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One-dimensionality in atomic nuclei: linear-chain alpha clustering in 14C

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The clustering of alpha particles in atomic nuclei results in the self-organization of various geometrical arrangements at the femtometer scale. The one-dimensional alignment of multiple alpha particles is known as linear-chain structure, evidence of which has been highly elusive since its proposal in the 1950s. We show via resonant alpha scattering of a radioactive 10Be beam that excited states in the neutron-rich nucleus 14C agree with recent predictions of linear-chain struc- ture based on an anti-symmetrized molecular dynamics model. Our results support the model's claim that the linear-chain states in 14C are stable against bending; their wavefunctions satisfy the orthogonality condition to lower-lying triaxially-deformed states that largely contain the bending 3-alpha configurations, thus stressing the importance of the fundamental quantum mechanical law of orthogonality in the one-dimensional formation of alpha clusters in atomic nuclei.

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