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Cluster Breaking and Melting Effects in Light Nuclei Uncovered by Control Neural Network

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In cluster models, the light nuclei are treated as few-body systems composed of alpha-clusters and valence nucleons, providing significant successful description for the states with well developed clustering structure. However, the shell-like states with melted alpha clusters is more general in low lying states, and the cluster breaking effect becomes significant above the 3N+N threshold. In this contribution, we discuss the formulation and dissolution of alpha-clusters in light nuclei, via extended cluster models with full consideration of cluster melting due to Pauli blocking in low-lying states and the breaking of alpha clusters in high-excited states. The wave functions for ground and excited states are effectively optimized via a newly proposed Control Neural Network method, and the spectra of light nuclei calculated fit well with experimental data. The melting and breaking mechanism of alpha-clusters are then manifested in various states by looking into the wave functions and observables of corresponding nuclei.

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