ELECTRONIC WHISPERING-GALLERY RESONANT TRANSPORT IN GRAPHENE P-N JUNCTION

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Owing to the relativistic nature of charge carriers, electronic transport in graphene p-n junctions exhibits several features analogous to light rays in optical media, thus making them an ideal platform for developing electron optics devices [1]. Remarkably, the electron confinement in graphene circular p-n islands favors high angular momentum states, leading to rich geometrical patterns decorating the local density of states. In particular, the whispering gallery modes (WGMs) have been experimentally observed [2], offering promising perspectives to create a new class of sensors, owing to the inherent sensitivity of these geometrical resonances. However, exploiting these highly sensitive resonances requires the transduction of WGMs to the outside world through source and drain electrodes, a yet unreported configuration. A movable and tunable circular p-n island has been demonstrated in an encapsulated graphene using the polarized tip of a scanning gate microscope [3]. In addition, the quasi-confinement of Dirac fermions forming WGMs can be optimized by changing the potential barriers smoothness, *i.e.*, changing the tip-to-device distance [4]. Using numerical simulations, we demonstrate in this work [5] that by squeezing the created p-n island in an etched constriction, the device (Fig.1a) allows probing selectively the resulting WGM signatures (Fig.1b) in in-plane electronic transport, which translate as oscillations in the device resistance (Fig.1c). In addition, we explore selectivity of the active mode by displacing the p-n island with respect to the constriction. These results are experimentally confirmed by our transport measurements (*e.g.*, see Fig.1d), thereby constituting a proof of concept for graphene whisperitronics devices.

References

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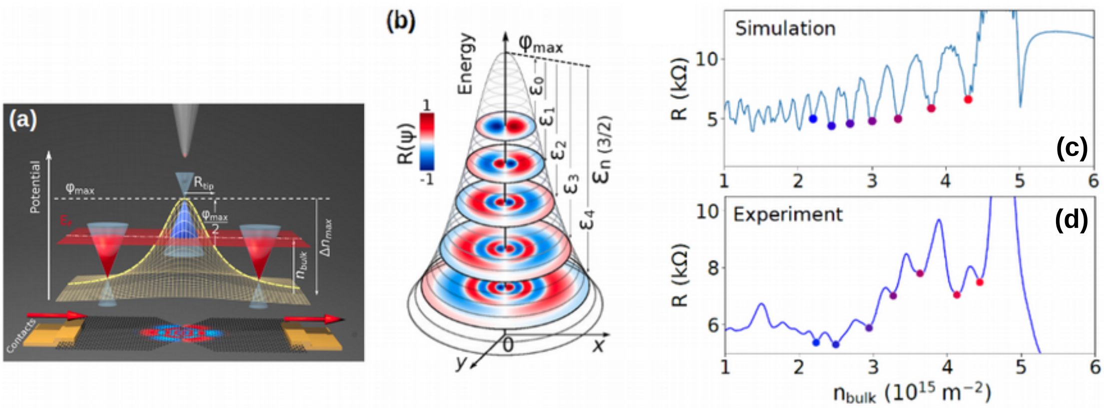

Figure 1: **(a)** *Model of the considered whisperitronics device: a polarized AFM tip is scanned above a constriction etched in a graphene device.* **(b)** *Wave function corresponding to the WGMs with angular momentum m = 3/2, for its different resonant energies.* **(c,d)** *Resistance of the device as a function of bulk carrier density, i.e., when tuning the back-gate voltage. The tip is placed above the center of the constriction.*

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