Optics I: Theory CPHY 6/72250
Assignment 4.

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Due: Nov. 16, 2017

1. Red light with wavelength $\lambda = 632.8nm$ and intensity of $1kW/m^2$ is normally incident on a mirror. Calculate the radiation pressure. (Force is the rate of change of momentum; consider the rate of change of linear momentum of the photons.)

2. Circularly polarized green light $\lambda = 532nm$ and intensity $1kW/m^2$ is normally incident on a black piece of paper with dimensions $1cm \times 1cm$. The light is completely absorbed. Calculate the torque on the paper (give magnitude and direction.) (Torque is the rate of change of angular momentum; consider the rate of change of angular momentum of the photons.)

3. Consider two identical sinusoudal plane electromagnetic waves propagating in opposite directions.

   (a) Sketch the electric field $\mathbf{E}$ in space at different times.

   (b) Sketch the magnetic field $\mathbf{H}$ in space at different times.

   (c) Give an expression for the Poynting vector $\mathbf{S} = \mathbf{E} \times \mathbf{H}$.

   (d) Sketch the energy density averaged over time as function of position.

4. Recalling that $R = rr^*$, plot R^σ and R^π for an air-glass interface ($n1 = 1.0$, and $n2 = 1.7$) for the cases.

   (a) when light is incident from the air side, and

   (b) when light is incident from the glass side.

5. As the sun rises over a frozen pond, an angle will be reached when its image on the surface of the ice ($n = 1.31$) is completely linearly polarized in a plane parallel to the surface. What is the incident angle?