HO Trigger Link Project

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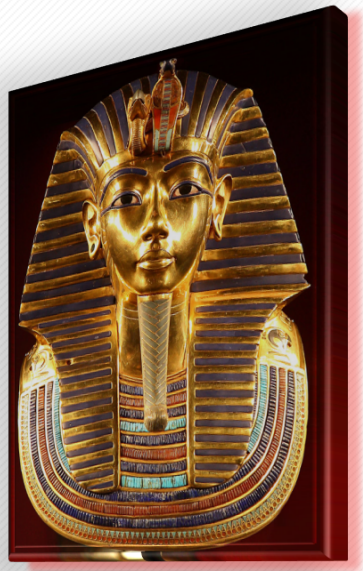
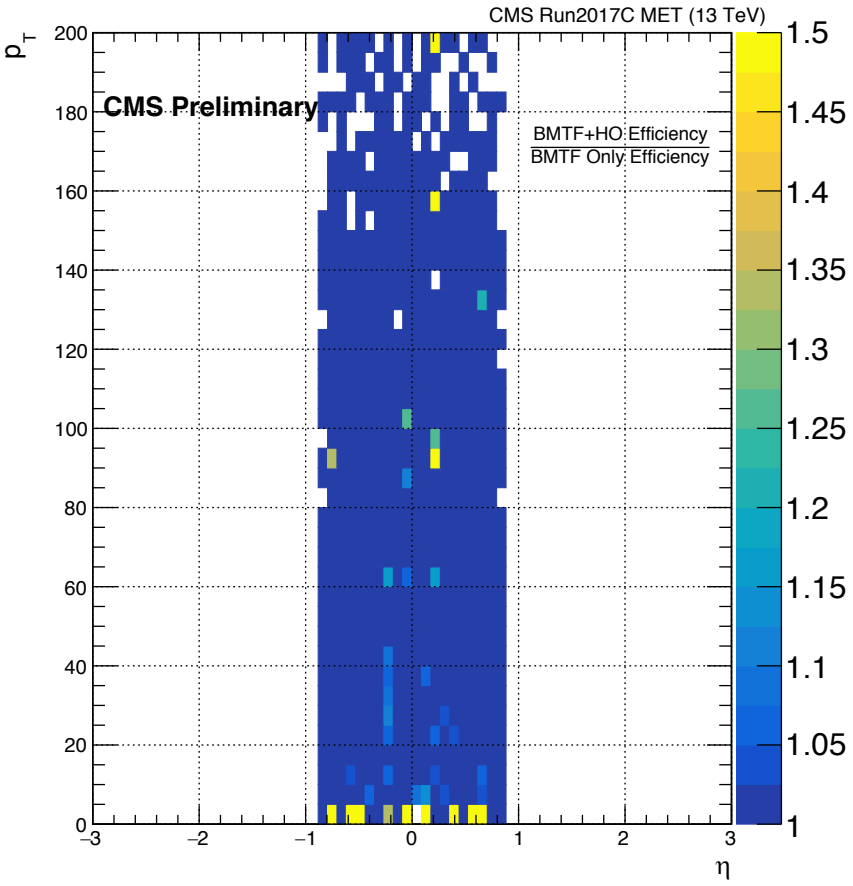
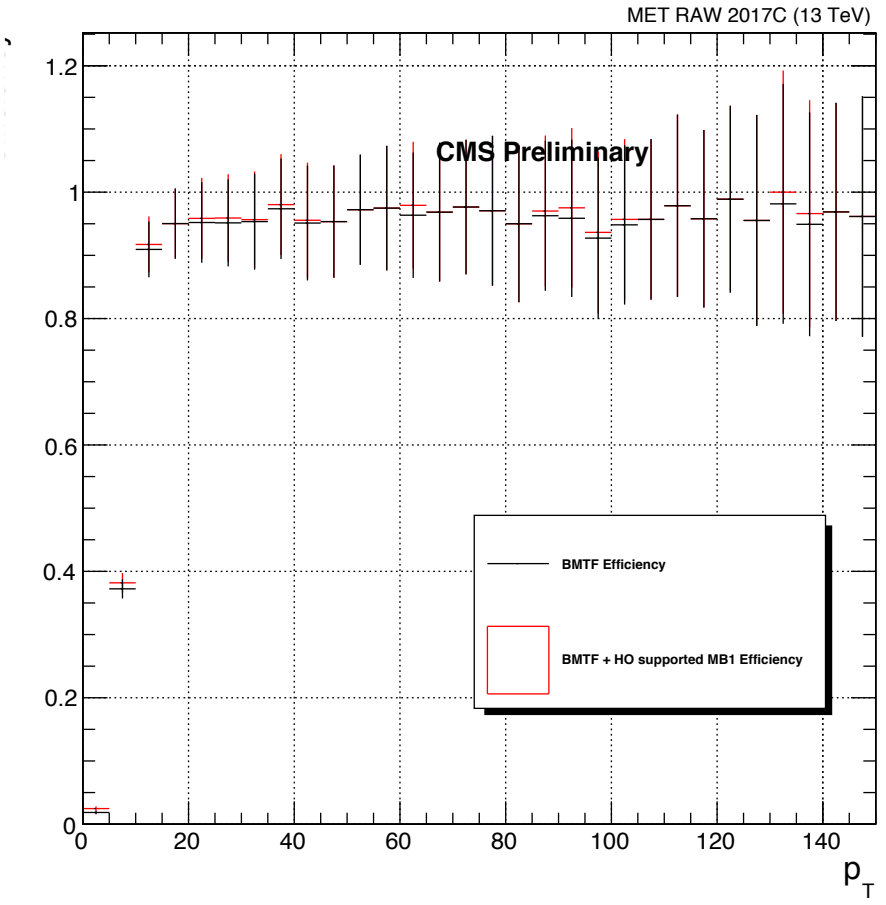


