ROLE OF THE DELTA RESONANCE IN THE POPULATION OF A FOUR-PARTICLE STATE IN THE 56Fe→54Fe REACTION

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In a recent experiment performed at GSI, Germany, the $I^{\pi}=10^{+}$ isomeric state of ^{54}Fe was populated in the fragmentation of a ^{56}Fe beam at an energy of E/A=500 MeV. This state was identified via the detection of the delayed characteristic internal gamma-ray transitions. This metastable state requires at least four unpaired particles. Therefore, it cannot be populated by two neutron removal reactions. The isomer was populated in the low-energy tail of the ^{54}Fe distribution. The population of the isomer can be explained by considering inner excitations of a neutron, the Δ resonance. Other, higher-lying resonances might also play a role. The removed pion accounts for the lower kinetic energy, while in the process additional valence nucleons are created, contributing to the four-nucleon nature of the isomeric state.

The present result opens up the possibility to study the final nuclear states following the decay of in-medium Δ(1232) and other higher-lying resonances in relativistic energy heavy-ion collisions. The resonance production as well as the quantum state of the resulting nucleon, described by the linear and total angular momenta, after pion emission is expected to depend on the projectile as well as its energy. The existence of a large number of metastable states allows the extension of the present work to other regions of the nuclidic chart. Experiments focusing on nuclei with the same atomic mass as the projectile are the most promising as these allow the direct investigation of the process, without the interference caused by additional neutron or proton emission.

The experimental setup, obtained experimental results as well as the interpretation and its significance will be presented.