LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

SLIDESHOW

Impressions from the 2013 Linear Collider Workshop in Tokyo

Images: Nobuko Kobayashi / KEK

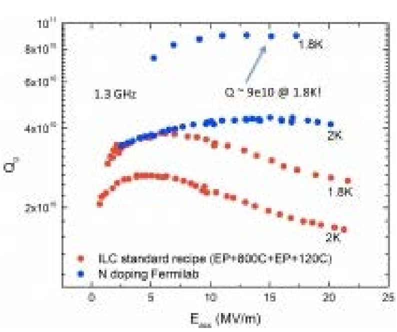
Did you miss last week's International Workshop on Future Linear Collider LCWS 2013 but wish you'd been there? Or were you one of the over 300 participants who discussed the physics case for a high energy linear electron-positron collider at the University of Tokyo? Whatever your motivation, here is a slideshow with some impression from the intense five-day meeting. Accelerator experts and detector developers reviewed progress of the designs of ILC and CLIC and their detectors, looked closely at the latest Higgs results from the LHC and discussed possible future scenarios for turning the linear collider into a real project with a host.

AROUND THE WORLD

'A little dirt never hurt'

Fermilab researchers may have found an unexpected way to improve SRF cavity performance: adding impurities

by Julianne Wyrick



After years of pursuing purity in the niobium material used to make superconducting radiofrequency cavities, a Fermilab team led by Anna Grassellino has found that baking cavities to introduce certain impurities may improve the cavity performance. The new method may provide a way for ILC-type cavities to reach up to three times higher quality factors—enabling more cost-effective accelerators.

DIRECTOR'S CORNER

Planning for the future of the US high-energy-physics programme

by Mike Harrison

The US Department of Energy High Energy Physics Advisory Panel is currently in the process of updating the 2008 US High Energy Physics roadmap. The Committee will produce a draft report by early March 2014 and a final report by May. Mike Harrison, Associate Director for the International Linear Collider, explains the context and possible outcome, for the ILC, of this roadmap.

IN THE NEWS

from *Phys.org*
18 November 2013
Beyond the Higgs boson: Five reasons physics is still interesting
Still in the dark. With the discovery of the Higgs, the crucial final piece of physicists' cosmic jigsaw known as the Standard Model has been put in place. However, there is plenty still to play for in particle physics.

from *Phys.org*
14 November 2013
SLAC-designed chips empower X-ray science
In addition to its work on chips for LCLS detectors, the team built chips for the Fermi Gamma-ray Space Telescope, which has 16,000 ASICs of nine different designs on board. Now, the group is building chips for SLAC's Stanford Synchrotron Radiation Lightsource; the CERN particle physics lab in Europe; nEXO, the next phase of the Enriched Xenon Observatory experiment; and the planned International Linear Collider project.

from *Nature*
12 November 2013
Physicists plan to build a bigger LHC
Some physicists caution that the VLHC would be only a small part of the global particle-physics agenda. Other priorities include: upgrading the LHC, which shut down in February for two years to boost its energies from 7 TeV to 14 TeV; plans to build an International Linear Collider in Japan, to collide beams of electrons and positrons as a complement to the LHC's proton findings; and a major US project to exploit high-intensity neutrino beams generated at the Fermi National Accelerator Laboratory in Batavia, Illinois.

from *Wired*
11 November 2013
The Experiments Most Likely to Shake Up the Future of Physics
The ILC could produce huge numbers of Higgs bosons, allowing scientists to precisely probe its properties. It might also uncover other anomalous events, which could test many exotic theories beyond the Standard Model. Assuming that final designs are approved and funded (and this is far from certain), the ILC could start construction in 2016 and be completed 10 years later.

from *The Guardian*
10 November 2013
Bigger, faster, stronger: stepping up the hunt for cosmic building blocks
"It may be that we will need a machine that is more precise although less energetic," added Heuer. "In that case, a linear device – a long, straight tunnel – through which lighter particles like electrons are accelerated might be better. Until we get more results from the LHC we cannot be sure. However, we have to be prepared and we are looking at possible designs for both types of machine."

from *Sankei Shimbun*
9 November 2013
「絶好球」に腰を引くのか
社会への波及効果を考えると、　　　は今の日本にとって「ど真ん中」の好球にみえる。ただし、球質　財政負担　は重い。誘致の最終判断は慎重に下すべきだが、腰の引けた消極的な姿勢では、まともに打ち返すことはできまい。凡打になることを恐れて「絶好球」を呆然　ぼうぜん　と見送るのは、なお悪い。(Considering the spillover effects to the society, the ILC seems like the pitched ball right down the middle, but the ball is heavy. For the decision weather Japan should bid on the ILC should need very careful consideration, but if you are up in the batter's box with coward attitude, you never be able to hit the ball. Looking over this golden opportunity by fear of the mishit will be even worse.)

