

# Optične komunikacije

## Predavanje 10:

### Komunikacijski izvori svetlobe

Zahteve?

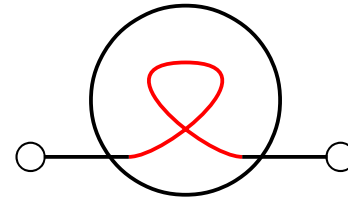
$P = ?$

*Vzdolžna koherenca?*

*Prečna koherenca?*

*Modulacija?*

*Toplotni izvor (žarnica z nitko)*



$P \approx$  poljubna...

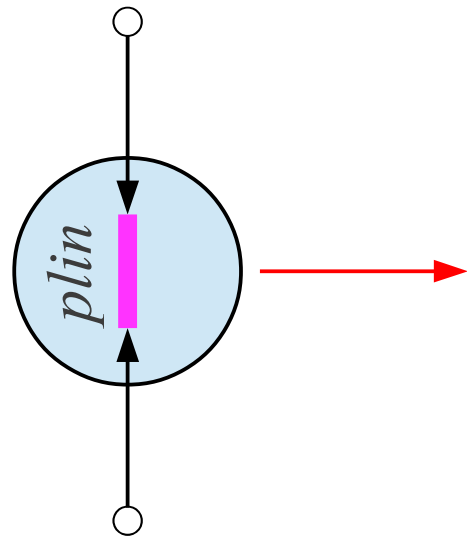
*bela svetloba  $\equiv$  beli šum*

*slaba prečna koherenca*

$\tau \approx 1\text{ms} \dots 100\text{ms}$

Tlivke (nizkotlačne, majhen  $\vec{J}$ )  $\rightarrow$  nizek  $P$ , Dopperjev pomik  $10^{-6}$

Obločnice (visokotlačne, velik  $\vec{J}$ )  $\rightarrow$  visok  $P$ , Doppler + trki

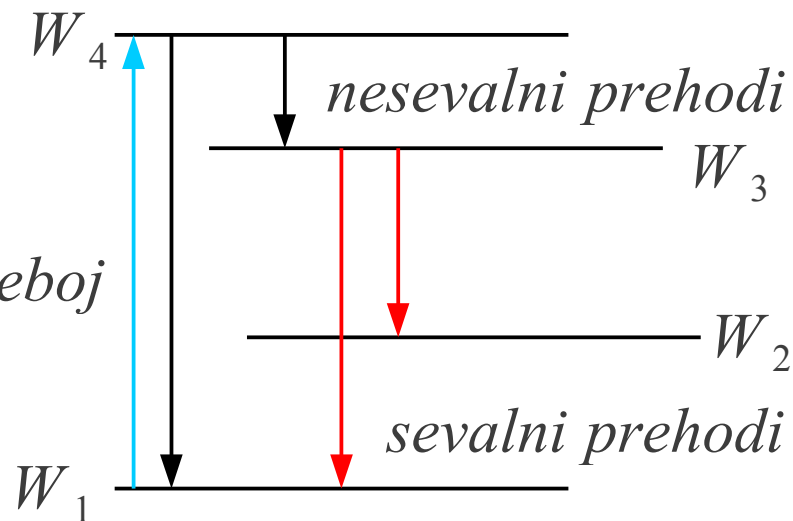


*Slaba prečna koherenca*

$$\tau \approx 1 \mu s \dots 100 \mu s$$

*električni preboj*

$$\Delta W = h \cdot f = \frac{h \cdot c_0}{\lambda}$$



$$W = h \cdot f = \frac{h \cdot c_0}{\lambda}$$

$h \approx 6.626 \cdot 10^{-34} \text{ Js} \equiv \text{Planckova konstanta}$

$$W = U |Q_e|$$

$Q_e \approx -1.6 \cdot 10^{-19} \text{ As} \equiv \text{naboj elektrona}$

$$W [eV] = U = \frac{W}{|Q_e|} = \frac{h \cdot c_0}{\lambda |Q_e|} \approx \frac{1.24 eV \cdot \mu m}{\lambda [\mu m]}$$

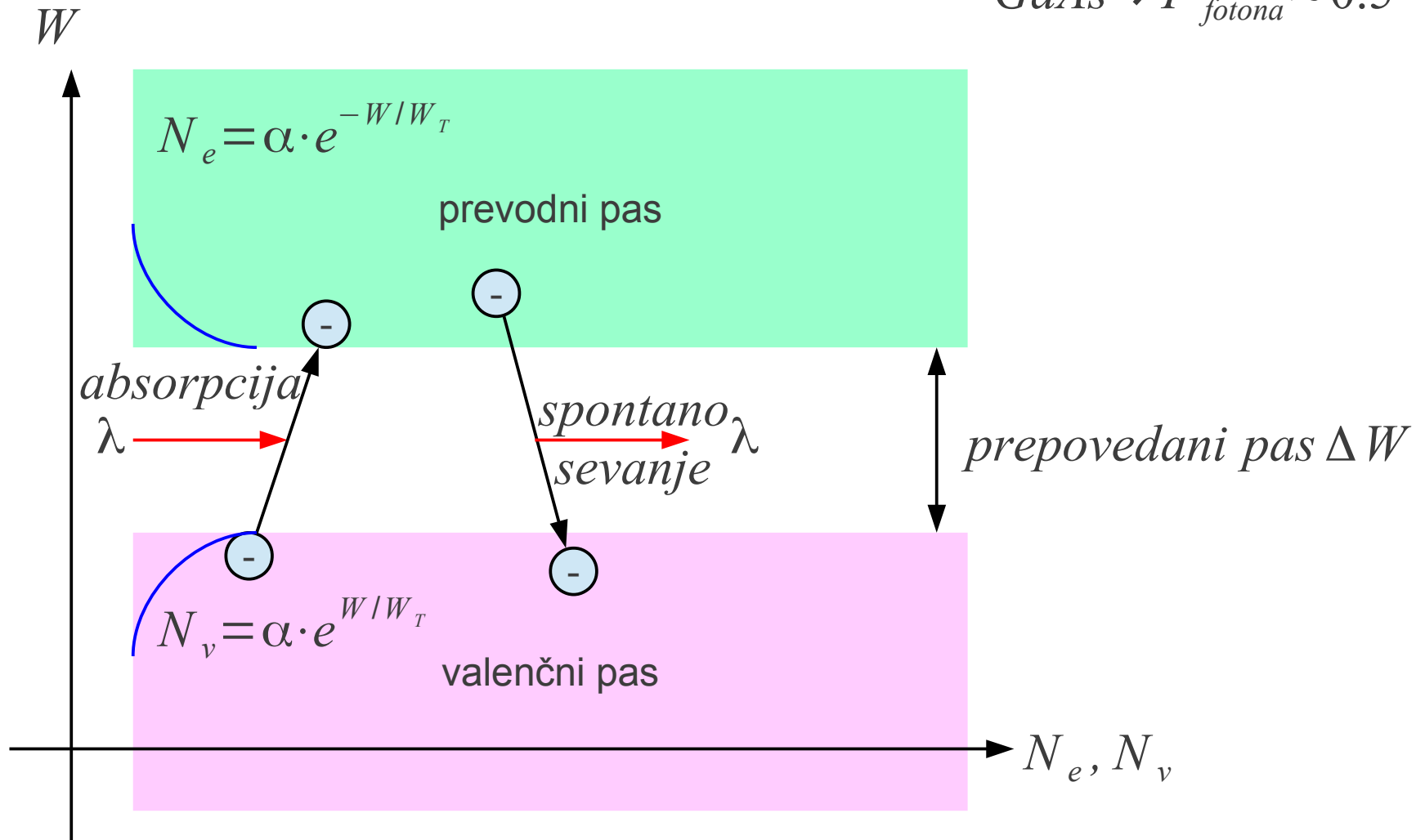
*optika!!!  
kemija!!!*

$$W [eV] \approx \frac{1.24 eV \cdot \mu m}{\lambda [\mu m]}$$

# Polprevodniki

$$Si \rightarrow P_{\text{fotona}} \approx 10^{-4}$$

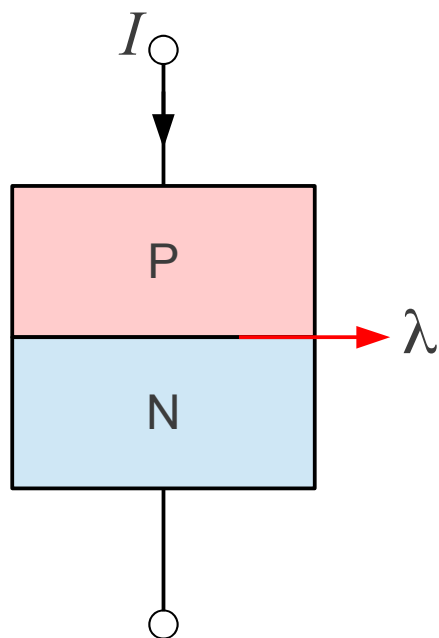
$$GaAs \rightarrow P_{\text{fotona}} \approx 0.5$$



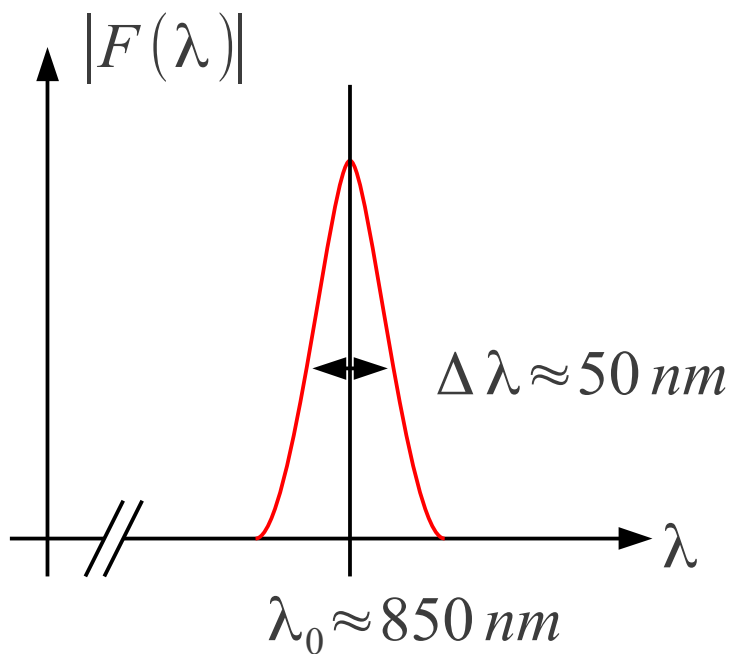
$$W_T = k_B \cdot T \approx 26 \text{ meV}$$

