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15 MARCH 2012

AROUND THE WORLD

SLAC P2 Marx ramps up reliability

by Leah Hesla

The newest incarnation of the SLAC P2 Marx modulator is designed to be more versatile and robust than its predecessor. Having prepped it for reliability, scientists will soon put the modulator's mettle to the test.

RESEARCH DIRECTOR'S REPORT

Towards a single directorate for ILC and CLIC physics and detectors studies

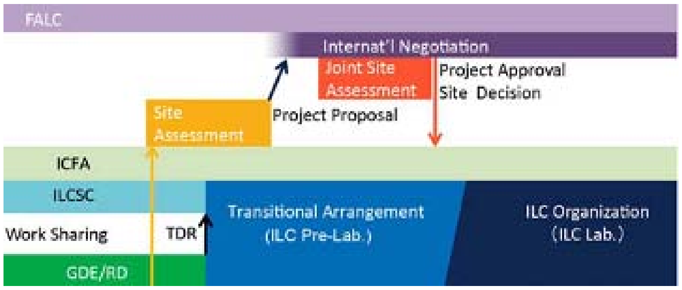
by Sakue Yamada

The ILC Steering Committee is now considering a new organisation for a linear collider project that includes both the ILC and CLIC programmes, in view of their individual progress and the cooperation between them, and it envisions a merger of physics and detector activities. It is a challenge to create a new mechanism that will satisfy all parties, but we should try hard to find one.

DIRECTOR'S CORNER

ILC Project Implementation Planning: the prequel / the draft

by Barry Barish



How should we approach questions on siting and funding the ILC? How should the construction project be governed and managed? What will be the responsibilities of the host country? How can in-kind contributions be managed most effectively? The Global Design Effort has addressed these and other such implementation issues in a new draft document submitted to the International Linear Collider Steering Committee. We make the draft available today and welcome your comments.

IMAGE OF THE WEEK

Students hunt Higgs too

Image: CERN/M. Lapka

Young researchers analysing real high-energy collisions from the LHC at CERN.

From 27 February to 24 March, about 8000 high school students in 31 countries come to one of about 120 nearby universities or research centres for one day in order to unravel the mysteries of particle physics. Lectures from active scientists give insight in topics and methods of basic research at the fundaments of matter and forces, enabling the students to perform measurements on real data from particle physics experiments themselves. At the end of each day, as in an international research collaboration, the participants join in a video conference for discussion and combination of their results.

View more photos from CERN | Read more about the masterclasses in *ILC NewsLine*

IN THE NEWS

from ***BBC News***
13 March 2012
Not just the Higgs boson
Such a fuss has been made about finally nailing down the Higgs you could be forgiven for thinking that – once the champagne had been quaffed and the Nobel Prizes handed out – we could all pack up and go home.

Not a bit of it. Only two of the four main experimental detectors straddling the 27km ring of the LHC are even looking for the Higgs and both are interested in much, much more.

from ***Discovery News***
13 March 2012
Neutrino 'Costume Change' Mystery Solved?
Another piece of the neutrino puzzle has fallen into place, thanks to new results announced last week by the Daya Bay collaboration in China.

The experiment has only been up and running for a couple of months, but the international collaboration's latest measurement might explain how neutrinos change "flavors" — akin to a costume change — as they move through space.

from ***Physics World***
9 March 2012
Daya Bay nails neutrino oscillation
Physicists working at the Daya Bay Reactor Neutrino Experiment in China have made the best measurement so far of a key property of neutrinos – the "mixing angle" θ_{13}, which describes the relationship between certain flavour and mass states of neutrinos.

from ***symmetry breaking***
9 March 2012
Scientists continue to see puzzling behavior in top quarks, reaffirm strength of Tevatron experiments
The Tevatron may be shut down for good, but – as evidenced by the catalogue of results presented at this week's Rencontres de Moriond conference – the collider's experiments still have plenty to say.

