Laser Rate Equations:

$$\partial_t n_{ph}(t) = -(\gamma_c - \kappa\, n(t)) \cdot n_{ph}(t)$$

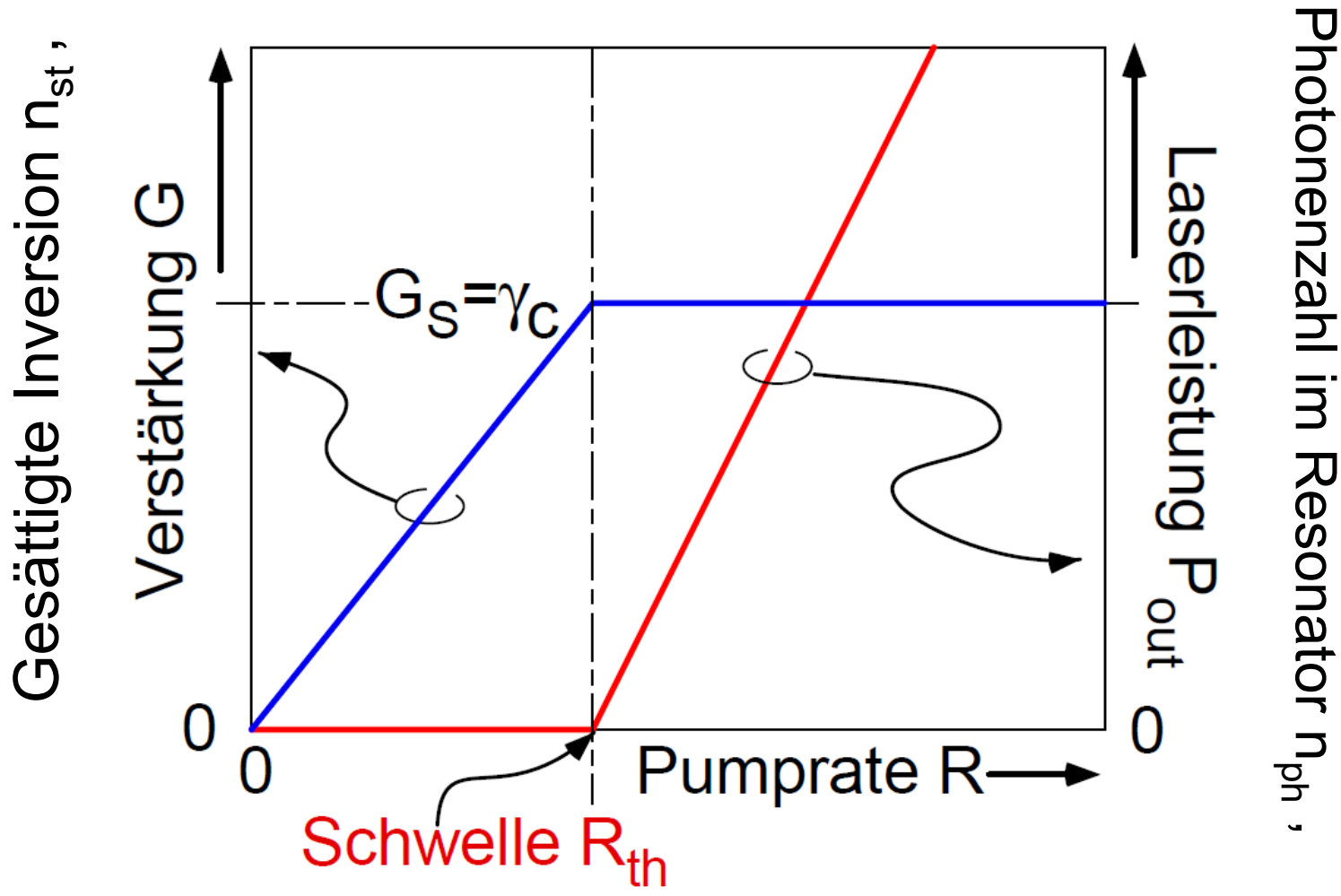
$$\partial_t n(t) = -\kappa\, n_{ph}(t) \cdot n(t) - \gamma\, n(t) + R$$

