Search for chiral doublet in ^{79}Kr with Hyperball2 array

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Nuclear chirality has been an interesting and debated topic in nuclear structure studies. This phenomenon involves spontaneous symmetry breaking and triaxial deformation. Nearly degenerate pairs of $\Delta I = 1$ rotational bands, which are interpreted as a manifestation of chirality [1], are observed systematically in several odd-odd and a few odd-A nuclei in the $A \sim 130$ and $A \sim 100$ regions. In these odd-odd nuclei, left- and right handed chiral geometries in the body-fixed frame can be formed from the mutually perpendicular angular momenta of the valence proton, valence neutron and the core rotation. In odd-A nuclei, chiral bands are built on the 3 quasi-particles configuration in which a broken pair provides one of the three angular momenta. For experimentally, two major criteria must be fulfilled [2]; (i) the observation of nearly degenerate $\Delta I = 1$ bands built on the same single-particle configuration and (ii) identical electromagnetic properties, namely similar $B(E2)$ and $B(M1)$ values of in-band and interband transitions [3]. Consequently, we had done two experiments; (i) Search for chiral candidates in new mass region with Hyperball2 array and (ii) Lifetime measurement of candidates chiral doublet bands in the ^{103,104}Rh isotopes with Gammasphere array and Cologne plunger device. The result of second experiments was published quite recently [4], we present about result of first topic in this conference.

In the mass 80 region, the best single particle configuration for chiral geometry is $\pi g_{9/2} \otimes \nu {g_{9/2}}^{-1}$ for an odd-odd nucleus. Angular momentum of valence proton is aligned along the short axis, and that of valence neutron is aligned along the long axis where three axes are defined by triaxial mass distribution. This mechanism is similar to $\pi h_{11/2} \otimes \nu {h_{11/2}}^{-1}$ in the mass 130 region. Thus it is expected to find similar doublet bands; however, no search has been done and we tried to search for chiral twin bands in ^{79}Kr as the first nuclei for this region. High spin states in ^{79}Kr were populated via the ^{70}Zn(^{13}C, 4n) reaction at the beam energy of 65MeV obtained from the 930 AVF cyclotron at Tohoku University, impinging upon a stack of two self-supporting 500 μg/cm^2 thickness ^{70}Zn targets. The emitted γ rays were detected with the Hyperball2 array consisted of 6 Clover-type and 14 normal-type germanium detectors with BGO anti-Compton suppressors. This array is developed not only for in-beam gamma-ray spectroscopy but also for hyper-nuclear gamma-ray spectroscopy [5]. A total of approximately 370-million triple gamma coincidence events was sorted into a cube, and level scheme of ^{79}Kr was deduced.

New side band linking to the yrast band was found. The spin and parity for the new band were assigned based on the linear polarization measurement of the linking transitions with the clover detectors. The analysis shows that the two bands are not degenerate in energy with a displacement of ∼1MeV, and the single particle behavior is not the same. Furthermore, $S(I) = [E(I) - E(I-1)]/2I$ of the side band indicates odd-even spin dependence. Therefore, we conclude that the current results point to different characters from chirality of the side band.

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