ilc newsline

ABOUT | ARCHIVE | SUBSCRIBE | CONTACT | LINEARCOLLIDER.ORG 14 JULY 2011

FEATURE

How to keep cavities blemish-free

by Rika Takahashi



Worrying about blemishes on the skin is not just an issue for people who pursue personal physical beauty, but also for accelerator scientists. Scientists and engineers at KEK have found a way to deal with unwanted stains on the inner surface of superconducting cavities, which might be one of the causes of performance limitation.

PROFILE

From CERN Bulletin: In conversation with Nobel Laureate Jack Steinberger



Awarded the 1988 Nobel Prize for Physics for his discovery of the muon neutrino, Jack Steinberger recently celebrated his 90th birthday and can still be found in his CERN office on an almost daily basis. If you happened to have a coffee with him… this is what he would tell you: his recollections, and thoughts about the present and future of particle physics.

DIRECTOR'S CORNER

PAC meeting in Taiwan: accelerator recommendations

by Barry Barish



The ILC Program Advisory Committee met at Academia Sinica in Taiwan in May. They made a set of specific comments and recommendations regarding the accelerator R&D programme and GDE plans and progress towards a *Technical Design Report*.

IMAGE OF THE WEEK



Cavity fabrication facility opening ceremony

Image: Nobuko Kobayashi

The opening ceremony of KEK's new Cavity Fabrication Facility (CFF). From left to right: Katsunobu Oide (Director, Accelerator Laboratory), Fumihiko Takasaki (Trustee), Atsuto Suzuki (Director General), Hideo Hirayama (Trustee), Kenji Ueno (Head, Mechanical Engineering Center).

IN THE NEWS

from ***Nature Blogs***
11 July 2011
Committee champions underground science
A proposed underground laboratory would be an important step in addressing three science questions of "paramount importance", says a report released today by the National Academies.

from ***The Guardian***
8 July 2011
Dreams of a Final Theory by Steven Weinberg – review
And even before start-up, there were hints that the answers from the LHC might not suffice: both the Cern Council and the US theoretical physics community have been making a case for an even bigger machine, called the linear collider.

from ***CERN***
7 July 2011
CERN launches Open Hardware initiative
CERN1 has today issued version 1.1 of the Open Hardware Licence (OHL), a legal framework to facilitate knowledge exchange across the electronic design community.

from ***New Scientist***
6 July 2011
Tevatron particles shed light on antimatter mystery
Now researchers at DZero, an experiment at the Tevatron particle accelerator at Fermilab in Batavia, Illinois, have found the largest source of CP violation yet discovered.

CALENDAR

UPCOMING EVENTS

German Linear Collider forum
MPI Munich, Germany
14- 15 July 2011

International Europhysics Conference on High-Energy Physics (EPS-HEP 2011)
Grenoble, France
21- 27 July 2011

The 2nd workshop on SCRF Cavity Technology and Industrialization for the ILC
Sheraton Chicago Hotel & Towers, Chicago, IL
24 July 2011

15th International Conference on RF Superconductivity (SRF2011)
Sheraton Chicago Hotel & Towers, Chicago, IL
25- 29 July 2011

Meeting of the Division of Particles and Fields of the American Physical Society (DPF 2011)
Brown University, Providence, Rhode Island, USA
09- 13 August 2011

Lepton Photon 2011 XXV International Symposium on Lepton Photon Interactions at High Energies
Tata Institute of Fundamental Research, Mumbai, India
22- 27 August 2011

ILC positron collaboration meeting
IHEP, Beijing, China
27 August 2011

POSIPOL 2011
IHEP, Beijing, China
28- 30 August 2011

Supersymmetry 2011 (SUSY 2011)
Fermilab, Batavia, IL
28 August- 02 September 2011

XXXI Physics in Collision (PIC 2011)
Simon Fraser University, Vancouver, Canada
28 August- 01 September 2011

View complete calendar

BLOGLINE

9 July 2011
Brian Dorney
In a World Without Color, Why do I believe in Gluons?

PREPRINTS

ILC REPORT

2011-031
Report of the sixth meeting of the ILC project advisory commitee (PAC)

ARXIV PREPRINTS

1107.1305
One-loop Higgs boson production at the Linear Collider within the general two-Higgs-doublet model: e+e- versus gamma-gamma

Copyright © 2011 ILC-GDE

FEATURE

How to keep cavities blemish-free

Rika Takahashi | 14 July 2011



Comparison of stain forming with sulfuric acid solution (top) and hydrofluoric acid solution (bottom). Image: Motoaki Sawabe

Worrying about blemishes on the skin is not just an issue for people who pursue personal physical beauty, but also for accelerator scientists. Scientists and engineers at KEK have found a way to deal with unwanted stains on the inner surface of superconducting cavities, which might be one of the causes of performance limitation.

