substance: hematite (α-Fe_2O_3)
property: magnetic properties

Low temperature magnetic transition : 260 K (Morin temperature).

$T \leq 260$ K: The magnetic arrangement has Fe^{3+} spins directed along the [1 1 1] axis and paired across the shared octahedral face.

$T \geq 260$ K: The spins become essentially localized in (111) sheets directed towards the three nearest neighbours. However, the spins have canted slightly out of the plane, giving rise to a weak ferromagnetic moment along the [1 1 1] axis (Fig. 1).

spin-wave spectrum: Fig. 2.

exchange parameters (see preceding document) (J_i given as J/k in K)

J_1 (J_{12})	6.0	J_i, $J_{ij'}$ are defined in [70S]	70S
	5.86		78K
J_2 ($J_{23'}$)	1.6		70S
	0.99		78K
J_3 ($J_{34'}$)	– 29.7		70S
	– 37.3		78K
J_4 ($J_{24'}$)	– 23.2		70S
	– 23.2		78K

Néel temperature

T_N	947...969 K		78K
	955 K	heat capacity anomaly over 3 K	75G
	963 K	Moessbauer spectrum	77N
	960 K	Moessbauer spectrum	64I
	950(10) K		65K
	968 K		69S

The two-magnon spectrum gives a peak at 1380 cm^{-1} [75H].

Magnetic ordering shows a very long short-range-order tail (Fig. 3) [75G]. Long-range order also shown in Fig. 3, see also [66W].

paramagnetic Curie temperature: $\Theta_p = -2940$ K at temperatures well above T_N [51G].

entropy of transition at T_N: 32.4 J K^{-1} mol^{-1} [75G]; close to value expected for randomistion of spin 5/2.

References:

51G Guillaud, C.: J. Phys. Radium 12 (1951) 490.
63T Tasaki, A., Iida, S.: J. Phys. Soc. Jpn. 18 (1963) 1148.
64I Iserentaut, C. M., Robbrecht, G. G., Dodo, P. T.: Phys. Lett. 11 (1964) 14.
65K Kren, E., Szabo, P., Konzos, G.: Phys. Lett. 19 (1965) 103.
66W van der Woude, F.: Phys. Status Solidi 17 (1966) 419.
69S Scharenberg, W.: Ber. Kernforschungsanlage Juelich, Jul-611-RX (1969) 1.
70S Samuelson, E. J., Shirane, G.: Phys. Status Solidi 42 (1970) 241.
75G Grenvold, F., Samuelsen, E. J.: J. Phys. Chem. Solids 36 (1975) 249.
75H Hart, T. R., Adams, S. B., Temkin, H.: Proc. Int. Conf on "Light Scattering in Solids", ed. 1975, 259.
77N Neskovic, N. B., Babic, R., Konstantinovic, J.: Phys. Status Solidi (a) 41 (1977) K133.
78B Balberg, I., Pinch, H. L.: J. Magn. Magn. Mater. 7 (1978) 12.
78K Kowalska, A., Stoniowska, B.: Acta Physiol. Pol. A54 (1978) 679.

Fig. 1.

Fe_2O_3. Magnetic susceptibility (χ_g) and weak ferromagnetic spontaneous specific magnetization (σ_0) vs. temperature [63T]. $\sigma, \chi_g \perp [111]$.

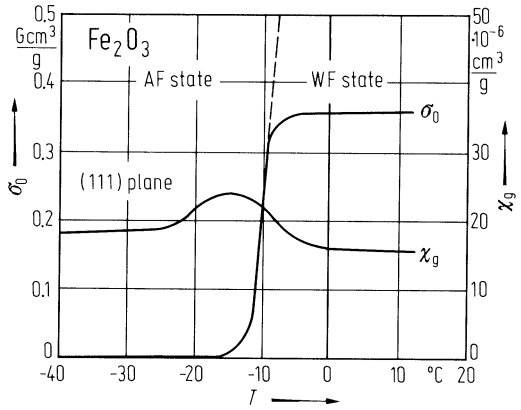

Fig. 2.

Fe_2O_3. Spin wave spectrum at 240 K. A part of the Brillouin zone is shown in the upper right corner [70S].

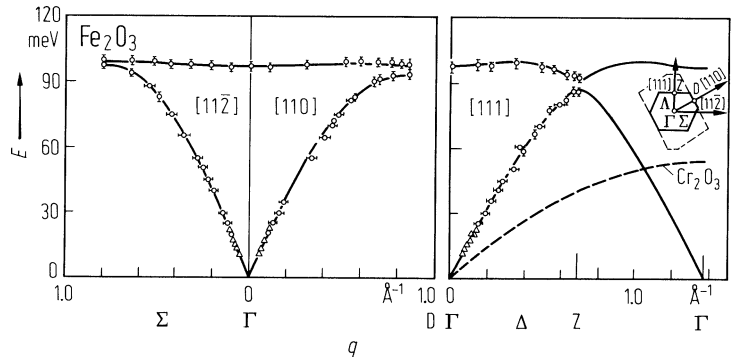

Fig. 3.

Fe_2O_3. Short and long-range magnetic order for Fe_2O_3. Full curve: long-range order, defined as M/M_0 where M is the sublattice magnetization and M_0 the saturation sublattice magnetization (from neutron scattering). Hatched curve: short-range magnetic order parameter, p, defined as $<S_0^x S_1^x + S_0^y S_1^y + S_0^z S_1^z >/S(S+1)$ where S_0 is the spin on the central ion and S_1 the spin on the ions in the first ion-shell surrounding the central ion. This parameter can be obtained from the heat capacity [75G].