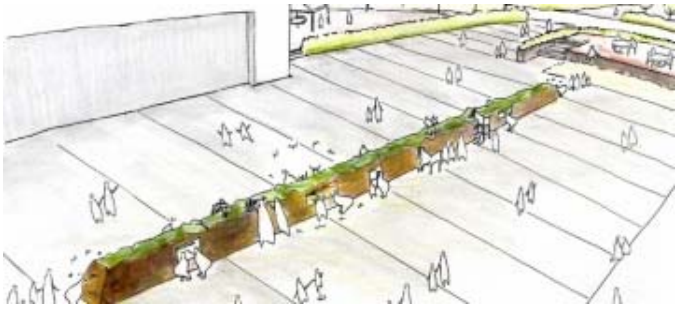
NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

Art explaining science with the help of the ILC

by Rika Takahashi



Want to help build the International Linear Collider? This autumn, the International Linear Collider exhibition will be installed at one of the biggest art event in Tokyo. Have a go at its construction...

DIRECTOR'S CORNER

Interesting times

by Mike Harrison

Future ex-Director Mike Harrison dedicates his last corner to describing the challenges that come with a change of emphasis in the R&D. The main R&D goal is optimised SCRF cost coupled with optimal design – but it's not that easy, Harrison says.

FEATURE

From symmetry: You keep using that physics word

I do not think it means what you think it means.

Physics can often seem inconceivable. It's a field of strange concepts and special terms. Language often fails to capture what's really going on within the math and theories. And to make things even more complicated, physics has repurposed a number of familiar English words.

Much like Americans in England, folks from beyond the realm of physics may enter to find themselves in a dream within a dream, surrounded by a sea of words that sound familiar but are still somehow completely foreign.

Not to worry! Symmetry is here to help guide you with this list of words that acquire a new meaning when spoken by physicists.

IN THE NEWS

from *Iwate Nichi Nichi*
6 September 2016
ILC、国体　動画に　水沢江刺駅交流プラザ
「国際リニアコライダー（ILC）」を新幹線利用者らに知ってもらおうと、奥州市はJR水沢江刺駅構内「南岩手交流プラザ」の一角にILCのPRコーナーを開設。5分間にまとめた動画の上映を始めた。(Oshu city installed the video booth at the Minami Iwate communicaion plaza at the JP Mizuwasa esashi station, and started to broadcast ILC promotion video to gain more understadings from Shinkansen passengers.)

from *hayadan.org*
30 September 2016
מאיץ החלקיקים שיכול להציל את הפיזיקה (Particle accelerator physics can save)
מאיץ שמציעים לבנות ביפן יוכל אולי לפתור את התעלומות שמאיץ ההדרונים הגדול בג'נבה לא הצליח לפתור בעת כתיבת הטור הזה צפוי משרד החינוך התרבות והספורט של יפן (MEXT) להחליט אם להמשיך בפרויקט ה-ILC. אנחנו סבורים שכדאי. (Japan's offer to build accelerator may be able to solve the mysteries Large Hadron Collider in Geneva failed to resolve. —-When writing this column is expected to Ministry of Education and Culture of Japan (MEXT) to decide whether to continue the ILC project. We think you should.)

from *The Kitakami Times*
30 September 2016
A wonderful summer full of "natsu-matsuri"
Another year, another summer. Japan's summer season may be hot and humid, but it's also full of traditional events that center on family and the community. Many of these "natsu-matsuri", or summer festivals, are held in August during the O-bon holiday, which is all about paying your respects to relatives who have passed. It's also a time to perform the various ceremonies and dances that have been passed down in each region for hundreds of years.
(**Japanese translation** available at the end of the article)

from *The Kitakami Times*
28 September 016
1st Anniversary of The Kitakami Tiimes
In this issue:
-Talking about 2016's LCWS with Prof. Shinya Narita of Iwate University
-ILC summer camp at an Ichinoseki hot spring resort
-Kesennuma: Unusual treats, sake, biking, and sea frolicking
-A wonderful summer full of "natsu-matsuri"

from *JND*
27 September 2016
「Tokyo Midtown DESIGN TOUCH」が10月14日から開催
そのほかの注目プログラムは、「Salone in Roppongi」。建築家・長坂常が世界で最も難解と言われる素粒子物理学の世界をデザインの視点で伝える。(One of the program attracting the most attention is "Salone in Roppongi." Architect Jo Nagasaka will present the world of particle physics from his own view point.)

