LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

DIRECTOR'S CORNER

Snowmass on the Mississippi in Minneapolis

Deputy Linear Collider Director Hitoshi Murayama says that for the ILC, momentum is key.

by Hitoshi Murayama

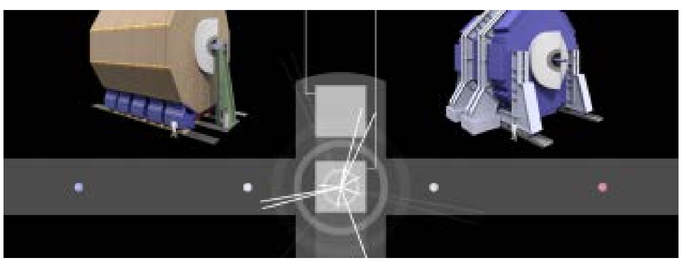
Waiting for his plane after an intense and productive *Snowmass* meeting with more than 700 participants in Minneapolis, Hitoshi Murayama reports that the scientific opportunities and aspirations discussed at the meeting seem to lead to basic community consensus. The hunt for the identity of the Higgs adds momentum.

FEATURE

The ILC at a glance 2

A new version of the ILC animation is released

by Perrine Royole-Degieux

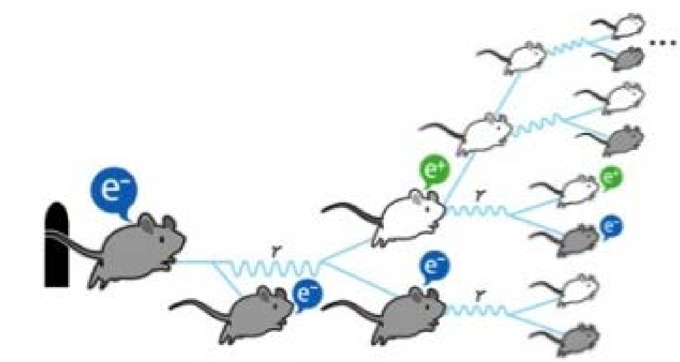


“The ILC in 2 minutes”, the new ILC animation, now includes the latest machine and detector design and also comes with optional sound and various languages subtitles. Make sure to share it!

LCPEDIA

Positron

by Misaki Kawaguchi



For a linear collider, a myriad of positrons, the electron’s antimatter partner, will be necessary to collide with electrons.

IMAGE OF THE WEEK

From symmetry magazine: Scientists look to next decades in US particle physics

Image: Reidar Hahn, Fermilab

From the output of the “Snowmass” meeting, US particle physicists will chart a path to answering some of science’s most intriguing questions. More than 600 particle physicists from nearly 100 universities and laboratories came together on the University of Minnesota’s Minneapolis campus to enumerate the field’s most pressing scientific questions and contemplate the experiments needed to answer them.

IN THE NEWS

from *NHK*
7 August 2013
学術会議　誘致に慎重姿勢
国際リニアコライダーの誘致について検討していた日本学術会議は、「費用負担など未確定の部分が多く、数年かけて判断すべきだ」という誘致に慎重な見解を大筋でまとめました。(Science Council of Japan reached broad agreement that Japan should take few years to evaluate whether Japan should host ILC, since the project has some uncertainties such as expense distribution between participated countries)

from *The Guardian*
6 August 2013
One year on from the Higgs boson find, has physics hit the buffers?
Despite the success of the Large Hadron Collider, evidence for the follow-up theory – supersymmetry – has proved elusive

from *Jiji Press*
6 August 2013
Japan Needs Years to Make Decision on ILC Building: Science Council Panel
-Members of a Science Council of Japan panel agreed in principle on Tuesday that Japan should spend several years to examine the significance of leading the proposed international project to construct a next-generation large-scale particle accelerator.

from *Nishi nihon shimbun*
27 July 2013
誘致、署名　万人超 経営者ら知事に活動報告
「国際リニアコライダー」　を脊振山地に誘致するため、署名活動に取り組む「九州への　誘致を実現する会」の岩木勇人事務局長　ら　人が　日、県庁を訪れ、古川康知事に活動報告した。(Representatives of the group to invite the ILC to Sefuri area visited the Saga governor and reported their activities include the 350 thousands signatures they collected.)

