

Opening Comments

2020/11/11

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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.

So far no additional new particles or new phenomena have been found in the LHC Run 2, suggesting that there seem to be no easily discoverable new particles, which enhanced the importance of the precision measurements of H125 and loophole-less searches at ILC more than ever. 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". We did and proposed ILC250 as a JAHEP agreement on July 22, 2017.

- The MEXT showed its position on March 7, 2018 with three bullet points, one of which suggested necessity to discuss ILC in the SCJ Master plan process. The MP process finished with ILC listed in its long list though not in its short. The next point was ESU, which was published on June 18, 2020 with ILC mentioned favorably. Meanwhile, LCB/ICFA met on Feb. 20, 2020 at SLAC with participation of a MEXT representative and a key diet member from Japan, made a statement outlining the timeline towards ILC realization including International Development Team hosted at KEK, which was established on Aug.2 and marked a new step towards the ILC realization. In parallel, the U.S. Snowmass process is on-going.

Current Status

- *Because of COVID19, it is not an appropriate time to bring up a big scientific project like ILC.*
- *However, the political environment about ILC is now very good, thanks, in particular, to strong US support. New PM, Mr. Suga, very well-informed of ILC. MEXT minister, Mr. Hagiuda stays in his position. A new deputy-MEXT minister, Ms. Takahashi, responsible for S&T policy from Iwate. Multiple discussion sessions since last time, more scheduled.*
 - *Remaining hurdle: how to secure financial resource outside the ordinary S&T budget.*
- *The climate change: The first stage of the ILC is 250 GeV but, now studies on energy upgrade even above 1 TeV is encouraged.*
- *In spite of COVID19, KEK is operating in the new normal mode, and various ILC promotion activities are on-going. Various strategy discussions are on going in KEK and JAHEP (Future HEP Project Committee). Note: 1st complete draft of KEK RM is out for comments from JAHEP. Final version after international review, maybe in April.*
- *The International Development Team took over LCC/LCB:*
 - *IDT Membership is open to public since Sep.11.*
 - *Preparation on-going for JFY2022 budget request to establish Pre-Lab*
- *JAHEP ILC Steering Panel has just been established.*
- *Tohoku upgraded its ILC promotion organization on Aug.6.*
 - *Now actively promoting ILC.*

IDT Phys/Det WG (WG3)

now preparing for Snowmass

Aug. 31: Snowmass Lol deadline: many from us!

Aug. 28: 1st Snowmass Tutorial

<https://indico.fnal.gov/event/45031/overview>

Oct. 5-8: Snowmass Community Planning Meeting

<https://indico.fnal.gov/event/44870/overview>

Oct. 14: 2nd Snowmass Tutorial

<https://indico.fnal.gov/event/45721/>

Recent LOI Presentations

Nov. 6 EF04: <https://indico.fnal.gov/event/45735/>

- **Takahiro on A_{LR} using radiative return to Z**
- **Keita on di-tau production**
- **Taikan on 2-fermion production**
- **Graham on precision EW measurements**

LCC Physics WG is now gearing up its activity towards Snowmass

90 questions to tackle

DESY 20-122,
KEK Preprint 2020-8,
IFIC/20-34, LCTP-20-14
SLAC-PUB-17543
July, 2020

ILC Study Questions for Snowmass 2021

LCC PHYSICS WORKING GROUP

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ABSTRACT

To aid contributions to the Snowmass 2021 US Community Study on physics at the International Linear Collider and other proposed e^+e^- colliders, we present a list of study questions that could be the basis of useful Snowmass projects. We accompany this with links to references and resources on e^+e^- physics, and a description of a new software framework that we are preparing for e^+e^- studies at Snowmass.

- July 7-8: Prep session (<https://indico.fnal.gov/event/43959/timetable/#20200707>) for July 20-22 Snowmass EF WS:
 - significant contributions from the ILC community
 - presentations on MC samples by Shin-ichi, Filip.
- July 20: Michael Peskin will report on this document in **the July 20-22 Snowmass EF WS** (<https://indico.fnal.gov/event/43963/timetable/#20200720>)
 - LCC physics WG will have a telecon tomorrow together with other people actively working on MC samples.

