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Electronic Properties of Quantum Point Contacts in a Quantum Ring A. DEVRIM GUCLU, Duke University, CYRUS J. UMRIGAR, Cornell University, HAROLD U. BARANGER, Duke University — We investigate the electronic properties of a narrow constriction (quantum point contact) in a quantum ring using variational and diffusion Monte Carlo methods. Quantum point contacts are basic building blocks of nanoscale devices. The experimental control over their width allowed the observation of conductance quantization in integer steps of $G_0 = 2e^2/h$. However, a puzzling additional structure is also observed around $0.7G_0$ in some devices. One possible explanation is the formation of a local quasi-bound state. Here, we present a first quantum Monte Carlo calculation showing that electrons can be strongly localized in the constriction, with a well quantized electron number N that varies abruptly as the width of the point contact decreases. We also study the low-lying excited states and investigate the possibility of a spin texture as a function of applied gate voltage.

A. Devrim Guclu
Duke University

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