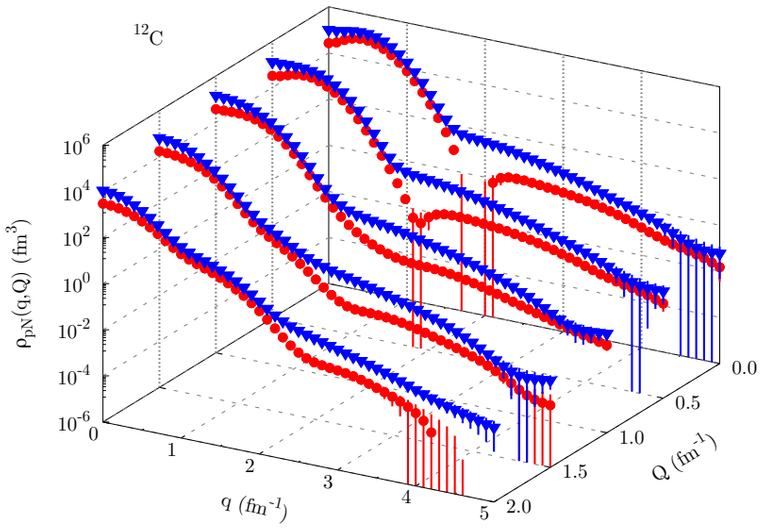
Nucleon momentum distributions for local chiral interactions

U.S. DEPARTMENT OF ENERGY | Office of Science

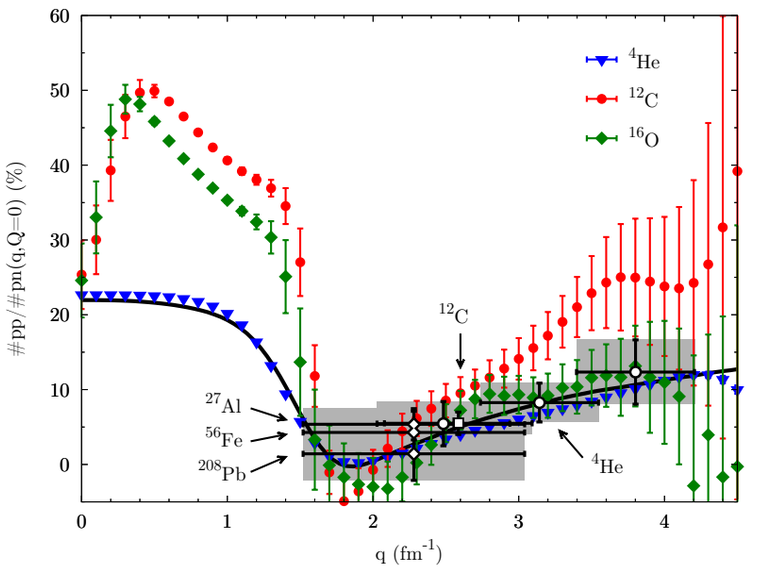
NUCLEI Nuclear Computational Low-Energy Initiative

Objectives

- We use quantum Monte Carlo methods to calculate single- and two-nucleon momentum distributions in ^{4}He, ^{12}C, and ^{16}O.
- We use correlated many-body wave functions optimized for local chiral interactions up to next-to-next-to-leading order (N^{2}LO).



Two-nucleon momentum distributions in ^{12}C as a function of both relative and center-of-mass momentum of the pair (q and Q).



pp pairs to pn pairs ratio in A = 4, 12, 16 nuclei as a function of the relative momentum q for back-to-back (Q = 0) pairs. Black symbols are extracted from experimental data.

Impact

- A collection of momentum distributions for p-shell nuclei has been produced for local chiral interactions at N^{2}LO. This largely extends the momentum distribution database, previously available for phenomenological potentials only, and it provides the possibility of examining the scheme and scale dependence of various properties of interest.
- The description of the momentum distributions at low and moderate momenta is similar to that provided by phenomenological potentials, while higher momentum components are typically reduced, consistent with the lower-energy regime of chiral interactions.
- The results for back-to-back pairs confirm the large pn to pp pairs ratio in the regime q ≈ 1.5 — 2.5 fm^{-1} up to ^{16}O, which appears to be nearly independent of the employed interaction scheme.
- The pp to pn ratio for local chiral interactions at N^{2}LO is compatible with available experimental data extracted from electron scattering experiments in the range q ≈ 2.5 — 4.0 fm^{-1} up to A = 16.

Accomplishments

D. Lonardoni, S. Gandolfi, X. B. Wang, and J. Carlson, Phys. Rev. C 98, 014322 (2018)