ORBITAL ORDERING AND FLUCTUATIONS IN TRANSITION METAL OXIDES

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9.7 cm

A short review of the frustrated magnetic interactions in transition metal oxides with orbital degrees of freedom is presented. The classical phase diagrams of e_g systems show a competition between different phases, with spin, orbital and mixed spin-and-orbital excitations, and strongly enhanced quantum fluctuations [1]. The orbital order explains a quasi-one-dimensional antiferromagnetic (AF) interactions of spins $S = 1/2$ in $KCuF_3$, and the measured superexchange between spins $S = 2$ in the A-AF phase of $LaMnO_3$. The spectral functions of a single hole in $LaMnO_3$ depend strongly on the type of the underlying orbital order [2]. Macroscopic hole doping $x \simeq 0.3$ promotes an orbital liquid in the ferromagnetic manganites, and the observed increase of the spin stiffness with x is well explained by e_g electron correlations [3]. Quantum fluctuations of t_{2g} orbitals play a prominent role in early transition metal oxides — they explain the isotropic AF order in $LaTiO_3$, and enhance ferromagnetic interactions in the C-AF phase of cubic vanadates. Finally, the t_{2g} orbital fluctuations stand behind the exotic magnetic properties of YVO_3, and stabilize the C-AF over G-AF order at finite temperatures [4].

[1] L.F. Feiner, A.M. Oleś, and J. Zaanen, Phys. Rev. Lett. **78**, 2799 (1997).
[2] J. Bała *et al.*, Phys. Rev. Lett. **87**, 067204 (2001).
[3] A.M. Oleś and L.F. Feiner, Phys. Rev. B **65**, 052414 (2002).
[4] G. Khaliullin, P. Horsch, and A.M. Oleś, Phys. Rev. Lett. **86**, 3879 (2001).

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