Weak Nuclear Response studies & Nuclear Isotope Detection using muon probes at the MuSIC facility at RCNP.

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MuSIC layout

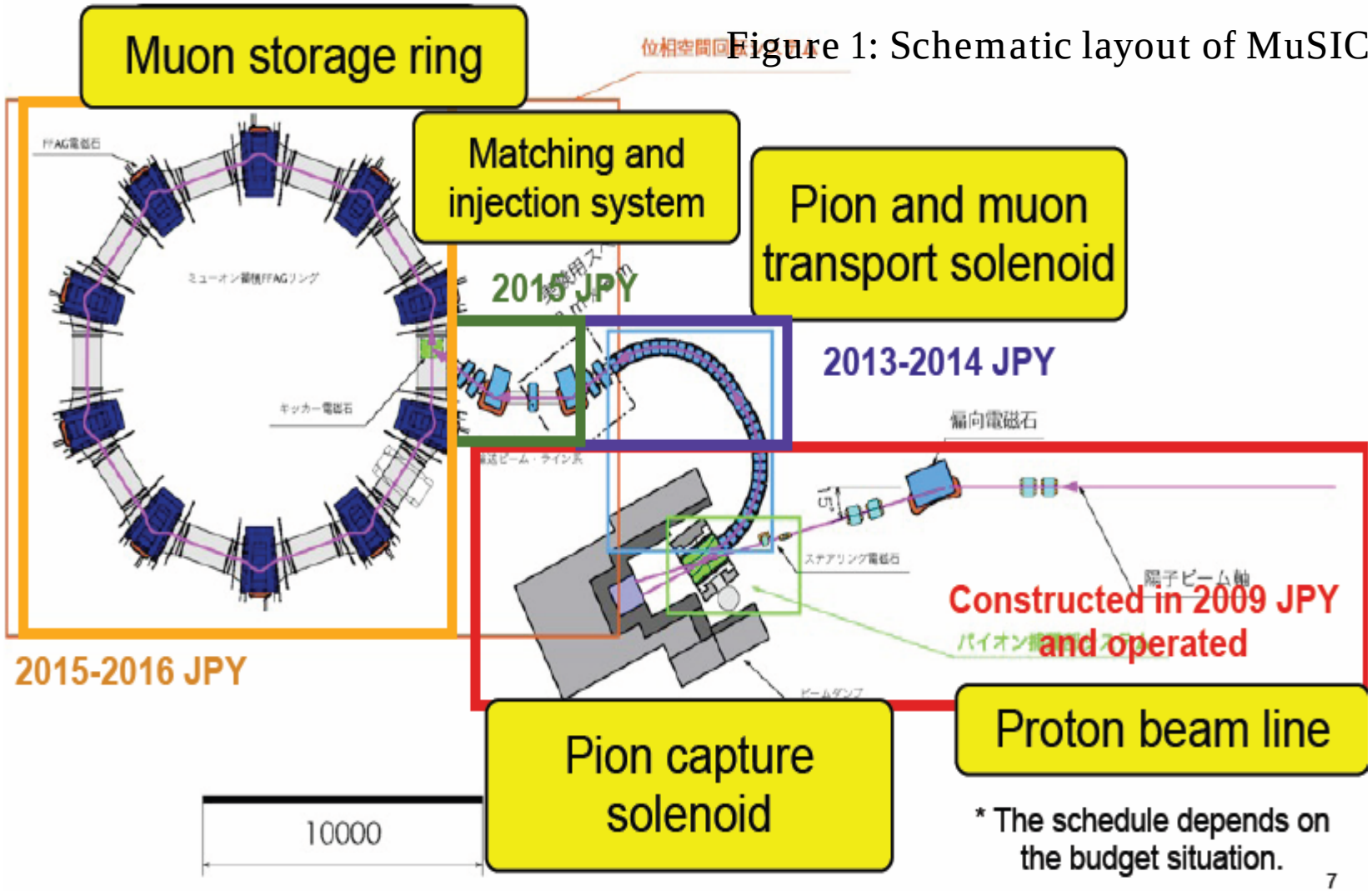
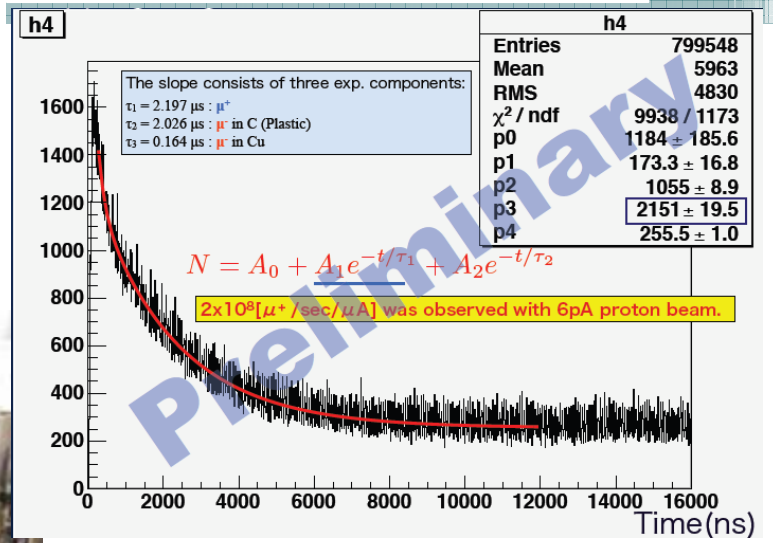


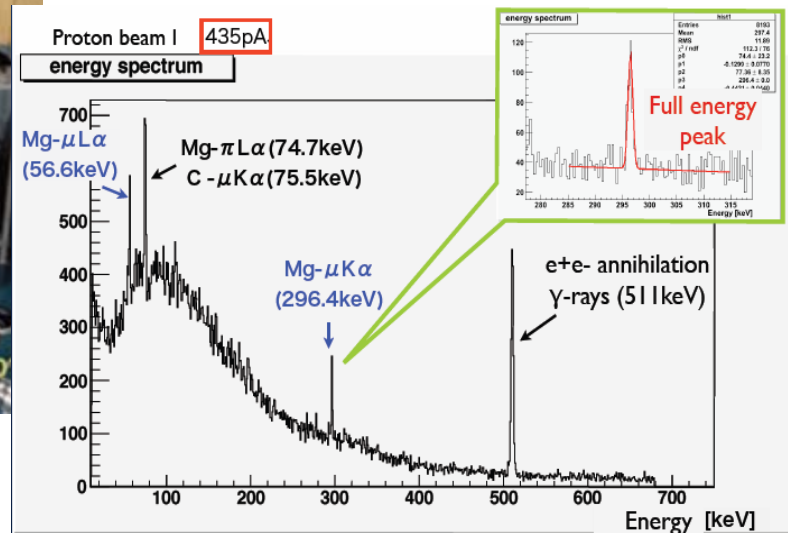
Figure 1: Schematic layout of MuSIC

MuSIC status

Figure 2: Solenoid and muon transport system



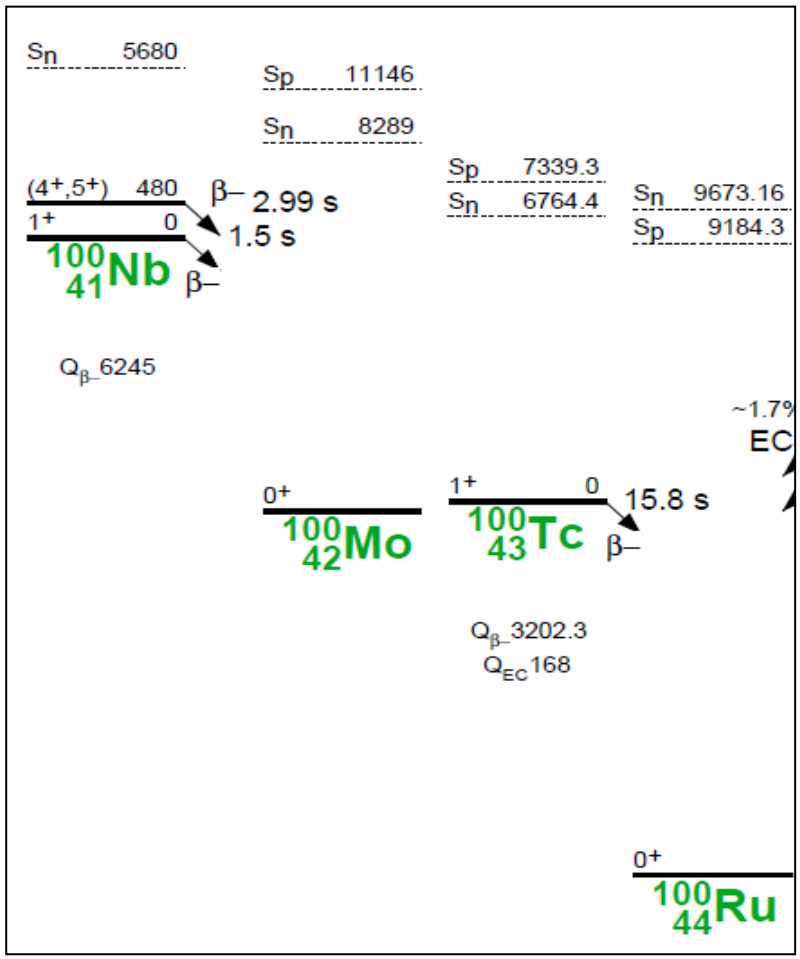
Muon lifetime measurement



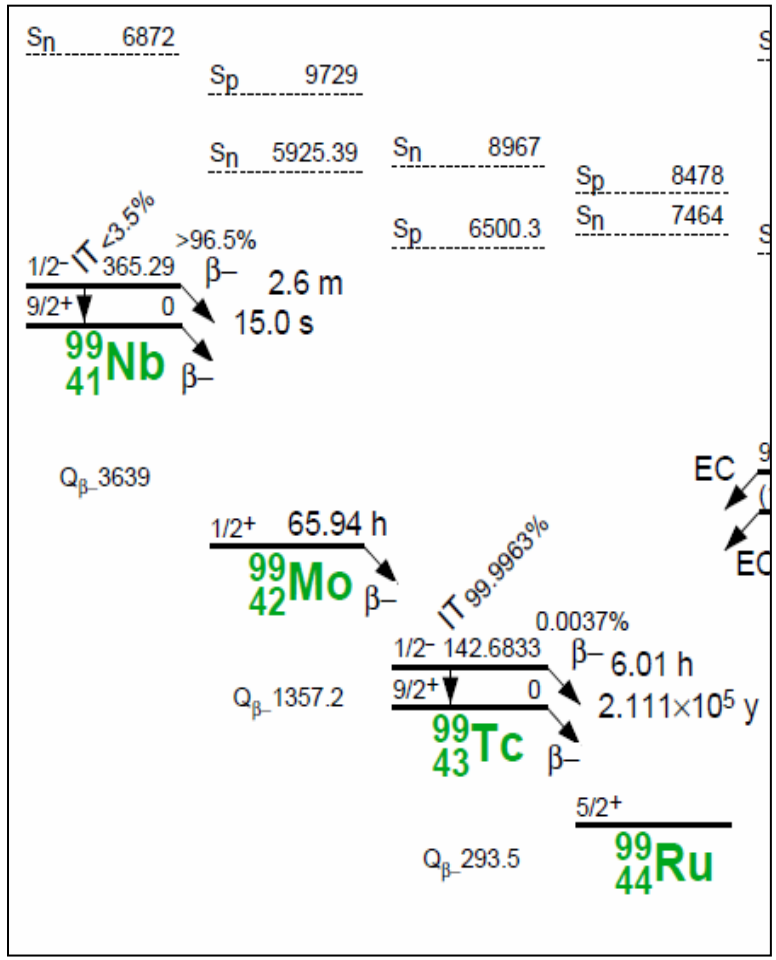
Muonic X-ray measurement

Isotope following (μ, γν) reaction

^{100}Mo (μ,γ)^{100}Nb β $^{-}$, 536, 600 keV γ



^{100}Mo ((μ, nγ)^{99}Nb β $^{-}$, γ 98, 138 keV



Experimental method

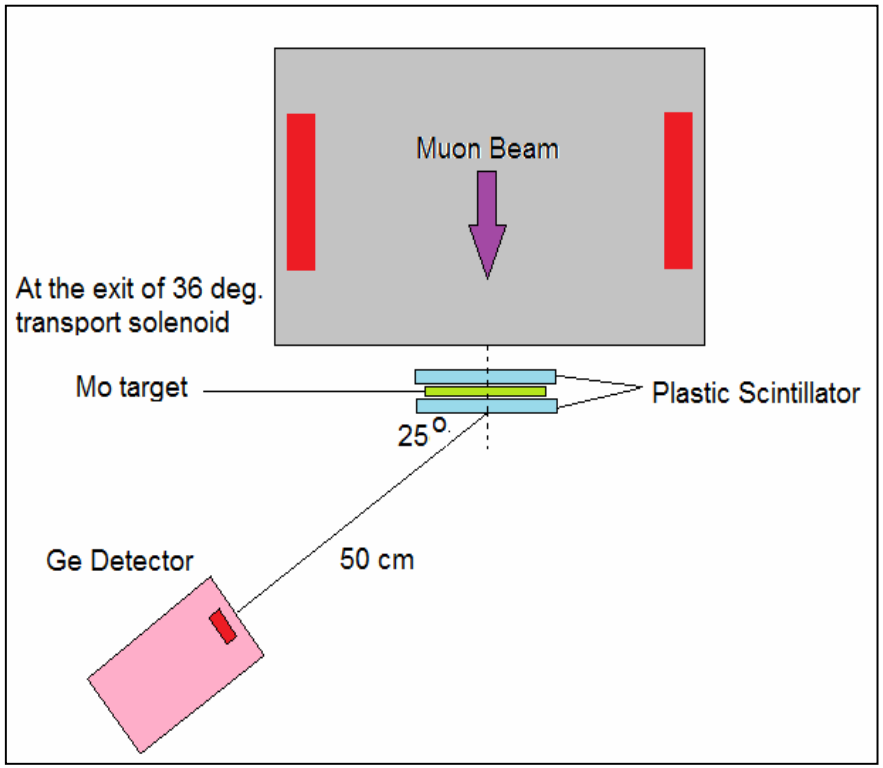


Figure 3: Online measurement setup

- There will be two setup needed for this experiment:
- Online: muonic X-ray measurement of Mo isotopes separation.
- Offline: γ ray measurement for nuclear response studies.

Simulation and calculations

- For 10nA beam current, about $1x10^9$ muon yield by MuSIC.
- Mo target dimension: 100mm x 100mm x 50mm
- Density: 11 g/cm^3
- Yields of γ and X rays ($\mu_{stop}=4x10^4$/sec)
- Y(X) ~ Mg K 259 keV, Mo K 3622 keV, L 476 keV
  $\varepsilon(X) \sim 2x10^{-5}$ where $\varepsilon(\gamma)$ is the peak efficiency of 25mm dia Ge at 30 cm
  $Y(X) \sim 5.52x10^{-1}$/sec = 2.0 k/hour
- $Y(\gamma)$ ~ ^{100}Mo ratio 0.096
- On line ^{100}Mo (μ,γ) ^{100}Nb 1.5 and 3 sec 536 KeV,
  ^{100}Mo $(\mu, n\ \gamma)$ ^{99}Nb 15 s 2.6 m 98KeV, 139 KeV
  $Y(X) \sim 1.38x10^{-3}$/sec = 5/hour
- Off line **5** hours bombardment RI of ^{99}Mo/^{99}Tc 145 keV
  Production ratio 5 hrs/95 hrs =mean life 0.05
  The Mo metal is placed on the top of the detector 50 mm dia
  $\varepsilon(\gamma) \sim 10^{-2}$ $Y(X) \sim 0.394$ k /sec = 1.42 M / hour

Conclusion

- Medium energy μ from MuSIC are use for the study of nuclear weak response by observing the nuclear activities following (μ, νγ) reactions.
- The muon captures use to determine nuclear isotopes separation by the emission of atomic muonic X-ray.
- The gamma ray emission from offline measurement might gives unique oppurtunities to study them directly through weak interaction.
- We aim to promising future of the study of nuclear weak response by using μ probe.

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