Assignment 5

Brage Bøe Svendsen

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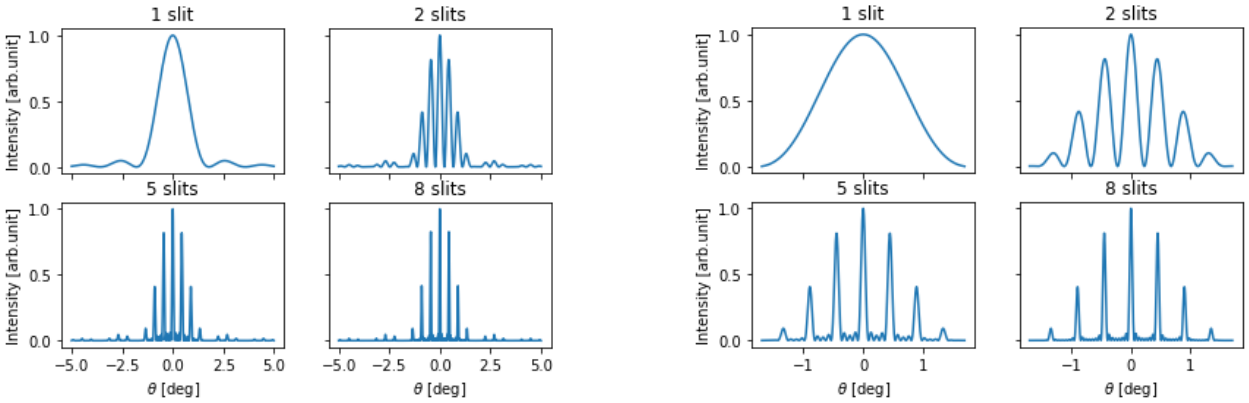
1 A5-1

We here study the diffraction pattern for multiple slit systems ($N = 1, 2, 5, 8$) when the wavelength is 532 nm and slit separation is $a = 68\mu$m. The intensity will be normalized with respect to the center peak, so distance to observation plane (5 meters) is irrelevant.

Figure 1 shows the diffraction patterns when the slit width is $b = 17\mu$m, i.e. $a = 4b$. The plot is shown twice, where the right-hand figure is zoomed in on the first diffraction maximum, in order to make out the details of the interference pattern.



(a) (b)

Figure 1: Intensity diffraction pattern when slit width is $b = 17\mu$m. (b) shows the same plot as (a) but zoomed in at the first diffraction maxima.

Figure 2 shows the diffraction patterns when the slit width is $b = 34\mu$m, i.e. $a = 2b$.

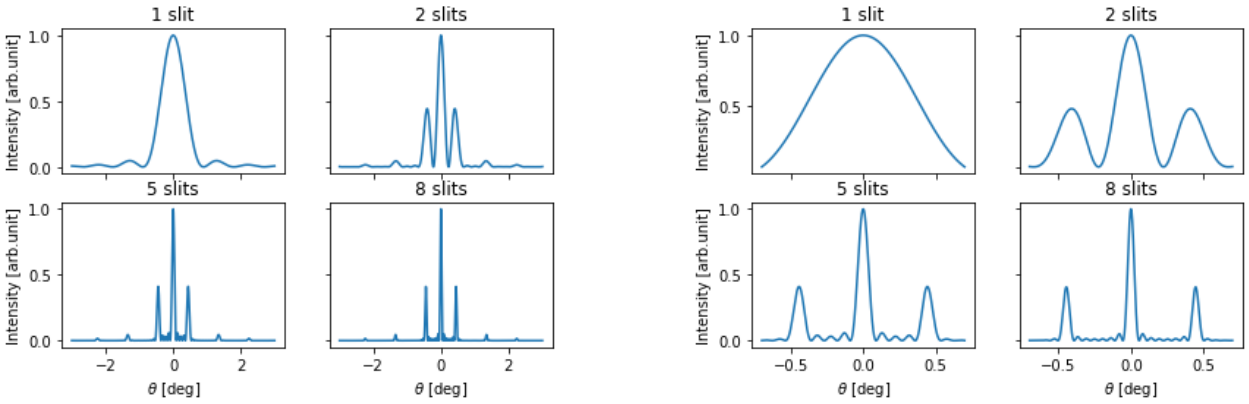
2 A5-2

Diffraction envelope minima are found when the slit width variable is $\beta = m\pi$, or equivalently

$$m\lambda = b \sin\theta \tag{1}$$

where $m = \pm 1, \pm 2, ...$ Similarly, we find interference maxima when $\alpha = p\pi$, i.e.

$$p\lambda = a \sin\theta \tag{2}$$



(a) (b)

Figure 2: Intensity diffraction pattern when slit width is $b = 34\mu$m. (b) shows the same plot as (a) but zoomed in at the first diffraction maxima.

where $p = 0, \pm 1, \pm 2, ...$ The condition for missing orders is found by dividing equation (1) by equation (2). That is, the condition at which diffraction minima and interference maxima coincide at the same point θ in the pattern. Doing this we find the missing order condition

$$a = \frac{p}{m} b. \tag{3}$$

We see from equation (3) that missing orders are independent from wavelength.

In figure 11-14d) in PPP, I count 10 fringes before they become completely dark at first minimum, when starting from the center and going either direction left or right. Following the discussion in the book section 11-6 the slit separation must then be $a = 10b$.

Figure 3 shows the diffraction pattern for such a double-slit arrangement, computed with the same code as in section A5-1. We note that the second diffraction maxima in figure 11-14d) has 8 interference peaks, which is also the case in figure 3.

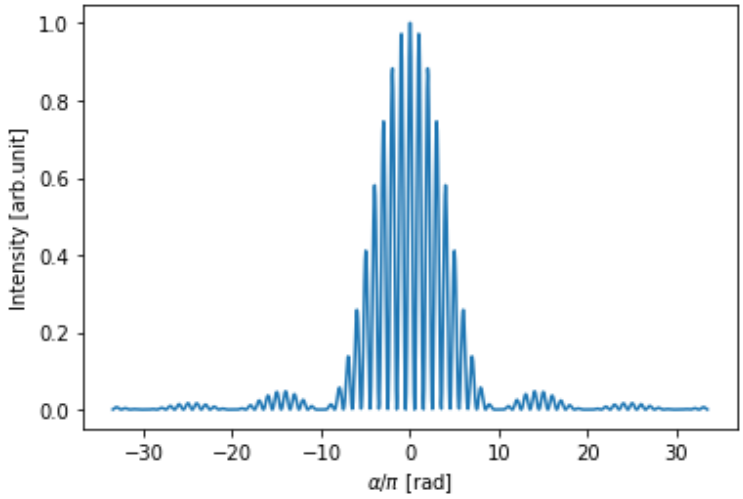


Figure 3: Numerical replication of figure 11-14d) in the book PPP, with $a = 10b$.