

Partial Order in the NFL-Phase of MnSi

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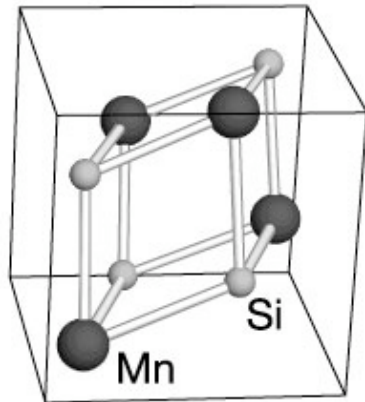
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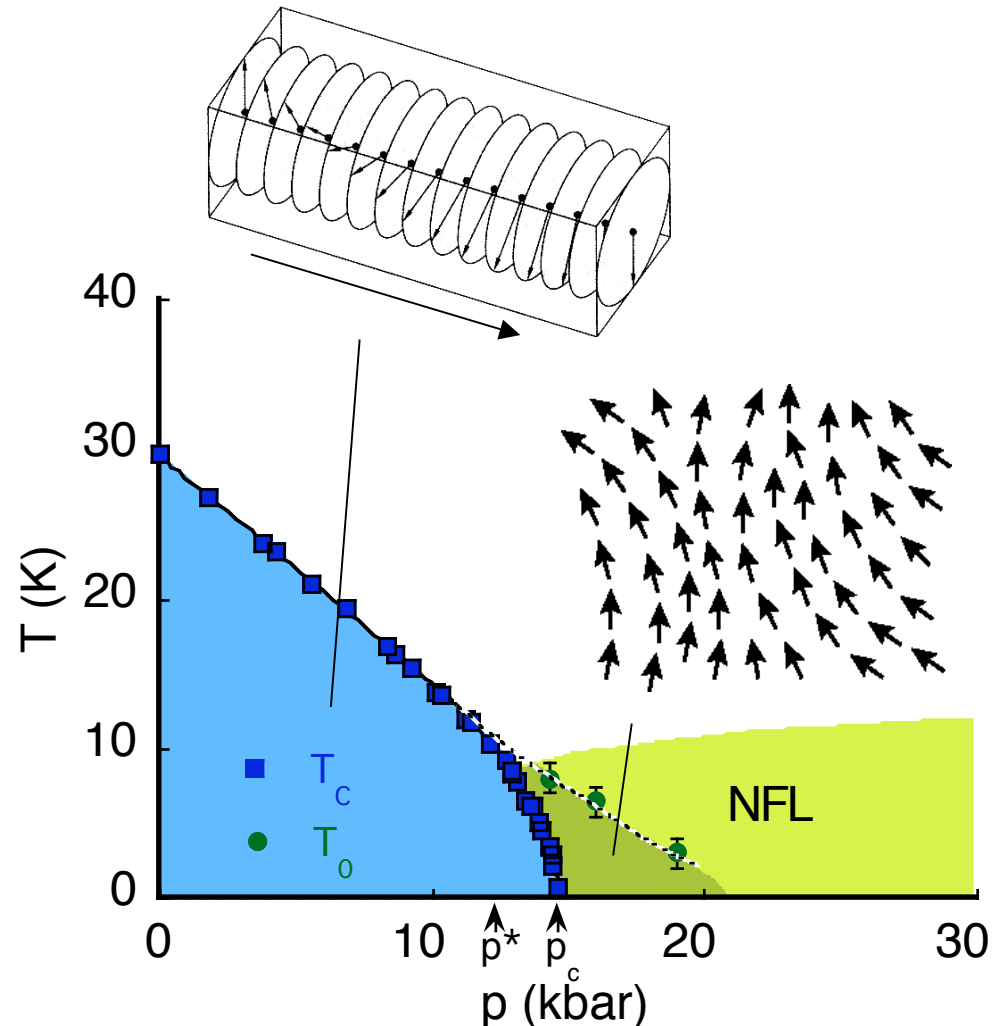


Instead of an introduction to MnSi ...



cubic (B20)
no inversion

- (1) ferromagnetism
- (2) spin-orbit coupling:
Dzyaloshinsky-Moriya
rotation-invariant
 $\lambda \approx 170 \text{ \AA}$ ($a = 4.558 \text{ \AA}$)
- (3) crystal field ($P2_13$):
helix locked at $\langle 111 \rangle$



Is there evidence for a “novel” metallic phase?

MnSi and the Search for Quantum Criticality

„break-through“ for paramagnons:

$$\langle m_\nu^2 \rangle = 4\hbar \int \frac{d^3\mathbf{q}}{(2\pi)^3} \int_0^\infty \frac{d\omega}{2\pi} n(\omega) \text{Im}\chi_\nu(\mathbf{q}, \omega)$$

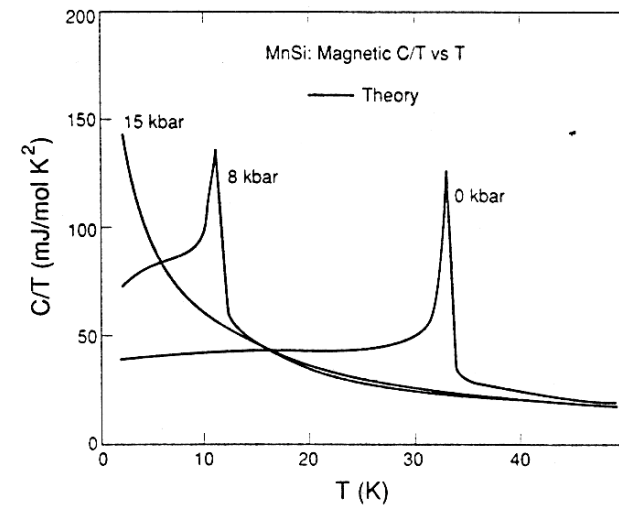
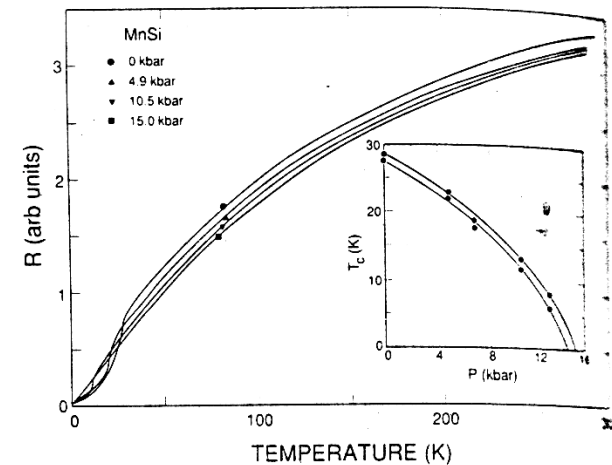
origin of Curie-Weiss susceptibility:
itinerant spin fluctuations

