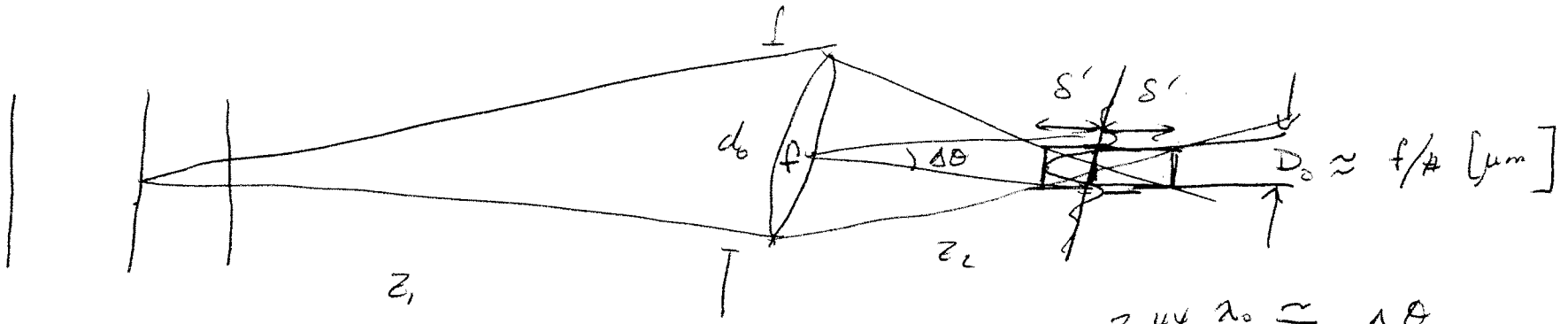
Problem Session 1/15/2010

7 Problems, Choose 5, No Calculators



$$2.44 \frac{\lambda_0}{d} \cong \Delta\theta$$

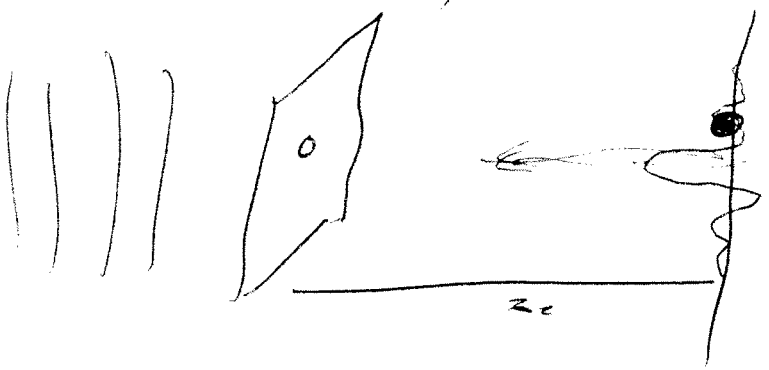
$$D_0 \simeq 2.44 \frac{\lambda_0 f}{d_0} = \underbrace{2.44 \lambda_0}_{\simeq 1 \mu m} \cdot f/\#$$

$$2.44 \frac{\lambda_0}{d} \cdot z_2 = D_0$$

$$\uparrow$$

$$f$$

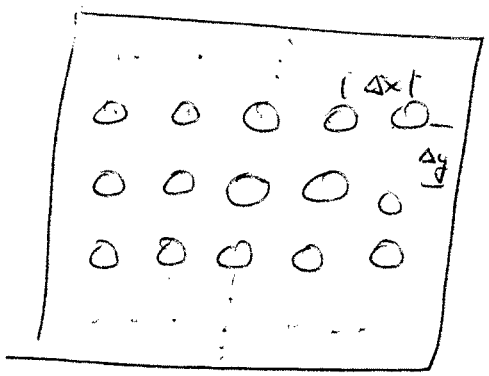
$$CYL\left(\frac{r}{d_0}\right)$$



$$1 - CYL\left(\frac{r}{d_0}\right)$$

$$\delta\left(\frac{x}{\lambda z_2}, \frac{y}{\lambda z_2}\right) - \frac{\pi d_0^2}{4}$$

$$- Sombr\left(\frac{d_0 r}{\lambda_0 z_2}\right)$$



$$1 - f(x,y)$$

$$f(x,y) = \text{comb}\left(\frac{x}{\Delta x}, \frac{y}{\Delta y}\right) * \text{cyl}\left(\frac{r}{d_0}\right)$$

