Magnetic and electronic phases of $U_2Rh_3Si_5$

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Motivation and scientific background

- Antiferromagnetic ground state (see Fig. 1) [1,2]
- Unique magnetic transition accompanied by a structural transition [1,2]
  - ➢ Possible Explanation: Bootstrapping scenario [3]
- Here: Detailed study of the magnetic and electronic properties of $U_2Rh_3Si_5$ [4]

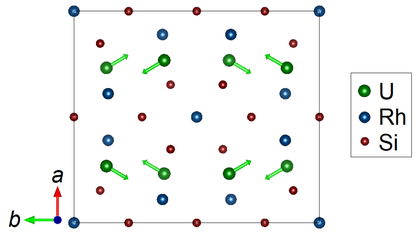

Fig. 1: Crystallographic and magnetic structure of $U_2Rh_3Si_5$.

High-field measurements

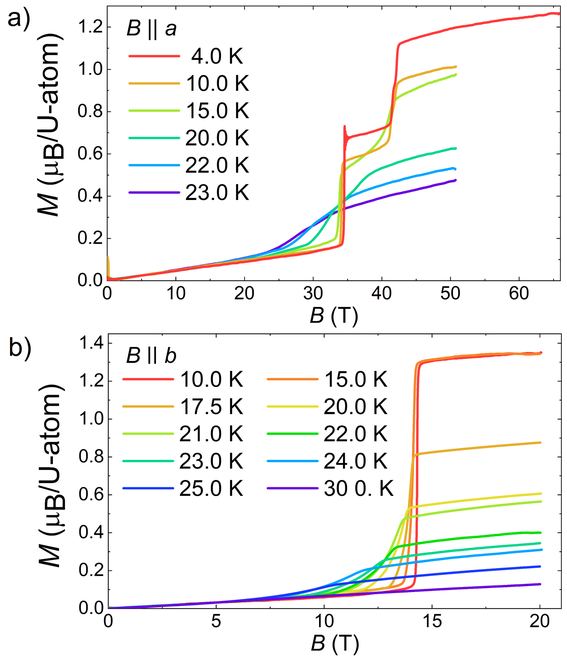

Fig. 2: Magnetization of $U_2Rh_3Si_5$ in pulsed magnetic fields for (a) $B||a$ and (b) $B||b$.

- Magnetization for $B||a$ and $B||b$ and magnetostriction of the b axis in pulsed magnetic fields (see Fig. 2, 3)
- Sharp jumps at transition fields
  - ➢ First order transitions
- No phase transition measured for the c axis up to 65 T [4]
- Various steps in the magnetization of the a axis

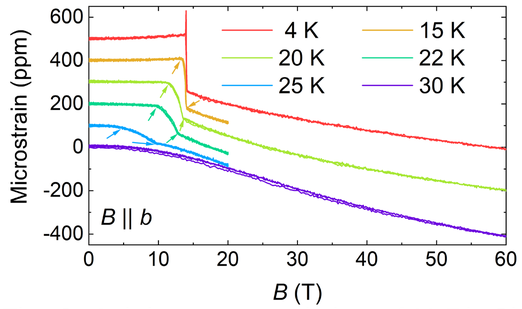

Fig. 3: Axial magnetostriction of $U_2Rh_3Si_5$ for magnetic fields along the b axis.

Literature:

[1] B. Becker et al., Phys. Rev. Lett. **78**, 1347 (1997).
[2] R. Feyerherm et al., Phys. Rev. B. **56**, 13693 (1997).
[3] R. G. Leisure et al., Phys. Rev. Lett. **95**, 075506 (2005).
[4] J. Willwater et al., Phys. Rev. B **103**, 054408 (2021).

Resistivity and susceptibility

- Two-step transition in the resistivity for all three axes (b axis shown in Fig. 4)
- Upturn at T^* = 26.5 K and maximum at T_N = 26.0 K

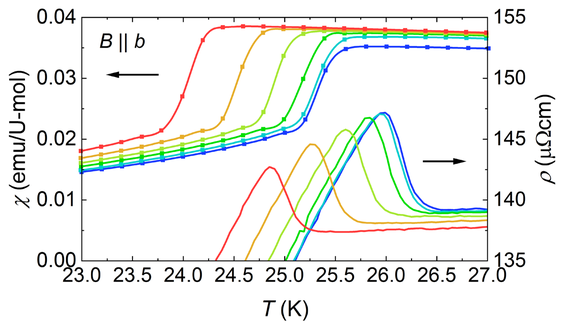

Fig. 5: Comparison of the susceptibility and the resistivity for the b axis.

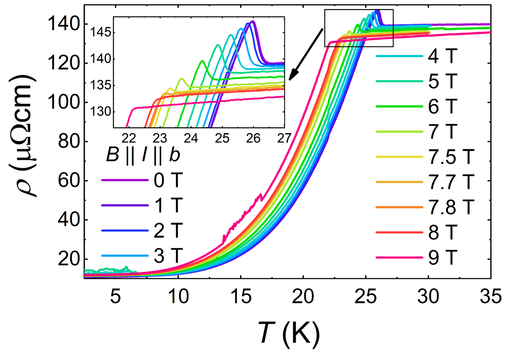

Fig. 4: Resistivity as a function of temperature for b axis.

- Comparison with the susceptibility (see Fig. 5):
  - – No signature at T^* in the susceptibility or the structural parameters [4]
  - – Drop of χ at T_N → magnetic transition

Magnetic phase diagram

- Strongly anisotropic magnetic phase diagram (see Fig. 6)
- a axis: Two additional high field phases II_a and III_a at low temperatures
  - ➢ Staircase scenario
- b axis: Intermediate phase range I'_b
- Additional feature in the resistivity at T^*
  - ➢ Novel electronic phase I^{El}?
  - ➢ Interdependence of electronic, magnetic, and structural degrees of freedom in a bootstrapping scenario?
  - ➢ Further studies on electronic properties?
    - ➢ Hall effect, Seebeck effect, ...

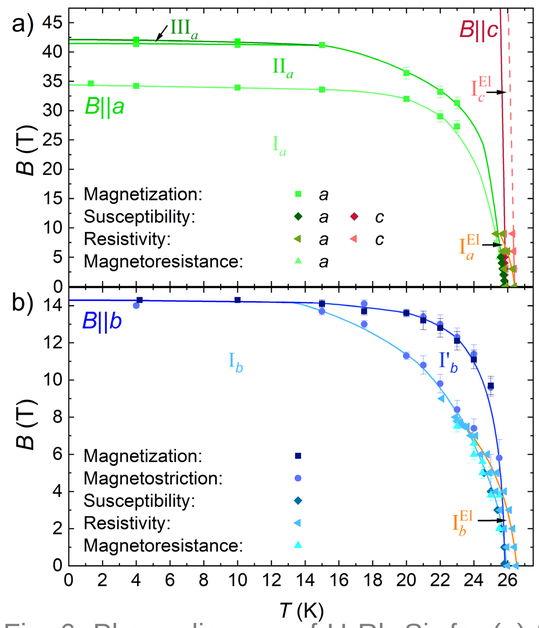

Fig. 6: Phase diagram of $U_2Rh_3Si_5$ for (a) the a and c axes and (b) the b axis