Is there an internal structure of Composite Fermions?

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Composite fermions are widely accepted to be the elementary quasi particle excitations of Fractional Quantum Hall states. Field theoretical descriptions as well as trial wave function approaches reveil them as fermionic objects composed of an ordinary electron with two (virtual) flux quanta closely bound to it. Pauli's exclusion principle, however, prohibits the flux quanta from simultaneously occupying the same site as the electron.

In our contribution we investigate the spatial correlations between electrons and their accompanying flux quanta in the ground state at half filling of the lowest Landau level. Contrasting the naiv picture, anticipating a homogeneous distribution of flux quanta around the electron, we find that flux quanta avoid the direct vicinity of the electron. Instead, they are found with a high probability at a distance d which equals half the inter-electron separation (Fig. 1). This correlation function is extremely stable against residual interactions between neighboring *composite fermions*.

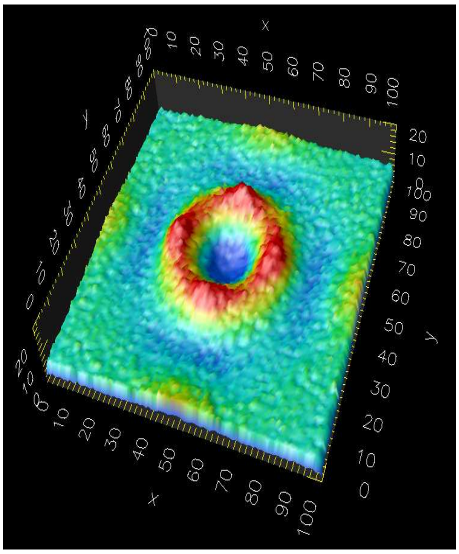

Figure 1: Electron-vortex correlation function in the $\nu = 1/2$-ground state of 18 electrons. The electron is located at the center of the ringlike structure. Features at the corner of the picture are due to periodic boundary conditions.

We investigate interacting electrons at half filling of the lowest Landau level by directly diagonalizing the few-particle Hamiltonian. Wave functions are assumed to obey periodic boundary conditions under magnetic translations (torus geometry). Zeros in the many-body wave functions can be identified with the fictitious flux quanta of the *composite fermion* picture. The non-vanishing winding number of the phase of the wave function identifies them as vortices. We calculate the correlation function $\langle\Psi_{1/2}|\sum_i^{N_e}\sum_k^{N_\phi-N_e}\delta(\underline{r}_i-\underline{r}_k)|\Psi_{1/2}\rangle$ between electron positions $\underline{r}_i$ and vortex positions $\underline{r}_k$ in the $\nu = 1/2$-ground state $\Psi_{1/2}$.

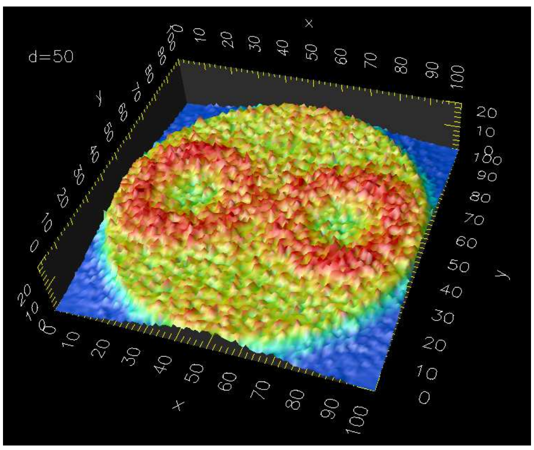

Figure 2: Vortex distribution in the presence of two electrons. The electrons are located at the center of the ringlike structures respectively.

A typical result for 18 electrons is shown in Fig. 1. The vortex probability distribution resembles a ringlike *cloud* encircling the electron at the center of the picture. Obviously, there is a very small probability of finding vortices close to the electron.

Furthermore, we investigated the vortex distribution function in the presence of two electrons. Strikingly, we find, up to very small electron separations, the superposition of two ringlike vortex distributions encircling each electron respectively. We interpret this as an indication of very weak residual interactions between the two *composite fermions*.