

Standalone pixel tracking & b-tagging studies in the HLT

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Pixel seeding and tracking in the HLT

CMSSW versions -

- **Phase1**: CMSSW_363_SLHC1
- **Stdgeom**: CMSSW_363

- 4000 events TTbar
- **Zero pileup**
- Gaussian vertex smearing,
 $\sigma = (15 \mu\text{m}, 15 \mu\text{m}, 1 \mu\text{m})$
- No pixel CPE templates
- Ideal conditions, no misalignment
- using the quickAssociatorByHits

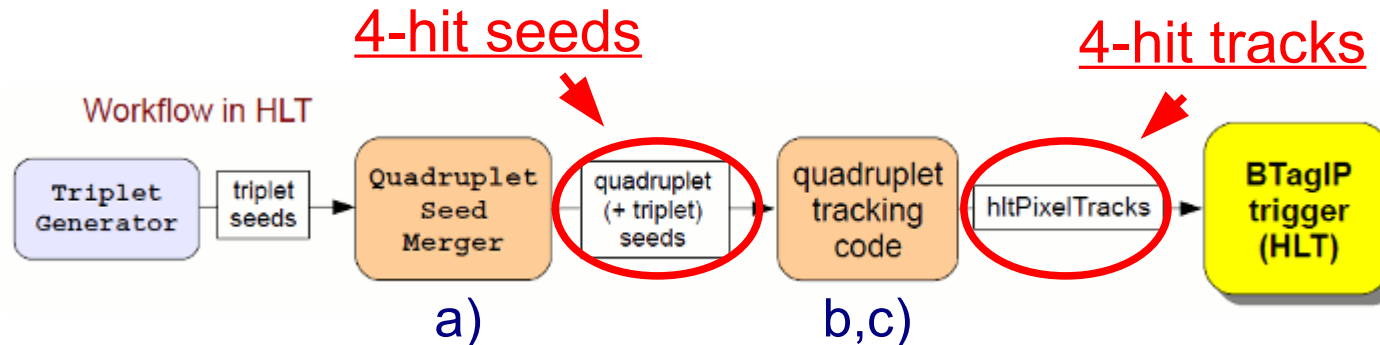
HLT BTagIP trigger path in CMSSW_363 -

- **HLT_BTagIP_Jet80** and **Jet120**
- level 2.5 comprises pixel-only tracking and b-tagging

HLT_BTagIP_Jet80

- 794 • at Level-1, the trigger is seeded by the single jet Level-1 trigger L1_SingleJet70.
- 795 • at Level-2, regional jet reconstruction is performed, requiring one jet with $E_T >$
- 796 80 GeV and $|\eta| < 3.0$.
- 797 • at Level-2.5, the pixel subdetector is used to **reconstruct pixel-only tracks**, and the
- 798 event primary vertex; **a first b-tagging step** is performed, requiring at least two pixel
- 799 tracks with a signed 3D impact parameter significance above 2.5.
- 800 • at Level-3, regional and partial tracking is performed, and a second *b*-tagging step is
- 801 performed, requiring at least two regional tracks with a signed 3D impact parameter
- 802 significance above 3.5.

Upgrades to the pixel-only seeding/tracking software



a) Use the QuadrupletSeedMerger to create quadruplet seeds

b) Updated the tracking code – (current code cannot produce quadruplet tracks)

- replaced track fitting algorithms:

- transverse circle fit: arbitrary number of hits, based on an algorithm which is deployed in H1 tracking software - Comp.Phys.Comm **69** (1992) 133
- r-z line fit: linear regression, arbitrary number of hits

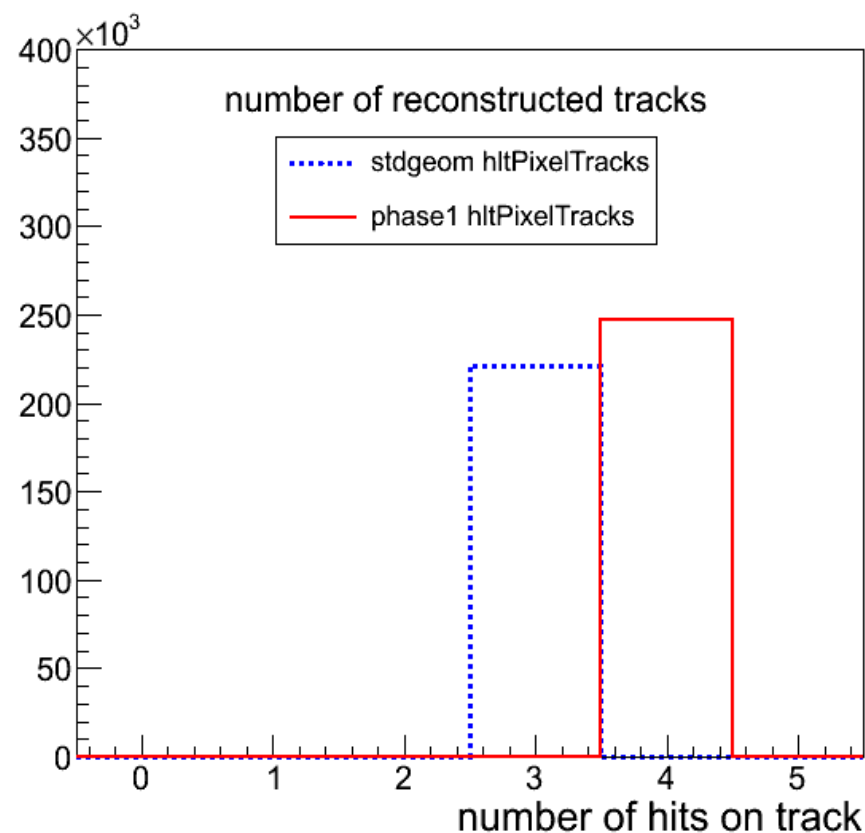
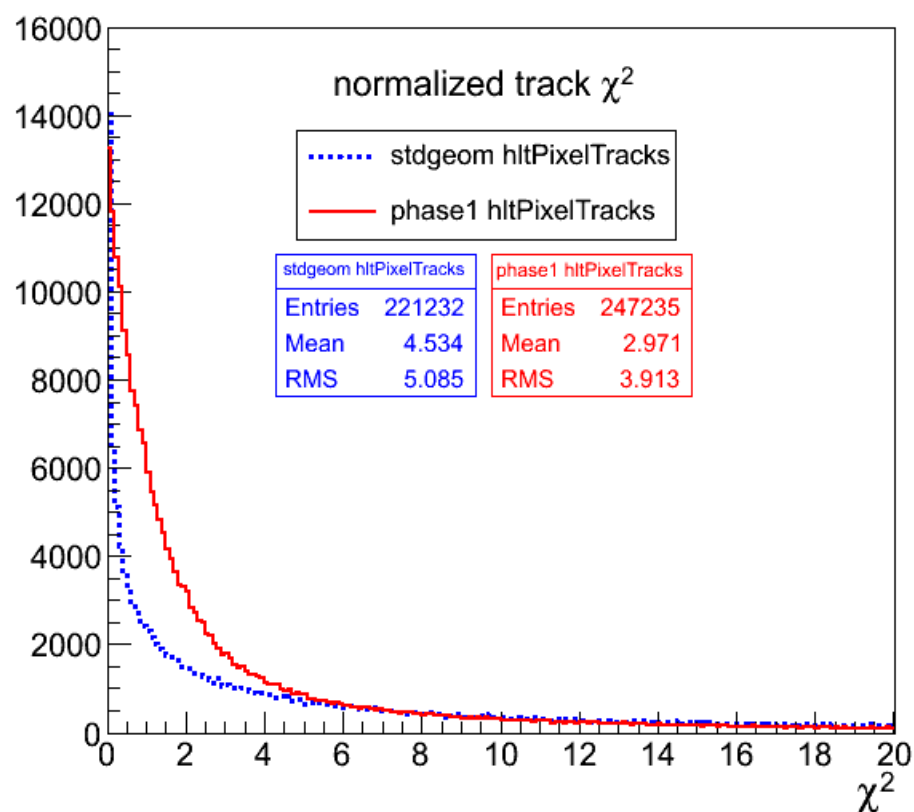
c) Recalculated track impact parameter error templates –

- effective errors (track errors $\oplus$ MS), hard coded in HLT for better speed
- using **MultiTrackValidator** from Validation suite

