LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

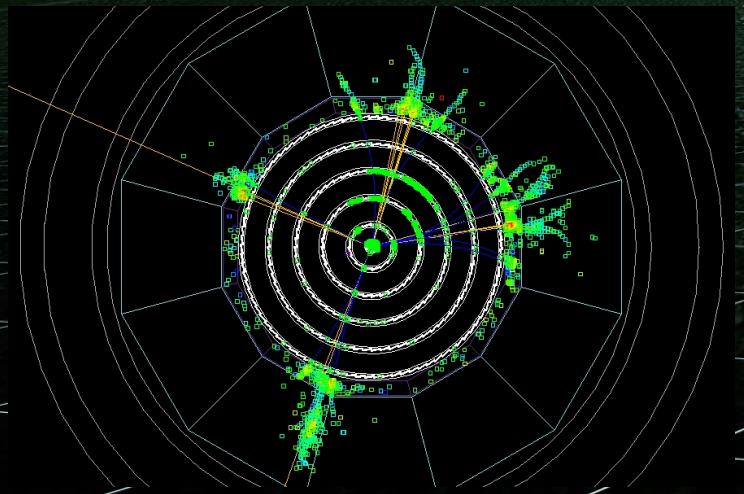
The latest status of ILC in Japan

Masao KURIKI (Hiroshima University/KEK)

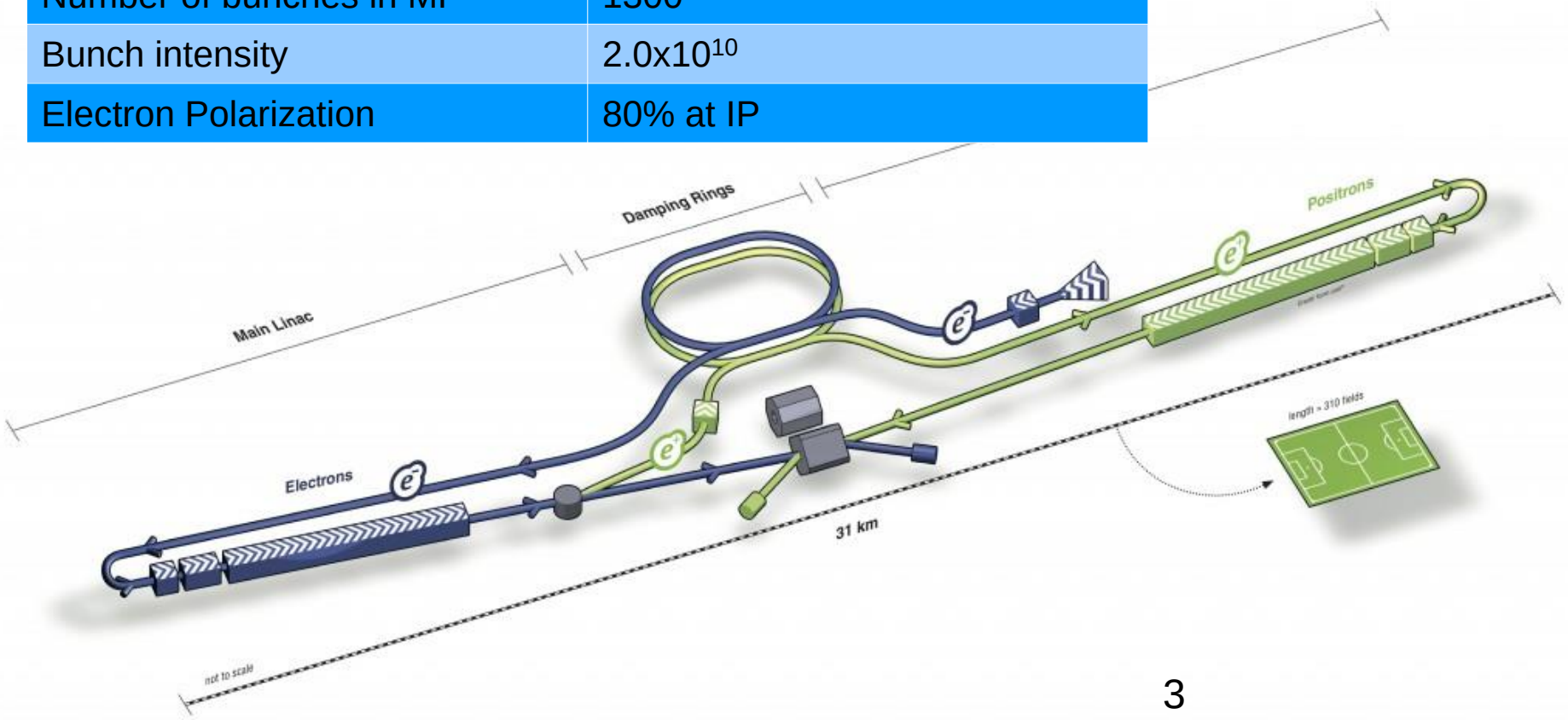
9 Sept. 2014

Internationa Linear Collider

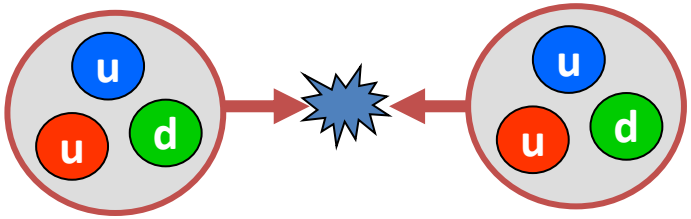
CME - 250-1000 GeV

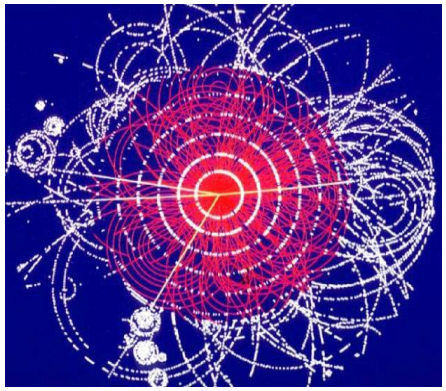


Parameter	Value
CME	250- 500GeV (1st) – 1TeV (2nd)
Total length	31km (1st), 50km (2nd)
Luminosity	2.0×10^{34} $s^{-1}.cm^{-2}$
Macro pulse length	0.8 ms
Number of bunches in MP	1300
Bunch intensity	2.0×10^{10}
Electron Polarization	80% at IP



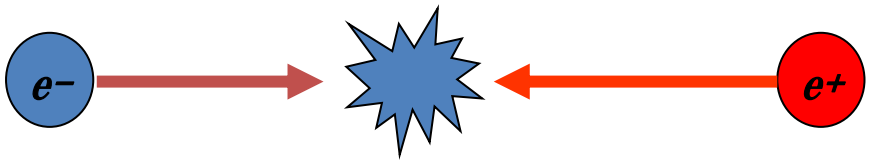
LHC /FCC

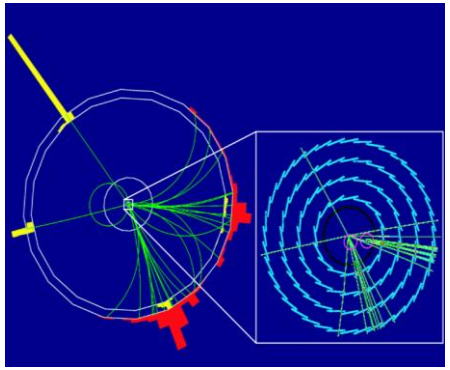




Collision by composite particle.
A large extendibility on energy and to new physics.

ILC / CLIC





Collision by elementary particle.
Precise measurements by full event reconstruction.

LHC/FCC + ILC/CLIC =
Disover new physics and establish a new principle.

Major Physics Processes in ILC

Energy	Reaction	Physics Goal
91 GeV	$e^+e^- \to Z$	ultra-precision EW
160 GeV	$e^+e^- \to WW$	ultra-precision Wmass
250 GeV	$e^+e^- \to Zh$	precision Higgs coupling
350 -450 GeV	$e^+e^- \to tt$ $e^+e^- \to WW$ $e^+e^- \to \nu\nu h$	top quark mass and coupling precision W coupling precision Higgs coupling
500 GeV	$e^+e^- \to ff$ $e^+e^- \to tth$ $e^+e^- \to Zhh$ $e^+e^- \to cc$ $e^+e^- \to AH,\ H^+H^-$	precision search for Z' Higgs coupling to top Higgs self coupling with 46% search for super-symmtery search for extended Higgs sector
1000GeV	$e^+e^- \to gXX$ $e^+e^- \to Zhh$ $e^+e^- \to ZXX$	Dark matter Higgs self coupling with 13% Any new particles (SUSY, ...)

