LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

FEATURE

From KEK: KEK and the U. S. Department of Energy (DOE) signed a Project Arrangement concerning high energy physics.

On October 6, 2015, KEK and the U. S. Department of Energy (DOE) signed a Project Arrangement concerning high energy physics.

A signing ceremony was held at the American Ambassador's Residence in the presence of H.E. Ms. Caroline Kennedy, Ambassador Extraordinary and Plenipotentiary of U.S.A and H.E. Mr. Hakubun Shimomura, then Minister of Education, Culture, Sports, Science and Technology (MEXT). The history of the U.S. - Japan cooperation program in the field of high energy physics has lasted for more than 35 years, with distinguished research outcomes and many talented researchers fostered through the project.

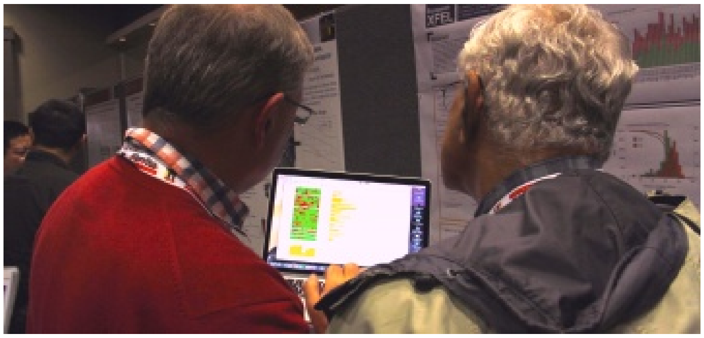
H.E. Ms. Kennedy and H.E. Mr. Shimomura expressed admiration for fruitful cooperation between the U. S. and Japan on science and technology, mentioning meaningfulness for continuing the U. S. - Japan cooperation program in the field of high energy physics for the future.

With the conclusion of this Project Arrangement between KEK and DOE, further development of cooperation in research is expected among the U.S. and Japanese institutes in the field.

AROUND THE WORLD

Superconducting cavities are a 'hot' topic

by Ricarda Laasch

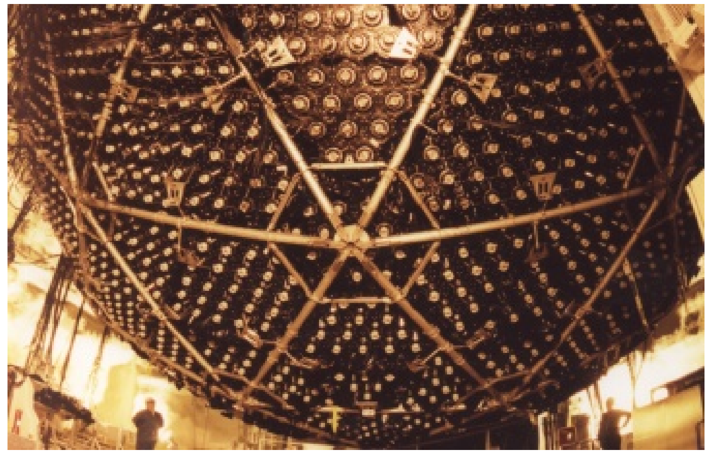


From 14 to 18 September 334 physicists, engineers and technicians from all around the world made their way to Whistler, Canada, for the 17th International Conference on Superconducting Radiofrequency (SRF). The conference takes place every two years and shines a light upon all new developments in the different fields of superconducting cavities. It is the leading conference in this field of physics and discusses the actual state of the art of this technology. And right now it is a topic that progresses very fast.

DIRECTOR'S CORNER

Elementary – an award for thorough detective work

by Brian Foster



European Regional Director Brian Foster is very pleased that this years' Nobel Prize in Physics was awarded to two particle physicists. Neutrinos had long been a complete puzzle, and the (improbable but true) discovery that they oscillate is an excellent example of the importance of experiments. The ILC can continue this tradition.

IMAGE OF THE WEEK

Size-0 module

by Barbara Warmbein

Probably the most advanced ultra-thin pixel sensors ever: DEPFET. Developed for the ILD detector's vertex subdetector, they will be used in the Belle II detector – an extreme example of fast-forward technology spin-off. The first full-size module for use in Belle II has just been completed. It comprises a thin sensitive area (75 microns) with roughly 200,000 DEPFET pixels and the monolithically integrated silicon support frame with all necessary read-out electronics. Stay tuned for a more detailed report in a future issue of NewsLine.

