News on ILC

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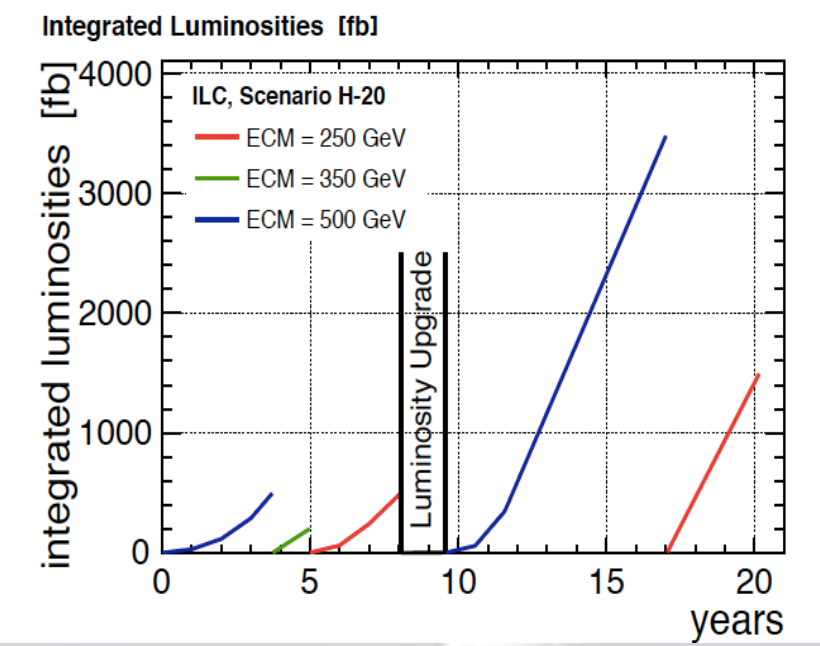
FCAL meeting at CERN (remote talk)

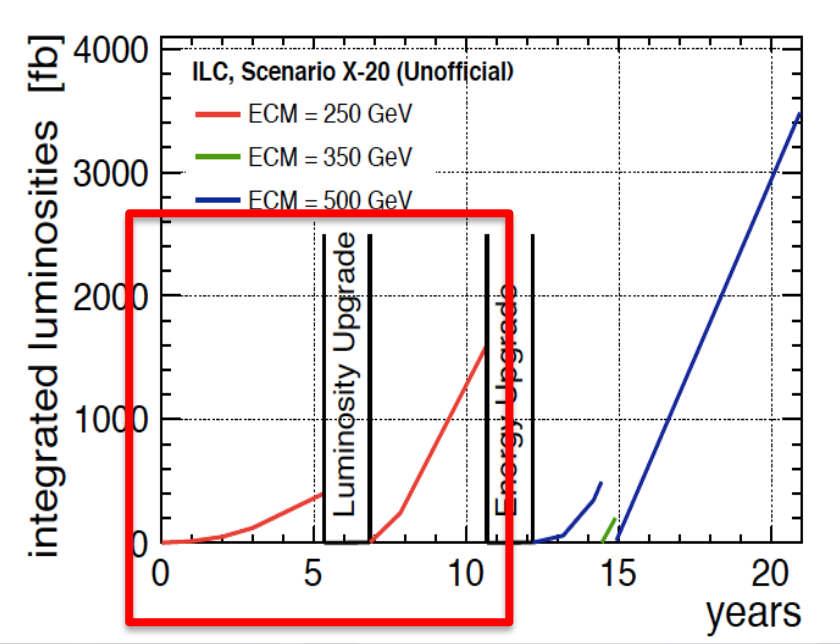
March 26, 2019

Staging：ILC250 Higgs Factory

Up to Dec. 2016 (LCWS Morioka)
500 GeV start sample scenario



After Dec. 2016
Generally agreed by ILC community
To be formalized this fall



ILC250 Higgs Factory

Build the ILC250 Higgs factory as the first stage ‘program’
～40% cost reduction wrt ILC500

