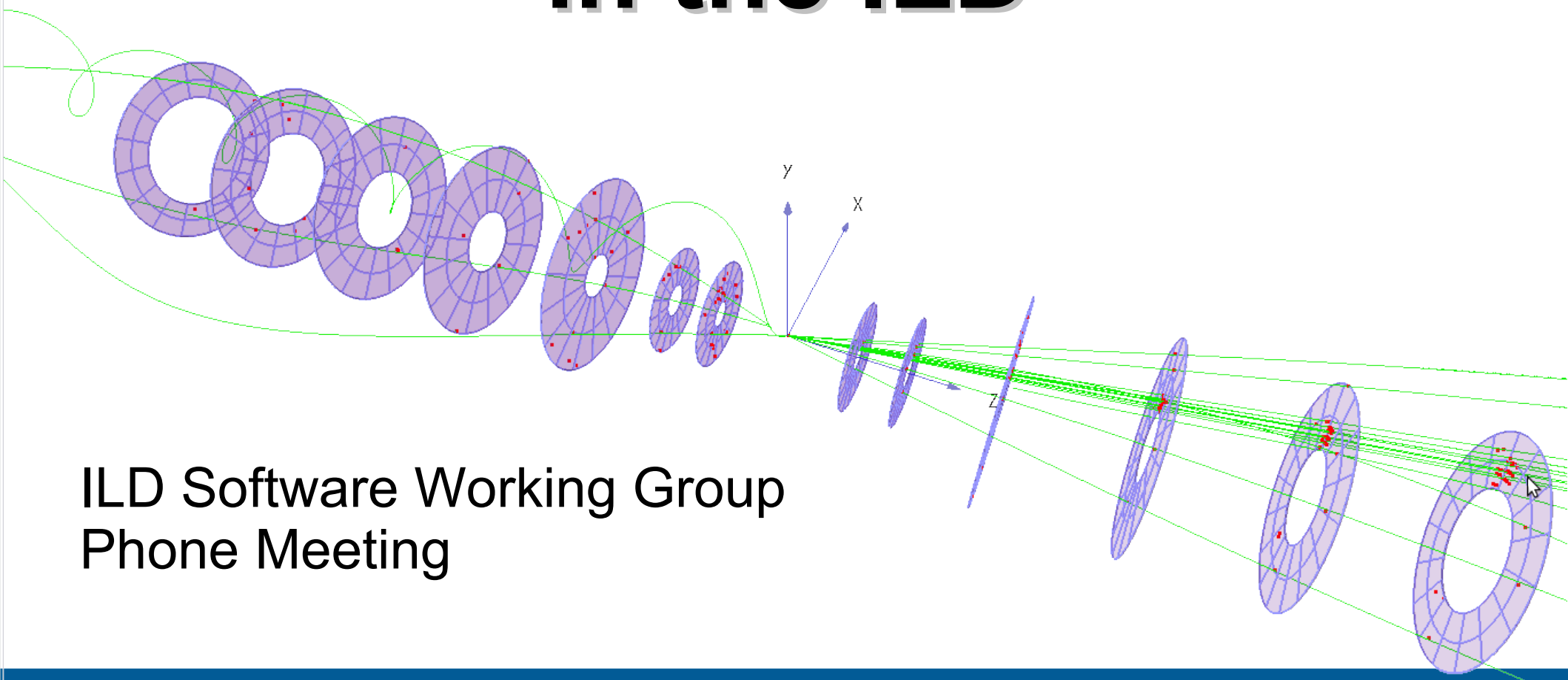
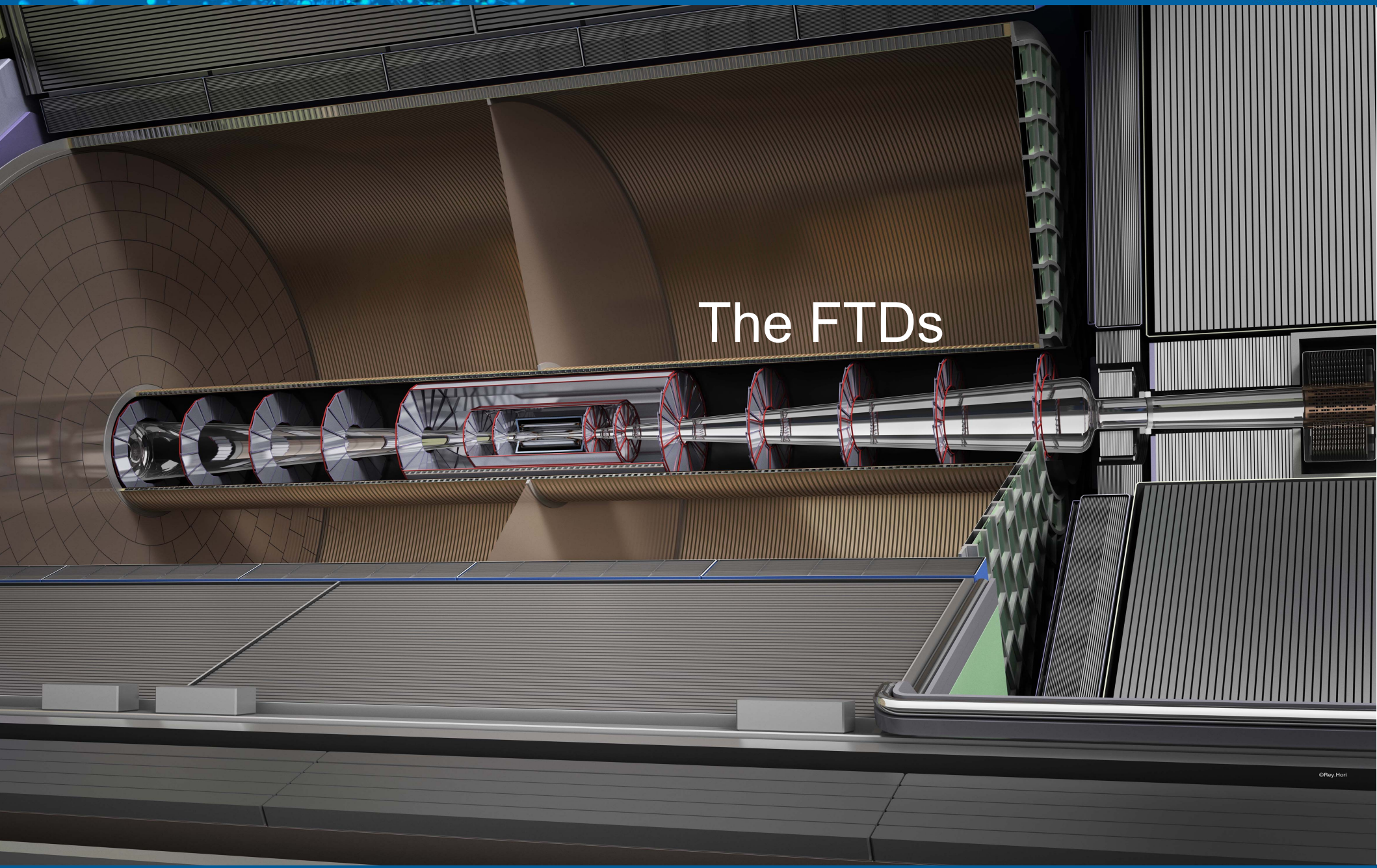
Forward Tracking in the ILD



ILD Software Working Group
Phone Meeting

The FTDs



SiliconTracking

- Old trackfinder for the FTDs (and others)
- SiliconTracking_MarlinTrk
- Problems:
  - maintainability
  - background
  - used Fortran (solved since Fortran Free Friday)

Goals

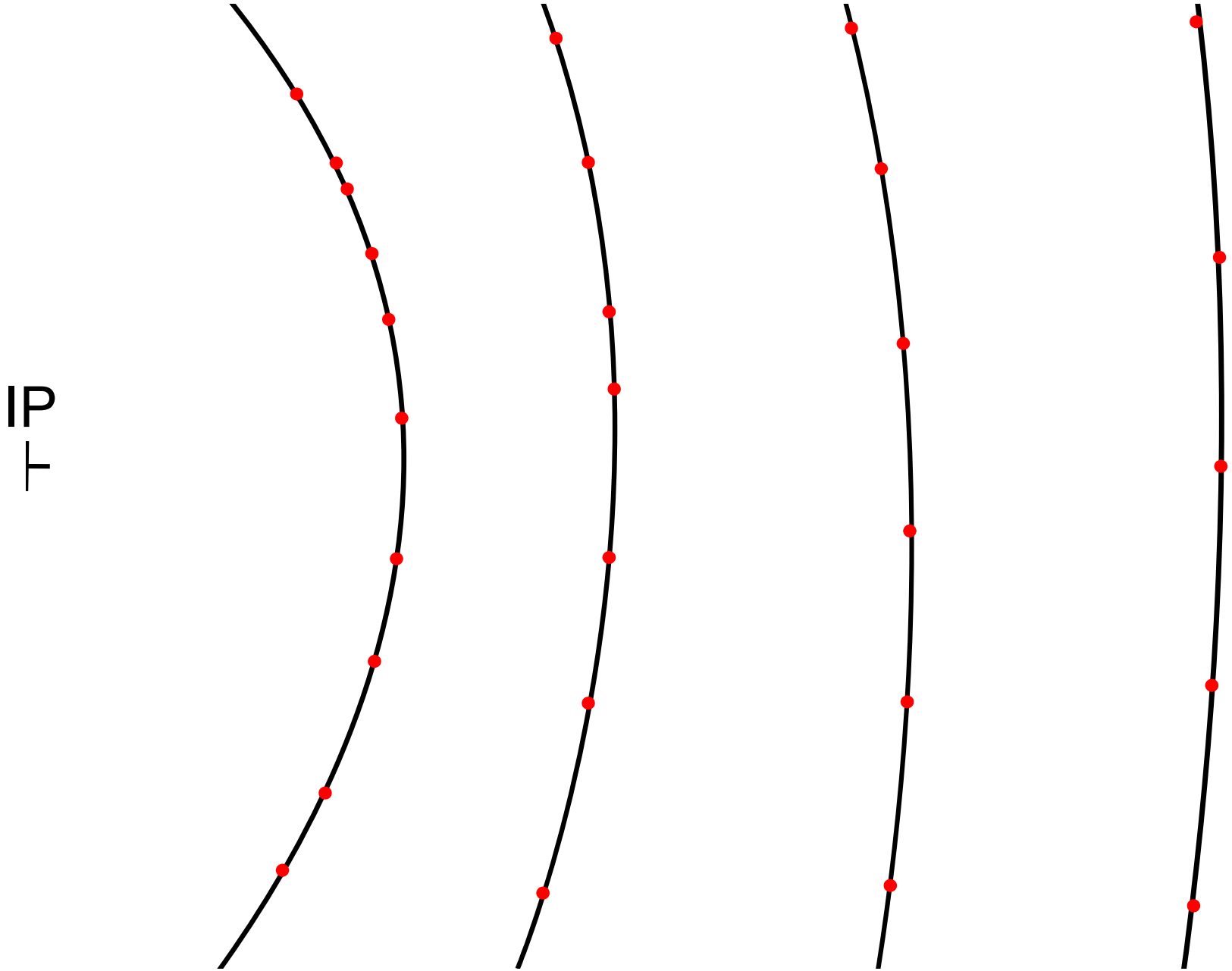
- Standalone track search for the FTDs
- Using KalTest + KalDet + MarlinTrk Combo
- Efficiency and ghostrate
- Deal with background (speed)
- Object oriented → more flexible, maintainable

