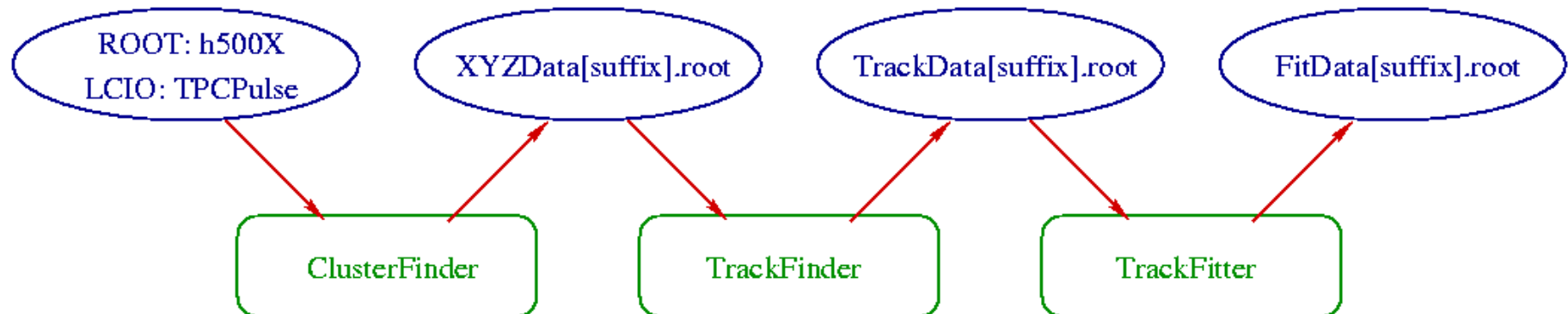


Reconstruction&Analysis

- Reconstruction Frame Work: MultiFit
 - methods for reconstruction
 - pulse finding
 - hit reconstruction
 - track finding and fitting
 - ansatz for Pad Response Function correction
- Resolution Analysis
 - Geometric Mean Method
 - Triplet Method
- Choice of Pad Layout
 - staggered and
 - non-staggered layout

MultiFit

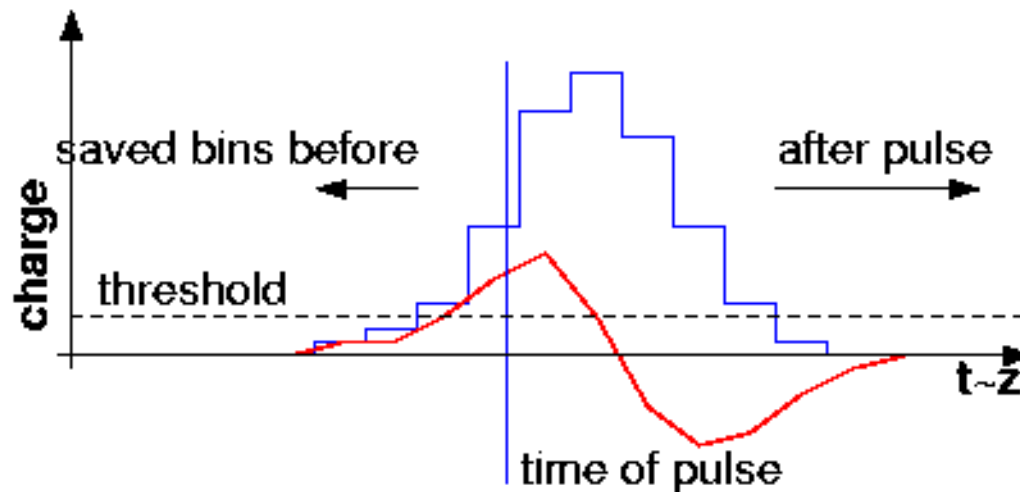
- Reconstruction is done in three steps



- ClusterFinder: reconstruction of 3D space points from the raw data
- TrackFinder: combines the space points to tracks
- TrackFitter: calculates the track parameter and residuals etc.

