LS coupling

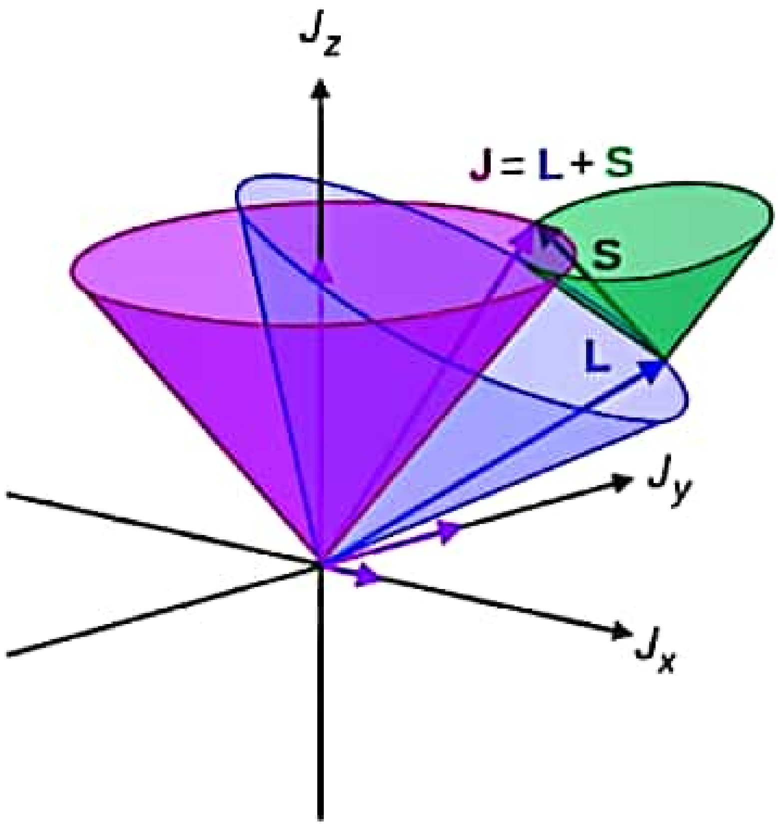

Illustration of L–S coupling. Total angular momentum **J** is purple, orbital **L** is blue, and spin **S** is green.

In light atoms (generally $Z \leq 30$[4]), electron spins $\mathbf{s}_i$ interact among themselves so they combine to form a total spin angular momentum **S**. The same happens with orbital angular momenta $\boldsymbol{\ell}_i$, forming a total orbital angular momentum **L**. The interaction between the quantum numbers **L** and **S** is called **Russell–Saunders coupling** (after Henry Norris Russell and Frederick Saunders) or **LS coupling**. Then **S** and **L** couple together and form a total angular momentum **J**:[5][6]

$$\mathbf{J} = \mathbf{L} + \mathbf{S},$$

where **L** and **S** are the totals:

$$\mathbf{L} = \sum_i \boldsymbol{\ell}_i, \ \mathbf{S} = \sum_i \mathbf{s}_i.$$

This is an approximation which is good as long as any external magnetic fields are weak. In larger magnetic fields, these two momenta decouple, giving rise to a different splitting pattern in the energy levels (the Paschen–Back effect.), and the size of LS coupling term becomes small.[7]

In the Russell-Saunders coupling scheme, term symbols are in the form of $^{2S+1}L_J$, where S represents the total spin angular momentum, L specifies the total orbital angular momentum, and J refers to the total angular momentum. In a term symbol, L is always an upper-case from the sequence "s, p, d, f, g, h, i, k...", wherein the first four letters stand for sharp, principal, diffuse and fundamental, and the rest follow in an alphabetical pattern. Note that the letter j is omitted.