

## 1.3.1.1.2 List of frequently used symbols and abbreviations

## 1.3.1.1.2.1 Symbols

Symbol	Unit	Property
$a, b, c$	nm, pm	lattice parameters
$A_n \langle r^n \rangle$	$\text{cm}^{-1}$	crystal field parameters
$B$	T, G	magnetic field
$B_c$		critical value of magnetic field for magnetic transition
$B_{\text{hf}}$		magnetic hyperfine field
$B_0$	$\text{Pa}, \text{Nm}^{-2}$	bulk modulus ( $B_0' = dB_0/dp$ )
$B_n^{\text{m}}$	$\text{cm}^{-1}$	crystal field parameters
$c_{ij}$	$\text{Pa}, \text{dyn cm}^{-2}, \text{erg cm}^{-3}$	elastic stiffnesses
$C$	$\text{J mol}^{-1} \text{K}^{-1}, \text{cal mol}^{-1} \text{K}^{-1}$	heat capacity
$C_B$		$C_p$ in magnetic field $B$
$C_d$		lattice dilatational contribution to $C$
$C_{\text{el}}$		electronic contribution to $C$
$C_L$		lattice contribution to $C$
$C_{\text{magn}}$		magnetic heat capacity
$C_N$		nuclear heat capacity
$C_p$		heat capacity at constant pressure
$C_{\text{ph}}$		phonon contribution of heat capacity
$C_{\text{Sch}}$		Schottky heat capacity
$C_V$		heat capacity at constant volume
$D_{\text{AnAn}}, d_{\text{AnAn}}$	$\text{\AA}, \text{nm}$	distance between An atoms
$e$	C	electron charge
$eq$	$\text{V cm}^{-2}$	electric field gradient
$e^2qQ$	$\text{mm s}^{-1}$	quadrupole coupling constant
$E$	$\text{eV}, \text{Ry}, \text{K}, \text{cm}^{-1}$	energy
$E_b$		binding energy
$E_F$		Fermi energy
$E_i$		incident (neutron) energy, initial energy
$E_{ij}$		two-ion interaction parameter
$E_{\text{loss}}$		energy loss
$E_{\text{tot}}$		total energy
$E$	$\text{Pa}, \text{N m}^{-2}$	Young's modulus
$f$	Hz	frequency
$f$		magnetic form factor
$F$	J	free energy
$g$		spectroscopic splitting factor
$G$	$\text{Pa}, \text{N m}^{-2}$	shear modulus
$\Delta G$	J	Gibb's free energy
$\mathbf{H}$		Hamiltonian
$H$	$\text{Oe}, \text{A m}^{-1}$	magnetic field (strength), frequently given as $\mu_0 H$ in tesla (T)
$H_{\text{core}}$		core contribution to magnetic hyperfine field
$H_{\text{cr}}, H_c$		critical field
$H_{\text{eff}}$		effective magnetic field
$H_{\text{hf}}$		magnetic hyperfine field
$H_{\text{orb}}$		orbital contribution to magnetic hyperfine field

Symbol	Unit	Property
$H, \Delta H_{(f)}$	Ry	enthalpy (of formation)
$i$	$\text{A cm}^{-2}$	current density (also $j$ is used)
$I$	various units	intensity
	$I_{\text{magn}}$	magnetic integrated neutron diffraction intensity
	$I_x$	intensity of RXMS
$I$		nuclear spin quantum number
$J$	eV	exchange interaction energy ( $J/k_B$ in K)
	$J_{0,1,2},$ $J_{\text{nm}}$	exchange interaction energies (for special meaning see corresponding tables or figures)
$k$		extinction coefficient (absorption index)
$J$		total orbital angular momentum quantum number
$k$	$\text{nm}^{-1}, \text{\AA}^{-1}$	wavevector
$k_B$	$\text{J K}^{-1}$	Boltzmann constant
$K$		Knight shift
$\Delta L/L, \Delta l/l$		thermal expansion ( $\Delta l/l$ vs. $T$ )
$m_c$	$m_0$	effective cyclotron mass
$m_0$	g	electron mass
$M$	G, $\text{A m}^{-1}$	magnetization (also $m$ is used)
$M_T$	$\text{J mol}^{-1} \text{T}^{-1}$	magnetocaloric coefficient
$n$		(linear) refractive index
$n$	$\text{cm}^{-3}$	carrier concentration
	$n_H$	Hall carrier concentration
$O_n^m$		equivalent operator for crystal field expansion
$p$	Pa, bar, Torr	hydrostatic pressure
	$p_{\text{N}_2}$	nitrogen equilibrium pressure
	$p_t$	transition pressure
$p$	$\mu_B$	magnetic moment (also $m$ is used)
	$p_{\text{eff}}$	effective (paramagnetic) moment
	$p_l$	orbital component of total magnetic moment
	$p_M$	magnetic moment per ion M
	$p_0$	ordered magnetic moment
	$p_s$	saturation magnetic moment
	$p_s$	spin component of total magnetic moment
$q, Q$	$\text{nm}^{-1}, \text{\AA}^{-1}$	wavevector
$Q$		the momentum transfer or neutron scattering vector
$r$	nm	(ionic) radius
$R$	$\Omega$	resistance
$\Delta R/R_0$		magnetoresistance
$R$		reflectivity
$R$	$\text{J K}^{-1} \text{mol}^{-1}$	gas constant
$R_H$	$\text{cm}^3 \text{C}^{-1}$	Hall coefficient
$R_0$	$\text{cm}^3 \text{C}^{-1}$	ordinary or normal Hall coefficient
$R_s$	$\text{cm}^3 \text{C}^{-1}$	anomalous Hall coefficient, spontaneous Hall coefficient
$S$		spin quantum number
$S$	$\mu\text{V K}^{-1}$	Seebeck coefficient (thermoelectric power)
$S$	$\text{J K}^{-1} \text{mol}^{-1}$	entropy
	$S_{\text{magn}}$	magnetic contribution to entropy

