



E-JADE and KEK

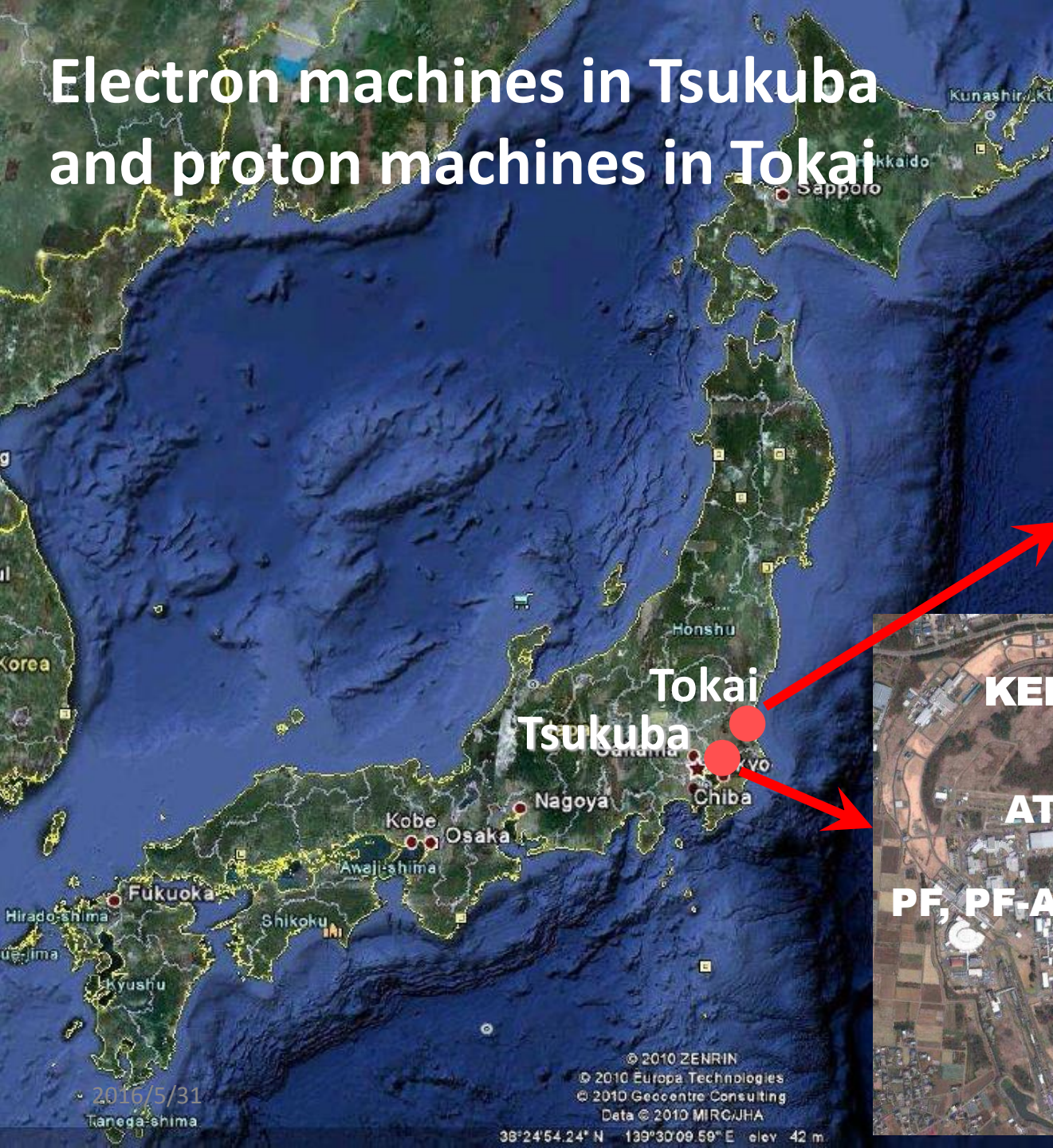
E-JADE Midterm Review Meeting 2016

Katsuo Tokushuku

Institute of Particle Nuclear Studies
(IPNS)

High Energy Accelerator Research
Organization (KEK)

Electron machines in Tsukuba and proton machines in Tokai



J-PARC



KEKB

ATFI

PF, PF-AR

2016/5/31
Tanegashima

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Data © 2010 MIRC/JHA
38°24'54.24" N 139°30'09.59" E elev 42 m.

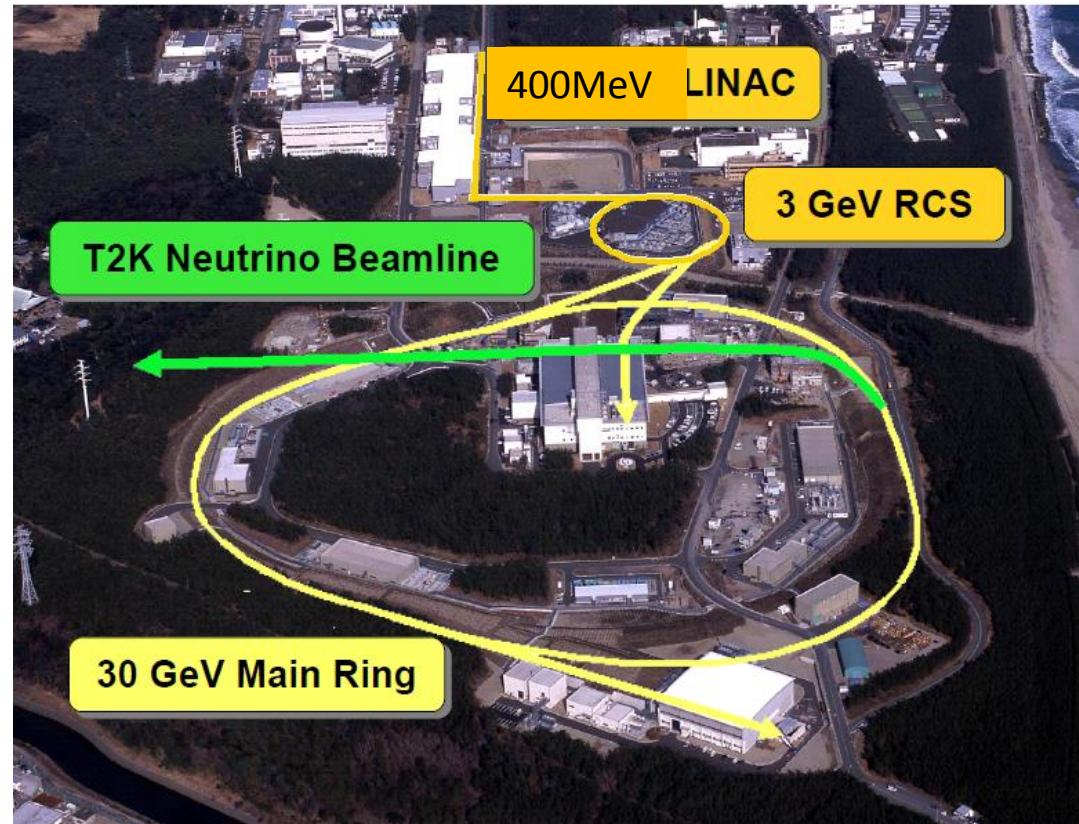
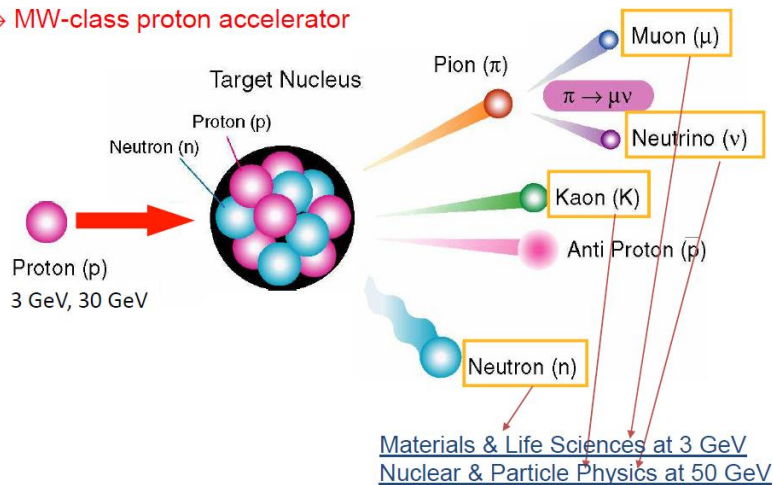
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2

Eye alt 2182.40 km

- Located in Tokai, 60km N.E. of KEK
- Completed in 2009
- Design goal
 - ▶ RCS: 1MW
 - ▶ MR: 750kW

