CMS Pixel Upgrade Simulation

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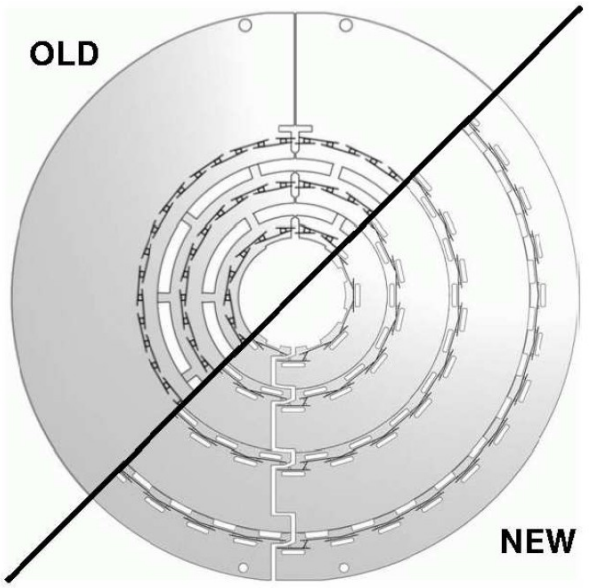
Phase1 pixel upgrade & simulation



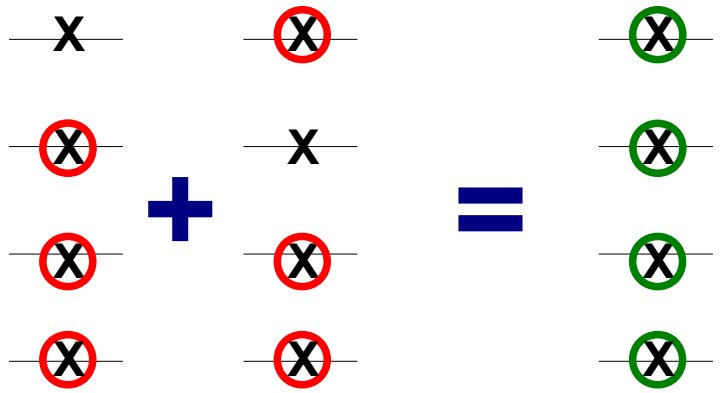
Phase1 upgrade -

- upgrade to 4 BPix layers / 3 FPix disks
- expect improved vertex / IP resolution
- investigate b-tag performance for:
  - HLT (pixel only tracks)
  - “offline” (full tracker)
- CMSSW_336, full simulation, ttbar & qcd
- participated in Phase1 Upgrade Technical Proposal

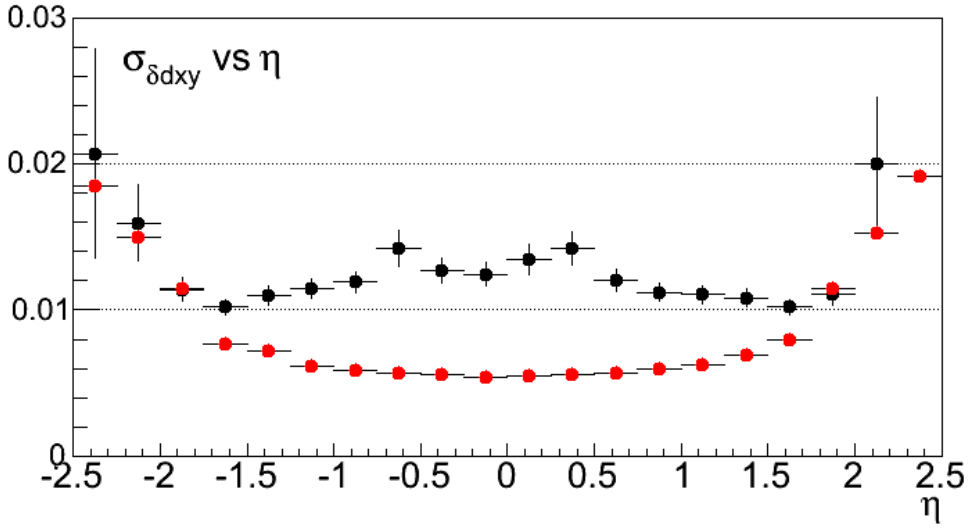
Current CMSSW tracking code cannot fully cope with 4 BPIX / 3 FPIX layers

