Magnetic properties of $LaMnO_3$

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9.7 cm

The discoveries of giant magnetoresistance and high temperature superconductivity have led to a renewed interest in transition metal oxides which show these behaviours by doping divalent and trivalent metal ions in these compounds.A lot of experiments have been performed in doped materials with a very little understanding of the phenomena.The parent compounds on the otherhand are well understood and might throw some light on the complex behavior of the doped materials.The parent compound of colossal magnets e.g. $LaMnO_3$ is a Mott-Hubbard and charge transfer insulator.A neutron scattering study of this compound has revealed an antiferromagnetic transition and from experiment, the transition temperature and the critical exponent β of the order parameter have been estimated.A theoretical calculation which goes beyond the mean field theory and takes into account the fluctuations in the critical region will be presented here.This theory can explain the experimental results quantitatively and can predict the critical exponents (β = .32) very close to the values predicted by other theoretical models (Heisenberg and Ising models in three dimension).In our model, cubic perovskite structure of the compound is assumed and the ground state of Mn^{4+} ion has ^5E symmetry having orbital degeneracy.In cubic model the exchange interaction between two neighbouring Mn^{4+} ions and the spin-orbit interaction in a single Mn^{4+} are considered.Using a spin-orbit parameter close to the free ion value (λ = -180K), the exhange parameter J = 5.89K has been found to predict the observed Neel temperature (139.5K).With these parameters a nice agreement with the experimental results have been obtained.

13.4 cm

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