quantitative estimate of T_c

$$T_c = 2.387cM_0^{3/2} \frac{(\hbar\gamma)^{1/4}}{k_B}$$

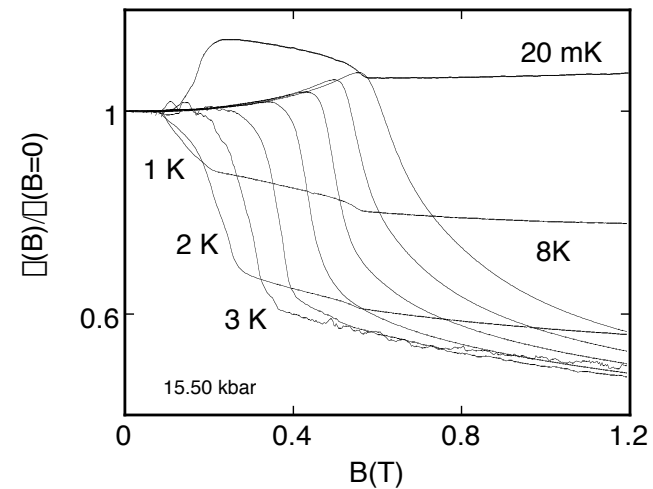
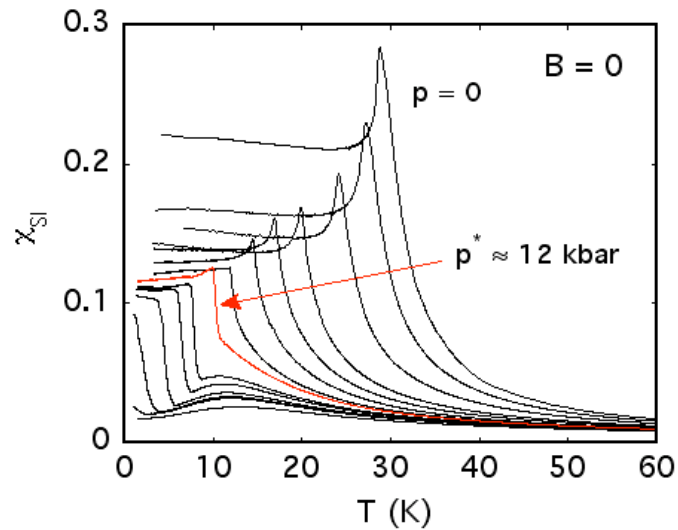
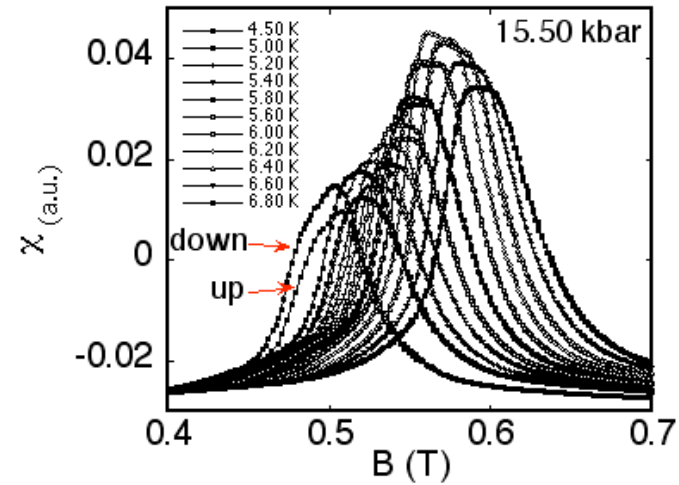
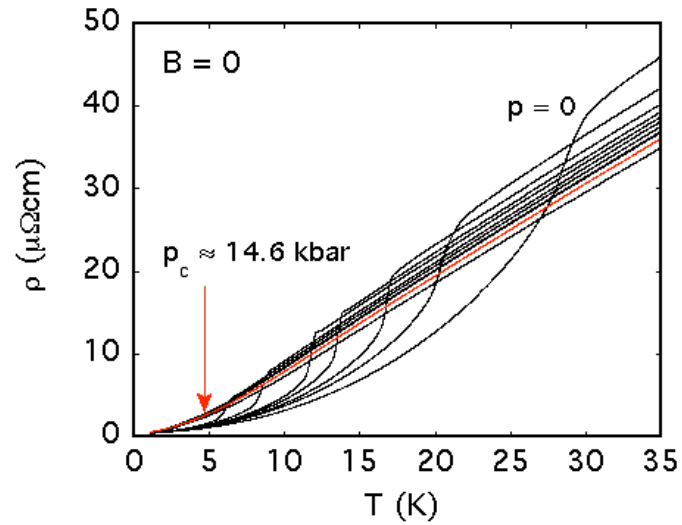
(MnSi expt.: 29.5K, calc.: 31K)

Lonzarich, Moriya,... (1984/85)