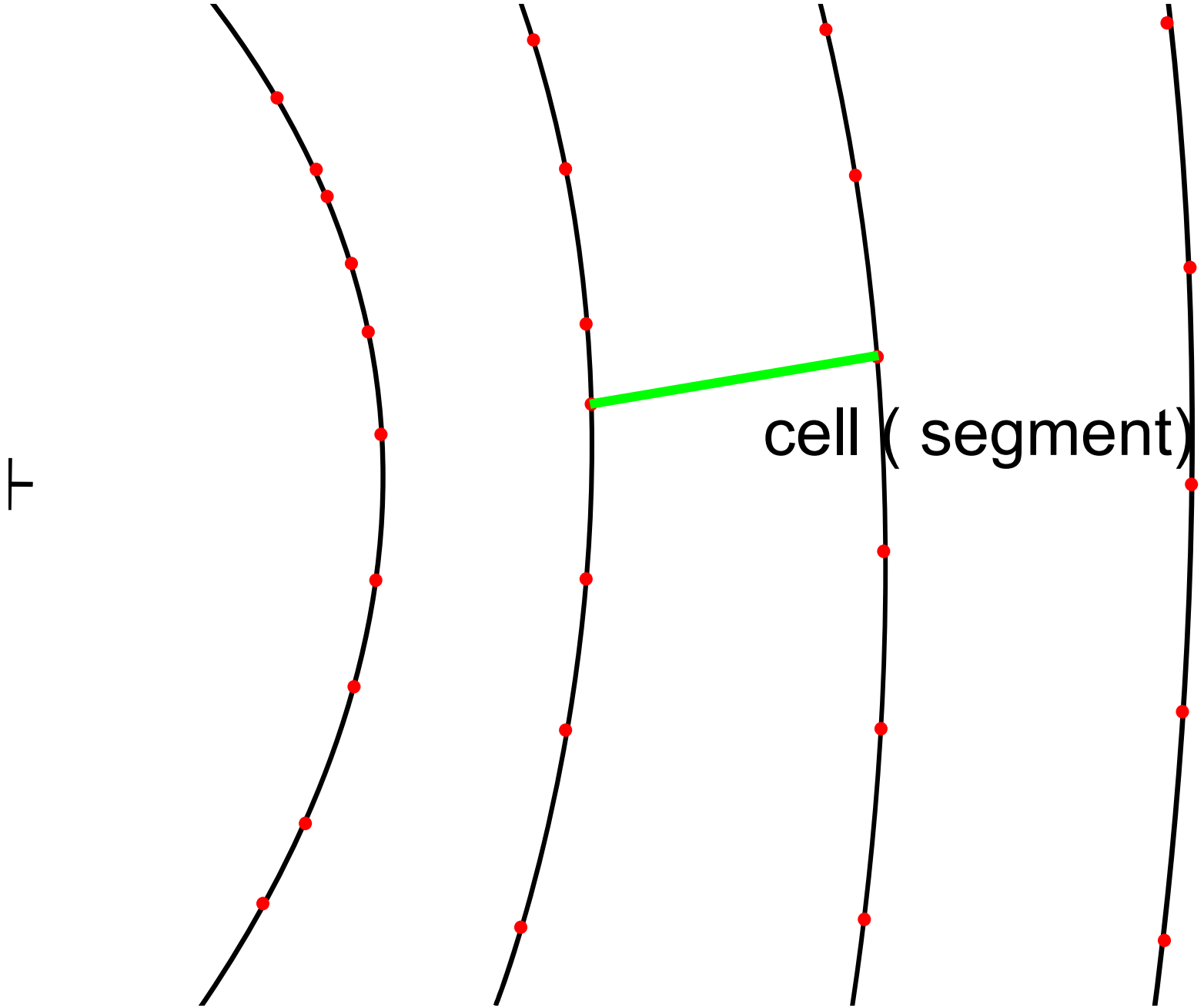
Tools

- Cellular Automaton
- Kalman Filter
- Hopfield Neural Network

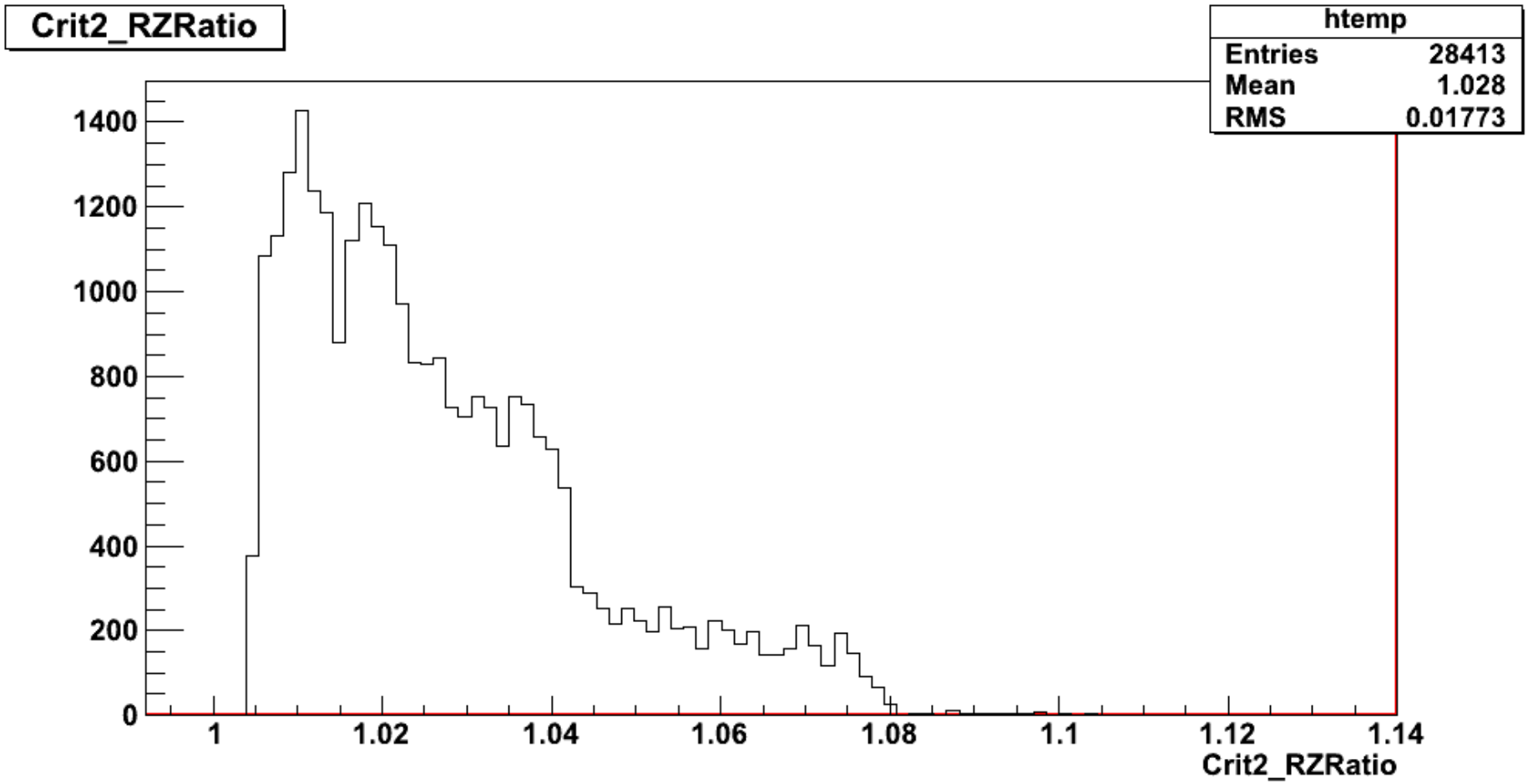
The Cellular Automaton

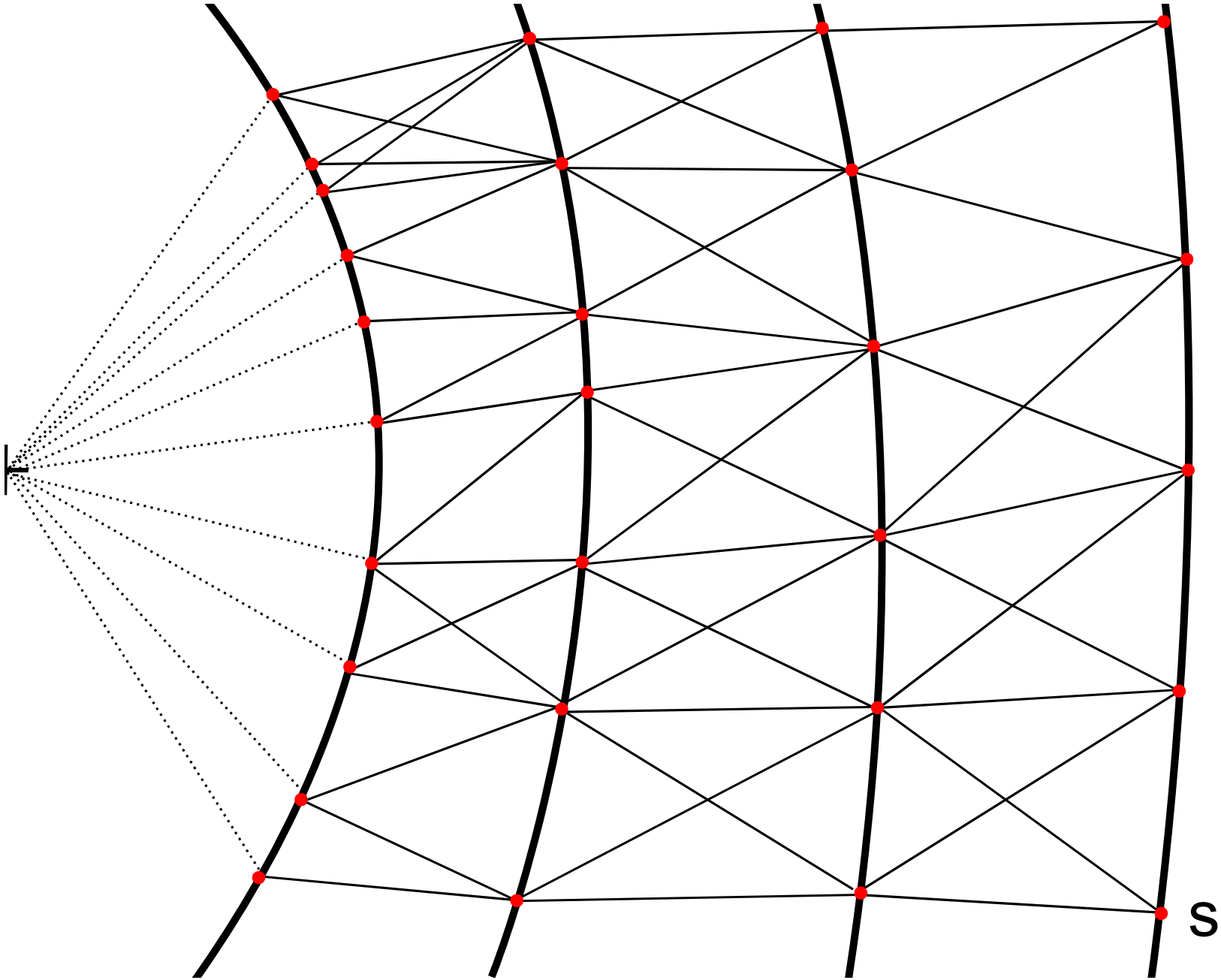
- Cells have a state (here: unsigned int 0 , 1 ,...)
- They are connected to other cells
- They evolve depending on those other cells

