The Zeeman effect

weak field: B is less than internal magnetic field.

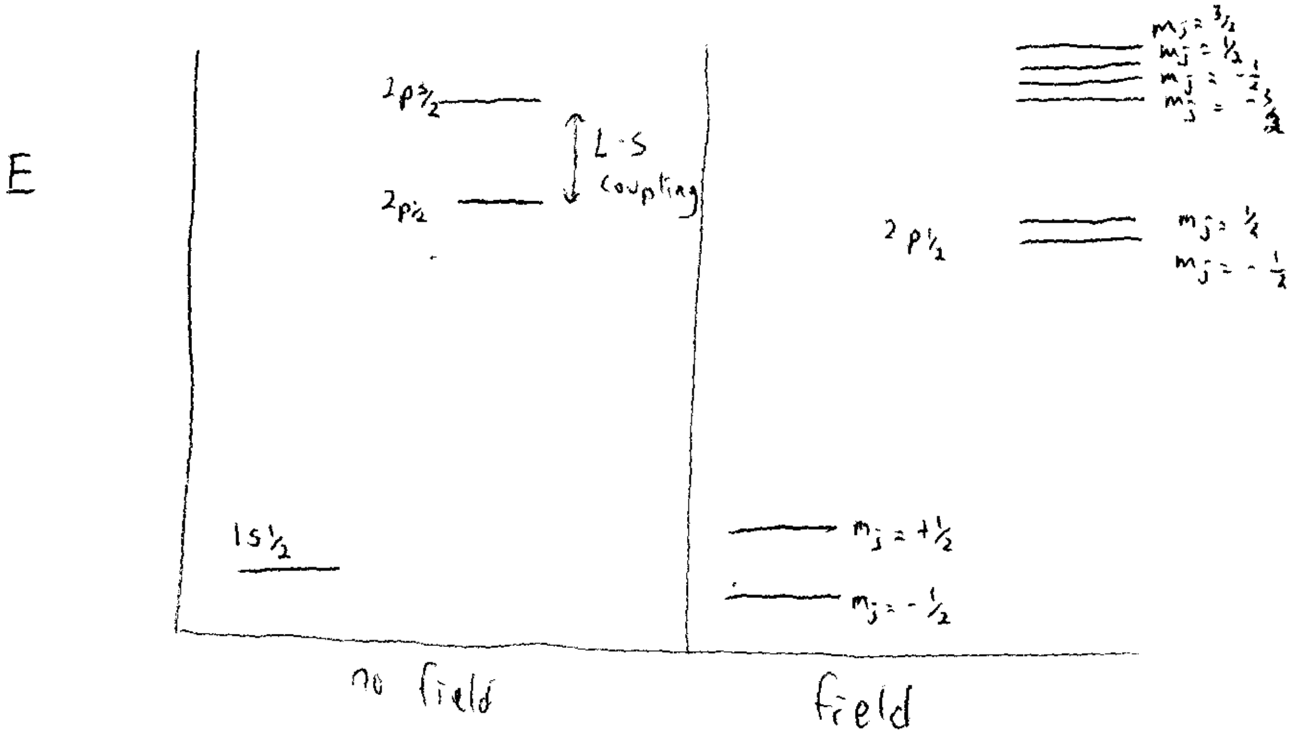
$$\Delta E = -\vec{\mu}_{tot} \cdot \vec{B} = \frac{e}{2m}\left(\vec{L} + 2\vec{S}\right)\cdot\vec{B}$$

'precess' about $\vec{J}$

$$\vec{\mu}_{tot} = \vec{\mu}_{orb} + \vec{\mu}_{spin} = -\frac{e}{2m_e}\left(\vec{L} + 2\vec{S}\right)$$

$$\Delta E = g_L \, m_j \, \mu_B \, B$$

$$g_L \equiv \frac{3J^2 - L^2 + S^2}{2J^2}$$ 'Landé factor'



Strong Field - The Paschen-Back effect

B is much larger than internal fields

$$\Delta E = -\vec{\mu} \cdot \vec{B}$$

$$\Delta E = -\mu_z \cdot B_z = \frac{e}{2m}\left(L_z + 2S_z\right) B_z$$

$$\Delta E = \frac{e\hbar}{2m}\left(m_l + 2m_s\right) B_z$$

Spin orbit coupling becomes unimportant

Selection rules become

$$\Delta m_s = 0$$

$$\Delta m_l = 0, \pm 1$$

$$\Delta l = \pm 1$$

In class problem: for a hydrogen atom in a strong magnetic field, $\vec{B}$.

A. Draw the splitting of the 1s and 2p states.

B. Using the selection rules, Draw the observed lines on 2p → 1s transition.

C. Is there a 2s → 1s transition?