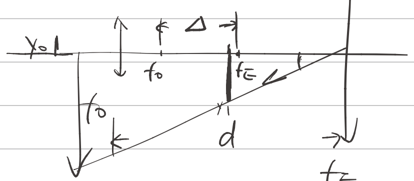
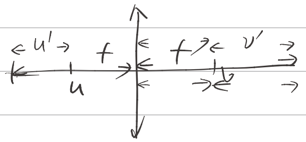
基础物理学2 期中小班辅导

△ 显微镜放大率公式推导

光学筒长. $\Delta = d - f_0 - f_E$





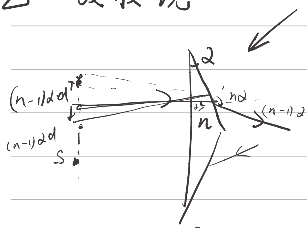
$$\frac{1}{u}+\frac{1}{v}=\frac{1}{f}$$

$$y_0 \longrightarrow y_1 = y_0 \cdot \frac{\Delta}{f_0}$$

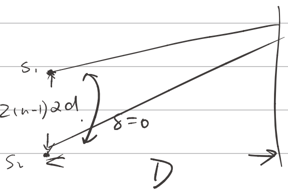
$$\left.\begin{aligned}\theta' &= y_1/f_E = y_0\frac{\Delta}{f_0 f_E}\\ s_0 &\longrightarrow \theta_0 = \frac{y_0}{s_0}\end{aligned}\right\} \Rightarrow M = \frac{\Delta s_0}{f_0 f_E}$$

$$M = \frac{v'}{f} = \frac{v-f}{f} = \frac{\frac{uf}{u-f}-f}{f} = \frac{\frac{f^2}{u-f}}{f} = \frac{f}{u-f} = \frac{v}{u}$$

△ 双棱镜

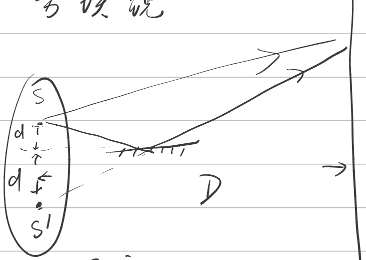


$\Rightarrow d \doteq 2(n-1)\alpha d$



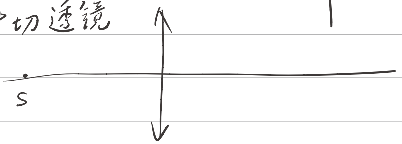
$$\Delta x = \frac{D}{2(n-1)\alpha d}\cdot\lambda.$$

△ 劳埃镜

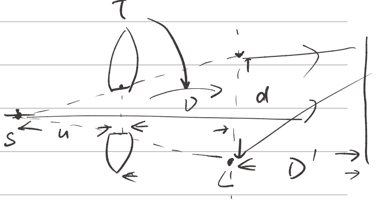


$$\Delta x = \frac{D}{2d}\cdot\lambda$$

△ 对切透镜

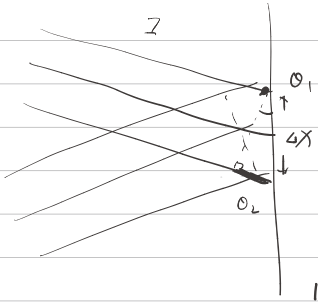


$\Rightarrow$



$$\Delta x = \frac{L-u}{d}\lambda.$$

Δ



$$\Delta x\cdot\sin\theta_1 + \Delta x\cdot\sin\theta_2 = \lambda$$

$$\Rightarrow \Delta x = \frac{\lambda}{\sin\theta_1+\sin\theta_2}.$$

$1e^{i\varphi}$

$$r_s = \frac{n_1\cos i_1 - n_2\cos i_2}{n_1\cos i_1 + n_2\cos i_2} \qquad r_p = \frac{n_2\cos i_1 - n_1\cos i_2}{n_2\cos i_1 + n_1\cos i_2}$$

$$t_s = \frac{2n_1\cos i_1}{\quad} \qquad t_p \ \frac{2n_1\cos i_1}{\quad}$$

① $\cos i_1 \to 0$ $\quad t_s.\ t_p \to 0$

② $i_1 \to 0$ $\quad t_s = t_p$ $\quad \underline{r_s = -r_p}$ 正入射

③ $\quad r^2 + tt' = 1$

正入射时的半波损失

$$n_1\sin\theta_1 = n_2\sin\theta_2 \Rightarrow k_1\sin\theta_1 = k_2\sin\theta_2 \Rightarrow k_{x_1} = k_{x_2}$$

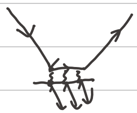
$k_z = \sqrt{k^2 - k_x^2}$ $\qquad$ 全反射 $\sin\theta_2 > 1$ $\qquad k_{x_2} = k_{x_1}$

$$k_z = \sqrt{k_2^2 - k_{2x}^2} = \sqrt{k_2^2 - k_{1x}^2} = \sqrt{\left(\frac{2\pi}{\lambda}\right)^2 n_2^2 - \left(\frac{2\pi}{\lambda}\right)^2 n_1^2\sin^2\theta_1}$$

