Abstract Submitted
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A Microscopic Description of the Elusive Hoyle State[1] ALISON DREYFUSS, Keene State College, KRISTINA LAUNEY, Louisiana State University, CAIRO BAHRI, University of Notre Dame, TOMAS DYTRYCH, JERRY DRAAYER, Louisiana State University — Using the symplectic Sp(3,**R**) symmetry inherent to nuclear dynamics together with a novel many-nucleon interaction, we are able to reproduce low-lying spectral features of ^{12}C, including the Hoyle state energy, and to gain a further understanding of the underlying physics. We employ a no-core symplectic model for symmetry-preserving interactions–with Sp(3,**R**) the underpinning symmetry –that offers a microscopic description of nuclei in terms of mixed shape deformations and allows for the inclusion of higher-lying configurations currently inaccessible to ab initio shell models. Our interaction is effectively realized by an exponential dependence on the quadrupole-quadrupole two-body interaction. We were able to reproduce the energies of the ground state rotational band, the Hoyle state, and the next excited 0^+ state, along with the $B(E2 : 2_1^+ \rightarrow 0^+_{\text{g.st.}})$ transition strength for ^{12}C. The success of this work indicates the importance of alpha-cluster structures in the ^{12}C nucleus and the inclusion of hierarchical many-body interactions.

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