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Study of the tensor force contribution in the N isotopic chain using QFS reactions

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In the shell model framework, the two-body nuclear force can be divided into a central, spin-orbit (SO) and tensor parts. The vast majority of studies performed so far in the chart of nuclides shows that the amplitude of the SO splitting scales with the function presented by G.Mairle [1], from systematics of nuclei studied so far in the valley of stability. Two exceptions to this trend have been found so far for the ^{133}Sn [2,3] and ^{35}Si [4] nuclei. As for the first, deviation to the trend has been attributed to the effect of the continuum, while the second to the effect of the central proton depletion that induces a strong reduction of the SO splitting of orbits probing the interior of the nucleus [5,6]. There is not so far striking evidence of the effect of the tensor force that should induce a change in the SO splittings that depends on its strength.

An experiment has been recently performed using the R³B setup at GSI, within the FAIR Phase-0 program. One of the scientific goals of is to study the role of the tensor force when approaching the neutron drip-line. During this experiment a "cocktail"of nuclei, among which ^{22}O and ^{21}N, was sent on a 5 cm LH2 target surrounded by tracking detectors and the CALIFA calorimeter [7]. This calorimeter allows to detect γ-rays and light particles from the QFS reactions in inverse kinematics. To study the spectroscopy of unbound states with an unprecedented energy resolution, this new setup includes the high resolution and granularity neutron detector NeuLAND [8].

In this work, the ^{22}O$(p, 2p)$ and ^{21}N(p, pn) QFS knockout reactions provide us information on the tensor force contribution to the $0p_{1/2}$-$0p_{3/2}$ SO splitting in the N isotope chain, from N=8 to N=14 shell closure, when the neutron $0d_{5/2}$ orbital is filled. The first reaction gives access to the $1/2^-$ and $3/2^-$ states in ^{21}N, and the second allows to check that 6 neutrons are indeed populating the $0d_{5/2}$ orbital in ^{21}N.

Preliminary results from this study will be presented.

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