Isomers in heavy nuclei: structure and projectile fragmentation studies

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Fragmentation reaction proved to be a powerful tool in the study of neutron-rich nuclei. Using internal isomeric decay spectroscopy a large amount of experimental information was obtained on heavy neutron-rich nuclei in the Hf-Hg region during the last decade. This region is characterised by the presence of nuclei with different shapes in their ground-states, such as prolate, oblate, triaxial and spherical. Shape transitional nuclei are difficult to treat theoretically, consequently this region is considered to be a crucial testing ground for nuclear models. The exact place where the shape transition is predicted depends on the details of the theoretical calculations The prolate-oblate transitional region was reached experimentally for (Z=76) Os and Ir (Z=77), as proved by the observation of oblate isomeric states in 197,198,199Os and 201Ir [1]. For Ta (Z=73) and W (Z=74) isotopes no clear evidence of oblate deformation exists so far, with 192W and 189Ta being the most neutron-rich isotopes with spectroscopic information.

Studying the population of isomeric states information about the fragmentation reaction process can be obtained. Experimentally we cannot determine the population of a single state with a given angular momentum, but only the total population of all the states decaying into a long-lived isomeric state. Therefore, the study of the population at high angular momentum provides a much more stringent test of the theory than populations at lower angular momenta. Recently, new experimental results were obtained on a large number of high-spin states (with spins up to 55/2 hbar) in nuclei in the vicinity of the N=126 line, from the fragmentation of ^{238}U [2,3]. The population of these states is larger than expected from existing theoretical calculations, with implications on the feasibility of different experiments requiring isomeric beams.

The talk will discuss both nuclear structure results and population of isomeric states in the fragmentation reaction.

[1] S.J. Steer et al., Phys. Rev. C 84. 044313

(2011) [2] A. M. Denis-Bacelar et al., submitted.

[3] M. Bowry et al., to be published.