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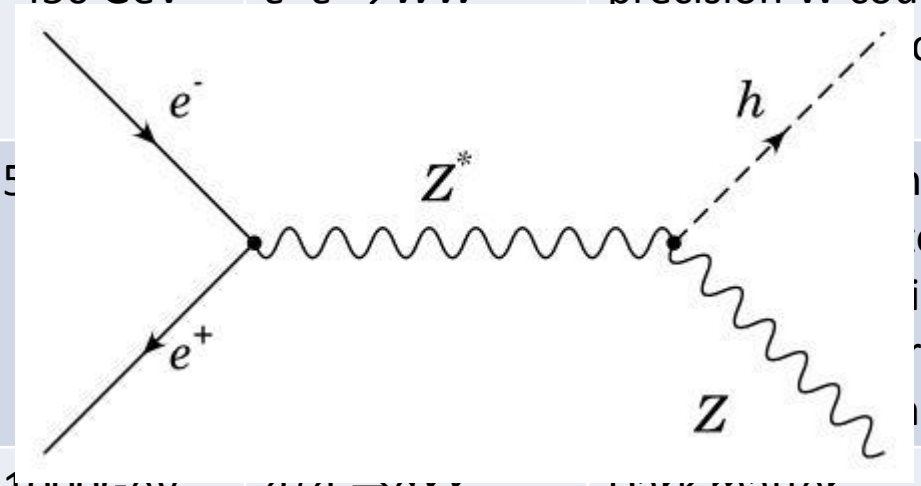

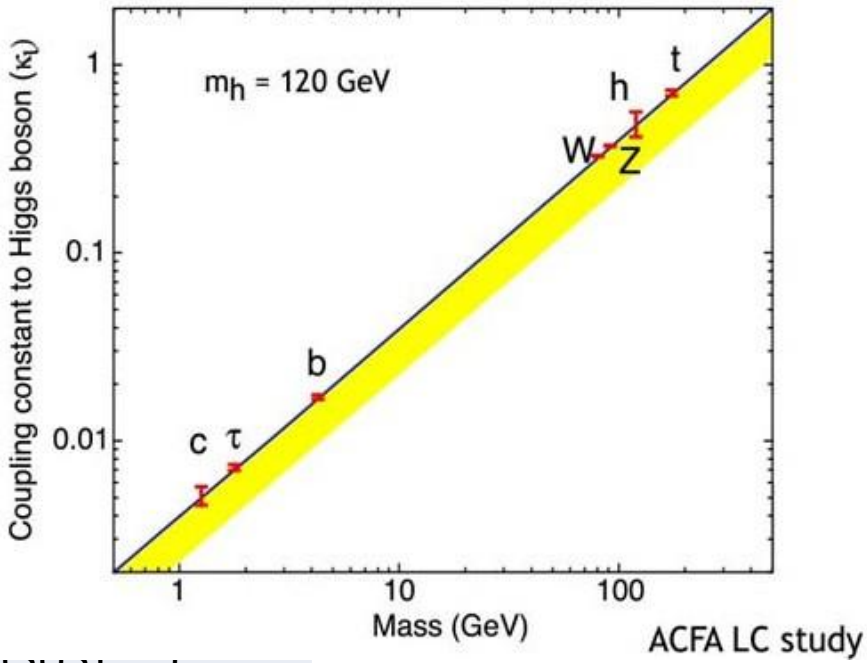

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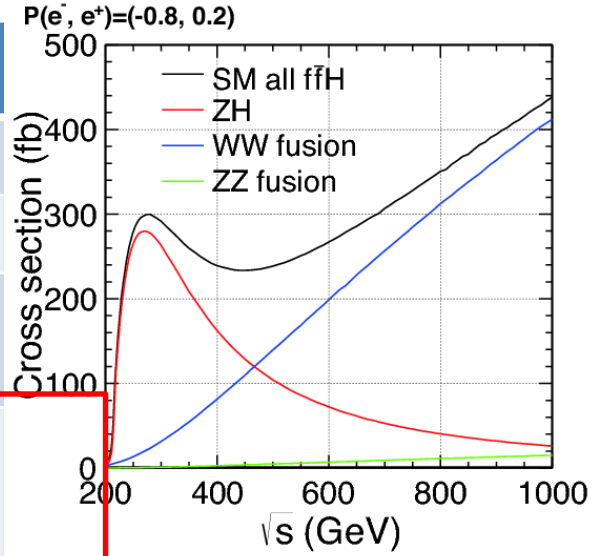

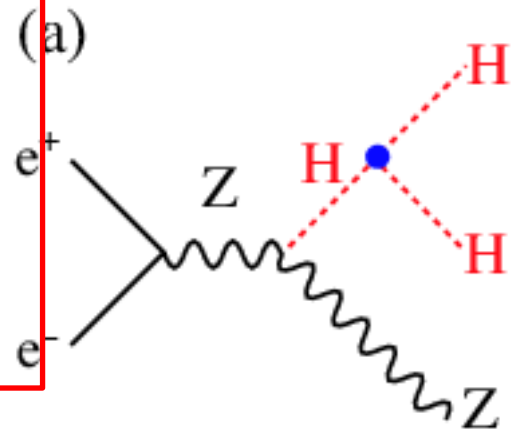

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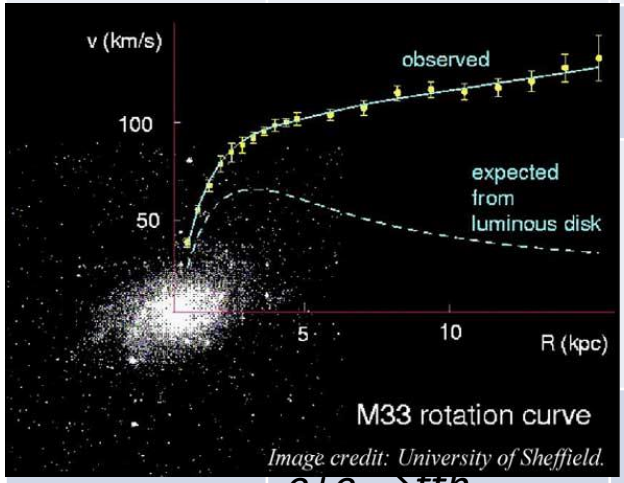

