NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

Gotta catch them all – and fast

by Barbara Warmbein

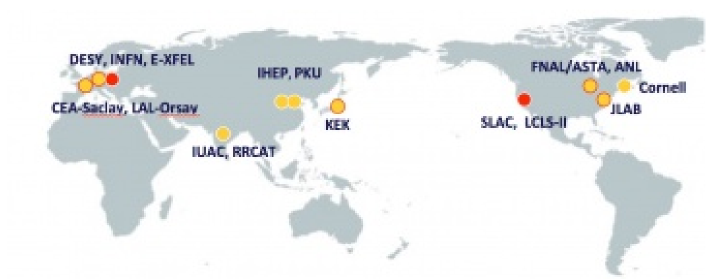
Silicon detectors play a crucial role in particle detectors, both present experiment at the LHC and future experiments like the ILC. More than 80 calorimeter and silicon tracking experts attended a dedicated workshop on high-granularity silicon devices, held last month in Hamburg.

FEATURE

In the light of new accelerators

Advancing superconducting cavities for present and future projects

by Ricarda Laasch



Did you know that more than 1000 superconducting radiofrequency cavities for roughly 150 cryomodules are needed for accelerator projects which are seeking approval at the moment? And it's more than 24000 cavities if we add the ILC and the FCC. The TESLA Technology Collaboration meeting is one of the key events to attract SCRF experts from all the world The latest one was held at the beginning of the month, at CEA Saclay, France.

DIRECTOR'S CORNER

Hiroshima

by Hitoshi Murayama

Remembering a visit of Barack Obama to Hiroshima, Deputy Director of the Linear Collider Collaboration Hitoshi Murayama explains how particle physics can also help build a safe and peaceful world.

A well-focused workshop on top quark physics held at KEK

by Hitoshi Yamamoto

The top quark is one of the pillars of the physics topics that linear colliders address. From 6 to 9 July 2016, a dedicated workshop on top physics at the lepton colliders was held at KEK.

IN THE NEWS

from *Physics Today*
21 July 2016
High-energy lab has high-energy director
PT: Japan is the most likely host for a future International Linear Collider, an electron–positron collider (see Physics Today, March 2013, page 23). What's your sense about whether the ILC will go ahead and whether it's the best next step for high-energy physics?
GIANOTTI: Japan is consulting with international partners to see if a global collaboration can be built. It's a difficult decision to be taken, and it has to be taken by the worldwide community. Europe will produce a new road map, the European Strategy for Particle Physics, on the time scale of 2019–20. That will be a good opportunity to think about the future of the discipline, based also on the results from the LHC Run 2 and other facilities in the world.

from *University Journal*
19 July 2016
国際リニアコライダー計画、戦略的人材育成が必要
国際リニアコライダー計画で、文部科学省の有識者会議は、エンジニアや精密加工要員らの戦略的な人材育成が必要とする報告書をまとめた。(Expert panl discussing the ILC have written up the report about the human resource, pointed out the needs of the strategic human resource cultivation to train future engineers and precision work technicians)

from *The Kitakami Times*
15 July 2016
LC Symposium, "The Realization of the ILC and Development of the Surrounding Region"
This symposium was hosted by the Iwate Accelerator Related Industry Research Society and backed by a total of 25 associations, companies, municipalities and other organizations. This was the first time that the mayors of Ichinoseki City, Hiraizumi Town, Kanegasaki Town and Oshu City came together to discuss the ILC and how it related to the future vision of their communities. About 500 people filled the auditorium to hear this discussion.

from *Symmetry Magazine*
12 July 2016
A primer on particle accelerators
Research in high-energy physics takes many forms. But most experiments in the field rely on accelerators that create and speed up particles on demand. What follows is a primer on three different types of particle accelerators: synchrotrons, cyclotrons and linear accelerators, called linacs.

from *Iwate Nichi Nichi*
09 July 2016
自然の法則　解明"ここ"で　市立全中学校
一関市は、次世代の大型加速器「国際リニアコライダー（ＩＬＣ）」への関心を高めてもらおうと、市内全ての市立中学校を対象に特別授業を実施している。(Ichinoseki city is implementing the special lecture about the ILC project for all the junior high schools to gain understanding for the ILC)

from *Iwate Nippo*
8 July 2106
Experiments and learning about the ILC at junior high schools in Ichinoseki
A special ILC class was held at Sakuramachi Junior High School on Thursday for the 86 students in the second grade, who learnt more about the research that would take place at the proposed International Linear Collider, and the significance of building it.
Translation provided by *Ichinoseki ILC Promotion Website*.
Read article in Japanese here

