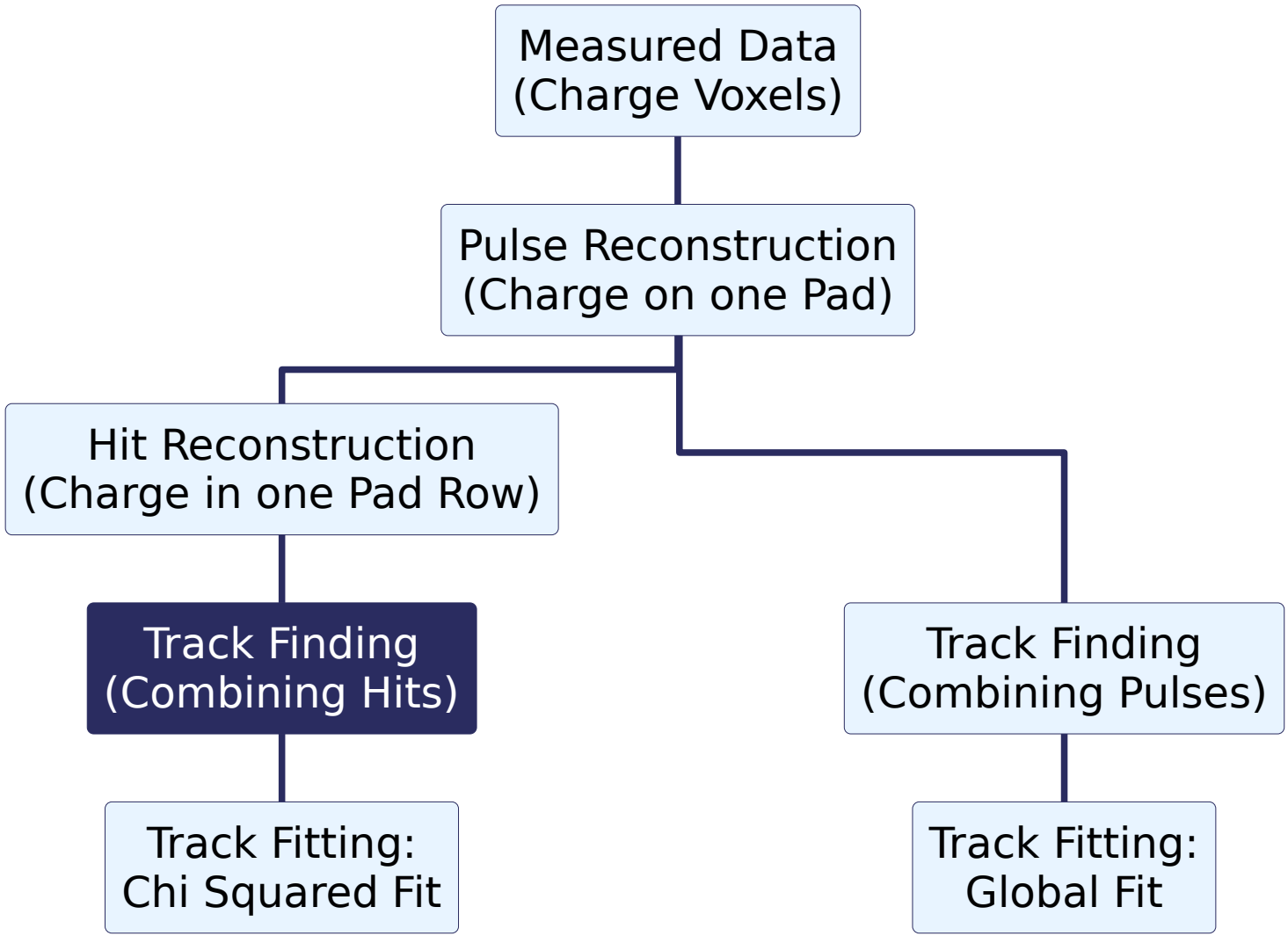
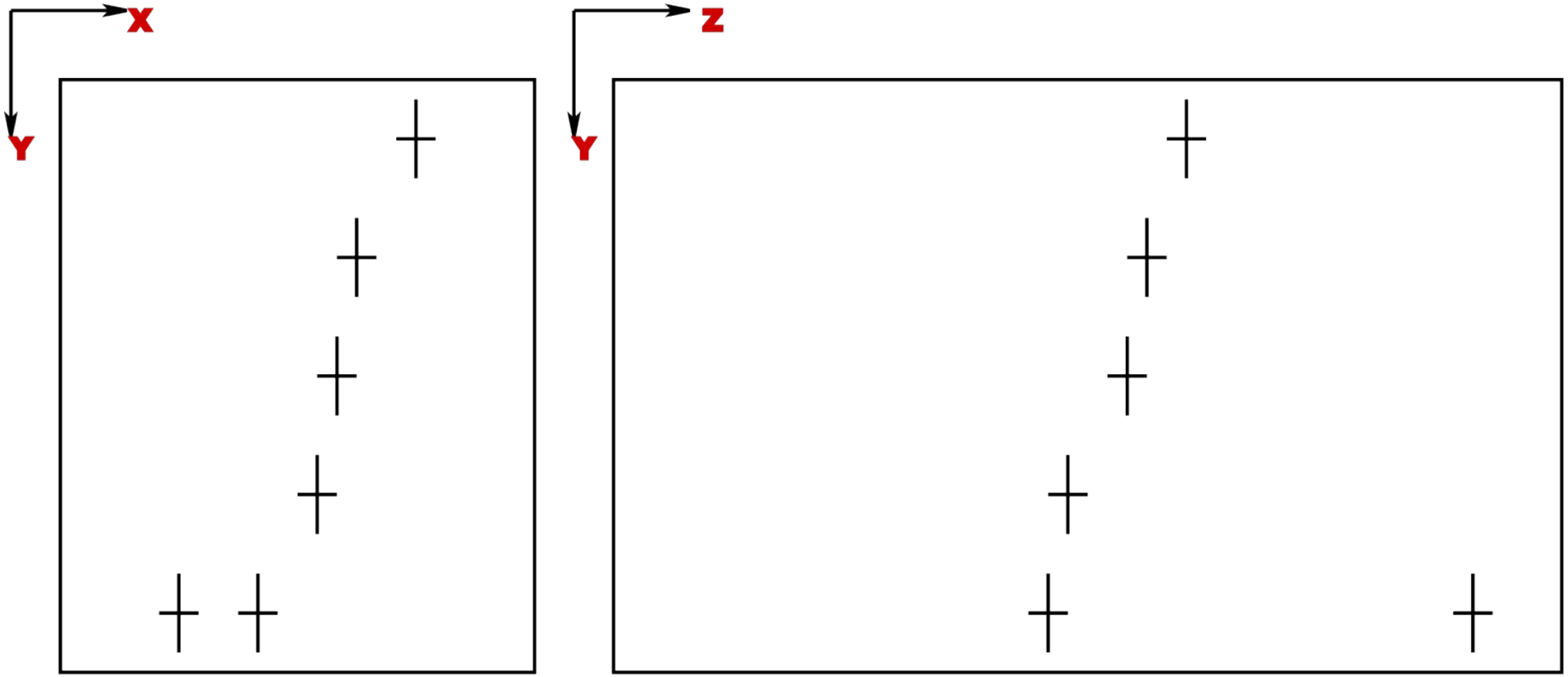
Track Finding