from *Science 2.0 Blog*
4 November 2013
P5, Planning and prioritizing the next decade of American particle physics.
Physics cases were made for American participation in the international linear collider (ILC). There are many sound scientific reasons to build the ILC and for the USA to take an active part in the project even if it is not built here. [...] "The physics case rest on the fact that the ILC is a scaling up of existing technologies to achieve interesting new results." As Michael Peskin more or less put it, we know how to build something like the ILC right now. Furthermore there is international political support for building the ILC. That may not ever be the case again unless we do it now. Taking part in the ILC has the advantage of sharing the cost, and risk across many nations. Legislators, the ones who will really have the final say in whatever is done, as they ultimately control the funding, will like that aspect.

from ***Mainichi Shimbun***
30 Oct 2013
国際リニアコライダー:外国人が住みやすい街に　推進団体、知事に提言書
「国際リニアコライダー」　の北上山地への誘致に向け、奥州市在住の外国人でつくる「インターナショナル　サポート委員会」は　日、県庁で達増拓也知事に、外国人が暮らしやすい環境に関する提言書を手渡した。(Toward the realization to invite the ILC to the Kitakami area, the group od foreign residents in Oshu city submitted the recommendation on the environmental consoderation for foreign researchers to Tasuya Tasso, governor of Iwate prefecture.)

ANNOUNCEMENTS

Reminder: European ILC informal discussion

Last week's issue of NewsLine announced a wrong date for the "Informal Discussion" to take place in conjunction with the French Linear Collider days. The meeting will take place on Friday, 29 November from 14:00 to 18:00 h at LAL Orsay. A special Indico page has been set up for this event.

CALENDAR

Upcoming events

French IRFU Linear Collider Days (jointly with CNRS)
CEA Saclay, France
27- 29 November 2013

ILC Tukusui Workshop 2013
KEK
17- 19 December 2013

Upcoming schools

Eighth International Accelerator School for Linear Colliders
Antalya, Turkey
04- 08 December 2013

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1311.3761
Performance of the first prototype of the CALICE scintillator strip electromagnetic calorimeter

1311.3505
Shower development of particles with momenta from 1 to 10 GeV in the CALICE Scintillator-Tungsten HCAL

1311.3397
The International Linear Collider

1311.3305
Future Electron-Positron Colliders and the 4-Dimensional Composite Higgs Model

1311.2890
Investigation into Electron Cloud Effects in the ILC Positron Damping Ring

1311.2647
The Higgs Bridge

1311.2543
Parallel Universe, Dark Matter and Invisible Higgs Decays

1311.2248
A measurement of the total cross section of σZh at a future e+e− collider using the hadronic decay mode of Z

1311.1906
A practical GMSB model for explaining the muon (g-2) with gauge coupling unification

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SLIDESHOW

Impressions from the 2013 Linear Collider Workshop in Tokyo

Images: Nobuko Kobayashi / KEK | 21 November 2013

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[Show as slideshow]
















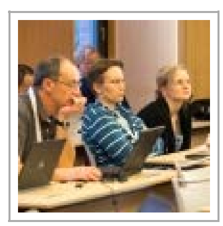
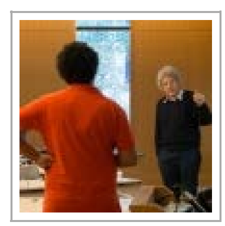
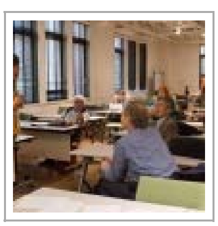




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LCWS | LCWS13

ILC NEWSLINE
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AROUND THE WORLD

'A little dirt never hurt'

Fermilab researchers may have found an unexpected way to improve SRF cavity performance: adding impurities

Julianne Wyrick | 21 November 2013

An SRF cavity entering the furnace where it will be baked with nitrogen or argon. Photo courtesy of Anna Grassellino

Like a jeweler hunting for a flawless diamond, for years, researchers have pursued purity in the niobium material used to make superconducting radiofrequency (SRF) cavities. But a team at Fermilab recently discovered that adding a bit of impurity may actually improve cavity performance.

