Magnetoelastic properties of High spin value compounds

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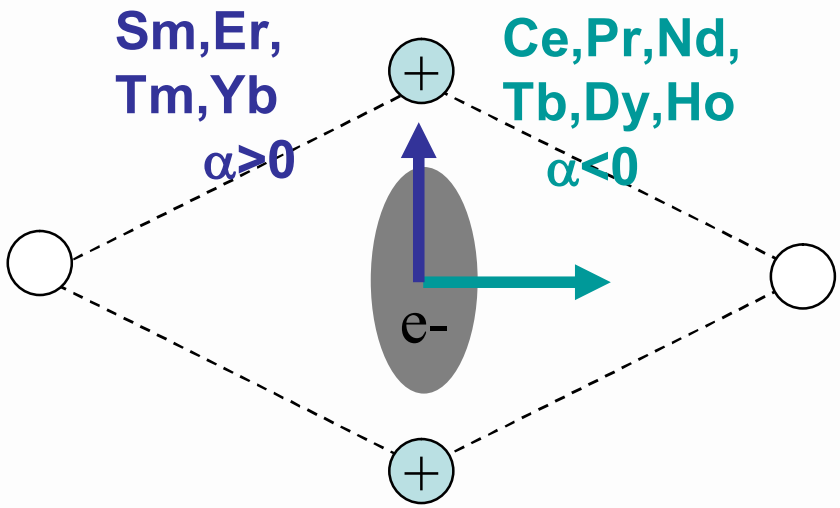
Gd^{3+}, S=7/2, L=0

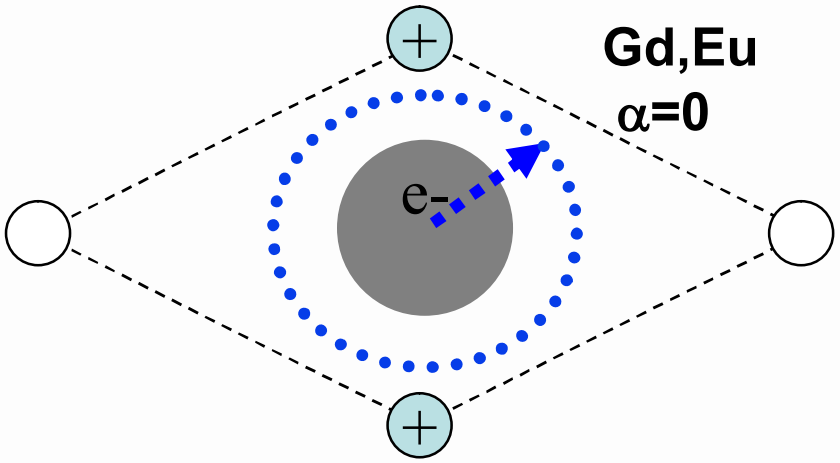
Crystal Field Effects



L≠0

Distortion of 4f – Charge Density

No Crystal Field Effects



L=0

Spherical 4f-Charge Density

$$H = \sum_{lm,i} B_l^m O_l^m(\mathbf{J}_i) - \sum_i g_i \mu_B \mathbf{J}_i \mathbf{H} - \frac{1}{2} \sum_{ij} \mathbf{J}_i J(ij) \mathbf{J}_j$$

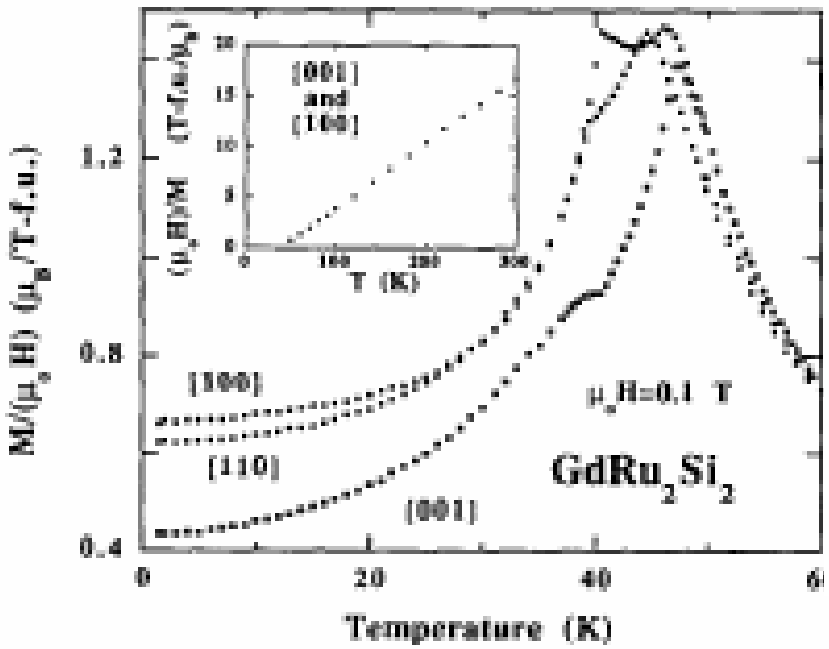
direct (dipolar)

