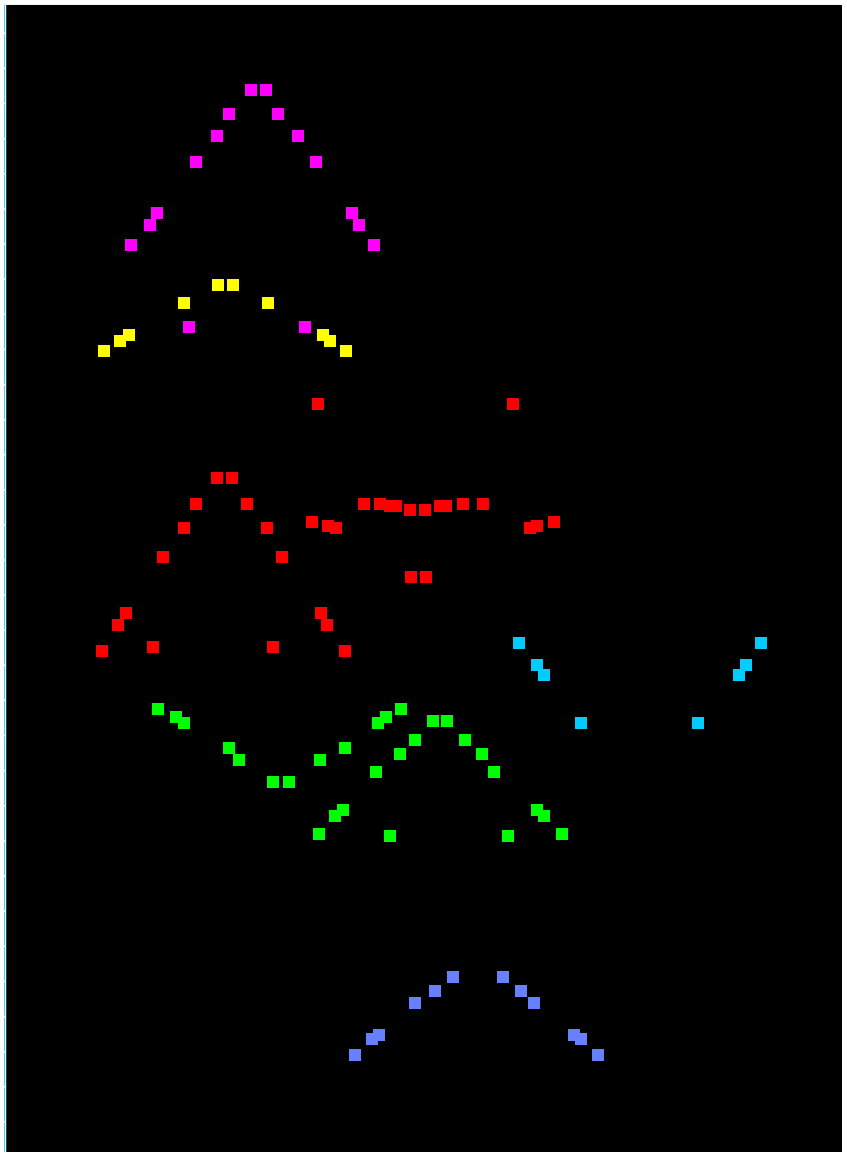
Visualizing ATLAS High–Luminosity Events



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Outline

Why visualize event?

- Check reconstruction algorithms
  - now against simulation
  - later against data
- check detector at startup
- check events in analysis
  - new physics candidates
  - pathological candidates
  - unknown (forgotten) bkgs.

ATLANTIS

- Descends from ALEPH's event display DALI
- Emphasizes understanding physics

Tools to tackle complexity:

- Using V–Plot
- Finding z–vertex
- Filtering hits

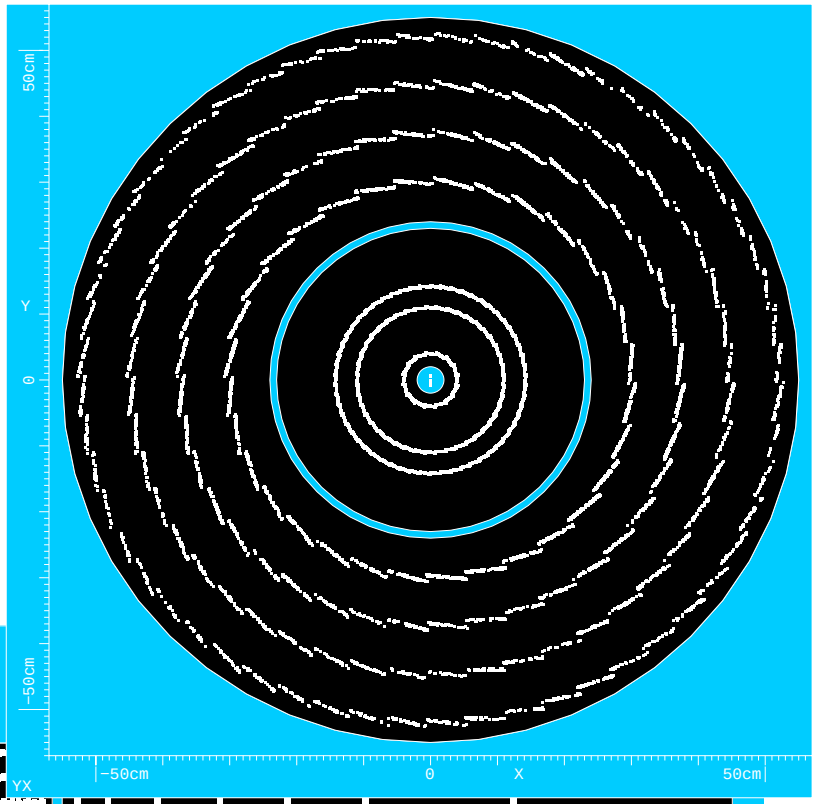
Tracking Comparisions

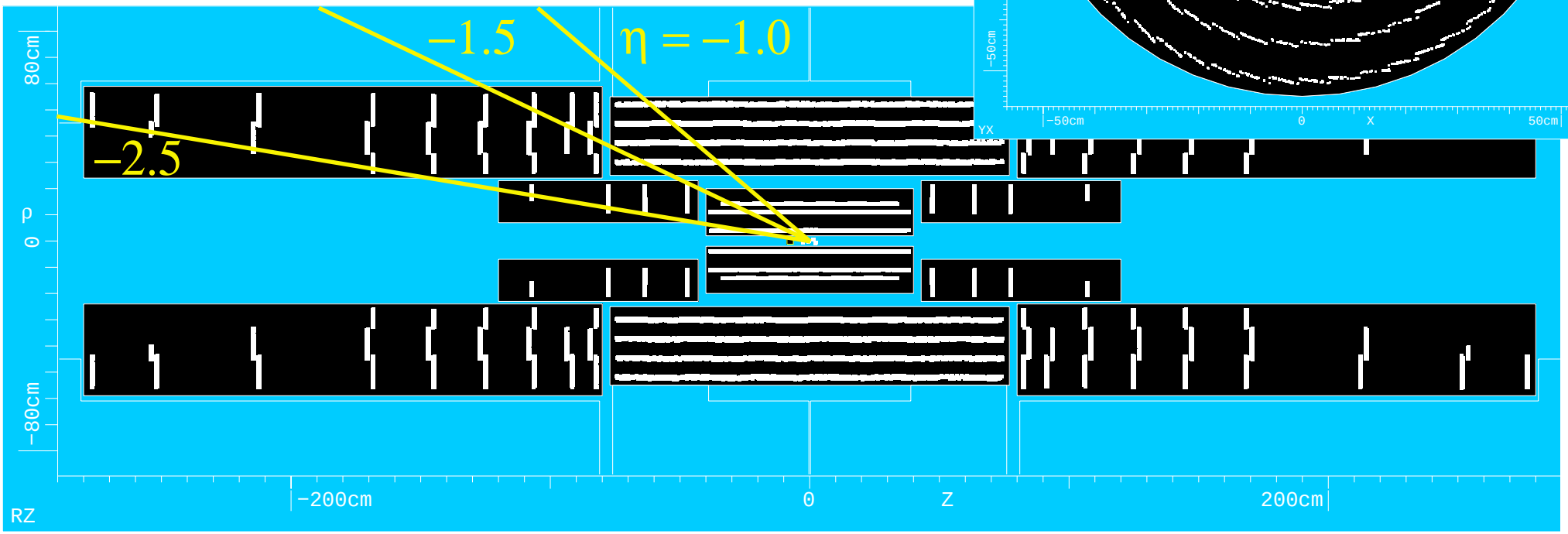
Conclusions & Future Work

High−Multiplicity of InnerDetector

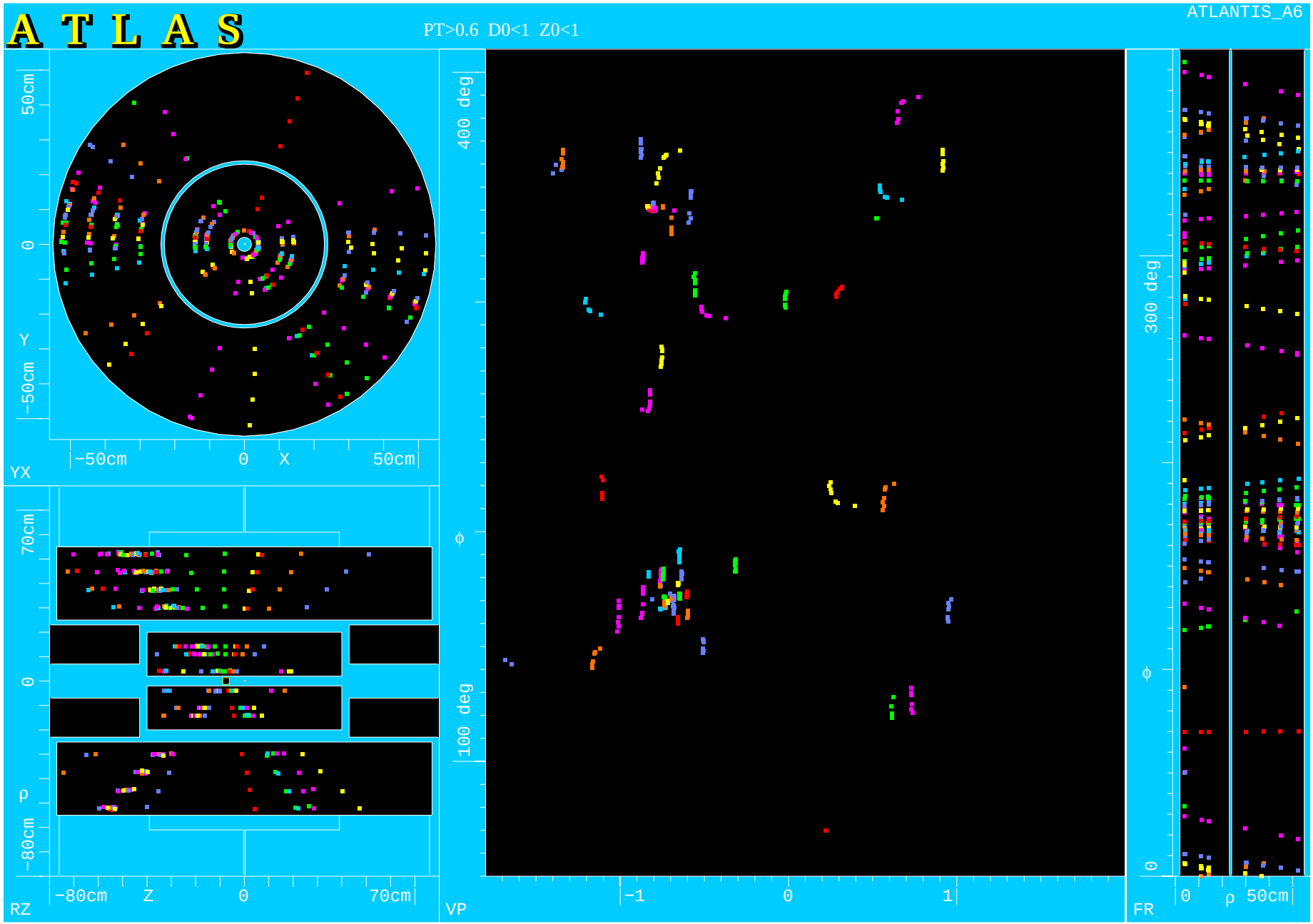
$pp \rightarrow HZ \rightarrow b\bar{b}\mu\mu$

