Fluctuations and dynamical instabilities in heavy-ion reactions

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We present a new method to implement fluctuations in the mean-field dynamics. Assuming local thermal equilibrium, we calculate the fluctuation amplitude according to the statistical value and we determine the associated density variance. The method can be applied to study the role of fluctuations in both stable and unstable dynamics. While in stable cases fluctuations are only responsible for the width of the distributions around mean values, their role becomes crucial in unstable situations, where bifurcations occur and different reaction exit channels are possible. We illustrate this point by describing the break-up of di-nuclear systems exhibiting neck instabilities.

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Heavy ion collisions with non-equilibrium Dirac-Brueckner mean fields

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The influence of realistic interactions on the reaction dynamics in intermediate energy heavy ion collisions is investigated. The mean field in relativistic transport calculations is derived from microscopic Dirac-Brueckner (DB) self-energies, taking non-equilibrium effects, in particular the anisotropy of the local phase space configurations, into account. Thus this approach goes beyond the local density approximation. A detailed analysis of various in-plane and out-of-plane flow observables is presented for Au on Au reactions at incident energies ranging from 250 to 800 A.MeV and the results are compared to recent measurements of the FOPI collaboration. An overall good agreement with in–plane flow data and a reasonable description of the out–of–plane emission is achieved. For these results the intrinsic momentum dependence of the non-equilibrium mean fields is important. On the other hand, the local density approximation, i.e. without non-equilibrium effects, with the same underlying DB forces and also a standard non–linear version of the $\sigma\omega$ model are less successful in describing the present data. This gives evidence of the applicability of self energies derived from the DB approach to nuclear matter also far from saturation and equilibrium, if non-equilibrium effects are accounted for.

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