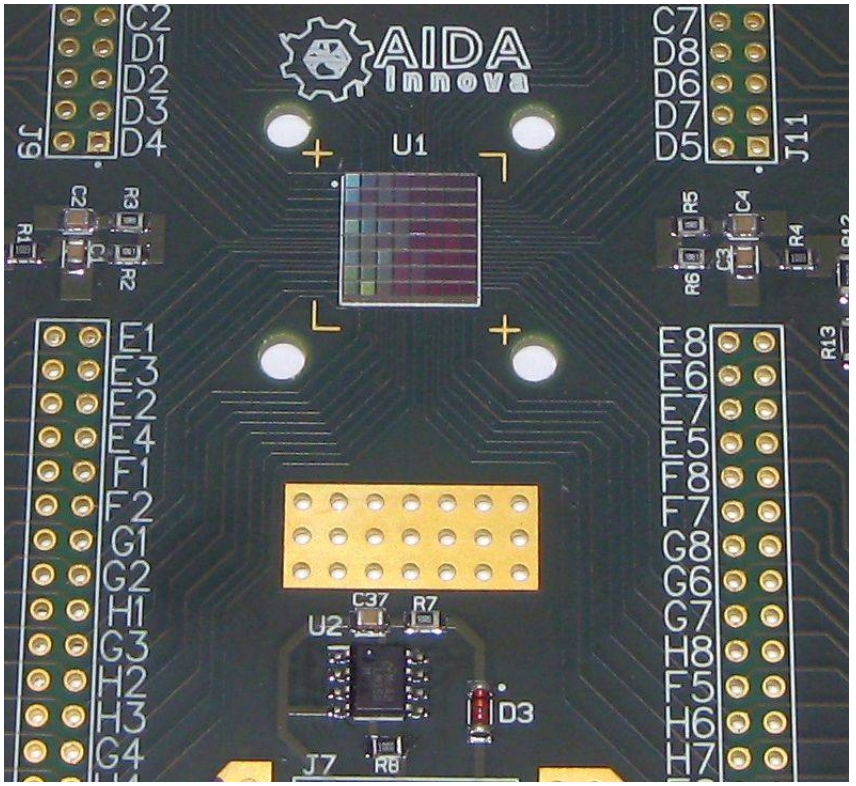
WP 8.4.1 AIDA innova 2023 annual meeting

SiPM array prototype for TileCal scintillators, ADApower and preamps

Under AIDAinnova collaboration we build a prototype system not only for the test of SiPM array with TileCal scintillators. For an eventual upgrade of some of PMTs to SiPMs, in the future.

People:

- Gerald Eigen Uni Bergen / Uni Göttingen
- **Ivo Polák FZU Prague presenter**
- Jiří Kvasnička FZU Prague
- Jaroslav Moravec FOTON
- Matěj Řehák FOTON



FOTON joy of technology

UNIVERSITY OF BERGEN

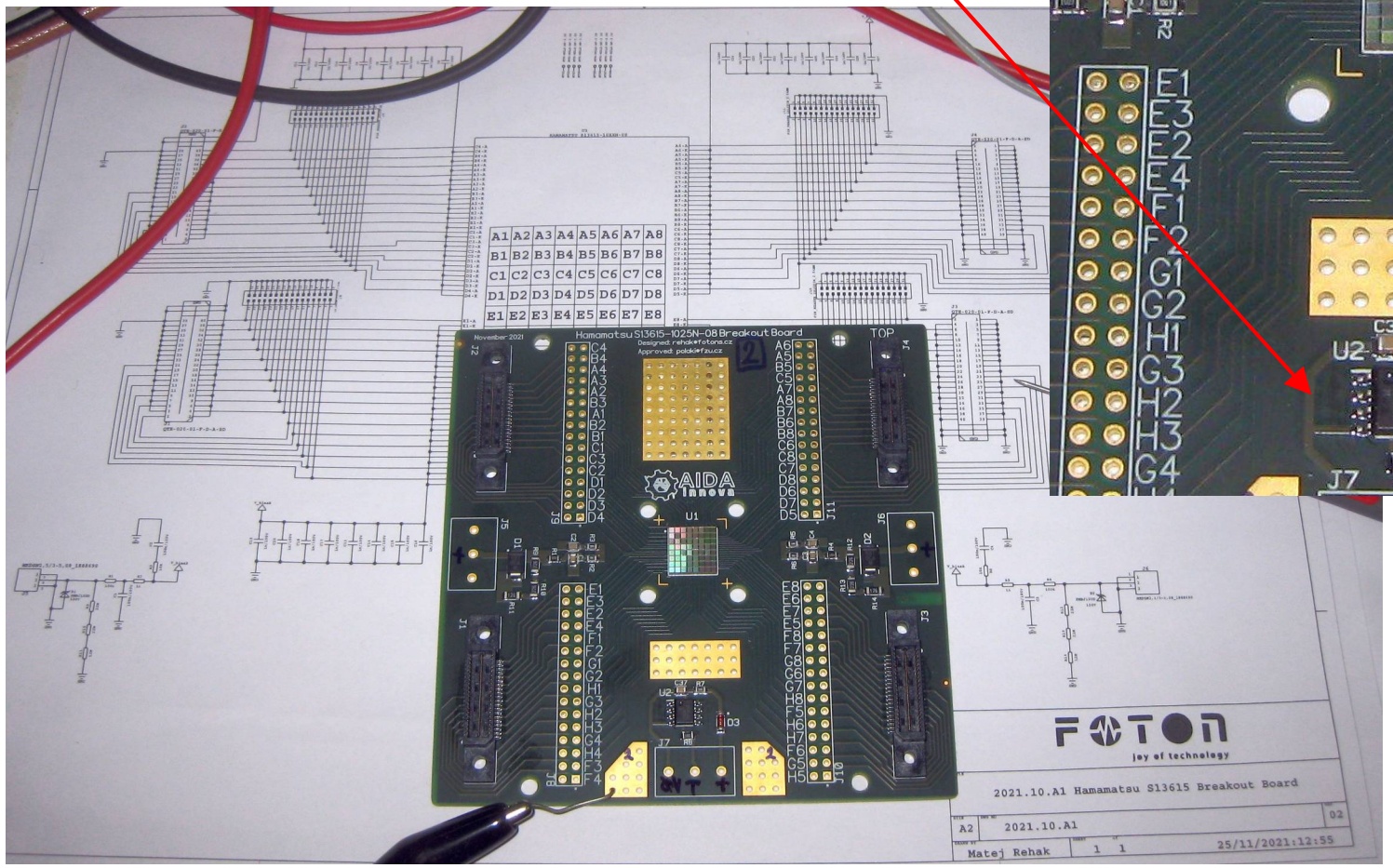
FZU Institute of Physics of the Czech Academy of Sciences

