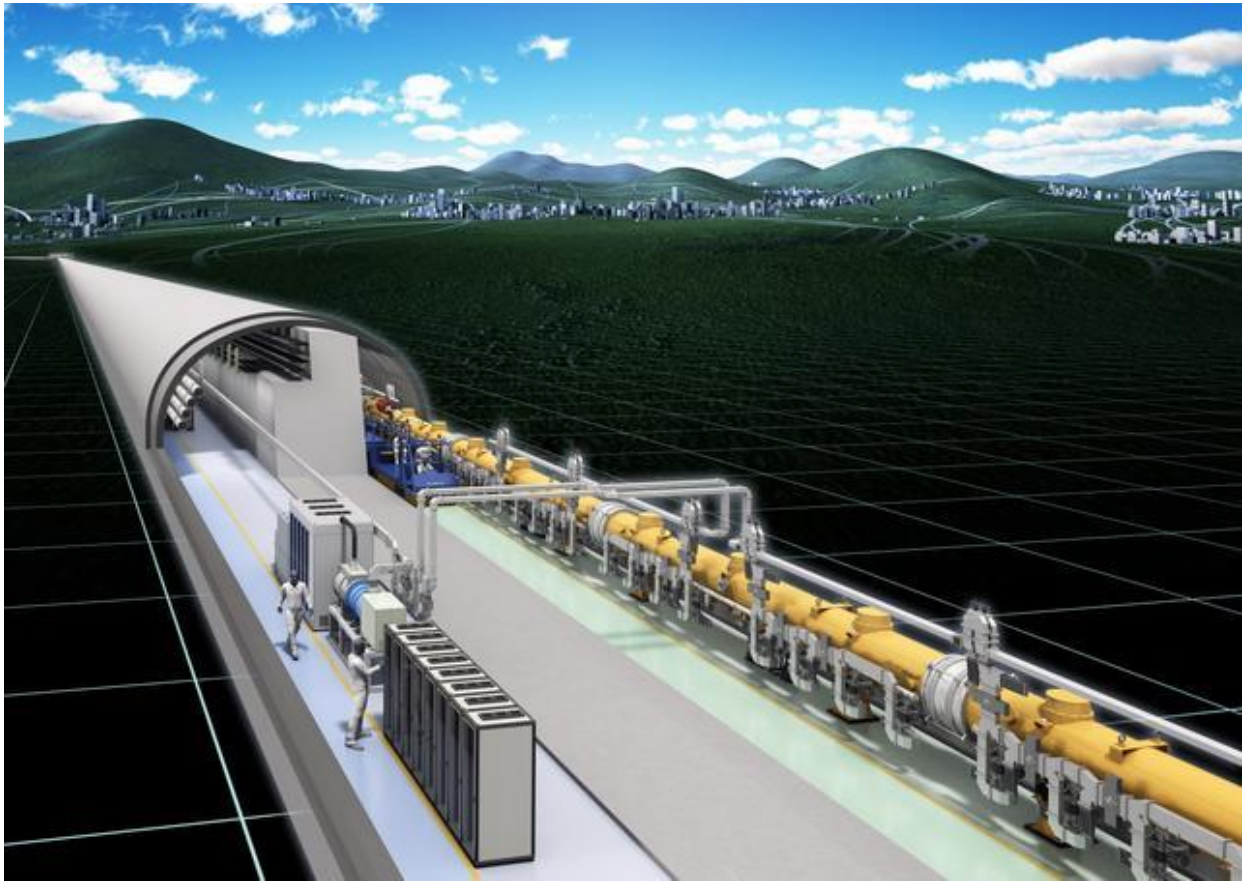
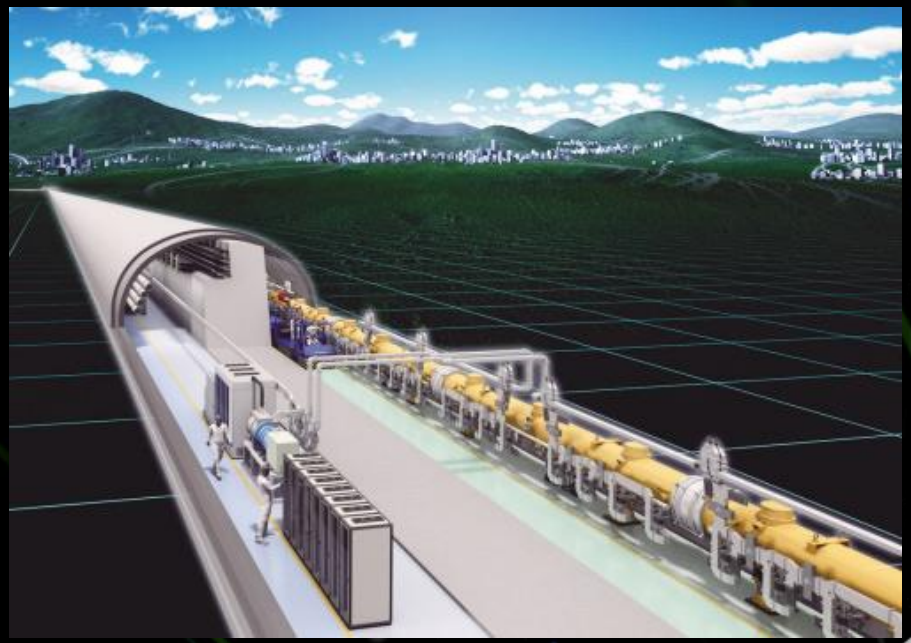
ILC after the TDR
plans and objectives

December 4th 2013 Workshop on Helmholtz Alliance Karlsruhe

School of Science, and ICEPP, the University of Tokyo
Chair: High Energy Physics Committee of Japan Sachio Komamiya





International Linear Collider ILC

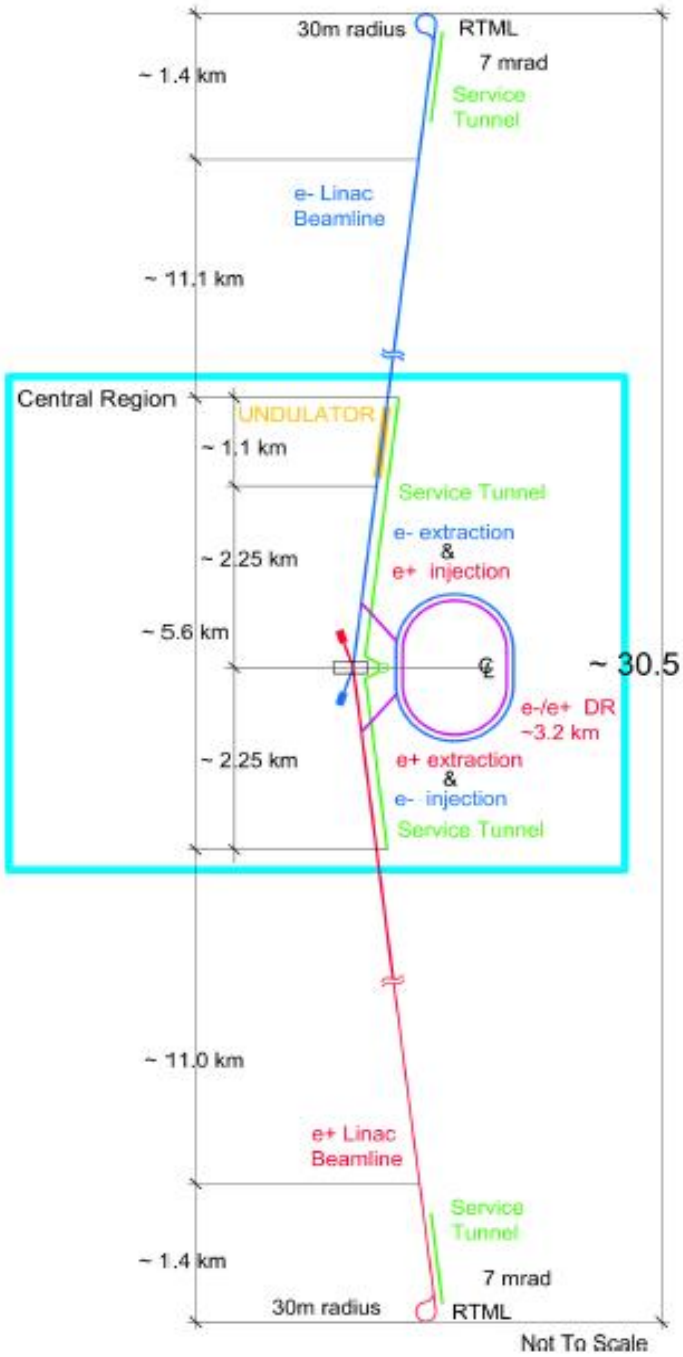
The next major accelerator project driven by truly international efforts

Superconducting linear accelerator of ~30km length will be constructed underground

Colliding electrons and positrons face-to-face to study the universe of 10^{-12} second after its creation.

Specially, detailed properties of the Higgs boson, top quark, dark matter particle, … will be studied.

tion

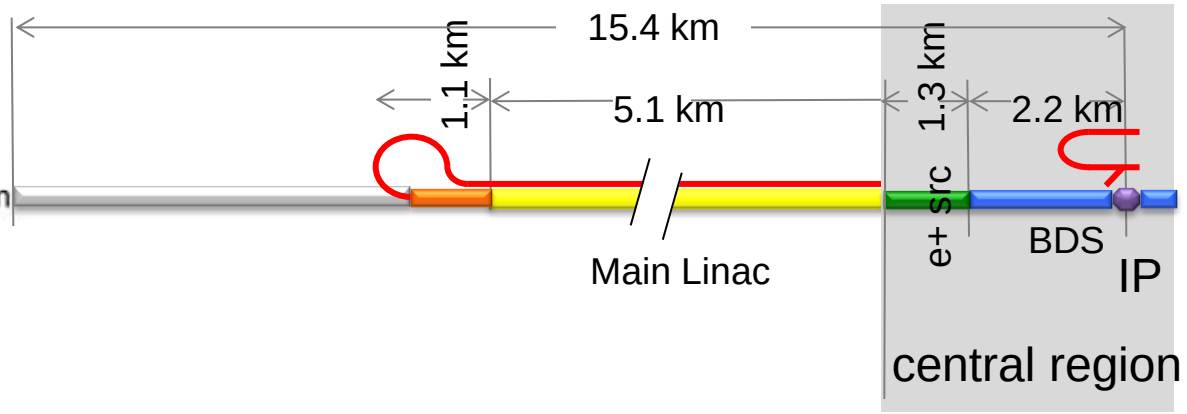


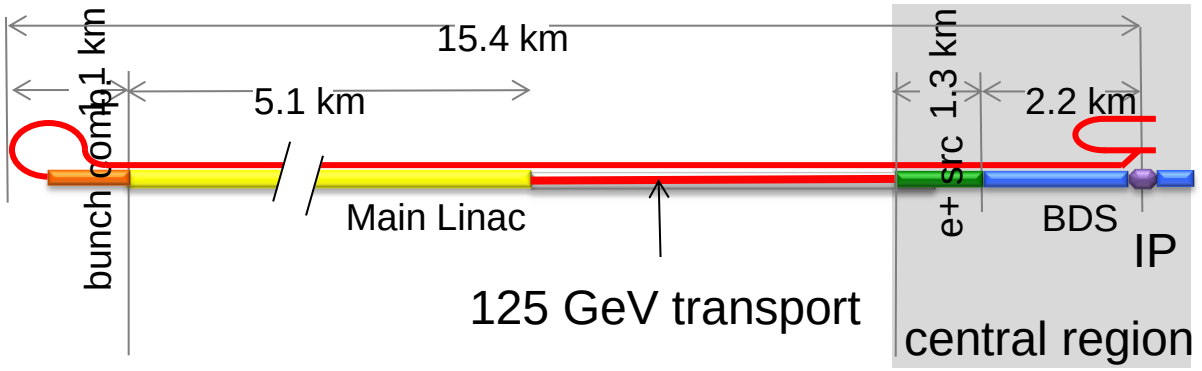
Advantages of linear collider

(1) No energy loss due to synchrotron radiation

for circular machine: $\Delta E \propto (E/m)^4/R$

(2) Extendability (length ⇒energy)