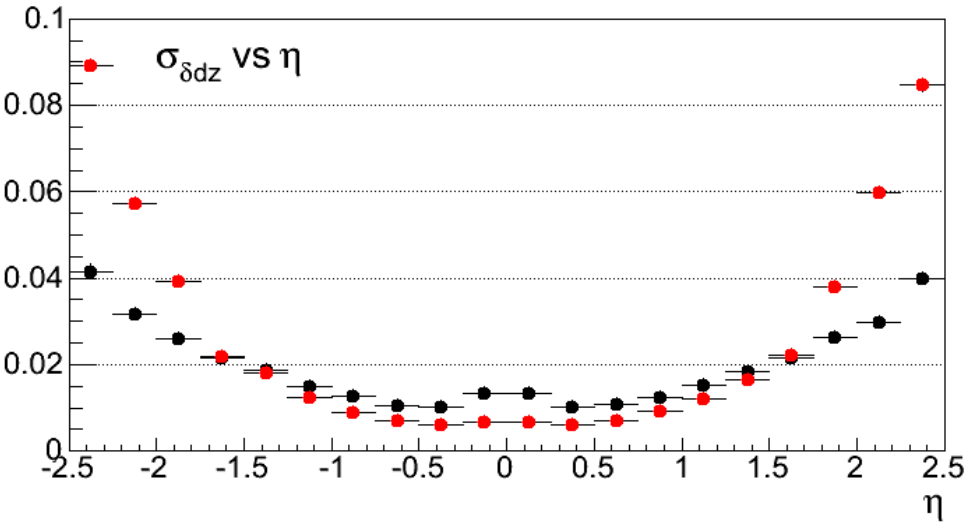
→ several modifications necessary:

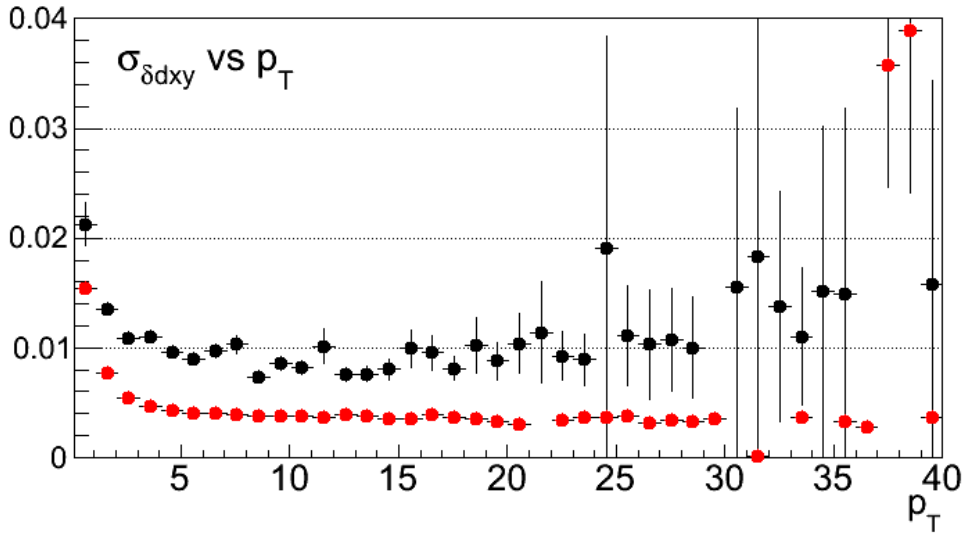
- replaced HLT (pixel-only) track fitting algorithms (for fitting 4 hits to a track)
- implemented modules for creating 4-hit track seeds from triplets
- removed quirks in Phase1 geometry
- Implemented merging in HLT & iterative tracking