Machine Parameters

ILC250 Higgs Factory

Quantity	Symbol	Unit	Initial	$\mathcal{L}$ Upgrade	TDR	Upgrades	
Centre of mass energy	$\sqrt{s}$	GeV	250	250	250	500	1000
Luminosity	$\mathcal{L}$	$10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$	1.35	2.7	0.82	1.8/3.6	4.9
Polarisation for $e^-(e^+)$	$P_-(P_+)$		80 %(30 %)	80 %(30 %)	80 %(30 %)	80 %(30 %)	80 %(20 %)
Repetition frequency	f_{rep}	Hz	5	5	5	5	4
Bunches per pulse	n_{bunch}	1	1312	2625	1312	1312/2625	2450
Bunch population	N_{e}	10^{10}	2	2	2	2	1.74
Linac bunch interval	Δt_{b}	ns	554	366	554	554/366	366
Beam current in pulse	I_{pulse}	mA	5.8	5.8	8.8	5.8	7.6
Beam pulse duration	t_{pulse}	μs	727	961	727	727/961	897
Average beam power	P_{ave}	MW	5.3	10.5	10.5	10.5/21	27.2
Norm. hor. emitt. at IP	$\gamma\epsilon_{\mathrm{x}}$	μm	5	5	10	10	10
Norm. vert. emitt. at IP	$\gamma\epsilon_{\mathrm{y}}$	nm	35	35	35	35	30
RMS hor. beam size at IP	σ^*_{x}	nm	516	516	729	474	335
RMS vert. beam size at IP	σ^*_{y}	nm	7.7	7.7	7.7	5.9	2.7
Luminosity in top 1 %	$\mathcal{L}_{0.01}/\mathcal{L}$		73 %	73 %	87.1 %	58.3 %	44.5 %
Energy loss from beamstrahlung	δ_{BS}		2.6 %	2.6 %	0.97 %	4.5 %	10.5 %
Site AC power	P_{site}	MW	129		122	163	300
Site length	L_{site}	km	20.5	20.5	31	31	40

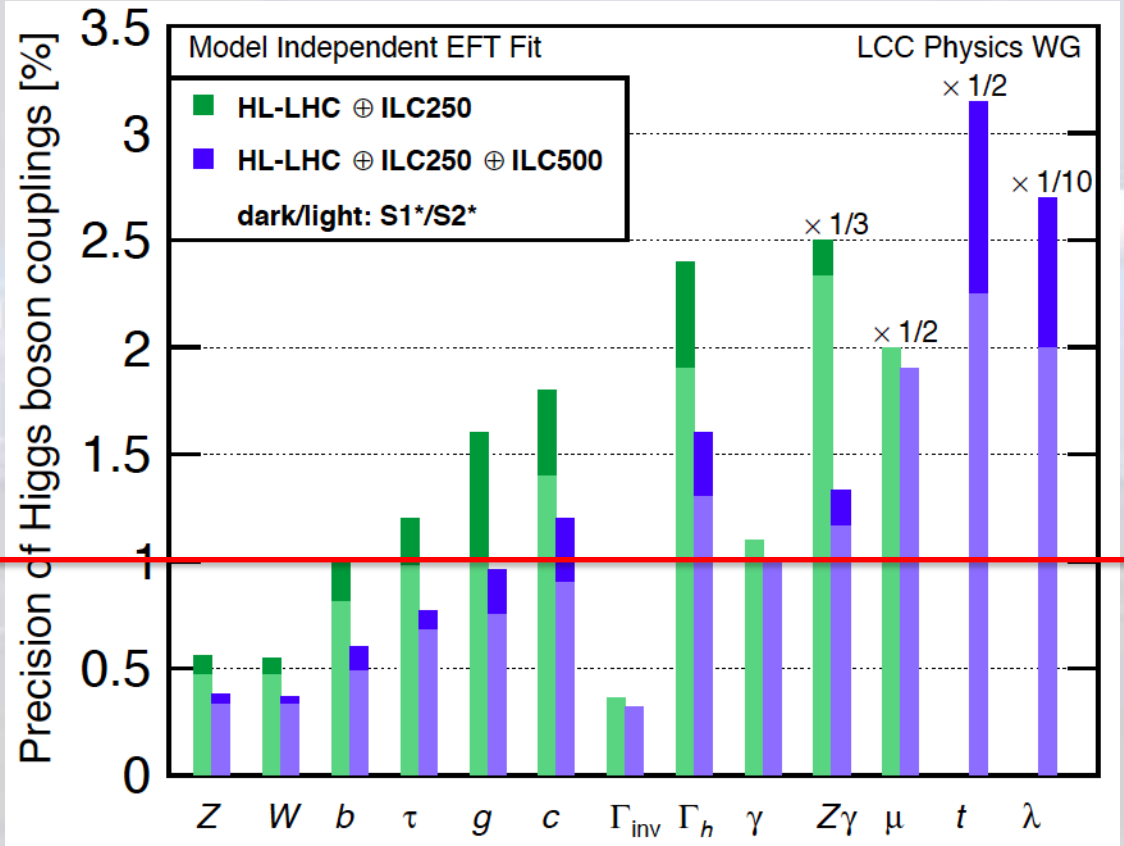
TABLE I: Summary table of the ILC accelerator parameters in the initial 250 GeV staged configuration (with TDR parameters at 250 GeV given for comparison) and possible upgrades. A 500 GeV machine could also be operated at 250 GeV with 10 Hz repetition rate, bringing the maximum luminosity to $5.4 \cdot 10^{34}\,\mathrm{cm}^{-2}\mathrm{s}^{-1}$ [10].

Cost of L upgrade (2.7×10^{34}): ~6% of initial construction cost

10 Hz repetition rate upgrade is not considered as ILC250 in this talk

Higgs Coupling Measurement Precisions

EFT approach



1%

Polarization
(e- e+) = (±0.8 ±0.3)
(-+, +-, ++, --) =
(45%, 45%, 5%, 5%)

ILC250
2000 fb-1 (~10 yrs)

ILC500 ('H20')
4000 fb-1 @500 GeV
(~20 yrs total)

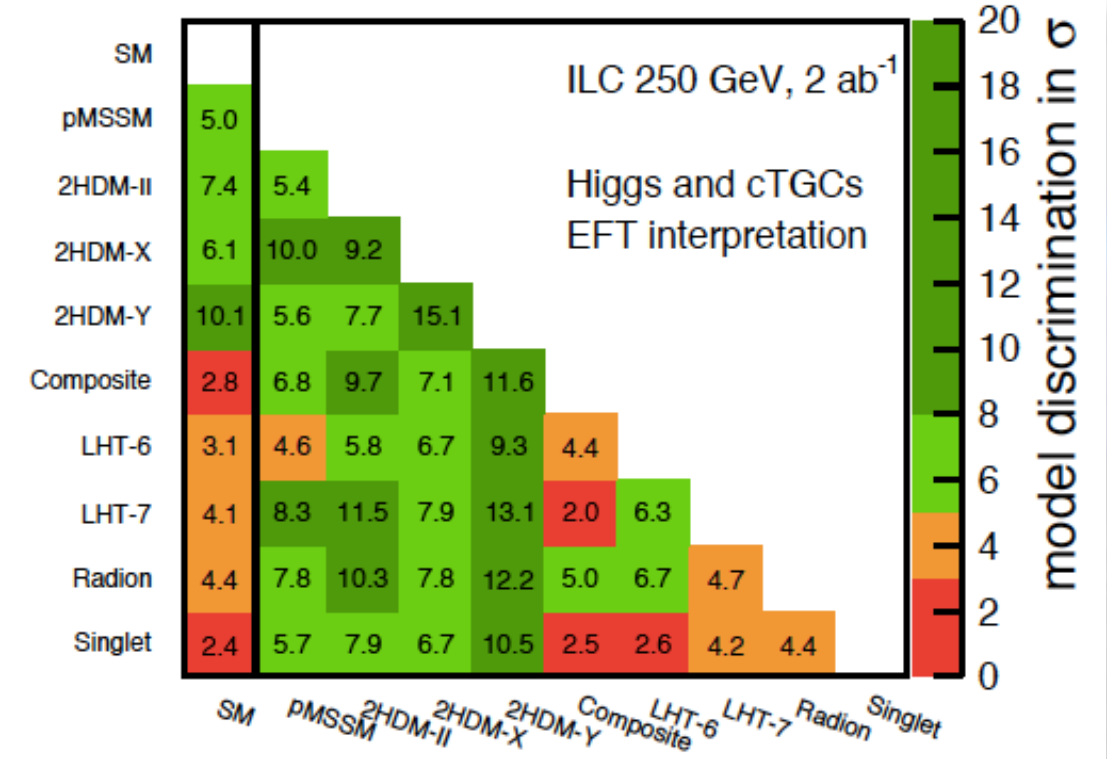
Based on full-simulation with realistic backgrounds

