LC NEWSLINE
THE NEWSLETTER OF THE LINEAR COLLIDER COMMUNITY

IMAGE OF THE WEEK

Lyn Evans pays courtesy visit to Japan's prime minister Shinzo Abe

Images: Prime Minister of Japan and His Cabinet

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FEATURE

A spin-off of ILC technology – already

by Rika Takahashi

On 15 March, scientists working on the Quantum Beam Technology Program at KEK's superconducting RF test facility (STF) confirmed the successful generation of X-rays using Inverse Compton Scattering (ICS) with superconducting radiofrequency (SCRF) acceleration technology. This is the world's first successful implementation of ICS X-ray sources with SCRF technology.

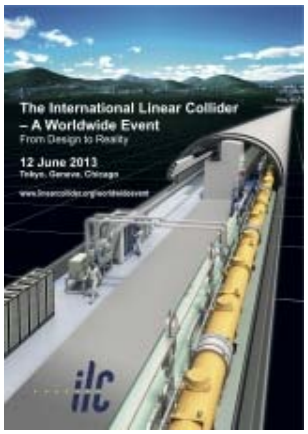
DIRECTOR'S CORNER

Le roi est mort, vive le roi ! (*)

by Mike Harrison

The problems of succession to the throne have bedeviled society throughout the ages. For centuries the European approach seemed to involve bloodshed ranging from the personal to the national level. The recent transfer of power in the linear collider world might not have been violent, but it still faces the eternal question of "OK, so where do we go from here?" Here are some thoughts on the ILC programme.

ANNOUNCEMENTS



From design to reality

12 June 2013 is a very special day for the ILC community. We are organising a global event, starting in Tokyo, moving to CERN and finally in Fermilab - to celebrate the publication of the Technical Design Report. We have invited VIPs from across the fields of politics, research funding, science and education to hear talks on ILC, public lectures, look to the future and to celebrate with us. However, the most important group is YOU, the people who did the work that made the TDR possible. Mark your calendars and join us for your local event. Please register at linearcollider.org/worldwideevent.

IN THE NEWS

from ***Nishinippon***
28 March 2013
「　　九州誘致に協力を」 推進会議が地元選出議員に要請
「国際リニアコライダー」　　を福岡、佐賀県境の脊振山地に誘致する産学官組織の「　　アジア−九州推進会議」は　日、都内のホテルで九州・山口選出の国会議員　人に誘致への協力を訴えた。(The association aims to invite ILC to Kyushu area met in Tokyo and asked for the cooperation to the 50 Diet members from Kyushu and Yamaguchi area)

from ***CERN Courier***
28 March 2013
Colliders unite in the Linear Collider Collaboration
The Compact Linear Collider (CLIC) and the International Linear Collider (ILC) – two studies for next-generation projects to complement the LHC – now belong to the same organization.

from ***Iwate Nippo***
27 March 2013
2大臣に　　誘致を要望 東北7団体の関係者
北海道東北地方知事会など地方　団体と東北　　推進協議会は　　日、山本一太科学技術担当相や根本匠復興相らに　　の東北誘致に関する要望を行った。山本科学技術担当相は「安倍内閣として方針を定めた上で要望を踏まえて検討したい」と述べた。(Six governors of north east area of Japan together with Tohoku ILC promoting association visited Ichita Yamamoto, Minister for science and technology and Takumi Nemoto, Minister for recovery and asked for the invitation of ILC to the Tohoku area)

from ***Kyodo News***
26 March 2013
岩手への次世代加速器誘致を要望 宮城県知事
宮城県の村井嘉浩知事は　日、内閣府を訪れ山本一太科学技術担当相と会談、宇宙の謎の解明を目指す次世代加速器「国際リニアコライダー　　」を、岩手県の北上山地に誘致するよう要望した。(Miyagi prefecture governor Yoshihiro Murai visited Science & Technology Minister Ichita Yamamoto and asked for the invitation of the ILC to Kitakami mountains)

from ***Physics Today***
24 March 2013
Momentum grows to build International Linear Collider in Japan
Japan's Advanced Accelerator Association for Promoting Science and Technology, whose members include nearly 100 companies, is actively campaigning for the ILC. "It would bring jobs," says Masanori Matsuoka, manager of Mitsubishi Heavy Industries and secretary general of the AAA. "This project is very important to realize innovation in Japan." The AAA estimates that construction alone would infuse the host region with up to $22 billion.

