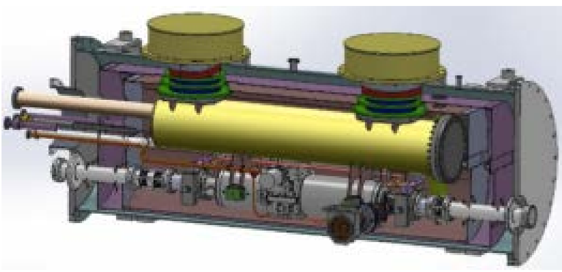
LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

Strengthening Asian capability in SCRF technology

by Rika Takahashi



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FEATURE

Some CLIC with your free-electron laser?

The CLIC study could transfer its X-band expertise to light sources and medical applications

by Barbara Warmbein

Particle physics has a long tradition of technologies serendipitously making their way into other realms of science or even everyday life. Think of the web or particle detectors for medical diagnostics. The scientists working on the CLIC accelerator, one of the potential successors of the Large Hadron Collider LHC, held a "High Gradient Day" specially targeted at industry during their workshop last week in order to catalyse the transfer of knowledge gathered over years of R&D.

DIRECTOR'S CORNER

The CLIC workshop 2014

by Steinar Stapnes

The yearly CLIC collaboration meeting took place last month at CERN, welcoming more than 300 physicists from all over the world. After many strategy processes and deliberations, the discussions and presentations were refreshingly focused on the physics, technologies and scientific challenges for the next phase of the project. CLIC's Steinar Stapnes, Associate Director for the Compact Linear Collider Study reports.

IN THE NEWS

from *wired*
3 March 2014
A Movie About the Large Hadron Collider That You'll Actually Understand
Enter Particle Fever. The new documentary opens tomorrow in New York, and aims to demystify the years of LHC research that led to the discovery of the Higgs boson particle—as well as make it exciting for audiences to watch.

from *Science*
3 March 2014
Physicist Seeks Illinois House Seat
In addition to teaching UIUC undergraduates, he spent years working on plans for the International Linear Collider and is part of an experiment called Mu2e at Fermi National Accelerator Laboratory (Fermilab), 200 kilometers to the north in Batavia, Illinois, that is looking for the morphing of muons into electrons.

from *ars technica*
28 February 2014
Physicists start thinking beyond the LHC, consider reviving the SSC
Could the tunnels we drilled for a collider in Texas house a Higgs factory?

from *phys.org*
27 February 2014
Why bigger accelerators are better in particle physics
While the world's largest circular particle accelerator – the Large Hadron Collider (LHC) – will continue operation for the next few years, scientists have already started the conversation to build a much bigger, post-LHC circular accelerator.

from *The Guardian*
22 February 2014
The future of particle physics?
If we want to continue to probe the structure of matter, to understand what the smallest constituents of nature are and how they interact, we have to think big and plan for the long term. Possibilities include machines that would dwarf the Large Hadron Collider, and neutrino beams crossing half a continent.

from *extremetech.com*
20 February 2014
Searching for supersymmetry: Work begins on Large Hadron Collider's 60-mile-long successor
In the shorter term, the International Linear Collider, which will smash electrons together instead of protons to investigate dark energy and multiple dimensions, will be completed around 2026. The future of high-energy physics is bright indeed. I have a feeling that, over the next 20 years or so, the universe is going to be forced to cough up some very juicy secrets indeed.

CALENDAR

Upcoming events

Workshop on Top physics at the LC
LPNHE, Paris
05- 06 March 2014

CALICE collaboration meeting
Argonne, Chicago, IL
19- 21 March 2014

Americas Workshop on Linear Colliders (AWLC14)
Fermilab
12- 16 May 2014

Upcoming schools

Joint Universities Accelerator School (JUAS)
Archamps, France

PREPRINTS

ARXIV PREPRINTS

1402.7295
Constraints on Light Magnetic Dipole Dark Matter from the ILC and SN 1987A

1402.7159
Radion in Randall-Sundrum model at the LHC and photon collider

1402.6449
Self-interacting scalar dark matter with local Z3 symmetry

1402.6400
Higgs Physics as a Proble of New Physics

1402.5870
Dark Matter Complementarity in the pMSSM and the ILC

06 January- 14 March 2014

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1402.5575

High-accuracy absolute distance measurement by two-wavelength double heterodyne interferometry with variable synthetic wavelengths

