HO Trigger Link Project

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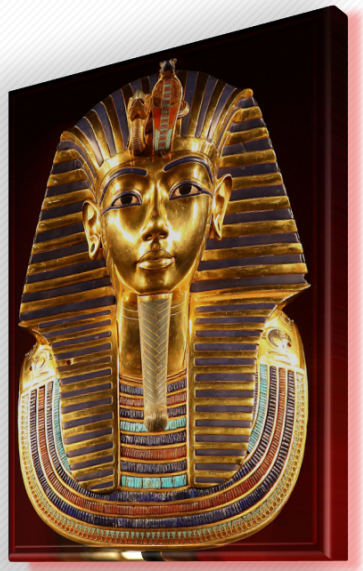
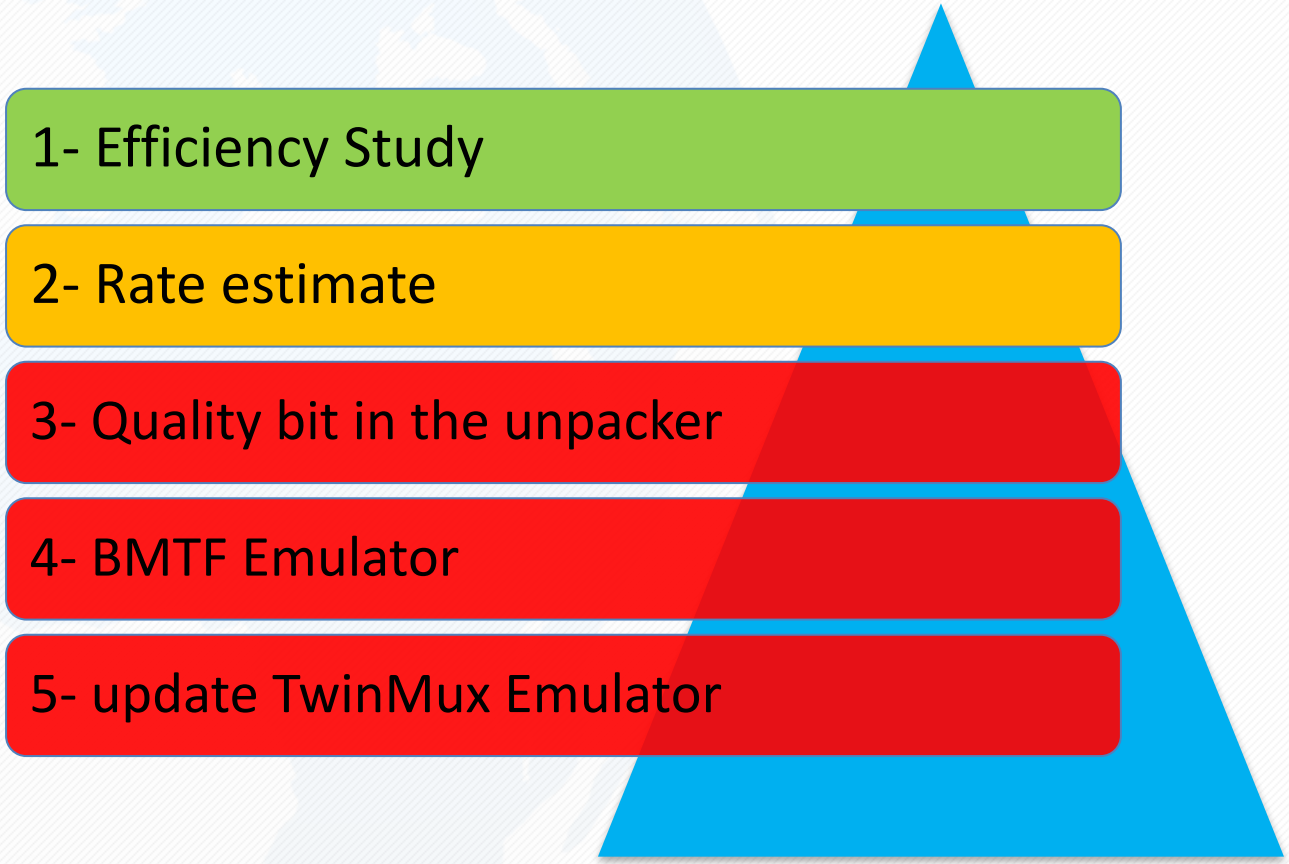
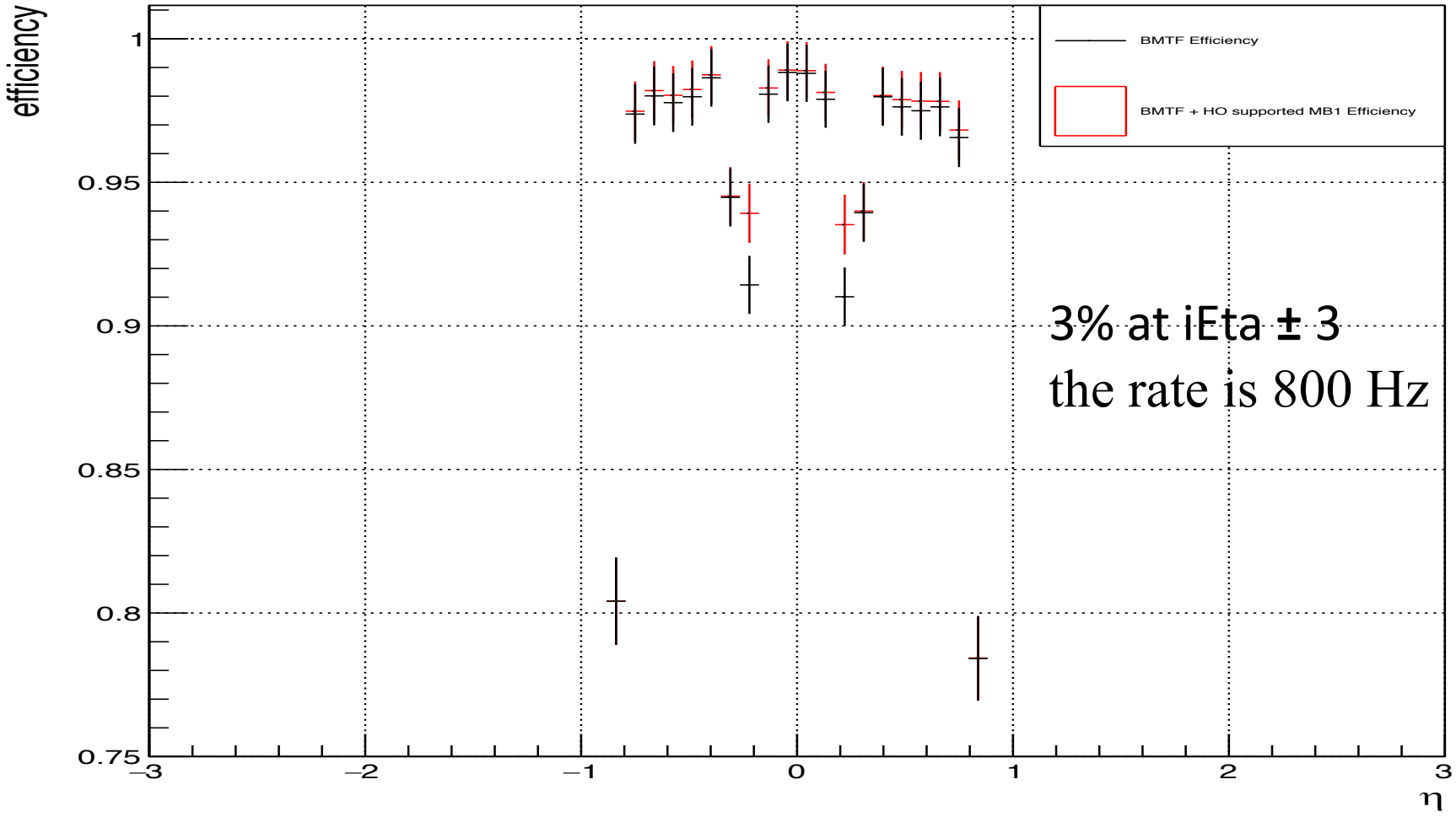


