Week 6 - Week commencing 7/3/2022

Week Outline

Online meeting to cover error fixing in the Python code and to discuss the next step of the project. After obtaining the power received by the detector, we can now calculate the photon noise as a quadrature sum of the wave noise and shot noise. The formulas for calculating them are as follows:

$$shot\ noise = \sqrt{2P_{opt}hv}$$

Where v is the frequency, found from the midpoint of the bandwidth and P_{opt} is the optical power calculated from last week.

$$wave\ noise = \frac{P_{opt}}{\sqrt{2dv}}$$

Where dv is the bandwidth.

$$Total\ photon\ noise = \sqrt{WaveNoise^2 + ShotNoise^2}$$

Following this, we can also calculate the power emitted by the hot bar with room by using the same procedure as for the room power with the addition of the Beam Filling factor:

$$P = (BeamFillingFactor)\lambda^2 \int B(v)\ Transmission\ \ dv$$

Then, the response of the hot bar in terms of power:

$$Response = \frac{dF0}{P_{hotbar}}$$

Then, finally the NEP can be found:

$$NEP = \frac{\sqrt{e_n}}{Response}$$

Tasks Outline

- Calculate the shot noise and wave noise using the optical power P_{opt} obtained last week
- Use the shot and wave noise to calculate the total photon noise
- Find the power of the hot bar using the equation given previously
- Use this power to find the response of the detector in terms of the power
- Calculate the NEP

Results

The results was calculated using the given equations to find the NEP. KID 2 was used as it has the clearest data:

- Total Photon Noise:

$$Total\ Photon\ Noise = \ 8.4367 \times 10^{-16} \frac{W}{Hz^{0.5}}$$

- Modelled P:

$$P = 2.6105 \times 10^{-10}\ W$$

- Room power P_{room}:

$$P_{room} = 2.4527 \times 10^{-10}\ W$$

- Hot bar power dp:

$$dP = P - P_{room} = 1.9800 \times 10^{-11}\ \ W$$

- NEP:

The NEP can now be calculated from the previous equations, dp and the noise spectral density. The NEP for KID 2 is given: