Transition into the vortex state in dysprosium observed on ZFC and FC curves

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The studies of the magnetic phase diagram of a single crystal of dysprosium (Dy) identified four main regions: helical antiferromagnetic phase, angular ferromagnetic phase, fan phase and collinear ferromagnetic phase [1]. Just below $T_N = 180$ K, an anomaly was identified and ascribed to the so called vortex state. The vortex state exists in the temperature range 170−180 K (at zero applied magnetic field) and disappears above 0.3 T. We have examined the region of the vortex state through the evaluating of the characteristic transition temperatures on zero field cooled curves (ZFC) and field cooled curves (FC) for applied fields up to 0.3 T. Measurements were performed on a QD PPMS ECII 9T device using the VSM option. We conclude that vortex state develops only by cooling as a kind of transition state between paramagnetic state and helical antiferromagnetic state. By heating, fully developed helical antiferromagnetic state converts directly into paramagnetic state.

References:

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