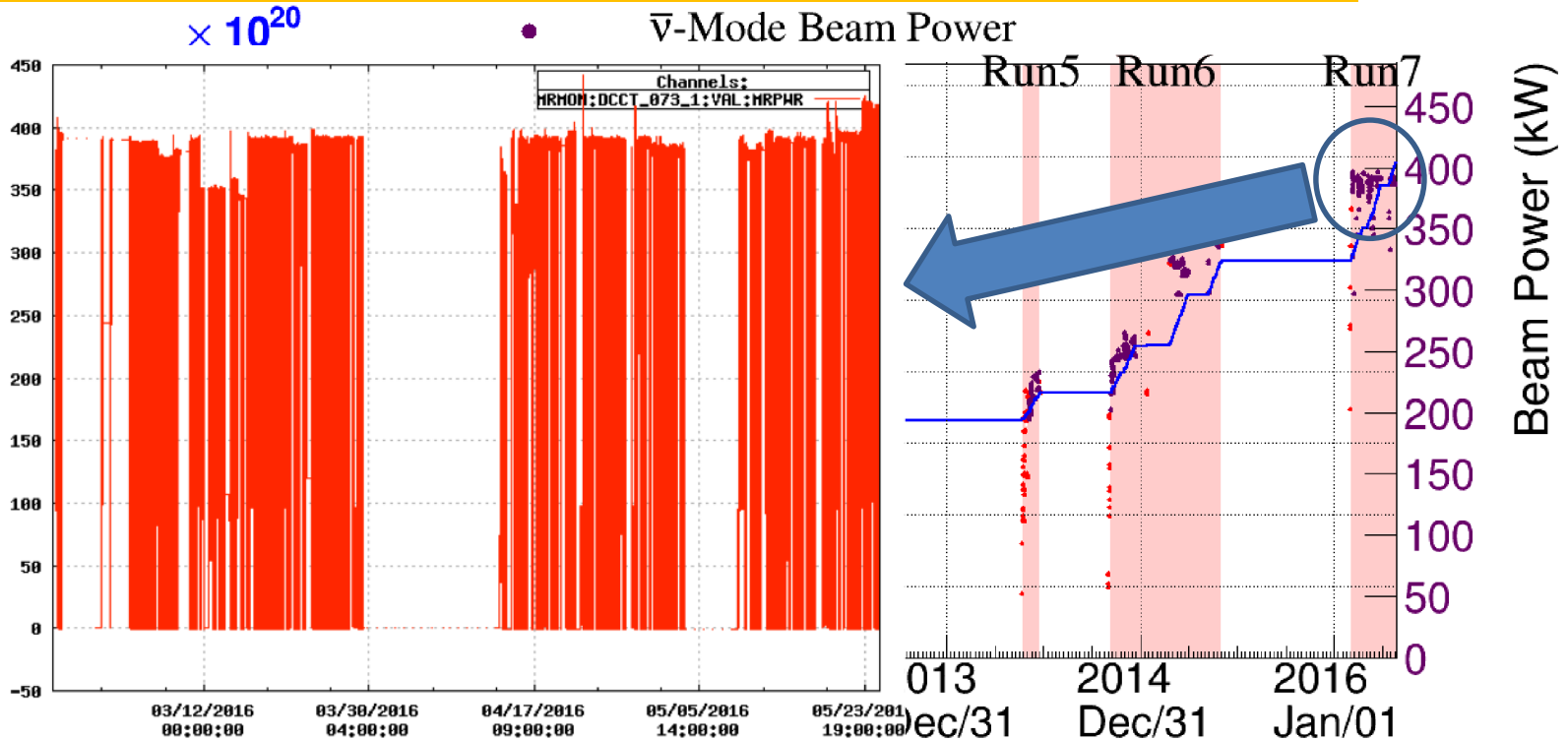
Goal

→ MW-class proton accelerator



Joint project of KEK & Japan Atomic Energy Agency (JAEA)

Achievement of proton delivery to Neutrino experiment

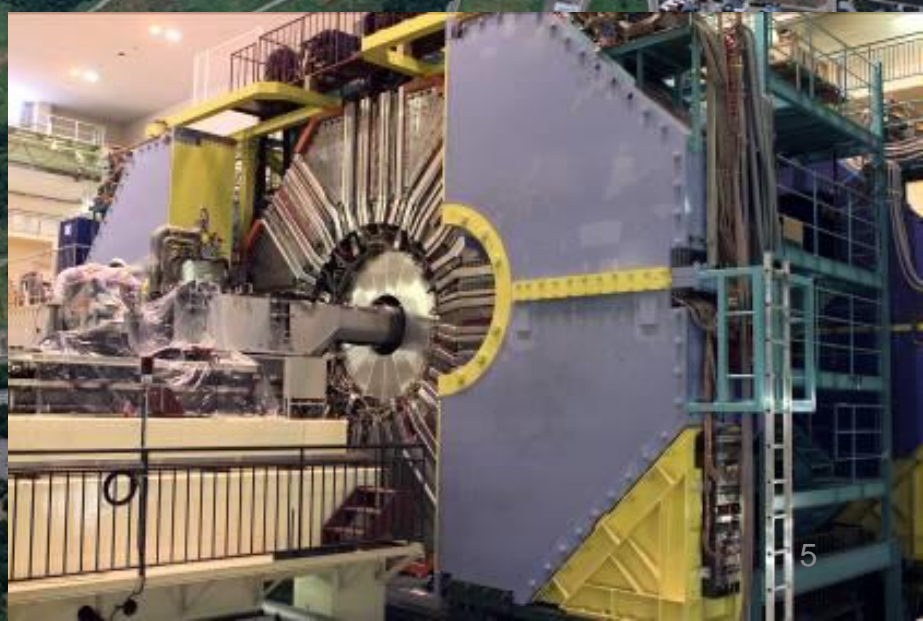
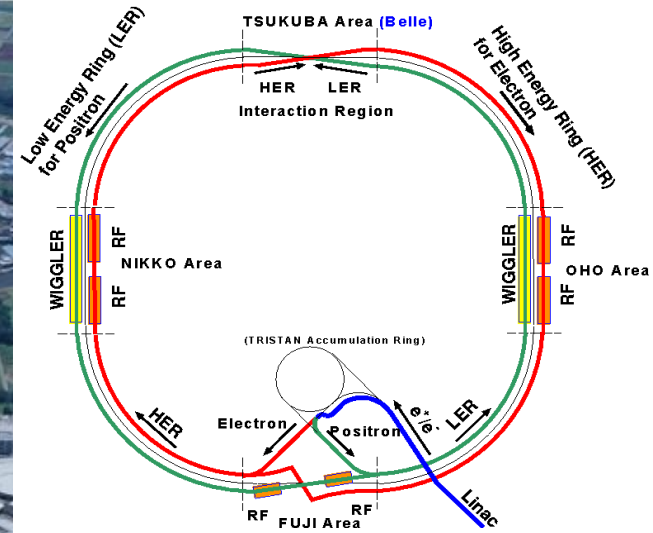


- Stable operation at **400kW** achieved (first design goal: 750kW)
 - ▶ ($E_p=30\text{GeV}$) x (**200Tp/5us pulse**) x (2.48sec cycle) **World record on P/pulse!**
- Taking anti-neutrino beam data for CPV search
- Number of protons on target (POT)
 - ▶ 1.4×10^{21} accumulated (by Apr26,2016), 18% of
 - ▶ 7.8×10^{21} aimed as original T2K goal

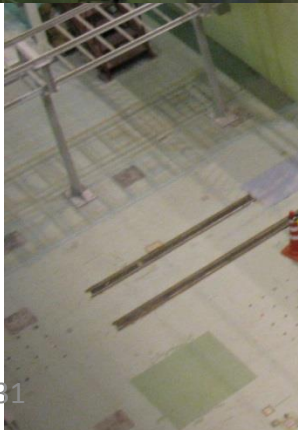
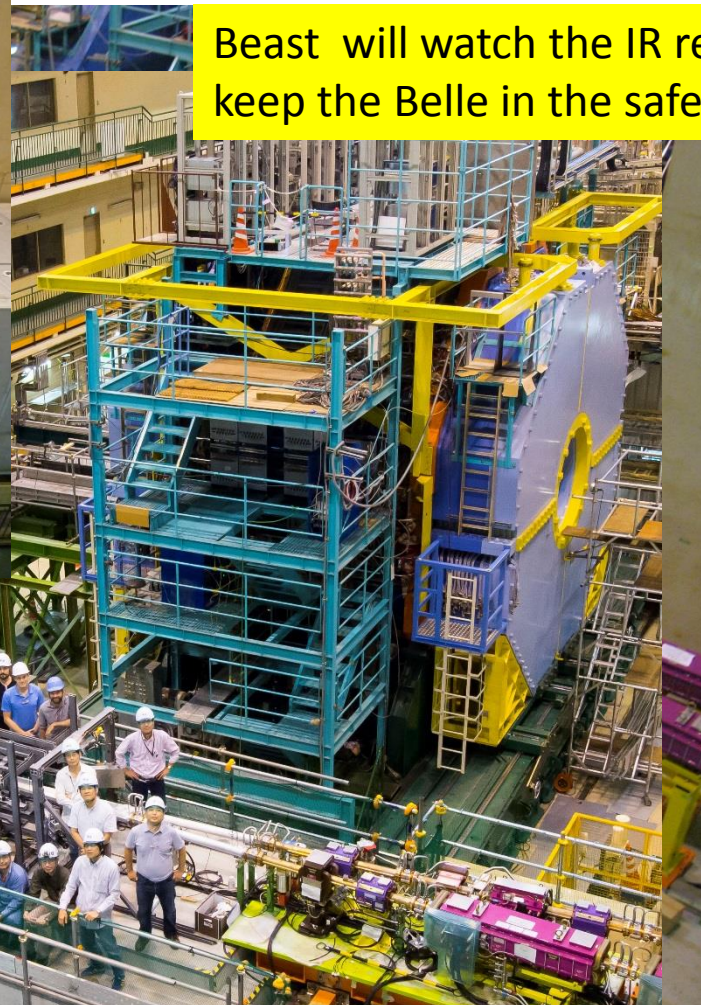
KEKB and Belle

↓

SuperKEKB and Belle II

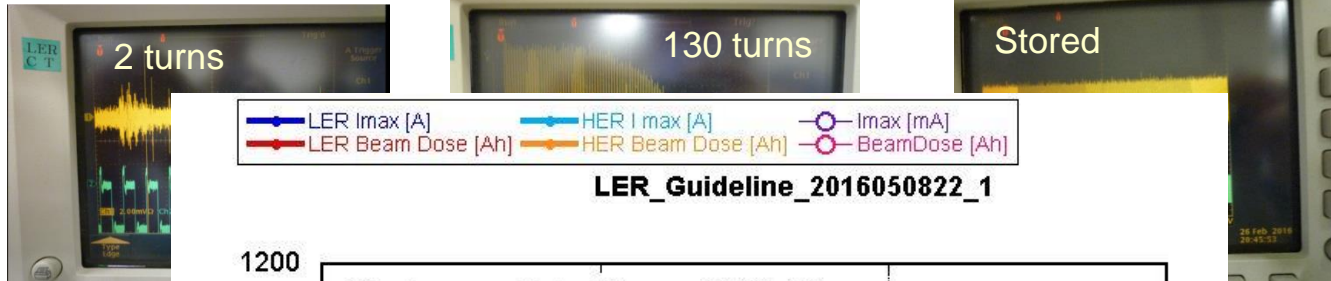


- Beam commissioning has started.

