Studies of the TRT tracking performance in p-p collision at high occupancy

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Project	TRT
Responsible	Anatoli Romaniouk
Description	Studies of the TRT tracking performance in p-p collision at high occupancy.

Motivation

Why is it important?

Proper understanding of TRT performance at high occupancy is important for:

- different ongoing physics analyses (good operation of the TRT detector will decrease tracking uncertainty)
- future work of TRT detector with higher energies and number of interactions per bunch crossing <mu>.

What are the methods?

- Comparison of TRT performance for high <mu> pp runs and HeavyIon runs.
- TRT occupancy vs <mu> study
- Tracking inside jets in TRT study (performed for the first time for high <mu> runs)

What was done around august - October 2013?

1. TRT occupancy vs high <mu> study.

Analysis shows dependence of TRT occupancy from high <mu> for different parts of TRT detector.
It was found that TRT Occupancy increases with increase of <mu> as it was expected. Occupancy distributions for specific <mu> could be described by Gaus.
See please for details
https://indico.cern.ch/getFile.py/access?contribId=7&resId=0&materialId=slides&confId=268227

2. First results from MC vs DATA comparison for high mu pp runs.

Study shows discrepancies between high mu data and MC. Several explanations was suggested and work is in progress now.
See please for details
https://indico.cern.ch/getFile.py/access?contribId=9&resId=0&materialId=slides&confId=270384

3. Note "TRT tracking performance in p-p collision at high occupancy"

Note was partially completed. Expected results from MC.
See please for details
https://svnweb.cern.ch/trac/atlasgroups/browser/Detectors/TRT/Documentation/HighOccupancyTrackingPerformance2013

