ILC Acc. Status in Japan:

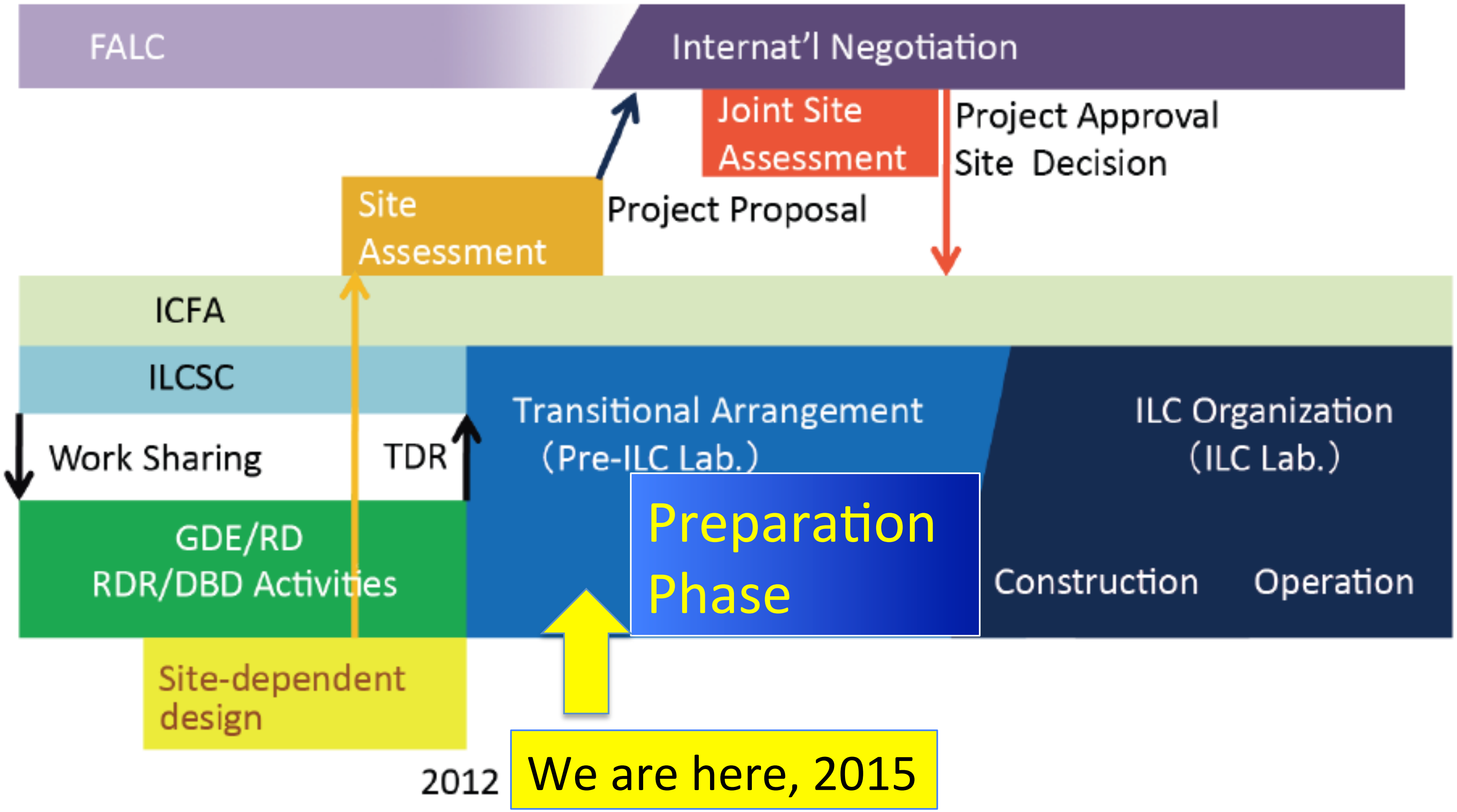
focusing to prepare for the "Preparation Phase"

Akira Yamamoto

(KEK, LC Project Office)

To be presented in SiD meeting, SLAC, 13 Jan. 2014

ILC Time Line: Progress and Prospect



MEXT's Organization for Studying ILC

based on SCJ's Recommendation

SCJ

Science Council, Japan

Recommendation in 2013

MEXT

Ministry of Education, Science, … Technology.

ILC Taskforce
formed in 2013

Academic Experts Committee
formed in 2014

Particle & Nuclear **Phys.** Working Group
formed in 2014

TDR Validation Working Group
formed in 2014

ILC project is being officially investigated by MEXT (Japanese Government), since June 2014

Well reported by H. Yamamoto Yesterday!

Focused, today !

MEXT, ILC Physics WG Members

- T.Kajita : Chair, Director of Institute of Cosmic Ray Research, Univ. Tokyo – Cosmic-ray physics,
- S. Okamura: Hosei Univ., (former Professor of Univ. Tokyo) -- Astrophysics
- H. Koiso: Head for KEK-B Accelerator of KEK -- Accelerator
- **S. Komamiya**: ICEPP, University of Tokyo – Particle physics
- H. Sakai: RIKEN, and former Prof. of Univ. of Tokyo. – Nuclear physics
- H. Shimizu: Tohoku University – Nuclear Physics
- S. Tanahashi: Nagoya University -- Particle Physics (theory)
- K. Tokushuku: Deputy Director of IPNS (physics), KEK, Particle physics
- T. Nakano: Osaka University, Director of RCNP – Nuclear physics,
- T. Nakaya : Kyoto University – Particle physics (neutrino),
- T. Hatsuta: RIKEN -- Nuclear and Hadron Physics (Theory),
- S. Matsumoto: IPMU, University of Tokyo, Particle physics (Theory),
- M. Yamauchi, Director of IPNS (Physics), KEK – Particle physics,
- T. Yamanaka ; Osaka University, -- Particle physics (Kon rare decay),
- H. Yokoyama, University of Tokyo – Science literacy, public relation in S&T

ILC TDR Verification WG Memebership

H. Yokomizo	Chair, Former Deputy Director for JPARC Center – Accelerator Science
T. Koseki	KEK, Head of JPARC Linear Accelerator --- Accelerator Science
T. Kato	JAEA, Deputy Director for JPARC Center --- Cryogenics
S. Kamigaito	RIKEN, Head of Accelerators – Accelerator Science
T. Kumagai	JASRI (Spring-8), Trustee – Accelerator Science
H. Koiso	KEK, Head of KEK-B Accelerator – Accelerator Science
S. Sasaki	Hiroshima U. --- Accelerator Science and Photon Science
H. Tanaka	RIKEN, Spring-8 --- Accelerator Science
F. Naito	KEK, Head of JPARC Linear Accelerators – Accelerator Science
K. Noda	NIRS – Accelerator Science and Medical Application