from *Science*
27 September 2016
Will Nobel Prize overlook master builder of gravitational wave detectors?
Next week, the 2016 Nobel Prize in Physics will be announced, and many scientists expect it to honor the detection of ripples in space called gravitational waves, reported in February. If other prizes are a guide, the Nobel will go to the troika of physicists who 32 years ago conceived of LIGO, the duo of giant detectors responsible for the discovery: Rainer Weiss of the Massachusetts Institute of Technology (MIT) in Cambridge, and Ronald Drever and Kip Thorne of the California Institute of Technology (Caltech) in Pasadena. But some influential physicists, including previous Nobel laureates, say the prize, which can be split three ways at most, should include somebody else: Barry Barish.

from *American Scientist Macroscope Blog*
25 September 2016
Particle Colliders on the Horizon
Nevertheless, fundamental science has led to a myriad of influential applications in society. (…) The moral is that we won't know the impact that building a new accelerator will have on society until many years after we use it. In the meantime it is guaranteed to foster peaceful international collaboration and continue to inspire the imagination and hope of future generations of scientists.

During my time at CERN, I worked as a part of the ATLAS collaboration, one of the groups working to analyze the collisions from the LHC. (…) I'm optimistic that I will go back soon and continue working with the LHC. But in the far future, I'm excited to hear which of these accelerators the world will agree to construct, and which will likely determine the focus of my future career.

from *环球科学*
23 September 2013
Hello Kitty 代言日本超级对撞机 (Hello Kitty speaks Japanese Super Collider)
你也许不熟悉超大型对撞机，但不可能不认识 Hello Kitty。这只源于日本、风靡世界的小猫是"卡哇伊"文化的代表，其可爱甜美的形象已经出现在上万种商品上，每年畅销数十个国家。如今，Hello Kitty 有了一项新工作：国际直线对撞机（International Linear Collider，ILC）的形象大使，为 ILC 在日本乃至全世界争取支持。（You may not be familiar with the super collider, but it is impossible not knowing Hello Kitty. Hello Kitty is from Japan, but swepted the world with "Kawaii" culture by its lovely sweet image. She has appeared in the tens of thousands of commodities, selling dozens of countries each year.Today, Hello Kitty has a new job: ILC (International Linear Collider, ILC) ambassador for the ILC in Japan and around the world to gain the support.)

from *Iwate Nippo*
8 September 2016
海外へのILC情報発信を要望　推進協が自民党などに (Requesting information be shared abroad: The Tohoku Conference for the Promotion of the ILC visits with LDP politicians and MEXT officials)
宇宙の起源解明を目指す超大型加速器国際リニアコライダー（ILC）の東北誘致を推進する東北ILC推進協議会は7日、自民党や文科省、超党派のリニアコライダー国際研究所建設推進議員連盟に、海外政府への情報発信の推進などを求める要望書を提出した。
(he Tohoku Conference for the Promotion of the ILC is working towards getting the ILC sited in Tohoku, and on September 7th, representatives met with politicians of the Liberal Democratic Party (LDP), the Ministry of Education, Science, Sports, Culture, and Technology (MEXT), and the non-partisan Federation of Diet Members for the ILC (FDMILC). There, they presented a formal request for more information to be shared with foreign governments.)
Read full translation provided by *Iwate & the ILC* website here.

from *Iwate Nippo*
31 August 2016
110 million yen requested for ILC-related items in MEXT's FY2017 budgetary allocations
The request was broken down into 60 million yen for risk analysis, investigation, and research related to the international large-scale accelerator plan, and 50 million yen for developing the core technology needed to improve performance, reduce size, and lower the cost of a future accelerator. (…) Another 40.8 billion yen was calculated for support for the reconstruction from the Great East Japan Earthquake and Tsunami (reconstruction special accounts portion).
(**Full translation** provided by *Iwate & the ILC* website)

from *Tanko Nichinichi*
19 August 2016
地元のILC誘致熱　発信（シリーズPR動画、候補地周辺で初ロケ） (Showing Local Enthusiasm for the ILC (PR video series films around candidate site for first time))
　北上山地が有力候補地となっている素粒子研究施設、国際リニアコライダー（ILC）を紹介するシリーズPR動画「ILC科学少年団」のロケが18～19日、奥州、一関両市で行われている。初日は水沢区内や国立天文台水沢キャンパスなどで撮影を実施。宇宙誕生の謎を解き明かすILCは、天文学とも結びつきが深い研究施設であることにも触れた。動画は今年10月から12月にかけ、全国のケーブルテレビ（CATV）局で放送されるほか、インターネット動画サイト「You　Tube」でも配信する予定だ。
(The "ILC Scouts," a program introducing the International Linear Collider, filmed in Oshu City and Ichinoseki City on August 18-19. On the first day, filming was held in Mizusawa ward and on the NAOJ Mizusawa Campus. The story touched on how the ILC, which could solve the riddle of how the universe began, has deep connections with astronomy. The episodes will be broadcast on cable TV networks nationwide from October to December this year, and will also be posted on Youtube.)
Read full translation provided by *Iwate & the ILC* website here.

