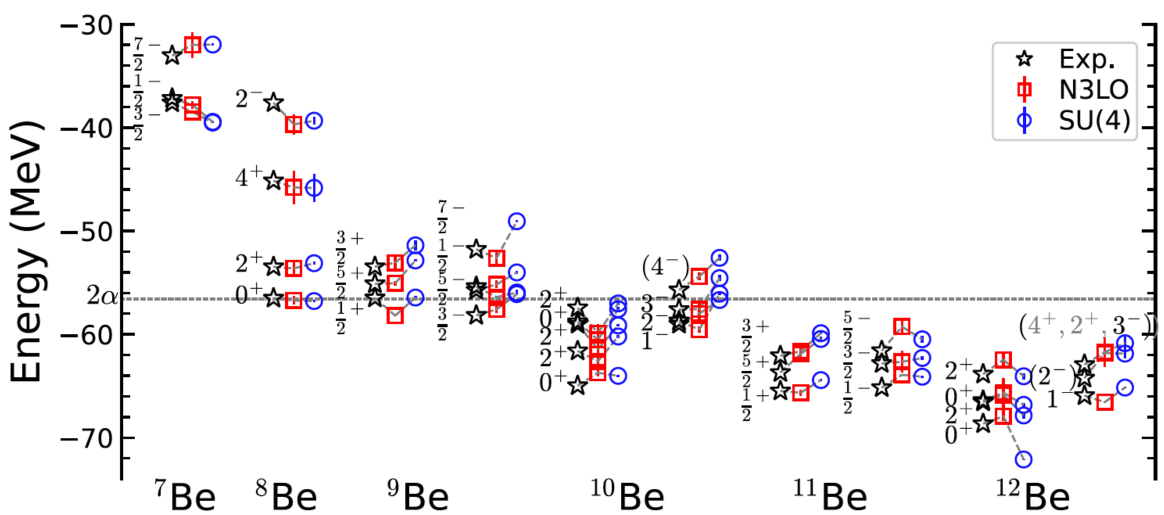
Unveiling the hidden structures of beryllium isotopes

Objectives

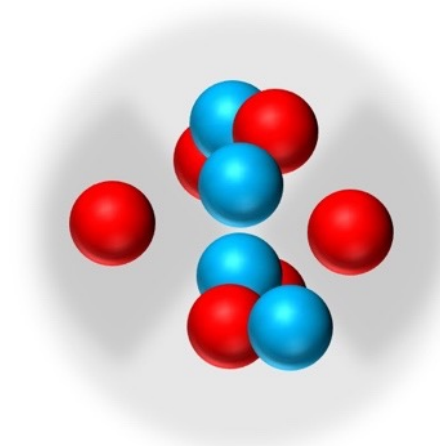
- Light nuclei such as the isotopes of beryllium provide a remarkable testing ground for our understanding of nuclear structure.
- These isotopes display many unusual features such as clustering, halo structures, and surprising changes to the expected ordering of nuclear states.
- In this work, researchers used nuclear lattice effective field theory to study beryllium isotopes from ^{7}Be to ^{12}Be.



Low-lying spectrum for beryllium isotopes ^{7}Be to ^{12}Be calculated using nuclear lattice effective field theory

Impact

- This research shows how light nuclei can take on shapes and structures very different from what simple models predict.
- The calculations reveal how protons and neutrons can cluster together and how extra neutrons can form extended “halo” clouds or molecular-like bonds around these clusters.
- These findings give scientists a clearer picture of how complex patterns emerge from the basic forces of nature and provide guidance for new experiments with rare isotopes.



The structure of beryllium-10 shows two alpha clusters bound by neutrons in molecular-like orbitals. This arrangement explains its unusual shape and properties.

Accomplishments

- [“Ab Initio Study of the Beryllium Isotopes ^{7}Be to ^{12}Be”, Shen et al., Phys. Rev. Lett. 134, 162503 (2025).]