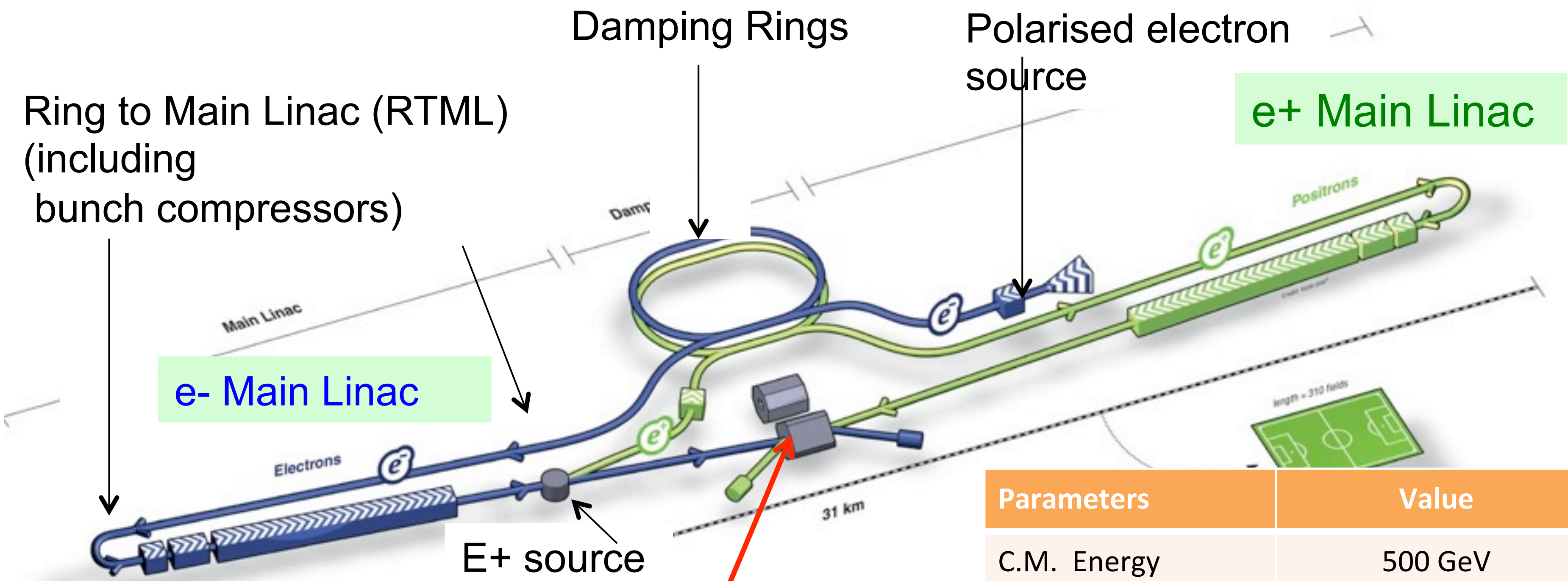
Schedule for Committee and WGs

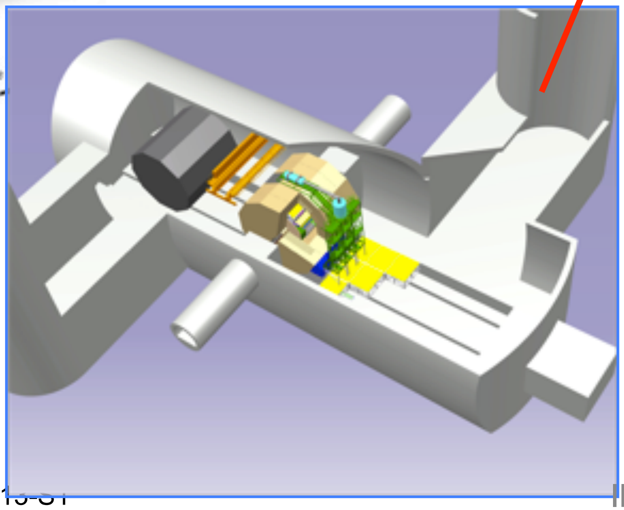
Experts committee	
	date
1	May, 2014
2	Nov. 2014
(3)	April, 2015

Physics WG		
	date	Subject
1	6/24	Status of Particle Physics and ILC physics overview
2	7/29	Future prospect in the US and in Europe
3	8/27	Cosmic-ray and Astrophysics, and ILC
4	9/22	Flavor and Neutrino physics, and ILC
5	10/21	Interium summary to be input to the Experts Committee
6	1/6	Experience from SSC

TDR Validation WG		
	date	Subjects
1	6/30	Overview
2	7/28	ML and SRF
3	9/8	SRF Q&A,, CFS
4	11/4	Schedule and Project Management including Cost and Human Resource
5		Acelerator system (Source, DR, BDS etc). Detectors How to prepare for human resource

ILC TDR Layout





Parameters	Value
C.M. Energy	500 GeV
Peak luminosity	1.8 x10^{34} $cm^{-2}s^{-1}$
Beam Rep. rate	5 Hz
Pulse duration	0.73 ms
Average current	5.8 mA (in pulse)
E gradient in SCRF acc. cavity	31.5 MV/m +/-20% Q_0 = 1E10

Technical Highlight in TD Phase

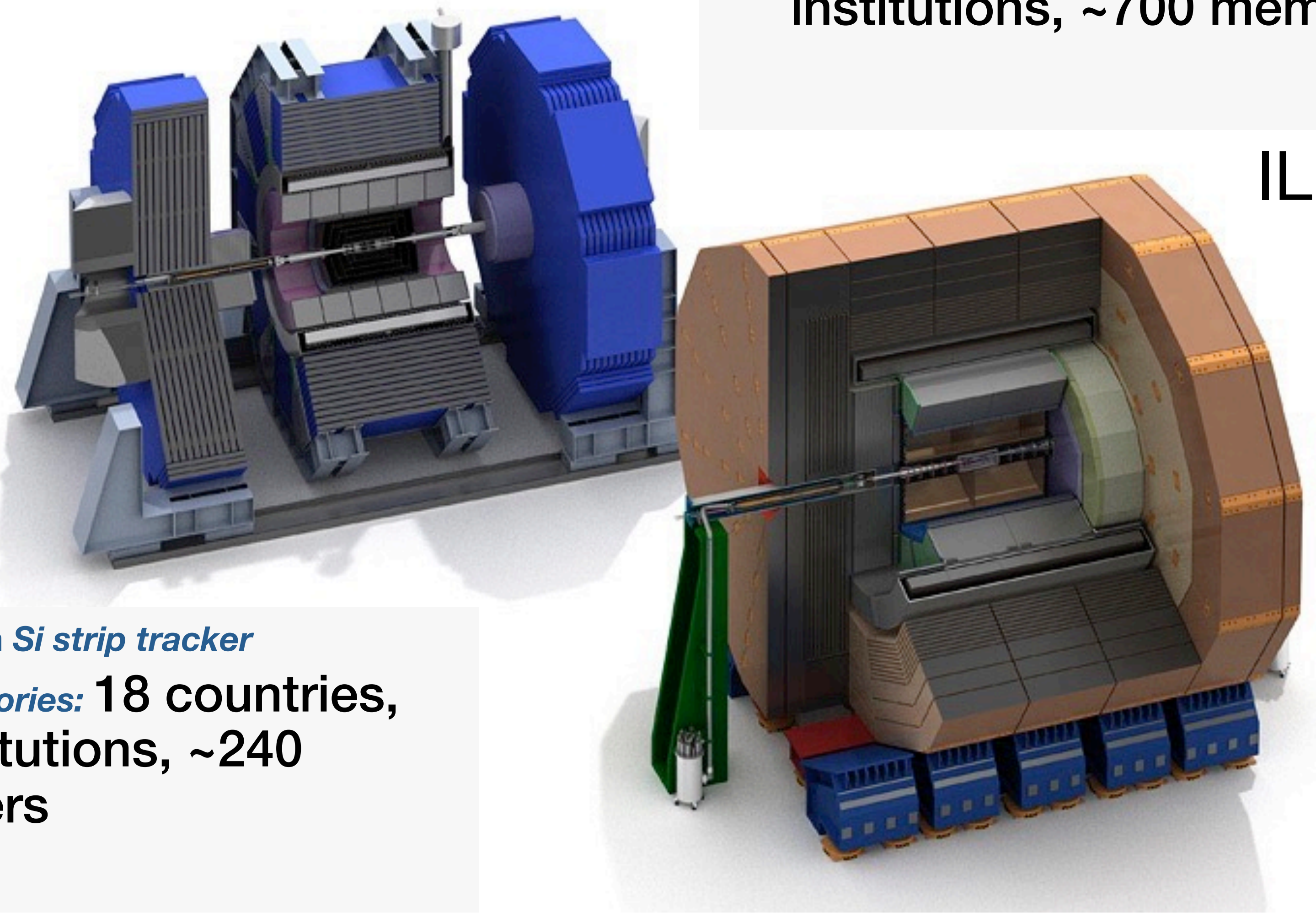
- SCRF Technology
  - Cavity: High Gradient R&D:
    - 35 MV/m with 50% yield by 2010 , and 90% by 2012 (TDR)
    - Manufacturing with cost effective design
  - Cryomodule performance including HLRF, and LLRF
  - Beam Acceleration
    - 9 mA: FLASH
    - 1 ms: STF2 - Quantum Beam
- Nano-beam handling
  - ILC-like beam acceleration
    - 4 pm: Ultra-low beam emittance: Cesr-TA, ATF
    - 44 nm: Ultra-small beam size at FF at ATF2
      - corresponding to ~7 nm at ILC energy

Two Detector Concepts in the ILC TDR

The number of Participants

- Large R with ***TPC tracker***
  - ***LOI signatories:*** **32 countries, 151 institutions, ~700 members**

ILD

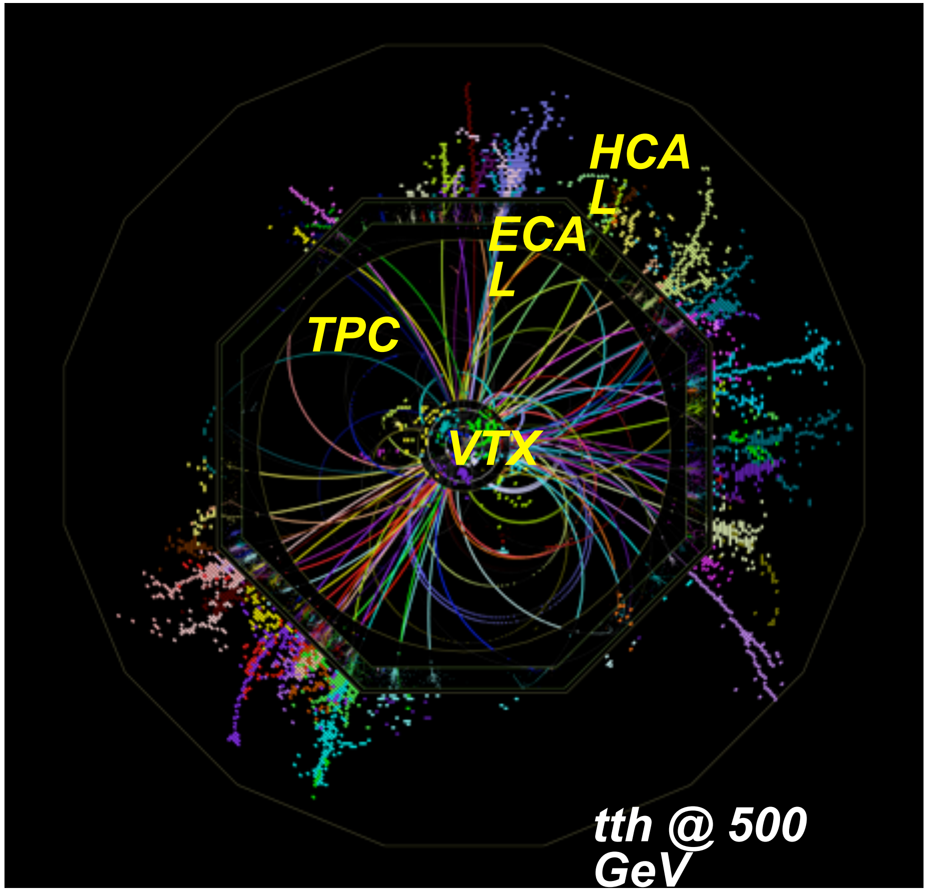


SiD

- High B with ***Si strip tracker***
  - ***LOI signatories:*** **18 countries, 77 institutions, ~240 members**

