E370

Stellar neutron sources and the s-process in massive stars

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Running Time: A total of 8 days running time is requested of which 2 days are needed for cyclotron optimization (momentum spread) beam line matching, spectrometer setup, 2 days for production and calibration measurements including the time needed for mode changes (0° mode, Faraday cups behind Q1 and in

scattering chamber), 2 days for changing to ^{6}Li beam and 2 days for measurements on ^{22}Ne using ^{6}Li beam at different angles.

Beam Line: Dispersive WS beam line and Grand Raiden Spectrometer in three modes (0° mode, Faraday cups behind Q1 and in scattering chamber).

Beam Requirements: Particle type and energy: ^{4}He of 206 MeV and ^{6}Li of 360 MeV
Beam intensity and energy spread: A maximum of 100 pnA is required, beam energy spread of the order of 100 keV or better.

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

Special Equipment required: Only existing and standard GR and focal plane equipment is needed.

Target Budget: Enriched ^{26}Mg and ^{24}Mg: ¥200,000

1 Summary of the Proposal

• **Proposed experiment**: Measurements of (α,α') on a self-supporting ^{26}Mg target foil and (^{6}Li,d) on a ^{22}Ne gas target with astrophysical motivation are proposed using the WS course and Grand Raiden(GR). GR will be used in three Faraday cup modes including the 0° mode with a Faraday cup downstream of the focal plane detector. This experiment is part of an astrophysics program at RCNP. It aims at resonance states above the α-threshold around 10 MeV excitation energy and is only possible with a high-resolution spectrometer since a resolution of 30 - 40 keV is required to resolve high-lying excited levels in the final nucleus. ^{22}Ne is a gas target and we will make use of the special, flat gas-target cell that allows dispersion matching as demonstrated previously. Target thickness will be of the order of 1 – 1.5 mg/cm^2 for best possible resolution.

• **Targets**: The targets of astrophysical interest are T = 1 nuclei in the sd-shell and we propose in this experiment measurements on ^{22}Ne and ^{26}Mg targets. The target thicknesses of about 1 – 1.5 mg/cm^2 are a compromise of count rate and good resolution requirements. ^{24}Mg will be used as the calibration target where precise excitation energies are known [14] up to 13MeV. ^{12}C and Mylar targets will be used to evaluate the background in the spectra.

• **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 3 mm and10 mm thick ΔE plastic scintillator with a 2 mm Aluminum sheet in between will provide energy loss and timing signals for particle identification in the first two detectors for α-particles and ^{6}Li.

• **Beam time request**:
The total beam time request of 8 days will be used as follows:
a) 2 days for beam preparation, detector and particle identification verifications, ion-optical setup and dispersion matching.
b) 2 days for measurements on ^{26}Mg and all calibration targets. Count rates are about 200 events per hour for a ^{26}Mg target for an estimated cross section of 1 μb/sr, a solid angle of 2.4 msr, a detector efficiency of 0.8 and a beam current of 100 pnA.
c) 2 days for change over to a ^{6}Li beam (360MeV) and dispersion matching.
d) 2 days for measurements on the ^{22}Ne gas target.