[1] Deutsches Elektronen-Synchrotron (DESY), Germany
[2] RWTH AACHEN III A, Germany
[3] TIFR, India

Needed tasks for BMTF



Efficiency study



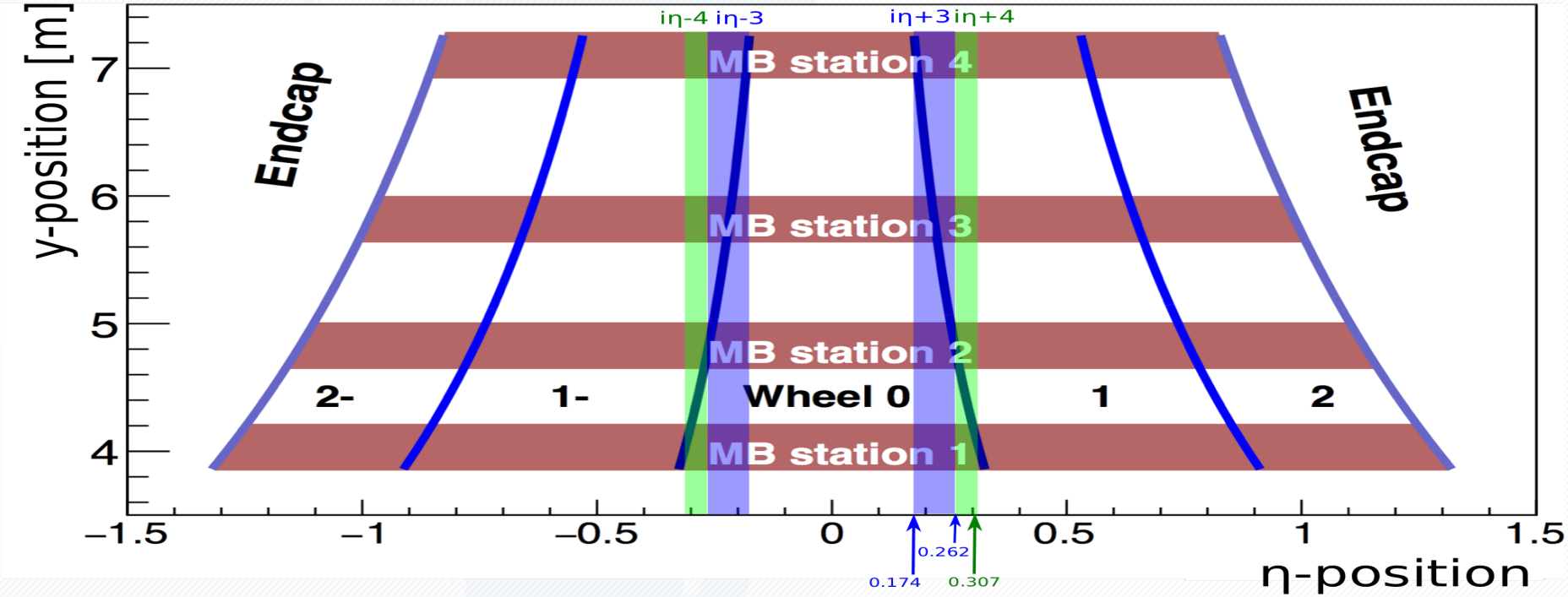
HO Validity bit

- I did contact Andrea Triossi about the HO validity bit.
- Up to now there isn't a quality bit for HO because HO doesn't contribute to the TwinMux algorithm, it is just readout through the HO word.
- There are 3 bits Q[2:0] that are the DT quality and 2 bits Q4 and Q3 that are the RPC quality bits.
- We can decide what quality bit do.
- One possibility could be to use the HO quality bit to increase the DT quality

