Peeter Joot
920798560

$n \sin\alpha = n' \sin\alpha'$ $\quad \begin{pmatrix} 1 & L \\ 0 & 1 \end{pmatrix}$

$1/f = 1/s + 1/s'$ $\quad \begin{pmatrix} 1 & 0 \\ 0 & n/n' \end{pmatrix}$

$x x' = f^2$

$x + f = s$ $\quad \begin{pmatrix} 1 & 0 \\ -1/f & n/n' \end{pmatrix}$

$x' + f = s'$

$m = -s'/s = x'/f$ $\quad \begin{pmatrix} 1 & 0 \\ 2/R & 1 \end{pmatrix}$

$\dfrac{1}{f} = \dfrac{(n'-n)}{n}\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right), R_2 < 0$

$n = c/v = \sqrt{\epsilon\mu}$ $\quad k\lambda = 2\pi$ $\quad k = n k_0$ $\quad \lambda = \lambda_0/n$ $\quad ck = \omega$ $\quad \omega = 2\pi\nu$

$\nabla\cdot(\epsilon E) = 0 = \nabla\cdot B$ $\quad S = \dfrac{c}{4\pi} E \times B$

$\nabla \times E = -\partial_0 B$

$\nabla \times B = +\partial_0(\epsilon E)$ $\quad I = c\epsilon_0 \langle |E|^2 \rangle$
$= c/4\pi \sqrt{\epsilon/\mu}\langle |E|^2\rangle$

$(\nabla\phi\cdot\nabla)\nabla\phi = \nabla(\nabla\phi)^2/2$

$\nabla e^{i\phi} = i\nabla\phi e^{i\phi}$

$\nabla = \hat{r}\partial_r + (\hat{\theta}/r)\partial_\theta + \hat{z}\partial_z$

$\nabla^2 = \partial_{rr} + 1/r\,\partial_r + \frac{1}{r^2}\partial_{\theta\theta} + \partial_{zz}$

$\nabla\left(\dfrac{e^{ikr}}{r}\right) = \hat{r}(ik - 1/r)e^{ikr}/r$

$\nabla_T^2 = \partial_{xx} + \partial_{yy} = \partial_{rr} + 1/r\,\partial_r$

$\begin{pmatrix} E \\ B \end{pmatrix} = \begin{pmatrix} E_0 \\ B_0 \end{pmatrix} e^{i\phi - i\omega t}$ $\quad |\nabla\phi|^2 \approx k_0^2\epsilon(\vec{r})$ $\quad k_0 n(\vec{r}) = |\nabla\phi|$

$\langle S\rangle = \dfrac{c}{8\pi k_0}|E_0|^2\nabla\phi$ $\quad \langle E\times B^*\rangle = \mathrm{Re}(E_0\times B_0^*)/2$

$\vec{t} = \dfrac{d\vec{r}(s)}{ds} = \dfrac{\nabla\phi}{|\nabla\phi|}$ $\quad n\dfrac{d\vec{r}}{ds} = \dfrac{\nabla\phi}{k_0}$ $\quad \dfrac{d}{ds}\left(n(\vec{r})\dfrac{d\vec{r}}{ds}\right) = \nabla n(\vec{r})$

$f(x) = g * h = \int dx' g(x') h(x-x')$

$F(k) = G(k) H(k)$.

$\vec{R} = \vec{r} - \vec{r}'$

$\vec{R}_s = \vec{r}_s - \vec{r}'$

$R = |\vec{R}|, R_s = |\vec{R}_s|$

$\psi = \dfrac{A}{\lambda i}\int da' \dfrac{e^{ik(r+r_s)}}{r r_s} K(\theta)$ $\quad K(\theta) = \frac{1}{2}(1+\cos\theta)$

$kR = kr - k\hat{r}\cdot r' + \dfrac{k}{2r}(r'^2 - (\hat{r}\cdot r')^2)$

$\psi = \dfrac{A}{\lambda i}\dfrac{e^{ik(r_s+r)}}{r r_s}\int da' e^{ikf(r')}$ $\quad f(r') = -(\hat{r}+\hat{r_s})\cdot r' + \dfrac{1}{2r}(r'^2 - (\hat{r}\cdot r')^2)$
$+ \dfrac{1}{2r_s}((r')^2 - (\hat{r_s}\cdot r')^2)$

$\begin{pmatrix} S \\ C \end{pmatrix}(w) = \int_0^w \begin{pmatrix} \sin \\ \cos \end{pmatrix}\left(\dfrac{\pi w^2}{2}\right) dw$

$C(\infty) = S(\infty) = 1/2$

$1 = (dS/dw)^2 + (dC/dw)^2$

$\tan(\pi w^2/2) = dy/dx$

$kf = \dfrac{k}{2}\left(\dfrac{1}{r_s} + \dfrac{1}{r}\right)(x'^2 + y'^2) = \dfrac{\pi}{2}(u^2 + v^2)$

$\psi(r) = \dfrac{A}{\lambda i}\dfrac{e^{ik(r_s+r)}}{r_s + r}\int e^{i\frac{\pi}{2}(u^2+v^2)} du\, dv$

$\mathcal{V} = \dfrac{I_{max} - I_{min}}{I_{max} + I_{min}} = |\gamma_{12}|$ $\quad = 2\dfrac{\sqrt{I_1 I_2}}{I_1 + I_2}|\gamma_{12}|$

$\gamma_{12} = \dfrac{\Gamma_{12}}{\sqrt{I_1 I_2}}$

$\psi_{1,2} = \sqrt{I_{1,2}(r)}\, e^{i\phi_{1,2}(r,t)}$ $\quad I = |\psi_1 + \psi_2|^2 = |\psi_1|^2 + |\psi_2|^2 + 2\mathrm{Re}\Gamma_{12}$, $\Gamma_{12} = \langle\psi_1\psi_2^*\rangle$

$\Gamma(\tau) = \Gamma_{\tau\tau} = \mathcal{F}_1(I(\omega)) = \langle\psi_1(t)\psi_2^*(t+\tau)\rangle$

$\mathrm{Re}(\Gamma(\tau)) = \int_0^\infty I(\omega)\cos\omega\tau\, d\omega$; $I(\omega) = \int_0^\infty d\tau\, \mathrm{Re}(\Gamma(\tau))\cos\omega\tau\, d\tau$

$\tau_{coh} = 1/\Delta\omega$ $\quad \Gamma_{12} = \langle\psi_1(r,t)\psi_2^*(r,t+\tau)\rangle$

$\tau = (s_2 - s_1)/c$ $\quad I = |\gamma_{12}|(I_1 + I_2 + 2\sqrt{I_1 I_2}\cos(\alpha_{12}(\tau) - \delta)) + (1 - |\gamma_{12}|)(I_1 + I_2)$

$= |\gamma_{12}| I_{coh} + (1 - |\gamma_{12}|) I_{inch}$

$\tau_a - \tau_b = (r_{1a} - r_{2a} - r_{1b} + r_{2b})/c = l\theta_s/c$

$\Gamma_{12} = \dfrac{1}{d_2 R_1 R_2} e^{ik\Delta r\cdot\hat{r}_{av}}\int I(r_s) e^{-ik\Delta r\cdot r_s/r_{av}}$ $\quad I = \sum |\psi_k + e^{ik\cdot l}\psi_k|^2 = 2\sum I_k + 2\mathrm{Re}\Gamma_{12}$

$\Gamma_{12} = \text{"}\mathcal{F}(I_k)\text{"} = \sum I_k e^{ik\cdot l}$

$\Delta r = r_1 - r_2$

$r_{av} = r_2 - \Delta r/2$

$k(R_1 - R_2) \approx k(r_{av} - r_s)\cdot\Delta r/r_{av}$

$\gamma(r_1, r_2) = \dfrac{\Gamma_{12}}{\Gamma_{12}|_{\Delta r = 0}}$ $\quad \mathcal{V} = |\gamma_{12}| = 2\left|\dfrac{J_1(\pi\theta_s d/\lambda)}{\pi\theta_s d/\lambda}\right|$ $\quad l_c \approx \lambda/\Delta\theta_s$

$\delta = 2kL\cos\theta$

$r = e^{i\delta_r}\sqrt{R}$

$t = e^{i\delta_t}\sqrt{T}$

$\Delta = 2\delta_r + \delta = 2\pi m$

$\psi_{trans} = \psi_0 t^2/(1 - Re^{i\Delta})$

$I_{trans} = I_{max}/(1 + F\sin^2(\Delta/2))$

$I_{max} = I_0 T^2(1 - R^2)$

$F = 4R/(1-R)^2$

$\mathcal{F} = \dfrac{\pi\sqrt{R}}{1-R} = \dfrac{\pi}{2}\sqrt{F} \approx \dfrac{\pi}{1}$