Modifications done in stdgeom accordingly

Standalone pixel tracking performance

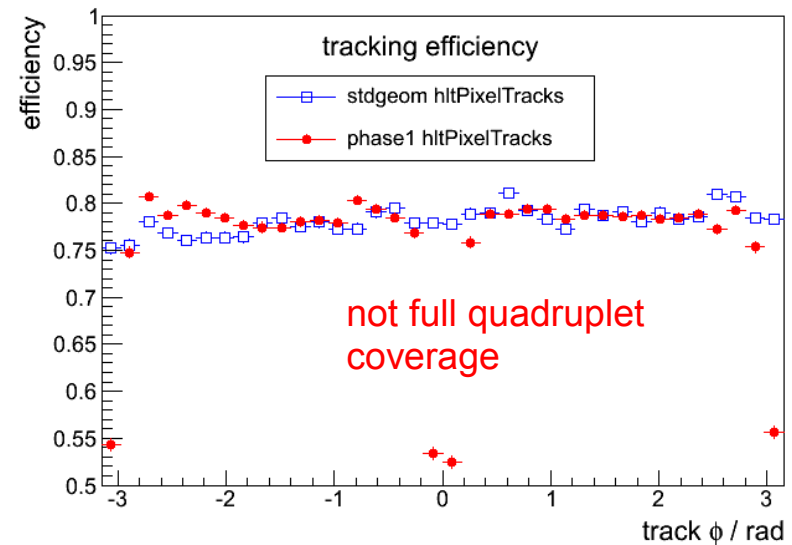
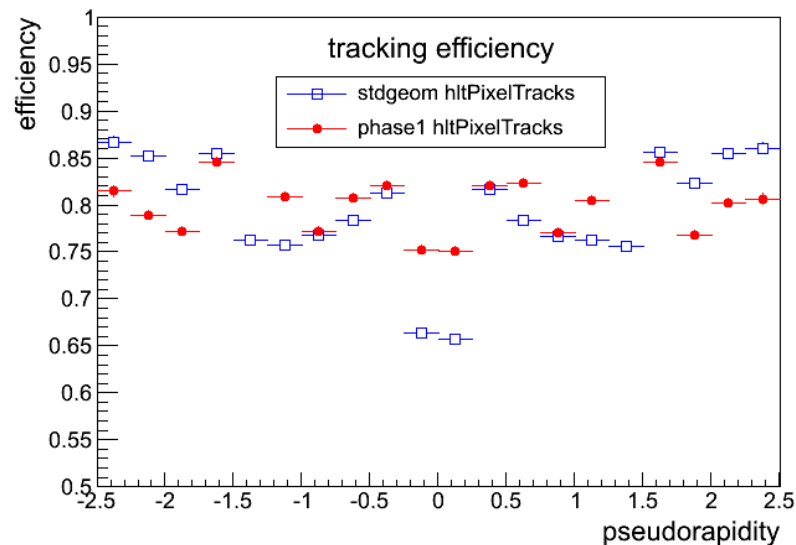
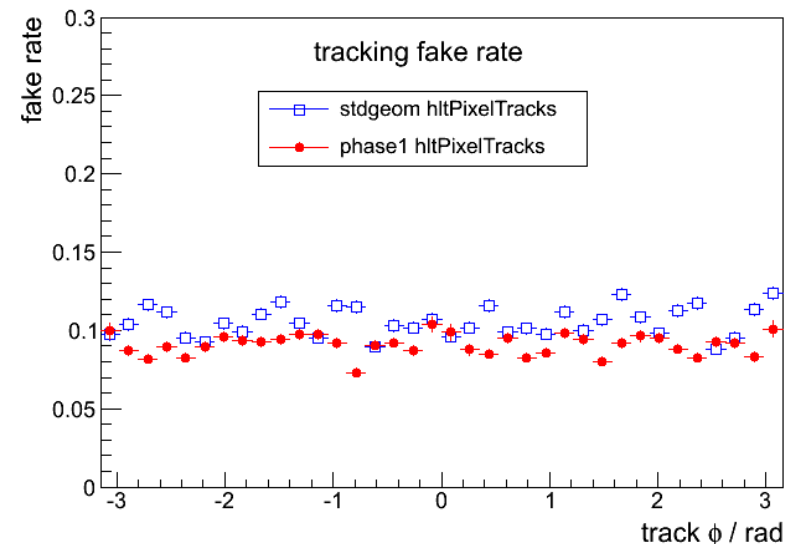
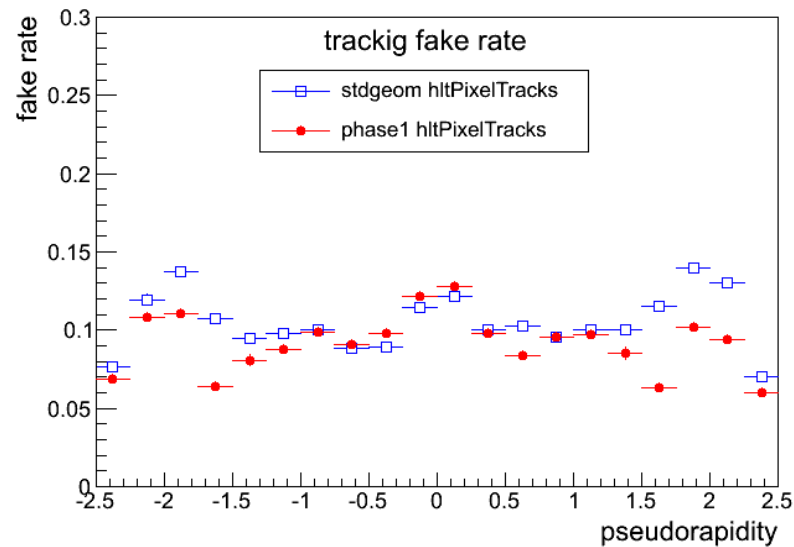
hits per track / track χ^2



Plots from MultiTrackValidator (std. Validation suite)