Ho data BX-1	0x6	windex	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP
HO data BX=0	0x6	windex	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP
HO data BX+1	0x6	windex	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	valid bit	BCn	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP	MIP

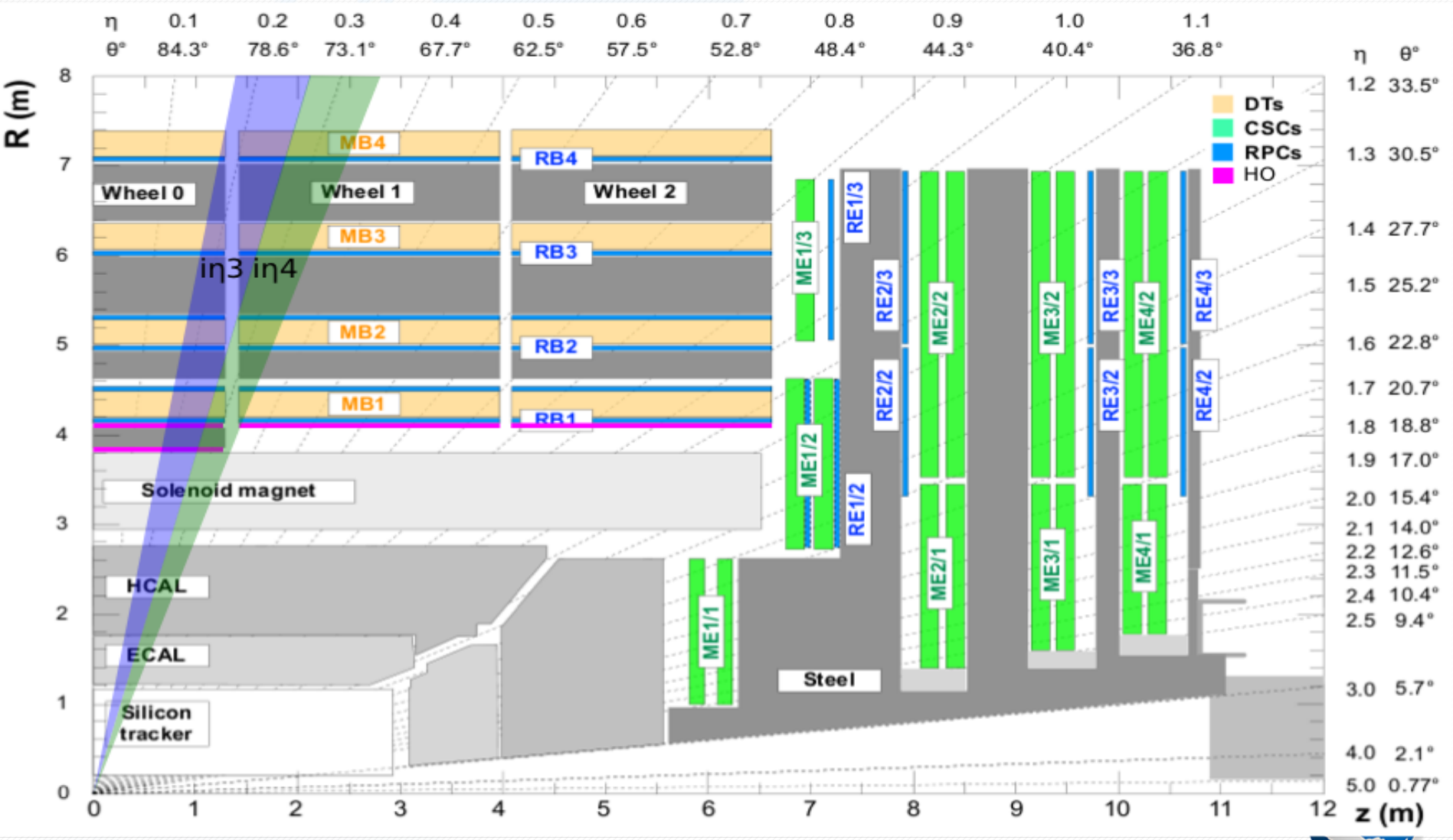
DT BX Info + MB1/2/3 theta input always present	0xC	BC0	L1A	0	0	0	0	bx offset (-4)	MB1 theta_HL [7:0]	MB1 theta [7:0]	MB2 theta_HL [7:0]	MB2 theta [7:0]	MB3 theta_HL [7:0]	MB3 theta [7:0]			
DT MB1 // MB1 output	0x1	P	FS	Ud	0	0	Q[2:0]	MB1 phi_bending [9:0]	MB1 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB1 phi_bending [9:0]	MB1 phi_value [11:0]
DT MB1 // MB1 output second track	0x1	P	FS	Ud	0	0	Q[2:0]	MB1 phi_bending [9:0]	MB1 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB1 phi_bending [9:0]	MB1 phi_value [11:0]
DT MB2 // MB2 output	0x2	P	FS	Ud	0	0	Q[2:0]	MB2 phi_bending [9:0]	MB2 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB2 phi_bending [9:0]	MB2 phi_value [11:0]
DT MB2 // MB2 output second track	0x2	P	FS	Ud	0	0	Q[2:0]	MB2 phi_bending [9:0]	MB2 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB2 phi_bending [9:0]	MB2 phi_value [11:0]
DT MB3 // MB3 output	0x3	P	FS	Ud	0	0	Q[2:0]	MB3 phi_bending [9:0]	MB3 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB3 phi_bending [9:0]	MB3 phi_value [11:0]
DT MB3 // MB3 output second track	0x3	P	FS	Ud	0	0	Q[2:0]	MB3 phi_bending [9:0]	MB3 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB3 phi_bending [9:0]	MB3 phi_value [11:0]
DT MB4 // MB4 output	0x4	P	FS	Ud	0	0	Q[2:0]	MB4 phi_bending [9:0]	MB4 phi_value [11:0]	P	FS	Ud	Q4	Q3	Q[2:0]	MB4 phi_bending [9:0]	MB4 phi_value [11:0]

