KEK and HiLumi LHC

Katsuo Tokushuku
Institute of Particle Nuclear Studies (IPNS)

High Energy Accelerator Research Organization (KEK)

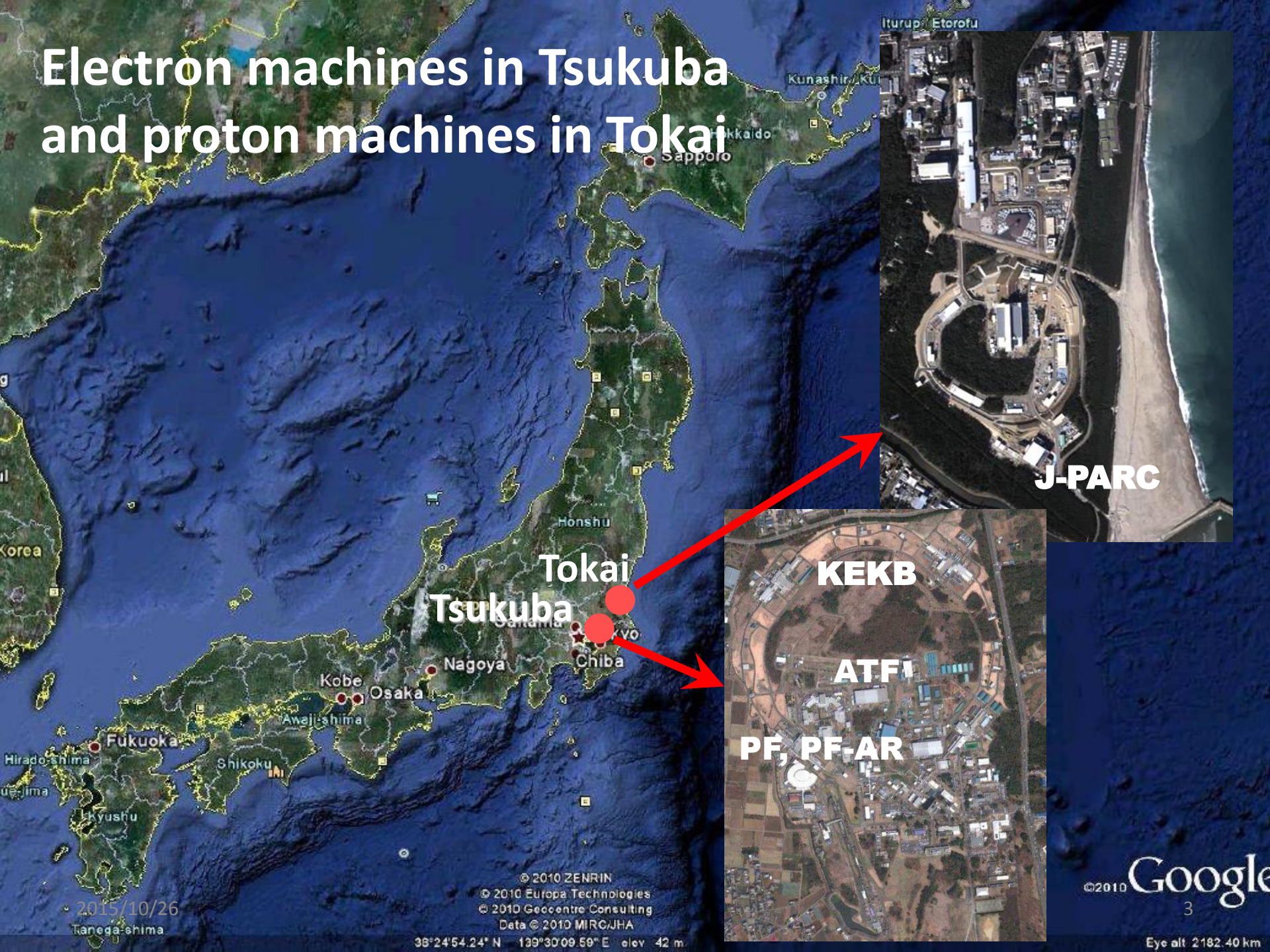
2015/10/26

KEK
High Energy Accelerator Research Organization

Contents

- KEK organization
- Roadmap and diverse physics project
- HL-LHC and KEK/Japan
- Various R&D activities for HL-LHC

Electron machines in Tsukuba and proton machines in Tokai



KEK new organization since April

- KEK Director General
  - Masanori Yamauchi

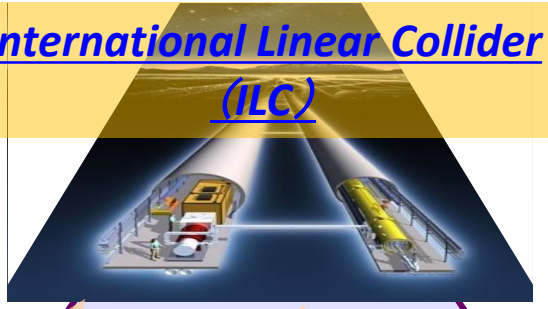
- 4 Executive Directors
  - Yasuhiro Okada (Research, International Relations..)

- IPNS Director
  - Katsuo Tokushuku
- Accelerator Laboratory Director
  - Seiya Yamaguchi

Quest for Birth-Evolution of Universe

International Linear Collider (ILC)

Quest for Unifying Matter and Force



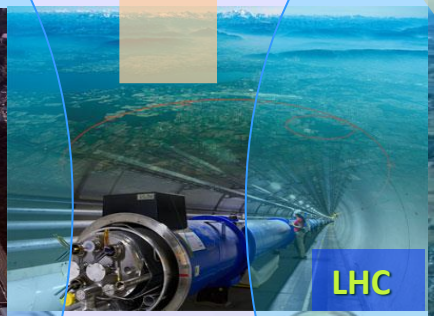
Scientific Activities
Technology Innovations
Talented Human Resources

Lepton CP Asymmetry

Power-Upgrade

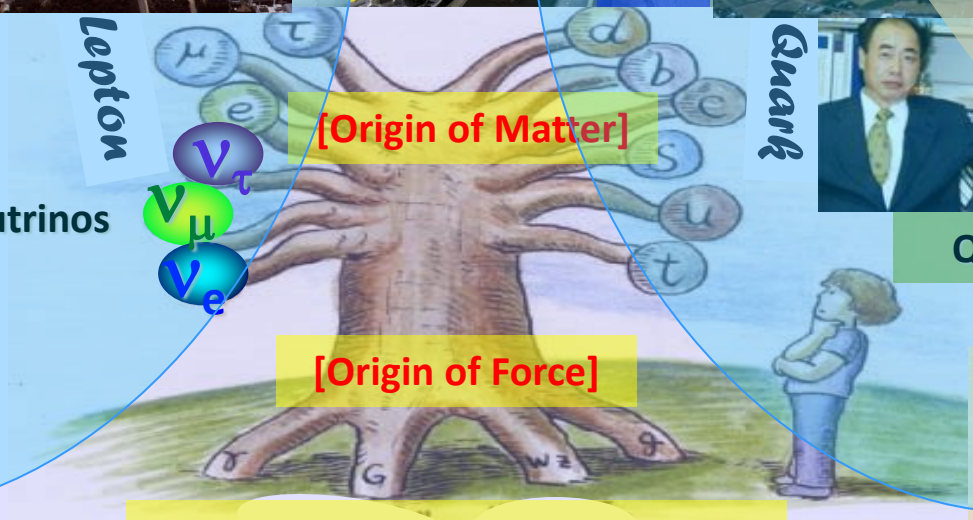
Beyond Standard Physics

SuperKEKB



Lepton

Quark



Quest for Neutrinos

Quest for 6 Quarks

Physics at IPNS/KEK

Energy Frontier

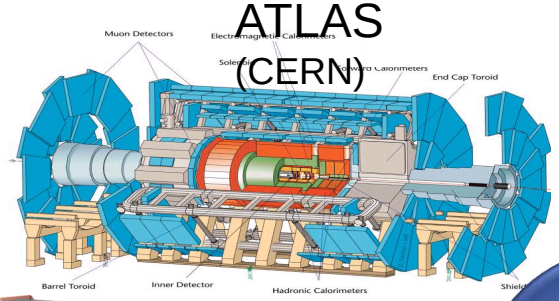
Flavor Physics

Hadron and Nuclear Physics

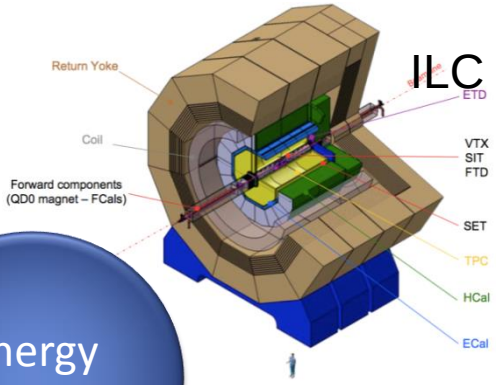
Astro-particle Physics

Theory

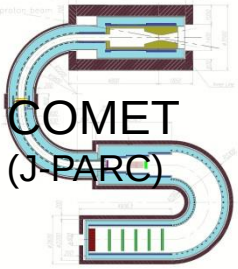
ATLAS (CERN)



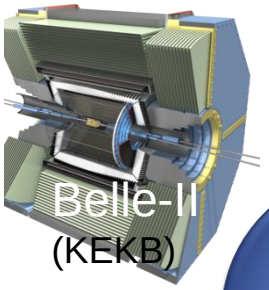
ILC



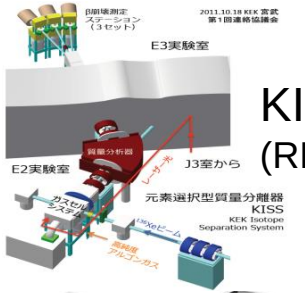
COMET (J-PARC)



Belle-II (KEKB)



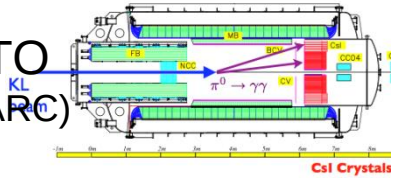
KISS (RIKEN)



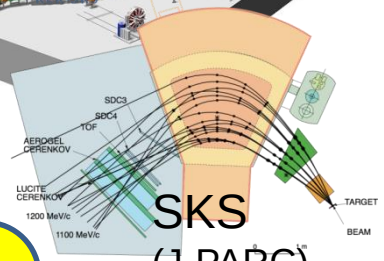
T2K (J-PARC)

Hadron hall (J-PARC)

KOTO (J-PARC)

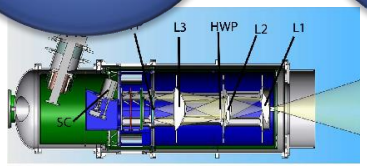


SKS (J-PARC)



UCN (RCNP)

QUIET (Atacama)



PolarBear2 (Atacama)

Theory

String theory
Particle physics
Hadron physics
Cosmo-physics
Lattice simulation

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HEP programs at KEK

- Flavor physics program
  - SuperKEKB and Belle II
    Super high lum. B factory at $8\times10^{35}/cm^2/s$
    ~5×10^{10} B, D, τ sample expected in ~2024
  - KOTO $K_L \rightarrow \pi^0\nu\nu$ at J-PARC
  - COMET $\mu \rightarrow e$ conversion search at J-PARC
  - g_μ-2/μEDM measurement at J-PARC MLF
  - Neutron EDM measurement at TRIUMF
- Neutrino program
  - T2K long baseline neutrino experiment
    J-PARC -----> 295km ----> SuperKamiokande
  - Future roadmap: 750kW upgrade and HyperKamiokande
- Energy frontier program
  - ATLAS at LHC
  - ILC

KEKB and Belle

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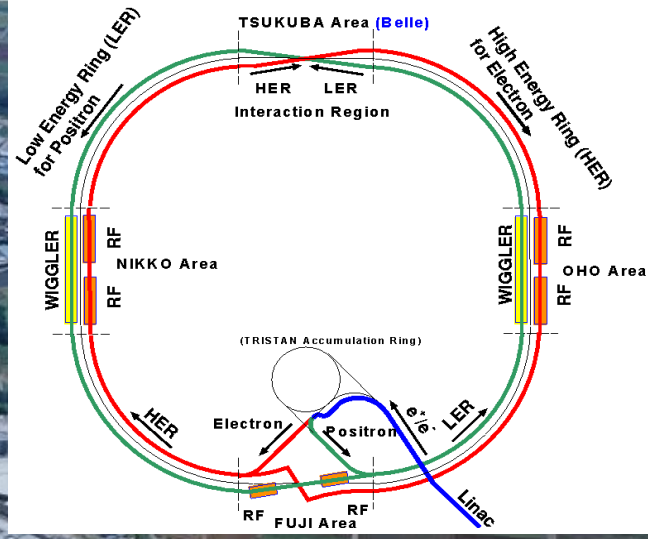
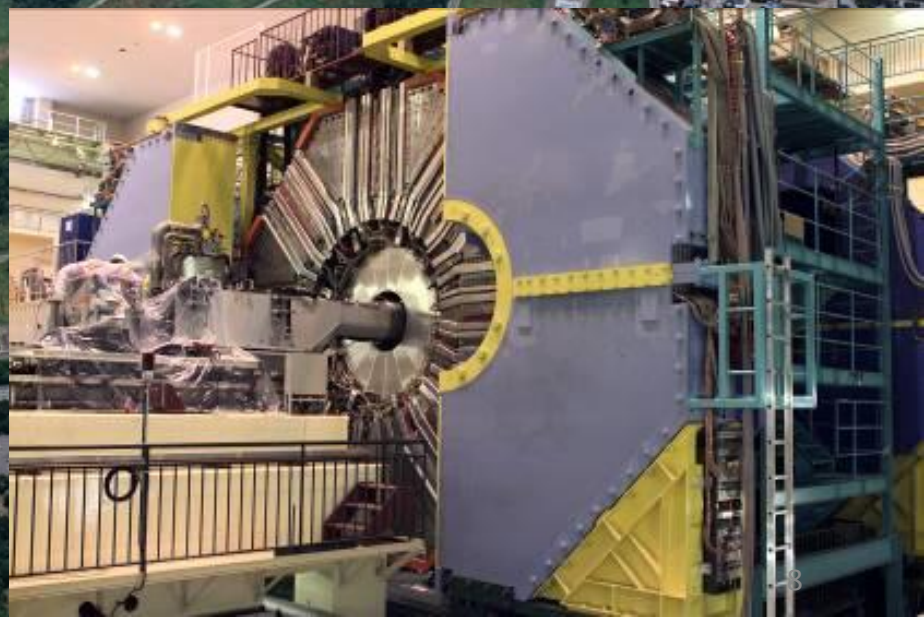
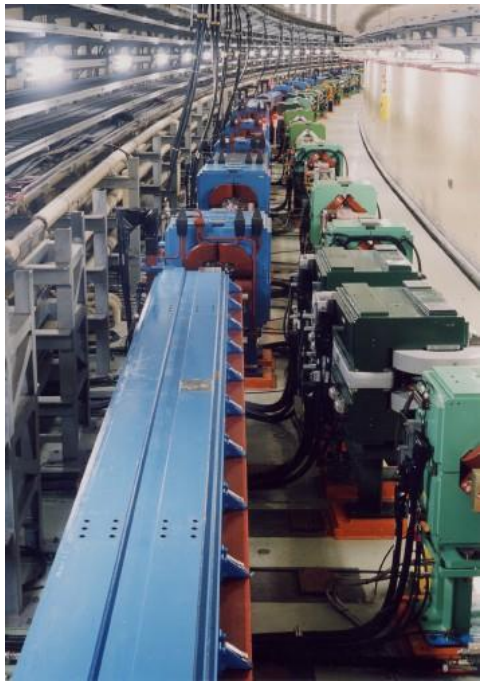
SuperKEKB and Belle II

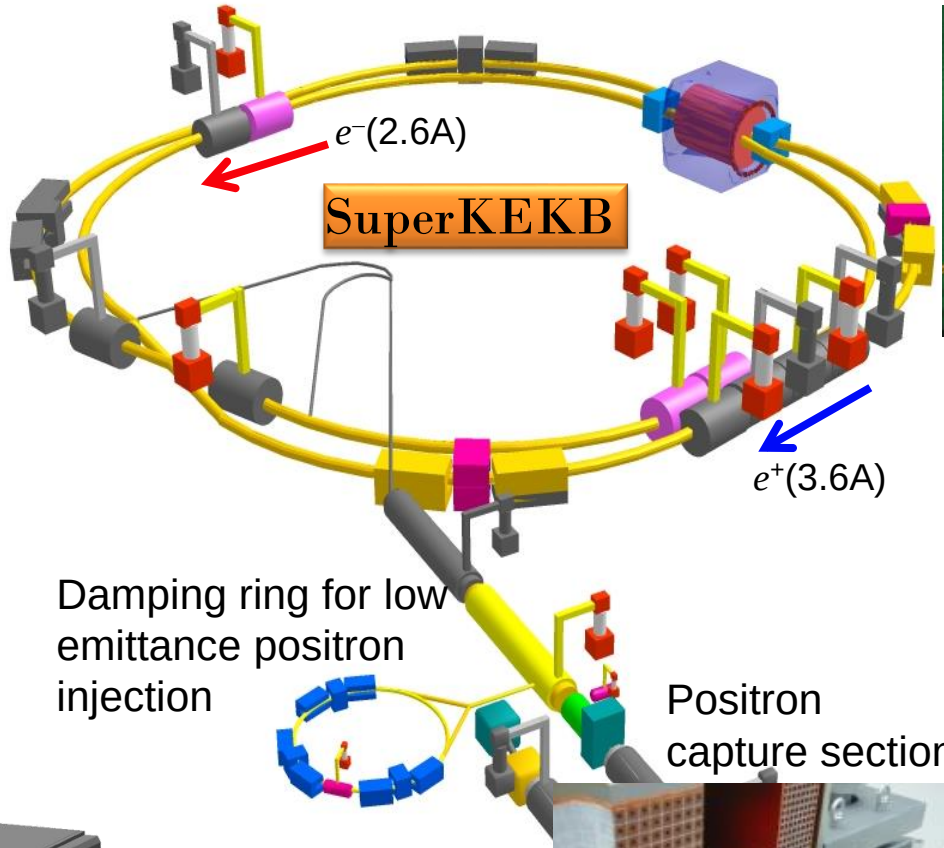




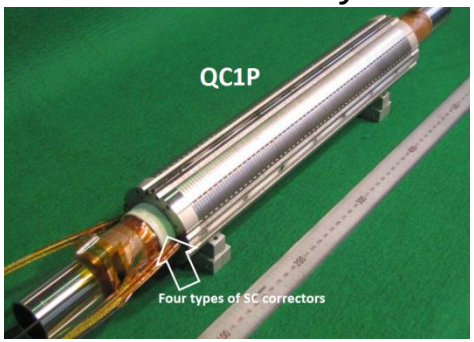
Accelerator upgrade

Low emittance lattice





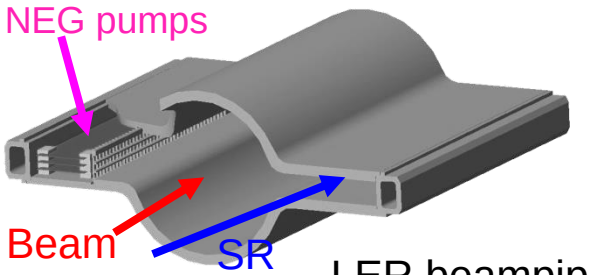
IR with β_y*=0.3mm
SC final focus system