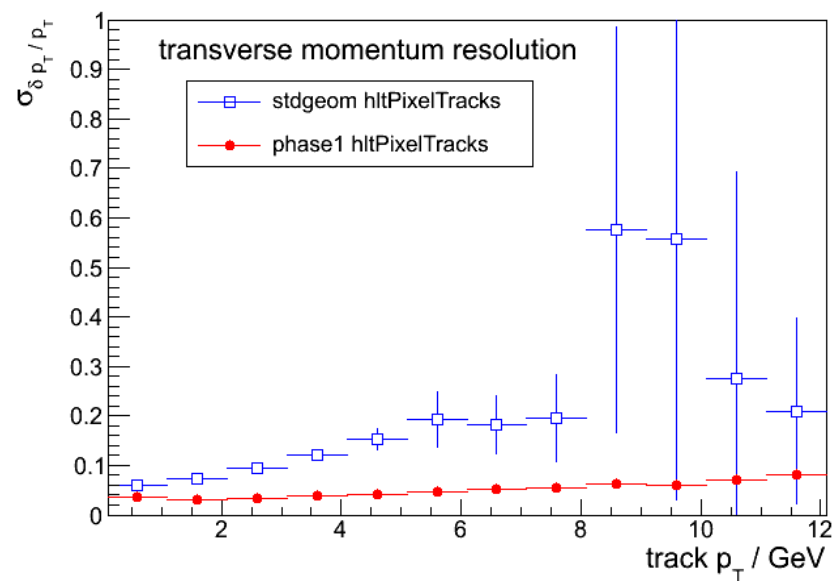
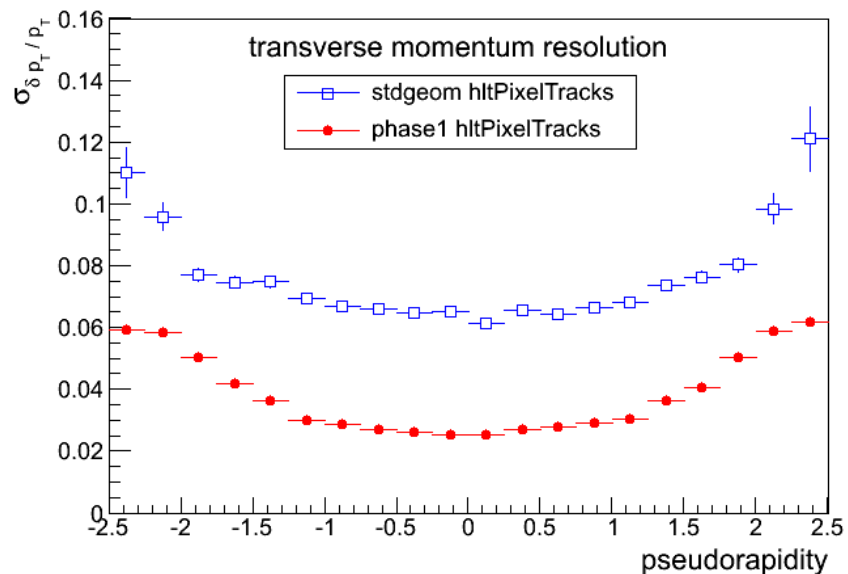
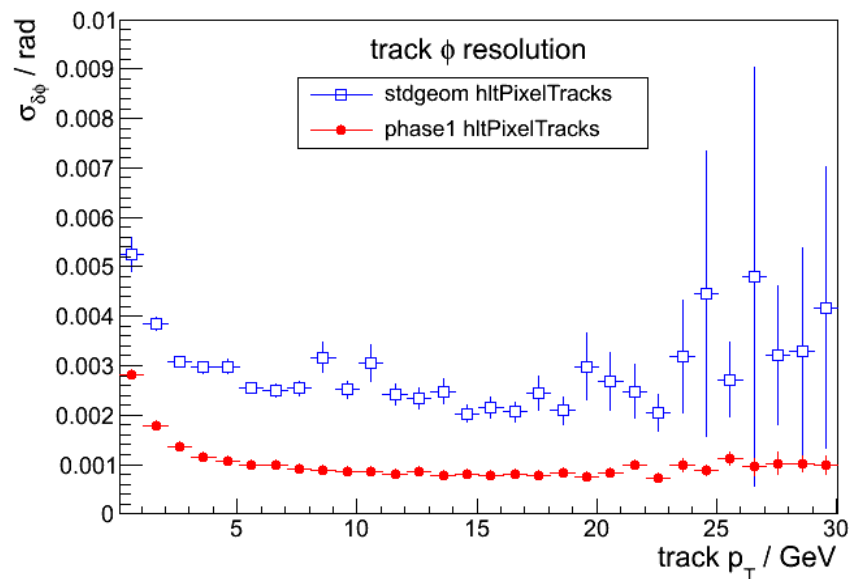
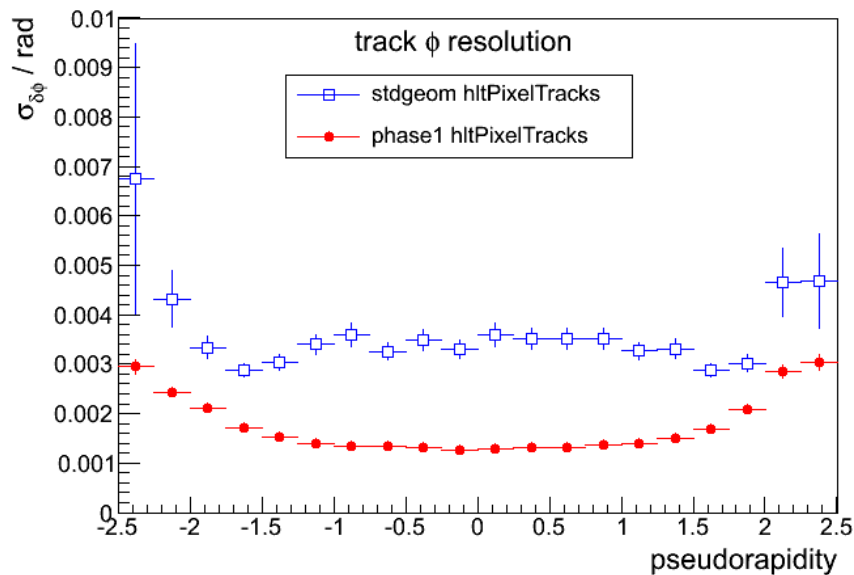
Standalone pixel tracking performance

tracking fake rates / efficiencies (MultiTrackValidator)