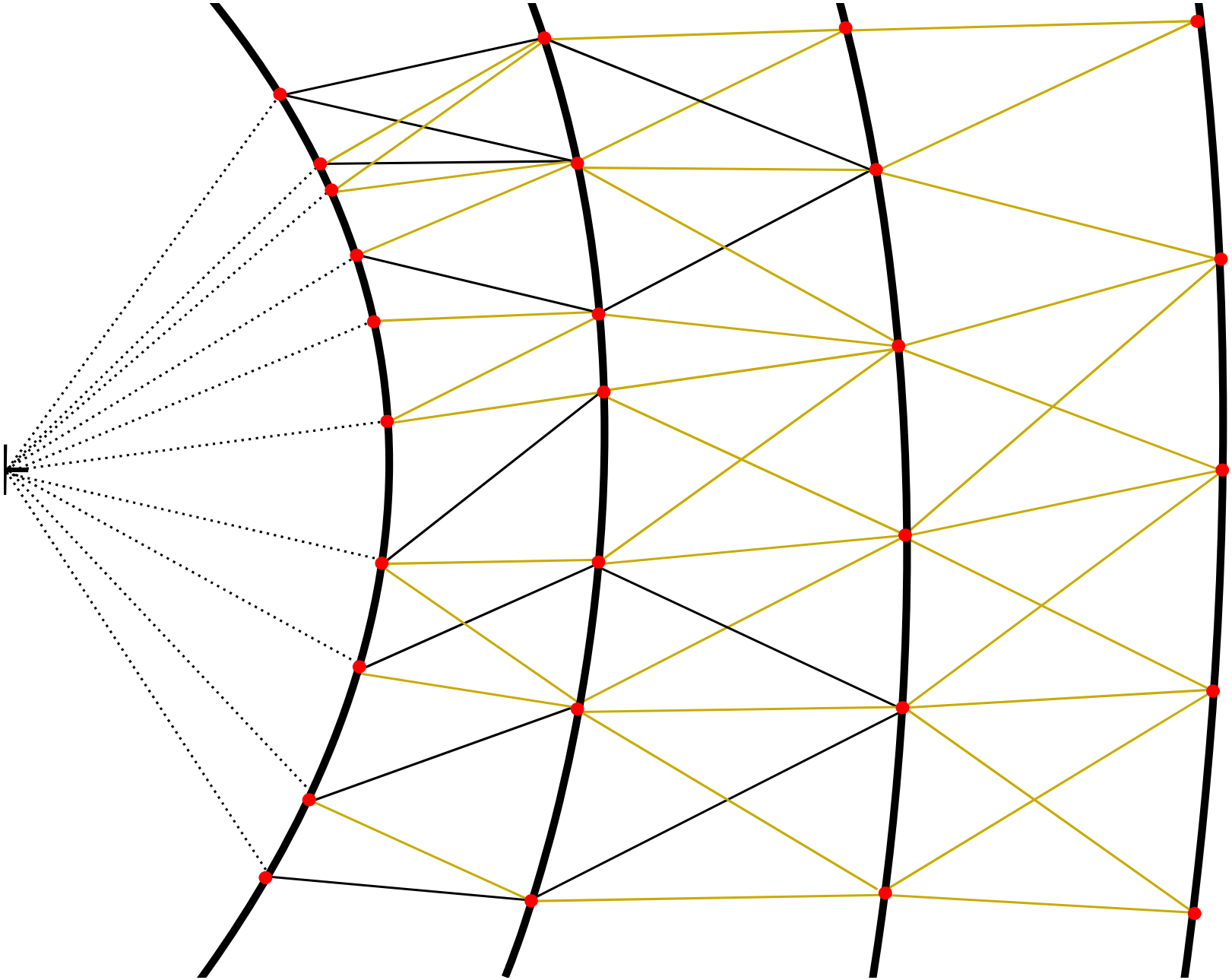

IP

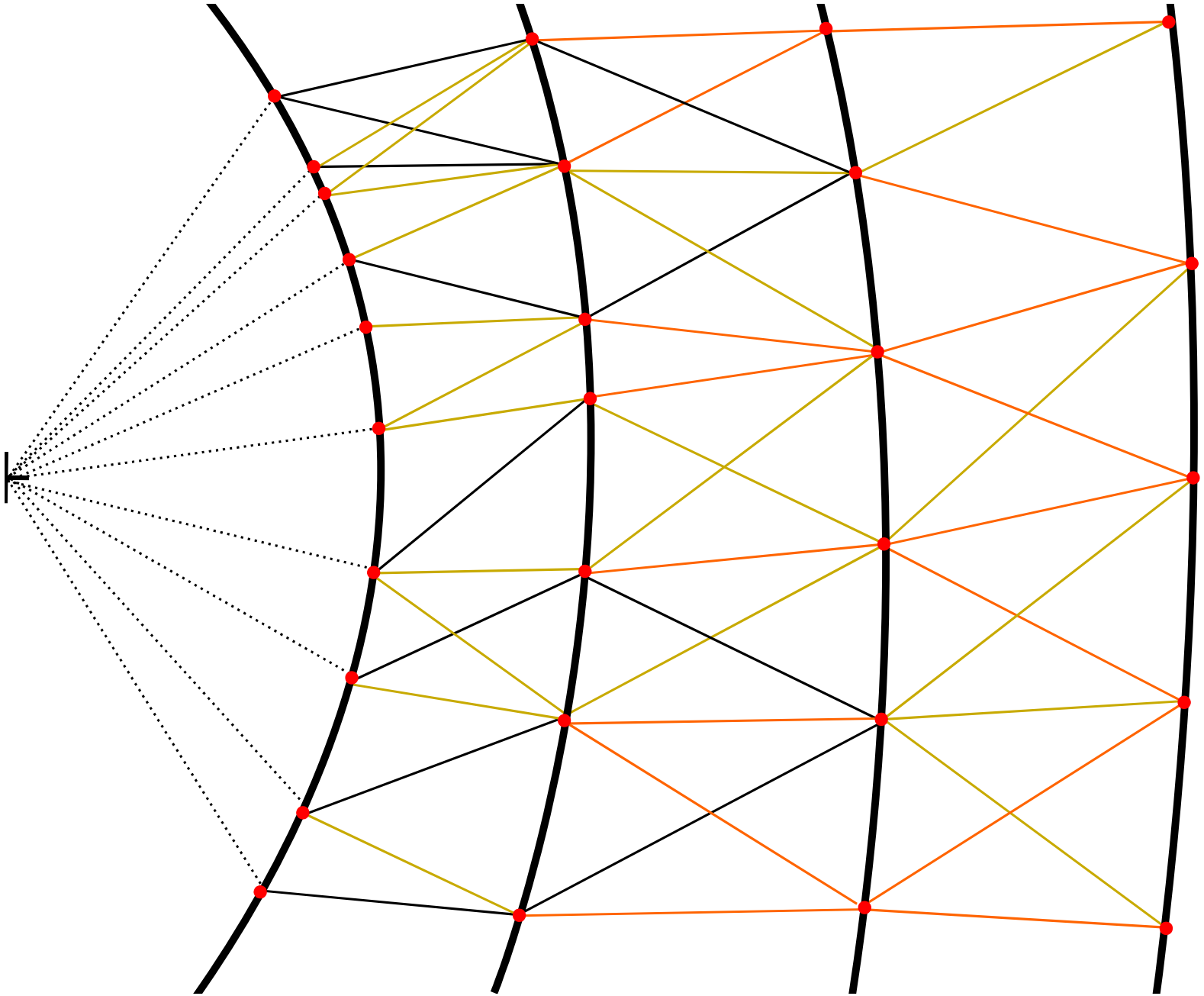

cell (segment)

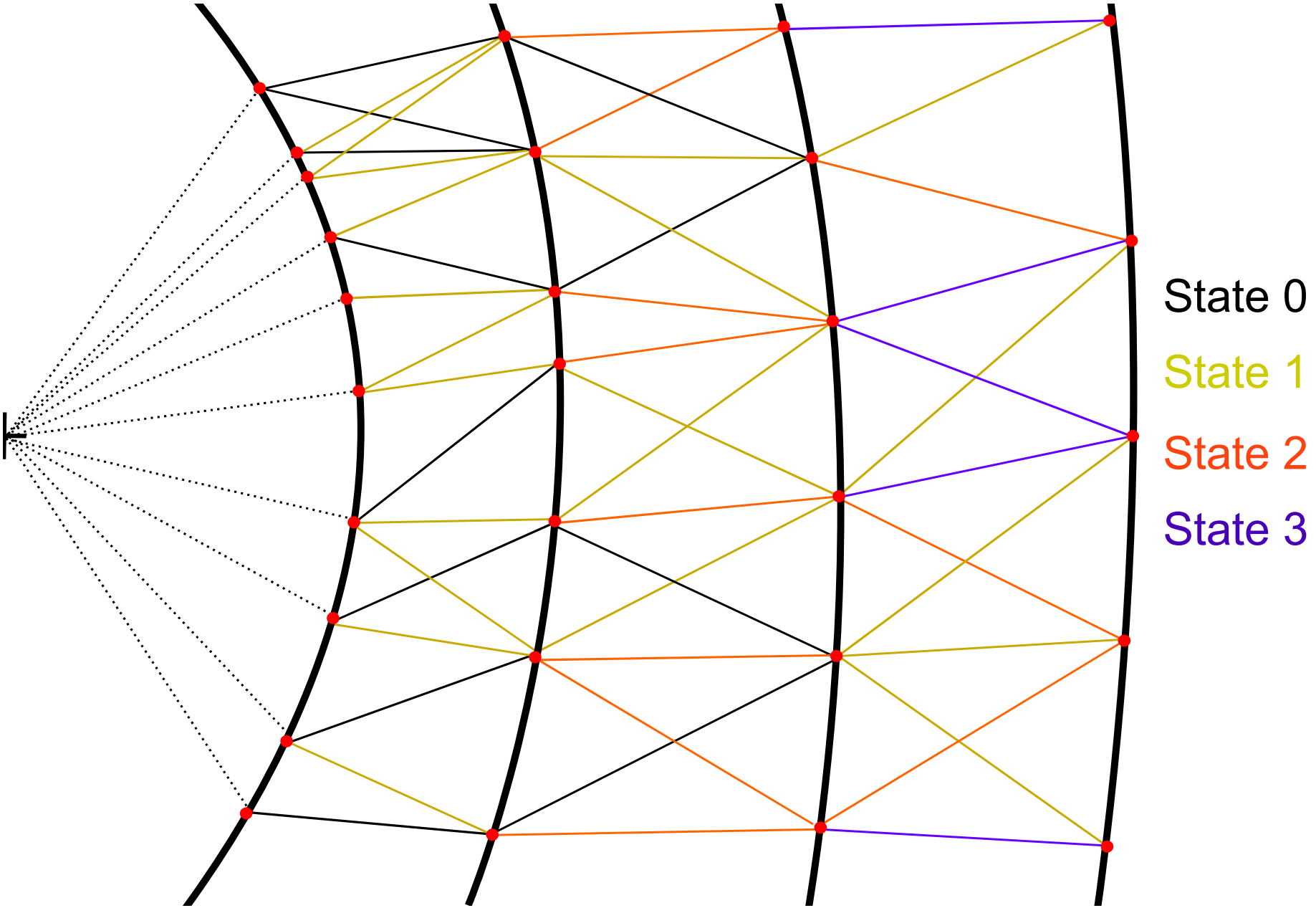
- Connecting all → combinatorial disaster
- Therefore: analyse properties of true tracks

