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Transference of Fermi Surface Anisotropy to Composite Fermions

TAYFUN GOKMEN, MEDINI PADMANABHAN, MANSOUR SHAYEGAN, Department of Electrical Engineering, Princeton University, Princeton, NJ 08544 —
The question of how the properties of the underlying particles affect the behavior of the emergent particles is of paramount interest in physics. The system of composite Fermions (CFs), complex electron-flux bound states that experience an effective magnetic field, offers a nontrivial example where this question can be addressed in various contexts. The CF formulation provides an elegant and powerful description of interacting two-dimensional (2D) electrons at high perpendicular magnetic fields. In particular, at a half-filled Landau level (LL), where the effective magnetic field vanishes, the CFs exhibit Fermi-liquid-like properties, similar to their zero-field electron counterparts. Interestingly, however, the Fermi energy and the effective mass of CFs, being determined solely by interactions, possess no memory whatever of the Fermi energy and the band mass of the electrons. That raises a fundamental question: Does an anisotropy of the electron Fermi surface survive composite fermionization? Here we provide an experimental resolution of this question by studying the properties of CFs in AlAs quantum wells where the electrons occupy an ellipsoidal Fermi surface with large eccentricity. Through a comparison of the piezo-resistance for electrons and CFs, we show that the CF Fermi surface qualitatively follows the anisotropy of the electron Fermi surface.

Tayfun Gokmen
Dept of Electrical Engineering, Princeton University, Princeton, NJ 08544

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