Physics 404 and 690-03: Intro to AMO Physics
Due date: Friday, February 3, 2012

Problem Set #1

Basic Review, Coherence, and Semi-Classical Atomic Physics

1. Intensity, electric field, and magnetic field of a laser
Calculate the intensity, electric field, and magnetic field of a laser beam at 780 nm with 10 mW of power and a flat intensity distribution over a disk of 10 μm in diameter. Calculate the photon flux (photons/second) for the laser beam.

2. First and second order coherence
Consider a parallel light beam whose field contains a large number of contributions from plane waves with the same frequency and wavevector, but with a random distribution of amplitudes and phase angles. Calculate the first-order and second-order degree of temporal coherence, $g^{(1)}(\tau)$ and $g^{(2)}(\tau)$ of this light field.

3. Hanbury-Brown and Twiss Experiment
Write a 1 page essay (double-spaced) summarizing the Hanbury-Brown and Twiss paper and the associated letter by E. Purcell – you may choose to concentrate on one or two aspects of the papers rather than the entire papers.

Extra graduate student problem
4. Total cross-section of a semi-classical atom
Show that the on-resonance total scattering cross-section for a classical atom is given by:

$$\sigma_{classic,\,on-resonance} = \frac{3}{2\pi}\lambda^2$$

where λ is the wavelength of incident on-resonance light.