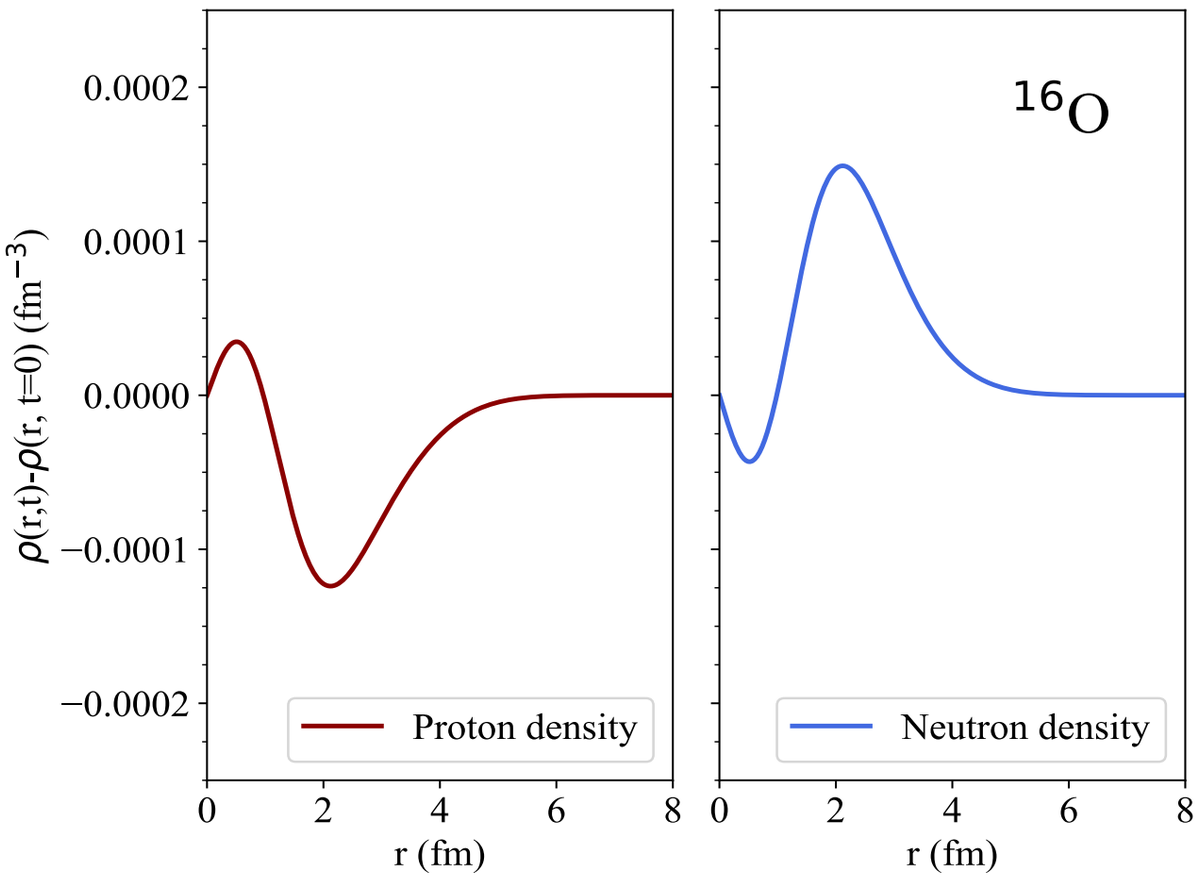
Computing nuclear response functions with time-dependent coupled-cluster theory

U.S. DEPARTMENT OF ENERGY | Office of Science

NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- Develop a time-dependent framework to address nuclear dynamical processes from first principles, using coupled-cluster theory.
- Test it as a first step on the response of the nucleus to an external electric dipole perturbation.



Proton and neutron density fluctuations induced by an electric dipole perturbation (snapshot at t = 500 fm/c). Protons and neutrons oscillate in counterphase, in agreement with the traditional interpretation of giant dipole resonances.

Impact (as of now)

- We validated the method by comparing dipole response properties of ^{4}He and ^{16}O with results from an established static approach, finding good agreement.
- We see the traditional picture of giant and pygmy dipole resonances as collective oscillations of protons against neutrons emerging from the time evolution of density fluctuations in ^{16}O and ^{24}O.
- We observe that the behavior of the nucleus in the strong electric field limit becomes chaotic.

Accomplishments (as of now)

- F. Bonaiti, C. Balos, K. Godbey, G. Hagen, T. Papenbrock, C. S. Woodward. arXiv:2510.19940 [nucl-th].

Contact: Francesca Bonaiti, bonaiti@frib.msu.edu