

# Investigations of scintillators for HGCal.

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## Outlook of the talk.

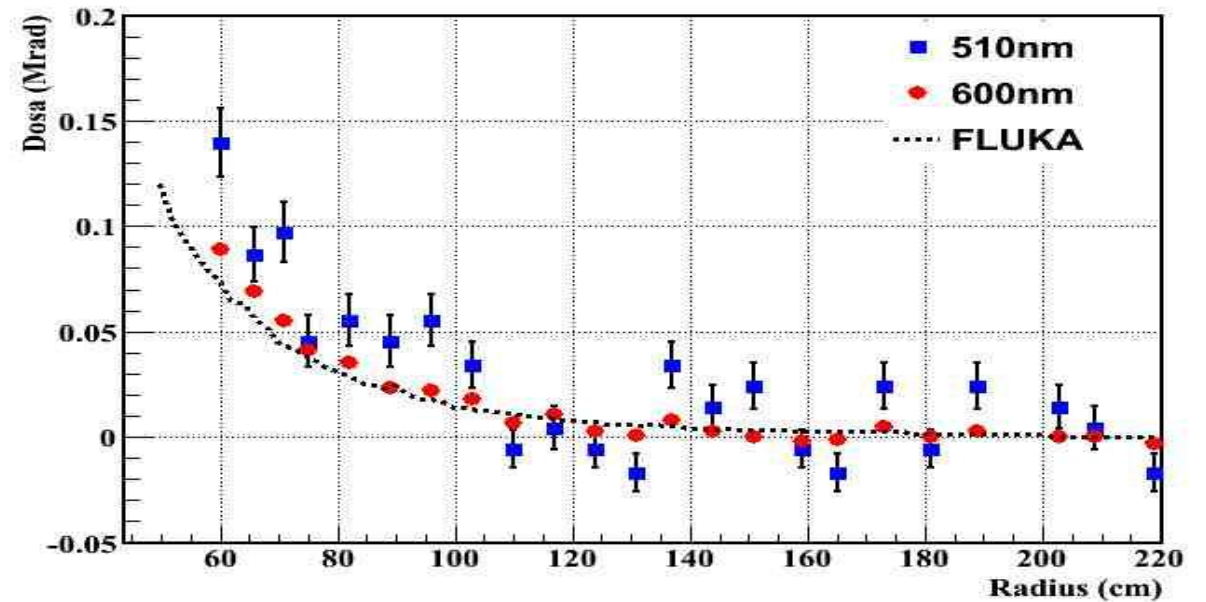
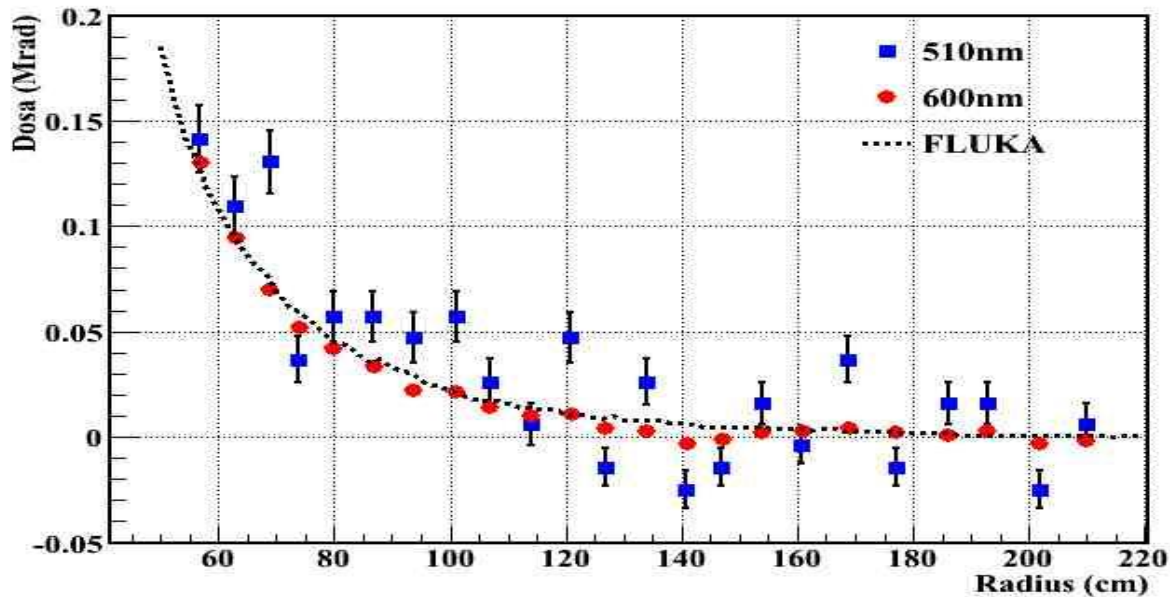
1. Investigation of the dependence of light output on the type of scintillators (SCSN-81, BC408, EJ260, UPS923a).
2. Investigation of the dependence of the light output on the reflective coating 30x30mm.
3. Investigation of the homogeneity of the light collection by the area of the scintillator. Square 20x20mm, 30x30mm, 40x40mm.
4. Study of the dependence of the light collection of scintillators on their shape. (Square, Rhombus, Triangle, Hexagon)
5. Investigation of radiation resistance of scintillators at IBR-2
6. Investigation of the SiBM resistance to IBR-2
7. Research module from 9 cells (3x3) with an irradiated scintillator.
8. In the plan. Measurement of the amplitude of the output signal of irradiated scintillators and SiPM.
9. Conclusion.

# Absorbed dose measured by film dosimeters in the HE calorimeter

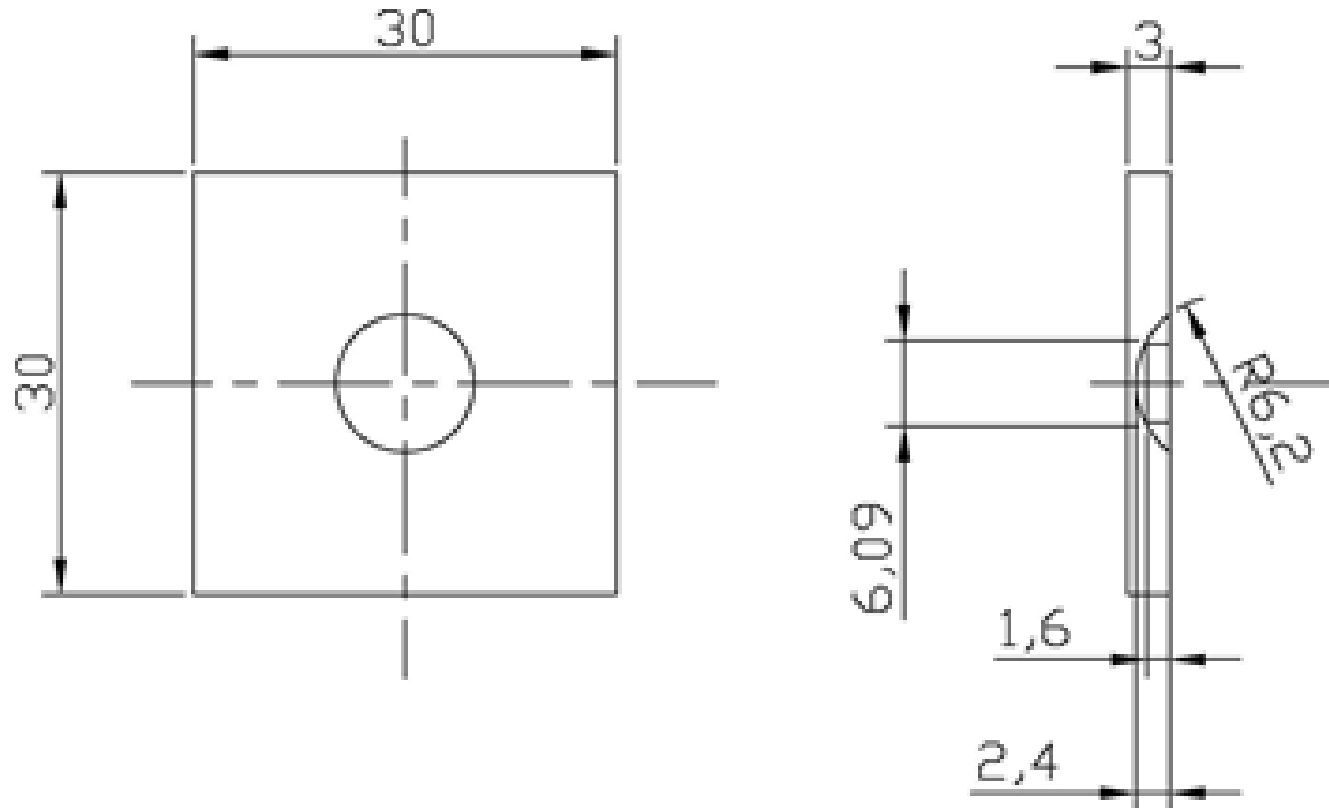
Installation of several rows of film radiachromic dosimeters (FWT-60): two measurement sets along L1 megatiles and two sets along L2 megatiles.

