#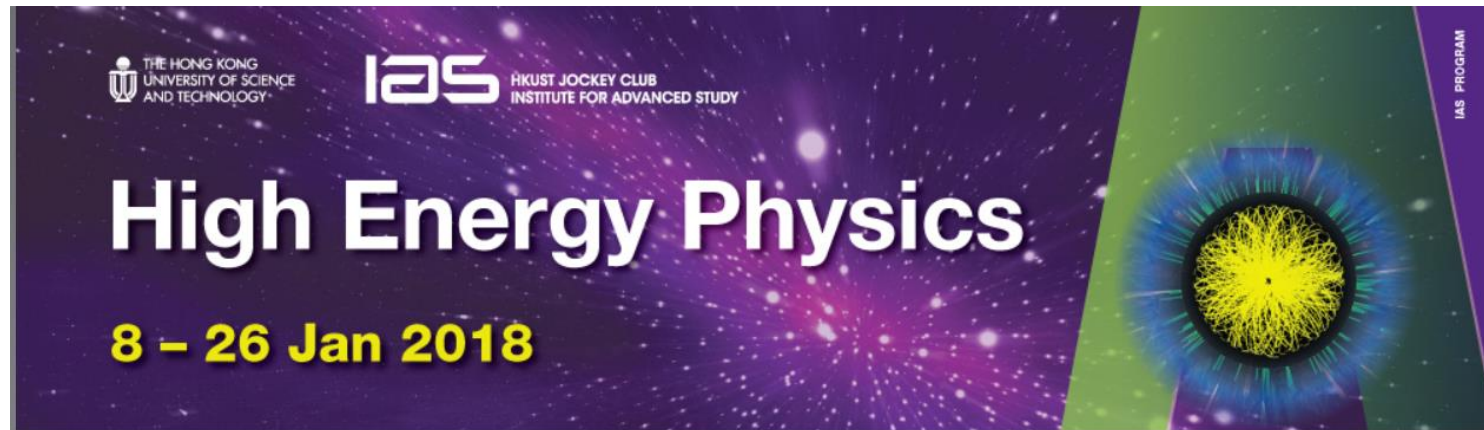 Challenges/Problems Yet-to-be Addressed Before the Construction of the ILC (my personal view)

Masakazu Yoshioka (KEK Professor Emeritus)