Features of ILC Detectors

- ILC detector performances
  - P resolution: X 100 of LHC
  - 細密度 : X 100 ~ 1000 of LHC
- It may be realized under very clean condition compared with LHC
- Cost to be equivalent or less compared with LHC detectors



ILC Project Overview anticipated

Years	TDR baseline Scenario
1 - 2	Pre-preparation for 2yrs (We are here !)
3 - 6	Preparation (4 yrs)
7 - 15	Construction (9 yrs)
(12 -)	(start installation)
16 -	Beam Commissioning start
17 –	Operation at 250 ~ 500 GeV (550 GeV)
TBD	Toward 500 GeV HL upgrade
TBD	Toward 1 TeV upgrade

ILC 準備期間に於ける主要課題

Main issues in the ILC Preparation Phase

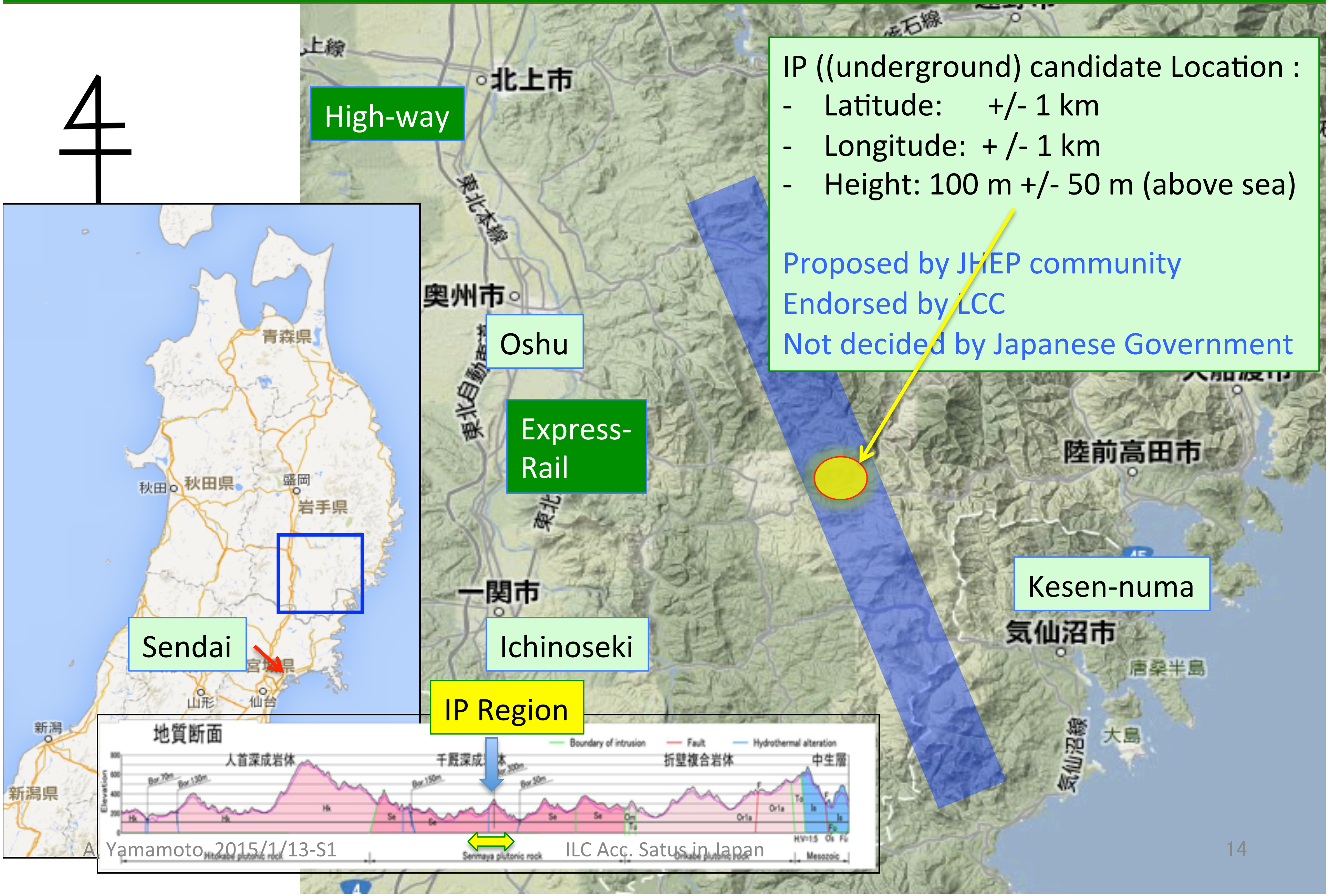
分野 (field)	課題 (Issues/Subjects)	協力体制 (Global Cooperation)
施設設計 CFS	候補地特性を反映した地質環境調査: Site-specific CFS design, env. assess. 基本計画、詳細設計、図面整備 General plan, eng. Design, drawings	JP-CFSがコアとな の連携 JP-CFS to take a central role in cooperation with global experts and regional experts.
加速器設計 Acc. Design Int.	詳細設計・パラメータ最適化 Engineering design, Parameter optim.	LCC-ILCを中心とした国際連携による検討 LCC-ILC to take a central role with global cooperation
SRF技術 SRF	製造・性能検証技術、 Fabrication & Test tech. (Hub-function) 性能の安定化 Stabilization of the performance	Tesla Tech. Collab., as common community - KEK-STF: Hub-Lab function - EXFEL: mass production and testing - LCLS : mass production and testing
ナノビーム技術 Nano-beam	低エミッタンス、極小ビームの安定的実現、運用 Ultra low emittance, nano-beam to be realized and stabilized	ATF Collab. As common community - KEK-ATF to be maximized in use, as a global unique facility for next generation training as well as the advance studies.
研究所運営 Management	新国際研究所の設立準備 Preparation for the int'l ILC laboratory	今後の検討課題 A main Issue for the ILC to be prepared

TO be discussed more in later session

CFS related works in progress to be discuss more in later sessions

- Site specific CFS work assuming Kitakami-site:
  - Accelerator Layout including IR location to be optimized
  - Detector hall design with the vertical shaft access
    - Assuming the IR point shifted ~ 800 m to north,
      - Authorized by Change Management Board (CMB), as CR-003.
  - ML ”tunnel” length, under investigation (CR-004), to be optimized further for:
    - Matching of e+ and e-accelerator lengths for the adequate timing,
    - Reserving further adequate operational margin of SRF cavity

ILC Candidate Location: Kitakami Area



IP ((underground) candidate Location :

- Latitude: +/- 1 km
- Longitude: + /- 1 km
- Height: 100 m +/- 50 m (above sea)

Proposed by JHEP community
Endorsed by LCC
Not decided by Japanese Government

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ILC-ACC 国際協力・組織構成

ILC Accelerator Organization

LCC-ILC Director: M. Harrison, Deputies: N. Walker and H. Hayano *KEK LC Project Office Head: A. Yamamoto

Sub-Group	Global Leader Deputy/Contact p.	KEK-Leader* Deputy	Sub-Group	Global Leader Deputy/Contact P.	KEK-Leader* Deputy
ADI	**N. Walker (DESY)** K. Yokoya(KEK)	K. Yokoya	**SRF**	**H. Hayano (KEK)** C. Ginsburg (Fermi), E. Montesinos (CERN)	H. Hayano Y. Yamamoto
Sources (e-, e+)	**W. Gai (ANL)** M. Kuriki (Hiroshima U.)	T. Omori	**RF**	**S. Michizono (KEK)** TBD (AMs , EU)	S. Michizono T. Matsumoto
Damping Ring	**D. Rubin (Cornell)** N. Terunuma(KEK)	N. Terunuma	**Cryogenics** (incl. HP gas)	**H. Nakai: KEK** T. Peterson (Fermi), D. Delikaris (CERN)	H. Nakai Cryog. Center
RTML	**S. Kuroda (KEK)** A. Latina (CERN)	S. Kuroda	**CFS**	**V. Kuchler (Fermi)** M. Miyahara (KEK), J. Osborne (CERN),	M. Miyahara T. Sanuki
Main Linac	**N. Solyak (Fermi)** K. Kubo (KEK)	K. Kubo	**Rad. Safety**	**T. Sanami (KEK)** TBD (AMs) S. Roesler (TBD, CERN)	T. Sanami T. Sanuki
BDS	**G. White (SLAC),** R. Tomas (Cern) T. Okugi(KEK)	T. Okugi	**Elect. Support** (PS etc.)	TBD	TBD
MDI	**K. Buesser (DESY)** T. Tauchi (KEK)	T. Tauchi	**Mechanical S.** (Vac. & others)	TBD	TBD
			Dom. Program, Hub Lab. Funct.	TBD	H. Hayano T. Saeki