L1b

L2b



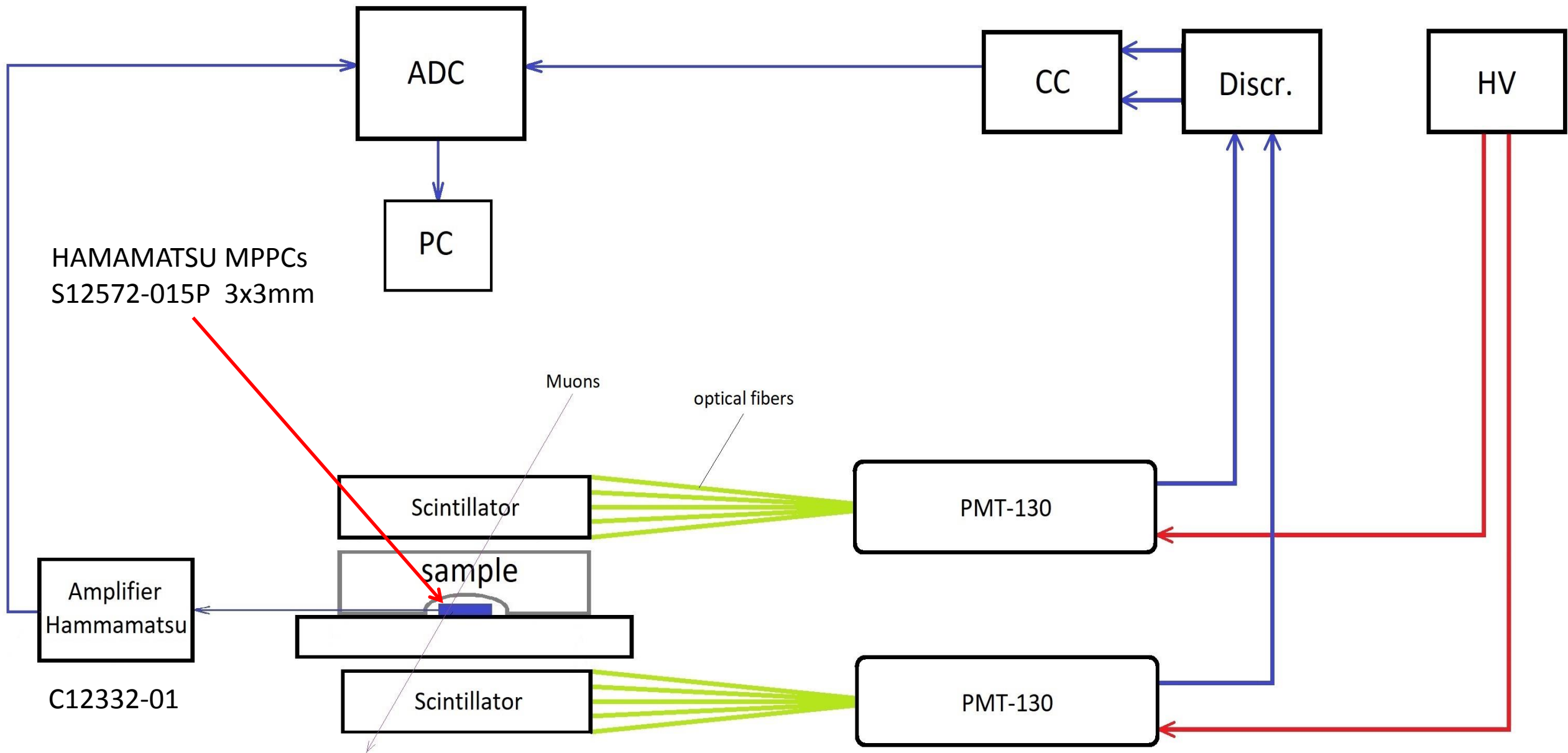
**Samples of scintillators were prepared by the Institute for Scintillation Materials (ISMA), Kharkov, Ukraine.**



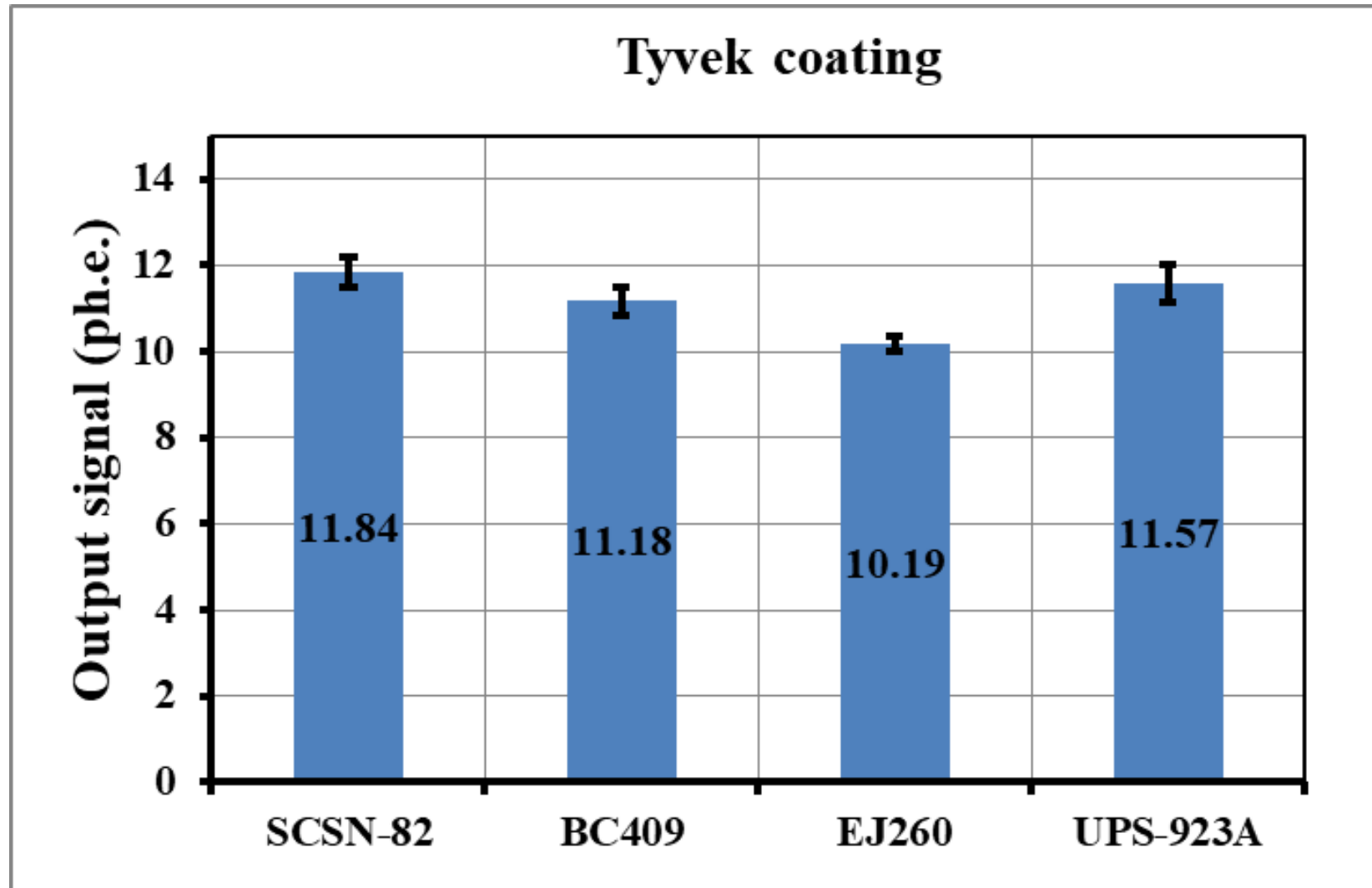
For the square shape were used SCSN-81, BC408, EJ260 and UPS923a types of scintillators.

The samples of hexagonal, rhombus and triangle shapes were prepared only from UPS923a.