CALENDAR

UPCOMING EVENTS

FJPPL-FKPPL Workshop on ATF2 Accelerator R&D
LAL, Orsay, France
19- 20 March 2012

ILC Mechanical & Electrical Review and CFS Baseline Technical Review
CERN
21- 23 March 2012

AIDA - Academia meets Industry: Solid-State Position Sensitive Detectors
DESY, Hamburg, Germany
26- 27 March 2012

AIDA 1st Annual Meeting
DESY, Hamburg, Germany
28- 30 March 2012

Joint ACFA Physics and Detector Workshop and GDE meeting on Linear Collider (KILC12)
Daegu, Korea
23- 26 April 2012

UPCOMING SCHOOLS

Physics and Technology of Particle Accelerators (JUAS 2012)
Geneva, Switzerland
09 January- 16 March 2012

USPAS sponsored by Michigan State University
Grand Rapids, Michigan, US
18- 29 March 2012

AIDA Student Tutorial - Solid State Detectors
DESY, Hamburg, Germany
27 March 2012

View complete calendar

ANNOUNCEMENTS

First Asia-Europe-Pacific School of High-Energy Phyics open for applications

The first Asia-Europe-Pacific School of High-Energy Physics, or AEPSHEP2012, will be held in Fukuka, Japan, from 14 to 27 October. Applications to attend are invited, particularly from students from countries in the Asia-Pacific region and from Europe, although applications from other regions will also be considered. Application deadline is 23 April.

The purpose of AEPSHEP2012 is to provide young physicists with an opportunity to learn about recent advances in elementary-particle physics from world-leading researchers. Visit the AEPSHEP2012 website for more information.

BLOGLINE

Quantum Diaries
Ghost Hunters: an international team tracks a disappearing particle

PREPRINTS

ARXIV PREPRINTS

1203.2631
A framework for precision 2HDM studies at the ILC and CLIC

1203.2074
Development of a TPC for an ILC Detector

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AROUND THE WORLD

SLAC P2 Marx ramps up reliability

Leah Hesla | 15 March 2012

Alfred Viceral, Mark Kemp and Patrick Shen, who worked on the development of the Marx P2, stand in front of the enclosed modulator. One cell is pulled out of its drawer. Image: Ray Larsen

Last month scientists at SLAC National Accelerator Laboratory, US, ran tests on their latest power generator prototype. It met ILC specifications, delivering 140 amps of current at 120 kilovolts.

But the real test, the test of endurance, is still thousands of hours of run time away.

Researchers are developing the SLAC P2 Marx modulator, the power generator for the ILC, to be a hardier, higher-endurance version of its predecessor, the P1. Though the P1 worked fairly well, after a thousand hours of operation it revealed weak links in its design. With the P2, scientists aim to eliminate those soft spots.

“Reliability was the motivation for going to the P2,” said Mark Kemp, electronics engineer at SLAC. “We wanted to get rid of the single-component bottlenecks.”

Using lessons learned from the P1, researchers went with a more distributed-control approach to the P2. In the P1, much of the operation rode on the success of specific nodes. The P2 design has more redundancies – if one component gives out, another is there to take up the slack.

“The first prototype had more single-point failures in places where it could take the whole thing down,” said Chris Adolphsen, who runs SLAC’s power programme for the ILC. “This one is nicer. The redundancy is better, so it’s a little more robust in that regard.”

The Marx-type modulator delivers power using multiple cells. In SLAC’s first prototype, each cell contained two arrays of fifteen switches. In contrast, each cell of the P2 has a mere two switches. This simplifies control and protection of the cell.

Scientists also decentralised the circuitry responsible for propagating power pulses. Ideally, each pulse is held strong for its entire length, resulting in a pulse with a flat top. With the P1, scientists relied on one cell to finely regulate power from all the other individual cells. The scheme tended to produce pulses that were rippled on top rather than flat. With the P2, scientists gave each cell’s circuit card a piece of the pulse pie. The smart control system figures out the best way to shift and add up all the contributions from each cell just right, producing a sturdy, square pulse every time.

