

# Opening Comments

2019/02/09

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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.

- With the LCB and ICFA statements on the ILC250, together with the LCC physics case report on ILC250, the MEXT re-reviewed ILC physics case and cost/technological readiness and finally finished their review process. The SCTJ, being asked by the MEXT, reviewed it and produced their assessment of ILC250, pointing out remaining issues and concluding that they cannot support ILC250 at this point while appreciating its academic significance. The MEXT will take into account the SCTJ's assessment together with other aspects of the project for their decision. Assuming that a green light will be given by March 7, we should now get ready for ESU. The next important events for us are the Lausanne meeting on April 8-9 and the Granada meeting on May 13-16.



# **Situation in Japan**

# SCJ's Report on ILC

## SCJ EB Meeting on Dec. 19 (10:00-12:00)

- As expected the SCJ EB endorsed the report from the SCJ's ILC committee. The report was sent back to MEXT immediately after that.
- The ILC part of the meeting ended in 15 minutes and **Mr. Iye commented that the decision belongs to the government. He also confirmed that the scientific significance of the ILC.**



From an article by K. Nakanishi that appeared in FNN prime

<http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-24-k273.pdf>



# SCJ's Official English Translation of the Executive Summary

**Now available as**

<http://www.scj.go.jp/ja/info/kohyo/pdf/kohyo-24-k273-en.pdf>

***No serious difference from the unofficial  
translation by KEK available from LC Newslines:***

<http://newslines.linearcollider.org/2018/12/21/>





# ***Executive Summary of the Science Council of Japan's Report***

**Emphasis in red by KF**

## **OVERALL ASSESSMENT**

While the 250GeV ILC project requires a long-term commitment to huge budget allocation for its construction and operation, **the expected scientific outcome is that if a certain deviation from the standard model prediction is found upon the precision measurement of Higgs coupling, it may provide a suggestion for the future direction of particle physics.** The Committee and the Subcommittee are not yet convinced that the prospective scientific outcome (possible indication of future direction) is sufficient to justify Japan's large share of the overall cost required for the project implementation. In regard to the technical feasibility of the 250GeV ILC, considerable hurdles remain to be cleared. As such problems are left to be solved in the adequate preparatory period of the project, they constitute matter of concern for the implementation of the project. The uncertainty surrounding proper international cost-sharing with respect to the long-term commitment to large budget allocation is another matter of concern.

**Judging from the plan and preparatory status of the project presented at the moment,** the Science Council of Japan does not reach a consensus to support hosting the 250GeV ILC project in Japan. **The SCJ considers that government should be cautious regarding a decision to announce its commitment to host the ILC in Japan.**



Particle physics in pursuit of the fundamental structure of natural world has made marvelous developments thanks to the coordinated efforts of theoretical studies and accelerator experiments, and accomplished the monumental establishment of the standard model. The central issue at the moment is the exploration of “physics beyond the standard model.” which is also the target of the ILC project. As the desired way of promoting the accelerator-based high energy physics experiment in the near future, it is envisioned to realize a high-luminosity lepton collider somewhere in the world, which plays a complimentary role to the hadron collider (the Large Hadron Collider and its future upgrade). On the other hand, in view of the finite resources available to humanity, the research style that presupposes and ever-growing scale-up of gigantic experimental facilities would eventually reach the limit of sustainability. The future way of “big science” is a theme to be deliberated by the whole academic community.

***KF's assessment of the report***

**Significant improvement from the Nov. 14 draft.**

**Misunderstandings of facts have been corrected.**

**Some good points are also made.**

**The report appreciates the ILC's academic significance.**

**It is not vetoing Eol from the government.**



# ***Clarifications on the report from the Science Council of Japan regarding the ILC***

The purpose of this note is to provide clarifications on the report from the Science Council of Japan (SCJ) regarding the International Linear Collider (ILC), which was released on December 19, 2018.

