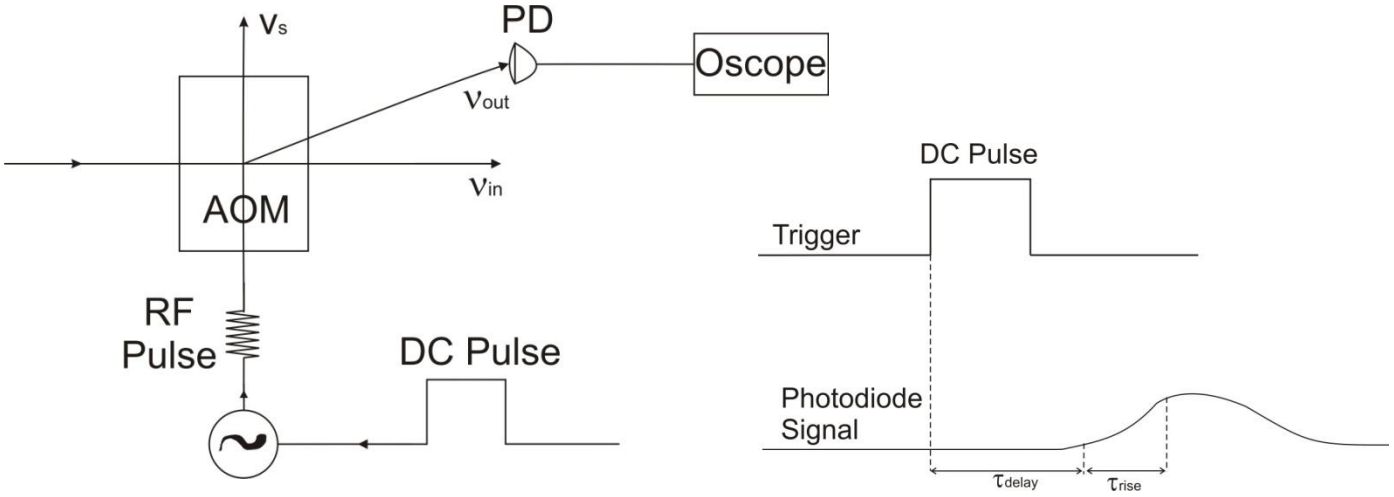
Phys 4061/5061 – Tutorial Eight

Details Pertaining to laboratory experiments covered in this tutorial can be found in the lab manual under the following sections

1. Optical Detectors
2. Zeeman Shift
3. Absorption/ fluorescence Spectroscopy

1. Optical Detectors

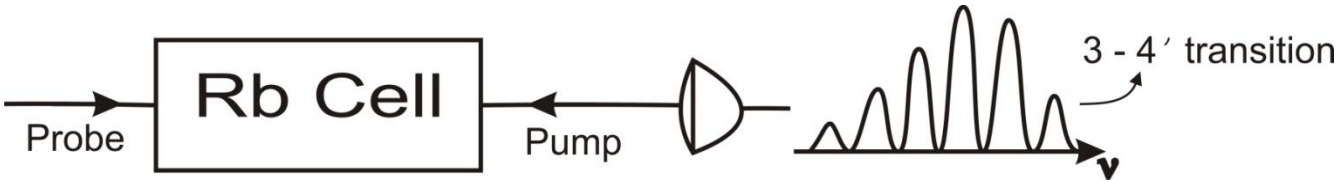


- τ_{rise} = time to cross laser beam (for sound waves)
- τ_{delay} = time for sound wave to reach laser beam
- desire RC < τ_{rise}

Termination

- $R_{internal}$ = 1 MΩ (for typical scope input)
- voltage drop across $R_{internal}$ is the signal
- use a 50Ω resistor in parallel so that R_{eff} ~ 50Ω
- smaller signal amplitude
- τ_{rise} ~ τ_{delay} where $\tau_{response}$ is response time of Photodiode

2. Zeeman shift



- F = 3 transitions ^{85}Rb → F′ = 2,3,4
- 3 – 4′ transition has seven degenerate transitions in zero B field
- Review effect of optical pumping with B field on
- Review effect of line strength with B field on

3. Atomic Structure in ^{85}Rb

Notation:

$n^{2S+1}L_J$

Example:

n = 5

L = 0, 1, 2, 3, 4

S = ½

Fine Structure

L = 0 $\quad J = L + S = \frac{1}{2}$ $\quad 5^2S_{1/2}$ Ground State

L = 1 $\quad J = L + S = \frac{1}{2}, \frac{3}{2}$ $\quad 5^2P_{1/2}, 5^2P_{3/2}$ Excited States

Hyperfine Structure

For ^{85}Rb

I = 5/2, n = 5, L = 1, J = 3/2 $\quad 5^2P_{3/2}$

$F = |I - J| \ldots |I + J| \quad \Rightarrow \quad F = 1, 2, 3, 4$