Additional checks

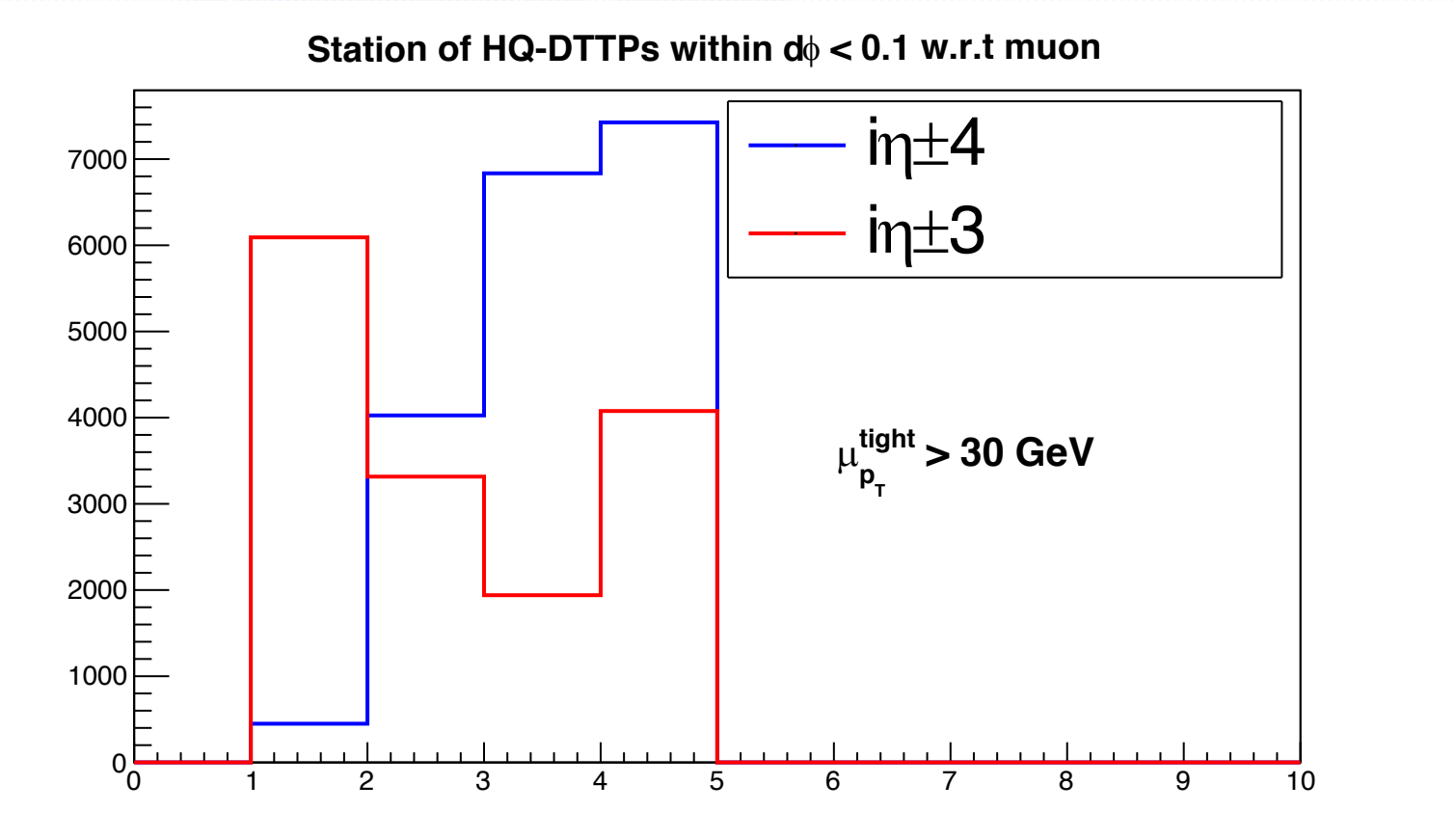


The y-projection of the muon stations 1 to 4. A straight muon track has a fixed η-value on the x-axis, i.e. it'll be a vertical straight line. The curved and bold blue lines are the wheel gaps. The shaded blue and green regions show the positions of HO iη tiles 3 and 4 respectively. Note that HO tile iη 4 has half the width of iη 3.