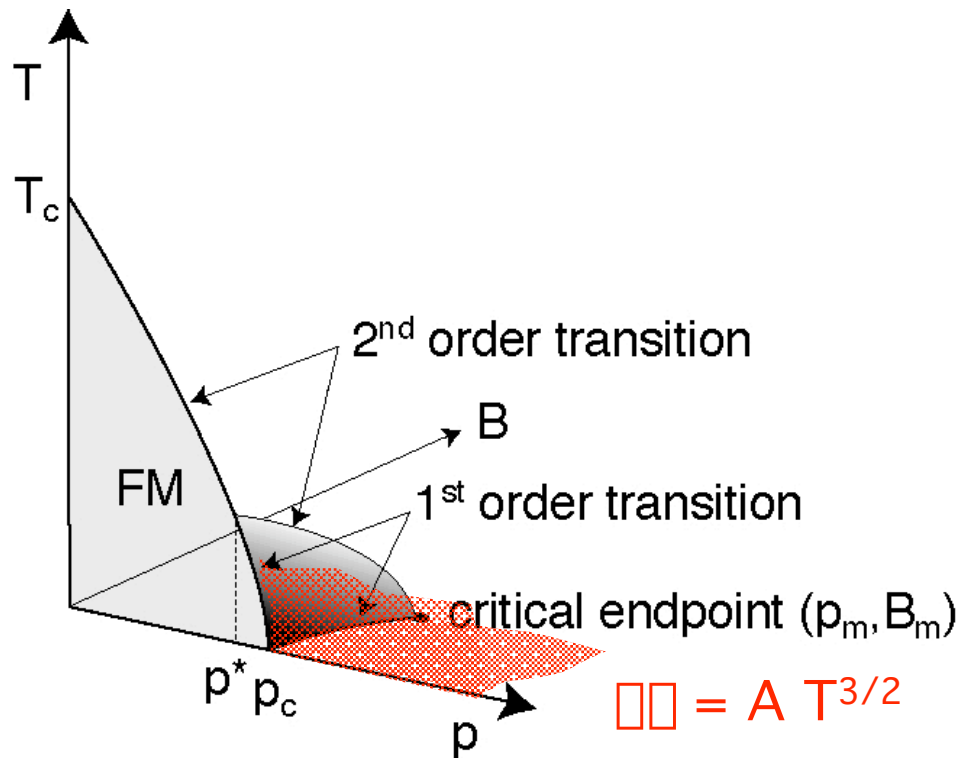


Thompson, Fisk, Lonzarich Physica B 161 (1989) 317

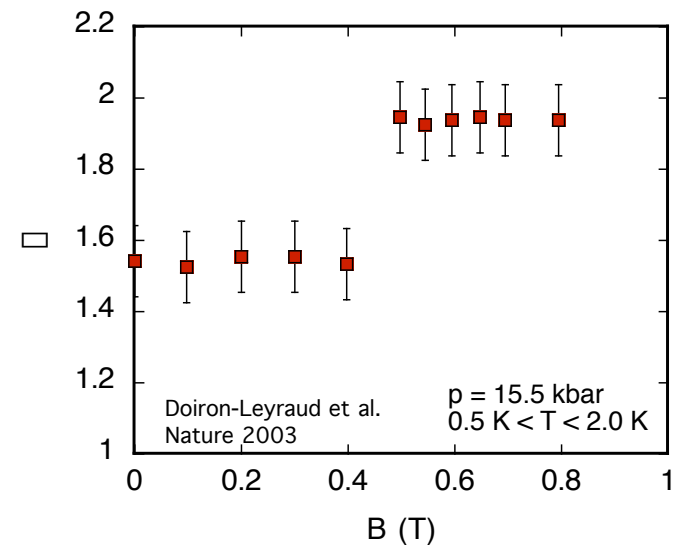
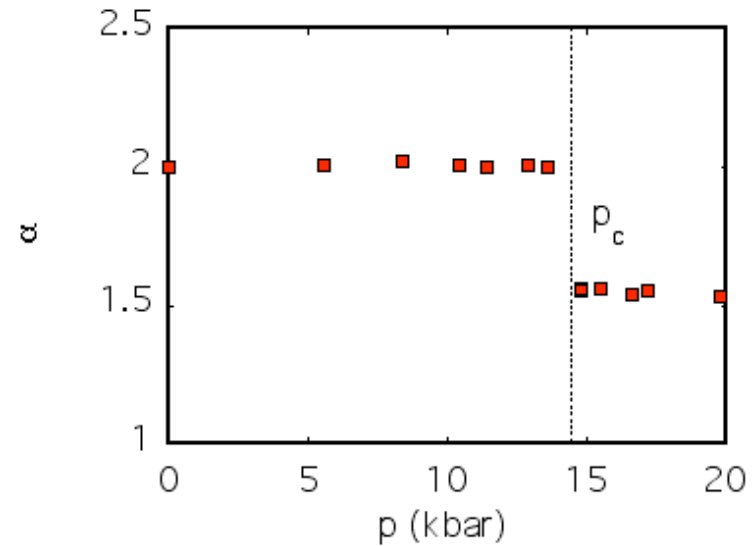
First Order Transition and Metamagnetism in MnSi



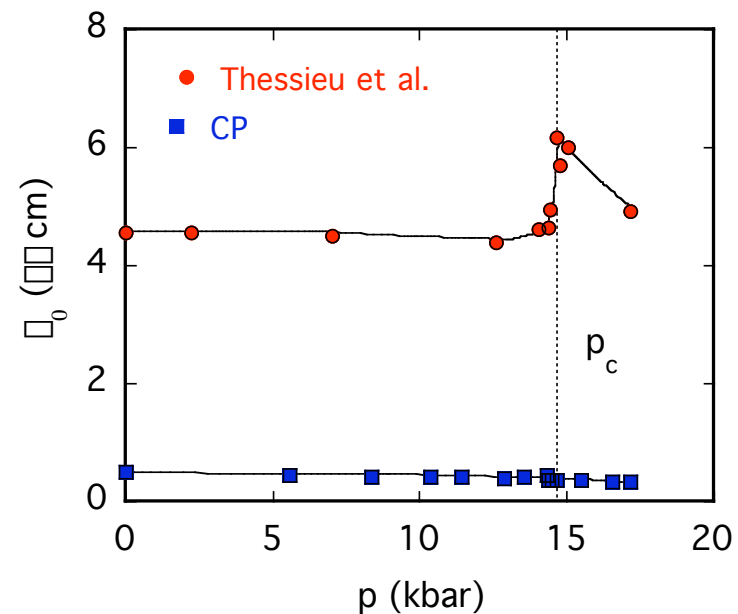
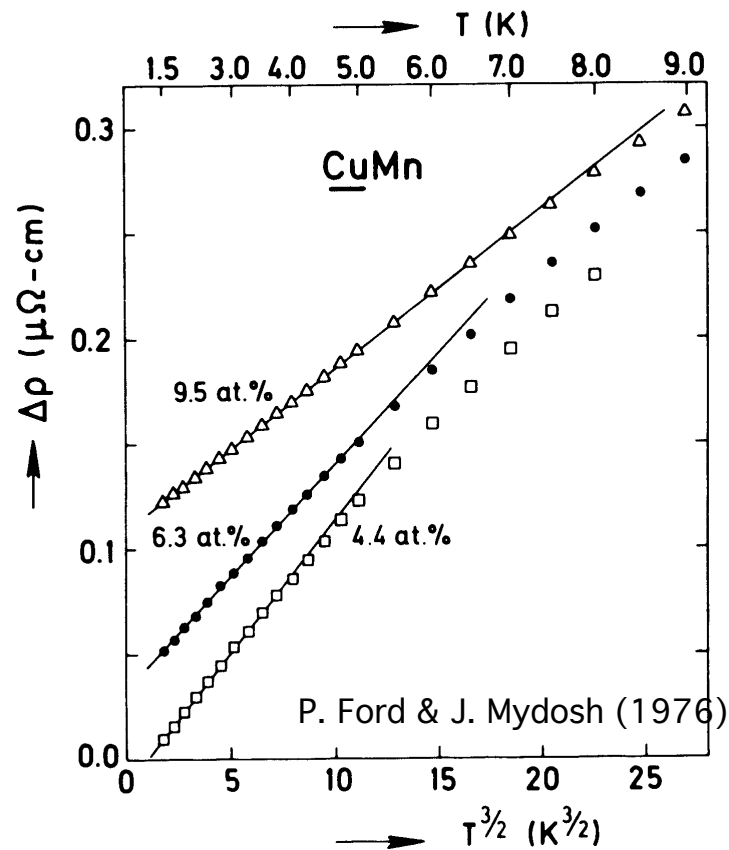
What is special about the resistivity?



