MAR07-2006-001316

Abstract for an Invited Paper
for the MAR07 Meeting of
the American Physical Society

Beyond the Quantum Hall Effect: New Phases of 2D Electrons at High Magnetic Field[1]

JAMES EISENSTEIN, Caltech

In this talk I will discuss recent experiments on high mobility single and double layer 2D electron systems in which collective phases lying outside the usual quantum Hall effect paradigm have been detected and studied. For example, in single layer 2D systems near half-filling of highly excited Landau levels new states characterized by a massive anisotropy in the electrical resistivity of the sample are observed at very low temperature. The anisotropy has been widely interpreted as the signature of a new class of correlated electron phases which incorporate a stripe-like charge density modulation. Orientational ordering of small striped domains at low temperatures accounts for the resistive anisotropy and is reminiscent of the isotropic-to-nematic phase transition in classical liquid crystals.

Double layer 2D electron systems possess collective phases not present in single layer systems. In particular, when the total number of electrons in the bilayer equals the degeneracy of a single Landau level, an unusual phase appears at small layer separation. This phase possesses a novel broken symmetry, spontaneous interlayer phase coherence, which has a number of dramatic experimental signatures. The interlayer tunneling conductance develops a strong and very sharp resonance around zero bias resembling the dc Josephson effect. At the same time, both the longitudinal and Hall resistances of the sample vanish at low temperatures when currents are driven in opposite directions through the two layers. These, and other observations are broadly consistent with theories in which the broken symmetry phase can equivalently be described as a pseudospin ferromagnet or an (imperfect) excitonic superfluid.

This work reflects a collaboration with M.P. Lilly, K.B. Cooper, I.B. Spielman, M. Kellogg, L.A. Tracy, L.N. Pfeiffer, and K.W. West.

[1]This work was supported by the NSF and the DOE.