Steady State:

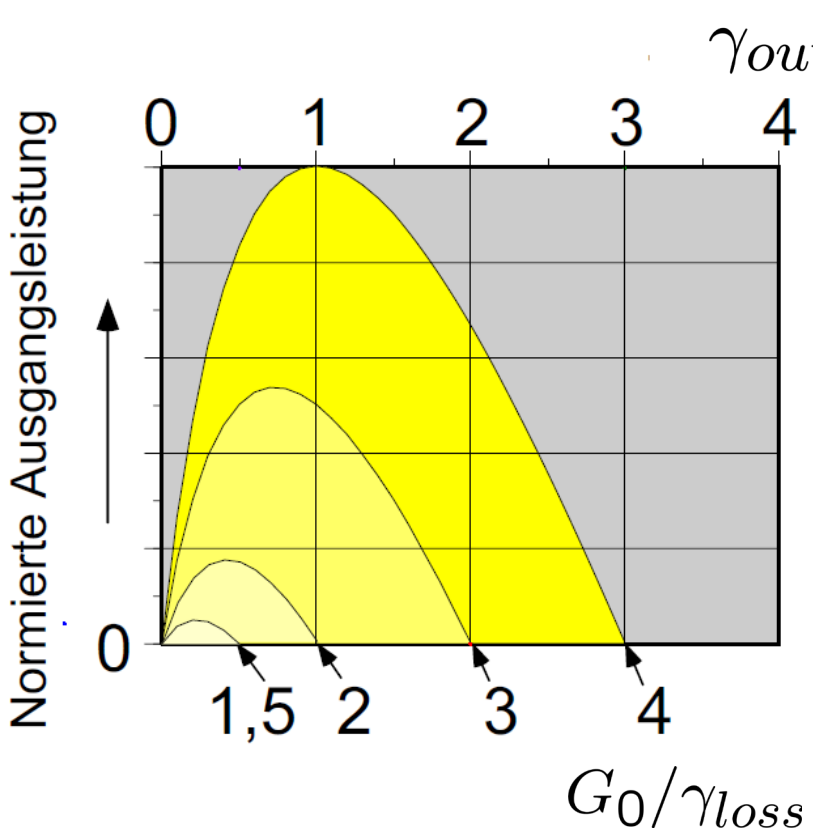
$$R < R_{th}: \quad \overline{n_{ph}} = 0 \qquad n_{st} = \frac{R}{\gamma}$$

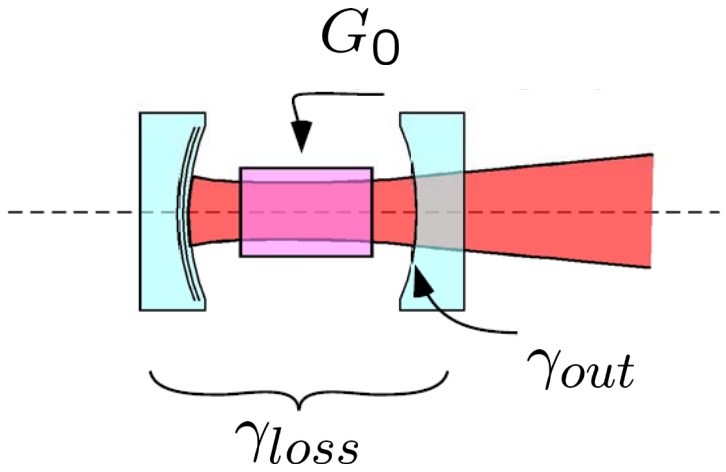
$$R \geq R_{th}: \quad \overline{n_{ph}} = \frac{1}{\gamma_c}(R - R_{th}) \qquad n_{st} = \frac{\gamma_c}{\kappa}$$

