

Performance of the new realistic seeding code with ACTS in DD4HEP/juggler

Wenqing Fan

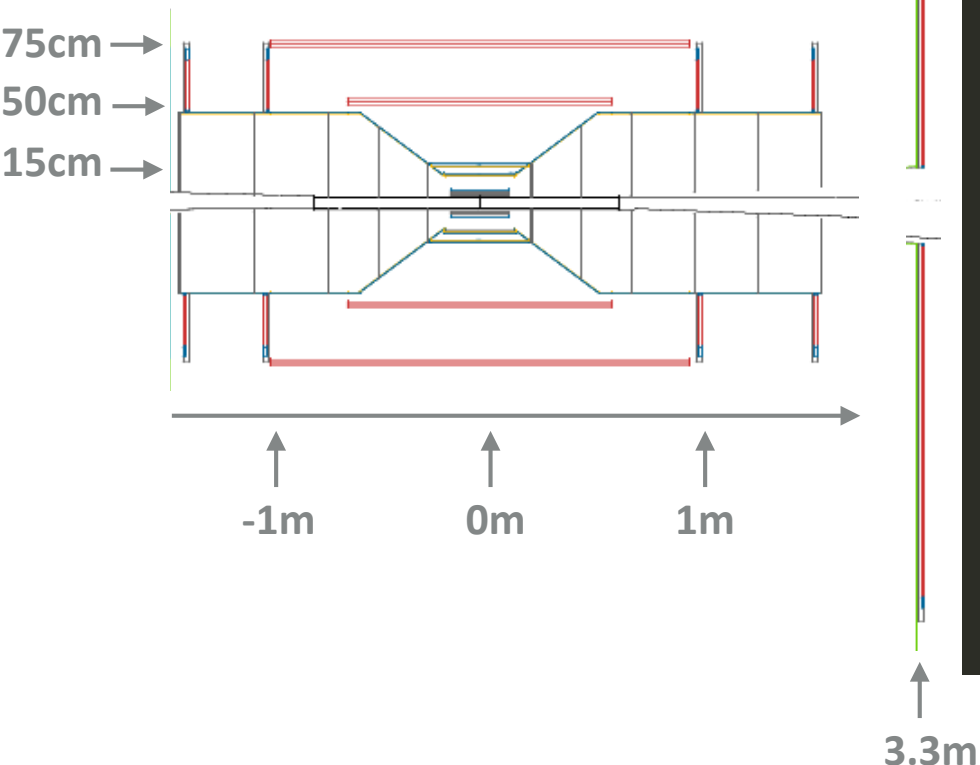
08/23/2022, LBNL

► Configuration

- ◆ **maxSeedsPerSpM**
changed from 10 to 1

► ATHENA hybrid tracking +3T field

- ◆ **Switch to ePIC geometry**
when it's ready

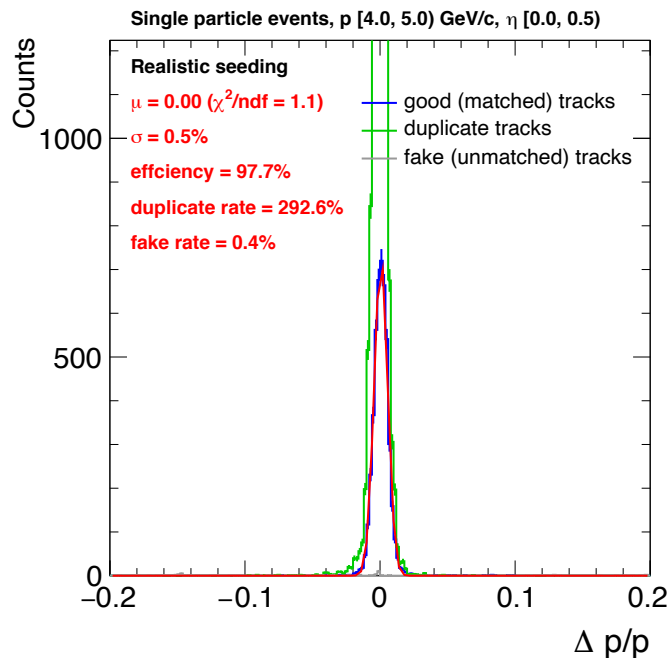
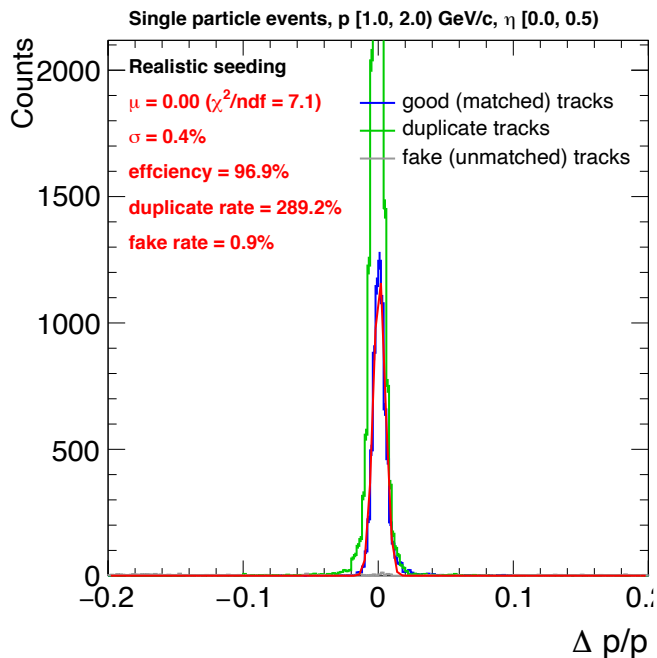


