Lange g factor

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$$\vec{J} = \vec{L} + \vec{S}$$

$$\vec{\mu}_l = -\mu_B \sqrt{l(l+1)} \qquad (1)$$

$$\vec{\mu}_s = -2\mu_B \sqrt{s(s+1)} \qquad (2)$$

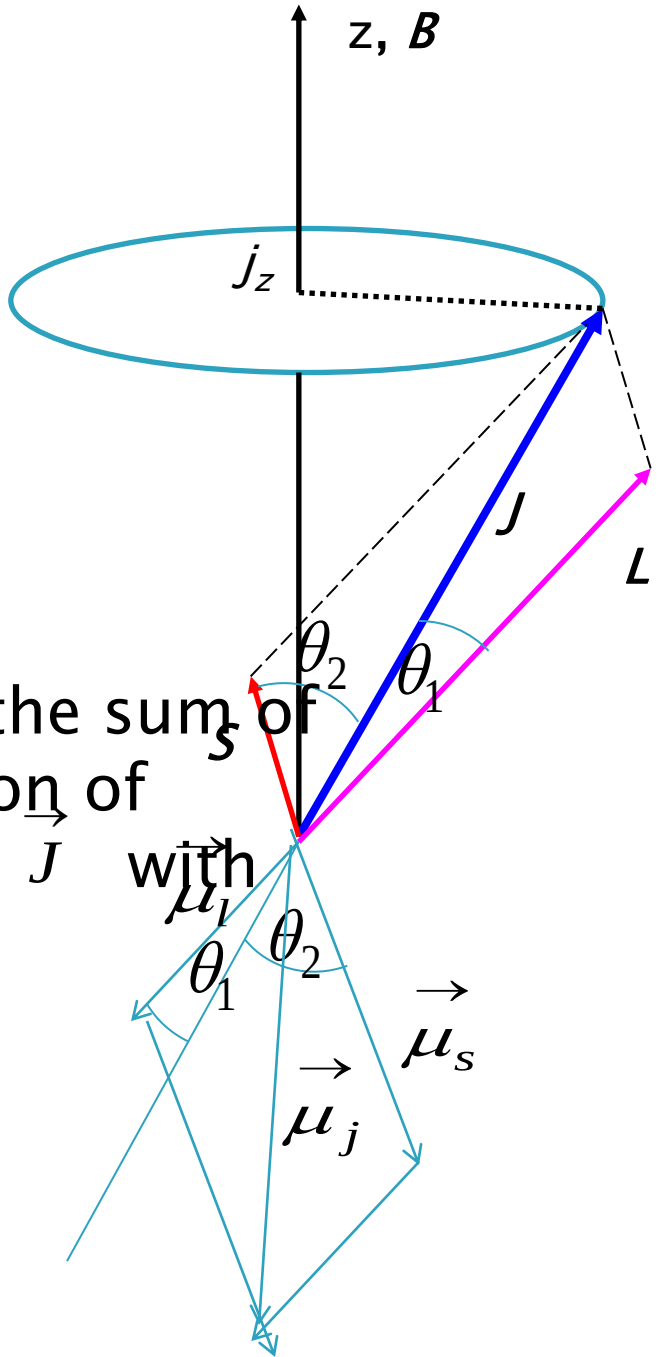
Total magnetic moment $\vec{\mu}_j$ is the sum of $\vec{\mu}_l$ and $\vec{\mu}_s$ in the direction of $\vec{J}$

If l and s makes angle θ_1 and θ_2 with $\vec{J}$

$$\vec{\mu}_j = \vec{\mu}_l \cos\theta_1 + \vec{\mu}_s \cos\theta_2$$

Or

$$\mu_j = \mu_l \cos\theta_1 + \mu_s \cos\theta_2 \qquad (3)$$



$$\vec{J} = \vec{L} + \vec{S}$$

$$\vec{S} = \vec{J} - \vec{L}$$

$$S^2 = J^2 + L^2 - 2\vec{J}.\vec{L}$$

$$L^2 = J^2 + S^2 - 2\vec{J}.\vec{S}$$

$$S^2 = J^2 + L^2 - 2JL\cos\theta_1$$

$$L^2 = J^2 + S^2 - 2JS\cos\theta_2$$

$$\cos\theta_1 = \frac{J^2 + L^2 - S^2}{2JL}$$

$$\cos\theta_2 = \frac{J^2 + S^2 - L^2}{2JS}$$

$$\cos\theta_1 = \frac{j(j+1) + l(l+1) - s(s+1)}{2\sqrt{j(j+1)}\sqrt{l(l+1)}}$$

$$\cos\theta_2 = \frac{j(j+1) + s(s+1) - l(l+1)}{2\sqrt{j(j+1)}\sqrt{s(s+1)}}$$

$$\mu_j = \mu_l \cos\theta_1 + \mu_s \cos\theta_2 \qquad (3)$$

$$\mu_j = \mu_l \frac{j(j+1) + l(l+1) - s(s+1)}{2\sqrt{j(j+1)}\sqrt{l(l+1)}} + \mu_s \frac{j(j+1) + s(s+1) - l(l+1)}{2\sqrt{j(j+1)}\sqrt{s(s+1)}}$$

Putting μ_l and μ_s from (1) and (2)

$$\mu_j = -\mu_B \sqrt{l(l+1)}.\frac{j(j+1)+l(l+1)-s(s+1)}{2\sqrt{j(j+1)}\sqrt{l(l+1)}}$$

$$-2\mu_B \sqrt{s(s+1)}.\frac{j(j+1)+s(s+1)-l(l+1)}{2\sqrt{j(j+1)}\sqrt{s(s+1)}}$$

$$\mu_j = -\mu_B \frac{j(j+1)+l(l+1)-s(s+1)}{2\sqrt{j(j+1)}} - 2\mu_B \frac{j(j+1)+s(s+1)-l(l+1)}{2\sqrt{j(j+1)}}$$

$$\mu_j = -\mu_B \left[\frac{j(j+1)+l(l+1)-s(s+1)}{2\sqrt{j(j+1)}} + \frac{2j(j+1)+2s(s+1)-2l(l+1)}{2\sqrt{j(j+1)}} \right]$$

$$\mu_j = -\mu_B \left[\frac{3j(j+1)-l(l+1)+s(s+1)}{2\sqrt{j(j+1)}} \right]$$ Multiply num deno by $\sqrt{j(j+1)}$

$$\mu_j = -\mu_B \sqrt{j(j+1)} \left[\frac{3j(j+1)-l(l+1)+s(s+1)}{2j(j+1)} \right]$$

$$\mu_j = -\mu_B g_j \sqrt{j(j+1)}$$

$$g_j = \left[\frac{3j(j+1) - l(l+1) + s(s+1)}{2j(j+1)} \right]$$

$$g_j = \left[\frac{2j(j+1) + j(j+1) - l(l+1) - s(s+1)}{2j(j+1)} \right]$$

Where $g_j = \left[1 + \frac{j(j+1) - l(l+1) + s(s+1)}{2j(j+1)} \right]$ is calle

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