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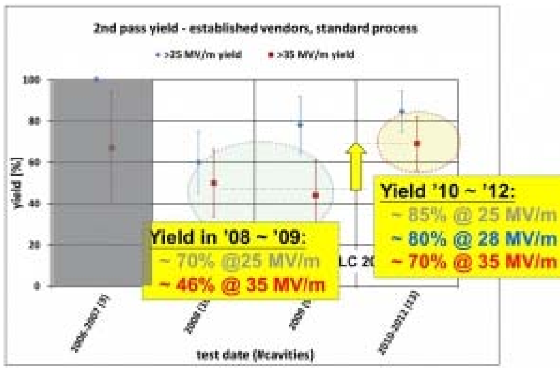
28 JUNE 2012

DIRECTOR'S CORNER



After the TDR: what's next for ILC?

Today's issue features a Director's Corner from Marc Ross, Project Manager for the Global Design Effort.

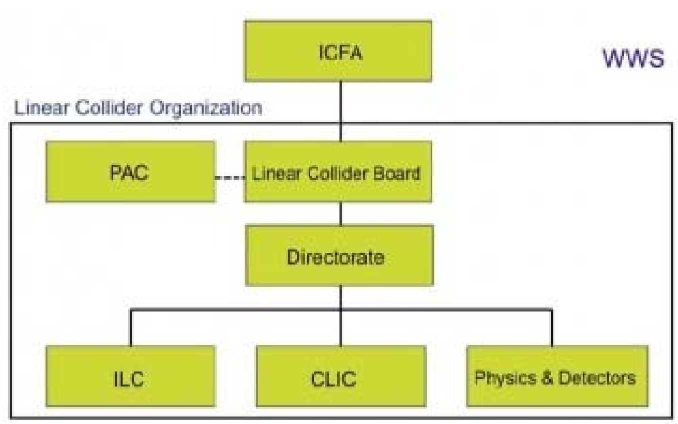
by Marc Ross

New machines set new challenges for accelerator experts, and there are a number of challenges that the ILC R&D team has had to face before sitting down to write a convincing Technical Design Report. Beam test facilities in all regions have delivered and are still delivering important results. Project Manager Marc Ross takes stock.

RESEARCH DIRECTOR'S REPORT

Organising the post-2012 era

by Jim Brau



The new Linear Collider Organisation is being planned with a united ILC and CLIC physics and detector effort. This is a natural step, but the devil is in the details. While there has been a lot of fruitful collaboration in the past, there also remain differences that must be considered.

AROUND THE WORLD

The grand unifying 3-D chip

New platform for detector technology brings particle physics and photon science together

by Barbara Warmbein

A new integration technology that could also be used in the ILC detectors will soon serve as a node point for connecting several German and international institutes and universities in the common goal to develop fast, efficient and reliable detector components in the Helmholtz Detector Technology and Systems Platform. The unusual aspect of the collaboration: these detectors are not only for Higgs- and SUSY-hunting apparatus for particle physics, but also for more compact and more targeted devices for use in light sources.

IN THE NEWS

from ***TradingCharts.com***
27 June 2012
Brown Announces Nearly $4 Million in Energy R&D Funding for Euclid Techlabs in Solon
High Power Rf Testing Of A 3-Cell Superconducting Traveling Wave Accelerating Structure
This project will design and demonstrate a prototype of a new kind of superconducting particle accelerator. This device could significantly reduce the cost of the International Linear Collider

from ***DESY***
25 June 2012
Helmholtz funds commercialisation of a new industry standard of electronic systems
Modern accelerators are extremely complex machines; monitoring requires an extremely precise and fast technology which is able to process in parallel a large number of data sets.

from ***The Guardian***
23 June 2012
Higgs rumours: fun for you, dangerous for me
The next update on the ongoing Higgs hunt will be on the 4th July. In the meantime, no spoilers please. Seriously, it would be bad for science.

from ***CERN***
22 June 2012
CERN to give update on Higgs search as curtain raiser to ICHEP conference
CERN will hold a scientific seminar at 9:00CEST on 4 July to deliver the latest update in the search for the Higgs boson.

CALENDAR

UPCOMING EVENTS

36th International Conference on High Energy Physics (ICHEP2012)
Melbourne, Australia
04- 11 July 2012

View complete calendar

ANNOUNCEMENTS

Special Higgs issue next week
With the start of the summer conferences and CERN's announced Higgs update next Wednesday, the makers of *ILC NewsLine* join in the #Higgsteria and will publish a special Higgs issue next week. What do the results from the LHC mean for the next-generation collider? How can the linear collider help study the Higgs boson? And what is this Higgs anyway? Stay tuned for next week's issue!

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DIRECTOR'S CORNER

After the TDR: what's next for ILC?

Today's issue features a Director's Corner from Marc Ross, Project Manager for the Global Design Effort.

Marc Ross | 28 June 2012

"We are just standing at the *entrance*, and our world efforts need to continue or become even stronger."

These are the words Kaoru Yokoya used to close his *ILC Newsline* Director's Corner at the end of last year. (The italics are mine.) Six months later his words continue to ring true and are perhaps a bit more urgent. We now have to ask how to make world efforts continue *and* become stronger.

The pressure we feel now, in mid-2012, is to finish the primary Global Design Effort (GDE) deliverable – the *Technical Design Report* (TDR). When completed, the TDR will represent the conclusion of a successful design and R&D programme, something remarkable in itself. We are obliged, of course, to put together the programme that will take us through the *entrance*, TDR in hand. This programme will fill the gap left behind when the GDE completes its mandate.

As we near the end of the Technical Design Phase, it is time to ask what has been accomplished and what remains to be done. The presentation of Satoru Yamashita at KILC12 in Daegu, Korea, summarised in the Director's Corner a few weeks ago, outlines what is needed to prepare the project – from a project perspective. In my Director's Corner this week, I would like to look to the other side – the technical side. With the writing and editing of the TDR text well underway, it is quite timely to do this.

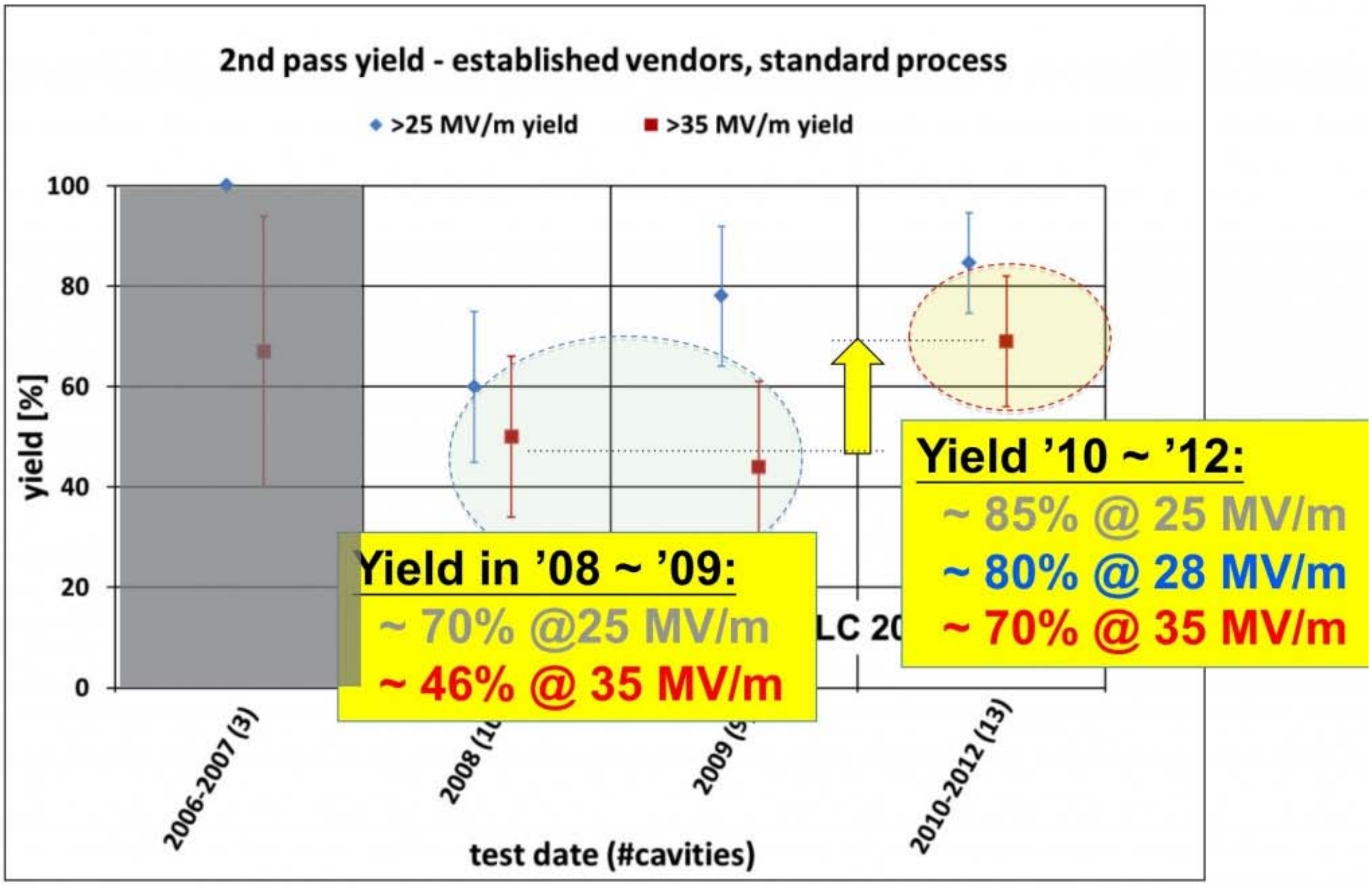
From the start of the Technical Design Phase, in 2007, we formulated and laid out a comprehensive R&D plan with agreed-upon goals and a rough timeline. This was a vital step towards the creation of the GDE R&D team – especially the definition of practical, but still quite challenging, targets. The importance of beam test facilities and cavity processing and test infrastructure was, of course, clear from the start.

At the end of the TDP, three beam test facilities are in operation, CesrTA at Cornell in the US, ATF at KEK in Japan, and FLASH/TTF at DESY in Germany, and two new facilities are coming online, Quantum Beam/STF at KEK and ASTA/NML, at Fermilab, US. On the infrastructure side we have the cavity mass-production and cryomodule assembly just getting started for the European XFEL and the nearly-complete renewal of the well-worn Jefferson Lab cavity processing system in addition to the proven fabrication, processing and test system at KEK and the similar system at Argonne and Fermilab.

What do we have to show for these investments? And what remains to be done? Critical TDP goals have been met but for one notable exception. Using CesrTA, we have developed models, tested them, and demonstrated vacuum chamber designs that will be quite effective in mitigating the electron cloud instability. The CesrTA electron cloud team will publish their report later this summer. Much of what has been learned will be applied in the future Super B-Factories. The CesrTA group will continue to test the performance of the mitigations and will be able to assess the long-term durability of coatings and key vacuum chamber features.

Main linac system testing with beam was deemed important enough to warrant test facilities in each region. These are naturally coupled with the nearby fabrication, processing and assembly facilities. The main linac is an ILC 'cost-driver' and a key element of the system test is value engineering. As we move forward, we expect to gain better understanding of production strategies and costs. FLASH/TTF is most advanced, by far, and beam tests done there have validated the SCRF technology parameters chosen for the ILC (read also this story in *ILC NewsLine*). Going forward, we plan to characterise operation and control at the highest practical gradients and beam currents.

The most visible superconducting radiofrequency performance target has been the 'cavity production yield', set to achieve 90% by the end of the TDP. The graph below, shown at the Project Advisory Committee (PAC) review last month, shows our progress towards that goal.