Since the development of the Kyoto camera, a high-resolution camera that enables the optical inspection of the inner surface of niobium superconducting cavities, scientists have noticed that brownish stains exist on the cavity walls. When they were vertically tested to evaluate their performance, the stains were sometimes found around the spots where heating is observed.

The inner surface of the superconducting cavities is polished to a mirror-like finish, since any defects of debris inside of cavity will interfere with its performance.

Fabricated cavities are at first coarsely electropolished, then annealed. This is followed by inspection and tuning. It is then given another electropolish finish for micro-level smoothness. Scientists suspected the brown spots probably formed at some point during this procedure.

To understand what they are, Motoaki Sawabe and his colleagues at KEK's STF surface research group decided to reproduce the stain. First, they dripped two microlitres of electropolishing solution on the chemically polished niobium plates. The plates were left for an hour, rinsed with pure water and dried at 50 degrees Celsius. They were able to reproduce the stain, but not every time.

Then they tried the same procedure with two different solutions: one containing sulfuric acid and another with hydrofluoric acid. Both acids are contained in the composition of the electropolishing solution. They found that the stains were only formed with the solution of hydrofluoric acid – the suspected cause of the stain.

So they conducted an elemental analysis using X-ray fluorescence, the method widely used for the investigation of metals, glass, ceramics or building materials. They detected fluorine and oxygen in the stain, which indicated that the stain is an oxide film containing fluorine. The next step was to determine where the oxygen came from. First they suspected that oxygen in the

air was responsible and conducted experiments in a zero-percent oxygen environment purged with nitrogen, but stains still formed.

They then tested the cavities' moisture, suspecting that oxygen comes from water, and – bingo! – the crisp stains were formed. With more detailed investigations, scientists found that the causes of the stain are moisture and vaporised hydrogen-fluoride from diluted electropolishing solution after rinsing. The hydrogen-fluoride vaporised when diluted, and they found that it vaporised in the very low-concentration electropolishing solution.

Based on these findings, scientists conducted a test with a single-cell cavity, and succeeded in preventing the stain from forming. They will soon conduct experiments with nine-cell cavities to better their understanding of stain formation.

"We are not sure if the stain really causes the performance limit," said Sawabe. "But now we know how to deal with them."

ELECTROPOLISHING | KEK | KYOTO CAMERA | SUPERCONDUCTING CAVITY

Copyright © 2011 ILC GDE
Printed from http://newsline.linearcollider.org

In conversation with Nobel Laureate Jack Steinberger

Awarded the 1988 Nobel Prize for Physics for his discovery of the muon neutrino, Jack Steinberger has been part of the CERN establishment for almost 50 years. He recently celebrated his 90th birthday and can still be found in his CERN office on an almost daily basis. If you happened to have a coffee with him… this is what he would tell you: his recollections, and thoughts about the present and future of particle physics.

I've been at CERN for 45 years, and I've seen this organisation go through a lot. Experiments have grown significantly and so have the aspirations of particle physics. When I did my thesis 64 years ago, I could do it alone in just 6 months and I could get worldwide interesting results. Now, experiments at CERN are made up of hundreds, if not thousands of people, working for 20 years to get a result.



My thesis advisor was Enrico Fermi, and in 1953 – unless it was 1952, I'd done my thesis a few years before - he was asked to be the chairman of the APS. It was more of an honorary job, but one of his few obligations included giving a farewell address at the end of that year. He gave a speech about the physics of the day, and it was a time when particle-producing accelerators were just getting started. The first accelerator used to produce particles was the cyclotron at Berkley and it had just gone online in 1948; although they were much smaller then than they are now, they were the biggest experimental devices ever made at that time. And so, in his speech, Fermi imagined what the final – or rather, the biggest – accelerator would be. He drew a circle that went around the globe, representing a particle accelerator that went around the Earth. The LHC has a diameter of 9km, so it's 1000x smaller than the accelerator that Fermi imagined.

