Nonequilibrium dynamics of nanowires: driving the energy current

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We have recently demonstrated for generic fermionic systems that the Joule heating is the dominating lowest–order mechanism that should be taken into account beyond the LR regime [1, 2]. Our main results is that a generic *isolated* (metallic or insulating) system under d.c. driving undergoes a quasiequilibrium evolution towards the infinite–temperature state. This evolution is due the Joule heating. Connecting the system to the heat bath should set the energy leading to a finite and literally d.c. current [2]. This method allows one to obtain the nonlinear d.c. response from the studies of an isolated driven system. It is important because numerical analysis of driven open systems (e.g., in terms of the Lidblad master equation) is by far more involved and possible only for selected systems and drivings.

We have carried out a preliminary studies on possibilities and limitation of generating an assumed current $I(t)$ in a quantum system [1]. This is a reverse problem to the commonly studied one. Usually one assumes the driving $F(t)$ which determines the system evolution $|\Psi_l(0)\rangle \to |\Psi_l(t)\rangle$ while the current is calculated only at the final stage of calculations as $I(t) = \langle\Psi_l(t)|J(t)|\Psi_l(t)\rangle$. We have shown that it is possible to tune electromagnetic pulse $F(t)$ that in a finite quantum system generates the assumed (arbitrary) $I(t)$.

Within the present project we intend to extend our studies and investigate the energy current in correlated nanowires driven out of equilibrium. We will focus on the following problems: (i) what determines the energy current in a quantum system driven far from equilibrium? (ii) can the energy current be controlled in a similar way as discussed above for the particle current.

[1] M. Mierzejewski and P. Prelovšek, Phys. Rev. Lett. **105**, 186405 (2010).

[2] M. Mierzejewski, J. Bonča, and P. Prelovšek, Phys. Rev. Lett. **107**, 126601 (2011).