29 JANUARY 20[illegible]

POLARIZED LIGHT

JONES VECTORS $\longrightarrow$ COHERENCY MATRIX

$$J = \begin{bmatrix} \langle E_x E_x^* \rangle & \langle E_x E_y^* \rangle \\ \langle E_x^* E_y \rangle & \langle E_y E_y^* \rangle \end{bmatrix} = \begin{bmatrix} \langle |E_x|^2 \rangle & \langle E_x E_y^* \rangle \\ \langle E_x^* E_y \rangle & \langle |E_y|^2 \rangle \end{bmatrix}$$

IF COMPLETELY POLARIZED ALONG x

$$J[\text{LP ALONG } x] = \begin{bmatrix} I_0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$\det J[\text{LP } x] = 0$$

$$y \quad J[\text{LP ALONG } y] = \begin{bmatrix} 0 & 0 \\ 0 & I_0 \end{bmatrix}$$

$$\left\langle \begin{bmatrix} E_0 \cos\theta \\ E_0 \sin\theta \end{bmatrix} \begin{bmatrix} E_0^* \cos\theta & E_0^* \sin\theta \end{bmatrix} \right\rangle = \cancel{\langle |E_0|^2 \cos^2\theta \rangle \quad \langle E_0}$$

$$J\,(\text{LP along } \theta) = \begin{bmatrix} \langle |E_0|^2 \rangle \cos^2\theta & \langle |E_0|^2 \rangle \sin\theta \cos\theta \\ \langle |E_0|^2 \rangle \sin\theta \cos\theta & \langle |E_0|^2 \rangle \sin^2\theta \end{bmatrix}$$

$$= I_0 \begin{bmatrix} \cos^2\theta & \cos\theta \sin\theta \\ \cos\theta \sin\theta & \sin^2\theta \end{bmatrix}$$

$$\det J\,(\text{LP} @ \theta) = \cos^2\theta \sin^2\theta - (\cos\theta \sin\theta)^2 = 0$$

$$\underset{\sim}{J} = \begin{bmatrix} \langle E_x E_x^* \rangle & \langle E_x E_y^* \rangle \\ \langle E_x^* E_y \rangle & \langle E_y E_y^* \rangle \end{bmatrix} = \begin{bmatrix} \langle |E_x|^2 \rangle & \langle E_x E_y^* \rangle \\ \langle E_x^* E_y \rangle & \langle |E_y|^2 \rangle \end{bmatrix}$$

$$\det \left[\underset{\sim}{J} - \lambda \underset{\sim}{I} \right] = 0$$

$$\boxed{\underset{\sim}{J}\, \underset{\sim}{x} = \lambda\, \underset{\sim}{x}\, \underset{\sim}{I}}$$

$$\det \begin{bmatrix} J_{xx} - \lambda & J_{xy} \\ J_{yx} & J_{yy} - \lambda \end{bmatrix} = 0$$

$$(J_{xx} - \lambda)(J_{yy} - \lambda) - J_{xy} J_{yx} = 0$$

$$J_{xx} J_{yy} - \lambda (J_{xx} + J_{yy}) + \lambda^2 - J_{xy} J_{yx} = 0$$

$$\lambda^2 - \lambda \underbrace{(J_{xx} + J_{yy})}_{\text{TRACE } \underset{\sim}{J}} + \underbrace{(J_{xx} J_{yy} - J_{xy} J_{yx})}_{\det \underset{\sim}{J}} = 0$$

$a = 1 \qquad b = - \mathrm{Tr}\, \underset{\sim}{J} \qquad c = \det \underset{\sim}{J}$

