**High-field magnetization of free-to-rotate GdCo5**

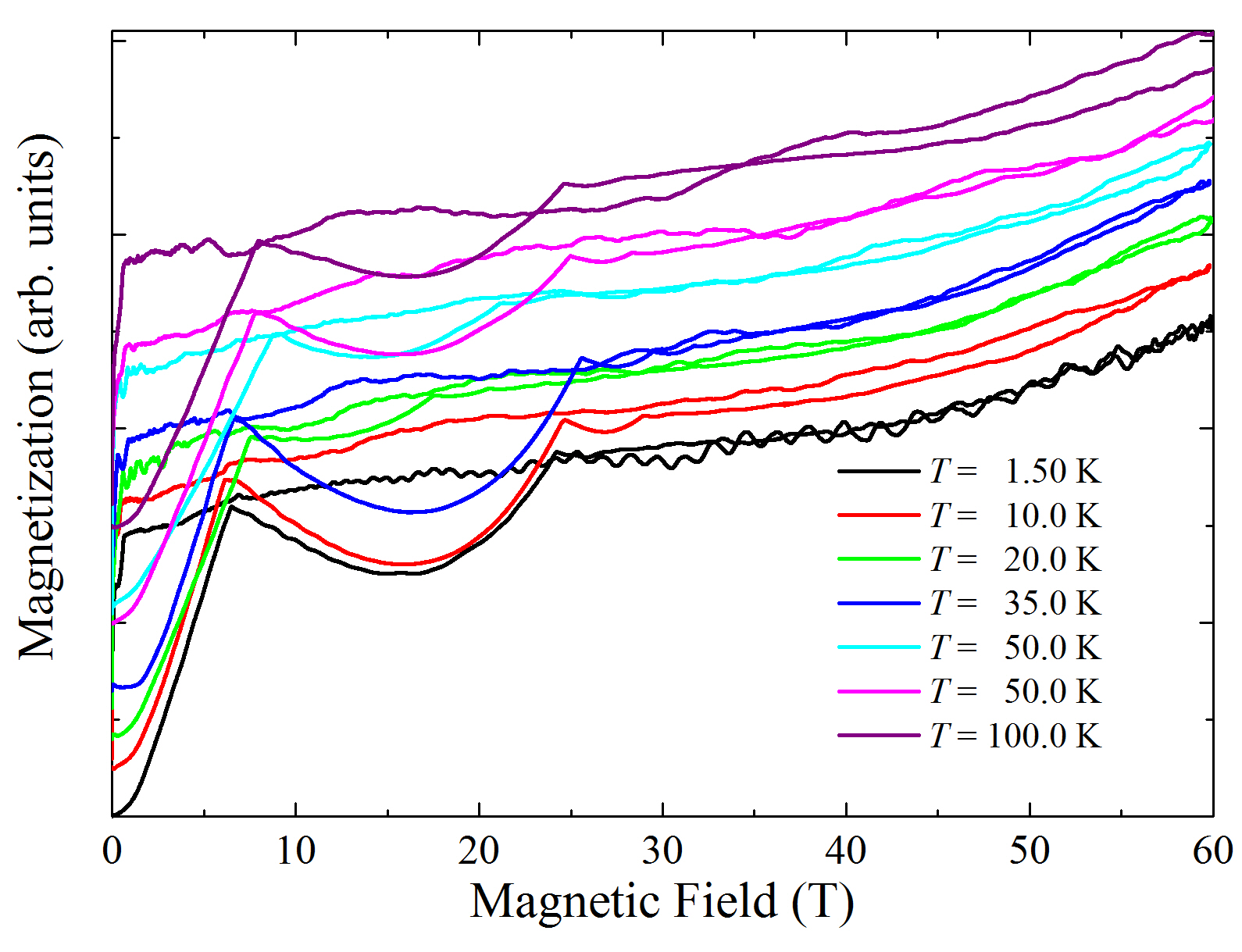
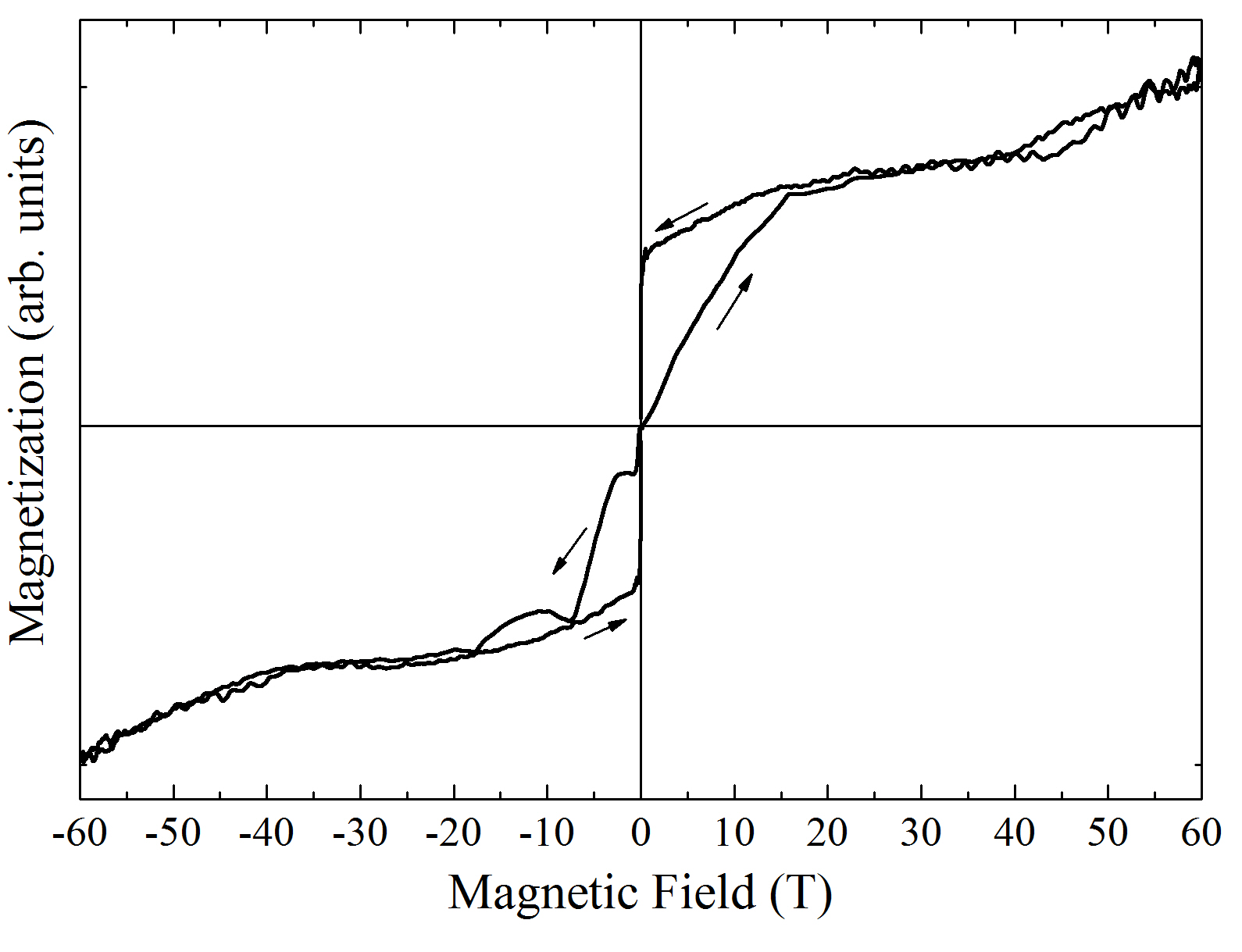
Goddard, P., Gotze, K., Pearce, M., Patrick, C., Kumar, S., Lees, M. (U. Warwick, Physics) and Singleton, J. (NHMFL, Los Alamos)

