

FEATURE

ILD collaborators make progress on detector design options

by Ties Behnke (DESY) and Roman Poeschl (CNRS/LAL)



With the publication of the *Detailed Baseline Design Report* in their sights, members of the ILD collaboration work diligently to form realisable models of their detector, ones that take into account both their physics simulations and the nuts and bolts of engineering designs.

FEATURE

All aboard the long bunch train

Collaborators for the ILC and for DESY's FLASH facility learn from long bunch train studies at a recent workshop

by Leah Hesla



Learning to stabilise a particle beam of longer pulses such as those needed for the ILC requires diligence, patience and practice. ILC and FLASH scientists share the fruits of all three at the recent workshop on long bunch trains.

DIRECTOR'S CORNER

Congratulations to Shin-ichi Kurokawa

by Barry Barish



Shin-ichi Kurokawa, who has been so instrumental in developing the Asian collaboration for the Global Design Effort, was awarded the Rolf Widerøe Prize for outstanding work in the accelerator field by the European Physical Society Accelerator Group

IMAGE OF THE WEEK



Young scientists at KEK

Image: Nobuko Kobayashi

Junior high school students in the Tsukuba area visited KEK for their school's job experience programme. Here they use a Kyoto camera to look for defects on the inside of an accelerating cavity.

IN THE NEWS

from ***The Economist***

24 June 2011

[More subatomic spot changing](#)

MINOS beams muon-neutrinos from Fermilab, America's biggest particle-physics lab located near Chicago, to a 5,000-tonne detector sitting in the Soudan mine in Minnesota, 735km (450 miles) to the north-west. On June 24th its researchers announced that they, too, had witnessed some of muon-neutrinos change to the electron variety along the way.

from ***Science***

23 June 2011

[Underground Physics Lab to Cost U.S. Energy Department at Least \\$1.2 Billion](#)

Physics fans, hold your breath: An underground lab that's absolutely vital to the future of particle physics in the United States will cost the Department of Energy (DOE) between \$1.2 billion and \$2.2 billion, according to a study presented today to the federal High Energy Physics Advisory Panel (HEPAP).

from ***EuCARD***

April – June 2011

[Testing the future of accelerators](#)

As accelerators are becoming more powerful the potential radiation damage to the components increases. Accelerator beams of the past have not contained enough energy to do the damage which beams in the future upgrades of the LHC and other future accelerator projects will be able to do

from ***EuCARD***

April – June 2011

[SCRF guns given boost by Pb cathode](#)

Pb has a quantum efficiency ten times greater than that of Nb, the more traditional SC photocathode material. It is therefore possible to produce a beam with higher brightness and average current than with Nb.

CALENDAR

UPCOMING EVENTS

Damping Ring Baseline Technical Review

INFN, Frascati, Italy
07- 08 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

A satellite meeting of SRF2011

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

[View complete calendar](#)

PREPRINTS

ARXIV PREPRINTS

[1106.5592](#)

Associated production of light gravitinos in e^+e^- and $e^- \gamma$ collisions

[1106.4903](#)

Searches for Lepton Flavour Violation at a Linear Collider

[1106.4691](#)

Phenomenology of the minimal $B-L$ Model: the Higgs sector at the Large Hadron Collider and future Linear Colliders

[1106.4658](#)

Determining R-parity violating parameters from neutrino and LHC data

FEATURE

ILD collaborators make progress on detector design options

Ties Behnke (DESY) and Roman Poeschl (CNRS/LAL) | 30 June 2011



ILD workshop participants. Image: Bruno Mazoyer (LAL)

The creation of a detector blueprint draws on diverse resources: physics cases, engineering choices, computational capacity and human drive. The *Detailed Baseline Design Report* (DBD) is slowly but steadily appearing on the horizon, and it will reflect the weaving together of these elements to present the best realistic manifestation of ILD.

After the Letters of Intent were completed in 2009, two detector concept groups, called ILD and SiD, were invited by the international advisory committee IDAG to move towards the DBDs. These documents will accompany the *Technical Design Report* (TDR) of the ILC machine. It is of paramount importance to restate the physics case for the ILC at energies up to 1 TeV, which will be

worked out by the community and presented in a separate document.

The ILD concept group met in May in Paris at LAL for the fifth dedicated ILD meeting to discuss the state of the work on the ILD concept and to plan the next steps. This meeting originally was planned to take place at KEK in Japan, but due to the serious earthquake and its consequences it was decided to move it on short notice to LAL.