$\dfrac{\omega_1 - \omega_2}{\bar{\omega}} = \dfrac{1}{\mathcal{F}m}$

$\bar{\omega} = \dfrac{\pi c}{L}(m + j) = \omega_0 + j FSR$

$\delta = \omega - \omega_m$ $\quad I_{Lto} = 1/(1 + \delta^2/\Gamma^2)$

$\Gamma = \dfrac{\pi c}{2L\mathcal{F}} = \dfrac{FSR}{2\mathcal{F}}$

$\gamma = \dfrac{a\omega}{2c}\sin\theta = \pi\dfrac{\omega}{\omega_0}\sin\theta$

$I = I_0(\sin\beta/\beta)^2\left(\dfrac{\sin N\gamma}{N\sin\gamma}\right)^2$

$\beta = \frac{1}{2}bky\sin\theta = \frac{1}{2}bky$

$\gamma = \frac{1}{2}bky_a = \frac{1}{2}ka\sin\theta$

$\omega_0 = 2\pi c/a$

$\gamma = m\pi = \pi\dfrac{\omega}{\omega_0}\sin\theta$

$l = Nm + 1$

$\Delta\delta = \dfrac{m\pi}{\omega_1}\Delta\omega = \dfrac{\pi}{N}$

$\dfrac{\Delta\omega}{\omega} = \dfrac{1}{Nm}$

$(\nabla^2 + k^2)E = 0$

$E = E_0 u\, e^{ik_0 z}$

$\dfrac{\partial^2 u}{\partial z^2} + 2ik_0\dfrac{\partial u}{\partial z} + \nabla_T^2 u - k_0 k_2 r^2 u = 0$

$\omega_{eff}/c = \sqrt{k_2/k_1}$, $m_{eff} = \hbar k_0/c$, $t_{eff} = z/c$

$u = \dfrac{z_0}{iq} e^{ik_0 r^2/2q}$, $q = z - iz_0$, $z_0 = \dfrac{\pi w_0^2}{\lambda}$

$= \dfrac{\omega_0}{\omega(z)} e\left(-r^2/w^2 + i\dfrac{kr^2}{2R} - i\tan^{-1}(z/z_0)\right)$

$w^2 = w_0^2(1 + (z/z_0)^2)$

$\dfrac{1}{q} = \dfrac{z}{z^2 + z_0^2} + \dfrac{i\lambda}{\pi w^2} = \dfrac{1}{R^2} + \cdot$

$\theta = \omega_0/z_0 = \lambda/(\pi w_0)$

$-i\phi + ik_0 z - i\omega t = iC$ $\quad \dfrac{dz}{dt} = V_{ph} = \dfrac{\omega}{k_{eff}}$

$k_{eff} = k_0 - \dfrac{z_0}{z^2 + z_0^2}$

$$u_{lm} = \frac{w_0}{w(z)} \exp\left(-\frac{r^2}{w^2} + \frac{ik_0 r}{R} - i(m+l+1)\phi(z)\right) H_l\left(\frac{\sqrt{2}x}{w(z)}\right) H_m\left(\frac{\sqrt{2}y}{w(z)}\right)$$

$$H_0 = 1$$
$$H_1 = 2x$$
$$H_2 = 4x^2 - 1$$
$$k_{eff} = k_0 - (m+l+1)\frac{z_0}{z^2+z_0^2}$$

$$q' = \frac{Aq+B}{Cq+D}$$

$$g_{1,2} = 1 - \frac{L}{R_{1,2}} \qquad 0 < g_1 g_2 < 1$$

$$\frac{N_e}{N_g} = \frac{P_e}{P_g} = e^{-(E_e - E_g)kT}$$
$$u_\omega = \hbar\omega \langle n_\omega \rangle D(\omega)$$
$$\langle n_\omega \rangle = \frac{1}{e^{\hbar\omega/kT} - 1}$$
$$D(\omega) = \frac{\omega^2}{\pi^2 c^2}$$

$$\frac{dN_e}{dt} = -AN_e + B_{abs}\, u N_g - B_{se}\, u N_e = 0,$$
$$\frac{dN_g}{dt} = -\frac{dN_e}{dt}$$

$$u_\omega = \frac{\hbar\omega^3}{\pi^2 c^2} \frac{1}{e^{\hbar\omega/kT} - 1}$$

$$\frac{A}{B_{se}} = \frac{\hbar\omega^3}{\pi^2 c^3} \qquad B_{abs}/B_{se} = 1 \qquad \frac{Bu}{A} = \langle n_\omega \rangle$$

$$\langle n \rangle^2 - (C-1) n_s \langle n \rangle - C n_s = 0$$

$$C = \frac{NR\Gamma_{st}}{\Gamma_{sp}\Gamma_{cav}}$$

$$n_s = \frac{\Gamma_{sp}}{\Gamma_{st}}$$

$$\langle n \rangle \approx \begin{cases} (C-1) n_s & C > 1 \\ \frac{C}{1-C} & C < 1 \end{cases}$$

$$N_2 = \frac{NR}{\Gamma_{sp} + \Gamma_{st}\langle n \rangle} = \frac{C}{1 + \langle n \rangle / n_s}$$