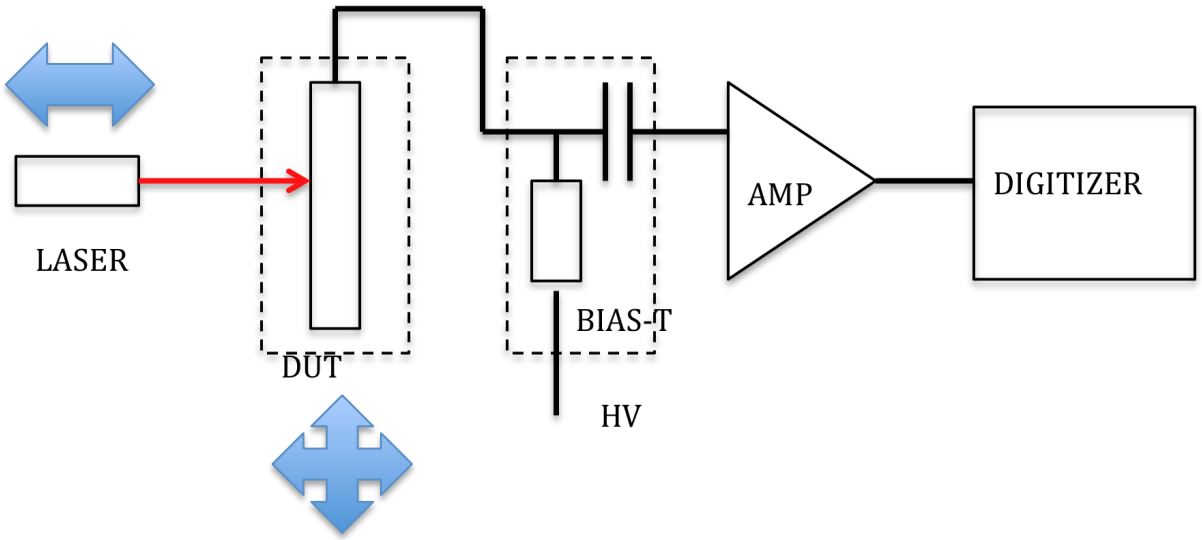
Particulars, Advanced measurement Systems