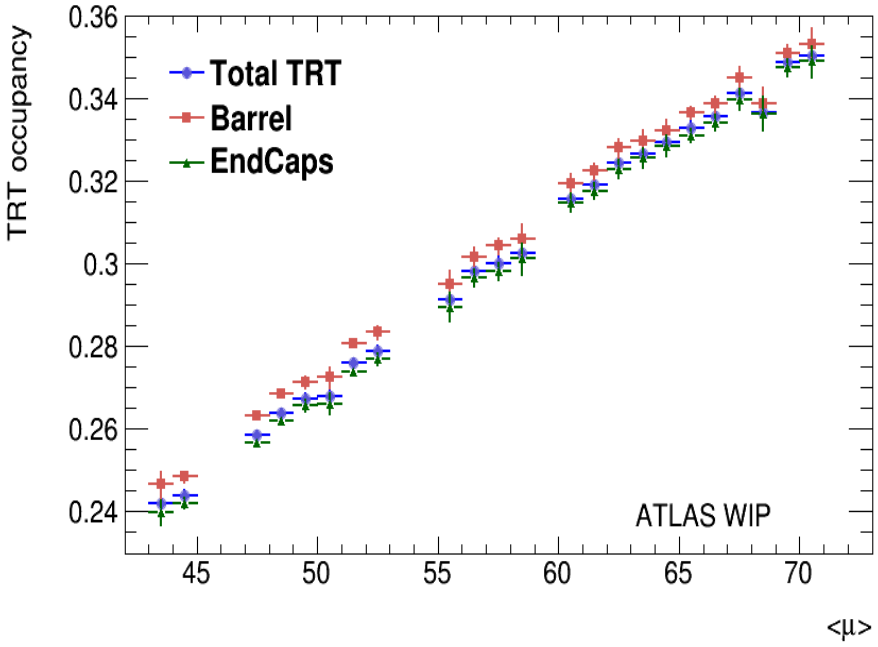
Previous important results

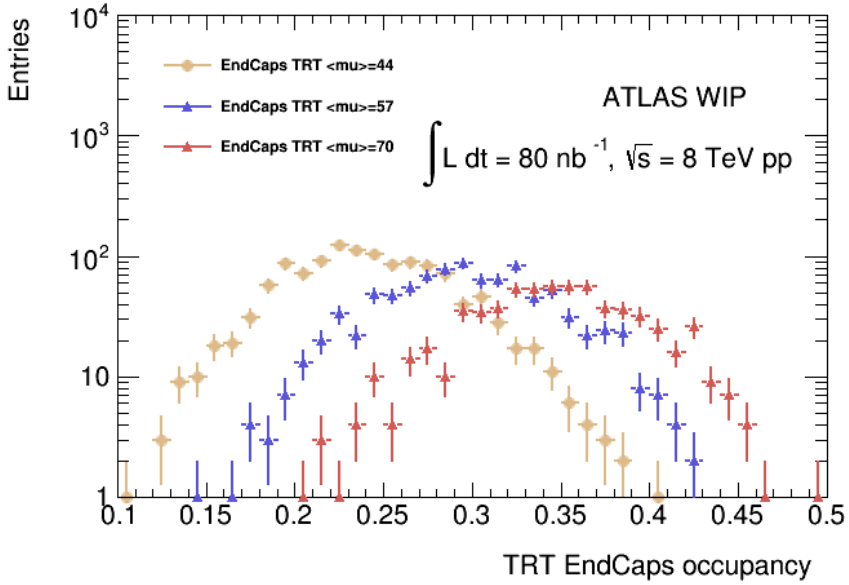
TRT tracking performance in pp at high occupancy vs HeavyIon run.

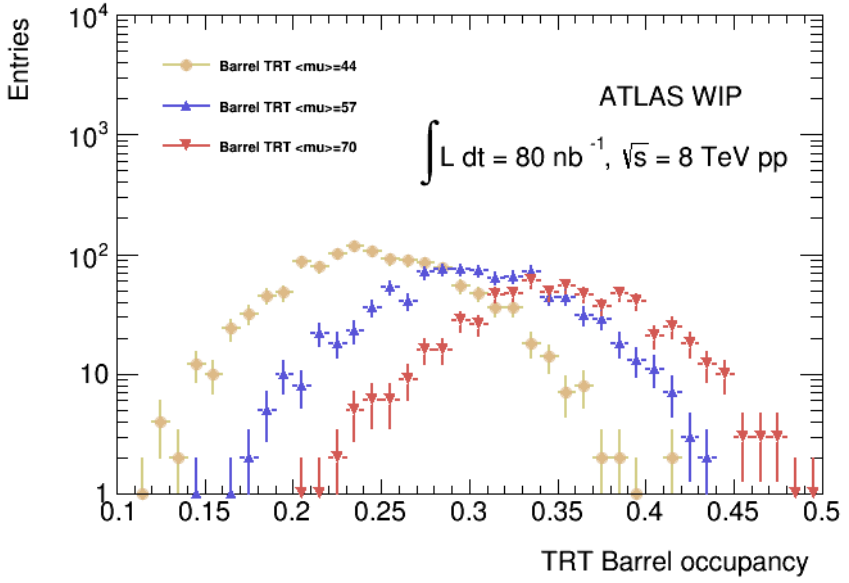
Analysis shows good agreement between TRT performance at high pileup pp runs and HeavyIon runs.
See please for details
https://indico.cern.ch/getFile.py/access?contribId=0&resId=1&materialId=slides&confId=255488