	$\|\eta\| < 2.5$	$\|\eta\| < 1.5$
Trks. (<0.6GeV)	896 (51)	541 (40)
Trks. (>0.6GeV)	388 (45)	251 (41)
Space Points	37202	19404





HZ Event Without Pileup



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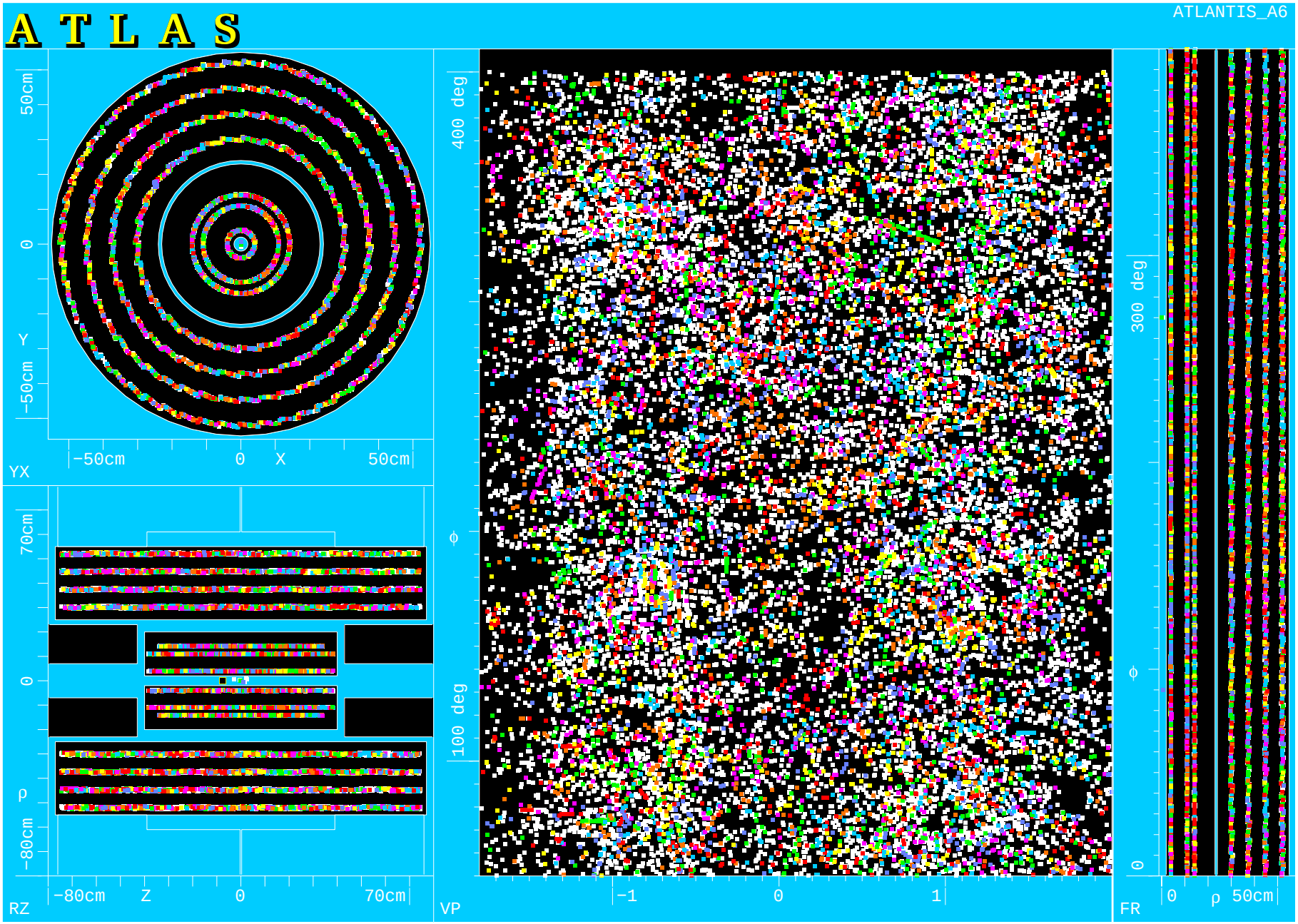


