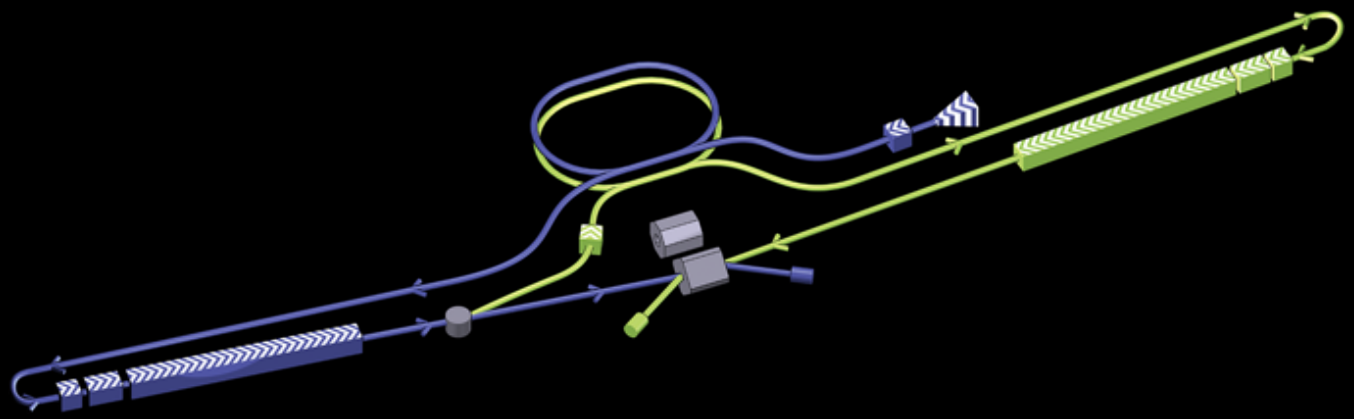
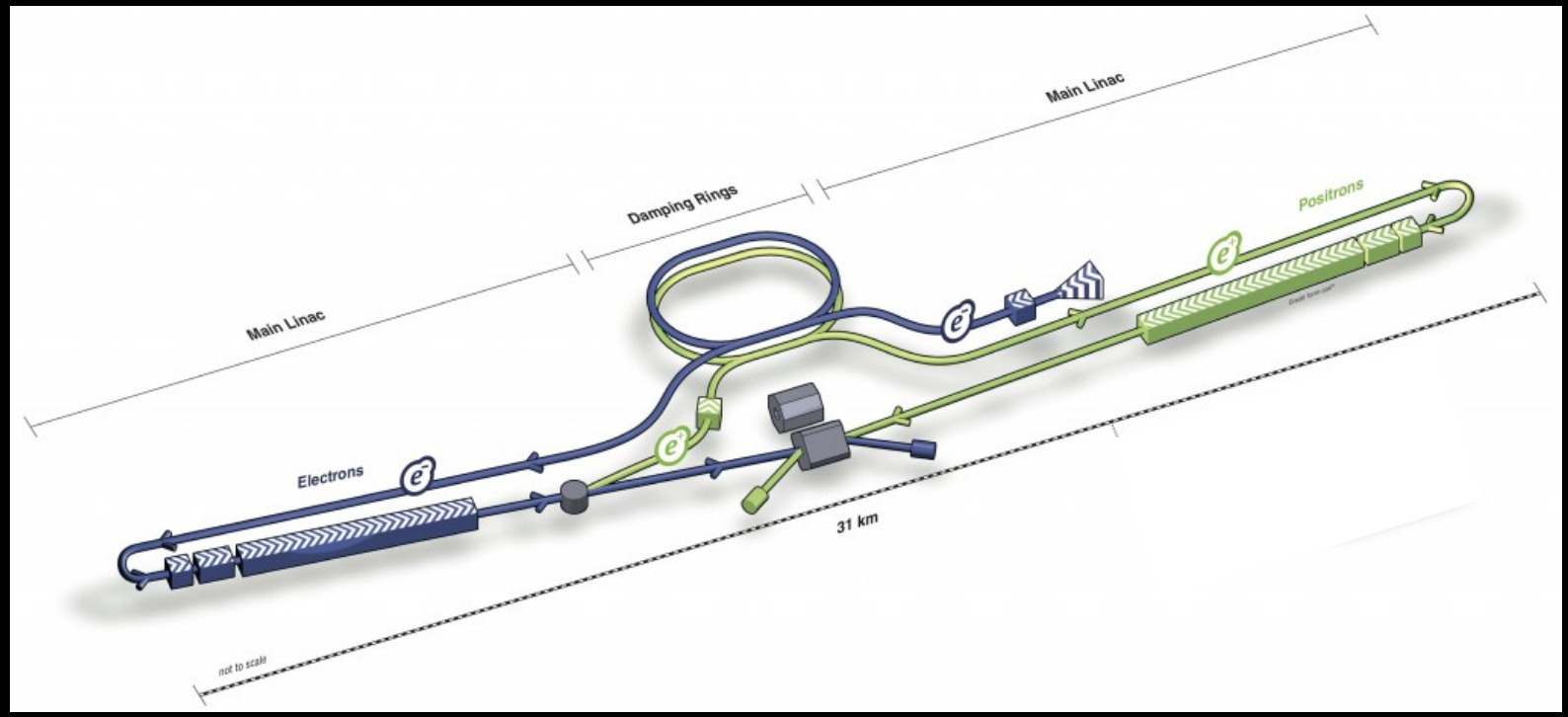
ILC Project

Tsunehiko OMORI
LCC/KEK



INSTR-17, Budker INP, Novosibirsk, Russia, 27 February 2017

ILC (International Linear Collider)

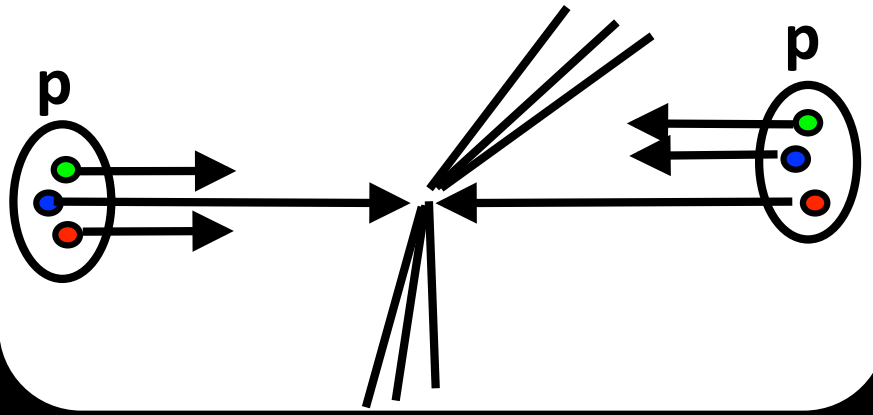


e^-e^+ collider

- 500 GeV CM with 31 km -> upgrade later to ~ 1TeV CM with 50 km
- IP beam size : 6 nm high, 500 nm wide, 300 μm long (@500 GeV CM)
- Luminosity 2 x 10^{34} /cm^2s (@500 GeV CM)
- First stage : 250 GeV Higgs Factory

Why Liner Collider ?

pp collider (LHC)

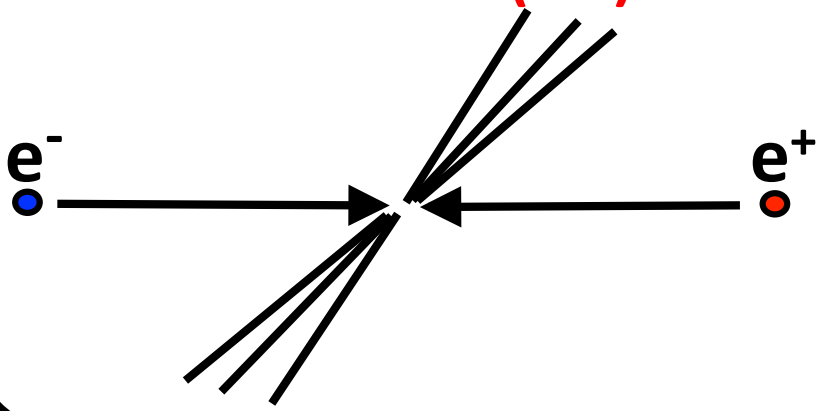


proton proton : composite

3 quarks and gluons

(partons = quarks and gluons)

e^-e^+ collider (ILC)



e^-e^+ : elementary particles

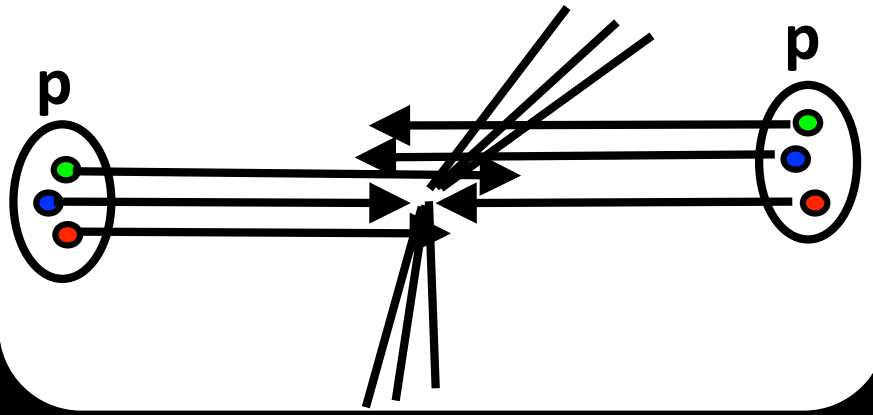
CMS energy = 2 x beam energy

(well defined)

Total momentum = 0 (balanced)

Why Liner Collider ?

pp collider (LHC)



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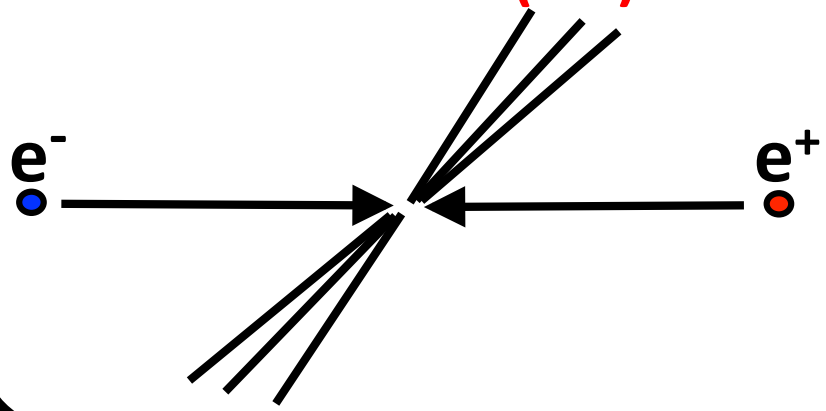

