Recurrent quantum scars in a mesoscopic graphene ring

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When coherent charge carriers cross micron-scale cavities, their dynamics can be governed by a few resonant states, also called "quantum scars", determined by the cavity geometry. Quantum scars can be described using theoretical tools [1,2], but have also been directly imaged in the case of high quality semiconductor cavities [3-5], as well as in disordered graphene devices [6], thanks to scanning gate microscopy (SGM)[7].

Here, we discuss spatially-resolved SGM images of low temperature charge transport through a mesoscopic ring fabricated from high quality monolayer graphene lying on top of hexagonal boron nitride (h-BN). SGM images are decorated with a pattern of radial scars in the ring area (Fig. 1), which is found to evolve smoothly and reappear when varying the charge carrier energy. The energies separating recurrent patterns are found to be directly related to geometric dimensions of the ring. Moreover, a recurrence is also observed in simulations of the local density of states of model graphene quantum rings. The observed recurrences are discussed in the light of recent predictions of relativistic quantum scars in mesoscopic graphene cavities [2].

References

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Figures

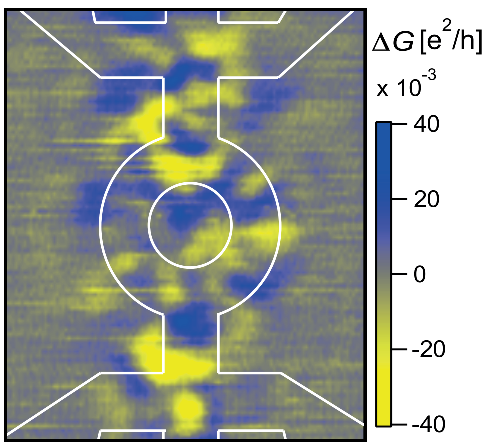

Figure 1: Typical SGM map recorded on a mesoscopic graphene ring lying on h-BN for V_{tip} = +0.5 V, n_p = 9.5 x 10^{11} cm^{-2} and a tip-sample distance of 70 nm