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Exotic cross-shell interactions at $N = 28$ with single-neutron transfer on ^{47}K

Shell evolution in nuclei far from stability, such as those in the region of $N \geq 28$ and $Z < 20$, is understood to arise from the complex interplay of orbital interactions, with different interactions accessible in unstable nuclei compared to stability. Experimental studies of these exotic regions provide stringent tests of modern shell model interactions, but are difficult to access experimentally. In this regard, the transfer reaction ^{47}K(d,p)^{48}K provides a unique opportunity to study the exotic $\pi s_{1/2}$-νfp interaction in a near-doubly magic nucleus, owing to the $\pi s^{-1}_{1/2}$ ground state structure of ^{47}K, which is near-degenerate with the 'standard' $\pi d^{-1}_{3/2}$ proton configuration in this region.

The first measurement of the ^{47}K(d,pγ)^{48}K transfer reaction has been performed at GANIL, in inverse kinematics using a reaccelerated radioactive isotope beam. The level scheme of ^{48}K has been greatly extended with nine new bound excited states identified and spectroscopic factors deduced. Detailed comparisons with SDPF-U and SDPF-MU shell-model calculations reveal a number of discrepancies between theory and experiment. Intriguingly, an apparent systematic overestimation of spectroscopic factors and a poor reproduction of the energies for 1^- states suggests that the mixing between the $\pi s^{-1}_{1/2}$ and $\pi d^{-1}_{3/2}$ proton configurations in ^{48}K is not correctly described using current interactions, challenging our descriptions of light nuclei around the N=28 island of inversion.

A complete analysis and discussion of the ^{47}K(d,pγ) reaction, and the complementary ^{47}K(d,tγ) reaction, will be presented.

Author: PAXMAN, Charlie James (GANIL)

Presenter: PAXMAN, Charlie James (GANIL)

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