Comparison of heavy-ion transport simulations: Mean-field dynamics in a box

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We have participated in the transport evaluation project (TMEP) of simulations for heavy-ion collisions to study zero-sound propagation due to the nuclear mean-filed potential in a neutron-proton symmetric matter that is enclosed in a periodic box at zero temperature and around normal density [1]. The results of several transport codes belonging to two families (BUU-like and QMD-like) have been compared among each other and to exact calculations. For BUU-like codes that employ the test particle method [2], which include our relativistic Vlasov-Uhling-Ulenbeck (RVUU) model [3,4], the results are found to depend on the combination of the number of test particles and the spread of the profile functions that weight integration over space. It is found that these parameters can be properly adapted to give a good reproduction of the analytical zero-sound features. For QMD-like codes, which are based on the molecular dynamics method firstly developed in Ref. [5], large damping effects are found, and they are attributable to the fluctuations inherent in their phase-space representation. Also, for a given nuclear

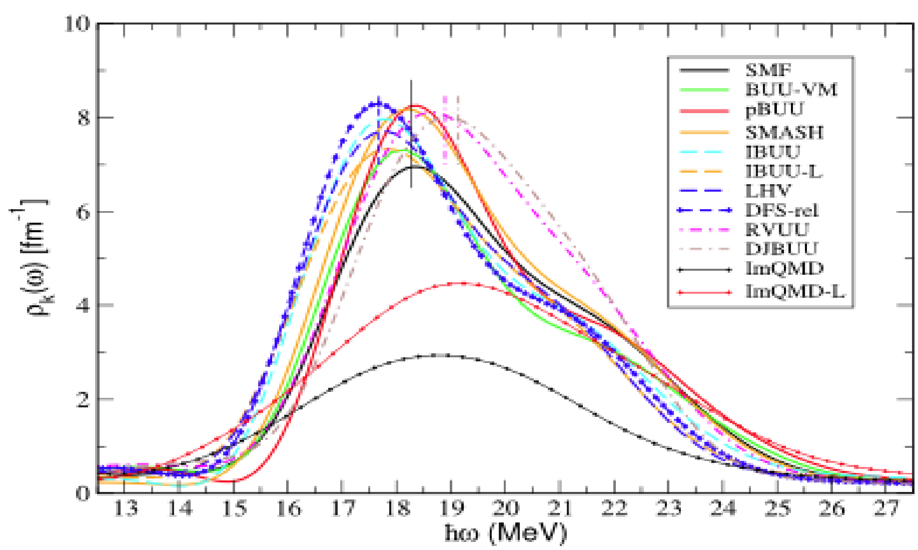

Fig. 1. Response function $\boldsymbol{\rho_k(\omega)}$, i.e., Fourier transform with respect to space and time, of the averaged density distribution from BUU-like and two QMD-like calculations. Results are shown also for DFS calculations with relativistic kinematics. The vertical lines indicate the analytical zero-sound energies for the different code types, downshifted by 2%.

effective interaction, QMD-like codes generally lead to slower density oscillations, as compared to BUU-like codes. The latter problem is mitigated in the more recent lattice formulation of some of the QMD codes as shown in Fig. 1 for the response function $\rho_k(\omega)$, i.e., Fourier transform with respect to space and time, of the averaged density distribution. We have further discussed the significance of these results for the description of real heavy-ion collisions.

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