Set #2

5. Refraction (Snell's law) is commonly understood within the context of classical electrodynamics in terns of "waves".

Should one adopt a description of electrodynamics in terms of "particles", could such refraction still be described in terms of "photons". Explain your reasoning.

6.

a. Compute the De Broglie wavelength (λ_{DB}) associated with a molecule of air ($\sim N_2$) in your room (STP).

Compute the average distance (d) between molecules (STP) and compare d and λ_{DB}.

b. Is this any different from the case discusse din class foe a conduction band electron (STP). Briefly explain.

7.

In a single-photon double-slit experiment the (single-photon "sp") source has been generated via a time-correlated photon parametric down-conversion process whereby a photon (pump) of energy $\hbar\omega_p$ is converted into a "pair" of photon each having energy $\hbar\omega_{sp}$.

a. If $\lambda_p = 355\ nm$ is the pump photon wavelength, compute the photon wavelength λ_{sp} of the down-converted single-photon impinging onto the double slit.

b. In a real experiment we need to place a "lens" between the image plane of the two slits and the farfield screen where the interference pattern is generated. Draw a scheme of the double slit interferometer showing all its components.

c. Derive an expression for the distance between the fringes in terms of the wavelength λ_{sp}, the lens focal length f and the distance d between the two slits.

d. Assuming that the center-to-center distance between the two slits is $d \simeq 500\ \mu m$, the focal length $f \simeq 500\ mm$, "estimate" the fringes distance. Compare your result with the observed fringe spacing that you may infer from the data collected (photon by photon) in the attached video.