Mode-selected heat flow through a one-dimensional waveguide network

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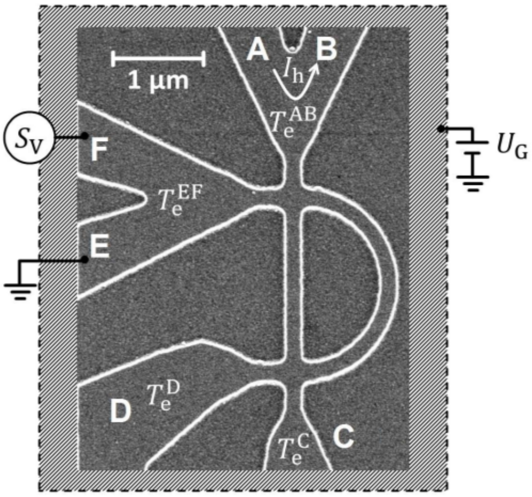
Short Abstract

Cross-correlated measurements of thermal noise are performed to determine the electron temperature in nanopatterned channels of a GaAs/AlGaAs heterostructure at 4.2 K. Two-dimensional (2D) electron reservoirs are connected by an extended one-dimensional (1D) electron waveguide network where electrons behave like waves. Hot electrons are produced using a current in a source 2D reservoir, are transmitted through the ballistic 1D waveguide and relax in a drain 2D reservoir. We find that the electron temperature increase in the drain is proportional to the square of the heating current. Electron-phonon interaction is negligible for heat transport between 2D reservoirs at temperatures below 4.2 K.



Above. Scanning electron micrograph of an identically processed sample. 1D waveguides of about 170 nm lithographic width form an asymmetric ring and are connected to narrow 2D electron reservoirs, labelled A to F. T_e** indicate the electron temperature of the 2D reservoirs and I_h indicates the path of the heating current. S_V and U_G indicate the thermal noise and the gate-voltage, respectively.