Pumped current and shot noise in adiabatically modulated graphene-based double-barrier structures

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Quantum pumping is a transport mechanism which induces dc charge and spin currents in a nano-scale conductor in the absence of a bias voltage by means of a time-dependent control of some system parameters. Quantum pumping processes are accompanied by considerable quantum noise. We study the adiabatic quantum pumping characteristics in graphene modulated by two oscillating gate potentials out of phase[1]. The direction of the pumped current can be reversed when a high potential barrier demonstrates stronger transparency than a low one, which results from the Klein paradox. We also investigated the pumped shot noise properties based on general expressions we derived based on the scattering approach[2]. It is found that comparing with the Poisson processes, the pumped shot noise is dramatically enhanced where the dc pumped current changes flow direction, which demonstrates the effect of the Klein paradox.

[1] "Quantum pumping with adiabatically modulated barriers in graphene", R. Zhu and H. Chen, Appl. Phys. Lett. **95**, 122111 (2009).
[2] "Pumped shot noise in adiabatically modulated graphene-based double-barrier structures", R. Zhu and M. Lai, manuscript in preparation.