Spin-orbit coupling as an intrinsic pinning mechanism for stripe orientation in high Landau levels

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We propose that the source of the unidentified "native" anisotropy of the quantum Hall stripes phase in narrow quantum wells is the combined influence of Rashba and Dresselhaus spin-orbit interactions. Separately Rashba and Dresselhaus interactions have global rotational invariance, but this symmetry is lost when both terms are present so that $[110]$ and $[1\bar{1}0]$ directions are not equivalent. We show that, to leading order in spin-orbit-coupling strength, the lowest energy stripe orientation is determined solely by the relative sign of the Rashba and Dresselhaus terms. When Rashba and Dresselhaus interactions have the same sign the preferred orientation is expected to be $[110]$, in agreement with observations in GaAs. Within Hartree-Fock, we also estimate the anisotropy energy and find close agreement with its experimental determination from tilted magnetic field measurements.