Progress towards 90% production yield for cavities with an average gradient of 35 megavolts per metre (MV/m).

One of the most positive performance advances seen during the TDP are the very high cavity gradient test results of around 42 MV/m. This led us to allow a *spread* of cavity gradients for the TDR baseline, i.e. cavities with gradients between 28 and 42 megavolts per metre (MV/m) will be accepted for assembly in to cryomodules, giving an average gradient of 35 MV/m as required. The yield of such cavities in 2010 to 2012 is 80%, as shown in the figure, and further work will be done to better understand and improve the remaining margin.

ATF2 is the last on my list. It is the notable exception mentioned above, and it is at ATF2 where serious work towards TDP targets is still underway. Importantly, ATF is the only test facility where beam size has been agreed upon as the goal. This means that the ensemble of beamline components, such as magnets and instrumentation, and their alignment and positional stability with respect to each other has to be correct. In addition, a specialised beam tuning procedure has to be developed and has to show effective convergence so that related issues can be studied. With a target vertical beam size less than 40 nm, there is little margin for error in the overall scheme. The ATF2 team reported their status at KILC12 meeting last month: 169 nanometre.

As I prepared this Director's Corner, the GDE announced that Lyn Evans of CERN has agreed to lead us forward, through the *entrance* that leads to preparation of a proper project. With positive anticipated results from the Large Hadron Collider and a strong positive push from the physicists who will use the ILC, along with the publication of the TDR, we are on our way.

CAVITY GRADIENT | SCRF | TDR | TECHNICAL DESIGN PHASE

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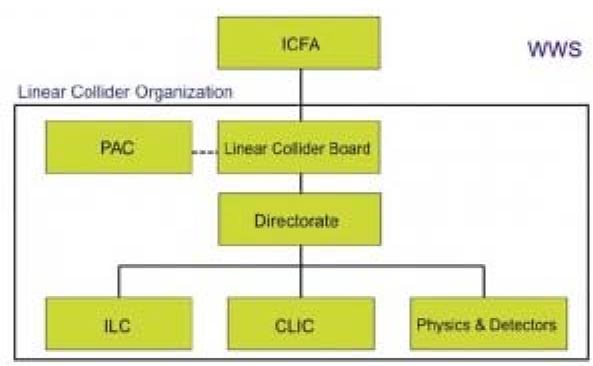
RESEARCH DIRECTOR'S REPORT

Organising the post-2012 era

Jim Brau | 28 June 2012

Last week the International Committee for Future Accelerators (ICFA) announced that Lyn Evans has been selected as the next Linear Collider Director to lead the new Linear Collider Organisation being created to bring the two linear collider programmes under one governance. The end of the GDE and Research Director era, with the completion of the *Technical Design Report* (TDR) on the ILC and the *Detailed Baseline Design* (DBD) report on the ILC detectors, led ICFA and the ILCSC to plan the organisation for the next phase of the linear collider programme, the period leading up to a project start. With the TDR/DBD completed, along with the *Conceptual Design Report* (CDR) for CLIC, the ILCSC has proposed a new structure that ensures close interaction within the broader ILC and CLIC communities. We are pleased by the ICFA director announcement and welcome Lyn Evans into his new leadership role.



The new organisation foresees a director each for ILC and CLIC but only one for Physics & Detectors.

The org chart (see figure) presented by Jon Bagger in recent talks (Granada, Sendai, Daegu) show the entries “SCRF Accelerator” (ILC), “Two-Beam Accelerator” (CLIC) and the “Physics & Detectors” efforts all within a single directorate and each led by an Associate Director (AD). This proposed structure is designed to help guide progress over the next few years, from the TDR/CDR phase to project start.