$$P \approx 10 \text{ mW}$$

*majhen vir  
boljša prečna koh. ?*

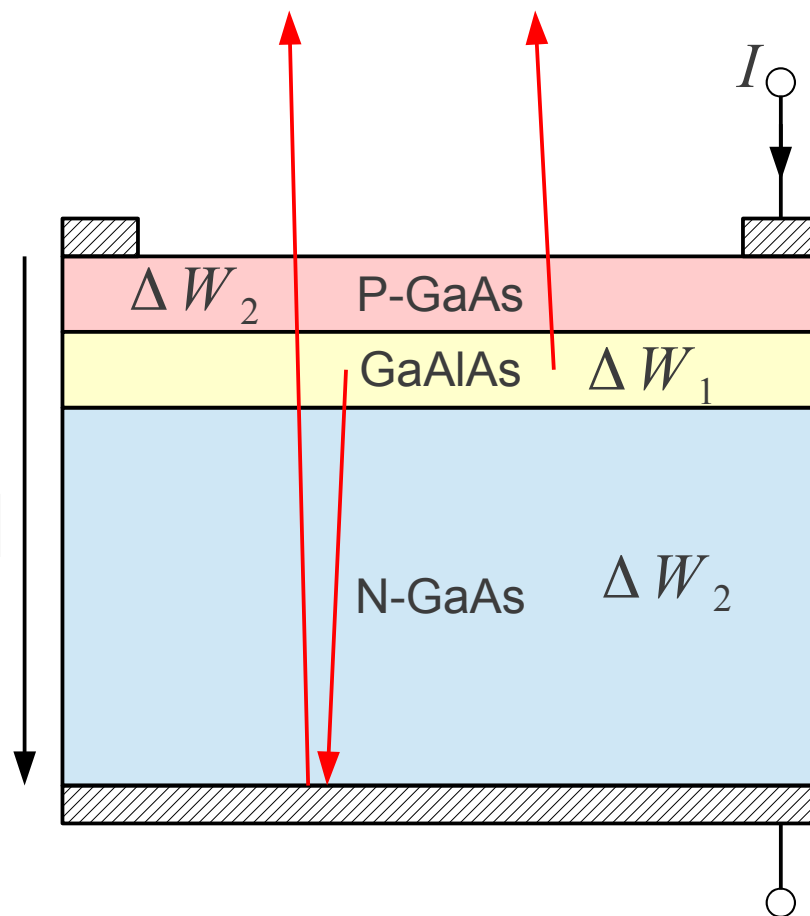


$$\tau \approx 10 \text{ ns} \dots 1 \mu \text{ s}$$



$$U \approx \Delta W [\text{eV}]$$

*Heterostruktura*  
 $\Delta W_2 > \Delta W_1$



*LED (ozkopasovni šum)*

*Rdeča  $\lambda_0 \approx 650 \text{ nm}$*

*Modra  $\lambda_0 \approx 450 \text{ nm}$*

$\lambda_0 \approx 850 \text{ nm}$

$U \approx 1.6 \text{ V}$

$U \approx 2.7 \text{ V}$

$\Delta \lambda \approx 50 \text{ nm}$

$U \approx 1.1 \text{ V}$

$P_{LED} \approx 10 \text{ mW}$

