Time-dependent Green's Functions Approach to Nuclear Reactions

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Time-dependent approaches provide a realistic description of nuclear reactions, allowing for simulations of central collisions of heavy isotopes with minimal assumptions and providing a direct connection with nuclear structure. In this context, non-equilibrium Green's functions techniques have the potential to include consistently the effect of many-body correlations in the static description and that of memory effects in the dynamical evolution of the system [1, 2]. As a first theoretical application of these techniques, simulations of the mean-field dynamics of collisions of one-dimensional nuclear slabs will be discussed [4]. Particular attention will be payed to the role of the off-diagonal elements of the Green's functions. Their relevance for the global time evolution will be assessed by analyzing the time reversibility and the Wigner distribution of the system. The extension of the dynamics to a correlated case, in which the self-energy is treated within the Born approximation, will be presented. Finally, conclusions regarding the extension of the method to 3D will be drawn and the potential pool of nuclear physics applications will be discussed.

[1] L. Kadanoff and G. Baym, *Quantum Statistical Mechanics* (Benjamin, New York, 1962).
[2] G. Baym, Phys. Rev. 127, 1391 (1962).
[3] M. Tohyama and A. S. Umar, Phys. Rev. C 65, 037601 (2002).
[4] A. Rios and P. Danielewicz, arxiv:0801.4171.