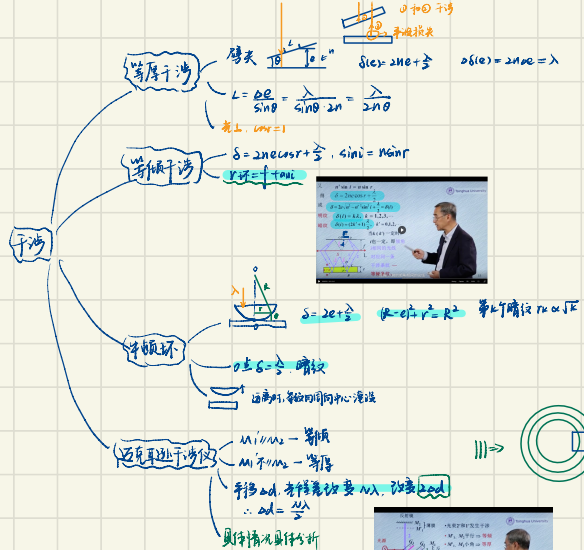


期末复习 tips 计有有限, $\lambda \rightarrow \frac{1}{\omega} \rightarrow \frac{1}{\omega}$

$I = I_0 \left(\frac{\sin \alpha}{\alpha} \right)^2 \left(\frac{\sin \beta}{\beta} \right)^2$ N : 缝个数
 $\alpha = \frac{\pi a \sin \theta}{\lambda}$, $\beta = \frac{\pi b \sin \theta}{\lambda}$
 衍射 干涉明

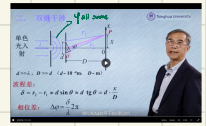
⑤ 具体干涉

- $S = 2ne \cos r + \frac{\lambda}{2}$
- $n_1 \sin i = n_2 \sin r$
- 小心取根: $\sin i = \sqrt{1 - \left(\frac{n_2 \sin r}{n_1} \right)^2} \leq 1$



① 干涉条件: 非相干光同时间, 叫稳定

$I = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos \Delta \phi$

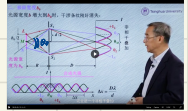


$x = D \sin \theta = D \sin \alpha$
 $\Delta x = \lambda$
 $\Delta x = \frac{\lambda}{2 \sin \theta}$
 $\Delta x = \frac{\lambda}{2 \sin \theta}$

② 干涉最大级次 $m = \frac{a}{\lambda}$

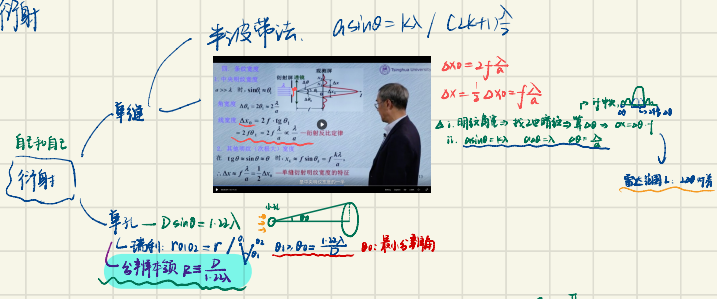
最大级次 $m = \frac{a}{\lambda}$
 相对级次 $\frac{m}{a}$
 绝对级次 m
 相干时间 τ_c

