Study of High-Spin Isomer in ^{151}Er using Ar Beam

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High-spin isomers are systematically studied in $N = 83$ isotones [1]. Life times of these isomers range between $\sim$10 ns and $\sim\mu$s. Their spins and parities are $49/2^+$ and 27^+ for odd and odd-odd nuclei, respectively, in $N = 83$ isotones with $60 \leq Z \leq 66$. Configurations of high-spin isomers are deduced experimentally and theoretically [1] to be $[\nu(f_{7/2}h_{9/2}i_{13/2})\pi {h_{11/2}}^2]_{49/2^+}$ for odd nuclei and $[\nu(f_{7/2}h_{9/2}i_{13/2})\pi(d_{5/2}{h_{11/2}}^2)]_{27^+}$ for odd-odd nuclei. These isomers are of stretch coupled configurations and have oblate shapes. They can be categorized to be high-spin shape isomers, as they are caused by the sudden shape change from near spherical to an oblate shape [2]. By the systematic study of high-spin isomers, several results were obtained, such as (1) change of Z=64 sub-shell gap energy [2] and (2) experimental pairing gap energy at high-spin states [3]. The Z=64 sub-shell gap energy was found to decrease from 2.4 to 1.9 MeV as the proton number decreases from 64 to 60. Paring gap energies of high-spin states were experimentally extracted by the three-point expression using binding energies and excitation energies of high-spin isomers. These pairing gap energies at high-spin states are as large as those of the ground states.

For the high-spin isomer in an $N = 83$ isotone ^{151}Er with $Z = 68$, spin-parity was reported to be $67/2^-$ by Grenoble group [4]. This spin-parity could not be reproduced by a deformed independent particle model [5], which explains well the isomerism of high-spin isomers in other $N = 83$ isotones. This model predicts that the spin-parity of the isomer would be $49/2^+$ or $61/2^+$. If the spin-parity of the high-spin isomer of ^{151}Er is really $67/2^-$, it requires to find a new mechanism to generate the isomer.

In order to study the isomerism of ^{151}Er, the experiment was carried out at EN course [6] in Research Center for Nuclear Physics (RCNP), Osaka University. The nucleus of ^{151}Er was produced by the reaction of ^{116}Sn(^{40}Ar,5n)^{151}Er. An enriched ^{116}Sn target of 1.4 mg/cm^2 was used with a lead backing of 11mg/cm^2 to stop the reaction products recoiled out from target. This target was bombarded by a ^{40}Ar beam of 200 MeV with intensity of around 25 enA. An ^{40}Ar beam was directly provided by the upgraded AVF cyclotron going through the new bypass beam line. Five high-purity germanium detectors were installed surrounding the target. The experiment was carried out using prompt and delayed $\gamma\gamma$ coincidence methods to reconstruct the level scheme of ^{151}Er. In order to determine the spin-parity of the high-spin isomer in ^{151}Er, measurements of γ-ray angular correlations and γ-ray linear polarizations were performed. Preliminary γ-ray gated spectrum is shown in Fig. 1. The detailed analyses are now in progress.

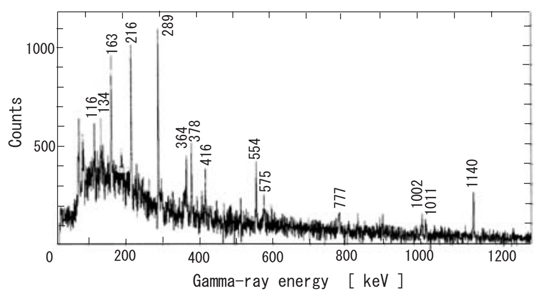

Figure 1: Gamma-ray spectrum gated by the doublet peak of 1100 keV in ^{151}Er.

References

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