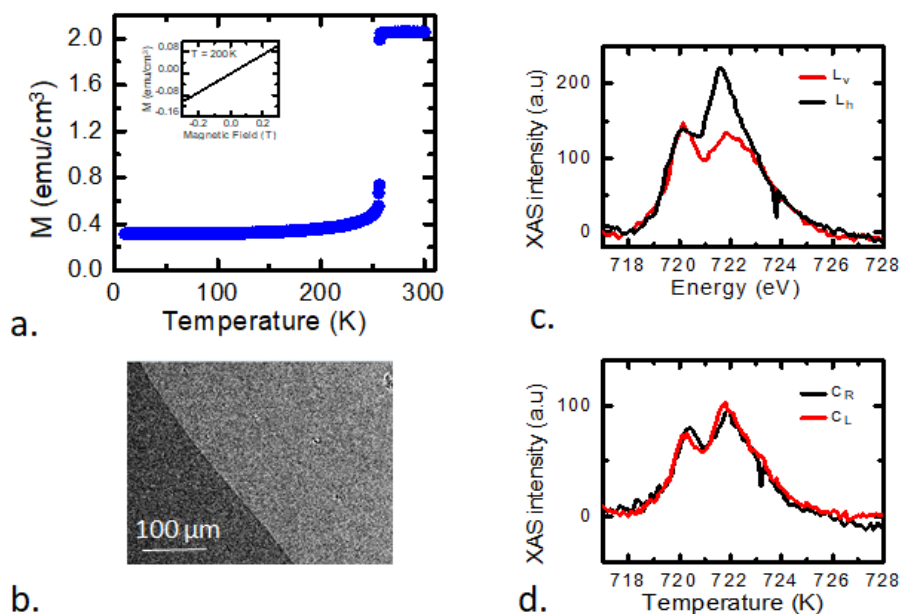


Supplementary information

Supplementary Figures



Supplementary Figure 1: Magnetic properties of the R-cut hematite crystal. (a) Temperature dependence of the net AFM moment as a function of temperature under a field of 1 T. (Inset: Field dependence of the net AFM moment as a function of field at 200 K). (b) Kerr imaging of magnetic moment in the canted antiferromagnetic phase of hematite at 280 K. (c-d) X-rays absorption spectroscopy for linear (L_v : vertical, L_h : horizontal) and circular polarized (C_R : right, C_L : left) x-rays.

Supplementary Note 1: Magnetic properties of the hematite single crystal:

The hematite crystals undergo a magnetic transition at the Morin transition, from a canted easy-plane phase to a purely antiferromagnetic phase. This transition happens at a temperature of 255 K and can be measured by SQUID magnetometry as shown in **Fig. S1.a**. The magnetic domain in a single crystal are of hundreds of micrometers above the Morin transition and can be measured with a Kerr microscope as shown in **Fig. S1.b**. Below the Morin transition, XAS-XMLD measurements as presented in **Fig. S1.c** (and the absence of XAS-XMCD **Fig. S1.d**) demonstrate the presence of the purely antiferromagnetic phase. In XMLD-PEEM we find domains that are larger than the field of view of 100 μm.