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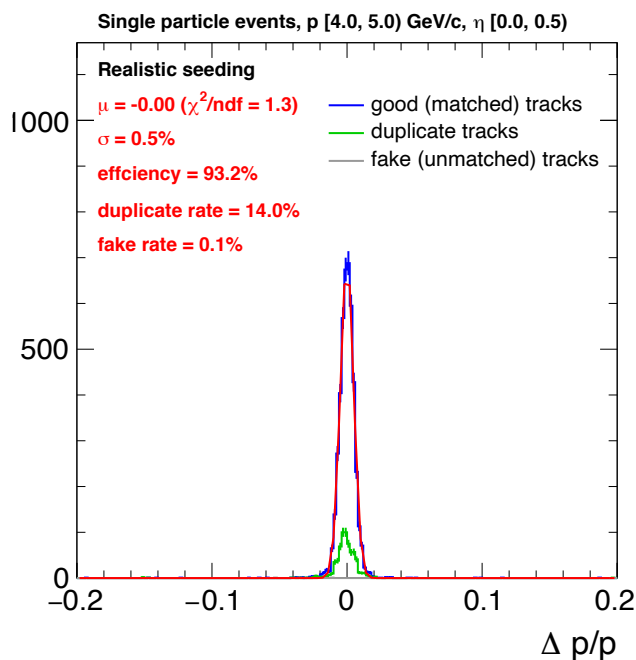
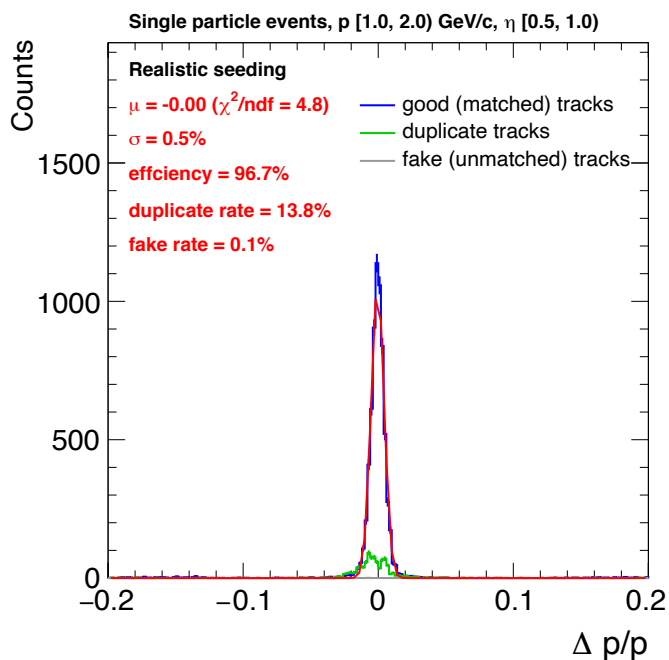
// double-hit space points for strip-like detectors.
std::vector<std::string> inputSpacePoints;
// Output track seed collection.
std::string outputSeeds;
// Output proto track collection.
std::string outputProtoTracks;
float bFieldInZ = 3 * Acts::UnitConstants::T; // z direction B field in kT
float minPt = 150 * Acts::UnitConstants::MeV; // Minimum pT in MeV
float rMax = 250 * Acts::UnitConstants::mm; // 320
float zMin = -2000 * Acts::UnitConstants::mm;
float zMax = 2000 * Acts::UnitConstants::mm;
float deltaRMin = 1 * Acts::UnitConstants::mm;
float deltaRMax = 320 * Acts::UnitConstants::mm;
float collisionRegionMin = -250 * Acts::UnitConstants::mm;
float collisionRegionMax = 250 * Acts::UnitConstants::mm;
float maxSeedsPerSpM = 1; // 12;
float cotThetaMax = 27.2899; // 45.003; // 27.2899; // About eta = 4
// 7.40627; // 2.7 eta
float sigmaScattering = 50;
float radLengthPerSeed = 0.1;
float beamPosX = 0;
float beamPosY = 0;
float impactMax = 3 * Acts::UnitConstants::mm;

// The minimum magnetic field to trigger the track
// parameters estimation
double bFieldMin = 0.1 * Acts::UnitConstants::T;

// Constant term of the loc0 resolution.
double sigmaLoc0 = 25 * Acts::UnitConstants::um;
// Constant term of the loc1 resolution.
double sigmaLoc1 = 100 * Acts::UnitConstants::um;
// Phi angular resolution.
double sigmaPhi = 0.02 * Acts::UnitConstants::degree;
// Theta angular resolution.
double sigmaTheta = 0.02 * Acts::UnitConstants::degree;
// q/p resolution.
double sigmaQOverP = 0.1 / Acts::UnitConstants::GeV;
// Time resolution.
double sigmaT0 = 1400 * Acts::UnitConstants::s;
    
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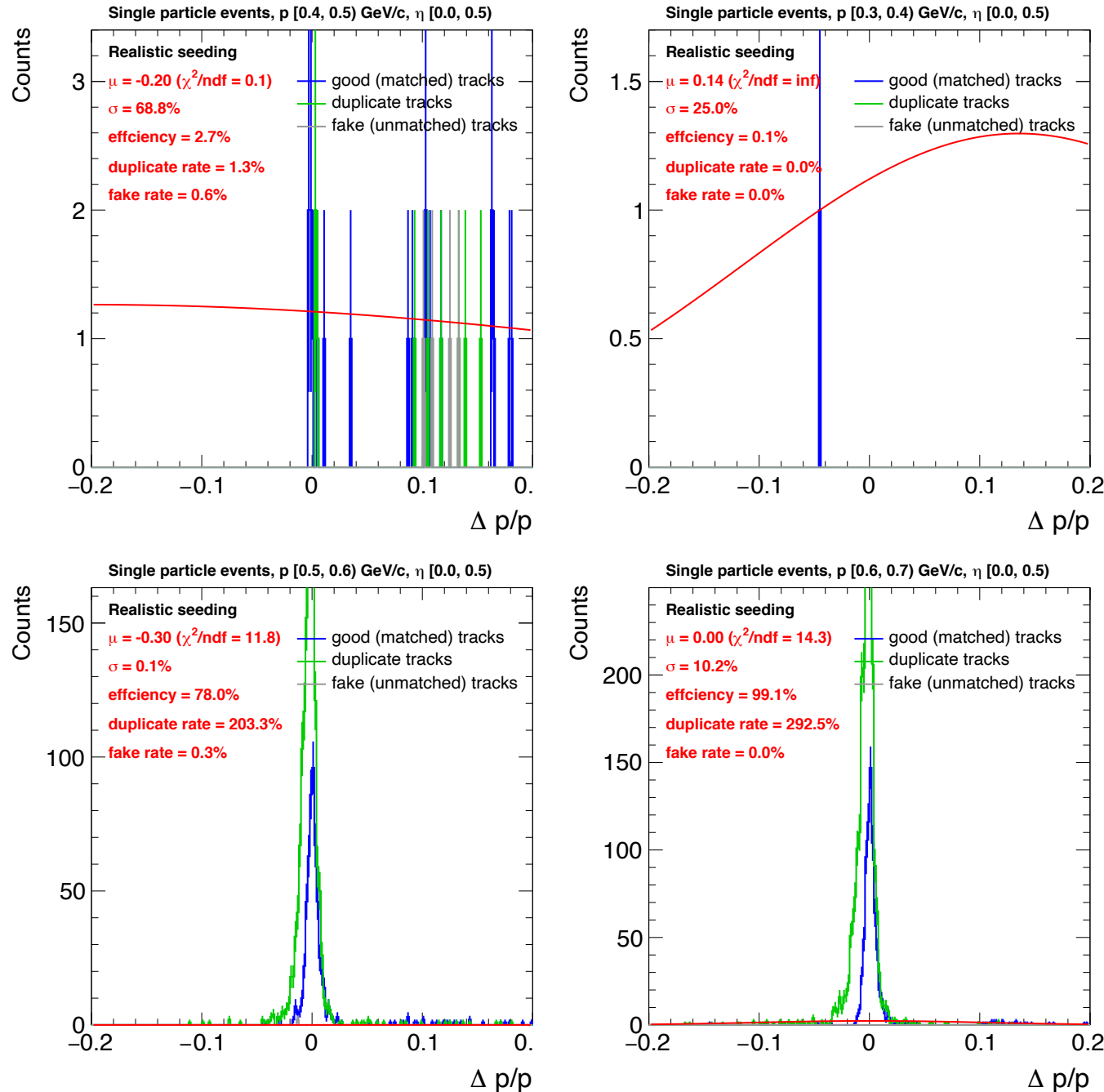
Number of fake tracks greatly reduced (<15% for maxSeedsPerSpM=1 and <35% for maxSeedsPerSpM=5)



