

Magnetic properties of the HF state in YbRh_2Si_2

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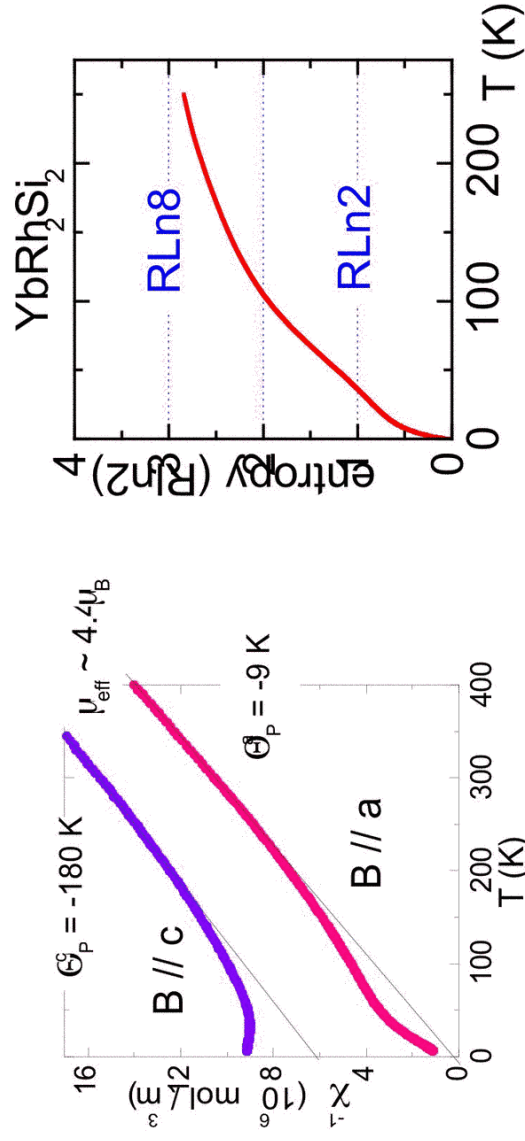
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J. Custers, Y. Tokiwa, T. Radu, J. Ferstl, G. Sparn, C. Geibel, F. Steglich

YbRh_2Si_2 unique because QC fluctuations have strong FM component:

- Divergence of bulk susceptibility in approach of QCP
- Strongly enhanced SW ratio, A/χ_0^2 scaling
- Absence of metamagnetism at field-induced 4f-localization

