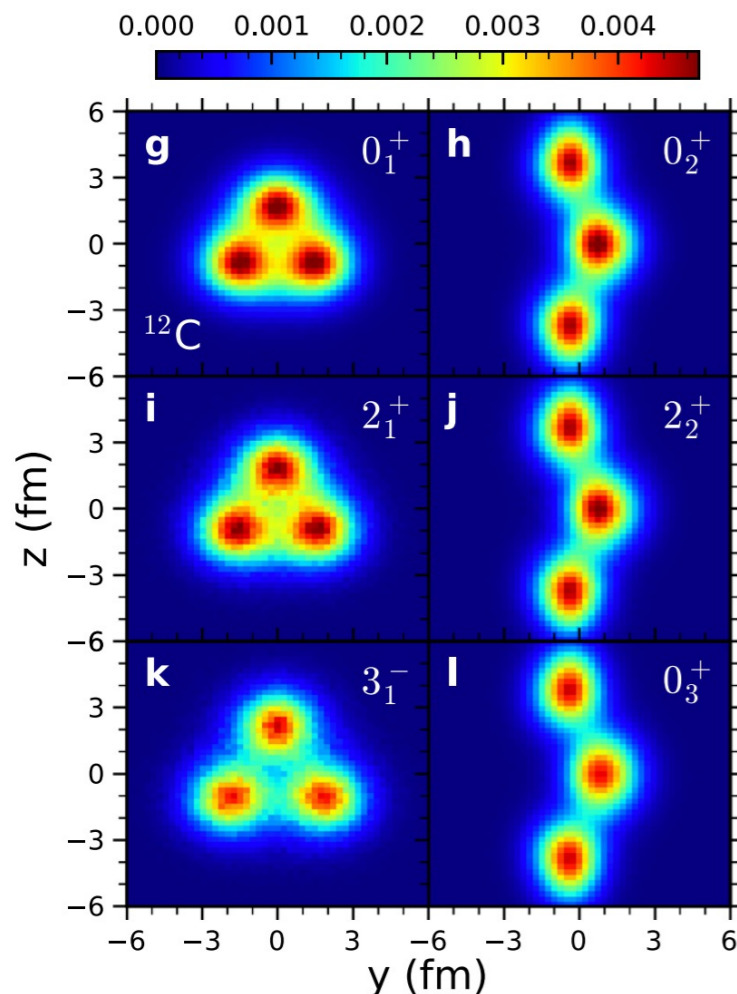


## Objectives

- We perform *ab initio* lattice calculations of the spectrum, form factors, transitions, and intrinsic shapes of the low-lying states of carbon-12.
- We compute full *A*-body density correlations and provide a model-independent picture of the intrinsic geometry of each nuclear state.

## Impact (as of now)

- We find that the low-lying states of carbon-12 have one of two geometries: either an equilateral triangle or an obtuse triangle composed of alpha clusters.
- The states with an equilateral triangle geometry also have a simple dual description in terms of the nuclear shell model.
- The states with an obtuse triangle geometry have no simple description in terms of the nuclear shell model.



Intrinsic shapes of the low-lying states of carbon-12. Panels **g**, **i**, **k** show members of the ground state rotational band. These states have an equilateral triangle geometry. Panels **h** and **j** show members of the Hoyle state rotational band, and Panel **l** shows the third  $0^+$  state. These states have an obtuse triangle geometry

## Accomplishments (as of now)

- Shihang Shen, Serdar Elhatisari, Timo A. Lähde, Dean Lee, Bing-Nan Lu, Ulf-G. Meißner, Emergent geometry and duality in the carbon nucleus, Nat. Commun. 14, 2777 (2023).
- <https://www.eurekalert.org/news-releases/989300>
- <https://www.youtube.com/watch?reload=9&v=s2wUQ0tFE1o>