$P_{MMF} \approx 100 \mu \text{ W}$

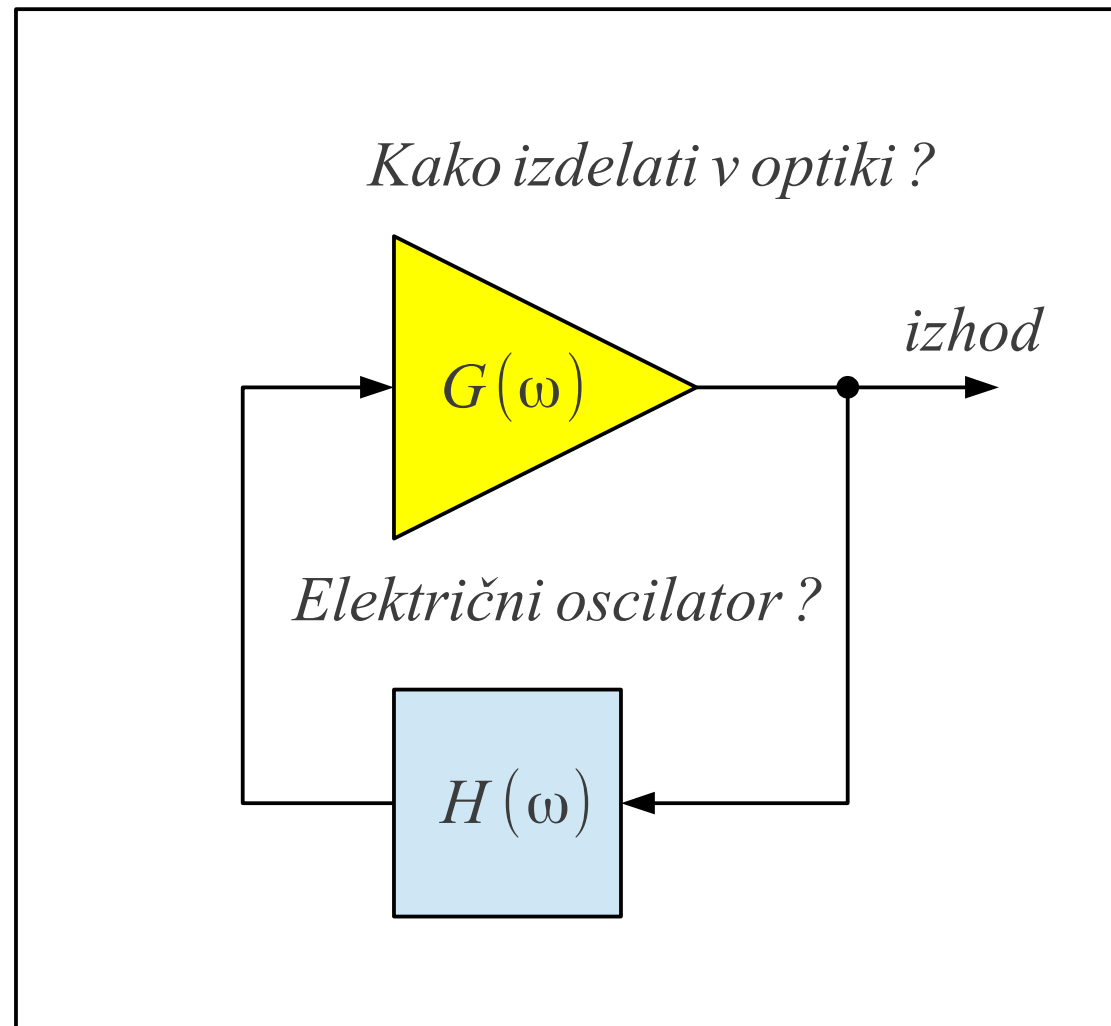
$P_{SMF} \approx 10 \mu \text{ W}$

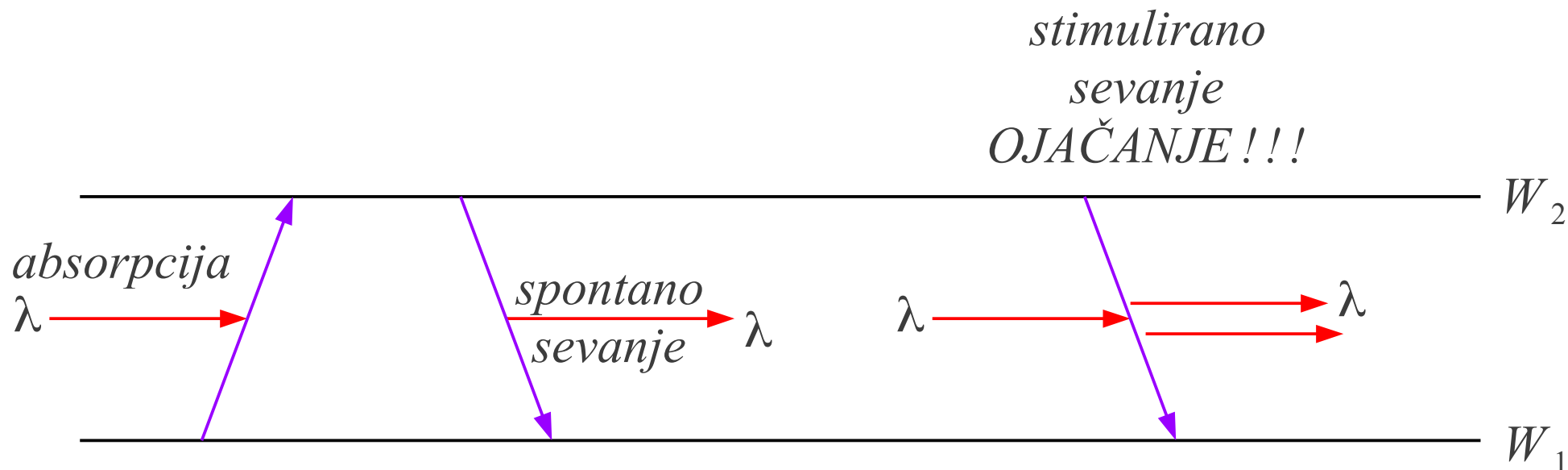
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$\lambda_0 \approx 1310 \text{ nm}$

$\Delta \lambda = \frac{\lambda_0^2}{c_0} \cdot \Delta f \approx 100 \text{ nm}$

$U \approx 0.7 \text{ V}$





absorpcija:  $\frac{dN}{dt} = B_{12} \cdot N_1 \cdot S$

Fizika zahteva:  $B_{12} = B_{21}$

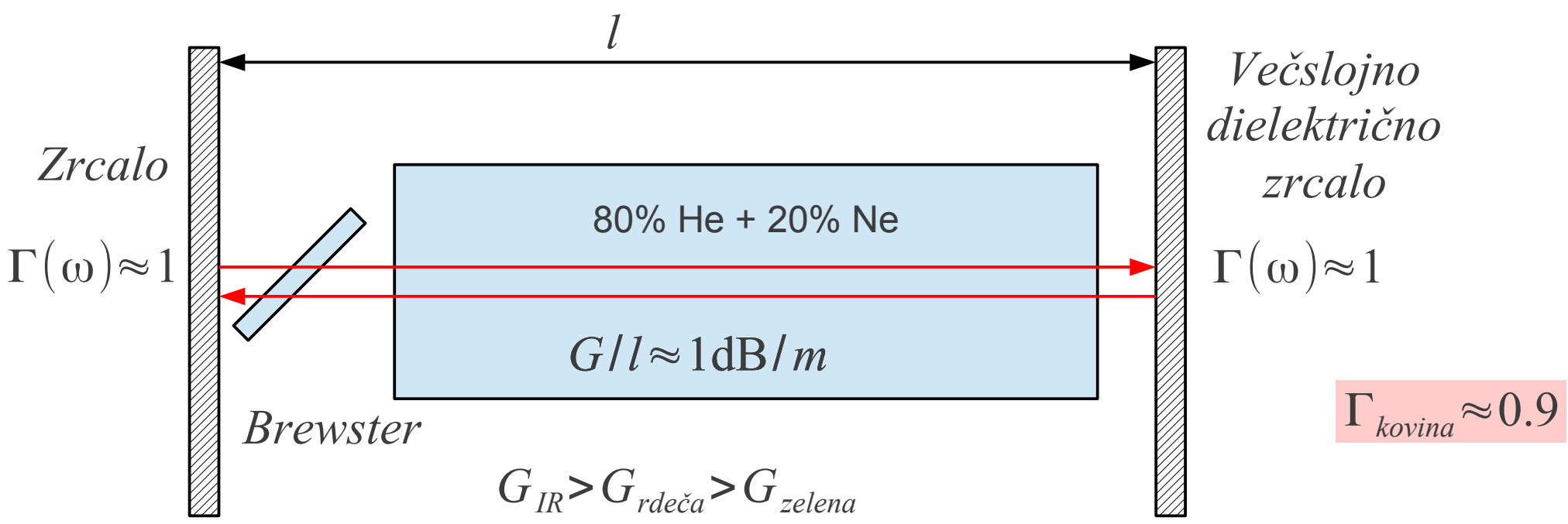
spontano sevanje:  $\frac{dN}{dt} = A_{21} \cdot N_2$

