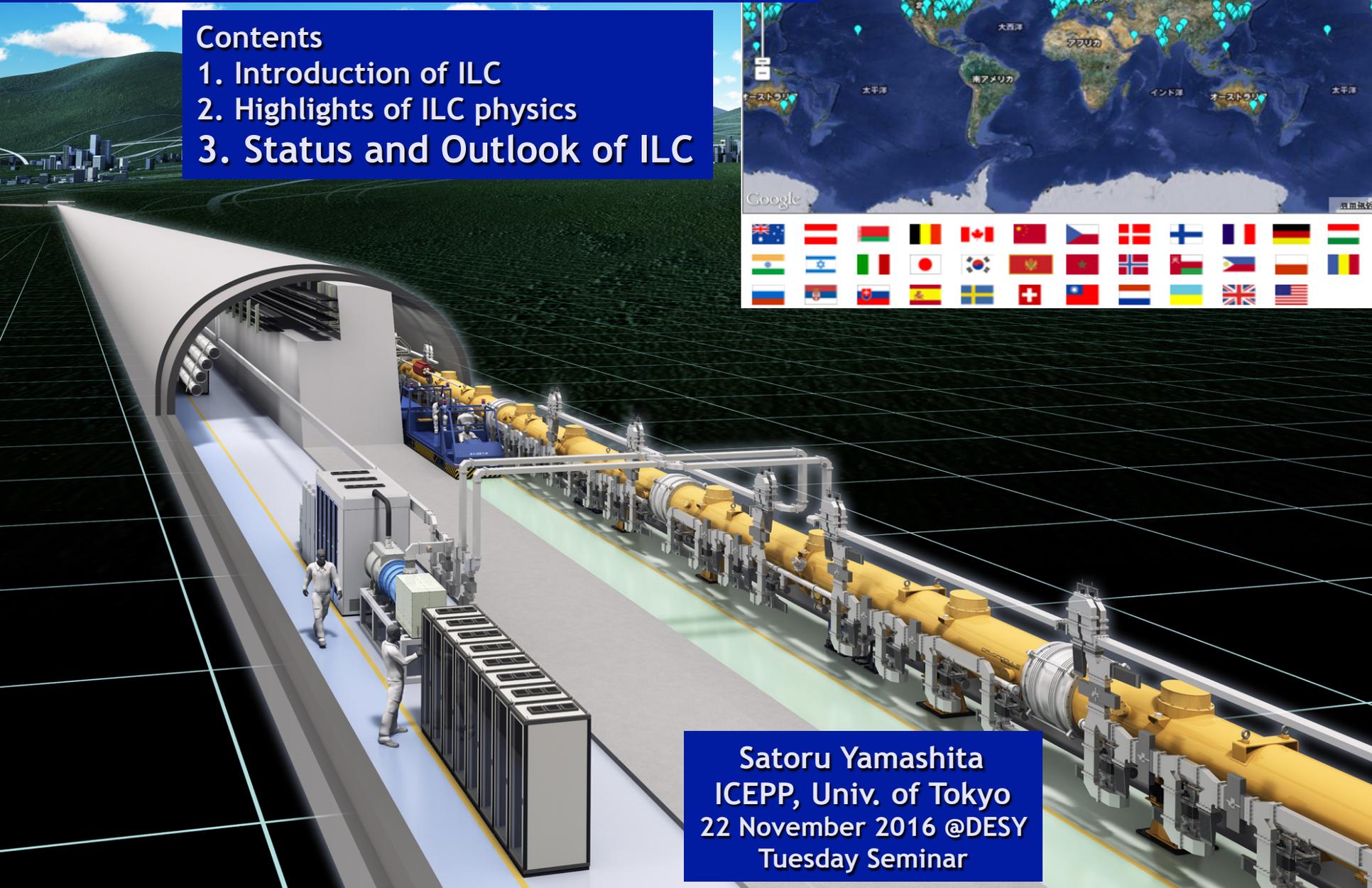


The International Linear Collider in Japan: Status and Outlook

Contents

1. Introduction of ILC
2. Highlights of ILC physics
3. Status and Outlook of ILC

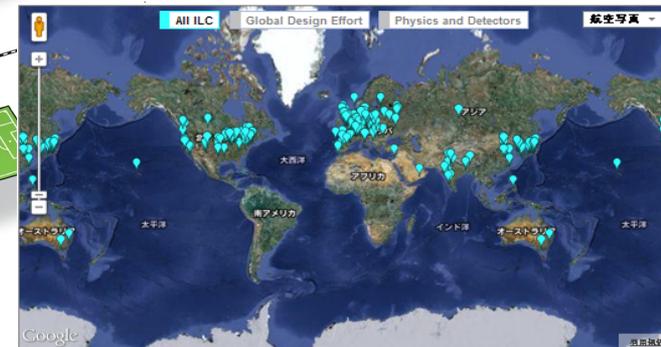
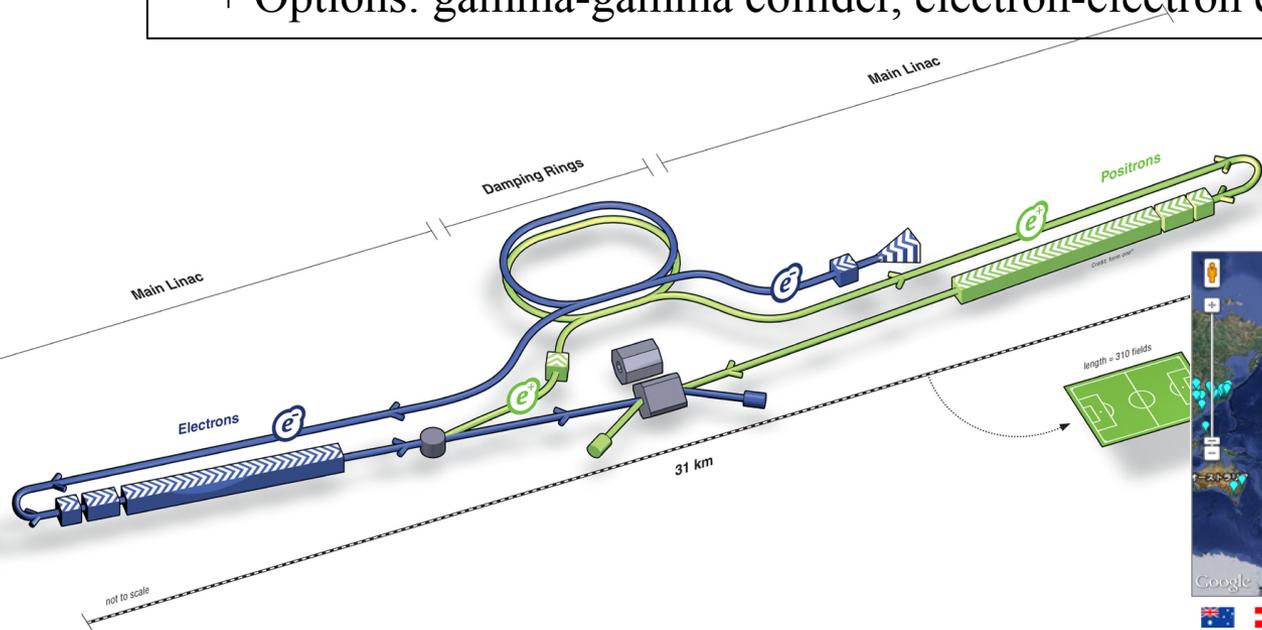


Satoru Yamashita
ICEPP, Univ. of Tokyo
22 November 2016 @DESY
Tuesday Seminar

International Linear Collider

- e^+e^- collisions: up to 500 GeV controllable
- Beam polarization: electrons $P > 80\%$ (90% / 10%)
positrons $P \sim 30\%$ (65% / 35%)
- Energy Upgrade potential: 1 TeV (current SCRF with ~ 50 km)

“ILC facility” has potential to go
multi-TeV with higher gradient SCRF (US FNAL, et al)
or with other technology (CLIC technology)
+ Options: gamma-gamma collider, electron-electron collider



Success of European XFEL is the KEY for ILC



- Matured Mass production scheme
- Established Construction process
- Robust Cost-estimate
- Secure Human-resources (Experts)

Year 2017 is crucial

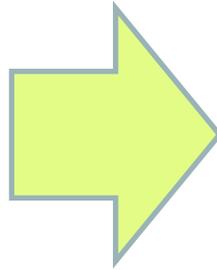
European XFEL is a 5% “prototype” of the ILC
Same SCRF technology in 1.5 km tunnel

**Proof: Mass production of
complete modules
and operation**

(Other projects using
ILC-type SCRF:
■ LCLS-II (US),
■ cERL, STF (Japan)

We are together in the hunt for new physics

LHC, SuperKEKB, ILC,
J-PARC, T2K, ν CP, MEG-II, Mu2e,
Muon $g-2$, KOTO, nEDM, $0\nu\beta\beta$,
Dark Matter, CMB B-mode, CMB
Satellite, SuMIRE, ...



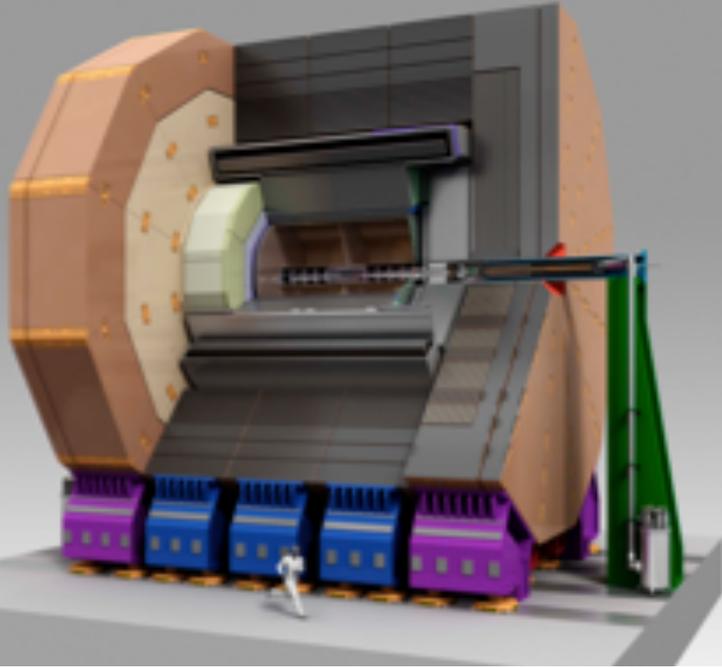
Look for BSM in
Higgs, Top, Neutrino,
Flavor, Dark Matter, ...

ILC will explore BSM through
Higgs, Top, $2f$ processes, Dark Matter, SUSY, ...

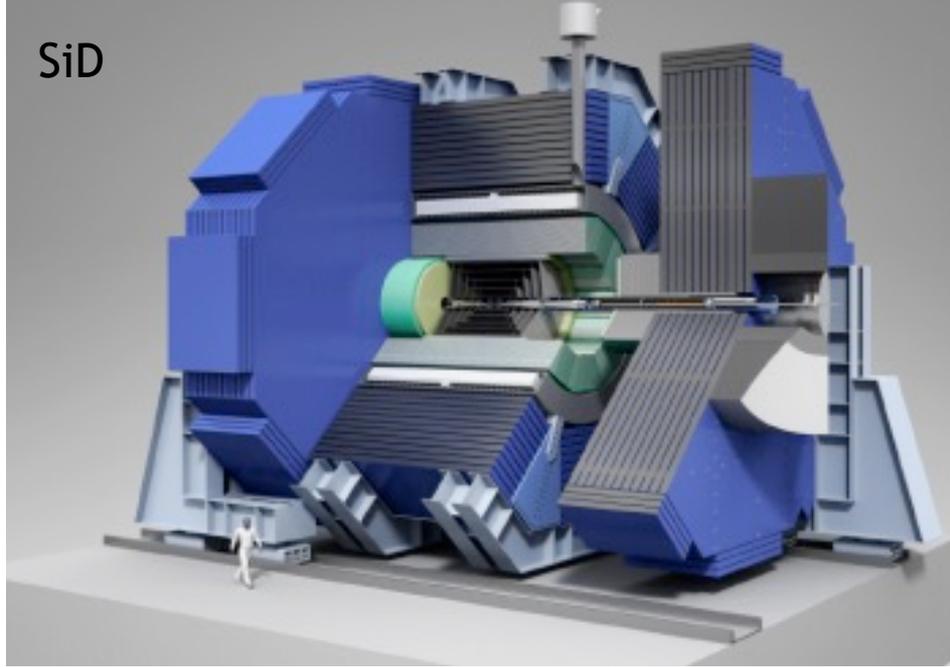
- Higgs Factory
- Top quark Factory
- Dark Matter / New particle Hunter

ILC Detector Concepts

ILD



SiD



ILD (International Large Detector)

SiD (Silicon Detector)

Height x Length

16 m x 14 m

14 m x 11 m

Weight

14,000 t

10,100 t

Magnetic field

3.5 T

5 T

ECAL inner radius

1.8 m

1.3 m

Tracker

TPC

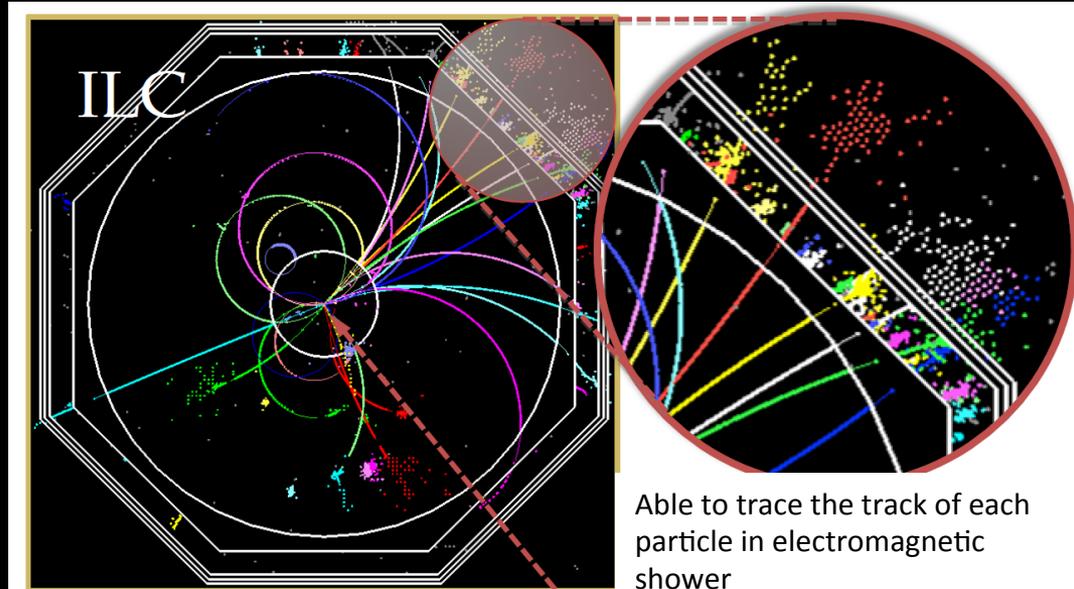
Silicon strip

State-of-the-art Detector R&D through International Collaboration

Designed to precisely measure even the most complex interactions

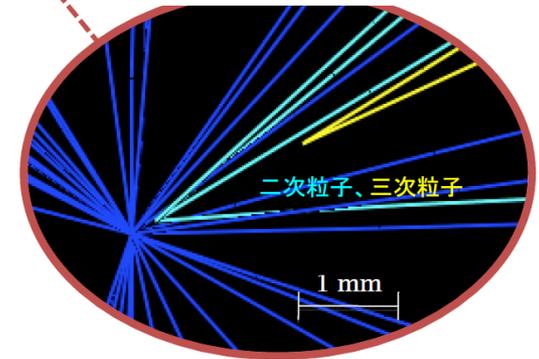
- Various types of detectors surround interaction point
 - Measure each particle with the most ideal device
- Reconstruct the original interaction

finely segmented sensors
→ high precision



Able to trace the track of each particle in electromagnetic shower

Tracks of short-life particles which decay immediately near collision point

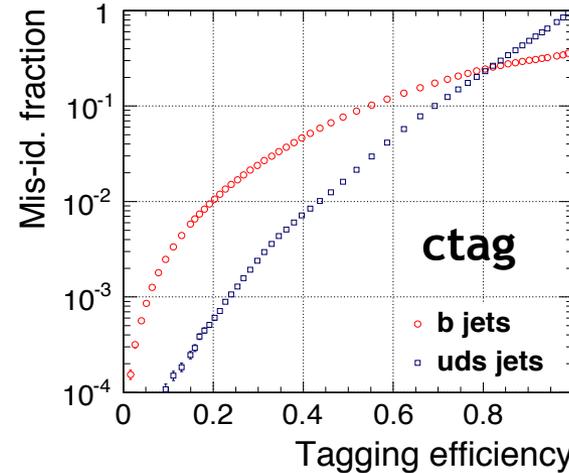
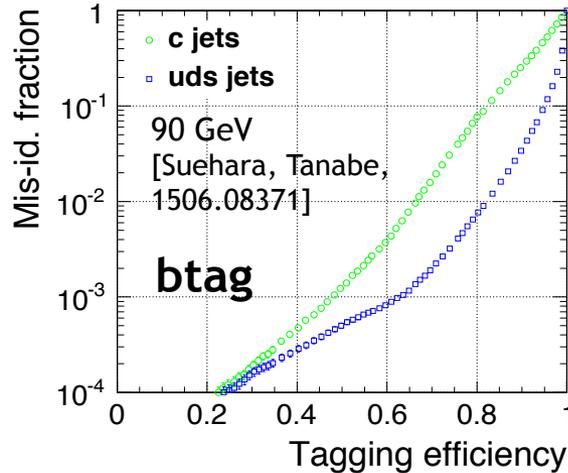


Sensor size	ILC	LHC (ATLAS)	Fine-ness ratio
Vertex detector	5×5 mm ²	400×50 mm ²	800 x
tracker	1×6 mm ²	13 mm ²	2.2 x
Electromagnetic calorimeter	5×5 mm ²	39×39 mm ²	61x

Flavor Tagging for Higgs, top and new particles

ILC detectors have excellent vertex detectors

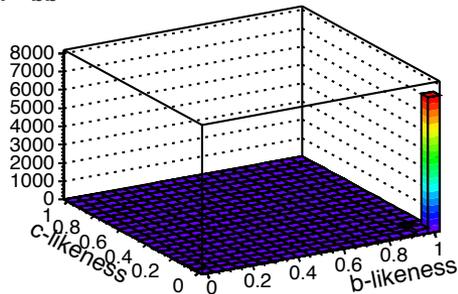
→ measure Higgs hadronic BRs with b-tag, c-tag



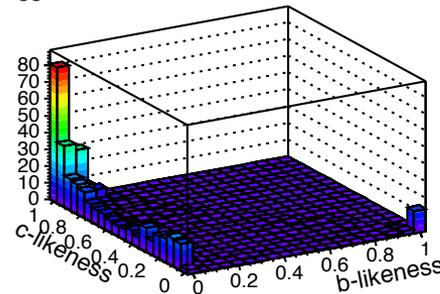
Template distributions for $H \rightarrow bb, cc, gg$:

ILC 250 GeV [H.Ono]

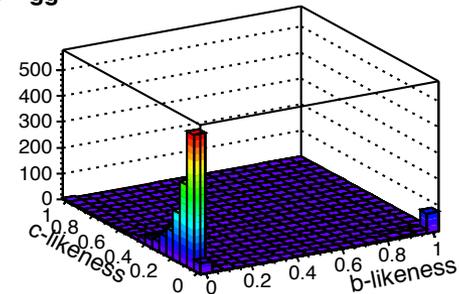
$h \rightarrow bb$



$h \rightarrow cc$



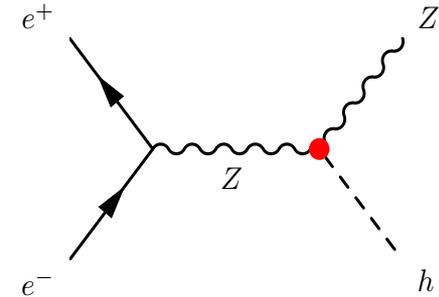
$h \rightarrow gg$



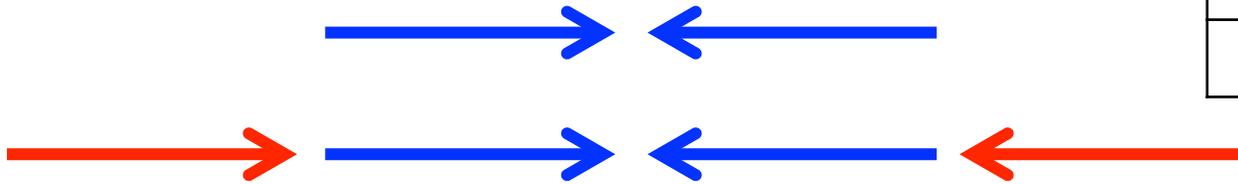
Excellent b-tag & c-tag capabilities

Power of ILC

- Interaction of elementary particles
- Control beam energy & polarization
- Exploit 4-momentum conservation
- Trigger-free operation
- Radiation hardness not an issue
- **Extendable in energy**



