Minimum Bias Trigger
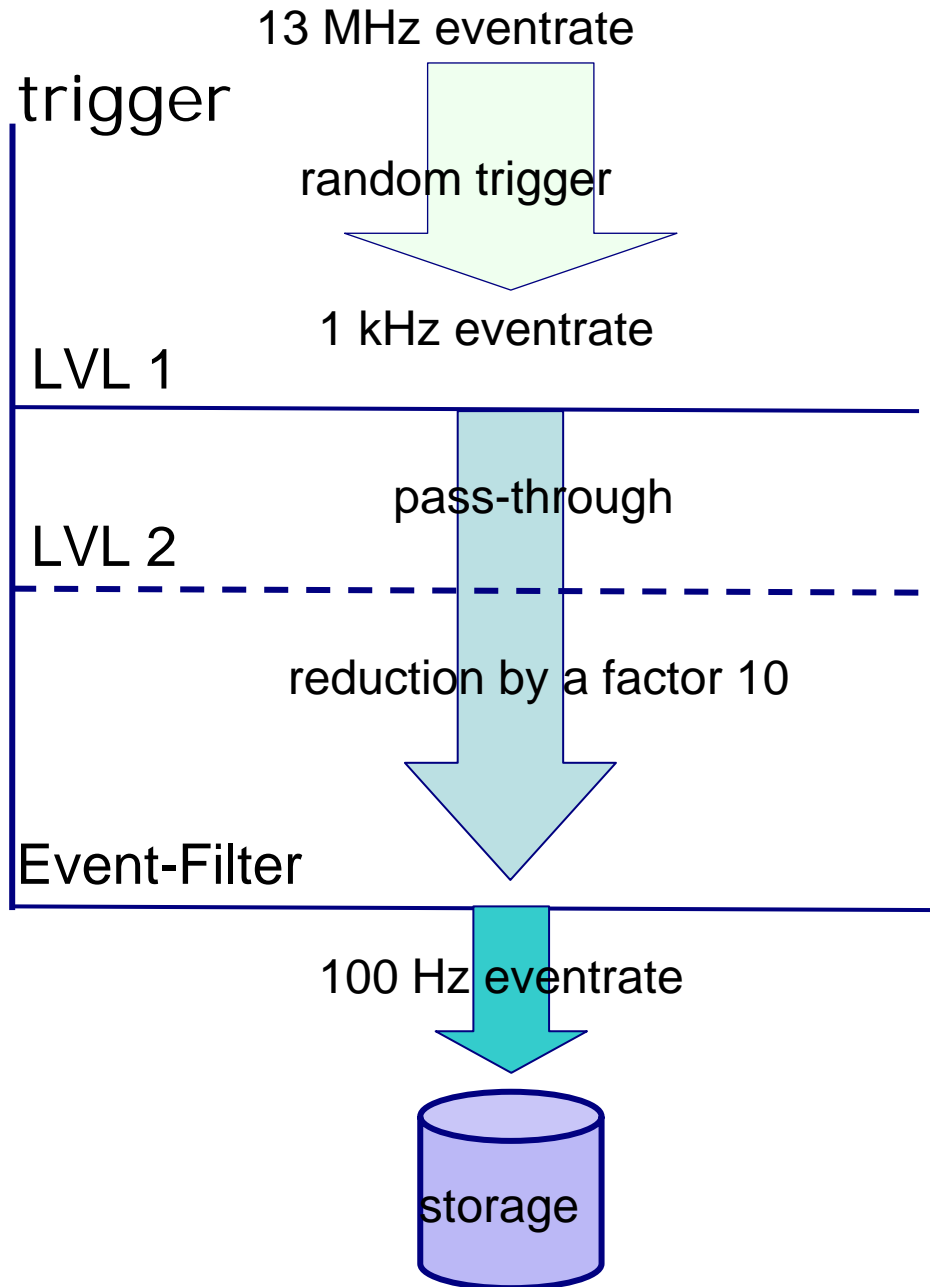
Regina Kwee

Humboldt Universität zu Berlin

DESY Zeuthen

22. May 2007 - DESY Hamburg

