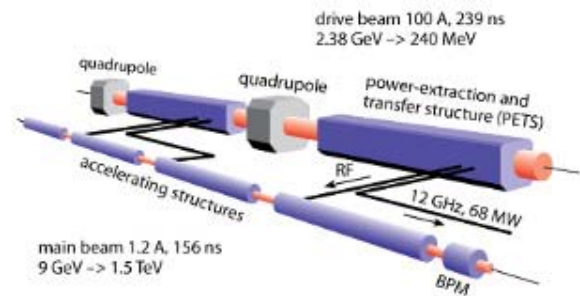
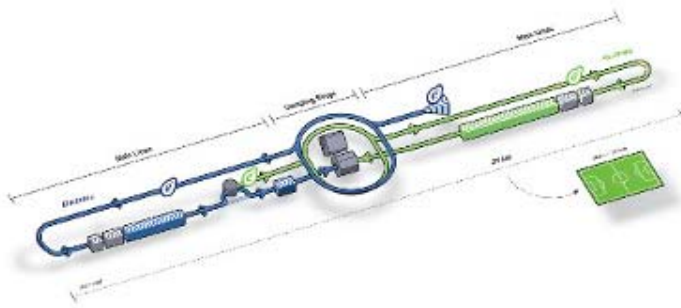


DIRECTOR'S CORNER

Moving towards one linear collider project

by Barry Barish



There are two very different technical approaches to implementing a future TeV-scale linear collider. The International Linear Collider is based on a superconducting radiofrequency main linac, while the Compact Linear Collider uses a two-beam acceleration concept. How will this lead to a single linear collider project?

RESEARCH DIRECTOR'S REPORT

The Higgs mandate

This month's Research Director's Report was written by Hitoshi Yamamoto, co-chair of the Worldwide Study and regional detector contact for Asia

by Hitoshi Yamamoto



One of the primary goals of the next global ILC workshop in Daegu, Korea, in April 2012 is to clarify the physics mandate of the ILC corresponding to narrowed-down physics scenarios, based in particular on LHC results from the Higgs boson search.

FEATURE

International forum reviews linear collider physics case

by Perrine Royole-Degieux



The international community of theorists and experimentalists working on ILC and CLIC is convinced of the strong physics case for a generic linear collider. More than one hundred of them gathered at DESY last week for three days of intense discussions and review of the different physics scenarios. Two papers are now under way and will be finalised by this summer. In the meantime the input from the whole particle physics community will be very welcome.



Japanese civil engineers visit DESY and CERN

Image: Hans-Joachim Christ, DESY

A delegation from the Japanese Society of Civil Engineering visited the European labs CERN and DESY this month to learn about how the laboratories run their projects.

IN THE NEWS

from **Nature**

14 February 2012

Obama shoots for science increase

Several basic-research programmes are trimmed, including nuclear physics and high-energy physics, a shift that is consistent with the administration's emphasis on applied research that is most relevant to energy technology.

"Basic research is systematically down," says Milind Diwan, a physicist at Brookhaven National Laboratory in Upton, New York, and co-spokesman for a planned particle physics experiment that received a drop in funding. "Those of us in fundamental-research have to live within those priorities."

from **BBC News**

14 February 2012

LHC energy boost will aid hunt for Higgs boson

The boost should improve the collider's chances of discovering "new physics" and definitively confirming or denying the existence of Higgs boson particle.

The proton beams' energies will be increased by 14%, for a total collision energy of 8 trillion electron volts.

from **Science**

13 February 2012

At DOE, Body Blows to Fusion, Nuclear Physics, and Particle Physics

The news for high-energy physicists may be even worse. The budget for such research, which explores fundamental particles and forces primarily through particle collisions, would fall 1.8% to \$777 million. That sounds like a mere haircut, but the effect at the United States' last dedicated particle physics laboratory, Fermi National Accelerator Laboratory (Fermilab) in Batavia, Illinois, could be momentous. "At first blush, it looks like a fairly disastrous budget," says Fermilab Director Pier Oddone.

from **CERN**

13 February 2012

LHC to run at 4 TeV per beam in 2012

It is accompanied by a strategy to optimise LHC running to deliver the maximum possible amount of data in 2012 before the LHC goes into a long shutdown to prepare for higher energy running. The data target for 2012 is 15 inverse femtobarns for ATLAS and CMS, three times higher than in 2011.

