LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

DIRECTOR'S CORNER

Study on technical feasibility

by Lyn Evans

The Japanese consultant Nomura Research Institute is about to embark on a world tour to visit labs around the world and industrial production sites for accelerator components. They are working on a study about the technical feasibility of the ILC and ways to reduce cost. They may be coming to a lab near you!

AROUND THE WORLD

Back in the beam

by Barbara Warmbein

Calorimeter prototypes have been taking showers at CERN – particle showers, that is. Detector developers have just packed up their equipment after finishing a campaign to understand the time structure of hadron showers. And they are happy with what they achieved. Find out how a beer chiller played a role in the test beam as well…

FEATURE

Here’s one we made earlier

by Barbara Warmbein

Particle detectors need to be at the forefront of technology in order to capture particle collisions in great detail and quick succession. R&D projects for upgrades of existing detectors or future ones are busy around the world, and sometimes the technologies developed and studied in these projects can help out in others. LC NewsLine has two examples.

IMAGE OF THE WEEK

Physics and football

Working in particle physics can easily fill your day. But there's always more to life than physics – football, for example. Three core members of the linear collider management team turn out to also be hardcore fans of Sunderland Association Football Club – so much so that one of them, John Osborne, founded the Sunderland Swiss Branch.

John Osborne is a civil engineer at CERN and heavily involved in the planning of tunnels for the linear collider (and other projects), while the other two are Directors in the Linear Collider Collaboration: Mike Harrison for the ILC and Brian Foster for Europe. They all come from the northeast of England, home of Sunderland football club. The Swiss branch has even made it into the Fanzine "Legion of Light"! Any more particle physics football fans out there?

IN THE NEWS

from *Discover Magazine*
October 2015
Physics Beyond the Higgs Boson
The "God Particle" was just the beginning. The Large Hadron Collider and other accelerators are poised to answer questions about the very fabric of the cosmos.

from *Tanko Nichi Nichi*
10 September 2015
文科省有識者会議示した諸課題　ＩＣＦＡが見解用意、年内に送付
文部科学省の「国際リニアコライダー（ＩＬＣ）に関する有識者会議」が今年６月、「これまでの議論のまとめ」と題し、ＩＬＣ誘致をめぐる提言や諸課題を公表したのを受け、「国際将来加速器委員会（International Committee for Future Accelerators＝ＩＣＦＡ（イクファ））」は、「まとめ」に対する見解を文書にし、年内にも有識者会議に送付する意向だ。(LC NewsLine reported that ICFA is preparing a document to clarify some of the issuesraised in the summary report, and itwill be submitted to the Panel before the end of this year.)

from *Motherboard*
7 September 2015
The Particle Accelerators of the Future May Be Based on Surfing Antimatter
High-energy physics isn't planning on taking a post-Large Hadron Collider breather. In fact, the international research community had been scheming up a successor well before the LHC even started smashing protons. The most advanced project to this end is the International Linear Collider, which will become the longest particle collider in the world with at least 19 miles of tunneling.

from *IBC /Iwate Prefecture*
7 September 2015
「ILCをもっとよく知り、もっと盛り上げよう！～（2）ＩＬＣ実現のための取り組み～」
ＩＬＣが本格的に動き出す時期に地域の中核を担う中学生を対象とした「ＩＬＣセミナー」の模様をお伝えします。(Short video intoroducing the effort to promote the ILC, such as "the ILC seminar" targeting the junior high school students)

CALENDAR

Upcoming events

17th International Conference on RF Superconductivity (SRF2015)
Whistler, BC, Canada
13- 19 September 2015

International Workshop on Future Linear Colliders (LCWS15)
Whistler, BC, Canada
02- 06 November 2015

Upcoming schools

15th Hellenic School and Workshops on Elementary Particle Physics and Gravity (Corfu2015)
Corfu, Greece
01- 26 September 2015

9th International Accelerator School for Linear Colliders
Whistler, British Columbia, Canada
26 October- 06 November 2015

Joint Universities Accelerator School
Archamps, Haute Savoie, France
11 January- 18 March 2016

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1509.03178
A Calibration System for Compton Polarimetry at e+e− Linear Colliders

1509.02904
Closing up on Dark Sectors at Colliders: from 14 to 100 TeV

1509.02853
Model-Independent Measurement of the e+e- -> HZ Cross Section at a Future e+e- Linear Collider using Hadronic Z Decays