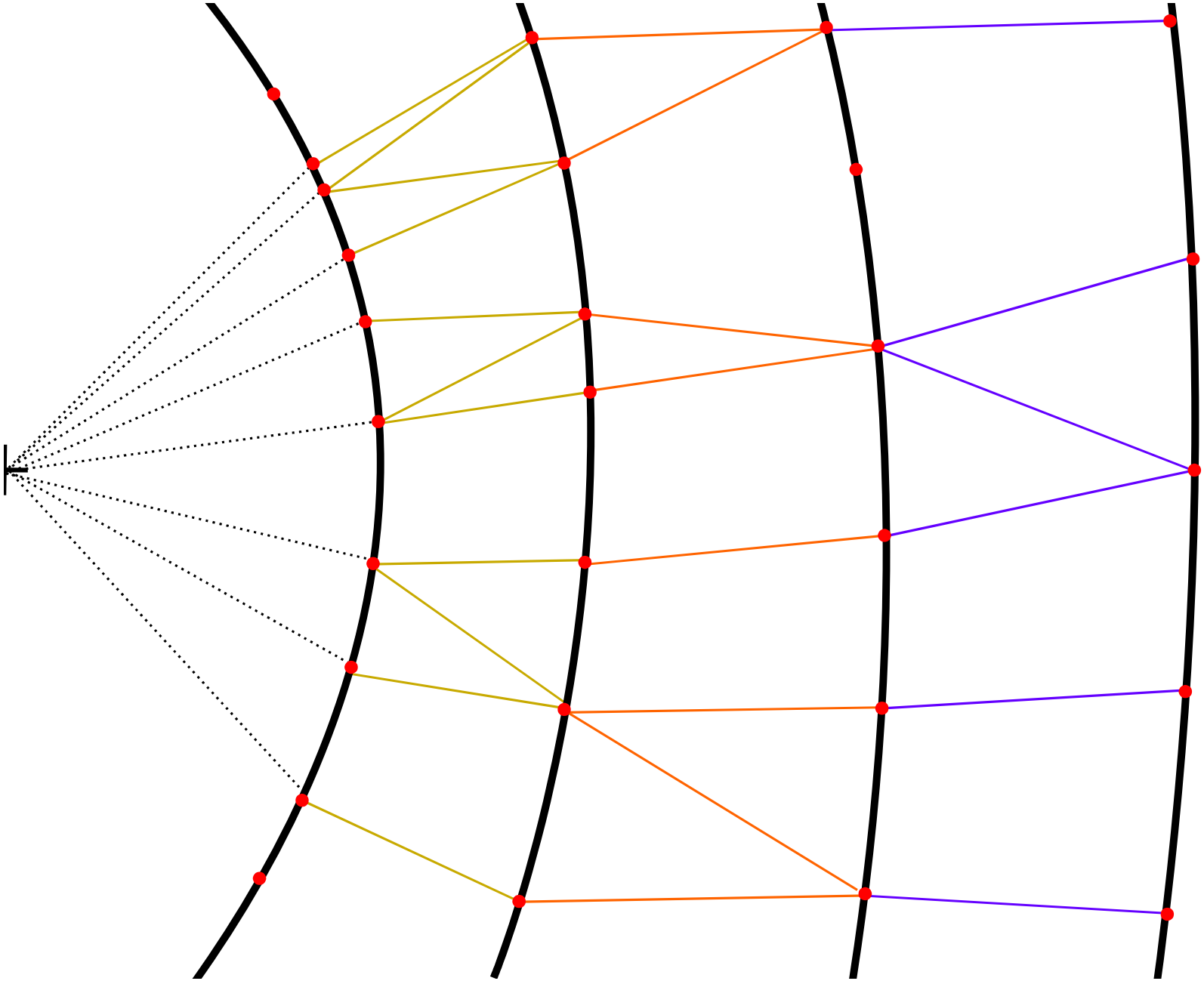



state 0



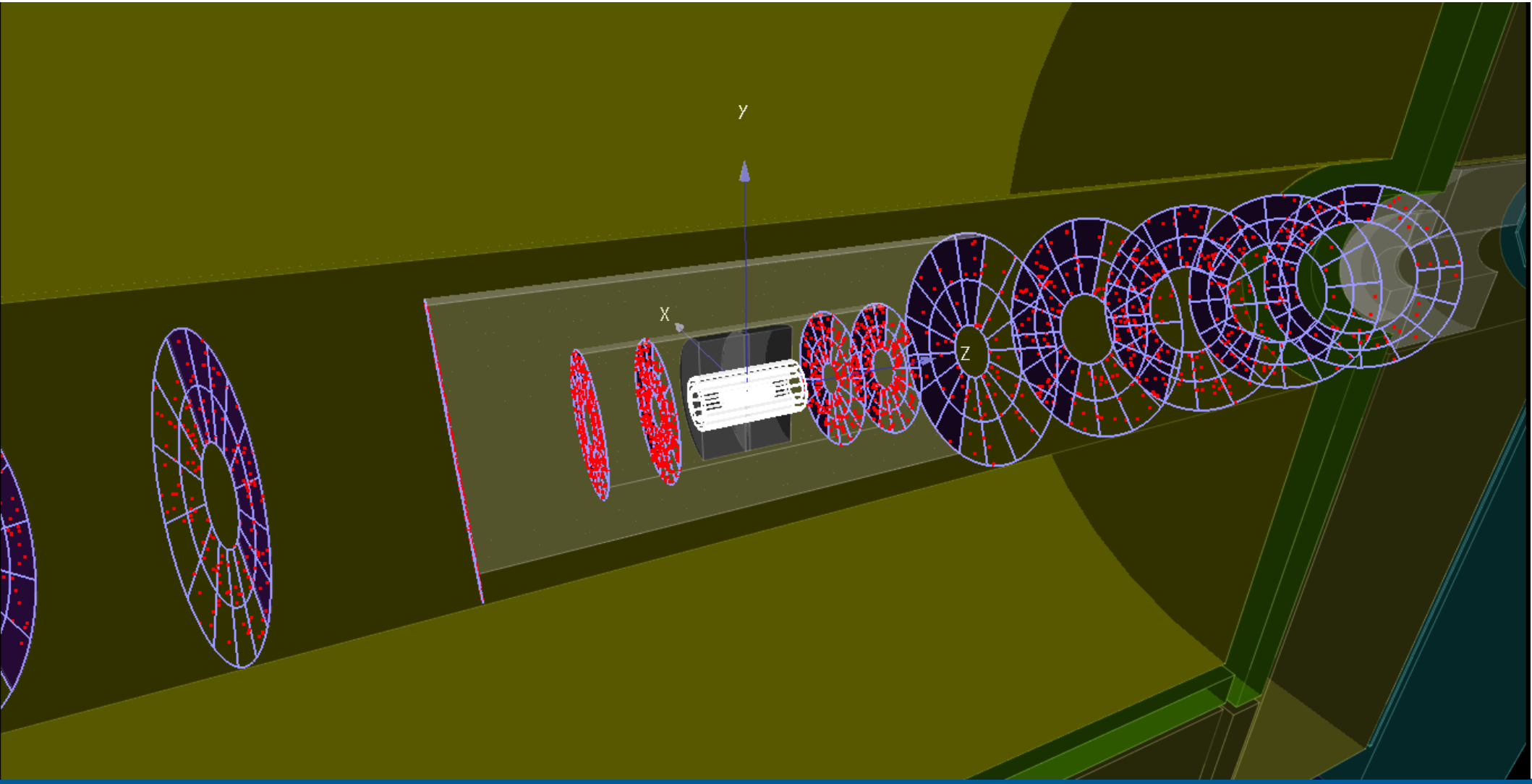



State 0
State 1
State 2
State 3

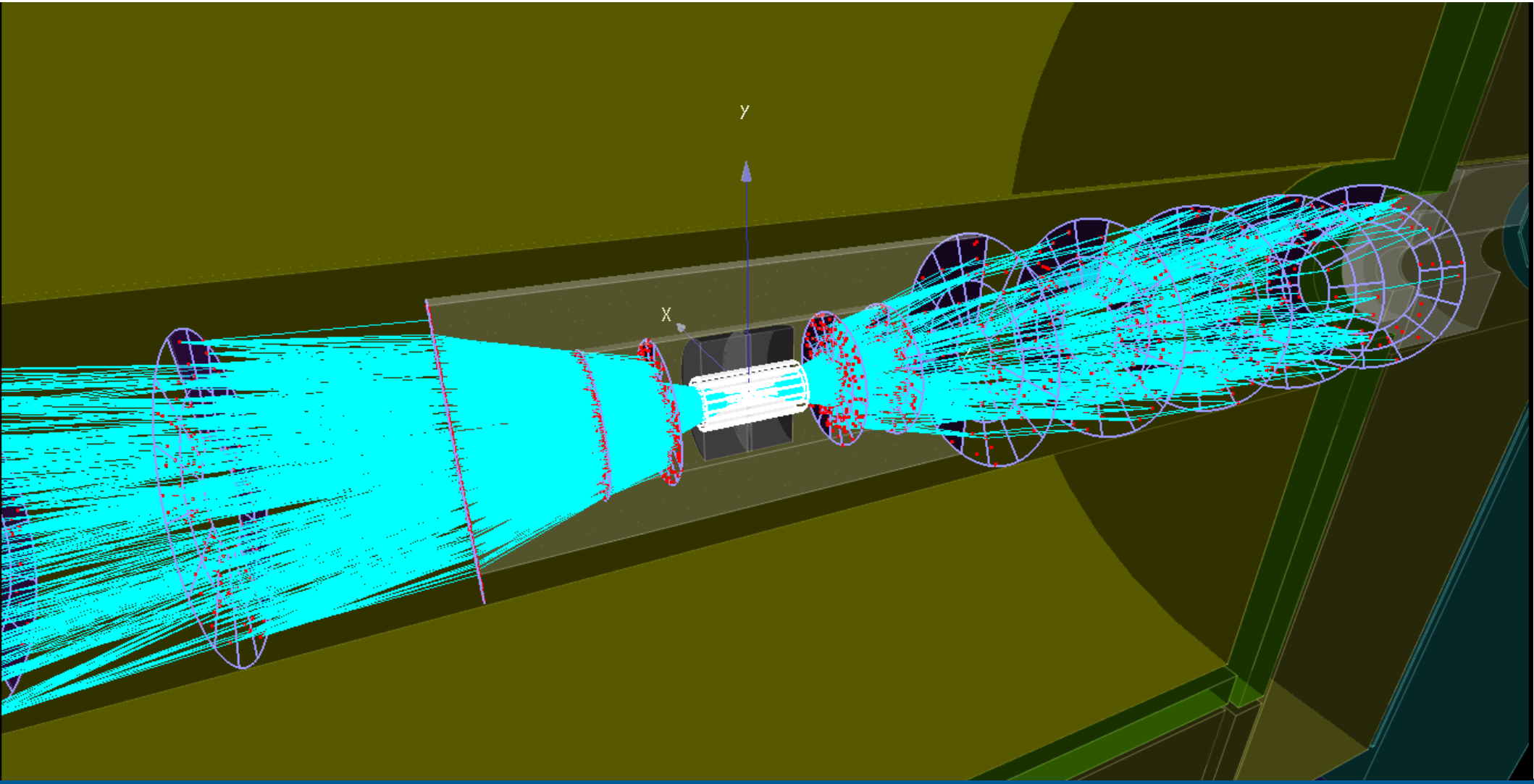


On the FTDs

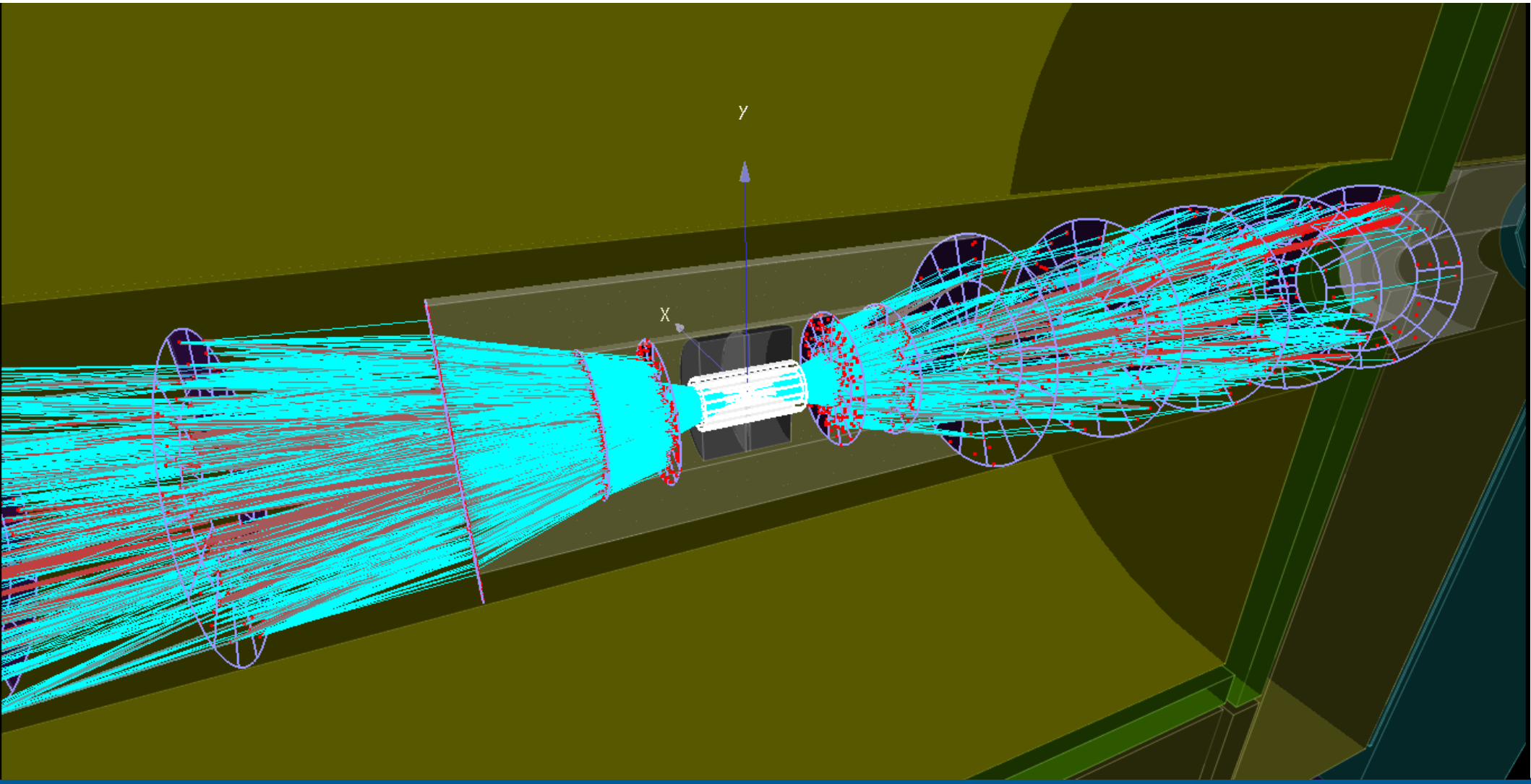
The Hits



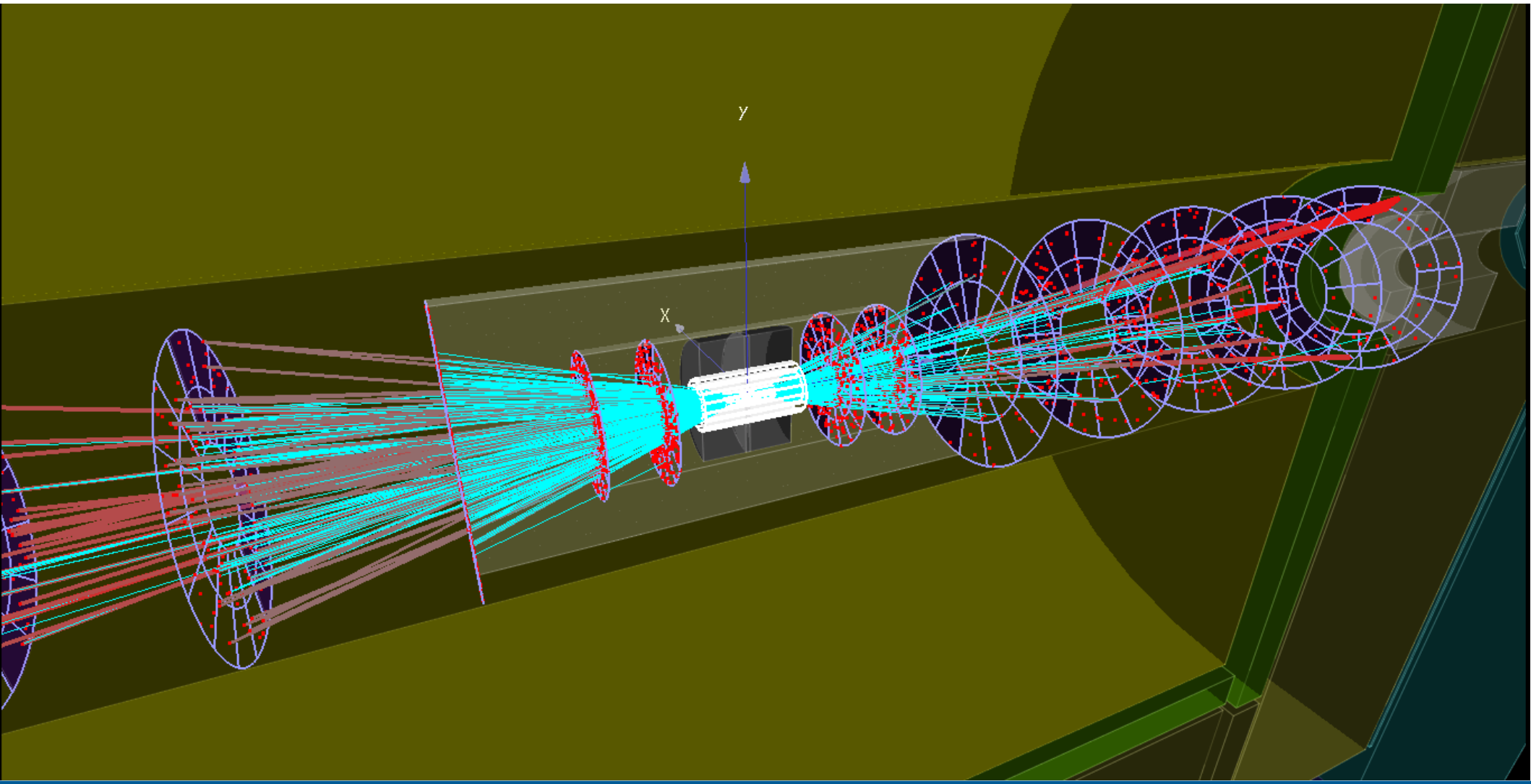
The Segments



