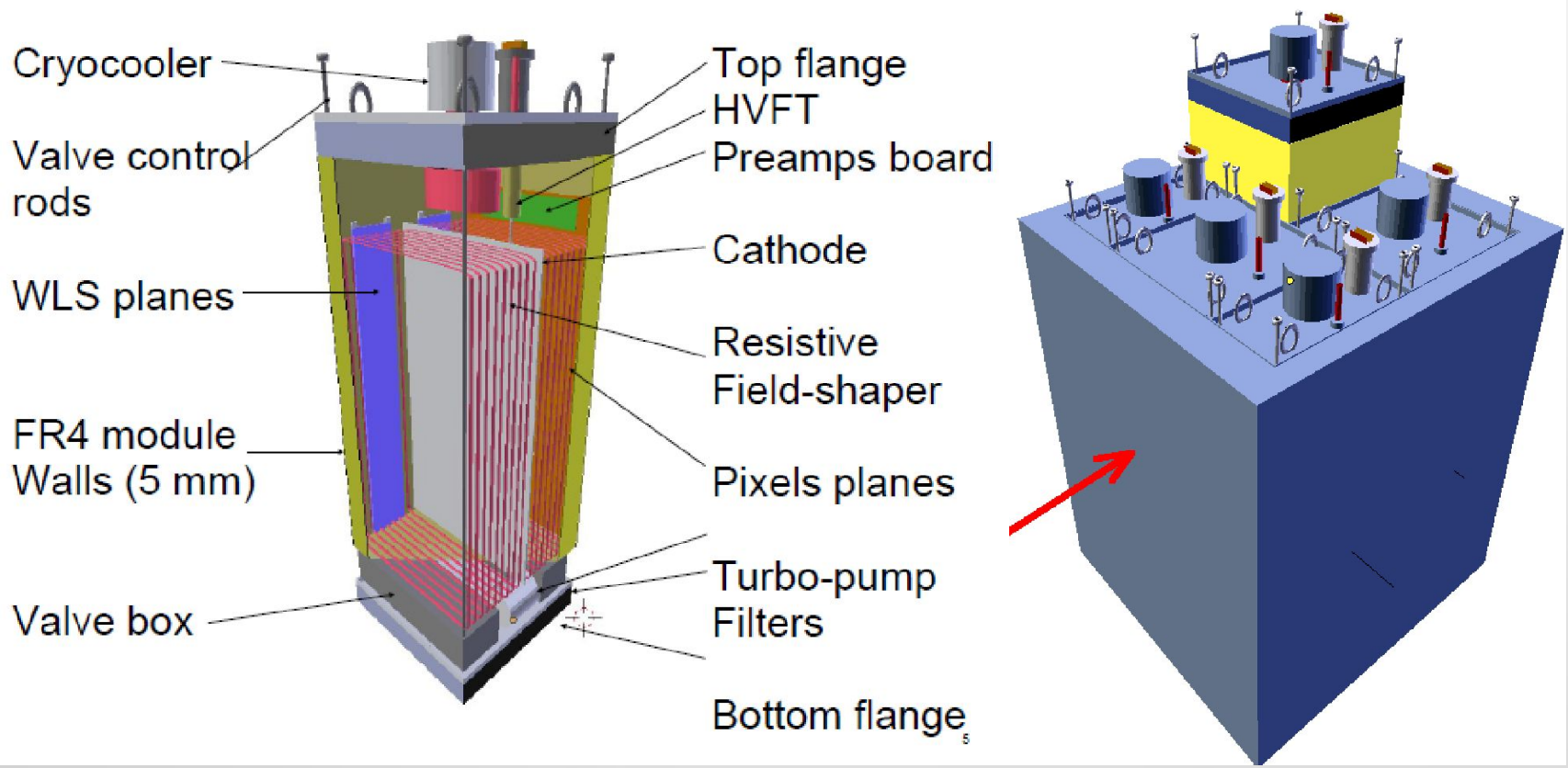
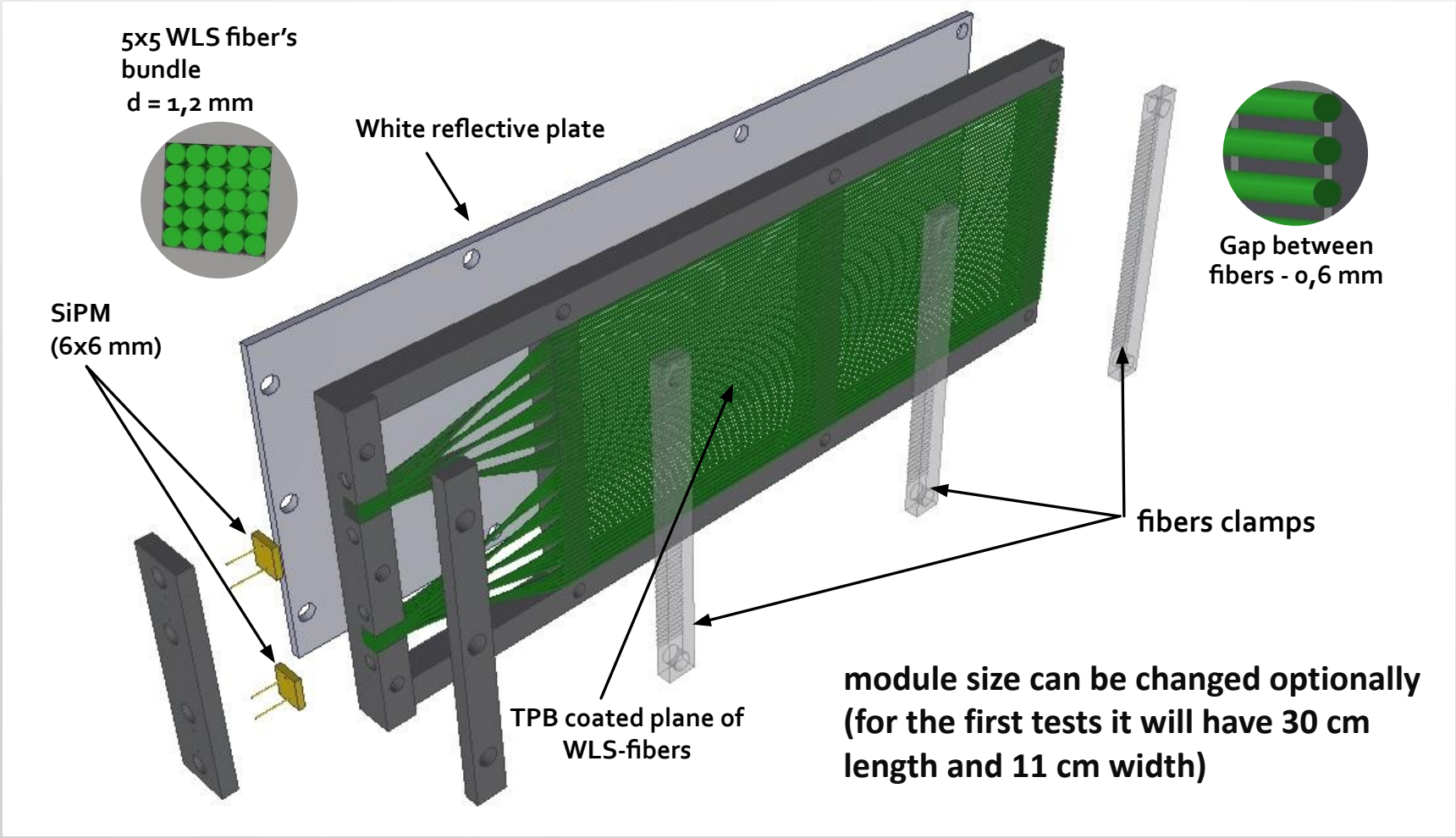
Sergey Sokolov, DLNP, JINR

