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Lifetimes of medium-high spin states in neutron-rich fission fragments

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The experimental investigation of the structure of atomic nuclei reveals the presence of different shapes as, for example, spherical or ellipsoidal. The latter can have sizable deviation (i.e., deformation) with respect to the spherical shape. Nuclear deformation is found especially far from the magic numbers of nuclear stability. The evolution of nuclear shapes in different regions of the nuclear chart is the subject of extensive studies, by means of different experimental and theoretical techniques.
Recent experimental results on the deformation of neutron-rich nuclei with mass A~100 at medium-high spin (8-10h) will be presented. Those follow the measurement of the lifetimes of excited states to determine transition strengths, from which the magnitude of the deformation can be inferred. Particular focus will be on a novel implementation of the *Doppler Shift Attenuation Method* (DSAM) for the measurement of lifetimes of excited states in fission fragments. This method has been applied to the first set of data taken with an *active fission target* coupled to an array of germanium detectors. The nuclei have been populated via neutron-induced fission on U-235, dissolved in a liquid scintillator (fission *tag* via *active target*). This reaction, combined with a high-resolution gamma detection system, has allowed for high-statistics studies, complementary to the those performed, for example, at radioactive ion beam facilities. Thermal neutrons have been delivered by the *Institut Laue-Langevin* (ILL) nuclear reactor and the FIPPS (*FIssion Product Prompt gamma-ray Spectrometer*) instrument has been used for gamma-ray detection. The active target has allowed to "tag" the fission events, suppressing the gamma rays produced via the beta decay of the fission fragments. The experimental data have been compared to simulations obtained using a Geant4 Monte Carlo code developed for FIPPS. Different event generators, in particular the one for fission fragments, based on the FIFRELIN database, have been included in the simulation code, as well as the full geometry of the detection system and the gamma decay through complete level schemes. New results have been obtained for the lifetimes of excited states in Zr-(97,101) and Nb-(100,102) nuclei, together with the re-evaluated values for Zr-(99,100,101,102). These have been compared with the previously reported measurements in the literature, via an accurate evaluation of all the systematic errors.
A development of a plunger device for lifetime measurements in neutron-induced fission experiments will be also presented in the final perspectives.

Type of contribution

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