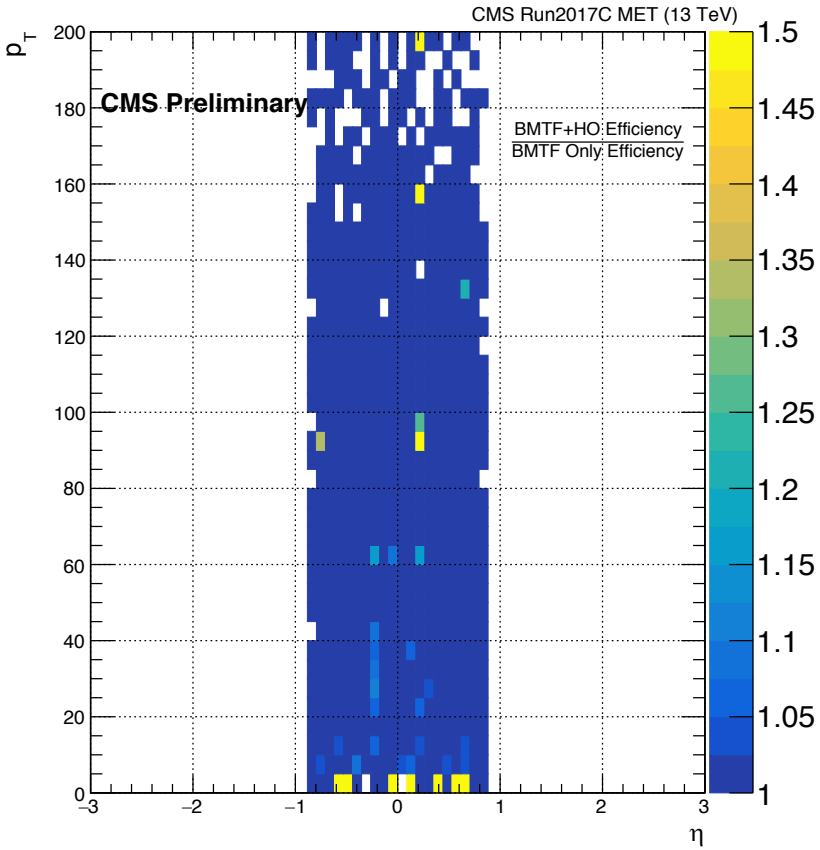
[1] Deutsches Elektronen-Synchrotron (DESY), Germany
[2] RWTH AACHEN III A, Germany
[3] TIFR, India

