Recent Activities in Japan

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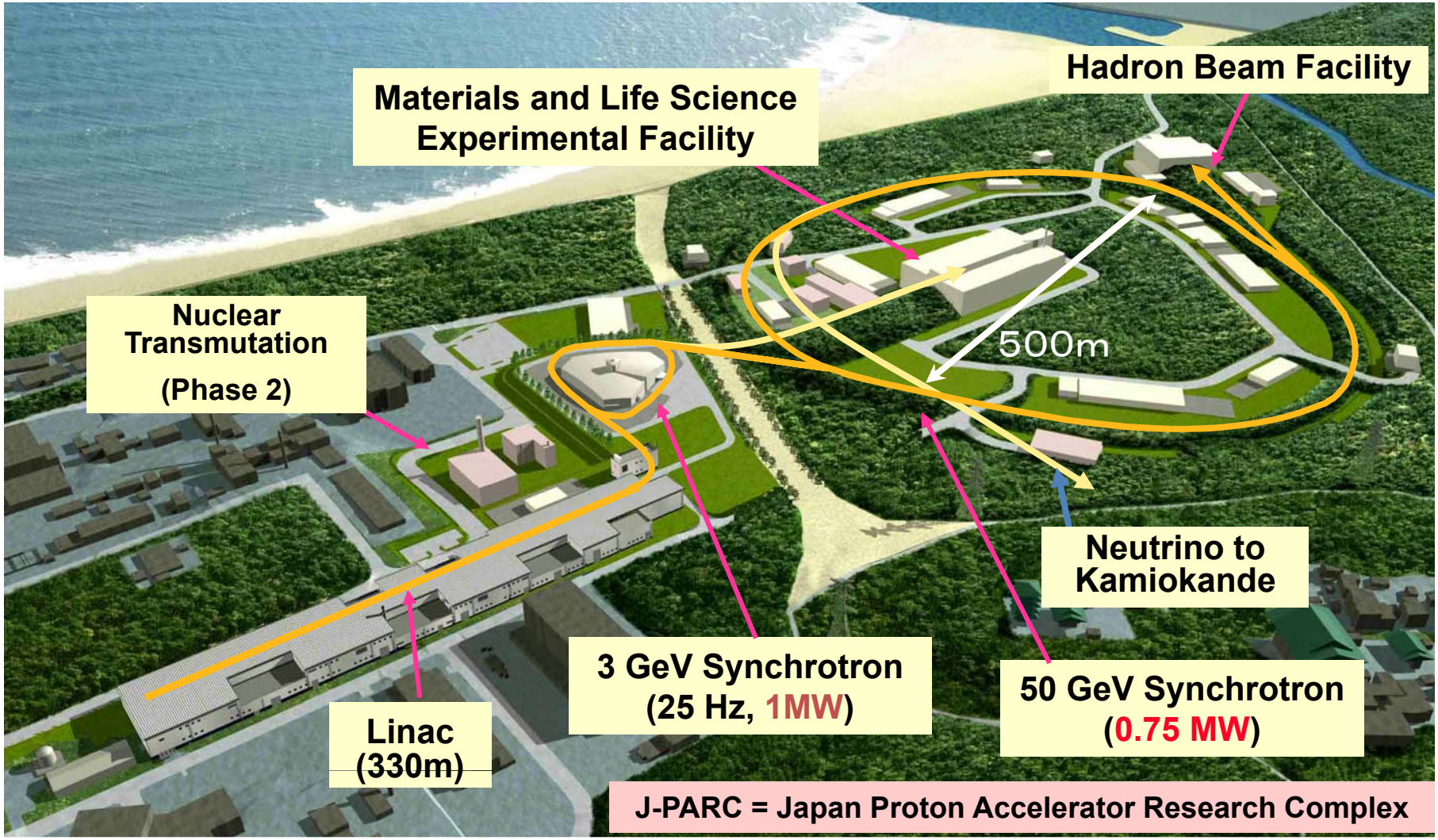
Chair of the executive committee of the
experimental nuclear physics community in Japan

1. J-PARC
2. RIBF＋CNS(U.Tokyo)
3. RCNP(Osaka U.)
4. ELPH (LNS) (Tohoku U.)

---------- under reconstruction

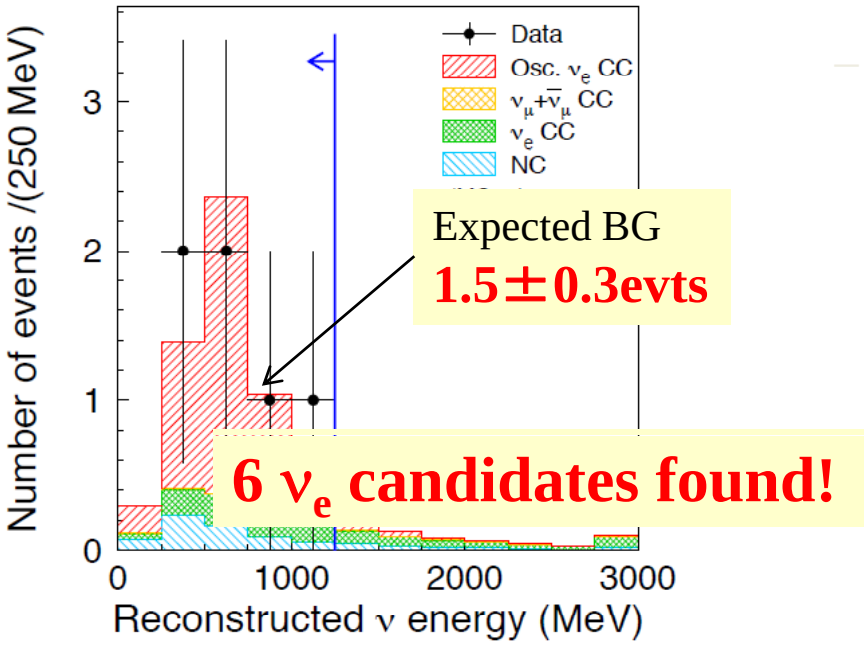
J-PARC Facility



Joint Project between KEK and JAEA

The first results from J-PARC

T2K: Indication of ν_e appearance



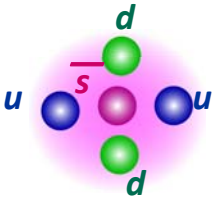
Non-zero θ_{13} at 2.5σ CL ($\Delta m_{23}^2>0$)

