Theory of radiation-induced zero resistance states in 2D systems

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Illumination of 2D electron systems by radiation detuned from a multiple of the cyclotron frequency can lead to vanishing dissipative resistance that is associated with an electrical instability and spontaneous formation of domains [1, 2, 3, 4, 5]. Such zero resistance states (ZRS) were initially discovered in high-mobility semiconductor 2D systems [2, 3], and, more recently, in 2D electron liquid on the surface of liquid He [4, 5]. ZRS should also be observable in graphene. We develop a model of the domain state in such nonequilibrium radiation-driven 2D system [6]. The analytical solution enables us to build the phase diagram incorporating continuous and discontinuous transitions between the uniform and domain states in a biased finite-size system. We calculate the residual negative resistance in the domain state and discuss the bias-induced transverse instability of the simplest domain configurations. We also study dynamics of the domain formation in 2D electron system on surface of liquid He [7], where the associated charge transfer can be monitored as image charges in a properly designed system of electrostatic gates [5].

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