Since 2013, my position is Tohoku/Iwate University

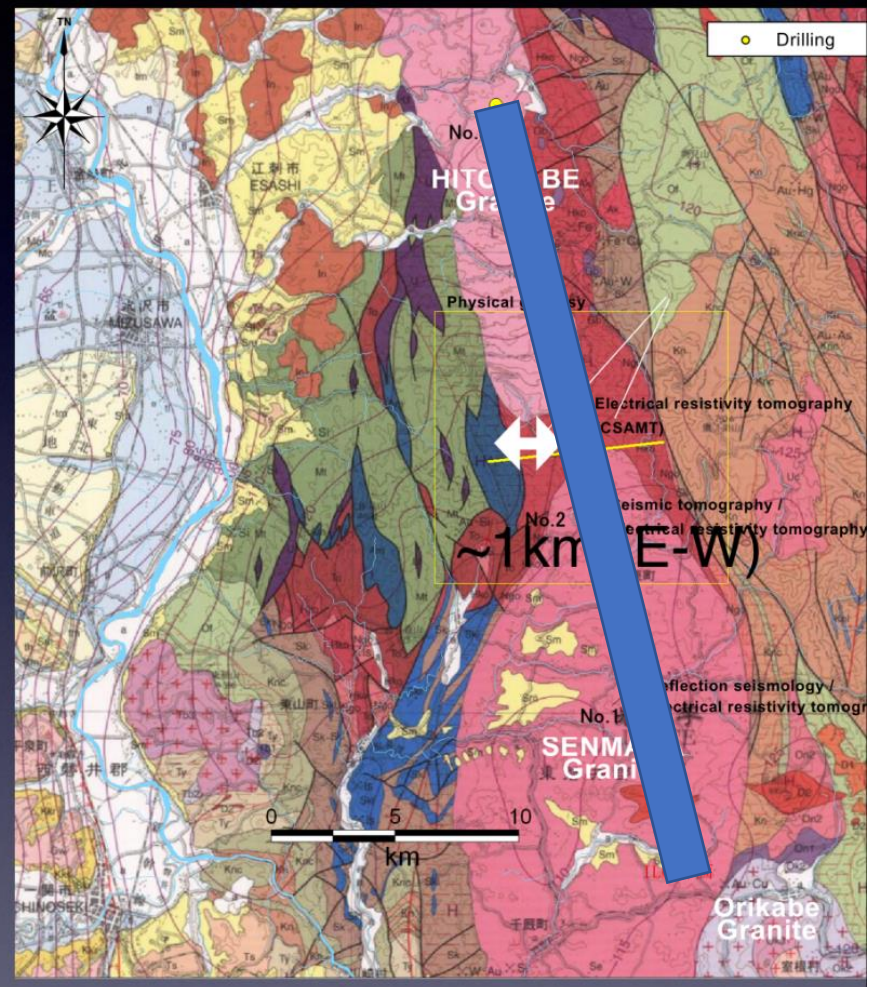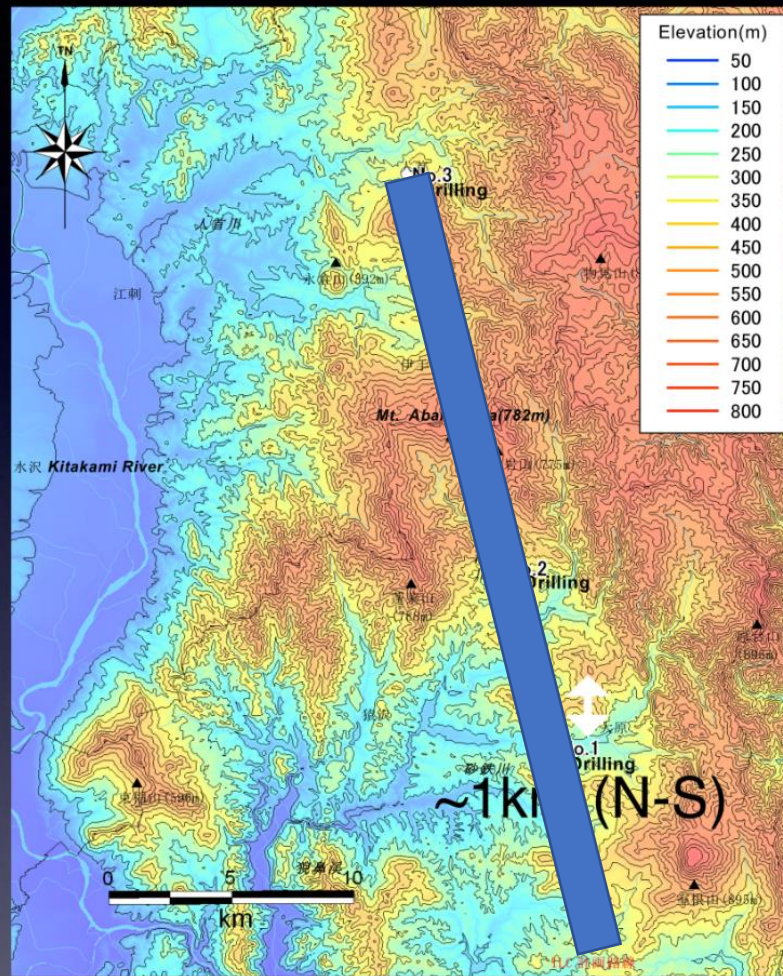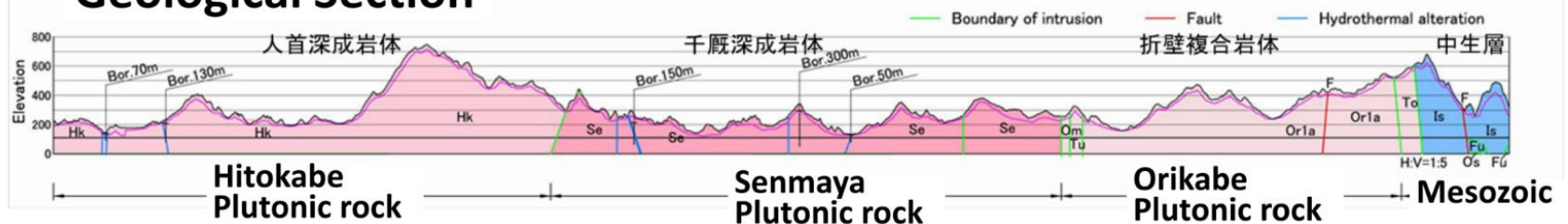Tohoku ILC Promotion Council/Tohoku ILC Preparation Office

