Truly a sum of its pieces?
Building medium-mass atomic nuclei from scratch

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References:
Medium-Mass Nuclei from Chiral Nucleon-Nucleon Interactions,
G. Hagen, T. Papenbrock, D. J. Dean, and M. Hjorth Jensen, Phys. Rev. Lett. 101, 092502 (2008).

About the graphics:
Top Right: Single-particle radial densities for ^{48}Ca from the chiral nucleon-nucleon potential at order N3LO for four different
values of the oscillator spacing. Densities were calculated using microscopic coupled-cluster theory with singles-and doubles excitations (CCSD).
Bottom Left: Binding energy of ^{40}Ca as a function of the model space frequency ($\hbar\omega$) and the size (label N) of the model space. The binding energy was calculated using coupled-cluster theory with singles- and doubles excitations and (CCSD) and with the more accurate Λ-CCSD(T) approximation.
Table: Binding energies of selected nuclei in the CCSD approximation and the more accurate Λ-CCSD(T) approximation. Microscopic coupled-cluster calculations of medium-mass nuclei (such as ^{40}Ca) from modern nucleon-nucleon forces are missing about 0.5MeV per nucleon in binding energy. The missing energy contributions are mainly attributed to omitted three-nucleon forces.

High-performance computing resources:
The coupled-cluster calculations were performed on Kraken at the University of Tennessee and on Jaguar at ORNL.

The Team:
This collaboration involves Oak Ridge National Laboratory (G. Hagen), University of Tennessee (Thomas Papenbrock), and University of Oslo (Morten Hjorth-Jensen).