The nuclear Many-Body problem: an open quantum systems perspective.

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Similarly to other complex systems, the understanding and description of nuclear processes in a simple way often requires the reduction of the information to few, selected degrees of freedom. The irrelevant degrees of freedom then act as an environment for the relevant ones. Using this strategy, nuclear systems enters into the class of Open Quantum Systems (OQS) and many phenomena can be studied, namely dissipation, fluctuations, decoherence...
In this contribution, the connection between nuclear physics and OQS will be illustrated in two special cases (i) the case of fusing nuclei (ii) the microscopic nuclear many-body problem. In the former case, when two nuclei collide with each others many channels are open and can influence the dynamics. The role of rotational states as well as intrinsic degrees of freedom disorder will be discussed. In the case (ii), I will show how mean-field theory can be seen as a starting point to develop new approaches where two- and more body correlations can be seen as an environment. A special attention will be paid to make connection with OQS theory concepts: master and Lindblad equation, non-Markovian effects, quantum jumps and quantum Monte-Carlo...

Refs:

S. Ayik, B. Yilmaz and D. Lacroix, "*Stochastic semi-classical description of fusion at near-barrier energies*" Physical Review C **81**, 034605 (2010).

G. Hupin and D. Lacroix, "*Quantum Monte Carlo method applied to non-Markovian barrier transmission*" Physical Review C81, 014609 (2010).

K. Washiyama, D. Lacroix and S. Ayik, "*One-body energy dissipation in fusion reactions from mean-field theory*" Physical Review C**79**, 024609 (2009), ibid. Physical Review C **80**, 031602(R) (2009), ibid. Physical Review C **79**, 054606 (2009)

D. Lacroix, "*Exact stochastic simulation of dissipation and non-Markovian effects in open quantum systems*", Phys. Rev. E77, 041126 (2008).

D. Lacroix, "*Stochastic Schrödinger Equation from optimal path evolution*", Ann. of Phys. 322, (2007), 2055.

D. Lacroix, "*Stochastic mean-field dynamics for fermions in the weak coupling limit*", Physical Review C73, 044311 (2006).

D. Lacroix, "*Exact and approximate Many-body dynamics with stochastic one-body density matrix evolution*", Physical Review C71 (2005) 064322.

D. Lacroix, S. Ayik and Ph. Chomaz, "*Nuclear collective vibrations in extended mean-field theory*", Progress in Particle and Nuclear Physics, 52, 497 (2004), 497.