NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

AROUND THE WORLD

Power napping for detectors

CLIC is looking at silicon capacitors to help with power pulsing

by Barbara Warmbein

If physicists had it their way, detectors of the future would be powered with air. They want no material and no electronic noise to disturb their measurements. Powering by air isn't a realistic option, so electrical engineers are tackling the challenge, putting a lot of effort into keeping noise down and material out. One of them is Cristian Fuentes at CERN. His latest project: power pulsing for the CLIC detector.

DIRECTOR'S CORNER

November in Paris: ILC prepares for Horizon 2020

by Brian Foster

At a meeting in France in November, ILC experts in both detector and accelerator technologies discussed project and funding opportunities for the upcoming EU Horizon2020 framework programme. LCC European Director Brian Foster also took the opportunity to visit the European-XFEL village at CEA in Saclay which has produced a cryomodule that exceeds ILC requirements.

IMAGE OF THE WEEK

First full-size ILC cryomodule assembled at KEK's STF test facility

Image: Nobuko Kobayashi

The image shows the assembly work of the cold mass for an ILC cryomodule in the superconducting rf test facility (STF) at KEK. Since the STF tunnel has a limitation for the size of the components to bring in, only half-size modules could be assembled before. STF now is equipped with new assembly facility in the tunnel, and this will be the first full-size ILC cryomodule to be assembled at KEK. This cryomodule will have a beam position monitor and a superconducting quadruple magnet in the centre, planned to be completed in December. In January, scientists will connect another half-size cryomodule, and start the cooling test in June.

IN THE NEWS

from *Kahoku Shinpo*
3 October 2013
推進協議会設立 官民　団体で構成 気仙沼
宮城県気仙沼市は　日、超大型加速器「国際リニアコライダー　　」誘致に向け、官民による「市国際リニアコライダー推進協議会」を設立した。Kesen-numa city in Miyagi prefecture established the city's ILC promotional body by public-private partnership on 2 October toward the invitation of the ILC.)

from *Futura Sciences*
2 December 2013
Boson de Higgs : l'origine des masses des quarks et leptons précisée
Pour aller plus loin, il faudra attendre le redémarrage du LHC en 2015. On espère surtout que les modes de désintégration du Higgs permettront d'avoir accès à de la nouvelle physique, comme la supersymétrie. Mais peut-être faudra-t-il attendre la mise en service de l'ILC pour cela.

from *The Conversation*
1 December 2013
Higgs boson's decay confirms physics model works
Last week, the ATLAS experiment at the Large Hadron Collider in Switzerland, showed evidence for the first time that a Higgs boson decays into a pair of tau particles. It is one of the crucial results that has followed on from the discovery of the Higgs boson.

from *Jiji news*
30 November 2013
益川さん、小林さんが講演　ノーベル賞受賞　年で
小林さんは「標準理論は決して究極のものではない。未知の素粒子があり、未知の相互作用がある。それが研究の大きな課題だ」と述べ、国際リニアコライダー　　など次世代の計画に期待を寄せた。Makoto Konayashi said "Standard model is not an ultimate theory. There should be unknown particles, and unknown interactions. Those are the questions to solve", expecting the next generation project such as ILC.)

from ***Nature***
26 November 2013
LHC plans for open data future
The intent is not just to keep data for posterity. Old data can be mined to test new theories and provide crucial references for new experiments, says Diaconu. Before the Higgs boson was discovered in 2012, for example, the Large Electron–Positron collider — the LHC's predecessor at CERN — came back into the spotlight as physicists scoured its 1990s-era data, looking for an exotic type of Higgs that had not been theorized at the time the data had been gathered.

from ***Cosmo online***
25 November 2013
Meet the particle snipers (part 2)
In week two of our particle sniper special we take a look at some of the more practical particle projects on the drawing board and explore some of the problems they will be training their sights on in the years to come.

from ***CERN Courier***
20 November 2013
IOP medals: from particles to the cosmos
This year [the IOPGlazebrook Medal] goes to Lyn Evans of CERN and Imperial College London, who receives the award for "his outstanding leadership of the Large Hadron Collider Project", the success of which " is in large measure the result of Lyn Evans's expertise in accelerator physics and his superb qualities as a project leader".