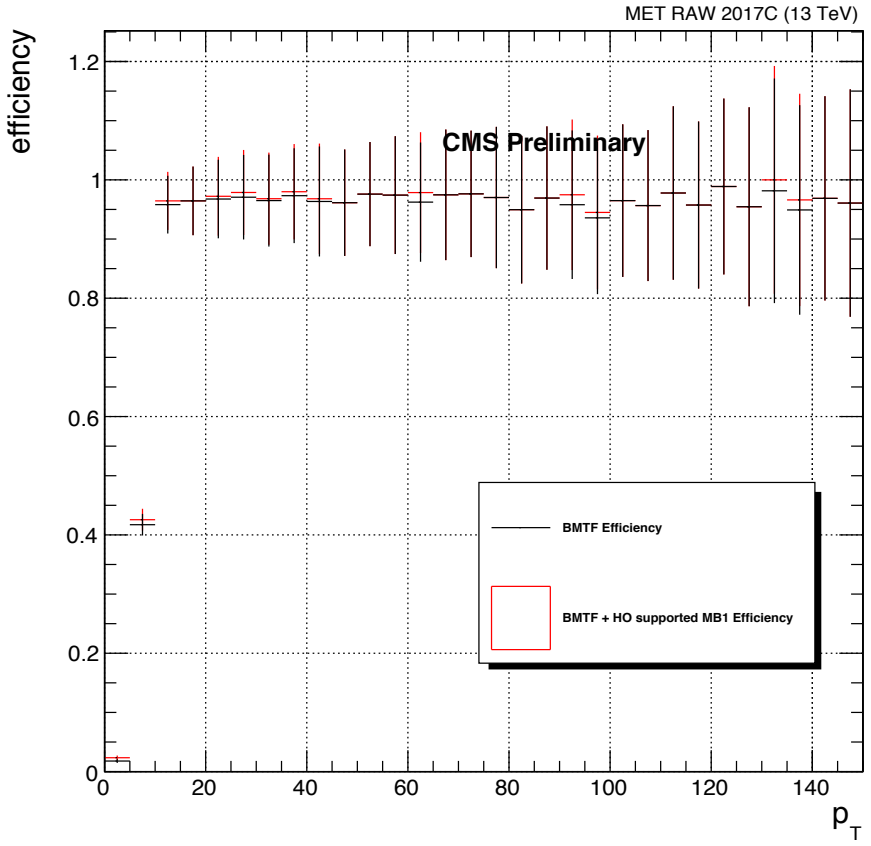
Low pT studies – Loose ID



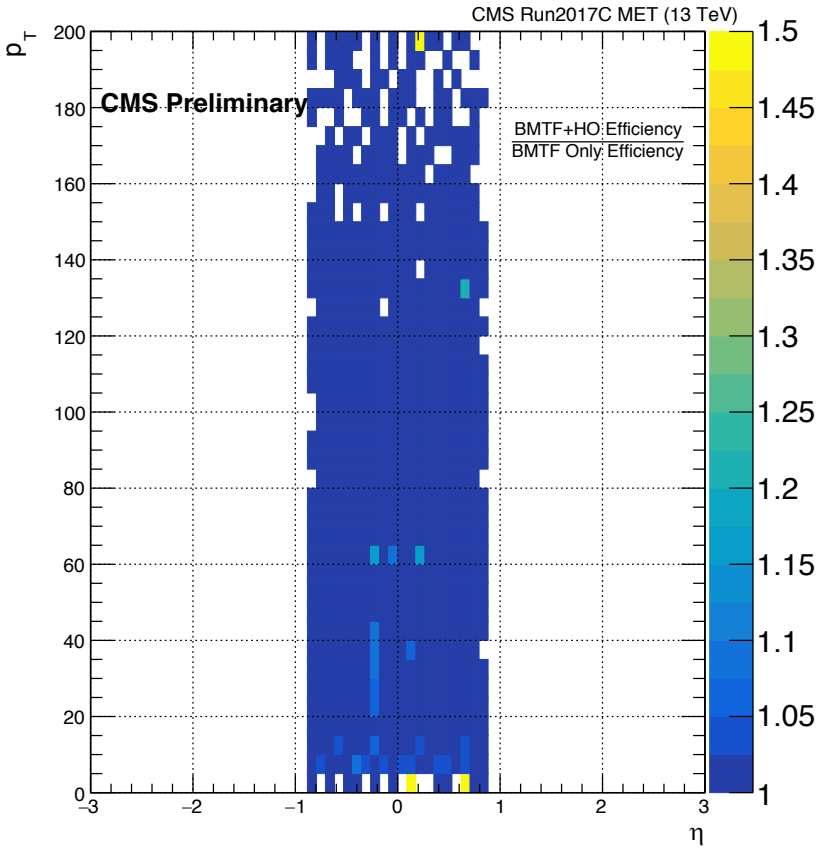


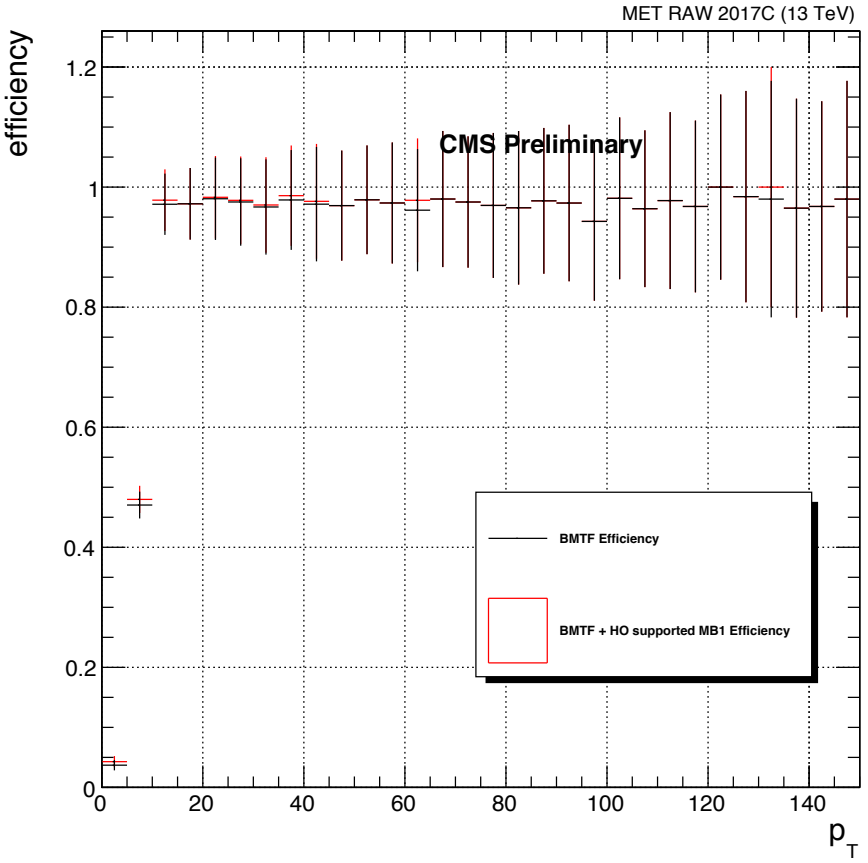
Low pT studies – Medium ID





Low pT studies – Tight ID

