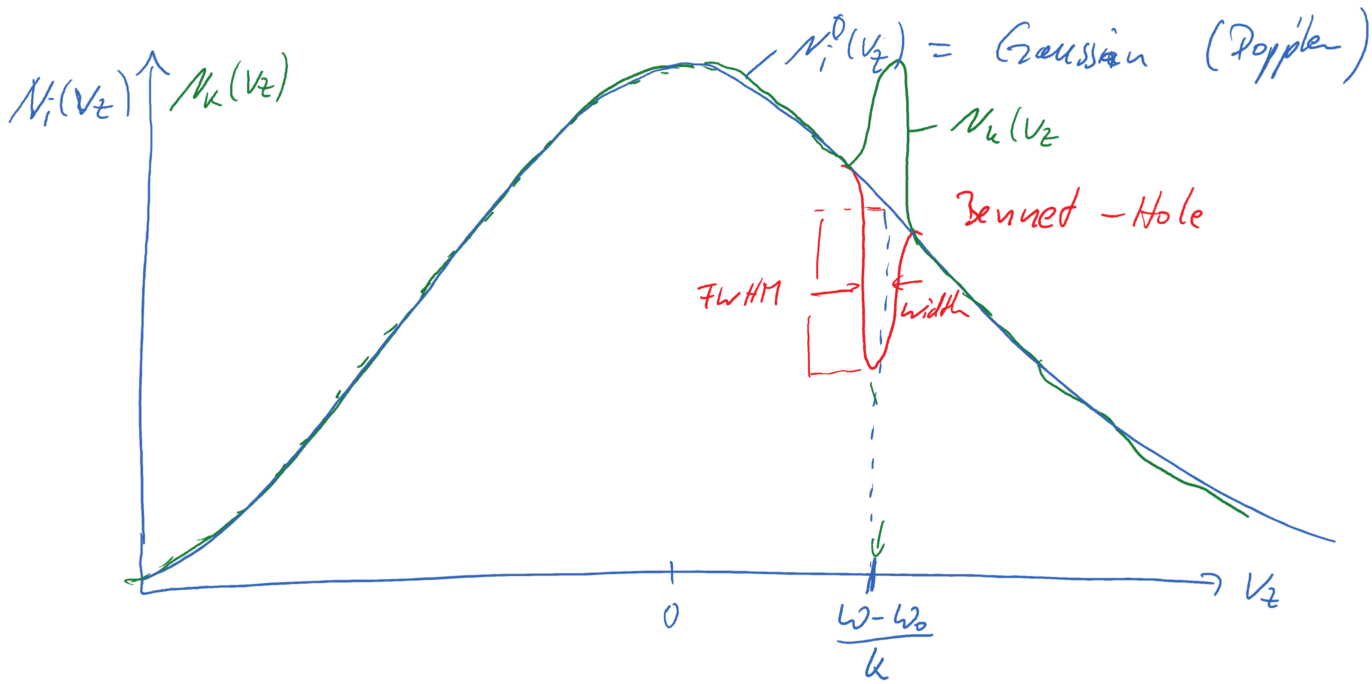
Doppler cont'd

Donnerstag, 20. Januar 2022 12:30

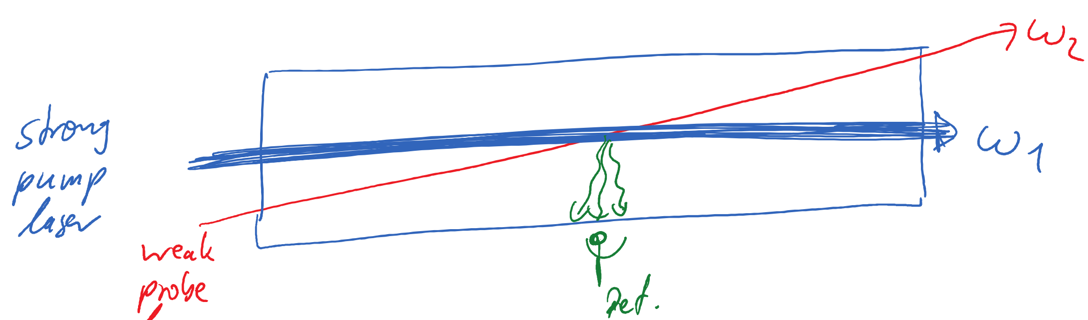


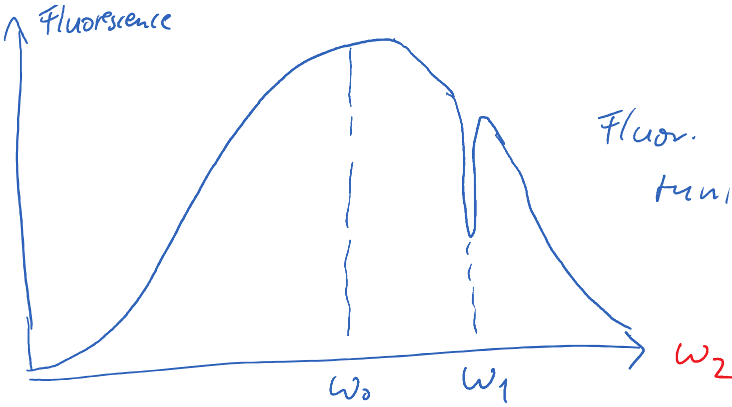
Bennet-hole = local minimum of atoms in lower