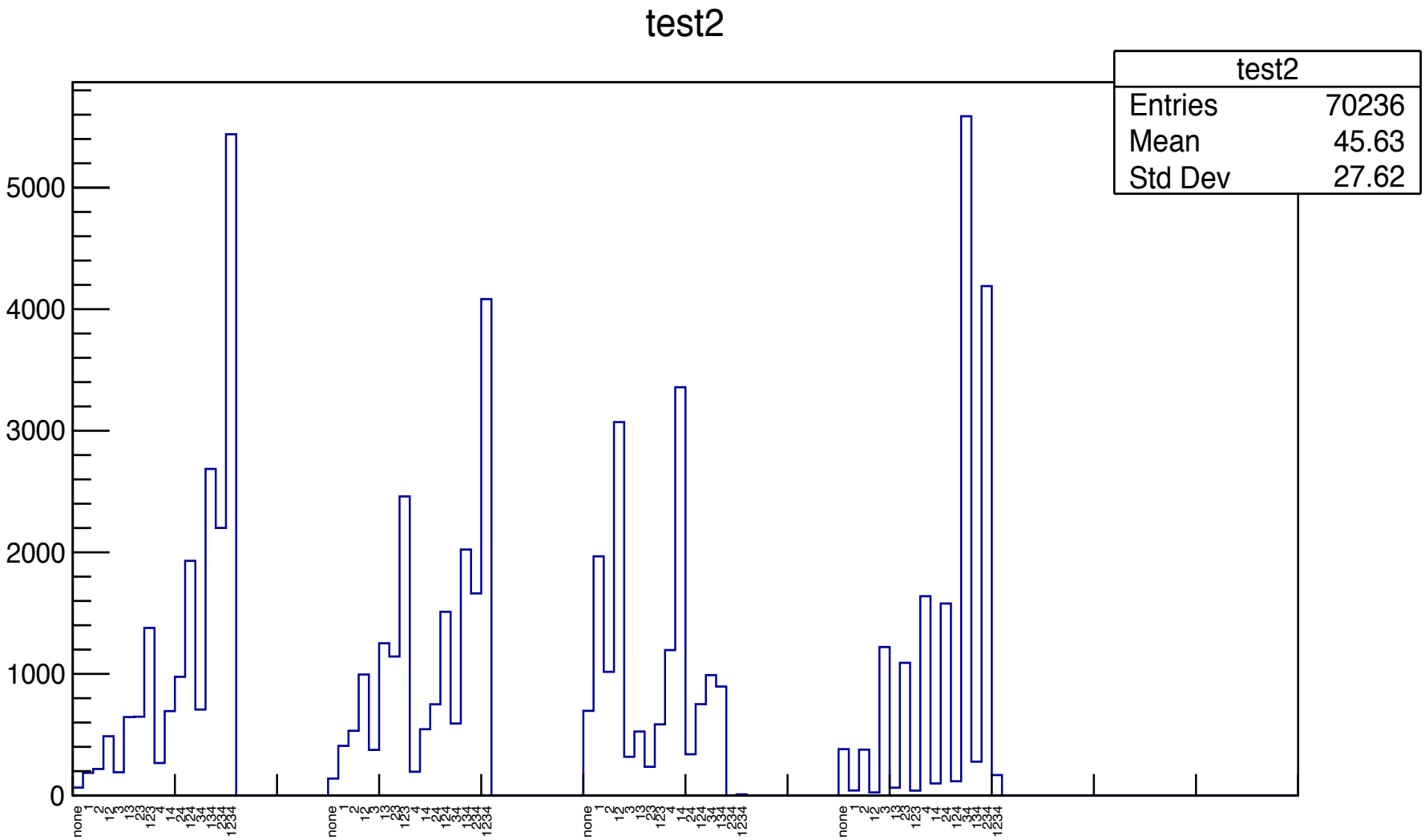
Additional checks



Additional checks



Additional checks



Danke

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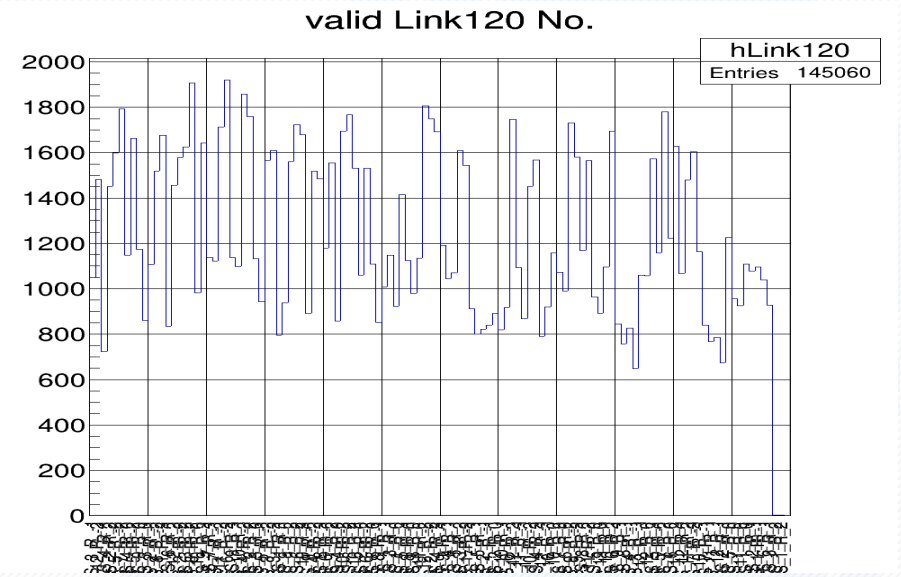
Thanks

