E387

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:
Non-Resonant Triple-α Reaction Rate at Low Temperature

SPOKESPERSONS:

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EXPERIMENTAL GROUP:

Name	Institution	Title or Position
N. Aoi	RCNP, Osaka Univ., Japan	Professor
H. Fujita	Dep. of Physics, Osaka Univ., Japan	Research Fellow
Y. Fujita	Dep. of Physics, Osaka Univ., Japan	Associate Professor
K. Hatanaka	RCNP, Osaka Univ., Japan	Professor
T. Hashimoto	RCNP, Osaka Univ., Japan	Assistant Professor
T. Kawabata	Dep. of Physics, Kyoto Univ., Japan	Associate Professor
K. Miki	RCNP, Osaka Univ., Japan	Post-Doctor
M. Itoh	CYRIC, Toho Univ., Japan	Assistant Professor
T. Itoh	Niigata Univ., Japan	M2
H.J. Ong	RCNP, Osaka Univ., Japan	Assistant Professor
H. Sakaguchi	RCNP, Osaka Univ., Japan	Research Fellow
T. Shima	RCNP, Osaka Univ., Japan	Assistant Professor
T. Suzuki	RCNP, Osaka Univ., Japan	Assistant Professor
T. Yamamoto	RCNP, Osaka Univ., Japan	M1

THEORETICAL SUPPORT:

Name	Institution	Title or Position
K. Ogata	RCNP, Osaka Univ., Japan	Associate Professor
M. Kamimura	RIKEN, Japan	Research Fellow

RUNNING TIME:

Installation time without beam	2 days
Beam tuning time for experiment	1.0 days
Data runs	9.0 days

BEAM LINE: Ring : WS course

BEAM REQUIREMENTS:

Type of particle	p
Beam energy	65 MeV
Beam intensity	$\leq$ 50 pnA
Any other requirements	energy resolution $\leq$ 20 keV halo-free, small emittance, dispersed beam

BUDGET: Experimental expenses 500,000 yen

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Non-Resonant Triple-α Reaction Rate at Low Temperature

SPOKESPERSON: Atsushi Tamii

SUMMARY OF THE PROPOSAL

The triple α reaction rate in stars is quite important in the astrophysical scenarios of the stellar evolution, accreting supernova, X-ray burst, explosive supernova, and synthesis of carbon and heavier elements. Recently, the theoretical treatment of non-resonant triple α reaction in widely used compilation of NACRE has been questioned by K. Ogata *et al.* The non-resonant triple α reaction rate has been reevaluated by a sophisticated calculation with continuum-discretized coupled-channels (CDCC) method, which dramatically increased the rate at low temperature. The enhancement have brought great impact on astrophysical model simulations. For example, the red-giant phase almost disappears in the standard stellar evolution calculations, which obviously contradicts astrophysical observations. Thus the result is very challenging to astrophysical models. There have been big discussions and reports from astrophysical studies in addition to nuclear reaction studies. Nuclear reaction studies are almost in an agreement that the NACRE rate must be tremendously enhanced at low temperature. The amount of enhancement is, however, much model dependent. Proper treatment of quantum mechanical effect among three objects at long distances with long-range interaction is the key issue. The theoretical works have great impact on not only the astrophysical study but also theoretical treatment of any three or more body system including nuclear fusion, fission, and possibly atomic or chemical processes where a long range interaction and quantum mechanical effect are essential, The conclusion must be clearly drawn in the field of nuclear physics.

We propose to measure the three-α continuum in ^{12}C with high-resolution and high-sensitivity to experimentally draw conclusion on the non-resonant triple α reaction rate at low temperature.