Challenging technology of ILC

(1) Very high acceleration gradient with super-conducting linac

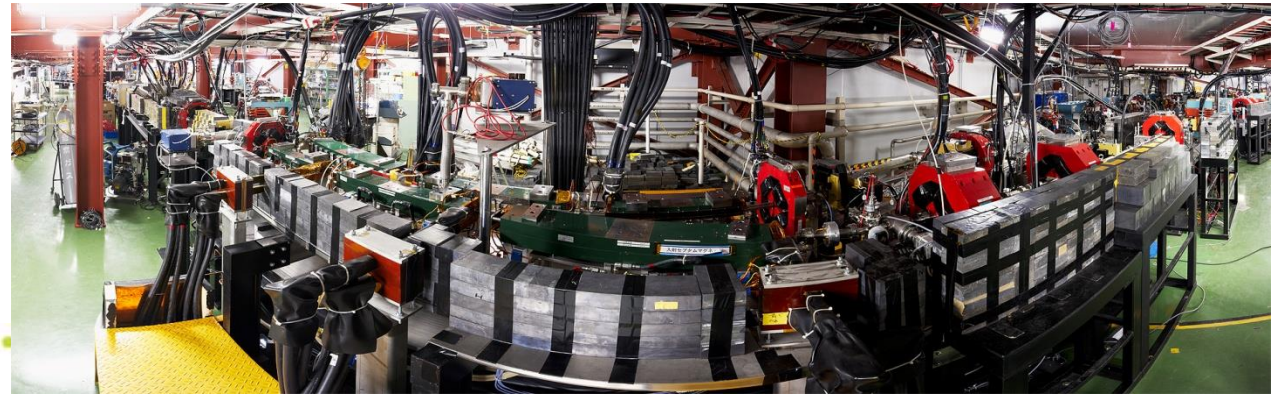
⇒ shorter length ⇒ low construction cost

super-conducting ⇒ low running cost

(2) Face-to-face collision of very narrow (flat) beams

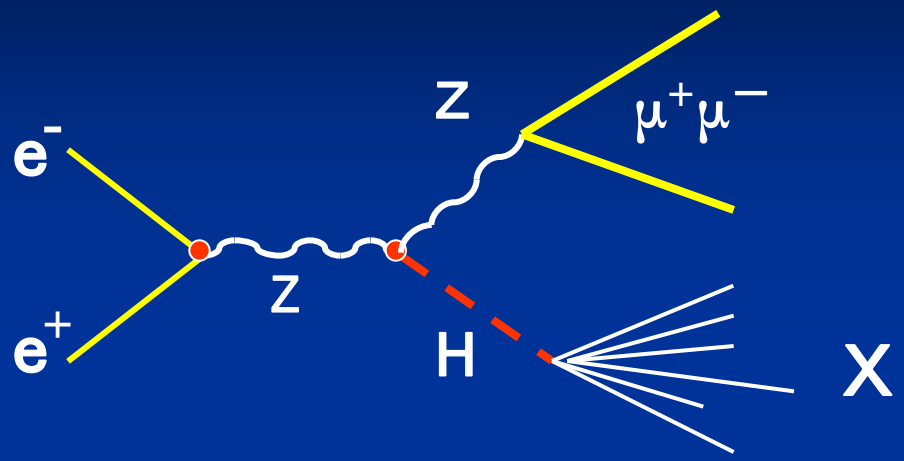
⇒ increase interaction probability ⇒lower running cost

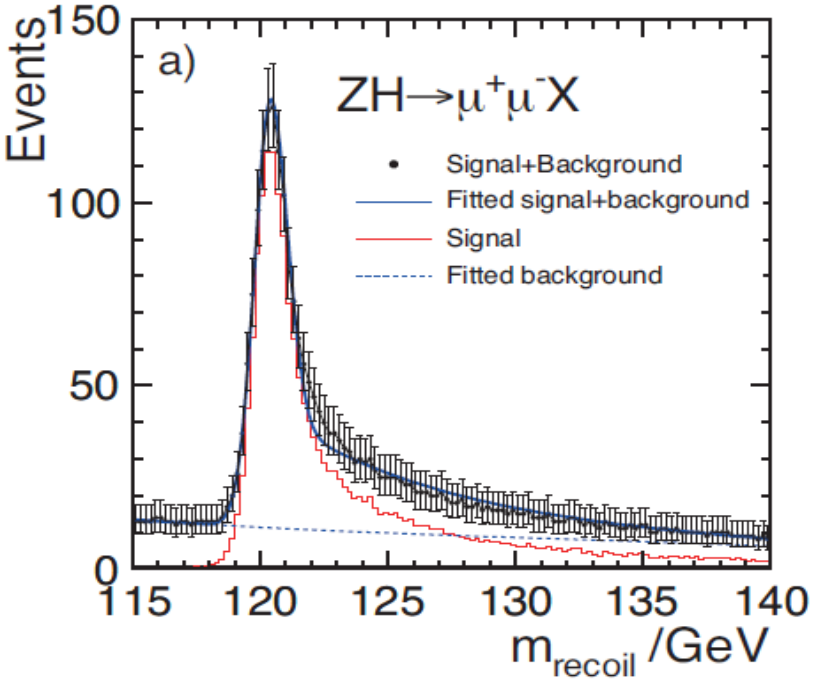
Both technologies are established as shown in TDR



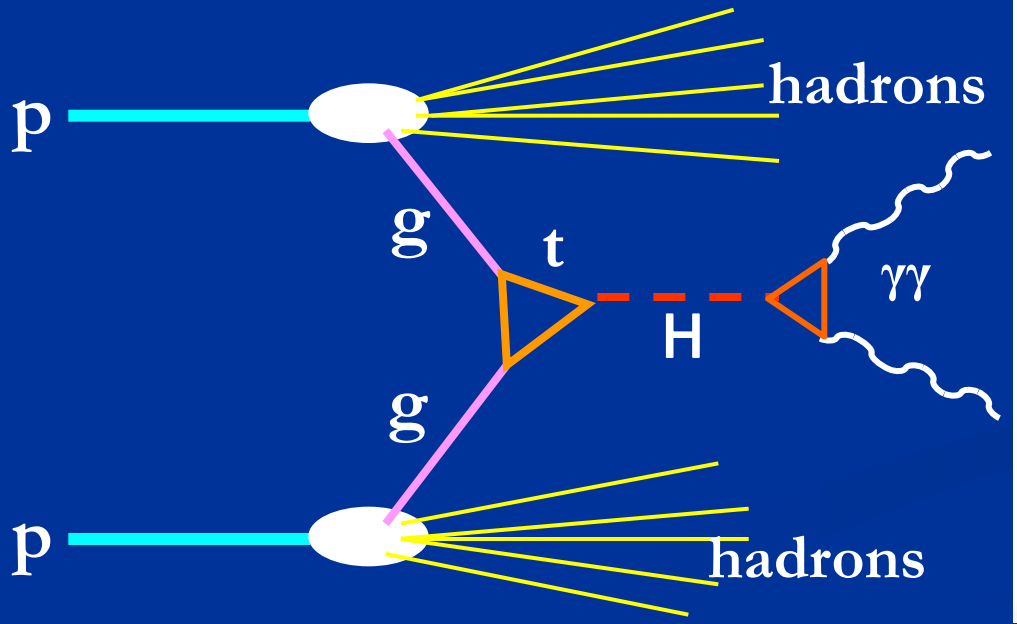
Two measurements are complementary and qualitatively different

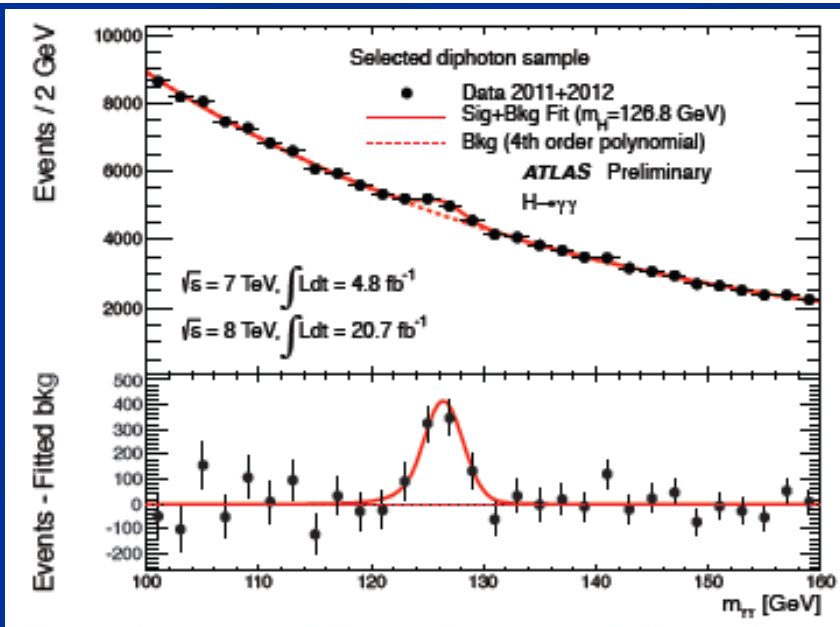
ILC $\mu^+\mu^-$ **recoil mass distribution**