from **IPMU**

13 February 2012

Missing dark matter located – Inter-galactic space is filled with dark matter

Galaxies have no definite "edges", the new research concludes. Instead galaxies have long outskirts of dark matter that extend to their nearby galaxies; the inter-galactic space is not empty but filled with dark matter

CALENDAR

UPCOMING EVENTS

CALICE collaboration meeting

Shinshu University, Matsumoto, Japan
05- 07 March 2012

ILC Mechanical & Electrical Review and CFS Baseline Technical Review

CERN
21- 23 March 2012

UPCOMING SCHOOLS

Physics and Technology of Particle Accelerators (JUAS 2012)

Geneva, Switzerland
09 January- 16 March 2012

Excellence in Detectors and Instrumentation Technologies (EDIT 2012)

Fermilab, Batavia, IL, USA
13- 24 February 2012

USPAS sponsored by Michigan State University

Grand Rapids, Michigan, US
18- 29 March 2012

[View complete calendar](#)

PREPRINTS

ARXIV PREPRINTS

1202.3017

Development of readout ASIC for FPCCD vertex detector

1202.2761

Forward Tracking in the ILD detector

1202.2673

Higgs portal dark matter at a linear collider

1202.1991

Implications of SUSY Searches at the LHC for the ILC

1202.1701

Charged Higgs Detection in the $\tau\nu$ Decay Mode at Future
Linear Colliders

1202.1533

Shielding Studies for Superconducting RF Cavities at
Fermilab

DIRECTOR'S CORNER

Moving towards one linear collider project

Barry Barish | 16 February 2012

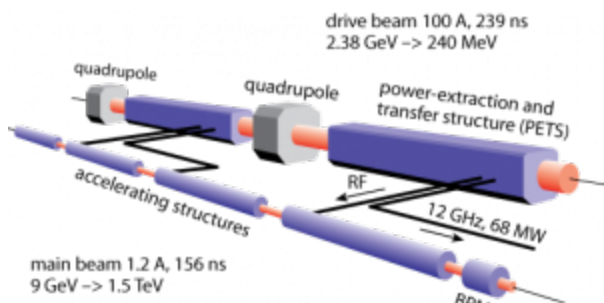


The International Linear Collider, based on superconducting radiofrequency technology. Image: ILC / form one visual communication

The International Linear Collider (ILC) is based on superconducting radiofrequency technology, while the Compact Linear Collider (CLIC) uses a two-beam acceleration concept. The ILC technique is more mature and the design more advanced: we are now putting together a detailed *Technical Design Report* that could serve as the basis of construction project. The CERN-based CLIC study still must demonstrate feasibility of the concept, and then the team will need to do systems demonstrations and develop a detailed machine design. So the timescale for CLIC is considerably longer. However, the CLIC energy reach is greater and that may be an important consideration. Meanwhile, the whole particle physics community awaits CERN's Large Hadron Collider physics results, which we anticipate will justify a future

linear collider, as well as guide the required parameters such as energy reach.

For several years, we have had a set of joint ILC/CLIC technical working groups that have served to exchange information, avoid duplication of effort and provide help to each other. In summer of 2010, we decided at a joint Global Design Effort (GDE) Executive Committee and CLIC Steering Committee meeting that it would be valuable to form an additional joint group to look at more general or strategic issues. Such issues could include agreed-upon points of comparison for the two approaches, determine what information is needed for making comparisons, and align dates and deliverables with expected decision points.



The Compact Linear Collider, using a two-beam acceleration scheme

After some discussion inside the International Linear Collider Steering Committee (ILCSC) about the role and mandate for this "general issues" group, the concept was endorsed with the proviso that this particular working group report directly to ILCSC and to the CLIC Collaboration Board, their equivalent oversight committee. This General Issues Working Group released its [first interim report](#) a year ago and last month they released its [second interim report](#). The ILC/CLIC General Issues Working Group membership is: Eckhard Elsen (DESY), Mike Harrison (BNL, co-chair), Philippe Lebrun (CERN, co-chair), Ken Peach (Oxford), Daniel Schulte (CERN) and Kaoru Yokoya (KEK).

The General Issues Working Group has met approximately monthly, and their first interim report concentrated on two elements of the charge:

- Identify synergies to enable the design concepts of ILC and CLIC to be prepared efficiently;
- Discuss plans for the ILC and CLIC efforts in order to identify common issues regarding siting, technical issues and project planning.

This first interim report contains a series of conclusions and recommendations.

Their first important conclusion came after reviewing the progress and plans of each joint working group. They concluded generally that "the common working groups have demonstrated their efficiency in tackling the technical challenges of a linear collider jointly."

