

Acts in sPHENIX

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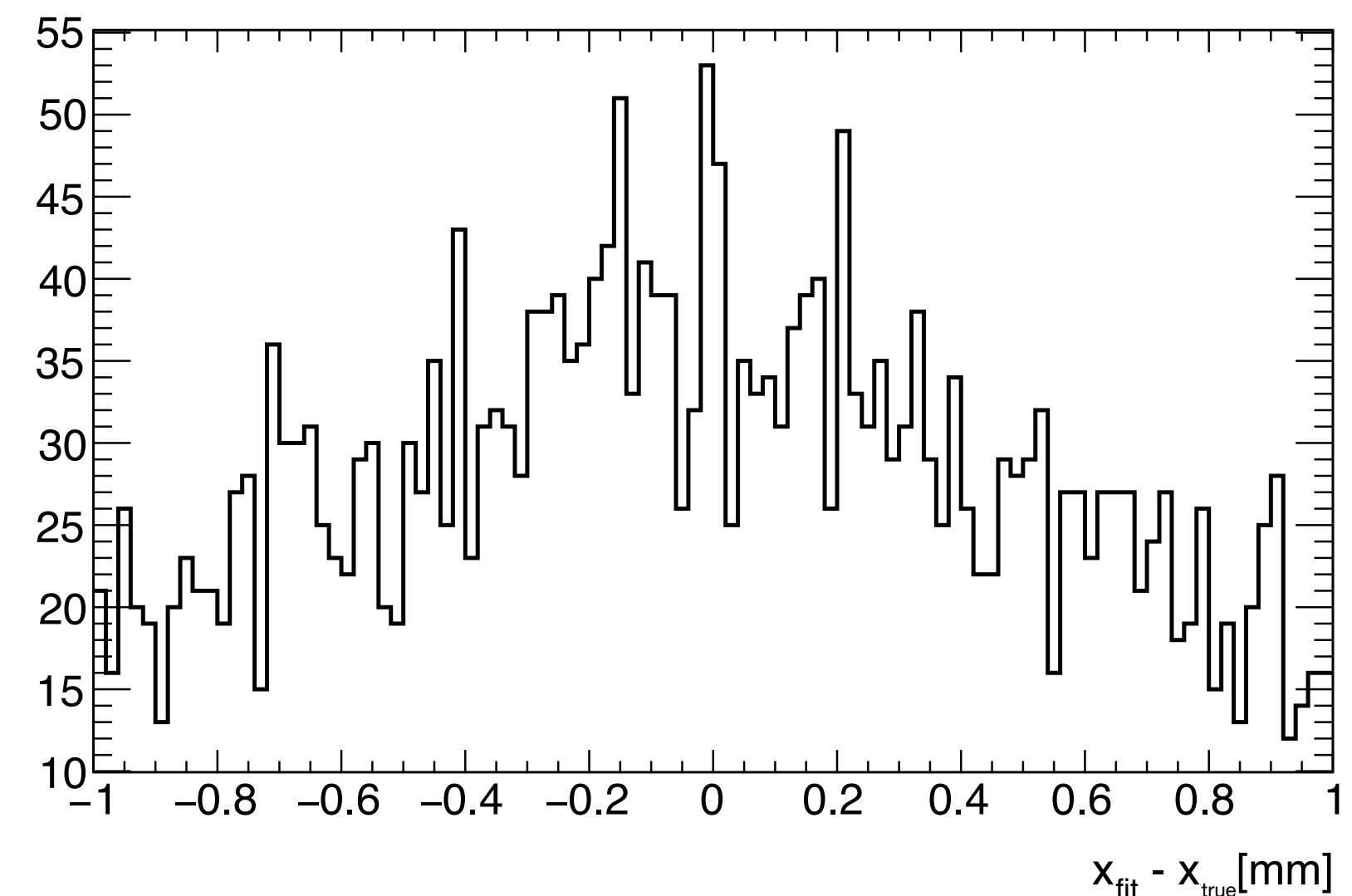
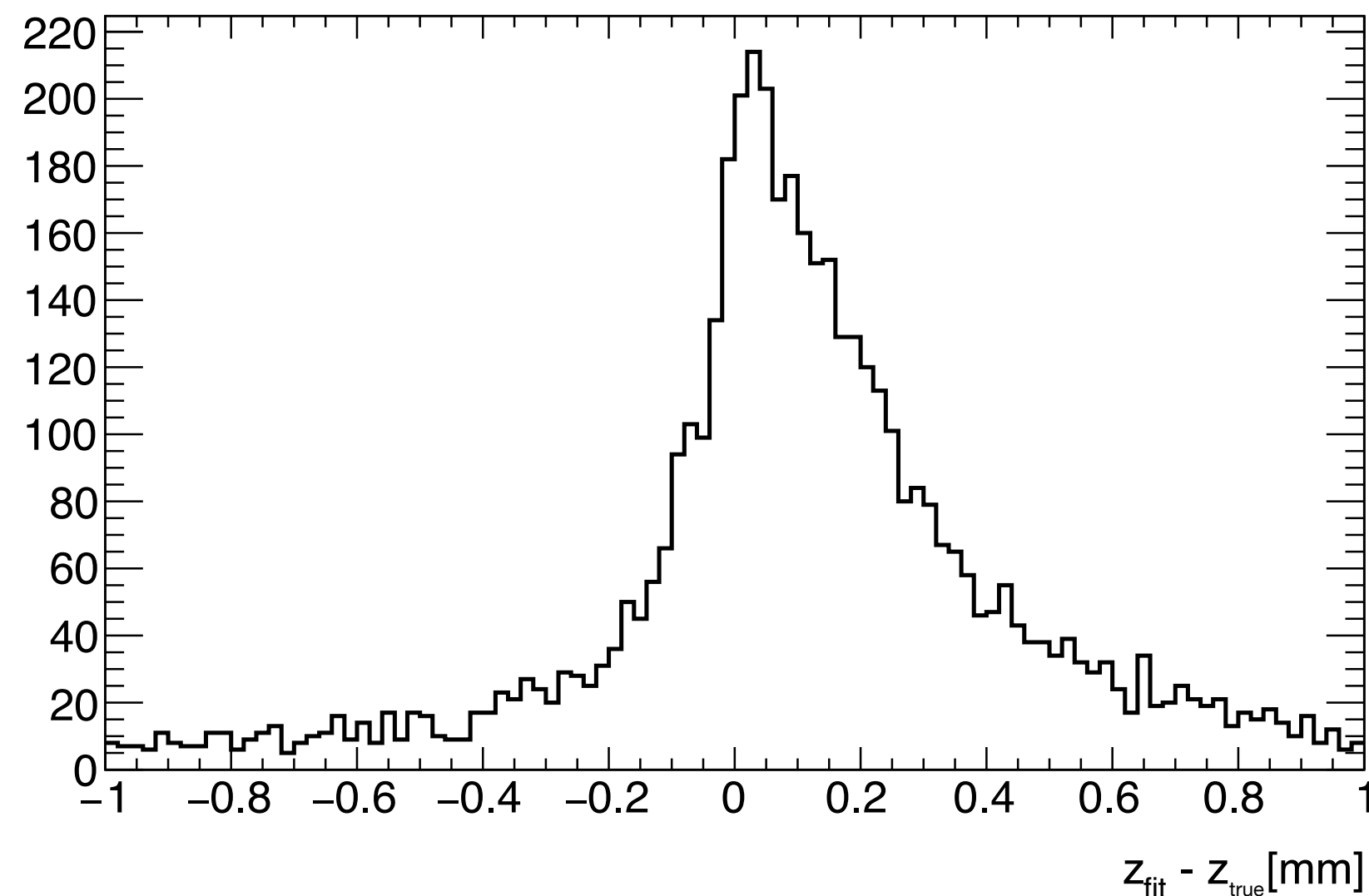
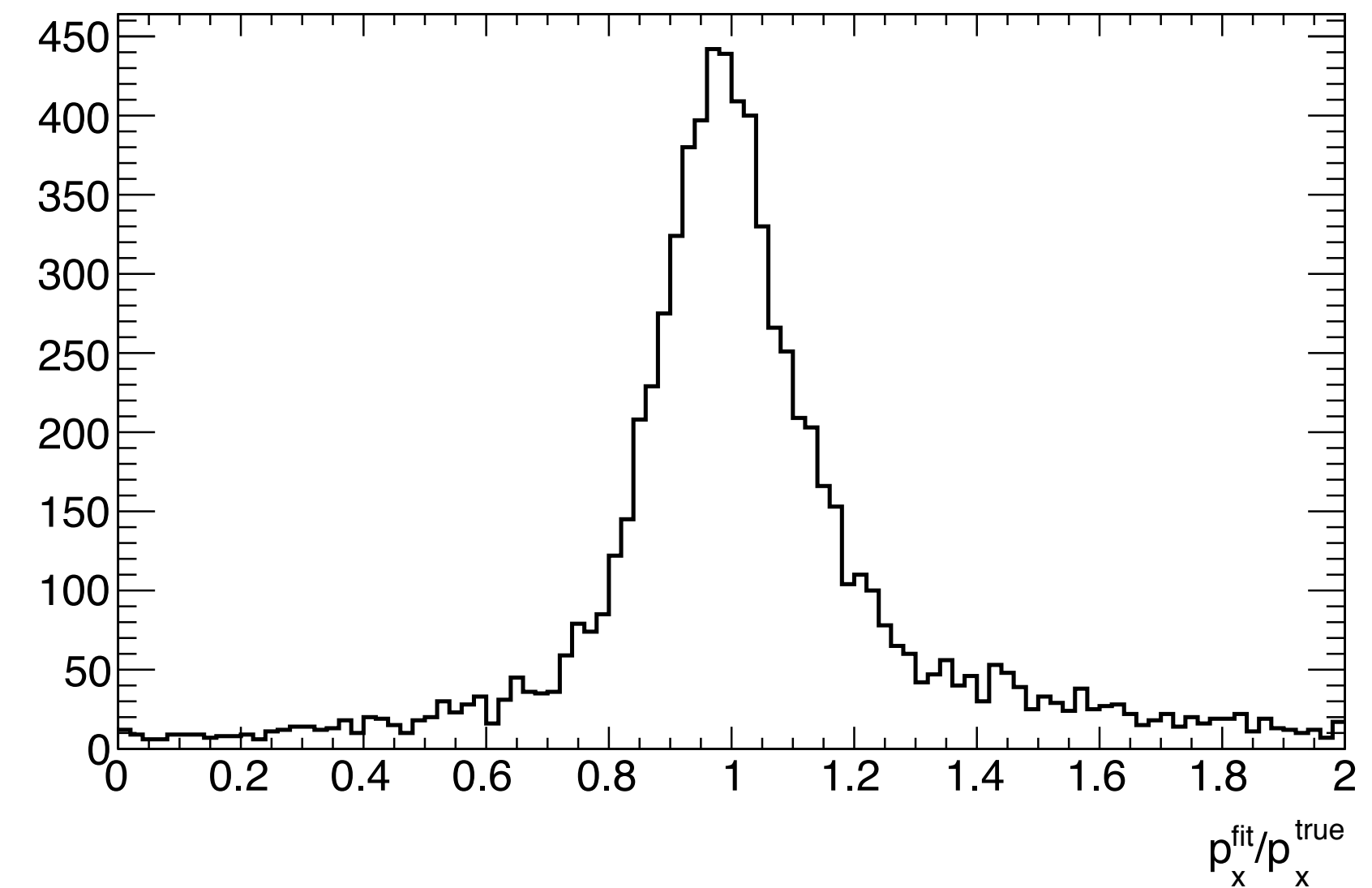
June 16, 2020