CALENDAR

Upcoming events

Corfu Summer Institute
Corfu, Greece
31 August- 23 September 2016

6th Low Emittance Rings Workshop (LOWeRING 2016)
SOLEIL, Gif-sur-Yvette, france
28 October 2016

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1610.00648
Exploring collider signatures of the inert Higgs doublet model

1610.00628
Higgs physics at CLIC

1609.09299
Yukawa's of light stringy states

1609.08807
Where does the X(5568) structure come from?

1609.08796
Measuring the trilinear neutral Higgs boson couplings in the MSSM at e+e− colliders

1609.08127
Prospects for three-body Higgs decays into extra light scalars

1609.07868
One loop effects of natural SUSY in third generation fermion production at the ILC

1609.07816
A Study of the Impact of High Cross Section ILC Processes on the SiD Detector Design

1609.07143
Gravitational wave and collider implications of electroweak baryogenesis aided by non-standard cosmology

1609.06555
Phenomenological signatures of mixed complex scalar WIMP dark matter

1609.06320
A small weak scale from a small cosmological constant

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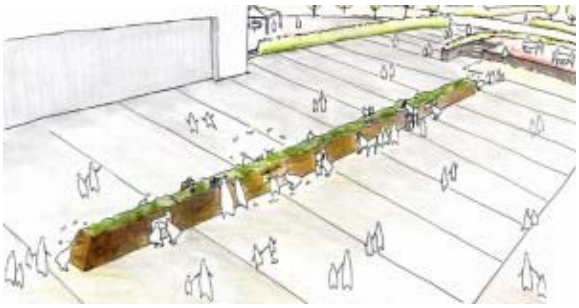
Art explaining science with the help of the ILC

Rika Takahashi | 6 October 2016



Architectural perspective of the ILC exhibition to be held in Tokyo. Image: Schemata Archtects

In Japan, autumn is regarded to be the best season to enjoy arts and entertainment. From late October to early November, various design and arts events are held in the Tokyo metropolitan area, attracting millions of visitors to exhibitions and art galleries.

This year, the International Linear Collider will be the theme of one of those exhibitions.

Tokyo Midtown, located in Roppongi, the city's most popular culture, art and nightlife district, is a commercial and residential complex. With various sensations such as the Ritz-Carlton hotel, the Suntory Museum of Art, the 21_21 DESIGN SIGHT museum, and 130 shops and restaurants, it attracts approximately 30 million visitors each year.

"Tokyo Midtown DESIGN TOUCH" is an art and design event hosted by Tokyo Midtown every year since 2007. The master concept of the event is "enjoy design with the five senses." The visitors can see, feel and hear artworks, and also smell and taste foods and beverages specially prepared for the event. Last year, roughly 1.43 million visitors enjoyed various design attractions and similar numbers are expected for this year, where the ILC plays a special role in the exhibition.

The ILC exhibition will be installed in the courtyard as a "Salone in Roppongi" exhibition. Salone in Roppongi has been showcasing Japanese design achievements since 2013 with a focus on internationally successful "Japanese design ability." This year's works attempt to convey science through the power of design, and the architect Jo Nagasaka chose the ILC as a theme.

Building 2-meter-long mock up of ILC exhibition at Salone in Roppongi. Image: Rika Takahashi

"I was so surprised to learn that the scientists are taking on a challenge to learn about such a tiny world by using such an extravagant system," said Nagasaka. "I want to describe what I felt by this work, and share the feeling of wonder with many visitors," he said.

Nagasaka works in Japan as well as abroad and has extensive experience in a wide range of areas from furniture to architecture. Now, his designs have finally reached particle physics. His design approach has been always based on 1:1 scale, regardless of what size he deals with, but this was impossible this time – after all the ILC is 31 kilometres long. So he designed a 1/2000 scale model of the ILC including the landscape of the construction site. "Particle physics is very difficult to comprehend for many people, so I aim to make the subject more understandable," he says.

Nagasaka uses a technique called rammed earth, to create the land where the ILC will be installed. Rammed earth is a technique generally used to build walls or floors using natural raw materials such as earth and chalk. To build the wall, they will pour a damp mixture of earth and a suitable proportion of cement into the external frame, and keep compressing and compressing. Nagasaka and his team will build a 15-metre-long wall of rammed earth at the exhibition site for the first two days of the event. “I want many visitors to actually participate in building the ILC,” said Nagasaka.