$\cancel{\lambda}$

$$\lambda = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{\mathrm{Tr}\, J}{2} \pm \frac{\sqrt{(\mathrm{Tr}(J))^2 - 4 \det J}}{2}$$

$$= \left(\frac{\mathrm{Tr}\, J}{2}\right)\left(1 \pm \sqrt{\frac{1 - 4 \det J}{\mathrm{Tr}(J)}}\right.$$

$$\underset{\sim}{J} \longrightarrow \underset{\sim}{\Omega} = \begin{bmatrix} \lambda_+ & 0 \\ 0 & \lambda_- \end{bmatrix}$$

$$\lambda_+ = \frac{\mathrm{Tr}\,J}{2}\left[1 + \sqrt{\frac{1 - 4\det \underset{\sim}{J}}{\mathrm{Tr}\,\underset{\sim}{J}}}\right]$$

$$\lambda_- = \frac{\mathrm{Tr}\,J}{2}\left[1 - \sqrt{\frac{1 - 4\det \underset{\sim}{J}}{\mathrm{Tr}\,\underset{\sim}{J}}}\right]$$

$$\det \underset{\sim}{\Omega} = \lambda_+ \cdot \lambda_- - 0 \cdot 0 = \lambda_+ \lambda_-$$

$$= \det \underset{\sim}{J}$$

1/29/10 - 5

MATRIX

$$\underset{\sim}{A}\,\underset{\sim}{x} = \underset{\sim}{b} \qquad\qquad \underset{\sim}{\mathcal{L}}\,\underset{\sim}{\mathcal{E}} = \underset{\sim}{\mathcal{E}}'$$

JONES VECTORS

$\cancel{\underset{\sim}{A}}$

$$\underset{\sim}{\mathcal{E}} + \underset{\sim}{\mathcal{E}}^* \rightarrow \underset{\sim}{J}$$

$\underset{\sim}{A}$

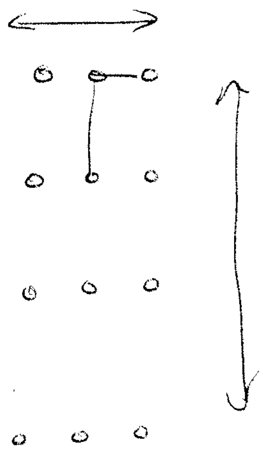
$$\begin{bmatrix} \langle |E_x|^2 \rangle & \langle E_x E_y^* \rangle \\ \langle E_x^* E_y \rangle & \langle |E_y|^2 \rangle \end{bmatrix} \underset{\sim}{J} \longrightarrow \underset{\sim}{\Omega} \begin{bmatrix} \lambda_+ & 0 \\ 0 & \lambda_- \end{bmatrix}$$

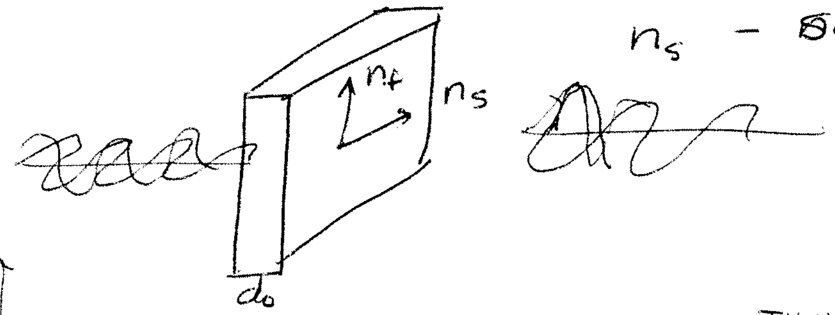
UNPOLARIZED

$$\begin{bmatrix} (\lambda_+ - \lambda_-) & 0 \\ 0 & 0 \end{bmatrix} + \begin{bmatrix} \lambda_- & 0 \\ 0 & \lambda_- \end{bmatrix}$$