Track Fitting

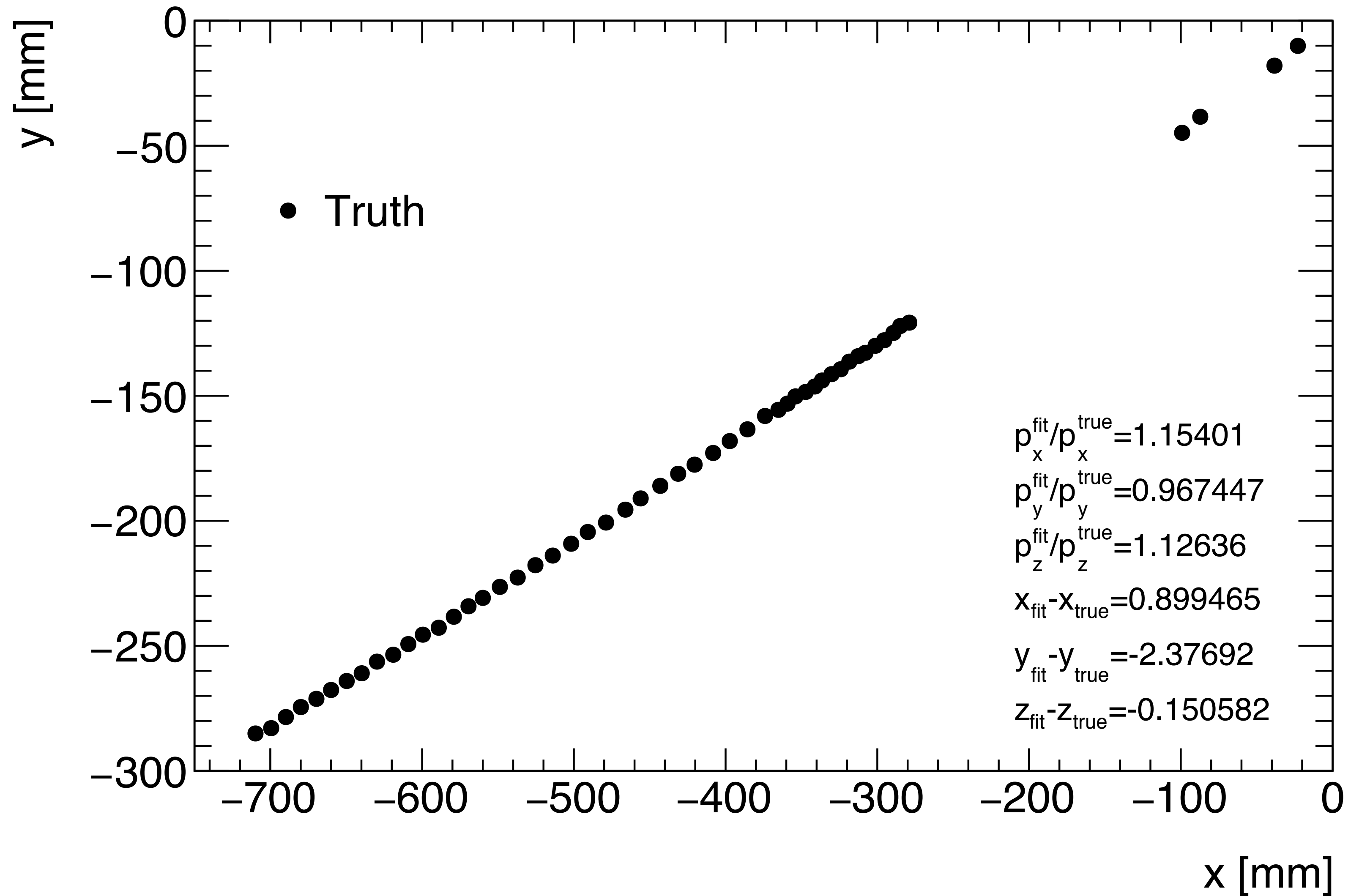
- Have track fitting running, trying to debug why track fits are poor
- At the moment, track parameters given to Acts are significantly better track fits that are returned from Acts
- We believe that coordinate transformations from global -> local are correct, since some track fits are okay

Track Fitting Performance

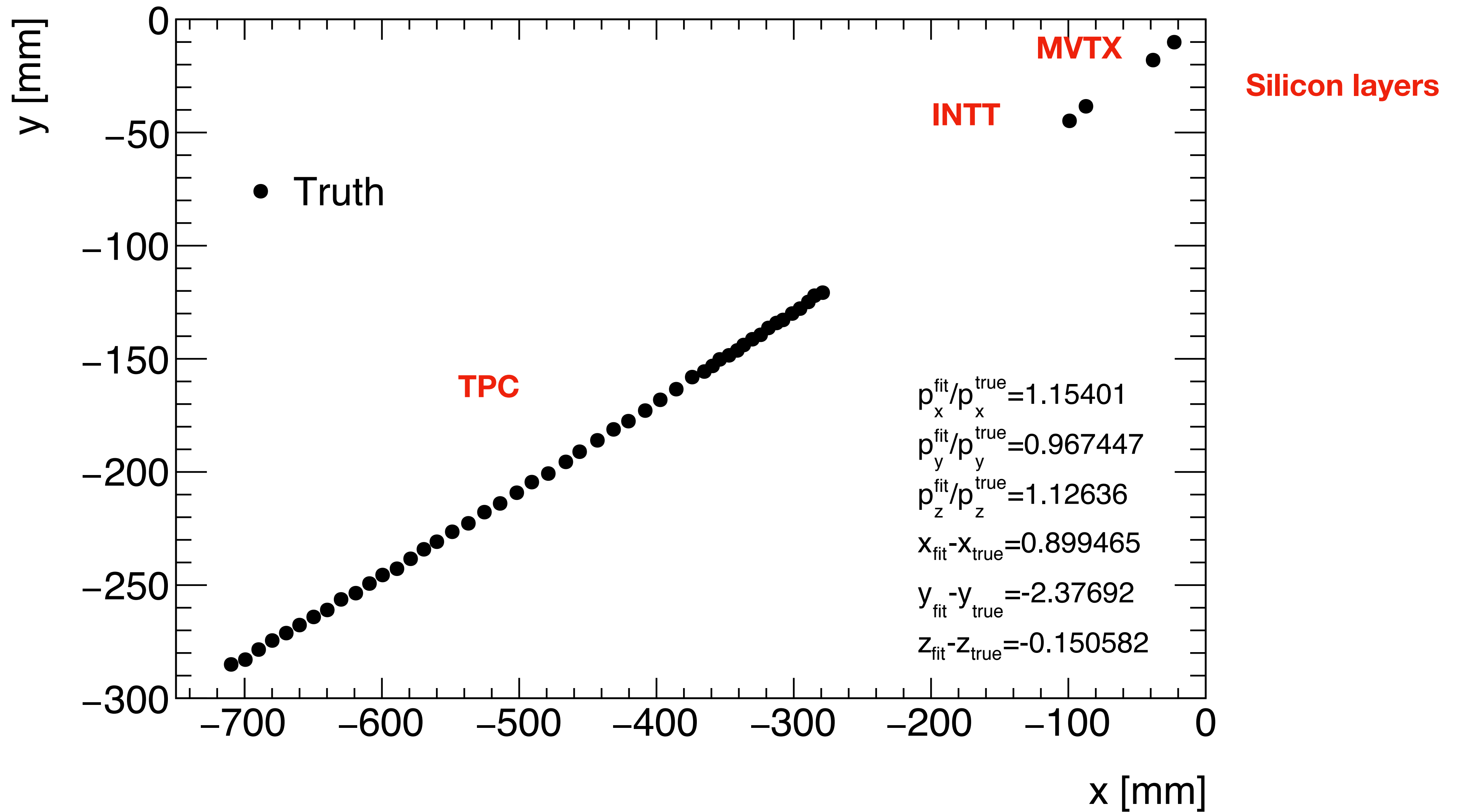
- Pretty bad, so we are clearly doing something wrong still
- PCA (x,y,z) fit residuals are really bad
- However it is unclear if it is something we are doing or something that the fitter isn't "understanding"



