Track-Cluster Matching Update

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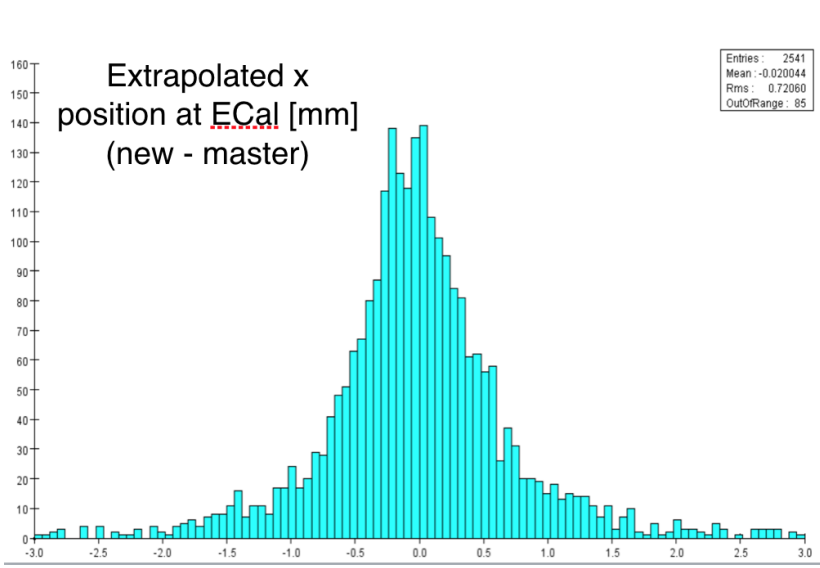
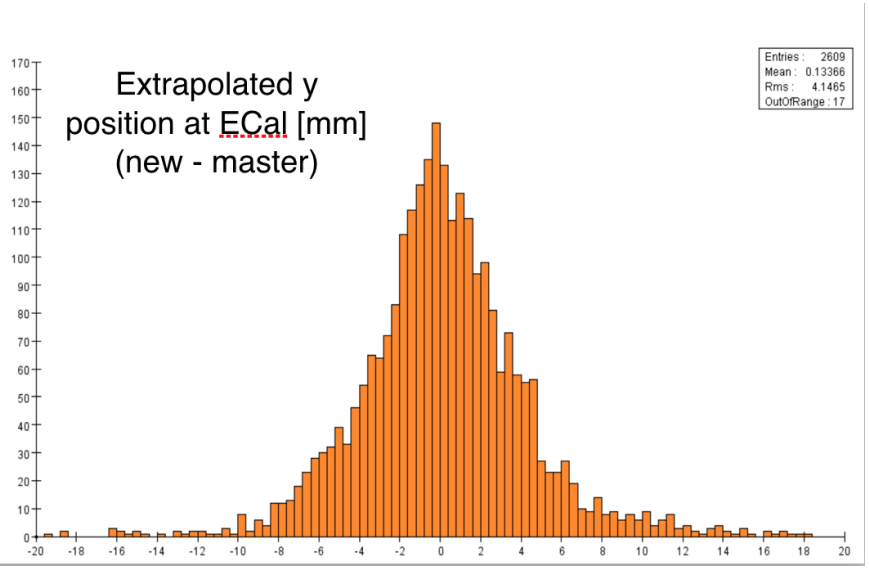
Intro

- Miriam updated the track extrapolation code:
  - TrackDataDriver uses TrackUtils.extrapolateTrackUsingFieldMap to create new TrackState@ECal for every GBL Track
    - Master extrapolates from TrackState@IP
    - New code extrapolates from TrackState@LastHit
- Track-cluster matching is performed using parameterized residuals
  - old parameterizations:
    - 2015: Rafo
    - 2016: Sebouh.
  - $n_\sigma^2 = \left[\frac{x_{cluster} - x_{extrap} - \mu_x(p)}{\sigma_x(p)}\right]^2 + \left[\frac{y_{cluster} - y_{extrap} - \mu_y(p)}{\sigma_y(p)}\right]^2$
    - $\mu_i(p)$ and $\sigma_i(p)$ are parameterized as polynomial within fit regions
    - outside fit regions, use constant values.
    - special edge case: remove y term.
  - This talk is on the new parameterizations of the means/ sigmas of the residuals

Changes to Extrapolation





Changes to Parameterization

		old		**new**	
		2015	2016	2015	2016
categories	e^+/e^-	✓	✓	✓	✓
	top/bottom	✓	✓	✓	✓
	GBL/MatchedTracks	✓			
	has SVT L6 hit?		✓	✓	✓
poly orders	has L6 hit	5	5	4	4
	no L6 hit	5	5	3	3

