Flux fractionalization transition in anisotropic $S = 1$ antiferromagnets and dimer-loop models

Souvik Kundu[1] and Kedar Damle[1]

[1] *Tata Institute of Fundamental Research, 1 Homi Bhabha Road, Mumbai 400005, India*

We demonstrate that the low temperature (T) properties of a class of anisotropic spin $S = 1$ kagome (planar pyrochlore) antiferromagnets on a field-induced $\frac{1}{3}$-magnetization ($\frac{1}{2}$-magnetization) plateau are described by a model of fully-packed dimers and loops on the honeycomb (square) lattice, with a temperature-dependent relative fugacity $w(T)$ for the dimers. The fully-packed O(1) loop model ($w = 0$) and the fully-packed dimer model ($w = \infty$) limits of this dimer-loop model are found to be separated by a phase transition at a finite and nonzero critical fugacity w_c, with interesting consequences for the spin correlations of the frustrated magnet. The $w > w_c$ phase has short loops and spin correlations dominated by power-law columnar order (with subdominant dipolar correlations), while the $w < w_c$ phase has dominant dipolar spin correlations and long loops governed by a power-law distribution of loop sizes. Away from w_c, both phases are described by a long-wavelength Gaussian effective action for a scalar height field that represents the coarse-grained electrostatic potential of fluctuating dipoles. The destruction of power-law columnar spin order below w_c is driven by an unusual *flux fractionalization* mechanism, topological in character but quite distinct from the usual Kosterlitz-Thouless mechanism for such transitions: Fractional electric fluxes which are bound into integer values for $w > w_c$, proliferate in the $w < w_c$ phase and destroy power-law columnar order.