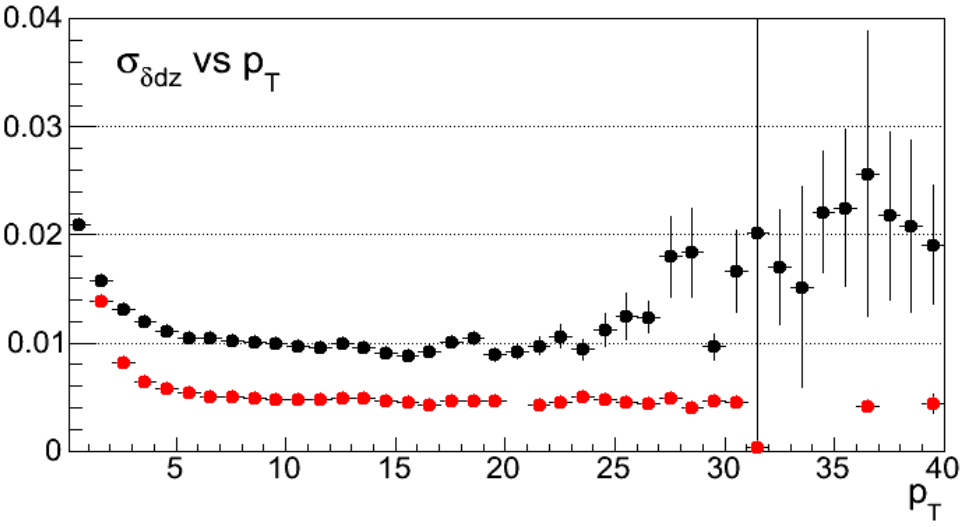


Pixel-only track reconstruction: impact parameters





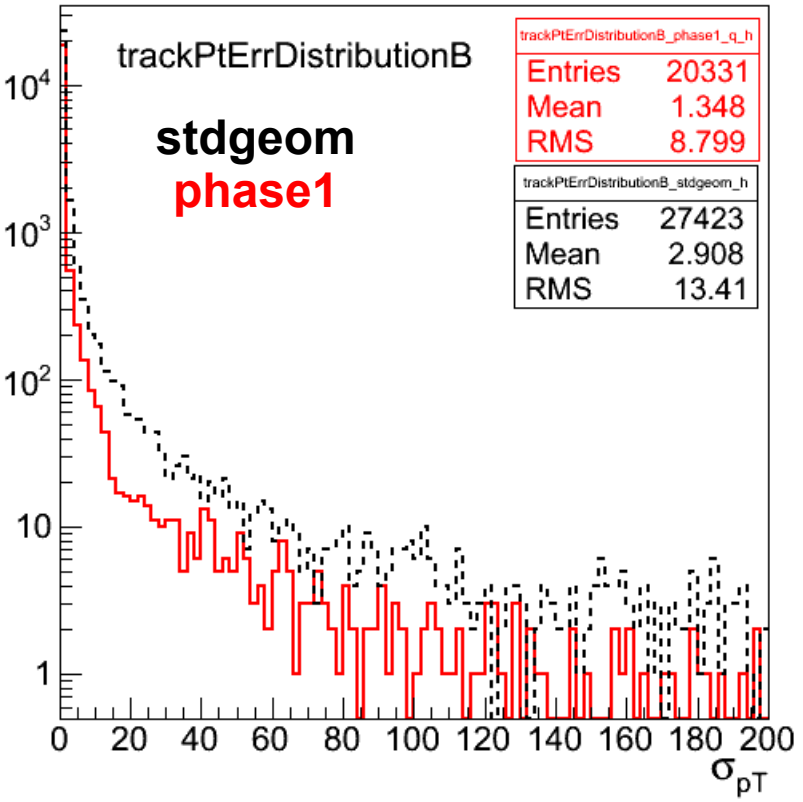




