2 - 3 Lifetime Measurement of the First $7/2^+$ State in ^{143}Eu Based on Gas-filled Spectroscopy

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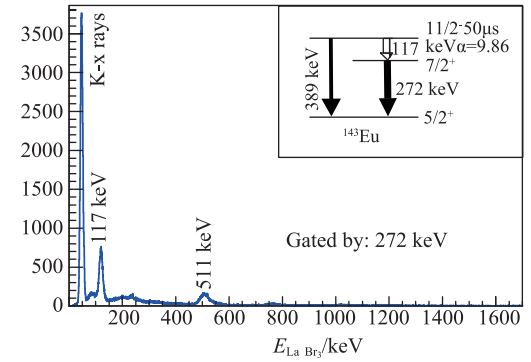

Fig. 1 $LaBr_3$ energy spectrum gated by 272 keV and partial level scheme below the 50 μs isomer of ^{143}Eu.

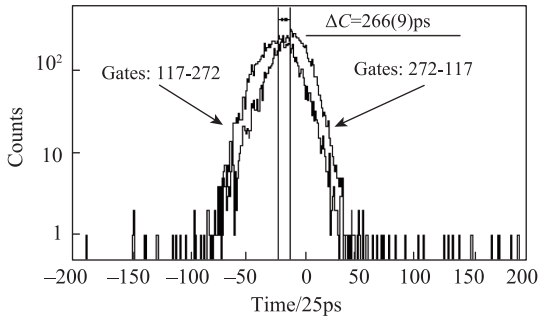

Fig. 2 The centroid difference between two time difference curves obtained by T_{117}-T_{272} and T_{272}-T_{117}, respectively. Considering the PRD and Compton background correction, the lifetime of $7/2^+$ excited state was deduced to be 109(17) ps.

The application of Lanthanum Bromide ($LaBr_3$) detectors provides a unique opportunity to measure lifetime of excited states in picosecond-nanosecond region. Reducing the background is of critical importance to get precise results. For some excited states feeding from isomers with lifetime longer than 1 μs, it can be achieved by the Spectrometer for Heavy Atom and Nuclear Structure (SHANS)[1].

^{143}Eu nuclei were populated via the ^{123}Sb(^{24}Mg, 4n) fusion-evaporation reaction. Most of the evaporation residues at ground state or long-lived isomers were transferred to detection terminal after a flight of about 1.4 μs in SHANS. In the case of ^{143}Eu, three transitions have been observed (Fig. 1). Since the background was reduced, the coincidence between 117 and 272 keV transitions is clear and the lifetime of the first $7/2^+$ state can therefore be deduced from time difference spectra between these two transitions.

Following the centroid shift method introduced by Régis *et al.* [2], the lifetime of $7/2^+$ excited state was deduced to be 109(17) ps (Fig. 2). The ground state $5/2^+$ and the first $7/2^+$ state are dominated by $\pi d_{5/2}$ and $\pi g_{7/2}$ configurations, respectively. M1 transition linking the two configurations is forbidden by l selection rule. The remained transition probalities are mainly contributed by the mixing from multi-quasiparticle configurations.

References

[1] Z. Y. Zhang, L. Ma, Z. G. Gan, et al., Nucl. Instr. and Meth. B, 317 (2013)315.

[2] J. M. Régis, G. Pascovici, J. Jolie, et al., Nucl. Instr. and Meth. A, 622(2010)83.