Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Can Frustration Preserve a quasi-two dimensional spin fluid? MARIANNA MALTSEVA, Rutgers University, PIERS COLEMAN, Rutgers University — One of the mechanisms recently proposed to account for non-Fermi liquid behavior in heavy fermion materials at a quantum critical point is based on the notion that the spins form a quasi-two-dimensional spin fluid. Using the Heisenberg antiferromagnet as a simple example to explore this line of reasoning, we show with the help of spin-wave theory that in general, geometric frustration fails to preserve a two-dimensional spin fluid. Even though one can eliminate the classical interlayer coupling by frustration, the layers always develop a quantum-mechanical coupling via tunneling. The magnon pair tunneling process responsible for this coupling is analogous to the pair tunneling process responsible for the Josephson effect generating a $\cos 2\theta$ or biquadratic coupling between layers. To end our discussion we consider a special case of XY model in which decoupled "sliding phases" of spin fluid may exist in certain finely tuned conditions. In general these finely tuned situations are equally susceptible to the strong-coupling effects of quantum tunnelling, forcing us to conclude that in general, geometric frustration can not preserve a two dimensional spin fluid.

Piers Coleman
Rutgers University

Date submitted: 01 Dec 2004 Electronic form version 1.4