Mechanism of hole propagation in the orbital compass models

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We explore the propagation of a single hole in the quantum compass model, whose nematic ground state is given by mutually decoupled antiferromagnetic (AF) chains [1]. This is the simplest model that describes orbital-like superexchange in two dimensions, which may be obtained as the strong-coupling limit of a spinless two-band Hubbard model, studied here by the mean-field theory and the variational cluster approach. Due to the symmetries of the model, the inherent disorder along one lattice direction turns out not to affect hole motion and doping a hole consequently does not lift the subextensive degeneracy of the nematic phase. We observe coherent hole motion due to both interorbital hopping perpendicular to the AF chains and three-site hopping along the chains. In the models for t_{2g} orbitals only the latter mechanism is present [2]. Finally, a generalized compass model having a fully isotropic AF ground state shows that a small admixture of interorbital hopping can trigger hole's mobility.

References:

[1] W. Brzezicki, M. Daghofer, and A. M. Oleś, Phys. Rev. B **89**, 024417 (2014).
[2] M. Daghofer, K. Wohlfeld et al., Phys. Rev. Lett. **100**, 066403 (2008).