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One Dimensional Localization In Strongly Gapped Bilayer Graphene

Unlike conventional semiconductors, bilayer graphene (BLG) allows us to investigate different strengths and configurations of disorder by independently controlling its bandgap and chemical potential. The mechanism of sub-gap conductance in strongly localized BLG is a highly debated topic with conflicting reports [1-3]. Here, we study the transport in strongly insulating bilayer graphene using conductance statistics as a probe. Conductance statistics provides a powerful tool to analyze the transport properties of strongly disordered systems. We show that in strongly localized BLG, the logarithm of conductance g (= $G/[e^2/h]$) shows marginal self-averaging, i.e. the relative fluctuations $var(\ln g) / \langle \ln g \rangle^2$ diminish logarithmically with increasing system size, suggesting the presence of unavoidable large resistance hops in one dimension (Fig. 1). Our analysis suggests that transport in this localized regime occurs via one-dimensional channels, possibly along robust edge-modes. The suppression of self-averaging may also be influenced by the strong electron-electron interaction at the edges of graphene and may represent a new class of localization mechanism.

References

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Figures

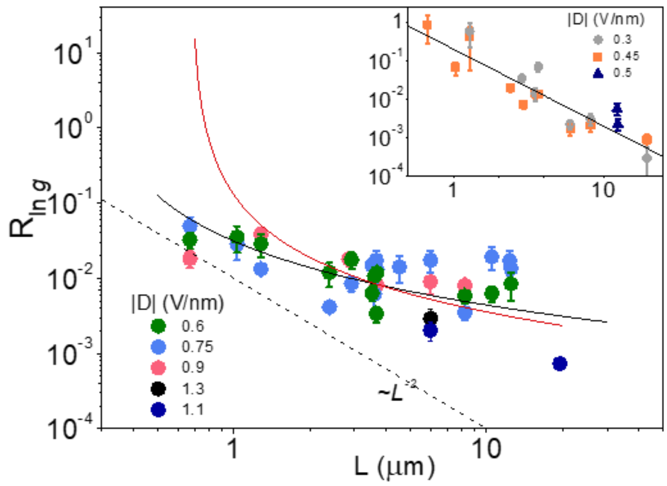

Figure 1: Relative fluctuations $R_{\ln g}$ = var (ln g_{cnp}) / < ln g_{cnp}> ^{2} as a function of length of the sample for |D| > 0.5 V/ nm (strongly localized system) showing marginal self-averaging. Inset shows $R_{\ln g}$ vs L for |D|< 0.5 V/ nm (moderately localized system). Here, strong self-averaging is indicated by the decay in $R_{\ln g}$ as $R_{\ln g} \propto L^{-2}$ (solid line).