Particulars TCT systems

General hardware description

www.particulars.eu

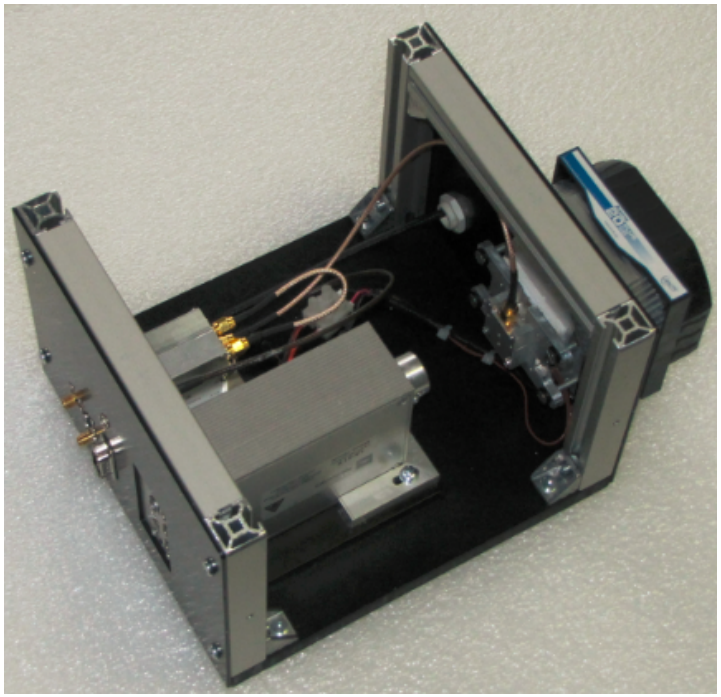
Basic description



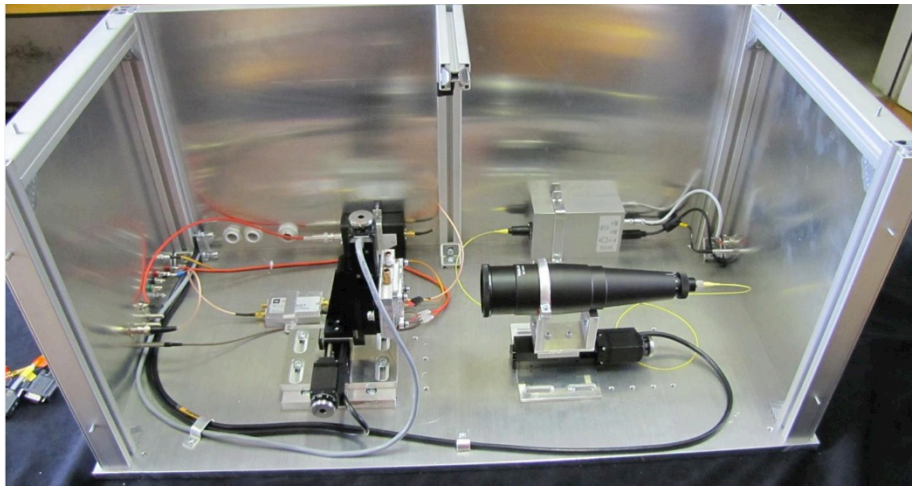
- Laser
- Focusing system
- Cooling block
- AMP
- Bias-T
- Translation system