DESY – ATLAS – Group - Meeting
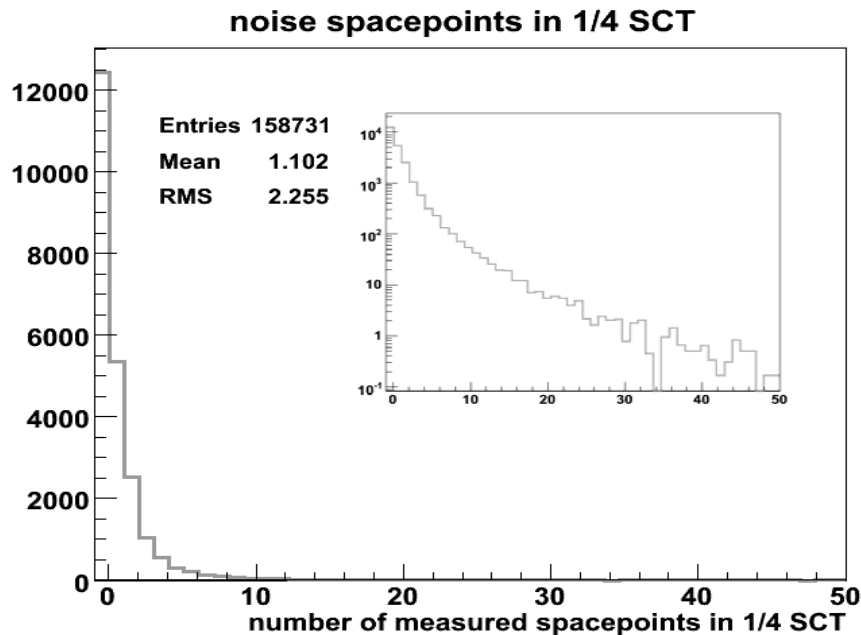
trigger concept

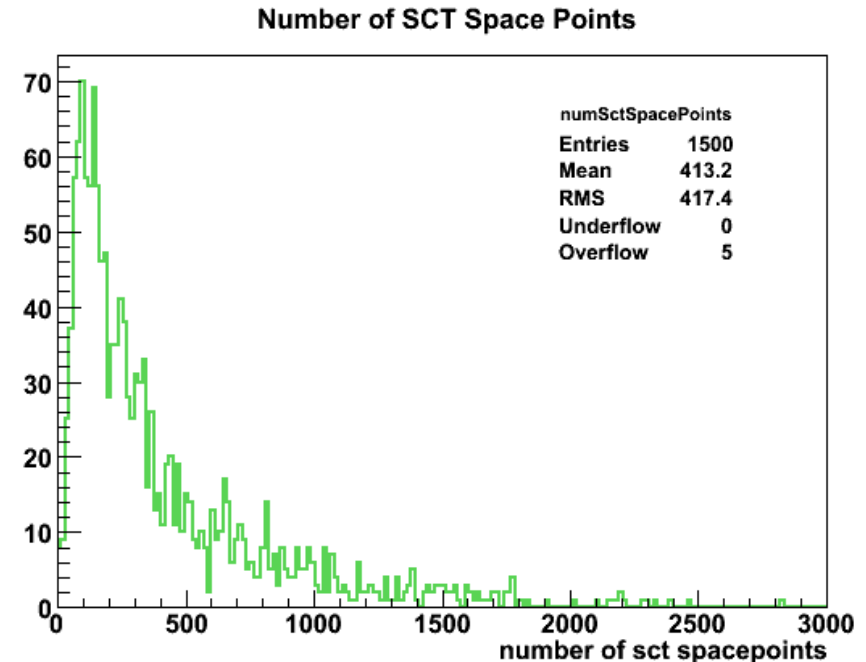10% minimum bias events are expected in 13 MHz at

