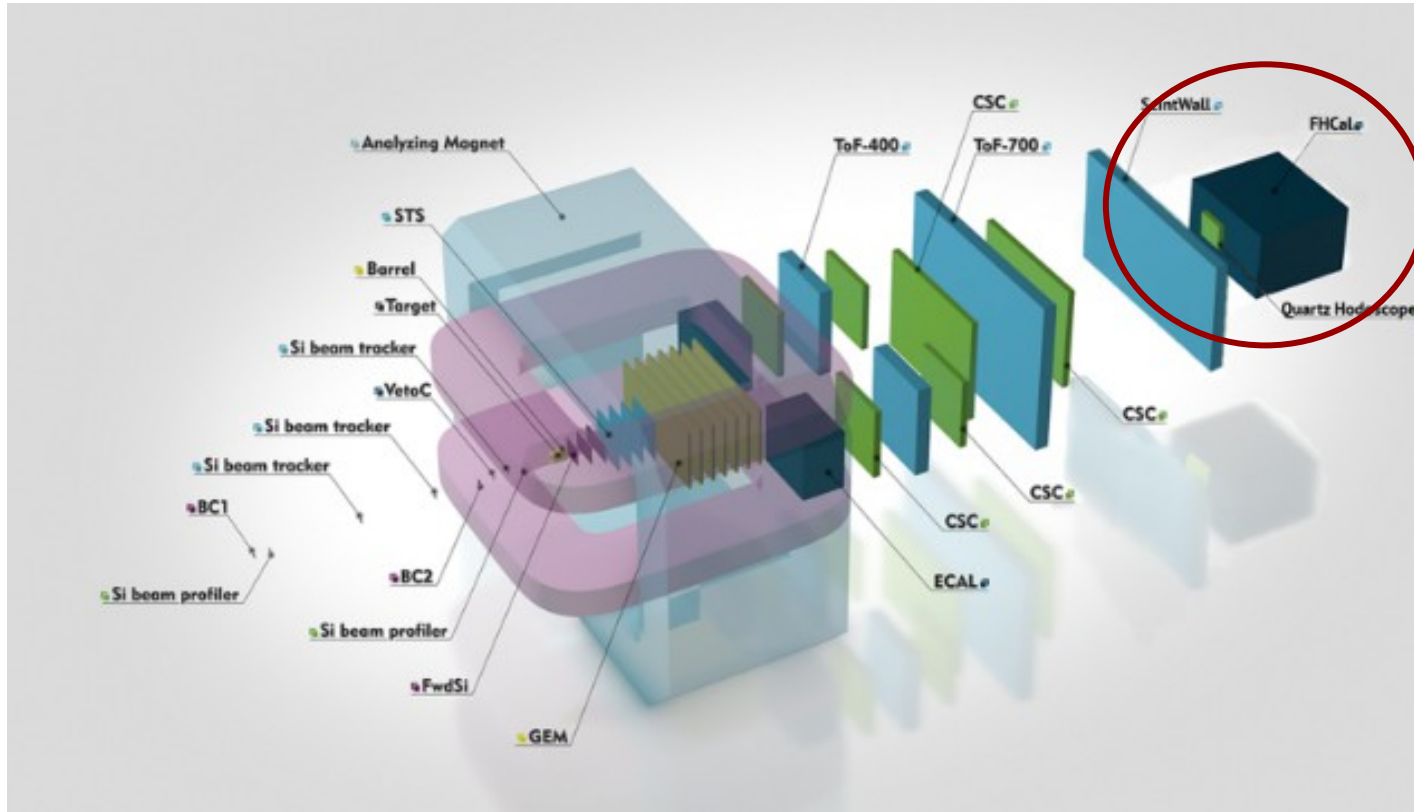


Status of forward detectors at BM@N facility

Sergey Morozov
on behalf of INR RAS, Moscow



Status of forward detectors at BM@N facility



Forward detectors:

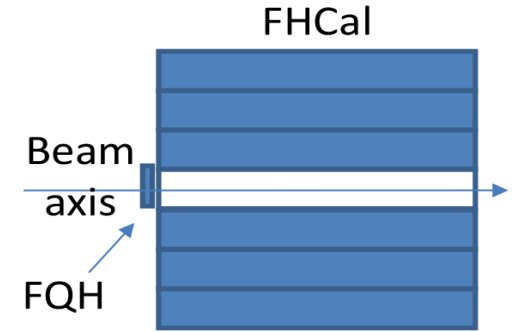
- **FQH** (**F**orward **Q**uartz **H**odoscope)
- **FHCAL** (**F**orward **H**adron **C**alorimeter)
- **ScWall** (**S**cintillation **W**all)

Can measure:

- charge distributions of spectator fragments
- centrality determination
- reaction plane orientation

Status of forward detectors at BM@N facility

35	36	1	2	3	4	5	45	46
37	38	6	7	8	9	10	47	48
39	40	11	12	13	14	15	49	50
41	42	16	17		18	19	51	52
43	44	20	21	22	23	24	53	54
		25	26	27	28	29		
		30	31	32	33	34		



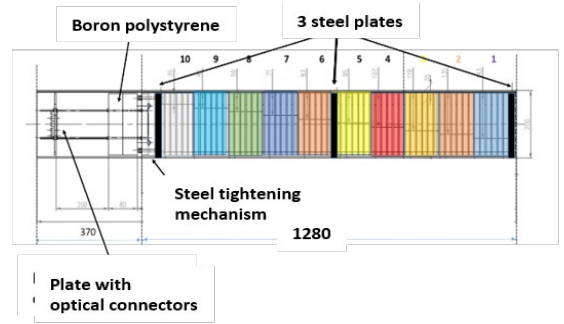
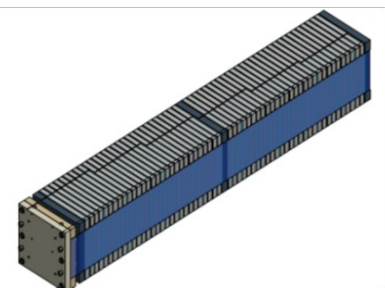
FHCAL - (Forward Hadron Calorimeter):

20 modules with 10 longitudinal sections (PSD CBM), transverse size 20x20cm², length – 5.6 λ_{int}.

34 modules with 7 longitudinal sections (FHCAL MPD like) – 15x15cm² (– 4.0 λ_{int}).

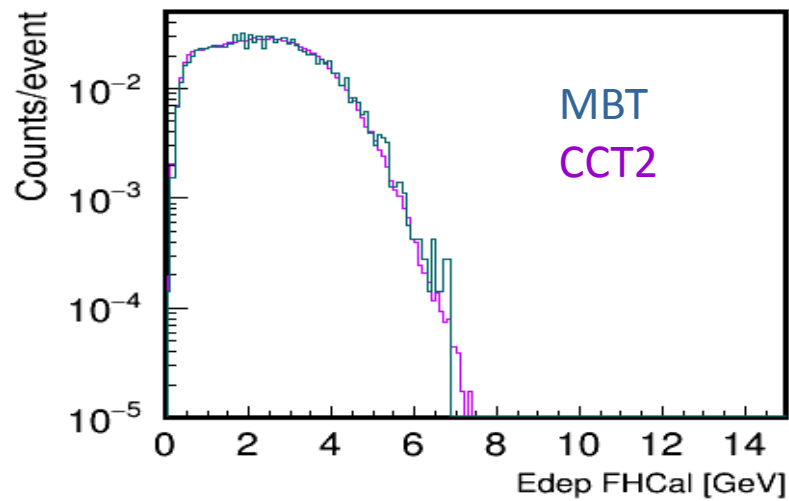
Hamamatsu MPPC S12572-010P, 3 x 3 mm².

434 readout channels.

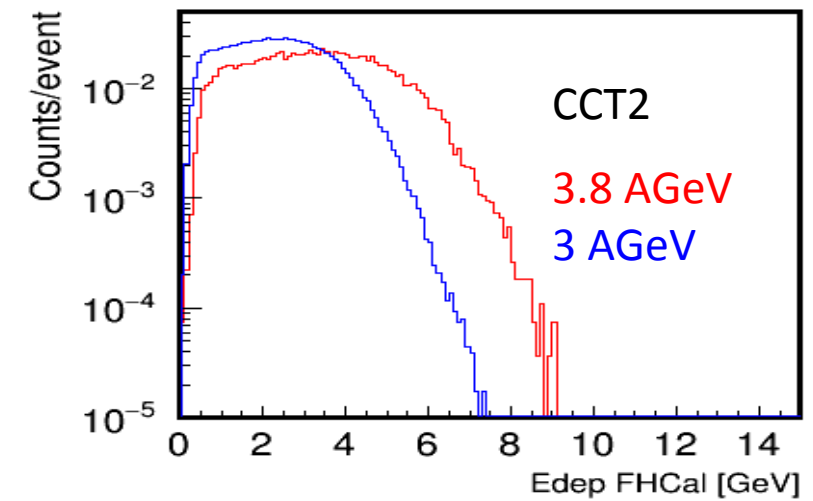
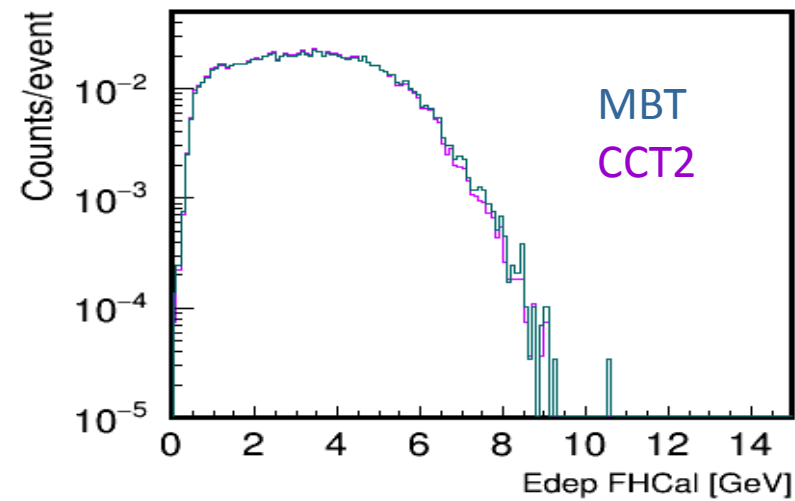