Symbol	Unit	Property
$S(Q, \omega)$	barn eV <sup>-1</sup> sr <sup>-1</sup> atom <sup>-1</sup>	INS response function
$t$	s	time
$T$	K, °C	temperature
$T_C$		Curie temperature
$T_K$		Kondo temperature
$T_{\max},$ ( $T_{\min}$ )		temperature at which a quantity (e.g. $\rho$ ) has its maximum (minimum)
$T_N$		Néel temperature
$T_s$		superconductive transition temperature
$T_i; T_0,$ $T_{1k}, T_{3k},$ $T_{1C}, \dots$		magnetic transition temperatures (for special meaning see corresponding tables or figures)
$T_1$	s	spin lattice relaxation time
$U$	eV, Ry	Coulomb interaction energy, internal energy
$v$	cm s <sup>-1</sup> , mm s <sup>-1</sup>	velocity (mostly of absorber in Mössbauer effect)
$V$	nm <sup>3</sup>	(unit cell) volume
$V_0$		volume under ambient conditions
$V_i, V^i$	eV	CF parameter of $i$ th order
$W$	eV, K	crystal field parameter
$W$	eV	band width, peak width
$x$		crystal field parameter
$Z$		atomic number
$\alpha, \beta, \gamma$	deg	unit cell angles
$\alpha$	K <sup>-1</sup>	linear thermal expansion coefficient
$\alpha$	cm <sup>2</sup> s <sup>-1</sup>	thermal diffusivity
$\beta$		critical exponent of spontaneous magnetization
$\gamma$		critical exponent of susceptibility
$\gamma$	J mol <sup>-1</sup> K <sup>-2</sup>	coefficient of electronic heat capacity
$\gamma(0)$		coefficient of electronic heat capacity (extrapolated to $T=0$ K)
$\gamma_b$		bar linear coefficient of electronic heat capacity (calculated)
$\gamma_p$		"paramagnetic" coefficient of the electronic heat capacity
$\gamma$	Hz T <sup>-1</sup> , Hz Oe <sup>-1</sup>	nuclear gyromagnetic ratio
$\gamma$		Grüneisen parameter
$\Gamma$	eV, K, mm s <sup>-1</sup>	linewidth
$\Gamma_{\text{loc}}$	K	relaxation rate of spin fluctuation
$\delta$		(tetragonal) distortion
$\Delta$	various units	energy gap, energy shift, energy width, activation energy (for special meaning see corresponding tables or figures)
$\Delta_{\text{CEF}}$	eV	CEF splitting energy (sometimes given as $\Delta/k_B$ in K)
$\varepsilon = \varepsilon_1 - i \varepsilon_2$		dielectric constant
$\varepsilon_1, \varepsilon_2$		real, imaginary part of dielectric constant
$\varepsilon_K$	deg	Kerr ellipticity
$\zeta$		reduced wavevector coordinate
$\theta$	deg, rad	angle (scattering angle, field angle...)
$\theta_K$	deg	polar Kerr rotation (angle)
$\Theta, \Theta_p$	K	paramagnetic Curie temperature
$\Theta_D$	K	Debye temperature

