

Search for the $1/2^-_2$ intruder bandhead in ^{35}P

Nuclei in the $N=20$ island of inversion, located around the neutron-rich ^{32}Mg isotope, have ground-states dominated by deformed and collective configurations arising from neutron-pair excitations across the shell gap (See Ref. [1] for a recent review). Particle-hole sd-pf cross-shell intruder configurations have also been observed in the low-lying level scheme of heavier $N = 20$ even-even nuclei. However, the expected $1/2^-_2$ intruder bandhead has not yet been identified in the odd-even nucleus ^{35}P . Previous attempts to identify this state suffered from a large background in the region of interest arising from contaminants in the target [2].

We will report on a recent measurement using the $^{36}\text{S}(d, ^3\text{He})^{35}\text{P}$ reaction in inverse kinematics with the Helical Orbit Spectrometer (HELIOS) at ATLAS/ANL [3]. Thanks to the unique capabilities of HELIOS, enhanced with a recoil detector setup, it is possible to perform the reaction in nearly background free conditions.

An analysis of the reconstructed ^3He spectrum in HELIOS did not show a peak that could be associated with the $1/2^-_2$ intruder state. We have not observed any candidate state in the region of interest with an intensity greater than 5% of the ground-state. This in turn can be used to set a limit to the amount of $2p2h$ excitations in the ^{36}S ground state wavefunction. These results provide an additional constraint to state-of-the-art theoretical descriptions to further understand the evolution of shell structure in the region.

[1] O. Sorlin and M. Porquet, *Prog. Part. Nucl. Phys.* 61, 602 (2008).

[2] C. E. Thorn, J. W. Olness, E. K. Warburton, and S. Raman, *Phys. Rev. C* 30, 1442 (1984).

[3] A. H. Wuosmaa et al., *Nucl. Inst. Meth.* 580, 1290 (2007).

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