NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

SCRF R&D for ILC upgrade – tin for the future?

Cornell experiments with Nb3Sn for cavities

by Barbara Warmbein

Cornell is working on a technology that could make superconducting cavities even more efficient: niobium alloyed with tin. Currently in single-cell research stage, tests show promising results, especially for the quality factor Q. Cornell university has always been a big player in the development of superconducting radio frequency technology SCRF, the technology chosen for the ILC. Even though research into Nb3Sn-cavities is not advanced enough to replace conventional cavities just yet, it might play a big role in future upgrades of the ILC – and in many other accelerators for all kinds of purposes the nearer future.

AROUND THE WORLD

From CERN: CERN announces LHC restart schedule

The Large Hadron Collider (LHC), the largest and most powerful particle accelerator in the world, has started to get ready for its second three-year run. Cool down of the vast machine has already begun in preparation for research to resume early in 2015 following a long technical stop to prepare the machine for running at almost double the energy of run 1. The last LHC magnet interconnection was closed on 18 June 2014 and one sector of 1/8 of the machine has already been cooled to operating temperature. The accelerator chain that supplies the LHC's particle beams is currently starting up, with beam in the proton synchrotron accelerator last Wednesday for the first time since 2012.

DIRECTOR'S CORNER

Challenges and goals for the LCWS14 in Belgrade 6-10 October

by Steinar Stapnes

Summer conferences are only just starting, but Steinar Stapnes, director for CLIC in the LCC, looks ahead to the linear collider autumn conference and its specific challenges for ILC as well as for CLIC.

IMAGE OF THE WEEK

Follow ICHEP remotely

"The portrait of the Brout-Englert-Higgs boson we have today is still a very rough sketch," says Juan Fuster in the ICHEP newsletter published today. The 37th International Conference on High-Energy Phyiscs ICHEP started this week in Valencia, Spain. Follow what's being discussed by checking the schedule or watch the webcast on Saturday 5 July. The first newsletter is available here.

IN THE NEWS

from *JPubb*
2 July 2014
国際リニアコライダー　ILC　に関する有識者会議　第1回　議事録
ここからサイトの主なメニューです
国際リニアコライダー(ILC)に関する有識者会議(第1回) 議事録

from *University of Birmingham*
30 June 2014
Birmingham goes 'Beyond the Boson' at the Royal Society
Scientists are only just beginning to learn what the Higgs boson can tell us beyond the current Standard Model theory of physics. Searches for what lies beyond the Higgs boson continue with CERN's Large Hadron Collider and planning is underway for future accelerators and experiments; including the 31km International Linear Collider and an even larger 100km circumference accelerator at CERN.

from *BBC News*
30 June 2014
Higgs boson spills secrets as LHC prepared for return
It's nearly time. After shutting down last year for vital repairs and upgrades, the Large Hadron Collider is being prepared for its comeback.

CALENDAR

Upcoming events

37th International Conference on High Energy Physics (ICHEP 2014)
Valencia, Spain
02- 09 July 2014

ICFA Workshop on High Order Modes in Superconducting Cavities
Fermilab
14- 16 July 2014

Applied Superconductivity Conference (ASC 2014)
Charlotte, NC, USA
10- 15 August 2014

POSIPOL 2014

ANNOUNCEMENTS

Positron polarisation workshop: POSIPOL 2014, 27 – 29 August

POSIPOL 2014 will be held at the new library of Ichinoseki-city, Iwate. As the ninth of POSIPOL workshop series, POSIPOL 2014 will discuss issues of polarised positron sources, high intensity positron sources, X-ray/Gamma-ray sources, and their applications. The positron sources for the linear colliders, ILC and CLIC, will be main subjects, but positron sources for other colliders such as B-factories will also be discussed. Visit the website to find out more.

