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Local Gate Control in Carbon Nanotube Quantum Devices[1]

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Carbon nanotubes exhibit many properties which make them ideal candidates for applications in coherent electronic devices for quantum computation.We have made significant technological advancements in device fabrication,for the creation of multiple spatially localized electrostatic gates on a single nanotube device. These advancements permit a previously unattainable level of device control in the quantum regime, essential forelectronic logic operations. Our measurements have demonstrated independent gate control in nanotube double quantum dots defined by naturally occurring tunnel barriers [1], as well as the controllable formation of intratube quantum point contacts [2]. In these devices conductance quantization is evident in units of e2/h, suggesting that both band and spin degeneracies may be lifted at zero magnetic field. Local gating has also permitted the fabrication of fully gate-defined intratube quantum dots with gate-tunable tunnel barriers. Multiple quantum dots with independent control over charge number and tunneling rates have been demonstrated [3], raising the functionality of carbon nanotube devices to match that of standard semiconductor heterostructures. New devices incorporating integrated RF-SETs, and microwave studies of gate-defined intratube quantum dots will be discussed.\[1] Science 303 p.655, 20042] PRL in press, cond-mat/04066523] To be published

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