And if a component did fall short, scientists wanted the modulator to be smart enough to compensate for it.

“We wanted to increase its capability for diagnostics and prognostics – to have a control system that could predict when the modulator might fail,” Kemp said.

The control system tracks components’ performances over time so that scientists can note when a component hits a known benchmark of impending failure. The doomed part can then be switched out at the next opportunity.

Though originally designed for the ILC, the SLAC P2 Marx has gotten the attention of other particle accelerator projects. CERN’s proposed CLIC collider is considering it for its drive beam, which generates its radiofrequency power. The future European

Spallation Source to be built in Lund, Sweden, and KEK in Japan are also interested in using it to power their beams, as is Fermilab, US, for its injector linac upgrade.

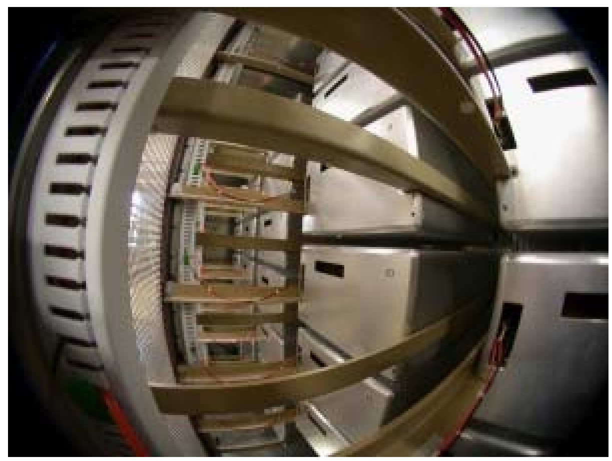
Keeping in mind its potential for widespread use, SLAC researchers designed the P2 to be not only more reliable, but also to better lend itself to being manufactured in industry.

One cell of the Marx P2 modulator. In developing their second Marx modulator prototype, SLAC scientists outfitted each cell, or building block, with more system control capabilities. This approach increases the number of fail-safes in the system and therefore its overall reliability. Image: Ray Larsen

The choice of the P2's cell voltage, for instance, is derived from state-of-the-art production in the semiconductor industry. Each of the modulator's 32 cells is four kilovolts, a value based on a single die of silicon. Matching the cell's voltage to semiconductor standards makes them compatible with chips produced *en masse* outside the laboratory.

"We're trying to be less specialised in the components and the fabrication techniques," Kemp said. "That lets us take advantage of the existing manufacturing capability."

The scientists at SLAC also extended the characteristic topology of the Marx setup – the ramping up of voltage through many small steps.



The Marx P2 modulator contains 32 numbered voltage cells, each contributing up to four kilovolts of potential. Image: Ray Larsen

"The Marx modulator is sort of like an Erector Set for power supplies – something with interchangeable parts," Adolphsen said. By constructing the modulator, where practicable, with even more smaller parts, they designed one that was more easily manufacturable.

As Kemp points out, "It's inherently easier to manufacture lots of little things than it is to manufacture a small amount of large things."

In the future ILC, there would be 500 to 600 modulators, each delivering an average 130 kilowatts of power. Researchers designed the P2 to be more accessible than the P1: it fits well in the kamaboko-shaped tunnel being proposed by civil engineers in the Asia region. Further, it's configured so people can easily get to its guts to perform maintenance.

SLAC scientists have begun the reliability tests of the P2. They'll proceed for several months, obtaining data in time for the ILC *Technical Design Report*. They believe their smaller-parts and distributed-control approach will make the modulator significantly more reliable, an advantage not only for the ILC baseline, but perhaps for other accelerators around the world.

"We put a lot of development into the building block and the control strategy," said Kemp. "It's something we can straightforwardly massage to be in many different applications."

