E404

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

Measurement of radiative widths of excited states above the α-decay threshold in ^{12}C

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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H. Akimune	Department of Physics, Konan University	P
H. Fujimura	Wakayama Medical University	L

RUNNING TIME:

Installation time without beam	3.0 days
Test of VDC	1.0 day
Setup and beam tuning time	1.0 day
Data runs using the CH_2 target	10.0 days
Background runs using the C target	2.0 days
Total	3.0 days + 14.0 days

BEAM LINE: AVF : WS course

BEAM REQUIREMENTS:

Type of particle	$^{12}C^{5+}$
Beam energy	250 MeV
Beam intensity	$\leq$ 1 pnA
	Energy resolution $\leq$ 200 keV

BUDGET: Experimental expenses 2,000,000 yen

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SUMMARY OF THE PROPOSAL

Excited states in ^{12}C nuclei play a very important role in the nucleosynthesis in the universe. In the normal sequence of the stellar nucleosynthesis, the triple α reaction for the helium burning proceeds through the 0_2^+ state (Hoyle state) at $E_x = 7.65$ MeV in ^{12}C. Since the highly excited 3α resonances such as the 3_1^- state at $E_x = 9.64$ MeV locates about 2-MeV above the α-decay threshold, these states contribute little to the triple α reaction under the normal circumstance in the stellar revolution. However, these highly excited resonances might play a part of the triple α reaction at very high temperature $T_9 > 1$.

To decide the rate of the triple α reaction, the radiative widths Γ_γ of the 3α resonances are the most important observables. Γ_γ for the 0_2^+ state is known to be 3.7 ± 0.5 meV, but that for the 3_1^- state is still unknown.

In the present work, we propose a new experiment to determine the radiative width of the 3_1^- state by means of the proton inelastic scattering under the inverse kinematic condition. A thin solid hydrogen target with a thickness of 0.5 mm will be bombarded by a 250-MeV ^{12}C beam, and the scattered ^{12}C and recoil proton are measured by the Grand Raiden spectrometer and Si + CsI telescope. The formation of the 3_1^- state was identified from the angle and energy of the recoil proton. If the 3_1^- state decays into the ground state by radiative transition, the scattered ^{12}C should be detected in coincidence with the recoil protons, otherwise, the 3_1^- state decays into 3α particles and the scattered ^{12}C is not detected. Thus, the radiative width of the 3_1^- state will be determined by comparing the number of the coincidence events with that of the singles events exciting the 3_1^- state.