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Systematic study of neutron-proton pairing in {\it sd}-shell nuclei via (p,^{3}He) and (^{3}He,p) transfer reactions

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The transfer of a neutron-proton pair from even-even to odd-odd self-conjugate nuclei stands out as the best tool to investigate np correlations being (p,^{3}He) and (^{3}He,p) the reaction of choice with high sensitivity. The exclusive cross sections populating to the lowest $J^\Pi = 0^+, 1^+$ states in the odd-odd $N = Z$ nuclei and the corresponding $\sigma(J^\Pi = 0^+)/\sigma(J^\Pi = 1^+)$ provide a model-independent approach to quantify the nature and interplay between T=0 (J=1) and T=1 (J=0) pairing correlations.

Nevertheless, the existing data concerning the $\sigma(J^\Pi = 0^+)/\sigma(J^\Pi = 1^+)$ ratio present clear inconsistencies in the trends across the sd-shell. These problems may be associated to the fact that the measurements were performed in different experimental conditions. Moreover, for some of the previous data no cross sections were obtained at forward angles and even in some of these measurements the absolute cross sections were not determined. In order to shed light to these discrepancies, we conducted an experiment at Research Center for Nuclear Physics (RCNP - Osaka University) to perform a series of systematic measurements of $(p,^3$He$)$ and (^{3}He,p) on ^{24}Mg, ^{32}S, ^{28}Si and ^{40}Ca targets. In addition, the joint analysis of the proposed systematic measurements will help to complete the understanding of using both np-pair stripping and pickup transfer mechanism for probing np pairing correlations. The systematics data sets are compared with predictions from the reaction framework coupled with structure model to evaluate the microscopic description of np pairing correlations in this region.

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