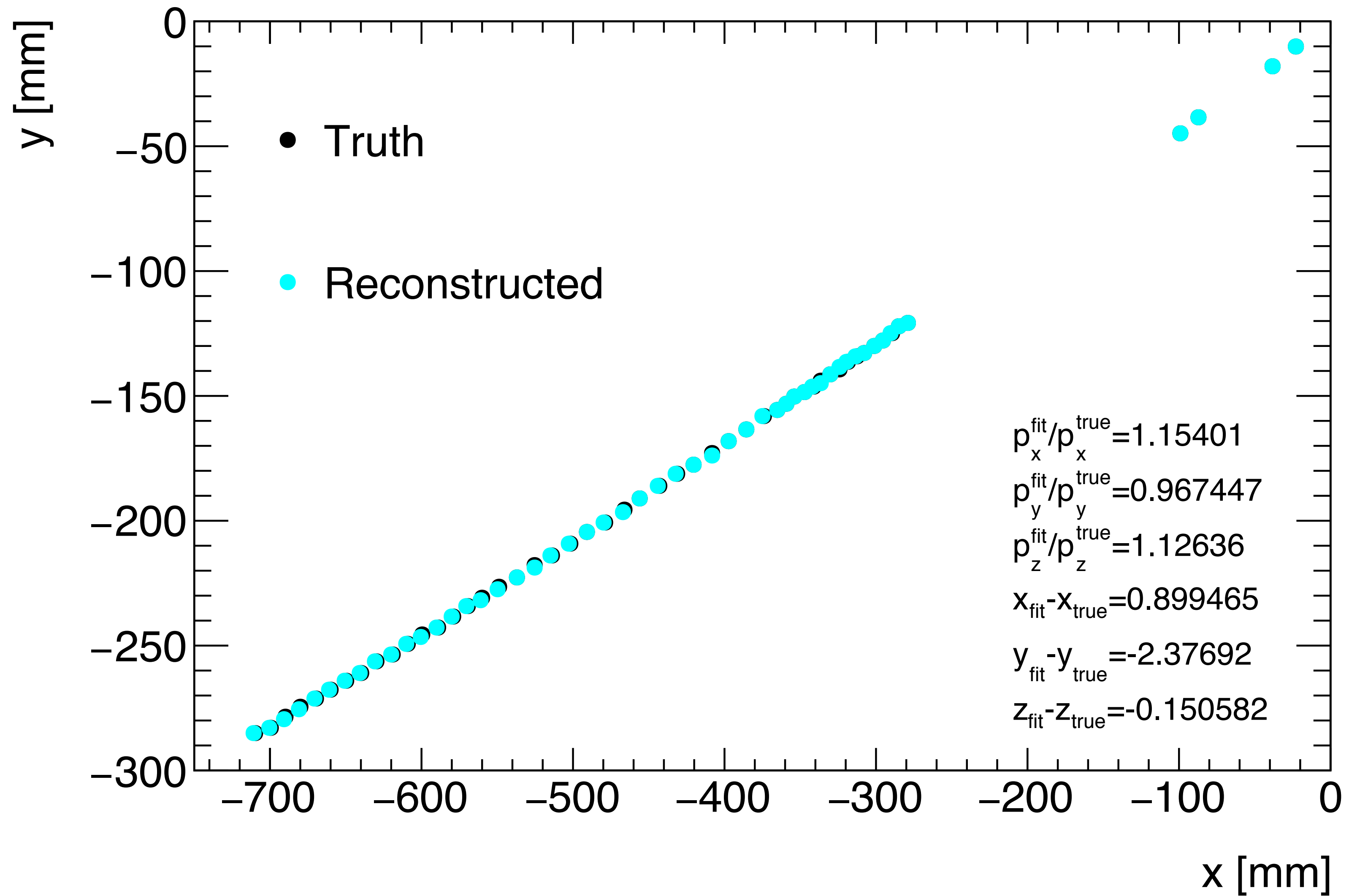
Hits of a Typical Track



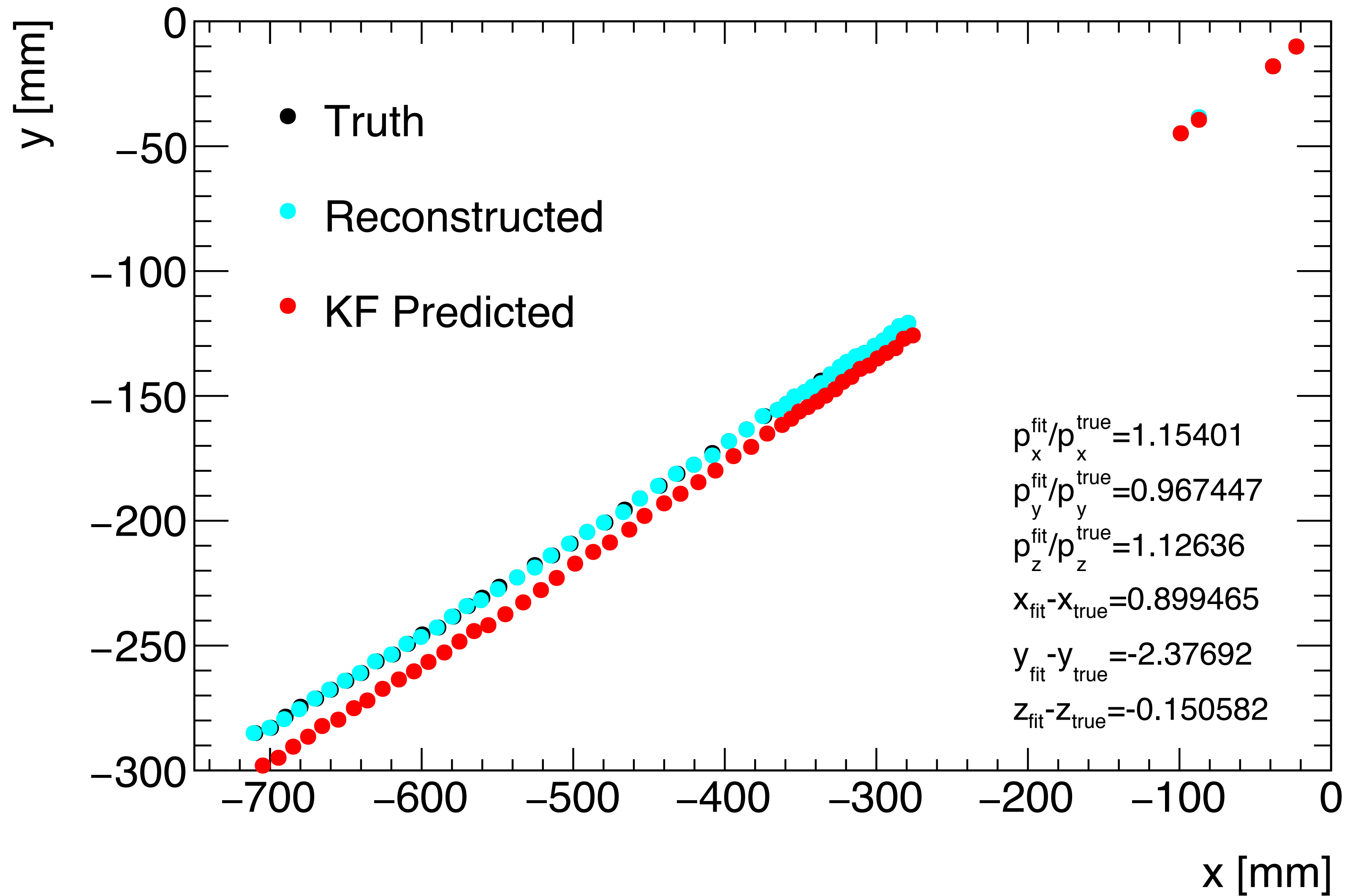
Hits of a Typical Track



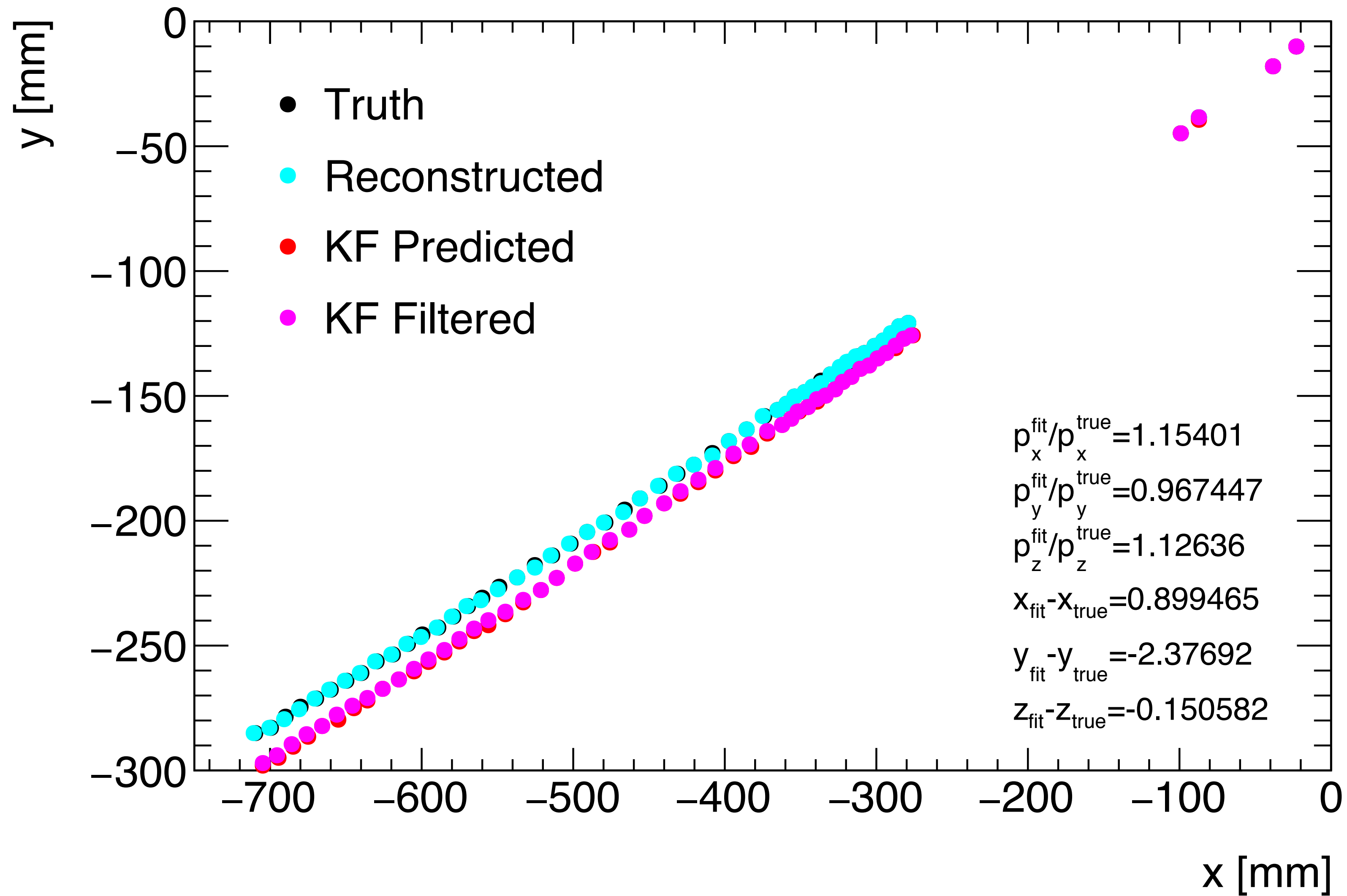
Hits of a Typical Track



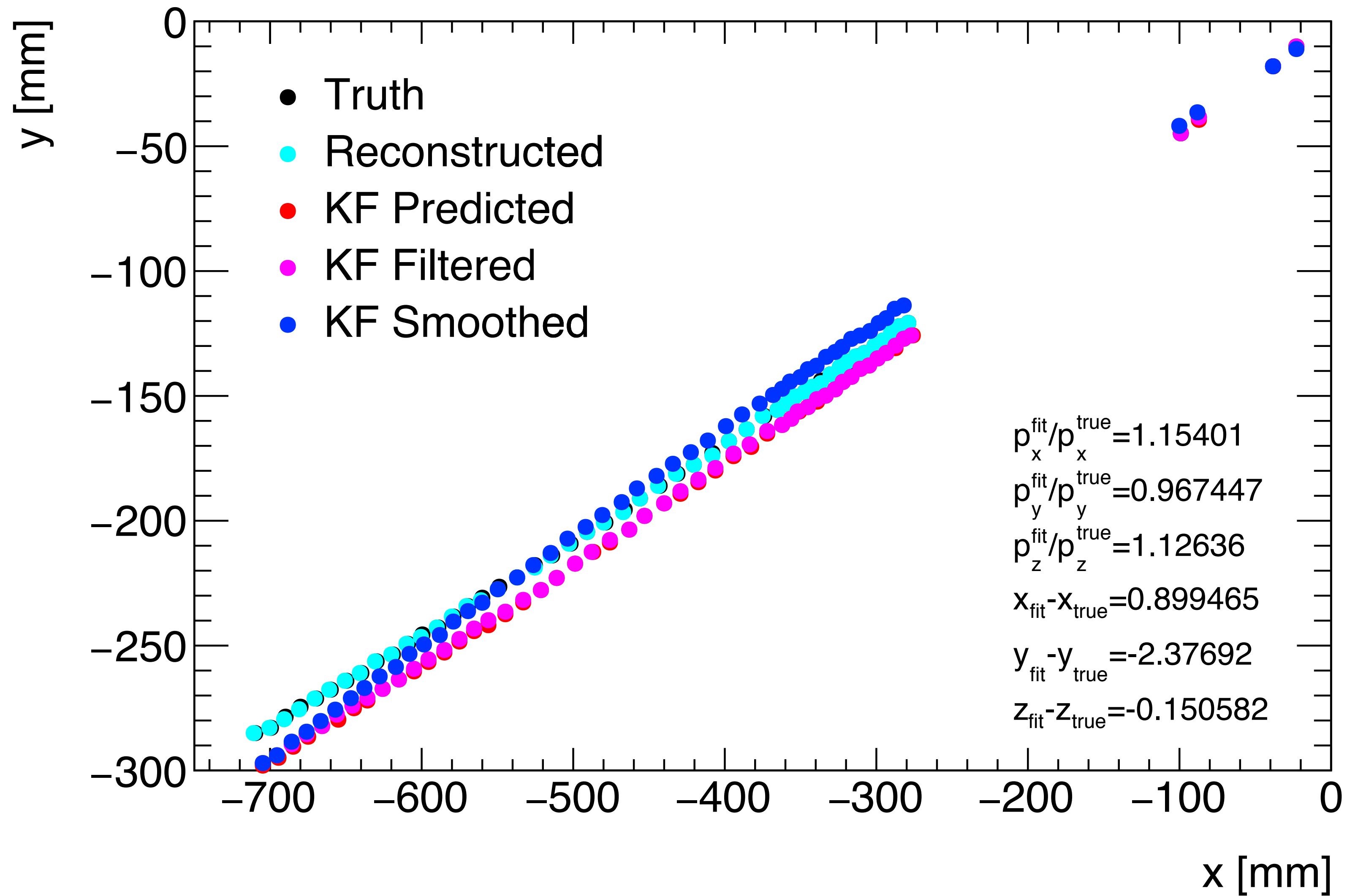
Hits of a Typical Track



Hits of a Typical Track



Hits of a Typical Track



Comments

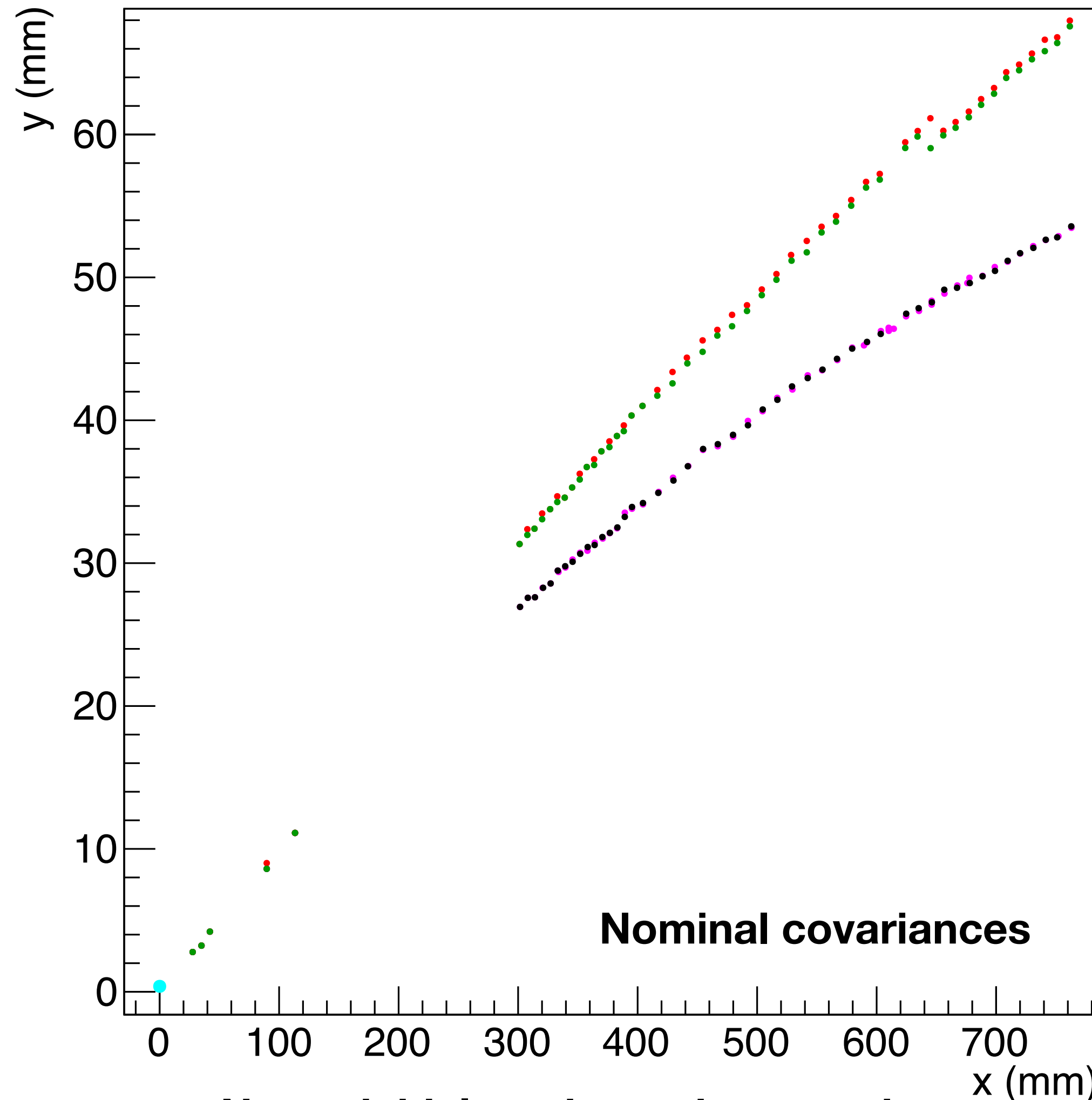
- We notice that the first hit in the TPC is always very poorly predicted with a small error
- The filtering makes a small correction to this position prediction due to the small predicted hit error
 - We think it is because the error on the local predicted position is smaller than the error on the local hit, so the gain is small and thus doesn't move the prediction drastically
- As the track moves outwards, the error on the predicted hit position remains smaller than the error on the local measurement - so the gain correction remains small and never converges on the measurement
 - i.e. the KF "thinks" the prediction is more right than the actual measurements
- This is for high p_T tracks (4-10 GeV). Low p_T tracks (e.g. 1 GeV) are never reconstructed because the prediction diverges too far from the measurements and the fitter gives up

