

Solid-State Laser

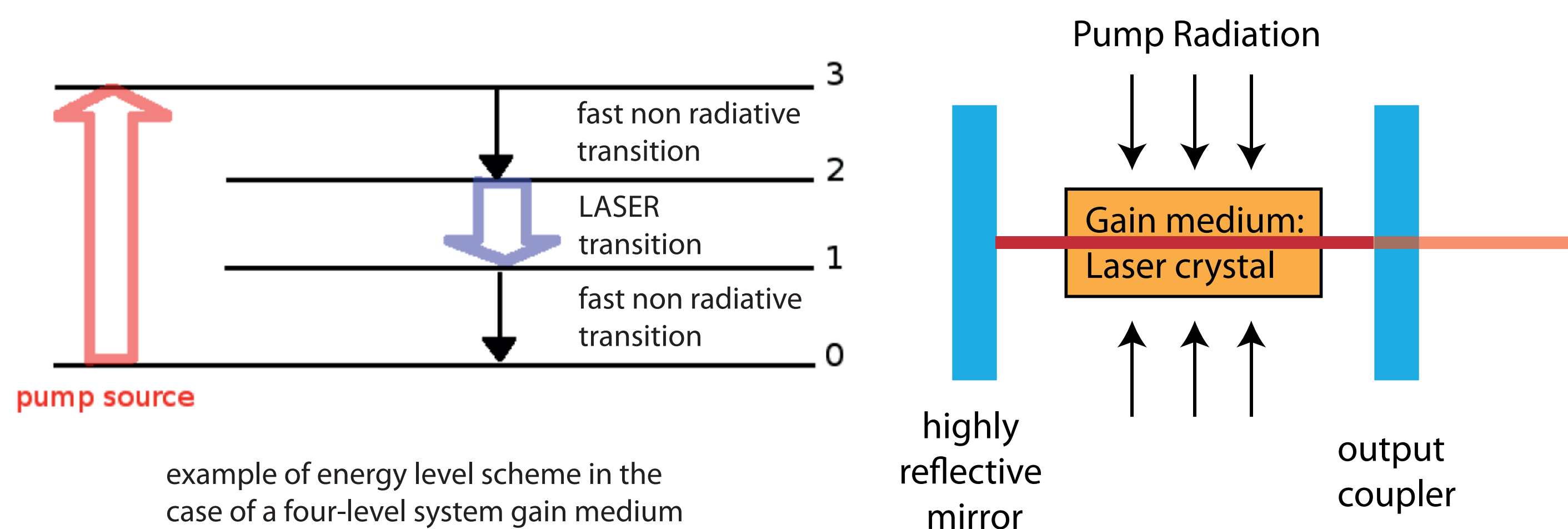
Abstract

Goal of the experiment:

- understand the basic concepts of lasers
- characterize all elements necessary to build a complete laser resonator
- learn and practice laser alignment