$\rho/T^2 = A$ singular für $T \rightarrow 0$
 □ quantum critical
metallic phase (?)

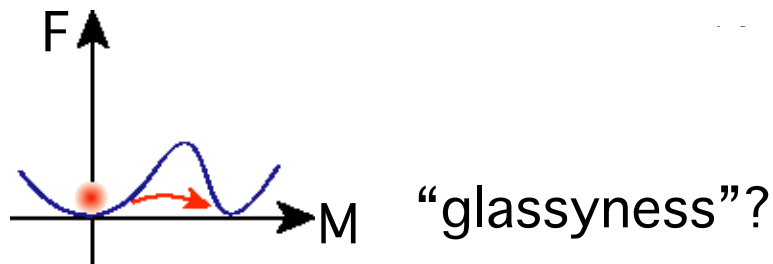


Origin of the $T^{3/2}$ resistivity?



BUT: high purity single crystals

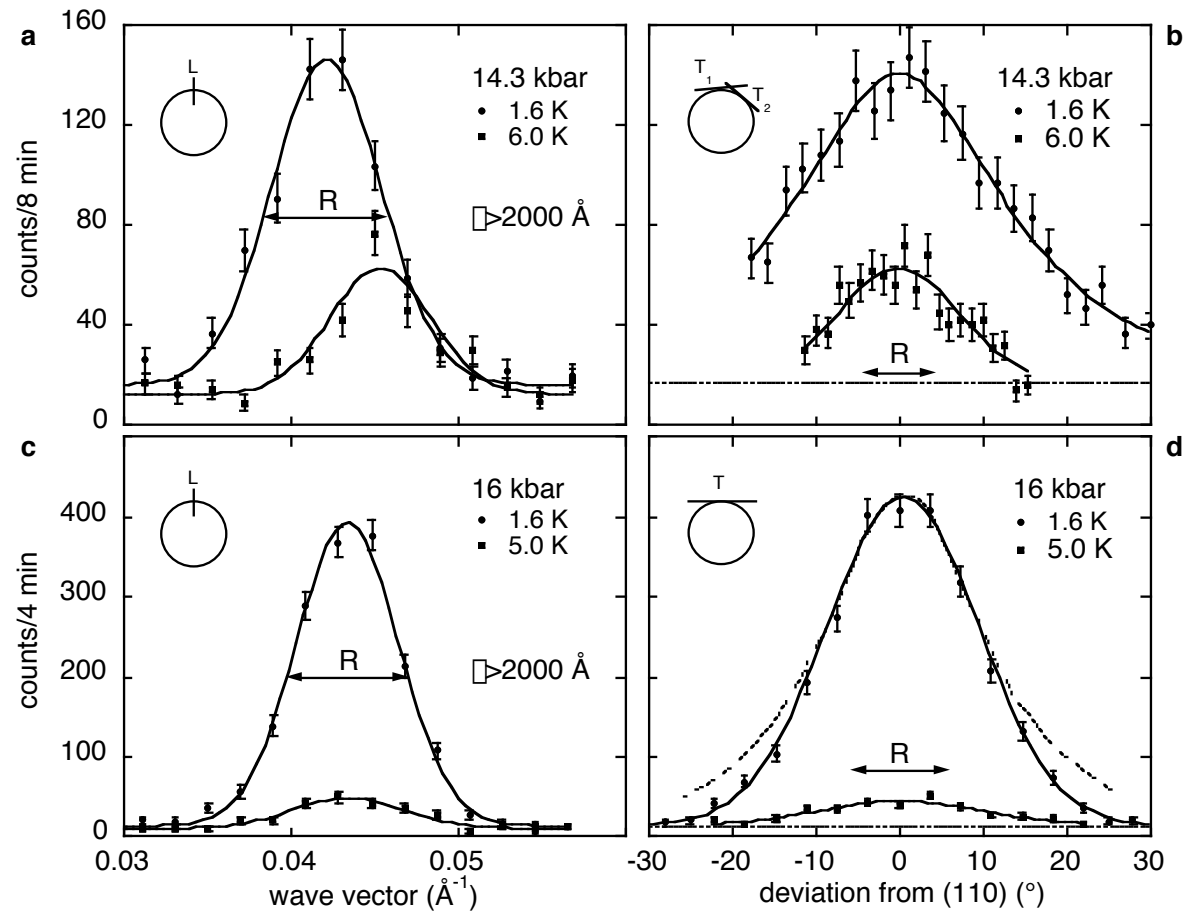
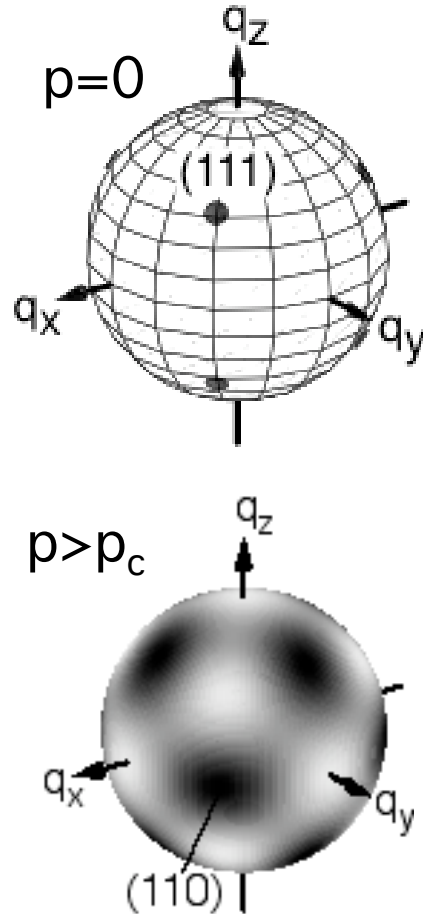
- mean free path $\approx 3000\text{\AA}$!
- structural perfect (cf. Silicon)



