Quantum dynamics of nuclear slabs: Mean field and short-range correlations

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Computational difficulties aside, nonequilibrium Green's functions seem ideally suited for investigating the dynamics of central nuclear reactions. Many particles actively participate in those reactions. At the two energy extremes for the collisions, the limiting cases of the Green's function approach were successful: the time-dependent Hartree-Fock theory at low energy and Boltzmann equation at high. The strategy for computational adaptation of the Green's function to central reactions is discussed. The strategy involves, in particular, progressing through one and two dimensions to develop and assess approximations, rotation to relative and average coordinates, discarding of far-away function elements, local expansion in anisotropy and preparation of initial states for the reactions through adiabatic switching. At this stage we concentrate on inclusion of correlations in one dimension, where relatively few approximations are needed, and we carry out reference calculations that can benchmark approximations needed for more dimensions. We switch on short-range interactions generating the correlations adiabatically in the Kadanoff-Baym equations to arrive at correlated ground states for uniform matter. As the energy of the correlated matter does not quite match the expectations for nuclear matter we add mean field to arrive at the match in energy. From there on, we move to finite systems. In switching on the correlations we observe emergence of extended tails in momentum distributions and evolution of single particle occupations away from 1 and 0. Subsequently we study collective oscillations for nuclear slabs, that exhibit damping tied to the heating of slab interiors.