ACCELERATOR R&D | MARX MODULATOR | POWER PULSING | RADIOFREQUENCY POWER | SLAC

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RESEARCH DIRECTOR'S REPORT

Towards a single directorate for ILC and CLIC physics and detectors studies

Sakue Yamada | 15 March 2012

Jon Bagger speaks at LCWS11 in Granada, Spain. Image: ILC

We are turning the last corner towards the completion of Detailed Baseline Design (DBD), which we plan to complete at the end of the year together with the Global Design Effort's *Technical Design Report* (TDR) for the ILC accelerator. In a few weeks each of the two detector groups will submit a detailed outline of its detector section, which will be monitored by the International Detector Advisory Group during the KILC12 workshop next month.

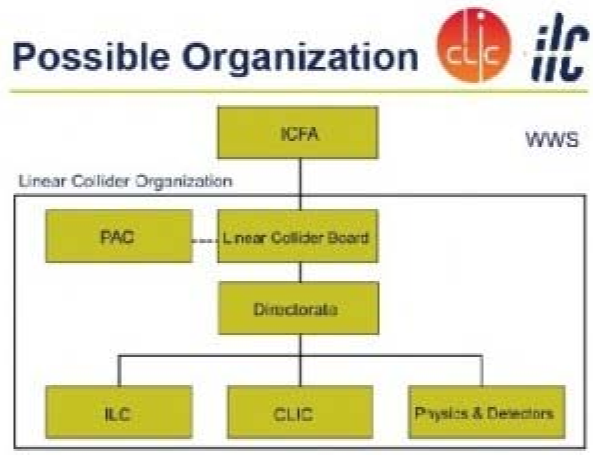
With the future achievement of these milestones in sight, the ILC Steering Committee (ILCSC) is now considering the new organisation that will lead the project beyond the TDR and DBD phase. Discussions started already in 2010 and a new scheme is being shaped into a concrete form, one whose contours became clearer last summer. The general consensus seems to be to create a new organisation for a linear collider project that includes both the ILC and CLIC programmes, in view of their individual progress and the cooperation between them. While details are yet to be worked out, the gross structure of the organisation was shown by Jon Bagger, the ILCSC chair, during LCWS11 in Granada. It is to be led by a single director who reports to a new linear collider board under the International Committee for Future Accelerators. Under the director are three structures: two for the accelerators, ILC and CLIC, and one for all physics and detector studies. While the accelerator activities remain separated with two responsible bodies, it is envisioned by the ILCSC that this is not necessary or desirable for the physics and detector side.

Accomplishing this merger of physics and detector activities is not a trivial goal. It is generally understood that the transition to the new mechanism will be made adiabatically, keeping the present structures until the atmosphere for such a merger becomes ripe. Also, such a big change requires thorough consideration by the entire community. It is desirable that the new scheme allows all the participating parties to work constructively. In order to realise such a new system, the consideration must take very many facets into account.

While it is beyond the given mandate, the joint working group between the ILC and CLIC for general detector issues is a useful contact point where ILC and CLIC colleagues can discuss this new direction. We met recently. In the short meeting, the discussion was not able go far beyond digesting the present situation, but a consensus was made that the matter must be discussed with wider participation. The joint working group may continue discussions, possibly with more members.

It is also recommended that the Worldwide Study discuss this question since it has been working for a linear collider in general. Through such considerations, we may prepare sensible inputs from a broad segment of the community for the future discussions by the ILCSC.