Procedure

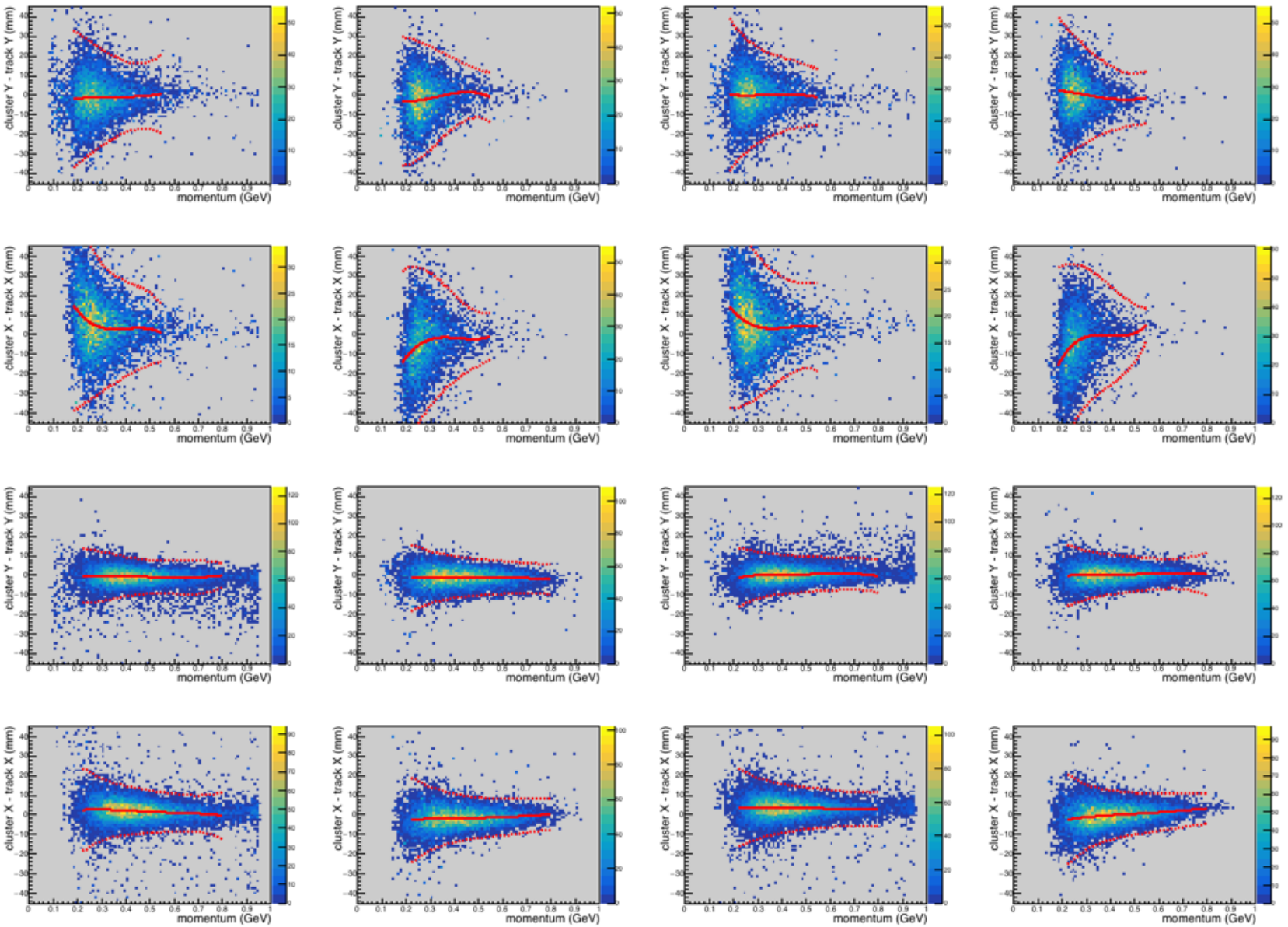
Events selection criteria

- e^+e^- pair on top/bottom.
- tri ntuple kinematic cuts ($p_{ele} < .9E_{beam}$, $p_{tot} < 1.3E_{beam}$)
- —cluster - track time - 55 ns— < 4 ns
- the cluster is in the fiducial region ($> 3/4$ crystal width from edge)
- 1 cluster on ecal side and 1 on positron side
- track $\chi^2/dof < 5$
- if tracks share > 3 hits, use track with best χ^2

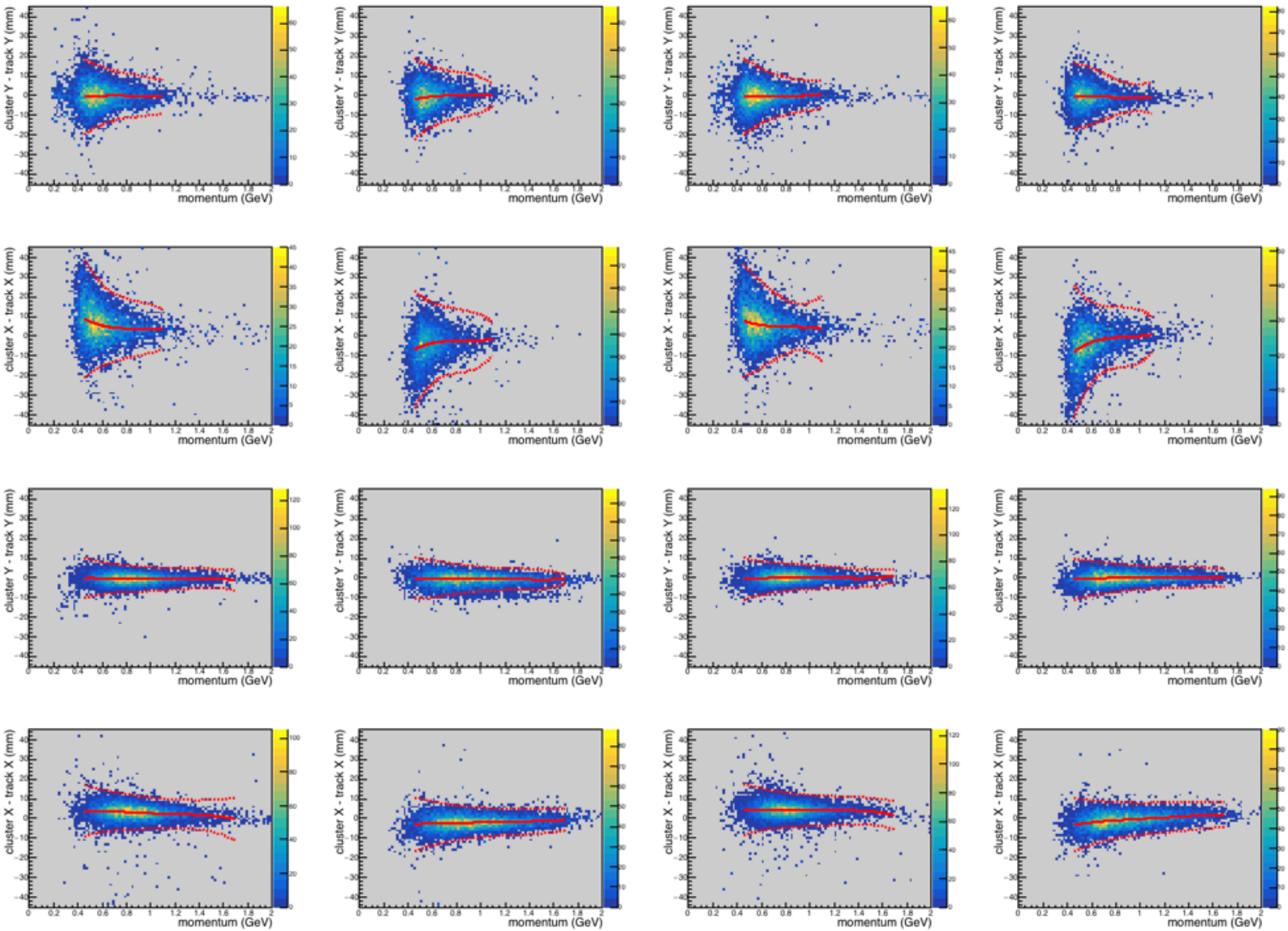
Procedure (continued)