POLARIZED UNPOL

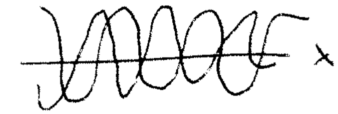
DOUBLE REFRACTION





n

n_s — SLOW $\Rightarrow$ $n_s > n_f$



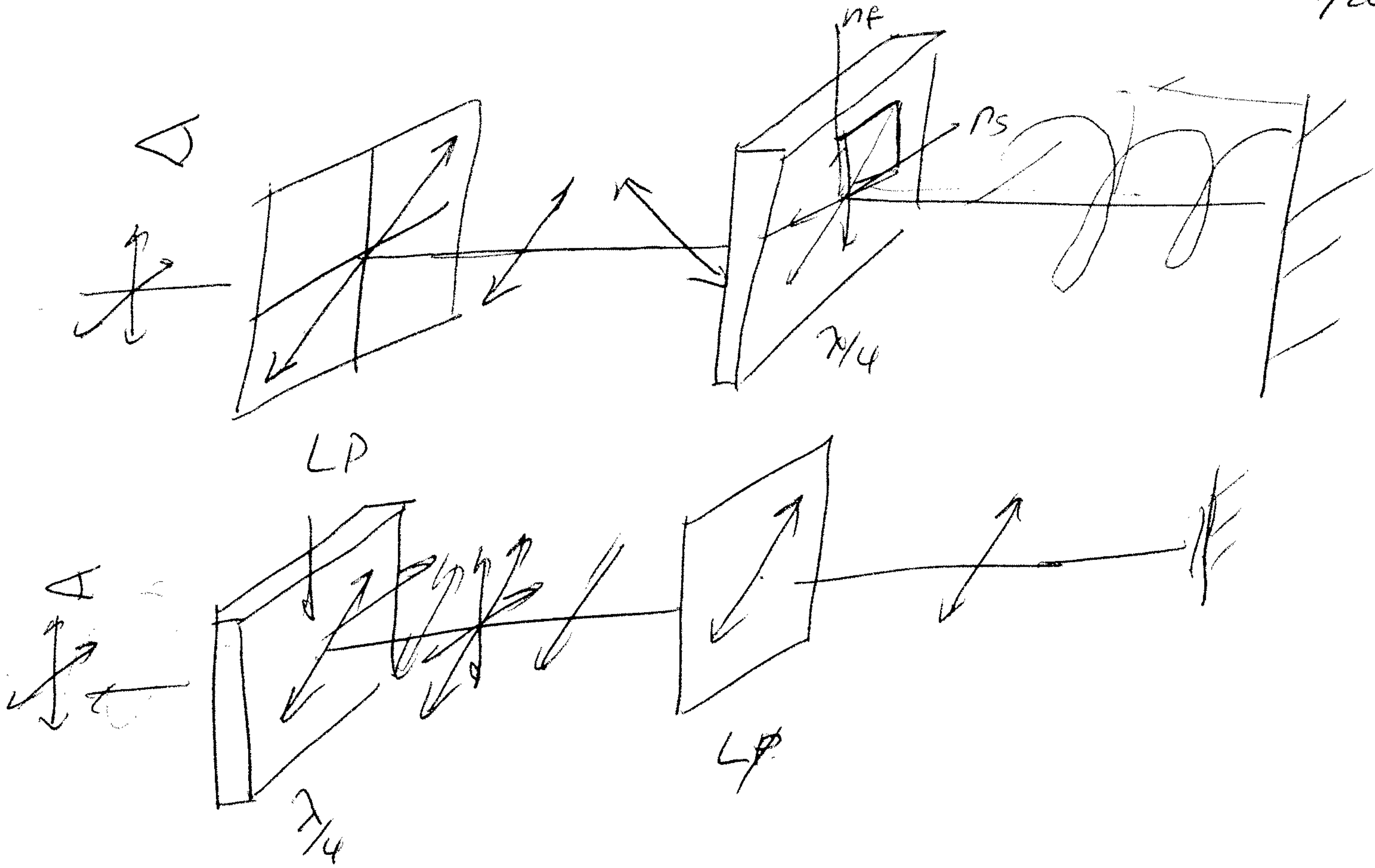
ω_o

$$\frac{2\pi d_o}{\lambda_o/n} = \frac{2\pi \overbrace{(n d_o)}^{\text{OPTICAL THICKNESS}}}{\lambda_o}$$