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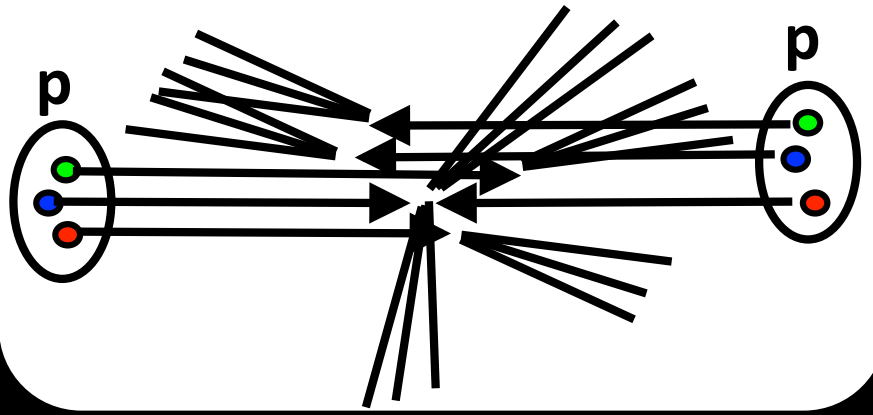

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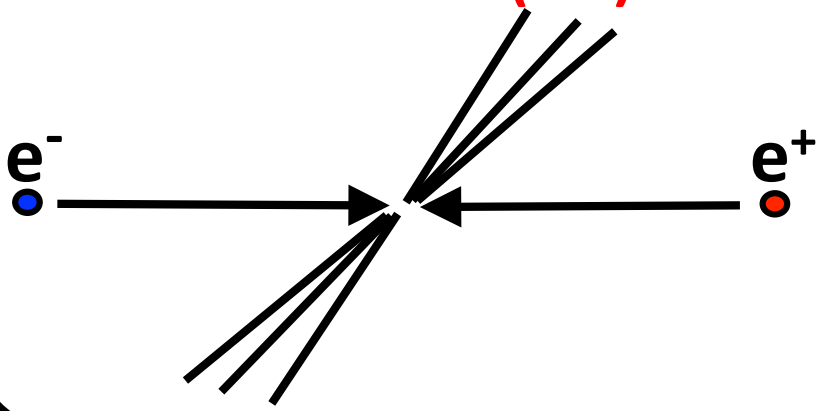
e^-e^+ collider (ILC)



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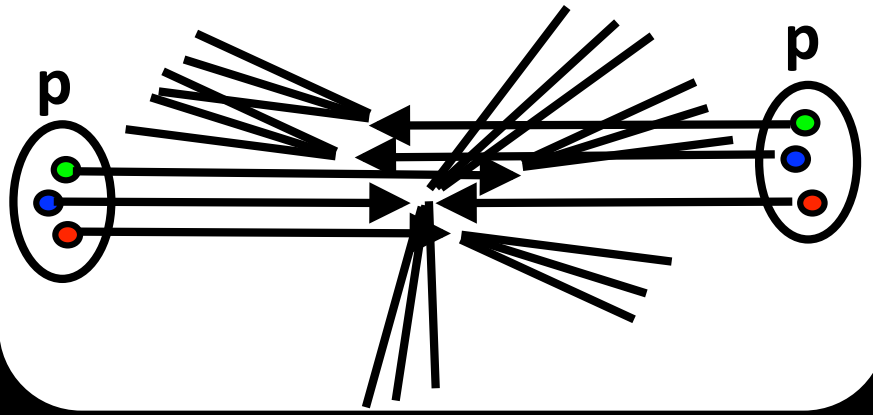

proton proton : composite

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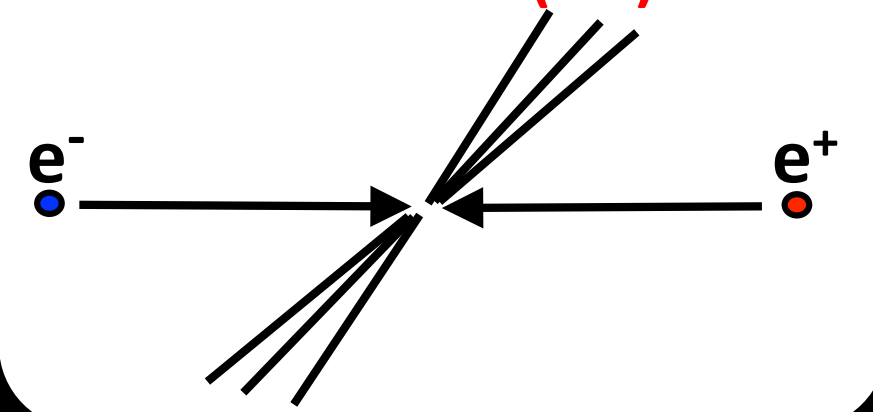
e^-e^+ collider (ILC)



e^-e^+ : elementary particles

CMS energy = 2 x beam energy

(well defined)

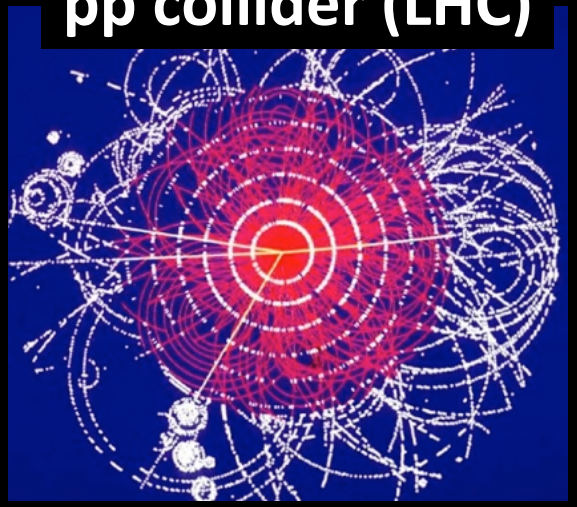
Total momentum = 0 (balanced)

Small back ground

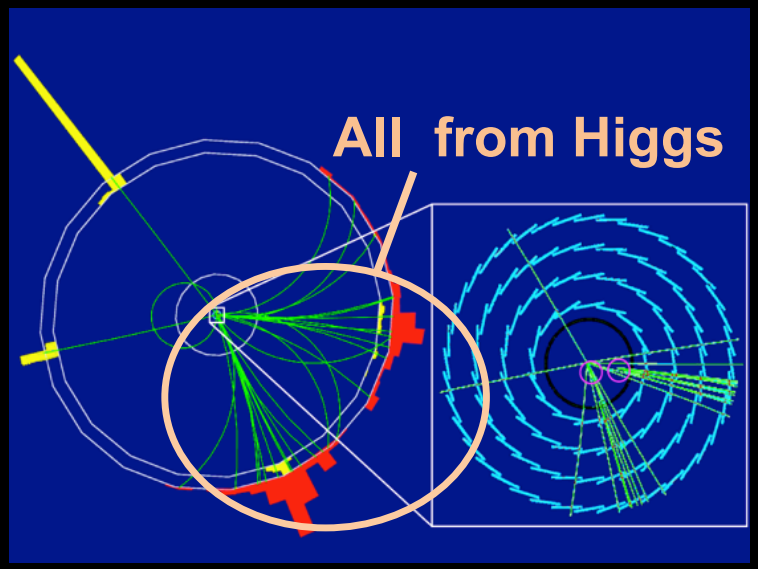
Mostly full reconstruction

Why Liner Collider ?

pp collider (LHC)



e^-e^+ collider (ILC)



proton proton : composite

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(partons = quarks and gluons)

e^-e^+ : elementary particles

CMS energy = 2 x beam energy

(well defined)

Total momentum = 0 (balanced)