state with $v_z = \frac{\omega-\omega_0}{k}$

width = power-broadened $\gamma_S = \gamma_0\sqrt{1+S_0}$

depth $\Delta N(v_z) \propto \frac{S_0}{1+S_0}$

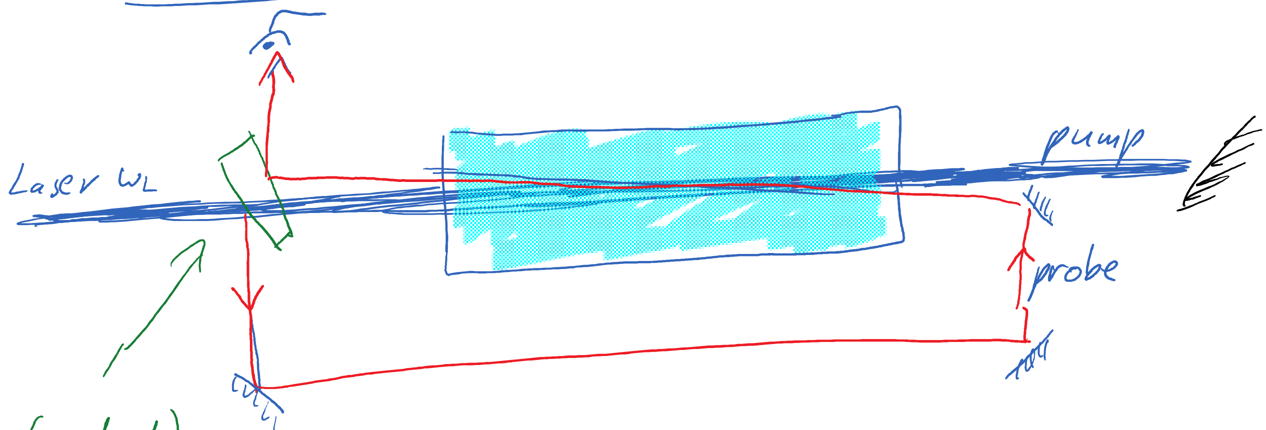
Observation with 2nd laser:





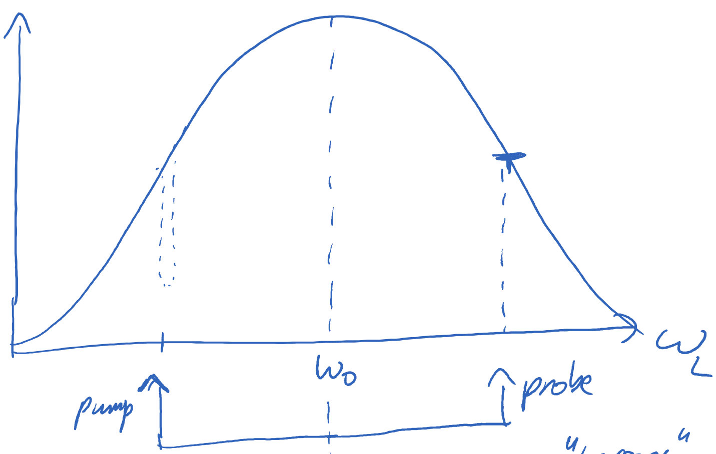
Fluor. while tuning $\underline{\omega_2}$

Lamb-Dip



(wedged) piece of glass
→ small reflector

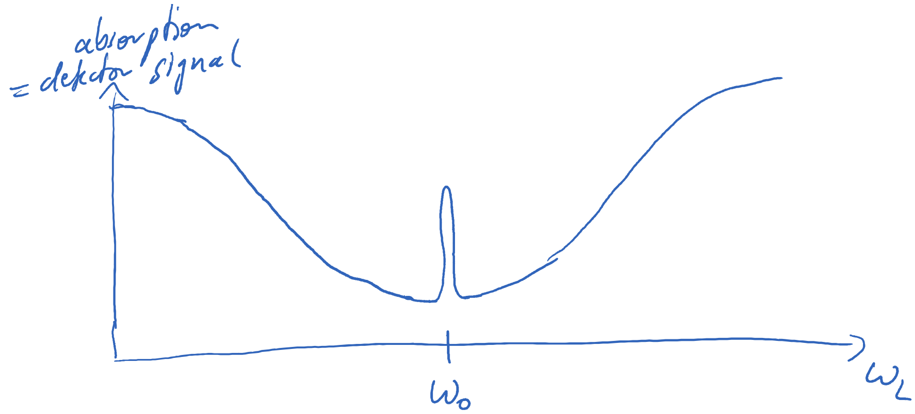
Fluorescence:



"wrong" laser frequency

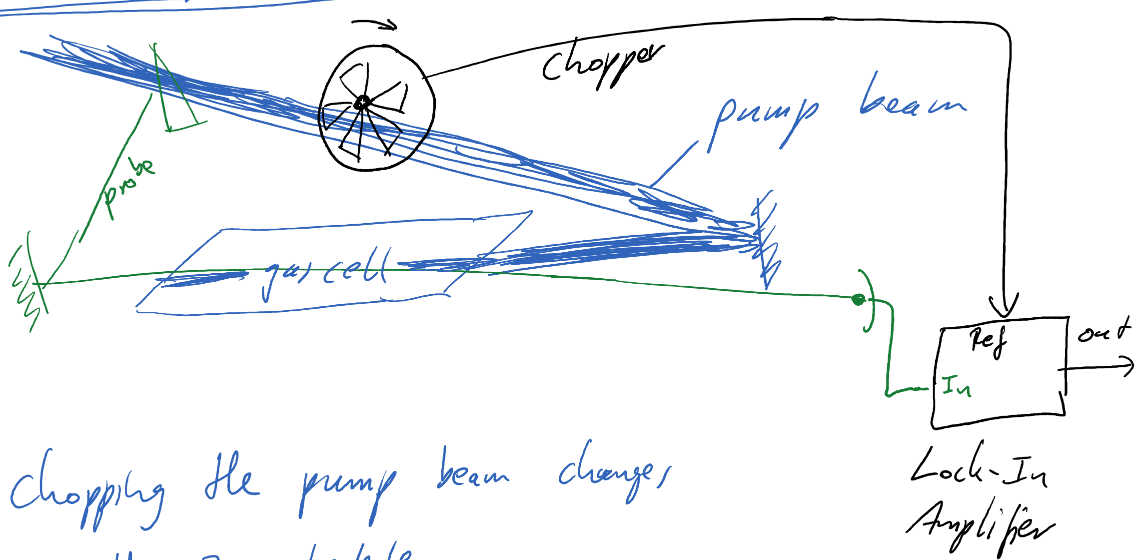
if "correct" $\omega_L = \omega_0$

→ pump beam creates Bennet hole @ ω_0
probe beam sees <u>less</u> absorption!