This year, a team led by Fermilab scientist Anna Grassellino found that baking niobium SRF cavities at high temperatures with gasses such as nitrogen or argon caused the cavities' quality factors (Q) to double or triple and to increase with gradients, a phenomenon opposite to what had been seen in the past. Grassellino thinks this phenomenon may be due to nitrogen or argon atoms — impurities — that diffuse into the niobium. Introducing the impurities through such a bake may provide a way for ILC-type cavities to reach high Q at high gradient—enabling more cost-effective accelerators.

"It's kind of interesting because, for many years, SRF has chased the idea of purity," Grassellino said. "While it is true that purity of the niobium bulk is crucial for reaching high gradients, we are now discovering that you need a little bit of dirt at the very surface of the niobium cavity — the first tens of nanometres — to actually improve the cavity quality factor."

Q refers to how well a cavity stores energy. If an SRF cavity has a higher Q, it requires less radiofrequency power to achieve a certain gradient. Gradient refers to the energy transferred to a particle over a certain distance. High Qs help accelerators save on costs needed for the machine's cryogenics, or refrigeration, system, which is used to dissipate heat created by radiofrequency power. High gradients reduce costs by keeping accelerators compact.

In the past, cavity Q has been known to decrease as gradient is increased — a limitation known as medium-field Q slope. But Grassellino found that baking SRF cavities at 800 to 1000 °C with nitrogen or argon causes Q to increase as gradient is increased – basically a reversed medium-field Q slope.

Grassellino came across this finding unexpectedly: She was hoping to use the high-temperature bake with nitrogen gas to convert niobium cavities to niobium nitride cavities. Instead of bonding with the niobium to form a new compound, the nitrogen atoms appeared to enter the cavity wall and take up residence in empty spaces in the niobium's crystal structure — basically just foreign atoms in an otherwise niobium cavity. Grassellino saw the same effect when she baked cavities with argon gas.

Surprisingly, the impurities have a beneficial effect: The addition of foreign atoms appears to lower the surface resistance of the cavities, which in turn increases Q.

“As often occurs in the physics world, we accidentally found a cure for medium-field Q slope,” said Grassellino, who recently published a paper on the finding.

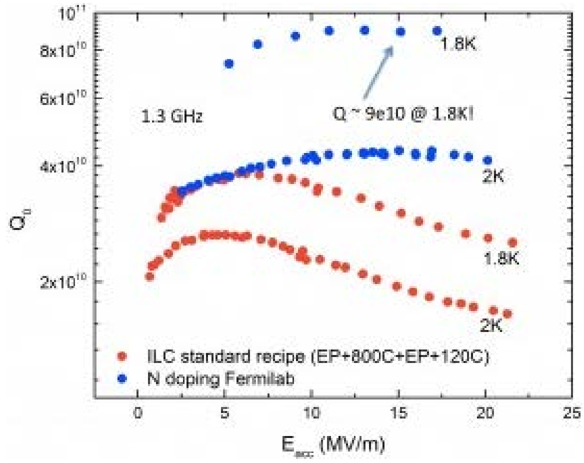
Of several single-cell, ILC-type cavities that Grassellino put through the bake, each reached a Q ranging between 3.5 $\times 10^{10}$ and 7 $\times 10^{10}$ at a temperature of 2 kelvins and a gradient of around 20 megavolts per metre. These Qs are two to three times higher than those of cavities treated with the standard ILC procedure. The same results were also achieved on a nine-cell cavity.

Increasing Q by adding impurities will be a big help for machines in which refrigeration costs are the main concern, according to Hasan Padamsee, former group leader of SRF at Cornell University.

“This treatment would have a big impact on a continuous-wave machine like LCLS-II,” Padamsee said, referring to the upgrade of SLAC’s Linac Coherent Light Source, a powerful X-ray laser. This type of machine requires high Q at medium accelerating gradients to keep refrigerator size, and costs, low.

“The gas-bake process is currently the best candidate treatment for achieving a Q high enough that LCLS would need only one cryoplant to cool it,” Grassellino said.

While achieving high gradient provides the most cost savings for a machine like the ILC, achieving both high gradient and high Q would be even better. In addition to refrigeration savings, increasing Q could lower ILC production costs by increasing cavity yield – or the fraction of cavities that meet the minimum Q – according to Anthony Crawford, a physicist in Fermilab’s Superconducting Materials Department.