Add RF systems for higher beam current

Damping ring for low emittance positron injection

Positron capture section



LER beampipe to suppress photoelectron instability

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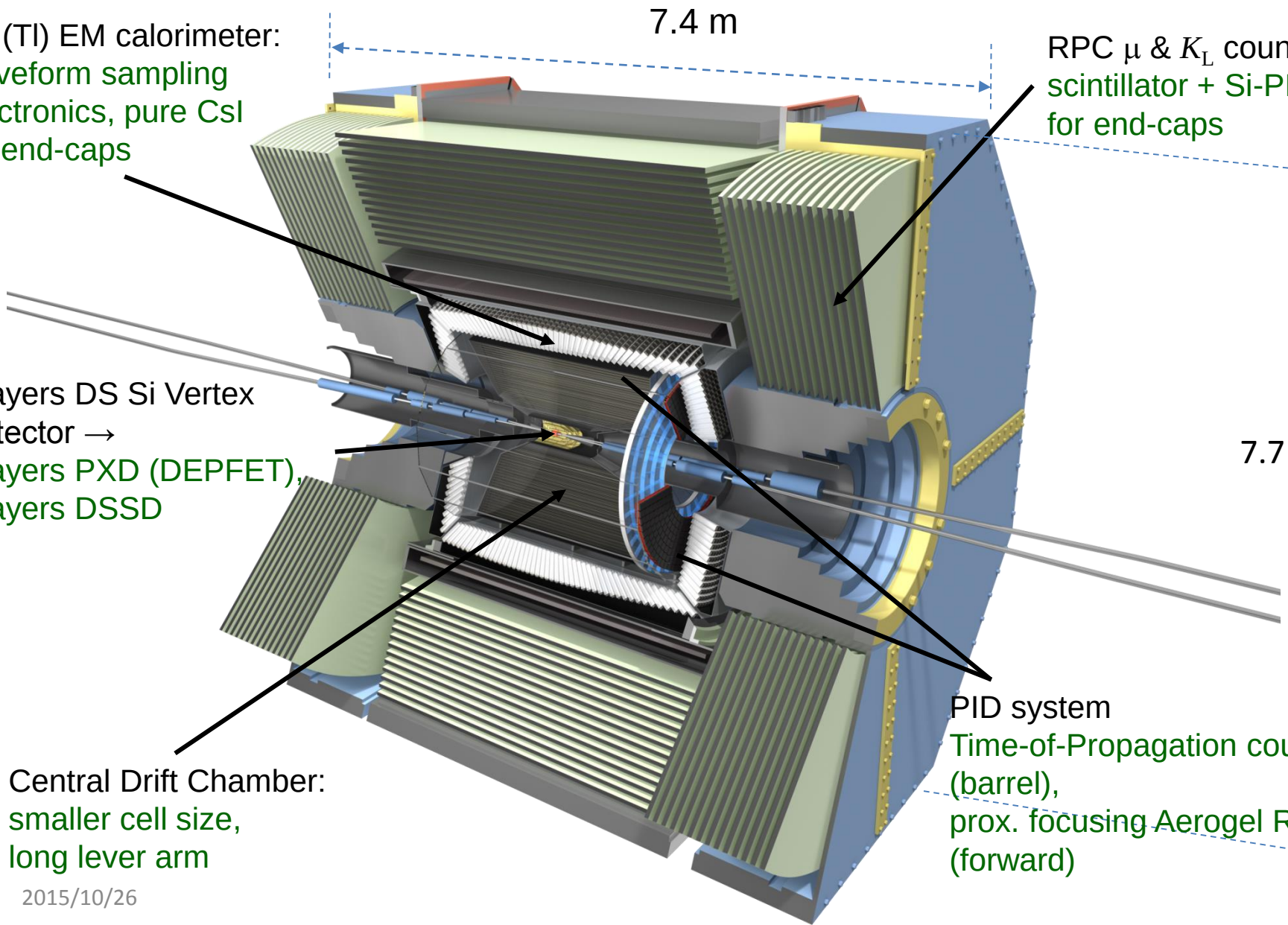
Belle-II Collaboration

Belle II

- 600 collaborators from 100 institutions in 23 countries
- Spokesperson:

  Tom Browder (Hawaii)
- Series of open collaboration meetings in 2008.03 ~2015.2

Belle II Detector Upgrade



CsI(Tl) EM calorimeter:
waveform sampling electronics, pure CsI for end-caps

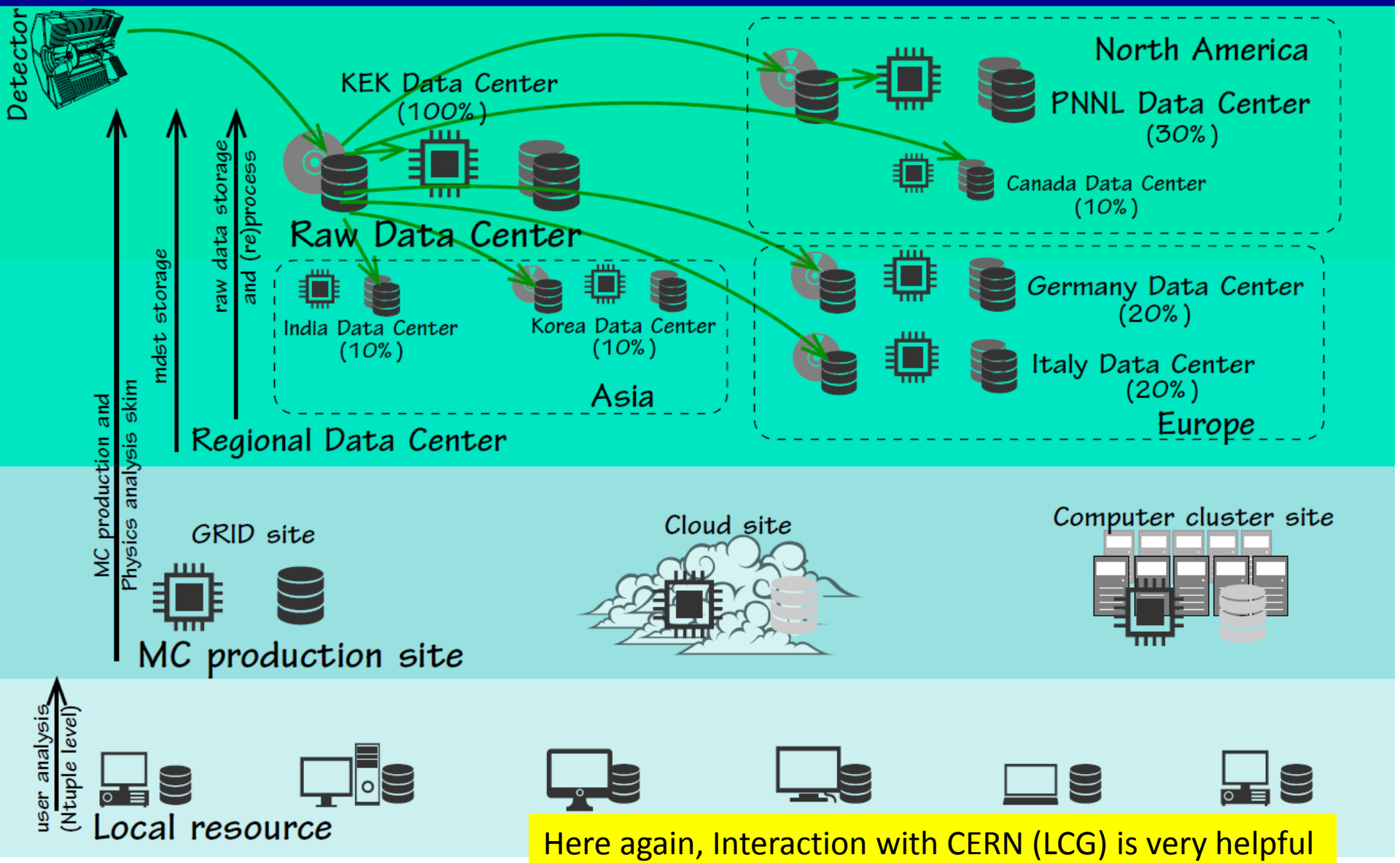
RPC μ & K_L counter:
scintillator + Si-PM for end-caps

4 layers DS Si Vertex Detector →
2 layers PXD (DEPFET),
4 layers DSSD

Central Drift Chamber:
smaller cell size,
long lever arm

PID system
Time-of-Propagation counter (barrel),
prox. focusing Aerogel RICH (forward)

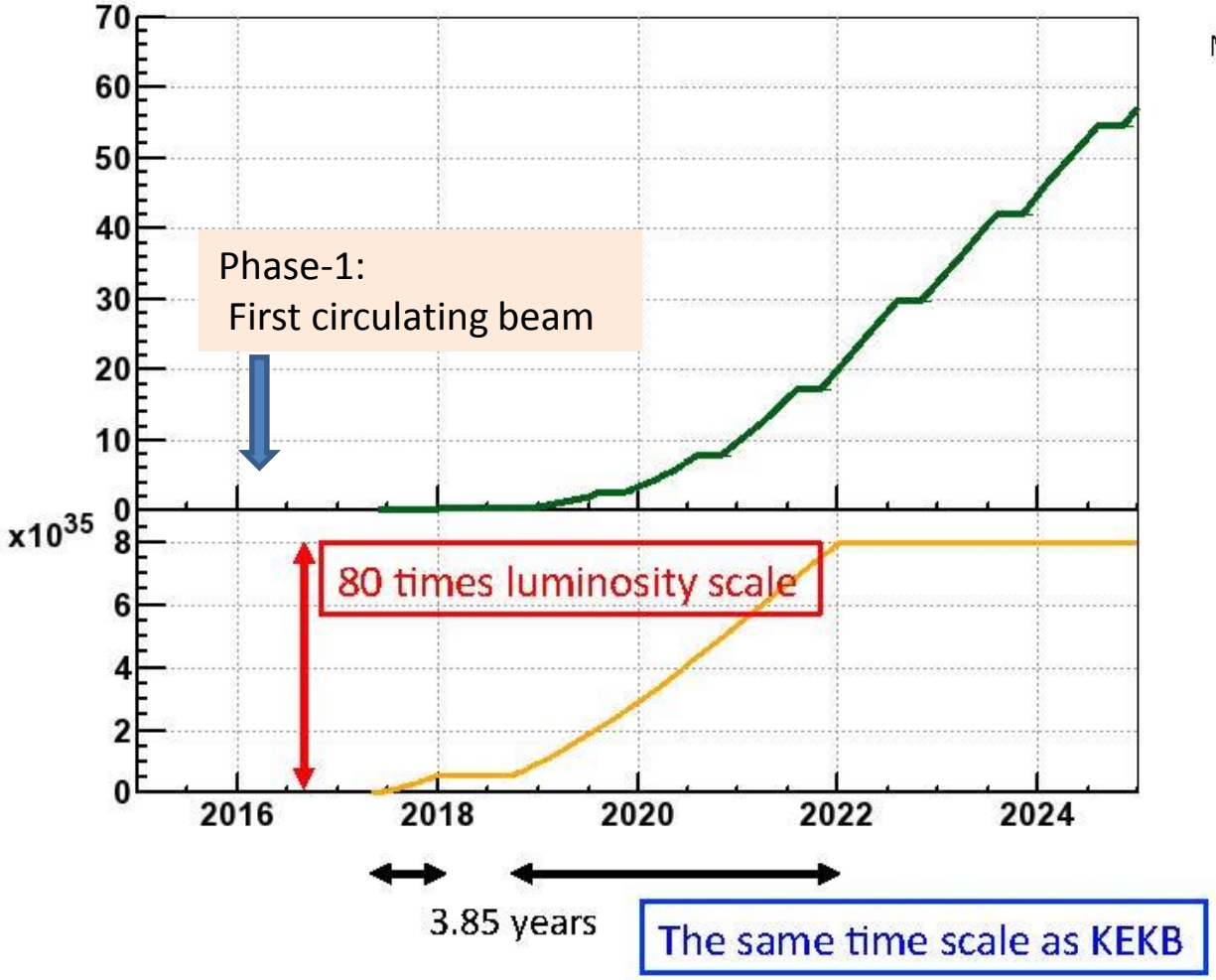
modified Belle II Computing Model after Year 4 (raw data part)



Here again, Interaction with CERN (LCG) is very helpful

SuperKEKB luminosity projection

A target luminosity profile of SuperKEKB/Belle II



This is the target we are aiming for.
As SuperKEKB is a challenging machine we need enough resources to handle many expected/unexpected issues.

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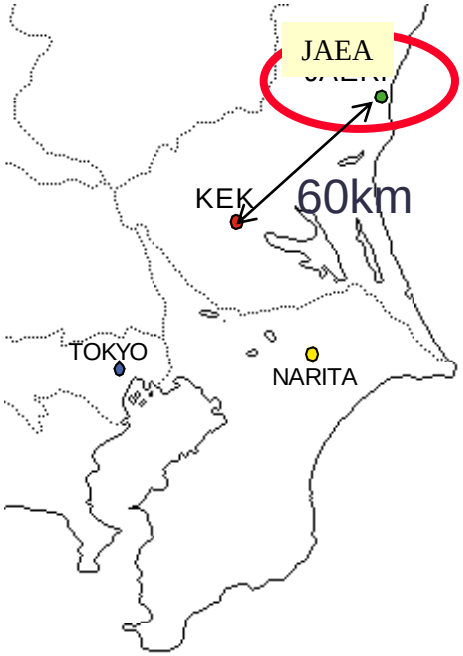
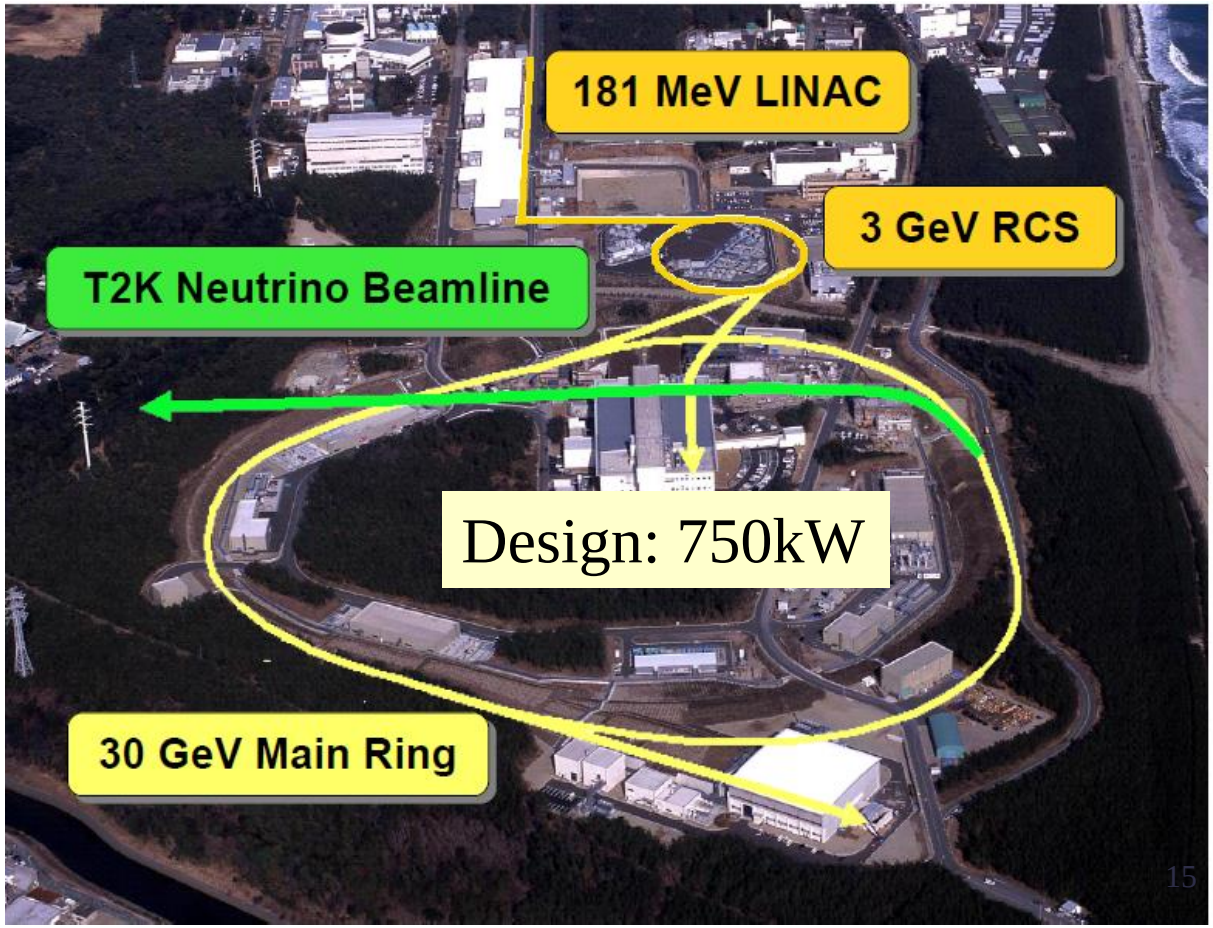
Interaction Region

J-PARC

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

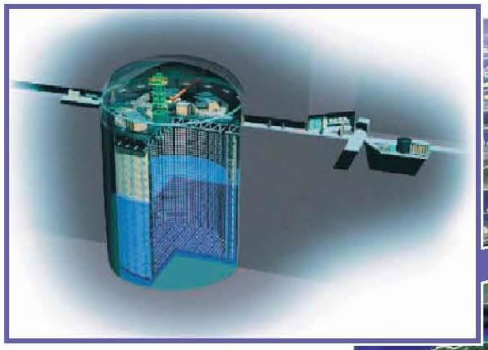




Joint project of KEK & Japan Atomic Energy Agency (JAEA)

T2K (Tokai to Kamioka) experiment

2010~ (Running)



Super-Kamiokande
(ICRR, Univ. Tokyo)

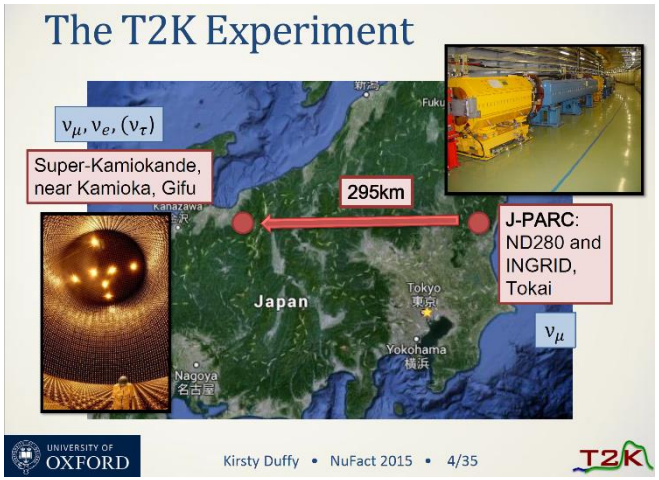
J-PARC Main Ring
(KEK-JAEA, Tokai)

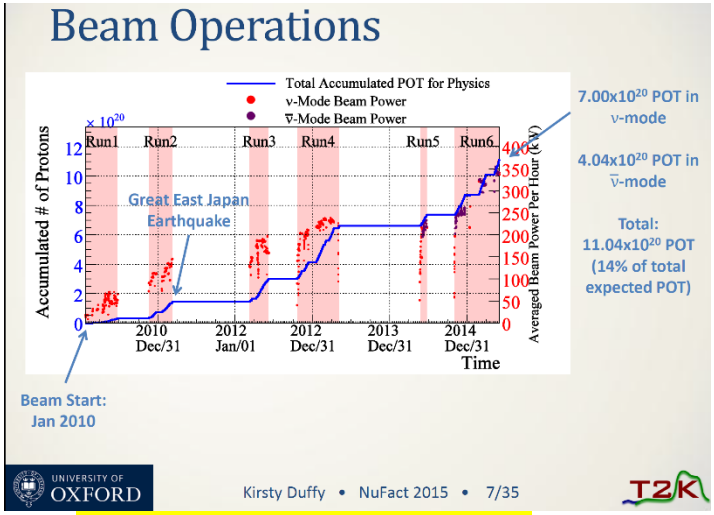
- High intensity ν_μ beam from J-PARC MR to Super-Kamiokande
- Evidence → Observation of $\nu_\mu \rightarrow \nu_e$ (2011-2013)
- Updated goals
  - Precise measurement of ν_e appearance
  - Precise meas. of ν_μ disappearance

→ Measure CPV phase, contribution to mass hier. determ.