from ***CERN Courier***
20 November 2013
European XFEL electron-injector installation
The installation of the electron injector for the European XFEL has begun at the project's Bahrenfeld site.

from ***Český rozhlas***
14 November 2013
Velmi velký hadronový urychlovač
V minulých letech neměli američtí fyzikové na tak velké projekty dost peněz. I dnes je VLHC jen jednou z možných variant strategických investic do částicové fyziky. Dalšími variantami jsou například zdokonalování samotného LHC, spolupráce na mezinárodním lineárním urychlovači v Japonsku nebo zkoumání velmi intenzivních neutrinových svazků v americké Fermiho národní laboratoři (Fermi National Accelerator Laboratory – Fermilab).

from ***KopalniaWiedzy.pl***
13 November 2013
Fizycy marzą o następcy LHC
Jak zauważają niektórzy fizycy obecnie pieniądze przeznaczane są na rozbudowę LHC, który przez najbliższe dwa lata będzie udoskonalany tak, by osiągnąć maksymalne energie zderzeń, planowana jest budowa International Linear Collider w Japonii, a fizycy z USA skupiają się na wykorzystaniu bardzo intensywnych strumieni neutrino generowanych w Fermi National Accelerator Laboratory.

from ***El Diario Montanes***
12 November 2013
«La nueva búsqueda del Acelerador de Partículas será la Materia Oscura»
Digamos que los aceleradores de tipo drónico, como el LHC, son esenciales para lograr grandes energías con las que hacer descubrimientos. El ILC trabajará para hacer medidas finas; aunque también podría alumbrar descubrimientos. Para entendernos, podríamos estudiar el propio Higgs con mucho más detalle.

from ***Science Guide***
6 November 2013
Kernonderzoek met Europees smaakje
Wat is de toekomst van het fameuze CERN? Heeft het een antwoord op de plannen voor de International Linear Collider die hoogstwaarschijnlijk in Japan gebouwd gaat worden? De Japanse overheid is bereid de helft van de kosten voor zijn rekening te nemen, dus er komt flink beweging op dit terrein op wereldschaal.

CALENDAR

Upcoming events

P5 Workshop on the Future of High Energy Physics
Brookhaven National Laboratory, Upton, NY
15- 18 December 2013

ILC Tukusui Workshop 2013
KEK
17- 19 December 2013

Upcoming schools

Eighth International Accelerator School for Linear Colliders
Antalya, Turkey
04- 15 December 2013

Joint Universities Accelerator School (JUAS)
Archamps, France
06 January- 14 March 2014

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1312.0931
Probing Scotogenic Effects in e+e- Colliders

1311.7240
Diphoton plus Z production at the ILC at O(α4)

1311.7155
Potential Precision on Higgs Couplings and Total Width at the ILC

1311.6661
Higgs Phenomenology in the Minimal Dilaton Model after Run I of the LHC

1311.6528
Measurement of Higgs couplings and self-coupling at the ILC

1311.6465
A New Method for the Spin Determination of Dark Matter

1311.4323
Weighing the Light Gravitino Mass with Weak Lensing Surveys

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AROUND THE WORLD

Power napping for detectors

CLIC is looking at silicon capacitors to help with power pulsing

Barbara Warmbein | 5 December 2013

Power pulsing tests, small scale – Cristian Fuentes' lab at CERN.

If physicists had it their way, detectors of the future would be powered with air. They want no material and no electronic noise to disturb their measurements. Powering by air isn't a realistic option, so electrical engineers are tackling the challenge, putting a lot of effort into keeping noise down and material out. One of them is Cristian Fuentes at CERN. His latest project: power pulsing for the CLIC detector.

Using a power-pulsing scheme, the CLIC detector, much like the ILC detectors, could save space that would otherwise have to be set aside for cooling mechanisms. Operating electronics produce heat, which would have to be carried away to keep the detectors operational; electronics on stand-by don't, at least not as much. Of course the CLIC bunch structure is different to that of the ILC, but the fundamental ideas – and the challenges – are very similar. The detector has to function when collisions happen, but can go to micro-sleep in the microsecond-periods of calm in between. This means that less heat is produced, so less heat has to be dissipated, which in turn means that the mass needed for cooling can be reduced.

