Update on Hydra electronics and laser system

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Overview

TECHNISCHE UNIVERSITÄT DARMSTADT

Update on the electronics

1. **Front-end readout adapters**
2. **Low-voltage supply multiplexer**

Update on the laser system

1. **Angle-controlled Mirror for alignment**
2. **Micromirror angle testbench**

HYDRA electronics

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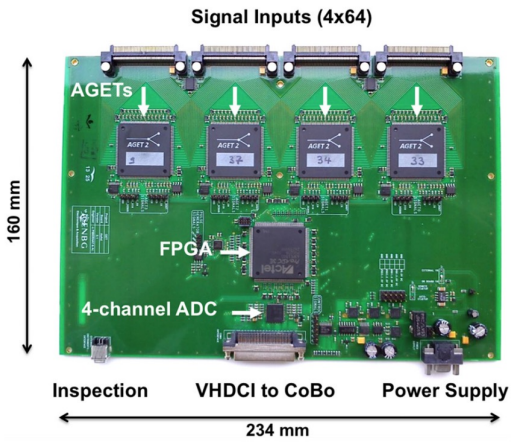
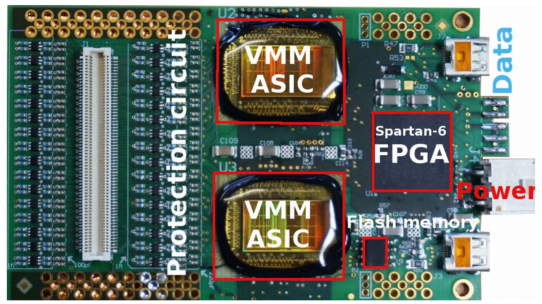
	TPC test (with laser)	Experiment
	Phase 1 prototype	phase 2 of prototype, HYDRA
	GET/AGET	SRS/VMM
Channels/chip	64 (256 per AsAd)	64 (128 per Hybrid)
max channel support	1024 with zCoBo (WU)	no limit (16k/crate)
Input range	10pC /1pC / 120 fC	2pC – 60fC (8 values)
Charge gain	0.2 / 2 / 16 mv/fC	0.5 -16 mv/fC
shaping time	50ns – 1us (16 values)	25 – 200 ns
Time resolution	1 ns	1 ns
ENC	850 e- at 30pF	300e- at 30pF
output	waveform	time/amplitude
readout rate	1 kHz	4 MHit/ch, 12 MHit/FEC
ADC bit	12 bit	8bit for time, 10bit for peak
Triggered	yes	optional

- With gain 5000, laser: 8fC/channel, pion 16fC/channel
- Complete readout (1024 chs) for GET system
- SRS missing: connection to TPC & LV power supply

❑ GET/AGET



❑ SRS/VMM3a (RD51 collaboration)



HYDRA electronics, readout with VMM3a Hybrids

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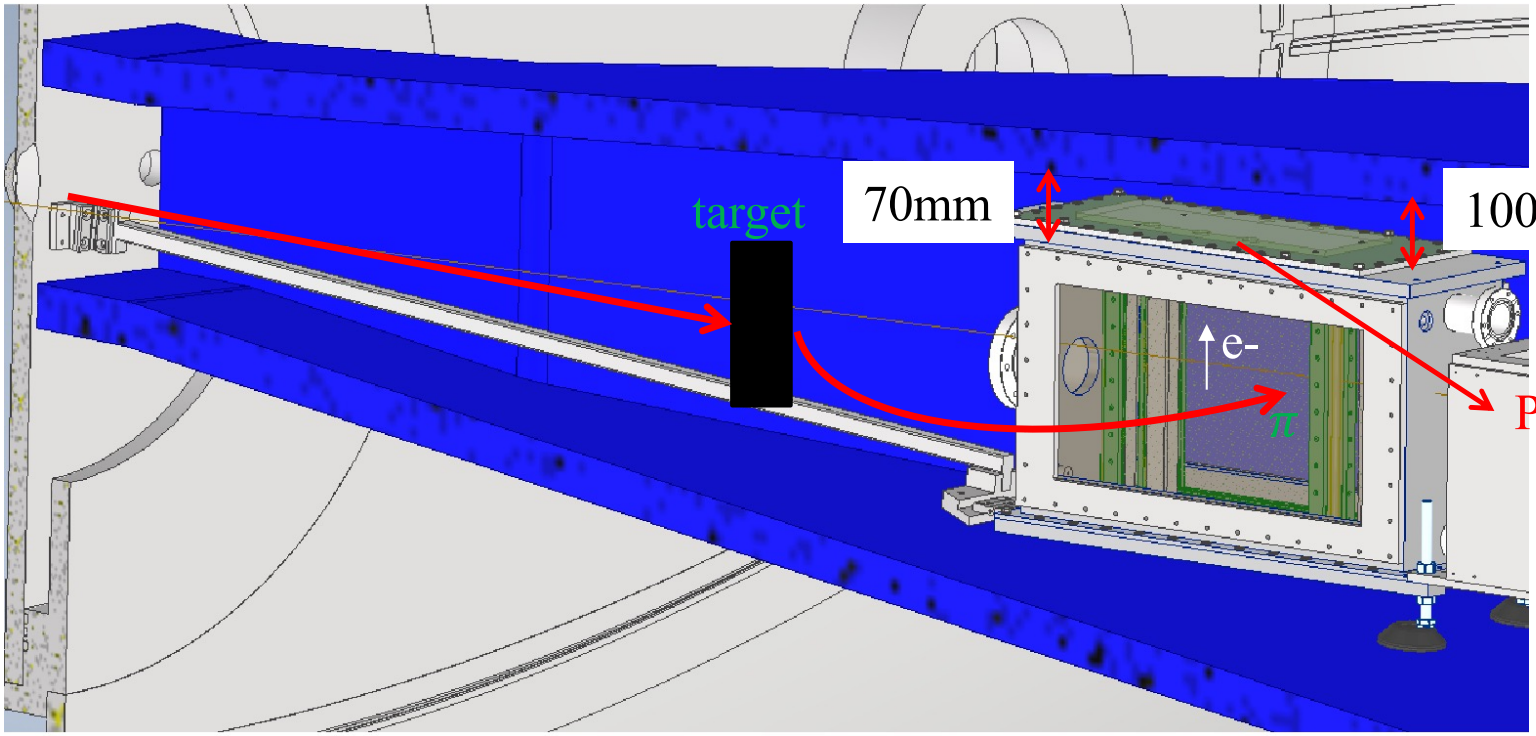
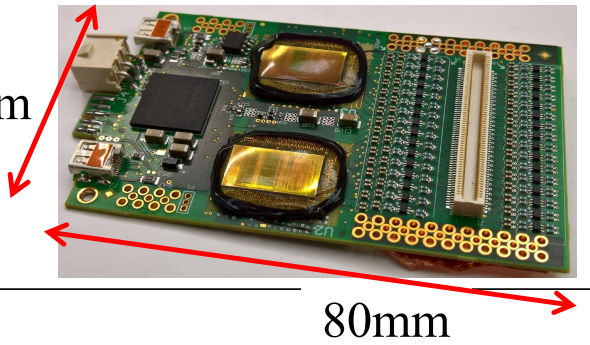


