Opening Comments

2017/02/04 Keisuke Fujii

WG Objectives

- On July 4, 2012, ATLAS and CMS announced the discovery of a Higgs-like boson with a mass of about 125GeV and the data that followed strongly indicates that it is a Higgs boson indeed. The world has changed since then. The discovery has vaulted the question of its properties on the top of the list of questions in HEP. The 125GeV boson is a window to BSM physics and ILC is the best machine to use it.
  The LHC Run2 will probably bring us more. It is important to stress that ILC, too, is an energy frontier machine. It will access the energy region never explored with any lepton collider. There can be a zoo of new uncolored particles or new phenomena that are difficult to find at LHC but can be discovered and studied in detail at ILC.

  We need to demonstrate that ILC will advance our understanding of particle physics qualitatively beyond the information that will be available from the results expected from the future stages of the LHC. The MEXT ILC Advisory Panel says "it is necessary to closely monitor, analyze and examine the development of LHC experiments". Be prepared for LHC Run2 results!

- The ILC project preparation office has been formed in KEK and the MEXT's ILC Task Force is reviewing the project. In parallel, site-specific design started and the detector optimization effort will continue. In response to the interim summary from the MEXT panel, ICFA sent a letter concerning issues raised there including a 4-page long summary of BSM scenario (new particle discovery potential in particular) in last Dec. Its followup document is almost complete now and will be submitted to arXive very soon. The next target for us to show our activities to the LC community is ALCW2017 on Jun. 26 to 30 at SLAC.

Support Document for the ICFA Letter

Support Document that follows up the ICFA letter

First authors' meeting held on Sep. 9

Discussed the structure and basic ideas about contents together with how to share the writing.

2nd authors' meeting held on Oct. 13

Reviewed the status of the draft and discussed the request from JHEPC and possible readjustment of the contents of the document.

3rd authors' meeting held on Nov. 1

Reviewed the status of the draft (significant progress, but there are still missing parts, expected to be filled in shortly) and discussed the timeline until LCWS 2016.

4th authors' meeting held on Nov. 16

Reviewed the status of the draft (significant progress, most part filled). All the part to be filled and frozen by next Monday for final editing by Jenny and KF until Nov. 28.

5th authors' meeting held on Dec. 13

Reviewed the status of the draft. Loose ends identified. The current draft is 47 pages long but we decided not to shorten it but to provide an executive summary consisting of 10 or so bullet points. Disclaimer concerning staging options will be added in the introduction. Michael will expand and generalize the DM treatment.

6th authors' meeting held on Jan. 25

Jenny, as the chief editor, made the draft into an at least formally complete form, eliminating loose ends. The draft now has abstract, 2-page executive summary, and conclusions which have been discussed intensively. ***We will submit this to arXive within a couple of days.***

The Potential of the ILC for Discovering New Particles

Document Supporting the ICFA Response Letter to the ILC Advisory Panel

LCC Physics Working Group

Keisuke Fujii[1], Christophe Grojean[2,3,4], Michael E. Peskin[5](conveners); Tim Barklow[5], Yuanning Gao[6], Shinya Kanemura[7], Hyungdo Kim[8], Jenny List[2], Mihoko Nojiri[1,9], Maxim Perelstein[10], Roman Pöschl[11], Jürgen Reuter[2], Frank Simon[12], Tomohiko Tanabe[13], James D. Wells[14], Jaehoon Yu[15]; Howard Baer[16], Mikael Berggren[2], Sven Heinemeyer[17], Suvi-Leena Lehtinen[2], Junping Tian[13], Graham Wilson[18], Jacqueline Yan[1]; Hitoshi Murayama[9,19,20], James Brau[21]

Abstract

This paper addresses the question of whether the International Linear Collider has the capability of discovering new particles that have not already been discovered at the CERN Large Hadron Collider. We summarize the various paths to discovery offered by the ILC, and discuss them in the context of three different scenarios: 1. LHC does not discover any new particles, 2. LHC discovers some new low mass states and 3. LHC discovers new heavy particles. We will show that in each case, ILC plays a critical role in discovery of new phenomena and in pushing forward the frontiers of high-energy physics as well as our understanding of the universe in a manner which is highly complementary to that of LHC.

