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Quantum Steering of Electron Wave in 70nm InAs Y-Branch Switches[1] G. M. JONES, C. H. YANG, Department of ECE, University of Maryland, College Park, MD, M. J. YANG, Naval Research Laboratory, Washington DC, Y. B. LYANDA-GELLER, Department of Physics, Purdue University, West Lafayette IN — We report quantum steering of electron wavefunction in gated Y-branch switches (YBS). In this quantum regime, the coherent transport characteristics are drastically different from their classical counterparts. The practical difficulty in realizing YBS has been in fabricating nanometer-scale electron waveguides without depleting electrons in narrow channels. We overcome this hurdle by using InAs because it has zero lateral depletion width. We first fabricated cross-junctions for bend resistance measurements to verify the relatively long elastic mean free path of our devices. In addition, in order to verify the gating effect, we characterized quantum point contact devices made on the same wafer and observed a series of quantum conductance plateaus. Finally, we measured conductances through two drains of YBS, and observed oscillatory transconductances that are always out of phase. Our observation not only verifies the quantum steering of electron wave functions in a semiconductor waveguide, but it also opens up possibilities for further studies of quantum switches in multiple-terminal, nanometer-scale structure for information processing.

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