Supplementary Material: Quantum Transports in Two-Dimensions with Long Range Hopping: Shielding, Localization and the Extended Isolated State

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ABSTRACT

This supplementary material shows the scaling of conductance for the 1D long range model.

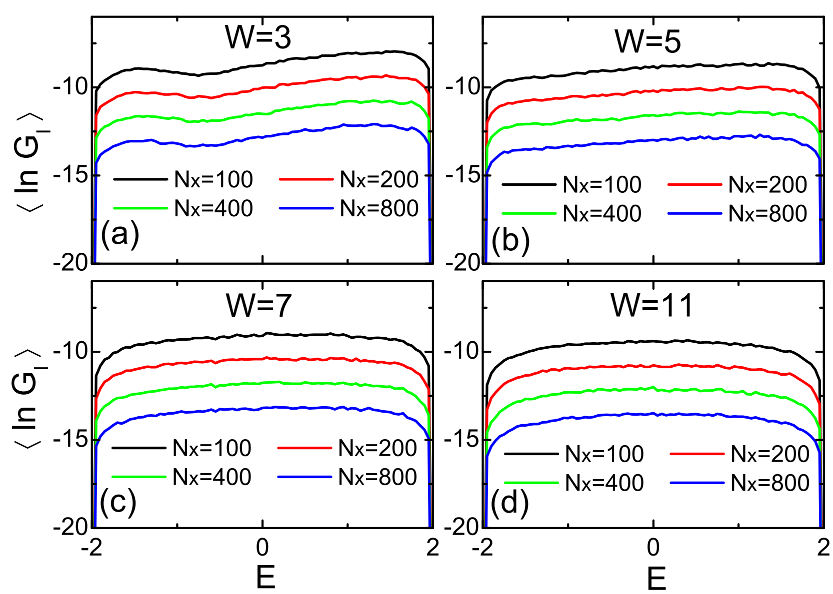

Figure S1. (Color online) Size scaling of the 1D long range model. Disorder averaged $\langle \ln G_{\mathrm{I}} \rangle$ as a function of Fermi energy E for different sample lengths: $N_x = 100$ (black), $N_x = 200$ (red), $N_x = 400$ (green), $N_x = 800$ (blue), at different disorder strengths: (a) $W = 3$, (b) $W = 5$, (c) $W = 7$, (d) $W = 11$. The average is over 5000 disorder samples.

In this supplementary material, we briefly summarize the 1D long range model. For the 1D non-interacting model, the shielding of band states and robustness of the isolated state have been discussed thoroughly in Ref.[3] Here we just present the results of localization properties from the size scaling of the intrinsic conductance. Figure S1 is the counterpart of Figure 5 in the main article, i.e., the scalings of $\langle \ln G_{\mathrm{I}} \rangle$ with increasing sample length N_x for different disorder strengths. As expected, all states are localized in the presence of disorder, because $\langle \ln G_{\mathrm{I}} \rangle$ is decreasing monotonically with the length N_x. Combining with our results in 2D presented in the main text, we conjecture that, for long range models defined by Equation 1 of the main article, $D = 2$ is also the critical dimension, like the well-known case of the short range models in the orthogonal class.[1,2,4]

Genuine delocalization can only be found in spatial dimension larger than 2, which will be investigated in the future.

References

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