IN THE NEWS

from *Iwate Nippo*
11 October 2015
高木復興相が初来県､知事と会談　復興加速へ抱負
高木毅復興相は１０日、就任後初めて本県を訪れ、県庁で達増知事と会談した。国際リニアコライダー（ＩＬＣ）の本県誘致に向けた支援も求めたという。(The Reconstruction Minister, Tsuyoshi Takagi visited Iwate Prefecture on 10 October. Iwate Governor Takuya Tasso requested for the support to invite the ILC to the prefecture)

from *Yomiuri Shimbun*
08 October 2015
［ＩＬＣ誘致］海外向け広報誌　ネットに
海外の研究者らに向け、「国際リニアコライダー（ＩＬＣ）」の候補地・北上山地周辺の魅力を紹介しようと、県ＩＬＣ推進協議会が英語版の広報誌「ＴＨＥ　ＫＩＴＡＫＡＭＩ　ＴＩＭＥＳ」をインターネット上で創刊した。(Iwate Prefecture International Linear Collider Promotion Council has published their first edition of the “THE KITAKAMI TIMES”, a web based magazine to introduce the ILC candidate site)

from *Iwate Nichi Nichi*
07 October 2015
ＩＬＣで世界の最前線へ　水沢高ＳＳＨ
県立水沢高校で６日、スーパーサイエンスハイスクール事業の講演会が開かれた。前高エネルギー加速器研究機構長の鈴木厚人県立大学長が講演し、北上山地（北上高地）が国内建設候補地となっている国際リニアコライダー（ＩＬＣ）の素粒子研究や、研究によってもたらされる効果などを語った。(Atsuto Suzuki, president of Iwate Prefectural University gave a lecture on 6 October to students of Mizusawa High School as a part of Super Science High School project. He explained about research and possible effect of the ILC)

PREPRINTS

ARXIV PREPRINTS

1510.03030
Tests of Scintillator+WLS strips for Muon System at Future Colliders

1510.02739
Matching NLO QCD Corrections in WHIZARD with the POWHEG scheme

1510.00246
Status and prospects of the nMSSM after LHC Run-1

1509.08721
Prospects for Higgs properties measurements at future colliders

1509.08369
On the Future High Energy Colliders

CALENDAR

Upcoming events

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

Upcoming schools

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

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15 October 2015

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Dr. Siegrist (Associate Director, Office of High Energy physics, DOE) and Dr. Yamauchi (Director General of KEK) sign the agreement while H.E. Ms. Kennedy (Ambassador of U.S.A), H.E. Mr. Shimomura (then Minister of MEXT) look on.

A signing ceremony was held at the American Ambassador's Residence in the presence of H.E. Ms. Caroline Kennedy, Ambassador Extraordinary and Plenipotentiary of U.S.A and H.E. Mr. Hakubun Shimomura, then Minister of Education, Culture, Sports, Science and Technology (MEXT).

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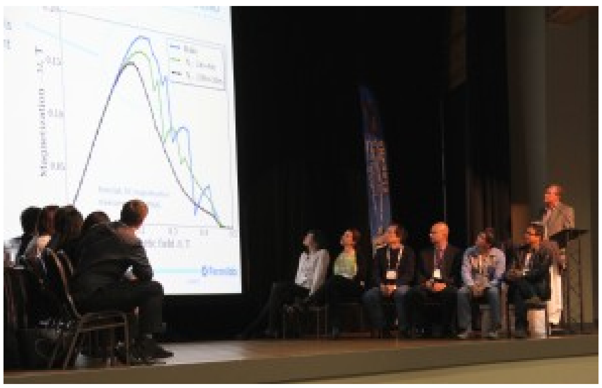
AROUND THE WORLD

Superconducting cavities are a ‘hot’ topic

Ricarda Laasch | 15 October 2015



A panel discussion during SRF15. Image: Sebastian Aderhold

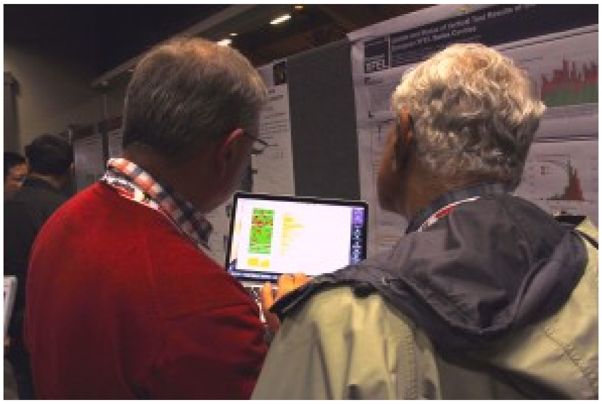
Superconducting cavities are an important part of the design for many international accelerator projects. These particle-accelerating structures are used for many different accelerators from those that produce brilliant light for investigating the microcosm of atoms and molecules to those that let elementary particles collide with each other to understand the beginning of the universe.

