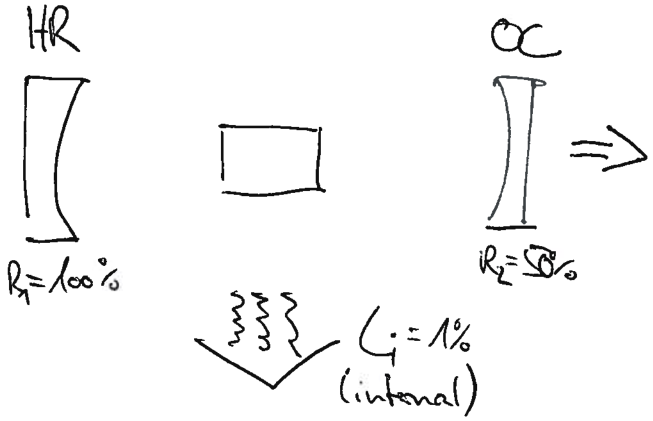
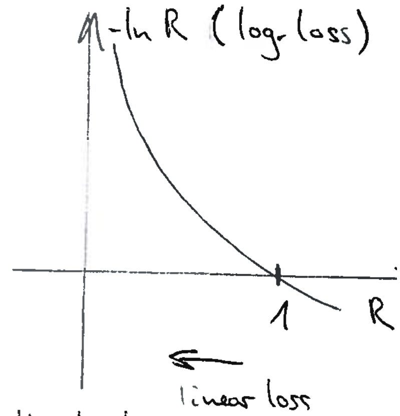
1.5 (p. 6)

logarithmic loss:

$$\gamma = -\ln(1 - \text{loss}) \qquad 0 < \text{loss} < 1$$



$\Rightarrow$ output loss: 0.5



$\Rightarrow$ the higher the reflectivity, ~~the higher the~~ the lower the log. loss

roundtrip loss:

$$1 - R_1 \cdot (1 - L_i) \cdot R_2 \cdot (1 - L_i) = 0.50995$$

$\rightarrow$ log. loss:

$$\gamma_{rt} = -\ln(R_1 R_2 \cdot \cancel{2} \cdot (1 - L_i))$$

$$= -\left[\ln(R_1 R_2) + 2\ln(1 - L_i)\right]$$

single-pass loss:

result: $\gamma_{sp} = \frac{\gamma_{rt}}{2} \approx 0.71 \cdot 0.5 \approx \underline{0.36}$

at threshold: $\boxed{\text{gain} = \text{loss}}$

single-pass gain:

$$\frac{\text{output phot. flux}}{\text{input phot. flux}} = \exp\left[\sigma \left(\overbrace{N_2 - \frac{g_2}{g_1} N_1}^{\text{inversion: } \Delta N \text{ (has units of density: } \frac{1}{m^3})}\right) \ell\right]$$

σ: gain ~~xx~~ in meter squared $[m^2]$

ℓ: gain medium's length $[m]$

$\rightarrow$

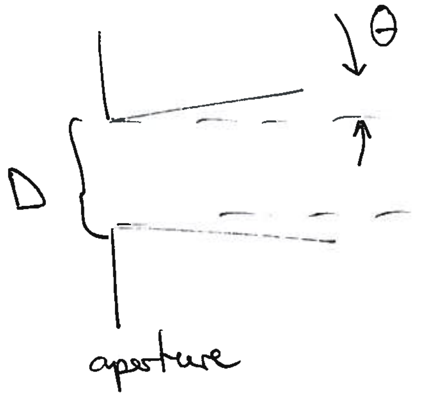
$$e^{2\sigma N_c l} \overset{!}{=} \cancel{1}\ \frac{1}{R_1 R_2 (1-L_i)^2}$$

critical (threshold) inversion

at threshold

esult: $\Rightarrow \quad N_c = \frac{\gamma_{rt}}{2\sigma l} = \frac{\gamma_{sp}}{\sigma l} \approx \cancel{3.38\cdot 10^{19}}\ \underline{1.7\cdot 10^{17}}\ \frac{1}{cm^3}$

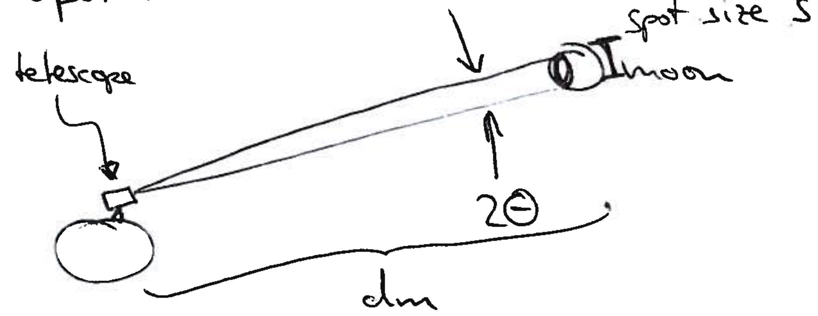
1.6 diffraction:



$$\Theta = \frac{\beta\lambda}{D} \approx 694\cdot 10^{-9}$$

$\beta \approx 1$

divergence



esult: $\Rightarrow s \approx d_m \cdot \sin(2\Theta) \approx d_m \cdot 2\Theta \approx \underline{533m}$