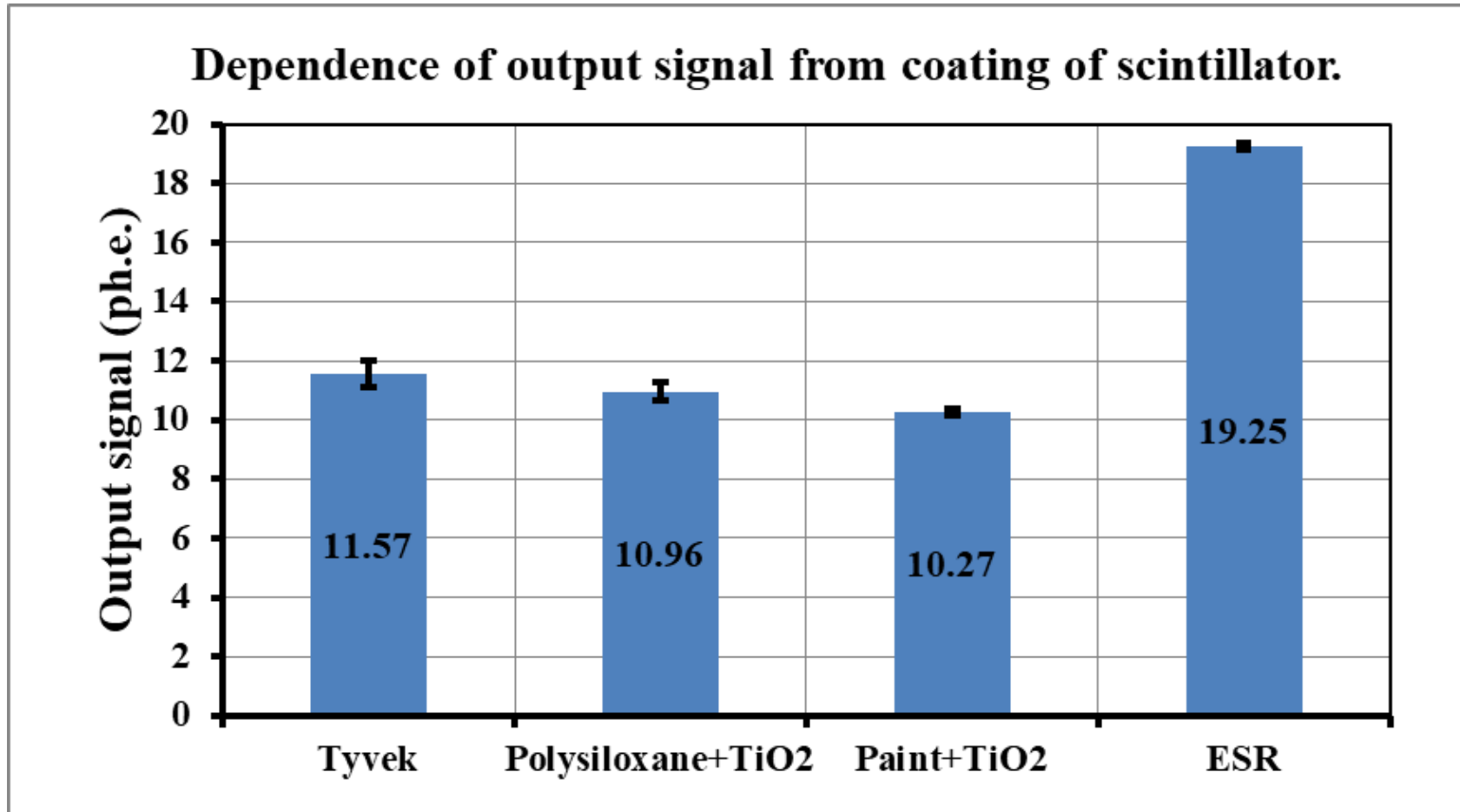
# Block scheme cosmic rays measurement



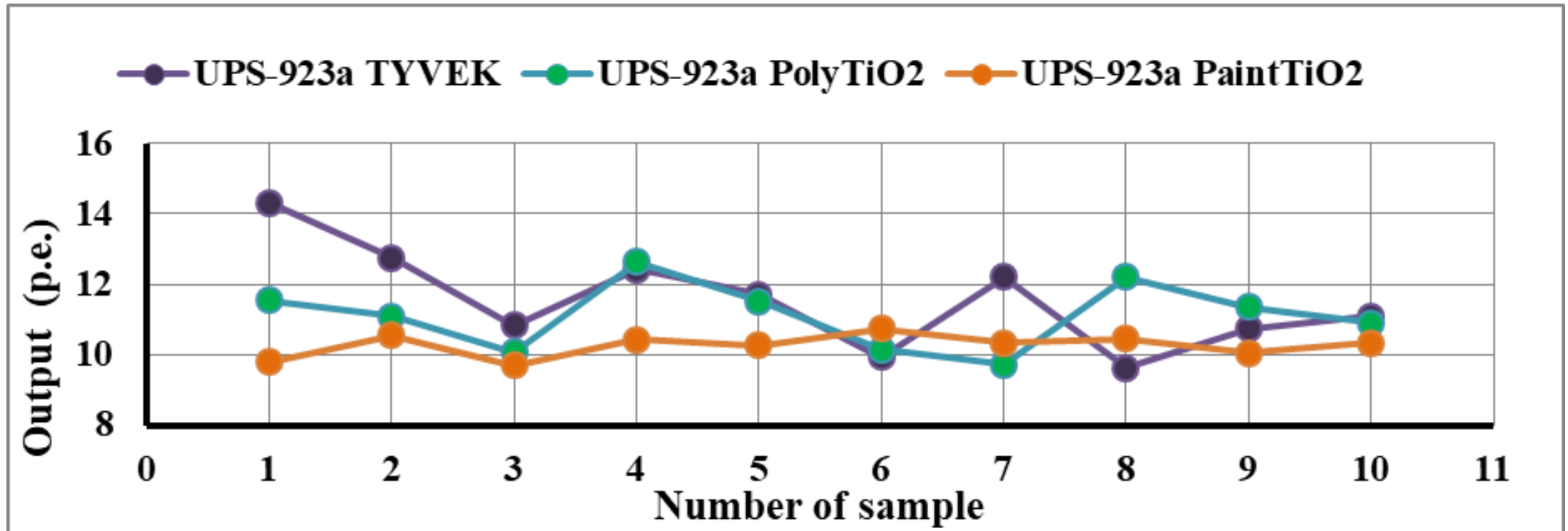
# Investigation of the dependence of light output on the type of scintillators (SCSN-81, BC408, EJ260, UPS923a).



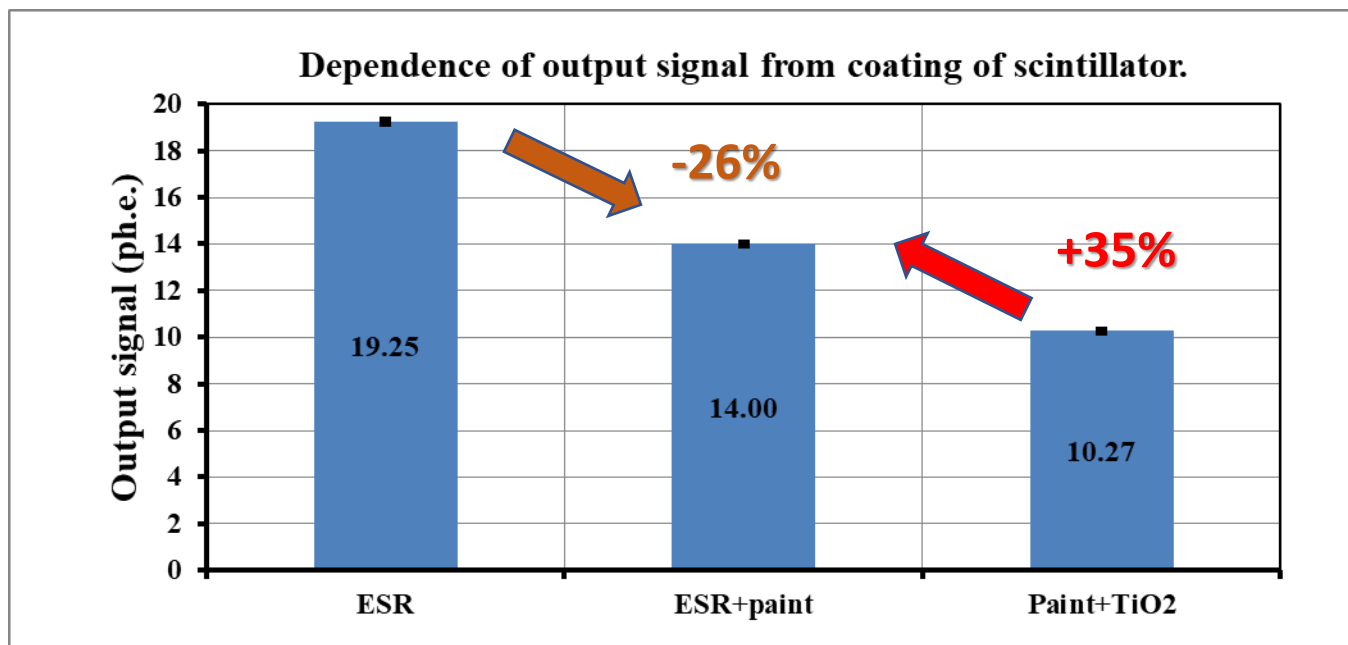
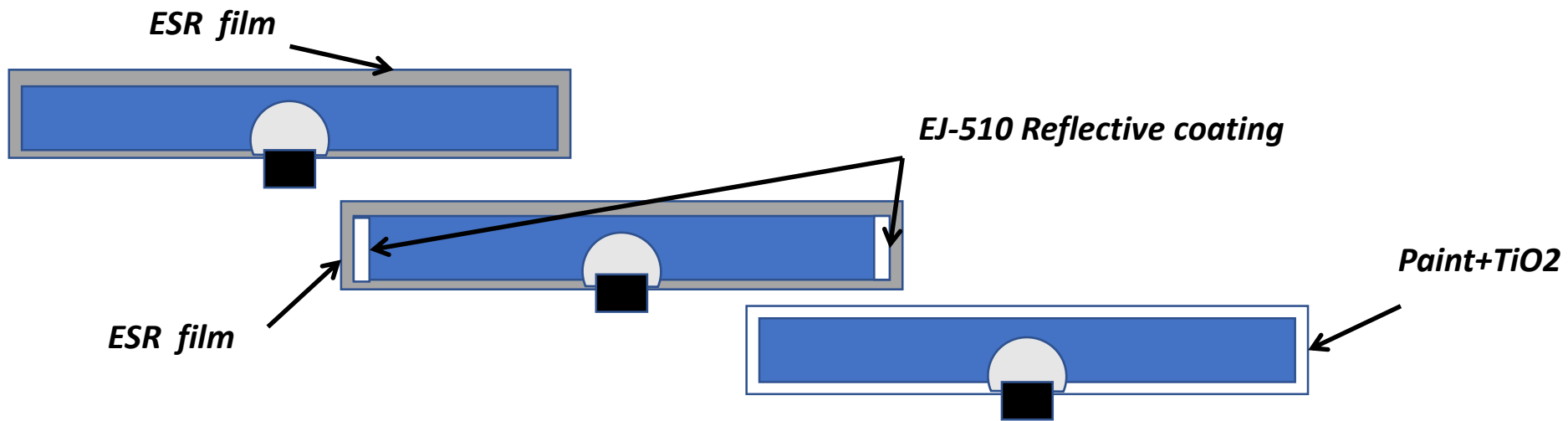
# Investigation of the dependence of the light output on the reflective coating 30x30mm .