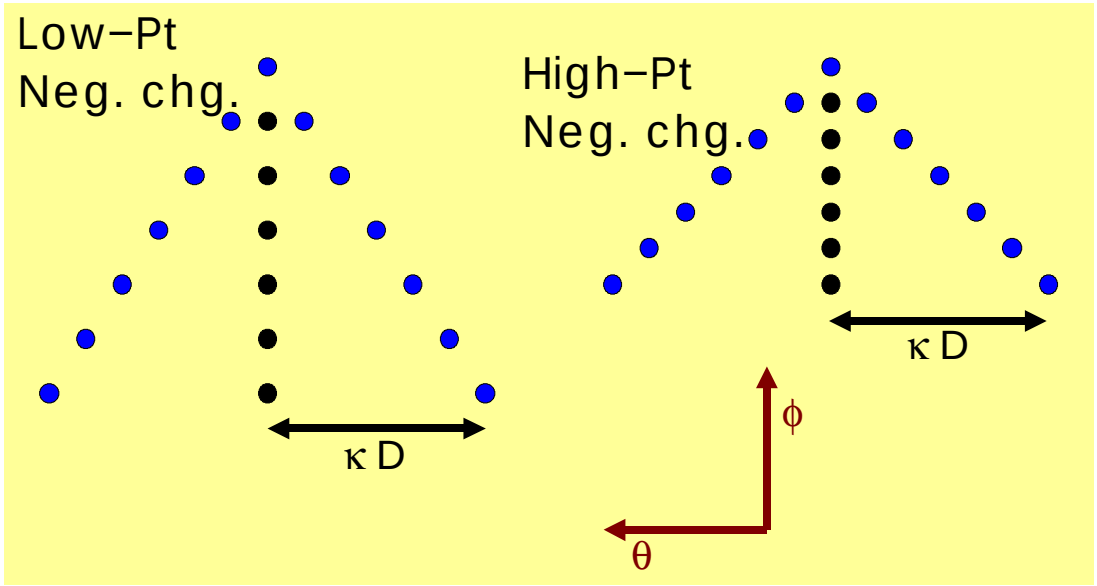
Tool 1: V–Plot

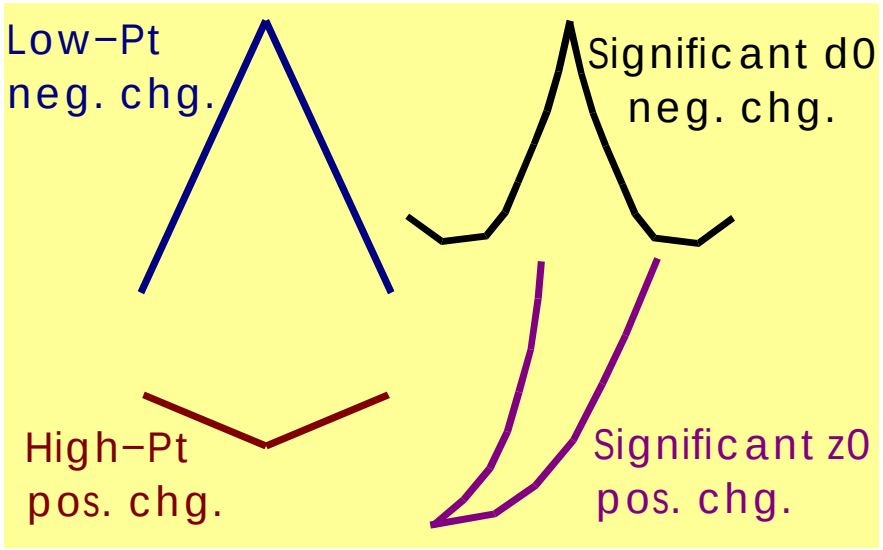
Plot two points for every spacepoint:

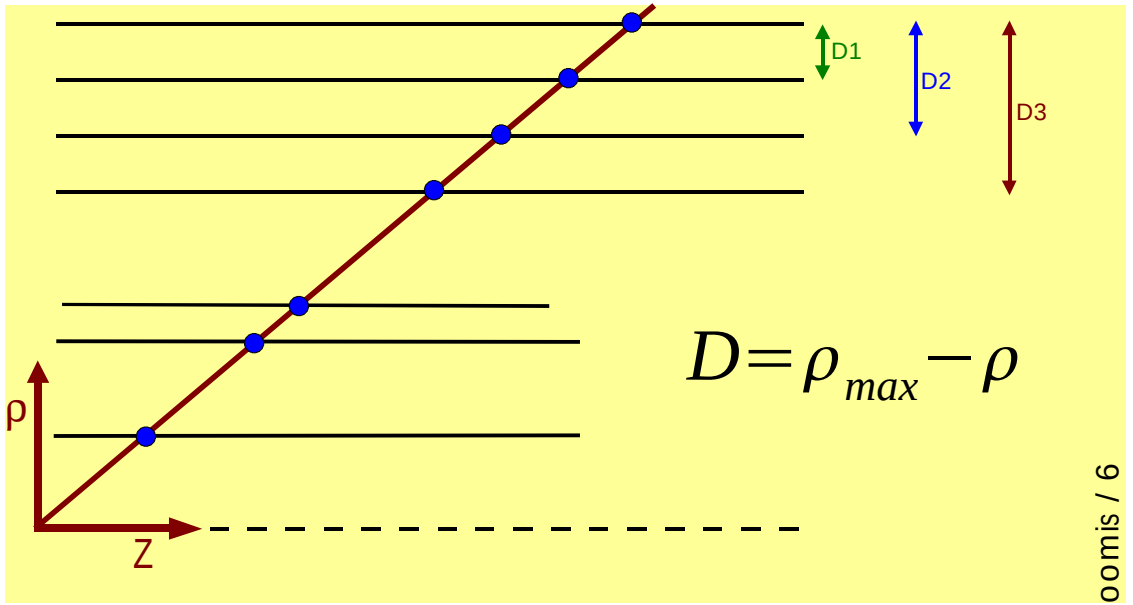
- center two points at (ϕ,θ)
- distance proportional to the distance to edge of detector

Visually from V–plot:

- ϕ, θ, pt, charge, d0, and z0







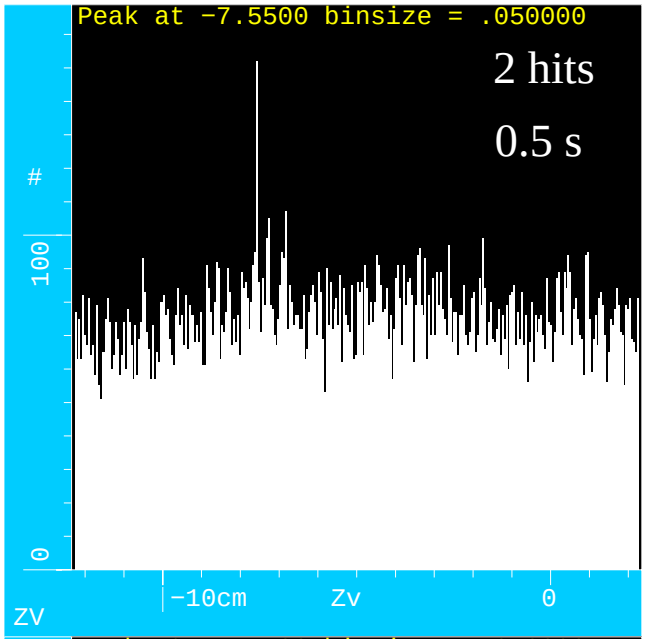
Tool 2: Finding the Z–Vertex

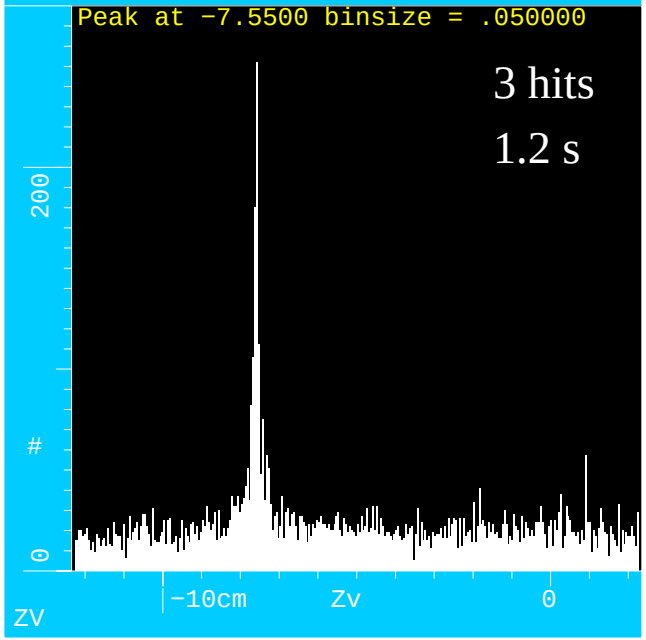
In ρ vs. z plane:

- form lines from all doublet or triplet (ϕ vs. ρ) combinations
- histogram of z–intercept
- choose z–vertex as the bin with the most entries

Speed:

- Doublet and triplet versions
  - better result from triplet version
  - but, 2.5× longer execution time
- tricks used to optimize method
- could obtain vertex from elsewhere
  - e.g. pp→HZ→bbμμ could get vertex from muons





Tool 3: Filtering Algorithm

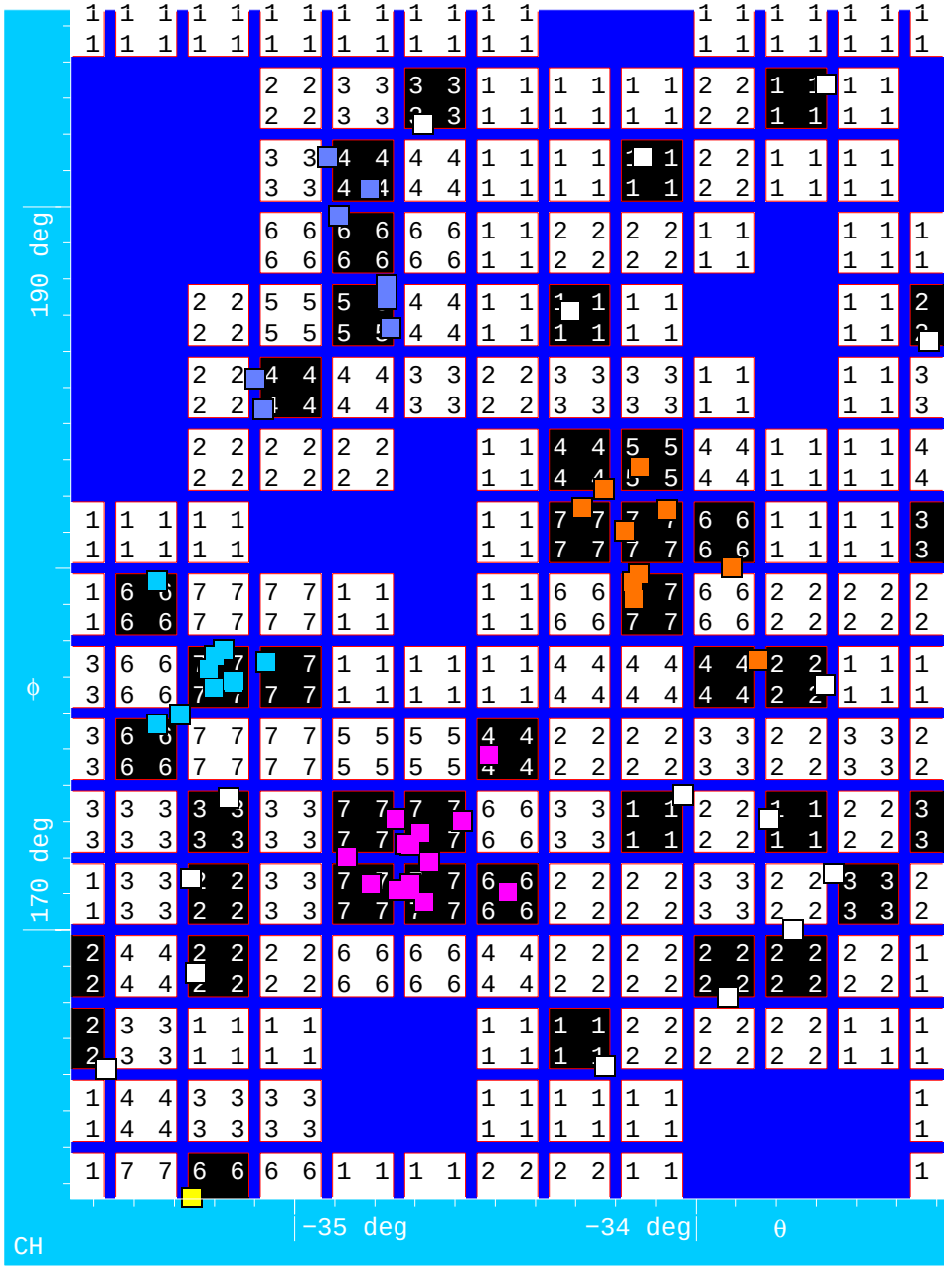
Bin spacepts. in ϕ vs. η (180 × 1000 bins)

Count number of DIFFERENT LAYERS in each bin.

