

Exercise 10.1 : Lasers (lecture 9)

- 1) Discuss the operational principle of a laser: Sketch the energy states involved and explain how optical gain can be achieved.
- 2) What is the main requirement for an efficient semiconductor laser?

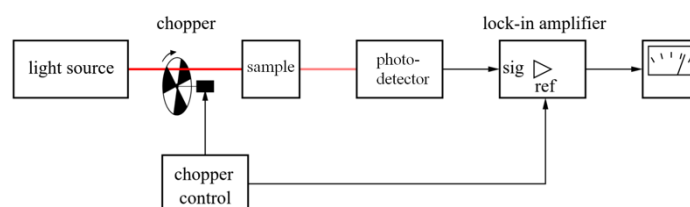
Exercise 10.2: Photoluminescence lifetimes

A pulsed laser with 180 femtosecond pulses with a repetition rate of 10 Hz is used to excite a semiconductor. The sample's photoluminescence decays over 1 ns. The sample also exhibits some Raman scattering.

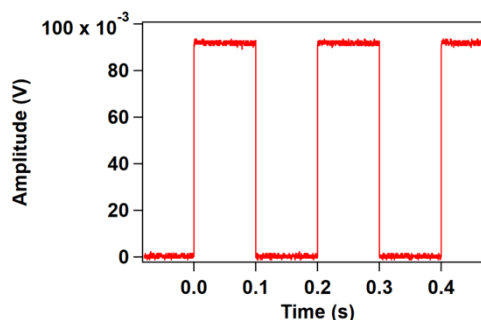
On a time axis, sketch the laser pulses, the Raman signal and the photoluminescence (PL) of the sample. Knowing that the Raman signal and the PL occur in the same spectral region, what strategy could you use to separate the Raman signal and the PL?

Exercise 10.3: Absorption of excited states

- 1) Which state is probed by absorption spectroscopy? Which states are probed by transient absorption spectroscopy?
- 2) Explain why it is not straightforward to measure the absorption of a material's excited state.
- 3) Assuming the following lock-in experiment:



The reference signal coming from the chopper is represented below:



What is the frequency of the signal that will be amplified in this lock-in experiment?