from ***Voice of America***
23 March 2013
After Higgs Hunt, Fermilab Charts New Paths in Physics Research
While the technology for the new International Linear Collider might be developed at Fermilab in the United States, engineering physicist Elvin Harms said that if it is approved, it might not be built there.

from ***Tanko Nichinichi Shimbun***
22 March 2013
あの　、私が作りました　堀内営さん
わくわく感をかきたてられるのが、　　関連のパンフレットに描かれたコンピューターグラフィックス　　。その画像の多くには、片隅に小さく「　　Rey.Hori/KEK」と書かれている。(ILC related illustrations excites our curiosity. Many of those are credited with the name “Rey Hori”)

from ***Sigma-not***
March 2013
Publikacja: Międzynarodowy zderzacz liniowy
W tej chwili najdłuższym akceleratorem liniowym jest ok. 3 km maszyna w Stanford (SLAC) o energii 50 GeV. Maszyna ILC – Międzynarodowy Zderzacz Liniowy (International Linear Collider) jest jednym z obecnie opracowywanych projektów podwójnego akceleratora liniowego e+e-, o docelowej energii kolizji wiązek elektronowej i pozytronowej ponad 1 TeV. (google translation)

CALENDAR

Upcoming events

Calorimetry for the High Energy Frontier (CHEF2013)
Paris, France
22- 25 April 2013

IPAC - 4th International Particle Accelerator Conference
Shangai, China
12- 17 May 2013

Photon 2013
Paris, France
20- 24 May 2013

European Linear Collider Workshop (ECFA LC2013)
DESY Hamburg
27- 31 May 2013

Upcoming schools

Excellence in Detectors and Instrumentation Technologies (EDIT 2013)
KEK, Japan
12- 22 March 2013

CERN Accelerator School: Course on Superconductivity for Accelerators
Erice, Sicily, Italy
24 April- 04 May 2013

View complete calendar

PREPRINTS

ARXIV PREPRINTS

1304.0381
Anomaly mediated supersymmetric models and Higgs data from the LHC

1304.0016
An extra Z’ gauge boson as a source of Higgs particles

1303.6191
Reconstruction of Inert Doublet Scalars at the International Linear Collider

1303.5255
Study of Top Effective Operators at the ILC

NEWSLINE
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IMAGE OF THE WEEK

Lyn Evans pays courtesy visit to Japan's prime minister Shinzo Abe

Images: Prime Minister of Japan and His Cabinet | 4 April 2013

On 27 March, LCC Director Lyn Evans paid a courtesy visit to Japan's Prime Minister Shinzo Abe. The Prime Minister acknowledged the significance of the linear collider project for the whole of humankind. Given that it is an international project, he said he needed to monitor the development closely and would continue to investigate the role of Japan. The video of the visit is also available at the Cabinet's website.

Lyn Evans presented Prime Minister Abe with a book about the LHC.

From left: Hitoshi Murayama, LCC Deputy Director, Masatoshi Koshiba, 2002 Nobel laureate in Physics, Lyn Evans, Shinzo Abe, and Takeo Kawamura, Chair of the Diet members association for ILC.

