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^{12}C and ^{16}O α-particle systems and the triple-α reaction within near-zero range Effective Field Theory

Friday 3 October 2025 12:10 (20 minutes)

We investigate the structure of ^{12}C and ^{16}O within an ab-initio Hyperspherical Harmonics framework using short-range Effective Field Theory-inspired interactions. For ^{12}C, ground and excited states are accurately reproduced with a two-body potential plus a fine-tuned three-body force, while ^{16}O requires a genuine four-body interaction to match experiment. We also analyze the triple-α reaction, crucial for stellar nucleosynthesis but poorly constrained at low energies. Employing the adiabatic hyperspherical approximation, we study the 0^+ Hoyle state and its role in the reaction dynamics. These results underline the relevance of cluster structures and many-body forces in light nuclei and their impact on astrophysical reaction rates.

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