❖ low luminosity 10^{31} cm^{-2} s^{-1}

❖ √s = 14 TeV

trigger

13 MHz eventrate

random trigger

1 kHz eventrate

LVL 1

pass-through

LVL 2

reduction by a factor 10

Event-Filter
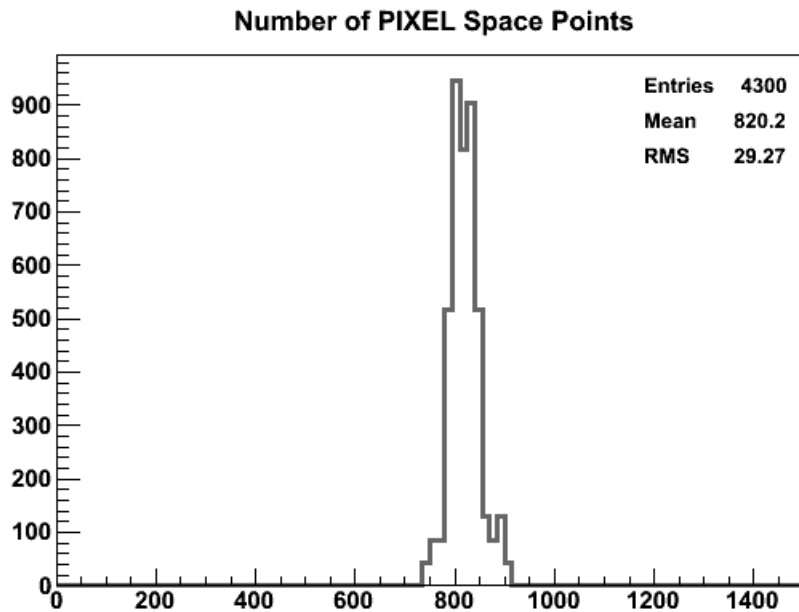
100 Hz eventrate

storage

Empty Event Rejection
SCT spacepoints

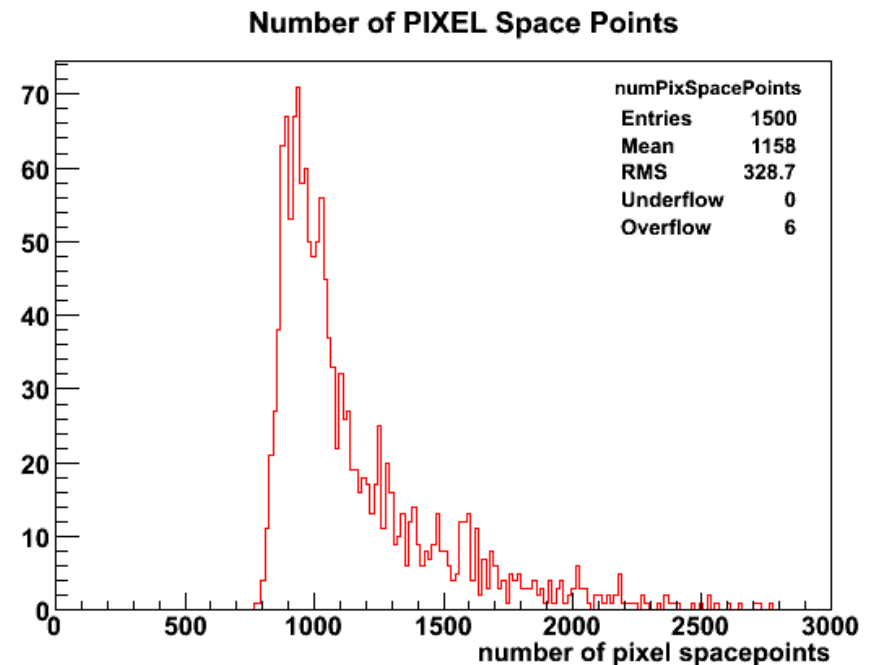❖ noise events in cosmic runs of a ¼ SCT barrel + ¼ SCT endcap

❖ SCT spacepoints in minimum bias events

Empty Event Rejection pixel spacepoints

❖ pixel spacepoints in simulated noise events

❖ pixel spacepoints in simulated minbias events

noise rejection efficiency

SCT cut	noise	minbias
20	0.40	99.2
30	0.23	98.7
40	0.20	97.7
50	0.19	96.1

good rejection efficiency!

pixel cut	noise	minbias
800	75.4	99.6
850	14.4	99.2
900	0.4	86.5
950	0	71.0

loss of minimum bias multiplicity!