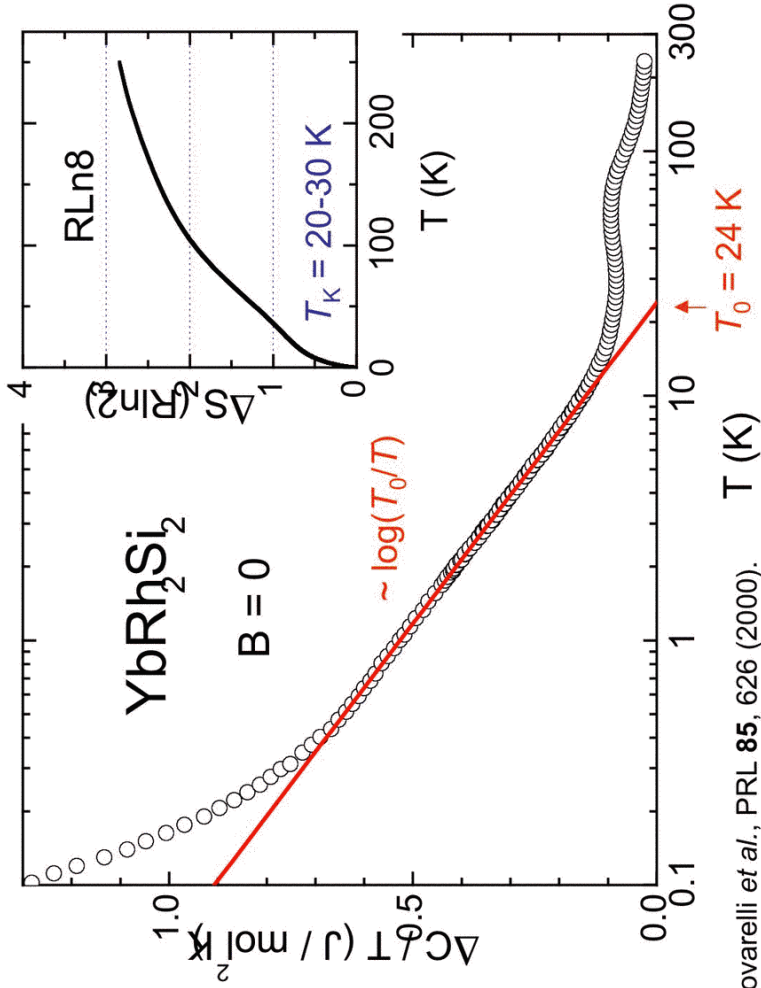
Different energy scales: CEF splitting



→ **doublet ground-state**, well separated from excited levels

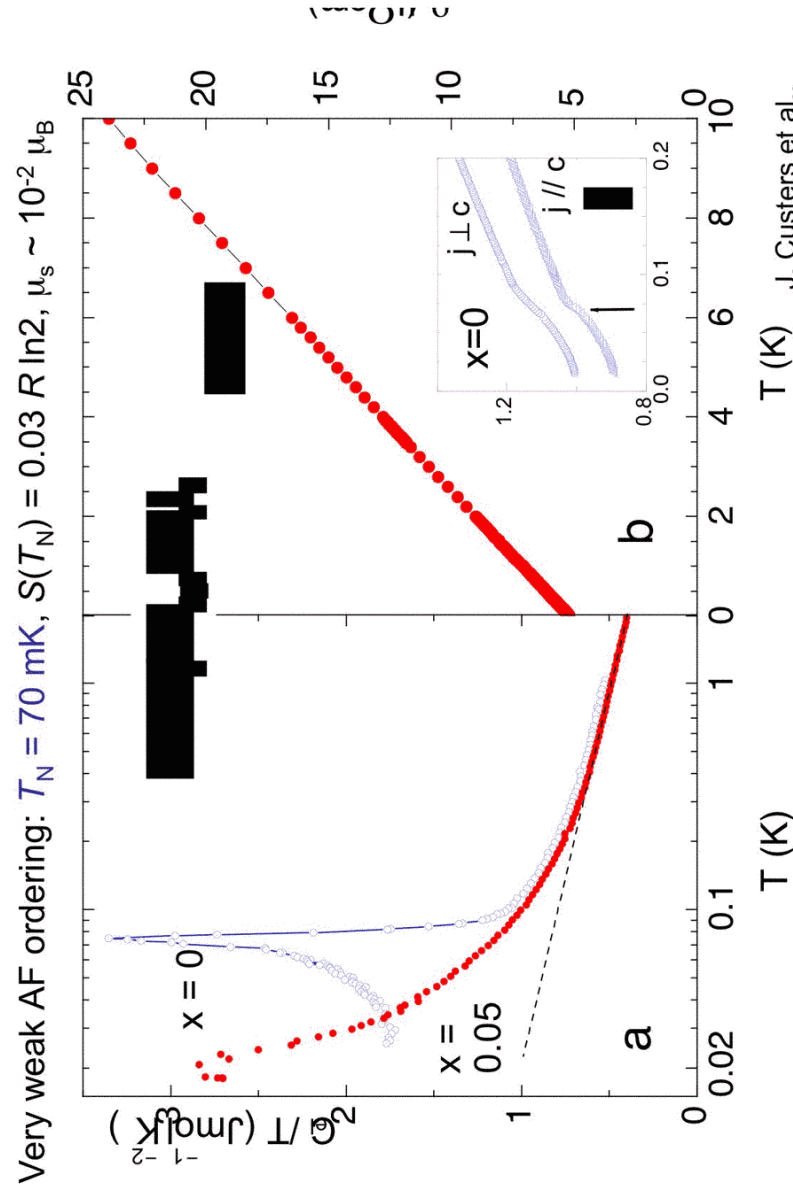
O. Trovarelli et al., PRL **85**, 626 (2000).

