



Test Beam Analysis: Muon data TB 2017 – 2018, Sr data analysis results

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The Tile Calorimeter Week

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Outline

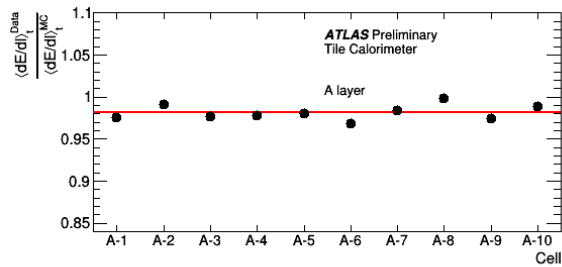
- Test Beam results 2017-2018
- Sr data analysis results

Outline

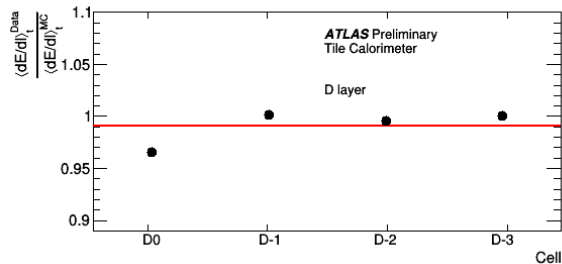
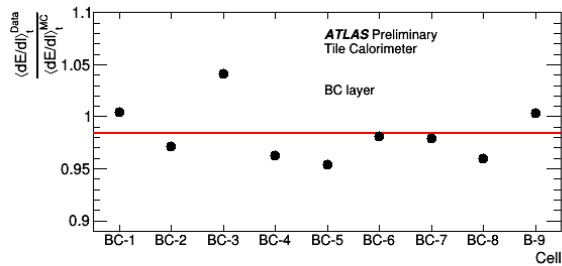
- **Test Beam results 2017-2018**
 - Demonstrator response to muon beams
- Sr data analysis results

TB data / MC – ntuples v.3

2017 JUNE data – 165 GeV



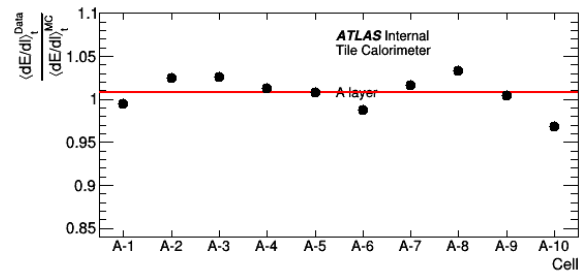
Layer	Mean	St.Err.on Mean
A	0.981	0.003
BC	0.984	0.009
D	0.991	0.008



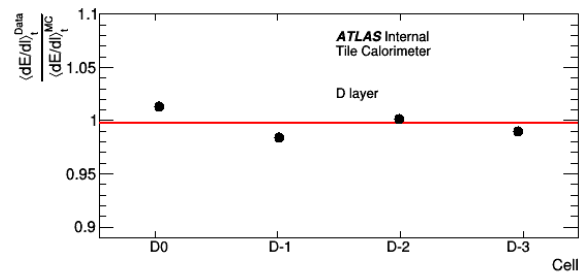
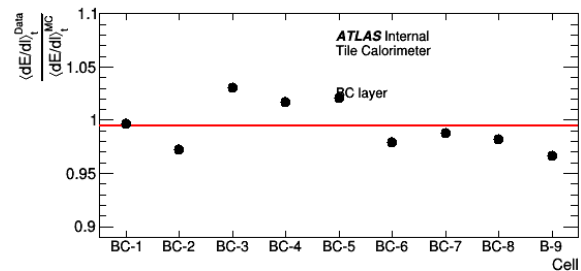
Cuts:

- Signal in last cell of LBC
- BC cuts:
|X1|<10mm && |Y1|<10mm &&
2.5 < Tot.E_Demo < 20 GeV
- HighGain = 1 in every channel of a layer

2018 MAY data – 160 GeV



Layer	Mean	St.Err.on Mean
A	1.007	0.006
BC	1.001	0.007
D	1.003	0.006

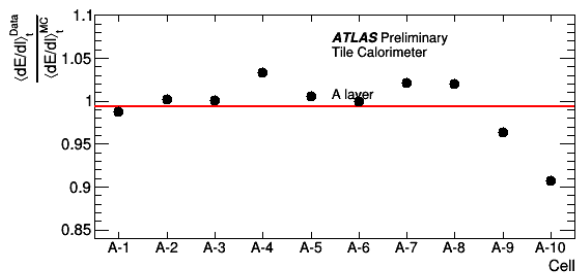


Cuts:

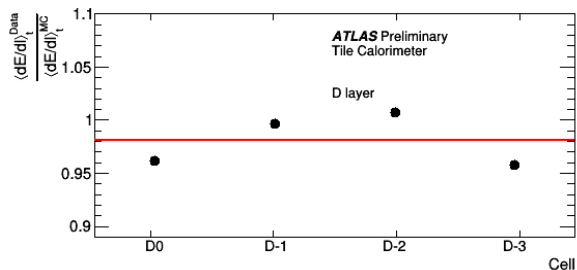
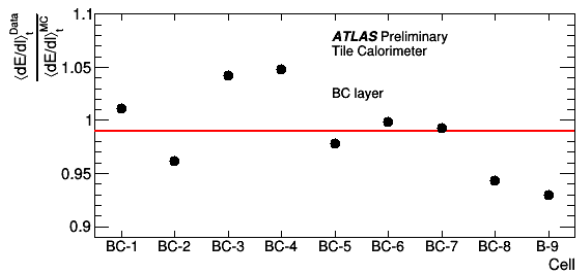
- Signal in last cell of LBC
- BC cuts:
|X1|<10mm && |Y1|<10mm &&
2.5 < Tot.E_Demo < 20 GeV
- HighGain = 1 in every channel of a layer

TB data / MC – ntuples v.3

2017 September data – 165 GeV



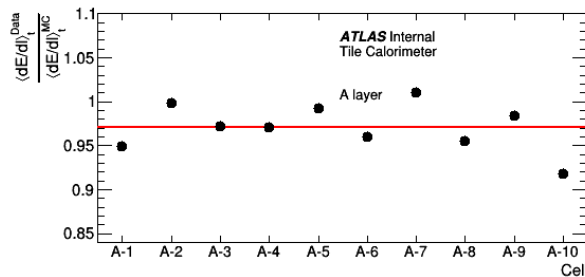
Layer	Mean	St.Err.on Mean
A	0.994	0.011
BC	0.990	0.011
D	0.981	0.011



