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Precision mass measurement of proton-dripline nucleus ^{22}Al and implications on suspected halo nature in the ground state

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Halo nuclei exist at the extremes of nuclear structure where a isotopes'mass distribution extends far outside the compact core: a consequence of a weakly bound nucleon(s). The unique properties of these isotopes provide stringent tests for nuclear structure models. These nuclei are positioned on the nuclear driplines, often restricting experimental access due to low production rates or short half-lives. Proton-halo nuclei are further suppressed due to the confining effect of the Coulomb barrier. The Facility for Rare Isotope Beams (FRIB) has extended the reach towards these isotopes, including ^{22}Al whose halo nature has recently been suggested based on observed isospin-symmetry breaking effects in the sd-shell region [1]. The level scheme found in this work, however, contains significant uncertainties as a result of its unmeasured mass, thus impacting the mirror asymmetry parameter. Precise knowledge of these isotopes'binding energy, i.e. mass, is paramount due to the role of weak binding in the emergence of the halo structure. The Low Energy Beam Ion Trap (LEBIT) facility at FRIB used Penning trap mass spectrometry to determine a mass excess for the ^{22}Al ground state of ME $= 18\ 093.6(7)$~keV, a factor of thirty improvement in uncertainty to the last measured value [2]. This result agrees well with the predicted binding energy from *sd*-shell USD Hamiltonians, which also predicts restricted halo formation due to minimal $1s_{1/2}$ occupation in the proton shell. A particle-plus-rotor model additionally investigates the possibility of enhanced s-wave occupation from the interplay of weak binding. Ultimately, our findings suggest the existence of halo structure in the ^{22}Al ground state would require strong continuum-induced deformation, similar to the suspected situation for ^{29}F [3].

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[1] J. Lee, et al., Phys. Rev. Lett. 125, 19 (2020)
[2] M.Z. Sun et al., Chinese Phys. C 48, (2024)
[3] K. Fossez and J. Rotureau, Phys. Rev. C 106, 3 (2022)

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