1 A Dipole on an Air/Dielectric Interface

- For a dipole sitting on an air/dielectric interface ($n_1 = 1, n_2 = 1.5$) calculate the ratio between the energy radiated into the upper half-space and the energy radiated into the lower half-space.

- Perform the calculations separately for a horizontal and a vertical dipole.

- Additionally, please calculate the apparent quantum yield, which is defined as the ratio between the power radiated in the lower half space and the total dissipated power.

2 Outcoupling Efficiency of a Dipole out of a Diamond Matrix

- Consider a dipole (SiV color center, $\lambda = 738$ nm) located 10 nm inside a semi-infinte diamond medium ($n = 2.4$). Calculate the apparent quantum yield of the dipole for vertical and horizontal orientation with respect to the interface with air using geometrical-optics arguments. Consider light collection in the air medium ($n = 1$).

- Would the apparent quantum yield change in the wave-optics picture?

- Comment on how the fluorescence collection efficiency varies as a function of the numerical aperture of the collection lens for a defect center surrounded by air and surrounded by diamond.