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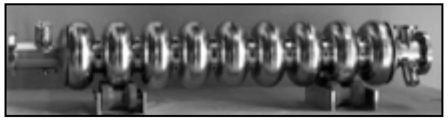
SCRF Procurement/Manufacturing Model

ILC Host-Lab



Technical Coordination for Lab-Consortium

Regional Hub-Lab: A

Regional Hub-Lab: E, & …

World-wide Industry responsible to **'Build-to-Print' manufacturing**

・市場は世界共通
・企業は製造責任
・研究所が性能責任

Regional Hub-Lab: B

Regional Hub-Lab: D

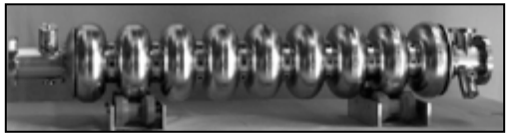
Regional Hub-Lab: C: **responsible to Hosting System Test and Gradient Performance**

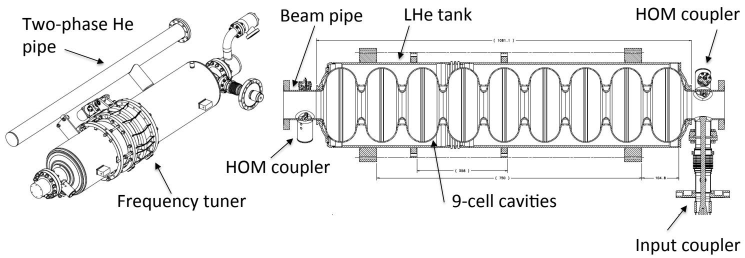
Regional hub-laboratories responsible to regional procurements to be open for any world-wide industry participation

------------ : Technical coordination link
⟷ : Procurement link

空洞･CMの製造および性能試験

Cavity/Cryomodule Fabrication





16,024 台 x 1.1

1,855 台

- Purchasing Material/Sub-component
- Manufacturing Cavity：機械加工
- Processing Surface：表面処理
- Assembling LHe-Tank ：組み立て
- Qualifying Cavity, 100 %：性能評価
- Cavity String Assembly：多連空洞組立
- Cryomodule Assembly:: CM 組立
- Qualifying CMs, 33 + 5 %：CM性能評価

A Model for Cavity and CM Production and Qualification Process

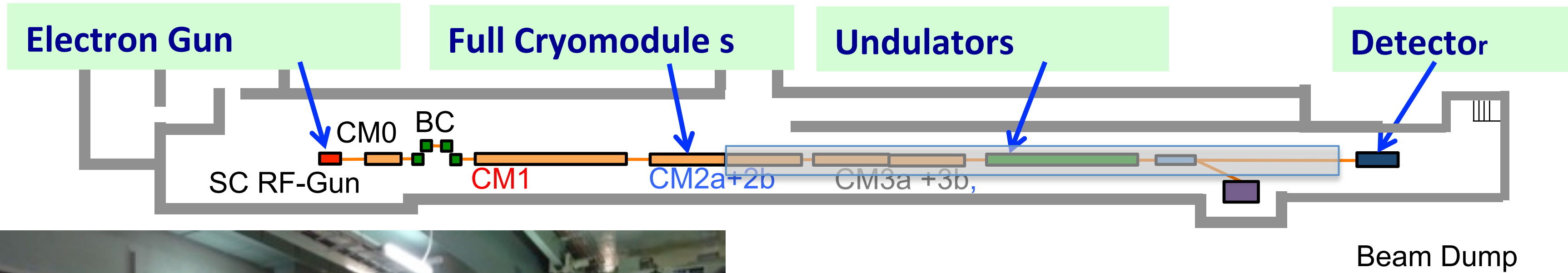
空洞とクライオモジュール製造と性能評価

Step hosted	Industry	Industry/ Laboratory	Hub-laboratory	ILC Host-laboratory
Regional constraint	no	yes or no	yes	yes
Sub-comp/material - Production/Procurement	Nb, Ti, specific comp. …		Procurement	
9-cell Cavity - Manufacturing	9-cell-cavity, Process, He-Jacketing		Procurement	
9-cell Cavity - Performance Test			Cold, gradient test	
Cryomodule component - Manufacturing	V. vessel, cold-mass …		Procurement	
Cryomodule/Cavity - Assembly		Cav-string/ CM-assembly		
SCRF Cryomodule - Performance Test			Cold, gradient test	
Accelerator integration, Commissioning				Accelerator sys. Integ.

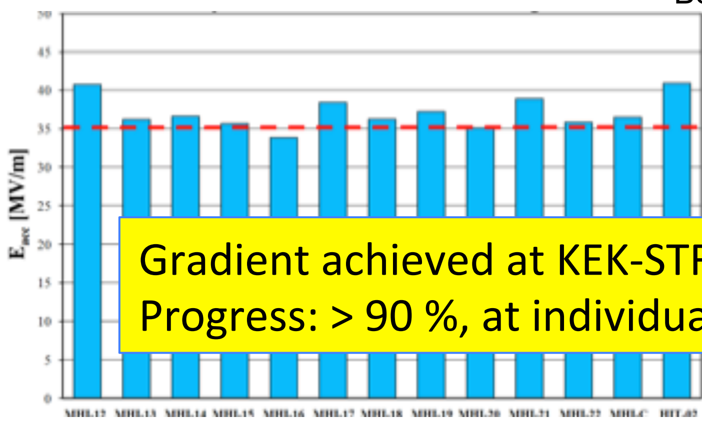
STF2; SCRF ACCELERATOR PLAN AT KEK

■ Objective
- High Gradient (31.5 MV/m)
  ＝＞Demonstration of full cryomodule
- ・Pulse and CW operation (for effectuve
- Training for next generation s

Plan:
- Multiple CM for system study
- In-house Cavity to be installed in cooperation with industry
- Wide range application including Photon Science