Energy visible in FHCal

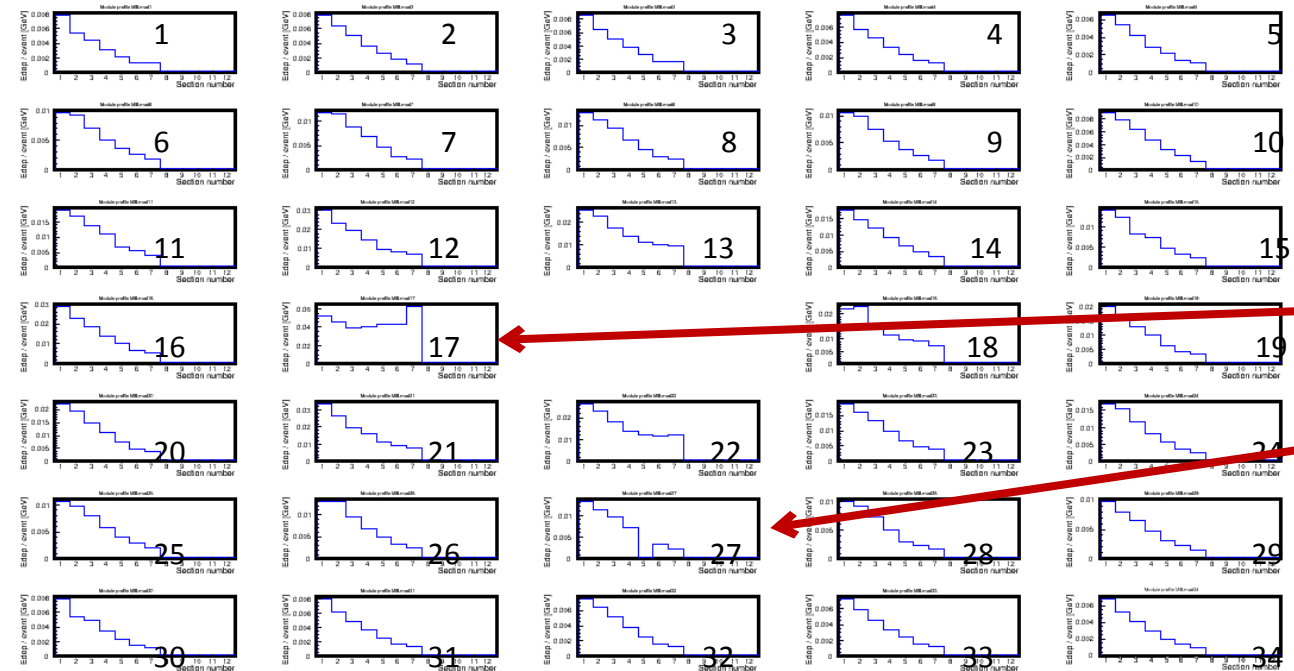
Run 8381 MIXED trigger, **3AGeV** 1024202 ev



Run 7821 MBT trigger, **3.8AGeV** 200000ev



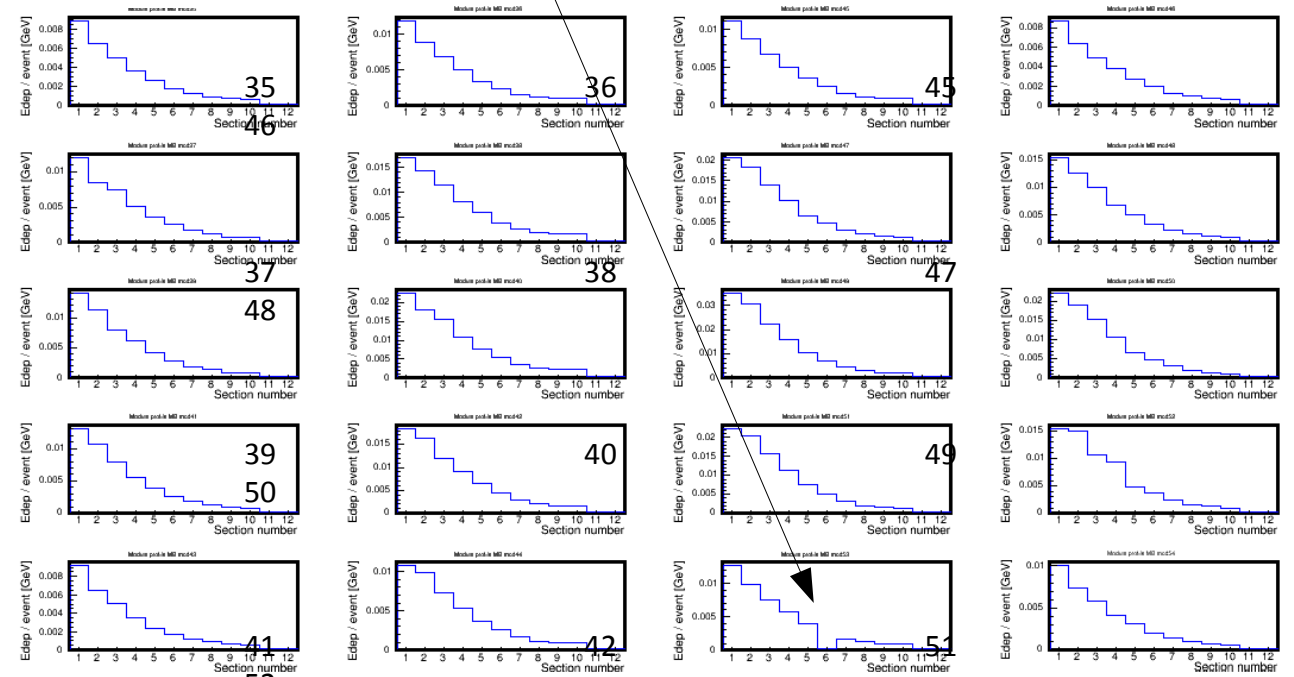
Status of forward detectors at BM@N facility



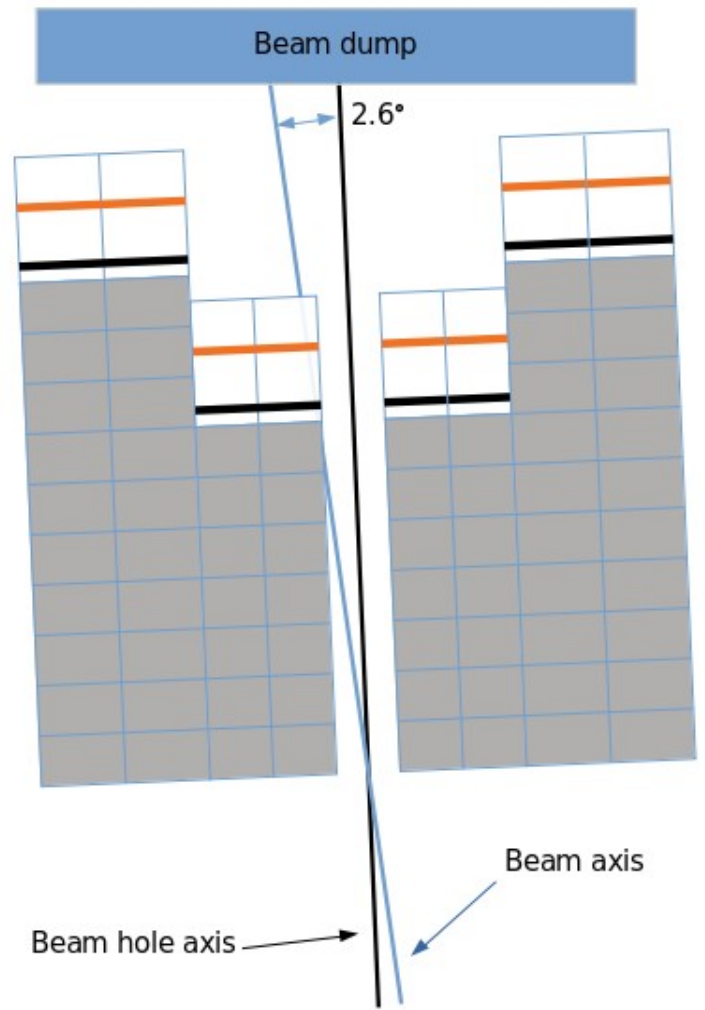
Shower profiles (MB)
 Run 7821 MBT trigger, 3.8AGeV
 200000ev

Beam affects the rear part of the 17th module
 Dead readout channel

35	36	1	2	3	4	5	45	46
37	38	6	7	8	9	10	47	48
39	40	11	12	13	14	15	49	50
41	42	16	17	18	19	20	51	52
43	44	21	22	23	24	25	53	54
		26	27	28	29	30		
		31	32	33	34	35		