from *Financial Times*
26 July 2013
Cern physicist Fabiola Gianotti on hunting for the ‘God particle’
The Italian scientist on how her work on the Higgs boson can be linked to a love of nature and musi

from *Kahoku Shimpo*

25 July 2013

誘致に意欲 同友会東北会議・宮城知事ら意見交換

「東日本大震災からの産業復興」をテーマに村井嘉浩宮城県知事と仙台経済同友会の大山健太郎、一力雅彦両代表幹事が意見交換し、県境を越えた連携の推進などで一致した。岩手県の北上山地への誘致を目指す超大型加速器「国際リニアコライダー 」をめぐっては、 氏とも実現に意欲を見せた。(Governor and two business experts of Miyagi prefecture met on 25 July, and agreed to cooperate to make efforts toward the recovery include invitation of the ILC)

from *nature*

24 July 2013

Cyclotrons come full circle

P5 is likely to recommend some US involvement in high-energy machines, both the LHC and a next-generation machine that Japan hopes to host, the International Linear Collider. The panel could also renew an emphasis, set in its 2008 report, on the intensity frontier, which led to the flagship LBNE proposal.

CALENDAR

Upcoming events

Meeting of the American Physical Society Division of Particles and Fields (DPF 2013)
University of California, Santa Cruz, CA, USA
13- 17 August 2013

POSIPOL 2013
Argonne National Lab
04- 06 September 2013

LC13 Workshop
Villazzano (Trento), Italy
16- 20 September 2013

16th International Conference on RF Superconductivity (SRF 2013)
Paris, France
22- 27 September 2013

ILD meeting
Cracow, Poland
24- 26 September 2013

Linear Collider Forum 2013
DESY, Hamburg, Germany
09- 11 October 2013

SiD Workshop
SLAC, USA
14- 16 October 2013

Upcoming schools

Linear Collider Physics School 2013
DESY, Hamburg
07- 09 October 2013

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1308.1145
A Beam Driven Plasma-Wakefield Linear Collider: From Higgs Factory to Multi-TeV

1308.1094
Measuring CP Violation in $h \to τ^+ τ^-$ at Colliders

1308.0297
Constraints on Higgs Properties and SUSY Partners in the pMSSM

1308.0052
Scrutinizing h(125) in Two Higgs Doublet Models at the LHC, ILC, and Muon Collider

1307.8265
Top quark precision physics at the International Linear Collider

1307.8134
WIMP dark matter as radiative neutrino mass messenger

1307.8102
A precise determination of top quark electro-weak couplings at the ILC operating at $\roots=500\,\GeV$

1307.8076
Non-Simplified SUSY: stau-Coannihilation at LHC and ILC

1307.7967
IRIDE White Book, An Interdisciplinary Research Infrastructure based on Dual Electron linacs&lasers

1307.7644
Measurement of the top Yukawa Coupling at a 1 TeV International Linear Collider using the SiD detector

1307.6157
Phenomenology of Supersymmetric Models with a Symmetry-Breaking Seesaw Mechanism

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DIRECTOR'S CORNER

Snowmass on the Mississippi in Minneapolis

Deputy Linear Collider Director Hitoshi Murayama says that for the ILC, momentum is key.

Hitoshi Murayama | 8 August 2013

The *Snowmass* meeting has just finished with a great deal of enthusiasm. I'm writing this article as I wait for my flight at Minneapolis-St. Paul airport under the lingering excitement from the meeting of more than 700 physicists. We discussed about the future of high-energy physics in the US and laid out scientific opportunities. There was a strong emphasis that we should think globally. I'm impressed by all the potential new projects addressing different aspects of particle physics, ranging from galaxy surveys and underground dark matter searches to high-energy colliders. And I believe the process built a broad consensus that the newly discovered Higgs boson must be studied with the best precision possible with a realistic plan, thanks to the tremendous amount of work done by many in the community.

Snowmass on the Mississippi rather than in the Rockies: many days, many people, many opinions.

The meeting is the finish line of a nine-month long marathon organised by the Division of Particles and Fields of the American Physical Society. The official title is "Community Summer Study 2013", but out of tradition this type of meeting is called *Snowmass* because it used to be held as a three-week-long workshop in Snowmass, Colorado. This time the meeting had a new format with many pre-*Snowmass* meetings for energy, intensity and cosmic frontiers.

