Spin Tensor Phases in Frustrated Magnets

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Strong geometrical frustration precludes conventional magnetic ordering. A common outcome is a completely disordered spin-liquid state at zero and at low temperatures. Another interesting possibility is a partial breaking of spin rotational symmetry described by spin-tensor order parameters. We shall discuss two examples of such unusual symmetry breaking. The first model example is a classical Heisenberg antiferromagnet on a kagome lattice [1]. At low temperatures the order by disorder mechanism selects a submanifold of planar spin states which are described by non-zero octupole moments. An interesting consequence of such a third-rank tensor order parameter is presence of various types of fractional vortices. The second example is a system of weakly coupled spin-1/2 frustrated ferromagnetic chains [2]. The high-field transition from the saturated phase occurs via condensation of bound magnon pairs. Such a condensate of is described by spin-nematic or second-rank tensor. We develop analytical theory for the bose condensation into nematic state and argue that corresponding transition is realized in $LiCuVO_4$.

[1] M. E. Zhitomirsky, Phys. Rev. B **78**, 094423 (2008).

[2] H. Tsunetsugu and M. E. Zhitomirsky, in progress (2009).