- Total pads (2x2mm²): 5632
- VMM3a hybrid board – 128 channels

→ 44 VMM3a hybrid boards to readout full pad plane



HYDRA electronics, readout with VMM3a Hybrids

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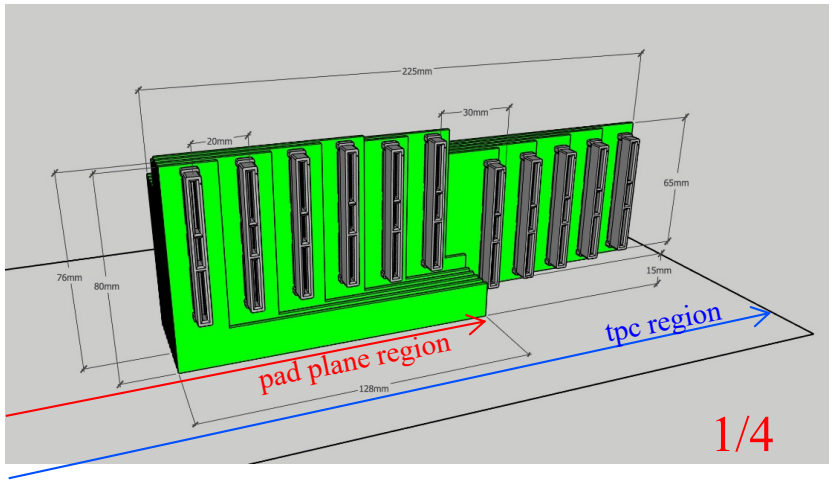
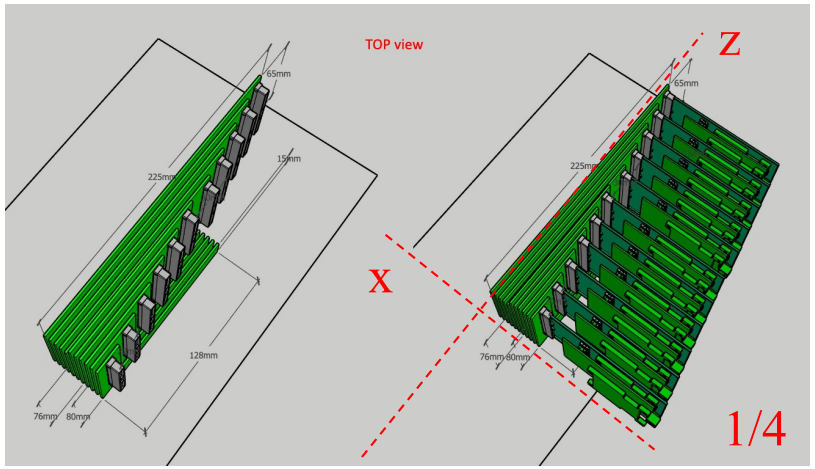
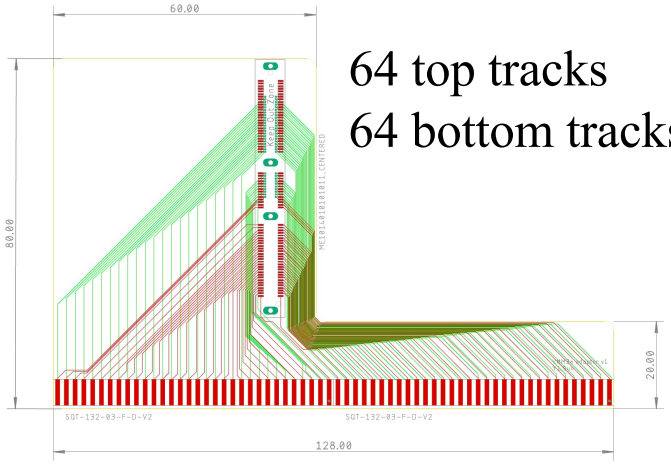
- Readout with customized adapters (with Bastian Löher@GSI and Uwe Bonnes@TUDa)