Symbol	Unit	Property
$\Theta_E$	K	Einstein temperature
$\kappa$	bar <sup>-1</sup>	linear compressibility
$\kappa$	nm <sup>-1</sup> , Å <sup>-1</sup>	inverse correlation range
$\kappa$	W cm <sup>-1</sup> K <sup>-1</sup>	thermal conductivity
$\kappa_{el}$		electron contribution to thermal conductivity
$\kappa_L$		lattice contribution to thermal conductivity
$\kappa_{ph}$		phonon contribution to thermal conductivity
$\kappa_{tot}$		total thermal conductivity
$\lambda$	nm, Å	wavelength
$\lambda$	mol cm <sup>-3</sup>	molecular field constant
$\lambda$	s <sup>-1</sup>	μSR relaxation rate
$\mu$	cm <sup>-1</sup>	absorption coefficient
$\mu_B$	J T <sup>-1</sup>	Bohr magneton
$\nu$	Hz	frequency
$h\nu$	eV, Ry	photon energy
$\xi$	Å	correlation length
$\rho$	Ω cm, Ω m	resistivity
$\rho_H$		Hall resistivity
$\rho_K$		Kondo resistivity
$\rho_{mag}$		magnetic contribution to resistivity
$\rho_0$		residual resistivity
$\Delta\rho/\rho(0)$		magnetoresistivity
$\sigma$		Poisson's ratio
$\sigma$	Ω <sup>-1</sup> cm <sup>-1</sup>	electrical conductivity
$\sigma_{ij}, \sigma_{opt}$	s <sup>-1</sup>	optical conductivity
$\sigma_{xx}, \sigma_{xy}$		diagonal, off-diagonal optical conductivity
$\sigma$	emu g <sup>-1</sup> = G cm <sup>3</sup> g <sup>-1</sup> , V s m <sup>2</sup> kg <sup>-1</sup> , A m <sup>2</sup> kg <sup>-1</sup>	magnetic moment per unit mass = specific magnetization
$\sigma_m$	A m <sup>2</sup> mol <sup>-1</sup>	magnetic moment per mol = molar magnetization
$\tau$	s	relaxation time
$\varphi, \phi$	deg	angle (e.g. between $B$ and crystal axis)
$\chi$	emu	magnetic susceptibility
$\chi_g$	emu g <sup>-1</sup> = cm <sup>3</sup> g <sup>-1</sup> , m <sup>3</sup> kg <sup>-1</sup>	magnetic mass susceptibility
$\chi_m$	emu mol <sup>-1</sup> = cm <sup>3</sup> mol <sup>-1</sup> , m <sup>3</sup> mol <sup>-1</sup>	magnetic susceptibility per mole
$\chi_v$	emu cm <sup>-3</sup> = cm <sup>3</sup> cm <sup>-3</sup>	volume susceptibility
$\chi_0$		temperature independent magnetic susceptibility
$\chi', \chi''$		real, imaginary part of ac magnetic susceptibility (sometimes $\chi_{ac}$ is used for ac magn. susceptibility)
$\chi_p$		magnetic susceptibility of a powder (polycrystalline) sample
$\chi_{VV}$		van Vleck contribution to susceptibility
$\omega$	s <sup>-1</sup>	angular frequency
$\omega/\gamma$	T	dHvA "frequency"

**1.3.1.1.2 Abbreviations**

ac	alternating current
AF	antiferromagnetically ordered magnetic moment system
An	actinide element
AO	atomic orbital
APW	augmented plane wave (method)
ARPES	angle-resolved photoelectron spectroscopy
ASA	atomic sphere approximation
ASW	augmented spherical wave (method)
ATA	average t-matrix approximation
bcc	body centered cubic
BE	binding energy
BIS	bremsstrahlung isochromat spectroscopy
BR	branching ratio
BZ	Brillouin zone
c, cr	mostly as subscript: critical
calc	calculated
CB	conduction band
CE	conduction electron
CEF, CF	crystal electric field
CEP	conduction electron polarization
CIS	constant initial state (spectroscopy)
CMS	cellular multiple scattering (method)
CNS	critical neutron scattering (method)
CPA	coherent potential approximation
CW, C-W	Curie Weiss (law)
D	diamagnetic
DCNS	diffuse critical neutron scattering (method)
DFT	density functional theory
DHO	damped harmonic oscillator
DVM	discrete variational method
dHvA	de Haas van Alphen oscillations (method)
DNS	diffuse neutron scattering
DOS	density of states
EBS	energy band structure
EDC	electron (intensity) distribution curve
EDM	electron delocalization model
ED(T)	electron delocalization (theory)
eff	effective
el	mostly as subscript: electronic
EMI	electrostatic multipole interaction
EQI	electrostatic quadrupole interaction
ESCA	electron spectroscopy for chemical analysis
exp	experimental
F	ferromagnetism, ferromagnetic

