Pulsed fields detect a dramatic change of electronic character in the ferromagnet Fe3−xGeTe2

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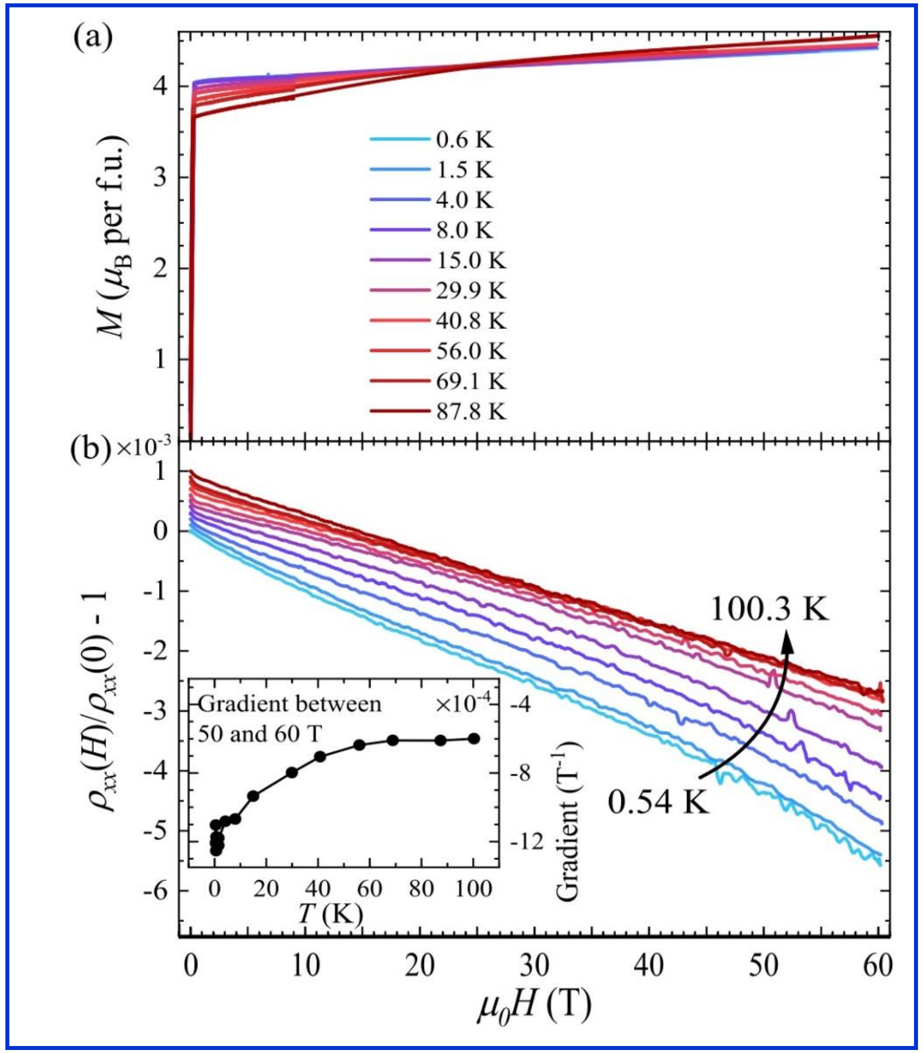
Magnetic van der Waals materials provide an exciting testing ground for fundamental theories of magnetism in the extreme two-dimensional limit. Moreover, the ease with which they are exfoliated and reassembled has led to proposals for a wide range of novel magnetic devices. Within this family, $Fe_{3-x}GeTe_2$ (FGT) is very promising, as it has both a high Curie temperature and good electrical conductivity, leading to heterostructures with potential for low-power, room-temperature spintronic technologies. Interestingly, FGT also shows coexistence of itinerant and localized magnetism; as a result, it has been suggested that Kondo-lattice behavior develops at low temperatures. Whilst Kondo-lattice behavior is accepted in *f*-electron systems, its presence in 3*d* compounds is controversial. An understanding of this issue is essential for designing future FGT devices.

In order to demonstrate Kondo-lattice behavior in FGT, magnetization [*M*(*H*) - [Figure (a)] and resistivity [$\boldsymbol{\rho}_{xx}$ - Figure (b) and $\boldsymbol{\rho}_{xy}$] data were recorded at many temperatures in pulsed magnetic fields of up to 60 T. These experiments reveal three distinct contributions to the magnetoresistance (MR; i.e., the variation of the resistivity in magnetic field): a linear negative component, a contribution from closed Fermi-surface orbits, and an enhancement proportional to the square of the applied magnetic field, linked to a noncoplanar spin arrangement. The availability of magnetization and resistivity data over a wide range of conditions enabled the ordinary Hall coefficient of FGT to be extracted reliably for the first time, demonstrating a significant change in character of the electrons and holes on the Fermi-surface at at about 80 K; eventually, the Hall coefficient reverses sign at 35 K. This change in character supports the development of Kondo-lattice behavior in this *d*-electron material below 80 K. Additional evidence comes from the negative linear component of the MR, which arises from electron-magnon scattering with an atypical temperature dependence [inset in Figure (b)] attributable to the onset of Kondo screening.



Facilities and instrumentation used: PFF - **65 T magnet, magnetometer and 3D printed rotator**

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