Beamgas Rejection with NewT

❖ Will NewT algorithms stay inside the EF time budget for minimum bias events?

❖ Does NewT reconstruct efficiently low pT tracks?

❖ What is fake rate is thereby expected ?

❖ Where can we cut to reject beam gas events?

❖ How efficient is beam gas rejected ?

Timing of NewT Algorithms

❖ TRT was excluded (analogue to IdScan)

❖ tested **two different setups** runnig on RDO in 12.0.6

   ➢ trigger- and offline-NewT

   ➢ for trigger setup: timing for „uncontrained seed search" and „contraint seed search" were measured.

❖ tested trigger setup implemented in 13 running on bytestream data

❖ used atlhtl3 [2 dual core processors each with Intel(R) Xeon(R) CPU 5160@3.00GHz, 4 MB cache, 8 GB memory]

table for EF algorithms on minbias events

zFinder ON	SCT [ms]	PIXEL [ms]	SCT+Pixel [ms]
SCTClustering	108.3	108	108.3
PixelClustering	44.4	44.7	44.4
SiTrigSpacePointFinder	87.1	21.3	108
SiTrigTrackFinder	96.5	99.8	134
TrigAmbiguitySolver	17.4	17.1	24.8
Total Time SP formation	245	177	264
Total Time up to tracking	360	294	423

table for offline setup for minbias ran from RDO

constraint seed search	SCT [ms]	PIXEL [ms]	SCT+Pixel [ms]
SCT_Clusterization:execute	110	110	130
PixelClusterization:execute	110	100	120
SiTrackerSpacePointFinder:e...	13.9	3.82	17.9
InDetSiSPTrackFinder:execute	17.5	24.7	72.9
InDetAmbiguitySolver:execute	17.6	17	25.7
Total Time SP formation	235	214	268
Total Time up to tracking	270	117	367

unconstraint seed search	SCT+PIX[ms] 500 MeV pT-cut	SCT+PIX[ms] 500 MeV pT-cut
Total Time up to SP = pixClust+sctClust+SP	521=112+226+183	436=87+181+168
Total Time up to tracking = SP+TrackFinder	850	589.58

in NewT
0.9 * 436 ms+ 0.1*850 ms = 475 ms for SCT+PIX
0.9 * 360 ms+ 0.1*740 ms = 400 ms for SCT

