Assignment #1.

1. (4pt.) The 2-*path* experiment involves electrons with the properties of *Hardness* and *Color* and the Big Question we asked was: "What path does an individual *white* electron take?" The answer turned out to be very non-classical: Not path *h*, not path *s*, not *both* at the same time, and not even *neither* at the same time! The 2-*slit* experiment is the same type of experiment. Classically, we'd think that electrons fired at a wall with two slits could follow one of two paths: they could go through the top slit, or they could go through the bottom slit. If we're imaginative, we could even suggest that maybe electrons will go through *both* slits at the same time, or they may even go through *neither* slits at the same time (if we're imagining electron *waves*, for instance). Tell a story similar to that told about the 2-path experiment that explains why we *can't* say any of the above about electrons fired at two slits. (Why do the results of the 2-slit experiment suggest that none of the four classical answers is adequate?) *Hint*: See Albert's discussion at the end of Chap 1.

2. (3pt.) Experiments that involve lining up "Color" and "Hardness" boxes next to each other seem to indicate that we can't know simultaneously what the *Color* and *Hardness* of an electron are. What about the possibility of constructing a "Color and Hardness" box (like the one in Figure 1.3 in Albert Chap 1)? This would supposedly measure both *Color* and *Hardness* of any incoming electron at the same time. Why can't such a composite box be built if all we have to work with are individual "Color" boxes and individual "Hardness" boxes (*i.e.*, why can't we build it as a composite box whose components are individual "Color" and "Hardness" boxes)?

3. (3pt.) A *state* of a physical system is just a description of the system at an instant in time in terms of its properties. In classical mechanics, states are represented by points (in *phase space*). In quantum mechanics, states are represented by vectors (in a vector space). The motivation for the latter is that quantum systems can be in states in superpositions. What is it mathematically about vectors that lets us represent such states in superpositions? Why do you think states in superpositions can't be represented in classical mechanics?