QUANTUM ORBITAL PHYSICS IN TITANATES AND VANADATES

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We discuss a collective behavior of orbital angular momentum in Mott insulators with t_{2g} orbital degeneracy. The frustrated nature of the superexchange interactions lead to an infinite degeneracy of classical states. Quantum effects select a particular orbital state depending on the spin configuration: (i) in the spin one-half antiferromagnet $LaTiO_3$, orbitals remain quantum disordered down to low temperatures; (ii) in ferromagnetic $YTiO_3$, weak orbital order is stabilized by an order-from-disorder mechanism; (iii) in large spin (e.g. S=1) systems like cubic vanadates orbitals may form fluctuating quasi-onedimensional structures susceptible to an orbital Peierls effect. Experimental consequences of orbital fluctuations will be discussed which might help to identify orbital states and detect elementary orbital excitations.

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