Status of new FHCal for BM@N experiment

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on behalf of INR RAS, Moscow

Detector Board Meeting, 12.01.2021

Forward hadron calorimeter for BM@N:

1) status of FHCal assembling

2) front-end electronics and read-out electronics installation

3) DCS (slowControl) development

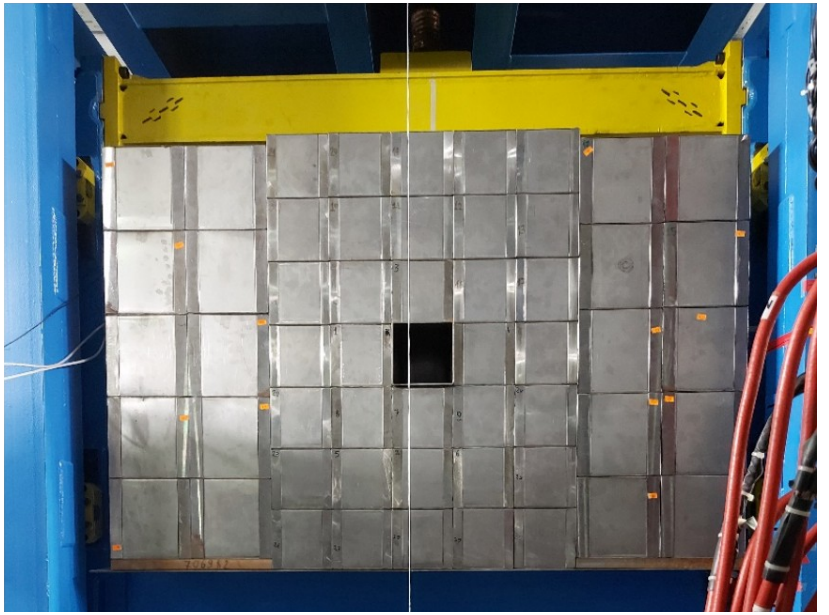
4) first results from calibration on cosmic muons

5) beam quartz/scintillator hodoscope development

6) new scintillation hodoscope for future BM@N

7) plans for the future

FHCal assembled and installed in the BM@N area

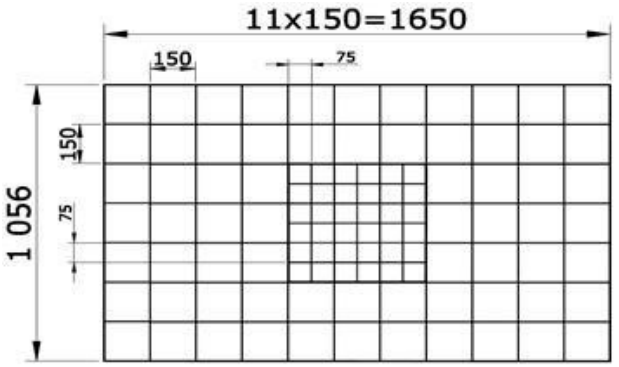


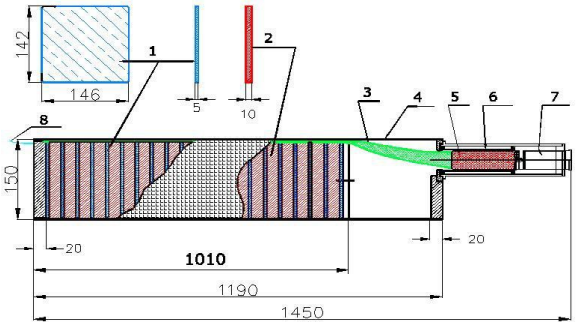
- 34 central small modules of 15cmx15cm (constructed for MPD experiment)

- 20 side large modules of 20cmx20cm (constructed for CMB experiment)

- longitudinal segmentation with 7 sections (small modules) and 10 sections (large modules), each section has an individual read-out with one MPPC (Hamamatsu)

old ZDC



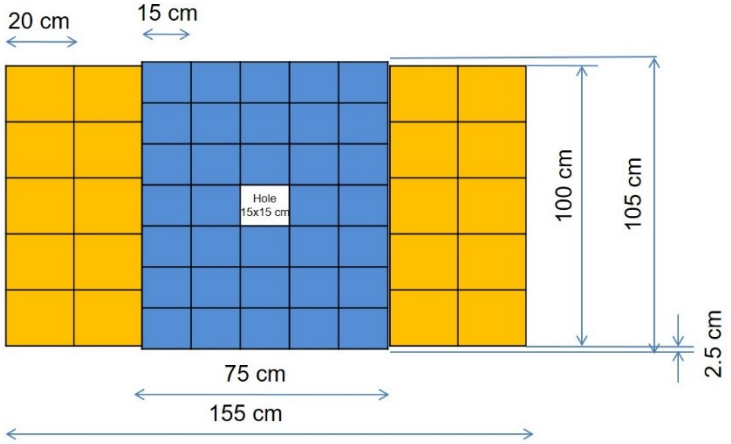


Central part: 36 modules (7.5x7.5cm^2)
Outer part: 68 modules (15x15cm^2)

64 layers (5mm (scint.)
+ 10mm (Pb)

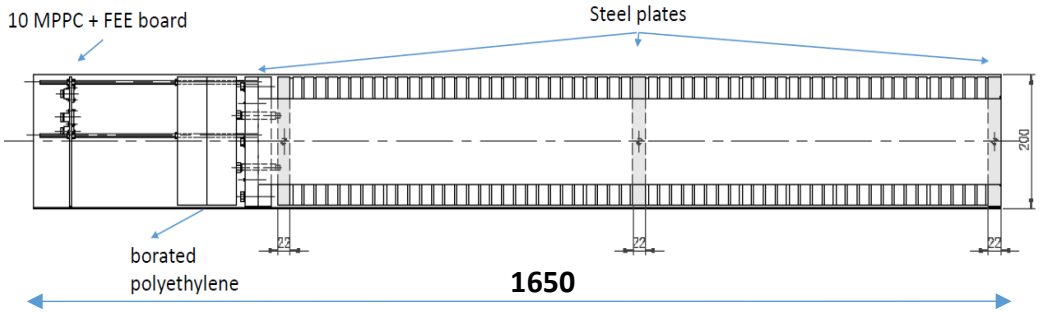
Au+Au high rate beam in future:

- high radiation doses in ZDC central modules with heavy ion beams → degradation of ZDC performance
  hole in the calorimeter center is needed
- hadron shower leakage in ZDC (small modules in the ZDC center, WLS plates for the light collection)



20 PSD CBM modules (20 cm x 20 cm)
34 FHCAL MPD modules (15 cm x 15 cm)

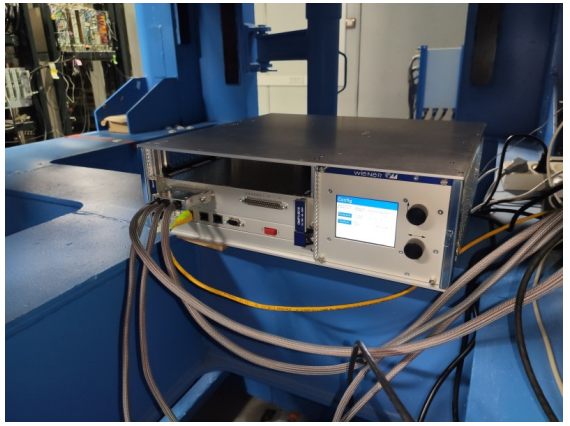
current FHCAL



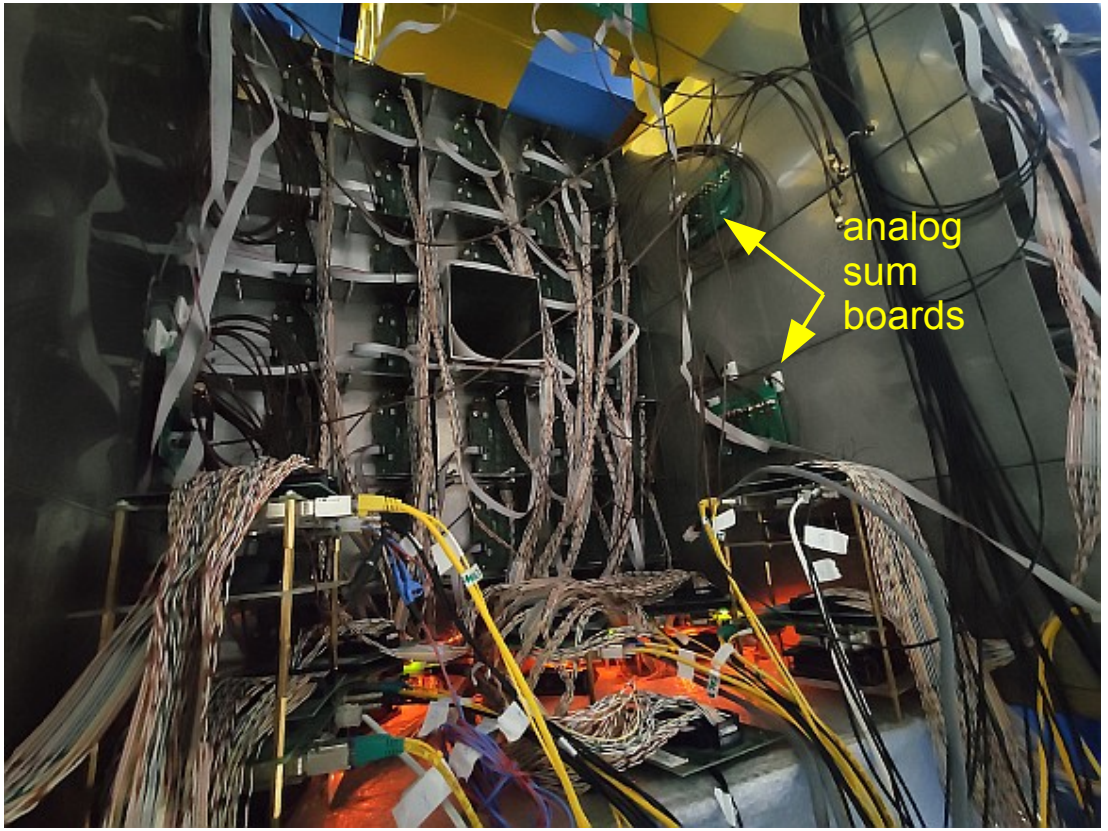
PSD CBM module - 60 Pb (16mm)/scint(4mm) layers
Light readout - with 10 MPPCs from 10 longitudinal sections

FHCAL MPD module - 42 Pb (16mm)/scint(4mm) layers
Light readout - with 7 MPPCs from 7 longitudinal sections.

