

Correlations in the interaction of ion beams with matter

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Heavy-ion collisions can be simulated through Monte Carlo approaches, to include the many different reaction mechanisms that can occur, which depend on the impact parameter, the bombarding ion incident energy and the reaction asymmetry. The relative occurrence and correlation among different mechanisms, such as deep-inelastic scattering, binary fragmentation, knock-on and pick-up reaction processes, follow in a natural way from Monte Carlo calculations. QMD models and their relativistic extensions are examples of such a kind of comprehensive approaches. They follow nuclear phase-space evolution during each ion-ion collision event, by correlating the coordinates of each nucleon to those of all other nucleons. Their fermionic versions are even more interesting from a theoretical point of view, since they fully describe the fermionic nature of nuclei through nuclear wave-function antisymmetrization. Unfortunately at present, due to their complexity, these approaches can not be conveniently applied in a practical and systematic way to simulate heavy-ion collisions occurring in application problems (e.g. shielding project, dose calculation), which have to be addressed by general purpose tools describing beam propagation and interaction in matter of whichever composition. In this talk results are shown obtained by coupling a new version of a QMD code, which describes the fast stage of ion-ion collisions, to the evaporation/fission/Fermi break-up routines present in the FLUKA multipurpose Monte Carlo transport and interaction code. In particular, we compare the predicted neutron and fragment production yields and cross-sections to available experimental data from thin and thick targets. In the calculation only a few QMD parameters, concerning nucleon-nucleon interaction potential and nucleon wave-packet gaussian width, are adjusted to reproduce the data. The role of these parameters is investigated and their relation with the nuclear matter equation of state is discussed.