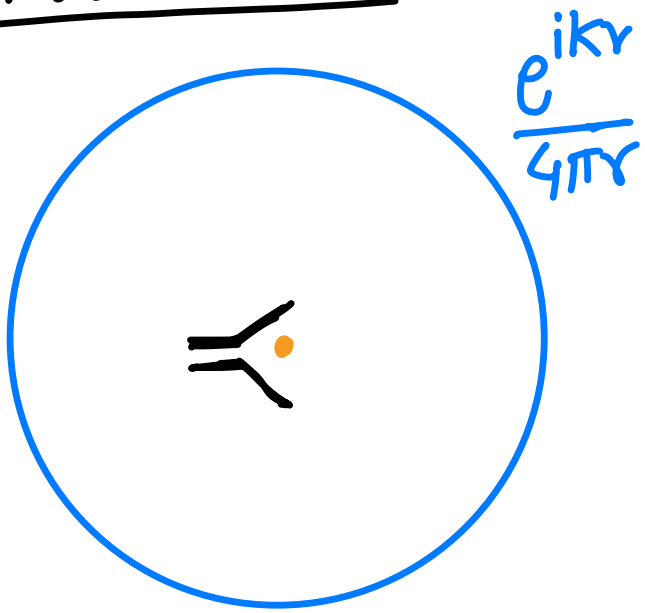
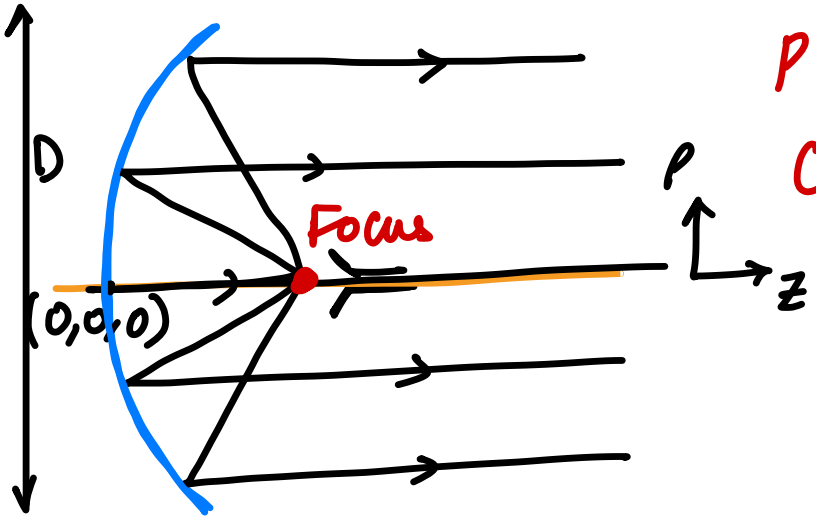
Parabolic Reflector

Phase Center



Parabolic Reflector Antenna



Place Focus on the phase Center of the feed horn.

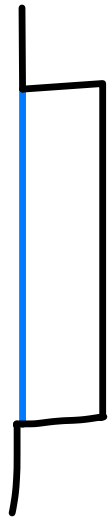
$$z = \frac{\rho^2}{4f} \qquad x = \rho\cos\phi \qquad y = \rho\sin\phi$$

Physical Aperture : $A_p = \frac{\pi D^2}{4}$

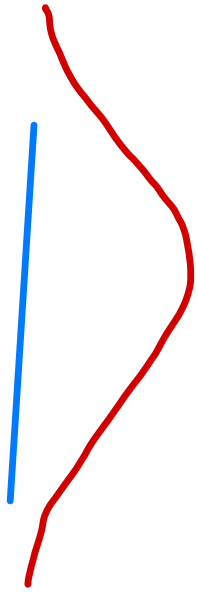
Effective Aperture : $A_e = \frac{\lambda^2 G}{4\pi}$

