Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Nematic and Valley Ordering in Anisotropic Quantum Hall Systems S.A. PARAMESWARAN, Princeton University, D.A. ABANIN, Princeton Center for Theoretical Science, S.A. KIVELSON, Stanford University, S.L. SONDHI, Princeton University — We consider a multi-valley two dimensional electron system in the quantum Hall effect (QHE) regime. We focus on QHE states that arise due to spontaneous breaking of the valley symmetry by the Coulomb interactions. We show that the anisotropy of the Fermi surface in each valley, which is generally present in such systems, favors states where all the electrons reside in one of the valleys. In a clean system, the valley ordering occurs via a finite temperature Ising-like phase transition, which, owing to the Fermi surface anisotropy, is accompanied by the onset of nematic order. In a disordered system, domains of opposite polarization are formed, and therefore long-range valley order is destroyed, however, the resulting state is still compressible. We discuss the transport properties in ordered and disordered regimes, and point out the possible relation of our results to recent experiments in AlAs [1].

[1] Y. P. Shkolnikov, S. Misra, N. C. Bishop, E. P. De Poortere, and M. Shayegan, *Observation of Quantum Hall "Valley Skyrmions"*, Phys. Rev. Lett. **95**, 068809 (2005)

[2] D.A. Abanin, S.A. Parameswaran, S.A. Kivelson and S.L. Sondhi, *Nematic and Valley Ordering in Anisotropic Quantum Hall Systems*, to be published.

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Date submitted: 19 Nov 2009 Electronic form version 1.4