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Single electron transport using surface acoustic waves in semiconductor devices HUGO LEPAGE, CRISPIN BARNES, Univ of Cambridge — A numerical approach to single electron transport provides the means to interpret results obtained experimentally and guide further experimental designs. We use surface acoustic waves (SAWs) to generate a quantized electron current. In piezoelectric materials, an oscillating stress and strain wave is accompanied by an electric potential modulation of similar waveform. By tuning the amplitude of the SAW, flying quantum dots can be created, trapping single electrons in the potential minima. Numerical solutions to the time dependent Schrodinger equation offer an accurate description of an electron's wavefunction as it is being transported by a SAW. We first model a 2D channel using a harmonic potential in the y dimension and add a sinusoidal SAW confinement in the x dimension. After introducing a tunnelling barrier allowing the electron to escape the channel, the system becomes akin to an electron beam splitter, where the electron wavefunction oscillates between both possible channels (or states). Be replicating typical potential layouts used by experimental groups, we were able to find the dependence of an electron tunnelling out of a 2D channel on the device's surface gate voltages. A model quantum computer using SAW-driven single electron qubits was proposed by Barnes in 2000.

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