T2K latest achievements

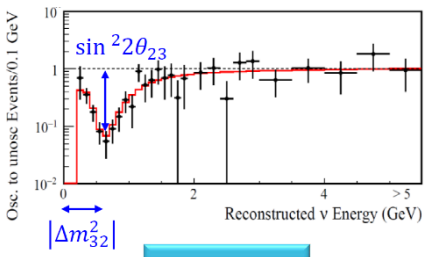
Kirsty Duffy (Oxford)
Aug.11 @ Nufact



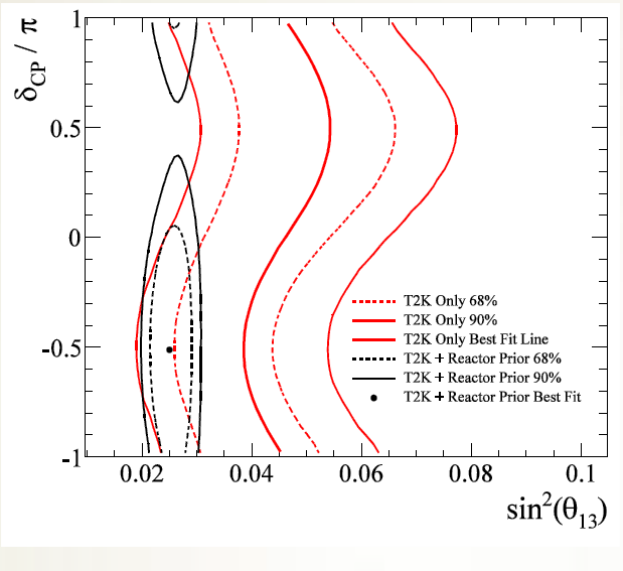


Stable operation at **345kW**

Maximum beam power: **371kW**

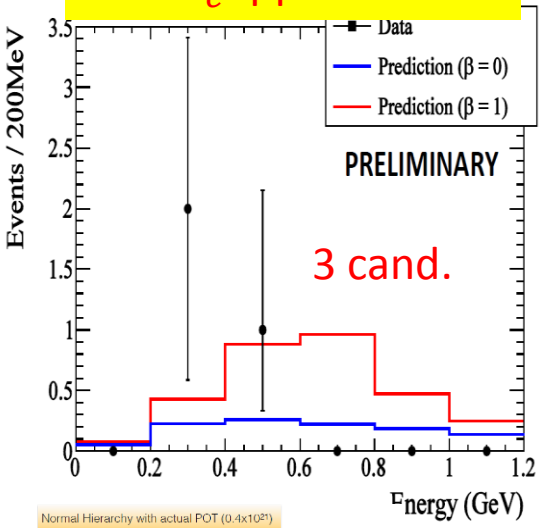


$46° \pm 3°$ T2K



Start measuring CPV phase

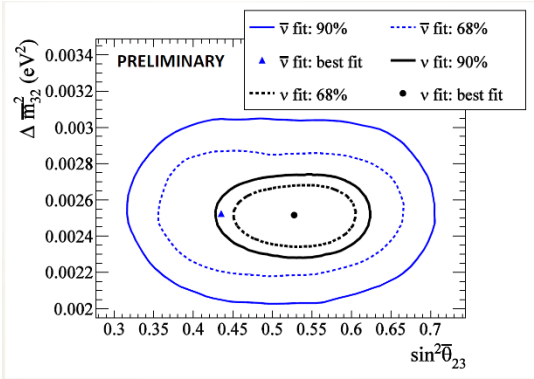
First $\overline{\nu}_e$ app search



Normal Hierarchy with actual POT (0.4x10²¹)

Expected events (NH)	$\delta_{CP} = -\pi/2$	$\delta_{CP} = 0$	$\delta_{CP} = +\pi/2$
Signal $\nu_\mu \rightarrow \nu_e$	1.961	2.636	3.288
Background $\nu_\mu \rightarrow \nu_e$	0.592	0.505	0.389
Background NC	0.349	0.349	0.349
Background other	0.826	0.826	0.826
Total	3.73	4.32	4.85

$\overline{\nu}_\mu$ disapp. meas.



Best fit values: $sin^2\overline{\theta}_{23} = 0.46^{+0.14}_{-0.06}$
$\Delta\overline{m}^2_{32} = 2.50^{+0.3}_{-0.2} \times 10^{-3} eV^2$

Start world leading meas.

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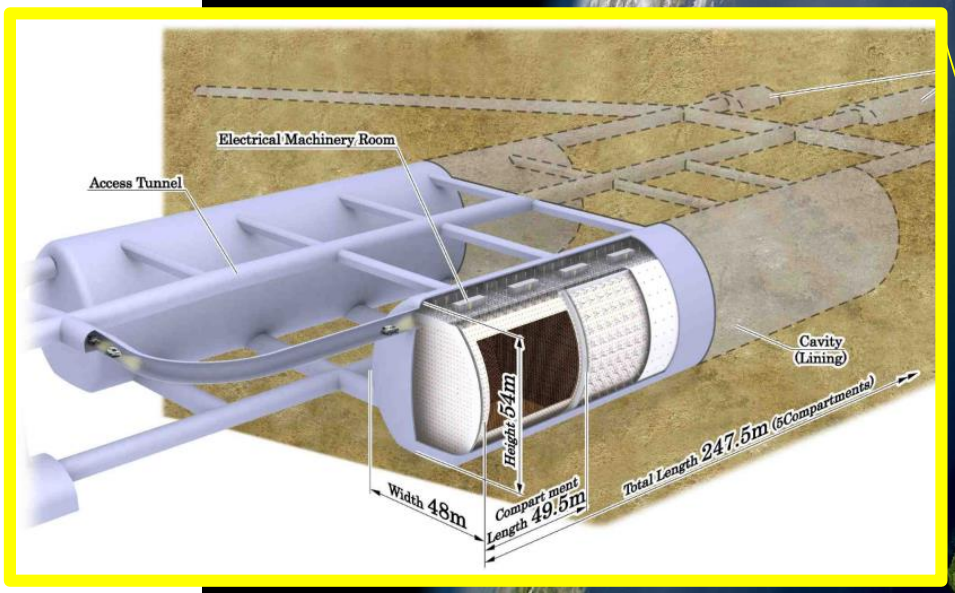
Next generation LBL experiment

J-PARC → Hyper-Kamiokande



LoI: The Hyper-Kamiokande Experiment arXiv:1109.3262v1

with realization of

- J-PARC MR at beam power of ~1MW (>=750kW)
- New 1Mt Water Ch det: Hyper-Kamiokande

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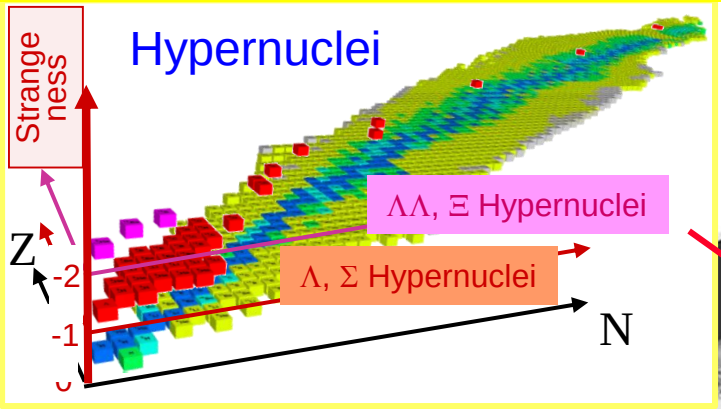
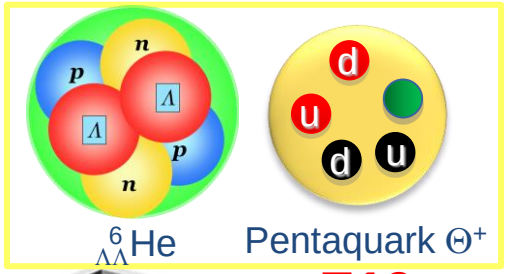
Nuclear & Particle Physics with J-PARC Hadron Beam

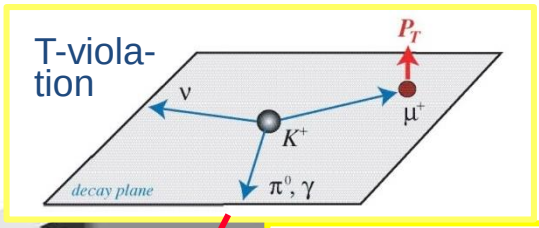
Since 24/April/2015 the normal operation has re-started!

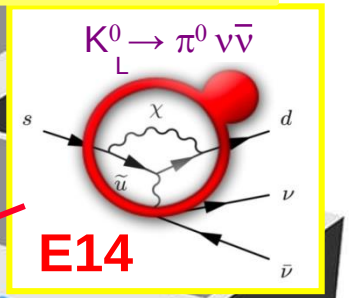




$^{6}_{\Lambda\Lambda}$He Pentaquark Θ+

E19





E14

Implantation of Kaon and the nuclear shrinkage

SKS

K1.8

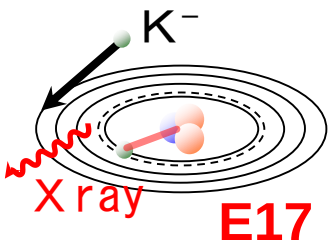
K1.8BR

KL

K1.1

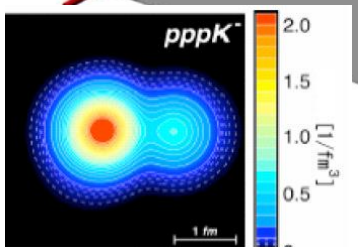
High p (not yet)

K1.1BR

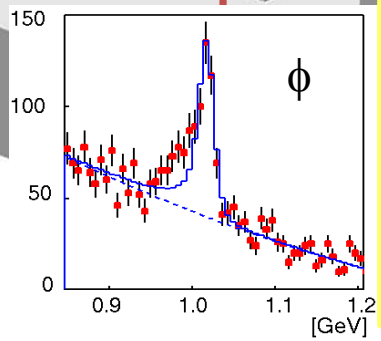


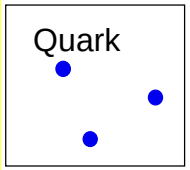
E17

Kaonic atom

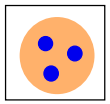


Kaonic nucleus





Free quarks



Bound quarks

Why are bound quarks haevier ?
Mass without Mass Puzzle

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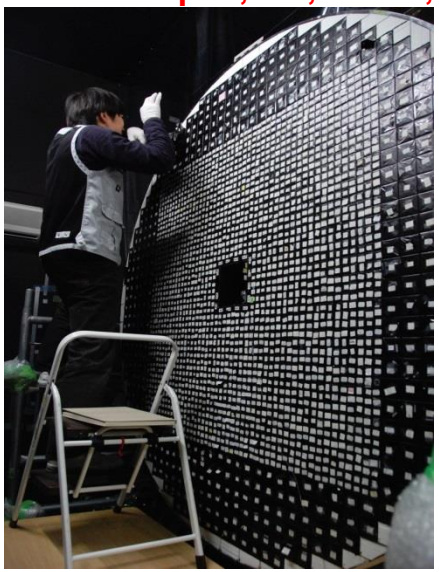
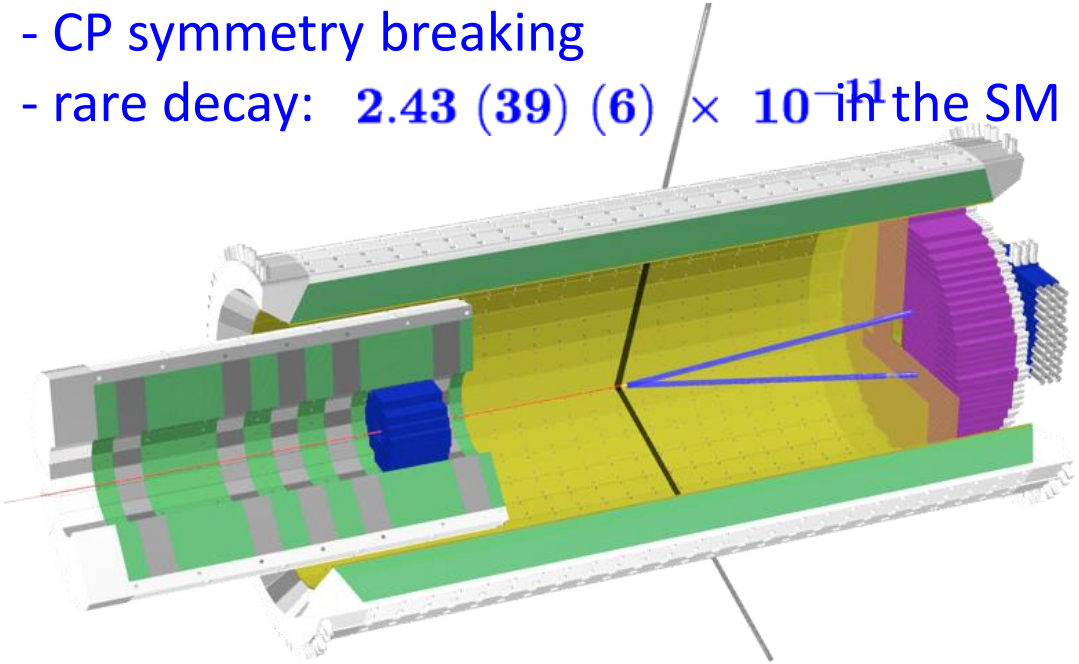
J-PARC KOTO experiment

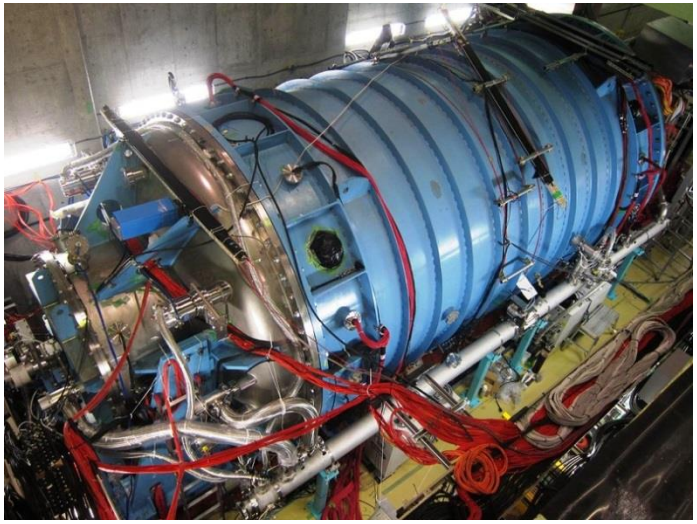
65 participants from Japan, US, Korea, Taiwan, Russia



$K_L \rightarrow \pi^0 \nu\bar{\nu}$

- CP symmetry breaking
- rare decay: $2.43\ (39)\ (6) \times 10^{-11}$ in the SM





- **CsI calorimeter** to measure $\pi^0 \rightarrow \gamma\gamma$
- background rejection:
  hermetic extra-particle detection (“veto”)
- Trigger/DAQ (37k channels):
  waveform digitization (14bits, 125MHz ADC), pipeline readout

