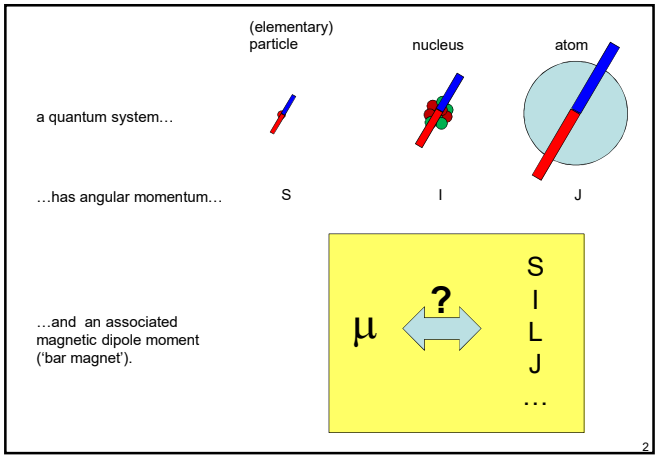
g-factor (bis)

www. hyperfinecourse .org



Wikipedia :

A ***g*-factor** (also called ***g* value** or **dimensionless magnetic moment**) is :

a dimensionless quantity which characterizes the magnetic moment of a particle or nucleus.

It is essentially a proportionality constant that relates the observed magnetic moment μ of a particle to the appropriate angular momentum quantum number and the appropriate fundamental quantum unit of magnetism, usually the Bohr magneton or nuclear magneton.

$$\mu_B = \frac{e\hbar}{2m_e} = 9.2741 \cdot 10^{-24} \frac{J}{T}$$

$$\mu_N = \frac{e\hbar}{2m_p} = 5.0508 \cdot 10^{-27} \frac{J}{T}$$

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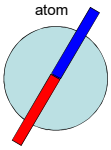
	(elementary) particle	nucleus	atom
a quantum system…			
…has angular momentum…	S	I	J

…and an associated magnetic dipole moment ('bar magnet').

$$\vec{\mu}_n = g_n \frac{\mu_N}{\hbar} \vec{I}$$

$$\vec{\mu}_S = g_e \frac{\mu_B}{\hbar} \vec{S}$$

electron: $g_e = -2.002319$

$$\vec{\mu}_J = g_J \frac{\mu_B}{\hbar} \vec{J}$$

Landé

neutron: $g_n = -3.82608545$, I=1/2
proton: $g_p = 5.585694713$, I=1/2
ground state ^{57}Fe: $g_n = 0.09062$, I=1/2

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$$\vec{\mu}_J = g_J \frac{\mu_B}{\hbar} \vec{J}$$

$$g_J = g_L \frac{J(J+1) - S(S+1) + L(L+1)}{2J(J+1)} + g_S \frac{J(J+1) + S(S+1) - L(L+1)}{2J(J+1)}$$

($g_S = -g_e = 2$)

$$\vec{\mu}_L = g_L \frac{\mu_B}{\hbar} \vec{L} \qquad (g_L = 1)$$

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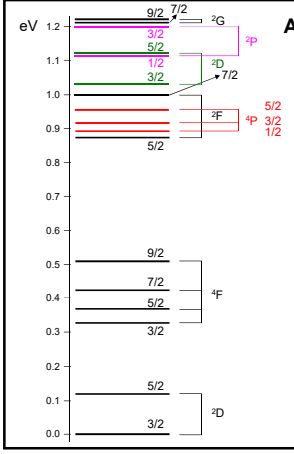
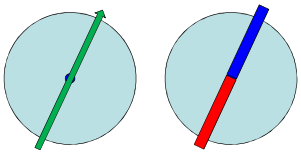


Atomic energies for La : interpreted



The atom has an angular momentum J=3/2 in its ground state.

A magnetic dipole moment ('bar magnet') must be associated with this angular momentum :

$$\vec{\mu}_J = g_J \frac{\mu_B}{\hbar} \vec{J}$$

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