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Superexchange interaction revisited for orthorhombic perovskite manganites $R\mathbf{MnO_3}$ (R=rare earth) BEOM HYUN KIM, B. I. MIN, Department of Physics, PCTP, Pohang University of Science and Technology — The manganese perovskite oxides $R\mathrm{MnO_3}$ (R= rare-earth element) show the strong interplay between charge, orbital, lattice, and spin degrees of freedom. Depending on rare-earth ions, their magnetic ground state varies from the A-type to E-type antiferromagnetism (AFM) through the spiral ordering and accordingly Mn-O-Mn bonding angles and local octahedral deformations are changed. Moreover, the ferroelectric properties emerge in the case of spiral or E-type $R\mathrm{MnO_3}$. In this study, we have studied the magnetic superexchange interaction in $R\mathrm{MnO_3}$ based on the microscopic model incorporating the $\mathrm{GdFeO_3}$-type octahedral tilting and the Jahn-Teller (JT) distortion. We have found that (i) the account of t_{2g} electrons is essential to describe both the nearest-neighbor (NN) and next-nearest-neighbor (NNN) superexchange interactions, (ii) the JT distortion angle as well as the octahedral tilting and the JT distortion strength is an important factor for the superexchange interactions, and (iii) two NNN interactions in the ab plane are anisotropic but are both antiferromagnetic. We have determined the magnetic-phase diagram of $R\mathrm{MnO_3}$ and discussed the magnetic ground states in relation to the experiments.

Beom Hyun Kim
Department of Physics, PCTP, Pohang University of Science and Technology

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