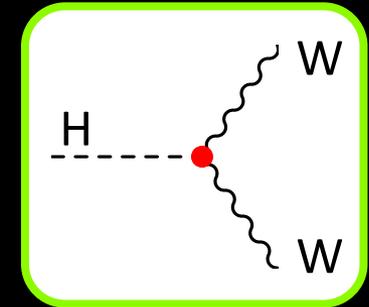
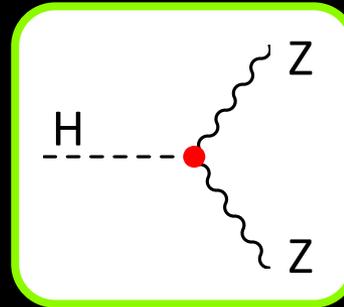
\sqrt{s}	$\int \mathcal{L} dt$
250 GeV	2000 fb ⁻¹
350 GeV	200 fb ⁻¹
500 GeV	4000 fb ⁻¹



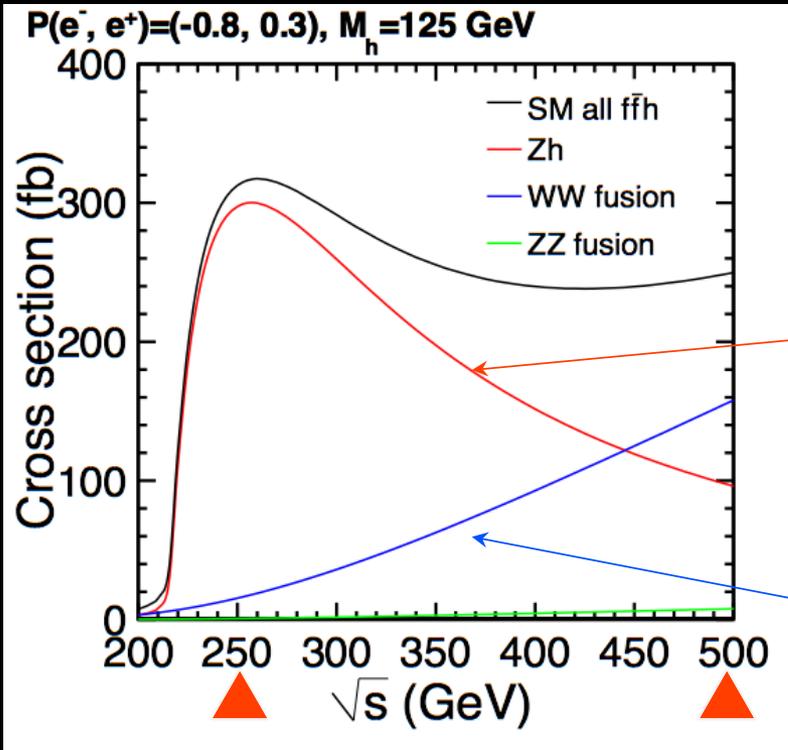
First Stage: 250 GeV, 350 GeV, 500 GeV
Future expansion: 1 TeV (extend 30km → 50km)
Further potential: multi-TeV (SCRF or CLIC technology)

Higgs Production

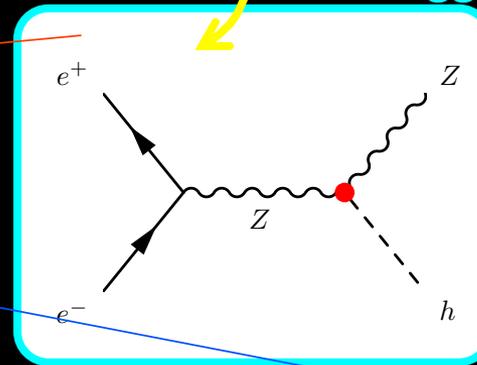
Coupling to gauge bosons



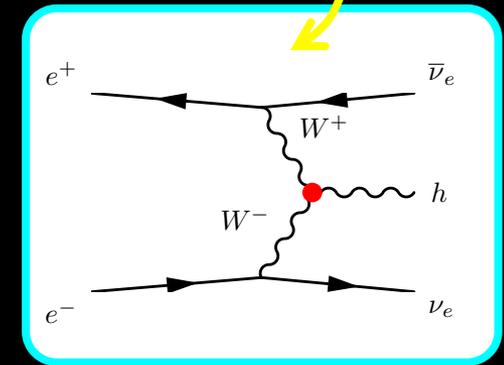
Production cross section



Higgs Production



Higgsstrahlung
 $\sqrt{s} = 250 \text{ GeV} \sim$

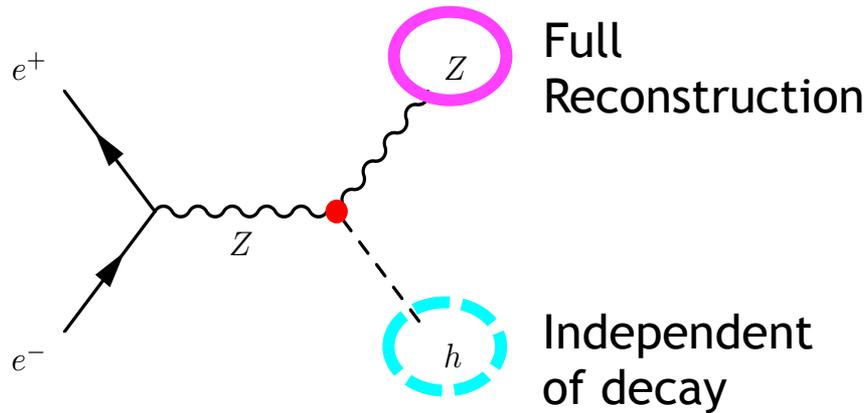


WW-fusion
 $\sqrt{s} = 350 \text{ GeV} \sim$

- At $\sqrt{s} = 250 \text{ GeV}$: best precision in Higgs mass and ZH cross section measurement
 - At $\sqrt{s} = 500 \text{ GeV}$: make use of both production channels
- all Higgs couplings are accessible

Higgs Recoil Measurement

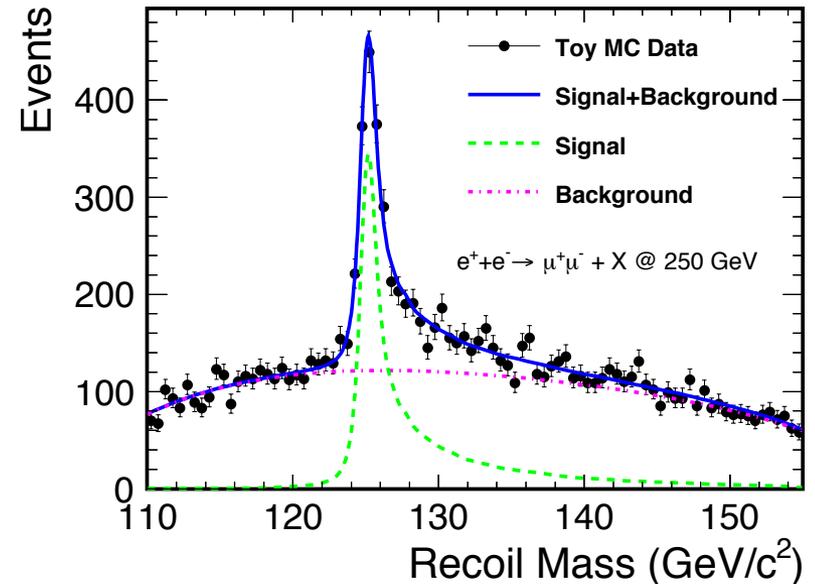
- Key measurement: Higgs recoil
- Use 4-momentum conservation



$$M_{\text{recoil}}^2 = (\sqrt{s} - E_Z)^2 - |\vec{p}_Z|^2$$

- Measure ZH cross section (= HZZ coupling) & mass

$Z \rightarrow \mu\mu, H \rightarrow \text{anything}$



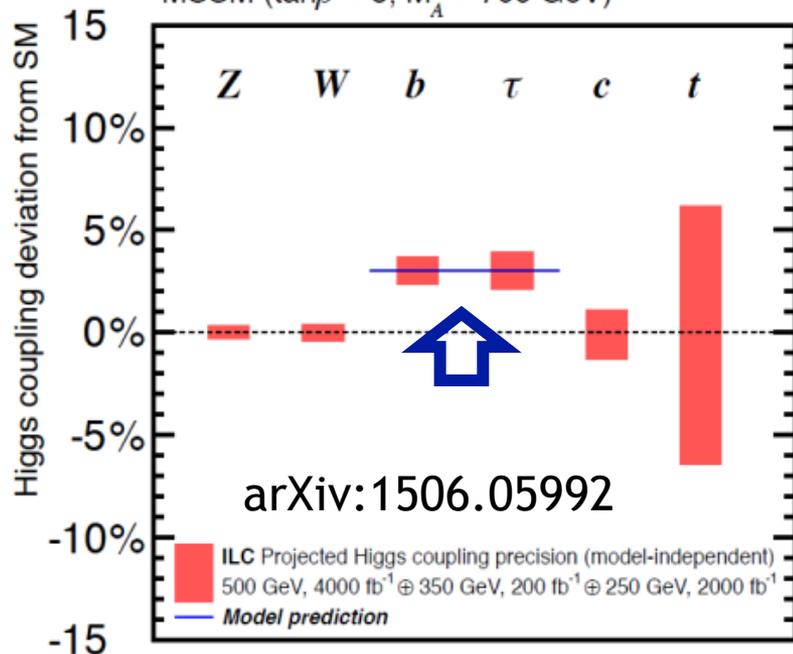
Absolute measurement of HZZ coupling \rightarrow absolute couplings, with
Unique capability of e^+e^- measurement

Power of Precision

- **$h(125)$ is SM-like \rightarrow any new physics is in the decoupling limit, require precision to see its effect.**
- **Any Deviation in Higgs couplings = Clear Evidence of BSM**

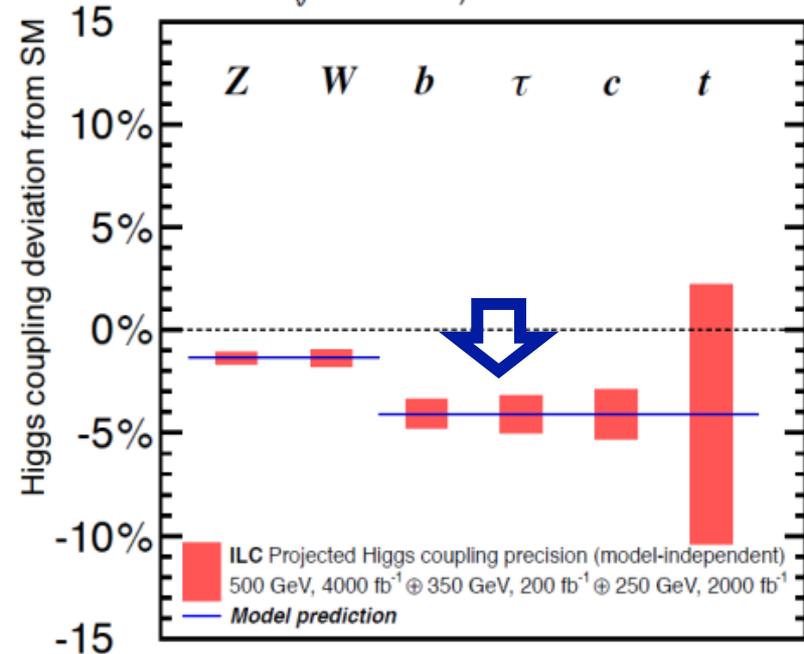
Supersymmetry (MSSM)

MSSM ($\tan\beta = 5$, $M_A = 700$ GeV)



Composite Higgs (MCHM5)

MCHM5 ($f = 1.5$ TeV)



Other possibilities: 2HDMs, NMSSM, extra-dim., etc...

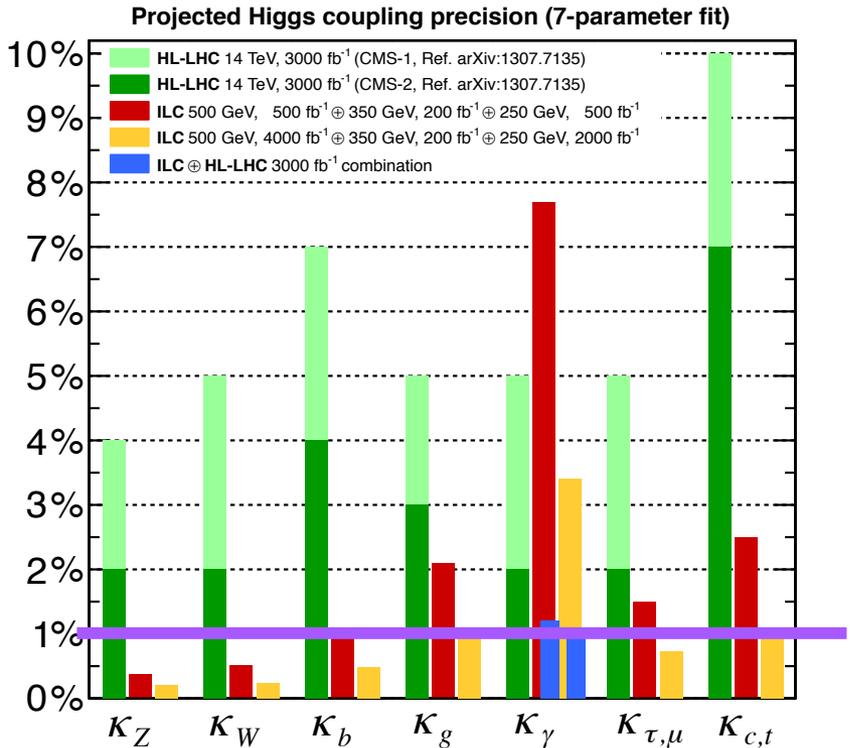
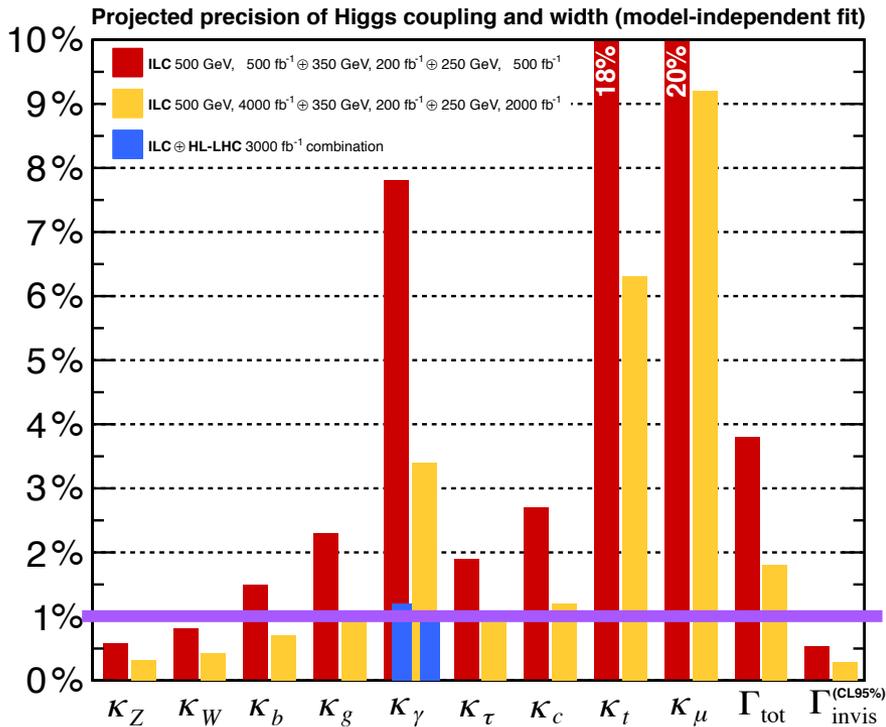
Aim for BSM Discovery through Precision

Higgs Couplings

Model-Independent:
Only possible at e+e-

Model-Dependent:
 Compare with LHC

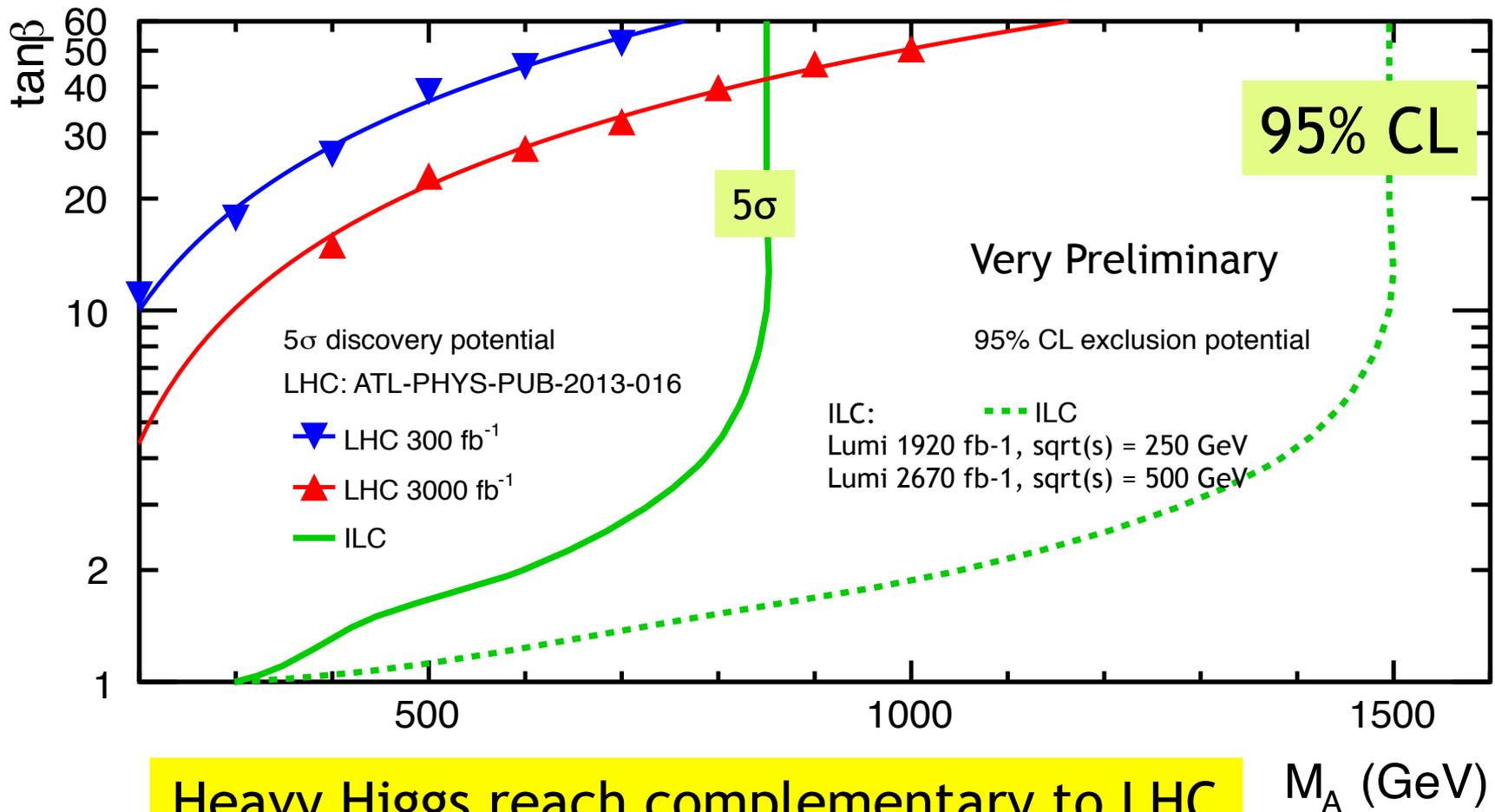
Including systematic uncertainties [arXiv:1506.05992]