We have built on this observation over the past year. For example, the joint ILC/CLIC detector group has contributed significantly to the recently released *CLIC Physics and Detector Conceptual Design Report*. Similarly, the joint ILC/CLIC Conventional Facilities Working Group is playing an important role towards that part of the ILC *Technical Design Report (TDR)*.

Another important conclusion of the General Issues Working Group was that they “did not find the potential for cost savings in a phased approach to a linear collider compelling enough at this time to warrant any significant effort to investigate further.” This practical conclusion significantly reduces the number of options that we need to investigate.

Finally, an issue that was raised in the first interim report was the necessity of developing acceptable systems test programmes for each technology that would precede construction. Both groups have taken steps to address that issue, CLIC in their five-year R&D plan and the ILC GDE in their presentation last fall to the ILC Project Advisory Committee.

The second interim report focusses on two of the remaining charge items, specifically, elements of project implementation (siting and technical procurement strategy) and comments on the linear collider decision process. The recommendations and conclusions of the report are summarised below:

- *The LC will be a jointly operated facility that will require appreciable infrastructure to host an international work team.*
- *The overall power requirements and energy management of a LC should be systematically examined and optimized so as to include efficient design of components and operation of the facility during its life cycle.*
- *Establish industrial architecture prior to launching procurement for each type of component, based on technical criticality, maturity of design, series numbers, quality assurance requirements, market structure and production follow-up capabilities.*
- *Develop cooperation with industry from early stages of the project, ensuring sufficient competition to be maintained throughout the procurement phase.*
- *Do not transfer to industrial suppliers technical responsibilities, which the project management is better placed to assess and to take.*
- *Maintain sufficient resources in the home laboratory to cope with tasks outside the capabilities or interest of industry, and to face unexpected technical, commercial or financial difficulties in the execution of the contracts.*
- *Following the anticipated regional reviews during 2012/3 on the state of particle physics in the light of the results from the first run of the LHC and other experimental and theoretical developments, and the strategic considerations that follow from them, the implications for the linear collider will need to be then assessed globally.*
- *Until the future of the linear collider program is more clearly established we recommend that no change be made to the successful joint WG operations.*



Philippe Lebrun (CLIC, CERN) co-chair of the General Issues Working Group



Mike Harrison (ILC, BNL), co-chair of the General Issues Working Group

The plan of the General Issues Working Group is to continue their work this coming year and to then issue one final report, which will “address points of comparison between the two approaches to the linear collider. Currently we envisage this to cover physics reach, accelerator technology, and cost and power estimates. In preparation for this report we are currently seeking input on the accelerator technology topic from the technical joint working groups. Additionally, we expect this analysis to provide recommendations for areas of joint efforts in the future.”

On behalf of the GDE, I can state that we find the recommendations of this joint working group to be thoughtful and follow sound project management principles. We welcome the recommendations and conclusions and believe that this has been a healthy and productive process. In particular, having an internal joint group of individuals from both CLIC and ILC working together on general issues that face moving a linear collider project ahead is a good step towards decision-making and consensus. I believe that both the ILC and CLIC are benefitting from looking together at issues that may well bear on the choice of what linear collider project goes forward.

RESEARCH DIRECTOR'S REPORT

The Higgs mandate

This month's Research Director's Report was written by Hitoshi Yamamoto, co-chair of the Worldwide Study and regional detector contact for Asia

Hitoshi Yamamoto | 16 February 2012



Next ACFA Physics and Detector Workshop and GDE meeting on Linear Collider (KILC12) will be held in Daegu, Korea. Image: KILC12

The joint ACFA Physics and Detector Workshop and GDE meeting on Linear Collider ([KILC12](#)) will be held in Daegu, Korea, from 23 to 27 April 2012. The timing of the workshop is likely to be just after the first combined result on the Higgs particle by two LHC experiments, ATLAS and CMS, is announced at the spring conferences. On 13 December last year, a press conference was held at CERN announcing that they saw tantalising hints of the Higgs particle, though they were not conclusive. LHC physicists have been working hard to improve their analyses ever since, but the combined results that would be announced this spring will be based on essentially the same amount of data as last year. A significant increase of statistics would have to wait for the 2012 summer conferences. With an indication of the Higgs particle at around 125 GeV, however, the possible physics scenarios for the ILC are rapidly becoming concrete. Thus, one of the primary goals of the Daegu workshop is to clarify the physics mandate of the ILC corresponding to the narrowed-down physics scenarios.

