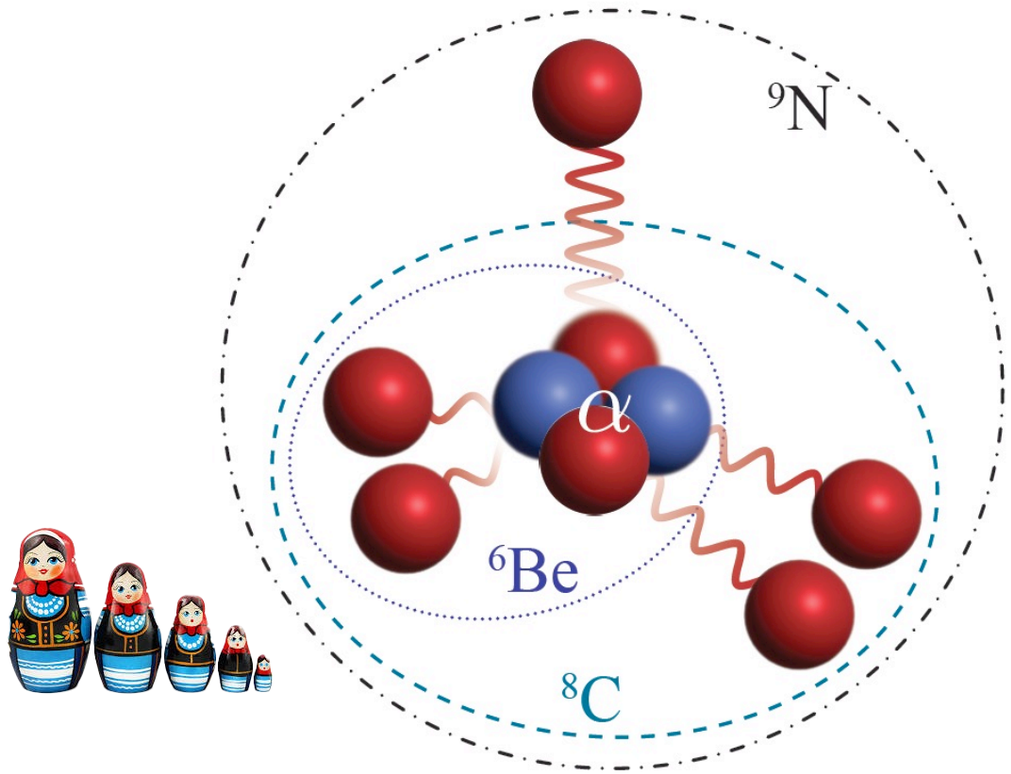
^{9}N and the limits of existence of atomic nuclei

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- A new light isotope of nitrogen, ^{9}N (7 protons, two neutrons) has been identified experimentally. The existence of such an exotic system is a good test of the quantum mechanics of open or unbound many-body systems. An To explain the elusive nature of ^{9}N, An open-quantum-system calculation using the complex-energy Gamow Shell Model (GSM) has been carried out.



^{9}N is a weakly bound grouping of 5 protons and an alpha particle. Its decay is like opening a set of nesting dolls; each decay reveals another nuclide which also decays by the emission of a single or a pair of protons.

Impact (as of now)

- This is the fist application of the GSM to a 5-proton-unstable system.
- The locations of the $1/2^{+}$ and $1/2^{-}$ resonant states predicted by the GSM are in excellent agreement with the experimental data giving further evidence for the experimental assignments.
- The $1/2^{+}$ state of ^{9}N, the mirror of an antibound state in ^{9}He, is most likely a broad resonant state rather than a subthreshold resonant state, but the latter cannot be completely ruled out in both the experiment and in theory.

Accomplishments (as of now)

- Published in Phys. Rev. Lett. **131**, 172501 (2023)
- Highlighted as Editor's suggestion
- Featured in Physics 16, 186 (2023)
- Featured by Science, Sep. 25, 2003, "Fleeting form of nitrogen stretches nuclear theory to its limits".