Two/three configurations

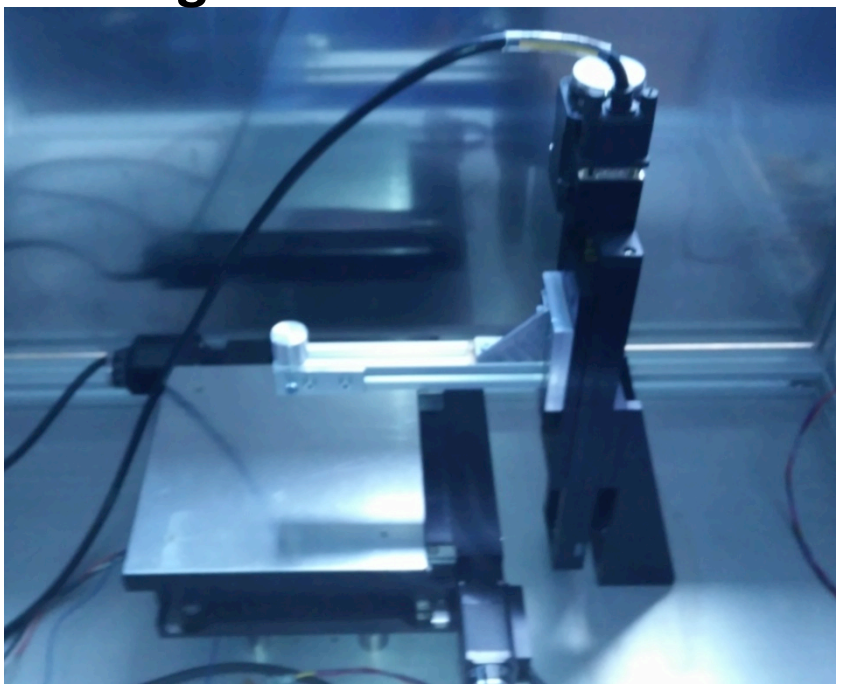
- Conventional TCT



- 3D TCT



- Large area TCT scanner

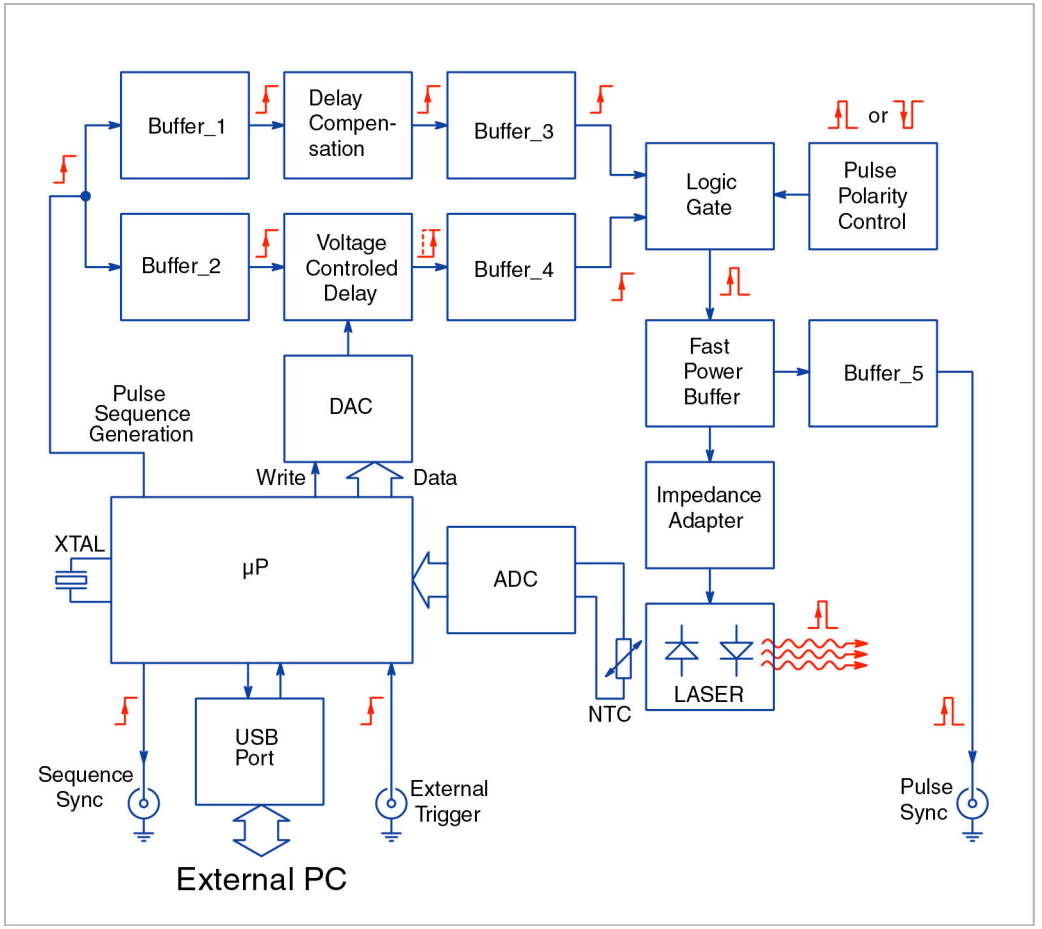


Lasers

- Optical methods exist which allow generation of femtosecond pulses, but the cost of the necessary equipment is often prohibitive for wider use.
- On the other hand, semiconductor LASER diodes provide a cheap way to realize a pulsed light source, but the minimum obtainable pusle width is limited by both the LASED diode and the driving electronics to a range from about 30ns to about 5µs.

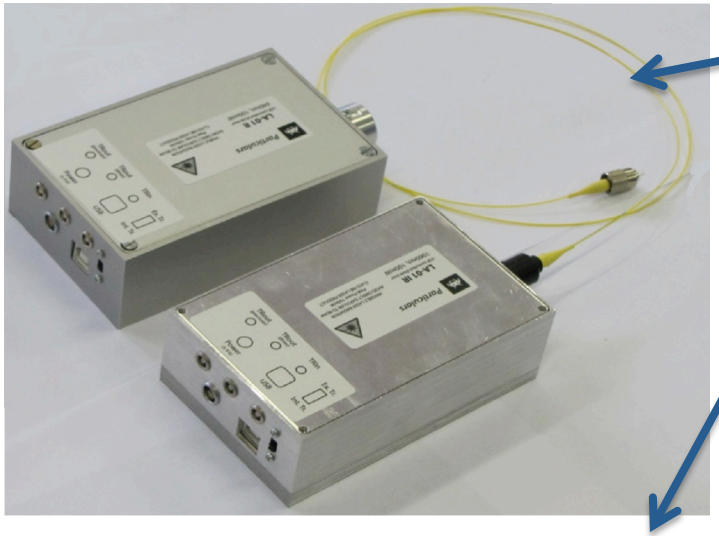
Use of paralel logic devices as a current generator

In our case advanced CMOS logic family (the 74ACxxxx series) with suitable imedance matching, geometry controll and simple microprocessor (µP) control of the pulse sequence generation via the use of an internal programmable timer, as well as a programmable pulse width control achieved by a voltage controlled delay.

