Tracking Performances with MC-free TrackMerging

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History

- Before committing the changes to switch from MC-assisted to MC-free Track Merging, the following final test was done:
  - install the head (r22944)
  - update the VXDCDCTrackMerger Module
  - substitute the reconstruction.py script, relevant part:

```
    # track merging
    if use_vxd and use_cdc:
        vxd_tracklets = 'VXDGFTracks'
        cdc_tracklets = 'CDCGFTracks'
    # track fitting
        VXDtrackFitter = register_module('GenFitter')
        VXDtrackFitter.param('GFTrackCandidatesColName', vxd_trackcands)
        VXDtrackFitter.param('BuildBelle2Tracks', False)
        VXDtrackFitter.param("PDGCodes", [211])
        VXDtrackFitter.param('GFTracksColName', vxd_tracklets)

        CDCtrackFitter = register_module('GenFitter')
        CDCtrackFitter.param('GFTrackCandidatesColName', cdc_trackcands)
        CDCtrackFitter.param('BuildBelle2Tracks', False)
        CDCtrackFitter.param("PDGCodes", [211])
        CDCtrackFitter.param('GFTracksColName', cdc_tracklets)


        vxd_cdcTracksMerger = register_module('VXDCDCTrackMerger')
        vxd_cdcTracksMerger_param = {
            'VXDGFTrackCandsColName': vxd_trackcands,
            'VXDGFTracksColName': vxd_tracklets,
            'CDCGFTrackCandsColName': cdc_trackcands,
            'CDCGFTracksColName': cdc_tracklets,
            'relMatchedTracks': 'MatchedTracksIdx',
            'chi2_max': 100,
            'recover' : 1
            }
        vxd_cdcTracksMerger.param(vxd_cdcTracksMerger_param)

        path.add_module(VXDtrackFitter)
        path.add_module(CDCtrackFitter)
        path.add_module(vxd_cdcTracksMerger)
#         track_merger = register_module('MCTrackCandCombiner')
#         track_merger.param('CDCTrackCandidatesColName', cdc_trackcands)
#         track_merger.param('VXDTrackCandidatesColName', vxd_trackcands)
#         path.add_module(track_merger)
```