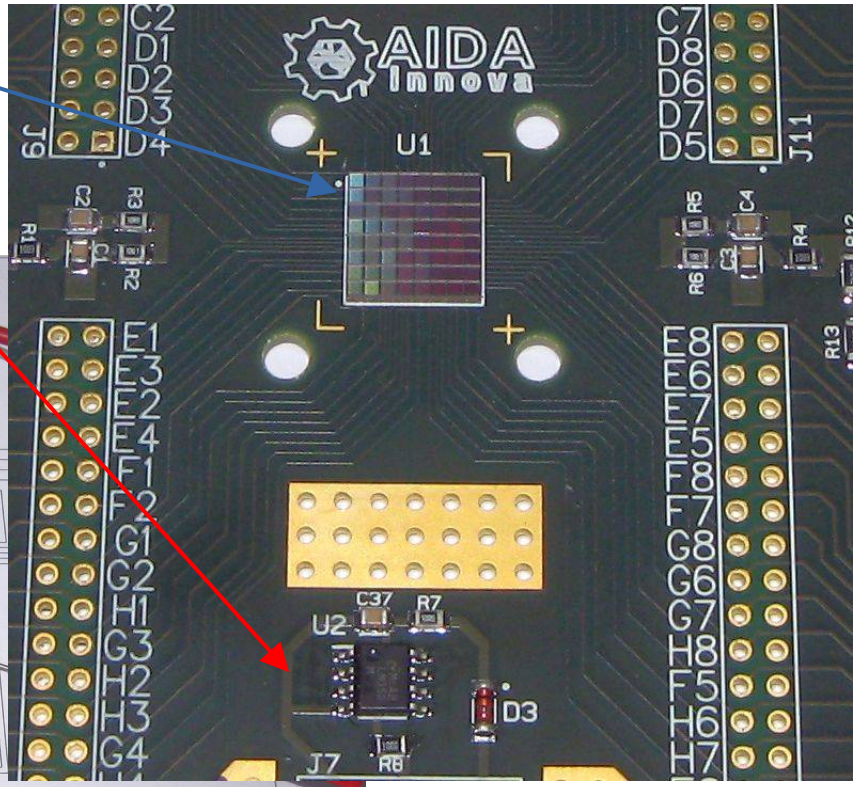
This project has received funding from the European Union's Horizon 2020 Research and Innovation programme under GA no 101004761.

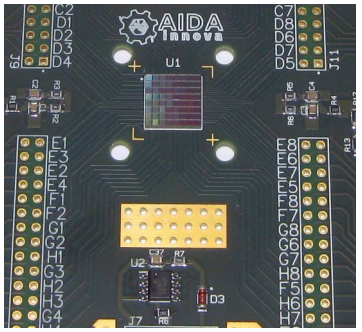
Expanding PCB for SiPM arrays

We use 64CH SiPM Hamamatsu S13615 – 1025 (U1)

- Small active footprint about 10 x 10 mm
- For the first test we use a few channels
- Temperature sensor LM35 onboard (U2)







- **SiPM expanding board** assembled, SiPM like a flip-chip, we used a quality service of company HC electronics in Czech republic

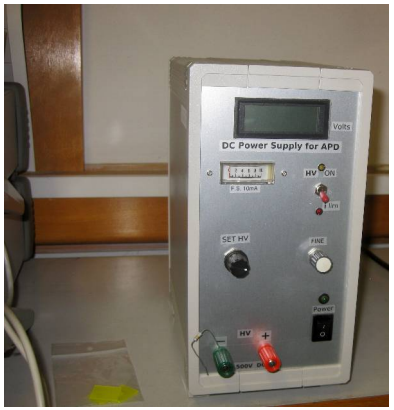
  http://www.hcelectronics.cz/en/services

- Tested in DC and ohmmeter mode for a shorts and trace integrity, a few channels has been tested with an oscilloscope on simple noise pulses
- Signal tests are prepared within next weeks
- Plans for next months (by end of 2023) :
  - 1. find and employ multichannel DAQ
  - 2. Lab test with 4 channels preamps and osciloscope readout
  - 3. integrating of multichannel DAQ and testing with UV-LED pulses
  - 4. when everything will come fine, come to TileCal beamtest in a autumn of 2023 or in 2024