NEWSLINE
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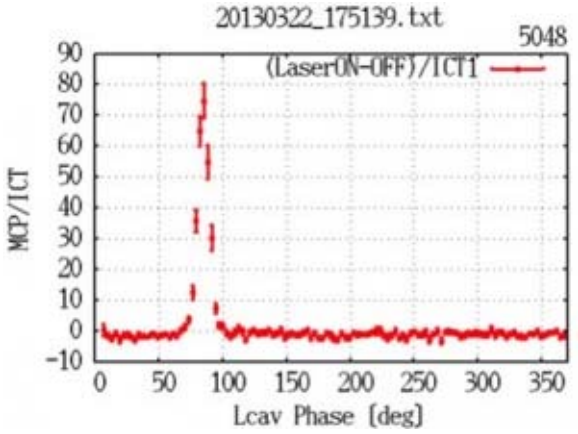
FEATURE

A spin-off of ILC technology – already

Rika Takahashi | 4 April 2013



X-ray signal peak at around 80 degrees, captured by MCP (Micro-channel photomultiplier) detector. The MCP signal normalized by beam intensity are plotted as a function of a phase between a laser in the 4-mirror and an electron beam.

On 15 March, scientists working on the *Quantum Beam Technology Program* at KEK's superconducting RF test facility (STF) confirmed the successful generation of X-rays using Inverse Compton Scattering (ICS) with superconducting radiofrequency (SCRF) acceleration technology. This is the world's first successful implementation of ICS X-ray sources with SCRF technology.

The Quantum Beam Technology Program is a 5-year programme supported by the Ministry of Education, Culture, Sports, Science, and Technology. This programme takes advantage of the quantum mechanical nature of the particles, and aims to develop a compact and high-quality particle source for broad and practical applications in medicine, life sciences, information technology, nanotechnology, and quantum science.

The name, Quantum Beam, refers to beams of particles such as neutrons, photons, and ions. "Quantum mechanics has a broad influence on our everyday lives," said Junji Urakawa, KEK scientist and the project manager for Quantum Beam. For example, without quantum mechanics there would be no transistors, and consequently, no personal computers. In addition, if there were no lasers, which also rely on quantum principles, no DVDs or Blu-ray players would exist. "However, our research is not designed for such purposes, and has not resulted directly in an application for society so far. This programme changed that," Urakawa said.

When a moving electron collides with a soft photon, the recoiling photon gains energy by transfer from the incoming electron. This process, called inverse Compton scattering (ICS), occurs in many astronomical environments that produce high-energy X-rays or gamma rays. In the Quantum Beam programme, accelerated electrons collide with a laser using a novel technology called four-mirror optical cavity that circulates laser pulses and amplifies its resonance.

Illustration of the superconducting accelerator (on the right), the beam line for squeezing its transverse size (middle), and the X-ray generation section (on the left) that operates through the collision of the accumulated laser power in the four-mirror optical cavity and using a squeezed electron beam.

ICS is widely recognised as a promising approach to achieve high-intensity high-quality X-rays, which might offer unique capabilities in a wide range of research fields, such as post-genome, nano technology, or structural analysis at the atomic level. Progressive advancements in these research areas will lead to various applications in the industrial, medical, and security-related fields. The practical implementation of ICS sources, however, depends on the ability to achieve high peak brightness of the X-rays. The key technology required to realise this brightness is superconducting RF (SCRF) accelerating technology.

SCRF cavities are capable of producing a higher accelerating gradient, meaning they achieve a greater acceleration over the same distance, than other accelerating structures.

This means a significant downsizing of the accelerator so that it could fit in an average hospital or laboratory room. These cavities are also more energy efficient, as they conduct electric current with almost no loss of energy.

KEK has made notable contributions to SCRF technology research and development (R&D) for the International Linear Collider. “Accelerators using SCRF have a capability to deliver high-power beams with a huge number of bunches, but at the same time with low charge and keeping its high quality characteristics. The brightness of X-rays from ICS is directly boosted by the collision of a huge number of bunches. This feature will make SCRF ILC technology spread to many applications,” said Hitoshi Hayano, KEK scientist and deputy head for the ILC activities of Linear Collider Collaboration. This successful X-ray generation is an example of a “spin-off effect” of the ILC R&D, even before the realisation of the project.