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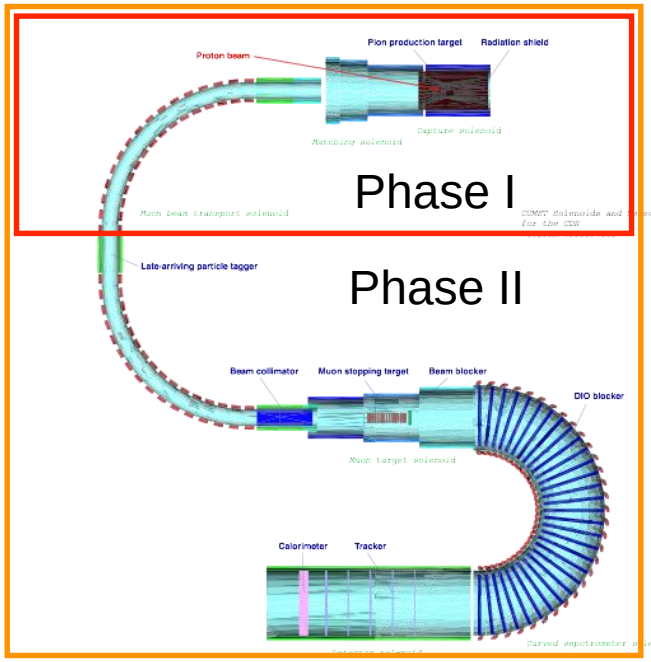
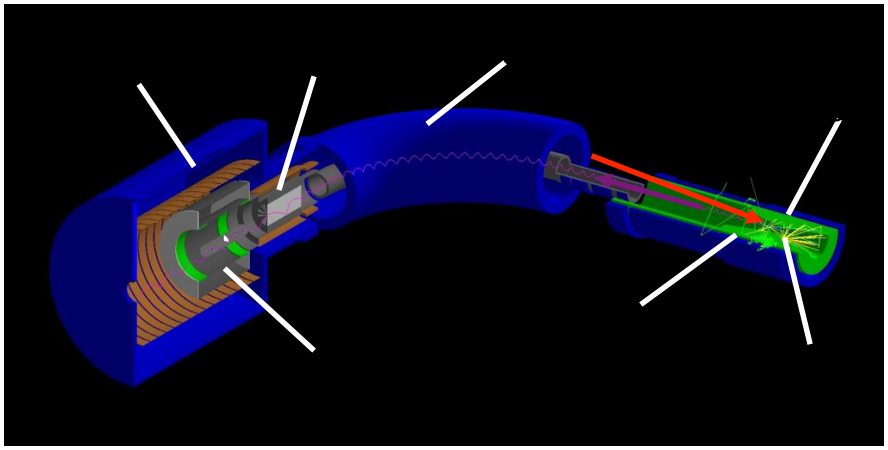
COMET Phase I & II

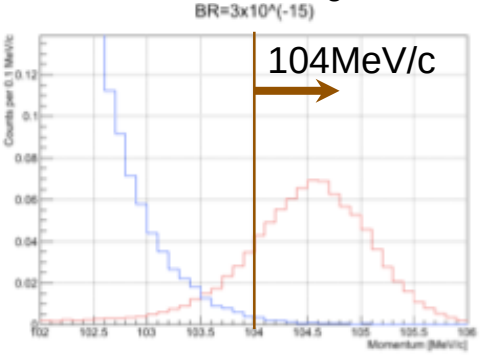
- Phase I
  - Detailed understanding of the beam background and achieving the sensitivity of < 10^{-14} (100 better than the current limit)
  - 8GeV, 3.2kW beam, ~90-days DAQ (Graphite as a primary target)
- Phase II
  - 8GeV, 56kW beam, 1-year DAQ (Tungsten as a primary target)
  - COMET final goal Sensitivity < 10^{-16}
- Proton beam extinction (w/o extraction) of 10^{-12} has been already achieved (Req. < $10^{-9\sim10}$)





Phase I background

0.03 BG expected
In 7.8x10^6 sec running time

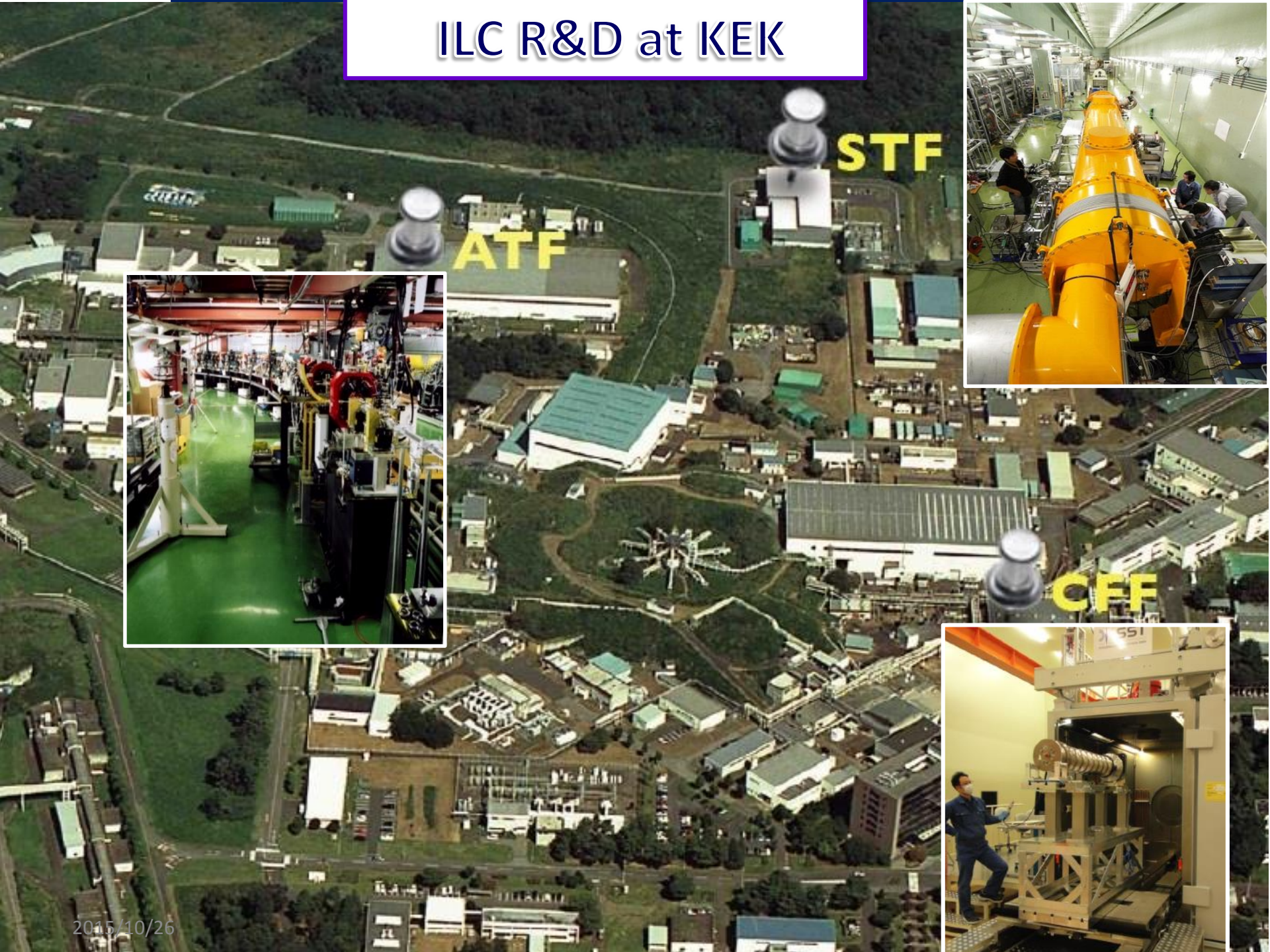


International Linear Collider

- KEK proposed to host ILC in Japan, which is under careful consideration in the Japanese Government.

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

ILC R&D at KEK



KEK
High Energy Accelerator Research Organization

KEK activities: Summary

- KEK has diverse program in particle physics.
  - Long baseline neutrino program with upgrade plan to HyperKamiokande.
  - Flavor physics program at SuperKEKB and J-PARC.
  - Energy frontier program: ATLAS/LHC and ILC

KEK
High Energy Accelerator Research Organization

FY2015: Special year!

- This is the very important fiscal year for KEK
  - The first circulating beam in SuperKEKB is planned in early 2016.
  - J-PARC SX beam experiments re-started.
  - T2K with anti-neutrino beam

- On the other hand, The KEK budget for this fiscal year is very tight. It is our first priority to run the current projects (J-PARC/SuperKEKB) on schedule. Now we are negotiating with our FA's for the better funding for the next FY.

- KEK is now working for a "Project Implementation Plan", for conducing the on-going projects and various future programs/upgrades for the next ~5 years (including LHC upgrade).

HiLumi LHC and KEK/Japan

- Discussions in KEK and HEP community
  - Japanese HEP sub-committee (2012)
  - KEK roadmap: (2013)
  - International Review (held by IPNS/KEK) (2014)

    The first priority for Japanese HEP community is the ILC and neutrino programs, HL-LHC has been endorsed as the on-going project.

- Discussion in Science Council of Japan
  - HL-LHC is listed as one of the big science project we pursue but not (yet) in the high-priority list.
  - We are preparing for the next (minor) update foreseen in 2016.

Recommendation of JAHEP sub-comm.

Feb 2012

The committee makes the following recommendations concerning large-scale projects, which comprise the core of future high energy physics research in Japan.

- **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.** In particular, if the particle is light, experiments at low collision energy should be started at the earliest possible time. In parallel, continuous studies on new physics should be pursued for both LHC and the upgraded LHC version. Should the energy scale of new particles/physics be higher, accelerator R&D should be strengthened in order to realize the necessary collision energy.

- **Should the neutrino mixing angle θ_{13} be confirmed as large, Japan should aim to realize a large-scale neutrino detector through international cooperation, accompanied by the necessary reinforcement of accelerator intensity, so allowing studies on CP symmetry through neutrino oscillations.** This new large-scale neutrino detector should have sufficient sensitivity to allow the search for proton decays, which would be direct evidence of Grand Unified Theories.

It is expected that the Committee on Future Projects, which includes the High Energy Physics Committee members as its core, should be able to swiftly and flexibly update the strategies for these key, large-scale projects according to newly obtained knowledge from LHC and other sources.

KEK roadmap / Review

2013

- KEK roadmap : Large Hadron Collider (LHC)/ATLAS

  The main agenda at LHC/ATLAS is to continually participate in the experiment and to take a proactive initiative in upgrade programs within the international collaboration at both the accelerator and detector facilities.

- International review on the Japanese contribution on LHC and ATLAS. (Nov 2013)
  - Chair: Eckhard Elsen (DESY)
  - J Dorfan, E Elsen, F Gianotti, M Lamont, J Nash, M Nojiri, L Rossi, A Schopper and B Strauss
  - The Report is in public:

  https://kds.kek.jp/indico/event/13329/session/7/material/1/0.pdf

Steps toward requesting new resource

- Year 2013: the update of 'Master Plan of big science projects' called by the Science Council of Japan.
  - 207 proposals are accepted in total from various area of science.
  - 27 projects were chosen as 'the high priority' projects in March 2014
  - Unfortunately, HL-LHC was not chosen among the 27.

    (High priority projects in HEP/NP are, Hyper-Kamiokande and J-PARC extension. ILC is handled separately.)

⇒ Outcome: It is not so easy to request HL-LHC budget in the straight way before the next update of the Master plan, which is planned in 2016.

⇒ But, the importance of the LHC upgrade is known to the KEK-DG and (a part) of the MEXT section.

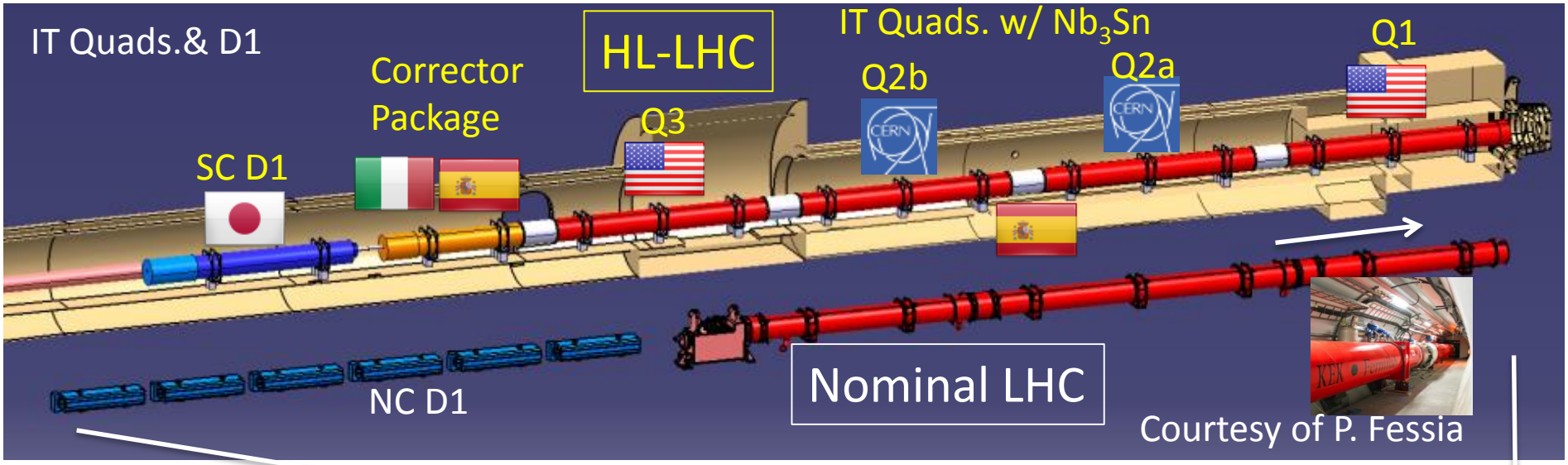
⇒ Prepare and update the budget plan to be ready for any chance.

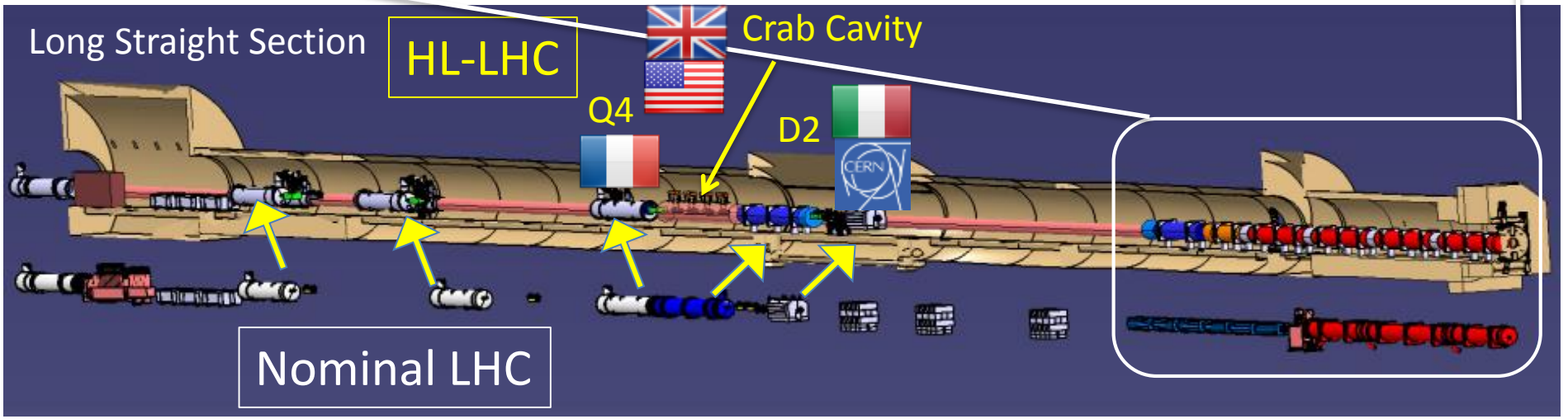
R&D projects for HL-LHC

- Various R&D programs related to the HL-LHC are successfully going on
  - D1 magnet prototype
  - Electro polishing for crab cavity
  - Beam halo Monitoring/ Beam dynamics
  - RF cavities for PS-Booster (LIU)
  - …

=> Big contributions to HiLUMI LHC

Layout of IR Magnets





Aperture increase in IT Quads:70mm→150mm ➡Large bore also for the new D1
Replacement of current NC D1 by SC D1: Shortening magnet length by 15m
➡ Making room for new crab cavities

D1 Magnet

- *Coil ID:* ***150 mm***
- *Integrated field:* ***35 T m*** *(26 Tm at present LHC)*
  - *5.59 T at 12 kA. L_{coil}=6.6 m*
- *T_{op}:* *1.9 K by HeII cooling*
- *Op. point (2D coil):* ***75 %***
- *Coil layout:* *1 layer of 15.1 mm cable*
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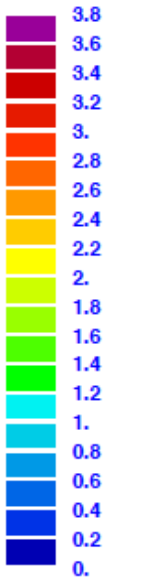
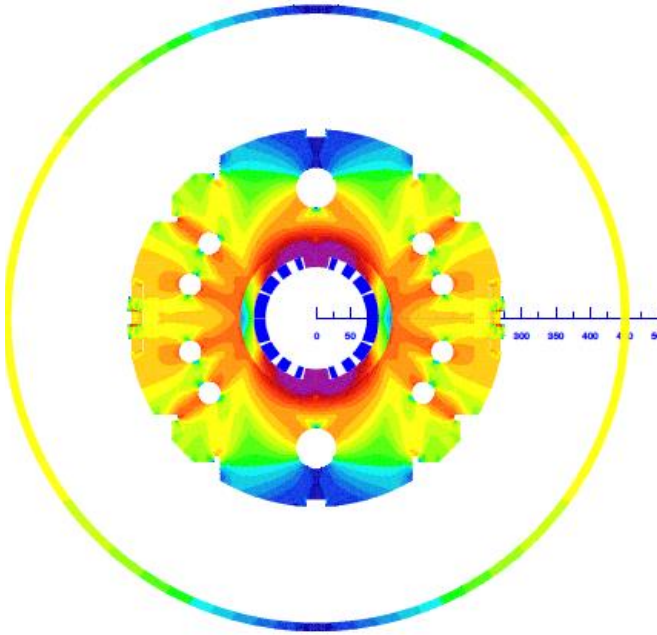
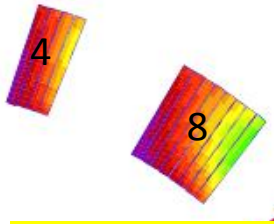
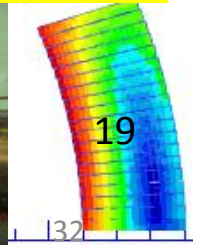
135 W in total, 2 mW/cm³ at local peak, Radiation dose >25 MGy







2m model coil is under construction!



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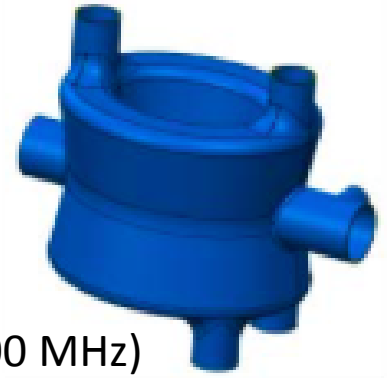
CERN-KEK Collaboration on Crab Cavity

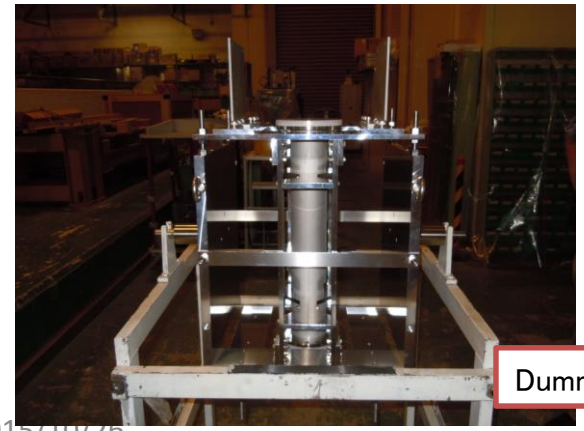
Objectives:

- Based on research and development on crab cavities for the LHC luminosity upgrade progressed, as a cooperative work between KEK and CERN, this agreement, Appendix 16, aims to develop state of the art surface treatment techniques for high field superconducting crab cavities that deflect beam bunches in order to realize the crab crossing for the LHC accelerator luminosity upgrade.