若 $n_2 < n_1\sin\theta$ $\quad = \pm\frac{2\pi}{\lambda} i\sqrt{n_1^2\sin^2\theta - n_2^2}$ $\rightarrow$ 只能取 i

$$e^{i\vec{k}\cdot\vec{r}} \qquad e^{ik_z z}\cdot e^{ik_x x} = e^{-\frac{2\pi}{\lambda}\sqrt{n_1^2\sin^2\theta - n_2^2}\,z}\cdot e^{ik_x x}$$

$\cos\theta = \frac{k_z}{k}$ $\qquad$ 金属 $n = i\alpha$



双折射

$$\vec{k} = \alpha\vec{x} + \beta\vec{y} + \gamma\vec{z} \qquad (\alpha x, \beta y, \gamma z)$$

$$\vec{k}\cdot\vec{r} = const \qquad \alpha x^2 + \beta y^2 + \gamma z^2 = 1$$

$$\alpha = \beta$$

$$k = \frac{2\pi n \vec{e_r}}{\lambda} \qquad \vec{e_r} = \begin{bmatrix} \frac{x}{r} \\ \frac{y}{r} \\ \frac{z}{r} \end{bmatrix} \qquad n = \begin{bmatrix} n & & \\ & n & \\ & & n \end{bmatrix} = nI$$

$$n^2 = \varepsilon = \begin{bmatrix} \varepsilon_{11} & \varepsilon_{12} & \varepsilon_{13} \\ & \ddots & \\ & & \varepsilon_{31} \end{bmatrix} \qquad n = \begin{bmatrix} \sqrt{\varepsilon_x} & & \\ & \sqrt{\varepsilon_y} & \\ & & \sqrt{\varepsilon_z} \end{bmatrix}$$

$$\varepsilon = \begin{bmatrix} \varepsilon_x & & \\ & \varepsilon_y & \\ & & \varepsilon_z \end{bmatrix}$$

$$\vec{k} = \frac{2\pi}{\lambda} n\vec{e_r} = \frac{2\pi}{\lambda r}\left(\sqrt{\varepsilon_x}\,\vec{x} + \sqrt{\varepsilon_y}\,\vec{y} + \sqrt{\varepsilon_z}\,\vec{z}\right)$$

琼斯矩阵

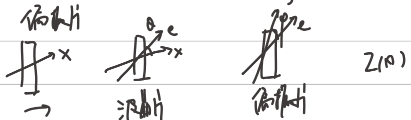
$$\vec{A} = A_x\vec{e_x} + A_y\vec{e_y} \qquad \tilde{A} = \left(A_x e^{i\varphi_x}\vec{e_x} + A_y e^{i\varphi_y}\vec{e_y}\right)e^{i(kx-\omega t)}$$

$$\tilde{A} = \begin{bmatrix} A_x e^{i\varphi_x} \\ A_y e^{i\varphi_y} \end{bmatrix} e^{i(kx-\omega t)}$$

① 偏振片 $\begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}$ $\qquad \Delta = \frac{2\pi}{\lambda}(n_o - n_e)d$

② 波晶片 $\begin{bmatrix} e^{i\frac{2\pi}{\lambda}n_e d} & 0 \\ 0 & e^{i\frac{2\pi}{\lambda}n_o d} \end{bmatrix} = e^{i\frac{2\pi}{\lambda}n_e d}\begin{bmatrix} 1 & 0 \\ 0 & e^{i\Delta} \end{bmatrix}$

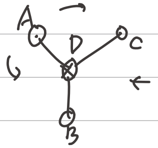
③ 坐标 $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$



$$\begin{bmatrix} A_x \\ A_y \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 0 \end{bmatrix}\begin{bmatrix} \cos\varphi & \sin\varphi \\ -\sin\varphi & \cos\varphi \end{bmatrix}\begin{bmatrix} 1 & \\ & e^{i\Delta} \end{bmatrix}\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}\begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

$$\begin{bmatrix}1\\0\end{bmatrix} = \frac{1}{2}\underbrace{\begin{bmatrix}1\\i\end{bmatrix}}_{e^{i\frac{\pi}{2}}} + \frac{1}{2}\underbrace{\begin{bmatrix}1\\-i\end{bmatrix}}_{e^{-i\frac{\pi}{2}}}$$

左旋　　右旋

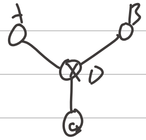


右旋 A→C→B

n_R

左旋 A→B→C

n_L



$$\begin{bmatrix}1\\0\end{bmatrix} = \frac{1}{2}\underbrace{\begin{bmatrix}1\\i\end{bmatrix}}_{e^{in_L\frac{2\pi}{\lambda}d}} + \frac{1}{2}\underbrace{\begin{bmatrix}1\\-i\end{bmatrix}}_{e^{in_R\frac{2\pi}{\lambda}d}}$$

$$= e^{in_L\frac{2\pi}{\lambda}}\begin{bmatrix}\cos\frac{\Delta}{2}\\ -\sin\frac{\Delta}{2}\end{bmatrix} \qquad \Delta = \frac{2\pi}{\lambda}(n_L - n_R)d$$

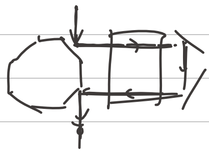
$$\begin{bmatrix}\cos\frac{\Delta}{2} & \sin\frac{\Delta}{2}\\ -\sin\frac{\Delta}{2} & \cos\frac{\Delta}{2}\end{bmatrix}$$

群速度与色散

$$n_g = n_p - \lambda\frac{dn}{d\lambda}$$

如何测量群速度？

如何测量相速度？



群速度