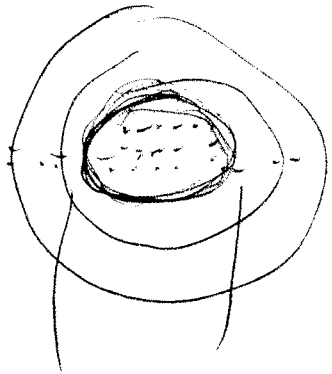
$$\Delta x, \Delta y \gg d_0$$

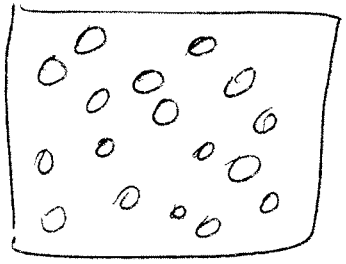
$$F(\xi,\eta) = (\Delta x \Delta y)\,\text{comb}(\Delta x\,\xi, \Delta y\,\eta) \cdot \frac{\pi d_0^2}{4}\,\text{somb}(d_0 \rho)$$

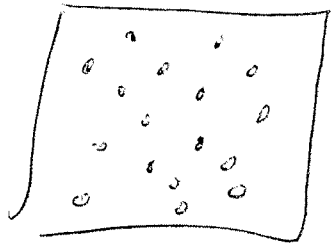
$$g(x,y) = F\left(\frac{x}{\lambda_0 z_2}, \frac{y}{\lambda_0 z_2}\right) = (\Delta x \Delta y)\frac{\pi d_0^2}{4}\,\text{comb}\left(\frac{x}{(\lambda_0 z_2/\Delta x)}, \frac{y}{(\lambda_0 z_2/\Delta y)}\right) \cdot \text{somb}\left(\frac{\sqrt{x^2+y^2}}{(\lambda_0 z_2/d_0)}\right)$$

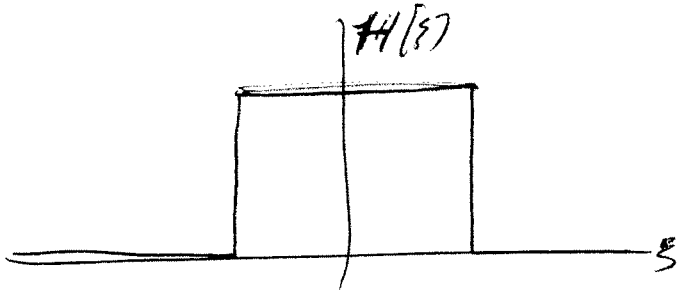
SCALE FACTOR FOR somb is $\dfrac{\lambda_0 z_2}{d_0}$

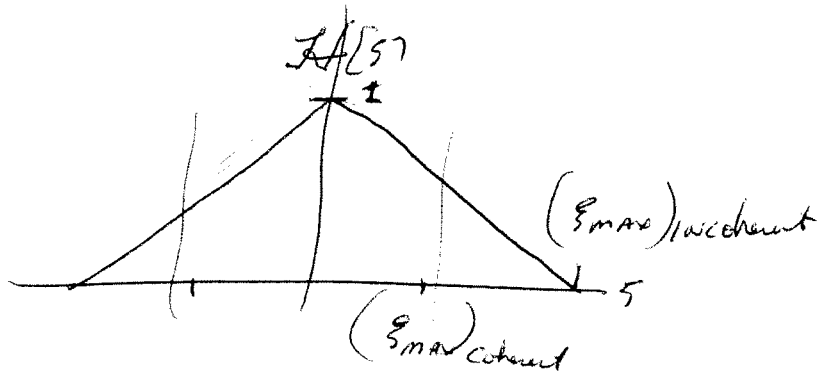
comb $\dfrac{\lambda_0 z_2}{\Delta x}, \dfrac{\lambda_0 z_2}{\Delta y}$