TRT occupancy vs <μ>

High <mu> pp data
MinBias stream

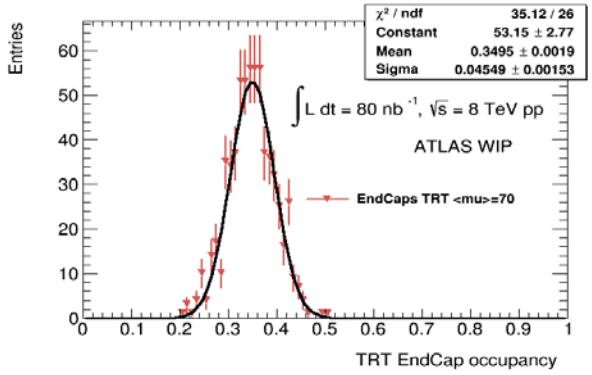


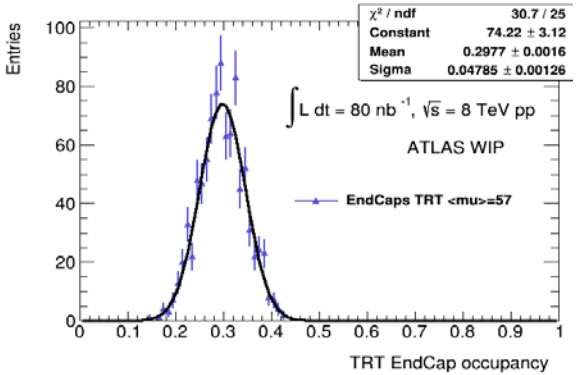


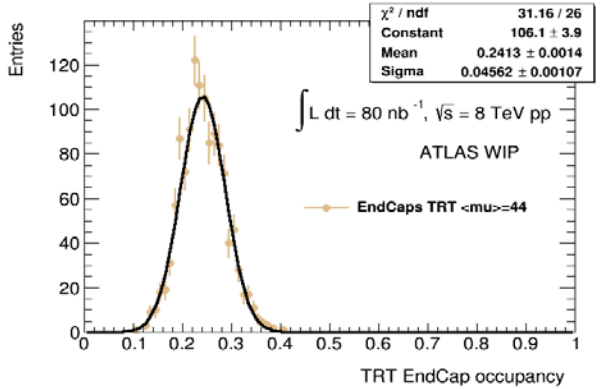


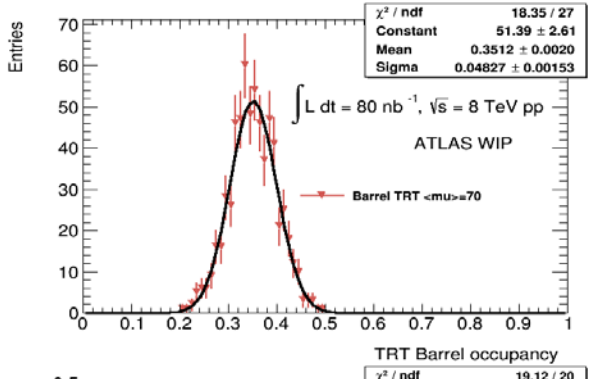
Fitting of plots could be used to understand the exact dependence of the studied variables from <mu> (next slide)

