NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

Special issue: Celebrating ten years since Snowmass (and ten years of NewsLine)

Ten years ago, scientists from all over the world gathered in the picturesque town of Snowmass in the US to constitute a new global collaboration for a future particle collider called the International Linear Collider. People who had worked on several different concepts for a linear collider reshuffled to work together on the ILC and its challenging technologies. They researched, designed, tested and improved the machine's design and continue to do so to this day, hoping for a governmental go-ahead. However, the ILC is not the only concept for a collider to complement the LHC at CERN. What has happened in these ten years, and where does the project stand today?

DIRECTOR'S CORNER

Ten Years and Counting...

Former GDE Director Barry Barish revisits the project he led for eight years

by Barry Barish

As is appropriate for an anniversary issue, this week's Director's Corner is authored by Barry Barish, who led the project from its conception in 2005 through major milestones up to the publication of the Technical Design report in 2013 and the formation of the Linear Collider Collaboration. He looks back at past achievements and advises the linear community to remain very, very patient.

FEATURE

And Still They Will Collide

by Barbara Warmbein

Is the beam delivery system delivering? Ten years ago, at the Global Design Effort's formative meeting in Snowmass, Colorado, ILC communicator Perrine Royole-Degieux interviewed Phil Burrows, then professor at Queen Mary University of London, about the beam delivery system. How has the home straight where the particle bunches get squeezed, focused and brought to collision, evolved in a decade?

FEATURE

The Big Milestone Timeline

IMAGE OF THE WEEK


ILC NewsLine

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Some 400 issues of ILC / LC NewsLine later the accelerator and detector designs have matured a lot, the project has experienced some ups, some downs and has taken many "important steps towards realisation," including the selection of a possible site in northern Japan.

While R&D continues and the community keenly anticipates results from the LHC's run 2, the project is now at a stage where its realisation is down to political decisions rather than technological challenges.

Have a look at the first edition and the archive and send us your personal memories of highlights from the last ten years ans hopes for the next ten!

IN THE NEWS

from *symmetry magazine*
18 Augsut 2015
The age of the universe
How can we figure out when the universe began?

from *CERN*
17 August 2015
ALICE precisely compares light nuclei and antinuclei
The ALICE experiment at the Large Hadron Collider (LHC) at CERN has made a precise measurement of the difference between ratios of the mass and electric charge of light nuclei and antinuclei.

from *Oshu city*
11 August 2015
Oshu for You, Episode 12 Esashi Fujiwara no Sato
New episode of “Oshu for You” with members of the ILC Support Committee, Episode 12 “Esashi Fujiwara no Sato.” Watch Amanda from Iwate prefecture trying to shoot an arrow like Katniss in the Hunger Games.

from *Argonne National Laboratory*
10 August 2015
Weerts to lead Physical Sciences and Engineering directorate
Hendrik (Harry) Joseph Weerts has been named the associate laboratory director for the Physical Sciences and Engineering (PSE) directorate at the U.S. Department of Energy’s Argonne National Laboratory. Weerts has served in the role on an interim basis since May 2014.

from *Iwate Nichi Nichi*
8 August 2015
あふれる色、人　一関夏まつり
設置された竹飾りは計57本。誘致が期待される次世代の大型加速器「国際リニアコライダー（ＩＬＣ）」の文字を組み入れたものなど工夫を凝らした作品が並んだ。(At the Tanabata Star festival, total of 57 bamboo decorations was displayed, which design included ILC)

CALENDAR

Upcoming events

XXVII International Symposium on Lepton Photon 2015 (LP 2015)
Ljubljana Exhibition and Convention Centre, Slovania
17- 22 August 2015

10th International Positron Source Workshop (POSIPOL 2015)
Cockcroft Institute, UK
02- 04 September 2015

17th International Conference on RF Superconductivity (SRF2015)
Whistler, BC, Canada
13- 19 September 2015

Upcoming schools

15th Hellenic School and Workshops on Elementary Particle Physics and Gravity (Corfu2015)
Corfu, Greece
01- 26 September 2015

The 2015 European School of High-Energy Physics
Bansko, Bulgaria
02- 15 September 2015

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1508.04383
Non-Simplified SUSY: Stau-Coannihilation at LHC and ILC

1508.03544
Production cross section estimates for strongly-interacting Electroweak Symmetry Breaking Sector resonances at particle colliders

1508.03363
Status and Challenges for FCC-ee

1508.03245
Status and CDiscriminative phenomenological features of scale invariant models for electroweak symmetry breakinghallenges for FCC-ee

1508.03031
Dark matter and neutrino masses from a scale-invariant multi-Higgs portal

1508.01208
Putting a Stop to di-Higgs Modifications

NEWSLINE
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DIRECTOR'S CORNER

Ten Years and Counting…

Former GDE Director Barry Barish revisits the project he led for eight years

Barry Barish | 20 August 2015

Younger selves: Snowmass 2005 participants.

Many of the striking advances in particle physics during the particle collider era have resulted directly from the complementarity of hadron-hadron and electron-positron colliders. Unfortunately, it is not practical to build a complementary circular electron-positron collider for the LHC capable of reaching center-of-mass energies of about 1 TeV (tera electronvolt) because of the large amount of energy radiated away as the electrons traverse around the circular ring. As a consequence, alternate and ambitious efforts have been undertaken to develop a high energy linear collider that will not have this problem.

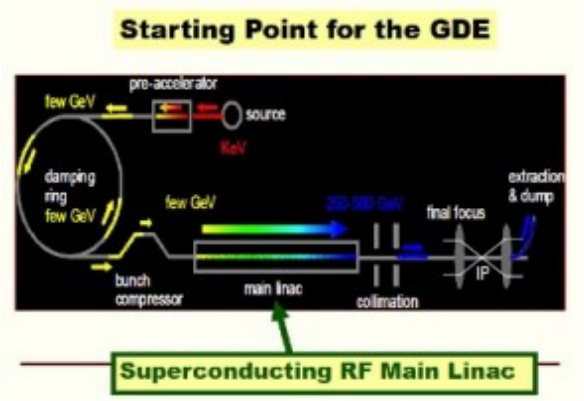
But, in contrast to the very successful circular colliders where particles collide on each traversal, a linear collider is a single-pass machine. This creates a whole new set of challenges. Since the particles go through each accelerating element only once in a linear collider, the radio frequency (RF) accelerating cavities must both have high gradients and be very efficient at transferring wall plug power into beam power. Also, since the electrons and positrons only cross each other once, the beams must be focused to extremely small (a few nanometres) beam spot sizes at the interaction point in order to achieve high collision rates.

The plan to build a linear collider motivated ambitious R&D programmes in the 1990's at SLAC in the U.S. and KEK in Japan on technologies for a room temperature linear collider, and at DESY in Germany for a low-temperature machine. Both programmes proved successful and the International Committee for Future Accelerators ICFA then took the responsibility of choosing which approach to pursue through creating an International Technology Review Panel (ITRP), which I chaired.

The ITRP process led to the choice of the low-temperature technology using superconducting RF cavities, and ICFA then asked me to become the Director of a Global Design Effort (GDE) to coordinate the R&D and design of a 0.5 – 1.0-TeV linear collider. I officially became the Director at a meeting at SLAC in March 2005, the GDE was born and we published the first issue of Newsline, including a Director's Corner on 18 August 2005.

As I explained in Symmetry Magazine at that time, *"The first decision I made was not to create a home laboratory for the GDE as had been outlined in the earlier plans. My reason is quite simple. If we want to move forward quickly and in the best way, we must involve in the GDE the key persons who have been developing the technologies and designs for the ILC. Recruiting and moving this set of people to a new site for what is still a fledgling project seemed unrealistic to me. My background is in large particle experiments and there we are very used to developing a design for a complex and difficult project with a dispersed collaboration."*

The first meeting of the GDE was at Snowmass 2005 where we set out our goals and plans. We agreed on plans to create an early conceptual design and then proceed to a technical design for the ILC. We coordinated the worldwide R&D programme, worked with experimentalists on the machine parameters, interfaces, as well as the concepts for the interaction region. We ambitiously set a goal of accomplishing a Technical Design Report within about five years, publishing a Refernce Design Report in 2007 and an Interim Report in 2011. It actually took us two years longer, due to financial cutbacks in 2008 and some of our own delays. The final product (TDR), underwent a rigorous year-long series of international technical and cost reviews before being officially released in June 2013.



I reported on the ILC/GDE design concept to HEPAP in May 2005.

The follow-on Linear Collider Collaboration (LCC), under Lyn Evans is continuing the R&D and design programmes and is facilitating the Japanese interest in hosting the project. The discovery of the Higgs boson has given the ILC a big boost, as detailed measurements at the ILC both at Higgs threshold and higher energies can uncover the underlying physics of this totally new and important phenomenon. In addition, we all look forward to results from the present run at LHC, where will certainly give even further motivation and guidance for the ILC physics programme.

We all await the Japanese government to hopefully make a positive decision to host this ambitious project as a part of a CERN-like worldwide collaboration. At present, the Japanese government is carrying out a review in their due diligence on the technology, costs, social impacts and reality of international collaboration. The science case for the ILC is compelling, the technical design is complete and practical, a very good site has been evaluated in Japan, and the site-dependent design is underway. The project cost is large, but it is comparable to other such large science projects like the LHC.

So, what's next? In my view, we must 'stay the course,' especially in facilitating the process and, above all, remaining very very patient. In the words of Confucius, *"It does not matter how slowly you go as long as you do not stop."*

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FEATURE

And Still They Will Collide

Barbara Warmbein | 20 August 2015

Phil Burrows re-enacting his explanation of the beam delivery system. Image: Oxford Physics Media Services

Is the beam delivery system delivering? Ten years ago, at the Global Design Effort's formative meeting in Snowmass, Colorado, ILC communicator Perrine Royole-Degieux interviewed Phil Burrows, then professor at Queen Mary University of London, about the beam delivery system. How has the home straight where the particle bunches get squeezed, focused and brought to collision, evolved in a decade?

