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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}He,^{6}He) and (^{3}He,^{6}He) before continuing with low yield (^{4}He,^{8}He) measurements.

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

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

Other requirements: Halo-free, small emittance, matched beam. ^{4}He 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}He,^{6}He), (^{4}He,^{8}He), and (^{3}He,^{6}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}He,^{6}He) and (^{3}He,^{6}He) reaction on several targets first.

• **Targets:** Production targets are ^{28}Si, ^{24}Mg, and ^{40}Ca for (^{4}He,^{6}He) and ^{40}Ca, ^{32}S, and ^{46}Ti for (^{3}He,^{6}He). The yields obtained in a test run on a ^{13}C target has shown that the (^{4}He,^{8}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/cm^2 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}He,^{6}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 $\leq$ 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}Mg(^{4}He,^{6}He) to better resolve levels of interest. The target thickness should not exceed 1 mg/cm^2.

Test runs also established the feasibility of the (^{4}He,^{8}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 pnA 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.