Single Photon Interference - Pre-lab exercise

You can use the lab report template to prepare the submission of the pre-lab exercises. Feel free to use calculations or graphs in your final report, but you don't need to include prelab with the report.

1. Theoretical graph

This lab uses the most complex fitting functions of all. Make a plot (with a computer!) of equation 1 using reasonable guesses for the necessary parameters. For example, the slit width a is on the order of a 100 μm, the two slits are separated by several slit widths, the laser wavelength is $\lambda = 650$ nm, and the distance between the slits and the viewing screen is $\ell \approx 50$ cm). You can assume $I_0 = 1$. Make sure you create enough points along the x axis to clearly see the features of the plot (refer to figure 6). A range of $-0.5 < x < +0.5$ cm should work well. Note: if you code this function in colaboratory or matlab it will be usable to fit your data. A good function "signature" (in python) is:

```
def f(x, I0, d, a, lam, L):
```

Use your plotting ability to answer these questions:

- What happens with separation between maxima or minima if we increase d? What if we decrease it?
- Same question, but for a.
- Same question, but for λ
- Same question, but for ℓ

Use these insights in setting the initial parameters when fitting your experimental data.

2. Experimental parameters estimation

The main objective of this lab is to observe particle-like behavior of photons. To verify that photons interfere with themselves, rather than with other nearby photons, we have to be sure that the rate of photons in this measurement is low enough that only one of them is in the vicinity of the double slit at any given time. You need to work through the steps in the Appendix B "Computing the photon rate", roughly estimating the photon flux in the apparatus. In this pre-lab summarize the results of such estimation, including the numbers you calculate at each stage. Write a nice bit of narrative text, not just a bunch of bullets with numbers. This should be about a paragraph long.

3. Odds and ends

1. How far does the detector slit move if you turn the micrometer from 300 to 350?
2. Fill in the blanks: "The _____ should never be exposed to room light, especially with _____."