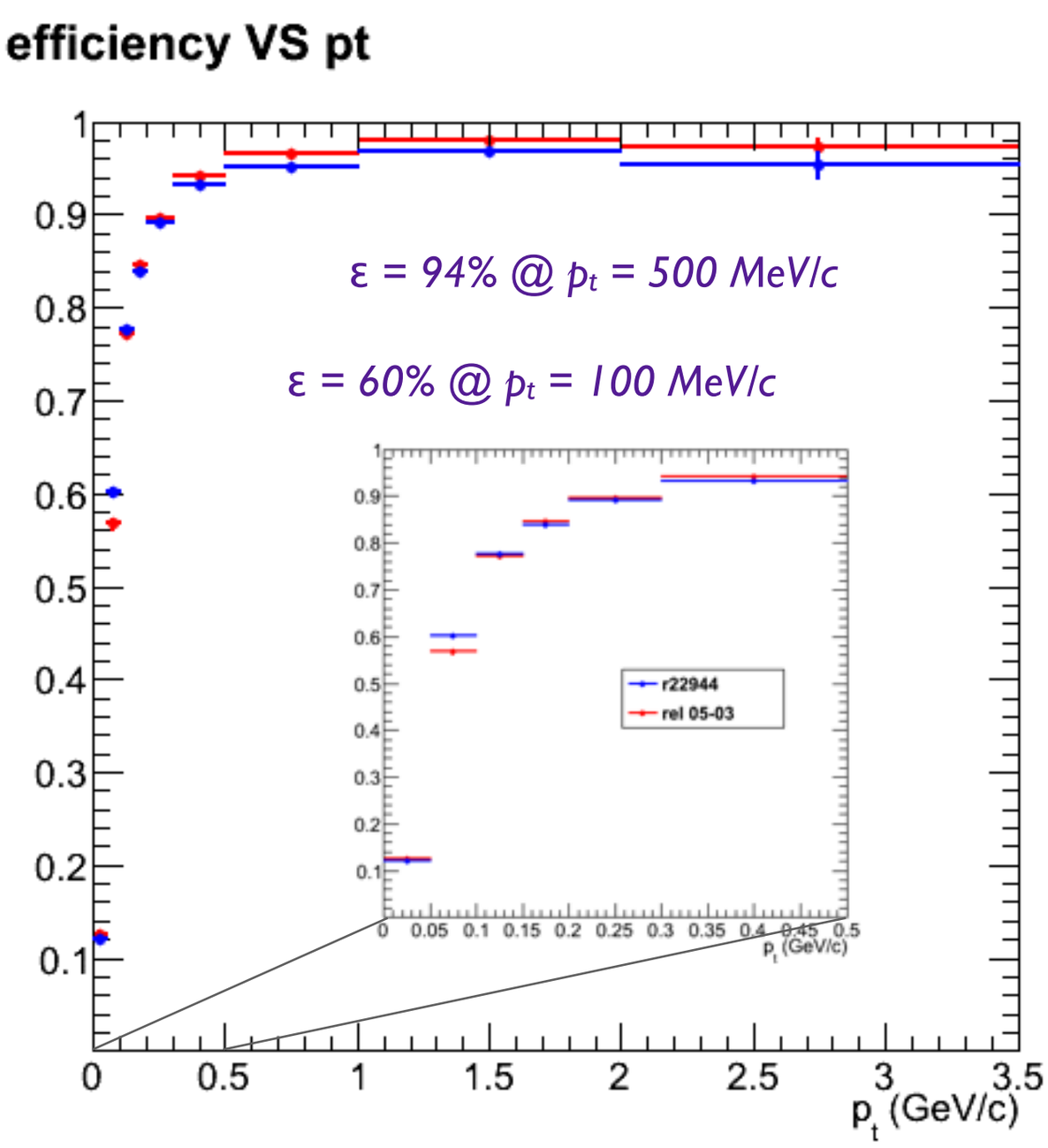
Integrated Efficiency

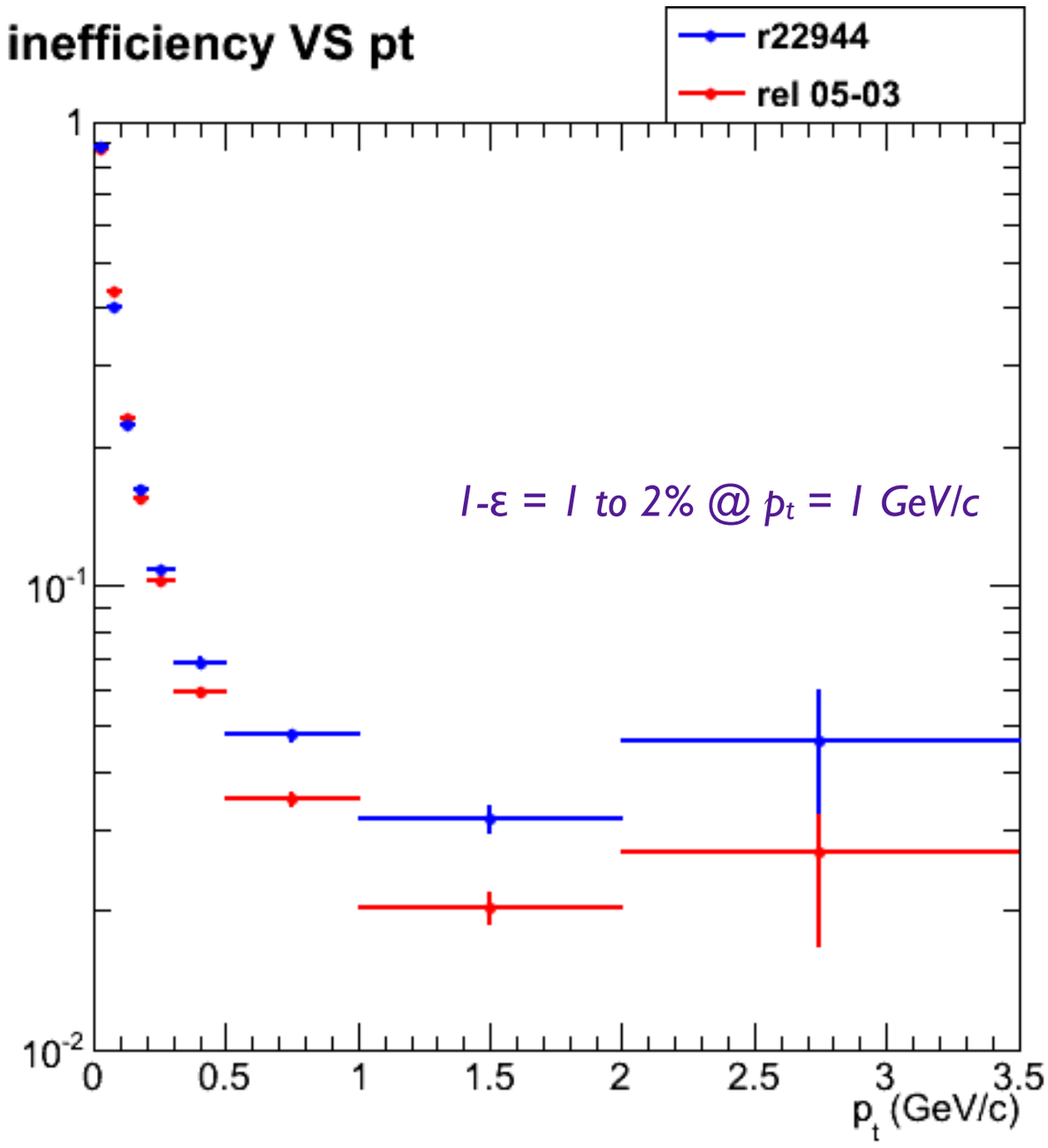
➡ this study is based on a sample of 10k Y(4S) generic decays reconstructed with the official standard reconstruction with the addition of the MC information

definition	*in %*	release-00-05-03	r22944*
$\frac{\#\text{MCParticles with at least one associated Track}}{\#\text{ MCParticles}}$	**physical efficiency**	85.6±0.1	84.8±0.1
$\frac{\#\text{MCTrackCands with at least one associated Track}}{\#\text{MCTrackCands}}$	**geom. accept. & det. ineff. factored out**	94.0±0.1	93.3±0.1
$\frac{\#\text{MCTrackCand with at least one associated TrackCand}}{\#\text{MCTrackCands}}$	**pattern recognition efficiency**	96.6±0.1	94.5±0.1

➡ no striking changes in the standard tracking reconstruction in r22944 (MC-free Track Merging) w.r.t to release-00-05-03 (MC-assisted Track Merging)