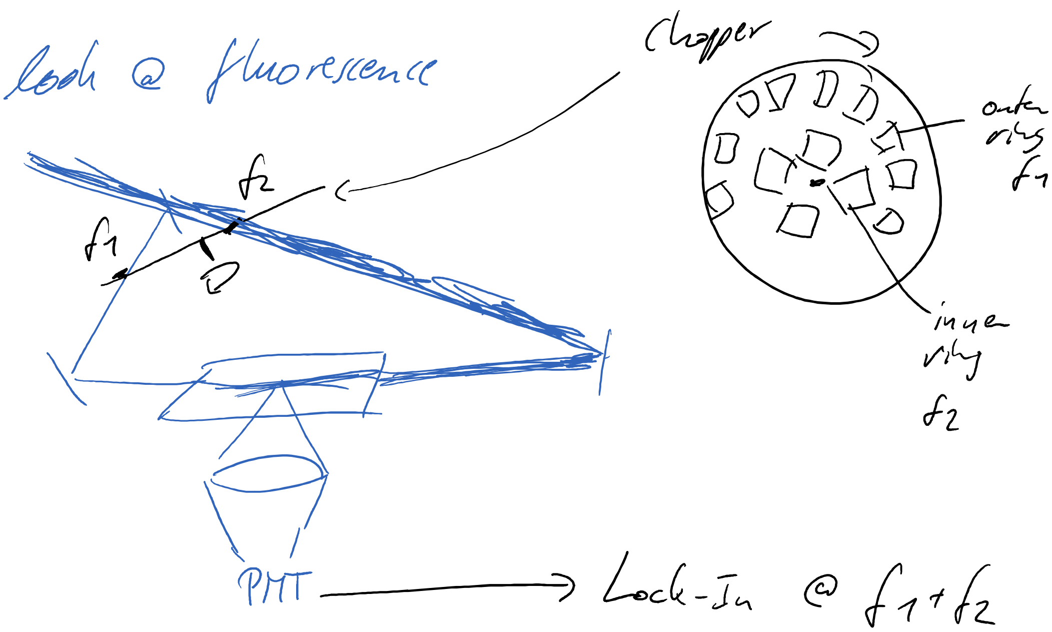
This is a Doppler-free signal of the atomic resonance frequency

Saturated absorption spectroscopy



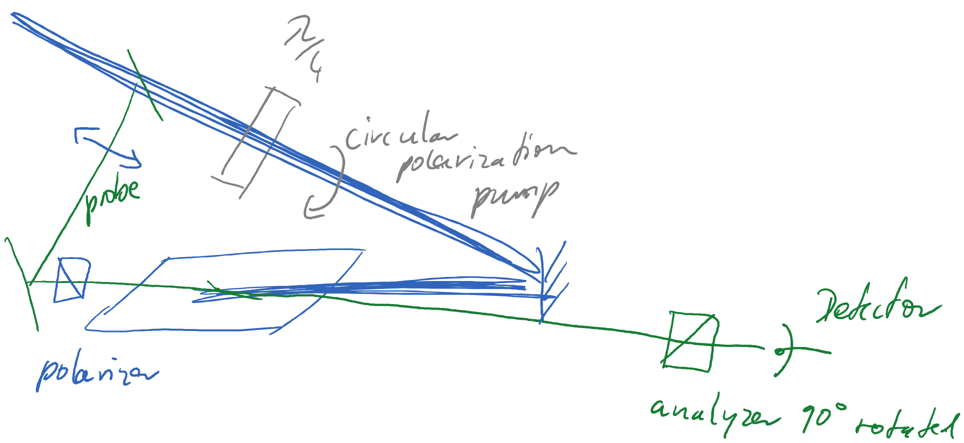
Chopping the pump beam changes the Bennet-hole
→ modifies probe absorption