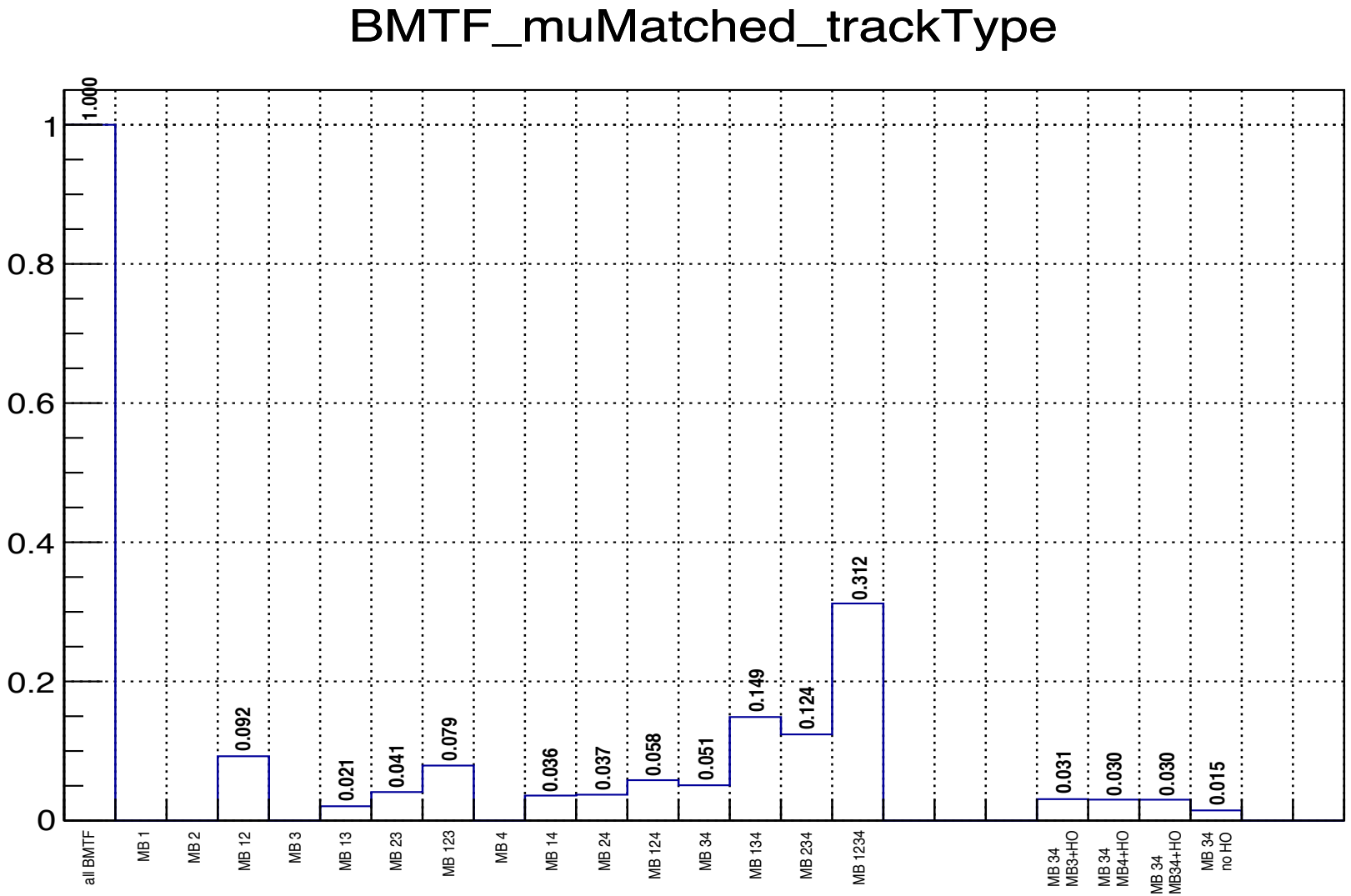




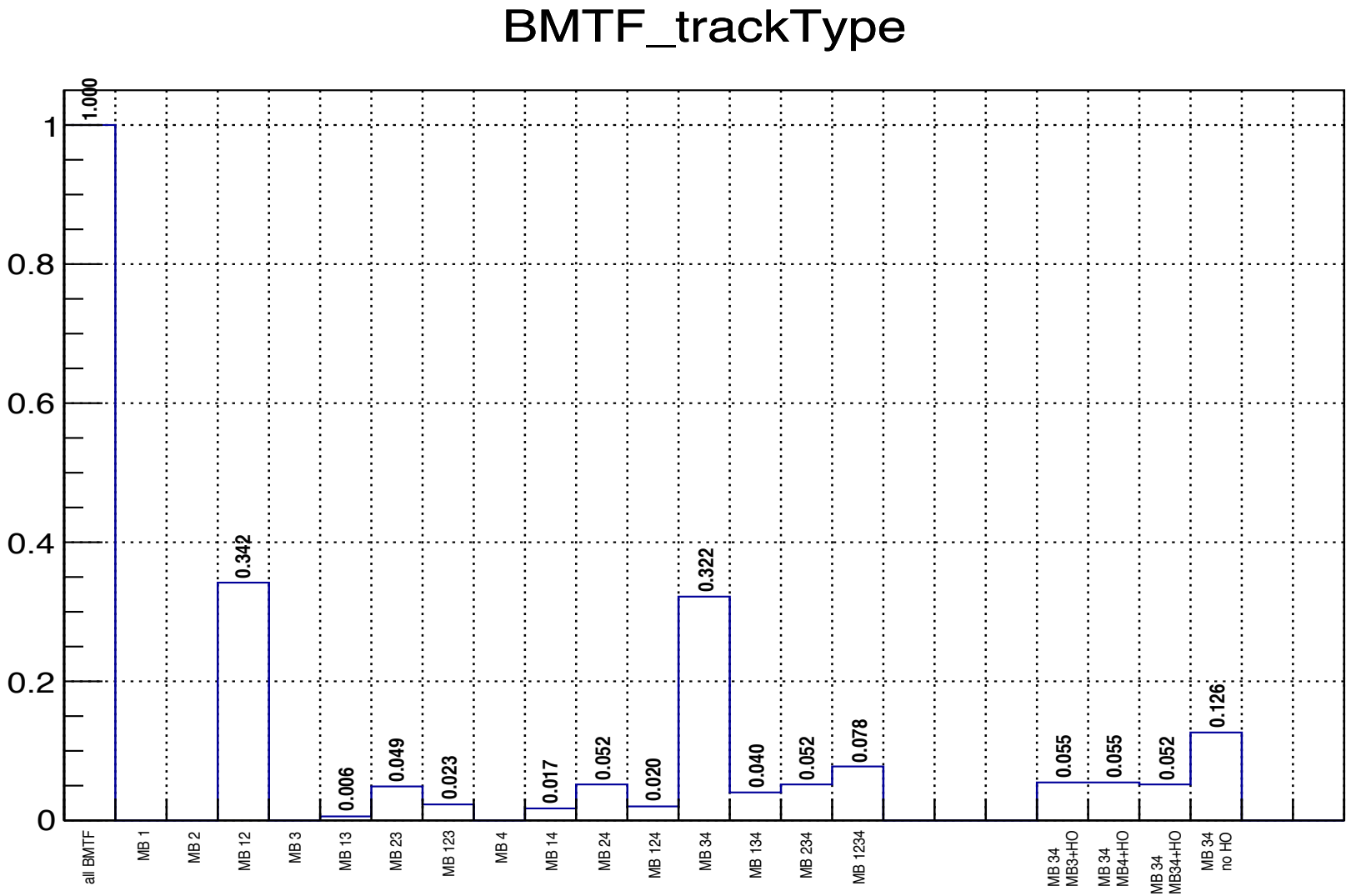
- Andrew suggested to look for medium and Loose muon ID and see and to plot just the 0 - 10 GeV range, with 0.5 GeV wide bins.