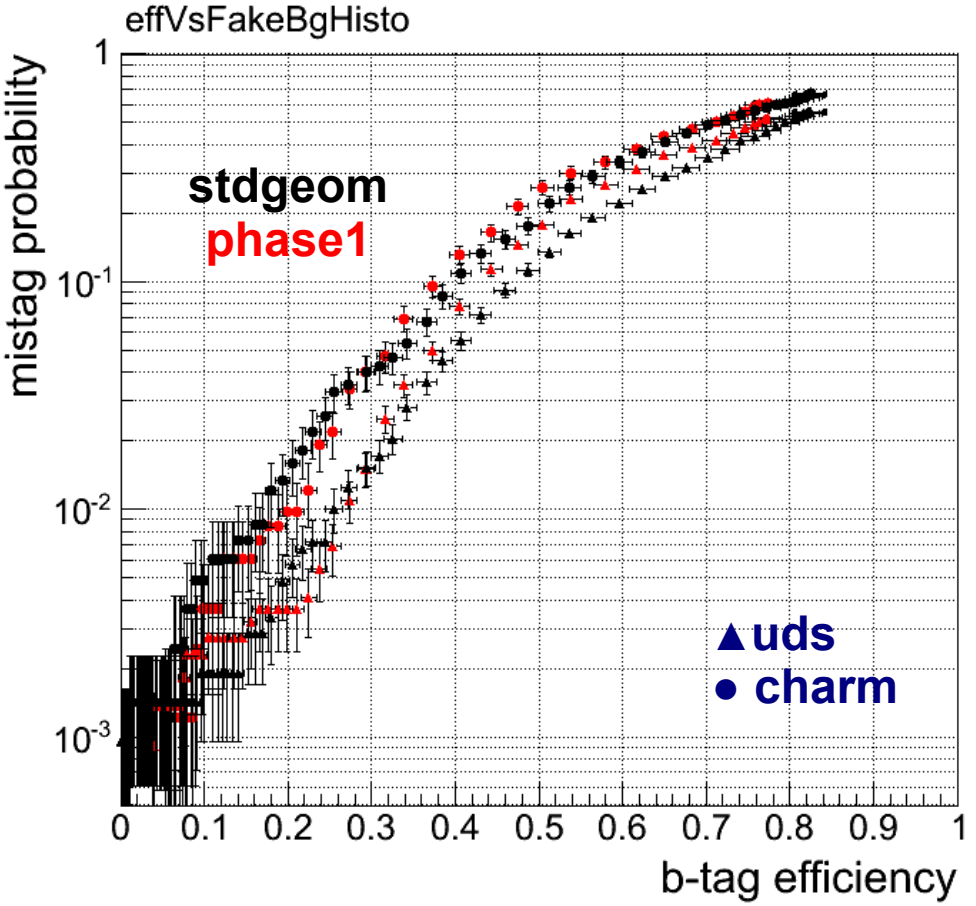
Significant improvement in track reconstruction

Quadruplet tracking/b-tag performance in HLT

- improvement in track reco (σ_{pT}, ..)