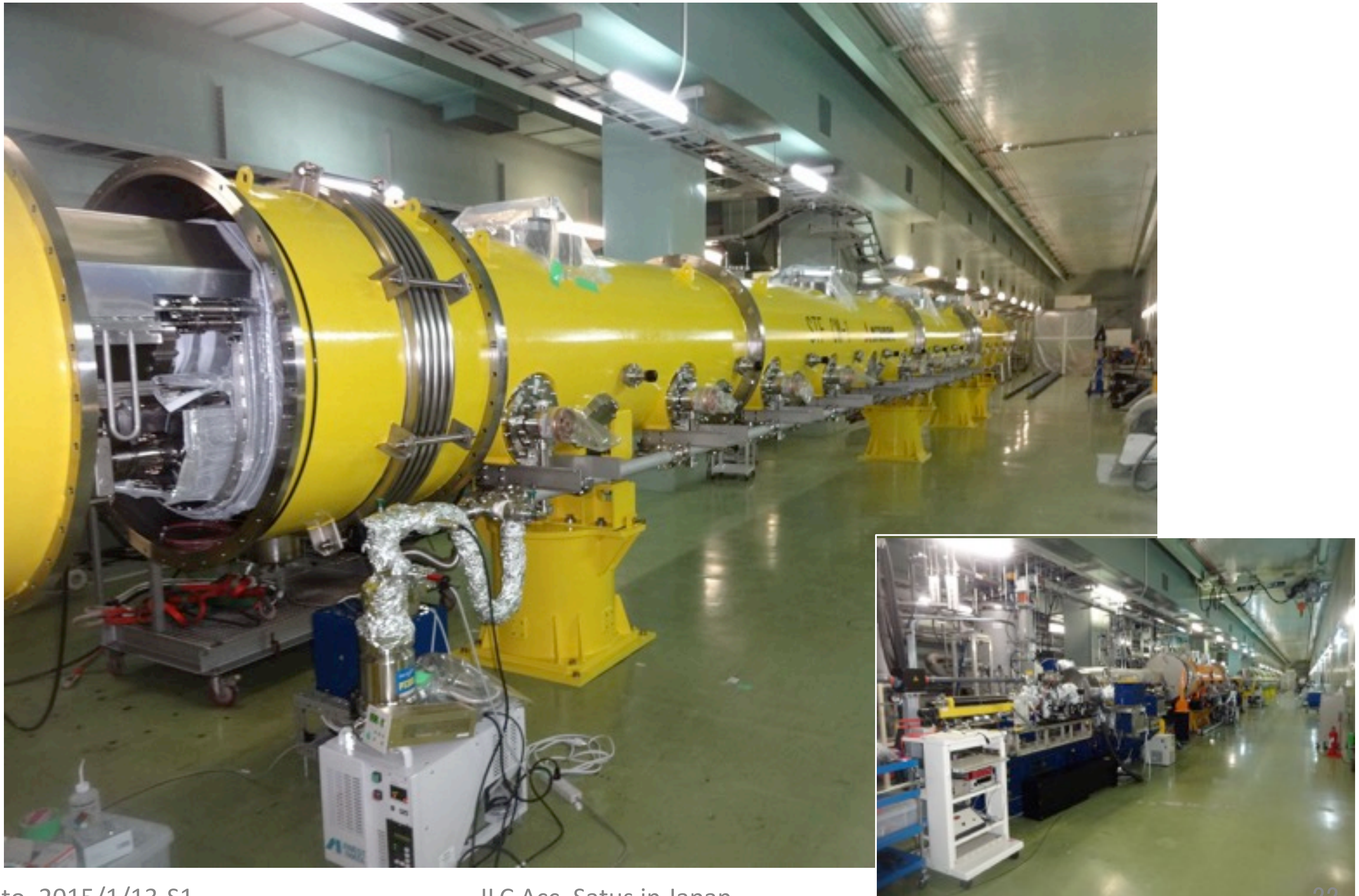


Beam Acceleration to be in 2015



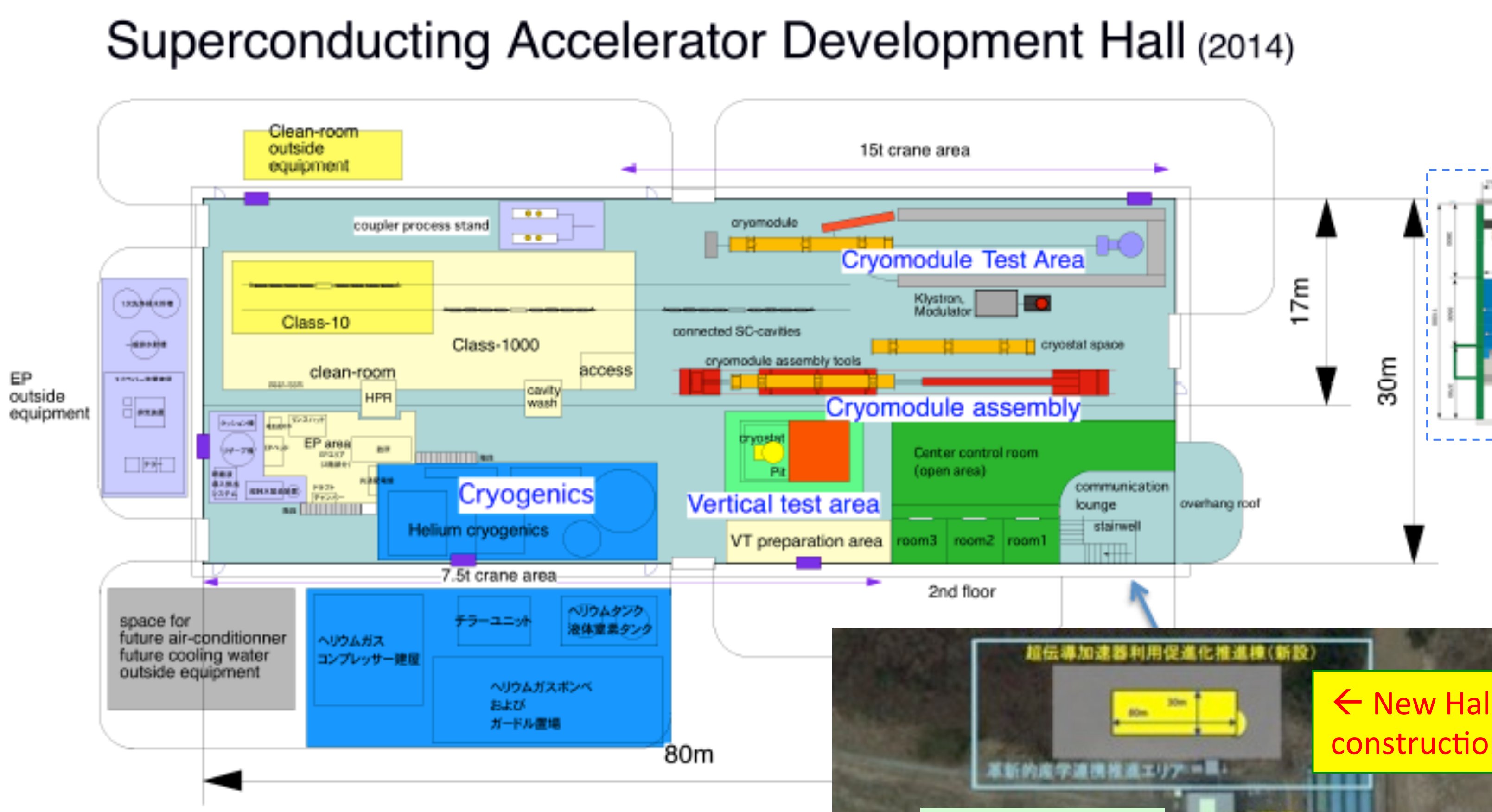
Gradient achieved at KEK-STF: > ~ 35 MV/m
Progress: > 90 %, at individual vertical test

A Photo at STF-2, in May, 2016



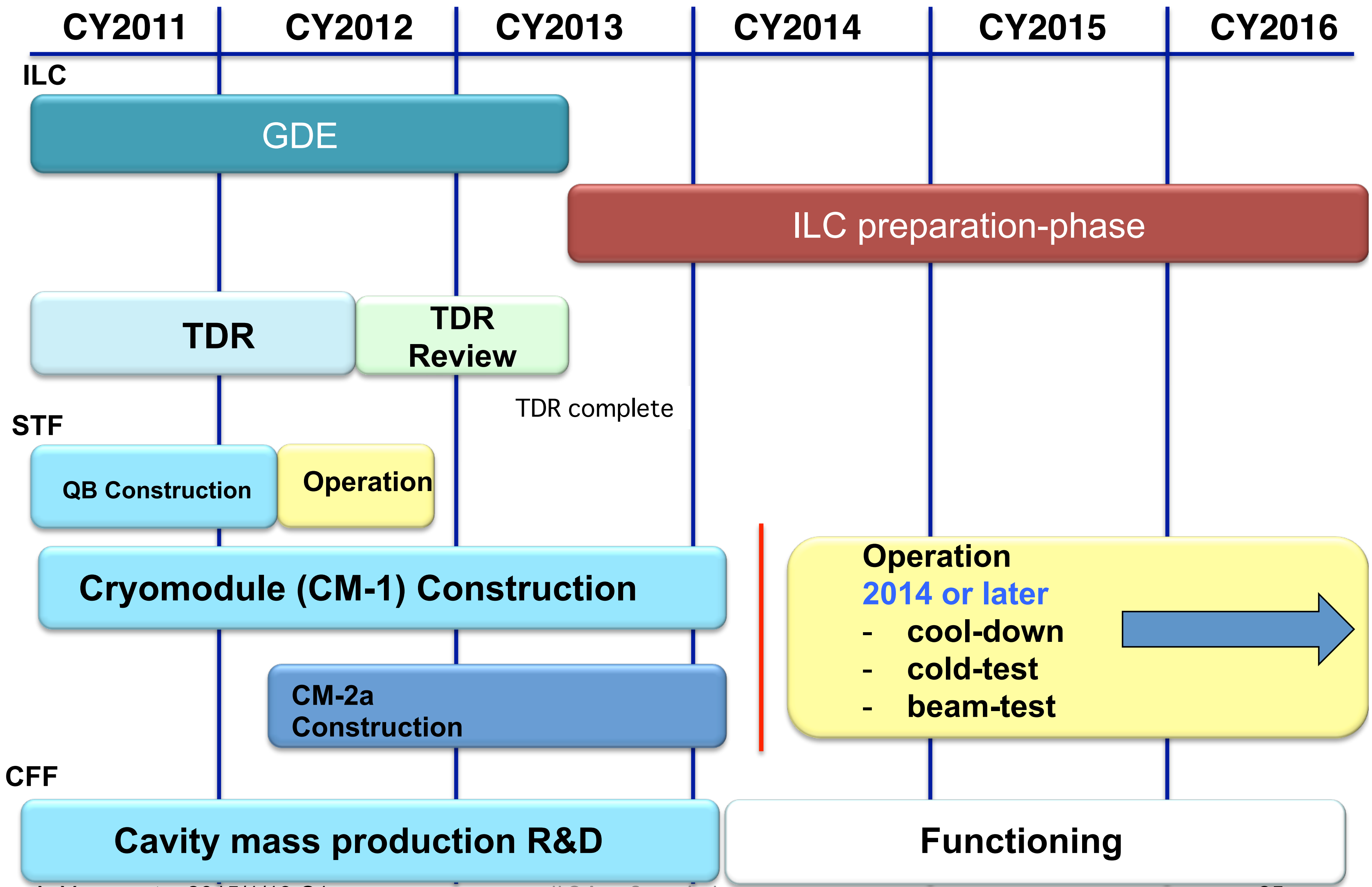
Progress in Cavity low-power-test at STF2 CMs, October – November, 2014

