PHGN 480: Laser Physics due 3 Sept 2012
Homework 1

You may use other resources for these (other texts, web), but cite what you use.

1) The following are useful for making estimates – you should memorize these relations:
   a. Wavelength of a photon that has 1eV in energy
   b. Energy (in eV) of a photon with wavelength of 1μm.
   c. Energy (in eV) for kT at room temperature (300K).
   d. Show that for light, $\frac{\Delta\lambda}{\lambda_0} = \frac{\Delta\omega}{\omega_0} = \frac{\Delta\nu}{\nu_0} = \frac{\Delta\sigma}{\sigma_0}$, where the Δ's correspond to bandwidth, and the denominators correspond to the central carrier frequency (or wavelength…). The symbols, in order are: wavelength, angular frequency, frequency, and wavenumber. In these expressions, you can drop any sign you get in the derivation.
   e. These relations are useful to convert spectral bandwidth into different units. As an example, calculate the bandwidth in nm ($\Delta\lambda$) for a signal with $\Delta\nu = 4\times10^{13}$ Hz for the two cases, where the central wavelength is 800nm and 200nm. (Background: the bandwidth required for a laser pulse of a given duration is inversely proportional to $\Delta\nu$, independent of the central frequency or wavelength.)

2) Hooker & Webb (H&W) problem 1.2

3) H&W problem 1.3. For part b, consider a photon moving at a velocity *c* an angle to a plane with a hole of area *A*. The projection of the velocity perpendicular to the plane is lower, as is the hole area. Average over the angles to get the factor.

4) H&W problem 2.1

5) H&W problem 2.2