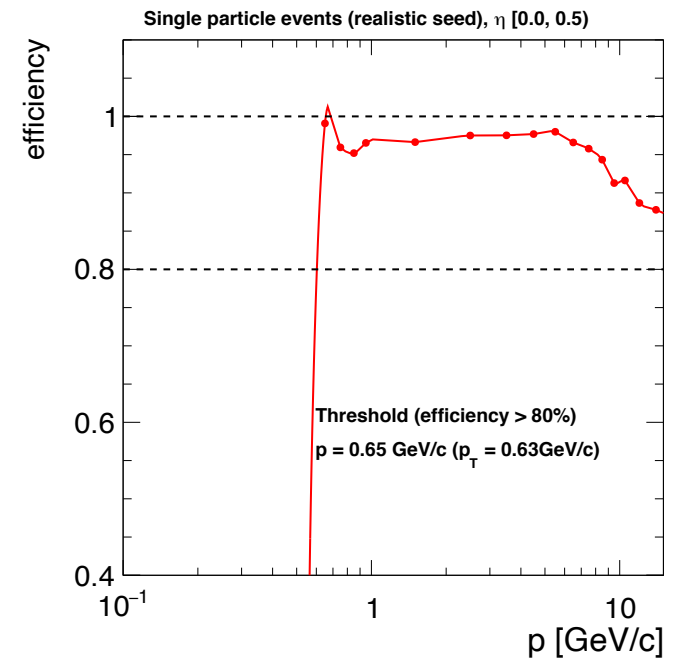
A very small decrease of efficiency

Threshold at midrapidity (maxSeedsPerSpM = 10)

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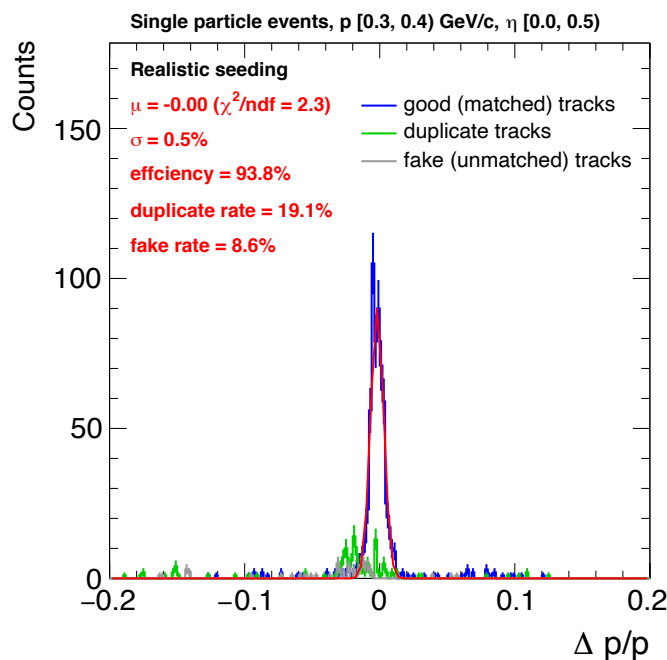
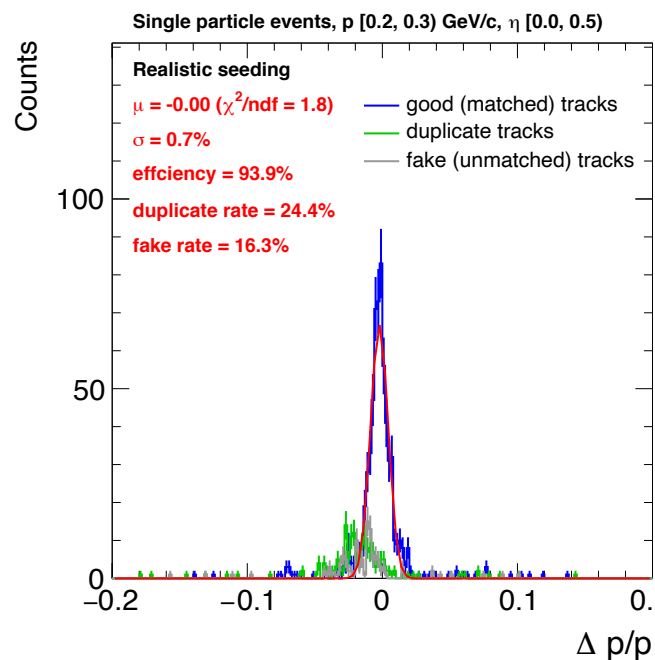
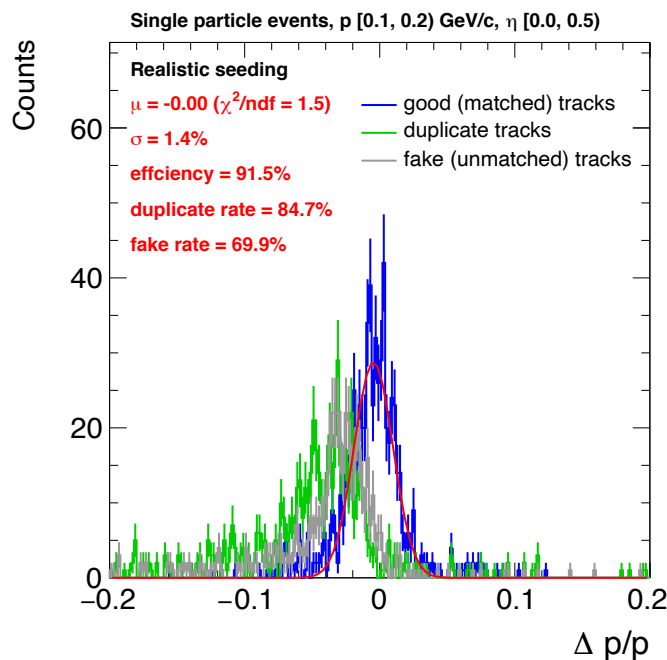
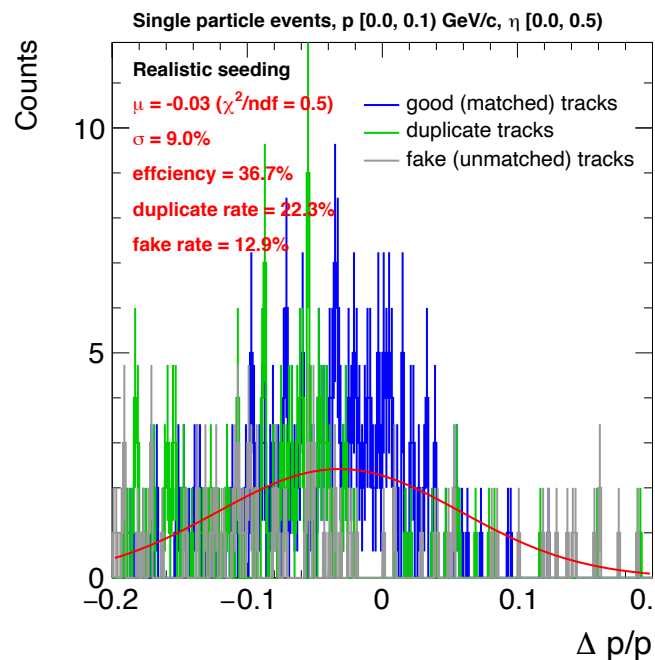


With maxSeedsPerSpM = 10, threshold much higher than the expectation (truth seeding ~0.15GeV)