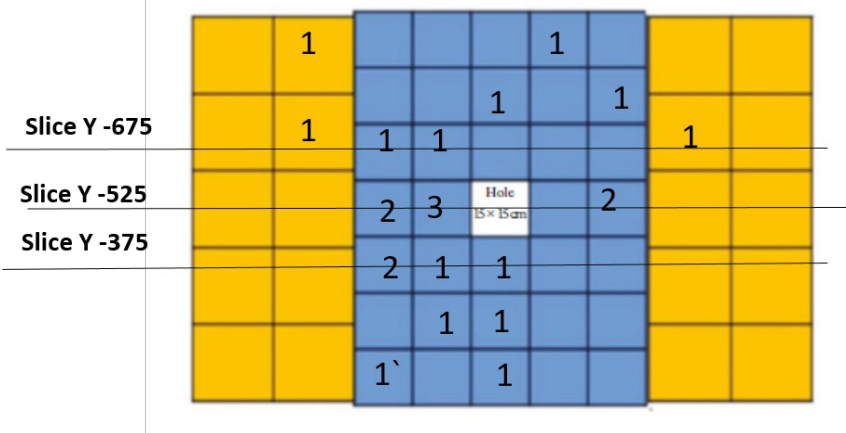


FHCal position relative beam axis

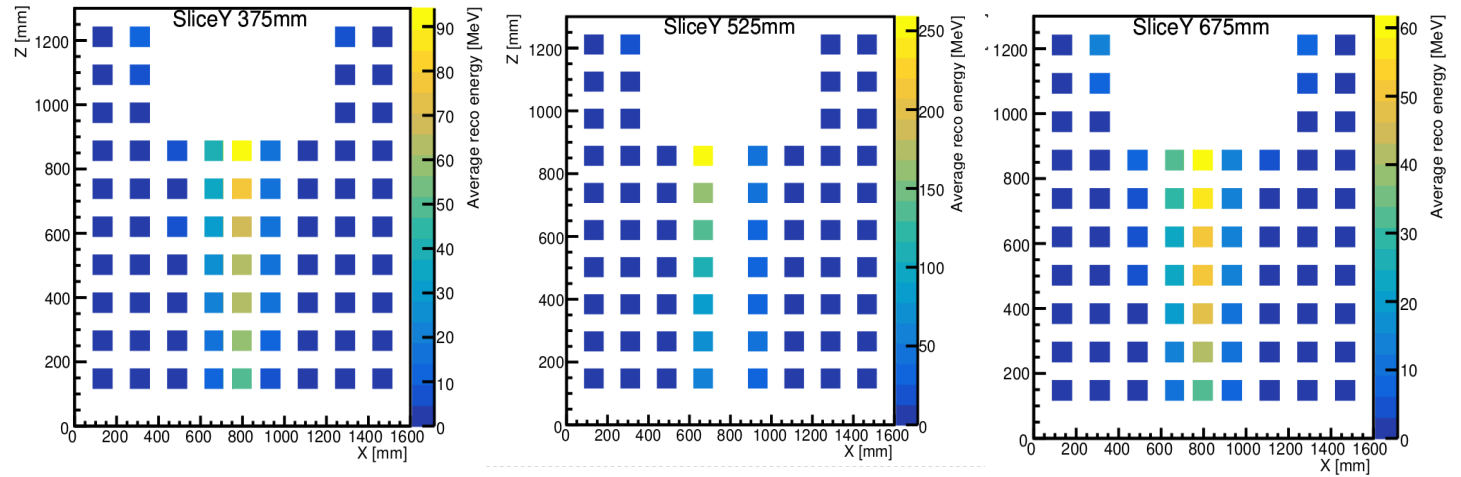


after run 8 FHCal was rotated and is now aligned to beam axis

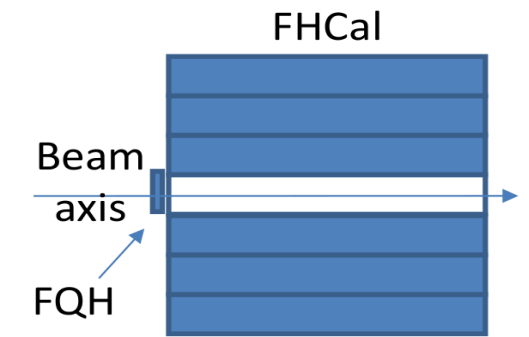
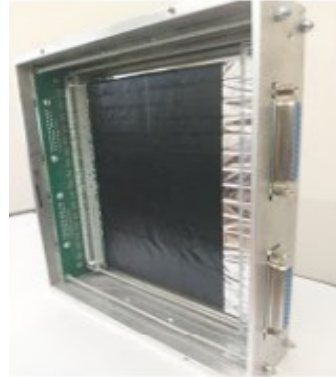
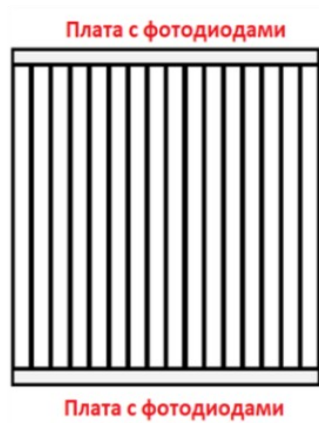
Number of failed FHCal modules during Run8



Energy distribution in sections of central modules layers for events with beam trigger BT



Forward Quartz Hodoscope (FQH)



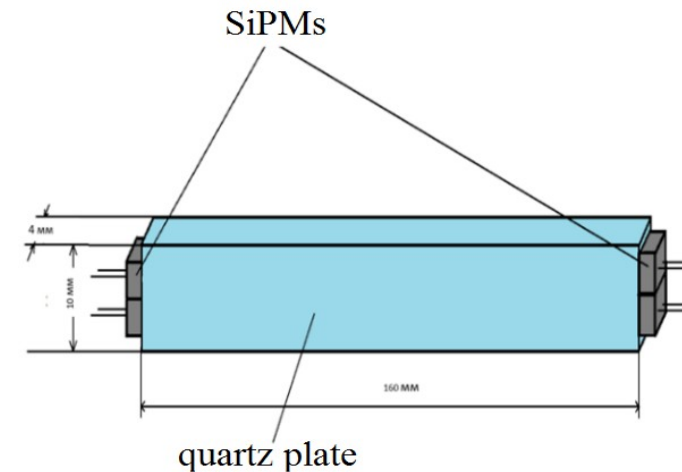
FQH - (Forward Quartz hodoscope):

16 quartz strips $160 \times 10 \times 4 \text{ mm}^3$,

2+2 MPPCs per strip,

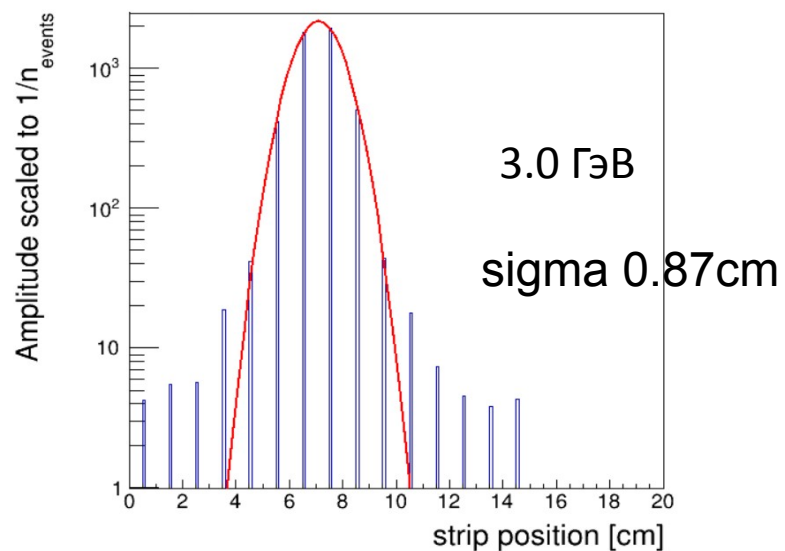
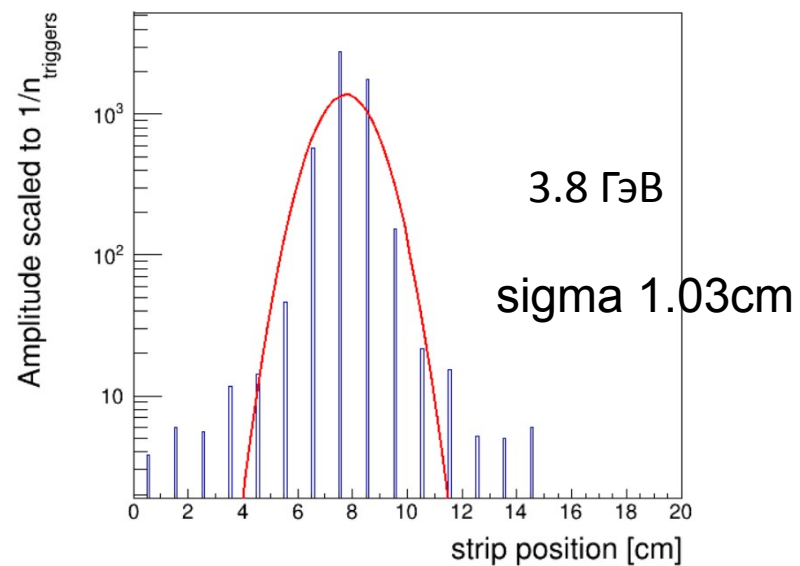
Hamamatsu MPPC S14160-3015PS, $3 \times 3 \text{ mm}^2$,

64 readout channels (low gain, high gain)

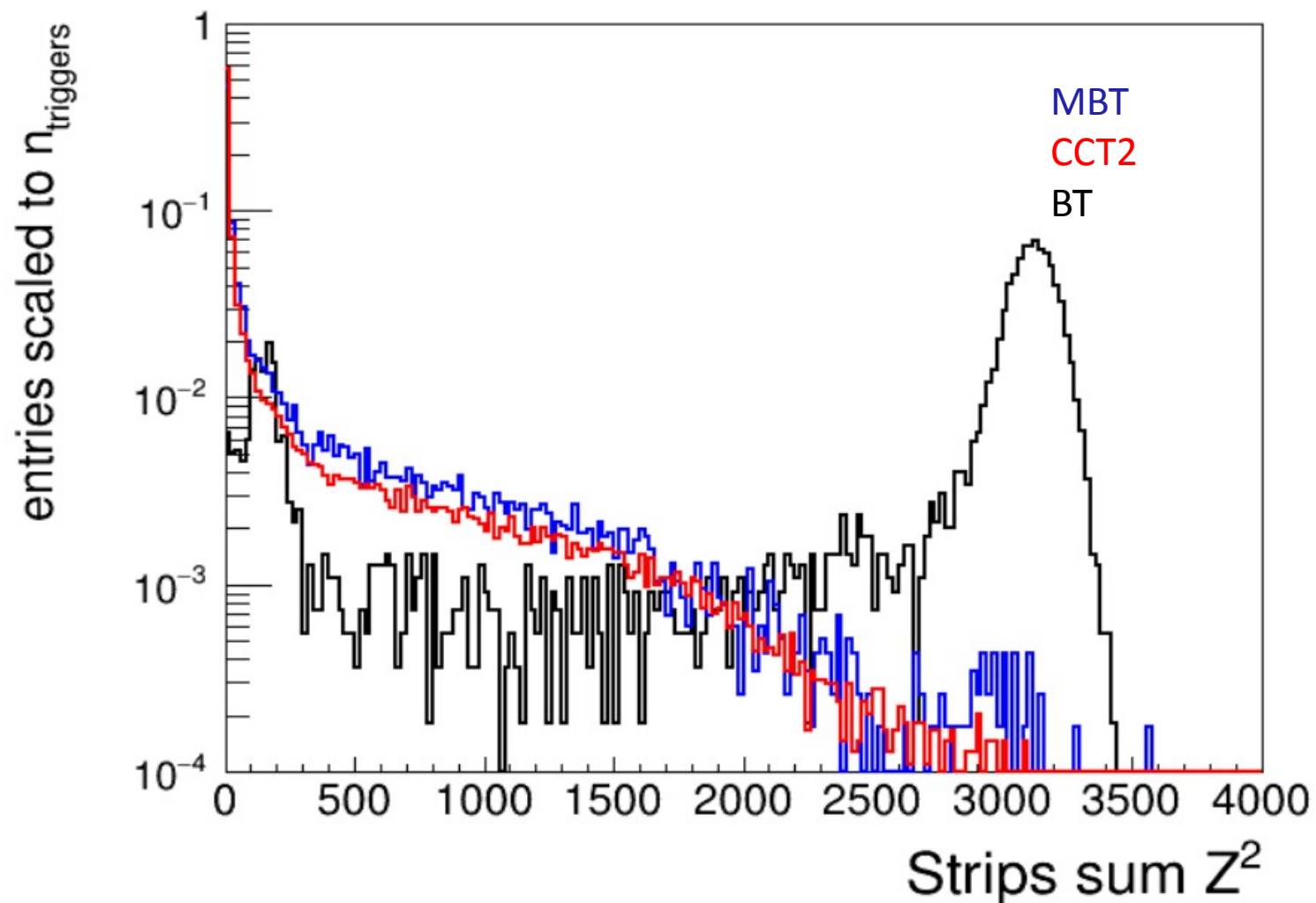


FHCa1 + FQH → collision centrality estimation, reaction plane

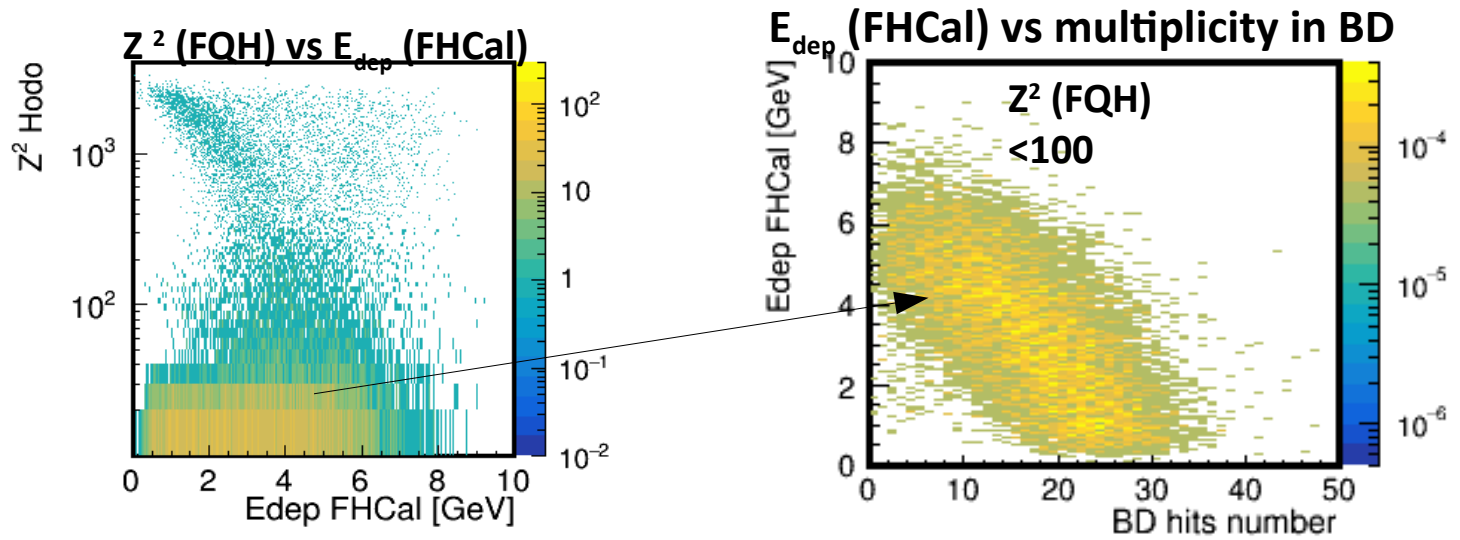
Beam profile. BT



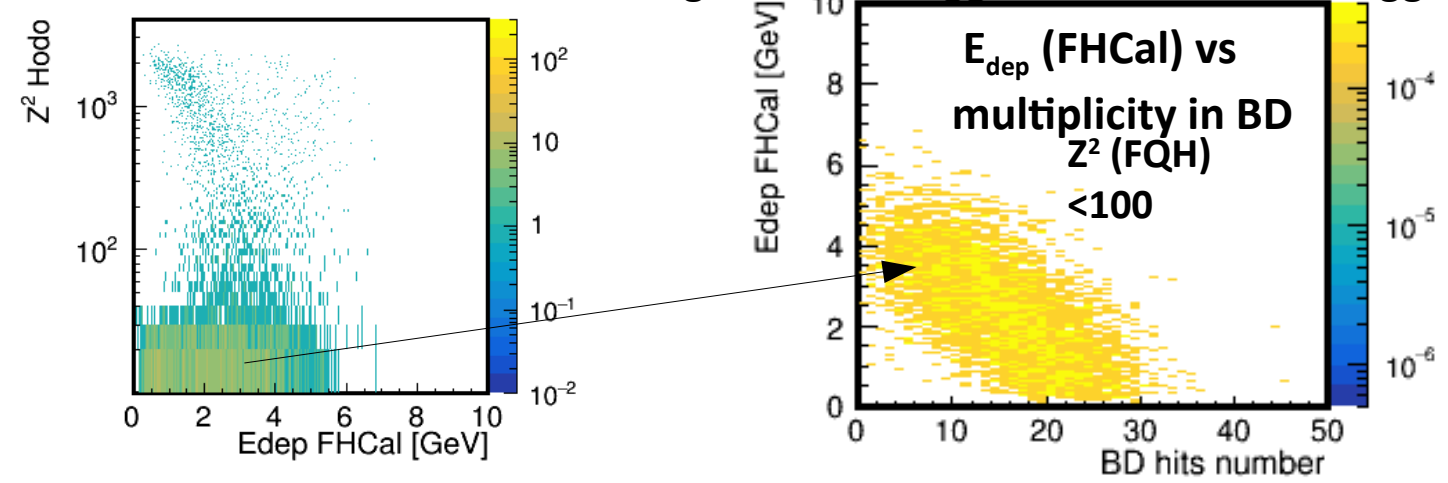
Fragments charge distribution in FQH



XeCsl@3.8A GeV. Run 7821 2% Csl target, MBT trigger.



XeCsl@3.0A GeV. Run 8381 2% Csl target, Mixed trigger. Selection MBT trigger.