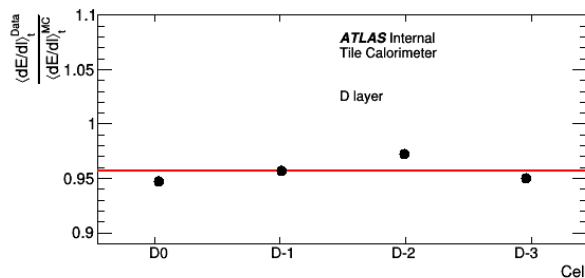
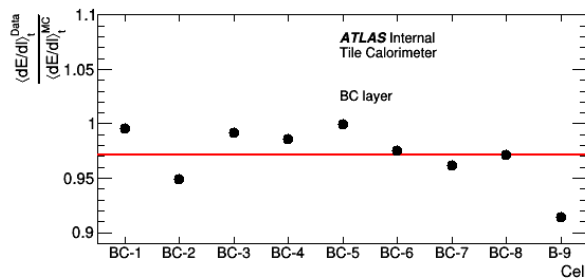
Cuts:

- Signal in last cell of LBC
- BC cuts:
|X1|<10mm && |Y1|<10mm && 2.5 < Tot.E_Demo < 20 GeV
- HighGain = 1 in every channel of a layer

2018 November data – 300 GeV



Layer	Mean	St.Err.on Mean
A	0.971	0.008
BC	0.971	0.005
D	0.957	0.005

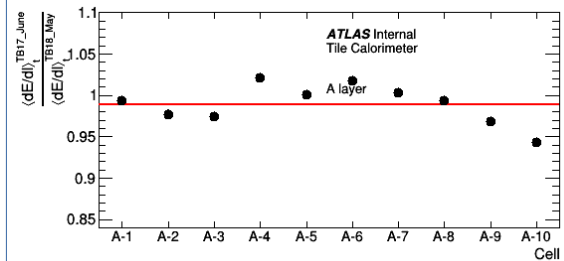


Cuts:

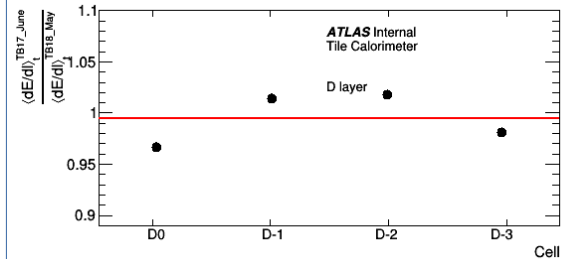
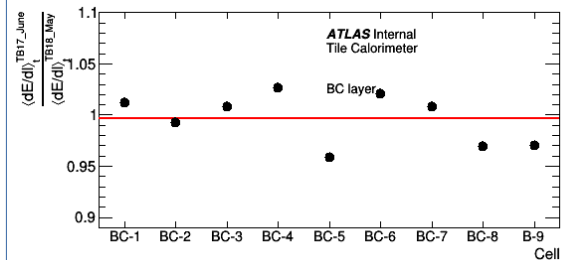
- Signal in last cell of LBC
- BC cuts:
|X1|<10mm && |Y1|<10mm && 2.5 < Tot.E_Demo < 20 GeV
- HighGain = 1 in every channel of a layer

$dE/dx_{TB17} / dE/dx_{TB18}$

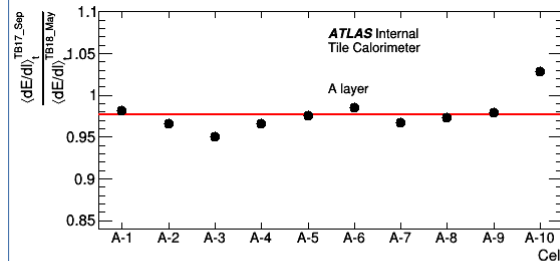
$dE/dx_{TB17_June} / dE/dx_{TB18_May}$



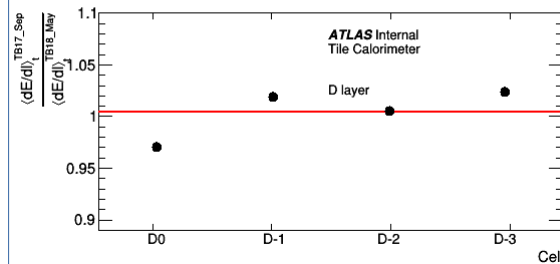
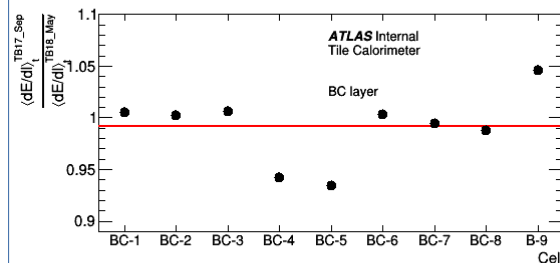
Layer	Mean	St.Err.onMean
A	0.990	0.007
BC	0.996	0.008
D	0.995	0.011



$dE/dx_{TB17_Sep} / dE/dx_{TB18_May}$



Layer	Mean	St.Err.onMean
A	0.977	0.006
BC	0.991	0.010
D	1.005	0.010



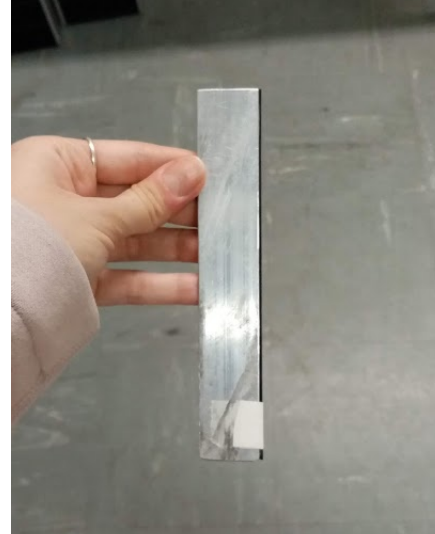
Outline

- Test Beam results 2017-2018
- **Sr data analysis results**
 - Motivation: Study central response dependence on the tile size and tile material.
 - In March-May 2021 two types of tiles (PSM and BASF) have been scanned with Sr source.
 - For each tile size three samples have been chosen and irradiated.

Fiber holder I



Fiber holder II (metallic) – chosen for now



R value – Sr and Muon data

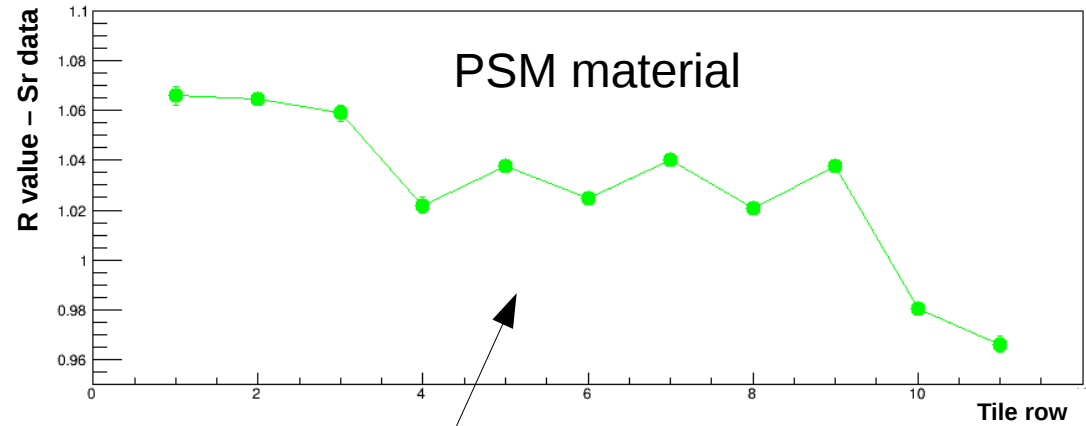
$$R = \langle E_{\text{central}} \rangle / \langle E_{\text{tot.surface}} \rangle,$$

$\langle E_{\text{central}} \rangle$ - $\langle R \rangle$ response in the central region (2x2cm square)

$\langle E_{\text{tot.surface}} \rangle$ is $\langle R \rangle$ response from total surface of the tile.