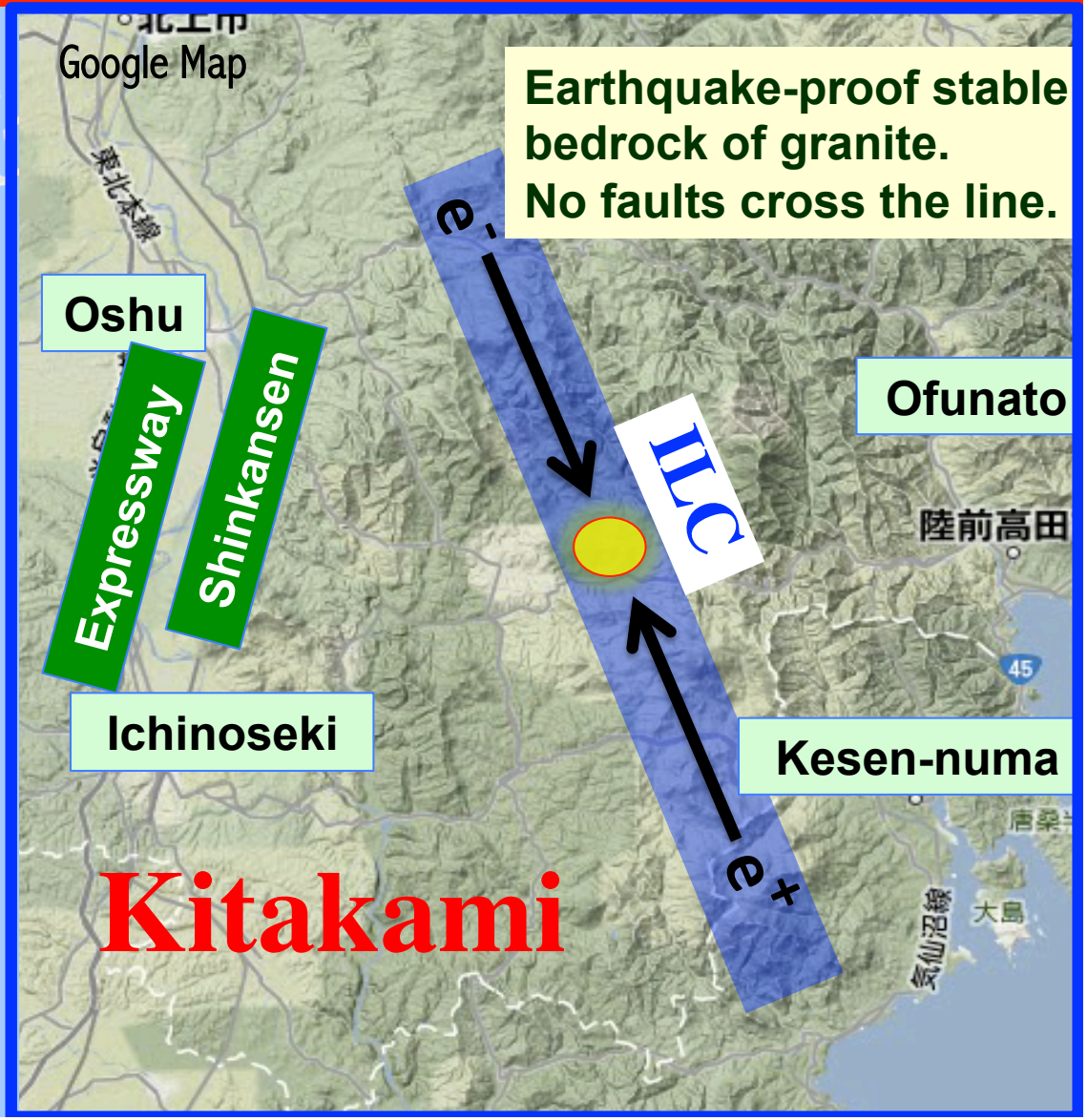
Small back ground

Mostly full reconstruction

International Linear Collider at Kitakami Hills

ILC Site Candidate : Kitakami

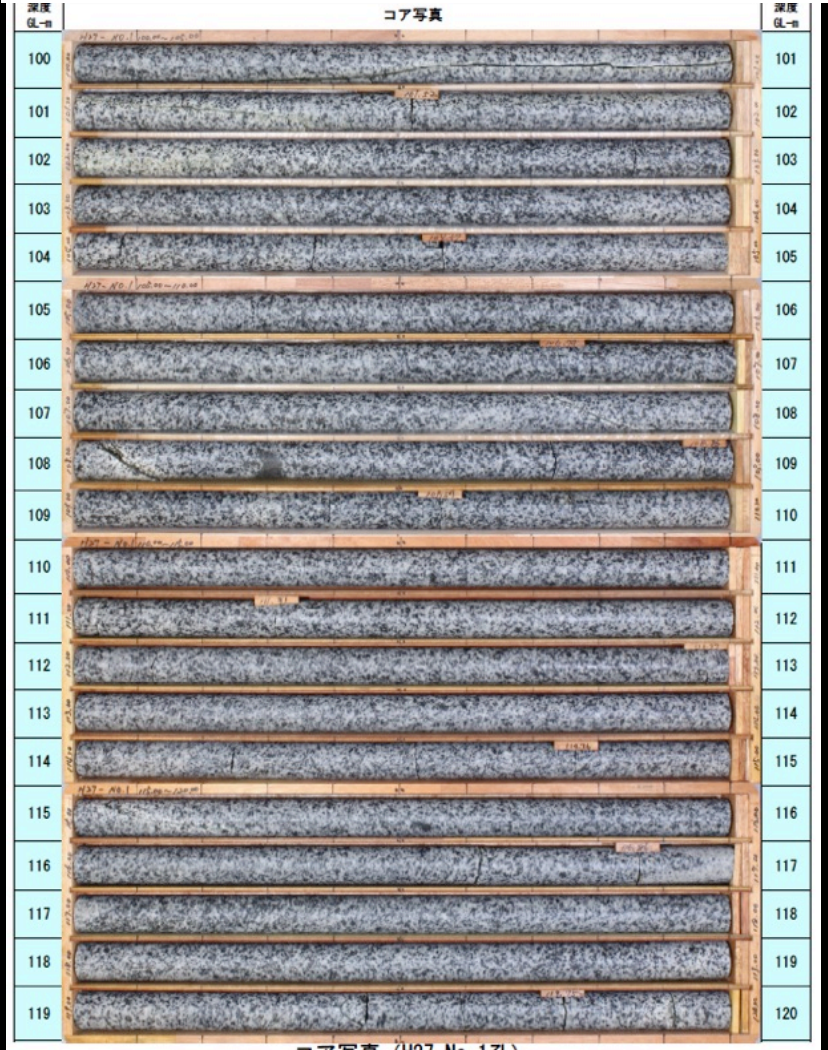
Good Access to Big/Middle-sized Cities, Ports, and Airports
Confortable Living Environment



Boring Exploration

T. Sanuki

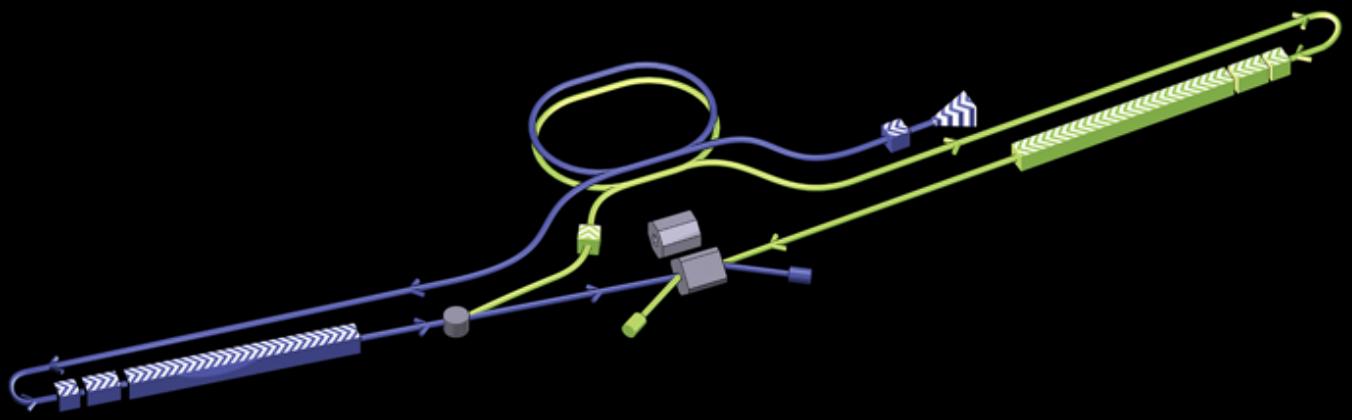
Boring Core
Extremely Good Granite Geology



コア写真（H27-No.1孔）

ILC Physics

Physics case for ILC is very simple and strong



Higgs, top, new physics

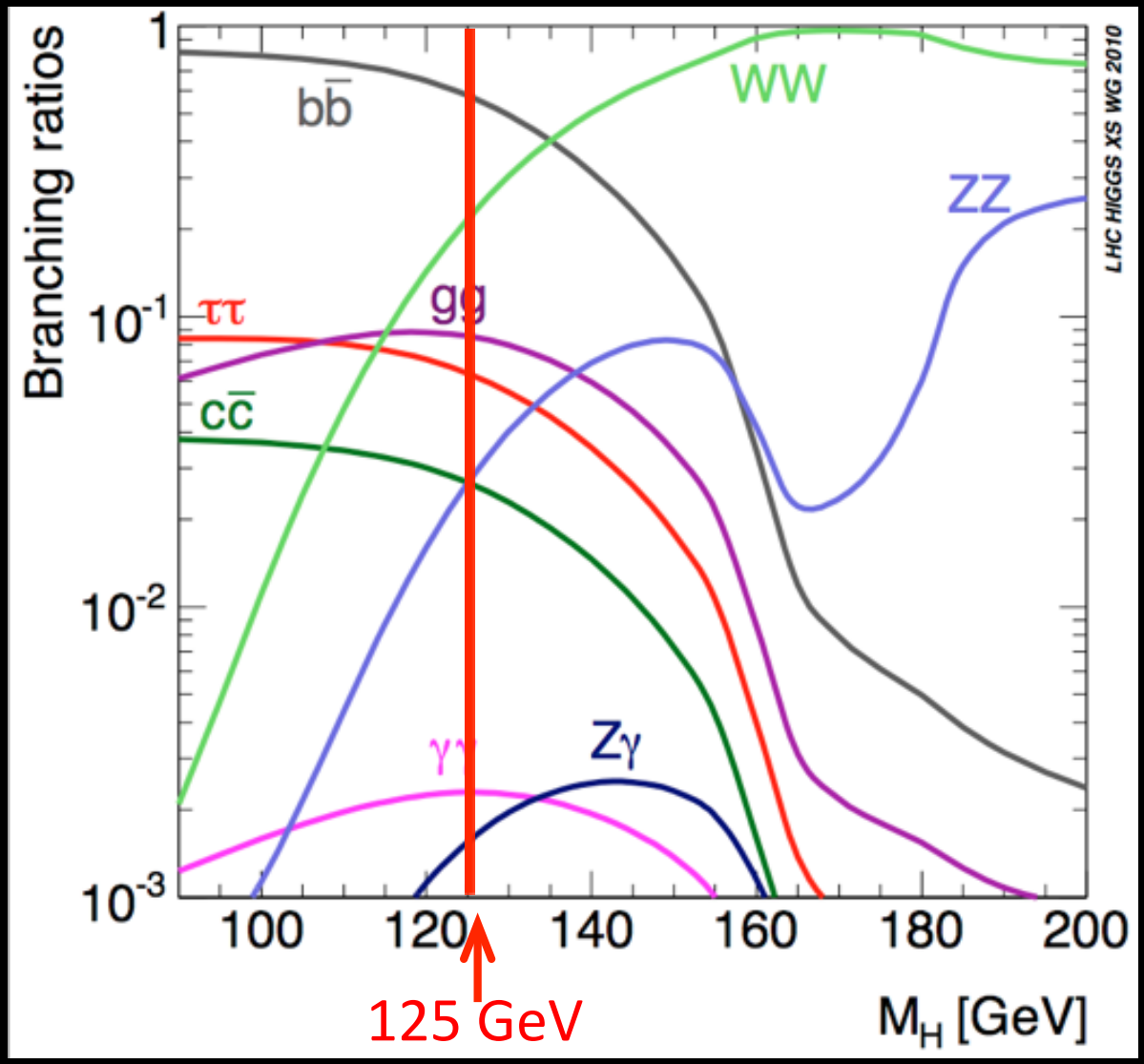
- Only two particles not studied precisely at e^-e^+ so far: Higgs & top
  - Higgs first of a kind (no spin), most important particle in today
  - top can talk to new physics, controls the fate of the Universe
- of course look for (uncolored) new physics