Different energy scales: Kondo Temperature



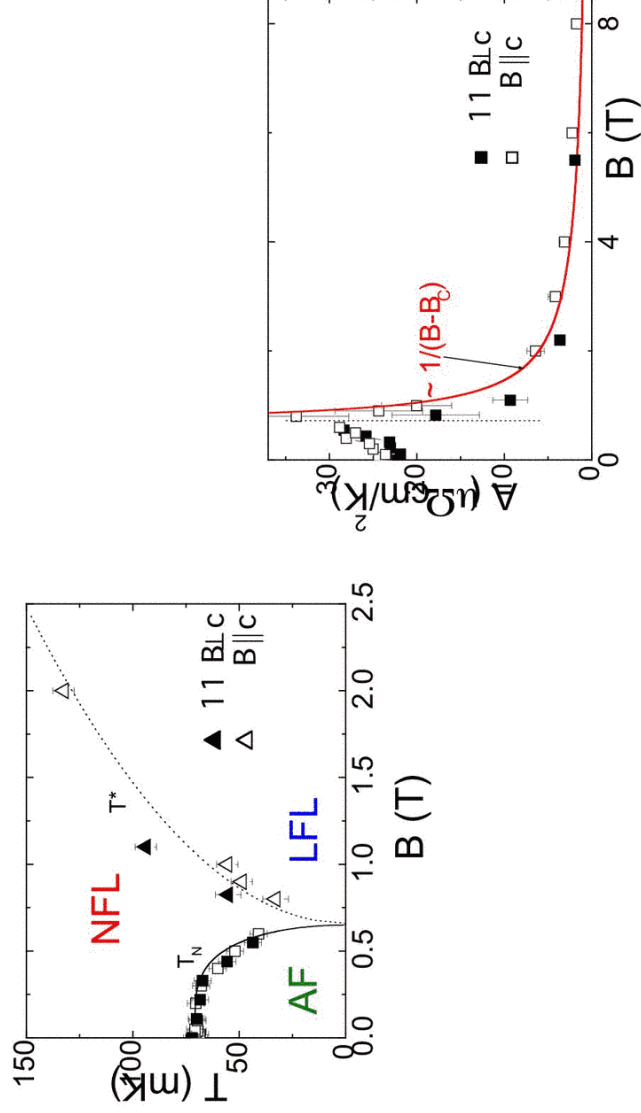
O. Trovarelli et al., PRL **85**, 626 (2000).

Different energy scales: T_N



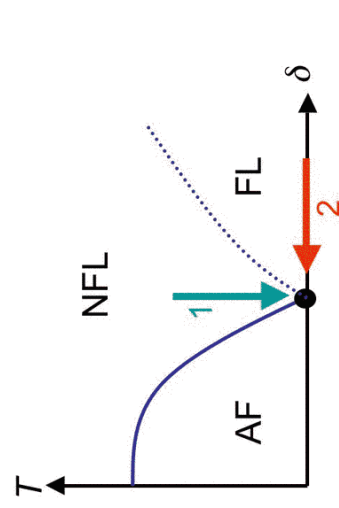
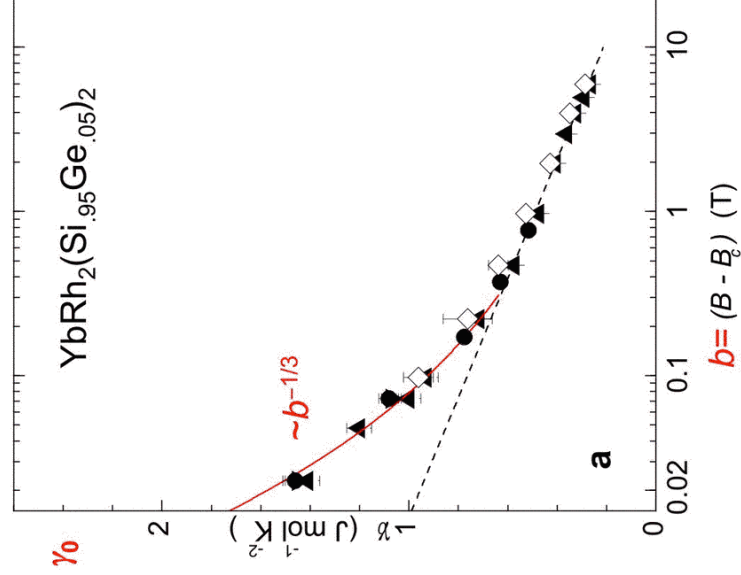
J. Custers et al.,
Nature **424**, 524 (2003)

