



Status of J-PARC and Future Plans

October 28-31, 2015

NNN15, Stonybrook University, NY

Naohito SAITO
J-PARC / KEK

High Energy Accelerator Research Organization (KEK)
Japan Atomic Energy Agency (JAEA)

**J-PARC Facility
(KEK/JAEA)**

LINAC
181 MeV → 400 MeV

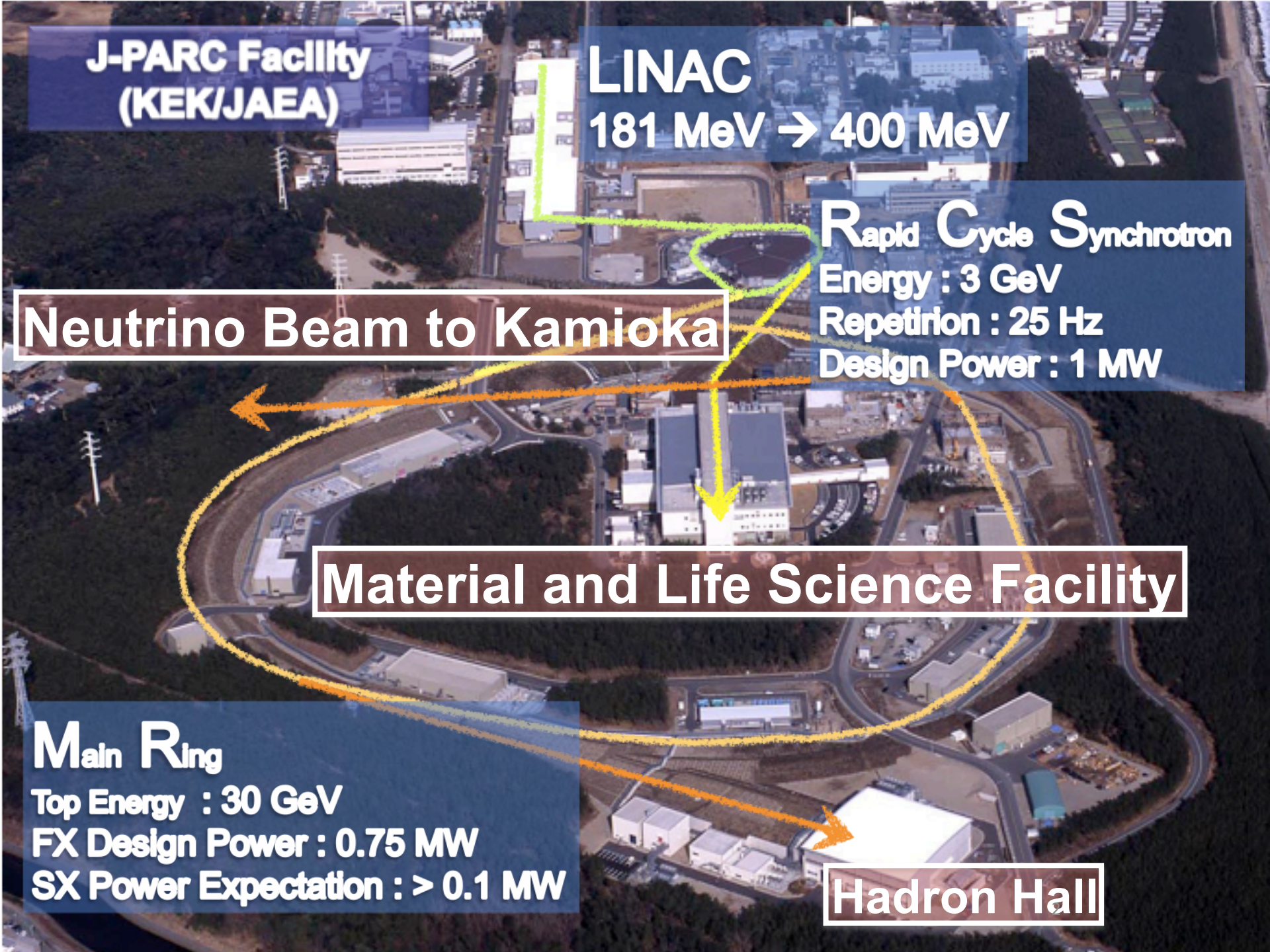
Rapid Cycle Synchrotron
Energy : 3 GeV
Repetition : 25 Hz
Design Power : 1 MW

Neutrino Beam to Kamioka

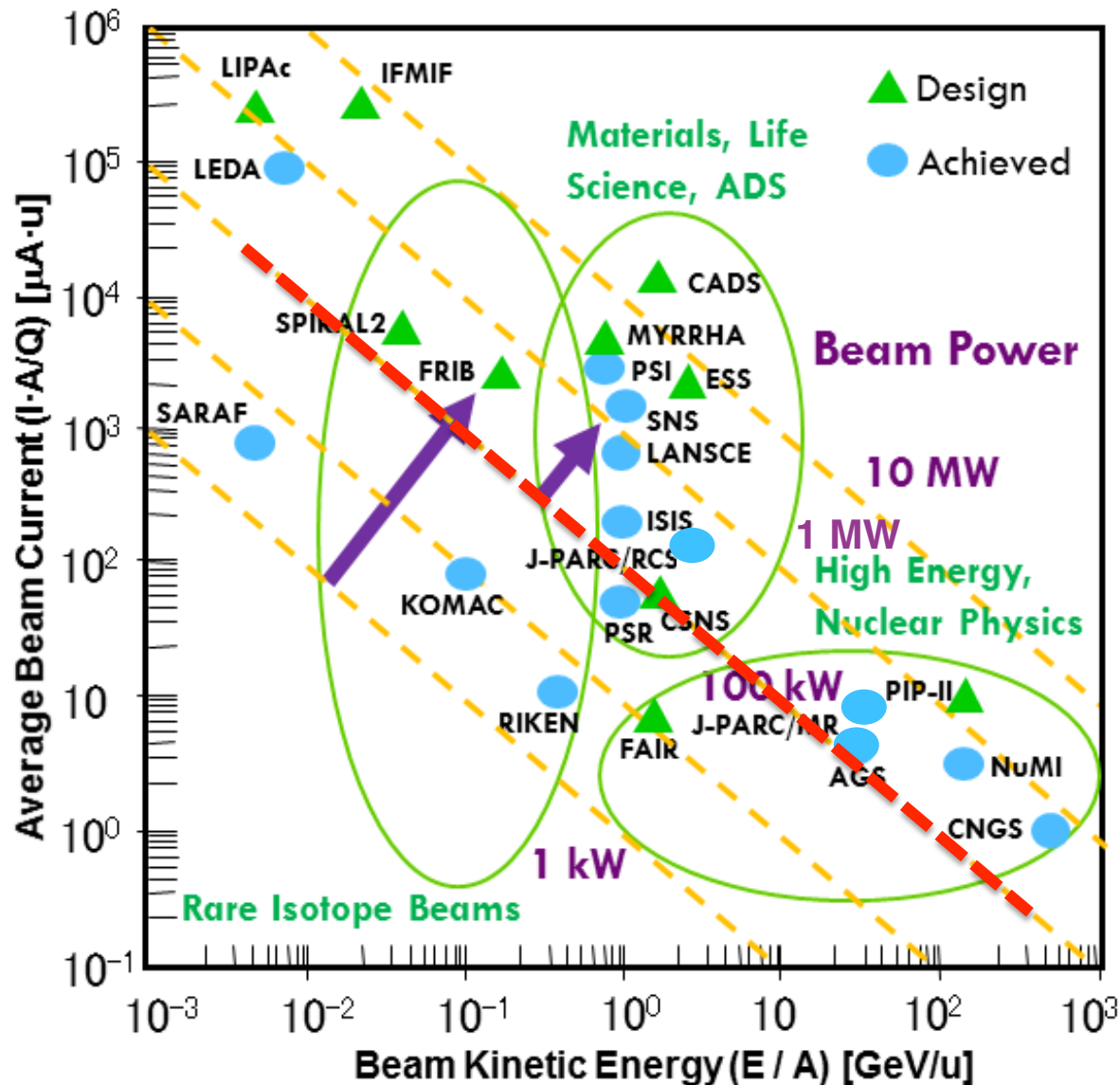
Material and Life Science Facility

Main Ring
Top Energy : 30 GeV
FX Design Power : 0.75 MW
SX Power Expectation : > 0.1 MW

Hadron Hall



A Quest for High Intensity



High Intensity



High Statistics



- More Precision
- More Rare Searches
- More Materials



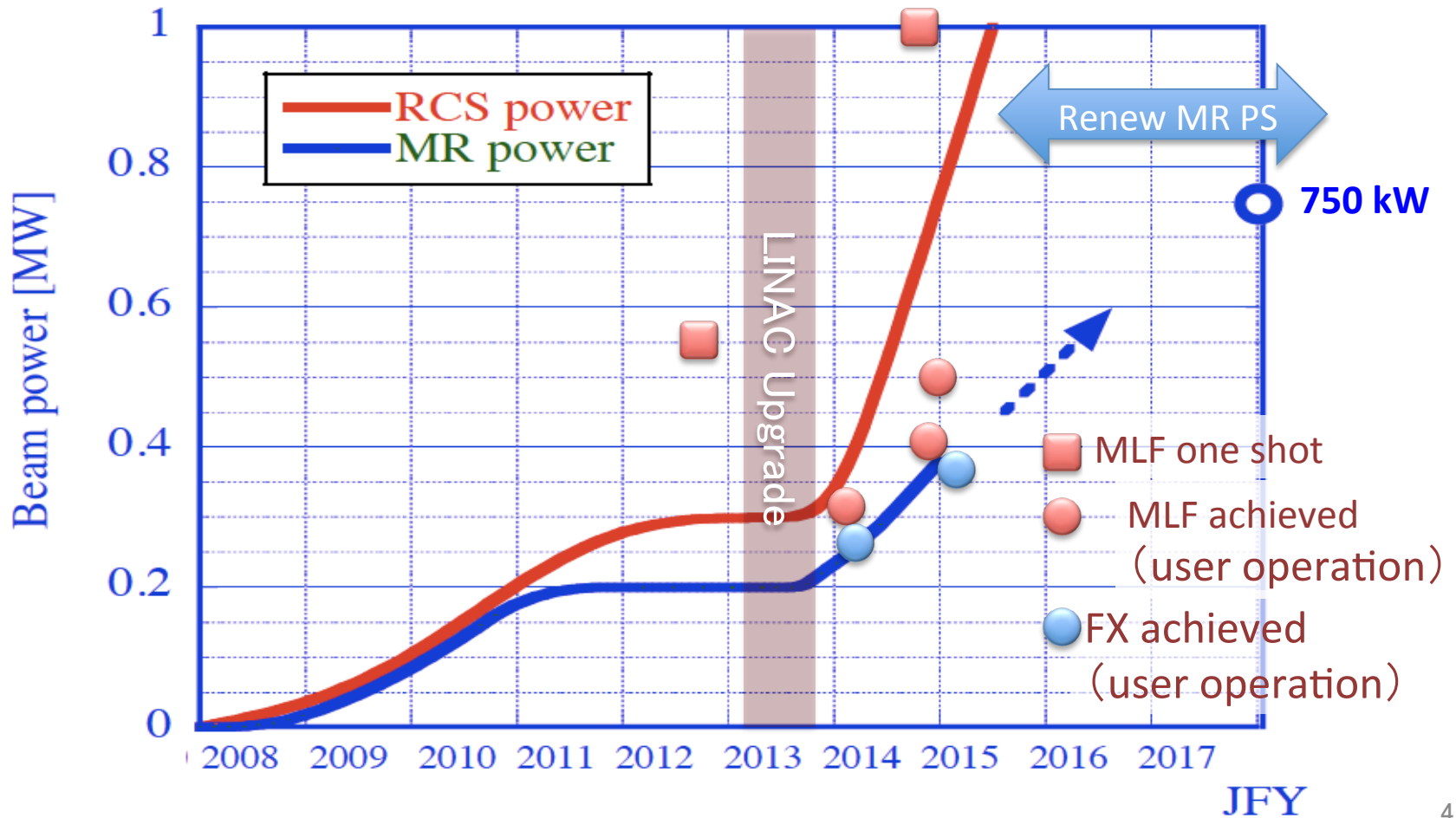
Discovery!

Beam Power

RCS ::1 MW achieved in Jan, 2015

Thanks to new working point!

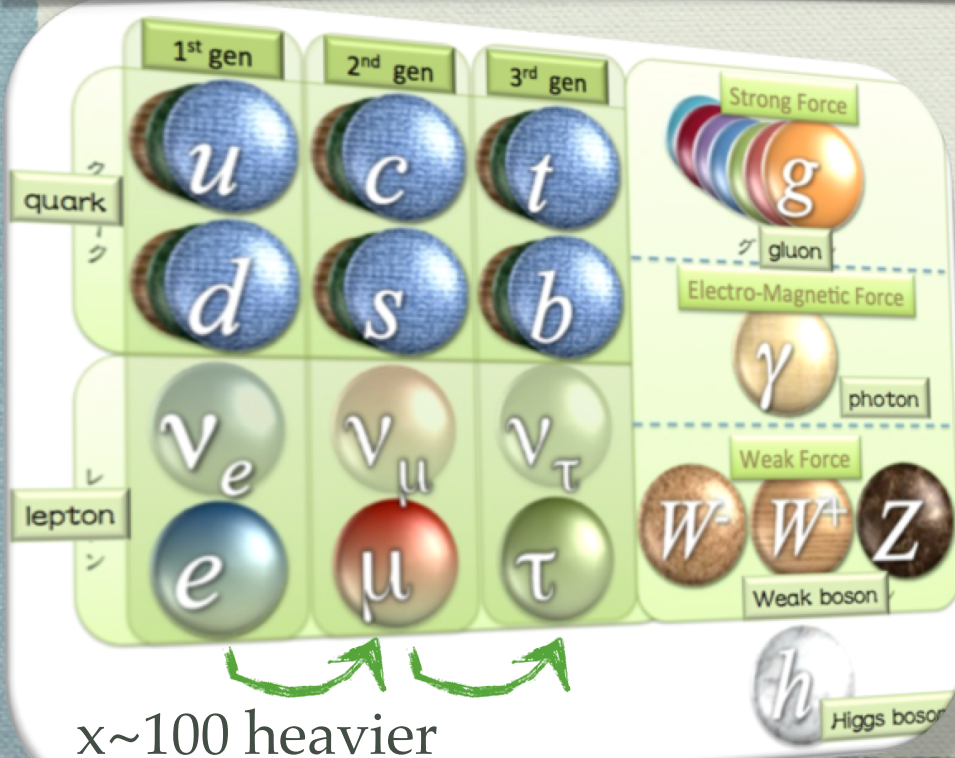
MR ::so far 0.36 MW for FX ; 0.9 MW reachable with new PS



Many Remaining Questions

◆ Completion of the Standard Model

Beginning of New Physics Era



Why 3 generations?

Why CP violates? (particle-anti-particle asymmetry)

Why mass distributed this way?

Baryon number, Lepton number, Lepton flavor violated?

What is Dark Matter, Dark Energy?

How we should understand the gravity?

Why our Universe is matter-dominant?

Is super-symmetry real?

Go Beyond the SM

Learn from the past (ancient Greek Philosophy)!



The basic framework is identical; small number of elements interacts through a number of interactions to produce everything!

Our view is limited by what we can see, touch, and feel!

We need to extend our "sense"; microscope / ultra-sensitive devices

“Microscope” = Accelerator

High Energy Frontier?
new phenomena in the unprecedented
energy region may provide an answer?



High Energy Accelerator

Any other way?
ultra-precision
measurement may
provide a hint for New
Physics?



High Intensity Accelerator

LHC, ILC

Energy Frontier

Higgs
SUSY,
Extra-dimensions...

Uncover SUSY
Grand Unification
New Physics to solve
many mysteries in the SM

T2K
COMET,
g-2/ μ EDM

Neutrino mass
Flavor violation
CP violation
Seesaw mechanism

Quark-Lepton
Symmetry

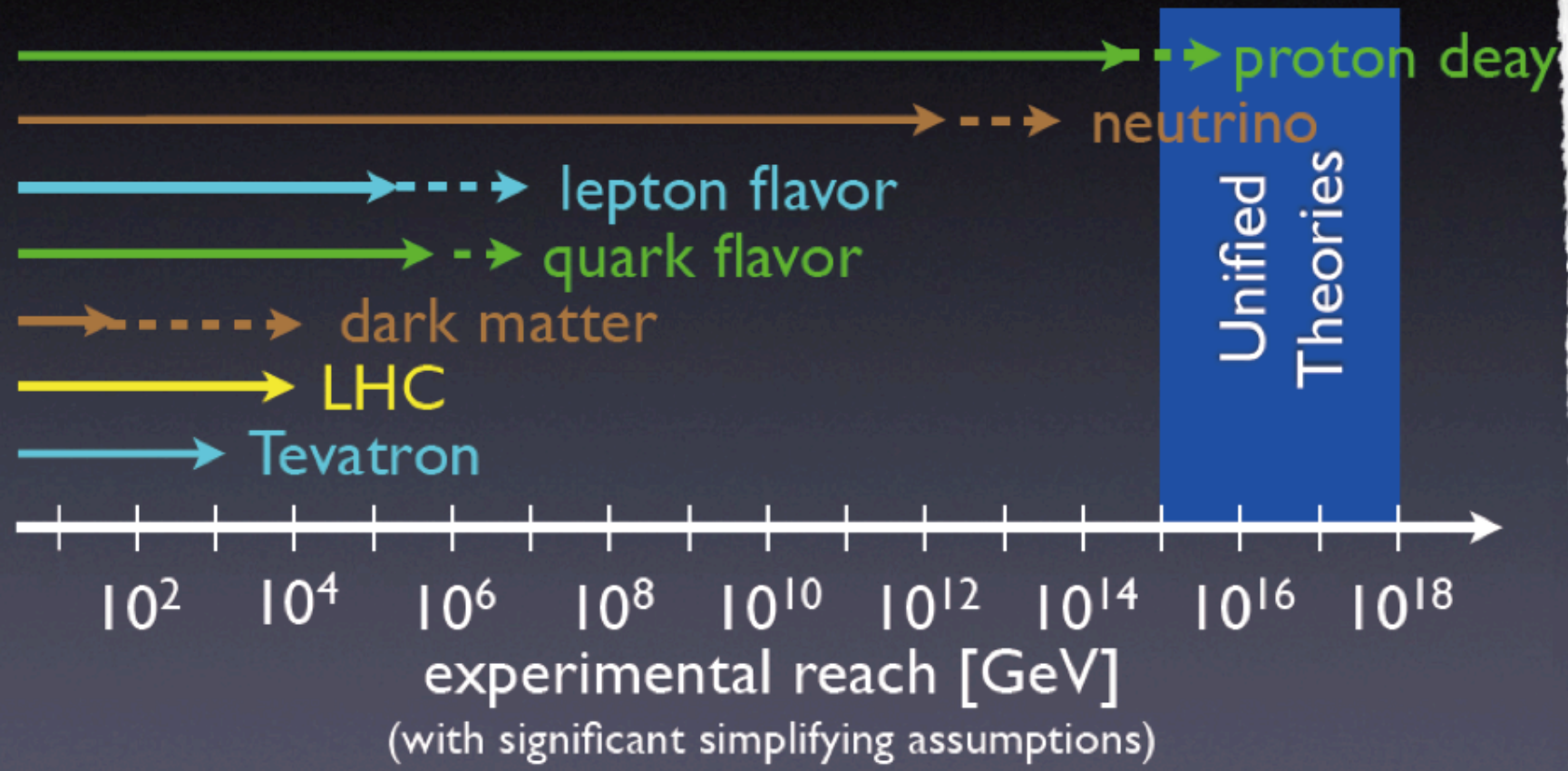
SuperKEKB
KOTO

Quark Flavor

CP violation
New mixing
LR symmetry
Charged Higgs?