Jan 25 2018

THE HONG KONG UNIVERSITY OF SCIENCE AND TECHNOLOGY

IaS HKUST JOCKEY CLUB INSTITUTE FOR ADVANCED STUDY

IAS PROGRAM

High Energy Physics

8 – 26 Jan 2018

Remind about the ILC in Kitakami candidate site

Basic policy of the ILC construction: Staging scenario
20.5km ⇒　31km　⇒　50km
250GeV⇒　500GeV⇒　1 TeV

The Kitakami candidate site has a potential to accept the 50km ILC

Staging

ILC 500GeV

~31km

Cost reduction by compact ILC

ILC 250GeV

~20km

Option A   ECM=250GeV   SRF 31.5MV/m

	2437.58m		4950.26m		3489.0m	2361.46m		4795.2m		2516m	

PM-12   PM-10   PM-8   PM+8   PM+10   PM+12

583m space   583m space

module space margin for option C, 31.5MV/m   module space margin for option C, 31.5MV/m

Ecm=250GeV

BC			e+inj			e-inj			BC	
51	90	189	189	24	module space	24	180	189	90	51
51	45	189	189	24	cryomodules	24	180	189	45	51
17	10	42	42	8	RF unit	8	40	42	10	17

e⁻ 134.8GeV = 10.0 12.8 53.5   53.5 5.0 E gain (GeV) 5.0 51.0 53.5 12.8 10.0 = e⁺ 132.3GeV
+5.8%margin

(note: 1 ML unit = 2 RF unit = 9 CMs (in TDR))

Total tunnel length = 20549.5m
(20.5km)

Shin Michizono (22 Jan 2018, ILC Status)

Location

Iwate Prefecture

花巻市

遠野市

釜石線

北上市

Mizusawa Esashi

奥州市

ILC Site

Tohoku Express way

Tohoku Shinkansen

東北本線

一関市

陸前高

Ichinoseki

Main Campus candidate Area

気仙沼市

気仙沼線

大島

Miyagi Prefecture

Central region

Satetu-gawa River

Geological Section

Hitokabe Plutonic rock — Senmaya Plutonic rock — Orikabe Plutonic rock — Mesozoic

Surface Access Stations

Option A

Site-specific design of
Surface Access stations.
arrangement can be optimized
and re-arranged site-by-site.

PM-10

electron linac

PM-8

surface design
access stations
  16,600m^2 5 area
to be further discussed.

©Rey.Hori/KEK

surface design
  IP area   78,500m^2 1 area
 to be further discussed specially
with LCC-MDI.

Interaction Region

damping ring

PM+8

positron linac

PM+10

©Rey.Hori/KEK
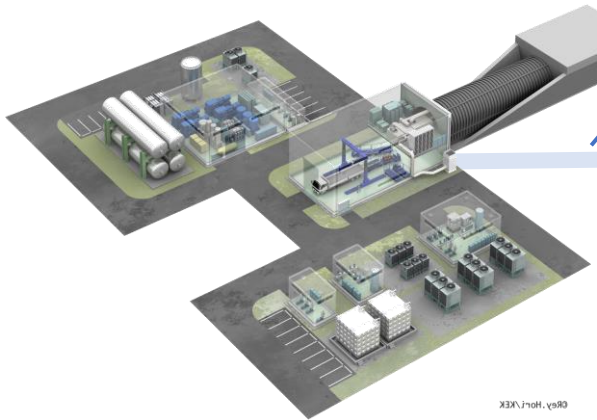
Basic Design of Underground Access Hall

Site-specific design of
Access Halls with detailed utility
design.