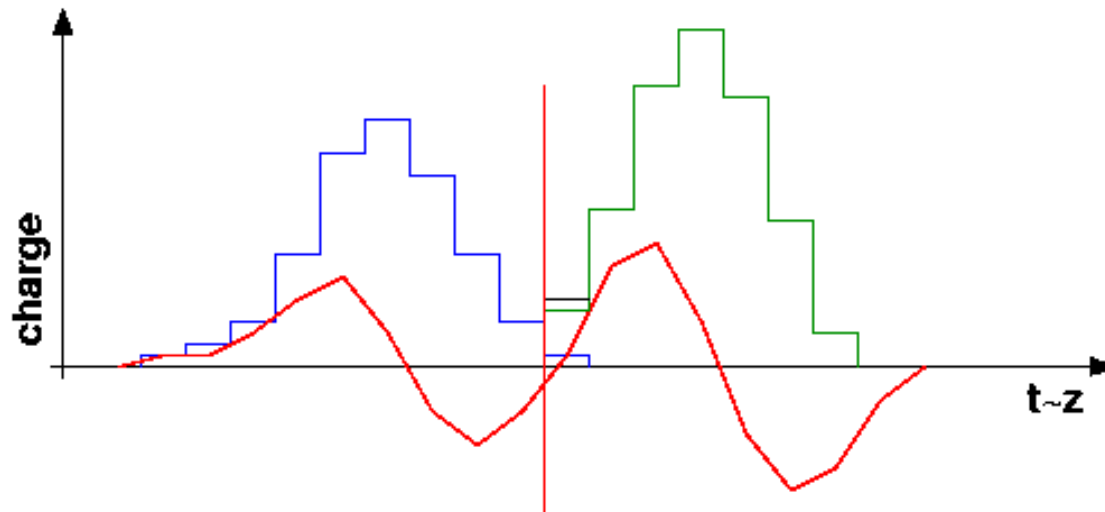
ClusterFinder: Pulse-Reco

- First, find pulses from raw data
 - detect pulses by threshold (use of different values for beginning and end)
 - save # bins before and after the pulse
 - calculate integrated charge
 - calculate a time information: inflexion point of rising slope (mean of positive derivative)