Cuts:

- To select central region - **square** center 2x2cm cut;
- To select total surface – x and y coordinate based cut.



Tiles	DataSet I - PSM (T1-3) + BASF (T4-11)	DataSet II - PSM (T1-3) + BASF (T4-11)	DataSet II - All BASF	DataSet II – All PSM	DataSet IV - All PSM	DataSet IV – All BASF	165/300 GeV mu data
T1 <R>	1.07134 +- 0.000828504	1.07497 +- 0.00101095	1.09035 +- 0.0022	1.07497 +- 0.0010	1.06602 +- 0.0037	1.08316 +- 0.0018642	-
T2 <R>	1.05816 +- 0.000190944	1.07335 +- 0.00194893	1.08992 +- 0.0011	1.07335 +- 0.0019	1.06467 +- 0.0022	1.07908 +- 0.00278856	1.089 +- 0.002 (165 GeV)
T3 <R>	1.06684 +- 0.000281842	1.07066 +- 0.00222251	1.10183 +- 0.0013	1.07066 +- 0.0022	1.05894 +- 0.0032	1.08874 +- 0.00168099	-
T4 <R>	1.06204 +- 0.00066014	1.0622 +- 0.001027806	1.0622 +- 0.00102	-	1.02188 +- 0.0033	1.05773 +- 0.00159839	-
T5 <R>	1.07005 +- 0.000244322	1.06759 +- 0.00112396	1.06759 +- 0.0011	1.04759 +- 0.0015	1.03784 +- 0.0002	1.06088 +- 0.000972412	-
T6 <R>	1.06078 +- 0.000245413	1.06103 +- 0.00301361	1.06103 +- 0.0030	1.02612 +- 0.00067	1.02497 +- 0.0010	1.05556 +- 0.00142313	1.062 +- 0.004 (300 GeV)
T7 <R>	1.05767 +- 0.000177228	1.05172 +- 0.00114151	1.05172 +- 0.0011	1.04859 +- 0.00042	1.03859 +- 0.0007	1.0507 +- 0.000704054	-
T8 <R>	1.05277 +- 0.000232373	1.05855 +- 0.000450387	1.05855 +- 0.0005	1.02808 +- 0.00228	1.02279 +- 0.0011	1.05555 +- 0.00071865	-
T9 <R>	1.05386 +- 0.00035538	1.05664 +- 0.00192061	1.05664 +- 0.0019	1.05368 +- 0.0033	1.04417 +- 0.0036	1.05135 +- 0.000862519	-
T10 <R>	1.03192 +- 0.00033315	1.03249 +- 0.00027	1.03249 +- 0.0003	1.00753 +- 0	0.98798 +- 0.0037	1.03427 +- 0.000767384	1.058 +- 0.005 (300 GeV)
T11 <R>	1.03658 +- 0.000658718	1.03038 +- 0.00101168	1.03038 +- 0.0010	-	0.96604 +- 0.0033	1.03289 +- 0.00179114	-
<A>	1.06544 +- 0.00386866	1.07299 +- 0.00125825	1.09404 +- 0.00389		1.0632 +- 0.002170	1.08366 +- 0.00279875	
<BC>	1.05953 +- 0.00258124	1.05962 +- 0.00219497	1.05962 +- 0.0022		1.0317 +- 0.00392	1.0553 +- 0.00157022	
<D>	1.03425 +- 0.00232906	1.03144 +- 0.00105497	1.03144 +- 0.0010		0.9770 +- 0.010968	1.03358 +- 0.000690377	
<A>/<BC>	1.00558 +- 0.004397	1.01262 +- 0.00241039	1.03248 +- 0.0042		1.0306 +- 0.0044	1.02688 +- 0.00306076	1.025424
<A>/<D>	1.03016 +- 0.00440154	1.04029 +- 0.00161874	1.06069 +- 0.0039		1.0882 +- 0.0124	1.04846 +- 0.00279692	1.029301

Our testing module's (LB65) A layer consists of mixture of PSM and BASF tiles.

R value – Sr and Muon data

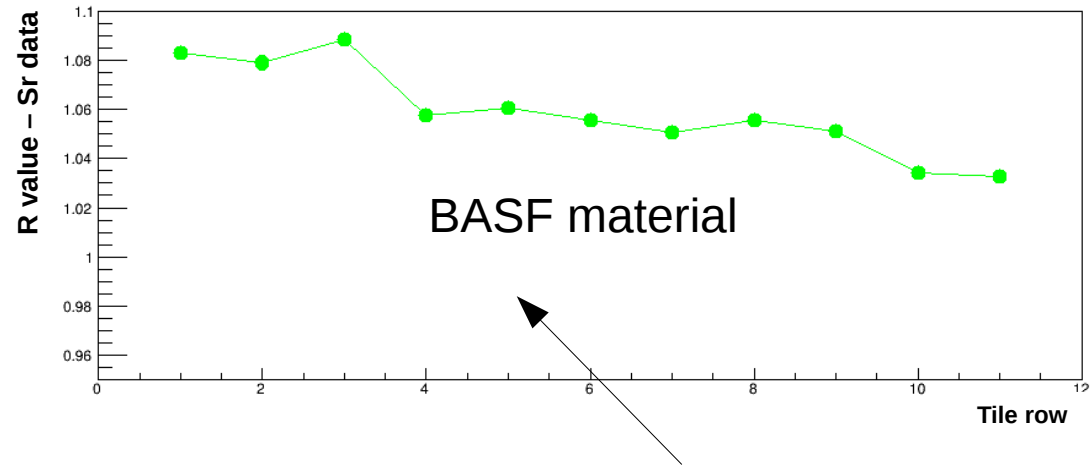
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Cuts:

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<A>	1.06544 +- 0.00386866	1.07299 +- 0.00125825	1.09404 +- 0.00389		1.0632 +- 0.002170	1.08366 +- 0.00279875	
<BC>	1.05953 +- 0.00258124	1.05962 +- 0.00219497	1.05962 +- 0.0022		1.0317 +- 0.00392	1.0553 +- 0.00157022	
<D>	1.03425 +- 0.00232906	1.03144 +- 0.00105497	1.03144 +- 0.0010		0.9770 +- 0.010968	1.03358 +- 0.000690377	
<A>/<BC>	1.00558 +- 0.004397	1.01262 +- 0.00241039	1.03248 +- 0.0042		1.0306 +- 0.0044	1.02688 +- 0.00306076	1.025424
<A>/<D>	1.03016 +- 0.00440154	1.04029 +- 0.00161874	1.06069 +- 0.0039		1.0882 +- 0.0124	1.04846 +- 0.00279692	1.029301

Our testing module's (LB65) A layer consists of mixture of PSM and BASF tiles.

