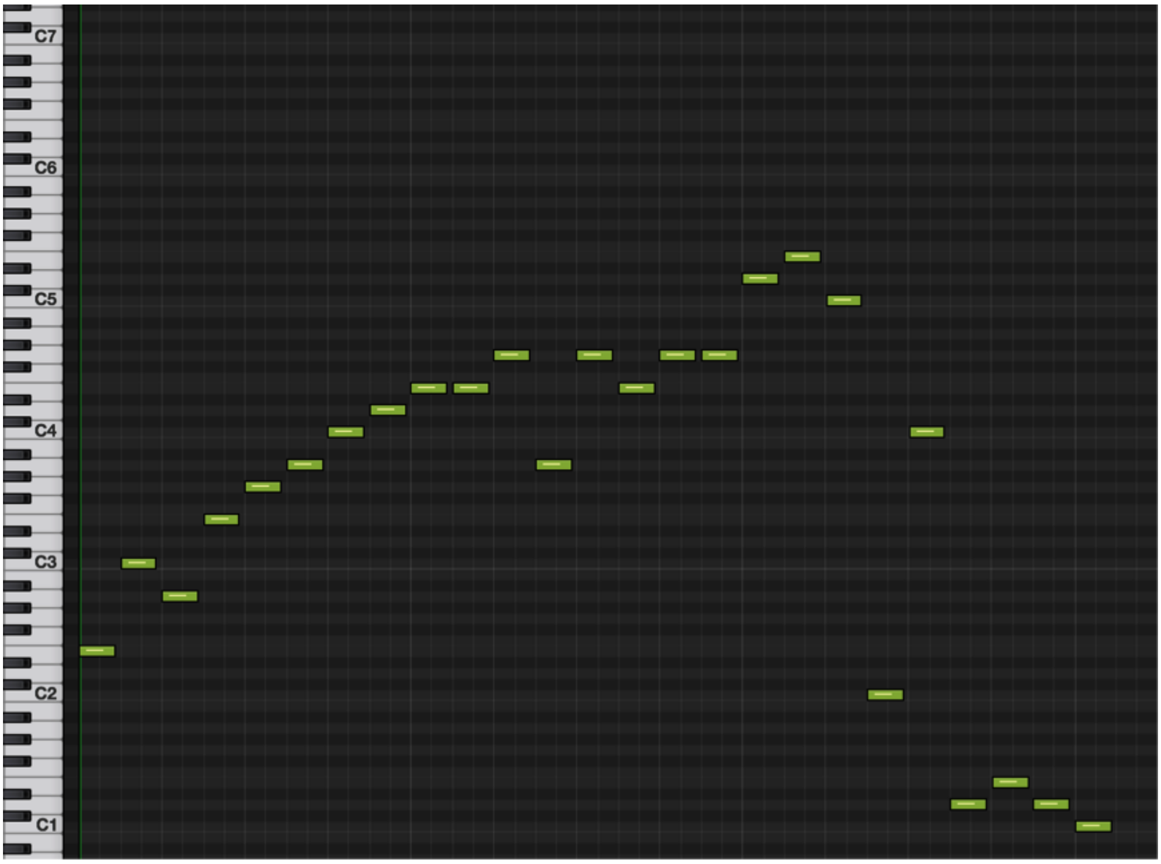
> Ambient music resulting from the sonification of a LHC dipole magnet. (Image: Maximilien Brice/CERN, Music: Domenico Vicinanza/Anglia Ruskin University and Genevieve Williams/University of Exeter)

> Music created from the sonification of a High-Luminosity LHC magnet training graph, as explained below. (Image: Maximilien Brice/CERN, Music: Domenico Vicinanza/Anglia Ruskin University and Genevieve Williams/University of Exeter)

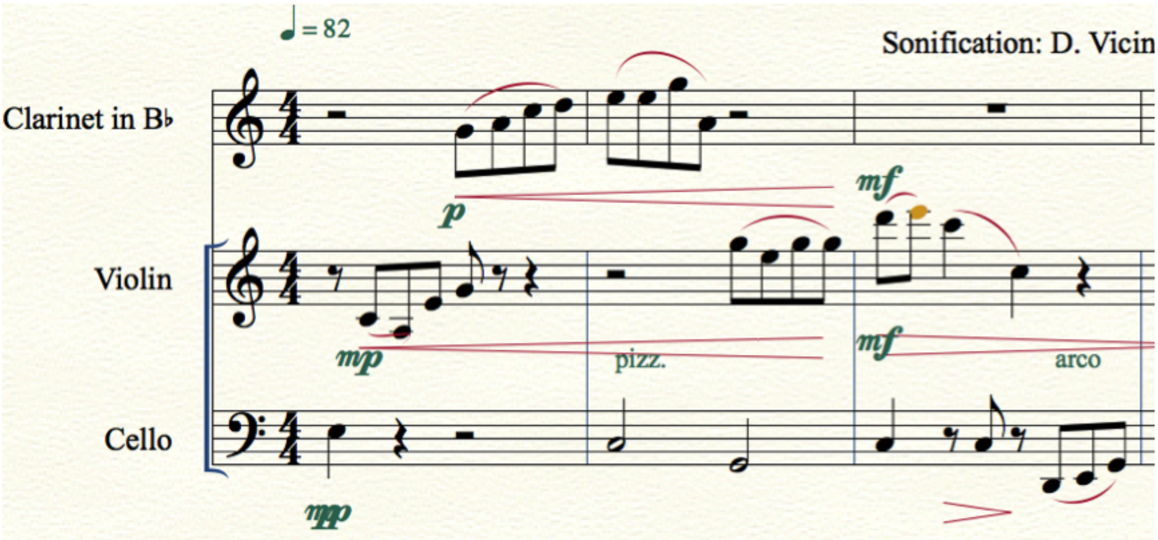
How does the sonification work?



The starting point is the graph above which shows magnet training. “Training” means that the current is gradually increased in the coils until the magnet quenches (http://home.cern/about/updates/2014/12/one-lhc-sector-full-energy) (suddenly returning to a non-superconducting state). This operation is repeated several times and produces this graph which was obtained with a quadrupole for the High-Luminosity LHC project.



The value of the quench current is mapped to a musical scale as seen in this image. The sequence of notes follows the same profile of the original graph.



The melody is finally orchestrated, for example by arranging it for violin, clarinet and cello as seen on this music score.

(Images: Domenico Vicinanza/Anglia Ruskin University and Genevieve Williams/University of Exeter)

http://home.cern/about/updates/2017/09/melody-magnets (http://home.cern/about/updates/2017/09/melody-magnets)

(Feed URL: http://home.web.cern.ch/about/updates/feed (http://home.web.cern.ch/about/updates/feed))

Looking for new physics in the neutrino sector

2 weeks ago (2017-09-25T13:29:36Z) (https://hub.polari.us/ParticleNews/note/y6a-VoWnSL--z_gvvUp9LA) via NavierStokesApp To: Public

"Looking for new physics in the neutrino sector"

In a new search for nonstandard neutrino interactions, the IceCube Collaboration has tested theories that introduce heavy bosons, such as some Grand Unified Theories. The study resulted in new constraints on these models, which are among the world’s best limits for nonstandard interactions in the muon-tau neutrino sector. These results have just been submitted to *Physical Review D*.

http://icecube.wisc.edu/news/view/533 (http://icecube.wisc.edu/news/view/533)

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Week 37 at the Pole

2 weeks ago (2017-09-22T21:29:45Z) (https://hub.polari.us/ParticleNews/note/4OijnE5MSxajEPa5Pr3Xug) via NavierStokesApp To: Public

"Week 37 at the Pole"

Their time at the Pole may be coming to an end, but apparently their beards are not! IceCube winterovers Martin and James are sporting some fine beards while they happily tackle their work in the dish pit.

http://icecube.wisc.edu/news/view/532 (http://icecube.wisc.edu/news/view/532)

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To 20 Tesla and beyond: the high-temperature superconductors

2 weeks ago (2017-09-22T13:30:05Z) (https://hub.polari.us/ParticleNews/note/lD75Y-rFSB6xlsaL2RS9rQ) via NavierStokesApp To: Public

"To 20 Tesla and beyond: the high-temperature superconductors"

Stefania Pandolfi (http://home.cern/authors/stefania-pandolfi)

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/cchts1_07_17.jpg)
Prototype “Roebel” cable based on the high-temperature superconductor ReBCO (rare-earth barium-copper oxide) is being used to wind a demonstration accelerator dipole at CERN as part of the EuCARD-2 project. (Image: H Barnard/CERN)

Future high-energy accelerators will need magnetic fields of 20 Tesla and above. In order to achieve this level of performance, a new technological leap is required after niobium-titanium (NbTi) and niobium-tin (Nb_3Sn) technologies (https://home.web.cern.ch/cern-people/updates/2016/07/once-upon-time-there-was-superconducting-niobium-tin) have reached their practical performance limits. The magnets of the future (https://home.web.cern.ch/about/updates/2017/09/next-stop-superconducting-magnets-future) will most probably be manufactured from high-temperature superconductors (HTS).

These materials are thus named because they exhibit superconducting behaviour at higher temperatures than niobium-titanium and niobium-tin, which are both known as low-temperature superconductors (LTS) and must operate at extremely low temperatures to reach and retain their superconductive state. In the LHC, the NbTi magnets are cooled to 1.9 Kelvin (–271.3 °C) using liquid helium as a coolant. Above a critical temperature and above a critical magnetic field, the superconductors fail to maintain their superconductive state, and stop operating correctly (they are said to undergo a “quench”). This is very undesirable behaviour for a magnet, because it results in the appearance of voltage and a rapid temperature increase, requiring quick detection so that the current can be turned off.

High-temperature superconductors exhibit very different properties from those of classical LTS. “High-temperature superconductivity was discovered more than 30 years ago, but only recently has the community made major steps forward,” says Glyn Kirby, lead engineer for HTS development in the Technology department.

Not only can HTS conductors retain superconducting behaviour up to around 100 Kelvin, but they can also bear a magnetic field much higher than 20 Tesla, which is the main factor of interest for the accelerator magnets of the future. Because the critical temperature is so high, the material has a very large operating margin, which is beneficial to avoid quenching and to increase the reliability of the magnet.

“For the moment, this technology is significantly more expensive than niobium-titanium and niobium-tin superconductors,” says Gijs De Rijk, deputy group leader of the Magnets, Superconductors and Cryostats group in CERN’s Technology department. “However, the raw material is not the dominant factor in the overall cost of the conductors, meaning they will potentially become less expensive when manufactured in large quantities,” he adds.

