24.111 Philosophy of QM Spring, 2002

Assignment #4: The Quantum Mechanical Representation of States (due Lec #9)

READING: Chapter 2 of Albert; chapters 1 – 3 of Hughes.

Read the appended passage from van Fraassen's *The Scientific Image*, beginning with "In quantum mechanics we can find…" and ending with "The observable phenomena which are actual, however, are the same." Write a short but careful critique of his reasoning in this passage (2 or 3 pages should suffice), drawing on what you now know about how states are represented in quantum mechanics. Specifically, you should answer all of the following questions: What, precisely, is the claim that van Fraassen is trying to establish? What argument does he give for this claim? Assuming his argument is a good one, is its conclusion in fact confined to the special case van Fraassen considers (namely, that of an operation on vectors corresponding to a rotation through 2π radians)? Or could the same argument be used to establish a much more general claim about when two vectors represent different states? *Is* his argument any good—and if not, why not?

Hint: Pay special attention to van Fraassen's reasoning in the second-to-last paragraph, and keep the following sermon in mind: One commits a "use/mention" fallacy when one conflates a property of a *representation* with a property of the thing it *represents*—as, for example, when we infer from the claim that "Ned" has three letters in it to the claim that Ned has three letters in him. (The fallacy gets its name because in the first kind of claim the name is *mentioned* whereas in the second it is *used*.) There is good reason to think that in the following passage van Fraassen commits something like the use/mention fallacy: "If ψ and $R_{2\pi}\psi$ really represented exactly the same physical state, then the superposition $(k\phi + m\psi)$ would represent the same state as $(k\phi + mR_{2\pi}\psi)$." Why would anyone think that this claim is true?