Numerical solution of the Dyson equation in the two-times plane: applications to quantum quenches and transport in many-body quantum systems

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A numerical approach to the solution of the Dyson equation for low dimensional quantum systems in the framework of non-equilibrium Green's functions is presented.
After a short introduction on the Dyson equation I will outline some features of the most used and well known approximations functional form of the self-energy, namely the Hartree-Fock, the second Born and the GW. I will then show how these features can be exploited to design a parallelized algorithm to solve the Dyson equation for the different components of single particle Green's function on the complex contour. I will discuss in detail some of the feature of this approach in terms of convergence properties, performances and limitations by means of some specific examples such as quantum quenches in ultracold gases and transport in the single impurity Anderson model. During the talk I will address some of the most important limitations of our approach both of numerical and physical nature and discuss some ideas which we are currently elaborating on in order to improve our approach both in terms of numerical precision and in terms of computational efficiency.