Kohärenz

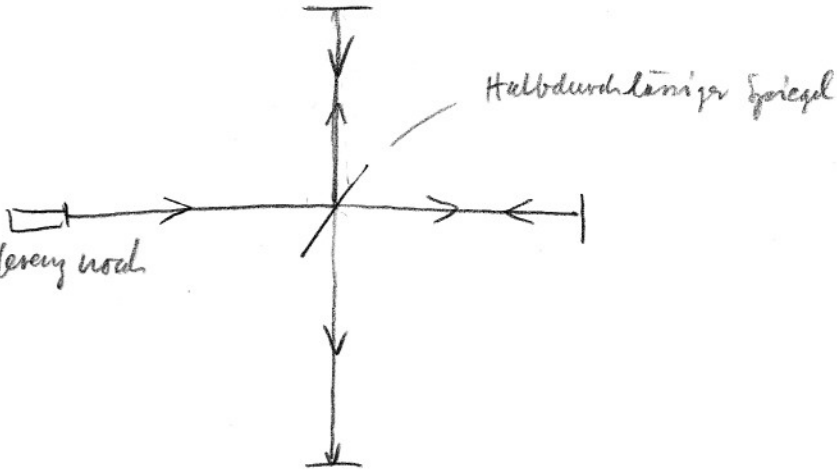
thermische Quellen: inkohärent $I = I_1 + I_2$ Intensitäten addieren

Laser: kohärent $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\left(2\pi \Delta l/\lambda + \Delta\phi\right)$ (Phasenunterschied 2 Quellen)

Interferenz, Amplituden addieren

zeitliche Kohärenz

Michelson – Morley



Kohärenzlänge L_c: max Δl wo Interferenz noch beobachtbar.

↓

Kohärenzzeit τ_c: $\tau_c = \frac{L_c}{c}$

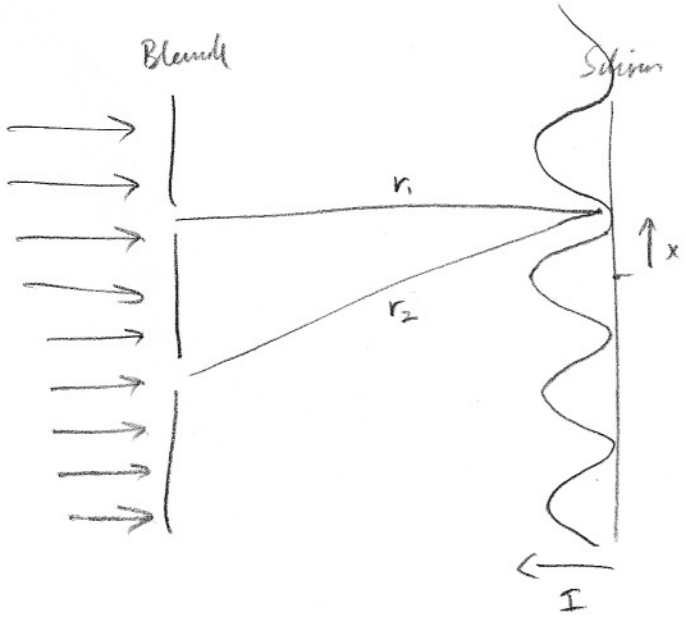
↓

$\Delta\nu \cdot \tau_c = \frac{1}{2\pi}$ (Fourier)

spektrale Reinheit

	λ [nm]	L_c [m]	τ_c	$\Delta\nu/\nu$
Drucklampen	632.8	$3\cdot10^{-2}$	10^{-10}	$3\cdot10^{-6}$
Ne	643.8	$3\cdot10^{-1}$	10^{-9}	$3\cdot10^{-7}$
Cd	605.8	$1\cdot10^{2}$	$3\cdot10^{-7}$	$1\cdot10^{-9}$
Kr				
He–Ne Laser stabilisiert	632.8nm	$5\cdot10^{5}$	$1.6\cdot10^{-3}$	$2\cdot10^{-11}$

räumliche Kohärenz



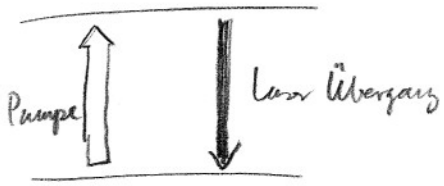
thermische Quelle → kann kohärent gemacht werden:

zeitlich: schmalbandiges Spektralfilter

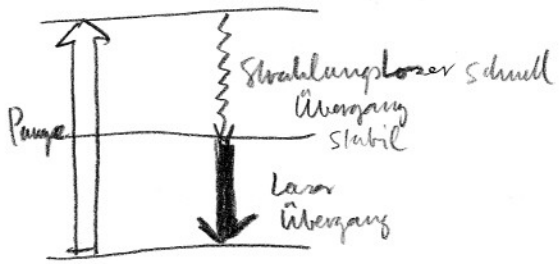
räumlich: Lochblende

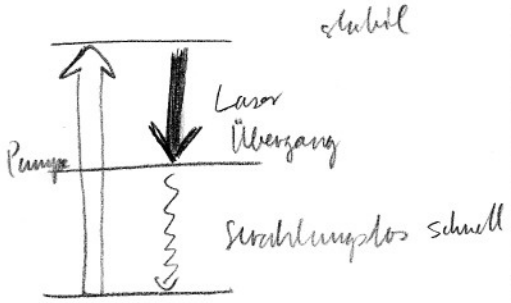
Verschiedene Lasertypen

2- Niveau System



3- Niveau System

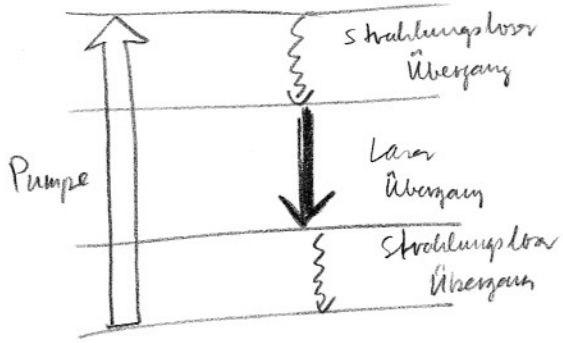




Rubin

Problem: GZ kann besetzt sein

4- Niveau System



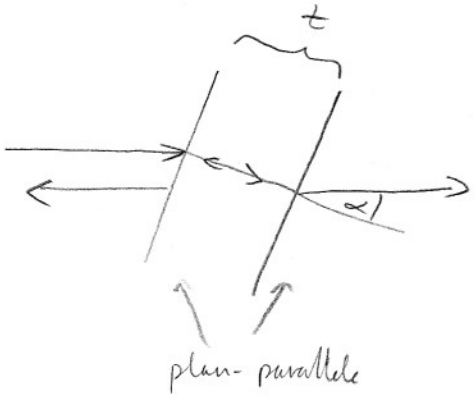
Nd:YAG, Nd:Glass, Ti:Saphir

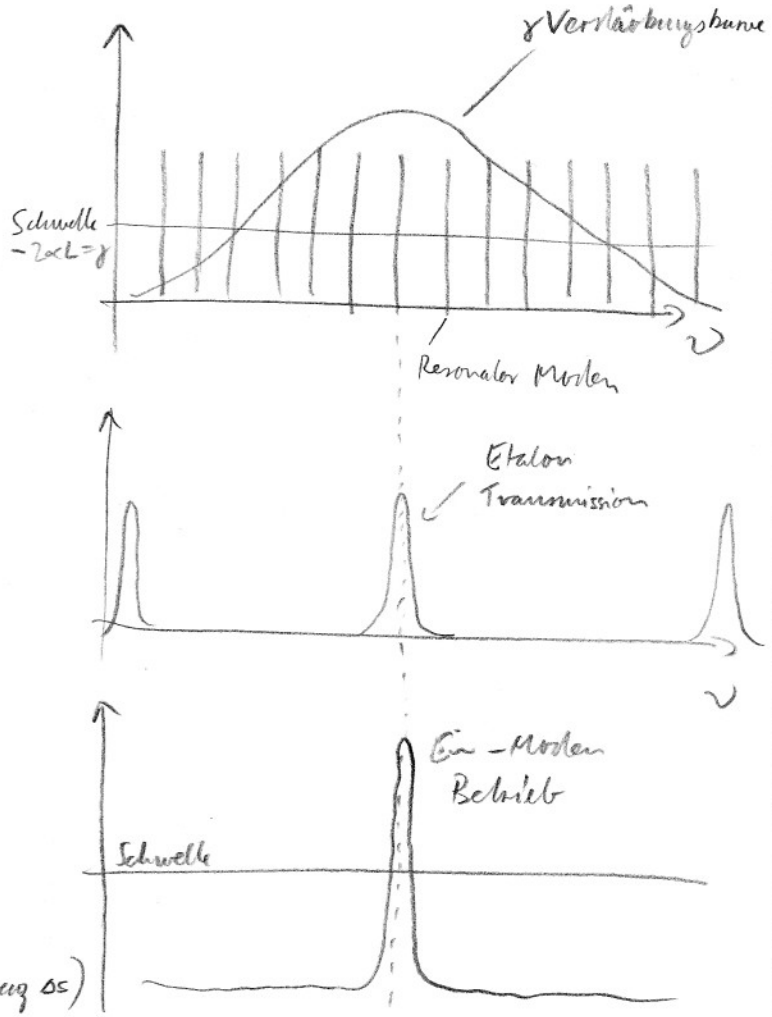
- Festkörper Laser (solid state)
  - Rubin
  - Neodym Glas / YAG / YLF
  - Ti:Saphir
- Gaslaser
  - HeNe
  - Ar Ionen
  - Excimer Laser
  - CO_2
- Farbstoff Laser
- Halbleiter
- Free Electron Laser

8.3 Einmodenlaser

nur eine Frequenz → Spektralfilter

z.B. Fabry-Perot Etalon





$$T = \frac{1}{1 + F \sin^2(\delta/2)}$$ Transmission

$$F = \frac{4R}{(1-R)^2}$$ Finesse

δ = Phasenverschiebung (optische Wegdifferenz Δs)

$\delta = 2\pi \Delta s / \lambda$

Δs = opt. Wegdifferenz = $2t \cdot \sqrt{n^2 - \sin^2\alpha}$

Stabilität / Linienbreite: – Schwankungen Resonator (ΔL) (≈ MHz)

– " Brechungsindex via δp (Druck etc.) (≈ 100 MHz)

→ feedback mit Piezo-positionierung zur Längenstabilisation → $\Delta\nu < 1$ Hz