1509.02555
Impressions of the Meson Spectrum: Hybrids & Exotics, present and future

1509.02406
Lineshape of the Higgs boson in future lepton colliders

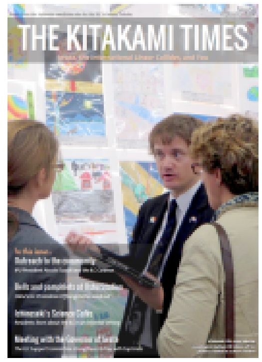
1509.01885
A study of the measurement accuracy of the Higgs boson decaying into tau pairs at the ILC

1509.00869
Dark matter searches

EPJC

Eur. Phys. J. C (2015) 75:371
Physics at the e+e− linear collider

ANNOUNCEMENTS



New publication: The Kitakami Times

Hot off the press: a new English-language newsletter about life in the possible future home of the ILC. Published by the Iwate Prefectural ILC Promotion Office in coorperation with Ichinoseki and Oshu, The Kitakami Times features local governments and foreign residents with articles about ILC awareness events, interviews with local officials, initiatives to “internationalise” the area, and much more. What will it be like to live in the mountains of Japan? How will the ILC integrate with the local area? What are people doing at the most local level to welcome to project? Check it out to find out more.
…Read more

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Lyn Evans | 17 September 2015

Cryomodule production for the European XFEL in CEA Saclay, France. Image: DESY

Since 2014, the Japanese Ministry of Education, Culture, Sports, Science and Technology (MEXT) has been conducting studies to gather information to decide whether Japan is interested in hosting the ILC. The summary report of the ILC Advisory Panel set up by MEXT for this purpose was outlined in the last edition of Newsline.

In addition to the internal MEXT committees they have also commissioned an additional study by one of Japan's leading consultancy firms, Nomura Research Institute (NRI), to study the technical and economic impact of the ILC, as a first-stage commissioned survey. Their report is now available, currently only in Japanese, but we are told that the English translation is in progress.

Very recently, MEXT has launched two new initiatives. The first is to form another internal committee to study human resource requirements for ILC construction and operation. We are providing them with all the information they request on this subject.

The second new initiative is to commission a further study by NRI to survey and analyse the technical feasibility of the project and the technical challenges posed by the construction of the ILC accelerator. The study consists of the following main elements:

1. Survey of the technical feasibility of the ILC accelerator
2. Survey of the technical issues that will need to be surmounted to manage mass production of the components required by the ILC accelerator
3. Survey of ways to reduce the cost.

As part of this study NRI plans to visit leading institutes for accelerator science and companies manufacturing accelerator components or related products in Europe and the USA this autumn.

This is a very tight schedule and we are looking for the cooperation of all institutes and companies to present our work in the best possible way. It is particularly important to show that we can handle big projects in collaboration with industry. The LHC and the on-going construction of the European XFEL hosted at DESY and LCLS-II hosted at SLAC should provide ample evidence of this.

The final report of this commissioned survey and analysis should be available by February 2016. Hopefully this will complete the information that MEXT needs in order to decide whether the Japanese government wants to proceed to the next step, opening international negotiations with potential partners.

AES | BABCOCK NOELL | CEA SACLAY | CERN | CNRS/LAL | CPI | DESY | FERMILAB | INDUSTRIALISATION | INFN | JLAB | MEXT | NOMURA | NRI | SFTC | SLAC

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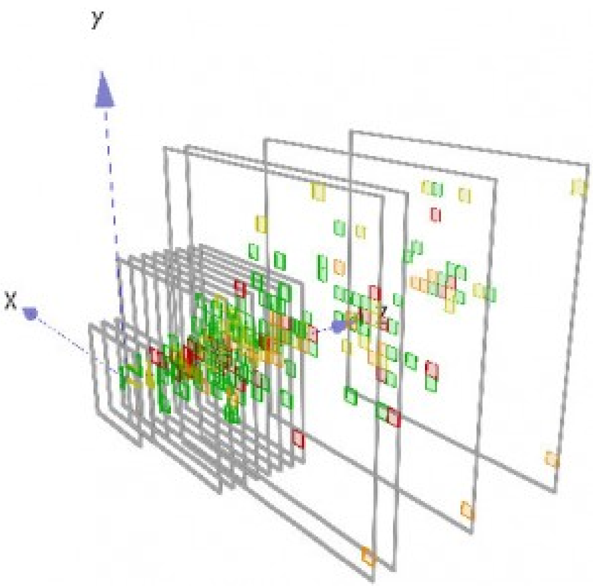
AROUND THE WORLD