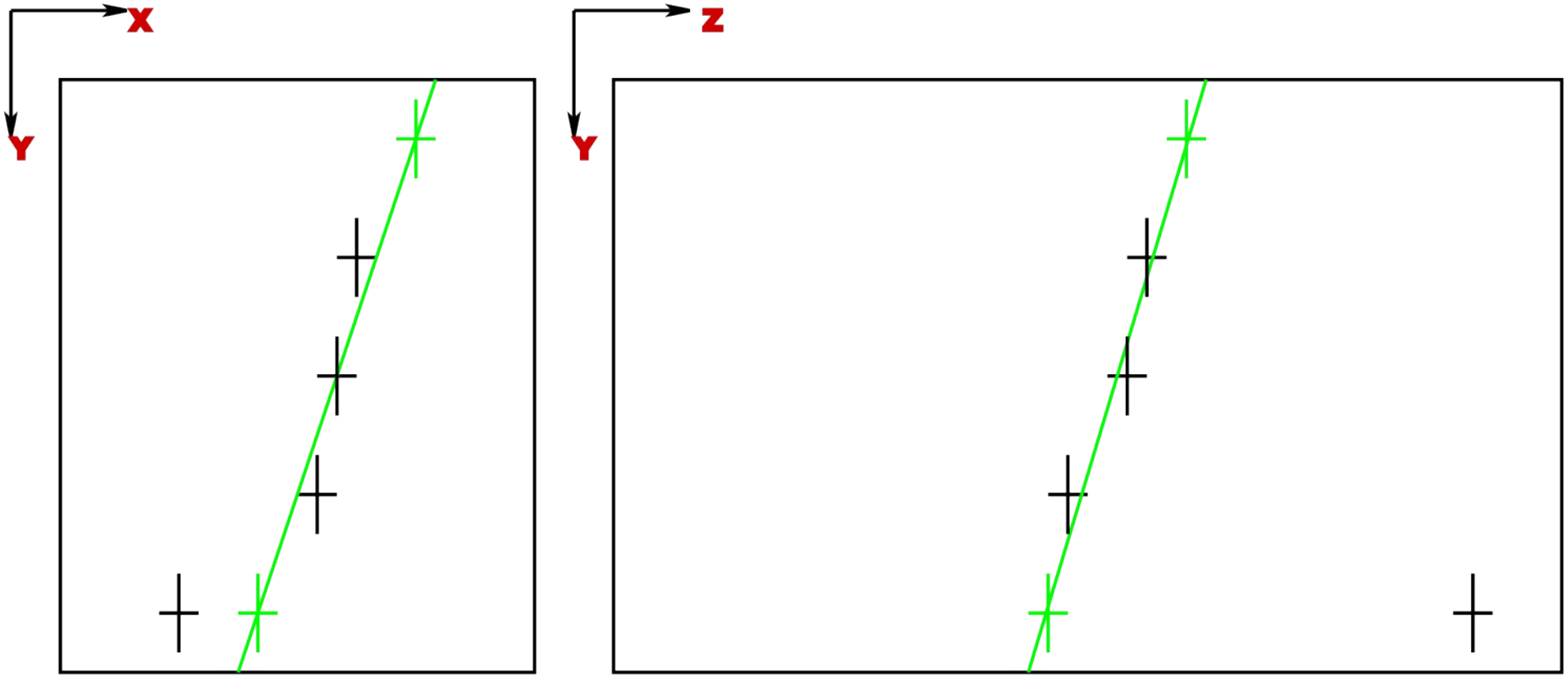
Simple Linear Track Finder

- If tracks are linear or curvature is small (compared to the size of your sensitive volume), a simple linear track finding can be used: Track Following Algorithm