1402.4143

Expectations for the Higgs boson identification at the ILC

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Strengthening Asian capability in SCRF technology

Rika Takahashi | 6 March 2014


Scientists at KEK's CFF celebrating the completion of the superconducting cavity KEK-001 Image: Nobuko Kobayashi

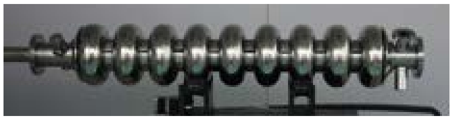
Sixteen thousand – that's the number of the superconducting radiofrequency (SCRF) accelerating cavities needed to build the 500-Giga-electronvolt linear collider. The fabrications of these 16 000 cavities will be divided between the three regions of Europe, the Americas, and Asia. This week, encouraging news about SCRF cavity fabrication came form Asia.

"This is our first in-house SCRF cavity," said Takayuki Saeki, SCRF specialist at the KEK laboratory in Japan. KEK has been working on a study for industrialisation of the SCRF cavity at a facility called CFF (Cavity Fabrication Facility) established in 2011. CFF is equipped with a press machine, vertical lathe, electron-beam welding machine, chemical treatment room, and surface inspection machine, where most of the cavity fabrication processes are done in a one-stop shop. At CFF, scientists are aiming for a high performance and high yield rate, for reducing the fabrication cost, establishing mass-production processes, and preparing the fixtures needed.

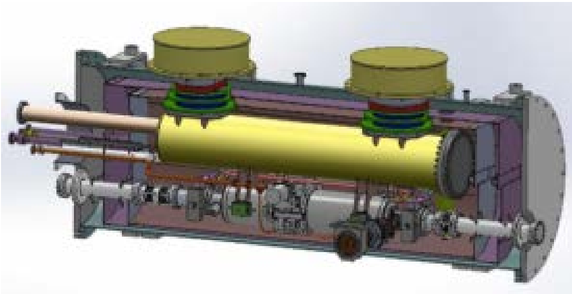
Prior to the first cavity called KEK-001, they produced a test cavity, KEK-000. "The aim of the KEK-000 was basically to gain experience with cavity fabrication, and learn the basics. This time, we focused more on mass-production," said Saeki.

"We used the different technique to weld the equatorial part of the cavity cells for the KEK-001. We chose the technique best suitable for mass production aiming for cost reduction," said Saeki. Scientists also adopted a cost-effective fabrication technique for the cavity end parts, which have complicated structures with components such as beam pipe, higher order mode RF coupler, power port, flanges. "We thoroughly investigate the all welding locations to determine the desirable parameters, using niobium plates and pipes. I think it worked very well." The performance test on KEK-001 will be conducted in a few months.

Another good news from KEK is the success in the vertical test of a single cell cavity made out of large-grain niobium, which reached the record accelerating gradient of 45 Megavolts per metre. Several major laboratories have investigated the use of large-grain and single-crystal material in the past years. Large-grain and single-crystal niobium is an alternative material to poly-crystalline, or fine-grain niobium for superconducting cavities, that has potential advantages such as reduced costs and better reproducibility in performance.


large grain 9-cell superconducting cavity (PKU4) Image: Peking University

Last year, a 9-cell niobium SCRF cavity made of large-grain niobium achieved an accelerating gradient of 32.6 MV/m at Peking University (PKU), Beijing, China, in cooperation with KEK. The fabrication of the cavity was finished with careful control of machining, better field flatness tuning, improved surface treatment and electron beam welding.The multiple surface treatment and performance tests on this cavity were carried out by KEK. This cavity, called PKU4, is the first cavity which has reached the requirement for the ILC both in accelerating gradient and intrinsic quality factor in China.