- Plot momentum vs each residual for each category.
- fit slices to gaussians.
- fit sigmas and means of gaussians to polynomials (ignoring poor gaussian fits).

Fits 2015



Fits 2016



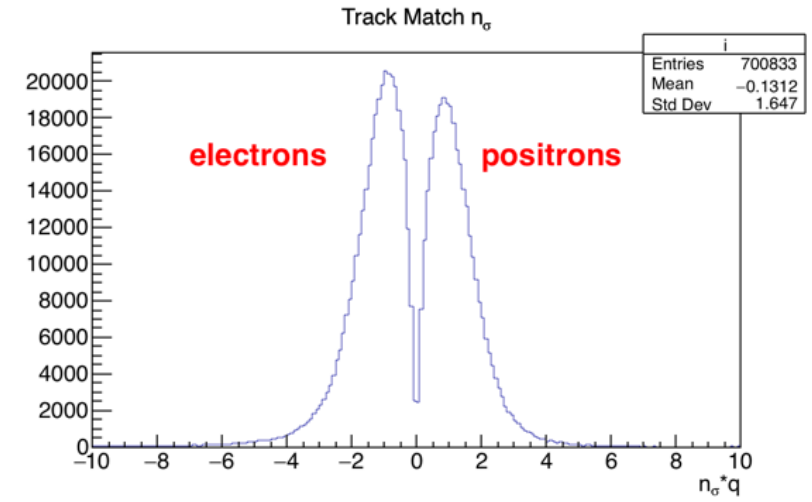
Testing the parameters

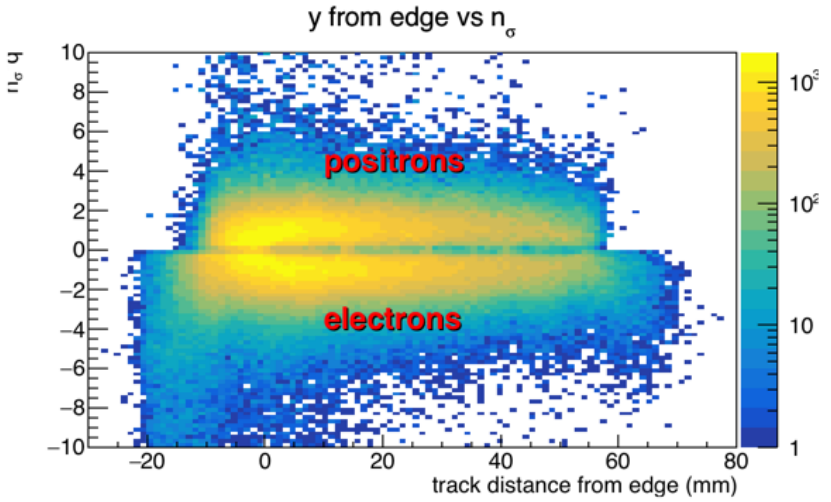
Plot n_σ for tracks in events that pass the following cuts

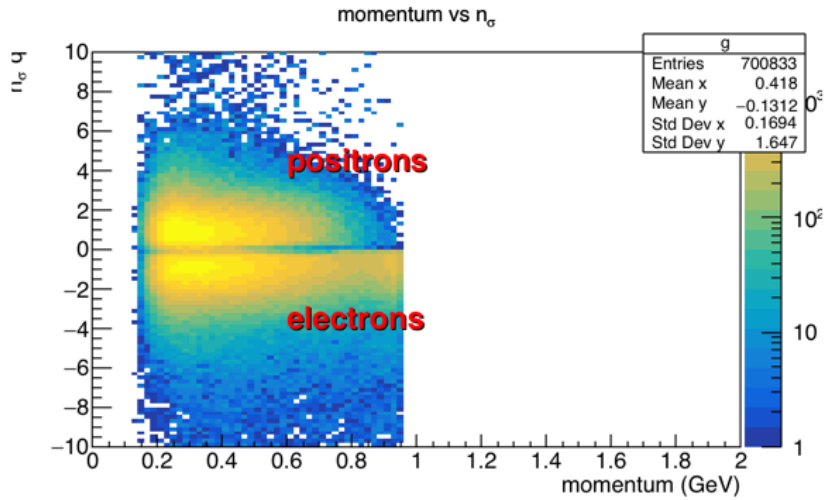
- tri ntuple kinematic cuts ($p_{ele} < .9E_{beam}$, $p_{tot} < 1.3E_{beam}$)
- —cluster - track time - 55 ns— < 4 ns
- track $\chi^2/dof < 7$
- if tracks share > 3 hits, use track with best χ^2
- $E_{cl}/p_{trk} < 1.3$.