A Setup for 4 channel SiPM test in autumn 2022

All in black box, of course
No fibres, LED and noise self trigger mode

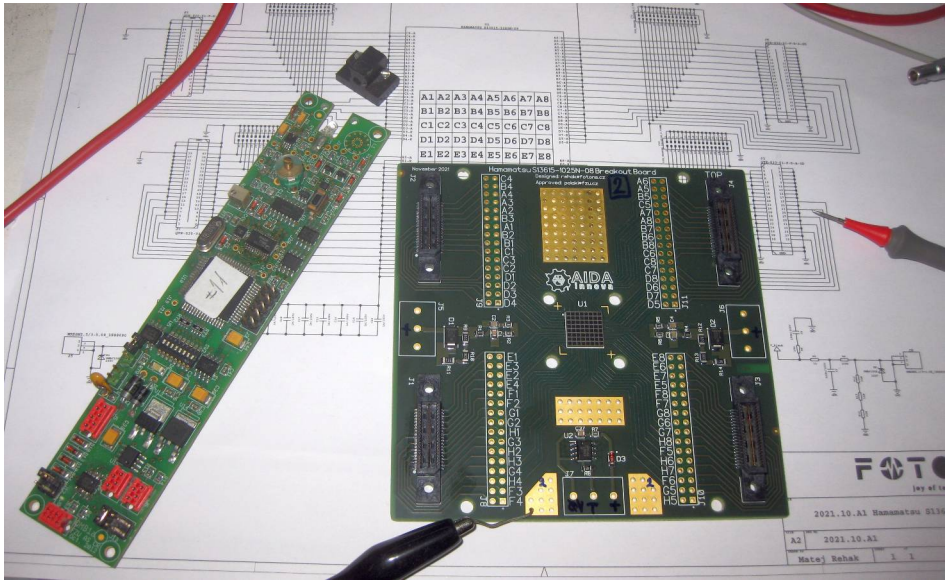
4CH Oscilloscope HD-6104 as simple DAQ



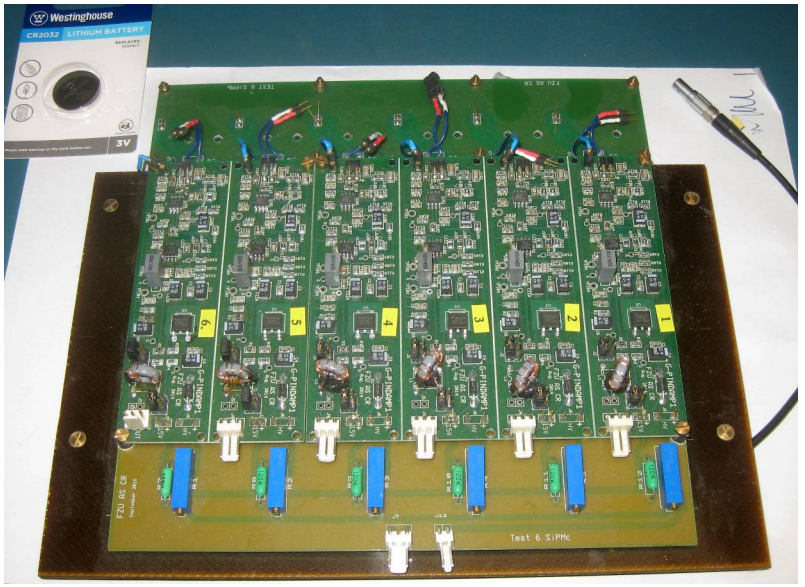
Bias voltage source

QR LED pulser 3.5ns

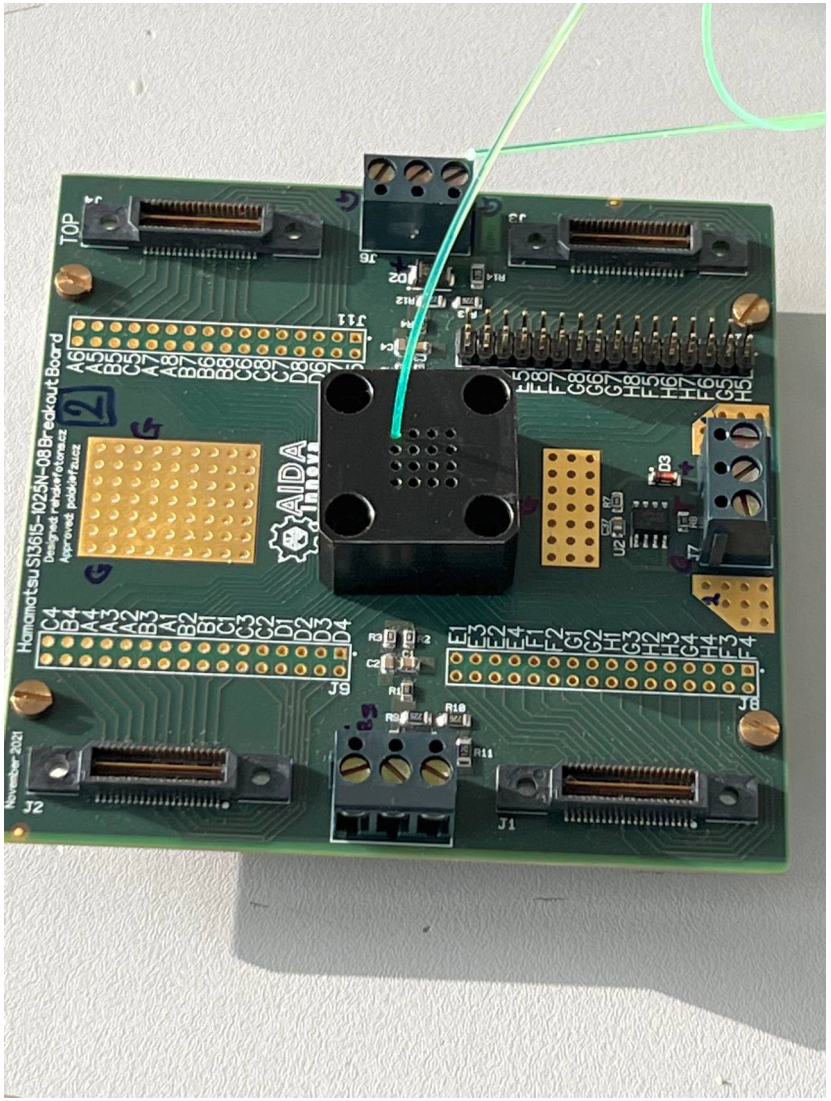
SiPM array board

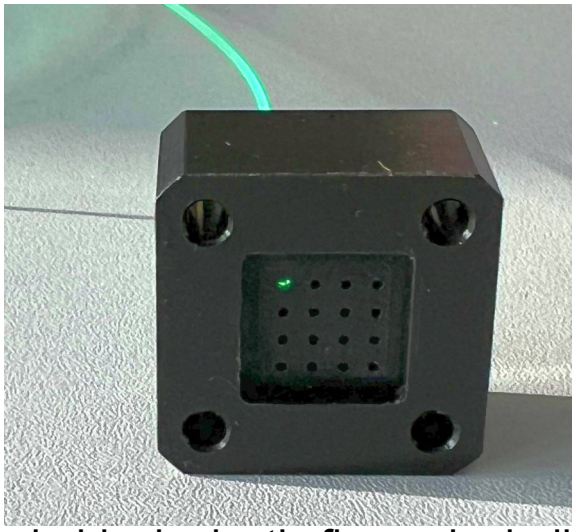


6x preamp, used four



A new flange for 16 fibres





- The bore in black plastic flange is dedicated for TileCal 0.8 mm OD fibres.
- The flange has 4 x 4 holes structure to satisfied to recent thick wall between fibres holes. The flange has all 16 holes arranged such that by four 90-degree rotations all 4 SiPMs of the array are illuminated
- Thus, we can measure the light yield and noise of each channel and study the cross talk
- This flange was designed and precisely made in a collaboration of University of Göttingen.

