The 15th International Conference on Electronic Properties of Two-Dimensional Systems
July 14 –18, 2003, Nara, Japan
ABSTRACT # 0295 (Invited)

Dissipationless 2D Electronic Transport Induced By Microwave

R.R. Du [1], M.A. Zudov[1], C.L. Yang[1], L.N. Pfeiffer[2], K.W. West[2]

[1]Department of Physics, University of Utah, Salt Lake City, Utah 84112, USA
[2]Bell Laboratories, Lucent Technologies, Murray Hill, New Jersey 07974, USA

Previously Zudov et al [1] reported the observation of giant amplitude oscillatory magnetoresistance in a 2DES in GaAs-$Al_xGa_{1-x}As$ heterostructures when the system is subjected to crossed microwave (f > 30 GHz) and weak (B< 0.5 T) magnetic fields. The period of the oscillation is determined by the ratio between the microwave frequency and the electron cyclotron frequency. The oscillation amplitude increases with sample mobility, therefore in the very clean samples the resistance minima approach zero. Following the initial experiments [1, 2], observations for apparently zero-resistance-states associated with such minima are recently reported [3, 4]. Such states are characterized by an exponentially vanishing low-temperature (T ~ 1 K) diagonal resistance and a classical Hall resistance. The activation energies associated with such states exceed the Landau level spacing by an order of magnitude. Using Corbino samples we have also measured the conductivity of such states and observed vanishing conductivity at low temperatures. Combining both the resistivity and conductivity data, we conclude that our findings represent a new dissipationless effect in 2D electronic transport. This paper will briefly survey the experimental development from oscillatory to zero-resistance-states as the sample mobility is improved, present the resistivity and the conductivity results, and discuss open issues in elucidating the origin of such dissipationless effect.

References

1. Zudov et al, Phys. Rev. B64, 201311(R), (2001)
2. Ye et al, Appl. Phys. Lett. 79, 2193 (2001)
3. Mani et al, Nature 420, 646 (2002)
4. Zudov et al, Phys. Rev. Lett. 90, 46807 (2003)

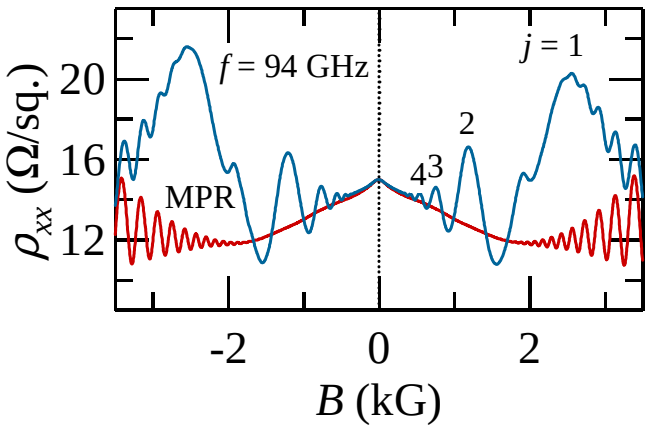

FIG. 1 Oscillatory magneto-resistance initially observed in a moderate-mobility 2DES in crossed microwave and magnetic fields.

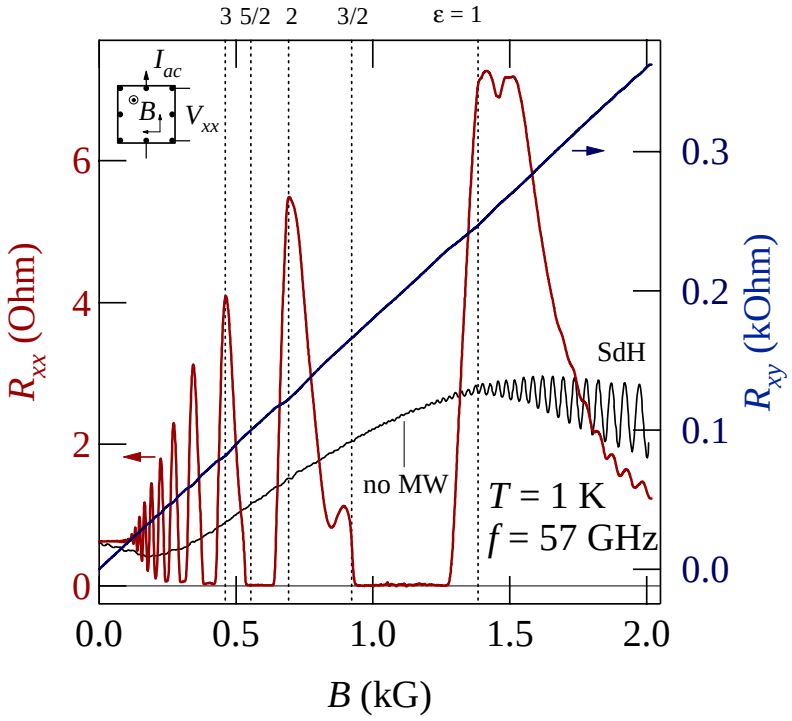

FIG. 2 Zero-resistance-states associated with oscillation minima observed in an ultrahigh-mobility 2DES.

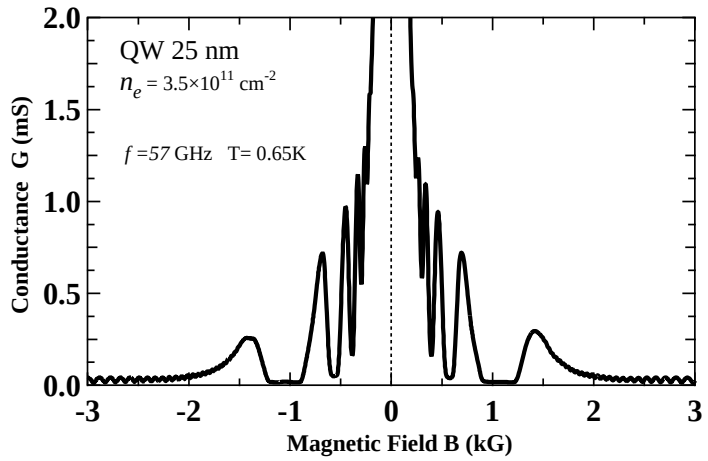

FIG. 3 Exponentially small conductivity associated with the oscillation minima measured in a Corbino sample.