Spin

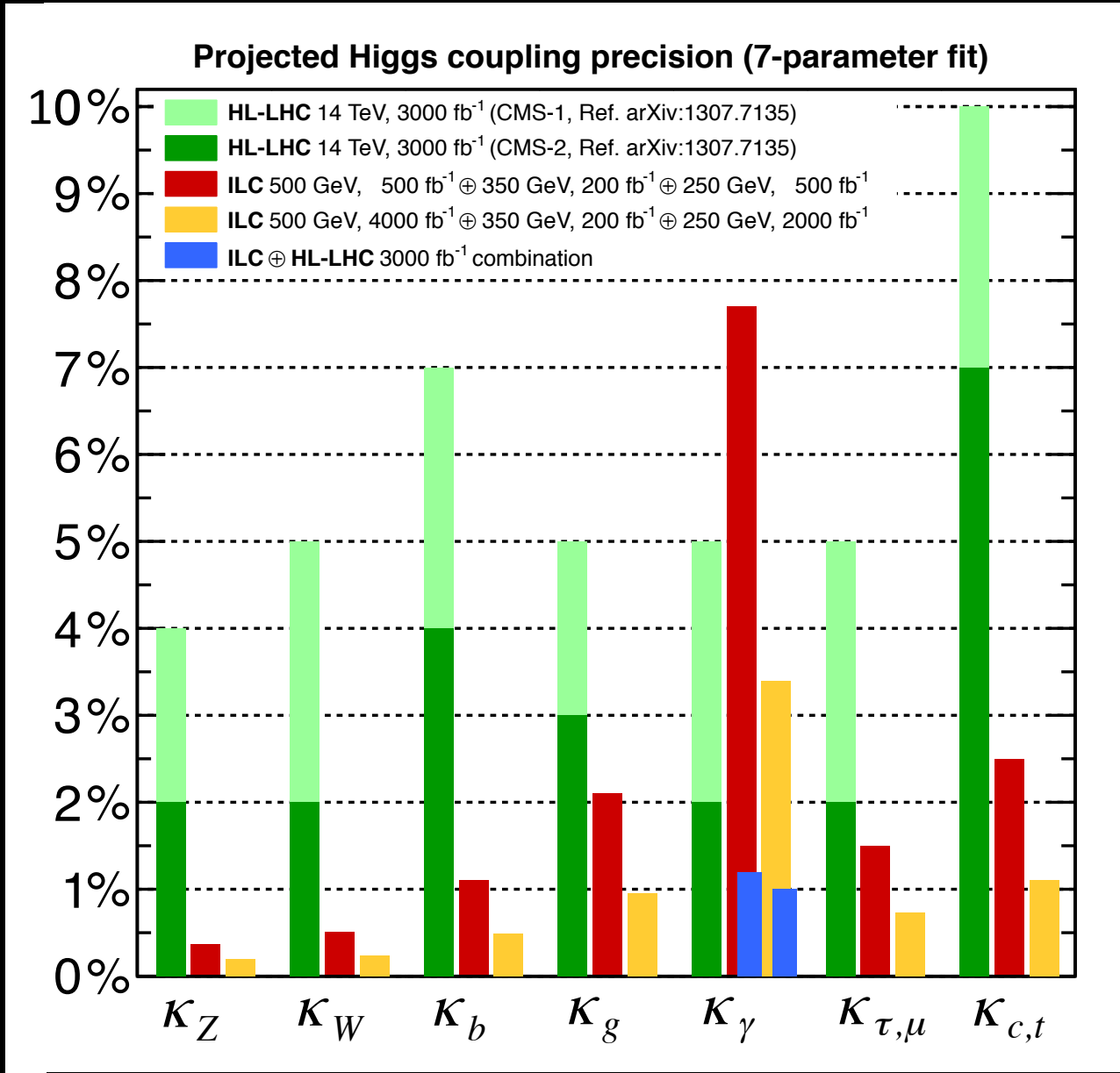
- every elementary particles spin forever
- electrons, photons, quarks, ...
- only Higgs boson doesn't spin
- a new breed
- Is it the only one? (SM)
- does it have brothers? sisters? (SUSY for example)
- maybe composite? (Higgs is NOT elementary particle)

Hitoshi Murayama (UC Berkeley), ILC Summer Camp 2016
Slightly modofied by TO

Higgs mass
dream case for experiments



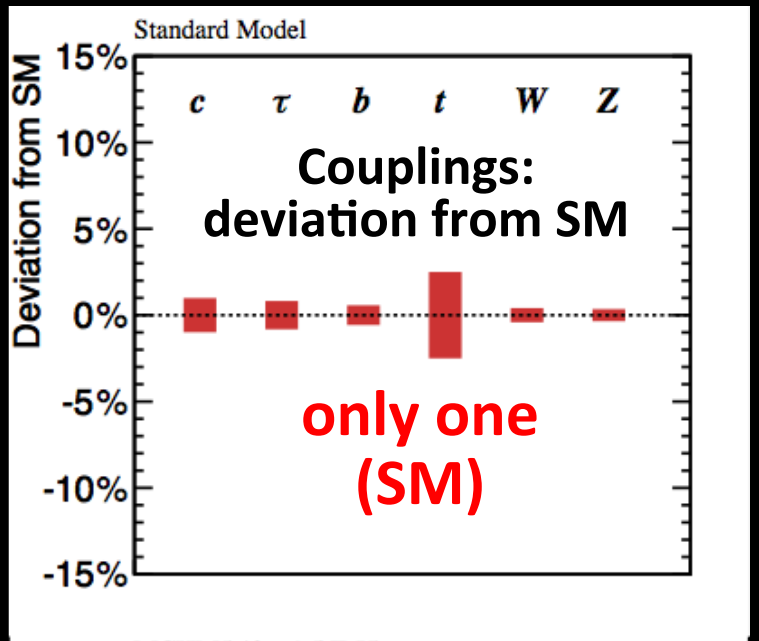
Higgs coupling measurements

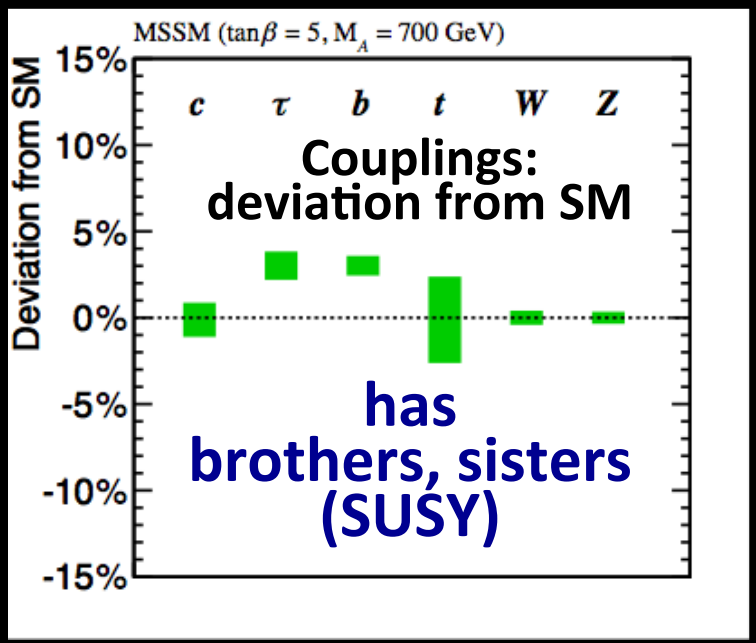


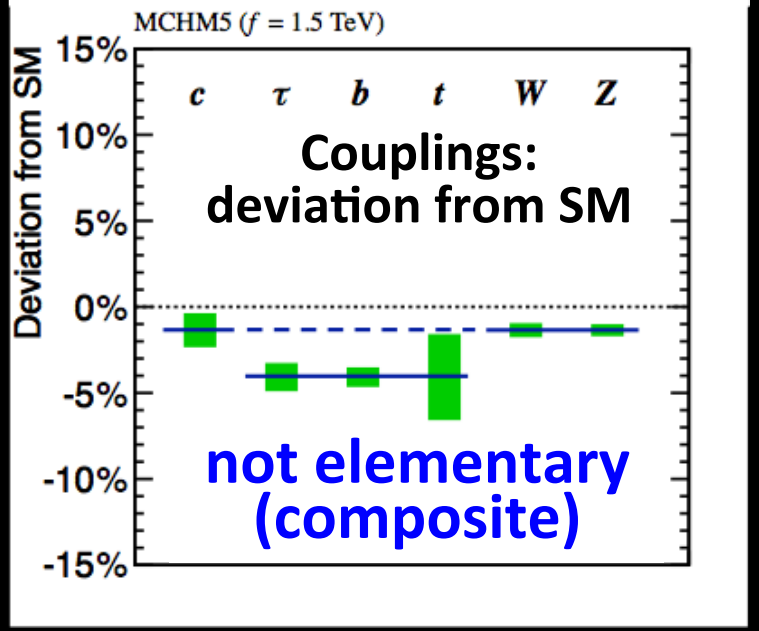
What is Higgs really?

- Only one? (SM)
- has brothers? sisters? (2HDM)
- not elementary? (composite)