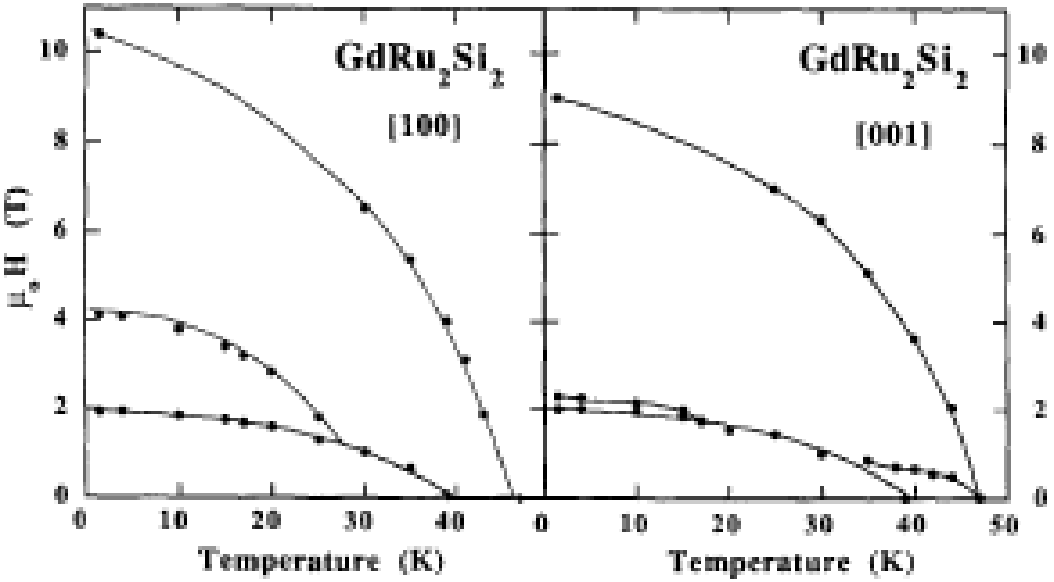
indirect (RKKY)