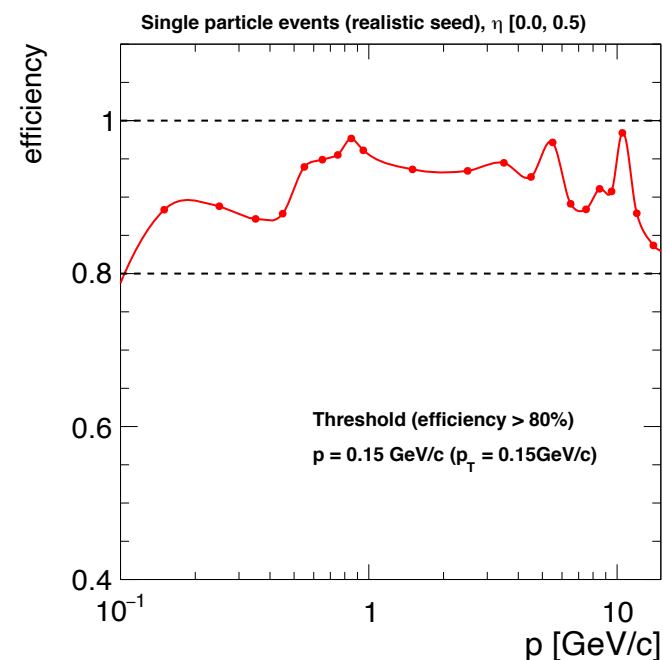


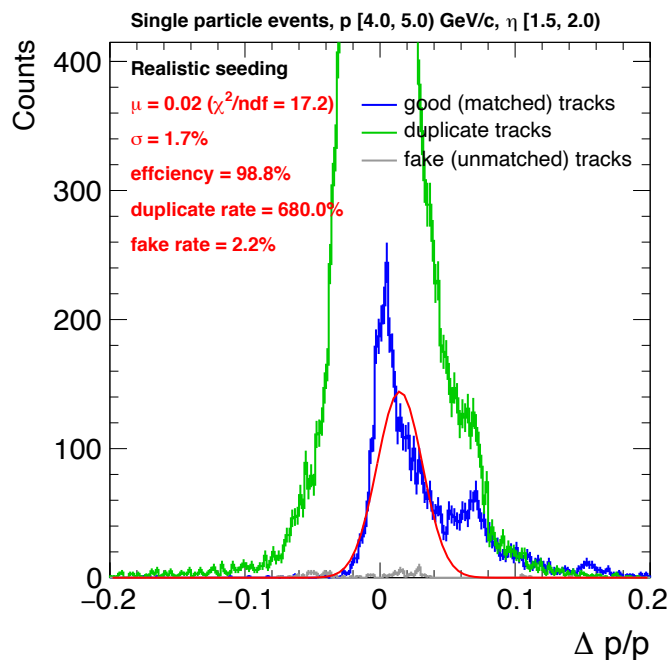
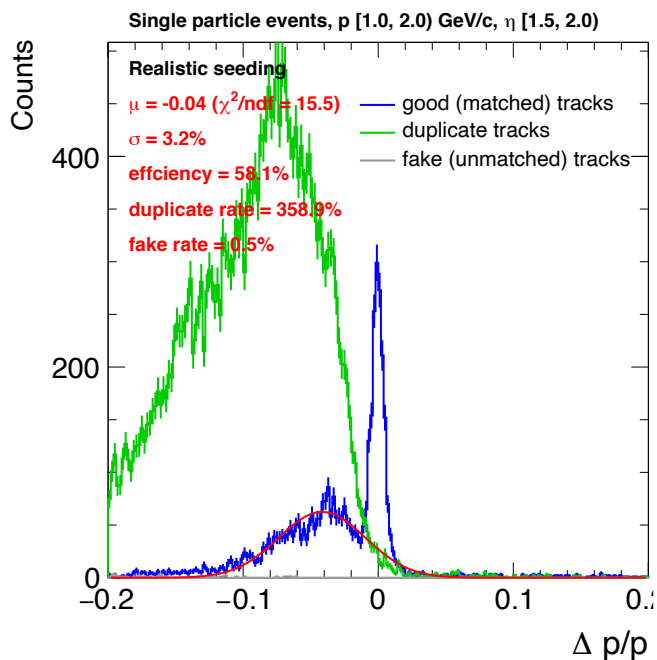
Threshold at midrapidity (maxSeedsPerSpM = 1)

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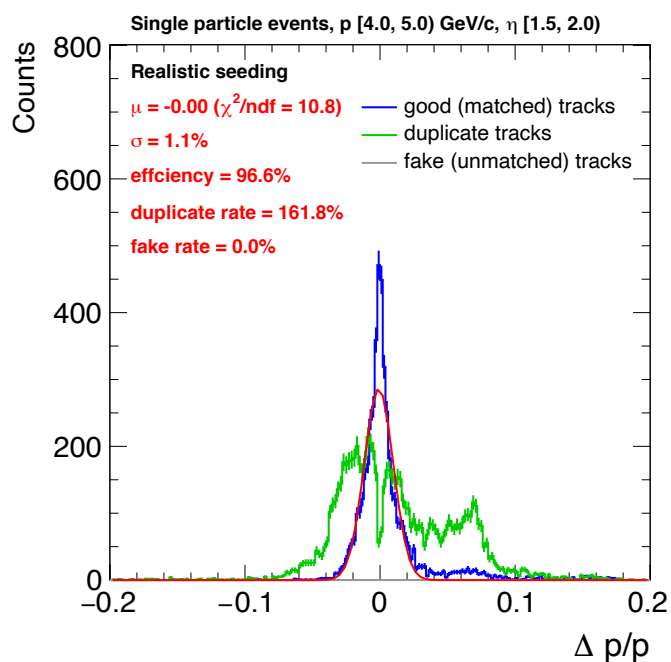
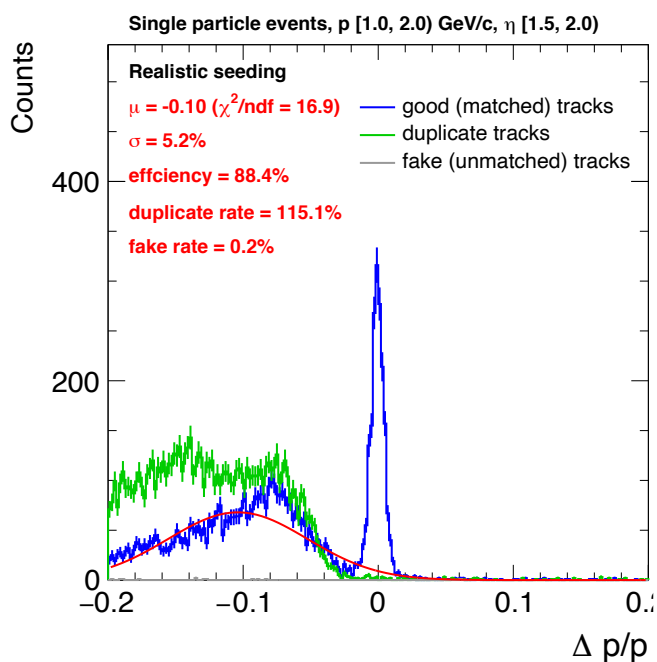