Dark (S1*) = current understanding of systematics

Light (S2*) = with improvements in systematics

Model Discrimination

ILC250



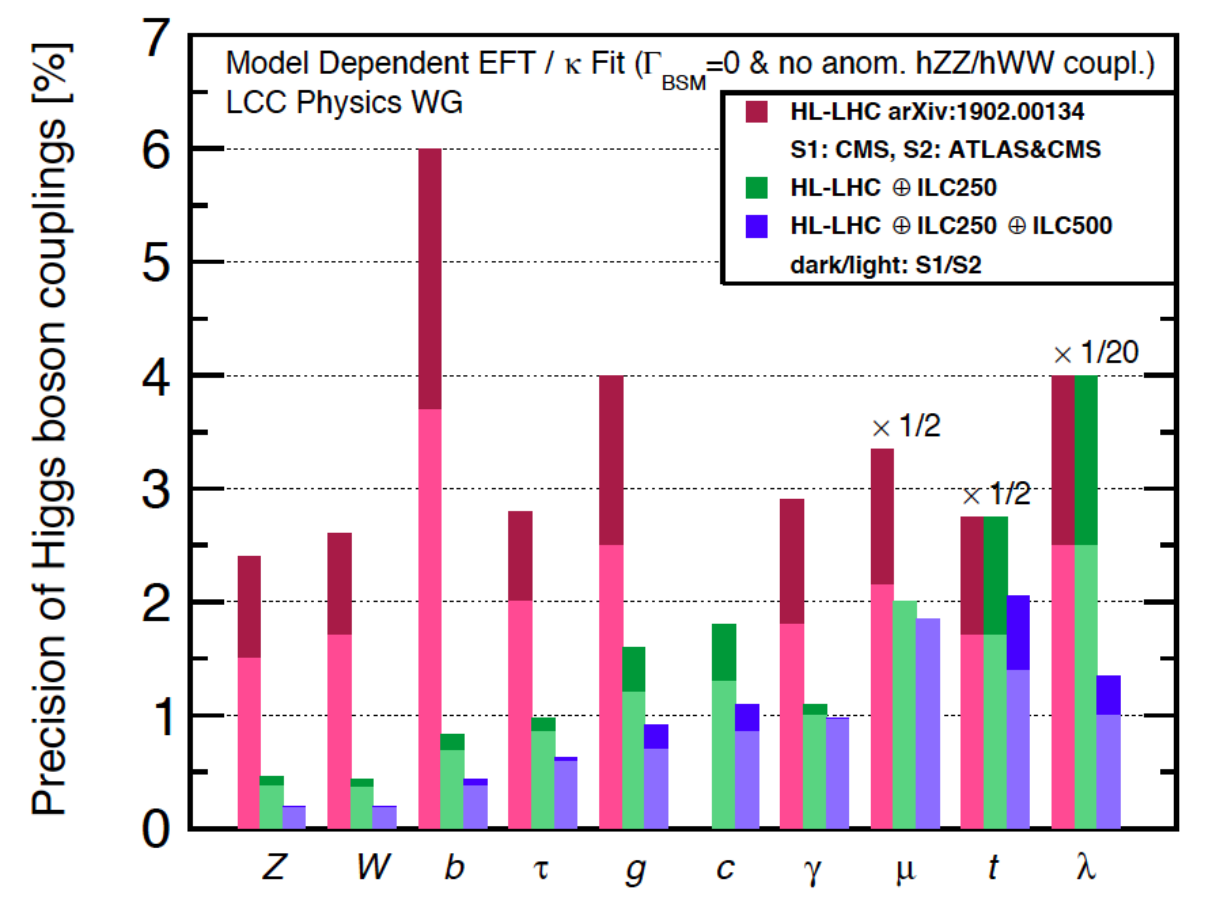
Separation among models in #sigma
(for 9 models unlikely to be rejected by HL-LHC)

ILC250 can identify the correct model more or less by pinpoint

The precision of ILC250 is necessary!

Comparison with HL-LHC

Common assumptions used: No Higgs decay modes other than SM
Higgs to Z/W are the same form as SM



