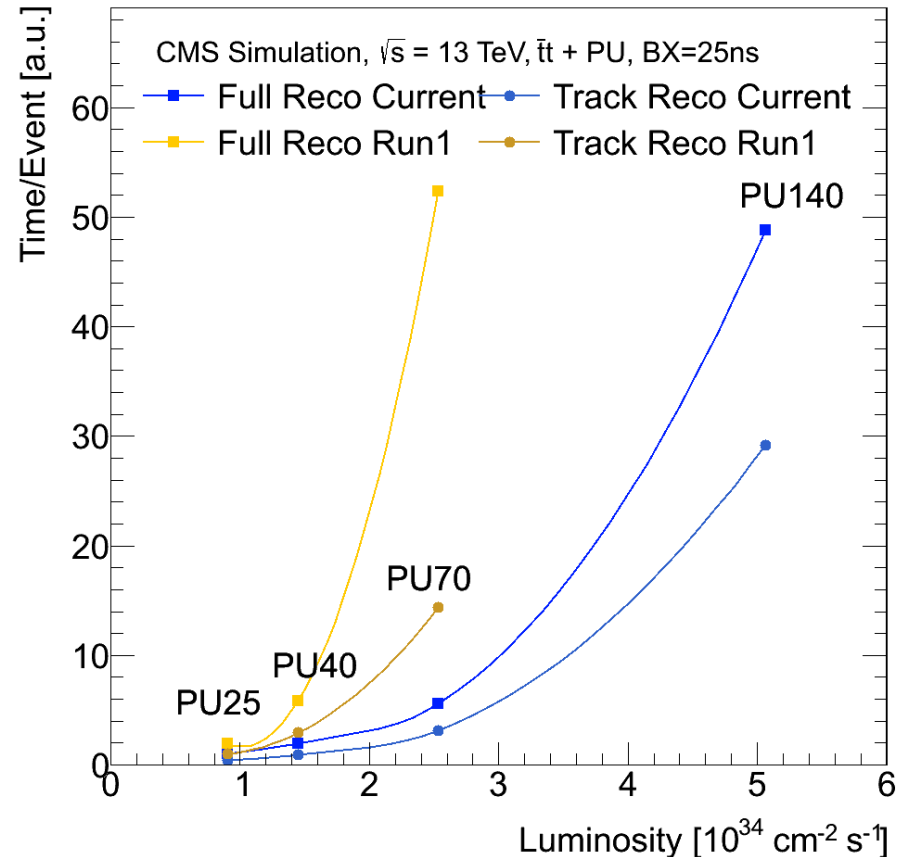


Toward an affordable Tracking at Run4

The usual Math

- At Run 4 w/r/t 2017
 - 4 time more lumi i.e. 4xPU (50->200)
 - Old estimation called for factor 60 in cpu
 - Extended coverage ($\eta \rightarrow 4$)
 - 10 times more events



We should aim to linear increase with number of reconstructed tracks

How we will afford it?

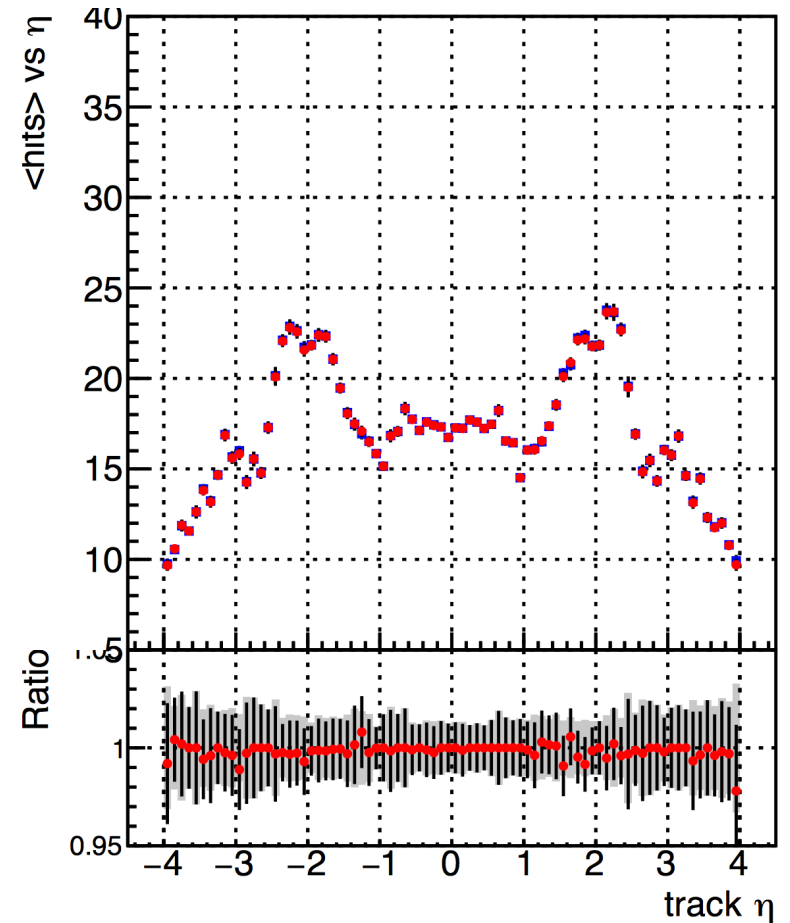
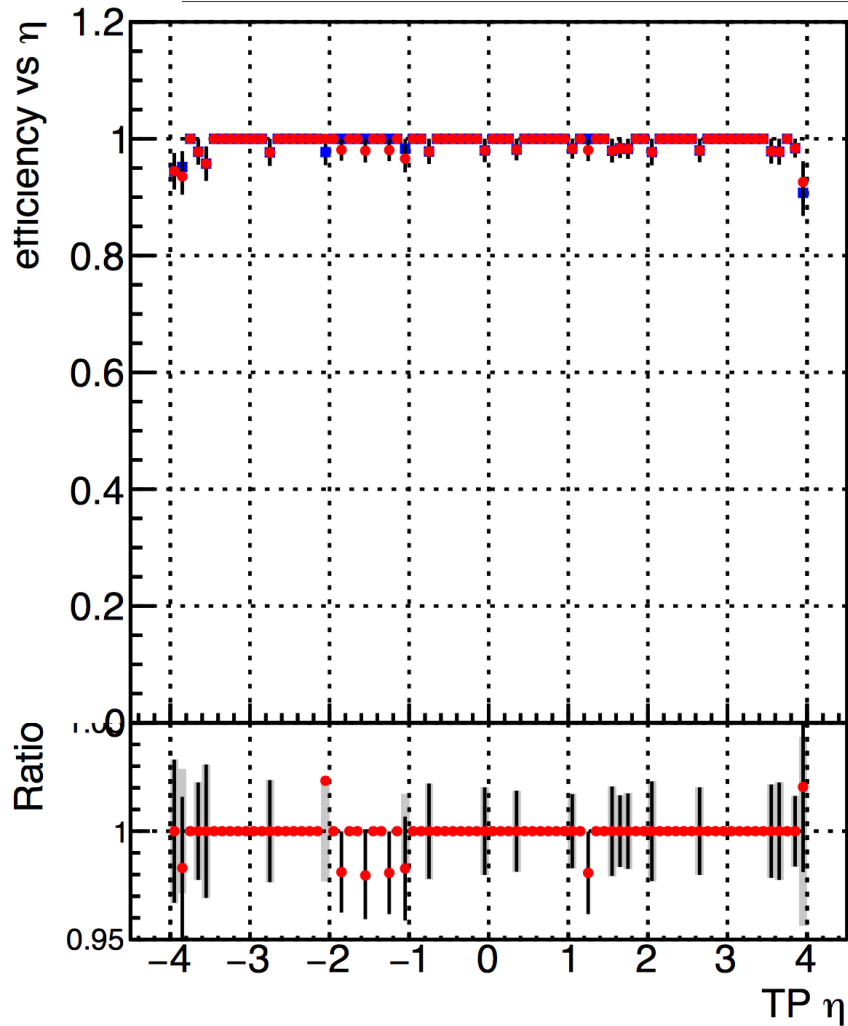
- New detector
 - 4 times better granularity in Inner Tracker
 - Macro-Pixels in Outer Tracker
- New Algorithms
 - Simple Cellular Automaton for seeding
 - Quadruplets & Triplets (extended in future to OT?)
 - Restricted window search in pixel detectors (IT&OT)
- Critical Metric for the Detector Layout
 - **Coverage of four contiguous layers in IT**