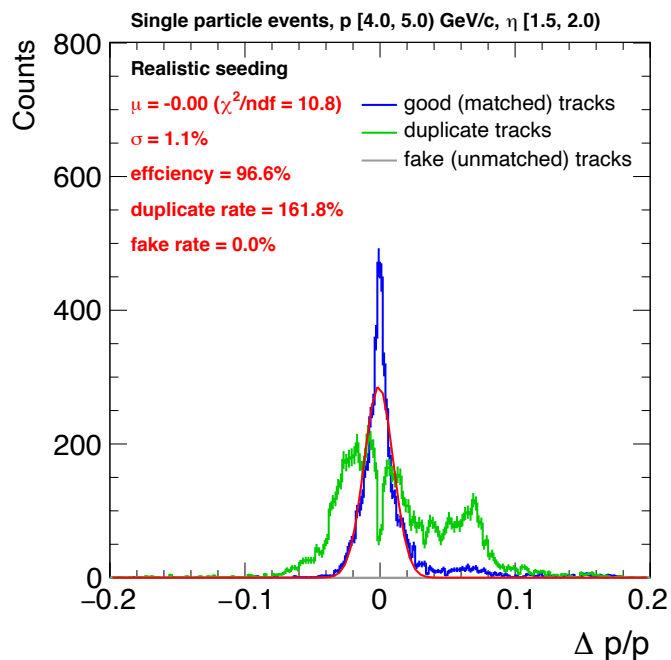
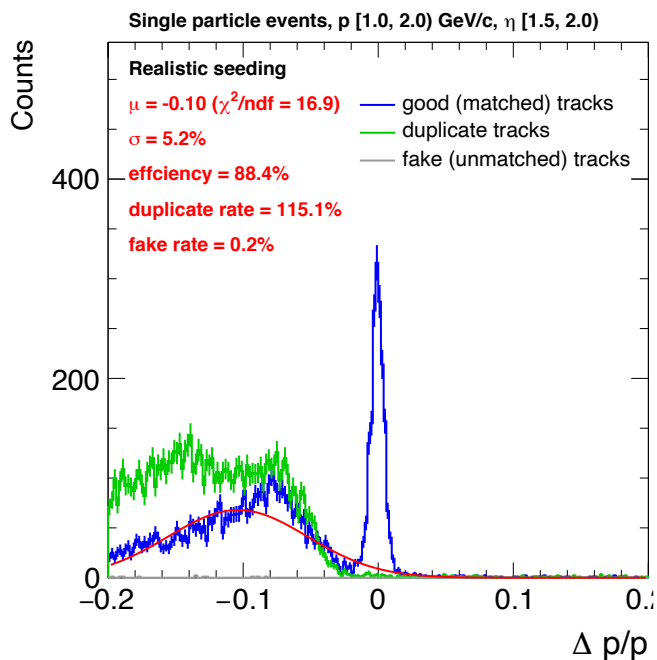
**With maxSeedsPerSpM
= 1 (or 5), threshold
close to the expectation
(truth seeding
~0.15GeV)**



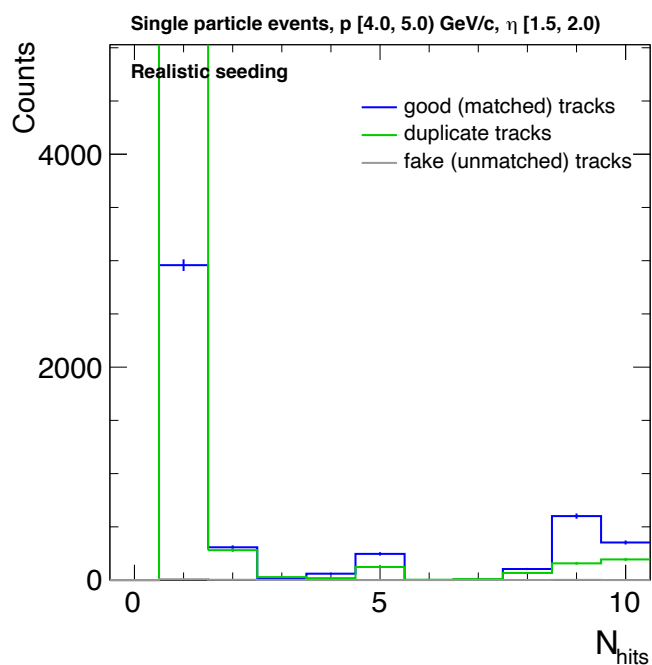
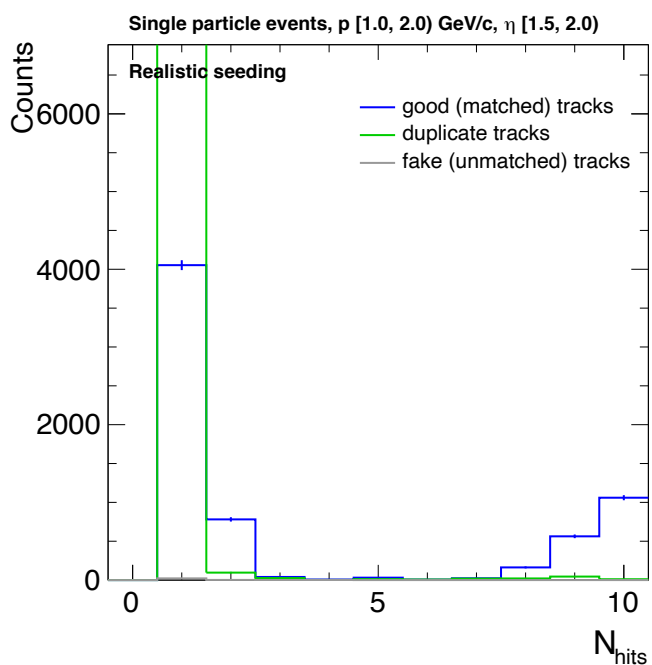


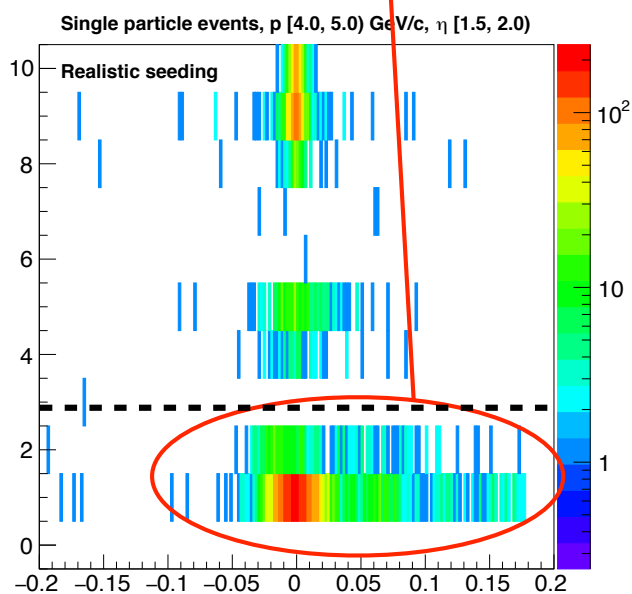
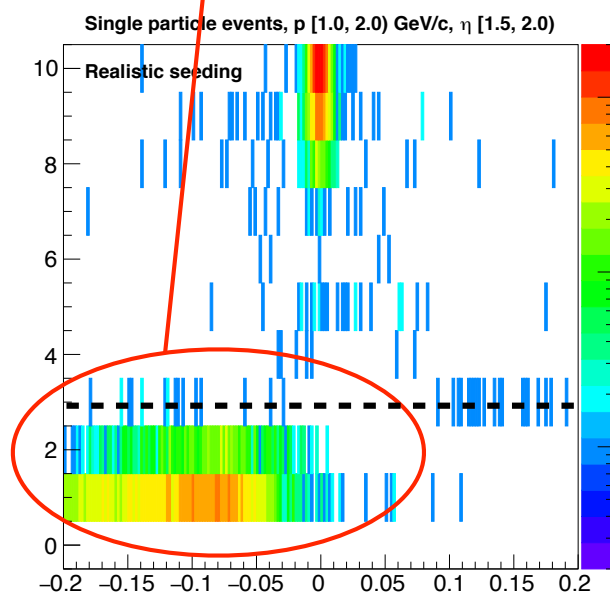
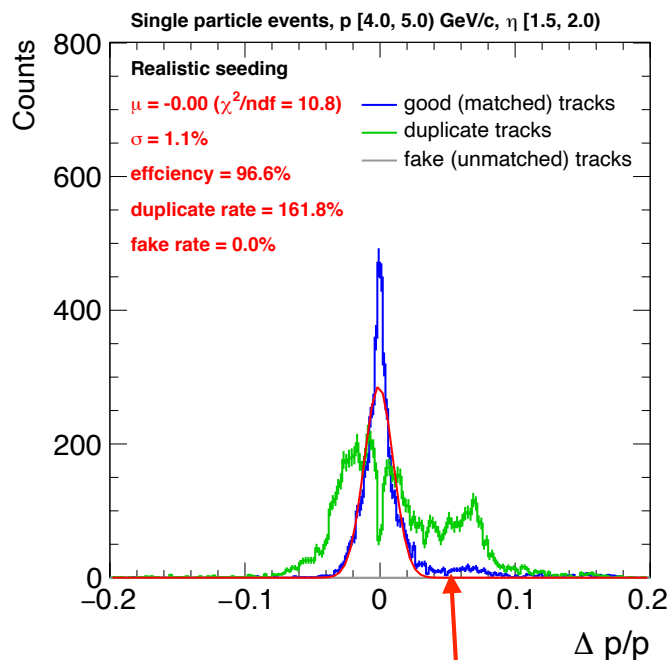
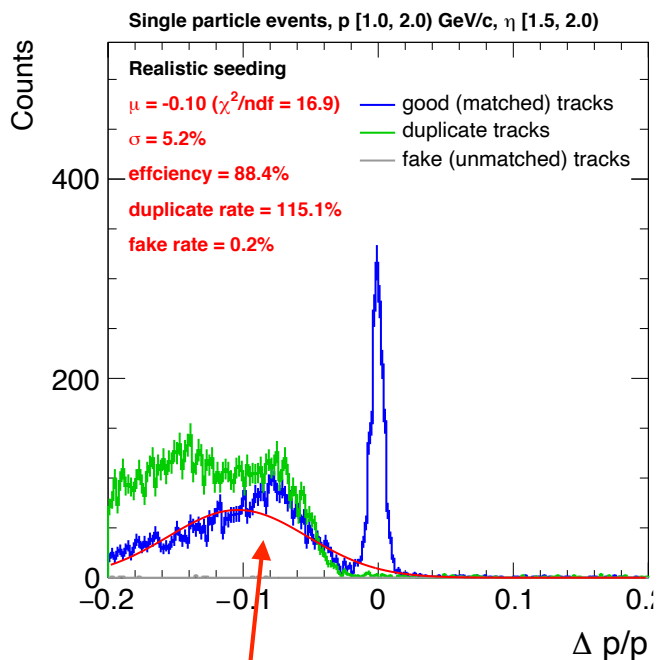
**Number of fake tracks
greatly reduced also at
forward rapidity**