STF-II Facility being extended
Facility to demonstrate Full CM assembly/test



A Hub-laboratory function for ILC to be demonstrated at KEK

Plan of STF R&D beyond TDR



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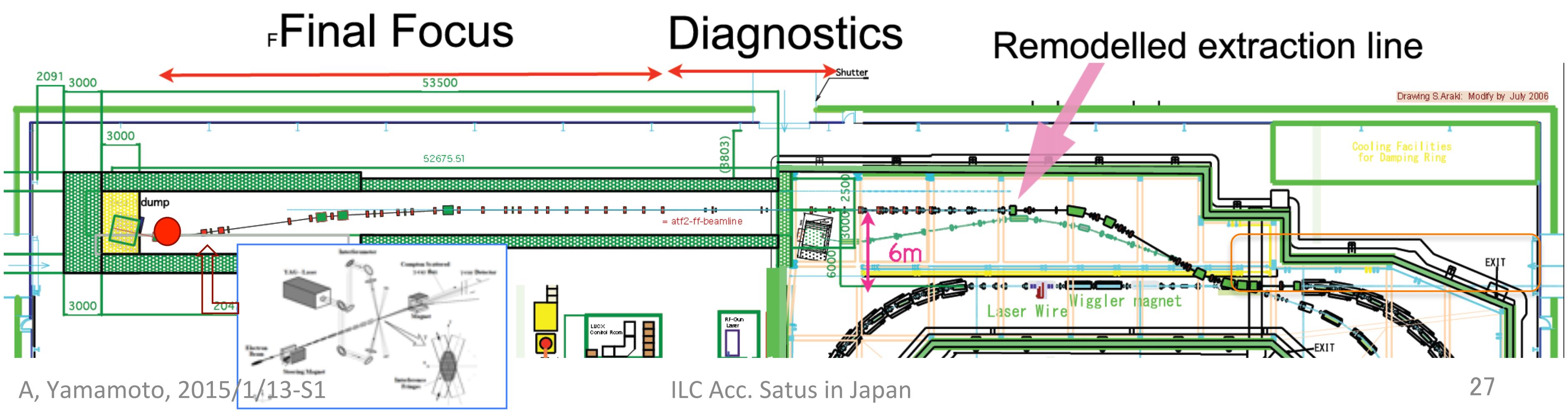
KEK-ATF2: BDS, FF Test for ILC

- Modeling of ILC - BDS
  - Same Optics:
  - Int'l Collab.
- ~25 Lab. , > 100 Collaborators

- Goal:
  FF Beam Size: 37 nm
  - (corresponding to 5.9 nm at ILC

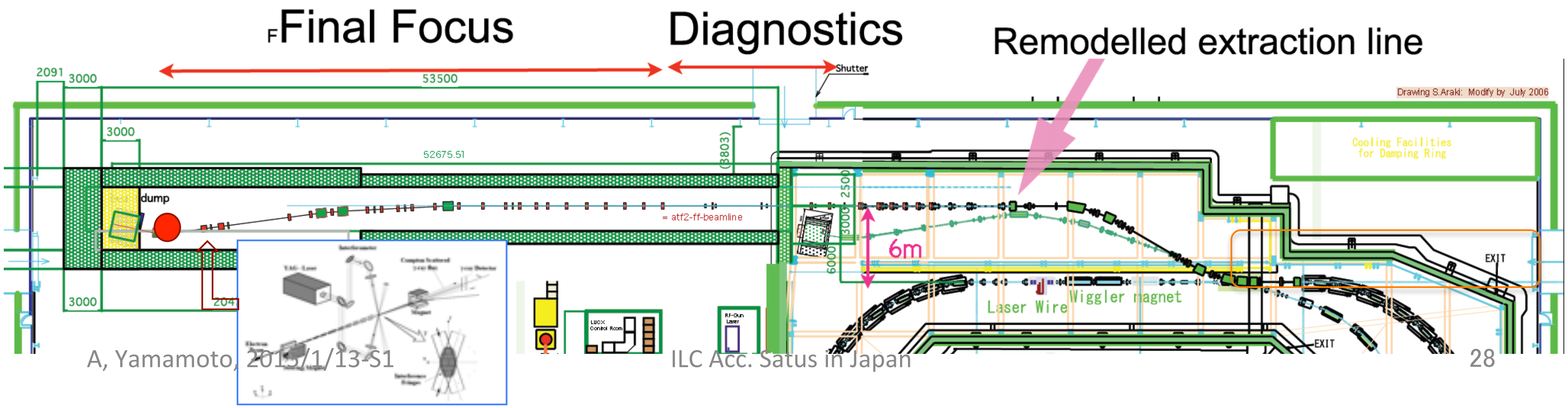


KEK-ATF2: BDS, FF Test for ILC

- Mode
  - Sa
  - In
- ~25
- Goal:

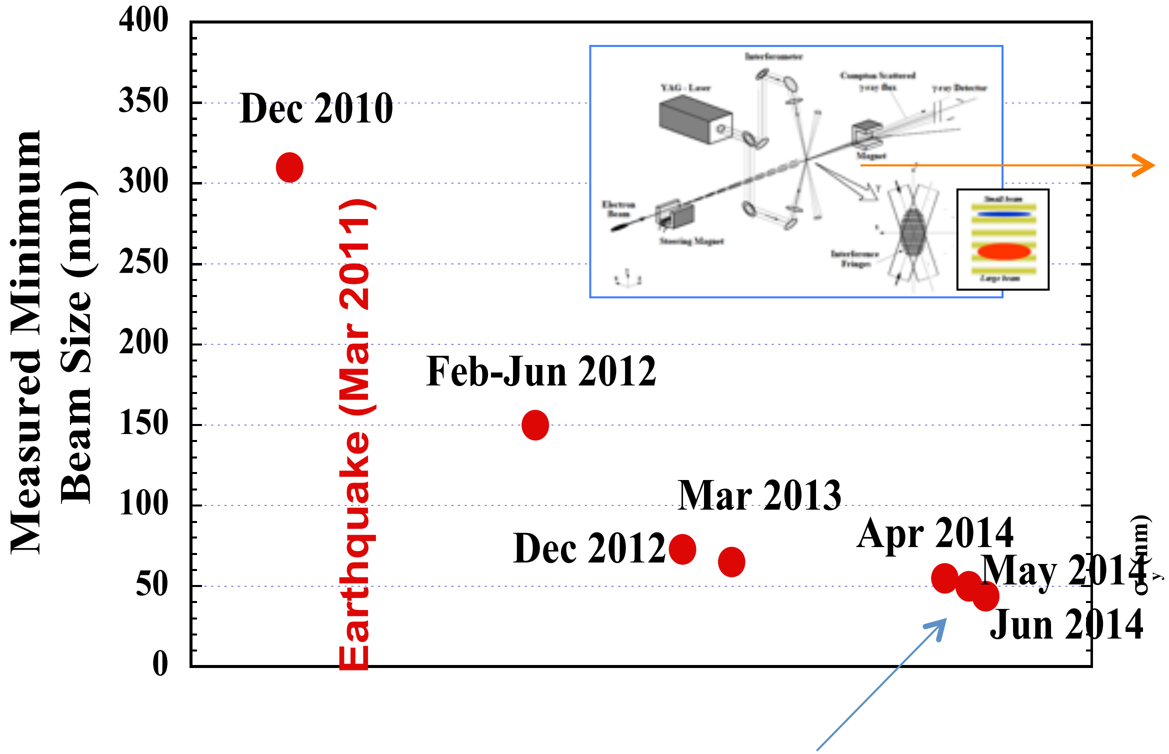
FF Beam Size: 37 nm
  - (corresponding to 5.9 nm at ILC

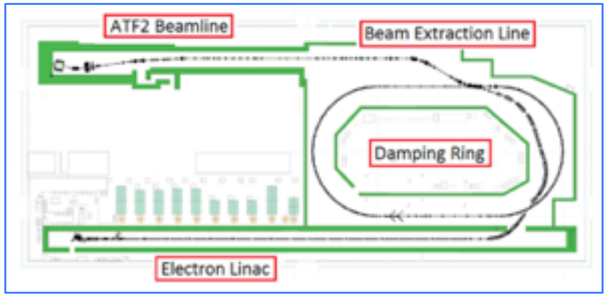
Parameter	ILC	ATF2
Beam Energy [GeV]	**250**	**1.3**
Energy Spread (e^+/e^-) [%]	**0.07/0.12**	**0.06~0.08**
Final quad – IP distance (L^*) (SiD/ILD detector) [m]	3.5/4.5	1.0
Vertical beta function at IP (β^*_y) [mm]	0.48	0.1
Vertical emittance [pm]	**0.07**	**12**
Vertical beam size at IP (s^*_y) [nm]	**5.9**	**37**
L^*/β^*_y (~natural vertical chromaticity, SiD/ILD detector)	**7300/9400**	**10000**