Field-induced quantum critical point



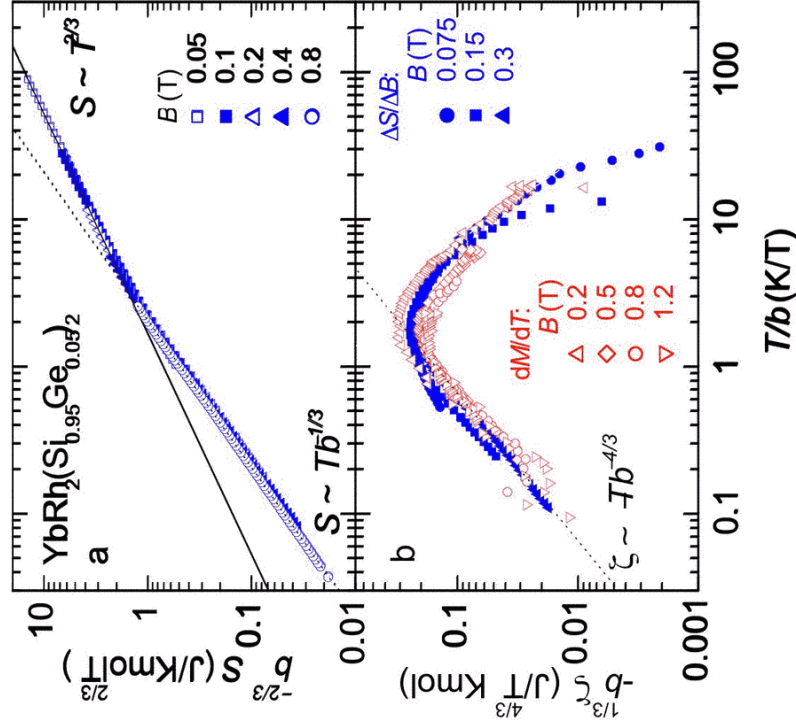
P. Gegenwart *et al.*, PRL **89**, 056402 (2002).