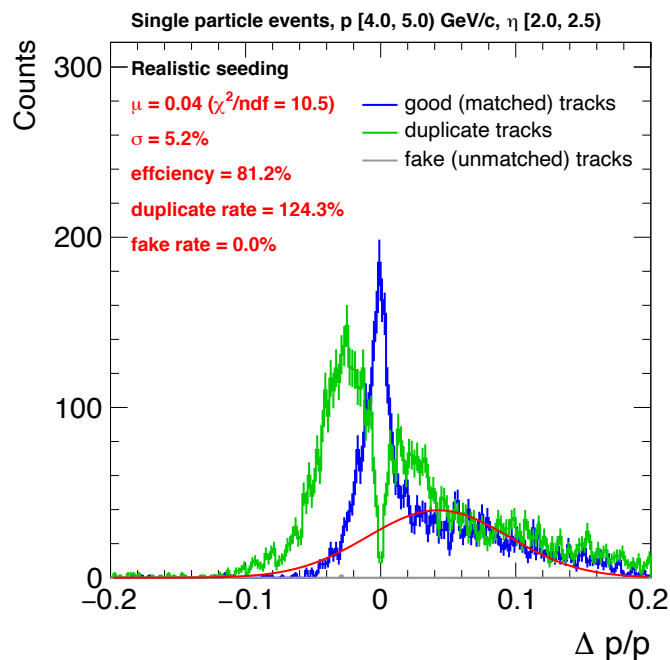
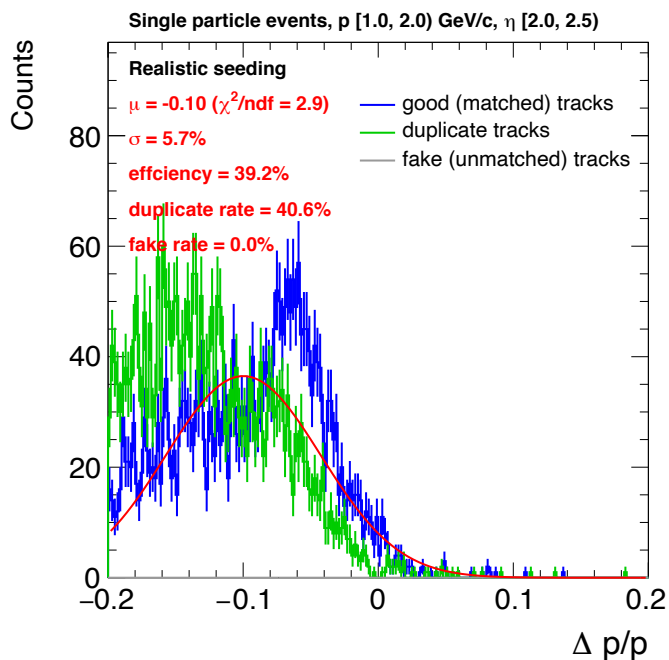


**Most of the fake tracks
are with only 1
associated hits**

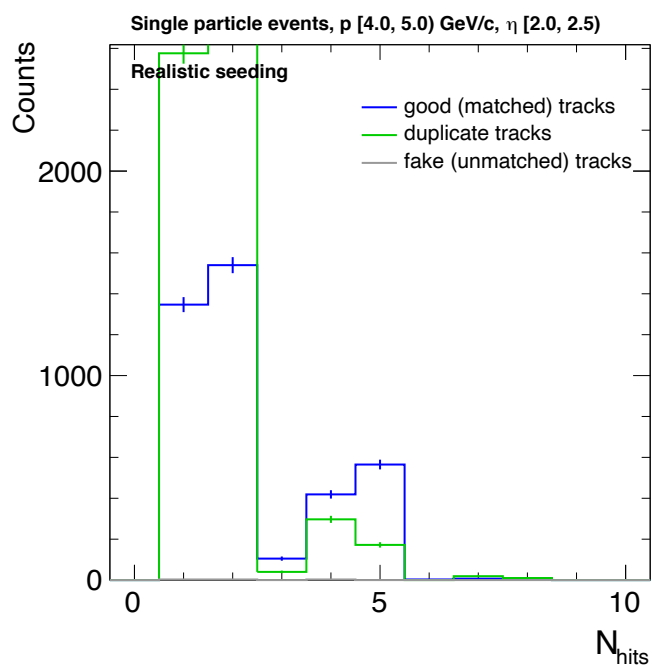
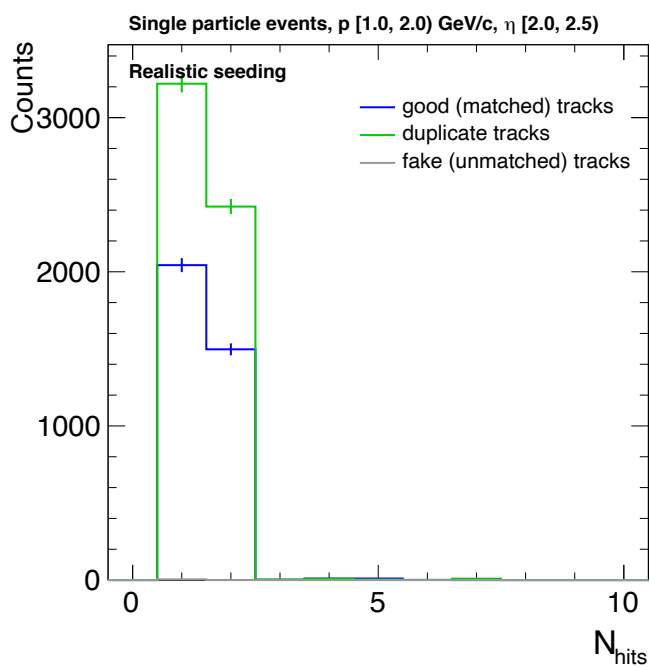


