Anisotropic Fermi Contour of Composite Fermions In Tilted Magnetic Fields

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The composite fermion (CF) formalism provides an extremely powerful yet very simple description of the fractional quantum Hall. In the CF picture, an even number of flux quanta pair up with each carrier at high magnetic field to form quasi-particles which, at filling factor $\nu = ½$, occupy a Fermi sea with a well-defined Fermi contour. The existence of a CF Fermi contour raises the question whether fermionization preserves any low-field Fermi contour anisotropy.

In the study presented here we employ the commensurability of the CF semi-classical orbits with a unidirectional periodic potential modulation [1] in a high-mobility (001) GaAs 2D hole system to extract the Fermi contour anisotropy created by parallel magnetic field, $B_{||}$. We measure the magnetoresistance along two perpendicular arms of an L-shaped Hall bar, shown in Figs. 1(a) and (b), at different tilt angles (θ) of the sample. The periodic modulation produces strong CF commensurability resistance minima near filling factor $\nu = ½$. When the magnetic field is purely perpendicular (θ = 0), as shown in the bottom traces of the Fig. 1 panels, the observed positions of the minima agree with the positions anticipated for a circular CF Fermi contour (dashed green lines in Fig. 1) [2]. As the sample is tilted to increase $B_{||}$, the minima move *away* (Fig. 1a) or *toward* (Fig. 1b) the magnetic field at $\nu = ½$ position, depending on the orientation of the Hall bar. These shifts are a direct measure of the changes in the size of the CF Fermi contour wave vectors along and perpendicular to $B_{||}$.

Our results provide stimulus for future studies to address the role of anisotropy in interacting carrier systems.

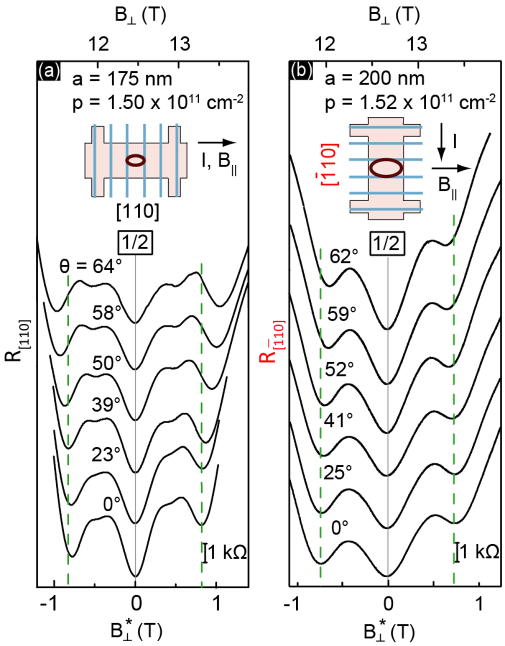

FIG. 1: CF commensurability minima near $\nu = ½$ measured along the two arms of an L-shaped Hall bar. $B^*_\perp$ is the effective magnetic field felt by the CFs. As the sample is tilted at an angle θ to introduce $B_{||}$ along [110], the resistance minima for the [110] Hall bar (a) move away from $\nu = ½$ ($B^*_\perp = 0$) while those in the [$\bar{1}$10] Hall bar (b) move towards $\nu = ½$.

References:

[1] D. Kamburov *et al.*, arXiv:1302.2540.
[2] D. Kamburov *et al.*, Phys. Rev. Lett. **109**, 236401 (2012).