Development of the optical module's prototype for ArgonCube

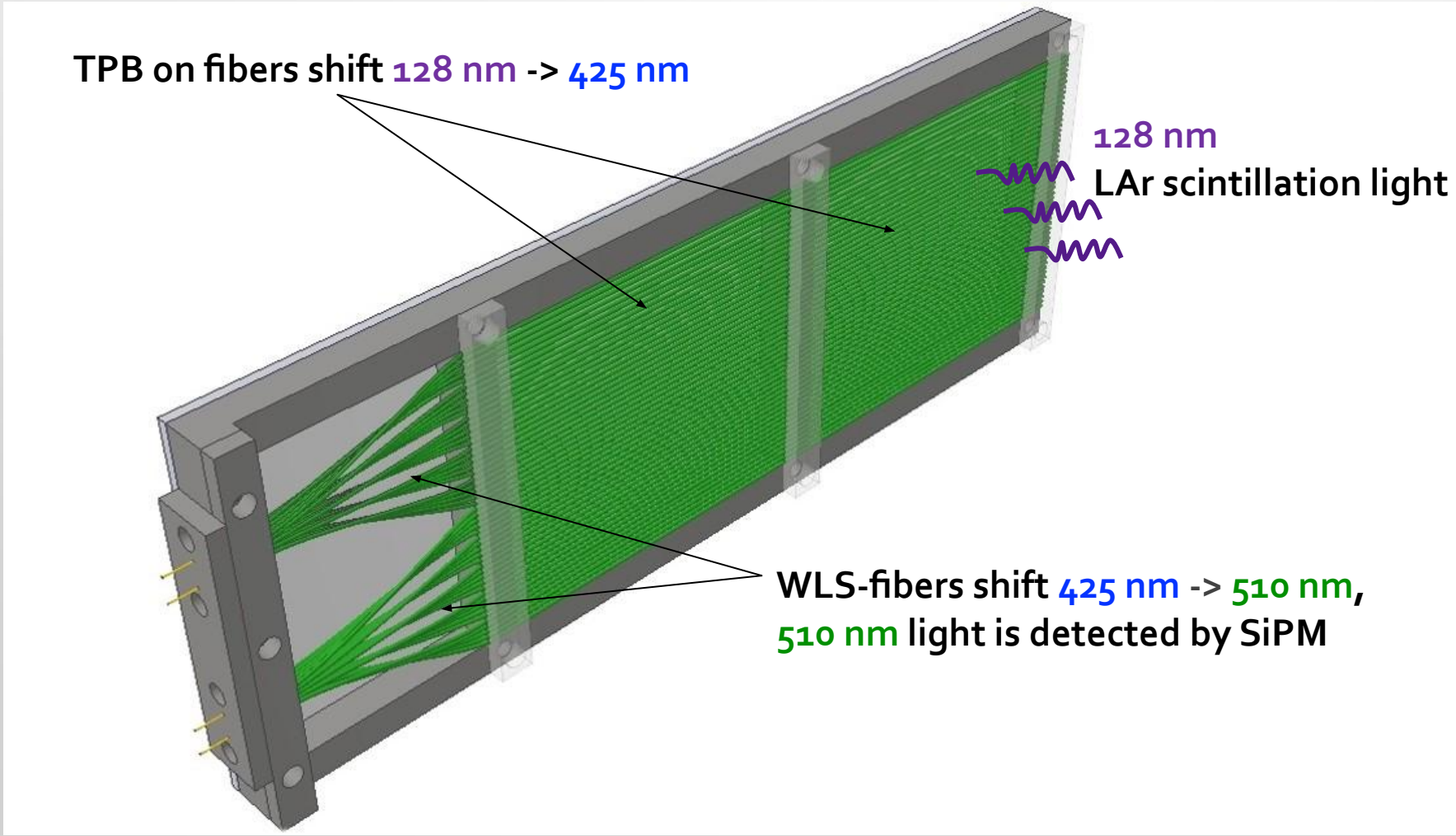
ArgonCube LAr TPC concept



Design of the optical module prototype



The mechanism of light collection

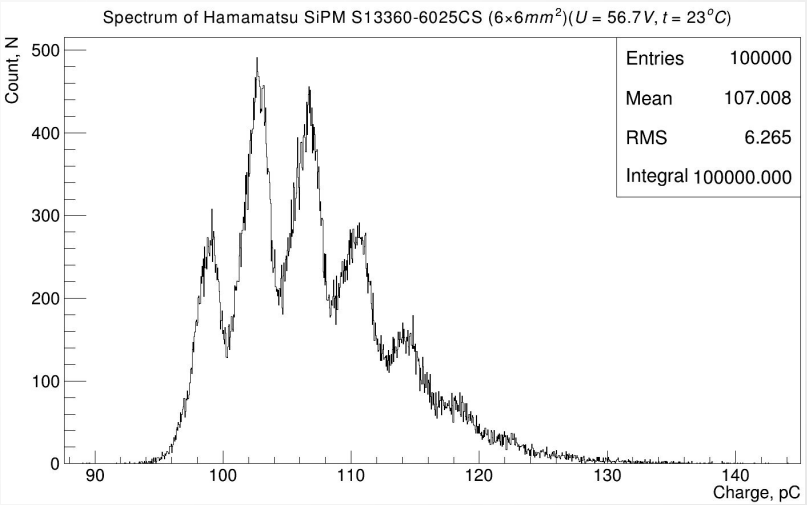


Performance of Hamamatsu SiPM S13360 - 6025CS in liquid nitrogen

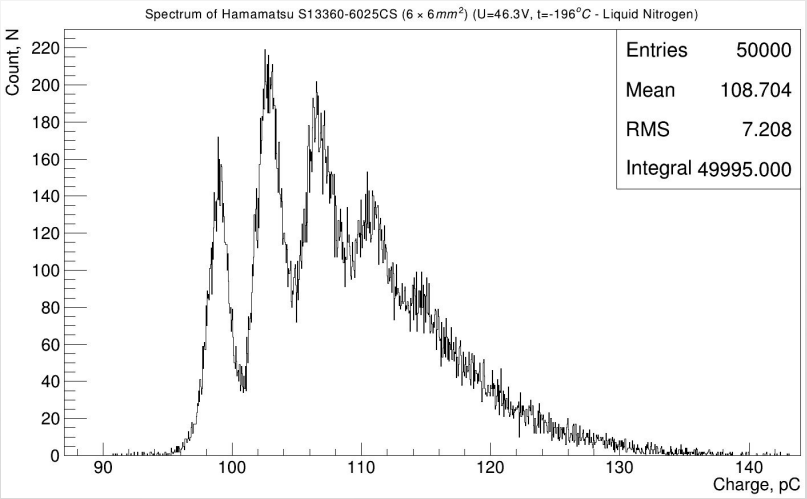
SiPM size - 6x6 mm (57600 pixels)