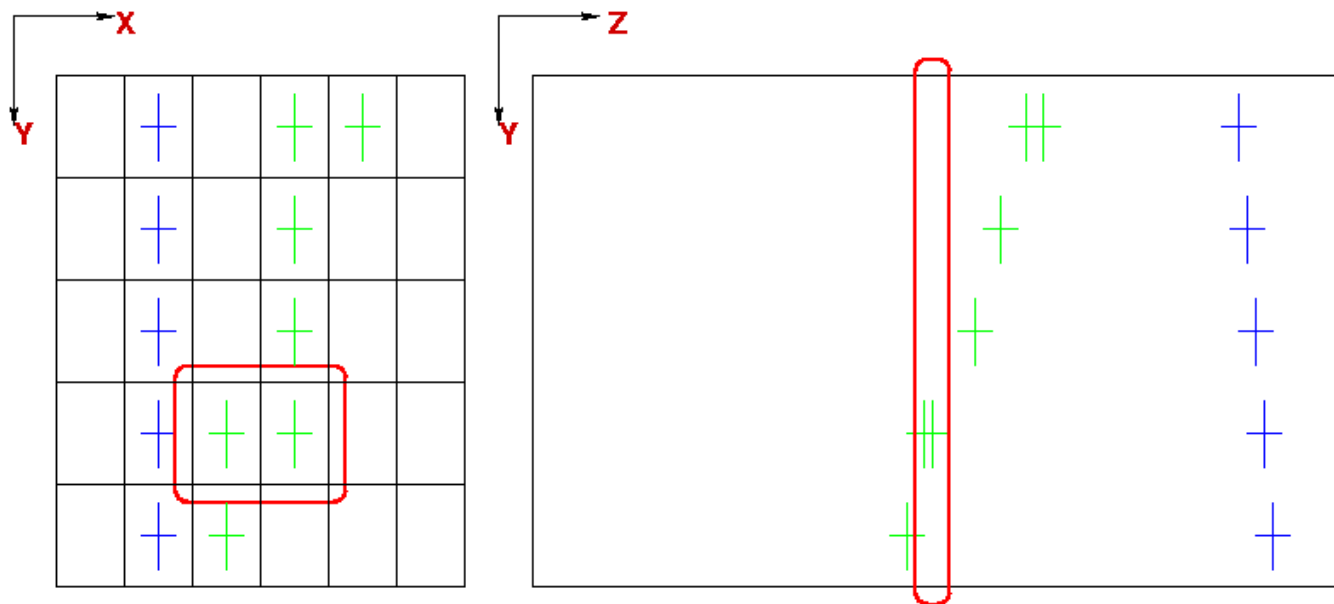
ClusterFinder: Double-Pulse Separation

- during the pulse search: separation of pulses
 - detect the change in slope using the zero-crossing of the derivative
 - ignore variations in the order of noise



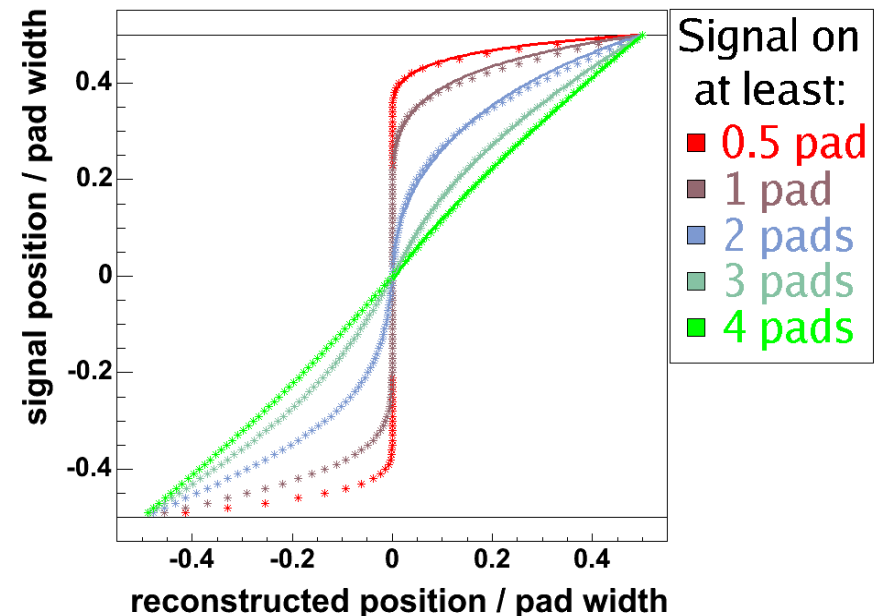
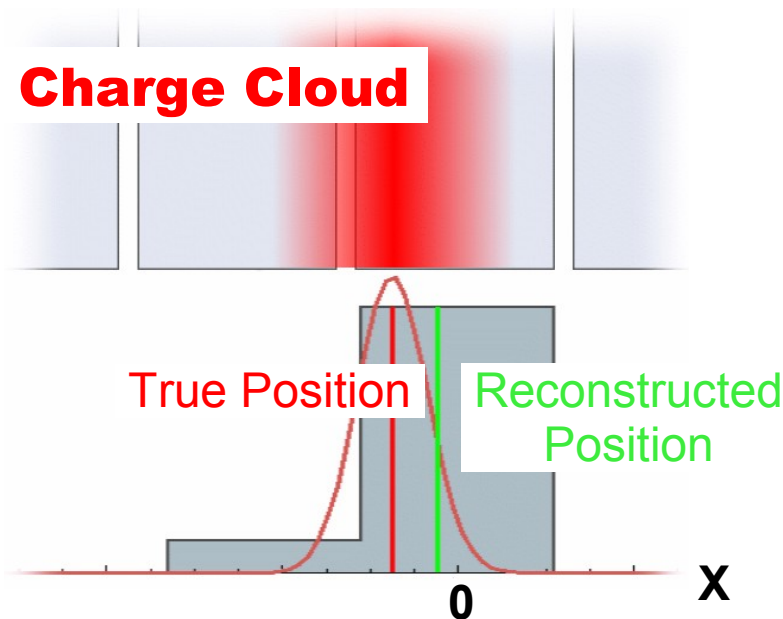
ClusterFinder: Merge Pulses