The study is *not* about setting priorities. There will be a committee called P5 (Particle Physics Projects Prioritization Panel) chaired by Steve Ritz, Director of Santa Cruz Institute for Particle Physics, University of California, Santa Cruz, that will come up with a realistic programme within certain budget scenarios from US Department of Energy (DOE) and National Science Foundation (NSF). Instead, the *Snowmass* meeting is meant to find and articulate scientific opportunities and our aspirations. All the plenary talks were truly impressive. I have learned a lot about what exciting discoveries may be waiting for us in the future. For instance, a Stage-IV cosmic microwave background experiment will not only reveal the structure of the Universe with B-mode polarisation from lensing, it can also measure the sum of neutrino masses down to the amazing accuracy of 16meV. New experiments on muons may discover flavour-changing processes with sensitivities *two orders of magnitude* better than the current limits, which probe many models based on the seesaw mechanism and supersymmetry. And new developments in instrumentation and accelerators will take us to an amazing future, well beyond what we can contemplate today.

What collider option would be the best for a precision Higgs study was an intense focal point of discussions. The Higgs working group discussed a whole range of options: a high-luminosity upgrade of the Large Hadron Collider (HL-LHC) accumulating three inverse attobarns, a new 80-to-100-kilometre tunnel to house a circular electron-positron collider or a higher-energy proton-proton collider, an ambitious new technology to collide muons and anti-muons in a storage ring, and the linear electron-positron colliders ILC and CLIC.

The Higgs boson that was discovered will come under a much bigger scrutiny. It is like a detective story. *It* brought order to the

Universe, so that atoms can exist. *It* protects our body from vaporising in a nano-second. But *it* seems to be one of a kind; we have not met anything like *it* before. We naturally ask: *Is it alone? How does it do it? Where did it come from?* These are the crucial questions now that we've finally met *it* after half a century of hunt. It truly is like a detective story.

Based on many simulation studies addressing systematic uncertainties, factoring in the realistic developments in the next 10 to 20 years, the study has coalesced down to two options: HL-LHC and ILC. It is clear that the investments already made on LHC should be fully exploited. LHC was built mostly by European contributions, but also had a significant share from US, Japan, Canada and India. It is the biggest scientific instrument ever built, and we scientists are all grateful to the taxpayers around the world to make this a reality. It will have nearly twenty years of life, first upgrading in energy and then in luminosity. Upgrading in energy is like getting a better mirror for a telescope: everything comes into sharper focus. Upgrading in luminosity is like having a longer exposure: things that had been too dark to see come into view.

At the same time, we have to study *it* in a different way. Ever seen a movie with soldiers looking at green images of night-vision goggles? Even when it is dark, you can see people and animals using infrared light that our eyes can't see. And infrared light allows us to see the stars at the center of our Milky Way galaxy orbiting around a supermassive black hole four million times heavier than the Sun. This is because infrared light goes around dust particles. Looking at the same thing in a different way can reveal the secret.

This is exactly what the ILC is supposed to do. It can *see* even when the Higgs boson is stealthed, decaying invisibly into dark matter particles of the Universe. It can precisely pinpoint what it does or where it is even in the dark. We would be like heroes in a spy movie revealing who exactly *it* is.

William Barletta, co-convener of the *Frontier Capabilities* Group, stated clearly "*We welcome the initiative for ILC in Japan*" and "*We are experienced and ready to do it*". Chip Brock, who led the *Energy Frontier* group, emphasised how crucial it is to carry out a precision study of the Higgs boson. The group concluded: "*An international research program focused on Higgs couplings to fermions and vector bosons to a precision of a few percent or less is required in order to address its physics.*" Chip also said unequivocally, "*To me, it's the ILC.*"

The next step for the world community is to figure out how this aspiration of the community can be realised. There is a long road ahead, but there is also a big momentum. Remember what you learned in high school: the time it takes goes as the distance divided by the momentum. The momentum is the key.

