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Theory of spatially inhomogneous Bloch oscillations in semiconductor superlattices[1] LUIS BONILLA, MARIANO ALVARO, MANUEL CARRETERO, Universidad Carlos III de Madrid — In a semiconductor superlattice with long scattering times, damping of Bloch oscillations due to scattering is so small that nonlinearities may compensate it and Bloch oscillations persist even in the hydrodynamic regime. To demonstrate this, we propose a Boltzmann-Poisson transport model of miniband superlattices with inelastic collisions and derive hydrodynamic modulation equations for the electron density, the electric field and the complex amplitude of the Bloch oscillations. For appropriate parameter ranges, we solve numerically these equations and show that there are solutions having the form of stable Bloch oscillations with spatially inhomogeneous field, charge, current density and energy density profiles. These Bloch oscillations disappear as scattering times become sufficiently short. For sufficiently low lattice temperatures, Bloch and Gunn type oscillations mediated by electric field, current and energy domains coexist for a range of voltages. For larger lattice temperatures (300 K), there are only Bloch oscillations with stationary amplitude and electric field profiles.

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Luis Bonilla
Universidad Carlos III de Madrid

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