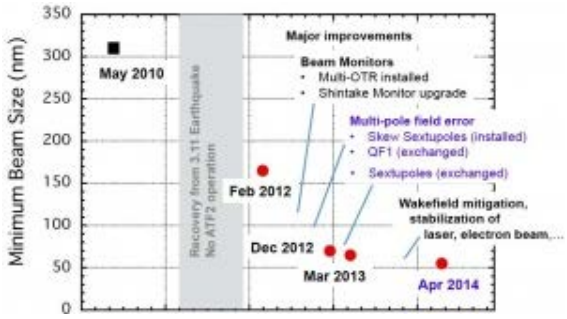
NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

FEATURE



How small can you go?

ATF2 breaks beam size records

by Nobuko Kobayashi

The world's smallest ever beam size of 55 nanometres was achieved by the ATF2 facility at KEK, reported Nobuhiro Terunuma at the AWLC workshop held at Fermilab. And what is more, the results are reproducible, which means that for the ILC, a recovery after a short break would be no issue.

DIRECTOR'S CORNER

ILC is big in the US P5 process

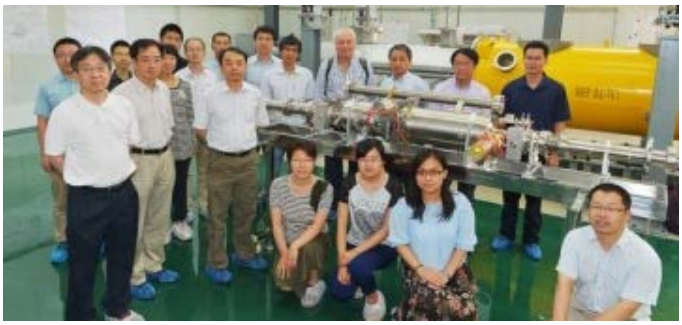
by Hitoshi Murayama

The ILC came away as a big winner in the P5 process, says LCC Deputy Director Hitoshi Murayama. He gives his take on the importance of the report and its expected positive impact on the ILC in this week's Director's Corner.

AROUND THE WORLD

LCC Director Lyn Evans visits IHEP

by YiLin Liu



During a recent visit to IHEP in China, an LCC delegation discussed China's role in the ILC project, including how China is going to participate, what China is going to contribute and who is going to join the project, with scientists from IHEP and Chinese universities. They also visited IHEP's ILC 1.3 GHz superconducting accelerator module.

IN THE NEWS

from *Fermilab Today*
17 June 2014
P5 committee members address questions on report
The majority of the questions fielded were about the P5 report's recommendation to form a new international collaboration that would build a long-baseline neutrino facility at Fermilab.

from *Deutsche Welle*
14 June 2014
CERN: The quest for dark matter
In the coming years, CERN researchers in Switzerland want to generate never-before seen components of matter in their particle accelerator to solve one of astrophysics biggest mysteries: the nature of dark matter.

from *Kahoku shinpo*
3 June 2014
一関市、　　誘致を　　宮城県北　市に看板
岩手県南と宮城県北にまたがる北上山地が候補地になっている超大型加速器「国際リニアコライダー　　」誘致の機運を高めようと、岩手県一関市は宮城県北の自治体と連携し、同県に　　看板を設置する。設置するのは宮城県気仙沼、登米、栗原、大崎　市各　カ所の国道沿いなど。(Iwate prefecture's Ichinoseki city government cooperates with 4 cities in Miyagi prefecture, Kesen-numa, Tome, Kurihara, and Osaki, in the effort to invite the ILC to the region, put up the ILC sign board along side the road.)

from *symmetry magazine*
12 June 2014
Researchers imagine the accelerators of the future
At the LHC Physics Conference in New York, experts looked to the next steps in collider physics.

from *Fermilab Today*
12 June 2014
Hasan Padamsee takes over as head of Technical Division
Now, the man who literally wrote the book on superconducting radio-frequency technology is leading Fermilab's Technical Division and the laboratory's SRF program.

