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Neutron-proton pairing in the self-conjugate nuclei of the f-shell through two-nucleon transfer reactions

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Neutron-proton pairing is the only pairing that can occur in the T=0 and the T=1 isospin channels. T=1 particle-like pairing (n-n or p-p) has been extensively studied unlike T=0 neutron-proton pairing. The over-binding of N=Z nuclei could be one of its manifestation.
Neutron-proton pairing can be studied by spectroscopy as in ref.[1].We have here studied it through transfer reactions in order to get more insight into the relative intensities of the two aforementioned channels. Indeed, the cross-section of np pair transfer is expected to be enhanced if the number of pairs contributing to the populated channel is important. The observable of interest is the ratio of the two-nucleon transfer cross-sections to the lowest 0+ and 1+ states.
Neutron-proton pairing is predicted to be more important in N=Z nuclei with high J orbitals so that the best nuclei would belong to the g9/2 shell [2]. However, considering the beam intensities in this region, we have focussed on fp-shell nuclei.
Measurements of the two-nucleon transfer reaction (p,3He) were performed at GANIL with three radioactive beams produced by fragmentation and purified by the LISE spectrometer: 56Ni, 52Fe, 48Cr. The set-ups were based on the coupling of the MUST2 Silicon array for charged particle detection with the EXOGAM gamma-ray array and a zero-degree detection (ZDD) for the last experiment.
The two first measurements with 52Fe (N=Z=26) beam, which is a partially occupied 0f7/2 shell nucleus and 56Ni (N=Z=28) beam, which has a fully occupied 0f7/2 shell allowed us to study np pairing according to shell occupancy [2]. The last measurement with 48Cr beam will allow to study the interplay between np pairing and deformation.
I will present the cross-sections measured in both channels (T=0 and T=1) and discuss the consequence for each pairing channel. The aforementioned ratio of cross-sections and the angular distribution for the ground state of 54Co will be compared with DWBA calculations. Preliminary results for 48Cr(p,3He) will also be presented.

[1] B. Cederwall et al, Nature 469 (2011) 469.
[2] B. Le Crom, M. Assié et al, Phys. Lett. B 829 (2022) 137057.

Attendance Type

Remote

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