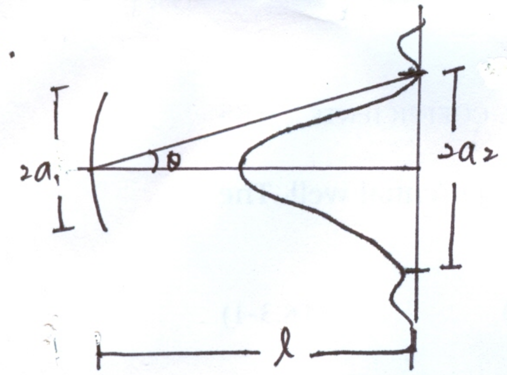
1.



取 $m=1$ 處，

繞射的第一暗紋 $<$ a_2

$$a_1\sin\theta = m\lambda,\quad m=1.$$

$$\theta = \frac{\lambda}{a_1}$$

又 $\theta < \dfrac{a_2}{l}$ $\Rightarrow$ 得 $\dfrac{a_1 a_2}{\lambda l} > 1$

2、 $k_x = \dfrac{2\pi l}{L}$， $k_y = \dfrac{2\pi n}{L}$， $k_z = \dfrac{2\pi m}{L}$.

$$\left(\frac{\varepsilon}{\varepsilon_0}\right)\frac{\omega^2}{c^2} = k^2 = k_x^2 + k_y^2 + k_z^2,\quad k = \sqrt{k_x^2 + k_y^2 + k_z^2} = \frac{2\pi n}{\lambda} = \frac{2\pi \nu_n}{c}.$$

$$dk = dk_x\, dk_y\, dk_z = \left(\frac{2\pi}{L}\right)^3$$

$$N_k = \frac{\frac{4}{3}\pi k^3}{\left(\frac{2\pi}{L}\right)^3}\times 2 = \frac{k^3 L^3}{3\pi^2} = \frac{8\pi \nu_n^3 L^3}{3c^3} \Rightarrow \frac{N_\nu}{V} = \frac{8\pi \nu^3 n^3}{3c^3}$$

$$\rho(\nu) = \frac{1}{V}\frac{dN_\nu}{d\nu} = \frac{8\pi \nu^2 n^3}{c^3} \Rightarrow N(\nu) = \frac{8\pi \nu^2 n^3}{c^3}d\nu$$

3.

$$\begin{bmatrix} r_{s+1} \\ r'_{s+1} \end{bmatrix} = \begin{bmatrix} 1 & d \\ -\frac{1}{f} & \left(1-\frac{d}{f}\right) \end{bmatrix} \begin{bmatrix} r_s \\ r'_s \end{bmatrix}$$

$$\begin{cases} r_{s+1} = A r_s + B r'_s \\ r'_{s+1} = C r_s + D r'_s \end{cases} \qquad A=1.\ B=d.\ C=-\frac{1}{f},\ D=\left(1-\frac{d}{f}\right)$$

$$\frac{1}{B}\left(r_{s+2} - A r_{s+1}\right) = C r_s + D r'_s$$

$$r_{s+2} - (A+D) r_{s+1} + (AD-BC) r_s = 0 \qquad b = \frac{1}{2}(A+D)$$

$$r_{s+2} - 2b r_{s+1} + r_s = 0,$$

令 $r_s = \rho e^{is\theta}$

$$e^{2i\theta} - 2b e^{i\theta} + 1 = 0$$

$$e^{i\theta} = b \pm i\sqrt{1-b^2},\quad b^2 \le 1,\quad b = \cos\theta.$$

$$-1 \le \frac{1}{2}\left(2 - \frac{d}{f}\right) \le 1.$$

$$0 \le 1 - \frac{d}{4f} \le 1$$