Efficiency VS Transverse Momentum

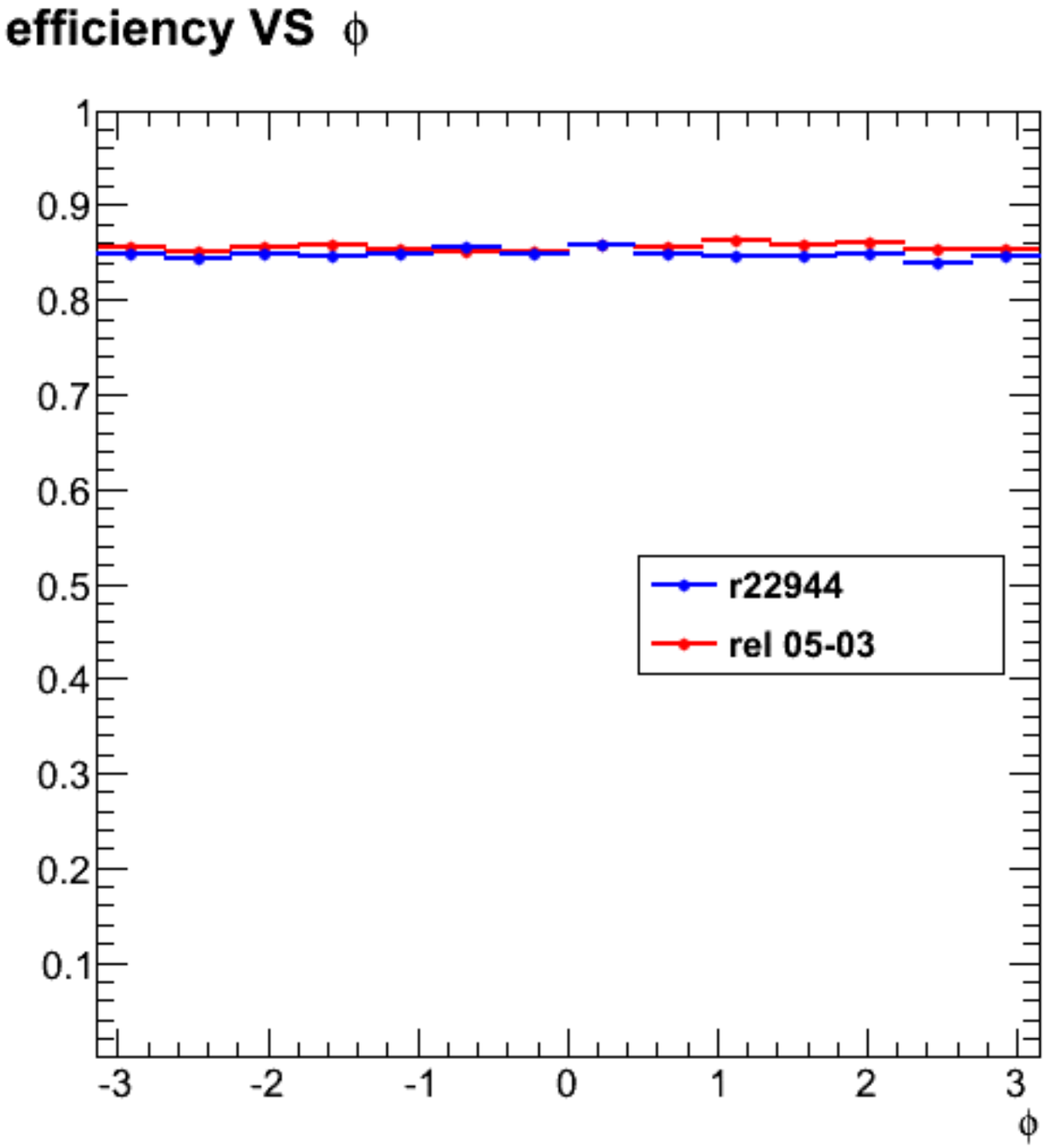


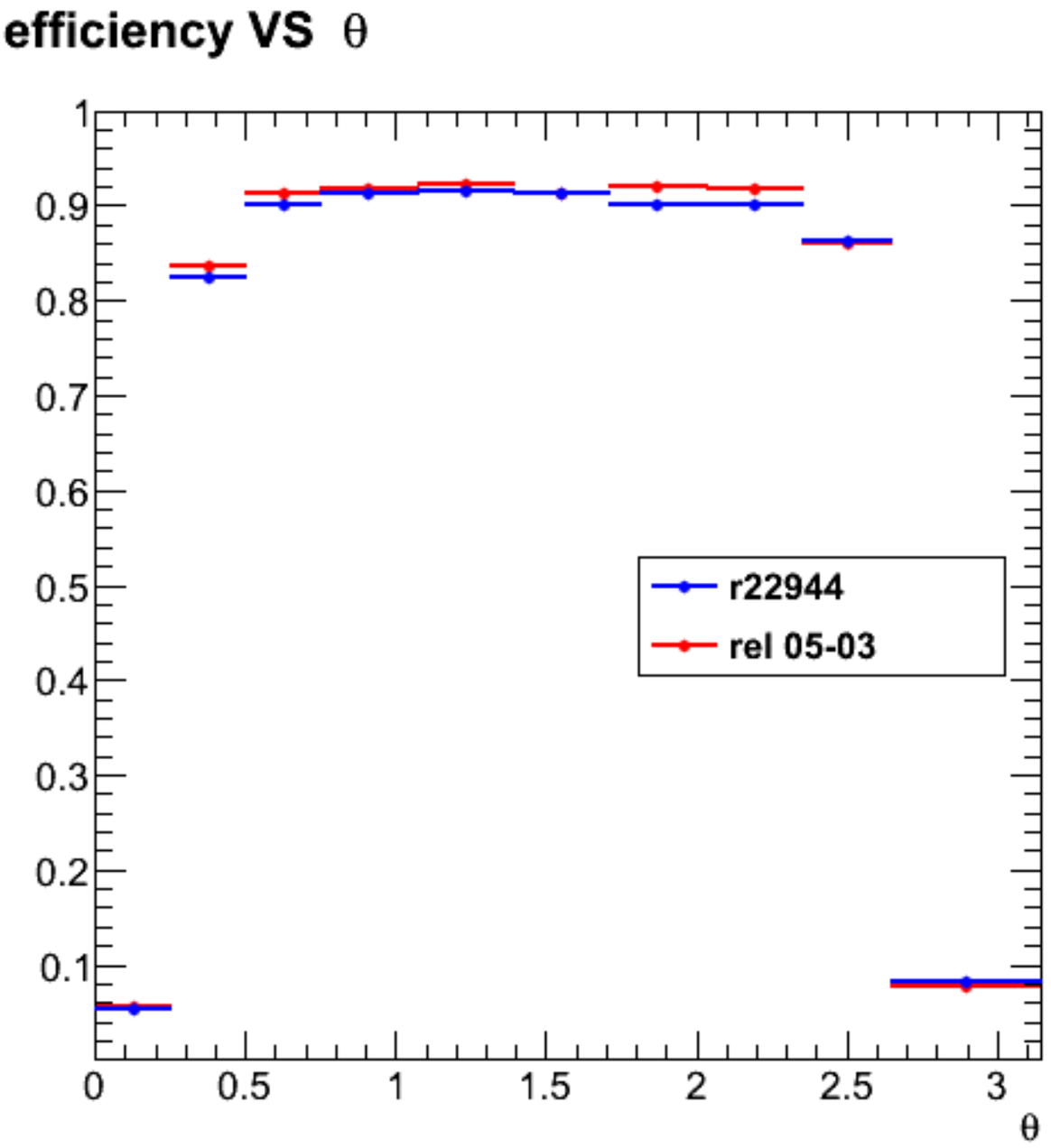


legend:

- r22944* (MC-free Track Merger): physical efficiency
- release-00-05-03 (MC-assisted Track Merger): physical efficiency

Efficiency VS Polar and Azimuthal Angles



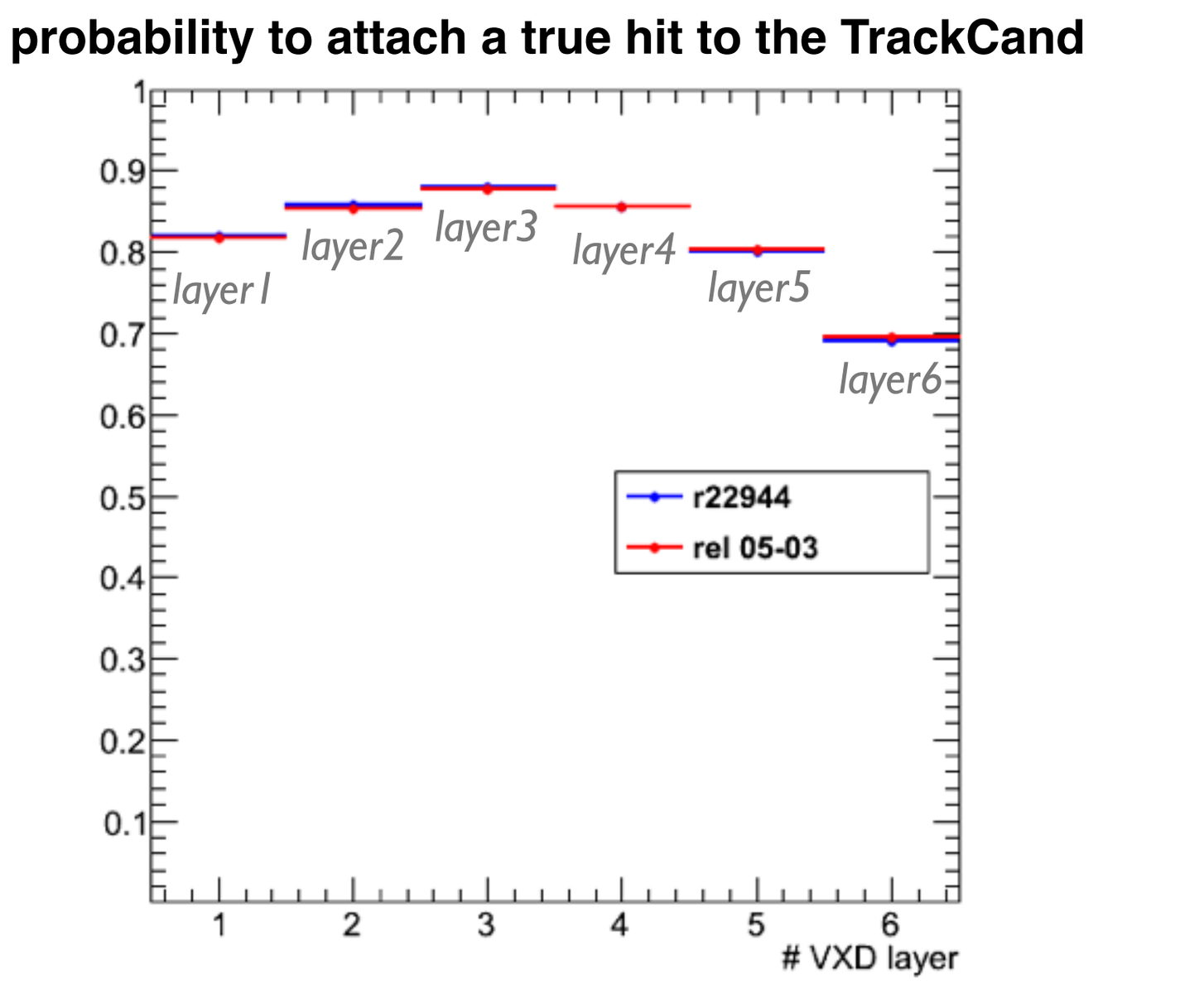


legend:

- r22944* (MC-free Track Merger): physical efficiency
- release-00-05-03 (MC-assisted Track Merger): physical efficiency

efficiency & purity

VXD Detector Information Usage



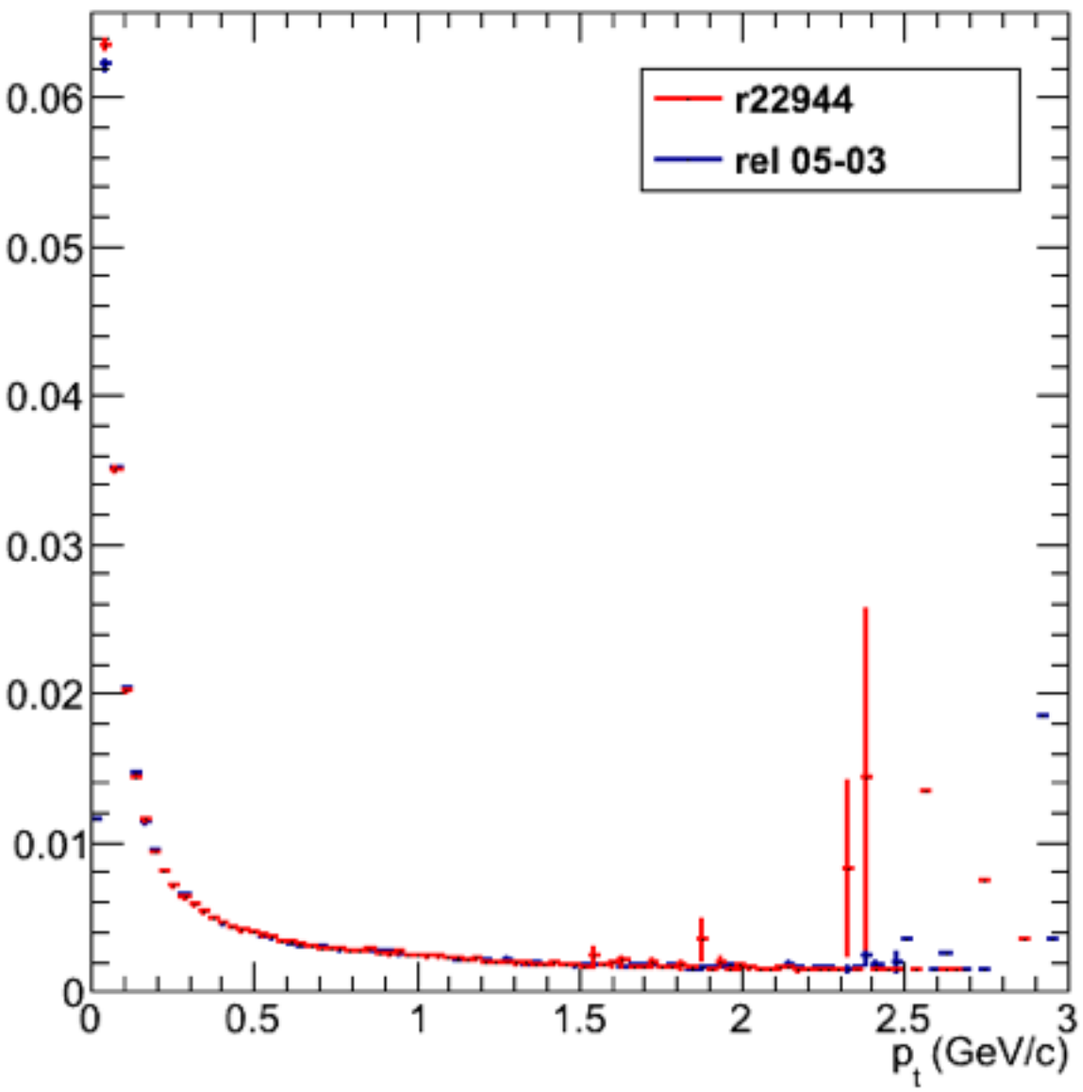
legend:

- r22944* (MC-free Track Merger): physical efficiency
- release-00-05-03 (MC-assisted Track Merger): physical efficiency

