FP 1

Ballistic transport in a two-dimensional Electron System:

How to play pinball with electrons

In this experiment you have the opportunity to learn different aspects of measuring and handling delicate samples: the lock-in technique to detect low voltages, using superconducting magnets to generate the magnetic fields required, and, methods to cool down samples below 4 Kelvin.
Gallium-arsenide (GaAs), the material of choice for producing high-frequency electronic semiconductor devices (the High Electron Mobility Transistor (HEMT) used in wireless telecommunications), can also illustrate important concepts in basic research because of its extremely high mobilities at low temperatures. Electrons at the high mobility interface between a GaAs well and an AlGaAs barrier exhibit extremely long mean-free paths of order several microns. Interesting physical phenomena result which reveal the ballistic trajectories of individual electrons. In particular, if barrier structures are introduced which are commensurate with the cyclotron orbit of an electron in a magnetic field, the electrons become effectively bound to these structures and the resistance develops a maximum. This phenomenon is called „commensurability oscillations“or „Weiss oscillations“after its discoverer, Prof. Dieter Weiss of the University of Regensburg, and it will be studied in detail in this experiment.

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