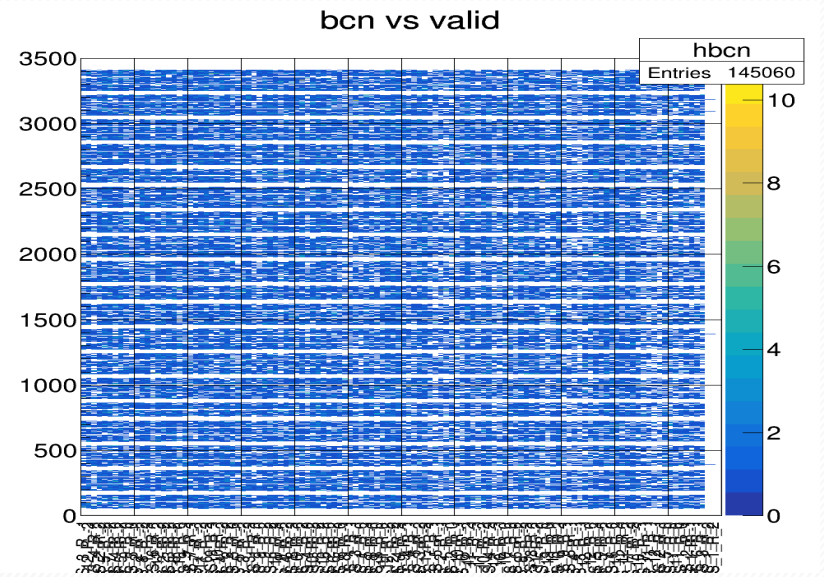
Back Up

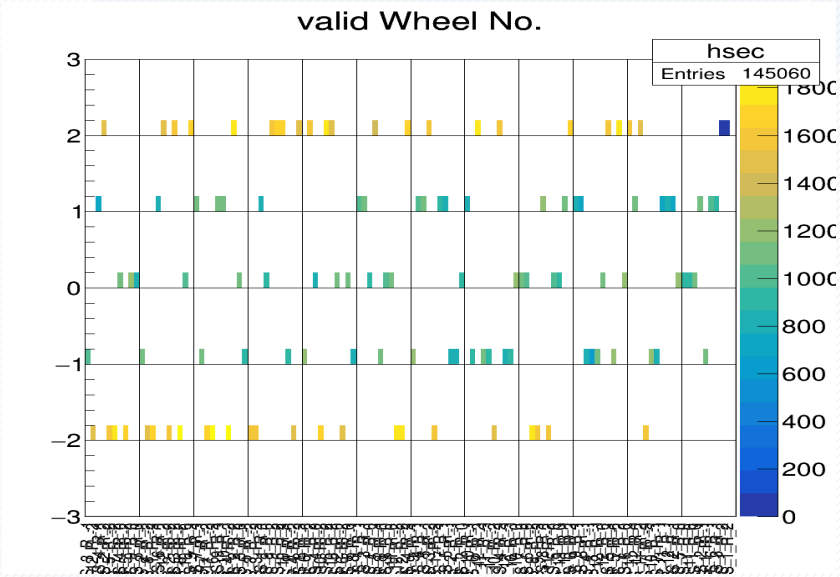
SiPMs Upgrade in LS1

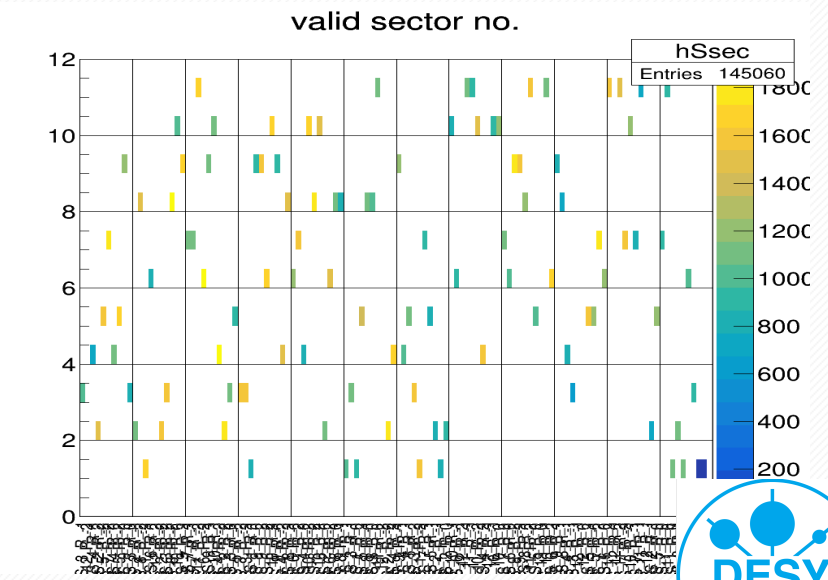
- HO used hybrid photo-detectors during CMS startup.
- Disadvantage in HPDs:-
  1- relatively small gain at low light flux signals ~ 2000.
  2- High sensitivity to the magnetic filed.
  3- high operation Voltage ~kv.
  4- The detection efficiency degrading with time.
  5- Instability with temp. change.
- During the LS1 the HPD replaced by SiPM.
- Advantage for SiPMs
  1- Gain of O(106) at low light flux.
  2- Approx. insensitive to magnetic fields.
  3- Significantly lower bias voltage O(100 v).
- SiPM boards are compact enough to easily fit into the limited space of the existing readout modules.

