

Spectroscopic Terms : L-S and j-j Couplings

1. Terminology

At this stage we define some terminology associated with atomic energy levels.

State—The 'state' of an atom is the condition of motion of all the electrons. It is specified by listing four quantum numbers for each electron. If several states have the same energy, they are said to be *degenerate*. The state with lowest energy is the *ground state*.

Energy Level—A collection of states having the same energy in the absence of external magnetic or electric field constitutes an 'energy level'. An energy level is characterised by a quantum number J , that is, by a particular value of the total angular momentum. The level with the lowest energy is the *ground level*.

Sublevel—An external field splits an energy level into several 'sublevels', each characterised by one or more magnetic quantum number.

Term—A collection of levels characterised by an orbital angular momentum and multiplicity (*i.e.* spin) comprises a 'spectroscopic term'. For example, a 3D term means the weighted average energy of the 3D_3 , 3D_2 and 3D_1 levels.

Configuration—The specification of the quantum numbers n and l for the orbitals of all the electrons of an atom is called the 'electron configuration' of the atom. For example, the electron configuration of the 6C atom is $1s^2 2s^2 2p^2$.

Equivalent Orbitals—Orbitals with the same n and l are 'equivalent'. The electrons in equivalent orbitals are called 'equivalent electrons'.

Statistical Weight—The number of distinct states in a specified collection is the 'statistical weight'. The statistical weight of a level is $2J + 1$; for a term it is $(2S + 1)(2L + 1)$; for a single electron it is $2n^2$.

Spectral lines are categorised according to the following nomenclature :

Component—A transition between two sublevels is called a 'component',

Line—A transition between two levels is a 'line'. A line is thus a blend of components.

Multiplet—A collection of transitions between two terms is called a 'multiplet'. A multiplet thus consists of a number of lines.

Resonance Line—Among the lines arising from transitions between the ground level and higher levels, the line of lowest frequency is called the 'resonance line'.