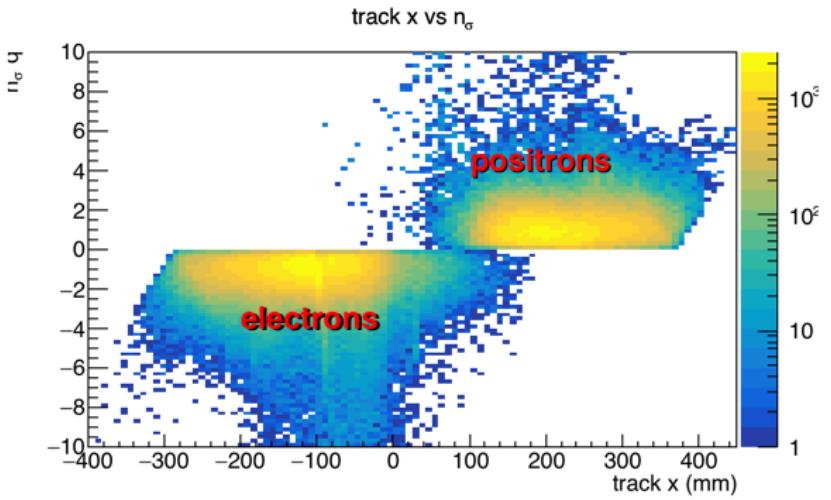
Results 2015

.png









Results 2015: tracks with L6 hits

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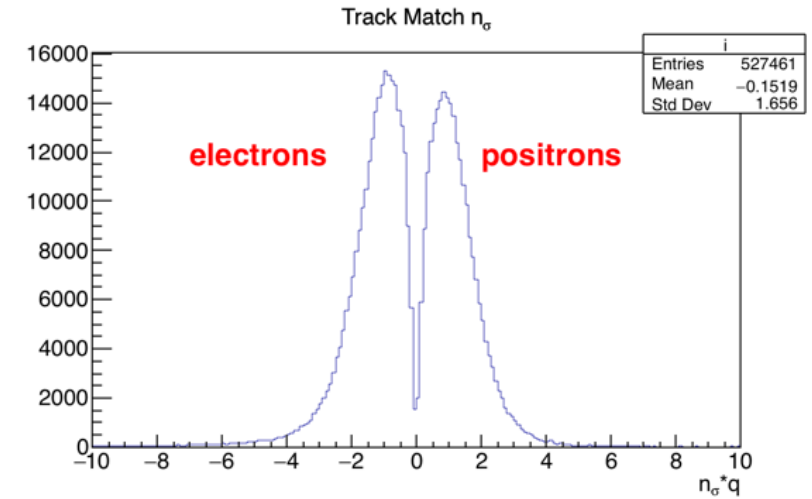

