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Neutron-proton pairing in the self-conjugate unstable nuclei 56Ni and 52Fe through 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 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.
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.
Measuring the two-nucleon transfer reaction (p,3He) for both 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 allows us to study np pairing according to shell occupancy.
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-section and the angular distribution for the ground state of 54Co will be compared with DWBA calculations [3].

[1] B. Cederwall et al, Nature 469 (2011) 469.
[2] P. van Isäcker et al, Phys. Rev. Lett. 94 (2005) 162502.
[3] B. Le Crom et al, Phys. Lett. B (2022) to appear.

Topic

Experiment

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