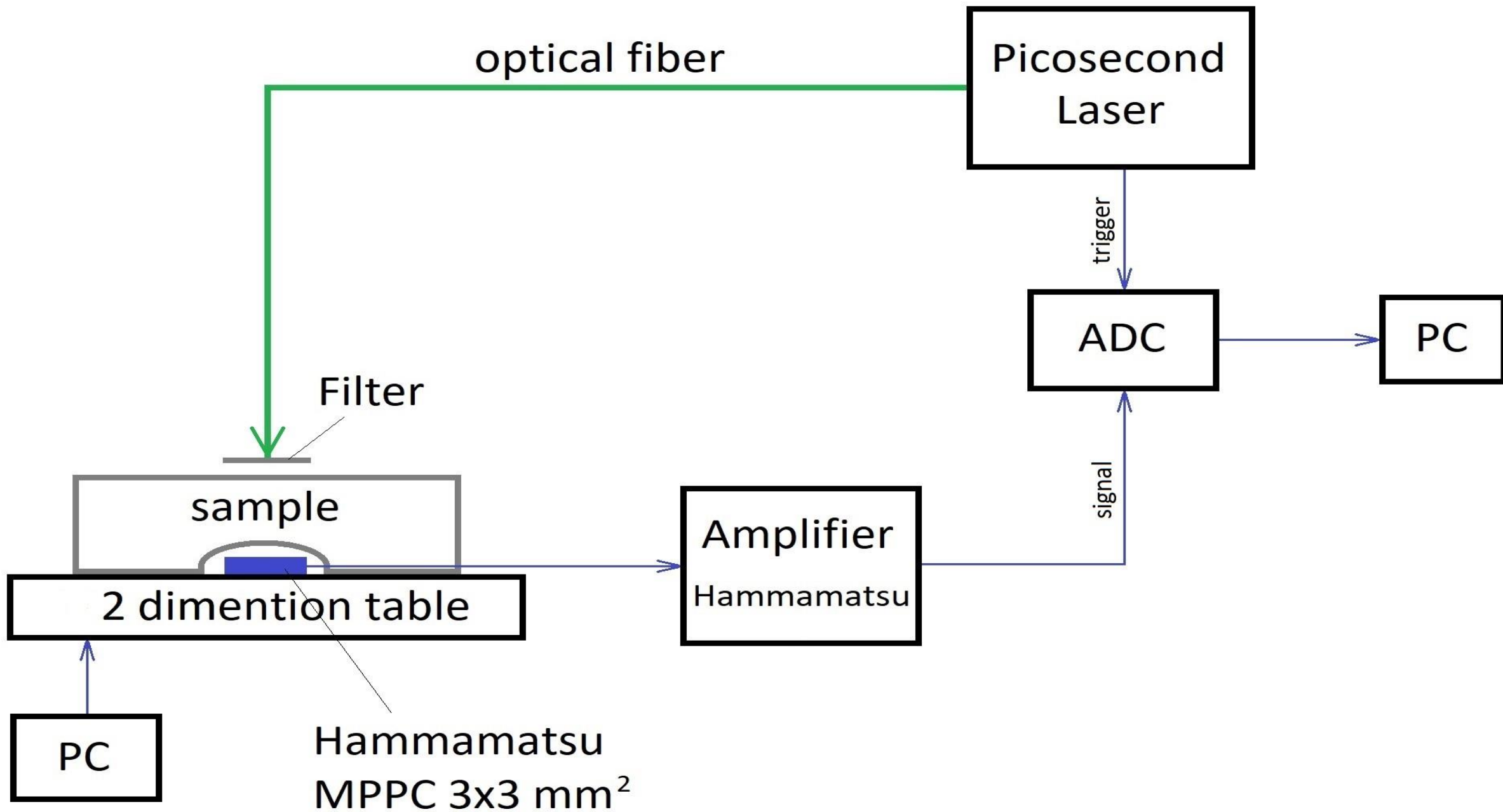
# Study repeatability of the light output from the reflective coating (Sample 30h30mm).