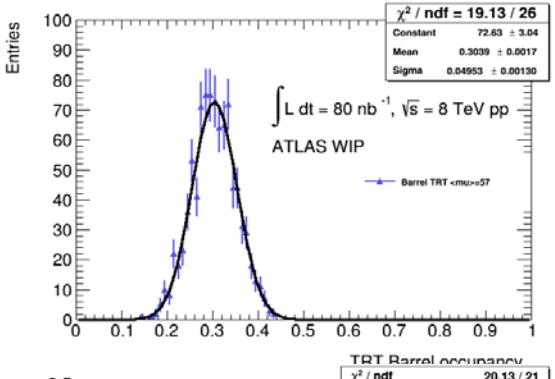
TRT occupancy vs <μ> plots with fits

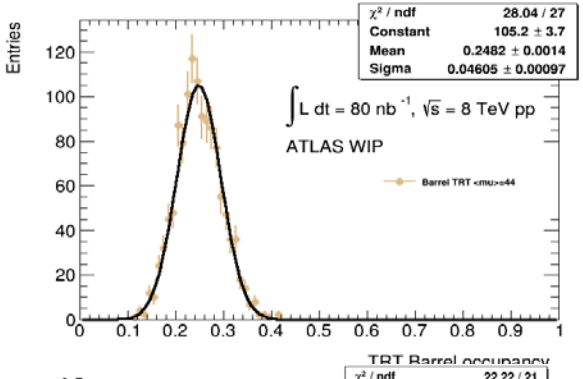


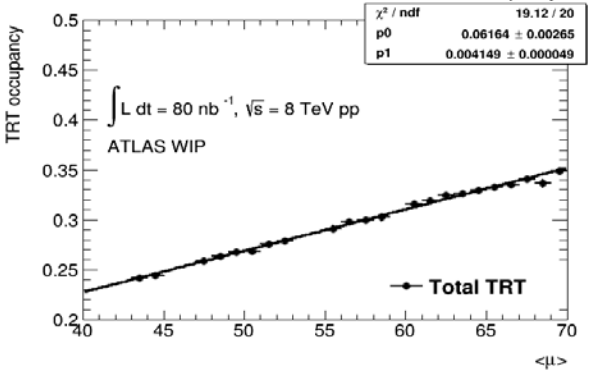


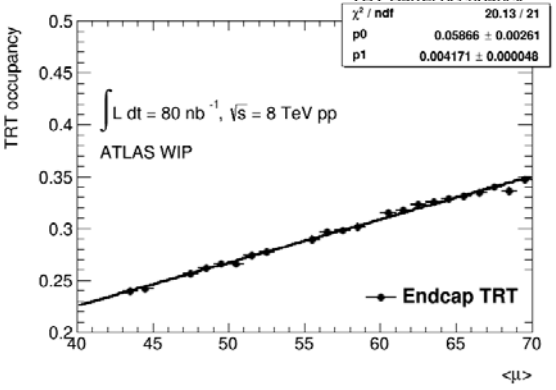


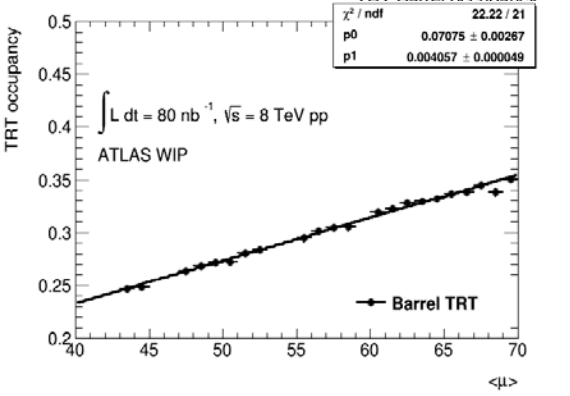












Tracking inside jets.

Why do we need jets?

Jets are high-density regions with large number of low and high Pt tracks and these facts make them the best candidates for study of TRT performance at high occupancy.

What do we already know?

results of Tracking in dense environment group from The Inner Detector Tracking Performance Workshop
https://indico.cern.ch/getFile.py/access?contribId=42&sessionId=5&resId=0&materialId=slides&confId=240314

- Track reconstruction efficiency drops off with pT.
- Loss of tracks in jet core leads to loss in sum pT of tracks.
- More energetic jets → more tracks in core
- Most energetic tracks in jet core.

What do we want to understand?

- Tracking inside jets in TRT for large range of Pt (extension fraction, precision hit fraction, number of TRT hits etc)
- Effects of high occupancy (pp runs with large <mu>)

Tracking inside jets.

Data pp high <mu> runs
(EnhancedBias stream)

