Normal Zeeman effect :-

Debye explained the normal Zeeman effect without taking into account the concept of spin of electron. If we neglect the spin motion of the electron, then the orbital angular momentum of the electron is

$$L = \frac{lh}{2\pi} \qquad \text{---------- (1)}$$

and magnetic moment $\mu_l = \frac{lh}{2\pi} \cdot \frac{e}{2m} \vec{L}$ ——— (2)

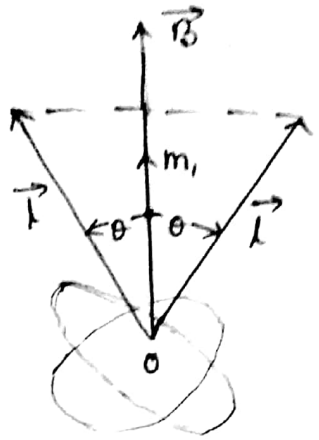

Fig -(1)

In the presence of an external magnetic field of flux density $\vec{B}$, the vector $\vec{l}$ processes around the direction of the magnetic field axis. This precession is known as Larmor precession.

The frequency of Larmor precession

$$\omega = \frac{Be}{2m} \qquad \text{——— (3)}$$

Fig-(1) shows two positions of the vector $\vec{l}$, as it processes about the electronic orbit.

The additional energy of the electron due to this precessional motion.

$$\Delta E = \mu_l B \cos\theta = \left(\frac{e}{2m} \cdot \frac{lh}{2\pi}\right) B \cos\theta$$

$$\left[\because \mu_l = \frac{le}{2m} \cdot \frac{lh}{2\pi}\right]$$

But $\frac{Be}{2m} = \omega$ and $l\cos\theta$ = projection of $\vec{l}$ on $\vec{B}$ $= m_l$

$$\therefore \Delta E = m_l \frac{eh}{4\pi m} \cdot B = m_l \omega \frac{h}{2\pi} \qquad \text{——— (4)}$$