ILC IDT Working Group on Modelling and Precision Theory

Introduction

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2020 European Strategy for Particle Physics:

"An electron-positron Higgs factory is the highest-priority next collider."

It is not difficult to reach this conclusion.

The next questions are more difficult:

How soon can an e+e- Higgs factory be realized ?

What do we need to do to prepare ?

The next e+e- collider targets

measurments of Higgs boson couplings with errors
<< 1%

measurements of $e^+e^- \to W^+W^-$, $Z\gamma$, ZZ and $e^+e^- \to f\overline{f}$ with errors < 0.1%

Among other requirements, this requires a major effort from the theory community:

* complete calculation of Higgs processes at the 2-loop EW level and precision EW at the 3-loop level

* event generators accurate to same level, with control of non-perturbative aspects of fragmentation

Conceptual issues are involved, especially, how to include EW systematically in simulation tools built for QCD at the LHC.

More accurate EW calculations, for Giga-Z, Tera-Z, and luminosity measurement with Bhabha scattering, require advances over today's calculational technology.

We would like to set up an organization to accomplish these goals in a timely way. This is the motivation for the Modelling and Precision Theory group.

For current methods for ILC simulation, see the ICHEP talk:

Mikael Berggren, https://indico.cern.ch/event/868940/contributions/3814465/ .

These data samples are available for download at

http://www.ilcsnowmass.org

See also: "ILC Study Questions for Snowmass 2021", arXiv:2007.03650 [hep-ph]

We welcome contributions from people interested in all proposed e+e- colliders — CEPC, FCC-ee, CLIC, ILC — and from those who are new to high-energy e+e- studies. Our goals are very strongly aligned, so advances that help one proposal help all.

However, I would like to point out that ILC is now potentially on the fastest timeline, with engagement both within the physics community and from governments.

In 2020, ICFA set up the ILC International Development Team (IDT), headed by Tatsuya Nakada, the chair of the 2013 European Strategy Study. Its goal is to realize ILC on the following timeline:

Rough timeline of the ILC under discussion

ILC IDT (~1.5 years)

- Prepare the work and deliverables of the ILC Pre-laboratory and workout with national and regional laboratories a scenario for their contributions
- Prepare a proposal for the organisation and governance of the ILC Pre-laboratory

In parallel:
Positive "signs" from the host country (Japan) government and agreements by the national/regional laboratories for providing their contributions.

ILC Pre-laboratory (~4 years) **begin: 2022**

- Complete all the technical preparation necessary to start the ILC project (infrastructure, environmental impact and accelerator facility)
- Prepare scenarios for the regional contributions to and organisation for the ILC.

In parallel:
Positive outcomes of the inter-governmental negotiation for the responsibility and cost sharing among the host (Japan) and partner countries

begin: 2026

ILC laboratory

- Construction and commissioning of the ILC (~10 years)
- Followed by the operation of the ILC
- Managing the scientific programme of the ILC

T. Nakada,

first data: 2037

T. Nakada at AWLC 2020

A proposal for the ILC Pre-Lab, including governance, tasks, and budget, is now available as

arXiv:2106.00602 [physics.acc-ph]

A specific funding proposal will be submitted by KEK this summer, and we anticipate approval in the FY 2022 Japanese budget.

ICFA, the European Strategy Report, and the US DOE and State Depts. have explicitly encouraged this process.

The Physics and Detector Organization under the IDT (and hopefully continuing under the Pre-Lab) is described at https://linearcollider.org/team/wg3 .

IDT WG3 conveners:

Hitoshi Murayama (Berkeley, IPMU)

Jenny List (DESY), Claude Vallee (Marseille)

IDT WG3 Physics Opportunities conveners:

Michael Peskin (SLAC), Aidan Robson (Glasgow),

Junping Tian (Tokyo)

IDT WG3 Modelling and Precision Theory conveners:

Gudrun Heinrich (KIT), Stefan Hoeche (Fermilab),

Zhao Li (IHEP), Juergen Reuter (DESY)

Please email any of us with your questions. Sign up for our mailing list at:

https://agenda.linearcollider.org/event/9154/

It is not too early to begin.

Thank you to all for your participation !