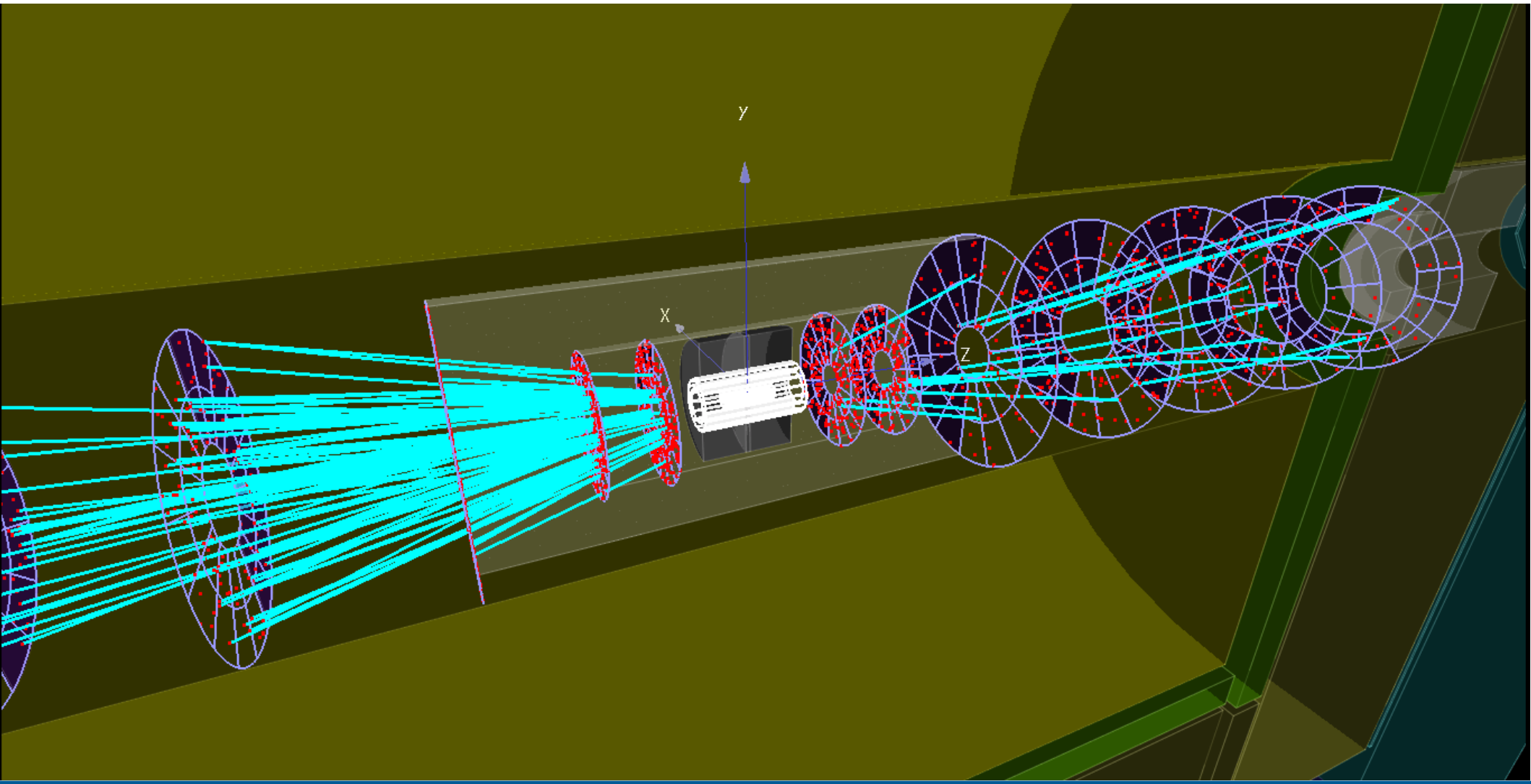
Cellular Automaton



Clean Up



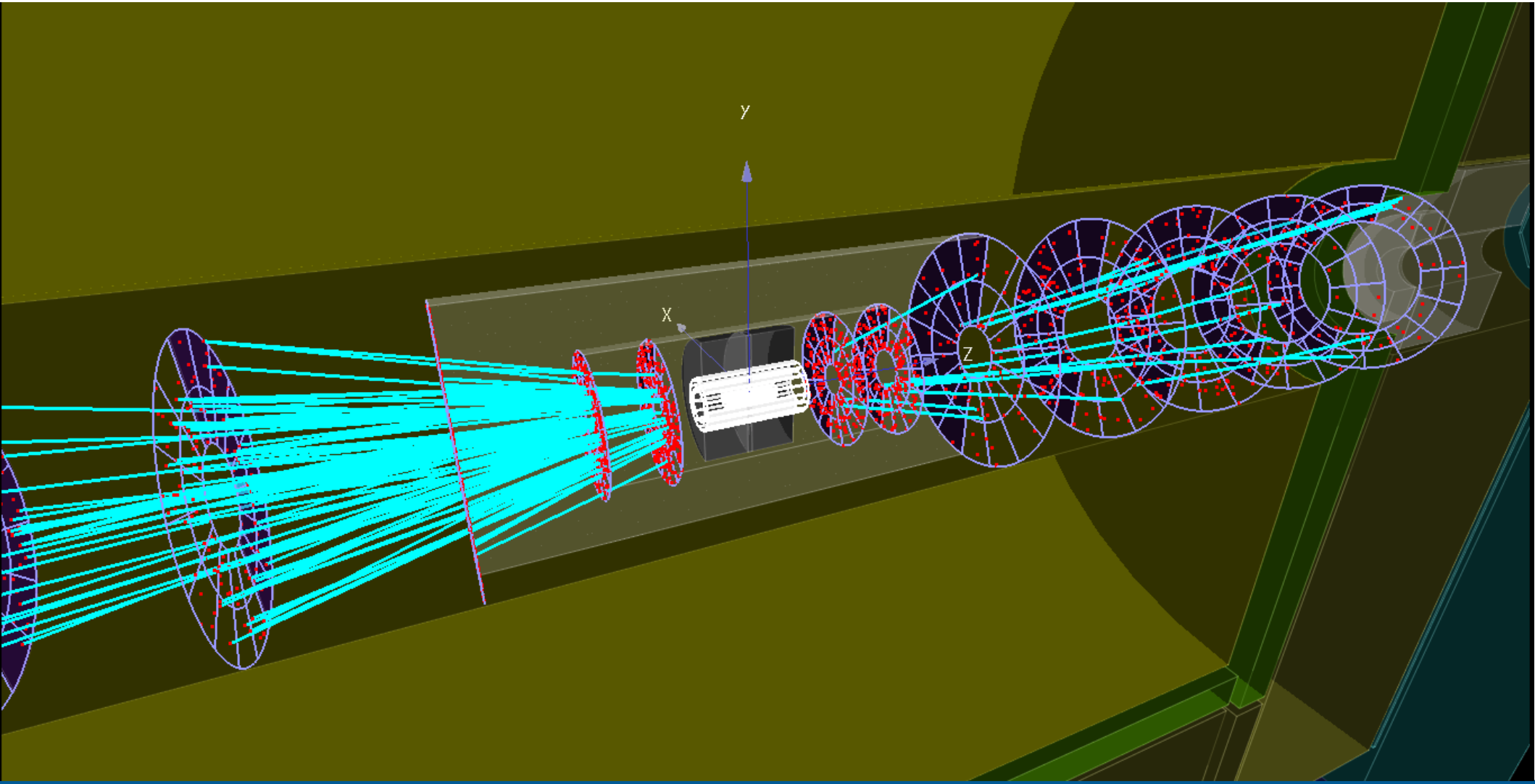
Track Candidates



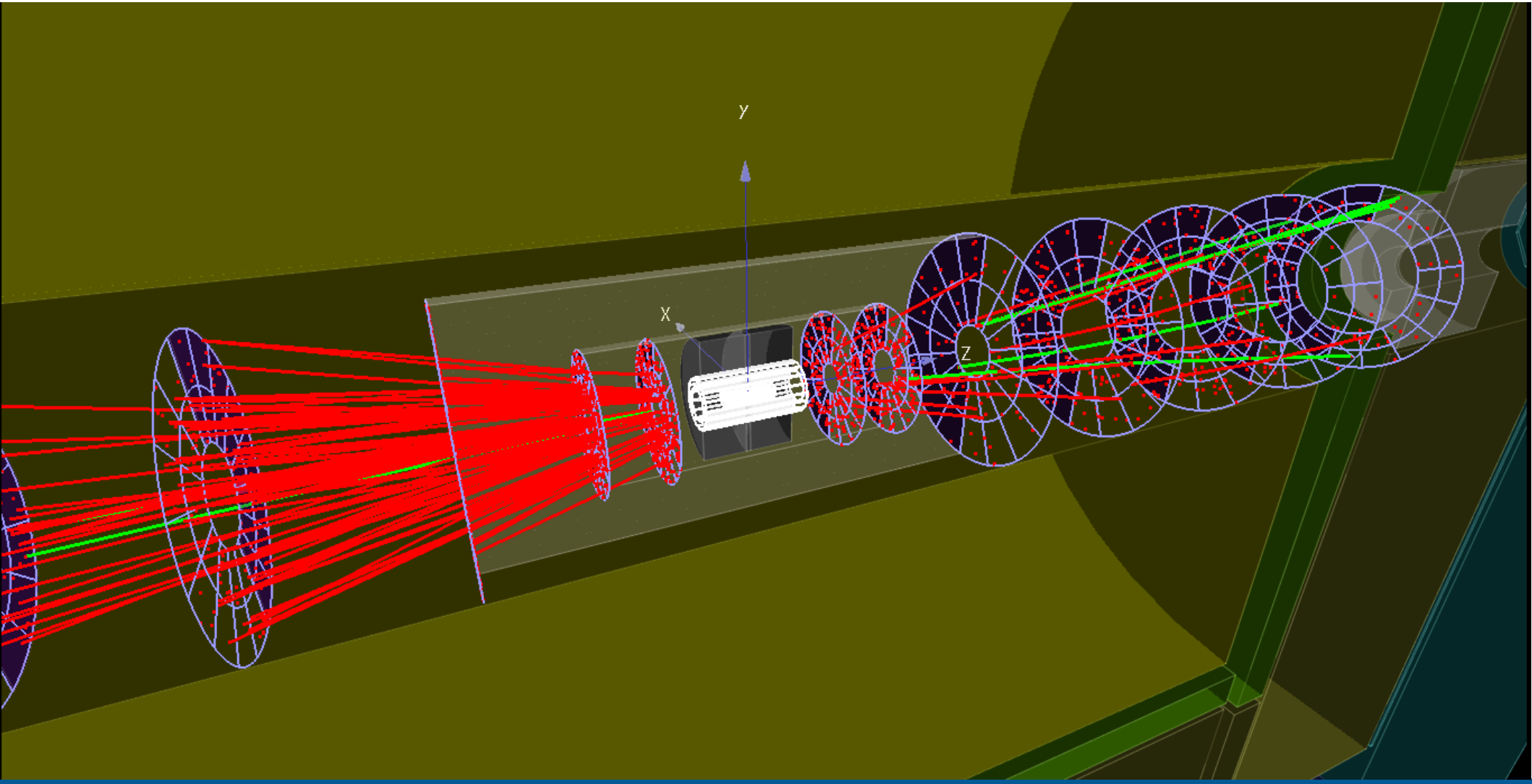
Kalman Filter

- Prediction → Filtering (Updating) → Smoothing
- KalTest + KalDet + MarlinTrk
- Quality Indicator: χ^2 probability