- The most interesting studies in the next slides.

MB3/4 + HO


BMTF_muMatched_trackType
1
0.8
0.6
0.4
0.2
0
1.000
0.092
0.021
0.041
0.079
0.036
0.037
0.058
0.051
0.149
0.124
0.312
0.031
0.030
0.030
0.015
all BMTF
MB 1
MB 2
MB 12
MB 3
MB 13
MB 23
MB 123
MB 4
MB 14
MB 24
MB 124
MB 34
MB 134
MB 234
MB 1234
MB 34 MB3+HO
MB 34 MB4+HO
MB 34 MB34+HO
MB 34 no HO

MB3/4 + HO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0.342
0.006
0.049
0.023
0.017
0.052
0.020
0.322
0.040
0.052
0.078
0.055
0.055
0.052
0.126
1
0.8
0.6
0.4
0.2
0
all BMTF
MB 1
MB 2
MB 12
MB 3
MB 13
MB 23
MB 123
MB 4
MB 14
MB 24
MB 124
MB 34
MB 134
MB 234
MB 1234
MB 34 MB3+HO
MB 34 MB4+HO
MB 34 MB34+HO
MB 34 no HO

Conclusion

- We still doing studies with MET samples looking for low-pT muons with different ID.
- Still simulating the DT failure.
- Still need to look for threshold effect on the rate for the higher mu pT samples.
- All in all HO can reduce the BMTF efficiency by 0.5 % and the rate with 14.1 % from MB3/4 + HO algorithm.
- We started to negotiate how to implement this algorithm in the TwinMux.