After the construction site is prepared, the accelerator will be installed, and the visitors can peek into the tunnel to see some parts of the machine. At the interaction point, visitors will see a 3D image of particle collisions using holography technology. The video will be created by Rhizomatiks, the company which was in charge of the augmented reality (AR) production for the closing ceremony of Rio Olympic games.

The exhibition will be held from 28 October to 6 November. Check out the detail at the Tokyo Midtown DESIGN TOUCH website . During the exhibition week, several media events are planned, and on 3 November, the organisers invited Lyn Evans, Director of the Linear Collider Collaboration, as a guest speaker.

If you are around the Tokyo area, please join the construction of the ILC!

ART | JAPAN | JO NAGASAKA | SCIENCE AND SOCIETY | TOKYO

NEWSLINE
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DIRECTOR'S CORNER

Interesting times

Mike Harrison | 6 October 2016

Can the accelerating gradient of cavities be increased? R&D continues.

Harry Weerts in his Directors Corner article on 11 August described the upcoming year-end changes to the ILC programme in both the LCC organisation and the accelerator design efforts. Since that time the ILC accelerator team has been assessing the impact of the change in direction of the US programme with the emphasis switching from design work back to SRF R&D and value engineering. The goal of the change is to emphasise cost optimisation of the ILC proposal from the current baseline as documented in the 2012 Technical Design Report and subsequent change requests – a laudable goal.

For the past few years the design of the facility has been evolving to account for both baseline improvements, cost optimisation and site-specific features of the preferred Kitakami site in northern Japan. After deliberation by the ILC Technical Board it was decided that without the US support the remaining resources in Japan and Europe were simply insufficient to generate the critical mass needed to sustain such a complex endeavour as the ILC design. Thus there was no choice but to suspend on-going design activities and plan for the eventuality of the US withdrawal. Not only has a significant amount of work been accomplished in the past few years but there is also work in progress that needs to be concluded and documented too.

In the “in-progress” category we have such items as a modified cryogenic layout which addresses the issue of helium maintenance during power outages (the ILC helium inventory is such that a catastrophic helium loss from a site-wide power outage could take up to a year to replenish), a beam commissioning and tune-up scenario that minimises the size and power of the beam dump system, and a positron production area rearrangement that leaves space for a conventional (non-polarised) positron source. In addition these design changes will form the basis of a lattice update and a conceptual layout of the various tunnels in the central region. No new design topics will be started from this point on but all the aforementioned items will be documented in the ILC EDMS database so that when the design efforts resume there is a well defined baseline available from which to start.

Mike Harrison’s role as Associate Director for the ILC will come to a close at the end of the year. Here’s a picture from

In addition to gracefully winding down the design efforts the new emphasis on R&D poses the issue of how best to inject the ILC requirements into the proposed SRF work and technology development. At the most basic level the goals are clear; increase the operating gradient and reduce the component costs thus reducing the ILC construction costs. One level down from these aims however, it becomes less clear. What constitutes sufficient information to actually establish a new gradient specification with confidence that it can be achieved in mass production? The SRF R&D programme up to the Technical Design report was based on results from 87 9-cell cavities to establish an average 31.5 MV/m cryomodule gradient used in the TDR design. While we will not need similar statistics to re-adjust the design value, how many data points are sufficient? How can we ensure that the proposed R&D programme will satisfy technical requirements that haven’t really been established yet? What constitutes an acceptance criterion for a tuner if it doesn’t look like the

(good old) GDE times.

ones used by the European XFEL? What is the cost (and schedule) of the R&D? In order to start to address these kinds of issues we will attempt to use the upcoming Morioka workshop to arrange special mini-workshops on various topics. At the behest of the funding agencies, the proposed R&D agendas were determined by the main HEP national labs and not the LCC. Morioka hopefully can start a dialogue which will address this imbalance.

Well as they say, all good things must come to an end, and with the upcoming LCC re-organisation, I shall join Brian and Harry as an ex-ILC Directorate member. As of the first of January I will no longer have the role of Associate Director for the ILC and with this, my last Director's Corner, my burgeoning career as a journalist will also come to an end. It is said that it is not the destination but the journey that's important in this life and this has certainly been the case for the last decade that I have spent working on the ILC. I have visited many locales and achieved a serious familiarity with the inside of many airports. Possibly a little more of the destination and less of the journey might have been nicer but I would like to take this opportunity to thank all of my colleagues both new and old who have been a pleasure to work with over the years. I feel confident that the next chapter in the saga will remain in good hands. Interesting times indeed!

