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Dilute excited states in light nuclei

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The results of measuring the radii of some excited states of light nuclei are presented. A method based on the analysis the diffraction patterns of the cross-section (Modified diffraction model MDM) was proposed. We studied the inelastic α-scattering on 9Be, 11B, 12C and 13C with the excitation of some excited states whose structure recently attracted a lot of attention from different theoretical investigations. The evidence that the famous Hoyle state (0+, 7.65 MeV) in 12C has the enhanced dimensions and is the head of a rotational band (besides the band based on the ground state) was obtained. The radius of the second 2+ member state (E= *9.8 or 9.6 MeV) occurred to be similar to that of the Hoyle state (~3.0 fm). A 4+ state was identified at E* = 13.75 MeV. The radii of the 8.86 MeV, 1/2- state in 13C and 8.56 MeV, 3/2- state in 11B occurred to be close to that of the Hoyle state and these states can be considered as analogues of the latter. Comparison of the data with the predictions of such theoretical models as alpha condensation (AC) and antisymmetrized molecular dynamics (AMD) has been done. Though some of the predictions of AC (e.g., the probability of the L = 0 component of alpha clusters in the Hoyle state) are close to the experiment most of the data disagree with them and one may speak only about rudimentary manifestation of the condensate effects.
A neutron halo was observed in the excited 3.09 MeV, 1/2+ state of 13C and in the 1.68 MeV, 1/2+ state of 9Be. The data obtained from the inelastic scattering were confirmed by the analysis of the asymptotic normalization coefficients extracted from the 12C(d,p)13C reaction.

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