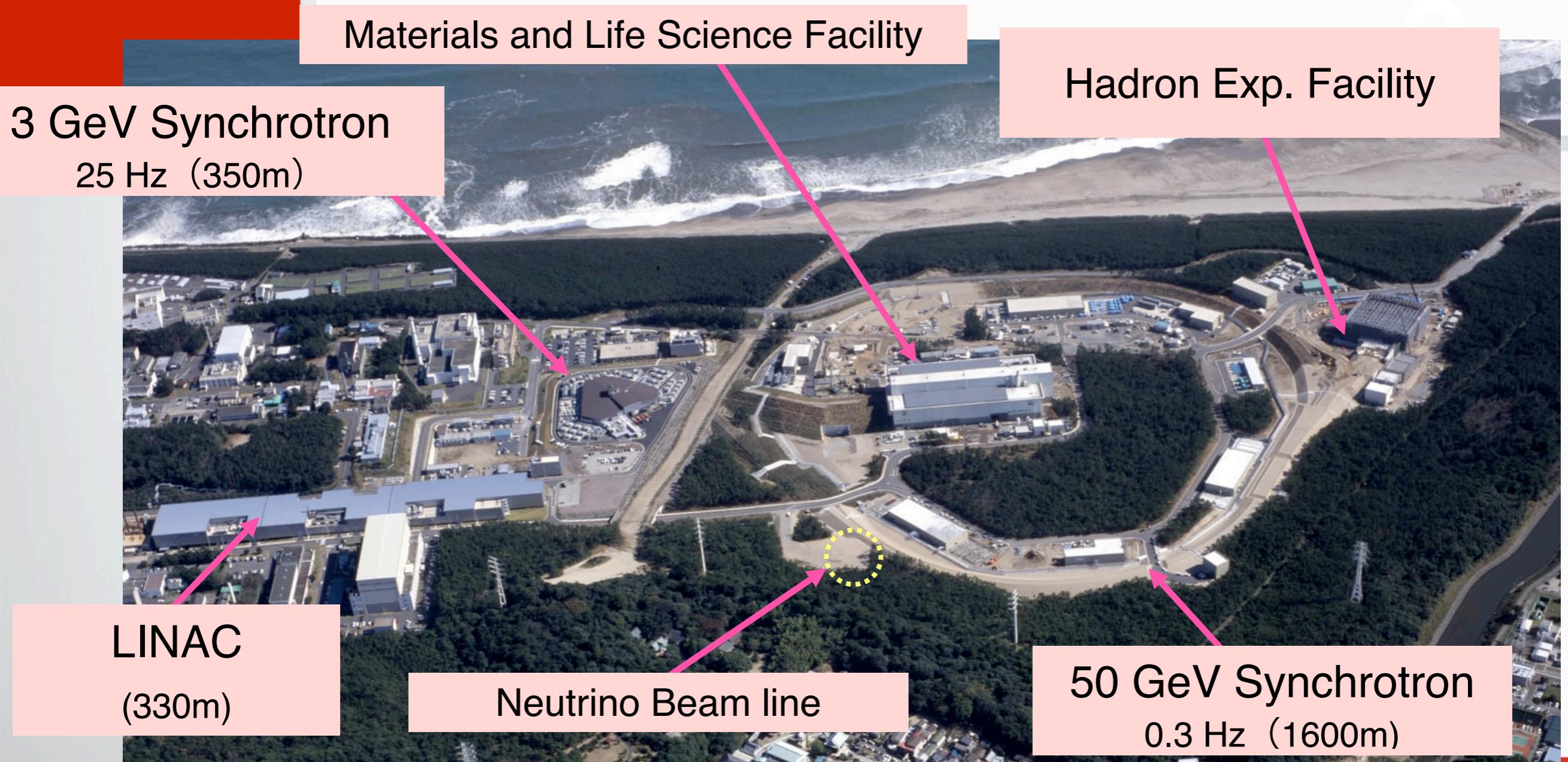


J-PARC Project

Tomofumi NAGAE
J-PARC Project Office/KEK



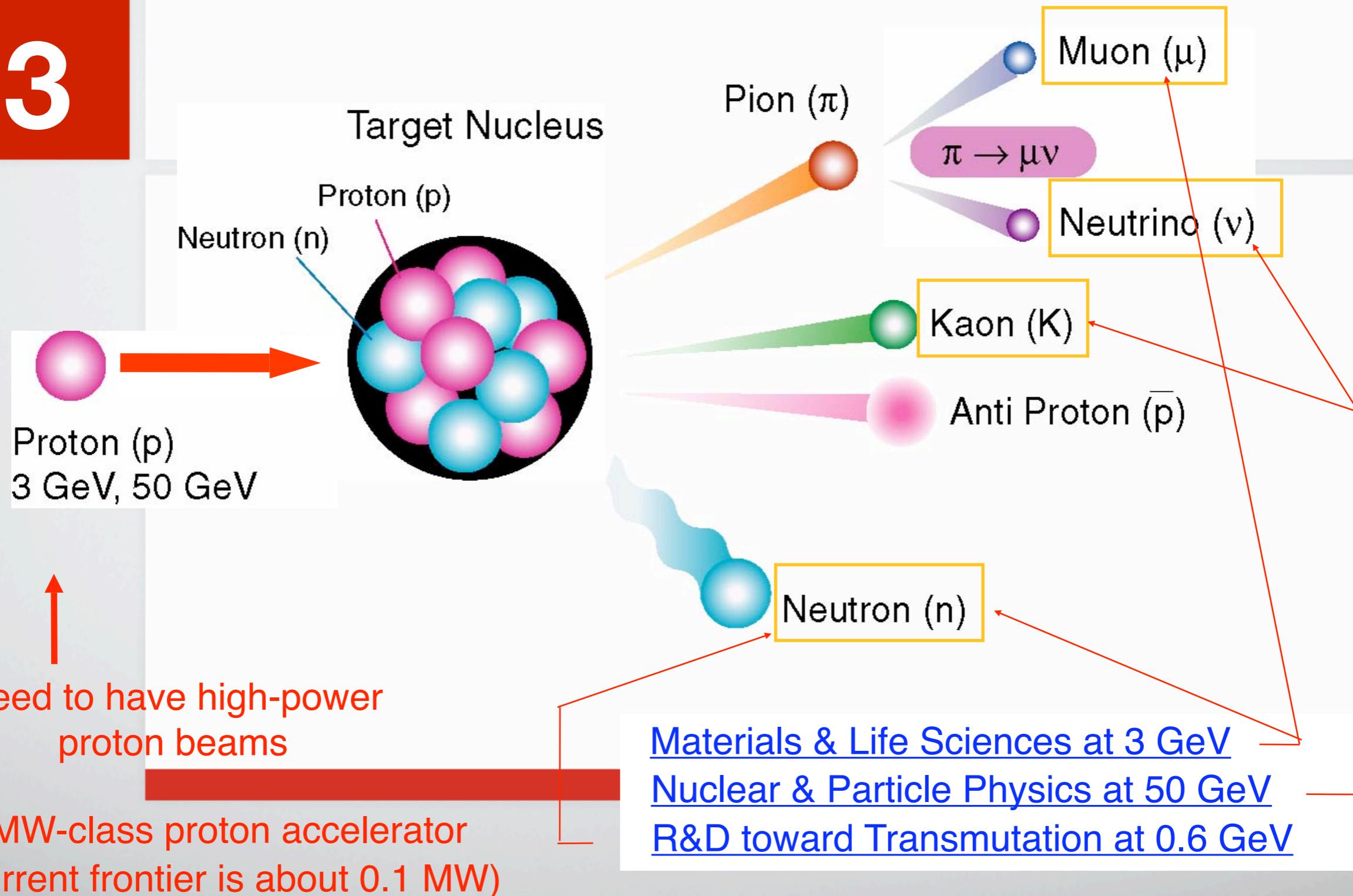
J-PARC Facilities in Tokai



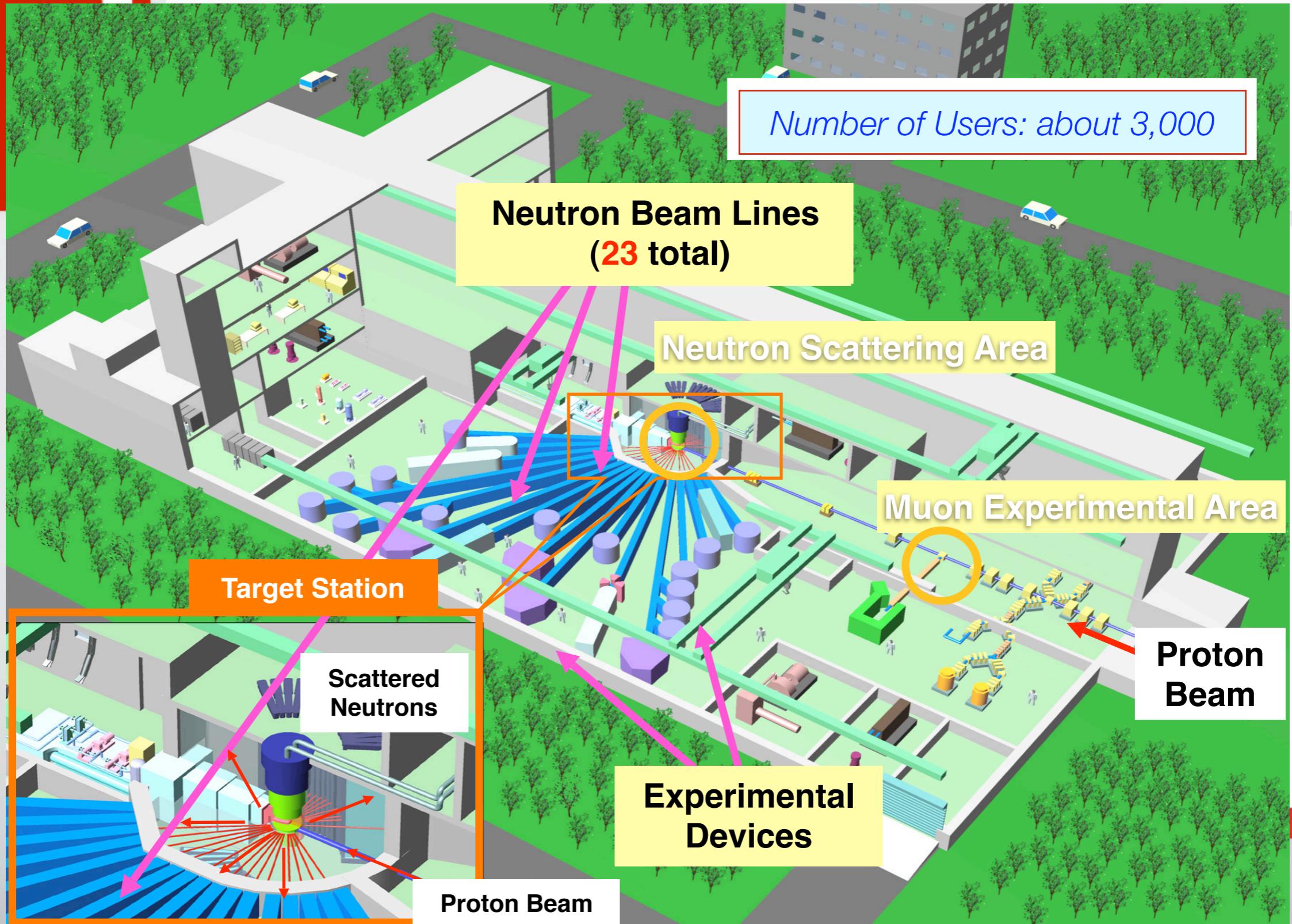
Nov., 2006

3

Goals at J-PARC



Materials & Life Science Experimental Facility





Neutrino Experimental Facility

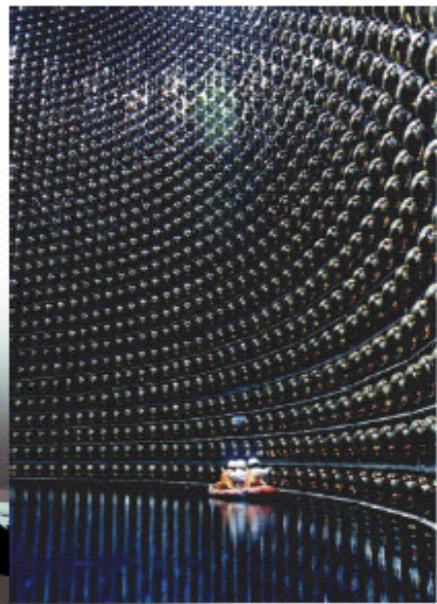
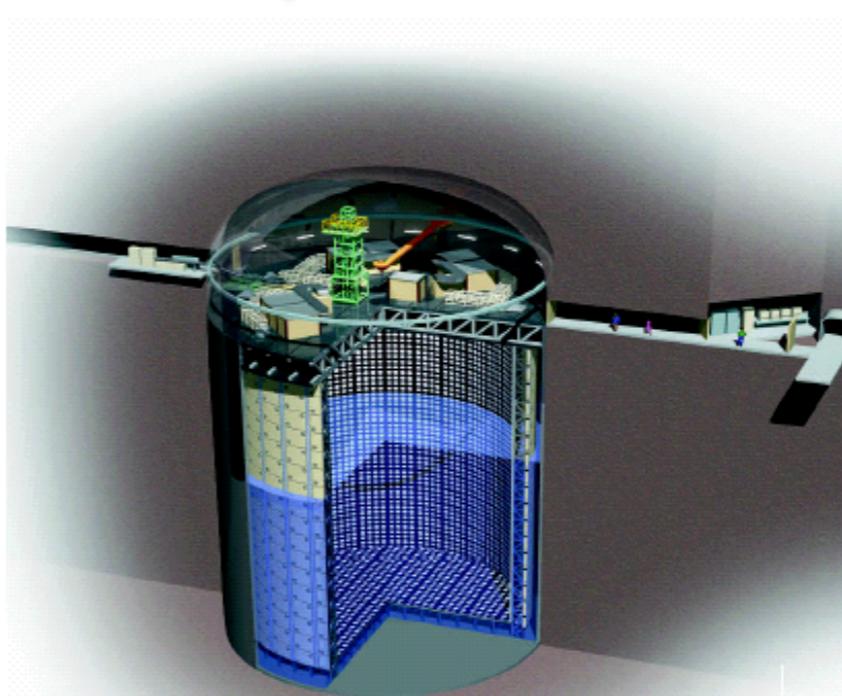


Number of Users: about 400
(about 1/4 from Japan)

Experiments with Intense Neutrino Beams

295 km
West

Super Kamiokande



岐阜県神岡町地下1000m

50000トン水 Chernobyl

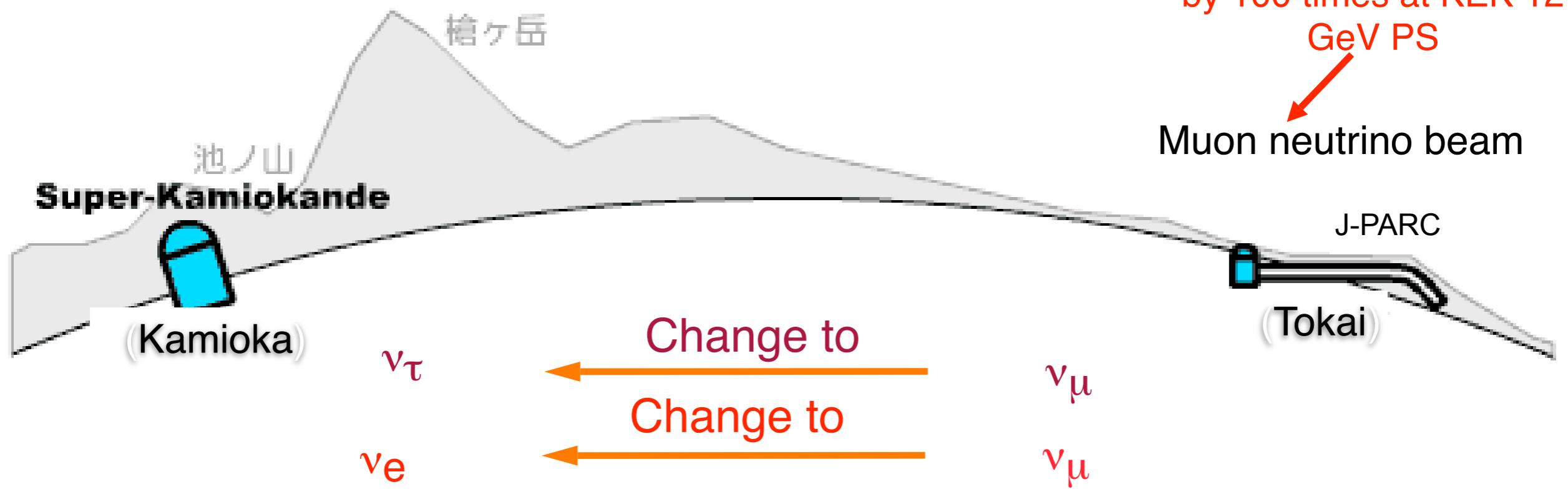
20インチPMT約12000本

1996~



T2K Experiment

T2K = Tokai to Kamioka

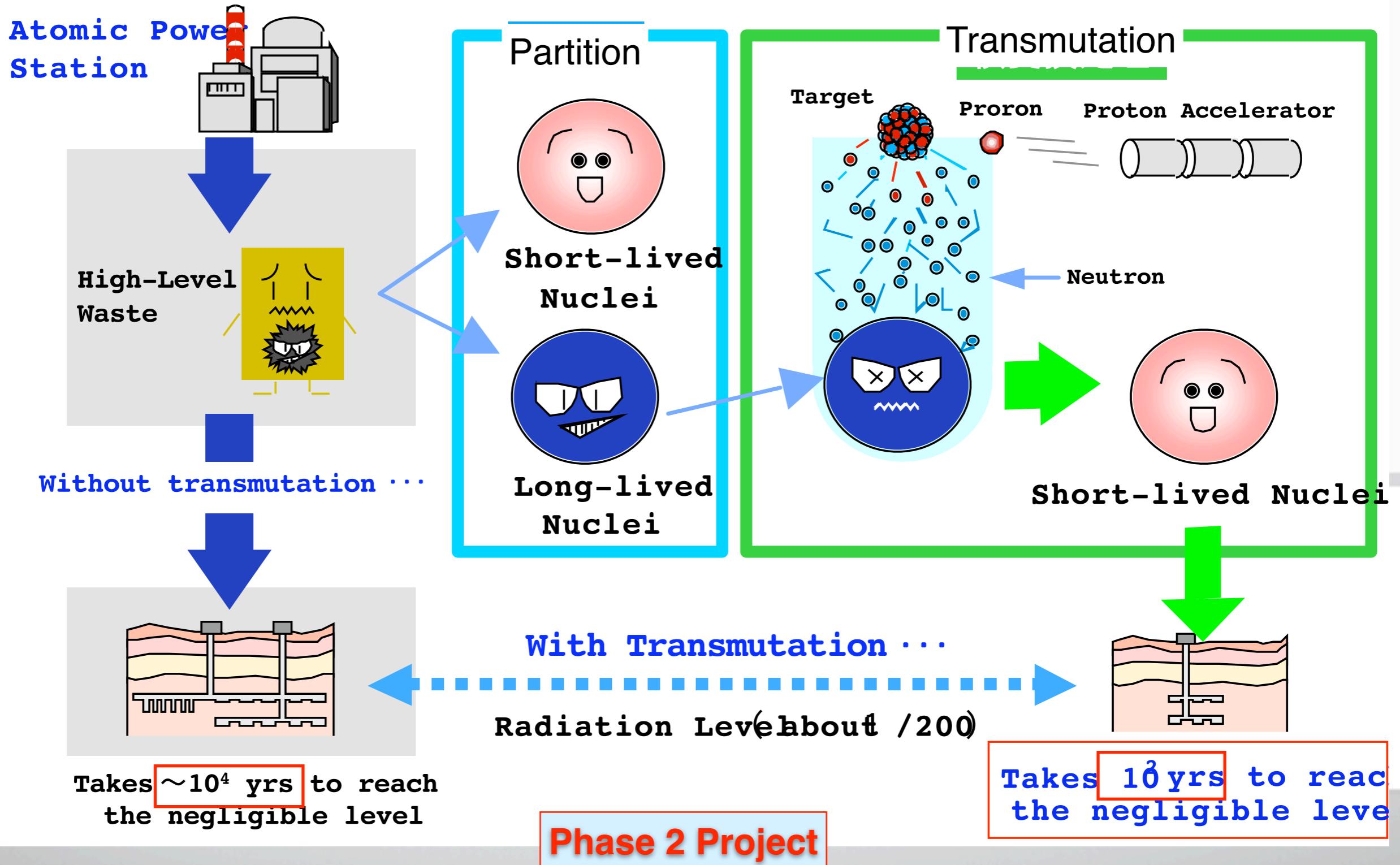


Disappearance of ν_μ \leftrightarrow High Statistics T2K

(Five year data at KEK-PS can be measured within a few weeks at J-PARC)

Detection of ν_e at Super Kamiokande \leftrightarrow Totally new experiment

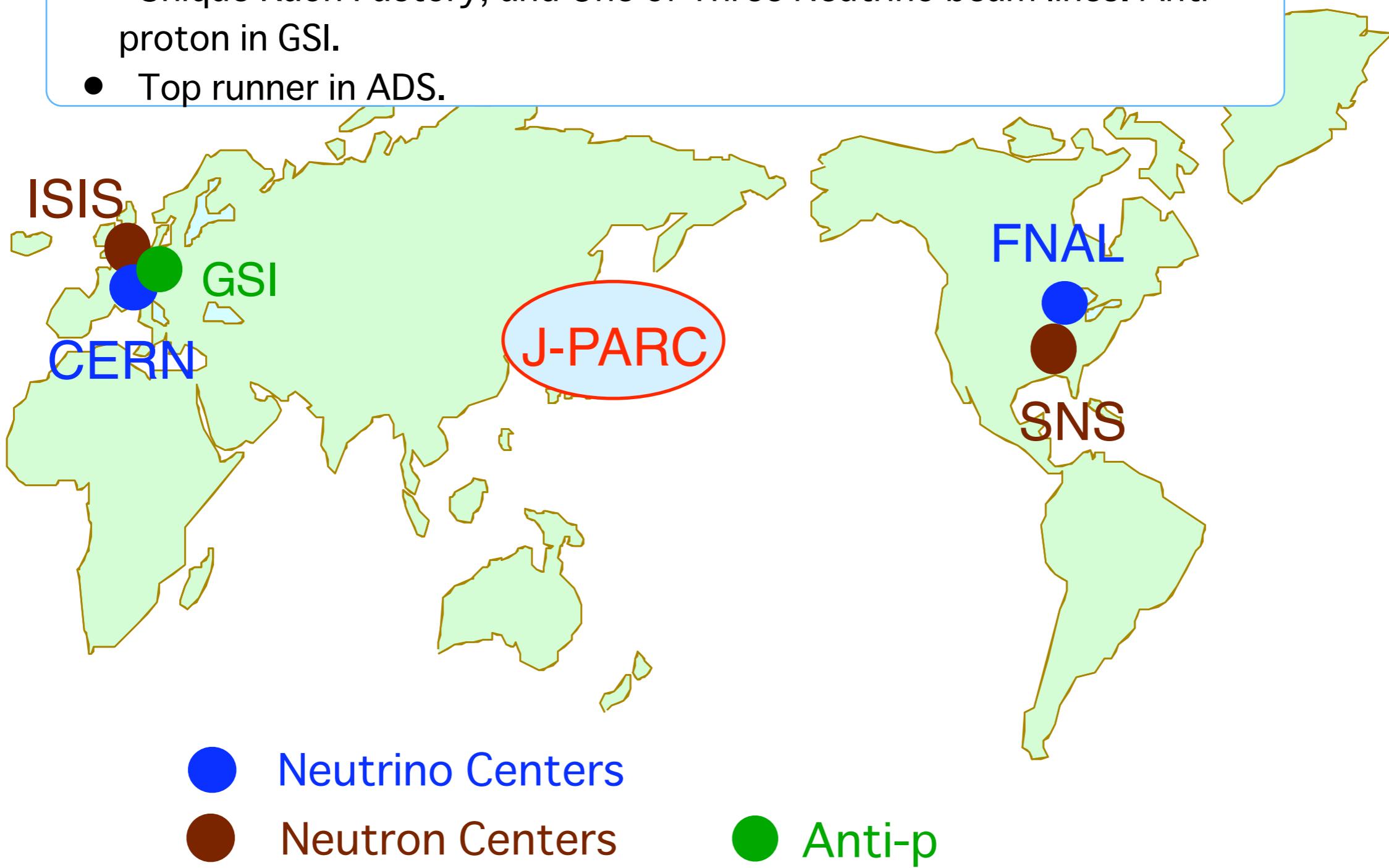
Accelerator-Driven Transmutation (ADS)

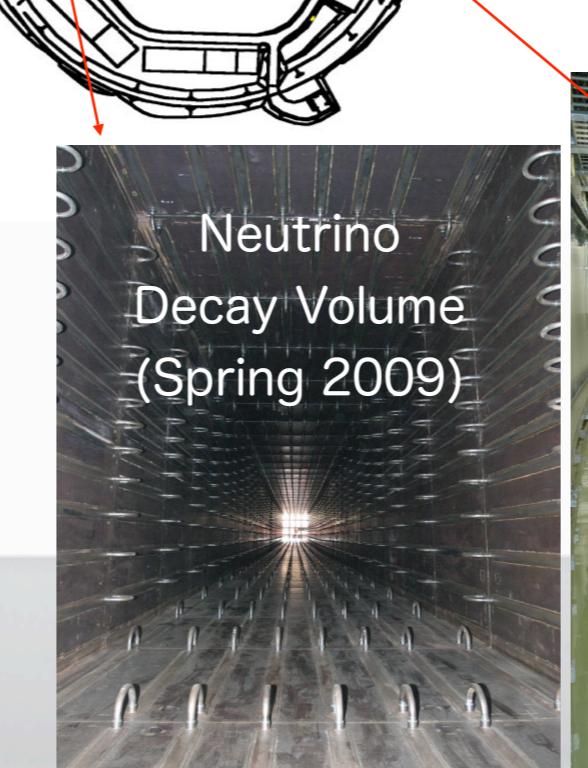
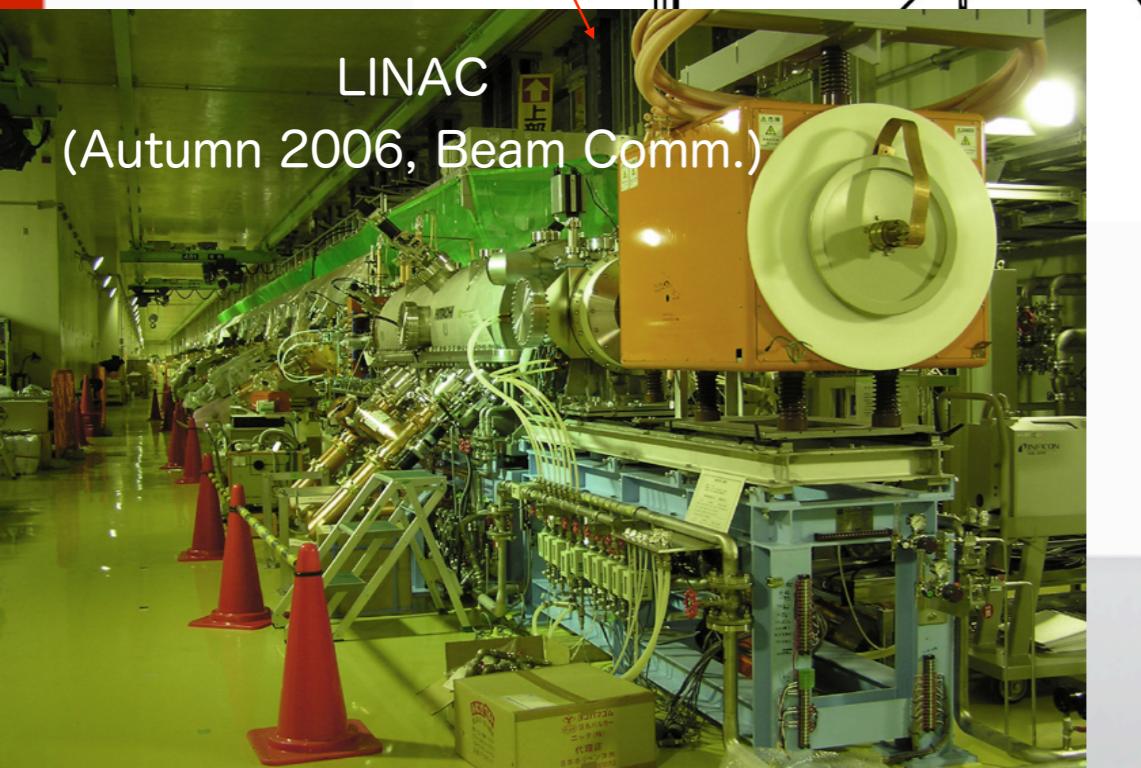
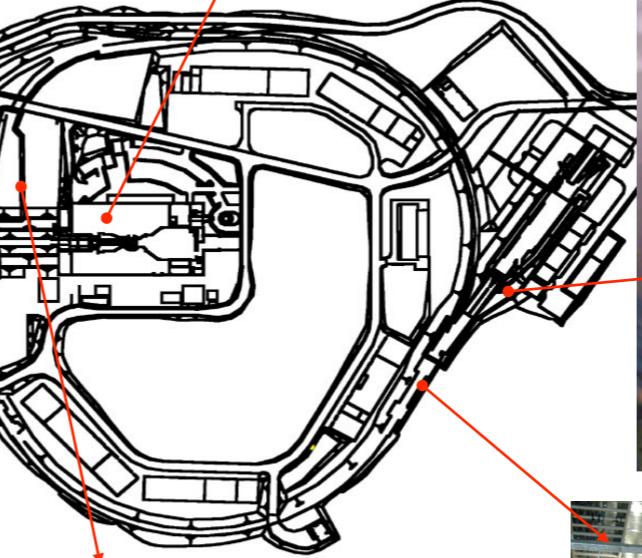
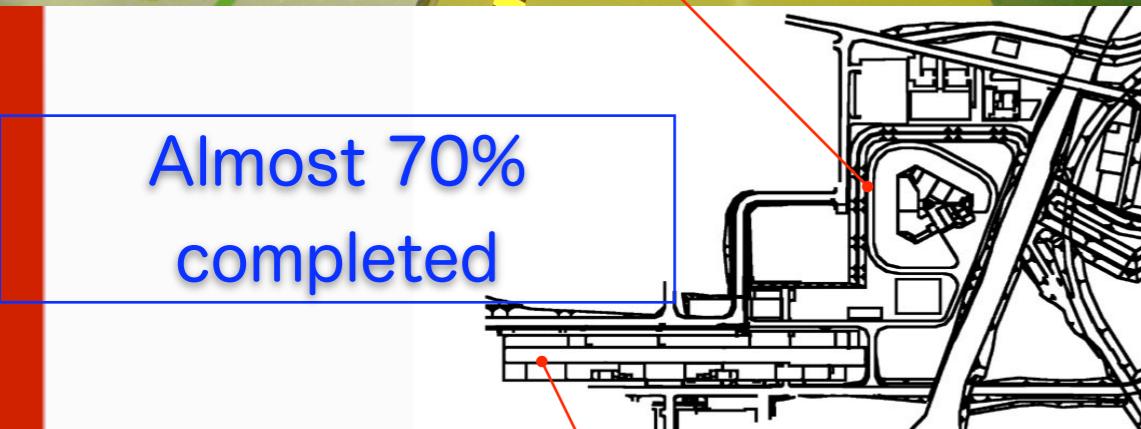
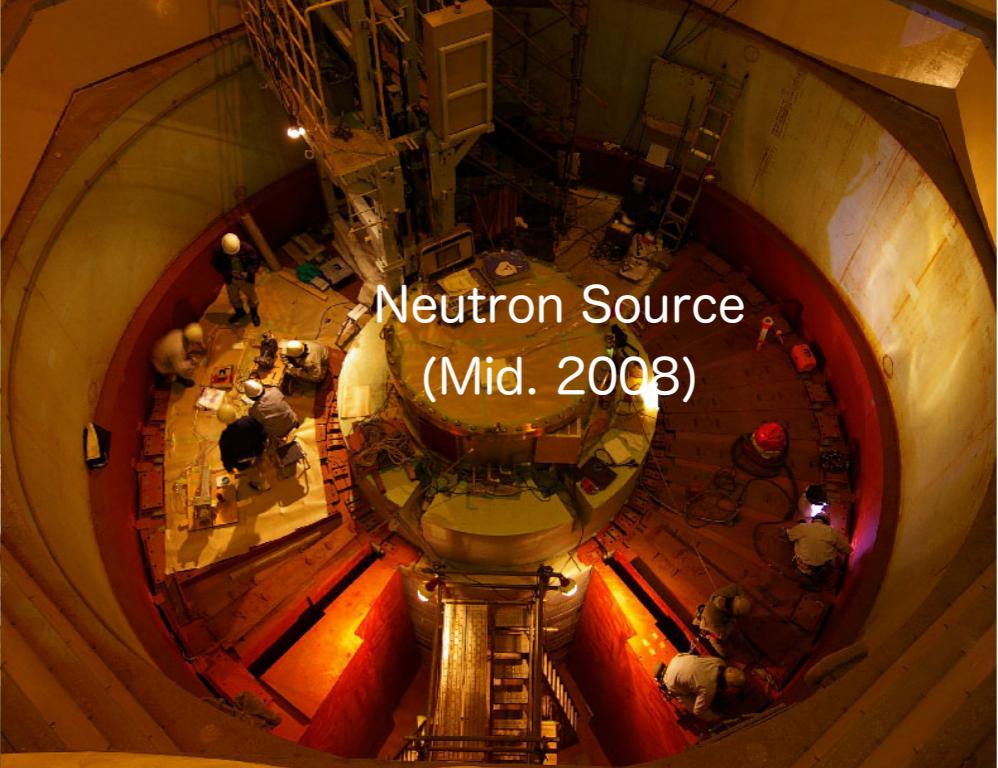
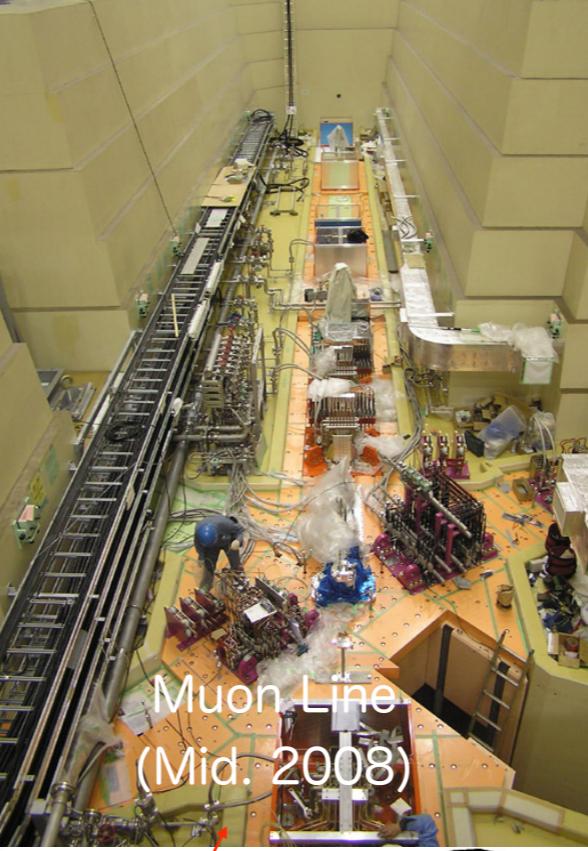




International Research Center

- One of Three major Neutron Sources in Material and Life Science
- Unique Kaon Factory, and One of Three Neutrino beam lines. Anti-proton in GSI.
- Top runner in ADS.





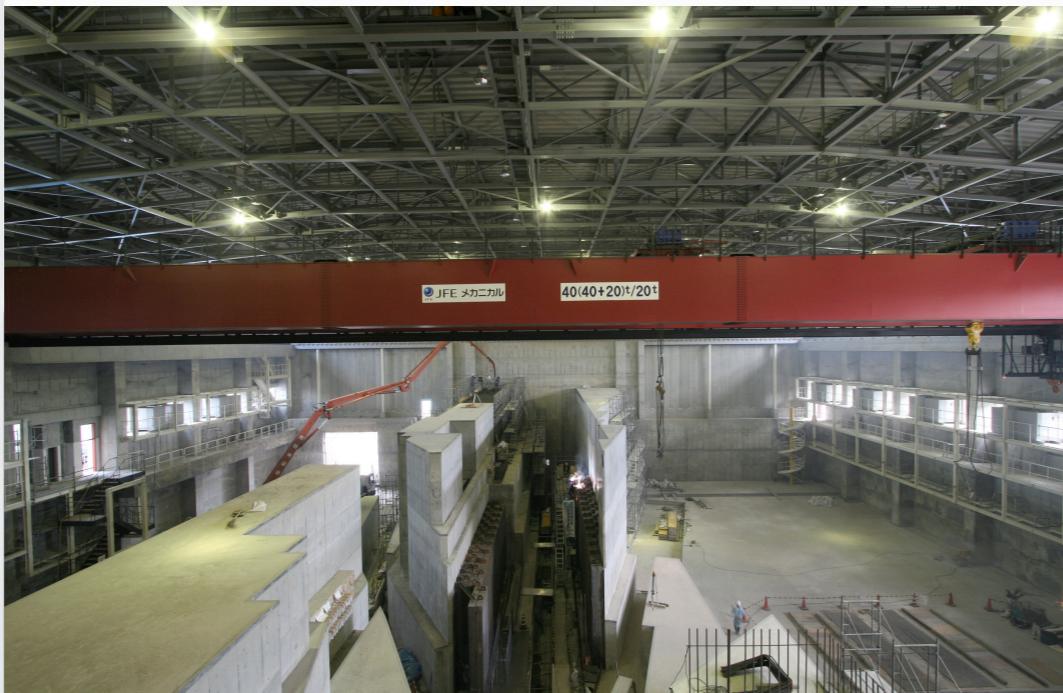
LINAC beam at 181 MeV: Jan.24,07





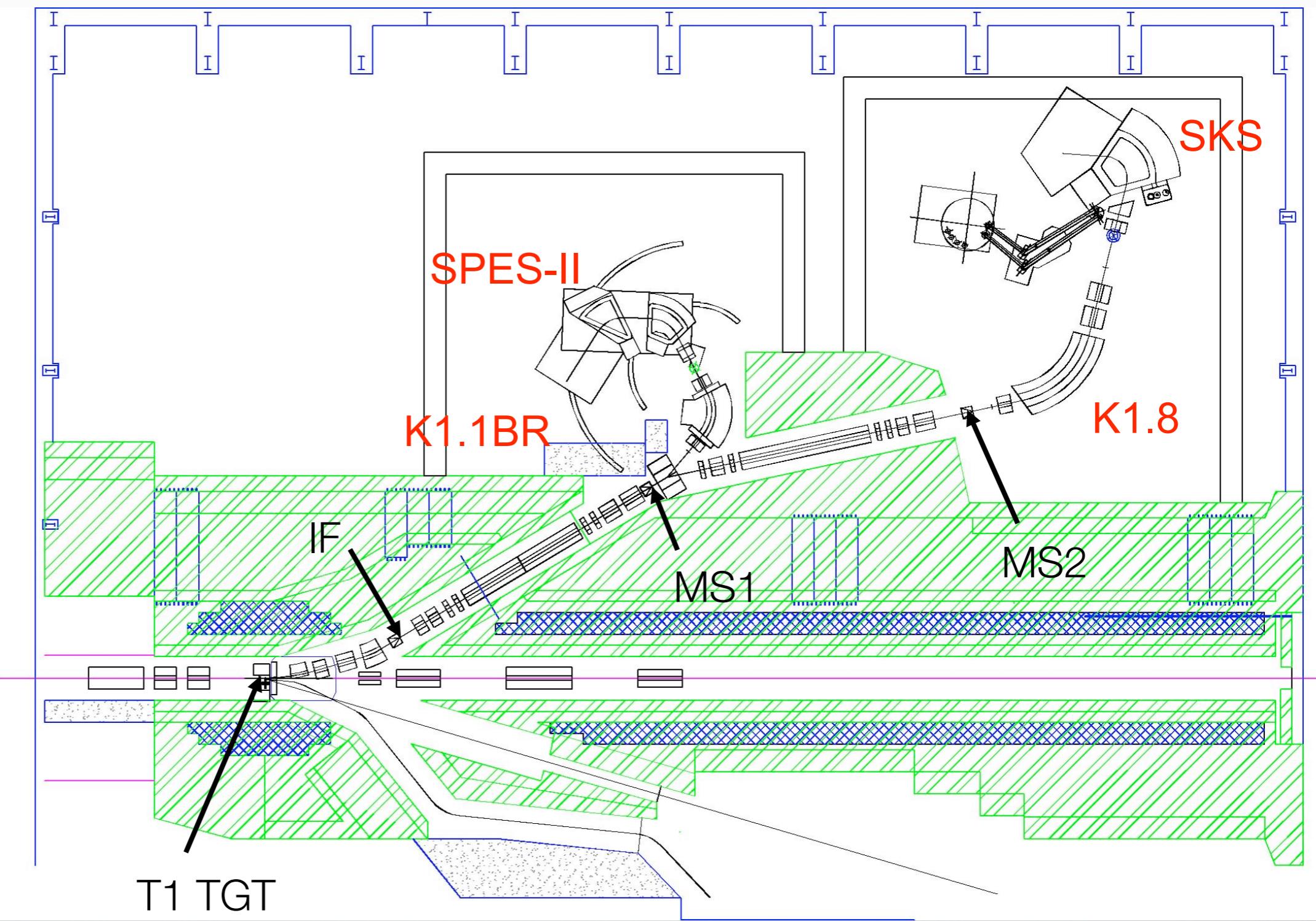
Hadron Exp. Hall

60m x 56m
Compl. in July, 2007



Layout Option - K1.8+K1.1BR

$\sim 10^7 \text{ K/sec}$, $K/\pi > 1$





Proposals at J-PARC

- Proposal Call : Nov., 2005 - Apr., 2006
- 20 proposals including 4 Lols
 - 13 proposals in Nuclear Physics
- Five Day-1 Experiments
 - E05: Ξ hypernuclei Spectroscopy (Nagae) [1st priority]
 - E13: Hypernuclear γ -ray Spectroscopy (Tamura) [2nd priority]

- E15: Search for K⁻p bound state (Iwasaki, Nagae)
- E17: Kaonic ${}^3\text{He}$ 3d \rightarrow 2p X-ray (Hayano, Outa)
- E19: Search for Penta-quark in $\pi^- p \rightarrow K^- X$ reaction (Naruki)
 - ↑ Day-1 experiments --
- E07: Hybrid-Emulsion for Double- Λ (Imai, Nakazawa, Tamura) E3-6 Nakazawa
- E03: Ξ -atom X rays (Tanida) QT-127 Tanida
- and more ...



New Hypernuclear Spectroscopy at J-PARC

- Spectroscopic studies on S=-2 systems; E05
 - Ξ hypernuclei with (K^-, K^+) reaction
 - Excited states of double- Λ hypernuclei
- Extensive study of hypernuclear γ spectroscopy; E13
 - Table of Hyper-isotopes
- Deeply-bound Kaonic Nuclei; E15
 - High-density matter



Spectroscopic Study of Ξ -Hypernucleus, $^{12}_{\Xi}\text{Be}$, via the $^{12}\text{C}(\text{K}^-, \text{K}^+)$ Reaction

E05

T. Nagae et al.

- ▶ Discovery of Ξ -hypernuclei
- ▶ Measurement of Ξ -nucleus potential depth and width of $^{12}_{\Xi}\text{Be}$
- ▶ Beam: K⁻ @ 1.8 GeV/c, 1.4x10⁶/spill
- ▶ CH₂ ~2 g/cm² : 2 weeks for tuning and calibrations
- ▶ ¹²C 5.4 g/cm² : 4 weeks
- ▶ Setup: K1.8 & SKS+

Unique experiment at J-PARC :
No other place can do this experiment !



Purpose of the experiment

P3-3 Hiyama

- First Spectroscopic Study of S=-2 systems in (K^-, K^+) reaction
 - Ξ -hypernuclei \rightarrow double- Λ hypernuclei
 - $\Xi p - \Lambda\Lambda$ mixing
 - First step for multi-strangeness baryon systems
- ΞN Interactions: almost no information
 - Attractive or repulsive ? \rightarrow potential depth
 - $\Xi p \rightarrow \Lambda\Lambda$ conversion ? \rightarrow conversion width
 - Isospin dependence ? \rightarrow Lane term($\tau_\Xi \bullet \tau_C / A$)

E3-7 Lanskoy

E4-1 Fujiwara

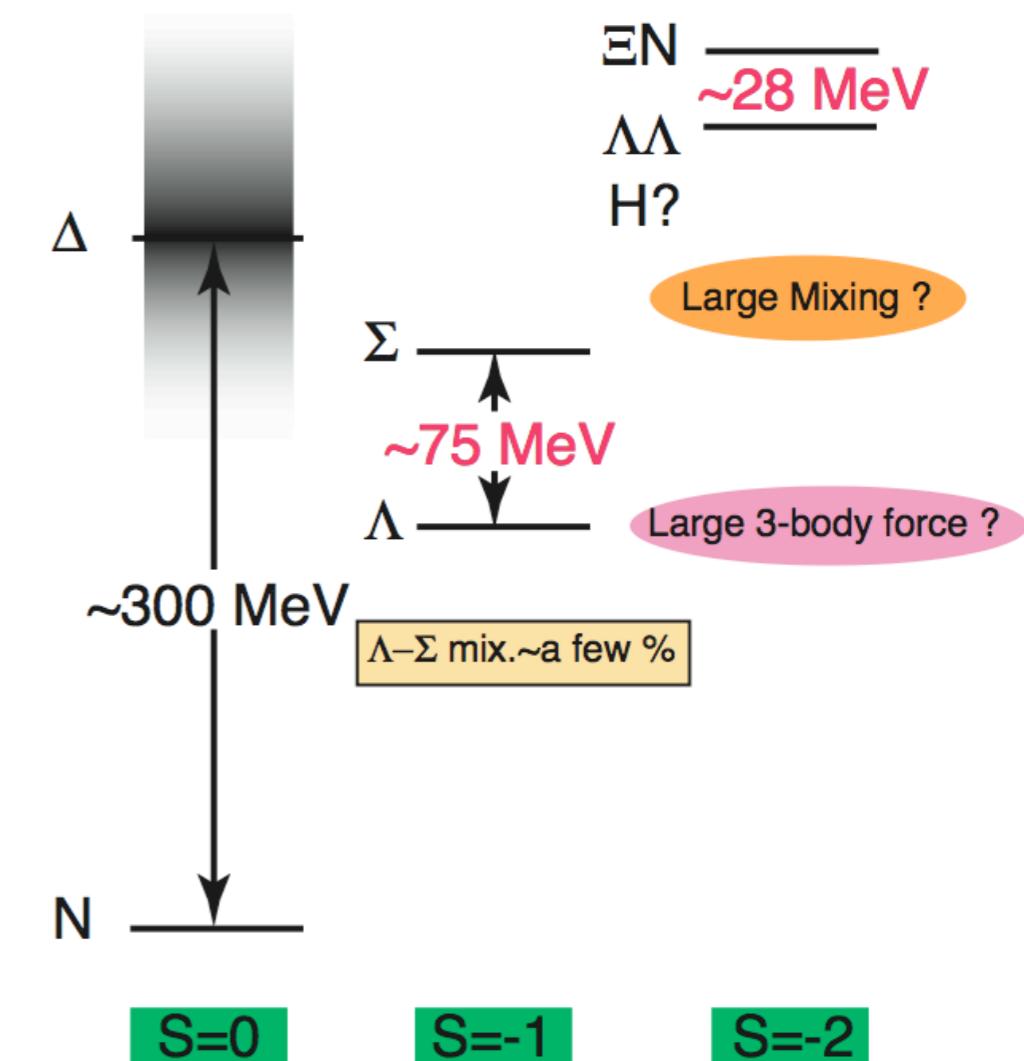
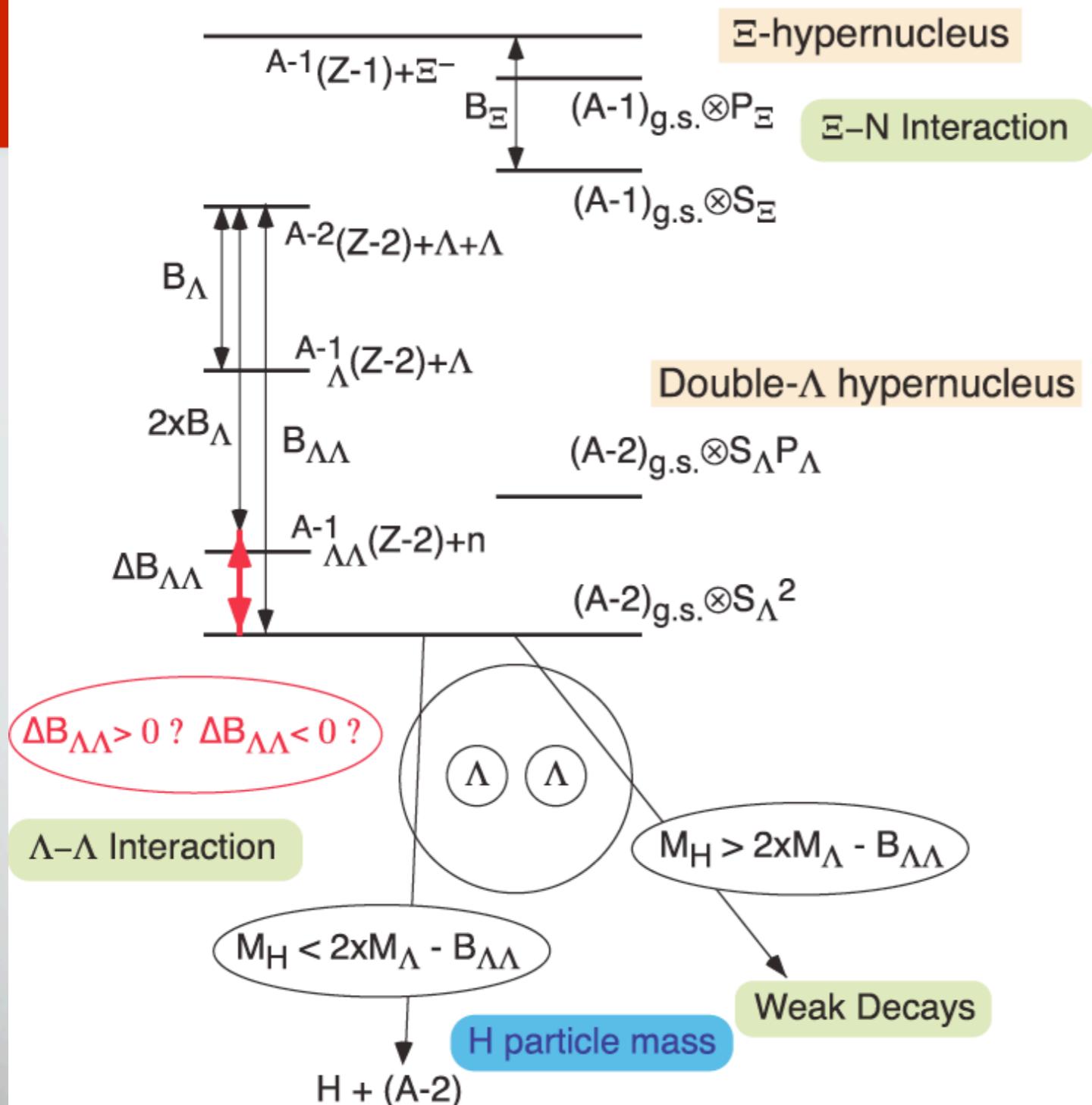
E4-2 Yamamoto

E4-5 Nemura



S=-2 Baryon Systems

Energy Spectrum of S=-2 systems

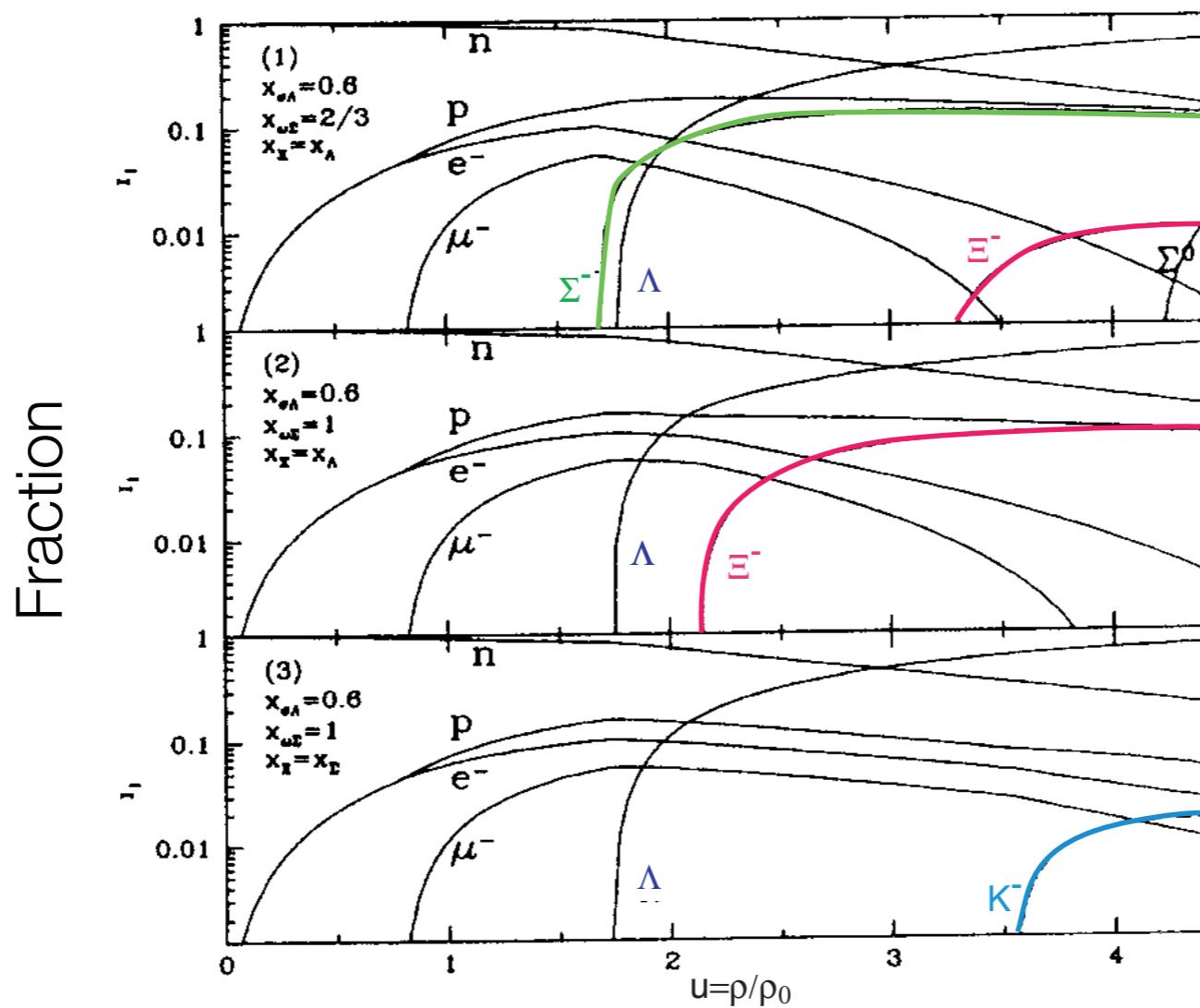


19

Ξ hypernuclei potential ?

- $\Lambda, \Sigma^-, \Xi^-, K^-$ in Neutron Star Core ?

- Chemical Potential: $\mu_B = m_B + \frac{k_F^2}{2m_B} + U(k_F)$

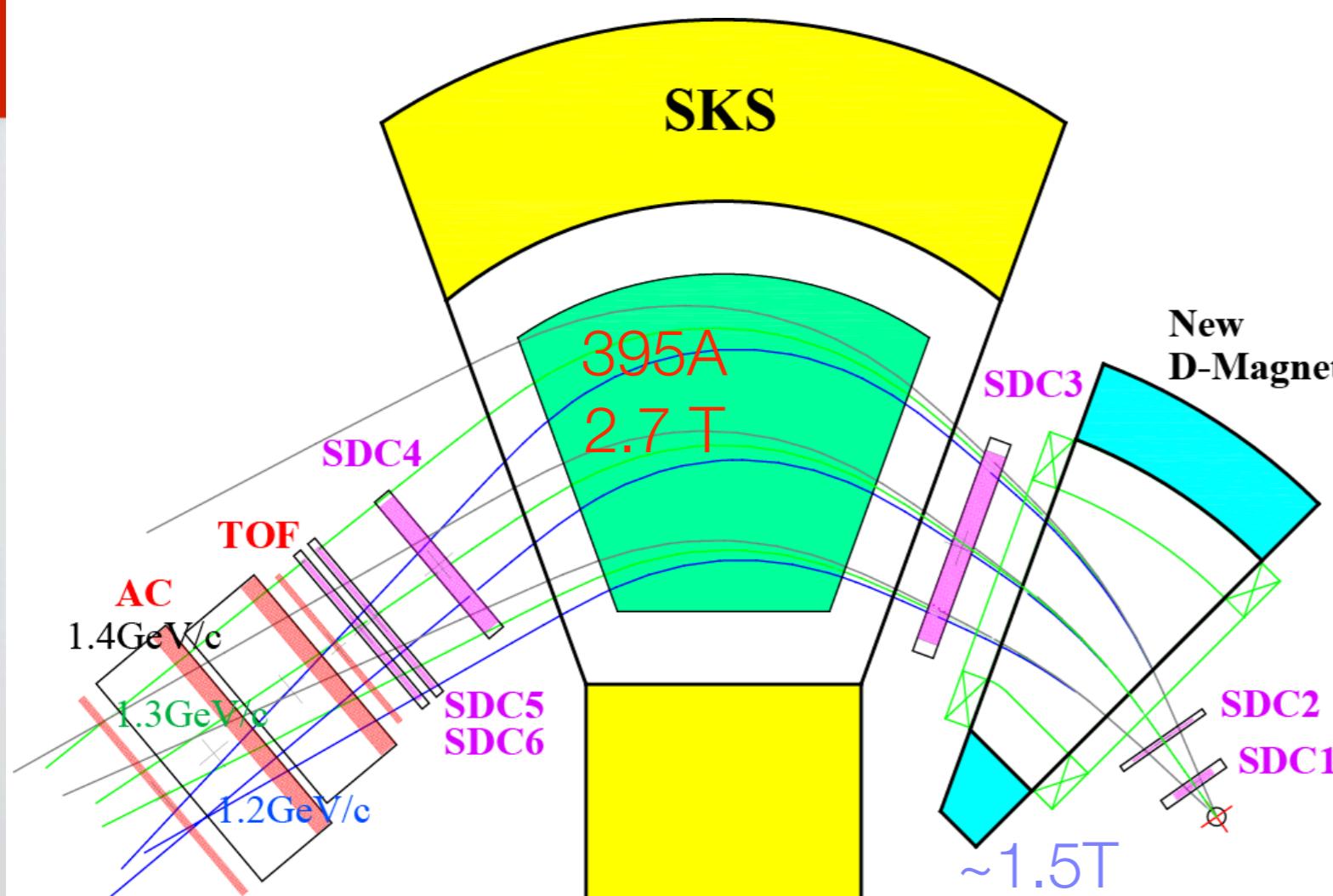


$U_\Sigma < 0, U_\Xi < 0$

$U_\Sigma > 0, U_\Xi < 0$

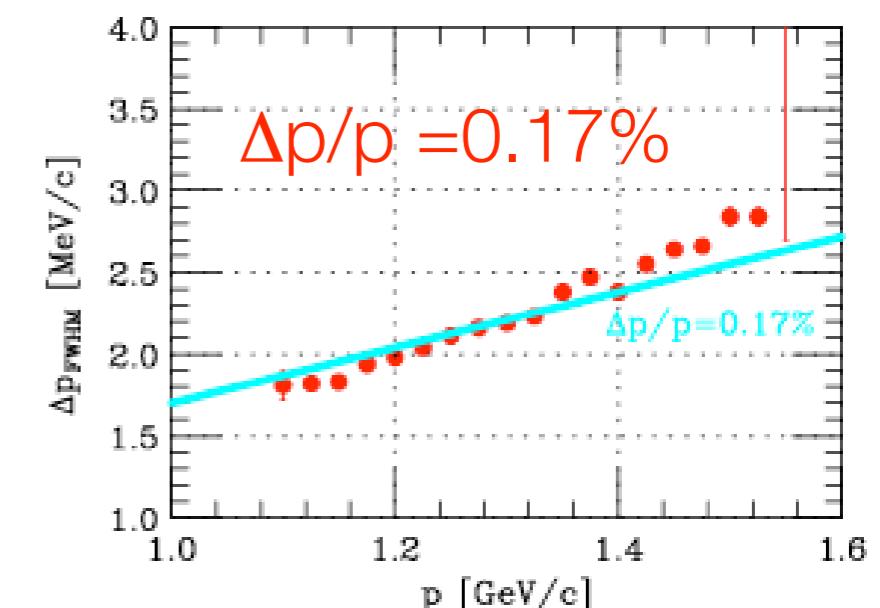
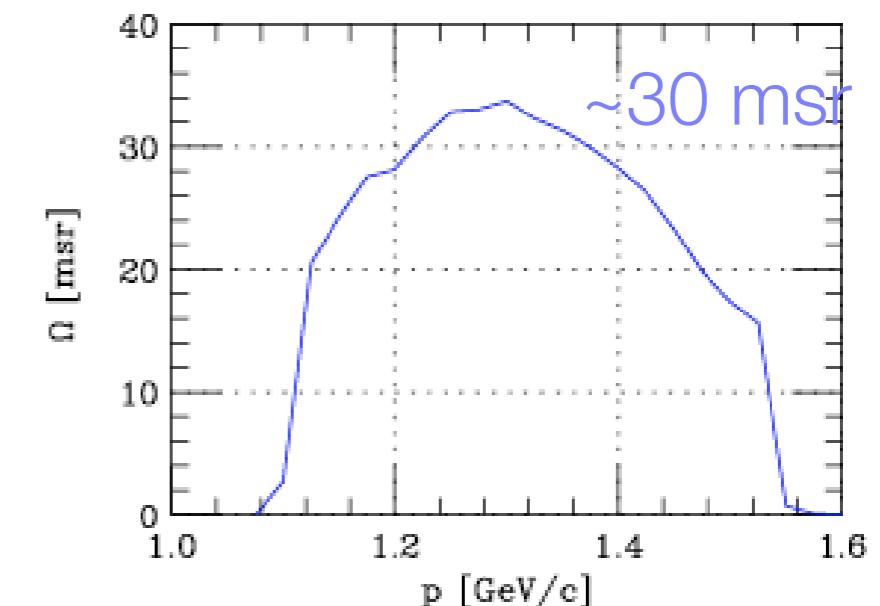
$U_\Sigma > 0, U_\Xi > 0$

SKS+ Spectrometer



- 95°total bend
- ~7m flight path
- $\Delta x=0.3$ mm (RMS)

QT-288 Takahashi





Gamma-ray Spectroscopy of Light Hypernuclei

E13

H. Tamura et al.

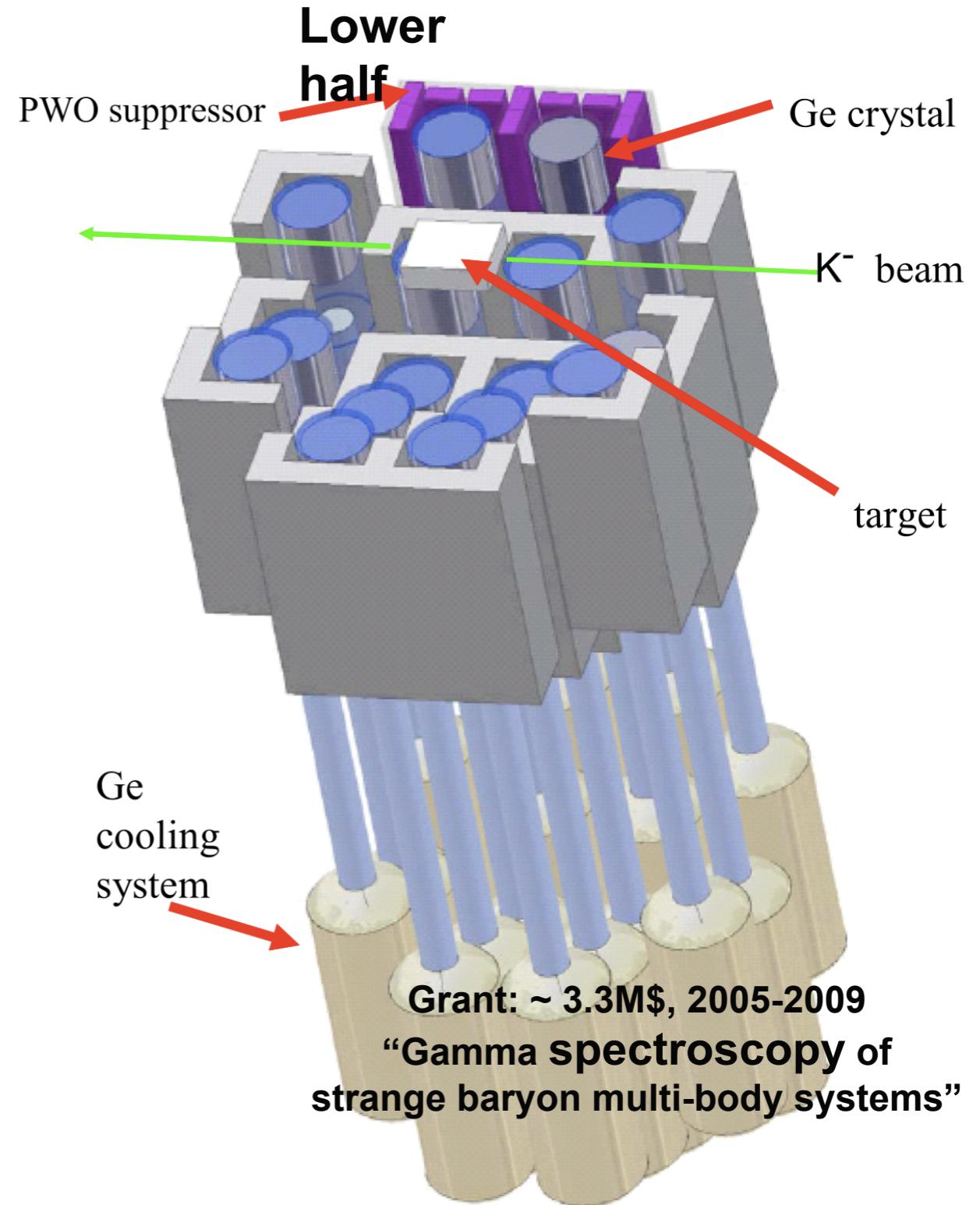
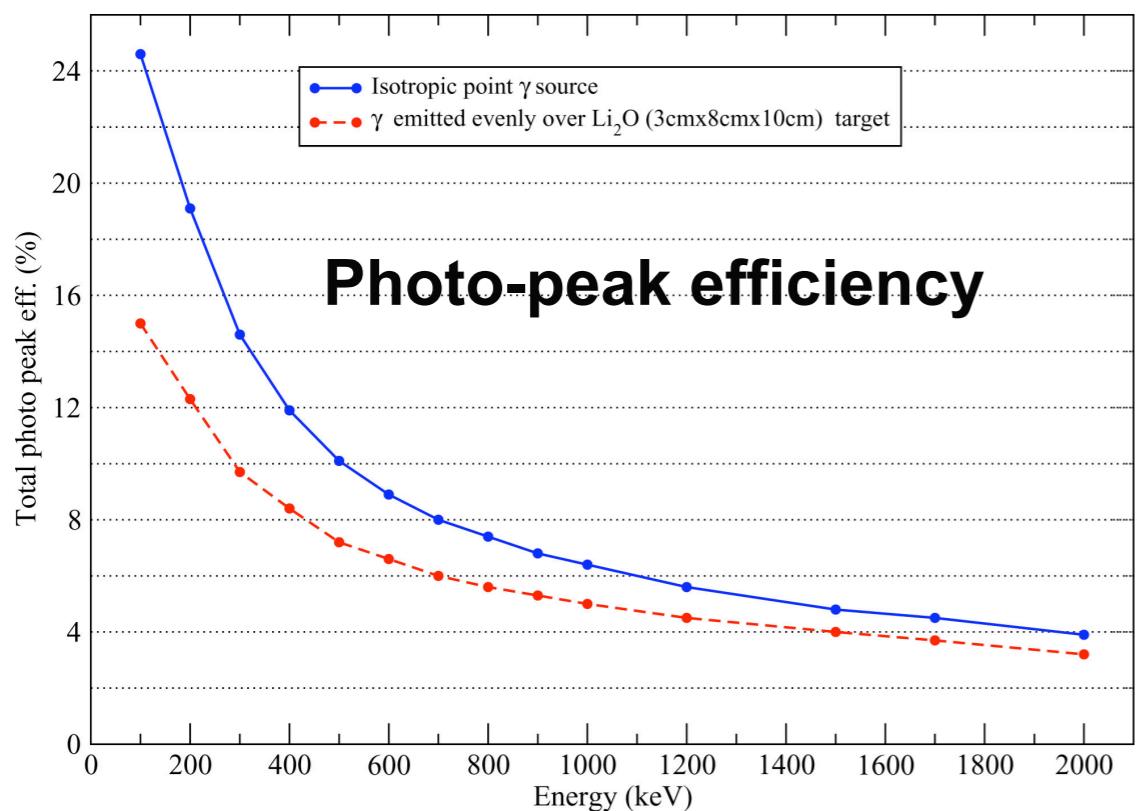
E3-1 Tamura

QT-147 Koike

- Spin-flip B(M1) measurement for g_Λ in nuclei
 - ${}^7\text{Li}(\text{K}^-, \pi^- \gamma) {}^7_\Lambda\text{Li}$ at 1.5 GeV/c: M1:3/2 $^+$ \rightarrow 1/2 $^+$
 - ΛN interaction in p-shell hypernuclei
 - ${}^{10}_\Lambda\text{B}$ and ${}^{11}_\Lambda\text{B}$
- Radial dependence of ΛN interaction in sd-shell hypernuclei
 - ${}^{19}_\Lambda\text{F}$: easiest in sd-shell
- Charge-Symmetry Breaking in ΛN interaction, and Spin-flip excitation (K^-, π^-) reaction
 - ${}^4_\Lambda\text{He}(\text{M1}:1^+ \rightarrow 0^+)$

Hyperball-J

- Single (r.e.~70%) \times 30-40
→ peak efficiency ~ 7% at 1MeV
(**x3** of Hyperball)
- Mechanical cooling (under development)
 - Lower temp. for less radiation damage
 - save space for flexible arrangement
- PWO background suppression counters replaced from BGO for higher rate



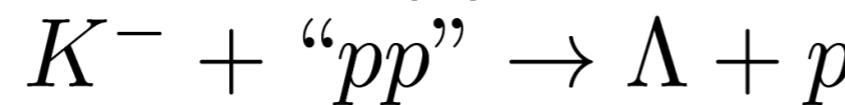
+ Waveform readout (under development)
=> Rate limit $\sim 2 \times 10^7$ particles /s
(**x5** of Hyperball)
=> Yield: $\times 15$ for single γ
 $\times 45$ for $\gamma\gamma$

A Search for deeply-bound kaonic nuclear states by in-flight ${}^3\text{He}(\text{K}^-, \text{n})$ reaction

E15

Evidence for K-pp in FINUDA

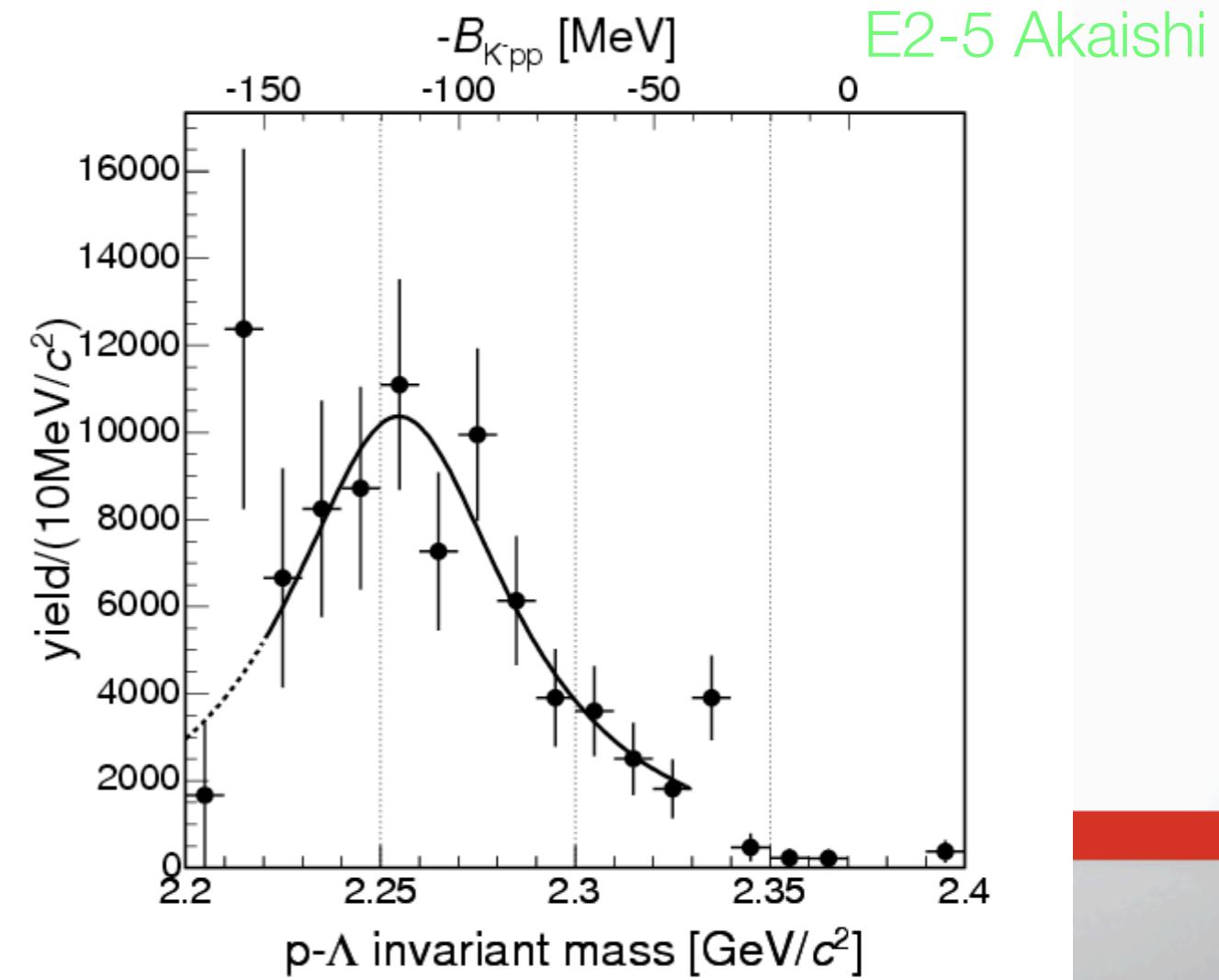
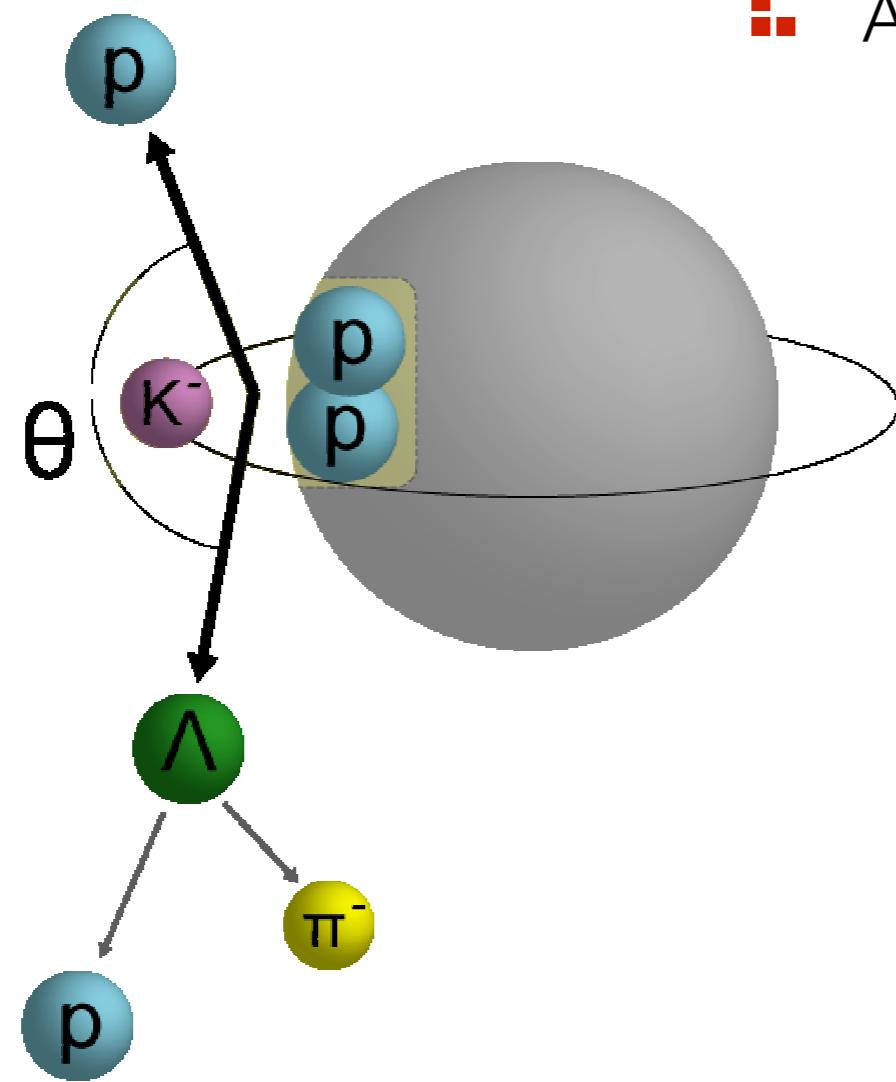
M. Iwasaki, T. Nagae et al.



E2-1 Fujioka

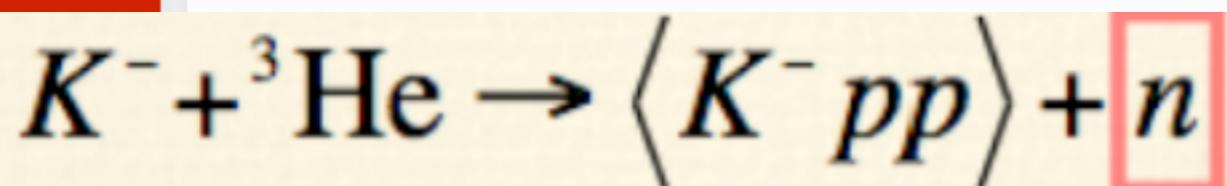
■ A bridge from $\text{K}^-\text{p}(\Lambda(1405))$ to K-Nucleus

E2-5 Akaishi



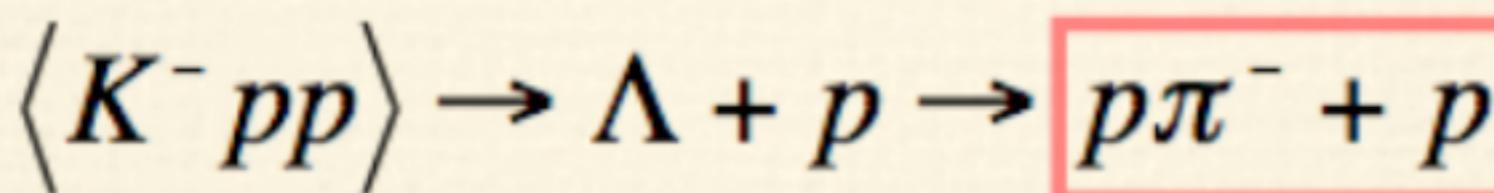
In-flight (K^- ,n) reaction on ^3He

QT-298 Ohnishi



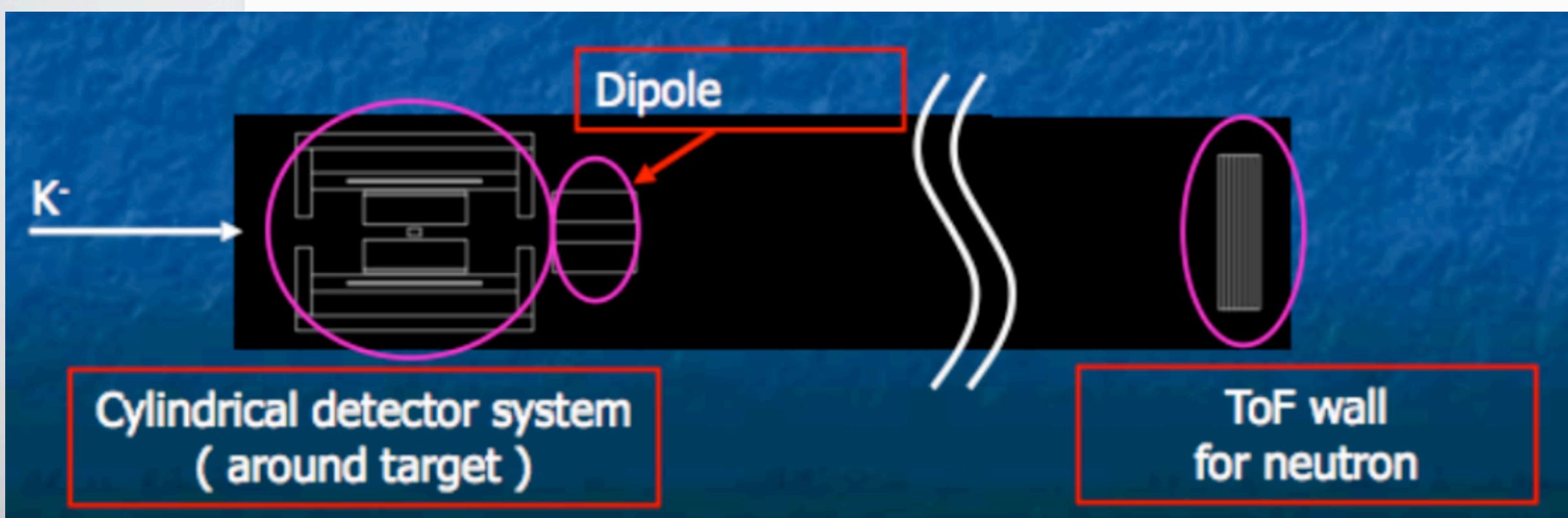
TOF

$\sigma_M = 9 \text{ MeV}$



CDC

$\sigma_M = 15 \text{ MeV}$





Summary

- J-PARC Construction: 2001 ~
 - ~70% completed
 - Beam commissioning: LINAC(Oct., 06), RCS(Sep., 07), MR(May, 08)
 - Beam from MR: ~ end of 2008
- Day-1 Experiments in preparation
 - Ξ hypernuclei
 - Hypernuclear gamma-ray spectroscopy
 - Deeply-bound Kaonic nuclei
 - etc.