The red data points show cavity Q decreasing with increased gradient, the “medium-field Q slope” phenomenon observed for standard ILC cavities in the past. The blue data points show cavity Q increasing with increased gradient, the reverse medium-field Q slope phenomenon seen after adding impurities. Image courtesy of Anna Grassellino

“If the cavity Q is too low, then the cavity must be reprocessed or eliminated from the production stream,” Crawford said. Also, higher Q – less power dissipation – means lessening heating effects, which could significantly improve the cavity yield, thereby lowering production costs for the ILC linacs. Adding impurities at the very surface might turn out to be the key to do it.

Grassellino, together with Alexandr Romanenko from Fermilab’s SRF Materials Department and the lab’s Cavity Processing Group, led by Allan Rowe, are already working toward optimised recipes by playing with bake temperatures, times and partial-pressure regimes. A collaboration working toward the LCLS-II optimised recipe is ongoing. Matthias Liepe at Cornell University and Charlie Reece at Jefferson Lab lead those institutions’ participation in this effort.

“These findings already provide a better processing recipe for the many continuous-wave accelerators planned worldwide,” Grassellino said. “Once we optimise the bake parameters, we might score and basically end up with a recipe for high Q at even higher gradients, which might become the new recipe of preparation for the ILC cavities and other projects at the forefront of SRF technology.”

CAVITY GRADIENT | FERMILAB | HIGH-GRADIENT CAVITY | MEDIUM-FIELD Q SLOPE | QUALITY FACTOR | SRF CAVITY | SRF TECHNOLOGY | SUPERCONDUCTING CAVITY

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DIRECTOR'S CORNER

Planning for the future of the US high-energy-physics programme

Mike Harrison | 21 November 2013


Steve Ritz, chair of the P5 committee. Image: Fermilab Visual Media Services

The US High Energy Physics (HEP) programme is presently guided by a roadmap put together in 2008 by US Department of Energy (DOE) High Energy Physics Advisory Panel (HEPAP). Since that time the global HEP situation has continued to evolve in regards to both the physics (most notably the Higgs boson) and international HEP planning (the 2013 European strategy for particle physics update, the Japan Association of High Energy Physicists (JAHEP) report in 2012). The US has also started to update its 2008 plan, and these activities are in their final phase with the start of the so-called P5 process. Strategic planning began in the beginning of 2013 with the HEPAP facilities subpanel report. This process was part of the DOE Office of Science review of possible facility initiatives (over 100 million dollars) over the upcoming decade. The panel assessed the science goals and construction readiness but did not rank the priorities.

Both the ILC accelerator and detectors were on this list and deemed ready for construction. During past year the US HEP community has performed an in-depth evaluation of the physics landscape via the Snowmass process. The results have been reported in LC NewsLine by Hitoshi Murayama, so I will not repeat them here, but suffice to say that the ILC physics goals were strongly endorsed. The remaining step in formulating a strategic plan requires consolidating the potential facilities and science goals with the anticipated resources, or in other words, establish programme priorities. This final step is the job of the Particle Physics Project Prioritisation Panel (P5) and has recently gotten under way under a charge from HEPAP “to develop an updated strategic plan for US high energy physics that can be executed over a 10-year timescale, in the context of a 20-year global vision for the field”, along with several other goals.

A critical aspect of this planning process is the anticipated resources which will be available to implement the HEP programme. This information is provided by the DOE Office of Science and forms a framework for the prioritisation since scientific opportunities and project concepts greatly exceed budget constraints. The budget scenarios under consideration involve two somewhat different options of flat funding for three years and then inflation, together with a more flexible model that effectively poses the question of “tell how much it costs to pursue the compelling physics”. Unquestionably, establishing a coherent programme in the two relatively flat budget scenarios is the most difficult task for P5.

HEP is of course a global activity these days, and any proposed US programme must be viewed in the international as well as domestic context. Likewise there must be a balance between short-term achievements and long-term goals.
Obviously there is no “correct” answer to a strategic planning exercise but rather the need for wisdom and balance in the formulation of a plan. There are 24 members of the P5 committee (chaired by Steve Ritz, UC Santa Cruz) who will perform this delicate task. The committee has been formed and will have three main community town-hall-style meetings. The first one took place at Fermilab in early November. The other two meetings will be held later this year at SLAC and Brookhaven National Laboratory. The latter venue will

contain several hours of discussion on the ILC in Japan as part of the energy frontier deliberations. Our ability at this time to accurately convey the global situation in regard to the ILC will be important even though events can move quickly. The committee will produce a draft report by early March 2014 and a final report by May. The progress of P5 can be monitored on usparticlephysics.org/p5 .

ILC R&D | P5 PANEL | SNOWMASS | US