RCNP EXPERIMENT E242

Experiment Proposal at RCNP using WS course and Grand Raiden, 01/27/2004

Resonance States in ^{22}Mg and ^{26}Si Nuclei using the (p,t) Reaction and Reaction Rates in the rp-Process

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Running Time: A total of 7 days running time is requested of which 2 days are needed for cyclotron optimization (momentum spread) beam line matching, spectrometer setup, and 5 days for production and calibration measurements.

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

Beam Requirements: Protons of 100 MeV, current $<$ 100 nA for low yield (p,t) reaction, energy spread $<$ 100 keV, single turn, halo-free, fully disp. matched.

Special Equipment required: Existing GR ^{3}He-stop in D1, and 6, 10 and 10 mm thick plastic detectors in GR focal plane for ΔE, E and veto signals. Targets are existing from previous experiments

1 Summary of the Proposal

• **Proposed experiment:** Measurements of the (p,t) reaction on ^{24}Mg and ^{28}Si 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. Previous development runs for the (^{4}He,^{8}He) reaction demonstrated also the feasibility of the (^{4}He,^{6}He) reaction. This reaction was subsequently used to identify several resonance levels near the p- and α-particle thresholds. In this proposal we suggest to measure levels in this energy region using the complementary (p,t) reaction, because the higher resolution and the observed different selectivity will provide more precise energies and clarify which reaction is better for future resonance level studies.

• **Targets:** The targets of astrophysical interest are ^{24}Mg and ^{28}Si. Carbon and Mylar targets will be used for calibration and the subtraction of carbon and oxygen impurity events. The target thicknesses have to be about 0.7 mg/cm^2, to ensure a good resolution of about 10 keV.

• **Apparatus and Beam Properties:** The WS course in dispersive mode and the Grand Raiden spectrometer with the standard VDC focal plane detector system will be used. A stack of 6 mm, 10mm, 10 mm thick ΔE, E plastic scintillator will provide energy loss and timing signals for particle identification in the first two detectors for tritons. Protons will pass through the first two detectors and provide a veto signal in the third, 6 mm thick detector. Aluminum absorbers in front and between scintillators may be used to optimize the detector signals.

• **Beam time request:** A total of 7 days of beam time is requested and will be used as follows:

a) 2 days beam preparation, detector verification, ion-optical setup and full disp. matching.

b) 2 days each for the reactions ^{24}Mg(p,t)^{22}Mg and ^{28}Si(p,t)^{26}Si. Expected count rates are about 1000 events/day for the g.s. and a few 100 events/day for larger excited states.

c) 1 day of calibration and impurity identification measurements on a pure carbon and a Mylar target consisting of oxygen and carbon.