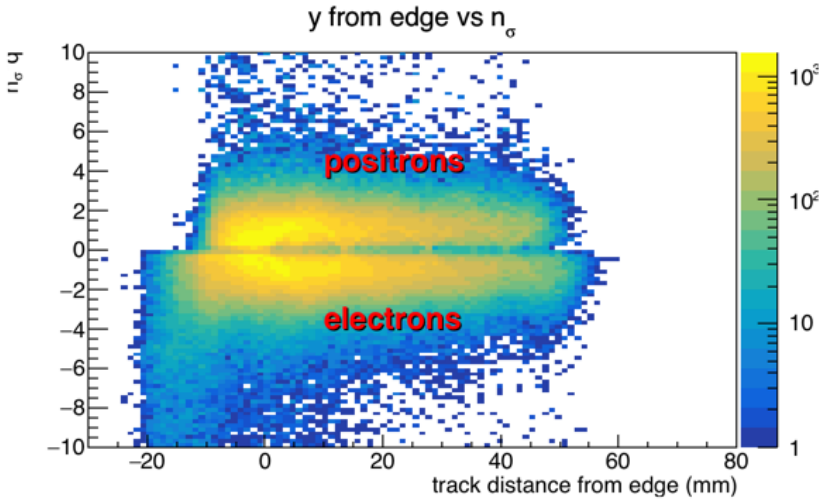

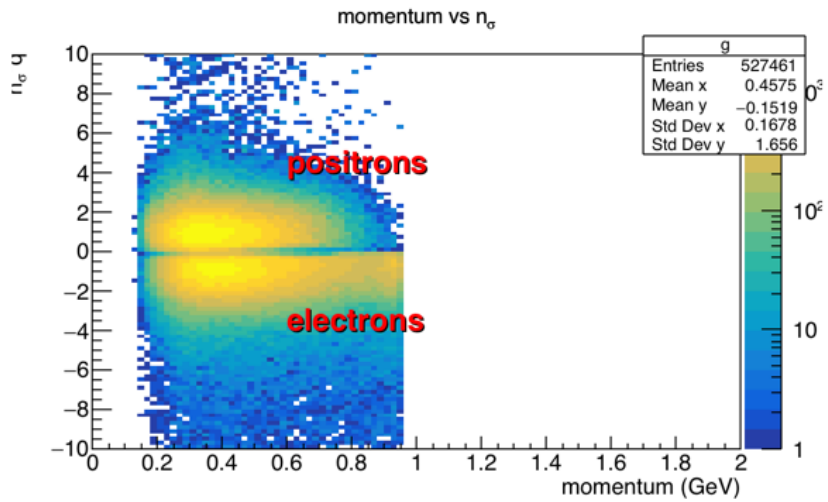

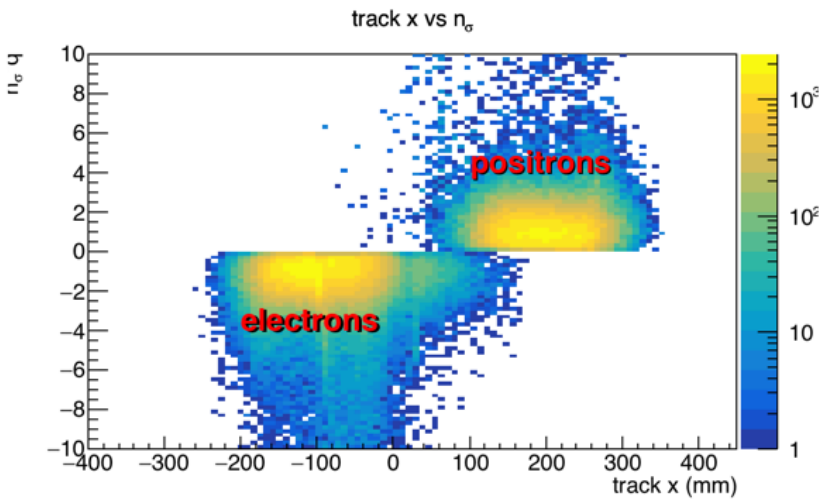

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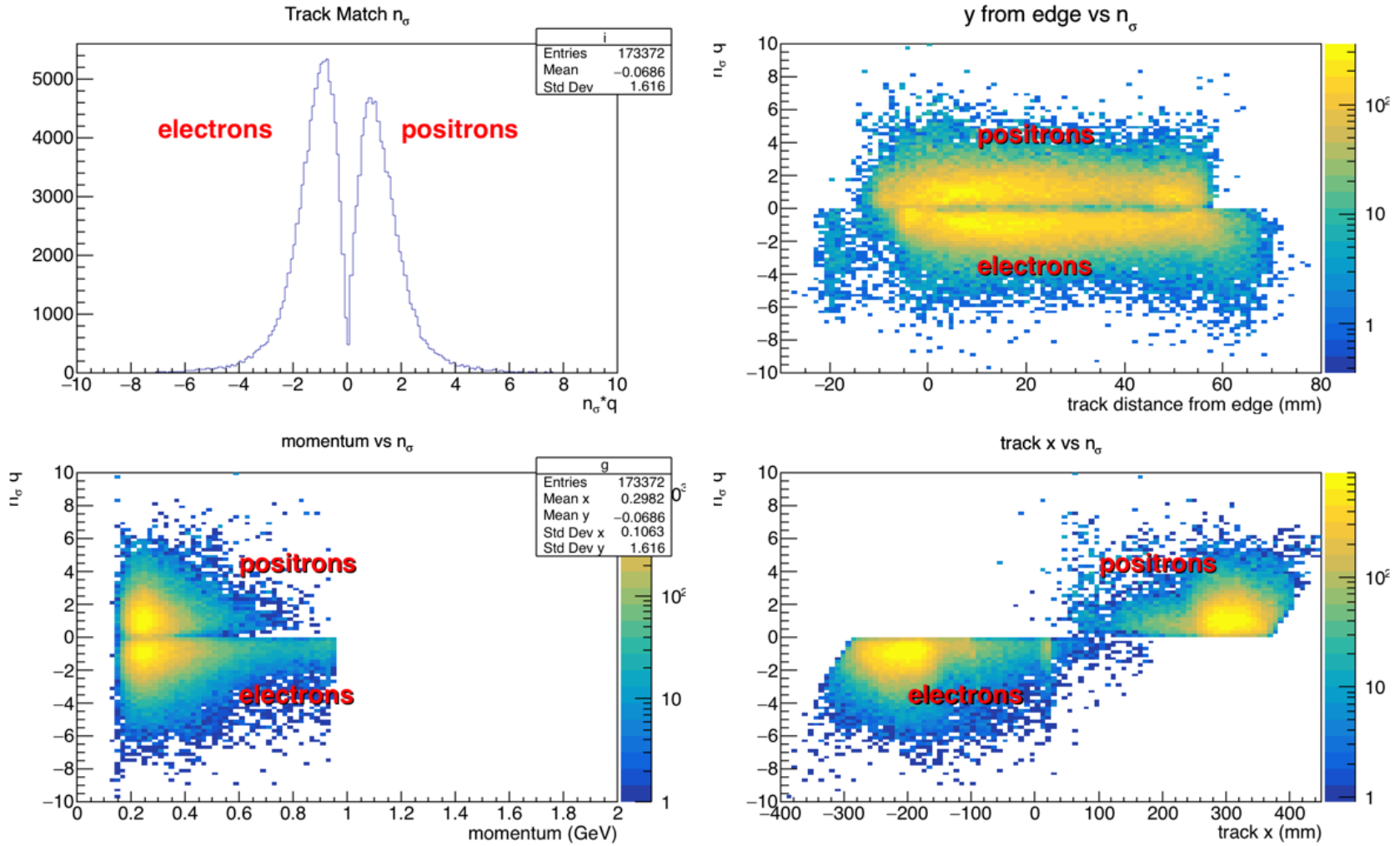

Results 2016

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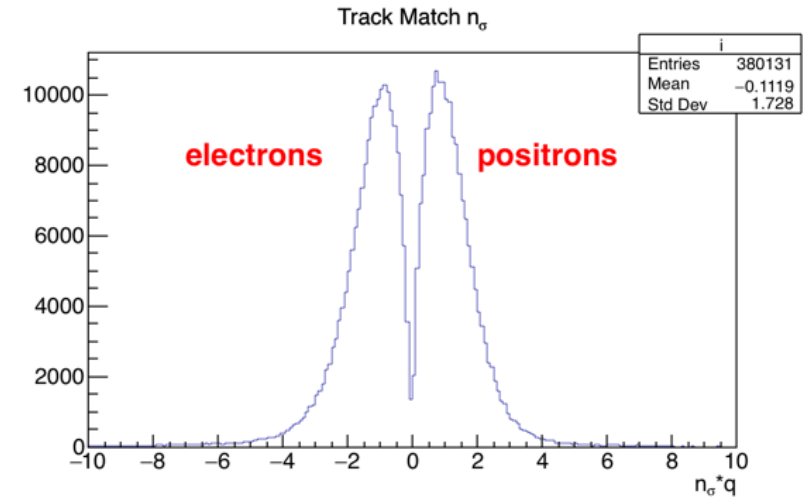

