



Magnetic Ions in Crystals (Princeton Legacy Library)

K. W. Stevens

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There have been many demonstrations, particularly for magnetic impurity ions in crystals, that spin-Hamiltonians are able to account for a wide range of experimental results in terms of much smaller numbers of parameters. Yet they were originally derived from crystal field theory, which contains a logical flaw; electrons on the magnetic ions are distinguished from those on the ligands. Thus there is a challenge: to replace crystal field theory with one of equal or greater predictive power that is based on a surer footing. The theory developed in this book begins with a generic Hamiltonian, one that is common to most molecular and solid state problems and that does not violate the symmetry requirements imposed on electrons and nuclei. Using a version of degenerate perturbation theory due to Bloch and the introduction of Wannier functions, projection operators, and unitary transformations, Stevens shows that it is possible to replace crystal field theory as a basis for the spin-Hamiltonians of single magnetic ions and pairs and lattices of magnetic ions, even when the nuclei have vibrational motion. The power of the method is further demonstrated by showing that it can be extended to include lattice vibration and conduction by electron hopping such as probably occurs in high-T_c superconductors. Thus Stevens shows how an apparently successful ad hoc method of the past can be replaced by a much more soundly based one that not only incorporates all the previous successes but appears to open the way to extensions far outside the scope of the previously available methods. So far only some of these have been explored. The book should therefore be of great interest to all physicists and chemists concerned with understanding the special properties of molecules and solids that are imposed by the presence of magnetic ions.



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