For the busy reader, a two-page executive summary is provided at the beginning of the document.

New request from JHEP via Hitoshi Yamamoto

Yet Another Document Planned by JHEPC

To be completed in March 2017
Japanese HEP committee is planning to issue
a statement on the ILC physics case
based on the LHC Run2 results (so far).

Hitoshi hopes that the support document will be an input to this JHEPC statement

The recommendation by the MEXT panel

Closely monitor, analyze, and examine the development of LHC experiments

The current LHC Run2 results

indicate that there seem to be *no new particles easily discoverable at the LHC*, which leaves

case 3-1:

No discoveries of new particles at LHC Experiments

The staging option resurfaced again during LCWS 2016!

Following this ILC Parameters Joint WG met on Jan. 4

- Our goal is to consider the physics potential for an ILC that starts operations at low energy, either 250 GeV, or 350 GeV.
- We need to make the 1st stage as attractive as possible.
  → as high Luminosity as possible for the 1st stage.
- We could consider a different choice for the machine parameters.
- Official request sent to Shin Michizono for some machine manpower to investigate the possibility.
- Lyn has asked us to provide a first update on the physics impact of the staging possibilities by mid February.

Jim Brau, as the LCC associate director for physics and detector, requested the LCC ILC Physics WG to define the physics goals of the initial stage.

- A short (2-page) report is being prepared now.

MEXT ILC Advisory Pannel

6th meeting
scheduled on Feb. 1 (Wed.) 15:00-17:00 JST

Agenda

1. Recent status regarding the ILC project (Report)
2. Plan for further review and a new WG

Our Group's Activities

Status & Next Step

Symmetry Breaking & Mass Generation Physics

- ZH : H->bb,cc,gg -> EPJ C (2013) 73:2343, now working on mh=125 GeV case: Ono+Miyamoto
  H -> WW* anomalous coupling: analysis done -> publication: Takubo -> P.R.D88,013010(2013)
  H->other modes: Tino (AA,mu+mu-) + Kawada/Tanabe/Suehara/Daniel (tau+tau-)->publication -> EPJC (2015) 75:617.
  Recoil mass: Jacqueline -> P.R.D94,113002(2016), Suehara (qq), CP mixing in h->tau+tau-: Daniel -> draft being reviewed by ILD, HVV couplings: Ogawa, Yumi Aoki
  direct mH reconstruction: Junping
- ZHH : full simulation of the H->bb&Z->all modes, fast simulation of nunuHH: finished: Junping + Takubo (Ph.D thesis: done) -> New analysis with improved analysis tools: Junping + Claude + Suehara + Tanabe, Jet-clustering: Shaofeng Ge, LCFIPlus: Suehara
  New analysis: ZHH->ZbbWW*: Kurata, Systematic Error: Tim, Junping
- nnHH : full simulation @ 1TeV, done for DBD: Junping -> publication
- nnH, eeH : precision measurements of HVV couplingsm, mh=125GeV: Junping
  BR measurements: Ono, Christian
- TTH : quick simulation studies with NRQCD corrections
  -> P.R.D84,014033(2011) -> full sim. @ 0.5 & 1 TeV: (Yonamine left) Tanabe + Sudo
- TT Threshold : Top Yukawa measurement: Horiguchi + Ishikawa + Tanabe, Theory: Kiyo + Sumino -> publication? (cf. a recent significant theoretical development!): Ozawa
- W mass (enW) : Koya Tsuchimoto -> Kotora (controlling systematic uncertainties)
- AA->HH : quick simulation studies, so far H->bb and WW BG
  -> P.R.D85,113009(2012) : Kawada, Theory: Harada

PHYSICAL REVIEW D 94, 113002 (2016)

Measurement of the Higgs boson mass and $e^+e^- \to ZH$ cross section using $Z \to \mu^+\mu^-$ and $Z \to e^+e^-$ at the ILC

