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Bubble structure in 46Ar: a direct proton-transfer reaction perspective

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Deviations from the typical liquid-drop-like saturated density of the nucleus are a focal point in the exploration of nuclear structure. Phenomena of nucleon localisation, such as clustering or bubble structures, provide a distinctive perspective on the macroscopic consequences of nuclear interaction.

We performed a proton-transfer direct reaction to probe the wavefunction of ^{46}Ar and extrapolated the probability of population of the $d_{3/2}$ hole-state relative to the $s_{1/2}$ in ^{47}K.
The experiment, performed at the Spiral 1 facility in GANIL with a post-accelerated radioactive ^{46}Ar beam impinging on a high-density cryogenic ^{3}He target relied on a state-of-the-art experimental setup for a precise reconstruction of the kinematics of the reaction.
The heavy reaction fragment was identified by the high-acceptance magnetic spectrometer, VAMOS, while the high-granularity silicon DSSSD detector, MUGAST, allowed the measurement of the angular distribution of the light ejectile while also performing particle identification. The AGATA gamma-ray tracking germanium array measured the gamma rays produced by the decay of the ^{47}K excited states.

Our experimental findings strongly suggest an empty $s_{1/2}$ orbital, corroborated by ab initio calculations, thereby supporting the existence of a bubble phenomenon within this nucleus. This comparison between theory and data serves as a compelling indication of the observed nuclear structure phenomenon.

session

I. Nuclear Structure and Reactions

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