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Investigation of ER-gated spin distributions for ^{16}O + $^{203, 205}Tl$ systems

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Evaporation residues (ERs), being the clearest signature of compound nucleus (CN) formation, serve as an effective probe for studying fusion dynamics. Their spin distributions provide insight into the angular momenta contributing to the fusion process. Although angular momentum distributions have been studied for several light and medium-mass systems, data for heavy nuclei ($A \gtrsim 200$) remain limited, where fission and quasifission strongly affect reaction dynamics. Systematic studies of ER cross sections and spin distributions in this mass region would help investigate the fusion–fission competition, the role of nuclear deformation and shell effects on ER formation, and their survival against fission [1].

In our previous work, ER cross sections were measured for the systems ^{16}O+$^{203,205}Tl$, where evidence of non-compound nuclear fission (NCNF) was observed in both reactions [2]. A detailed investigation of the partial waves contributing to CN and NCNF processes is therefore of considerable interest. In the present study, we aim to investigate the ER-gated spin distributions for the reactions^{16}O+$^{203,205}Tl$.

The experiment was carried out using pulsed ^{16}O beam, from the 15 UD Pelletron accelerator at IUAC, New Delhi [3], on ^{203}Tl and ^{205}Tl targets [4]. ERs were separated from the background using the first stage of the HYbrid Recoil mass Analyzer (HYRA) [5] operated in gas-filled mode. The TIFR 4π spin spectrometer [6], with 32 NaI detectors surrounding the target chamber, measured γ-fold distributions from the de-exciting compound nuclei ^{219}Ac and ^{221}Ac. The raw γ-fold spectra were gated with ERs at each E_{lab} to obtain ER-gated γ-fold distributions.

ER-gated γ-fold distributions were converted to γ-multiplicity distribution using a detector response matrix generated through a recursive algorithm [7]. The ℓ- distribution was derived from the γ-multiplicity distribution using a generalized relation [8] between the mean γ-multiplicity ⟨Mγ⟩ and the mean angular momentum ⟨ℓCN⟩, based on the CN decay scheme. Fig. 1 illustrates typical multiplicity and spin distributions for the ^{16}O + ^{203}Tl system at E_{lab} 92.33 MeV. Complementary theoretical calculations are expected to provide a more comprehensive understanding of the fusion reaction dynamics, which are ongoing.

References

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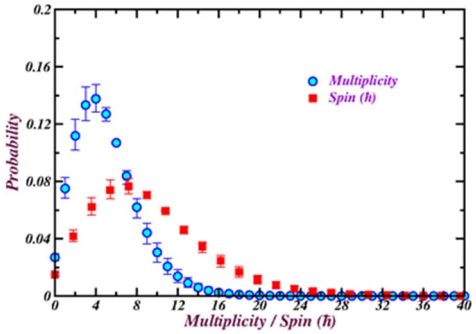

FIG. 1: γ-multiplicity and spin distributions for ^{16}O + ^{203}Tl at E_{lab} = 92.33 MeV.

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