Nonlocal thermoelectric detection of interaction and correlations in Quantum Hall edge states

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Nonequilibrium effects in interacting systems are among the most difficult problems in mesoscopic physics. This is even more crucial in quantum Hall systems where the electronic coherent nature, non-equilibrium features and interactions make the physics very complex[1,2]. Hereafter, we propose the nonlocal thermoelectric response as a direct indicator of the presence of interactions, nonthermal states and the effect of correlations[3]. This is done by assuming a quantum Hall setup where two channels (connected to reservoirs at different temperatures) co-propagate for a finite distance, such that a thermoelectrical response is only expected when the electron-electron interaction mediates heat exchange between the channels. The nonlocal Seebeck response measures the interaction strength. Considering zero-range interactions, we solve the charge and energy currents and noises of a non-equilibrium integrable interacting system, determining the universal interaction-dependent length scale of energy equilibration for a Luttinger liquid. Further, a setup with two controllable quantum point contacts allows thermoelectricity to monitor the interacting system thermalisation as well as the fundamental role of cross-correlations in the heat exchange at intermediate length scales. Finally, the proposed methodology could inspire novel methods in solid-state systems to measure heat currents by direct thermoelectrical conversion of the heat-exchange in electrical current signal.

A.B. acknowledge MUR-PRIN 2022 Grant No. 2022B9P8LN-(PE3)-Project NEThEQS "Non-equilibrium coherent thermal effects in quantum systems" in PNRR Mission 4 - Component 2 - Investment 1.1 "Fondo per il Programma Nazionale di Ricerca e Progetti di Rilevante Interesse Nazionale (PRIN)" funded by the European Union - Next Generation EU.

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