LHC $H\rightarrow\gamma\gamma$ **mass distribution**





Higgs Boson

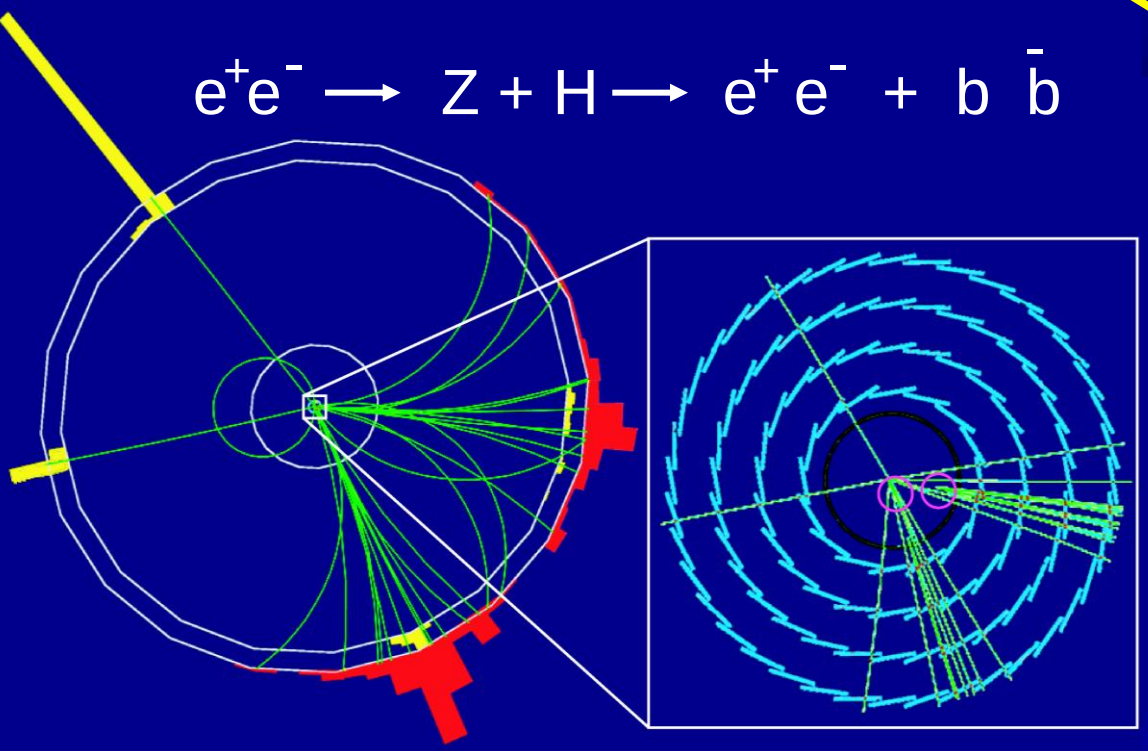
Precise measurement of Higgs Boson
⇒Deduce Principal Low in the Nature

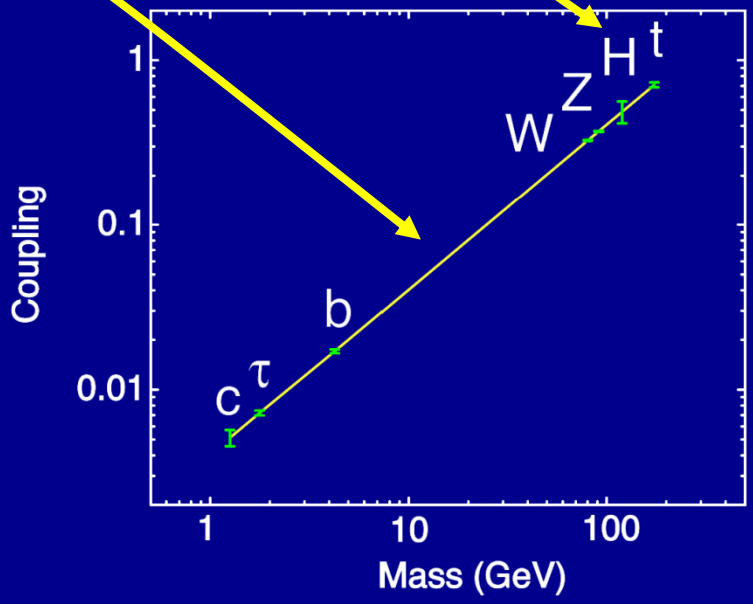
ILC in the first phase is the Higgs Boson Factory

O(10^5) such events will be collected and studied.

Origin of mass ⟷ Structure of the 'vacuum`

$e^+e^- \longrightarrow Z + H \longrightarrow e^+ e^- + b\ \bar{b}$





Importance of Precise Measurement of Higgs Properties
Decoupling Theories : Light Higgs Boson ~ SM Higgs Boson

Just for an example: Two Doublet Model (SUSY) ILC TDR

Coupling of h(=126GeV Higgs) and weak gauge bosons

V = W, Z

$$g(hVV)/g(hVV)_{SM} = \sin(\beta-\alpha)$$
$$\sim 1-2c^2 m_Z^4 \cot^2\beta/m_A^4 \quad (c=\text{radiative correction})$$
$$\sim 1-0.3\%(200\ \text{GeV}/m_A)^4$$

Coupling of h and SU2(2) I_w=1/2 quark

$$g(htt)/g(htt)_{SM} = g(hcc)/g(hcc)_{SM}$$
$$= \cos\alpha/\sin\beta = \sin(\beta-\alpha) + \cot\beta\cos(\beta-\alpha)$$
$$\sim 1-2c\cdot m_Z^2\cot^2\beta/m_A^2$$
$$\sim 1-1.7\%(200\ \text{GeV}/m_A)^2$$

Deviations from the Standard Model Higgs couplings are very small even for ILC precise measurements.

Coupling of h and quarks and leptons with $I_W = -1/2$

$g(hbb)/g(hbb)_{SM} = g(h\tau\tau)/g(h\tau\tau)_{SM}$
$= -\cos\alpha/\cos\beta = \sin(\beta-\alpha) - \tan\beta\cos(\beta-\alpha)$
$\sim 1+2c\cdot m_Z^2/m_A^2$
$\sim 1 + 40\%(200\ \mathrm{GeV}/m_A)^2$

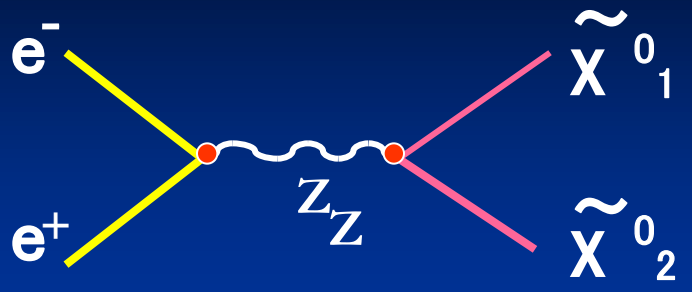
The deviations must be seen at ILC even for m_A ~1000GeV.

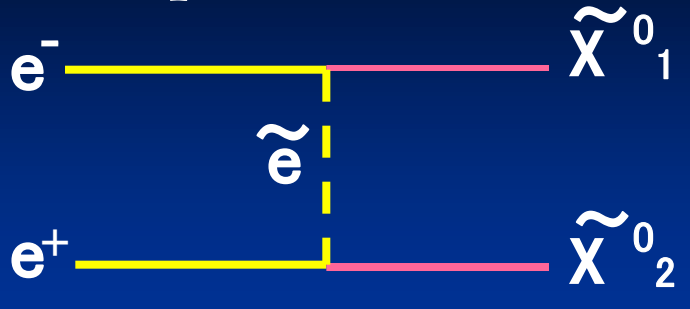
Very difficult for LHC

Note : $\Delta g/g = (1/2)\,\Delta g^2/g^2$

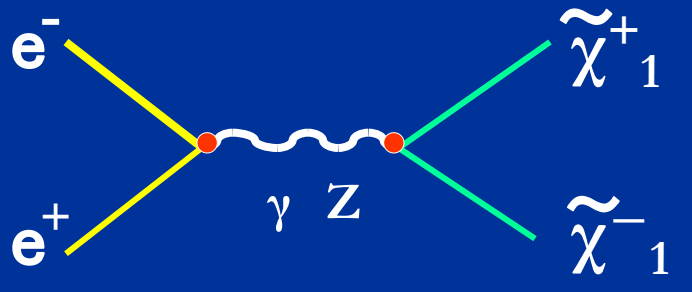
Possible Dark Matter Searches at ILC

The lightest and the next lightest SUSY particles

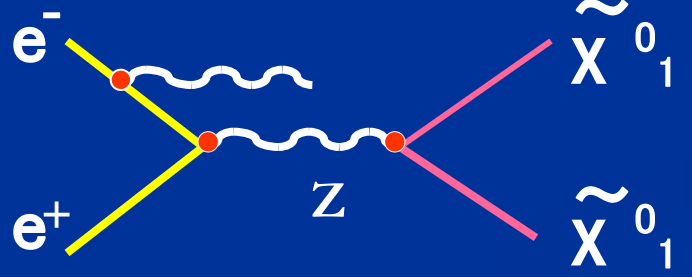


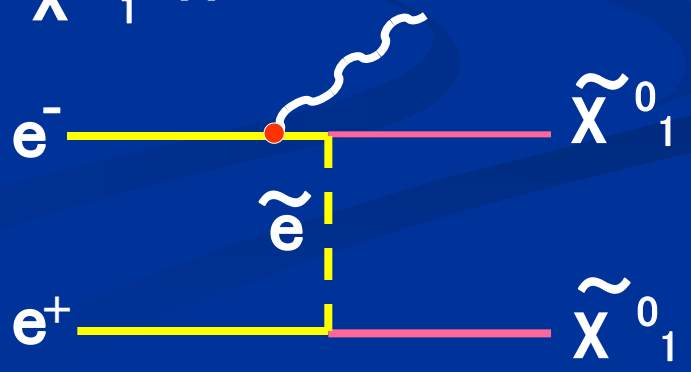


$\tilde{\chi}^0_1 \tilde{\chi}^0_2 \rightarrow \tilde{\chi}^0_1 \tilde{\chi}^0_1 Z$ or $\tilde{\chi}^0_1 \tilde{\chi}^0_1 h$



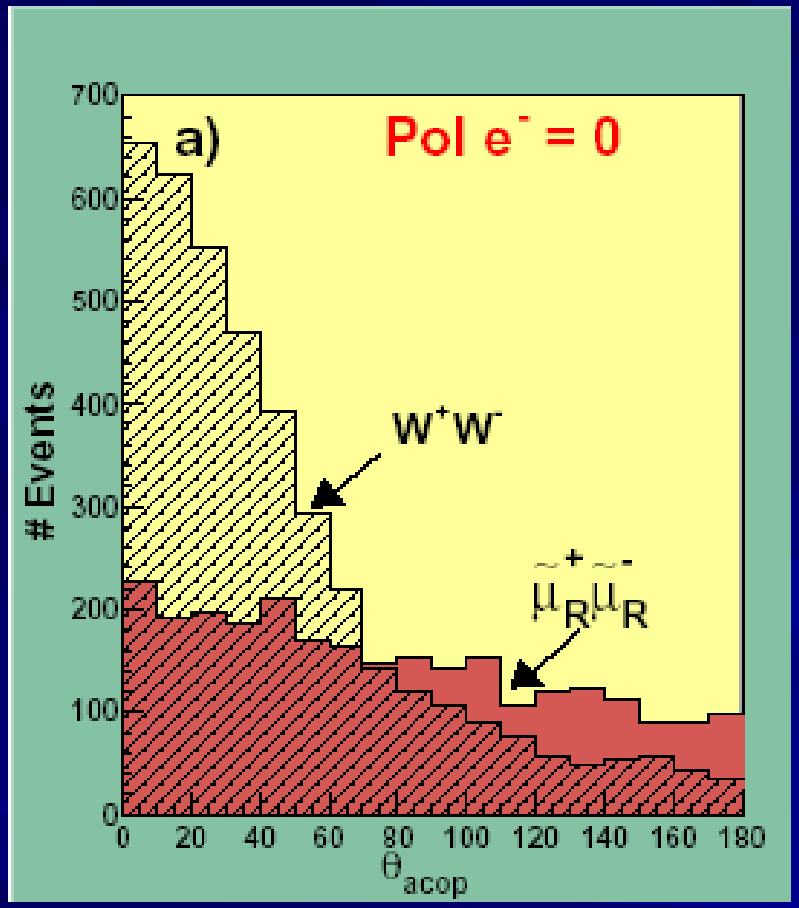
$\tilde{\chi}^+_1 \tilde{\chi}^-_1 \rightarrow \tilde{\chi}^0_1 W^+ \tilde{\chi}^0_1 W^-$