from *Scientific American Blog*
9 June 2014
Physicists Look Beyond the Large Hadron Collider, to the Very Large Hadron Collider
Physicists see both the LHC v3.0 and the ILC (or a like contraption) as essential follow-ups to their recent discoveries. Both machines would perform extra-high-precision measurements to check whether the Higgs is playing its intended theoretical roles.

from *IHEP*
9 June 2014
9-cell Cavity Clean Room Assembly Completed for the IHEP 1.3 GHz ILC Test Cryomodule
The clean-room assembly of a 1.3 GHz ILC 9-cell superconducting RF cavity in a test cryomodule was completed at IHEP on May 23rd 2014.

CALENDAR

Upcoming events

5th International Particle Accelerator Conference (IPAC'14)
Dresden, Germany
15- 20 June 2014

37th International Conference on High Energy Physics (ICHEP 2014)
Valencia, Spain

PREPRINTS

ARXIV PREPRINTS

1406.4313
Physics highlights at ILC and CLIC

1406.3636
Polarisation and Beam Energy Measurement at a Linear e+e− Collider

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

Upcoming schools

The 2014 European School of High-Energy Physics
Garderen, the Netherlands
18 June- 01 July 2014

View complete calendar

1406.3294
Fingerprinting non-minimal Higgs sectors

1406.2496
Search for anomalous quartic WWZγ couplings at the future linear e+e− collider

1406.2236
Radiative corrections to the Yukawa couplings in two Higgs doublet models

1406.1394
tanβ determination from the Higgs boson decay at the International Linear Collider

1406.1221
Spin-One Top Partner: Phenomenology

1406.1181
Light Neutralino Dark Matter: Direct/Indirect Detection and Collider Searches

1406.0517
Electroweak Baryogenesis, Electric Dipole Moments, and Higgs Diphoton Decays

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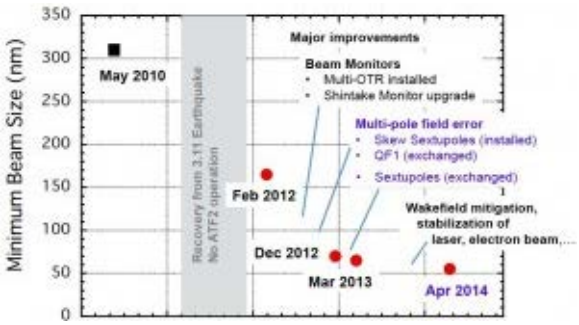
FEATURE

How small can you go?

ATF2 breaks beam size records

Nobuko Kobayashi | 19 June 2014



History of the minimum beam size achieved at ATF2

The Americas Workshop on Linear Collider 2014 was held at Fermilab just before the approval of the P5 report, which contains the positive message calling for US participation in the planned International Linear Collider (ILC), should the project commence (see 22 May issue of LC NewsLine).

In the workshop, there were many presentations on technical advancements which might lead ILC to the favorable position mentioned in the P5 report. One of the examples of such presentation was “ATF2 Status & Plans” by Nobuhiro Terunuma, a scientist at KEK, Japan.

ATF2 is a final-focus test beamline which squeezes the beam of electrons to nanometre size. This is a very important technology for efficient collisions of particle beams. There are two main goals at ATF2. Goal one is to produce and confirm the small beam size, and another is to produce and confirm the stable beam.

For the goal one, the result of the beam size of 55 nanometre, the world smallest size ever, was presented.

The target beam size at the ATF is 37 nanometres. Because of the difference in the beam energy, 37 nanometre at ATF will correspond to 5 nanometres at the ILC, the specification for the ILC design. After the recovery from the damage caused by the earthquake that occurred in March 2012, scientists initially succeeded to squeeze the beam down to 160 nano metres. Since then, a further reduction in beam size has been achieved at virtually every attempt.