An org chart is a useful starting point for learning about an organisation, but it leaves many details to the imagination. In this case, the content and role of the single box “Physics & Detectors” may not be broadly understood. The ILCSC certainly has a vision of what is meant. They have seen the excellent grounds-up cooperation within our community in work on the CDR and DBD. Many of us who have devoted many years of commitment to work on the ILC also contributed significantly to CLIC’s CDR. Now many CLIC-focused colleagues are making important contributions to the DBD process. The detectors adopted by CLIC for the CDR were based on the detectors developed over many years and validated for the ILC; CLIC leadership has acknowledged the value that these detector bases provided in enabling CLIC detectors to be rather quickly defined. There are many examples of this cooperation, and we expect it to continue.

Jon Bagger outlined the envisioned role of the Associate Director for Physics and Detectors (CLIC and ILC) in his KILC12 talk. The AD would be responsible for the worldwide effort advancing the physics and detectors of the future linear colliders, both ILC and CLIC. Specifically among the AD responsibilities foreseen by the ILCSC are articulation of the physics case for the linear collider, coordination of R&D on advanced detector technologies, development of detector concepts for both accelerator technologies, and preparing the way for collaboration formation and detector construction.

It is one thing to have grounds-up cooperation. It is another for a management team to set goals and priorities for the effort and participate in the grounds-up organisation. Our past successes have been built on both. The ILC Research Director coordinated our independent work, defining a framework with challenges to drive visible advances through the Common Tasks, LOI, DBD, etc. Our several R&D and concept groups have responded well to these challenges.

In some ways we find ourselves today at a similar period of transition to that which we experienced in 2006-2007. At that time, following the technology choice for the ILC, the GDE had been formed. The worldwide effort for the ILC machine was being organised and making progress toward a technical design backed by demonstrated technology. The World Wide Study Organizing Committee (WWSOC) continuing its stated broad interest in all possible future linear colliders, proposed to the ILCSC during its meeting at DESY in May 2007 that a Research Director be recruited to develop the ILC experimental programme, including the development of detectors, with an eventual production of detector design reports in parallel with progress reports on the machine side. The Letter of Intent process was proposed to launch this, and the concept of an International Detector Advisory Group (IDAG) was also proposed. The ILCSC responded to the WWSOC proposal and recruited Sakue Yamada to serve as the ILC Research Director (RD); this started the RD phase for the ILC. Since then, led by Sakue, we have progressed through a structured process leading to the DBD later this year, guided by the advice of the IDAG. Progress is reported regularly to the ILCSC and monitored by the ILCSC's Project Advisory Committee (PAC). This formal structure resulted in an expansion of the ILC common fund for the detectors, primarily to support the work of the IDAG. The framework has been crucial to our coordinated progress.

Now, we face a new set of challenges, having reached a higher level of readiness. How do we guide our progress over the next few years, following the success of the RD phase, preparing for the possible formation of an ILC laboratory, while continuing, in parallel, to develop the detector technologies for CLIC? There are a variety of views on how to proceed. We must begin by considering what we need to accomplish over the next few years. Foremost, we must maintain our momentum and improve the state of readiness that we have achieved. This is largely due to many independent efforts of interest groups in our community. They prioritise their specific goals, obtain funding, plan activities, and deliver results. This is the core of our effort and progress. While quite independent, their work is elevated and recognised as it fits into a broader mission, one that is defined towards realisation of the linear collider. To continue this successful model requires leadership appointed by ICFA and the ILCSC in the post-2012 era. Formally recognised, this leadership would guide our effort to define goals for the next phase and coordinate our progress.

However, while many of the activities of the ILC and CLIC efforts are common, a potential complication comes from their differing interests. Although combined within the next Linear Collider Organisation, the two accelerator efforts will maintain many separate activities, appropriately, as they have many different components, notably the main linac structure. Therefore, the ILCSC has proposed separate leaders for each machine technology in the organisation. However, the ILCSC has envisioned a closer relationship for the detector groups. While the two detector efforts have been working together very effectively based on many common interests, they also have important differences. For one, the ILC effort counts on an earlier start date. The accelerator technology is more mature and the focus of the ILC physics programme is limited to 1 TeV, while CLIC looks beyond that limit. And the technologies of the detectors have distinctive differences, such as the time structure that must be considered in the detector design. No less important is the interaction of the detector groups with the machine people, often working through the Machine-Detector Interface groups. With two machines having two designs this process is complicated. So there are differences in emphasis.