Metastable islands?

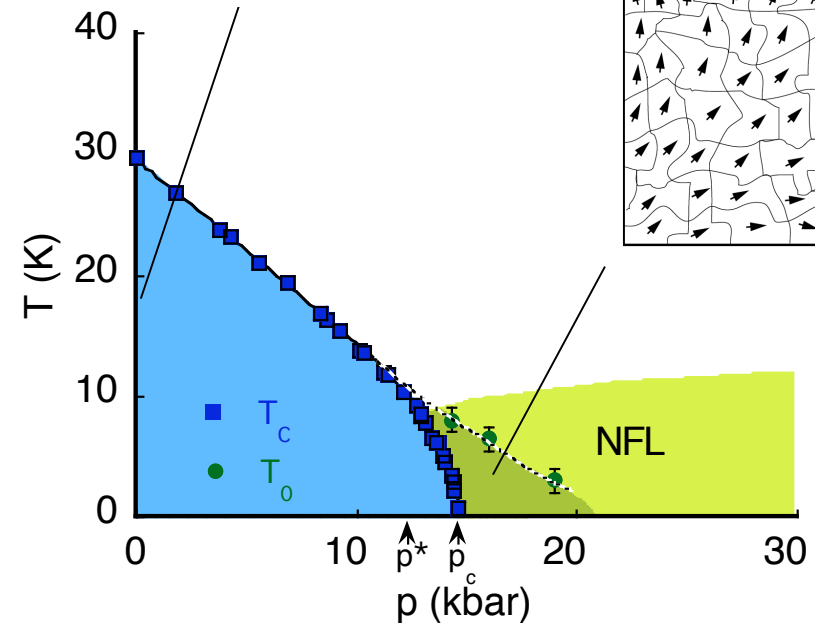
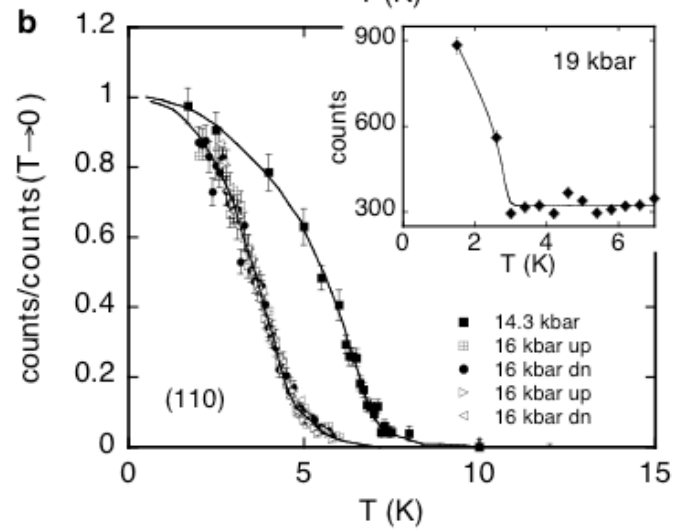
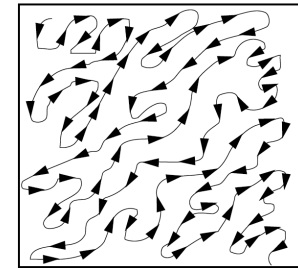
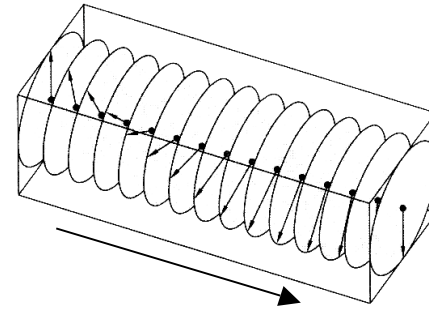
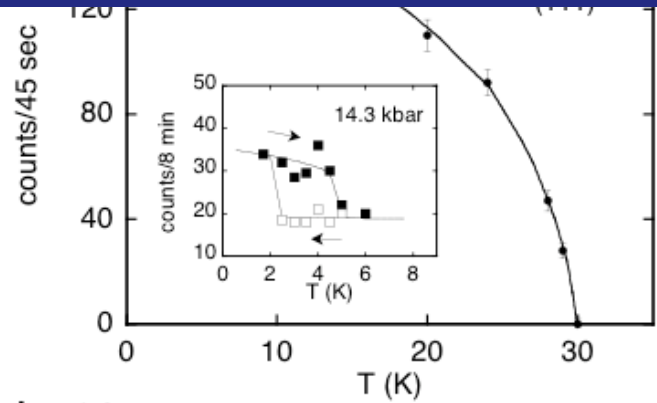
Doiron-Leyraud et al. Nature (2003)

