Single-electron transport by surface acoustic waves

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We use the theory of single electron adiabatic quantum pumping to calculate the current driven through a depleted quantum point contact, due to the piezoelectric potential created by a surface acoustic wave (SAW). For sufficient SAW power, an (almost) integer number of electrons is transferred per SAW period, thus giving quantized values to the current [1, 2]. This quantization is a result of quantum interference and does not require a Coulomb-blockade effect. We reproduce qualitatively various experimentally observed properties of the quantized acoustoelectric current [3], which include the dependance on SAW amplitude and wavelength, accuracy enhancement by a counter-propagating SAW and the effects of an additional source-drain bias. Conditions for optimal single-electron transport are discussed.

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