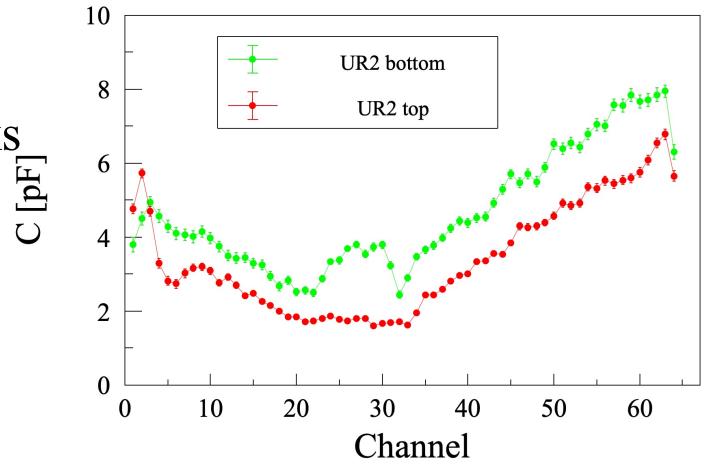




- PCB design (0.1mm track) and capacitance estimation (CapExt)



64 top tracks
64 bottom tracks



- 11 different adapters
- One track coupling to all the others: few pF

HYDRA electronics, readout with VMM3a Hybrids

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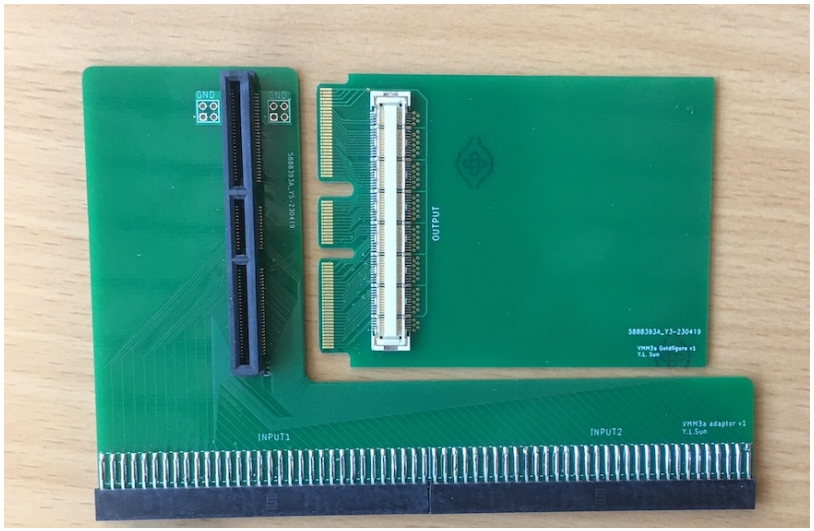
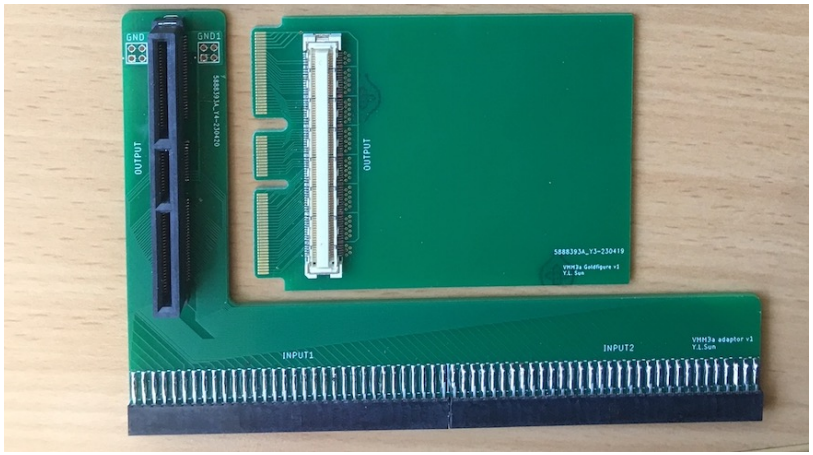
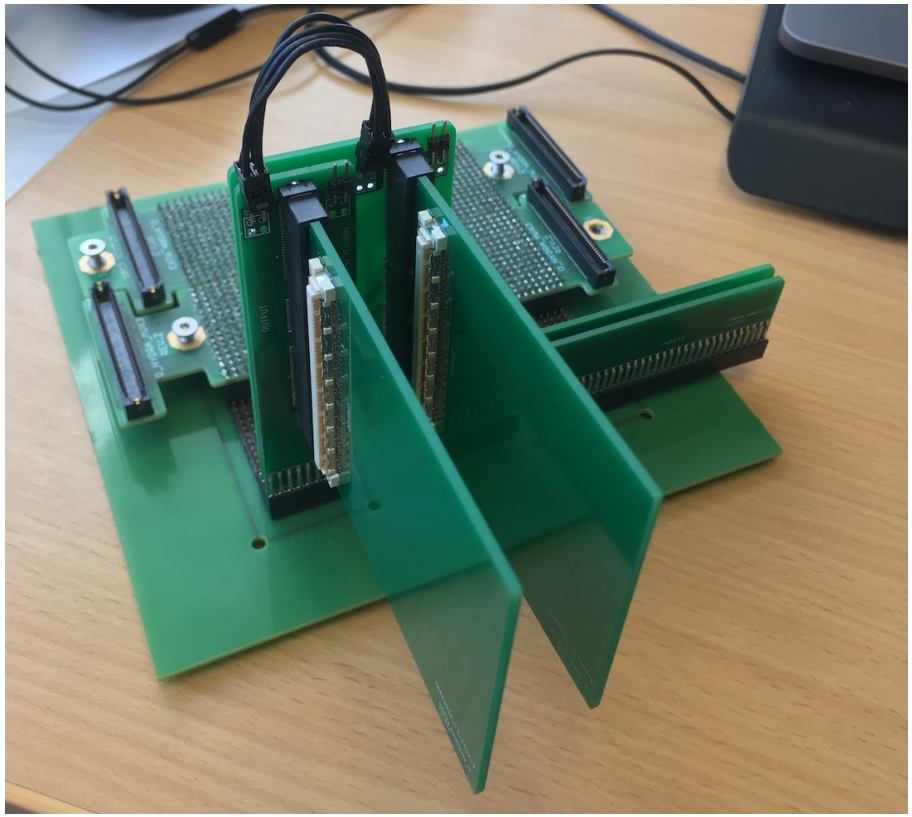