③ 光源相干宽度 $b_0 = \frac{\lambda}{\theta}$

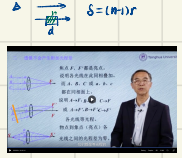


相干间隔 $d_0 = \frac{\lambda}{\theta}$ (最大间隔)
 相干孔径 $b_0 = \frac{\lambda}{\theta}$

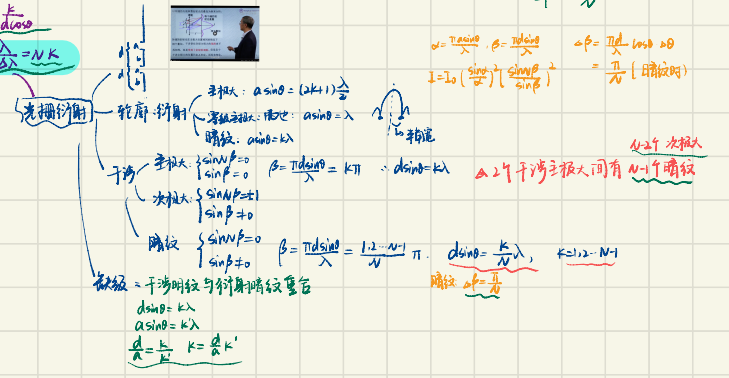
④ 衍射



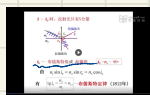
⑤ 光程 $n r$



色散 $D = \frac{dn}{d\lambda} = \frac{k}{\lambda^2}$
 分辨率 $R = \frac{\lambda}{\Delta \lambda} = N K$



② 布儒斯特角



$$n_1 \sin i_0 = n_2 \sin r_0 \\ = n_2 \cos i_0$$

△ 反射光只是垂直于入射光偏振光
折射光有平行。



③ 若沿光轴方向传播：不发生双折射

e 光沿光轴速度 $V = V_0$, $n_0 = \frac{c}{V_0}$
o 光沿光轴速度 $V_e, n_e = \frac{c}{V_e}$
 $V_0 > V_e$ 正; $V_0 < V_e$ 负



△ 当光线入射面, $\sin i = \sin r_0 \cdot n_0$,
only when $\sin r_0 = n_e$ 特殊情况下可用折射定律

主平面：光线和光轴组成平面

o 光：偏振上主平面

以光轴为对称轴的旋转椭球面

e 光：// $\Delta V_e > V_0$ 正, e 光沿上光轴方向传播 V_{max}



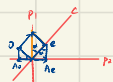
$$V_e = \frac{c}{n_e} \\ V_0 = \frac{c}{n_0}$$

通过晶片，相位差 $\Delta\varphi = |n_e - n_o| \frac{d}{\lambda} \cdot 2\pi$

△ 决定 $A_0 \neq A_0 \cos \delta$
 $A_e = A_0 \cos \delta$
 $A_o = A_0 \sin \delta$

△ 相位差 $\varphi = \frac{\pi}{2} + \delta$

偏振光干涉 $\Rightarrow$ o, e 光偏振方向不同, $\therefore$ 可干涉



$$I = A_0^2 + A_e^2 + 2A_0A_e \cos \delta \\ \Rightarrow |n_e - n_o| \frac{d}{\lambda} \cdot 2\pi + \pi$$

旋光率 $a = \frac{\varphi}{d}$

$$= \frac{\pi(n_e - n_o)}{\lambda}$$

n_e : 左旋圆偏振光 折射率

② 量子

光: $p = \frac{h}{\lambda} = \frac{h\nu}{c} = \frac{h}{\lambda} = h k$
 能量: $E = \frac{p^2}{2m} = \frac{h^2 k^2}{2m}$
 $E = h\nu = \hbar\omega$ (守恒)
 $p = \frac{h}{\lambda} = \hbar k, k = \frac{2\pi}{\lambda}$
 $\omega = \frac{E}{\hbar} = \frac{p^2}{2m\hbar} = \frac{\hbar^2 k^2}{2m\hbar} = \frac{\hbar k^2}{2m}$

$\sqrt{(m_0 c)^2 + (pc)^2}$
 always 成立

$|\psi(x)|^2 dx$ 概率 $\Rightarrow$ 归一化因子 $\int_{-\infty}^{\infty} |\psi(x)|^2 dx = 1, \psi(x) = C \psi_0(x)$
 算概率: 若对波函数叠加, 再算概率

康普顿: $\Delta\lambda = \lambda - \lambda_0 = \frac{h}{m_0 c} (1 - \cos\theta)$
 能量守恒: $h\nu_1 + m_0 c^2 = h\nu_2 + m_0 c^2$
 $h\nu_1 = h\nu_2 + E_k$
 $m\nu_1 = m\nu_2 + p_e$