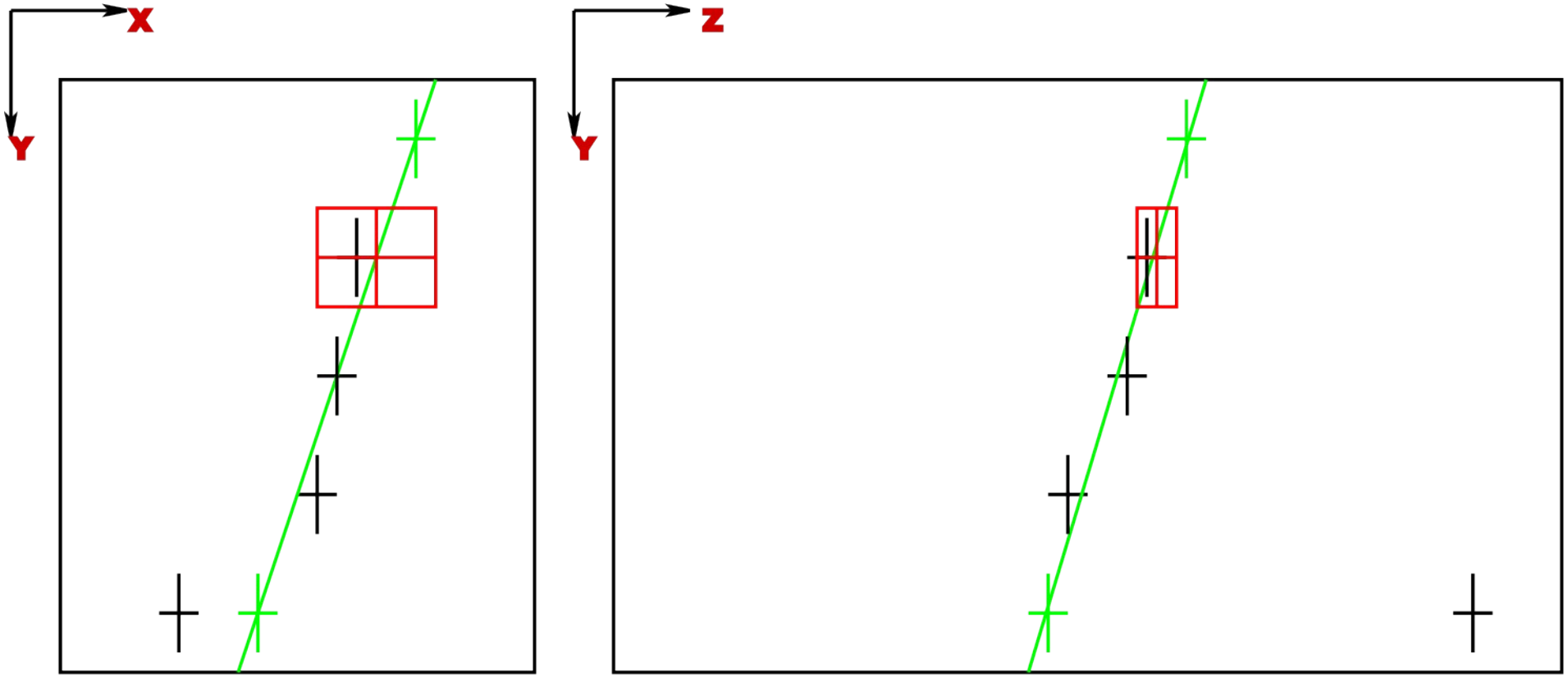
Simple Linear Track Finder

- Make a Track guess out of two Hits
  (randomly chosen with some constraints)
- Initialize search by fitting a straight line through them



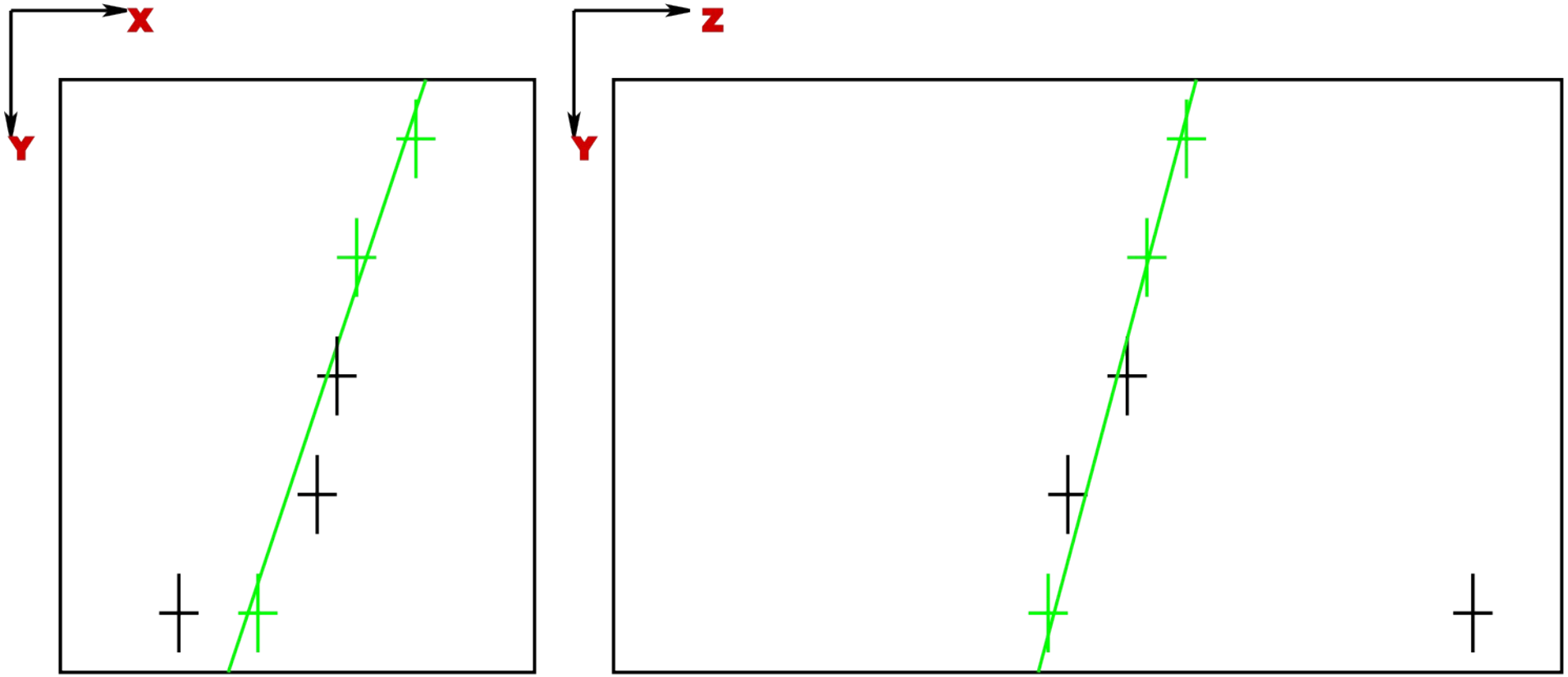
Simple Linear Track Finder

- Search inside a X- and a time window (red rectangles) for a Hit candidate in the next row
- Search windows should be large enough to account for small curvature