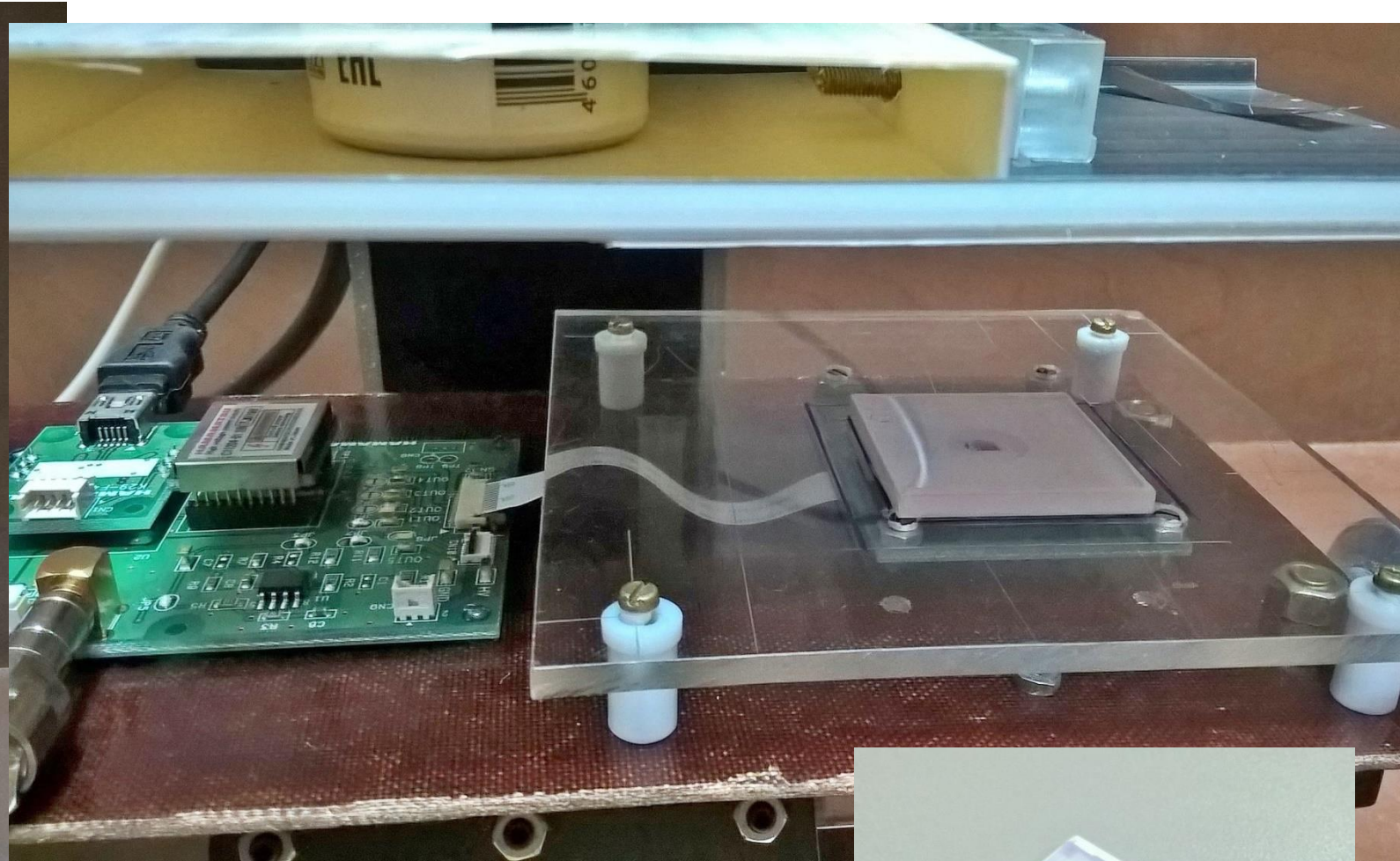






# Block-scheme laser measurement





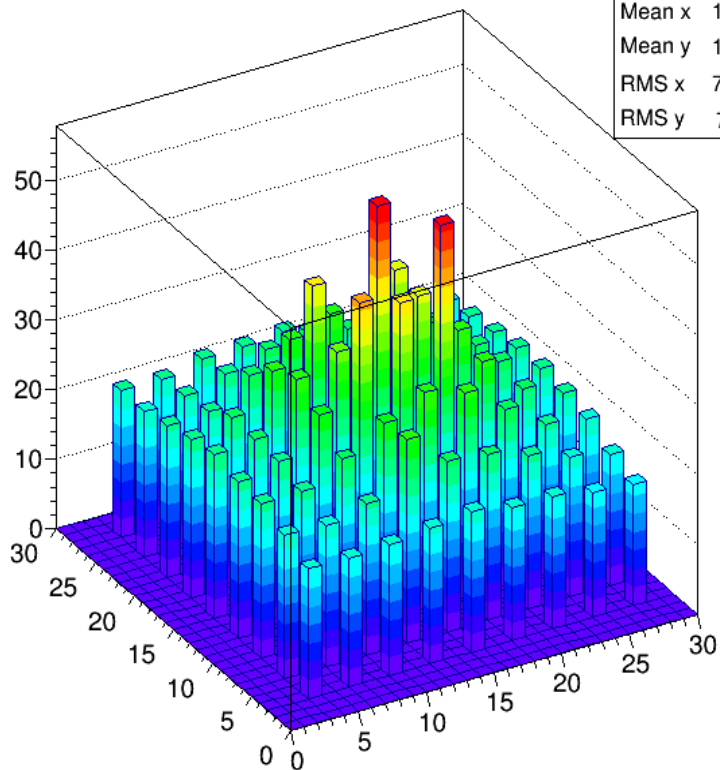
Experimental  
setup



# Results of measurement blocks 2317 samples.

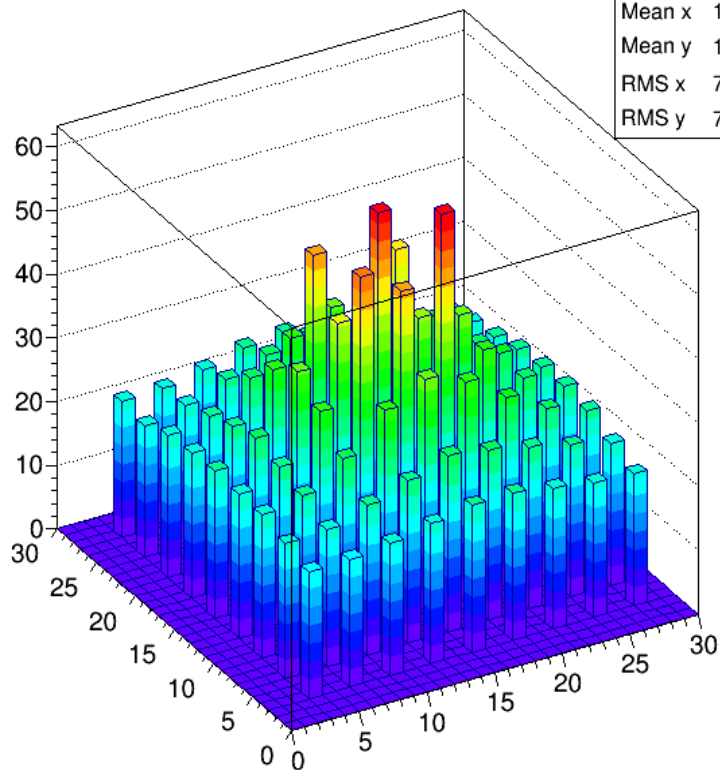
s2a

s2a	
Entries	82
Mean x	14.98
Mean y	15.15
RMS x	7.259
RMS y	7.211



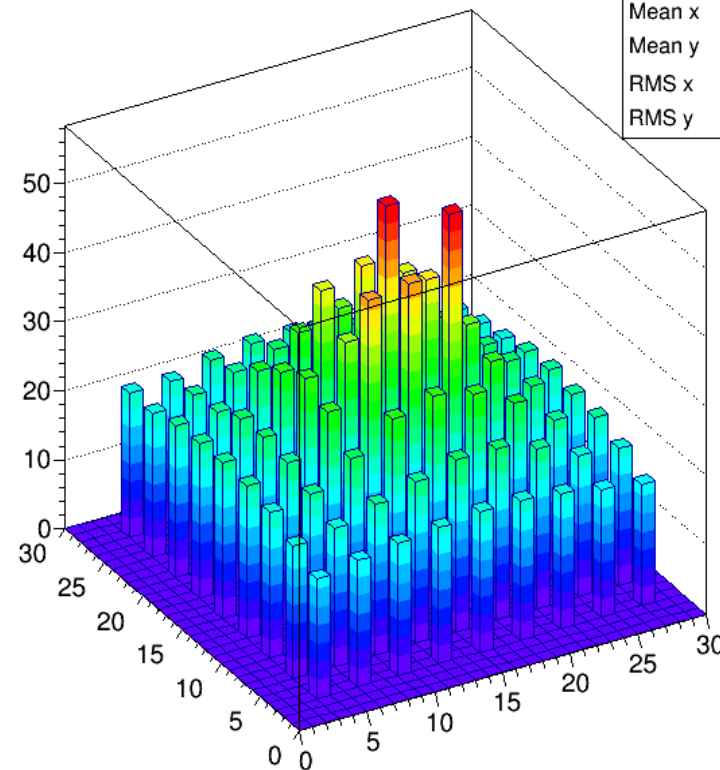
s1a

s1a	
Entries	82
Mean x	15.15
Mean y	14.99
RMS x	7.186
RMS y	7.163

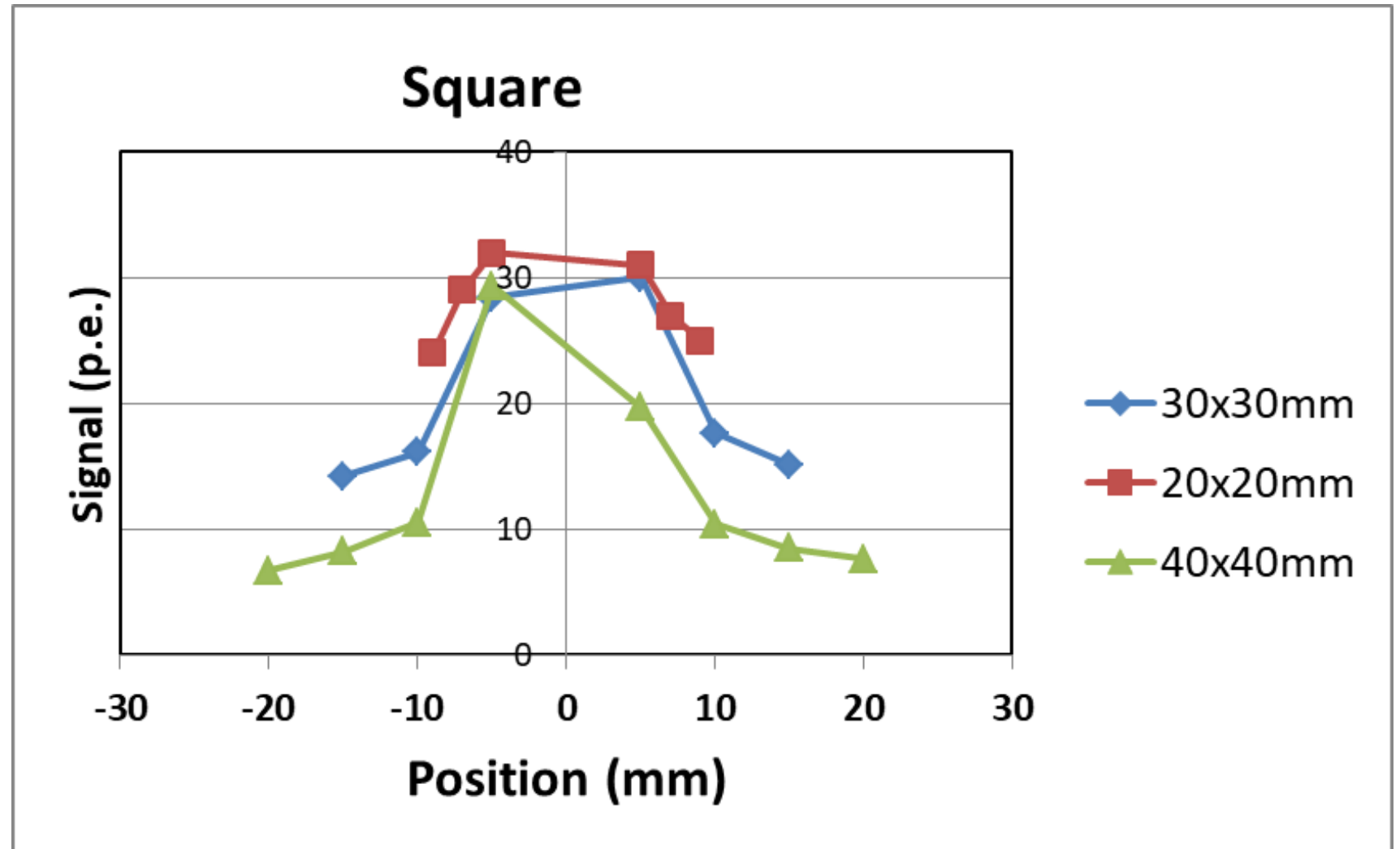
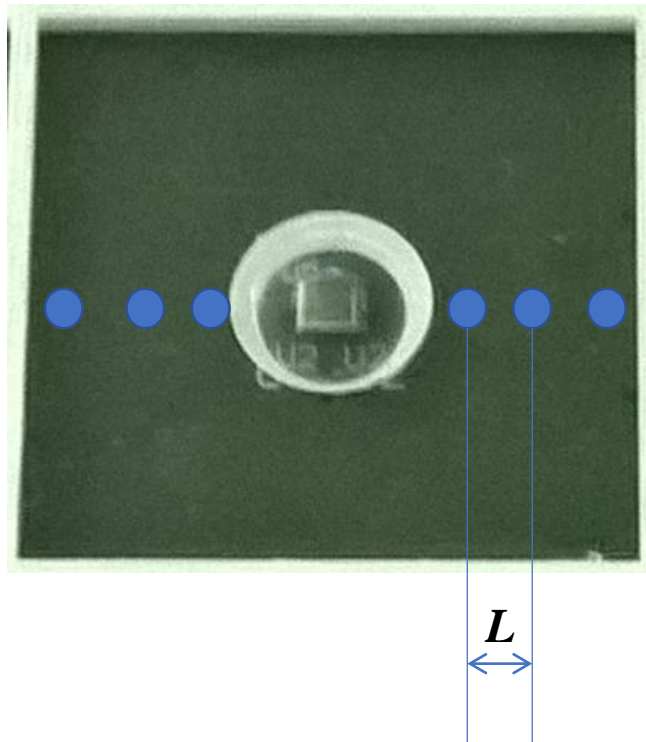


