Homework 11

Due Tuesday, March 12th in class

Read Chapter 2 of *A Brief History of the Philosophy of Time*, by A. Bardon (.pdf provided)
Re-read Ch. 6 - 8 of Jespersen and Fitz-Randolph.

Questions from the reading, our quantum mechanics lecture, and lab to think about and answer:

1. In the reading, Bardon contrasts *empiricism*, represented by Locke's views with *idealism*, represented by Kant's views. Summarize your understanding from what you read and your own ideas about what *empiricism* and *idealism* mean when we are thinking about time.

2. What Bardon calls "Locke's mistake" is explained in the first section, and summarized at the very end of that section. Put in your own words why you agree or disagree with Bardon's claim that "(Locke's) story about deriving the very idea of succession from experience can't work as it stands."

3. The last part of the Bardon chapter sets the stage for later discussions we will have about the psycho-physiology of time perception. If experiments tell us that our experience of 'now' is actually a perception of some short interval of time (but not an instantaneous moment), how could that be folded into our earlier discussions about the relativity of simultaneity?

4. Excited atoms undergo *spontaneous emission* of light as their electrons drop from a higher energy state to a lower energy state. The energy of the emitted photon is determined by the energy difference of the initial and final electron state energies:

$$E_\gamma = E_{\text{initial}} - E_{\text{final}} \; .$$

   Use the material on the Doppler effect around page 57 of J & F-R and our Thursday lecture to explain this idea:

   (a) If a group of randomly moving atoms all undergo the same spontaneous emission process, the light they produce will have a range of frequencies as viewed in the lab. Why?

   (b) Why does cooling the atoms down make this spread of frequencies narrower?

5. Re-read pp. 41-46 in Chapter 4 of J & F-R to answer these questions about the Quality Factor, applied to the idea of atoms decaying by spontaneous emission. This emission is like an oscillation; how long the atom lasts before decaying is like the number of cycles before the oscillation dies out; the range of emission frequencies observed is like the resonance curves that J & F-R show (and you measured in lab yesterday).

   (a) If an atom decays quickly, is that a large or small Q-factor? Will that give a wide or narrow resonance peak?

   (b) If an atom decays slowly, is that a large or small Q-factor? Will that give a wide or narrow resonance peak?