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Undergraduate Instruction in Nanoscience: Visualizing Quantum Confinement and Resonance Effects in 2DEG Nanostructures[1]
RONALD COSBY, ARKADY SATANIN, YONG JOE, Center for Computational Nanoscience, Department of Physics and Astronomy, Ball State University, Muncie, IN — Undergraduate learning about the basic physics of electron transport in nanostructures is enhanced by visuals depicting probe-induced conductance modifications. Historically, studies on electrostatically-defined nanostructures in the two-dimensional electron gas (2DEG) at the AlGaAs/GaAs heterostructure interface have revealed the physics of electron transport at the nanoscale. For structures strongly coupled to leads, a single electron picture satisfactorily explains the effects of quantum confinement, including quantization of conductance and the appearance of transmission resonances. Here, to aid undergraduate instruction, we add the basic concept of charge flow impediment by a local scatterer and probe the flow characteristics. Computationally scanning a short-range potential probe in conducting 2DEG nanostructures produces conductance modifications that illustrate propagating modes and resonance conditions. Structures and patterns selected for their instructional value are discussed.

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