Back in the beam

Barbara Warmbein | 17 September 2015



After nearly a year of campaign and some 10 weeks of data taking in various beams at CERN and at DESY, the detector layers, absorbers, support structures and electronics of several calorimeter prototypes for a future ILC detector are back in crates and on their way to DESY and other labs in Germany, Japan and the US. 25 people have more than 15 million events sitting ready to be analysed. The calorimeter test beam campaign is over – and it went very well, the researchers say.

One of the aims of the tests was to thoroughly understand the time structure of hadron showers in the calorimeter to cross-check against simulated data, compare absorber materials and extrapolate to a full-scale detector. The speciality of the ILC calorimeters will be their particle flow algorithm, the possibility to reconstruct and identify every single particle in the detector. The detectors are designed in such a way that the telling apart of individual particles and measuring their energy is made easier by making them extremely high-resolution camera equivalents with a huge number of channels.

One speciality is the energy measurement of so-called jets, cones of secondary particles produced in the calorimeters after a collision. In order for the energy measurement to be complete, all constituent particles need to be added up. Sometimes, depending on the material they are produced in, some of them – neutrons – are slower than others and could be mistaken for particles belonging to another event. Having the time information from the more than 3000 active cells provides the researchers with a lot of detail, and checking this data is one of the central outcomes of the test beam campaign.

Having all these channels also has a downside: information somehow needs to get from detector to researcher. This posed another challenge: integrate electronics and cables into the prototype in such a way that it could in principle form a part of a bigger, complete particle detector. In a test beam there is a lot of space, but in the real thing, every square millimetre counts. Katja Krüger, test beam coordinator from the German lab DESY, points to the layers of hadronic calorimeter with their electronics neatly hidden inside: “There’s only one ethernet cable coming out of the setup. And that’s even though this one-cubic-metre prototype has about as many channels as a third of the hadronic calorimeter of CMS.” And these channels make up only a fraction of the channel number for the final hadronic calorimeter in ILD

For the four weeks spent in the CERN SPS test beam in summer the CALICE team used a common data acquisition concept. “The data acquisition is new and palpably faster,” Krüger says. All calorimeter types, use the same data acquisition, making the reconstruction of particle information smoother.

The CALICE collaboration ran the last comparable campaign in 2006/2007, so it was time for a load of new data and new experiments. This time, in the analogue hadronic calorimeter alone, 27 boards with 144 channels each were tested with two different absorber materials, steel and tungsten, using different types of photo-sensors. Analysing and interpreting all the information is the team’s job for the next month. “Our list of things to develop and find out is definitely getting shorter,” says Felix Sefkow, former CALICE spokesman who was heavily involved in the campaign. “Having solved a fundamental component like data acquisition makes for a big item ticked off our list.” “It all helps pave the way to a full prototype that we’re aiming for in 2018,” adds Frank Simon from the Max Planck Institute for Physics in Munich, Germany, and spokesman of the CALICE collaboration.

The CALICE collaboration during their recent meeting in Munich. Image: MPI

German engineering: Vorsprung durch Bier

Chilling electronics instead of beer: original engineering in the test beam.

Test beam setups usually consist of a couple of active layers, electronics, cables going in and out, and excited physicists. This particular one also featured a rather rare component: a beer chiller. It wasn’t there to help students through the night shifts, however: it kept the electronics on the outside of the calorimeter prototype at a constant temperature. Why a beer chiller? It is cheap, does not use a lot of electricity and fulfils its job reliably because it’s simple and only does one thing: cool, explains project engineer Karsten Gadow from DESY, father of the idea to use beer technology for particle physics.

The CALICE chiller is in fact recycled from a previous experiment at DESY, the “Very Forward Proton Spectrometer”, part of the former H1 detector at the HERA accelerator. “I needed something that was radiation hard and could keep electronics at precisely 18 degrees. On my way to work I used to pass by this air conditioning company that also equipped pubs from time to time, and one day I put two and two together,” Gadow says. The chiller only fulfilled its designated function (to cool beer, that is) once: at the shutdown party for HERA.

