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Phase-dependence and manipulation of coherent oscillations of a single-electron wavefunction in a dynamic quantum dot MATTHEW BENESH, ADAM THORN, MASAYA KATAOKA[1], MICHAEL ASTLEY, CHRIS FORD, CRISPIN BARNES, JONATHAN GRIFFITHS, GEB JONES, IAN FARRER, DAVE RITCHIE, University of Cambridge, UK — Surface acoustic waves (SAWs) in a GaAs heterostructure generate dynamic quantum dots, each capable of carrying a single electron through a gated potential landscape. At the SAW velocity (2800 m/s), the change in potential due to a 100nm surface gate will occur in a period of 40ps in the rest frame of the dot. This high-speed modulation of the potential, far beyond the experimental limit of fast gate-switching, allows for the observation of coherent single-electron dynamics. Previous work has shown that an abrupt shift in dot confinement will cause an electron to oscillate unitarily from side to side. This excitation was measured non-invasively via a tunnel barrier, and good agreement was found between measurements and simulations of the dot dynamics. We present here the results of further work in which we examine the coherence length and phase-dependence of the single-electron oscillations. Through the use of a time-dependent model we also study surface-gate arrangements which may be used to manipulate the electron dynamics mid-stream.

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