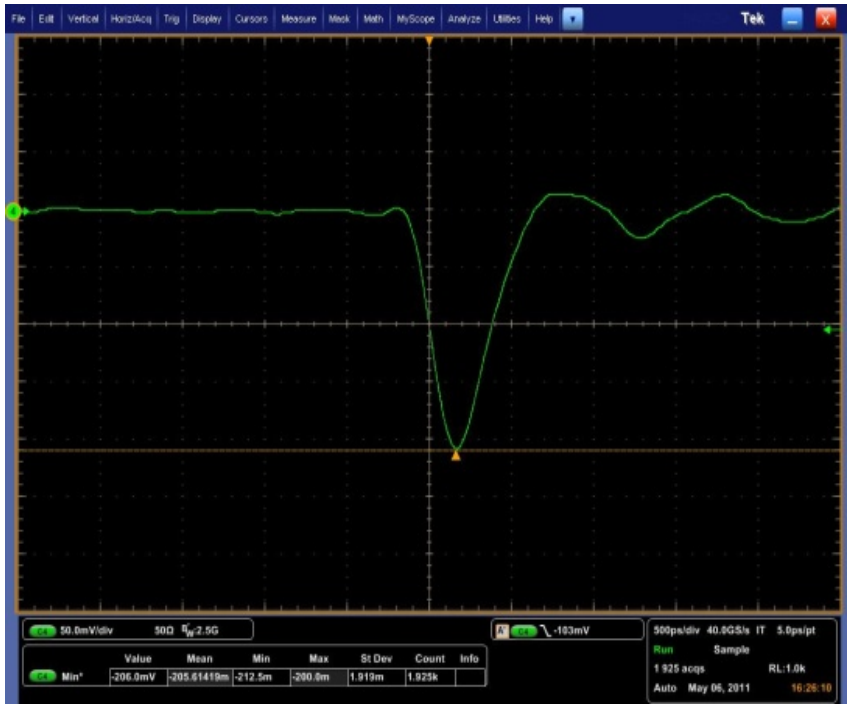


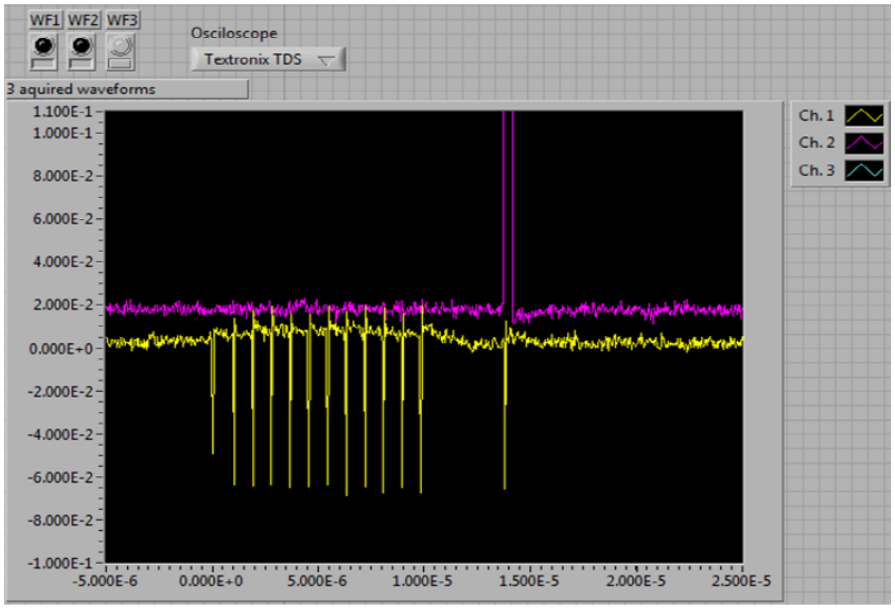
Parallelisation of four chips, each with six buffers, for a total output current of 24×25mA, or 600mA.

Lasers (cont.)