s1b

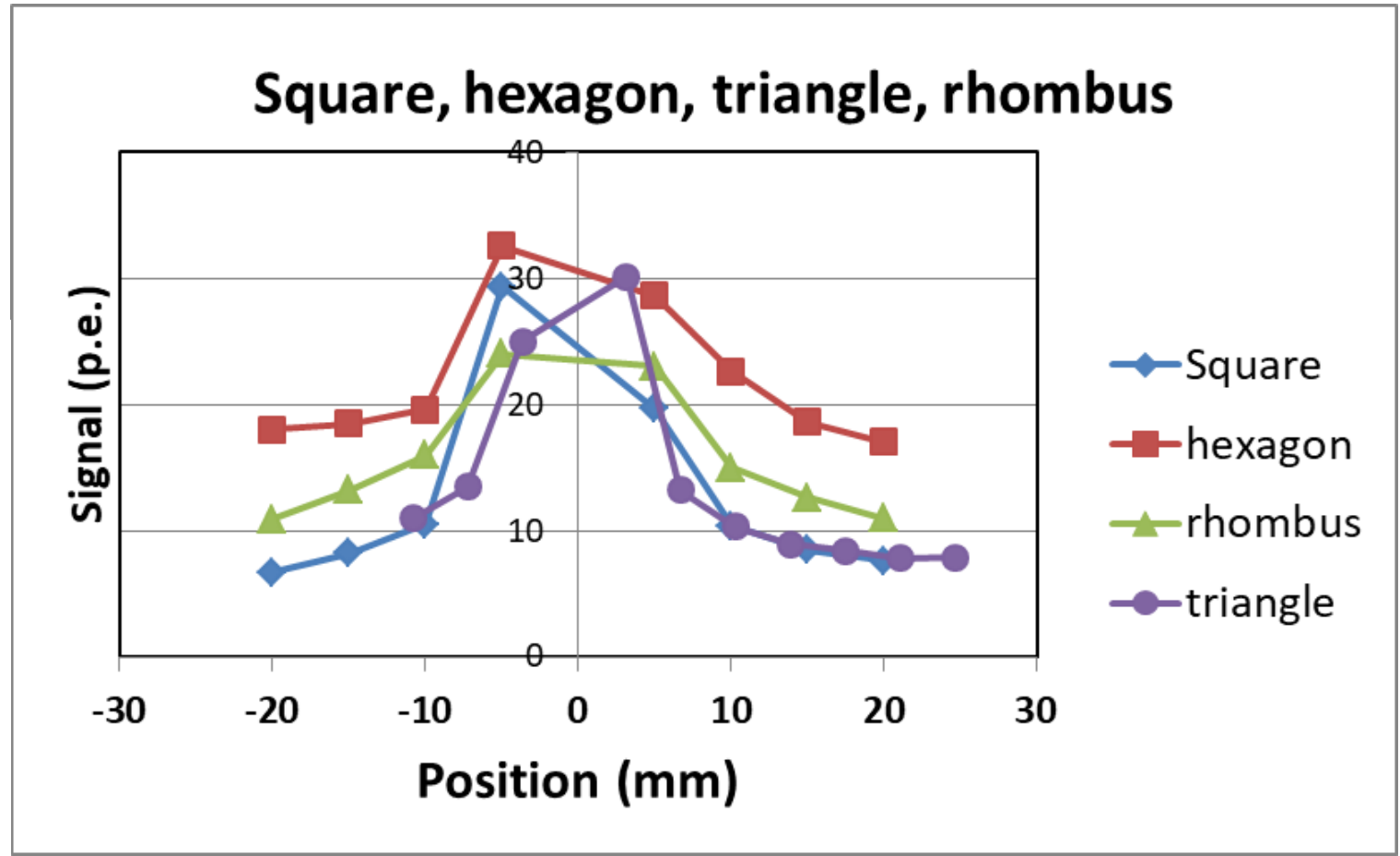
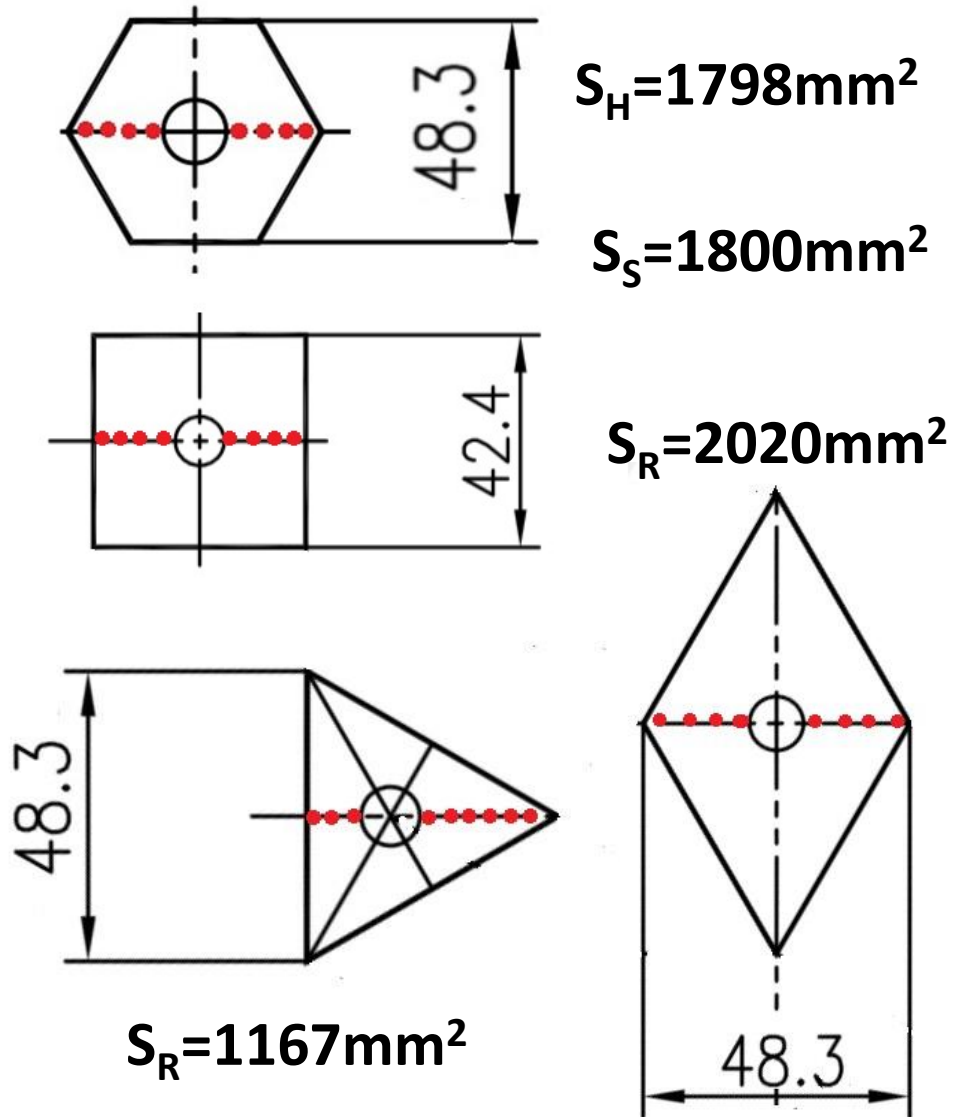
s1b	
Entries	82
Mean x	15.04
Mean y	15.17
RMS x	7.189
RMS y	7.165



# Investigation of the homogeneity of the light collection by the area of the scintillator. The form is a square



Investigation of the homogeneity of the light collection by the area of the scintillator hexagon, square, rhombus, triangle.

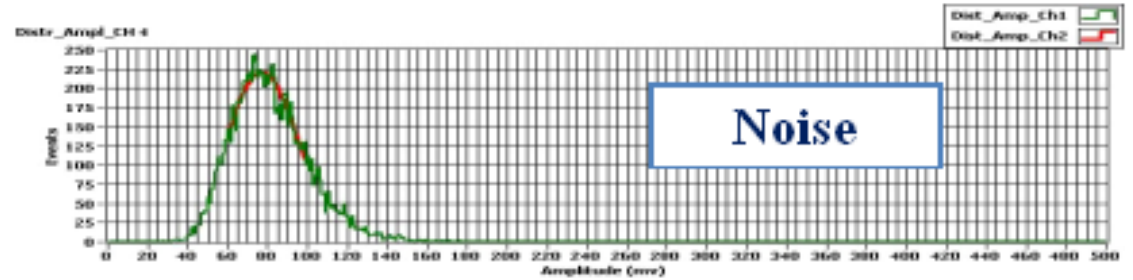


# Results of laser measurements of SiPMs irradiated to a value of $5.38 \times 10^{12}$ neutrons/cm<sup>2</sup>.

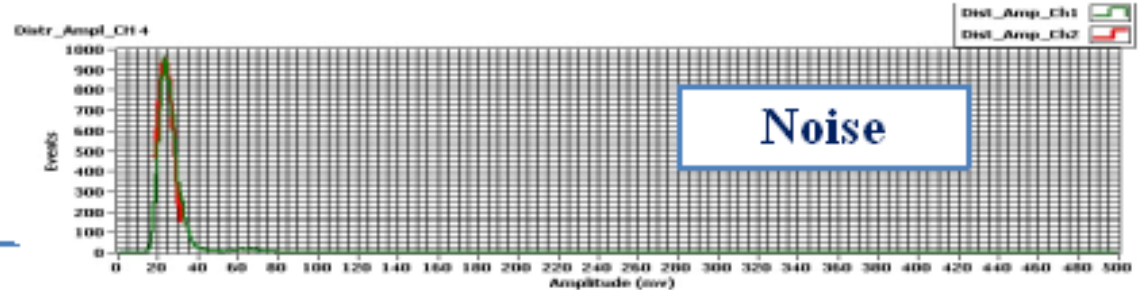
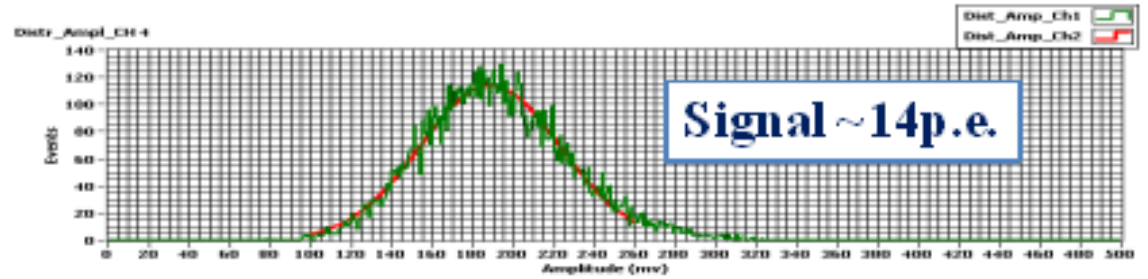
HAMAMATSUS  
12571 - 015P

## Laser Test

$T = +25\text{ }^{\circ}\text{C}$   
 $S/N = 1.8$



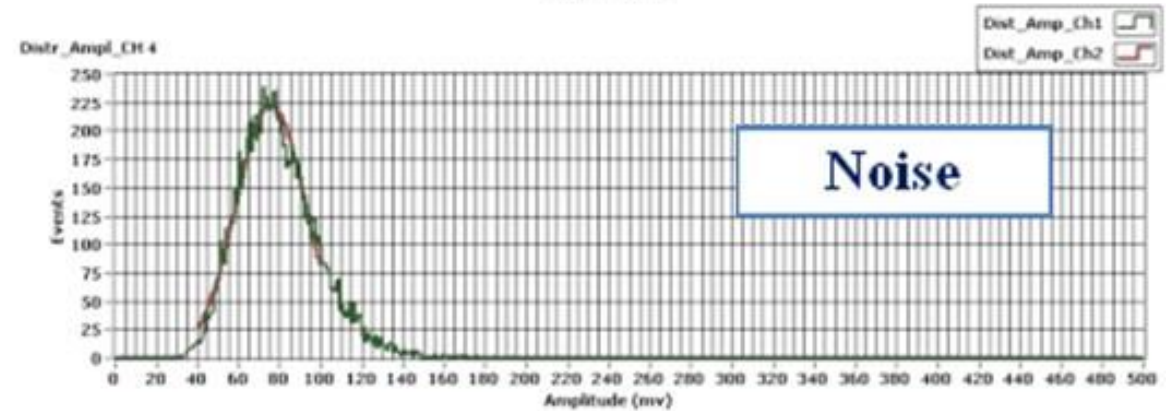
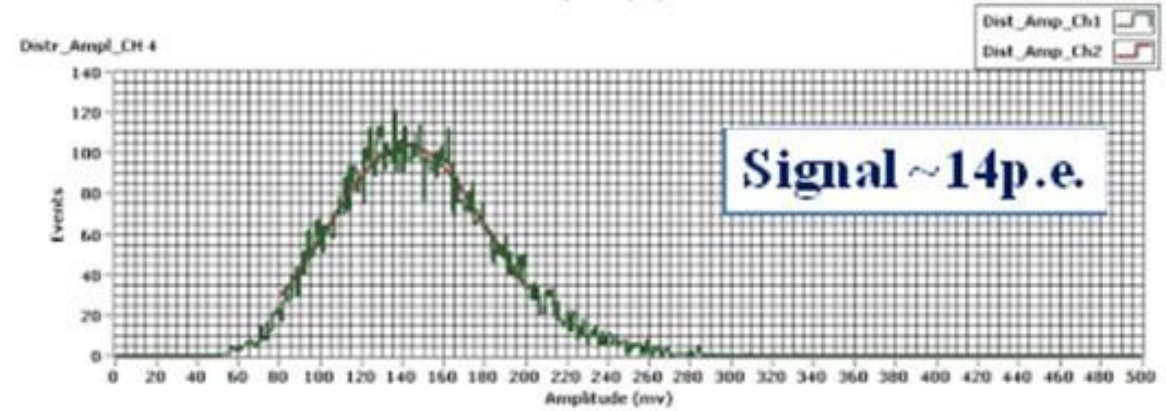
$T = -32\text{ }^{\circ}\text{C}$   
 $S/N = 11.8$



# The results of measurements of SiPM devices irradiated to $2.09 \times 10^{14}$ neutrons/cm<sup>2</sup> for both source of light at -32 °C.