$\Delta W = W_2 - W_1 \gg W_T$

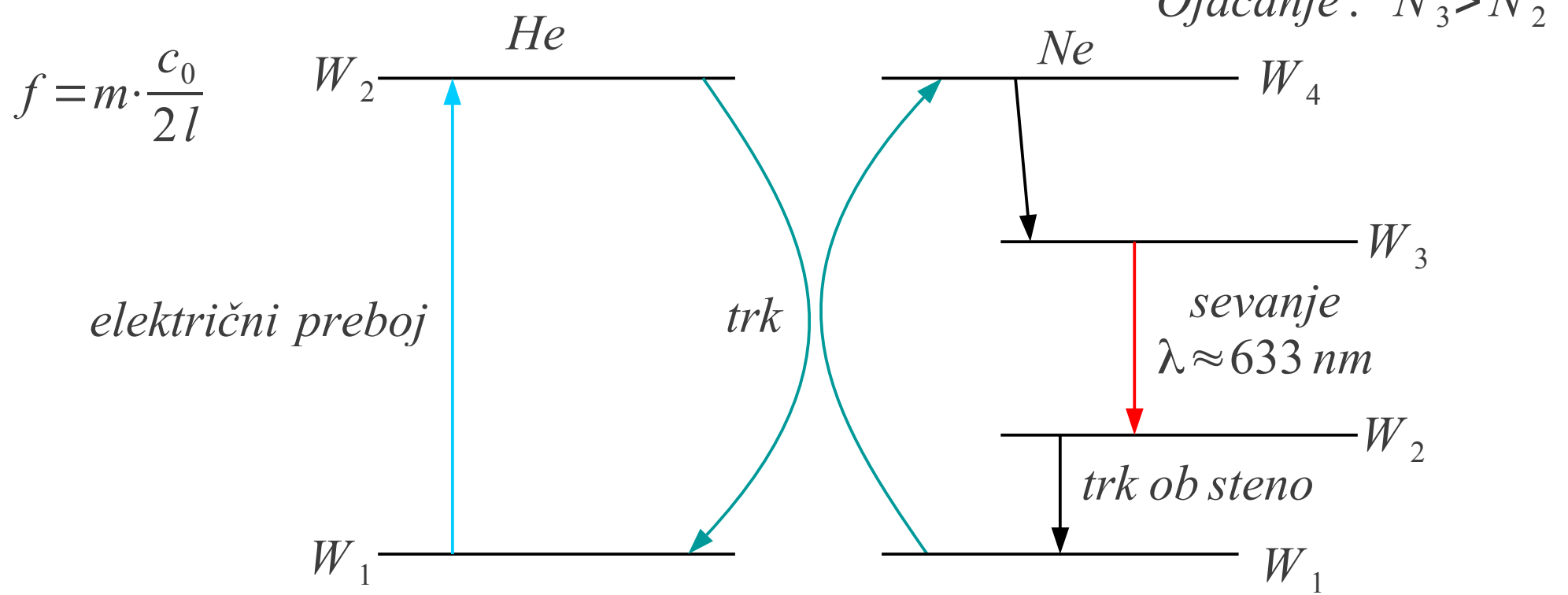
Toplotna porazdelitev:  $N_2 \ll N_1$

stimulirano sevanje:  $\frac{dN}{dt} = B_{21} \cdot N_2 \cdot S$

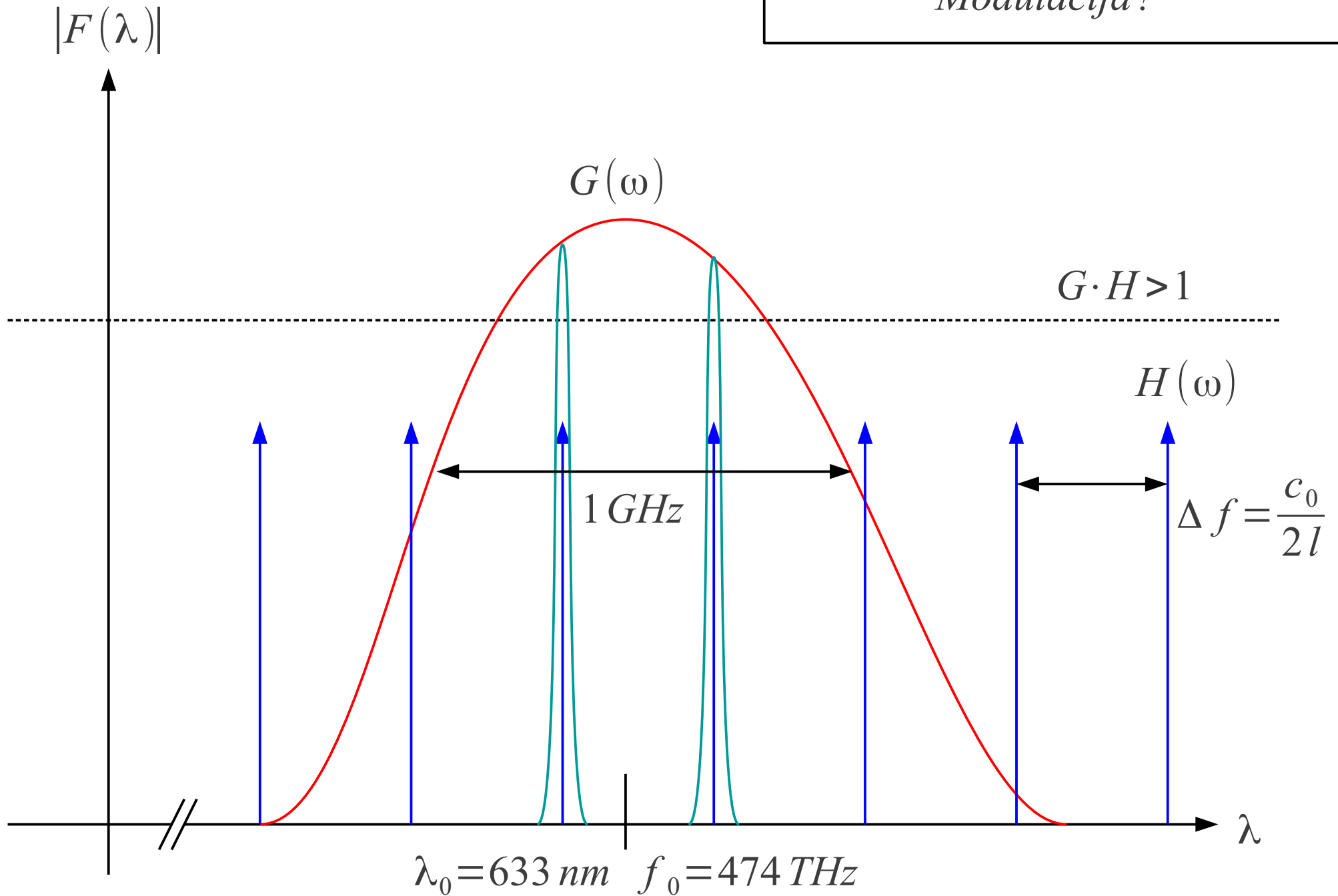




Rodovi  $TEM_{00m}$

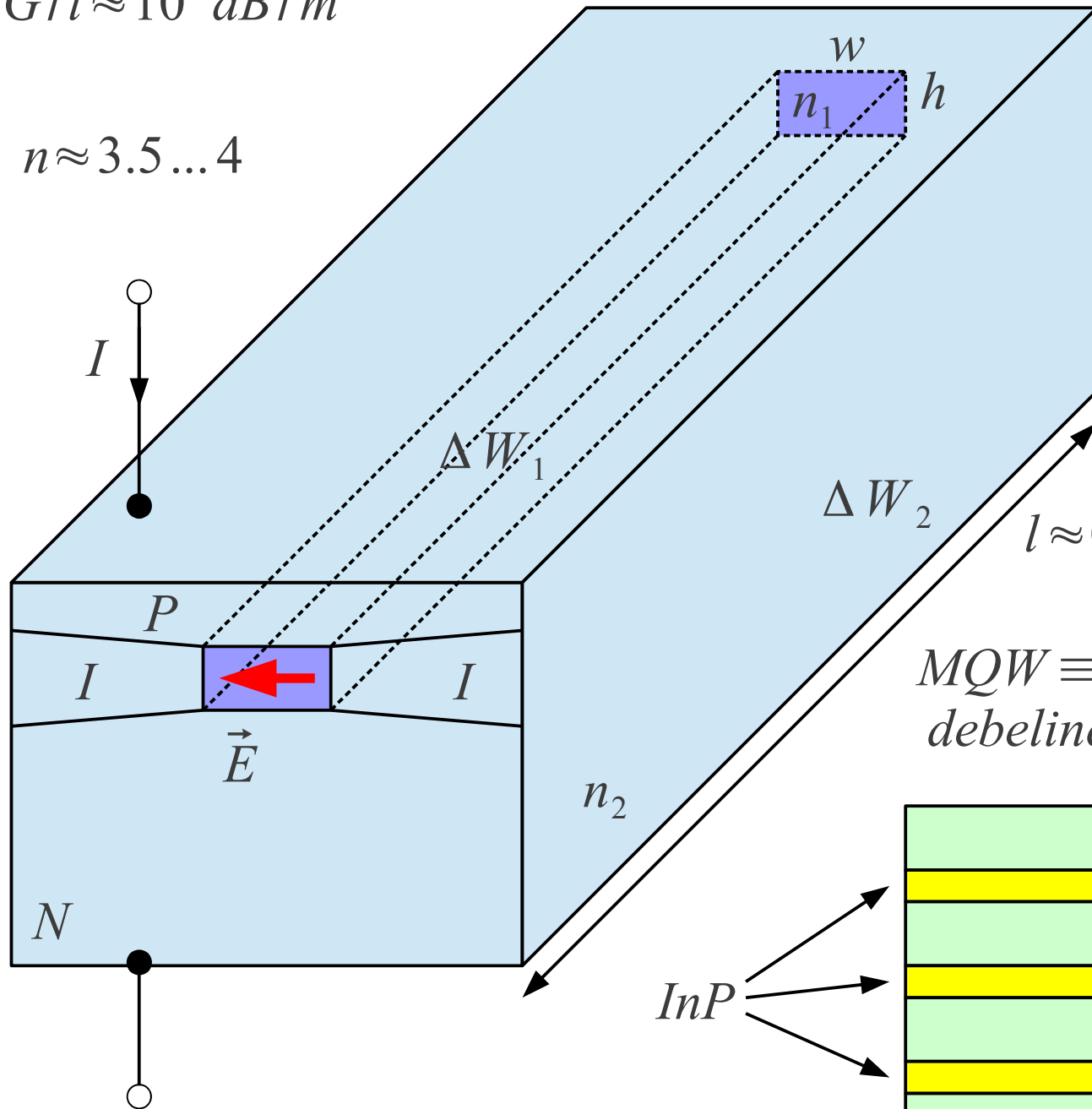