Testing Covariances

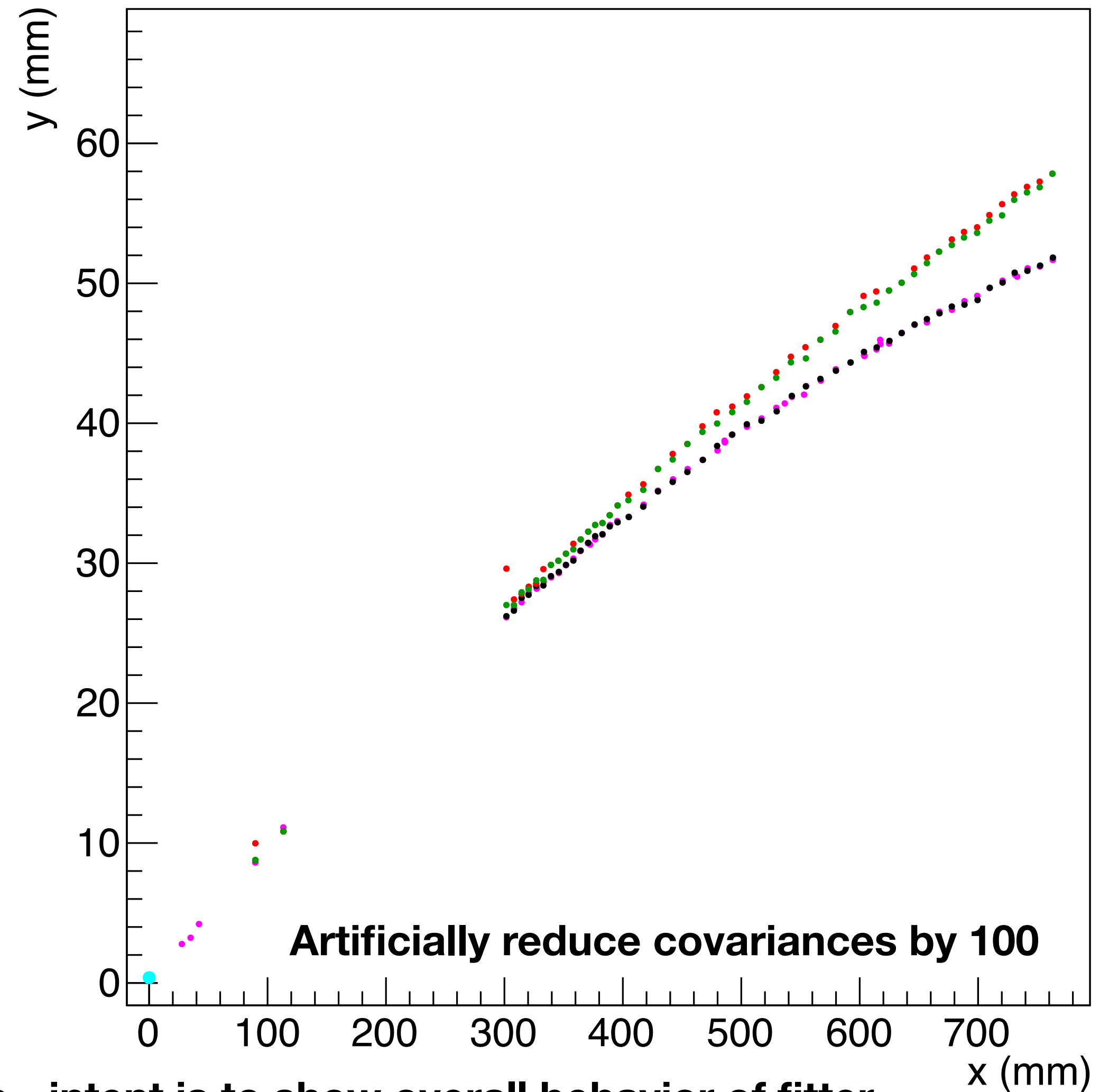
- Tony tried artificially reducing the TPC covariances by a factor of 100 to see if the KF would follow the measurements better
- Initially does better, but still get the same problem of predictions diverging from actual measurements
- See next page

Testing Covariances

y vs x (magenta=all-hits, black=acts-hits, red=prt, green=flt)