- Second, combine the found pulses to hits
 - start with the biggest pulse (charge)
 - define a time window for search
 - use recursive method
 - add the pulse if it is smaller (in a given error band)
 - take care of damaged pads



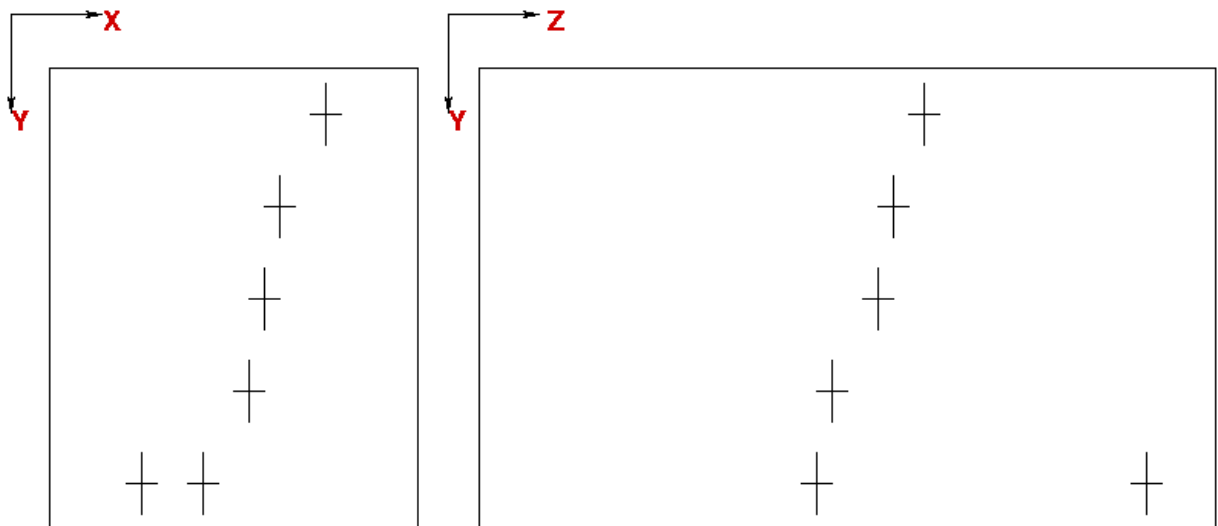
ClusterFinder: PRF Correction

- Optional: correction of hit coordinate in xy-plane using the Pas Response Function
 - calculate the signal width out of
 - diffusion coefficient
 - defocussing constant (diffusion in amplification region)



