U.S. DEPARTMENT OF ENERGY | Office of Science

Puzzling Sizes of Extreme Calcium Isotopes

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

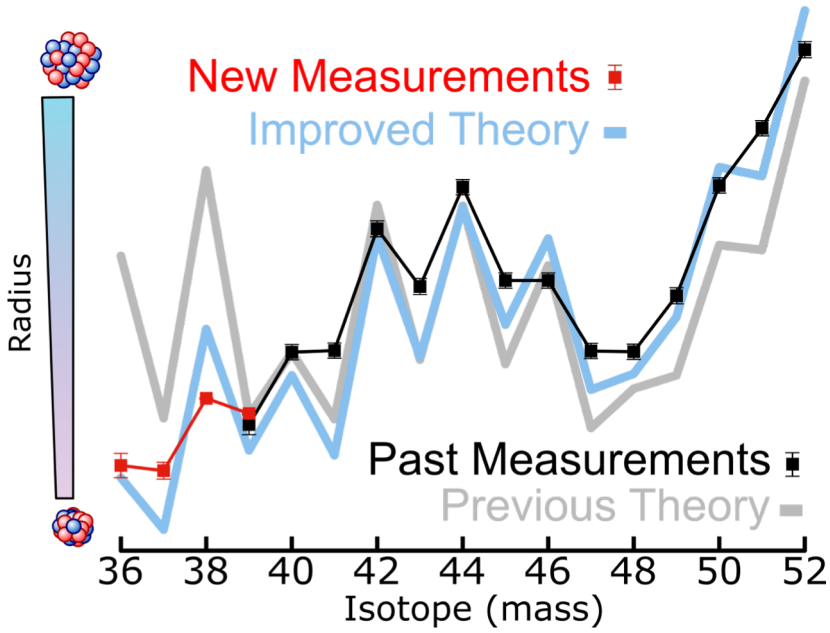
- The intricate behavior of charge radii along the chain of Ca isotopes, including the unexpectedly large charge radius of neutron-rich ^{52}Ca, poses a daunting challenge for nuclear theory.
- The charge radii of proton-rich isotopes ^{36,37,38}Ca are challenging as properties of these systems are impacted by the interplay between nuclear superfluidity and weak binding.

Impact

- Calculations carried out within nuclear density functional theory with the recently optimized Fayans functional show that the combination of a novel interaction and a state-of-the-art theoretical method can successfully explain the behavior of charge radii from the lightest to the heaviest Ca isotopes
- This success can be attributed to a better understanding of the peculiar ways in which protons interact with each other at large distances outside the surface of a proton-rich calcium nucleus.

Accomplishments

- Publication: A.J. Miller et al., Nature Physics, Feb. 11, (2019),



Charge radii of calcium isotopes. New data are shown in red squares and compared with theoretical values.