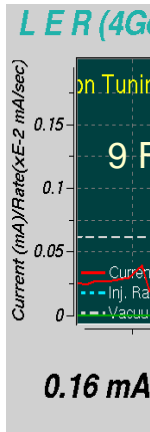


Exciting Moment ! : Beams are back

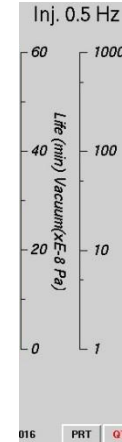
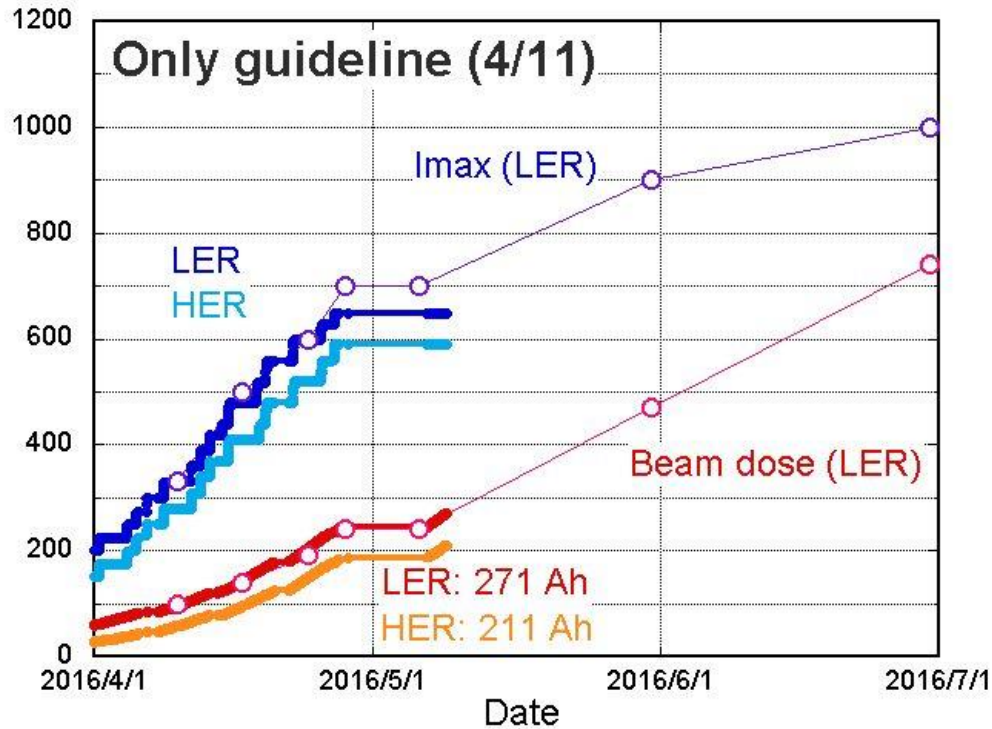
9 Feb. 2016



LER_Guideline_2016050822_1



I max [mA], Beam dose [Ah]



R&D for future accelerators -> E-JADE

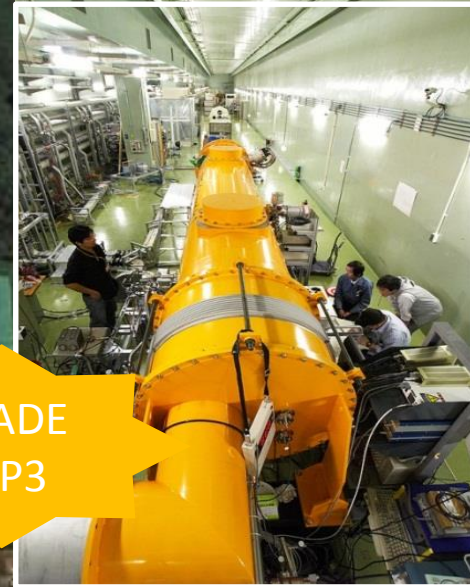
E-JADE
WP2



ATF

STF

E-JADE
WP3



CFF

E-JADE
WP1



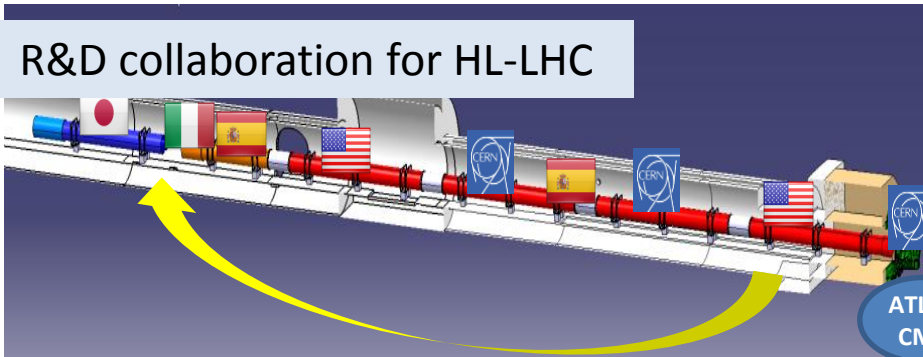
KEK and CERN have agreed to establish mutual offices at the respective labs: a CERN office at KEK and a KEK office at CERN, to facilitate and enhance common work on future accelerator projects and other related scientific projects of common interest.

■ LHC-Upgrade

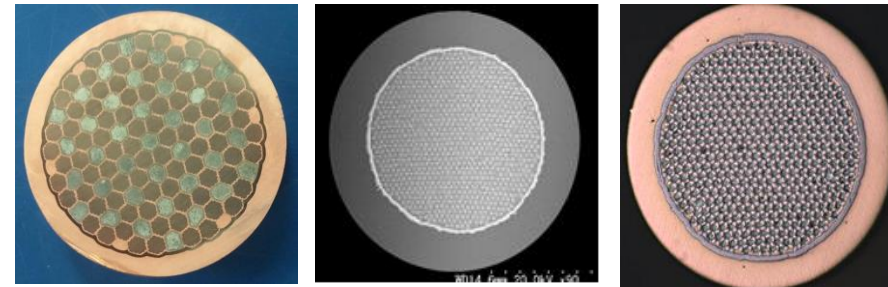
- ▶ Separation dipole magnet: D1
- ▶ Participation in development and testing
- ▶ Close communication for system integration

• FCC Developments

- Nb₃Sn conductor developments
- Participation in conductor evaluation (Including Evaluation using J-PARC neutron beam line)