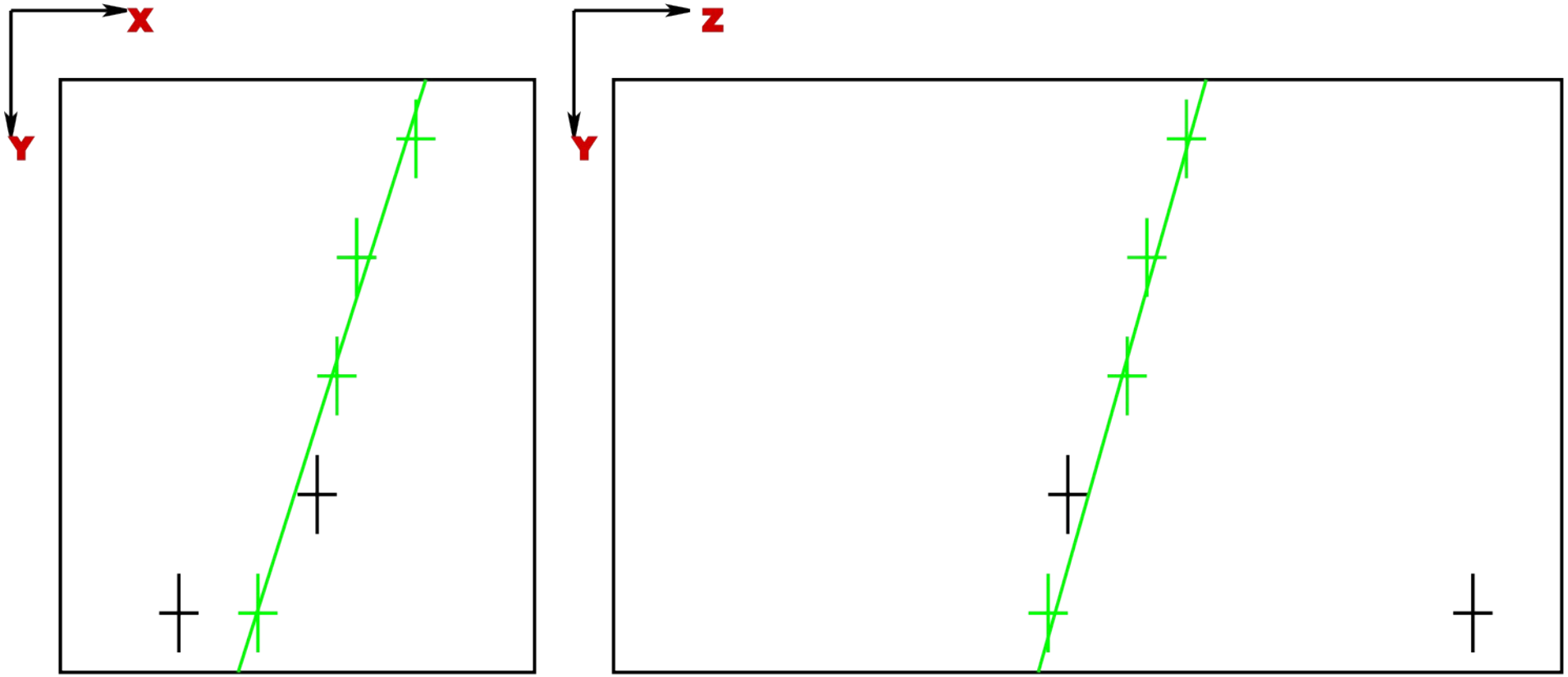
Simple Linear Track Finder

- If a Hit is found is the search windows, add it to the track and repeat straight line fit including the newly added Hit
- If two Hits are found, make straight line fit and take the Hit with the higher probability (best χ^2) is chosen