PM-10

Option A

electron linac

PM-8

Interaction Region

damping ring

PM+8

positron linac

To be further discussed with LCC-MDI

Utility Hall next to
the detector hall

PM+10

5-floor construction is different from just a cavern. It will be applied the control of "building standards law". Need to clear the inspection of design, proof of strength. Can we clear them?
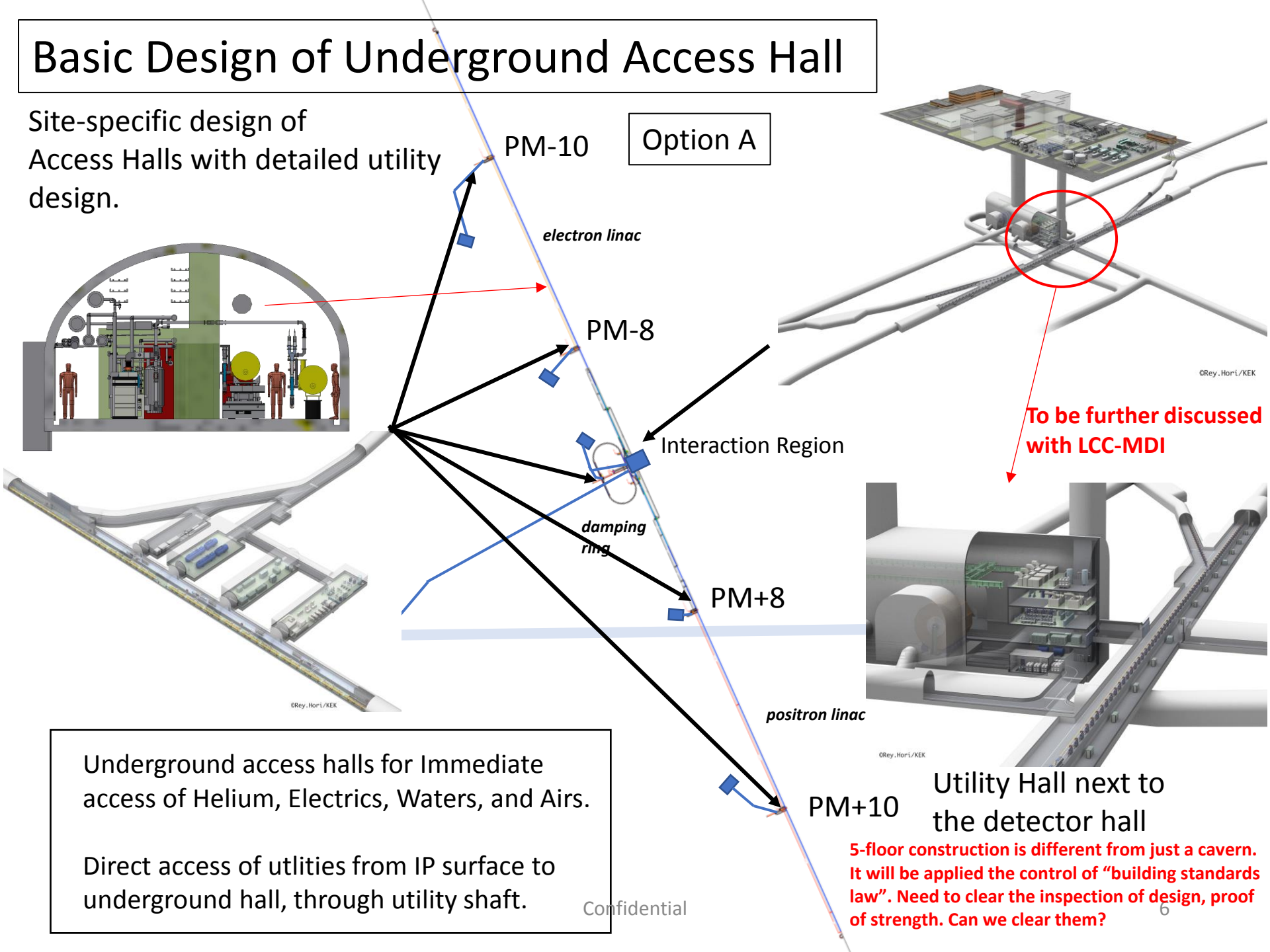
Underground access halls for Immediate access of Helium, Electrics, Waters, and Airs.