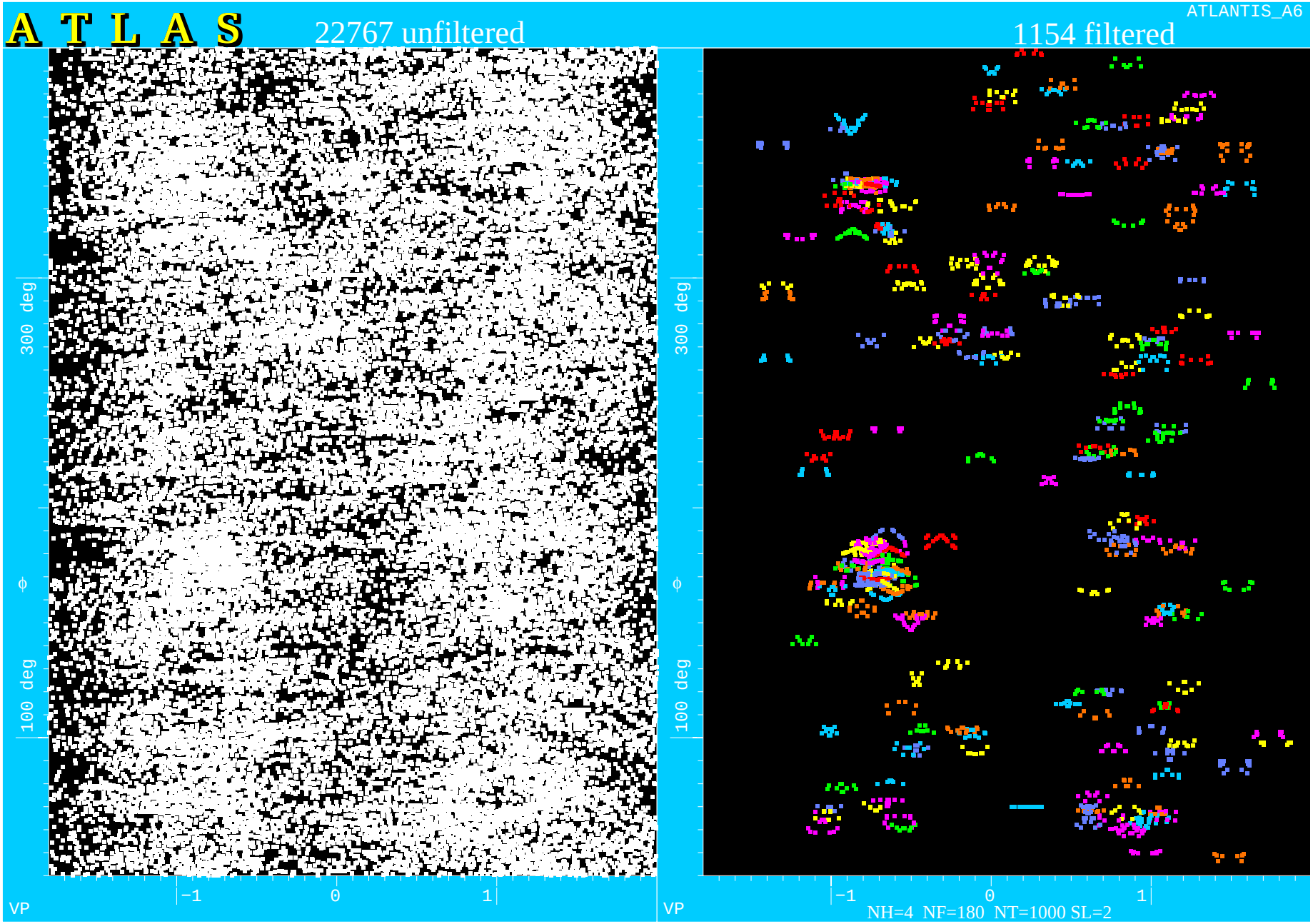
Cut spacepts. In bins with fewer than 4 layers firing

Group the spacepoints by clustering neighboring bins

- helps to associate hits in crowded regions (jets)