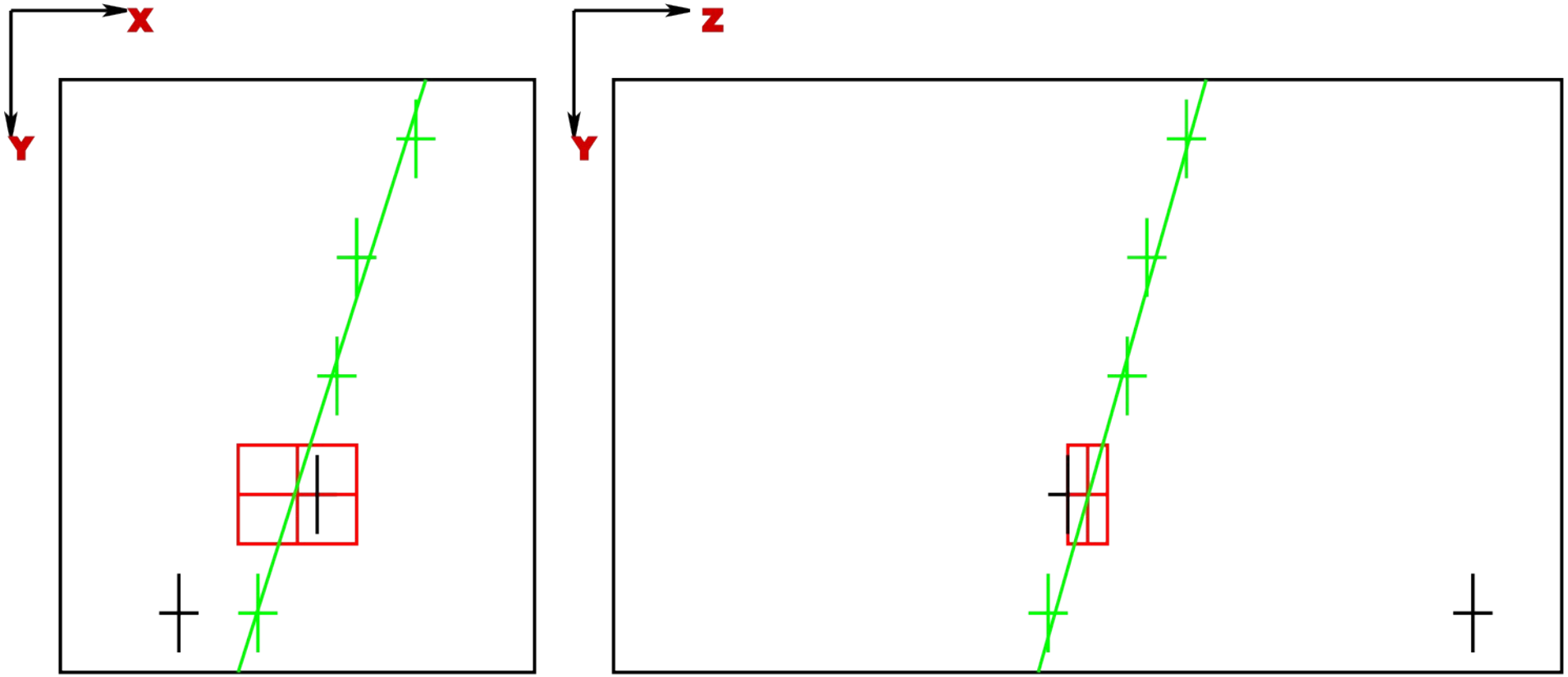
Simple Linear Track Finder

- Repeat this procedure (search, add, fit) in the following rows



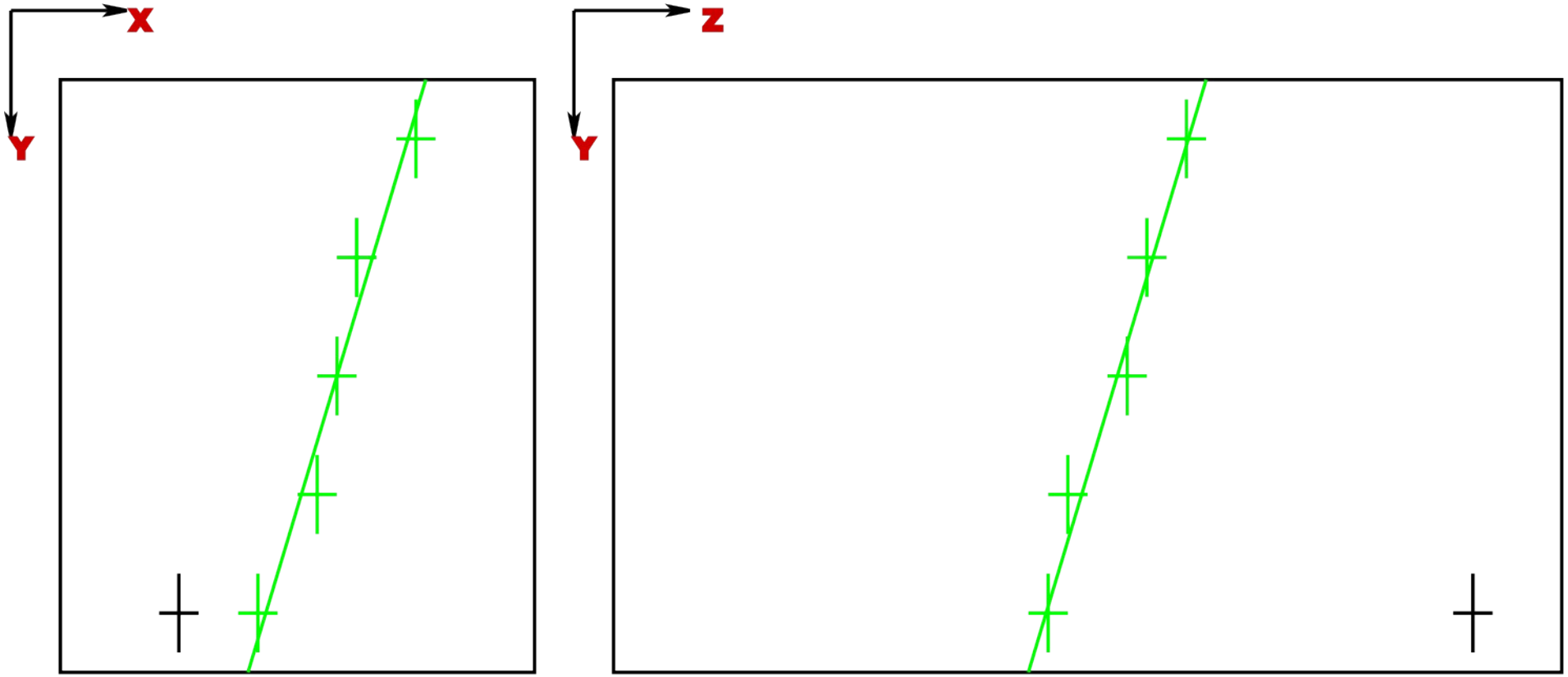
Simple Linear Track Finder

- Repeat this procedure (search, add, fit) in the following rows



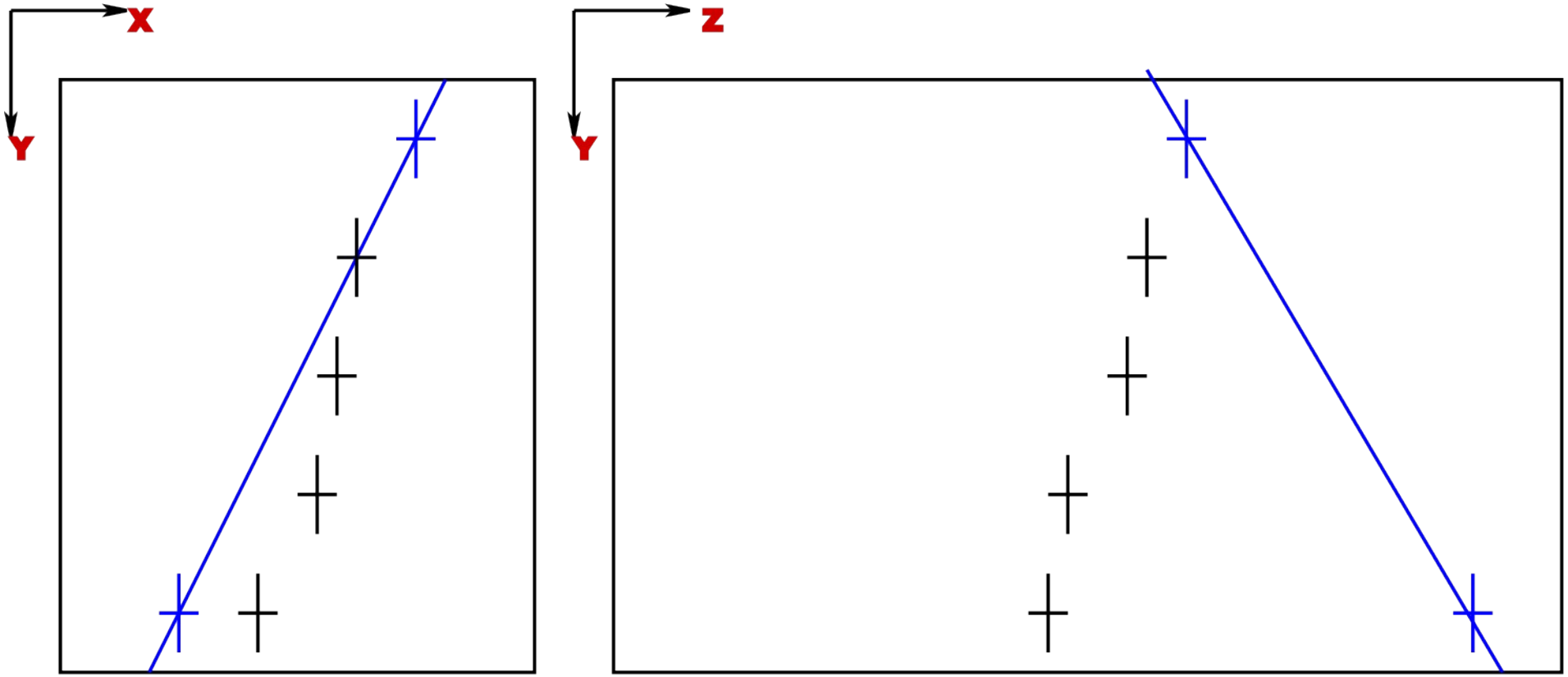
Simple Linear Track Finder

- If arrived at the last row, store Hits in a collection for later exact track fitting



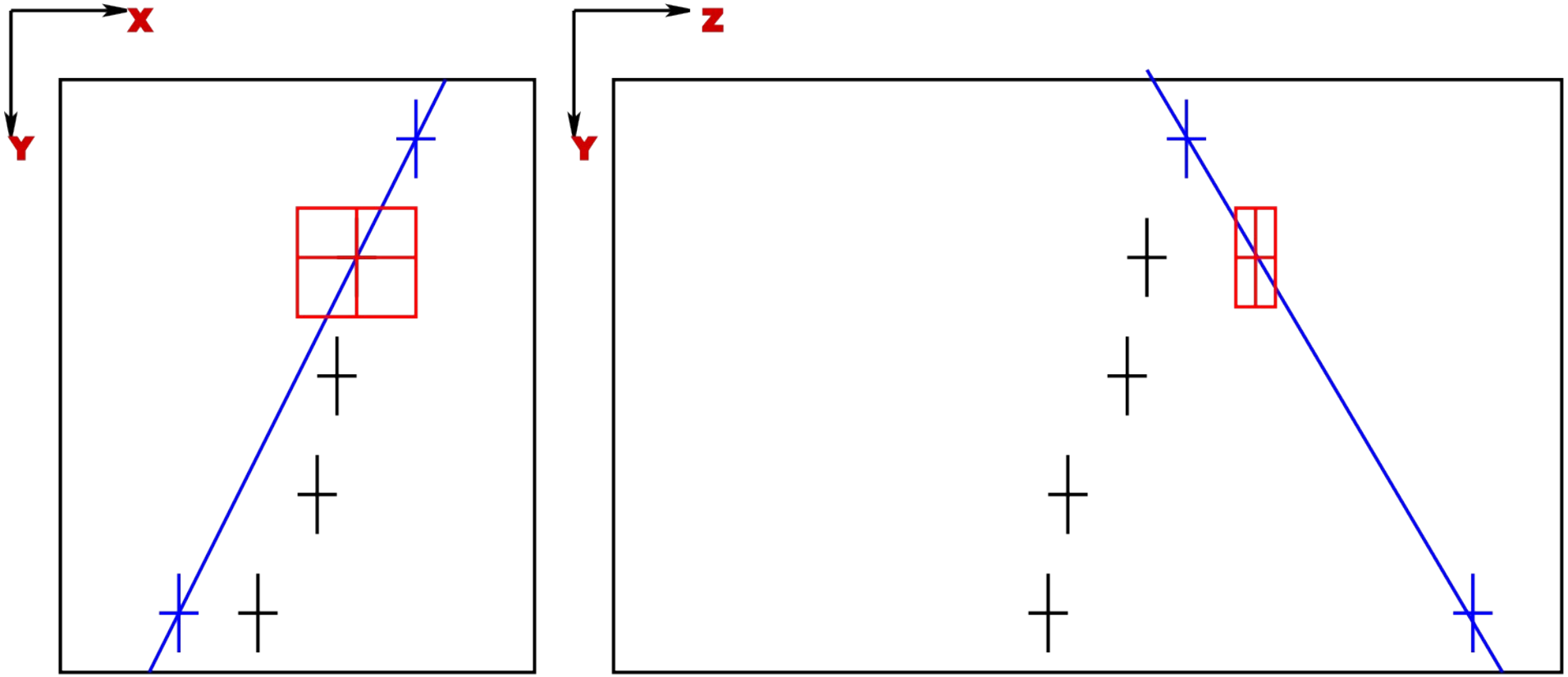
Simple Linear Track Finder

- A gap of at least one (or a few) row without a hit should be allowed to account for reconstruction errors