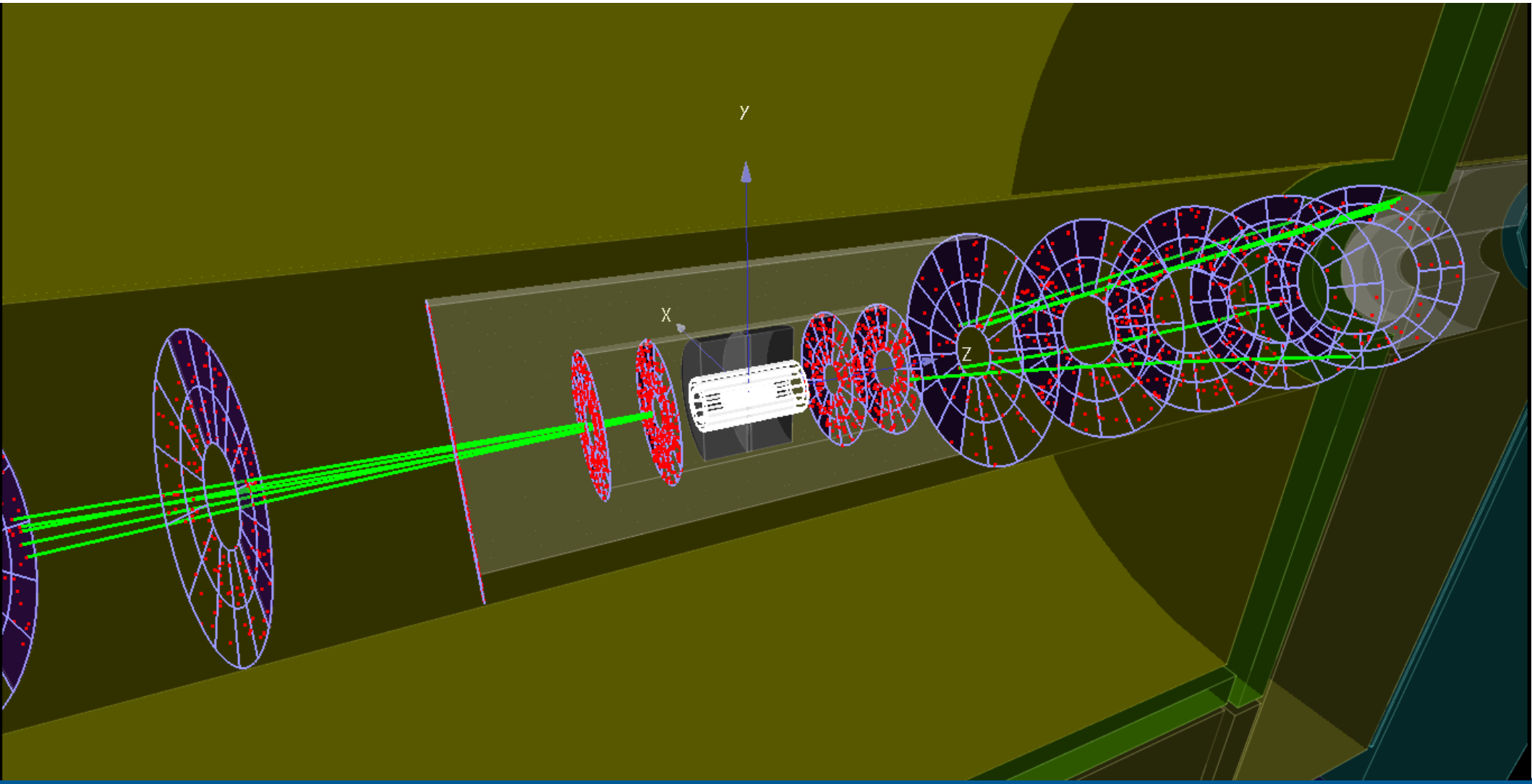
Track Candidates

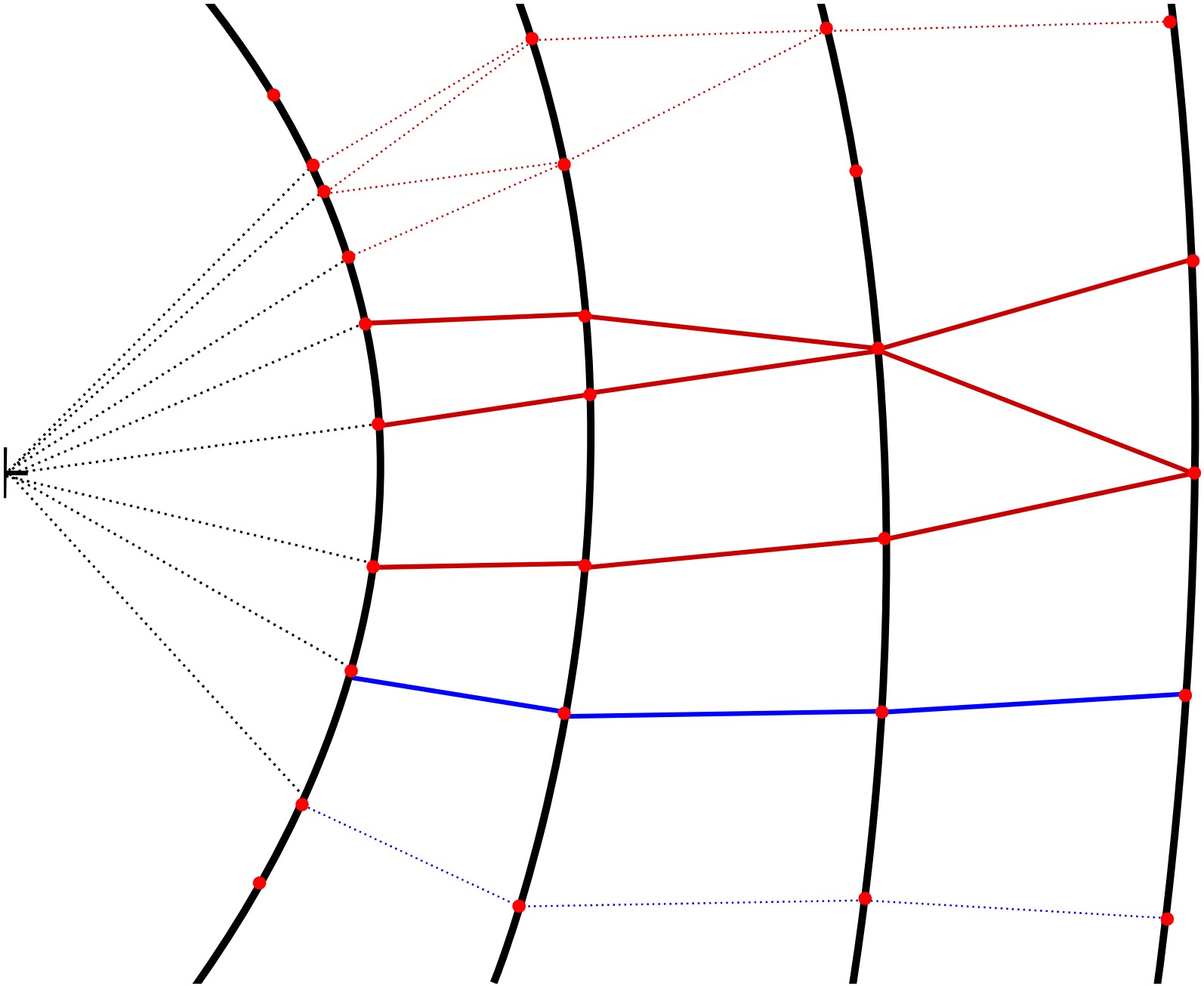


Kalman Filter



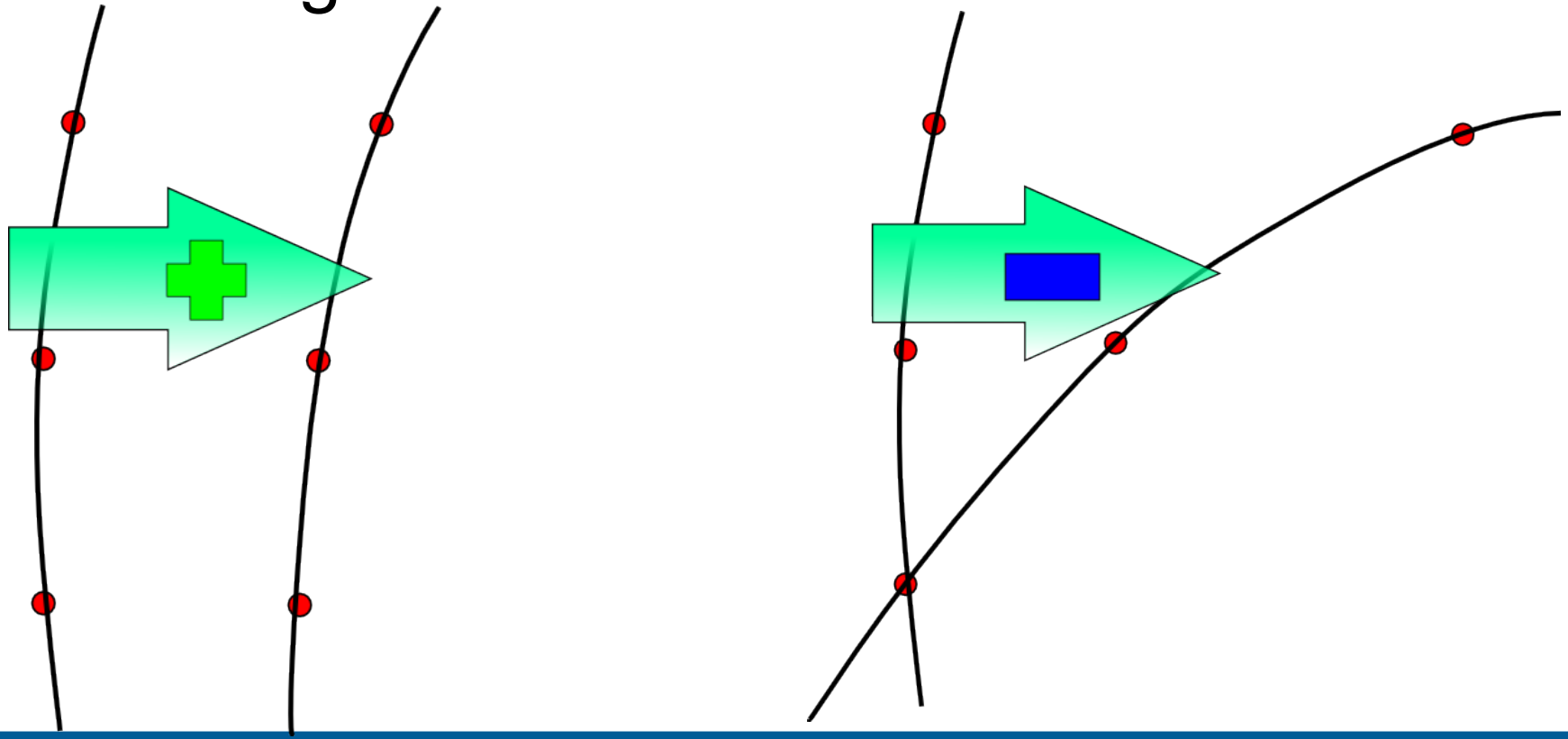
p > 0.005

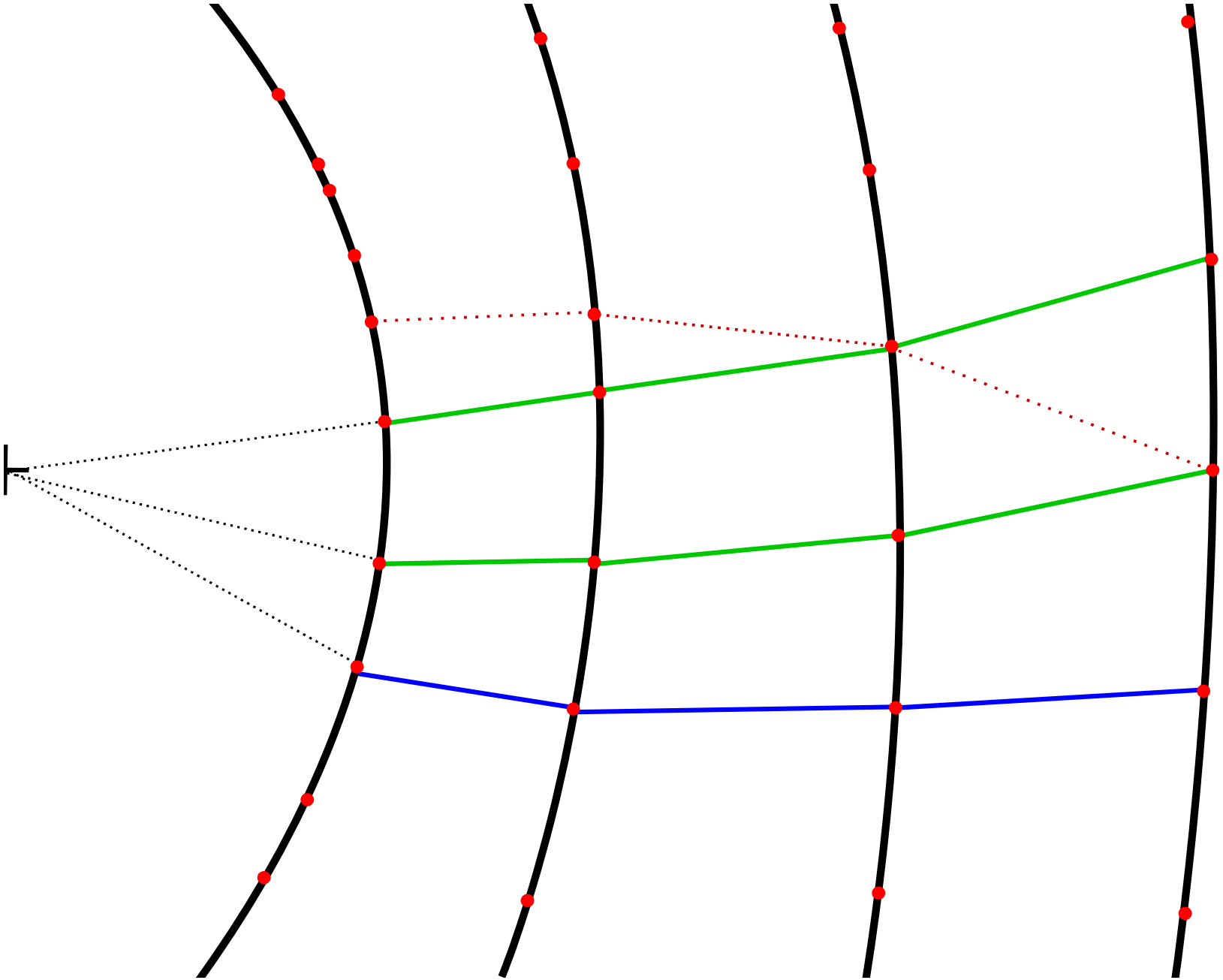




The Hopfield Neural Network

- Track ↔ Neuron
- Goal: the global minimum





At the moment

- Conversion to new geometry (staggered petals)
- release v01-01
