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RCNP EXPERIMENT E329

PROPOSAL FOR EXPERIMENT AT RCNP

13 July 2009

TITLE:
Resonance States in Proton Rich ^{42}Ti and ^{46}Cr Nuclei and Reaction Rates in the rp-Process.

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Running Time: A total of 10 days running time is requested of which 2 days are needed for cyclotron optimization (momentum spread) beam line matching, spectrometer setup, and 8 days for production and calibration measurements.

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

Beam Requirements: Particle type and energy: ^{4}He of 206 MeV. Beam intensity and energy spread: a minimum 400 pnA is required for low yield (^{4}He,^{8}He) reaction, beam energy spread of the order of 100 keV or better.

Other requirements: Single turn halo-free beam, fully disp. matched beam on GR target.

Special Equipment required: Existing GR ^{4}He-stop in D1, and 1, 10 and 6 mm thin plastic detectors in GR focal plane for Δ-E, E and veto signals, respectively.

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SUMMARY OF THE PROPOSAL

• **Proposed experiment:** Measurements of (^{4}He,^{8}He) on ^{46}Ti and ^{50}Cr targets with astrophysical motivation are proposed using the WS course and Grand Raiden (GR). GR will be used in a 0° mode with a Faraday cup inside dipole D1 that was specially built for this reaction. This experiment is part of an astrophysics program at RCNP using several neutron pickup reactions using the GR spectrometer. Some results of the (^{4}He,^{6}He) and the (p,t) reactions are completed. Also, the (^{4}He,^{8}He) reaction was performed, but the targets of interest, ^{46}Ti and ^{50}Cr did not yield sufficient rates to complete the measurement. In this experiment we will improve the luminosity by a factor of about 10, by increasing the beam intensity to about 400 pnA with the new ion source and the target from less than 1 mg/cm^2 to about 2 mg/cm^2.

• **Targets:** The targets of astrophysical interest are ^{46}Ti and ^{50}Cr. A ^{13}C and a ^{28}Si target with relatively large (^{4}He,^{8}He) cross sections will be used for energy calibration. The target thicknesses of about 2 mg/cm^2 are a compromise of count rate and good resolution requirements.

• **Apparatus and Beam Properties:** The WS course in disp. mode and the Grand Raiden spectrometer with the standard VDC focal plane detector system will be used. A stack of 1 mm, 10mm, 6 mm thick ΔE plastic scintillator for energy loss and timing signals for particle identification in the first two detectors for ^{6}He and ^{8}He particles. The ^{4}He and lighter particles will pass through the first two detectors and provide a veto signal in the third detector.

• **Beam time request:** The total beam time request of 10 days will be used as follows:

a) 2 days for beam preparation, detector verifications and particle identification, ion-optical setup and dispersion matching for the (^{4}He,^{8}He) reaction.

b) 1 day of ^{13}C,^{28}Si(^{4}He,^{8}He) and ^{24}Mg(^{4}He,^{6}He) reactions for energy calibration.

c) 3 days for measurements on ^{46}Ti(^{4}He,^{8}He)^{42}Ti. Expected counts for the g.s. is about 150 events/day, excited states: 20 events/day.

d) 4 days for measurements on ^{50}Cr(^{4}He,^{8}He)^{46}Cr. Expected counts for the g.s. is about 30 events/day, excited states: 4 events/day.