Aperture efficiency: $\eta = \frac{A_e}{A_p}$

$$G = \frac{4\pi A_e}{\lambda^2} = \eta\left(\frac{4\pi A_p}{\lambda^2}\right)$$



$$\Rightarrow G = \frac{4\pi A_p}{\lambda^2}$$



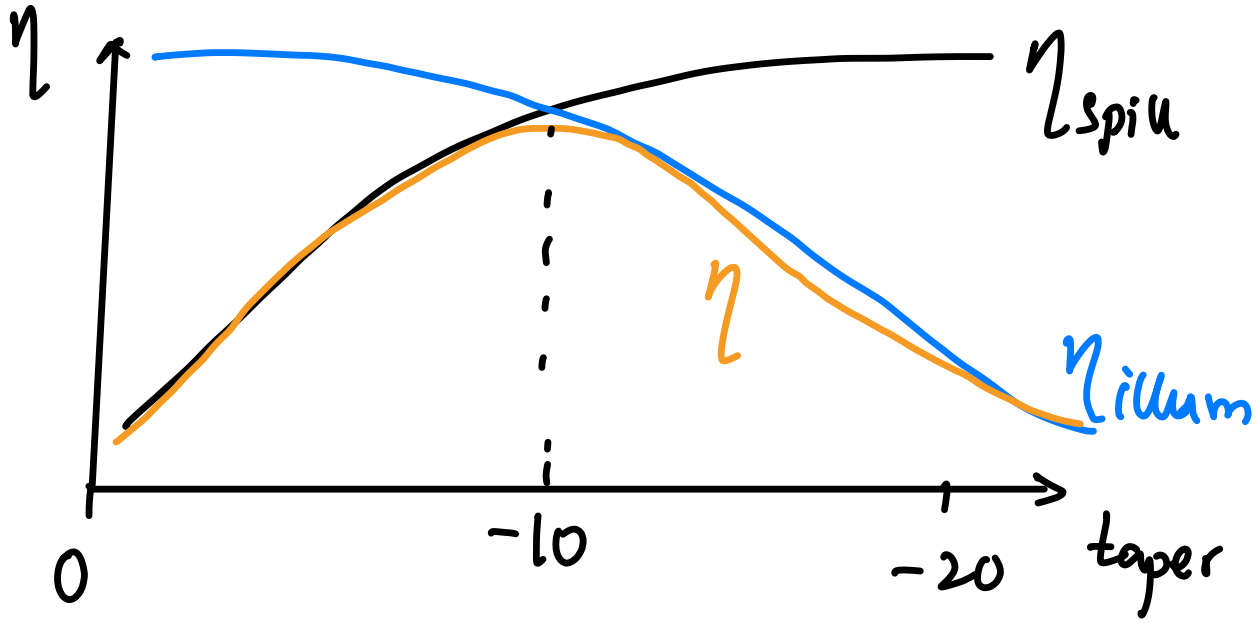
$\geq$

$$\eta = \eta_{illum} \cdot \eta_{spill} \cdot \eta_{phase} \cdot \eta_{pol} \cdot \eta_{block} \cdot \eta_{surface}.$$

Edge taper: Power at edge vs. center of reflector.

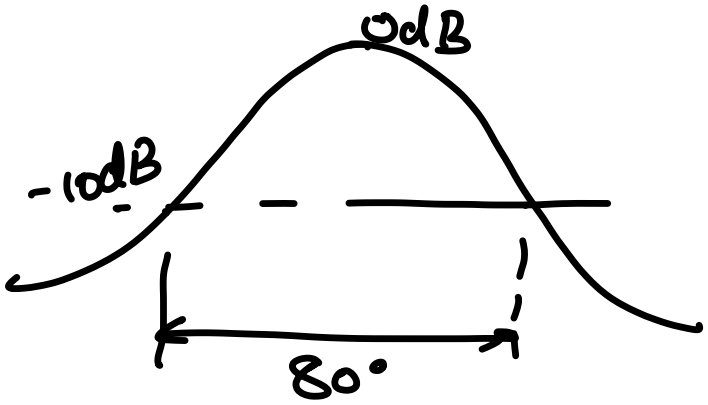
-3dB, -6dB, -10dB ...

taper high! $\Rightarrow$ $\eta_{spill} \downarrow$ but $\eta_{illum} \uparrow$



$\eta \simeq 0.55$ when taper = -10dB → typical optimum.

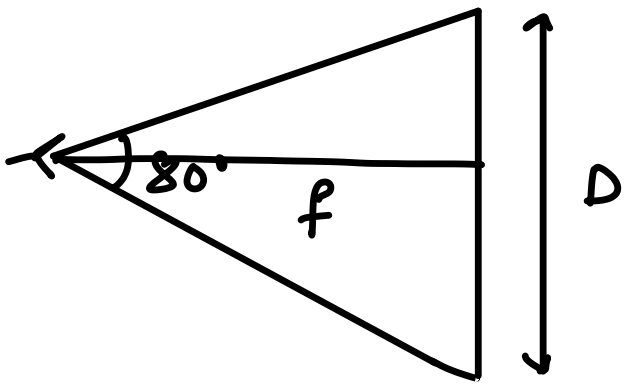
Design Example



$\theta_{-10dB} = 80°$

$G = 40dB.$

$\frac{f}{D}$ ratio



$$\tan\left(\frac{\theta_{-10dB}}{2}\right) = \frac{D}{2f}$$

$$\Rightarrow \frac{f}{D} \simeq 0.596 //$$

$$\frac{G}{\eta} = \frac{4\pi}{\lambda^2} \cdot \frac{\pi D^2}{4} = \left(\frac{\pi D}{\lambda}\right)^2 \Rightarrow \boxed{D = \frac{\lambda}{\pi}\sqrt{\frac{G}{\eta}}}$$

$$\frac{D}{\lambda} = \frac{1}{\pi}\sqrt{\frac{10^4}{0.55}} = 42.9$$

@ 10 GHz : $\lambda = 3 \times 10^{-2} \Rightarrow$ $\boxed{\begin{aligned} D &= 1.29\,m \\ f &= 0.77\,m \end{aligned}}$