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Transfer reactions induced with 56Ni: np pairing and N=28 shell closure

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Transfer reactions have been proven to be a powerful tool to understand nuclear structure. Two different physical aspects are being investigated with the use of transfer reactions on ^{56}Ni, which is a $N = Z$ unstable doubly magic nucleus.

$i)$ To probe the gap of $N = 28$, we study the spectroscopy of the $N = 29$ and $N = 27$ isotones by the (d, t), (p, d) and (d, p) one nucleon transfer reactions on ^{56}Ni ($N = 28$ isotone) and extract information on the single-particle configuration around the Fermi surface.

$ii)$ To study the np pairing in the self-conjugate nucleus ^{56}Ni, we have measured the two-nucleon transfer reactions $^{56}Ni(p,^3He)^{54}Co$ and $^{56}Ni(d,)^{54}Co$. In the $(p,^3He)$ reaction, the ratio of the population of the $T = 0$ and $T = 1$ states indicates a predominance of $T = 1$ pairing. The selectivity of the $(d,)$ reaction enables the investigation of the $T = 0$ channel with better precision.

During spring 2014 the experiment aiming to these studies took place at GANIL-Caen, France. The radioactive beam of ^{56}Ni at $30MeV/u$ was produced by fragmentation of ^{58}Ni and purification. Measurements were performed in inverse kinematics on CH_2 and CD_2 targets. The experiment included a 4π coverage for the study of the charged projectiles with the MUST2 and TIARA detectors, while 4 clovers of EXOGAM were also used for γ-particle coincidences in order to identify the populated state of the residue. The analysis of the $^{56}Ni(d,t)^{55}Ni$ and $^{56}Ni(d,p)^{57}Ni$ reactions yield the differential cross-section for transfer reaction to the ground state and the excited states of 55Ni and ^{57}Ni giving information about the shell closure and depicting the Fermi surface of ^{56}Ni. I will present the angular distribution and compare with the results for the (p, d), (d, t) and (d, p) reactions, as well as with DWBA calculations. The results for the transfer reaction $^{56}Ni(d,)^{54}Co$ will be also presented, completing the information about the strength of the isoscalar np pairing in the closure of the fp shell.

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