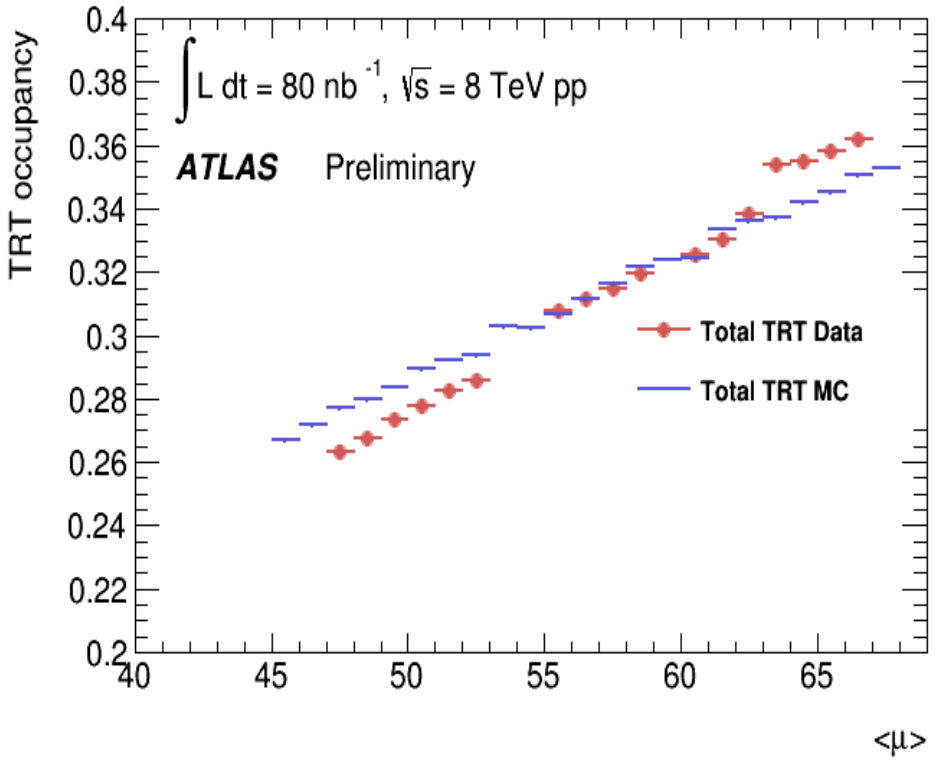
Track Selection

Events
Goodrun list; at least 1 primary vertex;
Tracks
nPixHits>1; nSCTHits>5; |eta |< 2.0; |d0_wrtPV|< 1.5;
|z0_wrtPV*sin(theta_wrtPV)|<1.5; Pt > 2 GeV