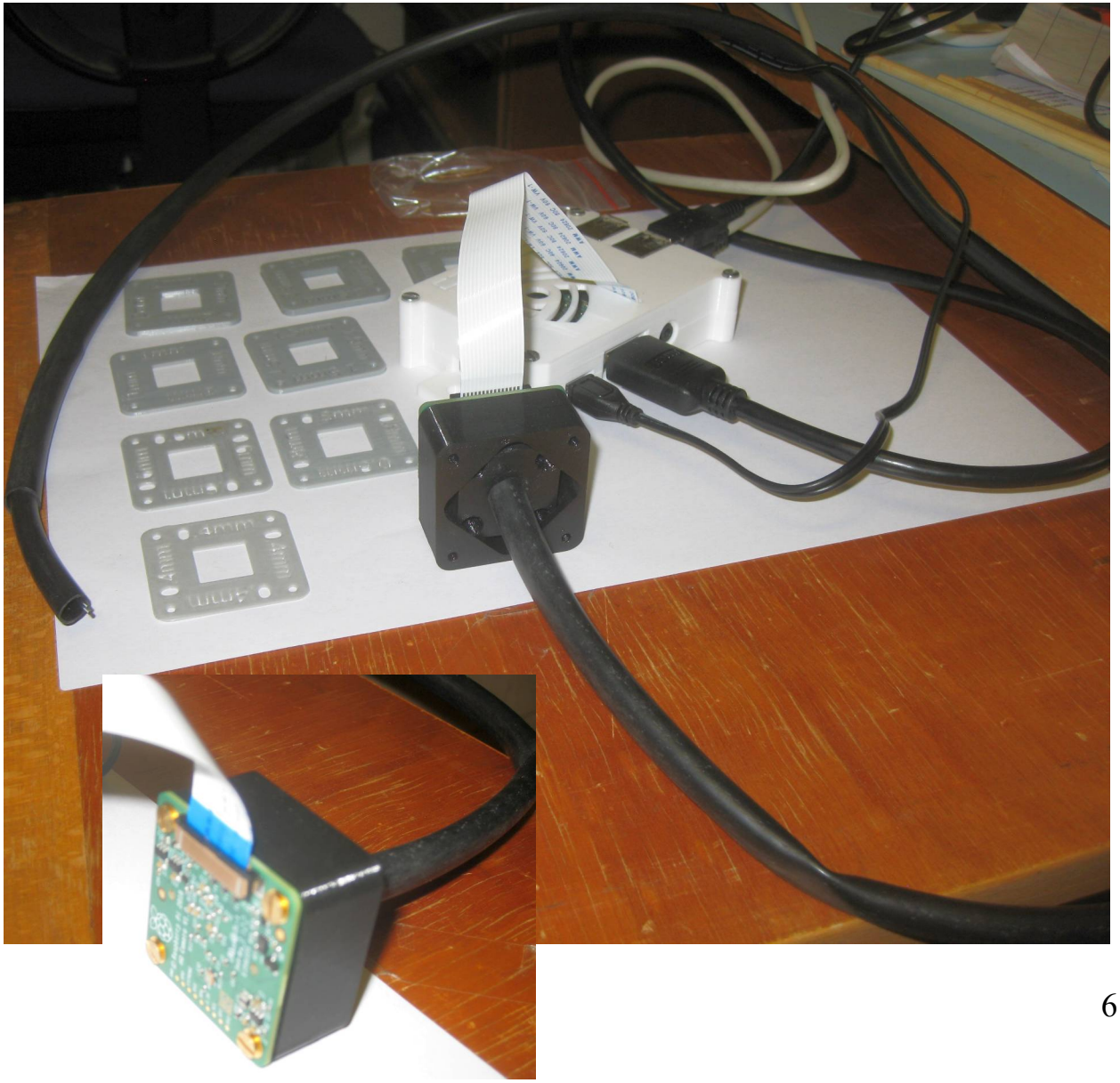
The Camera reads fibres

Motivation: study of the uniformity of the light distribution in fibres
Jiri's idea & 3D printing

- We bought a cheap HQ camera (~59CHF) for Raspberry Pi set,
- 12.3 megapixel Sony IMX477 sensor, 7.9mm diagonal image size

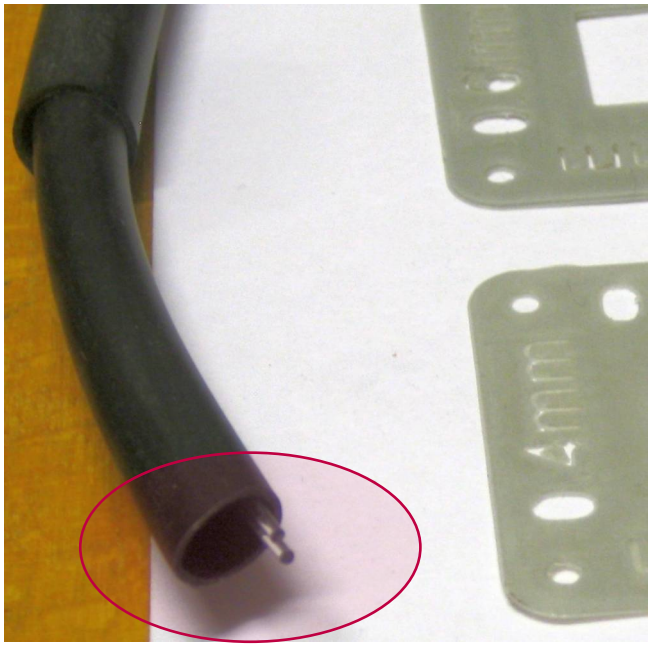
https://www.raspberrypi.com/products/raspberry-pi-high-quality-camera/

- IR filter is been removed = naked camera
- 3D printed flange to hold fibres in front of the camera
- Two plastic optical fibres installed in a black protective silicone tubing

