

Exercise for week 4: 29.09.2025

The fluorescence excited in a semi-infinite (in two directions) quartz plate ($n_{400 \text{ nm}} = 1.57$), containing a fluorochrome, by a colimated beam of UV light is **isotropically** emitted in the “violet” (400 nm), i.e. at a wavelength that is not absorbed by the fluorochrome or other absorbers.

- a) What is the critical angle θ_c at the quartz-air interface?
- b) Find the proportion of fluorescent photons that will:
 - i) Exit the quartz plate (neglect the reflections of the photons with $\theta < \theta_c$ at both interfaces) and
 - ii) Be totally reflected at the interfaces.
- c) What would be the answer to b) if
 - i) the refractive indices were equal?
 - ii) The quartz plate is immersed in water ($n_1 = 1.345$)
- d) What is the theoretical fluence rate of the fluorescence in the semi-infinite plate if it is uniformly illuminated with 1 mW/cm^2 of blue light over one side (fluorescence quantum yield of the fluorochrome: 5 %)?
(Neglect the scattering of light in the quartz plate).

