

# Recent/Upcoming developments

A. Salzburger (CERN)



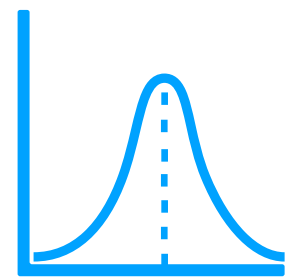
# Upcoming developments



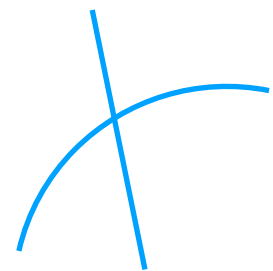
Geometry & Material



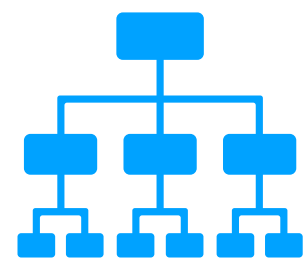
Event Data Model



Track Finding & Fitters



Vertexing



R&D lines (ML, GPU)

# Geometry (1)

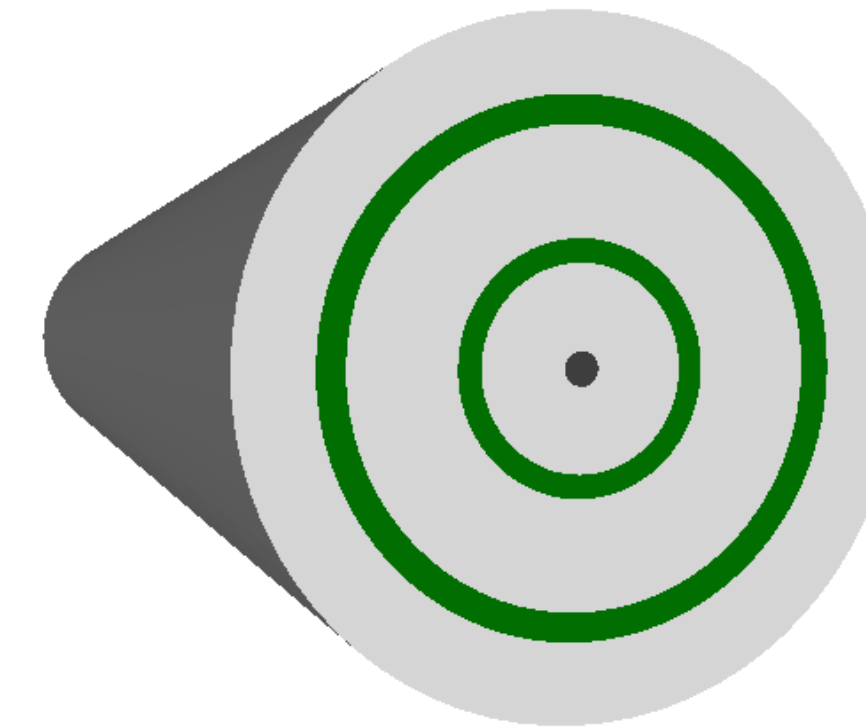
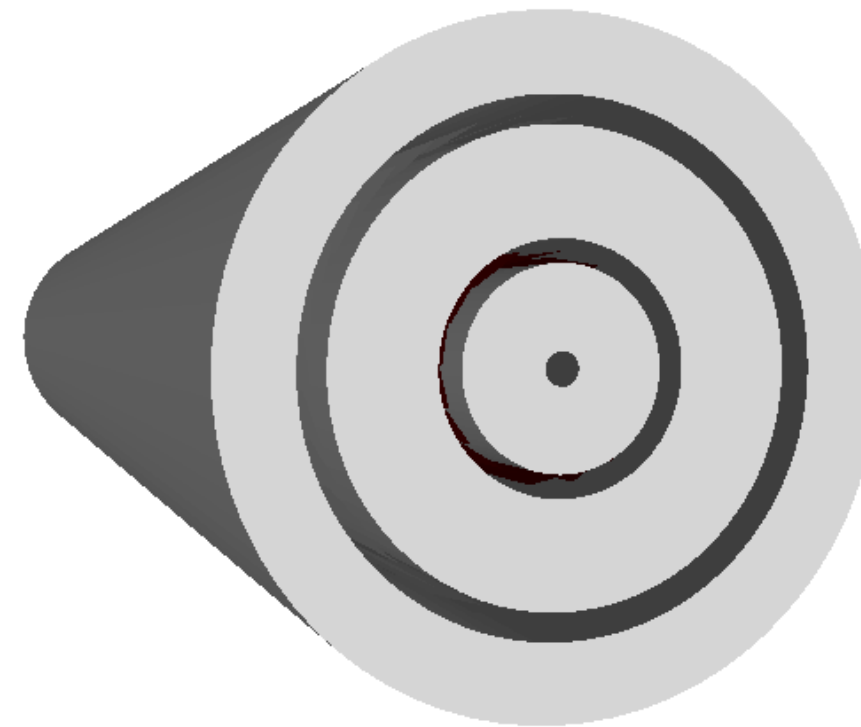
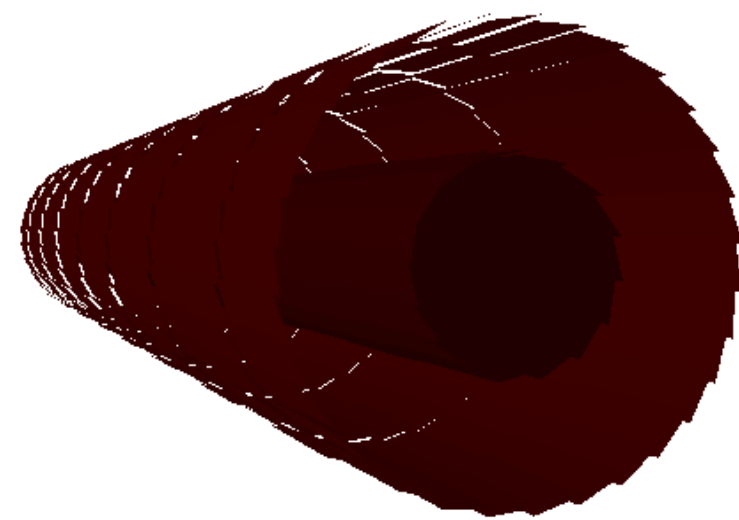
- ▶ Geometry model of ACTS stems from ATLAS `Trk::TrackingGeometry`
  - Conceptual building blocks

TrackingVolume

Layer

Surface

Quite some overlap between those



- `detray` GPU R&D geometry: re-implemented w/o layer concept
  - huge simplification in navigation code
  - can we do this also for ACTS/Core ?

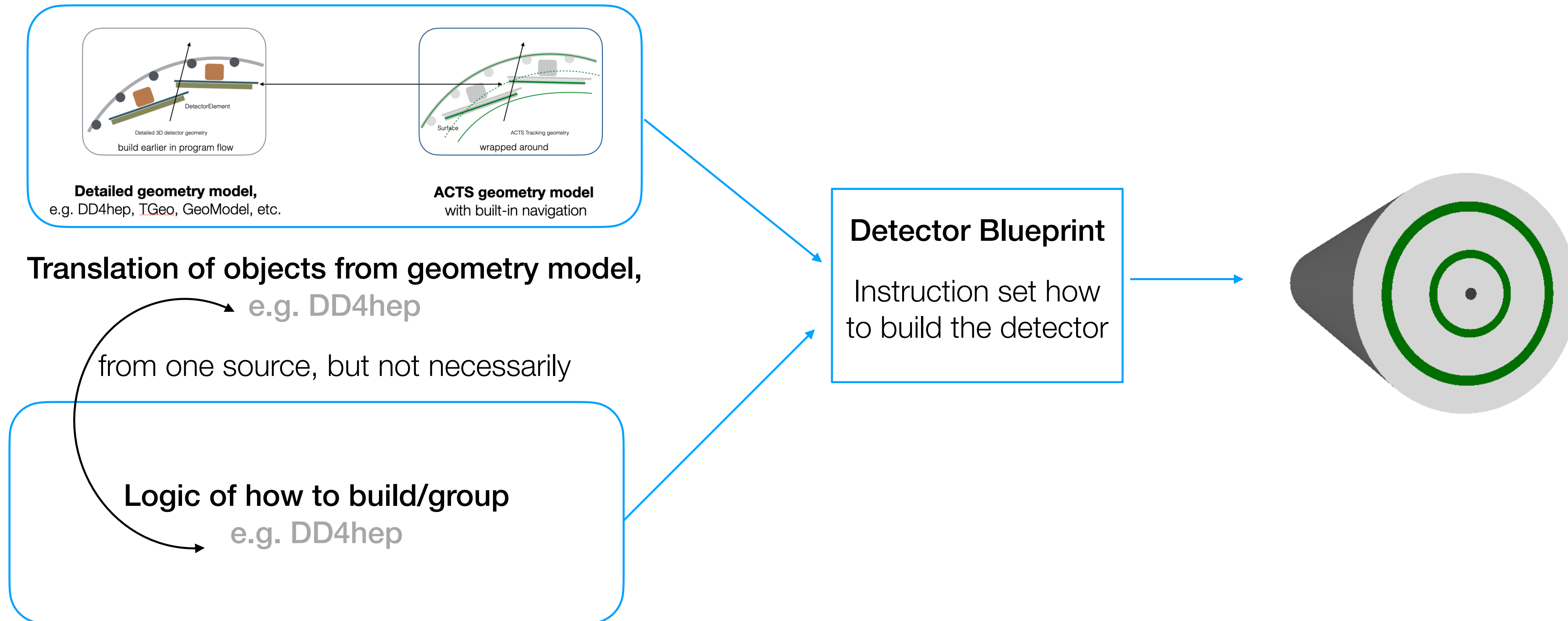
# Geometry (2) - Experimental

## ▶ Experimental::Detector Geometry model of ACTS

Acts::Surface	Acts::Surface	Surface objects are unchanged, allows client code to be untouched
Acts::Layer		Layer objects do not exist anymore, they are represented by volumes
Acts::TrackingVolume	Acts::Experimental::DetectorVolume	Double serving of volumes as containers or navigation volumes omitted
Acts::BoundarySurfaceT<Acts::TrackingVolume>	Acts::Experimental::Portal	Portal objects are not templated anymore, they are holder classes of surfaces and volume switches
Acts::TrackingGeometry	Acts::Experimental::Detector	Portal objects the top level entry point that will guide into the root volumes

# Geometry (3) - Blueprint

- ▶ New type of geometry building using `Experimental::Blueprint`



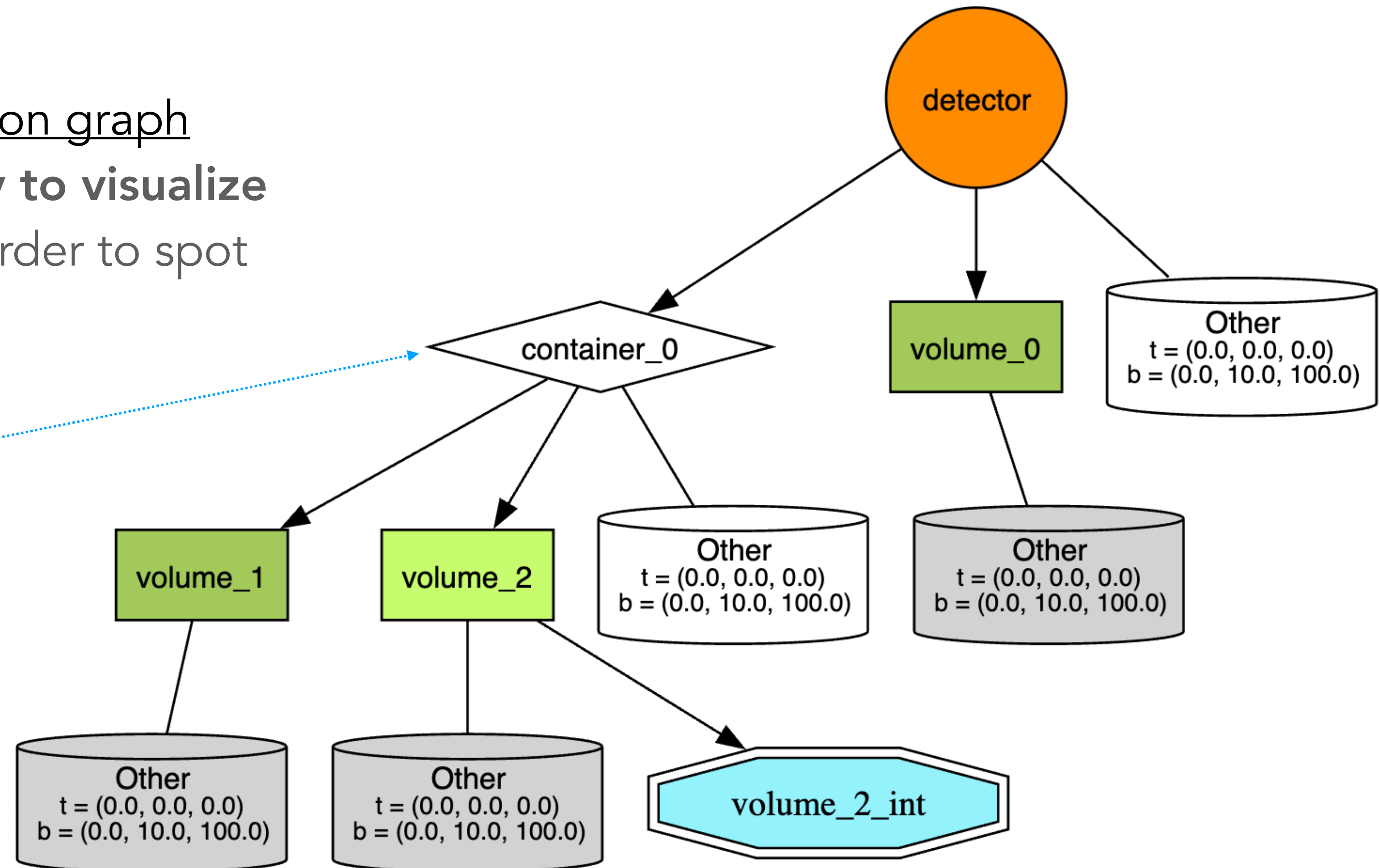
# Geometry (4) - Blueprint

- ▶ New type of geometry building using `Experimental::Blueprint`

Blueprint is an instruction graph

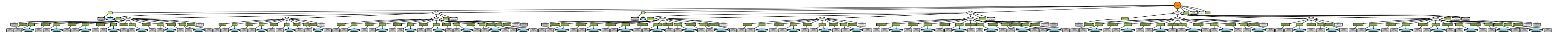
- **Added functionality to visualize** before building, in order to spot problems

non-coloured nodes  
are virtual containers

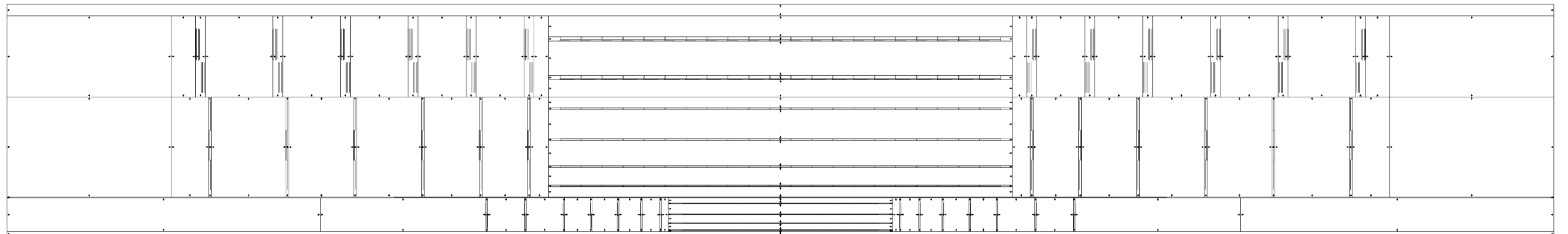


# Geometry (5) - Blueprint on ODD

ODD building blueprint from DD4hep:

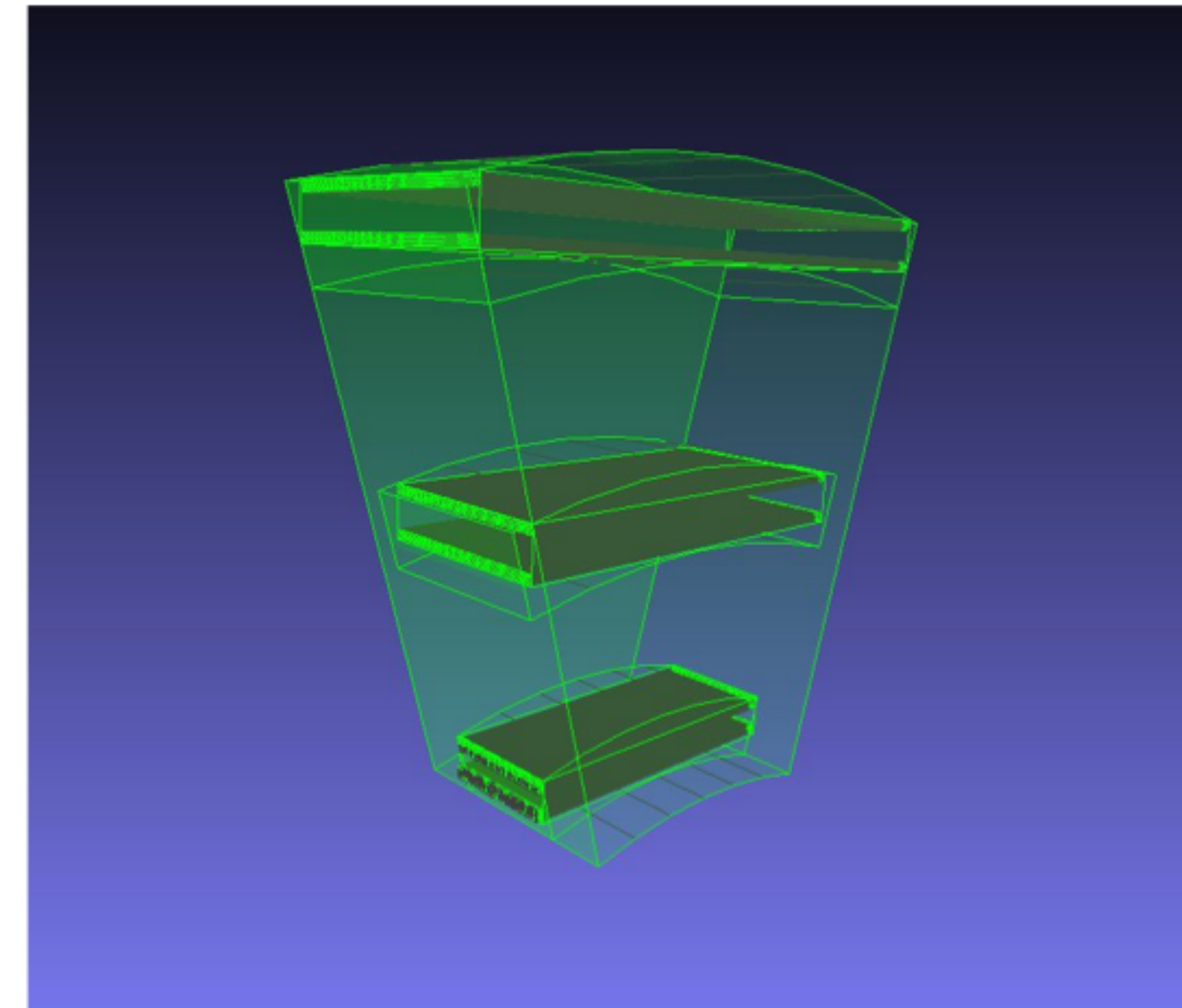
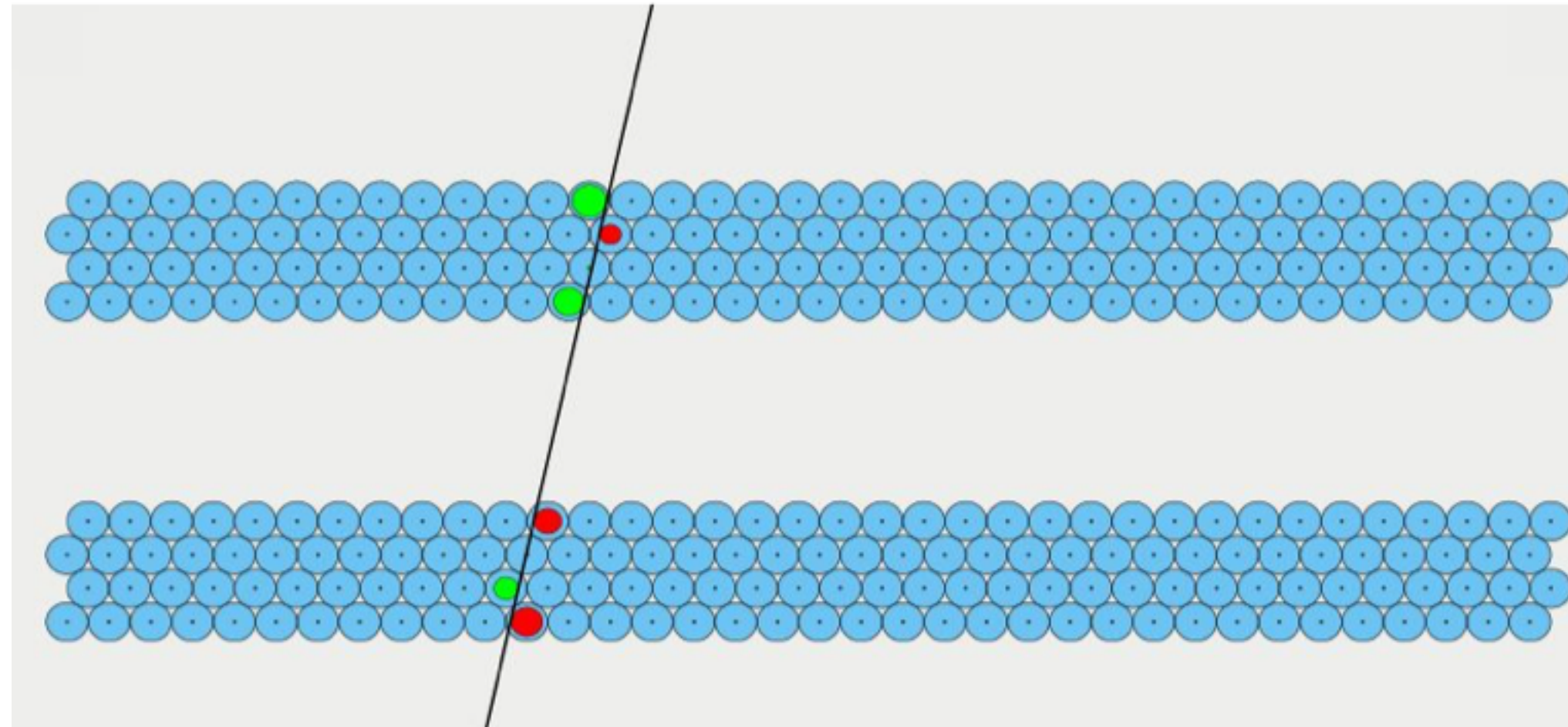


Resulting ODD detector



# Gen2 geometry - more developments

- ▶ In Gen2 geometry, navigation is outsourced to `Delegates`
  - allows for client-specified navigation
  - helped developing first prototypes for (ATLAS) Muon System



Mock up muon sector spectrometer .  
Every detector volume holds the navigation delegate