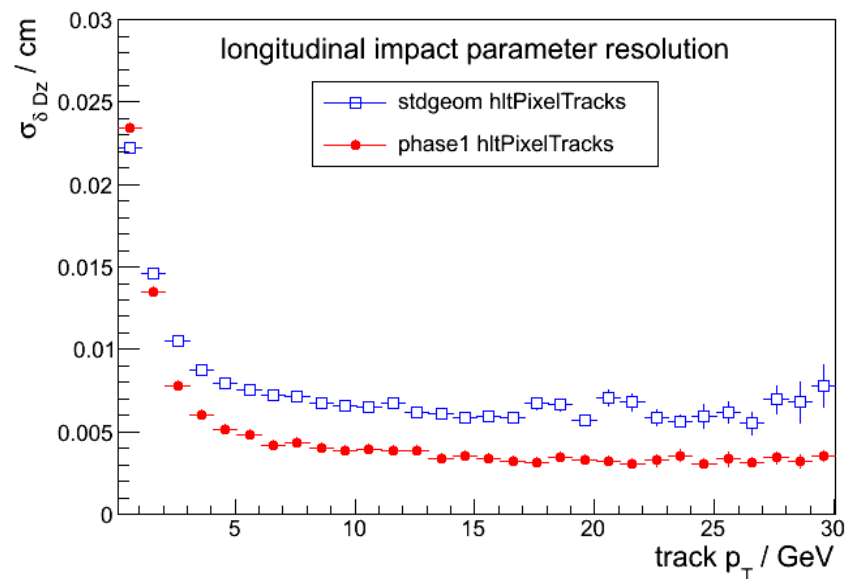
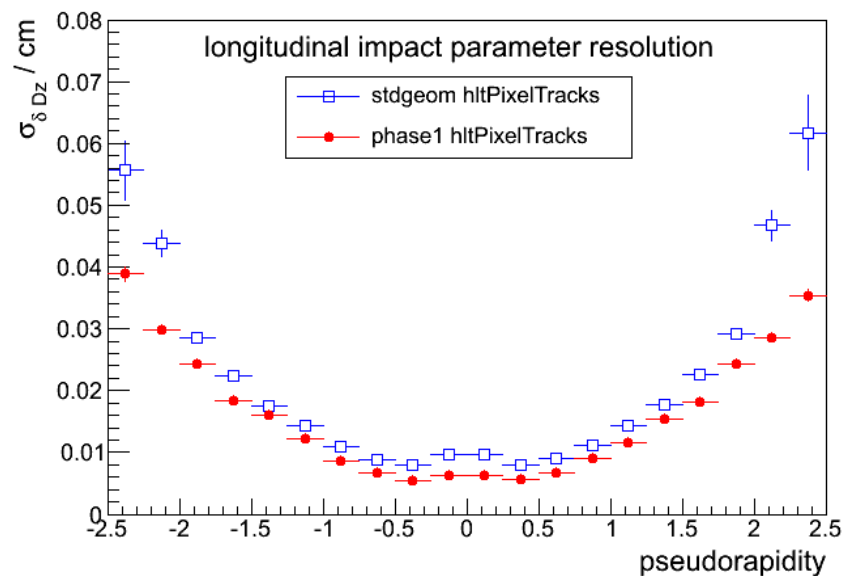
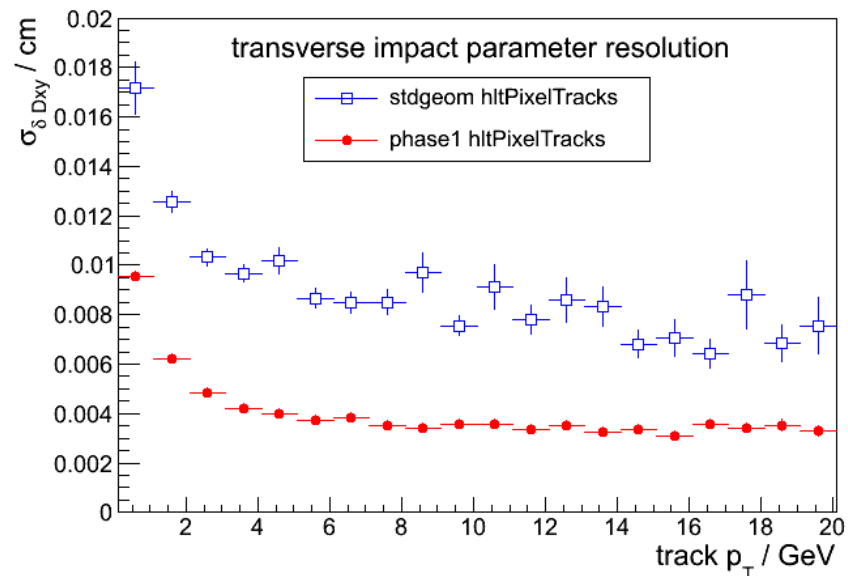
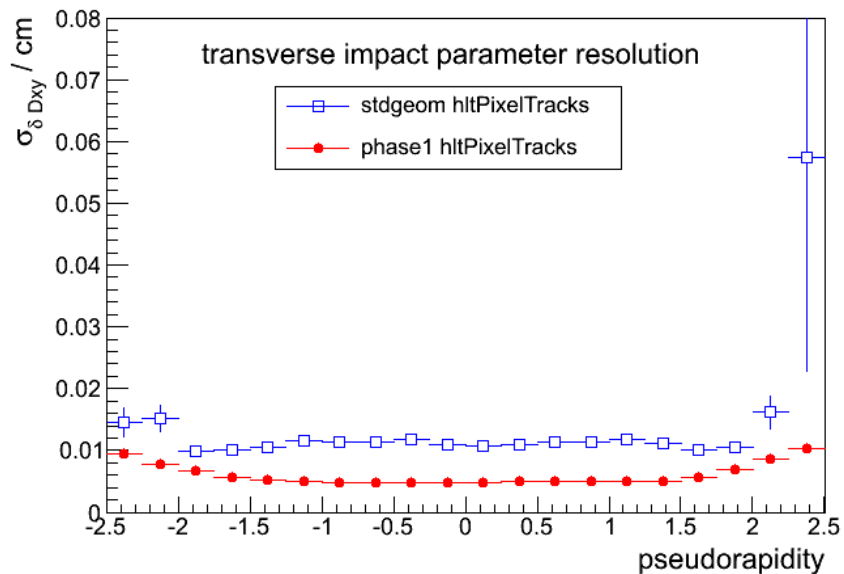
Standalone pixel tracking performance

