LC discussion

International Committee for Future Accelerators
Sponsored by the Particles and Fields Commission of IUPAP

ICFA

ICFA Statement on the MEXT's View with regards to the ILC Project

On the occasion of its annual meeting in Tokyo, March 6-8, 2019, the International Committee for Future Accelerators (ICFA) thanks Dr. Keisuke Isogai, Director General, Research Promotion Bureau of Japan's Ministry of Education, Culture, Sports, Science and Technology (MEXT), for his inaugural presentation to the Linear Collider Board (LCB) and ICFA. ICFA views the statement of continuing interest in the ILC within MEXT and related ministries and agencies as an important milestone along the path to the ILC. ICFA also thanks Hon. Takeo Kawamura, Member of the House of Representatives and Chair of the Federation of Diet Members for the ILC, for affirming support for the ILC within the Diet in his address to ICFA/LCB on March 6.

Discovered at CERN's Large Hadron Collider in 2012, the Higgs boson has been hailed as the most important discovery in particle physics in decades of research. This unique particle offers a portal for understanding the fundamental laws of Nature and is expected to be a great new tool for discovery.

ICFA confirms the international consensus that the highest priority for the next global machine is a "Higgs Factory" capable of precision studies of the Higgs boson. At this ICFA meeting options for a Higgs Factory were discussed -- the ILC, as well as other collider technologies.

ICFA reaffirms the scientific significance of the ILC and that the ILC is in a sufficient state of technical readiness for approval for construction.

Both the European Strategy for Particle Physics Report of 2013 and the United States Particle Physics Project Prioritization Panel (P5) Report of 2014 had expressed support for the initiative of the Japanese physics community to host the ILC in Japan.

ICFA recognises that although MEXT has interest in the ILC, and will continue to discuss the project with other governments, Japan is not yet able to declare its willingness to host the ILC. A clear statement of Japan's position towards hosting the ILC would have had significant impact in the ongoing discussions on the formulation of the European Strategy for Particle Physics Update.

ICFA notes with satisfaction the great progress of the various options for Higgs factories proposed across the world. All options will be considered in the European Strategy for Particle Physics Update and by ICFA.

Tokyo, March 2019

LC strategy discussion – "points for provocation"

Main strategy point [DRAFT]
The highest scientific priority [in experimental particle physics today] is precise studies of Standard Model (SM) processes and in particular the Higgs boson in e+e- collisions, "pointing the way" to new physics Beyond the Standard Model (BSM). The fastest and most versatile solution is construction of a linear e+e- collider (LC) facility starting from an initial energy and luminosity optimised to explore these processes in great detail. The facility should lay the foundation for a long term e+e- programme and hence be upgradable in the future with the same, improved, or new technologies to much higher energies, allowing improved precision and reach for SM and BSM physics. The LC should be pursued for construction start-up in a 3-5 year timeframe.

Background and justifications [meant to "provoke" and "guide" discussion sessions]
Electron-positron collisions provide clean and well-defined collisions for very precise studies of the Higgs and other SM particles and processes, and for direct searches for BSM physics in a completely new experimental environment. The goal of precision studies of the Higgs boson is to discover violations of the Standard Model predictions for the Higgs boson that point to new physics.

Higher-energy e+e- collisions would significantly improve the precision tests of the SM parameters and the sensitivity to BSM physics. The higher energies allow direct measurement of the Higgs self-coupling – a critical fundamental property of the Higgs field – with unrivalled accuracy.

Another point for discussion in Lausanne, related to the two above: how do we deal with the different starting energies (e.g. including top physics) and energy reach of ILC and CLIC in the discussion text?

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A LC can be upgraded to reach higher energies, and the next phases could be adapted depending on the results obtained. Beyond increasing the linac-lengths, R&D is ongoing for higher gradients, for example by improving SCRF cavities or X-band accelerating structures. In the longer term a linear collider infrastructure can be adapted or reused to significantly reduce the cost, risk and implementation time of a future linear collider using a different technology. For example, new accelerator technologies, such as plasma wakefield or di-electric based acceleration, promise more compact and hence affordable linacs.

- Comment: It is not yet clear whether these technologies can reliably accelerate low emittance electron-positron beams, or deliver sufficient power efficiency, and hence achieve luminosities for a general-purpose electron-positron collider. However, the promise to reduce the size and energy footprints, and importantly also cost, indicates that in the long term such technologies might provide new and affordable upgrade paths to much higher energies for a LC facility.

A particular strength of linear colliders is their close technological links to general accelerator advances and construction of smaller high-performance systems, such as FELs and other light sources, used for applications outside particle physics. The investments in these smaller accelerators world-wide are significant and the benefits of having many areas of science pursuing the developments of similar tools cannot be overstated in terms of future capabilities. The E-XFEL and LCLS-II are prime recent examples for SCRF; the SwissFEL, using normal conducting C-band structures, is a relevant example for CLIC like technologies.

Beyond the initial stage of a LC, benefitting from its physics guidance, the possibilities and opportunities for future machines in particle physics extend beyond running or upgrading a LC, Examples are hadron and even muon colliders where R&D and developments are on-going but further work is needed for realistic implementation proposals. Such machines can be built and operated in parallel with a LC installation and optimized as needed for size and energy. In terms of future scientific perspectives, continuity and flexibility for the field this approach seems very attractive.

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Both ILC and CLIC are now projects that can move forward towards implementation, and be ready for continuing the Higgs studies and Standard Model precision measurements within ~15 years, possibly overlapping with the HL-LHC programme.

From a resource point of view ILC is likely to bring significant fresh resources into international particle physics, and in principle the machine implementation can start within 3-4 years, profiting from the existing large scale SCRF cryomodule production lines in Europe, the US, and Asia. However, it is not yet clear if ILC will be hosted by Japan and negotiations between potential international stakeholders to resolve this is of great urgency.

CLIC can be implemented at and hosted by CERN and its timescale for initial operation is also around 2035, provided that the necessary effort is deployed to make it construction-ready by ~2025. For example, building smaller machines with X-band facilities in this timeframe should be pursued with high priority in order to move the technology efficiently towards large-scale industrial readiness in this timeframe.

Another point for discussion in Lausanne is how to deal with the general concern expressed some times that a LC will not be able to sustain as large a community as for example LHC.

An essential point for the realism of a LC is that both initial projects are affordable and can be constructed and operated within resource frameworks similar to those mobilised for LHC, and hence there is today a unique opportunity to move ahead quickly towards constructing a LC.

- Comment: How do we best express the need to make rapid progress with ILC in Japan and promote CLIC as the best machine option for CERN?

Actual activities “foreseen” in next phase:

Collect from presentations today/tomorrow (suggested main points):

- ILC, CLIC, Higher energies, Working with FELs and LS
- Physics for initial stage, Physics at higher energies
- Detector R&D and system development

What do we want to achieve:

- Discuss the key reasons why a LC is attractive and the timing is correct for such a project
- Get all of you involved and “engaged” in the discussion
- Identify areas were we need to make our case better

- Understand activities needed in next phase

- Working document for Granada preparation, as well as and for further discussions this year