# Geometry (6) - Quo vadis ?

▶ **Gen1** geometry: `Acts::TrackingGeometry`

Well established, baseline

▶ **Gen2** geometry: `Acts::Experimental::Detector`

Blueprint

Layer-less

Navigation delegates

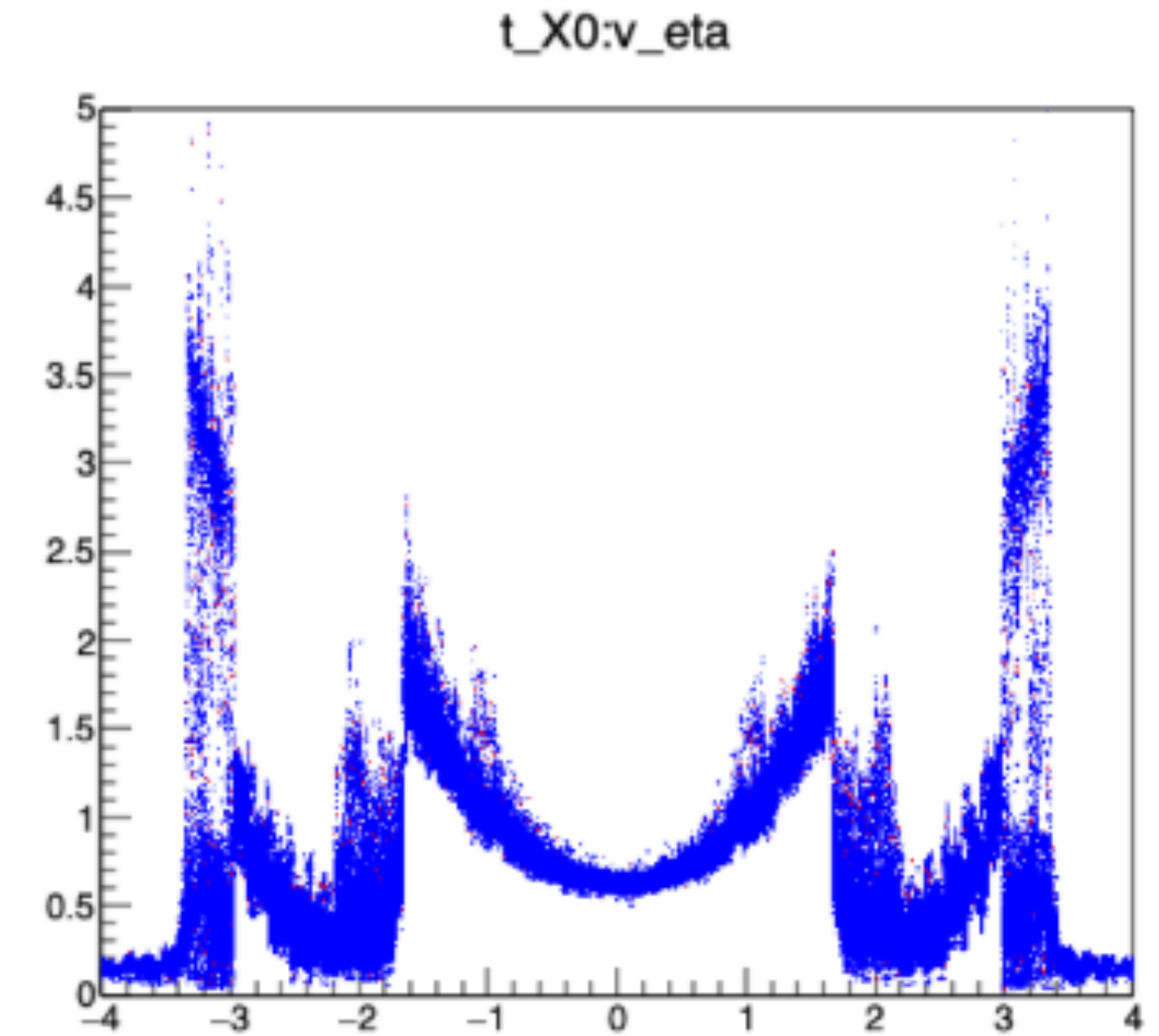
▶ **Gen3** geometry:

- adiabatic merge of those two concepts ?

- morph of Gen2 into full functionality of Gen1 ?

# Material

- ▶ New Grid based material classes introduced
- ▶ Material mapping/validation without & with propagation/navigation
  - This is to allow for material mapping/validation with optionally bypassing the propagator infrastructure
  - Support for Gen1/Gen2 geometry model
- ▶ Move most material mapping/validation into Core
  - Allow for more seemingness integration into SW stack