Where we stand

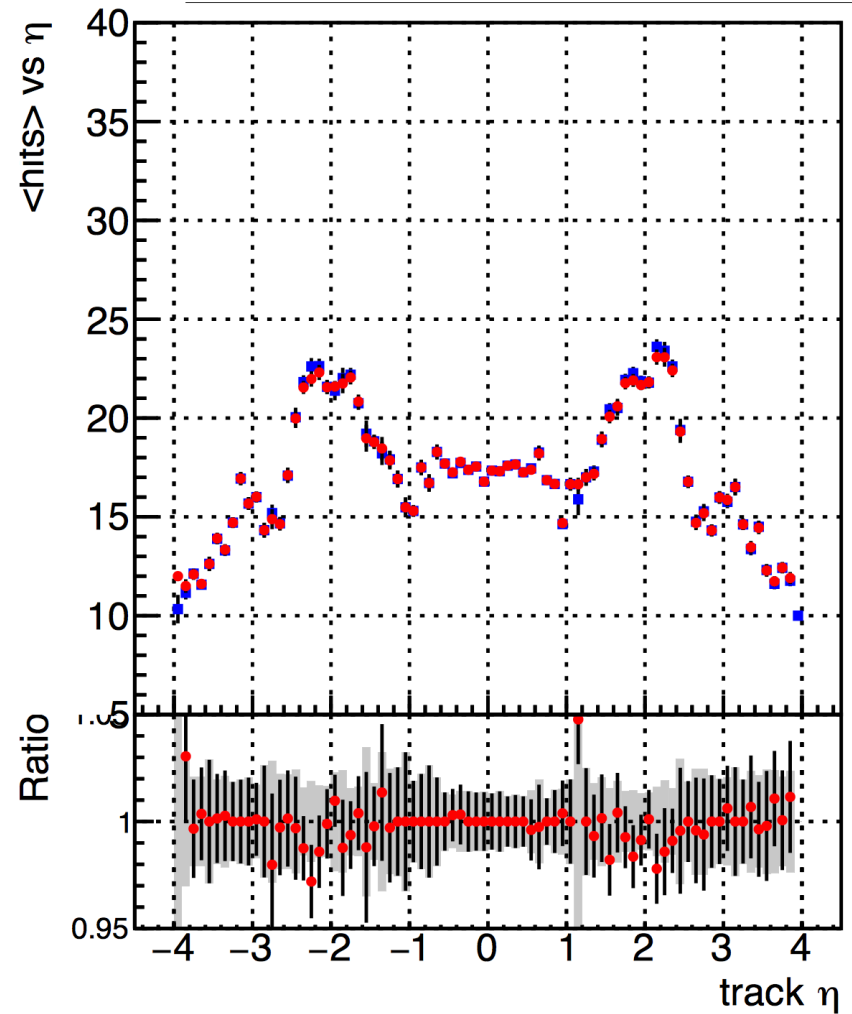
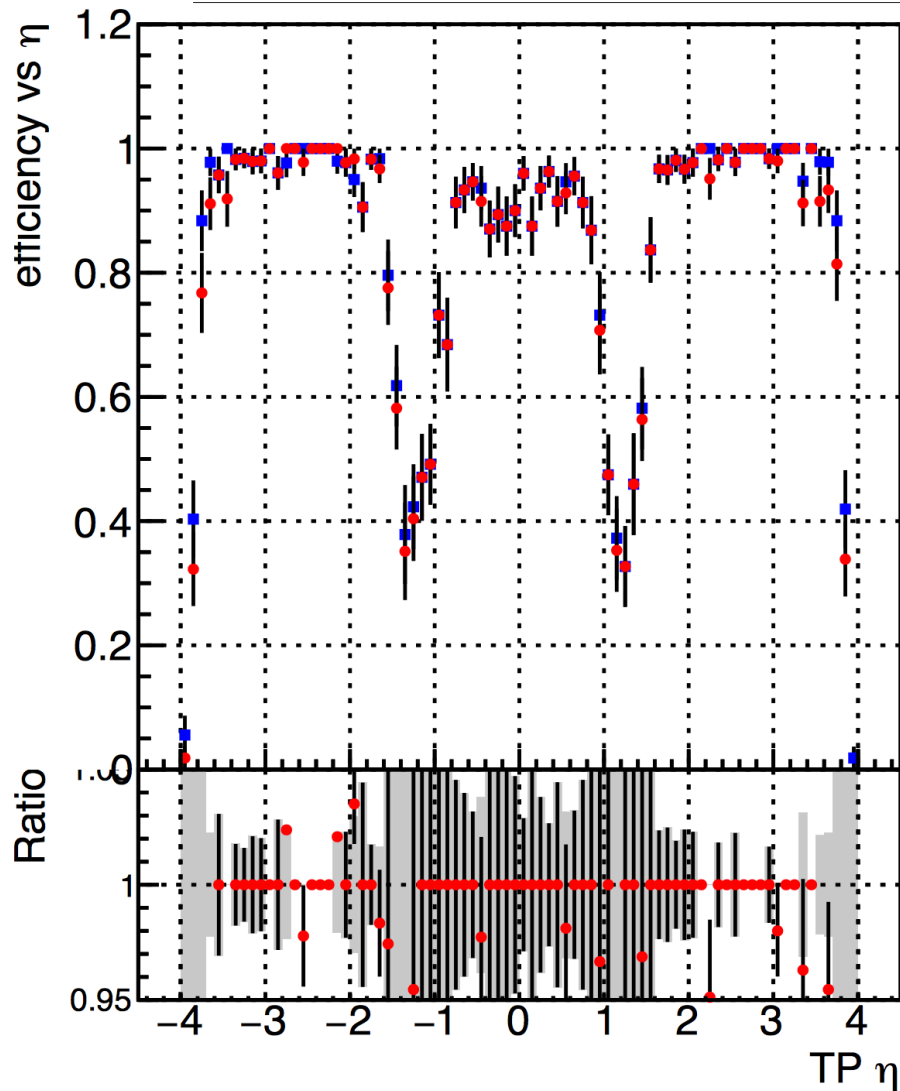
- Timing Tracking Only (seeds+building+fitting)
 - 3.8GHz machine, 8 core, 8 Threads
 - Phase1 PU50: 3.8 sec/ev
 - ~1700 reco-tracks/ev
 - Phase2 D11 PU200 current: 27.0 sec/ev
 - Phase2 D11 PU200 “New algos”: 14.8 sec/ev
 - ~7000 reco-track/ev

Timing linear with #reco-tracks: combinatorial beaten!
Colors for next set of slides....