The detector baseline document should describe the ILD concept in detail and should contain more realism in its description and planning than previous documents. Both the description of the hardware and the anticipated performance of the detector should be based on serious studies and results rather than estimates with unrealistic assumptions.

One of the main aims of the workshop was the definition of a so-called simulation baseline to be used for the mass simulation of events. This baseline is a compromise between a certain level of detail and simplifications necessary for modelling the detector. It must nevertheless maintain adequate performance and manageable simulation runs.

Speaking of realism, it is clear that a realistic detector model cannot be proposed without a tight collaboration between physicists and engineers; the role of the latter in the process cannot be overestimated. Much of the progress collaborators have made since the Letters of Intent was reported in the quest to move the physicists' models to a serious engineering model with allowances for cables, supporting structures and a critical view that everything eventually fits together. On the other hand a careful control of these things has to happen to ensure that the physics goals are not compromised; this also necessitates similar realism in the detector model used for physics simulation.

It was refreshing to see how many new physics analyses were presented during the workshop, mostly based on fully simulated and reconstructed ILD events. These analyses are a perfect way for young students to get involved and to learn about the physics and the detector. All of the analyses cover the topics for which the concept groups have been asked by the advisory group to demonstrate for the DBD.

The DBD itself will present on equal footing options for sub-detectors for ILD. Detector components that at the time of the DBD will have demonstrated their feasibility and performance in test beams will be considered as an option. An option has to be distinguished from an alternative, which reflects a less advanced proposal of a technology. ILD will not make any technology decisions at this moment, but maintain a broad spectrum of options and alternatives. This key element of the 'philosophy' of the DBD has been emphasised in particular in the concluding remarks of ILD Joint Steering Board member Ties Behnke.

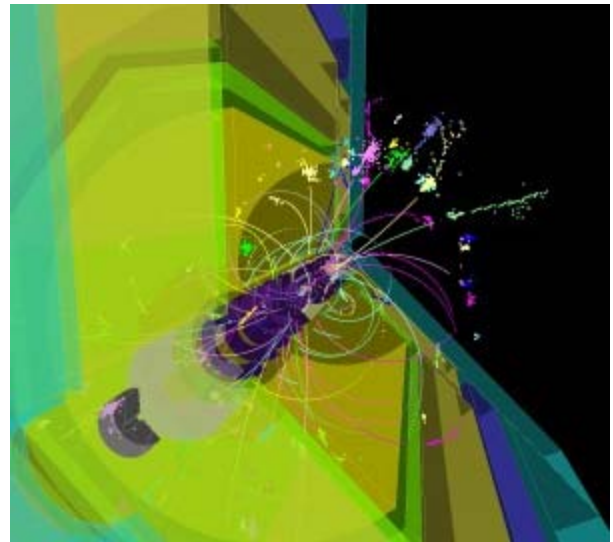
The workshop was a testament that the March catastrophe in Japan did not reduce the determination of our Japanese colleagues to pursue the work towards a linear collider in general and the ILD concept in particular. Apart from a strong participation by Japanese colleagues, this is maybe best underlined by the contribution of Akira Yamamoto, who summarised the ongoing efforts in Japan towards the siting of the machine in Japan.

Finally, did ILD succeed in defining a software baseline? Yes, although the definition of a baseline was slightly adapted. ILD decided that it would pursue an ambitious and active program to support in particular the two main hadronic calorimeter options, analogue and digital, on an equal footing and ensure that both options are adequately represented and simulated. This reflects the enormous work and progress that has taken place over the last years on both technologies, which enables ILD to seriously propose both as valid options.

[DBD](#) | [DETAILED BASELINE DESIGN](#) | [ILD](#) | [LOI](#)

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Three-dimensional image of a 500-GeV $t\bar{t}$ event simulated in the ILD detector.

FEATURE

All aboard the long bunch train

Collaborators for the ILC and for DESY's FLASH facility learn from long bunch train studies at a recent workshop

Leah Hesla | 30 June 2011



Participants listen attentively at the workshop on linac operation with long bunch trains, held at DESY from 6-8 June. Image: DESY

For all the complicated engineering and hulking structures involved in operating particle accelerators, it's the tiny, invisible particle beam at the centre of everything that is the machine's reason for being. A probe for burrowing into subatomic places or a light to shine on molecular forms, the beam is science's exploratory tool for the universe's smallest, remotest corners.

In their quest to make good, quality particle beams, researchers dissected the progress on this front at the recent [workshop on linac operation with long bunch trains](#). The workshop, the second in a series, covered beam studies done for the International Linear Collider and for DESY's Free-Electron Laser (FEL) [FLASH](#) and gave collaborators a chance to examine what's involved in making stable beams composed of roughly millisecond-long pulses – the 'long' in 'long bunch trains'.

Scientists presented the results of beam tests, called the 9-mA studies, performed in February. They looked in detail at how to tune the cavities for smooth timing and acceleration of the beam, methods to help prevent cavity quenching under the burden of so much power and modifying cavities' quality factors to achieve the highest gradients.

"It's about pushing the machine to its limits," said workshop chair John Carwardine. "For example, we need to show that we can accelerate long bunch trains with the superconducting cavities running at full throttle. If things aren't stable or you push too hard then you quench the cavities."

There is strong synergy with the FEL programme in this regard. For the ILC, eking out the last few percent of energy from the cavities translates to significant cost savings, while for the FLASH FEL users, a few percent extra energy translates to shorter photon wavelengths and to potentially opening up new materials science experiments.

"The value of FLASH to ILC researchers cannot be overstated," Carwardine said. As yet there is no other facility worldwide that can provide the kinds of beams needed for the ILC 9-mA studies. Long bunch trains are a fundamental advantage of superconducting technology for accelerators and are what distinguishes ILC, FLASH, and the [European XFEL](#) from regular-conducting machines. But it is only by operating the machine with the long bunch trains that scientists actually utilise the advantage.

"In the tests we tried to demonstrate what we could do in the control room, turning the knobs, versus what we showed on paper," Carwardine said.

Other communities also find the beams useful, and nowadays more than 90 percent of beam time at FLASH is dedicated to operation as an FEL photon source, supporting scientists from a wide spectrum of disciplines, including those as diverse as molecular biology and solid state physics.

Energy stability requirements for FEL operation are a factor ten more stringent than for the ILC linac.

"Once you've set it up right, the beam is amazingly stable" said DESY's Siegfried Schreiber, who is responsible for the operation of the German laboratory's FLASH facility. "But you have to find this operating point. It's tricky."

Beams with long bunches require a good deal of power to get them moving. Even in the absence of a beam, the cavities need quite a bit. Once the beam is turned on, they need even more to sustain their face-value acceleration. Should anything happen to the beam during the machine's operation – if the beam suddenly switches off – the extra power that gave it its boost now gives the cavities too much to handle, incapacitating the machine.

"Part of the challenge is actually managing the beam power and not losing it in the wrong places," Carwardine said.

"You can literally weld holes in the vacuum chamber," Schreiber said. Part of the future FLASH programme involves an upgrade of the present machine protection system that could also serve as a model for a linear collider.

For the ILC, the preferred beam current is fairly high as accelerator beams go. It's made of trains of bunches of 3 nanocoulombs each zipping along 3 million times a second. The resulting current is 9 milliamps (mA), and in the 9-mA studies, ILC scientists perform tests at the FLASH facility to get a better handle on controlling this heavy load.

ILC research has benefitted significantly from studies on improving beam stability. Conversely, efforts in support of the ILC programme have had a payback for FEL user operation, especially given that more of the FEL users are requesting long bunch trains.

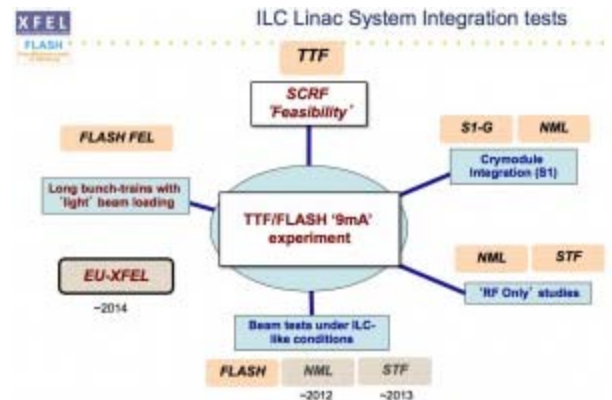
Schreiber estimates that about two-thirds of FLASH's user community would have something to gain from high beam currents and long bunch trains. Adapting their machine to serve these groups means understanding the particular acceleration process.