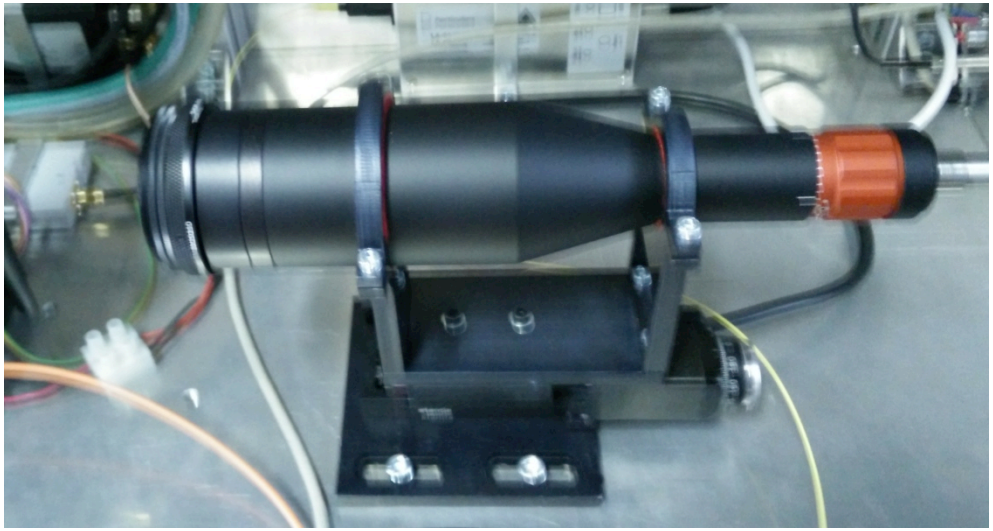


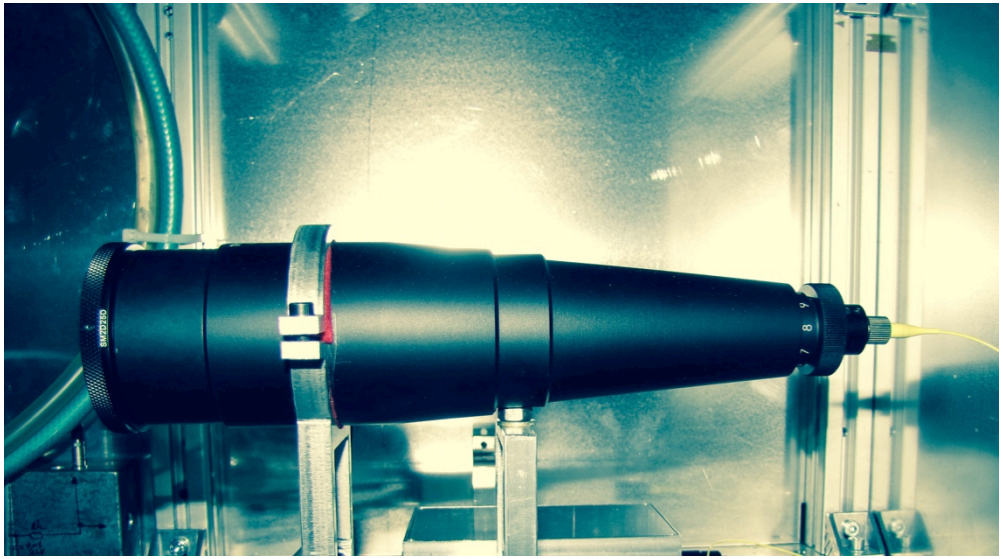
- Two configurations (open and pigtailed)
- Wavelengths (380nm, 420nm, 640nm, 980nm, 1060nm)
- pulse duration from 400 ps to 4000 ps with no bleeding
- pulse frequency from 50 Hz to 1 MHz
- program a desired sequence of pulses (1024 bit) (pump and probe measurements)





Focusing system



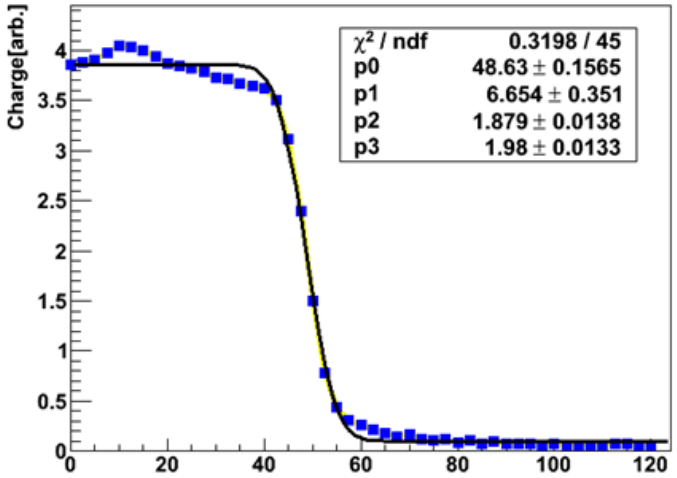


- **Fiber Collimator F220FC**
- **Beam Expander:**
  - New Thorlabs GBE15B
  - Old Thorlabs BE15M-B
- **Lens Thorlabs LA1050 (f=100mm, φ=2”**
- **Iris SM2D25D**
- **ND filters Thorlabs NE2R series (NE2R10A)**

Why:

$$w_0 = \frac{\lambda f}{\pi w}$$

Focusing system (cont.)

