Effective field theory with a $\theta$-vacua structure for 2d spin systems

AKIHIRO TANAKA, XIAO HU, National Institute for Materials Science — We derive a new 2+1d nonlinear sigma (NL$\sigma$) model description for coupled spin chains with competing AF-VBS orders, incorporating methods developed recently by ourselves and by Senthil and Fisher. The resulting 2+1d $O(4)$ NL$\sigma$ model contains a topological $\theta$-term whose vacuum angle $\theta$ varies continuously with $\delta$, the bond-alternation strength of the interchain interaction. This implies that the $\theta$-vacua structure for this NL$\sigma$ model can be explored by tuning $\delta$ in a suitable 2+1d spin system, as in the case of the 1+1d AF spin chains with bond-alternation. We discuss the implications for frustrated spin systems. A. Tanaka and X. Hu, Phys. Rev. B74, 140407 (2006).

Akihiro Tanaka
National Institute for Materials Science

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