Probing Integer and Fractional Quantum Hall States in GaAs with Microcavity Polaritons

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A MBE grown planar AlGaAs/AlAs microcavity can be monolithically integrated with a high-mobility 2-dimensional electron gas (2DEG) in the center anti-node of the cavity. Strong coupling can be achieved in this type of structure. Using a magnetic field, the spin polarization of quantum Hall states (QHS) can be directly measured by circular polarization resolved resonance spectroscopy of the polariton states [1,2]. Full spin polarization at $\nu = 1$ and rapid depolarization away from it was observed, consistent with the Skyrmionic nature of this state [2,3,4]. Current measurements of fractional states for $\nu < 2$ are under scrutiny, as well as plans for improved devices for more robust QHS.

References

[1] S. Ravets, et al., Phys. Rev. Lett., 120 (2018) 057401
[2] M. Lupatini, et al., Phys. Rev. Lett., 125 (2020) 067404
[3] E.H. Aifer, et al., Phys. Rev. Lett., 76 (1996) 680
[4] P. Plochocka, et al., Phys. Rev. Lett., 102 (2009) 126806

Figures

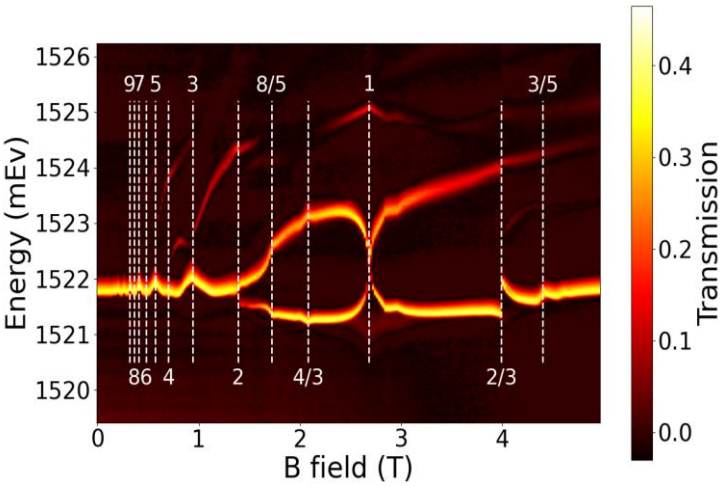

Figure 1: Transmission spectra of a microcavity with an integrated 2DEG as a function of applied perpendicular magnetic field. The cavity energy is fixed close to the energy of Landau Level 0 at filling factor $\nu = 1$. The white dashed lines indicate integer and fractional QHS. The change in polariton normal mode splitting comes from the change in oscillator strength.

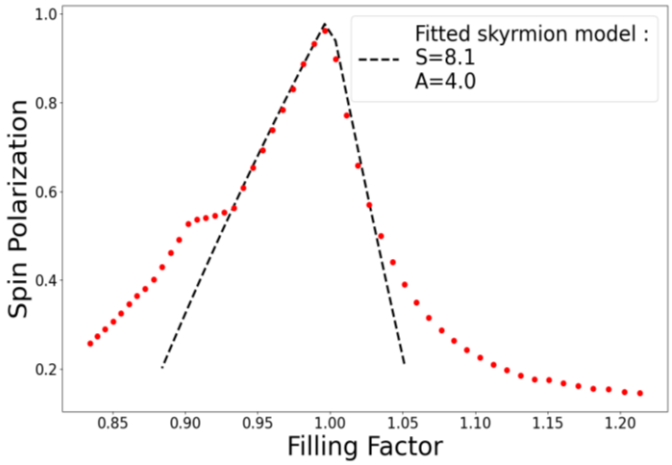

Figure 2: Spin polarization of the 2DEG around B = 2.67 T ($\nu = 1$). The red data points are extracted from spectral sweeps such as the one presented Figure 1. The black dotted line is a fit of a Skyrmion model with Skyrmion size S = 8.1 and Antiskyrmion size A = 4.0.