spacepoint formation in IdScan
0.9 * 33 ms+ 0.1*34 ms = 33 ms for SCT+PIX

possible combination
0.9 * 33 ms+ 0.1*850 ms = 115 ms for SCT+PIX
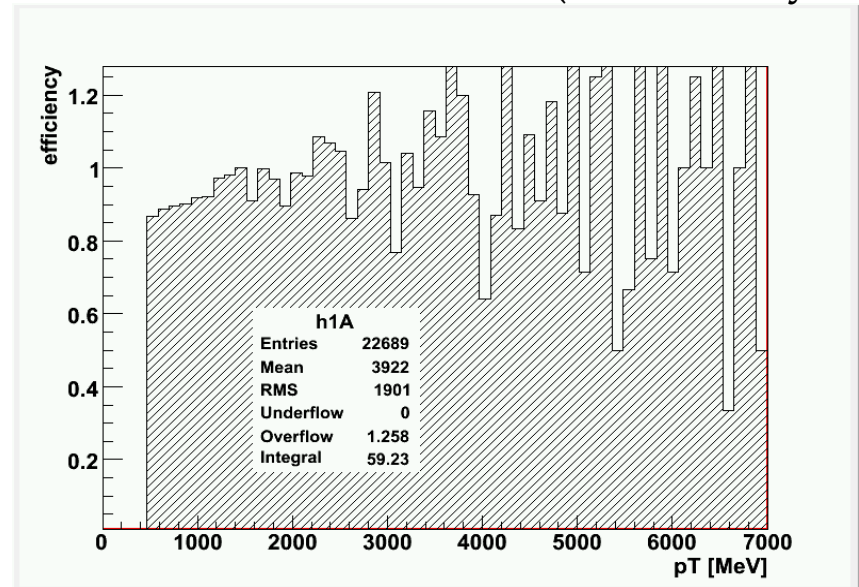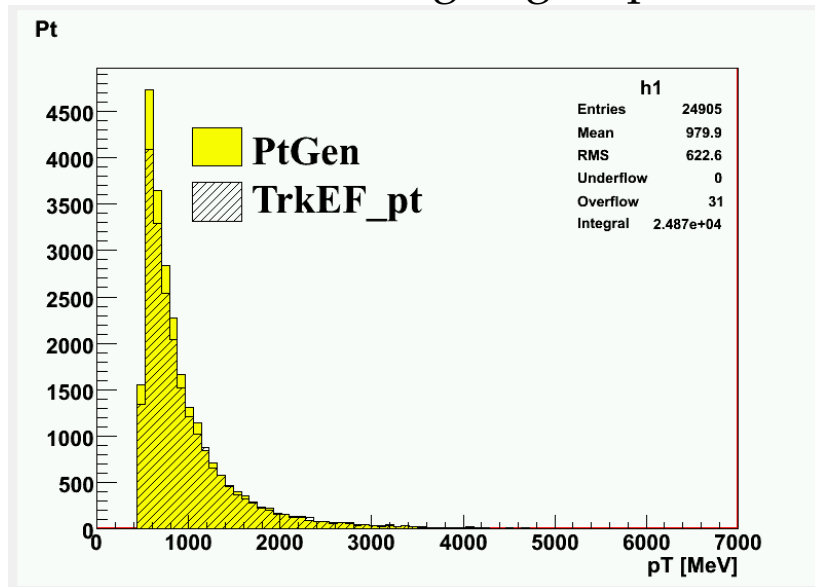
Timing Resumée

- ✓ trigger setup was 5 times slower than offline setup due different method to access event (in RegionSelector)
- ✓ no significant gain in speed was found using contraint seed serach with respect to unconstraint seed search
- ✓ Using the offline method of the RegionSelector, one will be fast and stay inside EF latency
- ✓ Even the timings for the trigger are well within the time budget.
- ✓ timing for minimum bias and empty events are shown