Illustration of the four-mirror optical cavity with laser axis (blue lines). An electron beam comes in from the right to the left (pink lines), and collides head-on with the laser beam inside of the four-mirror optical cavity. The generated X-rays leave to the left (green line).

The other technology that led to the success is the four-mirror optical cavity. By combining four mirrors to have two optical axes crossing in the centre, a cavity-like structure can be formed in which an injected laser pulse can be stored. This four-mirror optical cavity has a high stability even when its waist size is squeezed to facilitate the collision with an electron beam. When a four-mirror optical cavity is introduced to a head-on collision with an inverse Compton scattering electron, high-brightness X-rays can be generated because of the cavity’s capability of high power laser accumulation with high stability.

This four-mirror technology also has potential for applications. A short pulse and quasi-monochromatic X-ray source has been developed via ICS between a high-quality electron beam and a high-power laser for applications in various areas, such as the medical, biological, and scientific fields. Recently, compact X-ray sources in the range from 0.2 to 70 thousand electronvolts for biological and medical imaging, such as X-ray absorption and refraction contrast angiography, have become very important for our life. Also, since the energy of ICS X-ray is proportional to the square of the electron beam energy, we can realise a tunable source of high brightness monochromatic gamma-ray in the range from approximately 0.5 to several million electronvolts via ICS. Scientists can determine the abundance of difficult-to-identify isotopes in nuclear waste using ICS tunable gamma-ray based on nuclear resonance fluorescence (NRF) measurement for nuclear security.

INVERSE COMPTON SCATTERING | KEK | QUANTUM BEAM PROJECT | TECHNOLOGY TRANSFER

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DIRECTOR'S CORNER

Le roi est mort, vive le roi ! (*)

Mike Harrison | 4 April 2013

The European Approach to succession planning (the battle of Trafalgar).

The Global Design Effort (GDE) has successfully completed the R&D programme outlined back in 2006, and with the *Technical Design Report* (TDR) effectively complete and a cost estimate based on the TDR design done, the future programme must be addressed. The major new factor is the very real possibility that Japan may proceed with a bid to host the ILC. Indeed recent activities in Japan are so promising that we are plan the upcoming ILC programme based on this prospect. An early item of business will be that of site selection. Japan's timeline indicates that a possible site could be named by the summertime. This would allow the TDR generic site design to be modified as required for a real site, the first step in the evolution towards an engineering design.

Cavity production was a great success of the GDE global programme, but for a complete cryomodule there was only a proof-of-principle result during the S1 global programme. Cryomodules are expensive and a full-scale production demonstration will only be possible with a construction project. Fortunately for us we have one of those about to start: the European XFEL. In a few short months the cryomodule production line at Saclay, France, will start to turn. While Europen-XFEL cryomodules are not identical to ILC ones, they are sufficiently similar, meaning that the fabrication process will be of immense value to ILC planning. How we maximise the benefit to the ILC of the complete European XFEL project is a opportunity we cannot afford to miss.

The present Japanese thinking towards ILC construction favours a phased approach to a 500 GeV centre-of-mass energy, with an initial phase of around 250 GeV for a Higgs-factory scenario. The TDR, of course features a 500-GeV baseline with options towards higher energies. We will need to carefully evaluate the impact of this plan for lower-energy operation. The initial facility will be cheaper of course: it will reduce the required cryomodule production rate, hopefully decrease the project construction time, and introduce options on machine and tunnel layout not considered in the TDR baseline. We will need to carefully analyse the facts in order to understand how best to use the flexibility of a phased construction project and to what end.

Linear colliders are by definition single-pass devices and are inherently power hungry as the energy and luminosity are pushed ever higher. The CLIC *Conceptual Design Report* study looked to mitigate power consumption in several ways, and one of the more intriguing ideas was that of load balancing. Based on the observation that not all power is created equal (power at 3 am is less in demand than at 6 pm) the CLIC team looked at the possibility of rapid site power reduction in periods of high demand and equally rapid resumption of the physics operation. While cryogenic objects, such as the ILC, do not turn off as gracefully as the normal conducting CLIC, power consumption mitigation strategies will need a better evaluation in the future.

