CHAPTER OVERVIEW

14: Atomic Orbitals

In this chapter, we will be talking primarily about the Hydrogen atom. However, a lot of what we are saying will be an approximation to other atoms. In the Hydrogen atom, there are just two particles interacting, an electron and a proton. The proton is more than a thousand times more massive than the electron. That means that as a result of their interaction, the electron moves far more than the proton does. As such, we can view it as an electron moving about in the potential of the proton. Except for the fact that it provides this potential, to first order we can ignore the proton, and just consider the electron as the quantum mechanical particle.

For other atoms, there are additional electrons. The energy levels that we have calculated for Hydrogen can very easily be adapted to take into account a nucleus with more protons— all you have to do is multiply all of the energy levels by Z^2, the square of the number of protons in the nucleus (which is also the positive charge of the nucleus). We can then approximate other atoms by putting electrons into all of these energy levels. Because electrons are fermions, we can only put two into any given orbital. (Two because there are two possible spin states for an electron.) However, this implicitly assumes that the electrons are interacting only with the nucleus, and not with each other. That approximation will allow us to get a lot of insight into the structure of (for example) the Periodic Table of the elements, but is too much of an approximation to be able to figure out precise energy levels.
