Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Nematic quantum paramagnet and possible application to FeSe
FA WANG, Peking Univ, STEVEN A. KIVELSON, Stanford University, DUNG-HAI LEE, UC Berkeley — The nematic phases in iron pnictides are in close proximity to the stripe antiferromagnetic order, suggesting that magnetism is the driving force for the spontaneous 4-fold crystal rotation symmetry breaking. In contrast, bulk FeSe shows a nematic phase below 90K at ambient pressure, but has no magnetic long range order down to very low temperature. This prompts suggestions that the nematicity in FeSe is driven by some other mechanism. We argue that magnetic correlation can still drive nematic order in the absence of magnetic order. By field theoretical considerations and exact diagonalization results on finite size lattices, we conclude that the paramagnetic phase in frustrated spin-1 J_1-J_2 models on square lattice is such a "nematic quantum paramagnet", which breaks only the crystal 4-fold rotation symmetry. The prototype wavefunctions of such quantum ground states are horizontal(vertical) aligned spin-1 AKLT chains. We suggest that the local spins in FeSe may form this phase due to strong frustration. One unique consequence of this proposal is that the nematic paramagnetic phase will be close to both stripe and Neel antiferromagnetic order, and will thus host low but finite energy spin fluctuations at both ordering wavevectors.

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Date submitted: 05 Nov 2015 Electronic form version 1.4