PDE (at 510 nm) ≈ 24 %

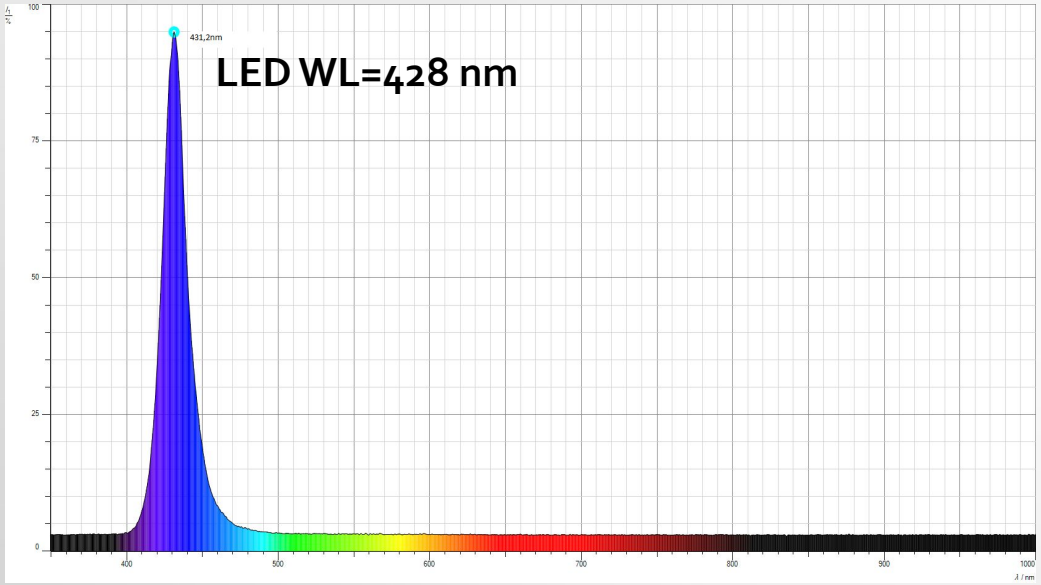
Spectrum of SiPM at room temperature

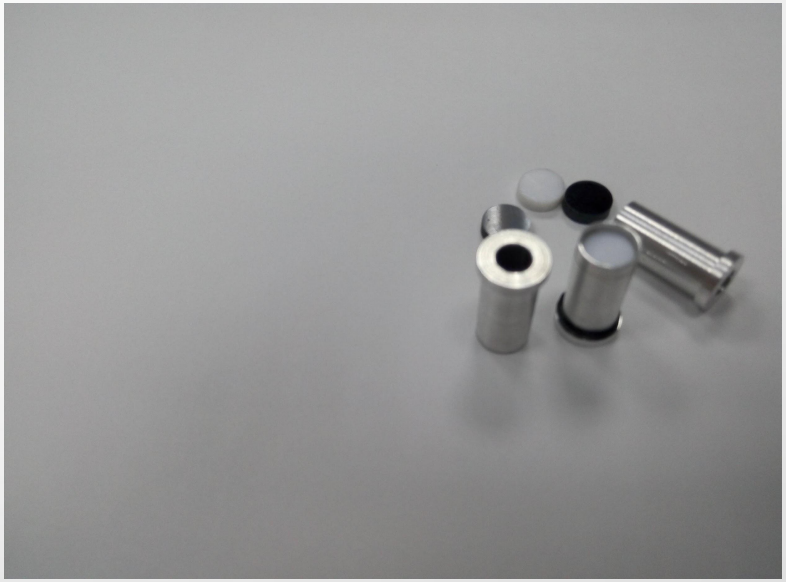


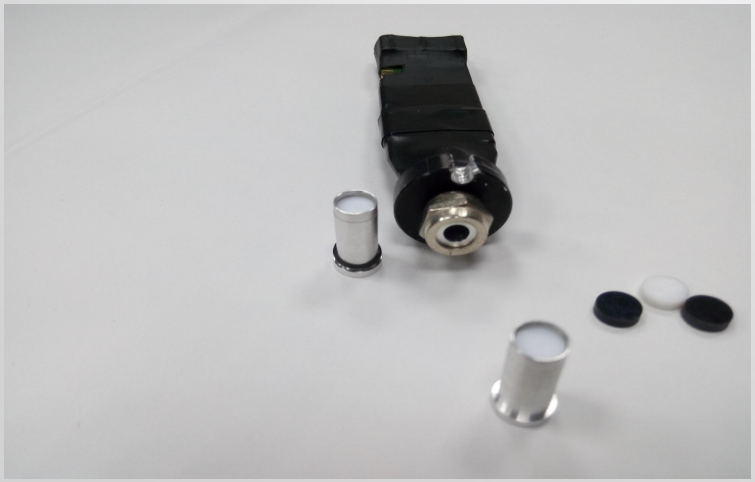
Spectrum of SiPM at liquid nitrogen temperature (-196 deg. of C)



LED source



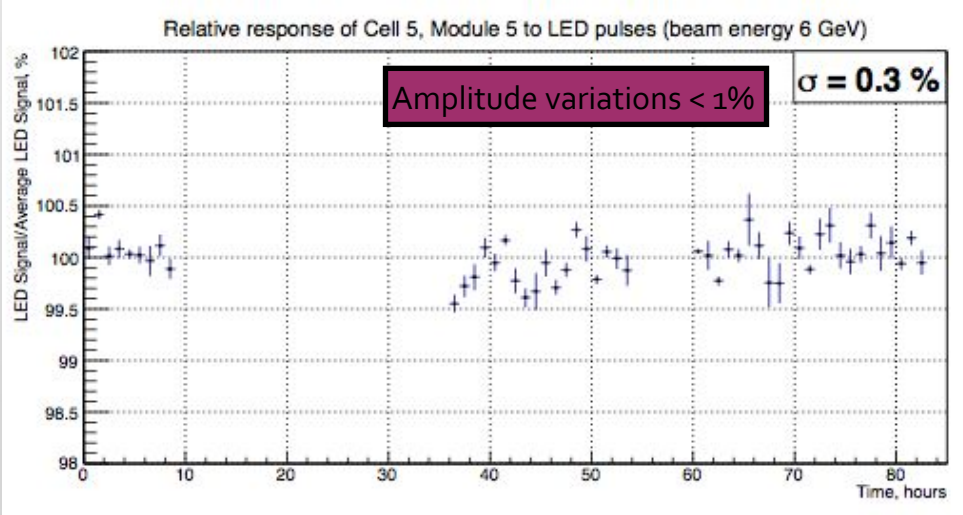




Light diffusing by Teflon (PTFE) layer

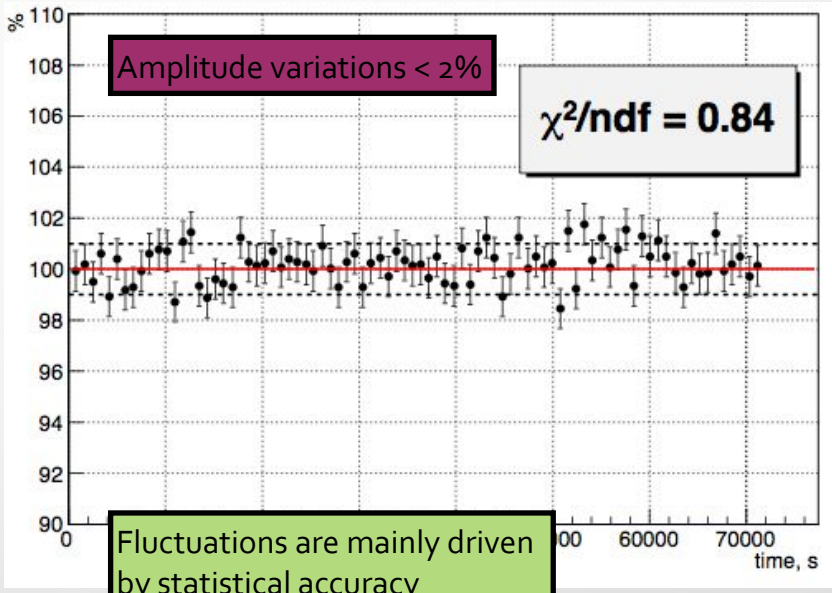
LED stability

High light intensity ~ 10^3 ph.e



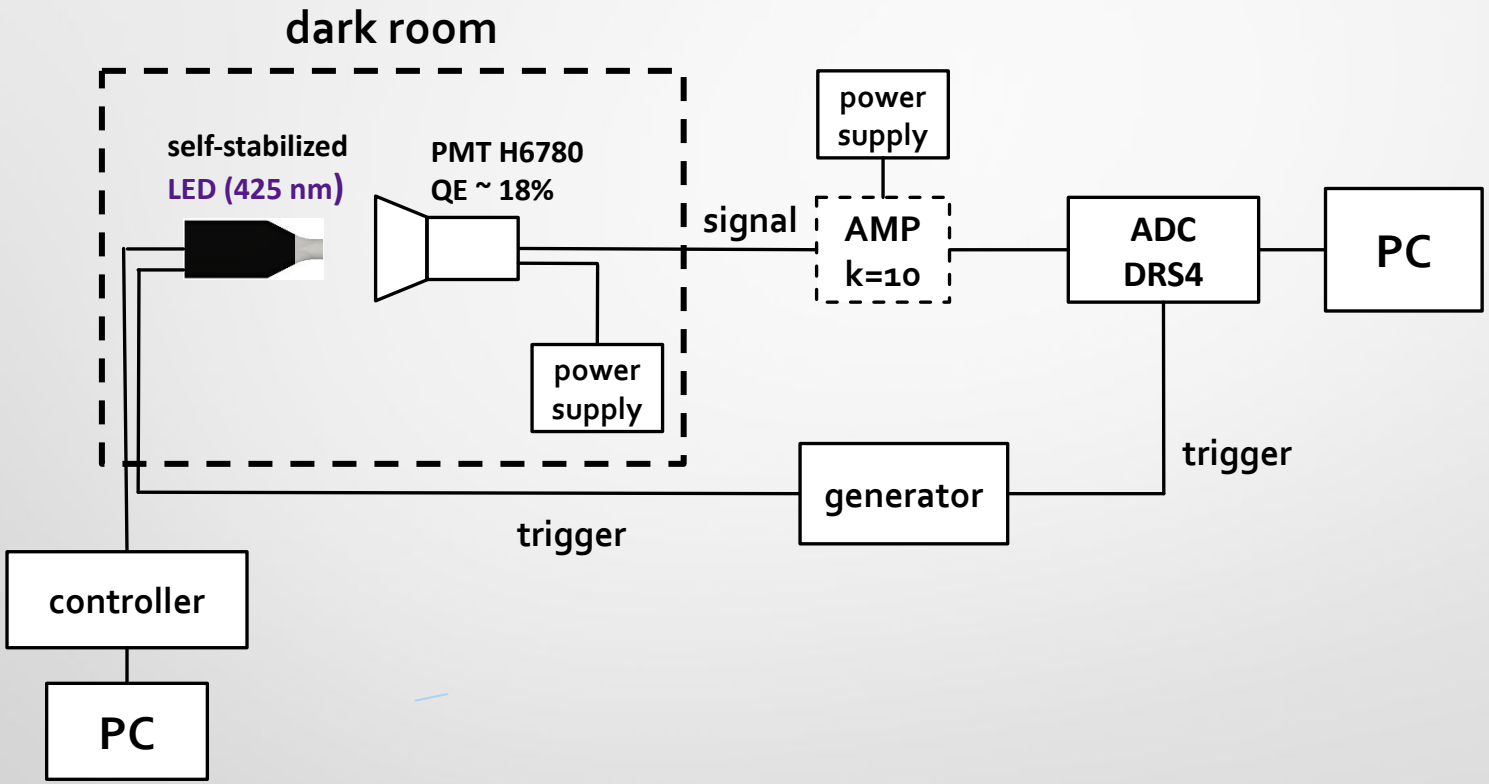
LED source stability measured by
ECALo prototype for the COMPASS experiment
(Has precise photosensor temperature stabilization < 10 mdeg)
in june-july 2015 @ T10 (CERN).
Temperature variation in the hall: 24 (nignt) - 38 (day)

