Physics 404 and 690-03: Intro to AMO Physics
Due date: Thursday, February 15, 2024

Problem Set #2

Basic Review, Coherence, and Semi-Classical Atomic Physics

1. Intensity, electric field, and magnetic field of a laser

(a) 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.

(b) 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.

(a) Calculate the first-order degree of temporal coherence $g^{(1)}(\tau)$ of this light field.

(b) Calculate second-order degree of temporal coherence $g^{(2)}(\tau)$ of this light field.

Extra graduate student problem

3. 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.