FHCal has been assembled and installed in the BM@N area

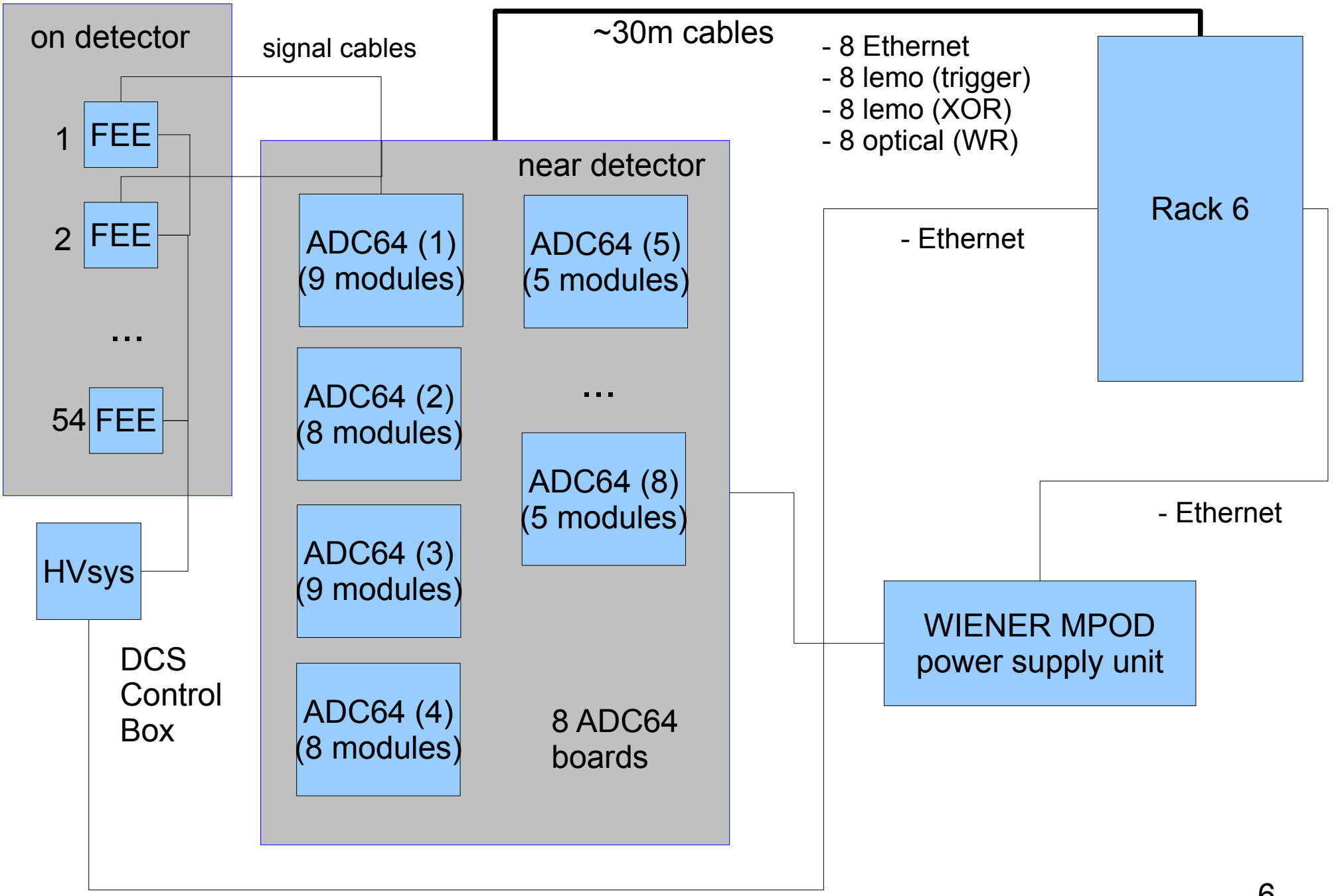


New WIENER MPOD power supply unit has been installed



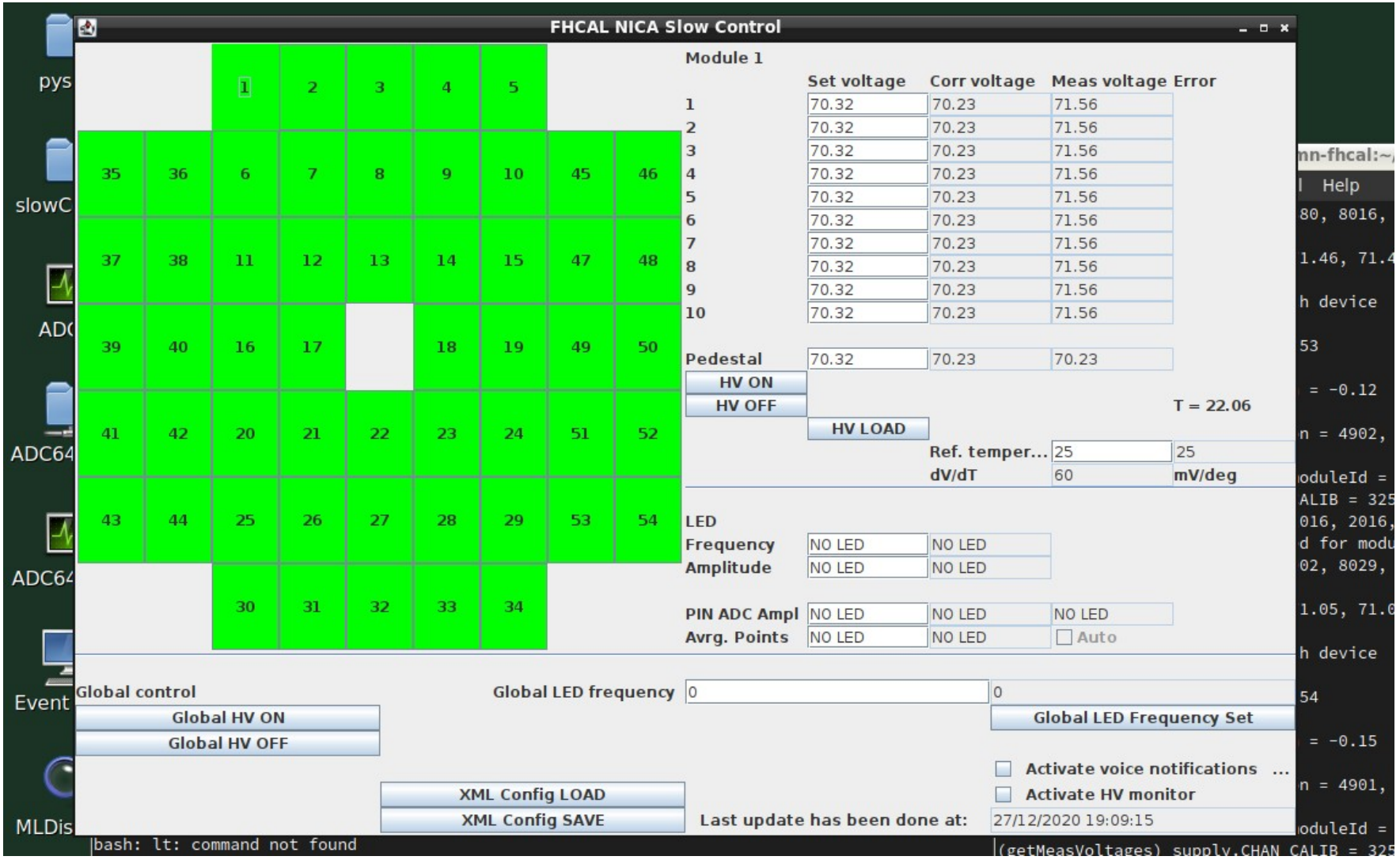
- 54 FEE boards have been connected and tested
- 8 ADC64s2 board are in places, tested, connected with new cables (yellow on foto) to Rack 6 + WR optical fibers
- 6 analog sum boards are connected to FEEs
- new power supply (WIENER MPOD) has been tested

Schematic view of connections at FHCal



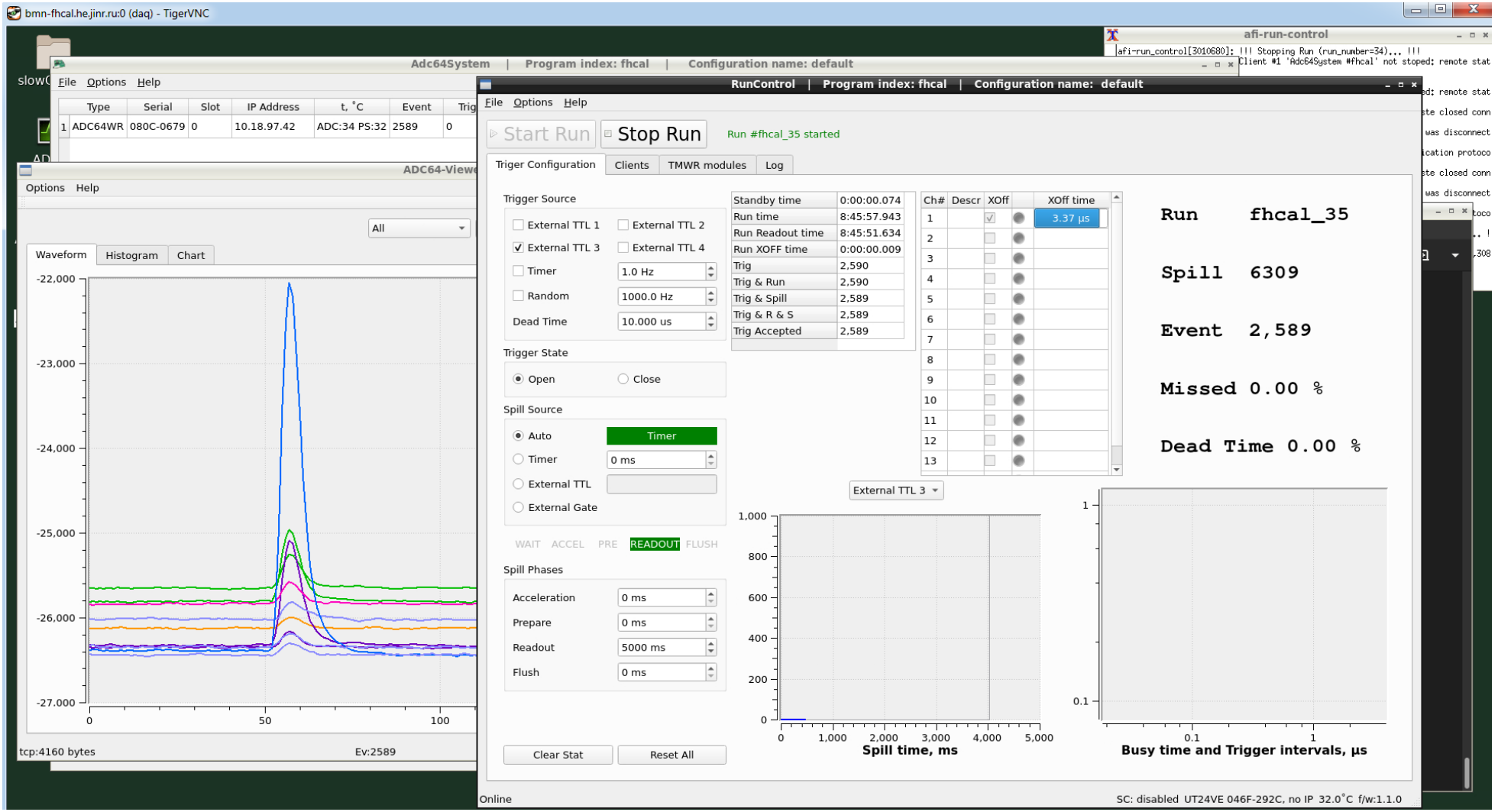
DCS for FHCal (Java version):