Low light intensity ≈ 1.75 ph.e

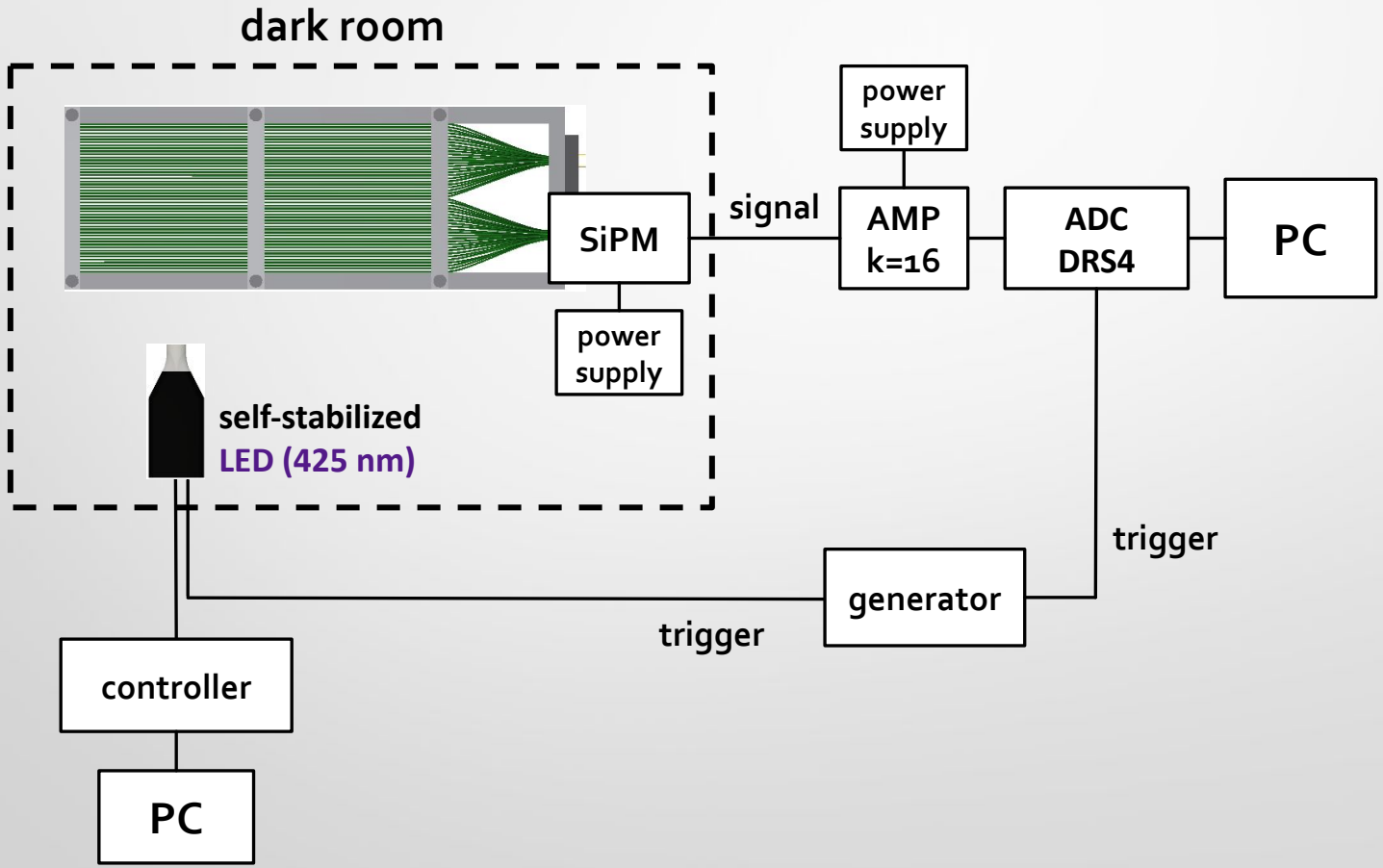


LED source stability measured by
20" Hamamatsu 12860 HQE PMT in a single point

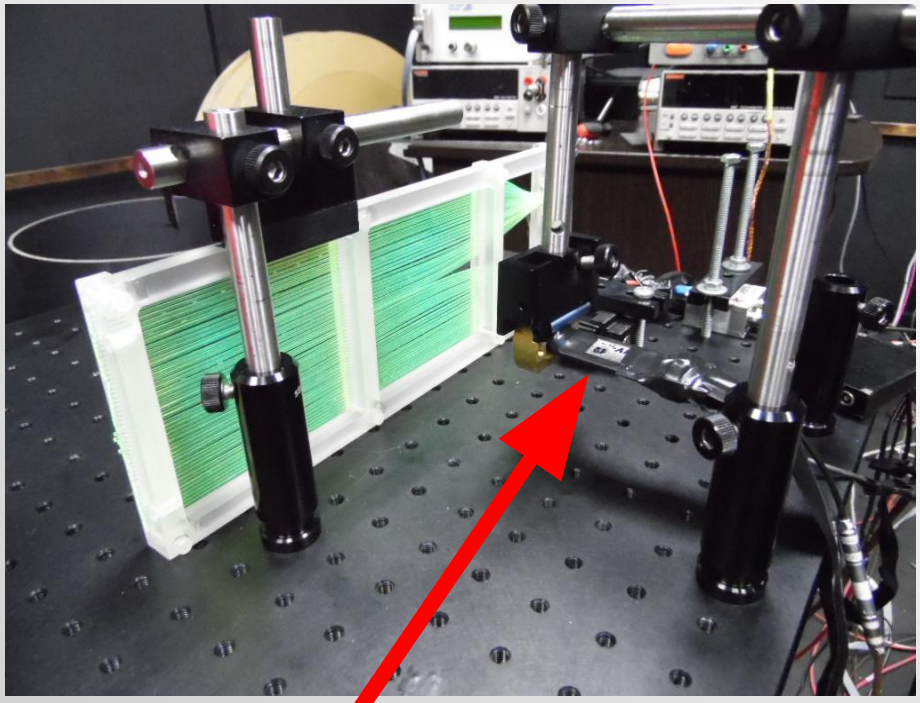
LED calibration scheme



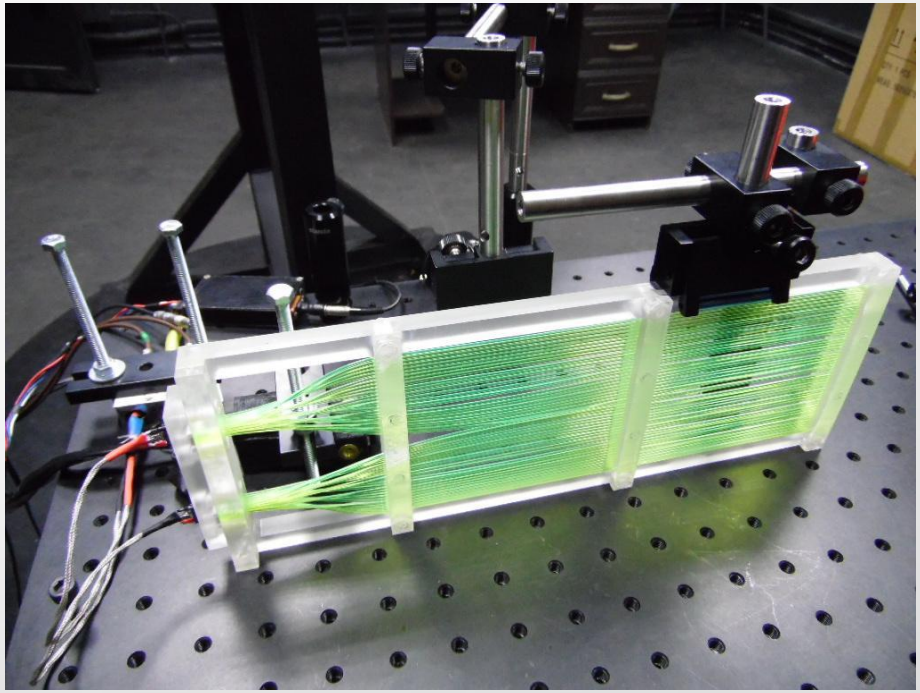
Room temperature testing scheme



Room temperature testing scheme

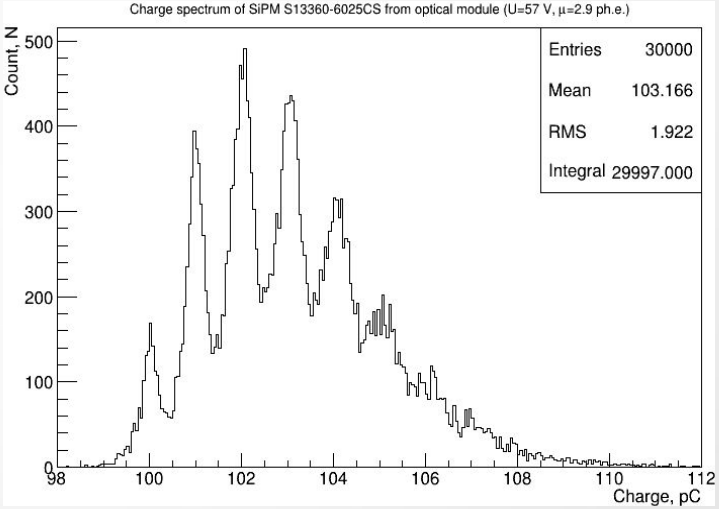


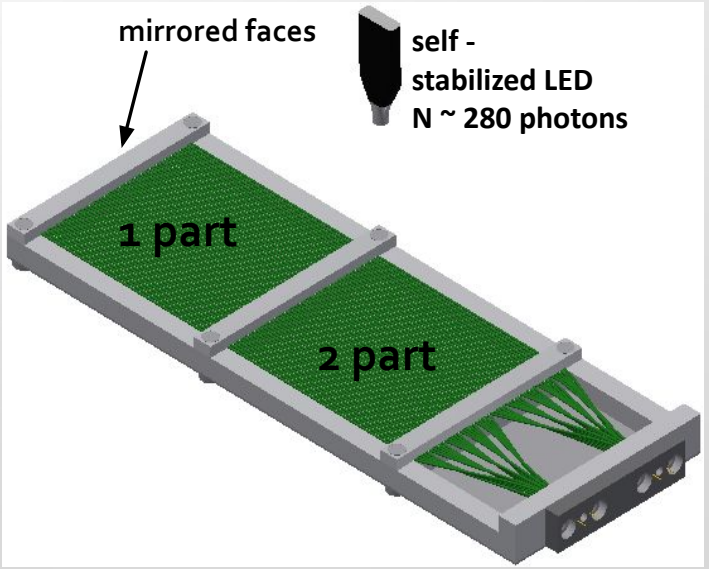
LED source