Lepton physics

Power of Expedition



courtesy Zoltan Ligeti

a slide by Hitoshi Murayama

Origin of Matter :

Explored with High Intensity Proton Driver = J-PARC



Super Kamiokande

T2K

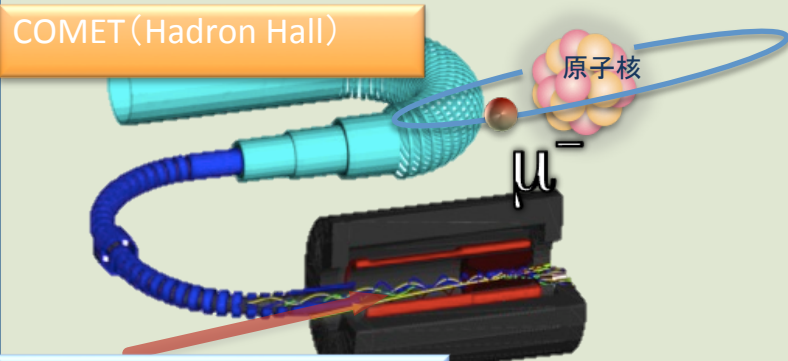
J-PARC

Neutrino Experiment : T2K

~ Mixing Angle, CP phase, and Mass Hierarchy ~

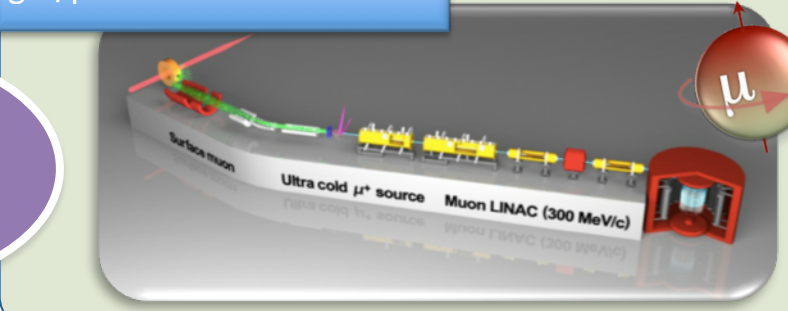
Muon Fundamental Physics

~ Flavor and CP are violated in the charged Lepton sector? ~



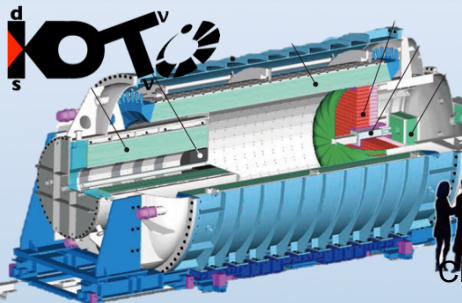
COMET (Hadron Hall)

原子核



g-2/μEDM (MLF H-line)

Ultra cold μ^+ source Muon LINAC (300 MeV/c)



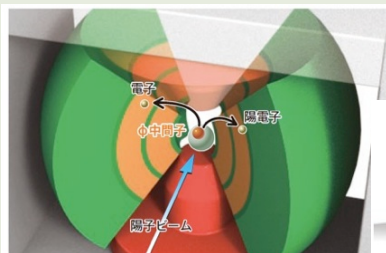
KOTO

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


CPV beyond CKM

Hadron Experiments

~ CP beyond CKM; Mass modification ~



Hadron properties in Nuclear Matter



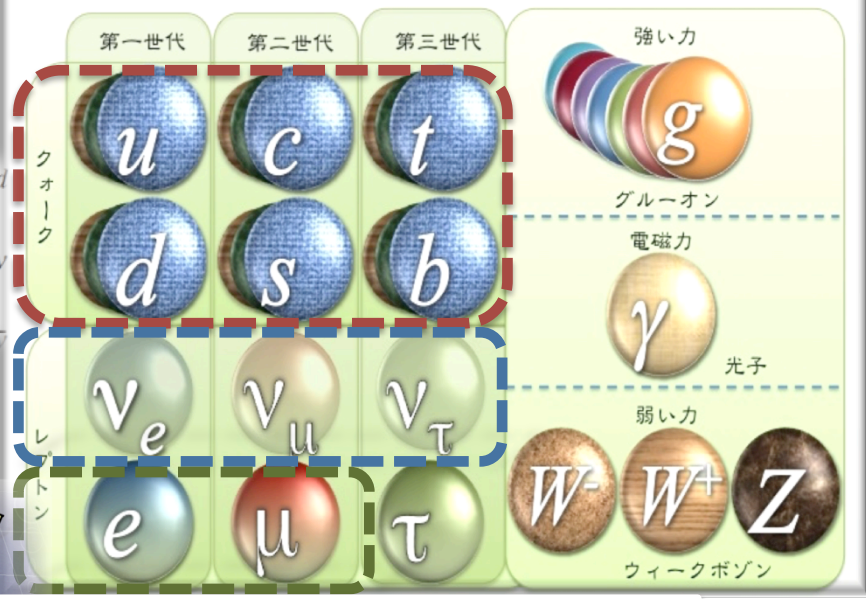
Origin of Matter

- Search for Physics Beyond SM in Quark and Lepton sectors
- Deeper understanding of Strong Int.

Particle-Nuclear Physics explored at J-PARC

Search for CPV beyond CKM theory

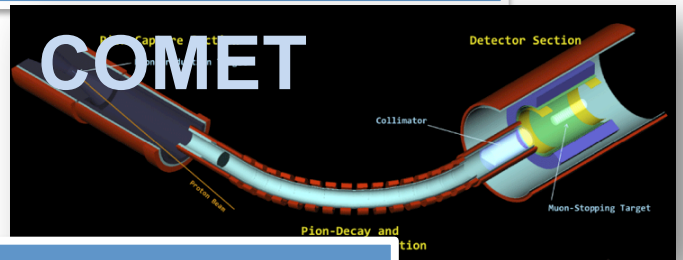
KOTO@Hadron Hall
 $K_L \rightarrow \pi^0 \nu \bar{\nu}$
 Diagram showing a \bar{u} quark and a ν neutrino interacting.



Neutrino Mixing thru PMNS matrix

T2K Exp.
 CPV in neutrino sector?
 Neutrino Facility at J-PARC
 295km distance between Super-Kamiokande and J-PARC.
 Diagrams for $\nu_e \leftrightarrow \nu_\mu$ and $\bar{\nu}_e \leftrightarrow \bar{\nu}_\mu$ oscillations.
 Labels: ニュートリノ, 反ニュートリノ, e, μ, τ , δ , θ .

Charged Lepton Flavor violated?



Explore role of strangeness in neutron stars

CPV in Charged Lepton?



Strange quark may play an important roles in an extreme high density matter, aka neutron star.

Ultra cold μ source
 Muon LINAC (300 MeV/c)
 $g_\mu - 2/\mu$ EDM

Multi-Probe Platform for Material and Life Science

With Synergetic Use of Neutron, Muon, Photon and Positron

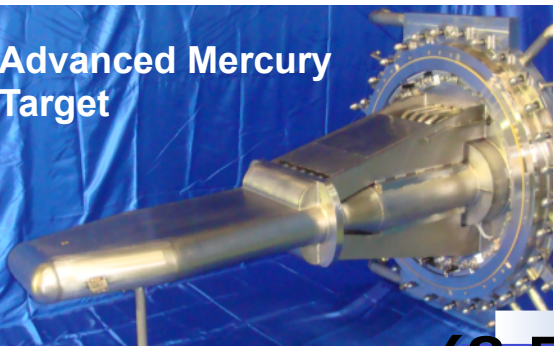


Material and Life Science Facility (MLF)



World Highest Intensity of Neutron Pulse Beam!

Advanced Mercury Target



(8.5)

500 kW
(2015.4)

1,000 kW (Design)

SNS, US

4.2

1,000 kW
(2009.12)



5.9

1,400 kW
(Design)

ISIS – TS2, UK

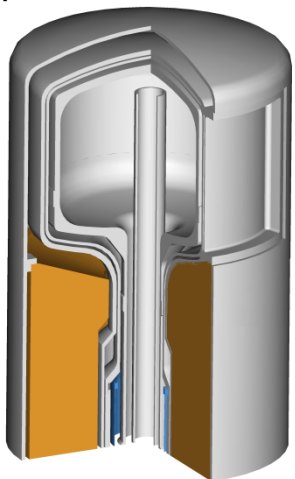
4.0

48kW

J-PARC

SNS

ISIS



Hi-performance Moderator

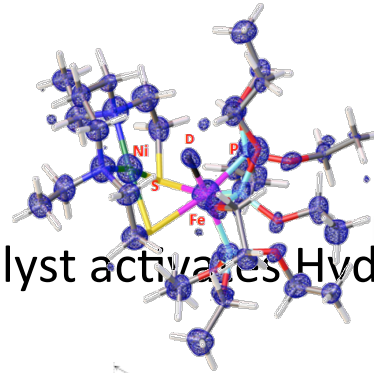
Unit: 10^{12} n/(sr·pulse)

Industrial Use of MLF at J-PARC

Examples of Industrial Use at MLF

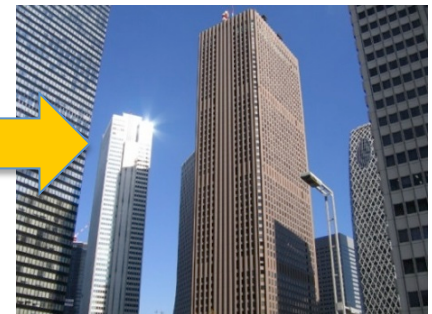
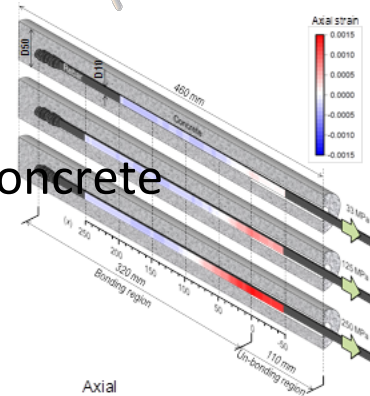
- Battery for Vehicles

Elucidate a mechanism of Ni-Fe Catalyst activates Hydrogen
⇒ **Development Battery w/o Pt**



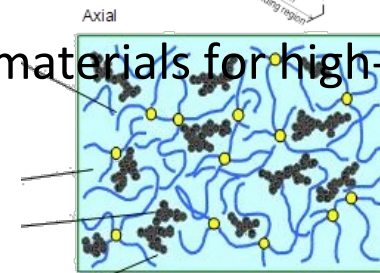
- For buildings with more strength

Inspect internal structure of reinforced concrete
⇒ **for more solid concrete**



- For high-function tire

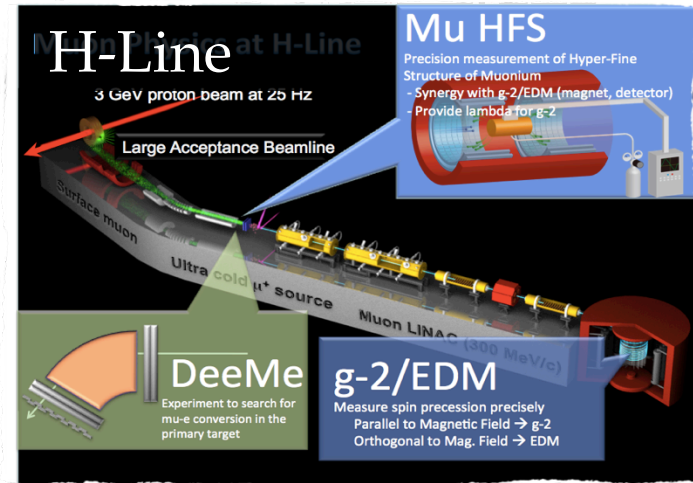
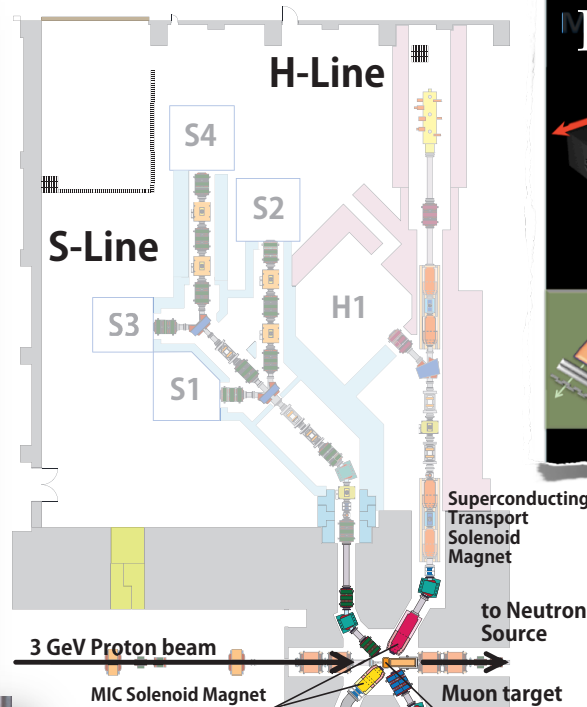
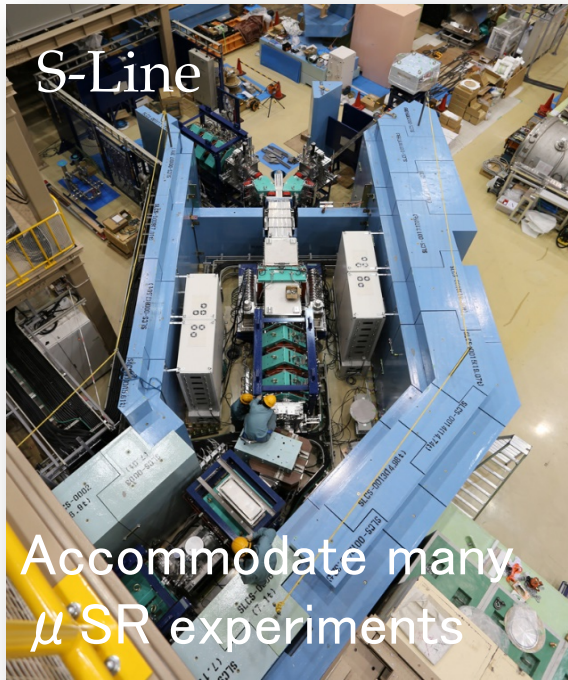
Investigate the microscopic structure of materials for high-function tire
⇒ **for higher performance tire**



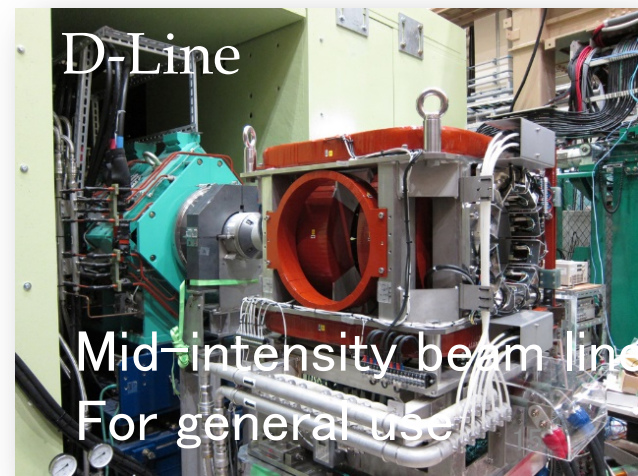
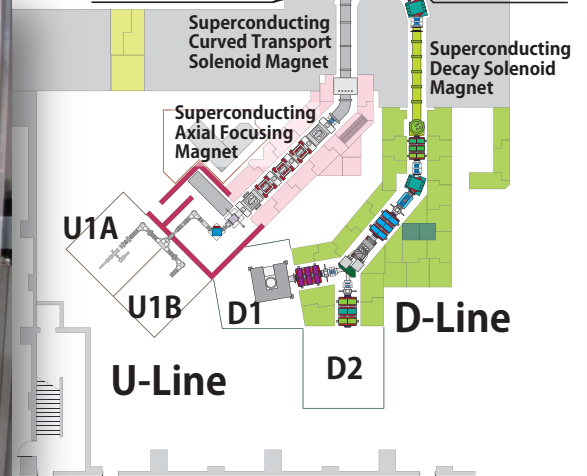
Microstructure of rubber



Muon Facility MUSE @ MLF

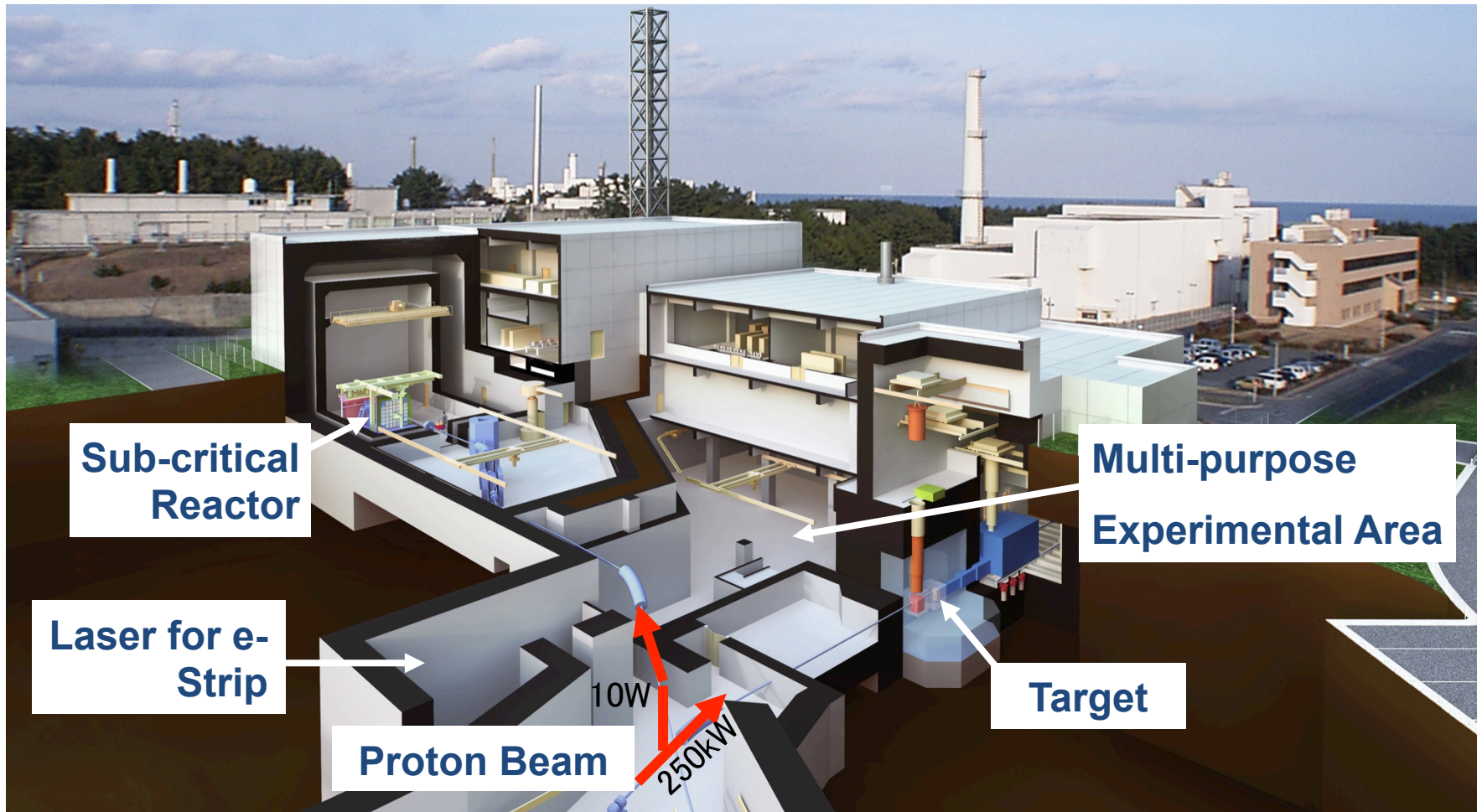


Fundamental Science with a large scale international coll.



