Enhanced Gamma Vibration And A Long-lived K Isomer In Axially Symmetric 172dy

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The γ vibration is one type of quadrupole shape oscillation in well-deformed nuclei, which causes an instantaneous breaking of axial symmetry. Experimentally, the existence of low-lying γ-vibrational band built on the $K^{\pi} = 2^{+}$ band head can serve as a signature of enhanced non-axial quadrupole collectivity. In this contribution, we will present the first spectroscopic results of the ground-state and γ-vibrational bands in $^{172}Dy_{106}$, the most neutron-rich Dy isotope studied to date.

The experiment has been carried out at the RI-Beam Factory at RIKEN using a high-intensity ^{238}U beam at 345 MeV/u. Gamma rays following β and isomeric decays of fission fragments were detected by the EURICA setup. The excited states of ^{172}Dy have been populated through the decay from a newly identified isomeric state and via the β decay from ^{172}Tb. This isomer has the same configuration as the $K^{\pi} = 8^{-}$ isomers that had been identified in the $N = 106$ isotones from $Z = 68$ to 82. The robust nature of the $K^{\pi} = 8^{-}$ isomer and the ground-state rotational band reveals an axially-symmetric structure for this nucleus. Meanwhile, the γ-vibrational levels have been identified at particularly low excitation energy compared to the neighbouring well-deformed nuclei, indicating the significance of the microscopic effect on the non-axial collectivity in this doubly mid-shell region. The underlying mechanism of the enhanced γ vibration in the neutron-rich Dy isotopes will be discussed in comparison with the deformed Quasiparticle Random-Phase Approximation based on a Skyrme energy-density-functional.