(*"**May you live in interesting times**" is an English expression purported to be a translation of a traditional Chinese curse. Despite being so common in English as to be known as "**the Chinese curse**", the saying is apocryphal, and no actual Chinese source has ever been produced."* — *Wikipedia)*

symmetry
dimensions of particle physics

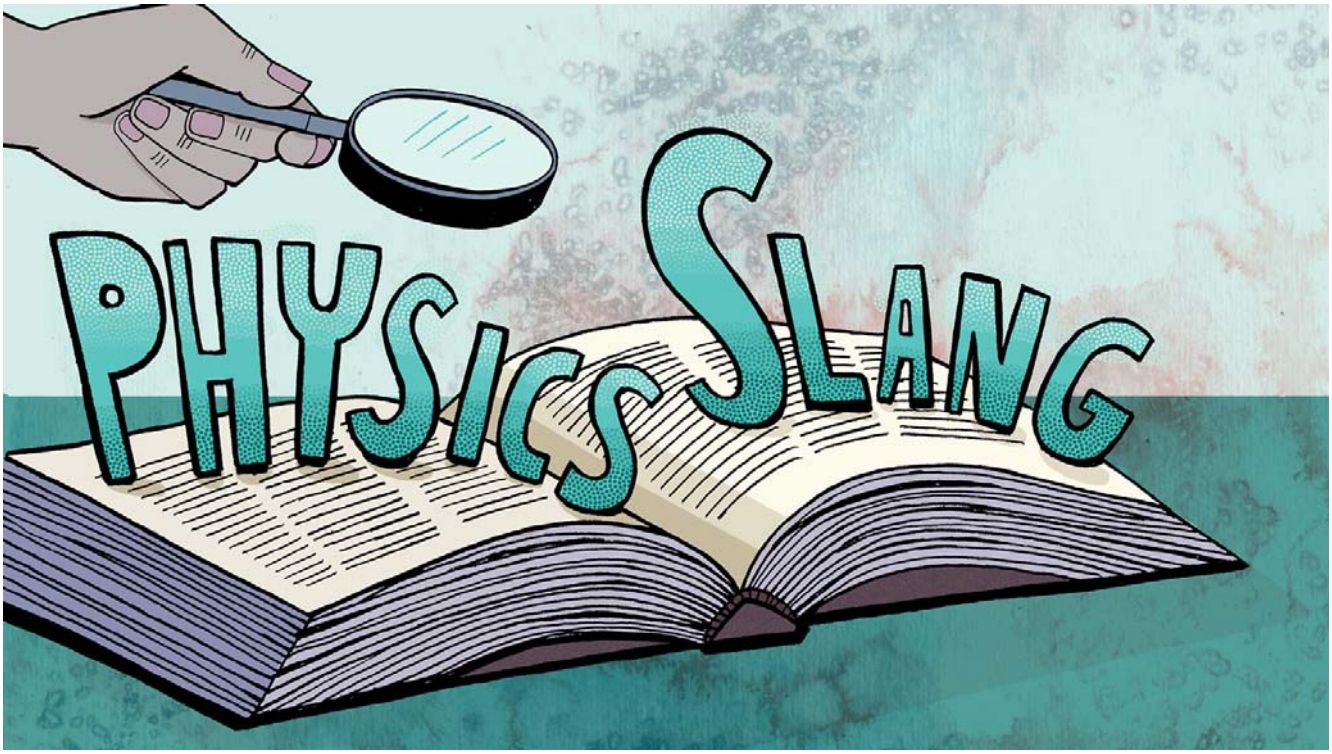

Illustration by Sandbox Studio, Chicago with Corinne Mucha

You keep using that physics word

09/27/16 | By Lauren Biron

I do not think it means what you think it means.

Physics can often seem inconceivable. It's a field of strange concepts and special terms. Language often fails to capture what's

(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_1_Physics_Slang_Quench.jpg)

