The 7th Homework of Optics

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5-2

设物距为 s，

$$U_{in} = \frac{Ae^{ikz}}{z} e^{ik\frac{x^2+y^2}{2s}}$$

$$U_{out} = U_{in}U_L = \frac{Ae^{ikz}}{z} e^{ik\frac{x^2+y^2}{2s}} \times e^{-ik\frac{x^2+y^2}{2F}} = \frac{Ae^{ikz}}{z} e^{ik\frac{x^2+y^2}{2s'}}$$

$$\Longrightarrow \omega_{in} = k\frac{x^2+y^2}{2s}, \quad \omega_{out} = k\frac{x^2+y^2}{2s'}$$

$$\Longrightarrow V = \frac{\omega_{out}}{\omega_{in}} = \frac{s'}{s}$$

5-5

在显微镜下观察的微小物体可近似看作一个点，且物近似位于物镜的前焦点上，对于相干照明，系统的截止频率由物镜孔径限制的最大孔径角 u_0 决定，故

$$f_c = \frac{\sin u_0}{\lambda}$$

截止频率的倒数即为分辨距离,

$$\delta_c = \frac{\lambda}{\sin y_0}$$

非相干时

$$\delta_c = 0.61\frac{\lambda}{\sin y_0}$$

5-6

(1)

40cm

(2)

5cm 内

(3)

$6.3 \times 10^{-3} rad = 21'42''$

(4)

6.3mm

5-7

(1)

大于 5cm

(2)

半角宽 $1'42''$

零级宽 0.78mm

(3)

半角宽 $1'42''$

零级宽 0.39mm

(4)

半角宽 $1'42''$

零级宽 0.78mm

5-9

$$I = I_0 \left(\frac{\sin N\beta}{\sin \beta} \right)^2 \qquad \beta = \frac{\pi dx'}{\lambda F}$$

5-10

(1)

x', y'	f_x, f_y
$0, 0$	$0, 0$
$0, 1$	$0, 2.8$
$\sqrt{2}/2, \sqrt{2}/2$	$2.0, 2.0$
$0.5, 2$	$1.4, 5.6$
$3, -5$	$8.3, -13.97$
$-10, -15$	$-27.8, -41.7$

(2)

$$42m^{-1}$$

5-11

(1)

形状为与 y 正交的等距细线

(2)

物光波：$\varphi_o = ky\sin\theta_o + \varphi_0$, 参考光波：$\varphi_R = -ky\sin\theta_o$

(3)

相距 2π 相位的两个点：

$$L = \lambda = 2d\sin\theta_o = 2d\sin\theta/2 \implies d = \frac{\lambda}{2\sin\theta/2}$$

(4)

将数据代入上式，

$$d_1 = 36.26\mu m, d_{60} = 0.6328\mu m$$

(5)

满足布拉格条件，构成体全息图。

$d = 0.6328\mu m$ 而底片最小分辨 $1000\mu m/3000 = 0.3\mu m$, 匹配。

(6)

$$\theta_0 = -\theta/2,\ \theta_{+1} = -\theta/2 + \theta = \theta/2,\ \sin\theta_{-1} = -\theta/2 - \theta = 3/2\sin\theta$$

5-12

$$\theta_0 = 0,\ \sin\theta_{+1} = 2\sin\theta/2,\ \sin\theta_{-1} = 2\sin\theta/2$$

5-13

$+1$ 级，$(0, y_0/2, z/2)$,

-1 级，无穷远