Summary

- 2017-2018 TileCal TB muon data have been analyzed and compared to MC.
- We see fluctuations in Demonstrator's cells responses.
- In March-May 2021 two types of tiles have been scanned with Sr source.
- For both PSM and BASF material we see that R ratio is decreasing with increasing of tile size.
- Muon data results are most compatible with Sr data recorded using Fiber holder II (fiber profile inserted in a metallic holder).

Thank you!

Backup

Comparison of different types of tiles – using Sr data set II

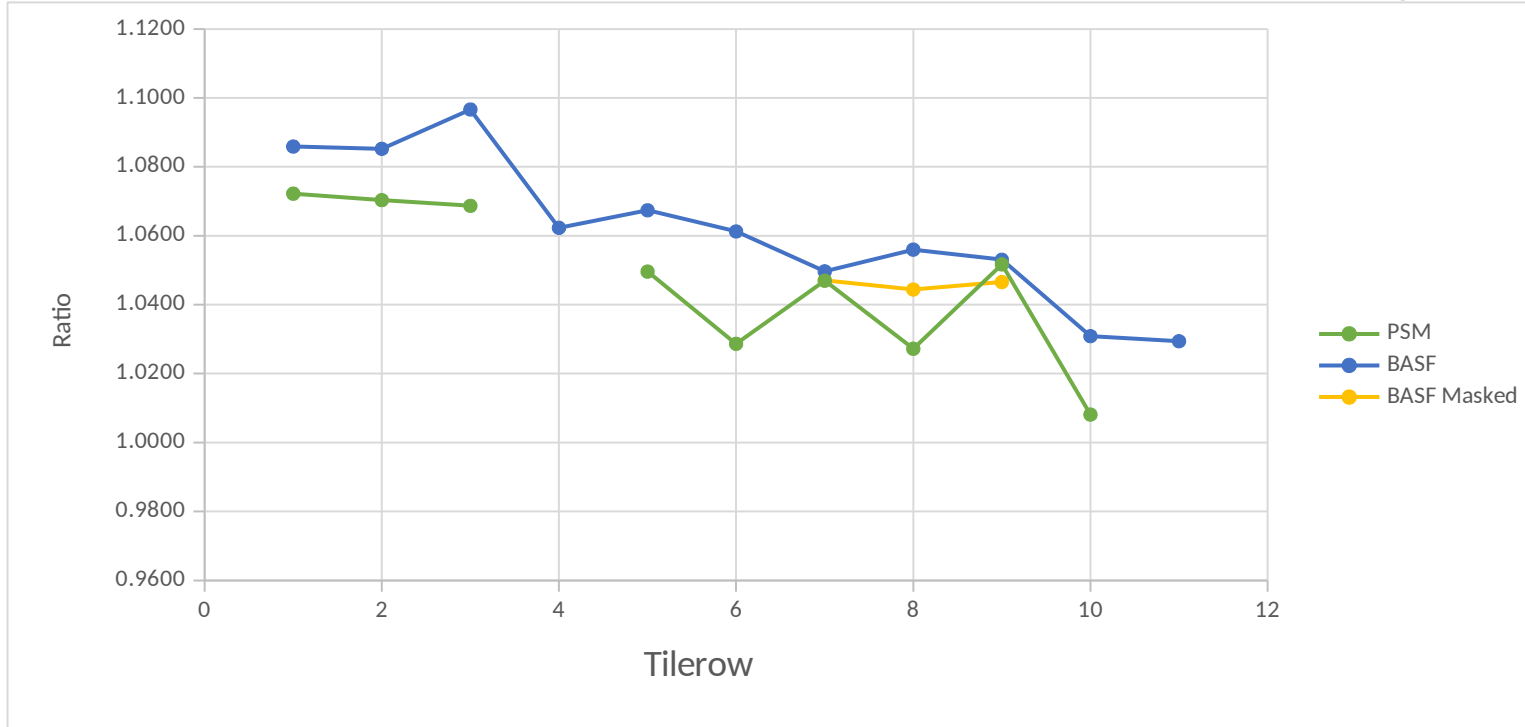
Our shape cuts – Tile region geometry cuts:

-0 mm from all 4 sides.

Energy cut:

$0 < \text{Signal} - \langle \text{Ped} \rangle < 1$

PSM: Tile rows 4 and 11 are missing, We have to understand the big oscillations in the region $5 \leq \text{Tile row} \leq 10$