- Debugging and efficiency
- Seperating core from implementation
- Sensible use of Hopfield Neural Network
- More analysis
- Measure the improvement (old vs. new software)

Future

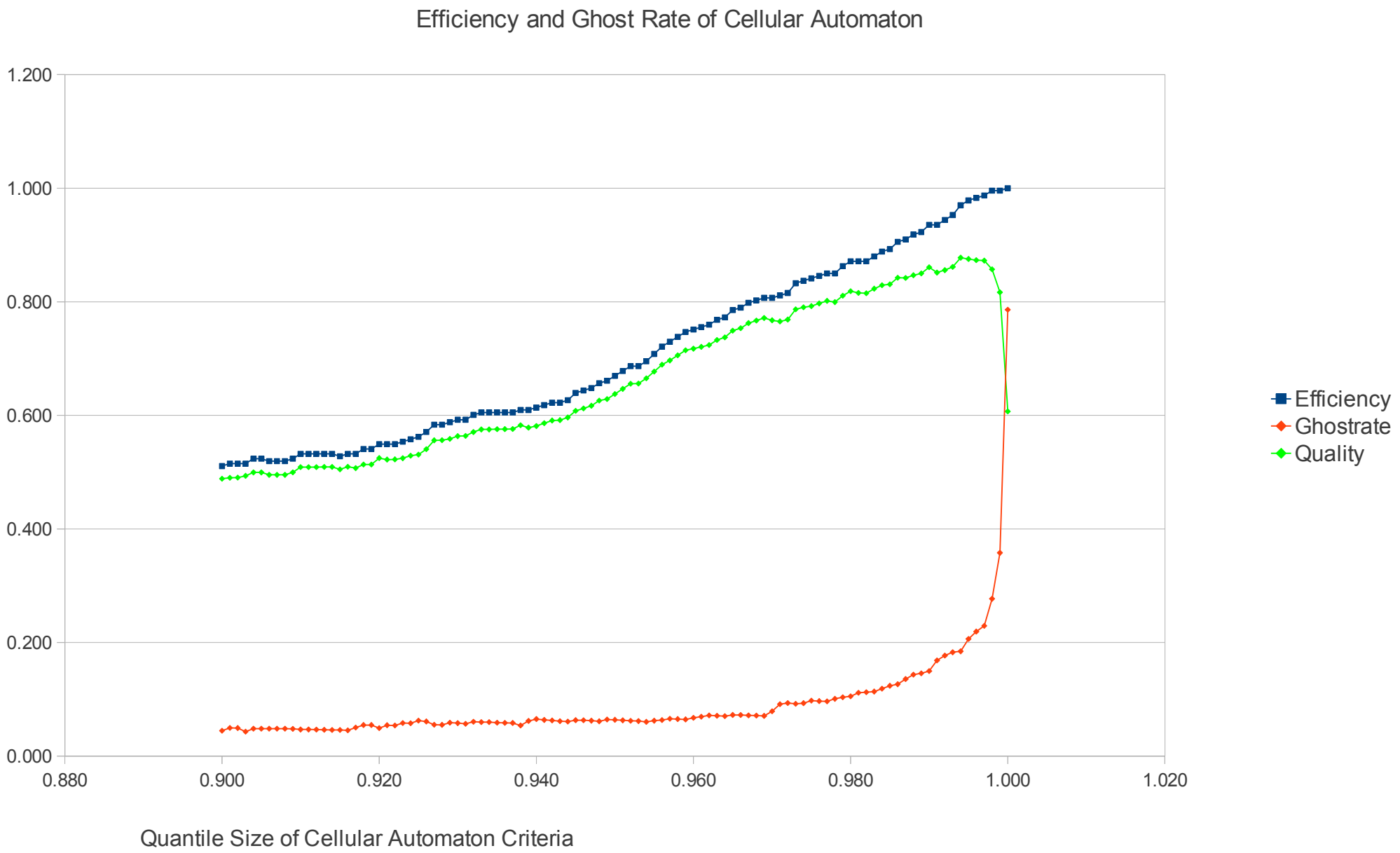
- Robustification (DAF)
- Picking up hits from other places
- Individual steering for pattern recognition → xml file
- Multilayer Perceptron (Rudi Frühwirth)
- Ghosthits

