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Empirical resistivity rule in the second Landau level of a two-dimensional electron system W. PAN, Sandia National Laboratories, J.S. XIA, C.L. VICENTE, E.D. ADAMS, N.S. SULLIVAN, Univ. of Florida and NHMFL, H.L. STORMER, Columbia Univ. and Bell Labs, Lucent Technologies, D.C. TSUI, Princeton Univ., L.N. PFEIFFER, K.W. BALDWIN, K.W. WEST, Bell Labs, Lucent Technologies — A phenomenological relationship, $R_{xx} \propto B \times dR_{xy}/dB$, called the resistivity rule, was observed twenty years ago. Yet, today we have only a relatively complex model that addresses the origin of this rule. It remains unclear whether a simpler model, based on some fundamental relationship exists. In recent experiments on ultra-high quality specimens performed in the second Landau level (LL), instead of rising in a stair- like fashion, R_{xy} is found to switch back and forth between FQHE and IQHE values several times as the filling factor varies from $\nu = 4$ to $\nu = 2$. This non-monotonic R_{xy} leads to regions of negative $B \times dR_{xy}/dB$, which cannot find an equivalent in R_{xx}, a positive definite, thus apparently violating the empirical rule. However, in a more detailed examination, we found, surprisingly, a new resistivity rule in the second LL. The regular, positive parts of $B \times dR_{xy}/dB$ are well reflected in $R_{xx}(+B)$, whereas the irregular negative going sections of $B \times dR_{xy}/dB$ closely match the inverted $R_{xx}(-B)$ trace, where $-B$ refers to the opposite magnetic field direction of $+B$. It is unclear whether our observations of an expanded resistivity rule reinforces or refutes the present model of its origin.

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