Standard b-tagging algo

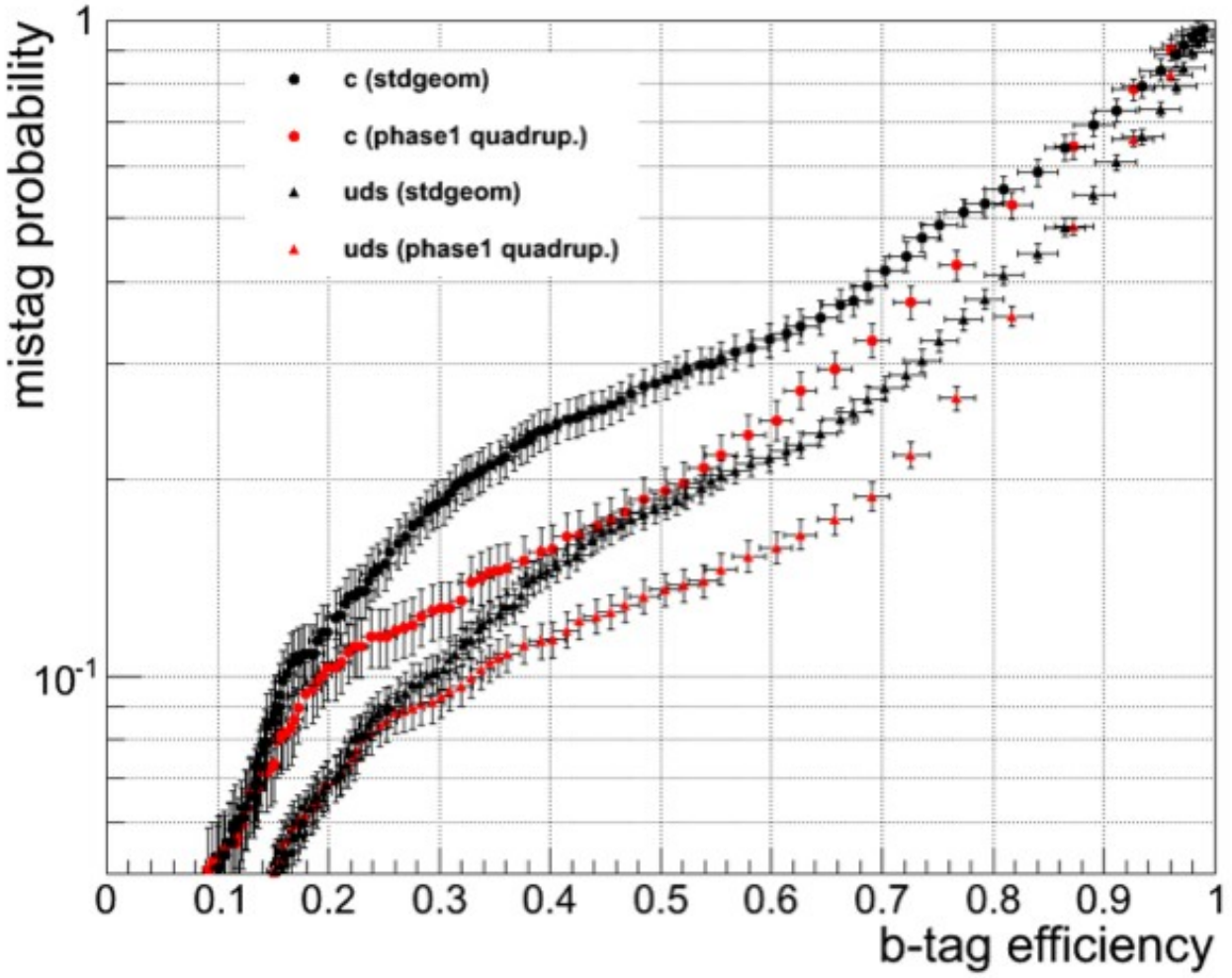


No improvement in b-tagging efficiency / fakerate

HLT pixel-only quadruplet b-tagging

We have re-written b-tagging algo

→ New “offline” b-tagging algorithm (based on track-counting 3D high efficiency algo) to short-circuit CMSSW IP producer & b-tagging modules