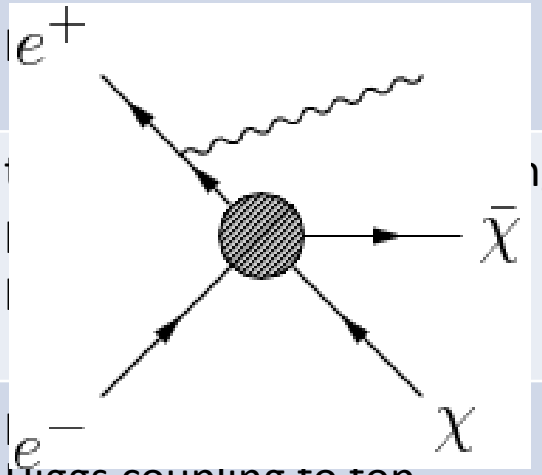

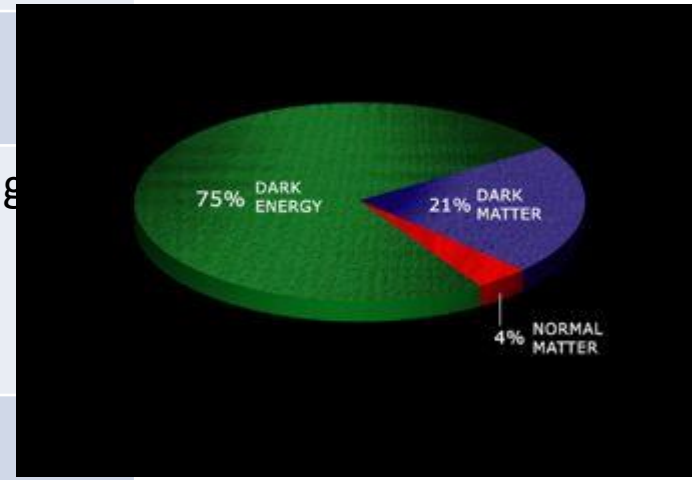

Major Physics Processes in ILC

		on EW
		on Wmass
		ggs coupling
-450 GeV	*e+e-→WW* *e → νvh*	top quark mass and coupling precision W coupling precision Higgs
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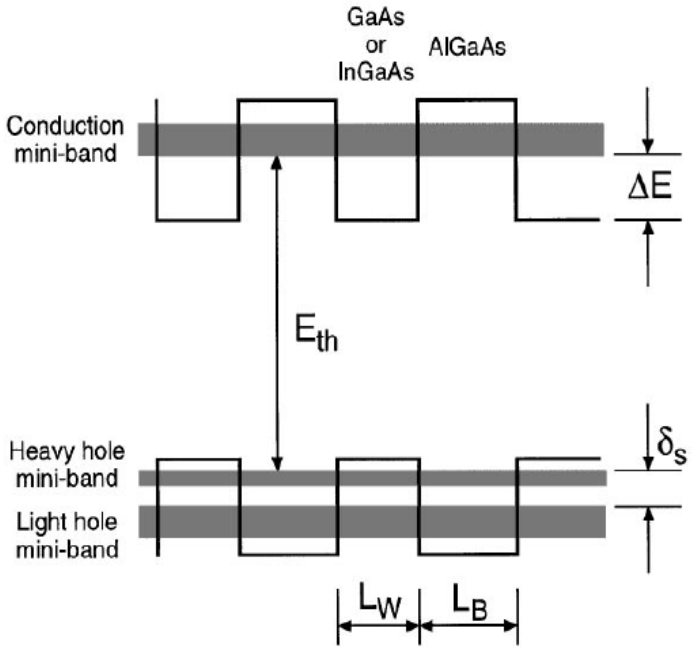
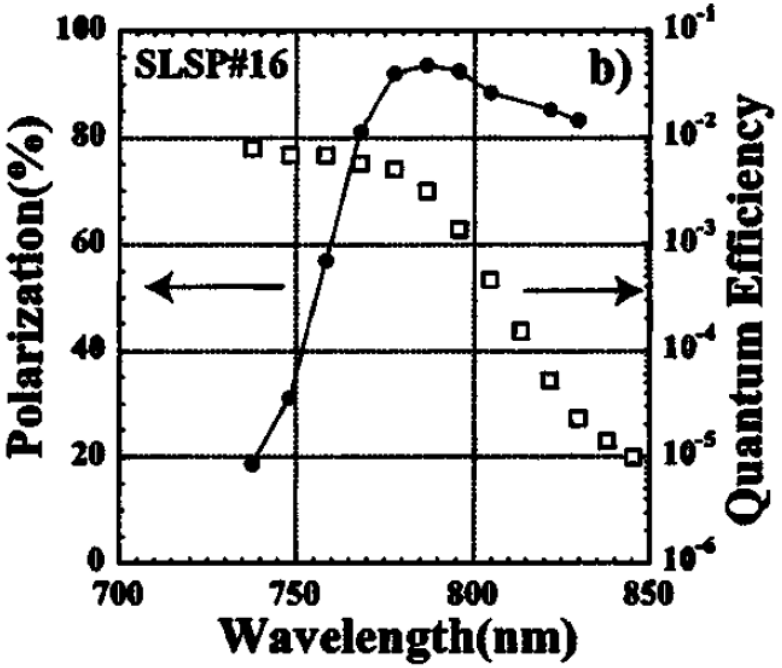
High precision
Event full-reconstruction

Discover New Physics
model independently!

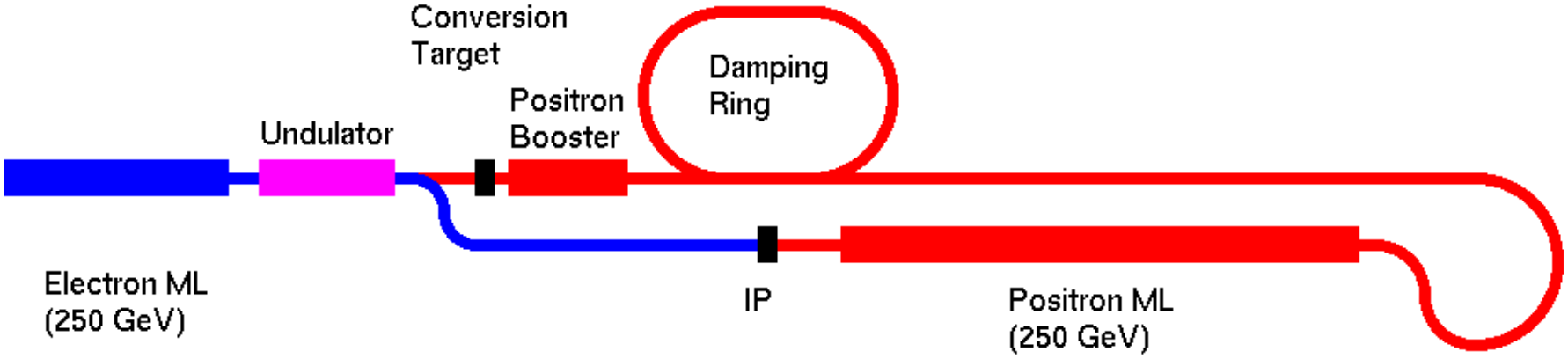
GaAs/GaAsP Strained Super-Lattice

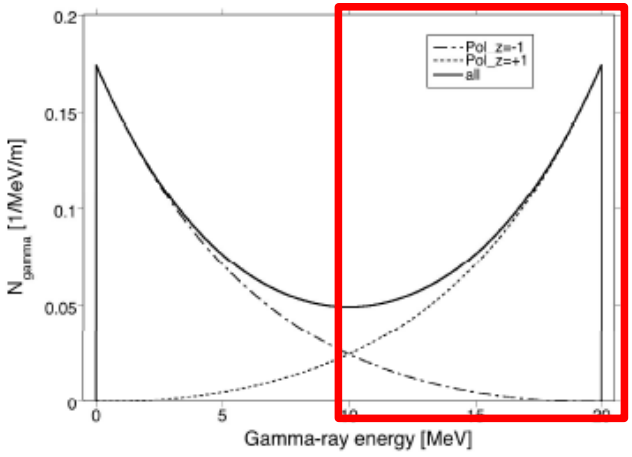
- **Photo-electron effect by circulary polarized right for spin polarized electron beam.**
- **By introducing a special structure, 90% polarization has been demonstrated.**

