Occupancy in the TPC

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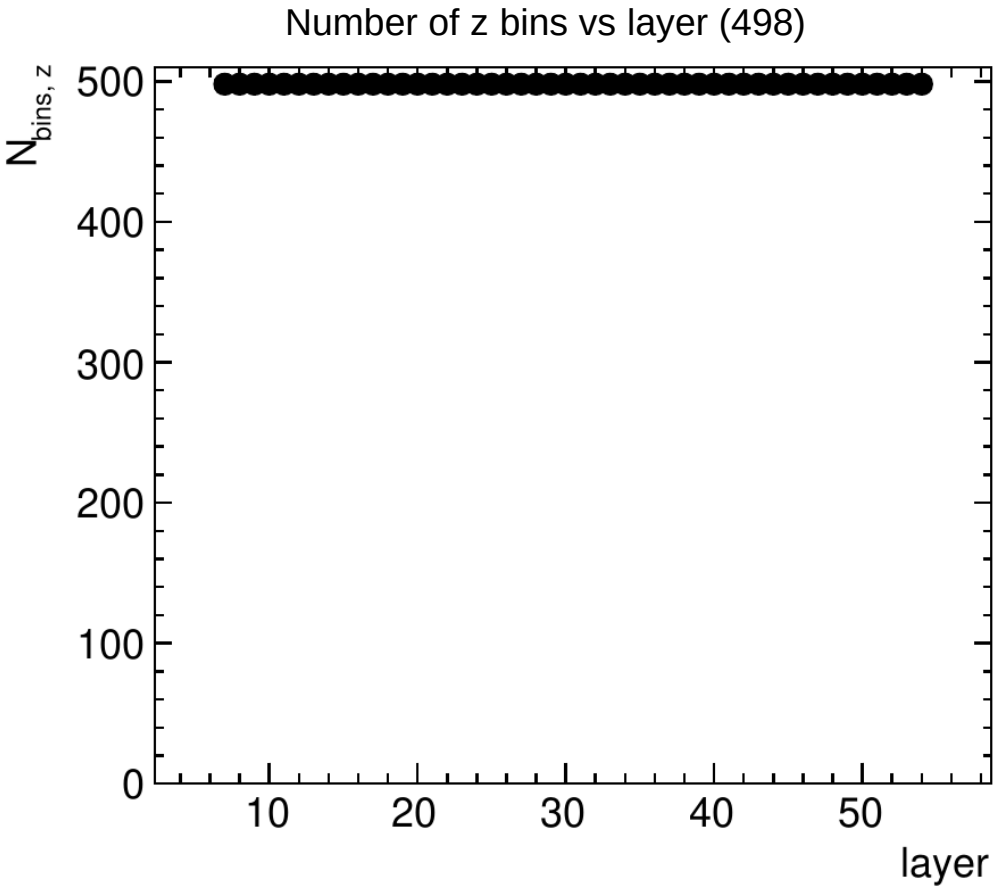
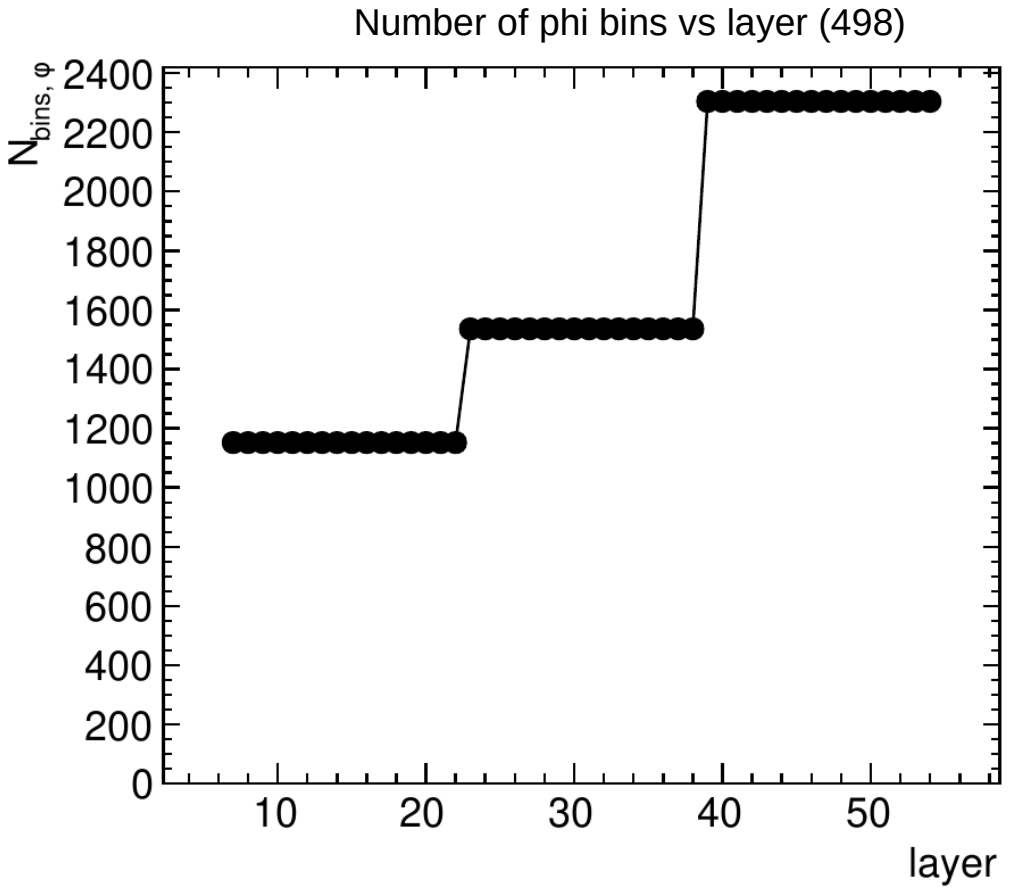
Definition and number of ‘channels’