Stronger than logarithmic mass divergence



- similar divergence in C/T
- T or b , respectively, define energy scale

Temperature over magnetic field scaling



Magnetic entropy

Comparison with M_{DC}

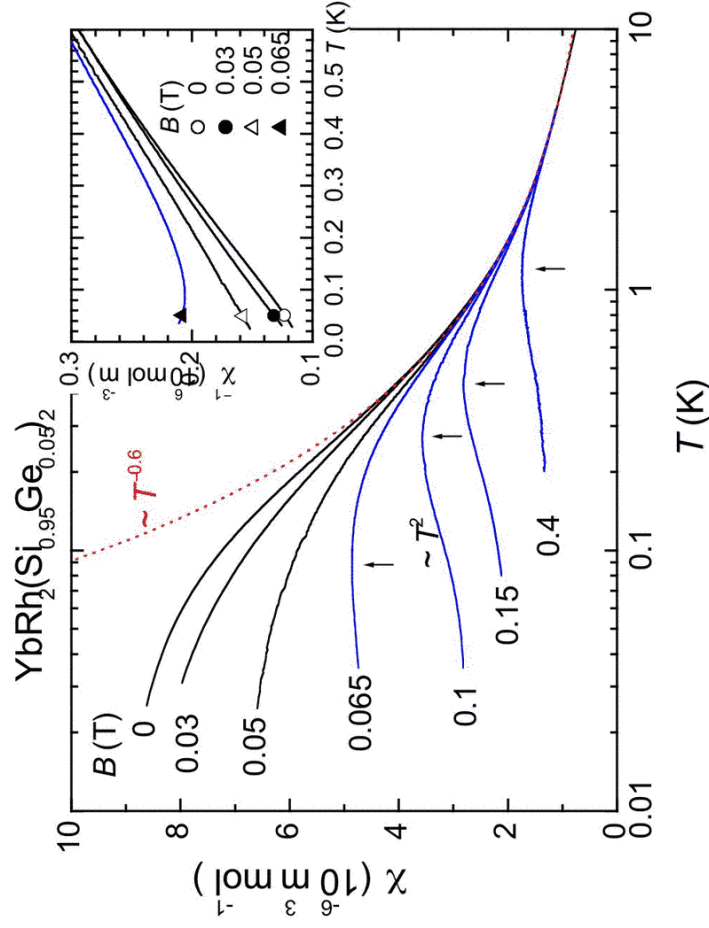
$$\alpha = \frac{\partial^2 F}{\partial T \partial B} = \frac{\partial S}{\partial B} = \frac{\partial M}{\partial T}$$

