PHSX 611: Printed Notes

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1 Angular Momentum

$$
\begin{array}{lll}
(1)\ [\hat{\ell}_x, \hat{\ell}_y] = i\hat{\ell}_z & (4)\ [\hat{\ell}^2, \hat{\ell}_i] = 0 & (7)\ [\hat{\ell}^2, \hat{\ell}_\pm] = 0 \\
(2)\ [\hat{\ell}_y, \hat{\ell}_z] = i\hat{\ell}_x & (5)\ \hat{\ell}_\pm = \ell_x \pm i\hat{\ell}_y & (8)\ [\hat{\ell}_z, \hat{\ell}_\pm] = \pm\ell_\pm \\
(3)\ [\hat{\ell}_z, \hat{\ell}_x] = i\hat{\ell}_y & (6)\ \hat{\ell}_+ = \hat{\ell}_-^\dagger & (9)\ [\hat{\ell}_+, \hat{\ell}_-] = 2\hat{\ell}_z
\end{array}
$$

2 Spherical Harmonics

I need to write up the derivation!

$$
Y_\ell^m(\theta, \phi) = \sqrt{\frac{(2\ell+1)(\ell-m)!}{4\pi(\ell+m)!}} e^{im\phi} \mathcal{P}_\ell^m(\cos\theta)
$$

3 Radial Equation

Derivation!

$$
R_{n\ell}(r) = \sqrt{\left(\frac{2}{na}\right)^3 \frac{(n-\ell-1)!}{2n(n+\ell)!}} e^{-r/na} \left(\frac{2r}{na}\right)^\ell \left[L_{n-\ell-1}^{2\ell+1}(2r/na)\right]
$$

$$
L_p^q(x) = \frac{x^{-p}e^x}{q!} \left(\frac{d}{dx}\right)^q (e^{-x}x^{p+q})
$$