Conductivity, shot noise, and hot phonons in bilayer graphene

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Conductivity and shot noise in graphene contain both interesting information on the nature of transport of charge carriers. For ballistic mono-layer graphene, the conductivity and the excess noise Fano factor are $4e^2/\pi h$ and 1/3 at the charge neutrality point, respectively [1,2]. At high bias voltage, the electron-electron and electron-phonon interactions should lead to a breakdown of ballistic transport and, therefore, modify conductivity and shot noise.

We have studied electrical conductivity σ and shot noise of bilayer graphene sheets at high bias voltage Vds [3]. As a function of bias, we find a linear increase of σ which is leveled off above Vds~0.2 V. In the linear region, a simple scaling law is found between the bias and gate voltage dependences of σ. The Fano factor F is found to first increase with bias and then reach a maximum at Vds~0.1 V, above which F decreases.

A mean-free-path type model is used to analyze the results. The increase of σ is directly related to the increase of the transmission modes within the bias widows [4]. We assign the saturation of σ and the decrease of F to the creation of optical/zone boundary phonons. F is also used as a thermometer to measure the electronic temperature. This defined temperature is in good agreement with that extracted from the conductivity model.

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