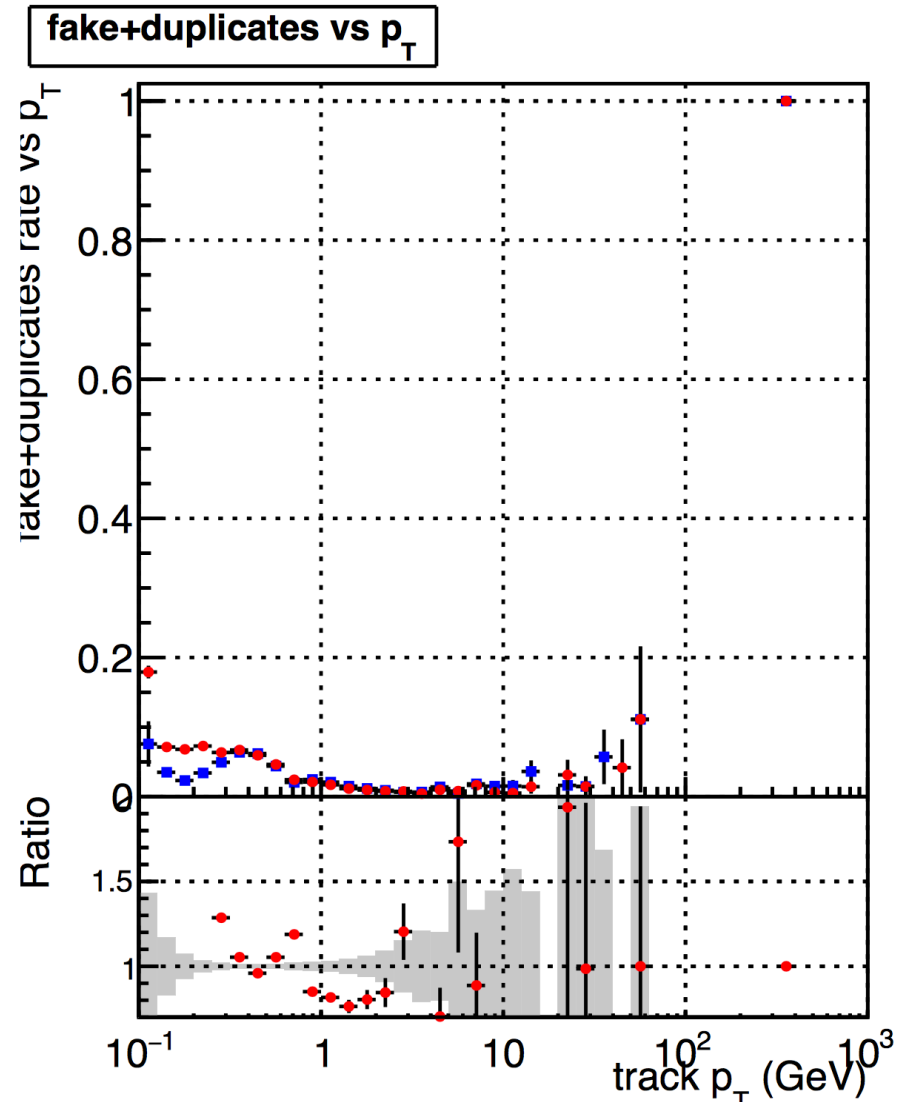
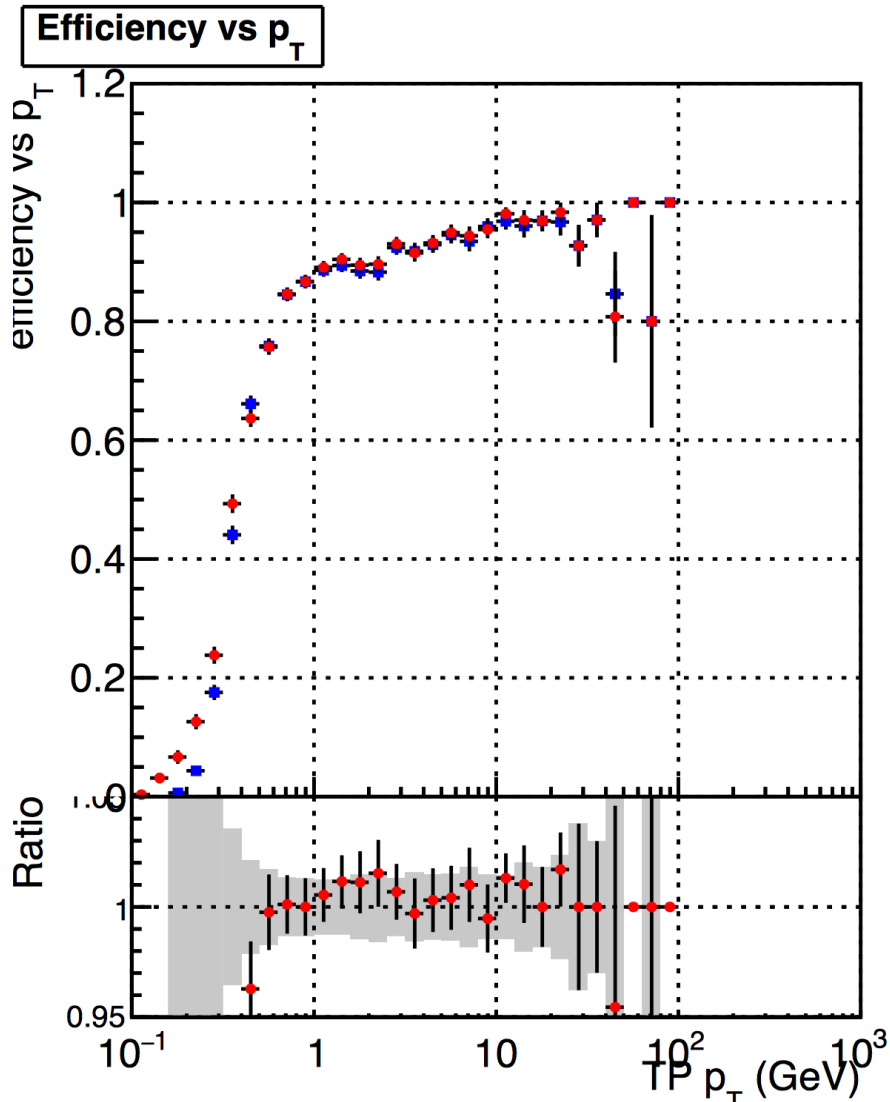
Performance: Mu 10GeV