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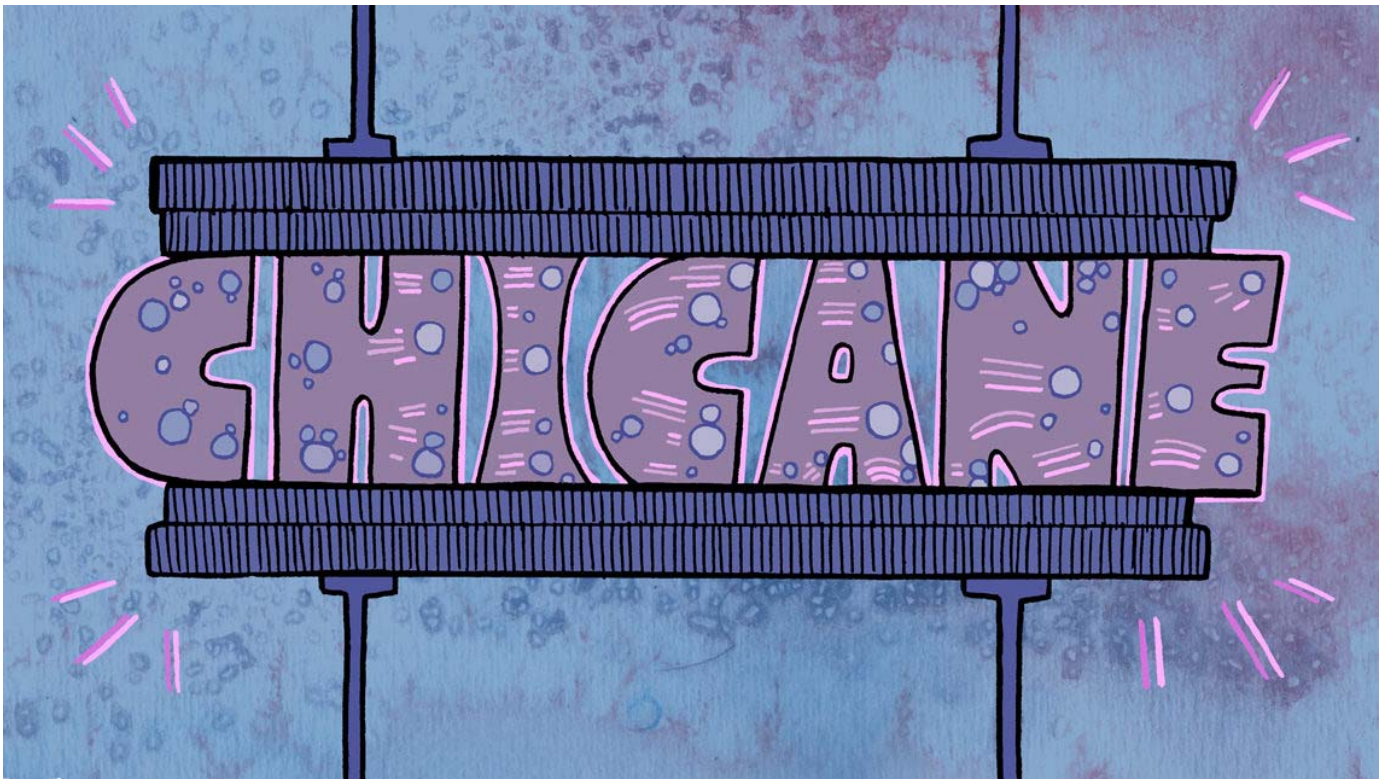

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(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_4_Physics_Slang_Cooler.jpg)

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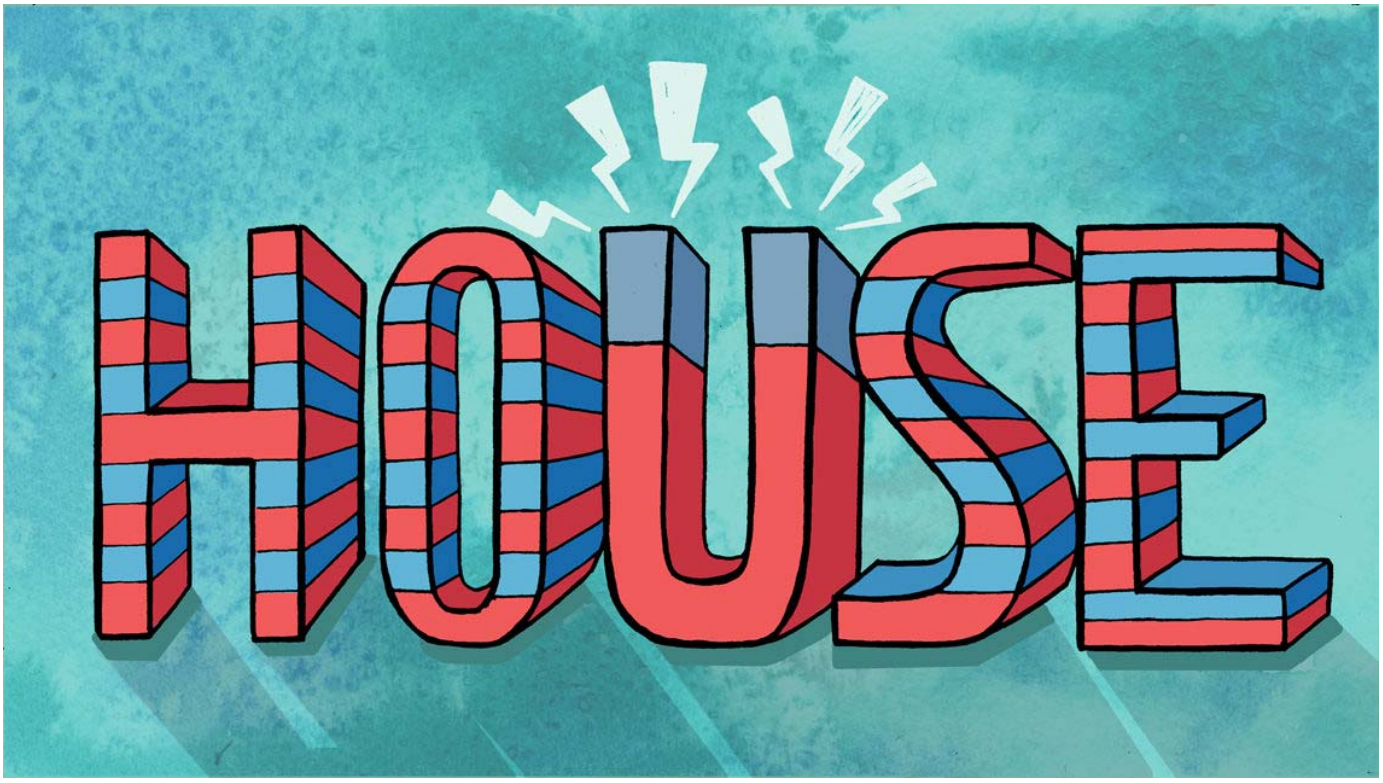

