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Transport Model Evaluation Project (TMEP): Status and Perspectives

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Heavy-ion collisions and their interpretation by transport model simulations can make a significant contribution to the study of the nuclear EOS, complementary to nuclear structure studies, astrophysical observations and microscopic many-body calculations, since they allow to control to a wide extent the thermodynamical conditions and give information on the composition of the system, in particular having access to the important regime of several times saturation density. However, in view of a strong model dependence of the results, the TMEP started from the idea to improve the significance of transport model studies by comparing simulations of different codes under as much as possible identical conditions in box calculations and simulations of real nucleus-nucleus collisions. Codes of the two main families of transport codes, BUU and QMD, and a significant selection of presently used codes were included in the comparisons in several publications in the last years. From the box calculations new and significant lessons for simulations have been derived, particularly on the influence of fluctuations (which differ significantly in BUU and QMD approaches) on many aspects of simulations. Still, in heavy-ion collisions the codes could not be made to converge sufficiently in some cases, relative to the pertinent questions on the EOS, mainly because collisions are open systems where different effects interact and small effects may lead to large final differences.
In the future the focus thus will have to shift from convergence to a quantification of the model differences of transport model analyses as a whole. Attempts in this direction with Bayesian model averaging will be discussed. Moreover, as the previous comparisons were largely done in simplified models of the physics of the collision, closer contact to experiments has to be made with more realistic models, including, momentum-dependent potentials of all constituents, studies the sensitivity of observables to the symmetry energy, including the clustering effect, and introducing microscopic input into transport. Finally, these efforts should be seen in the context of other approaches to quantify the uncertainty of EOS studies, either by not limiting the comparisons only the collisions, or by attempting to construct a universal transport code in a modular approach.

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