KEK responsibilities for:
Development of a vertical electro-polishing (VEP) system,
Application of VEP to crab cavities,
Fundamental studies on vertical electro-polishing conditions,



Crab Cavity
- Type : DQW (400 MHz)
- Used at ATLAS and CMS points

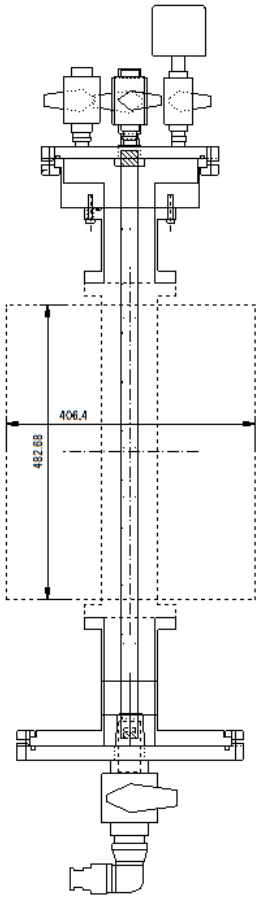


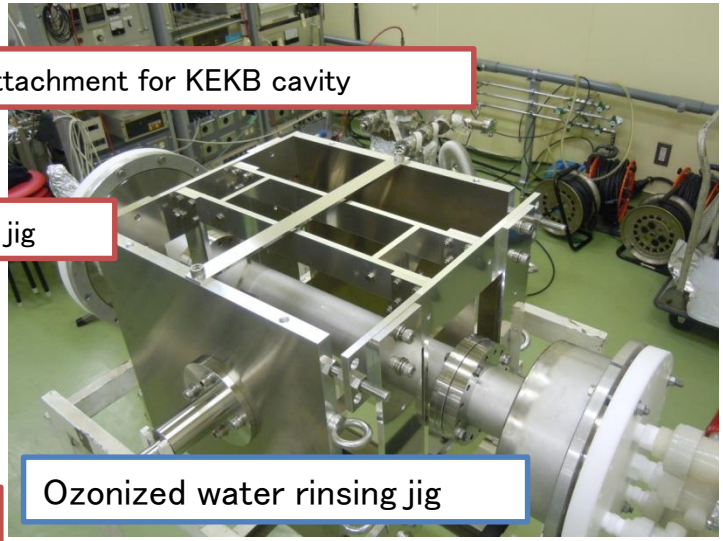
Dummy chamber held in the rotation jig

We are fabricating the vertical EP apparatus. The rotation jig and the ozonized water rinsing jig are already fabricated and assembled. After the fitting check of apparatus, we applied the vertical EP to the LHC crab cavity fabricated at BNL.

KEK
High Energy Accelerator Research Organization

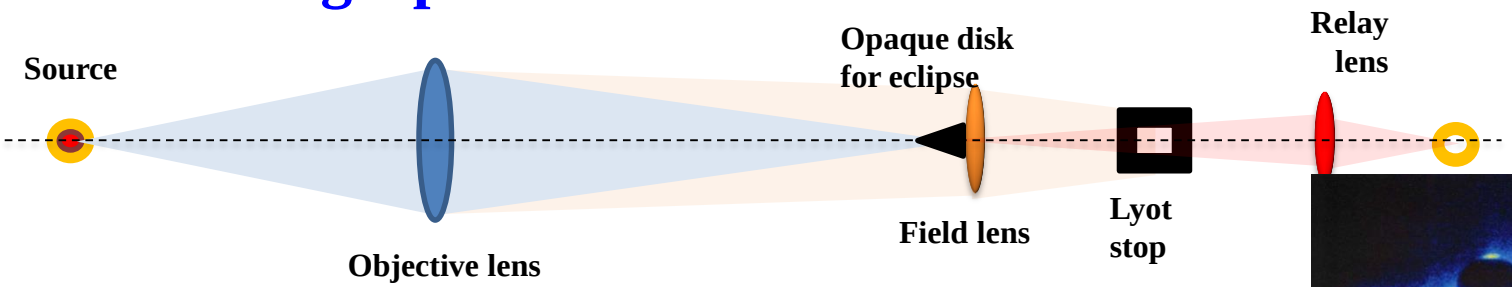
Ozonized water rinsing jig and our clean room for rinsing and re-assembling after VEP

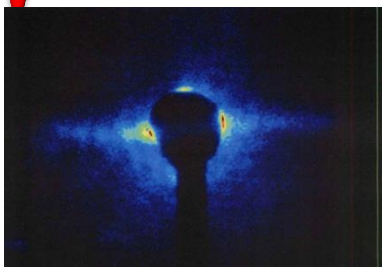




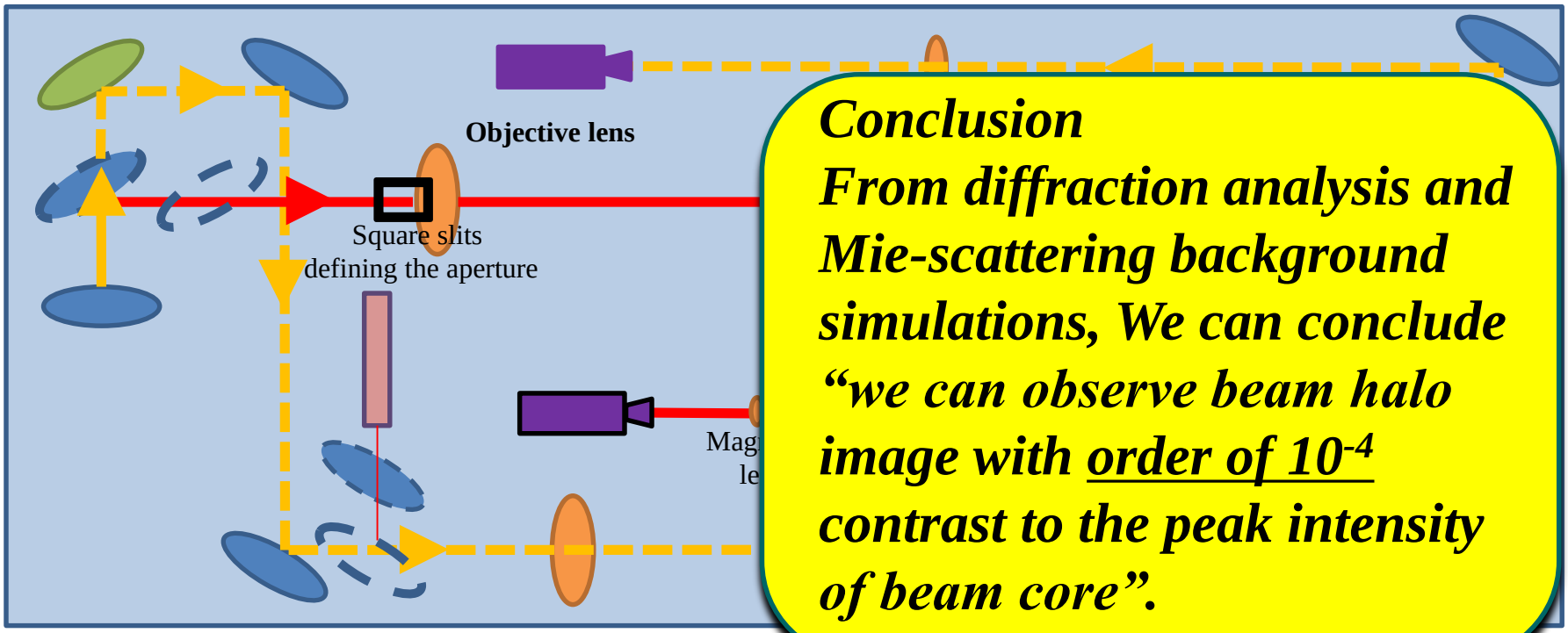
Beam monitoring

Coronagraph for beam halo measurement





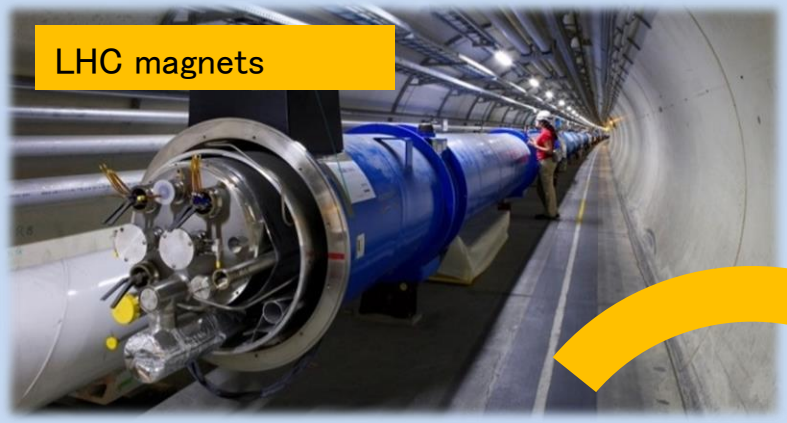
Setup of the coronagraph at B1



Conclusion

From diffraction analysis and Mie-scattering background simulations, We can conclude "we can observe beam halo image with order of 10^{-4} contrast to the peak intensity of beam core".

Very fruitful collaboration with CERN

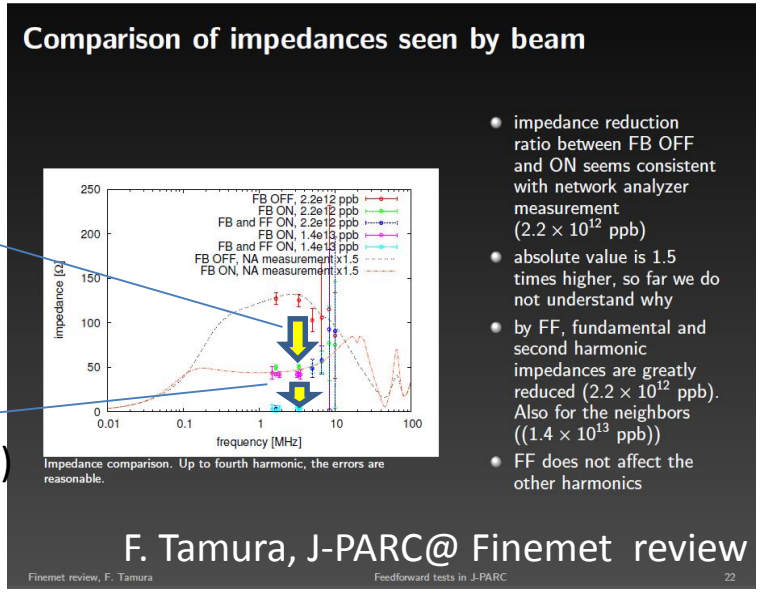


LIU: RF for PS booster

Finemet-FT3L technology will be used for PSB RF upgrade.

Impedance Reduction by Fast feedback

Low Level RF (Feed Forward)



Beam test at J-PARC during LS1 demonstrated that PSB RF system can handle 1.4E13 protons.

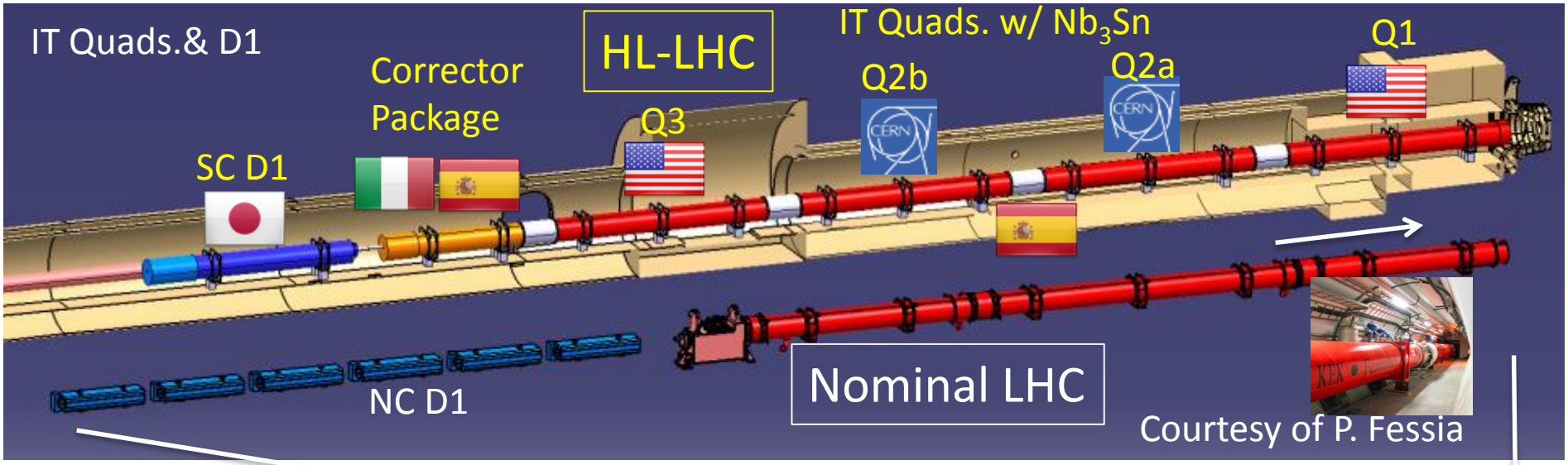
Conclusions

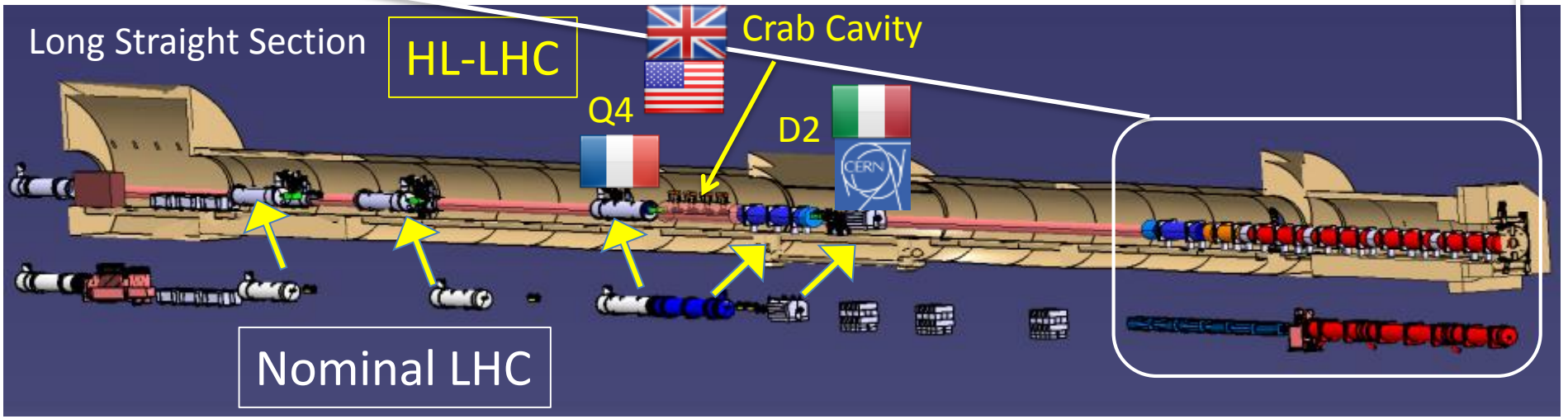
- KEK has diverse physics programs with future upgrades. LHC upgrade is one of the important programs. Priority among the various projects are under discussion.
- It is not yet easy to get the funding for the LHC/ATLAS upgrade but we keep pushing.
- There are several successful R&D projects related to HL-LHC/LIU. The support from CERN has been very effective.