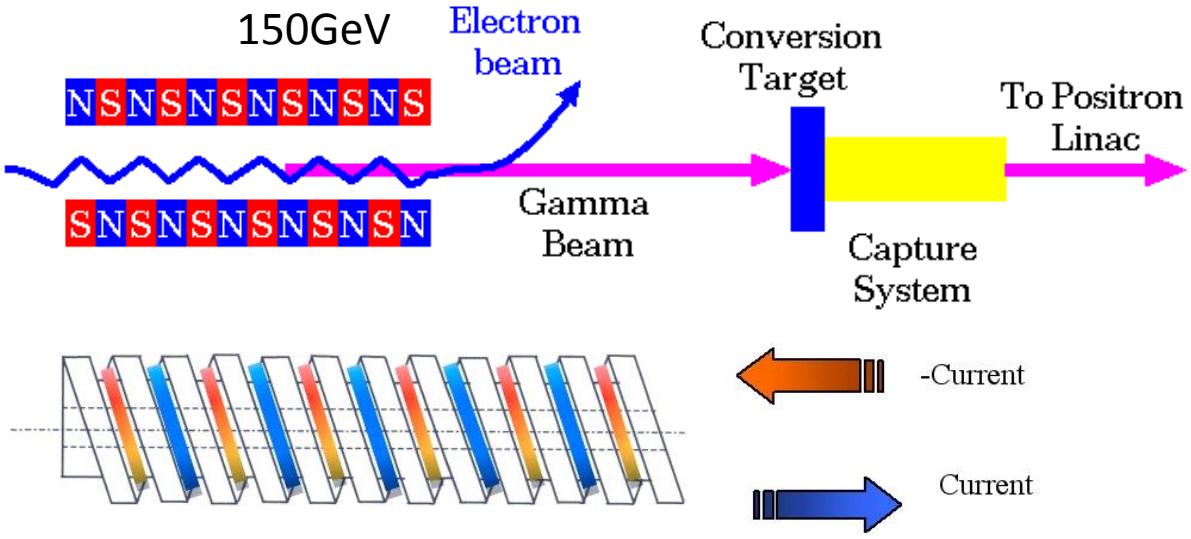




Undulator Positron Source

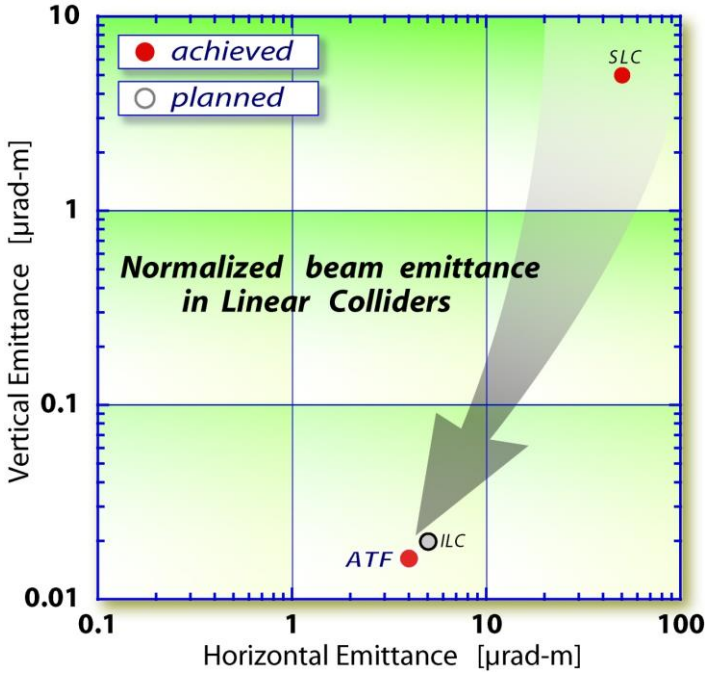






Damping Ring

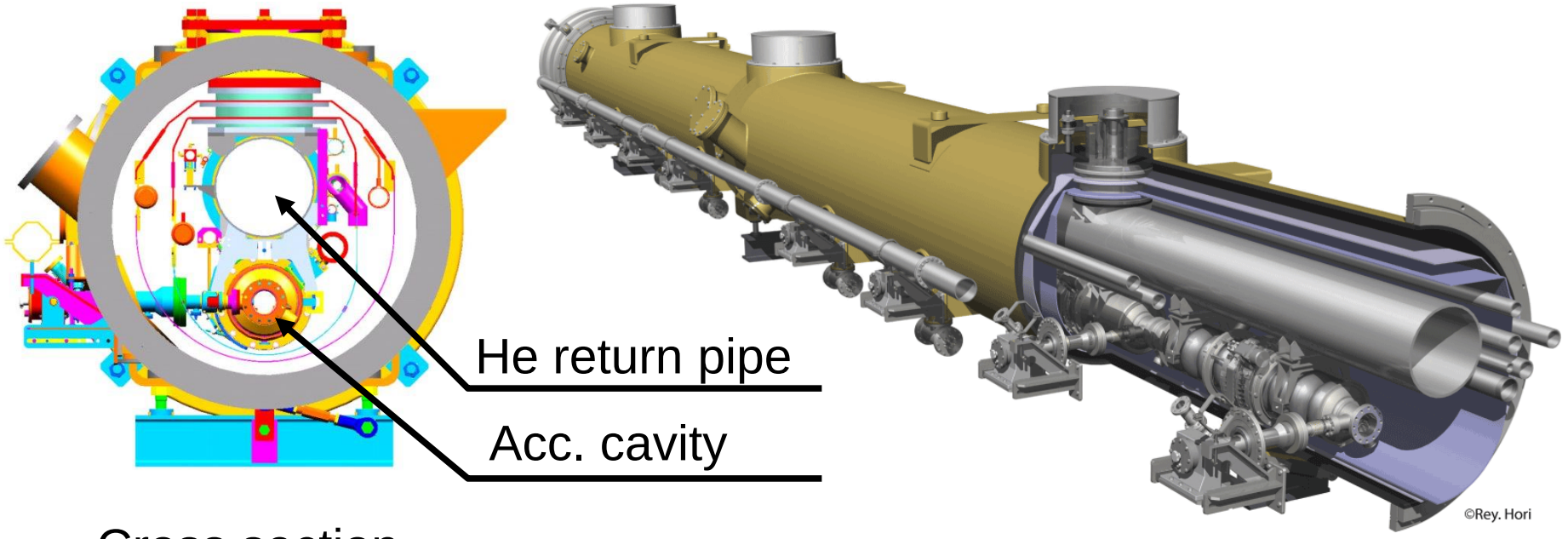
- DR makes the aligned parallel beam (low-emittance).
- KEK-ATF demonstrated the low emittance.



Particle	Axis	Injector (μm)	IP ((μm)
electron	Horizontal	1.0e-5	1.0e-5
	Vertical	1.0e-5	4.0e-8
positron	Horizontal	2.0e-2	1.0e-5
	Vertical	2.0e-2	4.0e-8

ILC Main Linac

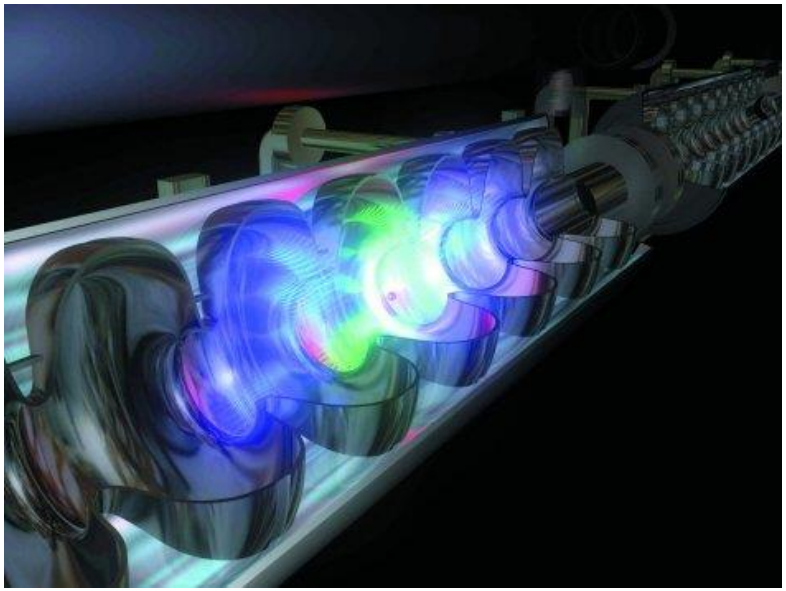
- Nb super conducting cavity with 2K super-fluid He.
- To maintain 2K, pump out liquid He in Cryomodule.
- 8 or 9 1m accelerator cavities are in a Cryomodule.

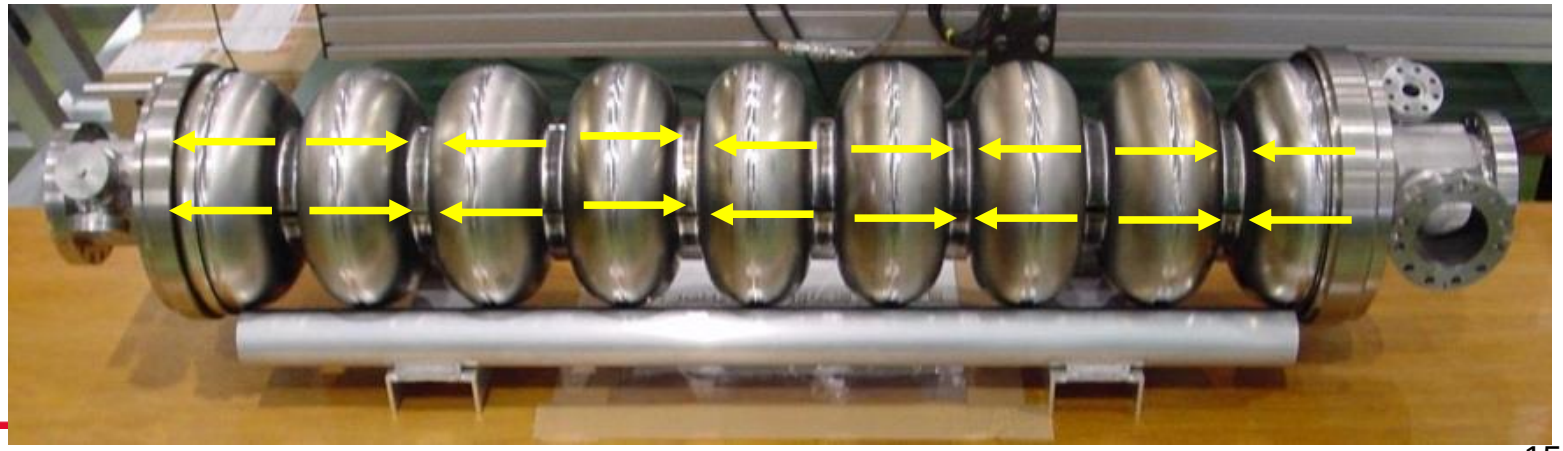


Cross section

Acceleration in ILC cavity

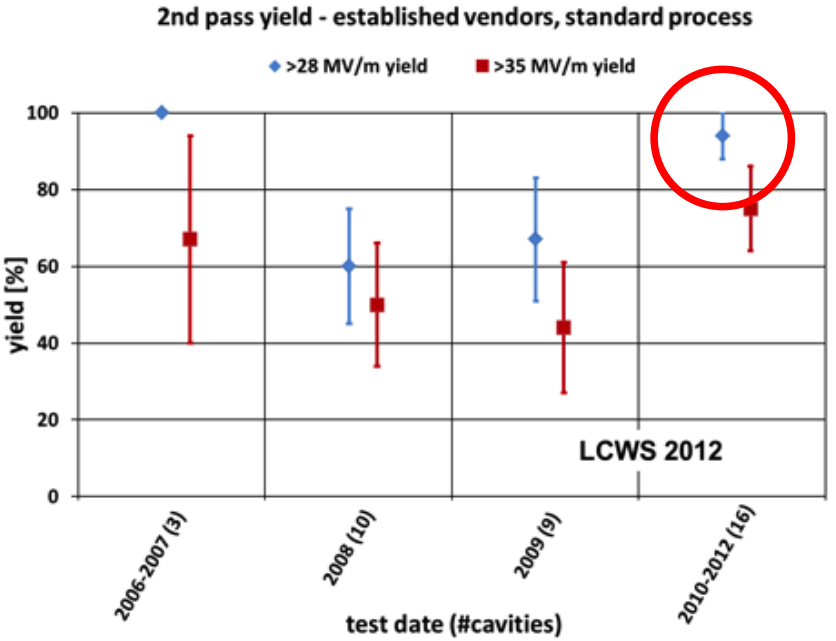
- 1.2m, 9 cells.
- Accelerator gradient：31.5MV/m.
- Standing wave (pi-mode).
- Electro-polishing technique for the high gradient.