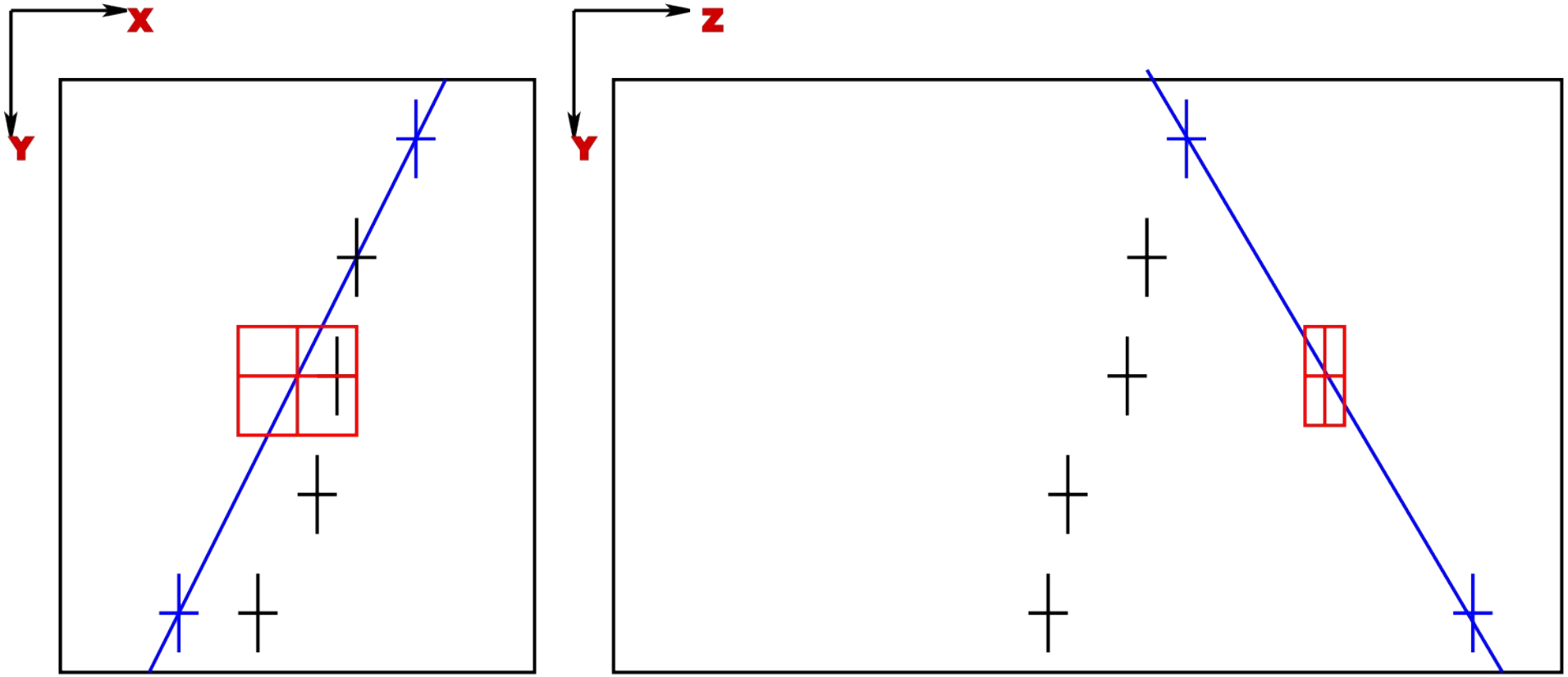
Simple Linear Track Finder

- If in one row no Hit is found, go on with the next row



Simple Linear Track Finder

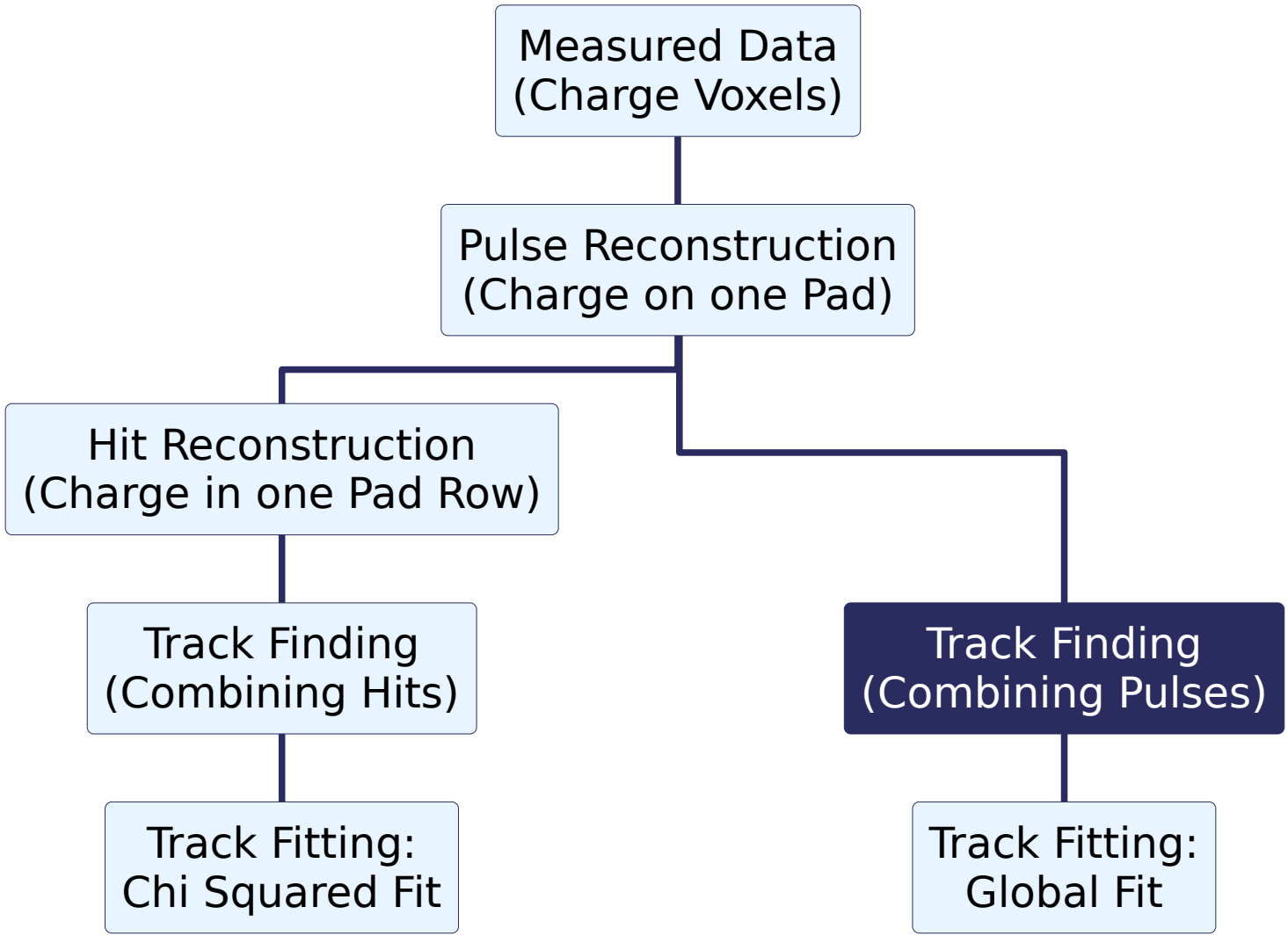
- If there also no Hit is found inside the search windows, stop track finding and try other initializing Hits combination (if any is left)



