Orbital angular momentum vector $\vec{l}$ of each electrons combines vectorially to produce the resultant orbital angular momentum vector, $\vec{L}$. Similarly, $\vec{s}$ for the different electrons combines to produce the resultant vector $\vec{S}$.

Then the resultant vectors $\vec{L}$ and $\vec{S}$ combine to give the resultant total angular momentum vector $\vec{J}$.

$$\vec{J} = \vec{L} + \vec{S} = (\vec{l}_1 + \vec{l}_2 + \vec{l}_3 + \cdots) + (\vec{s}_1 + \vec{s}_2 + \vec{s}_3 + \cdots)$$

The resultant vectors $\vec{L}$, $\vec{S}$, $\vec{J}$ can be expressed in terms of their corresponding resulting quantum numbers

$$\vec{L} = \sqrt{L(L+1)}\ h/2\pi, \quad \vec{S} = \sqrt{S(S+1)}\ h/2\pi$$

$$\vec{J} = \sqrt{J(J+1)}\ h/2\pi$$

(a) Determination of $\vec{L}$ and L where $\vec{L} \approx L\,(h/2\pi)$

(i) One electron system $(L = l)$

s^1 configuration (H, He^+, Li^{2+} etc.), $l = 0$, $L = 0$. (S state)

p^1 configuration (Boron), $l = 1$, ie $L = 1$ (P state).

d^1 configuration (Ti^{3+}), $l = 2$, $L = 2$ (D state)

(ii) two electron system : p^2 configuration $(l = 1)$;
$\vec{l}_1 = \vec{l}_2 = l\,(h/2\pi)$.

These two vectors can combine in the following ways. (Fig-1).

d²-configuration: $(l = 2)$; $\vec{l}_1 = \vec{l}_2 = 2\,(h/2\pi)$.

Their vertical combinations are shown in the following figure. (Fig. 2)