Composite fermions: spin physics and crystallization

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Many states and phenomena of composite fermions, namely electron vortex bound states that are formed when 2D electrons are exposed to a strong magnetic field, have been studied in the past. I will report on recent developments in two contexts.
(i) The phase diagram of the spin polarization of the state has been evaluated as a continuous function of the filling factor [1]. The results will be compared to experiments in graphene. A reanalysis of certain old Raman experiments shows presence of composite-fermion trion modes in which a photo-excited particle hole pair of composite fermions forms a bound state with a pre-existing particle or hole to produce a low energy excitation which is the smallest realization of a skyrmion.
(ii) It has been shown that a series of composite fermion crystals appear at very low fillings, as opposed to the earlier view of this phase as an electron crystal. The phase diagram and many other properties of the composite fermion crystal have been calculated [3]. It will also be shown that it supports a new kind of bubble interstitial defects that have much lower energy than the defects in a Hartree-Fock crystal [4], thus indicating that the very low energy of the defects observed experimentally is an indication of the correlated quantum nature of the crystal and its defects.

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[2] A. C. Balram, U. Wurzbauer, A. Wojs, J. K. Jain, A. Pinczuk, et al., unpublished.
[3] A. C. Archer, K. Park, J. K. Jain, "Competing Crystal Phases in the Lowest Landau Level," *Phys. Rev. Lett.* **111**, 146804 (2013).
[4] A. C. Archer and J. K. Jain, unpublished.