Working Progresss

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Search for electroweak production of supersymmetirc states in scenarios with compressed mass spectra

- Naturalness: $\mu \ll |M_1|, |M_2|$,

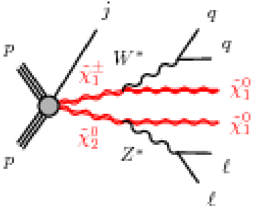
$\rightarrow$ three lightest electroweakino separated $\mathcal{O}$(100 MeV - 10 GeV)

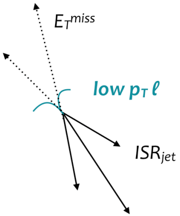
$\rightarrow$ Compressed mass spectra

Small $\Delta m(\chi_2^0, \chi_1^0), \Delta m(\chi_1^\pm, \chi_1^0)$

$\rightarrow$ **Final states with displaced low-p_t lepton pairs (e, μ) and p_t^{miss}**

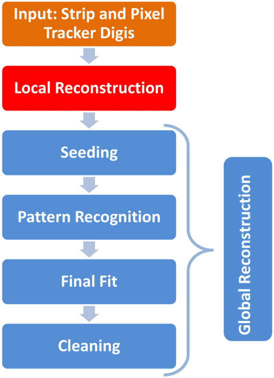
$\rightarrow$ **Final states with disappearing tracks**





Track Reconstruction Review

- Iterative tracking: **C**ombinatorial **T**rack **F**inder
- Proceeds 4 steps in 9 (7) iterations (Phase-0)



Up to 2016:

0 InitialStep (pixel triplets)

1 LowPtTripletStep (pixel triplets)

2 PixelPairStep (pixel pairs)

3 DetachedTripletStep (pixel triplets)

4 MixedTripletStep (Triplets)

5 PixelLessStep (Pairs: TIB1,2 TID/TEC ring)

6 TobTecStep (Pairs: TOB1,2 TEC ring 5, wheels 1-7)

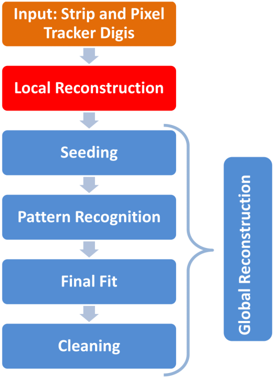
After 2017:

9 main iterations

step name	seeding	target track
Initial	pixel quadruplets	prompt, high p_T
LowPtQuad	pixel quadruplets	prompt, low p_T
HighPtTriplet	pixel triplets	prompt, high p_T recovery
LowPtTriplet	pixel triplets	prompt, low p_T recovery
DetachedQuad	pixel quadruplets	displaced−−
DetachedTriplet	pixel triplets	displaced−− recovery
MixedTriplet	pixel+strip triplets	displaced−
PixelLess	inner strip triplets	displaced+
TobTec	outer strip triplets	displaced++
JetCore	pixel pairs in jets	high p_T jet
Muon inside-out	muon-tagged tracks	muon

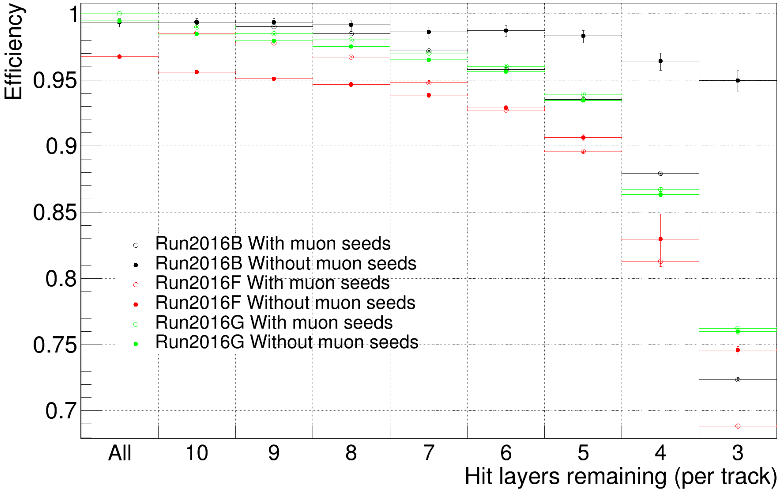
NEW: Dropping the muon seeded iterations

- Iterative tracking:
  Combinatorial **T**rack **F**inder
- Proceeds 4 steps in 9 (7) iterations (Phase-0)



- Default includes muon seeded iterations
- Dropped
  - MuonSeededSeeds-, TrackCandidates-, TracksInOut
  - MuonSeededSeeds-, TrackCandidates-, TracksOutIn
  - TrackCandidates-, TracksOutInDisplaced
  - PreDuplicateMerging with muon seeded tracks

Do we overestimate the efficiency by selecting muon (flagged) general tracks?

