The 5th Homework of Optics

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2018 年 12 月 3 日

3-23

(1)

$$x = 10\lambda/2 = 2946.5nm$$

(2)

在成像边缘处

$$2nh\cos\theta = (k-12)\lambda$$

$$2nh'\cos\theta = (k-10-5)\lambda$$

$$\Longrightarrow \cos\theta = \frac{k-12}{k} = \frac{k-15}{k-10}$$

$$\Longrightarrow k = 17$$

(3)

由第二问 $k = 17$

$$k' = k - 10 - 5 = 2$$

3-25

$$\Delta L = 2 \times 490\lambda = 577514 = \frac{\lambda^2}{\Delta\lambda}$$

$$\Longrightarrow \Delta\lambda = 0.6nm$$

$$\Longrightarrow \lambda_1 = 589.0nm, \quad \lambda_2 = 589.6nm$$

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精度为：

$$x = \lambda/10/2 = 31.64nm$$

量程为

$$\Delta L/2 = \frac{\lambda^2}{2\Delta\lambda} = 2 \times 10^9 nm = 2m$$

3-28

(1)

每个周期移动距离 $\Delta x = \lambda/2$

$$T = x/v = \frac{\lambda}{2v} = \frac{1}{\nu}$$

$$\Longrightarrow \lambda = \frac{2v}{\nu}$$

(2)

$$v = \frac{\nu\lambda}{2} = 15\mu m/s$$

(3)

$$x' = \lambda^2/\Delta\lambda/2 = 289395nm = 289.4\mu m$$

$$\nu' = v/x' = 0.025Hz$$

3-29

$$\frac{\lambda}{\delta\lambda} = \pi k \frac{\sqrt{R}}{1-R} \implies k = 97974$$

取 $n \approx 1$,

$$\nu_k = \frac{kc}{2nh} \implies h = 29392200nm = 29.39mm$$

3-31

(1)

$$\nu_k = \frac{kc}{2nh} \implies k = 2 * 50000/0.6 = 166667$$

(2)

$$\Delta i_k = \frac{\lambda}{2\pi nh \sin i} \frac{1-R}{\sqrt{R}} = 2.2 \times 10^{-6} rad$$

(3)

$$\frac{\lambda}{\delta\lambda} = \pi k \frac{\sqrt{R}}{1-R}$$
$$\implies \lambda/\delta\lambda = 2.6 \times 10^7, \quad \delta\lambda = 2.31 \times 10^{-5} nm$$

(4)

$$\nu_k = \frac{kc}{2nh}, \ k_{400nm} = 250000, \ k_{750nm} = 133333$$

则条数共有

$$\Delta k = 250000 - 133333 = 116667$$

频谱宽度, 取 $k = 200000, \lambda = 500nm$

$$\Delta\lambda_k = \frac{\lambda}{\pi k} \frac{1-R}{\sqrt{R}} = 2 \times 10^{-14} m$$

(5)

则 k 改变 10^{-5} 倍，$\Delta x/\lambda = 10^{-5} \times \Delta\lambda_k/\lambda = 3 \times 10^{-17} m$

3-32

(1)

$$\nu_k = \frac{kc}{2nh},\ k_{400nm} = 3.1,\ k_{750nm} = 1.65$$

$k = 2, 3$, 共 2 条

$$\lambda_1 = 413.3nm,\ \lambda_2 = 620nm$$

(2)

频谱宽度, 取 $k = 2, 3, \lambda = 620, 413nm$

$$\Delta\lambda_{620nm} = \frac{\lambda}{\pi k}\frac{1-R}{\sqrt{R}} = 4.03nm$$

$$\Delta\lambda_{413nm} = \frac{\lambda}{\pi k}\frac{1-R}{\sqrt{R}} = 1.79nm$$