Terunuma said there were two major contributing factors for the remarkable result. “ One of the biggest factors is that we have more control over the stabilisation of the beam orbit. The development on the study of wakefield mitigation also made a difference.” As bunches of particles fly through the accelerator pipes, electromagnetic wakes will be excited. These wakefields kick the beams, and disturb their orbit. This may deteriorate the beam quality, therefore intensive studies on wakefield mitigation are going on.

“Achieving the small beam size is of course impressive. But what impressed me even more was the demonstration that these very small beam sizes can be quickly re-established after a downtime — even over the weekend!” said Nick Walker, the global leader of accelerator design and integration group at the Linear Collider Collaboration.

In the previous experiment, squeezing the beam size usually took time, making the beam smaller to smaller gradually. It sometimes has taken months to squeeze down the beam. Now at the ATF2, the nano-size beam can be realised within a week.

“This is extremely important, since it shows that, even if it takes some time to slowly tune the beam size down (luminosity up), we can recover that point relatively quickly after a short shutdown, providing of course nothing significant changes in the accelerator,” said Walker.

ILC plans to adopt a “push-pull” scheme, switching between two detectors to allow the operation of both detectors at one interaction region, and this requires the short shutdowns to move the detectors in and out. “These results at ATF2 give us some hope that we can quickly recover the luminosity after doing a push-pull, and will not have to start from zero again, providing of course we keep temperatures stable inside the accelerator tunnel,” said Walker.

The experiment at the ATF2 is ongoing, and they are producing records of further smaller size beams. New result will be presented at the 37th International Conference on High Energy Physics (ICHEP) to be held from 2 to 7 July in Valencia, Spain.

ATF2 | AWLC2014 | FINAL FOCUS | JAPAN | KEK | REFERENCE DESIGN

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DIRECTOR'S CORNER

ILC is big in the US P5 process

Hitoshi Murayama | 19 June 2014

P5 Committee Chair Steve Ritz, left, addresses a question from the audience at Fermilab's 2014 Users Meeting. Image: Reidar Hahn

The P5 report was approved by the HEPAP meeting on May 22. As a new HEPAP member, I participated in discussions on the report, even though I had to call in from Japan. The news was already covered in the Director's Corner by Harry Weerts and Mike Harrison. But I'd like to write about my take on the importance of the report and its expected positive impact on the ILC.

The High-Energy Physics community in the United States went through a year-and-a-half long process to come up with "*an updated strategic plan for U.S. High Energy Physics that can be executed over a 10 year timescale, in the context of a 20 year global vision for the field*." ILC came out as a big part of the US strategy.

P5 stands for Particle Physics Project Prioritization Panel that reports to HEPAP, the High-Energy Physics Advisory Panel to the US Department of Energy and National Science Foundation. I was on a panel that recommended the creation of P5, which was meant to be a steward of the changing priorities in high-energy physics as new inputs emerge from cutting-edge experiments. However, there has been no P5 since the last panel produced its report in 2008. Meanwhile, the landscape of high-energy physics changed tremendously. A Higgs boson is discovered, the third neutrino mixing angle of θ_{13} is found to be as large as anybody could imagine, while the Large Hadron Collider has not (yet) seen any signs of physics beyond the standard model.

The US community, supported by the Division of Particles and Fields of the American Physical Society, embarked on the "Snowmass process," which in 2013 had a different structure from the past ones. Because the funding agencies did not allow for a monolithic workshop in Snowmass, Colorado, that typically lasted for three to four weeks for everybody to talk to each other, many smaller workshops took place from December 2012 through August 2013 focused on one of the three "Frontiers," Energy, Intensity, or Cosmic. Despite the new structure, the community dreamed, argued, studied, and presented vision of an exciting future for the field.