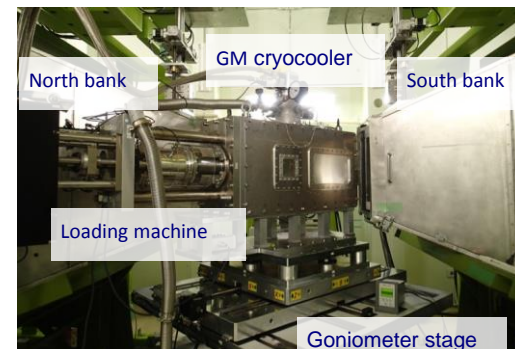


JP contribution to current LHC

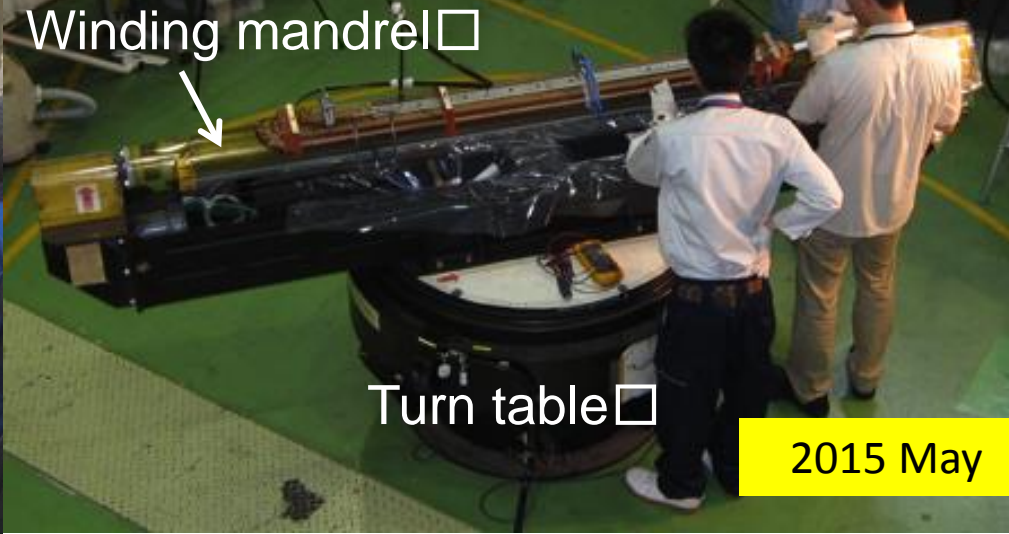
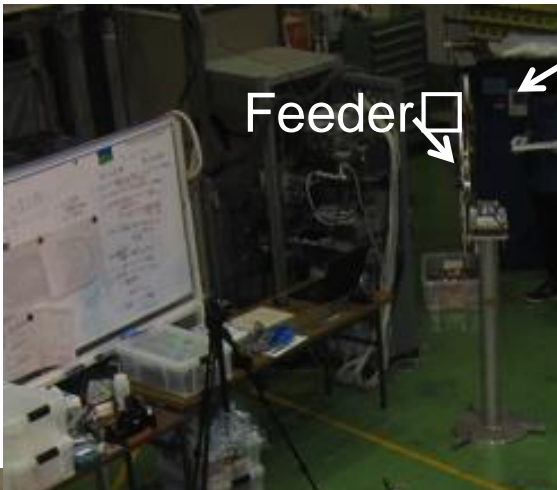
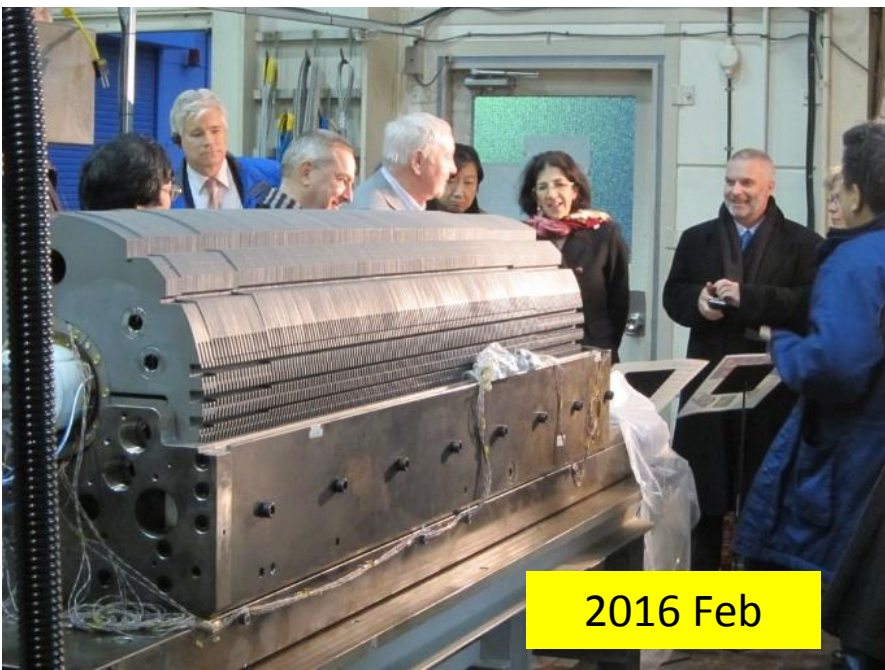


J-PARC neutron beam line "TAKUMI"

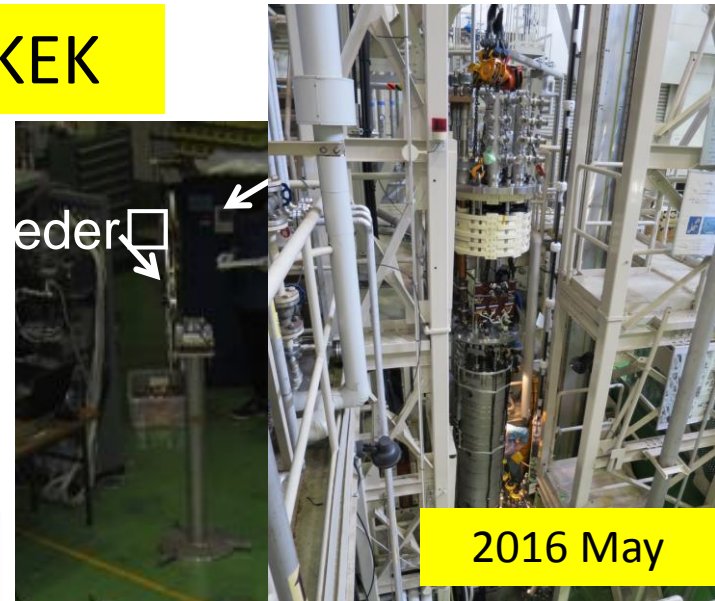
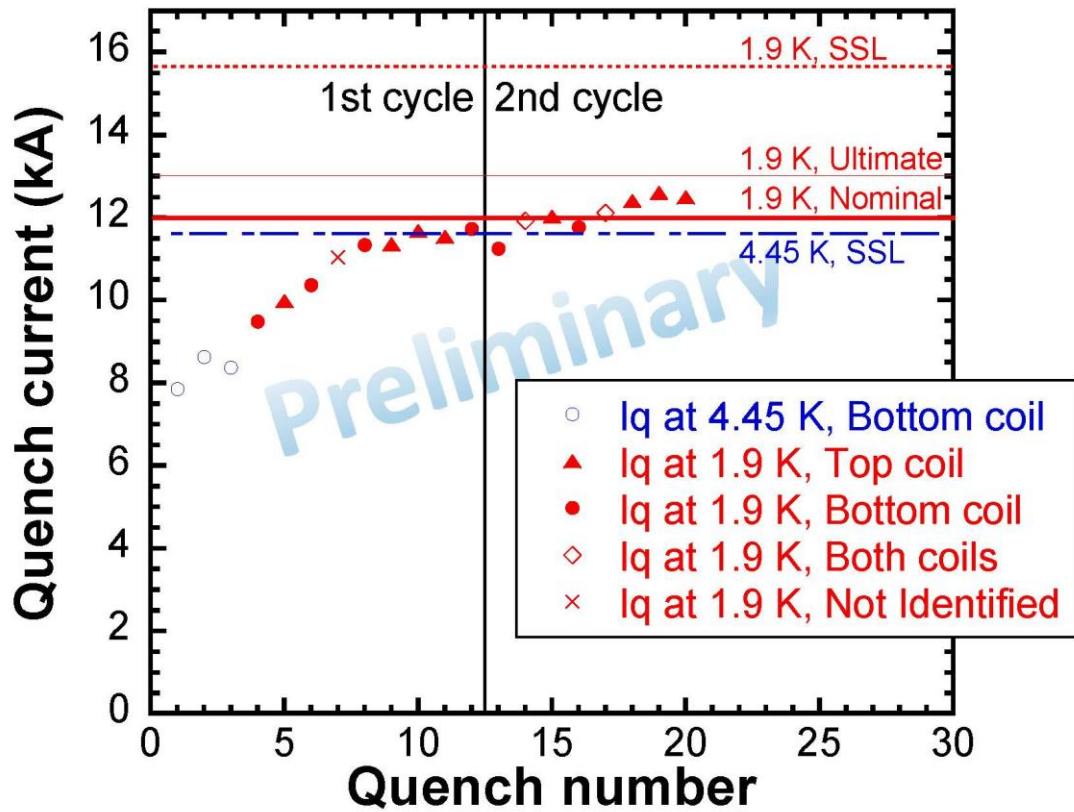
- Strain measurement at low temperature
- Reaction measurement at high temperature