Ichinoseki, Iwate, Japan
27- 29 August 2014

View complete calendar

PREPRINTS

ARXIV PREPRINT

1406.7701
Neutralinos betray their singlino nature at the ILC

1406.7507
A hadronic calorimeter with Glass RPC as sensitive medium

1406.6980
Electroweak precision tests in the LHC era and Z-decay form factors at two-loop level

1406.6689
Top Seesaw with a Custodial Symmetry, and the 126 GeV Higgs

1406.6367
CP violation with a dynamical Higgs

1406.5256
Precision calculations for the T-odd quark pair production at the CLIC e+e− linear collider

LC NEWSLINE
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AROUND THE WORLD

SCRF R&D for ILC upgrade – tin for the future?

Cornell experiments with Nb3Sn for cavities

Barbara Warmbein | 3 July 2014

Sam Posen assembles a Nb3Sn cavity to a test stand in the clean room. Image: Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)

Accelerator physicists are driven by one goal: to make particles go at high energies and in perfect beams at the highest efficiency and lowest cost possible. There are many different accelerator technology options for all sorts of particles, different types of colliders, storage rings and linacs, and different goals: medicine, light source, and, of course, fundamental research.

A big player in the development of superconducting radio frequency technology, the technology for the ILC, has always been Cornell University in Ithaca in the United States. It is here that Maury Tigner developed the concept for the linear collider in 1965, and some of the standard SCRF textbooks were written by Cornell's Hasan Padamsee, who has since become head of Fermilab's Technical Division. Now Cornell is working on a technology that could make superconducting cavities even more efficient: niobium alloyed with tin.

Niobium-three-tin, or Nb3Sn, holds great potential for all uses of SCRF because of its low surface resistance at a relatively high temperature and potential to operate at very high fields. With low surface resistance at 4.2 Kelvin (conventional all-niobium cavities typically operate at 2 K) less power is needed for the cryoplants that cool the accelerator – a factor that could greatly reduce costs. And high fields equal high accelerating gradients which, once the technology has proven its principle, would equal fewer cavities, a shorter accelerator and thus also less money.

Niobium cavities are well understood and are in use in many places around the world while R&D into improving and inspecting them goes on, for example at KEK, DESY or Fermilab. Different materials and coatings have always been part of that R&D, and Cornell isn't the first lab to pick up the idea of coating niobium single-cell cavities with Nb3Sn. However, Cornell has recently made important progress with the material, achieving for the first time very small surface resistance in Nb3Sn-accelerator cavities at usable gradients.

The Nb3Sn programme at Cornell is a very small team – essentially Cornell physicist Matthias Liepe and graduate student Sam Posen. Sam, who started in 2009 and is about to hand in his thesis, commissioned and calibrated the lab's own coating furnace and is in charge of all Nb3Sn tests. Single-cell cavities enter a chamber inside an ultra-high-vacuum oven – the coating furnace – all shiny and sparkling and come out all dull and lacklustre – but only to the eye, not to the accelerated particles. In the 1100-degree furnace tin

vaporises and diffuses onto the surface of the cavity, forming an alloy in extremely controlled ratios. “We know because of temperature-mapping tests that the surface is very uniform,” explains Sam Posen, “so they show very uniform performances.

The coated cavities reached gradients of approximately 14 Megavolts per metre with a quality factor at a temperature of 4.2 K of 2×10^{10}; 20 times the quality factor Q of standard niobium cavities, for which the Q at the same temperature is 6×10^{8}. So far, three single-cell cavities that have been produced using the coating furnace have reached these gradients. The next challenge: he currently has a cavity on his desk that has been electropolished instead of undergoing buffered chemical polishing (BCP). “It’s exciting to use such a recently accepted technology on a material that it has never been applied to.”

There is currently no project attached to the Nb3Sn research, though its outcome could be transformational for many future accelerators and even (upgrades of) the ILC. “This is really fundamental research in accelerator physics,” says Sam. “But it’s exciting to know that the application of my work might benefit many accelerator-driven sciences, and even industry.”

