Quantum optics lab report

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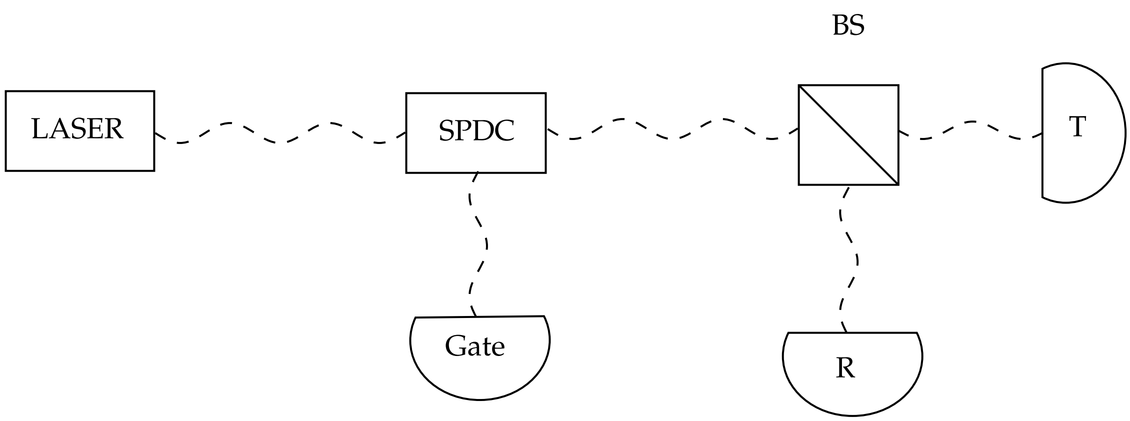

Figure 1: SPDC setup.

1 Photon statistics

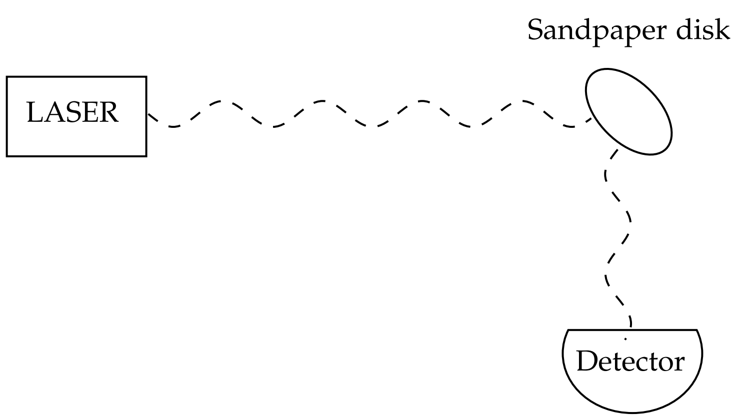

Figure 2: Sandpaper setup.

1.1 Analysis

With the sandpaper disk kept stationary, we expect the coherent state of the laser to be preserved, and therefore to have

$$\mathbb{P}(n) = \frac{e^{-\overline{n}}\overline{n}^n}{n!}\,, \tag{1}$$

while if the sandpaper disk is rotating we expect to see a thermal distribution, with

$$\mathbb{P}(n) = \frac{\overline{n}^n}{(1+\overline{n})^{n+1}}\,. \tag{2}$$

In order to see how these theoretical distributions compare to the data, we compute their first moments: the mean

$$\overline{n} = \sum_n \mathbb{P}(n)n\,, \tag{3}$$

the variance

$$\sigma^2 = \sum_n \mathbb{P}(n)(n-\overline{n})^2\,, \tag{4}$$

the normalized skewness

$$\text{skewness} = \frac{1}{\sigma^3}\sum_n \mathbb{P}(n)(n-\overline{n})^3\,, \tag{5}$$

and the normalized kurtosis

$$\text{kurtosis} = \frac{1}{\sigma^4}\sum_n \mathbb{P}(n)(n-\overline{n})^4\,. \tag{6}$$

The only parameter the distributions depend on is the mean; so starting from it we compute these moments. The results, for window sizes varying from 10 ns to approximately 3 ms, are shown in figure 3.