To explore the use of high-temperature superconductors in high field accelerator magnets for future particle accelerators, in 2013 CERN partnered with a European particle accelerator R&D project called EuCARD-2. The project involved 40 partners from 15 European countries including CEA (FR) (http://www.cea.fr/english), KIT (DE) (https://www.kit.edu/english/), University of Geneva (CH), University of Twente (NL) and Bruker HTS (DE). The aim of the project was to develop an HTS accelerator-quality demonstrator magnet, called Feather2, able to produce a standalone field of 5 Tesla, and between 17 and 20 Tesla when inserted into the Fresca2 high-field magnet (https://home.web.cern.ch/about/updates/2017/09/next-stop-superconducting-magnets-future). The first Feather2 magnet was built using an initial version of HTS conductor based on tapes of rare-earth barium-copper-oxide (generally referred as ReBCO). This was tested during the summer and achieved a standalone field of over 3 Tesla. The next magnet, based on high-performance ReBCO tape, is expected to exceed the 5 Tesla target by a significant margin, possibly approaching a field of 8 Tesla.

“Understanding and solving the issues related to the use of ReBCO wide tapes require novel approaches when it comes to cabling, coil-winding and magnetic field quality,” explains Kirby. “These require significant research and development before application in an accelerator becomes feasible, but HTS could revolutionise accelerator technology, and it is expected to have a major impact on other fields such as medical applications, magnets for high-field science, magnetically-levitated trains, space travel and fusion energy,” he concludes.

(http://cds.cern.ch/images/OPEN-PHO-ACCEL-2017-015-1)
Initial-development coil of new high-temperature superconductor (HTS) magnets based on ReBCO material (Image: Robert Hradil, Monika Majer/ProStudio22.ch)

This text is published on the occasion of the conference EUCAS 2017 (http://eucas2017.org/2017/) *on superconductors and their applications.*

http://home.cern/about/updates/2017/09/20-tesla-and-beyond-high-temperature-superconductors (http://home.cern/about/updates/2017/09/20-tesla-and-beyond-high-temperature-superconductors)

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Messaggeri di galassie lontane

2 weeks ago (2017-09-22T08:29:54Z) (https://hub.polari.us/ParticleNews/note/ywi5iPyGTny_kTfWn56EsA) via NavierStokesApp To: Public

"Messaggeri di galassie lontane"

PIERRE AUGER OBSERVATORY

I raggi cosmici di altissima energia provengono da galassie lontane e non dalla Via Lattea. Il risultato, pubblicato oggi su Science, arriva dall'Osservatorio Pierre Auger situato in Argentina, nella provincia di Mendoza e risponde a interrogativi che gli scienziati si pongono da mezzo secolo.

Read More ... (https://www.lngs.infn.it/en/news/messaggeri-galassie)

https://www.lngs.infn.it/en/news/messaggeri-galassie (https://www.lngs.infn.it/en/news/messaggeri-galassie)

(Feed URL: http://www.lngs.infn.it/en/news/rss (http://www.lngs.infn.it/en/news/rss))

Cosmic rays from beyond our galaxy, sleeping jellyfish, and counting a language's words for colors

3 weeks ago (2017-09-21T20:29:47Z) (https://hub.polari.us/ParticleNews/note/BnqQzHIDQFuKpGWV5stVWA) via NavierStokesApp To: Public

"Cosmic rays from beyond our galaxy, sleeping jellyfish, and counting a language's words for colors"

This week we hear stories on animal hoarding, how different languages have different numbers of colors, and how to tell a wakeful jellyfish from a sleeping one with Online News Editor Catherine Matacic, Brice Russ, and Sarah Crespi. Andrew Wagner talks to Karl-Heinz Kampert about a long-term study of the cosmic rays blasting our planet. After analyzing 30,000 high-energy rays, it turns out some are coming from outside the Milky Way. Listen to previous podcasts. [Image: Doug Letterman/Flickr; Music: Jeffrey Cook]

http://traffic.libsyn.com/sciencemag/SciencePodcast_170922.mp3 (http://traffic.libsyn.com/sciencemag/SciencePodcast_170922.mp3)

(Feed URL: http://www.sciencemag.org/rss/podcast.xml (http://www.sciencemag.org/rss/podcast.xml))

Concrete applications for accelerator science

3 weeks ago (2017-09-21T17:29:57Z) (https://hub.polari.us/ParticleNews/note/XV1JQMgYThGNYbR6rlBE7g) via NavierStokesApp To: Public

"Concrete applications for accelerator science"

A project called A2D2 will explore new applications for compact linear accelerators.

Particle accelerators are the engines of particle physics research at Fermi National Accelerator Laboratory. They generate nearly light-speed, subatomic particles that scientists study to get to the bottom of what makes our universe tick. Fermilab experiments rely on a number of different accelerators, including a powerful, 500-foot-long linear accelerator that kick-starts the process of sending particle beams to various destinations.

But if you're not doing physics research, what's an accelerator good for?

It turns out, quite a lot: Electron beams generated by linear accelerators have all kinds of practical uses, such as making the wires used in cars melt-resistant or purifying water.

A project called Accelerator Application Development and Demonstration (A2D2) at Fermilab's Illinois Accelerator Research Center will help Fermilab and its partners to explore new applications for compact linear accelerators, which are only a few feet long rather than a few hundred. These compact accelerators are of special interest because of their small size—they're cheaper and more practical to build in an industrial setting than particle physics research accelerators—and they can be more powerful than ever.

“A2D2 has two aspects: One is to investigate new applications of how electron beams might be used to change, modify or process different materials,” says Fermilab's Tom Kroc, an A2D2 physicist. “The second is to contribute a little more to the understanding of how these processes happen.”

To develop these aspects of accelerator applications, A2D2 will employ a compact linear accelerator that was once used in a hospital to treat tumors with electron beams. With a few upgrades to increase its power, the A2D2 accelerator will be ready to embark on a new venture: exploring and benchmarking other possible uses of electron beams, which will help specify the design of a new, industrial-grade, high-power machine under development by IARC and its partners.

It won't be just Fermilab scientists using the A2D2 accelerator: As part of IARC, the accelerator will be available for use (typically through a formal CRADA or SPP agreement) by anyone who has a novel idea for electron beam applications. IARC's purpose is to partner with industry to explore ways to translate basic research and tools, including accelerator research, into commercial applications.

“I already have a lot of people from industry asking me, ‘When can I use A2D2?’” says Charlie Cooper, general manager of IARC. “A2D2 will allow us to directly contribute to industrial applications—it's something concrete that IARC now offers.”

Speaking of concrete, one of the first applications in mind for compact linear accelerators is creating durable pavement for roads that won't crack in the cold or spread out in the heat. This could be achieved by replacing traditional asphalt with a material that could be strengthened using an accelerator. The extra strength would come from crosslinking, a process that creates bonds between layers of material, almost like applying glue between sheets of paper. A single sheet of paper tears easily, but when two or more layers are linked by glue, the paper becomes stronger.

“Using accelerators, you could have pavement that lasts longer, is tougher and has a bigger temperature range,” says Bob Kephart, director of IARC. Kephart holds two patents for the process of curing cement through crosslinking. “Basically, you'd put the road down like you do right now, and you'd pass an accelerator over it, and suddenly you'd turn it into really tough stuff—like the bed liner in the back of your pickup truck.”

This process has already caught the eye of the U.S. Army Corps of Engineers, which will be one of A2D2's first partners. Another partner will be the Chicago Metropolitan Water Reclamation District, which will test the utility of compact accelerators for water purification. Many other potential customers are lining up to use the A2D2 technology platform.

“You can basically drive chemical reactions with electron beams—and in many cases those can be more efficient than conventional technology, so there are a variety of applications,” Kephart says. “Usually what you have to do is make a batch of something and heat it up in order for a reaction to occur. An electron beam can make a reaction happen by breaking a bond with a single electron.”

In other words, instead of having to cook a material for a long time to reach a specific heat that would induce a chemical reaction, you could zap it with an electron beam to get the same effect in a fraction of the time.

In addition to exploring the new electron-beam applications with the A2D2 accelerator, scientists and engineers at IARC are using cutting-edge accelerator technology to design and build a new kind of portable, compact accelerator, one that will take applications uncovered with A2D2 out of the lab and into the field. The A2D2 accelerator is already small compared to most accelerators, but the latest R&D allows IARC experts to shrink the size while increasing the power of their proposed accelerator even further.

“The new, compact accelerator that we're developing will be high-power and high-energy for industry,” Cooper says. “This will enable some things that weren't possible in the past. For something such as environmental cleanup, you could take the accelerator directly to the site.”

While the IARC team develops this portable accelerator, which should be able to fit on a standard trailer, the A2D2 accelerator will continue to be a place to experiment with how to use electron beams—and study what happens when you do.

“The point of this facility is more development than research, however there will be some research on irradiated samples,” says Fermilab's Mike Geelhoed, one of the A2D2 project leads. “We're all excited—at least I am. We and our partners have been anticipating this machine for some time now. We all want to see how well it can perform.”

Editor's note: This article was originally published by Fermilab (http://news.fnal.gov/2017/09/concrete-applications-accelerator-science/).

http://www.symmetrymagazine.org/article/concrete-applications-for-accelerator-science?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/concrete-applications-for-accelerator-science?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

(Feed URL: http://www.symmetrymagazine.org/feed (http://www.symmetrymagazine.org/feed))

Next stop: the superconducting magnets of the future

3 weeks ago (2017-09-21T13:29:33Z) (https://hub.polari.us/ParticleNews/note/tMZ6pNotSY689Lycdf5CbA) via NavierStokesApp To: Public

"Next stop: the superconducting magnets of the future"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/fresca2-cryostat.jpg)
The FRESCA2 cryostat before the insertion of the magnet. (Image: Sophia Bennett)
The superconducting magnets of the future are under development and CERN is on the front line. To increase the energy of circular colliders, physicists are counting on ever more powerful magnets, capable of generating magnetic fields way beyond the 8 Tesla produced by the magnets in the Large Hadron Collider (LHC) (http://home.cern/topics/large-hadron-collider).

Magnets generating fields of almost 12 Tesla, based on a superconducting niobium-tin compound, are already being manufactured for the High-Luminosity LHC (http://home.cern/topics/high-luminosity-lhc). But CERN and its partners have also started work on the next generation of magnets, which will need to be capable of generating fields of 16 Tesla and more, for the colliders of the future such as those under consideration in the FCC (Future Circular Collider) (http://home.cern/about/accelerators/future-circular-collider) study. To achieve this goal, the performance of niobium-tin superconducting cable is being pushed to the limits.

One of the key steps in the programme is the development of a test station capable of testing the new cables in realistic conditions, i.e. in a strong magnetic field. Such a facility, in the form of a dipole magnet with a large aperture, has been set up at CERN. The magnet, known as FRESCA2, was developed as part of a collaboration between CERN and CEA-Saclay (http://irfu.cea.fr/en/index.php) in the framework of the European EuCARD programme (http://eucard2.web.cern.ch/).