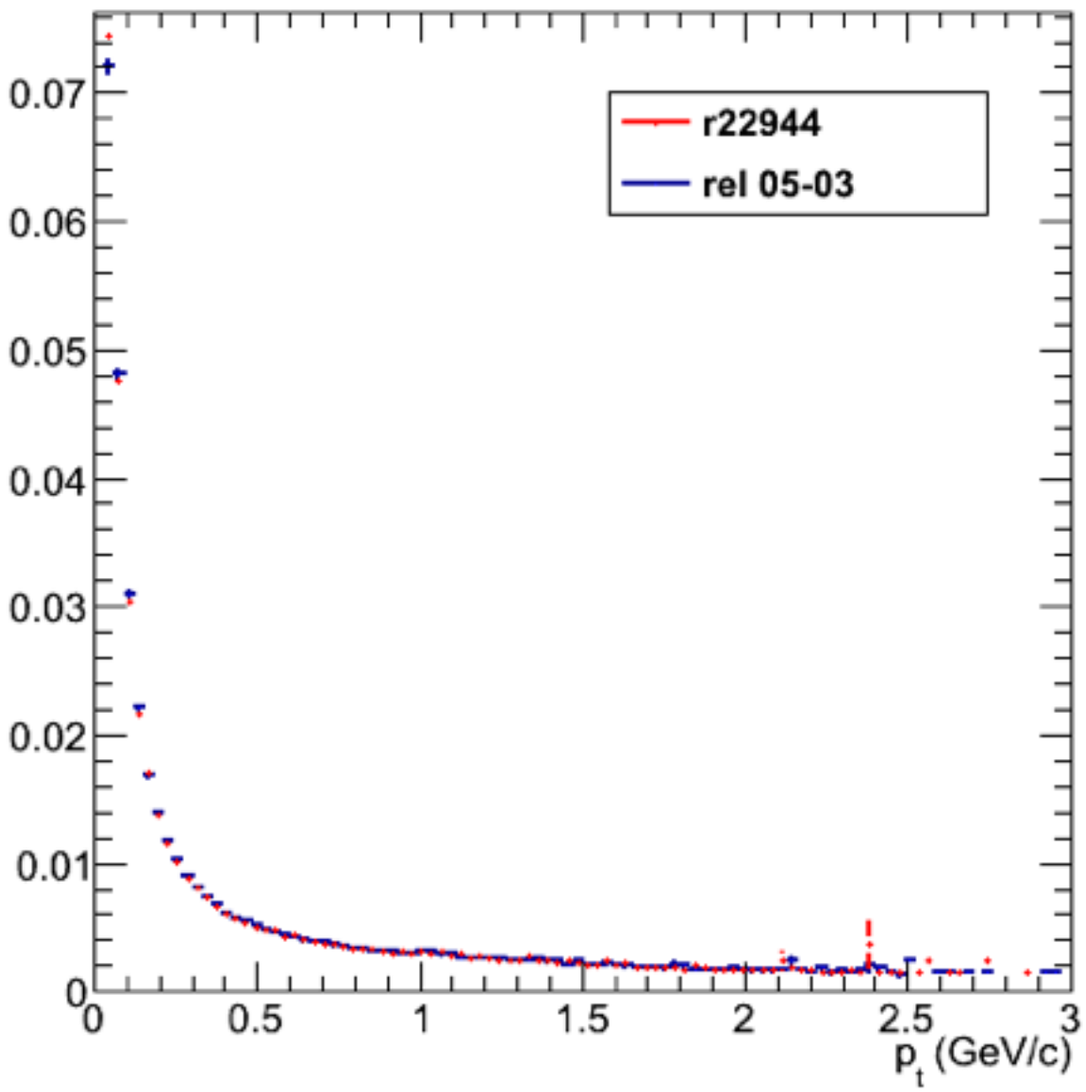
track quality

Impact Parameters Errors VS p_t

σ_{d0} VS p_t, *transverse* impact parameter



σ_{z0} VS p_t, *longitudinal* impact parameter



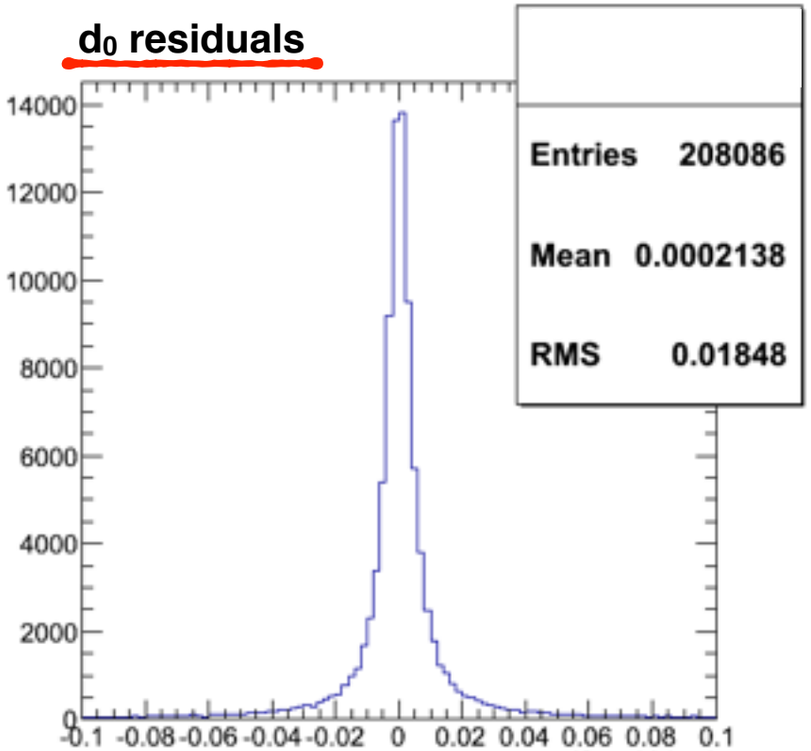
legend:

- r22944* (MC-free Track Merger): physical efficiency
- release-00-05-03 (MC-assisted Track Merger): physical efficiency

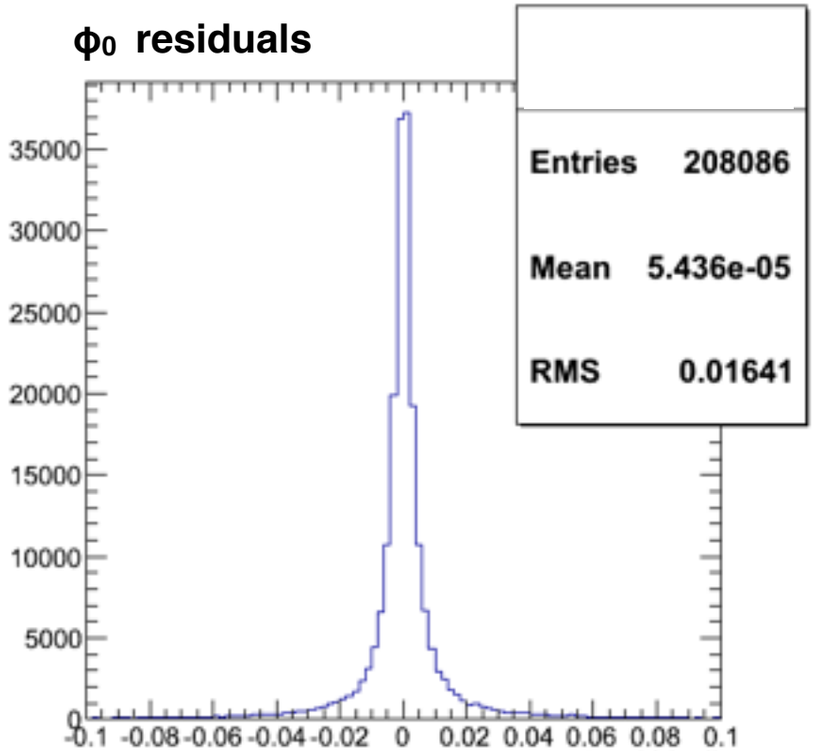
r22944*

Track Parameters Resolutions (reco-true)