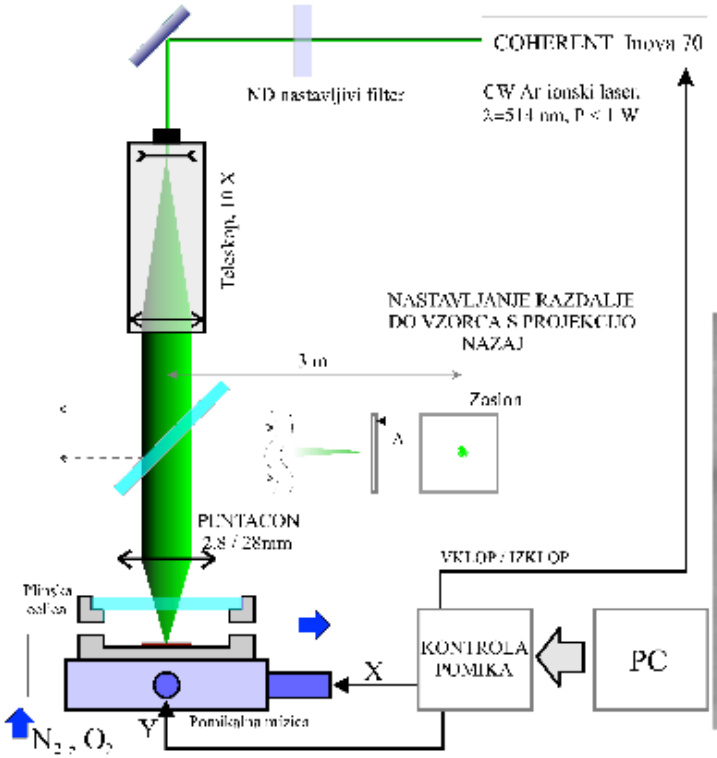


Spot size:

- 10-12 µm for 1060 nm
- 6-8 µm for 640 nm

Can we do better than that?

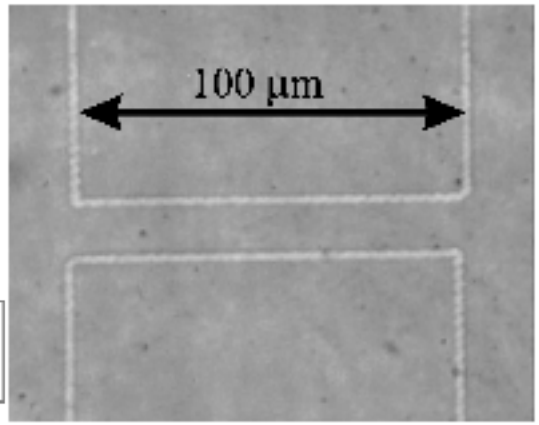
- Difficult for pigtailed sources
- Feasible for coherent sources

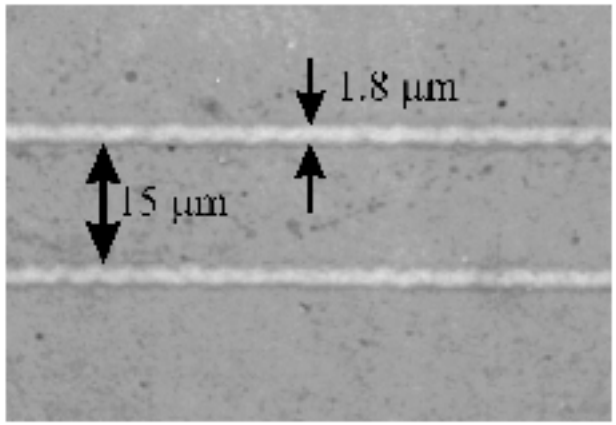


For example:

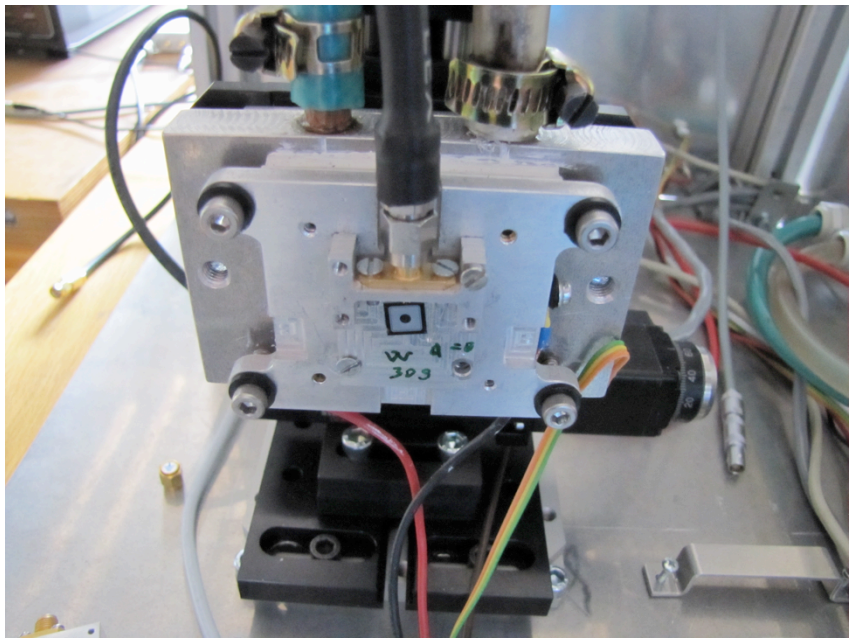
$YBa_2Cu_3O_{(7-\sigma)}$ laser transition from metallic (O_7) to insulating (O_6) phase.