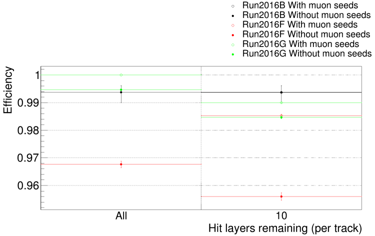


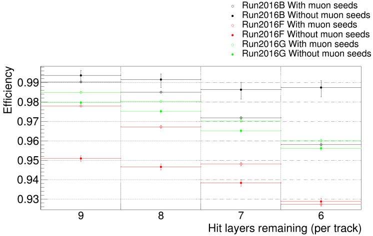
$$\epsilon_{no\mu} = \frac{N^{l=all}_{lt.no\mu}}{N^{l=all}_{lt.all}} < 1, \quad \frac{N^{l=10}_{lt.no\mu}}{N^{l=all}_{lt.all}} << 1, etc. \quad vs. \quad \epsilon = \frac{N^{l=all}_{lt.all}}{N^{l=all}_{lt.all}} != 1, \quad \frac{N^{l=10}_{lt.all}}{N^{l=all}_{lt.all}} \leq 1, etc.$$

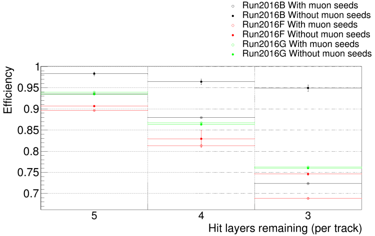
NEW: Dropping the muon seeded iterations

$$\epsilon_{no\mu} = \frac{N^{l=all}_{It.no\mu}}{N^{l=all}_{It.all}} < 1,$$

$$\frac{N^{l=10}_{It.no\mu}}{N^{l=all}_{It.all}} << 1, etc.$$

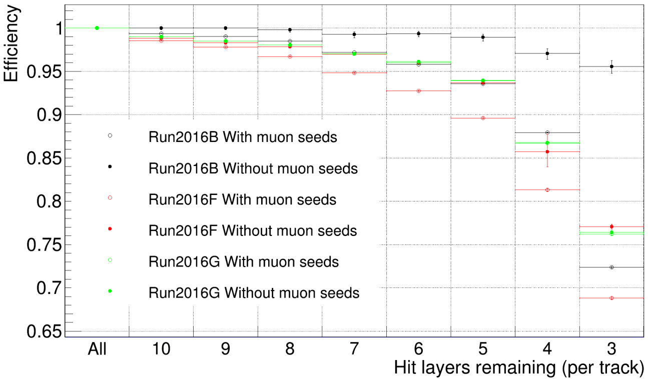






NEW: Tracking Efficiencies with and without muon seeds

What is the true efficiency for general (no muon) tracks?

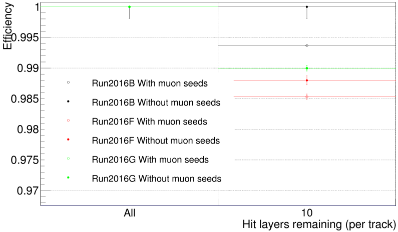


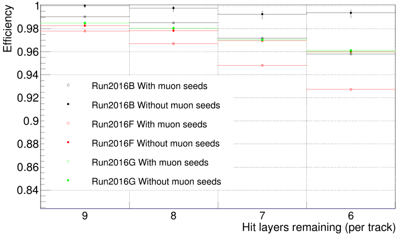
$$\epsilon_{no\mu} = \frac{N^{l=all}_{lt.no\mu}}{N^{l=all}_{lt.no\mu}} != 1, \quad \frac{N^{l=10}_{lt.no\mu}}{N^{l=all}_{lt.no\mu}(*)} \leq 1, etc. \quad vs. \quad \epsilon = \frac{N^{l=all}_{lt.all}}{N^{l=all}_{lt.all}} != 1, \quad \frac{N^{l=10}_{lt.all}}{N^{l=all}_{lt.all}} \leq 1, etc.$$