The ILC is also designed for SRF technology. Roughly 16 000 cavities are needed to accelerate electrons and positrons to high energies to study not only the Higgs boson but also other fundamental mechanisms of our cosmos. “I am sure there will be quite a lot of relevant results and discussions relevant for the ILC this year,” said Nick Walker, Global Coordinator for ILC Accelerator Design & Integration based at the German lab DESY, just before the conference.

Right now the field of SRF cavities is as active as it has ever been, not only because of the many accelerator projects around the world which have very high demands on the performance of the difference cavities, but also because the step from ‘home made’ cavities to actual ready-to-use industrial mass-produced cavities is happing right now. In the field of cavities the scientists have always worked closely with industrial partners to build the basic structures but the most important steps have always been done ‘in house’ – at the laboratories by the scientists. These steps have now been transferred to different companies with support of many laboratories to mass-produce cavities in an off-the-shelf fashion.

This transition within the field of cavities clearly reflects itself in the schedule of the conference. In the first two days many overview talks concerning important accelerator projects were given. Status Quo and further steps of the projects were introduced and discussed. Questions concerning design goals and used technologies were always part of the discussions. Each project learns from the projects before. The European XFEL – the first project to use mass produced ready-to-go cavities – is nearly at the end of the cavity production phase and everyone wants to see how the performance and the quality have developed along the production. With two companies producing a total of 800 cavities the statistical analysis of the cavity and the accelerator modules performance was important to many attendees. “It was the first time we have ever done this and we were worried about the performance and how it would work out,” explains Detlef Reschke, who is responsible for review and analysis of the results at the European XFEL project. “Now the results tell us that worrying was not needed.” This is good news for the ILC since the European XFEL uses a similar cavity design and 800 cavities can give a clear indication of how well the production went. Many posters within the poster session on different afternoons illustrated the steps within this project.

Following the European XFEL, the Linac Coherent Light Source II (LCLS-II), at SLAC in the US, is the next big project in line and it goes even a step further. A newly developed method to improve the cavities’ quality factor – which means less heat loss for each cavity – should now go into mass production. This method, which brings nitrogen atoms into the metal surface of the cavity, has been under investigation by many different laboratories. It lowers the resistance of the cavity and therefore its heat losses. A complete explanation for this effect is still under discussion within the community and was also ongoing at the conference, but the effect has been proven stable enough. Using the basic cavity recipe from the European XFEL which is now established at the companies and adding the new steps of nitrogen doping should bring LCLS-II, an extension of the already existing light source at SLAC, to life. “With three labs coordinating the R&D effort for the needed new technique the development of the doping process went fast and smooth, so that we have already been able to transfer this new technique to industry,” said Marc Ross, project manager for LCLS-II and former project manager of the Global Design Effort for the ILC. “And this proves that we can further develop and improve this technology fast enough for the ILC.”



Nick Walker and Hasan Padamsee looking at cavity statistics. Image: Ricarda Laasch

Aside from this leap into mass producing ready-to-go cavities there is still a lot R&D ongoing in the field. The following two days were filled with talks from young researchers and established members of this scientific community to present their newest insights concerning SRF cavities. Magnetic flux trapping and expulsion and improving the cooldown procedures were some of the hot topics at the conference. Extremely low temperatures are needed to make the superconductivity work, therefore the cavities need to be cooled down from room temperature to 2 Kelvin (-271 degrees Celsius). This cooling process can have an effect on the cavity performance and scientists are trying to find the best way to cool the structures to achieve the best possible result.

Hot topics took centre stage after the poster sessions as podium discussions concerning most interesting areas of research in the field right now. Apart from cooldown procedures for cavities, cryomodules and whole accelerators there were discussions about possible new materials and how to retain the performance of the cavities after the assembly into a cryomodules. Both topics are important for the future of the field. Different materials offer different properties which could lower heat losses and improve accelerating power. Different approaches are being made to find a new and possible better material than pure niobium from which cavities for the European XFEL and LCLS-II are made.