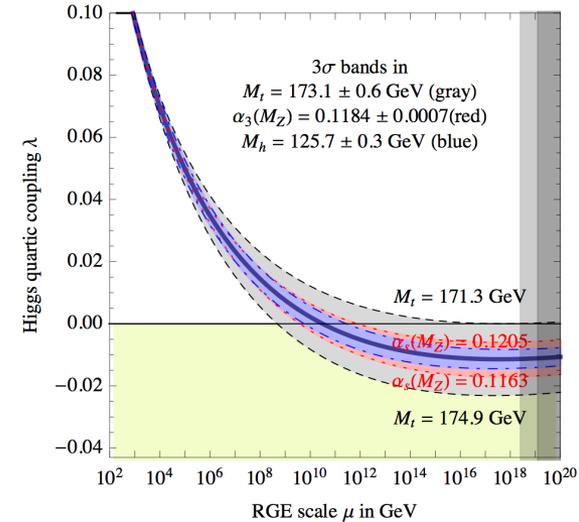
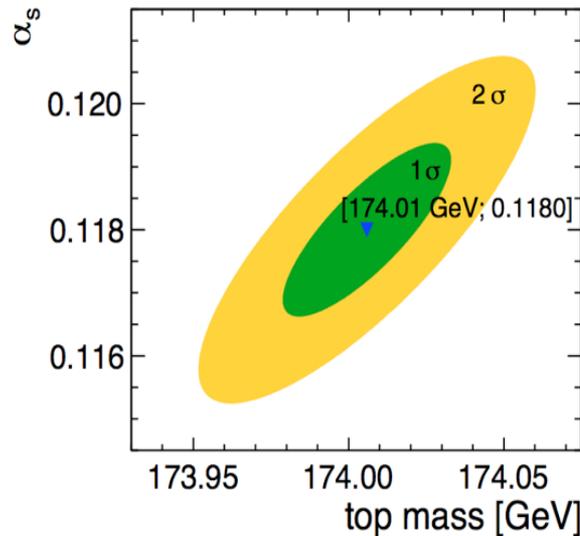
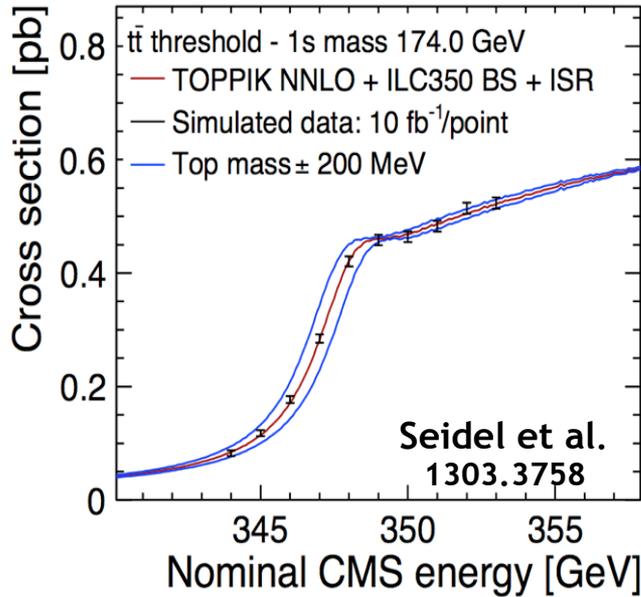
Sub-percent precision on most Higgs couplings with full ILC program

Heavy Higgs Mass Reach

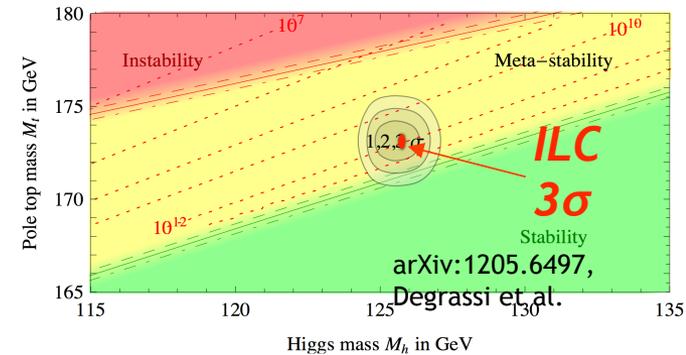
- LHC: Heavy Higgs direct resonance search
- ILC: Indirect search via effect on Higgs couplings $h \rightarrow b\bar{b}$, WW^*



Top mass measurement



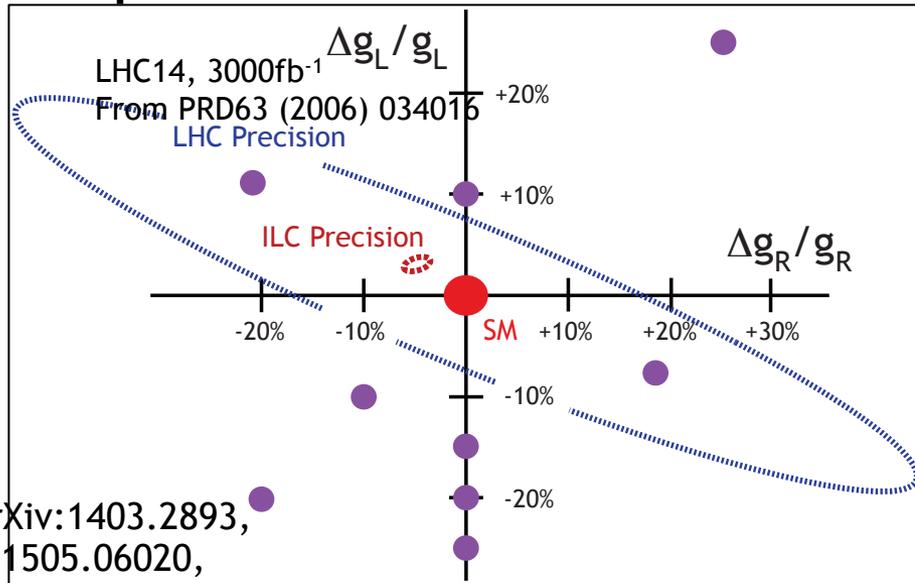
- Scan of top pair production threshold
Statistical uncertainty ~ 20 MeV
- Progress in theory \rightarrow prospect of < 50 MeV precision in \overline{MS} -bar scheme
- Allow extrapolation of SM to high energies



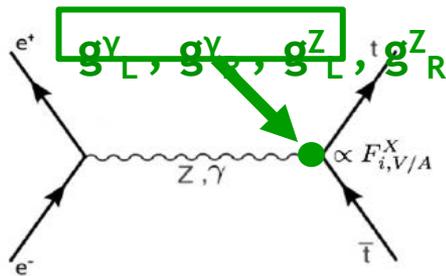
Test of SM at ultra-high energies up to Planck scale

Top Couplings and BSM

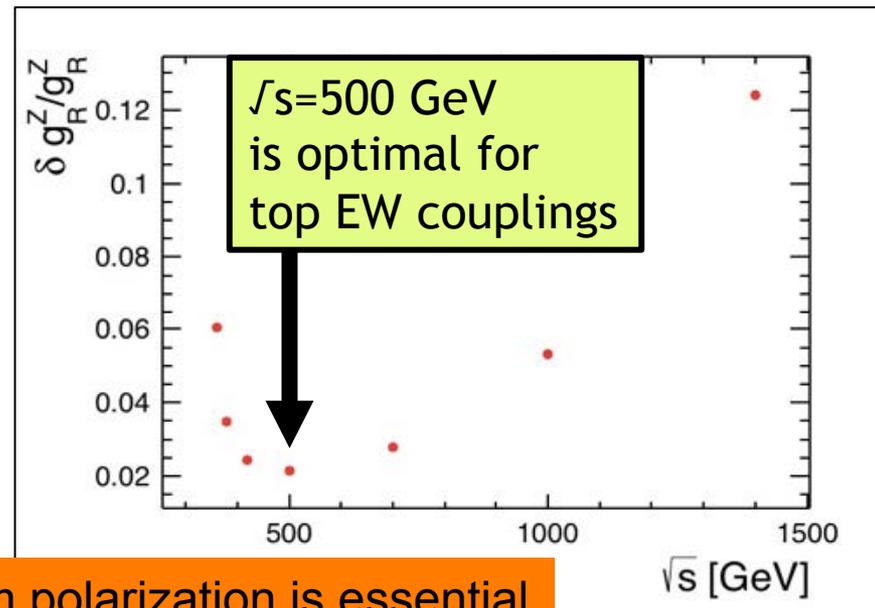
ILC has sensitivity to a variety of models with **compositeness / extra dimensions**:



[arXiv:1403.2893,
1505.06020,
1506.05992]



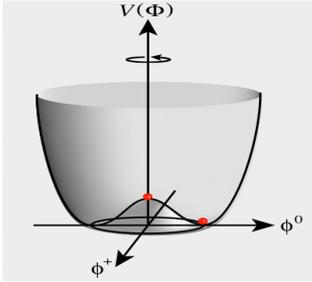
Probe up to 20 TeV
in e.g. extra dimension model
based on Pomerol et al.
[0806.3247]
Reach to 80 TeV in
extreme scenarios



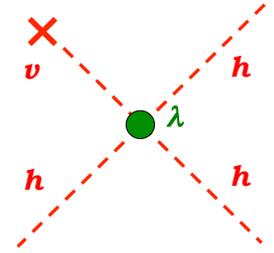
Beam polarization is essential

Discover New Physics at O(10TeV) through Top Couplings

Higgs Self-Coupling



$$V(\eta) = \frac{1}{2}m^2\eta^2 + \lambda v\eta^3 + \frac{1}{4}\lambda\eta^4$$

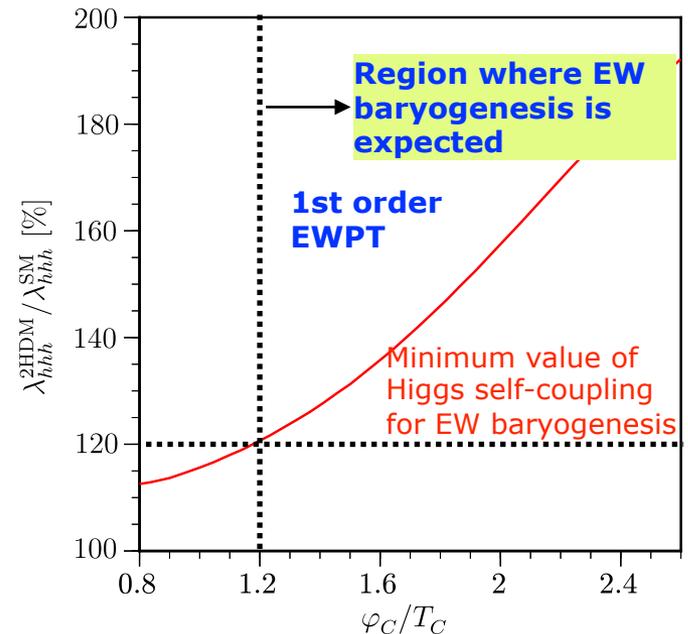


Higgs self-coupling is a direct probe of the Higgs potential: Crucial test of EWSB

Higgs self-coupling is
20%-100% larger than SM
in electroweak baryogenesis models

New physics models (e.g. electroweak baryogenesis) predict large deviations in Higgs self-coupling:

- Grojean, Servant, Wells, PRD71, 036001
- Hashino, Kanemura, Orikasa, 1508.03245
- Fuyuto, Senaha, PLB747, 152
- Perelstein, Katz, JHEP1407, 108



Kanemura, Senaha, Shindou, Yamada
Adapted from JHEP1305, 066

Higgs Self-Coupling Measurement

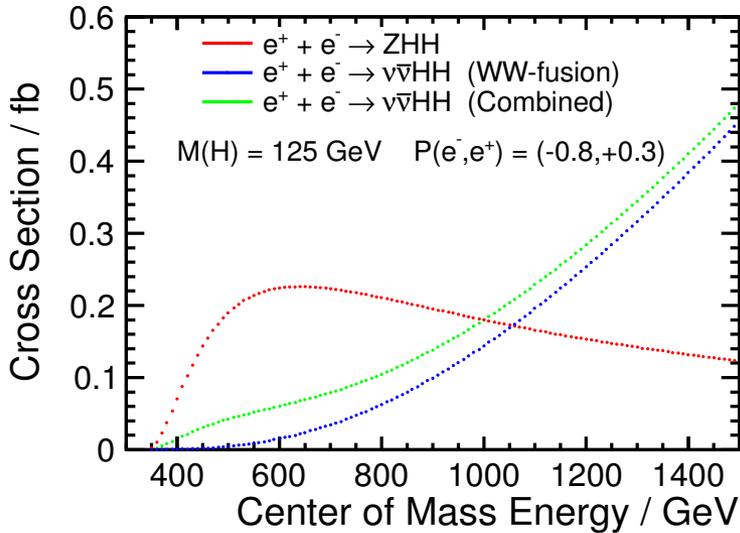
References:

J. Tian, LC-REP-2013-003

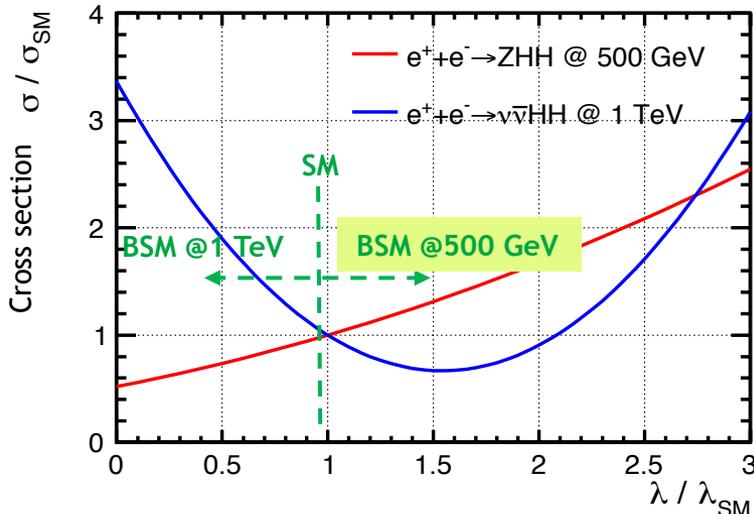
C. Duerig, Ph.D. thesis at DESY

M. Kurata, LC-REP-2014-025

Cross section: ZHH & vvH



Cross section vs. anomalous λ



ZHH

$\sqrt{s} \sim 500$ GeV

Diagram showing e^+ and e^- colliding via a Z^* boson to produce a Z boson and two Higgs bosons (H). The coupling is labeled λ .

Expected precision:

$\Delta\sigma/\sigma = 16\%$
 $\Delta\lambda/\lambda = 27\%$

BSM sensitivity:
 $\lambda > \lambda_{SM}$

UNIQUE FEATURE OF ILC 500

500 GeV, 4 ab⁻¹

vvH (VBF)

$\sqrt{s} \sim 1$ TeV

Diagram showing e^+ and e^- colliding via W^+ and W^- bosons to produce a neutrino ($\bar{\nu}$), a neutrino (ν), and two Higgs bosons (H). The coupling is labeled λ .

Expected precision:

$\Delta\sigma/\sigma = 13\%$
 $\Delta\lambda/\lambda = 10\%$

BSM sensitivity:
 $\lambda < \lambda_{SM}$

(1 TeV same as LHC)

500 GeV, 4 ab⁻¹
 + 1 TeV, 8 ab⁻¹

Z': heavy neutral gauge bosons

New gauge forces imply existence of heavy gauge bosons (Z').

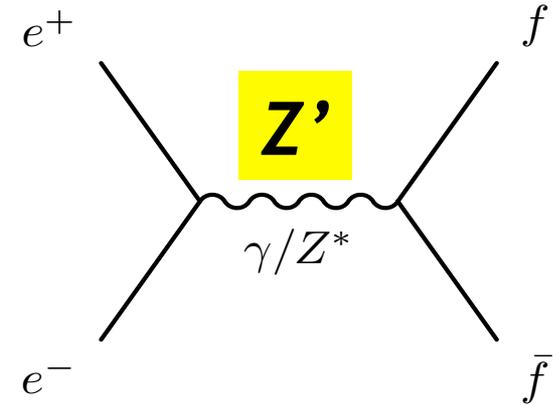
Synergy of hadron/lepton colliders:

LHC: direct production of Z' resonance

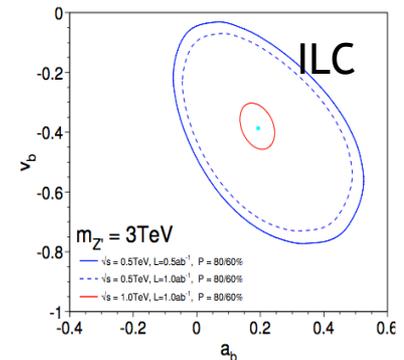
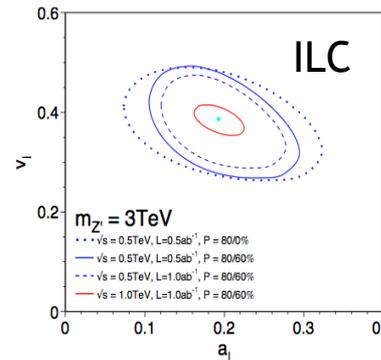
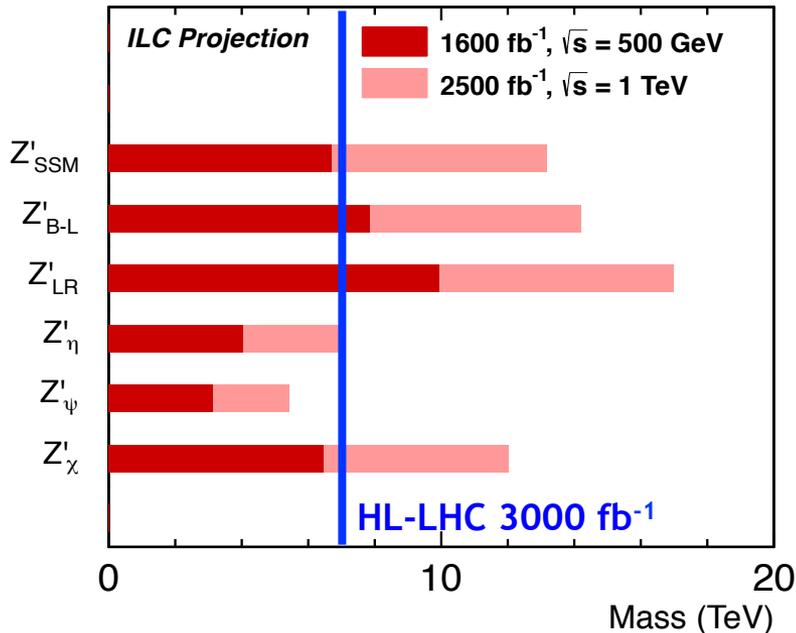
ILC: access Z' in the intermediate state

Z' reach up to 10 TeV range

Determine Couplings through beam polarization



Very preliminary



Determine Z' couplings through beam polarization

New Particle Searches

ILC reach for new particles

- Direct pair production: Up to half of CM energy
- Intermediate state: Typically multi-TeV range

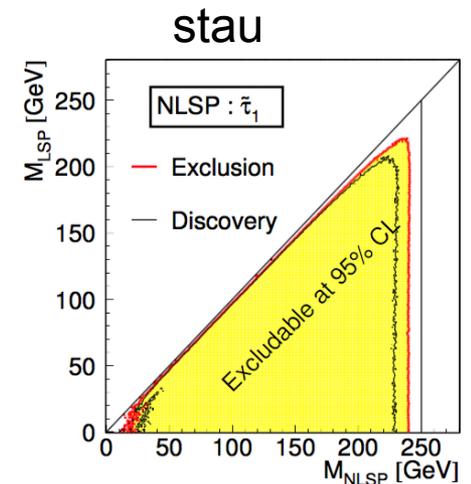
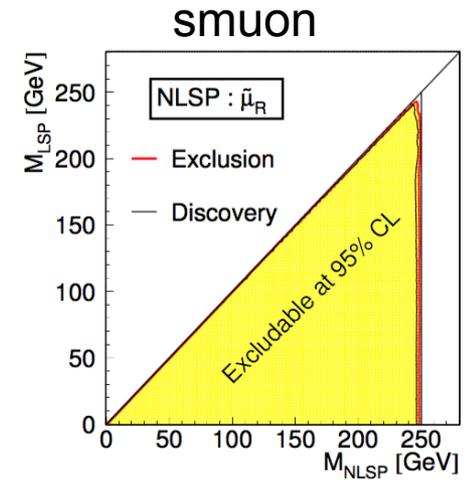
Direct production sensitive to any new particles (esp. color singlet states)

