

## ***Ab initio* picture of nuclei: Shapes, rotations, and vibrations from chiral potentials**

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### **Abstract**

The *ab initio* symmetry-adapted no-core shell model [1] is a first-principle framework, which – by exploiting approximate symmetries, the deformation related SU(3) and its embedding Sp(3,R) found to dominate in atomic nuclei – can now expand the reach of *ab initio* theory. This allows one to achieve nuclear descriptions, including the emergence of collective modes and  $\alpha$ -capture reactions, starting from the properties of two or three nucleons often tied to the symmetry patterns of quark and gluon dynamics. In particular, I will discuss how we can utilize the symplectic Sp(3,R) symmetry to identify equilibrium deformation, rotational bands and giant-resonance modes (Fig. 1). I will also discuss the emergence of collectivity in nuclei up to the Ca region as arising from nucleon-nucleon ( $NN$ ) chiral potentials, and its implications for ( $\alpha, \gamma$ ) reactions.

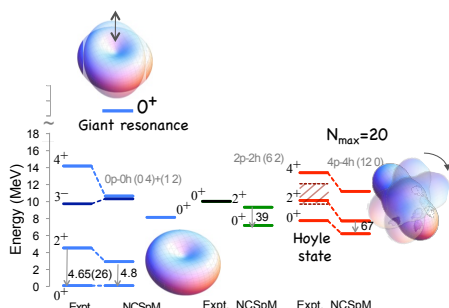


Figure 1. Energy spectrum of  $^{12}\text{C}$  [2] pointing to low-energy shape coexisting excitations, rotational structure and high-energy vibrational modes.

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### **References**

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