At the start of August, FRESCA2 reached an important milestone when it achieved its design magnetic field, generating 13.3 Tesla at the centre of a 10-centimetre aperture for 4 hours in a row – a first for a magnet with such a large aperture. By comparison, the current magnets in the LHC generate fields of around 8 Tesla at the centre of a 50-millimetre aperture. The development and performance of FRESCA2 were presented today at the EUCAS 2017 (http://eucas2017.org/2017/) conference on superconductors and their applications.

Testing of the cables under the influence of a strong magnetic field is a vital step. “We not only need to test the maximum current that can be carried by the cable, but also all the effects of the magnetic field. The quality of the field must be perfect,” explains Gijs De Rijk, deputy leader of the Magnets, Superconductors and Cryostats group at CERN. The precision with which the intensity of the magnetic field can be adjusted is an important feature for an accelerator. When the energy of the beams is increased, the intensity of the field that guides them must be increased gradually, without sudden spikes, or the beams could be lost. The fact that the magnets in the LHC can be adjusted with a great degree of precision, keeping their magnetic fields stable, is what allows the beams to circulate in the machine for hours at a time.

(http://cds.cern.ch/images/CERN-PHOTO-201701-007-1)
The FRESCA2 magnet before the start of the tests. (Image: Maximilien Brice/CERN)

The two coils of FRESCA2 are formed from a superconducting cable made of niobium-tin. Their temperature is maintained at 2 degrees above absolute zero. The magnet they form is much larger than an LHC magner, measuring 1.5 metres in length and 1 metre in diameter. This allows the magnet to have a large aperture, measuring 10 centimetres, so that it can house the cables being tested, as well as sensors to observe their behaviour. FRESCA2 will also be used to test coils formed from high-temperature superconductors (an article on this subject will be published tomorrow).

FRESCA2 is being modified so that by the end of this year it will be able to generate an even stronger field. The station will then be ready to receive the samples to be tested.

See the CEA-Saclay IRFU (http://irfu.cea.fr/Phocea/Vie_des_labos/Ast/ast.php?t=fait_marquant&id_ast=4148)(Institute of Research into the Fundamental Laws of the Universe) (http://irfu.cea.fr/Phocea/Vie_des_labos/Ast/ast.php?t=fait_marquant&id_ast=4148) *article (http://irfu.cea.fr/Phocea/Vie_des_labos/Ast/ast.php?t=fait_marquant&id_ast=4148)*.

http://home.cern/about/updates/2017/09/next-stop-superconducting-magnets-future (http://home.cern/about/updates/2017/09/next-stop-superconducting-magnets-future)

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CERN openlab tackles ICT challenges of High-Luminosity LHC

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"CERN openlab tackles ICT challenges of High-Luminosity LHC"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/rvs_7481.jpg)
CERN computing centre in 2017 (Image: Robert Hradil, Monika Majer/ProStudio22.ch)
CERN openlab (http://openlab.cern/) has published a white paper (http://openlab.cern/sites/openlab.web.cern.ch/files/technical_documents/Whitepaper_brochure_ONLINE.pdf) identifying the major ICT challenges that face CERN and other 'big science' projects in the coming years.

CERN is home to the Large Hadron Collider (LHC) (https://home.cern/topics/large-hadron-collider), the world's most powerful particle accelerator. The complexity of the scientific instruments at the laboratory throw up extreme ICT challenges, and make it an ideal environment for carrying out joint R&D projects and testing with industry.

A continuing programme of upgrades to the LHC and the experiments at CERN will result in hugely increased ICT demands in the coming years. The High-Luminosity LHC, (http://home.cern/topics/high-luminosity-lhc) the successor to the LHC, is planned to come online in around 2026. By this time, the total computing capacity required by the experiments is expected to be 50-100 times greater than today, with data storage needs expected to be in the order of exabytes.

CERN openlab works to develop and test the new ICT solutions and techniques that help to make the ground-breaking physics discoveries at CERN possible. It is a unique public-private partnership that provides a framework through which CERN can collaborate with leading ICT companies to accelerate the development of these cutting-edge technologies.

With a new three-year phase of CERN openlab set to begin at the start of 2018, work has been carried out throughout the first half of 2017 to identify key areas for future collaboration. A series of workshops and discussions was held to discuss the ICT challenges faced by the LHC research community — and other 'big science' projects over the coming years. This white paper is the culmination of these investigations, and sets out specific challenges that are ripe for tackling through collaborative R&D projects with leading ICT companies.

The white paper identifies 16 ICT 'challenge areas', which have been grouped into four overarching 'R&D topics' (data-centre technologies and infrastructures, computing performance and software, machine learning and data analytics, applications in other disciplines). Challenges identified include ensuring that data centre architectures are flexible and cost effective; using cloud computing resources in a scalable, hybrid manner; fully modernising code, in order to exploit hardware to its maximum potential; making sure large-scale platforms are in place to enable global scientific collaboration; and successfully translating the huge potential of machine learning into concrete solutions .

"Tackling these challenges — through a public-private partnership that brings together leading experts from each of these spheres — has the potential to positively impact on a range of scientific and technological fields, as well as wider society," says Alberto Di Meglio, head of CERN openlab.

“With the LHC and the experiments set to undergo major upgrade work in 2019 and 2020, CERN openlab’s sixth phase offers a clear opportunity to develop ICT solutions that will already make a tangible difference for researchers when the upgraded LHC and experiments come back online in 2021,” says Maria Girone, CERN openlab CTO.

Follow the launch event (https://webcast.web.cern.ch/event/49) for the white paper live via webcast from 09:50 CEST today.

http://home.cern/about/updates/2017/09/cern-openlab-tackles-ict-challenges-high-luminosity-lhc (http://home.cern/about/updates/2017/09/cern-openlab-tackles-ict-challenges-high-luminosity-lhc)

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Detectors: unique superconducting magnets

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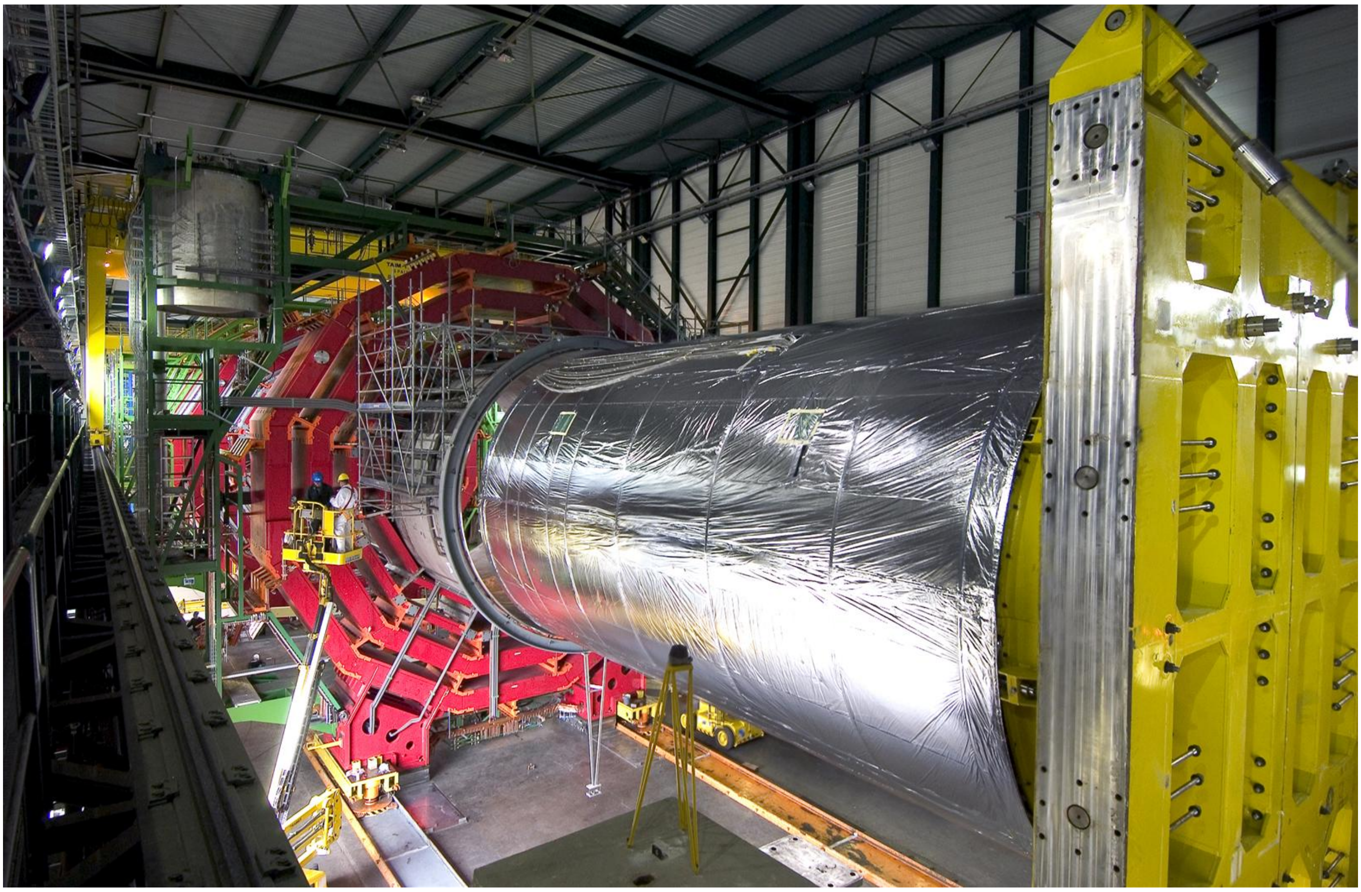
"Detectors: unique superconducting magnets"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/atlas-magnet.jpg)
The enormous toroidal superconducting magnet of ATLAS during its installation. Each of its eight coils, the last of which is being assembled in this photo, is 25 metres long. (Image: ATLAS/CERN)
Even before they were used widely in particle accelerators, superconducting magnets (http://home.cern/about/engineering/pulling-together-superconducting-electromagnets) were adopted for the detectors used to analyse collisions. A magnetic field is essential for identifying the particles emerging from collisions: it curves their trajectory (http://home.cern/about/how-detector-works) allowing physicists to calculate their momentum and to establish whether they have a positive or negative charge. The stronger the field and the larger the volume on which it acts, the higher the resolution of the detector.

As early as the 1960s, physicists saw the potential benefits of using superconducting magnets in their detectors. In the early 1970s, experiments in the United States and at CERN were developing large superconducting magnets capable of generating fields of up to 3.5 Tesla. This development work was all the more daring since the technology was still in its infancy. But contrary to the magnets for accelerators, which need to be produced in their dozens, the magnets in detectors are unique.

One of the trailblazers of these detectors was CERN’s Big European Bubble Chamber (BEBC), which entered service in 1973 and in which the superconducting magnet generated a field of 3.5 Tesla. Its stored energy was almost 800 megajoules, a level of performance that wouldn’t be bettered until the late 1990s.