ILC-type cryomodule to be tested at IHEP Beijing. image: IHEP

There are more advancements on SCRF technology in China. The Institute of High Energy Physics (IHEP), Beijing, is progressing the system assembly of the cryomodule, composed of composed of a 9-cell cavity housed in a cryostat, which maintains the cavity to very low temperature to realise superconductivity. It is now getting ready for the cold performance test later this year. This system will be a prototype to demonstrate full functioning for the ILC SCRF system requirement.

These activities and progresses indicate that China has the capability to manufacture superconducting cavities and the SCRF system integration for the ILC. “International collaboration is the key for the success for the ILC construction. And PKU4’s success is a very important milestone for superconducting technology development in China, and also for the China-Japan collaboration,” said Akira Yamamoto, regional director for Asia at the Linear Collider Collaboration. Asia is getting ready for the ILC construction.

CAVITY GRADIENT | CHINA | INDUSTRIALISATION | JAPAN | SCRF

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FEATURE

Some CLIC with your free-electron laser?

The CLIC study could transfer its X-band expertise to light sources and medical applications

Barbara Warmbein | 6 March 2014

Happy scientists at the end of acceptance-testing a new X-band klystron at SLAC in January. The testing team consists of people from CERN, SLAC, PSI, Trieste and the klystron manufacturer CPI. Image: SLAC

The planned CLIC accelerator would use a unique way of accelerating its electrons and their anti-particles, positrons: two accelerators would sit side by side, one, the main linear accelerator or "linac", to get the beams of particles from source to collision, and the other, the "drive beam", to pass as much power as possible on to the main beams. This gives them a big push, it increases the rate at which they accelerate – their gradient. The CLIC main beam will have an acceleration gradient of 100 Megavolts per metre. For comparison: the ILC gradient is 31.5 Megavolts per metre (MV/m); the LHC accelerates at 5 MV/m, but as it is a storage ring, the beam can pass through the accelerating structures several times, while beams in a linear accelerator have only one shot at being accelerated before they collide.

In order to test the accelerating structures, CLIC scientists build test stands that are not powered by the CLIC drive beam but by power sources called klystrons that provide radiofrequency power in the X-band range. They believe that these klystron test stands (combined with high-gradient accelerating structures) could be useful for future free-electron lasers, special accelerator-driven lasers that provide very particular laser light for studying materials, biological samples, molecular processes and much more. "The high gradient means that the accelerator can be very short because beams reach the designated energy much more efficiently," explains Walter Wuensch, head of the X-band R&D for CLIC. "We have done a lot of research on getting the gradient for CLIC, we have a lot of experience with X-band systems and sources are now available commercially. All this makes an X-band accelerator comparatively affordable." This means labs or companies can build or upgrade free-electron lasers and make them available for all sorts of applications.

Wuensch says that both the technology and beam diagnostic tools have been tested to the core. "We are confident we can build linear accelerators for free-electron lasers according to the desired specifications," he says. During a High-Gradient Day at last week's CLIC workshop, several light source operators from Switzerland, Turkey, Italy, China, Australia and Sweden exchanged their specs, wishes and future plans with the CLIC team. A free-electron laser driven by CLIC technology would be a dream come true for Wuensch and his colleagues.

Another topic at the High Gradient Day was the involvement of CLIC expertise medical projects. One of these, TERA TULIP, looks into operating a proton accelerator for cancer therapy. CLIC's high-gradient experience could help make the gantry through which the beam is passed to the patient shorter and lighter by installing the accelerator on the gantry itself, thus reducing the number of bending magnets needed for the proton beam and making the gantry more compact. If it could move around the patient and provide high-precision beams, damage to non-cancerous tissue could be avoided.

A few other potential applications which might benefit from X-band and high-gradient technology were discussed at the industry day, “but these are further down the line,” says Wuensch. We’ll make sure to let you know when the first free-electron laser using CLIC technology comes online.

A version of this story first appeared on the CERN homepage.