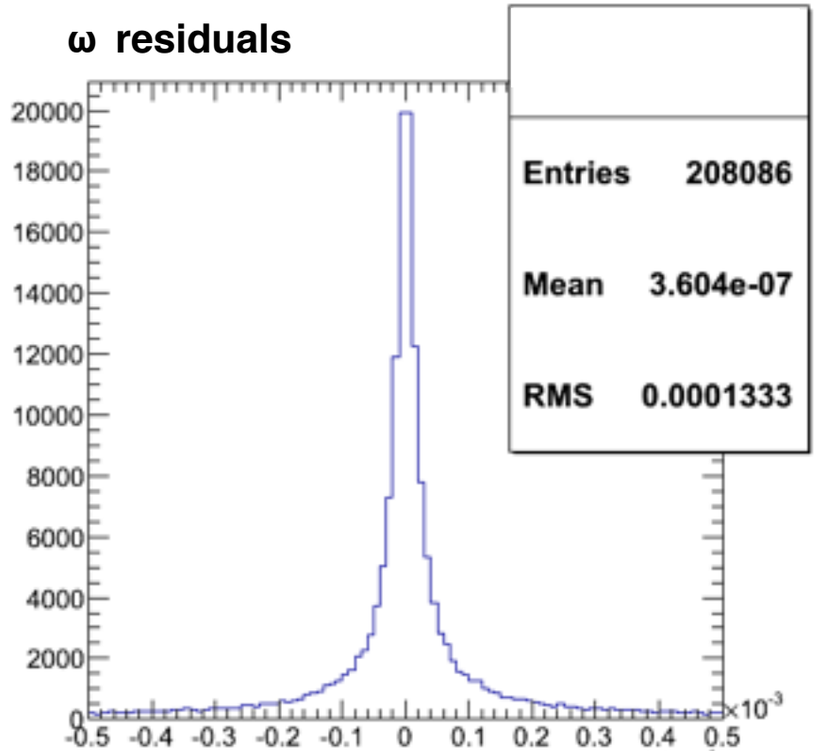
d_0 residuals



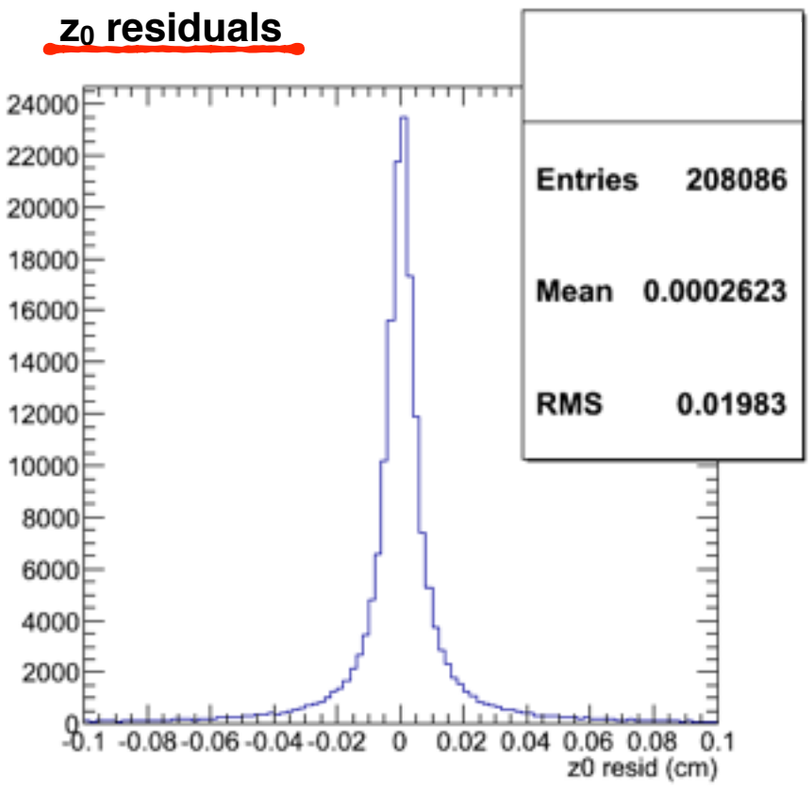
ϕ_0 residuals



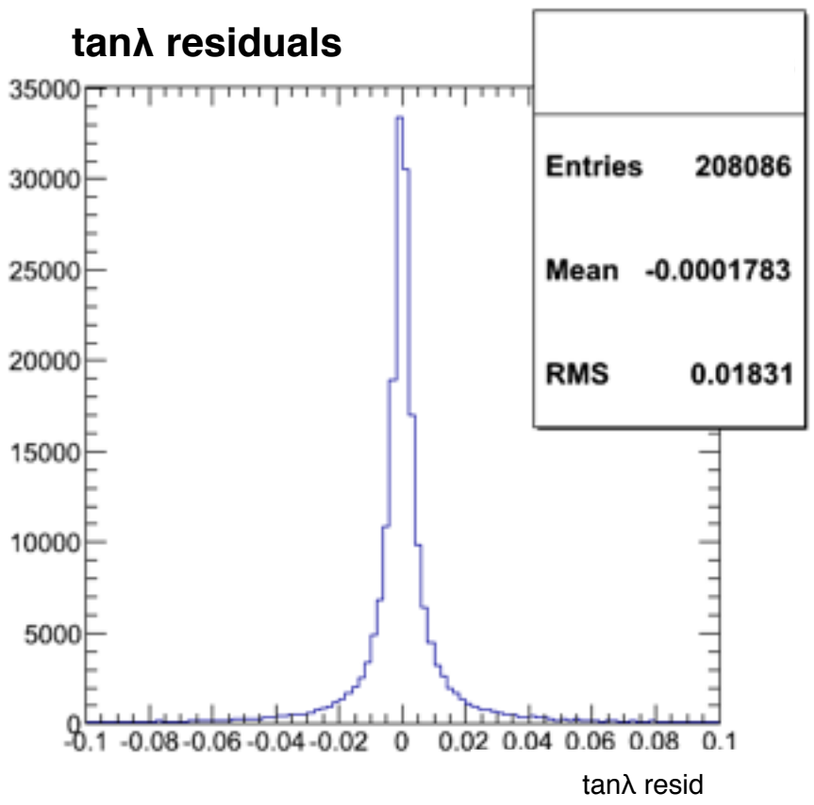
ω residuals



z_0 residuals

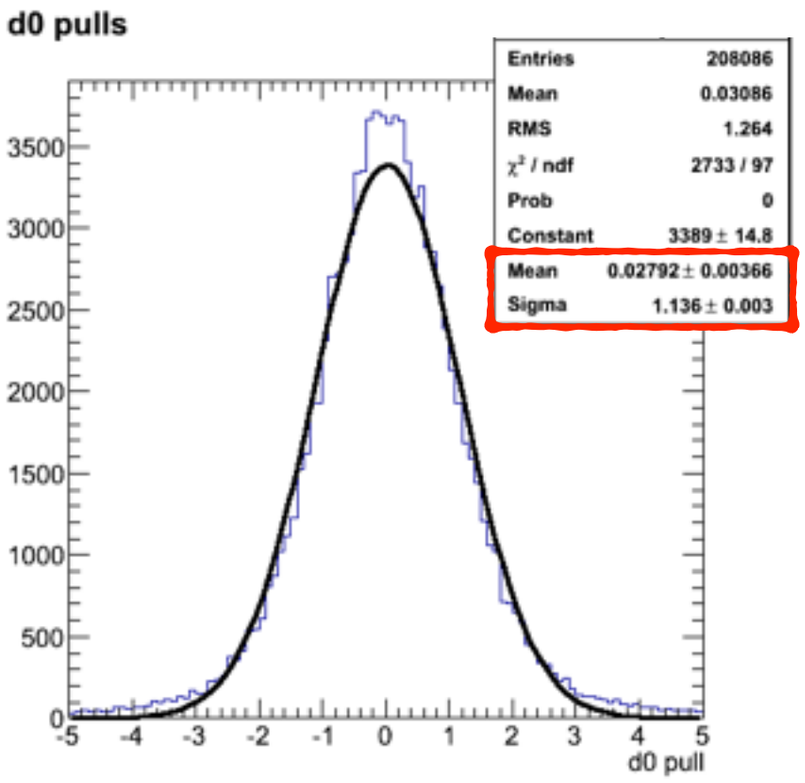


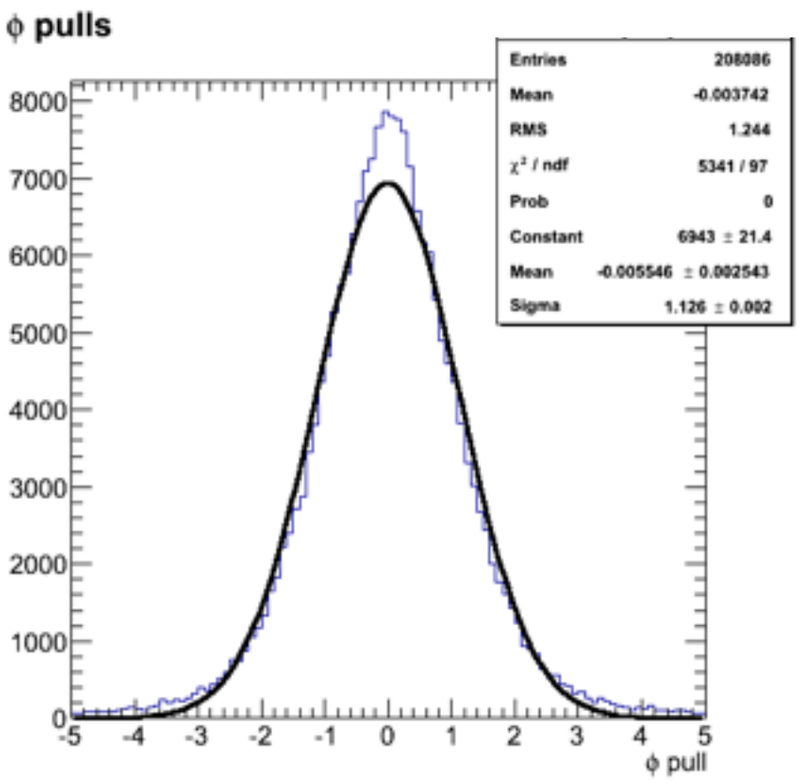
tanλ residuals

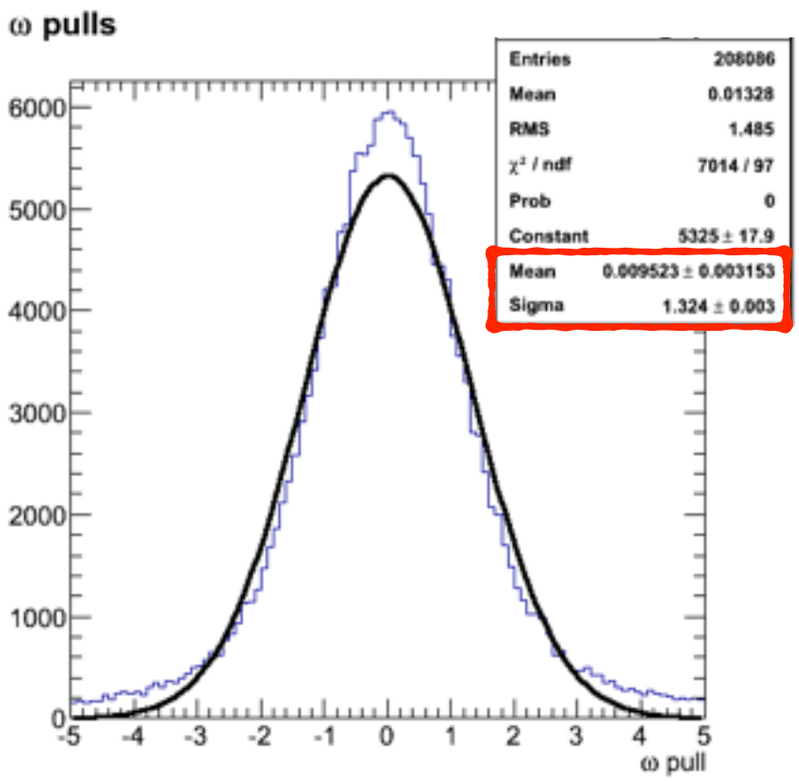