$$\left.\begin{aligned} \Delta\phi_s &= \frac{2\pi d_o n_s}{\lambda_o} \\ \Delta\phi_f &= \frac{2\pi d_o n_f}{\lambda_o} \end{aligned}\right\} \quad \underline{\Delta\phi = \frac{2\pi d_o}{\lambda_o}(n_s - n_f)}$$

$$\Delta\phi = \frac{\pi}{2} = \frac{2\pi d_o}{\lambda_o} n_s - n_f \Rightarrow d_o = \frac{\lambda_o}{4(n_s - n_f)}$$

1/20/80 - 7



OPTICAL INTERFERENCE & COHERENCE

DIFFRACTION $\equiv$ INTERFERENCE (FEW SOURCES)

MANY IRRADIATING POINT SOURCES

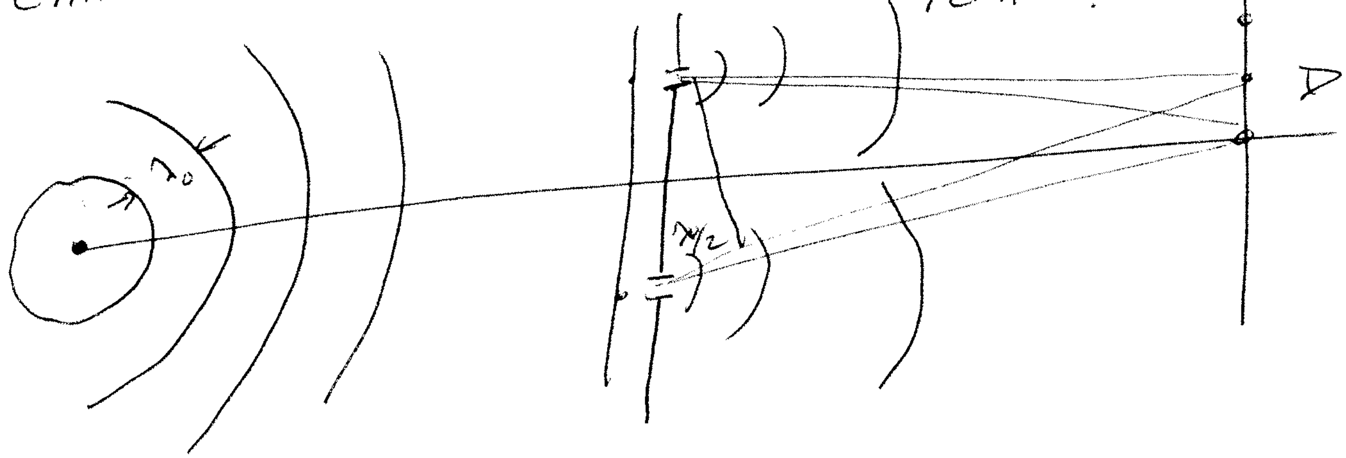
FRESNEL — PARABOLOIDS — LSI

FRAUNNHOFER — PLANE — LSV — FOURIER TRANSFORM

ANALYSIS OF SOURCE, RATHER THAN $\boxed{\text{IMAGING}}$ $\boxed{\text{OPTICAL}}$ SYSTEM