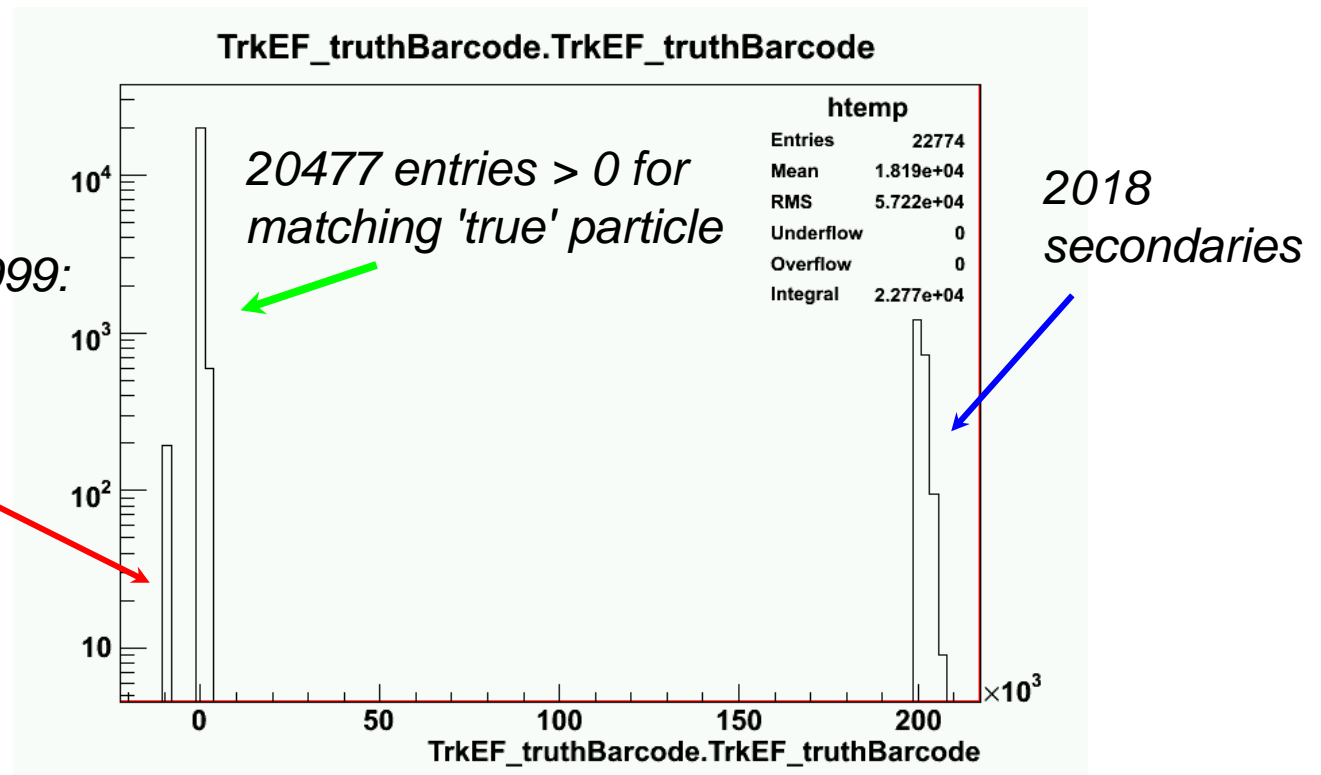# reconstruction efficiency for minbias sample in NewT

❖ TrkEF_pt = number of reconstructed tracks with |TrkEF-eta|< 2.5
❖ PtGen = number of stable, charged generated particles with
   PtGen ≥500 MeV produced in central region and possessing start- and end
   vertex

ε := TrkEF_pt/PtGen, is still prelimary as

- no matching of gen. pT to rec. pT was taken into account (reason why ε > 1)

❖ fake rate in NewT reconstruction for minbias (trigger setup) < 2%

*194 particles at -9999:*
no associated
true particle found

20477 entries > 0 for
matching 'true' particle

2018
secondaries

TrkEF_truthBarcode.TrkEF_truthBarcode

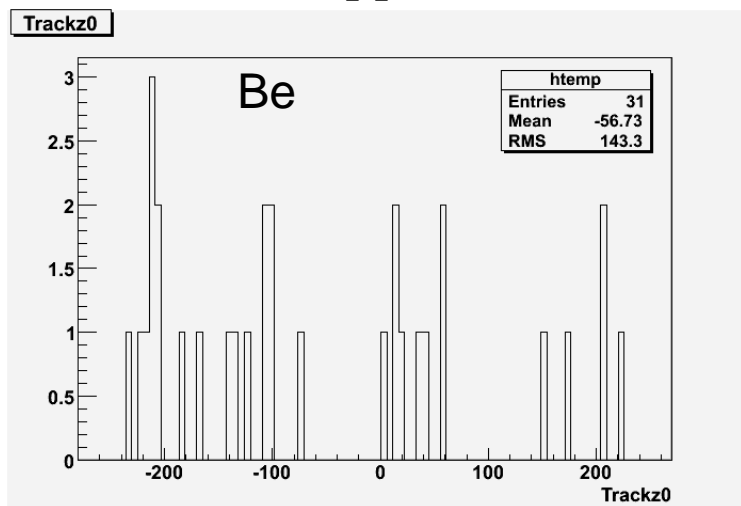| htemp	
Entries	22774
Mean	1.819e+04
RMS	5.722e+04
Underflow	0
Overflow	0
Integral	2.277e+04