Backup slides

- Backup slides

Layout of IR Magnets





Aperture increase in IT Quads:70mm→150mm ➡Large bore also for the new D1

Replacement of current NC D1 by SC D1: Shortening magnet length by 15m

➡ Making room for new crab cavities

Latest Design Parameters of MBXF for D1

- *Coil ID:* ***150 mm***
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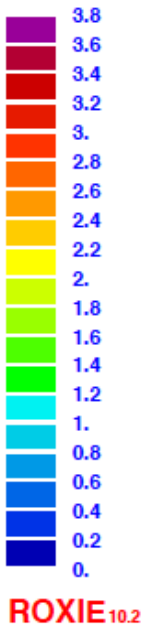
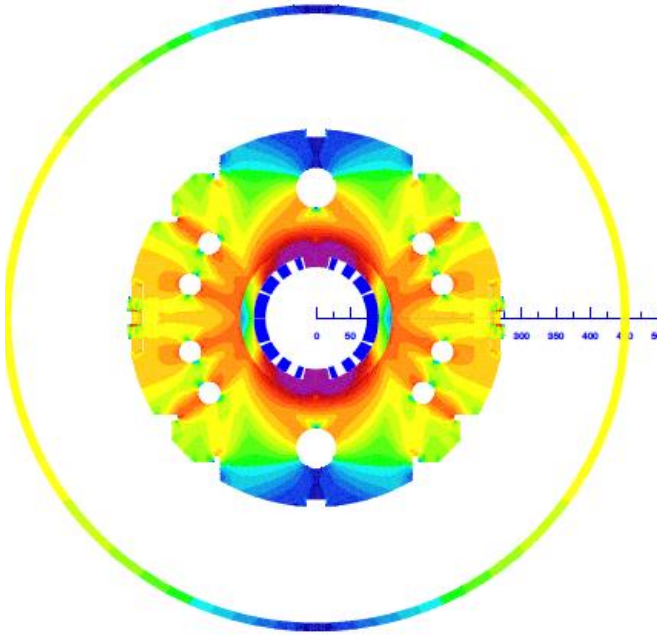
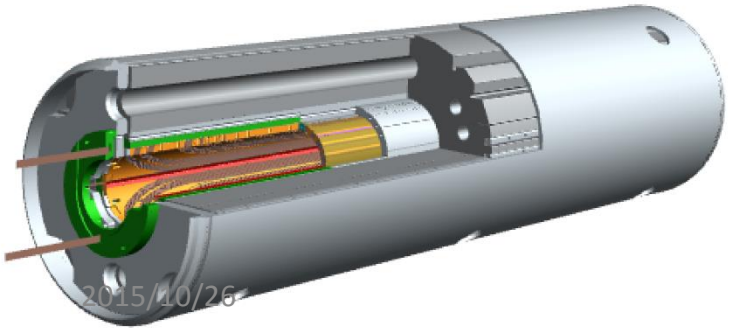
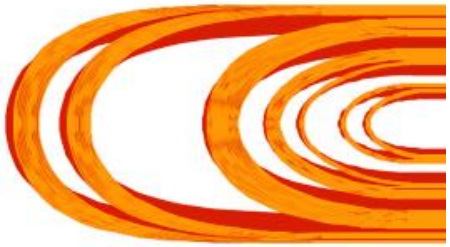
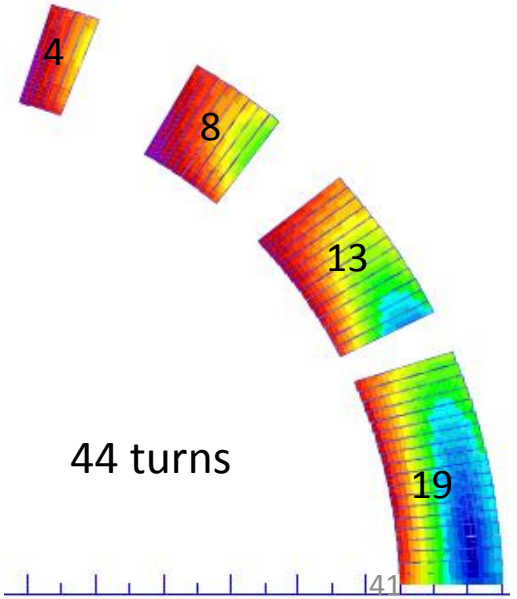




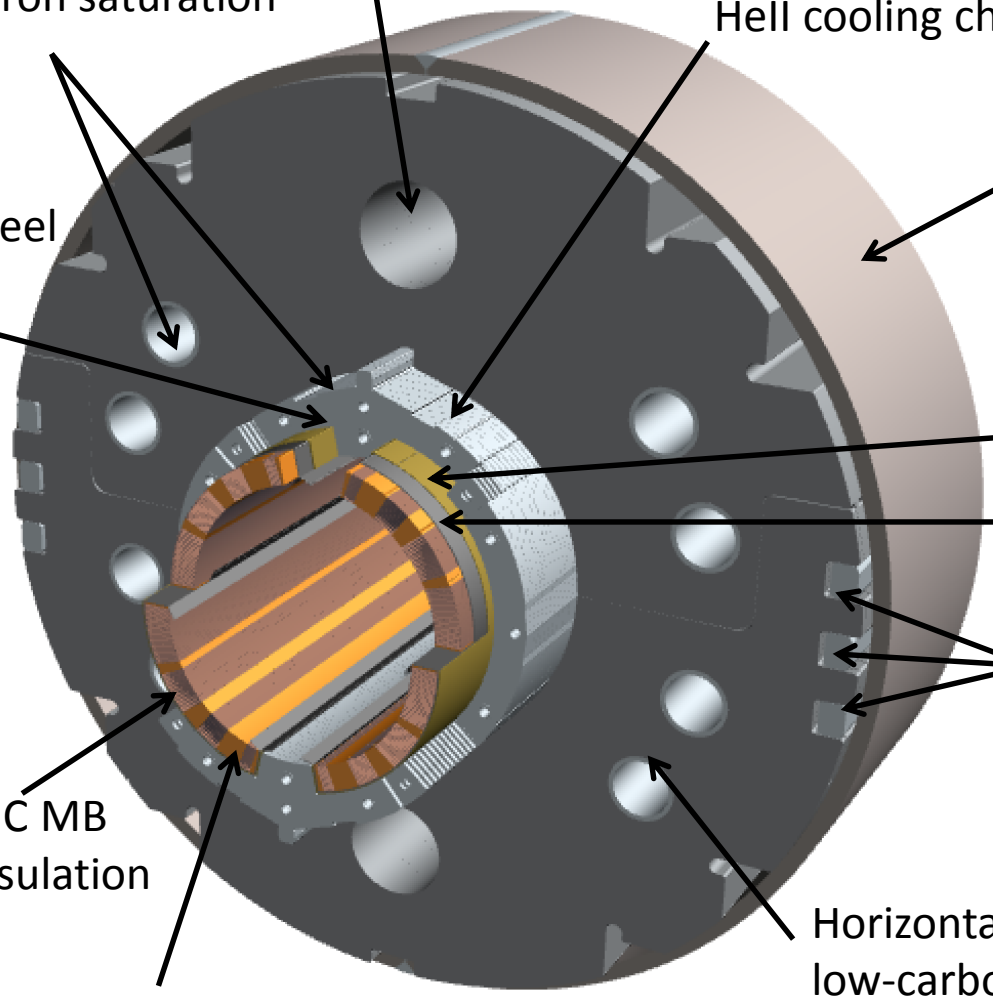




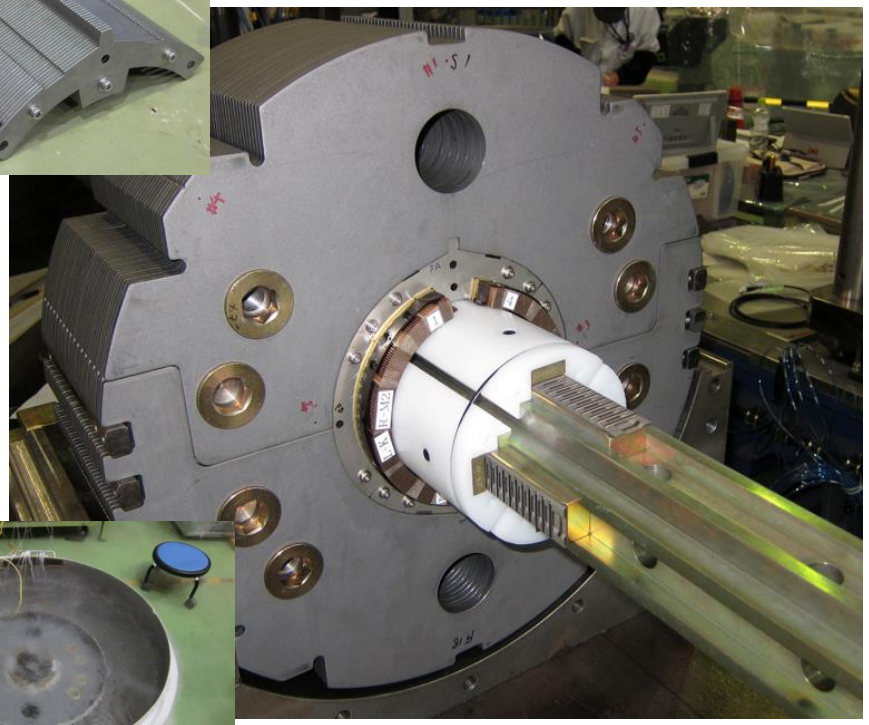


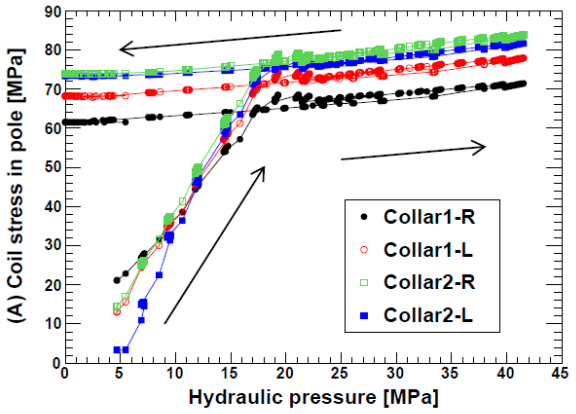
2m-long Model Magnet - Overview

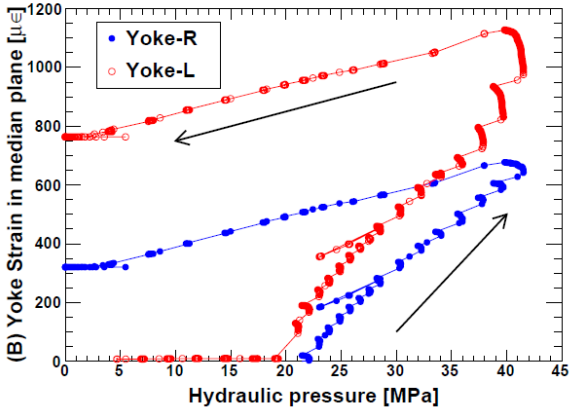
Single-layer coil, 4-split spacer collars, collared yoke by keying



200 mm Long Mechanical Short Model

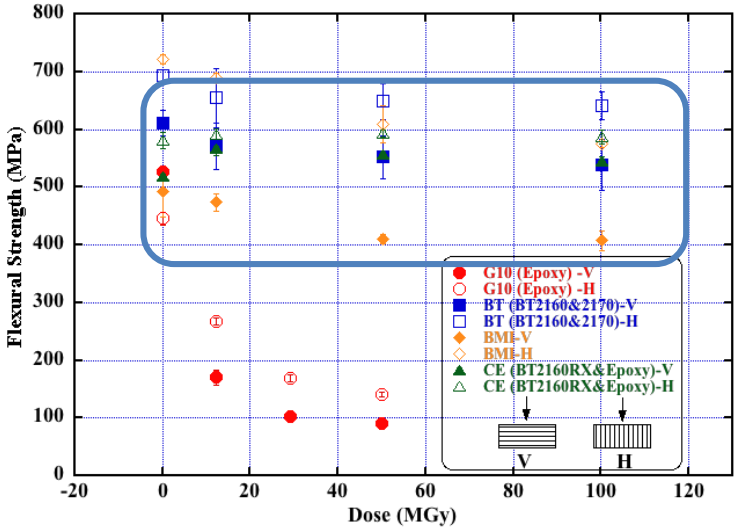


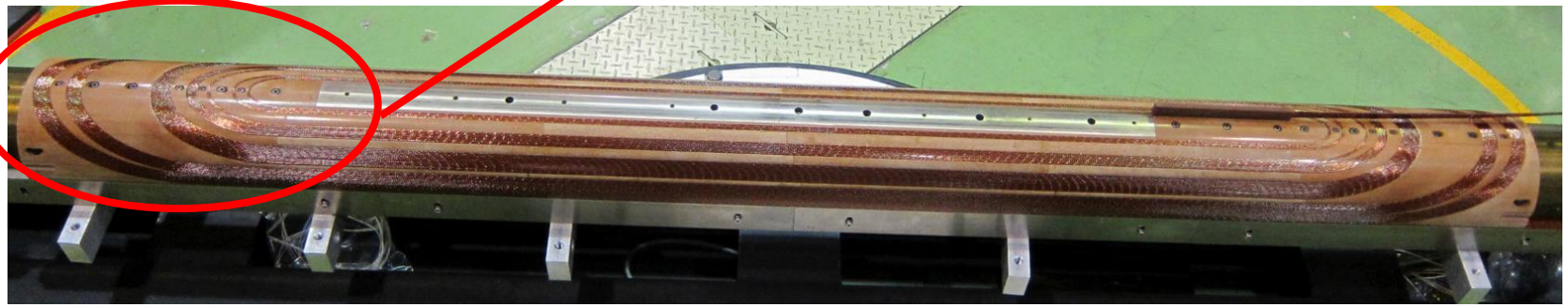




- Demonstration of the magnet fabrication processes and the mechanical design.
  - Test coil winding.
  - Collaring with the positioning mandrel
  - Yoking with alignment feature
- Improved alignment feature of the collared coil and the yoke was verified.
- Coil pre-stress after the assembly was around 60MPa as predicted.

Development of the 1st 2-m Model at KEK





- Single layer coil with LHC NbTi/Cu cable
- Radiation resistant GFRP for spacers and wedges + Cyanate Ester resin
- A set of top and bottom coils are successfully completed in October.
- Magnet assembly will be completed in Jan. 2016, followed by the cold test in March.

CERN–KEK collaboration on the crab cavity development

Objectives:
Based on research and development on crab cavities for the LHC luminosity upgrade progressed, as a cooperative work between KEK and CERN, this agreement, Appendix 16, aims to develop state of the art surface treatment techniques for high field superconducting crab cavities that deflect beam bunches in order to realize the crab crossing for the LHC accelerator luminosity upgrade.

Crab Cavity
- Type : DQW (400 MHz)
- Used at ATLAS and CMS points

KEK responsibilities for:
Development of a vertical electro-polishing (VEP) system,
Application of VEP to crab cavities,
Fundamental studies on vertical electro-polishing conditions,

CERN responsibilities for:
Necessary technical information and requirements for LHC crab cavities,
Support for the research activities in 3.1, such as experimental evaluation for electro-polishing and cavity performances,

Vertical electro-polishing at KEK

LHC Crab Cavity

- Compact and complicated cavity structure to meet space requirements
- High fields are required to sufficiently deflect beam bunches
  - 3.4 MV per cavity at 400 MHz with Q=10^{10},T=2K
  - 14 MV per interaction point using 4 crabs
  - (KEKB crab: 1.4 MV at 509MHz with Q=10^{9},T=4.4K)
- Surface treatment is one of important issues
  - CP(Chemical polishing) is used so far

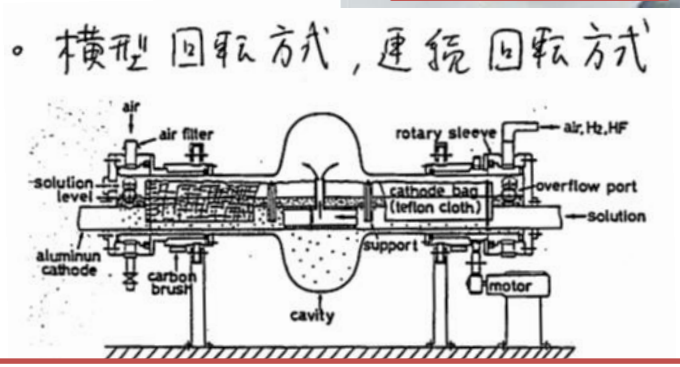
Alternative treatment: EP (Electro-polishing)

- Developed for TRISTAN SC cavities
- Horizontally rotating technique
- Smoother surface than CP
- Standard treatment method for high field cavities

VEP (Vertical EP)

- We proposed VEP for LHC crab cavities
- Difficult to apply the horizontally rotating technique to the LHC crab cavities
- Vertical positioning EP at our EP facility
- We started vertical EP R&D in collaboration with CERN