The assembly into cryomodules is one important step to get from a cavity towards a fully functioning particle accelerator, and it is not an easy procedure. Cleanliness and accuracy are key to building good modules which preserve the high quality of the cavities. Here CEA Saclay, France, has taken the step to hand this work over to an industrial partner and to prove that these complex cryomodules can be built within a tight schedule and in high numbers for accelerator projects like the ILC. “The modules were built by our industrial partner but we own the infrastructure and all the tooling. So after the production phase of the European XFEL CEA would be ready to build cryomodules for the ILC with the already well trained staff from our industrial partner,” said Olivier Napoly, Deputy Leader of the Accelerator Department at CEA and project leader of the module production for European XFEL at CEA.

The week-long conference had many participants from many countries all over the world and the general progress in the field of SRF cavities was shown. Also many vendors and companies involved in the production of cavities were at the conference as exhibitors as well as participants in the conferences poster sessions to show their techniques and production progress to the community. This close partnership between industry and laboratories is another key for accelerator projects like LCLS-II. “We’ll support the two companies to be able to use the nitrogen doping technique on the cavities for LCLS-II,” said Ari Palczewski, Jefferson Lab staff scientist involved in the knowledge transfer for nitrogen doping towards the companies. For the ILC all these activities are important steps to further improve and qualify this accelerating technology and its production process.

CAVITY | CRYOMODULE | SRF TECHNOLOGY

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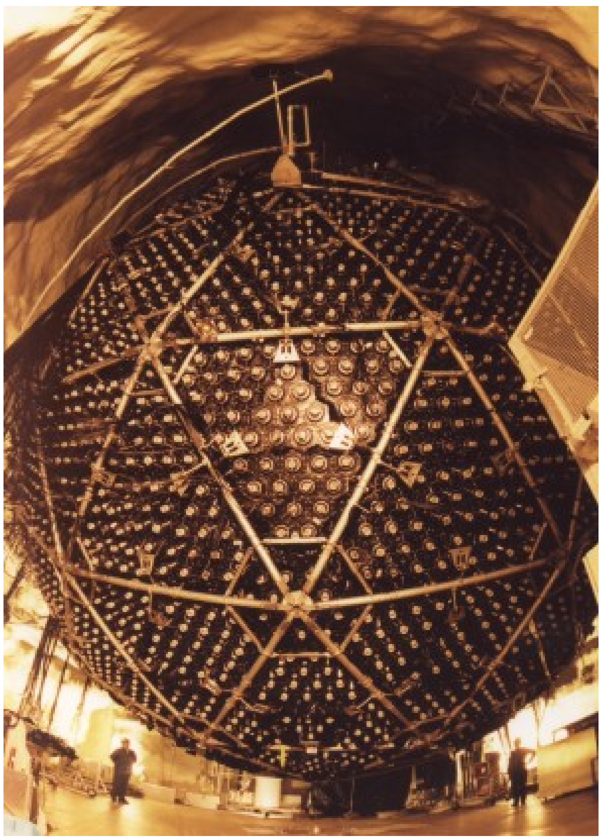
DIRECTOR'S CORNER

Elementary – an award for thorough detective work

Brian Foster | 15 October 2015


View of the SNO detector (before cabling). Image: Ernest Orlando, Lawrence Berkeley National Laboratory

Last week's announcement of the 2015 Nobel Prize in Physics will not only have given great satisfaction to the recipients, Takaaki Kajita and Arthur McDonald, but also to their many friends and colleagues both inside and outside the Super Kamiokande (Super-K) and Sudbury Neutrino Observatory (SNO) collaborations. Parochially, wearing my Oxford hat, this award also gives me much pleasure since Oxford has from the outset played a leading role in SNO.

In many ways the award forms the keystone of our current understanding of neutrino physics. The 2002 award to Raymond Davis and Masatoshi Koshiba marked the beginning of the field of neutrino astronomy, with the detection of solar neutrinos and the proof that they originated from nuclear fusion within the sun. Like all the best discoveries, this one opened up new questions and puzzles. It was almost immediately clear that there didn't seem to be enough solar neutrinos given our understanding of the mechanisms by which the Sun shines. The solution of this puzzle seemed for many years obvious to non-experts such as myself. Since our understanding of the Sun involved astrophysics, plasma physics and nuclear physics in extreme conditions, the application of Occam's Razor implied that clearly there must be a mistake in the calculations in one of these areas.