Scintillating Wall (ScWall)

ScWall view inside during production



Charge spectators detection

→ fragmentation model parameters

- + collision centrality
- + reaction plane

ScWall mounted on FHCaI frame during SRC run



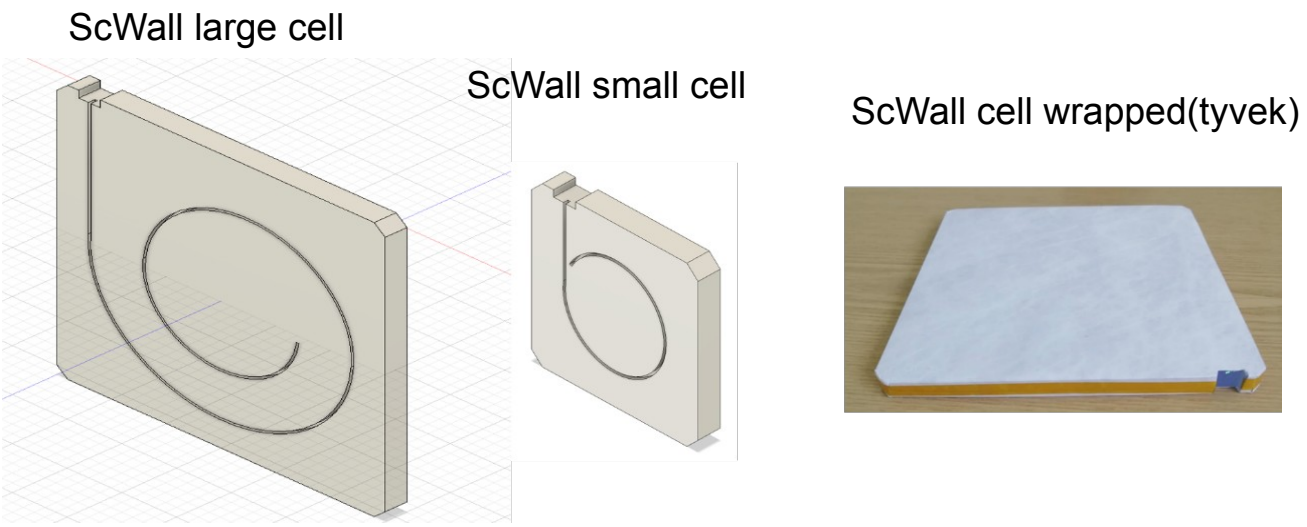
Status of forward detectors at BM@N facility

ScWall in run8 at BM@N

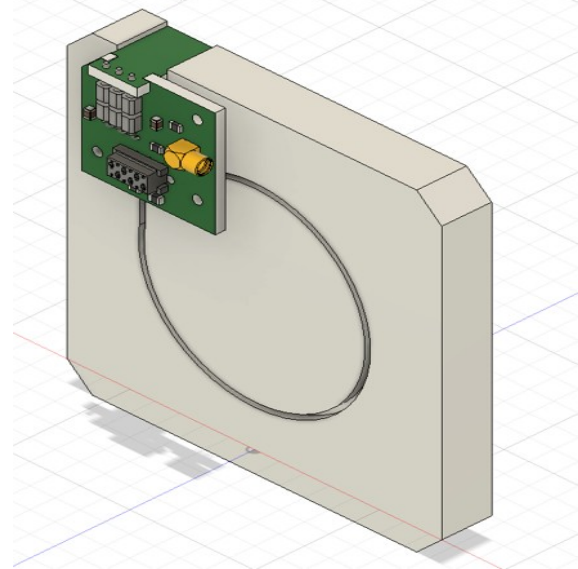
ADC64s2 based read-out
+ FEE electronics



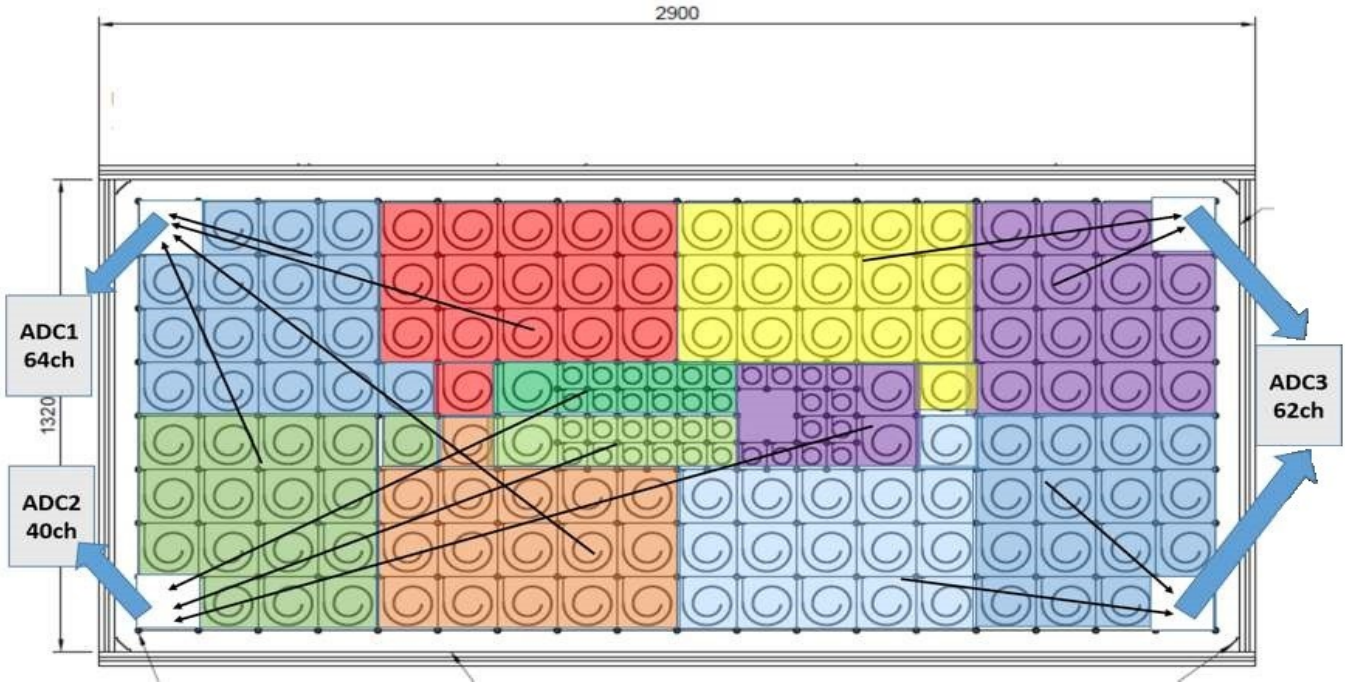
Status of forward detectors at BM@N facility



ScWall small cell detailed view with PCB, SiPM and connectors



ScWall schematic view of read-out areas

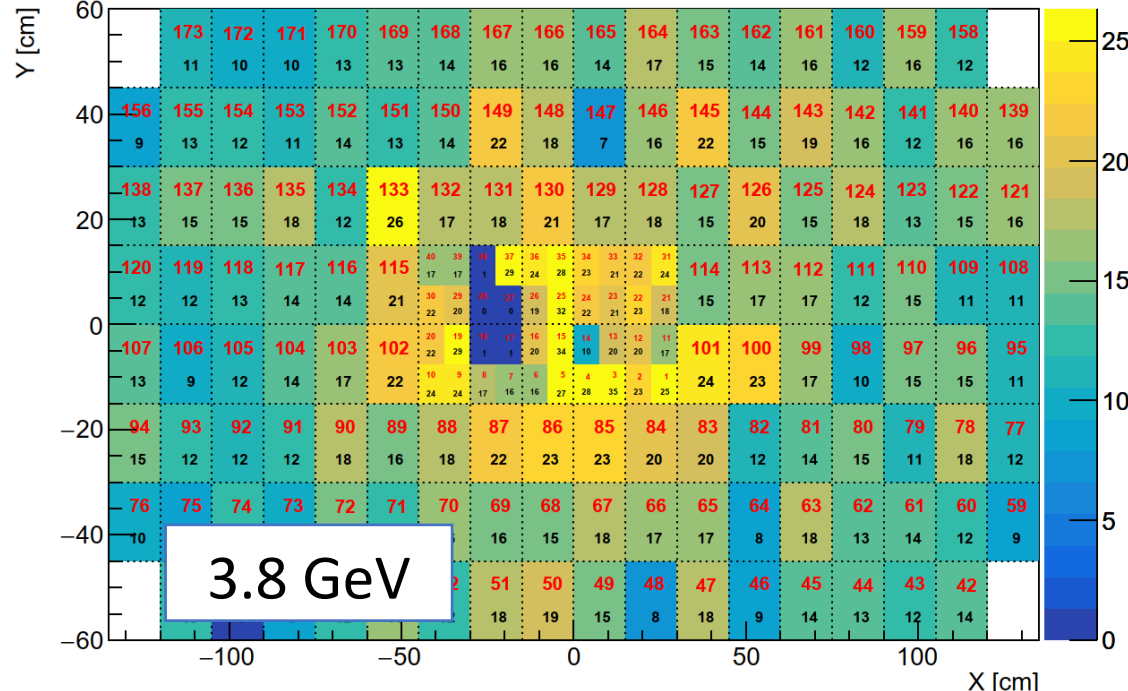
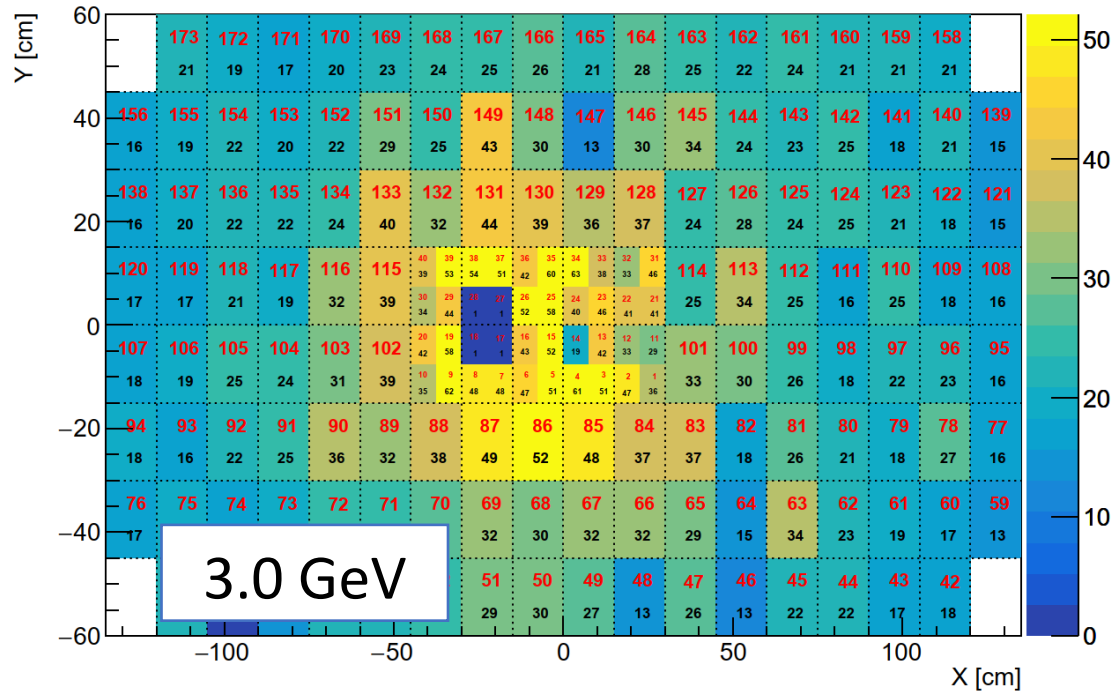


- Hamamatsu MPPC S13360-1325CS 1.3*1.3mm²
- Number of pixels: 2668
- Gain: 7*10⁵
- PDE: 25%

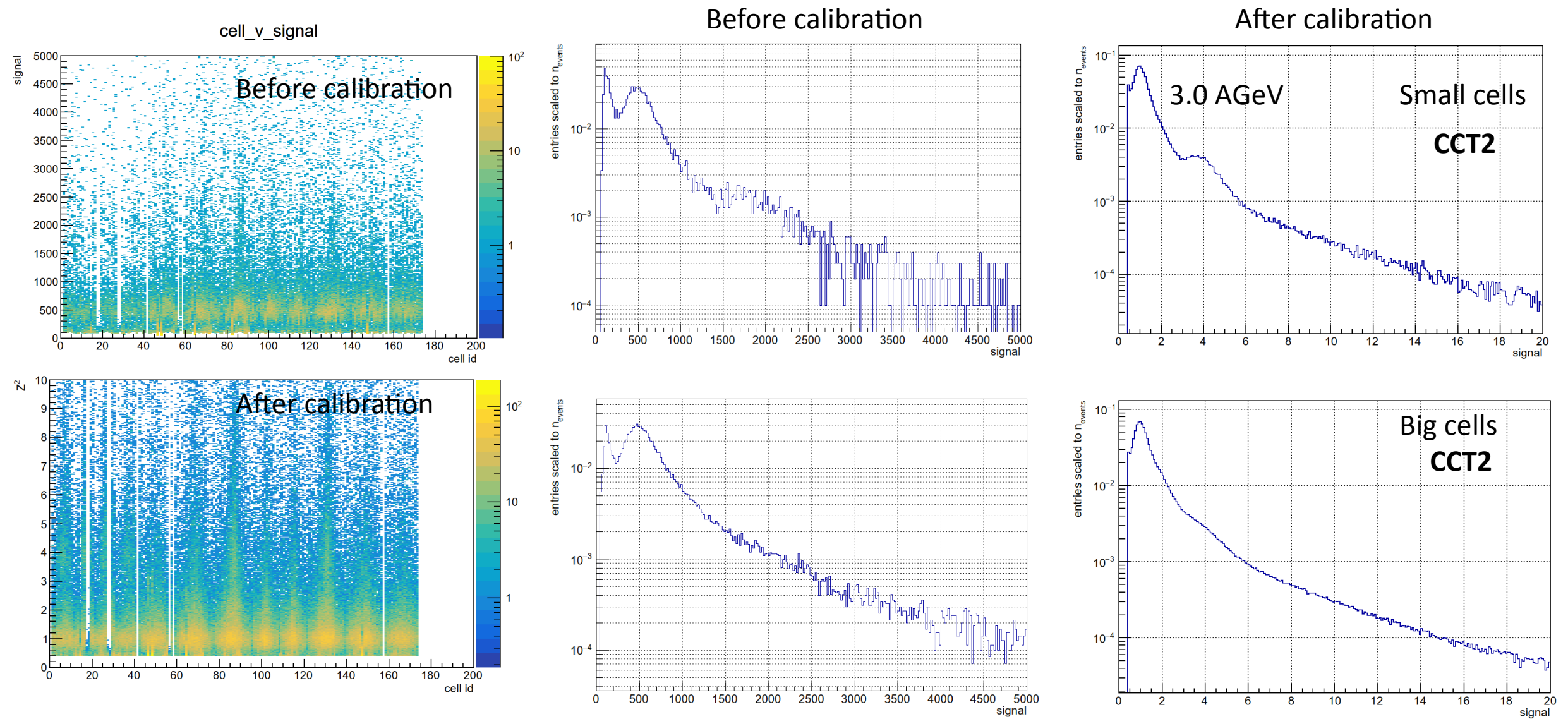


Light yield for MIP signal
 small cells 55 p.e. ± 2.4%
 big cells 32 p.e. ± 6%

ScWall average Z^2 distribution with CsI (2%) target, Xe, CCT2



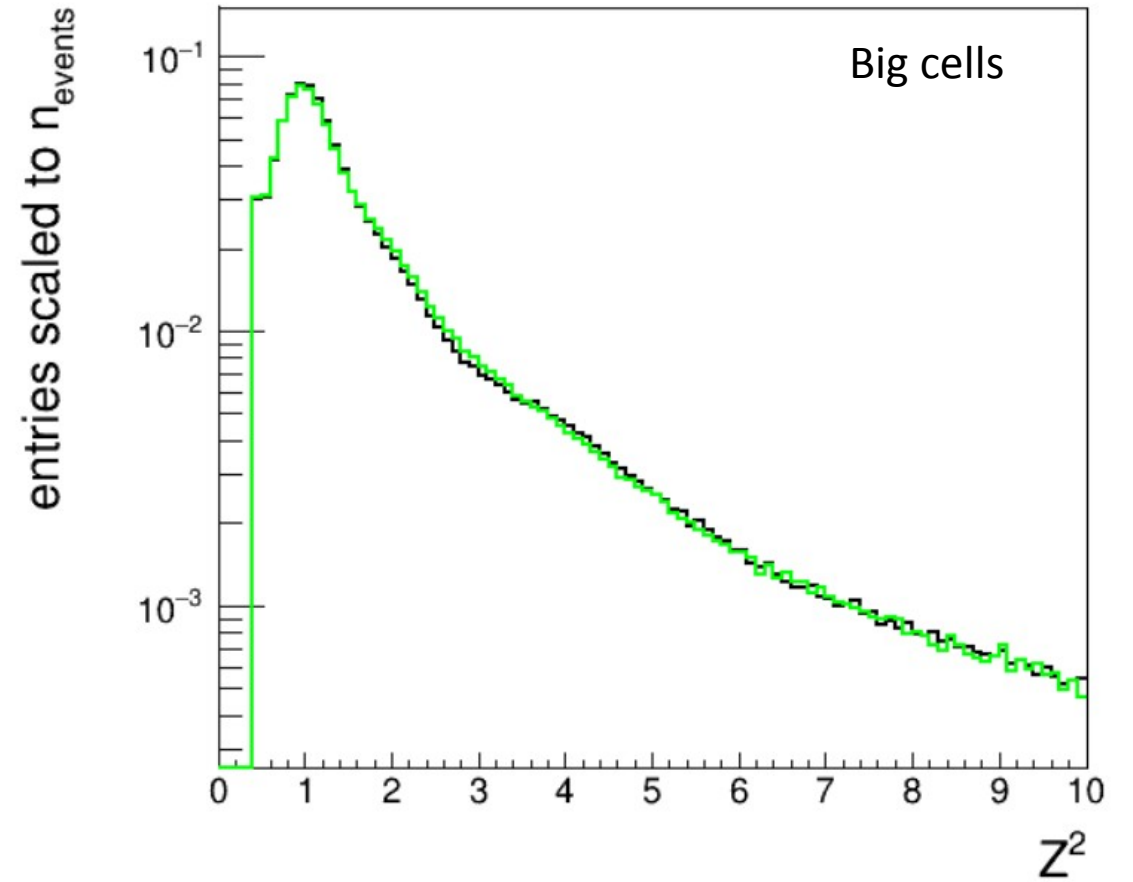
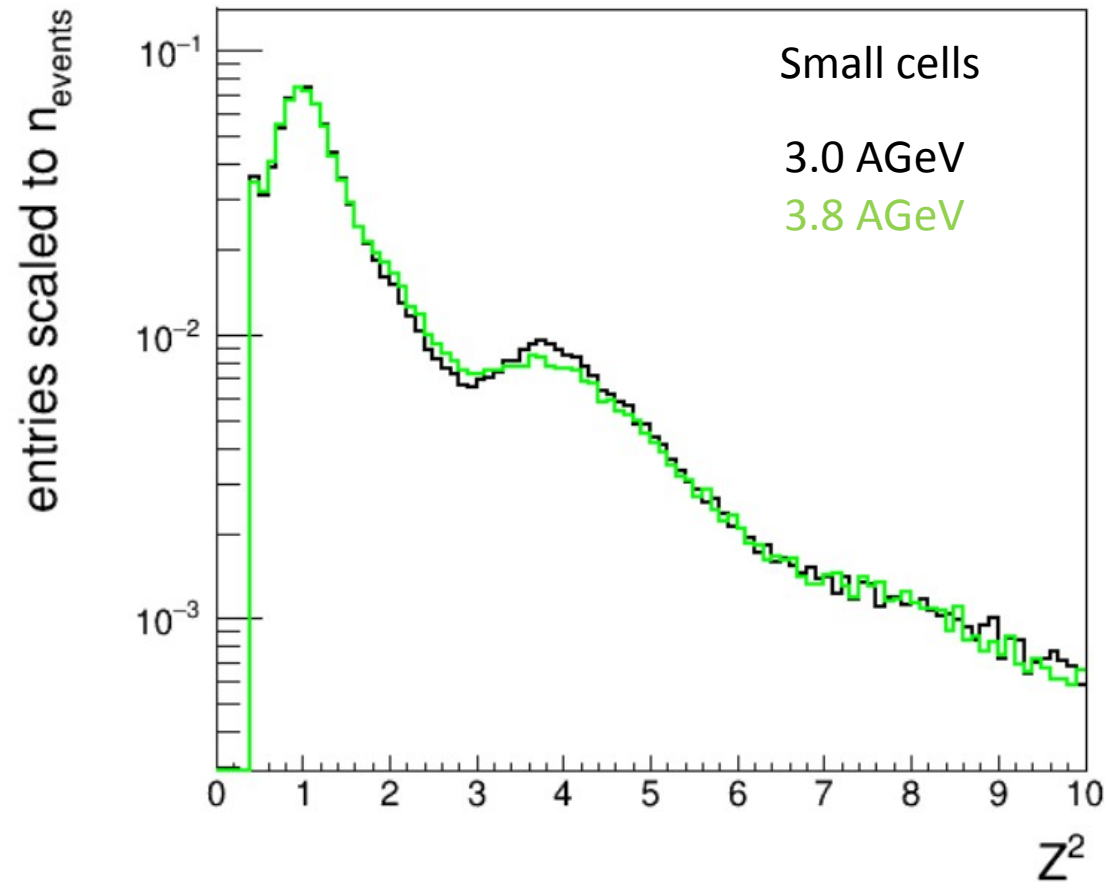
Status of forward detectors at BM@N facility