ADS Test Facility for Nuclear Transmutation

TDR being developed for construction start in JFY 2018



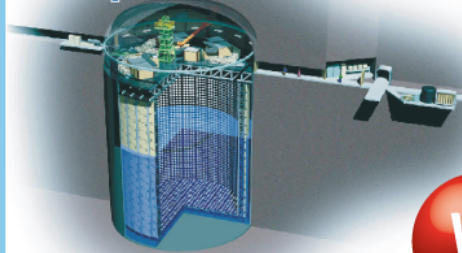
An aerial photograph of a coastal area, likely a research or industrial site. The image shows a large, irregularly shaped building complex with several large, light-colored roofs. The complex is situated on a peninsula or near a coastline, with a sandy beach and waves visible in the lower right. The surrounding area includes green fields and other smaller buildings. A large, semi-transparent green rectangular box is overlaid on the center of the image, containing the text "Neutrino Program" in white, sans-serif font.

Neutrino Program

Goal of T2K

Neutrino and anti-neutrino behave same?

Super-Kamiokande



ν_e

295km

ν_μ

ニュートリノ

$e i \delta$?

Neutrino Facility at J-PARC

$\bar{\nu}_e$

295km

$\bar{\nu}_\mu$

反ニュートリノ

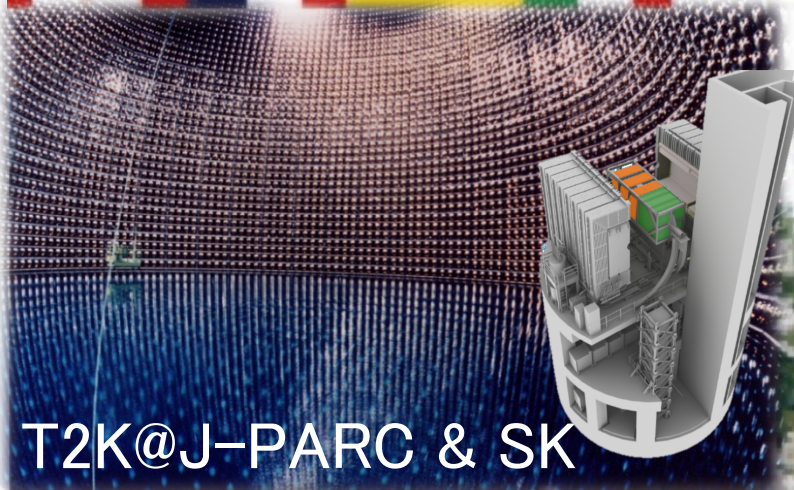
Search for CP Violation beyond CKM



Origin of Matter



T2K Collaboration



T2K@J-PARC & SK



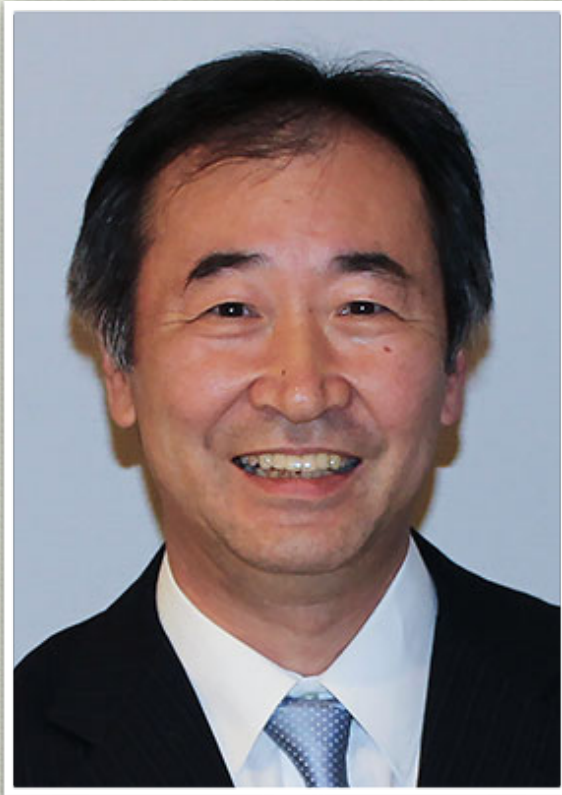
Nishina Memorial Prize 2014
Prof. Nakaya
Prof. Kobayashi

6th Yoji Totsuka Prize
Prof. Nakaya
Prof. Kobayashi
Prof. Shiozawa



~500 members, 59 Institutes, 11 countries

Congratulations!



Prof. Takaaki KAJITA

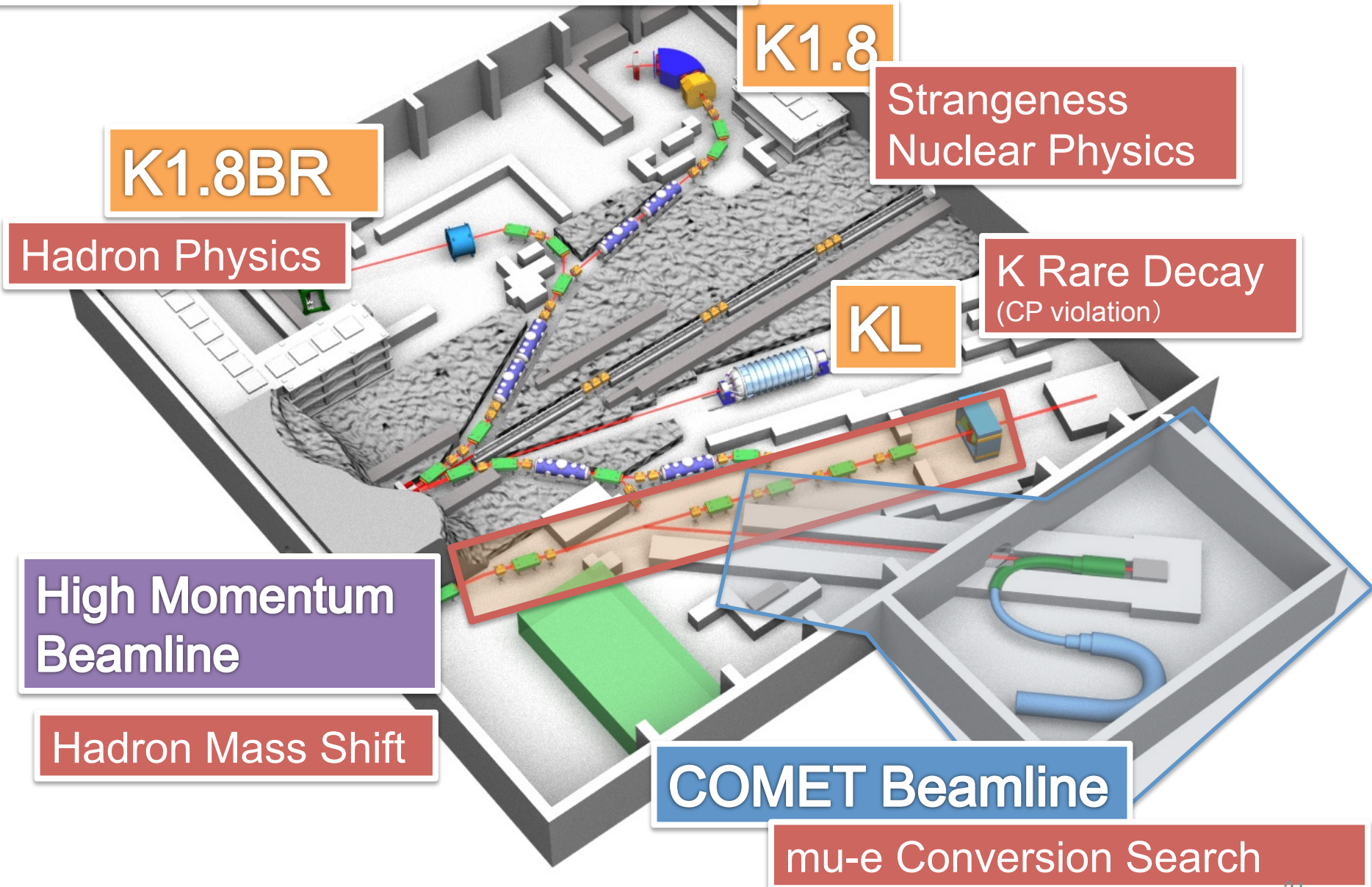


Prof. Arthur B. McDonald

- For Discovery of Neutrino Oscillation

Pictures from Nobelprize.org

Hadron Hall in 2016



Kaon program

KOTO : Study on $K_L \rightarrow \pi^0 \nu \nu$



Collaboration photo at KEK, October 2014

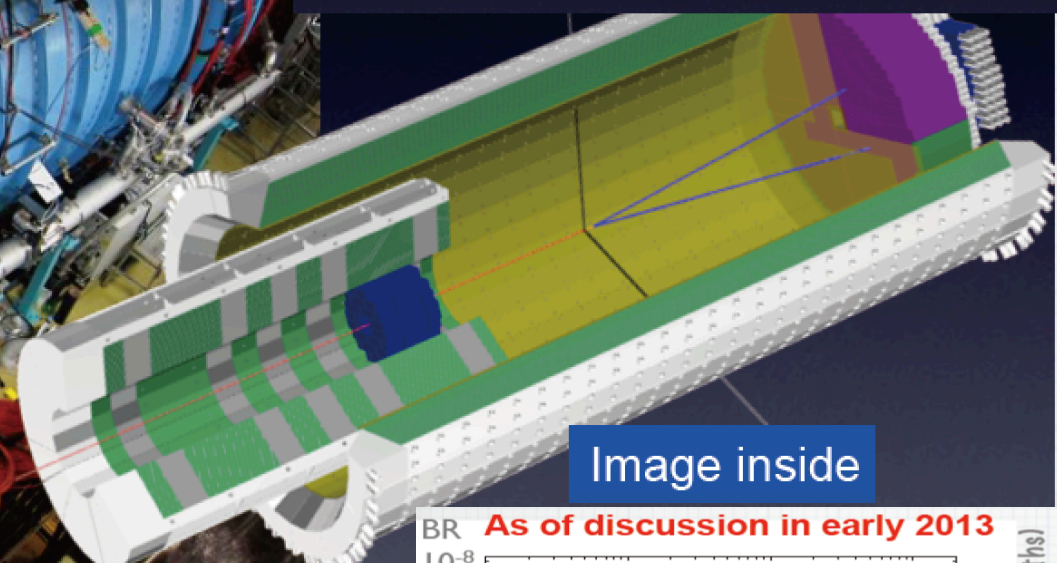
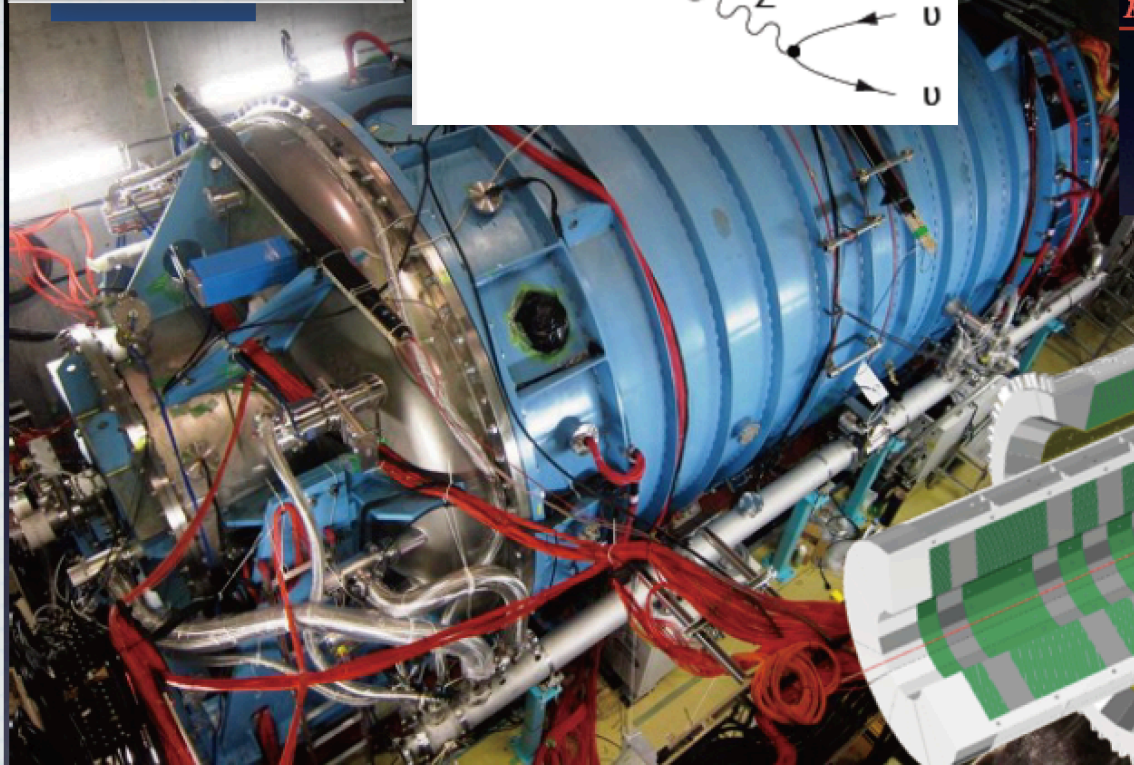
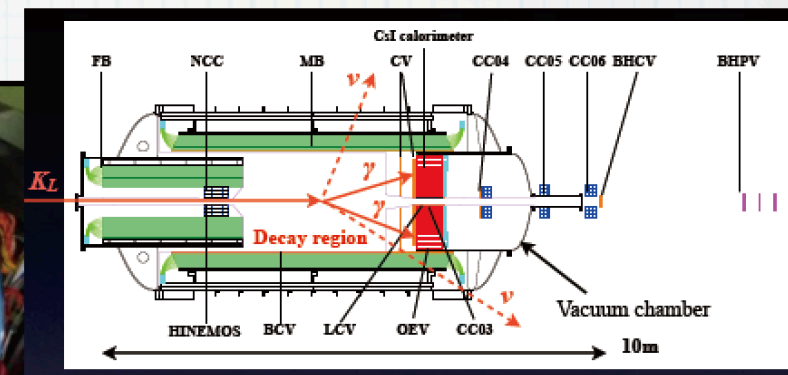
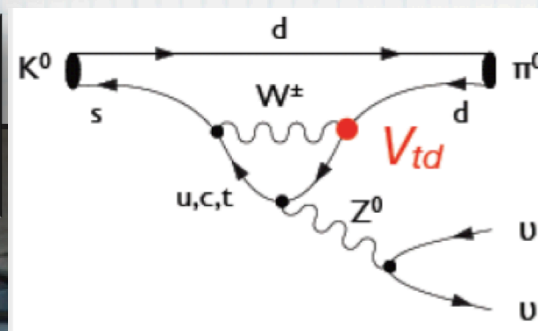
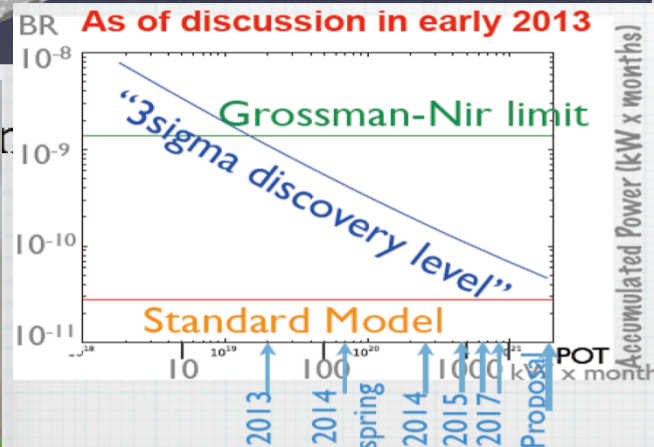