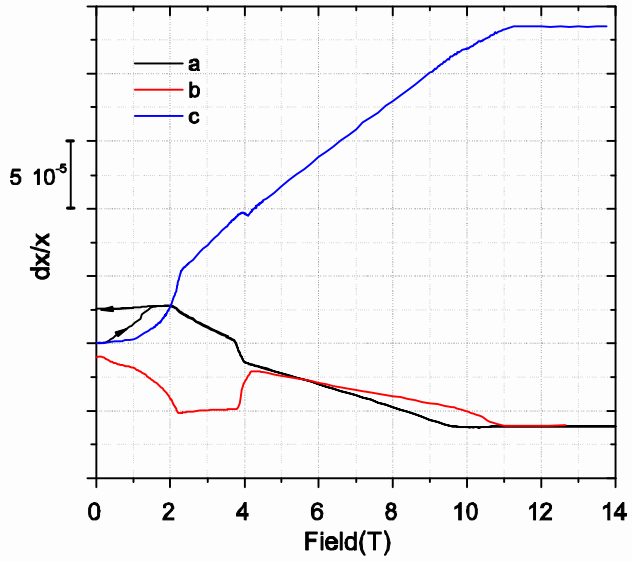
Studied compounds

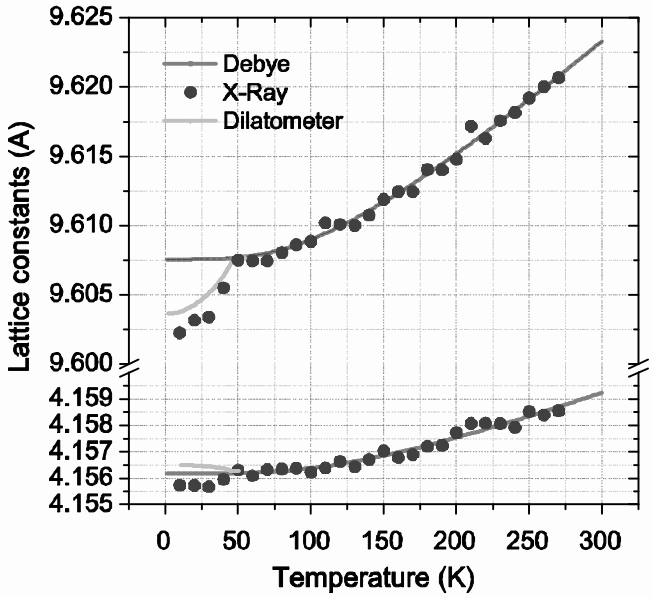
Substance/Formula	Neutron Exp.	Other Exp.	Magnetic structure	Additional notes
$GdCu_6$	7C2		(0.222 0 0) col. ab plane.	
GdCuSn	D4		-	
$GdRu_2Ge_2$	7C2	MP, MS, CP	(0.1429 0.4 0.5) AM ab plane.	
$GdRu_2Si_2$	7C2,D9	MXR, TE, MS, CP	(0.222 0 0) spiral bc plane.	Num. sim. avaliable
Gd_5Ge_3	D9,D4	MS, TE, CP	(0.31-35 0 0)	
GdSi	D9	MP, TE	(0.1 0.5 0)	
$GdPt_3Si$	D4		-	
Gd_2PdSi_3	D4	MXR, MP	(0.143 0.143 0)	Nuclear superstruct.

$GdRu_2Si_2$

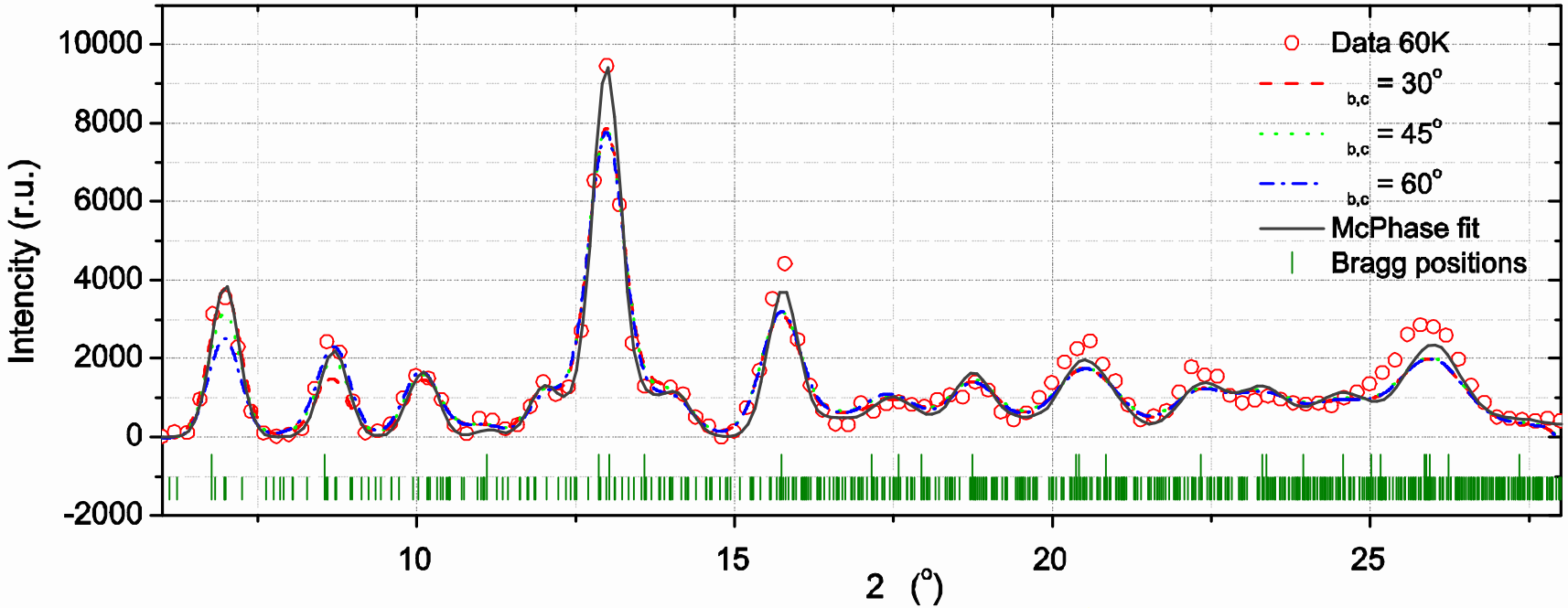

[001] and [100]
T (K)
[100]
[110]
[001]
μ_0H=0.1 T
$GdRu_2Si_2$
Temperature (K)

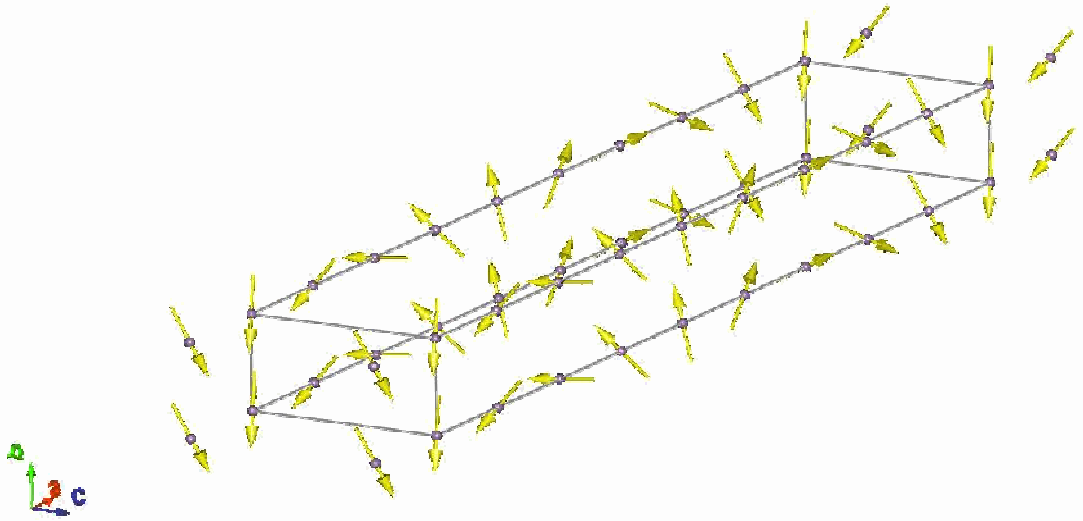

$GdRu_2Si_2$
[100]
$GdRu_2Si_2$
[001]
μ_0H (T)
Temperature (K)
Temperature (K)


a
b
c
5 10^{-5}
dx/x
Field(T)

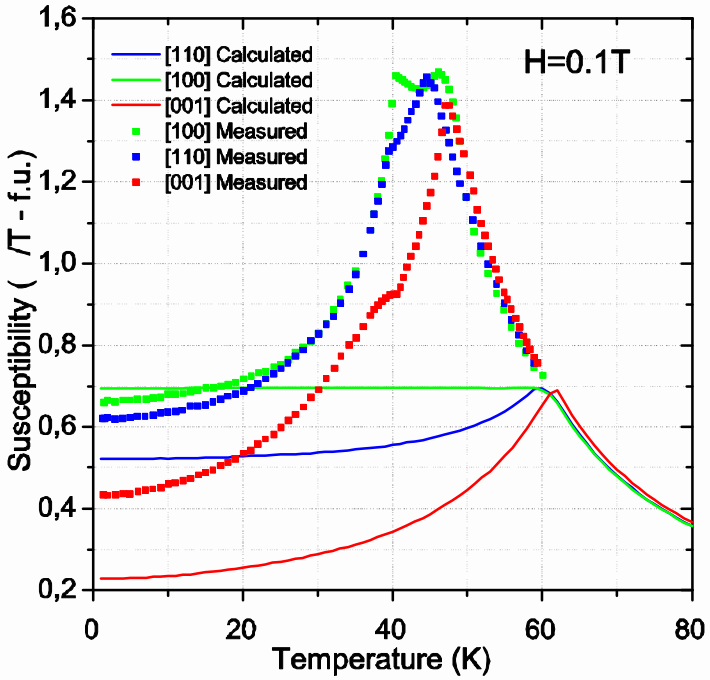

Debye
X-Ray
Dilatometer
Lattice constants (A)
Temperature (K)