Charge distribution over the scintillation wall before/after calibration. A peaks corresponding to charges $Z = 1, 2$ can be clearly seen.

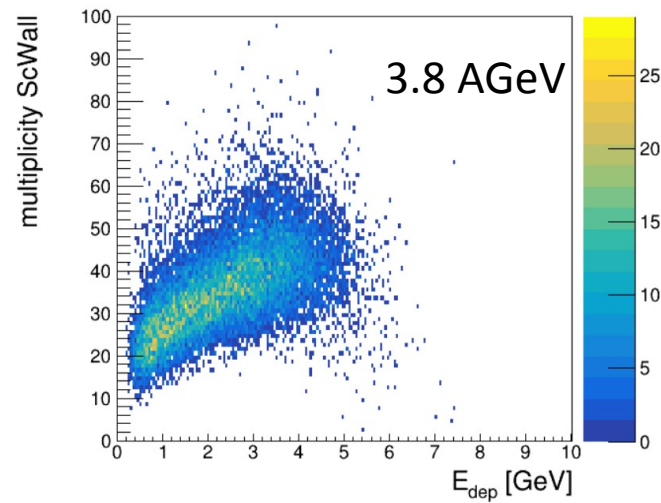
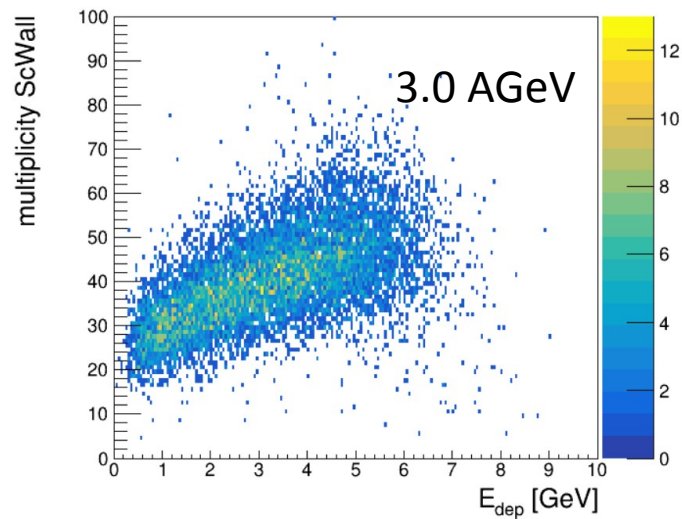
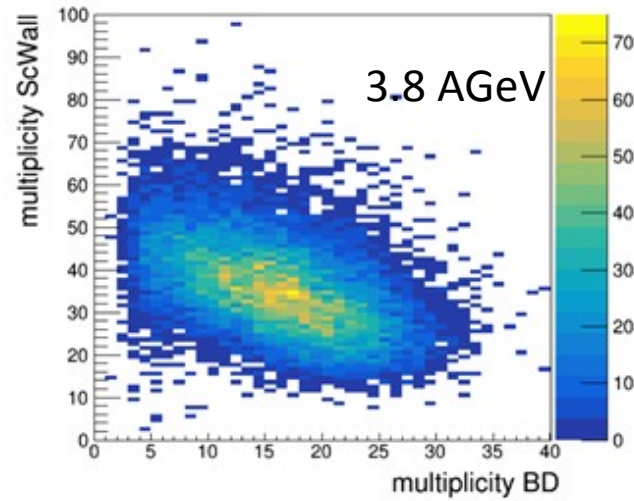
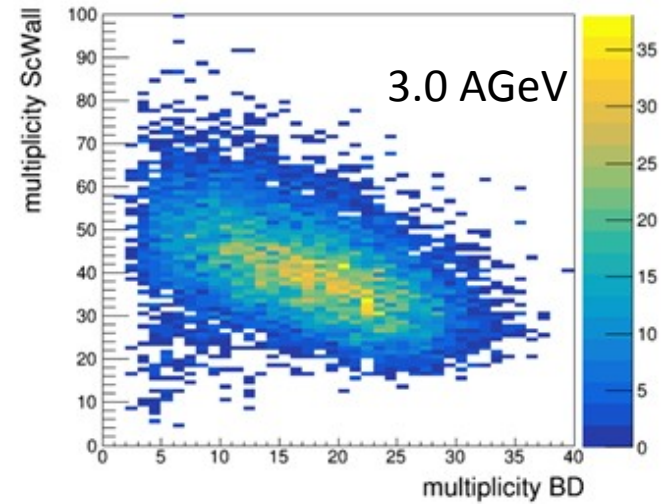
Cuts: BC1S (1Xe)

Runs: 8380, 81, 82, 84, 86, 87



- Comparison of the charge distributions over the scintillation wall for the two energies at 3.0 and 3.8 GeV for the CCT2 trigger.
- The two cell types (small and big) are presented separately.
- It can be seen that the distributions are very similar, with a slight difference in the second peak.

Multiplicity in ScWall / multiplicity in BD



Multiplicity correlates with energy deposition in the calorimeter, and anticorrelates with multiplicity in BD.