↑ Thermal and magnetic properties consistent

$$\div = \div_0(b) + T^2 b^{-7/3}$$

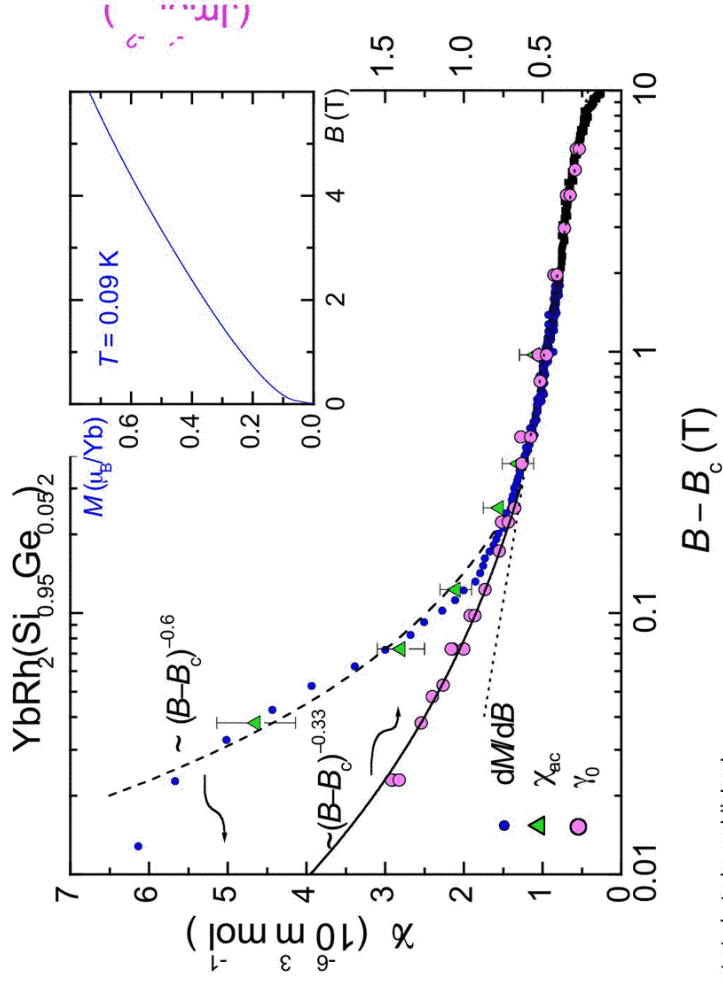
P. Gegenwart, et al., cond-mat/0406260

AC-susceptibility



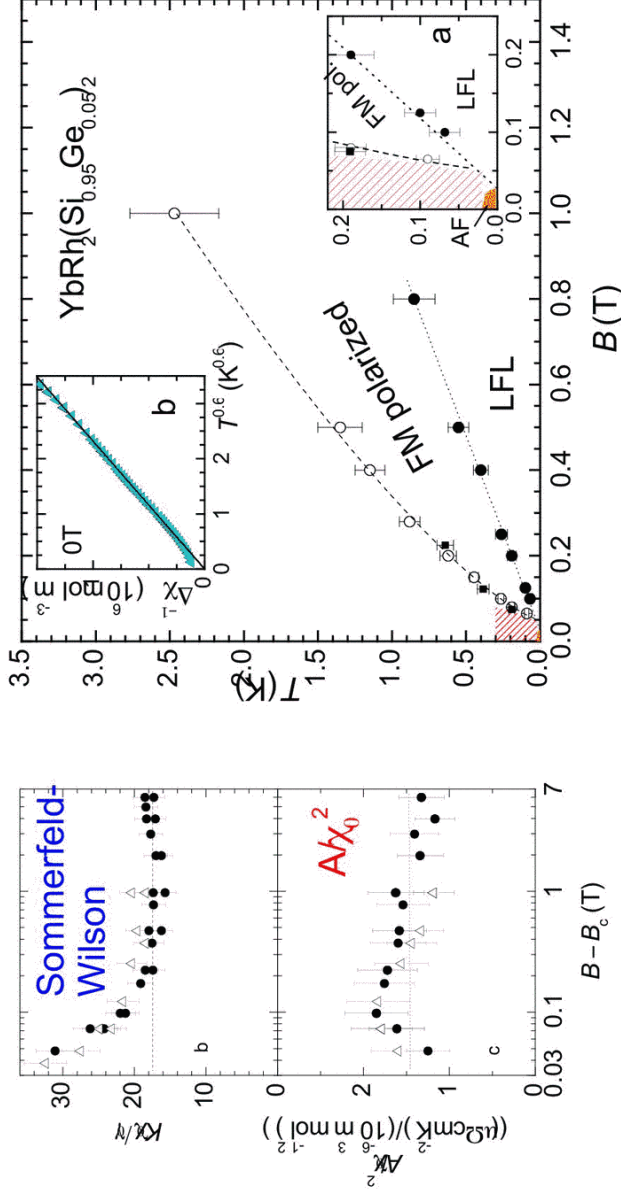
P. Gegenwart et al., to be published

Pauli-susceptibility



P. Gegenwart et al., to be published

Ferromagnetic quantum critical fluctuations