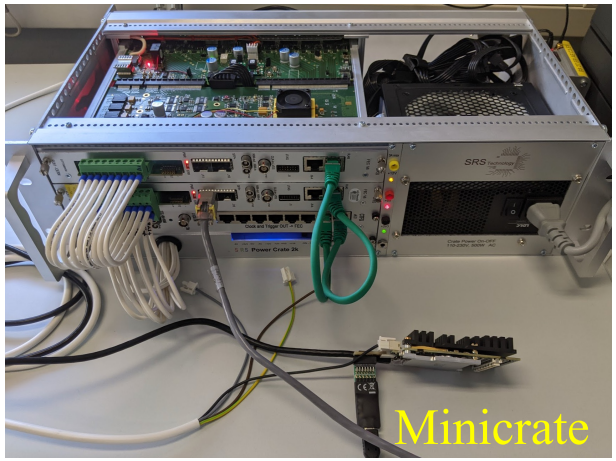


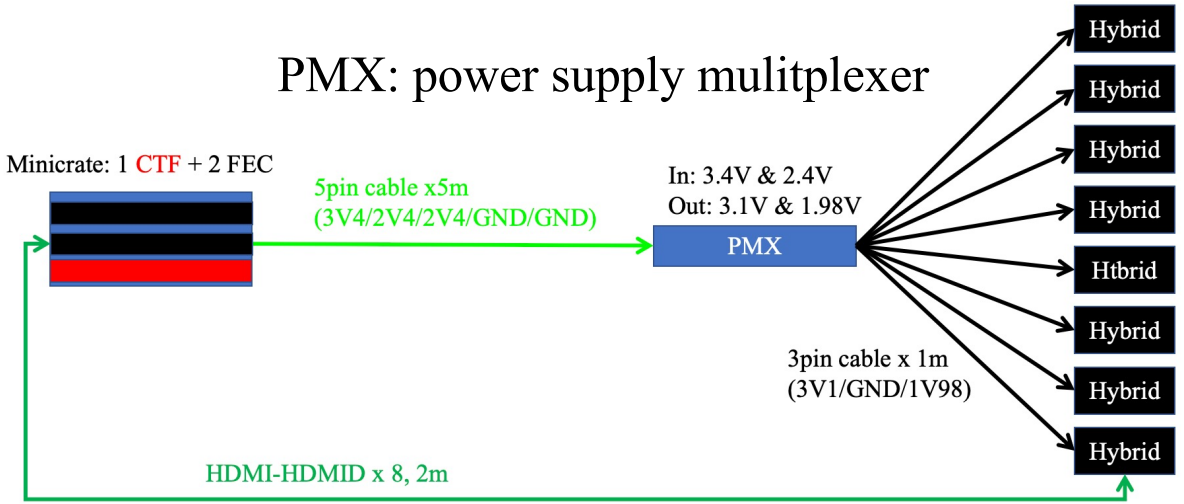


- First two adapters arrived
- Under test, Bastian Löher@GSI

HYDRA electronics, PMX

Julien Taieb@CEA, Bastian Löher@GSI





- ❑ RD51 original design
- ❑ Under test at GSI. Issue found: only possible to read 5 hybrids from one FEC, when they are powered via the PMX. > 5 hybrids:
  - ➢ Frontend configuration (HDMI I2C) works
  - ➢ Data recording (HDMI LVDS) does not work
  - ➢ Disconnecting hybrids until only 5 are connected makes data recording work
  - ➢ Discussions with experts from RD51 ongoing

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2. **Micromirror angle testbench**