It has evolved a lot, says Phil Burrows, who is still working on the project, now from Oxford University. While the 2005 article still wondered whether there would be two interaction points and whether consensus would be reached for a recommendation to the ILC management, things are now much clearer. "The biggest change in the world of beam delivery was the down-sizing from two to only one interaction point," says Burrows. The decision, taken in 2007, reduced considerably the civil engineering and beamlines and thus lowered the cost of the project. It also meant one less problem to solve for the beam delivery experts, because switching between two beam delivery tunnels while maintaining collisions and delivering high luminosity to both detectors would have been tough.

But eliminating one beam delivery tunnel didn't mean eliminating one detector – physicists don't back away from challenges for maximising discovery potential so easily. Instead they reinvented the interaction region, the place where electrons and positrons are actually brought to collision in the ILC. Instead of two tunnels serving two huge caverns housing one detector each, there will only be one (massive) cavern. This allows one detector to take data at the collision point while the other one is off beamline; then they swap places in an intricate detector ballet affectionately called 'push-pull'.

After a lot of discussion, the detector, machine and machine-detector-interface teams decided on a crossing angle of 14 milliradians (mrad), "another major milestone," says Burrows, because it meant that both selected detector concepts could adjust their designs and simulations accordingly. "But nothing is forever: we are continuing to optimise the design. At the moment we are looking at settling on the same focal length (the distance between the last focusing magnet and the actual interaction point) for both detectors, which would make machine operation easier but would also affect the inner detector design.

But beam delivery is more than tunnels and angles: beam size is critical. The beams of the ILC will need to be incredibly tiny, and the accelerator test facility ATF2 at KEK in Japan is the place where accelerator experts tweak it down to the designated beam size (in an energy-scaled version). Last year they broke the record of smallest beam size ever produced at 44 nanometres and demonstrated that they can maintain such small beams. Tests now continue to make them even smaller while increasing the beam current.

Another aspect of beam delivery is the very fast steering of the beams to make them collide at the IP, a project called Feedback on Nano-second Timescales or FONT. It is led by Phil Burrows, who says that FONT has ticked all the R&D boxes over the years: "We have demonstrated all technologies to build the intra-train beam-based feedback system. Beam position monitors with the needed resolution – tick. High-power amplifiers – tick. Prototype kickers – tick. A digital feedback system working on a bunch-by-bunch timescale – tick." Like the others, this project continues to evolve and is already being used and adapted for other linear collider applications: the technology is

used in the CLIC test facility CTF3 as a feed-forward system. “It makes sure that the drive beam, CLIC’s unique acceleration concept, will arrive at the accelerating structure at exactly the right time,” Burrows says. He should know: he became CLIC accelerator spokesman in 2014.

ACCELERATOR R&D | BEAM DELIVERY SYSTEM | FONT | MDI | SNOWMASS

10 YEARS OF GDE, ILC AND NEWSLINE

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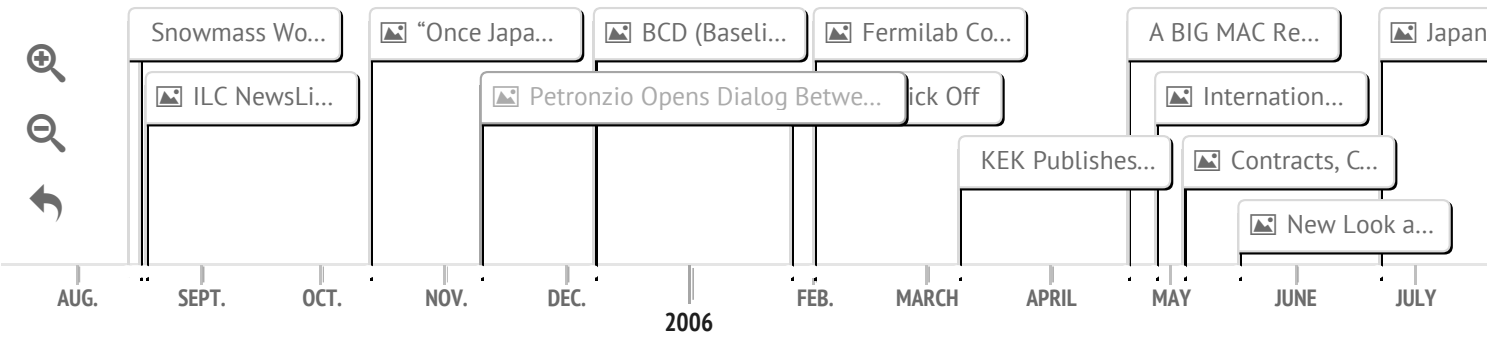
SNOWMASS WORKSHOPS



LC NEWSLINE
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IMAGE OF THE WEEK

First editions

20 August 2015


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