Cuts:

BC1S

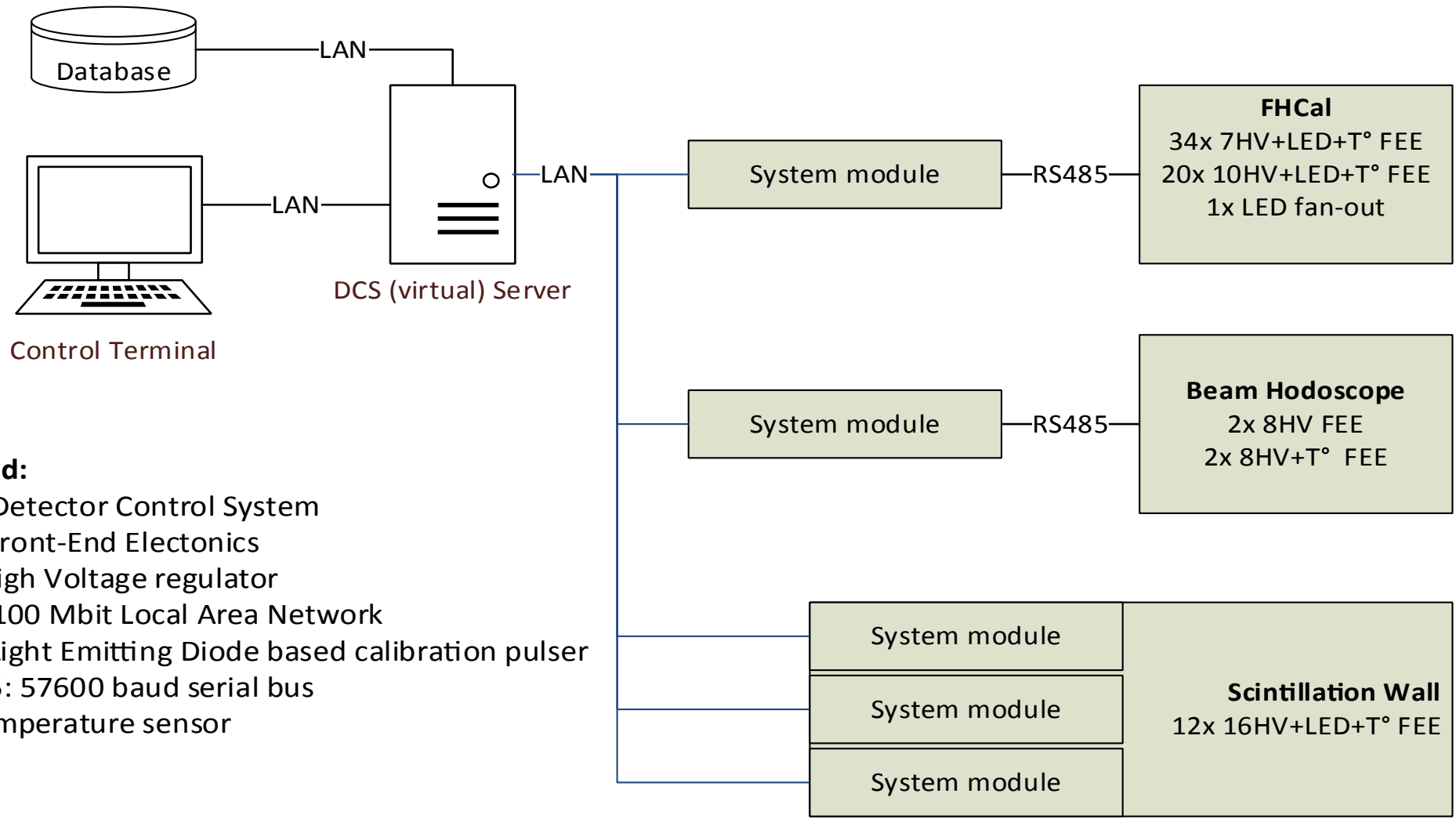
Z^2 (ScWall) > 0.4

vertex Z (-1.5 < Z < 1.5)

Z^2 (FQH) < 100

CCT2

Forward Detectors DCS schematic view

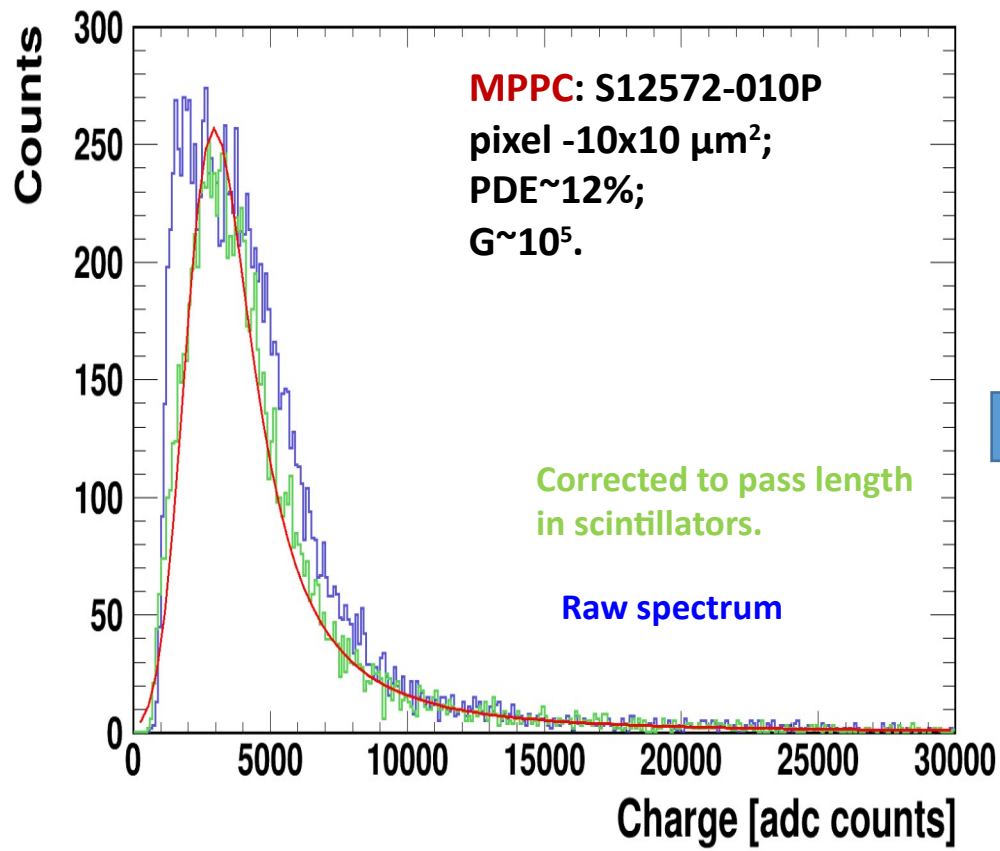


Legend:

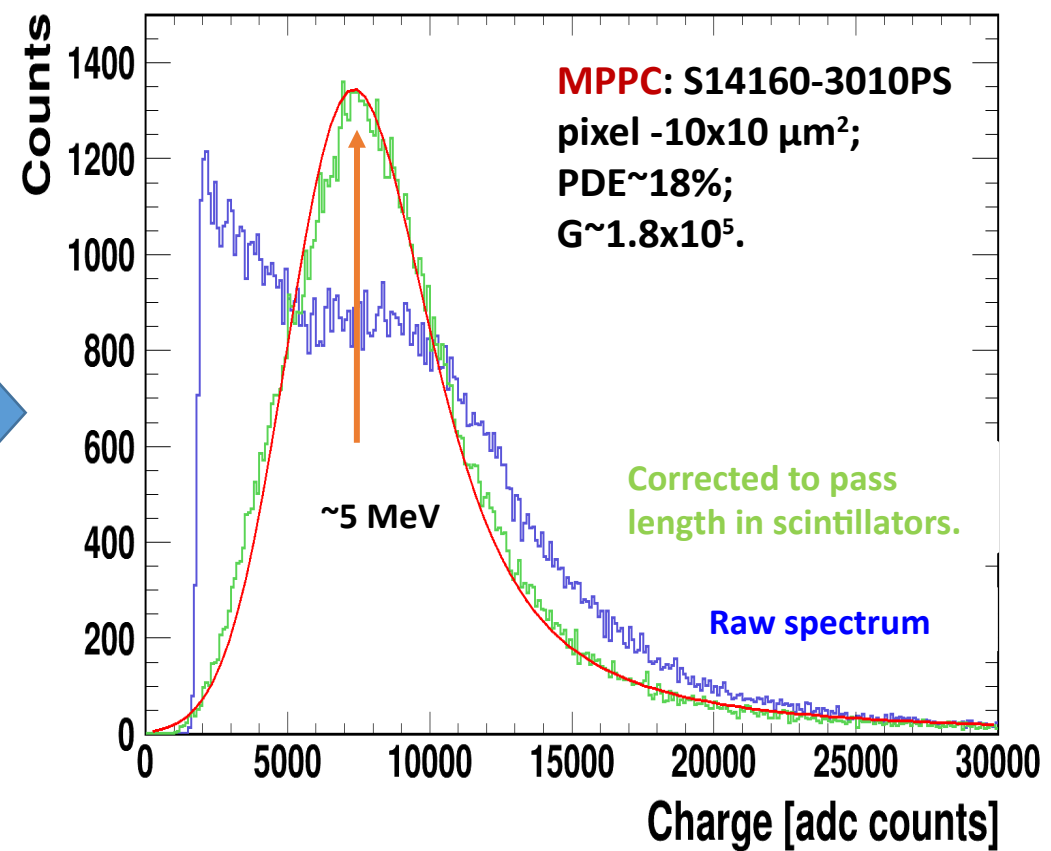
- DCS: Detector Control System
- FEE: Front-End Electronics
- HV: High Voltage regulator
- LAN: 100 Mbit Local Area Network
- LED: Light Emitting Diode based calibration pulser
- RS485: 57600 baud serial bus
- T°: temperature sensor

FHCal upgrade proposal: Replacement of existing MPPCs in the FHCal to new ones

Current version



Proposed version



Summary:

- FHCaI, FQH and ScWall have been used in run8 period of BM@N
- FHCaI angle of rotation is fixed to have beam parallel to FHCaI beam hole
- some failure channels in FHCaI and ScWall has been fixed

Outlook:

FHCaI:

- change of SiPMs for better signal-to-noise ratio samples is in plans
- possible change of large CBM modules → MPD FHCaI modules is under discussion now
- beam hole – no beam hole ? Possible nZDC (“neutron ZDC”) configuration is under study (MC needed)

ScWall:

- position of ScWall → should we return it to FHCaI frame (if FHCaI will be nZDC)? (MC needed)