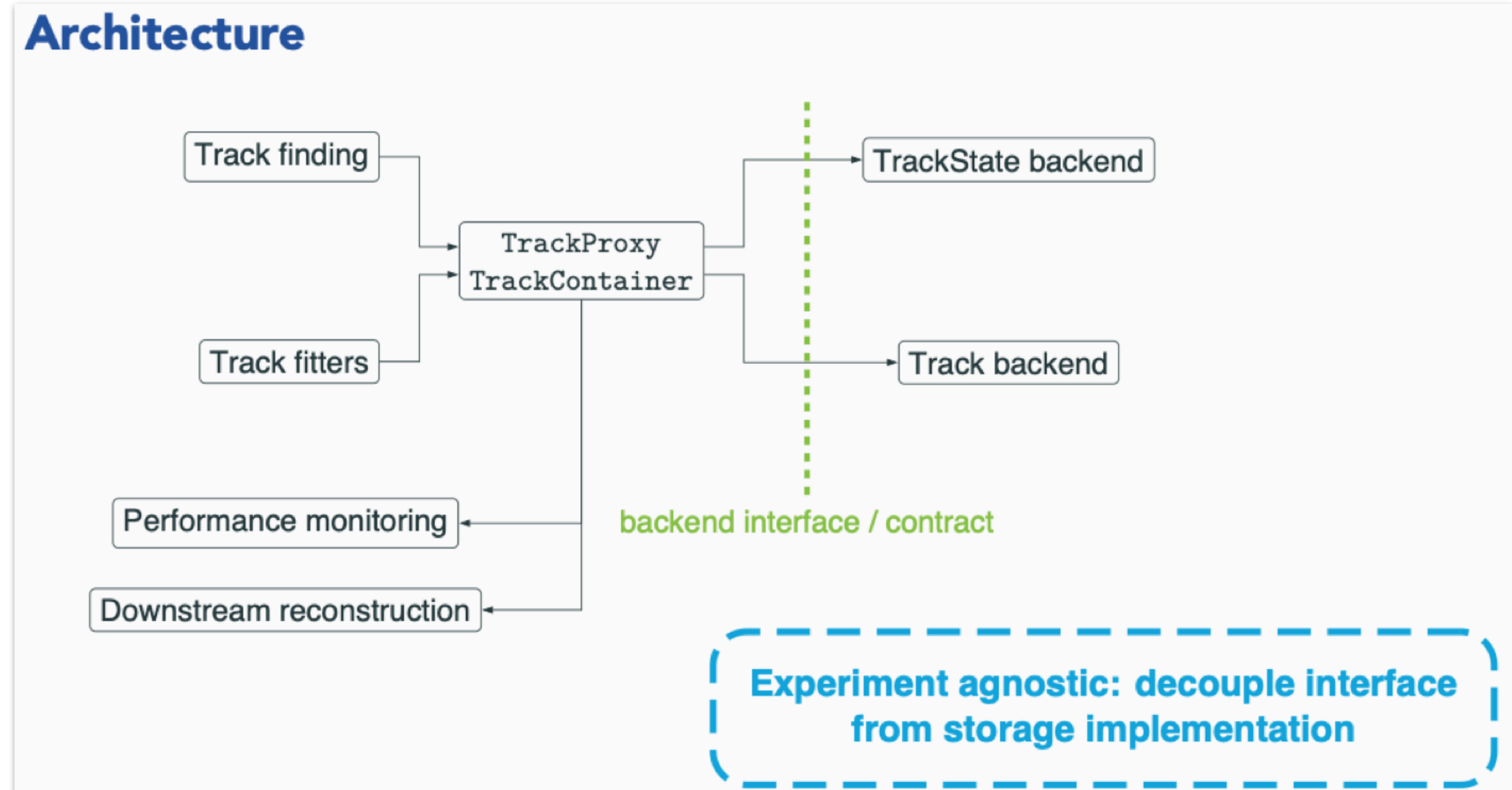


# Event Data model

## ▶ MultiTrajectory with frontend/backend split

ACTS has an internal EDM optimised for track reconstruction.

- recent work to separate transient model from I/O backend
- demonstrator with PODIO established
- Non-optimised EDM4Hep version also available



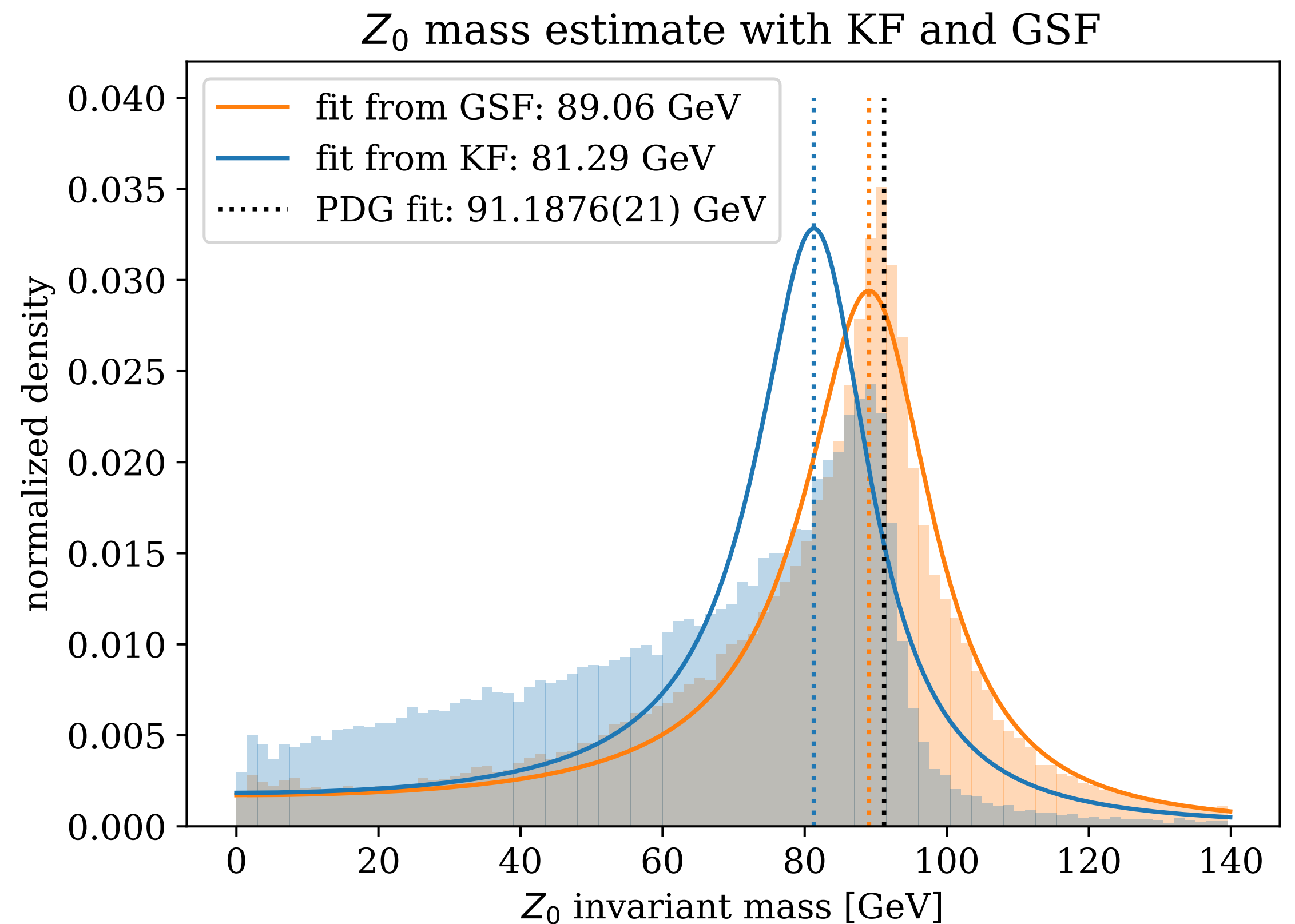
# Fitters (1)

- ▶ Gaussian Sum Filter has been validated on Open Data Detector

- shows nice performance on Geant4 simulated results
- Is designed as a re-fitter, i.e. after electron pattern recognition

