

Lifetime Measurement in $^{103,104}\text{Rh}$ with RDDS Method in Inverse Kinematics: A Test for Nuclear Chirality

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A spontaneous symmetry breaking is a common keyword in modern physics. Chiral symmetry breaking in nuclear structure has recently been debated.

This phenomenon is related to time reversal and arises from mutually perpendicular angular momenta of the valence proton, valence neutron, and core rotation in the body fixed frame. The nuclear chirality results in a nearly degenerate pair of $\Delta I = 1$ rotational bands, called chiral doublets.

First experimental step is to identify such a twin rotational bands, which are observed several odd-odd and a few odd- A nuclei in the $A \sim 130$ and $A \sim 100$ regions.

However, in the case of ^{134}Pr , $B(M1)$ and $B(E2)$ values are clearly different between both bands, that is, their electromagnetic properties are very different.

Hence, lifetime measurement for chiral candidates were one of the major requirements for establishing nuclear chirality.

Indeed, a few candidates are measured, and the $B(E2)$ and $B(M1)$ values between both twin bands in ^{135}Nd are very similar.

A similar measurement in the other mass region of $A \sim 100$ has been much anticipated.

Chiral candidates for $^{103,104}\text{Rh}$, are considered one of the best cases to study by lifetime measurements via the recoil distance Doppler shift (RDDS) method.

The high spin states of $^{103,104}\text{Rh}$ were populated in the $^{11}\text{B}(^{96}\text{Zr},4(3)\text{n})^{103(104)}\text{Rh}$ reactions at the beam energy of 330-MeV provided by the Argonne Tandem Linear Accelerator System (ATLAS). The Cologne plunger device and GAMMASPHERE array were used.

The data were collected for 7 distances between the target and the degrader; 8, 15, 23, 35, 50, 75, 100- μm .

On average, a total of approximately 4×10^8 unfolded events were sorted into $\gamma - \gamma$ matrices for each distance.

The germanium detectors are grouped in 17 rings by the same polar angles.

However, only 7 rings having forward or backward angles with respect to the beam axis were analyzed.

About 80 matrices were analyzed, and three and four lifetimes of the levels suspected for chiral nature are measured in ^{103}Rh and ^{104}Rh , respectively.

The results of analysis will be presented and discussed.

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