track parameters (MultiTrackValidator)



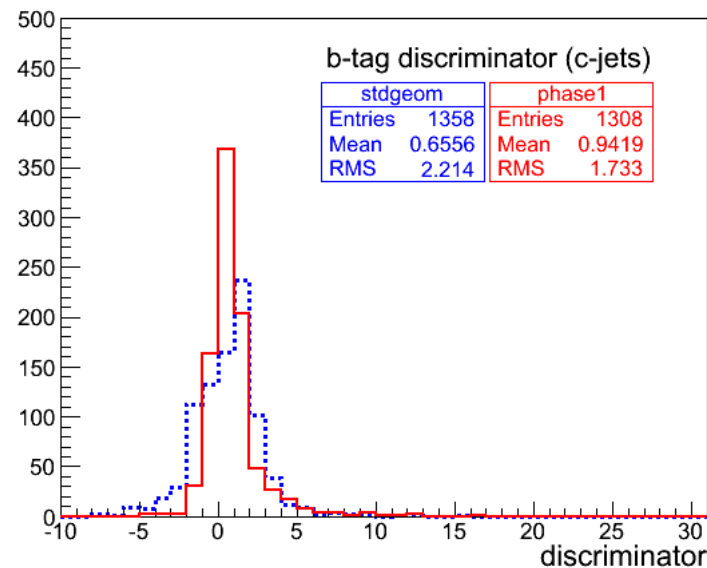
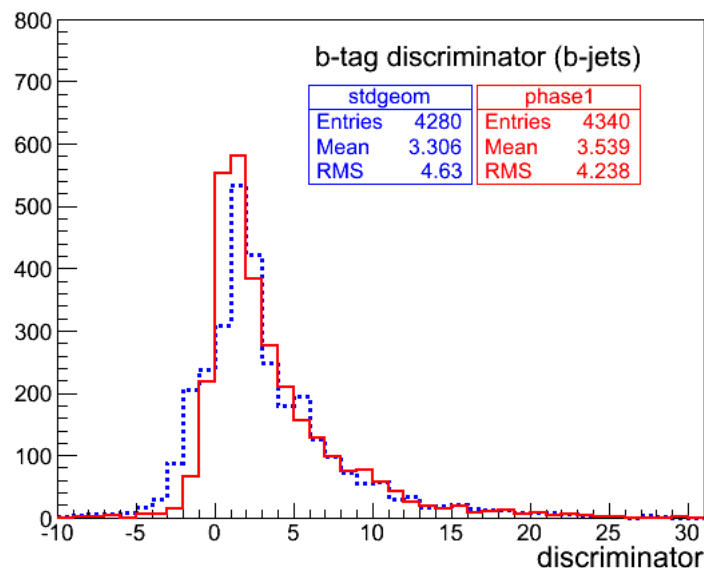
Standalone pixel tracking performance

track impact parameters (MultiTrackValidator)