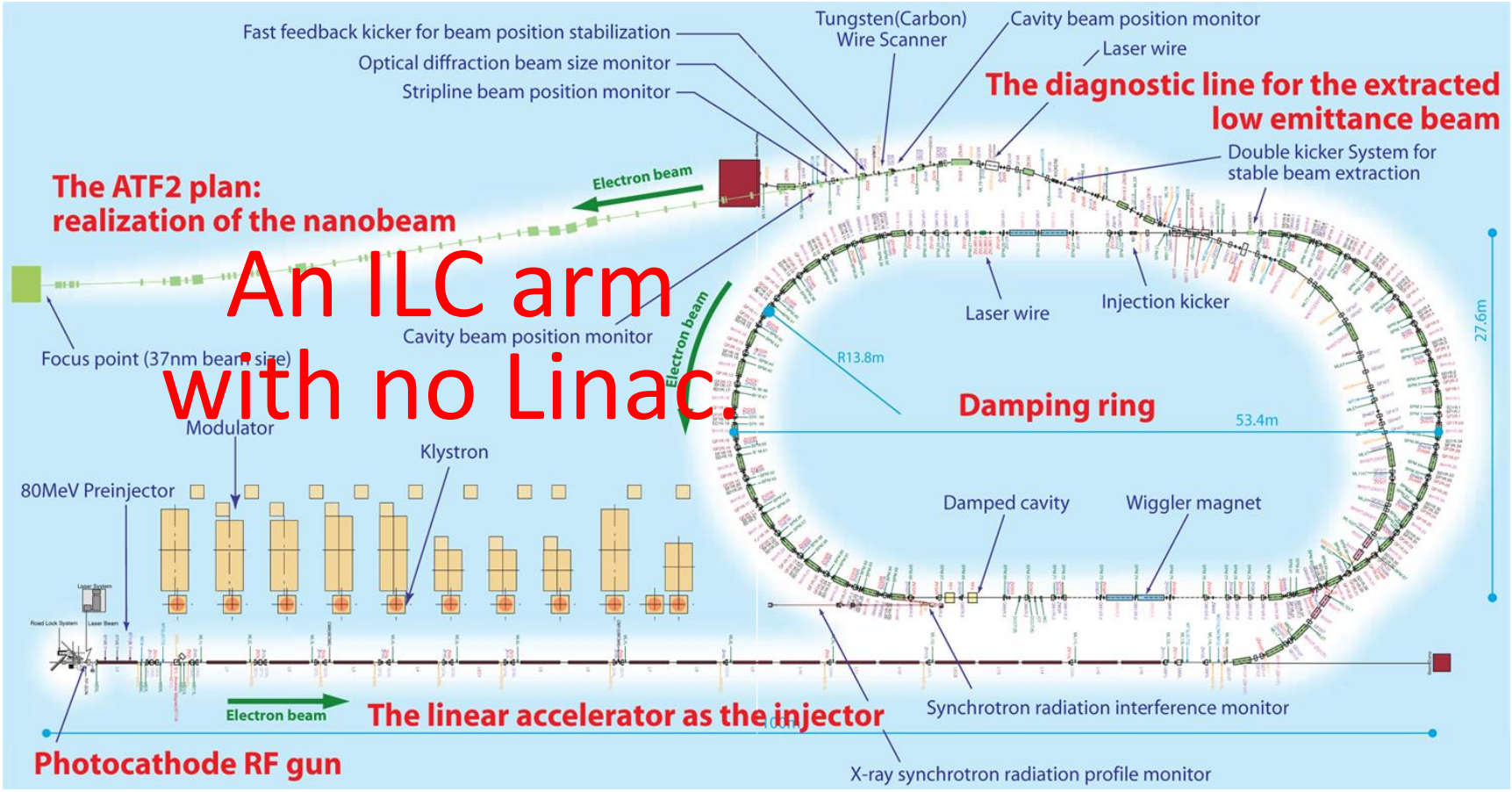
Fabrication / Industorialization

Production yield:
94 % @ > 28 MV/m,
Average gradient:
37.1 MV/m
Design average gradient:
35 MV/m

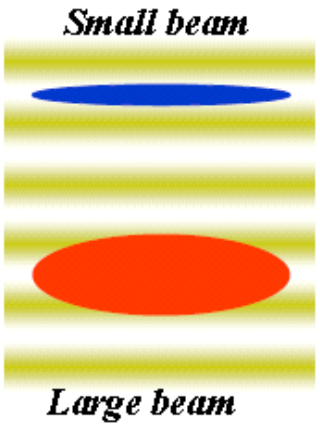


It is ready for production!

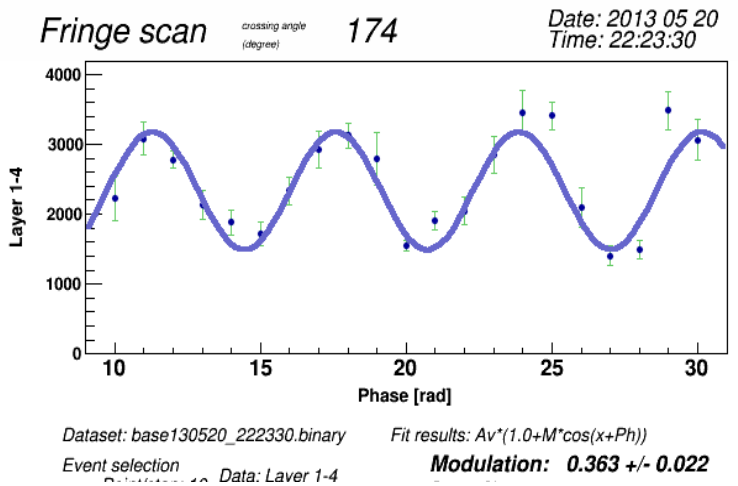
Final Focus Test (ATF2)

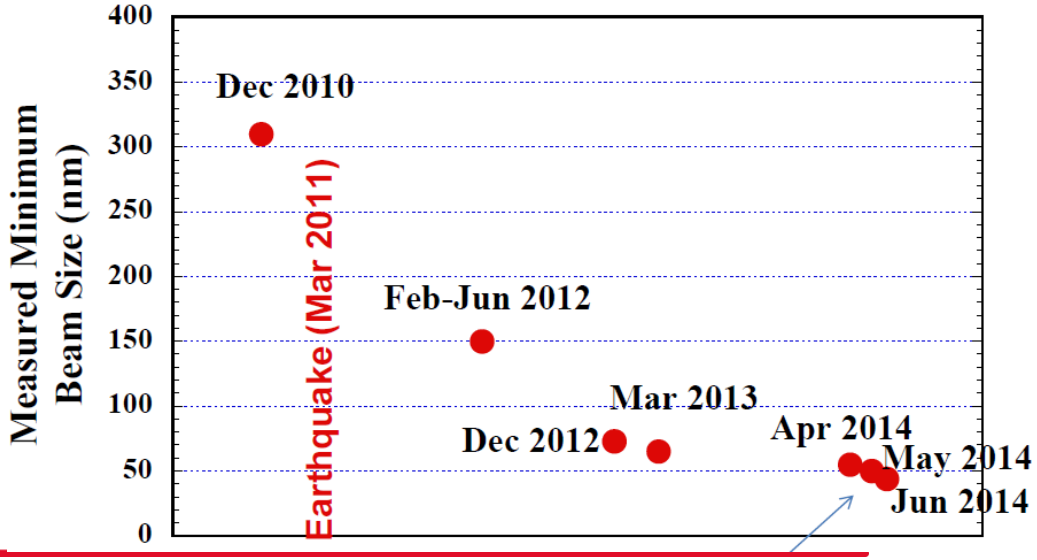


We are approaching!



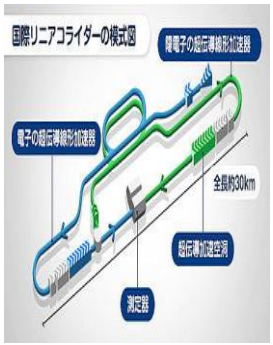
- **The beamsize at the virtual IP is measured as visibility by the laser fringe monitor.**
- **45nm is confirmed.**
- **37nm at 1.3 GeV is goal of ATF2. This number corresponds to 5.7nm at 250 GeV beam energy.**

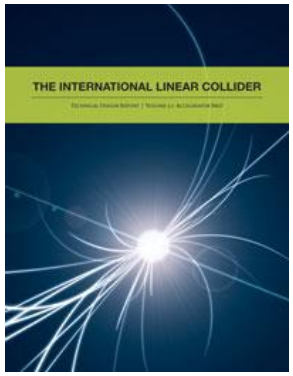


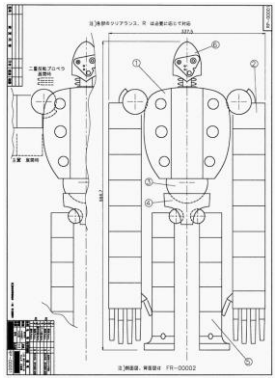


Summary of ILC Accelerator Technology

- R&D for fundamental technology was done.
- Industrialization is the biggest issue.
- Our next goal : establish technical detail design.