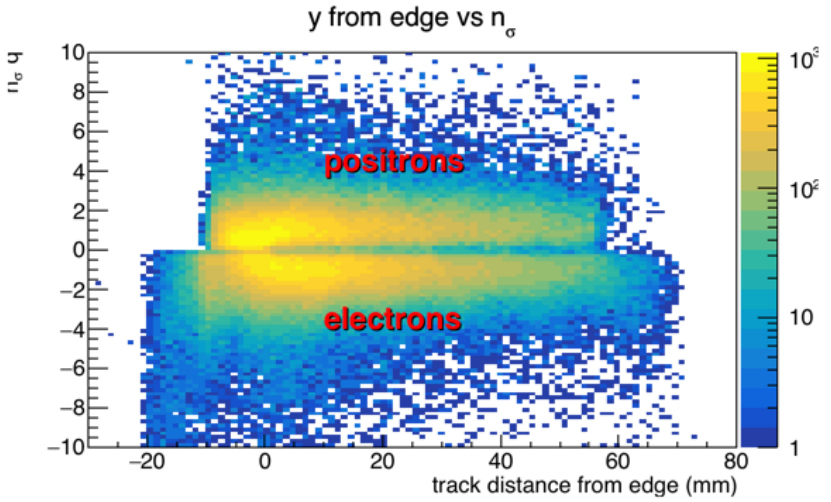

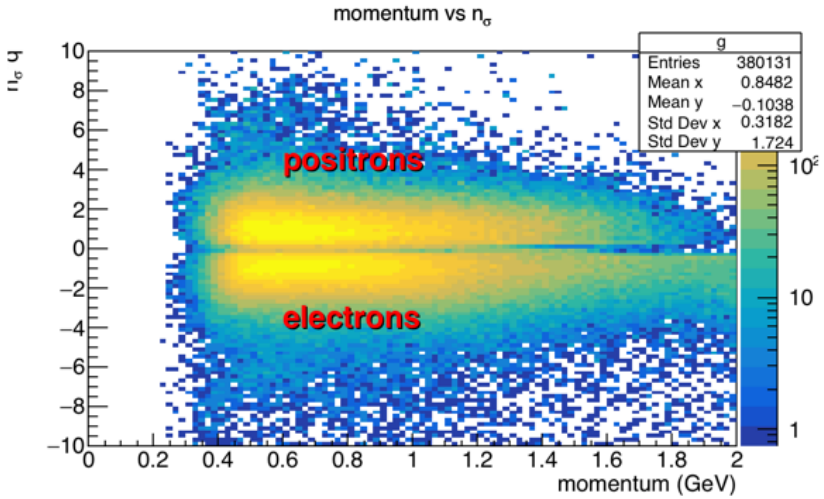

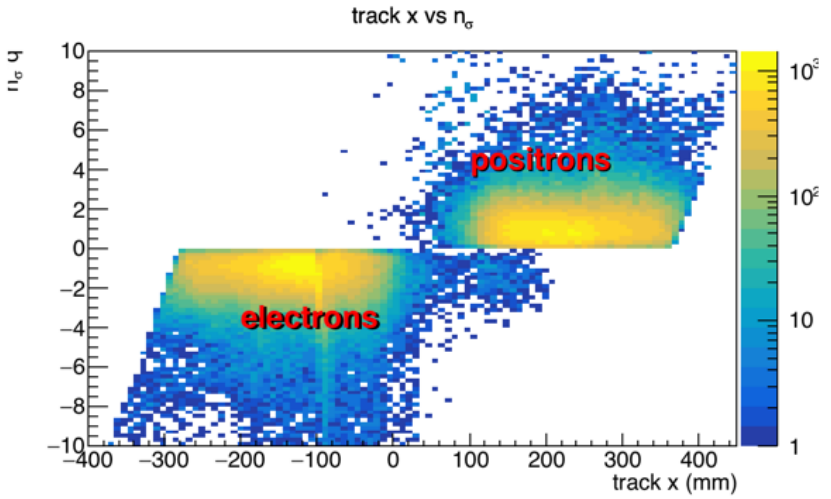

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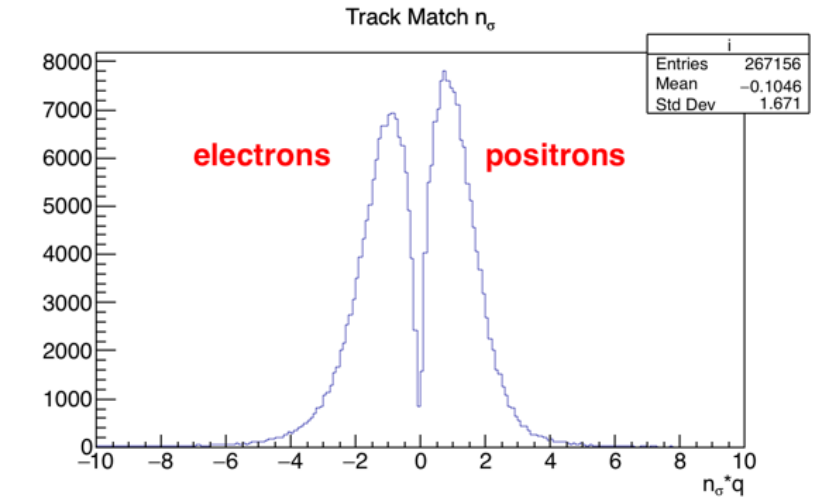

