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Protons in ^{46}Ar: Bubbles and Transition Probabilities

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Departures from the conventional liquid-drop-like saturated density of the nucleus represent a key interest in the study of nuclear structure. Phenomena of such as bubble structures offer a unique insight into the macroscopic effects of the nuclear interaction.
We present experimental indication of the occurrence of this phenomenon in ^{46}Ar, where the depletion is generated by the level inversion of the $s_{1/2} - d_{3/2}$ orbitals together with the unexpected presence of a sub-shell closure.
The experiment is aimed at probing the proton component of the wavefunction via a proton-pickup direct reaction: ^{46}Ar(^{3}He, d)^{47}K at an energy of 350 MeV. 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, has allowed to assess the transfer probability to the $d_{3/2}$ state relative to the $s_{1/2}$.
The heavy reaction fragment was identified by the VAMOS magnetic spectrometer, while the 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 array measured the gamma rays produced by the decay of the ^{47}K excited states.
It has been observed that measured transition probabilities in ^{46}Ar diverge by a factor of two from values predicted by the well-established shell model with SDPF-U interaction.
We found this peculiar bubble structure of the proton wavefunction to be strongly tied with the puzzle of transition probabilities in ^{46}Ar by comparing the experimental result with ab initio calculations.

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