FERROMAGNETISM AND SKYRMIONS IN THE "5/2" STATE OF THE FRACTIONAL QUANTUM HALL EFFECT

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We studied charged excitations of fractional quantum Hall states in the second Landau level, allowing for spin depolarization, in particular the incompressible liquid at filling factor $\nu = 5/2$, adiabatically connected to the Pfaffian state whose spin-polarized quasiparticles (QPs) obey non-Abelian quantum statistics. Using a combination of numerical studies (exact diagonalization and quantum Monte Carlo in spherical geometry), and taking account of non-zero well widths, we demonstrated that the ground state in the absence of disorder is spin-polarized, but its elementary charge excitations may involve spin reversal. Specifically, we showed that at a sufficiently low Zeeman energy and in reasonably wide structures it is energetically favorable for pairs of charge $e/4$ QPs to bind into spin textures of charge $e/2$. These textures were identified as skyrmions based on high overlaps with model skyrmion wave functions and on pair correlation functions being essentially identical to those of their polarized "parent" ground states. We also showed that Skyrmion formation at $\nu = 5/2$ is further promoted by disorder, and argue that this can lead to a depolarized ground state in realistic experimental situations. This resolves an apparent discrepancy between theoretical expectations for a polarized (Pfaffian) ground state and recent optical experiments indicating partial depolarization.

9.7 cm

13.4 cm

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