HAMAMATSUS1  
2571 - 015P

S/N=1.9



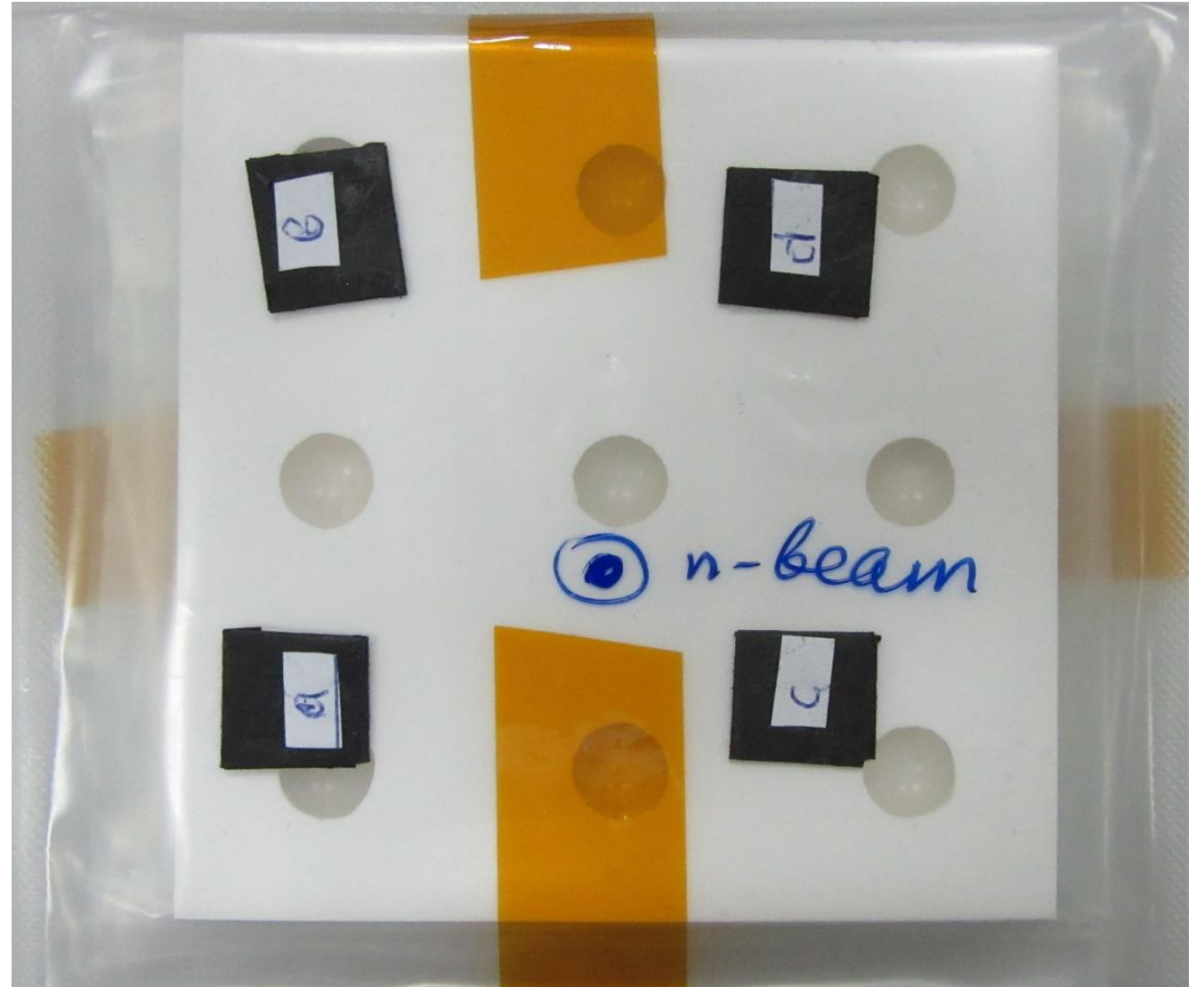


## Study of the resistance to scintillation assembly of 3x3 on IBR-2

Dose = 0.3Mrad

irradiated to a value of  
 $2 \times 10^{12}$  neutrons/cm<sup>2</sup>

**No changes were detected.**

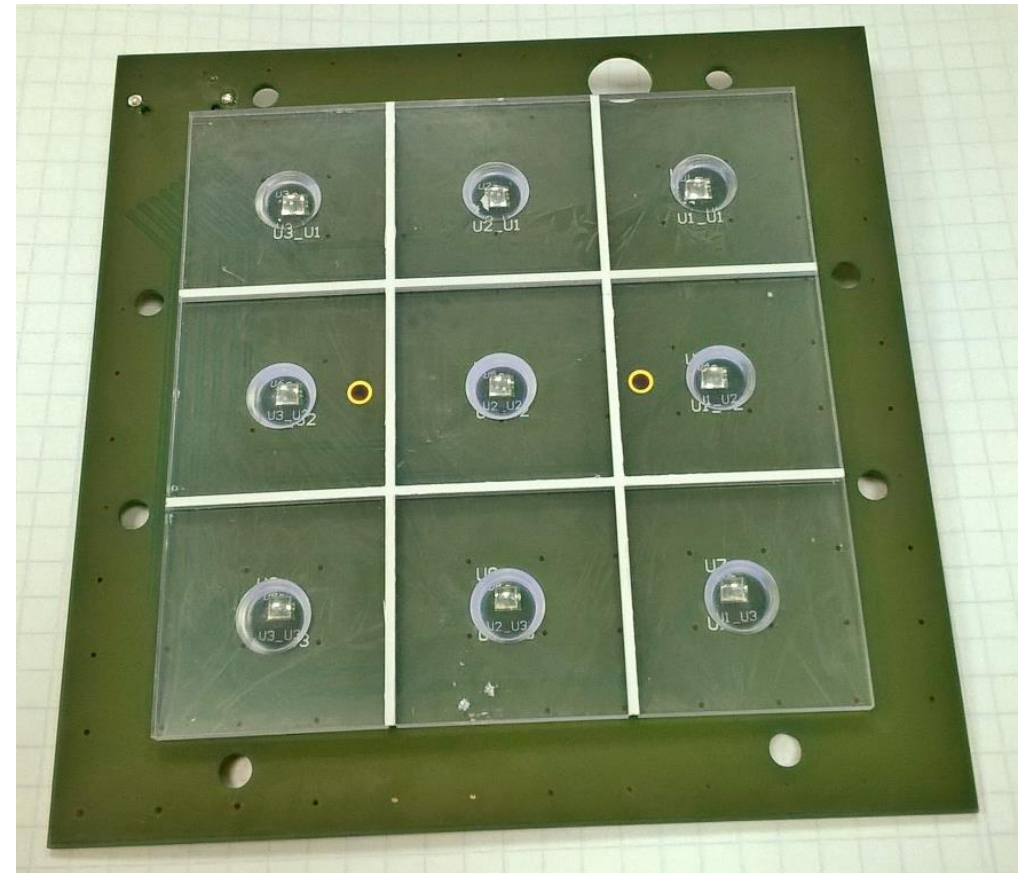


# *Research module from 9 cells (3x3) with an irradiated scintillator.*

Printed circuit board (PCB) with mounted sensors.



PCB is combined with the scintillator. The scintillator is divided into 9 cells.

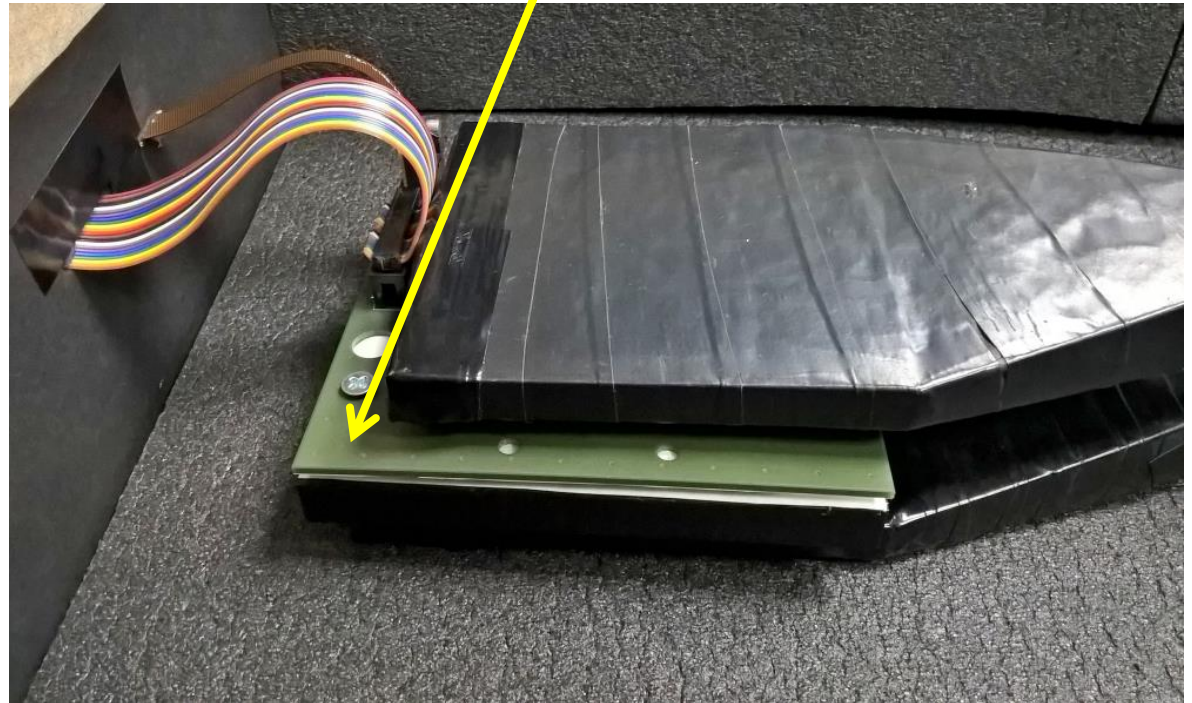


**ADC64** is a 64-channel 12-bit 62.5 MS/s ADC device with signal processing core and Ethernet interface



9-channel power supply system

The test layout of scintillators (3x3) is placed in a black box. It is placed between the trigger scintillators.



## Planned research in the near future.

- Investigate 3x3 scintillation assembly with different types of reflective coating.
- To study the effect of radiation damage on the IBR-2 pulsed reactor up to  $10^{14}$  cm<sup>-2</sup> neutron fluxes.
- To perform investigation of irradiated scintillators of different types and SiPM in CMS radiation fields. The samples will be ready for research at the end of 2018.

# *Conclusions*

1. Detected signal greatly depends on the shape of the scintillator in the range from 10 to 20 ph.e. The best result is obtained for a hexagonal cell.
2. The reflective coating of the scintillator is importance. The ESR coating has the best value.
3. Scintillators with painted ends and wrapped ESR film have given a signal to 1.4 times greater than the fully painted.
4. Irradiation of scintillators in a neutron flux to  $3 \times 10^{12}$  (0.3 Mrad) does not lead to a noticeable change in the detected signal.

**Thank you  
for attention!**

*Backup slides*

# PS1c (space run)

Distr\_Ampl\_CH0

