Frustration and Entanglement in Spin-Orbital Models

Andrzej M. Oleś[1]

[1] *Marian Smoluchowski Institute of Physics, Jagellonian University, Kraków, Poland; Max Planck Institute for Solid State Research, Stuttgart, Germany*

The orbital interactions are intrinsically frustrated due to their directional character and provide novel opportunities for quantum information. Strong coupling between spins and orbitals on exchange bonds leads to spin-orbital entanglement [1] which has several consequences in the physical properties of transition metal oxides. In model systems one finds, *inter alia*, magnetic phases originating from entanglement, and a cute and surprising rigorous topological order in the SU(2)$\otimes XY$ spin-orbital ring [2]. We argue that: (i) quantum fluctuations play a crucial role in the ground states and quantum phase transitions, and (ii) effective spin exchange constants alone do not determine spin bond correlations in the spin-orbital liquid which involves entangled states. When on-site spin-orbit coupling is considered in addition, as in iridates, effective spin models arise with frustrated interactions and rich phase diagrams, Hole propagation may be then quite unusual, with either hidden quasiparticles in the zigzag magnetic phase of Na_2IrO_3, or non-Fermi liquid behavior in the Kitaev liquid [3].

References:

[1] A. M. Oleś, Journal of Physics: Condensed Matter **24**, 313201 (2012).
[2] W. Brzezicki, J. Dziarmaga, and A. M. Oleś, Phys. Rev. Lett. **112**, 117204 (2014).
[3] F. Trousselet *et al.*, Phys. Rev. Lett. **111**, 037205 (2013); arXiv:1308.3373 (2013).