Image inside



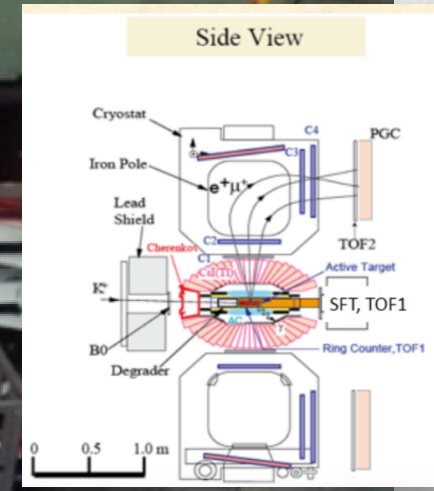
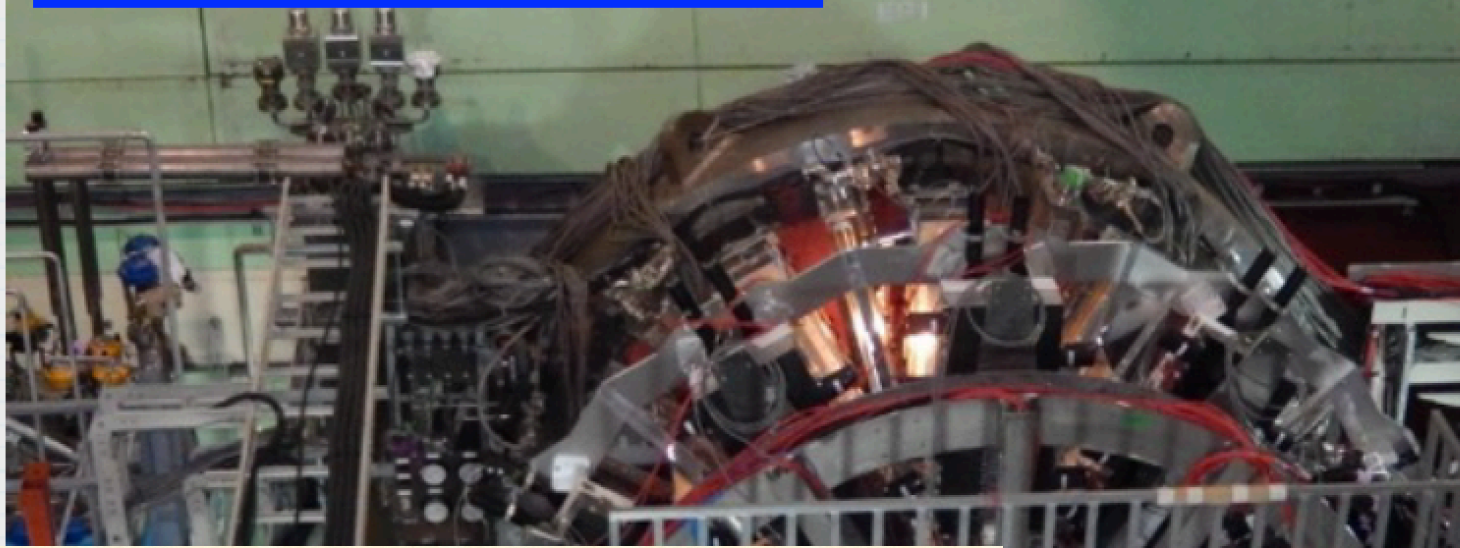
Slide by T. Nomura

Collaboration photo at KEK, October 2014

+ 2-year delay due to the HD accident

Kaon program

E36: Lepton universality in K^+ decay

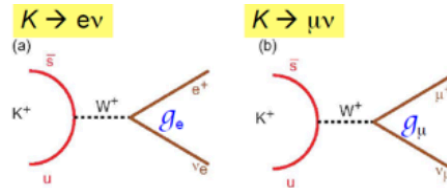


Lepton universality in K_{l2} decay

- Precise measurement of decay width ratio

$$R_K^{\text{exp}} = \frac{\Gamma(K^+ \rightarrow e^+ \nu)}{\Gamma(K^+ \rightarrow \mu^+ \nu)}$$

$$g_e = g_\mu ?$$



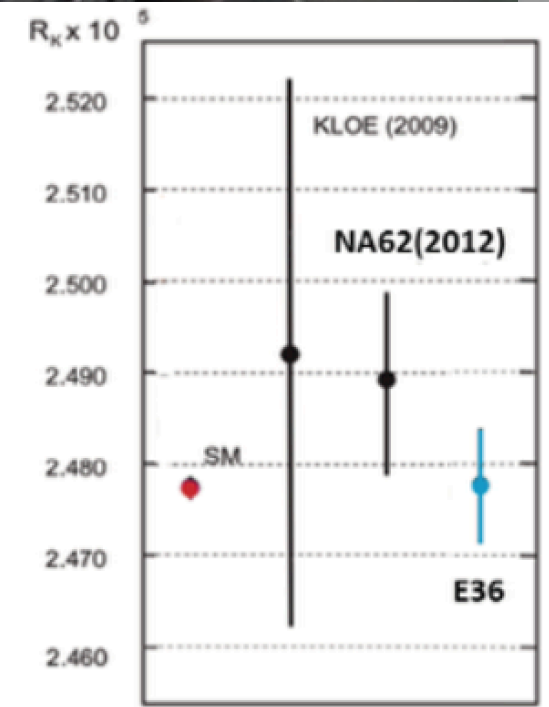
$$\Gamma(K_{l2}) = g_l^2 (G^2/8\pi) f_K^2 m_K m_l^2 \{1 - (m_l^2/m_K^2)\}^2$$

- In the ratio of the $\Gamma(Ke2)$ to the $\Gamma(K\mu2)$, the hadronic form factors are cancel out and R_K^{SM} is highly precise.

$$R_K^{SM} = \frac{m_e^2}{m_\mu^2} \left(\frac{m_K^2 - m_e^2}{m_K^2 - m_\mu^2} \right)^2 (1 + \delta_r) \quad R_K^{SM} = (2.477 \pm 0.001) \times 10^{-5}$$

SM uncertainty is $\Delta R_K/R_K \sim 0.04\%$

- Deviation of the experimental R_K from the SM prediction indicates lepton universality violation, which arises from New Physics ¹⁵



Muon Program

Search for $\mu \rightarrow e$ conversion

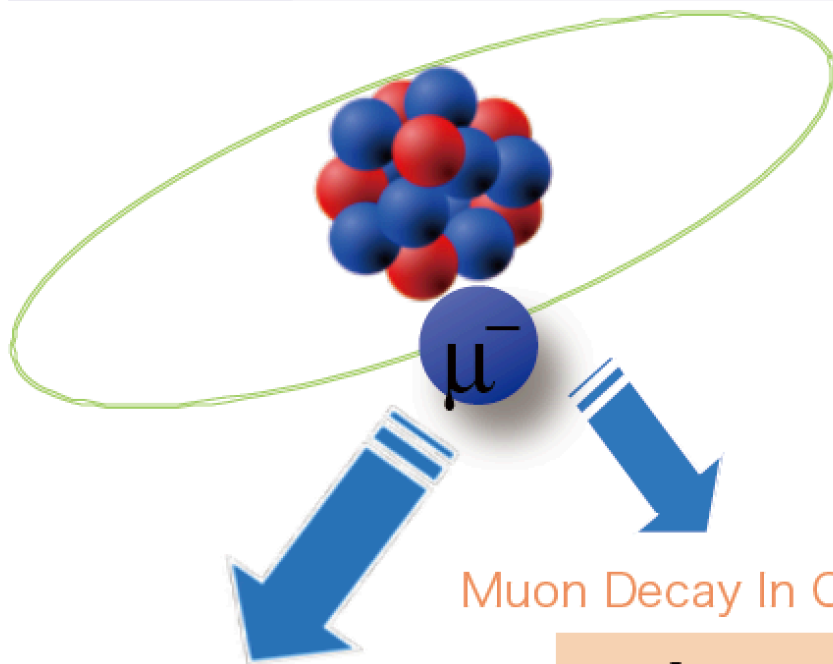
COMET @ HEF

and

DeeMe @ MLF H-line

COMET

$\mu \rightarrow e$ search using pulsed muon beam



Muon Decay In Orbit

nuclear muon capture

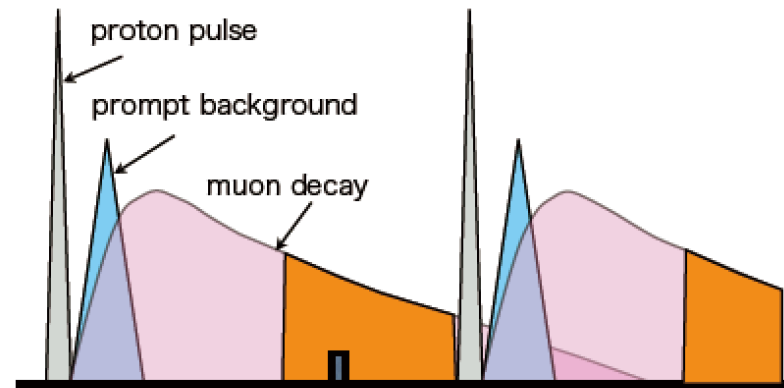


μ -e conversion



• $E_{\mu e(A)} \sim m_\mu - B_\mu = 105 \text{ MeV}$

$-B_\mu$: binding energy of the 1s muonic atom



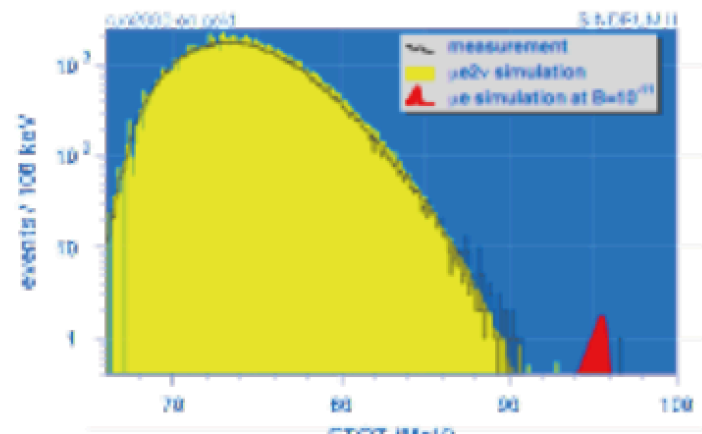
$\pi^- + (A, Z) \rightarrow (A, Z-1)^*, (A, Z-1)^* \rightarrow \gamma + (A, Z-1), \gamma \rightarrow e^+ e^-$
 Prompt timing

Other sources

μ^- decay-in-flight, e^- scattering, neutron streaming

$$R_{\text{ext}} = \frac{\text{number of proton between pulses}}{\text{number of proton in a pulse}}$$

SINDRUM II $\text{BR}[\mu^- + \text{Au} \rightarrow e^- + \text{Au}] < 7 \times 10^{-13}$



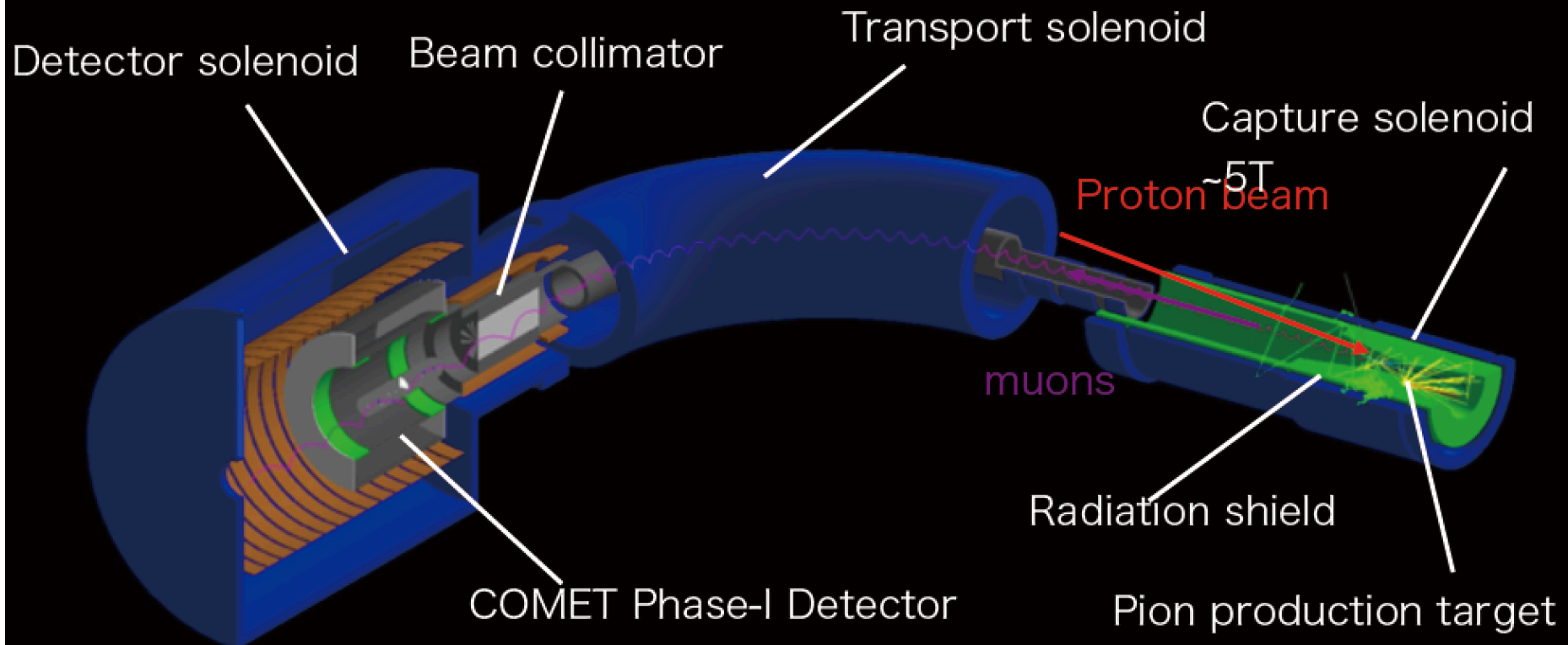
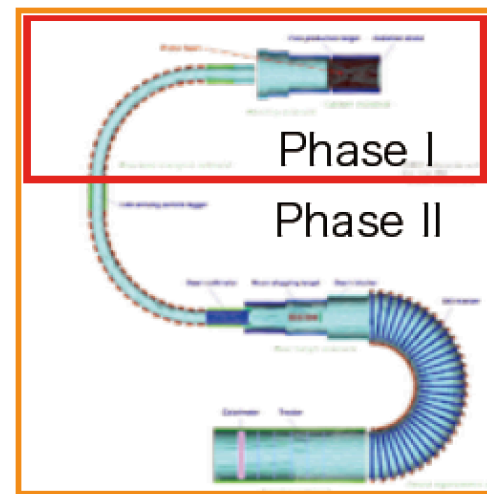
COMET Phase I

- Phase I

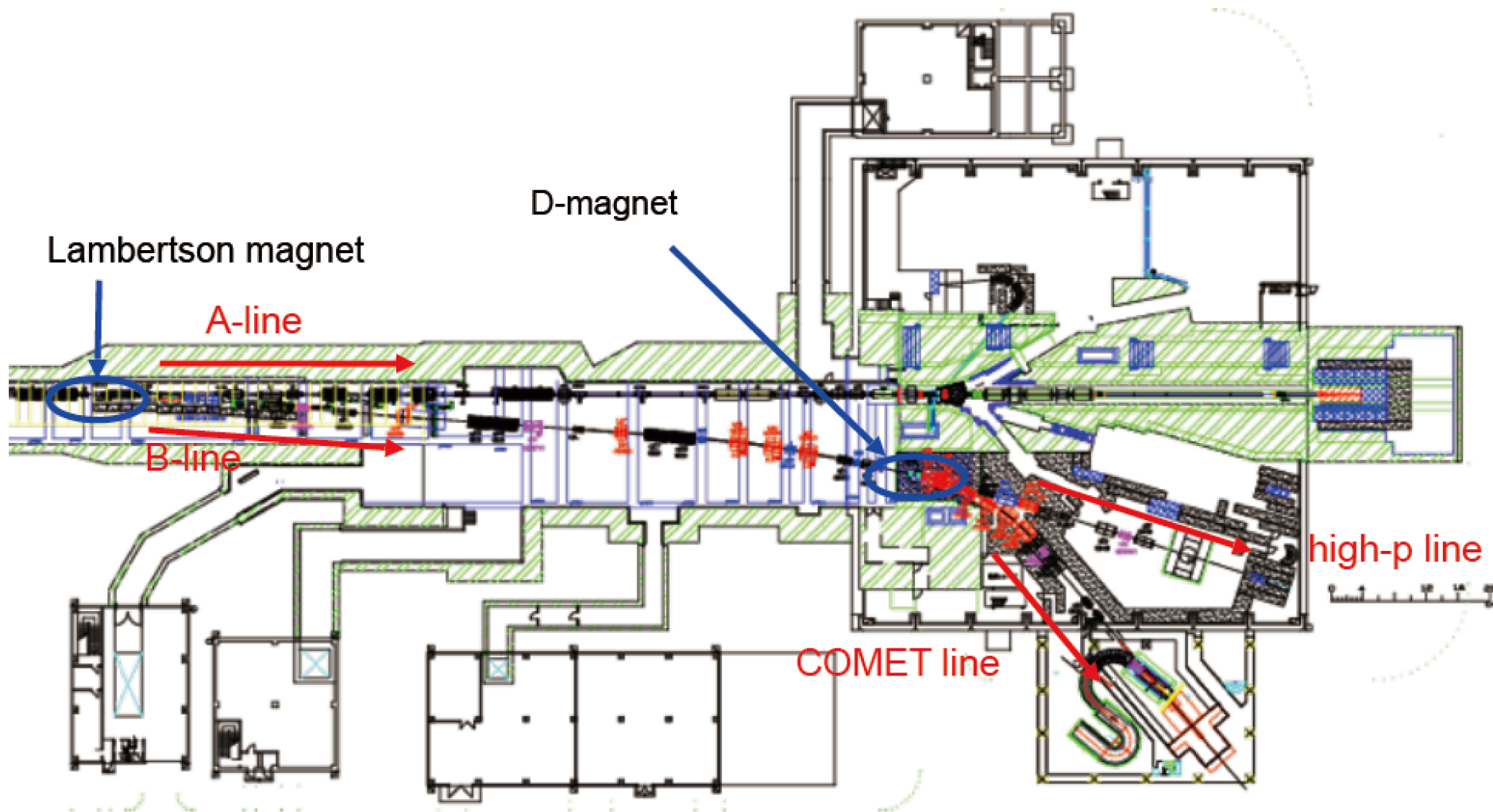
- Beam background study and achieving an intermediate sensitivity of $<10^{-14}$
 - 8GeV, ~3.2kW, ~90 days of DAQ

- Phase II

- 8GeV, ~56 kW, 1 year DAQ to achieve the COMET final goal of $<10^{-16}$ sensitivity



COMET Hall & Beamline

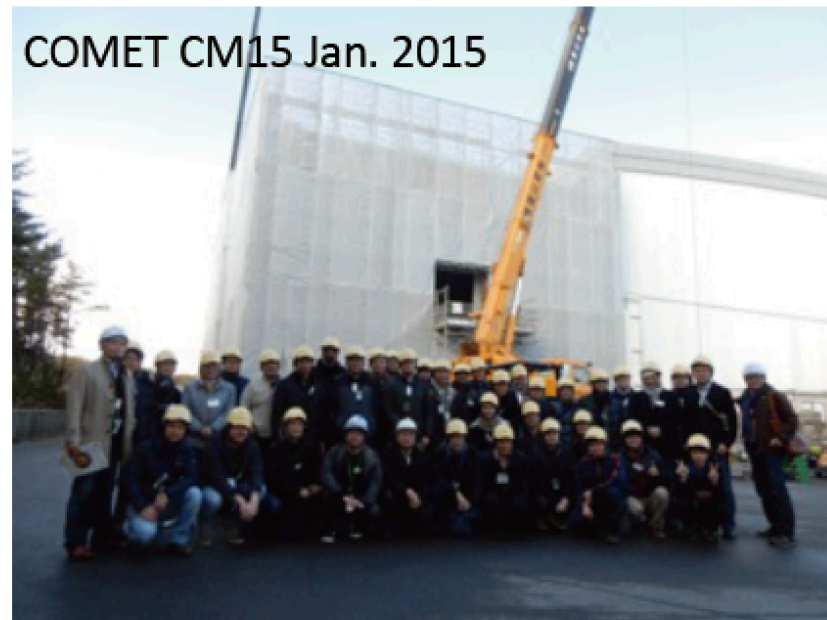


**Branch for COMET and high-p is realized by normal dipole magnets.
(No simultaneous operation of COMET and other hadron-hall experiments)**

