**SAMPLE PREPARATION**

Self-assembled arrays of Tin on Graphene occurs from the spontaneous dewetting of the thermally evaporated film under vacuum, a situation similar to what is described in [1]. evaporation is perform without lithographic mask in order to avoid any possible contamination of the graphene surface by polymer resist. The resulting structure consists of networks of 'islands' of homogeneous height (typically 30% higher than the nominal evaporated thickness) with random orientation and position (see Fig. 1 of main text). The typical lateral size of an island is of the order of 80 nm, with an average inter-island gap of 13 nm.

**CHARACTERIZATION OF THE SAMPLES BY RAMAN SPECTROSCOPY**

Raman spectroscopy was performed along the sample in order to assess the degree of disorder of the CVD-grown graphene used for that study. The spectra were slightly position dependent, due to local spatial inhomogeneities. We present in Fig.S1 two typical spectra taken at two different locations on the device which low temperature data are shown in the main text. Spectra are acquired with $\lambda = 633$ nm laser illumination with power kept at 1mW to avoid any heating effect. Table S1 sums up the informations extracted from these spectra. We were interested in the intensities $I$ and full width at half maximum (FWHM) $\Gamma$, in order to compare to existing experimental results [3].

It is known since the seminal work by Tuinstra and Koenig [2], that one can relate the intensity ratio $I_D/I_G$ in the Raman spectrum of graphite (and by extension to graphene) to the size of crystalline domains. Recent studies [3] have aimed at using Raman spectroscopy as a tool for the precise determination of the point defect density in graphene, using the $I_D/I_G$ ratio and the FWHM of the G and D peaks as markers for defect assessment. Following their analysis, our finding is that the ratio $I_D/I_G \approx 1$ and the larger than usual FWHM of our peaks are typical of very high defect density, typically $L_D < 5$ nm, where $L_D$ is the average distance between two point defects. However, it should be borne in mind that the nature and energy associated with defects induced in [3] by ion bombardment is probably different from our growth defects.

Simulations [5] indeed showed that the hopping energy associated with ion bombardment was much higher than expected. It is thus only possible to draw a qualitative conclusion. As for the number of layers, because in CVD growth the layers don’t grow A-B stacked, the 2D band is always a lorentzian [6]. It is therefore impossible to assess the number of layers with certainty from a Raman study, but the rather large 2D peak and good tunability of the device indicates that there are only few layers at most. Due to the chiral nature of carriers in graphene, there should be no localization in graphene at low temperature, owing to the effect called Klein tunneling [7]. However, this picture breaks down if we in-
SUPPLEMENTARY INFORMATION

<table>
<thead>
<tr>
<th></th>
<th>$I_D$</th>
<th>$I_G$</th>
<th>$\Gamma_D$</th>
<th>$\Gamma_G$</th>
<th>$\Gamma_{2D}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spectrum a</td>
<td>1143</td>
<td>1085</td>
<td>36 cm$^{-1}$</td>
<td>30 cm$^{-1}$</td>
<td>34 cm$^{-1}$</td>
</tr>
<tr>
<td>Spectrum b</td>
<td>1761</td>
<td>1671</td>
<td>50 cm$^{-1}$</td>
<td>42 cm$^{-1}$</td>
<td>36 cm$^{-1}$</td>
</tr>
</tbody>
</table>

Table S1. Values extracted from the Raman spectra. $I_D$, $I_G$ and $I_{2D}$ are the peaks intensities and $\Gamma_D$, $\Gamma_G$ and $\Gamma_{2D}$ the FWHMs.

Introduce inter-valley scattering, which requires atomically sharp defects for the electrons to scatter on. The Raman study confirmed that the sample showing superconducting/insulating transition indeed presented a very high density of these defects. To better understand our results, we have applied a magnetic field to remove superconductivity. Fig. S2 shows the temperature and gate voltage dependence of the resistivity under a field of $B = 1$ T. The sample shows a crossover from weak localization at high electrostatic doping, to an activated behavior with a variable exponent as we get closer to the Dirac point.

\[ R(T) = R_0 + A T^\alpha \]

The slope of the curve gives the transition threshold.

\[ dR \over dV_g = \alpha \nu z \]

Second method of finite-size scaling law at the transition threshold.

\[ \partial V_g \over \partial R(L) \quad \text{according to the second method exposed in the main text}. \]

\[ \nu = 1.1823 \pm 0.0173 \]

The critical exponent of the transition.

\[ | \nu - 1 | = 0.007 \]

\[ \nu = 0.5 \pm 0.05 \]

\[ 0.4 < \nu < 0.6 \]

\[ \text{TABLE S1. Values extracted from the Raman spectra. } I_D, I_G \text{ and } I_{2D} \text{ are the peaks intensities and } \Gamma_D, \Gamma_G \text{ and } \Gamma_{2D} \text{ the FWHMs.} \]

![Figure S2. Temperature dependence of the field effect for the tin-decorated sample in the normal state.](image)

The field effect is measured at different temperature for the sample in the normal state by application of a magnetic field (1 T) above the critical field of tin.

![Figure S3. Strong Localization of CVD Graphene Sample before tin decoration at low temperatures.](image)

Resistivity map obtained on a bare sample (without tin decoration) showing the crossover between strong localization at the charge neutrality point and weak localization at high electronic doping.

NORMAL STATE RESISTIVITY OF BARE GRAPHENE SAMPLE

To gain more insight, we cooled down a sample of bare CVD graphene (Fig. S3) without tin decoration, obtained from similar batch growth. This allows to probe the physics of the graphene matrix with no interference from tin. The system behaves exactly like tin-decorated graphene under magnetic field, except for the absolute value of the resistivity, which is higher. In addition to sample variability, one reason for that could be the suppression of weak localization in the sample under magnetic field, leaving only e-e interactions as a localization mechanism.

![Figure S3. Strong Localization of CVD Graphene Sample before tin decoration at low temperatures.](image)

Resistivity map obtained on a bare sample (without tin decoration) showing the crossover between strong localization at the charge neutrality point and weak localization at high electronic doping.

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SECOND METHOD OF FINITE-SIZE SCALING LAW AT THE TRANSITION THRESHOLD

We used an alternative method to obtain the critical exponent $z\nu$ according to the second method exposed in [8]. It is based on fitting the slope of $\log \left( \frac{dR}{dV_g} \right)_{V_{gc}}$ vs $\log (T^{-1})$ (see main text).

![Graph](image)

**Figure S4.** Second method of finite-size scaling law at the transition threshold. The slope of the curve gives the critical exponent of the transition.