CALENDAR

Upcoming events

38th International Conference on High Energy Physics (ICHEP2016)
Chicago, IL, USA
03- 10 August 2016

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

ALERT 2016 2nd Advanced Low Emittance Rings' Technology
Trieste, Italy
14- 16 September 2016

11th International Positron Source Workshop (POSIPOL 2016)
Orsay, France
14- 16 September 2016

Upcoming schools

Linear Collider Physics School
Frauenchiemsee, Germany
20- 27 July 2016

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1607.04288
Very Degenerate Higgsino Dark Matter

1607.04187
750 GeV diphoton resonance at the ILC

1607.03829
Implications of the 750 GeV gamma-gamma Resonance as a Case Study for the International Linear Collider

1607.03773
Indirect probes of the trilinear Higgs coupling: $gg \to h$ and $h \to \gamma\gamma$

1607.03210
ISR effects for resonant Higgs production at future lepton colliders

1607.03030
Scattering of W and Z Bosons at High-Energy Lepton Colliders

1607.01941
A “LHC Premium” for Early Career Researchers? Perceptions from within

1607.01320
Prospects for charged Higgs searches at the LHC

1607.00737
A new scalar mediated WIMPs with pairs of on-shell mediators in annihilations

1607.00622
$Bc \to BsJ$ form factors and Bc decays into BsJ in covariant light-front approach

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AROUND THE WORLD

Gotta catch them all – and fast

Barbara Warmbein | 22 July 2016

Silicon detectors like these two different kinds of wafers, combined in an artwork for the AIDA2020 workshop poster, are versatile and popular.

It's not the catchiest of titles – "Energy and time management with high-granularity silicon devices". But the subject matter is rather catchy, both literally and figuratively: it's not only about catching particles; it also caught on from one project to another. A recent workshop on silicon detector technology held during the first AIDA-2020 meeting in Hamburg in June brought together experts and users of the technology from a wide range of projects – including ILC and LHC detectors.

Silicon detectors are not only the components in your digital camera that detect light and make it possible to reproduce an image, they also play a crucial role in particle detectors, both present and future. Historically rather used for tracking detectors they're about to find their way into calorimeters; take for example the CALICE collaboration that among others carries out the R&D for a silicon-based calorimeter with an active area of 2500 square metres aimed at the ILD detector — one of the two detector concepts for the ILC. This silicon calorimeter would comprise around a thousand times more cells than typical calorimeters today. The R&D is driven by the concept of particle flow, a complete reconstruction of every particle from a collision. Both concept and technology are so promising that the CMS collaboration, a group of some 3000 scientists who plan, build, run and use the CMS detector at the LHC at CERN, has decided to build their calorimeter end cap with silicon as well. It will cover an area of 600 square metres. At a smaller scale a similar detector is also under study for LHC's ATLAS upgrade, where it would be positioned in front of the existing end cap calorimeter.

Some 80 calorimeter and silicon tracking experts from a variety of projects and labs as well as newcomers to the field attended the workshop, which started on 13 June, the day before the first annual AIDA-2020 meeting kicked off.

"AIDA-2020 provides the perfect platform for exchange," says Roman Pöschl from CNRS (at LAL, Orsay, France) who has organised the workshop together with Abe Seiden (UCSC) and Marcello Mannelli (CERN) on invitation of the AIDA-2020 management. "We meet as experts looking for the best technology without being bound to our respective projects and collaborations. And we managed to get everybody around one table."

Silicon is key for precision measurements in an environment with large numbers particles because it allows for a high degree of pixelisation. Therefore tangled jets of particles can be neatly separated into their individual components including information about their respective energies, allowing for very exact information about what went on when two particles collided. For LHC detectors, it will also have to provide an excellent time resolution to cope with the large pile-up, multiple interactions during one bunch crossing. The goal is to have a time resolution of 10 picoseconds and developers are busy putting this requirement to the test.

"We don't need this challenging time resolution for ILC detectors because the beam characteristics are so different between LHC and

ILC," says Pöschl, "but who knows, maybe we can use the information as well? We are certainly looking at the options." Using the CALICE silicon technology in CMS will be a "reality test", he says. And if you think that high-granularity silicon devices with precise time measurement are a challenge, think again – the participants have already started discussing ultra-high-granularity concepts for ultra-futuristic particle physics projects. Another factor 1000 is at stake.

ADVANCED EUROPEAN INFRASTRUCTURES FOR DETECTORS AT ACCELERATORS | AIDA-2020 | ATLAS | CALICE | CERN | CMS | DETECTOR DEVELOPMENT | SILICON TRACKING

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FEATURE

In the light of new accelerators

Advancing superconducting cavities for present and future projects

Ricarda Laasch | 22 July 2016

SRF technology in use around the world. Slide by Akira Yamamoto taken from Hasan Padamsee's closing talk.