It is a great testament to the genius, hard work and sheer persistence of John Bahcall that eventually it could be shown that it was highly unlikely that there was enough wrong with the so-called Standard Solar Model (SSM) to explain the deficit of neutrinos observed deep under the Earth's surface where the detectors were situated. There is perhaps no more egregious example of someone who ought to have received a Nobel Prize but didn't than John Bahcall – unless it is Nicola Cabibbo of Italy (for Cabibbo mixing) or George Rochester and Clifford Butler of the UK (for the discovery of strange particles). Sometimes the Nobel Committee works in ways even more mysterious than Nature itself.

If there was nothing wrong with the SSM, then we are forced to rely on Arthur Conan-Doyle rather than William of Occam. "How often have I [Sherlock Holmes] said to you [Dr. Watson] that when you have eliminated the impossible, whatever remains, however improbable, must be the truth?" ("The Sign of the Four", 1890). The only other possibility to explain the apparent neutrino deficit was that neutrinos were being lost on their way to the Earth, "oscillating" into another sort of particle. The race was on to find out what and how. Two separate lines of attack suggested themselves to the experimenters: capture as large a number of neutrino interactions as possible to measure the neutrino deficit accurately; and devise apparatus that could detect the "elastic scattering" and "charged current" interactions, mostly, or indeed for the latter solely, sensitive to electron-type neutrinos, and simultaneously detect the "neutral current" interaction, sensitive to all three types of neutrino. It was the combination of these two approaches, in Super-K and SNO, respectively, that both verified the SSM and left no room for doubt that the impossible, however improbable, was actually happening. Neutrinos oscillate, establishing, from the application of basic quantum mechanics, that they must therefore have a mass. This was the first, and remains the only, breach in the Standard Model of particle physics, which has been around almost, but not quite, as long as I can remember and has repulsed all our other attacks. This reason alone, not even taking into account the exquisite experimentation of both collaborations under the leadership of Kajita and McDonald, is enough amply to justify the award of the 2015 Nobel Prize in Physics.

What has any of this to do with the ILC? Well, directly, not much at all. Indirectly however, to those of us not in the field of neutrino physics, it gives further evidence for the strength of particle physics and the esteem in which it is held. Five of the last fifteen years since 2000 have seen Nobel Prizes awarded for discoveries in particle physics, more than any other subject. Furthermore, it reminds us that precision and careful experimentation can produce new insights into Nature without going to the “energy frontier”.

In proposing the ILC, we learnt from the lessons of history. Just as the Large Electron-Positron Collider (LEP) at CERN unambiguously pointed the way towards the discovery of the top quark through precision exploration of quantum corrections, so the ILC can discover new phenomena. Indeed the situation is even more promising than for LEP, since the W and Z were already theoretically well understood particles, whereas the properties of the Higgs, whose discovery precipitated the award of the 2013 Nobel Prize, are almost wholly unknown. Its very existence, the only fundamental scalar we know of and one whose sole reason to exist is an imperative embedded deeply within quantum field theories, is itself a mystery. There has never been a better reason to build a new accelerator and there has never been a proposal for a new collider that is more advanced or in better technical shape than the ILC. The nomination of a Japanese scientist as one of the 2015 Laureates further strengthens the position in Japan of fundamental science in general and elementary particle physics in particular. The time is indeed ripe for Japan to proceed to the next stage with the ILC project.

As usual, Conan Doyle has quotations that highlight our aspirations: “It has long been an axiom of mine that the little things are infinitely the most important.” (“A Case of Identity”);” ‘Data! Data! Data!’ he cried impatiently. ‘I can’t make bricks without clay.’ ” (“The Adventure of the Copper Beeches”); “It is a capital mistake to theorise before one has data. Insensibly one begins to twist facts to suit theories, instead of theories to suit facts.” (“A Scandal in Bohemia”). The ILC and the LHC together can provide the data we need to emulate Kajita and McDonald and push into that world beyond the Standard Model that will assuredly provide the raw material for the Nobel Prizes of the future.

HIGGS | NEUTRINOS | NOBEL PRIZE | PRECISION MEASUREMENTS

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IMAGE OF THE WEEK

Size-0 module

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Image: DEPFET Collaboration

BELLE-II | DEPFET | DETECTOR R&D | VERTEX DETECTOR

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