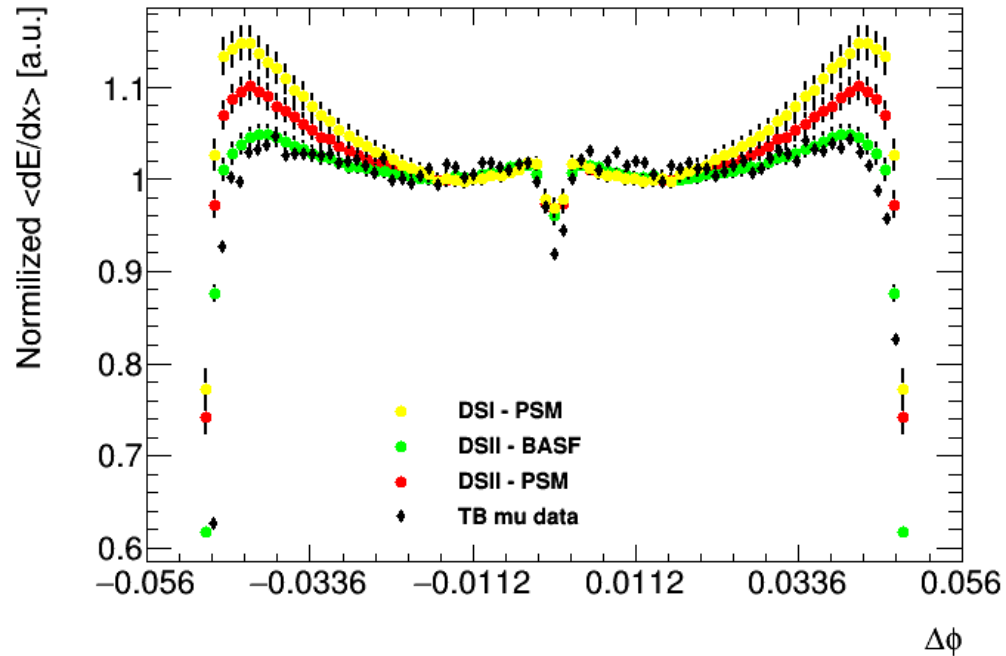
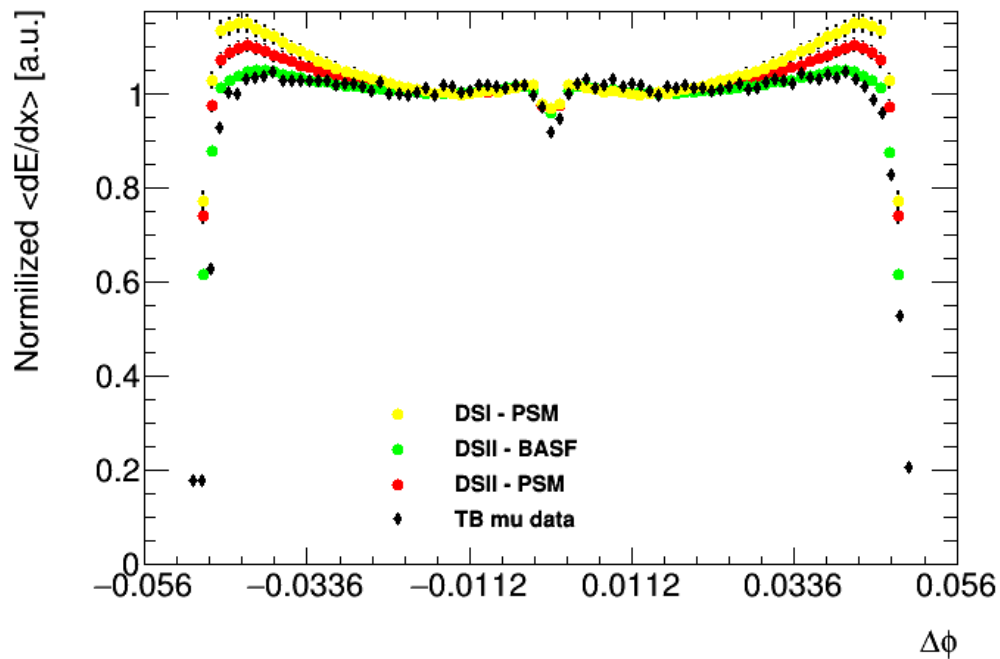
Sr data set II: Three samples and three sets for each tile

Edge masking

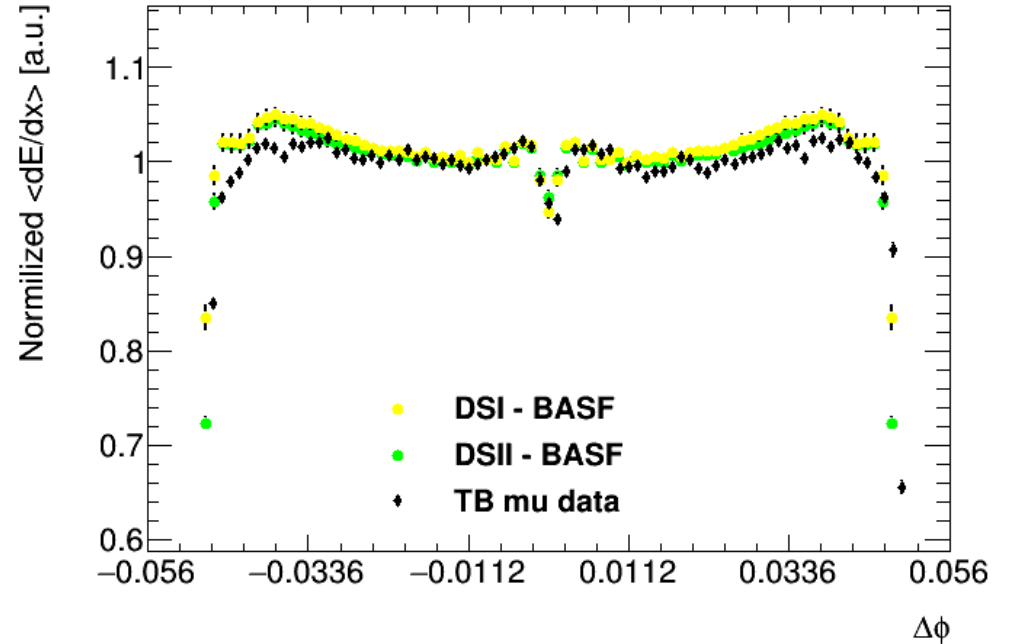
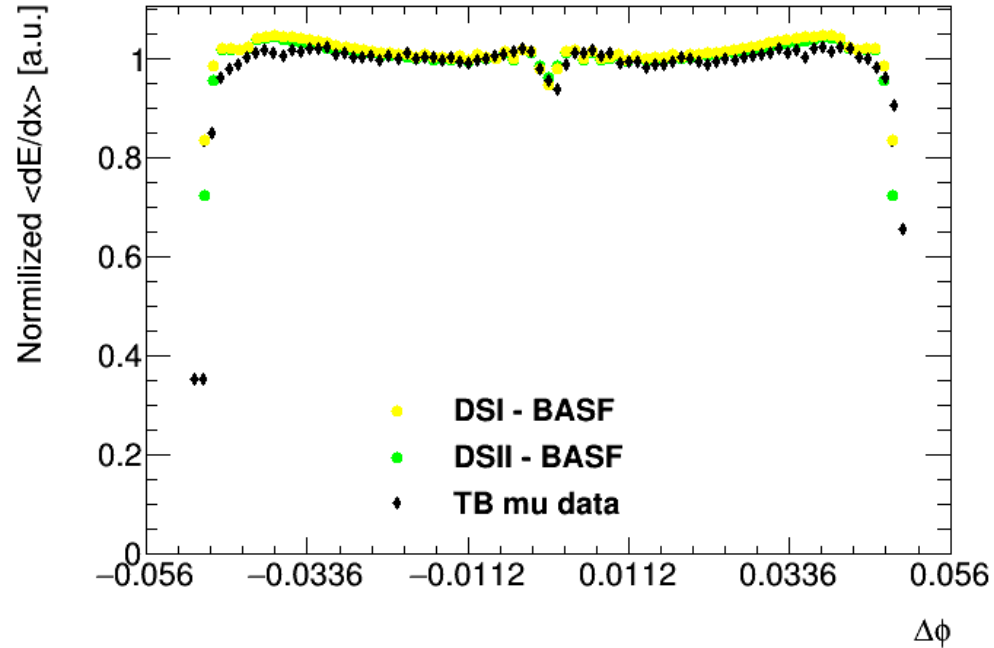
The scintillator tiles, used in Tile Calorimeter were produced in several batches, and there were two different materials used, PSM-115 and BASF-165H. The scintillators were sorted, according to the light yield to provide uniformity of the cell. In some cases, especially in the barrel models, cells B-C had mixed type of material, in this case, to equalize the light output, BASF tiles 7,8,9 were painted with white paint on the readout edges, to reduce the amount of signal entering the fiber. Readout side edges were painted on the 4 extremities for 22mm. Barrel modules 15, 16, 18 to 30, 32 were equipped using this technique). The same procedure was applied for part of the **A cells of modules 64 and 65, where PSM and BASF tiles had to be combined.** The masking strips were 2x6 mm and 2x5 mm on each readout side respectively.