- control HV on MPPCs and correct it with temperature changing to maintain the gain

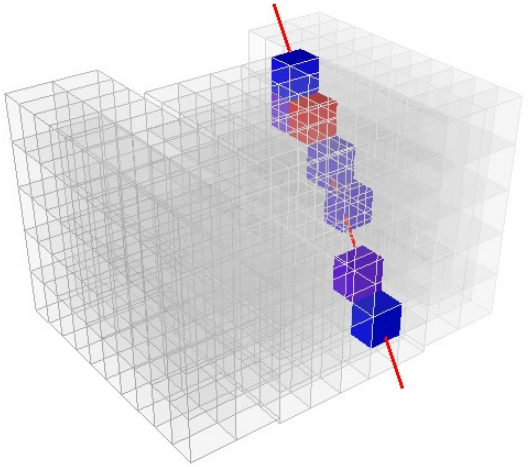


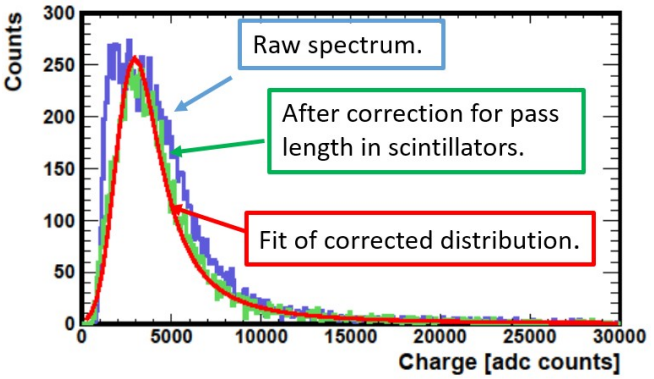
- the new version on python is under development

Tests of 8 ADC64 read-out system (on fhcal-bmn virtual mashine at BM@N computing node)

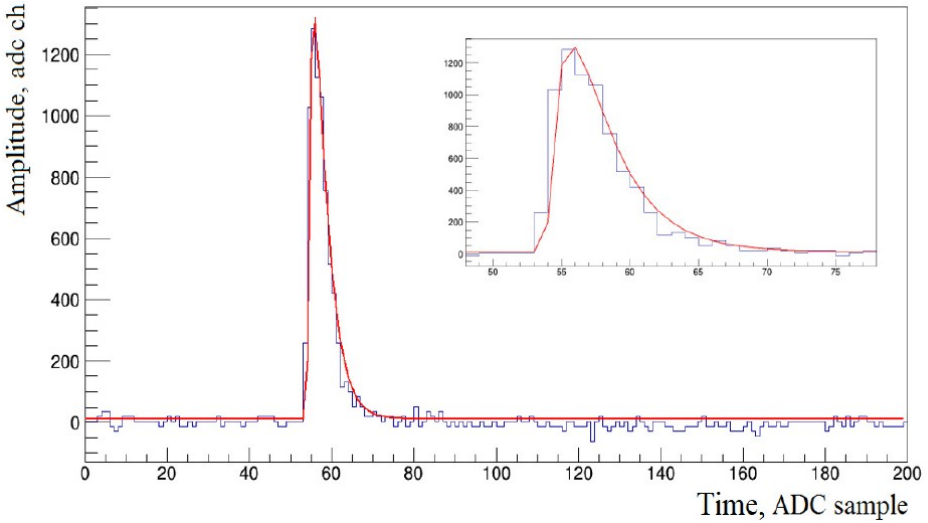


New cosmic muon calibration procedure based on 3D tracking with transverse and longitudinal granulation of FHCal has been developed and is under testing on cosmics with FHCal (remotely from INR)