Just to illustrate the complexity of the question a few observations can be listed. Some features make the merger easier and others make it more complicated. There are many people who are active on both ILC and CLIC detectors since CLIC adopted the two validated ILC detector concepts. For each detector group, ILD and SiD, however, the overlap of the members between ILC and CLIC is not complete. The two colliders' participation in detector activities is distributed differently when seen globally. The energy range and presumed timescale of ILC and CLIC accelerators are different. Thus the major physics goals can be different. This is reflected in the present objectives of R&D and simulation studies. While ILC detector groups may wish to include as much engineering studies in the post-DBD studies as they can, there will also be component R&D for both the ILC and CLIC to be continued, and some of them can be common. While both activities are international, they report to different international steering bodies now. There are also differences in organisational structure, the managing and decision-making mechanism and the phase of development.



Possible future organisation of the two linear collider groups

Under such circumstances, it is a challenge to create a new mechanism that will satisfy all parties. It may require some time to deliberate and reach a good solution. But we should try hard to find one. New results from LHC may help open a new door for such considerations, too.

FUTURE | ILC-CLIC COLLABORATION | ILCSC | PHYSICS AND DETECTORS

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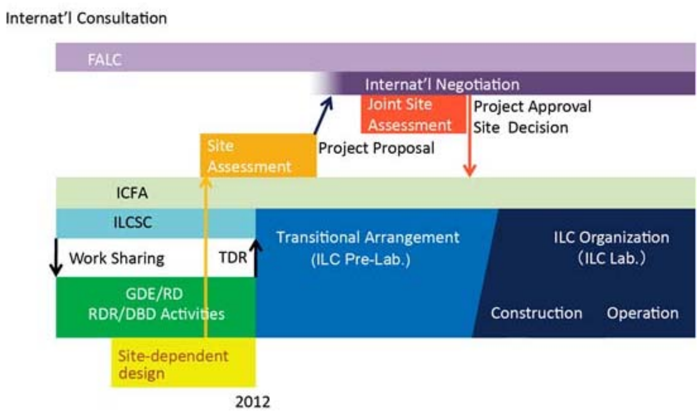
DIRECTOR'S CORNER

ILC Project Implementation Planning: the prequel / the draft

Barry Barish | 15 March 2012



Possible roadmap towards realisation of the ILC (from the ILC Project Implementation Planning document)

In order to make our ILC design as realistic as possible, we have considered many of the issues that will need good solutions when the ILC is built. As a result, we have developed and submitted a draft document to the International Linear Collider Steering Committee (ILCSC) as a starting point towards an actual ILC implementation plan. In the process, we have reviewed other very large projects and gained insight from both their experience and 'lessons learned.' The draft summarises our suggestions regarding ILC implementation planning. In our opinion, it is important for the group developing the design to transmit their views on implementation issues, alongside the technical design. We will include a shortened version as a chapter in our *Technical Design Report*.

Below is the Executive Summary from the Draft Project Implementation Planning document.

Following the International Committee for Future Accelerators' (ICFA) decision to base the design of a global linear collider on superconducting RF technology, the Global Design Effort was created and has carried out the mandate of coordinating the worldwide R&D program and developing a technical design for a 0.5-TeV linear collider. As a result of physics studies, ICFA gave the GDE guidance for the accelerator performance to be achieved. In carrying out the design presented in this report and in order to make it the design as realistic as possible, close attention has been also been paid to how best to implement such a global project. This has been important for two reasons: 1) it has helped to make sure that the design effort adequately took into account the practical aspects of implementing such a global project; and 2) by paying attention to these aspects of the future ILC project, we have developed knowledge and insight into how to implement the ILC and we document some of what we have learned and concluded in this chapter, in order to help guide future implementation planning.

*The **governance** of a large international science project is a very complex endeavor and one having little precedence for a truly global project, without a strong host laboratory. It is crucially important in implementing such a project, to determine how decisions are made on design and technical issues, who appoints key staff, and the responsibilities of the host laboratory.*

For background, we did a study of other recent major projects, including ALMA, ITER and the LHC. Lessons learned from these projects have helped inform what we believe to be key considerations in forming an effective governance for the ILC. In developing the ILC TDR, we came to understand the importance of defining the responsibilities of the host, having a well-established and agreed to scheme for in-kind contributions, an adequate common fund, etc. We have presented our understanding and conclusions regarding governance and our key recommendations to FALC, ILCSC and publicly at ICHEP-2010. The key points are discussed in the following section on governance.

