

SPIN WAVE AND MIXED SPIN-AND-ORBITAL EXCITATIONS IN KCuF_3

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We consider an effective spin-orbital model [1], which describes interactions between Cu^{2+} ions in d^9 configuration and investigate spin and mixed spin-and-orbital excitations in KCuF_3 for antiferromagnetic ground state with the ferro type of orbital order of occupied e_g orbitals. Spin excitations couple to mixed spin-and-orbital excitations in the spin-orbital superexchange model, as shown using the random phase approximation (Tjablikov decoupling) within the Green's function scheme [2]. Here we employ Holstein-Primakoff method for spin and orbital operators and derive the spin wave and spin-and-orbital wave excitations using the bosonic representation. The results demonstrate that this approach gives equivalent results to those of Ref. [2]. In addition, we include the charge transfer term which originates from two-hole charge excitations at a common neighboring $2p_\sigma$ orbital of a common fluorine ion in between two copper ions, and modifies the spin-orbital model. Implications of this new superexchange term on spin and spin-and-orbital excitations are discussed in antiferromagnetic phases with different orbital order.

[1] L. F. Feiner, A. M. Oleś, and J. Zaanen, Phys. Rev. Lett. **78**, 2799 (1997).

[2] A. M. Oleś, L. F. Feiner, and J. Zaanen, Phys. Rev. B **61**, 6257 (2000).

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9.7 cm