COSMIC FRONTIER | ENERGY FRONTIER | HIGGS | INTENSITY FRONTIER | P5 | SNOWMASS

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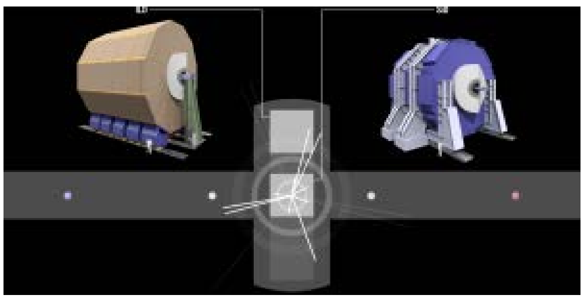
FEATURE

The ILC at a glance 2

A new version of the ILC animation is released

Perrine Royole-Degieux | 8 August 2013

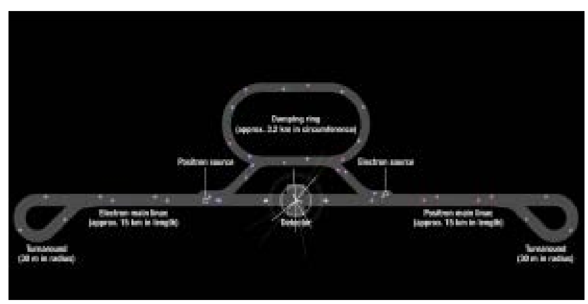


Schematic view of the ILC machine. Image: ILC/Rey.Hori

What will the ILC look like? How big is its linear accelerator? How would you describe a particle collision? The new ILC animation “The ILC in 2 minutes” helps explain and schematise the ILC operation. This longer version now includes the latest machine and detector design and also comes with optional sound and various languages subtitles.

The first schematic part – showing the basic principle of two linear accelerators facing each other and of two beams colliding in the centre, is now more descriptive, explicitly showing the sizes of the accelerator parts, and the damping rings location has been modified. A new sequence presents the two ILD and SiD detectors and a schematic view of the push-pull system, which will allow to switch between detectors. Then the animation dives into the (now-single) ILC tunnel and follows one beam till the final collision. The detector and final focus area has been reworked also. The author of the animation, illustrator and web designer Rey.Hori, worked in closed collaboration with ILC scientists from both accelerator and detector field and with ILC and the communicators. Rey.Hori is well-known in the ILC community for his truly realistic artworks — all derived from computed aided designs. He’s been working with KEK (Japan) since 2004.

This animation manages to show the whole ILC in just over two minutes, so it can be built into talks very easily to grab the viewers’ attention. You can view it on our ILCTV Youtube Channel (make sure to subscribe to receive our latest videos). You can also download it in handy and light formats on our ILC animation page with or without sound and subtitles. Description is so far available in English, Japanese, Chinese, French and German (you may activate the Youtube subtitle option to view them). This longer version is mainly released for the press as we know how TV broadcasters, journalists and bloggers love animations and images to go along with their interviews and reports.



Schematic view of the ILC detector push-pull system. Image: ILC/Rey.Hori

This latest version is aimed to serve as a stand-alone tool to communicate the ILC project. You are very welcome to put it on your websites and to show it publicly during talks and exhibitions. Please make sure that you credit it with “©ILC, Rendered and Authored by Rey.Hori.” The animation is licensed under a Creative Commons Attribution-NonCommercial-ShareAlike 3.0 Unported licence, which roughly means one can use, transmit, and adapt the work, as long as the author is credited and that it is not used for commercial purposes. Any new work based upon this animation must be licensed under the same conditions.

Make sure to also check the Linear Collider background information page for more videos, images and fact sheets about the ILC and CLIC projects. Another video, authored by Sandbox for Symmetry Magazine, and explaining the differences between the ILC and the LHC to a broad audience, is now available in four languages on Youtube. We look forward to adding more languages in the future. If you wish to translate this video or the ILC 2-minute animation into another language, please contact the communicators .

ANIMATION | ILC | OUTREACH | VIDEO

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LCPEDIA

Positron

Misaki Kawaguchi | 8 August 2013

Antimatter is like the shadow of matter, sharing same features, such as mass or spin. The electric charge, however, is opposite. The electron's antimatter partner is called the positron and carries a positive charge. Antimatter rarely exists in our everyday world. However, for a linear collider, a myriad of positrons will be necessary to collide with electrons. So scientists need to produce them.