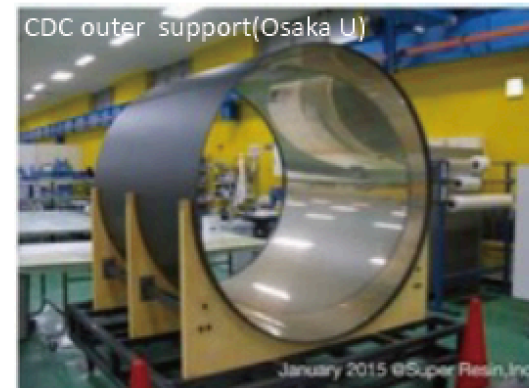
COMET Status

- Construction of Hadron South Exp. Building (completed in JFY 2014)
- Construction of new primary beam line
 - Strong support by the hadron beam line group
- Construction of pion/muon capture (in progress) & transport solenoid magnets (completed in JFY2014)
 - High field / high radiation tolerance
- Development and construction of detectors, Radiation tolerance test of detector components (in progress)
- Submission of Technical Design Report to J-PARC PAC (in Oct. 2014)

COMET CM15 Jan. 2015



CDC outer support(Osaka U)



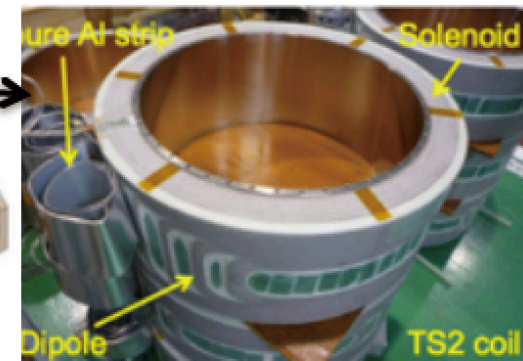
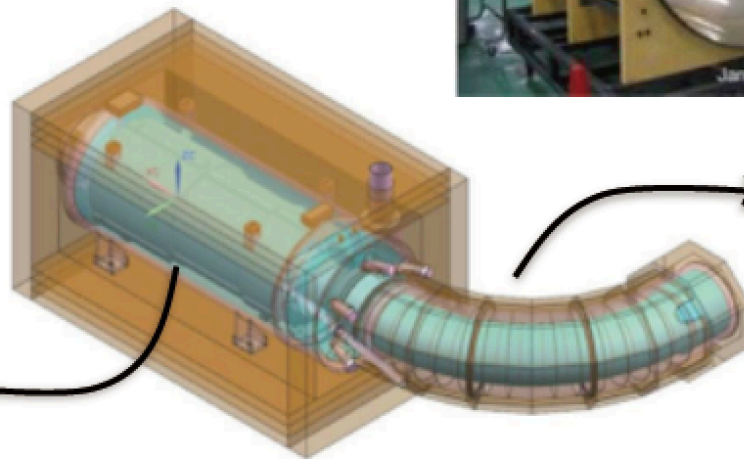
COMET Phase-I



Technical Design Report

September, 2014

Capture Solenoid Coil Winding

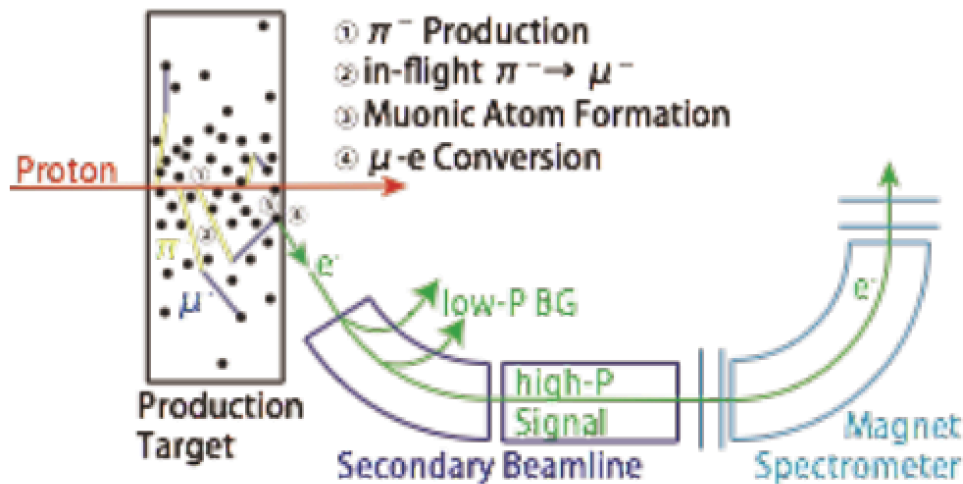


Transport solenoid + Dipole coils

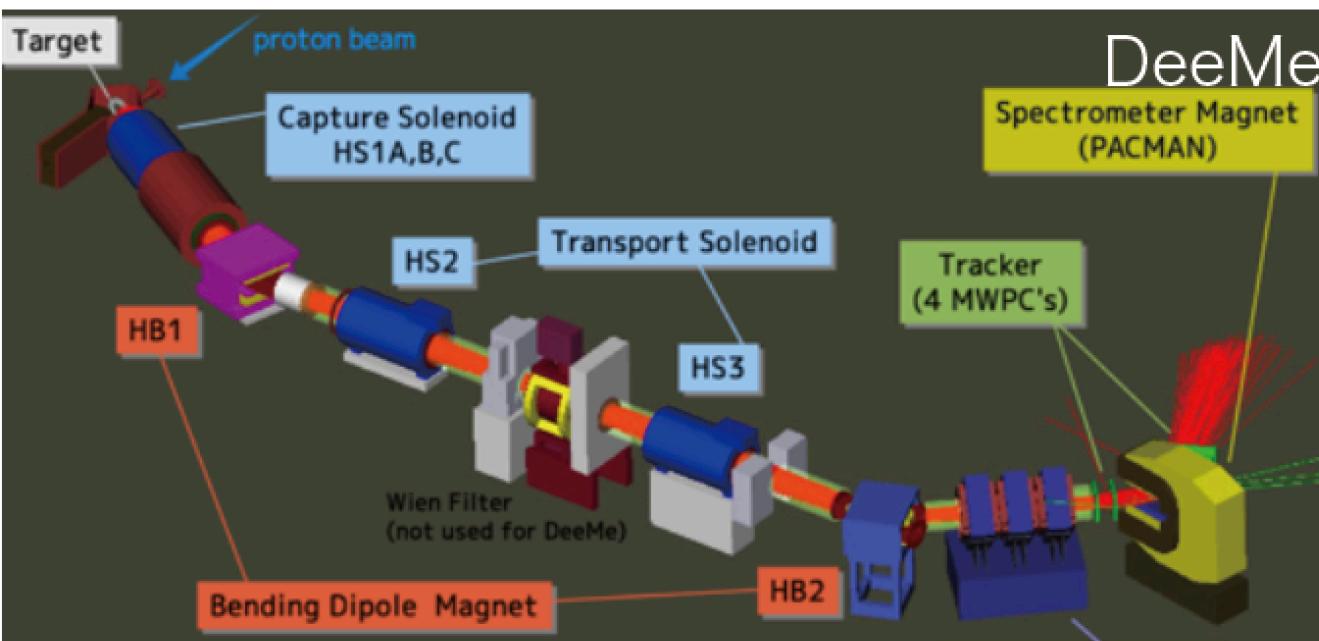
COMET is moving forward!



DeeMe: Search for μ -e Conversion



- **IMSS/Muon PAC: Stage-2 Approved**
- **J-PARC/RCS: High-Power High-Purity Pulsed Proton Beam.**
- **Production Target as μ -stopping target.**
- **H-Line/MLF: Large-Acceptance Beam line.**
- **State-of-the-Art MWPC Technology**
- **S.E.S. — BR \sim 5 x 10⁻¹⁵**
 (8 x 10⁷ sec of data taking with SiC target)
- Start the physics run with graphite target
 - S.E.S. — 1 x 10⁻¹³ (2 x 10⁷ sec)
- Aiming to start the engineering run in **2015**.



Magnet leased from TRIUMF is waiting for the installation at MLF



Muon Program

Muon $g-2$ /EDM measurement

@ MLF H-line



100+ collaborators from 26 institutions

Slide by T. Nomura

muon g-2/EDM measurements

Anomalous magnetic moment (g-2)

$$a_\mu = (g-2)/2 = 11\,659\,208.9 (6.3) \times 10^{-10} \text{ (BNL E821 exp)}$$

0.5 ppm

$$11\,659\,182.8 (4.9) \times 10^{-10} \text{ (standard model)}$$

$$\Delta a_\mu = \text{Exp} - \text{SM} = 26.1 (8.0) \times 10^{-10}$$

3 σ anomaly

In uniform magnetic field, muon spin rotates ahead of momentum due to $g-2 \neq 0$

general form of spin precession vector:

$$\vec{\omega} = -\frac{e}{m} \left[a_\mu \vec{B} - \left(a_\mu - \frac{1}{\gamma^2 - 1} \right) \frac{\vec{\beta} \times \vec{E}}{c} + \frac{\eta}{2} \left(\vec{\beta} \times \vec{B} + \frac{\vec{E}}{c} \right) \right]$$

BNL E821 approach
 $\gamma=30$ ($P=3$ GeV/c)

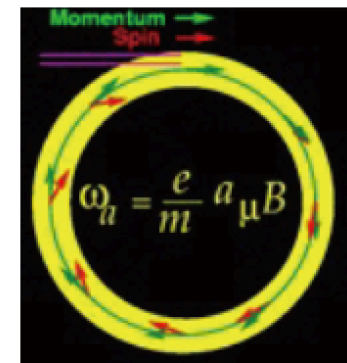
$$\vec{\omega} = -\frac{e}{m} \left[a_\mu \vec{B} + \frac{\eta}{2} \left(\vec{\beta} \times \vec{B} + \frac{\vec{E}}{c} \right) \right]$$

Continuation at FNAL with 0.1ppm precision

J-PARC approach
 $E = 0$ at any γ

$$\vec{\omega} = -\frac{e}{m} \left[a_\mu \vec{B} + \frac{\eta}{2} \left(\vec{\beta} \times \vec{B} \right) \right]$$

Proposed at J-PARC with 0.1ppm precision



New Muon g-2/EDM Experiment at J-PARC with Ultra-Cold Muon Beam

3 GeV proton beam
(333 μ A)

Graphite target
(20 mm)

$$\Delta(g-2) = 0.1 \text{ ppm}$$

$$\text{EDM} \sim 10^{-21} \text{ e} \cdot \text{cm}$$

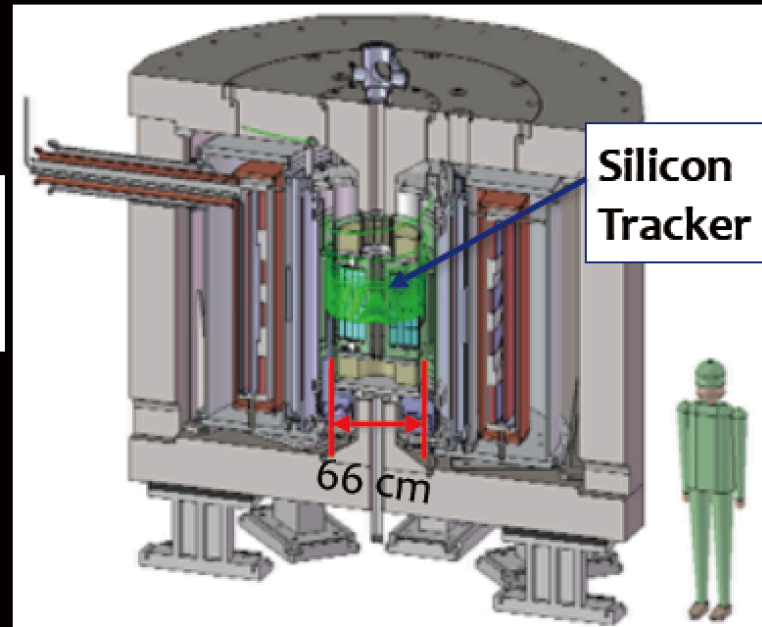
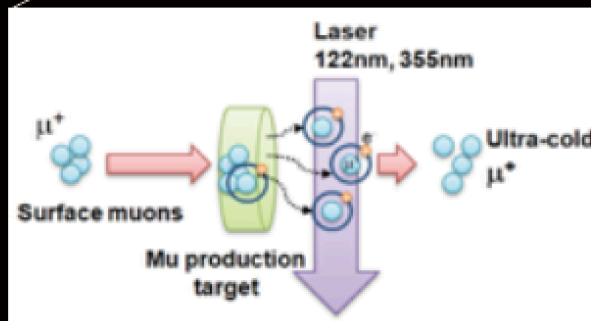
Surface muon beam
(28 MeV/c, 4×10^8 /s)

Muonium Production
(300 K \sim 25 meV \Rightarrow 2.3 keV/c)

Surface muon

Ultra Cold μ^+ Source

Resonant Laser Ionization of Muonium



Super Precision Storage Magnet
(3T, \sim 1ppm local precision)

LINAC (300 MeV/c)

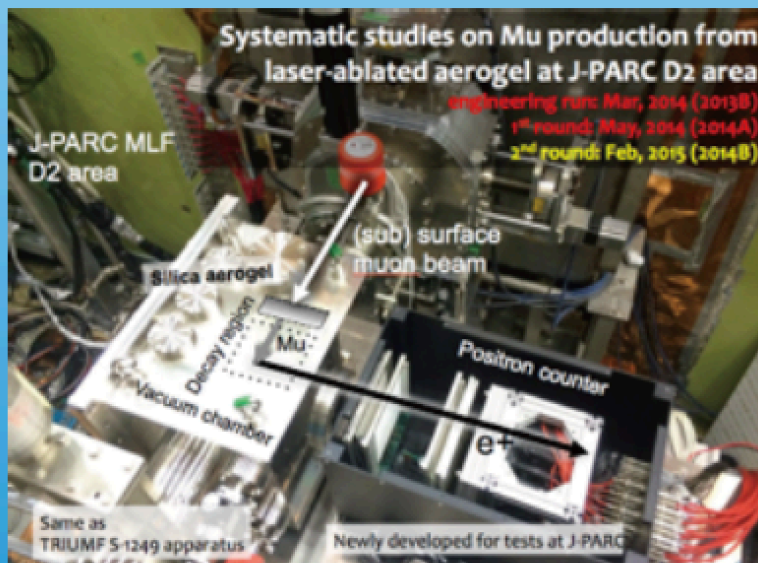
Muon storage

1. Ultra-cold μ^+ beam is injected to storage magnet.
2. Pulse kicker stops muons in storage area
3. Positron tracker measures e^+ from $\mu^+ \rightarrow e^+ \nu \bar{\nu}$ decay for the period of $33 \mu\text{s}$ ($5 \times$ lifetime)

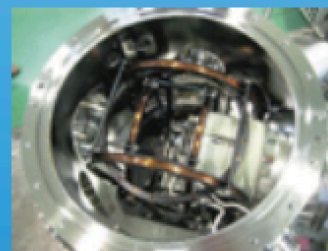
E34: R&D highlights



Ultra-slow muon production



Optimization of Mu production target
(Feb. beam time was canceled)

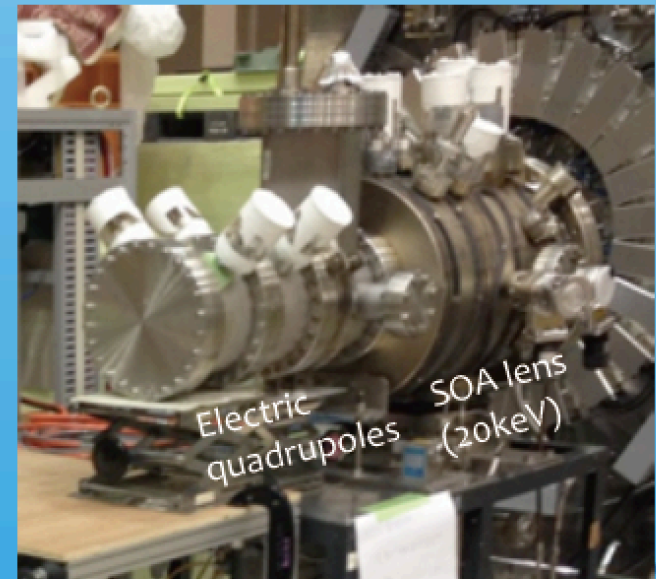


Laser-ionization chamber (RIKEN-RAL)

Muon acceleration test



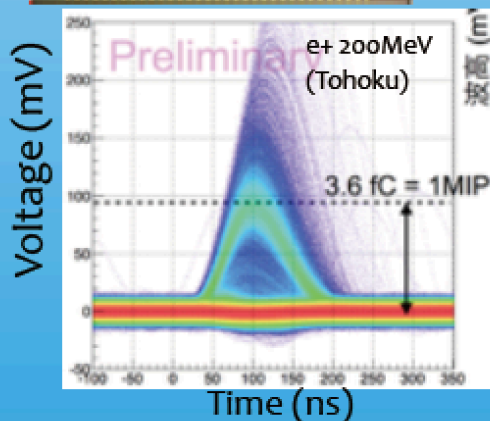
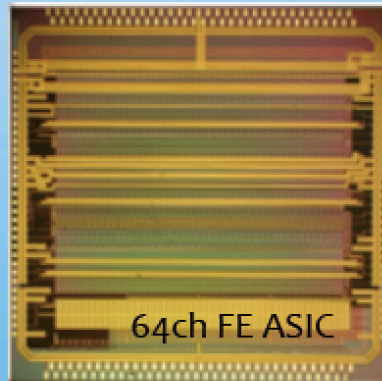
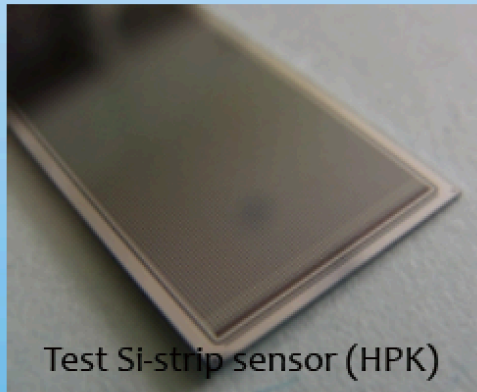
Beamline components were imported from RIKEN-RAL.
Now being assembled at MLF.



