Chap 11


Skills: Be able to

- Pick out lowest energy term and level, using Hund's rules
- Use Hund's rules to determine lowest energy term and level for a given configuration.
- Interpret a Grottrian diagram.
- Apply atomic selection rules.
Which term is lowest in energy? Which level?

Hund's Rules (in order):
1) Lowest state has highest $S$
2) " " " " L
3) for less than half-full sub shell, lowest $J$ must stabilize
   for more than half-full, highest $J$

We can use these rules to find lowest Energy level quickly.
1) make spins parallel
2) position so as to maximize $\Sigma m_i$
3) calculate $J$
Determine ground-state term for $d^2$

$\Sigma m_x = 3 = M_L$ 

$i.e.$ Belongs to F term

$S = 1$ 

$^3F$ term

which level? $L = 3, S = 1$

$J = \{4, 3, 2\}$

Subshell is less than half full, so lowest energy level is $J = 2$

$^3F_2$
[Ex]
d configuration has terms
'5' 'D' 'F' 'G' 'I' '3p'
'3D' '3F' '3G' '3H' '5D'
which is lowest in E?

1) highest S is 2 (quintet multiplicity)
   \[5\text{D}\]

Which level of this term is lowest in E?
L = 2  S = 2
J = \{4, 3, 2, 1, 0\}
less than half-filled, so J = 0
\[5\text{D}_0\]
Atomic Selection Rules

$\Delta l = \pm 1$

$\Delta L = \pm 1, 0$

$\Delta S = 0$

$\Delta J = 0, \pm 1$ \quad J=0 \leftrightarrow J=0$

These selection rules are apparent on a Grotrian Diagram.
\[ \lambda = n\mu \]

Note: \( E \approx E(n) \) very rough

\( E = E(n, s, l) \)

(diffuse levels of same term very close in \( E \))
Lasers

Light Amplification by Stimulated Emission of Radiation

3 possible events

Absorption

Spontaneous emission

Stimulated emission

Same rate constant, so relative rate determined by relative populations of the two levels. Normally, more absorption
lasers need a population inversion:

We can achieve this with a multi-level system:

These two states will have a population inversion, lasing transition.
Note that light will be coherent in-phase same wavelength