# Induced Transformations- and Size Dependence- of Fractional Quantum Hall Effects Under Tilted Magnetic Fields

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Two-dimensional electron systems subjected to high transverse magnetic fields can exhibit Fractional Quantum Hall Effects (FQHE), which signify incompressible correlated electronic states in the vicinity of mostly odd- and some even-denominator rational fractional filling factors, $\nu \sim p/q$, of Landau levels.[1] Although graphene has recently become an interesting material for studying FQHE, the GaAs/AlGaAs system, due to its extra-ordinarily high quality, is still a material of choice for studying related phenomena.[1] In the GaAs/AlGaAs 2D electron system, a double degeneracy of Landau levels due to electron-spin, is removed by a small Zeeman spin splitting, $g\mu_B B$, comparable to the correlation energy. Then, a change of the Zeeman splitting relative to the correlation energy can lead to a re-ordering between spin polarized, partially polarized, and unpolarized many body ground states at a constant filling factor.[2] Since previously studied state transitions occurred at a constant filling factor ($\nu \sim p/q$), the initial and final states had the same quantized Hall resistance, i.e., $R_{xy} = (p/q)^{-1}(h/e^2)$.

We show here that tuning the spin energy by tilting the specimen in a magnetic field can produce fractionally quantized Hall effect transitions that include both a change in $\nu$ for the $R_{xx}$ minimum, e.g., from the $\nu = 11/7$ to the $\nu = 8/5$, and a corresponding change in the $R_{xy}$, e.g., from $R_{xy}/R_K = (11/7)^{-1}$ to $R_{xy}/R_K = (8/5)^{-1}$, with increasing tilt angle, see Fig. 1. Further, we exhibit a striking size dependence in the tilt angle interval for the vanishing of the $\nu = 4/3$ and $\nu = 7/5$ resistance minima, including "avoided crossing" transport characteristics, and observable shifts of $R_{xy}$ at the $R_{xx}$ minima- the latter occurring for $\nu = 4/3, 7/5$ and the $10/7$. The results demonstrate both size dependence and the possibility, not just of competition between different spin polarized states at the same $\nu$ and $R_{xy}$, but also the Zeeman-energy-dependent-crossover between distinct FQHE associated with different Hall resistances.[3]

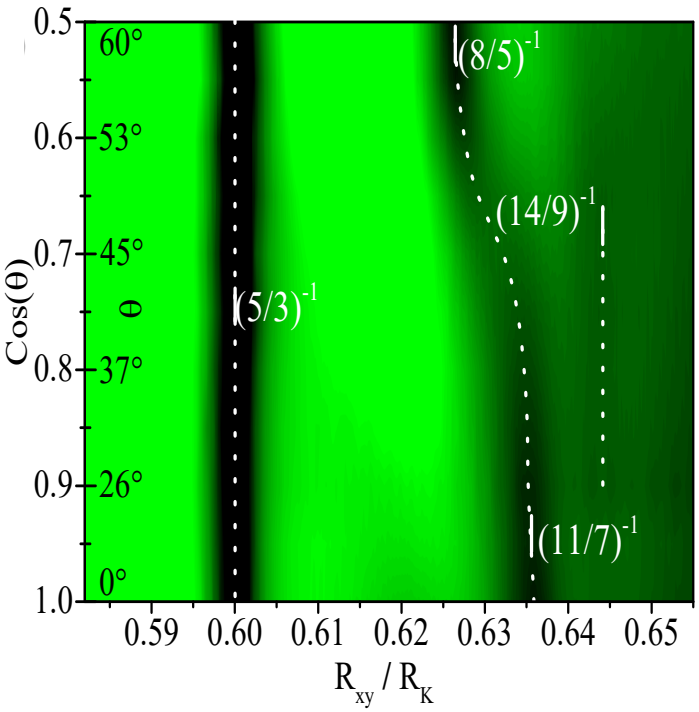


Fig. 1. A color plot of $R_{xx}$ vs. cos($\theta$) (ordinate) and vs. $R_{xy}/R_K$ (abscissa) provides a detailed view of '11/7' to '8/5' transformation with tilt angle ($\theta$). The dotted lines indicate the trajectories of $R_{xx}$ minima.

References

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