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Activity driven transport in extended systems

The transport properties of an extended system driven by active reservoirs is an issue of paramount importance, which remains virtually unexplored. Here we address this issue, for the first time, in the context of energy transport between two active reservoirs connected by a chain of harmonic oscillators. The couplings to the active reservoirs, which exert correlated stochastic forces on the boundary oscillators, lead to fascinating behavior of the energy current and kinetic temperature profile even for this linear system. We analytically show that the stationary active current (i) changes non-monotonically as the activity of the reservoirs are changed, leading to a negative differential conductivity (NDC), and (ii) exhibits an unexpected direction reversal at some finite value of the activity drive. The origin of this NDC is traced back to the Lorentzian frequency spectrum of the active reservoirs. We provide another physical insight to the NDC using nonequilibrium linear response formalism for the example of a dichotomous active force. We also show that despite an apparent similarity of the kinetic temperature profile to the thermally driven scenario, no effective thermal picture can be consistently built in general. However, such a picture emerges in the small activity limit, where many of the well-known results are recovered.

Primary authors: SANTRA, Ion (Raman Research Institute); Prof. BASU, Urna (S.N. Bose National Centre for Basic Sciences)

Presenter: SANTRA, Ion (Raman Research Institute)

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