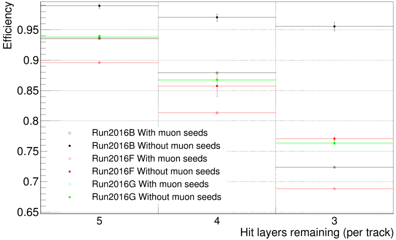
$$(*) N^{l=all}_{lt.no\mu} | e.g. reRECOstep(l=10) = N^{l=all}_{lt.all} \times \frac{N\_sel^{l=10}_{lt.all}}{N\_sel^{l=all}_{lt.all}},$$

NEW: Dropping the muon seeded iterations

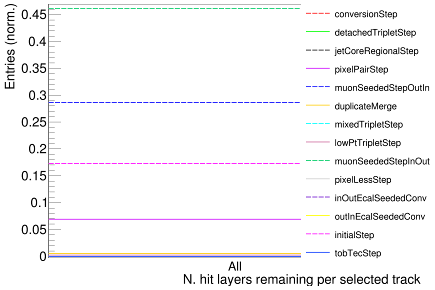
$$\epsilon_{no\mu} = \frac{N^{l=all}_{It.no\mu}}{N^{l=all}_{It.no\mu}} != 1, \qquad \frac{N^{l=10}_{It.no\mu}}{N^{l=all}_{It.no\mu}(*)} \leq 1, etc$$

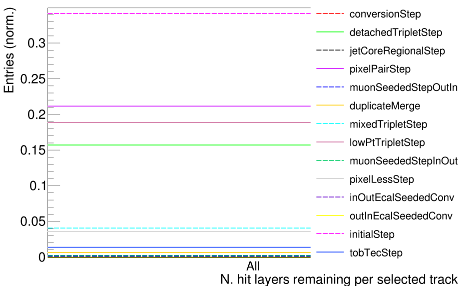






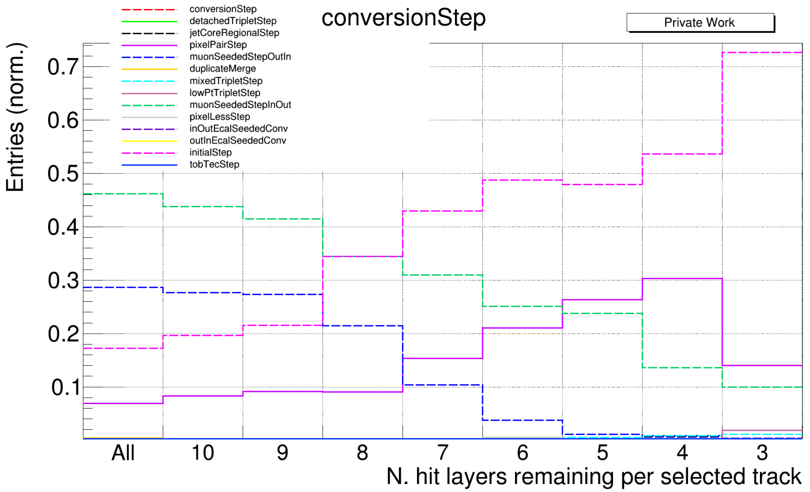
NEW: Reconstruction algorithm: Default reco 2016, sel tracks vs. all tracks





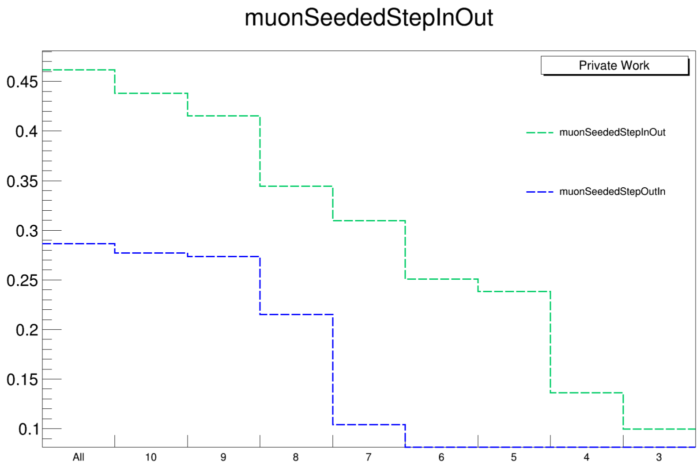
Dataset: 2016 RunF, with muon seeded iterations