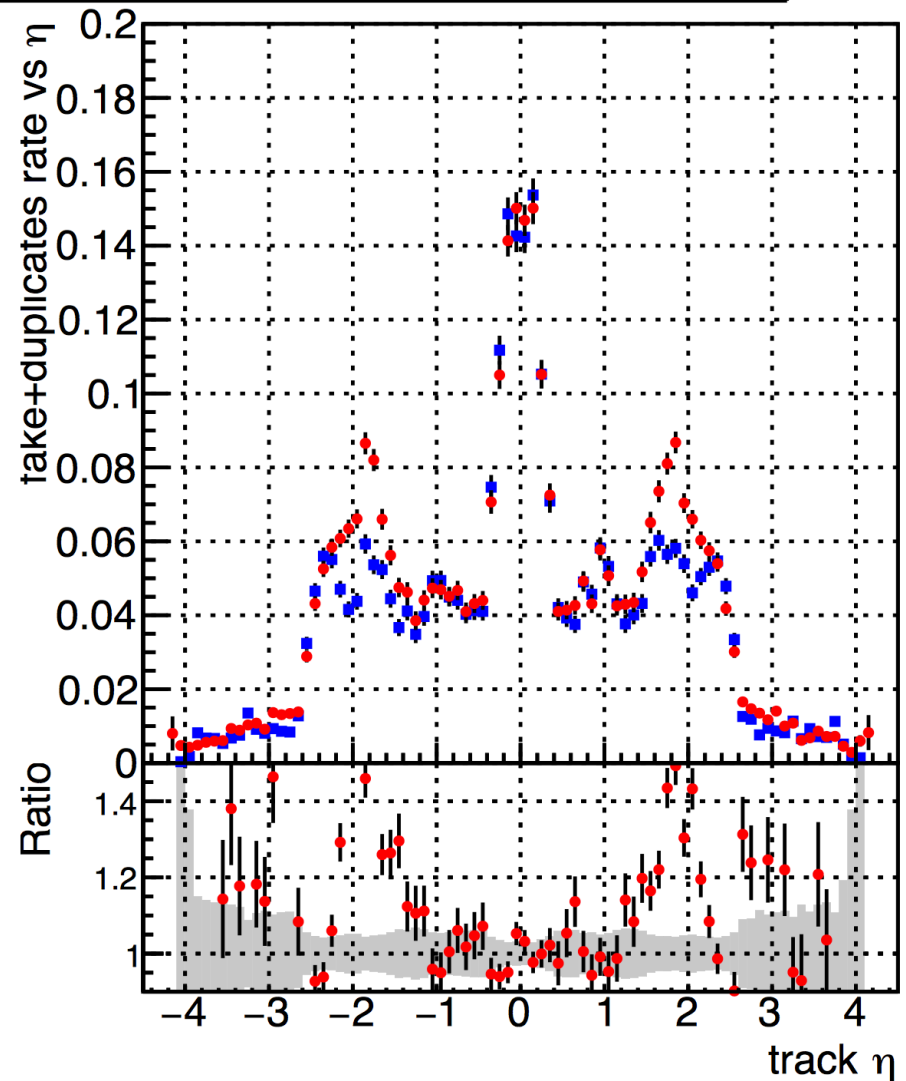
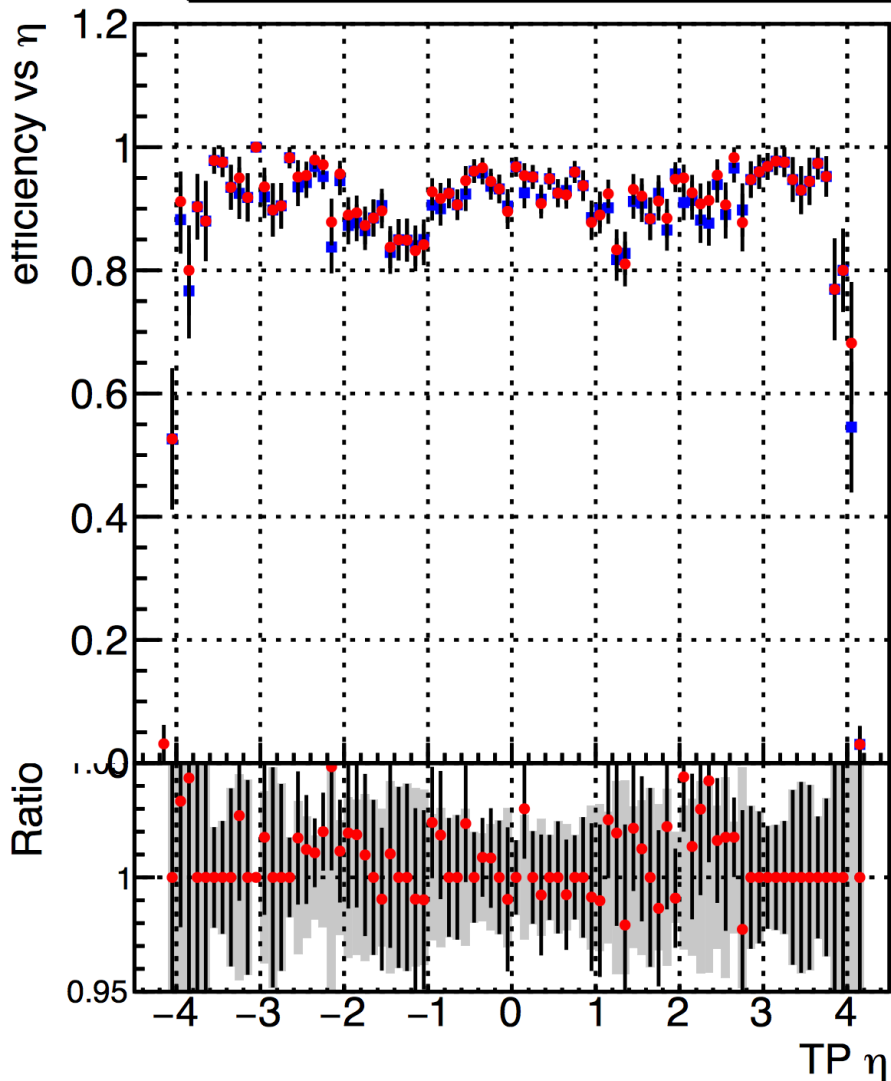
Mu10GeV InitialStep (quadruplets)



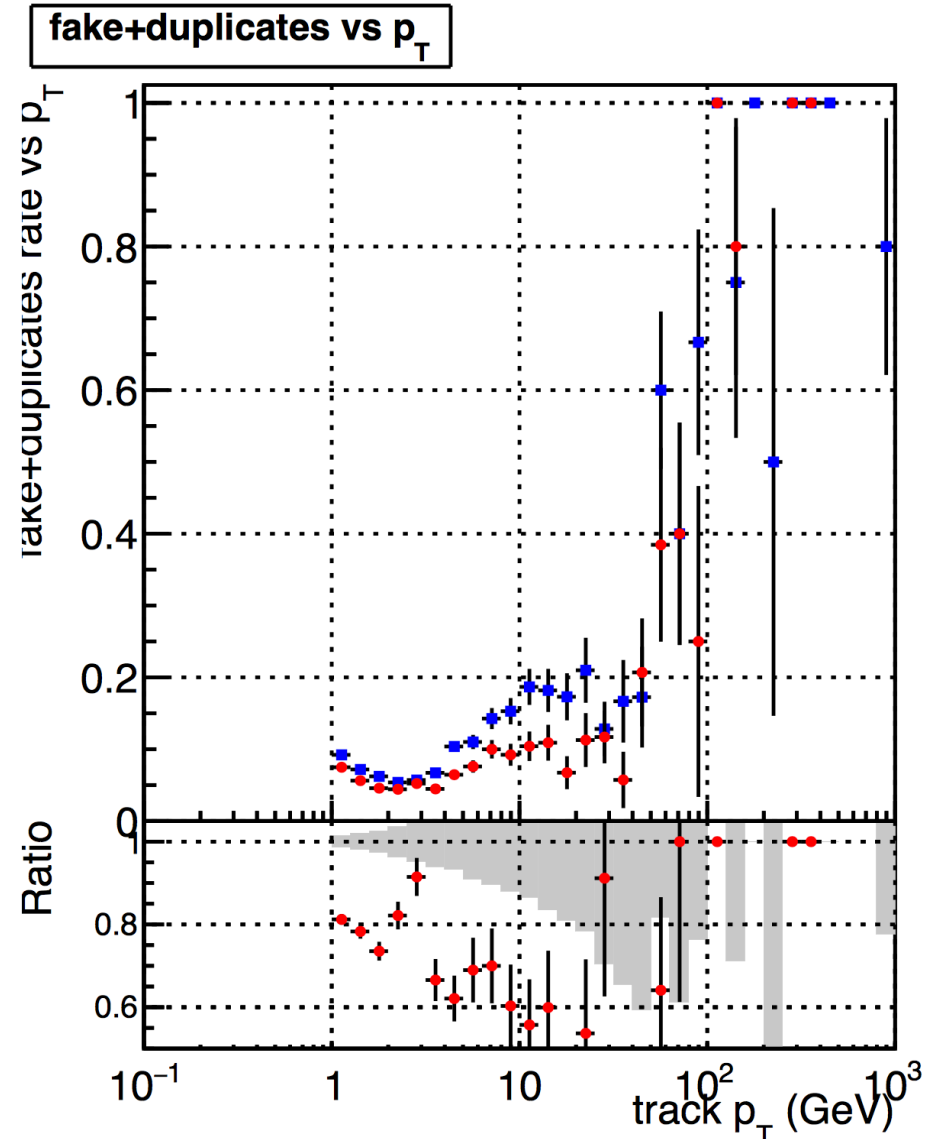
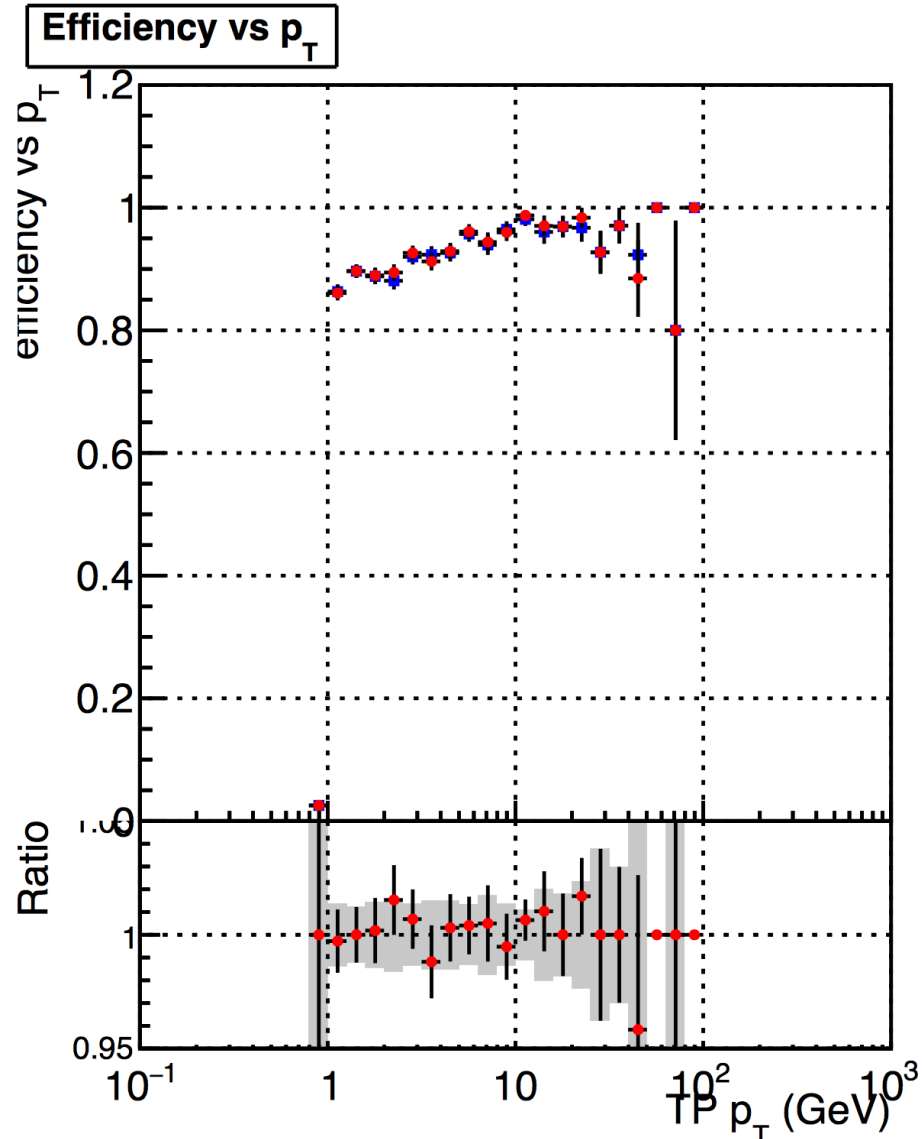
Performance: $t\bar{t}$ 200PU HP tracks (HP selection not tuned yet)