V–Plot Without & With Filter



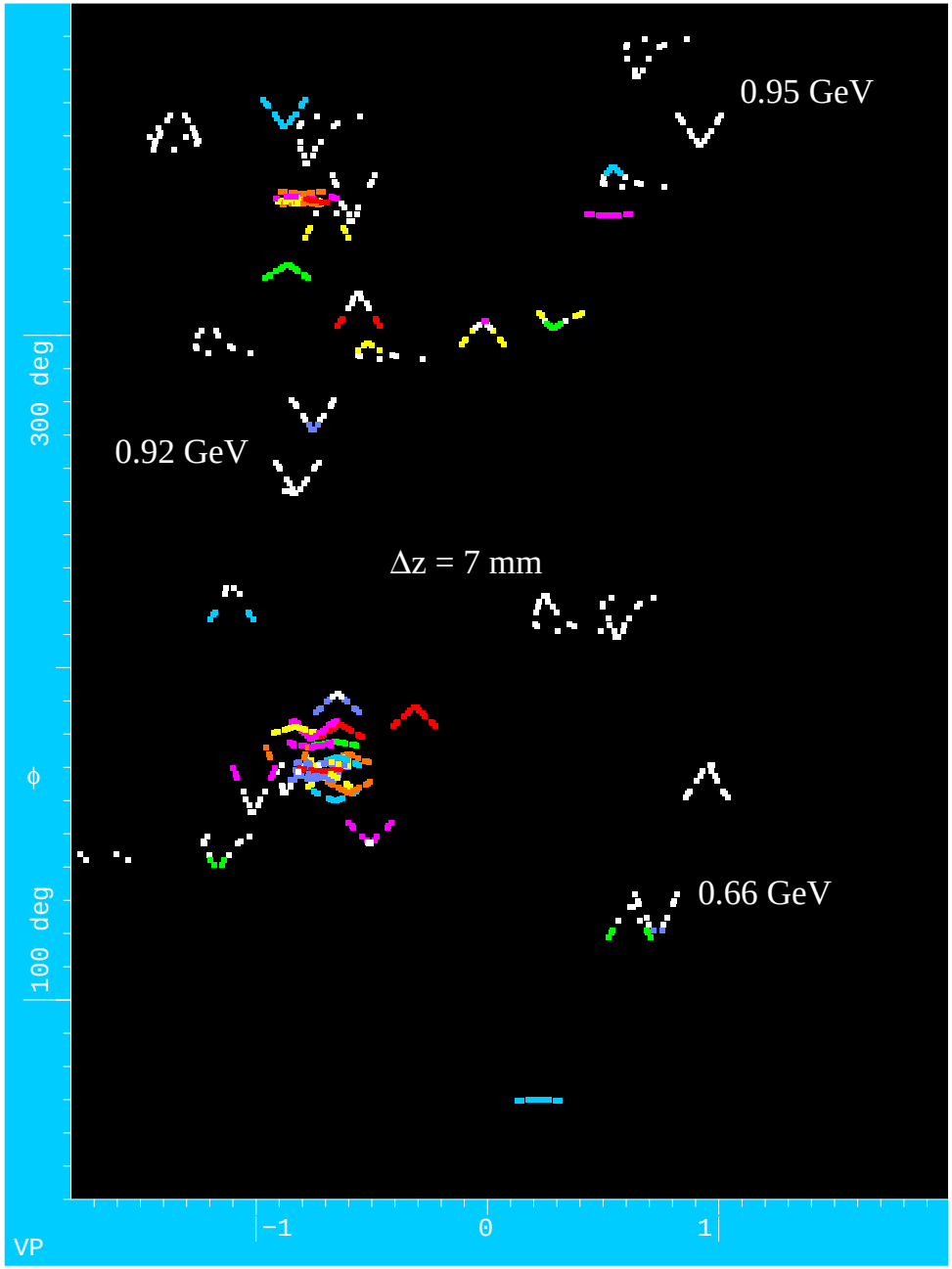
Performance of Hit Filter

Performs well on Higgs event

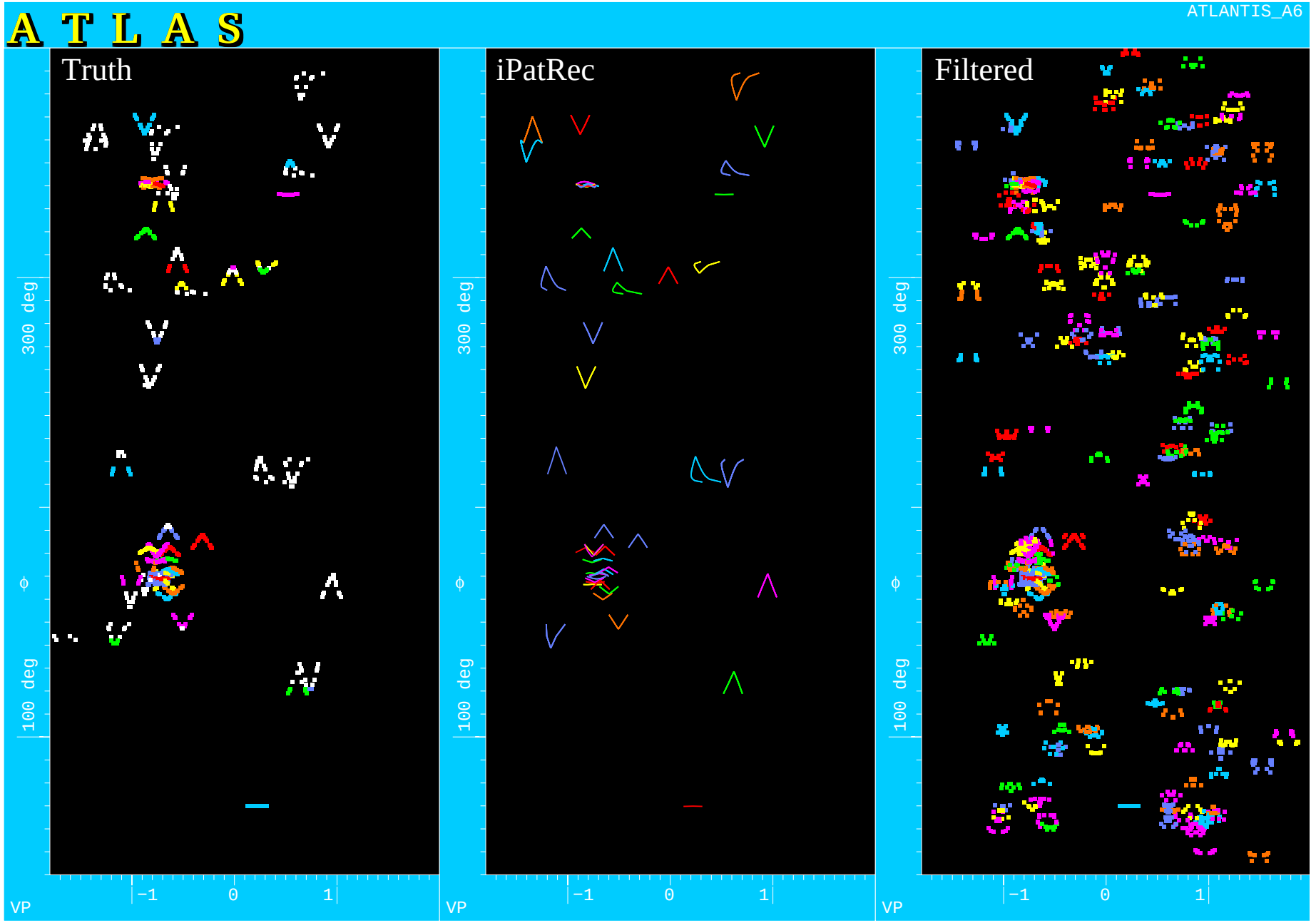
- Lose low−pt tracks
  - binning in ϕ is an implicit cut on transverse momentum
- Lose tracks from other z−vertices
  - θ binning cuts on z−position

Can tune parameters to change performance.

