

RCNP EXPERIMENT E187
Resonance States in Proton Rich Nuclei and the Reaction Rates
in the rp-Process.

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Running Time: Approved 7.0 days (11 days requested), start with ($^4\text{He}, ^6\text{He}$) and ($^3\text{He}, ^6\text{He}$) before continuing with low yield ($^4\text{He}, ^8\text{He}$) measurements.

Beam Line: Dispersive WS beam line and Grand Raiden Spectrometer in 0° transmission mode.

Beam Requirements: ^4He ^3He , 210 MeV, 100 particle nA (after radiation tests and approval)

Other requirements: Halo-free, small emittance, matched beam. ^4He beam stops in D1, momentum slits & TOF pickups in WS course, 1, 10 and 6 mm scintillators in focal plane.

Budget: Targets and scintillation detector: 0.6 MYen, Travel Expenses: 0.5 MYen

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Summary of the Proposal

- **Proposed experiment:** Measurements of ($^4\text{He}, ^6\text{He}$), ($^4\text{He}, ^8\text{He}$), and ($^3\text{He}, ^6\text{He}$) reactions are proposed using the WS course and Grand Raiden (GR). GR will be used in the new 0° mode with two Faraday cups inside dipole D1. We plan to measure the ($^4\text{He}, ^6\text{He}$) and ($^3\text{He}, ^6\text{He}$) reaction on several targets first.

- **Targets:** Production targets are ^{28}Si , ^{24}Mg , and ^{40}Ca for ($^4\text{He}, ^6\text{He}$) and ^{40}Ca , ^{32}S , and ^{46}Ti for ($^3\text{He}, ^6\text{He}$). The yields obtained in a test run on a ^{13}C target has shown that the ($^4\text{He}, ^8\text{He}$) reaction is also feasible but requires long runs. The production targets will be ^{40}Ca and ^{50}Cr . Target thicknesses of 1 - 2 mg/cm² will be used as a compromise between good resolution and beam running time.

- **Apparatus and Beam Properties:** The WS course and Grand Raiden spectrometer with the standard VDC focal plane detector system will be used. In addition to the existing 1 mm thick ΔE plastic scintillator used in the development run, a thin detector of 6 cm is needed to improve particle identification. The ($^4\text{He}, ^6\text{He}$) reaction with typical cross sections of 0.1 mb/sr will be measured with a dispersive beam and full matching techniques to obtain a resolution ≤ 50 keV. The feasibility tests with a resolution of 90 keV due to target effects have shown that 50 keV is desirable for the $^{24}\text{Mg}(^4\text{He}, ^6\text{He})$ to better resolve levels of interest. The target thickness should not exceed 1 mg/cm².

Test runs also established the feasibility of the ($^4\text{He}, ^8\text{He}$) reaction with cross sections of about 100 nb/sr using a ^{13}C target. Beam development is planned, to establish the maximum alpha beam current at Grand Raiden. The presently maximum beam current of 40 pA is a conservative limit. It is expected that the current can be raised by a factor of 2 - 4 without exceeding radiation limits. Additional local shielding at the target can also be considered.