Our Group's Activities

Status & Next Step

Symmetry Breaking & Mass Generation Physics

- ZH : $H \rightarrow bb, cc, gg \rightarrow$ EPJ C (2013) 73:2343, Ono+Miyamoto: IDR: Kurata
 $H \rightarrow WW^*$ anomalous coupling: publication: Takubo \rightarrow P.R.D88,013010(2013)
 $\rightarrow H \rightarrow WW^*$ to be reexamined: Liao Libo, Mila, Uli
 $H \rightarrow$ other modes (AA, $\mu^+\mu^-$) + Kawada/Tanabe/Suehara/Daniel, ($\tau^+\tau^-$) \rightarrow publication \rightarrow EPJC (2015) 75:617., $H \rightarrow Z\gamma$: Kazuki Fujii
Recoil mass: Jacqueline \rightarrow P.R.D94,113002(2016), Suehara (qq), CP mixing in $h \rightarrow \tau^+\tau^-$: Daniel
 \rightarrow accepted for publication in PRD, HVV couplings: $H\gamma$: Yumi Aoki
direct mH reconstruction: Junping
- EFT: EFT vs BSM, EFT fit on top EW couplings (NLO SMEFT): Junping
- Zgamma: Takahiro Mizuno
- ZHH : full simulation of the $H \rightarrow bb$ & $Z \rightarrow$ all modes, fast simulation of $nnuHH$: finished: Junping + Takubo (Ph.D thesis: done) \rightarrow New analysis with improved analysis tools: Junping + Claude + Suehara + Tanabe, Jet-clustering: Masakazu, Shaofeng Ge, LCFIPlus: Suehara, Yonamine; Vertex Finder: Kiichi Goto
New analysis: $ZHH \rightarrow ZbbWW^*$: dE/dx: Kurata, Systematic Error: Tim, EFT: Junping, ZHH paper draft: Junping, Masakazu, Claude
- nnHH : full simulation @ 1TeV, done for DBD: Junping \rightarrow publication
- nnH, eeH : precision measurements of HVV couplings, $m_h=125\text{GeV}$: Junping
BR measurements: Ono, Christian
- TTH : quick simulation studies with NRQCD corrections
 \rightarrow P.R.D84,014033(2011) \rightarrow full sim. @ 0.5 & 1 TeV: (Yonamine left) Tanabe + Sudo
- TT Threshold : Top Yukawa measurement: Horiguchi + Ishikawa + Tanabe, Theory: Kiyo + Sumino \rightarrow publication? (cf. a recent significant theoretical development!): Ozawa \rightarrow Yuto Eda
- W mass (m_W) : Koya Tsuchimoto \rightarrow Kotera (controlling systematic uncertainties) \rightarrow Kotera
- AA \rightarrow HH : quick simulation studies, so far $H \rightarrow bb$ and WW BG
 \rightarrow P.R.D85,113009(2012) : Kawada, Theory: Harada

Status & Next Step

Beyond the Standard Model

- SUSY : full simulation studies for LOI → publication
 - **EWkino** (Compressed Spectrum Case): Jacqueline→Tomohiko : P.R.D101, 095026 (2020)
- Extra U(1) (Z' tail), Compositeness, Extra Dimensions, etc.
 - **TT** : full simulation studies for LOI → **New study with MELA**: Yo Sato, **vertex charge**: Okugawa
 - **tau tau** : full simulation studies (benchmark process) → **Keita Yumino**
 - **2f: full simulation study**: Hiroaki Yamashiro → Yuto Deguchi, Uesugi
- 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) , **New analysis**: Yonamine, Jurina, Daniel
- 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 → Yu Kato
- **W-H+/W+H-**: (Shinzaki), Ishikawa (exp) + Kanemura, yagyū (th)
- **Generic DM search (mono-photon)**: Tanabe → Yonamine
(exotic higgs decay): Kurata, **Special theory guest**: Shigeki Matsumoto
- Other projects
 - Heavier Higgs bosons?: Yokoya, (Abhinav) → Christian Drews
 - X(750) : Junping → published in PRD (Phys.Rev. D94 (2016) no.9, 095015)
 - **h→cc, bb, bs QFV decays**: Hidaka
 - **Kinematical Fitter** : kajiwara
 - **pair monitor** : Ahmed
 - **LGAD simulation** : Mami Kuhara

Short Term Schedule

- Weekly Meeting
 - Every Fri. at 14:00 (conf. ID: to be announced)
- General Meeting
 - 10:30 on **Wed. Feb. 10, 2021?**
- **ECFA LCWS 2021 next spring?**
- **Snowmass Mid-term assessment: April 17-20, 2021**
- **Snowmass Summer Study: July 11-20, 2021 (Seattle)**