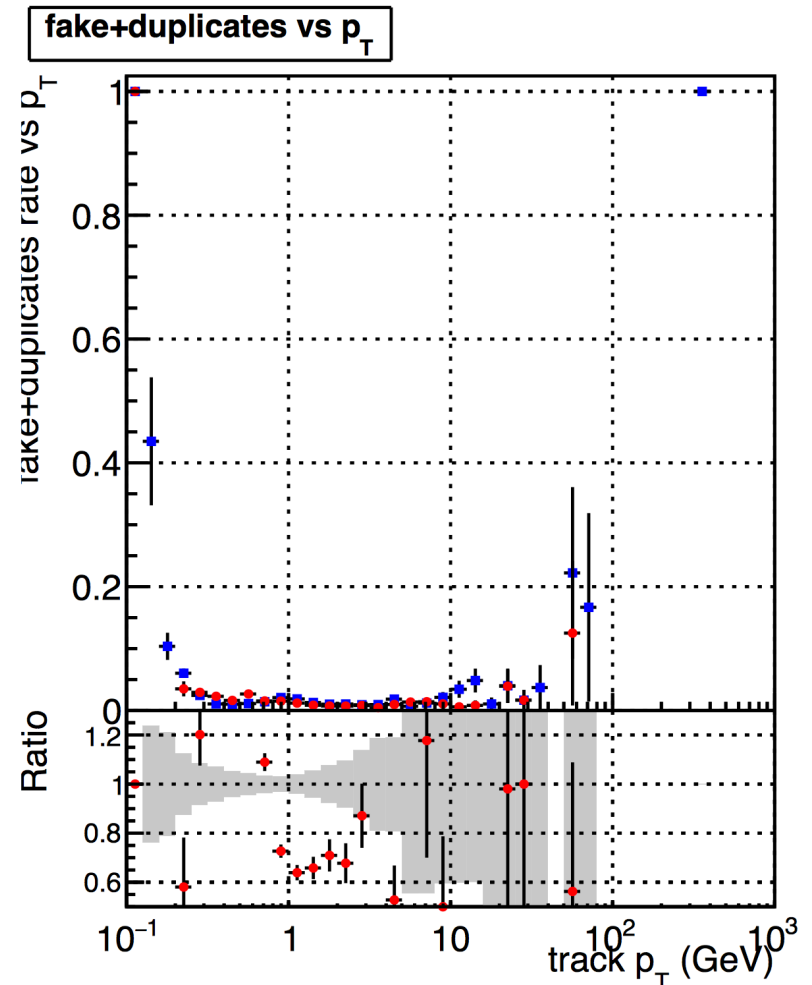
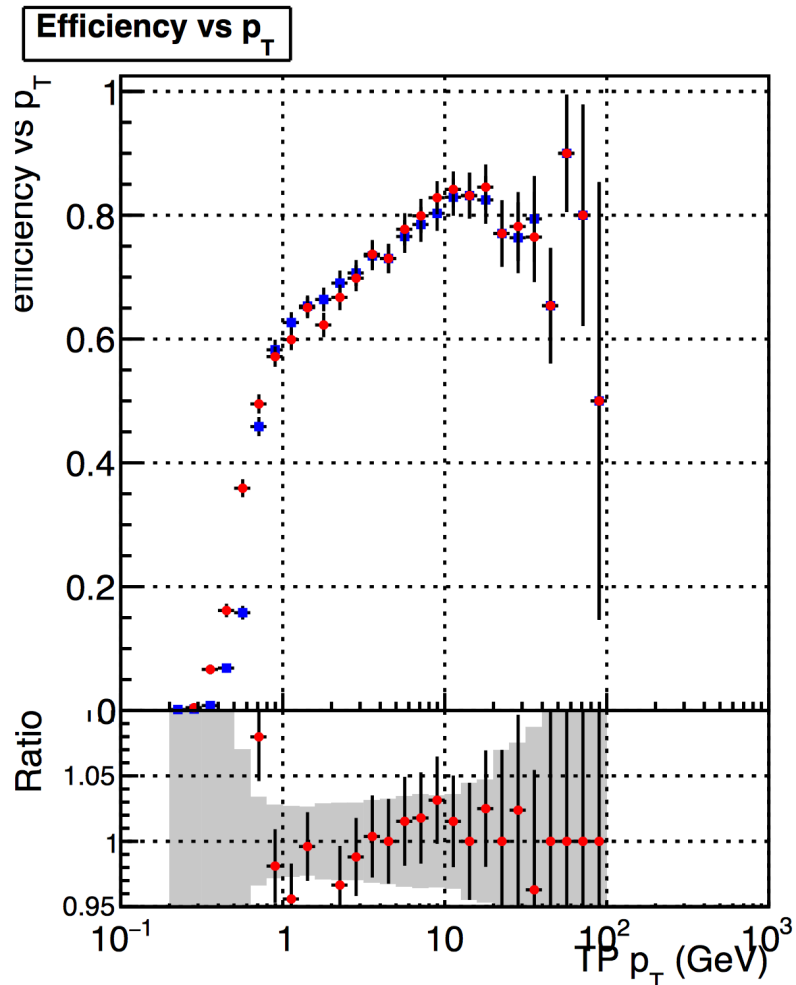
ttbar 200PU HP tracks (HP selection not tuned yet)