(http://cds.cern.ch/images/CERN-EX-0509015-01)
The superconducting coil of CMS, the biggest superconducting solenoid magnet ever built, being inserted in its cryostat. (Image: Maximilien Brice/CERN)

In the 1980s, significant progress was made on improving the magnets' performance and making them more "transparent", so that they didn't interact with the particles and change their characteristics. Increasingly larger magnets were constructed and the work culminated in the 2000s with the giant superconducting magnets of the landmark CMS (http://home.cern/about/experiments/cms) and ATLAS (http://home.cern/about/experiments/atlas) experiments at the Large Hadron Collider (http://home.cern/topics/large-hadron-collider) (LHC). The first of these is a huge solenoid (https://cms.cern/detector/bending-particles) that generates a field of 4 Tesla and is able to store 2.7 gigajoules, enough energy to melt 18 tonnes of gold. The second is an enormous and completely novel toroidal magnet (https://atlas.cern/discover/detector/magnet-system) formed of eight superconducting coils, which also generate a magnetic field of 4 Tesla, surrounding a smaller solenoid.

The next generation of superconducting magnets for detectors, which will be even bigger and more powerful, is being developed in the context of preparations for major accelerator projects at CERN and elsewhere.

This text is published on the occasion of the conference EUCAS 2017 (http://eucas2017.org/2017/) on superconductors and their applications. It is based on the article entitled "Unique magnets" (http://cerncourier.com/cws/article/cern/69630)*, which appeared in the September issue of the CERN Courier* (http://cerncourier.com/cws/latest/cern).

http://home.cern/about/updates/2017/09/detectors-unique-superconducting-magnets (http://home.cern/about/updates/2017/09/detectors-unique-superconducting-magnets)

(Feed URL: http://home.web.cern.ch/about/updates/feed (http://home.web.cern.ch/about/updates/feed))

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50 years of stories

3 weeks ago (2017-09-19T18:29:14Z) (https://hub.polari.us/ParticleNews/note/uN_5NnBLRPmiZgQT1nCP-A) via NavierStokesApp To: Public

"50 years of stories"

To celebrate a half-century of discovery, Fermilab has been gathering tales of life at the lab.

Science stories usually catch the eye when there's big news: the discovery of gravitational waves, the appearance of a new particle. But behind the blockbusters are the thousands of smaller stories of science behind the scenes and daily life at a research institution.

As the Department of Energy's Fermi National Accelerator Laboratory celebrates its 50th anniversary year, employees past and present have shared memories of building a lab dedicated to particle physics.

Some shared personal memories: keeping an accelerator running during a massive snowstorm (https://youtu.be/3WPczm4X93A); being too impatient for the arrival of an important piece of detector equipment (https://youtu.be/NBci-sWMM1E) to stay put and wait for it to arrive; accidentally complaining about the lab to the lab's director (https://youtu.be/f0exO-lltHs).

Others focused on milestones and accomplishments: the first daycare (https://youtu.be/UC20NW3c4Zc) at a national lab, the Saturday Morning Physics Program (https://youtu.be/hBrVbYIcbkc) built by Nobel laureate Leon Lederman, the birth of the web (https://youtu.be/zSzkKl092YU) at Fermilab.

People shared memories of big names that built the lab: charismatic founding director Robert R. Wilson (http://news.fnal.gov/2017/04/working-for-wilson/), fiery head of accelerator development Helen Edwards (http://news.fnal.gov/2017/04/ball-of-fire/), talented lab artist Angela Gonzales (http://news.fnal.gov/2017/08/50th-memories-three-short-stories-fermilab-colors/).

And or course, employees told stories about Fermilab's resident herd of bison (http://news.fnal.gov/2017/08/bison-tales/).

There are many more stories to peruse. You can watch a playlist (https://www.youtube.com/playlist?list=PLCfRa7MXBEspzm_h0h3qmOD6crVWDq1G5) of the video anecdotes or find all of the stories (both written and video) collected on Fermilab's 50th anniversary website (http://50.fnal.gov/fifty-years-stories/).

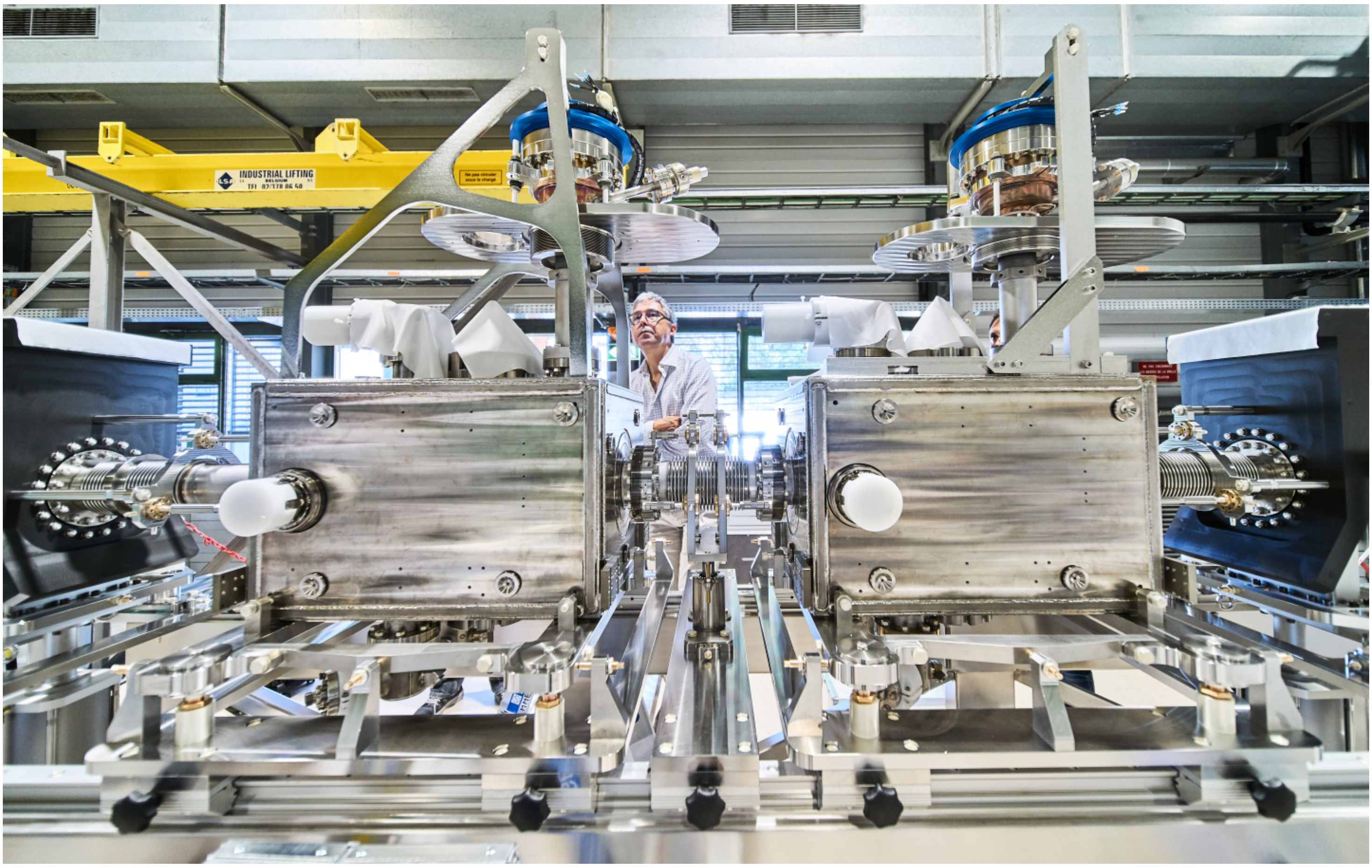
http://www.symmetrymagazine.org/article/50-years-of-stories?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/50-years-of-stories?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

(Feed URL: http://www.symmetrymagazine.org/feed (http://www.symmetrymagazine.org/feed))

Superconductors boost acceleration

3 weeks ago (2017-09-19T12:29:43Z) (https://hub.polari.us/ParticleNews/note/yU4sGBg8TzuL2Plcz5zvAA) via NavierStokesApp To: Public

"Superconductors boost acceleration"



(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/_dsc6888.jpg)
The new superconducting crab cavities being assembled at CERN. These cavities will be used in the future High-Luminosity LHC to tilt the particle bunches before they collide. (Image: Jules Ordan/CERN)
Thanks to their amazing properties, superconductors have become a vital ally of particle physics. As well as using superconducting magnets to steer particles in the right direction, accelerators use superconducting cavities (http://home.cern/about/engineering/radiofrequency-cavities) to accelerate them. During the EUCAS 2017 (http://eucas2017.org/2017/) conference on superconductors and their applications, which is taking place this week in Geneva, many presentations are being made on this subject.

A radiofrequency accelerating cavity is basically a metal chamber in which electromagnetic waves generate an electrical field. As particles pass through the chamber, they receive an electrical impulse. Compared to traditional copper cavities, superconducting cavities generate very strong electrical fields. Those in the Large Hadron Collider (http://home.cern/topics/large-hadron-collider) (LHC), for example, generate an electrical field of 5 million volts per metre.

The first work on superconducting cavities for particle physics began in the 1960s. But it was not until the 1980s that they were actually used in an accelerator, an electron collider at Cornell University in the United States. Meanwhile, the designers working on the Large Electron-Positron Collider (http://home.cern/about/accelerators/large-electron-positron-collider) (LEP) at CERN were investigating the technology as a way of doubling the energy level of their machine. The 27-kilometre ring was fitted out with 280 such cavities, allowing the LEP to exceed 200 GeV in the 1990s. The LHC is equipped with similar cavities. The brand new XFEL synchrotron (http://home.cern/about/updates/2017/09/european-xfel-worlds-most-powerful-x-ray-source-starts) at the DESY (http://www.desy.de/index_eng.html) laboratory in Germany is made up of no fewer than 800 accelerating cavities, which rely heavily on the work carried out in the 1990s by the TESLA collaboration.

Today, the development of new superconducting cavities continues, particularly at CERN, where so-called “crab cavities” (http://home.cern/topics/high-luminosity-lhc/new-technologies-high-luminosity-lhc) are under development to tilt particle bunches before they collide in the High-Luminosity LHC (http://home.cern/topics/high-luminosity-lhc). These cavities will help to maximise overlapping of the beams in order to increase the probability of collisions each time they meet, otherwise known as luminosity. At Fermilab, the Cornell Laboratory and SLAC in the United States, new coatings are also being studied to improve performance even further.

This text is based on the article entitled “Souped up RF” (http://cerncourier.com/cws/article/cern/69631)*, which appeared in the September issue of the CERN Courier* (http://cerncourier.com/cws/latest/cern).

http://home.cern/about/updates/2017/09/superconductors-boost-acceleration (http://home.cern/about/updates/2017/09/superconductors-boost-acceleration)

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Ritorna SHARPER il 29 settembre!

