

Investigation of ternary particles in the spontaneous fission of ^{252}Cf

This work investigates the light charge particle ($Z = 1$ to 6) in the spontaneous fission of ^{252}Cf . A position-sensitive ΔE - E telescope with excellent energy resolution was employed to identify and characterize the emitted particles. Transmission-type ΔE detectors from Micron Semiconductor, with thicknesses of $16\ \mu\text{m}$ and $150\ \mu\text{m}$, are used for specific energy loss (ΔE) measurements. Timepix detectors, in thicknesses of $300\ \mu\text{m}$ and $600\ \mu\text{m}$, measure the residual energy (E) of the emitted particles. Partial-energy spectra for the different ternary particle types were obtained due to the placement of aluminum foils ($30\ \mu\text{m}$) and ΔE detectors ($16\ \mu\text{m}$ and $150\ \mu\text{m}$) in front of the E detectors. The detector system achieves sufficient resolution to discriminate protons (^1H), deuterons (^2H), tritons (^3H), ^3He , and ^4He isotopes clearly.

Gaussian fitting of the measured partial-energy spectra allowed for the extraction of yield and energy information for each identified particle type. However, the ^1H spectrum required additional analysis due to potential contributions from background reactions such as $\text{Al}(\alpha, p)$, $\text{Al}(n, p)$, and $\text{Si}(n, p)$. The Talys nuclear reaction code was employed to quantify these contributions specifically for hydrogen. The calculations confirmed the presence of ^1H from the $\text{Al}(\alpha, p)$ reaction within the measured energy range. Background-free energy spectra were obtained by subtracting the calculated spectra from the experimental data. Gaussian fitting approach allowed to determine yields and kinetic energies for a broad range of light particles emitted during ternary fission of ^{252}Cf , including ^1H , ^2H , ^3H , ^4He , ^3He , ^6He , ^8He , Li, Be, B, and C.

Section

Nuclear physics (Section 1)

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