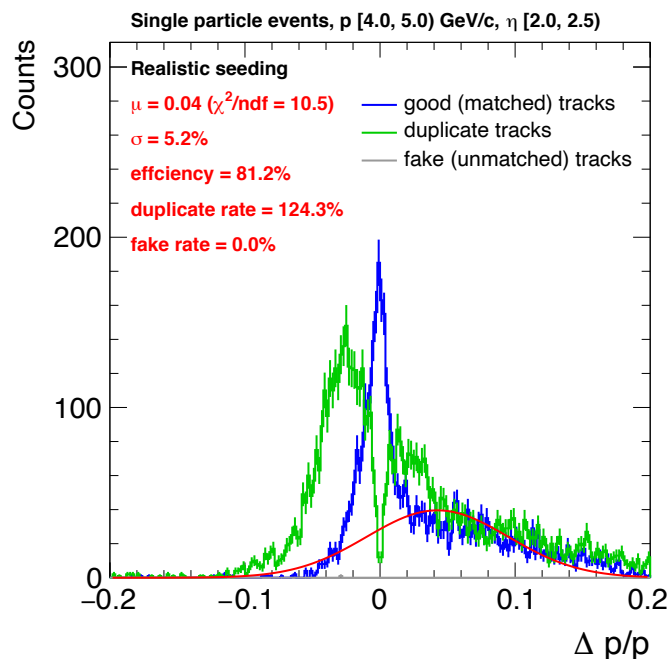
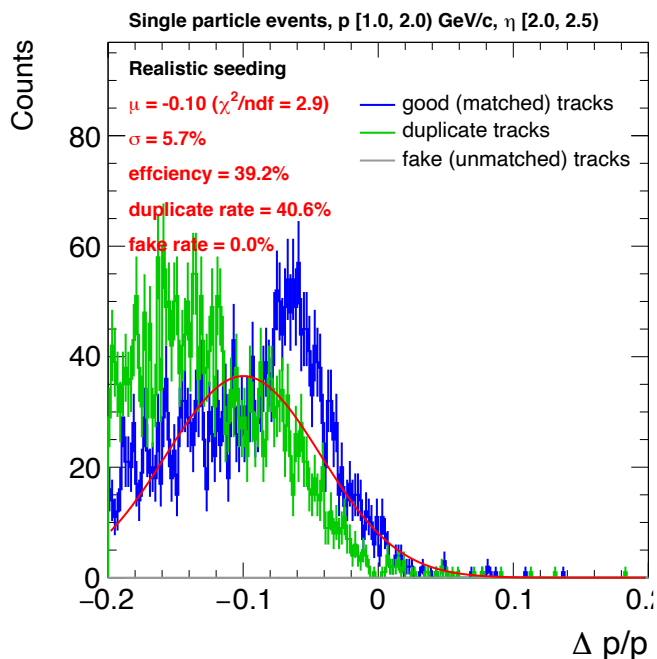


The multi-peak structure come from a mix of low hits (<3) and high hits tracks



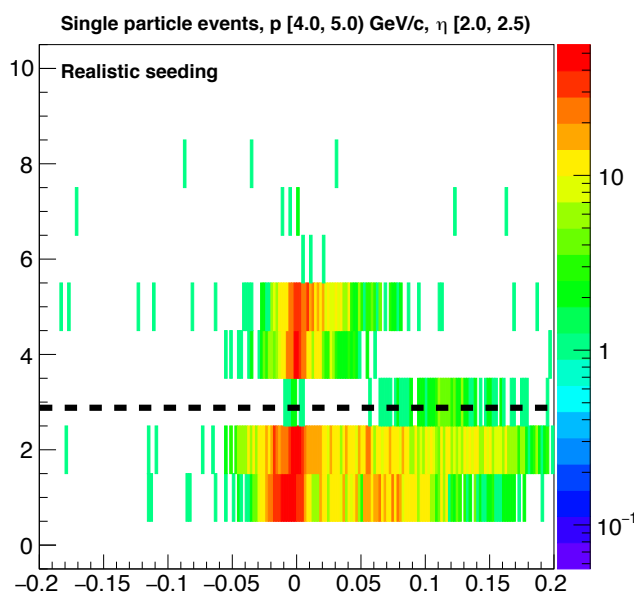
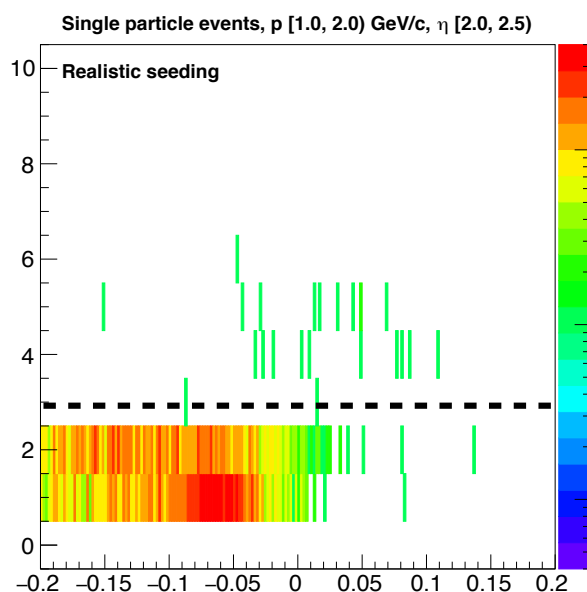
**Most of the fake tracks
are with <3 associated
hits**



