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Non-Local Translationally Invariant Nuclear Density MICHAEL GENNARI, ANGELO CALCI, MATTEO VORABBI, PETR NAVRATIL, TRIUMF — 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 of the harmonic oscillator wavefunctions. This enables the ab initio NCSM nuclear structure to be used in high energy nuclear reactions and density functional theory. The ground state local and nonlocal density of Helium-4, Helium-6, Helium-8, and Oxygen-16 are calculated to display the effects of COM removal on predicted nuclear structure. We show that amplified effects of the COM removal can be seen in related quantities like kinetic density, which is dependent on gradients of the nonlocal nuclear density. Additionally, we include nonlocal density in calculations of optical potentials – as opposed to using the local approximation – which produces more accurate theoretical predictions for the optical potentials of lighter nuclei. We present differential cross sections and analyzing powers for proton scattering on Helium-4, Helium-6, Helium-8, and Oxygen-16 at high energies using modern nucleon-nucleon and three-nucleon chiral interactions.

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