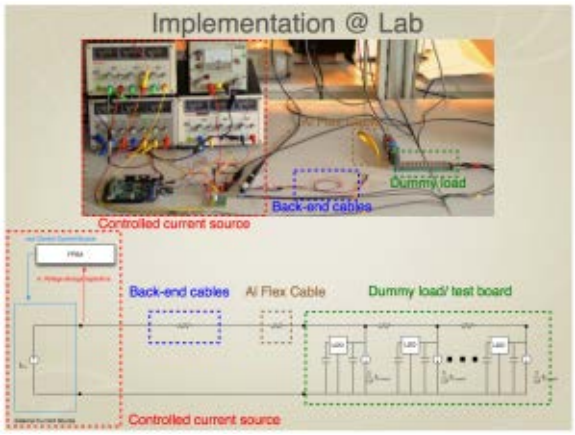
After completing his PhD in electronic engineering on DC-DC converters for the trackers of the High Luminosity Large Hadron Collider – CERN (HL-LHC) experiments, Cristian Fuentes joined the Linear Collider Detector group at CERN as a research fellow to help them with their power-pulsing. There already are detector prototype chips, the CLICpix chip, for example, that can take care of their own status, meaning they gather all the data and then go back to an idle state before the next collisions happen. However, they still have to get their power from somewhere, and Fuentes is investigating a solution based on capacitors – a kind of tiny rechargeable battery – built into the detector structure. "I am trying to find the best capacitors and the best way to charge them again," says the Chilean.

The detector structure, much to the regret of collision-curious particle physicists, consists of more than just the detector itself. Readout infrastructure, mechanical support and cables all add to the material budget that could otherwise be used for more collision-relevant detector material. So the idea is that the required elements to power the detectors should be as small as possible. Cooling is a potential space eater as well, so the idea is to cool the capacitors and the rest of the electronics with air. All this intricate interplay of factors poses challenges that Fuentes is trying to tackle in a lab at CERN.

"The energy will be stored in the capacitors, but other elements are needed to distribute the power to the detector chips. For instance, cables are needed to provide the current to the capacitors and voltage-regulators to provide the constant voltage that the detector chips require," explains Fuentes.

His most difficult challenge at the moment is to keep the material of all these elements as low as possible. For instance, in order to

reduce the impact of the cables, their traditional material, copper, will be replaced by aluminium. This, for example, reduces the cable mass by a factor of four, which makes aluminium more attractive than copper for particle physics usage. As this is not the standard procedure in the industry, flexible printed circuit board (PCB) prototypes were built at CERN to evaluate their behaviour.



The setup explained.

In a similar way, other capacitor technologies were evaluated beside conventional technologies like ceramic capacitors. One of these technologies are silicon capacitors, which showed good performance and low material contribution. Fuentes tested a setup of several silicon capacitors, aluminium flexible PCBs and voltage regulators in the lab and found that the principles of the proposed solution work.

“With today’s technology, we are at the limit of CLIC material requirements,” says Fuentes, “but I am sure that the technology will evolve and that by the time these detectors are actually built we will fulfil the design goals set today.”

His next step is to find the best way to stack up and interconnect the power elements – PCBs, capacitors and voltage-regulators – to the CLICpix chips. This requires the study of new 3D packaging technologies.

CERN | CLIC | DETECTOR R&D | POWER PULSING

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DIRECTOR'S CORNER

November in Paris: ILC prepares for Horizon 2020

Brian Foster | 5 December 2013

Cryomodule assembly at CEA, Saclay, France. (Image: DESY/ILC, photographer: Heiner Müller-Elsner)

While not quite having the poetical resonance of April, nevertheless November in the French capital has many charms. Researchers from all over the world experienced these last week. From Wednesday to Friday, more than 80 people met at Saclay to discuss R&D efforts for both the ILC detectors and the accelerator. The “Irfu Linear Collider Days”, expertly organised by Maxim Titov and his committee, concentrated on French activities and plans for the first two days, opening up to the rest of the world on Friday.