At the TTC meeting (TESLA Technology Collaboration meeting) scientists from all over the world came together to present their advances for superconducting radiofrequency cavities and related topics. This summer meeting from 5 to 8 July 2016 was hosted by CEA in Saclay, near Paris in France, where the production of the European XFEL (X-ray free electron laser) cryomodules just finished. TTC remains a meeting were nuts and bolts, measurements and problems and many other hands-on topics are discussed openly between physicists, engineers and everyone else involved with the technology.

The meeting was opened by a talk from Hasan Padamsee, Chair of the TTC, who dedicated the talk to Helen Edwards, a recently deceased pioneer accelerator developer who worked at and with many laboratories like Fermilab and DESY. "Helen Edwards was a leader in the design, construction, commissioning and operation of the Tevatron. She pressed the start and shutdown buttons of this machine", said Padamsee. "She made significant contributions to the TESLA technology as an active member of the TTC."

The talk summarised the highlights of superconducting radio frequency (SRF) in already running projects: Big accelerator machines like the European XFEL at DESY, LCLS-II (Linac Coherent Light Source II) at SLAC, STF2 (Superconducting Test Facility 2) at KEK and many more all around the planet are using SRF technology. Padamsee showed important developments from all of them, ranging from test results of the cavities to module assemblies. "The European XFEL needed 800 cavities for 100 cryomodules; many ongoing – already approved – projects like LCLS-II, FRIB, RAON, ESS, PIP-II and many more will require a further 1200 cavities for more than 200 cryomodules," summarised Padamsee. "This means our community will be busy for at least the next decades. And this calculation does not include the projects which are still seeking for approval. We are in for a lot of fun and work!" He also hinted that his closing talk would be dedicated to future projects like the ILC.

A number of plenary talks followed about the status updates from ongoing projects. Here the progress and especially lessons learned from all these projects for future projects were important messages. The challenges and difficulties the projects had overcome and how they had handled them, were always part of the talks. "This is the spirit of TTC. It is not about the accomplishments alone. It is about understanding the problems and being open even across the whole planet," explains Akira Yamamoto, Asian Director for the *ILC*. "This is also why this community advances so fast together – from project to project."

Especially for the ILC this meeting had many highlights to offer. Nick Walker, scientist at DESY, showed a statistical analysis of European-XFEL cavity production comparing it to the ILC requirements. The ILC requirements in vertical test for cavities were defined in the Technical Design Report (TDR): an average accelerating gradient of 35 megavolts per metre (MV/m) and an assumed yield of 75% in the first pass. For the second pass – which means after an additional surface cleaning – the yield should be 90% with the same average of 35MV/m. The so called *ILC recipe,* which describes the surface treatment process, was used to build half of the European XFEL cavities. Nick Walker used the results from those cavities to extrapolate to a full-size ILC cavity production. "For the maximum gradient we got a yield of 94% with an average of 35 MV/m – for the first and second pass – which is better than we need," explained Walker. "If we look at the useable gradient – meaning considering field emission, quality factors and so on – we have a yield of 82% and an average of 33.4 MV/m. Well, not perfect but really close. This is a very encouraging result."

Fermilab presented new results for an improved nitrogen treatment of cavities. LCLS-II uses nitrogen doping to enhance the quality factor and therefore reduce the cryogenic costs of the machine. One price to be paid for this enhancement is a lower accelerating gradient which makes it not yet suitable for the ILC. This could change dramatically with the new "nitrogen infusion" technique Fermilab presented. Instead of doping the cavity with nitrogen gas at 800 degrees Celsius, the new infusion technique combines the exposure to nitrogen with the relatively mild 120-degree bake. This means that the nitrogen atoms penetrate the niobium less deep and only the first few nanometers below the surface are enriched with nitrogen atoms. What is more, the heat treatment is done in a way that no further surface chemistry needs to be done before the vertical test, which is usually necessary. "We have *infused* a number of different one-cell cavities with the result that each of them reached above 35MV/m and four out of five went up to 45 MV/m with a Q-factor of 2×10^{10}." explains Sebastian Aderhold. "So far we are still working on improving this technique to understand its possibilities and limits." The big question after the talk was from Akira Yamamoto: Could this reduce the cost for the ILC? The answer to this is: possibly. If this technique could be well matured for TESLA-shape nine-cell cavities and if one chemistry step can be omitted, this might reduce the costs. So far it is hard to say by how much. Attempts to understand the infusion benefits were also presented.