Occupancy: average fraction of cells with one hit per event

cells = (pad,zbin)

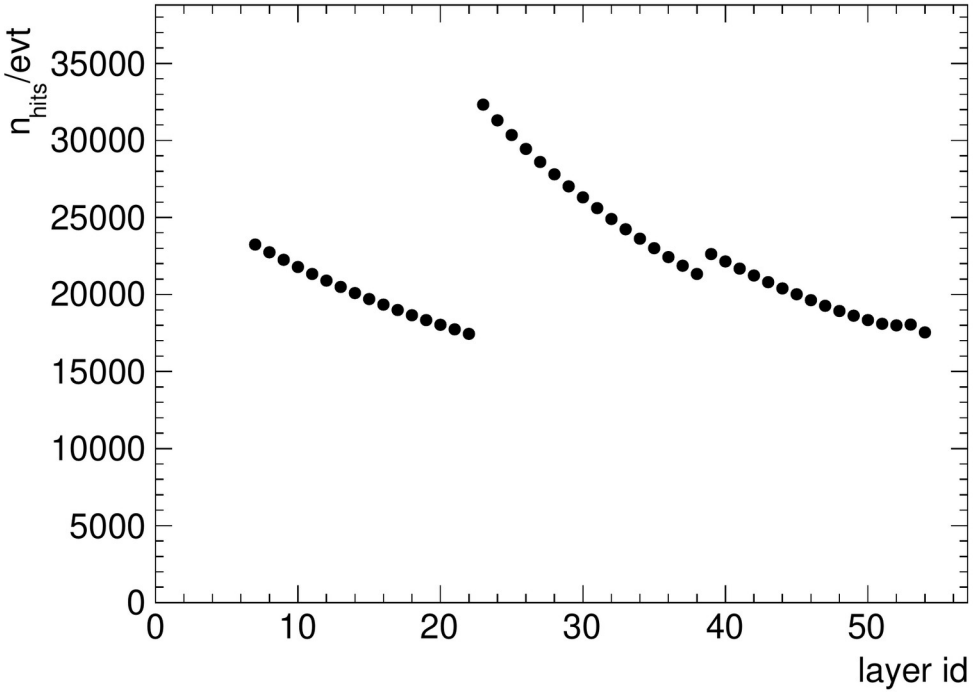


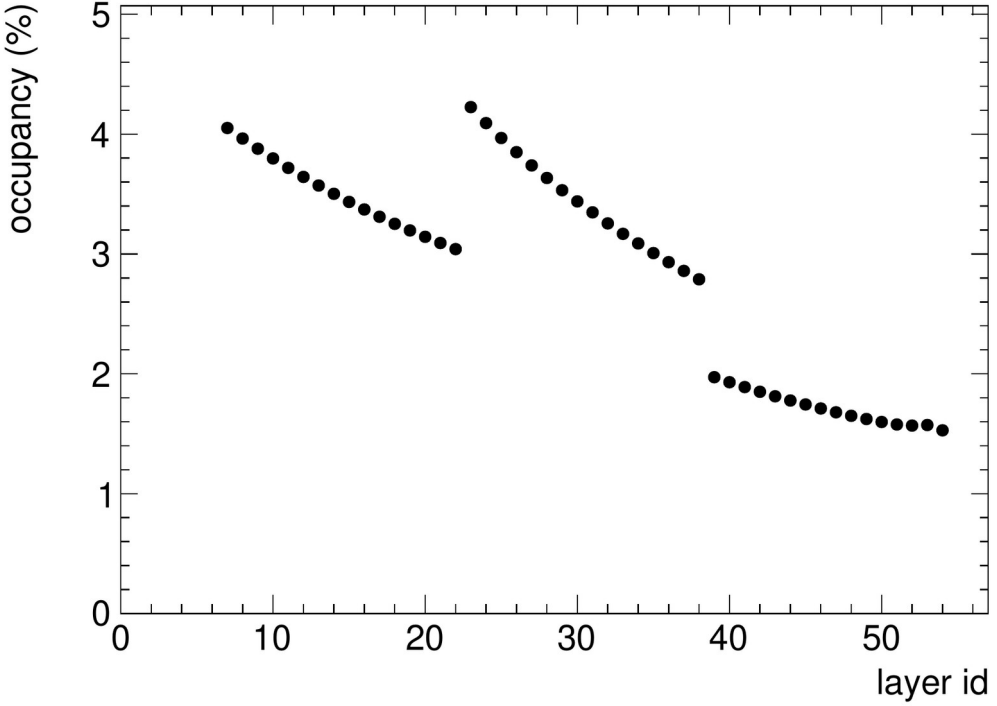


Mean occupancy vs layer - Single HIJING files