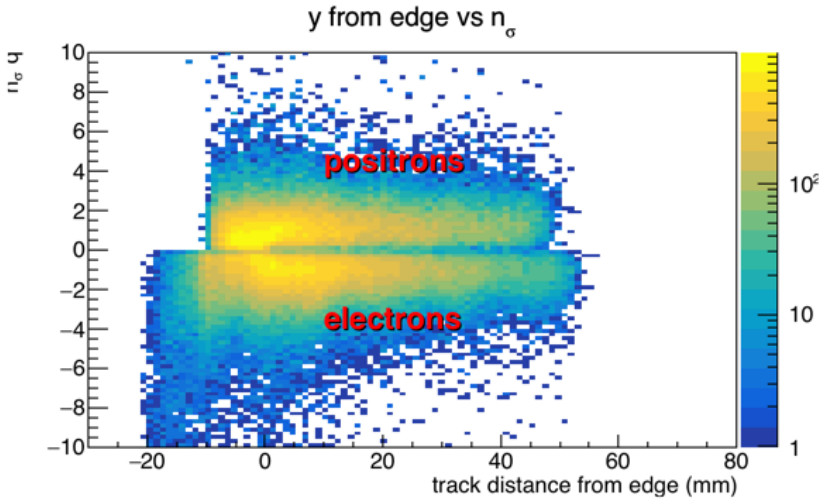

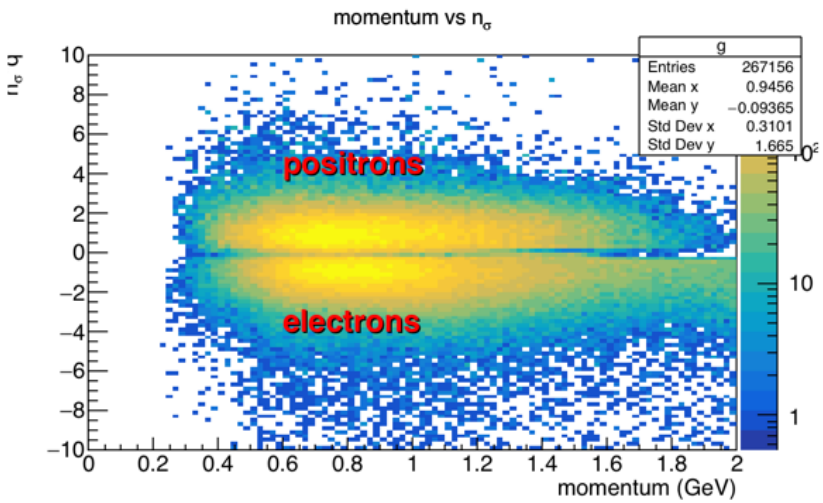

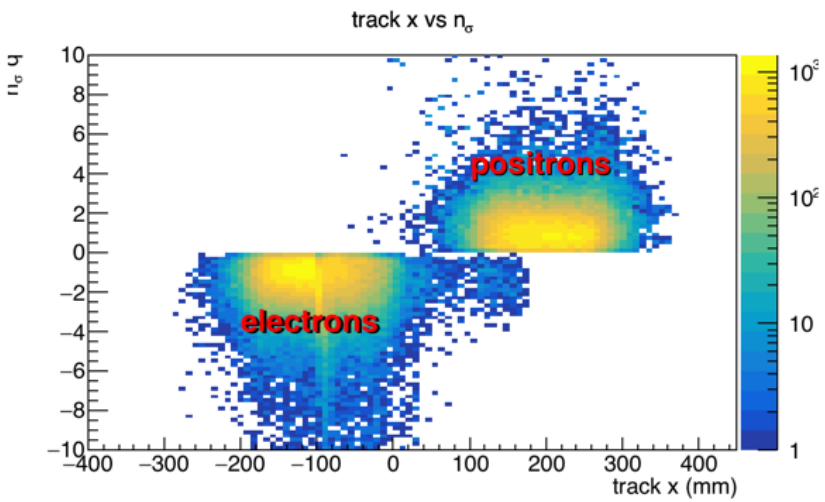

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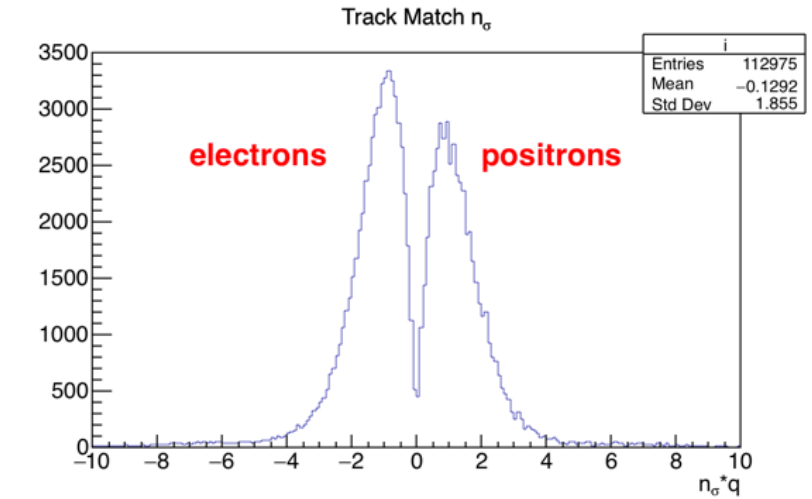