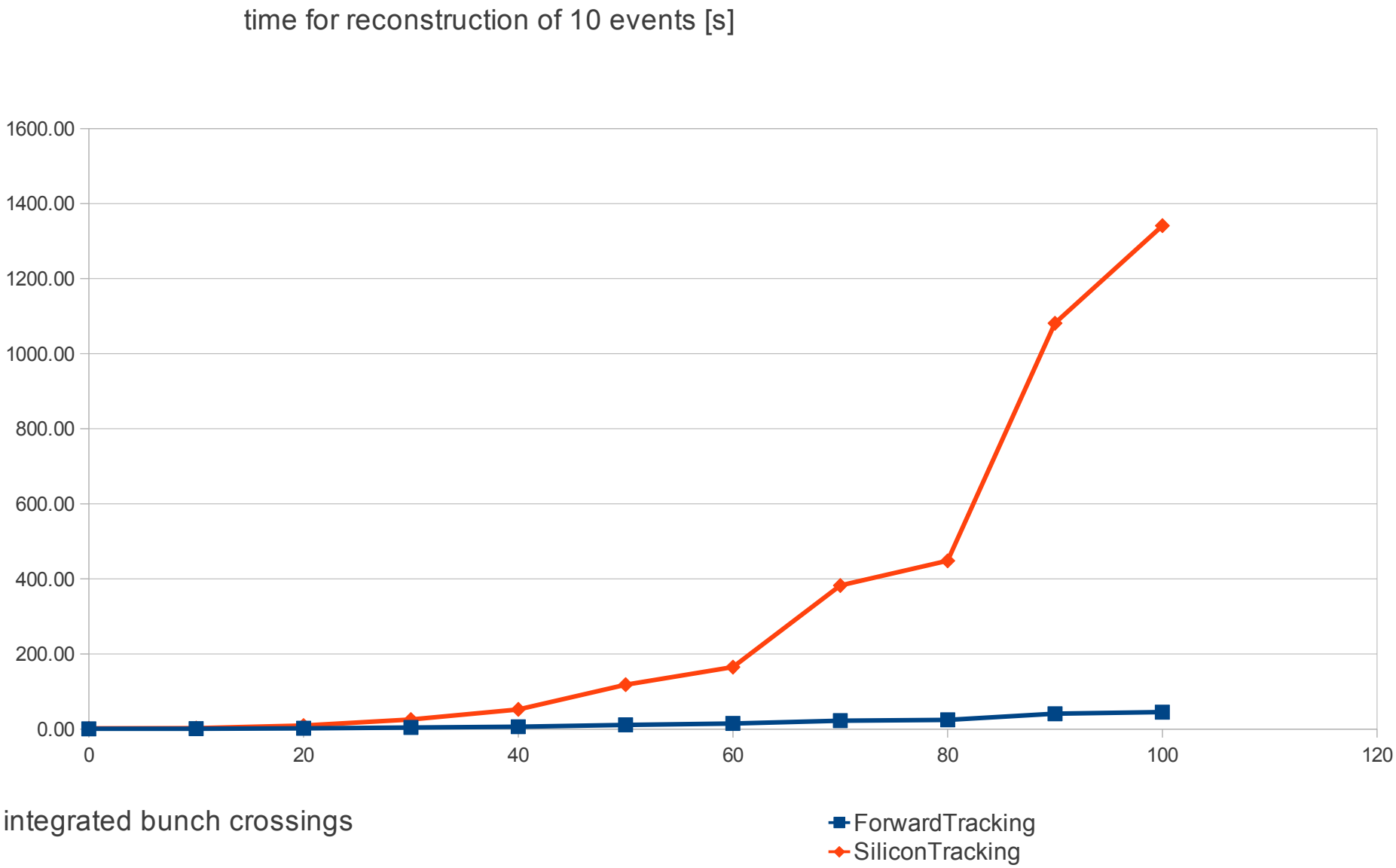
Thank you!

Back Up

Dependencies

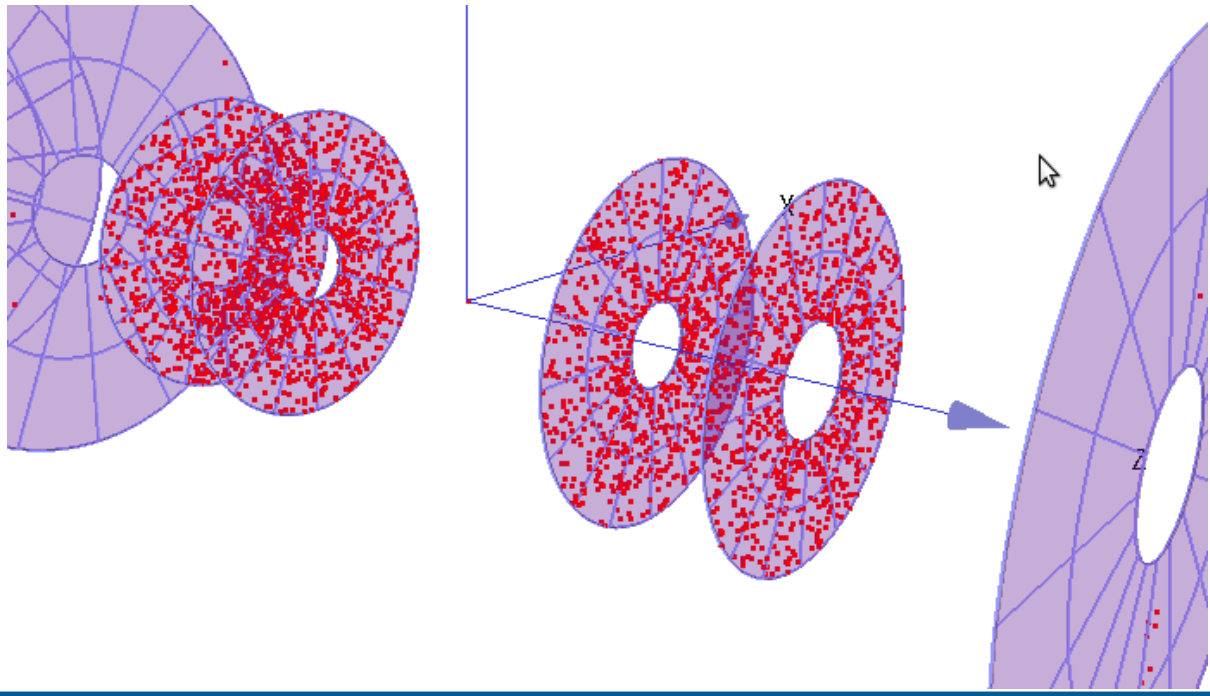
- FTD drivers and gear → at the moment in between solution
- The real background
- Bad χ^2 probability distribution
- Number of integrated bunchcrossings


Efficiency and Ghost Rate of Cellular Automaton
1.200
1.000
0.800
0.600
0.400
0.200
0.000
0.880
0.900
0.920
0.940
0.960
0.980
1.000
1.020
Efficiency
Ghostrate
Quality
Quantile Size of Cellular Automaton Criteria

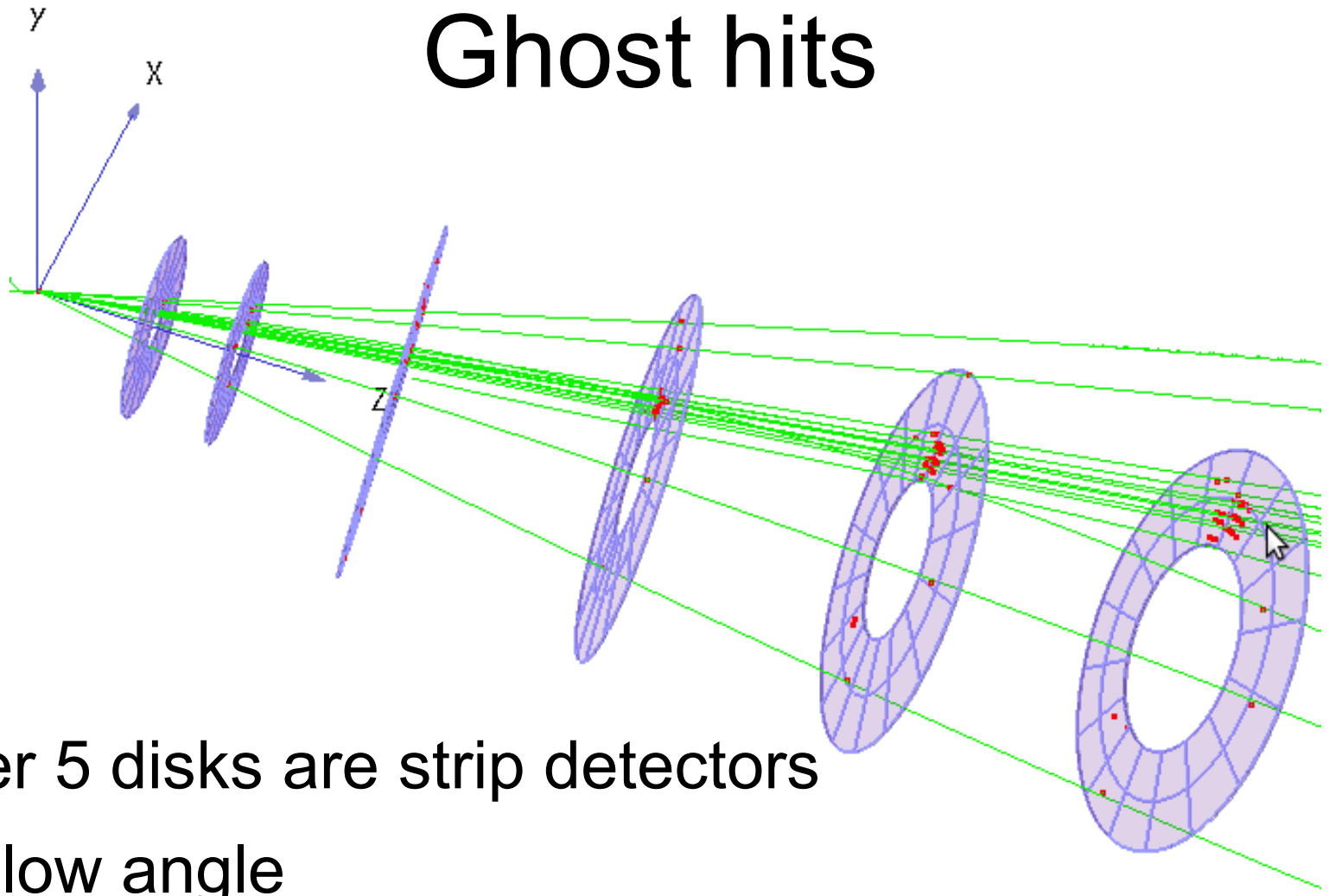

time for reconstruction of 10 events [s]
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
0
20
40
60
80
100
120
integrated bunch crossings
ForwardTracking
SiliconTracking

Background

- Inner 2 disks are pixel detectors
- How many bunch crossings?
- 100 BX * hit density ≈ 900 hits / pixel disk



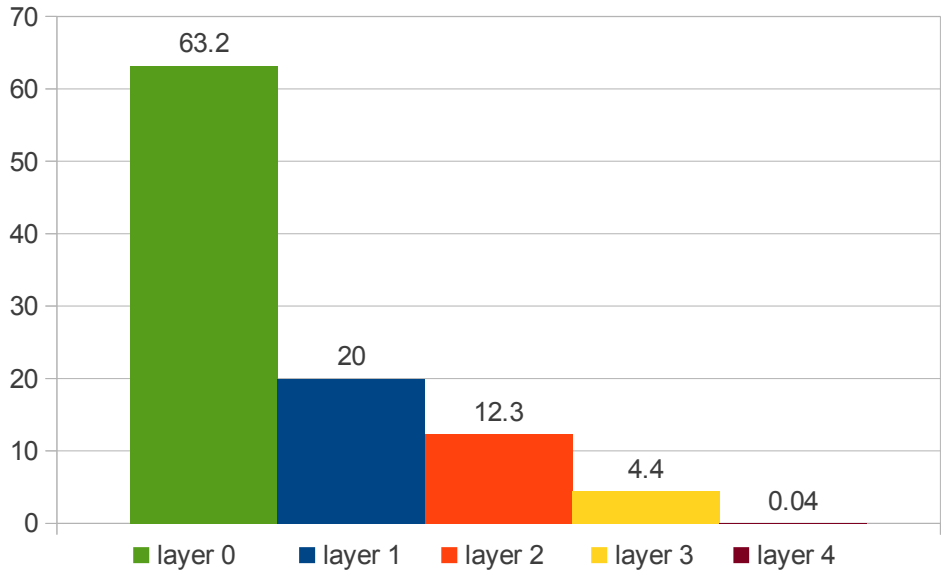
Ghost hits



- Outer 5 disks are strip detectors
- Shallow angle
- Depending on new Digitiser

tracks will

- Skip a layer
- Connect directly to the IP



regions

Very forward region:
- $5.0^0 < \vartheta < 11.5^0$: only FTD measuremts. contributing,
- Range of FTD 1 (2) starts where that FTD 6 (7) ends.

Intermediate region:
- $11.5^0 < \vartheta < 25.5^0$: complex mix of VTX + FTD + TPC,
- FTD: only FTD 1 … 3, plus FTD 4 until $\vartheta < 16.5^0$,
- TPC: 10 pad-rows @ 11.5^0 … 100 pad-rows @ 25.5^0.

Barrel + FTD 1 only:
- $25.5^0 < \vartheta < 36.7^0$: VTX + FTD 1 + SIT + TPC.

ETD: ignored by track fitting (no more precision)
- $9.8^0 < \vartheta < 36.9^0$: PR link to fwd. ECAL, useful in PFA.