G4Hits: /sphenix/sim/sim01/sphnxpro/Micromegas/1/G4Hits_sHijing_0-12fm*.root

Clusters: /sphenix/user/hpereira/work/g4simulations/DST/CONDOR_Hijing_Micromegas/Clusters/*.root





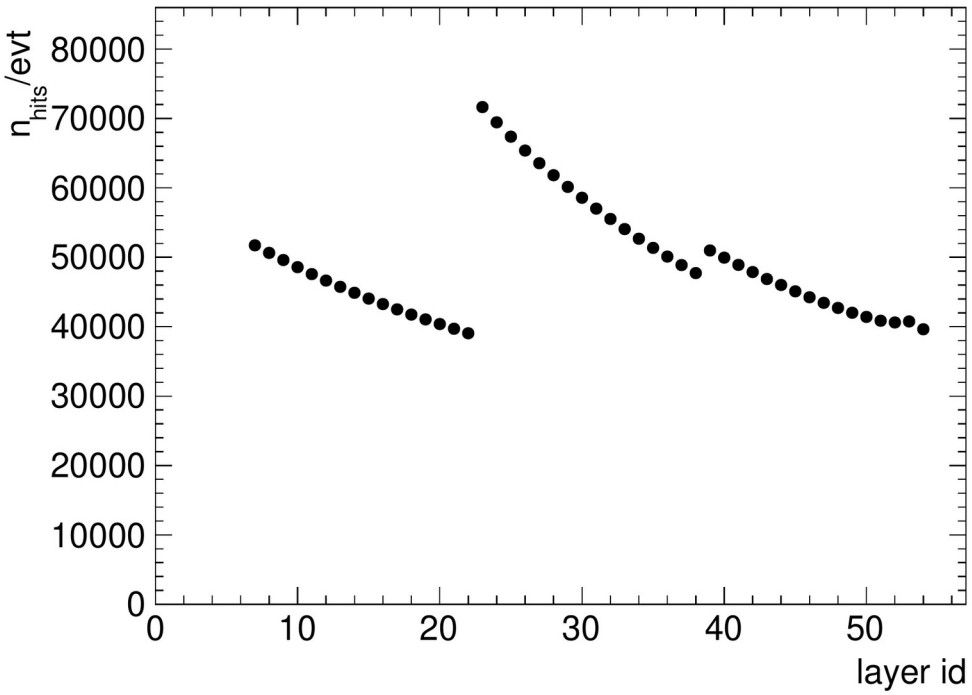
Number of hits/event/layer vary from 17000 to 34000

