RCNP EXPERIMENT E344

PROPOSAL FOR EXPERIMENT AT RCNP

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TITLE:
Search for high-spin isomeric states in N=80 isotones

SPOKESPERSON:

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EXPERIMENTAL GROUP:

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T. Morikawa	Dep. of Physics, Kyushu Univ.	Assistant Professor

RUNNING TIME:	Installation time without beam	7 days
	RI beam tuning	1 days
	Data runs	10 days
	In total, we request	11 days.
BEAM LINE:		Ring : EN course

BEAM REQUIREMENTS:	Type of particle	^{18}O
	Beam energy	66 MeV (9.2 MeV/u)
	Beam intensity	3 pμA

BUDGET:	Experimental expenses	2,700,000 yen

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SUMMARY OF THE PROPOSAL

We propose to investigate high-spin metastable states in nuclei around the N=82 shell closure, which having simple configurations, constitute ideal laboratories for the study of excited states in mesoscopic quantum systems. The comparison of the experimental and theoretical excitation energy of the many-quasiparticle isomers will allow us to extract the amount of pairing correlations and their reduction with seniority in the highly excited states of the nucleonic superfluid system.

In the present experiment we want to study high-spin states in the N=80 nucleus 136Ba, which being close to stability, can be populated at high spins using the unique fusion-evaporation reaction employing the neutron-rich ^{17}N radioactive beam available at RCNP and the heaviest Sn isotope ^{124}Sn as target. There is no other stable projectile-target combination which can populate high-spin states in ^{136}Ba.

The identification of the predicted 14+ and 22+ high-spin isomers in 136Ba will proof the yrastness of the maximum aligned multi-quasiparticle configurations in the N = 80 nuclei, in which only the 20+ isomer in 140Nd is presently known. From the comparison with theoretical predictions of schematic and self-consistent models we will deduce the strength of the pairing correlations and find out if they persist in high-spin isomers as observed above N = 82. The study of the 136Ba nucleus with Z=56, having the Fermi surface in the middle of the d5/2/g7/2 sub-shell (between Z=50 and Z=64), is essential for the understanding of the evolution of the pairing correlations. In fact, the very different occupation of the d5/2/g7/2 sub-shell in the two nuclei (^{136}Ba has 8 proton holes in Z=64, while ^{140}Nd only 4), is expected to lead to sizable differences in the pairing correlations in the high-seniority maximum aligned states. The present experiment is also essential for our research program aimed to the identification of high-spin isomers in the N=80 series of isotopes, which will finally allow the extraction of the proton pairing gap Δp in high-seniority states from the odd-even mass differences.

The ^{17}N RI-beam will be delivered at the EN course by using the ^{9}Be(^{18}O,^{17}N)10B primary reaction. The separated 17N secondary beam will be transported through the spectrometer at F2 to bombard a ^{124}Sn target of 10 mg/cm2. The ^{136}Ba nuclei populated by the p4n reaction channel will be selected through the particle- coincidences between the Ge detectors and a charged particle detector array. The high-spin isomers will be searched for by using delayed-coincidences at the focal plane. Prompt-delayed-coincidences will also be registered and will be used to identify structures built above the isomeric state.

We request 1 day for the 17N RI-beam preparation and 10 days of data acquisition.