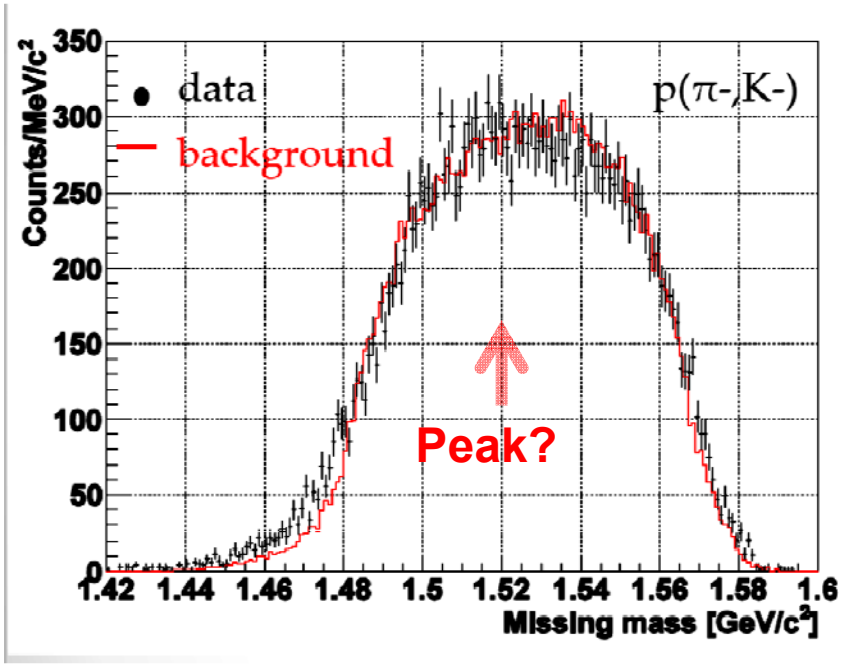
$0.03 < \sin^2 2\theta_{13} < 0.28$ 90%CL range

$\sin^2 2\theta_{13} = 0.11$ Central value

assuming $\Delta m^2_{23}=2.4 \times 10^{-3}$ eV^2, $\sin^2 2\theta_{23}=1$, $\delta_{CP}=0$

E19: Pentaquark Θ^+ not observed in $\pi^- p \rightarrow K^- X$ reaction





Upper limit 0.26 μb/sr (90%CL)
To be published in PRL

Earthquake: damage and recovery

No Tsunami Effect
Main Buildings were almost OK

However, many utility buildings, roads, and extended buildings had significant damage.

Beam Recovery

Beam to Linac: December 9

09:30 Key was on.

Nov. of 2006. The first beam was on at the Linac.

3 days before the target date

14:00 Beam went throughout the Linac at 3 MeV with RFQ acceleration.