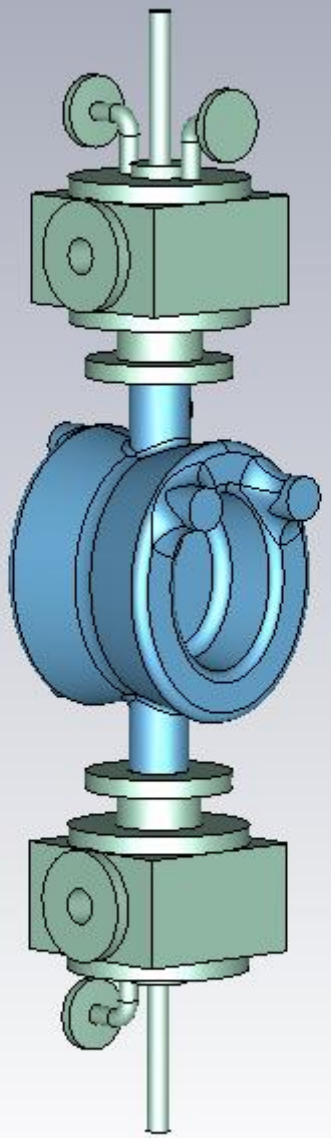
BNL DQW cavity

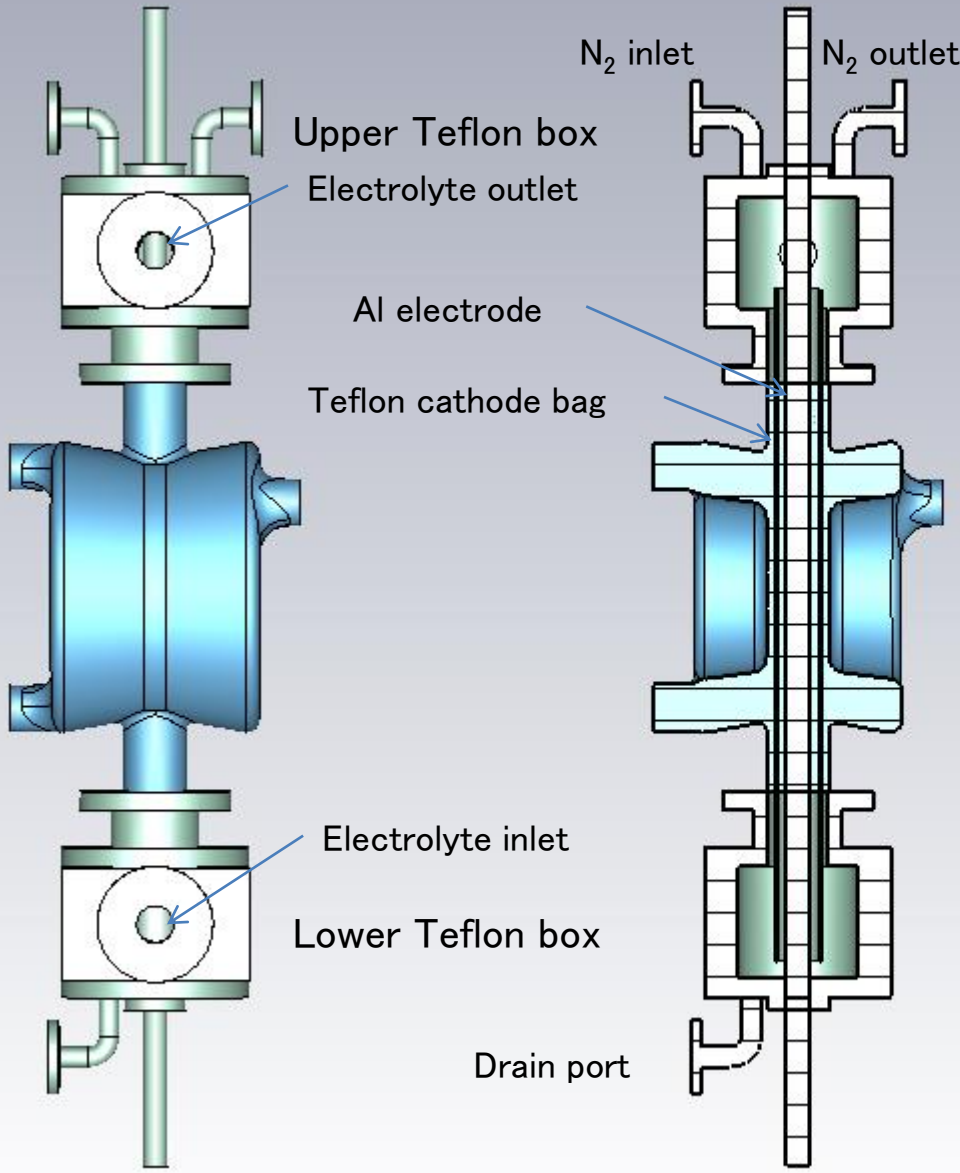


Horizontally rotating EP system developed for TRISTN SC cavities

Our EP apparatus for 500 MHz cavity

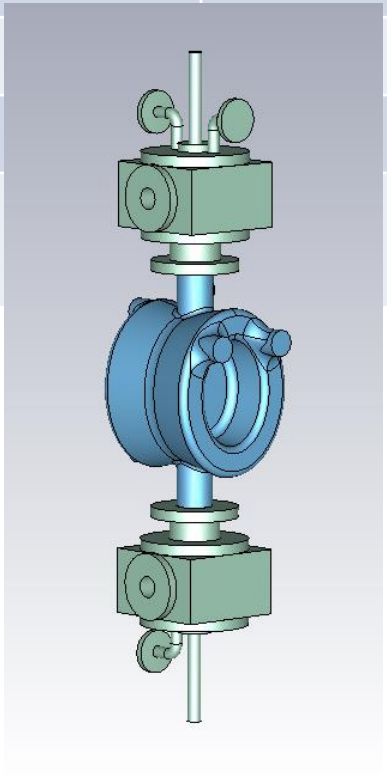
Vertical EP apparatus





Timetable for Vertical EP at KEK

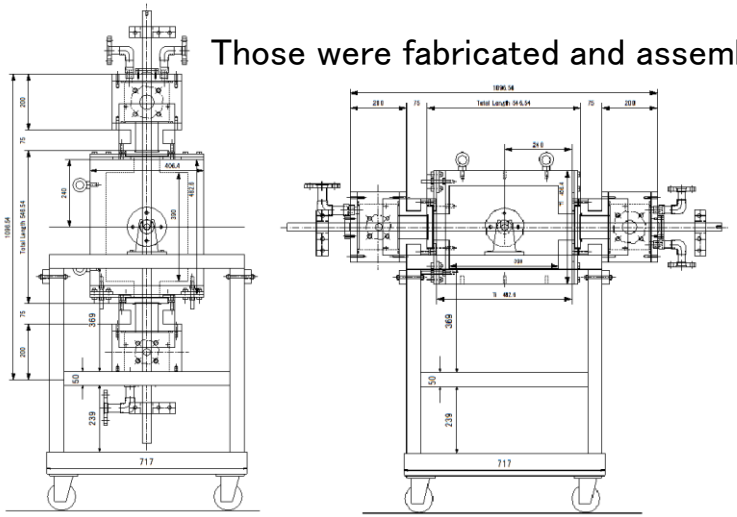
Item	Sep. 2015	Oct.	Nov.	Dec.	Jan. 2016	Feb.	Mar.
Electrode	Fabrication						
Teflon box	Fabrication						
Rotation jig	Almost done, a stand has to be fabricated (the stand for KEKB cavity can be used temporarily)						
Ozonized water rinsing jig	Almost done, a Teflon attachment has to be fabricated (the Teflon attachment for KEKB cavity can be used temporarily)						
Dummy cavity	Done						
Fitting check							
Vertical EP at KEK							
Sending the cavity back to CERN and cold test							



We are fabricating the vertical EP apparatus. The rotation jig and the ozonized water rinsing jig are already fabricated and assembled. After the fitting check of apparatus, we applied the vertical EP to the LHC crab cavity fabricated at BNL.

Rotation jig and dummy cavity to support the cavity during VEP

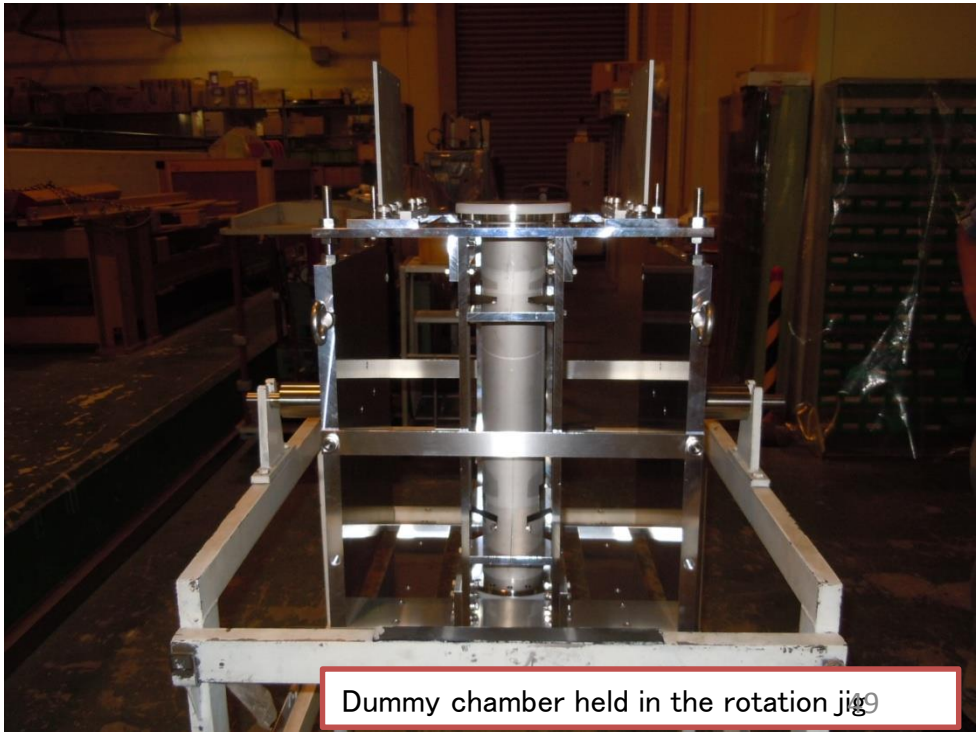
Those were fabricated and assembled



Dummy cavity and its support

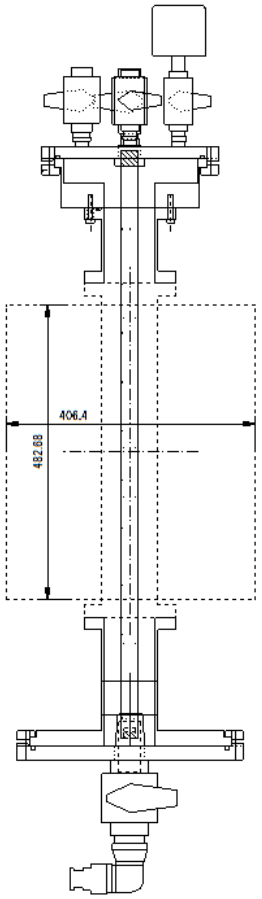
rotation jig

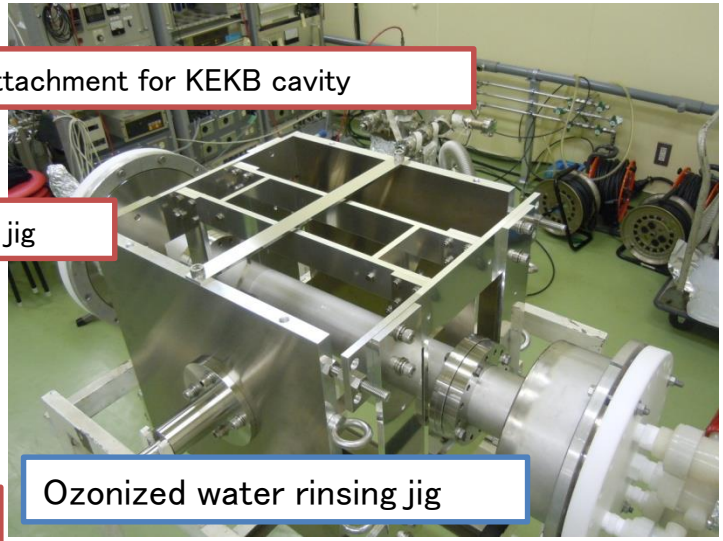
Existing stand for KEKB cavity



Dummy chamber held in the rotation jig

Ozonized water rinsing jig and our clean room for rinsing and re-assembling after VEP





Design of Coronagraph for the observation of beam halo at LHC

Toshiyuki Mitsuhashi (KEK),
Enrico Bravin,
Rhodri Jones,
Federico Loncarolo
Hermann Schmickler,
Georges Trad (CERN)

The coronagraph is planned to apply for an observation of beam halo image in the LHC. This project will perform *by two phases*.

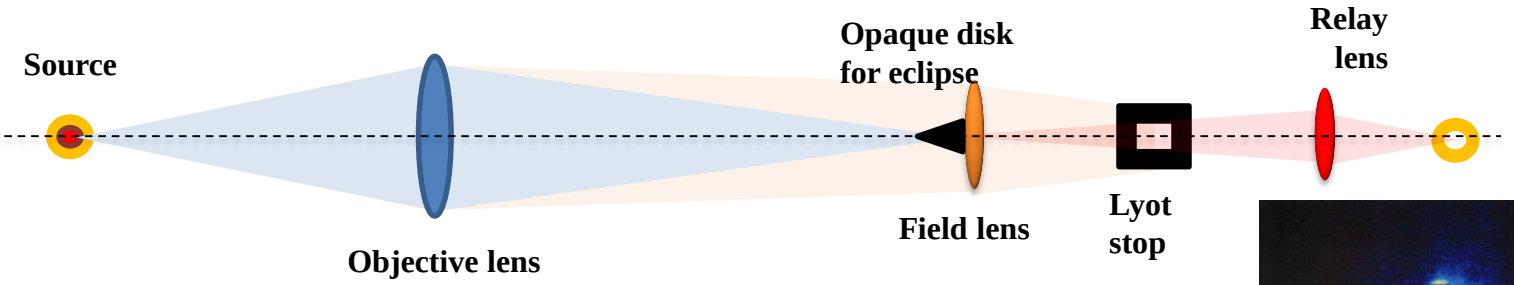
Phase1: Test observation,
aiming a halo observation with *10^3 to 10^4* contrast to the beam core, and it will set in B2 SR monitor line.

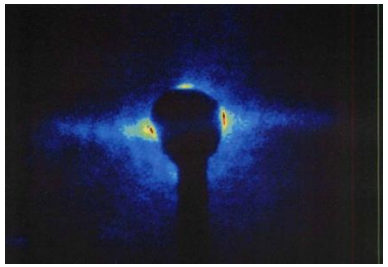
Install the coronagraph in B2 SR monitor line in December 2015.

Phase2: Design and construct an optimum coronagraph for the LHC,
aiming *10^5 to 10^6* contrast.

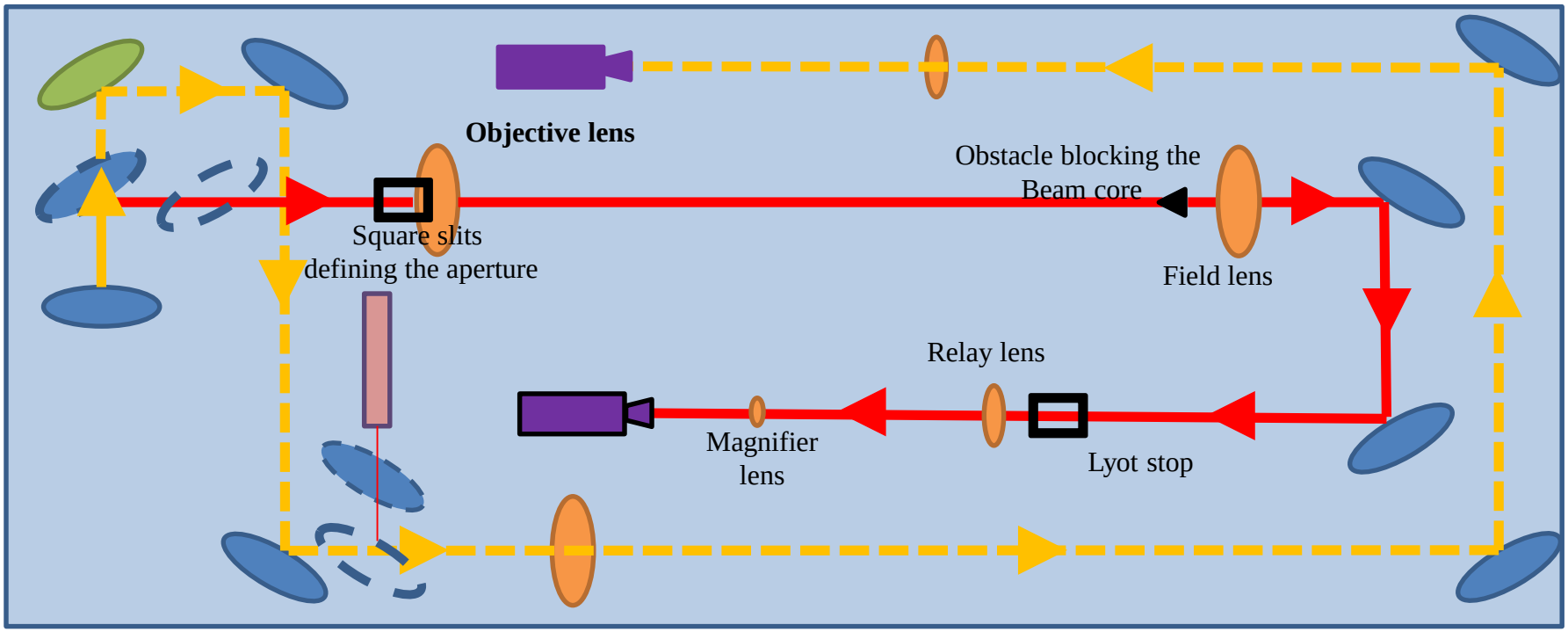
Coming 2 Years.

Coronagraph for beam halo measurement

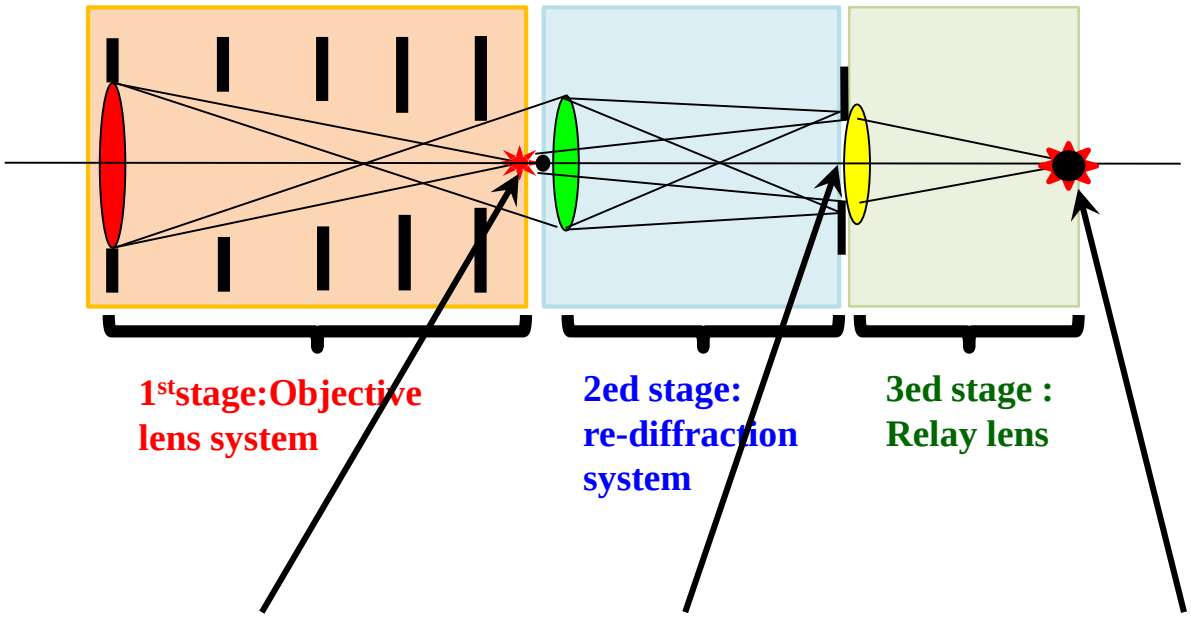




Setup of the coronagraph at B1

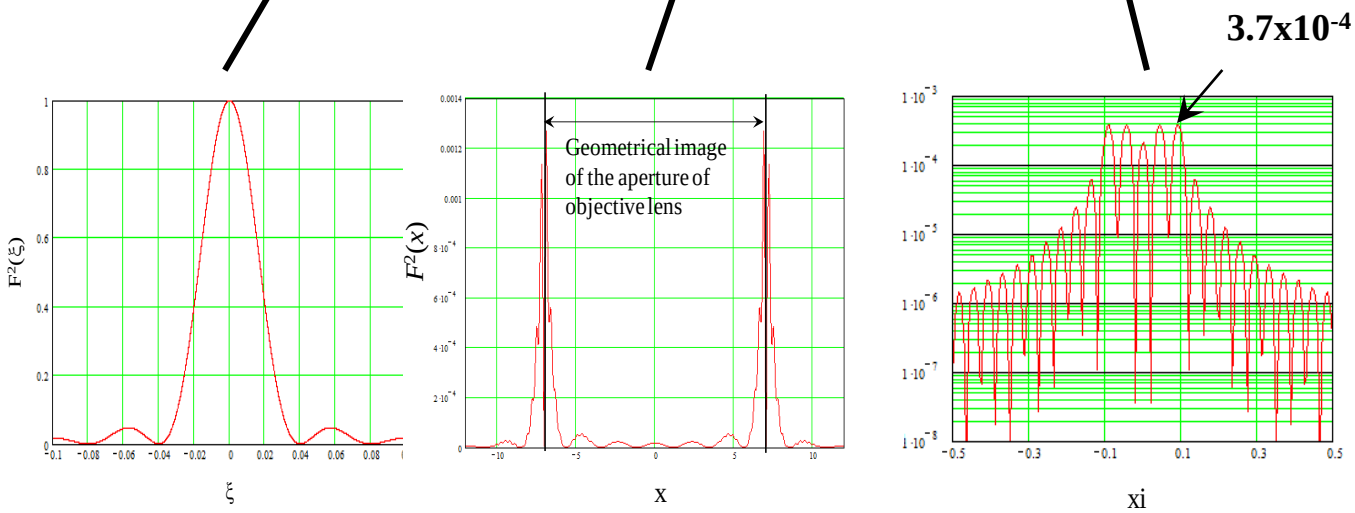


3 stages-optical system in the Lyot's coronagraph



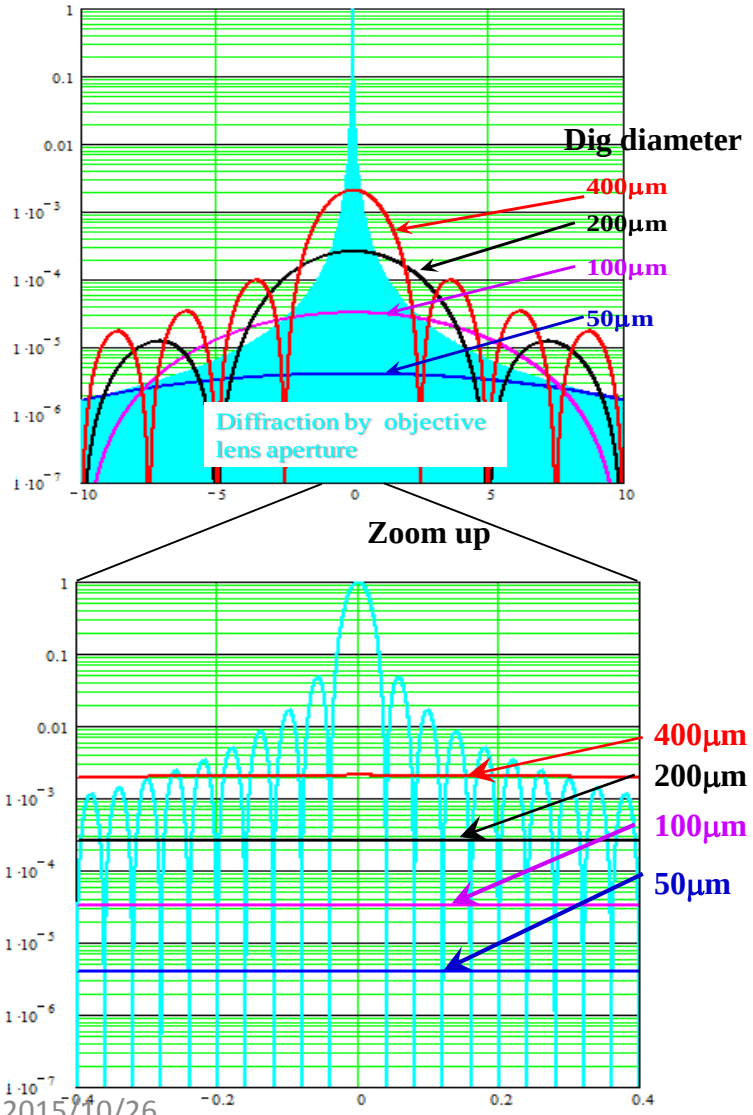
From diffraction analysis, the background in phase1 coronagraph from leakage of diffraction fringe is estimated to 3.7×10^{-4}.