Direct access of utlities from IP surface to underground hall, through utility shaft.

©Rey.Hori/KEK

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Table 5-1: New beam parameters optimized for ILC250GeV.

			TDR		New
Center−of−mass energy	E_{CM}	GeV	250	500	250
Bunch population	N	e10	2	2	2
Bunch separation		ns	554	554	554
Beam current		mA	5.78	5.78	5.78
Number of bunches per pulse	Nb		1312	1312	1312
Collision frequency		Hz	5	5	5
Electron linac rep rate		Hz	10	5	5
Beam power (2 beams)	P_B	MW	5.26	10.5	5.26
r.m.s. bunch length at IP	σ_z	mm	0.3	0.3	0.3
relative energy spread at IP (e−)	σ_E/E	%	0.188	0.124	0.188
relative energy spread at IP (e+)	σ_E/E	%	0.15	0.07	0.15
Normalized horizontal emittance at IP	ε_{nx}	μm	10	10	5
Normalized vertical emittance at IP	ε_{ny}	nm	35	35	35
Beam polarization (e−)		%	80	80	80
Beam polarization (e+)		%	30	30	30
Beta function at IP (x)	β_x	mm	13	11	13
Beta function at IP (y)	β_y	mm	0.41	0.48	0.41
r.m.s. beam size at IP (x)	σ_x	nm	729	474	516
r.m.s. beam size at IP (y)	σ_y	nm	7.66	5.86	7.66
r.m.s. beam angle spread at IP (x)	θ_x	μr	56.1	43.1	39.7
r.m.s. beam angle spread at IP (y)	θ_y	μr	18.7	12.2	18.7
Disruption parameter (x)	Dx		0.26	0.26	0.51
Disruption parameter (y)	Dy		24.5	24.6	34.5
Upsilon (average)	Y		0.020	0.062	0.028
Number of beamstrahlung photons	n_γ		1.21	1.82	1.91
Energy loss by beamstrahlung	δ_{BS}	%	0.97	4.50	2.62
Geometric luminosity	Lgeo	e34/cm²s	0.374	0.751	0.529
Luminosity	L	e34/cm²s	0.82	1.79	1.35

The International Linear Collider
Machine Staging Report 2017
Addendum to the International Linear Collider Technical Design Report published in 2013

KEK 2017-3
DESY 17-180
CERN-ACC-2017-0097

|	
E_{cm}	250 GeV
Luminosity	**1.35 e34/cm²/s with pol. e-**
Beam power	5.26 MW (2 beams)
Wall plug power	117.3 MW

Match cooperation between following four sectors in Japan is well functioning toward getting green light hopefully this year

- Academic society (JAHEP: Japan Association of High Energy Physics)
- Political sector (Federation of diet members>150)
- Bureaucracy (MEXT: Experts meetings for FSs)
- Industry sector (AAA: Advanced Accelerator Association Promoting Science & Technology >100)