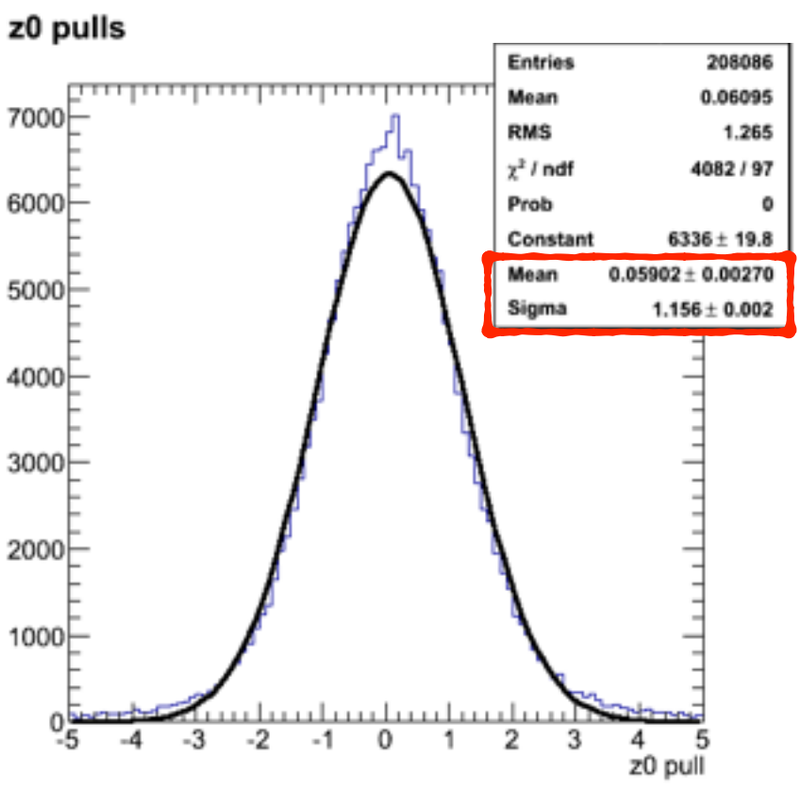
r22944*

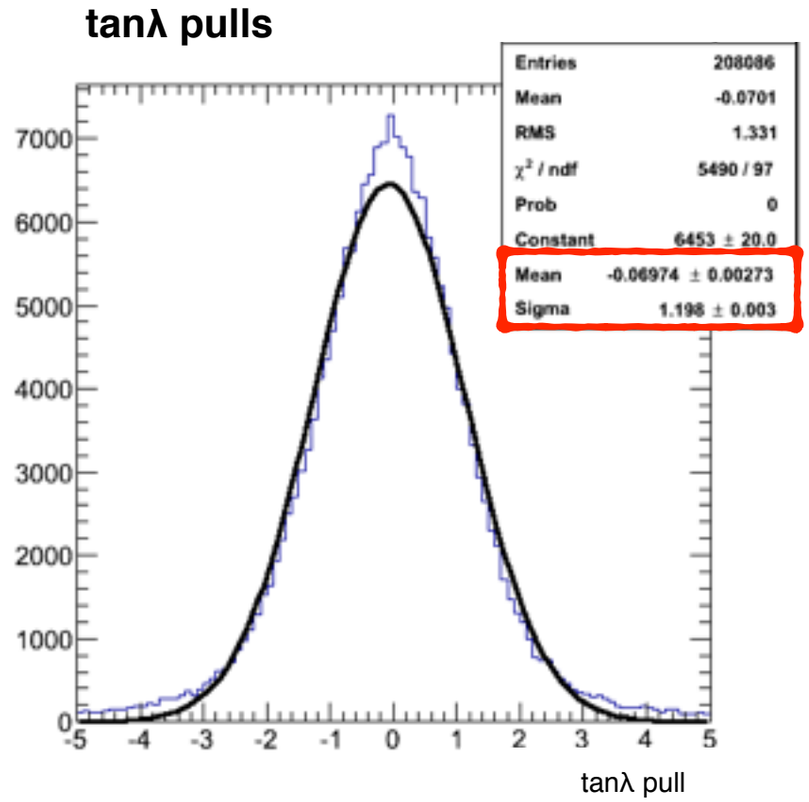
Track Parameters Pulls (reco-true)/error









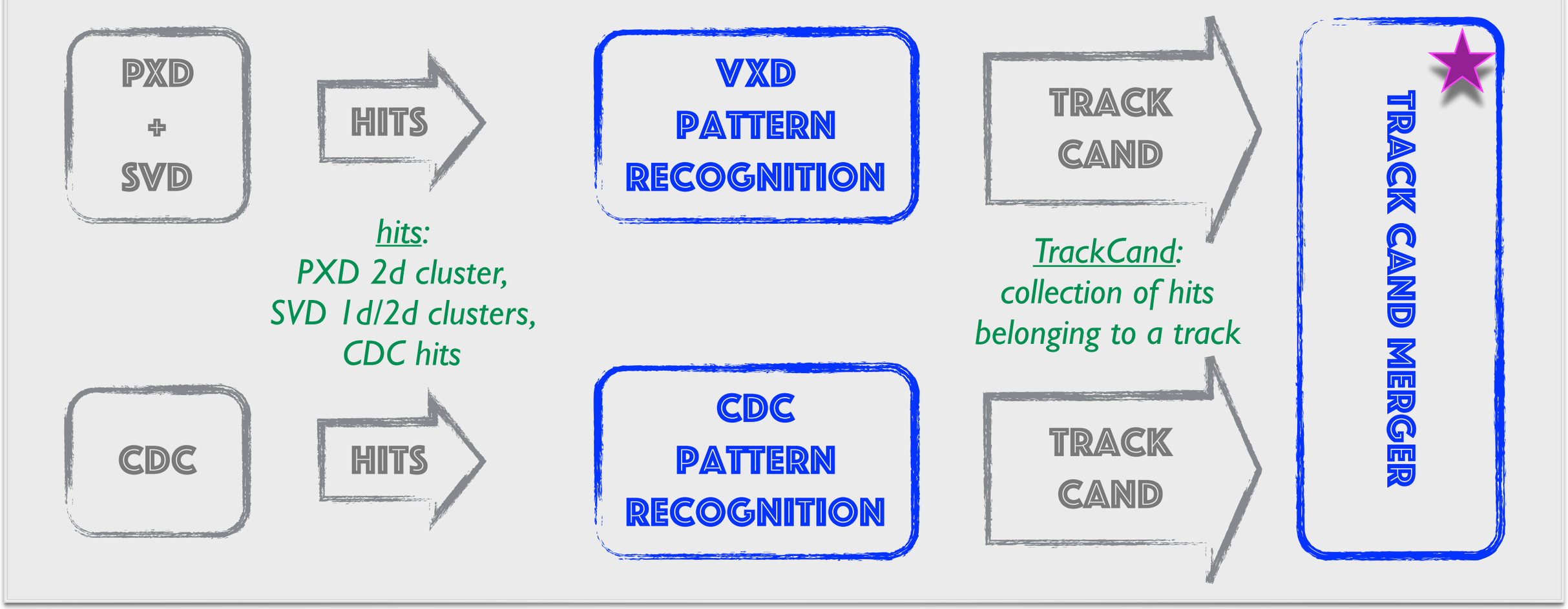


- 30% underestimated errors on ω, 15% on the other track parameters
- 3-6% bias in the impact parameters and -7% in tanλ


