Transport through electronic whispering gallery modes in a graphene p-n junction

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Owing to their relativistic nature, graphene charge carriers transmission and refraction through p-n junctions are governed by Klein tunneling. As a consequence, their confinement in circular p-n islands favors high angular momentum states, leading to rich geometrical patterns decorating the local density of states [1]. Among them, the recently reported whispering gallery modes (WGMs) [2] offer promising perspectives to create a new class of sensors, owing to the inherent sensitivity of these geometrical resonances.
Here we create a p-n island in an encapsulated graphene device using the polarized tip of a scanning gate microscope [3], and probe the resulting whispering gallery modes signatures in in-plane electronic transport through the circular p-n island. By squeezing the tip-induced p-n island in an etched constriction (Fig.1a), we observe oscillations in the device resistance (Fig.1b). We relate these oscillations to the quasi-confinement of Dirac fermions in the tip-induced p-n island, which can be optimized by changing at will the potential barriers smoothness, using to the tip-to-graphene distance [4]. Combining tight-binding simulations and exact resolution of the Dirac equation, we precisely assign the measured device resistance features to WGMs (Fig.1c). Ultimately, we demonstrate selectivity of the active mode by displacing the p-n island with respect to the constriction. This work therefore constitutes a proof of concept for graphene whisperitronics devices [5].

References

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Figures

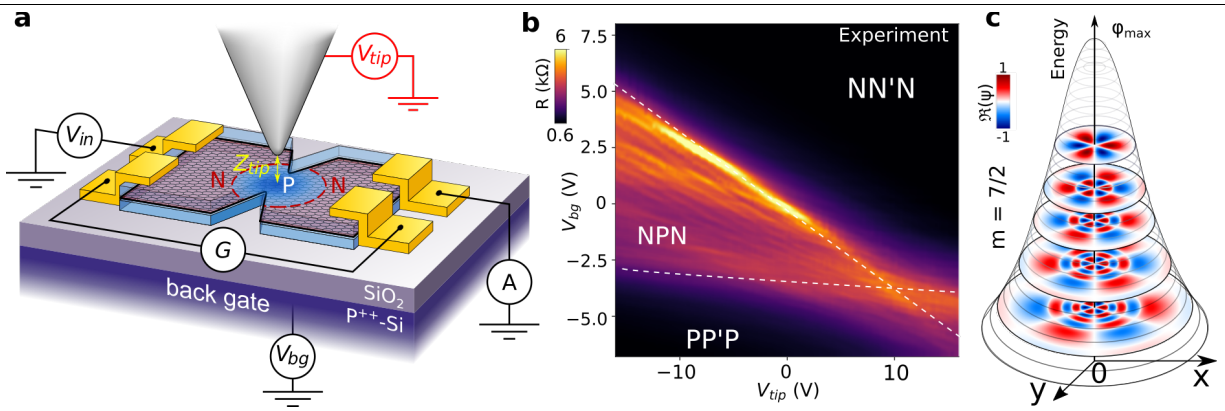

Figure 1: **a,** Scheme of the experiment: a polarized AFM tip is scanned above a constriction etched in an encapsulated graphene device. **b,** Resistance of the device as a function of tip and backgate voltages, when the tip is placed above the center of the constriction. **c,** Wave function corresponding to the WGM with angular momentum m = 7/2, for its different resonant energies.