RCNP EXPERIMENT E243

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

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

Spokespersons: G.P.A. Berg
Kernfysisch Versneller Intituut, 9747 AA Groningen, The Netherlands
Ph: 31-50-363-3558, FAX: 31-50-363-4003, E-Mail: gpberg@kvi.nl
K. Hatanaka
Research Center for Nuclear Physics, Osaka Univ., Osaka 567-0047, Japan
Ph: 81-06-6879-8928,FAX: 81-06-6879-8899,E-Mail:hatanaka@rcnp.osaka-u.ac.jp
M. Wiescher
University of Notre Dame, Notre Dame, IN 46556, USA
Ph: 001-219-631-6788, FAX: 001-219-631-5952, E-Mail: wiescher.1@nd.edu

Experimental Group: T. Adachi, D2, Dept. of Physics, Osaka Univ., Japan
A. Bacher, Professor, IUCF, Indiana Univ., Bloomington, IN, USA
A. van den Berg, Research Physicist, KVI, Groningen, The Netherlands
G.P.A. Berg, Senior Physicist, KVI, Groningen, The Netherlands
C.C. Foster, Research Physicist, Foster Consulting Services L.L.C., USA
Y. Fujita, Associate Professor, Dept. of Physics, Osaka Univ., Japan
H. Fujita, Research Fellow, WITS, Univ. of South Africa
K. Fujita, D1, RCNP, Osaka Univ., Japan
J. Görres, Research Professor, Univ. of Notre Dame, USA
K. Hatanaka, Professor, RCNP, Osaka Univ., Japan
S. Kubono, Professor, CNS, Univ. of Tokyo, Japan
H. Schatz, Associate Professor, Michigan State Univ., USA
Y. Sakemi, Associate Professor, RCNP. Osaka University, Japan
Y. Shimbara, Research Fellow, Dept. of Physics, Osaka Univ., Japan
Y. Shimizu, D2, RCNP, Osaka Univ., Japan
Y. Tageshige, M2, RCNP, Osaka Univ., Japan
A. Tamii, Associate Professor, RCNP, Osaka Univ., Japan
T. Wakasa, Associate Professor, Kyushu Univ., Japan
M. Wiescher, Professor, Univ. of Notre Dame, USA
H. Wörtche, Research Physicist, KVI, Groningen, The Netherlands
M. Yosoi, Research Associate, RCNP, Osaka Univ., Japan

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° mode.

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

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

Budget: Targets to be purchased ^{46}Ti, ^{50}Cr, and ^{13}C, 2 mg/cm^2 thick: 0.5 MYen

1 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 GR. GR will be used in a 0° mode with a specially designed Faraday cup inside dipole D1. After several development runs and successful experiments using the (^{4}He,^{6}He) reaction and the development of a high intensity ^{4}He beam of $>$ 150 pnA the feasibility of the (^{4}He,^{8}He) reaction is now established.

• **Targets:** The targets of astrophysical interest are ^{46}Ti and ^{50}Cr. A ^{13}C target with a relatively large (^{4}He,^{8}He) cross section will be used for energy calibration. Target thicknesses of about 2 mg/cm^2 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 ΔE plastic scintillator will provide 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, 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}He,^{8}He) reaction.

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

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

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