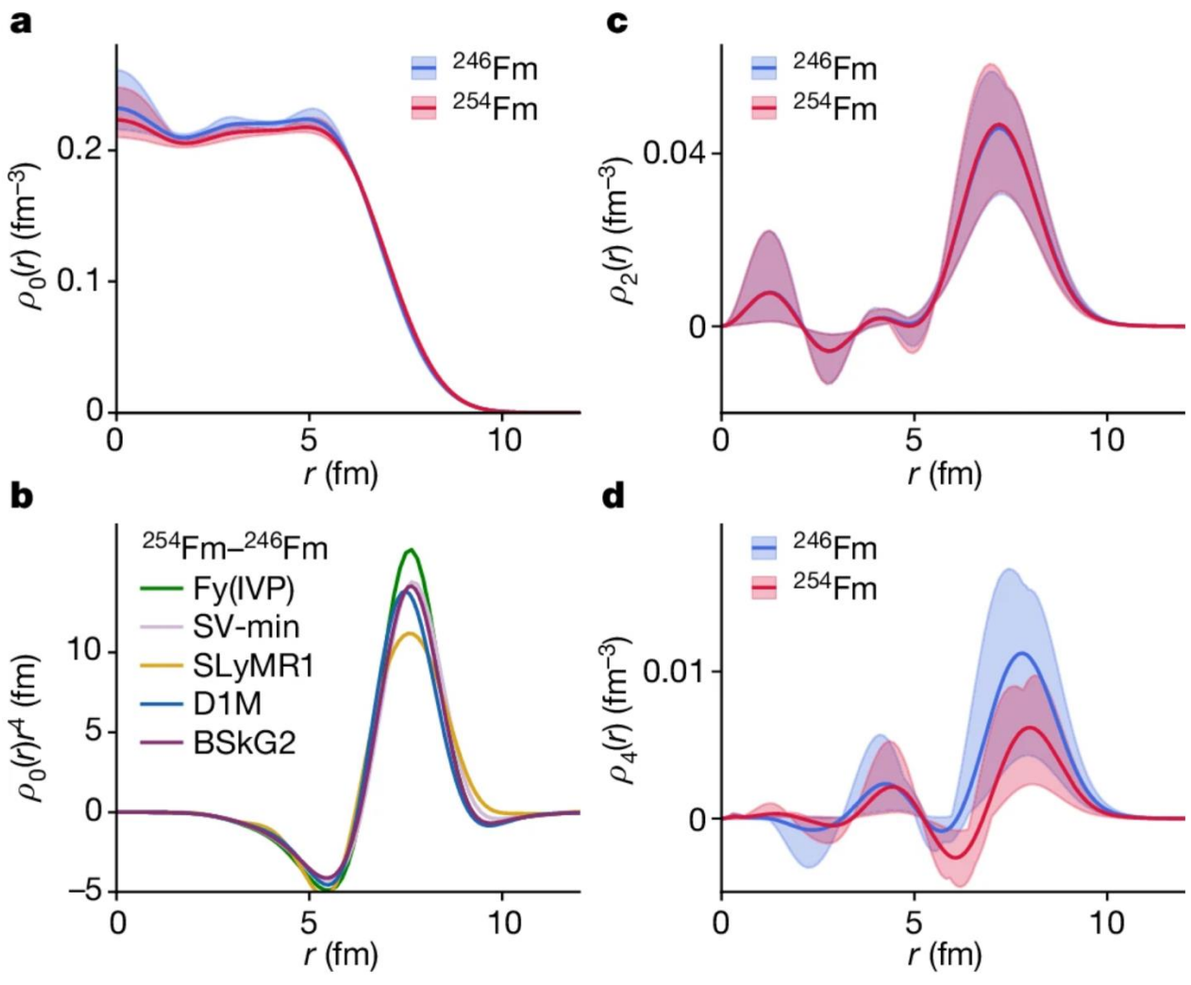
Laser spectroscopy of fermium isotopes: diffused shell effects in the heaviest nuclei

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- A range of nuclear models based on energy density functionals studied the charge radii of the Fm isotopes measured at GSI/FAIR.
- The computational frameworks range from single-reference calculations to calculations including the configuration mixing of symmetry-restored reference states, with other methods that include beyond-mean-field corrections to a varying degree.



Comparison of different model predictions for multipole proton radial densities of ^{246}Fm and ^{254}Fm. The agreement between various predictions confirms theoretical expectations of the transition towards a bulk behavior in very heavy nuclei.

Impact (as of now)

- Within their uncertainties, all model predictions are strikingly consistent with the experimental data for fermium and nobelium, and with each other.
- The models reproduce well the observed smooth evolution of the nuclear size along the Fm and No chains. Both the remarkable consistency of model prediction and the similarity of predictions for different isotopes suggest a transition to a regime in which shell effects have a diminished effect on the size compared with lighter nuclei. This remarkable similarity in the predictions is primarily, among other factors, owing to a large single-particle level density in the heaviest nuclei.

Accomplishments (as of now)

- Published in Nature 634, 1075–1079 (2024)
- Highlighted by MSU and other media.