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Nematic order and a new field theory of the quantum Hall effect JOSEPH MACIEJKO, BENJAMIN HSU, YEJE PARK, Princeton University, STEVE KIVELSON, Stanford University, SHIVAJI SONDHI, Princeton University — Motivated by recent experimental and theoretical studies of anisotropic versions of the fractional quantum Hall (FQH) effect, we construct an effective field theory for a continuous quantum phase transition between an isotropic FQH state and a nematic FQH state. The theory parallels earlier work on FQH ferromagnets. The $SO(3)$ order parameter $\mathbf{n}$ of the ferromagnet is replaced by the Landau-de Gennes nematic tensor order parameter Q_{ab} which can be mapped to a $SO(2,1)$ Lorentz vector. We construct an analog of the CP^1 representation of a ferromagnet in terms of complex $SU(1,1)$ spinors. We identify these vector and spinor order parameters with the unimodular metric and zweibein fields appearing in Haldane's recent geometrical description of the FQH effect, where the metric field g_{ab} is given by the matrix exponential of the nematic order parameter Q_{ab}. Our theory predicts that if the gap of the Girvin-MacDonald-Platzman collective mode can be made to collapse at zero momentum in a FQH system, an instability to a FQH nematic state should occur.

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