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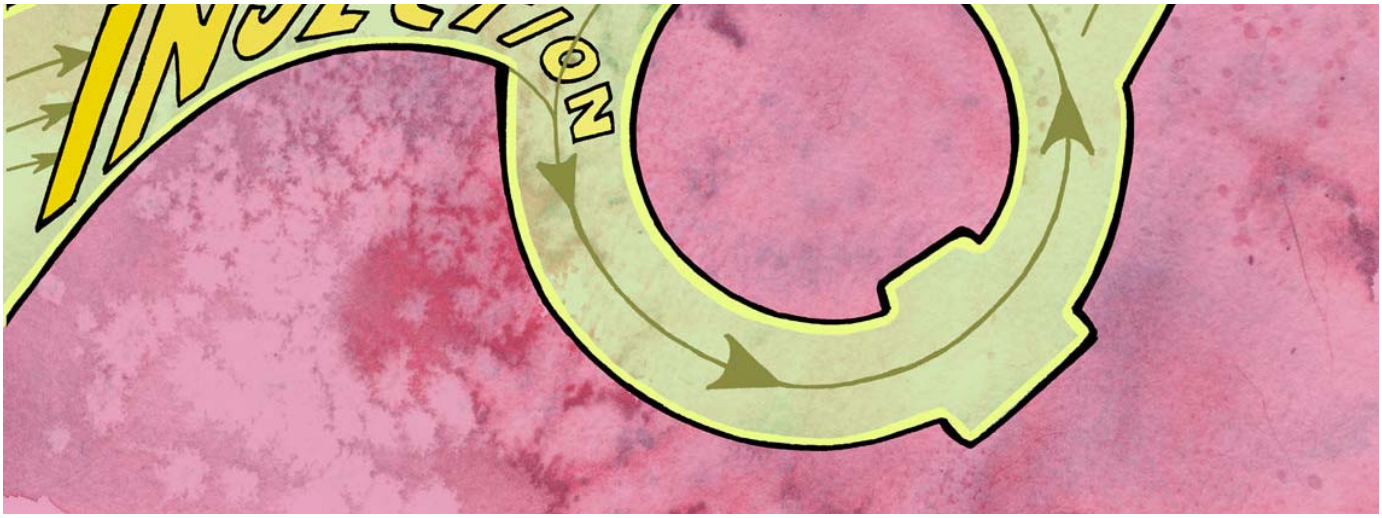

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(http://www.symmetrymagazine.org/sites/default/files/images/standard/Inline_10_Physics_Slang_Decay.jpg)

Illustration by Sandbox Studio, Chicago with Corinne Mucha

really going on within the math and theories. And to make things even more complicated, physics has repurposed a number of familiar English words.

Much like Americans in England, folks from beyond the realm of physics may enter to find themselves in a dream within a dream, surrounded by a sea of words that sound familiar but are still somehow completely foreign.

Not to worry! *Symmetry* is here to help guide you with this list of words that acquire a new meaning when spoken by physicists.

Quench

The physics version of quench has nothing to do with Gatorade products or slaking thirst. Instead, a quench is what happens when superconducting materials lose their ability to superconduct (or carry electricity with no resistance). During a quench, the electric current heats up the superconducting wire and the liquid coolant meant to keep the wire at its cool, superconducting temperature warms and turns into a gas that escapes through vents. Quenches are fairly common and an important part of training magnets that will focus and guide beams through particle accelerators. They also take place in superconducting accelerating cavities.