The prospect of a construction project in the foreseeable future brings to the surface not only the issues I have outlined above but many others as well (e.g. value engineering, configuration control). How do we choose and prioritise the programme for the near future? To answer these (and other) questions I have asked several people to serve on a new entity; the ILC Technical Board (TB). In addition to myself the TB will comprise of Hitoshi Hayano, as my deputy, Olivier Napoly (CEA/Saclay), Marc Ross (SLAC), Nikolay Solyak (Fermilab), Nobuhiro Terunuma (KEK), Nick Walker (DESY), "Kirk" Yamamoto (KEK) and *ex officio* in his role as Head of the KEK LC Project Office, Akira Yamamoto. This group will determine the ILC programme for the next three years that will be submitted to the Linear Collider Directorate and the Linear Collider Board for ratification. Initially the programme will be defined on the basis of constant global effort for the next few years. Indicating where additional effort would be useful will also be part of their mission. I hope we have something to report by LC2013 in Hamburg.

So there we have it. Deciding the path forward for the ILC programme, while important, does not have quite the same romance as trying to eviscerate ones antagonists with a cannon ball on a triple-masted frigate. Global projects back then were a lot smaller, but what they lacked in scope they appeared to make up for with enthusiasm. I hope we can demonstrate that we have a similar level of purpose.

(*) The king is dead, long live the king!

CAVITY PRODUCTION | CLIC | CRYOMODULE | HIGGS FACTORY | TECHNICAL DESIGN REPORT

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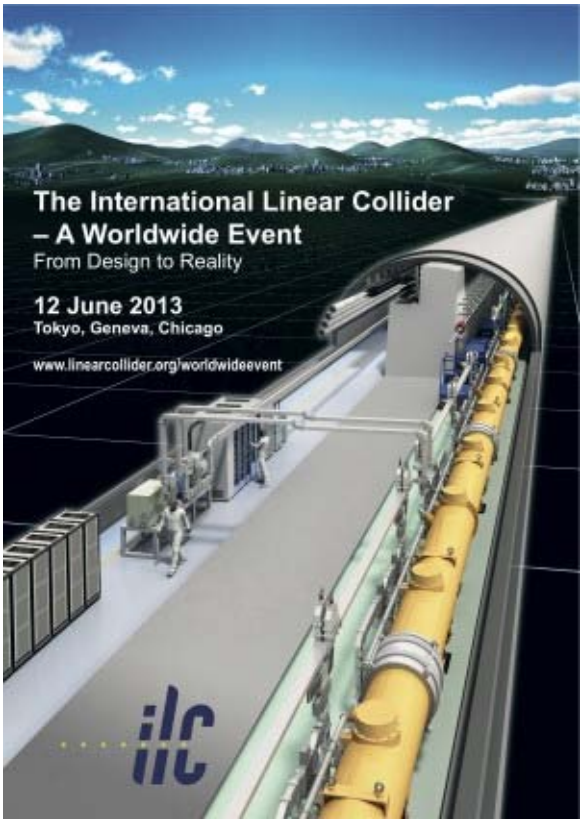
ANNOUNCEMENTS

From design to reality

4 April 2013



Let's celebrate the completion of the Technical Design Report.

12 June 2013 is a very special day for the ILC community. We are organising a global event, starting in Tokyo, moving to CERN and finally in Fermilab – to celebrate the publication of the *Technical Design Report*. We have invited VIPs from across the fields of politics, research funding, science and education to hear talks on ILC, public lectures, look to the future and to celebrate with us. However, the most important group is YOU, the people who did the work that made the TDR possible. Mark your calendars and join us for your local event. Please register at linearcollider.org/worldwideevent.