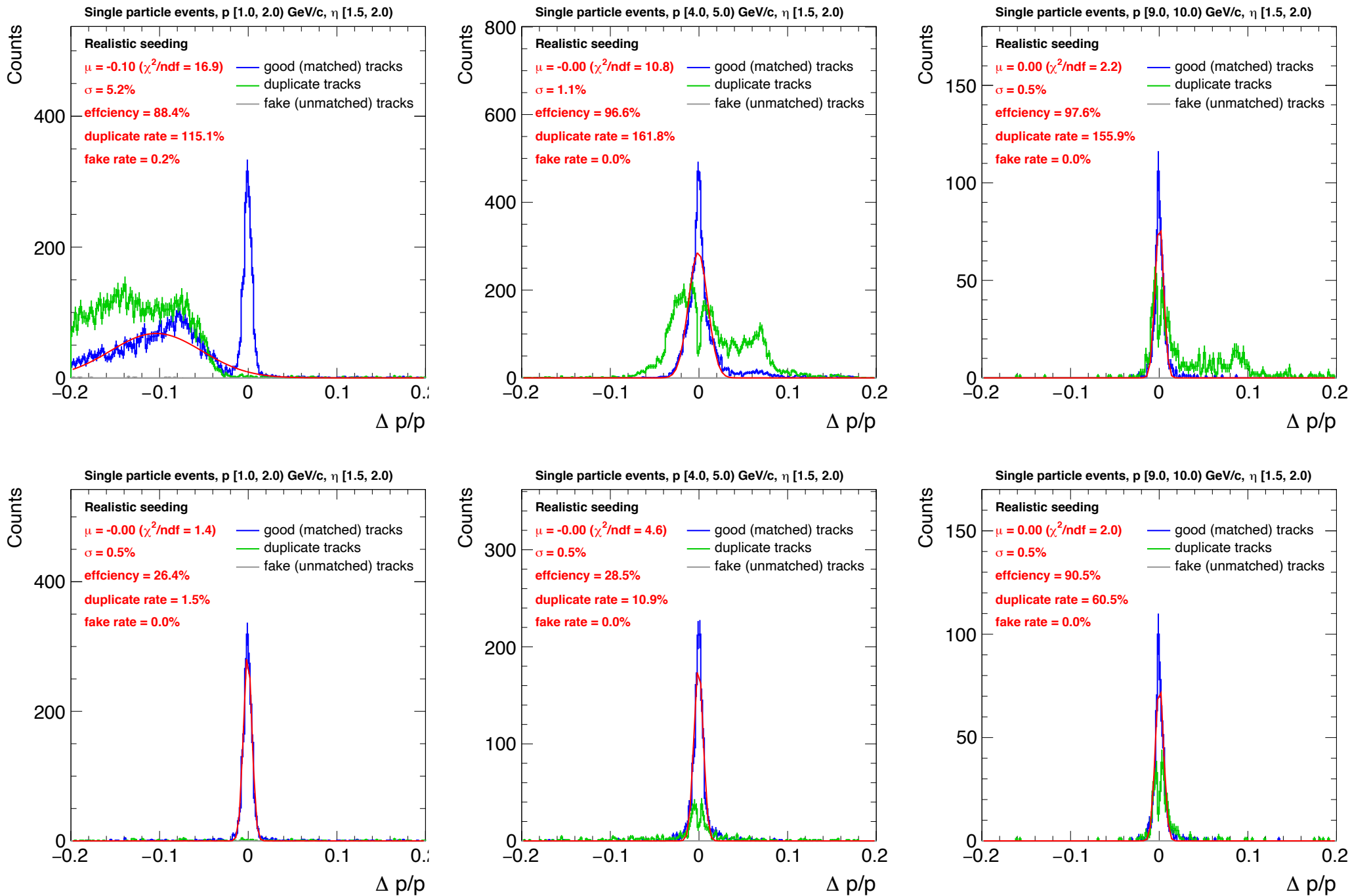


**Most of the tracks in
1-2GeV has <3
associated hits**

**The multi-peak structure
come from a mix of low
hits (<3) and high hits
tracks**

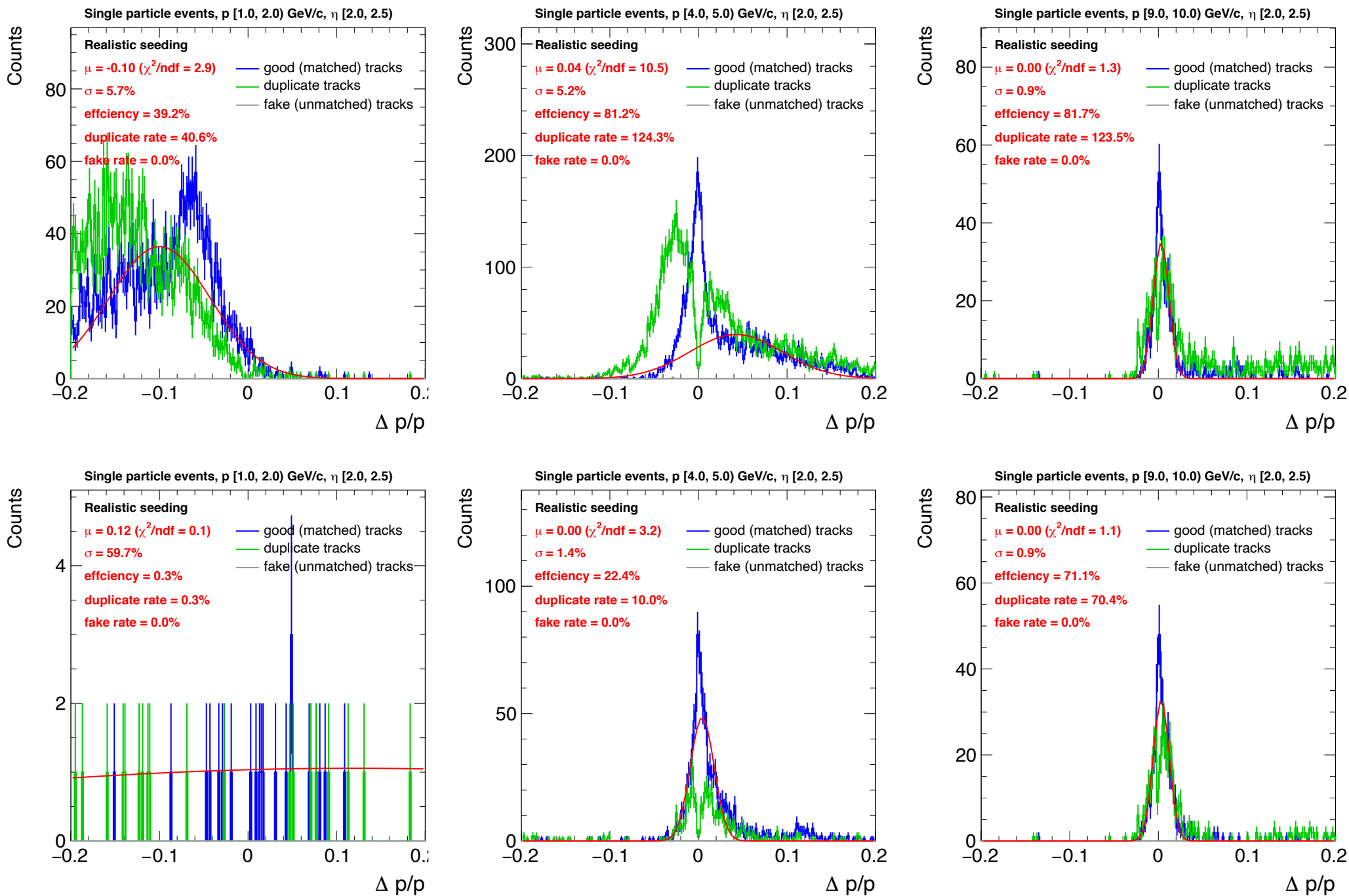


**Why so small associated
hits? (bad chi2?)**



More forward ($\text{maxSeedsPerSpM} = 1$ and $\text{nhits} \geq 3$)

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- ▶ Try tune down “maxSeedsPerSpM = 1” seem to work pretty well
 - ◆ Reduced the number of duplicate tracks without significant loss of efficiency
 - ◆ Lower threshold value at midrapidity
 - ◆ “maxSeedsPerSpM = 5” gives similar performance
- ▶ The multi-peak momentum distribution at forward rapidity is related to tracks with very few hits (<3)
 - ◆ Once constrain “good tracks” to be with at least 3 hits, momentum distribution looks better (low efficiency <5GeV)
 - ◆ Check the number of associated hits in truth seeding as function of momentum
- ▶ Switch to ePIC geometry soon