Partial Magnetic Order in the NFL-Phase of MnSi



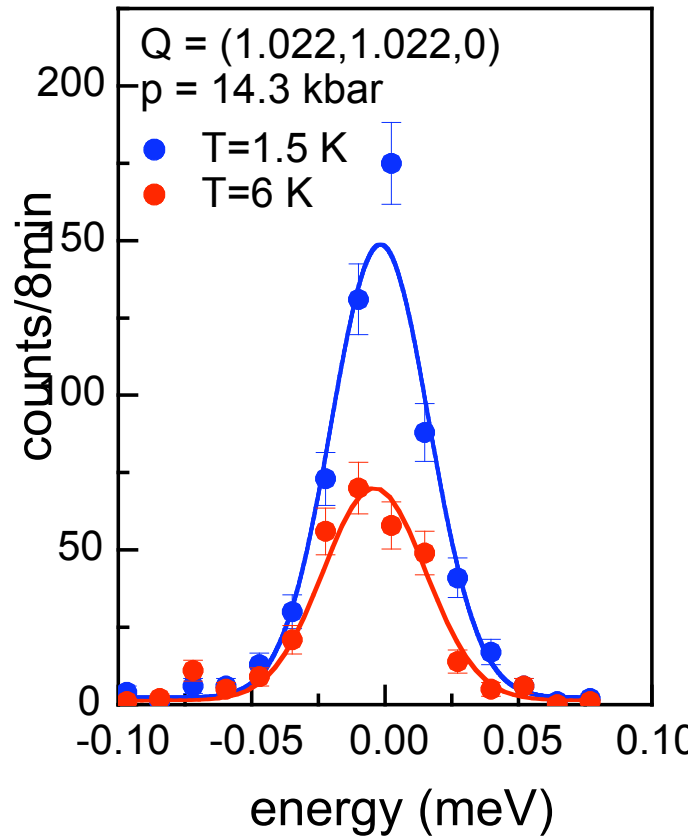
experiments at 4F1 (LLB Saclay)

Temperature Dependence of the Partial Order



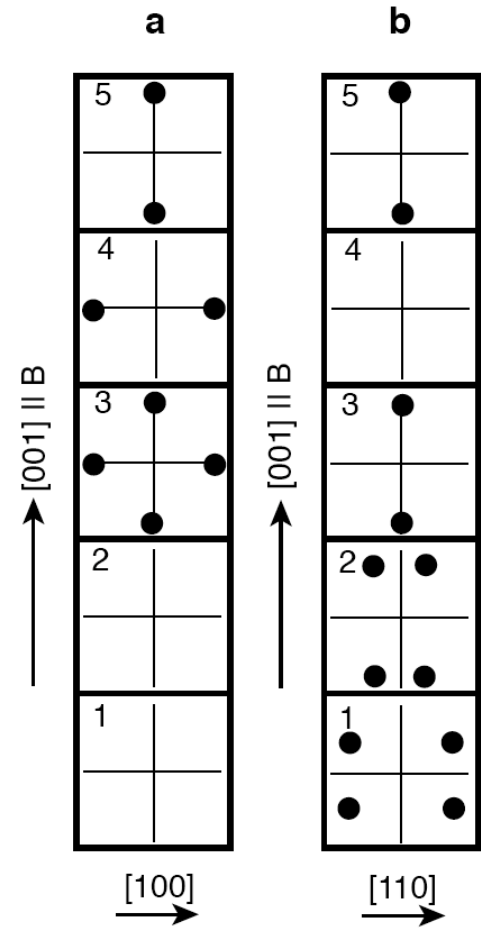
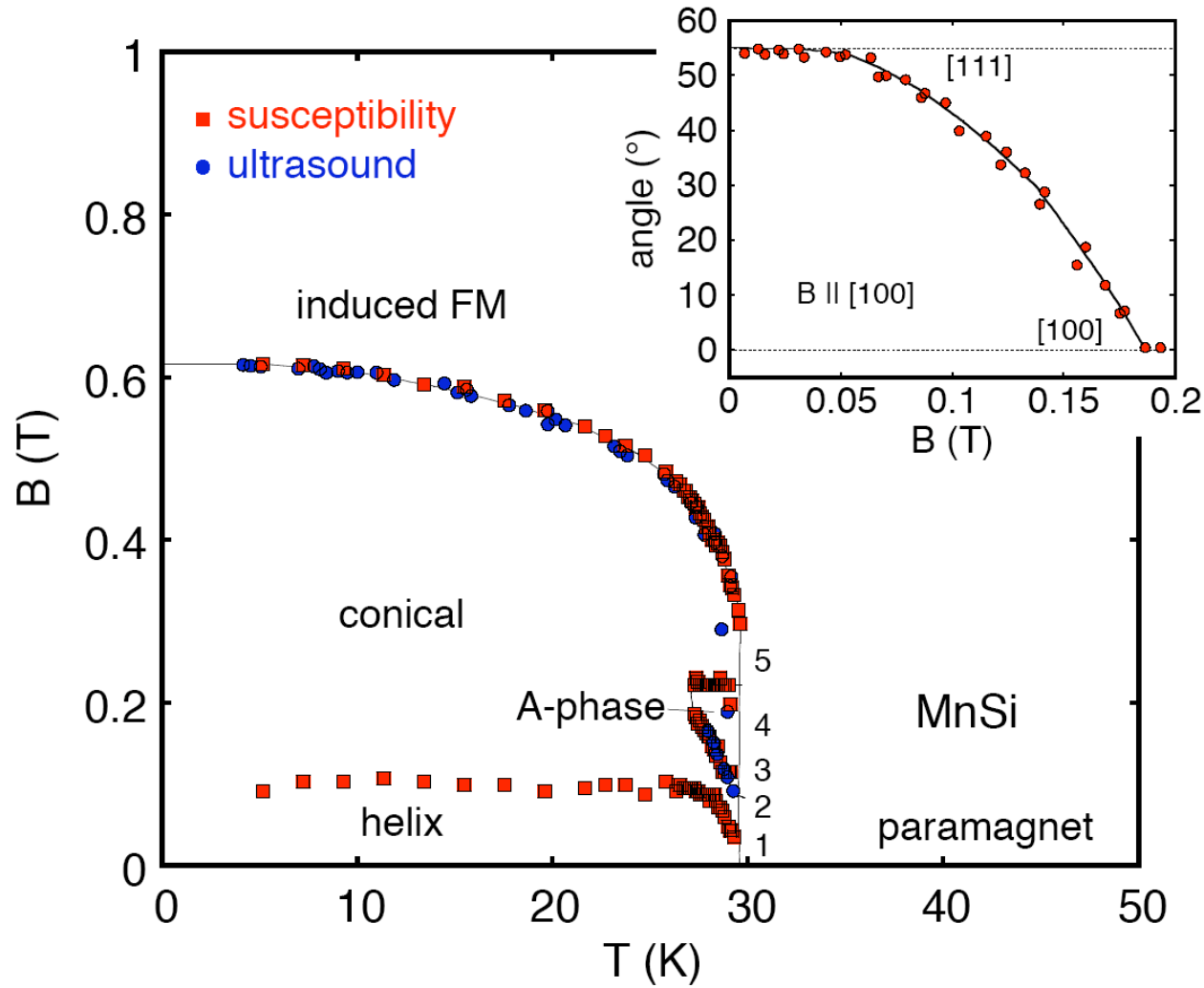
crossover to partial order

Is there an abundance of fluctuations?