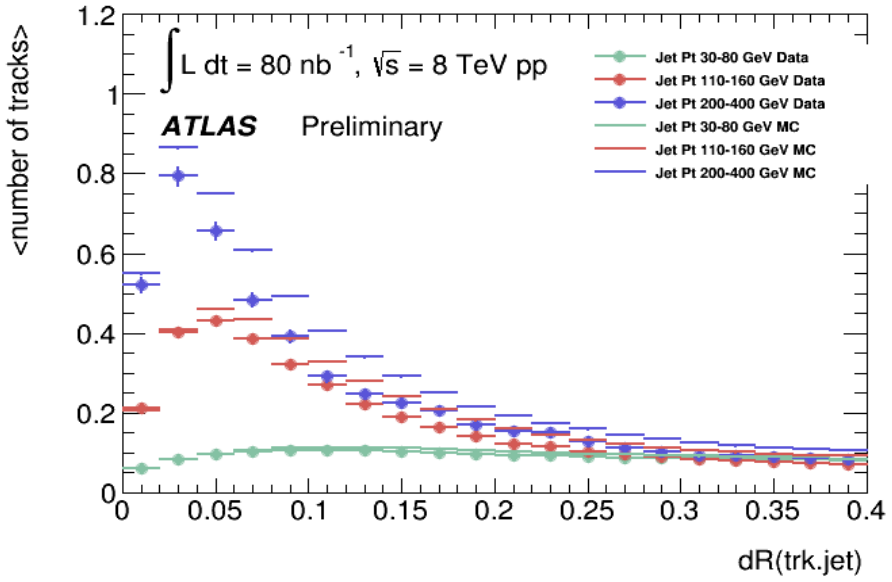
Selection for AntiKt4TopoEM jets

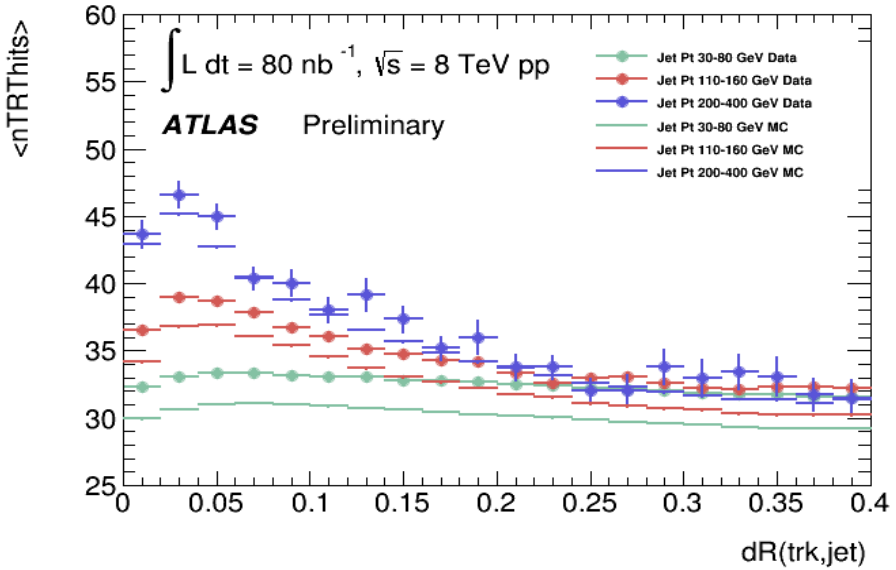
|eta |< 2.0, |AntiKt4TopoEM_jvtxf|>0.5
Excluding the lightest jet if dR(jet1/jet2)<0.8

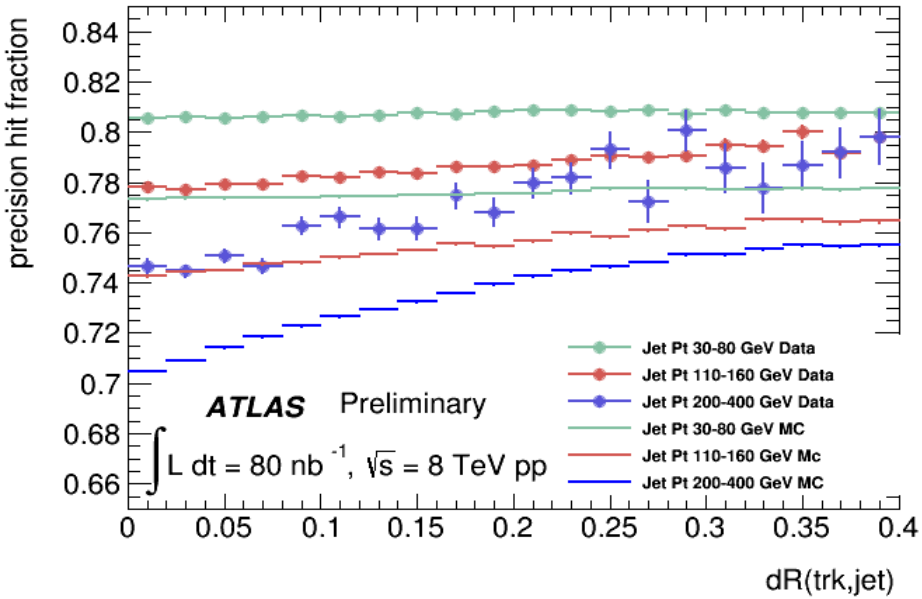
1st jet pt region	**30 GeV < Pt < 80 GeV**
2nd jet pt region	**110 GeV < Pt < 160 GeV**
3rd jet pt region	**200 GeV < Pt < 400 GeV**



