

Graphene ratchets

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The ratchet effect, which is the induction of a dc current by an ac force in the absence of any net bias, represents one of the most intriguing phenomena in non-equilibrium transport. For graphene, one expects that its gapless and chiral nature negatively affects ratchet effects, because it hinders the confinement of electrons. Despite this expectation, a ratchet mechanism that is particularly efficient in graphene exists [1]: It is based on barriers in which the, say, left half is modulated by an ac gate voltage. Then electrons entering the barrier in evanescent modes from that side may be excited to propagating modes. Evanescent mode entering from the right, by contrast, decay before reaching the driving region. This mechanism is rather efficient in graphene, because all evanescent modes within a certain energy range contribute. The corresponding mechanism in a two-dimensional electron gas works only with modes that fulfill certain resonance conditions, which leads to a much smaller current.

[1] P. San-Jose, E. Prada, S. Kohler, and H. Schomerus, arXiv:1103.5597