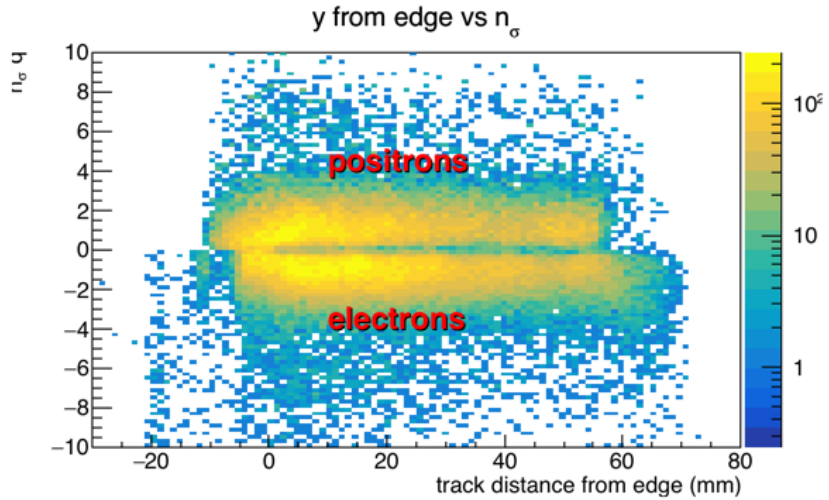

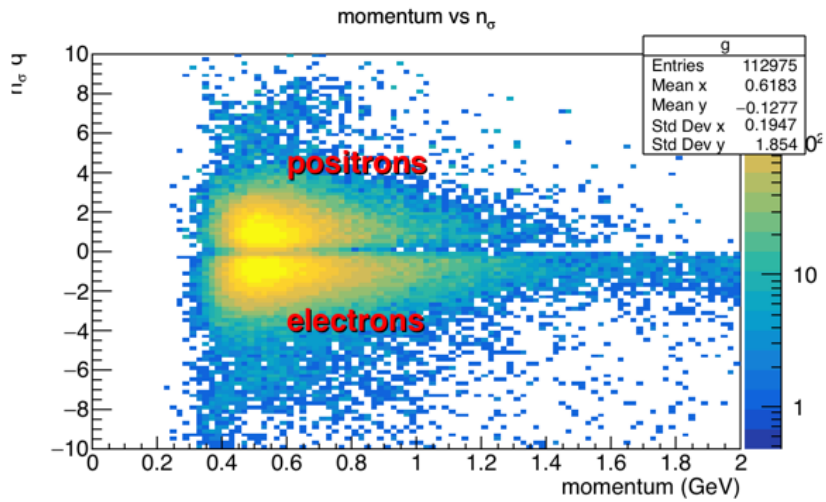

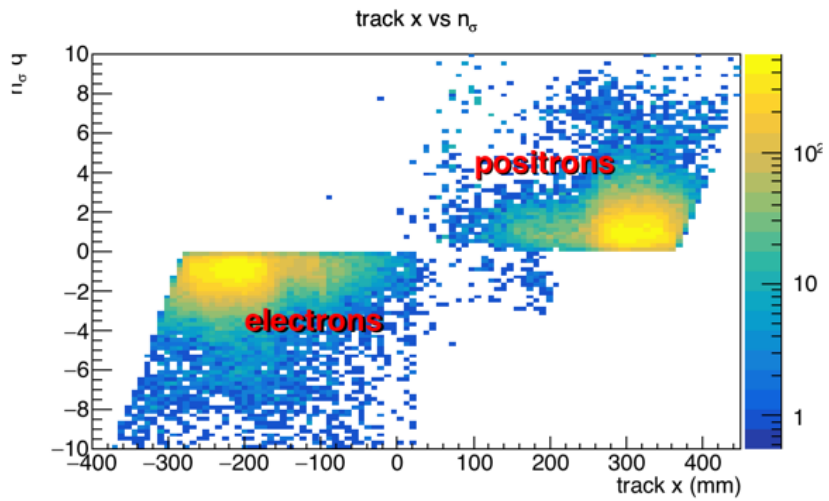

Integration Tests

Miriam ran the integration tests with new track states:

- Integration tests, **new TrackStates@Ecal** with **old parameterization**:
  - EngRun2015V0ReconTest.testIt:59-¿comparePlots:98 expected:¡2040¿ but was:¡2042¿
  - PhysRun2016FeeReconTest.testIt:60-¿comparePlots:87 expected:¡295¿ but was:¡293¿
  - PhysRun2016MollerReconTest.testIt:59-¿comparePlots:86 expected:¡3609¿ but was:¡3607¿
  - PhysRun2016V0ReconTest.testIt:59-¿comparePlots:86 expected:¡4974¿ but was:¡4978¿
- **New TrackStates@Ecal** with **new parameterization**:
  - EngRun2015FeeReconTest.testIt:60-¿comparePlots:100 expected:¡0.61¿ but was:¡0.68¿
  - EngRun2015MollerReconTest.testIt:59-¿comparePlots:98 expected:¡928¿ but was:¡930¿
  - EngRun2015V0ReconTest.testIt:59-¿comparePlots:98 expected:¡2040¿ but was:¡2039¿
  - PhysRun2016FeeReconTest.testIt:60-¿comparePlots:87 expected:¡295¿ but was:¡293¿

Comments on the Integration Tests

- EngRun2015FeeReconTest: Only 3 tracks in the histogram: 5 hit bottom tracks. The tracks that were mismatched to a cluster had very low momentum (should not be matched to an FEE cluster)
- PhysRunMollerReconTest: Test requires both tracks matches to clusters... opening angle is very small at 2.306 GeV. Most Moller pairs have only one electron hitting Ecal (due to Ecal hole).
- PhysRunV0ReconTest: About 33 events were different between new and old versions. Making a track χ^2 cut at 100 for both tracks, only one event is different. (the cut is currently $\chi^2/dof < 100$, is this a bug?)
- PhysRun2016FeeReconTest: Same thing happened with new track states with old parameterization
- EngRun2015V0ReconTest: Haven't looked at this yet.
- EngRun2015MollerReconTest: Haven't looked at this yet.
- Miscellaneous: Why do we have a $(p, E) < 1.5E_{beam}$ cut to remove FEEs in V0s and Mollers?