That was the dream over 50 years ago, but as for the future of particle physics – especially after the LHC – I do not know. It will depend on what we find out at the LHC and no one quite knows what that will be. But there is clearly a general interest in the kind of physics that we do here. A cultural interest – we want to know what the world is like and this part of the unknown that we are trying to understand here. But there's also the fact that experiments are always getting bigger and more expensive; there is a limit as to what governments will be willing to invest.

Hopefully something interesting will come out of the LHC. What everyone is interested in, myself included, is something that gives us indications of new physics outside of the Standard Model. For me, any indication beyond this would be something absolutely beautiful. So far, everything that we have found can be interpreted within the Standard Model.

But now I spend most of my time trying to follow what is going on in astrophysics. With the discovery of the inhomogeneities of the cosmic microwave background in 1992, and their precise measurement since then, astrophysics and cosmology have seen a beautiful advance in the last two decades, but I am afraid that further progress, learning about dark matter and dark energy is challenging. I hope that the LHC will help us to learn what dark matter is.

Interview by Katarina Anthony for the CERN Bulletin

ilc newsline

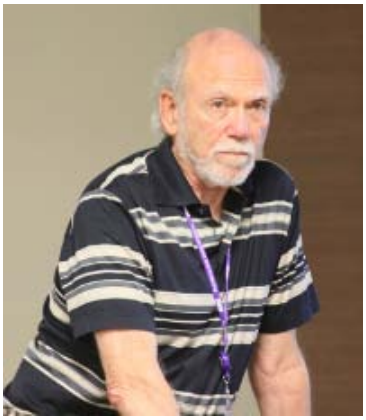
DIRECTOR'S CORNER

PAC meeting in Taiwan: accelerator recommendations

Barry Barish | 14 July 2011



Lyn Evans, chairing the Taiwan ILC Program Advisory Committee meeting



The author, Barry Barish, presenting to the PAC

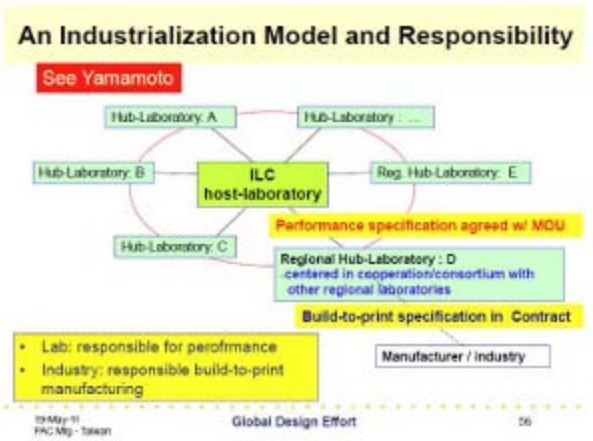
The ILC Program Advisory Committee (PAC) held their semi-annual review of the ILC detector and accelerator programmes at Academia Sinica in Taipei, Taiwan from 19-20 May and made a set of specific recommendations regarding the GDE accelerator R&D programme towards a *Technical Design Report* (TDR). Overall, the review was quite positive and supportive of our achievements and progress. They agree that we are on track to produce a TDR based on our solid R&D programme. The PAC report contains six specific recommendations regarding the ILC accelerator programme and I briefly address each of those below.

1. The PAC believes that a primary current responsibility of the GDE is to keep costs under control through the TDR phase.

Cost containment has been the central theme of our work since completing the *Reference Design Report* (RDR). We recognise from the RDR costing that the ILC will have comparable costs to the LHC and ITER and therefore we need to pay special care to cost containment as we move forward. The highest priority in establishing a new baseline for the TDR has been to find areas of cost savings that can compensate for other areas where there will inevitably be cost growth. Now that a new baseline is established, we are beginning to a new costing study and we intend to make every effort to "keep costs under control" as we develop the TDR.

2. The Committee strongly favors the cryomodule production model where industry builds to print and HEP lab(s) take responsibility for meeting performance specifications.