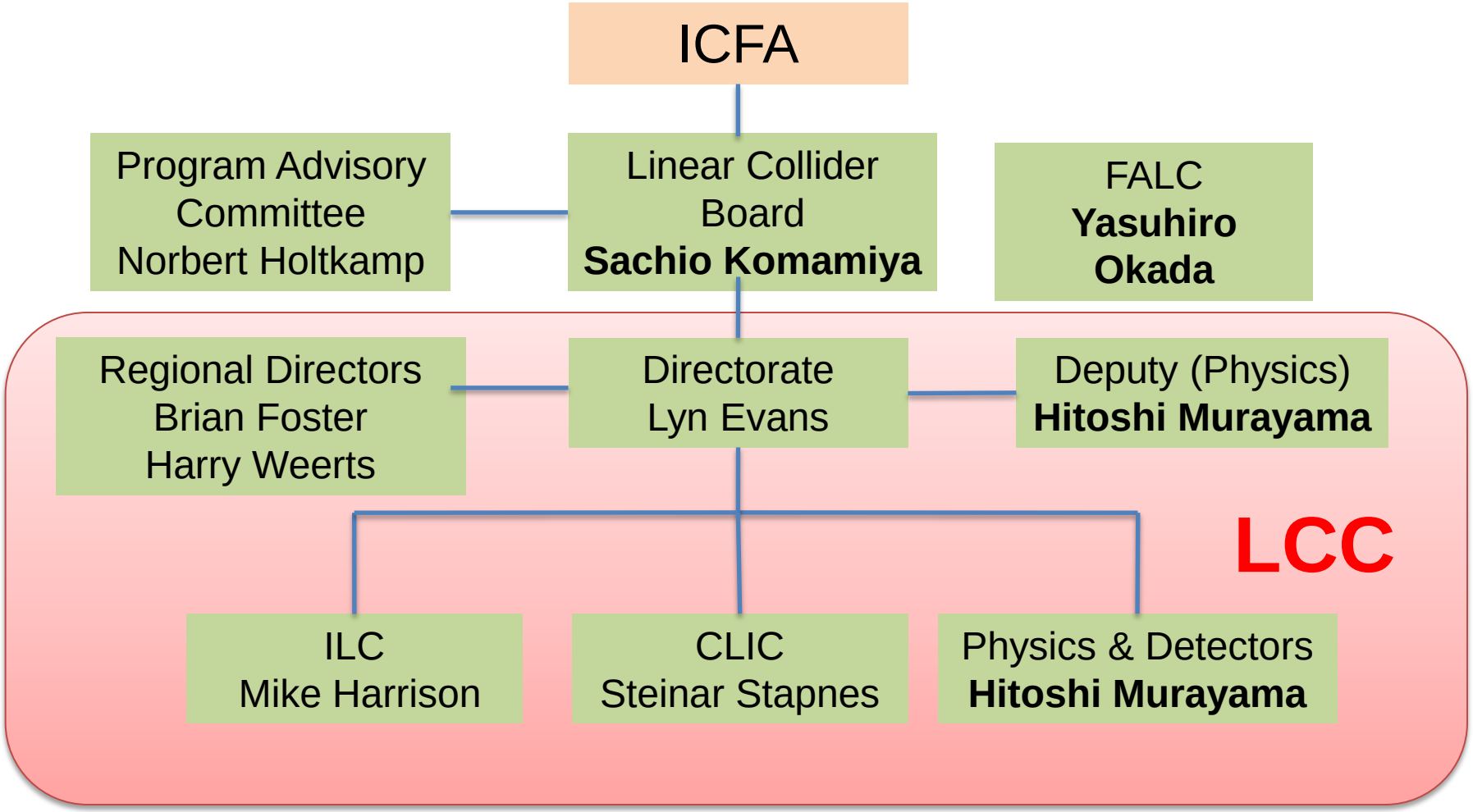
Baseline design
（2007）

Reference design
（2011）

Technical design
（2013）

Engineering design
（2015?）

Linear Collider Collaboration



World-wide Event : International Linear Collider - From Design to Reality -

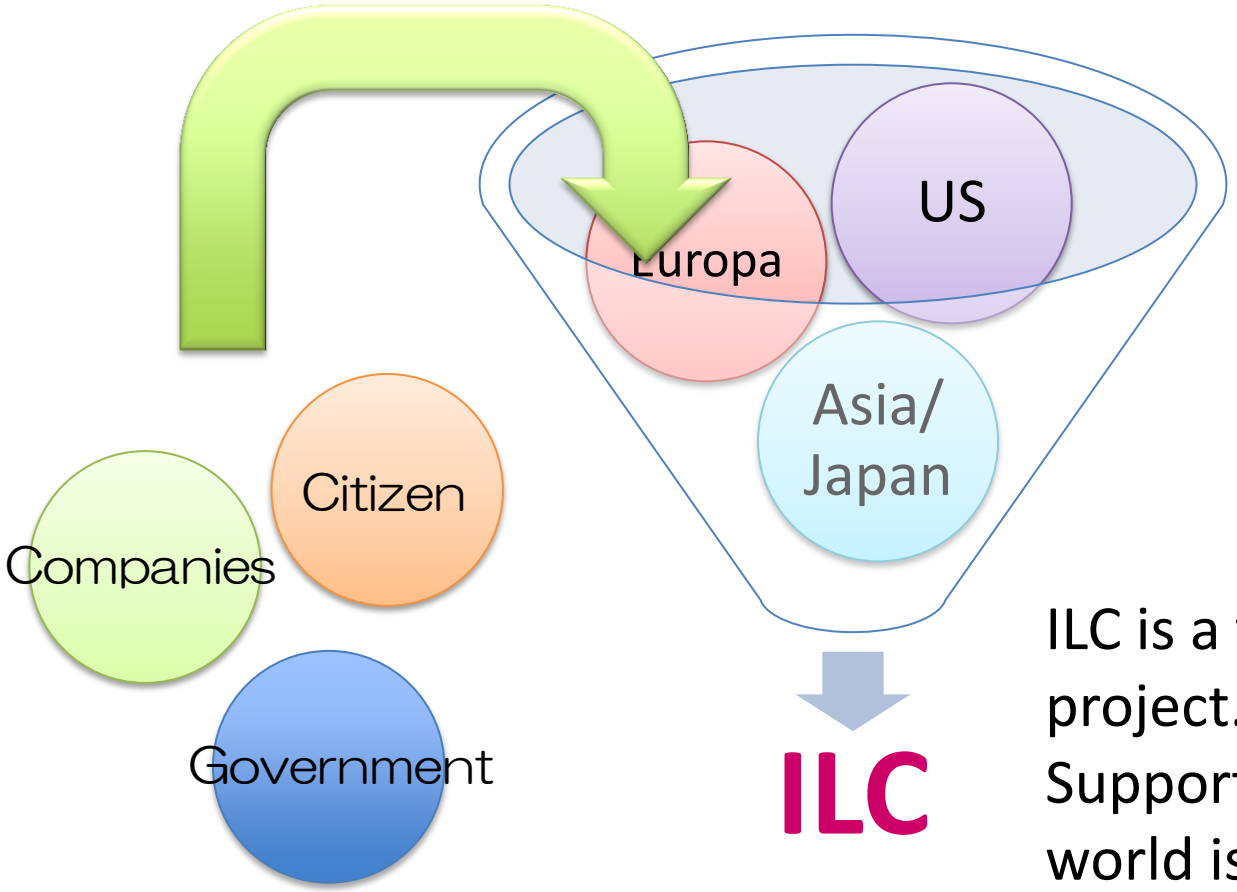
2013/6/12 Tokyo - Geneva- Chicago

Tokyo

Geneva

Chicago

Support from the World



ILC is a truly international project.
Supported by all of the world is a necessary condition.

From Europa

EPS2013@Stockholm

A lepton collider: a decisive asset…

..if

- can be decided/built soon
- It might start at 250 Gev, but it should be upgradable to 500 GeV, with a possible extension to 1 TeV c.m.

Best candidate: ILC

- Mature design
- TDR delivered
- Japanese community has submitted to the government a request to host it.

Japan should put something on the table and then CERN will come.

European Strategy for Particle Physics, CERN

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.*

Authorized by CERN council on 2013/5/3

From US

2013 HEPAP Facilities Subpanel

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

Snowmass Energy Frontier WG
Chip Brock

bottom line

This Higgs Boson changes everything.

We're obligated to understand it using all tools.

US-P5

- ’As the physics case is extremely strong, all Scenarios include ILC support at some level through a decision point within the next 5 years.’
- ’ Play a world-leading role in the ILC experimental program and provide critical expertise and components to the accelerator, should this exciting scientific opportunity be realized in Japan'

From Asia/Japan

A 2013 report from the Asian High Energy Physics Community states:

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

The recommendations of the Subcommittee on Future Projects of High Energy Physics (February 2012)

The Japan Association of High Energy Physicists

- **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.**

A Proposal for a Phased Execution of the International Linear Collider Project (October 2012)

The Japan Association of High Energy Physicists

JAHEP proposes that ILC be constructed in Japan …: Physics studies shall start with a precision study of the "Higgs Boson", and then evolve into studies of the top quark, "dark matter" particles, and Higgs self couplings, by upgrading the accelerator.

(A) A Higgs factory with a center-of-mass energy of approximately 250 GeV shall be constructed as a first phase.