Danke

شكرا

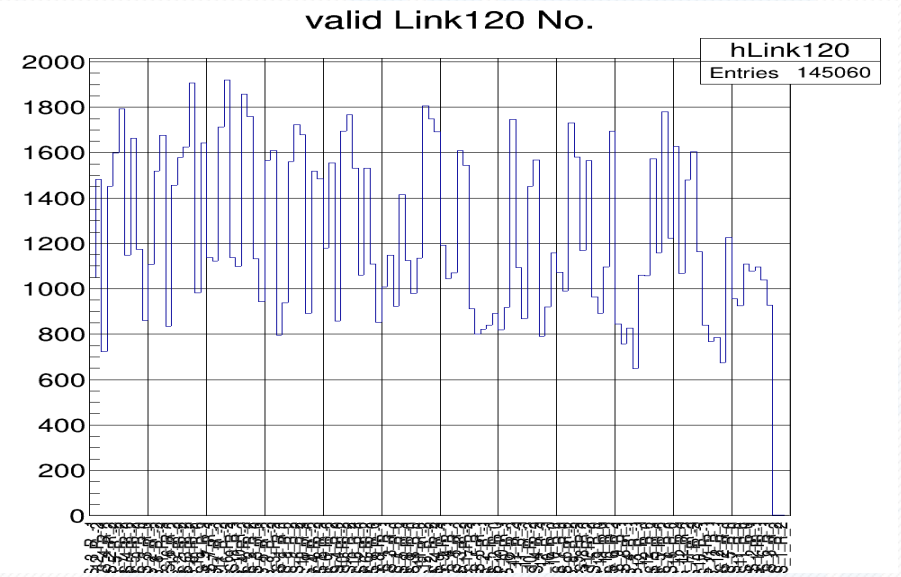
Thanks

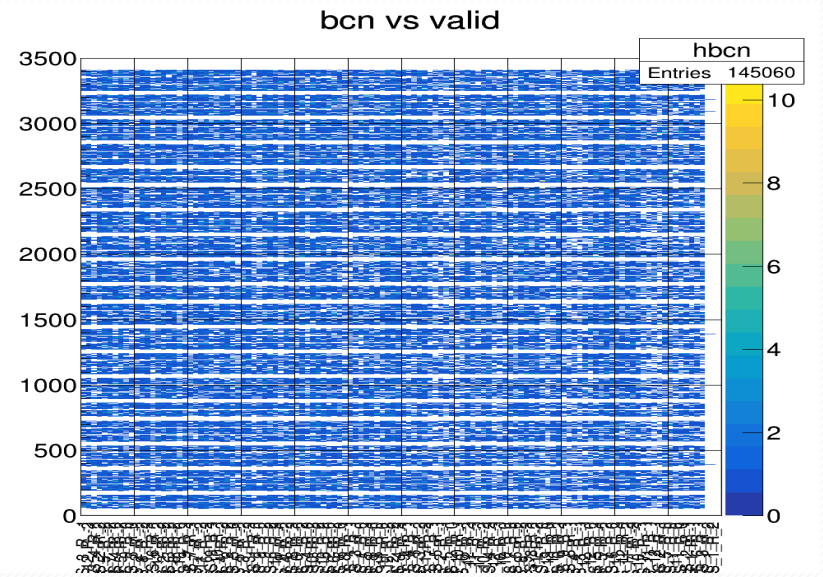
Back Up

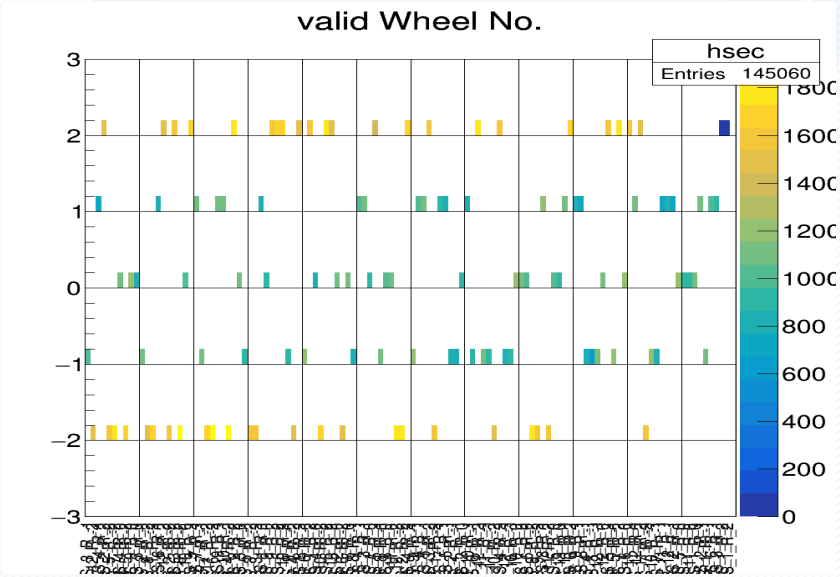
SiPMs Upgrade in LS1

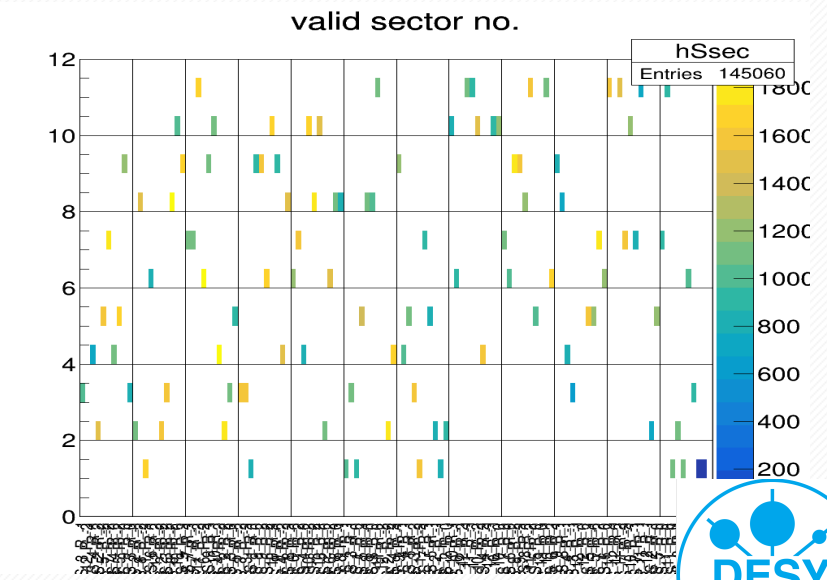
- HO used hybrid photo-detectors during CMS startup.
- Disadvantage in HPDs:-
  1- relatively small gain at low light flux signals ~ 2000.
  2- High sensitivity to the magnetic filed.
  3- high operation Voltage ~kv.
  4- The detection efficiency degrading with time.
  5- Instability with temp. change.
- 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

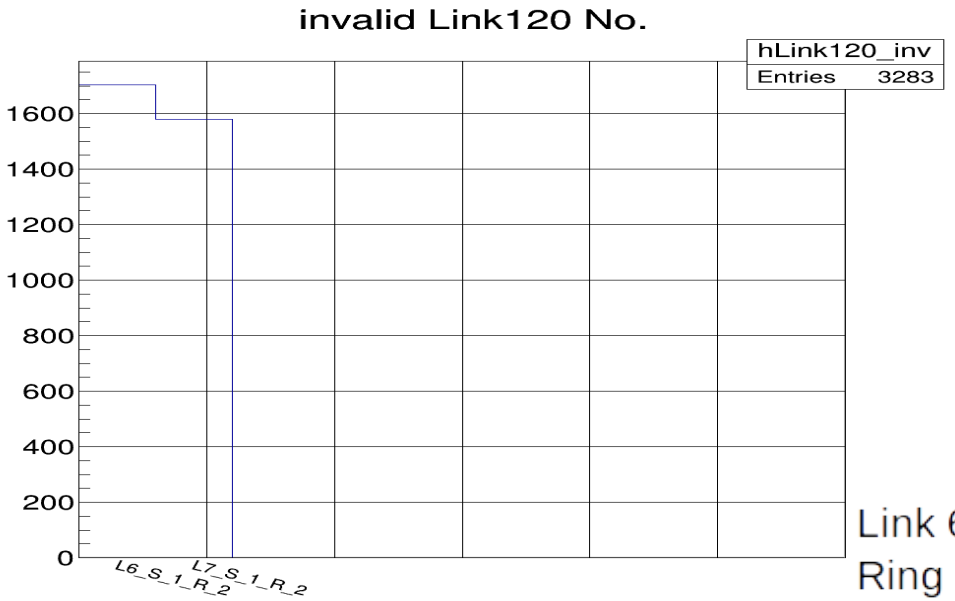

valid Link120 No.
hLink120
Entries 145060
2000
1800
1600
1400
1200
1000
800
600
400
200
0