E34: R&D highlights

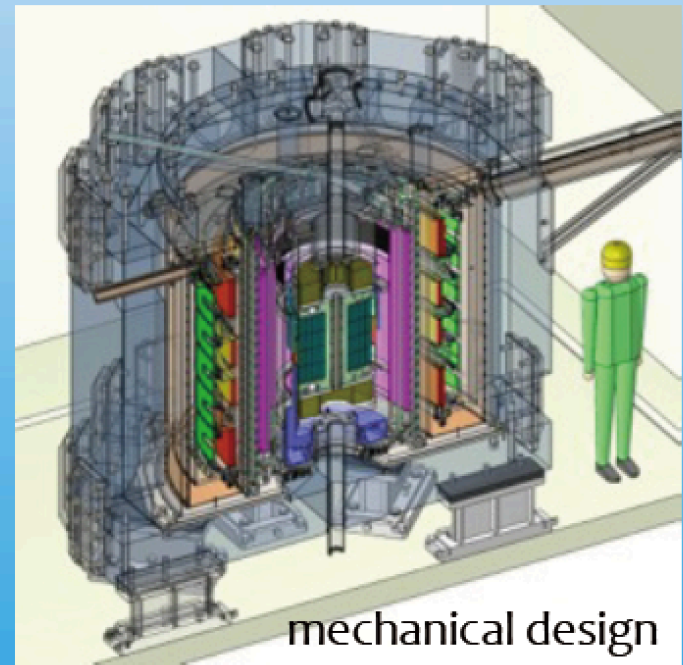


Positron tracking detector

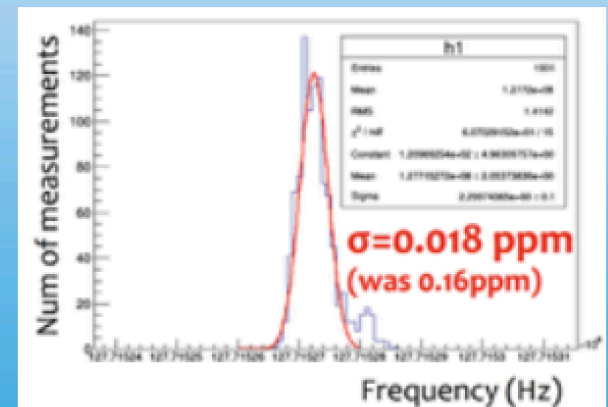


A Silicon-strip sensor and ASIC prototype was assembled and evaluated with e^+ (Tohoku) and $\mu^+ \rightarrow e^+$ (J-PARC). $S/N > 15$.

Muon storage magnet



Precision B-field measurement



Signal spectrum under 3T MRI

TDR in preparation for stage-2

(Rough) scope in time domain

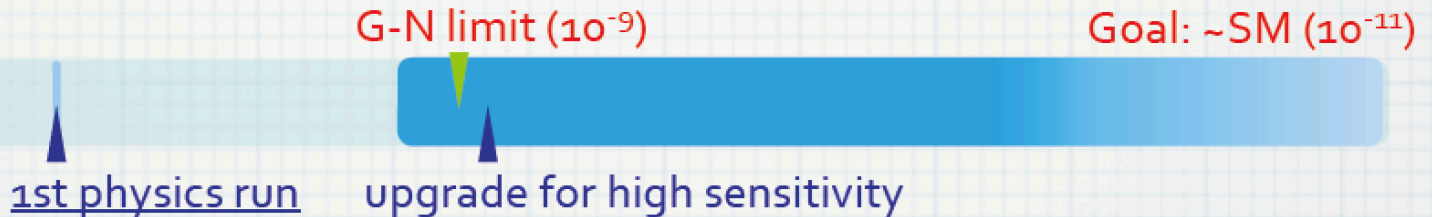
JFY

2013	2014	2015	2016	2017	2018	2019
------	------	------	------	------	------	------

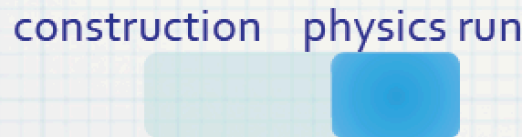
J-PARC
SX power



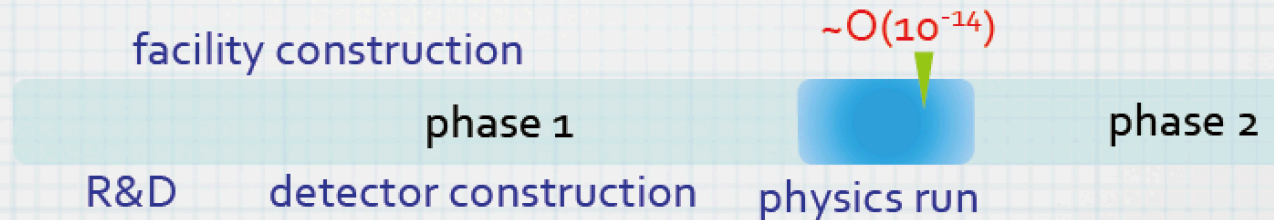
$K_L \rightarrow \pi^0 \nu \nu$
KOTO



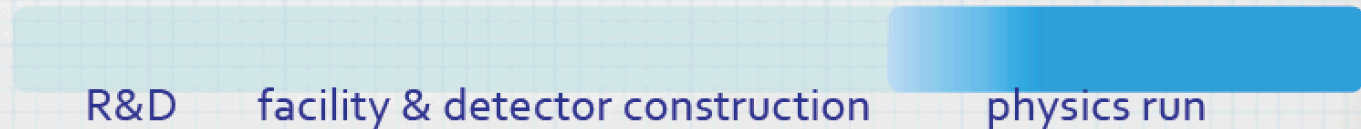
K: Lepton universality
E36



μ : μ -e conversion
COMET



μ : g-2/EDM
** At MLF H-line

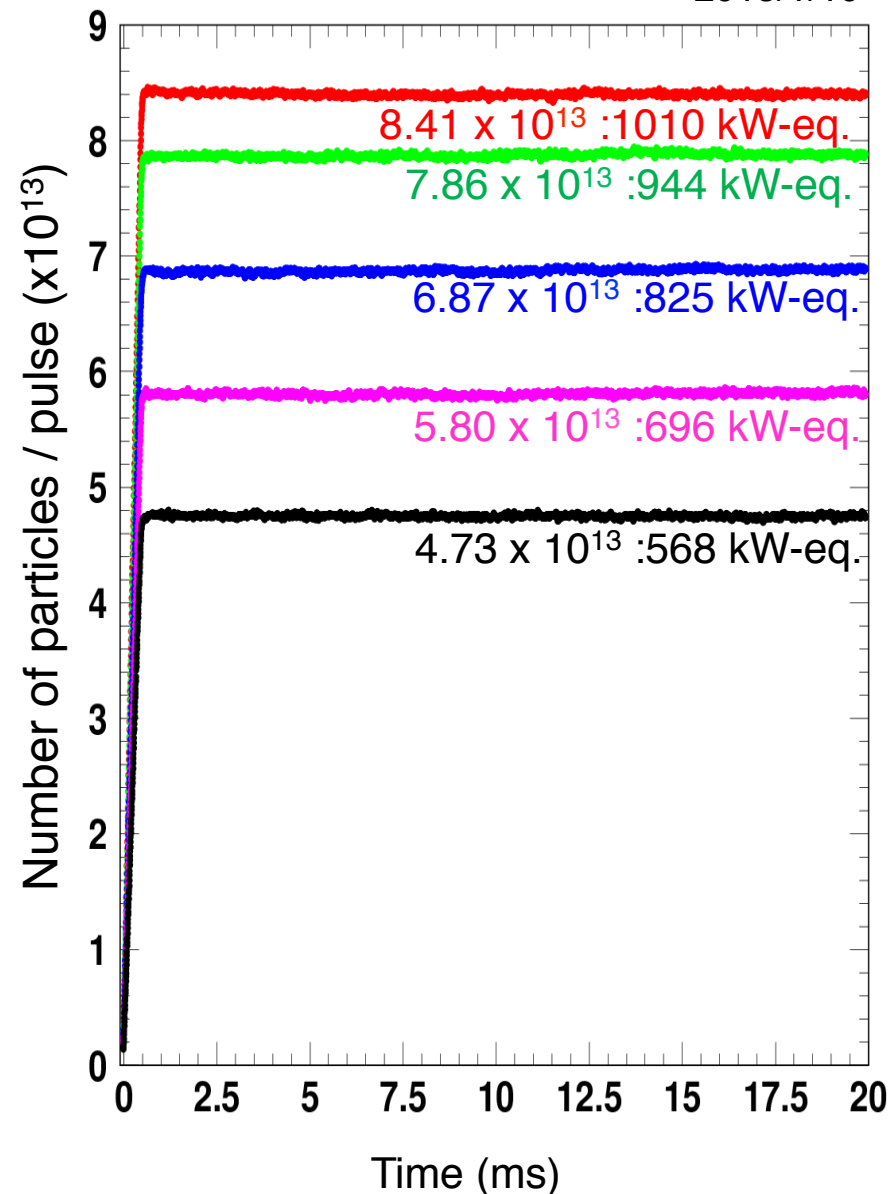


An aerial photograph of the J-PARC (Japan Proton Accelerator Research Complex) facility. The image shows a large industrial and research complex with numerous buildings, roads, and parking lots. A semi-transparent green rectangular box is overlaid on the center of the image, containing the title text in white. The background shows a mix of green fields and urban development.

Accelerator Improvements at J-PARC

Demonstration of 1 MW-eq. beam@RCS

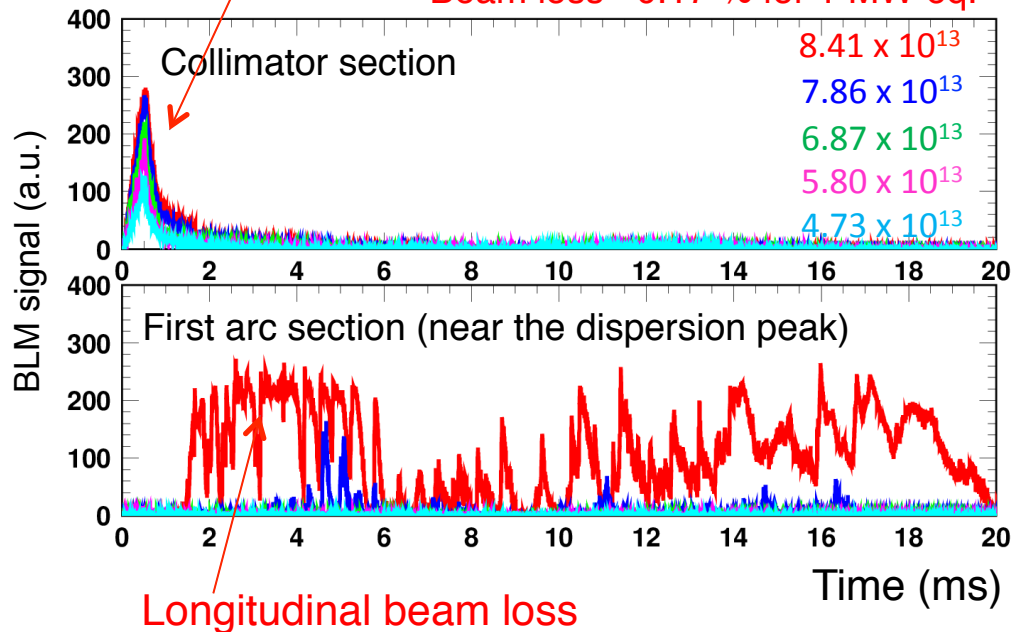
2015/1/10



BLM signals @ collimator & arc sections

Mainly from foil scattering during injection

Beam loss $\sim 0.17\%$ for 1 MW-eq.

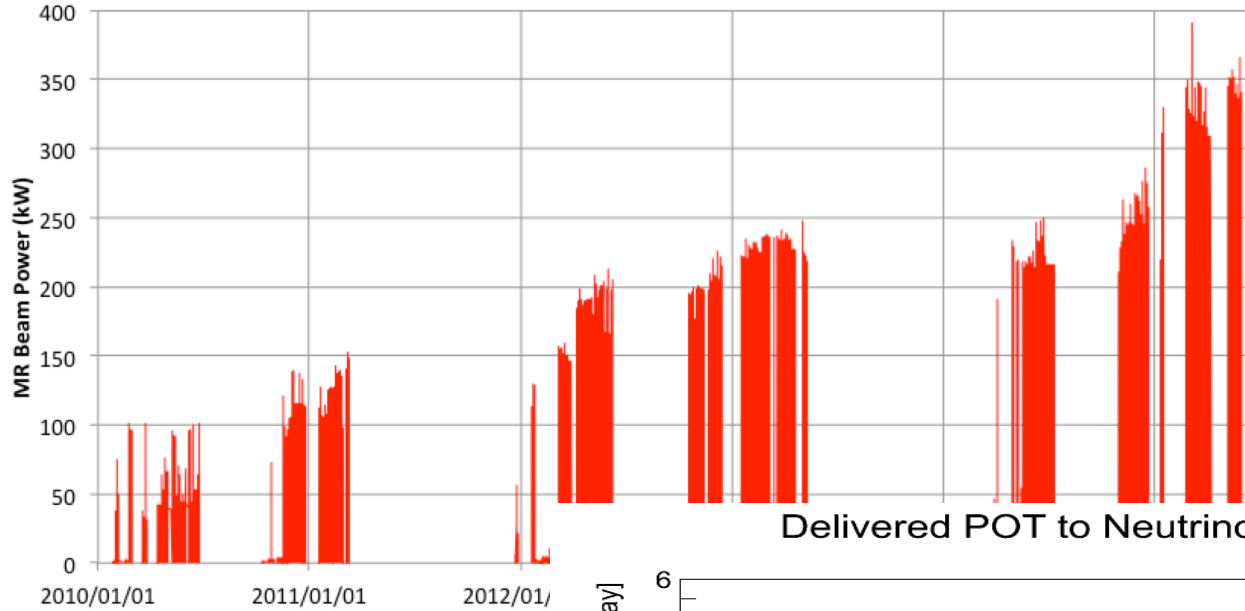


The anode power supplies of the rf power amplifiers were reinforced in the 2015 summer shutdown periods.

→ On Oct. 12, 2015, stable beam acceleration of 1 MW-eq beam was confirmed without the longitudinal losses.

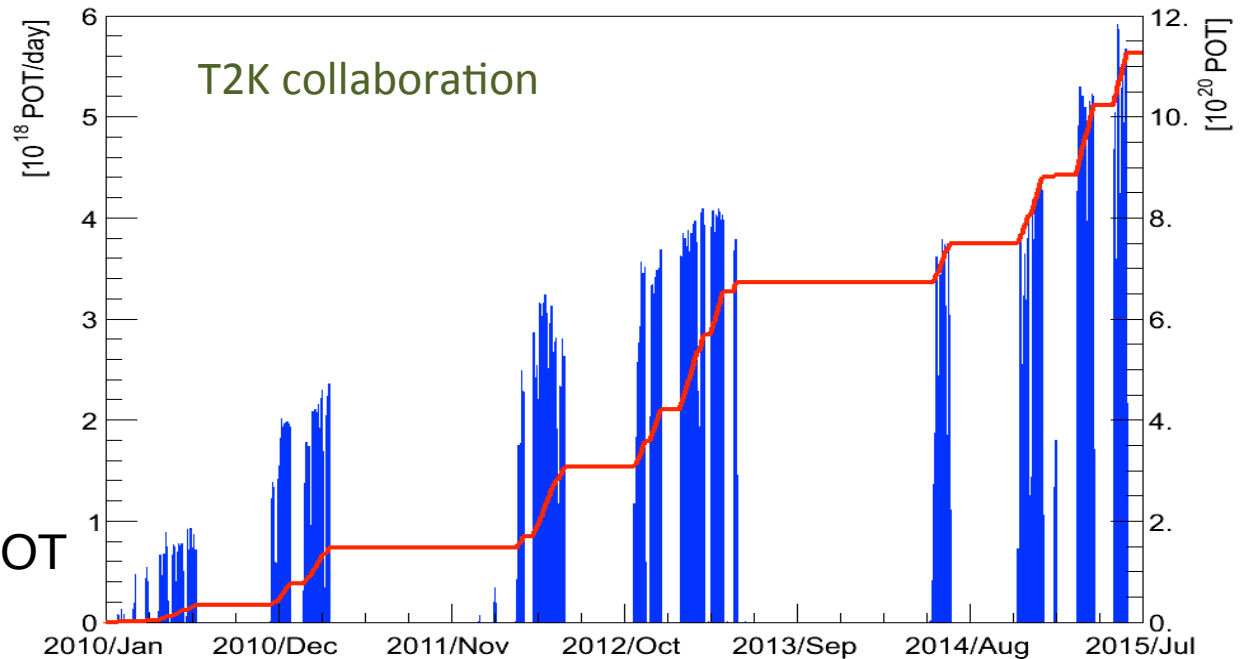
History of MR beam power

MR Beam Power



Delivered beam power is 3

T2K collaboration

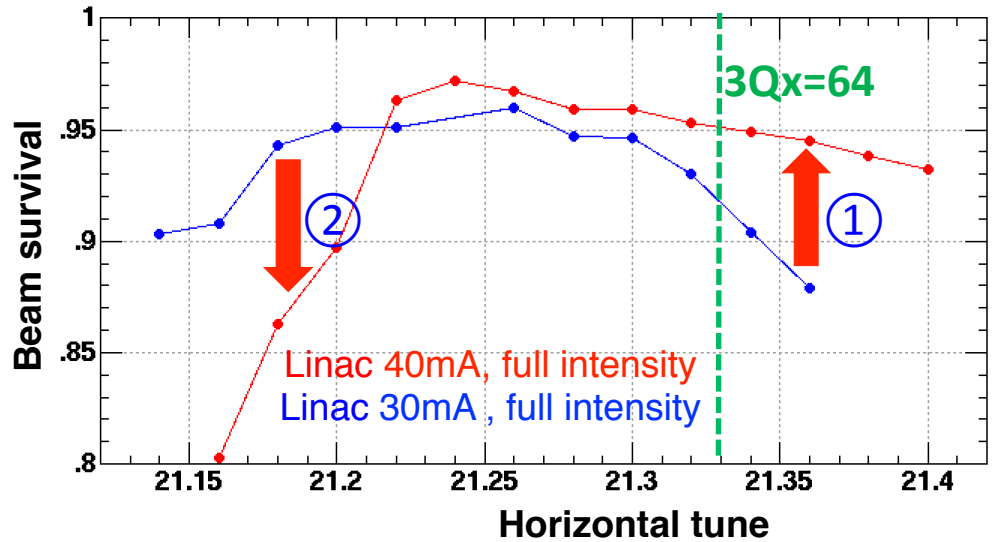
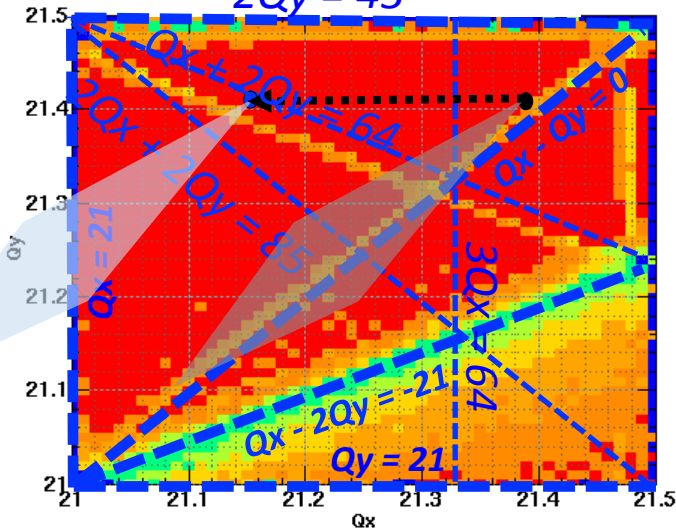


Total number is $> 1.1 \times 10^{21}$ POT
as of June 3.