Strategies for new particle search:

- Stable neutral particles → Use of initial-state radiation (e.g. mono-photon)
- Unstable particles → Discovery possible even with small energy release due to small mass gap

Examples:

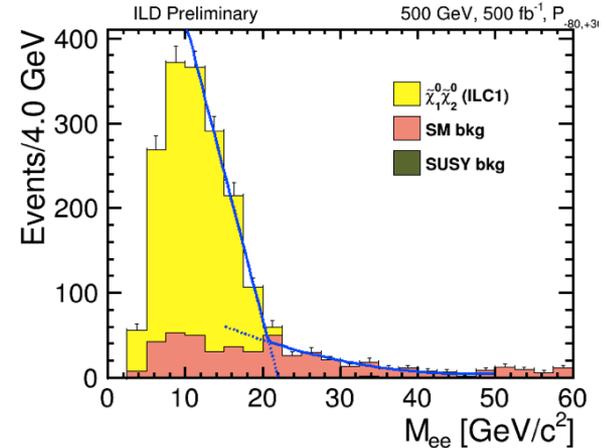
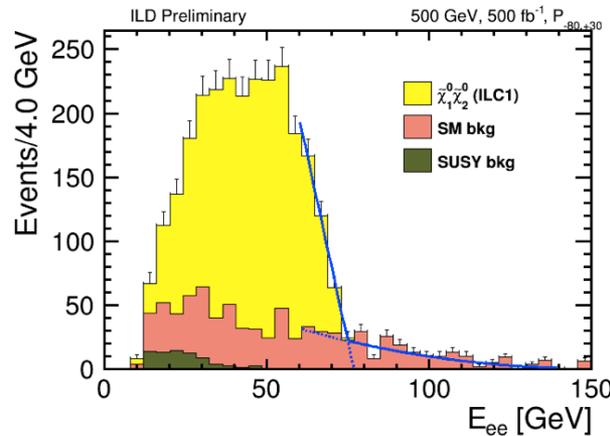
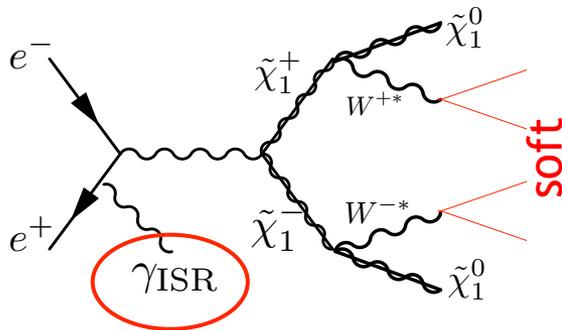
- Dark matter
- Color-singlet SUSY particles: sleptons, ewkinos, higgsinos (chargino/neutralino)
- Extended Higgs sector: additional scalars, pseudoscalars (2HDMs, NMSSM, ...)



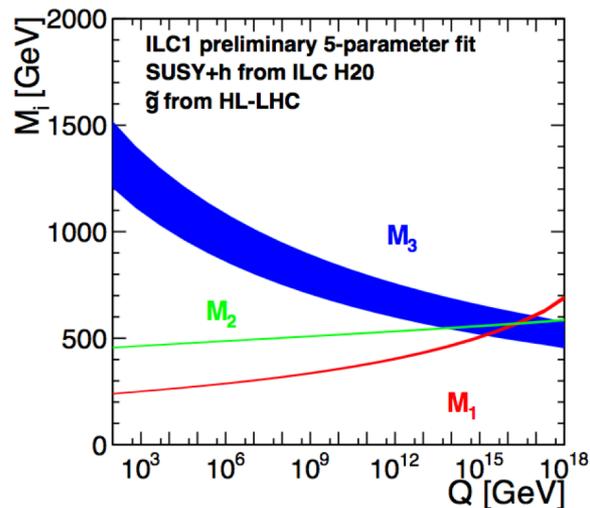
Light Higgsinos in Natural SUSY

[S.-L. Lehtinen, J. Yan, et al.]

Search for light higgsinos $O(100)$ GeV, motivated by naturalness



Extraction of kinematic edges \rightarrow ewkino mass extraction at $O(1)\%$ level



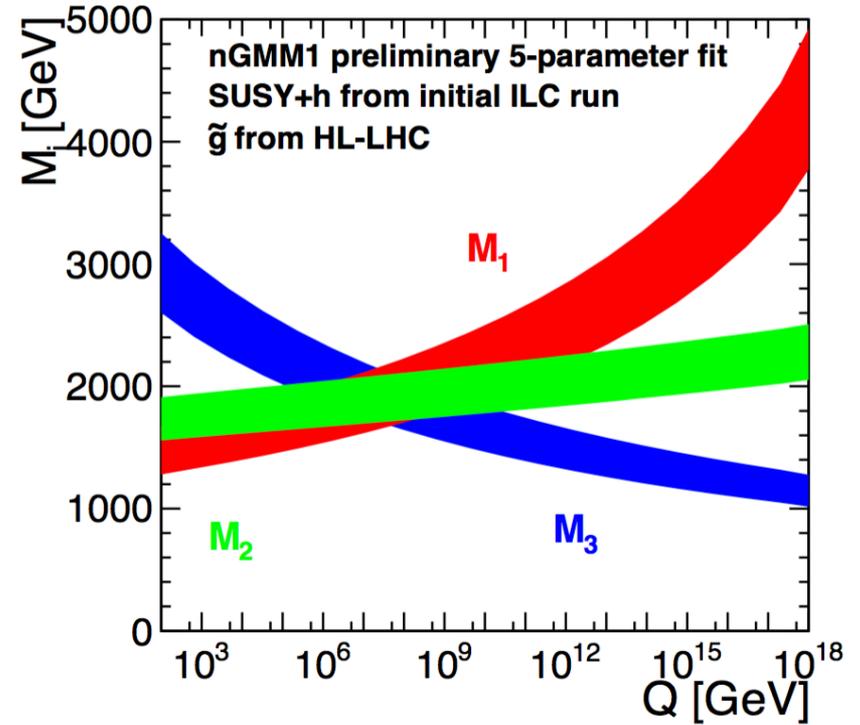
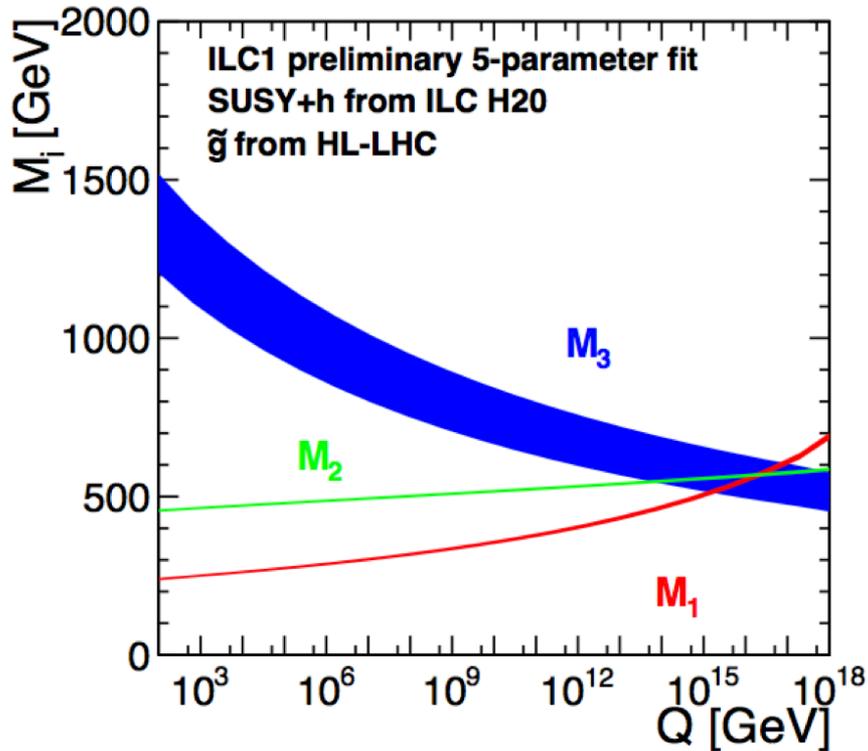
Extract underlying SUSY parameters:
 gaugino masses via mixing with Higgsino

LHC/ILC SYNERGY (with gluino @LHC):
 Test of Gaugino Mass Unification

If no LHC discovery \rightarrow Prediction of next energy scale assuming naturalness

Possible “super discovery” LHC + ILC

Recent version

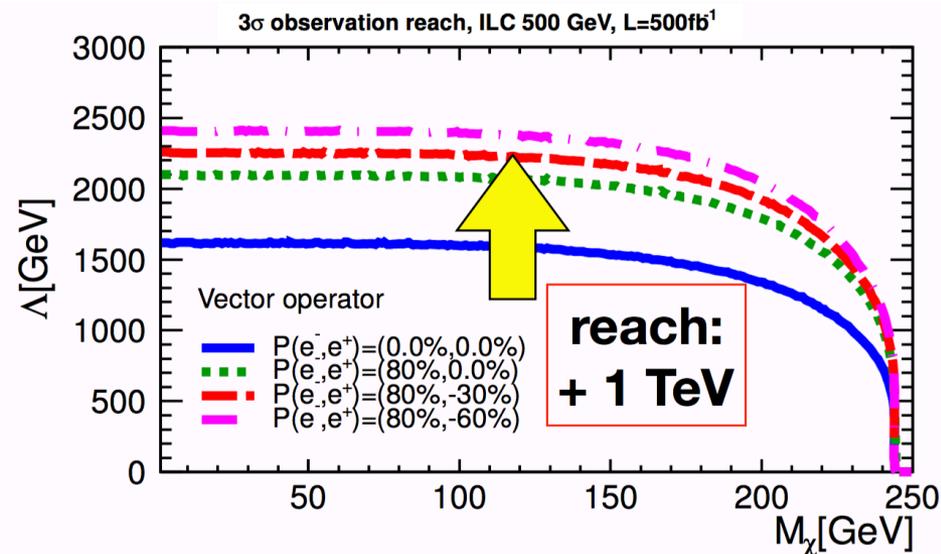
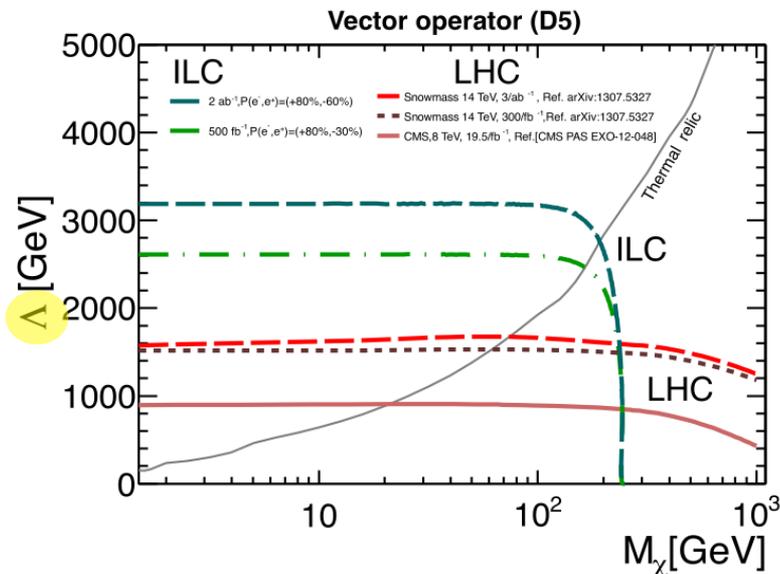


[S.-L. Lehtinen, J. Yan, et al., work in progress]

Beam polarization and energy scan are essential

WIMP Search with Mono-photons

[A. Chaus, M. Habermehl]



ILC DM search complementary with LHC & Direct Detection:

- Sensitivity to **lepton couplings** (vs. quark couplings)
- Sensitivity to **large mediator scale** (vs. large DM mass)

ILC has Unique Capabilities for Dark Matter search

NMSSM Higgs Bosons

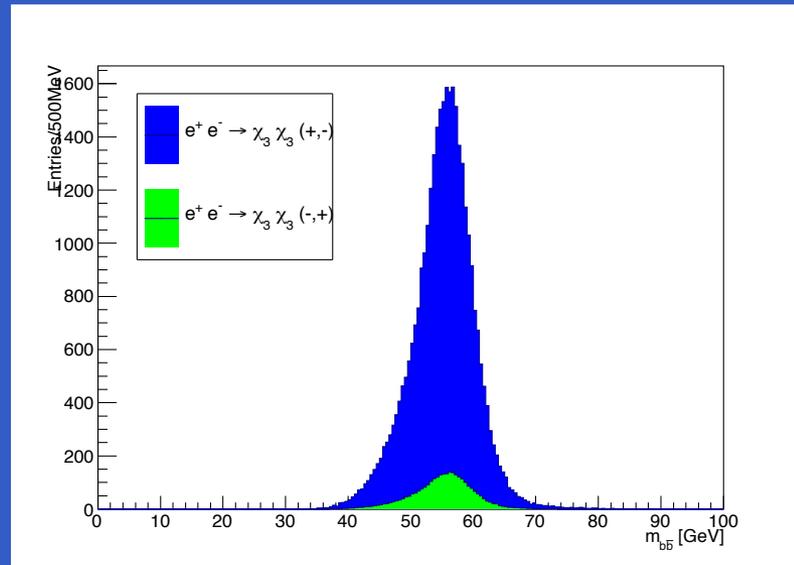
Additional scalars lighter than H(125) in the NMSSM
 $h_1 \sim 60$ GeV, $h_2 \sim 125$ GeV = H(125), $a_1 \sim 10$ GeV

[C. Potter, ECFA-LC 2016]

DSiD Reconstruction $h_1 \rightarrow b\bar{b}$



DSiD is the Delphes fast simulation card based on SiD performance in DBD (1602.07748). See Saturday morning talk in SiD session for details.



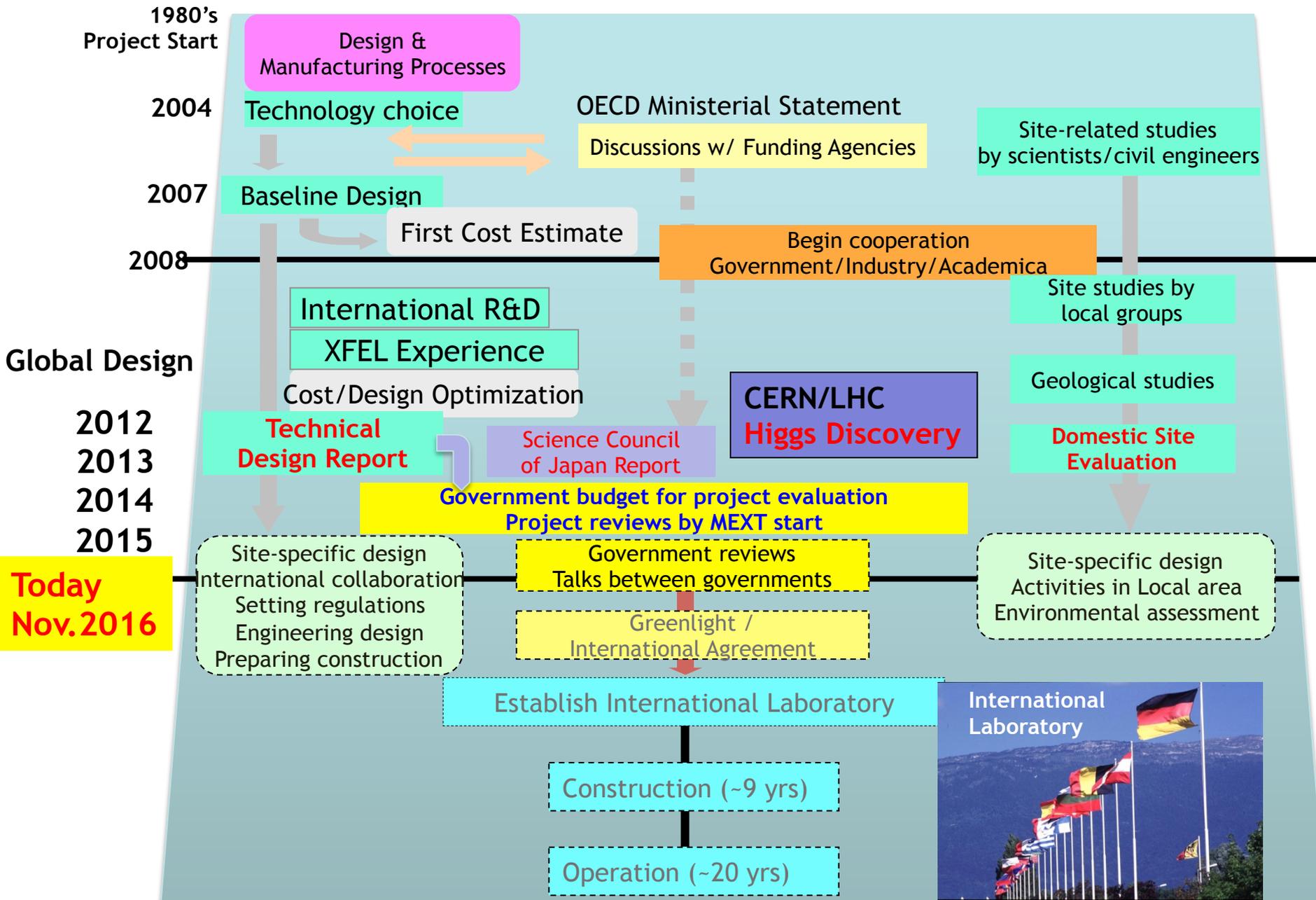
Reconstructed $h_1 \rightarrow b\bar{b}$ in $e^+e^- \rightarrow \chi_3 \chi_3$ events at $\sqrt{s} = 500$ GeV. We assume 2000fb^{-1} integrated luminosity for each beam polarization configuration. Background has not been evaluated so signal selection is not optimized.

Status and outlook

- Domestic Politics and actions with Industry-Academia
- International actions in political / government level
- Activities at Local area (Tohoku region)
- Outreach to general society

Timeline of ILC

Where we are now



Statements from High Energy Physics Communities from the World

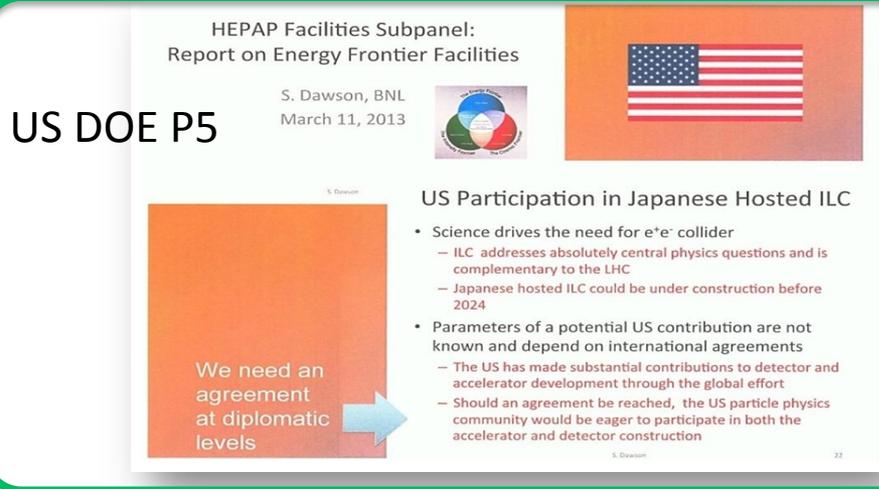
- > Current European Strategy approved by CERN Council in 2013 next update expected 2020

5. It is fundamental to complement the results of the LHC with measurements at a linear collider. In the energy range of 0.5 to 1 TeV, the ILC, based on superconducting technology, will provide a unique scientific opportunity at the precision frontier; *there should be a strong well-coordinated European activity, including CERN, through the Global Design Effort, for its design and technical preparation towards the construction decision, to be ready for a new assessment by Council around 2010.*



AsiaHEP/ACFA Statement on the ILC (draft)

AsiaHEP/ACFA welcomes the proposal by the Japanese HEP community for the ILC to be hosted in Japan. AsiaHEP/ACFA looks forward to a proposal from the Japanese Government to initiate the ILC project.