- ❖ reconstruction efficiency in NewT for different cuts on # reconstructed tracks
- ❖ ε:=(cut at j no. of rec. tracks, with cut on gen. pT > 500 MeV)/ (no. of rec. tracks, with cut on gen. pT > 500 MeV)
  for j=1…30
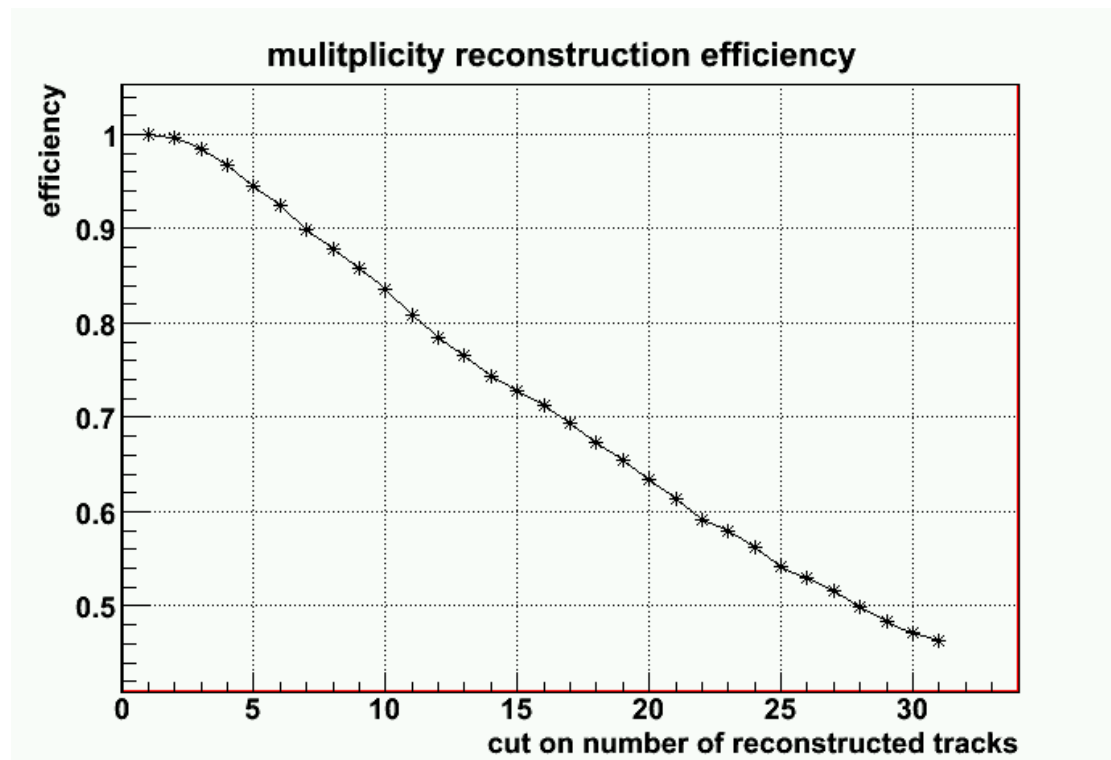
z0 cut for beamgas rejection

no were cuts applied

R. Kwee
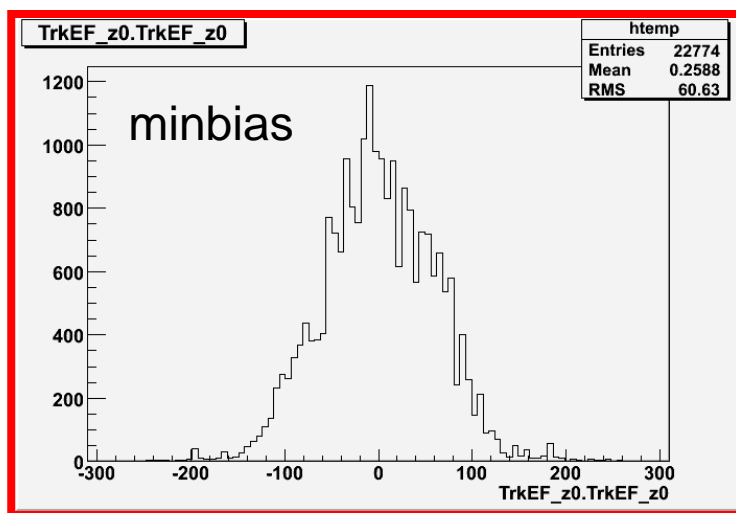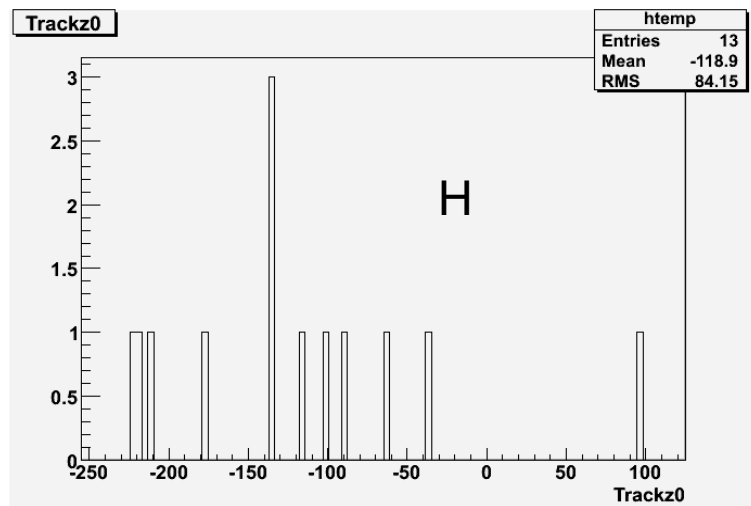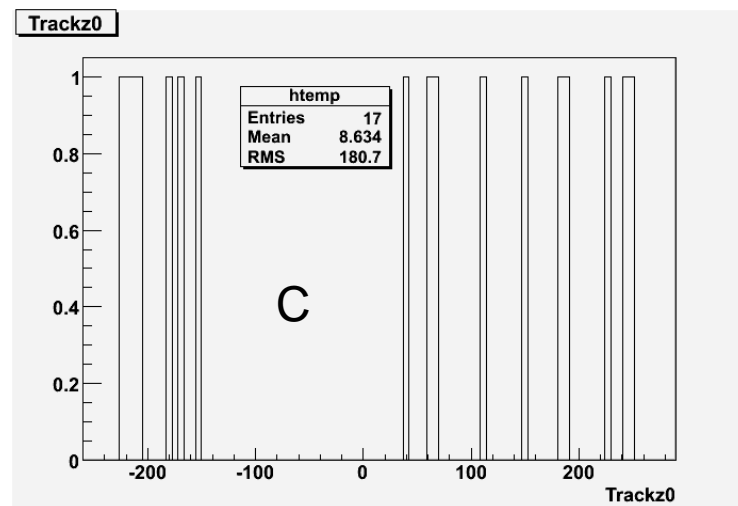
conclusion/outlook

❖ NewT seems very suitable for reconstructing minimum bias events: good reconstruction efficiency, low fake rate

❖ For trigger implementation one should use the offline method to access an event as the spacepoints finding algorithm is much faster (more than 5 times!)

❖ empty event rejection is very efficient by cutting on the number of SCT spacepoints (>99 %)

❖ beamgas rejection needs further study with better data sample

❖ else implementation can start!

❖ in rel. 13 a minimum bias slice exsists already using a fake RoI and only silicon pattern recognition algorithms, but this has to be precised

backup

R. Kwee