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A NEUTRON DIFFRACTION STUDY OF THE MAGNETIC STRUCTURES IN RD_2 (R = Tb, Dy, Ho and Er)

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The magnetic structures in cubic RD_2 (R = Tb, Dy, Ho and Er) were studied by neutron diffraction. The dideuterides of Tb, Dy and Ho have modulated magnetic structures with a period of $4a_o/\sqrt{11}$ Å along [113]. This modulation is commensurate with the crystal lattice and leads to a nonpermitive cubic magnetic lattice with a translation of $4a_o$ Å. The ionic magnetic moments are of a single magnitude, independent of position. The magnetic structure of ErD_2 contains a commensurate component which belongs to a cubic magnetic lattice, with lattice parameter $4a_o$ and an additional incommensurate component. An intermediate magnetic structure of the type found in ErD_2 appears in the Tb, Dy and Ho compounds above T_N, but disappears below T_N, giving way to the apparently more stable commensurate structure mentioned above.

NEUTRON SCATTERING STUDY OF SPIN WAVES IN THE ANTIFERROMAGNET $RbMnCl_3$

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$RbMnCl_3$ is a transparent antiferromagnet (T_N=94K) with 6 formula units per unit cell. The magnetic structure consists of ferromagnetic planes stacked in the sequence A(+), B_1(-), B_1(+), A(-), B_2(+), B_2(-) along the c-axis, with spin direction perpendicular to the c-axis. There are two kinds of sites for the Mn^{2+} ions; the A-sites (containing "lone spins") and the B-sites (containing much closer spin pairs). The principal magnetic exchange interactions can therefore be labeled J_{AB} and J_{BB}.

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This study of the spin wave spectrum of $RbMnCl_3$ was undertaken with the objective of determining whether the magnetic interactions are the conventional Heisenberg type, where J_{AB} and J_{BB} are of the same order of magnitude, or whether the strong coupling model[1] with $J_{BB} \gg J_{AB}$ applies. A large cylindrical single crystal (~2.5 cm in volume) was used to collect data at liquid helium temperature on a triple axis spectrometer. Measurements were performed with the scattering vector along three principal directions: [001], [110] and [100]. Two distinct optic branches observed in the [001] direction immediately ruled out the strong coupling model. A fit to the data was then performed using the Heisenberg model with excellent results. We found $J_{BB}/J_{AB} = 1.65$ ($\pm$0.1) completely independent of the spin values S_A and S_B. This result clearly shows that the dominant interactions are of the Heisenberg superexchange type acting through the intervening Cl ions. With $S_A = 2.4$ and $S_B = 2.5$, $J_{BB} = 0.73$ meV and $J_{AB} = 0.44$ meV, results which are consistent with the exchange in other manganese halides.

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MAGNETIC STRUCTURES OF $DyCo_2Si_2$ AND $DyCu_2Si_2$. A NEUTRON DIFFRACTION STUDY

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The compounds $DyCo_2Si_2$ and $DyCu_2Si_2$ belong to the family AB_2X_2 (A = lanthanide, actinide, B = transition metal, X = Si, Ge). The crystallographic structure belongs to the space group I4/mmm with A,B and X at 2a, 4d and 4e positions, respectively. The lattice parameters are a = b = 3.885Å, c = 9.748Å and a = b = 3.964Å, c = 9.982Å for $DyCo_2Si_2$ and $DyCu_2Si_2$, respectively. The room temperature neutron ($\lambda \sim 2.4$Å) diffraction patterns of the two compounds agreed with the reported[1,2] crystallographic structure.

The diffraction pattern of $DyCo_2Si_2$ at 4.2K revealed the existence of reflections with $h + k + \ell$ = odd which are crystallographically forbidden. Among these reflections the 00ℓ are missing. As previously reported[3] this corresponds to a type I antiferromagnetic structure on the dysprosium sublattice. The magnetic moment lies along the c axis and is equal to $9.5 \pm 0.5\ \mu_B$.