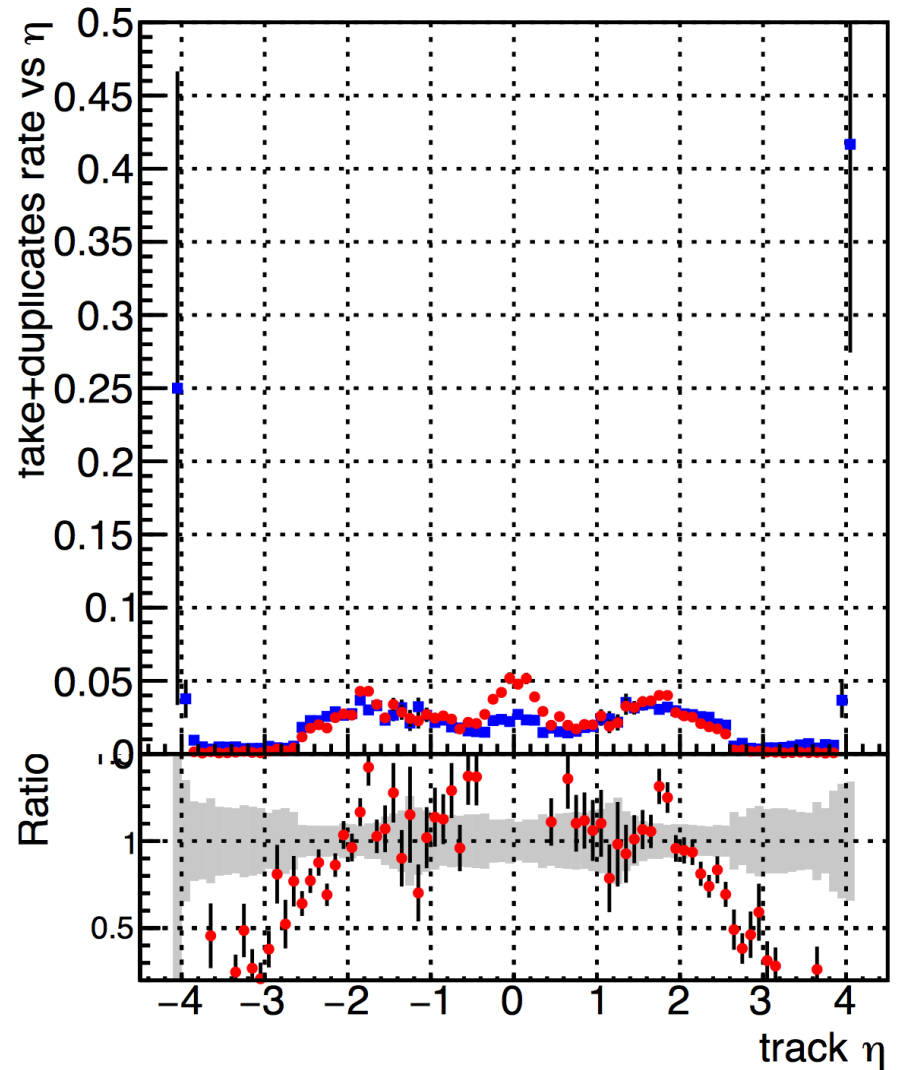
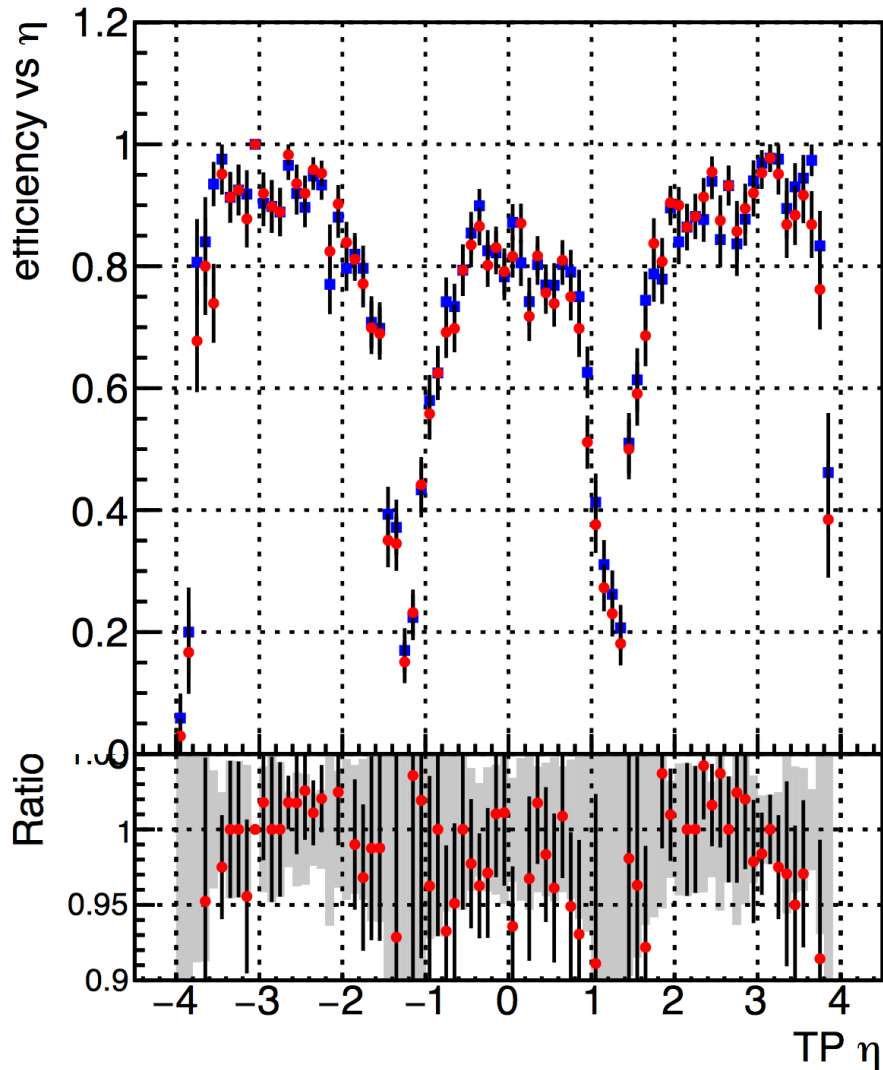
Ttbar 200PU BTV-like selection