Unpacker

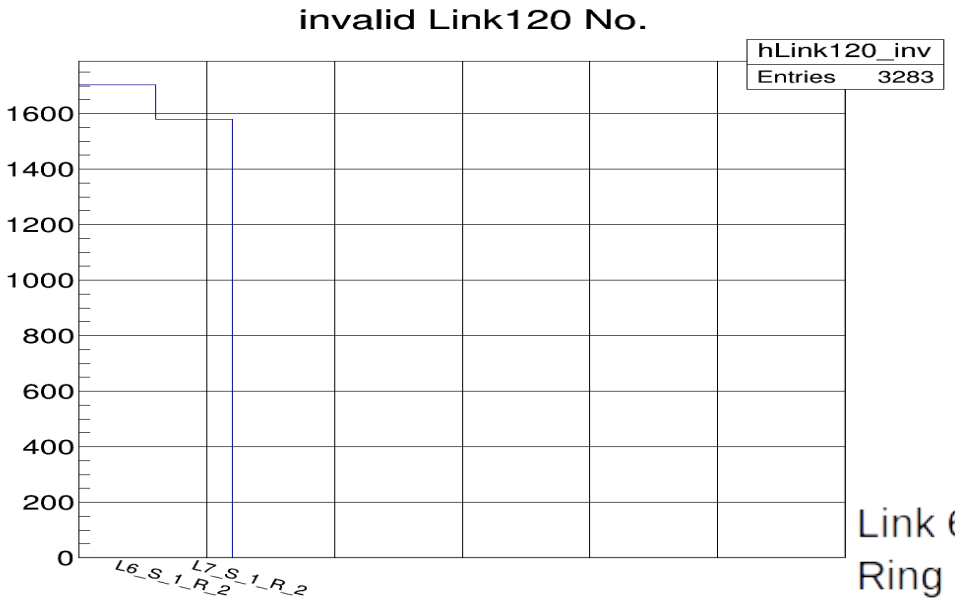

valid Link120 No.
hLink120
Entries 145060
2000
1800
1600
1400
1200
1000
800
600
400
200
0

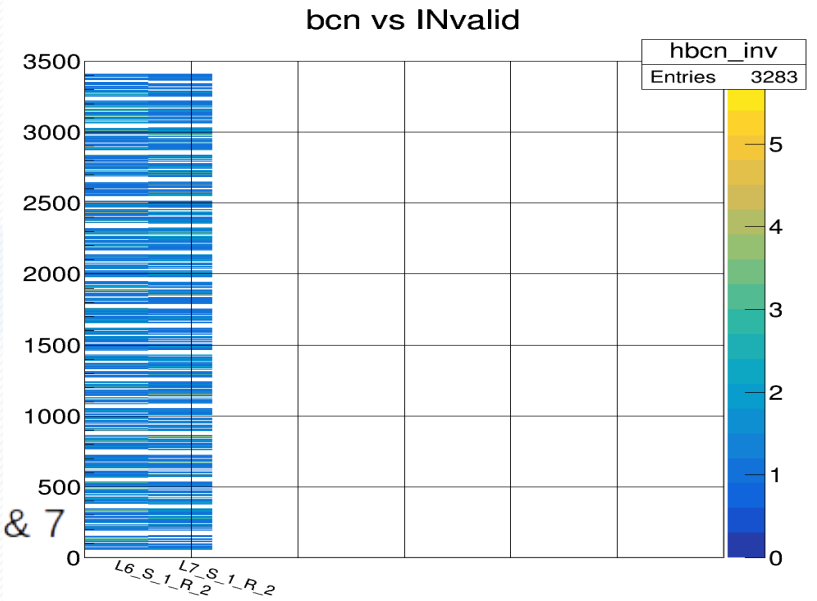

bcn vs valid
hbcn
Entries 145060
3500
3000
2500
2000
1500
1000
500
0
10
8
6
4
2
0


valid Wheel No.
hsec
Entries 145060
3
2
1
0
−1
−2
−3
1600
1400
1200
1000
800
600
400
200
0

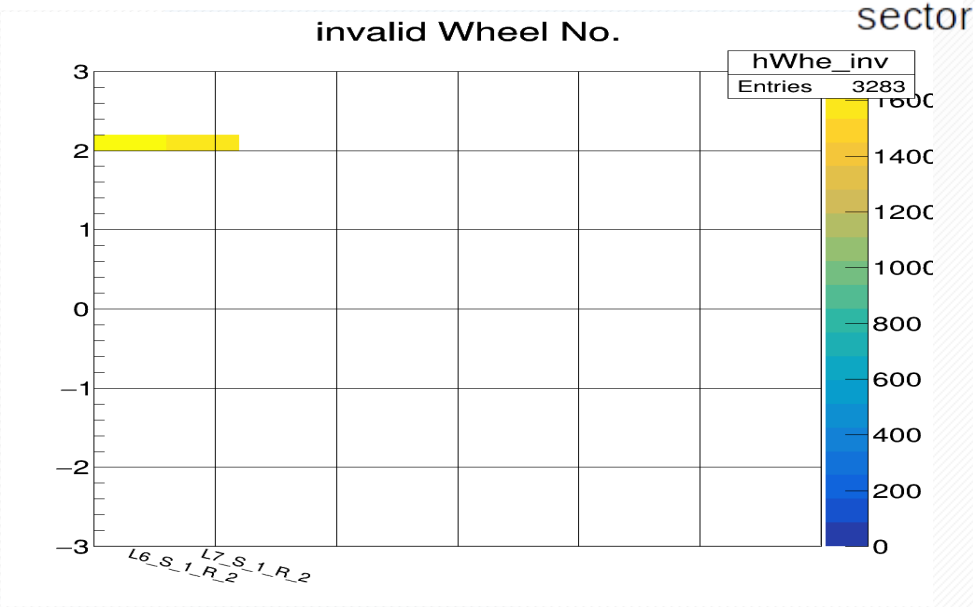

valid sector no.
hSsec
Entries 145060
12
10
8
6
4
2
0
1600
1400
1200
1000
800
600
400
200