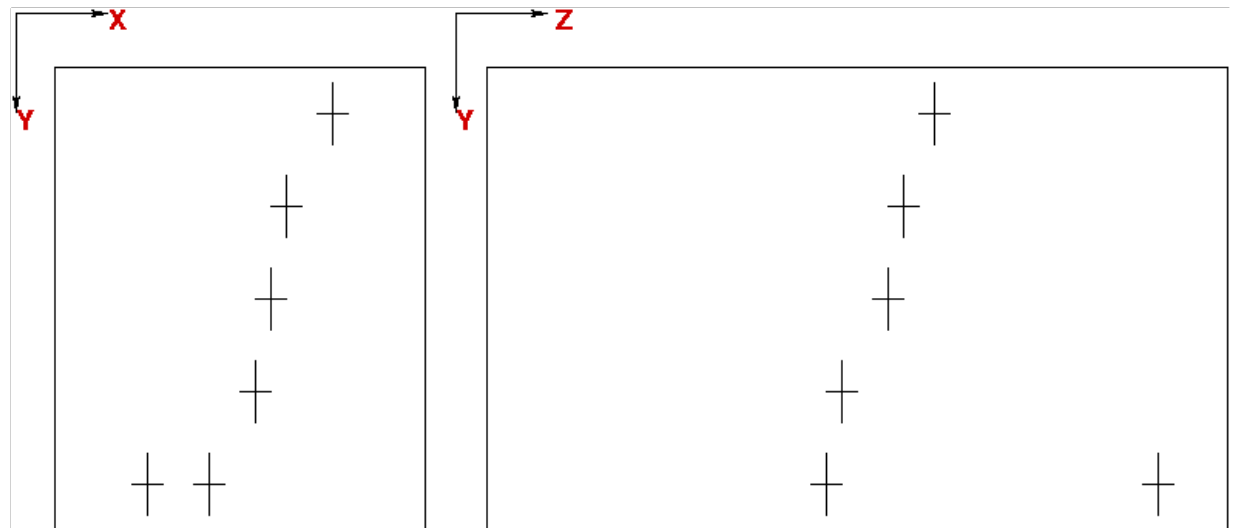
TrackFinder: Track Following

- Combine the hits to tracks using straight 3D track-following method
 - initialise the track with two hits in different rows with a certain distance
 - calculate probable position for next row
 - add hit in search window, if it is free (if more than one: with the least Chi2)
 - refit track and continue with next row



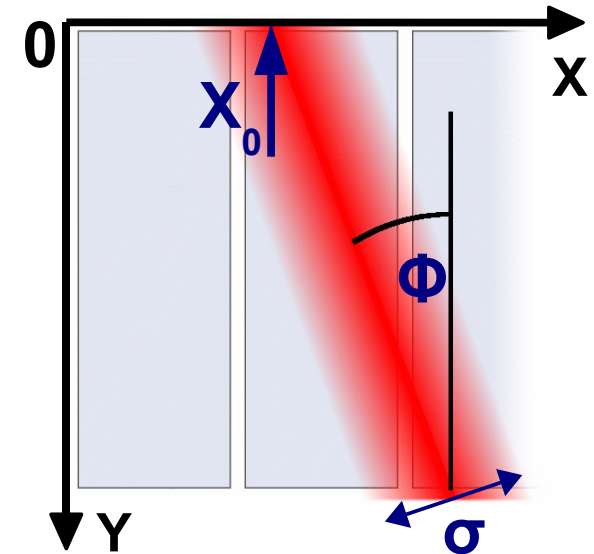
TrackFinder: False Track

- To avoid false tracks
 - allow only small gaps
 - save tracks
 - with a minimal number of hits
 - a minimal probability (dangerous for curved tracks)



Trackfitter

- Various fitting techniques
 - for the Chi2-based methods
 - errors of the hits as weight
 - otherwise all set to 1
 - for the advanced methods
 - the noise value can be set
- Calculate track parameter
 - in XY:
 - straight: intercept, slope
 - curved: curvature, centre-coordinate
 - in YZ: intercept, slope
- Determine the residuals for the hits
 - including and excluding the corresponding hit during the track-fit

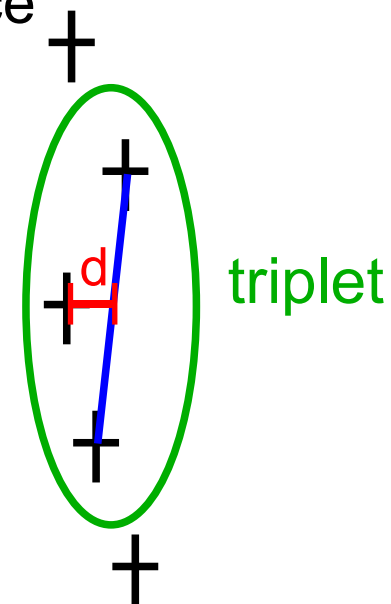


Determine the Resolution

- Geometric Mean Method
 - Determine width of distribution of residuals for:
 - track with all hits:
 - track without the corresponding hit
 - resolution: geometric mean of both
 - for straight tracks: analytically proven
 - for circular tracks: produces the right result in MC