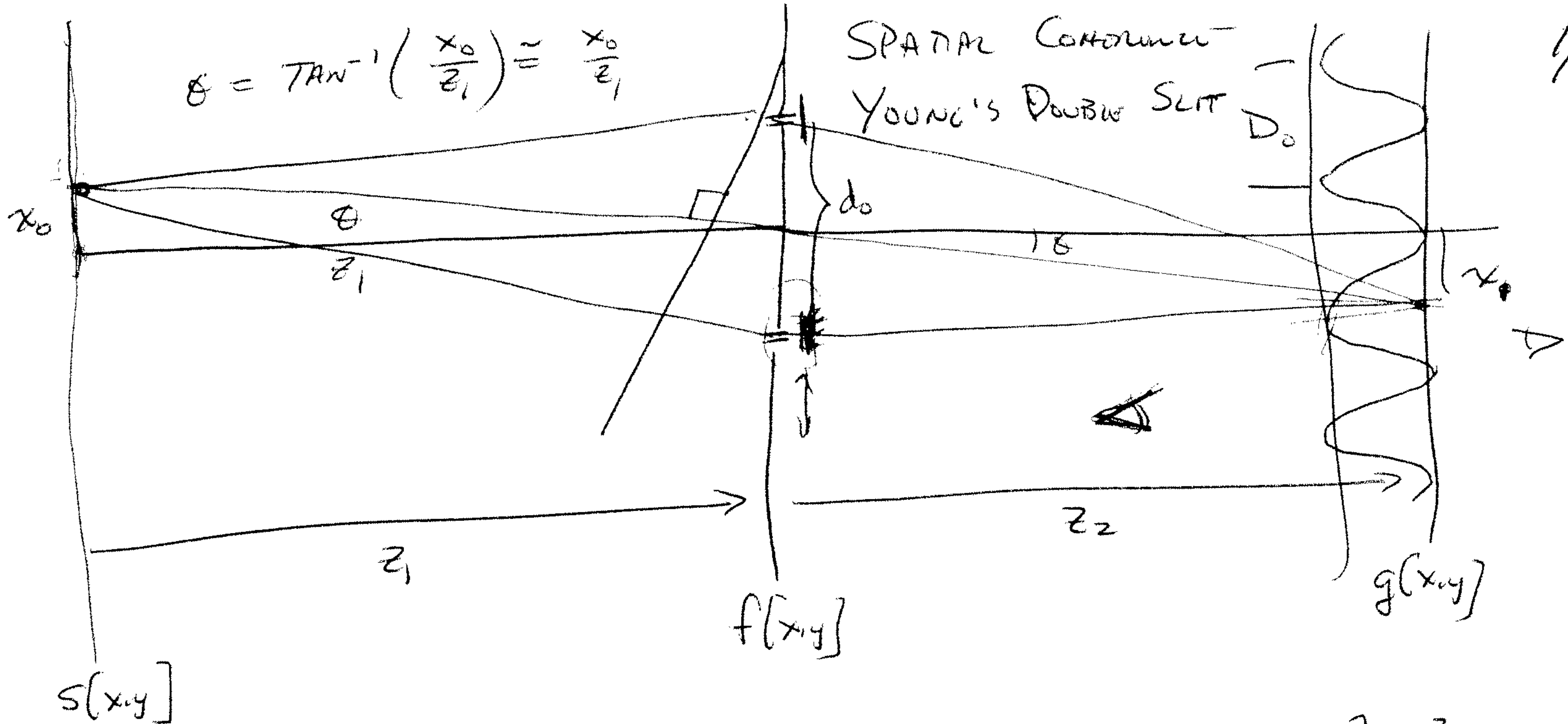
CHARACTERISTICS — COHERENCE — SPATIAL — TRANSVERSE

TEMPORAL — LONGITUDINAL



SPATIAL COHERENCE

YOUNG'S DOUBLE SLIT

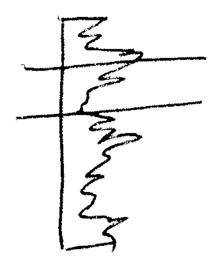


$$\delta[x - x_0]\,\delta(x) \xrightarrow{\mathcal{F}_z} e^{-2\pi i \frac{x}{\left(\frac{\lambda_0 z_1}{x_0}\right)}}\, 1[y]$$

