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A Physical Picture for the Negative Drag in High Landau Levels
ADY STERN, RAFI BISTRITZER, Weizmann — Experimental investigation of the longitudinal drag resistivity, ρ^D, of a bi-layer subjected to a strong magnetic field in the regime of large filling factors found an anomalous behavior at low temperatures T: ρ^D depends non monotonously on T and becomes negative when the filling factors of the two layers differ by an odd number. A calculation of ρ_D within the framework of the self consistent Born approximation was generally consistent with the experiment; nevertheless, it left the physical picture obscure. We employ the exact eigenstates method to unravel that picture. We find the oscillating sign of ρ^D to originate from the effect of disorder on the relation between an adiabatic momentum transfer to an electron and the displacement of its position. For localized states a momentum transfer $\mathbf{q}$ implies a displacement of ql_H^2, with l_H being the magnetic length. For extended states, the combined effect of a short range disorder and a rapidly oscillating wave function at high Landau levels results in an additional, potentially larger, displacement whose sign depends on the electron's energy.

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