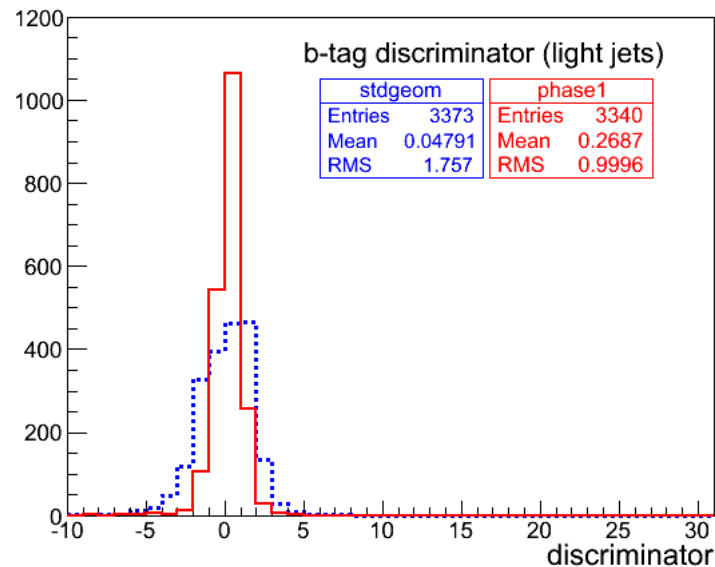
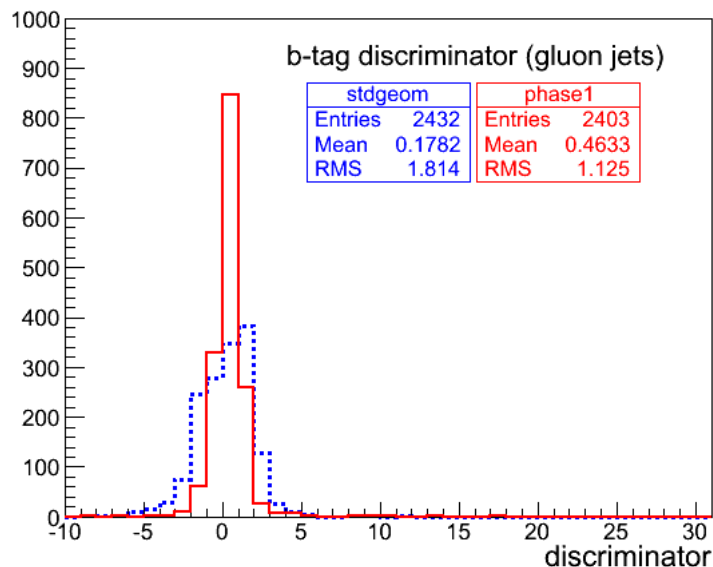


Standalone pixel b-tagging performance

track counting (3D) high efficiency discriminators

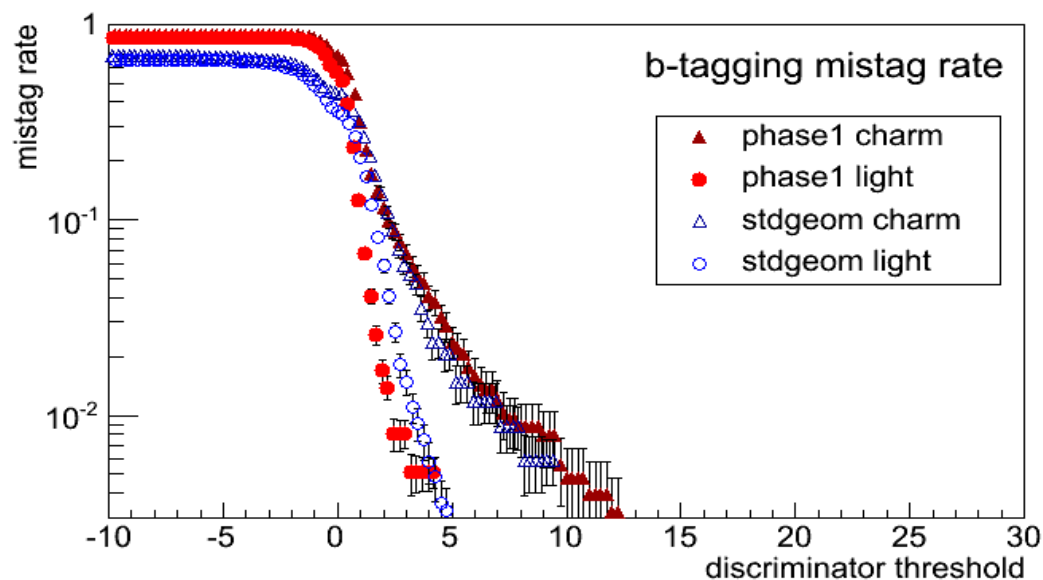
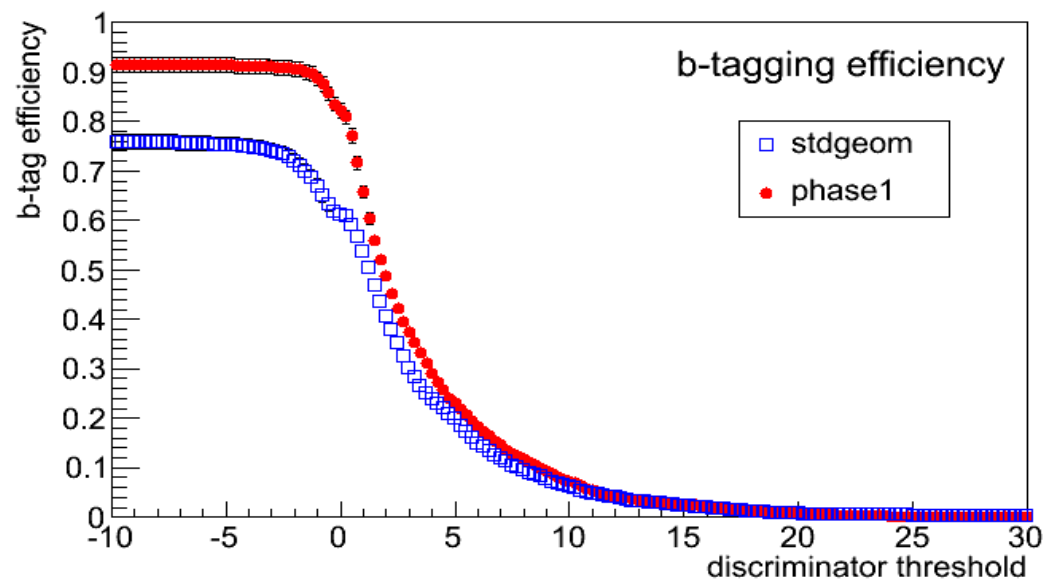


