

**Experiment Proposal at RCNP using WS course and Grand Raiden, 01/27/2004**  
**Resonance States in Proton Rich  $^{42}\text{Ti}$  and  $^{46}\text{Cr}$  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 3 days are needed for cyclotron optimization (momentum spread) beam line matching, spectrometer setup, and 7 days for production and calibration measurements.

**Beam Line:** Dispersive WS beam line and Grand Raiden Spectrometer in  $0^\circ$  mode.

**Beam Requirements:**  $^4\text{He}$  of 206 MeV, minimum current 150 pA, energy spread  $< 100$  keV, single turn halo-free, fully dispersion matched.

**Special Equipment required:** Existing GR  $^4\text{He}$ -stop for  $^8\text{He}$  reaction products in D1, and 1, 10 and 6 mm thin plastic detectors for  $\Delta$ -E, E and veto signals.

**Budget:** Targets to be purchased  $^{46}\text{Ti}$ ,  $^{50}\text{Cr}$ , and  $^{13}\text{C}$ , 2 mg/cm<sup>2</sup> thick: 0.5 MYen

## 1 Summary of the Proposal

- **Proposed experiment:** Measurements of ( $^4\text{He}, ^8\text{He}$ ) on  $^{46}\text{Ti}$  and  $^{50}\text{Cr}$  targets with astrophysical motivation are proposed using the WS course and GR. GR will be used in a  $0^\circ$  mode with a specially designed Faraday cup inside dipole D1. After several development runs and successful experiments using the ( $^4\text{He}, ^6\text{He}$ ) reaction and the development of a high intensity  $^4\text{He}$  beam of  $> 150$  pA the feasibility of the ( $^4\text{He}, ^8\text{He}$ ) reaction is now established.

- **Targets:** The targets of astrophysical interest are  $^{46}\text{Ti}$  and  $^{50}\text{Cr}$ . A  $^{13}\text{C}$  target with a relatively large ( $^4\text{He}, ^8\text{He}$ ) cross section will be used for energy calibration. Target thicknesses of about 2 mg/cm<sup>2</sup> will be used, a compromise of count rate and good resolution requirements.

- **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 1 mm, 10mm, 6 mm thick  $\Delta$ E plastic scintillator will provide energy loss and timing signals for particle identification in the first two detectors for  $^6\text{He}$  and  $^8\text{He}$  particles. The  $^4\text{He}$  and lighter particles will pass through the first two detectors and provide a veto signal in the third, 6 mm thick detector.

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

- a) 3 days for beam preparation, detector verifications, ion-optical setup and full dispersion matching for the ( $^4\text{He}, ^8\text{He}$ ) reaction.

- b) 1 day of  $^{13}\text{C}(^4\text{He}, ^8\text{He})^9\text{C}$  and ( $^4\text{He}, ^6\text{He}$ ) reactions of selected targets for energy calibration. (300 events/day in g.s.)

- c) 3 days for measurements on  $^{46}\text{Ti}(^4\text{He}, ^8\text{He})^{42}\text{Ti}$ . Expected counts for the g.s. is about 100 events/day, excited states: 20 events/day

- d) 3 days for measurements on  $^{50}\text{Cr}(^4\text{He}, ^8\text{He})^{46}\text{Cr}$ .