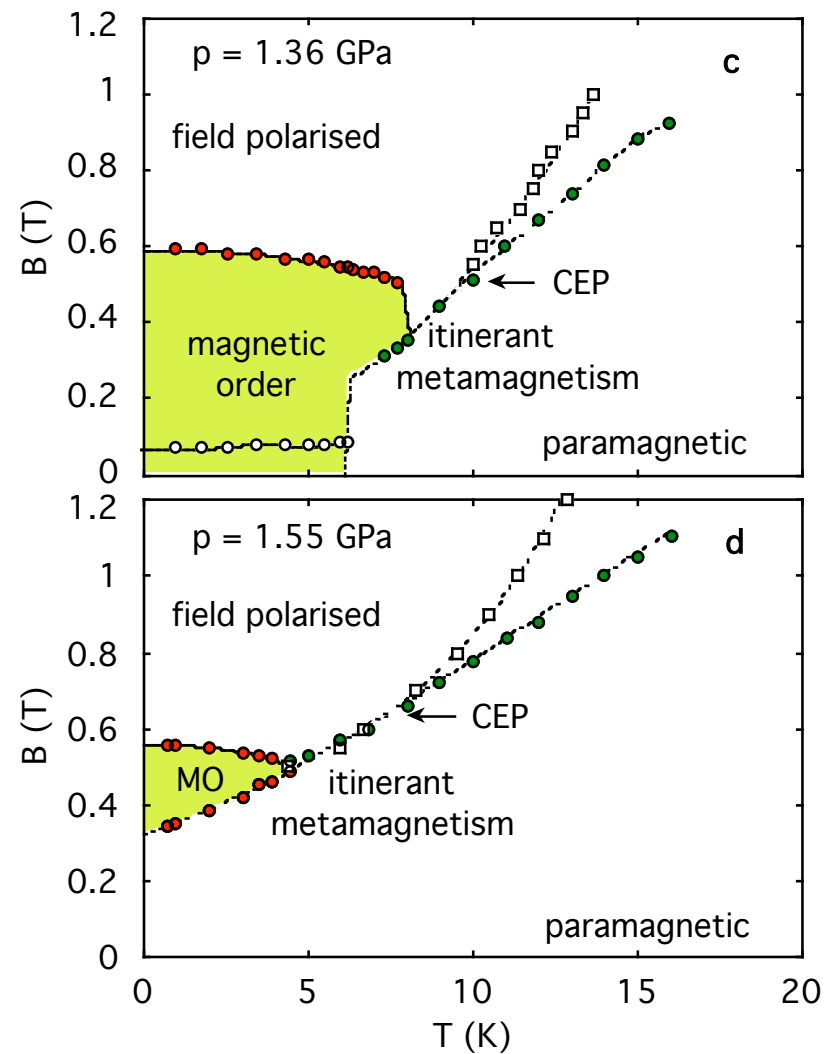
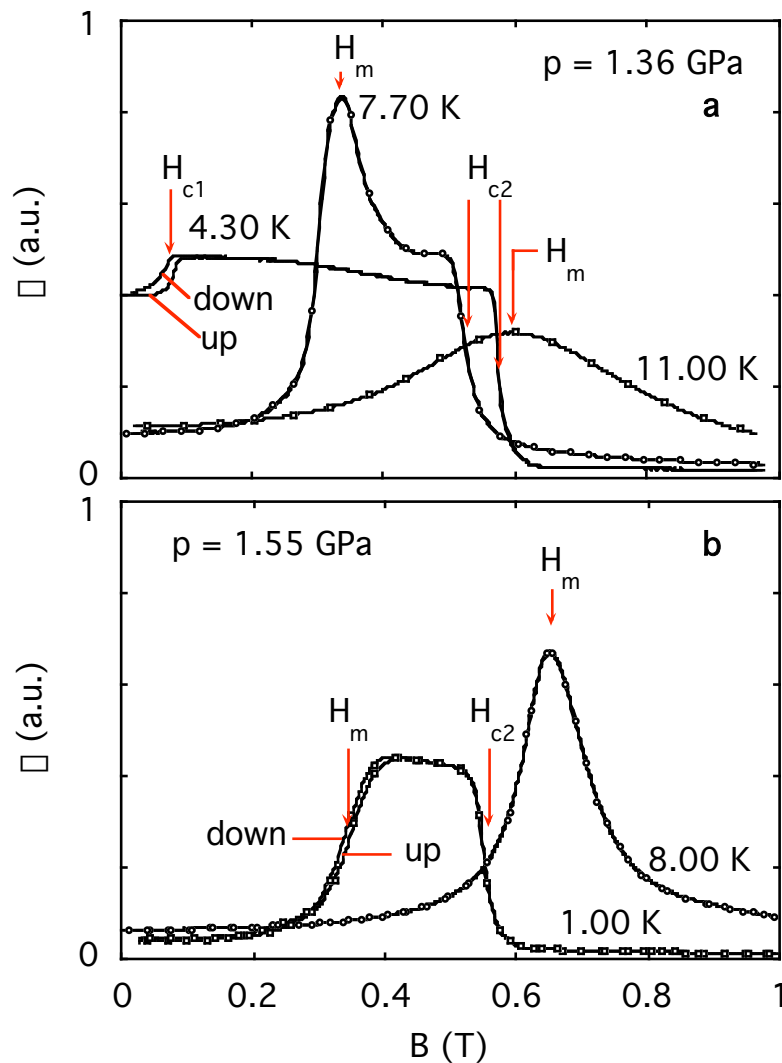
resolution limited:
 $\Delta E \approx 50 \mu\text{eV}$ (0.5K)