HEPAP Facilities Subpanel:
Report on Energy Frontier Facilities

S. Dawson, BNL
March 11, 2013

US DOE P5

We need an agreement at diplomatic levels

US Participation in Japanese Hosted ILC

- Science drives the need for e^+e^- collider
 - ILC addresses absolutely central physics questions and is complementary to the LHC
 - Japanese hosted ILC could be under construction before 2024
- Parameters of a potential US contribution are not known and depend on international agreements
 - The US has made substantial contributions to detector and accelerator development through the global effort
 - Should an agreement be reached, the US particle physics community would be eager to participate in both the accelerator and detector construction

- > German HEP community (KET, German Committee for HEP) Statement on future e^+e^- machines (after workshop in MPI-Munich, May 2016): Clear support for the ILC project.

Excellent and very helpful !

2. The ILC meets all the requirements discussed at this workshop.ⁱⁱ It is currently the only project in a mature technical state. Therefore this project, as proposed by the international community and discussed to be hosted in Japan, should be realised with urgency. As the result of this workshop, this project receives our strongest support.ⁱⁱⁱ

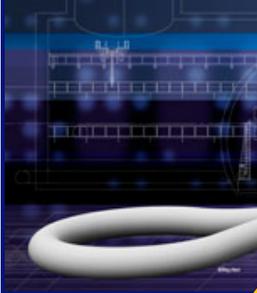
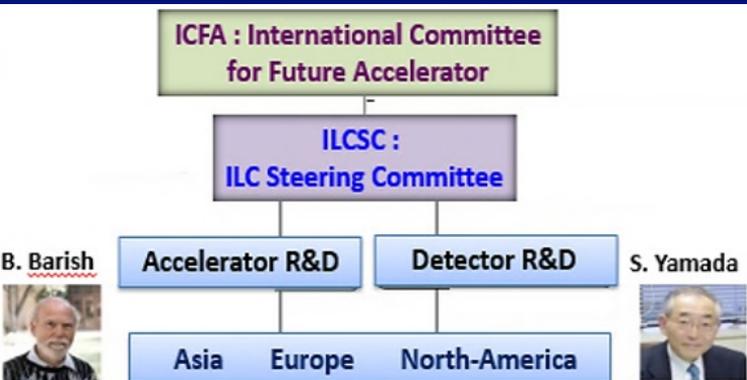
Activity bodies in Japan for ILC

■ 6 bodies

1. Japanese **Researchers HEP society and KEK**
2. **Federation of Diet members supporting ILC**
3. **MEXT**: Ministry of Education, Sports, Culture, Science and Technology
4. Japanese **Embassy** (in US, EU countries, EC, Asia, Russia,,), and **Ministry of Foreign Affairs**
5. Advanced Accelerator Association promoting Science and Technology (**AAA**) **Industry-Academia**
6. **MOVES**: Policy makers, top-level opinion Leaders, executives of BIG Industry, Local Bodies in **Tohoku** (bureau of Economy, business association, prefecture/city local governments, Universities).

Footprint of ILC Project

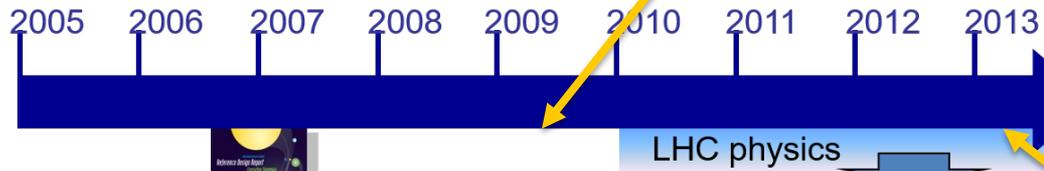
30 June 2009: Ministerial Meeting at Prime Minister's Residence



27 March 2013: Prof. Lynn Evans visits PM Shinzo Abe @ Prime Minister's Residence



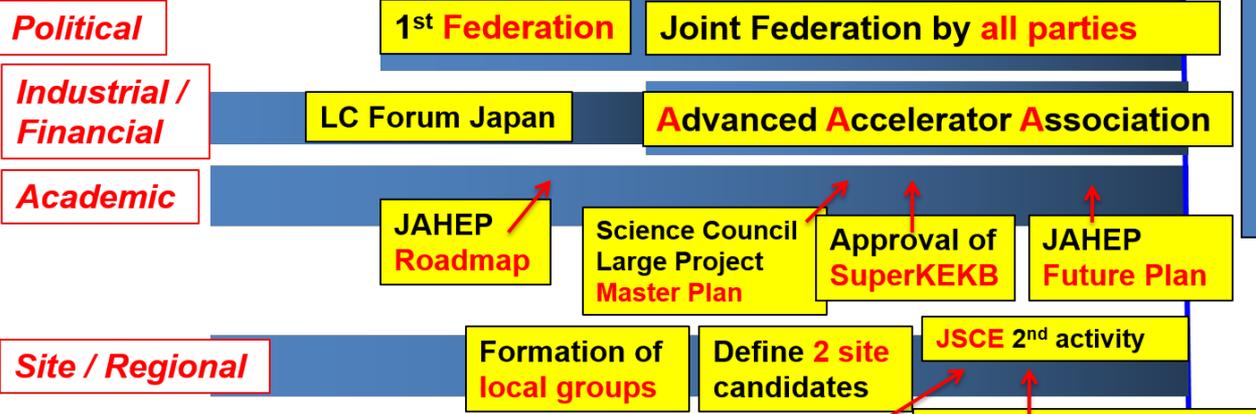
Timeline



Global efforts



Japanese efforts



Federation of Diet Members for ILC

- Since 2006 in LDP, since 2008 non-partisan
- Currently about 150 members
- Frequent meetings (almost every month)



Need to understand Japanese system (not to misunderstand any more)

- **Parliamentary cabinet system** (議院内閣制) like UK + National civil service system with “**examination**” (Chinese historic system)
 - **Ruling party** (与党) fully cooperate with the government.
 - **Government officers** under Ministers are expert of Bureaucracy (**NOT expert** of science & technology)

CULTURE

- Silence is virtue.
- Decisions are made normally by Unanimous (most real work done by tremendous “**ground works**” before the discussion)

Start of the strong political actions for ILC in 2009

Sep. 2009



7 Ministers had a meeting for ILC at Prime Minister's office

Chief Cabinet Secretary, Ministers of Finance, Foreign Affairs, MEXT, Economy, Science & Technology, and Construction / transportation.

Invited to attend (Profs. Koshiba, A. Suzuki, Takasaki, Komamiya, Yamashita)

March 4, 2016: General Meeting of Diet Members for ILC

(23 Diet members, 33 staff members, ~15 Gov. officials, 10 researchers/industries)



Hon. Shionoya reported on US visit



Attendance from Ministries/Agencies

Ministry of Culture, Education, Sports, Science and Technology (MEXT):

Kazuo Todani	Deputy Minister
Futoshi Sano	Director-General for Policy Coordination
Yayoi Komatsu	Director-General, Research Promotion Bureau
Hiroshi Ikukawa	Deputy Director-General, Research Promotion Bureau
Masami Watanabe	Director for Basic Research Promotion Division, Research Promotion Bureau
Sadahiro Hagiwara	Director for Particle and Nuclear Physics Promotion Office, Basic Research Promotion Division, Research Promotion Bureau

Cabinet Office (CAO)

Takeo Nakagawa	Deputy Director-General for Science, Technology and Innovation
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Ministry of Foreign Affairs (MOFA)

Takahashi Noritsugu	Director of International Science Cooperation Division, Disarmament, Non-proliferation and Science Department, Foreign Policy Bureau
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Ministry of Land, Infrastructure, Transport and Tourism (MLIT)

Toshihiko Takahashi	Engineering Affairs Division, Secretary division of Minister of MLIT
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Ministry of Economy, Trade and Industry (METI)

Kazuhiko Muto	Director for International Affairs Office, Industrial Science and Technology Policy and Environment Bureau
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ILC Tokyo Event

Univ. of Tokyo (April 22, 2015) during ALCW 2015



Hon. R. Shonoya



Mr. H. Masuda



三つもの...
はILCの建設とそこで研究する事を切望している。
The ILC's role in particle physics is to explore with exquisite detail the time just after the beginning of the Universe. This research is unique and indispensable for a deep understanding of how our Universe began, how it evolved, and how it works today. We are eager to build and work at the facility.



INDUSTRY SECTORS

Advanced Accelerator Association

Promoting Science & Technology

central body for ILC in industry-academia

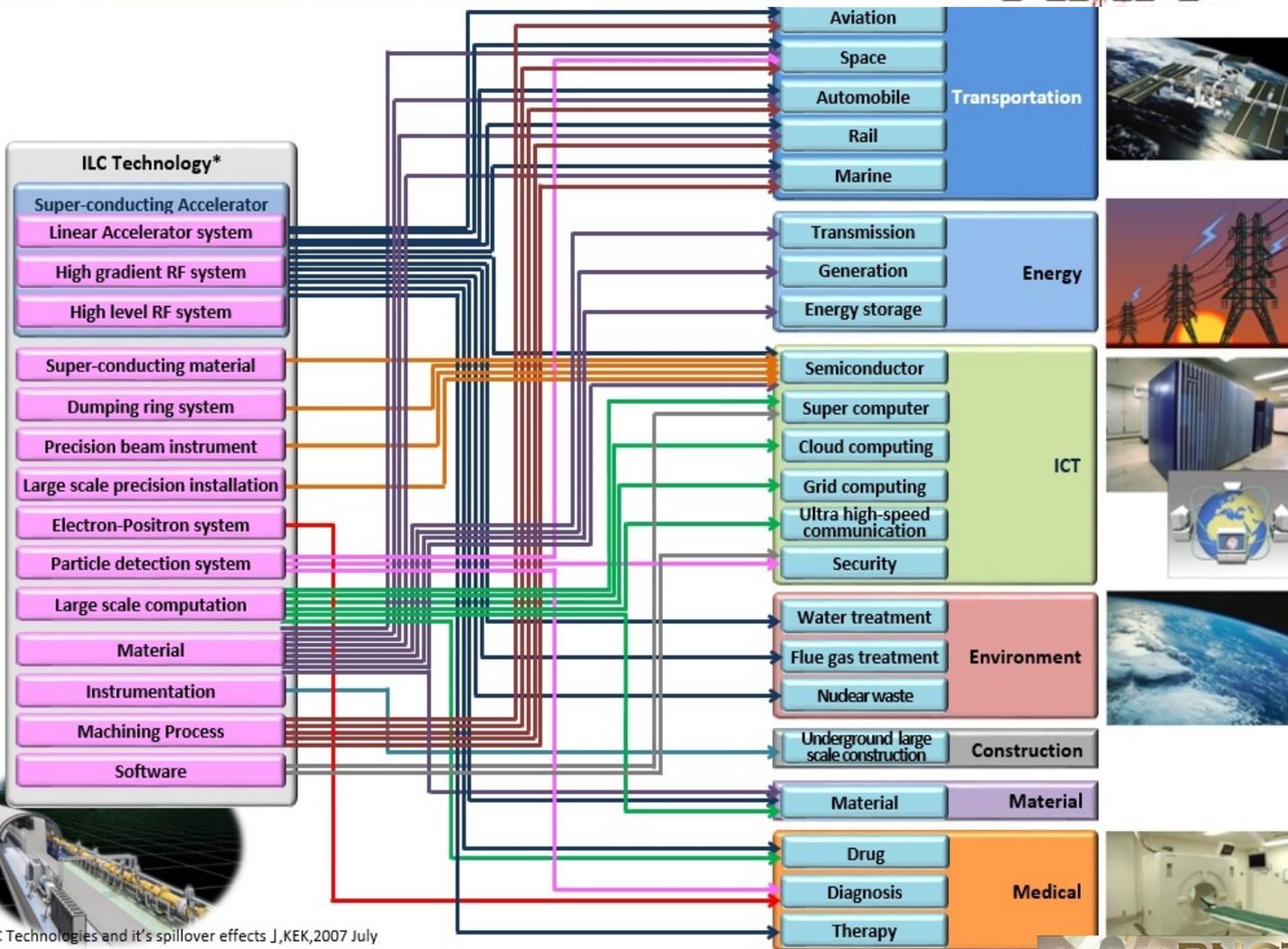
AAA incorporated on December 3, 2014

Reformed as general incorporated company

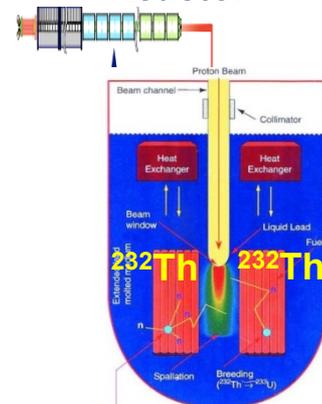
>100 companies, 40 universities and research institutions

- Key technology development and cost reduction
- Promote public understanding
- Promote industry application of accelerator technology from ILC, SCRF, nano-beam and others
- Expanding the manufacturing process of accelerator projects in the private sector
- Study urban development, maximizing ripple effects
- Facilitate international actions in cooperation with Diet members, Government, Business sectors.

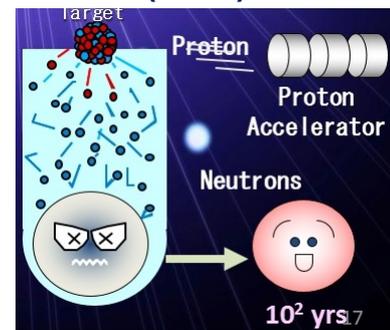
ILC Technologies and it's spillover effects



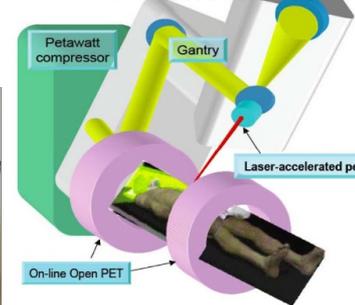
Accelerator Driven Subcritical Nuclear Reactor



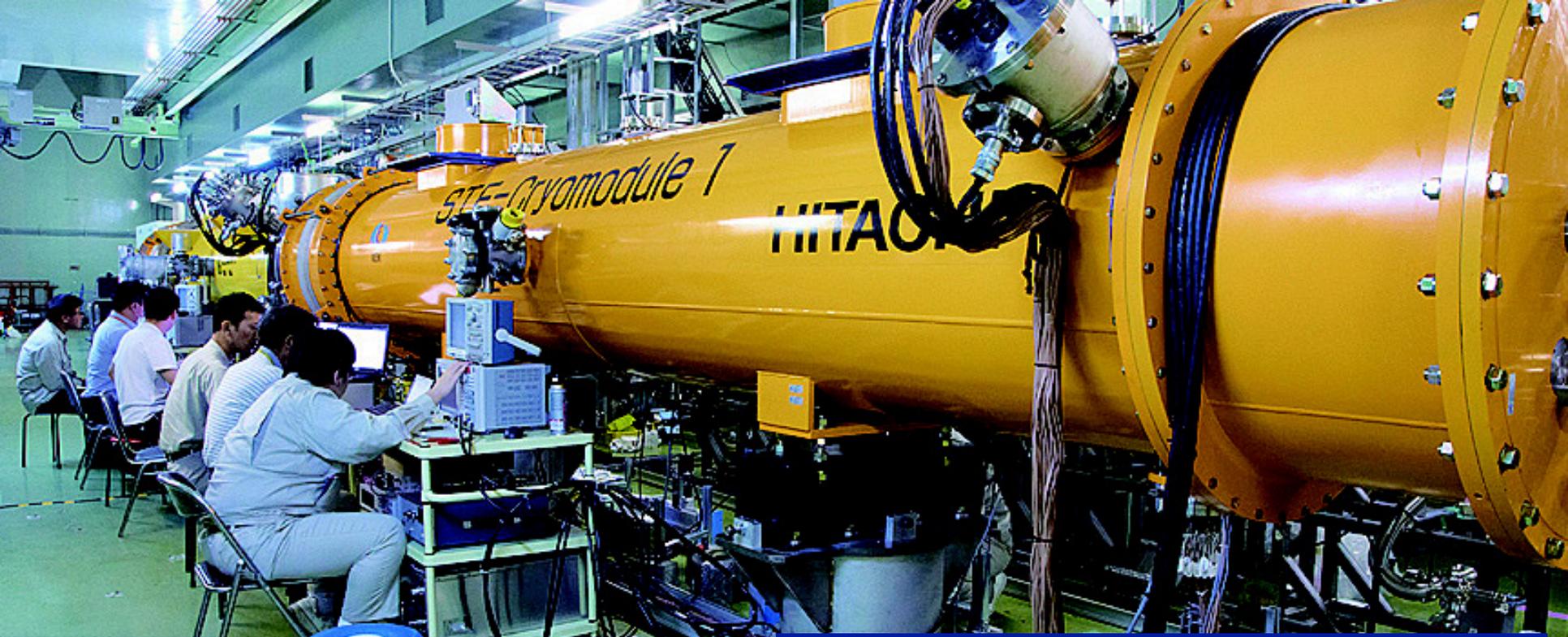
Accelerator Driven Transmutation System (ADS)



Accelerator inside Scanner



* ILC Technologies and it's spillover effects J, KEK, 2007 July



ILC Technical Design Report Completed
(December 2012)

Lyn Evans' Courtesy visit as the LCC Director to
Prime Minister Shinzo Abe (March 2013)



Support from politicians:



Federation of Diet Members (Multiple Parties)

Chair: Mr. Takeo Kawamura

Secretary-General: Mr. Ryu Shionoya

(150+ Diet Members, Nov 2016)

August 6, 2013 Presented Resolution and Policy Report to PM Shinzo Abe

“The ILC should be promoted as a Prime Minister project, to be funded separately from the normal government budget, in the growth-for-Japan framework in view of the national strategic areas” (partial translation of resolution)

Support from Business Communities

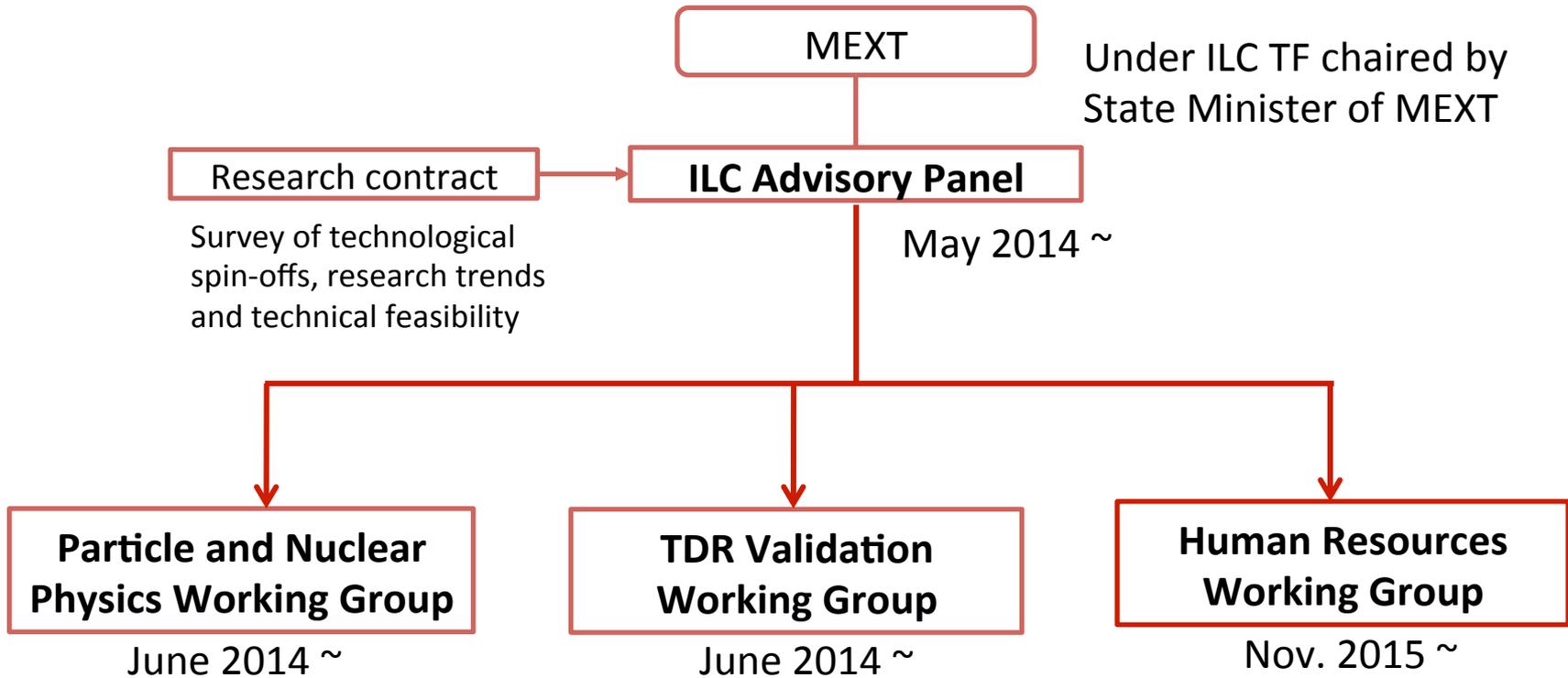
Japan Association of Corporate Executives (April 2013, August 2013)

Japan Chamber of Commerce and Industry (August 2013)

Japan Business Federation (January 20, 2014)

Prime Minister Shinzo Abe (interviews by Media in Dec. 2014)

“Project merit is understood. Japanese government has started reviews on the project. Issues are cost and especially international sharing.”