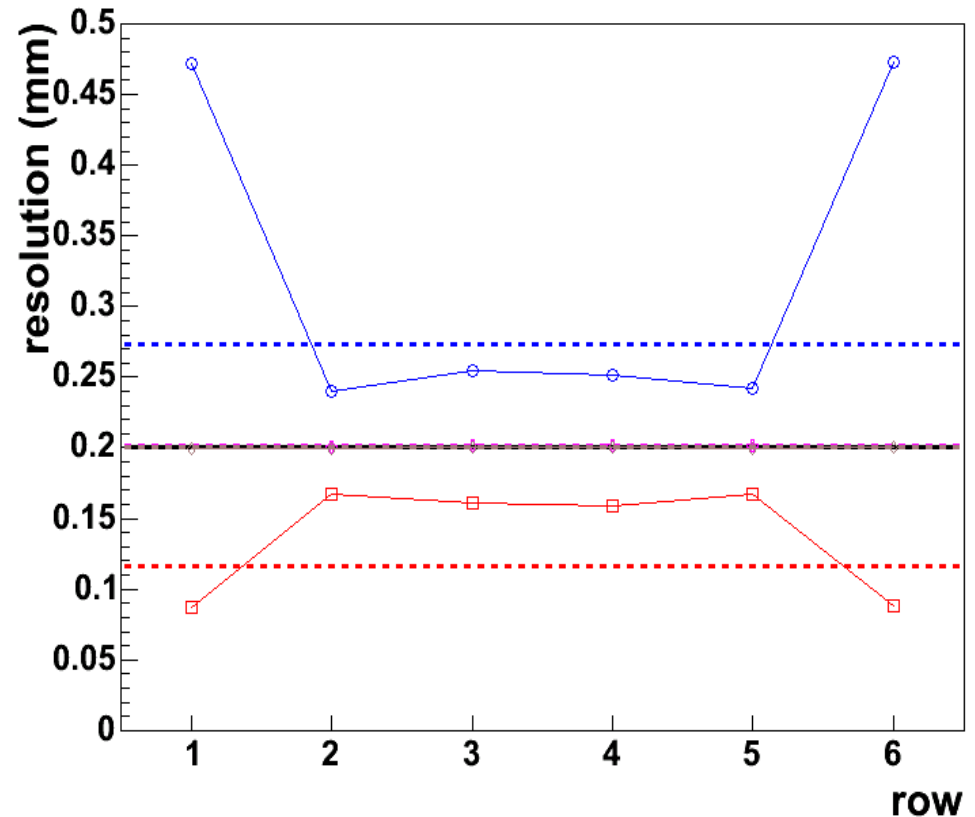
- Triplet Method
 - determine residual only from three adjacent pad rows:
 - draw straight line through outer hits
 - determine distance between straight line and central hit
 - resolution σ assuming same uncertainty for all hits:

$$\sigma = \sigma_d \sqrt{2/3}$$



MC Test of Analysis Methods

- Circular tracks
 - 500mm < R < 2000mm
 - through the centre
 - no pad effects included
- Geometric mean
 - sensitive to local variations
- Triplet
 - neglect global correlations
- Both methods are complementary