ILC was discussed heavily in the workshops for the Energy Frontier, together with the physics prospects at the high-luminosity LHC (HL-LHC), CLIC, a muon collider, and future hypothetical circular colliders in a 50- to 100-km tunnel. It was quickly recognised by the community that the ILC is the only viable option besides the HL-LHC in the foreseeable future, thanks to the detailed work on the Technical Design Report (TDR) by the Global Design Effort (GDE) led by Barry Barish. If we keep our eyes on a new collider taking data before 2030, aimed at precision study of the discovered Higgs boson and the top quark as well as searching for new physics from electroweak processes, ILC uniquely fits the bill. Chip Brock, a co-convener for the Energy Frontier working group, concluded, "*This Higgs Boson changes everything. We're obligated to understand it using all tools*." and said, "*To me, it's the ILC.*" William Barletta, representing the Capabilities Working Group added, "*U.S. accelerator community is capable to contribute*" to the ILC and "*We are experienced & ready to do it.*"

The P5 took over where the Snowmass process left off. The Snowmass process is a grass-roots process, dreaming what the

community wants to do, without a reality check on what programme would fit within the anticipated budget envelope. P5 had to face the funding reality and make difficult choices. It was given three budget scenarios, A, B, and C. The scenario A is quite gloomy. B is better but still tight. C is "*unconstrained*" but within reason. I couldn't help notice that this is the opposite order from grades I give to students when I teach in Berkeley. I smelled trouble.

Yet, Steve Ritz from UC Santa Cruz did a fantastic job in responding to the charge. He as the chair of P5, together with the HEPAP chair Andy Lankford from UC Irvine, assembled a committee of excellent scientists, including two from Europe and two from Japan. It is remarkable that they came up with their report based on *consensus*. Steve told me that they kept discussing recommendations until there was no single person against. This time-consuming process was successful. Amazing.

The P5 report has 29 (!) recommendations. But the report is relatively short and crisp, and it is definitely worth reading. As clear from the title, "*Building for Discovery — Strategic Plan for U.S. Particle Physics in the Global Context*", it correctly emphasises the global nature of our field. It lists five science drivers:

- Use the Higgs boson as a new tool for discovery
- Pursue the physics associated with neutrino mass
- Identify the new physics of dark matter
- Understand cosmic acceleration: dark energy and inflation
- Explore the unknown: new particles, interactions, and physical principles.

In view of these science drivers, they commented on various collider options. For obvious reasons, they said "*The LHC upgrades constitute our highest-priority near-term large project.*" They also recommended to "*Pursue accelerator R&D with high priority at levels consistent with budget constraints*". On the other hand, they decided to "*Reassess the Muon Accelerator Program (MAP)*."

The report evaluated the physics case of ILC to be "*extremely strong*." In particular, "*The ILC would then follow the HL-LHC as a complementary instrument for performing these studies in a global particle physics program, providing a stream of results exploring three of our Drivers for many decades.*" The three drivers here refer to discovery through Higgs, dark matter, and the unknown. Remember the funding for the ILC in the U.S. was zeroed out after the completion of the TDR. Concerning this, P5 said "*we plan in all Scenarios for ILC support at some level through a decision point within the next five years*." This is *big*. U.S. can restart investment in the ILC.

Obviously, how much U.S. can contribute to the ILC construction and operation would depend on the budget scenario. Their recommendation on the ILC is very clear and positive. "***Motivated by the strong scientific importance of the ILC and the recent initiative in Japan to host it, the U.S. should engage in modest and appropriate levels of ILC accelerator and detector design in areas where the U.S. can contribute critical expertise. Consider higher levels of collaboration if ILC proceeds.***" I could not have expected a stronger recommendation that this.