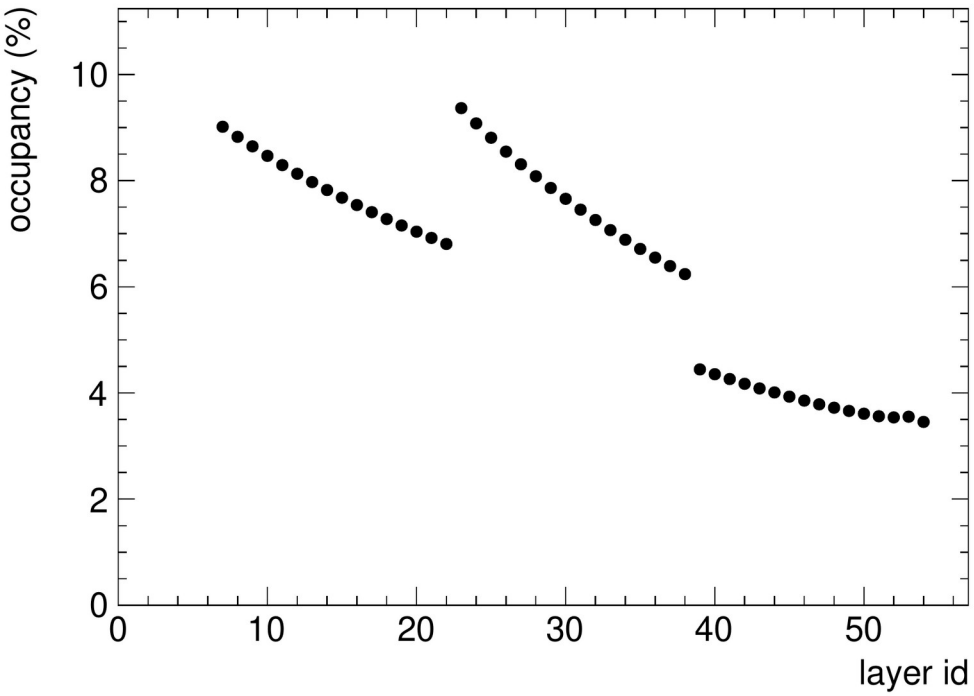
Occupancy vary from 1.5% to 4.2%

Mean occupancy vs layer (cont.) - HIJING + 100kHz pile-up

Clusters: /sphenix/user/hpereira/work/g4simulations/DST/CONDOR_Hijing_Micromegas/G4Hits_merges/*.root

Clusters: /sphenix/user/hpereira/work/g4simulations/DST/CONDOR_Hijing_Micromegas/Clusters_merged/*.root





Number of hits/event/layer vary from 39000 to 78000

Occupancy vary from 3.8% to 9.5%

Do the numbers make sense ?

TPC time window: [-13.2, 13.2] µs

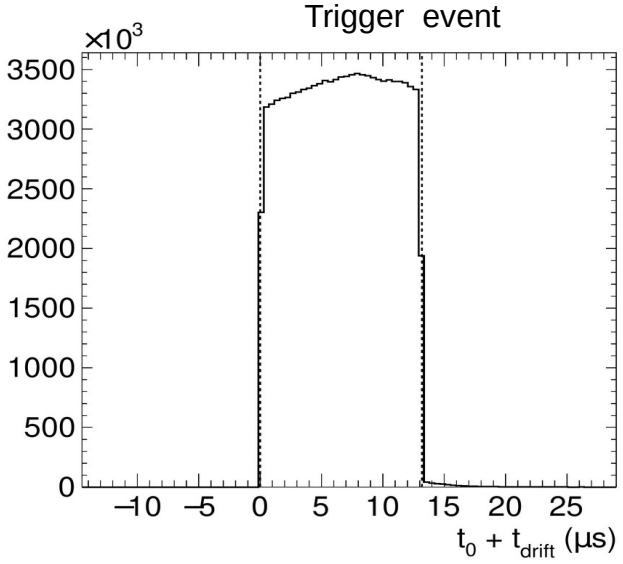
At 100kHz this corresponds to 2.64 PU events per trigger event

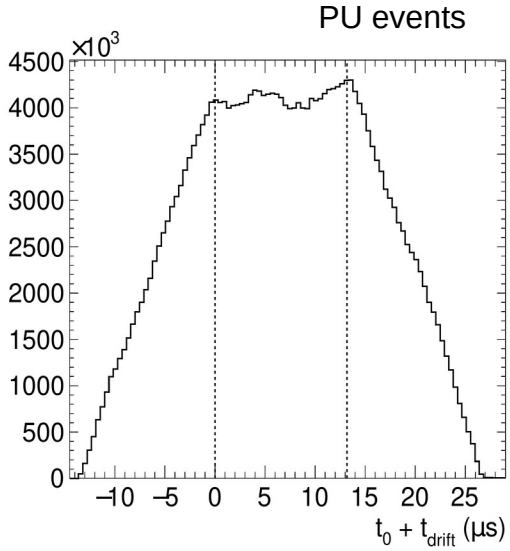
However, only half the time-shifted hits from PU fall into the TPC time window

(because for each hits, $t0+v_{drift}.|z-z_{GEM}|$ must be in [0, 13.2] µs)

So one expects 1+2.64/2 = 2.32 increase in the number of hits from HIJING to HIJING+PU

This is consistent with the numbers from previous slides (34000x2.3 = 78200)

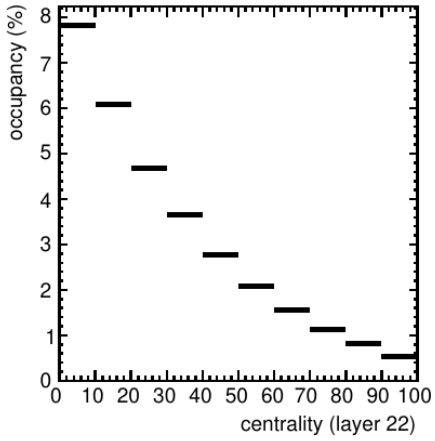


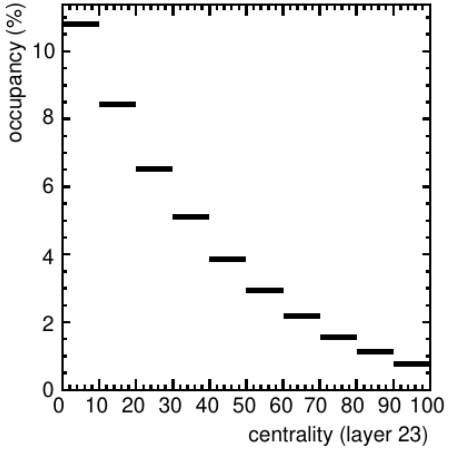


PU Hits distribution is the convolution of single HIJING t_{drift} distribution and flat t_0 distribution in [-13.2, 13.2] µs