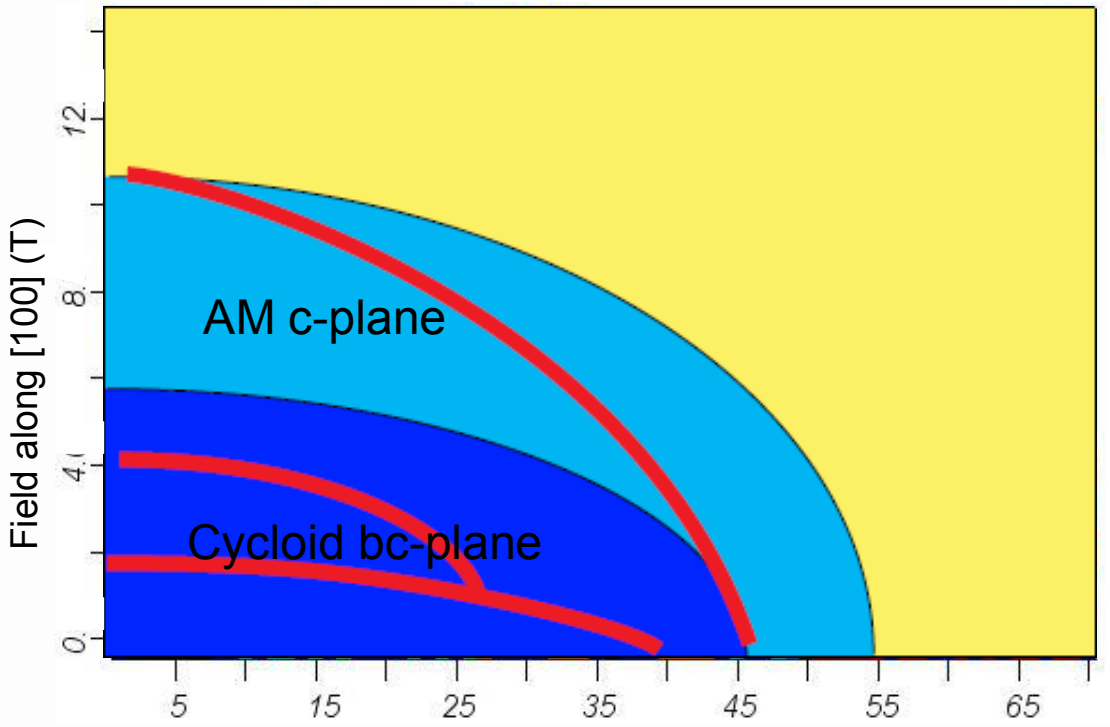
$GdRu_2Si_2$


Intencity (r.u.)
10000
8000
6000
4000
2000
0
-2000
10
15
20
25
2 (°)
Data 60K
b,c = 30°
b,c = 45°
b,c = 60°
McPhase fit
Bragg positions


a
c

$GdRu_2Si_2$





$$\mathcal{H} = -\frac{1}{2}\sum_{ij} J_i^{\alpha}\mathcal{J}_{\alpha\beta}(ij)J_j^{\beta}$$

RKKY

$$\mathcal{J}_{\alpha\beta}(\boldsymbol{\tau}) = \sum_j \mathcal{J}_{\alpha\beta}(ij)e^{-i\boldsymbol{\tau}(\mathbf{R}_i-\mathbf{R}_j)}$$

dominant

Dipolar interaction

$$\mathcal{J}_{\alpha\beta}(ij) = (g_J\mu_B)^2\frac{3(R_i^{\alpha}-R_j^{\alpha})(R_i^{\beta}-R_j^{\beta})-\delta_{\alpha\beta}|\mathbf{R}_i-\mathbf{R}_j|^2}{|\mathbf{R}_i-\mathbf{R}_j|^5}$$

about 0.1% of RKKY

To Do:

- Introduce non diagonal exchange as a source of anisotropy
- Domain imaging with magnetic X-Ray.
- Further data analysis and numerical simulations for other compounds.

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