Better IP resolution
results in narrower
distributions for
UDS / G / C



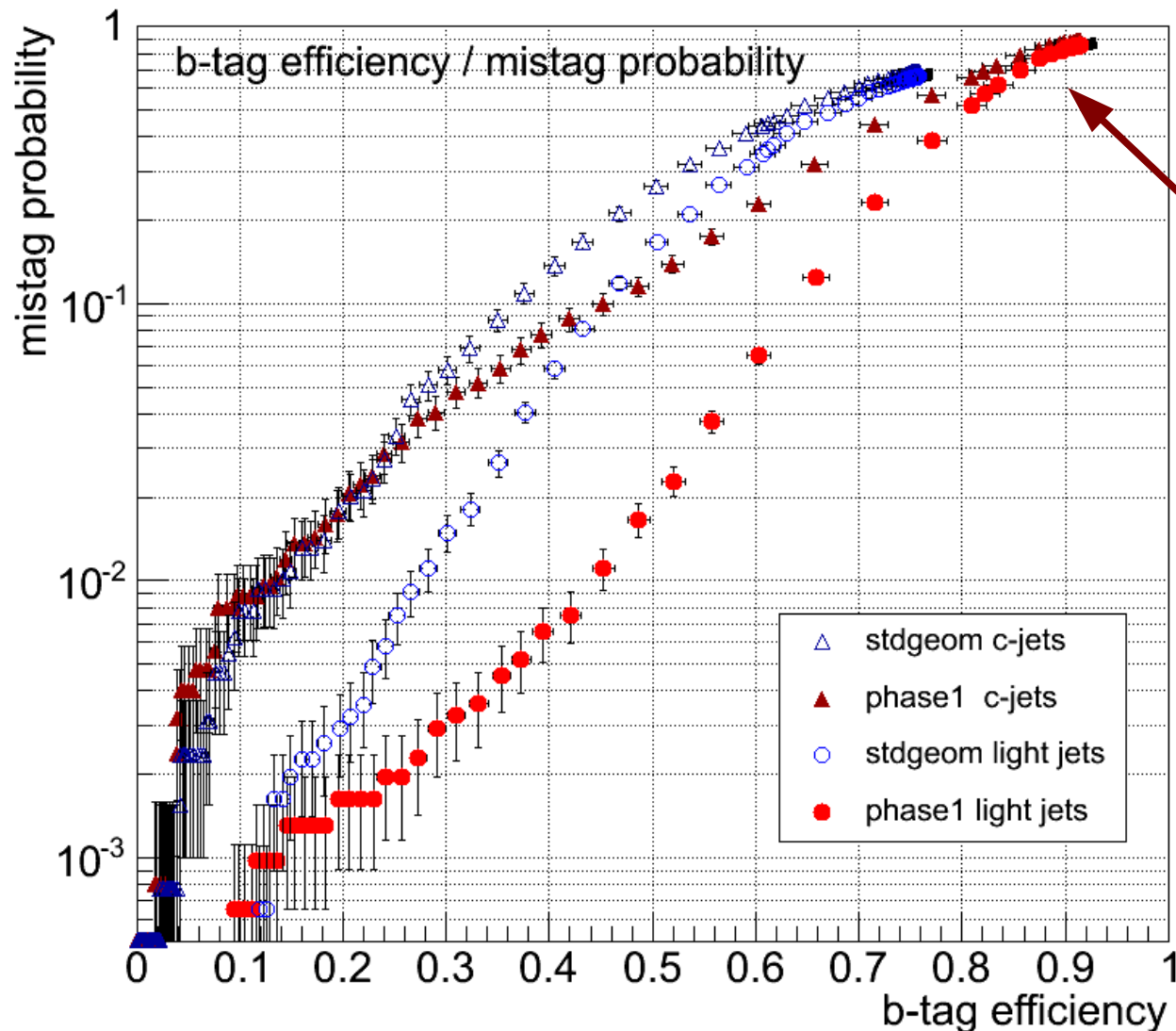
Standalone pixel b-tagging performance

b-tagging efficiency & fake rates



Standalone pixel b-tagging performance

b-tagging performance



Higher max. efficiency mostly due to increased number of tracks per jet (after IP producer cuts)