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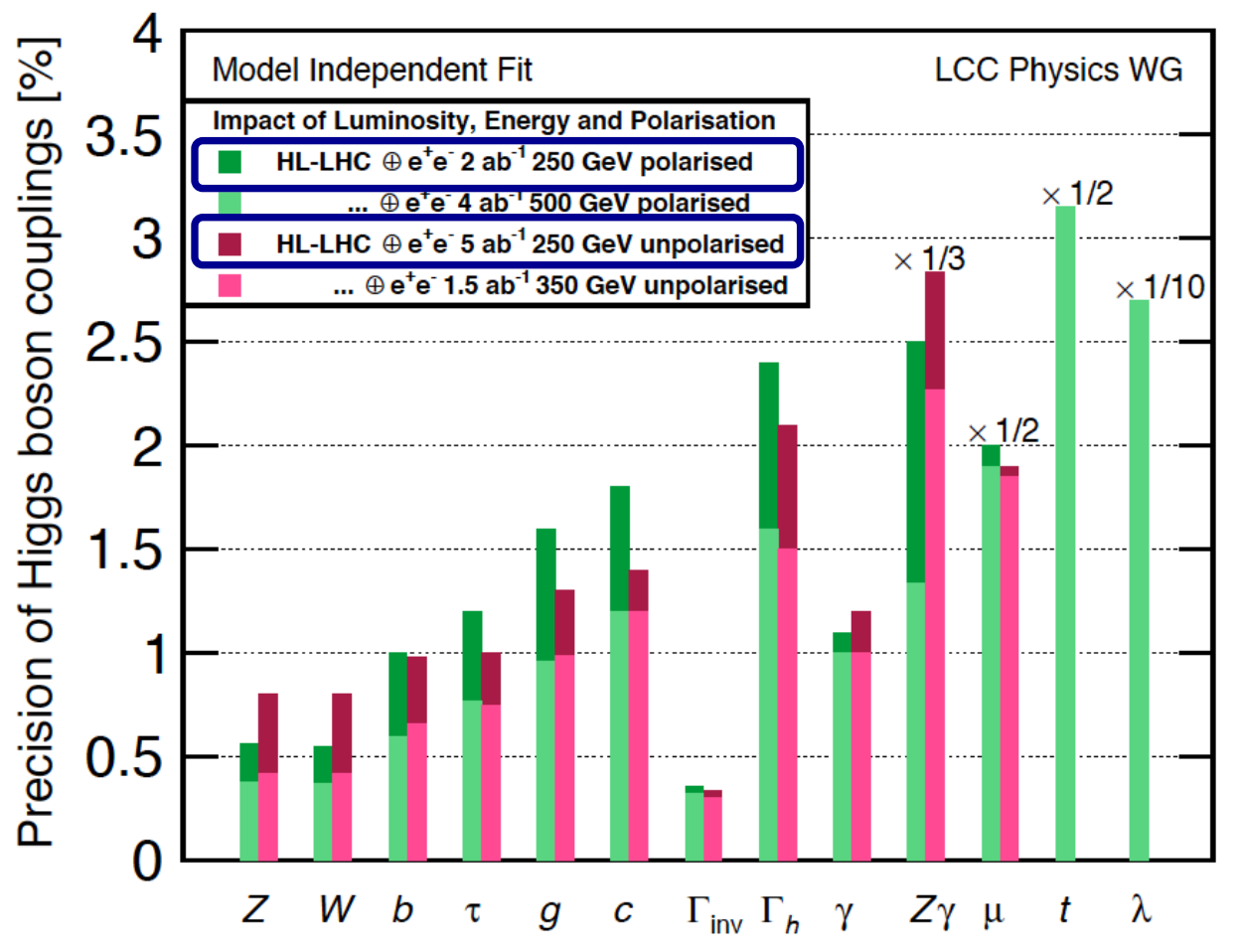
Light: S2 = with improvements in systematics