- Scientific Merit of the ILC project (pg 2-3 of the “Summary”)
 - “The ILC is considered to be important because of its capability to investigate **new physics beyond the Standard Model by exploring new particles and precisely measuring the Higgs boson and top quark**. It should be also noted that the ILC might be **able to discover a new particles which are difficult to be detected** in LHC experiments.”
 - “ILC experiments are **able to search for new particles, different from the ones that LHC experiments have been searching for**. In case these new particles are supersymmetric particles, **ILC and LHC experiments can study them complementally**. On the other hand ILC experiments **can carry out more precise measurement of the Higgs boson and the top quark**, which are beyond the reach of LHC experiments.”

Recognition of the wonderful Scientific merit

ILC Advisory Panel's Summary (relevant points)

- International collaboration (pg 4 and Recommendation 1 of the “Summary”)
 - “It is necessary to conduct the ILC project with support not only by a single country but also by international collaboration. It is important to confirm the willingness of each participating country to cover a reasonable part of the project cost.”
 - “It is necessary to proceed with the ILC project based on worldwide attitudes to the ILC project.”
 - “The ILC project will lose international momentum if decisions on the ILC project implementation are not made in a timely manner.”
 - “As the ILC project requires huge investment, it is indispensable and essential prerequisite for the implementation to have a clear vision of participation and cost sharing by international partners including European countries and the United States while taking into account mid-term and long-term domestic economic and financial situations.”

Recognition of the world situation and importance of the cost sharing

- **Recommendation 1:** “The ILC project requires huge investment that is so huge that a single country cannot cover, thus it is indispensable to **share the cost internationally**. From the viewpoint that the huge investments in new science projects must be weighed based upon the scientific merit of the project, a clear vision **on the discovery potential of new particles as well as that of precision measurements of the Higgs boson and the top quark** has to be shown so as to **bring about novel development that goes beyond the Standard Model of the particle physics.**”
- **Recommendation 2:** “Since the specifications of the performance and the scientific achievements of the ILC are considered to be designed based on the results of LHC experiments, which are planned to be executed through the end of 2017, it is necessary to **closely monitor, analyze and examine the development of LHC experiments**. Furthermore, it is necessary to clarify how to solve technical issues and how to **mitigate cost risk** associated with the project.”
- **Recommendation 3:** “While presenting the total project plan, including not only the plan for the accelerator and related facilities but also the plan for other infrastructure as well as efforts pointed out in Recommendations 1 & 2, it is important to have **general understanding on the project by the public and science communities.**”

To reach to GO, (step-by-step) It is necessary to have

- **Positive Prospects of the International Cost sharing at the political levels**
(not the researchers level)
- **Clearer vision of the Ecm and physics potential** (Higgs, top, new particles) monitoring and reflecting the LHC run2 results
(by **the end of 2017** in timely manner)
- Secure (guarantee) **stable cost** evaluation
(large projects in other fields often expand cost)
- **Social understanding**



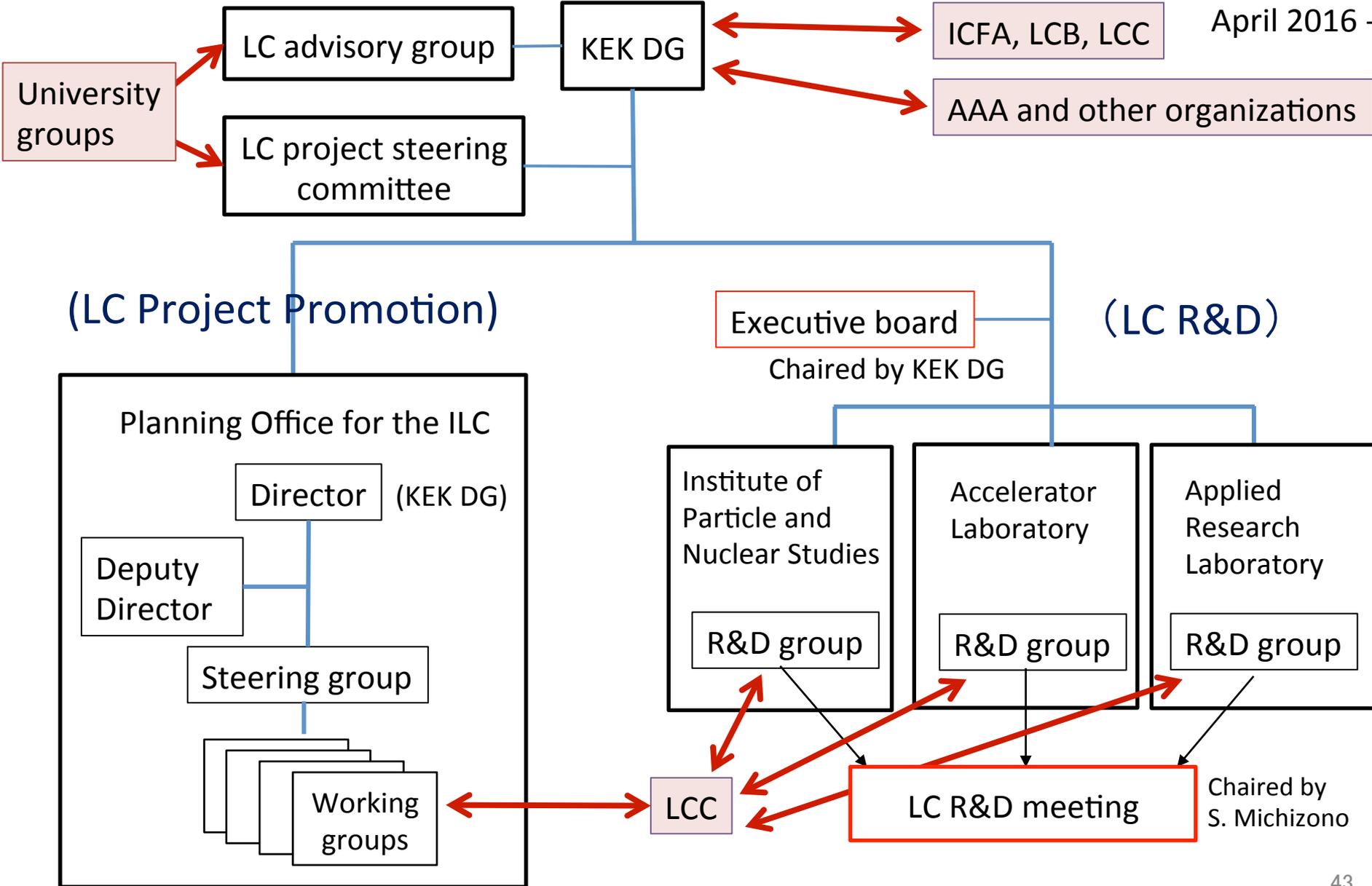
→ Urgent **ACTIONS taken in 2015 and 2016 so far**

1. **Structuring and strengthening the teams** at KEK, industry-academia, Tohoku area
2. Actions taken together with
**political levels, business sectors, industrial sectors,
local governments, media influencers, ...**
3. Interactions, Dialogues, Discussions and Actions with
parliament members and/or governments in foreign countries

Reformation of ILC R&D and project promotion at KEK

M. Yamauchi (KEK)

April 2016 -



Diplomatic actions in **2013**

Trial in multi-lateral way

- **2013 July** Japan-EU-US multilateral Gov discussion
 - **High level officers: Japan & EC**
 - **MEXT**: deputy Minister of MEXT
 - **EC**: Director General of EC research & innovation
 - **CERN DG**
 - Others from director-level officers on HEP/large infrastructure divisions
 - **US, Germany, France, UK, Italy, Spain**
 - At that time, US: Undersecretary of Energy (Science), Director of Office of Science, both have not been assigned yet due to conflicts in Congress

→ Switch from Multilateral to **Bilateral since 2014**:

- **US-Japan first, then expand to European countries, Russia, Asian countries and other nations / regions**

Inter-governmental discussion

“High level” discussion is necessary

- Each country needs “high-level” recognition and trigger
 - Each country has its own domestic and/or on-going projects in wide area of S&T fields as well as High Energy Physics. → Wider stakeholders (industry, economy, diplomacy, etc..) and recognitions of ILC project from wide area of government are desired (necessary) to obtain the EXTRA-Budget for the project.
- **Japanese high level:**
 - **TOP Prime Minister, Chief Cabinet Secretary, Minister of Finance all recognize the ILC project**
 - **Many times** discussions and Q&A on ILC project have been made **in official National Diet session.**
 - **MEXT Minister, Chief Officer (Vice Minister) keep supporting the ILC project**

Recent diplomatic actions in 2016

Will be introduced later in this talk

■ Germany:

- G7 S&T Ministers forum (May) → KEK visit
- Political interactions at Inter-Parliamentary Union (IPU), Oct. 2016 in Geneva
- Meeting with Bundestag member (former Research Minister) in Tokyo

■ France:

- IEEE @Strasbourg in Oct-Nov. 2016

■ Canada, Italy:

- G7 S&T Ministers forum (May) → KEK visit

■ Spain:

- Spanish Embassy in Tokyo (13 May 2016)
- MoU between INEUSTAR and AAA (industry groups) for ILC and ITER-BA

■ India:

- India-Japan forum (chaired by A. Suzuki)
- New activities between India Inter-University and KEK for ILC and HEP
- Political interactions at IPU, Oct. 2016 in Geneva

■ Austria

- Minister visit to KEK

US-JAPAN

We need **Scenario-C case** in US P5 report for ILC

- US P5: HL-LHC, LBNF(DUNE), then ILC

Key 2 sectors in US

■ Government support

- DOE Office of Science & OSTP
- President election 2016 Nov.

■ Congress support

- S&T related committee members, Appropriation Committee members.
- There is active move in Congress members team(s) to **double the basic science budget in US**, Hon. Alexander, Hon. Murkowski, et al.

■ + For ILC, one more politics: **deepening US-Japan alliance with S&T**

- Japan Caucus (~80 members) in US House of Representatives
- Japan Study Group (Senate, House, private sectors, Univ.)

Japan-US Discussions at the Political Level

- April 30 2013 at Washington DC:
Symposium on Advanced Science and Technology centered on the ILC
 - MEXT Minister, Secretary of Energy US, Federation of Diet members of Japan for ILC
- **January 2014, MEXT Minister met with Dr. Moniz (Secretary of Energy) at Washington DC and discussed on ILC**
- July 2014, Federation of Diet members visited Washington
- Apr.2015, Federation of Diet members visited Washington

1st US Visit by federation of Diet Members of Japan for ILC



Minister-Level discussion on ILC Jan. 2014

2nd US Visit by Federation of Diet Members



Hon. Ryu Shionoya
Secretary General of
Federation

Hon. Takeo
Kawamura
Chair of
Federation

Hon. Hirofumi Nakasone
President of Japan-US
Parliamentary Friendship
League

3rd US Visit by Federation of Diet members



Letter from Federation of Diet Members to Secretary of Energy (January 8, 2014)

Example of the “first communication”

Dear Dr. Moniz:

We, the Diet members of Japan, established a multiparty federation of Diet members to realize the International Linear Collider (ILC). There are now a total of over 150 members from the House of Representatives and the House of Councillors, representing more than 20% of the policymakers in Japan.

The ILC is a global project, to be designed and realized by a worldwide cooperation of scientists and engineers. In Japan, for the first time ever, the government has allocated a budget for the coming Japanese fiscal year to investigate and examine the ILC project itself, which is in addition to the existing funding for the research and development. This has great significance in that the Japanese government has shown a vital interest in the ILC project.

The Science Council of Japan (SCJ) has evaluated the ILC project from the scientific viewpoint. Despite the media reports of the cautious attitude toward the ILC, and while the financial concern still remains within the scientific community, the SCJ has actually identified the concrete tasks for the realization of the ILC. The ultimate decision for Japan to host the ILC project rests with the Japanese government and the Diet. Both houses of the Diet are strongly in support of the realization of the ILC project.

We have reached the stage where we must now work together with the other governments for the realization of the ILC. The Japanese government intends to perform concentrated investigations and address the major issues and arrive at a conclusion about hosting the ILC by the end of JFY2015.

The most important issue for the realization of the ILC is whether it can become a truly global project. For this purpose, the Japanese government is currently gathering information from abroad and is starting unofficial talks with the United States and European countries about forming a partnership. The United States is the most trusted partner as seen by the Japanese government and scientists. Thus a strong involvement from the United States in the ILC project is indispensable for its realization. The United States has played and continues to play a central role in the worldwide efforts in designing and developing the key technologies for the ILC. These technologies and the people who have developed them are the linchpins for building the ILC. The Particle Physics Project Prioritization Panel (P5) commissioned by the DOE and NSF is regarded as very important to the Japanese government, particularly MEXT, who will be closely watching the discussions on P5. We hope to inform the key players in the P5 deliberations that these preparations are taking place.

We, the Federation of Diet Members for the ILC, strongly wish for the support and understanding from the U.S. government and Congress members to regard the ILC project as one of the many collaborative endeavors of mutual interest such as in science and technology, security, and economic cooperation to promote a strong partnership between Japan and the United States. The Federation will cooperate with the Japanese government and the United States so that the discussions to create the framework between the governments can proceed in a visible manner. We hope that the progress at the political level in Japan towards the realization of the ILC as stated above can be shared within the U.S. government and Congress. We also hope that the U.S. government and Congress can support the realization of the ILC project through a mutual understanding between Japan and the United States and to consider the possibility of a strong involvement in the ILC project from the United States.

Sincerely yours,

Takeo Kawamura



Chair, Federation of Diet Members for the ILC
Member, House of the Representatives of Japan

Ryu Shionoya



Secretary General, Federation of Diet Members for the ILC
Member, House of the Representatives of Japan

Kenji Kosaka



Deputy Chair, Federation of Diet Members for the ILC
Member, House of the Councillors of Japan

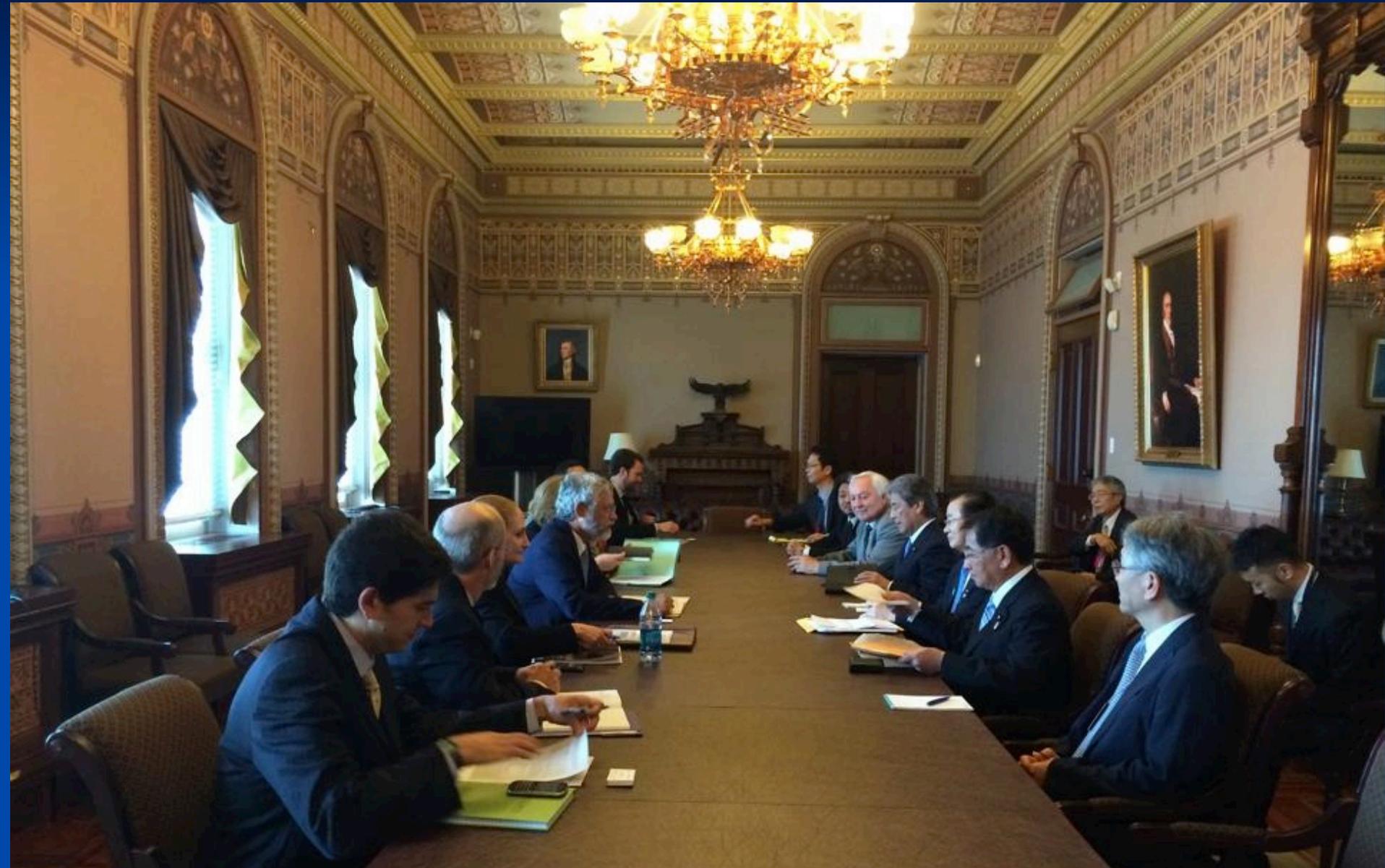
US-Japan

Starting from high-level

- **Minister Level:** (2013 Sep and 2014 Jan.) Minister – Secretary, discussion on ILC
 - Minister of MEXT (Shimomura) and **Secretary of Energy Dr. Moniz**
- 2014 Dec. Undersecretary Orr is in his position
- **Top Officer level** (2015 Apr) Deputy Minister – Undersecretary
 - MEXT deputy Minister **Tsuchiya** and US Undersecretary Dr. Orr
- 2015 July **Mr. Tsuchiya in administrative vice Minister** of MEXT (top of MEXT officers)
- **2015 Oct** US director of **OSTP, Presidential advisor Dr. Holdren** visit Japan (US-J S&T) Working dinner with Diet members, undersecretary Mr. Tsuchiya of MEXT, Industry executives
- 2015 Dec. US Office of Science director assigned
- 2016 Feb. 12 – **DOE Office of Science Director** level
 - @DOE Washington DC. Director C. Murray, J. Siegrist + 3
 - Japan: 3 Diet Members, MEXT (Mr. Ikukawa), 4 researchers

Meeting with Dr. John P. Holdren, Assistant to the President for S&T, Director of OSTP

July 23, 2014, White House, Eisenhower Executive Office Building



Visit Washington by Diet members on 26th - 30th April 2015

- **Hon. Takeo Kawamura**, Member, House of the Representatives of Japan
 - Chair, Federation of Diet Members for ILC,
 - Former Chief Cabinet Secretary of Japan, Former Minister of Education, Culture, Sports, Science and Technology.
 - Director of Province Creation Headquarter and Space and Marine Committee of Liberal Democratic Party
- **Hon. Ryu Shionoya**, Member, House of the Representatives of Japan
 - Secretary General, Federation of Diet Members for ILC
 - Former Minister of Education, Culture, Sports, Science and Technology
 - Acting Chair of Policy Research Council of Liberal Democratic Party
- **Hon. Shunichi Suzuki**, Member, House of the Representatives of Japan
 - Vice Chair, Federation of Diet Members for ILC
 - Former Minister of the Environment
 - Vice Chair of Headquarter of LDP for Recovery Plan for Tohoku Disaster
- **Accompany from Japan:** 15 members from universities, research institutes, industry (AAA), Embassy