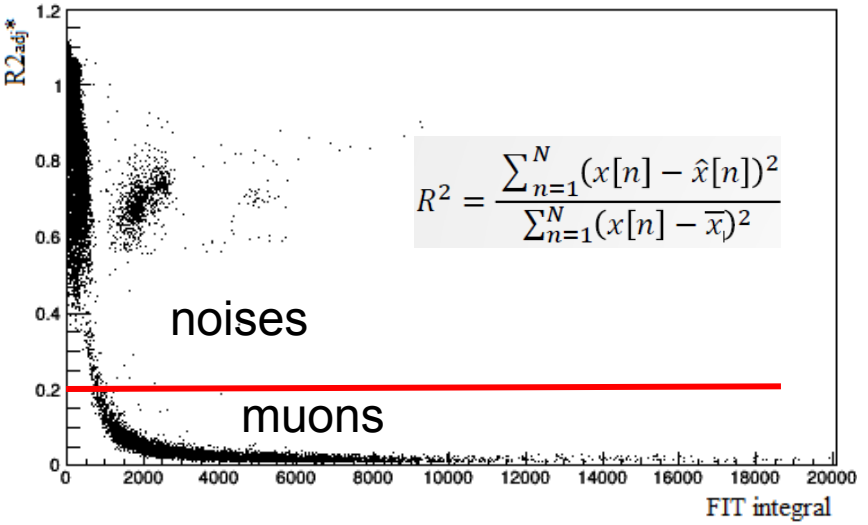




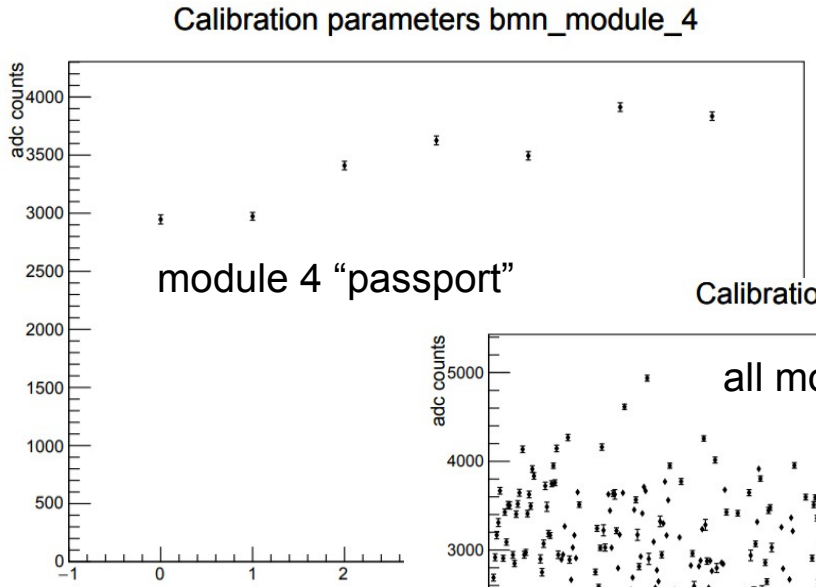
Fit signal by composition of exponents

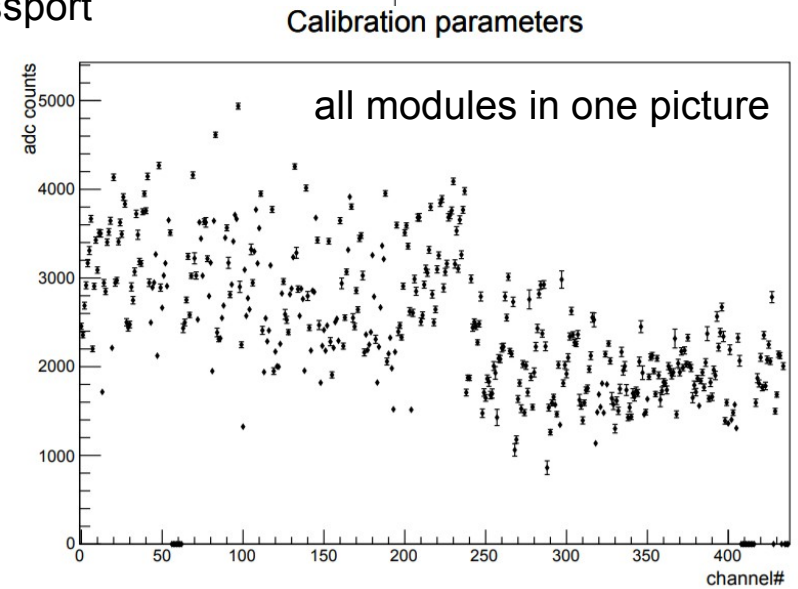


Rejection of noises with fit quality par.



Tests of 8 ADC64 read-out system (on fhcal-bmn virtual mashine at BM@N computing node)

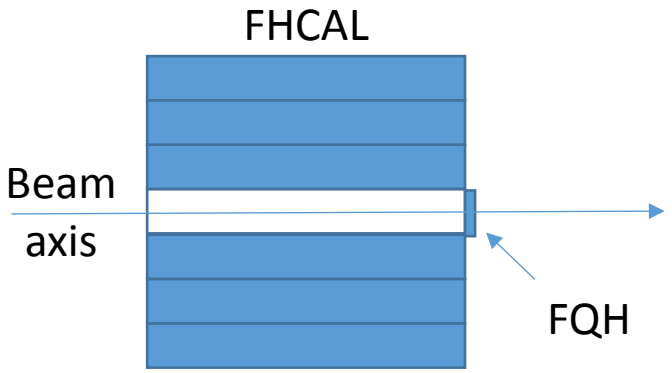


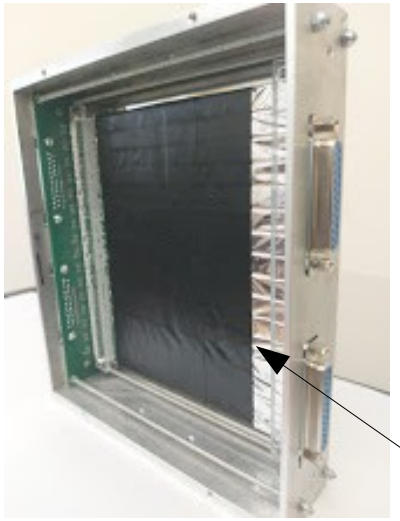


Cosmic muon calibration results

- the final goal: prepare “the quality passport” for each module of FHCal

The use of the Forward Quartz Hodoscope (FQH) to measure fragments charges in the FHCal beam hole.



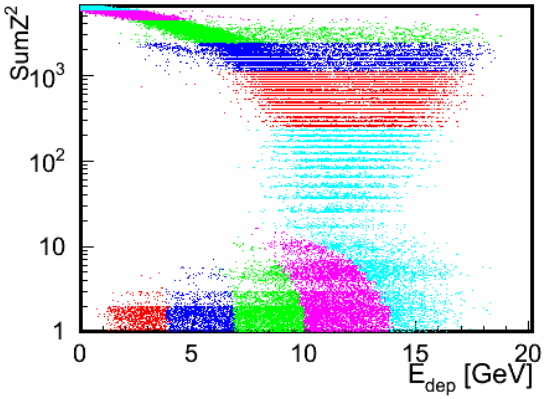


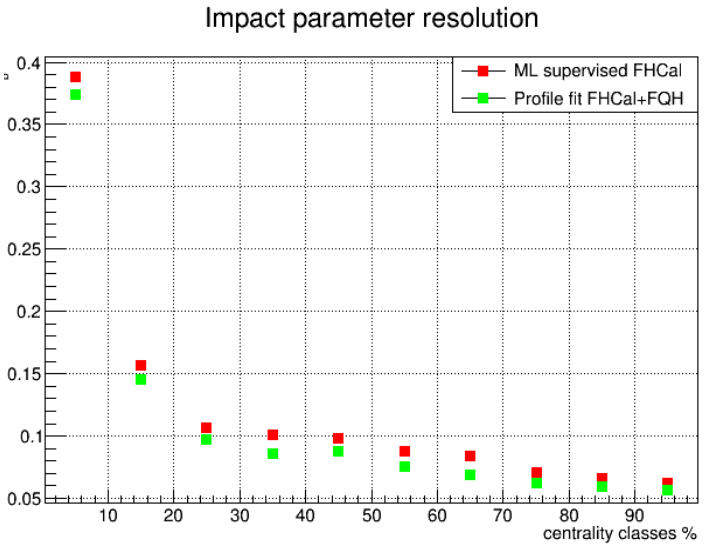
- Forward Quartz Hodoscope (FQH) is ready (2 variations – with scintillator and with quartz plates)

- TQDC board planned to use for read-out is under testing now with new FEE (at INR)

16 strips (160 x 10 x 4 mm^3) with 2-side MPPC read-out

- fragments charge measurements in the FHCal beam hole.
- alignment of the FHCal
- MB and centrality triggers