Ttbar PU200: quadruplets

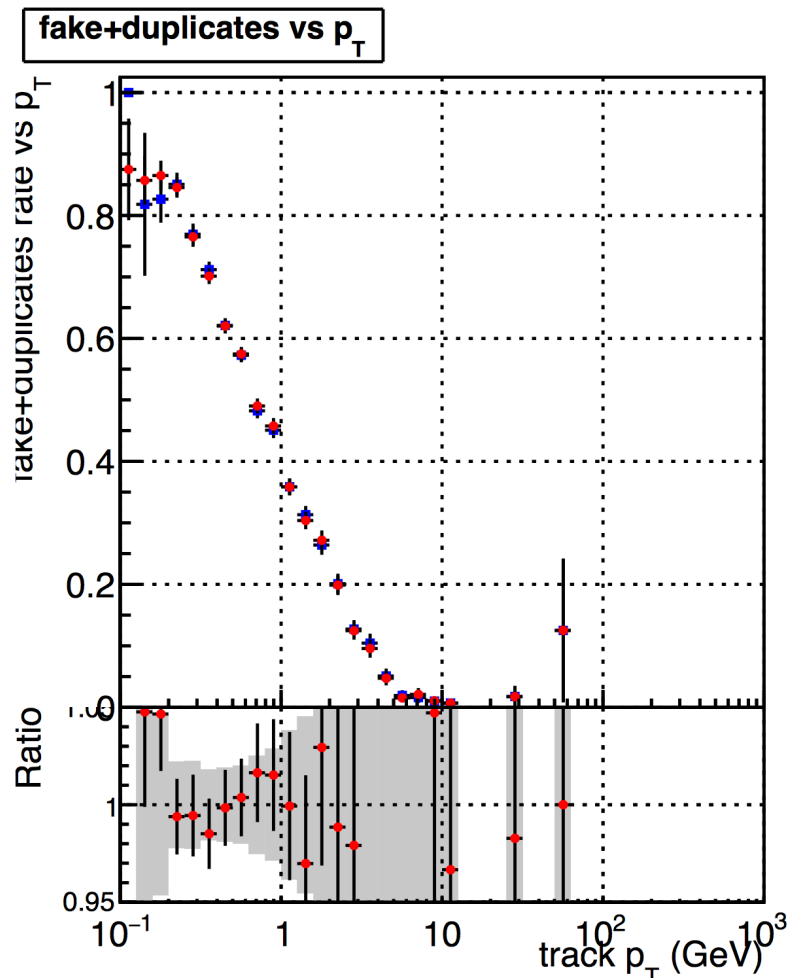
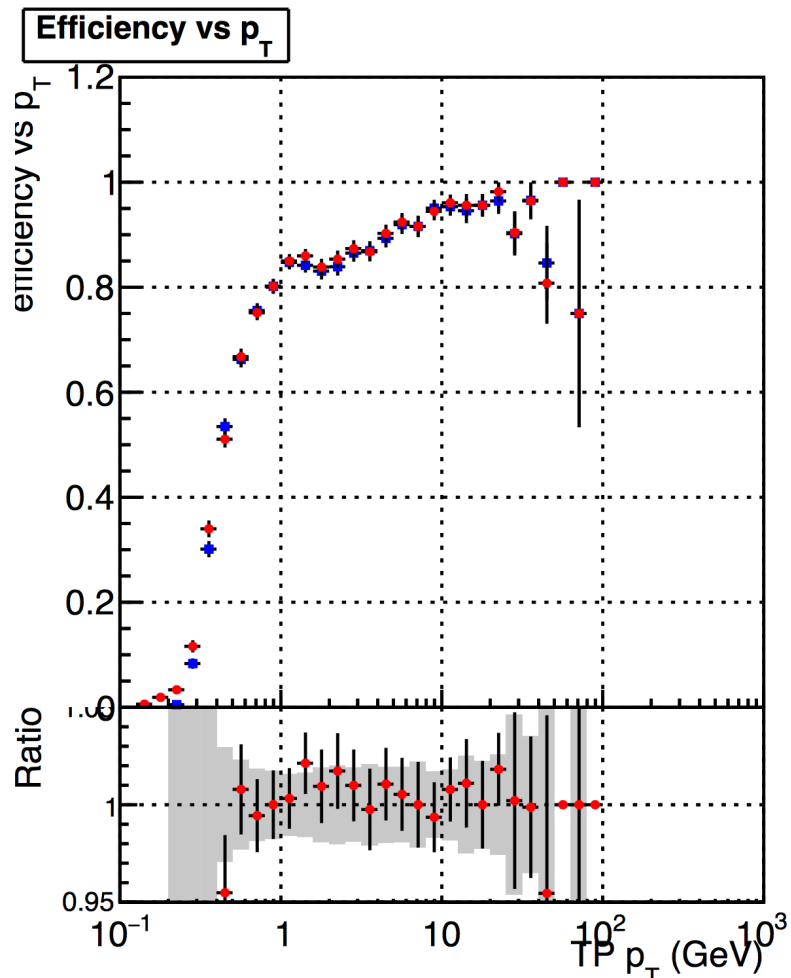


Ttbar PU200: quadruplets



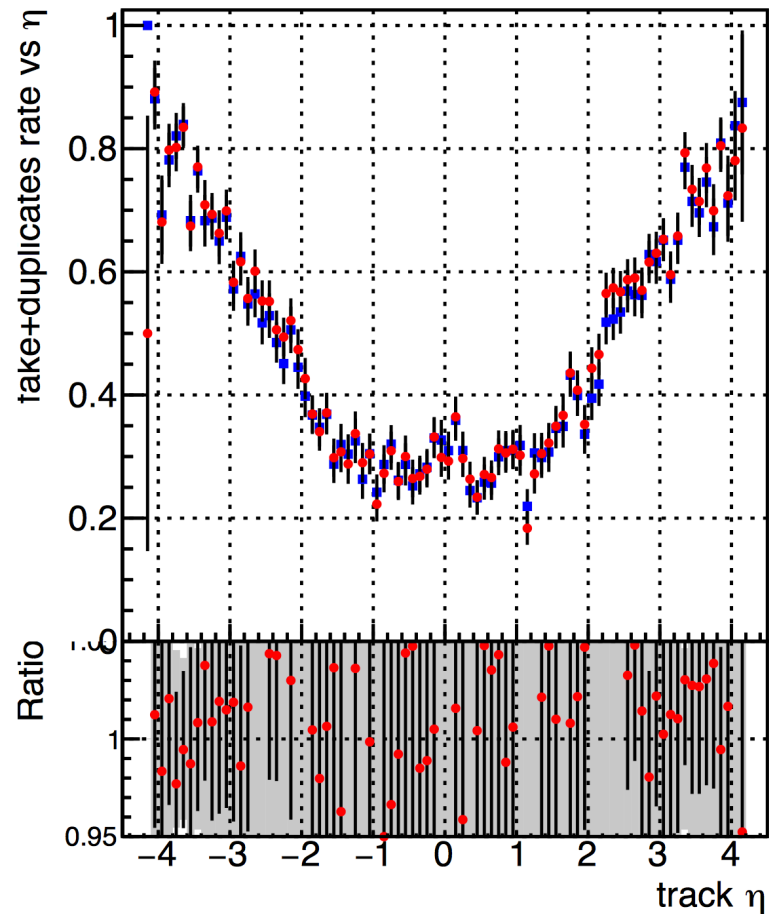
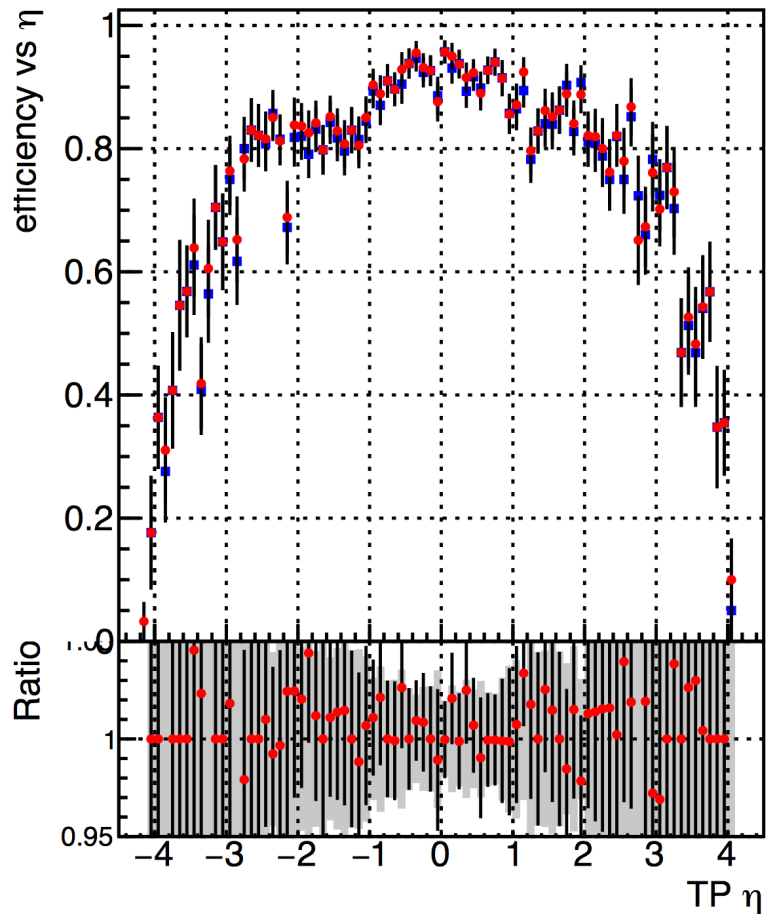
ttbar PU 200: what physics will see