2015 Oct US director of **OSTP**, Presidential advisor **Dr. Holdren** visit Japan

US-Japan S&T High-level meeting

Working dinner with Diet members, undersecretary Mr. Tsuchiya of MEXT, Industry executives

Proposal of starting US-Japan Working Group (Joint Activity) for ILC

Proposed by US DOE (Dr. Jim Siegrist) at 2015 Oct US-J S&T high-level meeting

Office of S&T Policy director Dr. Holdren's suggestion: 2 key actions for ILC in US-Japan

Establishment of joint activity for ILC in the framework of US-Japan high-level meeting

Facilitate supports from US Congress by Diet members' actions

Meeting on **6 Oct. 2015 (TOKYO)**:

US Government

- Dr. **Holdren** (Assistant to the President for Science and Technology, Director of OSTP) + OSTP Dr. Menfis (senior advisor)
 - Dr. **Turekian** (Assistant to the Secretary of State for Science and Technology) + US Embassy in TOKYO
- Diet members

- Ruling Parties: **Hon. Kawamura**, **Hon. Nakasone**, **Hon. Shionoya**, **Hon. Suzuki**, **Hon. Otsuka**, **Hon. Saito (new-Komei)**
- Opposite Party: **Hon. Takagi (democratic party)**, **Hon. Tsumura (democratic party)**

MEXT: **Mr. S. Tsuchiya** (administrative vice-Minister of MEXT)

Industry Executives (AAA executive members):

- **Mr. Nishioka** (Mitsubishi Heavy Industry, former President of MHI), Executives from Hitachi, Kyocera, Mitsubishi Electric, Toshiba



US-Japan HEP collaboration framework revised

2015 Oct

US Ambassador Kennedy

Minister of MEXT



DOE Siegrist

KEK Yamauchi

Progress: Oct 2015 – Feb 2016

2015

- Oct.7: **KEK-DOE agreement** including US-Japan R&D on ILC in the framework of US-Japan governmental-level high-level S&T discussions
- Dec.10: Hon. Takeo KAWAMURA (ILC-Fed. Chair) visit to Washington DC
 - Discussion with US Congress Members, agree to hold **US-Japan S&T Forum on ILC / Space / etc.**

2016

■ Feb. 9: US-Japan S&T Forum (Washington. DC)

- Hon. Ryu SHIONOYA (ILC-Fed. Sec.-Gen.), Hon. Shun-ichi SUZUKI (ILC-Fed. Vice Chair), Hon. Taku OTSUKA (ILC-Fed. Vice Exec. Officer), Hiroshi IKUKAWA (MEXT, Research Promotion Bureau, Deputy Director-General). Tohoku Economic Federation Members, Mr. YAMURA (Iwate ILC Promotion Association Chair). Scientists from US and Japan.
- **Meeting with US Congress members: US-Japan Caucus members and others, agreed to enhance US-Japan cooperation in S&T**

■ Feb. 10: Meeting with Dr. Cherry Murray (DOE Office of Science Director)

- DOE Associate Director for HEP Dr. James Siegrist + others, Hon. Ryu SHIONOYA (ILC-Fed. Sec.-Gen.), Hon. Shun-ichi SUZUKI (ILC-Fed. Vice Chair), Hon. Taku OTSUKA (ILC-Fed. Vice Exec. Officer), Hiroshi IKUKAWA (MEXT, Research Promotion Bureau, Deputy Director-General), Embassy of Japan, Scientists.
- **DOE proposed a joint “Discussion Group” for ILC**

Japanese Delegation to Washington DC

Feb. 11-12, 2016

6 parties visting US together

- 3 Diet members from the **Federation of Diet members supporting ILC**
Hon. Shionoya, Hon. Suzuki, Hon. Otsuka
- **MEXT (high-rank)** officer (Ministry of Education, Sports, Culture, Science and Technology)
- Advanced Accelerator Association promoting Science and Technology
(AAA) Industry
- Executives from **Tohoku** bureau of Economy, Iwate business association, prefectural local government
- Japanese **Researchers** (~10 researchers)
- Japanese **Embassy** in the US

Progress: March 2016 - June 2016

2016

- March 4, 2016: General Meeting, Federation of Diet Members for the ILC
 - Report on **the plan for US-Japan discussion by MEXT.**
- Mar.16: **Inter-Parliamentary Union (IPU)** held in Zambia
 - Hon. Shun-ichi SUZUKI. Talk with **German Bundestag member** about cooperation on ILC.
- April 26: General Meeting, Federation of Diet Members for ILC
- May 13: Letter “Demand for Action” on ILC presented to MEXT Minister Hon. Hiroshi HASE from the Federation of Diet Members for the ILC
- May 13: Embassy of Spain: Spain-Japan Industrial-Academic Symposium on ILC and Fusion Energy
 - MoU of promoting cooperation signed by Mr. NISHIOKA (AAA Chair)
- **May 15-17: G7 S&T Ministerial Meeting at Tsukuba**
- May 20: Executive Meeting, Federation of Diet Members for the ILC
 - Discussion on the upcoming meeting between MEXT and DOE
- **May 25: MEXT/DOE Meeting, US-Japan joint “Discussion Group” on ILC created**
 - Cherry Murray (Director, Office of Science), Hiroshi IKUKAWA (Deputy Director-General, Research Promotion Bureau, MEXT)
- June 1: Executive Meeting, Federation of Diet Members for the ILC
 - Report on the MEXT-DOE Meeting on the Discussion Group for the ILC
- **June: Reorganization of Tohoku-area efforts : Establish “Tohoku ILC preparation office”**

US-Japan MEXT-DOE : May 2016 – Oct 2016

DOE/MEXT Joint Discussion Group, First Meeting: May 25, 2016 @ Washington, DC

- MEXT: Hiroshi IKUKAWA (Deputy Director-General, Research Promotion Bureau), Masami WATANABE (Director, Basic Research Promotion Division, Research Promotion Bureau), Tomohiko ARAI (Science Counselor, Embassy of Japan)
- DOE: Cherry Murray (Director, Office of Science), Jim Siegrist (Associate Director, Office of High Energy Physics), Corey Cohn, Senior S&T Advisor, Office of Science
- Agreed to start joint discussion group, discussions on possible joint research such as cost reduction, cost sharing, and project management.

June 2016: FNAL Meeting DOE with FNAL / KEK @ FNAL

August 2016: Working-level meeting at Chicago DOE / MEXT with FNAL / KEK

DOE/MEXT Joint Discussion Group, Second Meeting: Oct. 18, 2016 via TV conference

- MEXT: Yasuhiro ITAKURA (Deputy Director-General, Research Promotion Bureau), Masami WATANABE (Director, Basic Research Promotion Division, Research Promotion Bureau) + more, Tomohiko ARAI (Science Counselor, Embassy of Japan)
- DOE: Cherry Murray (Director, Office of Science), Jim Siegrist (Associate Director, Office of High Energy Physics) + more
- Agreed to start joint research on cost reduction from next April, under the Japan-U.S. Agreement on Cooperation in Research and Development of Science and Technology; begin with the following topics (input from Fermilab/KEK)
 - use of reduced-cost niobium material
 - cavity surface treatment for High gradient (stable mass production), High Q-value (nitrogen doping, power efficiency)

In Parallel to US-Japan R&D on cost reduction, toward realization of ILC

What's new this time: Industry should be involved to play leading role

Action required by physicists in the framework of LCC and institutes level

Various potential to reduce the cost

1. Optimization of methods and designs
 - A. Bring developing countries onboard (e.g. in Asian countries) for material and low-tech (e.g. magnets), human resources
 - B. Cost reduction of tunnel structure (already in progress within LCC)
 - C. Reduce HR cost e.g. by local hiring (TDR's cost estimate is too high e.g. on commissioning work)
 - D. Other design work from cost point of view
 - E. Reuse of accelerator components (magnets, vacuum systems, etc.)
2. Staging scenario starting from lower than 500 GeV

Further Expand the future potential

(Long-term) Further R&D on high gradient (niobium alloy sheets for 90-100 MV/m)

What will happen next in US-Japan ?

What will happen next in US-Japan ?



Nov 8, 2016

Nov 18, 2016

Recent Progress: June 2016 - Nov 2016

International

- **US-Japan** joint discussion group: **cost reduction study started**
- **Progress in Europe & Asia: political interactions**
 - **Spain-Japan** (May-Jun.): Industry-Industry interaction, MoU between INEUSTAR and AAA
 - **Germany-Japan (Oct): parliamentary member interactions@Tokyo**
Direct discussion for ILC between German Parliament Member and JP Diet members
 - **Europe-Japan & France-Japan (Oct.):** parliament & industry members interactions, IEEE@Strasbourg → create an entrans window to EU / France politics
 - **India-Japan (Oct.):** Parliamentary member interactions, IPU@Geneva, Inter-University organization in formation (Japan: A. Suzuki)
- ICFA/LCB/LCC: preparation for new organization next January

Germany-Japan

- Mar. 16-24, 2016: The Inter-Parliamentary Union (IPU) took place in Zambia where Hon. Shun-ichi Suzuki had contact with a German Bundestag member, Herr **Axel E. Fischer**, with whom he spoke about the ILC.
- After the good discussion, Herr Fischer mentioned that Prof. **Dr. Heinz Riesenhuber** (former Minister of Scientific Research) is a good contact. Prof. Riesenhuber has good connections with Japan. There is a possibility for Prof. Riesenhuber to visit Japan in the fall of 2016, where the Federation of Diet members and AAA will try to make contact.

→ realized in Oct 27 2016

Oct. 27, 2016 @ Tokyo

Meeting with German Bundestag members for ILC



Wonderful discussions !!

Germany: Prof. Dr. Heinz Riesenhuber (former Minister of Research),
Herr Mark Hauptmann + German Embassy

Japan: Hon. S. Suzuki, Hon. N. Tamura, Hon. T. Shina, Hon. Y. Takaki
+ Scientists (S.Yamada, S.Komamiya, Y.Okada, SY)

Various things are discussed concerning ILC in an hour.

Hon. Riesenhuber knew about accelerators and the ILC project very well, including the timeline of the ongoing ILC review process in Japan, and HL-LHC, DESY, GSI, etc...

He praised the progress and collaboration of the international community of high energy physicists for the project, then he said he was very happy to hear the political interest in Japan, and pointed out that it is the right time to start communication for ILC in political level, and will support the facilitation for it. Hon. Riesenhuber told he gladly welcome the discussion with German researchers.

Window to EU and France

IEEE: Strasbourg, Oct. 2016

AAA Chairman
T. Nishioka

Catherine Trautmann,
Former French Minister of Culture
Former EU Parliament member
Former Mayor of Strasbourg



I'm Shina Takeshi, Member of the House of Representatives of Japan. Joining me here today from Japan are Hon. Shintaro Ito, members of the industry, Consulate of Japan, and scientists.

The IEEE NSS/MIC conference has a world-wide nature and this is why we are delighted to participate in such a big international event.

@IEEE NSS/MIC Plenary
Hon. T. Shina



Two Diet members participated
and discussed on ILC



@EU-Japan
VIP meeting
Hon. Ito



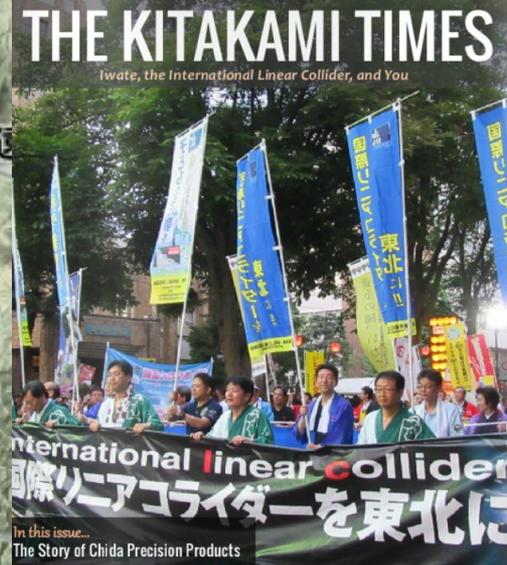
Summary of the inter-nations so far

- Diplomatic actions at Congress/Parliament level and Government levels (Minister, Officers) have started.
- **Bi-lateral** discussions, rather than multi-lateral.
- From Japanese side, first focused on **US-Japan**, and **legal framework** (high-level inter-government agreement) and **DOE-MEXT “discussion group”** are both active now.
- **Europe-Japan** (EU, Germany, France, Spain, ...) and **Asia-Japan** (**start with India**) interactions at the parliamentary level and industry/academia, has been **started**, and to be strengthened more step by step. For this, **we need your tight cooperation and timely actions**.
- Include more Asian countries, Russia, and rest of the world.

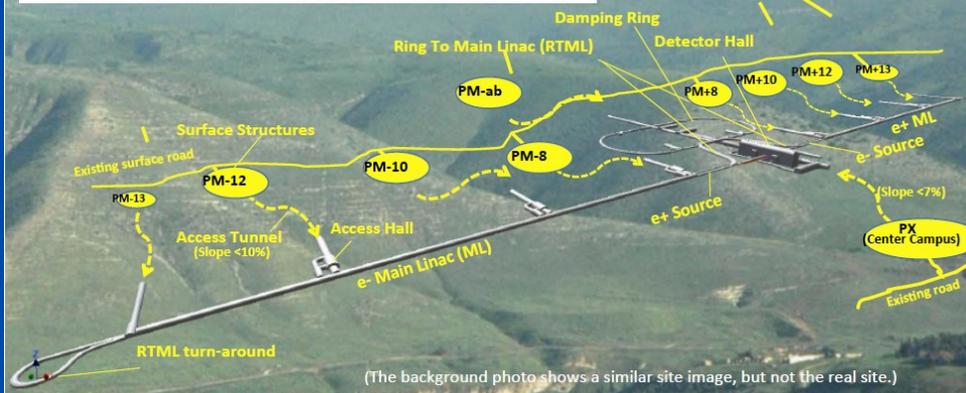
LOCAL AREA (TOHOKU)

and

OUTREACH



superior geology, stable bed rock against earthquake



(The background photo shows a similar site image, but not the real site.)



Kitakami



Relatively NEW

- Surface land information surveyed by local government.
 - Environmental assessment partially done already.
 - Concrete “tentative” design in hand in the dedicated team with engineering profs., AAA, local team and prefecture.
- **Non-disclosure agreement (NDA)** to open surface information was signed between KEK and local government. **KEK is preparing NDA with laboratories abroad** and engineering companies.

Growing Support and ongoing studies in local regions

- Very active efforts by local government, Universities, business groups, companies for preparation of ILC
- **“Tohoku Conference for the promotion of the ILC” (2014~)**
 - Top Executives
 - **University Presidents, Prefectural Governors,**
 - **Mayors, Leaders of Tohoku Economic Federations**
- Progress in mapping (potentially) accelerator-related companies
- Wide-area regional/urban development: specific proposals (Multiple blueprints→synergy with ILC project)
- Regional economic effects (Estimates by university and private sector)

Top Executives

↑ University Presidents, Prefectural Governors, Mayors, Leaders of Tohoku Economic Federations



launched in August, 2014



Welcome ILC to Kitakami



Oshu City



Ichinoseki Station



Morioka



Tohoku tourism ad seen on Tokyo Metro



Posters and "Toy IILC" by school children of Oshu City welcoming international workshop on IILC

International Workshop on Future Linear Colliders

LCWS2016

5-9 DECEMBER , 2016
Aina Center & MALIOS ,
MORIOKA CITY , IWATE , JAPAN

The workshop will be devoted to the study of the physics cases for future high energy linear electron positron colliders, taking into account the recent results from LHC, and to review the progress in the detector and accelerator design for both the ILC and CLIC projects.



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H. Yamamoto (Tohoku University-IOC Chair)

Website : <http://lcws2016.sgk.iwate-u.ac.jp>

Contact : lcws2016@iwate-u.ac.jp



TOHOKU
UNIVERSITY



Science x Hello Kitty: July, 2016







Nov. 3, 2016 @Roppongi (Central Tokyo)



More News from Japan

GOOD for ILC

- **S&T national policy** for 5 years plan (2016-2020) defined under the Prime Minister's leadership implies the importance of S&T diplomacy, large scale project including accelerator projects.

(requested increase of S&T budget to >200B US \$ / 5 years)

- **Promotion of Local area development and local economy** is now one of the central issues in the national cabinet policy. Especially after Olympic2020 in Tokyo
- Newly introduced **the S&T advisor for Minister of Foreign Affairs** (Dr. Kishi). New window of International protocol.
- **Government document "Tohoku Regional Plan"** (March 2016)
By MLIT (Ministry of Land, Infrastructure, Transportation and Tourism) mentioning ILC in several points.

Other important Milestone

- **National budget** still not healthy condition. First need increase consumer tax (8%→10% (expected Oct. 2019))

[PUBLIC] Excerpts from the **Fifth Basic Plan for Science and Technology**
National S&T policy (2016-)

(Unofficial translation)

P31: Promoting international collaborative research and creating world's top-level research centers

In order for Japan to position itself as a main player in the global research network and to continue exerting its presence to the world, it is important to promote international collaborative research and to create research centers that become central cores for exchanging international brainpower.

For this purpose, the country should utilize inter-university research institutes and collaborative research centers to enhance international collaborative research for scientists that stay in Japan. **The country should promote the Big Sciences, such as nuclear fusion, accelerators, and space development and utilization,** by operating and making full use of domestic and international facilities and establishing a framework with other countries to intensify international collaborative research. In addition, **bilateral and multilateral cooperation will be strengthened to build a mutually profitable relationship,** while cooperating strategically with other countries to extract common challenges, and **enhancing management of matching funds and overseas collaborative centers.**

Furthermore, Japan should attract the leading researchers from home and abroad, **promoting the formation of world's top-level research centers,** which features an excellent research environment and high level of research. In addition, Japan should capture the efforts by the Okinawa Institute of Science and Technology and promote necessary expansion.

Excerpts from **Tohoku Regional Plan** (March 2016)
By **MLIT (Ministry of Land, Infrastructure, Transportation and
Tourism)** (1/2)
[Google translation, sorry]

(p.19) In addition, in the Tohoku area, in recent years, the medical device industry, along with the integrated proceeds of the automotive industry, higher education institutions such as universities and research institutes that have raised the research results of interest from home and abroad in each prefecture is located are addition, **ILC (International Linear Collider)** attract the activities of international research centers of the world's most advanced have been carried out actively, such as, are deployed to the new industrial foundation is expected.

(p.31) In addition, from the fact that in the Tohoku area are formed advanced and diverse intellectual foundation of universities and research institutes, towards the formation of Tohoku area with vitality their talents and knowledge of the industry, academia and government, the world's most advanced international research along with the advance to attract offices, there is a need to promote the beginning and the strategic industrial development the creation of new employment and human resource development opportunities, such as advanced science and technology industry. For example, such as **ILC (International Linear Collider)** that local is advancing actively attract is considered.

Excerpts from **Tohoku Regional Plan (March 2016)**
By **MLIT (Ministry of Land, Infrastructure, Transportation and
Tourism) (2/2)**

[Google translation, sorry]

(p.40) In recent years, the automobile is being progressed integrated in Tohoku area, medical equipment, semiconductor, for the industry of environmental recycling, etc., to strengthen the competitiveness by innovation such as through industry-academia-government collaboration, attract activities of international research centers of the world's most advanced (for example, such as that local is advancing actively attract **ILC (International Linear Collider)**), to facilitate the creation and the like of the tech industry.

(p.148) In addition, a leading research facility in particle physics, **ILC (International Linear Collider)** and Tohoku synchrotron radiation facility (tentative name), while based on the study situation of the country, etc., Tohoku area of industry, local governments and universities, etc. together on, promote the information collection and research study on planning.