Kalman Filter

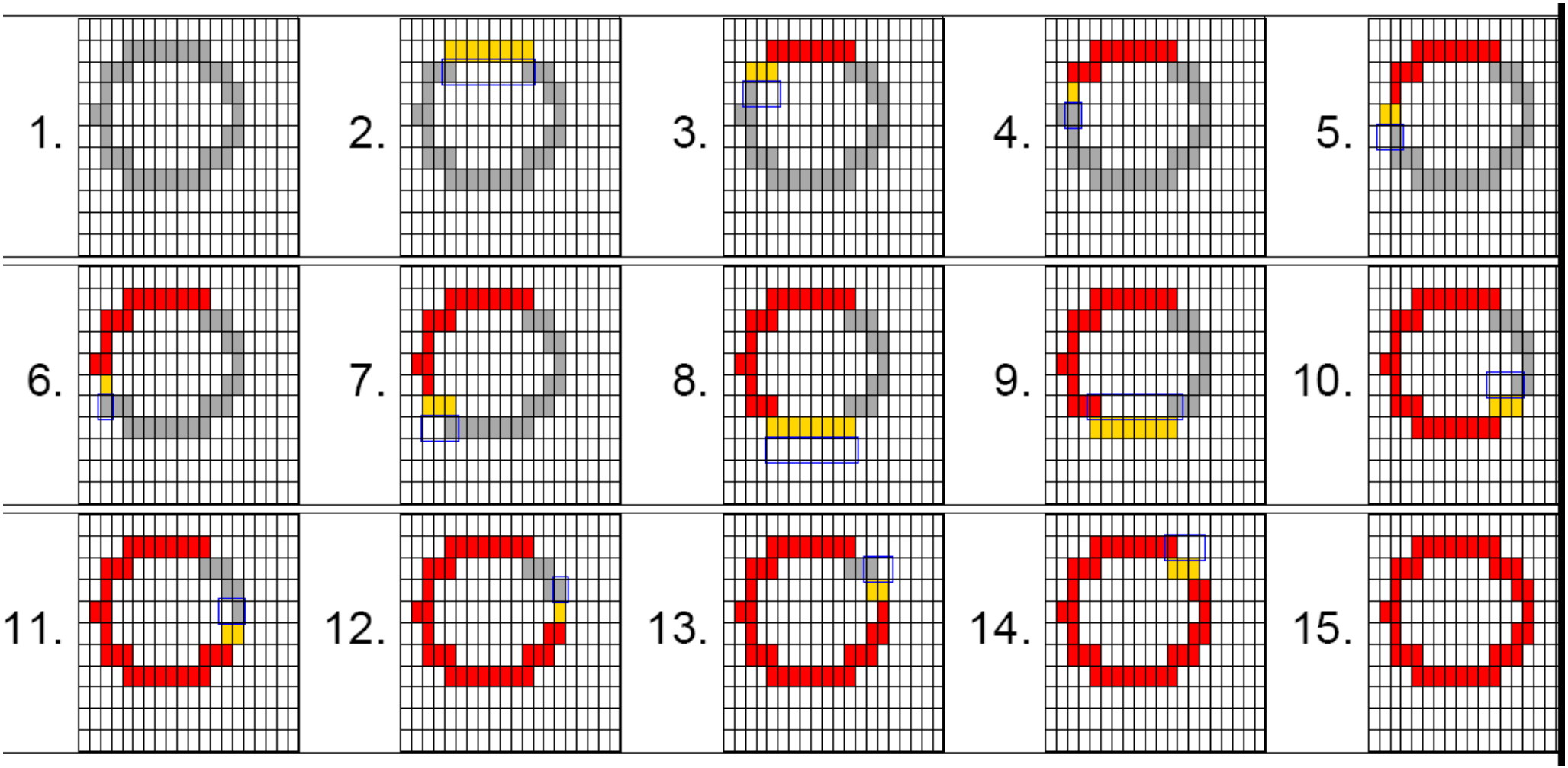
- Other possibility to find hits belonging to a track:
  Using a Kalman filter technique
- Similar Method to the Track Following explained before:
  - Initialized with a few Hits
  - New Hits are added one by one
  - Basically a Chi Squared fit where hits are added one by one
- Advantages:
  - Can take into account track shape different from straight line
  - Fit is not completely redone after adding a Hit,
    so you save computing time
  - Results is Track (=Hit collection) including(!) Chi Squared Fit results
- For more information, see (for example):
  “Pattern Recognition and Event Reconstrcution in Particle Physics Experiments”, R. Mankel, 2004
  “Applied Fitting Theory V: Track Fitting Using the Kalman Filter”, Paul Avery, 1992

Track Finding



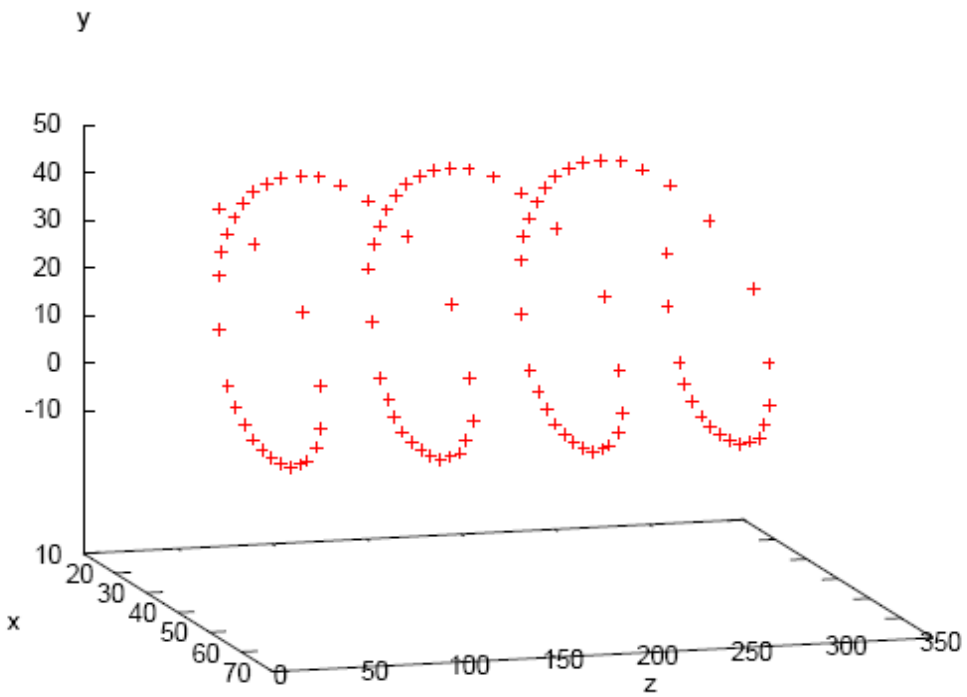
Topological Track Finder

- Search for connected Pulses in a row (inside time window)
- Search for Pulses in adjoining rows (inside time window) and take them as starting point for a new search for connected Pulses



Topological Track Finder

- This algorithm can find straight and curved tracks, even curlers
- Special care has to be taken for rows with two possibilities to go on (noise, delta electrons etc.)
- Rows with no charge have to be taken into account and algorithm should search in the second next row too (like before)
- Hits can be derived from connected charge in one row
- But no probability measure for adding of “Hits” (connected charges)



Track Object

- Object Properties (so far):
- Collection of constituents:
  A vector (array) of Hits resp. Pulses belonging to the track
- Basic Track parameters (a first guess):
  Intercept (where does it enter the sensitive volume)
  Slope (angle)
  Maybe a curvature estimate