

Characterization of ternary and quaternary particle emission in spontaneous fission of ^{252}Cf

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In this study, the energy spectra and yields of various ternary and quaternary particles produced during the spontaneous fission of ^{252}Cf were measured and analyzed. Particles with atomic numbers $Z = 1$ to 6 were clearly identified, including hydrogen and helium isotopes such as ^1H , ^2H , ^3H , ^4He , ^6He , and ^8He . 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 ^1H , ^2H , ^3H , ^4He , ^6He , ^8He , 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 ^{252}Cf . Two main pathways were identified: pseudo-quaternary fission, resulting from the decay of unstable light charged particles (LCPs) such as ^7Li , ^8Be , and $^9\text{Be}^*$, and true quaternary fission, characterized by the independent emission of two LCPs. Angular distributions of α -particle coincidences from ^8Be decays were analyzed, and the results aligned with the predicted decay kinematics of ^8Be from both its ground and first excited states.

Although the statistics were limited, the energy spectrum of (α, t) pairs from the second excited state of ^7Li was successfully analyzed and compared to the ternary Li particle data. The study reported yields and energy spectra of particles from these processes.

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