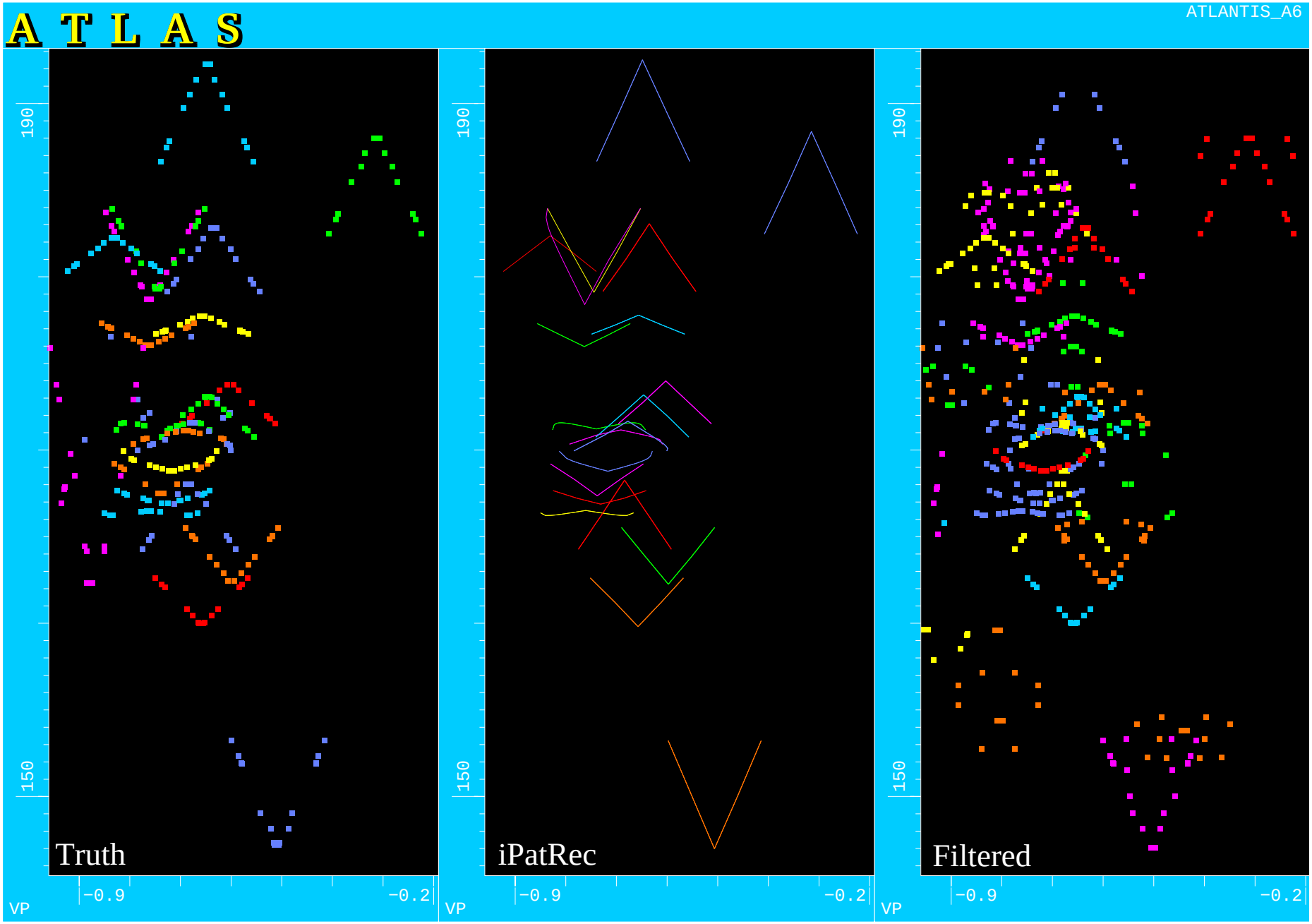
- e.g. Filter for low−pt tracks



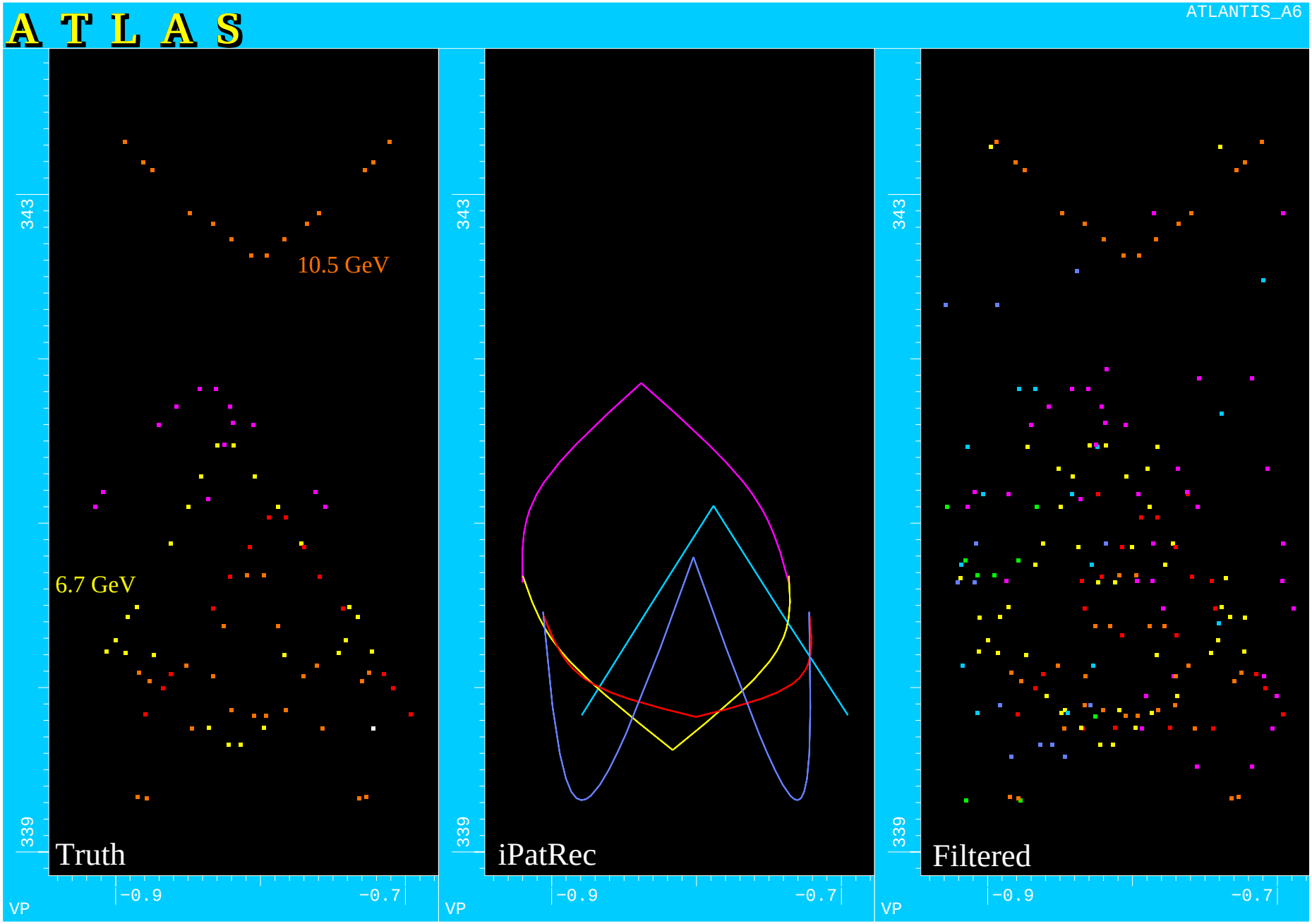
Comparison of iPatRec and Filter



Zoomed View of Jet 1



Zoomed View of Jet 2



Conclusions & Future Work

Events are too crowded to understand with traditional views, BUT...

Tools make visualization possible:

- V−plot allows:
  - quick visual check of tracking performance
  - allows checks to be done WITHOUT Monte Carlo truth information!
- Z−finding algorithm works
- Hit filtering works and helps to group associated spacepts.

Get other subdetector data

- Transition Radiation Tracker
- Calorimeters
- Muons

Solve technical issues

- θ dependence of SCT spacepts.

Improve method in endcaps

Use Java rather than FORTRAN:

- graphics speed adequate
- port Z−finder
- port hit filter