Cavity before and after coating. Image: Cornell Laboratory for Accelerator-based Sciences and Education (CLASSE)

CORNELL | NB3SN | Q | SCRF | SUPERCONDUCTING CAVITY

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3 July 2014

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With the closure of the last of 1695 magnet interconnections in June, the LHC is getting ready for the cooldown. Some of the pre-accelerators are already back in service. Image: CERN

"There is a new buzz about the laboratory and a real sense of anticipation," said CERN Director General Rolf Heuer, speaking at a press conference at the EuroScience Open Forum, ESOF, meeting in Copenhagen. *"Much work has been carried out on the LHC over the last 18 months or so, and it's effectively a new machine, poised to set us on the path to new discoveries."*

Over the last 16 months, the LHC has been through a major programme of maintenance and upgrading, along with the rest of CERN's accelerator complex, some elements of which have been in operation since 1959. Some 10,000 superconducting magnet interconnections of were consolidated in order to prepare the LHC machine for running at its design energy.

"The machine is coming out of a long sleep after undergoing an important surgical operation," said Frédérick Bordry, CERN's Director for Accelerators and Technology. *"We are now going to wake it up very carefully and go through many tests before colliding beams again early next year. The objective for 2015 is to run the physics programme at 13 TeV."*

The LHC experiments also took advantage of this long pause to upgrade their particle detectors. *"The discovery of a Higgs boson was just the beginning of the LHC's journey,"* said senior CERN physicist Fabiola Gianotti at the same press conference. *"The increase in energy opens the door to a whole new discovery potential."*

The Higgs boson, first mentioned in a 1964 paper by Peter Higgs, is linked to the mechanism, proposed the same year by Higgs and independently by Robert Brout and François Englert, that gives mass to fundamental particles. During its first three years, the LHC ran at a collision energy of 7 to 8 TeV delivering particle collisions to four major experiments: ATLAS, CMS, ALICE and LHCb. With the large amount of data provided by the LHC during this first period, the ATLAS and CMS experiments were able to announce the discovery of

the long sought Higgs boson on 4 July 2012, paving the way for the award of the 2013 Nobel Prize in physics to theorists François Englert and Peter Higgs.

By providing collisions at energies never reached in a particle accelerator before, the LHC will open a new window for potential discovery, allowing further studies on the Higgs boson and potentially addressing unsolved mysteries such as dark matter. The ordinary matter of which we, and everything visible in the universe is composed, makes up just 5% of what the universe is made of. The remainder is dark matter and energy, so the stakes for LHC run 2 are high.

CERN's accelerator complex schedule:

2 June 2014: restart of the Booster

18 June 2014: restart of the Proton Synchrotron (PS)

Early July: powering tests at the Super Proton Synchrotron (SPS)

Mid-July: Physics programme to restart at the Isolde facility and at the PS

Mid-August: Antimatter Physics programme to restart at the Antiproton Decelerator (AD)

Mid-October: Physics programme to restart at the SPS

Early 2015: Beam back into the Large Hadron Collider (LHC)

Spring 2015: Physics programme to restart at the LHC experiments

ACCELERATOR | CERN | LHC | LS1

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DIRECTOR'S CORNER

Challenges and goals for the LCWS14 in Belgrade 6-10 October

Steinar Stapnes | 3 July 2014

This year's Linear Collider Workshop takes place in Belgrade.

As the summer conferences are taking place, providing – we hope – further physics guidance for us, it is also time to start thinking about the autumn linear collider programme. The highlight for the linear collider community is the yearly international Linear Collider Workshop which in 2014 will take place from 6 to 10 October in Belgrade, Serbia. It is being hosted by the Vinca Institute of Nuclear Sciences. The workshop webpage is available at lcws14.vinca.rs/welcome/. General information about Belgrade and the workshop was presented by Ivanka Bozovic-Jelisavcic, the chair of the Local Organising Committee, who introduced the LCWS14 planning during the last day of the Americas Linear Collider Workshop at Fermilab in May.