The closing words for the meeting were given again by Hasan Padamsee about the future of the field. He also ventured into the topic of communication and motivated the need for outreach for the ILC. The physics case needs to be explained to the public and the benefits should be made clear to everyone. He finished with an overview of the future projects and their needed numbers of cavities and cryomodules: more than 1000 cavities for roughly 150 cryomodules are needed for projects which are seeking approval at the moment. "And these numbers don't include the ILC and the FCC which would mean – both together – another 23000 cavities", said Padamsee. "I guess SRF continues to be needed in the future and so TTC expertise and continuous exchange."

CEA | DETAILED BASELINE DESIGN | EUROPEAN XFEL | FCC | FERMILAB | ILC | KEK | LCLS II | SCRF | SRF | TESLA TECHNOLOGY COLLABORATION

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DIRECTOR'S CORNER

Hiroshima

Hitoshi Murayama | 22 July 2016

President Obama embraces a Hiroshima survivor.

On 27 May this year, Barack Obama visited the site of atomic bombing in Hiroshima – a first for a serving President of the United States. I was deeply moved by the picture where Obama embraced an aging hibakusha, an atomic bomb survivor. It was very significant that the visit was not about the war crimes committed by Japan, a political debate about nuclear deterrent, or whether it was the right decision for the US to drop the atomic bomb. It was all about what nuclear weapons do to people and how we can avoid a complete annihilation of human civilisation by a push of a button with another push for nuclear disarmament.

Being a physicist, I welcomed this historic visit with a bittersweet feeling. We physicists created this monster. Physics is about understanding how nature works. Once we understand something, we can use the new knowledge to create a new technology. Sometimes that technology can be extremely harmful.

When I started working on the linear collider I was very happy to learn and today I am happy to confirm that the technologies developed for the future linear colliders are very peaceful and useful. Past studies for linear colliders have led to an amazing technology that helps to make particle accelerators much smaller and much less expensive. It can be used for cancer diagnosis and therapy with a smaller device that fits inside hospital buildings. It allows for much brighter light sources that can be used for studying proteins and developing new medications, designing new materials, and even archaeology to study what is inside a precious artifact without cracking it. It is hoped that accelerator technology can be used to reduce nuclear waste by transmuting dangerous long-lived isotopes to ones that decay away quickly. It would also aid securing borders by “seeing through” cargos without touching them. The technology to steer and focus particle beams to nanoscale would help with nanoscale fabrication.

In addition, large-scale scientific projects such as particle accelerators would bring people and nations together, even when some of them are in hostile situations. I was very impressed to learn about the SESAME project, a new light source built in Jordan. For this project, Middle Eastern countries in very difficult political situations are working together: Baharain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestininan Authority, and Turkey. CERN, the site for the largest particle accelerator to date, attracts scientists from about a hundred countries, some of them also in hostility.

I believe that the basic research we conduct with particle accelerators will help build a more peaceful world.

Read also : Science for Peace (16 october 2014) by Hitoshi Murayama, Barack Obama’s speech in Hiroshima or watch a video of his speech

APPLICATIONS | FUNDAMENTAL SCIENCE | LIGHT SOURCES | MEDICAL APPLICATIONS | MILITARY APPLICATIONS | TECHNOLOGY TRANSFER

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IMAGE OF THE WEEK

A well-focused workshop on top quark physics held at KEK

Hitoshi Yamamoto | 22 July 2016

Participants of the top workshop at lepton colliders Top@LC2017 at KEK.

The top quark is one of the pillars of the physics topics that linear colliders address. With its large mass of about 175 GeV the top quark is the heaviest particle in the standard model – even heavier than the Higgs boson. Its value suggests that the top quark may have something to do with the reason why the Higgs field froze to a certain value, giving masses to elementary particles. Many theoretical models beyond the standard model have their smoking guns appearing in the properties of the top quark. At a linear collider top quark pairs would be produced in clean electro-weak production, a distinct difference compared with the LHC, which supports considerably the discovery of new physics.

From July 6 to 8, 2016, the 'Workshop on top physics at the lepton colliders' was held at KEK. This was the fourth in the series and the first time that the workshop was held in Asia. More than 40 experimentalists and theorists from three regions who are actively engaged in top quark studies at lepton colliders gathered together to participate in vigorous discussions. An international committee put together the program that also included reviews of incoming results from the LHC. Even though the size of the meeting was modest, it was the right size to focus on well-defined topics. The workshop was jointly hosted by KEK and Tohoku University and supported in part by a JSPS program 'international studies on top physics at linear colliders', the virtual French-Japanese Laboratory TYL/FJPPL, and the E-JADE program. In 2017 the workshop will be held at CERN.

KEK | PHYSICS | TOP QUARK

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