HYDRA Laser Calibration System

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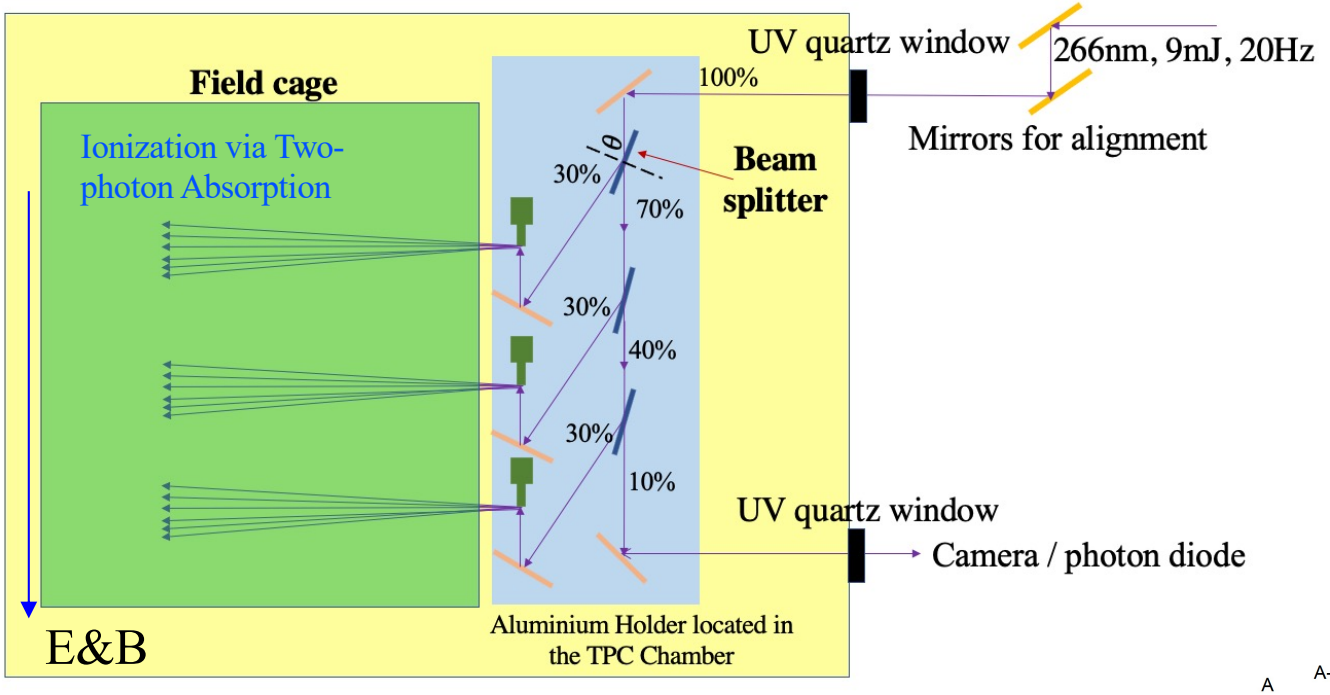
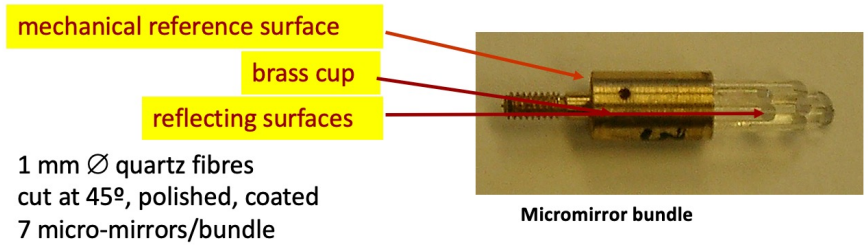
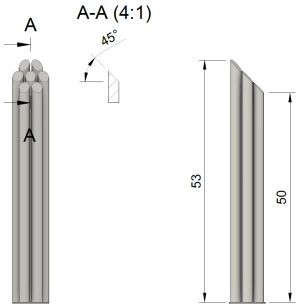
- Concept from STAR and ALICE experiments



Viron Nd:YAG laser





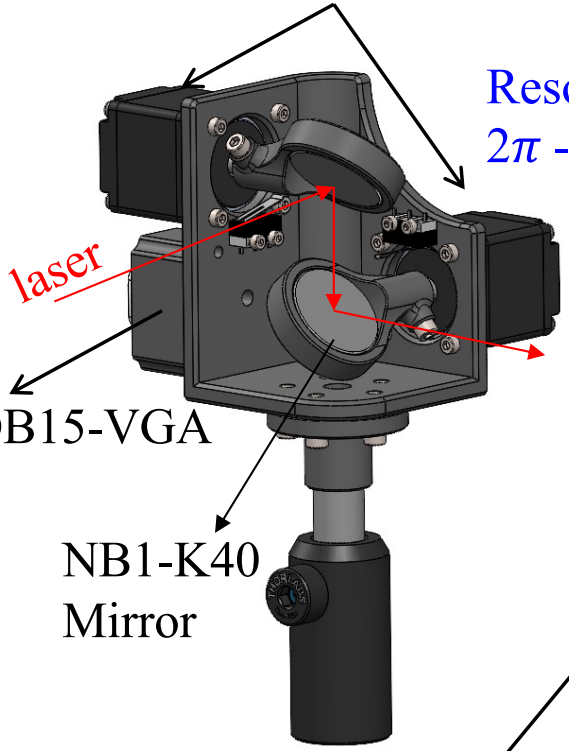
Micromirror Bundle from STAR (A. Lebidev)