2m Model coil production and test at KEK

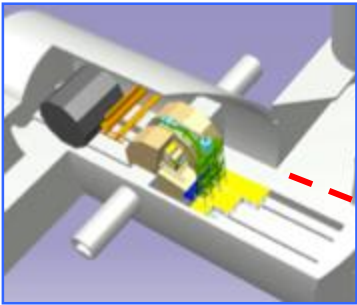


2m Model coil production and test at KEK

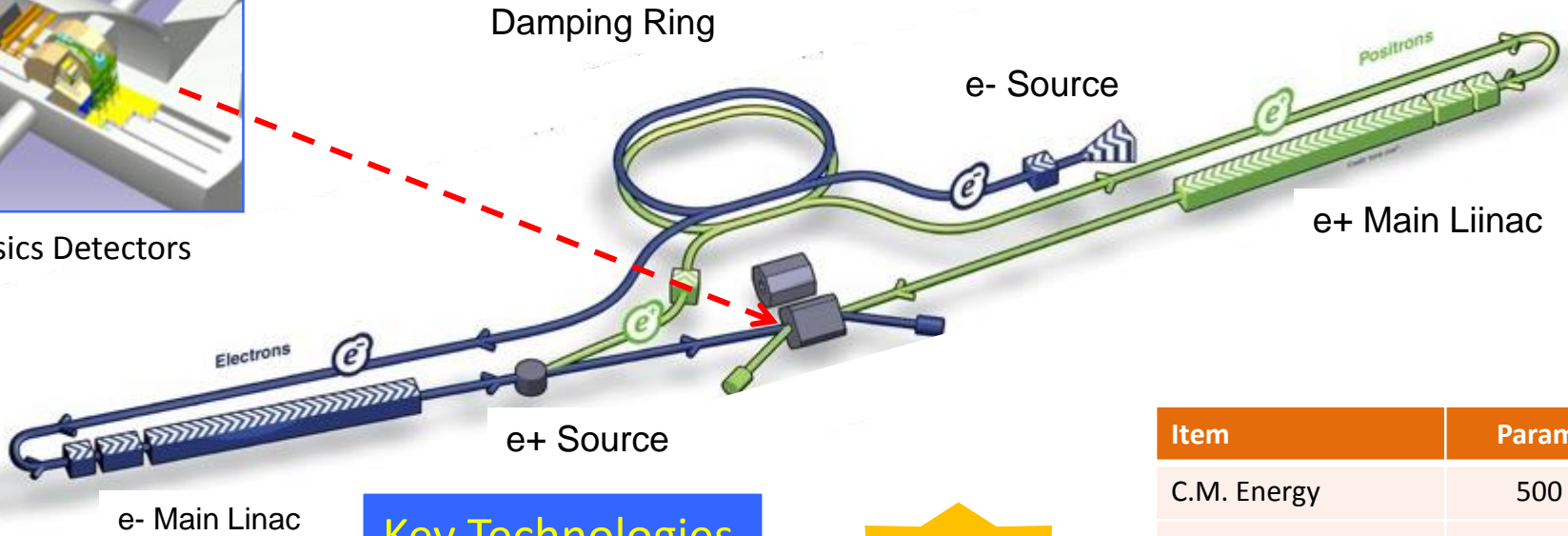


Big progress with the support from CERN:
More contacts expected for future tests

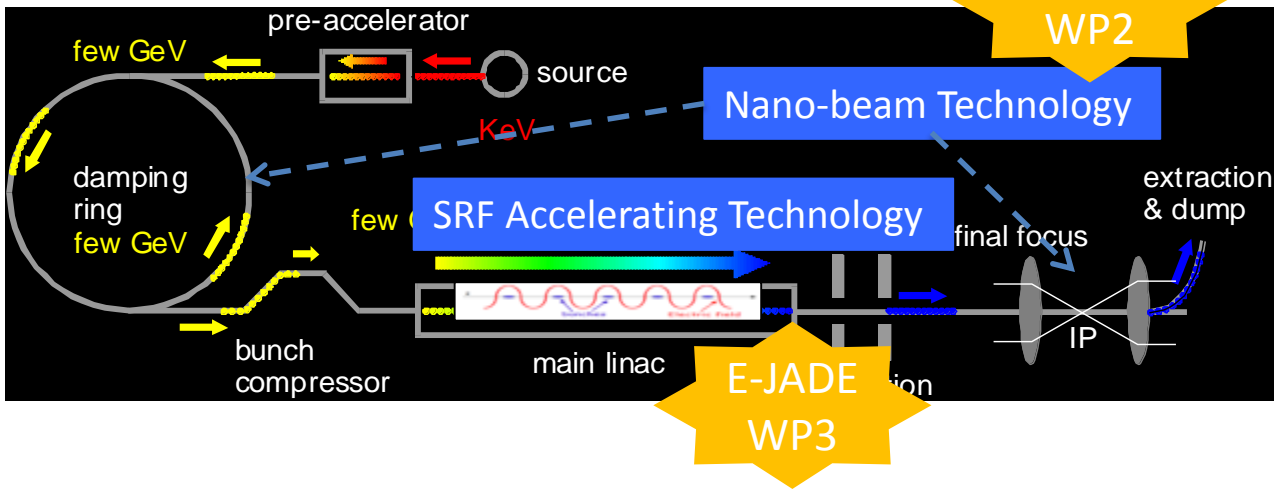
ILC Acc. Design Overview (in TDR)



Physics Detectors

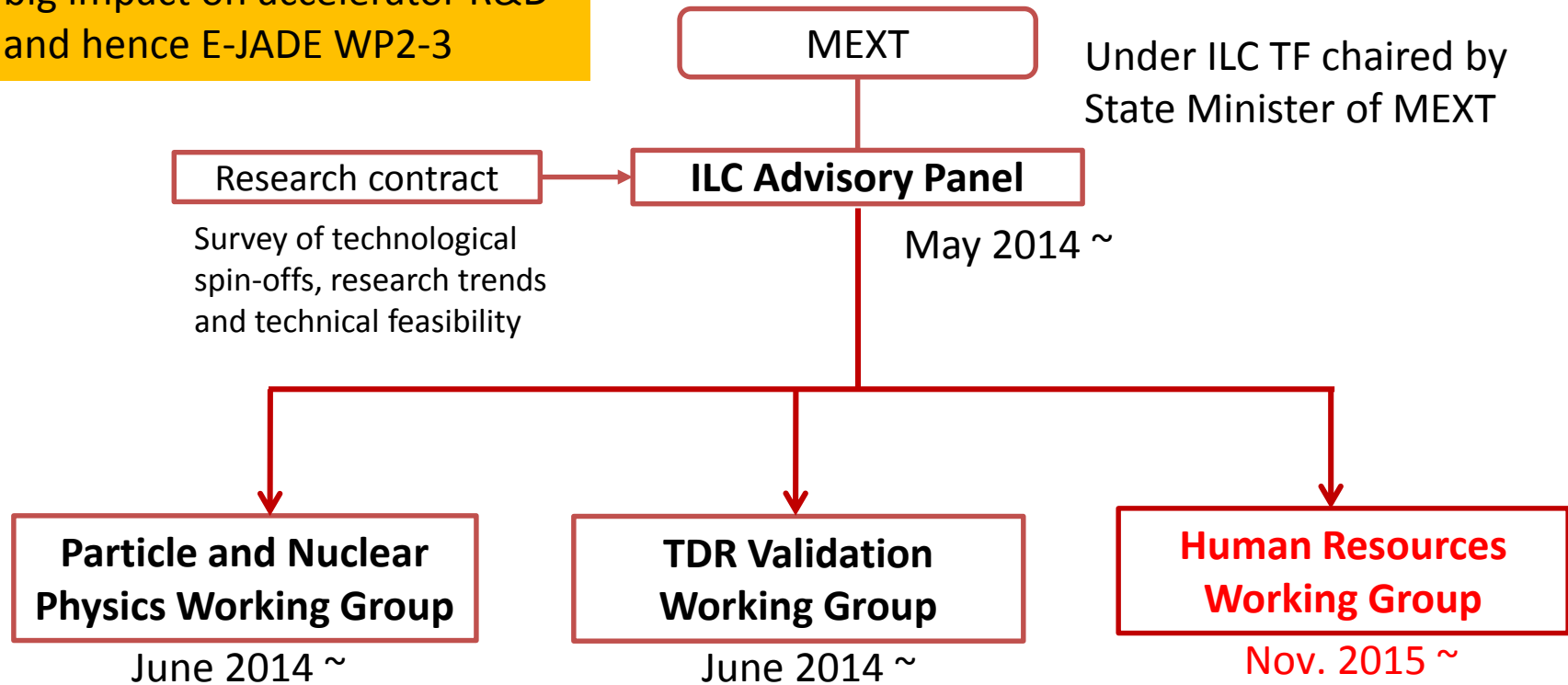


Key Technologies



Item	Parameters
C.M. Energy	500 GeV
Length	31 km
Luminosity	$1.8 \times 10^{34} \text{ cm}^{-2}\text{s}^{-1}$
Repetition	5 Hz
Beam Pulse Period	0.73 ms
Beam Current	5.8 mA (in pulse)
Beam size (γ) at FF	5.9 nm
SRF Cavity G.	31.5 MV/m
Q_0	$Q_0 = 1 \times 10^{10}$

The progress of the discussions on ILC in the JP government is a big impact on accelerator R&D and hence E-JADE WP2-3



- “Summary of Discussions” released by the ILC Advisory Panel (August 2015)
 - ▶ Recommendation 1: **Share the cost internationally** and **Find a clear vision on the discovery potential of new particles.**
 - ▶ Recommendation 2: **Closely monitor and analyze the development of the LHC experiments** and **Mitigate cost risk.**
 - ▶ Recommendation 3: **Obtain general understanding by the public and science communities.**

- Chairperson of ICFA sent a document to the panel to clarify scientific and technical issues raised in the report, which has been distributed to the panel members.

- The Panel started a new sub panel on human resources, which will study how to secure and train researchers and engineers necessary to construct ILC. This will continue until summer 2016.