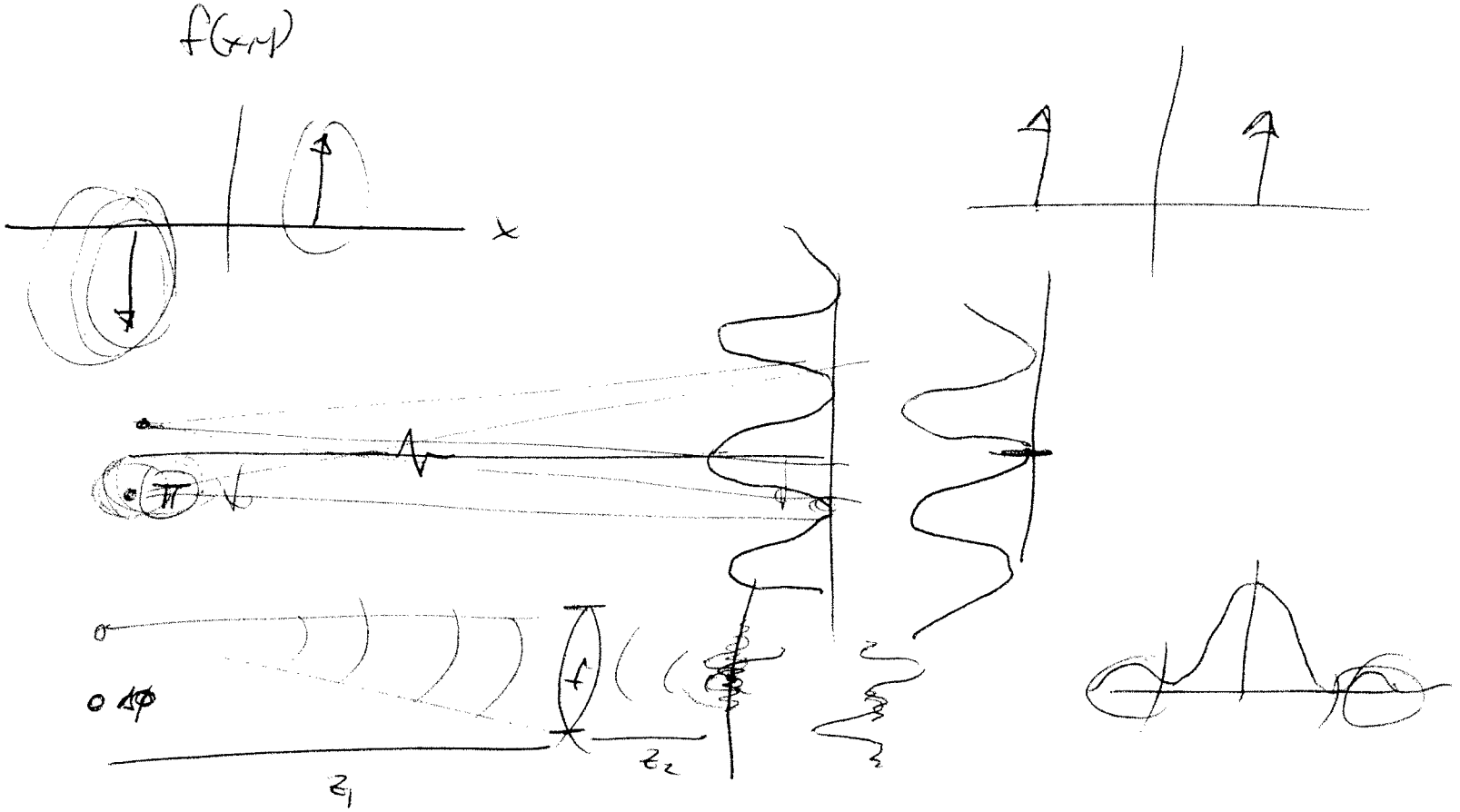








$$(\xi_{max})_{INC} = 2\,(\xi_{max})_{coherent}$$

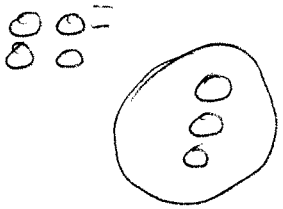


ARRAY THEOREM

$$f(x,y) \propto \sum_{n=1}^{N} \delta(x - x_n) \longrightarrow \underline{\underline{F(\xi,\eta)}} \cdot \sum_{\eta} e^{+2\pi i \xi x_n}$$