Angle-controlled Mirror for alignment

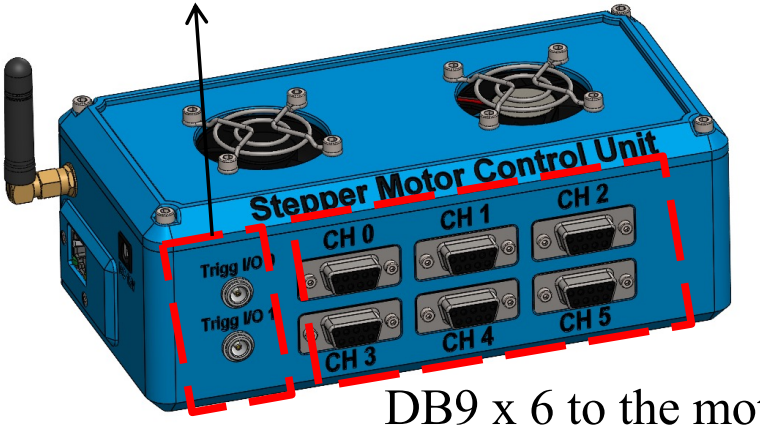
Alexandru Enciu@TUDa

NEMA11 Stepper motor x 2

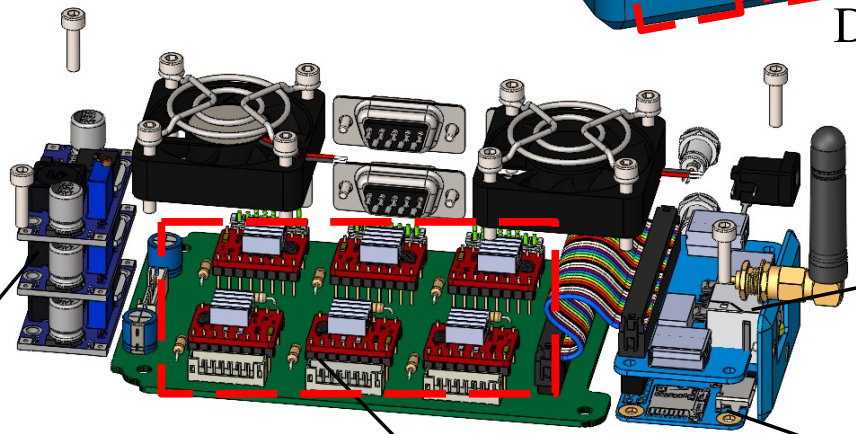
Resolution: ~2mrad
2π - 3200 steps



Trigger to laser source



DB9 x 6 to the motor



Raspberry Pi -
USB/LAN hub

SBC: Banana Pi
ZERO M2, with wifi
Linux, ruing python
program

DC-DC converters

Stepper Motor Controller x 6
1.8° step angle or 200 steps/revolution
16 microstep

Angle-controlled Mirror for alignment

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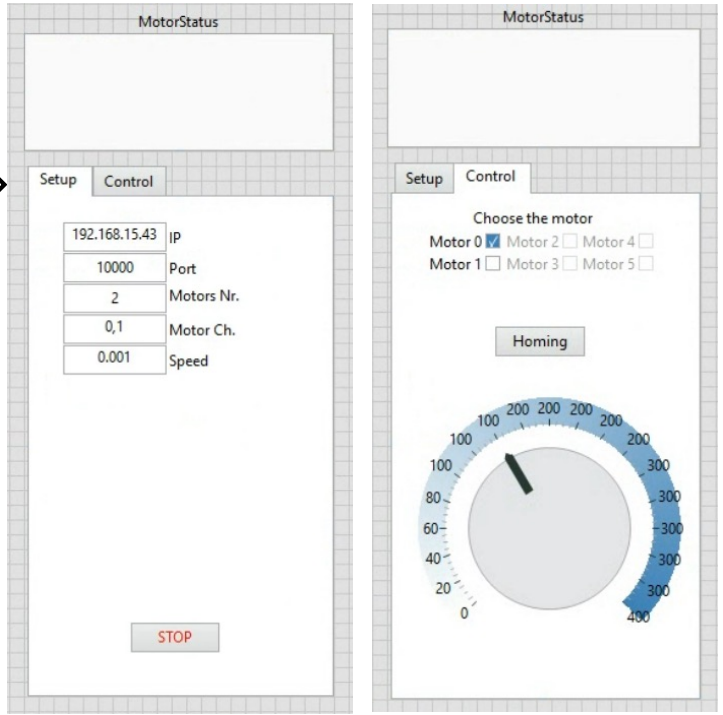
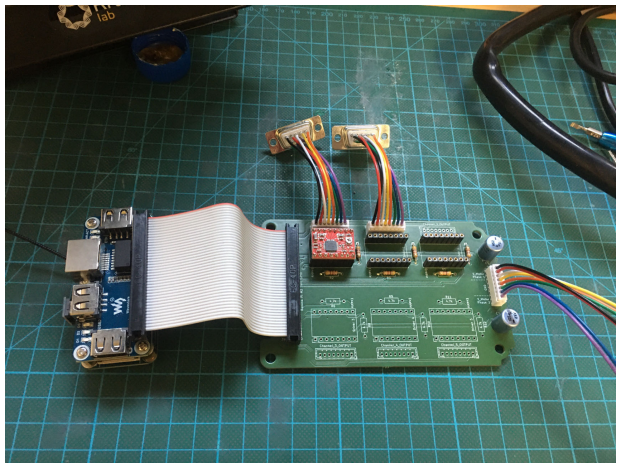
"Brain of the laser system"

Labview GUI



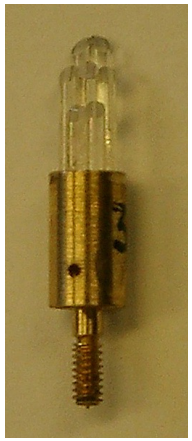


All components arrived, to do:

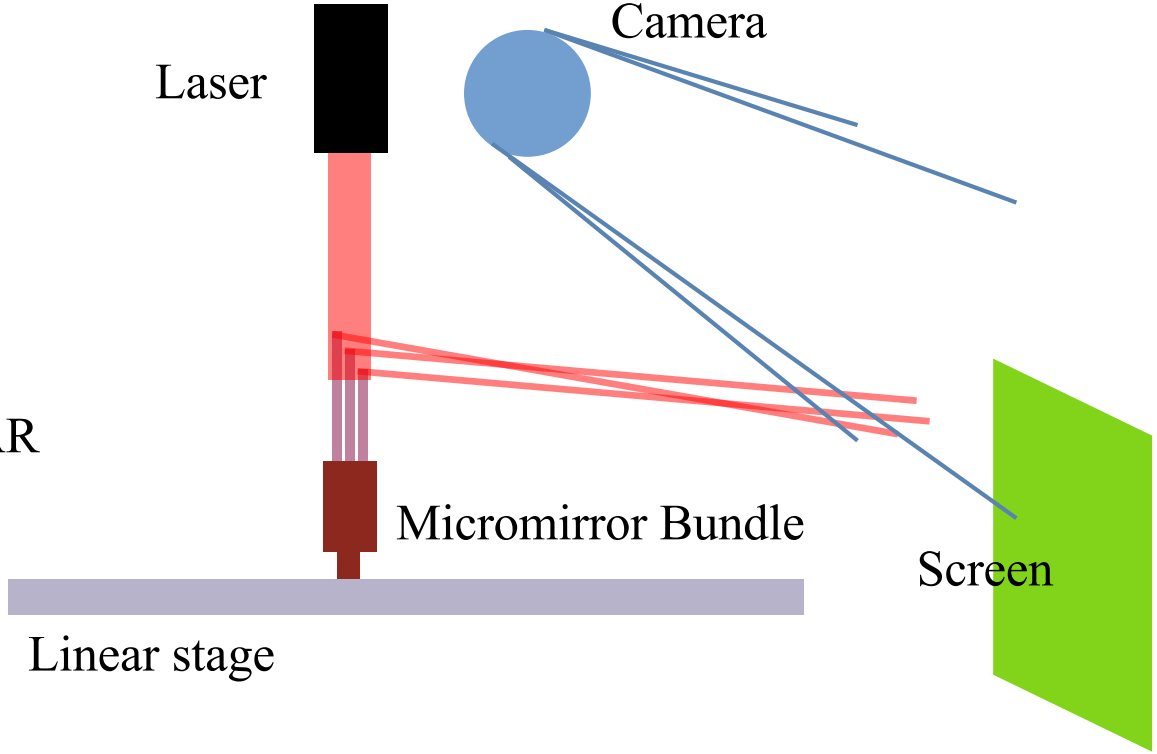
- ❑ Print 3D case
- ❑ Soldering and assembly