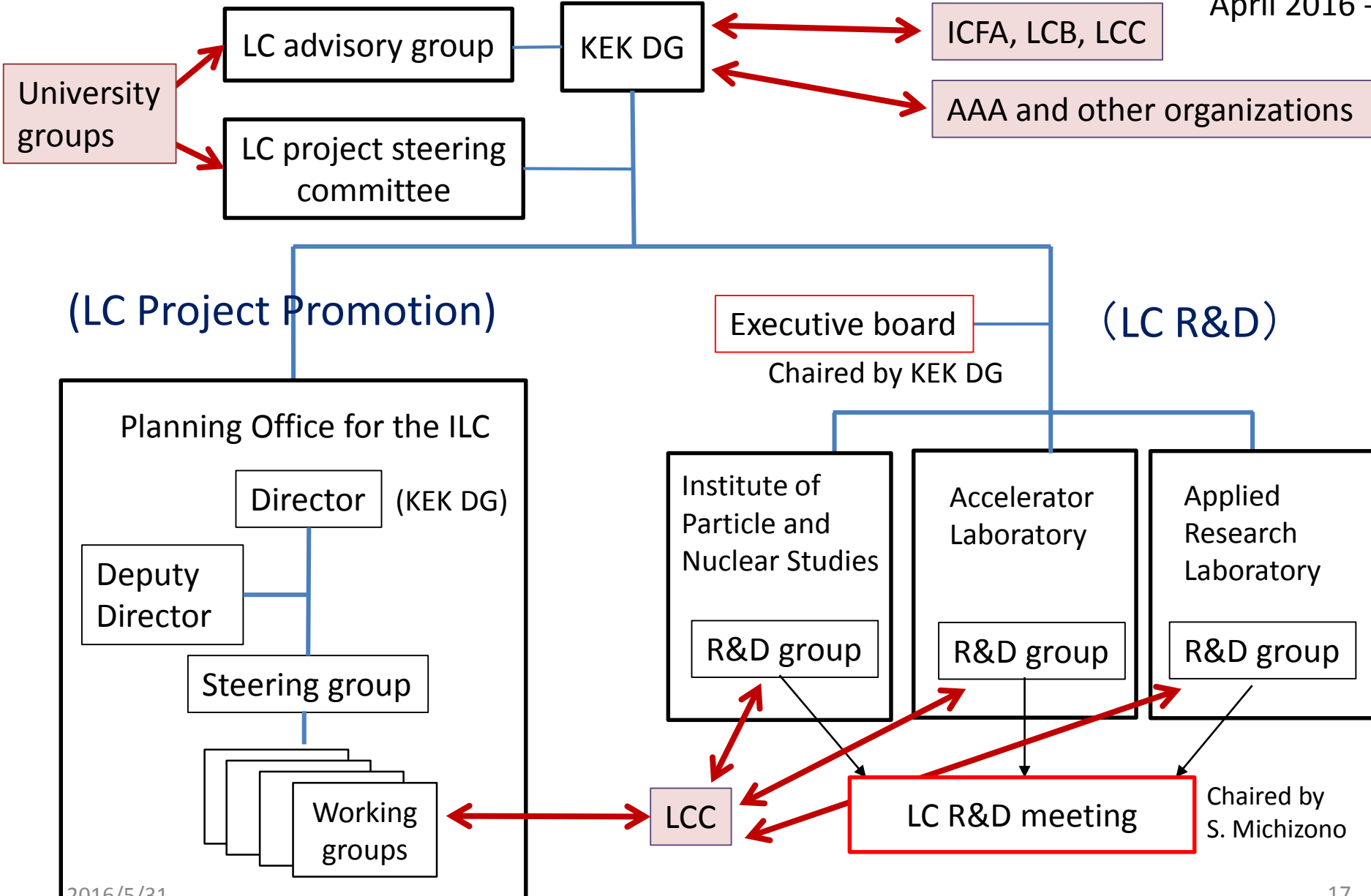
Table 3. Human resources required during the ILC accelerator preparation (FTE) ¹⁾

	Pre-P. ²⁾	Main Preparation ³⁾				Construction ⁴⁾		Notes
	(present)	P1	P2	P3	P4	C1	C2	
Acc: JP : abroad	42 ≥ 20	54 28	74 41	98 65	122 89	172	530	JP: needs to mature SRF mass-prod. technology ⁵⁾ EU/US: already has experience ⁶⁾
CFS: JP : abroad	3 1	11 3	11 5	13 5	17 5	52	53	JP: is primarily responsible, w/ outsourcing abroad: professional contribution
Comm: JP : abroad	2 1	7 3	10 4	13 6	14 7	109	109	JP: is primarily responsible abroad: professional contribution ⁷⁾
Admin: JP : abroad	5 3	8 4	10 6	14 8	18 10	77	230	JP: is primarily responsible abroad: professional and regional contribution ⁸⁾
Sum	≥ 77	118	161	222	282	410	922	

Additional comments

- 1) During the preparation phase, the contribution from abroad is to gradually increase to 20–40% (of total number) and to prepare for further contribution in the construction phase after reaching an international agreement for the ILC construction and work-sharing.
- 2) Pre-preparation Phase: Current status (based on general advanced accelerator R&D budget)
- 3) Preparation Phase: To be supported by a specific ILC construction preparation budget and human resources. This table excludes human resources already integrated and established with existing, ongoing accelerator construction projects in the world.
- 4) Construction Phase: Number of labor workers (hourly described in ILC-TDR converted to FTE).
- 5) Japan needs to integrate human resources and training to demonstrate SRF mass-production technology and a functioning Hub-lab (project management, quality control, and performance evaluation).
- 6) Europe and US will have integrated and experienced in their own projects (such as E-XFEL and LCLS-II) with human resources already trained with a level of 50–100 FTEs in each laboratory (DESY/INFN-LASA, CEA/CNRS-Saclay/CNRS-LAL-Orsay, SLAC, Fermilab, and JLab). These existing well-trained human sources are not included in this table.
- 7) Common technical supports need to be quickly increased in the construction phase, and to be further studied.
- 8) Human resource to prepare for the ILC Laboratory to be studied after the project judgment.

April 2016 -



- Hosting ILC has been proposed to Japanese government, which is being intensively studied by MEXT at the ILC Advisory Panel and three working groups.

- KEK will do:

- ▶ Continue accelerator R&D program at ATF, STF and CFF facilities collaborating with the international team.
- ▶ Provide the ILC panel with appropriate information to help their timely conclusion.
- ▶ Develop a KEK's evolution plan to prepare for green light given by MEXT.