Cannibalism, strangulation and suffocation

These gruesome words take on a new, slightly kinder meaning in astrophysics lingo. They are different ways that a galaxy's shape or star formation rate can be changed when it is in a crowded environment such as a galaxy cluster. Galactic cannibalism, for example, is what happens when a large galaxy merges with a companion galaxy through gravity, resulting in a larger galaxy.

Chicane

Depending on how much you know about racecars and driving terms, you may or may not have heard of a chicane. In the driving world, a chicane is an extra turn or two in the road, designed to force vehicles to slow down. This isn't so different from chicanes in accelerator physics, where collections of four dipole magnets compress a particle beam to cluster the particles together. It squeezes the bunch of particles together so that those in the head (the high-momentum particles at the front of the group) are closer to the tail (the particles in the rear).

Cooler

A beam cooler won't be of much use at your next picnic. Beam cooling makes particle accelerators more efficient by keeping the particles in a beam all headed the same direction. Most beams have a tendency to spread out as they travel (something related to the random motion, or "heat," of the particles), so beam cooling helps kick rogue particles back onto the right path—staying on the ideal trajectory as they race through the accelerator.

House

In particle physics, a house is a place for magnets to reside in a particle accelerator. House is also used as a collective noun for a group of magnets. Fermilab's Tevatron particle accelerator, for example, had six sectors, each of which had four houses of magnets.

Barn

A barn is a unit of measurement used in nuclear and particle physics that indicates the target area ("cross section") a particle represents.

The meaning of the science term was originally classified, owing to the secretive nature of efforts to better understand the atomic nucleus in the 1940s. Now you can know: One barn is equal to 10^{-24} cm^2. In the subatomic world, a particle with that size is quite large—and hitting it with another particle is practically like hitting the broad side of a barn.

Cavity

Most people dread cavities, but not in particle physics. A cavity is the name for a common accelerator part. These metal chambers shape the accelerator's electric field and propel particles, pushing them closer to the speed of light. The electromagnetic field within a radio-frequency cavity changes back and forth rapidly, kicking the particles along. The cavities also keep the particles bunched together in tight groups, increasing the beam's intensity.

Doping

Most people associate doping with drug use and sports. But doping can be so much more! It's a process to introduce additional materials (often considered impurities) into a metal to change its conducting properties. Doped superconductors can be far more efficient than their pure counterparts. Some accelerator cavities made of niobium are doped with atoms of argon or nitrogen. This is being investigated for use in designing superconducting magnets as well.

Injection

In particle physics, injections don't deliver a vaccine through a needle into your arm. Instead, injections are a way to transfer particle beams from one accelerator into another. Particle beams can be injected from a linear accelerator into a circular accelerator, or from a smaller

circular accelerator (a booster) into a larger one.

Decay

Most people associate decay with things that are rotting. But a particle decay is the process through which one particle changes into other particles. Most particles in the Standard Model are unstable, which means that they decay almost immediately after coming into being. When a particle decays, its energy is divided into less massive particles, which may then decay as well.

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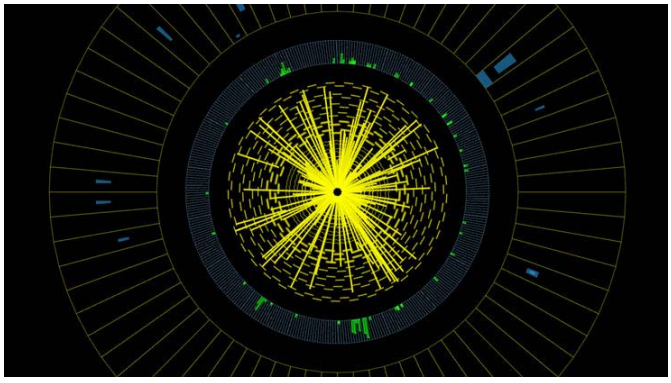
04/28/15

Ten things you might not know about antimatter (/article/april-2015/ten-things-you-might-not-know-about-antimatter)
Antimatter has fueled many a supernatural tale. It's also fascinating all by itself.



(/article/lhc-smashes-old-collision-records)

09/29/16

LHC smashes old collision records (/article/lhc-smashes-old-collision-records)
The Large Hadron Collider is now producing about a billion proton-proton collisions per second.

(/article/creating-the-universe-in-a-computer)

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Creating the universe in a computer (/article/creating-the-universe-in-a-computer)
Computer simulations help cosmologists unlock the mystery of how the universe evolved.

(/article/small-cat-big-science)

09/21/16

Small cat, big science (/article/small-cat-big-science)
The proposed International Linear Collider has a fuzzy new ally.

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