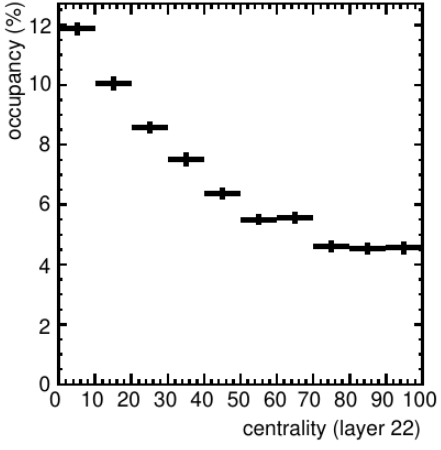
Centrality dependence

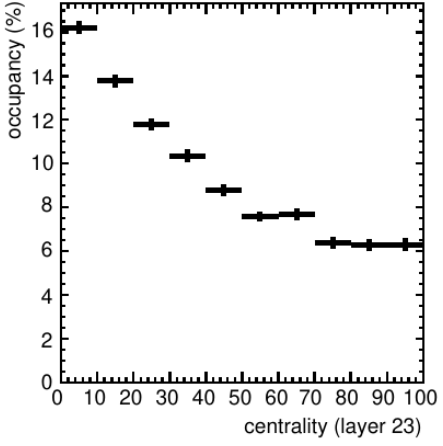
Single HIJING events





HIJING + PU events

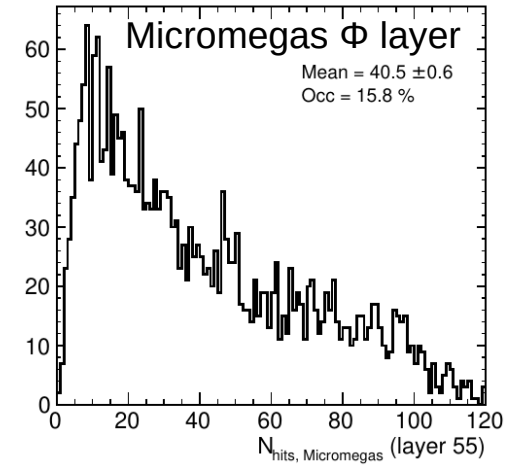


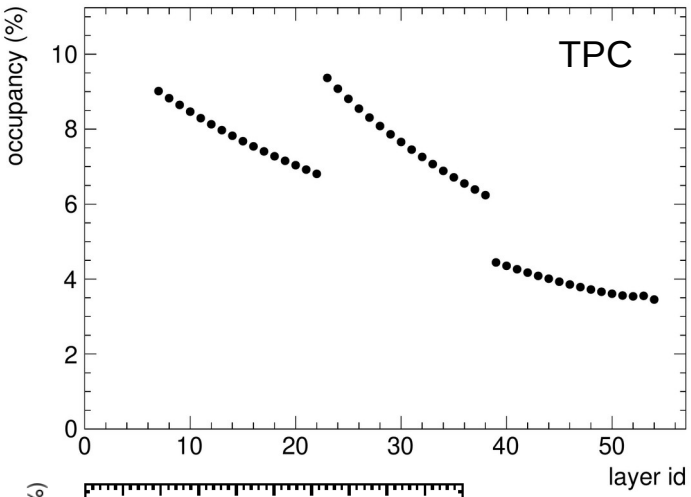


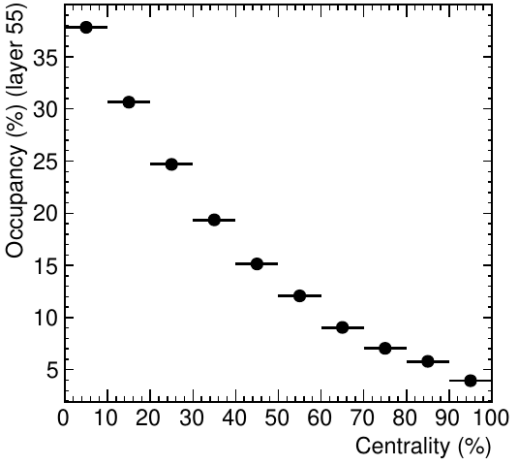
Left: layer 22, min occupancy
Right: layer 23, max occupancy