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FC	field cooled
fcc	face centered cubic
Fi	ferrimagnetic
FU, F.U.	formula unit
FWHM	full width at half maximum
hf	hyperfine
HMI	hybridization-mediated interaction (model)
HMTII	hybridization-mediated two-ion interaction (model)
HR ARPES	high resolution angle-resolved photoelectron spectroscopy
HT	high temperature ( $T > 300$ K)
HWHM	half width at half maximum
IC	incommensurate (magnetic structure); also "Inc." is used
IC(A) (T) (S)	intermediate coupling (approximation) (theory) (scheme)
INS	inelastic neutron scattering
IR	infrared
IS	isomer shift
KF	Kouvel-Fisher
KKR-Gr	Korringa- Kohn-Rostoker (method)-Green's function
L	longitudinal, lattice
LA	longitudinal acoustic
LAPW	linearized augmented plane wave (method)
LB	Landolt-Boernstein
LDA	local density approximation
LDA+ $U$	local density approximation + on-site Coulomb repulsion $U$
LF	longitudinal field
lhs	left-hand side
LLW	Lee-Leask-Wolf (model)
LMTO	linearized muffin-tin orbital
Ln	lanthanide element
LO	longitudinal optical
LSD(A)	local spin density approximation
LT	low temperature, mainly $< 10$ K
LW	longitudinal wave (structure)
magn	mostly as subscript: magnetic
max	maximum
MCW	modified Curie-Weiss law
MD	molecular dynamics (method)
MF	modulated ferromagnetism
MF(A)	molecular field (approximation)
MFT	molecular (or mean) field theory
min	mostly as subscript: minimum
MO	molecular orbital
MPD	magnetic phase diagram
MR	magnetoresistance
MT	metamagnetic transition
ND	neutron diffraction

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NDS	neutron diffraction scattering
NGR	nuclear gamma resonance (Mössbauer effect)
NMR	nuclear magnetic resonance
NNIR	near-normal incidence reflectivity ( $\text{Re } \sigma_{ij}$ )
(n)nn	(next) nearest neighbour
NOS	number of states
NS	neutron scattering
OP	orbital polarization
opt	optical
P, Para	paramagnetism, paramagnetic
PDC	phonon dispersion curve
PE(S)	photoemission (spectroscopy)
PNS	polarized neutron scattering
poly	polycrystalline
PP	Pauli paramagnetism
R(NC)SP	relativistic non-collinear spin polarized
R, RE	rare earth element
RAPW	relativistic augmented plane wave (method)
RFE	random field effect
RG	renormalization group
rhs	right-hand side
RIM	(1) rigid-ion model (2) random interaction model
RKKR	relativistic KKR (method)
RKKR-Gr	relativistic KKR-Gr (method)
RKKY	Ruderman-Kittel-Kasuya-Yosida (exchange interaction)
RLAPW	relativistic LAPW (method)
RLMTO	relativistic LMTO
rlp	reciprocal lattice point
rlu	reciprocal lattice unit
RPA	random phase approximation
RRR	relative residual resistivity
RS	Raman scattering
R-S	Russell-Saunders (coupling)
RSDFT	relativistic spin-density functional theory
RSP-LAPW	relativistic spin polarized LAPW
RSSS	relativistic single-site scattering (model)
RT	room temperature
RXMS	resonant X-ray magnetic scattering
s.c., sc	single crystal
sc	self-consistent
s.g.	space group
SDFT	spin density functional theory
SIC	self interaction corrected
SIC-LSDA	self interaction corrected LSDA
sint.	sintered

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SO(C)	spin-orbit (coupling)
SO(I)	spin-orbit (interaction)
SP	spin polarized (band)
T	transverse
TA	transverse acoustic
TB	tight binding (LMTO)
TF	transverse field
th	theoretical, thermal
THI	transferred hyperfine interaction
TIP	temperature independent paramagnetism
TLS	two-level system (effect)
TO	transverse optical
TOF	time-of-flight (spectrum)
tot	mostly as subscript: total
UPS	UV photoemission spectroscopy
VB	valence band
VEC	valence electron concentration
WF	Wiedemann-Franz (law)
WL	white line
WTDP	weak temperature dependent paramagnet
X	pnictogens P, As, Sb, Bi
XANES	X-ray absorption near edge spectroscopy
XAS	X-ray absorption spectroscopy
XPS	X-ray photoelectron spectroscopy
XRES	X-ray resonance scattering
Y	chalcogens S, Se, Te
ZF(C)	zero field (cooled)
$\mu$ SR	muon spin resonance
$\perp, \parallel$	perpendicular, parallel to a crystallographic axis