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Phonon Absorption Experiments on Composite Fermions

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We present a time-resolved phonon absorption technique as an efficient tool to investigate the properties of the fractional quantum Hall effect (FQHE). We interpret our data within the Composite Fermion (CF) picture of the FQHE, were the CF quasiparticles are constructed by attaching two magnetic flux quanta ϕ_0 to each electron. As a result, the CFs at filling factor ν and electron density n experience only an reduced magnetic field $B^* = B - 2\phi_0 n$, so that they behave in B^* in analogy to electrons in the magnetic field B and form Landau levels of CFs with effective filling factor $p = \frac{\nu}{1-2\nu}$ in particular. In a first set of experiments, we measure phonon excitation gaps in the FQH regime for various filling factors and find that the measured gaps can be well described in the framework of Landau-level transitions of CFs involving no spin flip [1]. We are able to deduce the CF mass $m^*(10\ \mathrm{T}) = 0,5\mathrm{m}_0$ from these transitions. We apply the same model to energy gaps which we deduce from transport experiments. These gaps are transitions from one level to another reduced by disorder. Here, spin flip are allowed. From results near the crossing of two levels, we were able to deduce the g-factor of CFs [2]. A second set of phonon absorption experiments focuses on the specific heat C of the 2DES at various filling factors ν [3]. Here, we find an exponential dependence $C \propto (1/T)^2 exp(-\Delta/T)$ on temperature T if the 2DES is in a state with an energy gap Δ. At $\nu = 1/2$, where the external magnetic field is fully cancelled by the gauge field, we find a linear temperature dependence as expected for a Fermi sea of CFs.

1. F. Schulze-Wischeler, F. Hohls, U. Zeitler, D. Reuter, A. D. Wieck, and R. J. Haug, Phys. Rev. Lett. **93**, 026801 (2004).

2. F. Schulze-Wischeler, E. Mariani, F. Hohls, and R. J. Haug, Phys. Rev. Lett. **92**, 156401 (2004).

3. F. Schulze-Wischeler *et al.*, to be published in 2006.