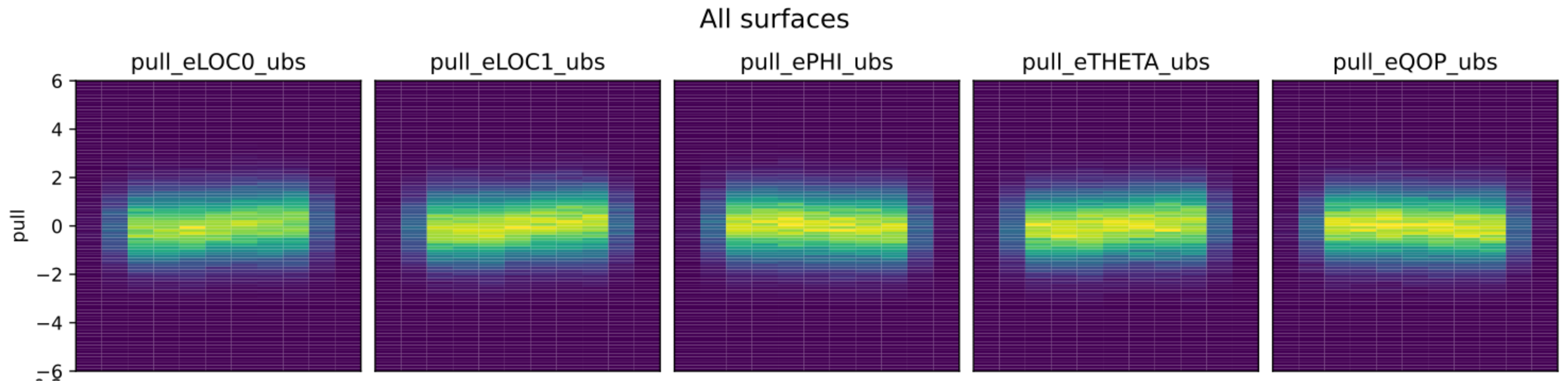
- ▶ Electron pattern recognition **not** yet implemented

- start with concept from ATLAS to enlarge window if electron hypothesis is triggered ...



# Fitters (2)

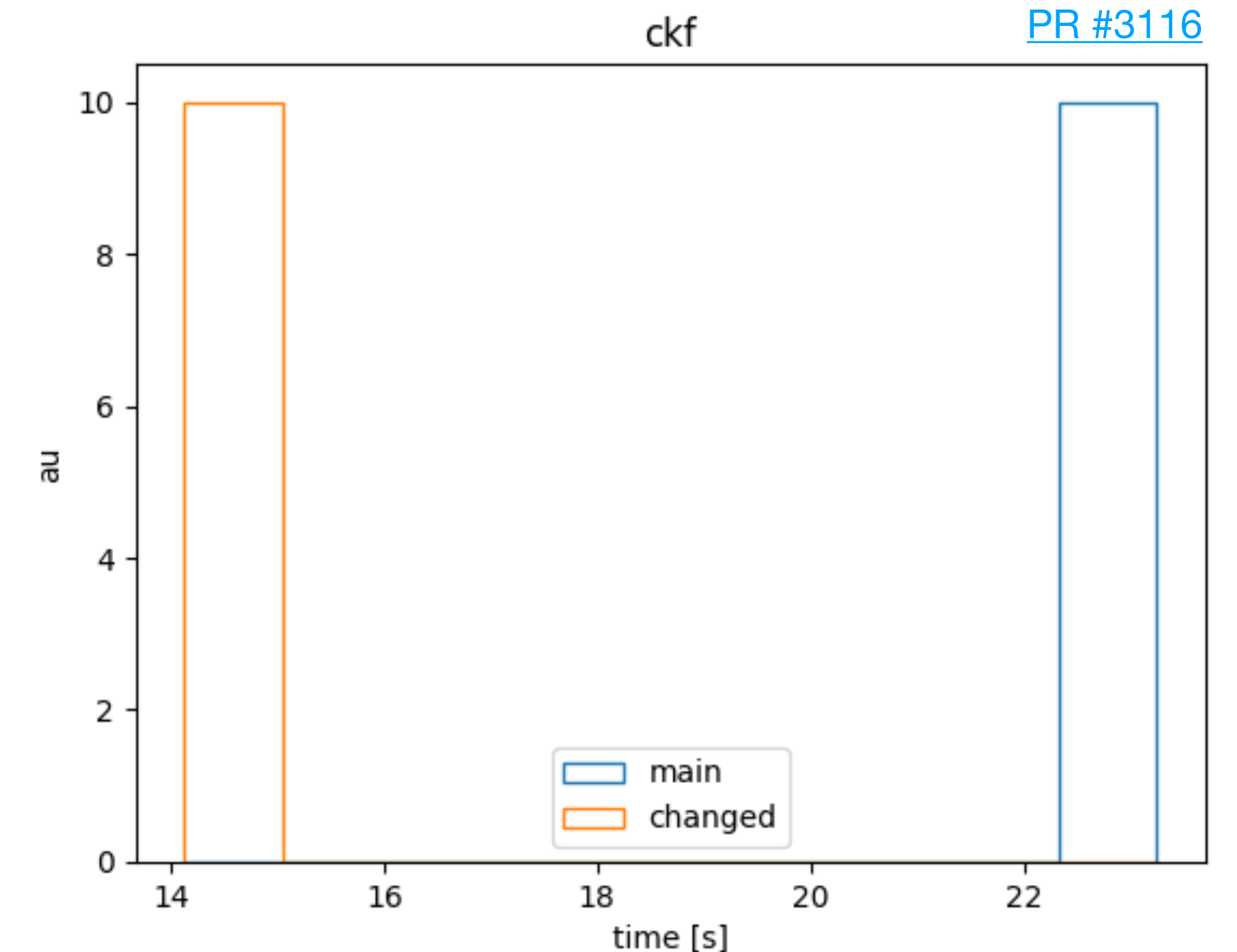
- ▶ Global chi2 fitter progress
  - First pipe-line on OpenDataDetector implemented
- ▶ Material effect integration **not** yet implemented
  - Exists in a python based prototype