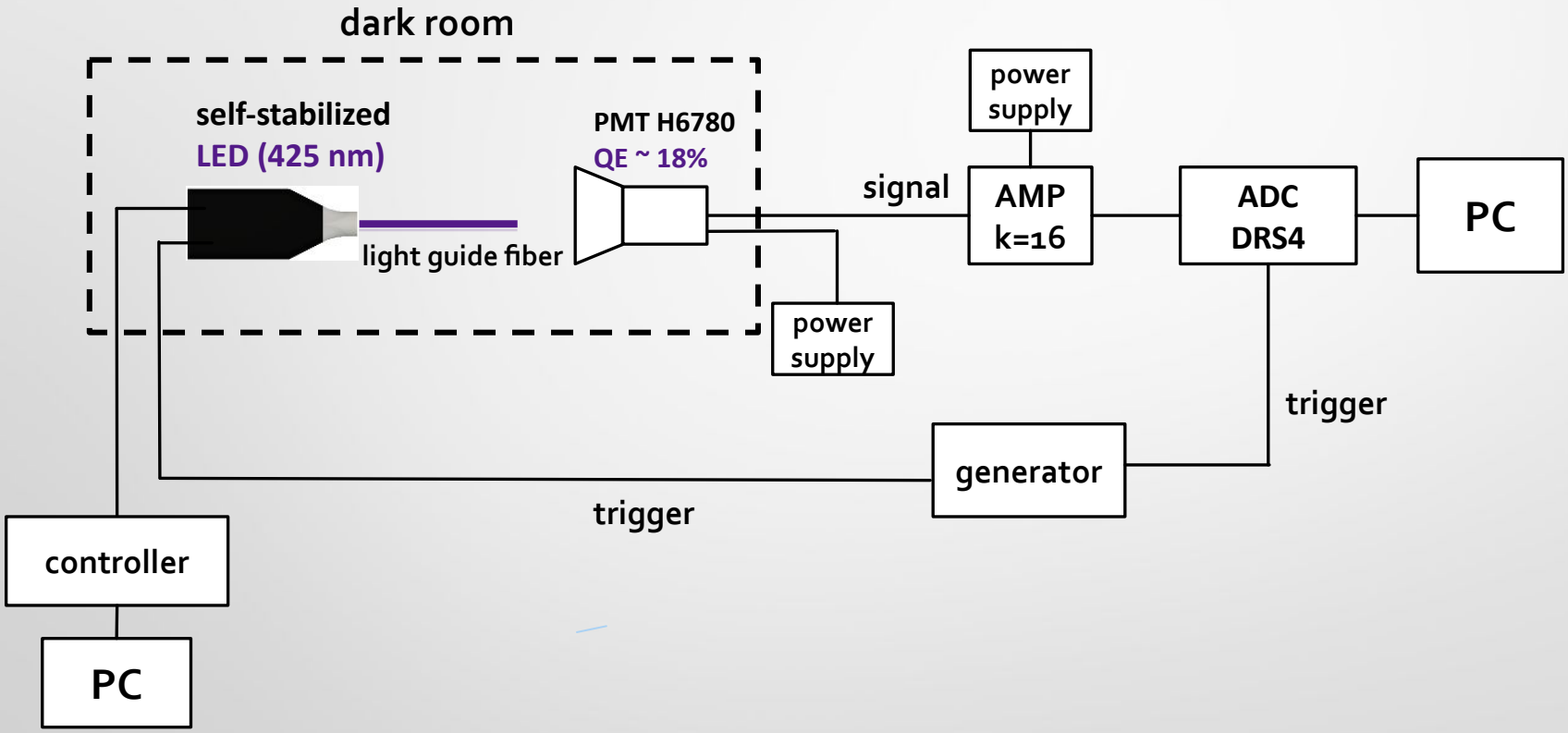
Results of testing under room temperature conditions

	U, V	2 part		1 part	
		μ	PDE, %	μ	PDE, %
frame with fibers	57	2,36	0,84	2,07	0,74
frame with fibers + white plate	57	3,14	1,12	2,85	1,02
frame with fibers + mirrored faces	57	3,55	1,26	3,45	1,22
frame with fibers + white plate + mirrored faces	57	4,94	1,76	4,84	1,72
frame with fibers + mirrored faces + TPB	57	3,50	1,25	3,18	1,13