Lumi 1920 fb-1, sqrt(s) = 250 GeV
Lumi 2670 fb-1, sqrt(s) = 500 GeV



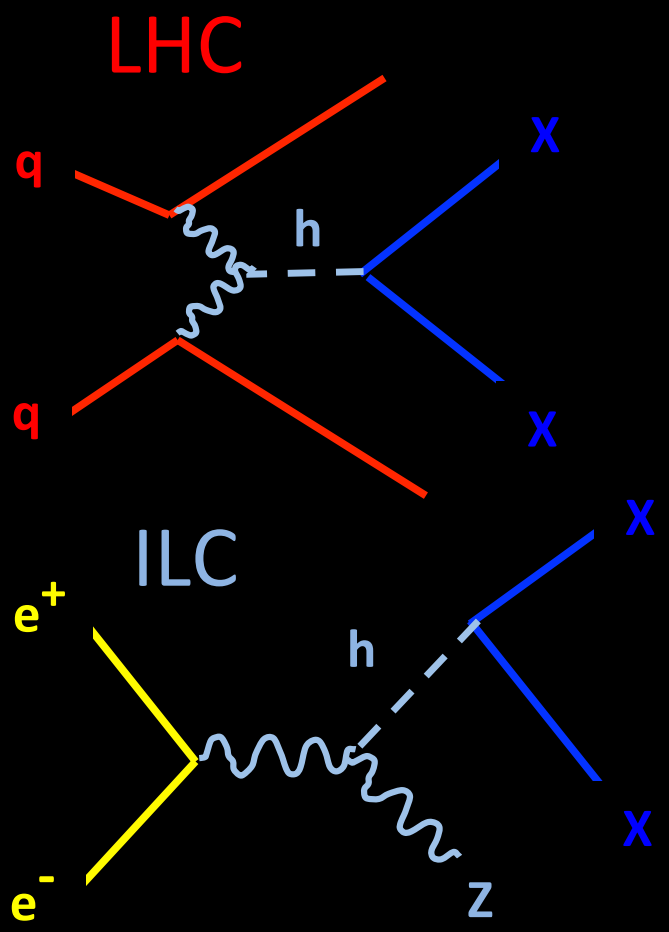


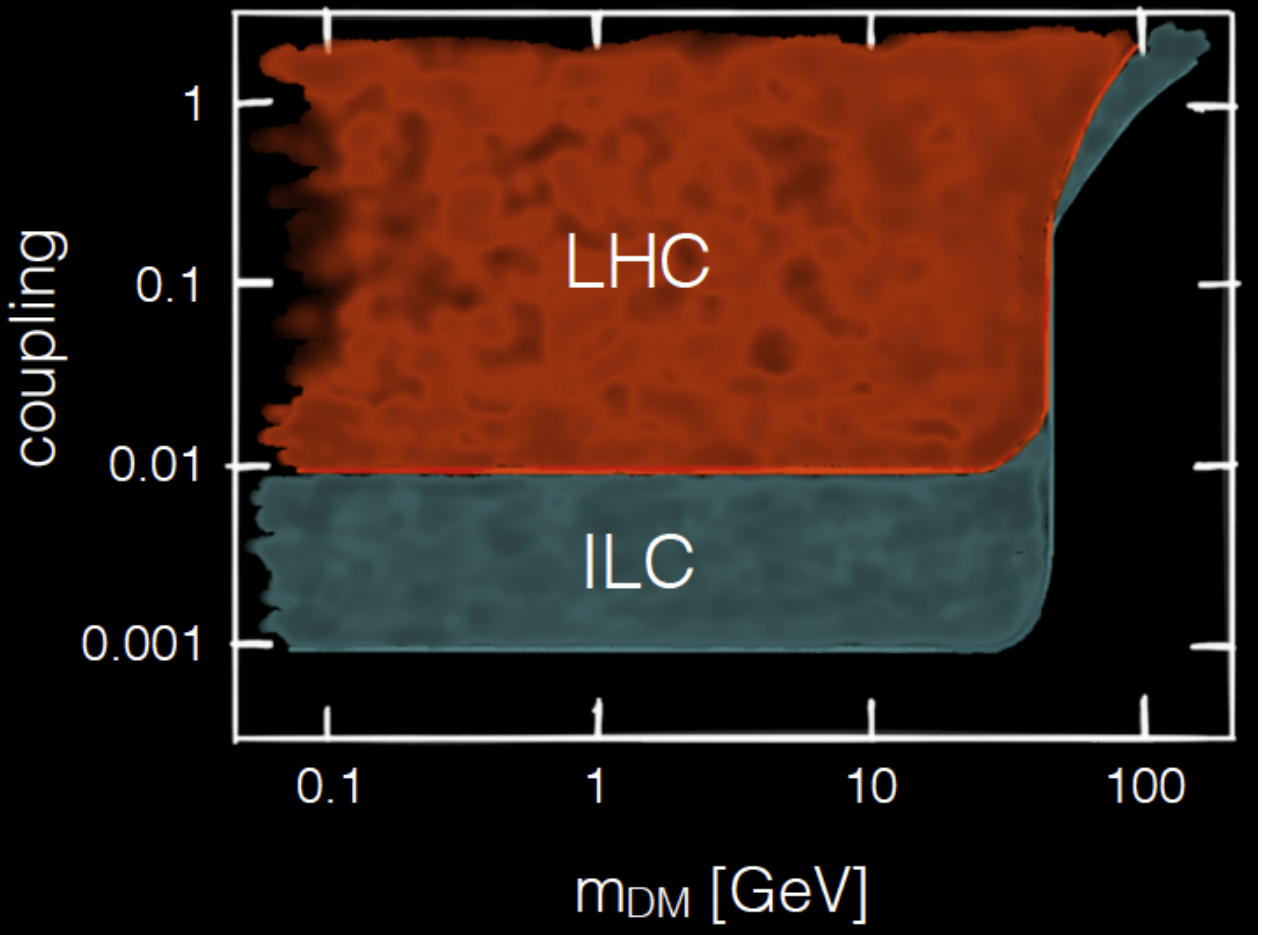


Hitoshi Murayama (UC Berkeley), ILC Summer Camp 2016, modified by TO

Dark matter & the Higgs

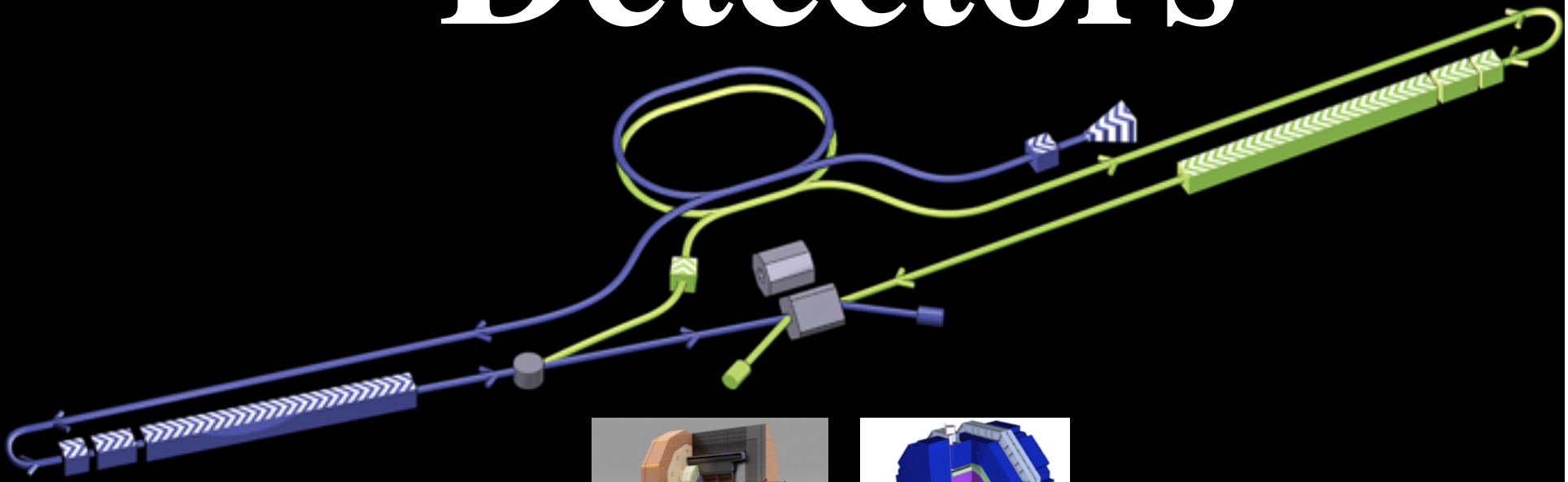
An example: dark matter interacting via the Higgs force

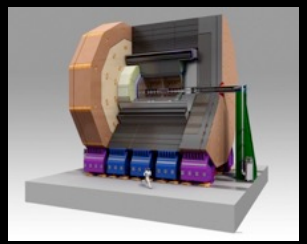


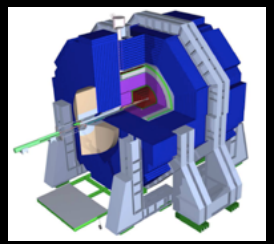


Nathaniel Craig (UC Snta Barbara), LCWS2016

Accelerator and Detectors

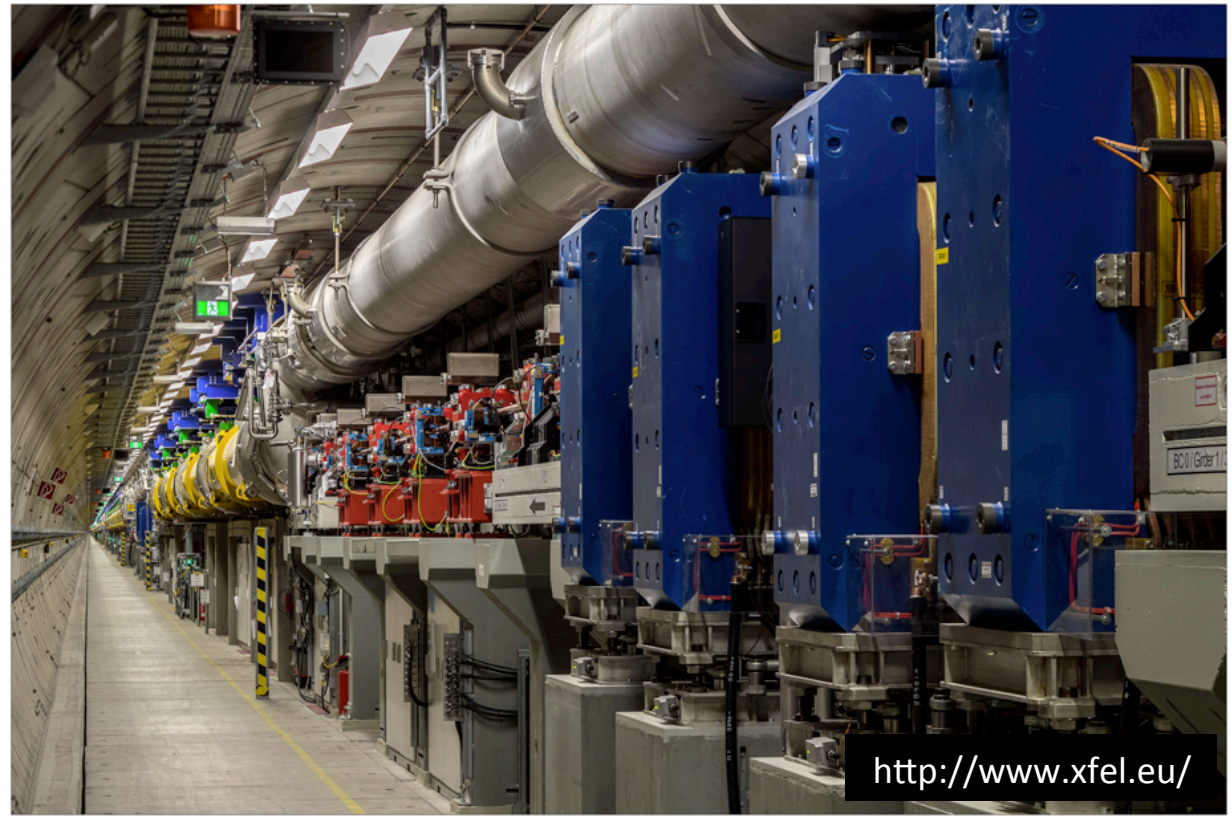






European XFEL

XFEL based on 17 GeV SRF Linac



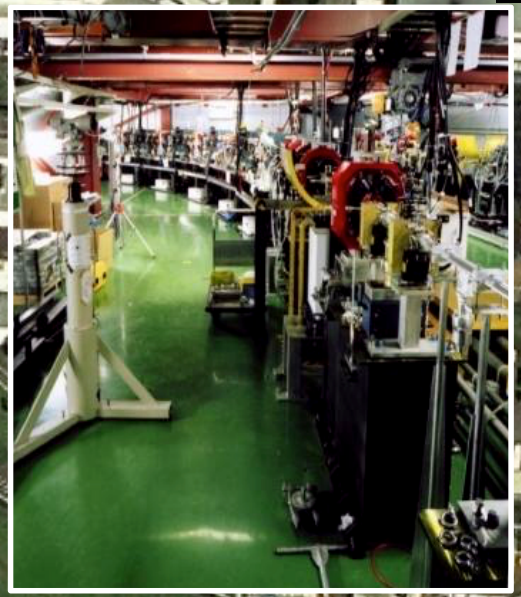
- Denmark
- France
- Germany
- Hungary
- Italy
- Poland
- Russia
- Slovakia
- Spain
- Sweden
- Switzerland

- Now the commissioning of XFEL is ongoing.
- XFEL Superconducting Linac:
  Essentially the same as ILC, Number of modules&Cavities 1/20 of ILC
- ILC will follow all experiences of the XFEL.