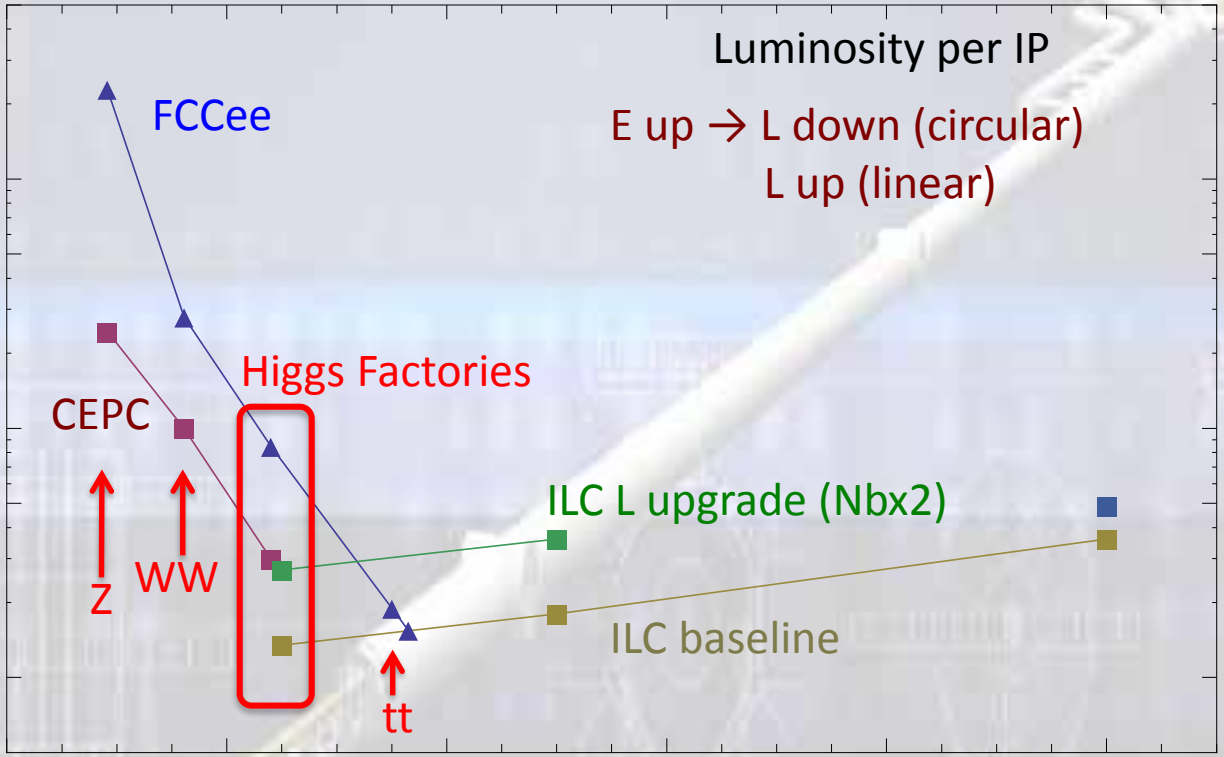
Power of Polarization



Polarization:
(e- e+) = (±0.8 ±0.3)
(–+, +–, ++, ––) =
(45%, 45%, 5%, 5%)

- 2 ab-1 (polarized) is roughly equivalent to 5 ab-1 (unpolarized)
- Effective luminosity ～ x 2.5 by polarization

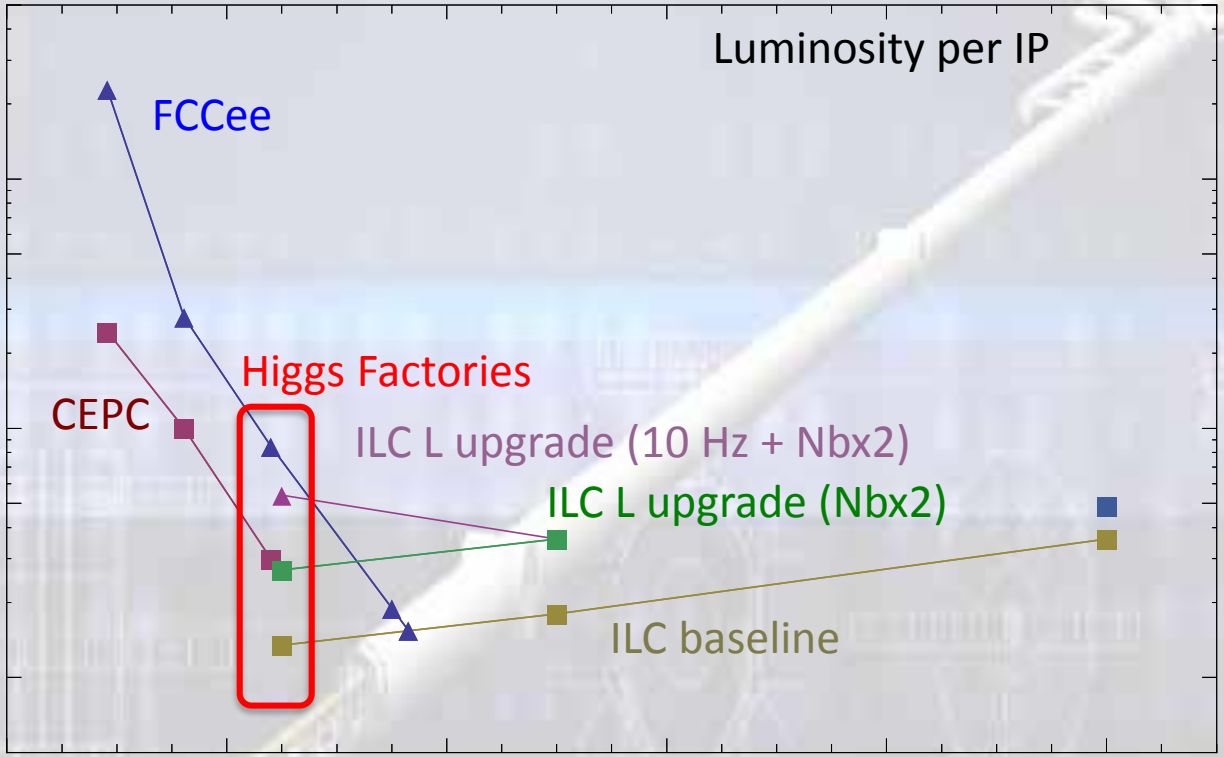
Luminosity vs Energy



- FCCee/CEPC are for 1 IP (their CDR have 2 IPs)
- ILC Higgs Factory numbers do not include effective x～2.5 by polarization

Numbers are based on inputs to EPPSU

Luminosity vs Energy



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MEXT ILC Advisory Panel on ILC250

Final Report: July 4, 2018

On Scientific Merits

. . .