Don't
PANIC!
backup slides

Track Reconstruction (1)

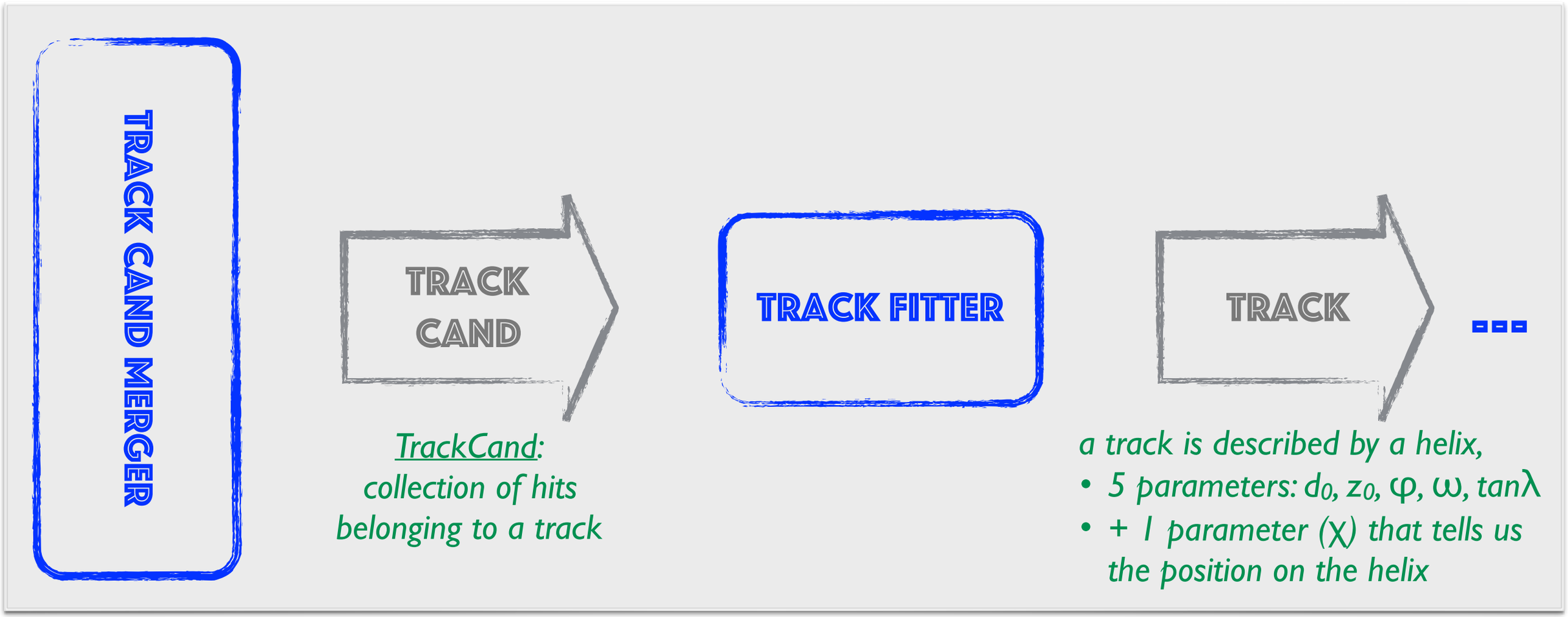
no PXD data reduction
simulation



new CDC TrackFinder

MC-free merger

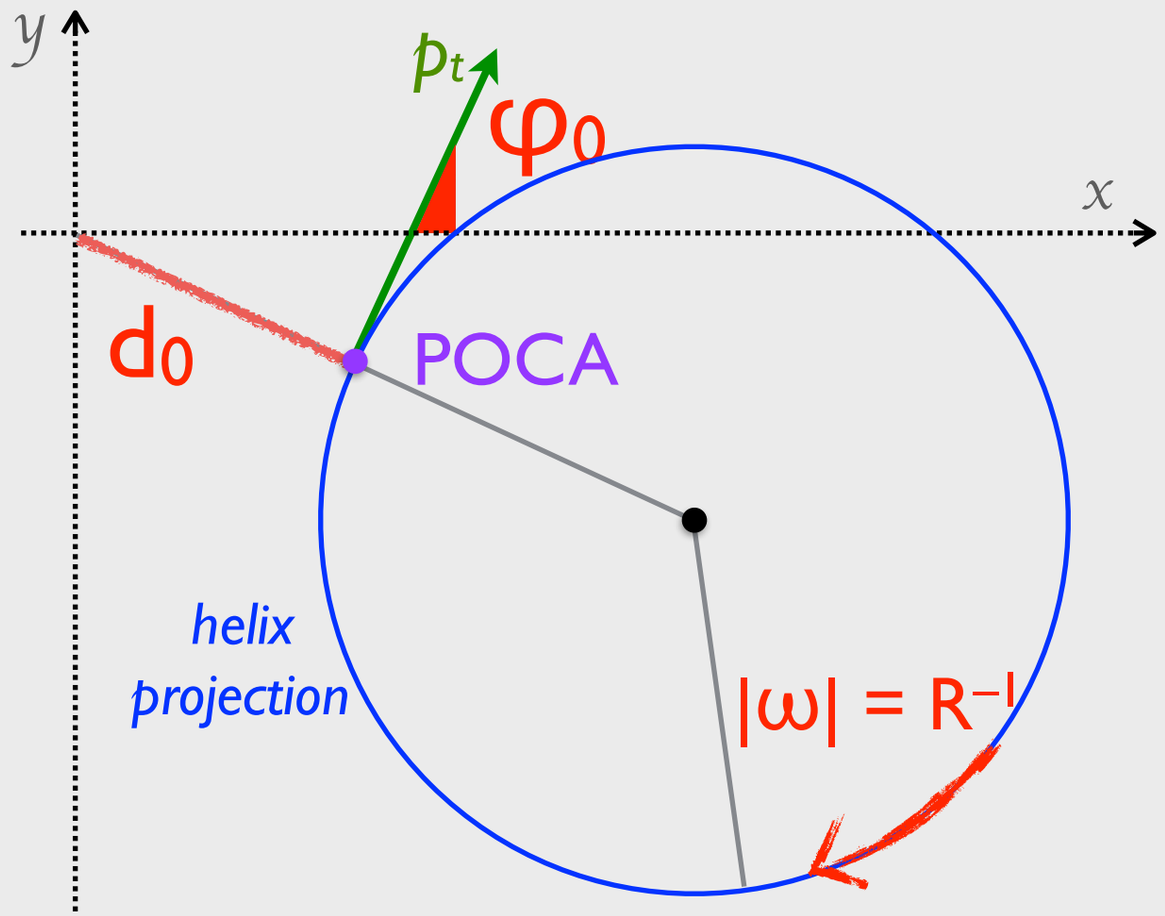
Track Reconstruction (2)



DAF -- a Kalman fit that weights hits and rejects ourliers with pion mass hypothesis

Track Parameterisation

TRANSVERSE PLANE



- POCA = Point Of Closest Approach
- d_0 is the 2d signed distance of the POCA from the z axis, the sign depends on the angular momentum of the track (>0 in the fig.)
- φ_0 is the angle between p_t and the x axis at the POCA, $\varphi_0 \in [-\pi,\pi]$
- the sign of ω, the curvature, is the same as the charge of the track (>0 in the fig.)

LONGITUDINAL VIEW

- $\tan\lambda$ is the ratio of p_z and p_t, $\lambda \in [-\pi,\pi]$
- z_0 is the signed distance of the POCA from the transverse plane