

Abstract: We have performed detailed measurements of magnetic and dielectric properties of high quality magnetite (Fe_3O_4) single crystals in weak magnetic and electric fields. These measurements can reveal details of phase transitions and other features that are not yet fully understood. We focused not only at the Verwey transition - a well known phase transition taking place at about 120 K in stoichiometric samples - but we also explored and described new relaxation effects in magnetite at low temperatures. The low-temperature properties were also found to be exceptionally sensitive to sample quality, stoichiometry and homogeneity. The results presented in this thesis were acquired on sensitive non-commercial SQUID magnetometer complemented by four-probe dielectric spectroscopy and dc conductivity measurements.