5. Anemometer (6 points)

Anemometer is a device measuring flow rate of a gas or a fluid. Let us look the construction of a simple laser-anemometer. In a rectangular pipe with thin glass walls flows a fluid (refractive index $n = 1{,}3$), which contains light dissipating particles. Two coherent plane waves with wavelength $\lambda = 515\,\mathrm{nm}$ and angle $\alpha = 4°$ between their wave vectors, are incident on a plate so that *(a)* angle bisector of the angle between wave vectors is normal to one wall of the pipe and *(b)* pipe is parallel to the plane defined by wave vectors. Behind the pipe is a photodetector, that measures the frequency of changes in dissipated light intensity.

1) How long is the (spatial) period Δ of the interference pattern created along x-axis (see Figure; 2 pts)?

2) Let the oscillation frequency of the photometer signal be $\nu = 50\,\mathrm{kHz}$. How large is the fluid's speed v? What can be said about the direction of the fluid flow (2 pts)?

3) Let us consider a situation, when the wavelengths of the plane waves differ by $\delta\lambda = 4{,}4\,\mathrm{fm}$ ($1\,\mathrm{fm} = 10^{-15}\,\mathrm{m}$). What is the frequency of signal oscillations now (fluid's speed is the same as in previous section)? Is it possible to determine the flow direction with such a device (2 pts)?

