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Study of neutron-proton pairing in N=Z unstable nuclei through transfer reactions

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Nucleon-nucleon pairing can occur in T=0 and T=1 isospin channels: particle-like pairing (n-n or p-p) which is quite well-known can occur only in the isovector channel, whereas neutron-proton pairing can be in both T=1 and T=0 channels. Isovector n-p pairing should be similar to particle-like pairing due to charge invariance but isoscalar n-p pairing is mostly unknown. The over-binding of N=Z nuclei could be a manifestation of n-p pairing.

We have studied neutron-proton pairing through transfer reactions. Indeed, the cross-section for a n-p pair transfer is expected to be enhanced if there is an important n-p pairing. Neutron-proton pairing is expected to be important in N=Z nuclei with high J orbitals. We have used 52Fe and 56Ni beams at 30A MeV because current radioactive ion beam facilities cannot produce beams of 0g9/2 nuclei with enough intensity to measure two nucleon transfer reactions.

The measurement was performed at GANIL with radioactive beams produced by fragmentation of a 75A MeV 58Ni beam on a 185 mg.cm-2 Be target purified by the LISE spectrometer. An efficient set-up based on the coupling of the MUST2 and TIARA Silicon arrays for charged particle detection with the EXOGAM gamma-ray detector was used.

Using 52Fe (N=Z=26) which is a partially occupied 0f7/2 shell nucleus and 56Ni (N=Z=28) which has a fully occupied 0f7/2 shell will allow us to compare n-p pairing according to shell occupancy. We measured two transfer reactions: (p,3He) which will populate T=0 and T=1 states and (d,α) which is selective for ΔT=0.

Results from the 56Ni(p,d)55Ni reaction will be shown in order to validate the analysis procedures. First information on the nature of the n-p pairing will be discussed based on the relative intensities of the 0+ and 1+ states populated in 54Co in the 56Ni(p,3He) reaction.

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