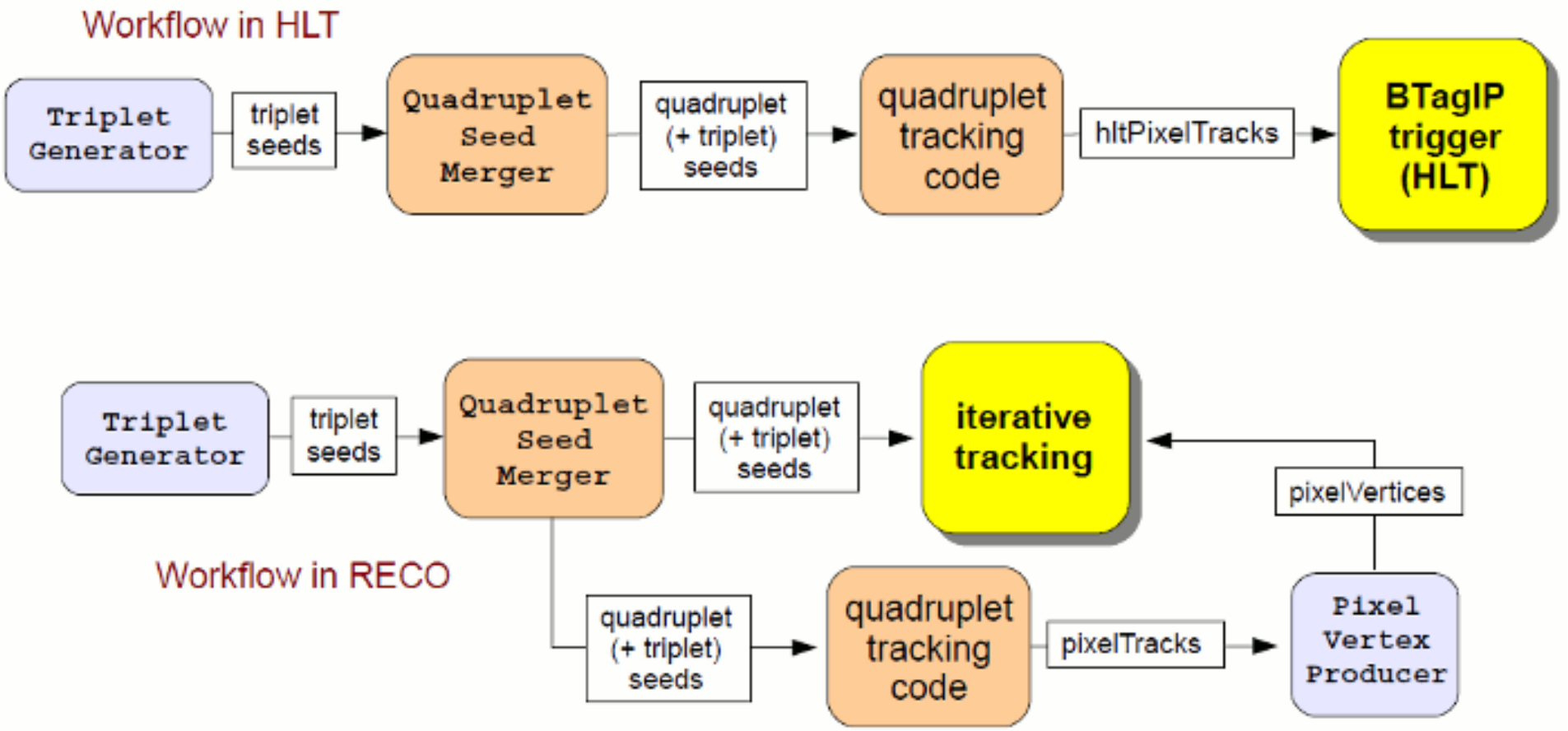
- Siginificantly better efficiency ./. fake
- To be improved by further tuning

→ More places in CMSSW tracking code where the current geometry is implicitly hard-coded

→ downstream of the IP calculation (**`TrackIPProducer`** or B-Tagging modules)

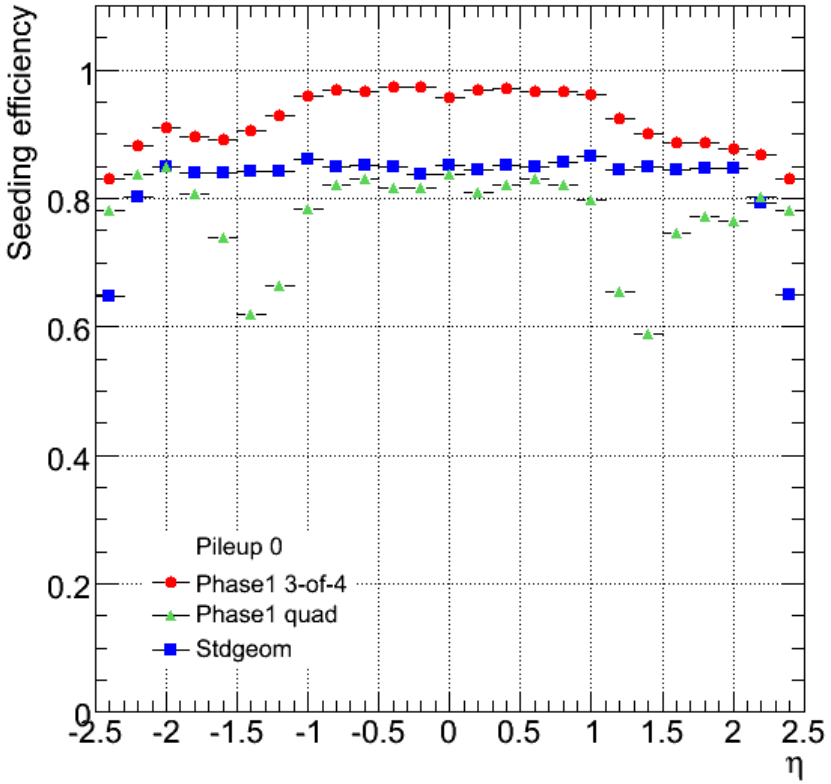
Work in progress !