3 weeks ago (2017-09-19T10:29:28Z) (https://hub.polari.us/ParticleNews/note/tLWbnDOJT2KSjiae76MrSg) via NavierStokesApp To: Public

"Ritorna SHARPER il 29 settembre!"

Dopo il grande successo delle passate edizioni, torna il 29 **settembre** a L’Aquila **SHARPER - Notte Europea dei Ricercatori** per far conoscere al pubblico quanto il lavoro dei ricercatori possa contribuire a migliorare il futuro della nostra società.

Read More ... (https://www.lngs.infn.it/en/news/ritorna-sharper-il-29-settembre)

https://www.lngs.infn.it/en/news/ritorna-sharper-il-29-settembre (https://www.lngs.infn.it/en/news/ritorna-sharper-il-29-settembre)

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IceCube launches an international contest to engage students in STEM research and careers

3 weeks ago (2017-09-18T17:29:22Z) (https://hub.polari.us/ParticleNews/note/W1Q5aTsjTci5e27Z6f69ug) via NavierStokesApp To: Public

"IceCube launches an international contest to engage students in STEM research and careers"

The new South Pole Experiment Contest run by the IceCube Collaboration is a contest developed for middle school students from around the world.

http://icecube.wisc.edu/news/view/530 (http://icecube.wisc.edu/news/view/530)

(Feed URL: http://icecube.wisc.edu/news/feed (http://icecube.wisc.edu/news/feed))

The magic of superconductors in the spotlight

3 weeks ago (2017-09-18T12:29:19Z) (https://hub.polari.us/ParticleNews/note/_Ew6_o6tTDqi7qiK9ERfdQ) via NavierStokesApp To: Public

"The magic of superconductors in the spotlight"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/quadrupole-nations-unis-eucas2017.jpeg)
A superconducting magnet from the LHC on display outside the United Nations Office in Geneva during the EUCAS 2017 conference. (Image: Michael Struik/CERN)
A major conference on superconductors and their applications gets under way today in Geneva. Organised by CERN in collaboration with the University of Geneva (https://www.unige.ch/) and EPFL-SPC (Swiss Plasma Center) (http://spc.epfl.ch/) under the auspices of the European Society for Applied Superconductivity (http://www.esas.org/), EUCAS 2017 (http://eucas2017.org/2017/) will welcome more than 1000 scientists and engineers to share the latest advances in superconductor technology and its applications.

It's no coincidence that CERN is co-organising this conference. The Large Hadron Collider (LHC) (http://home.cern/topics/large-hadron-collider) is quite simply the biggest application of superconductivity in the world, with 23 kilometres of superconducting magnets (http://home.cern/about/engineering/pulling-together-superconducting-electromagnets) around its 27-kilometre circumference.

The phenomenon of superconductivity (http://home.cern/about/engineering/superconductivity) was discovered in 1911. Below a very low critical temperature, some materials lose all of their electrical resistance. This amazing property opens up many exciting possibilities. Since there is no resistance to stop the flow of current and the superconductor does not heat up, it can carry far stronger electrical currents than "normal" or resistive conductors. A coil made from superconducting material can produce stronger magnetic fields than resistive electromagnets. This is the property that is of particular interest to particle physicists.

In circular accelerators like the LHC, particles are kept in their orbits by a magnetic field. But the higher the energy (speed) of the particles, the stronger the field needs to be. The energy of circular accelerators is therefore limited by the power of their magnets. At the end of the 1960s, this limit began to stand in the way of progress and superconductivity was exactly the innovation required to overcome it.

At the start of the 1970s, the idea really started being taken seriously. At the time, the most advanced work on the technology was being carried out by the "Energy Doubler" project at the Fermilab (http://fnal.gov/) laboratory in the United States. This project later became the Tevatron, the first superconducting collider, which started operation in 1983. Its success really accelerated the use of superconductors for high-energy physics and since then, superconductivity and particle physics have driven each other on. Following the extraordinary technological achievement of the LHC, the future of superconductors is now taking shape in accelerator projects such as the High-Luminosity LHC (http://home.web.cern.ch/about/accelerators/high-luminosity-large-hadron-collider) and, in the longer term, bigger colliders able to push back even further the boundaries of the energy levels that humanity is able to explore.

This text is based on an article published in the September issue of the CERN Courier (http://cerncourier.com/cws/latest/cern) *entitled "Powering the field forward" (http://cerncourier.com/cws/article/cern/69629).*

http://home.cern/about/updates/2017/09/magic-superconductors-spotlight (http://home.cern/about/updates/2017/09/magic-superconductors-spotlight)

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Week 36 at the Pole

3 weeks ago (2017-09-15T21:29:11Z) (https://hub.polari.us/ParticleNews/note/F3uEKLH9Sp2emeIbkFSSLg) via NavierStokesApp To: Public

"Week 36 at the Pole"

Just because it's light enough to take pictures outdoors, doesn't mean the sun is up. Not yet—or not officially—anyway. The one and only sunrise each year at the South Pole is a slow process.

http://icecube.wisc.edu/news/view/531 (http://icecube.wisc.edu/news/view/531)

(Feed URL: http://icecube.wisc.edu/news/feed (http://icecube.wisc.edu/news/feed))

SENSEI searches for light dark matter

3 weeks ago (2017-09-15T19:29:12Z) (https://hub.polari.us/ParticleNews/note/NQFzFgXiT0KxYrs43VZe7g) via NavierStokesApp To: Public

"SENSEI searches for light dark matter"

Technology proposed 30 years ago to search for dark matter is finally seeing the light.

In a project called SENSEI, scientists are using innovative sensors developed over three decades to look for the lightest dark matter particles anyone has ever tried to detect.

Dark matter—so named because it doesn't absorb, reflect or emit light—constitutes 27 percent of the universe, but the jury is still out on what it's made of. The primary theoretical suspect for the main component of dark matter is a particle scientists have descriptively named the weakly interactive massive particle, or WIMP.

But since none of these heavy particles, which are expected to have a mass 100 times that of a proton, have shown up in experiments, it might be time for researchers to think small.

"There is a growing interest in looking for different kinds of dark matter that are additives to the standard WIMP model," says Fermi National Accelerator Laboratory scientist Javier Tiffenberg, a leader of the SENSEI collaboration. "Lightweight, or low-mass, dark matter is a very compelling possibility, and for the first time, the technology is there to explore these candidates."

Sensing the unseen

In traditional dark matter experiments, scientists look for a transfer of energy that would occur if dark matter particles collided with an ordinary nucleus. But SENSEI is different; it looks for direct interactions of dark matter particles colliding with electrons.

"That is a big difference—you get a lot more energy transferred in this case because an electron is so light compared to a nucleus," Tiffenberg says.

If dark matter had low mass—much smaller than the WIMP model suggests—then it would be many times lighter than an atomic nucleus. So if it were to collide with a nucleus, the resulting energy transfer would be far too small to tell us anything. It would be like throwing a ping-pong ball at a boulder: The heavy object wouldn't go anywhere, and there would be no sign the two had come into contact.

An electron is nowhere near as heavy as an atomic nucleus. In fact, a single proton has about 1836 times more mass than an electron. So the collision of a low-mass dark matter particle with an electron has a much better chance of leaving a mark—it's more bowling ball than boulder.

Bowling balls aren't exactly light, though. An energy transfer between a low-mass dark matter particle and an electron would leave only a blip of energy, one either too small for most detectors to pick up or easily overshadowed by noise in the data.

"The bowling ball will move a very tiny amount," says Fermilab scientist Juan Estrada, a SENSEI collaborator. "You need a very precise detector to see this interaction of lightweight particles with something that is much heavier."

That's where SENSEI's sensitive sensors come in.

SENSEI will use skipper charge-couple devices, also called skipper CCDs. CCDs have been used for other dark matter detection experiments, such as the Dark Matter in CCDs (or DAMIC) experiment operating at SNOLAB in Canada. These CCDs were a spinoff from sensors developed for use in the Dark Energy Camera in Chile and other dark energy search projects.

CCDs are typically made of silicon divided into pixels. When a dark matter particle passes through the CCD, it collides with the silicon's electrons, knocking them free, leaving a net electric charge in each pixel the particle passes through. The electrons then flow through adjacent pixels and are ultimately read as a current in a device that measures the number of electrons freed from each CCD pixel. That measurement tells scientists about the mass and energy of the particle that got the chain reaction going. A massive particle, like a WIMP, would free a gusher of electrons, but a low-mass particle might free only one or two.

Typical CCDs can measure the charge left behind only once, which makes it difficult to decide if a tiny energy signal from one or two electrons is real or an error.

Skipper CCDs are a new generation of the technology that helps eliminate the "iffiness" of a measurement that has a one- or two-electron margin of error. "The big step forward for the skipper CCD is that we are able to measure this charge as many times as we want," Tiffenberg says.

The charge left behind in the skipper CCD can be sampled multiple times and then averaged, a method that yields a more precise measurement of the charge deposited in each pixel than the measure-one-and-done technique. That's the rule of statistics: With more data, you get closer to a property's true value.

SENSEI scientists take advantage of the skipper CCD architecture, measuring the number of electrons in a single pixel a whopping 4000 times.

"This is a simple idea, but it took us 30 years to get it to work," Estrada says.

From idea to reality to beyond

A small SENSEI prototype is currently running at Fermilab in a detector hall 385 feet below ground, and it has demonstrated that this detector design will work in the hunt for dark matter.

Skipper CCD technology and SENSEI were brought to life by Laboratory Directed Research and Development (LDRD) funds at Fermilab and Lawrence Berkeley National Laboratory (Berkeley Lab). LDRD programs are intended to provide funding for development of novel, cutting-edge ideas for scientific discovery.

The Fermilab LDRDs were awarded only recently—less than two years ago—but close collaboration between the two laboratories has already yielded SENSEI's promising design, partially thanks to Berkeley lab's previous work in skipper CCD design.

Fermilab LDRD funds allow researchers to test the sensors and develop detectors based on the science, and the Berkeley Lab LDRD funds support the sensor design, which was originally proposed by Berkeley Lab scientist Steve Holland.

"It is the combination of the two LDRDs that really make SENSEI possible," Estrada says.

Future SENSEI research will also receive a boost thanks to a recent grant from the Heising-Simons Foundation.

"SENSEI is very cool, but what's really impressive is that the skipper CCD will allow the SENSEI science and a lot of other applications," Estrada says. "Astronomical studies are limited by the sensitivity of their experimental measurements, and having sensors without noise is the equivalent of making your telescope bigger—more sensitive."

SENSEI technology may also be critical in the hunt for a fourth type of neutrino, called the sterile neutrino, which seems to be even more shy than its three notoriously elusive neutrino family members.

A larger SENSEI detector equipped with more skipper CCDs will be deployed within the year. It's possible it might not detect anything, sending researchers back to the drawing board in the hunt for dark matter. Or SENSEI might finally make contact with dark matter—and that would be SENSEI-tional.

