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Investigation of the 2.26-MeV excited state of ^{8}Li

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Study of exotic nuclei is one of the main directions of modern nuclear physics. The most famous representative of exotic nuclei is halo.
The nucleus ^{8}Li is a compelling candidate for studying halo formation. Various theoretical approaches have been applied to study its structure. Despite this, significant ambiguities remain due to limited experimental constraints. Some methods reproduce the radius or quadrupole moment of ^{8}Li accurately but fail to describe both ^{8}Li and its mirror nucleus –^{8}B simultaneously. Several research groups have attempted to determine the structure of ^{8}Li directly by deducing its matter radius or density distribution through cross section measurements. One study indicated that there is no halo in ^{8}Li [1], while another found that ^{8}Li exhibits a skin-like structure [2], contrasting with its mirror nucleus ^{8}B. Consequently, the structure of the ^{8}Li nucleus remains unclear, particularly for its excited states. The most promising candidate for a possible exotic structure is the 2.26-MeV excited state of ^{8}Li which is located 200 keV above neutron emission threshold.
To analyze the possibility of exotic structure in the 2.26-MeV excited state of ^{8}Li we used independently two different methods –MDM (Modified diffraction model) and DWBA. We applied MDM to existing literature data on d+^{8}Li and ^{8}Li+^{12}C scattering and obtained radii of low-lying excited states of ^{8}Li. Radii of the excited states are practically similar as for the g.s. except radius of the 2.26-MeV state which is significantly increased. Independently, DWBA was applied to new experimental data ^{7}Li(d,p)^{8}Li [3]. The 2.26 MeV state is considered as a single-particle quasi-stationary state. It was shown that the wave function of the 2.26 MeV state is very similar to a system with a neutron halo. Both results of the MDM and DWBA analysis are arguments in favor of neutron halo in the 2.26 MeV state of the ^{8}Li nucleus.

1. G.W. Fan et al., Phys. Rev. C 90, 044321 (2014)
2. A. Dobrovolsky et al., Nucl. Phys. A 766, 1–24 (2006)
3. N. Burtebayev et al., to be published

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