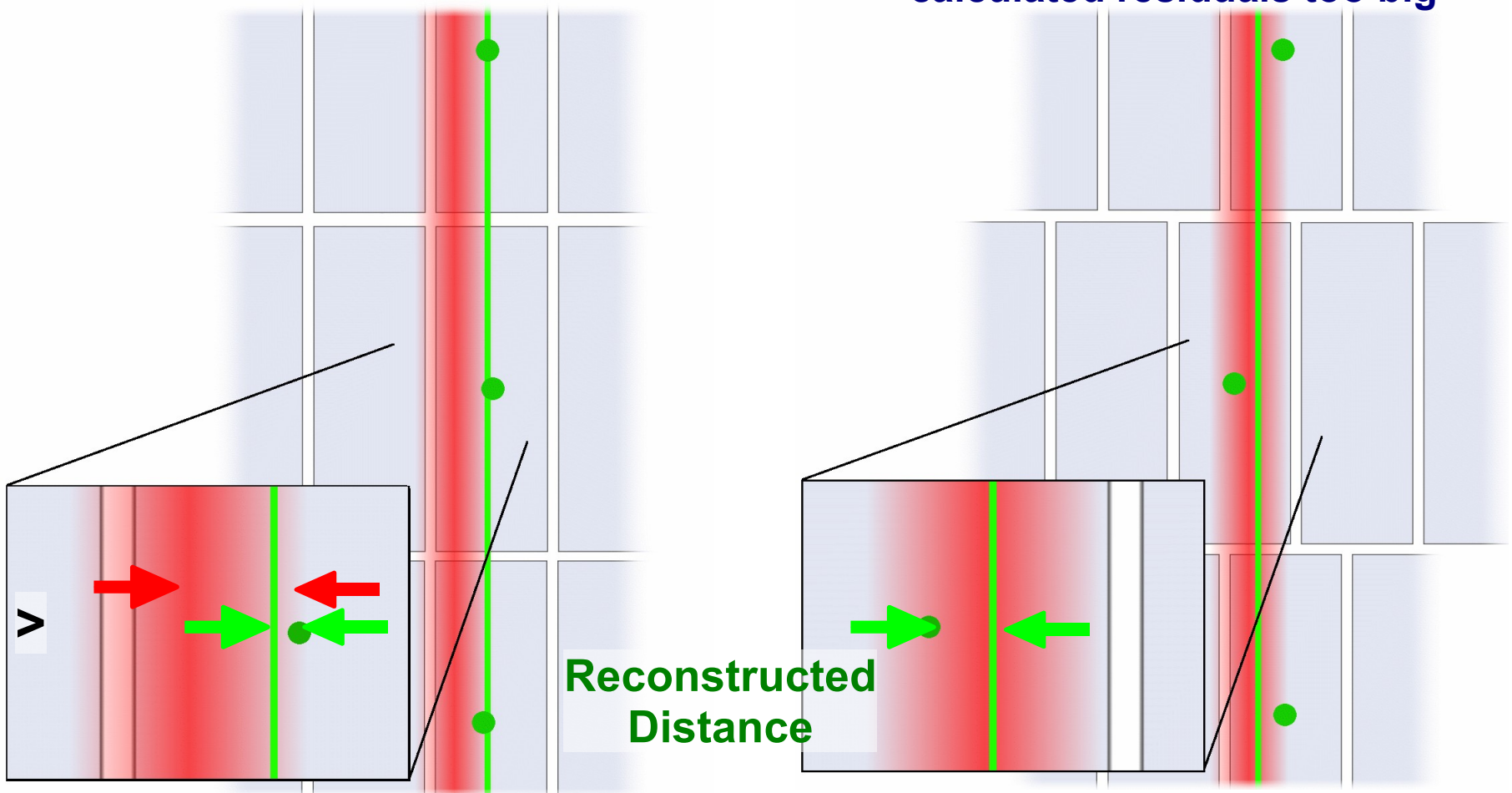


—○— residual without hit —◇— geometric mean
—□— residual with hit —+— triplet — MC truth