*We have considered various **funding models** for a globally supported ILC, which was necessary for us to understand how it could be built, the responsibilities of the host, etc. Earlier models for the ILC have been based on equal sharing among the three regions of the world, Europe, Asia and the Americas. Although that may be possible, there is no natural way to organize* *such a sharing, and instead, we consider and favor a funding model similar to that used in both XFEL and ITER, namely a 'share' system, where the "major" countries or regions should contribute a minimum, perhaps 10%, and other countries would join as members of regional consortia or by making particular contributions. Running and decommissioning costs need to also be considered and agreed to at the time the project is funded.*

The responsibilities and the authority of the ***project management*** *and project team need to be determined in advance and must be sufficient to enable the project management to effectively implement the project. This central management team will be responsible for finalizing this design, carrying configuration management, a formal change-control process, making technical decisions, maintaining schedule and other responsibilities of the project management.*

Certain ***host responsibilities*** *are crucial to the success of a global project. The host will need to provide a variety of services similar to what is provided by CERN, a successful example of a multi-country large collaborative laboratory. In addition to the necessary contributions to the infrastructure, construction and operations the host will be expected to prepare for the legal condition as an international organization.*

Siting *is a major issue, from selecting the site to dealing with the configuration and site-dependent aspects of the design and implementation. Technical issues, like seismic conditions, will need to be considered and a 'site-dependent' design, taking the conditions of a particular site, will need to be developed, as true to the original non site-specific design as is practical. The multiple issues, like access, providing infrastructure, safety, etc. will need to be considered issue by issue in developing the site depended design to be implemented. We envision the design will evolve from the configuration-controlled ILC design produced by the global design team and the site dependent changes will be done through a formal change control process.*

We assume that the major contributions from countries to the ILC will be in the form of ***in-kind contributions****. This has the substantial advantage that most resources for the construction can be made within the collaborating countries. This is important for political reasons, as well as to build technical capacity within the collaborating countries. However, this scheme comes with major challenges in terms of managing the different deliverables, integrating them, maintaining schedule, dealing with unforeseen cost increases for specific items, etc.*

We have carefully considered this issue, and have studied the various ways to treat such contributions. We suggest that a ***flexible*** *form of in-kind contribution, for example one employing a form of "juste retour", is preferable (i.e. each member state receives a guaranteed fraction of the industrial contracts). This enables the central management to place the work where it will be the most effective, while spreading the work and resources equitably. A very important additional point we learned from other projects is that sufficient central resources must be made available, in order to effectively coordinate and integrate the project through the central management.*

The central technology for the ILC, superconducting RF systems, has many other applications and therefore a world-wide plan for distributing this work is necessary.

A special implementation topic for the ILC is the industrialization and mass production of the SCRF linac components. We have developed a model for this production, which involves multiple vendors worldwide and a globally distributed model based on the "hub laboratory" concept. Basically, the cost-effective scheme we propose will use industry for what they do best, large-scale manufacturing, and the participating high energy laboratories for what they do best, integration and assuming technical risk for performance.

We have considered the overall ***project schedule*** *for ILC construction and commissioning and have found that they are dominated by the time to construct the conventional facilities and by the time required to construct, install and commission long lead time technical components, like the SCRF system. An 8-year construction, installation and commissioning schedule appears feasible.*

Finally, we have considered and discuss in this chapter the future technical activities that will help continue to move the ILC forward toward construction. Overall, we have used project implementation planning as an integrated element in developing a technical design for the ILC that we believe can be smoothly evolved into a final design and implementation plan to the ILC project, once approved and funded.

ILCSC | PROJECT IMPLEMENTATION PLANNING | TECHNICAL DESIGN REPORT