Gamma-ray Spectroscopy of Spontaneous Ternary Fission of ^{252}Cf

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A new experiment has been performed at GSI, aimed at the investigation of various aspects of γ-ray emission in spontaneous ternary fission of ^{252}Cf. The experimental setup (see Fig. 1) consists of the fission fragment (FF) and light charged particle (LCP) detector system CODIS2, and two segmented Super Clover Ge detectors facing the ^{252}Cf source at a distance of 8 cm. CODIS2 is the successor of CODIS (see [1, 2, 3, 4]), having a similar Frisch-gridded 4π twin ionization chamber (IC) with sectored cathode for measuring FF energies *and* emission angles, and two rings of LCP detectors with 12 ΔE-E telescopes each. Compared to CODIS, several modifications have been made for the FF IC to accept the higher counting rate (2×10^4 fissions/s) and for the LCP telescopes to improve mass and nuclear charge resolution. Figure 2 demonstrates the high separation power achieved for the LCP registration. The GSI segmented Super Clover Ge detectors used in the experiment are among the largest Ge detectors in the world consisting of 4 Ge crystals, each one 14 cm in length and 6 cm in diameter.

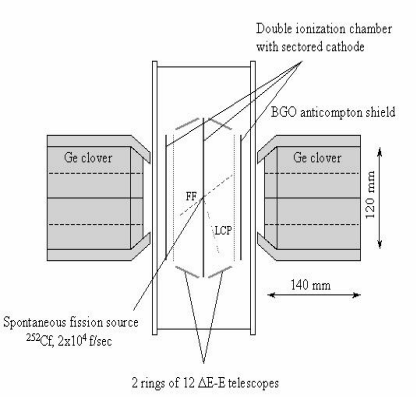

Figure 1: Sketch of the new experimental setup for the study of ^{252}Cf ternary fission. The central part is the FF and LCP detector system CODIS2, contained in a cylindrical vessel filled with 570 torr methane as the counting gas.

From the list-mode data registered during several weeks of measurement we will be able to deduce the following sets of parameters and their mutual correlations: masses, kinetic energies and emission angles of the FFs; masses, charges, kinetic energies and emission angles of the LCPs; energies and emission angles of the γ-rays.

Our main topics of interest include the following issues:

- *Gamma-ray spectroscopy of fission fragments.* By applying Doppler-shift corrections to the γ-rays emitted from the FFs in flight one can unambiguously assign the γ-ray transitions to particular FFs under given conditions on fragment masses and energies.

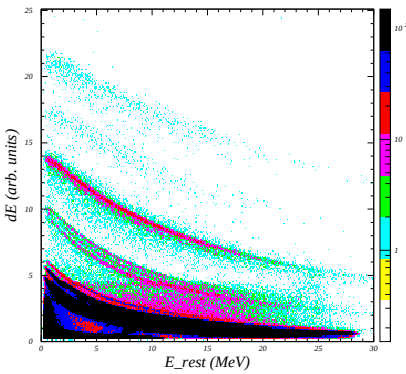

Figure 2: Sample plot for the separation of LCPs with the newly designed LCP telescopes. The plot shows ΔE-E_{rest} patterns from He to C LCPs (bottom to top). Note that for the Li LCPs the three parallel lines for the ^{7,8,9}Li isotopes are well separated from each other.

- *Angular anisotropy of γ-rays in binary and ternary fission.* Measurements of angular distributions of single γ-ray transitions may provide important information on the fragment spins and their alignment. Of special interest is the comparison between the binary and ternary data. In the latter case the FF spin population and alignment might be affected by the emission of the LCPs [4].

- *Emission of LCPs in excited states.* In addition to the γ-decay of the ^{10}Be first excited state observed in the previous measurement [2, 3], γ-rays from other LCPs (e.g., Li-isotopes) should become accessible.

- *LCP yields.* New data on isotopic ^{252}Cf LCP yields are obtained due to the outstanding resolution of the LCP telescopes.

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References

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