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"Looking" at Competing Quantum Phases of the Second Landau Level[1]

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Partially populated higher Landau levels of 2D electron systems support striking collective states in which quantum Hall phases overlap and compete with alternate phases emergent from remarkable interplays between fundamental interactions and quantization of 2D states in a magnetic field. Optical studies by light scattering methods are revealing previously unexpected roles of the spin degree of freedom in quantum phases of the second (N=1) Landau level [1,2]. Inelastic light scattering experiments uncover the collapse of the long wavelength ferromagnetic spin wave for filling factors that are below nu=3. This discovery, interpreted as loss of spin polarization in the N=1 Landau level, is made more intriguing by findings that a sharp spin wave does not recover at filling factors nu=8/3 and 5/2 that support well-known fractional quantum Hall states. Simultaneous resonant elastic (Rayleigh) scattering measurements indicate that below nu=3 the collective states of quasiparticles in the partially populated N=1 Landau level break into sub-micron size domains of fluid that seem to lack full spin polarization and that persist to temperatures that are above 1K. The determination of spin polarization in the quantum Hall state at nu=5/2 requires further consideration. While coexisting with spin unpolarized domains, quasiparticle condensation at nu=5/2 may still result in an incompressible fluid that has spin polarization. This work is in collaboration with T. D. Rhone, U. Wurstbauer, Y. Gallais, J. Yan, L.N. Pfeiffer and K.W. West.

[1] T.D. Rhone et al BAPS.2010.MAR.Y2.3
[2] T.D. Rhone et al., submitted for publication.

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