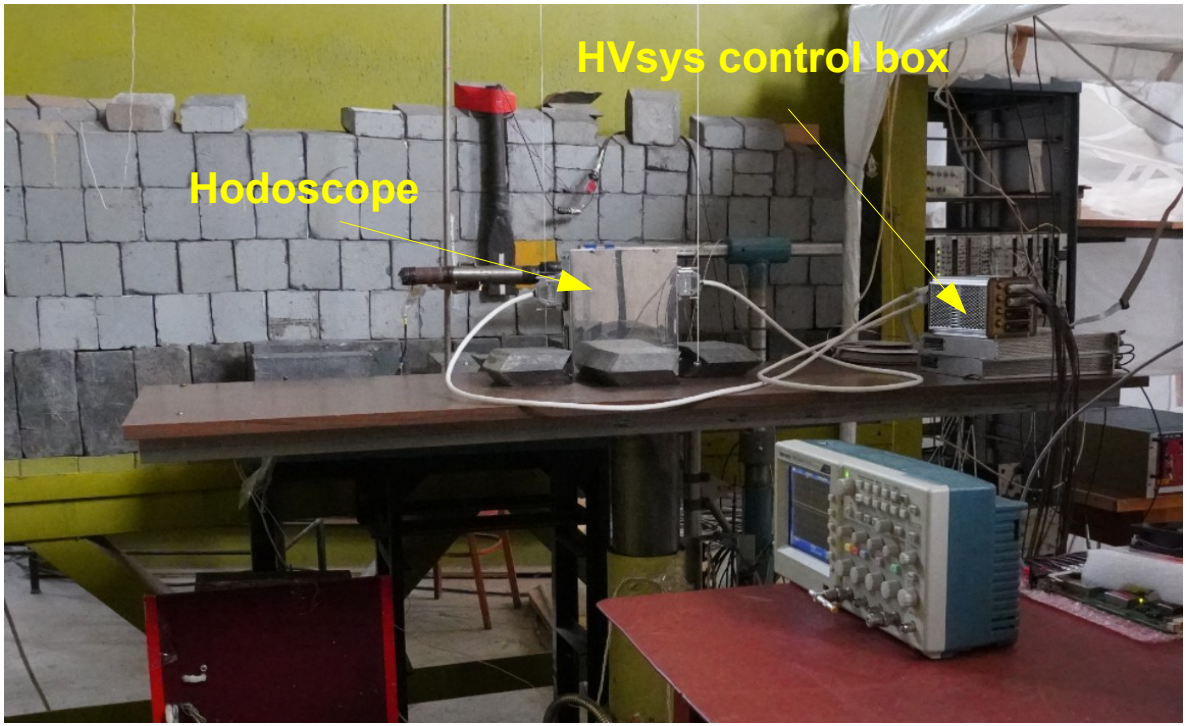


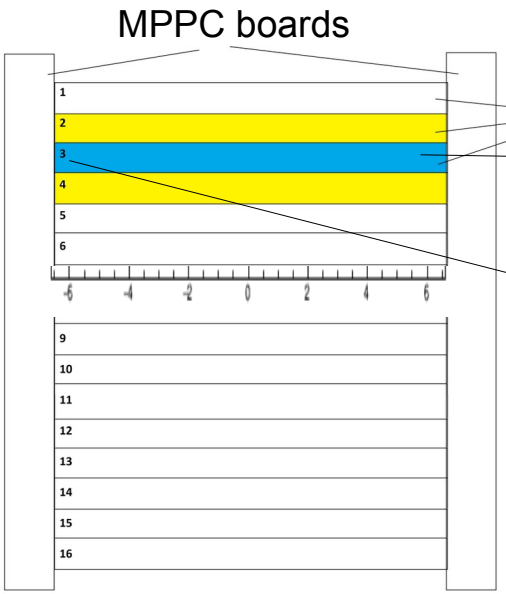


- the impact parameter resolution is slightly better when FQH+FHCal are used

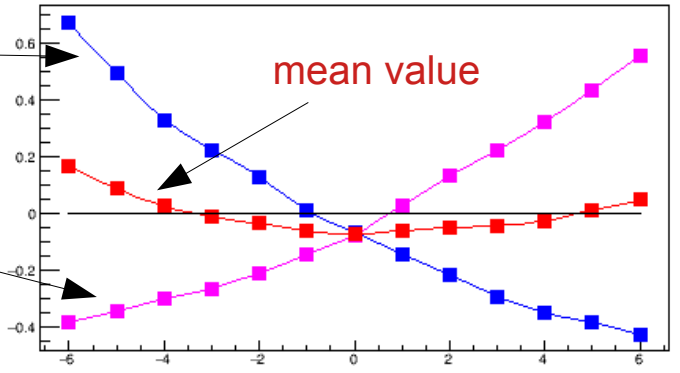
- FQH will allow to measure charge fragments in the FHCal beam FHCal hole:
  - can be useful to tune fragments models in event generators

Hodoscope's tests has been performed on "PAKHRA" synchrotron at LPI (Troitsk)