The Ministry of Education, Culture, Sports, Science and Technology (MEXT) examined the ILC project through the ILC Advisory Panel, and subsequently called for an external evaluation from the SCJ in July 2018. The SCJ is an organization consisting of Japanese scientists, and it conducted a detailed review of the ILC proposal by establishing a special panel. The report was submitted to the MEXT and published after a review in the executive meeting of the SCJ. **While acknowledging the scientific case for the ILC, the panel concluded that it did not support at this time that Japan host the ILC due to issues yet to be resolved. One of the reasons pointed out is that the international negotiation on cost-sharing has not been proven to be successful.**

It should be noted that, in the decision-making process by the Japanese government, the SCJ report will be taken into account along with other factors such as merit to the society. We strongly hope that **an official statement by the Japanese government on its position towards the ILC will be available in a timely manner for full consideration in the European strategy process. KEK, in collaboration with many Japanese and international associates, is working diligently in maintaining the progress and making the ILC a reality in Japan.** Therefore, your continual support is highly appreciated and solicited.

21 December 2018

***Planning Office for the ILC at KEK***

**Emphasis in red by KF**



# ***From KEK: Regarding the “Assessment of the revised International Linear Collider Project”***

We would like to express our gratitude to the review committee of the revised International Linear Collider (ILC) project of the Science Council of Japan (SCJ) for their prompt and detailed evaluation. We here present our opinions in response to **the final report published by the Science Council of Japan.**

**The SCJ appreciated the scientific significance of the ILC project, the “pursuit of new physics beyond the standard model,” but also pointed out issues concerning the hosting of the ILC project in Japan, in particular the cost-sharing as an international project and the international project organization and management. To address these issues, we ask the Japanese government to promptly convey a forward-looking position regarding the implementation of international discussions toward the realization of the ILC.**

Humankind has so far revealed the extreme microscopic world by studies using accelerators. However, there remain big questions regarding the natural world that remain unanswered, and it is the greatest challenge of modern physics to elucidate them. There is broad consensus among particle physicists that the Higgs particle holds the key. Precision studies of the Higgs particle have the potential to expand the horizon of humankind’s understanding of nature. The Linear Collider is an important project that can be a major turning point in deciding the “direction of physics” for the next 50 to 100 years.

The scientific significance of the ILC project is widely accepted, but the significance and consequences of Japan taking on a major part of the ILC project should be discussed not only from the academic but also societal points of view. Investigations of the project by researchers have now reached the stage at which further progress requires international discussions by the government. If, in the course of these discussions, it becomes clear that international and domestic conditions are not satisfied, the project will be canceled. **We will advance the ILC project, establishing worldwide consensus, including on its budget, while gaining support from both academic circles and society at large.**

As for the identified technical issues, the global community will cooperate, combining resources to resolve them. Based on our experience and achievements at LHC, KEKB, European XFEL, and other research facilities, we are convinced that we can solve them.

— *this article has been previously released on the KEK website in Japanese.*

**Emphasis in red by KEK**

# **Message *from politicians* in response to Science Council of Japan's final report**

We wish to express our sincere gratitude for the intensive discussions conducted at the Science Council of Japan. It is extremely important that the scientific merits of the ILC and the significance of Japan contributing to international collaborative research have been recognized.

The ILC has a far-reaching impact on a wide range of national policies, such as science and technology innovation, diplomacy and national security, industrial development and growth, and regional revitalization and post-disaster reconstruction. **We believe that it is our political mission to push forward the ILC project as a national priority.**

Japan has been and will remain a science and technology-oriented nation. We will continue to seek public understanding for the ILC project and will work to address the issues raised by the Science Council of Japan.