$mc^2 = m_0 c^2 + E_k$
 $= \sqrt{(m_0 c)^2 + (pc)^2}$

光: $m_0 = 0$
 $E = pc$

$\Delta x \Delta p_x \geq \frac{\hbar}{2}$
 $E \sim \frac{\Delta p_x^2}{2m}$
 $\Delta x \Delta x \geq \frac{\hbar}{2}$

无限深势阱

① (0,a) 内 $U(x) = 0$
 外 $U(x) = \infty$

② $E_n = \frac{n^2 \hbar^2}{8ma^2}$
 $= \frac{p_n^2}{2m} = \frac{\hbar^2 k^2}{2m}, k = \frac{n\pi}{a}$

③ $\psi_n(x) = \sqrt{\frac{2}{a}} \sin(\frac{n\pi}{a}x) e^{-iE_n t/\hbar}$
 $U_n = \frac{E_n}{\hbar}$

一维谐振子

$E_n = (n + \frac{1}{2}) \hbar\omega = (n + \frac{1}{2}) \hbar \sqrt{\frac{k}{m}}$

$U(x) = \frac{1}{2} kx^2, \omega = \sqrt{\frac{k}{m}}$
 $= \frac{1}{2} m\omega^2 x^2$

薛定谔方程

薛定谔方程: $\hat{H}\psi(x,t) = [-\frac{\hbar^2}{2m} \frac{\partial^2}{\partial x^2} + U(x)] \psi(x,t) = E\psi(x,t)$

① 量子化条件 $L_n = m v r_n = n \hbar$

$m = n^2 r_1$
 $E_n = \frac{1}{n^2} E_1, E_1 = -\frac{me^4}{2(4\pi\epsilon_0)^2 \hbar^2}$
 $E_1 (\frac{1}{n_1^2} - \frac{1}{n_2^2}) = h\nu$ 跃迁

② 轨道角动量 $L = \sqrt{l(l+1)} \hbar$
 $L_z = m_l \hbar$

$l = 0, 1, \dots, n-1$
 $m_l = 0, \pm 1, \pm 2, \dots, \pm l$
 $n = k, l, m, \dots$
 $l = s, p, d, f, g, \dots$
 次壳层

自旋角动量 $S = \sqrt{s(s+1)} \hbar$
 $S_z = m_s \hbar$
 $s = \frac{1}{2}, m_s = \pm \frac{1}{2}$

总角动量 $J = \sqrt{j(j+1)} \hbar$
 $j = l \pm s = l \pm \frac{1}{2}$
 $\vec{J} = \vec{L} + \vec{S}$

除0外, 磁量子数 E_{m_l} 可细分为2个能级

最多: $\frac{2(l+1)}{2} = l+1$ 个电子
 自旋1+1

$\omega_B = \frac{e\hbar}{2me}$

$E = E_{m_l} \pm E_S$

$\Delta E = 2E_S = 2\mu_B B$

② X射线 $\sqrt{V_{max}} = 0.496 \times 10^8 (V-1)$

变数衍射 $(\frac{dN}{dV})_{\theta} = N_2 / N_1$

吸收 $(\frac{dN}{dV})_{\theta} = N_2 / N_1$

自发 $(\frac{dN}{dV})_{\theta} = N_2 / N_1$
 $N_{21} = N_{20}$

$A_{21} \propto B_{12} \propto N_{10} = N_{20}$

光放大 $(N_2 > N_1)$
 激活介质
 3个及以上能级
 上能级亚稳态 (自发辐射小)
 下能级非基态 (自发辐射大)
 光学谐振腔
 作用: 定向性, 单色性, 相干性
 驻波
 $k \frac{\Delta x}{2} = nL$
 谐振

费米能量 $E_F(n) = \frac{\hbar^2}{2m} n^{\frac{2}{3}}$

费米温度 $T_F = E_F / k$

$v_F = \sqrt{2E_F / m}$



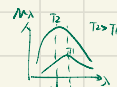
让 N 最大的 v

$m = \sigma^2 = \int_0^{\infty} N_v dv$

$N = C \sqrt{E}$

$N_v = \frac{2\pi k}{C} \frac{v^3}{e^{E/kT} - 1}$

单位时间从单位面积发出频率在 ν 附近单位 ν 区间的能量



$\lambda_{max} T = C_2$

ps 能级附近 $2mEk = p^2$ 低速成立

$\sqrt{(m_0 c)^2 + (pc)^2}$ always 成立

光 $E = pc = mc^2$

相对论: $E_k = \sqrt{(m_0 c)^2 + (pc)^2} - m_0 c^2$

光子 光子 (无质量)