Lock-In produces a good signal/noise ratio alternative : look @ fluorescence

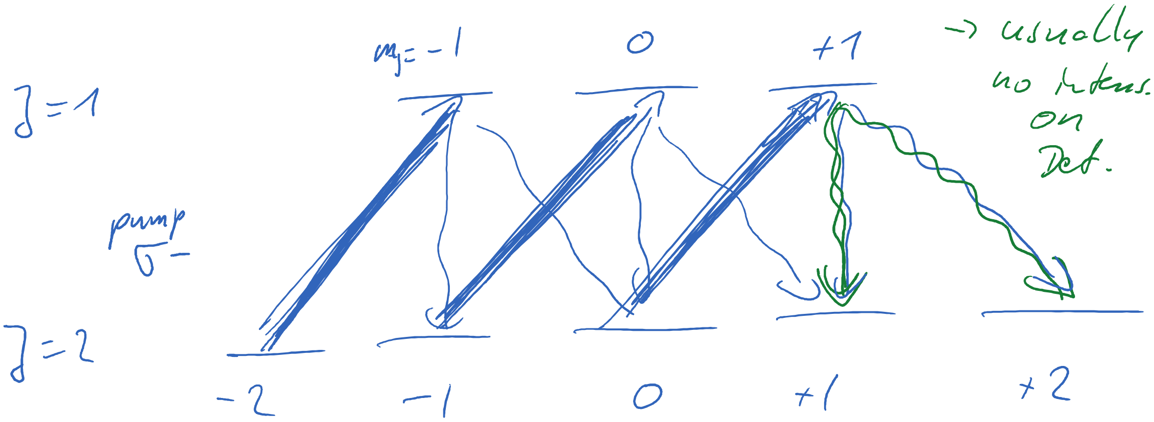


detects single fluorescence photons

Polarization spectroscopy



example

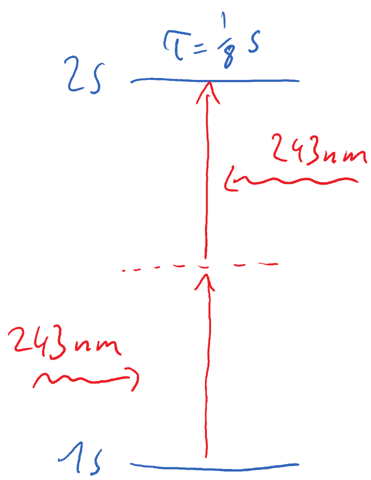


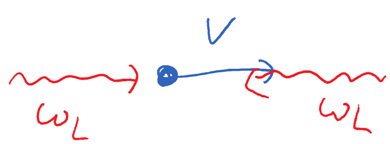
optical pumping with σ light creates
birefringence in the sample

$\Rightarrow$ Probe beam's linear polarization is slightly
rotated in the sample

$\rightarrow$ light on detector

H(1s - 2s) : 2-photon spectroscopy





2x 243 nm

the one we've been talking about

$$\left.\begin{array}{l}\omega_L - k \cdot v_z \\ \omega_L + k\, v_z\end{array}\right\} 2 \cdot \omega_L$$

no (1st order) Doppler shift

($\Leftarrow$ 2nd order Doppler shift
eigentime of atoms (= moving clock))

$$\frac{\Delta\omega}{\omega} \approx 4 \cdot 10^{-15} \qquad 10\,\text{Hz in } 2{,}5\,\text{PHz}$$