y vs x (magenta=all-hits, black=acts-hits, red=prt, green=flt)



Note - initial track not the same between two figures - intent is to show overall behavior of fitter

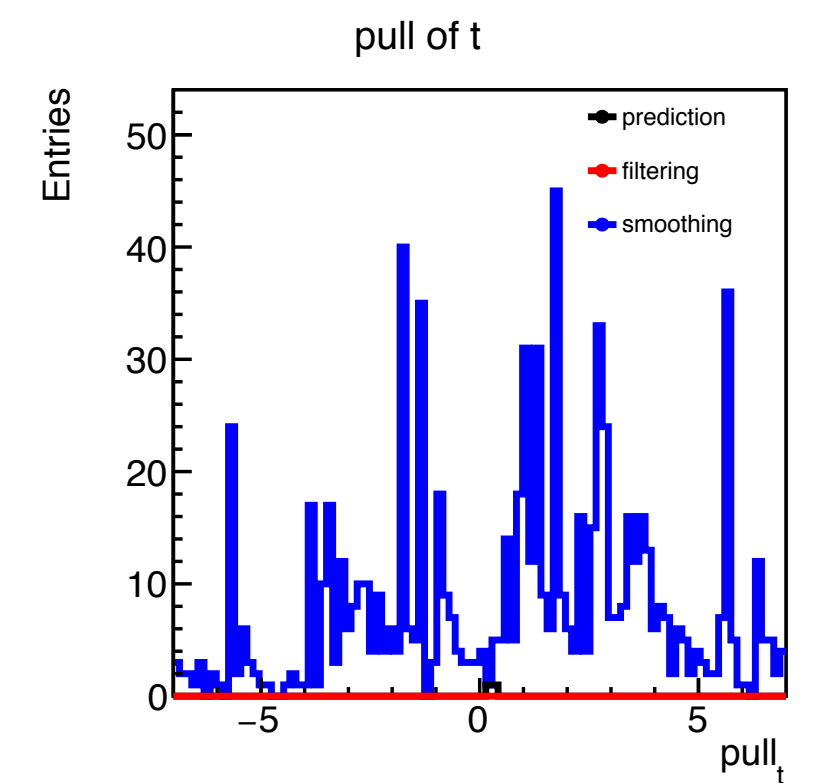
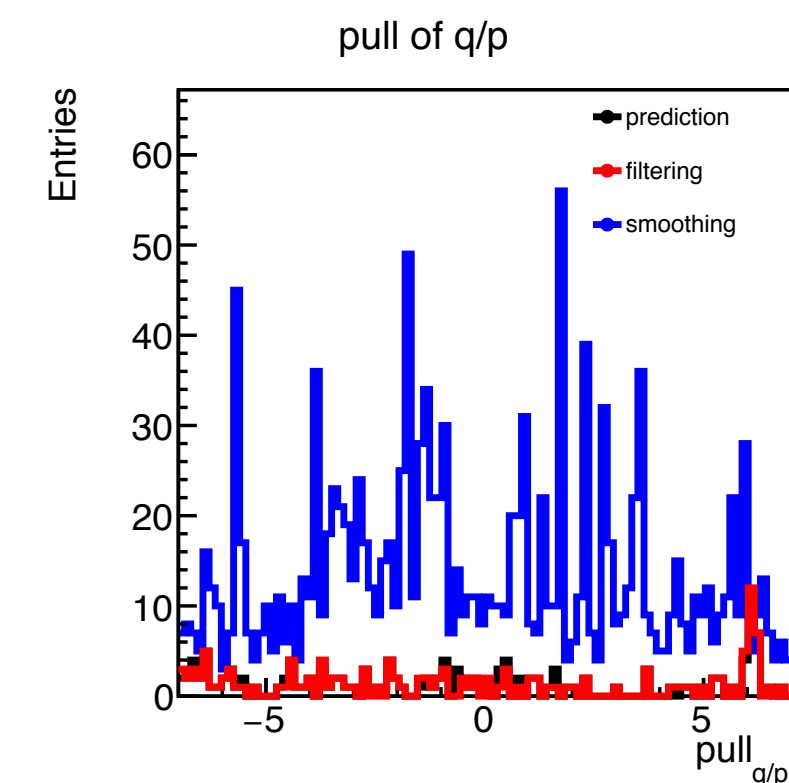
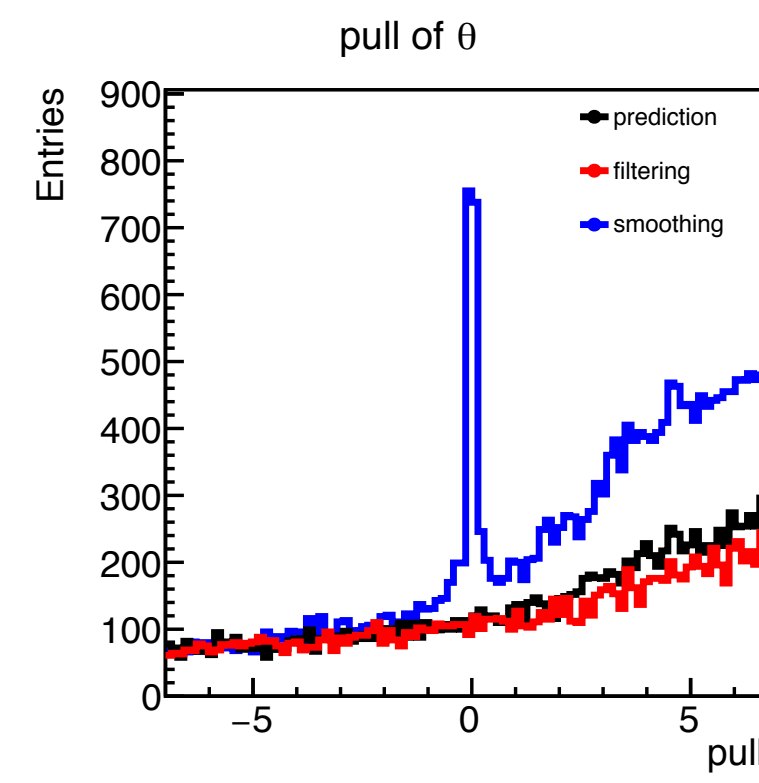
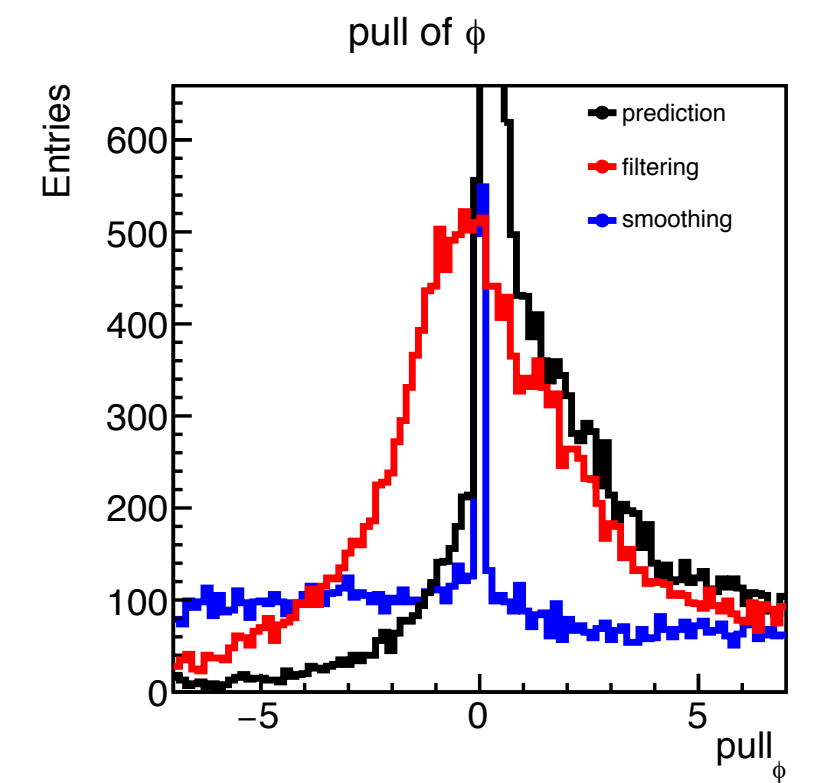
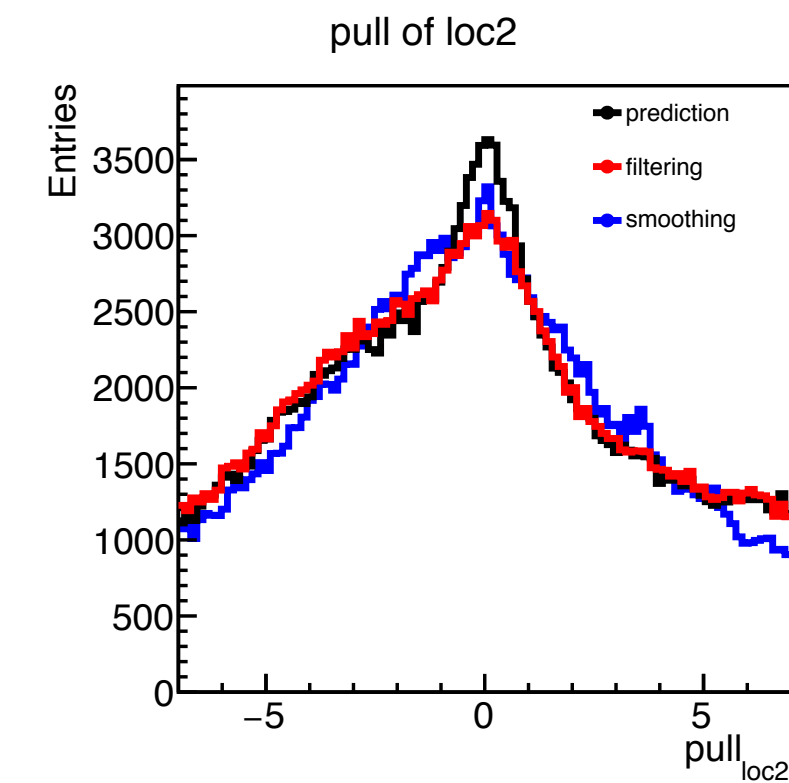
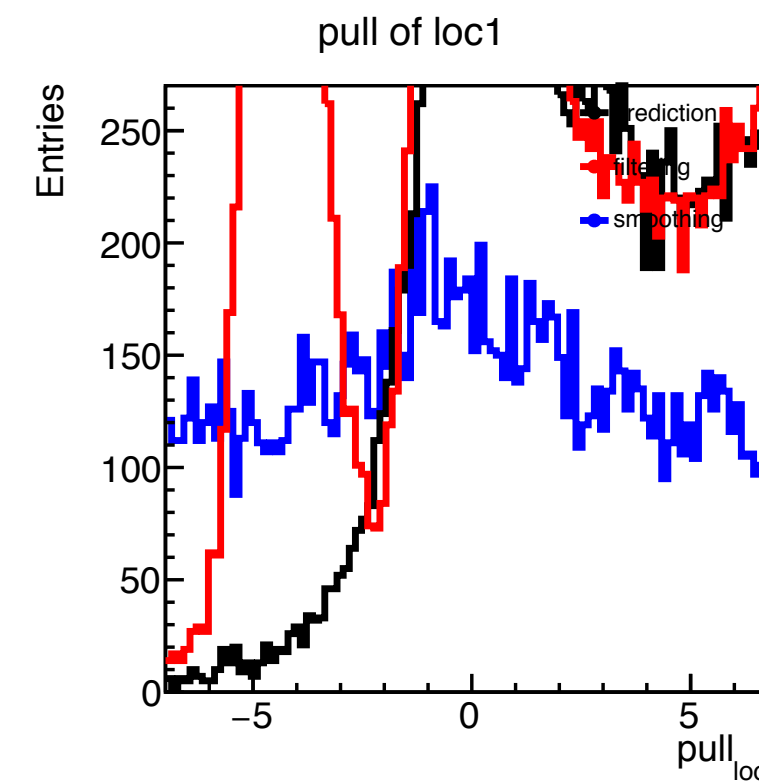
Final Thoughts