Preliminary international discussion
- Japan/US
- Japan/France
- Japan/Germany
- ACFA (Asian Committee for Future Accelerator)
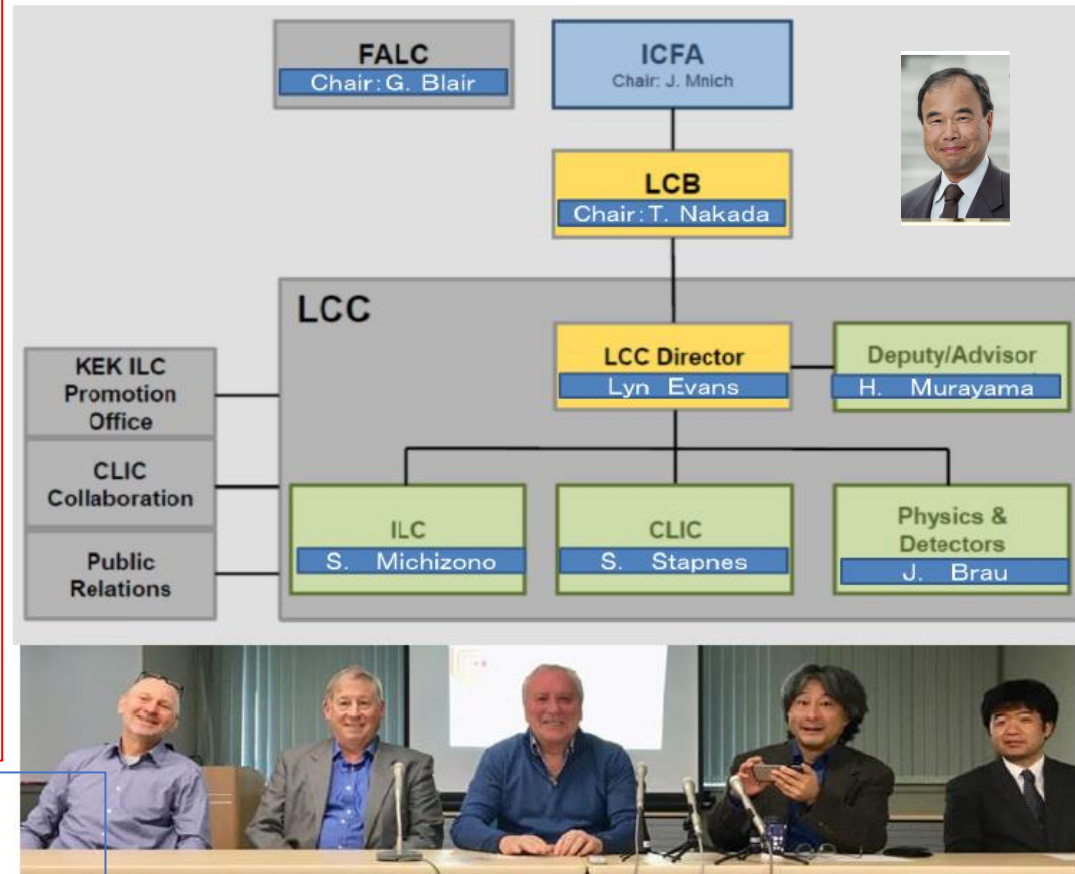
ILC Local structure in Tohoku

- Tohoku ILC Promotion Council
    - Academy, Tohoku Economy Federation and local governments
- Tohoku ILC Preparation Office Headed by Atsuto Suzuki ⇒site specific design

8

ICFA Statement on the ILC Operating at 250 GeV as a Higgs Boson Factory

The discovery of a Higgs boson in 2012 at the Large Hadron Collider (LHC) at CERN is one of the most significant recent breakthroughs in science and marks a major step forward in fundamental physics. Precision studies of the Higgs boson will further deepen our understanding of the most fundamental laws of matter and its interactions.

The International Linear Collider (ILC) operating at 250 GeV center-[...] excellent science from precision studies of the Higgs boson. Therefore, ICFA considers the ILC a key science project complementary to the LHC and its upgrade.

ICFA welcomes the efforts by the Linear Collider Collaboration on cost reductions for the ILC, which indicate that up to 40% cost reduction relative to the 2013 Technical Design Report (500 GeV ILC) is possible for a 250 GeV collider.

ICFA emphasizes the extendibility of the ILC to higher energies and notes that there is large discovery potential with important additional measurements accessible at energies beyond 250 GeV.

ICFA thus supports the conclusions of the Linear Collider Board (LCB) in their report presented at this meeting and very strongly encourages Japan to realize the ILC in a timely fashion as a Higgs boson factory with a center-of-mass energy of 250 GeV as an international project[1], led by Japanese initiative.