Steps to GO

1. **COST reduction** in US-Japan, and LCC frameworks **is crucial and urgent**
2. **LHC run2 results** (2016, 2017) to be continuously monitored (to determine the initial and max energy = project scope and definition as the governments), and evaluate the cost with cost reduction efforts in US-Japan and design work by LCC.
3. **Surveys** in individual countries by Embassy, MEXT (expected in 2017)
4. (as expected) **Year 2017 will be very crucial for ILC.**
5. If we (world HEP) work and “clearly answer” properly, actively, internationally and timely, a **decision** will be made to proceed by the government cabinet backed by partner countries’ prospects.

Simple but difficult questions we have to “answer clearly” to governments (timely)

- Do we (world HEP) **need** electron-positron collider as the next global machine in addition to the frontier hadron collider?
- If YES,
then which is better,
Straight one , or Circular one?
- If Straight,
then which energy shall we start
(ultimate way of cost reduction)
and how far we aim to extend the energy reach in future ?

Summary (1/2)

- Diplomatic actions at Congress/Parliament level and Government levels (Minister, Officers) have started.
- **Take Bi-lateral** way, rather than multi-lateral.
- From Japanese side, first focused on **US-Japan**, and **legal framework** (high-level inter-government agreement) and **DOE-MEXT ILC “discussion group”** are both active now.
- **Europe-Japan (EU, Germany, France, Spain, ...)** and **Asia-Japan (start with India)** interactions at the parliamentary level and industry/academia, has been **started**.
- **Germany-Japan political interactions have been started using the occasion of IPU and meeting at Tokyo in Oct 2016**, and to be strengthened more step by step. For this, **we need your tight cooperation and timely actions**.
- Include more Asian countries, Russia, and rest of the world.

Summary (2/2)

- In Japan, various efforts are made for outreach, such as “Science x Kitty” and events in the central Tokyo, and also in local areas.
- In addition to the supports from MEXT and MOFA (Ministry of Foreign affairs), cooperation with other Ministry such as MELT (Ministry of construction) is started.
- At Tohoku area, new activity “Tohoku ILC preparation office” is in operation. Non-disclosure agreement has been made between Tohoku and KEK to give surface info to KEK. It will be expanded very soon with DESY, etc..
- The question on the accuracy of the cost estimate, human resources, reliable performance, etc.. all would be clarified by the success of European XFEL and LCLS-II, and STF, soon.
- We will need to answer clearly the way to go soon. Timely and clear answer, and strong global support will lead “a decision”.

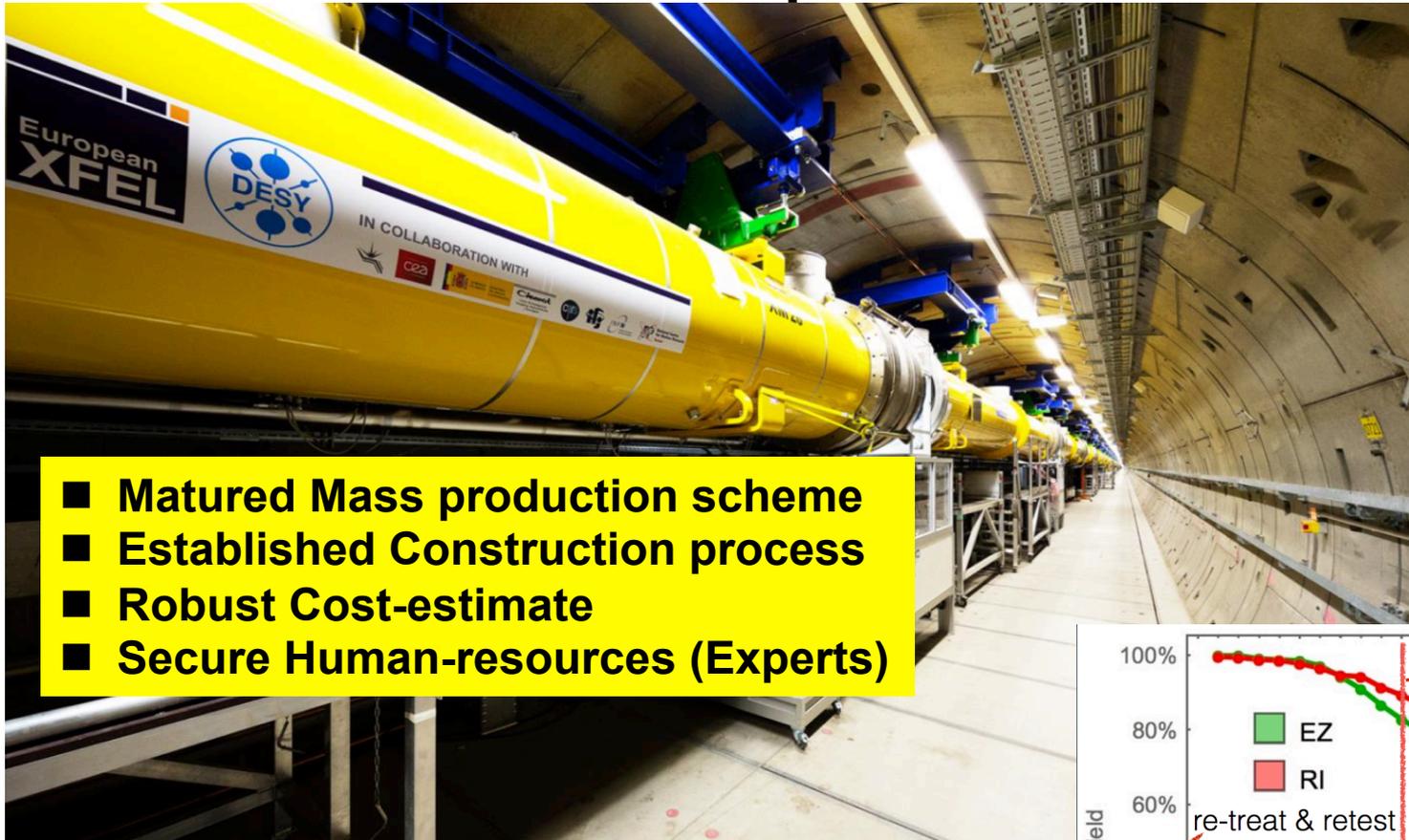
TIMING is important

Year 2017 is crucial

Considerations for the **construction timing**:

- After 2020 Tokyo Olympic Games
- Careful adjustment of the international budget profile, not to overlap with the cost peak of HL-LHC (especially for EU), and Neutrino program(s) (especially for US) (also human resources)
- Other big S&T projects,
e.g. ISS international Space Station, ITER

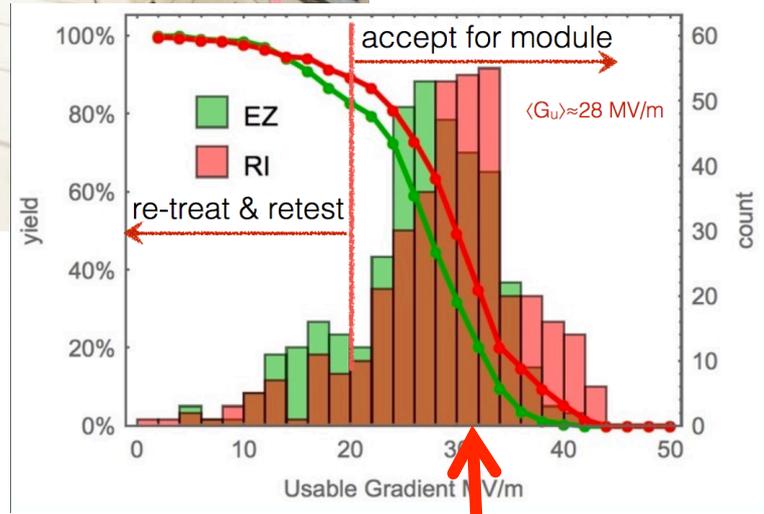
European XFEL



- Matured Mass production scheme
- Established Construction process
- Robust Cost-estimate
- Secure Human-resources (Experts)

European XFEL is a 5% “prototype” of the ILC
Same SCRF technology in 1.5 km tunnel

Proof: Mass production of complete modules



(Other projects using ILC SCRF: LCLS-II, cERL, ...)

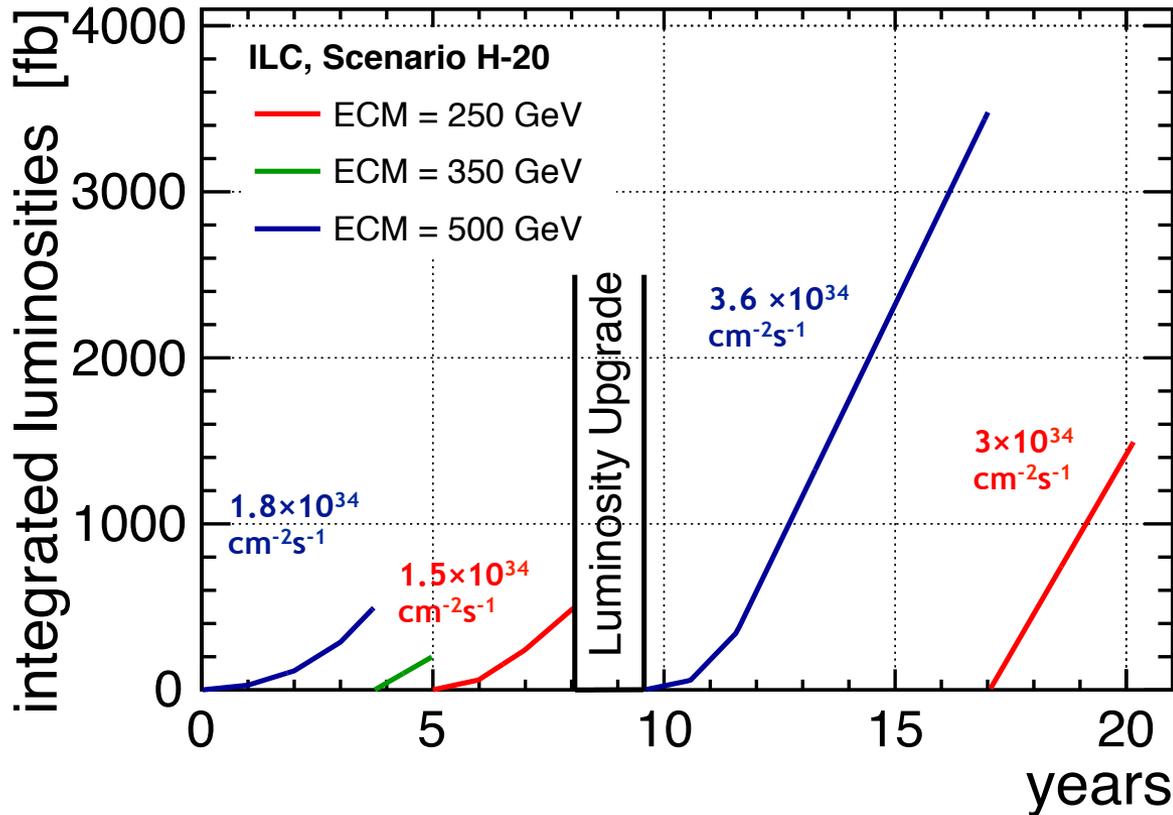
ILC specs: 31.5 MV/m

A Running Scenario for ILC

H-20 running scenario
 arXiv:1506.07830 (June 2015)
 Endorsed by LCC

500 GeV: BSM, Higgs & top physics,
 Higgs self-coupling, top Yukawa
 350 GeV: Top threshold scan
 250 GeV: Higgs mass, CP, σ_{ZH} , ...

Integrated Luminosities [fb]

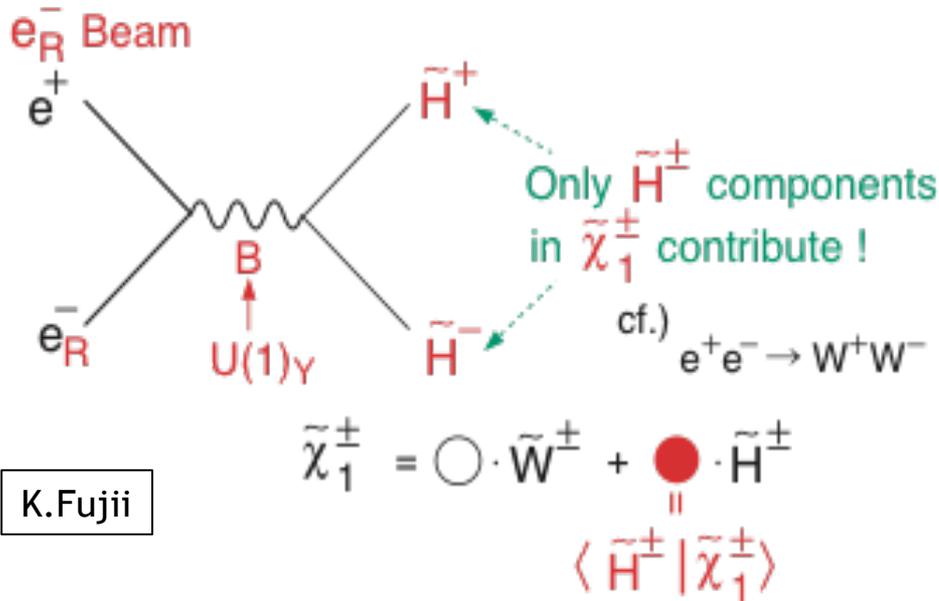


Total for 20 years:

\sqrt{s}	$\int \mathcal{L} dt$
250 GeV	2000 fb ⁻¹
350 GeV	200 fb ⁻¹
500 GeV	4000 fb ⁻¹

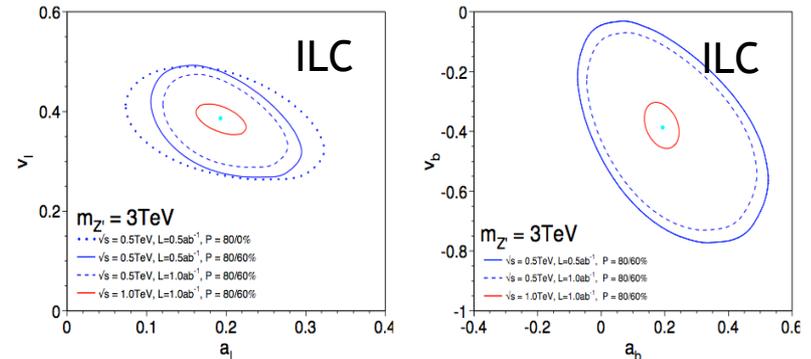
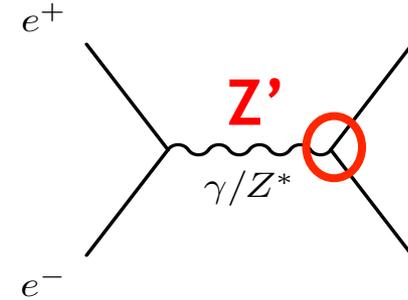
Power of Beam Polarization

ex.1) Chargino pair production



K.Fujii

ex.2) Z' in $2f$ process



Decompose Higgsino & Wino through beam polarization

Determine Z' couplings through beam polarization

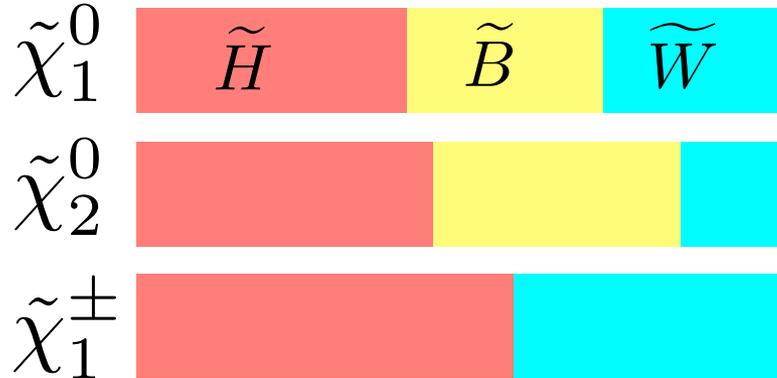
Other benefits of beam polarization: bkg. suppression, signal enhancement

SUSY: Parameter Determination

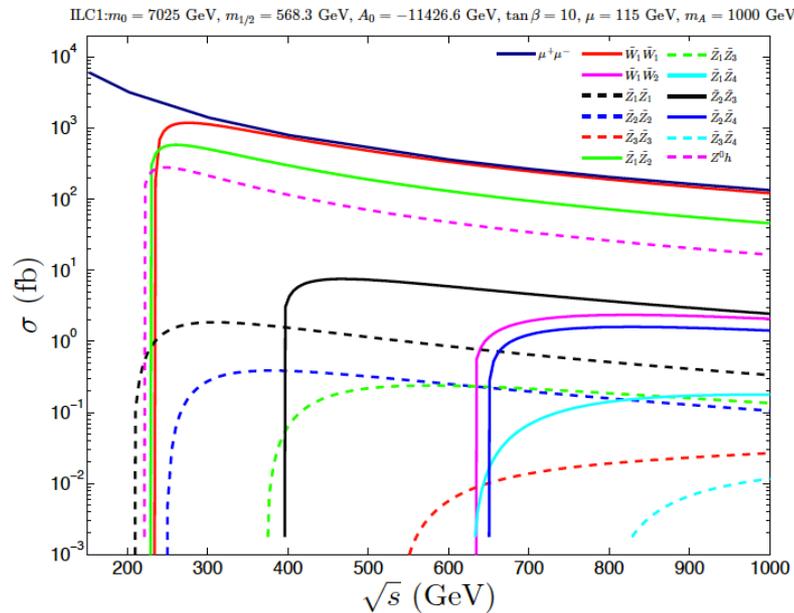
Beam
Polarizations



Mass & Mixing



Threshold Scan



$\tan\beta$

μ
higgsino

M_1
bino

M_2
wino

“There are two possible predictions of ILC achievements depending on the results obtained in the LHC experiments. If LHC experiments find any new particle(s) whose mass is below a certain energy, it will be possible for ILC experiments to study the new particle(s), in addition to precision measurements of the Higgs boson and the top quark.”

“Second, if no new particle is found in the 13TeV operation of LHC or the mass of the discovered particle is above a certain energy, then the main subject to be studied in ILC experiments will be the indirect exploration of new physics through precision measurements of the Higgs boson. Even though LHC experiments on the Higgs boson and top quark measurements have come first, ILC experiments will have superior capabilities for studying the properties of the Higgs boson and the top quark with precision, providing attractive opportunities for the ILC project.”

“Thus the specifications of the performance and the scientific achievements of the ILC are considered to be designed based on the results of LHC experiments.”

- Apr. 2015: US visit by Hon. Kawamura, Hon. Shionoya, Hon. Suzuki
→ meetings with US Congress members, Government high levels
- EU visit by Hon. Kosaka, Hon. Shina (EU-Japan Parliament Conference)
(Strasbourg) → introduce ILC in the first session to EU parliament members
- From Sep. 2015
thru Jan. 2016: US visits by academy-industry groups
to support and prepare dialogues between parliaments & governments
- Oct. 2015: Meeting @ Tokyo with Dr. John P. Holdren (S&T Adviser to US President
Obama) and Dr. Vaughan Turekian (S&T Adviser to Secretary of State)
- Apr. 4, 2015: Meeting between MEXT Minister Hase, Hon. Kawamura (ILC Fed. Chair),
Hon. Shionoya (ILC Fed. Director General), Mr. Nishioka (AAA Chairman)
- Dec. 9-11, 2015: US visit by Hon. Kawamura, (Washington, DC)
Meetings with Congress members on Space and ILC
- Feb. 11-12, 2016: US-Japan S&T Forum (Washington, DC)
US visit by ILC Fed. members Hon. Shionoya, Hon. Suzuki, Hon. Otsuka
Meetings with Congress members & DOE Director of the Office of Science
- Feb. 17, 2016: Japan visit by Congress members, Congressional Study Group on Japan
- Mar. 16-24, 2016: Inter-Parliamentary Union (Zambia), communication by Hon. Suzuki
- May 2016: US-Japan Joint Discussion-Group on ILC (MEXT and US DOE) started
First meeting in Washington DC
(Representatives: Dr. Cherry Murray, US DOE, Director of the Office of Science
Mr. Itakura, Japan MEXT, Deputy Director in charge of Research Promotion Bureau)
- Aug 2016: DOE-MEXT Discussion Group meeting @ Chicago among the officers and directors of FNAL & KEK
- Oct 2016: Meeting between chairs of US-Japan Joint Discussion Group on ILC: Second meeting via
teleconference
- Oct. 2016: Inter-Parliamentary Union (Geneva), Hon. Suzuki, Hon. Ito