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A highly correlated topological bubble phase of composite fermions

Data robustness. In order to check the robustness of the RFQHS, we remeasured Sample 1 twice by thermally cycling it and by repeating the illumination procedure. When repeating such measurements, small variations in the quality of data and sample density are quite typical. Nonetheless, our data shown in both Extended Data Fig.1*a* and Extended Data Fig.1*b* exhibit the RFQHS.

We also measured a sample fabricated from a different wafer; will refer to this sample as Sample 2. Sample 2 has the same structure as Sample 1 and they were both grown in the Pfeiffer lab several years apart. Both samples belong to the generation of samples grown before 2020[49]. However, because the state of the vacuum in the chamber at the time of growth was different, the mobility of Sample 2 was slightly lower, $\mu = 28\times10^6 cm^2 / Vs$. Data obtained from this sample are shown in Extended Data Fig.1*c* and also exhibit the RFQHS.

Transport anomalies near ν=5/3 in the literature. In the literature we found three instances of anomalies at the filling factor of the RFQHS. In Ref. 50 authors identified the ground state with an even denominator FQHS. Because of the lack of Hall resistance, data remain open to interpretation. In two other publications, authors did not focus on the $8/5< \nu <5/3$ region perhaps because a) Hall resistance was not measured in Ref.51 or b) R_{xx} data had a very weak feature in Ref.52.

The isotropic nature of the RFQHS. Because the partial Λ-level filling factor of the RFQHS is close to 1.5, we also need to examine whether or not the RFQHS is a stripe phase of CFQPs[39]. This candidate ground state is ruled out not only because the mismatch of the Λ-level filling factors, but also because the measured Hall resistance is inconsistent with such ground state. Indeed, based on the behavior of stripes in high Landau levels, we expect that R_{xy} of a stripe phase of CFs is near the classical Hall resistance[13,14]. The observed quantization of the Hall resistance to $R_{xy} = 3h/5e^2$ is in clear violation of such an expectation. Furthermore, the longitudinal magnetoresistance nearly vanishes when measured along the two mutually perpendicular crystal directions of our sample. This is shown in Extended Data Fig.2. Since the longitudinal magnetoresistance at B = 7.76 T does not exhibit a dramatic anisotropy, we conclude that a stripe phase of CFQPs is not an acceptable candidate ground state for the RFQHS.

Supplementary References

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