Karlsruher Institut für Technologie
Institut für Theorie der Kondensierten Materie

Übungen zur Theorie des Magnetismus Sommersemester 16

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Blatt 1
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1. The spin of an Oxygen molecule (4 Punkte)

In this exercise, we determine the total spin of an Oxygen molecule in its ground state.

(a) Determine the molecular orbitals for Oxygen.
(Hint: Consider the overlap of p-orbitals and choose the z-direction along the molecule axis.)

(b) Assign the electrons to bonding and anti-bonding shells and assume that the spin degeneracy is lifted by the exchange hole effect. What is the total spin of the Oxygen?

2. Ground state of free magnetic ions (3 Punkte)

In this exercise, we consider trivalent Ce ions which are important in many interesting compounds. We determine the Curie susceptibility, which is the main contribution at sufficiently high temperatures.

(a) Find the ground state of a single Ce^{3+}, by using Hund's rules.

(b) Determine the Lande-factor and the Curie-constant.

3. Determination of the valence state by the Curie-constant (4 Punkte)

In this exercise, we try to distinguish between U^{3+} and U^{4+} by a measurement of the Curie-constant $C = \frac{N}{V}\frac{\mu_B^2}{3k_B}g^2J(J+1)$, where g is the Lande-factor and $J(J+1)$ is the eigenvalue of the total angular momentum. Assume that data from an experiment shows that $g^2J(J+1) = 13 \pm 0.3$. Is this experiment accurate enough to distinguish between U^{3+} and U^{4+}?

(a) Determine the ground state of U^{3+} and U^{4+} by using Hund's rules.

(b) Calculate the Lande-factor for both, U^{3+} and U^{4+}, and decide if the experiment is accurate enough.