Physics Courseware
Quantum Mechanics

Angular momentum

Problem 1.- A particle is prepared in the state: $\psi = \frac{2Y_2^1 + Y_3^2 + Y_3^0}{\sqrt{6}}$. An experiment to measure angular momentum yields *l*=2. If the magnetic quantum number is measured immediately after, what value do you expect to measure?

Solution: When the angular momentum is measured the wavefunction will "collapse" to Y_2^1, which has magnetic quantum number **m=1**.

Problem 1a.- A particle is prepared in the state: $\psi = \frac{Y_2^1 + Y_3^2 + Y_4^0}{\sqrt{3}}$. Then, an experiment to measure angular momentum yields *l*=4. If the magnetic quantum number is measured immediately after, what value do you expect to measure?

Solution: When the angular momentum is measured the wavefunction will "collapse" to Y_4^0, which has magnetic quantum number **m = 0**.

Problem 2.- What are the places where the probability of finding the electron of the hydrogen atom with quantum numbers n=3, l=0 and m=0 vanishes?

Solution: The angular wavefunction with l=0 and m=0 is just a constant, so the only places where the probability vanishes are where the radial wavefunction is zero.

This happens when $1 - \frac{2}{3}\frac{r}{a} + \frac{2}{27}\left(\frac{r}{a}\right)^2 = 0$,

Which has two solutions**: r=7.1a** and **r=1.9a**

Problem 3.- What is the angular eigenfunction that has L^2 eigenvalue of $12\hbar^2$ and L_z eigenvalue of $-2\hbar$?

Solution: If L^2 is $12\hbar^2$ it means that *l*=3. The fact that L_z is $-2\hbar$ means that m=-2, so the angular wavefunction is Y_3^{-2}