Abstract Submitted
for the MAR06 Meeting of
The American Physical Society

Lattice Distortion Driven by Spin-Lattice Coupling CHENGLONG JIA, JUNG HOON HAN, Sungkyunkwan University — We analyzed lattice-coupled antiferromagnetic spin models on a variety of frustrated lattices. Inspired by the picture of a hexagonal spin cluster proposed for the paramagnetic $ZnCrO_4$ (S. H. Lee *et al.*, Nature(2002).), we considered hexagon contractions in the *pyrochlore* lattice. Hexagon distortions give rise to mutually orthogonal arrangements of spins for nearby hexagons, and has an energy gain of $-alpha^2/2$ per spin, where α is the spin-lattice interaction strength. However, due to the local rotational symmetry of the $\langle S_i \cdot S_j \rangle$, mean-field theory predicts a lack of lattice displacement in the *triangular* and *kagomé*lattices. In contrast to the valence-bond-solid(VBS) state of the Affleck-Kennedy-Lieb- Tesaki type, we argue that a type of VBS order (partial VBS, PVBS) with only four of the six bonds of the triangular lattice being filled by singlets can be stabilized through spin-lattice interactions and lead to lattice deformations as in the compound $YMnO_3$ (Seongsoo Lee *et al.*, PRB(2005)). The ground state is derived as the direct product of states, one of which represents the conventional long-range ordered spins, and the other given by the $\sqrt{3} \times \sqrt{3}$ modulation of the valence bond amplitudes, $|GS\rangle = |LRO\rangle \otimes |PVBS\rangle$. The excitation spectrum for the modulated valence bond state is worked out within the single- mode approximation. The spectrum offers a new collective mode, which is distinct from the spin wave excitations of the magnetically ordered ground state, and in principle, observable by neutron scattering.

Chenglong Jia
Sung Kyun Kwan University

Date submitted: 12 Jan 2006 Electronic form version 1.4