**The Federation of Diet Members for the ILC and the Liaison Committee for Realizing the ILC will be working at full strength to ensure that the Japanese government reaches a positive decision to realize the ILC project in Japan.**

**Takeo KAWAMURA**

Chairperson, Federation of Diet Members for the ILC

Chairperson, Liaison Committee for Realizing the ILC, Liberal Democratic Party\*

**Emphasis in red by KF**

\*In September 2018, the Liberal Democratic Party, created a new organization, called the Liaison Committee for Realizing the ILC. The Liaison Committee brings together various strategic groups involved in making important policies, such as science technology and innovation, regional revitalization, reconstruction from natural disasters, and national resilience.



# **MEXT Minister's Press Conference on Dec. 21**

## MEXT Minister's Press Conference (Dec. 21, 2018)

### - Regarding the ILC Report of the Science Council of Japan -

#### ◆Journalist

Recently, the Science Council of Japan delivered a report on the International Linear Collider (ILC) to the Ministry of Education, Culture, Sports, Science, and Technology (MEXT). The report states “the Science Council of Japan cannot reach a consensus to support hosting the ILC.” How will MEXT respond to this report and what are its next steps?

#### ■MEXT Minister

We asked the Science Council of Japan (SCJ) to consider the International Linear Collider following the issue of a report in July by MEXT's ILC Advisory Panel. On December 19th, we received the SCJ's response to our request. The project was thoroughly discussed in the SCJ by researchers from diverse academic fields. I am grateful to those researchers for their work. Now MEXT will consider government's response, taking into account the SCJ's report. **The SCJ's summary acknowledges the scientific significance of the ILC in the field of elementary particle physics, but also expresses concerns. The main concerns are the prospects for international cost sharing and the availability of human resources. We would like next for the government to proceed with careful consideration of the ILC, while paying attention to these concerns.** Regarding the schedule, the key international research organization acknowledged on December 5th that it is unrealistic to expect the Japanese government's expression of its position on the ILC in 2018. They requested a statement from the Japanese government by the beginning of March, 2019. While carefully monitoring such international developments, we will consider how the government should respond, after carefully reviewing the contents of the SCJ's report.

**Emphasis in red by KF**

#### ◆Journalist

Today, the governors of the Miyagi Prefecture and the Iwate Prefecture said the government should consider societal significance as it makes a decision on the ILC. What do you think of this?

#### ■MEXT Minister

I think **a comprehensive examination taking into account such viewpoints is necessary. We will consider more factors now, including intra-government coordination.**



# ILC Promotion bodies in Japan

Japan: Parliamentary cabinet system

Government

**National Diet (Parliament)**

Representatives ~480  
Councillors ~240

**Political**

**Federation of  
the Diet Members  
for ILC (2006, 2008~)**

Founded by LDP in 2006 → Multi-  
parties in 2008. Now ~150 Members

**Industry &  
Academia  
Business sector**

**AAA**

**Advanced Accelerator  
Association (2008~)**  
(2014~ incorporated company)

Industry-Academia cooperation  
Led by Executives of Leading  
Companies and KEK DG

**Local Area  
Candidate area**

**ILC Tohoku  
Promotion Office  
(2016, June~)**

Led by Local Governments, Business Associations, Univ. Presidents.  
Cooperation of Civil engineering at candidate site area  
Geological surveys, preparation for campus

**Cabinet (Prime Minister's office)**

**Ministries**

**MEXT** (Education, Culture, Sports, S&T)  
**CAO** (Cabinet office) – S&T Council (**CSTI**)  
**MOFA** (Foreign Affairs) -- Embassy  
**MLIT** (Civil, Sightseeing, Transport)  
**METI** (Economy, Trade, Industry)  
+ ...  
**MOF** (Ministry of Finance)

**Central activity in  
Researchers**

**KEK**

**ILC Promotion Office  
(led by KEK DG, 2014~)**

Technological leadership for Accelerator  
Cooperation with MEXT

**KEK** JAEA,  
QST,  
JAXA, RIKEN,  
**Universities,,**

**J-HEP Committee  
Japan HEP Community**

**SCJ**  
Science  
Council  
of Japan

# Realizing the ILC as National Project with Cross-Cutting Policies

**Established on Sep. 18**





## The Committee made a resolution on September 18, 2018

- ✓ To position ILC as a cross-policy “national project”, covering not only science, technology and innovation but also many challenges faced by the national government;
- ✓ To secure the financial resources for the realization of ILC (beyond the Olympic Games) outside the ordinary science and technology, academic or university budgets; and in addition,
- ✓ To make sure that, as for the international agreement of ILC, certain critical decisions, such as the share of overseas investments be roughly half, be satisfied before the international agreement necessary for the start of construction of ILC is reached.

From deliberations in the academic sector to the political decision-making process.

We will make all possible efforts to help the Japanese government so that it can give the statement in time for the LCB/ICFA meeting on March 2019, in Tokyo.



# ***LCC Physics WG***

# **LCC submitted 2 10-page documents to ESU, now finalizing an 80-page Support Document.**

<https://ilchome.web.cern.ch/content/ilc-european-strategy-document>

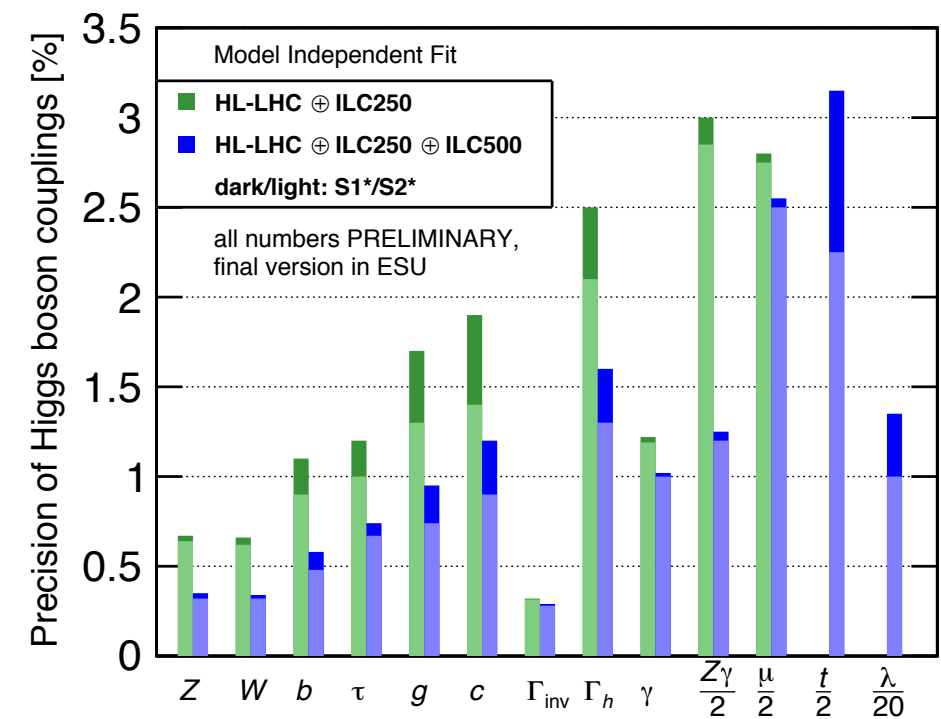
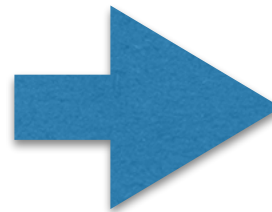
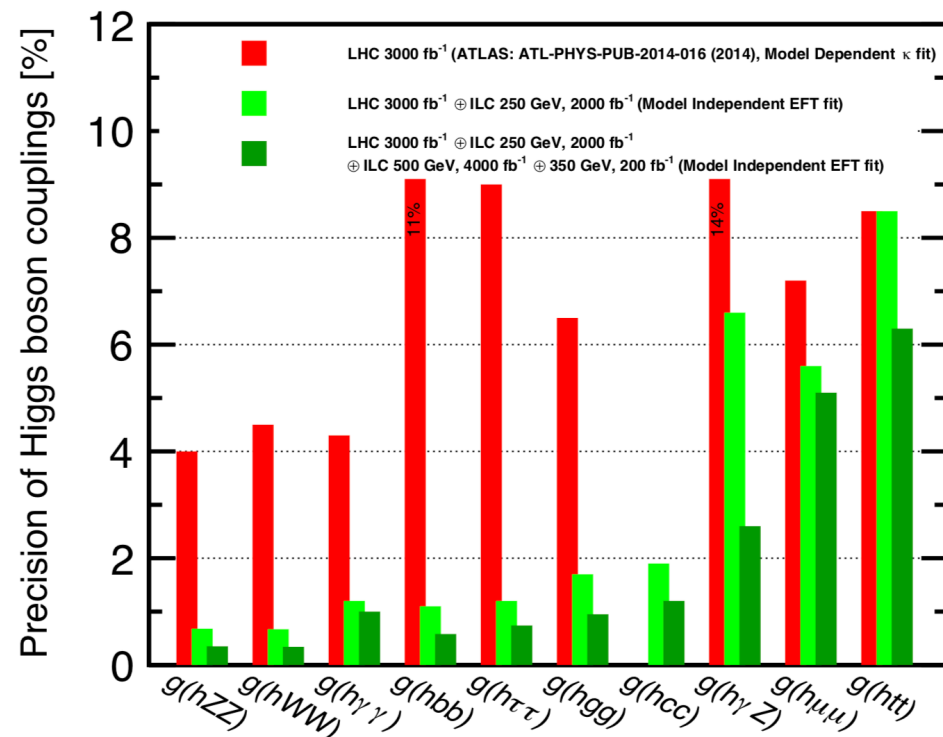
<https://arxiv.org/abs/1901.09829>

<https://arxiv.org/abs/1901.09825>

# New Manhattan Plots

*for comparison with new HL-LHC projections*

*ILC scenario 2 and EFT analysis*



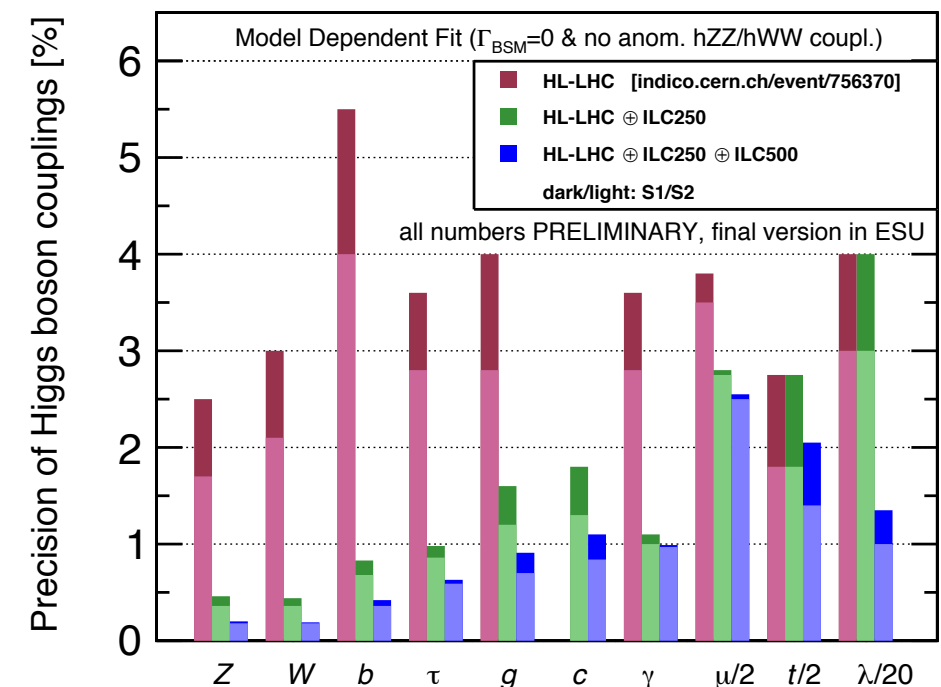
**New plots shown in the ILC ESU**

**10-page input:**

<https://arxiv.org/abs/1901.09829>

## Disclaimer

**LHC numbers are subject to change, should be updated when the HL-LHC yellow report comes out.**





# **Linear vs Circular Discussion**

**Political support:** ILC has been considered in depth over a number of years by the government of Japan, which is soon expected to make **an Expression of Interest to host the project.**

Politicians, governments, and funding agencies in Japan have been discussing the ILC with their counterparts in Europe and the US for a number of years, and have been encouraged by these discussions.

**Other large collider projects have not yet reached a similar stage.**

**Technical maturity:**

The RDR (CDR equivalent) for the ILC was published in 2007 and the **TDR in 2013.**

**Circular collider projects have only recently published their CDRs.**

The ILC's quoted performance and costs are deeply understood and thus reliable.

**Timeline:** Given a go-ahead, the ILC will very soon be ready to start construction. First collisions can occur within around 15 years from now.

**According to current run plans, the ILC will complete its 2 ab-1 250 GeV run at about the time FCCee begins its ZH run.**

**Physics:** Beam polarization is a powerful tool not available at high energy circular colliders.

When measuring Higgs couplings, **polarization compensates for the lower integrated luminosity at 250 GeV compared to FCCee (2 vs 5 ab-1)** not just by the increased rates but also by its power to remove some correlations among different EFT operators.

In the case that ILC observes new phenomena other than in the Higgs couplings, polarization will play an essential role in determining their chiral properties.

Polarization will also allow **systematic uncertainties** on many measurements **to be significantly reduced.**

**Upgradeability:** The ILC's collision energy can be readily upgraded to 500 GeV and above.

**A technical design for a 500 GeV stage exists.**

Likewise, **a technical design exists for upgrading the luminosity:**

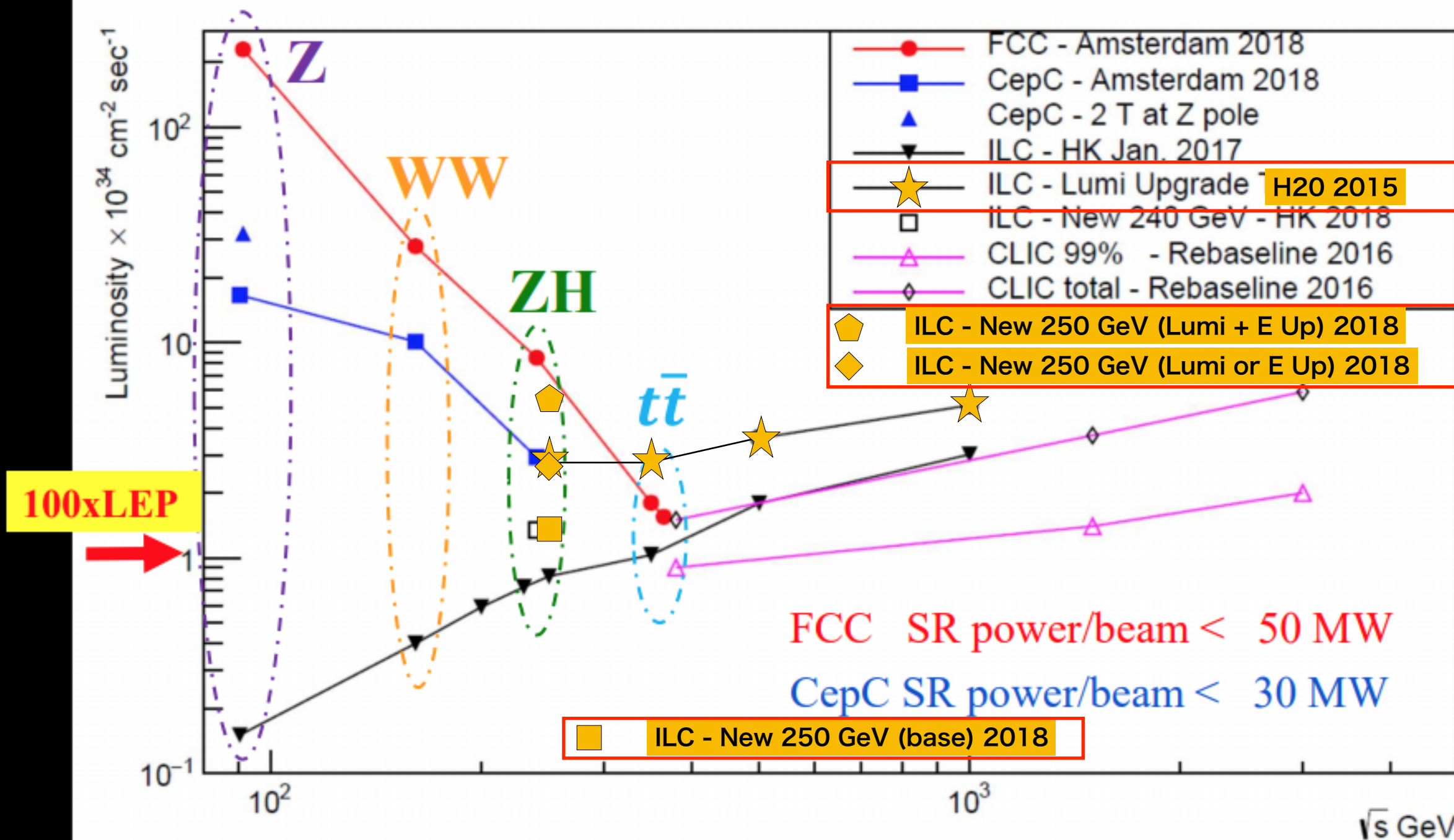
- **by a factor 2 by doubling the number of bunches per pulse,**
- **another factor 2 by doubling the repetition rate.**

The ILC250 infrastructure is reusable. It provides long-term perspectives beyond current technologies (e.g. a plasma-based accelerator).

# CepC, FCC, ILC, CLIC

## luminosity comparison

### $e^+e^-$ Collider Luminosities





# Our Group's Activities



# Status & Next Step

## Symmetry Breaking & Mass Generation Physics

- ZH :  $H \rightarrow bb, cc, gg \rightarrow$  EPJ C (2013) 73:2343, now working on  $m_h=125$  GeV case: Ono+Miyamoto  
 $H \rightarrow WW^*$  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: Ogawa, Yumi Aoki (Hgamma)  
 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  $nnuHH$ : finished: Junping + Takubo (Ph.D thesis: done)  $\rightarrow$  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  $\rightarrow$  publication
- nnH, eeH : precision measurements of HVV couplings,  $m_h=125$  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 →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)
- LHT: Kato (exp) + Harigaya (th): ZHH 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<sup>+</sup>/W-H<sup>-</sup>: (Shinzaki), Ishikawa (exp) + Kanemura, yagyu (th)
- **Generic DM search (mono-photon)**: Tanabe → Yonamine
- New projects?
  - AMSB: Tanabe
  - Heavier Higgs bosons?: Yokoya, (Abhinav) → Christian Drews
  - 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. Mar. 30, 2019 ?
- HPNP 2019, Univ. Osaka, Feb. 18-22, 2019
- ILD Benchmarking Days, KEK, Feb. 23-27, 2019
- Lausanne LC community Meeting, April 8-9, 2019
- Granada Open Symposium for ESU, May 13-16, 2019