Editor's note: This article is based on an article (http://news.fnal.gov/2017/09/hunt-light-dark-matter/) published by Fermilab.

http://www.symmetrymagazine.org/article/sensei-searches-for-light-dark-matter?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/sensei-searches-for-light-dark-matter?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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The science (and showers) of Sudbury Neutrino Observatory

3 weeks ago (2017-09-15T10:28:53Z) (https://hub.polari.us/ParticleNews/note/dg3kkKmbR7aT9vrXvrRekA) via NavierStokesApp To: Public

"The science (and showers) of Sudbury Neutrino Observatory"

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/_dsc7212.jpg)
Art McDonald presenting in CERN's main auditorium on 4 September (Image: Julien Ordan/CERN)
Watch Art McDonald, Nobel prize-winning physicist, speaking on the science involved in building the Sudbury Neutrino Observatory.

Speaking at CERN last week, he discusses how scientists and technicians building the machine took more than 70,000 showers as part of their efforts to maintain a completely clean and uncontaminated laboratory, and how at one point the team had to repair the 78-tonne tank of liquid scintillator after it sprung a leak, using the same principles that you would use to fix a flat tyre on your bike.

McDonald was jointly awarded the Nobel Prize in Physics 2015 with Takaaki Kajita *"for the discovery of neutrino oscillations, which shows that neutrinos have mass"*. He is the director of this unique observatory, which hopes to detect solar neutrinos through their interactions with a large tank of heavy water.

> Watch the recording here (https://cds.cern.ch/video/2282818).

http://home.cern/about/updates/2017/09/science-and-showers-sudbury-neutrino-observatory (http://home.cern/about/updates/2017/09/science-and-showers-sudbury-neutrino-observatory)

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Cargo-sorting molecular robots, humans as the ultimate fire starters, and molecular modeling with quantum computers

4 weeks ago (2017-09-14T18:28:57Z) (https://hub.polari.us/ParticleNews/note/hvCrOjCNQbCFcrSOGFsKyA) via NavierStokesApp To: Public

"Cargo-sorting molecular robots, humans as the ultimate fire starters, and molecular modeling with quantum computers"

This week we hear stories on the gut microbiome's involvement in multiple sclerosis, how wildfires start—hint: It's almost always people—and a new record in quantum computing with Online News Editor David Grimm. Andrew Wagner talks to Lulu Qian about DNA-based robots that can carry and sort cargo. Sarah Crespi goes behind the scenes with Science's Photography Managing Editor Bill Douthitt to learn about snapping this week's cover photo of the world's smallest neutrino detector. Listen to previous podcasts. [Image: Curtis Perry/Flickr; Music: Jeffrey Cook]

http://traffic.libsyn.com/sciencemag/SciencePodcast_170915.mp3 (http://traffic.libsyn.com/sciencemag/SciencePodcast_170915.mp3)

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Charmonium surprise at LHCb

4 weeks ago (2017-09-13T10:28:51Z) (https://hub.polari.us/ParticleNews/note/vFz_5wXsSS6bnoq5QRU_mQ) via NavierStokesApp To: Public

"Charmonium surprise at LHCb"

Stefania Pandolfi (http://home.cern/authors/stefania-pandolfi)

(http://home.cern/sites/home.web.cern.ch/files/image/update-for_the_public/2017/09/lhcb.png)
The LHCb cavern (Image: Maximilien Brice/CERN)
Today, the LHCb experiment at CERN presented a measurement of the masses of two particular particles with a precision that is unprecedented at a hadron collider for this type of particles. Until now, the precise study of these "charmonium" particles, invaluable source of insights into the subatomic world, required dedicated experiments to be built.

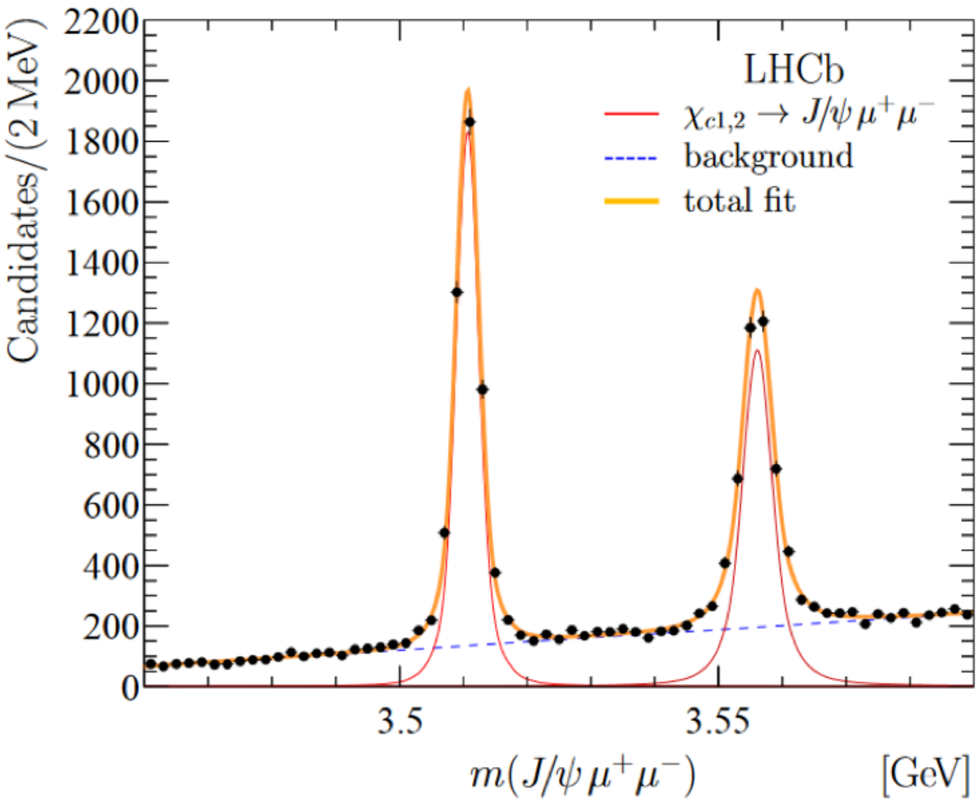
"Thanks to this result, the LHCb collaboration opens a new avenue to precision measurements of charmonium particles at hadron colliders, that was unexpected by the physics community", says Giovanni Passaleva, Spokesperson for the LHCb collaboration. Indeed, this kind of measurement seemed impossible until recently.

The two particles, χ_{c1} and χ_{c2}, are excited states of a better-known particle called J/ψ. An excited state is a particle that has a higher internal energy, namely a mass, than the absolute minimum configuration which is allowed. The J/ψ meson and its excited states, also referred to as charmonium, are formed by a charm quark and its antimatter correspondent, a charm antiquark, bound together by the strong nuclear force. The J/ψ revolutionary observation in November 1974 triggered rapid changes in high-energy physics at the time, and earned its discoverers the Nobel Prize in physics. Just like ordinary atoms, a meson can be observed in excited states where the two quarks move around each other in different configurations, and because of Einstein's famous equivalence of energy and mass, after a tiny amount of time they can disappear and transform into some other particles of lower masses. The LHCb experiment studied, for the first time, the particular transformation of χ_{c1} and χ_{c2} mesons decaying into a J/ψ particle and a pair of muons in order to determine some of their properties very precisely.

Previous studies of χ_{c1} and χ_{c2} at particle colliders have exploited another type of decay of these particles, featuring a photon in the final state instead of a pair of muons. However, measuring the energy of a photon is experimentally very challenging in the harsh environment of a hadron collider. Owing to the specialised capabilities of the LHCb detector in measuring trajectories and properties of charged particles like muons, and exploiting the large dataset accumulated during the first and second runs of the LHC (http://home.cern/about/updates/2015/05/major-work-ready-lhc-experiments-run-2) up to the end of 2016, it was possible to observe the two excited particles with an excellent mass resolution. Exploiting this novel decay with two muons in the final state, the new measurements of χ_{c1} and χ_{c2} masses and natural widths have a similar precision and are in good agreement with those obtained at previous dedicated experiments that were built with a specific experimental approach very different from that in use at colliders.

"Not only are we no longer obliged to resort to purpose-built experiments for such studies," continues Passaleva, "but also, in the near future, we will be able to think about applying a similar approach for the study of a similar class of particles, known as bottomonium, where charm quarks are replaced with beauty quarks." These new measurements, along with future updates with larger datasets of collisions accumulated at the LHC, will allow new, stringent tests of the predictions of quantum chromodynamics (QCD), which is the theory that describes the behaviour of the strong nuclear force, contributing to the challenge of fully understanding the elusive features of this fundamental interaction of nature.

Find out more on the LHCb website (http://lhcb-public.web.cern.ch/lhcb-public/Welcome.html#Chic12).



The image above shows the data points (black dots) of the reconstructed mass distribution resulting from the combination of the J/ψ and the two muons. The two particle states are the two narrow peaks standing out from the distribution of data. (Image: LHCb collaboration)

http://home.cern/about/updates/2017/09/charmonium-surprise-lhcb (http://home.cern/about/updates/2017/09/charmonium-surprise-lhcb)

(Feed URL: http://home.web.cern.ch/about/updates/feed (http://home.web.cern.ch/about/updates/feed))

Clearing a path to the stars

4 weeks ago (2017-09-12T17:28:43Z) (https://hub.polari.us/ParticleNews/note/6xhaSnj5RZGUEU_Rk9MNoA) via NavierStokesApp To: Public

"Clearing a path to the stars"

Astronomers are at the forefront of the fight against light pollution, which can obscure our view of the cosmos.

More than a mile up in the San Gabriel Mountains in Los Angeles County sits the Mount Wilson Observatory, once one of the cornerstones of groundbreaking astronomy.

Founded in 1904, it was twice home to the largest telescope on the planet, first with its 60-inch telescope in 1908, followed by its 100-inch telescope in 1917. In 1929, Edwin Hubble revolutionized our understanding of the shape of the universe when he discovered on Mt. Wilson that it was expanding.

But a problem was radiating from below. As the city of Los Angeles grew, so did the reach and brightness of its skyglow, otherwise known as light pollution. The city light overpowered the photons coming from faint, distant objects, making deep-sky cosmology all but impossible. In 1983, the Carnegies, who had owned the observatory since its inception, abandoned Mt. Wilson to build telescopes in Chile instead.

“They decided that if they were going to do greater, more detailed and groundbreaking science in astronomy, they would have to move to a dark place in the world,” says Tom Meneghini, the observatory’s executive director. “They took their money and ran.”

(Meneghini harbors no hard feelings: “I would have made the same decision,” he says.)

Beyond being a problem for astronomers, light pollution is also known to harm and kill wildlife, waste energy and cause disease in humans around the globe. For their part, astronomers have worked to convince local governments to adopt better lighting ordinances, including requiring the installation of fixtures that prevent light from seeping into the sky.