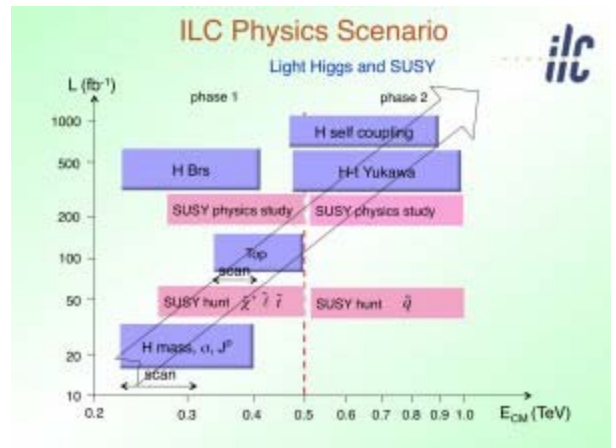
Before jumping into the ILC mandate, let us look at how significant the observed hints are for the Higgs particle. Suppose the Higgs particle did not exist. In this scenario, there is some probability that statistical fluctuation could result in an excess of events that may look like a Higgs signal. According to the [updated reports by ATLAS and](#)

[CMS](#), if the Higgs particle did not exist, the probability that the statistical fluctuation alone produces a Higgs signal anywhere between 110 GeV and 600 GeV that is more significant than the actually observed signals' probabilities are 0.014 and 0.069 for ATLAS and CMS, respectively. Then, what is the combined probability of the two experiments? Here, one has to take into account that the two experiments observed an excess of events at the same Higgs mass around 125 GeV. That is, once one experiment sees a signal at a certain Higgs mass, another experiment can then focus on that mass. Even though the proper and official procedure for combining the two results will be presented soon, the combined number would be much less than the simple product of the above two probabilities. This is indeed a small number, but it is right for them to be conservative and not to claim a discovery yet. After all, this is the Higgs. Still, it seems to be reasonable for us to think about the physics mandate of the ILC assuming that the Higgs particle really exists there.

The mass of Higgs where the excess was seen (that is, approximately 125 GeV) happens to be very interesting and optimal region where the ILC can perform a rich variety of physics studies. If the mass were larger, around 160 GeV, the Higgs would decay mostly to WW and ZZ, and it would be difficult to measure the decays to other final states where we can verify if the Higgs particles

is the origin of mass. And, if the Higgs mass were lower, then the Higgs signal would become weak and it may not be discovered by the end of 2012, setting up a murky situation surrounding the Higgs particle that could persist for a few more years.

Indeed, we have been working on the ILC in order to study ‘this’ Higgs particle, which can be observed in one day of data-taking at the ILC while it takes about a year at the LHC. The figure shows the physics topics to be studied by the ILC in the scenarios that the Higgs particle is light (around 125 GeV) and that nature chooses supersymmetry to exist. The topics shown in blue belong to the Standard Model, and they, if the Higgs is light, are mostly guaranteed for the ILC. The ones shown in pink are those of the supersymmetry, and they may not exist or may be replaced by other new physics such as models with extra dimensions. As mentioned in the previous research directors’ reports ([20 October 2011 by Sakue Yamada](#) and [17 November 2011 by Michael Peskin](#)), it is important to note here that the Higgs particle is not just another new particle: its field fills the vacuum of the universe, giving mass to all massive elementary particles of the Standard Model, and it embodies a serious inconsistency of the Standard Model that requires that some new physics should exist in the Terascale. Many new physics models would lead to Higgs properties that delicately deviate from those of the Standard Model with patterns specific to the models, and precision measurements of the Higgs particle is likely to point to the correct physics.



A possible ILC physics scenario

At the KILC12 workshop, a large part of the afternoon of the opening day is dedicated to the LHC results and their implications for the ILC, and a panel discussion is planned later in the workshop. Lively exchanges of opinions are expected. The workshop has other important benchmarks: the outline of the detailed baseline design of the ILC physics and detector efforts will be presented to the International Detector Advisory Group, and the accelerator baseline will finally be announced after intense optimisation efforts.

Late April is a nice season in Korea and participants can also enjoy excursions to nearby historic sites. See you all soon in Daegu!