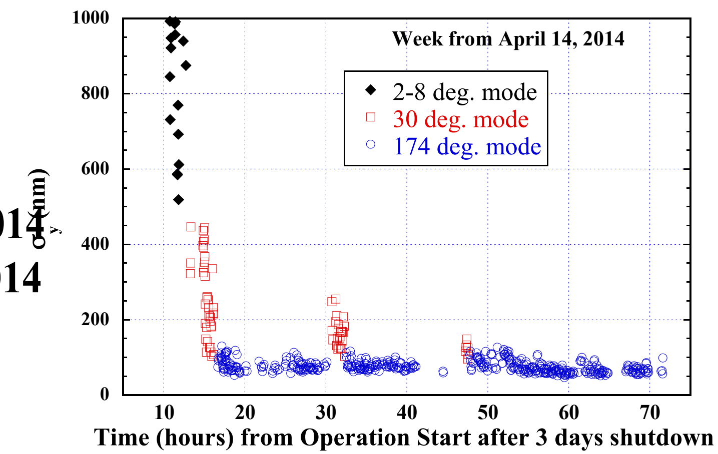


IPAC2014, K. Kubo
ICHEp2014, S. Kuroda

Progress in Beam Size at ATF2



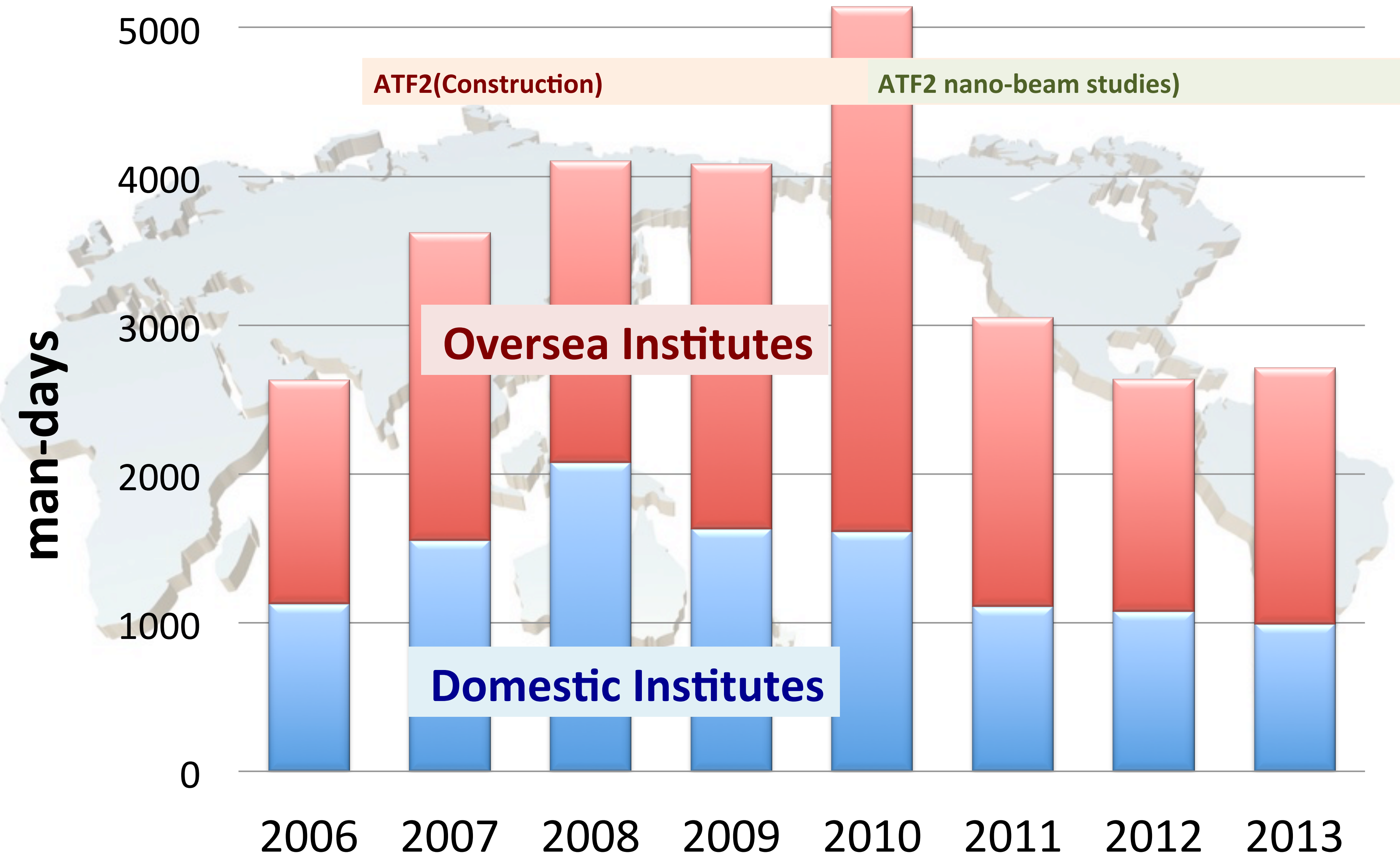




Beam Size 44 nm observed,
(Goal : 37 nm
corresponding to 6 nm at ILC)

Quick tuning to reach ~ 50 nm after long shut-down, less than 20 hours

Collaborators visiting ATF for Nano-Beam Handling Research

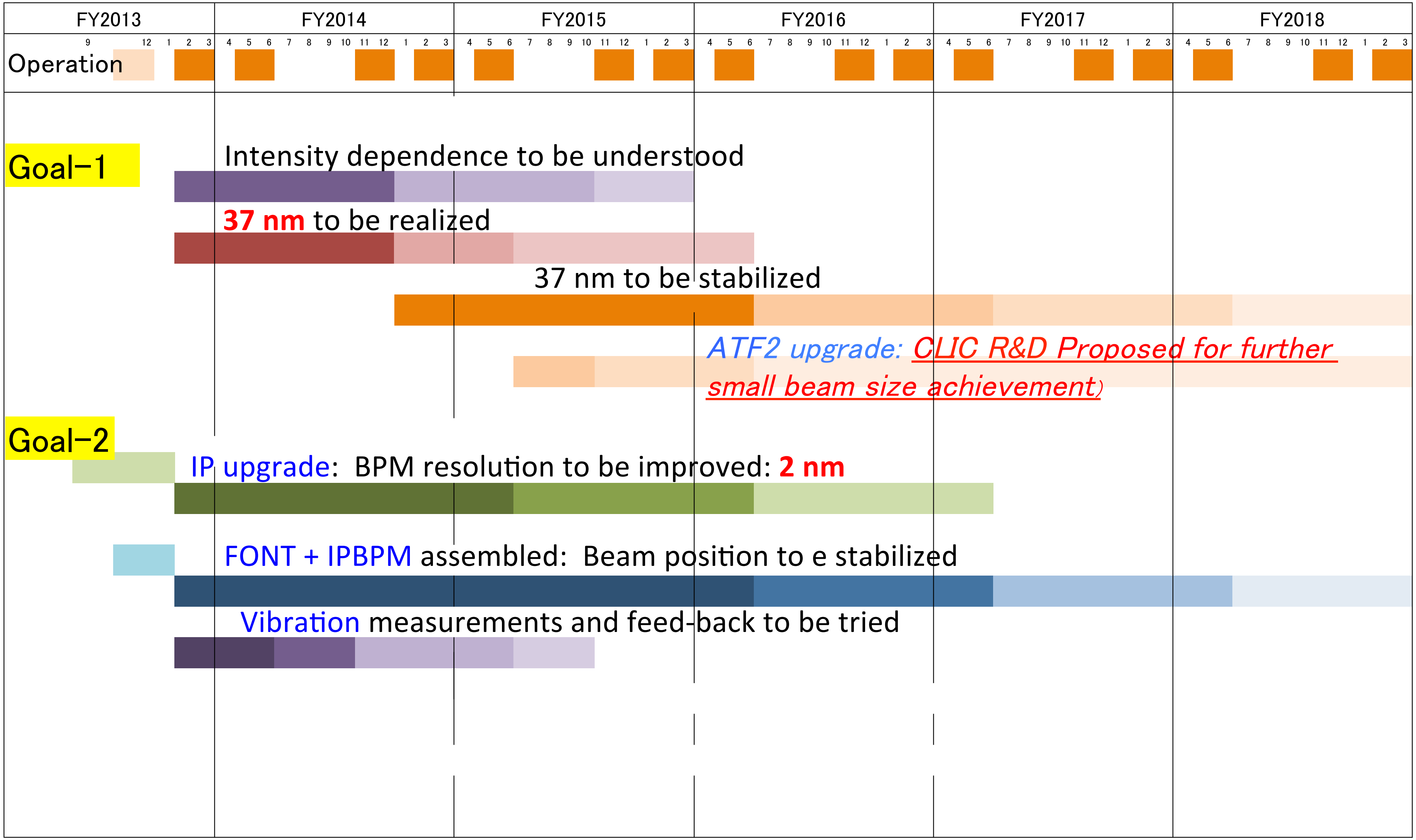


先端加速器技術開発に果たしているKEK-STF, ATF の役割･意義･実績

KEK-STF and ATF Contribution
to the Adv. Acc. Technology Development

	STF	ATF
国際連携 Int'l community	Tesla Technology Collab.	ATF Collaboration Unique facility, worldwide
参加国 Participating countries	Germany, Italia, Swiss, France, USA, China, Korea, India, Japan, etc. ..	Swiss, Germany, France, UK, Italia, Spain, Russia, USA, China, India, Korea, Japan, etc.,
国際協力機関数 Numbers of institutions,	~13	~ 25
参加メンバー数 Number of collaborators	~50	55
主な成果 Major progress	S1-Global: Int'l CM test, Quantum beam, In-house Cavity Fabrication New diagnostics	Ultra low emittance beam, Nano-beam test reaching 44 nm.,
博士号取得者数 PhDs awarded	5	52
修士号取得者数 Master deg. Awarded	5	18