"The better we understand the acceleration process, the better we can upgrade the hardware and controls to further improve the performance," Schreiber said.

This has led to many accelerator improvements, such as a new, stable oscillator for providing power at 1.3 gigahertz, real-time integrated computing circuits for higher sampling rate and lower latency, and many other hardware upgrades so improvements to all FLASH's cryomodules can be treated equally.

The workshop made clear that the mutual research benefits between the proposed collider that is the ILC and the test machine that is FLASH strengthens both.

"The machine is part of the experiment," Schreiber said.



Experimental contributions to the FLASH 9 mA experiment.
Image: John Carwardine



Sebastian Schulz discusses photo-injector stability with workshop attendees. Image: DESY

A third long bunch train workshop to address operating parameters for the next round of studies is planned for next year.

"We still have a lot of work ahead of us," Carwardine said. "There were a lot of excellent presentations and some very good discussion during the workshop, which helps tremendously in understanding and prioritising what we need to do next."

Workshop participants included scientists from KEK in Japan, Rutherford Appleton Laboratory in the UK, Argonne National Laboratory and Fermilab in the US and of course DESY. Global Design Effort project managers were also in attendance.

Stay tuned to future issues of *ILC NewsLine* to learn about some of the results presented at the second long bunch train workshop.

[9 MA EXPERIMENT](#) | [ACCELERATOR R&D](#) | [BEAM-POWER](#) | [DESY](#) | [FLASH](#)

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DIRECTOR'S CORNER

Congratulations to Shin-ichi Kurokawa

Barry Barish | 30 June 2011



Shin-ichi Kurokawa

It is with special pleasure that I pay tribute today to Professor Shin-ichi Kurokawa, who was awarded this year's Rolf Widerøe Prize by the European Physical Society Accelerator Group. Shin-ichi was cited for his "outstanding leadership in the design, construction and operation of several high-energy accelerators, including the KEK PS, TRISTAN and the KEK B-Factory. Through his intensive participation in the international collaboration within ACFA and ICFA, he initiated and expanded worldwide scientific exchange, building sturdy bridges of understanding and collaboration between Japan, Asia and the rest of the world." For the ILC, he is as responsible as any single individual in making the word 'global' in Global Design Effort a reality.

The Global Design Effort (GDE) for the International Collider was created by the International Committee for Future Accelerators (ICFA) and its subcommittee, the International Linear Collider Steering Committee (ILCSC) in 2005, following the important technology decision to base the design on superconducting radiofrequency technology. The GDE is organised geographically into European, American and Asian regions with equal representation for GDE management and responsibilities for the technical developments and design.

Making the Asian region a reality was, to a large extent, due to the tireless work of Shin-ichi Kurokawa, who travelled almost continuously through Asia to put together this collaboration. He has also played leading roles in ICFA, ILCSC and the Asian Committee for Future Accelerators (ACFA). We owe him much for laying the groundwork for our important and successful Asian efforts in the GDE.

Shin-ichi Kurokawa graduated in physics from the Tokyo Institute of Technology in 1966 and received his Sc.D. in physics in 1972. He came to the laboratory as an experimental particle physicist, but soon became involved in accelerator physics and joined the Accelerator Department in 1981. He has worked on particle physics accelerators since that time. Among other accomplishments, he successfully led the KEKB project and has headed the KEK accelerator division. He has played an important role in developing and exploiting 30 years of accelerators for particle physics in Japan, and over the last decade has been instrumental in globalising the design efforts for the ILC.

Rolf Widerøe was a Norwegian physicist who is credited with originating many of the concepts used in particle accelerators. These concepts included using magnetic induction to accelerate



The author presented the ILC Reference Design to Kurokawa in his role as chair of the ILCSC in 2007.

electrons, which is called a betatron. He also developed resonance acceleration using radiofrequency electric fields. These concepts were basic to the development of particle accelerators. Despite his brilliant scientific career, he became a well-known Nazi collaborator, resulting in his Norwegian citizenship being revoked. After World War II, he continued his career by working on radiation therapy for cancer and early collaboration at CERN.

It has been a pleasure for all of us in the ILC GDE to have worked with Shin-ichi Kurokawa. On behalf of my colleagues and me, we give him our hearty congratulations for this most deserving award.

[ACFA](#) | [ICFA](#) | [ILCSC](#) | [ROLF WIDERØE PRIZE](#)

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