[ASIA](#) | [DAEGU](#) | [HIGGS](#) | [LHC](#) | [PHYSICS CASE](#) | [PHYSICS SCENARIO](#) | [STANDARD MODEL](#)

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FEATURE

International forum reviews linear collider physics case

Perrine Royole-Degieux | 16 February 2012



Family picture at the 2012 Linear Collider Forum at DESY, Germany. Image: DESY

2012 will be a decisive year for particle physics and the linear collider projects. What will be the outcome of the [update of the European strategy for particle physics](#)? In light of CERN's Large Hadron Collider (LHC) 2012 results, will the linear collider physics case stay strong?

The international community of theorists and experimentalists working on ILC and CLIC are convinced it will be even stronger and they're working hard at demonstrating it. More than one hundred of them gathered at DESY last week for three days of intense discussions and review of the different physics scenarios. Besides and complementary to the physics chapters of the ILC *Technical Design Report* and CLIC *Conceptual Design Report*, two papers are now underway to make the

strongest possible case for a generic linear collider.

The [Linear Collider Forum](#) is traditionally aimed at the German linear collider community, as an initiative of the Helmholtz Alliance "Physics at the Terascale".

"Because this year is special, we invited our colleagues from abroad and focused our discussions specifically on linear collider phenomenology," said Gudrid Moortgat-Pick, a theorist from the University of Hamburg and co-chair of the forum.

An important part of the meeting was dedicated to a thorough review of brand new LHC results, with presentations from the ATLAS and CMS collaborations on the Higgs, top physics, supersymmetry and searches for exotic new physics. ILC and CLIC phenomenologists presented their latest results on benchmark studies, which shows the linear collider detector performances. They reviewed important physics scenarios and addressed the main questions that can be answered by a linear collider, including those that cannot be addressed by the LHC.

"A precision machine, the linear collider, is needed for example to fully identify and understand the Higgs boson, whatever its mass will be revealed to be," said Sabine Riemann from DESY Zeuthen, co-chair of the forum.

A key discussion during the forum was how to share these results with the particle physics community and how to make the linear collider physics case clear independently of which machine (ILC or CLIC) would eventually run the beams.

Two papers are now under preparation.

In the first one, the forum aims at compiling the contributions to the workshop into a thorough 100- to 150-page review article. It is planned to be submitted by this summer to the *European Physical Journal*. The paper will cover many different physics scenarios, without a



3rd Linear Collider Forum at DESY, Germany. Image: DESY

detailed comparison of the relative performance of the respective machines. The physics motivation for a linear collider will be demonstrated, exploring Higgs and top physics, Standard Model precision measurements and of course physics beyond the Standard Model.

As reflected in the presentations during the forum, this review paper will demonstrate that all types of measurements needed for new discoveries and full scans of LHC results are actually within reach at a linear collider. "Everybody from the particle physics community is warmly welcome to participate in the writing of this paper so that we can draw the clearest and most comprehensive picture of the field," said Moortgat-Pick. Those interested in contributing are invited to contact the LC forum chairs as early as possible. A dedicated website is now in place for more information: lcforum.desy.de

The second paper was briefly presented during the forum and will be considered as the official linear colliders input for the European Strategy Group. It will be delivered before the end of July to the European Strategy Preparatory Group by the Global Design Effort European Regional Director Brian Foster, CERN Linear Collider Studies Leader Steinar Stapnes and the chair of the ECFA Study for the Linear Collider, Juan Fuster. An international and dedicated ILSCS subcommittee, chaired by François Le Diberder (LAL, France) is in charge of drafting this very short 15-page document, with the help of the community.

Frank Simon from the Max-Planck-Institute of Physics, Munich, co-chair of the forum, was (happily) surprised by the success of the forum with participants coming from all over the world and from both ILC and CLIC communities. "You could feel optimism in our community," he said. "2012 is a busy and decisive year for us with exciting LHC results ahead, the release of the ILC *Technical Design Report*, the CLIC *Conceptual Design Report*, the European strategy for particle physics and the emergence of Japan's interest in hosting the ILC!"

Simon, together with the LC-Forum team, is also welcoming the common approach of ILC and CLIC in writing a global case for a linear collider. "We need a precision machine to complement the LHC," he said. "At which energy, we hope Nature will tell soon. In the meantime we need to get ready."

Further links:

- [Linear collider forum website](#)
- [2012 Linear collider forum agenda and slides](#)
- Further reading in *ILC NewsLine*: "[Is the Higgs enough?](#)"

[CLIC](#) | [DESY](#) | [EUROPEAN STRATEGY FOR PARTICLE PHYSICS](#) | [LC FORUM](#) | [PHYSICS CASE](#)

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