Beam to 3 GeV Ring: December 17

Attained to 300 kW: December 21

Beam to 50 GeV Ring: December 22

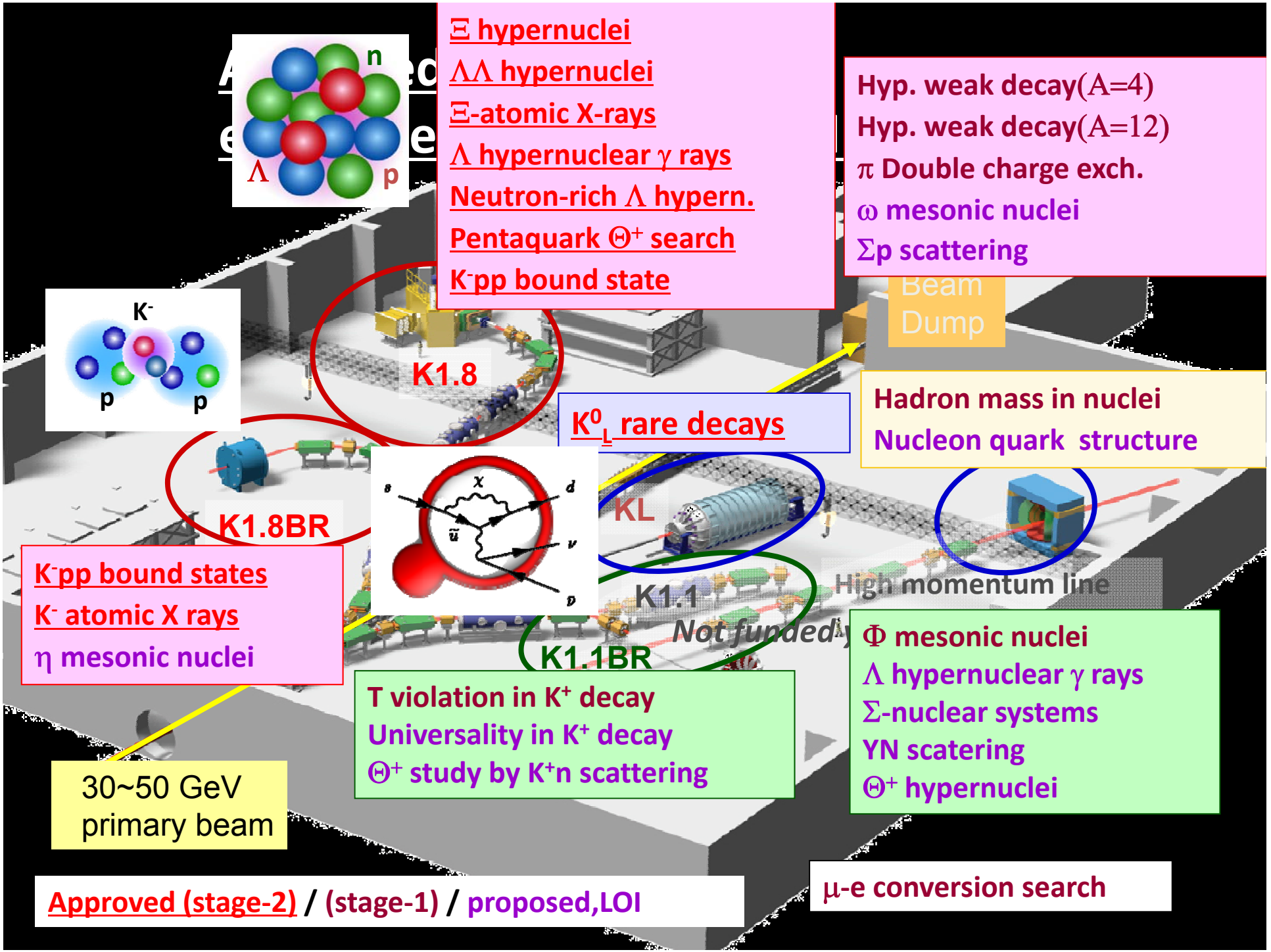
Beam to Neutrino: December 24

Beam to Hadron Hall: January 28

Major Issues for the Coming 5 Years

Red = JAEA
Purple = KEK

- Accelerator + Neutrino
  - RCS to 1 MW
  - MR to 0.75MW (New Electric Power Generators for MR)
- Neutron
  - The last few Beamlines (JAEA 3, KEK 1), Data Analysis System, Sample Preparation Facility
- Muon
  - The third beamline S, The fourth beamline H for g-2, etc.
- Hadron
  - High Momentum Beamline + Comet for μ–>e down to 10^{-16}
  - Hall Extension
- ADS
- Infrastructure
  - Research Building, Radioactive Handling Building, Lodging


Ξ hypernuclei
ΛΛ hypernuclei
Ξ-atomic X-rays
Λ hypernuclear γ rays
Neutron-rich Λ hypern.
Pentaquark Θ+ search
K-pp bound state
Hyp. weak decay(A=4)
Hyp. weak decay(A=12)
π Double charge exch.
ω mesonic nuclei
Σp scattering
n
Λ
p
K-
p
p
K1.8
Beam Dump
K0L rare decays
Hadron mass in nuclei
Nucleon quark structure
K1.8BR
KL
K-pp bound states
K- atomic X rays
η mesonic nuclei
K1.1
High momentum line
Not funded
K1.1BR
Φ mesonic nuclei
Λ hypernuclear γ rays
Σ-nuclear systems
YN scatering
Θ+ hypernuclei
T violation in K+ decay
Universality in K+ decay
Θ+ study by K+n scattering
30~50 GeV primary beam
Approved (stage-2) / (stage-1) / proposed,LOI
μ-e conversion search

Future Plans for Hadron Hall

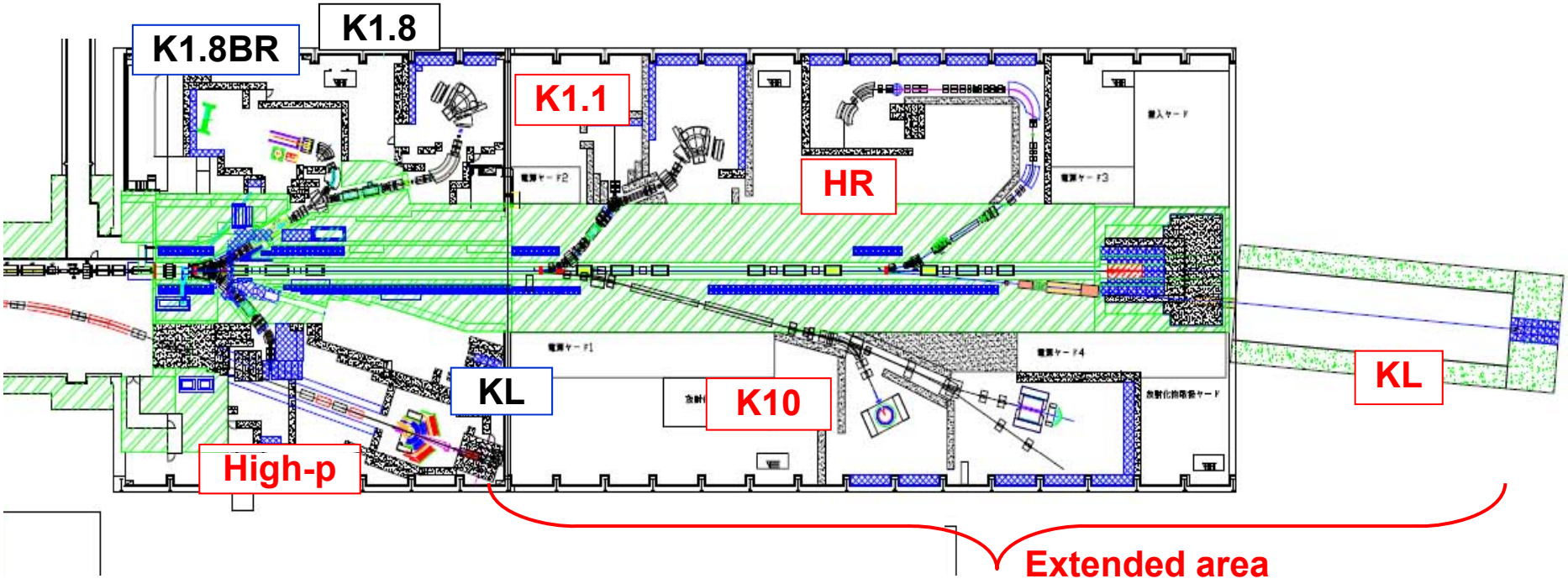
Primary proton / high momentum secondary beam line

-- Mass shift of hadrons in nuclei, charmed baryon spectroscopy, nucleon quark structure

