Towards Inclusion of Dissipation in Quantum Time Dependent Mean-field Theories

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The question of accounting dissipative effects in the quantum description of the dynamics of finite fermion systems is a long standing problem. It was in particular formally addressed in the late 1970's in the context of heavy ion collisions and strongly debated in relation to ongoing experiments at that time, especially the ones concerning incomplete fusion reactions. The 1980's and following decades saw the dominance of semi classical approaches in this field with some account of quantum effects at various levels of sophistication but never with a routine and robust account of dissipation within a well formalized quantum framework. The question is also currently being attacked in the community of electronic dynamics as attacked by Density Functional Theory. Some experiments have recently revealed typical dissipative features, for example in the response of fullerenes to laser irradiation. The field has been little explored yet from the theoretical point of view but focusing many investigations.

We shall briefly review the situation in the nuclear and electronic case, summarizing the major theoretical approaches. We shall then discuss strategies to implement dissipative effects in a simple manner in the case of time dependent mean field approaches and illustrate them on simple examples.