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Study of the ^{8}Li low-lying excited states

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In the A=8 multiplet, a halo was first discovered in ^{8}B in [1] based on the increased quadrupole moment. It was shown that the halo structure is core ^{7}Be and has a valence proton. It should be noted that the halo was discovered despite the presence of both the Coulomb and centrifugal barriers. In [2], using total cross sections, the presence of a proton halo in ^{8}B was confirmed, and the root-mean-square radius R_{rms} = 2.58 fm and the halo radius R_h = 4.24 fm were determined. However, the latest research indicates that ^{8}B looks like a normal heavy ion [3]. All experiments confirm a narrow width of the longitudinal momentum distribution of the core, and an obvious tail structure in the density distribution.

This implies that mirror nuclei ^{8}Li will be an interesting candidate for exploring the formation of the halo structure. Many calculations have been made to investigate its structure, such as ab initio calculations, the cluster model, the shell model, the Hartree-Fock method, and the relativistic mean field. In fact, there is still a large ambiguity to explain the structure of ^{8}Li theoretically due to the lack of experimental constraints. Although some of these methods could reproduce the radius or the quadrupole moment for ^{8}Li well, none of them could well describe both 8Li and 8B simultaneously.

Meanwhile, several groups have tried to determine its structure directly by deducing its matter radius or density distribution through the measurement of cross sections. In [4] using total cross sections, it is stated that there is no halo in ^{8}Li. In [5] ^{8}Li was found to have a skin-like structure by comparing with the Li isotope and its mirror ^{8}B. However, the structure of the ^{8}Li nucleus still cannot be clearly concluded, especially for excited states.

We applied Modified diffraction model (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, practically similar as for g.s.

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