Magnetic Phase Diagram at $p=0$

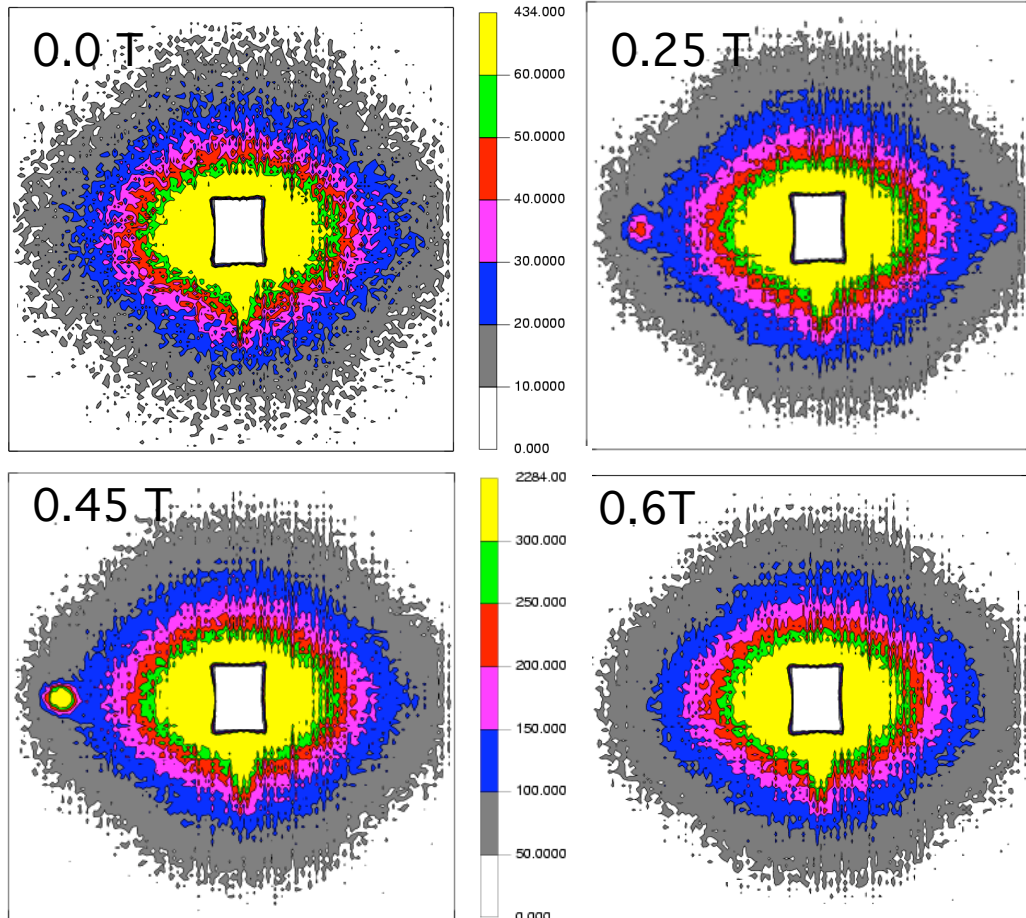


Ishikawa et al. 80'ies
Lebech et al 90'ies

Magnetic Phase Diagram near p_c



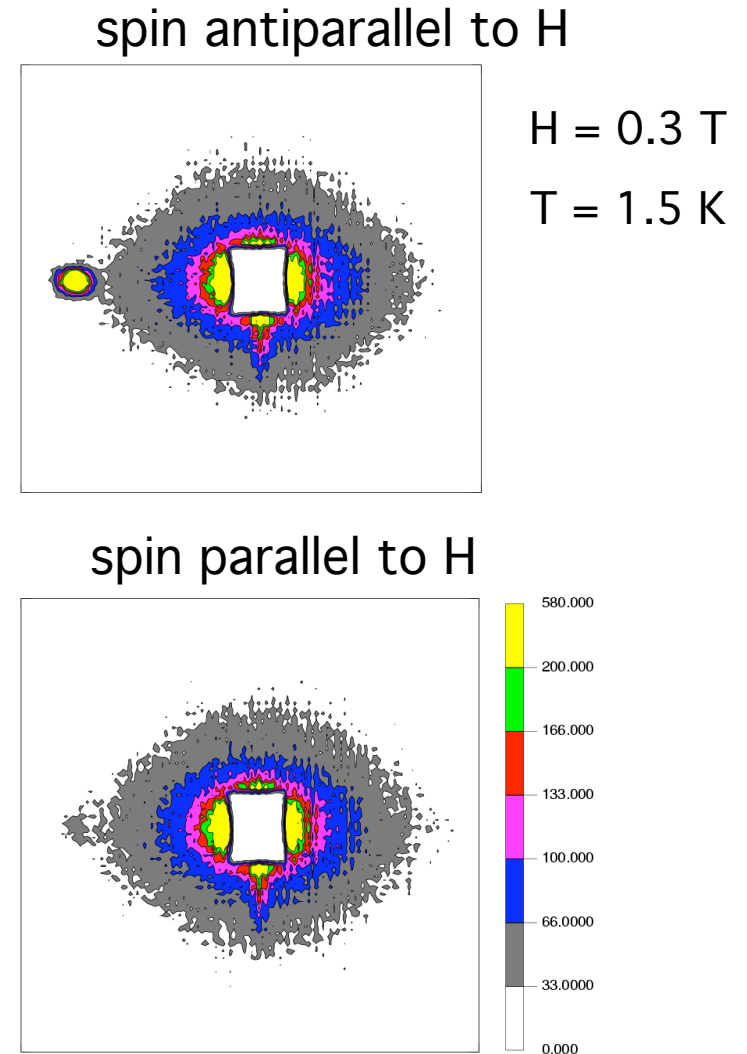
Small Angle Scattering above p_c



$p \approx 18 \text{ kbar} > p_c$

SANS at V4 HMI Berlin

Field induced long-range order



Chirality unchanged

Instead of a summary...