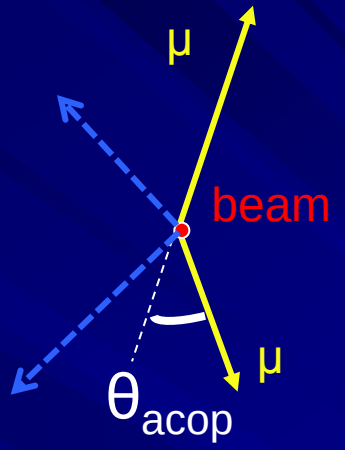


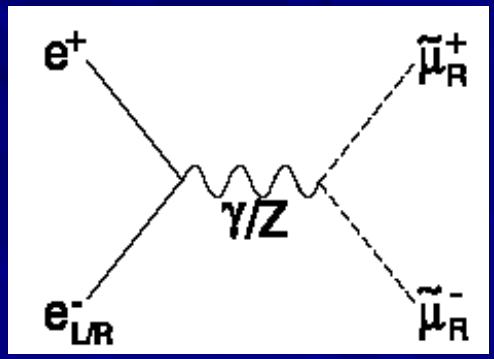
Power of electron polarization at ILC

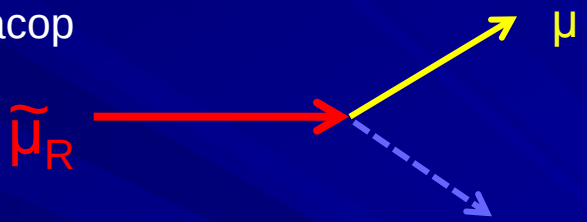
Scalar muon production

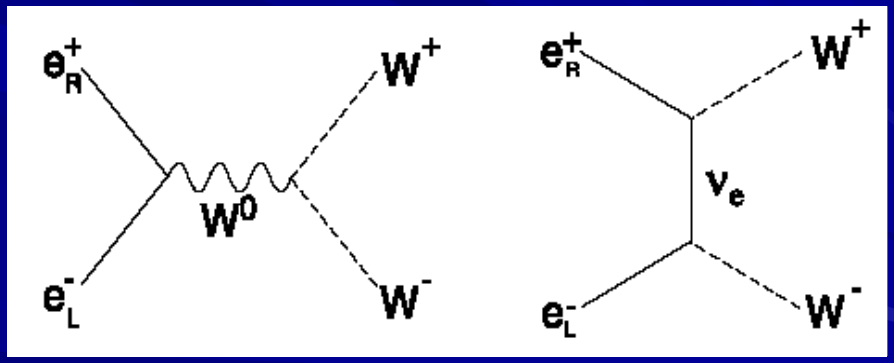


Unpolarized





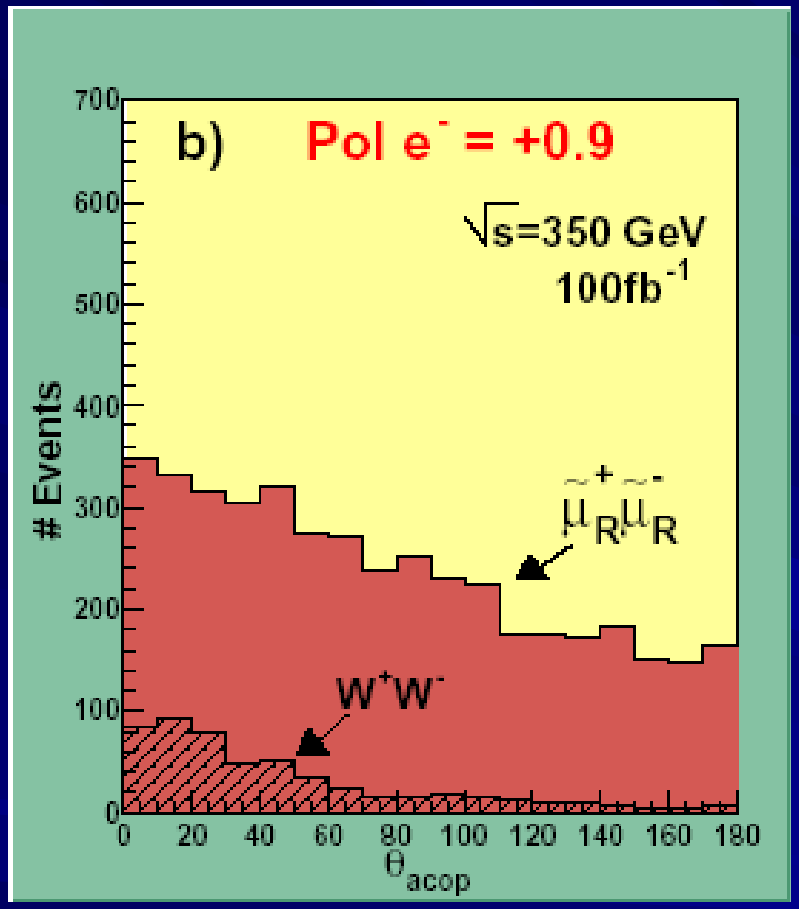


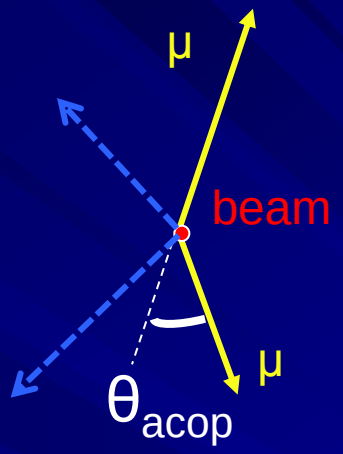


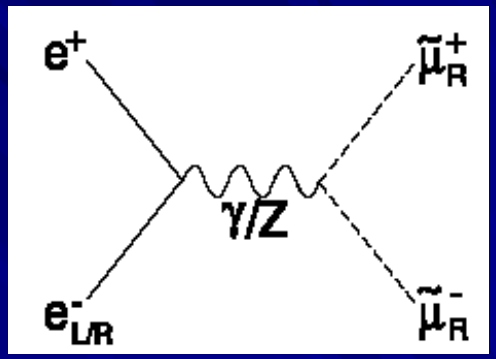
Background signal

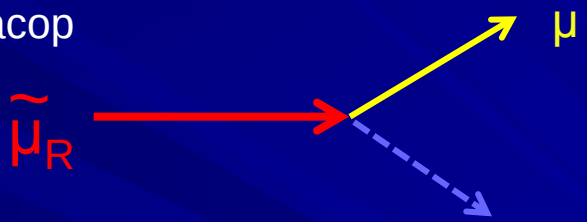
Power of electron polarization at ILC

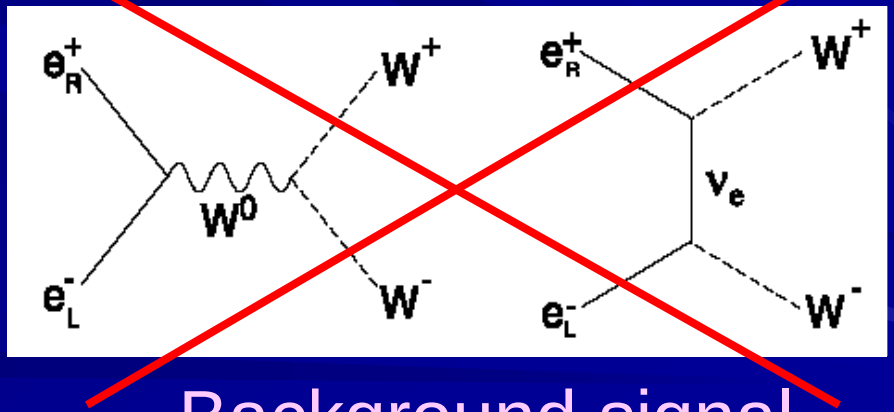
Scalar muon production











Polarized (90% e^-_R)

Background signal

Very Brief History of the Linear Collider Project

1980s LC Accel. R&D was started at DESY, KEK, SLAC

1991 First Linear Collider Workshop (Finland)

1990s Five major accelerator technologies were under hard competition:
TESLA, S-band, C-band, X-band, CLIC

1998 Physics and detector issues are rather accelerator design independent
World-wide-studies of physics and detector for LCs was formed (grass-roots-organization)

2000 Under OECD Global Science Forum, Consultative Group of High Energy Physics started (2000-2002)

2002 ICFA created **ILC Steering Committee (ILCSC)**

2004 International Technology Recommendation Panel **(ITRP) chose super-conducting RF for the main linac technology**

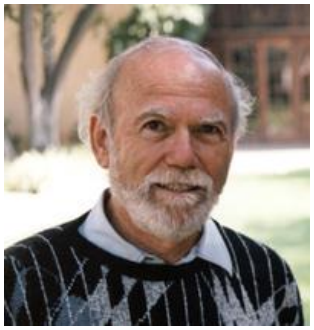
International Technology Recommendation Panel Meeting
August 11 ~ 13, 2004. Republic of Korea

2004 KEK DG Yoji Totsuka held first workshop at KEK on LC with Superconducting RF technology

2005 Global Design Effort (GDE) was established

Snowmass Meeting

GDE Director
Barry Barish



2007 Reference Design Report（basic design with cost)

Project Managers

Marc Ross

Nick Walker

Akira Yamamoto

Regional Directors

Michael Harrison

Brian Foster

Kaoru Yokoya

2009 LOI for detector concepts (ILD,SiD)

Research Director Sakue yamada

Recent Activities

2012 March Recommendation of subcommittee for future projects of Japanese HEP (chair: Toshinori Mori)

April ILC strategy council (chair: Satoru Yamashita)
Site selection committee was moved under this council (cochairs: K. Kawagoe, H.Yamamoto)

July **Higgs Boson was discovered at LHC**

Oct. A Proposal for a Phased Execution of the International Linear Collider Project was worked out (The Japan Association of High Energy Physicists)

Dec. **Technical Design Report（TDR)**

2013 Feb. ICFA creates Linear Collider Board（LCB） and Linear Collider Collaboration (LCC) (Director: Lyn Evans)

Consensus building in Japanese particle physics society

The Subcommittee on Future Projects of Japanese High Energy Physics

Chair: Toshinori Mori (ICEPP, The University of Tokyo)

- Subcommittee members are all younger than 50 years old at the start of the subcommittee.
- Handed the report to HEPC on February 11, 2012
- Endorsed by Japanese Association of High-Energy Physicists (JAHEP) in March 2012

Recommendation of subcommittee for future projects of Japanese HEP

The committee makes the following recommendations concerning large-scale projects, which comprise the core of future high energy physics research in Japan.

- **Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an e^+e^- linear collider.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

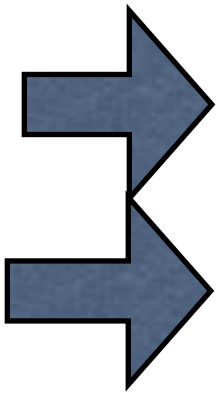
- **Should the neutrino mixing angle θ_{13} be confirmed as large, Japan should aim to realize a large-scale neutrino detector through international cooperation, accompanied by the necessary reinforcement of accelerator intensity, so allowing studies on CP symmetry through neutrino oscillations.** This new large-scale neutrino detector should have sufficient sensitivity to allow the search for proton decays, which would be direct evidence of Grand Unified Theories.

It is expected that the Committee on Future Projects, which includes the High Energy Physics Committee members as its core, should be able to swiftly and flexibly update the strategies for these key, large-scale projects according to newly obtained knowledge from LHC and other sources.

It is important to complete and start the SuperKEKB including the detector, as scheduled. Some of the medium/small scale projects currently under consideration have the implicit potential to develop into important research fields in the future, such as neutrino physics and as such, should be promoted in parallel to pursue new physics in various directions. Flavour physics experiments such as muon experiments at J-PARC, searches for dark matter and neutrinoless double beta decays or observations of CMB B-mode polarization and dark energy are considered as projects that have such potential.

Recommendation

Should a new particle such as a Higgs boson with a mass below approximately 1 TeV be confirmed at LHC, Japan should take the leadership role in an early realization of an ***e^+e^- linear collider****. In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both* ***LHC*** *and the* ***upgraded LHC*** *version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.*



indeed, light Higgs discovered (Jul ’12)

Japanese high-energy community proposed early ILC starting@250GeV (Oct ’12)

A Proposal for a Phased Execution of the International Linear Collider Project

The Japan Association of High Energy Physicists (JAHEP) endorsed the document on 18 October 2012

ILC shall be constructed in Japan as a global project based on agreement and participation by the international community.

Physics : Precision study of the Higgs Boson, top quark, "dark matter" particle, and Higgs self-coupling,

Scenario : Start with a Higgs Boson Factory ~250 GeV. Upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.
Technical extendability to a 1 TeV region shall be secured.

Japan covers 50% of the expenses (construction) of the overall project of a 500 GeV machine. The actual contributions, however, should be left to negotiations among the governments.

Supports from the World

European Strategy approved by CERN Council, EC

Chair: Tatsuya Nakada (Swiss Federal Institute of Technology Lausanne)

e) There is a strong scientific case for an electron-positron collider, complementary to the LHC, that can study the properties of the Higgs boson and other particles with unprecedented precision and whose energy can be upgraded. The Technical Design Report of the International Linear Collider (ILC) has been completed, with large European participation. The initiative from the Japanese particle physics community to host the ILC in Japan is most welcome, and European groups are eager to participate. *Europe looks forward to a proposal from Japan to discuss a possible participation.*

Asia ACFA-HEP

Chair: Mitsuaki Nozaki (KEK) 3rd ACFA-HEP Meeting on 17.07.2013 in Chiba

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.

USA HEPAP Facilities Subpanel :
Report on High Energy Frontier Facilities Chair: Sally Dawson

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

Report from P5 (Particle Physics Program Prioritization Panel) in Spring 2014

Statement on a Linear Collider Project in Japan as input to the European Strategy Process

The German Committee for Particle Physics (KET)

25.11.2012

In view of the recent discovery of a new Higgs–like particle at the Large Hadron Collider (LHC) at CERN and the recent proposal by the Japanese scientific community [1]) to host the International Linear Collider (ILC), the German particle physics community has discussed again the priorities for experiments at the high energy frontier. The results are summarised here as an addendum to the priorities described in a previous document submitted to the Strategy group [2,3]) which remain unchanged.

1. The successful running of the LHC and its experiments continues to be the recommendation with highest priority. This includes in particular the high luminosity upgrades of the LHC and the Phase-2 upgrades of the experiments, which currently constitute the only way to directly explore the multi-TeV energy regime.

2. The proposal of the Japanese community to host the ILC as an international project finds enthusiastic support in the German community. In view of the unique capabilities of such a facility for precision measurements of the newly discovered particle, the foreseen expandability to higher energies and the technical readiness of the project as documented in the Global Design Effort [4]) we strongly recommend to contribute actively to the realisation of this project.

Federation of Diet members to promote a construction of international laboratory for LC

31st July 2008 established a suprapartisan ILC supporters

(July 2008～)

President	Kaoru Yosano
Deputy	Yukio Hatoyama
Secretary-General	Takeo Kawamura
、	Yoshihiko Noda
Director	Norihisa Tamura
	Masamitsu Naito

proposers

Akihito Ohhata、Koji Omi、Ikuo Kamei, Takeo Kawamura, Tetsuo Saito, Yoshiaki Takagi, Norihiko Tamura, Masamitsu Naito, Yoshihiko Noda, Yukio Hatoyama、Fumuhiro Himori, Kosuke Hori, Eisuke Mori, Kaoru Yosano、Hidekatsu Yoshii

Renewed on 1st Feb 2013
lead by Takeo Kawamura

New Officers (October 2011～)

Supreme advisor	Kaoru Yosano
President	Yukio Hatoyama
Acting president	Takeo Kawamura
Secretary-general	Tatsuo Kawabata
Deputy	Tatsu Shionoya
Dupty President	Tetsuo Saito
President of bureau	Norihisa Tamura
Director of bureau	Keisuke Tsumura
Deputy	Takeshi Kai

Advanced Accelerator Association of Japan (AAA)

June 2008 established an industry-academy collaboration

Industry: 95 companies (Mitsubishi HI、Toshiba、Hitachi、Mitsubishi Electric、Kyoto Ceramic et al.) Academy: 38 institutes (KEK, Tokyo、Kyoto、Tohoku, Kyushu, RIKEN, JAEA et al.)

AAA homepage http://aaa-sentan.org

Supreme advisor	Kaoru Yosano
President Emeritus	Masatoshi Koshiba
President	Takashi Nishioka (Mitsubishi HI)
Trustee	Atsuto Suzuki (KEK)
〃	Akira Maru (Hitachi)、
〃	Yoshiaki Nakaya (Mitsubishi Electric)
〃	Yasuji Igarashi (Toshiba)、
〃	Akira Noda (Kyoto University)
〃	Keijiro Minami (Kyoto ceramic)
Auditor	Sachio Komamiya (University of Tokyo)

LCC Director Lyn Evans visited Prime Minister Abe and other VIPs

Apr 25-27, 2013, Tokyo

- Visited
  - Prime Minister Shinzo Abe
  - Minister of science and technology, Ichita Yamamoto:
  - Takeo Kawamura: chair of the federation of diet members for ILC, former MEXT minister

    With Koshiba, Murayama, Yamashita
  - Hakubun Shimomura: MEXT minister
  - HIroya Masuda: former minister of interior
  - Kiyohiko Ito: managing director JACE (Japanese Association of Corporative Executives: Industry)
  - etc. etc.

Very Recent Activities

2013 April ILC Taskforce started in MEXT Japan

2014 May ECFA LC DESY, Hamburg

2013 June ILC Event TDR Review is completed

(Tokyo ⇒Geneva ⇒Chicago)

2013 June ILC Review Committee was formed

in the Science Council of Japan

2013 July-August Snowmass Minneapolis

2013 August Kitakami site in Japan was selected by scientists (MEXT, Politicians agree with this procedure)

2013 Sept. UKLC Community Meeting Oxford

2013 Nov. 11-15 LCWS2013 The University of Tokyo

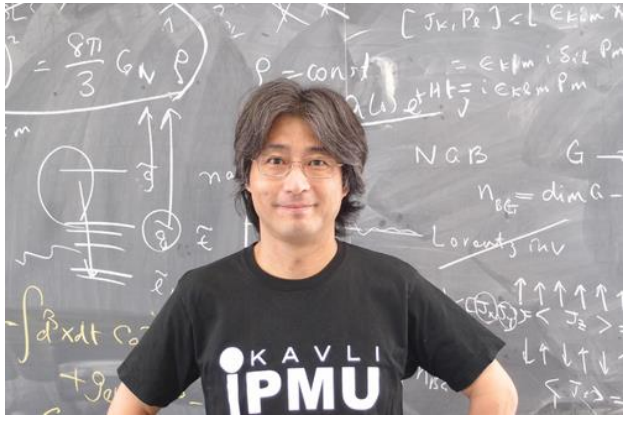
The new leaders
Linear Collider Directorate = LCD

Michael Harrison
ILC Accelerator

Hitoshi Yamamoto
Physics and Detector

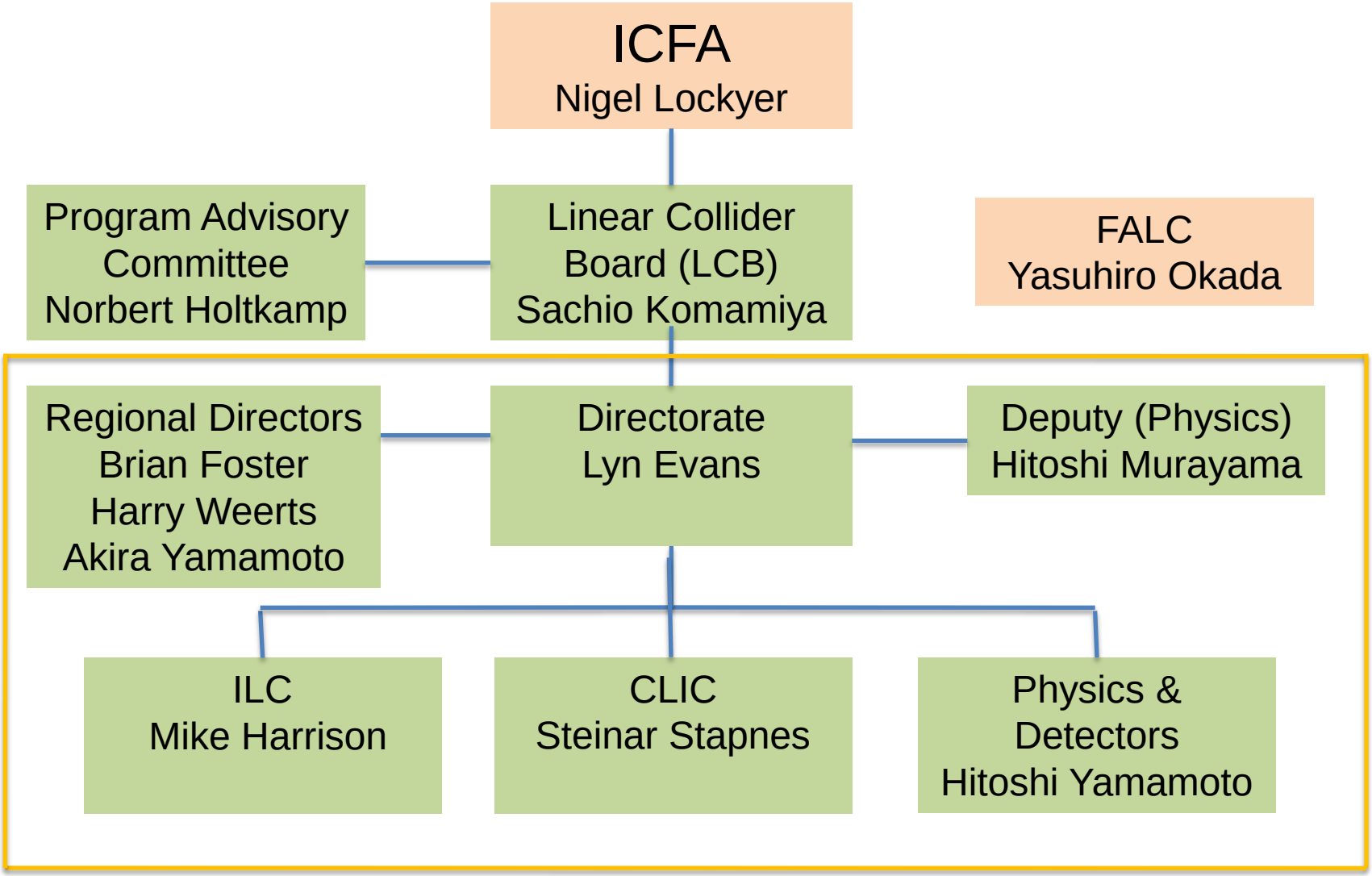
Steinar Stapnes
CLIC Accelerator

Lyn Evans
Director



Hitoshi Murayama
Deputy

Organization of Linear Collider Projects



Linear Collider Collaboration = LCC

The Next Step for the Global Team

- Move from the Technical Design Phase to the Engineering Design Phase towards the real construction

  both for accelerator and detectors ⇒ LCB set up PAC

- Reinforce Public relations: ILC is a truly global project
- Study further and establish the organization/governance of the new ILC laboratory

  refer to the "Project Implementation Plan" of TDR

  further developments are needed.

  Work with governments
- Site and host country establishment
- International negotiation of the cost share etc.

ILC site evaluation in Japan by scientists

ILC site evaluation committee (8 physicists)

Kiyotomo Kawagoe (Kyushu) co-chair
Masanori Miyahara (KEK)
Akira Sugiya (Saga)
Tohru Takahashi (Hiroshima)
Hoitoshi Yamamoto (Tohoku) co-chair
Shinya Narita (Iwate)
Atsuto Suzuki (KEK)
Satoru Yamashita (ICEPP,Tokyo)

Technical evaluation subcommittee	16+8 members (civil engineering experts)
Socio-environmental subcommittee	12+8 members (socio-environmental experts)
International review committee	12 members (all scientists)

The ILC site evaluation committee of Japan has assessed the two candidate sites based on technical and socio-environmental criteria and unanimously concluded as follows:

The Kitakami site is evaluated to be the best domestic candidate site for the ILC.

In addition, the committee strongly recommends the central campus of the Kitakami site to have a good environment for living and research and to be located near the Shinkansen line for convenient access to Sendai and Tokyo.

Kitakami mountains (stable granite hilly district) The selected site in Japan

Special Committee for Studying the ILC Project in the Science Council of Japan (SCJ)

10 committee members

Social Engineering, Philosophy, Biology, Radiological Science, Particle Physics, Solid State Physics, Quantum Technology, Geophysics, Nuclear Physics, Chemistry

27 May	2013	MEXT asked SCJ to study the ILC Project	
31 May	2013	The committee was set up	
14 June	2013	Sachio Komamiya	Physics and outline of the ILC Project
1 July	2013	Atsuto Suzuki	Status of the project and plan of the ILC lab
9 July	2013	Hideyuki Takatsu	International Cooperation in ITER Project
		Katsunobu Oide	Risk in ILC
30 July	2013	closed discussion	
6 August	2013	discussions on the “memo on arguing points”	
12 August	2013	Hitoshi Murayama	Science of ILC
29 August	2013	discussions on the response to the MEXT	

The response to MEXT 27th September
Official English translation of the report is soon be ready.

Special Committee for Studying the ILC Project in the Science Council of Japan (SCJ)

Many SCJ scientists tend to oppose new projects which have possibility to reduce their own budget, irrespective of scientific importance of the projects. However, they recognize that they will loose their credibility and authority, if they behave as a group of self-defensive narrow-minded scientists. Approval of project is a governmental matter. SCJ will recommend 2-3 years of intensive evaluation by knowledgeable persons outside of the field and the governmental officials by supplying necessary budget, for international negotiations by participation of the government.

Scientists and governmental officials should not fall into "Nash Equilibrium" (This equilibrium is stable; If "players" try to slip out from the equilibrium, someone inevitably looses profit. Please find it in text books of micro-economics or game theory).
To avoid "Nash Equilibrium" all the players need to trust one another and to avoid betrayal.

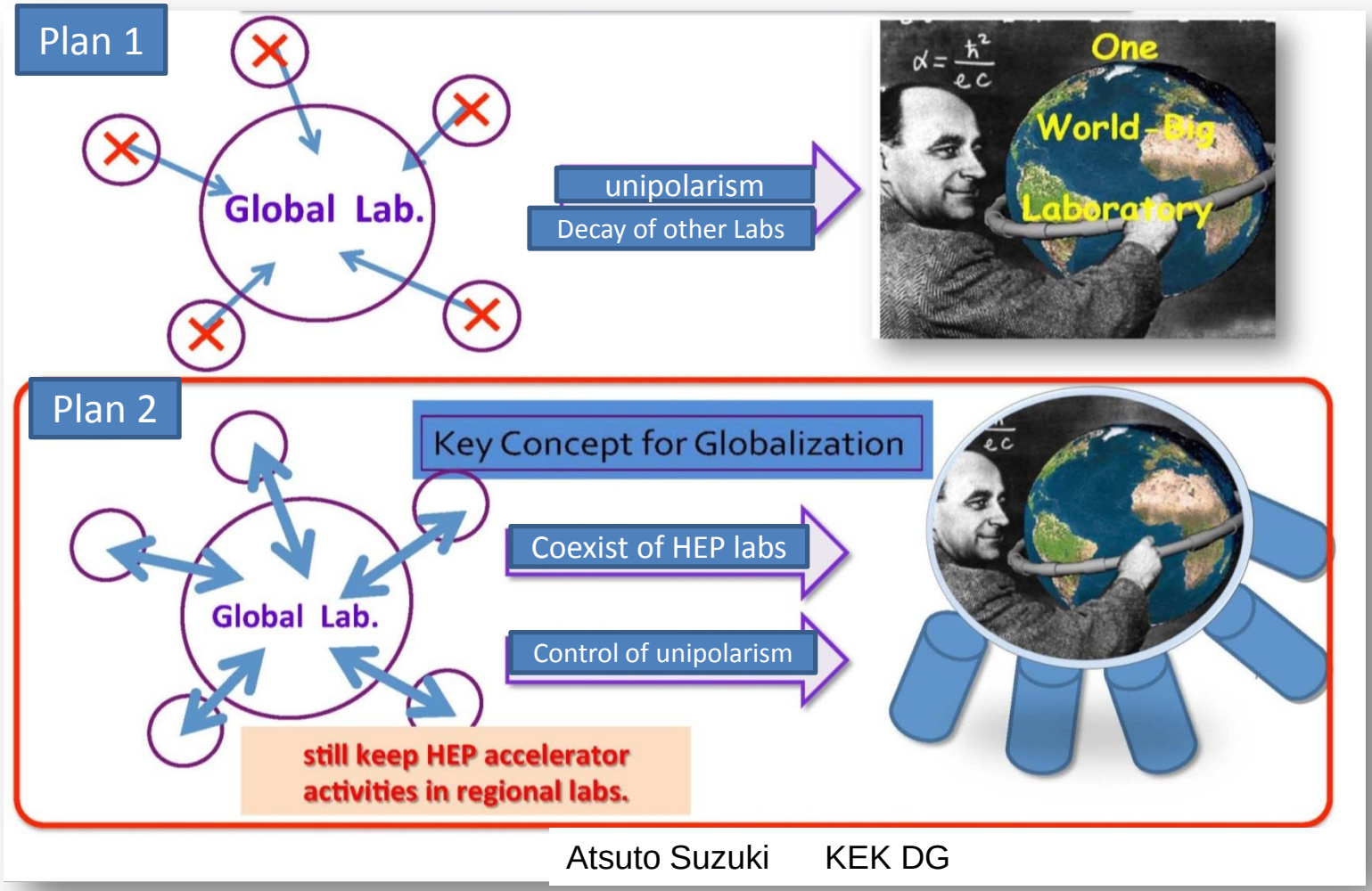
We know that the project of the size cannot be justified only by academic reasons. Scientists, government officials, politicians, industrialists should trust one another towards the success of the project.
The MEXT is very supportive for the ILC project. We will work out with MEXT the items that SCJ ask us towards the final approval.

Please watch out any positive sign from our government.

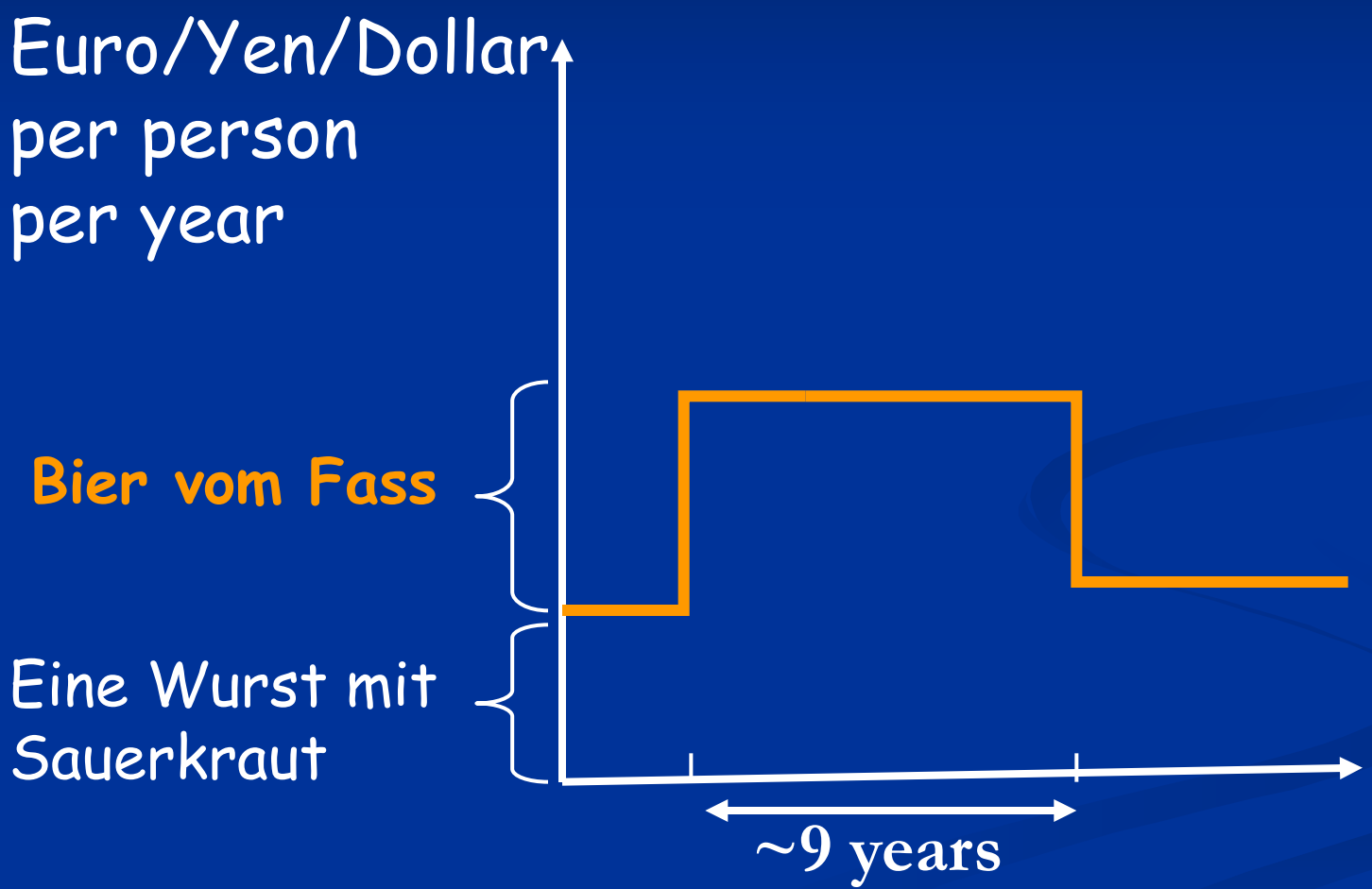
Linear Collider Board（LCB）

- **Detailed design of ILC Lab organization**
  legal framework, human resources, procurement
- **Preparation of roadmap for international approval of ILC**

Proposal of multinational Lab：
Contract Int. treaty of members of ILC project



ILC budget (German version) (for a host country/region)



Accelerator ~ 8B$ ~800Byen

TDR cost profile for the ILC Accelerator

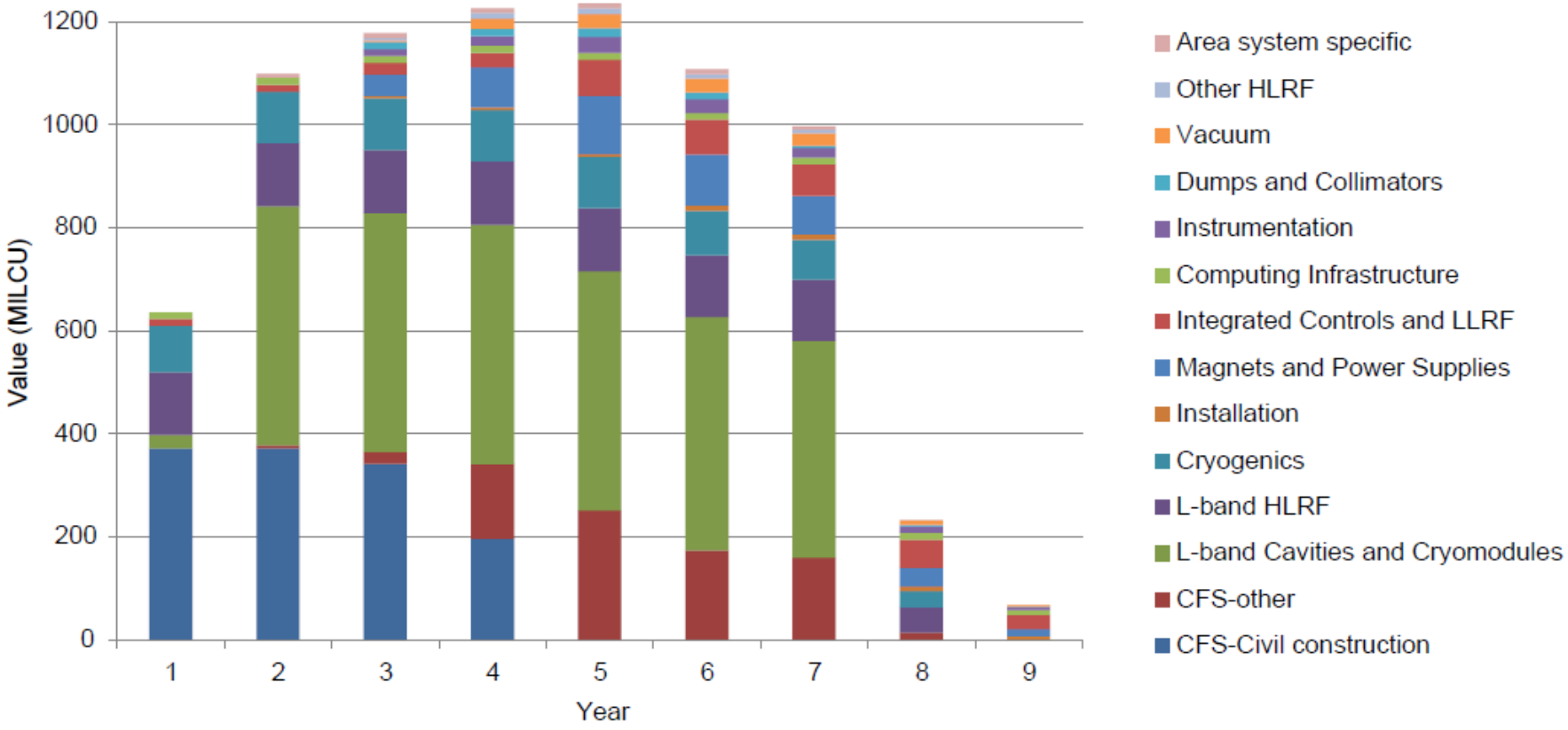


Figure 15.13. Value profile vs. project year. broken down by technical system.

Economy Industry

Technologies brought by HEP and Astrophysics

Accurate atomic clock was invented to experimentally prove Einstein's general relativity

⇒ brought GPS （car navigation system, map on Smartphone）

Scientists at CERN tried to exchange data or information via computers

CERN

⇒ Invention of World-Wide-Web (WWW)

⇒ Internet, Information-oriented society

Accelerator technologies for particle physics

⇒ Medical accelerators（cancer therapy, sterilization)

Superconductive technology（Superconductive magnets, magnetic levitation train = Linear motor car)

Possibility of Japan to be a host of ILC

Some facts to believe Japan to host ILC, if we work very hard for the next few years.

1) Discovery of a Higgs Boson at LHC
2) TDR of ILC project is completed and reviewed.
3) CERN is expected to work on LHC upgrade
   Support from international community
   Europe, Americas, Asians
4) Supports of Political and Industrial sectors
   - Federation of Diet Members, MEXT
   - Advanced Accelerator Association of Japan
5) Site selection in Japan (Kitakami mts)
6) Built consensus in HEP community of Japan
   - Report from subcommittee of future HEP projects of Japan (March 2012)
   - Phased Execution of ILC（October 2012）

LCWS13

Tokyo

11-15 November 2013

Mr. Kawamura's Talk in LCWS13

President of the Federation of Diet members to promote a construction of international laboratory for LC

- Text (in English)
  - Can be downloaded from the indico page on 11th November 2013
    http://icepp.s.u-tokyo.ac.jp/LCWS13/
- Highlights
  - We are aware that people are usually worried that an increase of academic budget in one field may mean a decrease in other fields. … We shall arrange a dedicated budget to accommodate its much wider implications. It is the responsibility of the government to carry this out.
  - The Department of Education has requested the Department of Finance to provide an ILC investigation fund of 50 million yen in next year's budget. … once it has been approved, we members of the house will have achieved one of the most important milestones of recent years.

ILC Timeline
Proposed by LCC

- 2013 - 2016
  - Negotiations among governments
  - Accelerator detailed design, R&Ds for cost-effective production, site study, CFS designs etc.
  - Prepare for the international lab.
- 2016 – 2018
  - 'Green-sign' for the ILC construction to be given (in early 2016)
  - International agreement reached to go ahead with the ILC
  - Formation of the ILC lab.
  - Preparation for biddings etc.
- 2018
  - Construction start (9 yrs)
- 2027
  - Construction (500 GeV) complete, (and commissioning start)

    (250 GeV is slightly shorter)

The ILC project desperately desires support of the German particle physics society (bottom up) and the German Government (top down). **Germany is the key to lead the ILC project.**

Minister of Education and Research
State Secretary
Ministerial Director
  above this level probably change with the formation of the new government
Ministerial-Raeten (*)
Ministerial-Rat (*)

Helmholtz Association
  Head Helmholtz Association *
  Head of Research section
  Representative, Research field Structure and Matter *
DESY Directorate
  The Chair
  Director Accelerator ***
  Director Particle and Astro-particle Physics ***

We need to work together to convince many level of organizations to realize the ILC .
ILC is NOT a Japanese project. It is a truly international project.
LCB really thanks from the bottom of the heart to the continuous and enthusiastic support from the German particle physics society.

Quest for Birth-Evolution of Universe

International Linear Collider (ILC)

Quest for Unifying Matter and Force

KEK DG keeps showing this ugly slide since 2008

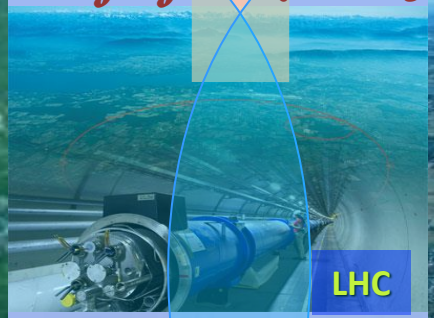
Lepton CP Asymmetry

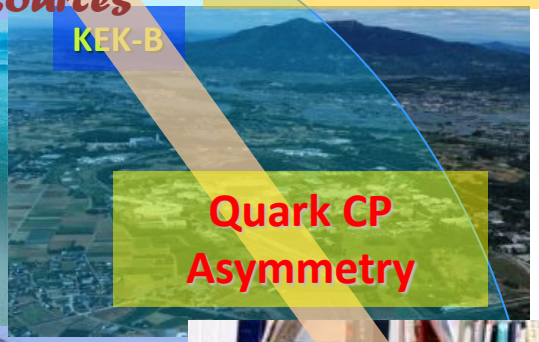
Scientific Activities
Technology Innovation
Encouraging Human Resources

Beyond Standard Physics

Power-Upgrade

Super-KEKB



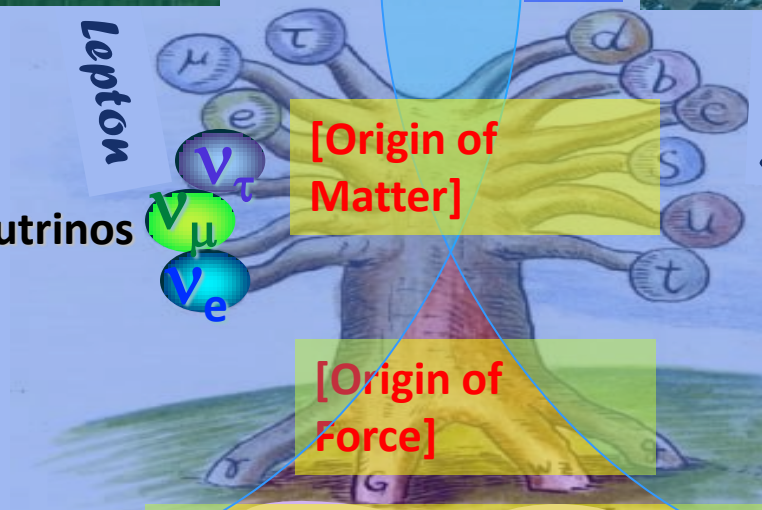


Quark CP Asymmetry

Quest for 6 Quarks

Lepton

Quark

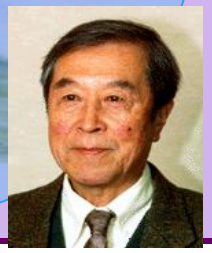


Quest for Neutrinos

[Origin of Matter]

