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Isomeric beams: population of high-spin states in projectile fragmentation

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Fragmentation (including spallation) is the main reaction mechanism used to produce exotic nuclei in the majority of the present and future radioactive beam facilities. However the understanding of the reaction mechanism is still not good enough to predict accurately the yields of exotic nuclei. The situation is worse in the case of isomeric states.

The main experimental observables to test the theory of peripheral fragmentation are the production cross sections, the longitudinal momenta of the fragments and isomeric ratios. 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.

An earlier study based on two data points suggested that for spin I ≥ 17ħ there is a higher population than predicted by theoretical models [1,2]. Recently, new experimental results were obtained on a large number of high-spin states (I ≥ 17ħ) in nuclei in the vicinity of the N=126 line, from the fragmentation of 238U [3,4].

The experimental results will be compared with models. The standard abrasion-ablation model based on macroscopic, geometrical approach in which the momentum of the fragments originate from the angular momenta of the removed nucleons is the most widely used; both cross section and isomeric ratio calculations are usually done with the ABRABLA code [5]. In addition the microscopic IntraNuclear Cascade model [6] will be employed. This model considers the individual nucleon-nucleon collisions, and the angular momentum originates from both single-particle removals and collective effects.

The talk will discuss the population of high-spin states in the light of the newly obtained results.

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