<https://twiki.cern.ch/twiki/bin/viewauth/Atlas/TileSr90Table>

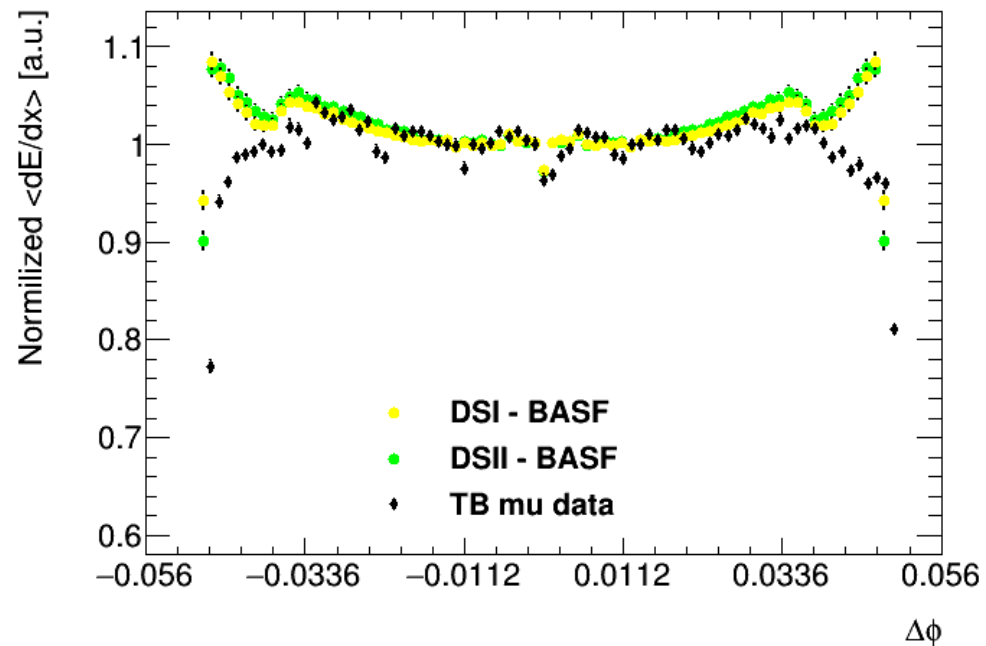
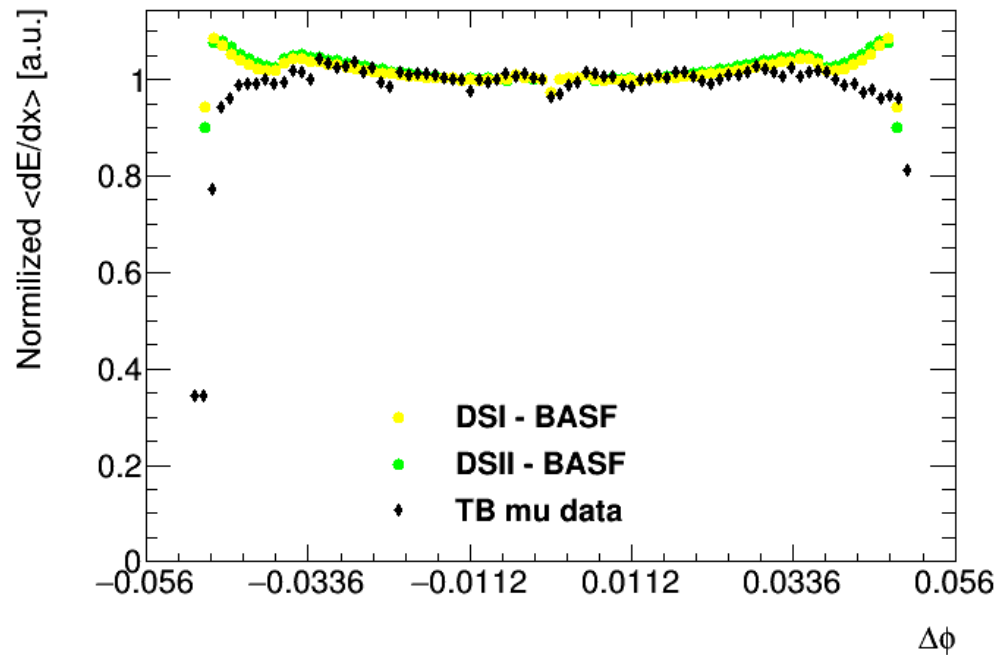
U-shapes: Tile 2



