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Effects and relevance of off-shell transport

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The heavy-ion experimental program at SIS and the future FAIR facility explore nuclear matter at extreme conditions of large densities and temperatures where according to many-body theory a strong modification of hadron properties occurs. An understanding of the properties of strongly-interacting hadronic and partonic matter - created in heavy-ion collisions - from a microscopic point of view is a challenging task. This requires to go beyond the semi-classical BUU and QMD type of approaches, which are based on on-shell degrees-of-freedom, and to employ the off-shell transport theory based on Kadanoff-Baym equations, which allow to also propagate broad states with spectral functions that change their properties dynamically according to the environment.

We discuss the basic ideas of such an off-shell microscopic transport approach - Parton-Hadron-String Dynamics (PHSD) - and illustrate the importance of off-shell dynamics by some examples. We also show the impact on observables for the description of vector mesons - via dilepton decay spectra - as well as for strange degrees of freedom such as anti-kaons and phi-mesons.

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