This is precisely the scheme we presented to the PAC. To do mass production of cavities and cryomodules cost-effectively, we need to minimise the risks for industry and use them for what they do best, manufacture to specifications.



Model for cost-effective cryomodule production, as proposed by Akira Yamamoto, GDE project manager for superconducting radiofrequency research

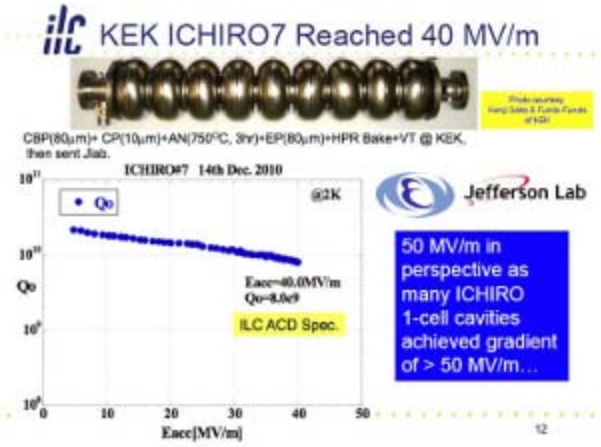
3. The PAC is very encouraged by the progress that has been achieved so far towards reaching the cavity gradient goals.

At the previous PAC meeting last autumn, we reported that we had achieved the 2010 milestone of 35 megavolts per metre (MV/m) with more than 50% yield. Rongli Geng of Jefferson Lab presented our progress on cavity gradients at the May PAC review and showed that our goal of 90% yield at 35 MV/m for the TDR is within reach. He also concluded that an average gradient of 38-39 MV/m is also reachable. He reported that the ILC cavity global database

now contains results from all three regions. He also reported progress on reducing field emission. Finally, he discussed considerations for continued R&D after the TDR, including some progress on alternative cavity shapes and some suggested efforts at hydroforming and mechanical polishing. He outlined global planning needed to embark on a serious high-gradient ILC 1-TeV programme.

4. The problems which arose during the recent first S1-Global test are a cause for concern, and the Committee supports a careful disassembly of the equipment followed by a report on the findings.

Hitoshi Hayano (KEK) presented the results of the S1-Global test, which in addition to being a test of ILC prototype cryomodules, provides a significant test of 'plug compatibility,' a concept we are following to integrate components made in different laboratories. He pointed out a series of problems that have been identified in this test, including that a couple cavities degraded upon being put into S1-Global. One coupler degraded, two tuners did not work and one piezo had discharge problems. Although we accept the concern of the committee, we believe most of these problems are more of a reflection of a learning process than representing fundamental issues.



Progress reported by Rongli Geng on achieving high gradient with the ICHIRO7 alternate cavity shape

5. The progress made in the studies at the FLASH, CesrTA and ATF2 test facilities is impressive, and the Committee strongly supports continuation of this work.

Along with the superconducting radiofrequency (SCRF) R&D, the core of our programme are the experiments on FLASH, demonstrating our operating conditions for SCRF with beam; the CesrTA programme, demonstrating the viability and specific mitigation schemes in the ILC damping rings; and ATF2 final focus demonstrations. We are particularly encouraged by the rapid recovery of ATF2 from the Japanese earthquake, even since the PAC review.



Jean-Eudes Augustin, former PAC chair, during the review

6. The PAC strongly supports the KEK pilot plant project for cavity production.

The present scheme at KEK is to build an industrial technology development centre (i.e., Pilot Plant) for the R&D stage that could be extendable for further R&D beyond the technical design phase and eventually become a potential 'mother plant' in the production phase with a capacity of roughly 150 cavities per year.

Overall, this PAC review covered a lot of territory, including reviewing the new ILC baseline that will be the basis of the technical design, reviewing of our SCRF status, progress and plans for industrialisation, reviewing of our major R&D programmes and even having discussions of what programme should follow once the TDR is complete. It was a very constructive review, where the committee made both useful suggestions and was generally quite supportive of our progress and plans toward a *Technical Design Report* at the end of 2012.

ACCELERATING GRADIENT | INDUSTRIALISATION | PAC | PAC REVIEW | S1-GLOBAL | SCRF | TDR

Copyright © 2011 ILC GDE
Printed from http://newsline.linearcollider.org