

# Opening Comments

2020/07/01

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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 with three bullet points, one of which suggested necessity to discuss ILC in the SCJ Master plan process. The MP process has been finished with ILC listed in its long list though not in its short. The next point was ESU, which has just been published recently 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 is relevant to the third point, inter-governmental discussions.

# ***MEXT's view in regard to the ILC project Executive Summary***

***March 7, 2019***

***Research Promotion Bureau, MEXT***

- ***Following the opinion of the SCJ, MEXT has not yet reached declaration for hosting the ILC at this moment. The ILC project requires further discussion in formal academic decision making processes such as the SCJ Master Plan, where it has to be clarified whether the ILC project can gain understanding and support from the domestic academic community.***
- ***MEXT will pay close attention to the progress of the discussions at the European Strategy for Particle Physics Update.***
- ***The ILC project has certain scientific significance in particle physics particularly in the precision measurements of the Higgs boson, and also has possibility in the technological advancement and in its effect on the local community, although the SCJ pointed out some concerns with the ILC project. Therefore, considering the above points, MEXT will continue to discuss the ILC project with other governments while having an interest in the ILC project.***

***highlight in red by KF***

- **LCB/ICFA at SLAC on Feb. 20 → ICFA issued a statement on Feb. 22**

## **ICFA Statement on the ILC Project**

February 22, 2020

ICFA was encouraged by the reports from **Mr. H. Masuko, Deputy-Director General, MEXT Research Promotion Bureau** and **Hon. T. Kawamura, Chairperson of the Federation of Diet Members for the ILC**, at the ICFA meeting held at the SLAC National Accelerator Laboratory, Stanford, USA, on the 20<sup>th</sup> February 2020.

Based on these reports:

- **ICFA reconfirms the international consensus for a Higgs factory and wishes to see the timely construction of the ILC in Japan.**
- **ICFA acknowledges and welcomes the inter-governmental discussion** between Japan, the United States and European nations, to advance international collaborative activities for the ILC.
- **ICFA notes the need for a preparatory phase** ahead of the establishment of the ILC laboratory and the construction of the ILC in Japan.
- **ICFA advocates establishment of an international development team to facilitate transition into the preparatory phase.**
  - The development team should be **hosted by KEK, with leadership chosen with the help of ICFA.**
  - The team would develop a plan for the preparatory phase for the construction of the ILC, including technical, organizational and governance issues. It also would be tasked with understanding the activities and resources required in the preparatory phase. **The process of developing the plan should involve the interested laboratories and community.**
  - ICFA anticipates that these development activities could **be completed in approximately one year**, at which point it would be possible **to launch the preparatory phase for the ILC, provided Japan expresses intent to do so together with international partners.**
- In view of progress towards realisation of the ILC in Japan, **ICFA encourages the interested members of the high energy physics community, laboratories, and nations, to support and participate in these preparations aimed at the successful establishment of the ILC.**

# **ILC Situation in Japan**

# *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** (next page).*
- *The climate change: The first stage of the ILC is 250 GeV but, now **studies on energy upgrade even above 1 TeV is encouraged.***
- *Emergency state has just been lifted all over Japan.*
  - *KEK is restarting its normal activities. (SuperKEKB is running. JPARC has started beam tuning.)*
  - *In Tokyo, **various ILC promotion activities resuming.***
- *Various strategy discussions are on going in KEK (KEK Roadmap, IPNS Research Planning Committee) and JAHEP (Future HEP Project Committee).*
- *The International Development Team to take over LCC/LCB being discussed to be installed in a timely fashion.*

