L8HENES

Threshold gain σtr. Calculation for a HeNe laser

$\lambda := 6328 \cdot 10^{-10} \cdot m$ $L := .1 \cdot m$ $\tau sp := 10^{-7} \cdot s$ $c := 3 \cdot 10^{8} \cdot \frac{m}{s}$ $ma := 1.67 \cdot 10^{-27} \cdot kg$

$\nu o := \frac{c}{\lambda}$ $\nu o = 4.741 \times 10^{14}\, s^{-1}$ $R1 := .98$ $R2 := .98$ α is neglected

Doppler broadening

$T := 300 \cdot K$ $k := 1.38 \cdot 10^{-23} \cdot W \cdot \frac{s}{K}$ $\ln(2) = 0.693$

$ac := 2 \cdot \sqrt{\frac{2 \cdot k \cdot \ln(2)}{ma \cdot c^2}}$ $ac = 7.135 \times 10^{-7}\, K^{0}$ $MN := 20$

$\Delta\nu d := ac \cdot \nu o \cdot \sqrt{\frac{T}{MN}}$ $\Delta\nu d = 1.31 \times 10^{9}\, s^{-1}$

We use approximately $gd := \frac{1}{\Delta\nu d}$

$\gamma tr := \frac{1}{2 \cdot L} \cdot \ln\left(\frac{1}{R1 \cdot R2}\right)$

$\gamma tr = 0.202\, m^{-1}$

We then have for the treshold condition

$\sigma := \frac{8 \cdot \pi \cdot \tau sp \cdot \Delta\nu d}{\lambda^2} \cdot \gamma tr$

$\sigma = 1.661 \times 10^{15}\, m^{-3}$

$\sigma = 1.66 \cdot 10^{9} \cdot cm^{-3}$