CALICE | CALORIMETER | CERN | DESY | DETECTOR R&D | FERMILAB | KEK | MPI | PARTICLE FLOW | TEST BEAM

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FEATURE

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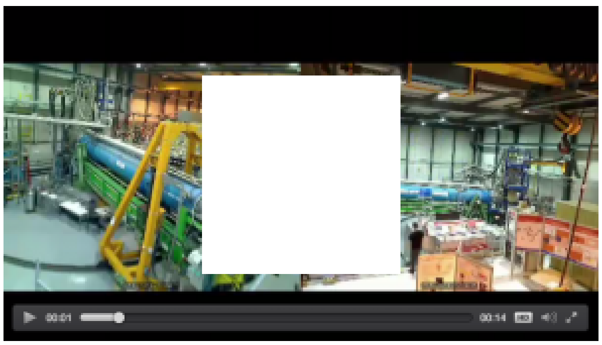


They follow the sun: the CAST experiment at CERN.

In a large surface building around the corner from the LHC experiment LHCb at CERN, a group of around 100 researchers is hoping to detect dark matter particles by pointing a superconducting magnet at the sun.

The CAST project's magnet – a former test magnet from the LHC – is equipped with an X-ray telescope and X-ray detectors at either end. It starts its day job 45 minutes before sunrise and follows the sun until the limits of the building are reached (1.5 hours later). It starts working again around sunset, when the sun comes back into reach. Its aim: to find axions, hypothetical particles that may be produced in huge amounts in the centre of the sun.

Axions are a candidate for dark matter and could also explain why the strong interaction doesn't show signs of a physical imbalance called CP violation, whereas the weak interaction does. If found, axions would be a revolution in physics, but so far they have been hiding very well. Scientists think that they are extremely light particles and that they hardly interact with normal matter.

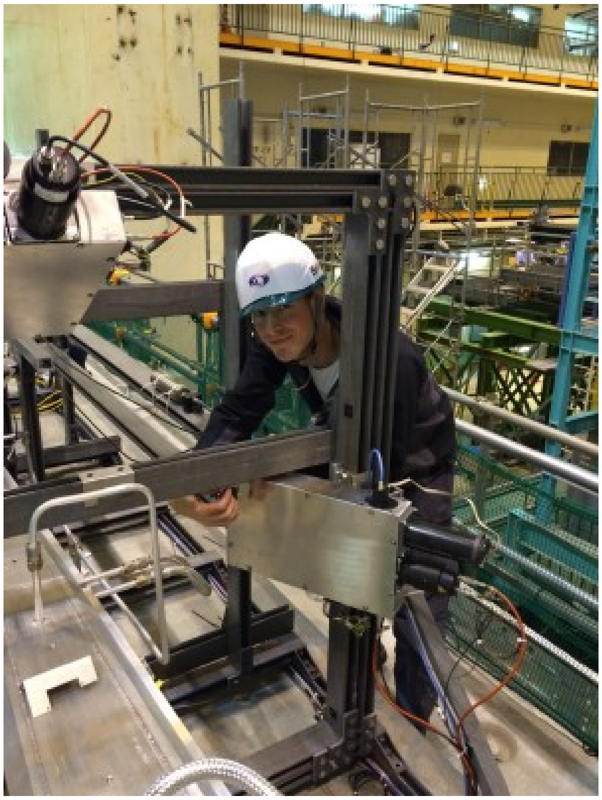
Theory predicts that axions are produced when a photon converts into an axion in a large electromagnetic field. Both photons and such a field exist in the centre of the sun, so CAST researchers concluded two things: not only must axions be produced in the sun, but the process could also be reversed if the axion hits another large electromagnetic field. In the centre of the LHC magnet it should thus be possible to convert an axion back into a photon and detect the photon as it travels through the magnet.