U-shapes: Tile 6

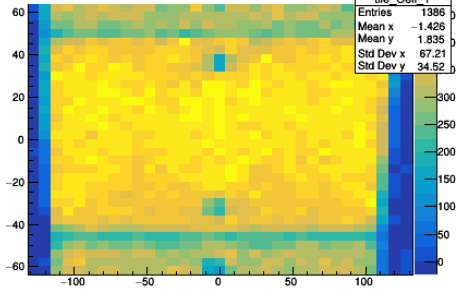


U-shapes: Tile 10

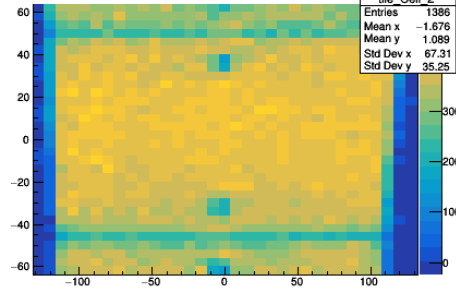


Tile 2 scan

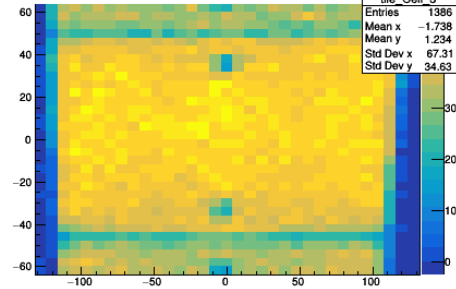
tile_Cell_1



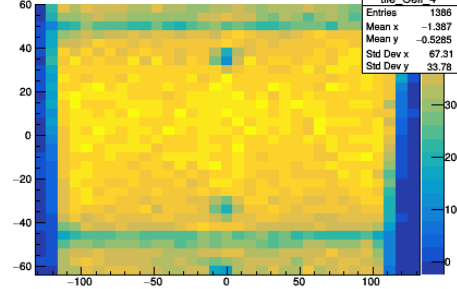
tile_Cell_2



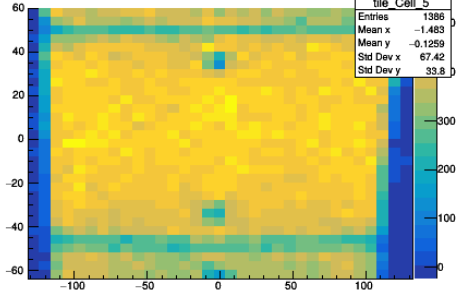
tile_Cell_3



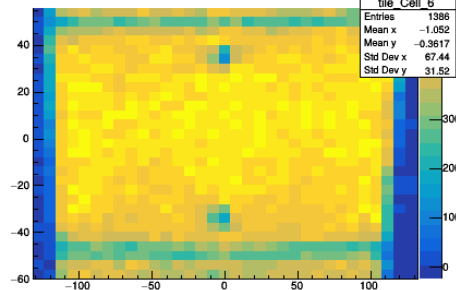
tile_Cell_4



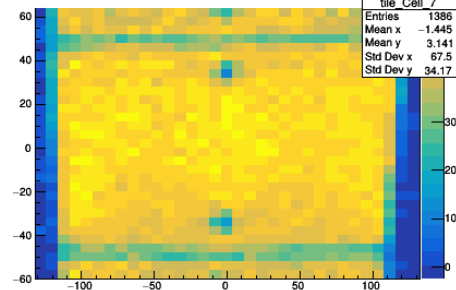
tile_Cell_5



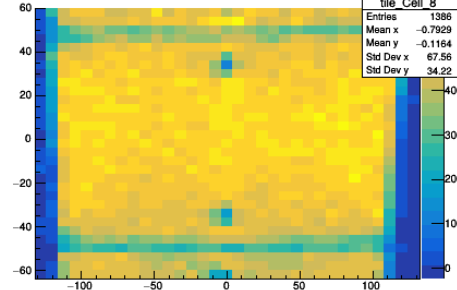
tile_Cell_6



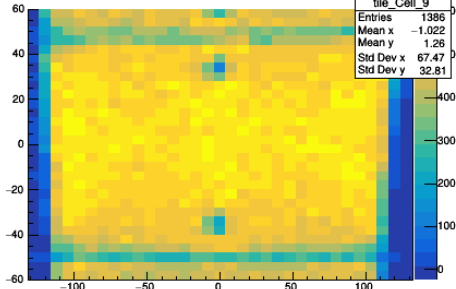
tile_Cell_7



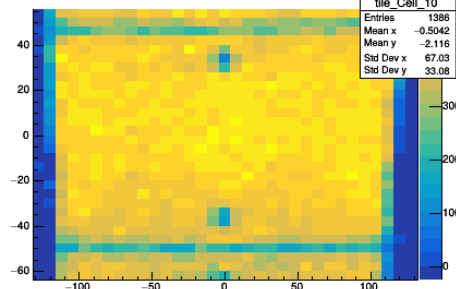
tile_Cell_8



tile_Cell_9



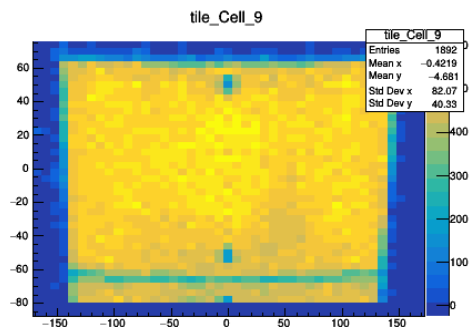
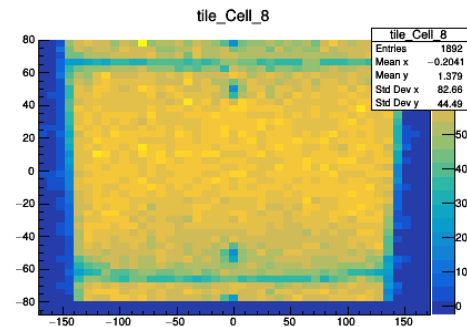
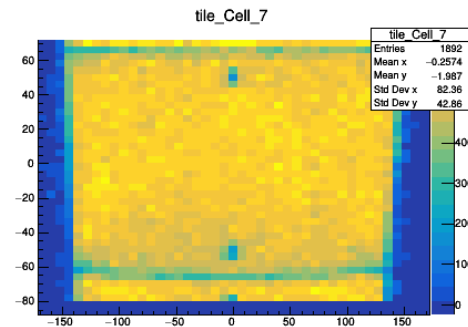
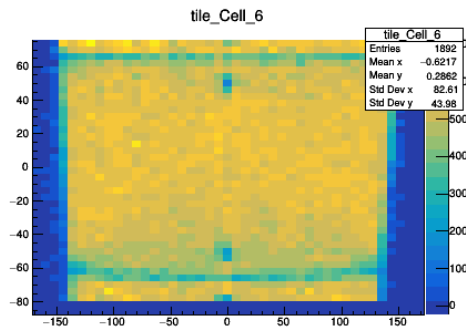
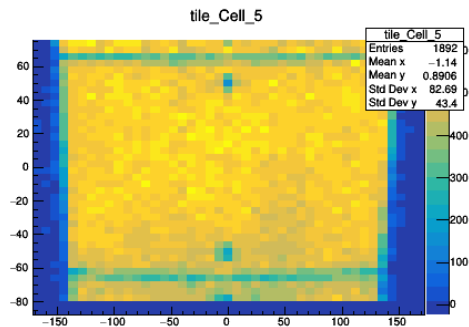
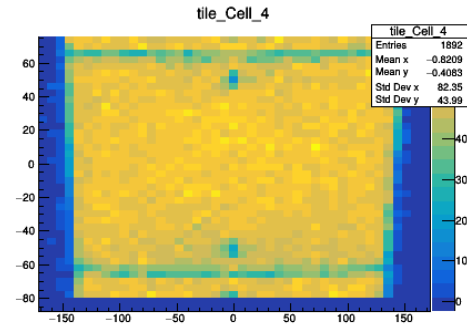
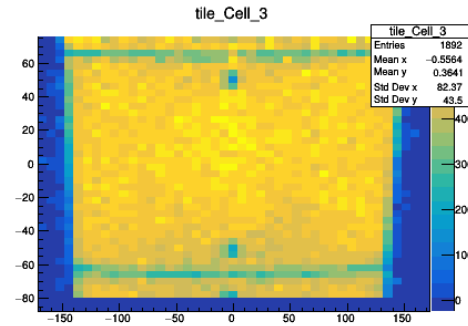
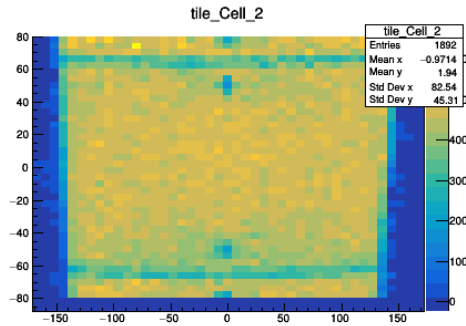
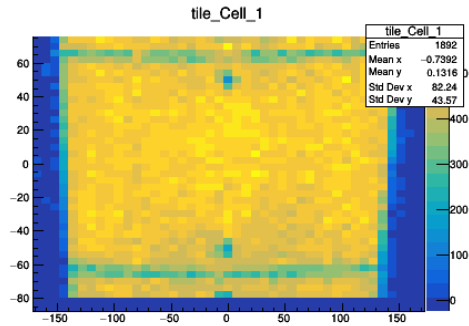
tile_Cell_10