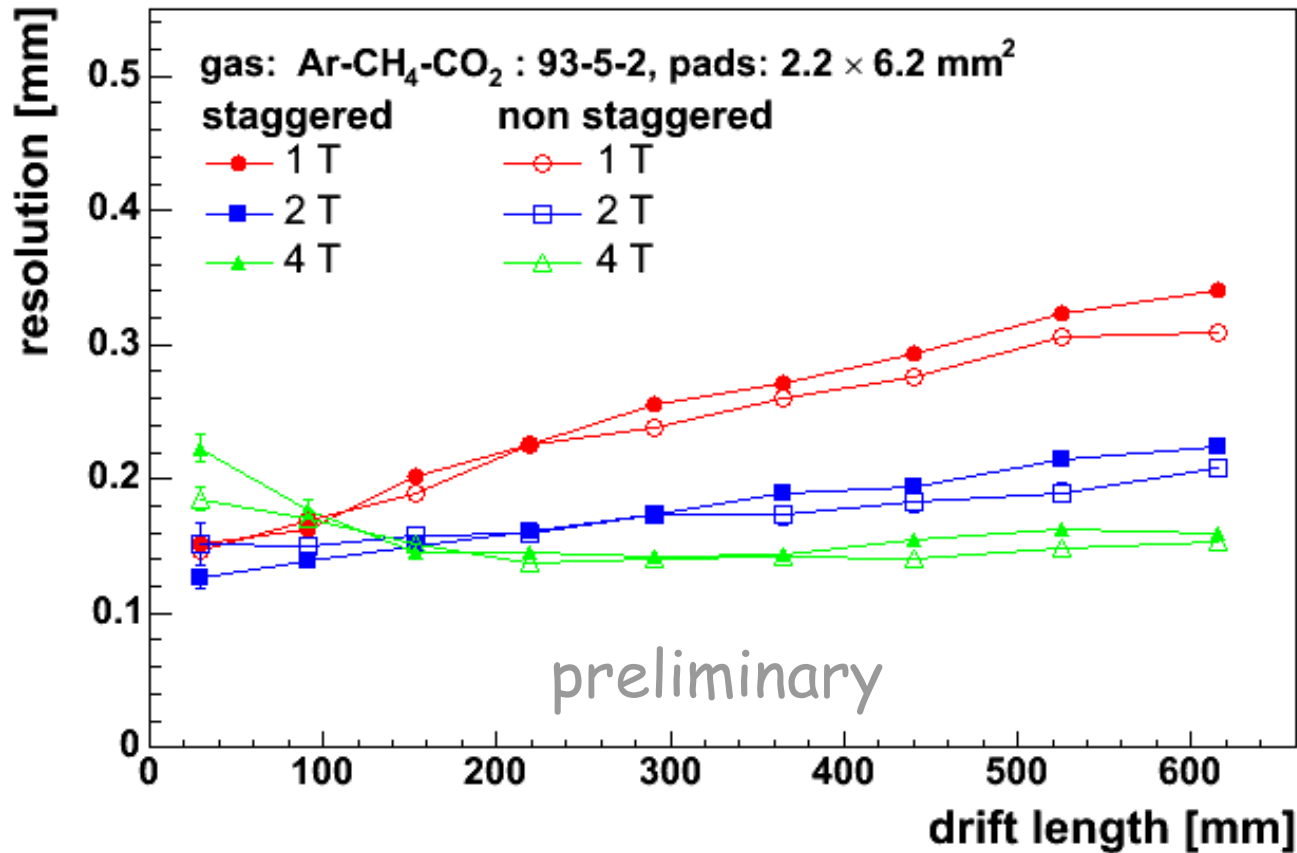
Staggered vs. Non Staggered

Non-staggered Pads:
reconstructed track “gets drawn”
towards the reconstructed points
calculated residuals too small

Staggered Pads:
points get reconstructed
too far from track
calculated residuals too big



Point Resolution with Pad Response Function



- Staggered and non-staggered measurements get comparable
- Bigger values for small drift lengths in 4T (2T) data still indicate not enough charge sharing

Summery&Outlook

- MultiFit is a reconstruction tool for small TPC-prototypes
 - modular (3-step reconstruction)
 - stand alone program
 - use ROOT for IO
 - read ROOT and LCIO based input data
 - analysis with ROOT scripts
- MaTRIX: **M**arlin based **T**rack **R**econstruction for **I**LC **E**xperiments will be the Successor
 - embedded in the Marlin analysis framework
 - use LCIO for IO and
 - GEAR as geometry interface
 - LCCD allows handling of conditions data
 - better encapsulation of the modules