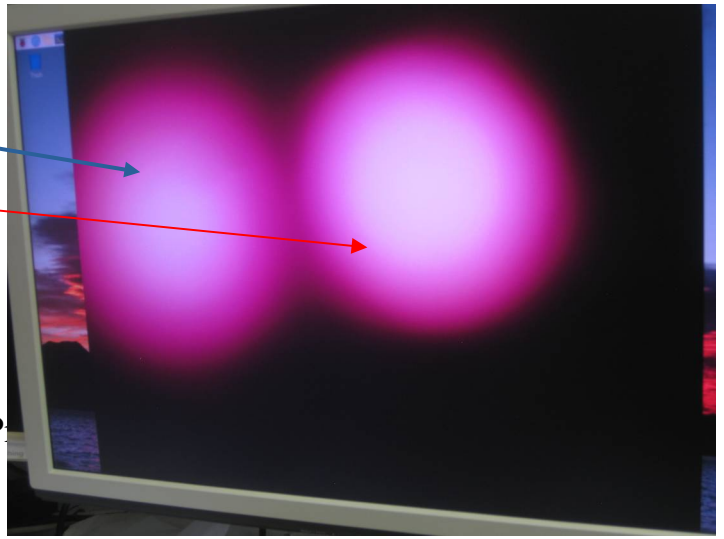


Two plastic clear fibres 1mm OD first test

- Fibre #1 one end of the fibre is polished in a direction toward to the camera
- Fibre #2 is not polished
- Fibre length is ~ 1m, insert into black double sleeves (silicon tubing)



- Left circle is not polished
- Right one is polished
- We can see a difference in the intensity

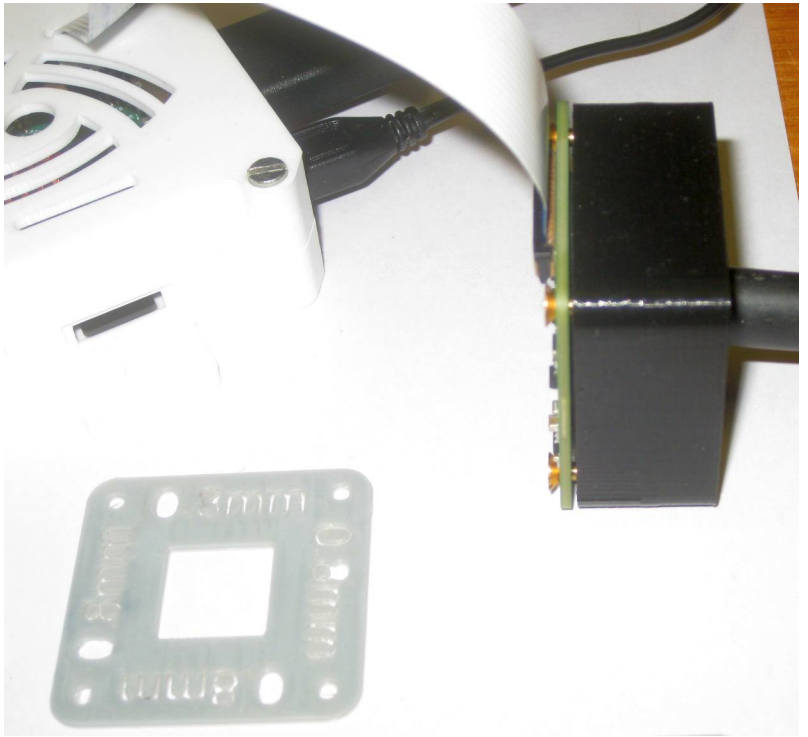


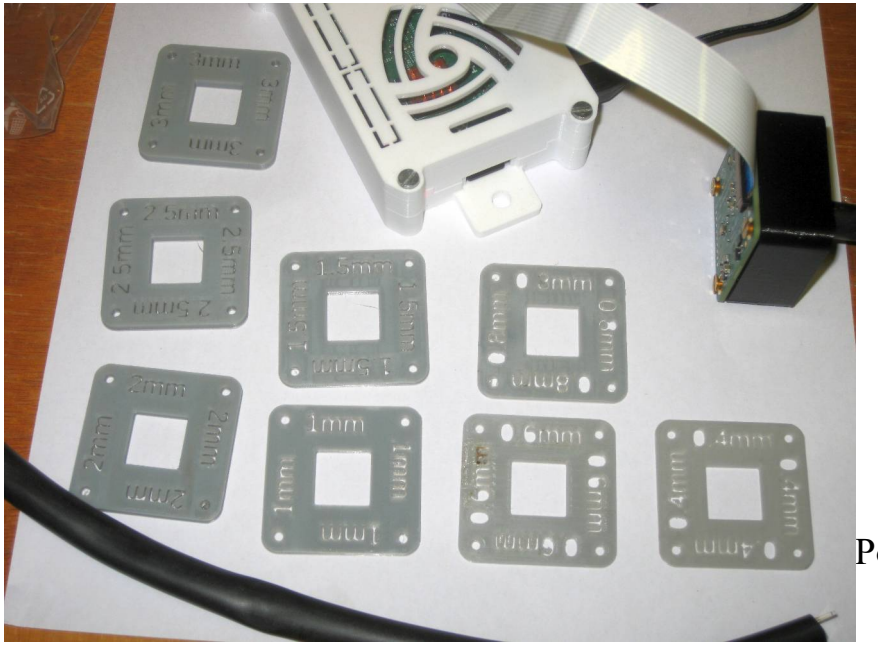
A Washer to keep a distance of fibres to the camera

- Jiri has printed a set of 8 washers
- The Set consists thickness from

0.4 mm, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5, to 3.0 mm

- 2 plastic fibres (1mm diameter) are fixed in distance of about 0.7mm (+-0.3mm) to camera chip surface **plus the washer**





The sandwich consists:

(1) Washer (if applied)

(2) PCB with the camera flip chip

(3) The flange with inserted fibres

Flange light output profile, recent test

Motivation: assure good illumination coverage of SiPM array from the flange for the SiPM test

Setup:

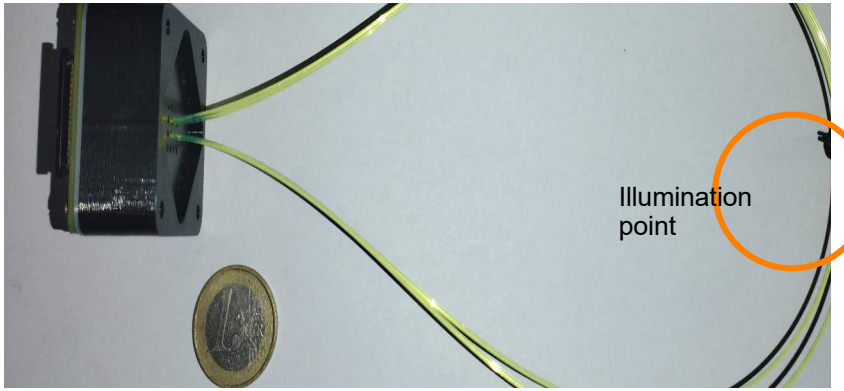
- Sony IMX477 sensor of Rpi HQ camera
- (optional) spacers controlling the distance from sensor
- WLS fibres fixed in the flange (both ends), light source white LED continues: outer fibre bend

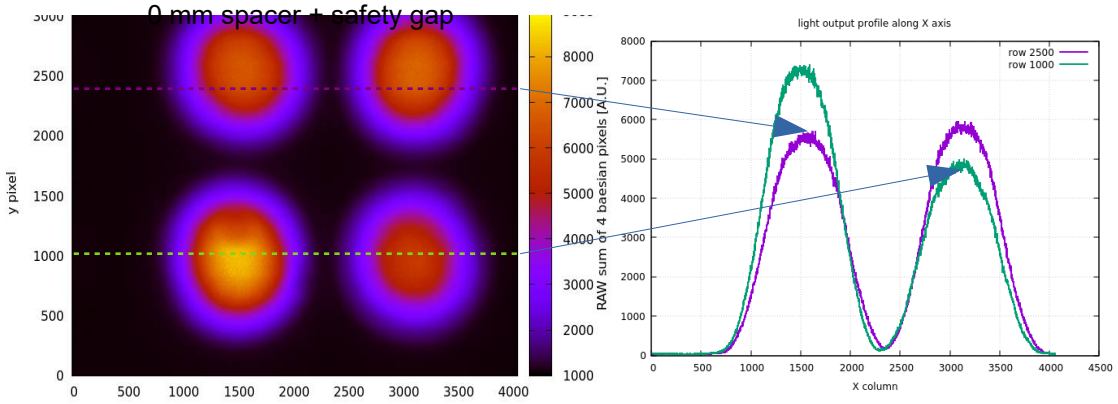
we are able to read the raw data of the camera

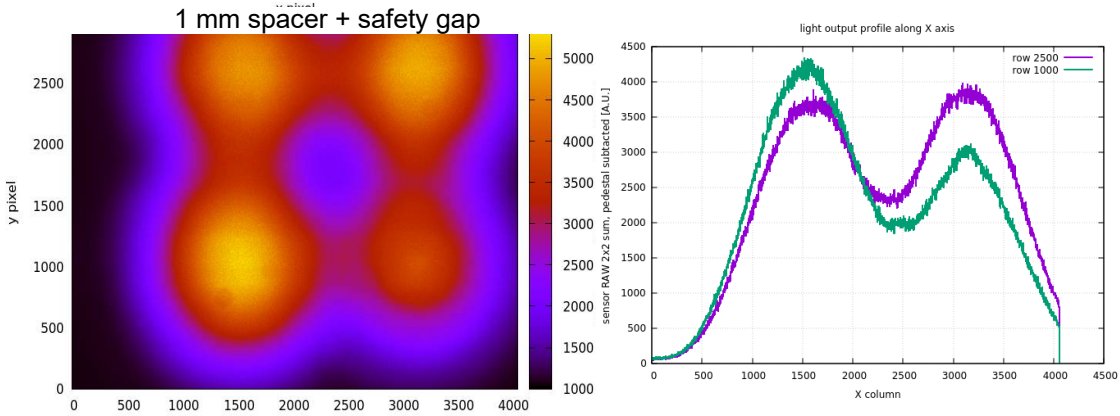
- camera calibration, gamma and linearity to be investigated
- sum of 2x2 pixels (to avoid bayer filter effects)

Conclusion: we have a tool to approximate the light output spot from the WLS fibre when not in direct contact with surface of the camera

We are ready to test with long WLS fibres and scintillator (driven with UV LED pulses)

