

Angular momentum 1

Let $\mathbf{L}\psi$ be the angular momentum of wavefunction ψ where \mathbf{L} is the operator

$$\mathbf{L} = \mathbf{r} \times \mathbf{p} = \begin{pmatrix} L_x \\ L_y \\ L_z \end{pmatrix}$$

From the cross product we have

$$L_x = yp_z - zp_y$$

$$L_y = zp_x - xp_z$$

$$L_z = xp_y - yp_x$$

Verify the commutation relation

$$\mathbf{L} \times \mathbf{L} = i\hbar\mathbf{L}$$

which in component form is

$$[L_y, L_z] = i\hbar L_x$$

$$[L_z, L_x] = i\hbar L_y$$

$$[L_x, L_y] = i\hbar L_z$$

Let L^2 be the magnitude squared of \mathbf{L} .

$$L^2 = |\mathbf{L}|^2 = L_x^2 + L_y^2 + L_z^2$$

Verify the commutation relations

$$[L_x, L^2] = [L_y, L^2] = [L_z, L^2] = 0$$

Eigenmath script