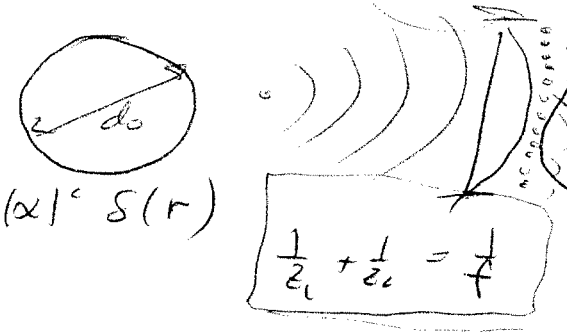
LABEYRIE STELLAR SPECKLE INTERFEROMETRY 1970

SEURAT

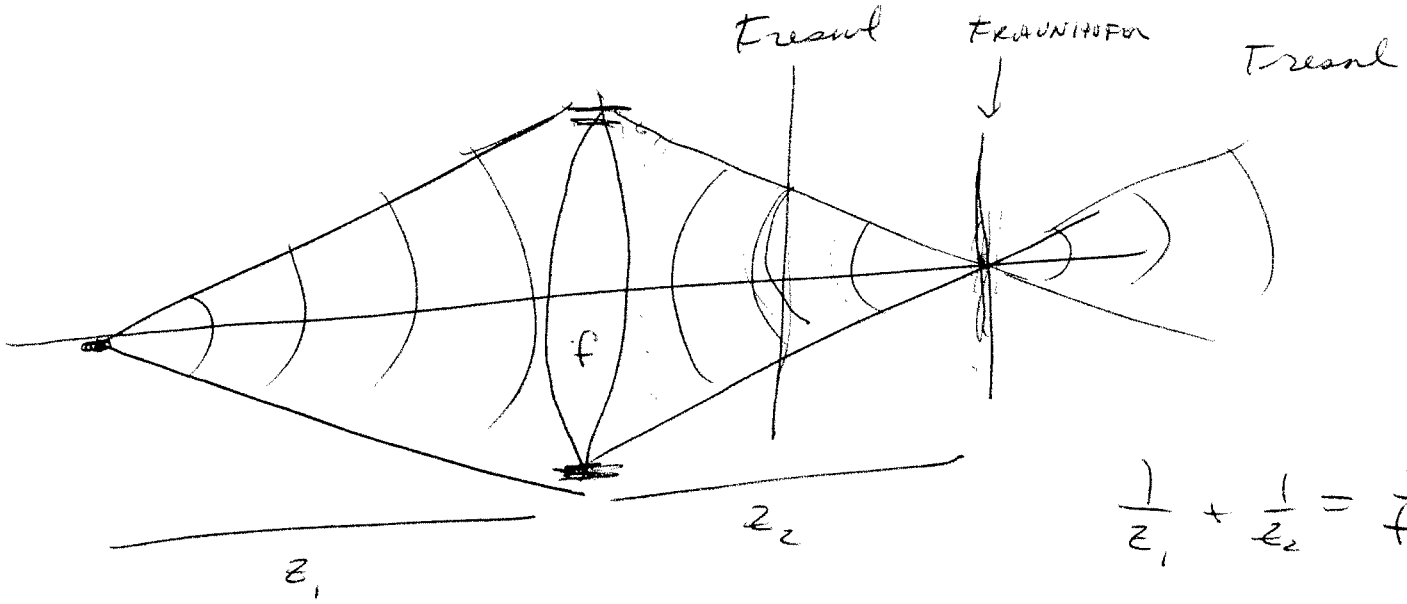


QUADRATIC-PHASE LP FILTER

$$P(r)\, e^{-i\pi \frac{r^2}{\lambda_0 f}}\, e^{+i\pi \frac{r^2}{\lambda_0 z_2}}\, e^{+i\pi \frac{r^2}{\lambda_0 z_2}}$$



$$e^{+i\pi \frac{r^2}{\alpha^2}} \propto e^{-i\pi \frac{r^2}{\alpha^2}} = |\alpha|^2\, \delta(r)$$



$$\frac{1}{z_1} + \frac{1}{z_2} = \frac{1}{f}$$