2.3: Complex Functions

The concepts of complex conjugate and modulus that we discussed above can also be applied to complex functions. For instance, in quantum mechanics, atomic orbitals are often expressed in terms of complex exponentials. For example, one of the *[Math Processing Error]* orbitals of the hydrogen atom can be expressed in spherical coordinates (*[Math Processing Error]*) as

[Math Processing Error]

We will work with orbitals and discuss their physical meaning throughout the semester. For now, let's write an expression for the square of the modulus of the orbital (Equation *[Math Processing Error]*):

[Math Processing Error]

The complex conjugate of a complex function is created by changing the sign of the imaginary part of the function (in lay terms, every time you see a +*[Math Processing Error]* change it to a -*[Math Processing Error]*, and every time you see a -*[Math Processing Error]* change it to a +*[Math Processing Error]*). Therefore:

[Math Processing Error]

Notice that *[Math Processing Error]* is **always** real because the term

[Math Processing Error]

This has to be the case because *[Math Processing Error]* represents the square of the modulus, and as we will discuss many times during the semester, it can be interpreted in terms of the probability of finding the electron in different regions of space. Because probabilities are physical quantities that are positive, it is good that *[Math Processing Error]* is guaranteed to be real!

> Confused about the complex conjugate? See how to write the complex conjugate in the different notations discussed in this chapter in this short video: http://tinyurl.com/ lcry7ma