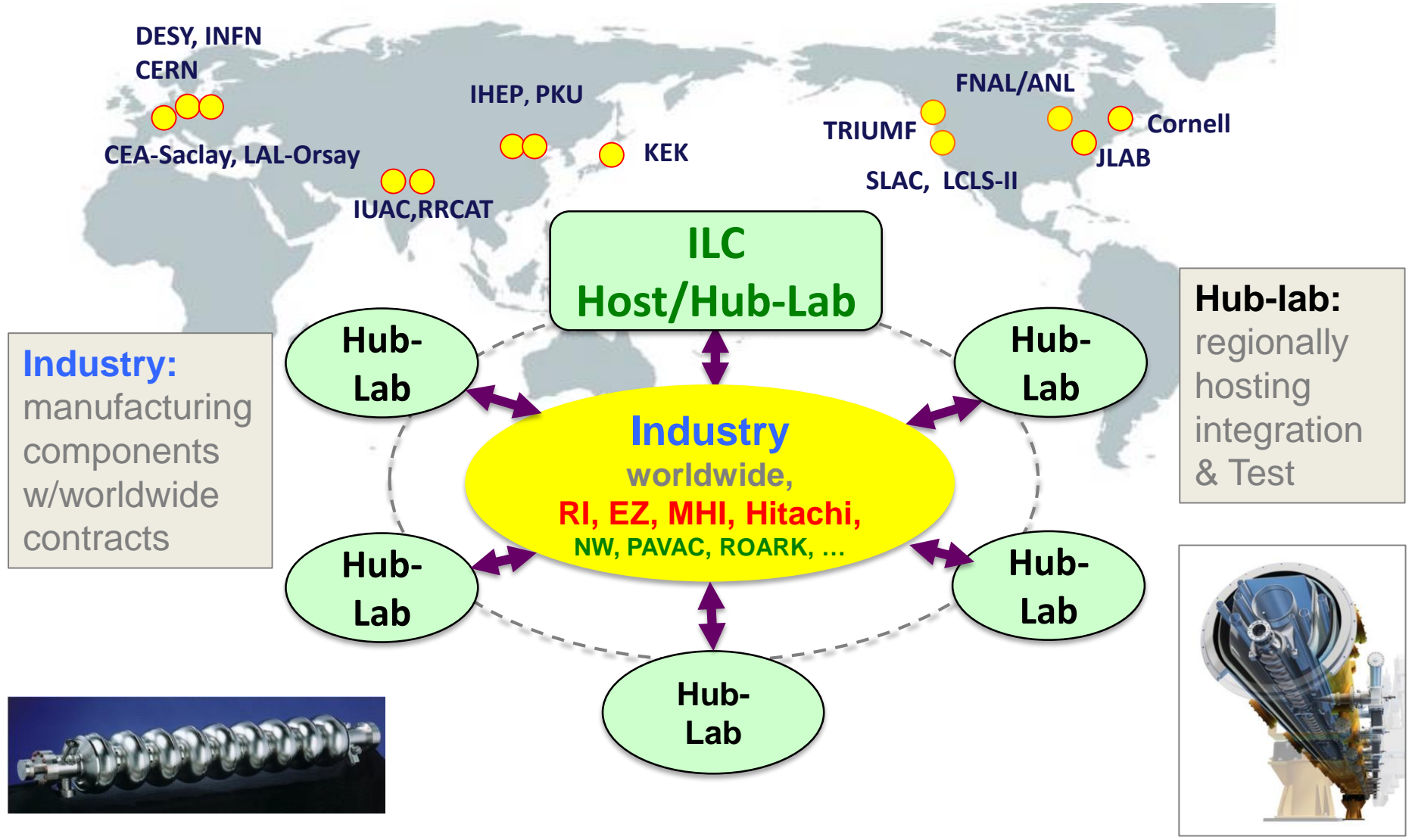


E-JADE

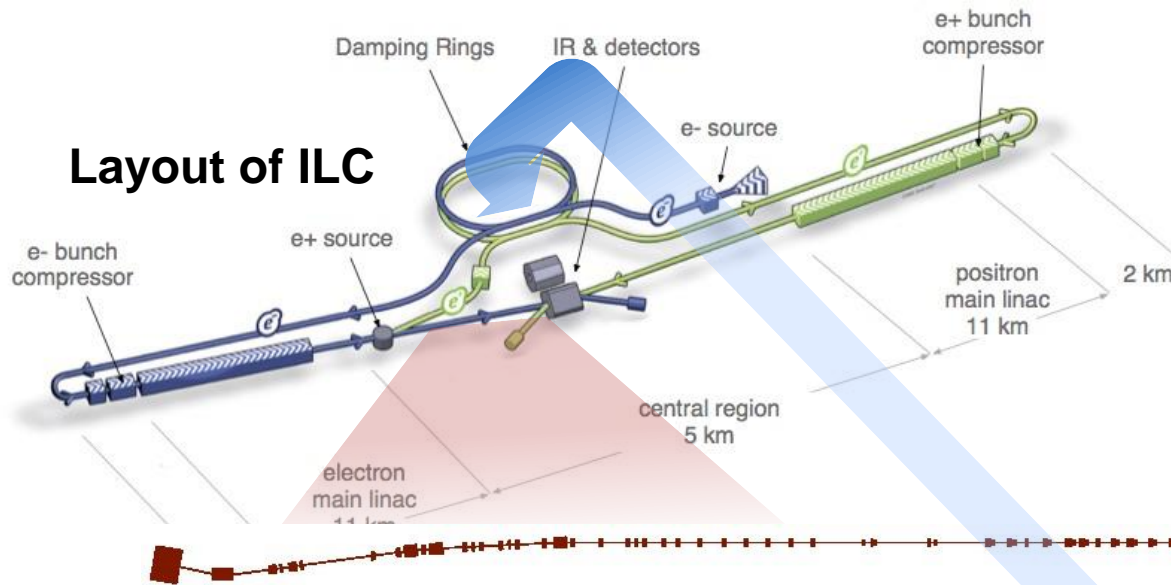


E-JADE

ILC SRF Global Manufacture/Integration Model



- SRF acceleration structure/cavity and the associated integration technologies
- Cryomodule performance stability after regional fabrication and inter-regional transportation
- Cryogenics engineering with further optimization in energy balance

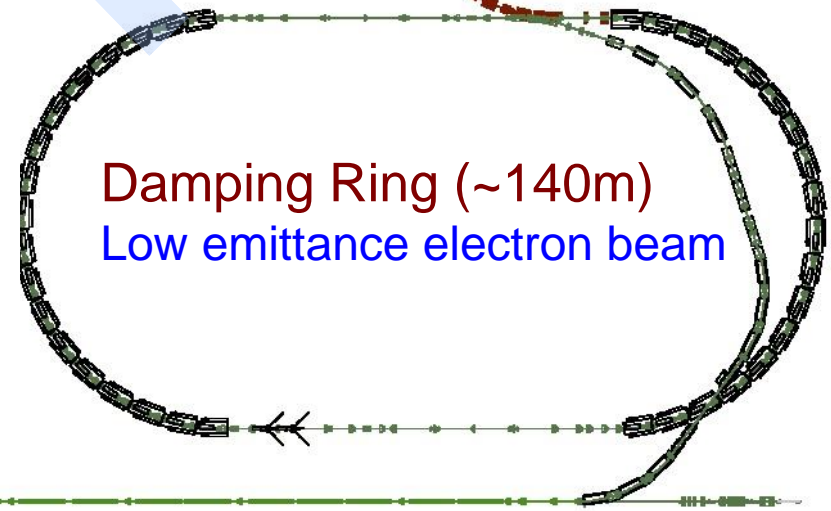


Develop the nanometer beam technologies for ILC

- Key of the luminosity maintenance
- 6 nm beam at IP (ILC)

ATF2: Final Focus Test Beamline

Establish the technique for small beam (**Goal: 37 nm**) and its position stabilization in a few nm.



1.3 GeV S-band Electron LINAC (~70m)

ATFに参加している代表的研究機関

- ATF International Collaboration -

欧州原子核研究機構(CERN)

ドイツ(Germany)

電子シンクロトロン研究所(DESY)

フランス(France)

IN2P3; LAL, LAPP, LLR

イギリス(UK)

Univ. of Oxford

Royal Holloway Univ. of London

STFC, Daresbury

Univ. of Manchester

Univ. of Liverpool

Univ. College London

イタリア(Italy)

INFN, Frascati

スペイン(Spain)

IFIC-CSIC/UV

ロシア(Russia)

Tomsk Polytechnic Univ.

アメリカ(USA)

SLAC国立加速器研究所

ローレンス・バークレー国立研究所(LBNL)

フェルミ国立加速器研究所(FNAL)

ローレンス・リバモア国立研究所(LLNL)

ブルックヘブン国立研究所(BNL)

コーネル大学(Cornell Univ.)

ノートルダム大学(Notre Dome Univ.)

日本(Japan)

高エネルギー加速器研究機構(KEK)

東北大学 (Tohoku Univ.)

東京大学 (Univ. of Tokyo)

早稲田大学(Waseda Univ.)

名古屋大学(Nagoya Univ.)

京都大学 (Kyoto Univ.)

広島大学 (Hiroshima Univ.)

中国(China)

中国科学院高能物理研究所(IHEP)

韓国(Korea)

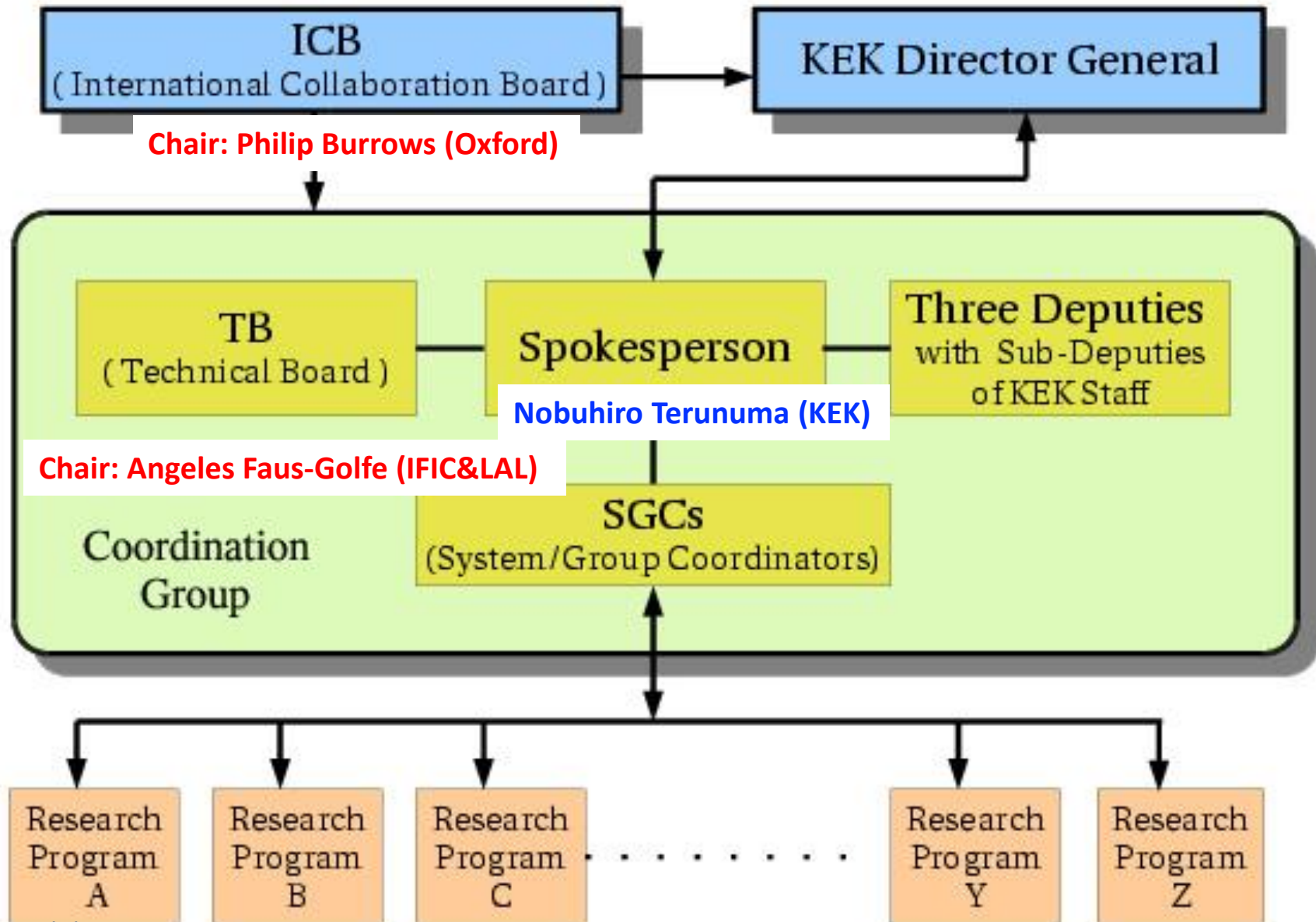
ポハン加速器研究所(PAL)

キョンプク大学(KNU)

