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Nonequlibrium dynamics of many-body systems driven by a constant electric field[1]

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We present a fundamental study of a Holstein polaron in one dimension and a single hole in the two dimensional t-J-Holstein model driven by a constant electric field. Taking fully into account quantum effects we follow the time-evolution of systems from their ground state as the electric field is switched on at $t = 0$, until they reach a steady state. At small electron phonon coupling (EP) the Holstein polaron experiences damped Bloch oscillations (BO) characteristic for free electron band [1]. An analytic expression of the steady state current is proposed in terms of EP coupling and electric field. In the strong coupling limit weakly damped BO, consistent with adiabatic evolution along the polaron band, persist up to extremely large electric fields. In the t-J model adiabatic regime is observed followed by the positive differential resistivity (PDR) at moderate fields where carrier mobility is determined [2]. At large field the system enters negative differential resistivity (NDR) regime where current remains finite, proportional to $1/F$. The crossover between PDR and NDR regime is accompanied by a change of the spatial structure of the propagating spin polaron, see Fig. 1. Finally we discuss the interplay between strong correlations and lattice effects in a driven t-J-Holstein model.

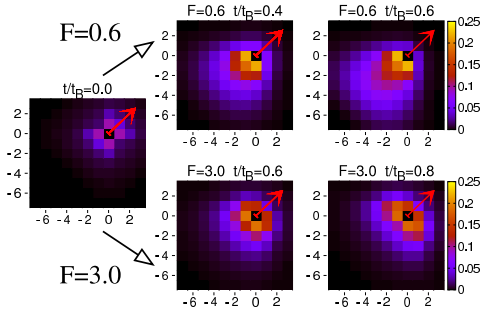

Figure 1: Spin disturbance behind the propagating spin polaron.

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[2] M. Mierzejewski, *et al.* Phys. Rev. Lett. **106**, 196401 (2011).

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