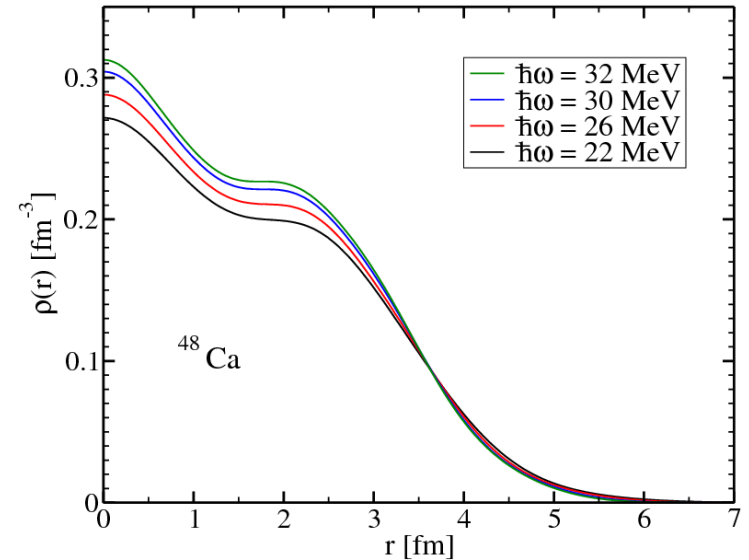


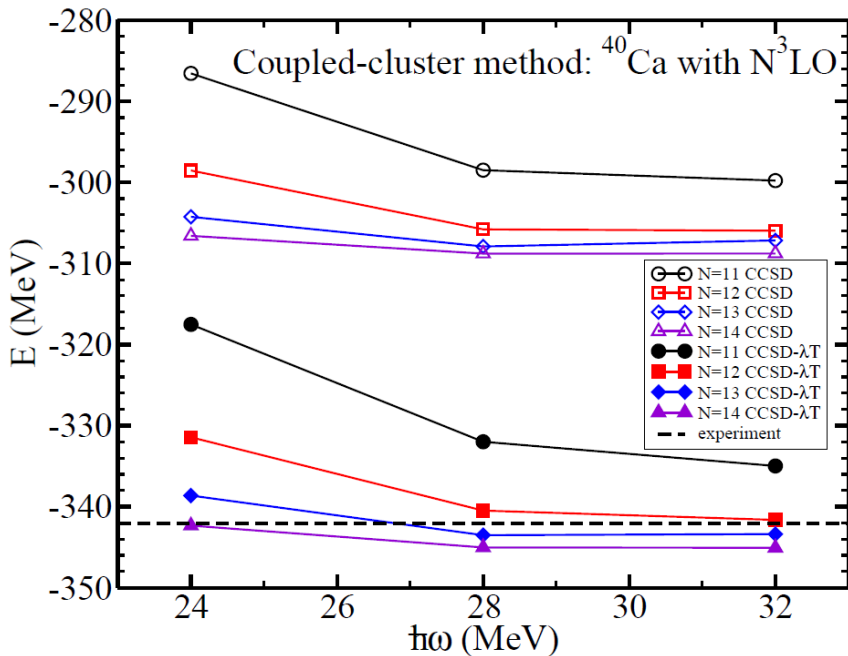
Truly a sum of its pieces?

Building medium-mass atomic nuclei from scratch

Atomic nuclei consist of protons and neutrons, and the forces that bind these constituents are better known today than ever before. Progress toward the DOE milestone “Carry out microscopic calculations of medium mass nuclei with realistic interactions...” is being made with development of coupled-cluster theory and the use of high-performance computing facilities.



First-principles calculations of medium-mass nuclei (such as ^{40}Ca and ^{48}Ca) provide us with better understanding of how nucleons interact and a microscopic foundation for the nuclear density functional, the key to solving heavier nuclei.



Binding energy per nucleon (in MeV)

Nucleus	CCSD	Λ -CCSD(T)	Experiment
^4He	5.99	6.39	7.07
^{16}O	6.72	7.56	7.97
^{40}Ca	7.72	8.63	8.56
^{48}Ca	7.40	8.28	8.67