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Nuclear isomers – a probe of nuclear structure and deformation for the heaviest nuclei

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When the liquid drop fission barrier vanishes in the fermium-rutherfordium region only the stabilization by quantum mechanics effects allows the existence of the observed heavier species. Those are in turn providing an ideal laboratory to study the strong nuclear interaction by in-beam methods as well as decay spectroscopy after separation [1].

Among the nuclear structure features to be studied nuclear deformation and exotic shapes are the most intriguing, leading also to meta-stable states. In particular interesting are K-isomers detected up the heaviest one in 270Ds [2] which is located at the edge of the onset of the decent towards sphericity [1,3], following various theory predictions which are confirmed by recent experimental findings for the synthesis of superheavy nuclei (SHN) [4,5]. Initially low statistics data had been extended in a second experiment showing increasingly complex decay spectra, despite the even-even character of the investigated nuclei.

Detailed nuclear structure studies in terms of in-beam gamma spectroscopy or decay spectroscopy after separation (DSAS) are presently still hampered by the limited efficiencies of the existing experimental facilities. Detailed DSAS studies were up to now limited to deformed nuclei around the sub-shell closures in the region of Z=100-112 and N=152-162 [6]. The recently completed linear accelerator facility SPIRAL2 at GANIL in Caen, France [7], equipped with the versatile separator spectroscopy set-up S3 [8], planned to come online in 2023/2024 will address this problem with world-wide competitive beam intensities and efficient separation paired with effective mass identification.

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