- We think we have implemented everything correctly to provide to the Acts fitter (e.g. source links, track parameters, corresponding rotated covariances) but still see issues with the track fitting
- Xiaocong implemented an option to rescale the predicted covariance when entering a new volume [here](#)
- Will test this out and see if it improves the situation upon entering the TPC
- The problem that we see seems to be a general problem of Kalman Filters, which Xiaocong pointed out was mentioned in a paper:
 - “In situations involving large state errors and very precise measurements, application of the standard extended Kalman Filter mechanization leads to conditions in which the state estimation error covariance decreases more rapidly than the actual state errors. Consequently, the extended Kalman filter begins to ignore new measurements even when the measurement residual is relatively large.”

Extras

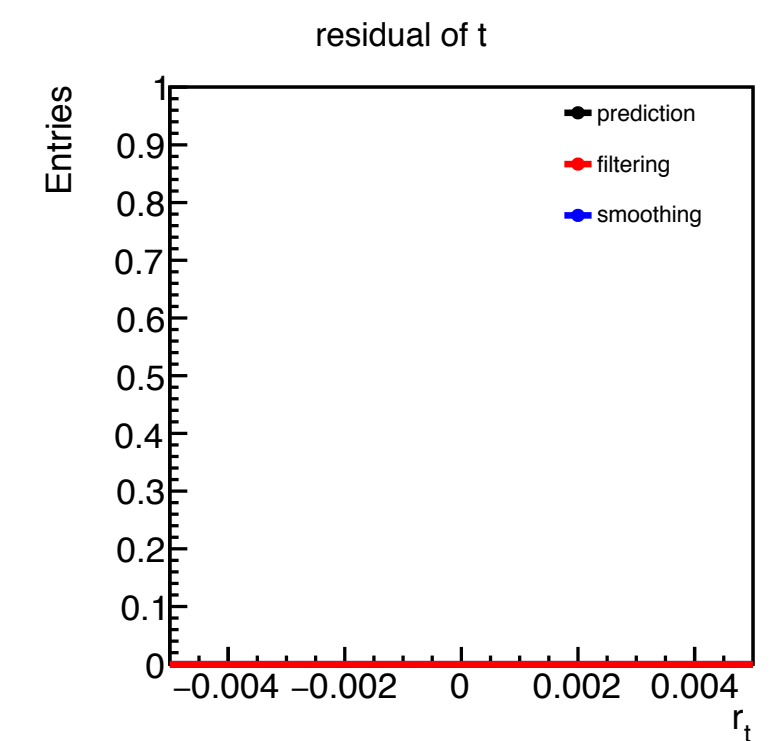
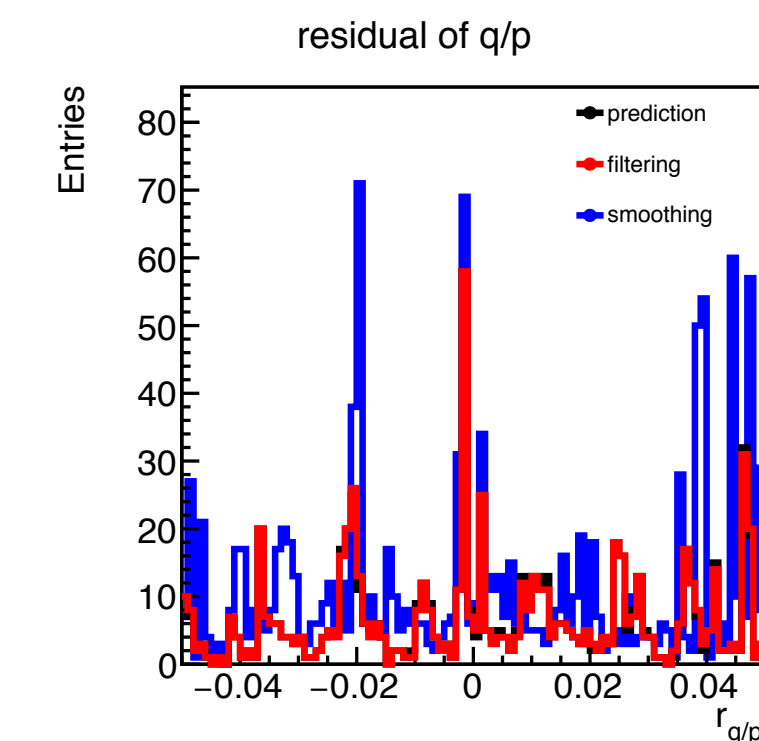
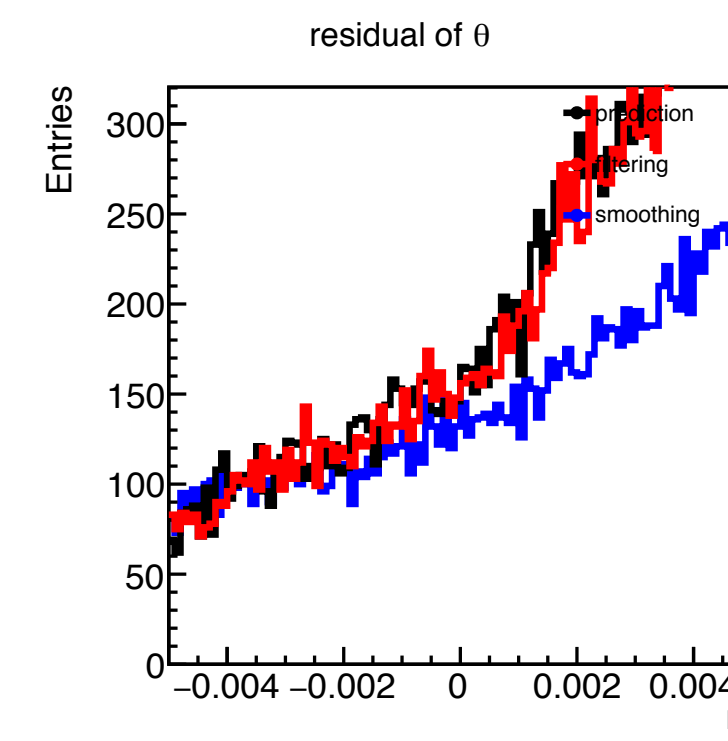
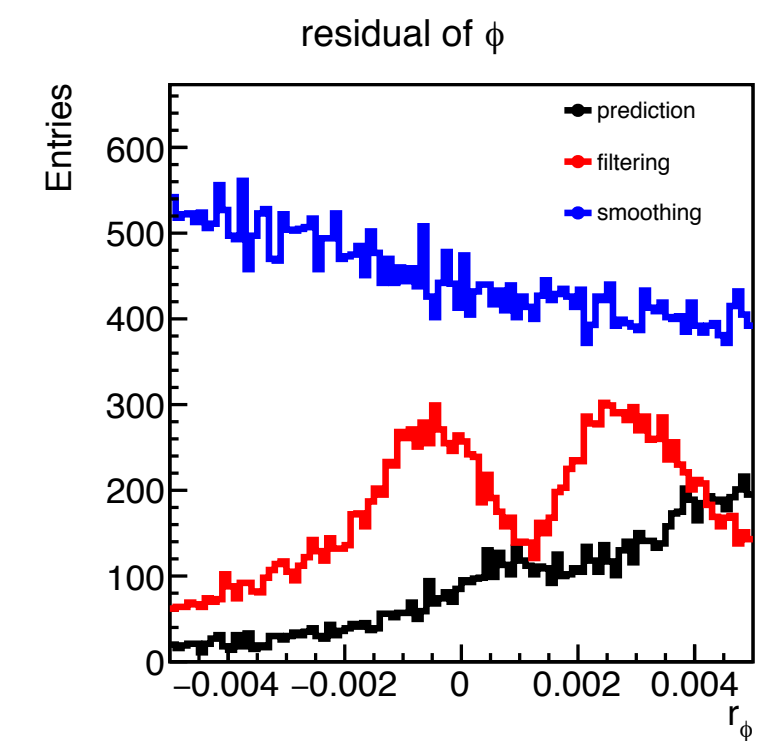
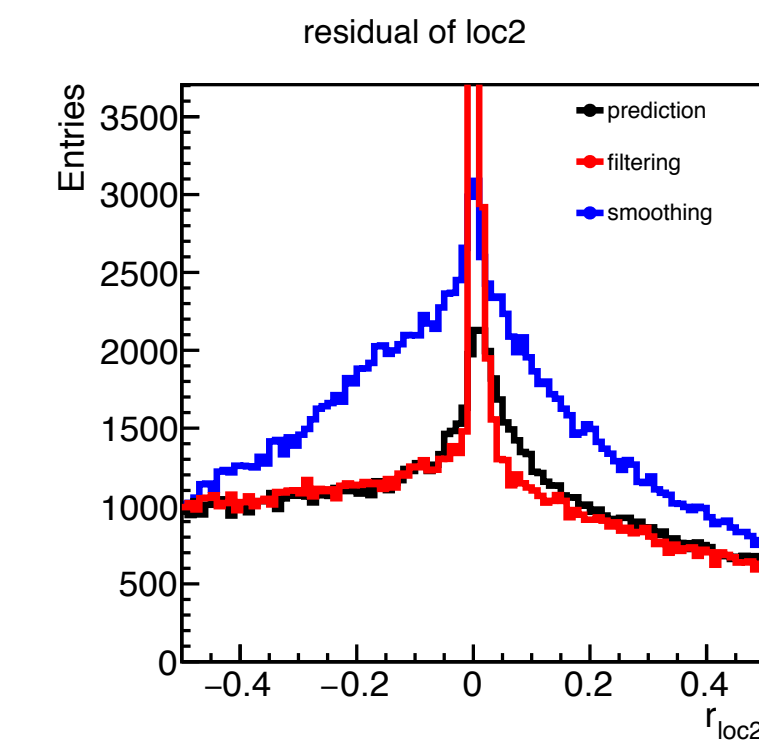
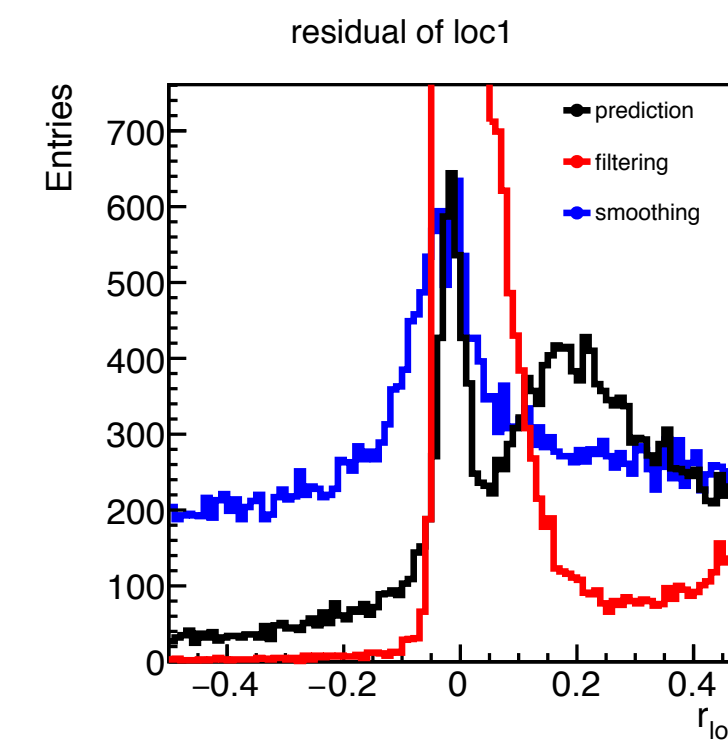
Pulls