Jim Siegrist, the director of the Office of High-Energy Physics (OHEP) of the US Department of Energy, is already at work trying to implement the report. At the Fermilab Users' Meeting on 11 June, Jim said "*The meaning of 'modest' will depend on the HEP budget.*" The initial support will be by redirection of effort. He said it was in general not easy to redirect effort because he had to move people around, yet he would start working on it. The next point was "*The meaning of 'appropriate' will depend on the areas where Japan would like us to help*." His understanding was that the current priority was for site-specific R&D and design, which I believe is true. Finally he said "*We would await further discussions with the Japanese government.*" Actually, the MEXT Minister Shimomura wrote a letter to the Energy Secretary Moniz to discuss the ILC further; it should help keep the ball rolling.

I keep hearing from him and other agency people that the report was received well in Washington DC. The President's budget proposal for OHEP was grim, but the hopes are high that the good reception of the report may result in positive mark-ups in the Congress. More importantly, OHEP can allocate funds to restart the work on the ILC in the US.

Welcome back, USA!

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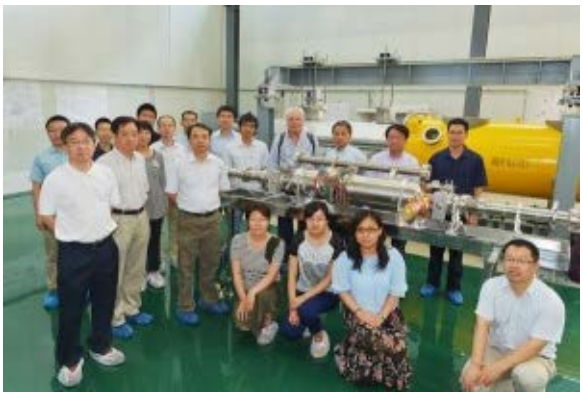
AROUND THE WORLD

LCC Director Lyn Evans visits IHEP

YiLin Liu | 19 June 2014



LCC delegation and ILC group at IHEP (Image: IHEP)

Prof. Lyn Evans, Director of the Linear Collider Collaboration (LCC), visited the Institute of High Energy Physics (IHEP) on June 9th. Accompanying him were Prof. Akira Yamamoto, the LCC Asian Regional Director, and Prof. Hitoshi Yamamoto, the LCC Associate Director for Physics and Detectors. The LCC delegation held a special symposium and participated in the LCC-China International Linear Collider collaboration meeting at IHEP.

During the symposium, Prof. Evans introduced the LCC organization, which consists of both the Compact Linear Collider Study (CLIC) and International Linear Collider (ILC) projects. The LCC aims to coordinate research and development work for the world's next big collider, and to come to a decision as to whether and where it should be built. He outlined the LCC international collaboration structure and the organization and personnel of the ILC accelerator division. Akira Yamamoto reported the possible future physics discoveries at ILC and the technological development of the cutting-edge detectors required. Hitoshi Yamamoto elaborated on the research progress of the key ILC accelerator technologies and the preparatory work for the international construction of the machine.

In the afternoon, the LCC delegation held an in-depth discussion with Chinese physicists from IHEP and various universities. A broad consensus was reached on China's role in the ILC project, including how China is going to participate, what China is going to contribute and who is going to join the project.

After the meeting, the delegation visited the ILC 1.3 GHz superconducting accelerator module which is being assembled at IHEP. Prof. Evans expressed appreciation for the contribution China has made to the superconducting accelerator technology for the ILC, and encouraged the ILC team at IHEP to play a bigger role in the future ILC collaboration.

At the end of their visit, Prof. Zhan Wenlong, Vice-President of the Chinese Academy of Sciences, met with Prof. Evans and his delegation. Prof. Evans introduced recent progress on the ILC project and expressed his hope that China would participate in the construction and future research programme of the ILC. Prof. Zhan then outlined current ideas for the development of high energy physics in China and the Chinese government's positive attitude towards participation in major international scientific collaborations.

Lyn Evans is a former Project Manager for the LHC at CERN. In June 2012, he was appointed the new Linear Collider Director by the International Committee for Future Accelerators.

This story first appeared on the IHEP website.

CHINA | IHEP | ILC R&D | LCC | SCRF