Positrons are created through a reaction called electron-positron pair production. First, a high-energy electron beam is directed to a metal target, which is generally made of tungsten. When electrons pass through the target, they interact with the positively charged nuclei of atoms within the target and emit gamma rays. Gamma rays quickly convert into electron-positron pairs, thus creating electrons and positrons which then again radiate gamma rays. These reactions, in which electrons and positrons multiply like rats, are called electromagnetic showers. With this technique, many electrons and positrons are produced from one high-energy electron source.

As electrons and positrons are created in pairs, it is then necessary to separate and collect only positrons. Emitted particles are first placed into a high magnetic field produced by a solenoid coil. This field is roughly parallel to the particle tracks, so that electrons and positrons are directed in the forward direction. In the next step, positrons enter acceleration tubes and only those which have the required energy are accelerated by the strong electromagnetic wave. Usually, only accelerated positrons within a relatively narrow band of energy are used for experiments. After the acceleration of some amount, electrons are thrown away by a bending magnet.

"The positron source being considered for the International Linear Collider is more complex," KEK physicist Tsunehiko Omori says. The baseline design for the ILC uses a helical undulator, a device to produce polarised photons. And then, polarised positrons are created from polarised photons.If polarised positrons are used in an experiment, they present clear results because they have oriented spin. "A beam of polarized positrons would allow us to categorise their reactions with electron easier, and increase precision in many important measurements", said Omori. "For the ILC, positrons will be produced from the electron beam, which is also used for the collisions. This causes the complexity of the ILC positron source. The positron source is one of the biggest pieces of homework in out post-Technical Design phase," Omori says.

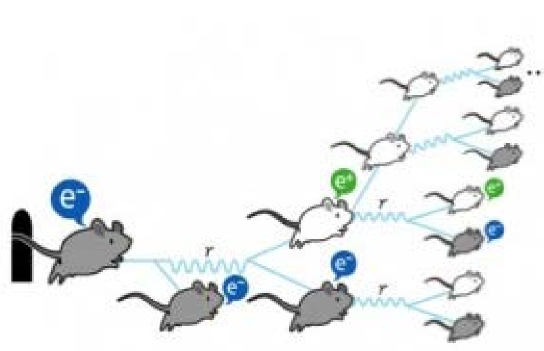

Image: Kaori Kurokawa

breaking

July 29, 2013

Scientists look to next decades in US particle physics

From the output of the "Snowmass" meeting, US particle physicists will chart a path to answering some of science's most intriguing questions.

By Kelen Tuttle

Today, more than 600 particle physicists from nearly 100 universities and laboratories came together on the University of Minnesota's Minneapolis campus. Over the next nine days, this diverse group of experts—who study the most fundamental components of our universe: energy, matter, space and time—will dream big. They will enumerate the field's most pressing scientific questions and contemplate the experiments needed to answer them.

"Particle physics answers some of the largest, most fundamental questions in all of science," said Michael Peskin, one of the conveners of the meeting, which was organized by the American Physical Society's Division of Particles and Fields. "By coming together to discuss these questions from multiple perspectives and techniques, we can identify opportunities for our field."

Held once or twice a decade, this grassroots planning exercise—within the particle physics community known as the "Snowmass community summer study," after the Colorado location of previous summer studies—will lead to a roughly 300-page document that assesses and summarizes particle physics' opportunities for discoveries.

"We all bring different, reinforcing reasons why high-energy physics is important and should be supported," said Steve Ritz, a meeting convener. "There's clear evidence that there's more to discover; we have profound questions to answer."

Along with input from the US Department of Energy and the National Science Foundation, the ideas that spring from the Snowmass process will inform the US Particle

Physics Project Prioritization Panel (P5) as it creates a new strategic plan for future US high-energy physics investments.

"The P5 process takes the science vision of the community and turns it into a plan that's feasible and executable over a 10- to 20-year timescale," said Jim Siegrist, director of the Office of High Energy Physics in the Department of Energy's Office of Science.

The strategic plan will offer a coherent path forward, building a strong position from which the US high-energy physics community, working with the international community, can answer grand scientific questions and improve our understanding of nature.

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