High Intensity beam study at MR

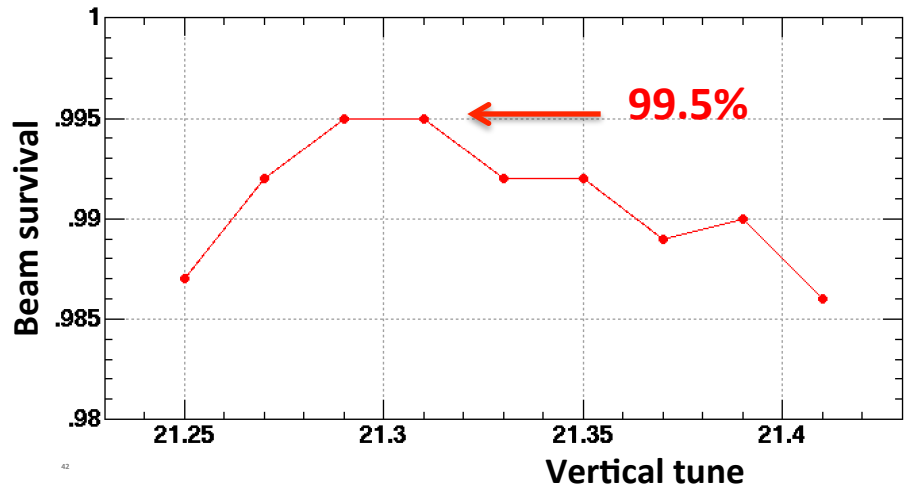
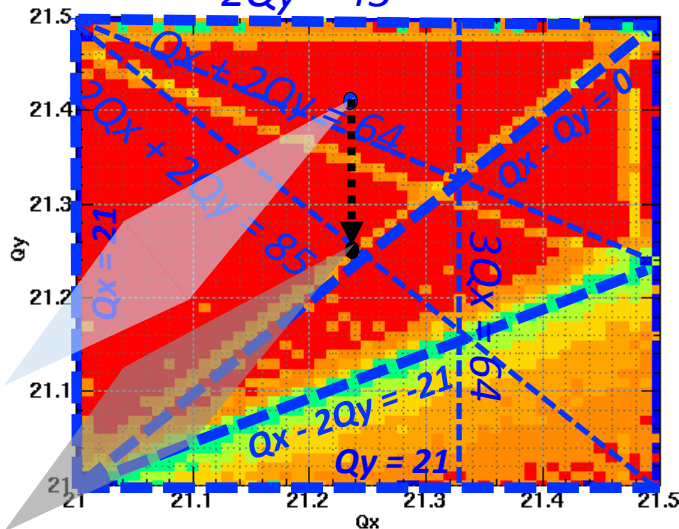
Horizontal tune survey at 3 GeV

$2Q_y = 43$



Vertical tune survey at 3 GeV

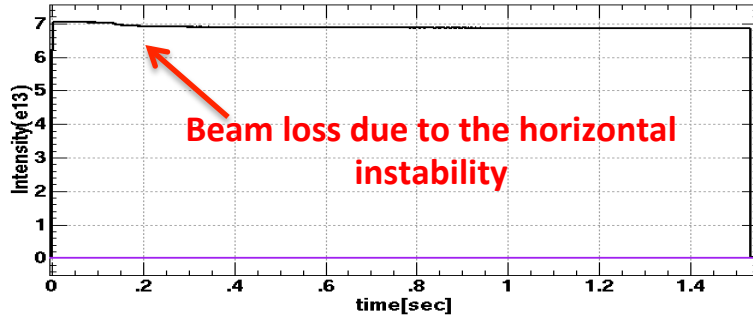
$2Q_y = 43$



- ① 3rd Integer resonance correction ($3Q_x=64$) by Trim-Sext.
- ② Larger tune spread and crossing integer resonance ($Q_x=21$)

High Intensity beam study at MR (cont'd)

High power trial with two bunches



Extracted beam : 3.41e13 ppb
6.82e13 ppp (132 kW eq. ,2 bunches)

	Beam loss[Watt]	
INJ(K1+K2+K3+K4)	144	7.43e+11
P2 --> +90ms	241	1.00e+12
P2+90ms --> +120ms	31	1.30e+11
P2+100ms ---> EXT		1.83e+11

Total beam loss ~ 420 W

Near future tunable knobs to reduce the beam loss:
Injection kicker, BxB feed-back,
2nd harmonic cavity, VHF cavity, etc.

Bunch number	repetition period (sec)	Beam power (kW)	Beam loss (kW)	Notes
1	2	132	0.42	measurement
2	8	529	1.7	estimation
3	8	1009	3.2	estimation

The MR has capability to reach 1MW with the high repetition rate operation.

An aerial photograph of the J-PARC (Japan Proton Accelerator Research Complex) facility. The image shows a large industrial complex with numerous buildings and parking lots, situated near a coastline. A prominent green semi-transparent rectangular box is overlaid on the center of the image, containing the text "Future Plan at J-PARC" in white. The surrounding area includes green fields and a road network.

Future Plan at J-PARC

Master Plan of Science Council of Japan for “Large Scale Research Project”

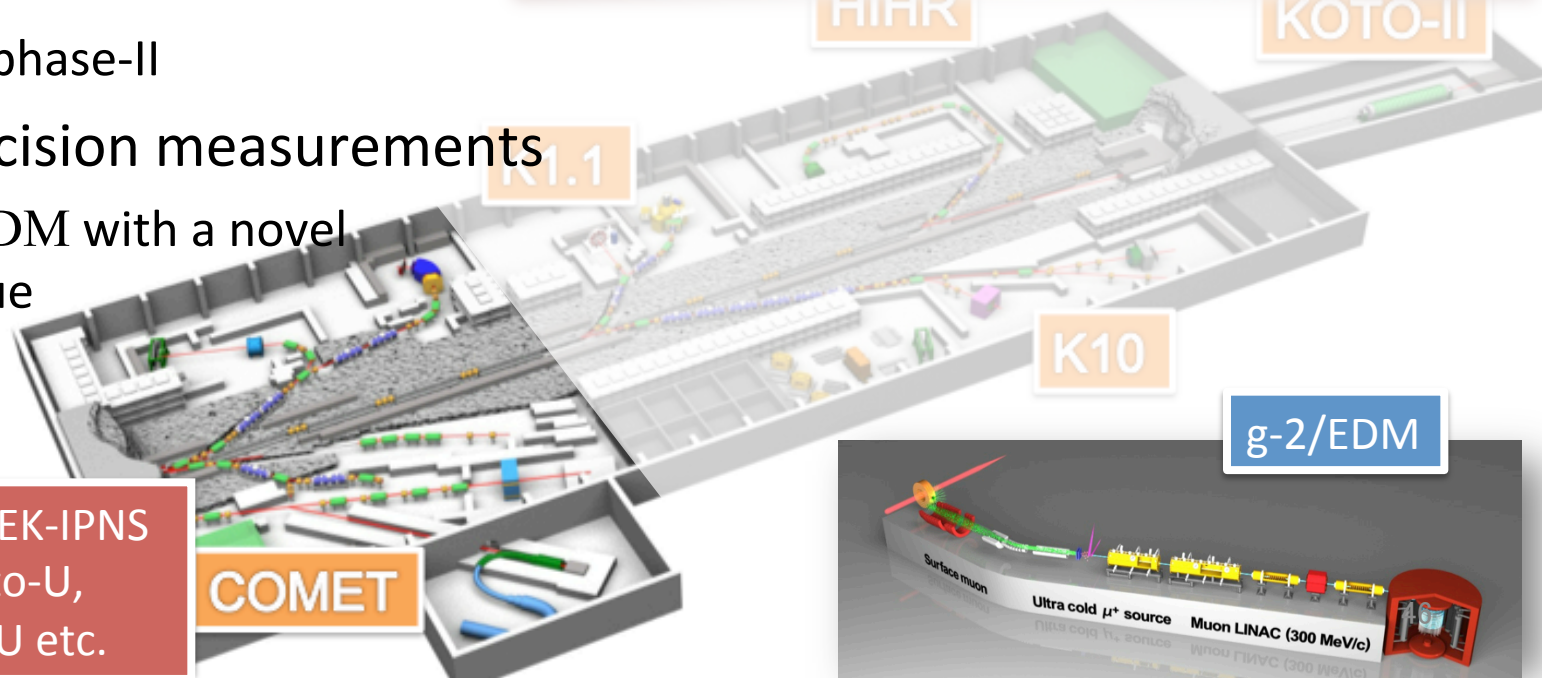
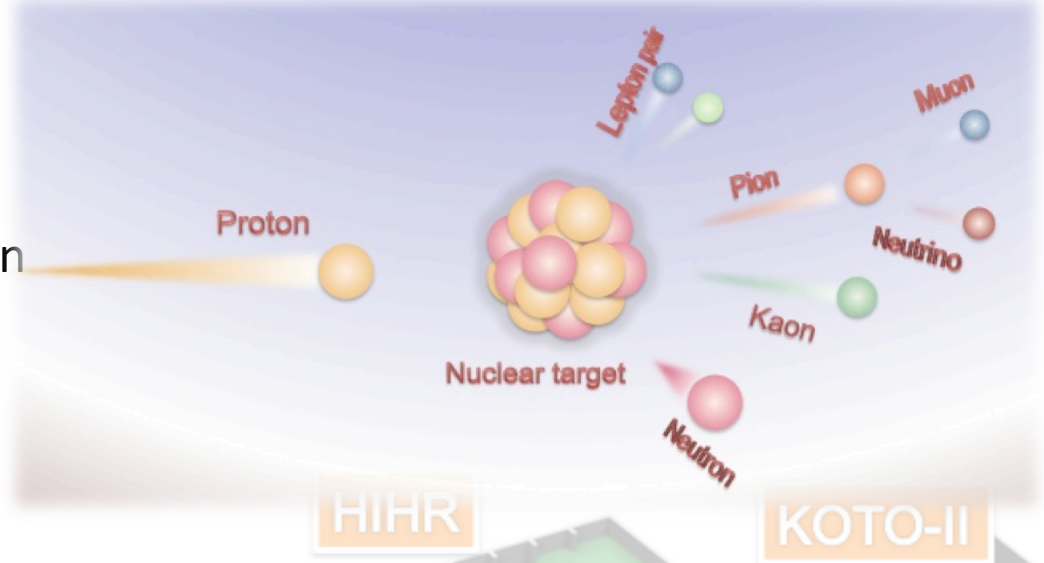
- J-PARC upgrades and Hyper-K are selected as 27 important projects among 209 proposals under Japan Science Council !



The screenshot shows the official website of the Science Council of Japan (SCJ). At the top left is the SCJ logo, a circular emblem with a stylized sunburst. To its right is the text "Science Council of Japan". In the top right corner, there is a search bar and the text "Cabinet Office Common Search System". Below the header is a navigation bar with five items: "Home", "About SCJ", "Our Reports", "Domestic Activities", and "International Activities". A descriptive paragraph follows: "Science Council of Japan (SCJ) is the representative organization of Japanese scientist community ranging over all fields of science subsuming humanities, social sciences, life sciences, natural sciences, and engineering." On the left side, there is a vertical menu with four items: "President's Room", "Vice Presidents", "Charter of SCJ", and "Code of Conduct for Scientists". The main content area features a "Top News" section with a teal header. The news item is titled "International Conference on Science and Technology for Sustainability 2013 was held (October 9-10, 2013) **NEW!**". The text below the title reads: "The International Conference on Science and Technology for Sustainability was held under the theme of 'Colossal Multiple Disaster (Earthquake, Tsunami, and Nuclear Plant Accident) - Repercussions, Countermeasures, and Future Policy Choices.'" A blue link labeled "more" is provided. To the right of the text is a group photograph of approximately 20 people, mostly men in suits, sitting and standing in front of a blue backdrop. The backdrop contains Japanese text and the logo of the InterAcademy Council (IAC). The page number "45" is visible in the bottom right corner.

Elucidation of Origin of Matter with J-PARC Upgrades

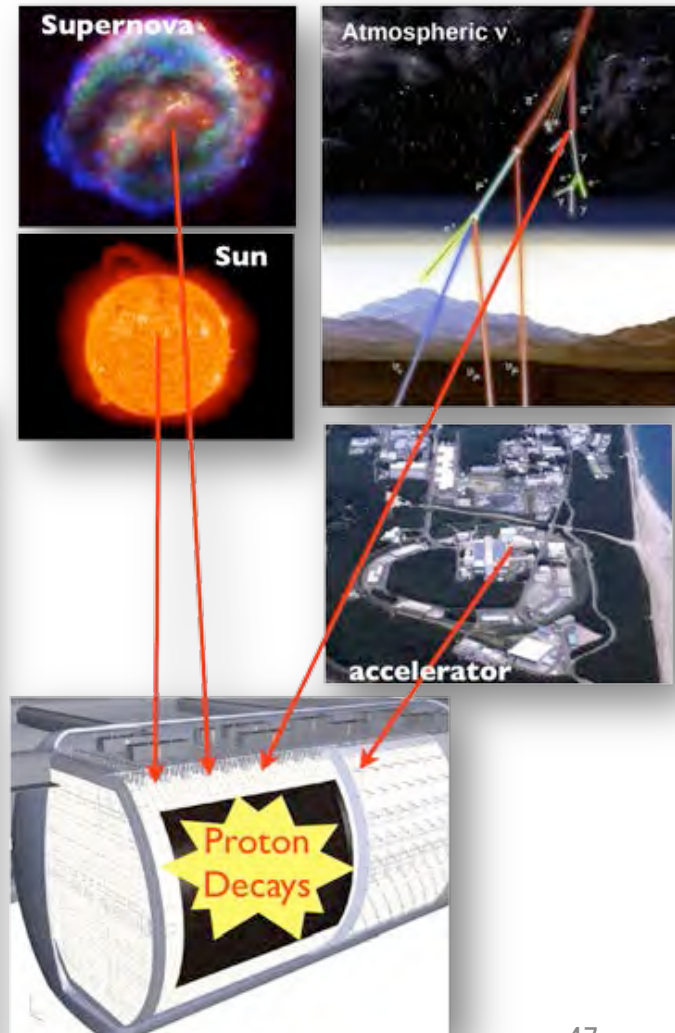
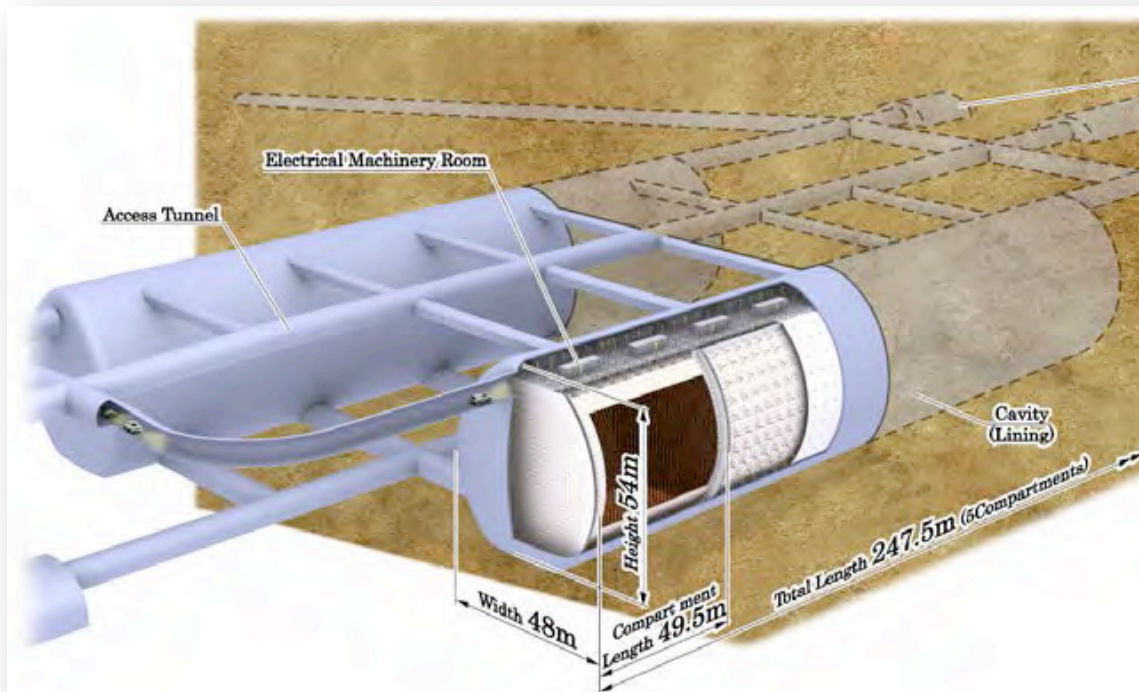
- Hadron Hall Extension
 - A Search for CPV beyond CKM with Kaon rare decay KOTO-II
 - Strangeness Nuclear and Hadron Physics
- Muon to electron conversion experiment
 - COMET phase-II
- Muon precision measurements
 - $g_{\mu-2}/\mu$ EDM with a novel technique