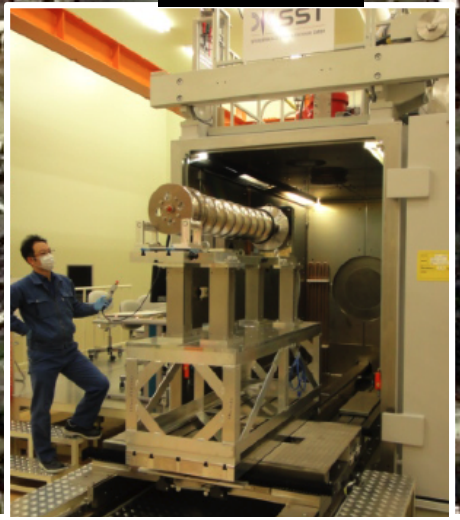
ILC R&D at KEK

STF

ATF

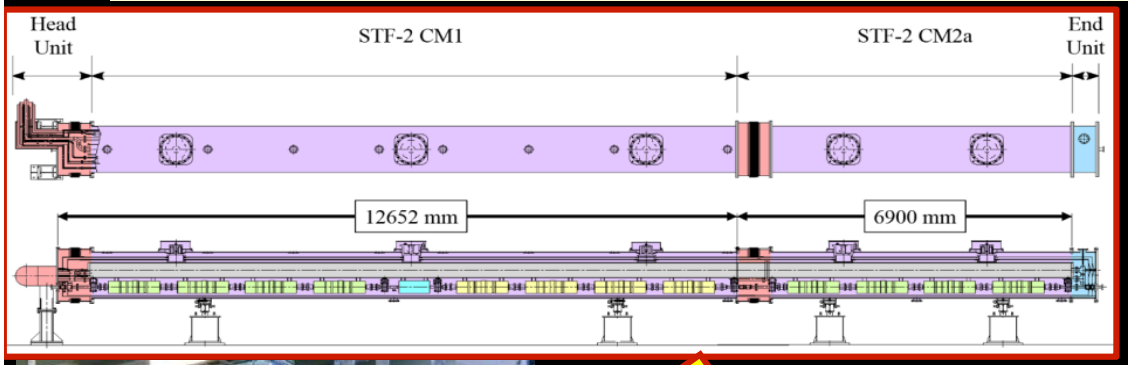


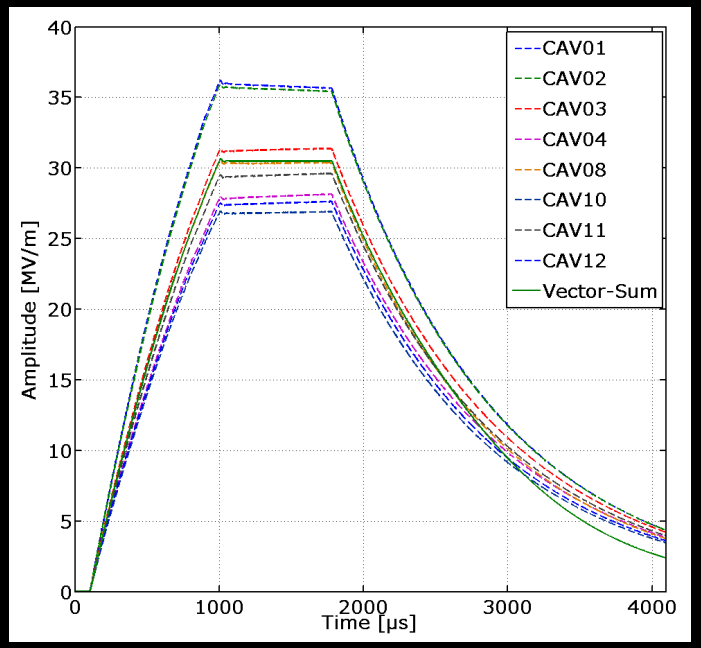
CFF



STF: Accelerator Cryomodule Test

8 Cavities were tuned on resonance by piezo, and vector-sum operation was done at 31MV/m.





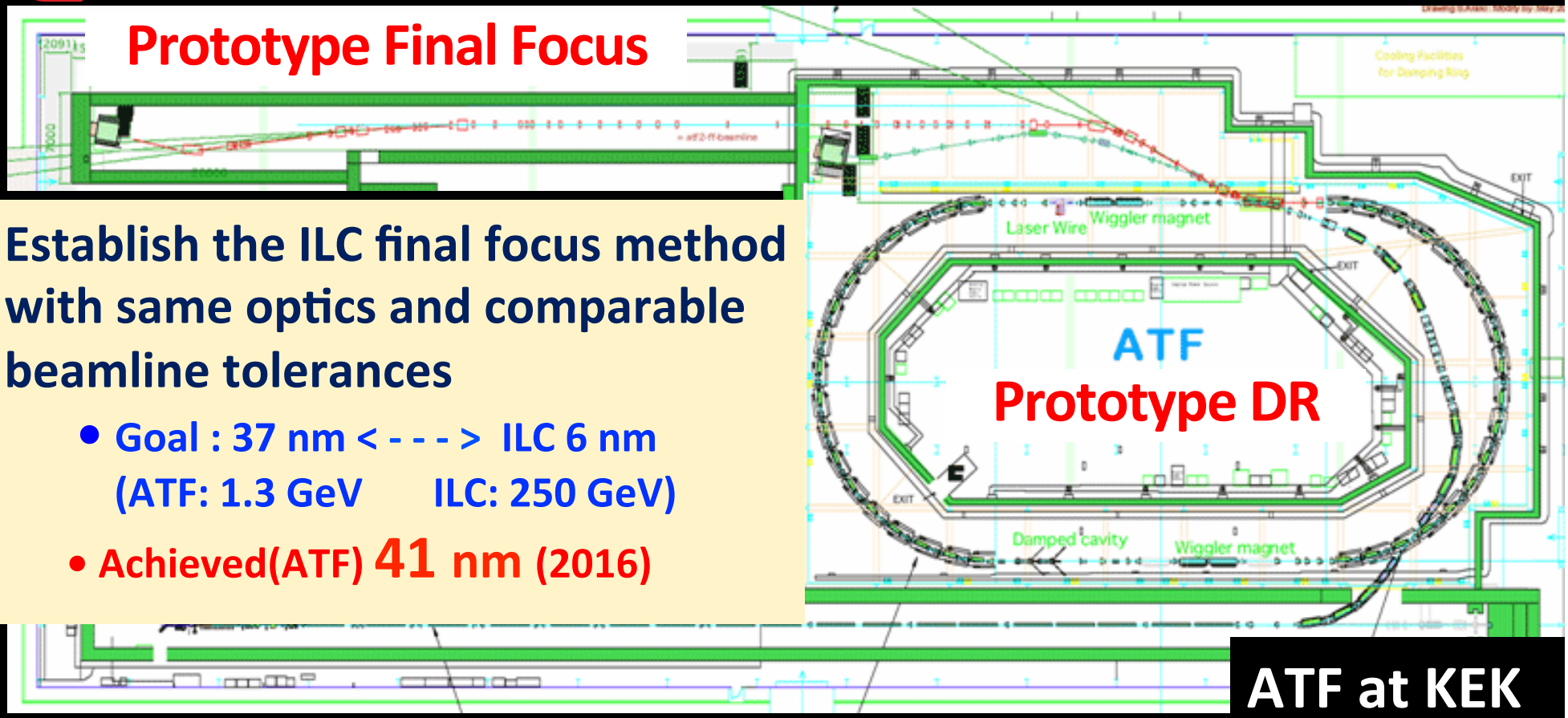
Waveguide system

STF at KEK

View from upstream

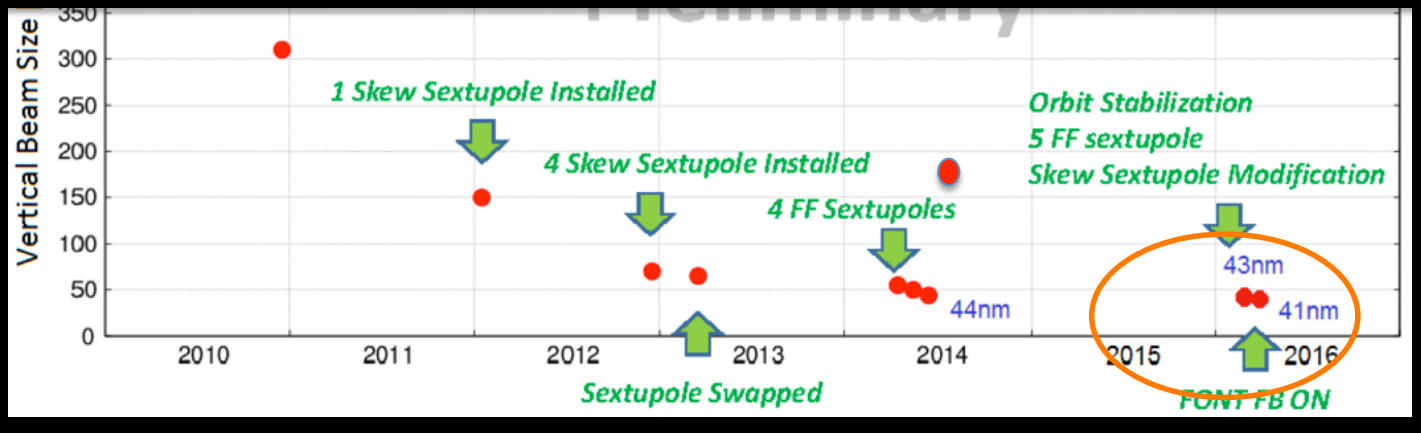
Nano-meter Beam Size at ATF

Prototype Final Focus

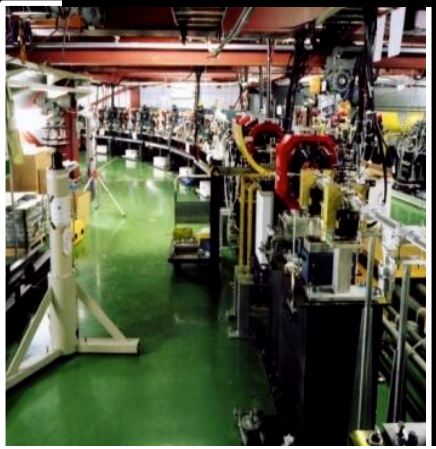


Establish the ILC final focus method with same optics and comparable beamline tolerances