CLIC | FREE-ELECTRON LASER | SLAC | TECHNOLOGY TRANSFER | X-BAND

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DIRECTOR'S CORNER

The CLIC workshop 2014

Steinar Stapnes | 6 March 2014

CLIC workshop participants gathering outside the CLIC test facility CTF3. Image: Anna Pantelia, CERN

The yearly CLIC collaboration meeting took place at CERN on 3-7 February 2014. A record participation of more than 300 scientists/students from the more than 70 collaborating institutes set the scene for a very busy and lively week. After completing the *Conceptual Design Report* (CDR) in 2012, and the European Strategy update in 2013, the discussions and presentations were refreshingly focused on the physics, technologies and scientific challenges for the next phase of the project.

The week started with an open plenary session on Monday 3 February afternoon giving an overview of the CLIC project – accelerator, physics/detectors, placed in the context of other studies for machines at the energy frontier. In addition to the CLIC option, a hadron machine in a large new tunnel, the Future Circular Collider (FCC), was highlighted as another possibility for a post-LHC high-energy frontier facility. The co-operation and common studies between CLIC and FCC are being developed and will be a priority in the coming years. The technical project developments will take place in parallel with LHC running at higher energies, hopefully providing guidance to the studies of future machine options.

The parallel sessions Tuesday 4 and Wednesday 5 February were the core of the workshop. One major goal of the workshop was to encourage presentations by young researchers and students and with around 150 presentations, most of them during the parallel sessions, this goals was achieved. The accelerator parallel sessions covered parameters and design, X-band activities, system tests – among them CTF3, FACET and ATF, implementation studies and technical developments – for example related to power/energy reduction, high-efficiency radiofrequency power systems, instrumentation studies and the newly initiated EU project PACMAN (Particle Accelerator Components Metrology and Alignment to the Nanometre scale). During the same days, the CLIC detector and physics community arranged their parallel sessions providing an overview of the current activities and future plans in these areas. An Institute Board meeting on Wednesday during lunchtime and a wrap up session in the afternoon completed the physics and detector sessions.

A special session on 6 February covered high-gradient normal-conducting accelerators for industrial and medical applications as well as XFELs (free electron lasers), using CLIC and other high-gradient technology developments. At this point in time, several of the key CLIC technologies have reached a level of maturity where applications in other areas than particle physics can be considered and open new possibilities. With this in mind, the CLIC collaboration invited laboratories, projects and industries with interests in these topics, including other frequency structures and power units, to an open “high gradient day”. Most of these laboratories and industrial suppliers are already involved in the CLIC study. The programme covered FEL-related projects and technologies, focusing on opportunities linked to high-gradient systems, followed by sessions on medical and industrial applications of high-gradient systems. In the afternoon there was a parallel session on low emittance rings, with emphasis on collaboration, technical developments and performance tests in and for light-sources and damping rings.

A plenary session on 7 February morning focused on system tests of key CLIC challenges, also with the aim of defining the future system test plans and opportunities that would be needed beyond CTF3 (the CLIC Test Facility) before construction. This included common studies with light-source and FEL laboratories, as well as several other accelerator test-facilities (as for example FACET at SLAC, US or ATF at KEK, Japan).

A Collaboration Board afternoon provided the opportunity to summarise the 2013 achievements and review the goals for 2014. Among the most clear goals are to complete re-baselining of a staged implementation taking into account the Higgs energy scale and improved power/cost models and to increase the X-band test capacity further providing the key to faster evaluation of accelerating structures and design optimisation steps. The CTF3 programme remains a key part of the collaborative efforts, and other experimental studies and programmes in conjunction with test-facilities and light source laboratories are high priority as mentioned above. Detector and physics studies towards energy-frontier physics and common reference studies with FCC where possible will be emphasised. On the organisational side, Phil Burrows was elected spokesperson for the accelerator collaboration for the next three years, replacing Roberto Corsini who had completed his term and was warmly thanked by the Collaboration Board.

ACCELERATOR R&D | CLIC | DETECTOR R&D | TECHNOLOGY TRANSFER