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Ab initio translationally invariant nonlocal one-body densities

Nonlocal nuclear density is derived from the no-core shell model (NCSM) one-body densities by generalizing the local density operator to a nonlocal form. The translational invariance is generated by exactly removing the spurious center of mass (COM) component from the NCSM eigenstates expanded in the harmonic oscillator (HO) basis. The ground state local and nonlocal density of ^{4,6,8}He, ^{12}C and ^{16}O are calculated to display the effects of COM removal on predicted nuclear structure. This enables the ab initio NCSM nuclear structure to be used in intermediate energy nuclear reactions. We include the nonlocal density in calculations of optical potentials and show more accurate theoretical predictions for the differential cross sections of proton scattering off of stable and exotic light nuclei.

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