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RCNP EXPERIMENT E

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:

Study for high-spin oblate shape isomer by using RI beam induced fusion reaction

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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Takeshi Koike	Tohoku University	Associate Professor
Michael Carpenter	Argonne National Laboratory	Staff Physicist
Paul Fallon	Lawrence Berkeley National Laboratory	Staff Physicist
and CAGRA collaboration		

RUNNING TIME :

Installation time without beam	1-7 days
(It depends on the readiness of CAGRA.)	
Beam tuning for ^{17}N RI beam	: 2 days
Data runs	: 7 days

BEAM LINE: EN course

BEAM REQUIREMENTS :

Type of particle	^{18}O
Beam energy	9.2 MeV/u
Beam intensity	1.5 pμA

BUDGET :

Experimental expenses	1,300,000 yen

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Study for high-spin oblate shape isomer by RI beam induced fusion reaction

SPOKESPERSON: Atsuko Odahara

SUMMARY OF EXPERIMENT

Study for shape evolution as a function of isospin and angular momentum enables us to disentangle competition between single-particle and collective motions in finite quantum many-body system. For this study, isomer search is one of the best experimental methods, as the isomer is very efficient probe for the shape change. For example, high-spin isomers in N=83 isotones with $60 \leq Z \leq 67$, give us information of sudden shape change from spherical shape to oblate deformation. Therefore we can call them high-spin oblate shape isomer. Systematic study of high-spin oblate shape isomers enable to extract interesting topics; (1)decrease of the Z=64 sub-shell gap energy between $2d_{5/2}$ and $1h_{11/2}$ single-particle orbits as the decrease of the proton number from 64 and (2) experimental pairing-gap energy of high-spin states. To expand the systematical study of the high-spin oblate-shape isomers in nuclei with wider proton number, we propose to search for isomers in ^{142}Pr with N=83 and Z=59.

As this ^{142}Pr nucleus locates in the mass region close to the β-decay stability line, it is difficult to populate high-spin states by the reaction using combination of stable beam and stable target. On the other hand, the RI beam induced fusion reaction enables to produce high-spin states with the largest cross section and to bring the best S/N γ-ray spectrum, even if beam intensity is too low comparing the stable beam. Therefore, we propose to search for high-spin oblate shape isomers by low-energy (around 5-10 MeV/u) RI beam induced fusion reaction at EN course combined with CAGRA to search for isomers in ^{142}Pr. CAGRA, germanium-detector array for γ-ray, combined with the Si-ball, silicon-detector array for charged particles, can provide us high-efficiency and high-S/N measurement for this isomer search experiment by using RI beam.

The RI beam of ^{17}N will be delivered using EN course with the ^{9}Be(^{18}O,^{17}N)^{10}B primary direct reaction. The nucleus ^{142}Pr will be produced by the ^{130}Te(^{17}N, 5n) secondary fusion reaction. Isomers can be searched by the delayed-$\gamma\gamma$ coincidence method as well as by the analysis of γ-ray spectra with delayed component in time difference between γ-ray and RI beam.

We request 2 days for beam tuning of the ^{17}N RI beam and 7 days for data run.