Line width 1.8 m





Cooling block

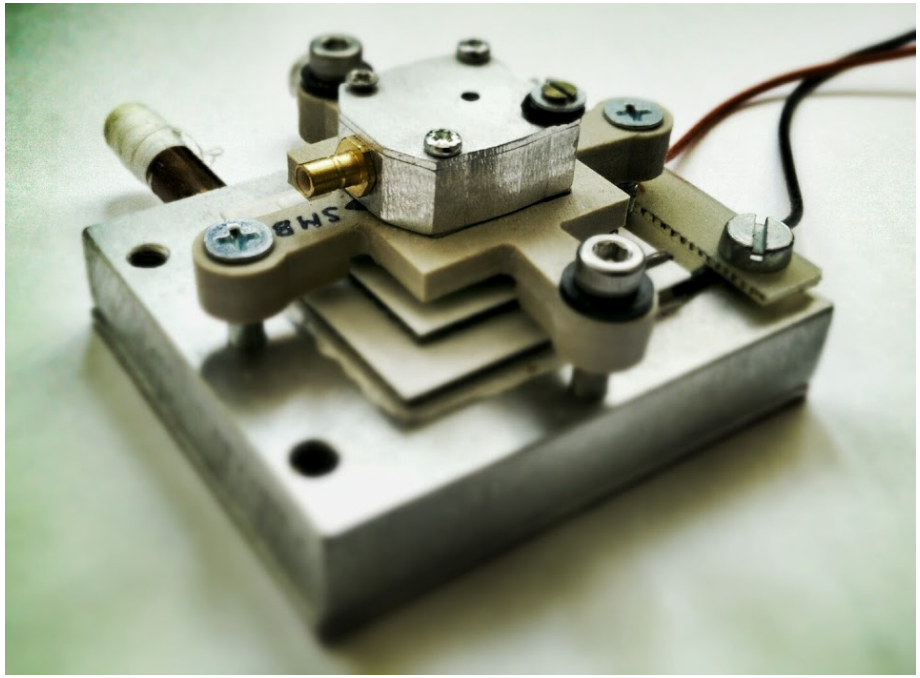


Peltier cooler (80W) stabilized by a water cooled block.
(temperature range -20°C ➔ +100°C)

Can we do better?

Triple-decker Peltier (150W)
(temperature range -60°C ➔ +100°C)

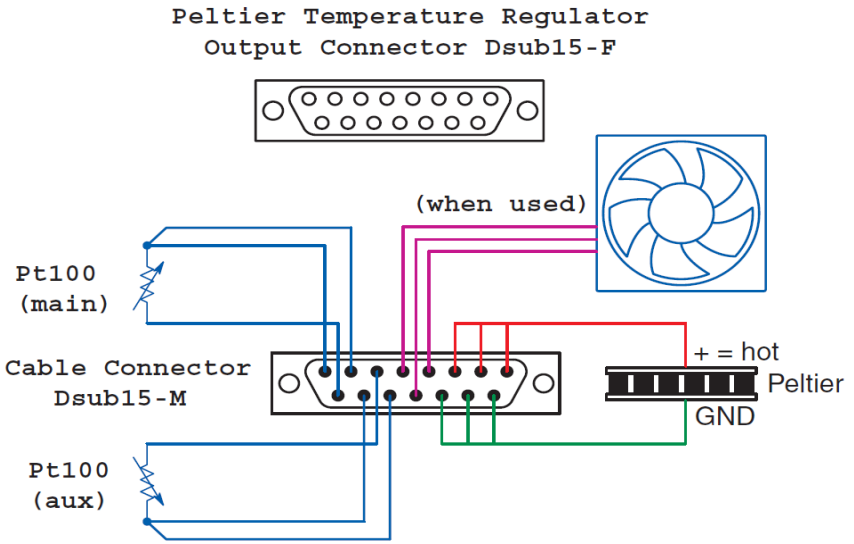
Note the change in sample case design! SMB connector for reduced thermal coupling.



