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Magnetic Moment Measurement of Isomeric State of Cu-75 Using Spin-aligned RI Beam at RIBF

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Unstable nuclei with extremely unbalanced proton-to-neutron ratio often exhibit evolved shell structure and collectivity such as vibrated/deformed shapes, which compete with each other to determine the resultant structure. The nuclear magnetic moment is one of the important observables with which we can catch a glimpse into the competition.
A technique to orient the nuclear spin is necessary for the magnetic moment measurement. Recently a scheme of the two-step reaction was developed to produce high spin alignment (rank-two orientation) in RI beams [1]. This scheme realizes high spin alignment as well as high production yield of RI beams by combining a technique of momentum dispersion matching at the beam transportation. It has opened up opportunities to produce spin alignment for unstable nuclei, for which the spin alignment would have tended to significantly attenuate if the conventional scheme was employed because of the mass difference between a projectile and the final fragment.
The two-step scheme was employed in the magnetic moment measurement of the isomeric state of the neutron-rich nucleus Cu-75. The experiment was carried out at RIBF. The Cu-75 beam with spin alignment reaching 30% was produced from a primary beam of U-238 via an intermediate product of Zn-76. For the measurement of the magnetic moment, a method of time-differential perturbed angular distribution (TDPAD) was employed. Owing to the high spin alignment realized with the two-step scheme, the oscillation in the TDPAD spectrum was observed with significance larger than 5 sigma. The magnetic moment of the 66.2-keV isomer, which is one of the two low-lying isomers in Cu-75, was determined for the first time.
In this talk, the magnetic moment measurement employing the two-step scheme will be introduced and the result of the experiment of Cu-75 will be presented. Discussions on the competition between shape and shell at the neutron-rich Cu isotopes, through the precise analysis of the magnetic moment with a help of the state-of-the-art Monte Carlo shell model calculation, will also be given.
References:

[1] Y. Ichikawa et al., Nature Phys. 8, 918 (2012).

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