Parallel field induced novel phenomena in a weakly interacting 2D electron gas

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Here we report observation of parallel field induced novel phenomena in a weakly interacting and ultra clean 2DEG system. At low temperature, the parallel field is found to induce a nonmonotonic colossal magnetoresistance, which is enhanced by a factor of ∼300 and shows no saturation at up to 45 T[1]. More interestingly, its temperature dependence is strongly anisotropic and nonmonotonic: in the configuration $I \parallel B$, it evolves from metallic (*i.e.*, $\frac{dR_{xx}}{dT} > 0$) to insulator-like (*i.e.*, $\frac{dR_{xx}}{dT} < 0$) below 10 K with increasing field, but the resistance remains much smaller than the resistance quantum $\frac{h}{e^2}$ even in the "insulator" regime[2]; on the other hand, when $I \perp B$, it retains features of metallic phonon scatterings below 10 K and above 40 K, but develops a resistivity saturation in-between with increasing field. We attribute these phenomena to the non-trivial magneto-orbital coupling effect, which might drive the system from 2D to quasi-3D, as well as from the quantum regime ($i.e., T \ll T_F$) to the classical regime ($i.e., T \gg T_F$).

[1]Xiaoqing Zhou et al., Phys. Rev. Lett. **104**, 216801 (2010).
[2]Xiaoqing Zhou et al., arXiv:cond-mat/1103.349 (2011).