The workshop in Belgrade will start Monday morning and run until Friday around 13:00. The format will be familiar to the linear collider community, with plenary sessions Monday and Friday, and parallel sessions Tuesday to Thursday. The parallel session working groups will be defined by end July and 6 to 8 working groups can be expected both for the detector&physics and accelerator sectors. It is not too late to influence the programme for the workshop – ideas and comments are welcome .

This Linear Collider Workshop is the sixteenth in the series that started in 1991. This workshop is, in general terms, devoted to the study of the physics cases for future high-energy linear electron-positron colliders, taking into account the recent results from LHC, and to review the progress and future plans for the ILC and CLIC detector and accelerator projects.

Both ILC and CLIC have key challenges to address during the second half of 2014, and the workshop provides an excellent opportunity to discuss and hopefully conclude on some of these challenges. For ILC the ongoing process in Japan related to a site-specific implementation and providing the information needed to national committees and decision makers are high on the priority list. A restructured international ILC accelerator team has been established and this team is getting up to speed on these challenges. Another key issue is to establish a running/luminosity scenario addressed to Higgs and top physics – to mention the two most obvious areas – in the best possible way, taking advantage of how the machine can be upgraded in stages. Detector optimisation studies will a focusing point for both ILC and CLIC detector versions. The recently concluded P5 process will hopefully also provide improved support for continued effort on the US side, and by October more consequences of the P5 report will be known. For CLIC the physics studies will move from Higgs towards Beyond-the-Standard-Model topics in preparation for whatever the LHC at 13-14 TeV will unveil, and the accelerator collaboration will review the status and goals for the next phase and in particular the rapidly increasing interest for using X-band technologies in smaller accelerator projects which would be very benefitial for the technology.

On the social side there will be a welcome drink Sunday evening, reception Monday evening, a dinner Wednesday evening and a public lecture Thursday evening, in addition to ample opportunity to discuss with colleagues and friends outside the workshop events.

As usual there will be opportunities for smaller discussions for specific topics and steering groups. Additional satellite meetings will also

take place in connection to the workshop, an example being the FCAL workshop on 12 and 13 October.

The registration for the workshop will open in the coming week and it is time for all of us to start planning our travels to Belgrade in October.

ACCELERATOR R&D | CLIC | DETECTOR R&D | ILC | LCWS

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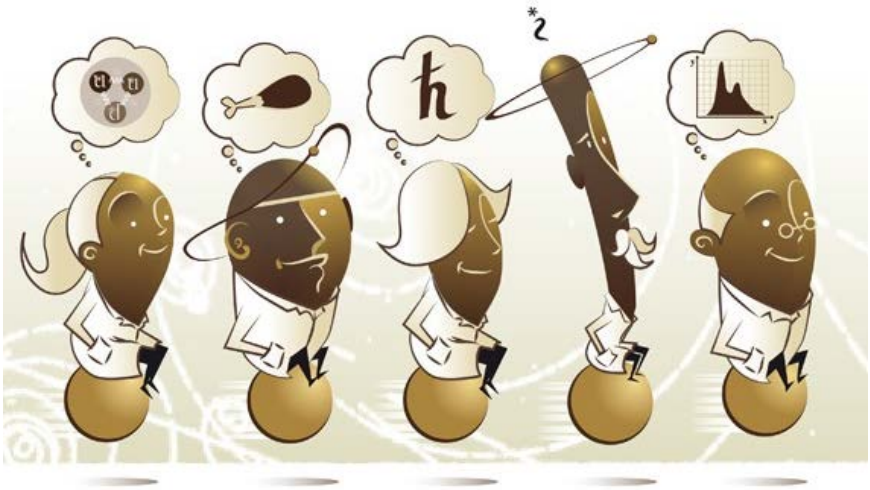

Image: ICHEP