- Pulls and residuals created with Examples/scripts/boundParamResolution.C
- Show that they are pretty bad - not sure if they are more informative to the trained eye

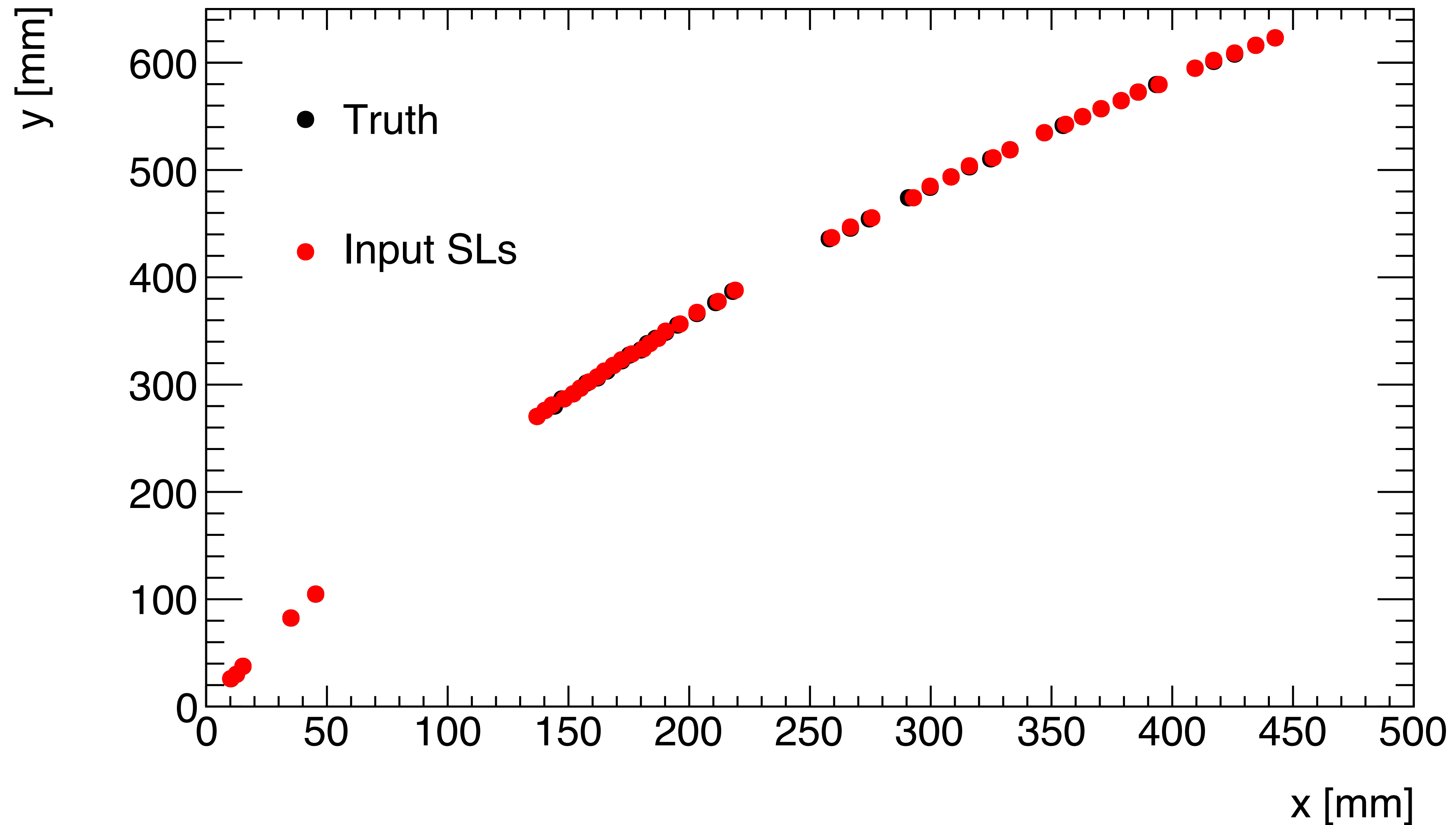


Residuals

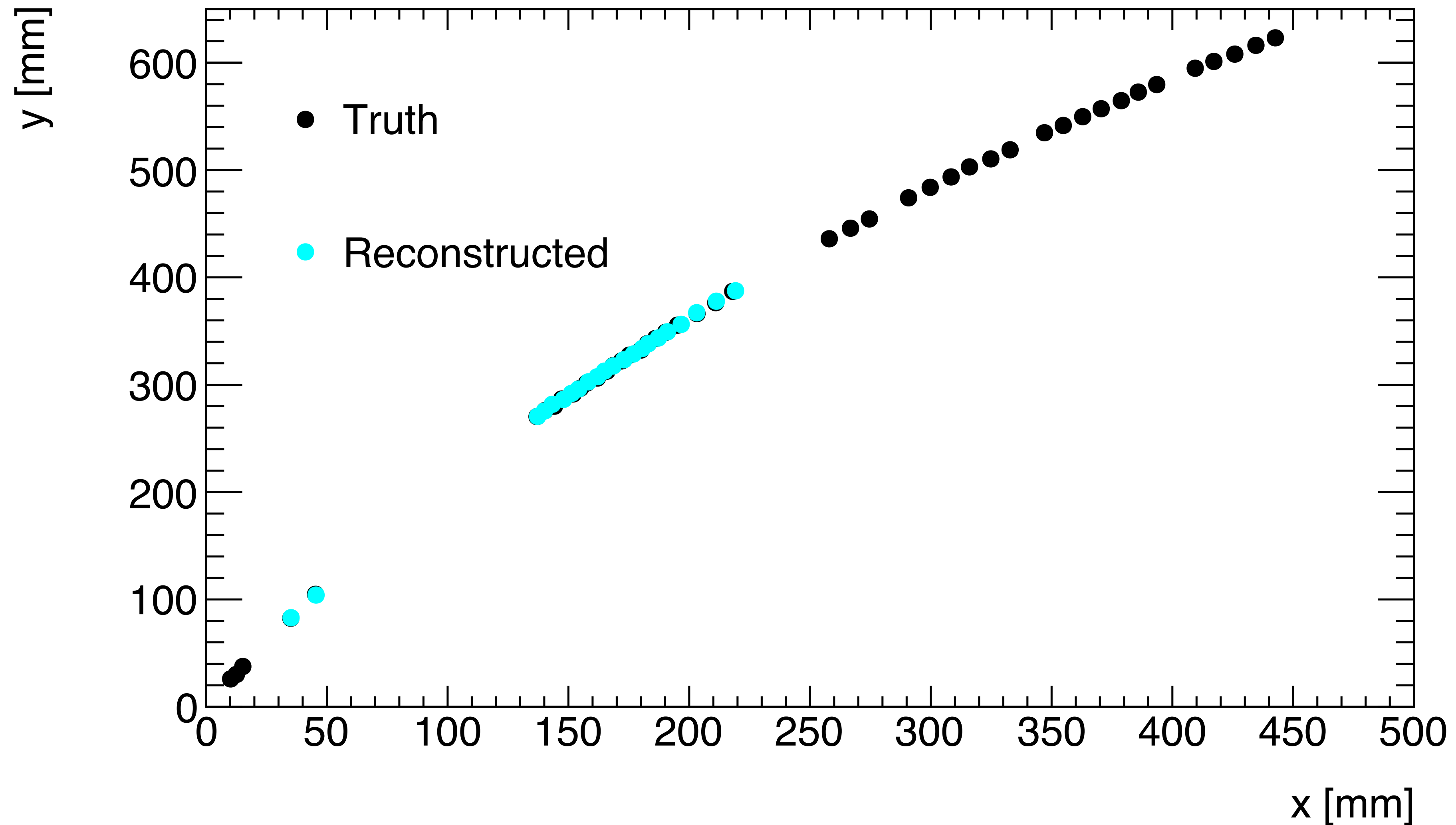
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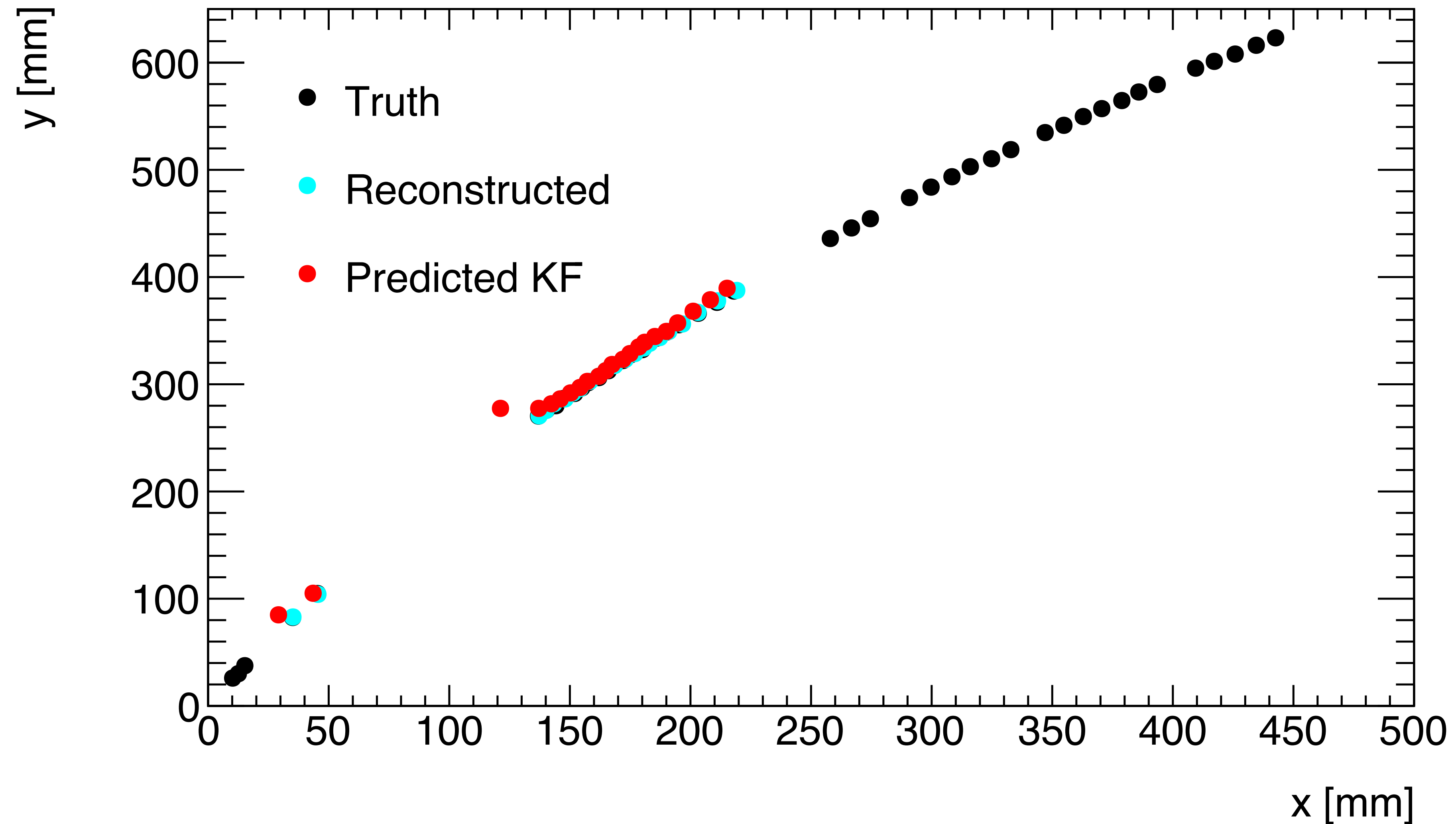
Example Low Pt Track



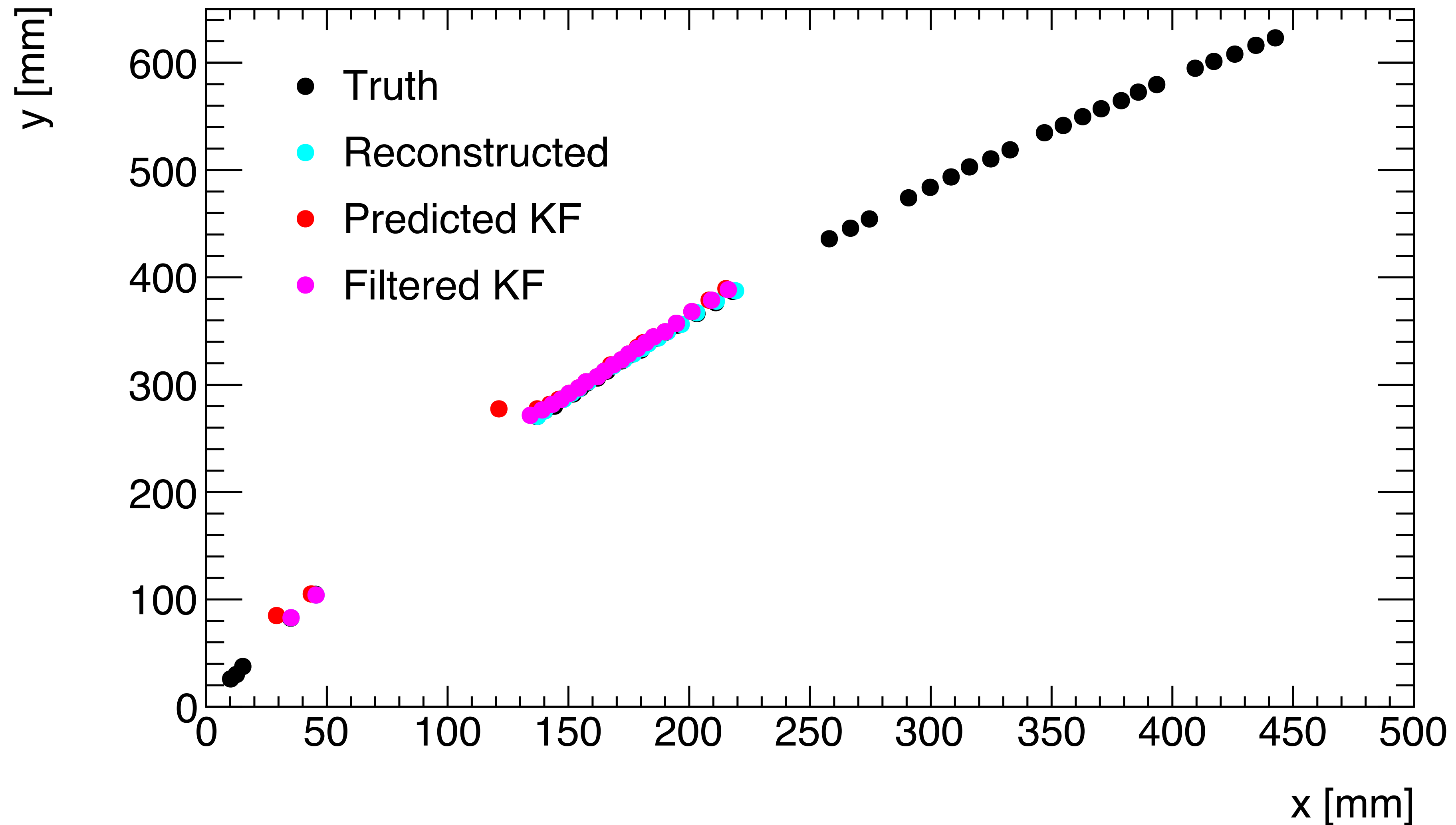
Example Low Pt Track



Example Low Pt Track



Example Low Pt Track



Example Low Pt Track