While CAST has narrowed down the possibilities for axion production in the sun, it hasn't found any direct evidence yet. Recently, even more exotic particles called solar chameleons were added to the CAST search list, and this is where ILC detector R&D comes in. Solar chameleons are predicted to have much lower energy, so a detector that can spot low-energy X-rays with very little background irritation was needed. "The InGrid detector our collaboration has advanced for the ILD TPC sounded like just the right thing," says Klaus Desch from the University of Bonn. "We needed to equip it for operation in the vacuum of the X-ray telescope, but after initial hiccups an InGrid detector started taking data in autumn 2014." The team will look at the data when they are sure to understand the busy background well enough to spot what they are looking for.

Another example of linear collider tech used in a running experiment comes from the calorimeters. In fact, it's two examples: when the Belle II detector at the SuperKEKB accelerator at KEK in Japan goes online in a couple of years, it will use the ILC-candidate pixel sensor DEPFET for its vertex detector.

But before Belle II starts operation, another detector will takes its place to understand the background radiation from the beam so that Belle II results will not be affected by it. This commissioning detector – a bulwark against the heavily increased intensity of the upgraded accelerator – is appropriately called BEAST II.

And the CLAWS of the BEAST come from the linear collider world, from the CALICE collaboration to be precise. CLAWS stands for sCintillation Light And Waveform Sensors and consists of scintillators, SiPMs, normally used to study the hadronic showers in a calorimeter (see this week's other story), and popular because of their time resolution. In the first phase of SuperKEKB commissioning, to begin in early 2016, CLAWS will re-use eight small scintillator tiles that already have been used in CALICE detector prototypes to


Frank Simon from MPI Munich installing the CLAWS detector in the Belle detector hall. Image: MPI Munich

measure the time structure of hadronic showers over long timescales of several microseconds, a sub-experiment called T3B (Tungsten Timing TestBeam). In BEAST II, CLAWS will measure how the background evolves over time after the injection of new electrons or positrons by continuously monitoring particle rates over many turns around the ring. This requires a time resolution of about one nanosecond to reliably tell individual particle bunches apart, and continuous readout for hundreds of microseconds – a capability that these scintillator tiles together with a specialised readout system can provide. The information from CLAWS will be particularly useful for the future vertex detector that needs to tell individual events apart and could be confused by beam background.

CLAWS is being installed this week, so stay tuned for more news from the beast…

BELLE-II | CALICE | CAST | CERN | DEPFET | DETECTOR R&D | INGRID | KEK | MPI | SIPM | TECHNOLOGY TRANSFER | TPC

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IMAGE OF THE WEEK

Physics and football

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John Osborne is a civil engineer at CERN and heavily involved in the planning of tunnels for the linear collider (and other projects), while the other two are Directors in the Linear Collider Collaboration: Mike Harrison for the ILC and Brian Foster for Europe. They all come from the northeast of England, home of Sunderland football club. The Swiss branch has even made it into the Fanzine "Legion of Light"!

Any more particle physics football fans out there?

trip was; especially time spent in Covent Garden with thousands of supporters and passers-by stopping to chat and have their pictures taken with the branch flag.

Switzerland Branch
(John Osborne)

I set up the site five years ago with some fellow Sunderland fans working at CERN. You might have heard about CERN in the news, it's a physics lab, Higgs Boson, Big Bang etc.

I was born in Low Fell, Gateshead, and have been a fan since a young lad. I left the North East in 1985 for Liverpool University to study civil engineering, and worked all over the UK before coming to CERN 17 years ago to build the Large Hadron Collider tunnels.

My favourite season was promotion from the old division three after the Lawrie McMenemy disaster. I have been to Wembley twice for the Milk Cup (Norwich) and FA Cup (Liverpool) defeats. I was always in the Fulwell End, but now prefer the nice and warm Black Cats Bar!

I also work on a project called the International Linear Collider, which is another massive project, most likely going to be built in Japan. Two of the global leaders on this project are Sunderland fans, one is a member of the Facebook page, Professor Brian Foster from Oxford University. We quite often end up in a bar in Tokyo to watch SAFC matches!

Other members include Jim Howard who works in Geneva for Japan Tobacco and a co-worker from CERN called Tony Harrison, who used to work at Nissan. My 17-year-old son is also a member, despite never living in the UK, he is a big fan.

We normally meet up in pubs in Geneva to watch some matches, but some of us went to Spurs in January. We will hopefully get to more games next season with direct Geneva to Newcastle flights.

CIVIL ENGINEERING | DIRECTORATE | FOOTBALL | LCC