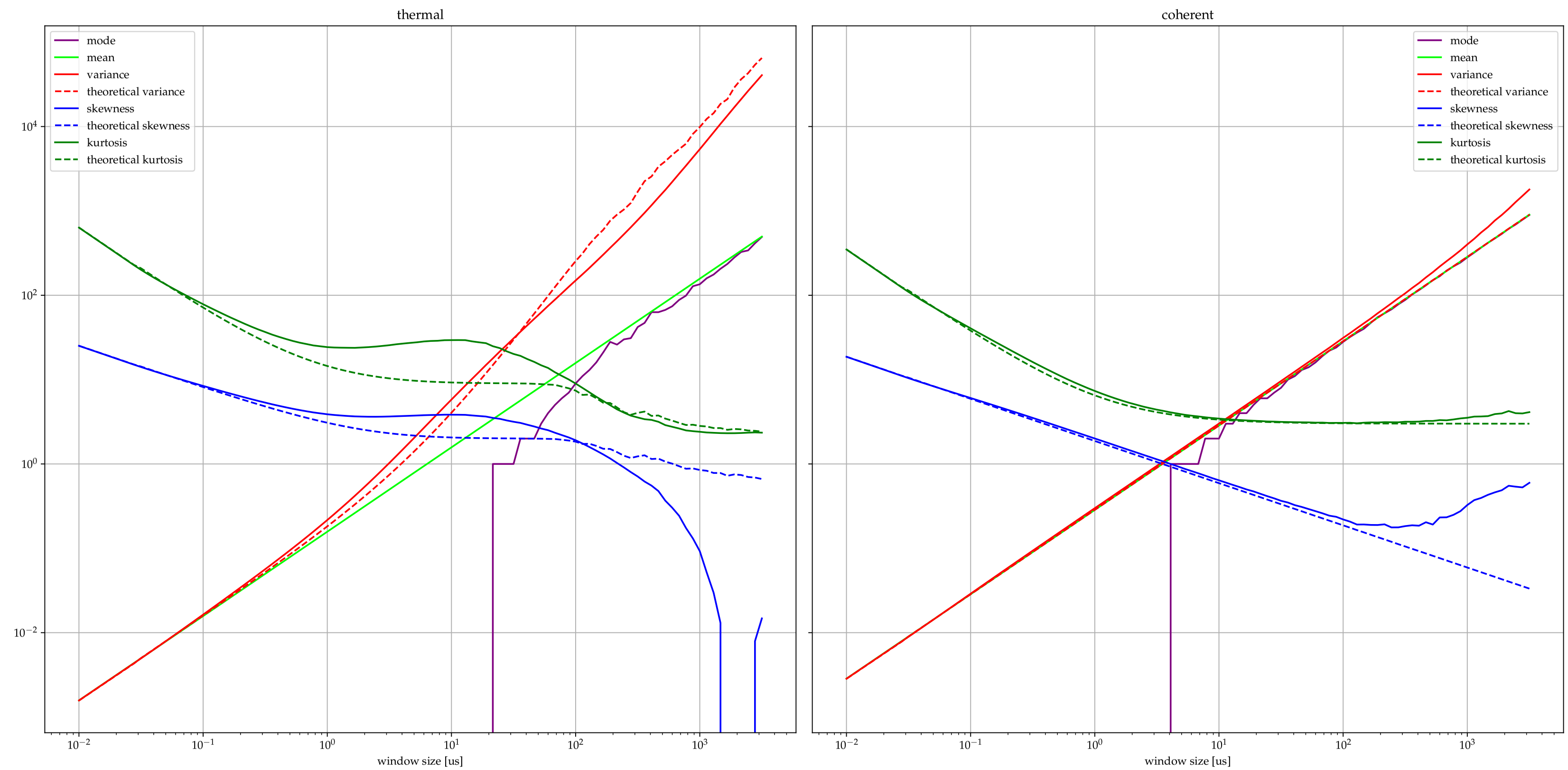

Figure 3: Photon statistics.