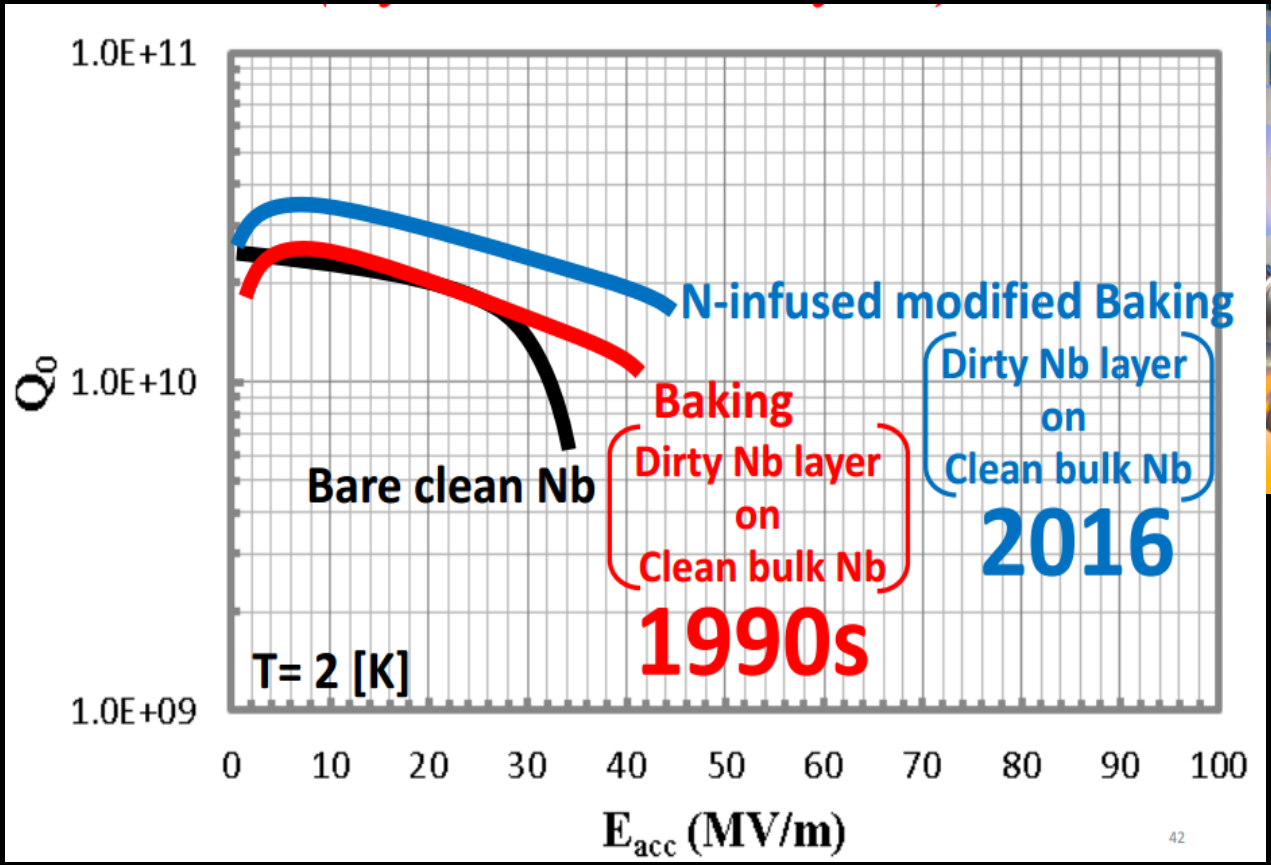
- **Goal : 37 nm < - - - > ILC 6 nm**
  (ATF: 1.3 GeV ILC: 250 GeV)
- **Achieved(ATF) 41 nm (2016)**



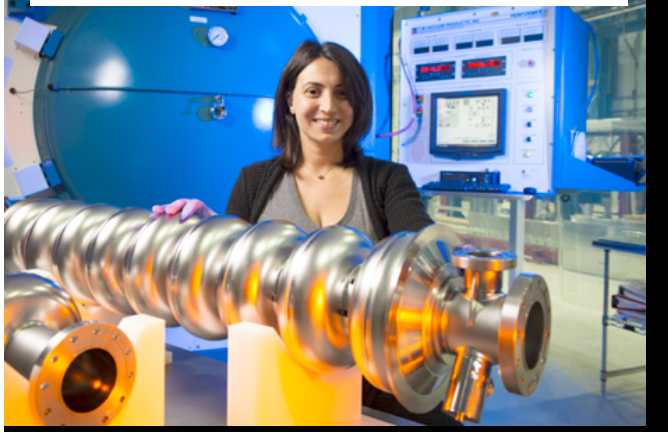
ATF at KEK

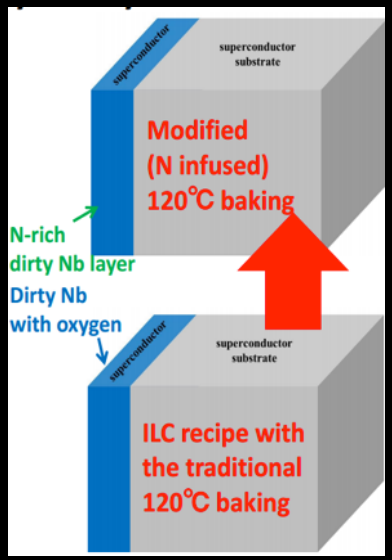


Possibility of Higher Gradient in Future
Recent Progress in FNAL



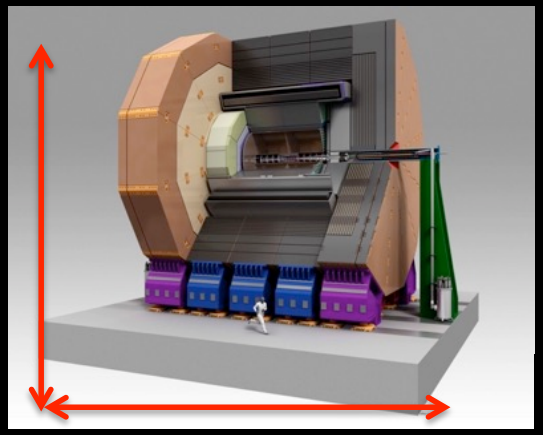
FNAL: Dr. Anna Grassellino

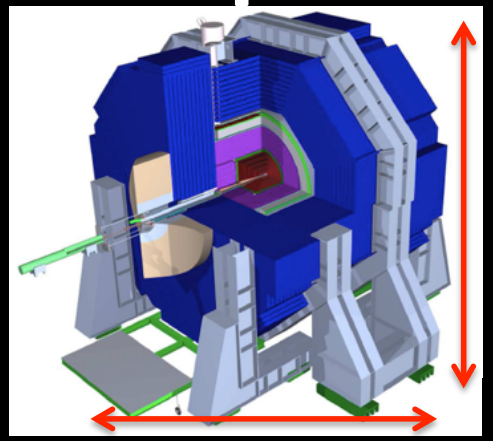




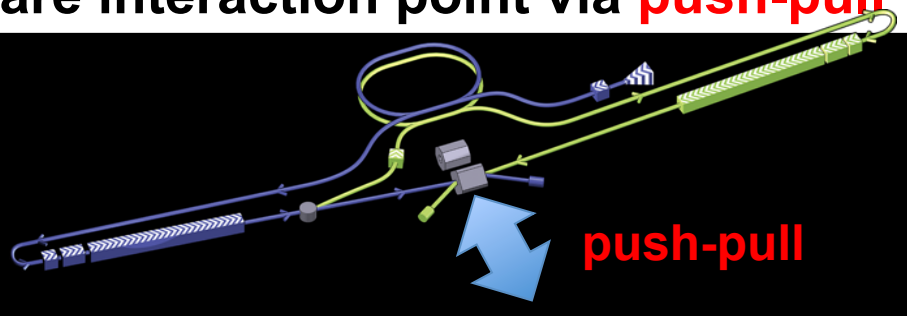
http://news.fnal.gov/2016/05/anna-grassellino-receives-2016-ieee-particle-accelerator-science-technology-award/

Two Detector Concepts





ILD	SiD
Both optimized for PFA PFA Performance ~$B \cdot R_{ECAL,inner}^2$ (two-track separation @ ECAL)	
B = 3.5 T	B = 5 T
$R_{ECAL,inner}$ = 1.8 m	$R_{ECAL,inner}$ = 1.27 m
Si + TPC tracking	Tracking: Si only
Share interaction point via push-pull	



Status of the ILC Project

Keynote by Hon. Takeo Kawamura, at LCWS 2016
a member of the House of Representatives,
President of the Federation of Diet members for ILC

Participants of LCWS2016

Supports from the World

- **European Strategy** approved by CERN Council, June 2013
  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 Statement on ILC**
  Chair: Mitsuaki Nozaki (KEK) July 2013

- **USA** Particle Physics Project Prioritization Panel (P5) Report
  Chair: Steve Ritz (UC Santa Cruz), May 2014

Supports from Policy Makers and Industries in Japan

- **Federation of Diet members to promote ILC**

160 Diet Members
(*both the Upper and Lower Houses*.)

Supreme advisor	**Kaoru Yosano**
President	**Takeo Kawamura**
Secretary-general	**Ryu Shionoya**

- **Advanced Accelerator Association, AAA**

100 Companies and 30 Universities

Honorary Chairman	**Masatoshi Koshiba**
Supreme advisor	**Kaoru Yosano**
Chairman	**Takashi Nishioka**
Vise-Chairman	**Atsuto Suzuki**

LCC Director Lyn Evans' Courtesy visit to Prime Minister Shinzo Abe

March 2013, Tokyo

Dr. Lyn Evans, LCC Director Prime Minister Shinzo Abe

Photo: Prime Minister's Office
http://japan.kantei.go.jp/96_abe/actions/201303/27ilc_hyokei_e.html

US-Japan dialogues

"Federation of Diet members for ILC" is successively dispatching delegations to US.

Hon. R. Shionoya
Secretary-general of the Federation

2013 Joint Symposium at Washington DC

The first visit

Hon. S. Suzuki
Hon. T. Otsuka
Hon. R. Shionoya

2016 Meeting at Hudson Institute

It was proposed to form US-Japan discussion group by both governments

↓

It was formed soon later.

ILC Collaboration with Indian Physicists

- Representatives from 10 Indian accelerator labs and KEK had a meeting to discuss Indian involvement in ILC.
- Agreed to set up “Indo-Japan Centre for Accelerators and Detectors” in Banaras Hindu University as a base of Indian participation in ILC.

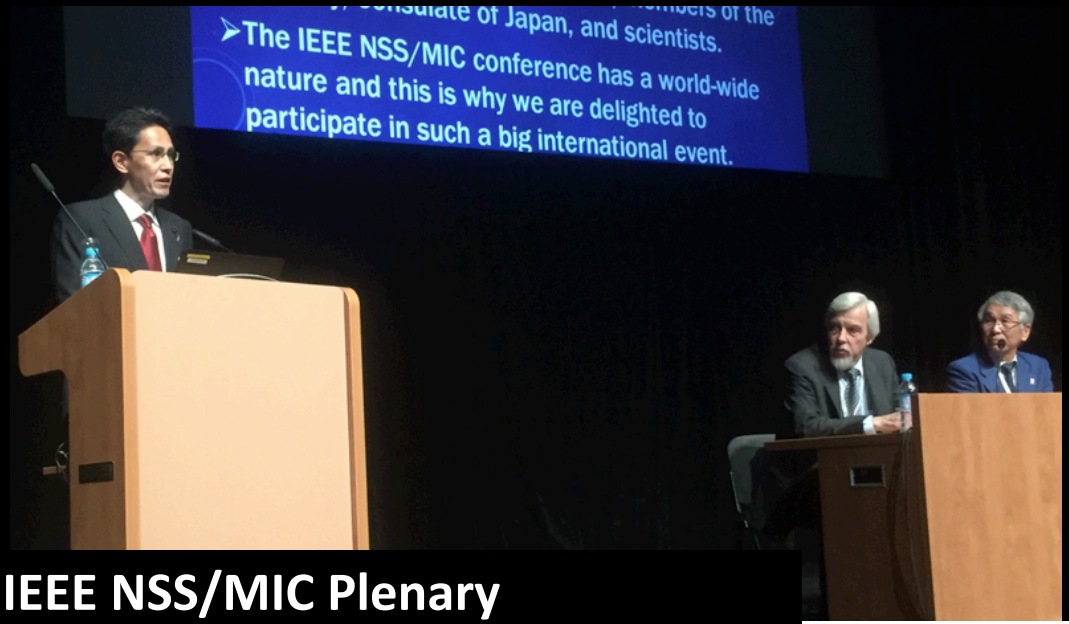
April 29, 2016, IUAC, Delhi

Dr. K.P. Upadhyay
Registrar

Dr. Masanori Yamauchi
Director General

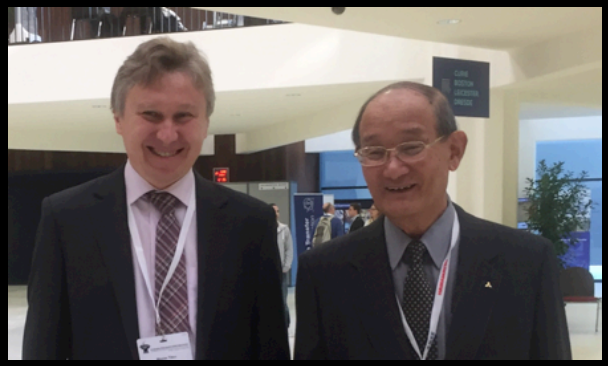
- Jan 30th, 2017
- MoU was signed by both by Banaras Hindu University and KEK

IEEE NSS/MIC Conference, Strasbourg, France
29 Oct 2016 - 6 Nov 2016



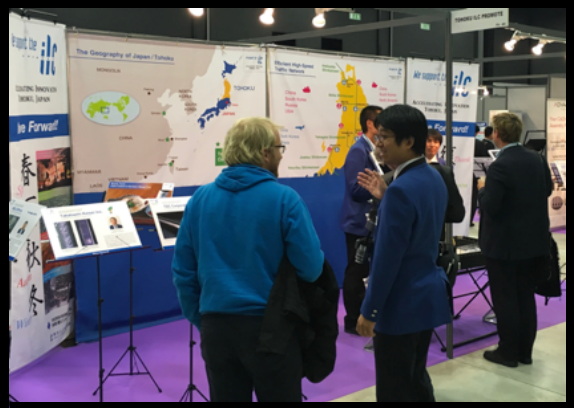
IEEE NSS/MIC Plenary
Hon. T. Shina
Federation of Diet members for ILC

Industrial Exhibition



Dr. M. Titov
Conference Chair.

Mr. T. Nishioka
AAA Chair.



Industrial Exhibition

EU-Japan VIP meeting Hon. S. Ito
Federation of Diet members for ILC

Official government-level consideration is ongoing in Japan

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

Science Council of Japan → Recommendation in 2013 → **MEXT**

ILC Taskforce
formed in 2013

Commissioned Survey by NRI
(in 2014, and 2015)

ILC Advisory Panel
in JFY 2014

First meeting
8-May-2014

- **Particle & Nuclear Phys. WG** in 2014 - 2015
- **TDR Validation WG** in 2014 - 2015
- **Human Resources WG** in 2015 - 2016
- **Management WG** (coming soon) in 2017

LCWS2016 at Morioka Japan

Dec 2016

Keynote by Hon. Takeo Kawamura,
a member of the House of Representatives,
President of the Federation of Diet members for ILC

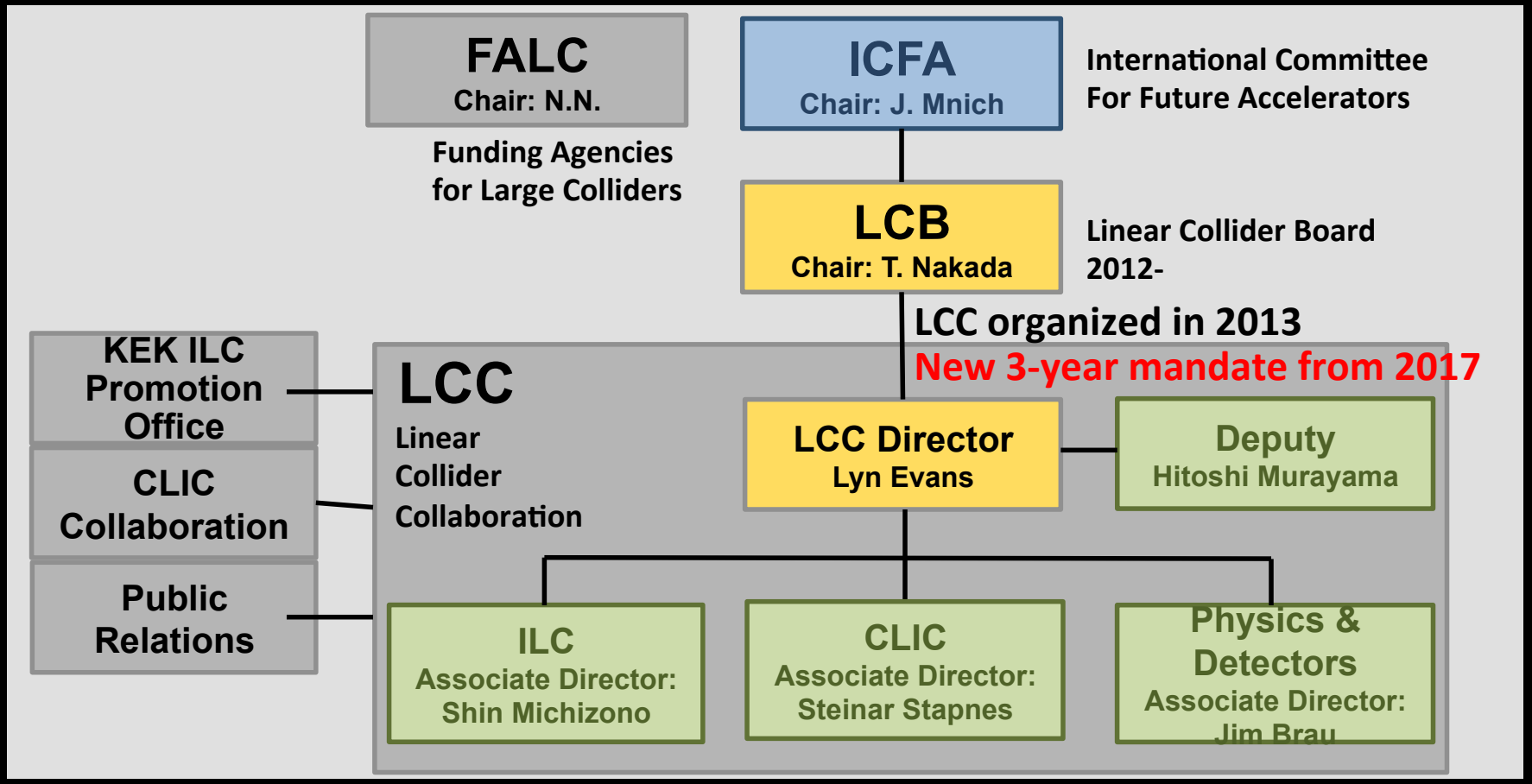
Standing ovation

About 350 participants

LCB/LCC Organization 2017

New LCC managements
Press Conference
at Morioka Japan
Dec 2016

S. Stapnes J. Brau L. Evans H. Murayama S. Michizono



Summary

- **Physics case for ILC is very simple and strong.**
  - **Higgs, top, new physics.**
- **ILC accelerator design is 'ready'.**
- **The ILC detectors are pushing the state of the art of particle detection technologies.**
- **There are strong supports by the international science community.**
- **Official government-level consideration is ongoing in Japan**