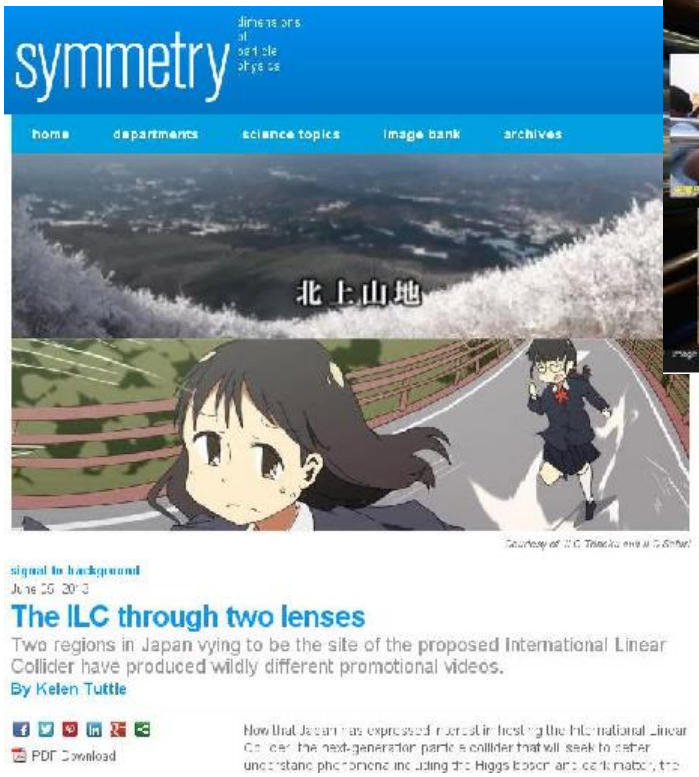
(B) The machine shall be upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.

(C) Technical extendibility to a 1 TeV region shall be secured.

ILC in Public Society

- ILC is a too big project which is justified only by Science.
- It should be valuable not only for Science, but also for various aspects of the public society.
  - Social Development,
  - Public Investment,
  - Education,
  - International and domestic politics,
  - Public/commercial technology development.


ILC
SEFURI
参加者募集!
第１２回サイエンスカフェ@ふくおか
「宇宙の謎に迫る」 ～宇宙を語る～
★講演ではなく、科学者と語りあう場★


symmetry
dimensions of particle physics
home
departments
science topics
image bank
archives
北上山地
signal to background
June 25, 2013
The ILC through two lenses
Two regions in Japan vying to be the site of the proposed International Linear Collider have produced wildly different promotional videos.
By Kelen Tuttle
PDF Download
50-foot physics experiment on the move
July 8, 2013
Physics and the birth of the emoticon
symmetry tweets
July 12, 2013


NHK公開復興サポート 明日へ
in東北大学×
Tohoku University Science Café
2/11（月・祝）東北大学川内厚生会館
3つのカフェがひとつになった!?
10:30～
サイエンスカフェ・mini
検証:『地震に対する心構え（2010）』は役に立ったか？
12:30～
サイエンスカフェ・スペシャル with JAMSTEC
「3.11 あのとき深海で何が起こったか
～地震の根源を探る
地球深部探査船『ちきゅう』のたび」
14:30～
サイエンスカフェ・スペシャル
国際リニアコライダー計画
～ヒッグス粒子と宇宙創成の謎に迫る～
申込方法
参加費 無料
FREE
事前申込が必要です

Policy speech by Prime Minister Abe In 138th Japanese Diet (28 February 2013)

Japan is taking a strong leadership in the world technology innovation such as utilization of Hydro-methane, the high reliability rocket technology, and the aggressive challenge on the advanced accelerator technology …. Japan will promote these activities intensively. (translation by MK)

ILC promotion alliance by Diet members

- Nonpartisan Organization from LDP (Liberal Democratic Party) to JCP (Japan Communist Party)
- 150 members.

2013年2月1日

Chair: 川村健夫
Takeo Kawamura

2013年3月26日

AAA (Advanced Accelerator technology Asso.)
For good liaison between Industry and Academy.

2013/3/27 LCC director Lyn Evans visits Prime Minister Abe

Dr. M. Koshiba（2002 Nobel Laurier) , T. Kawamura(Chair of ILC Diet Asso.), T. Siotani (SG of ILC Diet Asso.), H. Murayama(LCC Vice Director), A. Suzuki (DG of KEK), S. Yamashita (Chair of ILC strategy council)

Japan-US Science-technology cooperation symposium 2013/4/30 Washington DC

Poneman
DOE deputy Secretary

T. Kawamura
Chair of ILC Diet Asso.

H. Masuda, Chair of
Japan Policy Council

H. Shimomura, Ministor
of MEXT

Sieglist
DOE-HEP

S. Shioya
SG ILC Diet A.

Holdren Scientific
assistant to President

Science Council of Japan

日本学術会議
SCIENCE COUNCIL OF JAPAN

- SCJ is under Cabinet Office.
- Representative of Japanese Scientists.
- Give an advice to promote Scientific studies and reflect results of Scientific studies in life.

SCJ Special session for ILC

27 May 2013

MEXT (Ministry of Education, Science , Sports, and Culture) ask SCJ to examine ILC project from Scientific point of view.

30 September 2013

"Statement for ILC project" by SCJ

(1) Scientific significance of ILC

For precision measurements of Higgs and top quark properties and search any phenomena beyond SM, ILC has a strong significance in Scientific research.

The ILC significance has to be clearly explained to justify a large investment for the project.

SCJ Special session for ILC

(2) Investigations for issues of ILC construction in Japan

To make a judgment for ILC project, the government should take the expenses for investigations to examine issues for 2-3 years.

Simultaneously, discussions with foreign laboratories and funding agencies should be continued to make a plan for international budgetary sharing.

(translation by MK)

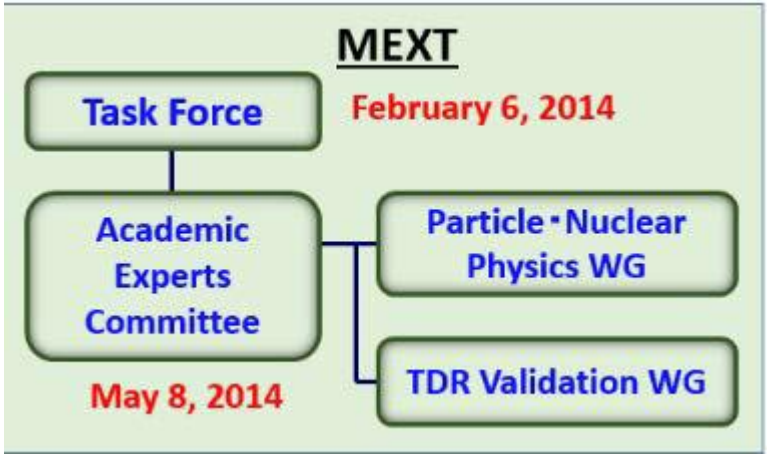
The investigation should answer..

- A more precise research strategy for the ILC in view of the LHC upgrade path;
- The funding framework that does not affect the broader field of science or other critical national priorities.
- Detailed plan of international cost-sharing

- A domestic organization to implement the project consisting of the High Energy Accelerator Research Organization (KEK) and universities;
- Human resources required during construction and operation, in particular, for leadership positions.

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

- "Academic Experts Committee" (sometimes called "Wiseman Committee") in May 2014 conducted by MEXT, not by SCJ.
- And two sub-working groups established Particle-Nuclear Physics WG (on physics)
- TDR Validation WG (on accelerators)
- Both consisting of (almost) non-ILC members
- Had already 2 meetings for each
- 1.5-2 years to come to a conclusion



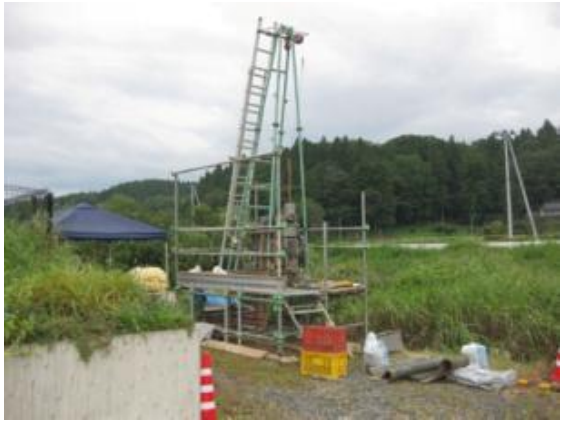
Japanese Candidate site

【Press Release】 ILC Strategy Council (23/8/2013)

We recommend Kitakami area as the best candidate site for ILC in Japan.

The central campus should be located in near of Shinkansen train stations by considering accessibility and daily life.

(translation by MK)




IWATE


Kitakami
Oshu
Hiraizumi
Ichinoseki
宮城県
Sendai
matsushima
Shinkansenn station
air port

Good Access

- By Shinkansen train, 2h 10min from Tokyo to Ichinoseki where is one of the candidate location of the central campus.
- It is shorter than from Tokyo to Kyoto (2h 20min) and Osaka (2h 40min)

Nice Hospitality

Welcome sign for Posipol2014 and ILD meeting in Japanese traditional way.