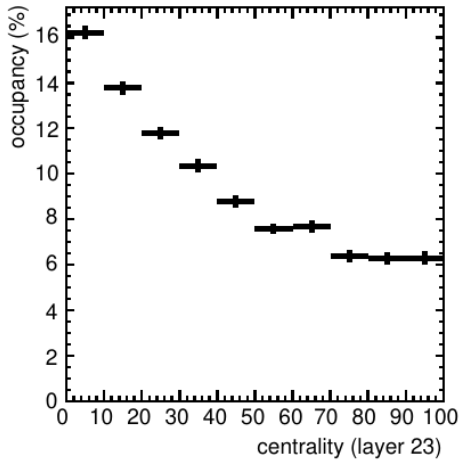
Centrality dependence less pronounced when adding PU (expected)

Comparison to Micromegas









up to 16% with little impact from PU

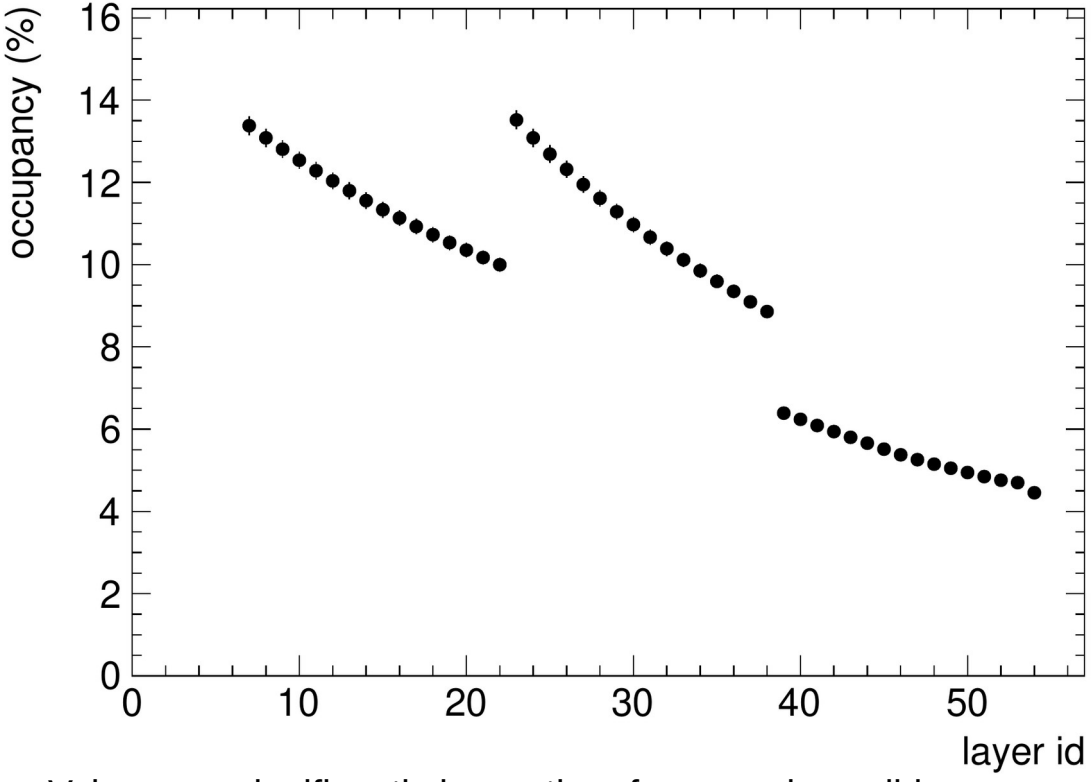
centrality dependence more pronounced than in the TPC, because of little effect from PU

Comparison with HIJING files from Christof

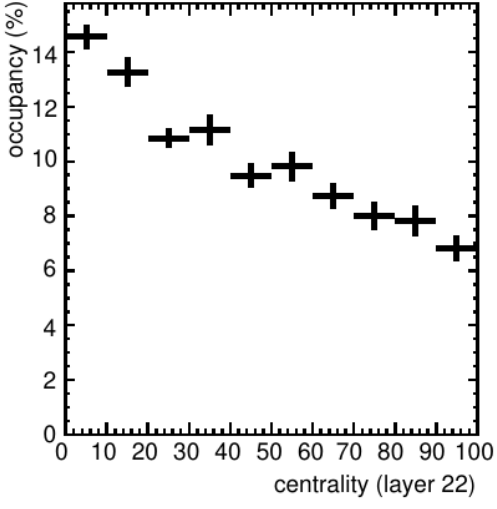
Cluster files at:

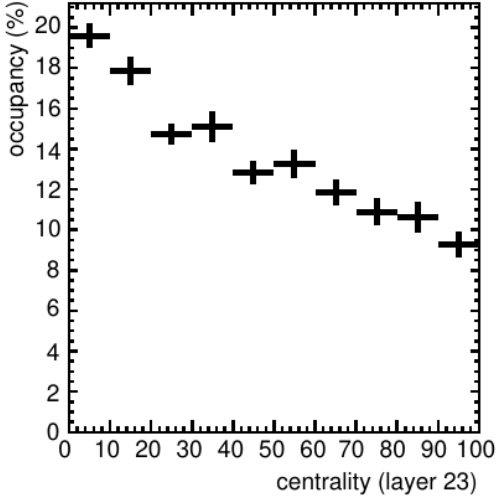
/sphenix/user/bogui/MacrosModular/macros/macros/g4simulations/clus_only/SvtxCluHijMBPu100_Mar20_1_*

