

Scattering and dissipation are central issues in physics of two-dimensional electron systems (2DES). Quantized Hall effects are probably the most fascinating and best understood dissipationless transport phenomena, owing to single- or many-particle gaps in the energy spectrum opened in *high* ($B \sim 10^5$ Gauss) magnetic fields and low temperatures.

Even though 2DES have been studied for more than two decades, 2D electrons continue bringing surprises. Quite remarkably, dissipationless transport can be induced by microwave illumination in *low*, non-quantizing ($B \sim 10^3$ Gauss) magnetic fields. Stepping from microwave-induced resistance oscillations (MIRO) [1], this novel phenomenon is characterized by a periodic series of apparently "zero-resistance" (dissipationless) states (ZRS) [2,3], developed at the MIRO minima in ultra-clean 2DES. While no quantization of the Hall resistance has been observed, low-temperature diagonal resistance appears exponentially small, possibly signaling a novel non-equilibrium state of matter. Although it was suggested that the effect can be related to a radiation-induced negative, linear response conductivity which gives rise to inhomogeneous phases in the bulk of 2DES, the exact mechanism of ZRS remains an open issue.

This talk will survey experimental development from MIRO to ZRS, review experimental aspects [3-5] and discuss selected theoretical proposals which provide a starting point towards elucidating the nature of this extraordinary phenomenon [6].

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