RCNP EXPERIMENT E305

PROPOSAL FOR EXPERIMENT AT RCNP

10 July 2007

TITLE:

Resonance States in ^{30}S, ^{34}Ar and ^{38}Ca Nuclei using the (p, t) Reaction and Reaction Rates in the αp- and rp-processes

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EXPERIMENTAL GROUP:

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RUNNING TIME:	Beam line matching, GR set up and tuning	3 days
	(p, t) production runs on the three targets	9 days
	Total request	12 days

BEAM LINE: Dispersive WS beam line and Grand Raiden Spectrometer in 0° mode.

BEAM REQUIREMENTS:	Type of particle	p
	Beam energy	100 MeV
	Beam intensity	100 nA, minimum 50 nA

OTHER REQUIREMENTS: Single turn, halo-free beam with small emittance that is fully dispersion matched on GR target.

BUDGET: Targets will be provided by Notre Dame group.

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SPOKESPERSONs: S. O'Brien, G.P.A. Berg

SUMMARY OF THE PROPOSAL

Measurements of (p, t) reactions at 100 MeV on ^{32}S, ^{36}Ar, and ^{40}Ca targets with astrophysics motivation are proposed using the high resolution Grand Raiden spectrometer from 0° to 17°. The product nuclei, namely ^{30}S, ^{34}Ar, and ^{38}Ca, play an important role in the energy generation of type I X-ray bursts. For calibration and background subtraction, carbon and Mylar targets will be used. By applying dispersion matching techniques, the expected energy resolving power is 4 keV. The spectral resolution will be determined by target effects that will be discussed below. The goal is to resolve levels up to and above 8 MeV excitation energy, that is, to resolve levels within 2 MeV above the p- and α-thresholds.
These measurements will be taken using the experimental technique established by a previous (p, t) experiment at RCNP [**?**]. Thus, at 0°, Grand Raiden will be used in the established dispersion matched 0° mode with a Faraday cup placed inside dipole D1. Finite angle measurements in the range of 8 - 17° will be performed to help determine the excitation energy and the angular momentum of the final state by placing the Faraday cup inside the scattering chamber. The focal plane detector system will be used. In addition to the 1 mm thick ΔE and 3 mm thick E plastic scintillators, a third scintillator will be used as a veto detector.
The yields per level obtained in an experiment on ^{24}Mg and ^{28}Si targets have shown that the cross sections of the (p, t) reaction are of the order of 0.1 μb/sr [**?**]. The low cross sections require redundant identification measurements to eliminate background events typical for 0° experiments. For target thicknesses larger than about 2 mg/cm^2 the resolution will be effected by target effects. With a target thicknesses of 2 mg/cm^2 we expect a count rate of about 500 counts for a level with a cross section of 0.1 μb/sr in 24 hrs ^{40}Ca run for a beam current of 100 nA at 0°.

References

[1] A. Matic, Doctoral Thesis, KVI 2007.