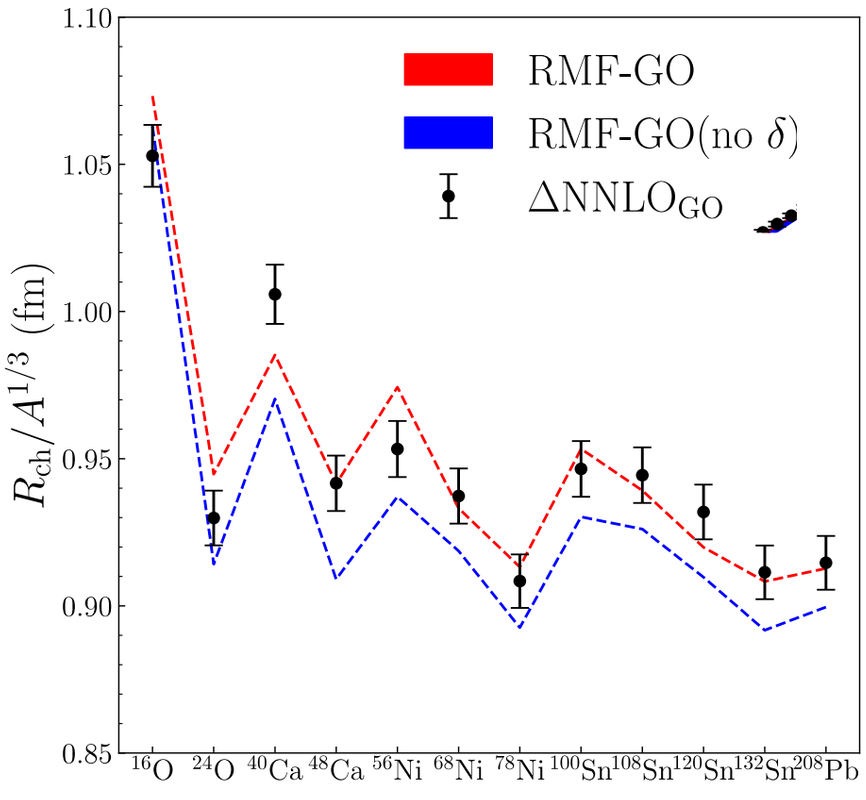
Connecting relativistic density functional theory to microscopic calculations

Objectives

- Optimize relativistic density functionals to microscopic theory predictions for ground-state properties of nuclei and nuclear matter properties
- Improve Lagrangians used in relativistic density functional theory calculations based on guidance from microscopic calculations



The new relativistic density functional theory models are fit to microscopic nuclear structure predictions using, for example, the **Δ**NNLO$_{GO}$ Hamiltonian. The inclusion of the δ meson improves the reproduction of charge radii overall, while local discrepancies, e.g., at ^{40}Ca, highlight the role of missing Fock terms.

Impact (as of now)

- First optimization of relativistic density functional theory to microscopic input pseudodata for both properties of nuclei and nuclear matter properties
- Improved prediction of some trends in the data through the inclusion of a new delta meson, especially charge radii and neutron skins
- Significant tension in the reproduction of energies of symmetric vs neutron-rich nuclei, which is attributed to the missing Fock terms in relativistic mean-field calculations
- Considerable difficulty in reproducing trends predicted by new nuclear Hamiltonians with relatively large short-range three-nucleon force couplings, suggesting the effects of such forces are poorly captured by current relativistic mean-field functionals

Accomplishments (as of now)

- Preprint: Reed, Heinz, Arthuis, Schwenk, Tews, arXiv:2505.00828