Background of experiment

LASER: Light Amplification by Stimulated Emission of Radiation

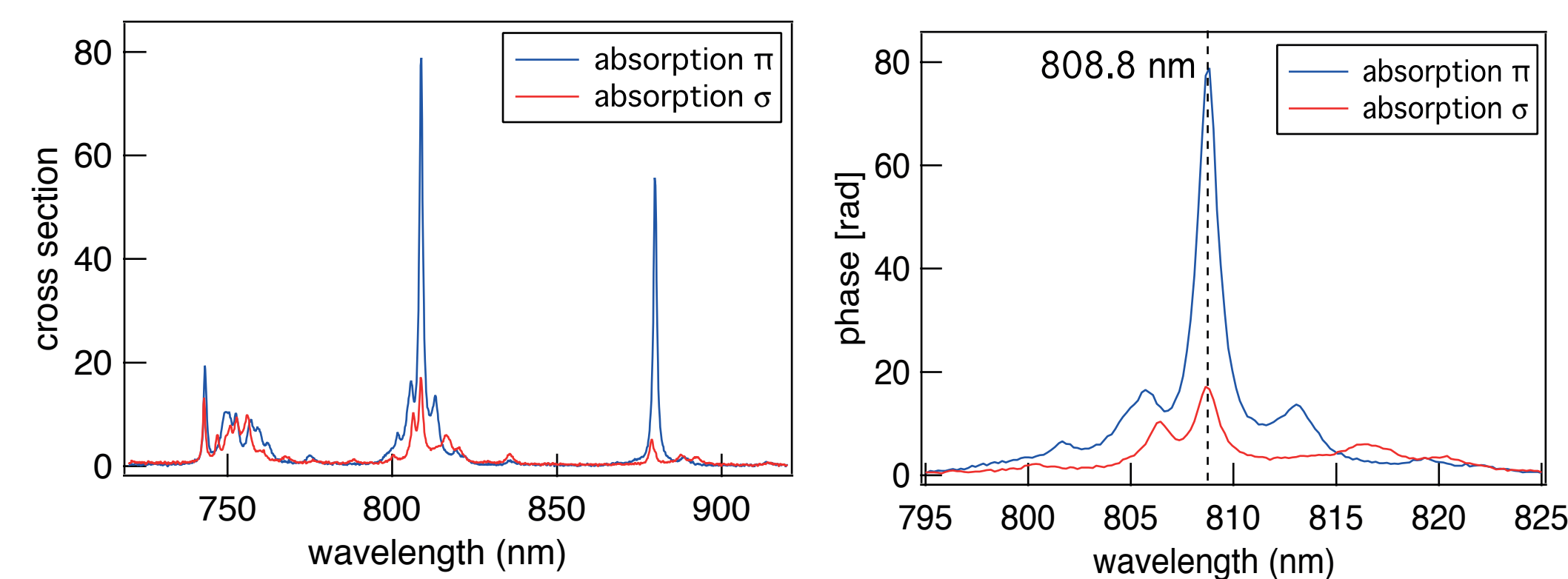


THREE BASIC COMPONENTS

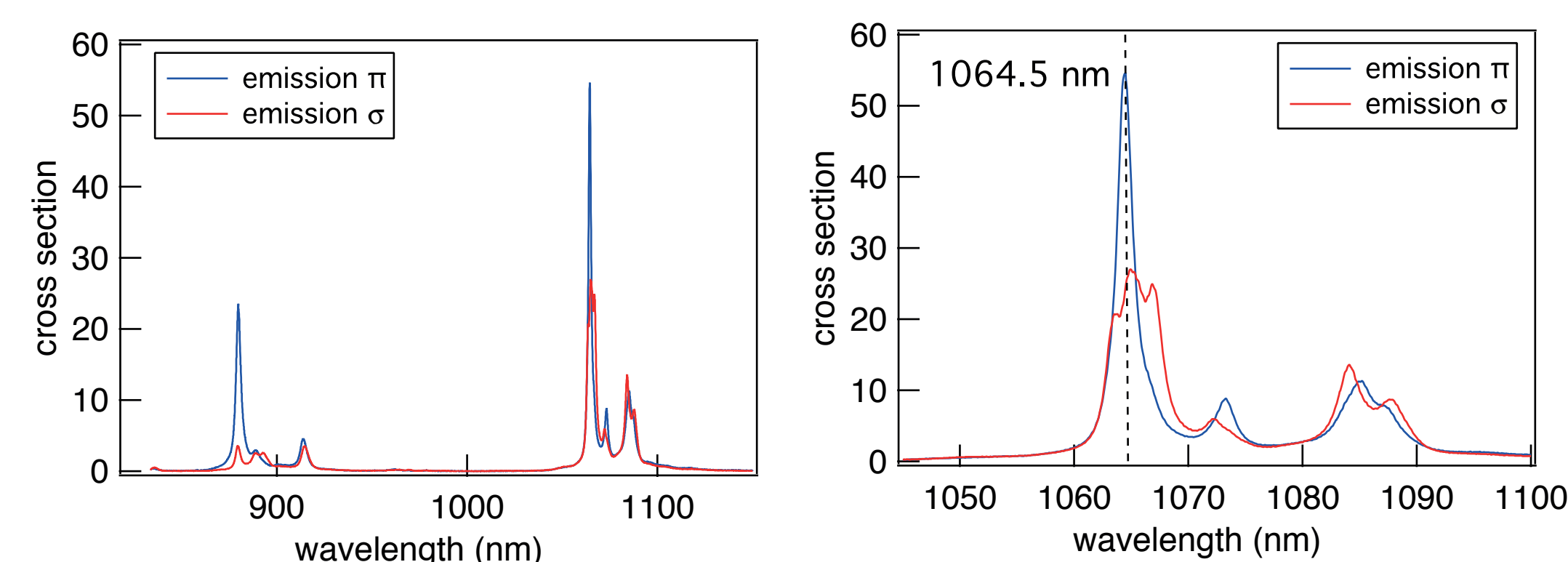
- **Pump laser:** Provides energy in the form of laser radiation
- **Gain Medium:** Host for stimulated emission absorption of the pump radiation and emission of laser radiation at another wavelength
- **Stable optical resonator**

Gain medium: spectroscopy of Nd³⁺ doped YVO₄

Absorption



Emission



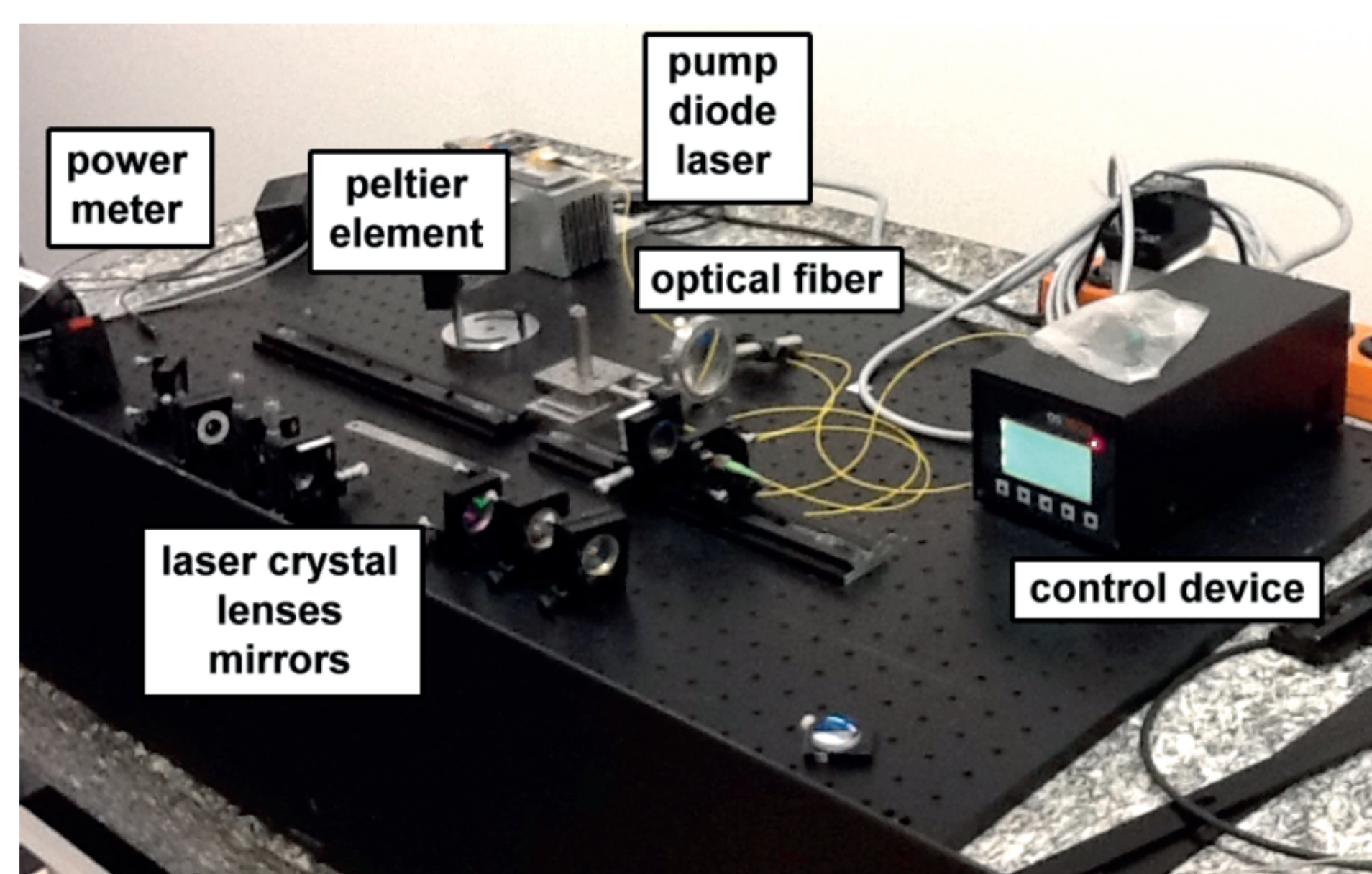
- Pump radiation has to match an absorption line of gain medium
- 808 nm easily accessible with cheap pump diodes
- Laser radiation at 1064 nm

Pump radiation:

Fiber coupled laser diode, emitting 4 W of power, temperature stabilized

Stable optical resonator:

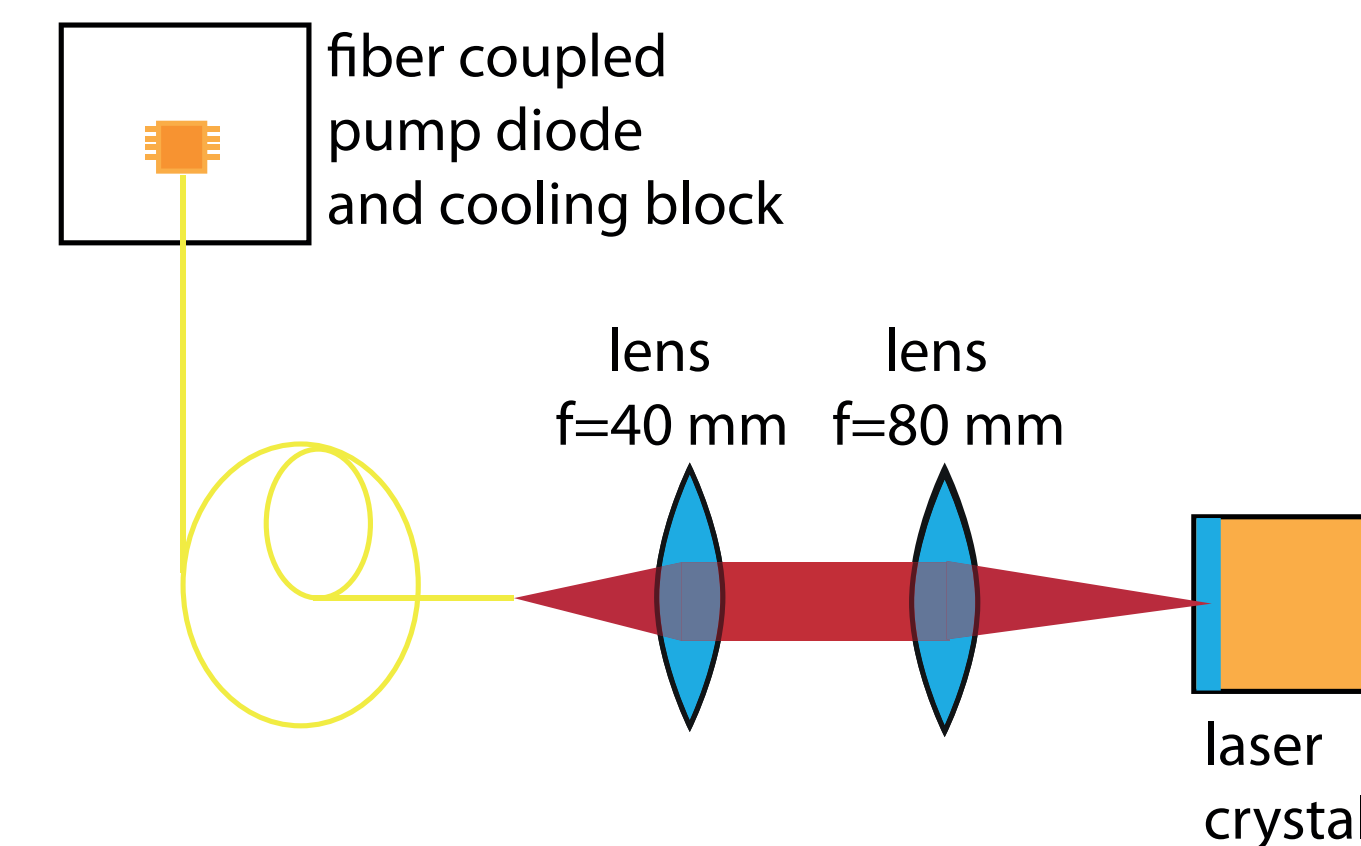
Mode matching between laser beam and pump beam for good efficiency
Thermal lens affects cavity stability



Picture of the laser setup

Experimental setup and student tasks

Characterization and alignment of the pump diode



tasks

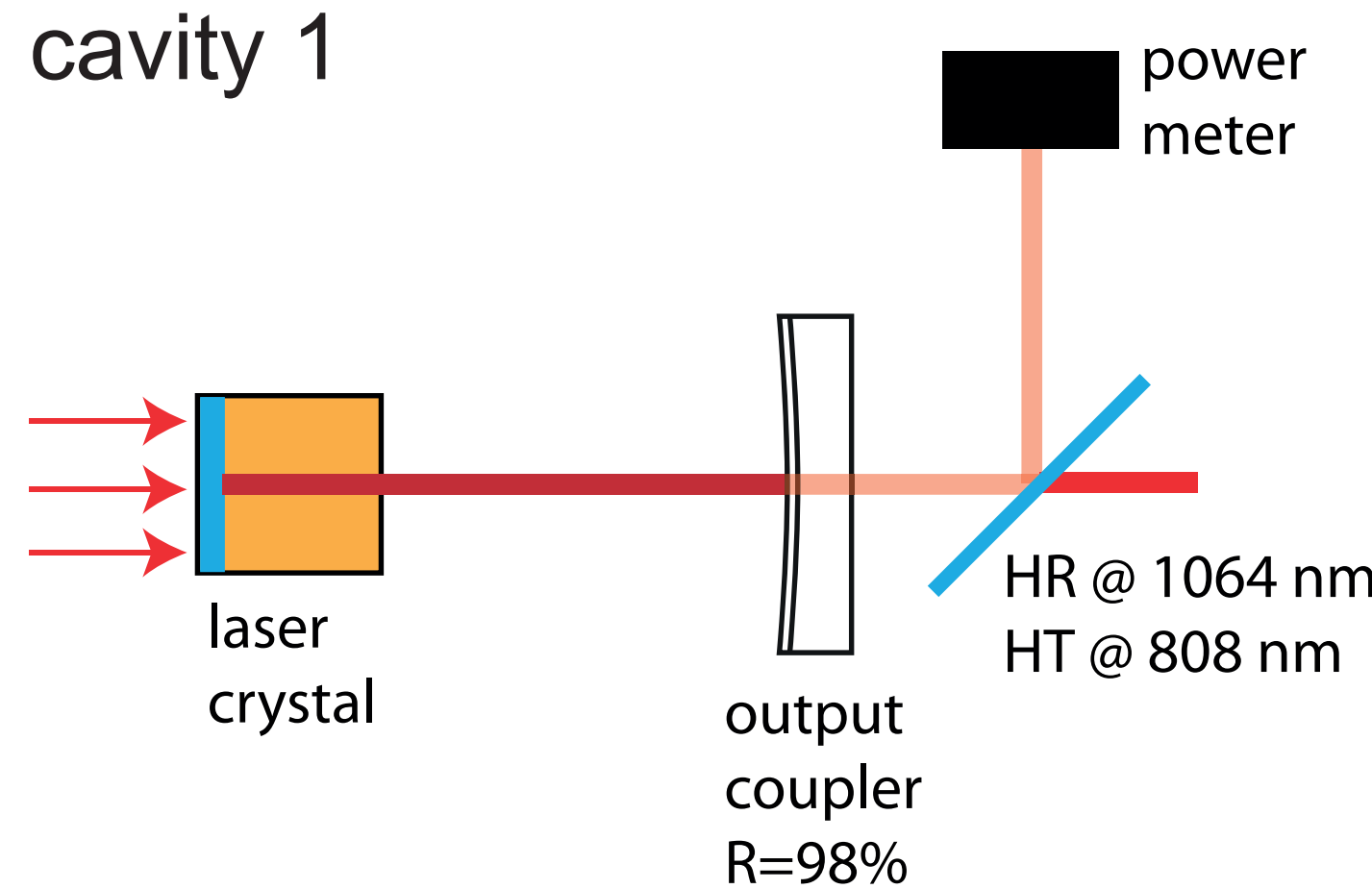
- Output power versus current
- Temperature stabilization testing
- Collimation and focusing

acquired skills

- Diode lasers
- Temperature stabilization
- Laser alignment

Laser cavities

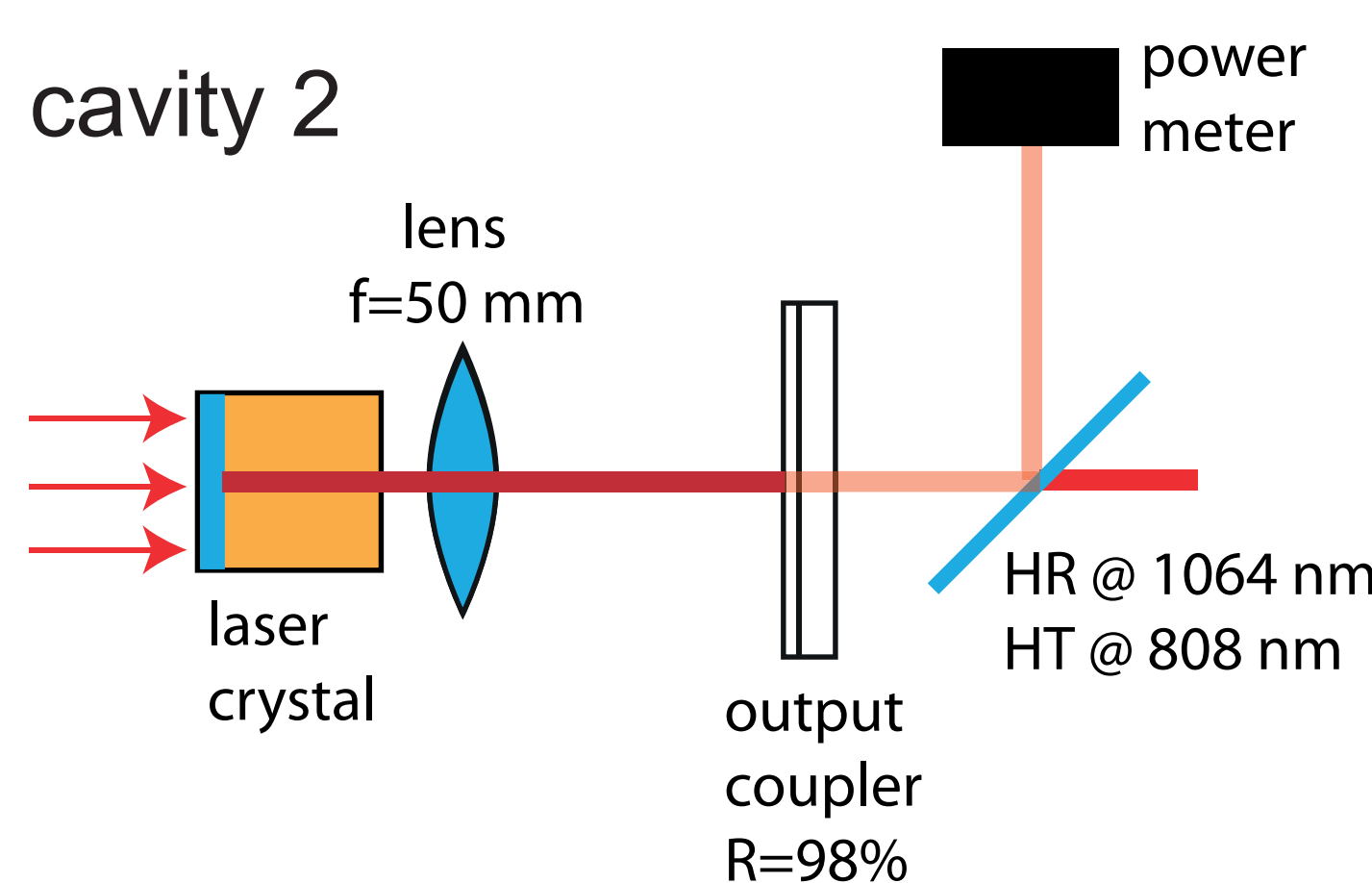
cavity 1



tasks

- Laser alignment
- Output power dependence on cavity length
- Output power dependence on diode temperature
- Comparison to expected behavior in terms of cavity stability and absorption of pump radiation

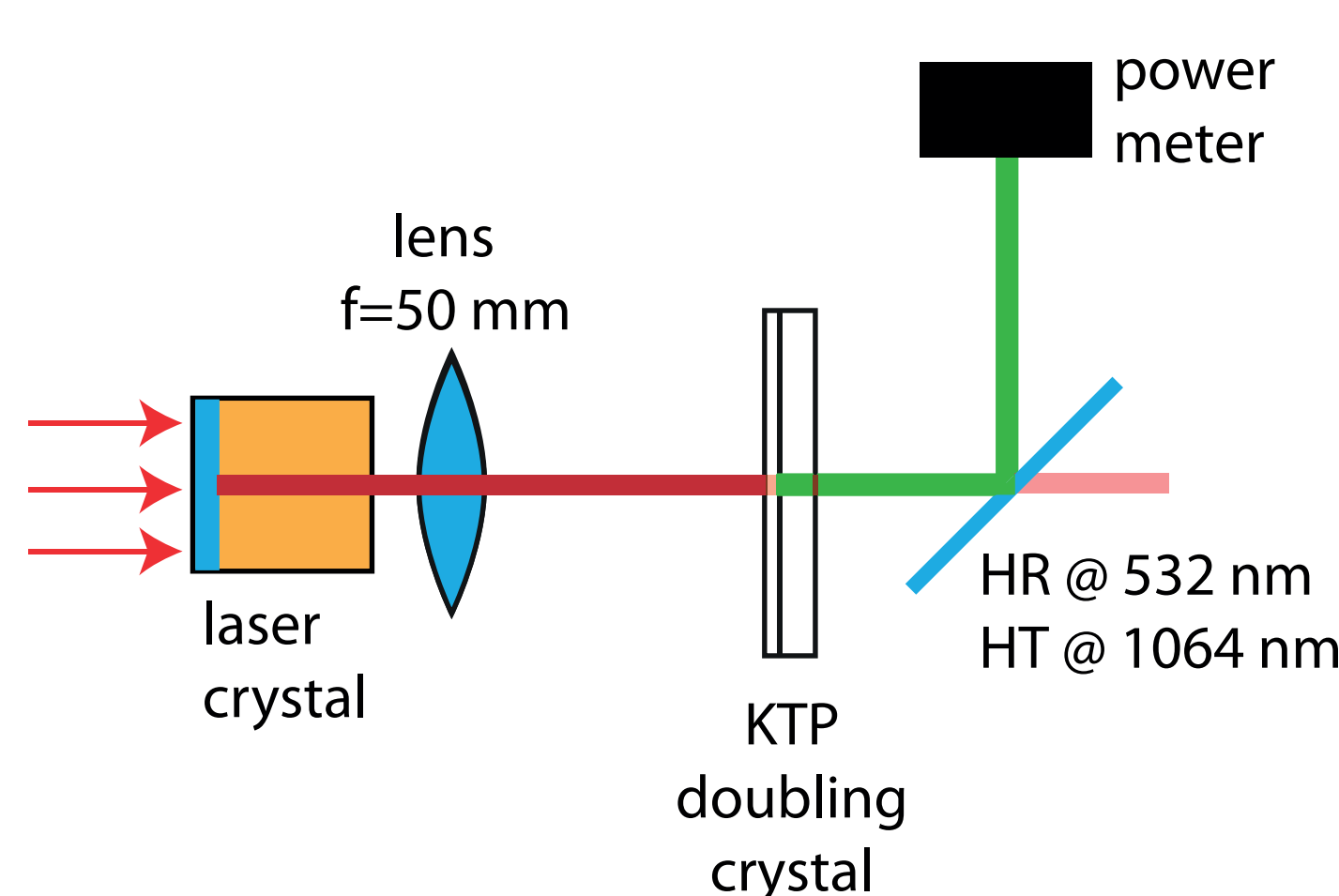
cavity 2



acquired skills

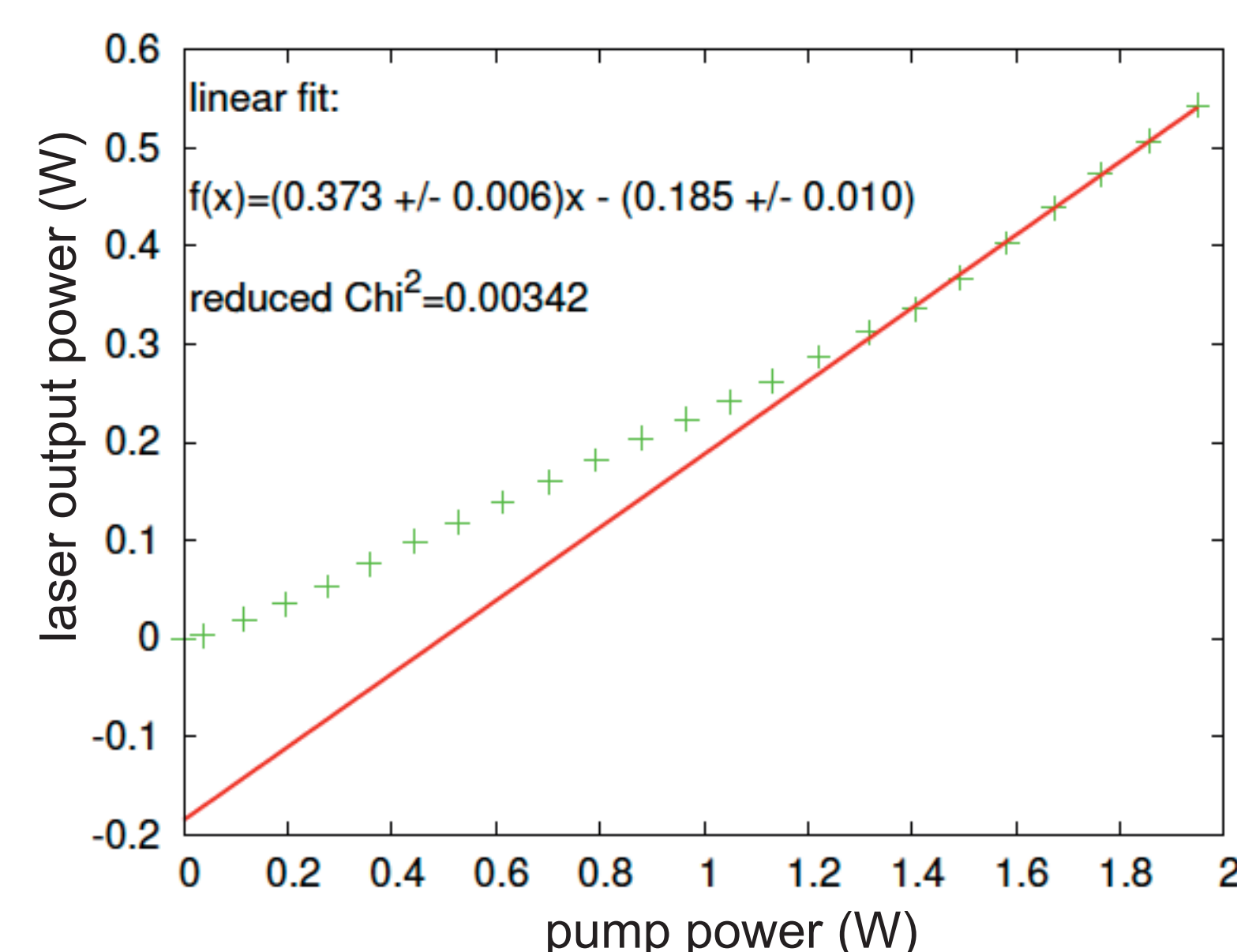
- Laser alignment
- Experimental verification of cavity stability zones
- Experimental verification of wavelength dependency of diode laser, effect on output power

Frequency Doubling

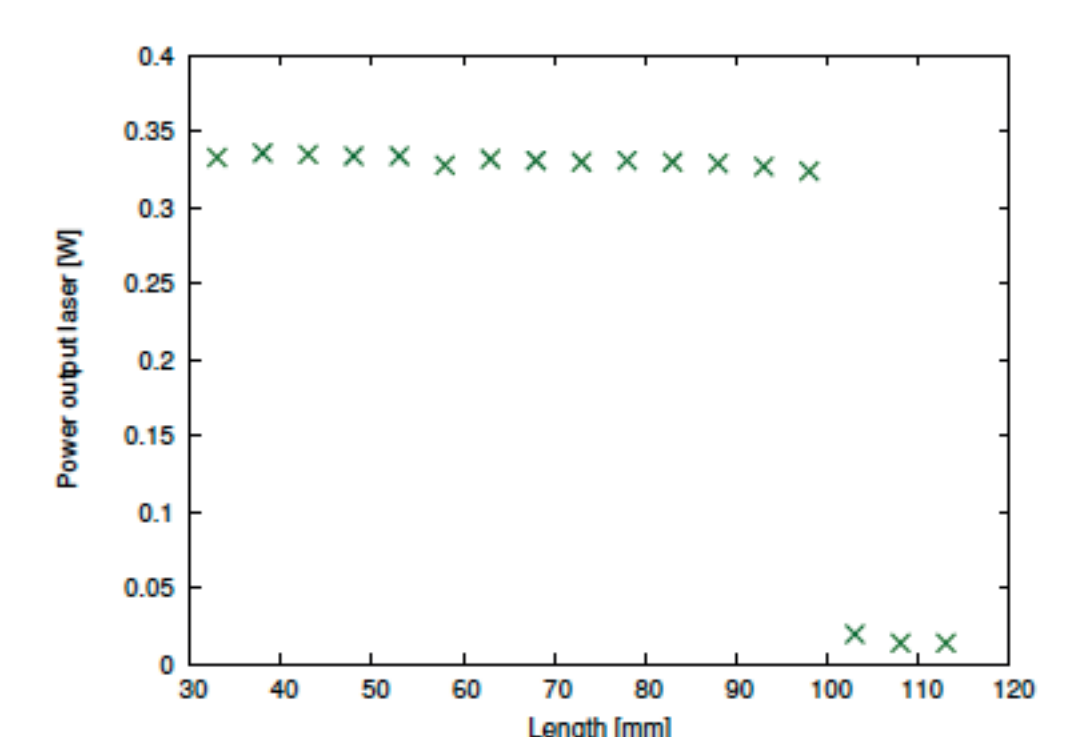


Results

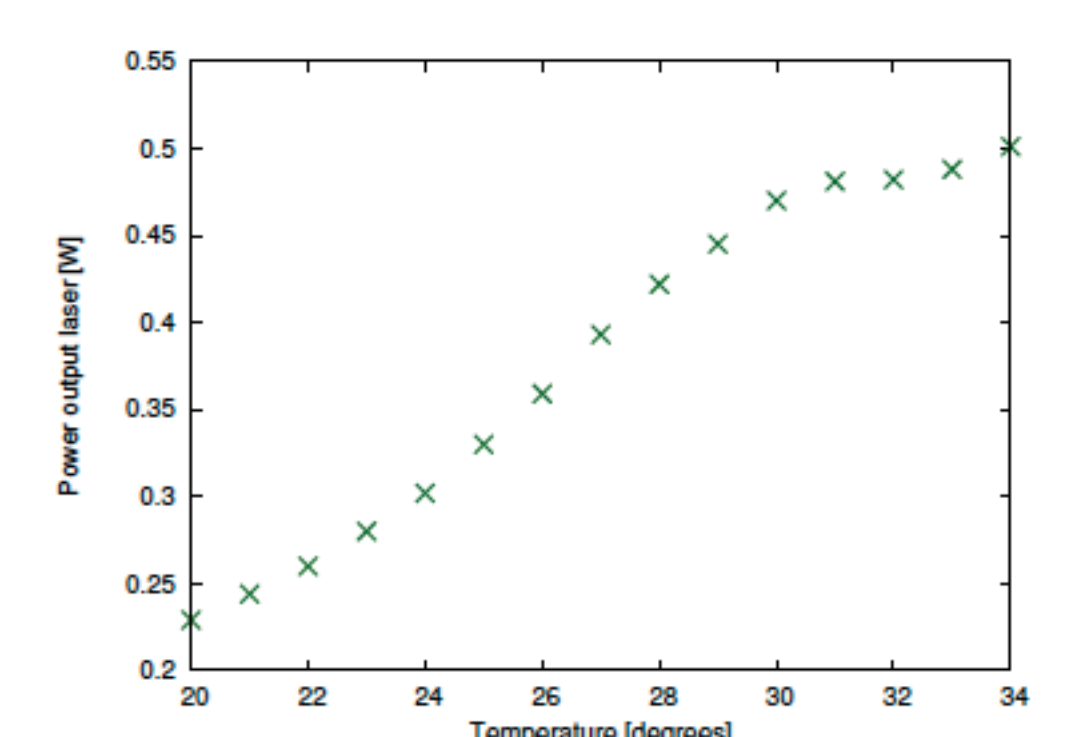
Typical dataset for one cavity



- Up to 550 mW of output power
- Slope efficiency of 37%



Cavity stable up to 10 cm of cavity length



Optimal temperature of diode: 30 degrees