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Interweaving of Spin and Pseudospin in Bilayer Quantum Hall Systems[1]

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In a bilayer quantum Hall system, the layer index may effectively act like a two-valued degree freedom that is analogous to the spin of the electron. Near filling factor $\nu = 1$ this pseudospin is thought to lock into a linear combination of the two possible values of the layer index, yielding an interlayer coherent state analogous to an easy-plane ferromagnet. Such systems possess excitations known as merons, vortex-like objects in which the pseudospin tilts out of the plane near their cores. In quantum Hall systems these are charged objects, and can be injected into the groundstate by doping away from $\nu = 1$, yielding a pseudospin textured state. However, recent experiments [1] have suggested that charged excitations may tilt the *real* electron spin away from its most polarized state. In this work [2] we study the possibility of simultaneously producing both spin and pseudospin textures in a quantum Hall bilayer near $\nu = 1$. Our Hartree-Fock calculations demonstrate that the groundstate generically forms a textured crystal, and that for appropriate choices of Zeeman coupling, interlayer tunneling, interlayer separation, and interlayer bias, the texture can be present in both the spin and pseudospin degrees of freedom. Such states spontaneously break the real rotational spin symmetry and possess a gapless spin wave mode. The possible relevance of this to enhanced NMR relaxation rates observed recently in experiment is discussed.

[1] I. Spielman et al., PRL **94**, 076803 (2005); N. Kumada et al., PRL **94**, 096802 (2005).
[2] J. Bourassa, B. Roostaei, R. Côté, H.A. Fertig, and K. Mullen, PRB **74**, 195320 (2006).

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