(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_1_%20Clearing%20a%20path%20to%20the%20stars.gif)
Artwork by Corinne Mucha

Many towns and cities are already reexamining their lighting systems as the industry standard shifts from sodium lights to light-emitting diodes, or LEDs, which last longer and use far less energy, providing both cost-saving and environmental benefits. But not all LEDs are created equal. Different bulbs emit different colors, which correspond to different temperatures. The higher the temperature, the bluer the color.

The creation of energy-efficient blue LEDs was so profound that its inventors were awarded the 2014 Nobel Prize in Physics. But that blue light turns out to be particularly detrimental to astronomers, for the same reason that the daytime sky is blue: Blue light scatters more than any other color. (Blue lights have also been found to be more harmful to human health than more warmly colored, amber LEDs. In 2016, the American Medical Association issued guidance (https://www.ama-assn.org/ama-adopts-guidance-reduce-harm-high-intensity-street-lights) to minimize blue-rich light, stating that it disrupts circadian rhythms and leads to sleep problems, impaired functioning and other issues.)

The effort to darken the skies has expanded to include a focus on LEDs, as well as an attempt to get ahead of the next industry trend.

At a January workshop at the annual American Astronomical Society (AAS) meeting, astronomer John Barentine sought to share stories of towns and cities that had successfully battled light pollution. Barentine is a program manager for the International Dark-Sky Association (IDA), a nonprofit founded in 1988 to combat light pollution. He pointed to the city of Phoenix, Arizona.

Arizona is a leader in reducing light pollution. The state is home to four of the 10 IDA-recognized “Dark Sky Communities” in the United States. “You can stand in the middle of downtown Flagstaff and see the Milky Way,” says James Lowenthal, an astronomy professor at Smith College.

But it’s not immune to light pollution. Arizona’s Grand Canyon National Park is designated by the IDA as an International Dark Sky Park, and yet, on a clear night, Barentine says, the horizon is stained by the glow of Las Vegas 170 miles away.

(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_2_%20Clearing%20a%20path%20to%20the%20stars.gif)
Artwork by Corinne Mucha
In 2015, Phoenix began testing the replacement of some of its 100,000 or so old streetlights with LEDs, which the city estimated would save $2.8 million a year in energy bills. But they were using high-temperature blue LEDs, which would have bathed the city in a harsh white light.

Through grassroots work, the local IDA chapter delayed the installation for six months, giving the council time to brush up on light pollution and hear astronomers' concerns. In the end, the city went beyond IDA's "best expectations," Barentine says, opting for lights that burn at a temperature well under IDA's maximum recommendations.

"All the way around, it was a success to have an outcome arguably influenced by this really small group of people, maybe 10 people in a city of 2 million," he says. "People at the workshop found that inspiring."

Just getting ordinances on the books does not necessarily solve the problem, though. Despite enacting similar ordinances to Phoenix, the city of Northampton, Massachusetts, does not have enough building inspectors to enforce them. "We have this great law, but developers just put their lights in the wrong way and nobody does anything about it," Lowenthal says.

For many cities, a major part of the challenge of combating light pollution is simply convincing people that it is a problem. This is particularly tricky for kids who have never seen a clear night sky bursting with bright stars and streaked by the glow of the Milky Way, says Connie Walker, a scientist at the National Optical Astronomy Observatory who is also on the board of the IDA. "It's hard to teach somebody who doesn't know what they've lost," Walker says.

Walker is focused on making light pollution an innate concern of the next generation, the way campaigns in the 1950s made littering unacceptable to a previous generation of kids.

In addition to creating interactive light-pollution kits for children, the NOAO operates a citizen-science initiative called Globe at Night (https://www.globeatnight.org/), which allows anyone to take measurements of brightness in their area and upload them to a database. To date, Globe at Night has collected more than 160,000 observations from 180 countries.

It's already produced success stories. In Norman, Oklahoma, for example, a group of high school students, with the assistance of amateur astronomers, used Globe at Night to map light pollution in their town. They took the data to the city council. Within two years, the town had passed stricter lighting ordinances.

"Light pollution is foremost on our minds because our observatories are at risk," Walker says. "We should really be concentrating on the next generation."

http://www.symmetrymagazine.org/article/clearing-a-path-to-the-stars?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/clearing-a-path-to-the-stars?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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TED-Ed: Emptying the vacuum

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"TED-Ed: Emptying the vacuum"

Could we create a perfect vacuum? In a universe filled with matter and energy, we often think of deepest outer space as a vacuum, empty of everything. But it is far from it, with a multitude of particles and electromagnetic radiation zooming through it. This new animation, made in collaboration with TED-Ed, explores why CERN's accelerators need to be one of the emptiest spaces in the universe and asks if there is such a thing as totally empty space.

Read more about the content in this animation on the TED-Ed website (https://ed.ted.com/lessons/is-it-possible-to-create-a-perfect-vacuum-rolf-landua-and-anais-rassat).

http://home.cern/about/updates/2017/09/ted-ed-emptying-vacuum (http://home.cern/about/updates/2017/09/ted-ed-emptying-vacuum)

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Week 35 at the Pole

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"Week 35 at the Pole"

Now you see him, now you don't! Winterover Martin had some fun taking photos at the ceremonial pole last week. Although it was still quite cold outside, the light was sufficient for a much faster a selfie.

http://icecube.wisc.edu/news/view/529 (http://icecube.wisc.edu/news/view/529)

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Detectors in the dirt

1 month ago (2017-09-08T17:28:46Z) (https://hub.polari.us/ParticleNews/note/3xeFed0FTiqSrgVGKWVbag) via NavierStokesApp To: Public

"Detectors in the dirt"

A humidity and temperature monitor developed for CMS finds a new home in Lebanon.

People who tend crops in Lebanon and people who tend particle detectors on the border of France and Switzerland have a need in common: large-scale humidity and temperature monitoring. A scientist who noticed this connection is working with farmers to try to use a particle physics solution to solve an agricultural problem.

Farmers, especially those in dry areas found in the Middle East, need to produce as much food as possible without using too much water. Scientists on experiments at the Large Hadron Collider want to track the health of their detectors—a sudden change in humidity or temperature can indicate a problem.

To monitor humidity and temperature in their detector, members of the CMS experiment at the LHC developed a fiber-optic system. Fiber optics are wires made from glass that can carry light. Etching small mirrors into the core of a fiber creates a “Bragg grating,” a system that either lets light through or reflects it back, based on its wavelength and the distance between the mirrors.

“Temperature will naturally have an impact on the distance between the mirrors because of the contraction and dilation of the material,” says Martin Gastal, a member of the CMS collaboration at the LHC. “By default, a Bragg grating sensor is a temperature sensor.”

Scientists at the University of Sannio and INFN Naples developed a material for the CMS experiment that could turn the temperature sensors into humidity monitors as well. The material expands when it comes into contact with water, and the expansion pulls the mirrors apart. The sensors were tested by a team from the Experimental Physics Department at CERN.

In December 2015, Lebanon signed an International Cooperation Agreement with CERN, and the Lebanese University joined CMS. As Professor Haitham Zaraket, a theoretical physicist at the Lebanese University and member of the CMS experiment, recalls, they picked fiber optic monitoring from a list of CMS projects for one of their engineers to work on. Martin then approached them about the possibility of applying the technology elsewhere.

With Lebanon’s water resources under increasing pressure from a growing population and agricultural needs, irrigation control seemed like a natural application. “Agriculture consumes quite a high amount of water, of fresh water, and this is the target of this project,” says Ihab Jomaa, the Department Head of Irrigation and Agrometeorology at the Lebanese Agricultural Research Institute. “We are trying to raise what we call in agriculture lately ‘water productivity.’”

The first step after formally establishing the Fiber Optic Sensor Systems for Irrigation (FOSS4I) collaboration was to make sure that the sensors could work at all in Lebanon’s clay-heavy soil. The Lebanese University shipped 10 kilograms of soil from Lebanon to Naples, where collaborators at University of Sannio adjusted the sensor design to increase the measurement range.

During phase one, which lasted from March to June, 40 of the sensors were used to monitor a small field in Lebanon. It was found that, contrary to the laboratory findings, they could not in practice sense the full range of soil moisture content that they needed to. Based on this feedback, “we are working on a new concept which is not just a simple modification of the initial architecture,” Haitham says. The new design concept is to use fiber optics to monitor an absorbing material planted in the soil rather than having a material wrapped around the fiber.

“We are reinventing the concept,” he says. “This should take some time and hopefully at the end of it we will be able to go for field tests again.” At the same time, they are incorporating parts of phase three, looking for soil parameters such as pesticide or chemicals inside the soil or other bacterial effects.

If the new concept is successfully validated, the collaboration will move on to testing more fields and more crops. Research and development always involves setbacks, but the FOSS4I collaboration has taken this one as an opportunity to pivot to a potentially even more powerful technology.

http://www.symmetrymagazine.org/article/detectors-in-the-dirt?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click (http://www.symmetrymagazine.org/article/detectors-in-the-dirt?utm_source=main_feed_click&utm_medium=rss&utm_campaign=main_feed&utm_content=click)

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Taking climate science to court, sailing with cylinders, and solar cooling

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"Taking climate science to court, sailing with cylinders, and solar cooling"

This week we hear stories on smooth sailing with giant, silolike sails, a midsized black hole that may be hiding out in the Milky Way, and new water-cooling solar panels that could cut air conditioning costs with Online News Editor David Grimm. Sarah Crespi talks to Sabrina McCormick about climate science in the U.S. courts and the growing role of the judiciary in climate science policy. Listen to previous podcasts. [Image: NASA Goddard Space Flight Center; Music: Jeffrey Cook]

http://traffic.libsyn.com/sciencemag/SciencePodcast_170908.mp3 (http://traffic.libsyn.com/sciencemag/SciencePodcast_170908.mp3)

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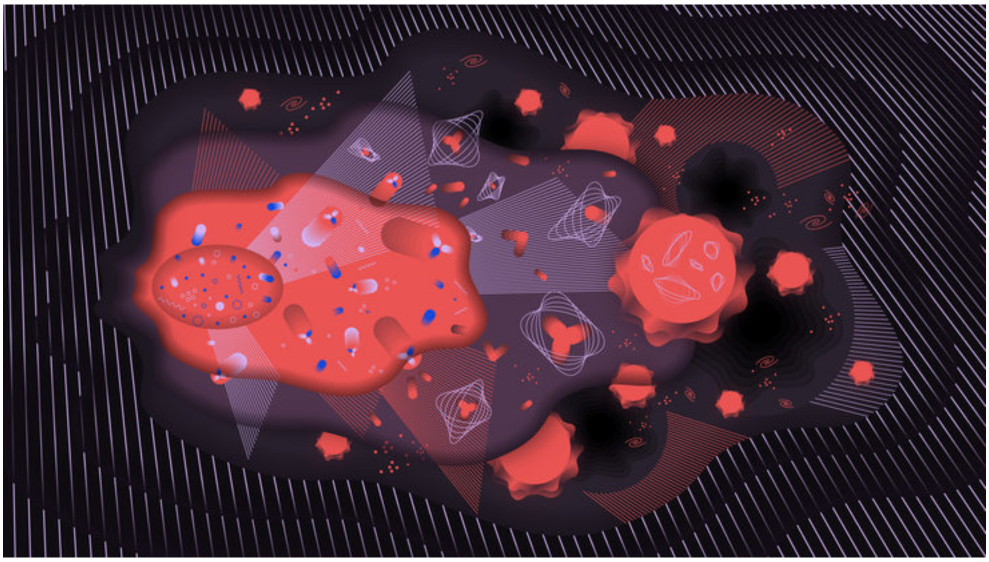
What can particles tell us about the cosmos?