[1] In the LCB report the European XFEL and FAIR are mentioned as recent examples for international projects.
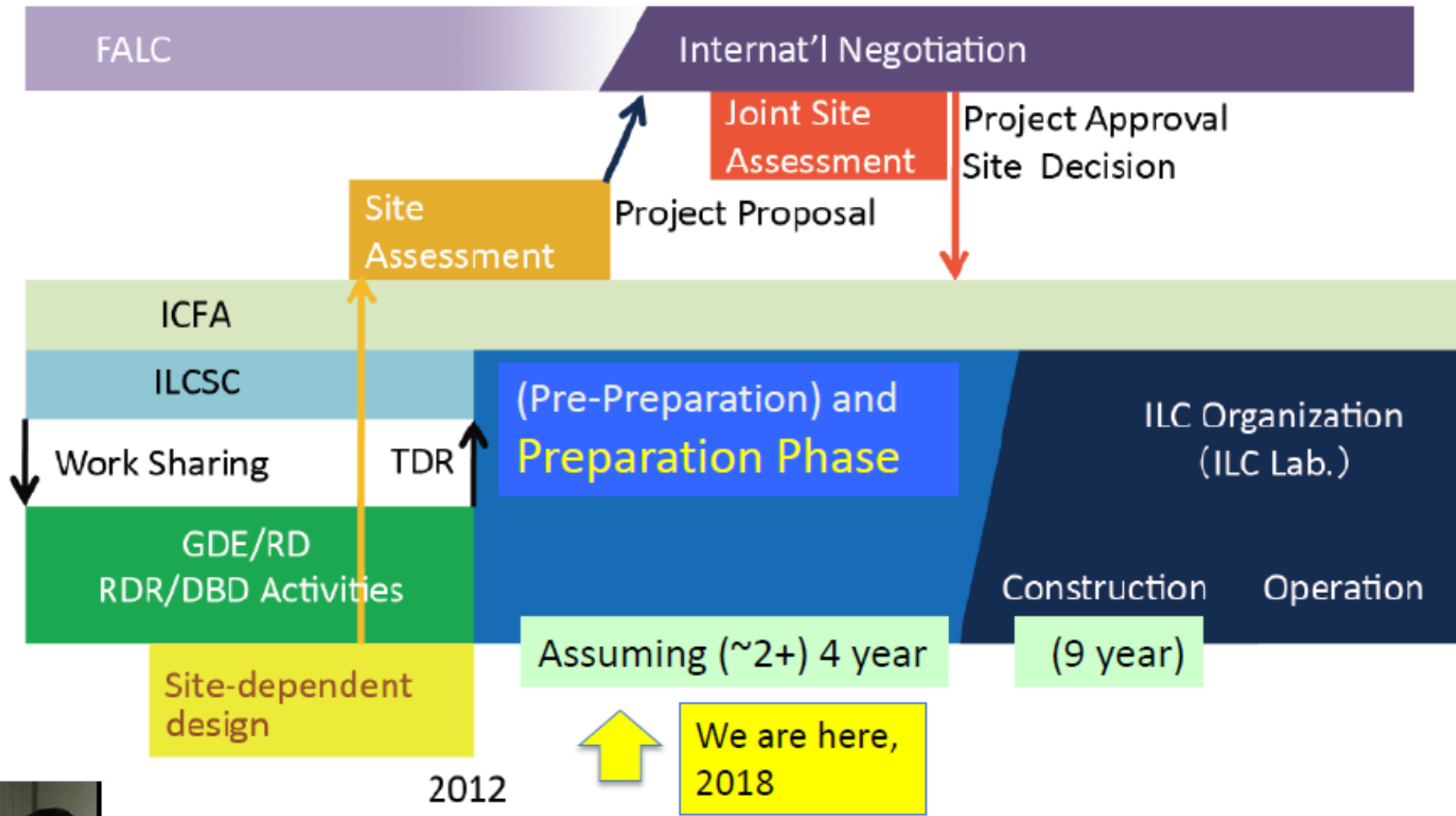
Ottawa, November 2017

http://icfa.fnal.gov/wp-content/uploads/ICFA-Statement-Nov2017.pdf

Shin Michizono (22 Jan 2018, ILC Status)

