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Spectroscopy along Flerovium Decay Chains

Flerovium isotopes (element Z=114) were produced in the fusion-evaporation reactions ^{48}Ca+^{242,244}Pu in a decay spectroscopy experiment conducted at the GSI Helmholtzzentrum für Schwerionenforschung in Darmstadt, Germany. Within 18 days of beam time, 29 flerovium decay chains were identified by means of correlated implantation, α-decay, and spontaneous fission events. The study engaged an upgraded TASISpec decay station placed in the focal plane of the gas-filled separator TASCA. Data shows robust promise for spectroscopy of rare superheavy nuclei and benchmarks theoretical models at the upper limit of nuclear stability [1].

Besides doubling the number of directly produced odd-A ^{289}Fl nuclei, the spectroscopic results allow to establish α-decay fine structure along the ^{289}Fl chain. Supported by α-electron and α-photon coincidences and corroborated by Geant4 simulations, the results call for at least two parallel α-decay sequences starting from at least two different states of ^{289}Fl. The experimental results are discussed with extensive nuclear structure calculations based on the symmetry-conserving configuration mixing theory.

For even-even ^{288}Fl, a precise Q_α value was derived. For the first time, an α-decay branch was observed for ^{284}Cn. This led to the discovery of ^{280}Ds and the first determination of a Q_α series *across* Fl, and this Q_α series is *not* compliant with a pronounced magic shell gap at proton number Z=114. A consistent conclusion can be drawn from the first observation of an excited state in the even-even isotope ^{282}Cn - its sheer existence at relatively low excitation energy requires an understanding of both shape coexistence and shape transitions for the heaviest elements.

Experimental challenges, results, and nuclear structure impact will be discussed.

[1] https://www.nuclear.lu.se/english/research/basic-nuclear-physics/nustar/element-114-faq/

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