1 month ago (2017-09-05T18:29:24Z) (https://hub.polari.us/ParticleNews/note/BHQOIQQnTvijJjNTDCi-dA) via NavierStokesApp To: Public

"What can particles tell us about the cosmos?"

The minuscule and the immense can reveal quite a bit about each other.



In particle physics, scientists study the properties of the smallest bits of matter and how they interact. Another branch of physics—astrophysics—creates and tests theories about what's happening across our vast universe.

While particle physics and astrophysics appear to focus on opposite ends of a spectrum, scientists in the two fields actually depend on one another. Several current lines of inquiry link the very large to the very small.

The seeds of cosmic structure

For one, particle physicists and astrophysicists both ask questions about the growth of the early universe.

In her office at Stanford University, Eva Silverstein explains her work parsing the mathematical details of the fastest period of that growth, called cosmic inflation.

“To me, the subject is particularly interesting because you can understand the origin of structure in the universe,” says Silverstein, a professor of physics at Stanford and the Kavli Institute for Particle Astrophysics and Cosmology. “This paradigm known as inflation accounts for the origin of structure in the most simple and beautiful way a physicist can imagine.”

Scientists think that after the Big Bang, the universe cooled, and particles began to combine into hydrogen atoms. This process released previously trapped photons—elementary particles of light.

The glow from that light, called the cosmic microwave background, lingers in the sky today. Scientists measure different characteristics of the cosmic microwave background to learn more about what happened in those first moments after the Big Bang.

According to scientists' models, a pattern that first formed on the subatomic level eventually became the underpinning of the structure of the entire universe. Places that were dense with subatomic particles—or even just virtual fluctuations of subatomic particles—attracted more and more matter. As the universe grew, these areas of density became the locations where galaxies and galaxy clusters formed. The very small grew up to be the very large.

Scientists studying the cosmic microwave background hope to learn about more than just how the universe grew—it could also offer insight into dark matter, dark energy and the mass of the neutrino (http://www.symmetrymagazine.org/article/how-heavy-is-a-neutrino).

“It's amazing that we can probe what was going on almost 14 billion years ago,” Silverstein says. “We can't learn everything that was going on, but we can still learn an incredible amount about the contents and interactions.”

For many scientists, “the urge to trace the history of the universe back to its beginnings is irresistible,” wrote theoretical physicist Stephen Weinberg in his 1977 book *The First Three Minutes*. The Nobel laureate added, “From the start of modern science in the sixteenth and seventeenth centuries, physicists and astronomers have returned again and again to the problem of the origin of the universe.”

Searching in the dark

Particle physicists and astrophysicists both think about dark matter and dark energy. Astrophysicists want to know what made up the early universe and what makes up our universe today. Particle physicists want to know whether there are undiscovered particles and forces out there for the finding.

“Dark matter makes up most of the matter in the universe, yet no known particles in the Standard Model [of particle physics] have the properties that it should possess,” says Michael Peskin, a professor of theoretical physics at SLAC. “Dark matter should be very weakly interacting, heavy or slow-moving, and stable over the lifetime of the universe.”

There is strong evidence for dark matter through its gravitational effects on ordinary matter in galaxies and clusters. These observations indicate that the universe is made up of roughly 5 percent normal matter, 25 percent dark matter and 70 percent dark energy. But to date, scientists have not directly observed dark energy or dark matter.

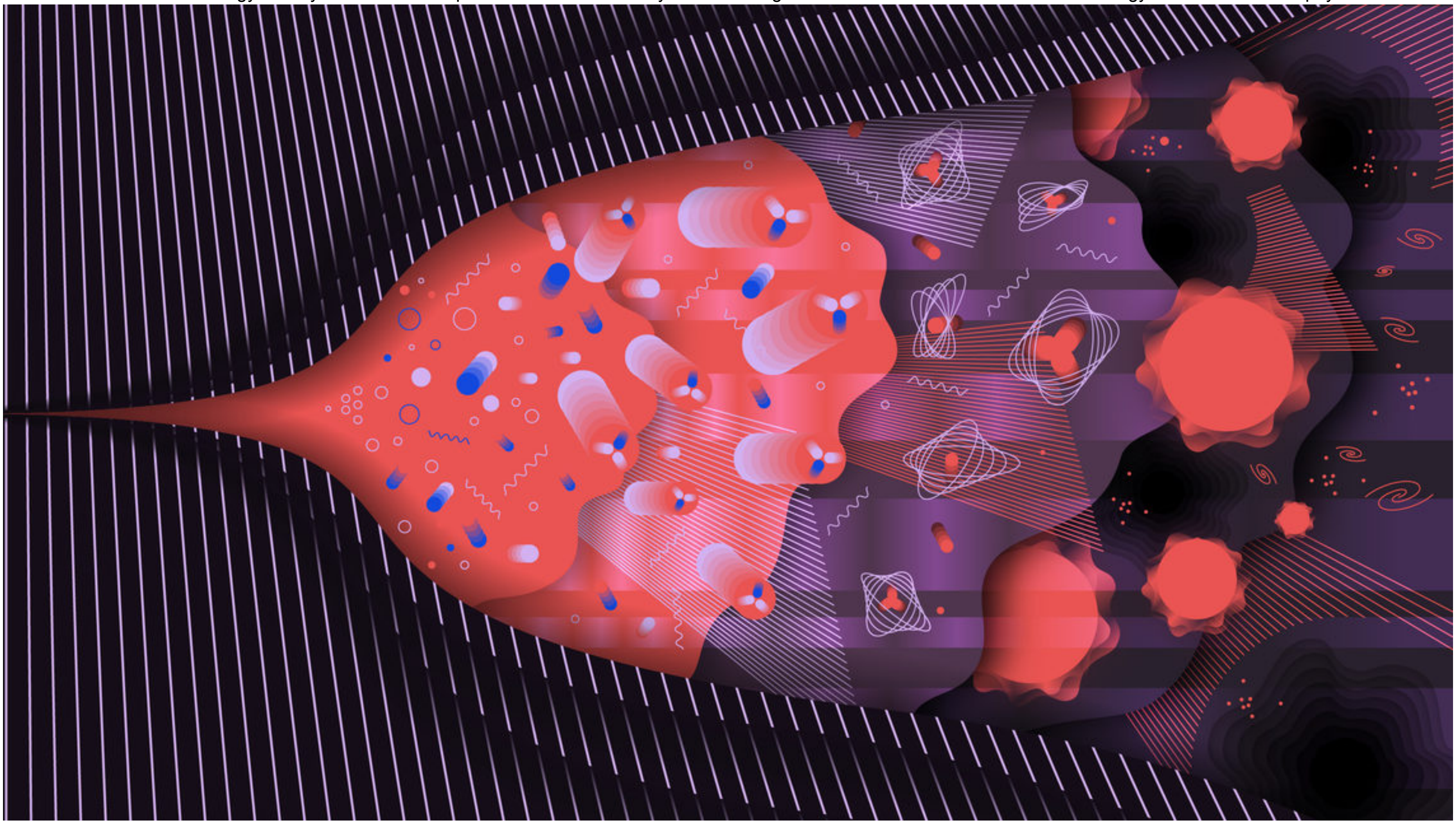
“This is really the biggest embarrassment for particle physics,” Peskin says. “However much atomic matter we see in the universe, there’s five times more dark matter, and we have no idea what it is.”

But scientists have powerful tools to try to understand some of these unknowns. Over the past several years, the number of models of dark matter has been expanding, along with the number of ways to detect it, says Tom Rizzo, a senior scientist at SLAC and head of the theory group.

Some experiments search for direct evidence of a dark matter particle colliding with a matter particle in a detector. Others look for indirect evidence of dark matter particles interfering in other processes or hiding in the cosmic microwave background. If dark matter has the right properties, scientists could potentially create it in a particle accelerator such as the Large Hadron Collider.

Physicists are also actively hunting for signs of dark energy. It is possible to measure the properties of dark energy by observing the motion of clusters of galaxies at the largest distances that we can see in the universe.

“Every time that we learn a new technique to observe the universe, we typically get lots of surprises,” says Marcelle Soares-Santos, a Brandeis University professor and a researcher on the Dark Energy Survey. “And we can capitalize on these new ways of observing the universe to learn more about cosmology and other sides of physics.”



(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_Particle_astro.jpg)
Artwork by Ana Kova

Forces at play

Particle physicists and astrophysicists find their interests also align in the study of gravity. For particle physicists, gravity is the one basic force of nature that the Standard Model does not quite explain. Astrophysicists want to understand the important role gravity played and continues to play in the formation of the universe.

In the Standard Model, each force has what’s called a force-carrier particle or a boson. Electromagnetism has photons. The strong force has gluons. The weak force has W and Z bosons. When particles interact through a force, they exchange these force-carriers, transferring small amounts of information called quanta, which scientists describe through quantum mechanics.

General relativity explains how the gravitational force works on large scales: Earth pulls on our own bodies, and planetary objects pull on each other. But it is not understood how gravity is transmitted by quantum particles.

Discovering a subatomic force-carrier particle for gravity would help explain how gravity works on small scales and inform a quantum theory of gravity (https://www6.slac.stanford.edu/news/2015-11-18-qa-slac-theorist-lance-dixon-explains-quantum-gravity.aspx) that would connect general relativity and quantum mechanics.

Compared to the other fundamental forces, gravity interacts with matter very weakly, but the strength of the interaction quickly becomes larger with higher energies. Theorists predict that at high enough energies, such as those seen in the early universe, quantum gravity effects are as strong as the other forces. Gravity played an essential role in transferring the small-scale pattern of the cosmic microwave background into the large-scale pattern of our universe today.

“Another way that these effects can become important for gravity is if there’s some process that lasts a long time,” Silverstein says. “Even if the energies aren’t as high as they would need to be sensitive to effects like quantum gravity instantaneously.”

Physicists are modeling gravity over lengthy time scales in an effort to reveal these effects.

Our understanding of gravity is also key in the search for dark matter. Some scientists think that dark matter does not actually exist; they say the evidence we’ve found so far is actually just a sign that we don’t fully understand the force of gravity.

Big ideas, tiny details

Learning more about gravity could tell us about the dark universe, which could also reveal new insight into how structure in the universe first formed.