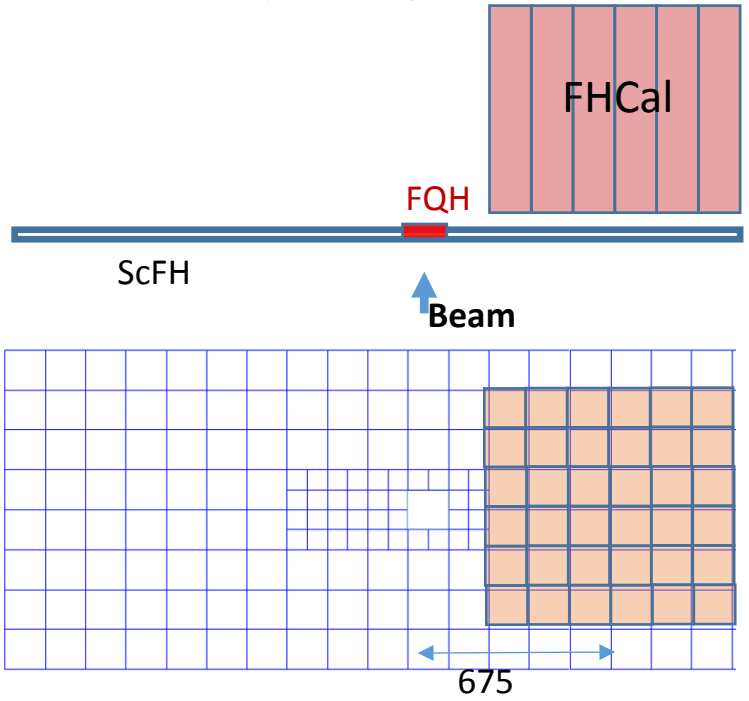




non-uniformity of response



- difference is not more then ~20% with dual side read-out

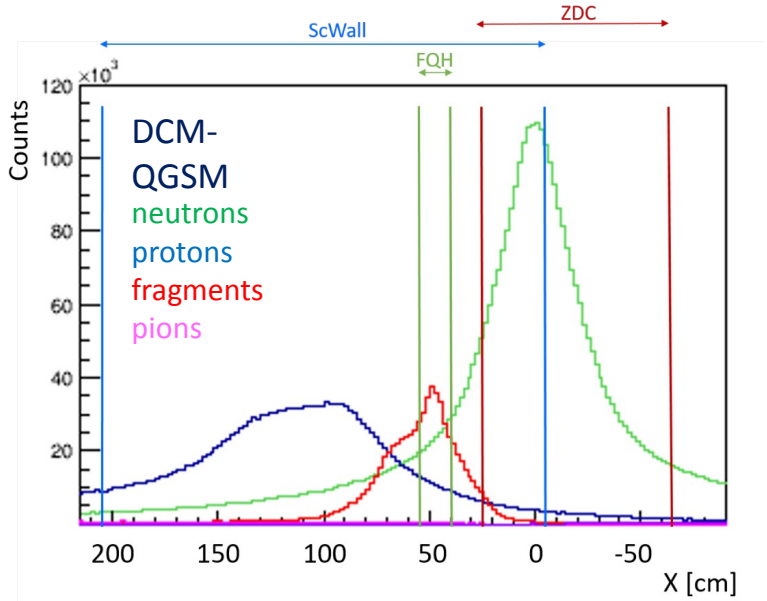


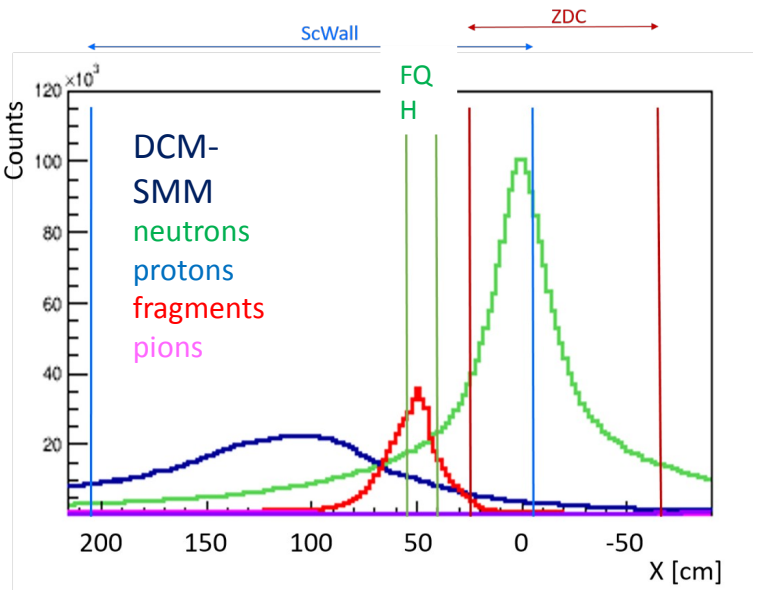
Additional segmented scintillation wall is planned:

- FHCal (36 MPD modules 15 x 15cm^2) to measure neutron spectators

- Scint. Wall: 36 cells (75 x 75 x 10 mm^3)
  + 134 cells (150 x 150 x 10 mm^3)
- FQH (16 quartz strips 160 x 10 x 4 mm^3) to measure heavy fragments

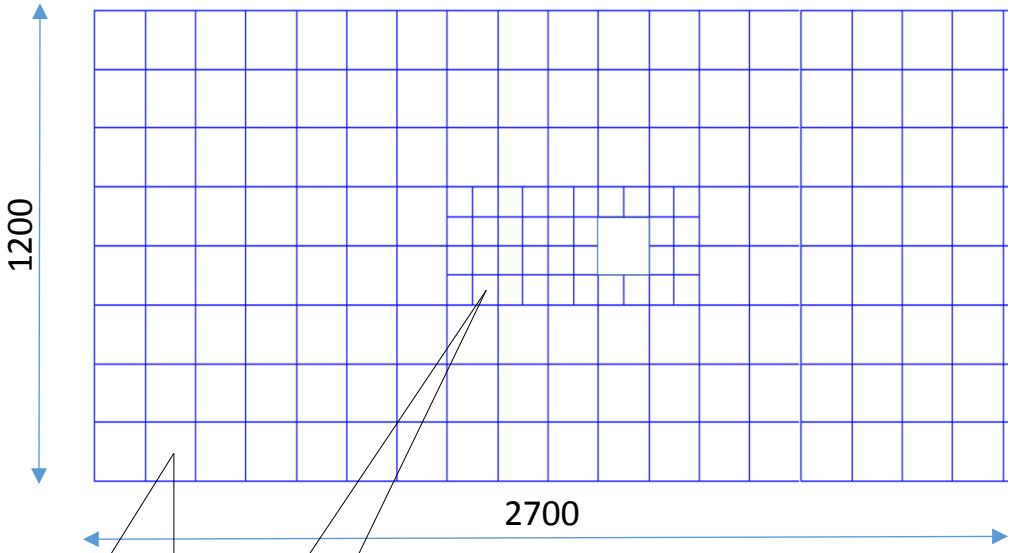
Separate measurements of the neutron, proton and fragments could be possible with this detector system.

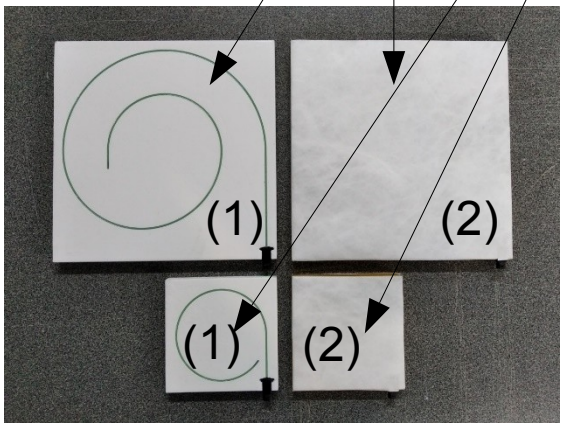




- large spatial separation between the proton and neutron spectators on the plane located at 9m from the target for Au+Au @4.5 AGeV with different event generators.

Schematic view of new BN@N Forward Scintillator Hodoscope (FScH)





Already constructed samples of scintillator cells for tests.

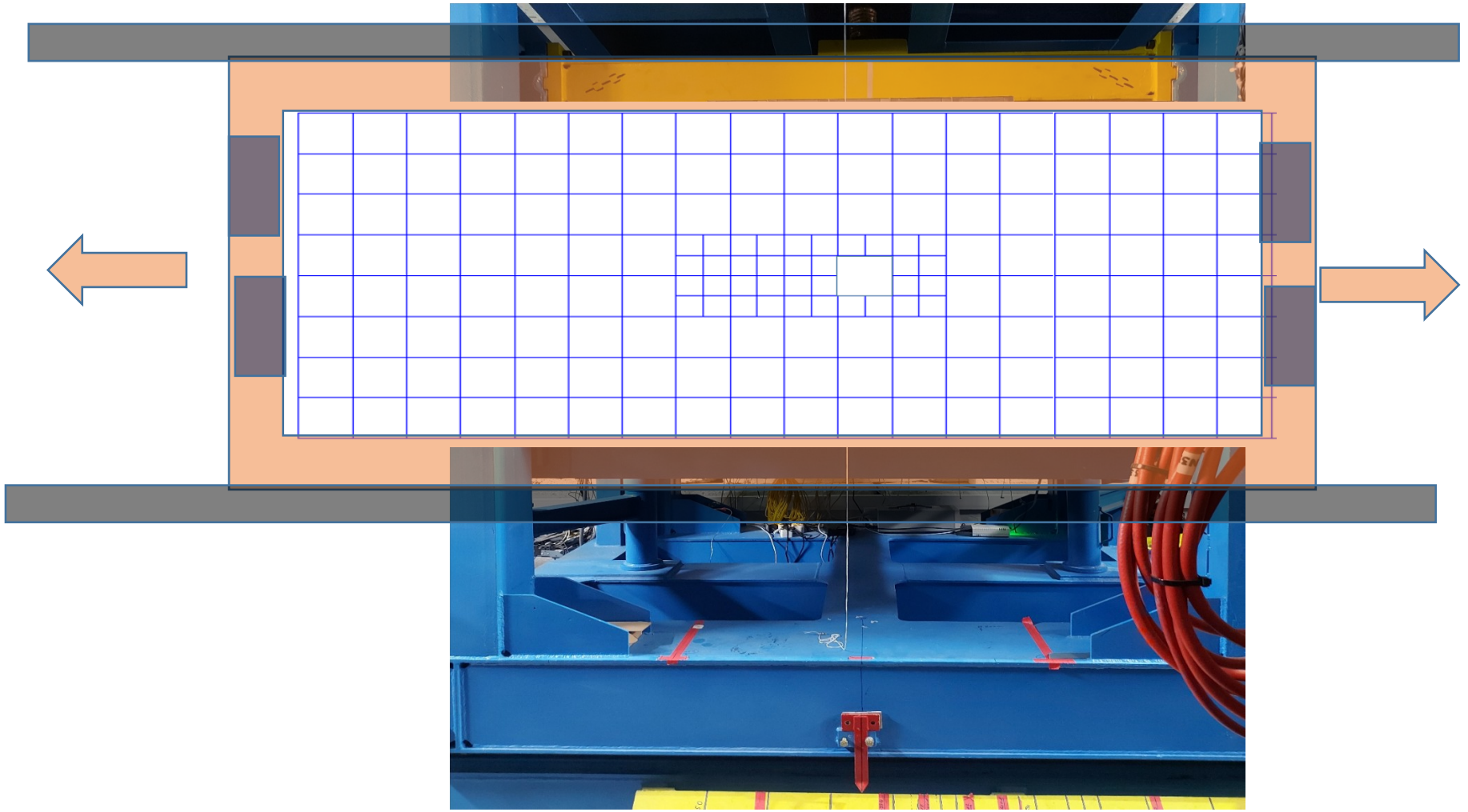
Tests have been done at “PAKHRA” synchrotron, LPI (Troitsk)