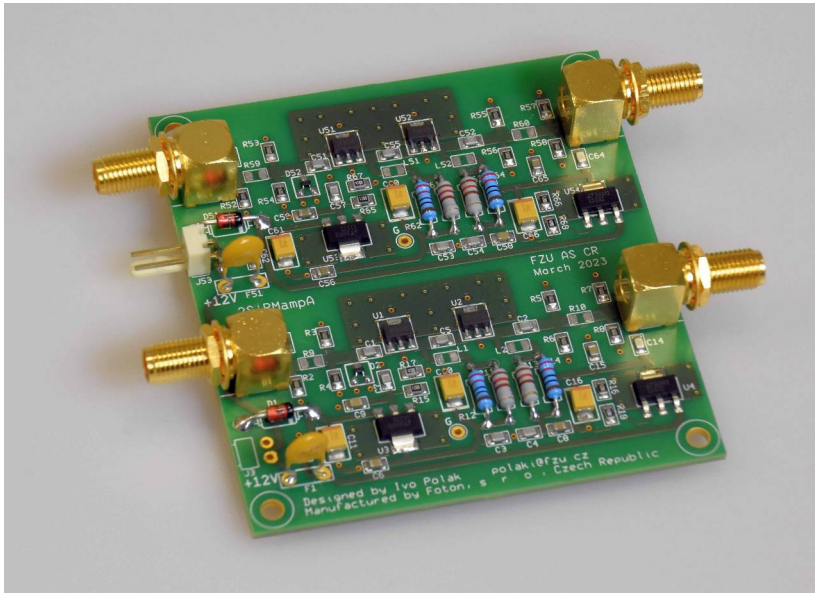






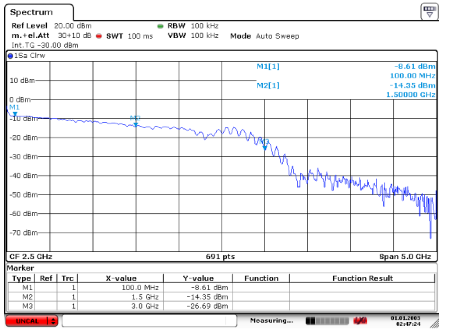
Ivo Pol

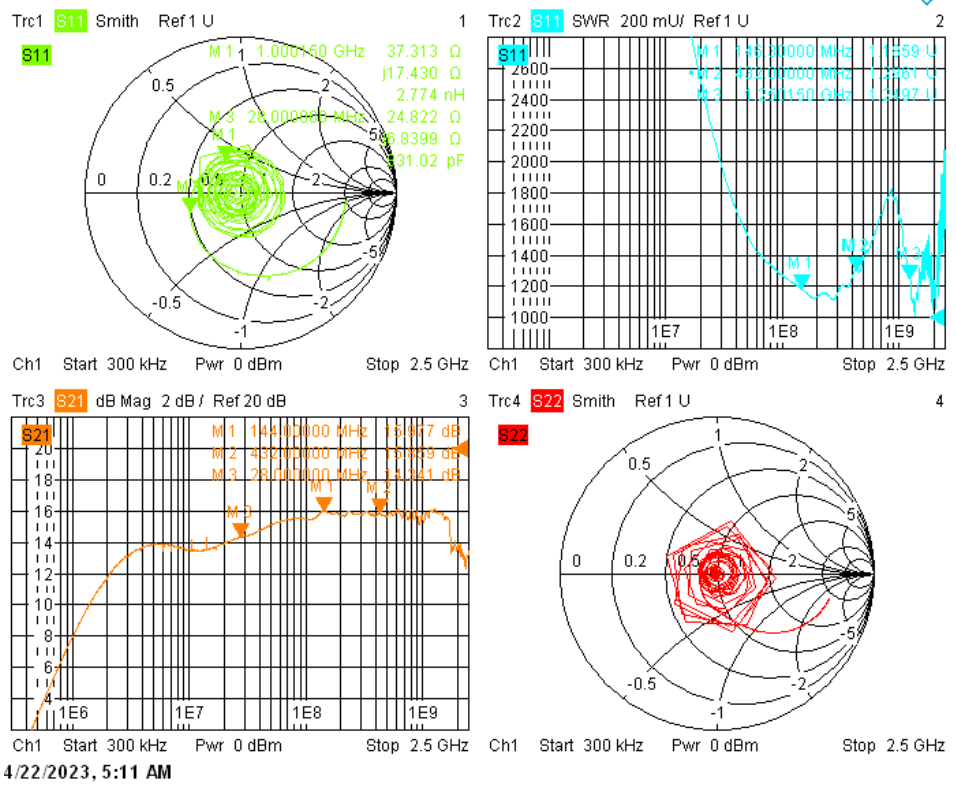
2 CH Fast preamp for SiPM



Amplifier with a bandwidth of 2MHz to 2.5GHz

First results, it was assembled last week.





- Fast amplifier for measuring response of a “new” SiPM array, then optimize a bandwidth for multichannel system
- Good match to 50 Ohm
- ESD and high pulse protection on input
- Optimizing of low frequency response
- Power supply 8 to 12V (internaly regulated by LDO) 0.25A for two signal channels

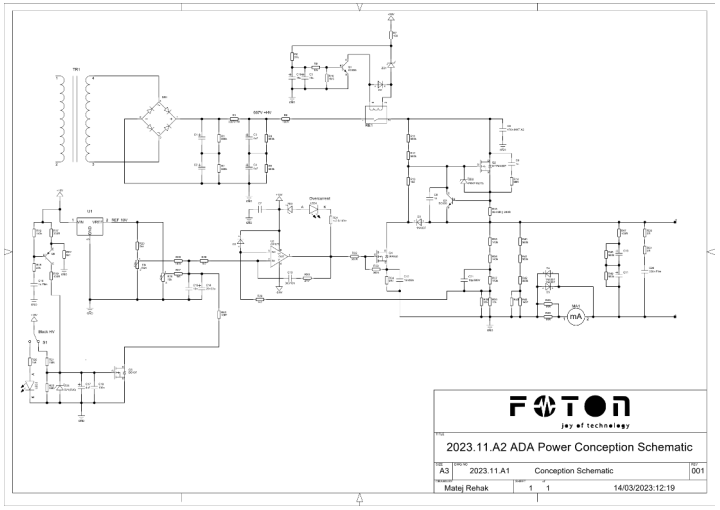
ADApower

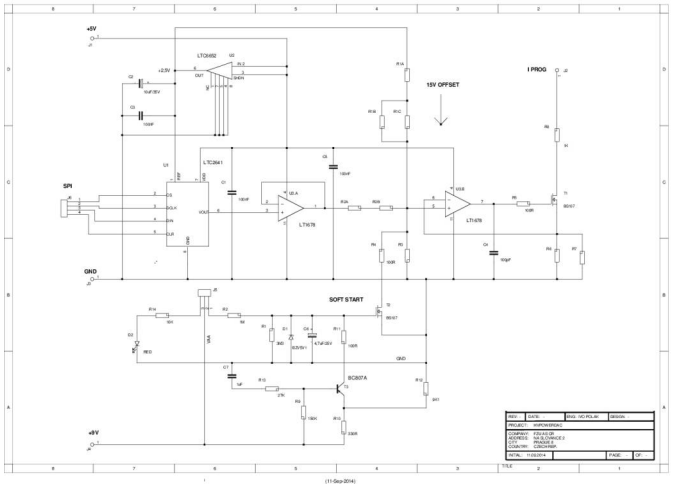
- We are in developing & prototyping phase

- 16bit DAC can control HV regulator with step of 1mV
- Measuring of Output voltage, monitoring current