Occupancy vs layer



Occupancy vs centrality





Values are significantly larger than from previous slides

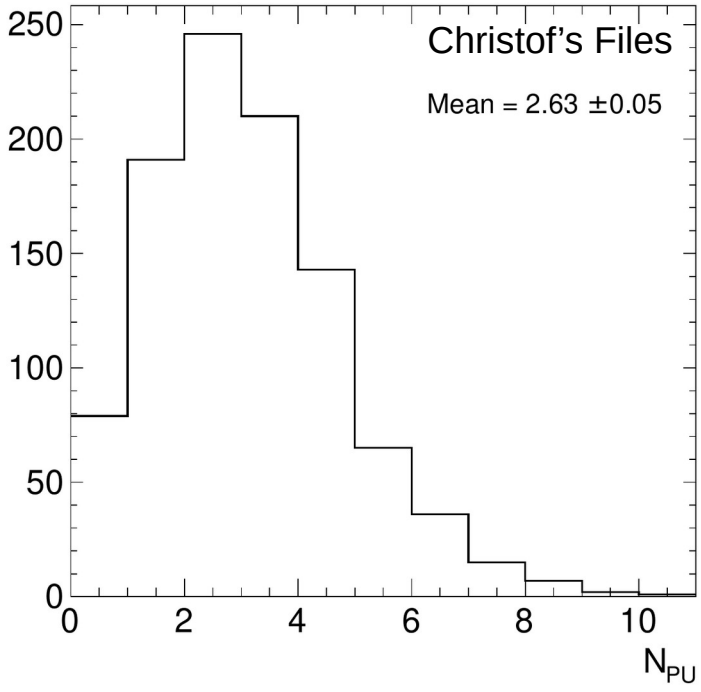
Investigating source of the difference

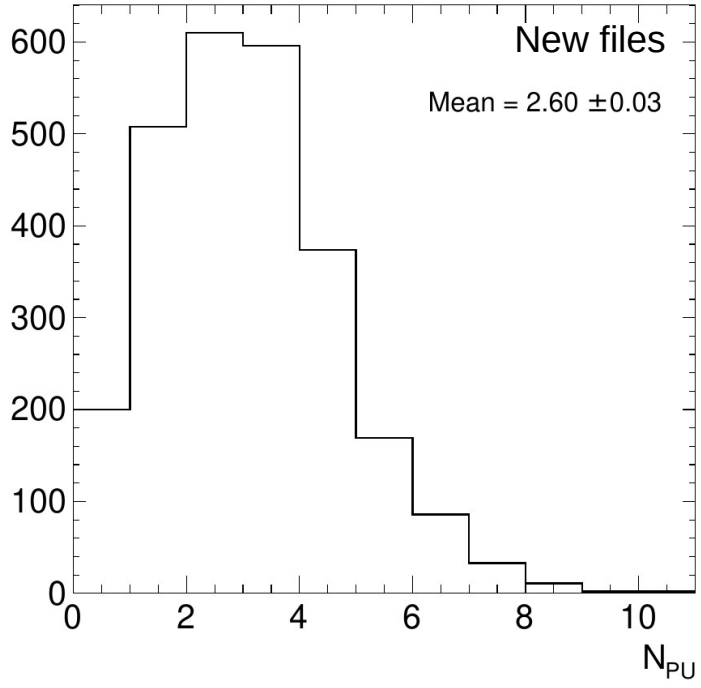
Checks so far

- Mean number of embedded PU per trigger event matches:
  not a problem on PU rate
- Number of G4Particles in “main” HIJING event (embed_id==0) matches:
  not a problem of HIJING config. Same thing for number of G4Hits in the TPC
- Number of G4Particles in PU HIJING events (embed_id == -1, -2, ...) don’t match
  For the new files the distribution is the same as for the main HIJING event
  For Christof files it is significantly larger except for embed_id == -1.

  → it seems the “main” Hijing event is identical for both sets of simulations
  and there is something I dont understand (either in the files or my evaluators) for the PU events, that create the difference in occupancy
  Need to check how the PU embedding is done