**Introduction**

RECo5 materials (RE = rare earth) host strong Co magnetism together with highly anisotropic 4*f* electrons. Early work on SmCo5 led to the development of the strong permanent magnets now used extensively for commercial application [1]. Recent advances in first-principles calculations have provided the ability to model the complex interplay of interactions in these materials [2]. In order to inform and extend the calculations we measured the high-field properties of GdCo5. This system exhibits a collinear ferrimagnetic state at low fields and is known to undergo a spin reorientation above 40 T [3]. Observation of this reorientation allows the Co-Gd and Gd-Gd exchange energies to be established and compared to first-principles calculations.

**Experimental**

Isothermal magnetization measurements were performed in a 65 T short pulse magnet at NHMFL-LANL using a compensated-coil magnetometer located in a 4He refrigerator. A small (~1 mm3) plate-like single crystal was housed in a PCTFE ampoule and permitted to rotate freely during the field pulse.

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**Fig.1** Magnetization of free-to-rotate GdCo5 at *T* = 1.5 K (upper) and at various temperatures (lower). The arrows indicate the up and down field pulses. The low-field behavior on the up sweeps is caused by mechanical reorientation of the sample.

**Results and Discussion**

The upper panel of Figure 1 shows the magnetization data taken during consecutive forward and reverse field pulses at 1.5 K. The low-field behavior on the up sweep is caused by the initial mechanical motion of the sample as the easy axis aligns with the applied magnetic field. At slightly higher fields a plateau-like feature is observed that corresponds to the saturated moment of the ferrimagnetic phase [2,3]. The magnetization kink observed at approximately 40 T is indicative of the expected spin reorientation. The lower panel shows further data taken at various temperatures up to 100 K.

**Conclusions**

At low temperatures the magnetization of free-to-rotate GdCo5 exhibits the features expected from the ferrimagnetic ground state and the field-induced spin reorientation. A comprehensive analysis of the experimental data is underway, together with a comparison to the results of first-principles calculations.

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**References**

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[3] Kuz’min, M. D. *et al.*, Phys. Rev. B **70**, 172412 (2004).