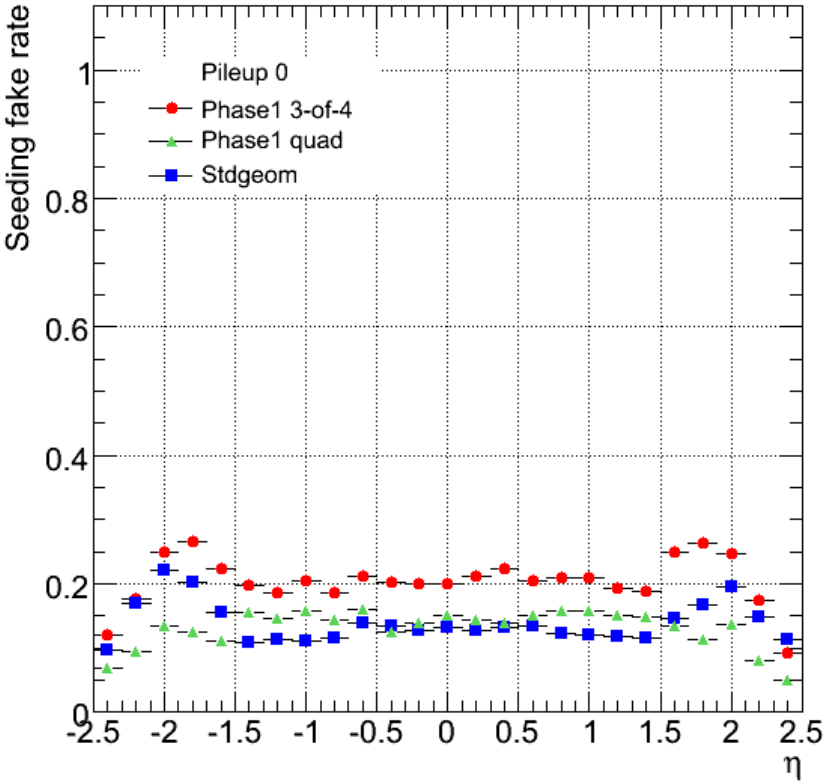
Track reconstruction workflows in CMSSW



Quadruplet seeding efficiency for iterative tracking

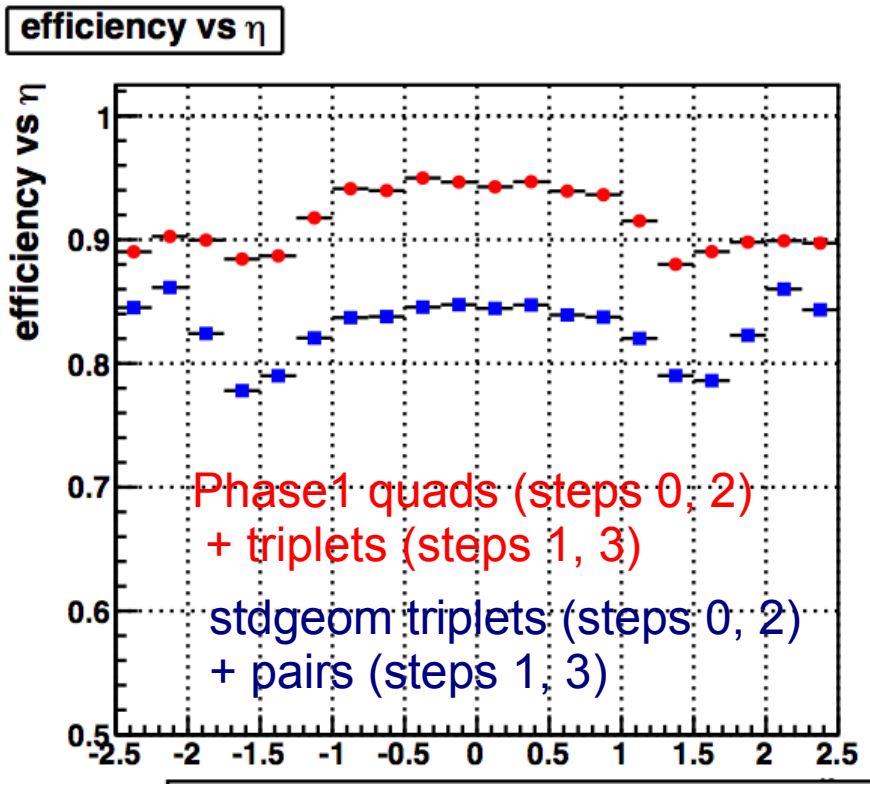
- Fullsim CMSSW_3_3_6; R39F16 phase1, geometry tag 28, std. pixel size
- Process: 6k ttbar, pu0 (no jet pT range defined)
- Example for **`step0(newSeedWithTriplets)`** → **merged quadruplets** only (no triplets)
- Expect:
  - Drop in efficiency (4-plets more demanding)
  - Reduce of the fake

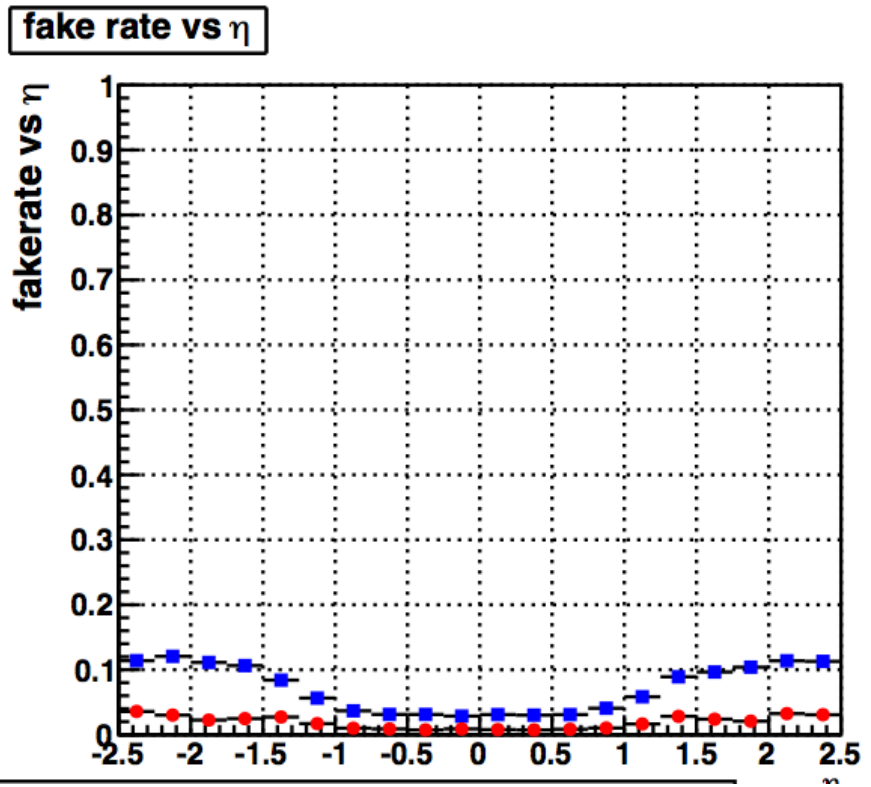




State of the art: Seeding in iterative tracking

Combined (final) seeds after 4 iterative steps





New track fit algorithms & quadruplet seed merger code are part of the Official CMSSW upgrade releases since CMSSW_3_6_3_SLHC1

Fully developed by M.A&J.O.
https://twiki.cern.ch/twiki/bin/viewauth/CMS/SLHCTrackerDESYSimTools