Abstract Submitted
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Low Bias Negative Differential Resistance in Graphene Nanoribbon Superlattices[1] GERSON J. FERREIRA, Universidade de São Paulo, MICHAEL N. LEUENBERGER, University of Central Florida, DANIEL LOSS, University of Basel, J. CARLOS EGUES, Universidade de São Paulo — We theoretically investigate negative differential resistance (NDR) for ballistic transport in semiconducting armchair graphene nanoribbon superlattices at low bias voltages V_{SD}. We combine the modulated graphene-Dirac hamiltonian with the Landauer formalism to calculate the current I_{SD} through the system. This description is expected to be valid at low biases and for narrow samples. We find three distinct transport regimes in which NDR occurs: (i) a "classical regime" in which the transport across the crossings of barrier and valley bandgaps is suppressed; (ii) a quantum regime dominated by superlattice miniband conduction, with current suppression arising from the misalignment of miniband states with increasing V_{SD}; (iii) a Wannier-Stark ladder regime with current peaks occurring at the crossings of Wannier-Stark rungs from distinct ladders. We emphasize that all the above mechanisms show NDR at voltages lower than 500 mV. Interestingly, within the miniband transport regime the NDR occurs at biases as low as 10 mV, i.e., comparable to the miniband width.

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Gerson J. Ferreira
Universidade de São Paulo

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