PHYS 2380 - Assignment 5 - Clarifications

April 6, 2017

Clarifications for assignment 5:

1.) In the integral identity (equation 2), on the right hand side α should be substituted in place of a.

2.) In problem 1b, treat the probability density as an average of the single state probability densities. This is equivalent to separating the probability density into two parts, one part which contributes to the probability with integrand P_c and another part which vanishes due to orthogonality and does not contribute to the integral P_v. Consider

$$P = \int P_c(r,\theta,\phi)d\tau + \int P_v(r,\theta,\phi)d\tau = 1 \tag{1}$$

where $d\tau$ is the spherical volume element. The integrand P_c is made of the terms that contribute and do not vanish (the like-pairs such as, for example, $\psi^*_{200}\psi_{200}$). There are four such states that contribute to P_c given in equation 3 on the assignment. The orthogonality causes all mixed-pairs (the P_v part which sums the cross-terms) to vanish. So just calculate the terms that contribute:

$$P_c(r,\theta,\phi) = \frac{1}{4}\left(\psi^*_{200}\psi_{200} + \psi^*_{210}\psi_{210} + \psi^*_{211}\psi_{211} + \psi^*_{21-1}\psi_{21-1}\right) \tag{2}$$

This is essentially just the average of the probability densities for each of these states. The integral of P_c is equal to 1, but we're interested in the integrand itself. The question is if the integrand P_c is symmetric. Does it depend on all coordinates r, θ and ϕ?

3.) In problem 3, explicitly calculate the integrals for the expectation values $< r >$ and $< V >$ for each m, and verify the formulae we derived in class for $< r >_{nl}$ and $< V >$. You can use these to check the results of your integration.