- Temperature correction:
  - analog loop
  - digital via slow control

ON/OFF display and LED indicators = dark mode





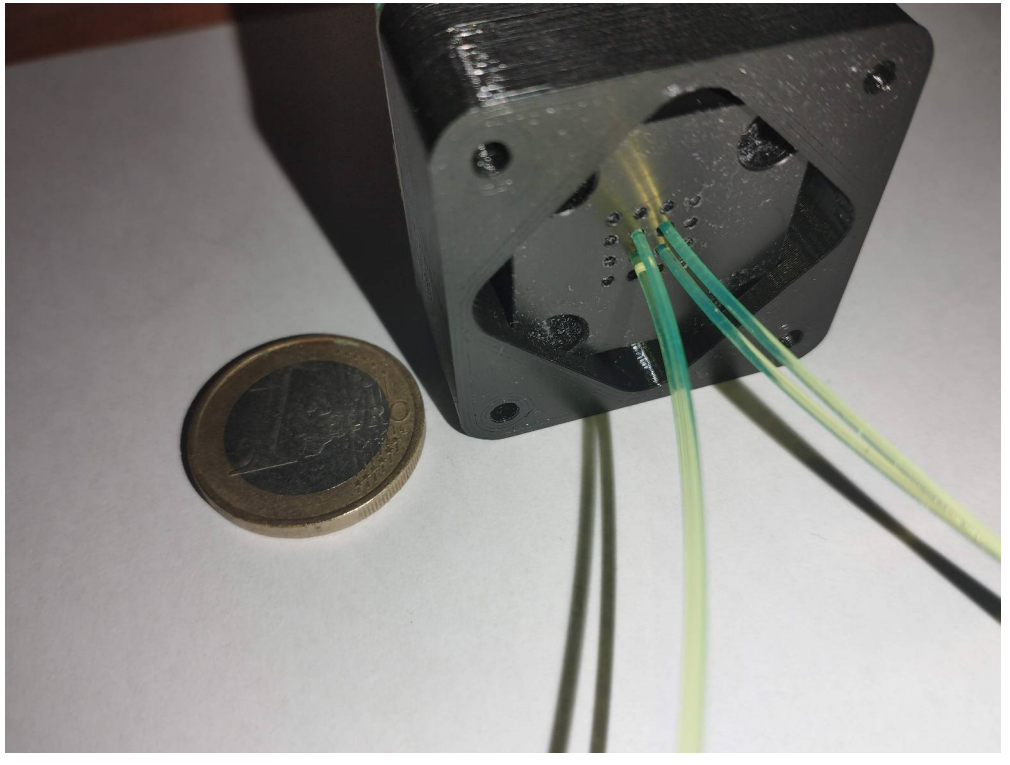
Summary of our last year activities

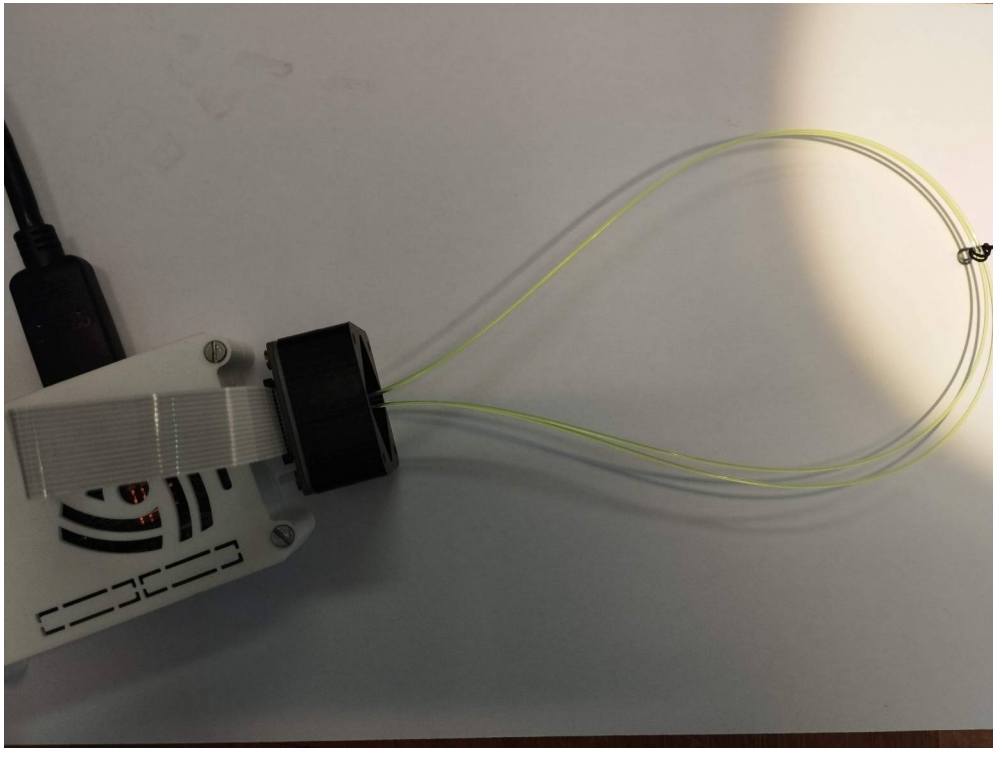
- Tested expanding PCB for 64CH SiPM array
- A flange for 16 fibres on SiPM array
- Testing phase of fast 2CH (BW 2.5GHz) preamplifier
- Prototyping phase of ADApower supply

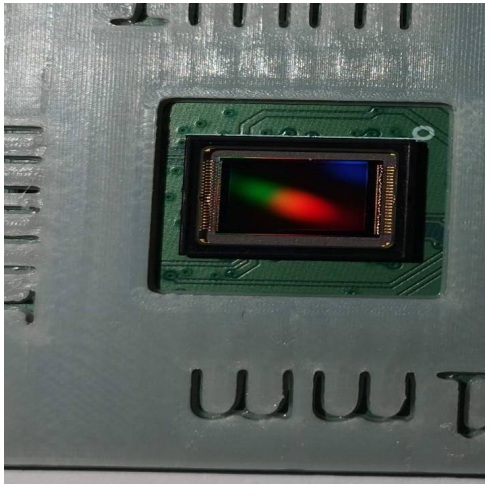
Plans:

- Testing of SiPM array setup at University of Göttingen in May and possibly in June
- Employing of multichannel DAQ

Backup photos







Pictures from camera, no lenses two fibres