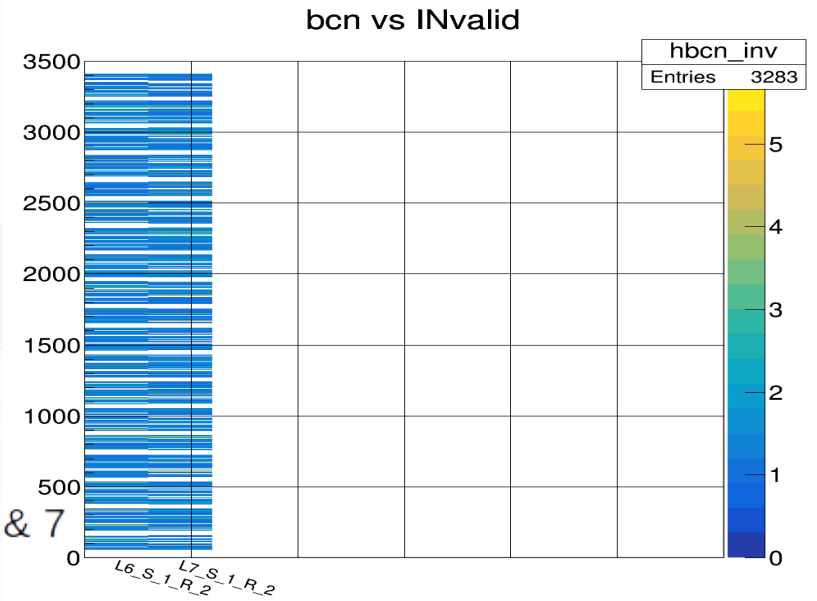

bcn vs valid
hbcn
Entries 145060
3500
3000
2500
2000
1500
1000
500
0
10
8
6
4
2
0


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

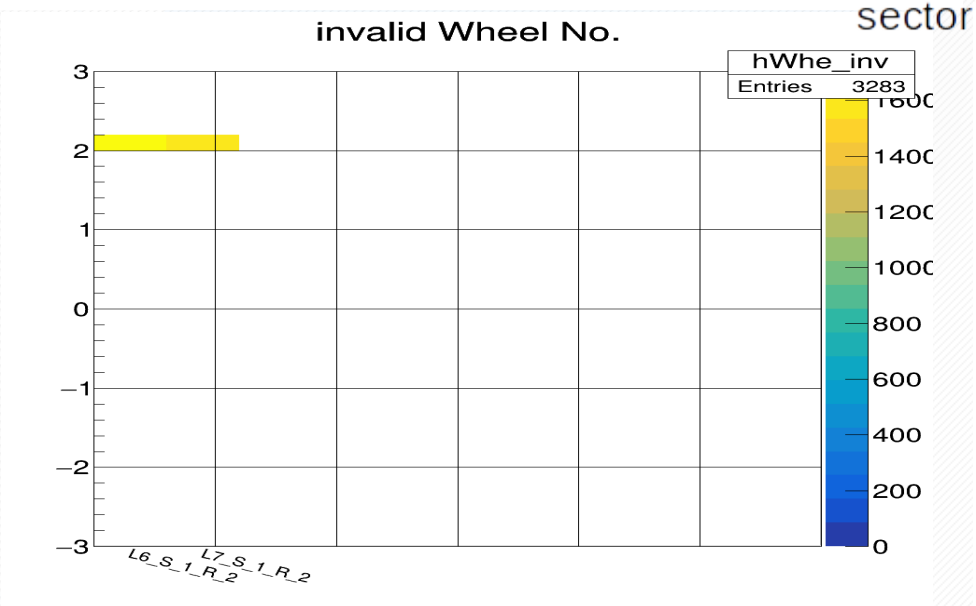

valid sector no.
hSsec
Entries 145060
12
10
8
6
4
2
0
1600
1400
1200
1000
800
600
400
200