*HeNe omogoča  $\lambda_0 \approx 1532 \text{ nm}$   
Modulacija?*



$G/l \approx 10^4 \text{ dB/m}$

$n \approx 3.5 \dots 4$



*Vodenje valovanja*

$$n_1 > n_2$$

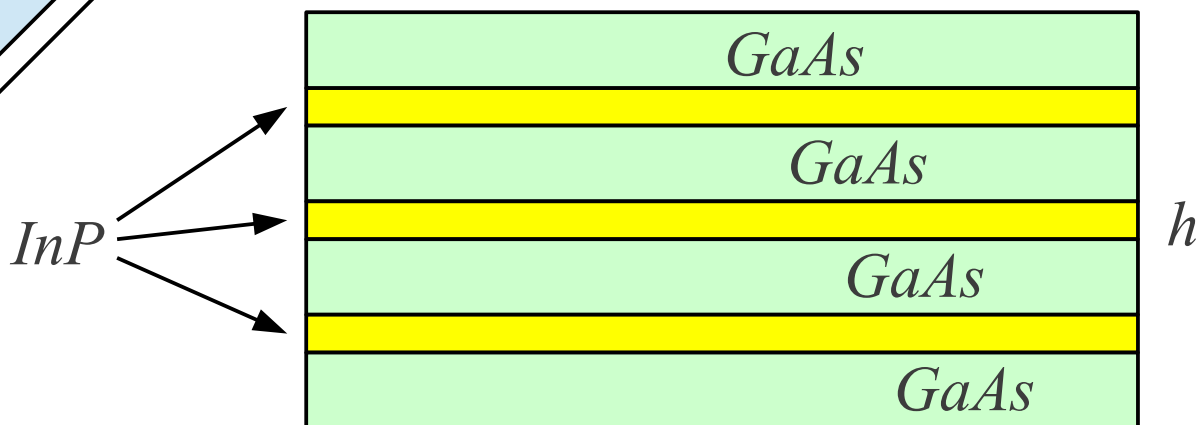
*Brez izgub v oblogi*

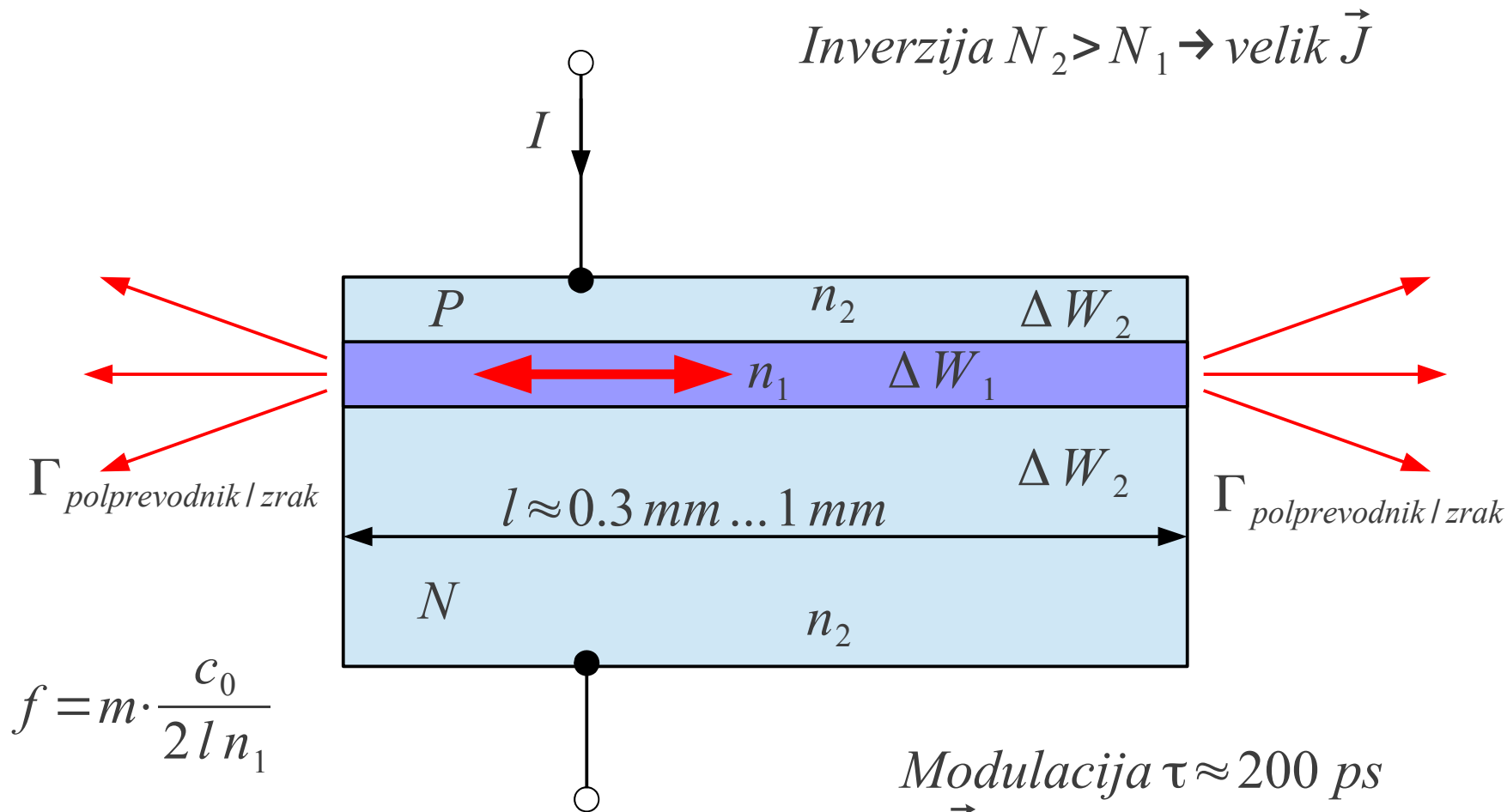
$$\Delta W_1 < \Delta W_2$$

*Velik  $\Gamma$  polprevodnik l zrak*