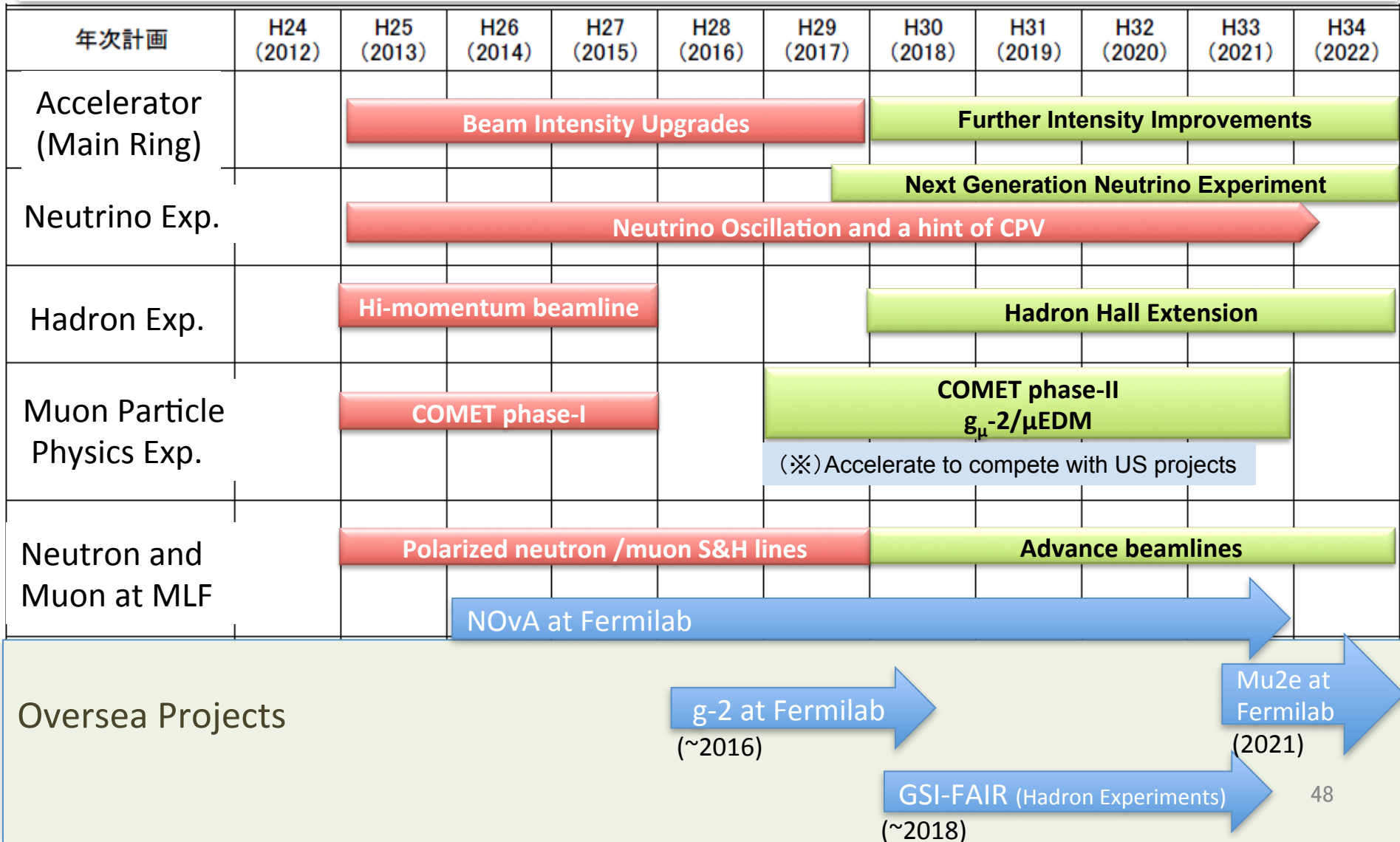
Collaboration of KEK-IPNS and U.Tokyo, Kyoto-U, Tohoku-U, Osaka-U etc.

Nucleon decay and neutrino oscillation experiment with A Large Advanced Detector

- 1 Mt class water-cherenkov detector, together with J-
PARC High Intensity Proton
Beam!

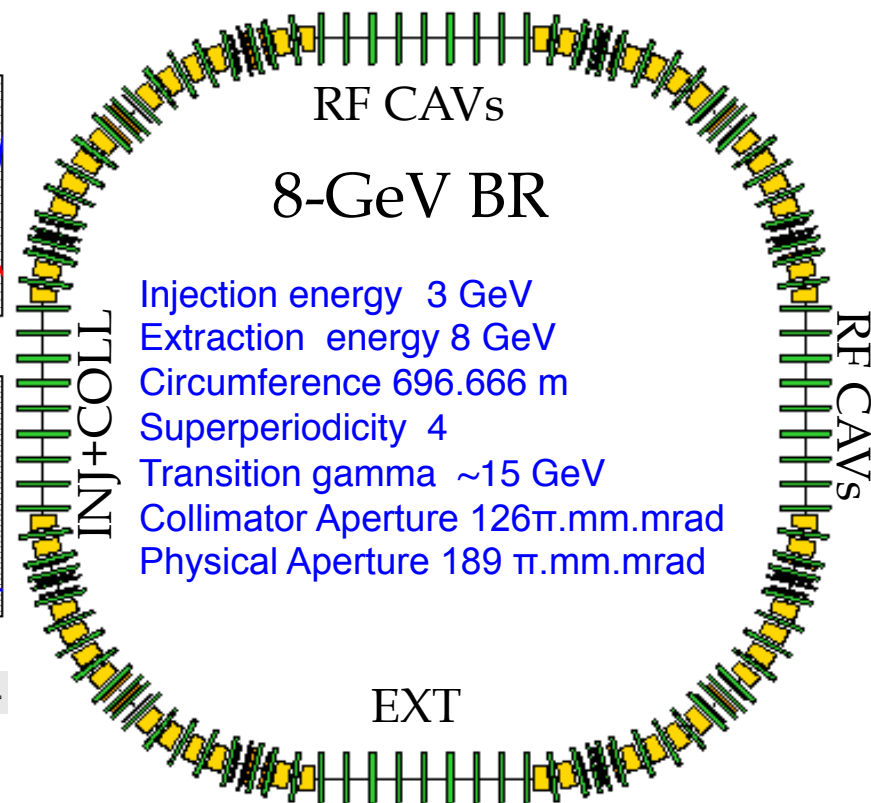
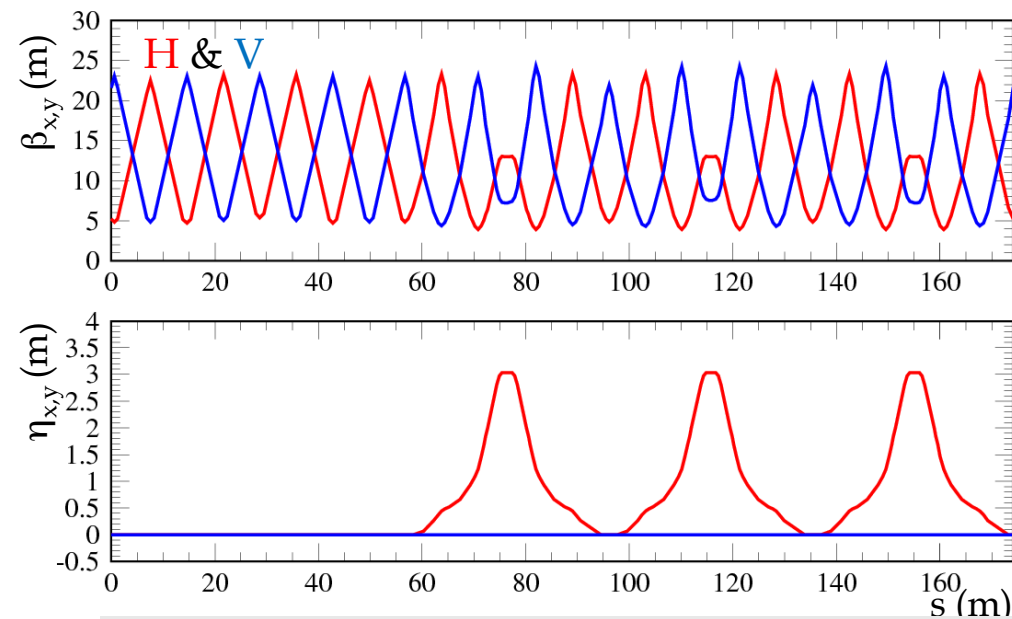


Elucidation of the origin of matter with an upgrade of J-PARC Intended Schedule (JFY2017-)



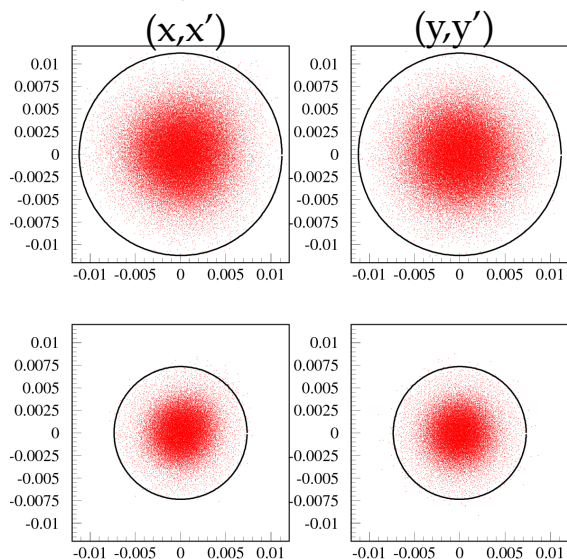
The 8-GeV booster ring

Beta & Dispersion for 1-superperiod



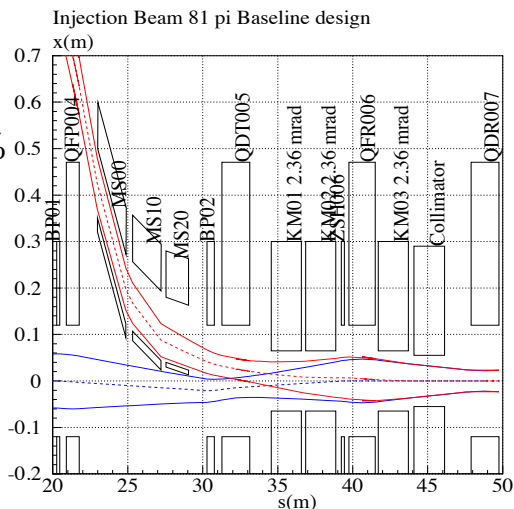
Injection energy 3 GeV
 Extraction energy 8 GeV
 Circumference 696.666 m
 Superperiodicity 4
 Transition gamma ~ 15 GeV
 Collimator Aperture 126π .mm.mrad
 Physical Aperture 189π .mm.mrad

Phase plot @ inj.(3GeV) & extr.(8GeV)



@ 3GeV
 $\epsilon > 125.5\pi \quad \sim 0.04\%$

@ 8GeV
 $\epsilon > 54\pi \quad \sim 0.06\%$



8 GeV injection in the MR using new septa&kickers

RCS : 1.4 MW
 MR > 2.2 MW

RCS : 2 MW
 MR > 3.2 MW

The proton driver in the KEKB Tunnel

- Outline of acceleration :

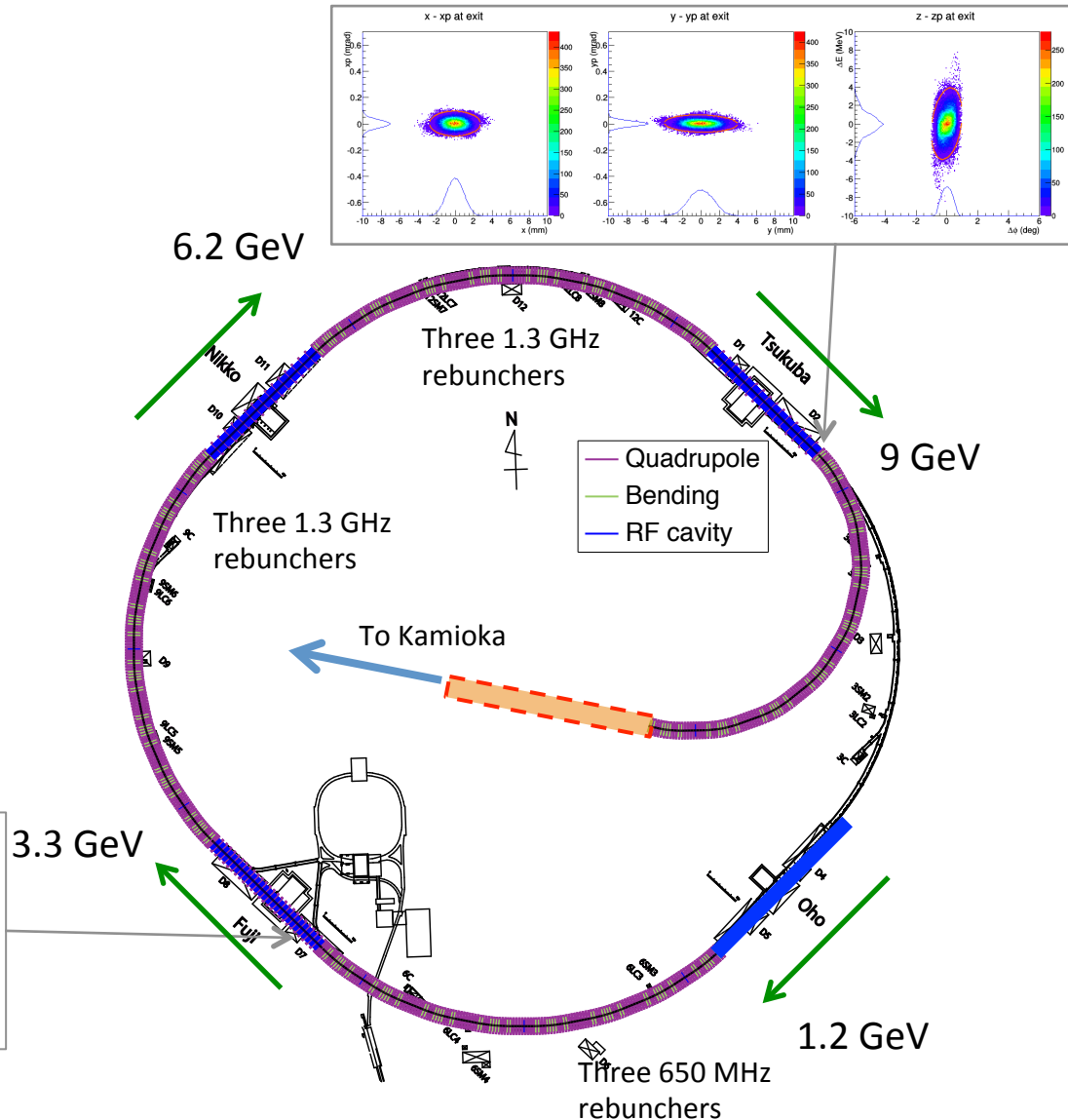
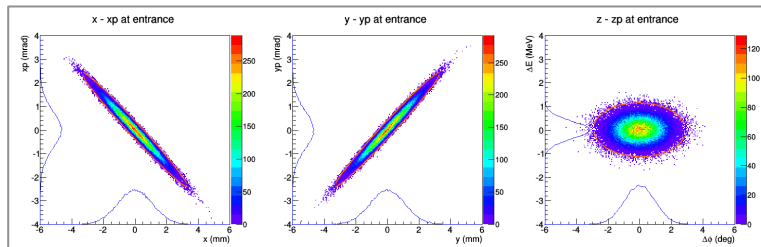
- 1.2 GeV in 1st straight.
- 3.3 GeV in 2nd straight.
- +2.9 GeV in 3rd and 4th straight.
 $3.3 + 2.9 \times 2 = 9.0 \text{ GeV}$

- Peak current : 100 mA (pulse)

- Beam duty : 1 %

- Beam power :

$$9000 \text{ MeV} \times 0.1 \text{ A} \times 1 \% = 9 \text{ MW}$$



R&Ds are necessary : Higher gradient SC cavities, High power target, Horn...

The international workshop on future potential of high intensity proton accelerator for particle and nuclear physics (HINT2015)

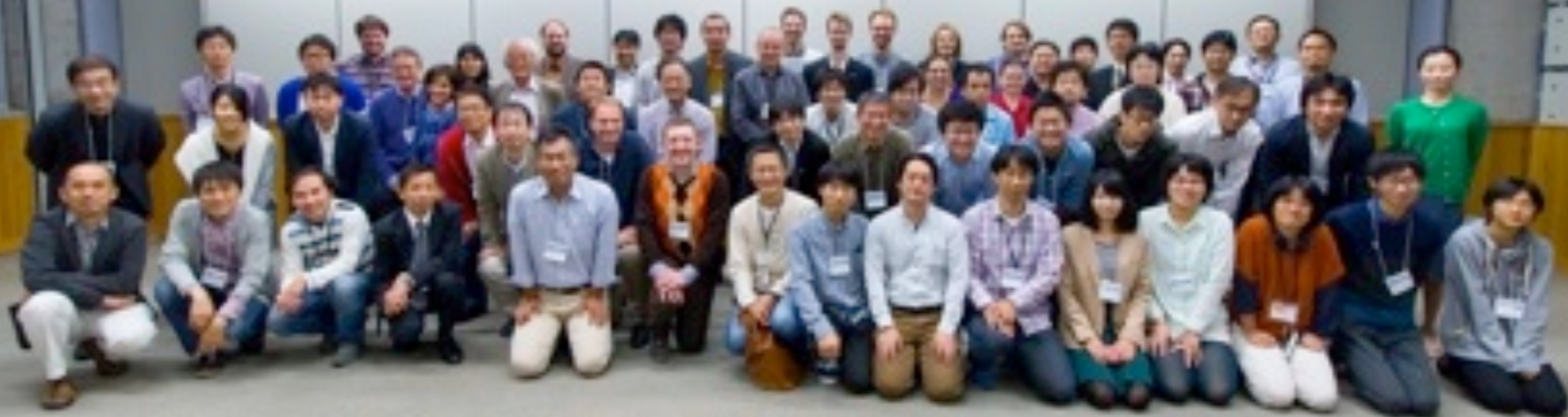
HOME

REGISTRATION

PROGRAM

ACCESS

October 13-15, 2015



HINT2015

Oct. 13 - 15, 2015
IQBRC, Tokai

The international workshop
on future potential of high intensity proton accelerator
for particle and nuclear physics

- Muon particle physics with high intensity beam

J-PARC: Next 5 Years

- Achieve Design Intensity
- More Science Outputs
- Explore Intensity Frontier

Accelerator

- RCS: 1 MW achieved
- MR 0.75 MW → 1.3 MW
- Explore Multi-MW Possibility

Neutrino

- Established non-zero θ_{13}
- Constrain CPV. Hierachy?
- Prepare next gen. of Exp.

ADS (Acc. Driven System)
Staged R&D approach from
ADS Target Test Facility to
Transmutation Exp. Facility

Hadron

- Restarted Physics Production
: Hyper-nucl/hadron physics,
K-rare decays
- Complete new beam line for
COMET/Hi-p BL and 1st results

MLF

Stability and Intensity

- Neutron : Diverse Material and
Life Science
- Muon : Produce outputs from
D and U lines / New beam lines
to extend Muon Science Frontier
(g-2/EDM/HFS/DeeMe)

Summary

- J-PARC is a multi-purpose facility with the high-intensity proton driver
 - Particle and Nuclear physics
 - Material and Life Science
 - R&D for nuclear transmutation
- High power scenario is refined based on REAL DATA : MR 0.75 MW \rightarrow 1.3 MW
- Multi-MW proposals are being developed
- We invite YOUNG scientists to share more excitements!

Including Young at Heart!