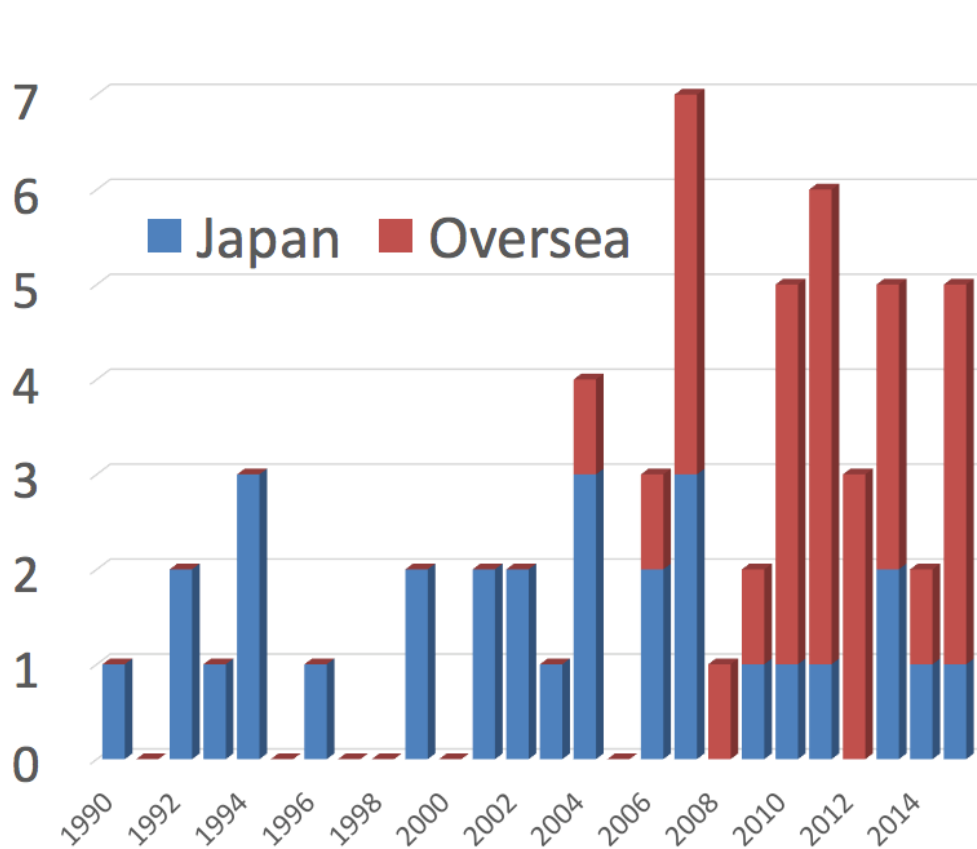
インド(India)

Raja Ramanna Centre for Advanced Technology

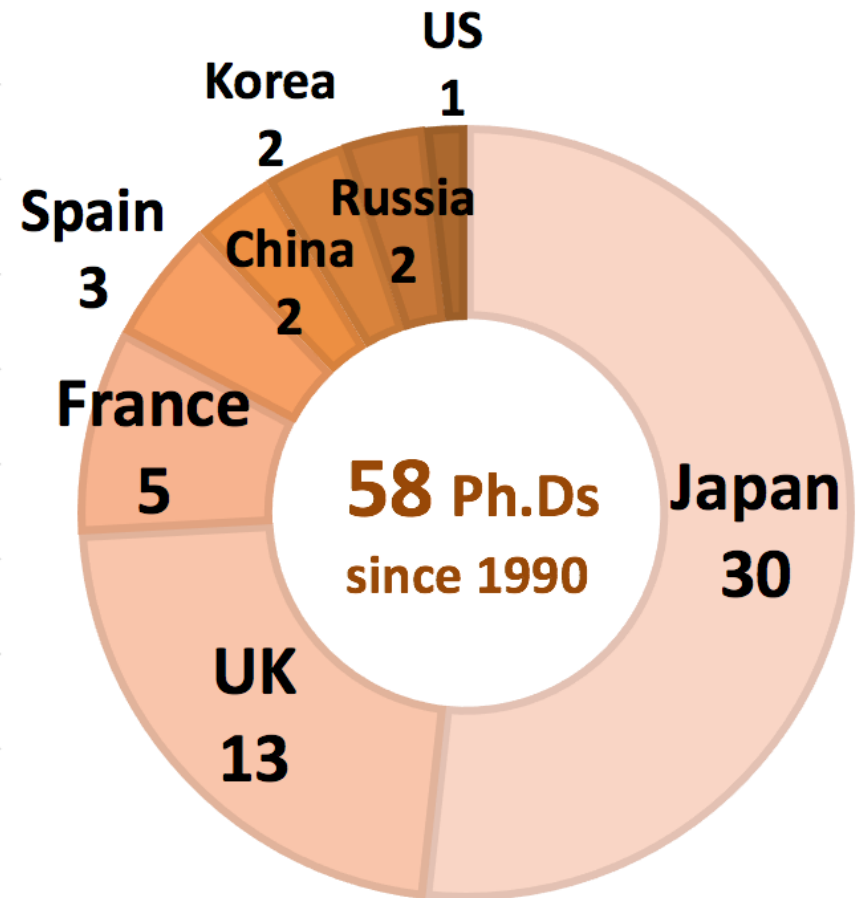
ATF International Collaboration



58 Ph.Ds related to ATF R&D

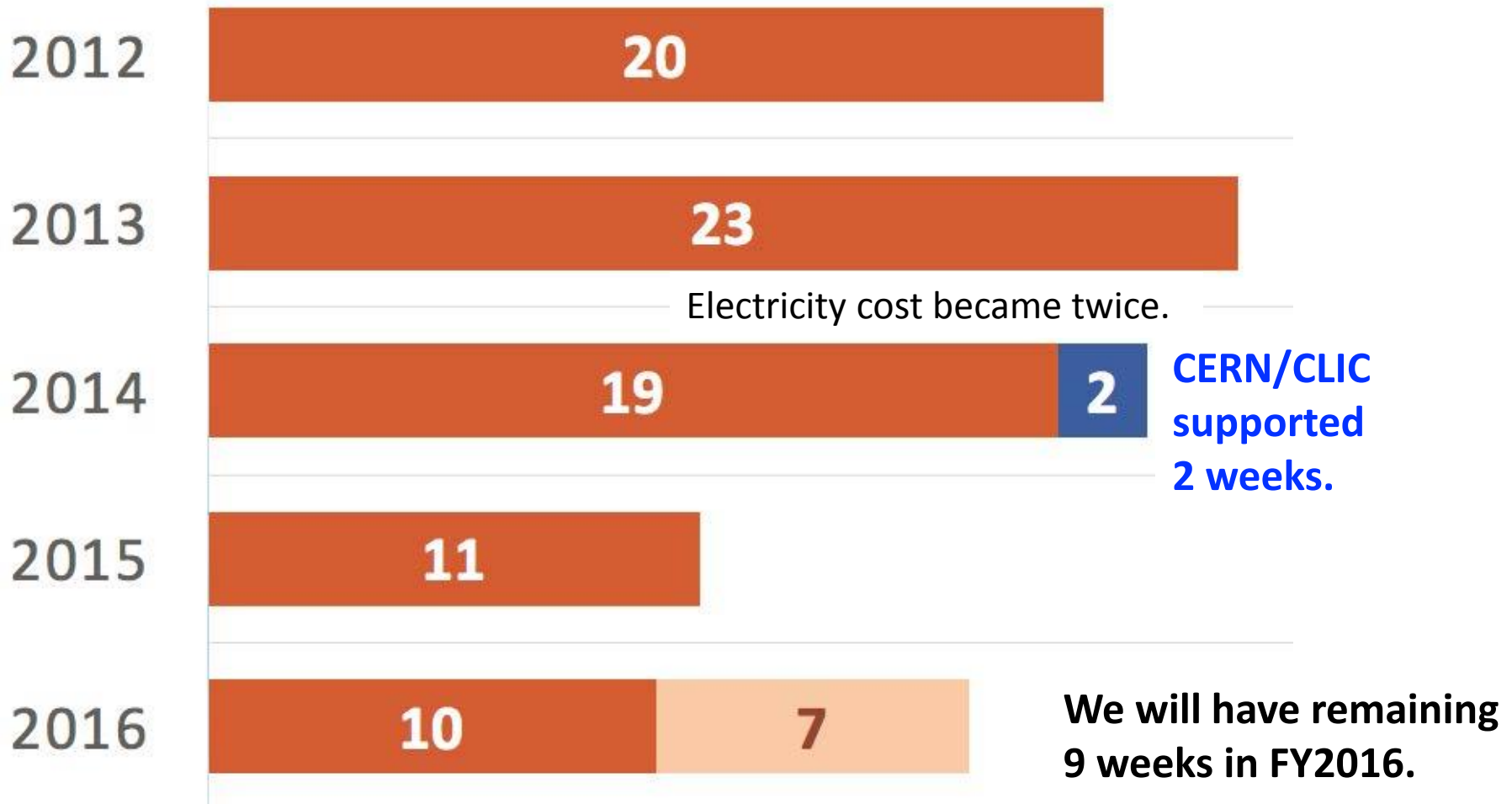


ATF International Collaboration
established in 2005



History of ATF Beam Weeks

Calendar Year



Since 2014, because of the high electricity cost and KEK tight budget, the running time is significantly reduced. In this FY year, we have 9 more weeks. (i.e. 2 weeks in Jan-Mar/2017. The budget after April/2017 is not yet known.)

- There is no direct matching fund in Japan for E-JADE.
- Japanese researchers are visiting European institutes with several resources:
 - ▶ KEK internal budget
 - ▶ JSPS (Kakenhi, Grant-in-aid)
 - ▶ JSPS (Strategic Young Researcher Overseas Visits Program for Accelerating Brain Circulation) : KEK-CERN -> For long stay of young researchers.

	CERN	DESY	Others
WP1	10		
WP2			
WP3	8	3	
WP4	18		
Total	36	3	0

Note: Only the stay longer than 1month is shown. There are many short visits. (Including my attending this meeting.) Production and Test of the HL-LHC model magnet have been done in Japan so that it is not

39/169 = 23% of planned secondments.

K. Tokushuku is applying a new fund for long stay of Accelerator researchers at CERN.

- It is essential to have international cooperation for R&D (and construction) of the future accelerators for particle physics.
- KEK is leading on-going research with J-PARC and SuperKEKB accelerators.
- Test facilities for future accelerators and the operating accelerators give unique opportunities for EU accelerator physicists.