Study of Isospin transport fenomena in heavy ion collisions at Fermi energy

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This PhD thesis is developed in the framework of the FAZIA project [1]. FAZIA is an international collaboration aimed at the design of a 4π multiarray detector for the investigation of heavy ion reactions around Fermi energy ($25 \sim 35 AMeV$). The principal feature of FAZIA detector is the high performance in isotopic resolution of detected fragments. During the R&D phase a big efforts was done to improve the $\Delta E - E$ and PSA (Pulse Shape Analysis) techniques for the identification of fragments coming from a nuclear reaction. The results obtained are the best in the world panorama concerning the isotopic resolution for a Si based telescope detector (FAZIA is a three stages telescope with Si-Si-CsI(Tl) detectors) [2].

The R&D phase ended in 2015 and in June there was the first experiment (ISO-FAZIA) dedicated to the study of isospin transport effects and the fission of Quasi-Projectile i.e. the remnant of the projectile in binary collision.

For the ISO-FAZIA experiment we used 4 FAZIA Blocks (each block includes 16 telescopes) located in a belt configuration, symmetrically mounted with respect to the beam direction and covering the polar angles between 3.7° and 17.8° degrees. The investigated systems were $^{80}Kr + ^{48,40}Ca$ at $35 AMeV$.

My thesis is dedicated to the study of isospin drift and diffusion compairing the two systems with a different isospin content of the target. We expect to observe an enrichment in neutron content of the fragments detected in coincidence with QP in the neutron rich system (this is a hint of isospin diffusion related to the density gradient between projectile and target) and a neutron enrichment of light charged fragments coming from the neck with respect to heavier ones (this effect is caused by isospin drift driven by the isospin gradient between projectile and target) [3]. The observation of those effects is very important for the comparison with trasport models that can give us precious information about the symmetry energy term inside the nEoS (nuclear equation of state) [4].

References

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