# (C)KF refinements

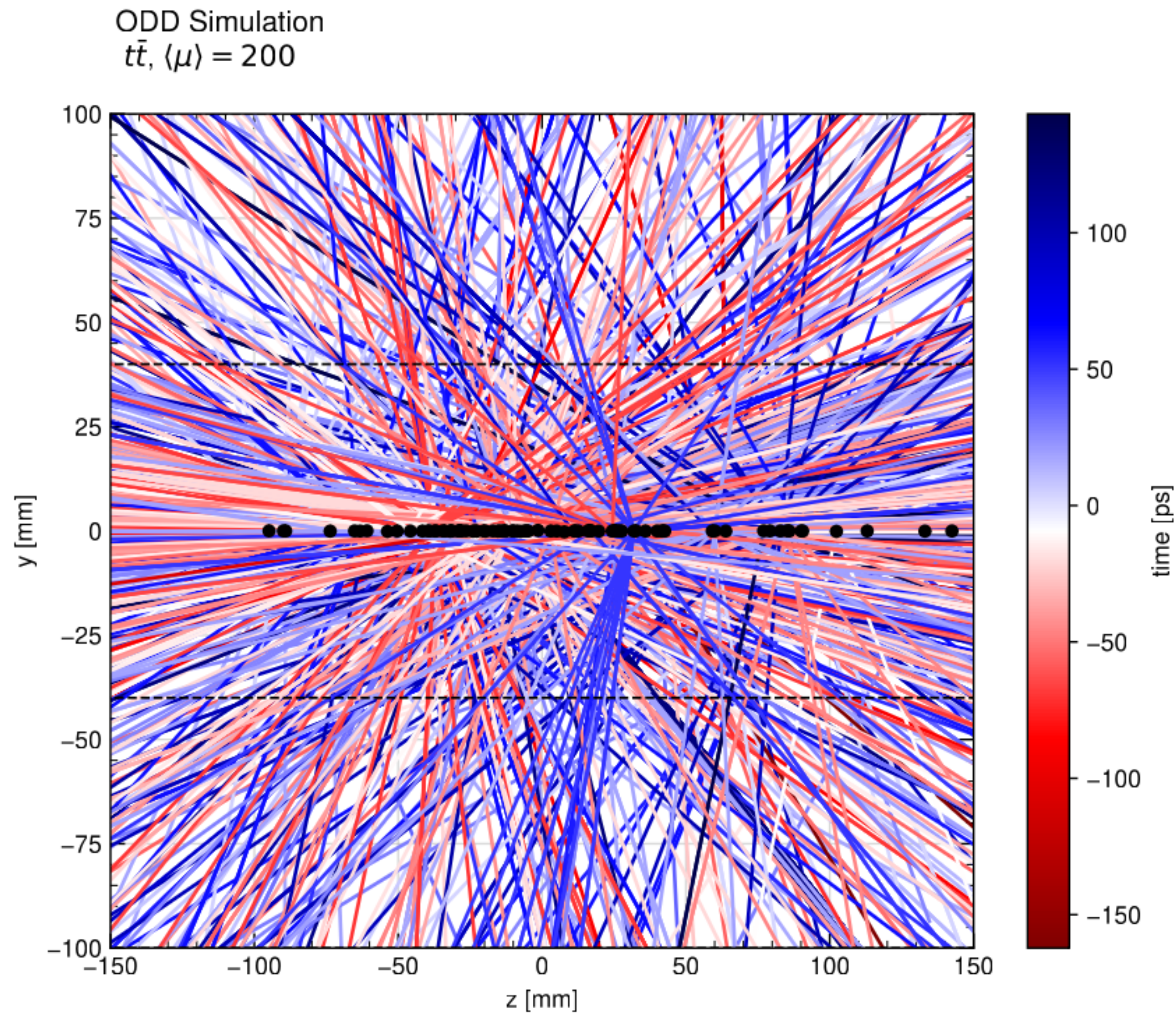
- ▶ Speed performance optimisation
  - Work on a new stepper has started
- ▶ Combinatorial Kalman filter updates
  - Improved branch stopping logic introduced
  - Smoothing separated from forward filtering
  - New, alternative CKF with external propagator steering in development

0.6209846368715083



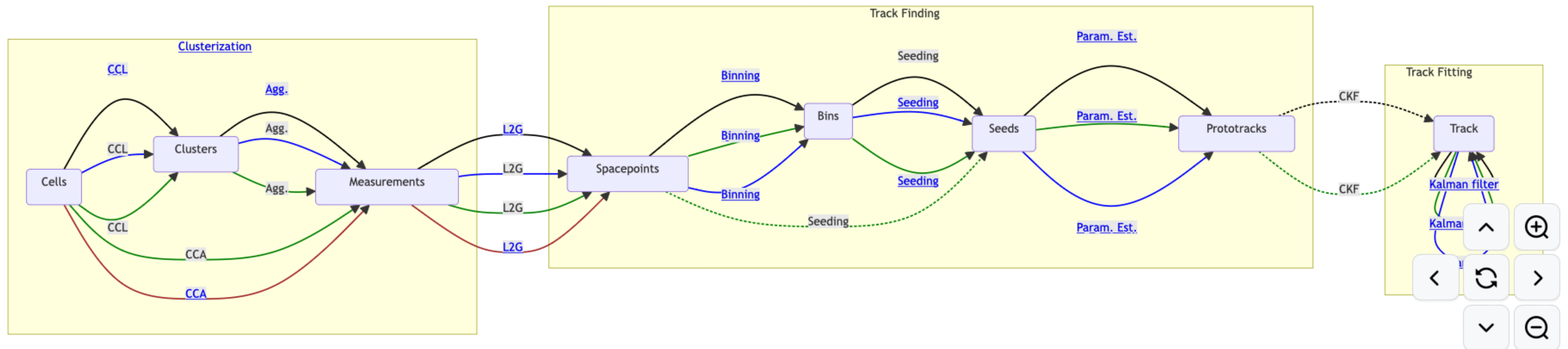
# Vertex reconstruction: fully time-aware

- ▶ Introduction of time in all components of vertex reconstruction
  - full exercise on OpenDataDetector in progress



# R&D line: parallelisation

- ▶ First chain runs on OpenDataDetector in stand-alone
  - Performance (physics/computing) evaluation to start
- ▶ Integration of 'traccc' suite as Plugins started
  - Aim is to be able to evoke a traccc reconstruction chain from ACTS





# R&D line: machine learning

- ▶ NN based cluster position / calibration
  - NN based clusterization available