'The strongest advantage of experiments at the 250 GeV ILC is their capability to precisely measure the couplings of the Higgs boson. If any coupling(s) is measured to be different from the Standard Model prediction, a particle-by-particle pattern of the deviation will elucidate the nature of new physics, suggesting a future direction of elementary particle physics. Mysteries in the Standard-Model such as the nature of dark matter and compositeness of the Higgs boson may also be clarified with this measurement.'

. . .

Also commented on cost estimation, technical feasibility, human resources, organization/management, and international cooperation.

Science Council of Japan on ILC250

Report: Dec 19, 2018

Executive summary (official translation)

…

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.

…

(Concerns: No clear prospect for proper international cost-sharing or securing human resources. Not convinced that cost is justified by the scientific merit. Technically, considerable hurdles remain to be cleared.)

Question being asked: 'Should Japan initiate serious international negotiations, such as cost-sharing and governance?'

MEXT Minister Shibayama: 'SCJ report is one input to be considered.'

On Announcement by Japanese Government

Chair's Summary from the LCB phone meeting that took place on 5 December 2018 concerning the status of the ILC discussion in Japan

In order to adhere to the plan, it would be crucial to have a statement from the Japanese government in time for the March 2018 LCB/ICFA meeting, expressing its strong interest to host the ILC in Japan and intention to initiate international discussion, together with an indication of possible Japanese contribution along the line suggested in the LCB conclusion endorsed by the ICFA in Ottawa in November 2017.

→ Effective deadline: March 7, 2019 LCB/ICFA meeting in Tokyo
(to be properly included in the European Strategy Update discussion)

(LCB, Nov 2017)

…A natural expectation would be that the cost for the civil construction and other infrastructure is the responsibility of the host country, while the accelerator construction should be shared appropriately. …

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 in Japan 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.

On MEXT's View

- The base case we could hope was
  - 'We will enter international negotiations, and if that be successful we are willing to host'
  - Such was not the case.

Positive aspects :

- This was the result of discussions among all relevant ministries (incl. Financial).
- For the first time, the Japanese government made an official announcement on the ILC to the world.
- Now the international discussions are 'official'.
- MEXT said that it will now move to establish discussion groups with Europe.

- SCJ Master Plan
  - March 2019: deadline of inputs
  - September 2019: selection of 'large projects'
  - October 2019: selection of key projects
  - December 2019: committee meeting by researchers
  - January 2020: management meeting

ICFA Statement on the MEXT's View

. . . ICFA confirms the international consensus that the highest priority for the next global machine is a "Higgs Factory" capable of precision studies of the Higgs boson. At this ICFA meeting options for a Higgs Factory were discussed -- the ILC, as well as other collider technologies.

ICFA reaffirms the scientific significance of the ILC and that the ILC is in a sufficient state of technical readiness for approval for construction.

. . .

ICFA recognises that although MEXT has interest in the ILC, and will continue to discuss the project with other governments, Japan is not yet able to declare its willingness to host the ILC. A clear statement of Japan's position towards hosting the ILC would have had significant impact in the ongoing discussions on the formulation of the European Strategy for Particle Physics Update.

ICFA notes with satisfaction the great progress of the various options for Higgs factories proposed across the world. All options will be considered in the European Strategy for Particle Physics Update and by ICFA.

Coordination Council for Realization of ILC by Ruling Party（LDP）

- Established Sep 18,2018
  - Takeo Kawamura (chair), Toshihiro Nikai, Akira Amari, + …

    Chairs of committees related to science and technologies and disaster recovery.

Resolution:

1. 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;

2. To secure the financial resources for the realization of ILC (beyond the Olympic Games) outside of the ordinary science and technology, academic or university budgets;

3. (On cost sharing)