Other of 2 fringes in the centre, most of diffraction fringes have intensities of 10^{-5} to 10^{-6} range.



Diffraction analysis for Phase 1 Coronagraph

Simulation result of background produced by Mie-scattering from dig on objective surface

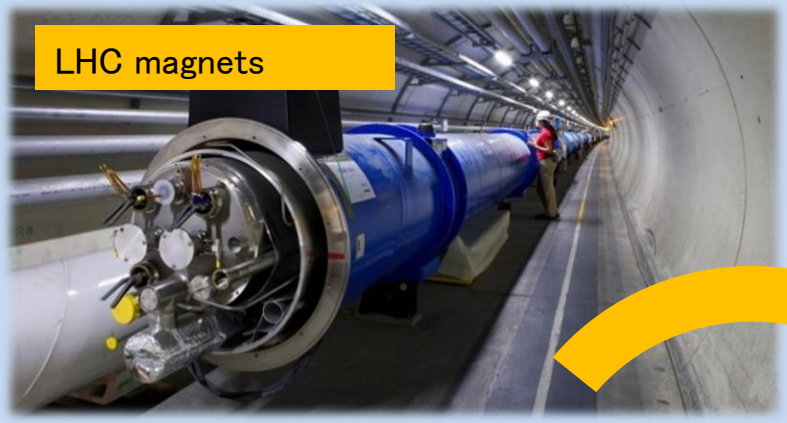


The digs having a diameter smaller than 100mm are the majority. An order of 10^{-4} to 10^{-5} background can be appeared phase 1 using the B2 SR monitor line.

Conclusion

From diffraction analysis and Mie-scattering background simulations, We can conclude "we can observe beam halo image with order of 10^{-4} contrast to the peak intensity of beam core".

Very fruitful collaboration with CERN



LIU-RF Collaboration Status

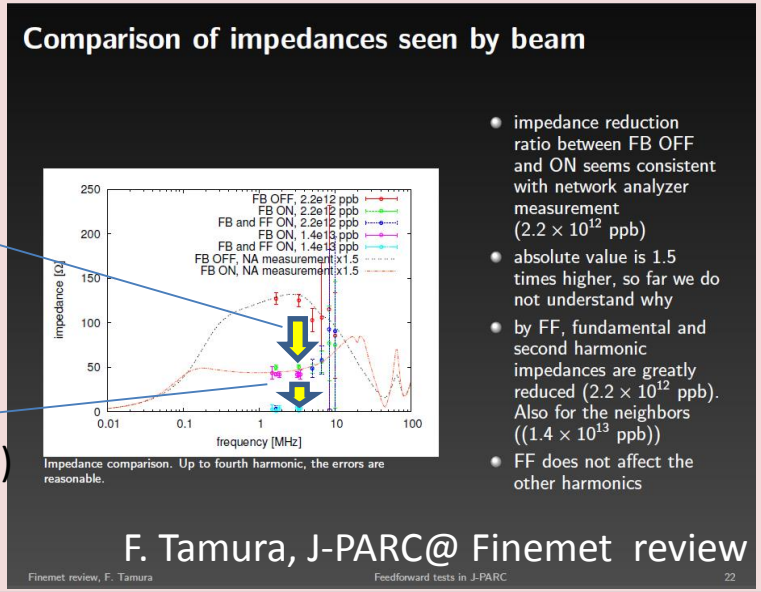
- Successful Collaboration for both sides
  - CERN obtains Finemet cavity technology
  - KEK obtains technology for Solid State Amplifier
  - Common interest for high intensity beam, instabilities, RF.
  - RF collaboration continues for over 10 years (since LEIR cavities)!
- **Green light** for PSB RF upgrade by wideband system
- **Remarkable progress on PS longitudinal damper** which is mandatory with the future beam characteristics for HL-LHC.
- Other applications of wideband system as by-products
  - Anti-Proton decelerations at ELENA, AD
  - Medical applications: MedAustron, KHIMA

Contributions for PSB RF Upgrade

Finemet-FT3L technology will be used for PSB RF upgrade.

Impedance Reduction by Fast feedback

Low Level RF (Feed Forward)



Beam test at J-PARC during LS1 demonstrated that PSB RF system can handle 1.4E13 protons.

Recent Progress of PSB RF upgrade

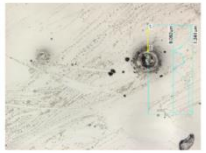
- After LS1,
  - 10 cell Finemet FT3L cavities are used as:
    - C02 RF for acceleration
    - C04 RF for 2nd Harmonic RF
    - C02 + C04, dual harmonic RF

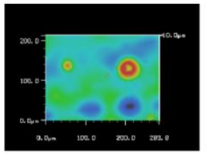
    This cavity is tested up to highest intensity !

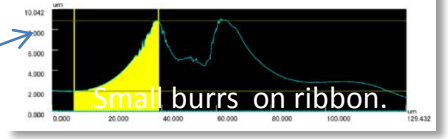
    The cavity is used for the PSB normal operation.
  - Radiation level to install the RF system was measured
    - Long lifetime of MOSFETs in Solid State Amplifiers in tunnel
  - Applications of Finemet FT3L cavities for C16 (Blow-up RF) becomes possible.
    - **All PSB RF systems (C02, C04 and C16)** can be replaced by Finemet FT3L system

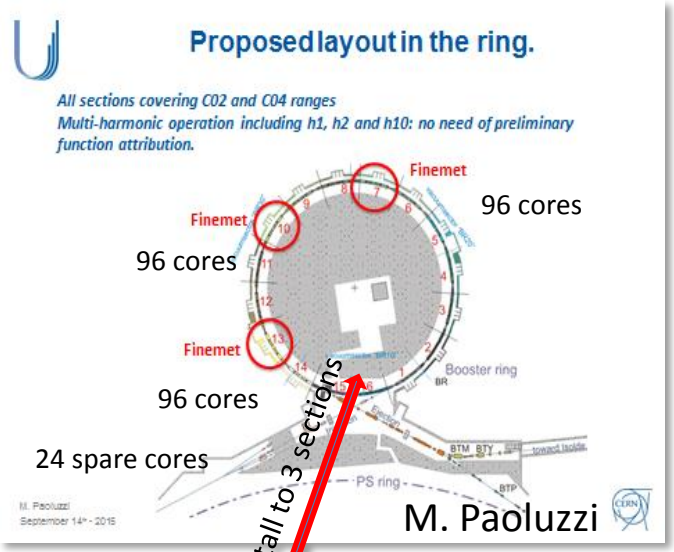
Future contribution for PSB RF

KEK supports the productions of Finemet FT3L cores using established recipe for J-PARC



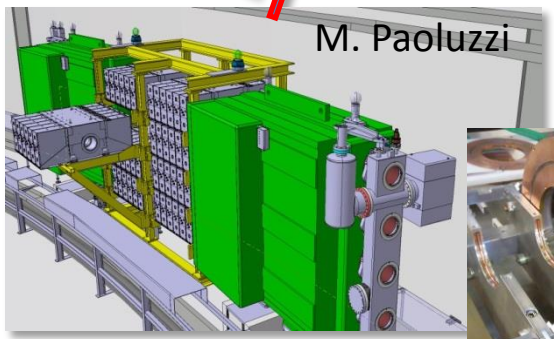






Install to 3 sections

M. Paoluzzi



48 cavity cell /straight

Removal of burrs from amorphous ribbon for SiO_2 coating

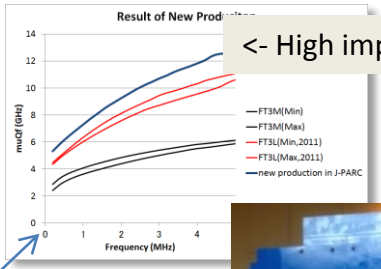
Core winding with monitoring insulation between ribbons

High-quality Magnetic annealing by KEK-made oven

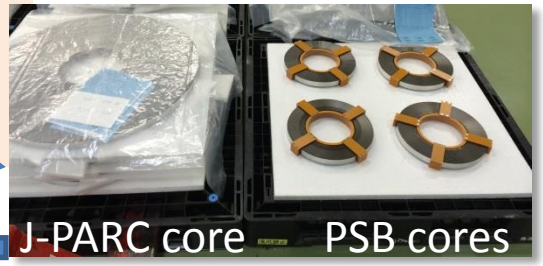
Impedance measurement & checking SiO_2 coating

Shipping to CERN

Assembling & installation



<- High impedance !

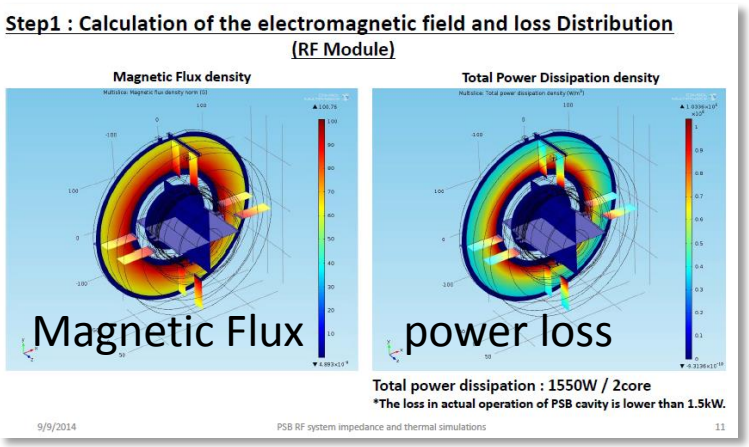


J-PARC core PSB cores

Contributions for PS Damper

Damper system for Coupled Bunch Instability at PS will be necessary after LS2

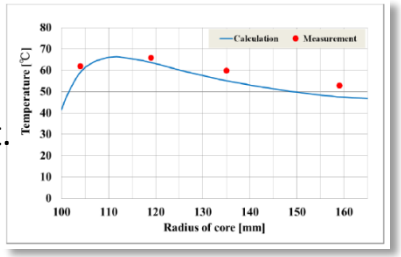
- Choice of design
  - ~~LEIR-type (tube driven)~~
  - PSB-type (solid state amp, wider bandwidth) ← Good to damp many modes
- Calculation and Measurements



Wideband Finemet Damper

Cavity measurements

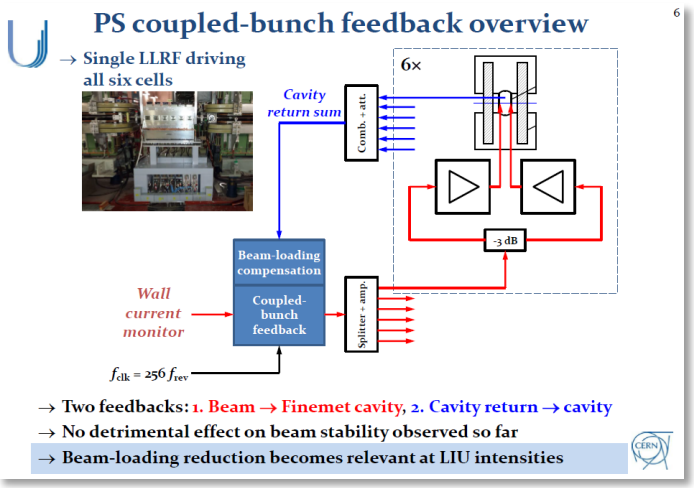
Temp. measurement was consistent.



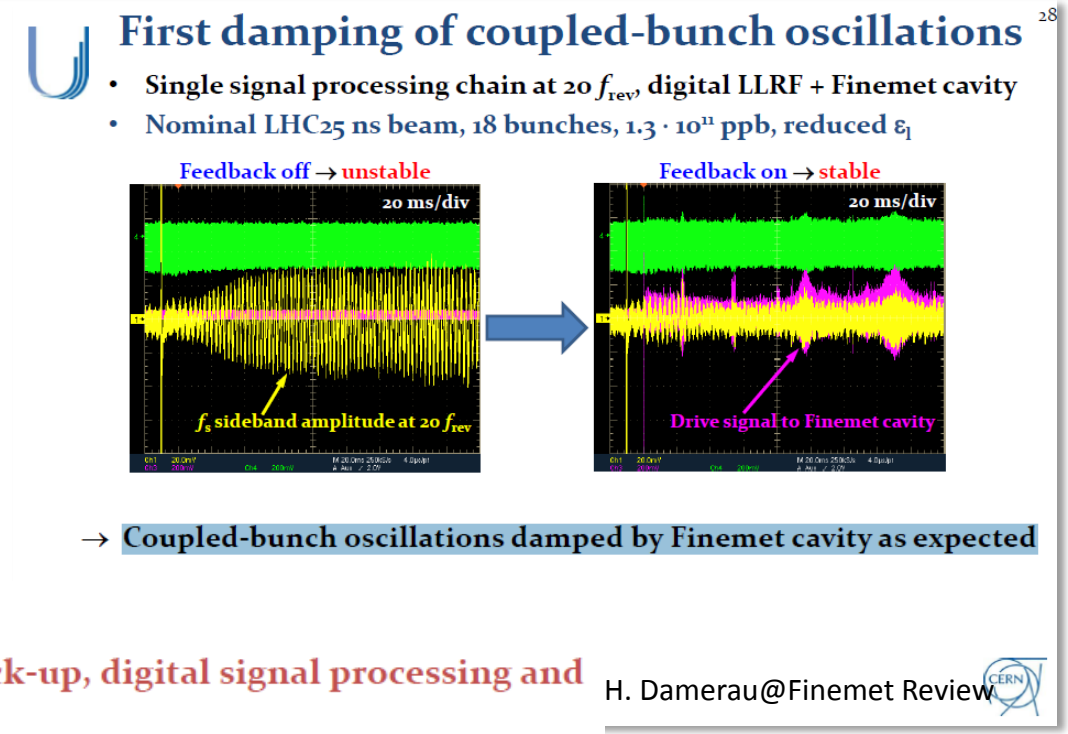
Four out of the six cells are now equipped with amplifiers.
=> Two Amplifiers will be produced by the budget of Japanese ATLAS group and will be shipped in next March.

Recent Progress for Damper

- **Coupled-bunch feedback required to reach intensities beyond ~1.7 · 10¹¹ ppb with LHC-type beams**



H. Damerau@Finemet Review



- **Coupled-bunch damping**
  - → Complete feedback chain of pick-up, digital signal processing and Finemet kicker
  - → Damping (in phase) and excitation (anti-phase) observed
- **New coupled-bunch feedback signal processing already superior to present operational feedback**
  - → Study retrofit of new LLRF to existing feedback

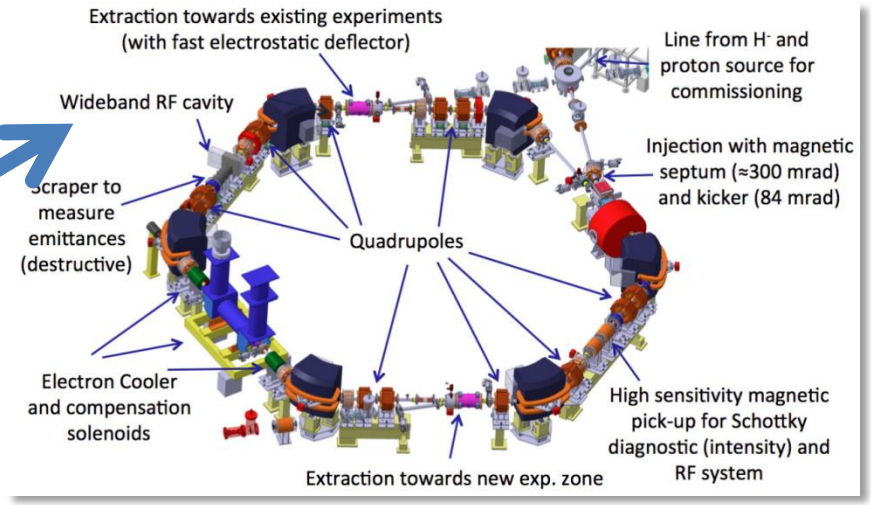
Damper works remarkably!

Other Applications as by-products

This technology will be used

- Anti-proton decelerations
  - ELENA deceleration cavity
  - AD
- Unstable Nuclei
  - TSR
- Medical Accelerators
  - MedAustron (in use)
  - KHIMA

  (Korean Heavy Ion Medical Accelerator)



W. Bartmann@IPAC14