Mr. Katsube
Mayer of Ichinoseki city

Mochi pounding

Good quality of life

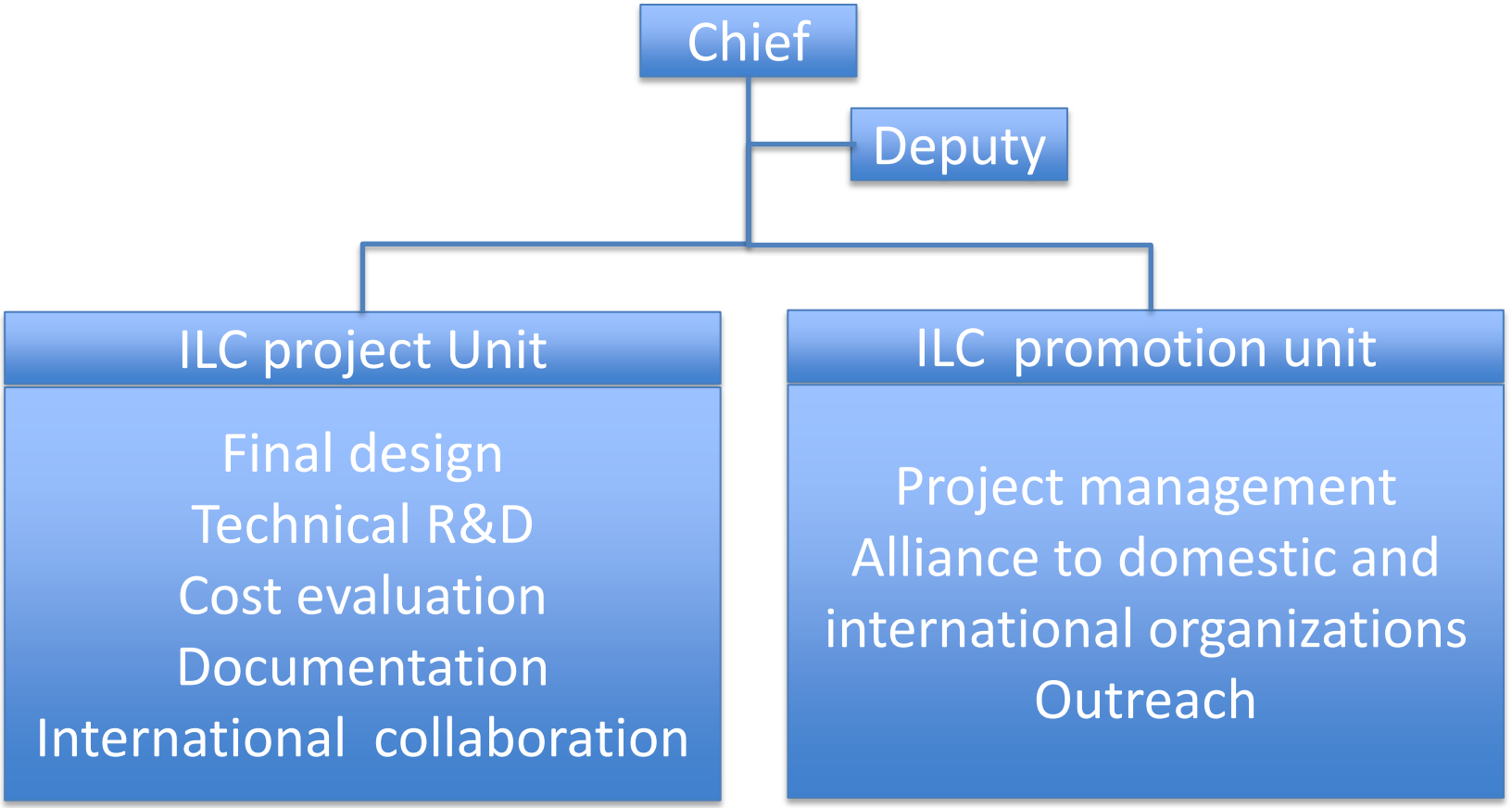
- Hiraizumi known as cultural area based on the pure land (極楽浄土) Buddhism. (Unesco World Heritage)
- You can enjoy a peaceful boat cruising in Geibikei.

Wikipedia

Tohoku, Iwate area strongly supports ILC

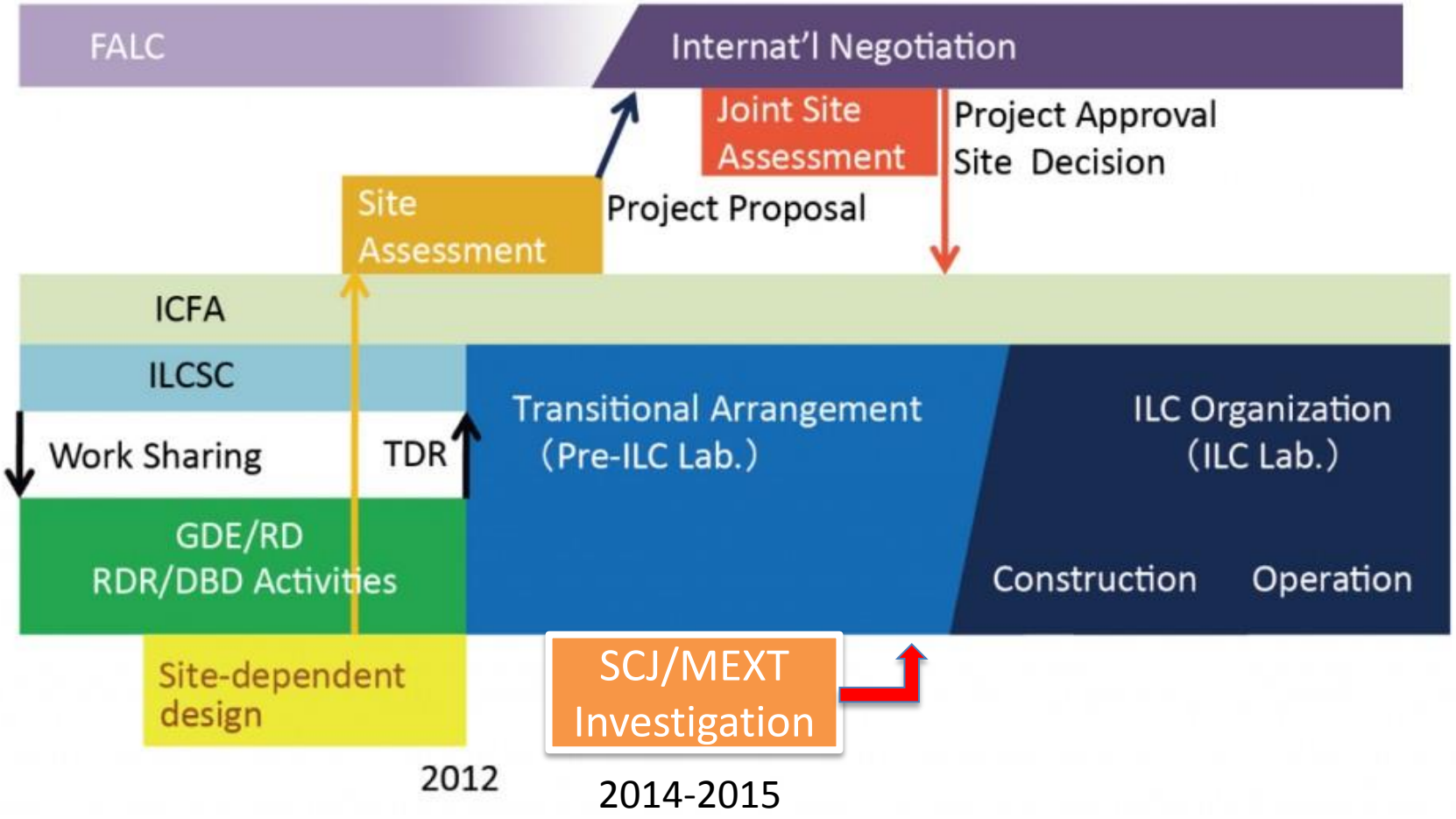
KEK ILC pre-opening office

2014 February



http://www.kek.jp/ja/NewsRoom/Release/20140206173000/

Internat'l Gov't Consultation



Host Nation

J. Bagger

- We need to think more broadly
  - CERN was founded on the ashes of war by a set of visionary physicists
    - And today, we are beneficiaries of their foresight

CERN

Host Nation

- So perhaps today, at the dawn of the Asian century, the world needs Japan, China, Korea, India, Vietnam all collaborating on a peaceful endeavor
  - The SESAME light source is attempting something similar in the Mideast
    - Its current members include Bahrain, Cyprus, Egypt, Iran, Israel, Jordan, Pakistan, Palestinian Authority, and Turkey
    - Where else but science could these nations meet on common ground?

Another Center of Physics

- ILC can be “another CERN” in Asia for 21st century.
- It is a peaceful endeavor to the mystery of universe.
- Japan can and have to lead the journey.

NPO国際交流推進センター

Summary

- ILC is technically ready for construction.
- ILC candidate site in Japan is decided. Kitakami area welcomes ILC.
- SCJ supports ILC in physics and recommend investigation on related issues.
- MEXT start the investigation by organizing a Taskforce and two WGs. ILC should be justified in various contexts.
- ILC could be another center of physics in 21st century.

LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator