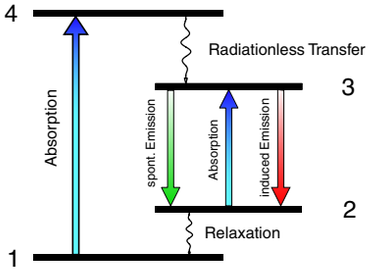
Diode Pumped Nd:YAG Laser

Topics:

- ✓ Properties of Diodelaser
- ✓ Optical Pumping
- ✓ Rate Equation Model
- ✓ Static and Dynamic Behaviour
- ✓ InGaAs Photo Detector
- ✓ Thermoelectric Detector
- ✓ Photometer
- ✓ Spectral Characterisation



Optical pumping of Nd:YAG lasers is of particular interest, because these have become widely accepted for industrial as well as medical use, along with the CO_2 laser. The laser active material which, in the case of the Nd:YAG laser, consists of Neodymium ions accommodated in a transparent YAG host crystal (Yttrium Aluminium Garnet). Where up to a few years ago Nd:YAG lasers were mainly excited by using a powerful discharge lamps, optical pumping with laser diodes is becoming more and more important. This is because powerful laser diodes are economically available nowadays and emit light at high optical power levels with a narrow spectral bandwidth which matches the energy levels of the Nd:YAG crystal. The great advantage over the discharge lamp is that the emission of the laser diodes are almost completely absorbed by the Nd:YAG, whereas the relatively broad spectral emission of discharge lamps is absorbed only to a small extent.
A theoretical analysis of the Nd:YAG laser is performed, and a rate equation model derived. The steady state solution is presented and the dynamic situation considered to investigate spiking. The set-up provides all the necessary components to assemble a complete diode laser pumped Nd:YAG laser, a 500 mW laser diode with driver, Peltier cooler controller, collimating and focusing optics, Nd:YAG crystal, laser mirrors, a photo detector and all the necessary mounts, etc. The stability criterion of the resonator is verified experimentally. The dependence of the pump wavelength versus the diode laser temperature and drive current proven, and the absorption spectrum of Nd:YAG derived.
By using a few additional modules, this basic set-up can be upgraded to „Frequency Doubling with KTP“ or to the „Generation of Short Pulses“. The oscillation at 1.3 µm or an active Q - switch are available as options.

Properties of the diodelaser

The relative output power of the diodelaser as a function of the injection current and the temperature is determined. If there is a laser power meter, this can also be done in absolute units. The wavelength of the diodelaser and its dependence on the injection current and temperature can be determined in the subsequent set-up by using the well known absorption transitions as wavelength references.

Absorption spectrum

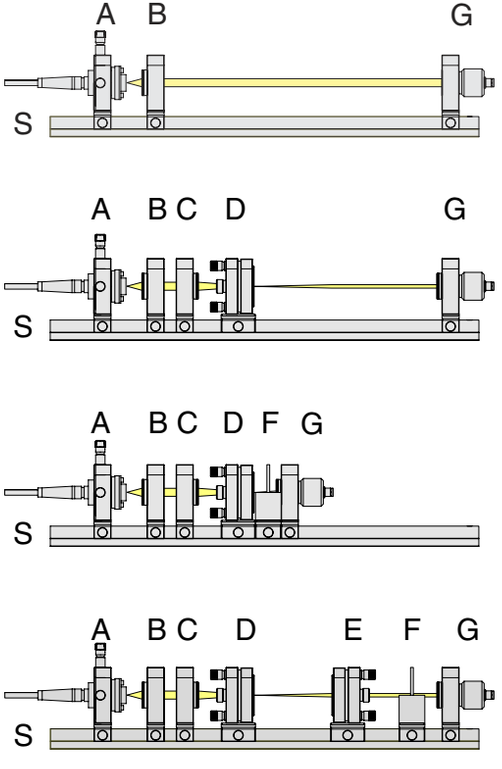
The transmission or absorption spectrum is received if the measured values of the diodelaser radiation transmitted by the YAG-rod are represented graphically as a function of the temperature. Three or even four maxima appear to which the well known wavelengths can be attributed. One maximum appears particularly well. The laser experiments are later performed using this wavelength since the pumping efficiency is the highest here.

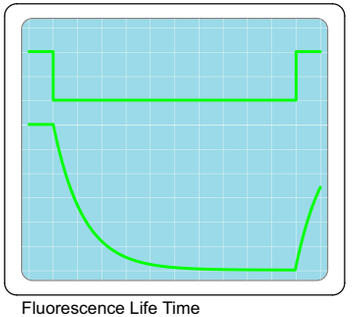
Measurements of the fluorescence life time

The initial level for the emission of the 1064 nm wavelength radiation is the $^4F_{3/2}$ level with the rather high lifetime of about 230 µsec. That means that about 230 µsec pass until the intensity of spontaneous emission has decreased to 1/e of its initial value. If the Nd:YAG crystal is periodically pumped, the course of the spontaneous emission can be represented in time on the screen of an oscilloscope.

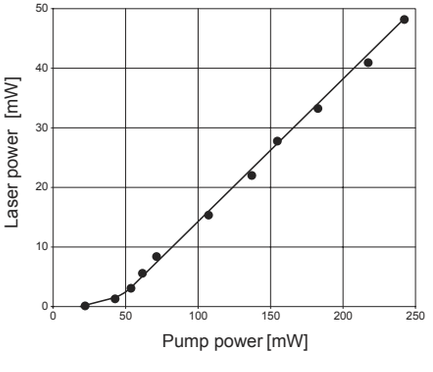
Laser properties

If the laser has been adjusted to maximum output power, the measurements of slope efficiency and threshold can be performed. The measured values allow conclusions to be made on the acceptable threshold energy and efficiency of the system.





Fluorescence Life Time



Required Equipment

Cat. No.	Qty.	Description
02.0502	1	Profile rail OCM 650, 500 mm with ruler
02.2126	3	Mounting plate for click 25
02.2202	1	Filter plate holder FH 650 for 3 filters
02.2526	1	Target screen in 25 mm click mount
02.5404	1	Laser mirror adjustment holder right
02.5406	1	Laser mirror adjustment holder left
04.0030	1	Focussing optic with triplet lens system
04.0050	1	Biconvex lens f=60 mm in click 25 mount
04.0122	1	RG 1000 Coloured glass filter
04.0302	1	Infrared display card 0.8-1.2 µm
04.0306	1	Optic cleaning set
04.0486	1	Nd:YAG rod in holder LSF 650 1/2”
04.0488	1	Laser mirror SHG100
04.0490	1	Laser mirror R=100 mm T=2% @ 1064 nm
05.0210	1	DIMO 808 diode laser module
07.0003	1	Set of 3 BNC connection leads
07.0102	1	PIN Si photo detector BPX 61 with housing
07.0200	1	LDC01 laser diode controller
10.0080	1	EXP 08 Manual
Required Options:		
19.0140	1	Dual trace oscilloscope 100 MHZ
Options:		
09.0085	1	1.3 µm option
09.0086	1	Option spatial filter