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This paper presents a full simulation study of the measurement of the production cross section (σ_{ZH}) of the Higgsstrahlung process $e^+e^- \to ZH$ and the Higgs boson mass (M_{H}) at the International Linear Collider (ILC), using events in which a Higgs boson recoils against a Z boson decaying into a pair of muons or electrons. The analysis is carried out for three center-of-mass energies $\sqrt{s} = 250$, 350, and 500 GeV, and two beam polarizations $e^-_{\mathrm{L}}e^+_{\mathrm{R}}$ and $e^-_{\mathrm{R}}e^+_{\mathrm{L}}$, for which the polarizations of e^- and e^+ are $(Pe^-, Pe^+) = (-80\%, +30\%)$ and $(+80\%, -30\%)$, respectively. Assuming an integrated luminosity of 250 fb^{-1} for each beam polarization at $\sqrt{s} = 250$ GeV, where the best lepton momentum resolution is obtainable, σ_{ZH} and M_{H} can be determined with a precision of 2.5% and 37 MeV for $e^-_{\mathrm{L}}e^+_{\mathrm{R}}$ and 2.9% and 41 MeV for $e^-_{\mathrm{R}}e^-_{\mathrm{L}}$, respectively. Regarding a 20 year ILC physics program, the expected precisions for the HZZ coupling and M_{H} are estimated to be 0.4% and 14 MeV, respectively. The event selection is designed to optimize the precisions of σ_{ZH} and M_{H} while minimizing the bias on the measured σ_{ZH} due to discrepancy in signal efficiencies among Higgs decay modes. For the first time, model independence has been demonstrated to a sub-percent level for the σ_{ZH} measurement at each of the three center-of-mass energies. The results presented show the impact of center-of-mass energy and beam polarization on the evaluated precisions and serve as a benchmark for the planning of the ILC run scenario.

DOI: 10.1103/PhysRevD.94.113002

Status & Next Step

Beyond the Standard Model

- SUSY : full simulation studies for LOI -> publication
  - EWkino (Compressed Spectrum Case): Jacqueline
- Extra U(1) (Z' tail), Compositeness, Extra Dimensions, etc.
  - TT : full simulation studies for LOI -> New study with MELA: Sato
  - tau tau : full simulation studies for LOI -> ditto
  - 2f: full simulation study: a new student
- Hidden Sector / XD : P.R.D78, 015008 (2008)
- LHT : P.R.D79, 075013 (2009)
- Model discrimination: Saito + Suehara .. : P.R.D84, 115003 (2011)
- R-handed neutrinos: Saito : P.R.D82, 093004 (2010)
- LHT: Kato (exp) + Harigaya (th): ZHZH finished, working on eHeH, nHnH, ..: Draft (n-1)?
- Very light gravitino: Katayama (Master's thesis), Tanabe (exp) + Matsumoto (th)
  --> 1st Draft --> Takuaki Mori (Tokyo) -> ?
- Quasi stable stau: Yamaura (Master's thesis) + Kotera + Kasama —> reactivated?
- Higgs portal/h->Invisible: Honda -> Yamamoto -> Ishikawa, Ogawa, Junping -> Kato (Tokyo)
- W-H+/W+H-: (Shinzaki), Ishikawa (exp) + Kanemura, yagyu (th)
- Generic DM search: Tanabe
- New projects?
  - AMSB: Tanabe
  - Heavier Higgs bosons?: Yokoya, (Abhinav) -> Ishikawa?
  - X(750) : Junping -> published in PRD (Phys.Rev. D94 (2016) no.9, 095015)
  - Correlation btw h->gamma gamma & h->gg in mSUGRA: Hidaka
  - m_nu, DM, baryogenesis: Machida

Short Term Schedule

- Weekly Meeting
  - Every Fri. at 14:00 (conf. ID: to be announced)
- General Meeting
  - 10:30 on Sat. Apr. 15, 2017 (KEK MCU2 conf. ID:XXX)
- HPNP2017, Toyama, March 1-5, 2017
- Annual ILC Detector Meeting, KEK, March 30-31, 2017
- Top@LC2017, CERN, June 7-9, 2017
- ALCW 2017, SLAC, June 26-30, 2017