High purity tracks from reco PV vs. TrackingParticles from gen PV
(fake rate includes pileup tracks)



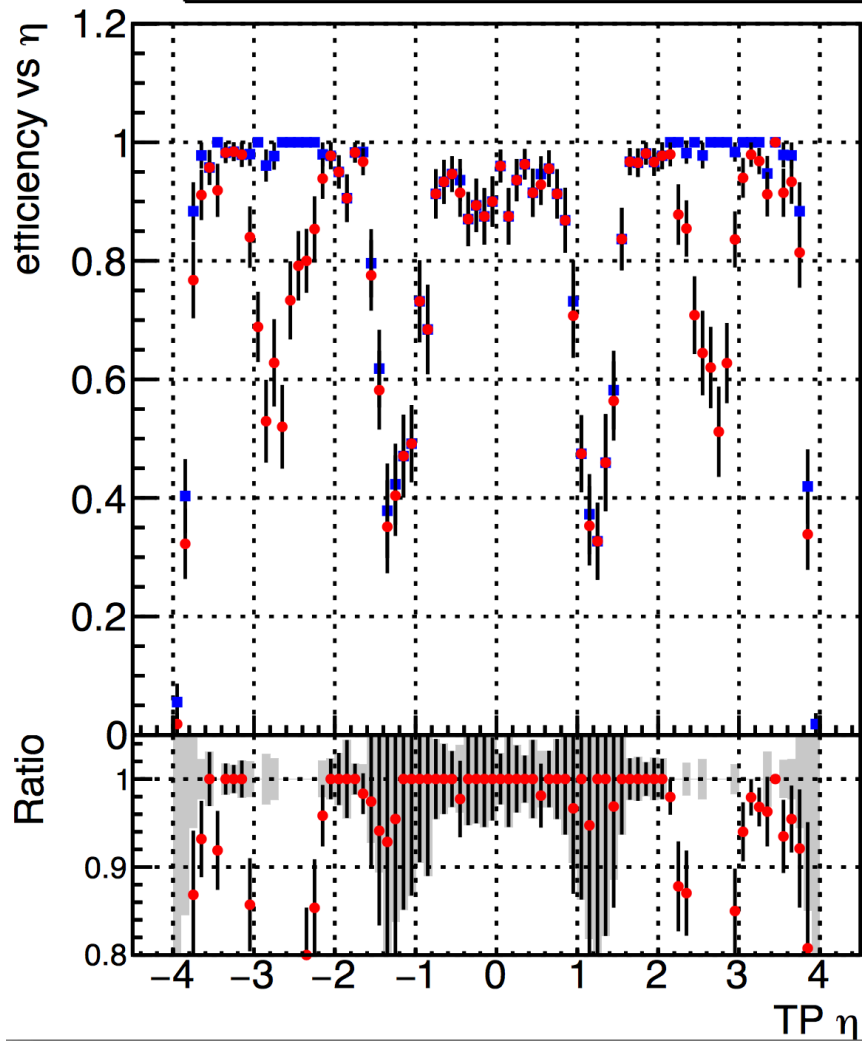
$t\bar{t}$ PU 200: what physics will see

High purity tracks from reco PV vs. TrackingParticles from gen PV
(fake rate includes pileup tracks)



Mu10GeV: what can go wrong?

Just missing FPIX1+FPIX2+FPIX3+FPIX4

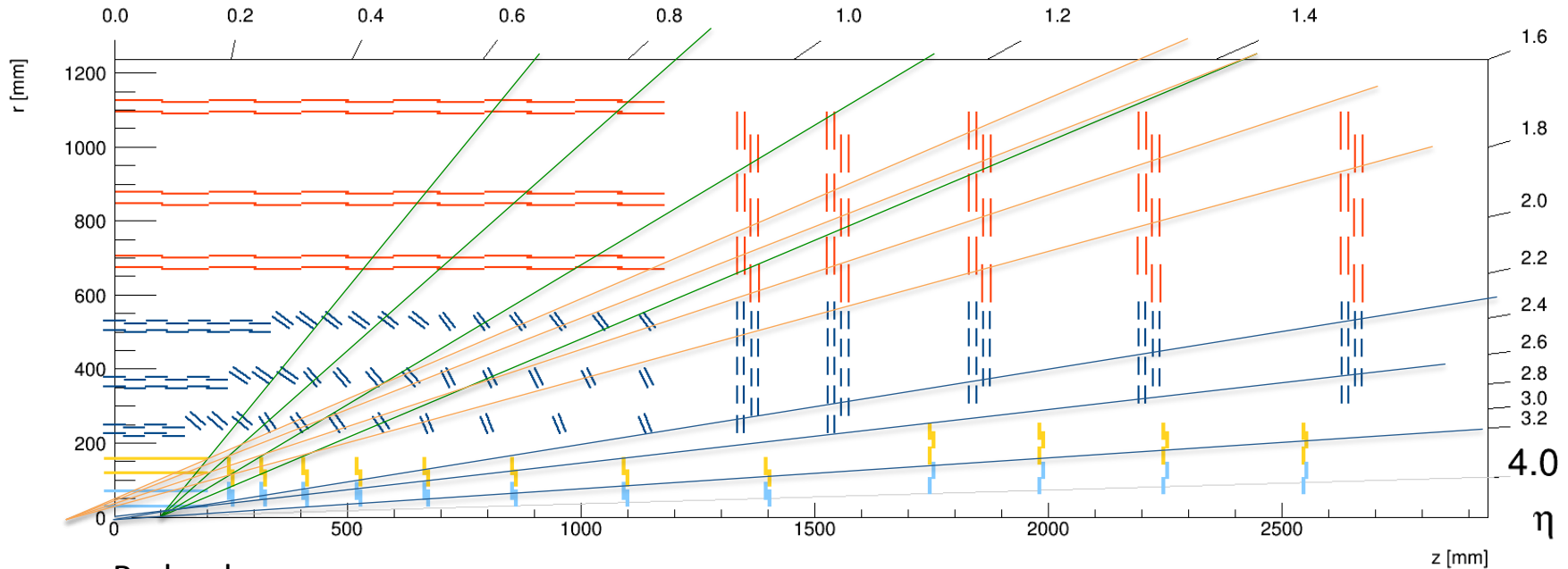


Real Quadruplets requires four efficient contiguous layers.
(can be configured with holes)

Triplet "extension" less sensitive:
It will find next IT layer

Holes: cannot be filled adding disks:

- move first disk as close as possible to barrel
- add an extra outer ring to innermost disks



Redundancy:

- Seeding: (purely technical)
 - Split inner (blue) and outer (yellow) “rings” in different “seeding layers”
 - Split inner and outer disks in different iterations
- Tracking
 - Some inner rings seem redundant
 - Lack of layers at $\eta \sim 2.6$
 - A doublet/triplet design may be more efficient (2+3+3+3 or 2+4+4?)
 - Optimal z-position of inner and outer rings is clearly different

Occupancy at PU200