$$l \approx 0.3 \text{ mm} \dots 1 \text{ mm}$$

*MQW  $\equiv$  Multiple Quantum Well  
debeline plasti 10 nm ... 100 nm*





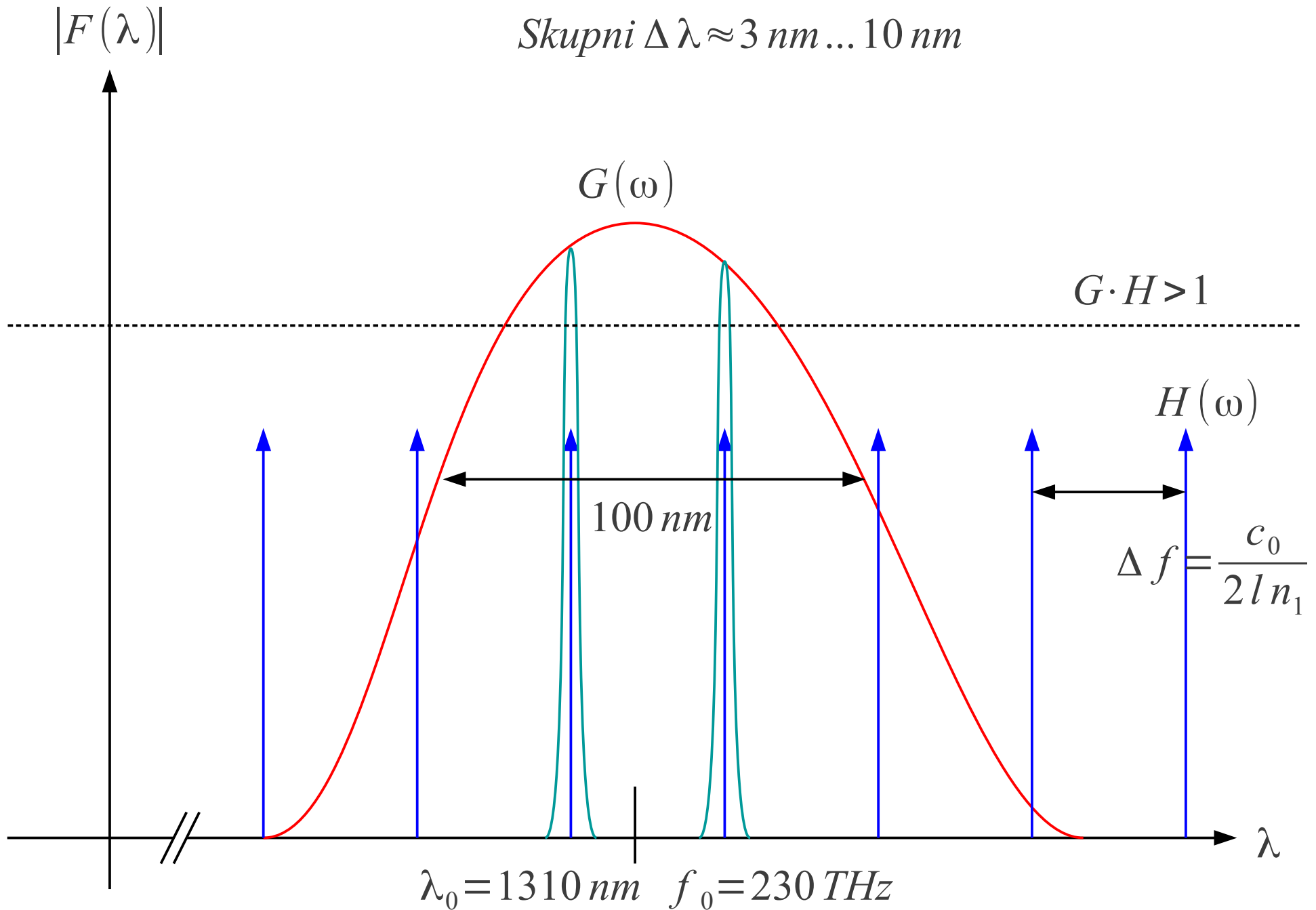
*Izbira širine valovoda  $w = ?$*

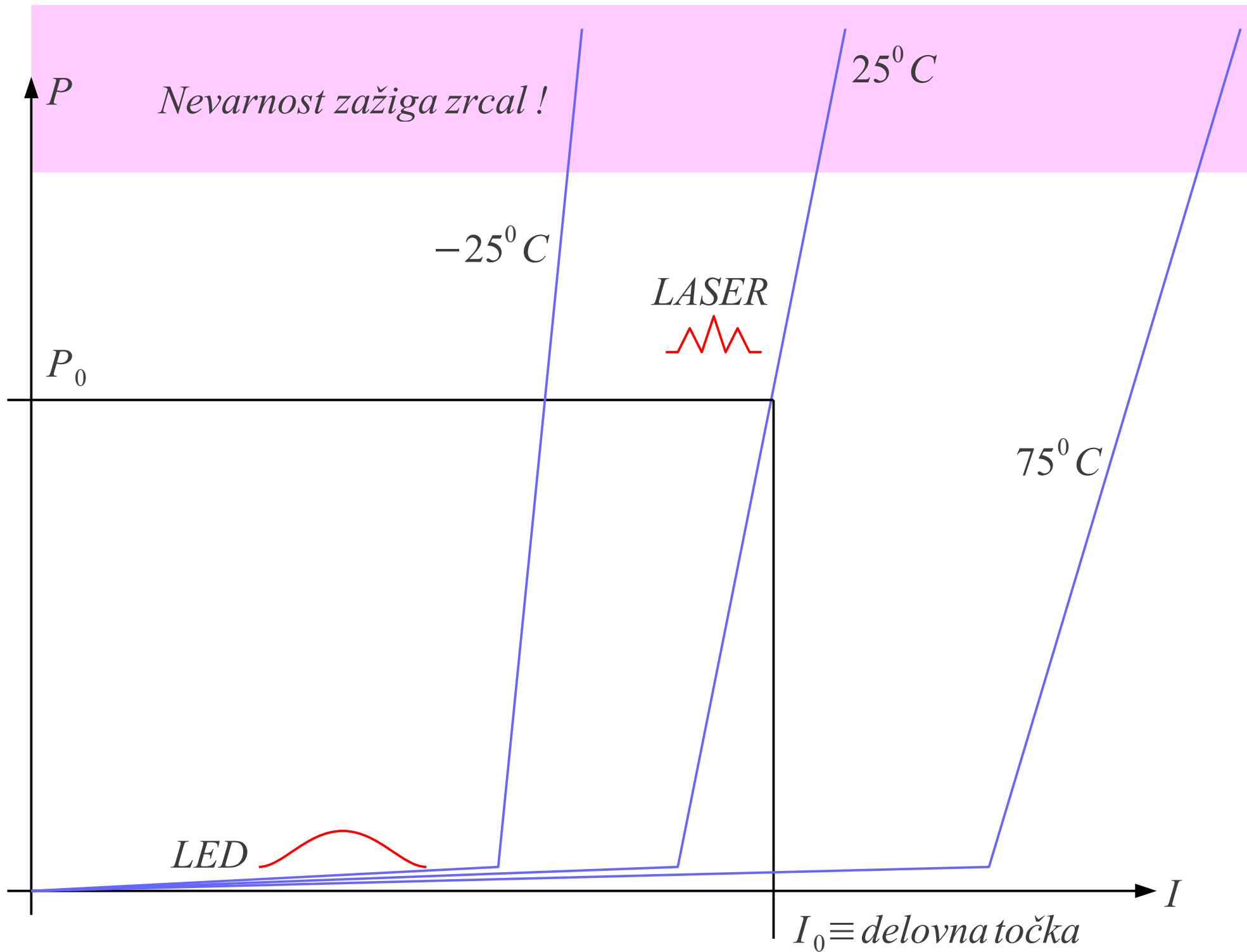
*$w < 10 \lambda \rightarrow$  en sam prečni rod  $TEM_{00m} \rightarrow$  telekomunikacijski laser  $P \approx 100 \text{ mW}$*

*$w > 10 \lambda \rightarrow$  množica prečnih rodov  $TE_{lmn} \rightarrow$  močnostni laser  $P \approx 100 \text{ W}$*

*Nihanje na 5...100 vzdolžnih rodovih!*

*Skupni  $\Delta\lambda \approx 3\text{ nm} \dots 10\text{ nm}$*





*Okno*