Micromirror angle testbench

Alexandru Enciu@TUDa



Micromirror
Bundle from STAR
(A. Lebidev)



Micromirror angle testbench

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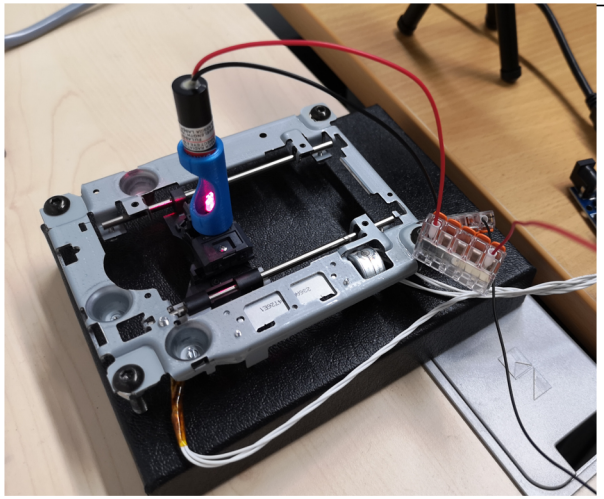
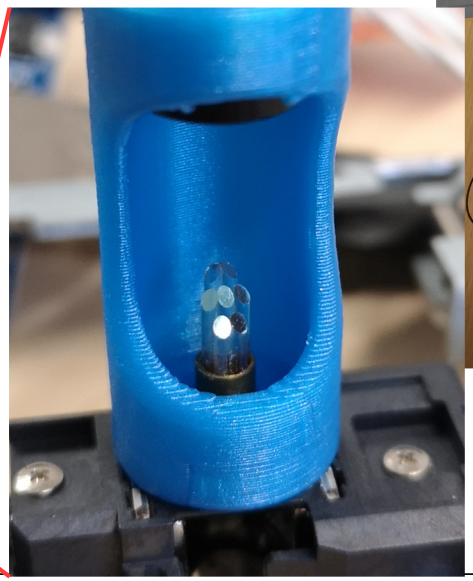
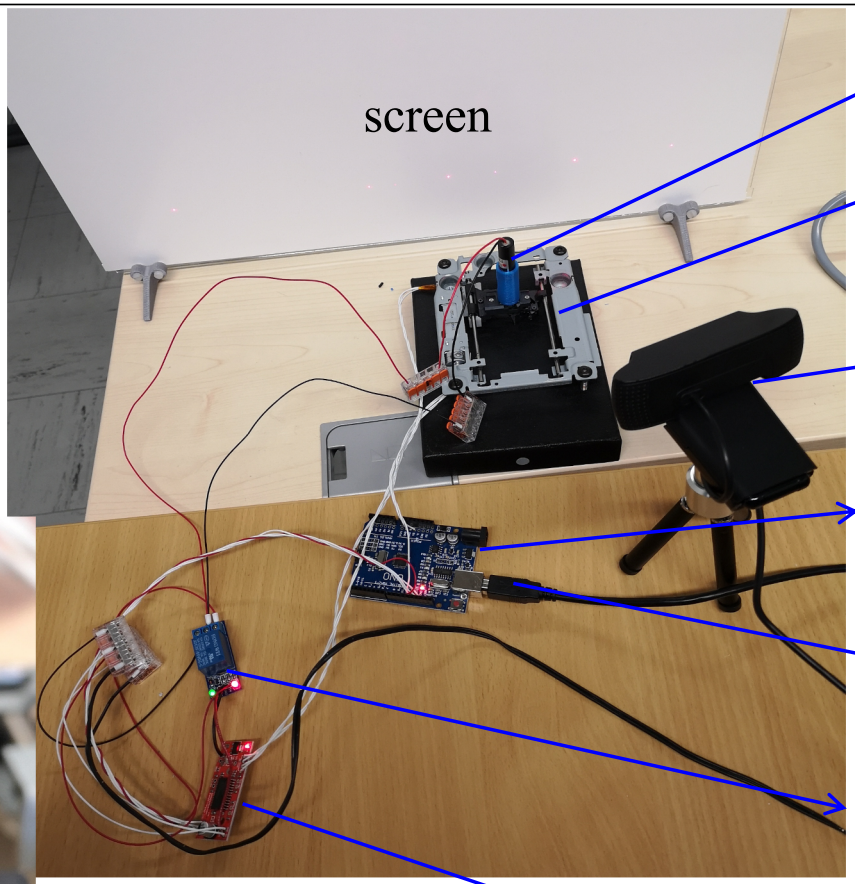
Alexandru Enciu@TUDa







Red laser 650nm

DVD linear motor, 0.0625mm/step

Web camera 8bit **C920**

Arduino UNO board

USB to the PC

5V relay to control laser on/off

Stepper motor driver (48 steps/revolution)

Micromirror angle testbench

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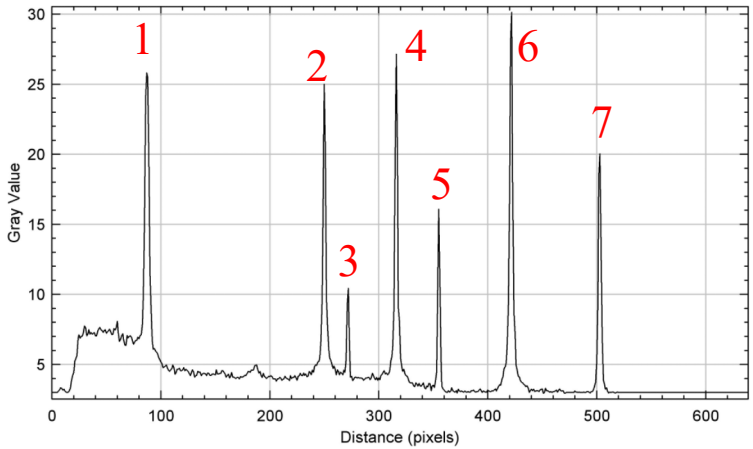
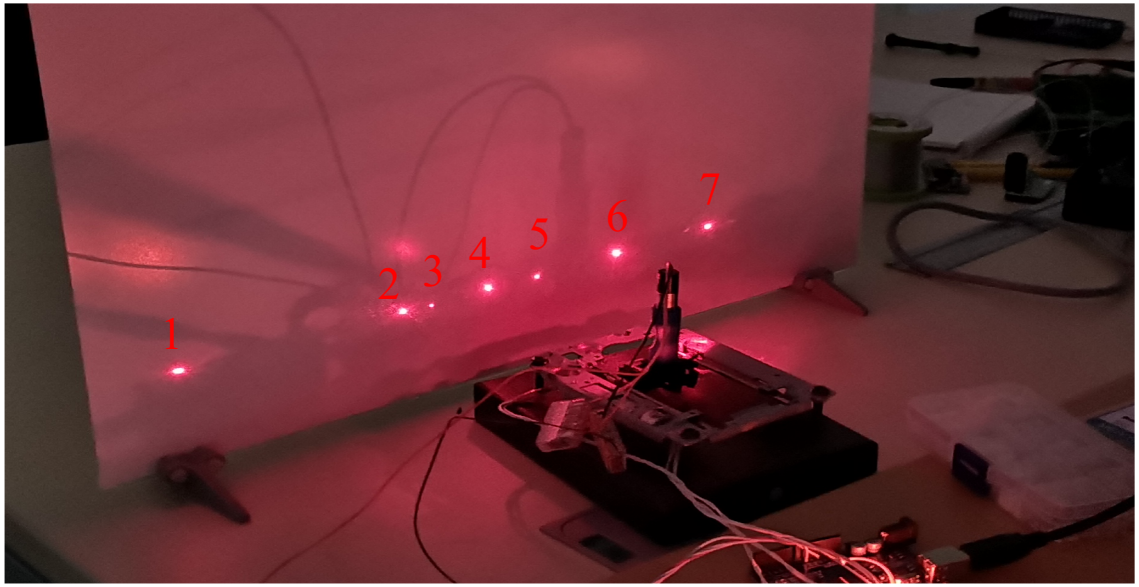


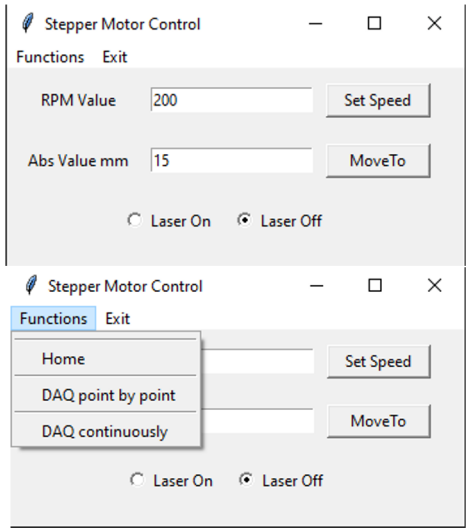
Pixel values



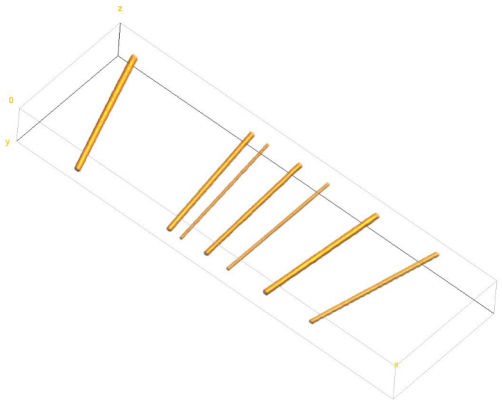
Micromirror reflexions on screen

Image in the web camera

Micromirror angle testbench



- Python GUI
  - Control Laser on/off
  - Control the stepper motor
  - Image processing with Python OpenCV and ImageJ



- 3D reconstruction to get the relative angle between two mirrors

→ Analysis ongoing

- Need to improve resolution of the setup:

Stepper motor (48step→3200step)

Camera (8bit→12bit)

Thank you for your attention!