The 2nd International African Symposium on Exotic Nuclei IASEN2024



Contribution ID: 33

Type: Oral

## Characterization of ternary and quaternary particle emission in spontaneous fission of <sup>252</sup>Cf

In this study, the energy spectra and yields of various ternary and quaternary particles produced during the spontaneous fission of <sup>252</sup>Cf were measured and analyzed. Particles with atomic numbers Z = 1 to 6 were clearly identified, including hydrogen and helium isotopes such as <sup>1</sup>H, <sup>2</sup>H, <sup>3</sup>H, <sup>4</sup>He, <sup>6</sup>He, and <sup>8</sup>He. Distinct energy distributions were observed for each particle type, and Gaussian fitting was applied to estimate their yields and energies. The analysis successfully quantified the yields of ternary particles, including <sup>1</sup>H, <sup>2</sup>H, <sup>3</sup>H, <sup>4</sup>He, <sup>6</sup>He, <sup>8</sup>He, as well as heavier fragments like lithium (Li), beryllium (Be), boron (B), and carbon (C). In addition to ternary particle emissions, this study investigated quaternary fission (QF) processes in <sup>252</sup>Cf. Two main pathways were identified: pseudo-quaternary fission, resulting from the decay of unstable light charged particles (LCPs) such as <sup>7</sup>Li, <sup>8</sup>Be, and <sup>9</sup>Be<sup>\*</sup>, and true quaternary fission, characterized by the independent emission of two LCPs. Angular distributions of  $\alpha$ -particle coincidences from <sup>8</sup>Be decays were analyzed, and the results aligned with the predicted decay kinematics of <sup>8</sup>Be from both its ground and first excited states. Although the statistics were limited, the energy spectrum of ( $\alpha$ , t) pairs from the second excited state of <sup>7</sup>Li was successfully analyzed and compared to the ternary Li particle data. The study reported yields and energy spectra of particles from these processes.

## Notes

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