⑪

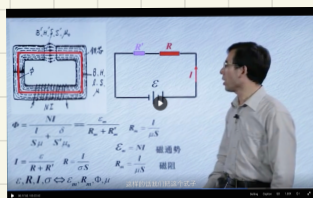
$$\phi = \frac{NI}{\frac{L}{\mu_0 \epsilon_0} + \frac{L}{\mu_0 \epsilon_0}}$$

$M > M_{\text{per}}$

$$M = \left| \frac{d\phi}{dt} \right| = L \sin \alpha \omega$$

$T > T_{\text{居里}}$ 铁 $\rightarrow$ 顺

$$\vec{J}_{\text{磁化}} = \vec{M} \times \vec{e}$$



能量密度

$$W = neV$$

$$W = \frac{S}{V_{\text{磁}}} = \frac{EH}{V_{\text{磁}}}$$

$$\oint \vec{H} \cdot d\vec{l} = \oint \frac{d\vec{B}}{d\vec{B}} \cdot d\vec{l}$$

位移电流密度为: $\frac{d\vec{B}}{dt}$ 无符号

$$\oint \vec{E} \cdot d\vec{l} = \oint \frac{d\vec{B}}{dt} \cdot d\vec{l}$$

⑫ 取一个面积为 S 回路

$$\oint \vec{E} \cdot d\vec{l} = -\oint \frac{d\vec{B}}{dt} \cdot d\vec{l} = \text{磁}$$

可取与磁感线
垂直的回路

$\Rightarrow$ 路径 matters
 $\therefore$ 闭合积分 $\neq 0$

$$\oint \vec{E} \cdot d\vec{l} = -\oint \frac{d\vec{B}}{dt} \cdot d\vec{l} = \oint \frac{d\vec{B}}{dt} \cdot d\vec{l}$$

$$\text{⑬ } \oint \vec{E} \cdot d\vec{l} = -\oint \frac{d\vec{B}}{dt} \cdot d\vec{l}$$

$$L = \frac{\Phi}{I} = \frac{N\Phi}{I}$$

$$\text{顺接: } L = 4\pi \mu_0 \mu_r \frac{N^2}{l} \quad \text{反接: } L = 4\pi \mu_0 \mu_r \frac{N^2}{l}$$

$$\frac{1}{2} LI^2 = \frac{1}{2} \oint \vec{B} \cdot d\vec{l} \quad V$$

$$= \frac{1}{2} \oint \frac{B^2}{\mu_0 \mu_r} dV$$

$$\vec{E} = -\mu \frac{d\vec{B}}{dt} = -\frac{d\vec{B}}{dt}$$

$$M_{\text{总}} = \frac{\Phi}{I} = \frac{N\Phi}{I}$$

$\Phi_{\text{总}}$ 总磁通量

⑭ 对表面的 E/B 上内积

$$\text{⑮ } \vec{j} = nq\vec{v}$$

$$\text{⑯ 孤立系统: } F = -\left(\frac{\partial \Phi}{\partial x}, \frac{\partial \Phi}{\partial y}, \frac{\partial \Phi}{\partial z} \right)$$

$$\text{⑰ } I = \oint \vec{j} \cdot d\vec{l} = \frac{dq}{dt} \quad \lambda \cdot Edl$$

⑱ 看清是求球的 C 或圆柱的 C

$$\text{⑲ } I_{\text{磁化}} = \oint \vec{M} \cdot d\vec{l}$$

$$\text{⑳ 功率: } \frac{P}{S} = \frac{P}{S} = \frac{P}{S} = \frac{P}{S}$$

$$\frac{P_{\text{磁}}}{S_{\text{磁}}} = I = S = \frac{1}{2} E_{\text{磁}} H_{\text{磁}}$$