E381

RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

11 July 2011

TITLE:

Search of potential resonances in the ^{12}C+^{12}C fusion reaction using charged-particle decays from the ^{24}Mg(α,α')^{24}Mg* reaction

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EXPERIMENTAL GROUP:

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RUNNING TIME: Installation time and access to Grand Raiden before beam time 5 days

Setup with beam(detector tests, disp. matching)	3 days
Energy and angle calibration runs	1 day
Check the contribution from carbon and oxygen contaminants	1 day
Data runs	4 days

BEAM LINE: Fully dispersion matched WS beam line and Grand Raiden Spectrometer in the mode of Faraday cups behind Q1.

BEAM REQUIREMENTS:

Type of particle	α beam
Beam energy	388 MeV
Beam intensity	$\leq$ 20 enA
Any other requirements: Energy spread $\leq$ 100 keV Single turn halo-free beam, small emittance, fully dispersion matched beam on GR target.	

BUDGET: Experimental expenses for Si strip detectors and ^{24}Mg target 2,800,000 yen

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SPOKESPERSON: X. Tang, G.P.A. Berg, T. Kawabata

SUMMARY OF THE PROPOSAL

The ^{12}C+^{12}C fusion reaction is an important reaction for various stellar evolution scenarios, such as massive stars, type Ia supernovae and superbursts. There are hints from both nuclear and astrophysical studies suggesting the existence of $0^+/2^+$ resonances around $E_{c.m.}$=1.5 MeV (Excitation energy E_x = 15.4 MeV in ^{24}Mg) that may enhance the carbon burning reaction rate. We propose to search for these resonances using the ^{24}Mg(α,α'+X) reaction. To establish a reliable correlation between the ^{24}Mg states and the measured ^{12}C+^{12}C resonances, the energies of the populated 0^+ and 2^+states will be determined with an accuracy about 20 keV. The charged particles decaying from ^{24}Mg*,namely α, ^{8}Be and p, will be measured in coincidence with the inelastically scattered α particle to provide further constraints on those correlated states. Finally, using the correlation observed at higher energies, we will search for possible resonant states within the excitation energy range of 14 to 16 MeV, which is not accessible at present in fusion measurements.