On Friday morning, head of CEA-Irfu Philippe Chomaz welcomed delegates from France, Germany, Italy, Japan, Norway, Spain, UK and the US. Marc Winter stood in for CNRS/IN2P3 director Jacques Martino, who was in Poland, and reiterated this welcome and the importance that the ILC has in the French Roadmap for particle physics. During the morning, the large countries reported on activities in both machine and detectors. During the lunch break Eckhard Elsen from DESY and I were treated to a private tour of the European XFEL cryomodule construction “village” on the Saclay site. With Olivier Napoly as our expert guide, we were able to see for ourselves the impressive facility that has been constructed from the buildings of a nuclear physics facility. Our group at DESY has been involved in the characterisation of the cavities that are here built into cryomodules, so it was fascinating to see the complex procedure that is already producing modules with fantastic performance. While not yet fully in production mode, the Saclay assembly line has already produced a module whose performance exceeds that required for ILC, a remarkable achievement considering that the specification for the cavities and cryomodules for XFEL is much less than required for ILC.

On Friday afternoon the meeting relocated to LAL in Orsay, just down the road from Saclay, for a smaller meeting organised by me, as European Director of the LCC, and Juan Fuster, the Chair of the ECFA study on the physics and detectors for a linear collider. The purpose of the meeting was to discuss the possibilities for obtaining funding for ILC-related activities from the new European scientific-funding framework, Horizon 2020 (H2020), which takes over next year from the current scheme Framework 7 (FP7). Having been successful in several projects in FP7, it is important to understand the new framework for European funding and how to maximise our chances of success. We were very grateful that Svet Stavrev, head of CERN’s European Projects Office, could give us a comprehensive introduction to the H2020 programme and also give us some recommendations of what seemed to be the most suitable thematic areas towards which we should tailor our applications. Around 30 people drawn from the main meeting listened to Svet and to a subsequent sequence of talks illustrating the main areas of activity going on inside Europe.

I summarised the situation for the accelerator, where a number of possible areas could be proposed, in particular to modify specific items of the design in the Technical Design Report to optimise it for the actual site now chosen in Japan. Most of the talks were however concerned with the technologies being developed for the two detector concepts. There was a useful discussion at the end of the meeting to try to map out a strategy for the future in response to the calls for H2020 proposals, which are due early this month. Three different opportunities were identified for ILC detector and physics proposals: one would be participation within the new AIDA II proposal; a second in the *Marie-Curie Innovative Training Networks* in cooperation with the theoretical community and finally a third to

explore cooperation with the accelerator community to study site-specific issues. Several meetings will be organised in the New Year to put some detail on the general themes worked out at the meeting.

I was able to take advantage of the meeting to have some very helpful and informative discussions with both Jacques Martino from CNRS/IN2P3 and with Phillipe Chomaz and Ursula Bassler from CEA-Irfu. I was gratified by their very positive attitude towards ILC and look forward to working with them closely in the future as we move towards implementation of the ILC. Next week I attend the Communication and Policy development for Research Infrastructures in Europe (CoPoRI) meeting organised by the ESFRI group that supervises European involvement in large research infrastructures. The ILC is on the ESFRI Roadmap by virtue of its place on the CERN Roadmap and I look forward to discussions with colleagues on how we can take the next steps. Often the most important and productive results are obtained in the corridors and coffee breaks of such gatherings. I will also get advice from our European Commission contact on how to build on our conclusions from the Paris meeting. Our meeting in Paris, following on from similar recent ones in the UK and Germany, is an important building block in constructing a strong European contribution to the ILC project.

CEA-IRFU | EUROPEAN UNION | EUROPEAN XFEL | FRANCE | H2020 | HORIZON 2020

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IMAGE OF THE WEEK

First full-size ILC cryomodule assembled at KEK's STF test facility

Image: Nobuko Kobayashi | 5 December 2013

The image shows the assembly work of the cold mass for an ILC cryomodule in the superconducting rf test facility (STF) at KEK. Since the STF tunnel has a limitation for the size of the components to bring in, only half-size modules could be assembled before. STF now is equipped with new assembly facility in the tunnel, and this will be the first full-size ILC cryomodule to be assembled at KEK. This cryomodule will have a beam position monitor and a superconducting quadruple magnet in the centre, planned to be completed in December. In January, scientists will connect another half-size cryomodule, and start the cooling test in June.