Spin Orbit coupling

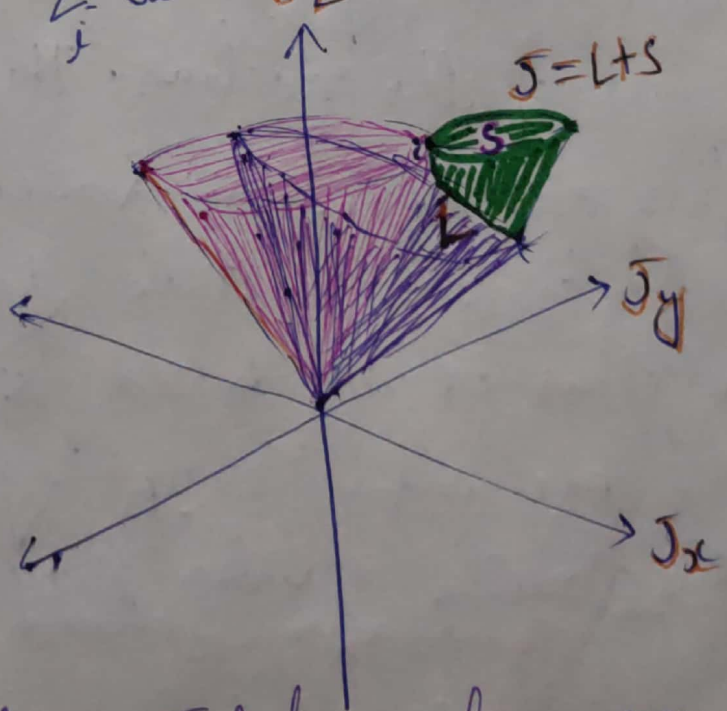
The spin orbit coupling is the interaction between the electrons spin and its orbital motion around the nucleus. When an electron moves in the finite electric field of the nucleus, the spin orbit coupling causes a shift in the electrons atomic energy levels due to the electromagnetic interaction between the spin of the electron and the electric field. In the rest frame of the electron, there exists a magnetic field created by the interaction of the angular momentum of the electron and the electric field of the nucleus. The electric field in this case can have various physical origins, such as the electric field of an atomic nucleus or the band structure of a solid. The spin orbit coupling increases with the atomic number Z of the atom.

In light atoms (generally $Z \leq 30$), electron spins s_i interact among themselves so they combine to form a total spin angular momentum S. The same happens with orbital angular momenta l_i, forming a total orbital angular momentum L. The interaction between the quantum numbers L and S is called Russell-Saunders coupling or LS coupling. Then S and L couple together and form a total angular momentum J.

$$J = L + S$$

where L and S are the totals.

$$L = \sum_i l_i \quad , \quad S = \sum_i s_i$$



L-S coupling. Total angular momentum J is purple, orbital L is blue, and S is green.