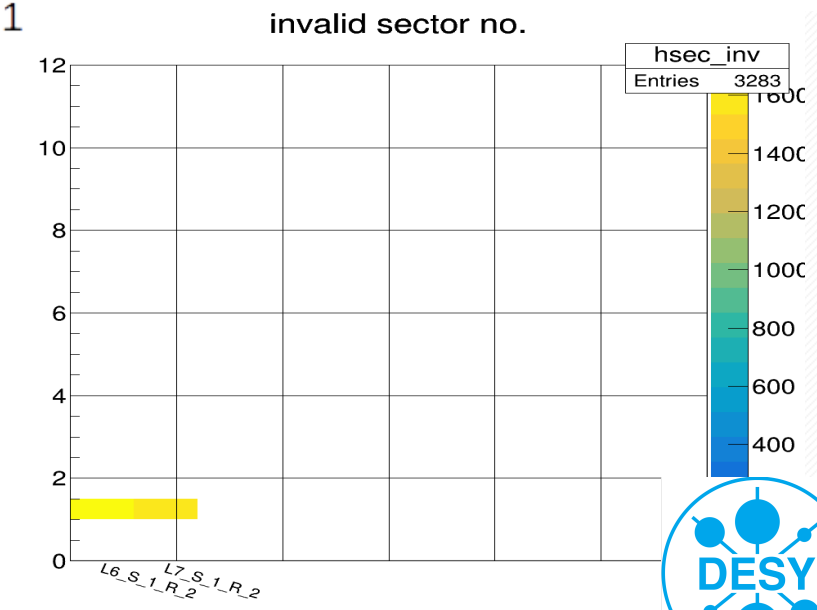
Unpacker



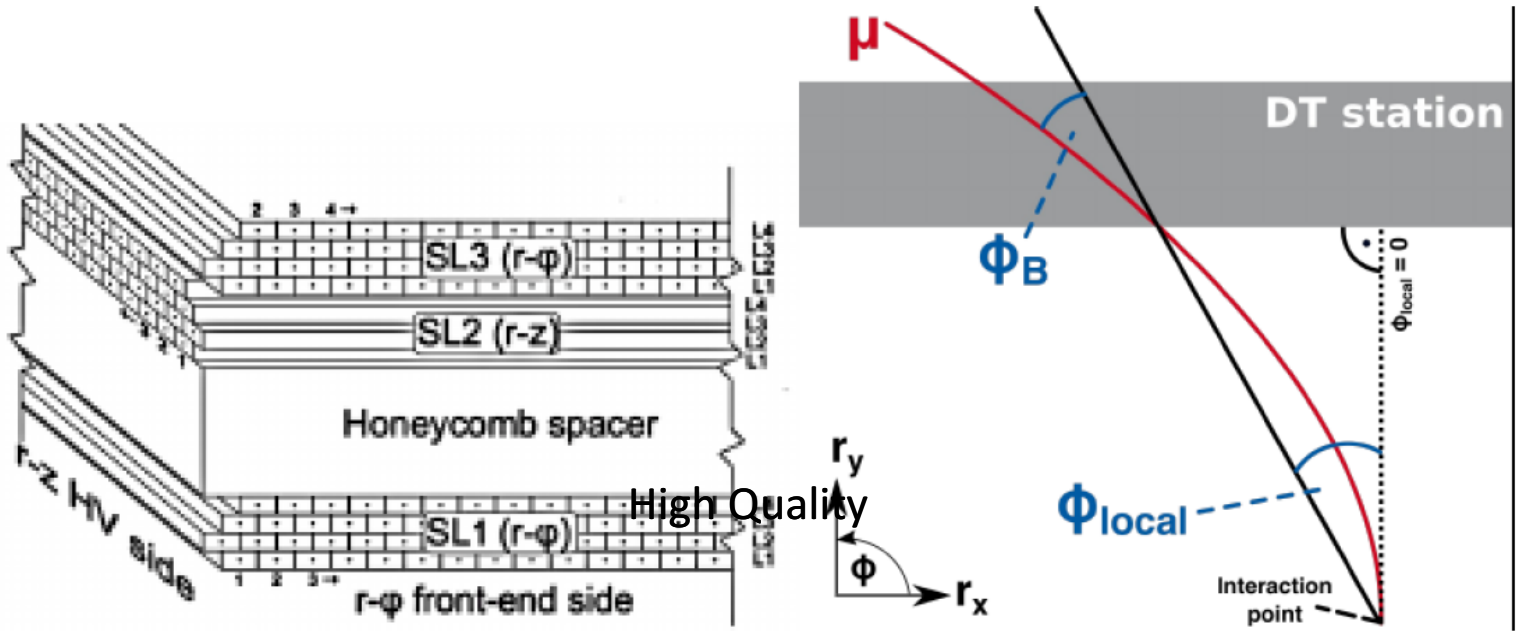


Link 6 & 7
Ring 2
sector 1





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)

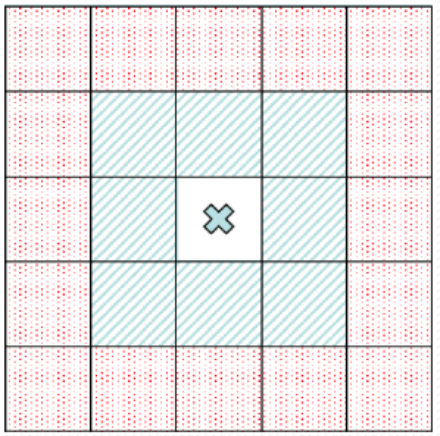
High Quality (LQ)

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



DT-BMTF feedback

- We got a feedback from the DT and BMTF group suggested to take the more advanced variable to match the BMTF-MBTP.
- Simply it checks if an MBTP was used by the BMTF to create a track or no.
- Georgios told us to use the **Track address** .
- We should look at **Track address** of index 0 which is station 1.
- If the **Track address[0] -> 1 then only HQ MB1 used.**
- If the **Track address[0] -> 2 then only LQ MB1 used.**
- If the **Track address[0] -> 3 neither LQ nor HQ are MB1 used.**
- Also need to check muon/segments in the same wheel.
- We Got some incorrect values for this **Track address[0].**
- Georgios suggested to use the official BMTF code to reproduce the Ntuples.

Discussion

- Me and Soham met serval times and we discussed that.
- I tried to use and after several trails I succeed to get the correct results from both codes.

```
**********************
*    * bmtftrAdd *
**********************
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       3 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       3 *
* bmtfTrAddress[0]       1 *
* bmtfTrAddress[0]       3 *
* bmtfTrAddress[0]       1 *
```

Our Code

BMTF Code

```
tfMuonTrAdd[0]
************************
************************
trAddress 4
tfMuonTrAdd[0]       1 *
tfMuonTrAdd[0]       3 *
tfMuonTrAdd[0]       3 *
tfMuonTrAdd[0]       1 *
tfMuonTrAdd[0]       1 *
tfMuonTrAdd[0]       1 *
tfMuonTrAdd[0]       3 *
tfMuonTrAdd[0]       3 *
tfMuonTrAdd[0]       1 *
************************
```

Next steps

- I've modified the BMTF code to add our Digi Collections and variables we need.
- It's not clear to us which path to take
  1- Continue with our framework (one advantage is we know what we do actually) but still need to compare our BMTF variables with George Code.
  2- User Georgios Code (I already added our collection to it) but the code is very wide and one need to understand it more, probably we got support from Georgios and other people.
- It's also still not clear to us how we will send out HO-TPs.
  1- Complement with DT-TPs (eta-mask)
  2- send MB1 Matched HO-TPs separately and form our tracks.

Next steps

- BMTF Rate is 1.3 kHz at 22 GeV.
- Supported HO-MB1 HQ rate is 100 Hz at 22.
- We need to have the efficiency study(BMTF-HO).
- Over the weekend i will work on that in one of the two.
- Will meet together with Soham Monday to finalize this efficiency study.