NEW:Default reco 2016, shortened tracks



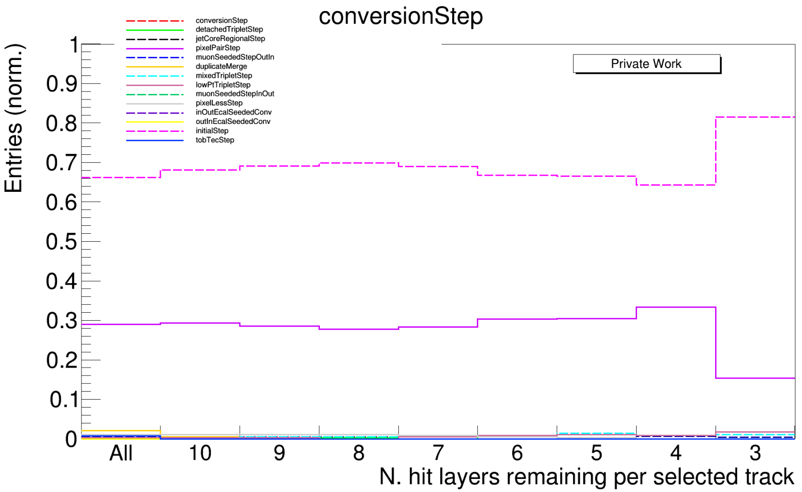
Dataset: 2016 RunF, with muon seeded iterations

NEW:Muon Seeds in 2016 default reco, shortened tracks



Dataset: 2016 RunF, with muon seeded iterations

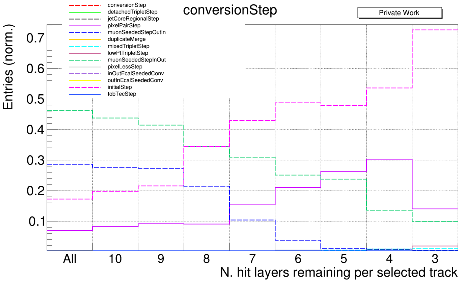
NEW:Default reco 2016 without muon seeds, shortened tracks

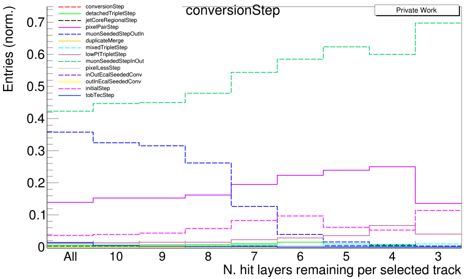


Dataset: 2016 RunF

NEW:Using the AlgoMask Information

- Possible methods: track.algoName(), trackIsInAlgoMask(e.g.reco::Track::pixelPairStep)
- AlgoMask information is trusted more
- double counting is possible (most likely)





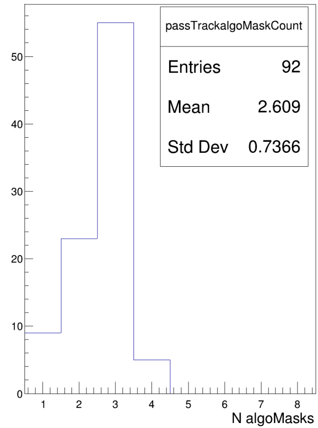
algoName

algoMask

Dataset: 2016 RunF, with muon seeded iterations

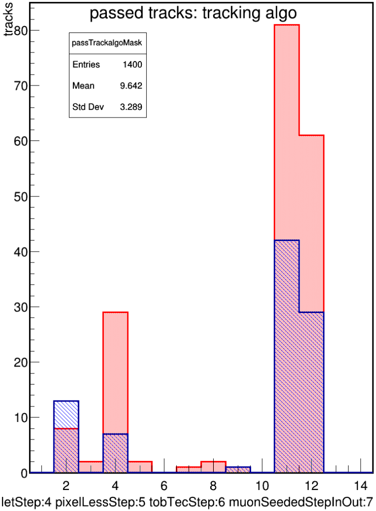
NEW:Using the AlgoMask Information

- trackIsInAlgoMask()
- double counting is possible (most likely)