Tracking inside jets. Data vs MC

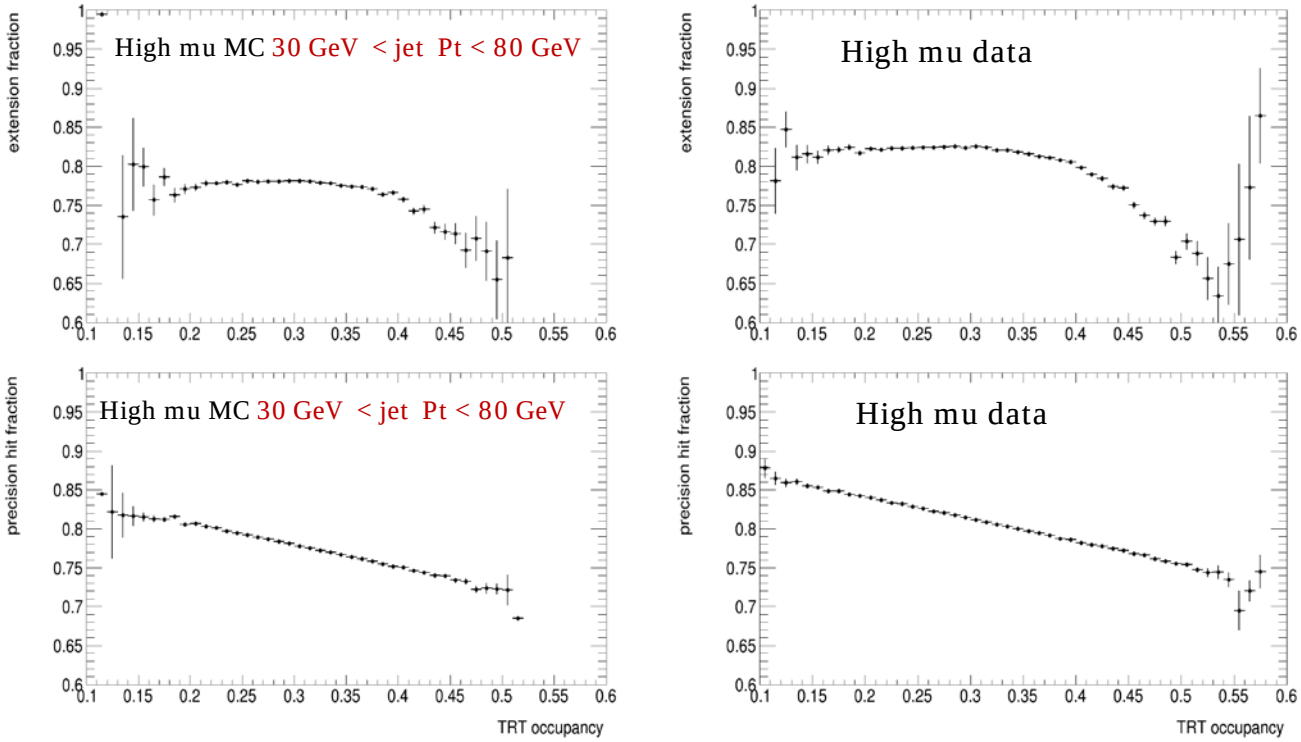






Significant discrepancies were found in basic plots

Data vs MC comparison



Track Selection

nPixHits>1; nSCTHits>5;
|eta |< 2.0; Pt > 2 GeV;
|d0_wrtPV|< 1.5;
|z0_wrtPV*sin(theta_wrtPV)|<1.5;

Values for extension fraction and precision fraction are lower in MC than in data.

Ongoing MC study includes

-MC efficiency estimations
-2D reweighting for MC

Summary.

Conclusions

Current stage of analysis is near to be finished.
Basic plots for data have an agreement with results from tracking in dense environment group.
Discrepancies between data and MC is ongoing study. (New MC production might be needed).
Documentation could be found on SVN:
https://svnweb.cern.ch/trac/atlasgroups/browser/Detectors/TRT/Documentation/HighOccupancyTrackingPerformance2013

Future plans

- To complete tracking inside jets study
- Electrons inside jets study for high <mu> runs
-Ideas from Alex looks very reasonable:

Study MC for details as: “Fake” hits and tracks?
Track separation?
Influence of shared hits on track extension and in PrecHits fraction?

End.
Thank You!