Saturated inversion/amplification and photon number/laser power vs. R



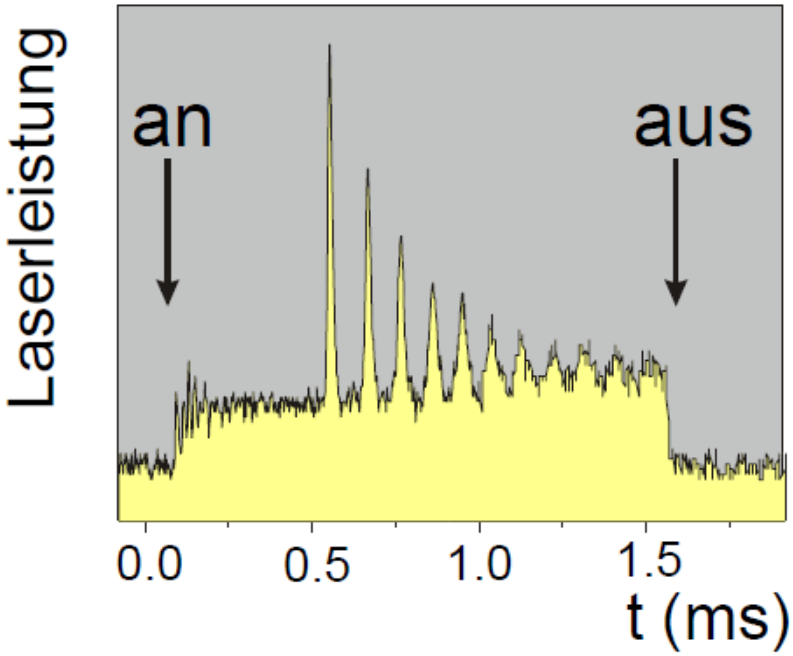
Outcoupled laser power $P_{out} = \hbar\omega\gamma_{out}(\frac{R}{\gamma_{out}+\gamma_{loss}} - \frac{\gamma}{\kappa})$



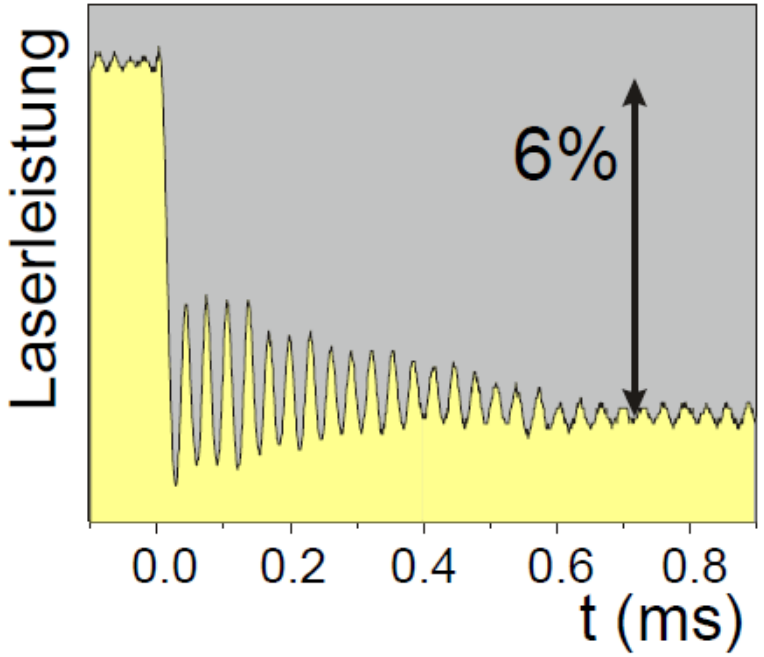


$$G_0/\gamma_{loss} = \frac{R\kappa}{\gamma}/\gamma_{loss}$$

Laserspiking



Relaxation oscillations



Nd:YAG laser, λ = 1064 nm.

Natural lifetime τ = 240 ms γ = 4.2 103 s^{-1}

Cavity storage time τ_c = 20 ns γ_c = 5.0 107 s^{-1}

Normalized pump power R/R_{th} = 1 … 1.5