# May 13, 2020 from a Yomiuri news paper article

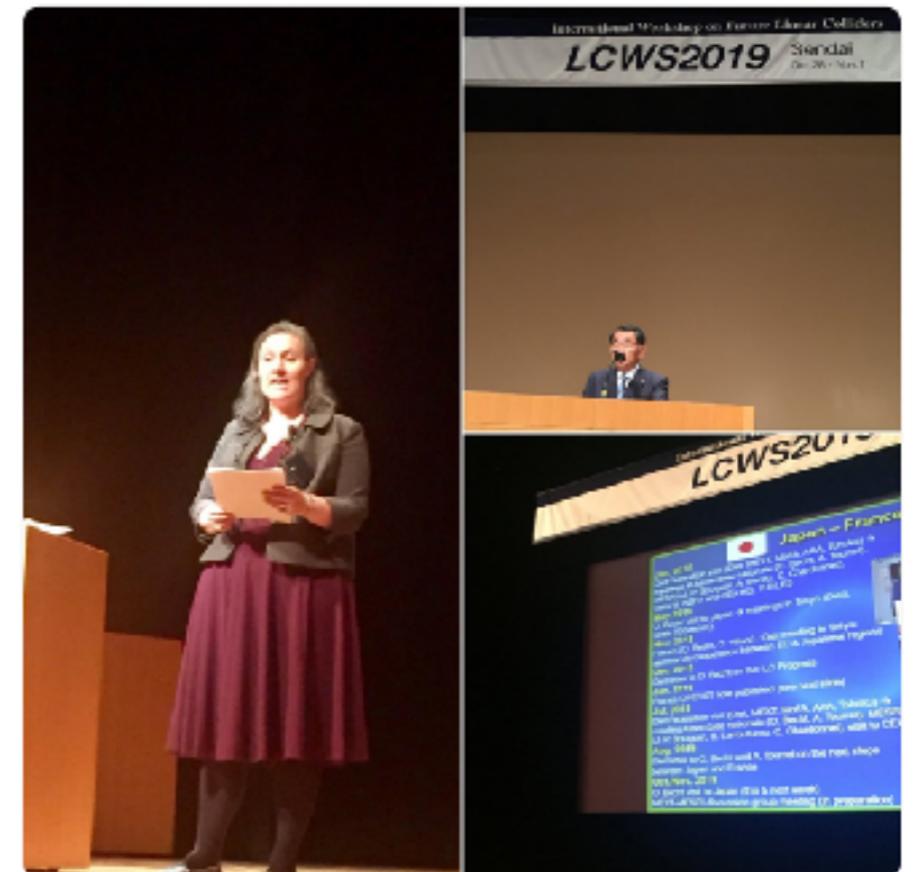
We would like to share with you the following news about the ILC project. It was reported recently (May 13) by Japan's largest newspaper (Yomiuri) that **a letter was sent from the U.S. Deputy Secretary of State to Japan's Foreign Minister** back in February.

The letter reportedly conveyed **strong support for advancing the ILC project**, confirming, at a much higher level, the view expressed by the U.S. government in a speech given at the **Sendai LCWS (by Melinda Pavek, US Embassy in Tokyo)**.



フォローする

Embassy speaker Melinda Pavek emphasized U.S. support for Japan hosting the International Linear Collider (ILC). The ILC facility is the critical next step to advance humanity's understanding of matter, energy, and the origins of the universe.



19.05 - 2019年11月4日

## Nov. 1, 2019

# *Recent Development in the Political Sector*

On June 5, 2020, the **National Diet (parliament)** of Japan passed a series of bills related to the recovery efforts after the **Great Eastern Japan Earthquake** of 2011, including a **10-year extension of the Reconstruction Agency**, which is now set to expire in March 2031. The special annual budget allocated for the recovery efforts will also be sustained.

At the house special committee meetings held prior to the voting, supplementary resolutions were adopted, containing **a supplementary resolution about the ILC project** (see below), out of a total of approximately 25 supplementary resolutions. As per the tradition, a response by the government was given by the Minister of Reconstruction at the end of the committee meetings, who stated that **the contributions by the committee members and the intent of the supplementary resolutions will be duly respected.**

#### 衆議院附帯決議

5 「新しい東北」に資する国際リニアコライダー等の国際研究開発プロジェクトが我が国で実施される場合には、被災地に誘致されるよう関係機関と連携、協力すること。

Supplementary Resolution #5 by the House of Representatives (unofficial translation)

*In cases where international research and development projects, such as **the International Linear Collider** which will contribute to the creation of a “New Tohoku”, are to be implemented in Japan, coordination and cooperation should be done with relevant organizations so that the projects can be hosted in the disaster-stricken areas.*

#### 参議院附帯決議

26 国際リニアコライダー計画は東北が世界的候補地になっていることから、その推進は福島イノベーション・コースト構想と並んで東北をフィールドとした科学イノベーションの創出による「新しい東北」に資するものであり、国内誘致に向け関係機関と検討を進めること。

Supplementary Resolution #26 by the House of Councillors (unofficial translation)

*Since the Tohoku area is the world’s candidate site for **the International Linear Collider** project, its implementation will contribute, alongside the Fukushima Innovation Coast Framework, to the creation of a “New Tohoku” by becoming a breeding ground for scientific innovation; considerations towards hosting in Japan should proceed together with the relevant organizations.*

***EPPSU***

### 3. High-priority future initiatives

a) An electron-positron Higgs factory is the highest-priority next collider. For the longer term, the European particle physics community has the ambition to operate a proton-proton collider at the highest achievable energy. Accomplishing these compelling goals will require innovation and cutting-edge technology:

- *the particle physics community should ramp up its R&D effort focused on advanced accelerator technologies, in particular that for high-field superconducting magnets, including high-temperature superconductors;*
- *Europe, together with its international partners, should investigate the technical and financial feasibility of a future hadron collider at CERN with a centre-of-mass energy of at least 100 TeV and with an electron-positron Higgs and electroweak factory as a possible first stage. Such a feasibility study of the colliders and related infrastructure should be established as a global endeavour and be completed on the timescale of the next Strategy update.*

*The timely realisation of the electron-positron International Linear Collider (ILC) in Japan would be compatible with this strategy and, in that case, the European particle physics community would wish to collaborate.*

### 6. Organisational issues

a) An ambitious next-generation collider project will require global collaboration and a long-term commitment to construction and operations by all parties. CERN should initiate discussions with potential major partners as part of the feasibility study for such a project being hosted at CERN. *In the case of a global facility outside Europe in which CERN participates, CERN should act as the European regional hub, providing strategic coordination and technical support. Individual Member States could provide resources to the new global facility either through additional contributions made via CERN or directly through bilateral and multilateral arrangements with the host organisation.*

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*Version française ci-dessous*

PR03.19.06.2020

## **Particle physicists update strategy for the future of the field in Europe**

Geneva, 19 June 2020. Today, the CERN Council announced that it had unanimously updated the strategy intended to guide the future of particle physics in Europe within the global landscape (the document is available [here](#)). The updated recommendations highlight the scientific impact of particle physics and its technological, societal and human capital.

The 2020 update of the European Strategy for Particle Physics proposes a vision for both the near- and the long-term future of the field, which maintains Europe's leading role in particle physics and in the innovative technologies developed within the field.

The highest-priority physics recommendations are the study of the Higgs boson and the exploration of the high-energy frontier: two crucial and complementary ways to address the open questions in particle physics.

“The Strategy is above all driven by science and thus presents the scientific priorities for the field,” said Ursula Bässler, President of the CERN Council. “The European Strategy Group (ESG) – a special body set up by the Council – successfully led a strategic reflection to which several hundred European physicists contributed.” The scientific vision outlined in the Strategy should serve as a guideline to CERN and facilitate a coherent science policy across Europe.

The successful completion of the High-Luminosity LHC in the coming years, for which upgrade work is currently in progress at CERN, should remain the focal point of European particle physics.

The Strategy emphasises the importance of ramping up research and development (R&D) for advanced accelerator, detector and computing technologies as a necessary prerequisite for all future projects. Delivering the near and long-term future research programme envisaged in this Strategy update requires both focused and transformational R&D, which also has many potential benefits to society.

The document also highlights **the need to pursue an “electron-positron Higgs factory” as the highest-priority facility after the Large Hadron Collider (LHC)**. Construction of this future collider at CERN could start within a timescale of less than 10 years after the full exploitation of the High-Luminosity LHC, which is expected to complete operations in 2038. The electron-positron collider would allow the properties of the Higgs boson to be measured with extremely high precision. The Higgs boson was discovered at CERN in 2012 by scientists working on the LHC, and is expected to be a powerful tool in the search for physics beyond the Standard Model.

Another significant recommendation of the Strategy is that Europe, in collaboration with the worldwide community, should undertake a feasibility study for a next-generation hadron collider at the highest achievable energy, in preparation for the longer-term scientific goal of exploring the high-energy frontier, with an electron-positron collider as a possible first stage.

It is further recommended that Europe continue to support neutrino projects in Japan and the US. Cooperation with neighbouring fields is also important, such as astroparticle and nuclear physics, as well as continued collaboration with non-European countries.

“This is a very ambitious strategy, which outlines a bright future for Europe and for CERN with a prudent, step-wise approach. We will continue to invest in strong cooperative programmes between CERN and other research institutes in CERN’s Member States and beyond,” declared CERN Director-General Fabiola Gianotti. “These collaborations are key to sustained scientific and technological progress and bring many societal benefits.”

“The natural next step is to explore the feasibility of the high-priority recommendations, while continuing to pursue a diverse programme of high-impact projects,” explains ESG Chair Halina Abramowicz.

**“Europe should keep the door open to participating in other headline projects that will serve the field as a whole, such as the proposed International Linear Collider project.”**

Beyond the immediate scientific return, major research infrastructures such as CERN have vast societal impact, thanks to their technological, economic and human capital. Advances in accelerators, detectors and computing have a significant impact on areas like medical and biomedical technologies, aerospace applications, cultural heritage, artificial intelligence, energy, big data and robotics. Partnerships with large research infrastructures help drive innovation in industry.

In terms of human capital, the training of early-career scientists, engineers, technicians and professionals from diverse backgrounds is an essential part of high-energy physics programmes, which provide a talent pool for industry and other fields.

The Strategy also highlights two other essential aspects: the environment and the importance of Open Science. “The environmental impact of particle physics activities should continue to be carefully studied and minimised. A detailed plan for the minimisation of environmental impact and for the saving and reuse of energy should be part of the approval process for any major project,” says the report. The technologies developed in particle physics to minimise the environmental impact of future facilities may also find more general applications in environmental protection.

The update of the European Strategy for Particle Physics announced today got under way in September 2018 when the CERN Council, comprising representatives from CERN’s Member and Associate Member States, established a European Strategy Group (ESG) to coordinate the process. The ESG worked in close consultation with the scientific community. Nearly two hundred submissions were discussed during an Open Symposium in Granada in May 2019 and distilled into the Physics Briefing Book, a scientific summary of the community’s input, prepared by the Physics Preparatory Group. The ESG converged on the final recommendations during a week-long drafting session held in Germany in January 2020. The group’s findings were presented to the CERN Council in March and were scheduled to be announced on 25 May, in Budapest. This was delayed due to the global Covid-19 situation but they have now been made publicly available.

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- MEXT will pay close attention to the progress of the development of the European Strategy for Particle Physics Update.***
- The ILC project has certain scientific significance in particle physics particularly in the precision measurements of the Higgs boson and also has possibility in the technological advancement on the local community, although the SCJ pointed out the difficulties with the ILC project. Therefore, considering the above, MEXT will continue to discuss the ILC project with other countries having an interest in the ILC project.***

***Master Plan published in Jan. 2020, ILC listed in a long list though not in the short list.***

***ESU published on June 19, 2020, where ILC is very positively mentioned***

***IWG report in Oct. 2019  
G-J, F-J Discussion  
Groups, Strong support  
from US. IDT will start  
soon!***

***Expect more serious intergovernmental discussions start soon given the ESU, towards Pre-Lab phase.***

# ***LCC Physics WG***

# ***LCC Physics WG is now gearing up its activity towards Snowmass***

- ***A list of physics questions*** has been compiled by Michael Peskin with inputs from LCC Physics WG members + alpha (main contributions from ILD, Jenny and Junping in particular).
- LCC Physics WG is planning to ***provide MC samples for new comers*** willing to participate in the Snowmass process.
- A recent draft (with descriptions of MC samples) has been sent to Snowmass EF conveners.
  - ***LCC Physics WG will meet tonight to finalize the document and post it to arXiv.***
- Discussions/studies for the MC samples on going
  - Fast simulation based on DELPHES, SGV
  - Mini-/Micro-DST from full simulation data
- ***LCC Physics WG nominated ILC contact persons for relevant EF WGs. Individual ILC people have signed up for Snowmass Energy Frontier WGs, participating in WG activities.***

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Liaisons between the Energy Frontier working groups and the ILC community:

EF01: EW Physics: Higgs Boson properties and couplings

- **Shin-Ichi Kawada** (DESY) [[shin-ichi.kawada@desy.de](mailto:shin-ichi.kawada@desy.de)]

EF02: EW Physics: Higgs Boson as a portal to new physics

- **Maxim Perelstein** (Cornell) [[m.perelstein@cornell.edu](mailto:m.perelstein@cornell.edu)]

EF03: EW Physics: Heavy flavor and top quark physics

- **Roman Poeschl** (Orsay) [[poeschl@lal.in2p3.fr](mailto:poeschl@lal.in2p3.fr)]

EF04: EW Precision Physics and constraining new physics

- **Sunghoon Jung** (Seoul National U) [[nejsh21@gmail.com](mailto:nejsh21@gmail.com)]

EF05: QCD and strong interactions: Precision QCD

- **Juergen Reuter** (DESY) [[juergen.reuter@desy.de](mailto:juergen.reuter@desy.de)]

EF06: QCD and strong interactions: Hadronic structure and forward QCD

- (not relevant to ILC)

EF07: QCD and strong interactions: Heavy Ions

- (not relevant to ILC)

EF08: BSM: Model specific explorations

- **Mikael Berggren** (DESY) [[mikael.berggren@desy.de](mailto:mikael.berggren@desy.de)]

EF09: BSM: More general explorations

- **Taikan Suehara** (Kyushu U) [[suehara@phys.kyushu-u.ac.jp](mailto:suehara@phys.kyushu-u.ac.jp)]

EF10: BSM: Dark Matter at colliders

- **Filip Zarnecki** (Warsaw) [[Filip.Zarnecki@fuw.edu.pl](mailto:Filip.Zarnecki@fuw.edu.pl)]

A theory liaison:

TF07: Collider phenomenology

- **Mihoko Nojiri** (KEK) [[nojiri@post.kek.jp](mailto:nojiri@post.kek.jp)]

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# Letter of Interest from ALCC

- The American Linear Collider Committee (ALCC, chaired by Hugh Montgomery) submitted a Letter of Interest to the Snowmass process. It can be found at:

<https://www.snowmass21.org/docs/files/summaries/EF/SNOWMASS21-EF0-014.pdf>

## Abstract

A worldwide community of physicists and laboratories intends to realize a physics program of energy- frontier, electron-positron collisions with the International Linear Collider (ILC). The project would be hosted in Japan with participation from around the globe. **Snowmass participants are strongly encouraged to participate in the ILC studies.**

## The ILC and Snowmass

The International Linear Collider is a mature project, well matched to the contemporary needs of particle physics. Extensive discussion of the ILC project and **a major reinvigoration of the participation of the U.S particle physics community in concert with its global partners** is appropriate. **It is time for an open discussion of the ways in which the U.S. Community and its supporting laboratories can envisage leadership roles within the ILC project.** A document with a compilation of physics and detector issues designed to encourage and guide immediate studies, is in preparation.

- Other LIOs can be found at <https://snowmass21.org/loi>

# Our Group's Activities

# Status & Next Step

## Symmetry Breaking & Mass Generation Physics

- ZH :  $H \rightarrow bb, cc, gg$  → EPJ C (2013) 73:2343, Ono+Miyamoto: IDR: Kurata  
H →  $WW^*$  anomalous coupling: publication: Takubo → P.R.D88,013010(2013)  
→ H →  $WW^*$  to be reexamined: Liao Libo, Mila, Uli  
H → other modes (AA,  $\mu^+\mu^-$ ) + Kawada/Tanabe/Suehara/Daniel, ( $\tau^+\tau^-$ ) → publication → EPJC (2015) 75:617., H →  $Z\gamma$  : Kazuki Fujii
- Recoil mass: Jacqueline → P.R.D94,113002(2016), Suehara (qq), CP mixing in  $h \rightarrow \tau^+\tau^-$ : Daniel  
→ 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: Junping
- Zgamma: Takahiro Mizuno
- ZHH : full simulation of the  $H \rightarrow bb$  &  $Z \rightarrow$  all modes, fast simulation of  $n\nu H$ : finished: Junping + Takubo (Ph.D thesis: done) → New analysis with improved analysis tools: Junping + Claude + Suehara + Tanabe, Jet-clustering: Kurata, Shaofeng Ge, LCFIPlus: Suehara, Yonamine  
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 → 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  
→ 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 → Yuto Eda
- W mass ( $m_W$ ) : Koya Tsuchimoto → Kotera (controlling systematic uncertainties) → Kotera
- AA → HH : quick simulation studies, so far  $H \rightarrow bb$  and  $WW$  BG  
→ 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 →analysis finished.
- 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)** , **RHN: Yonamine**
- 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, yagy (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

# Short Term Schedule

- Weekly Meeting
  - Every Fri. at 14:00 (conf. ID: to be announced)
- General Meeting
  - 10:30 on **Thu. Sep. 10, 2020**
- **ALCW2020 in October?**
- **Snowmass meeting on Nov. 4-6**