Cooling block (cont.)

Temperature control:

- Use any current source and any temp. controller (Yokogawa)
- Particulars temp. controller.



- 8A PDI controller
- range -65°C to +65°C
- reads main (Pt100 (main)) and cold side (Pt100 (aux)) temperature
- controls fan (when used)
- controls Peltier element
- computer controlled (http://www.particulars.si/downloads/PA-TController-Driver.zip)

Amp & Bias-T

AM-01 amp is a RF amplifier with a (0.01-2000) MHz bandwidth. The amplification can be set to 35 dBm and 55 dBm.

Problems:

Can be burned (unavoidable when using high bias voltages)

We have noticed FR resonance @ 3.6 GHz in some samples (work in progress)

BT-01 is a standard three-port network used for setting DC bias point of device under test while not disturbing the res of the RF read-out chain. It has a 0.01 MHz to 2000 MHz bandwidth with a reasonable 50 Ω impedance match over the entire band.

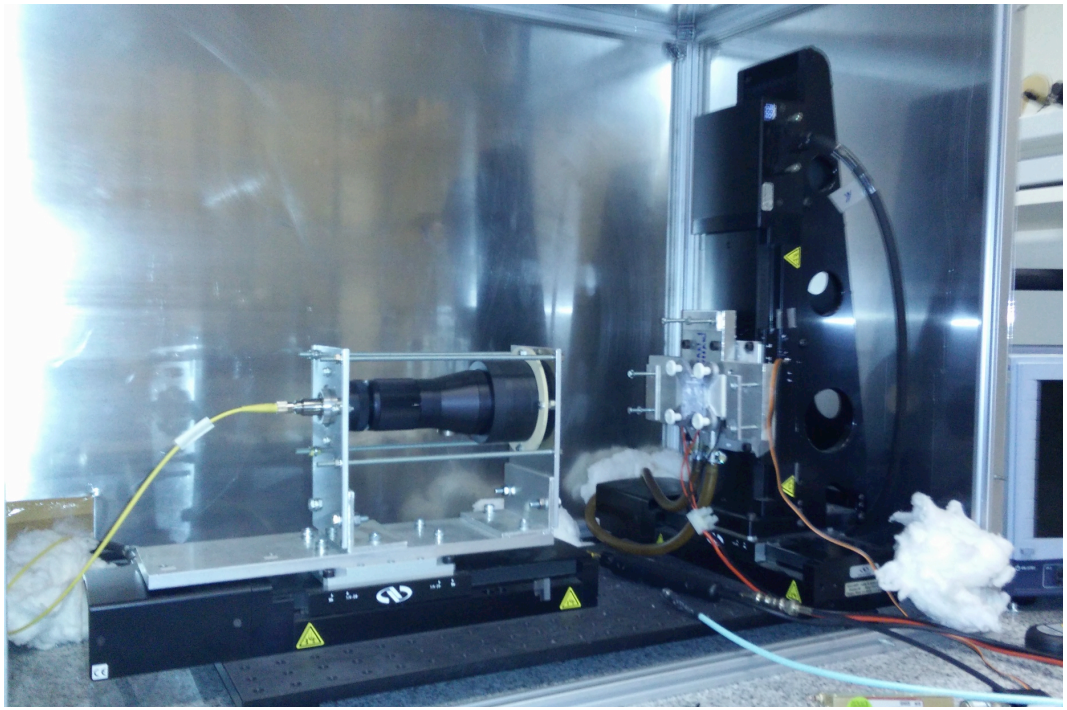
Problems:

Some of them snapped at voltages lower than specified (problems in pcb cleaning after the device mounting)

Translation stages

Standard use: Standa 8MT series

- minimal incremental motion 0.1 µm
- resolution 0.2 µm
- travel range varies 50-100 mm
- load capacity 5kg
- low cost



Non-standard use: Newport ILS series

- minimal incremental motion 0.1 µm
- resolution 0.02 µm
- travel range varies 250 mm
- low pitch and yaw
- load capacity of a small truck
- cost humongous (15K)

No real advantage!