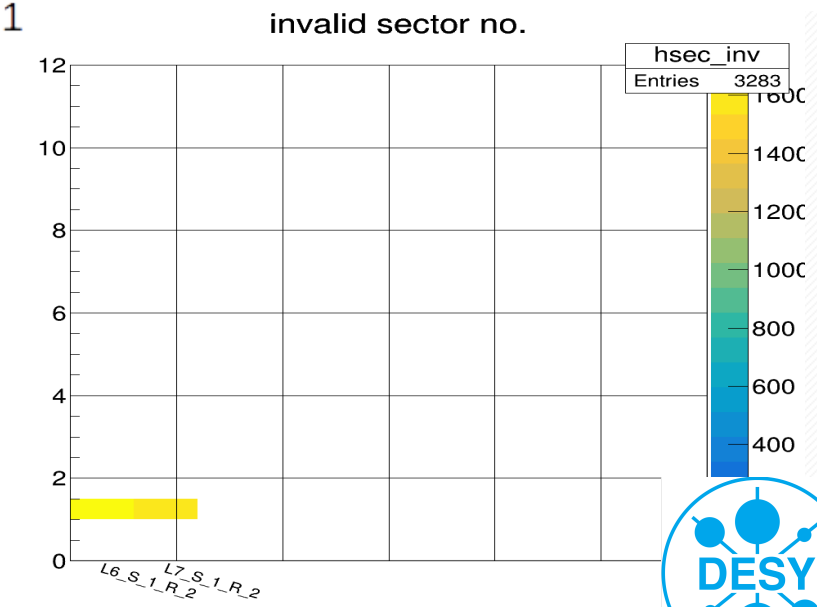
Unpacker



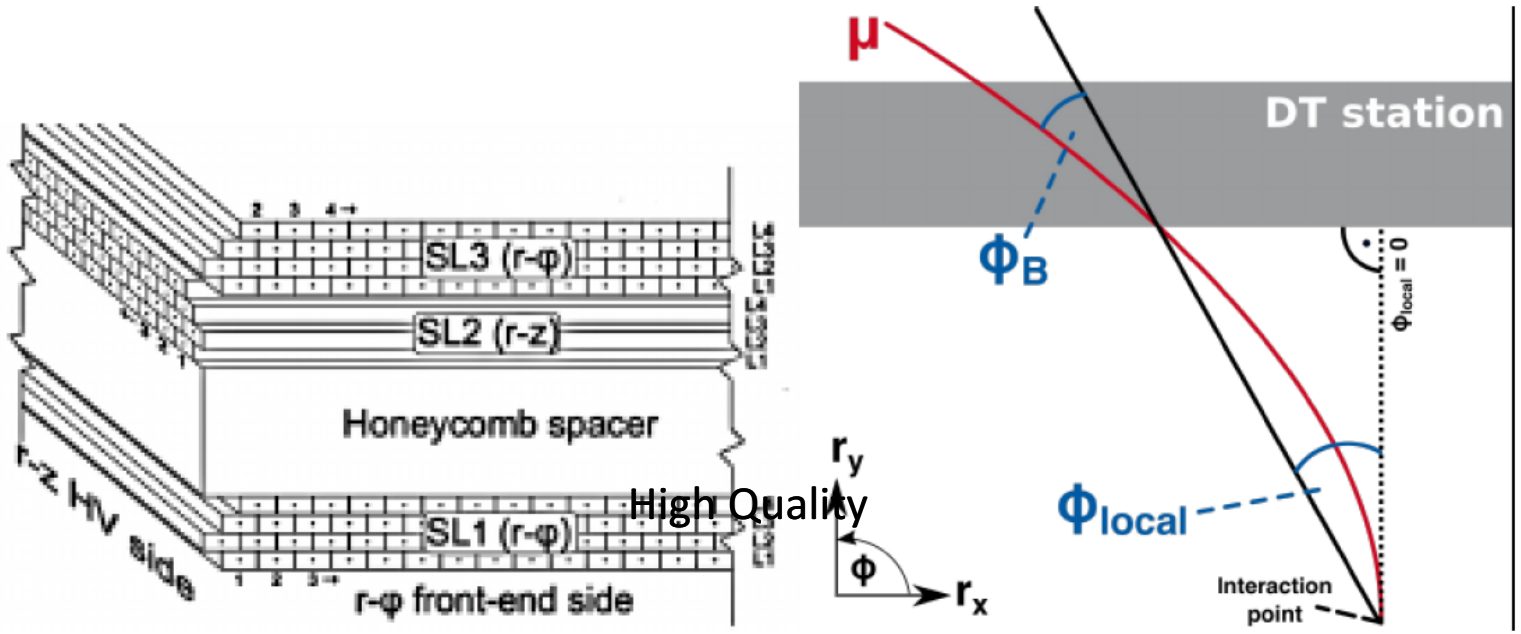


Link 6 & 7
Ring 2
sector 1





The Muon Drift Tube (DT) system [1]



- 4 staggered layers form 1 SuperLayer (SL).
- $SL_{r\text{-}\phi}$ have wires parallel to the beamline, and measure quantities in the r-ϕ plane.
- SL_z have wires perpendicular to the beamline, and measure quantities in the r-z plane.
- In MB1/2/3, one chamber is formed by 2 $SL_{r\text{-}\phi}$ and 1 SL_z.
- In MB4, one chamber is formed by only 1 $SL_{r\text{-}\phi}$.
- The DT chambers provide Trigger Primitives (TPs) which store information about the location of the hit, number of aligned DT-hits, the bending angle ϕ_B etc. It also contains a quality code which indicates the number of SL hits and the how well aligned they are.

Emulator – classification of the Muons

Low Quality (LQ)

High Quality (LQ)

The quality is defined according to the number of aligned hits in the trigger segment.

- Low Quality if (0 < LQ < 4)
- For LQ, try to find a matching HOTP in the same wheel as the DTTP such that Delta (iEta < 1).

- High Quality (3 < HQ < 7).
- For HQ, try to find a matching HOTP such that Delta iEta x Delta iPhi < 1 x 1, i.e. within a 3 x 3 tile window.

- If a matching HOTP is found, then DTTP has support from the HO.
- HO-TPs has to be combined with DT-TPs and then BMTF will treat this combined TPs in a special way.
- This modified TPs could be useful in many cases such that DT frailer and increasing the efficiency in the cracked region and the gap regions