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Observations of Low-lying Collective Excitations in Quantum Phases of the Second Landau Level[1]

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Astonishing quantum phases emerge in partially populated higher Landau levels of 2D electron systems. There are even-denominator fractional quantum Hall fluids in the second (N=1) Landau level, and quantum Hall phases that mingle and compete with alternate ground states. Such findings are striking manifestations of novel collective states that emerge from fundamental interactions in 2D. This talk considers results of inelastic light scattering studies of low-lying excitation modes of quasiparticles in these quantum Hall regimes. Experiments in the states of the lowest (N=0) Landau level uncover interplay from interactions in the spin and charge degrees of freedom and the impact of spin textures is clearly seen in spectra of low-lying spin excitations [1,2]. More recent work, explores excitations of the quantum Hall fluids that reside in the N=1 Landau level [3]. These experiments discovered the intriguing collapse of the long wavelength ferromagnetic spin wave for filling factors that are slightly below filling factor nu=3. While the collapse of the spin wave at fillings near nu=1had been linked to loss of spin polarization due to formation of spin textures, the low-lying excitation modes seen in the N=1 level below nu=3 seem much more complex because a sharp spin wave does not recover for fractional quantum Hall states such as nu=8/3 and 5/2. These measurements suggest significant roles for quasiparticle spin in the competing quantum phases that emerge in the second Landau level. This work is a collaboration with T. D. Rhone, J. Yan, Y. Gallais, I. Dujovne, C. Hirjibehedin, J. Groshaus, B.S. Dennis, L.N. Pfeiffer and K.W. West.

[1] J. Groshaus et al., Physical Review Letters 100, 086806 (2008).
[2] Y. Gallais et al., Physical Review Letters 100, 046804 (2008).
[3] T.D. Rhone et al., contributed talk at this meeting.

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