ILC Time Line: Progress and Prospect

Shin Michizono (22 Jan 2018, ILC Status)

ILC status

KEK/LCC

Shin MICHIZONO

- *The ILC250*
- *KEK's activities*
- *SRF facilities in the world, European XFEL*
- *ILC cost reduction R&D*
- *ILC250GeV staging*

Shin Michizono (22 Jan 2018, ILC Status)

Efforts by Tohoku ILC preparation office

◆ Site specific CFS design in collaboration with KEK
◆ Geological survey
- Boring survey
- Elastic wave exploration
- Electrical prospecting
- Ground survey
- Hydrological survey
=== We are trying to cover whole area ===

◆ Environmental impact assessment
◆ Investigations of various laws and regulations
- High pressure gas safety law
- Electricity business act
- Fire service act
- Building standards law
- ·······
◆ Organization of local industry alliance for ILC construction
- Cost saving
- Activation of local economy
◆ Town planning for accepting researchers and their families
◆ And many other issues------
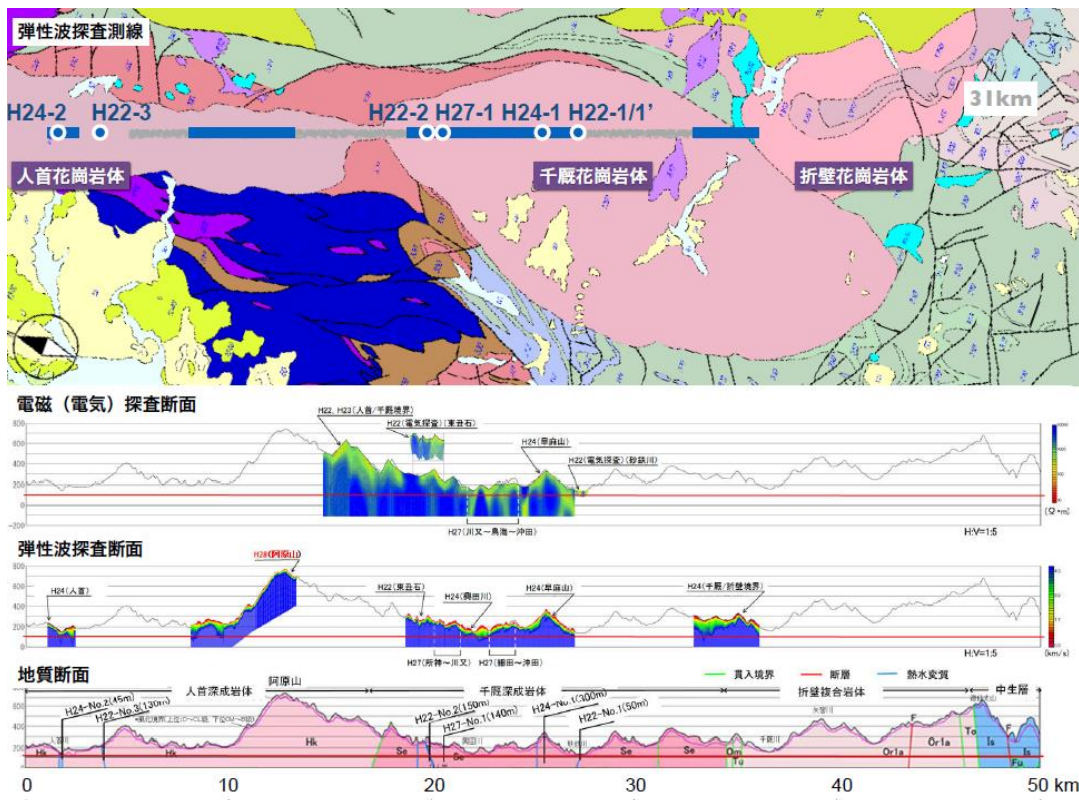
Mt. Iwate

Thank you for your attention

This is a painting by a kid of Ichi-no-seki city to welcome ILC in beautiful Kitakami candidate site.