Abe: prime minister

Amari: election

Nikai: general secretary

2 out of 3 most important posts of LDP

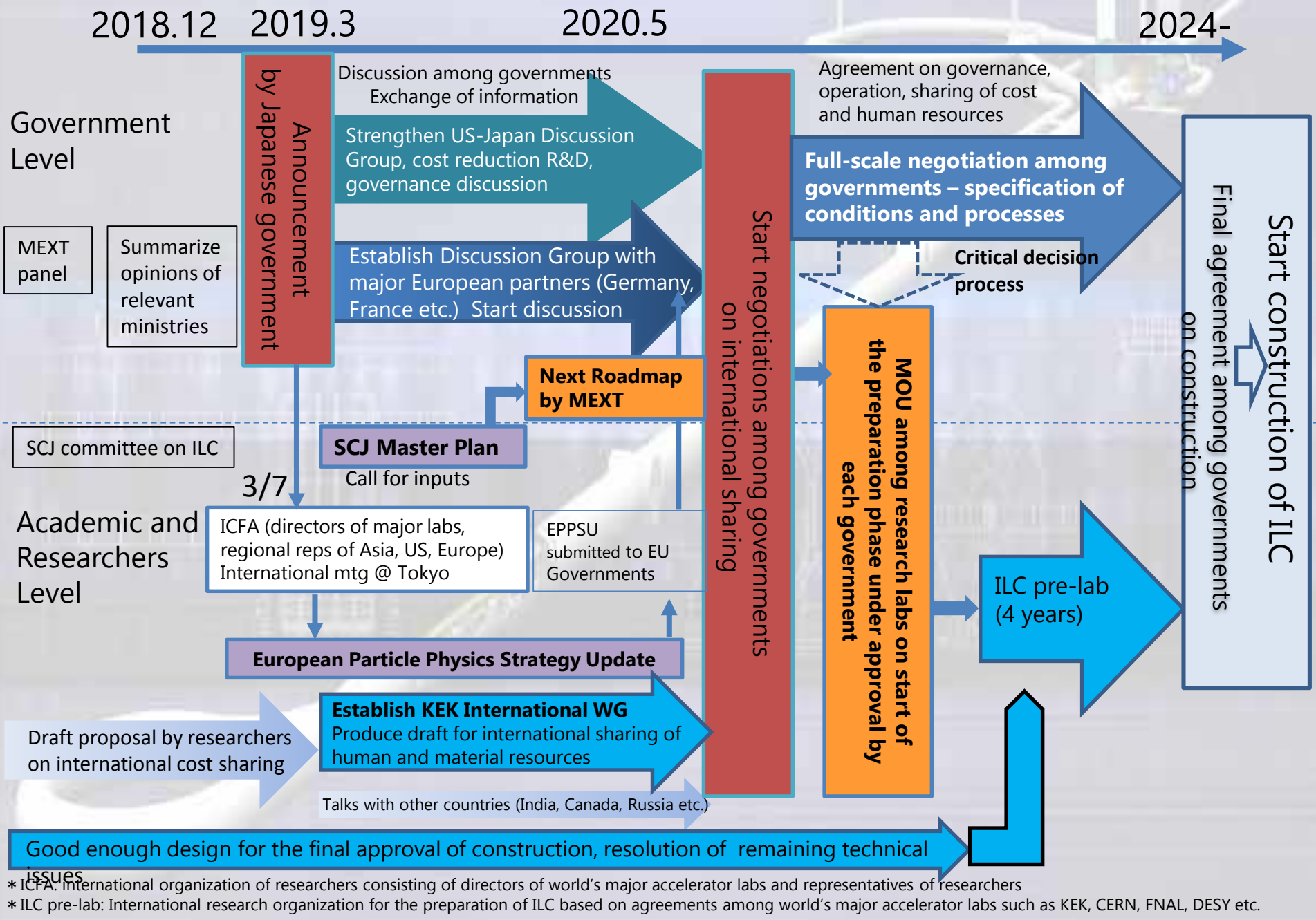
Hon. Kawamura's Speech
at ICFA/LCB Reception (March 6)

. . . Currently, the major movement at the political and governmental level is that the Liberal Democratic Party's Liaison Committee for Realizing the ILC was established in September last year to start discussions as a legislative body across multiple ministries and various policies. In tandem with these political efforts, the governmental side has also started to consolidate the opinions not only within MEXT (the Ministry of Education, Culture, Sports, Science and Technology) but across different ministries.

. . . As the environment has ripened socially, politically, and administratively, the next mission for politics is to secure the budget for the construction. In parallel with the government's administrative process, we will begin in earnest from our role as political and legislative body to obtain the necessary budget for construction.

. . . Investment in science is a political responsibility. We are committed to hosting the ILC in Japan as an investment for the future, a new page in Japanese and global history. I hope this passion of Japan for ILC is well understood by the participants who gathered here today, and I beg you to firmly support this plan as international organizations of researchers.

Processes and Approximate Timelines Toward Realization of ILC (by researchers)



* ICFA: International organization of researchers consisting of directors of world's major accelerator labs and representatives of researchers
* ILC pre-lab: International research organization for the preparation of ILC based on agreements among world's major accelerator labs such as KEK, CERN, FNAL, DESY etc.