[Origin of Force]

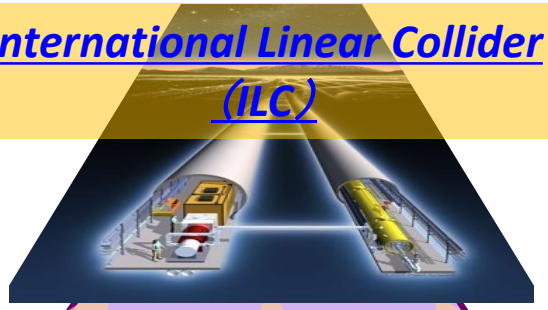
Higgs Particle [Origin of Mass]



Quest for Birth-Evolution of Universe

International Linear Collider (ILC)

Quest for Unifying Matter and Force



Lepton CP Asymmetry

Scientific Activities
Technology Innovation
Encouraging Human Resources

Beyond Standard Physics

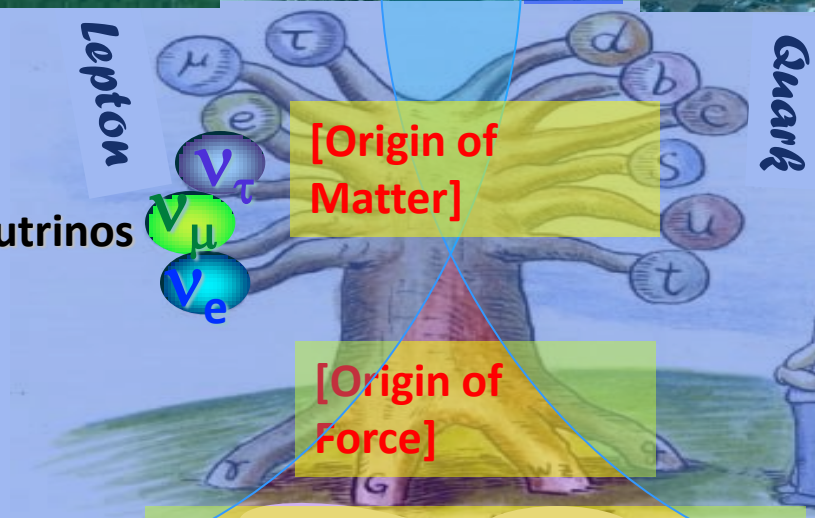
Power-Upgrade

Super-KEKB

All roads lead to ILC

Lepton

Quark

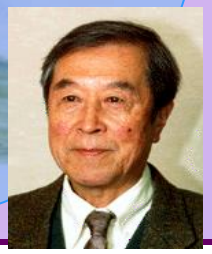


Quest for Neutrinos

[Origin of Matter]

Quest for 6 Quarks

[Origin of Force]

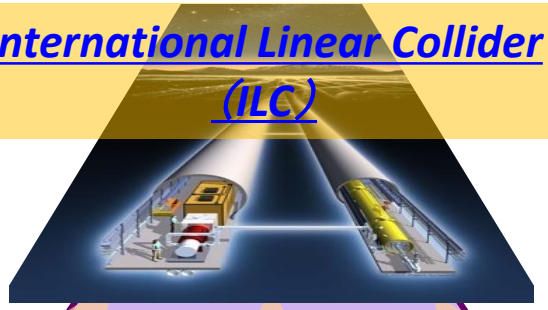


Higgs Particle [Origin of Mass]

Quest for Birth-Evolution of Universe

International Linear Collider (ILC)

Quest for Unifying Matter and Force



Lepton CP Asymmetry

Power-Upgrade

Scientific Activities
Technology Innovation
Encouraging Human Resources

Beyond Standard Physics

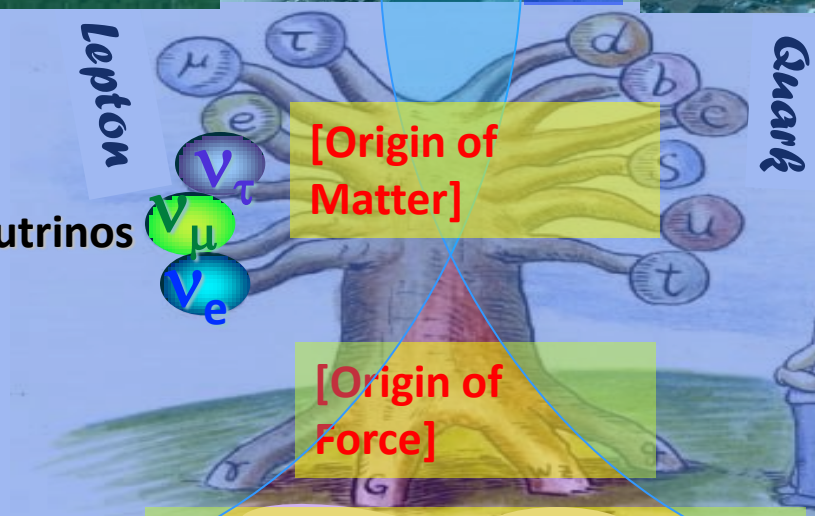
Super-KEKB

We lead all roads to ILC

LHC

Lepton

Quark

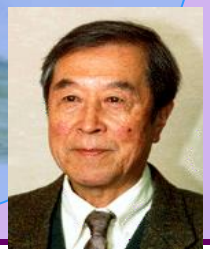


Quest for Neutrinos

[Origin of Matter]

Quest for 6 Quarks

[Origin of Force]



Higgs Particle [Origin of Mass]

Future of the Energy Frontier Physics: My vision

High Energy Physics (Elementary Particle Physics) was developed along with the advance of accelerator technology. At least in the first half of this century we need very high energy accelerators.

The development of accelerator technology was lead by high energy physics. Scientists in the other fields are rather “users” of the machines, and did not directly contribute to the accelerator technology development. It is obvious that our field needs more experts of accelerator technologies to build “F1-machines”.

In July last year the Higgs Boson was discovered at LHC. This discovery was an outstanding achievement since the November Revolution of 1974 (Discovery of the charm quark). Detailed study of the Higgs Boson lead to a breakthrough towards the new paradigm beyond the Standard Model.

We hope that LHC will directly discover new particles beyond the Standard Model. On the other hand, energy extendability of LC is ensured by the ability to extend the linac. For example, we can perform precise measurement of Dark Matter particle when we set the energy above the threshold.

Also unexpected discoveries may happen in the energy frontier. C. D. Anderson discovered muon, when he searched for the Yukawa's pions. M. Koshiba discovered neutrinos from the supernova 1987A, when he searched for nucleon decay predicted by GUTs. Columbus discovered the American Continent, when he tried to reach India due to the Toscanelli's prediction.

Even if we (experimentalists) cannot believe theorists' predictions or cannot digest their theories, we should pretend to trust theorists and search for the new particles or new phenomena that they predict. Then "serendipity" might work.

If ILC were not planned, the energy frontier machine would be LHC alone in the next 20-30 years. If the society did not have a positive vision on science, we could forget about the future.

However, triggered by the discovery of the Higgs Boson, now we have the fact that the particle physics has a bright future towards the paradigm beyond the Standard Model.

We need to enhance awareness for community's future for 20-30 years. Linear Colliders (ILC and CLIC) are essential tools for our society.

We will share the common vision.

We know that the project of this size cannot be justified only by scientific importance.
We need to convince governments and people the social benefit of the ILC project.
We advertise the project in Japan for its large economic effects and various social contributions:

(1) Immediate economic effects for industries

Civil construction, Accelerator and Electric engineering, …

(2) Spin-off of the accelerator/detector technologies

ILC is a 'F1-machine' ⇒ many types of technology transfers
Superconductivity, Precise machining, Large scale computing, …

(3) Incentive for young generations to become scientists or engineers

Science literacy will be gained
Since we have little natural resources in Japan, our future depends on science and technology.

(4) Internationalize the host country

No other large scale international organization in Japan
To be a host of large international project is a peaceful and truly international contribution.
Some politicians are keen of "dignity of the country".

The most important thing in proceeding the project is to share a common vision.
In order to boost the project we share a common feeling “that should do”.

Realistic, robust and simple design has to be persued for the accelerators.

TDR shows technical feasibility of the ILC project including its cost.
EDR (Engineering Design Report) of ILC should show the detailed design based on the given site. Experts will examine if there are rooms for simpler design. Design of efficient and simple production /test lines for the components must be included.

How to tender and procure the superconducting cavities/modules, how to test and to pick out defectives, and to feedback to the producer ?
How to build efficient and simple positron sources ?
How to design realistic commissioning procedure of the beam delivery system ?

Since we have relatively sufficient time to design robust systems, except for the SCRF, realistic milestones have to be set with prioritization.

These are the subjects for the ILC division of LCC.
PAC will examine these milestones.

LCB meetings will be held only twice every year, preparation of the meeting is specially important.
In particular subcommittee(s) must be established for pursuit the following two items for ILC.

I Make a roadmap towards the international agreement (treaty)

II Discuss and decide the organizational form of the ILC Lab
（Governance, Project Management etc.）

Two documents are ready for the item II:

a. PIP (Project Implementation Planning) is the basis for working into a final Organizational form.

b. Select items in CPDG (Comprehensive Project Design Guidance) which are not included in PIP.

Important matters for the final form of the LC Lab

(a) Legal framework

The framework will evolve from that based on MoU to that on International Treaty.

（Experience of XFEL: It was not easy to reach an agreement even for a limited-liability company.)

(b) Procurement

Although based on In-kind, significantly large Common Fund is needed

(ITER: almost all in-kind, LHC: 80% by the Host)

(c) Staff composition

Basically seconded staffs from many labs.

It is essential to have full time core members in the Central Team employed by the Common Fund.

(d) Organization

Director General, Directorate,

Council, User's Committee

(e) Role of host

Short term agility and long time stability are needed for the organization

(2) Building Models for the International sharing of expenses and responsibilities

The experts in LCC have to design various models of package proposal.

Civil Engineering （basically host）
SCRF （basically international division）
Other components

We should not duplicate the same mistake that the ITER project have made.
A simple In-kind contribution based on a value engineering is inefficient, because decision making takes time due to feedback process to each funding agencies.
Experts need to adjust package design considering the record of performance of industries and that based on equality of opportunity.

MEXT will start official contact with other regions and countries with help of LCC and Japanese scientists from KEK and universities. The Ministry of Foreign Affairs has to be involved in the international negotiations.

We eager to see a “green light” from the Japanese government, but they want to see the signs of contributions from oversea. We need continual communication in order not to fall into a “Nash equilibrium”.

（3） Staffing of the ILC Lab

Close inspection of number of staffs (accelerator physicists and engineers) necessary for the project based on TDR

Number of necessary staffs/postdocs in each section

Host
Set up strategy to increase the number of staffs.

Temporary transfer of staffs from laboratories all over the world
Inspect current and expected number of staffs in laboratories or universities in each region/country