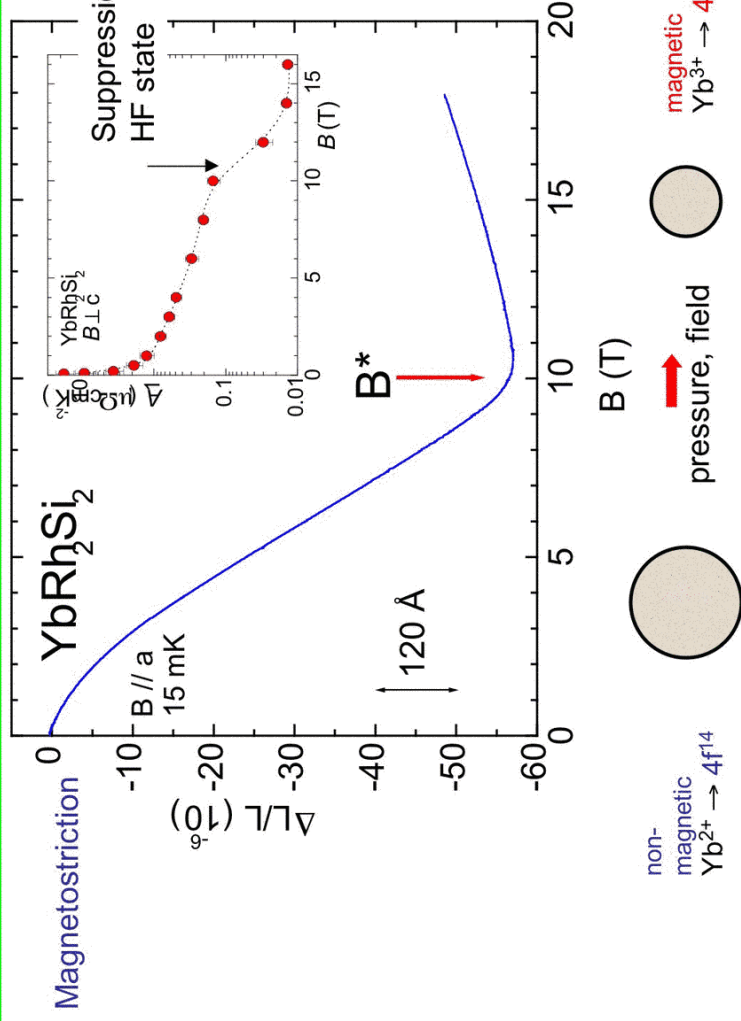


CeCu_{5.9}Au_{0.1}: $\Theta(q=Q)=0, \Theta(0)<0$

YbRh₂Si₂: $\Theta(q=0)=0!$

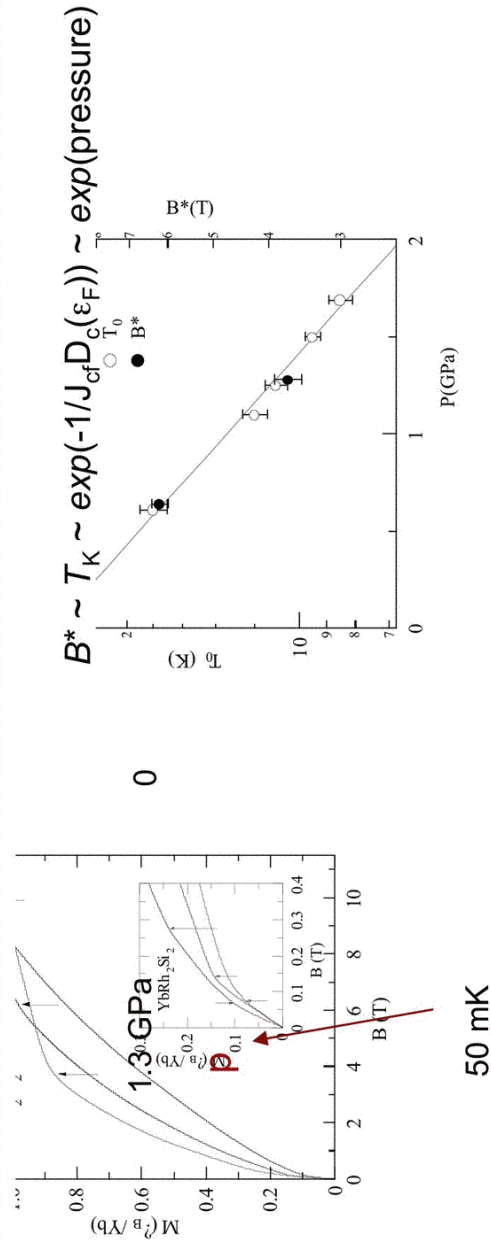
$$\chi^{-1}(q, \omega) = \frac{(T^\alpha + (-\Theta(q))^\alpha)}{C}$$

Field-induced 4f-localization



Y. Tokiwa, P. Gegenwart, F. Weickert, R. KÜchler, J. Custers, J. Ferstl, C. Geibel, and F. Steglich
 J. Magn. Magn. Mat. 272-276 (2004) e87.

