Phys 2053: Homework VII

due March 16, 2016

Hydrogen Atom

1. (*5 pts*)
Go to the following website
http://homepages.ius.edu/kforinas/physlets/quantum/hydrogen.html
which you also find on the class homepage.

Answer the 5 questions on the web-site.

Analytic Considerations

3. (*2 pts*)
Prove that the most likely distance from the origin of an electron in the $n = 2, l = 1$ state is $4a_0$, where a_0 is the Bohr radius. Compare your answers with the graphical solution in the app of Problem 1.

4. (*2 pts*)
For the $n = 2$ states ($l = 0$ and $l = 1$), compare the probabilities of the electron being found inside the Bohr radius. Your answers should be consistent with the graphical solution you find in the app of Problem 1.

5. (*3 pts*)
For the $n = 2, l = 1$ wave functions, find the direction in space at which the maximum probability occurs when $m_l = 0$ and when when $m_l = \pm 1$. Compare your solution with the graphical solution in the app of Problem 1.

6. (*2 pts*) For each l value, the number of possible states is $2(2l + 1)$. Show explicitly that the total number of states for each principal quantum number is

$$\sum_{l=0}^{n-1} 2(2l + 1) = 2n^2 \tag{1}$$