ATF 2 Further Plan



ILC 準備期間に於ける主要課題

Main issues in the ILC Preparation Phase

分野 (field)	課題 (Issues/Subjects)	協力体制 (Global Cooperation)
施設設計 CFS	候補地特性を反映した地質環境調査: Site-specific CFS design, env. assess. 基本計画、詳細設計、図面整備 General plan, eng. Design, drawings	JP-CFSがコアとなり国際連携、候補地域との連携 JP-CFS to take a central role in cooperation with global experts and regional experts.
加速器設計 Acc. Design Int.	詳細設計・パラメータ最適化 Engineering design, Parameter optim.	LCC-ILCを中心とした国際連携による検討 LCC-ILC to take a central role with global cooperation
SRF技術 SRF	製造・性能検証技術、 Fabrication & Test tech. (Hub-function) 性能の安定化 Stabilization of the performance	Tesla Tech. Collab., as common community - KEK-STF: Hub-Lab function - EXFEL: mass production and testing - LCLS : mass production and testing
ナノビーム技術 Nano-beam	低エミッタンス、極小ビームの安定的実現、運用 Ultra low emittance, nano-beam to be realized and stabilized	ATF Collab. As common community - KEK-ATF to be maximized in use, as a global unique facility for next generation training as well as the advance studies.
研究所運営 Management	新国際研究所の設立準備 Preparation for the int'l ILC laboratory	今後の検討課題 A main Issue for the ILC to be prepared

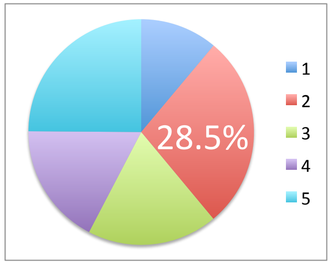
Rev. 150108

TDR におけるILC加速器建設に必要な研究所の人材 (FTE)

HR required in TDR for the ILC acc. Construction

		Integ. Labor in (Person-hr)	Integ. labor in (p-yr)	平均/年 Av. In yr	規模 Staff/yr
	Acc. Constr (9 yrs)	22,898	13,471		
1	CFS + Survey/Align.	1,359 (6%)	800	89	
2	Acc. (SRF-ML)	6,520 (28.5%)	3,835	426	1,124
3	Acc.（etc）	5,321 (23%)	3,130	348	
4	Administration	3,998 (17.5%)	2,352	261	
5	Install. (in ~4 yr)	5,700 (25%)	3,353	(+838)	

Given in TDR



~1,000 staff needs to be realized for the ILC accelerator. construction

参考 : For a reference :

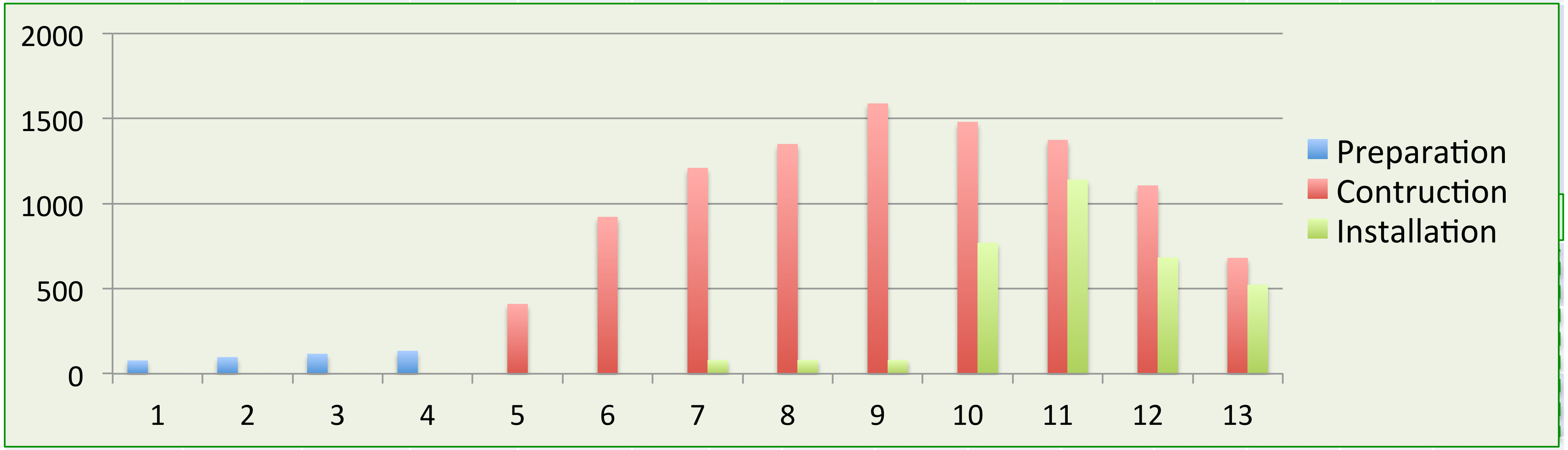
- 国際的連携をもつ加速器研究所の規模 = 人材源の国際的な基盤 :
    - **Staff numbers of particle and accelerator laboratories, related to ILC, and global base :**
    - CERN : ~ 2500 , DESY: ~2,400, CEA-Saclay: ~4,200, CNRS-LAL: (TBD), etc.、
    - Fermilab: ~1,700, SLAC: ~1,700, BNL: ~3,000, JLab : ~800, etc.,
    - KEK: ~750, IHEP: ~1,400、PAL: (TBD), RRCAT: (TBD)、etc.,
- これらの研究所・大学を基盤とした国際協力・連携によりILC の建設・運用が計られる.
    - ILC is planned to be realized, based on global cooperation with the above institutions.

ILC 加速器建設にむけた研究所人材構想

[人・年（FTE) 国際協力分担の仮定を含む]

[HR considered for the ILC preparation, linked to construction（FTE)]

Stage	Preparation				Construction									Sum
	1	2	3	4	1	2	3	4	5	6	7	8	9	



Notes: HR required for the ILC preparation (CFS, Acc., and administration):
- HR in the 1st preparation year to be filled from the existing staff in fraction of ~80%),
- HR needs to be gradually increased to reach a factor 1/5 ~ 2, during the prep. phase,
- The guideline is to provide 10 %level in fraction to the staff required for the ILC laboratory,
- The global collaborators anticipated from a fraction of 5 % to 20% of existing ones,
- The Japanese HR needs to be boosted/complemented by using “sub-contract,
  - Worldwide fraction in japan,
  - CFS: ~90 %, Acc. 60^70%, and (1/3 ~ 1/2 to be subcontracted)

ILC Project-Cost Overview (for 500 GeV)

Revised: 150113

V- 1410122	Value 物件費 Oku- JY	Uncertainty (-/+) %,	Oku- JY	Human Resource 労務費 P-hours	FTE	Oku-JY	Uncertainty (-/+) %,	Oku-JY	Value+HR 物件+労務 Oku- JY	Range 範囲 Oku-JY	See note
Formal Preparation (4 years)											
Accelerator + CFS 加速器本体+施設+ADm	**209** **(123+91)**	---	---	---	**423**	**51**	---	---	**260**	---	A1
Lab. Support. 共通： Land, Load, Lab ...	**66 + TBD**	---	---	TBD	**TBD**	**TBD**	---	---	**66 + TBD**	---	A1
Detectors	**TBD**			TBD	**TBD**	**TBD**			**TBD**		A1
Construction (9 years)											
Accelerator (Acc. + CFS) (TDR values)	**8,309** **(5,707+2602)** **(7.98 BILC)**	26%	2,160	22.9 M	**13,471**	**1,598**	24%	384	**9,907**	7,363 ~ 12,451	A2
Lab. Support - Safety, Computing, etc	**TBD**			TBD		**TBD**			**TBD**		A2
Det. Constr (for 9 yrs)	**SiD: 315** **(315 MILC)** **ILD: 451** **(392 MILC)**	--- ---	+127 (+/-48)	--- ---	**748** **1,400**	**89** **150**	--- ---	--- ---	**531** **601**	404~531 553~649	A2
Full Operation (per year)											
Acc. + CFS Operation	**390** **(390 MILC)**	40%	156	---	**850** **(TBD)**	**101**	25%	25	**491**	TBD	A3
Lab. Support	**TBD**	---	---	---	**TBD**	**---**	---	---	**TBD**	TBD	A3
Det. Operation	**TBD**			---	**TBD**	**---**			**TBD**		A3

Schedule for Committee and WGs

Experts committee	
1	May, 2014
2	Nov. 2014 (Status report given
(3)	April, 2015 (Interimu Report expected

TDR Validation WG		
1	6/30	Overview
2	7/28	ML and SRF
3	9/8	SRF Q&A,, CFS
4	11/4	Schedule and Project Management including Cost and Human Resource
5	(1/26)	Acelerator system (Source, DR, BDS etc). Detectors How to prepare for HR and Preparation Phase

LCC visiting Tohoku

January 13, 2015

Primary School Children’s Work for ILC

Daito-Cho, January 13, 2015

ILC Double Cream Roll

Best Awarded; World-wide Children getting together for ILC

Summary

- ILC Project is in a formal investigation process conducted by the MEXT "Wise Person's Committee, associated with two working groups (for Science and TDR) .
  - *We are working hard to provide all necessary information in cooperation with LCC.*
- An official evaluation/judgment by the Japanese Government is expected in (by the end of) JFY2016.
  - *We need to wait for it with patience.*
- Project plan, including the preparation and operation, needs to be further established
  - *We need much more input from detector systems, through close communication.*

Acknowledgements

- *We would thank:*
  - two detector groups and MDI-CFS collaboration specially to have realized a revision of the **Detector Hall design** with **"Vertical-shaft Access"**, including the Change Management Process, led by M. Harrison and B. List, as a major progress after the TDR process, in last year.

- *It will be further discussed by:*
  - *the CFS group led by C. Kuchler, in the next sessions.*