

Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Frustrated classical Heisenberg model with biquadratic interactions in a rhombic lattice: exact ground-state phase diagram L.X. HAYDEN, University of Missouri, T.A. KAPLAN, S.D. MAHANTI, Michigan State University — The model cited has nearest-neighbor (nn) ferromagnetic and nnn Heisenberg interactions plus nn biquadratic interactions. The rhombic symmetry comes from assuming the nnn interaction only between sites on a square lattice connected by (1,1) (not (1,-1)) diagonals, as done for various multiferroic manganites^{1,2}. The biquadratic interactions replace the much smaller anisotropic terms usually used². The ground state problem in the thermodynamic limit is reduced, exactly, to a 3-spin problem, enabled by the LK cluster method³, leading to the phase diagram. We find 4 phases: (1) ferromagnetic, (2) general-wave-vector (\mathbf{Q}) spiral, (3) up-up-down- down or “E-type”, degenerate with $\mathbf{Q} = (\pi, \mathbf{0})$, and (4) disordered. The uudd- ($\pi, 0$) degeneracy is removed in favor of uudd by a small ferromagnetic nnn interaction connecting sites along the (1,-1) diagonal (such an interaction was in fact found in ref. 1, where the observed uudd state was discussed). It is argued that the present model is probably realistic for these materials.

¹T. Kimura et al., Phys. Rev. B **68**, 060403(R) (2003)

²M. Mochizuki and N. Furukawa, J. Phys. Soc. Japan **78**, 053704 (2009)

³D. H. Lyons and T. A. Kaplan, J. Phys. Chem. Solids **25**, 645 (1964)

Thomas A. Kaplan
Michigan State University

Date submitted: 30 Nov 2009

Electronic form version 1.4