Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Dzyaloshinskii-Moriya interactions in valence bond systems I[1]
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We investigate the effect of Dzyaloshinskii-Moriya interactions on the low temperature magnetic susceptibility for a system whose low energy physics is dominated by short-range valence bonds (singlets). Our general perturbative approach is applied to specific models expected to be in this class, including the Shastry-Sutherland model of the spin-dimer compound $SrCu_2(BO_3)_2$ and the antiferromagnetic Heisenberg model of the recently discovered $S = 1/2$ kagome compound $ZnCu_3(OH)_6Cl_2$. The central result is that a short-ranged valence bond phase, when perturbed with Dzyaloshinskii-Moriya interactions, will remain time-reversal symmetric in the absence of a magnetic field but the susceptibility will be nonzero in the zero temperature limit. Applied to $ZnCu_3(OH)_6Cl_2$, this model provides an avenue for reconciling experimental results, such as the lack of magnetic order and lack of any sign of a spin gap, with known theoretical facts about the kagome Heisenberg antiferromagnet.

[1]NSF DMR-0748925

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Date submitted: 20 Nov 2008 Electronic form version 1.4