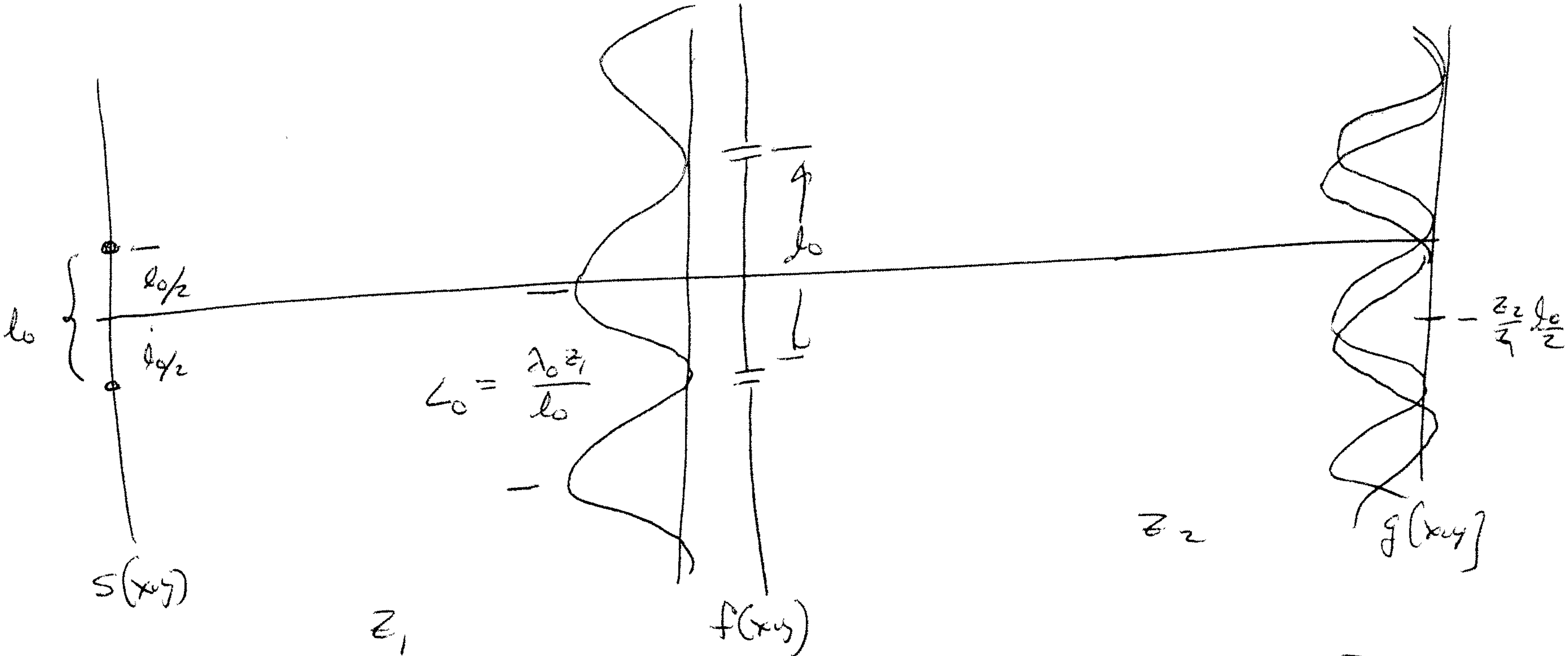
$$d_0 D_0 = \lambda_0 \cdot z_2$$

CENTER OF ~~#~~ COSINE FRINGES IS $x_1 = -\frac{z_2}{z_1} x_0$

$$f[x,y] = \left(\delta\left(x + \frac{d_0}{2}\right) + \delta\left(x - \frac{d_0}{2}\right)\right)\delta(y)$$



1/29/11



(1) VARY PHASE OF TWO SOURCES (OR TWO APERTURES)
THE COSINE FRINGES MOVE TRANSVERSELY

(2) VARY AMPLITUDE OF SOURCES, MODULATION OF ~~PART~~ IRRADIANCE PATTERN CHANGE

1/29/12