- uniformity of light collection w.r.t. beam spot

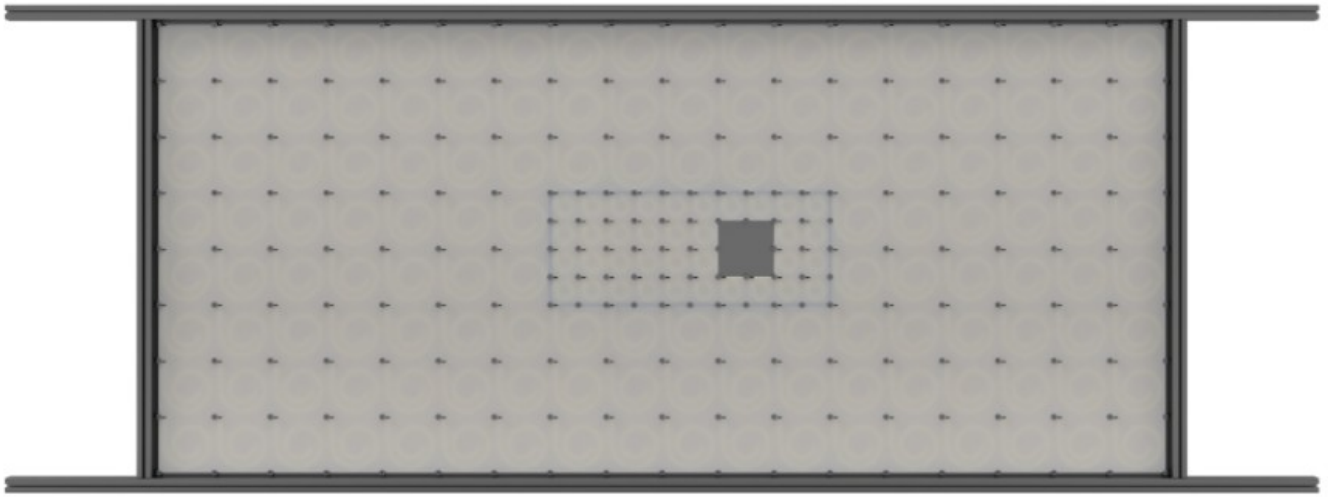
1) chemical prepared “foam” type reflection coating
2) tyvek’s coated plates

(results show tyvek coated plates to be better..)

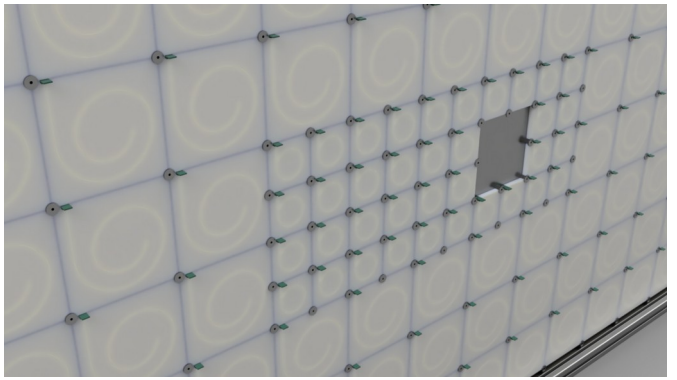
Another possible solution: the hodoscope frame will be fixed to the platform frame

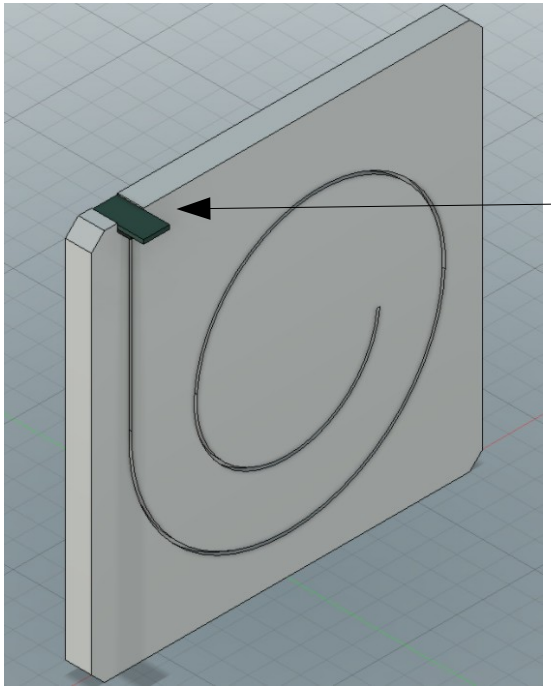


Schematic view of scint. wall design

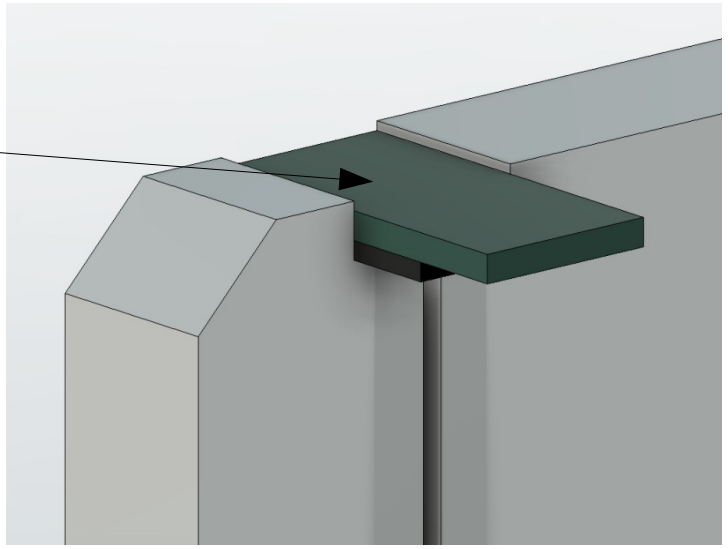


assembling of scint. wall





MPPC
mounting
PCB



Plans for the future:

- check all problems with FEE boards and fix them – January 2021

- module calibration and “module passport” - February 2021

- mounting the beam quatrz/scint hodoscope (FQH) on the FHCal back side – March 2021

- desing and construct new scintillation hodoscope wall – September 2021 (optimistic)