Question

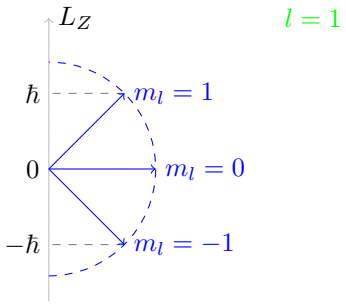
Orbital Quantum Number: Find the percentage difference between the maximum value of L and L_z for an atomic electron in the p, d and f states.

Solution

p state

$$\begin{aligned} l &= 1 \\ m_l &= 0,\ \pm 1 \\ L &= \sqrt{l(l+1)}\,\hbar = \sqrt{2}\,\hbar \\ L_Z(max) &= \hbar \end{aligned}$$

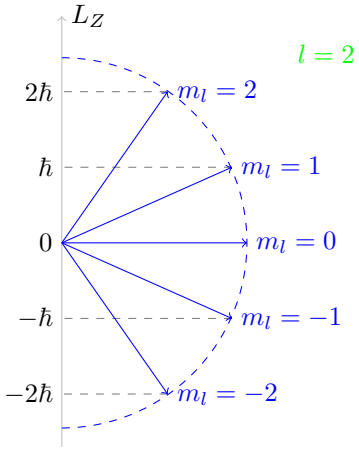
Percentage difference $= (\sqrt{2} - 1)/\sqrt{2} = 29.3\%$



d state

$$\begin{aligned} l &= 2 \\ m_l &= 0,\ \pm 1,\ \pm 2 \\ L &= \sqrt{l(l+1)}\,\hbar = \sqrt{6}\,\hbar \\ L_Z(max) &= 2\hbar \end{aligned}$$

Percentage difference $= (\sqrt{6} - 2)/\sqrt{6} = 18.4\%$



f state

$$\begin{aligned} l &= 3 \\ m_l &= 0,\ \pm 1,\ \pm 2,\ \pm 3 \\ L &= \sqrt{l(l+1)}\,\hbar = \sqrt{12}\,\hbar \\ L_Z(max) &= 3\hbar \end{aligned}$$

Percentage difference $= (\sqrt{12} - 3)/\sqrt{12} = 13.4\%$