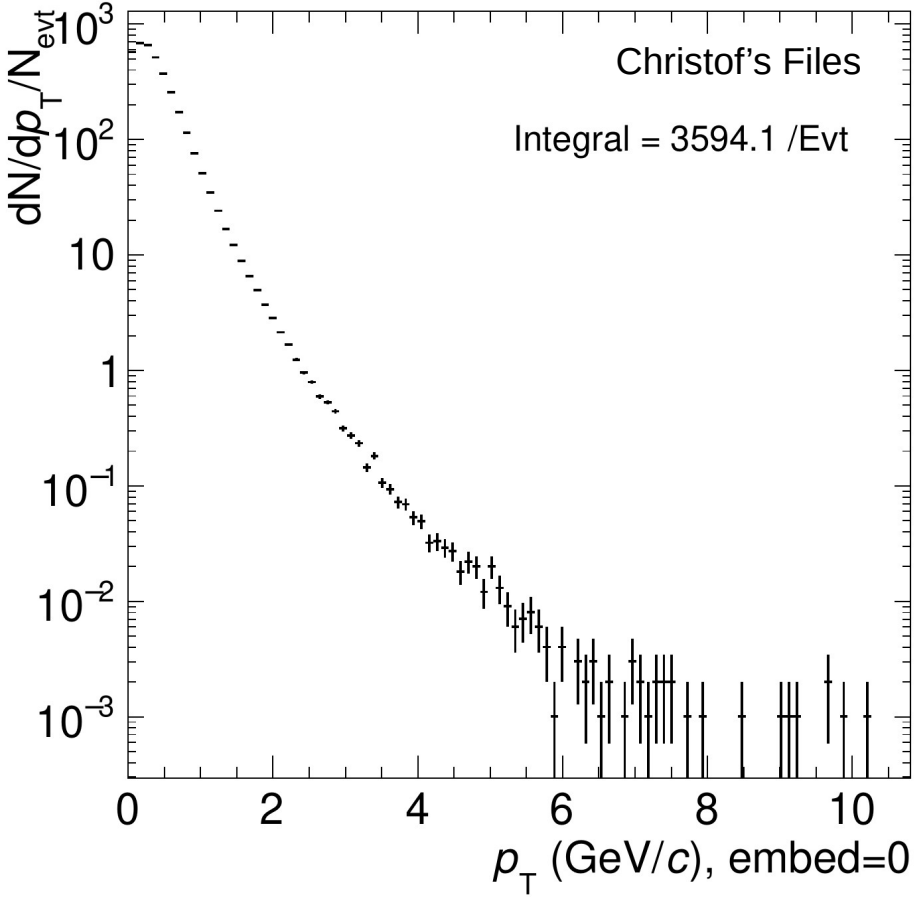
Mean number of embedded PU per trigger event

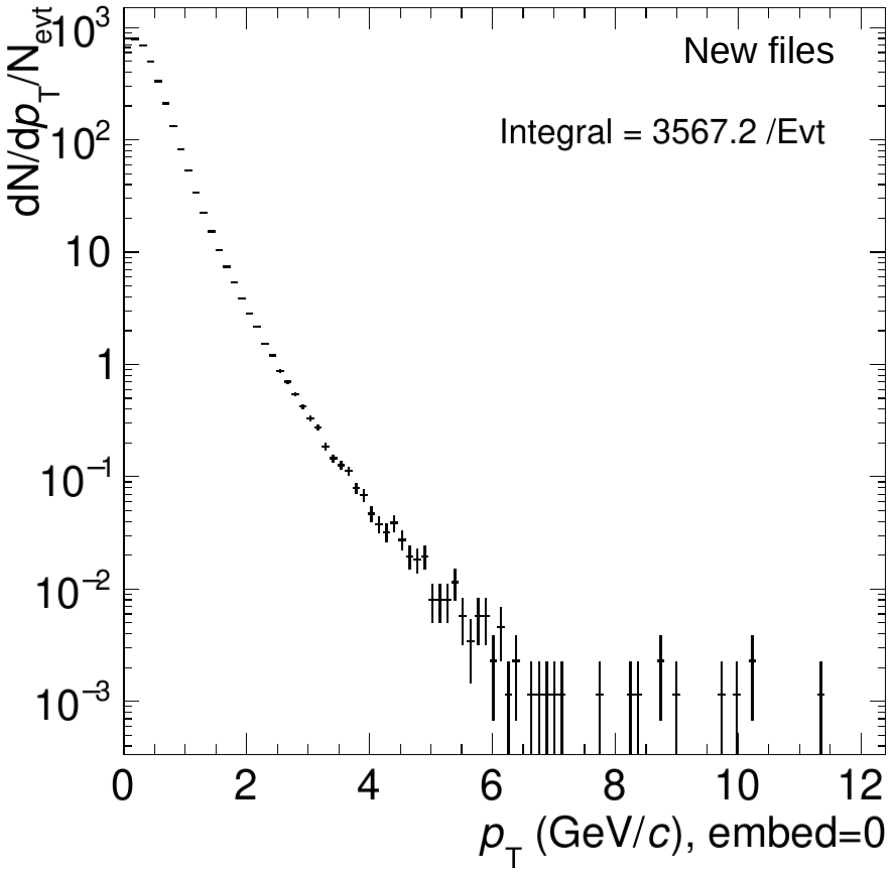




The mean is slightly larger (and the distribution slightly different) for Christof's file but I think this is because the TPC time window for merging is a bit larger (tbc). Nothing dramatic.

Number of G4Particle and p_T distribution for embed=0





Number of G4Hits and time distribution for embed=0