Cuts:

- Tot.E in Demonstrator < 20 GeV
- Cuts on BC1 and BC2:
(Ycha1_0>-30 && Ycha1_0<20 && Xcha1_0>-50 && Xcha1_0<35) &&
(Ycha2_0>-30 && Ycha2_0<40 && Xcha2_0 > -55 && Xcha2_0<30)

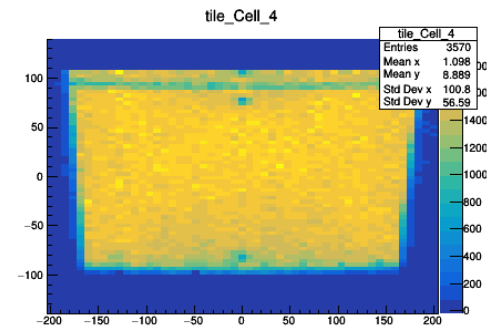
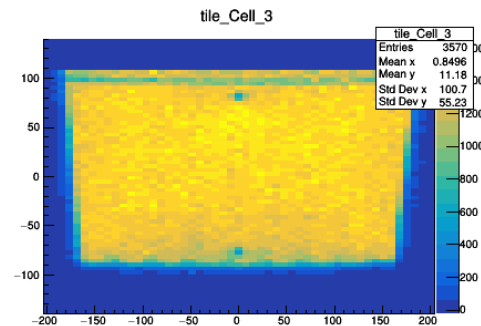
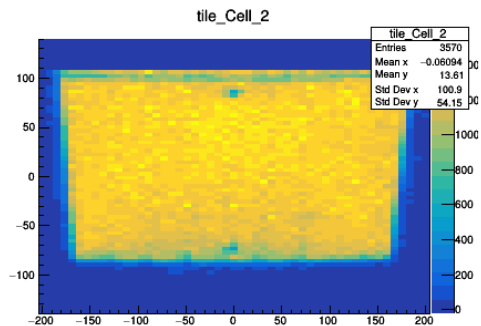
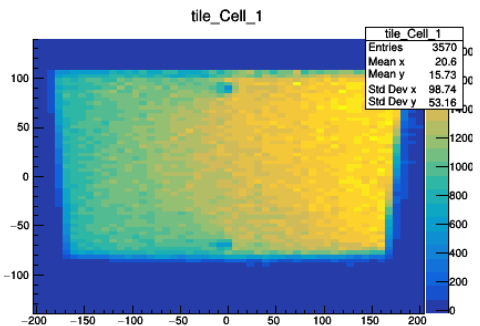
Tile 6 scan



Cuts:

- Tot.E in Demonstrator < 20 GeV
- Cuts on BC1 and BC2:
(Ycha1_0>-30 && Ycha1_0<20 && Xcha1_0>-50 && Xcha1_0<35) &&
(Ycha2_0>-30 && Ycha2_0<40 && Xcha2_0 > -55 && Xcha2_0<30)

Tile 6 scan

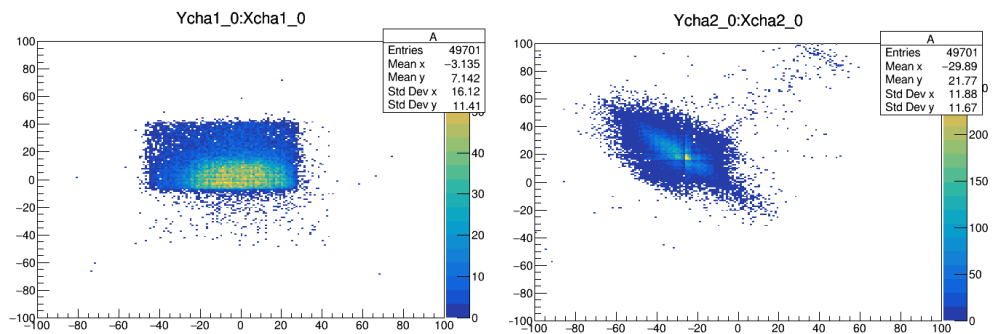


Cuts:

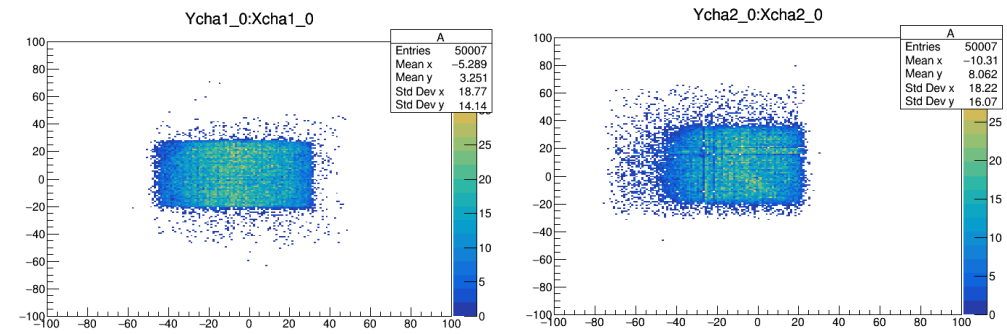
- Tot.E in Demonstrator < 20 GeV
- Cuts on BC1 and BC2:
(Ycha1_0>-30 && Ycha1_0<20 && Xcha1_0>-50 && Xcha1_0<35) &&
(Ycha2_0>-30 && Ycha2_0<40 && Xcha2_0 > -55 && Xcha2_0<30)

BC responses during 2017-2018 TBs

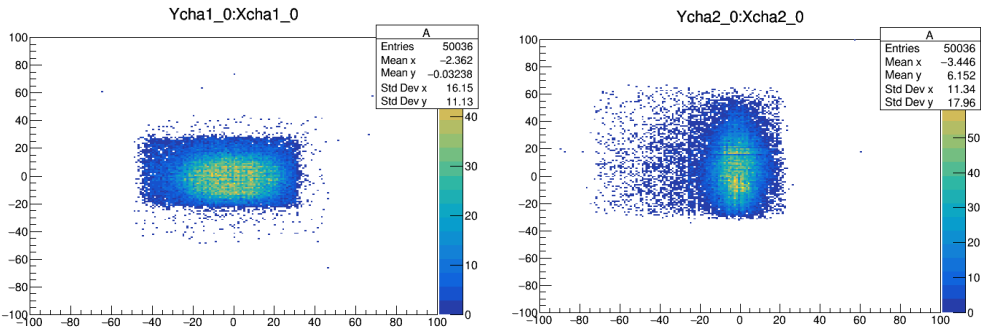
2017 June data



2018 May data



2017 September data



2018 November data