Can these differences be overcome with a management responsible for both? It is not clear at this time. From the ILC perspective we need a proactive management guiding our steps toward realisation of a collider as soon as possible. An Associate Director for Physics and Detectors in the new Linear Collider Organisation would help us sharpen our readiness and build on our momentum. We look forward to working with Director Lyn Evans to establish an effective management in support of our work.

CLIC | DBD | DETECTORS | ILC | POST-TDR | TDR

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AROUND THE WORLD

The grand unifying 3-D chip

New platform for detector technology brings particle physics and photon science together

Barbara Warmbein | 28 June 2012

The current, most recent module of the "Helmholtz cube" that uses 3-D technology and the latest bonding techniques.

Detector specialists who have been watching and helping with the progress of the vertically integrated micro-electronics – 3-D ASIC chip for short – know that they are in for something big. Something big that's rather small, incidentally, but that's not the main point here – follow this link if you'd like to know more about the details of the incredible shrinking pixel sensor that could one day get us the data from the ILC detectors. Size matters aside, the point here is that the system is so versatile and has so many advantages that it can be used in all sorts of detectors (and even your mobile phone), which is why it plays a major role in a new platform organised and funded by the German Helmholtz Association of research centres on detector technologies and systems. Nine Helmholtz institutions, eleven universities and seven other research institutes from a total of seven countries (France, Germany, Great Britain, Italy, Poland, Switzerland and the US) are involved. Not all of these are particle physics institutes; in fact, they are the minority as many of the others do applied research, for example in medical studies with accelerator-based light sources.

The new platform rests on three pillars – technology, data transfer and detector prototypes. Heinz Graafsma from DESY in Germany, who develops detectors for photon science experiments, coordinates the technology pillar. “We've been pushing for this pillar to develop the 3-D systems further – it will come in handy for all sorts of applications,” Graafsma says. The European XFEL, for example, has inherited the bunch structure from the ILC's planned predecessor TESLA. Conventional detectors cannot read out the results in real time, but they also cannot store all the information – which would lead to a scientist's worst-case scenario: data would get lost. Enter the 3-D electronics: “Thanks to its vertical structure it can store all information from all bunches,” says Graafsma. A no-loss-win situation, so to speak.

Particle physicists and photon scientists have been sitting around one table to develop detector technologies and ways to transfer the data for a while, but rather unofficially and mainly at DESY. The new Helmholtz platform puts the grassroots collaboration on a more official level that also has a much wider scope, with Helmholtz centres like the Dresden institute for material, cancer and nuclear safety research (HZDR) or the Darmstadt heavy-ion research centre (GSI). The platform is subsidised by the Helmholtz Association as a so-called portfolio topic with a total of 13 million euros between 2012 and 2016. After 2016 it is planned to continue the projects developed on the platform within the scope of the Helmholtz Association's research programme.

“There is a lot we can learn from each other, which in the end can help push the technology even further,” says DESY's Ties Behnke, also head of the DESY ILD TPC group for which the 3-D technology could also be interesting. Particle physicists have the big collaborations and experience with solving challenging technological problems on extreme scales, photon scientists have faster turnaround and can thus gain wider and more immediate experience with the new technologies.

One planned application of the newly formed collaboration across the board is the so-called Helmholtz cube – a plug-and-detect component that uses the latest knowledge in not only 3-D ASICs but also the latest (and thinnest) bonding techniques. This Helmholtz cube is currently in the prototyping phase but will by 2013 become a component that Helmholtz researchers can just pick off the shelf, attach their specialised detector to and program it to their specific needs, go to the neutron, photon or high-energy beamline they need for their research.

3-D SILICON TECHNOLOGY | DESY | HELMHOLTZ ASSOCIATION | PARTICLE PHYSICS | PHOTON SCIENCE