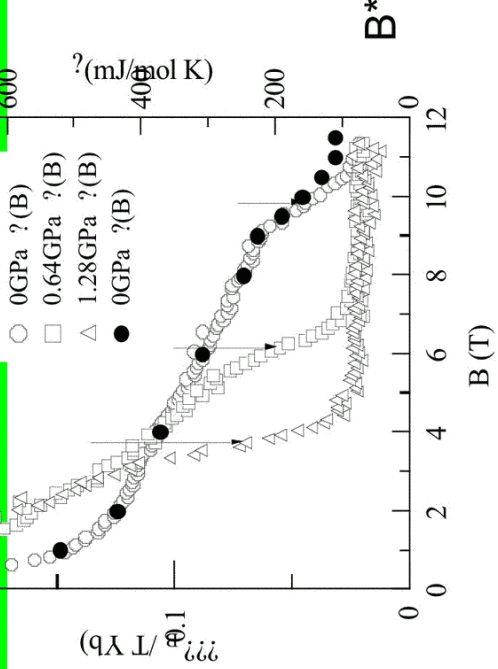
Pressure dependence of B^*



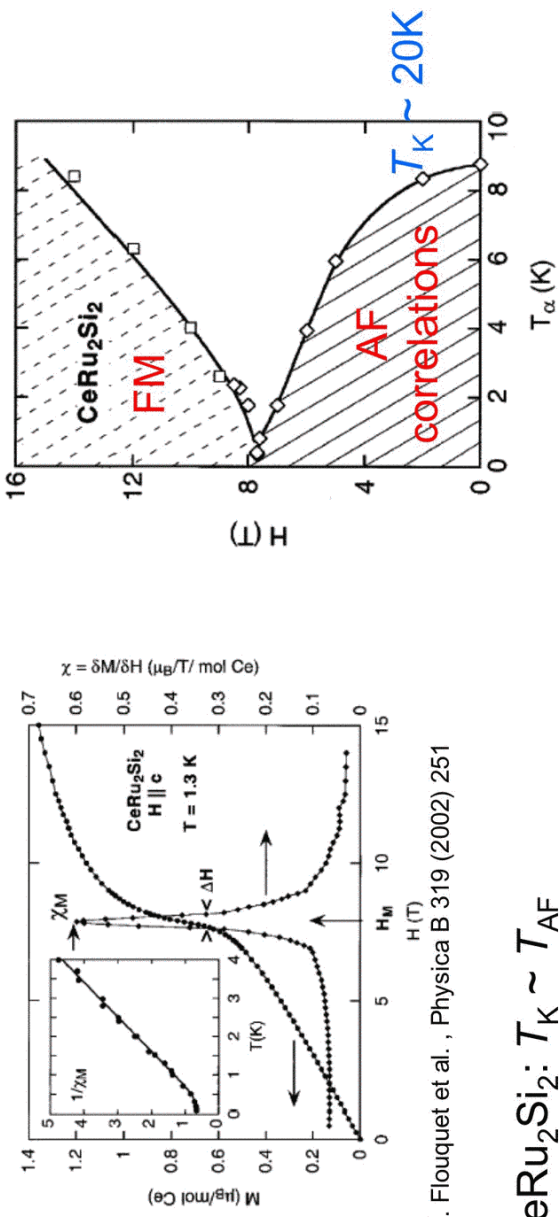
Y. Tokiwa et al., to be published.

$$\frac{\partial B^*}{\partial \ln p} = -130$$

Absence of metamagnetism at B*



Comparison to other HF systems



J. Flouquet et al., Physica B 319 (2002) 251

- CeRu₂Si₂: $T_K \sim T_{AF}$
- Sharp metamagnetic transition
- YbRh₂Si₂: $T_K \gg T_{AF}$
- AF correlations much faster suppressed than Kondo effect
- No metamagnetic transition!

Conclusion

QC fluctuations have a very strong FM component:

- Divergence of susceptibility
- Enhanced SW ratio, A/χ_0^2 scaling
- Absence of metamagnetism at field-induced 4f-localization