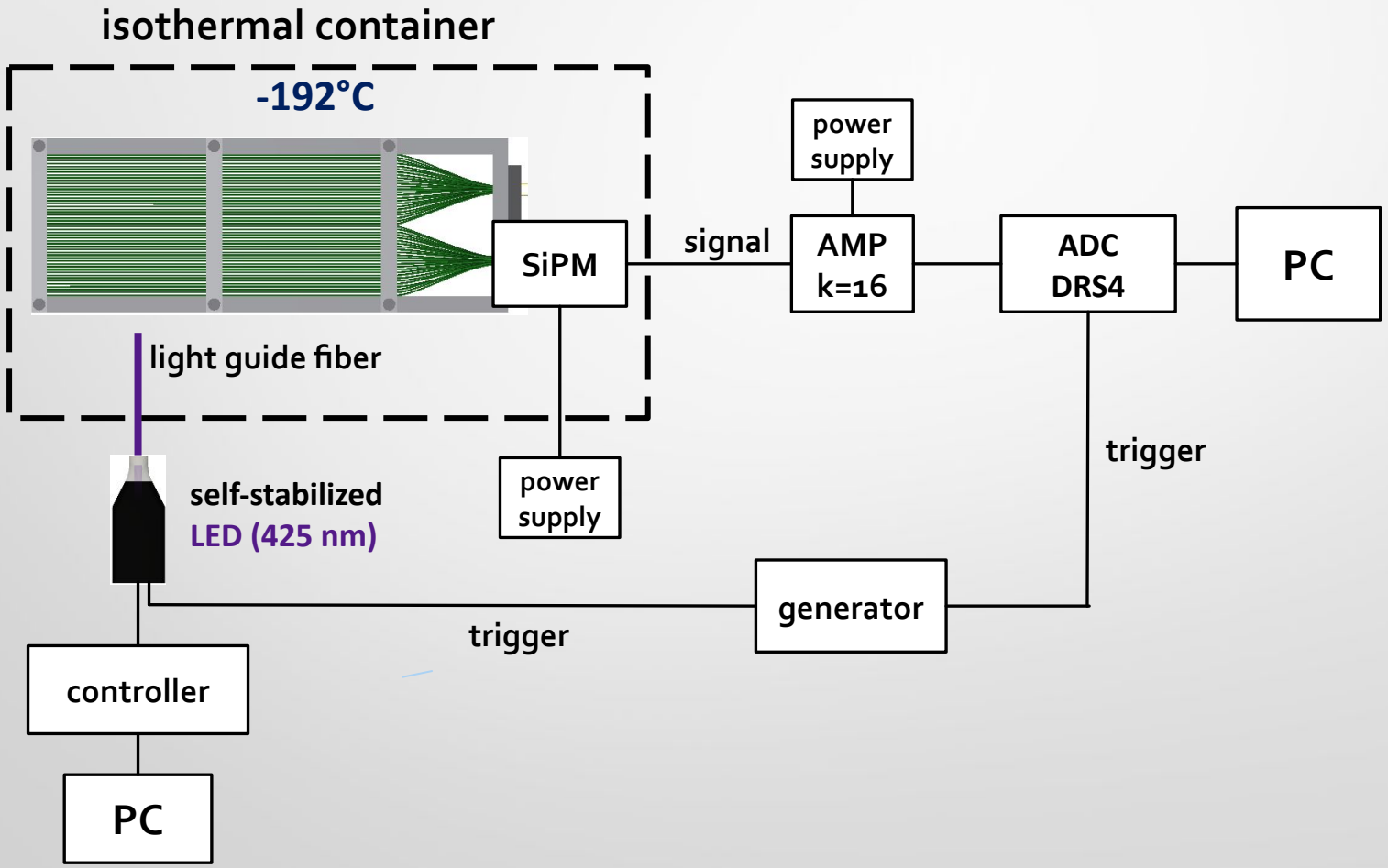




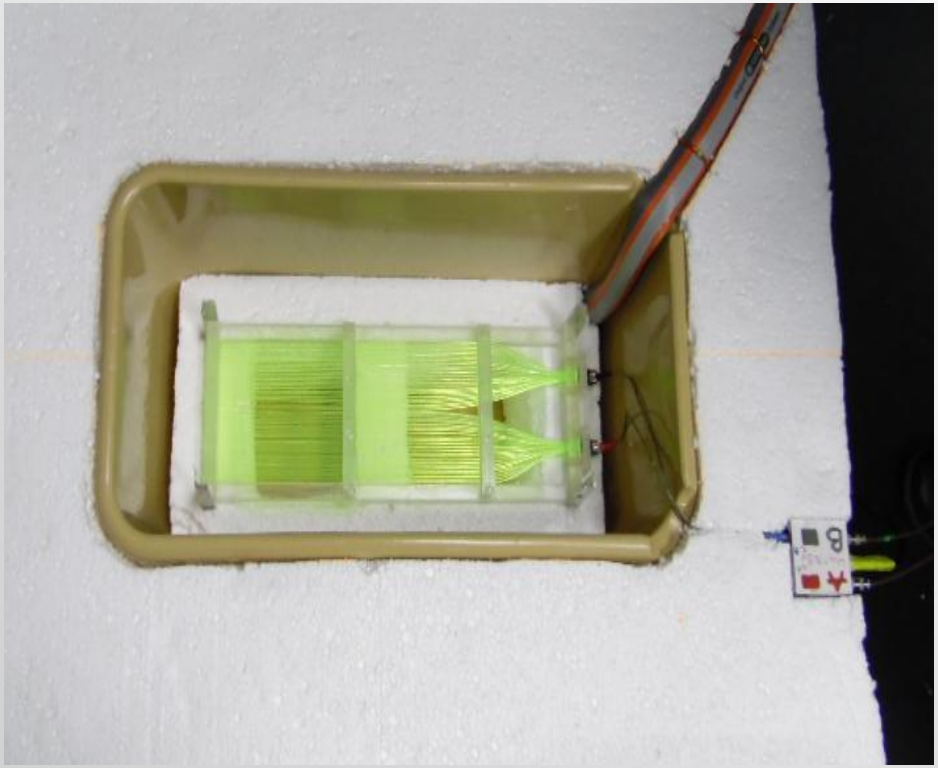
Light guide fiber calibration scheme

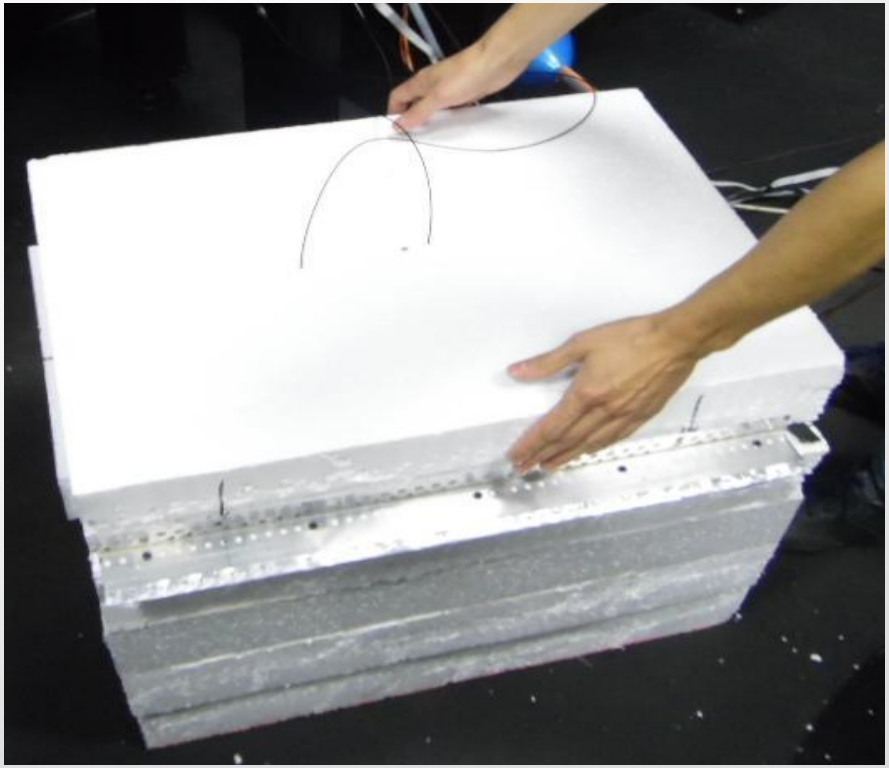


Nitrogen low temperature testing scheme

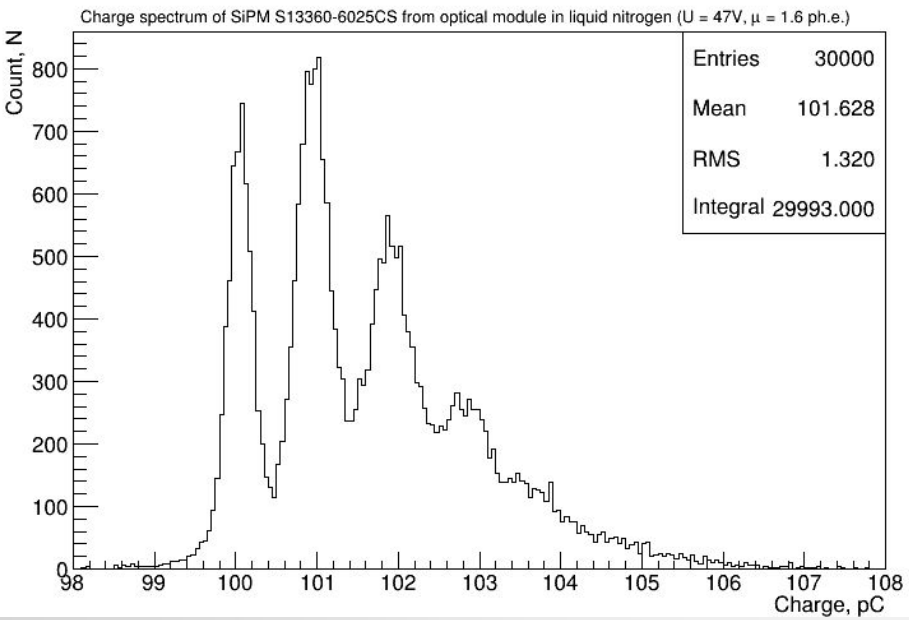


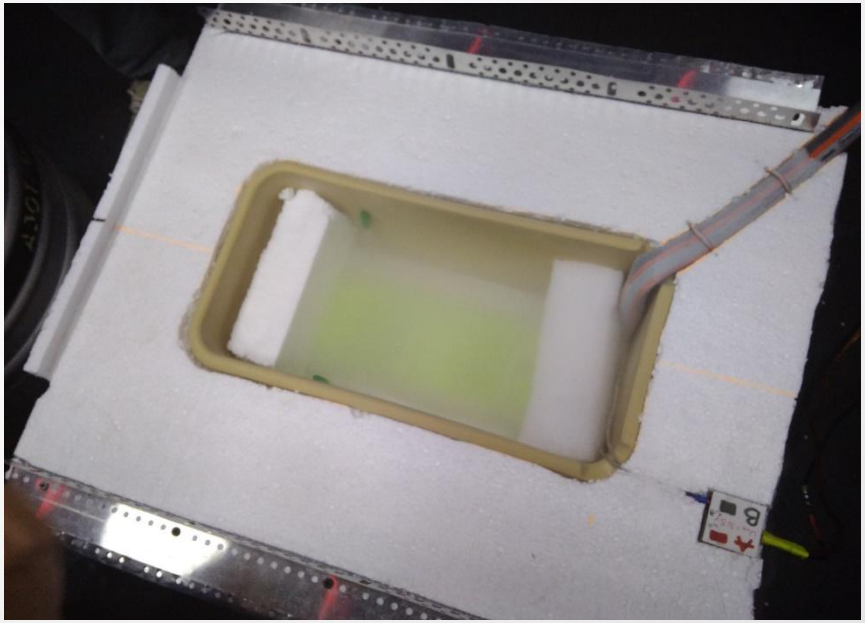
Nitrogen low temperature testing scheme





Results of testing under liquid nitrogen conditions

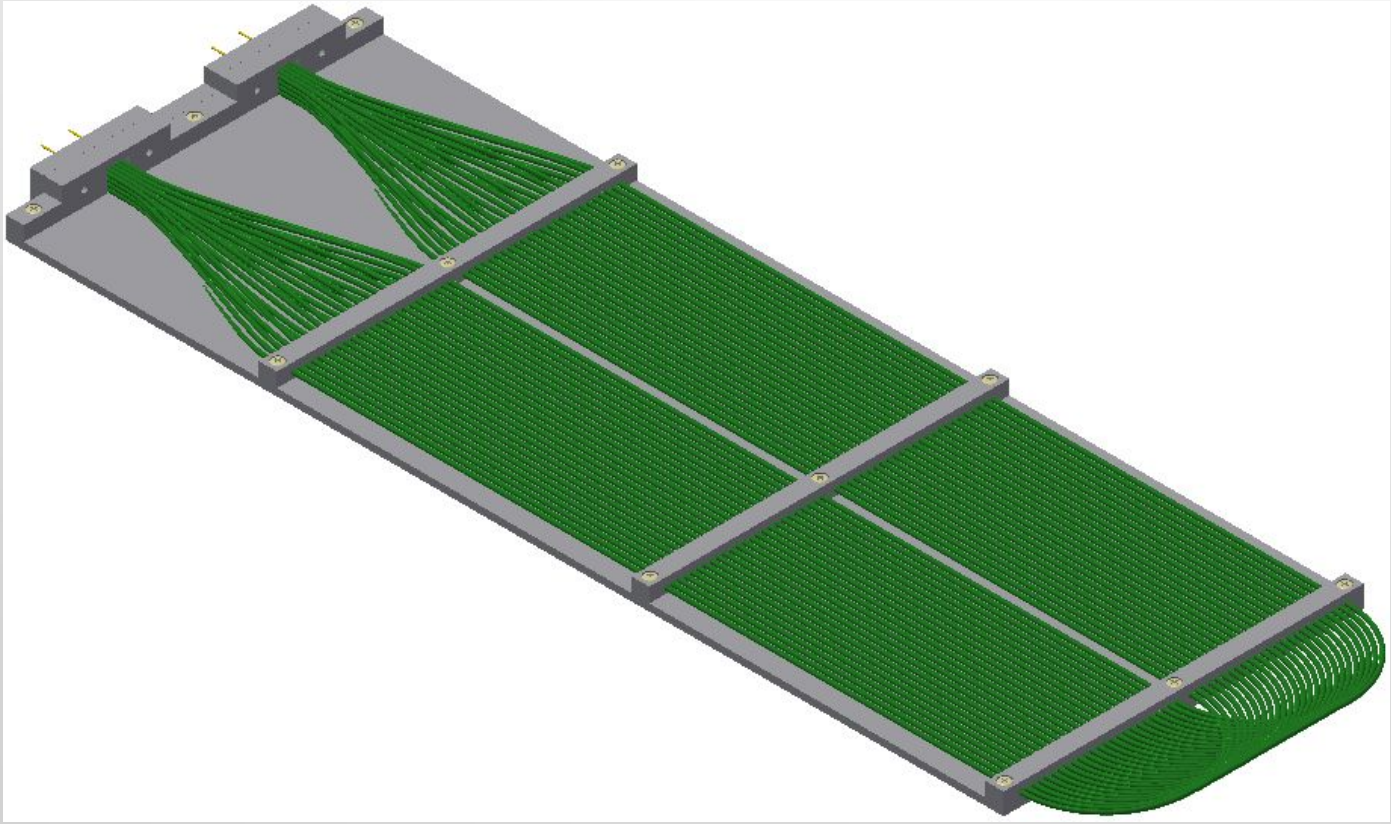




	U, V	μ, ph.e.	PDE, %
frame with fibers + mirrored faces +TPB+LN	46	5,57	1,99
	46,5	5,9	2,09
	47	6,16	2,19
	47,5	6,38	2,26
	48	6,58	2,34

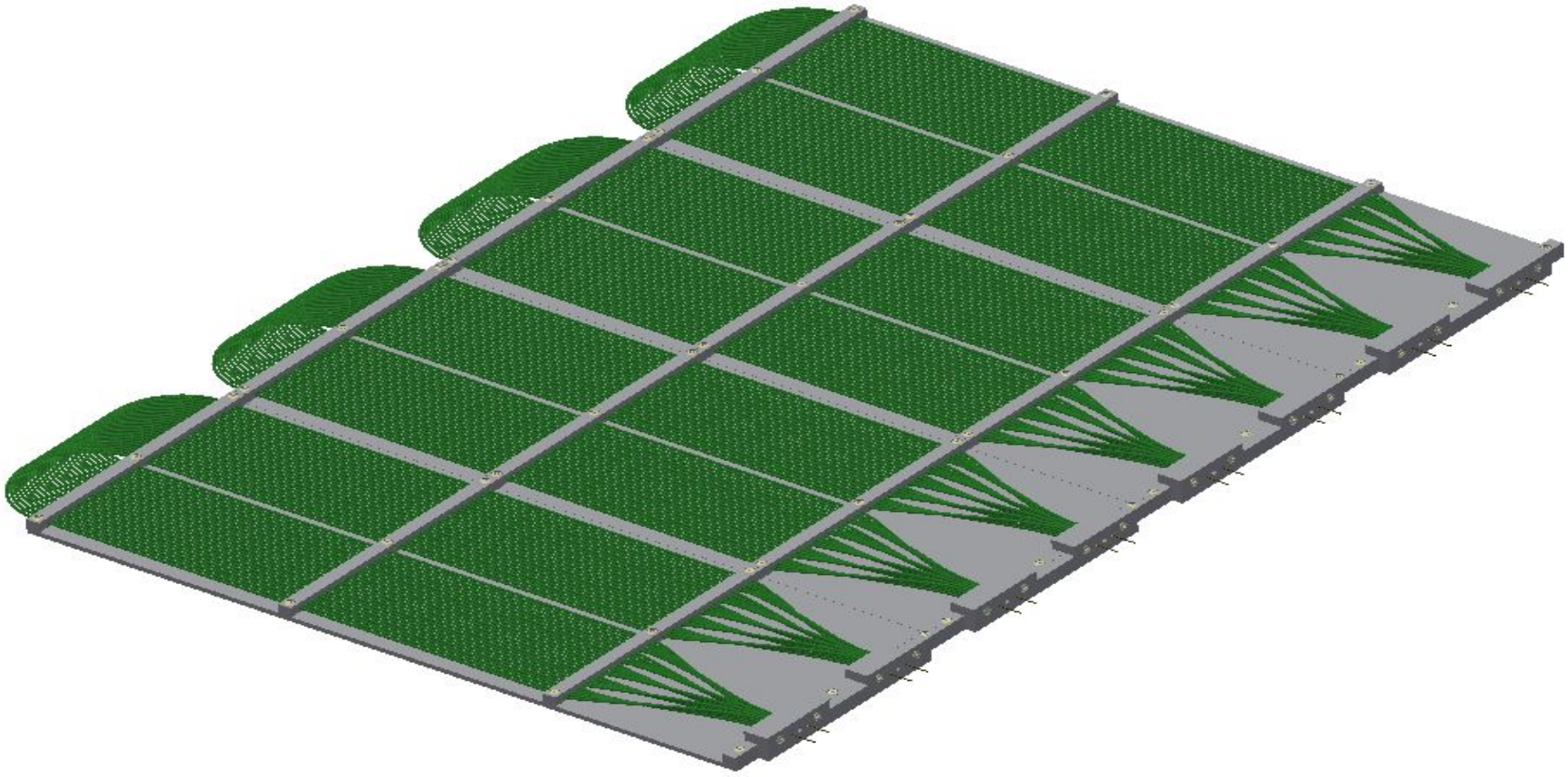
The advanced prototype design

Maximum thickness ~ **10 mm** (place to install SiPM)
The rest thickness of module ~ **6 mm**
The ends of the optical fibers will be round that will give us to increase the light yield ~ 20 %



Assembling of prototypes

The next step will be to assemble the detector, what consist of 4 similar module
The size of the assembling will be 30*40 mm



Conclusion

- Optical module prototype reveals a good performance under liquid nitrogen conditions
- Mirrored fiber faces and white plate usage lead to PDE increasing
- PDE in liquid nitrogen is higher then in the air, because of different refractive indices
- TPB cover has no impact on prototype performance
- The tests of optical module prototype have shown a good light collection performance
- The advanced prototype of the optical module is already under construction