Dataset: 2016 RunF, with muon seeded iterations

NEW:Using the AlgoMask Information



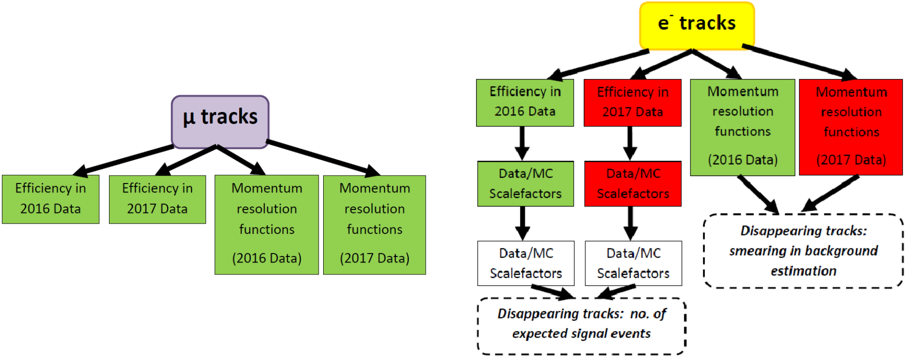
Dataset: 2016 RunF, with muon seeded iterations

Red algoMask

Blue algoName

- duplicateMerge = 1;
- initialStep = 2;
- lowPtTripletStep = 3;
- pixelPairStep = 4;
- detachedTripletStep = 5;
- mixedTripletStep = 6;
- pixelLessStep = 7;
- tobTecStep = 8;
- jetCoreRegionalStep = 9;
- conversionStep = 10;
- muonSeededStepInOut = 11;
- muonSeededStepOutIn = 12;
- outInEcalSeededConv = 13;
- inOutEcalSeededConv = 14;

Big scale plans



- Present status at TRK POG miniworkshop @Padova in 2 weeks
- Gather study on electron and muon tracks in a PAS
- Continue study with electrons only

Open questions and next steps

- Start with the 2017 efficiency (scale factors)
- No RAW-RECO for 2017 SingleElectron -> reconstruct samples myself from RAW, e.g. Run2017F, relaese name 9_2_X>10
- used: cmsDriver.py command, –step RAW2DIGI, RECO, with 94X_dataRun2_v6 conditions in 9_4_6, 9_2_11
- yields: cscRecHits trying to insert duplicate entry
- Group meeting talk 6th of March
- DPG talk

Next Steps

Backup

Iterative Tracking - 2017

Challenges:

- Tracking mainly combinatorial problem

  → pile up (PU) has strong effect on reconstruction efficiency, accuracy and timing
- Average PU expected to rise with RunII due to 25ns bunch crossing
- Average PU rises from ≈ 25 to ≈ 45
- Higher occupancy in tracker (+5% in Pixel, +45% in Strip)
- Special Problem: ghost hits in double sided strips
- Effect on iterations that are seeded using double-sided hits (PixelLess/TobTec)
- Pixel dynamic inefficiency caused by saturation of the readout chip buffer

Solutions:

- Timing-Oriented developments
- Reduce time needed for strip-seeded iterations
- Extend **strip-pair pattern to include additional third hit** (nr. of produced seeds reduced, nr. of tracks remains)
- Out of time pileup increases reconstruction time and fake rate
- Particles from different bunch crossing arrive at random time, corresponding clusters characterized by low charge

  → **Selection on the cluster charge** (CCC)
- Further improvements e.g. order of the iterations (faster iterations run first) [?]

Iterative Tracking After 2017

- Physics-Oriented developments

  MounSeedStep OutIn:
- Outside-in iteration seeding using information from outermost muon detectors
- Recovers PU-dependant efficiency loss
- Re-reconstruction of muon-candidate tracks with looser requirements to recover hit collection efficiency

  MounSeedStep InOut:
- Requiring muon candidates (muon detectors) to be confirmed through a corresponding track (tracker)
- Reduces false reconstruction rate, improves momentum resolution

  DuplicateMerge:
- Tags clusters as merged if they are associated with more than one track
- Setting 'isMerged' flag in SiStripCluster-container