Extension of the Hadron Hall and three new secondary lines

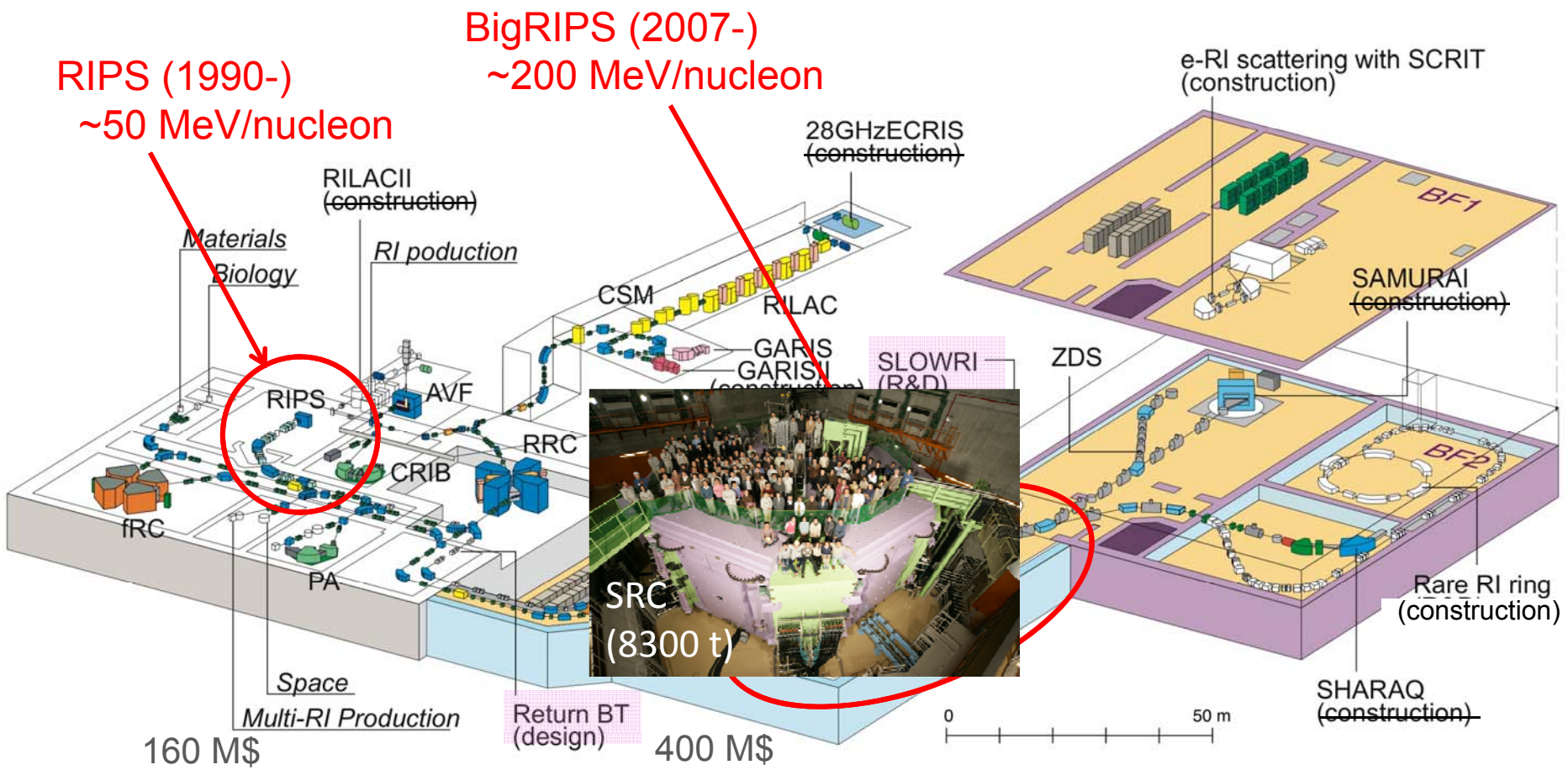
-- Baryon-baryon interactions, baryon modification in nuclei,

Exotic hadrons and hadrons in nuclei



RIKEN RIBF (RI Beam Factory) -- fragmentation-based RI bemas (1990- / 2007-)

RIBF – a new generation RIB facility in operation
with world highest capability of producing exotic nuclei in coming years!



160 M$
135 MeV/nucleon
for light nuclei (1986-)

400 M$
345 MeV/nucleon
up to U (2006-)

experimental
equipment

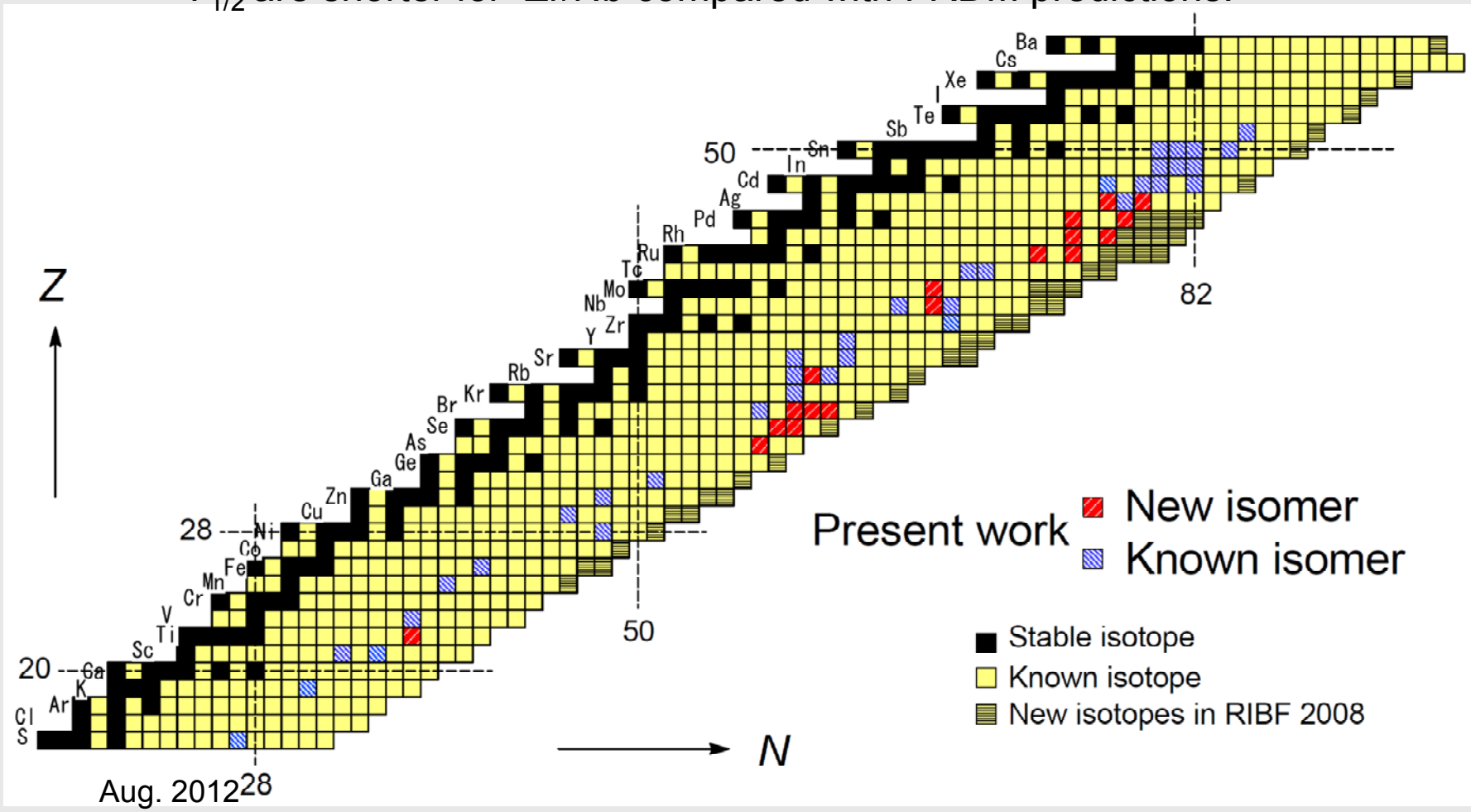
Extension of knowledge in the nuclear chart

47 new isotopes T. Onishi et al., J. Phys. Soc. Jpn. (2011) 073201

18 new (μs) isomers D. Kameda et al., 2012

18 new half-life data S. Nishimura *et al.* PRL106, 052502 (2011) – r-process

- $T_{1/2}$ are shorter for Zr/Nb compared with FRDM predictions!



Secondary reaction studies

In-beam γ-ray spectroscopy with direct reactions *e.g.* ^{42}Si
Interaction cross section measurements → new halo in Ne, Mg
(t,^{3}He) at SHARAQ (high-resolution spectrograph)
→ isovector spin monopole mode

DALI2

160 NaI(Tl)s
* 4.5 x 8 x 16 (cm^3)

for 1MeV γ ray（*v*/*c*=0.3）
efficiency ~21%
energy resolution ~8%

EURICA (2012-): Euroball Cluster detectors at RIBF

- Euroball Cluster detectors
- Support structure
- Readout electronics

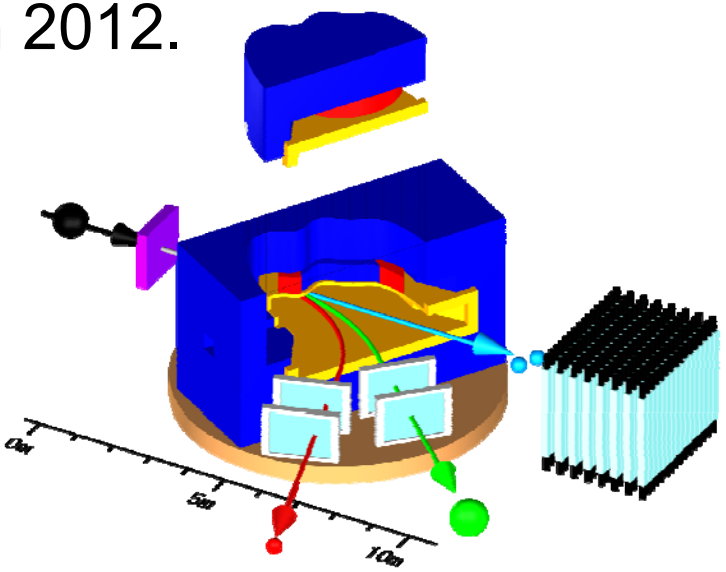
RIKEN RIBF (Japan)

Aug. 2012

Courtesy of S. Nishimura

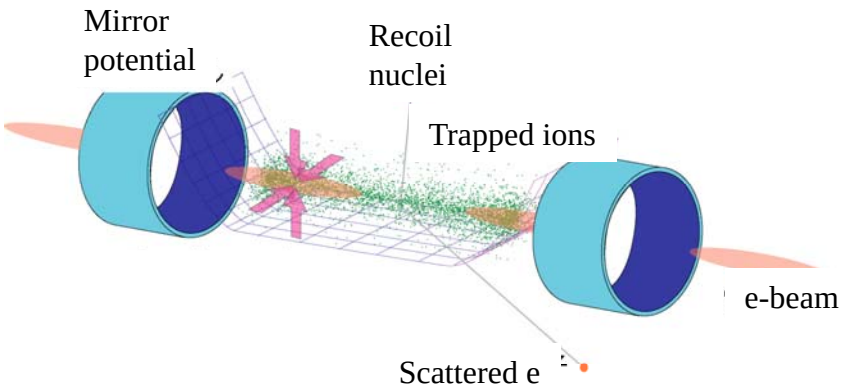
new equipment

SAMURAI: 1st experiments performed in 2012.



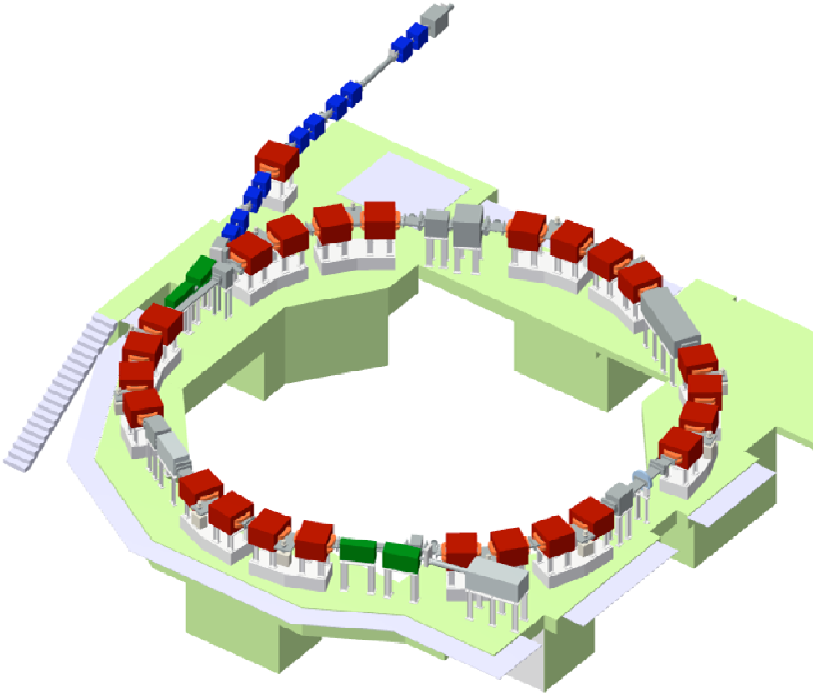
SCRIT (e^- - RI scattering)

under construction



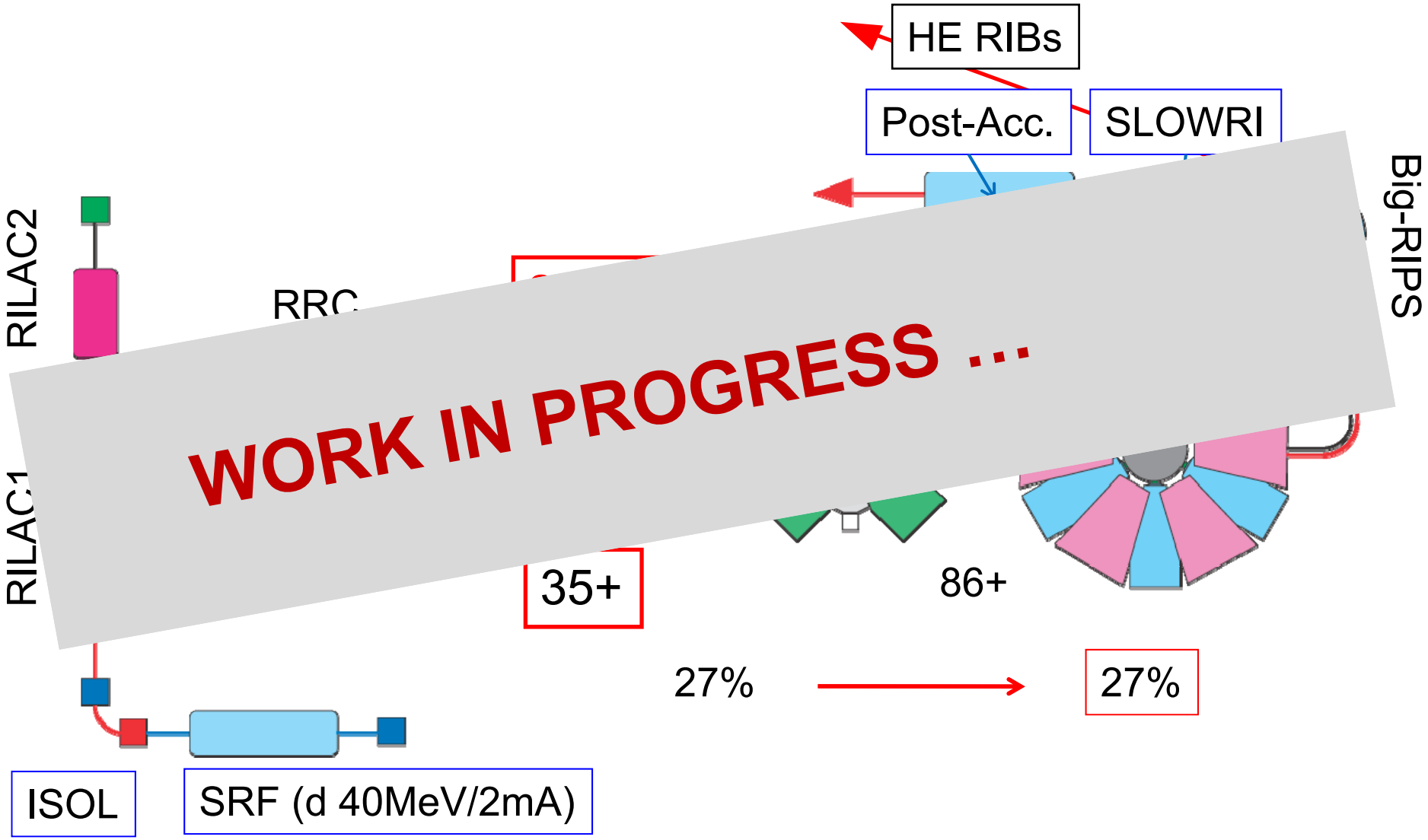
Rare RI-Ring (mass Measurements)

under construction



Aug. 2012

RIBF Upgrade Options – Long-term plan



Secondary reaction studies with ZeroDegree

In-beam γ-ray spectroscopy with direct reactions

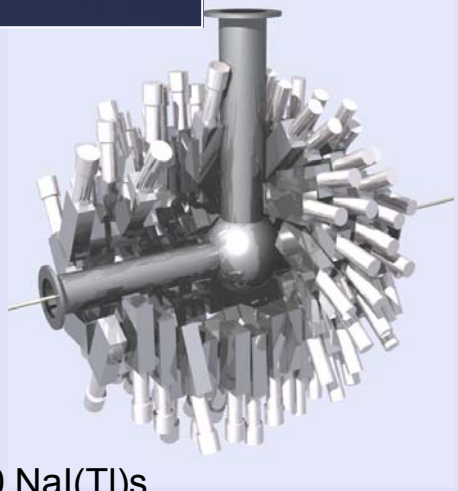
CNS GRAPE

18x2 Segmented Ge's
* 2cm^{t} x 6cm$^{\phi}$

for 1MeV γ ray (v/c=0.3)
efficiency ~5%
energy resolution ~1%
position sensitive ~ 2mm

CNS, Univ. Tokyo

DALI2



160 NaI(Tl)s
* 4.5 x 8 x 16 (cm^3)

for 1MeV γ ray (v/c=0.3)
efficiency ~21%
energy resolution ~8%

Secondary reaction studies with SHARAQ (2009-)

by **CNS, Univ. of Tokyo** w. GANIL (FPD)

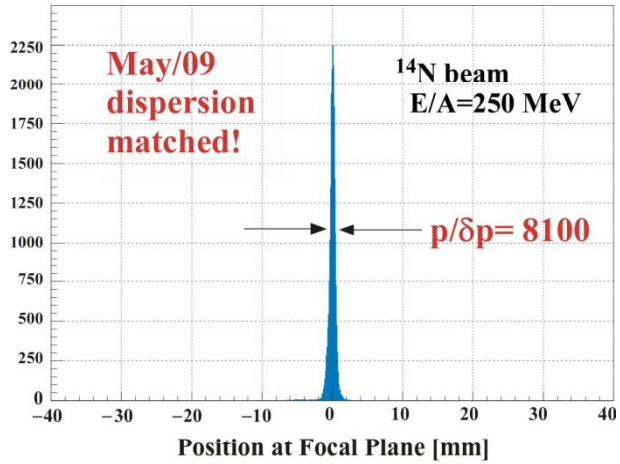
High **resolution** spectrometer for fast RIB

$p/\Delta p$ ~ 15,000, $\Delta\theta$<1mrad, $B\rho$=6.8Tm

by Dispersion matching technique

$p/\Delta p$ ~ 7,000, $\Delta\theta$<1mrad, $B\rho$=6.8Tm

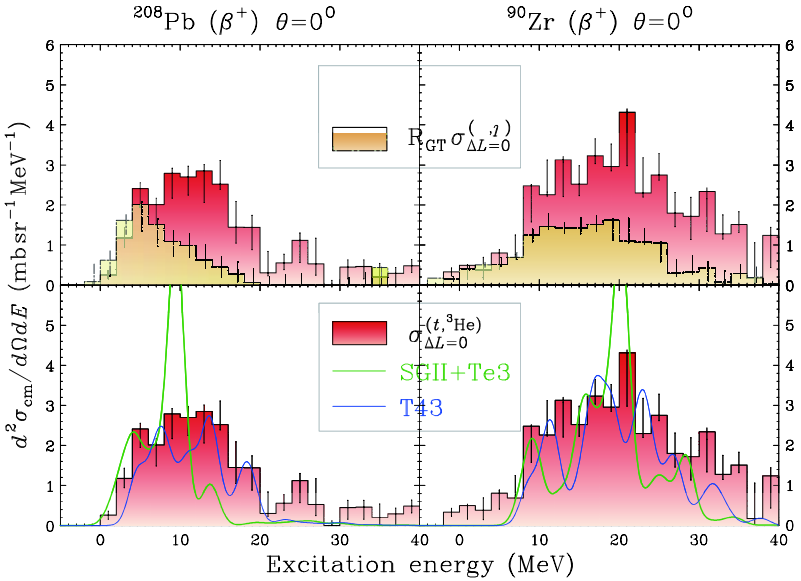
by High-resolution achromatic mode



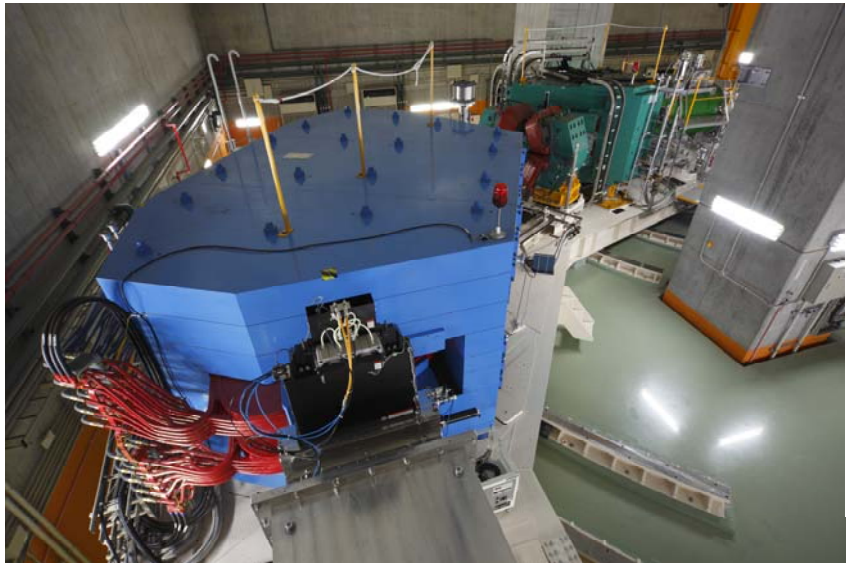
^{90}Zr, ^{208}Pb(t,^{3}He)

K. Miki *et al.*, PRL (2012)

Isovector spin monopole



Triton beam 300MeV/u 1x10^{7}pps



Other physics programs

(^{10}C,^{10}B(IAS))	isovector non-spin monopole resonance
(^{12}N,^{12}C)	β^--type IVSMR via exothermic reaction
^{1}H(^{12}Be,n)	(p,n) reaction of ^{12}Be (inverse kinematics)
^{4}He(^{8}He,^{8}Be)	search for tetra-neutron states
^{14,22}O(pol-p,2p)	spin-orbit splitting in O isotopes

CRIB (CNS RI Beam separator)

Experiments using low-energy RI beams performed under international collaborations. (We welcome new users!)

Recent researches with Asian collaboration:

Proton resonant scattering

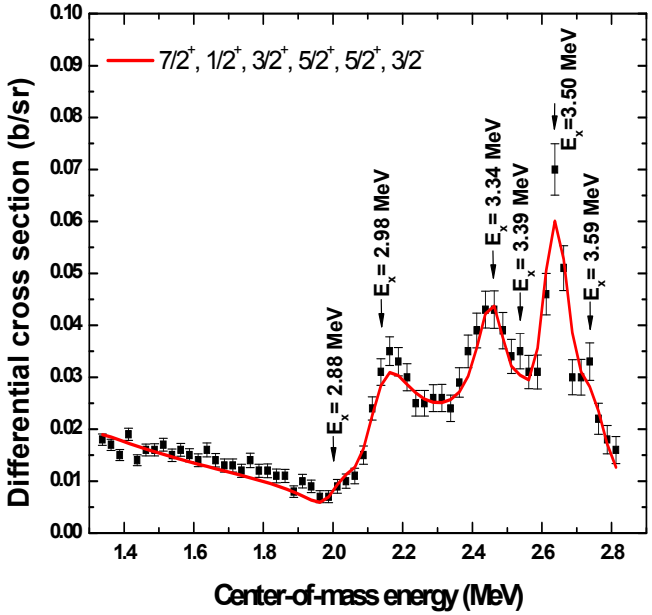
- ✓^{26}Si+p (Collaborated with Chung-Ang C.S. Lee, Y.K. Kwon, H.S.Jung et al., Korea)
- ✓^{21}Na+p, ^{22}Na+p, ^{17}F+p (IMP J.J. He /CIAE Wang Youbao, W.P. Liu et al., China)

(α,p) reaction measurement with active target:

- ✓^{22}Mg(α,p) (IOP, N.N. Duy, L.H. Khiem, Vietnam)

Determination of (p,γ) reaction rate with ANC

- ✓^{12}N(d,n) reaction measurement for ^{12}N(p,γ) (CIAE Guo Bing, Wang Youbao, W.P. Liu et al., China)



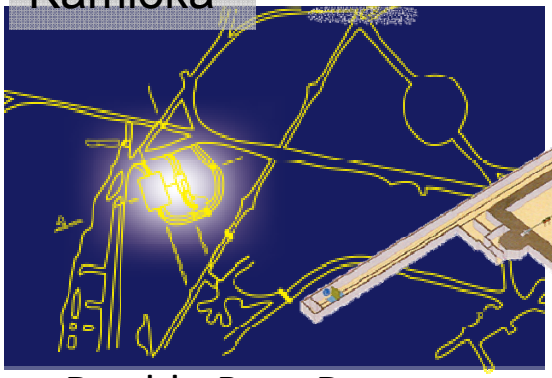
^{26}Si+p experiment: Observed proton resonances with resonant scattering, and determined resonance parameters:

Published as
H.S. Jung et al., Phys. Rev. C (2012).

Initiatives and man-power from Asian physicists

RCNP (Research Center for Nuclear Physics), Osaka Univ.

Kamioka



Double Beta Decay

Ring Cychlotron in Osaka

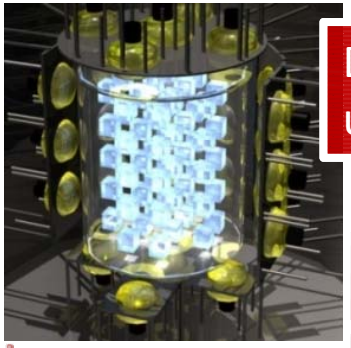
High precision spectroscopy

Laser electron facility at Spring-8

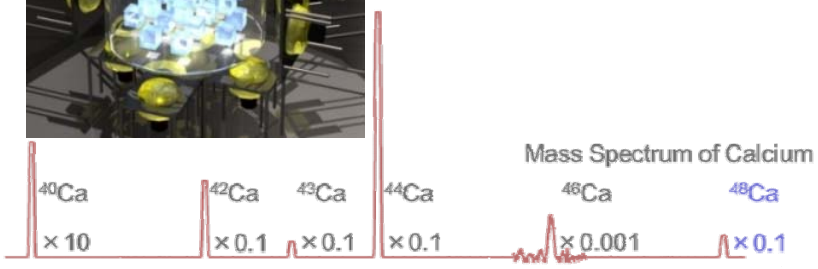
Hadron Physics

"Subatomic Physics project"

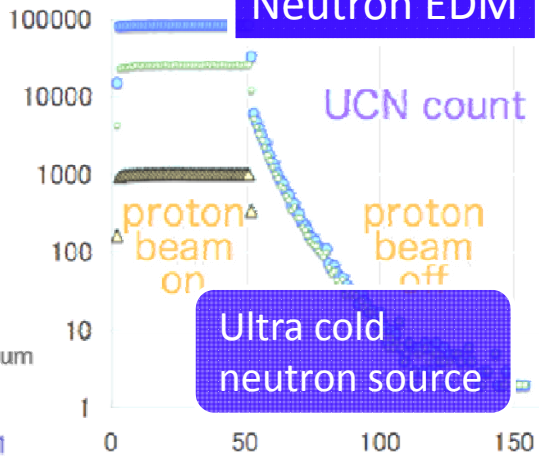
Origin of matter in the Universe from highly sensitive measurements



Double Beta Decay using 48Ca

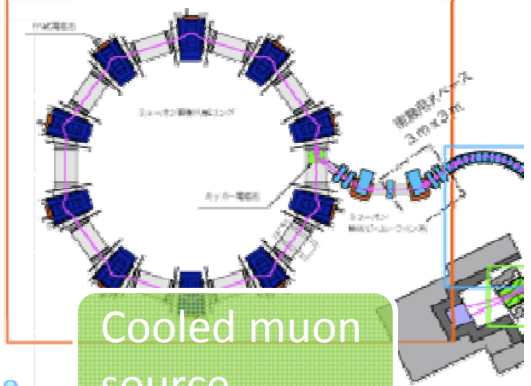


Neutron EDM



Ultra cold neutron source

μ-e conversion



Cooled muon source