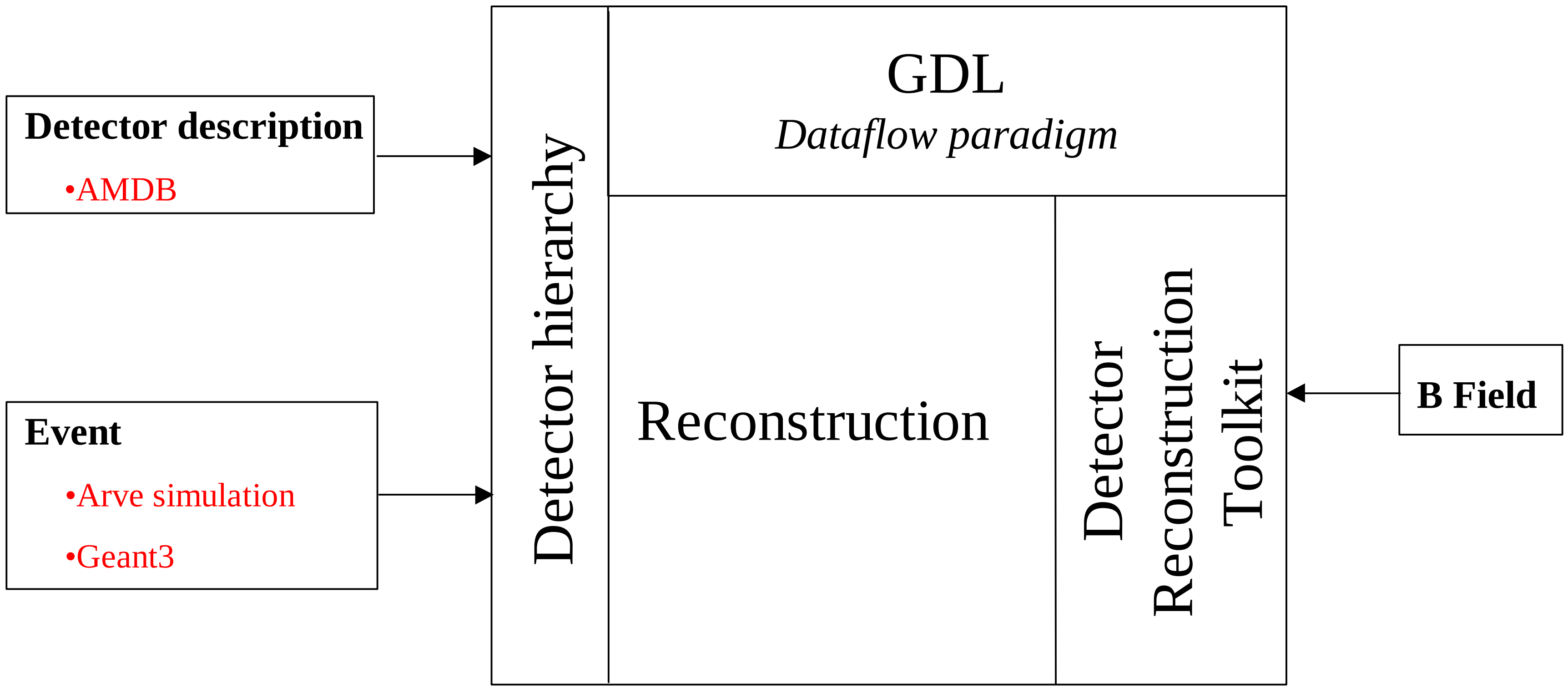
AMBER

ATLAS Muon Barrel and Endcap Reconstruction

An Arve based program for the reconstruction of tracks

in the muon spectrometer.

Overall Architecture



Detector description

- AMDB

Event

- Arve simulation
- Geant3

Detector hierarchy

GDL

Dataflow paradigm

Reconstruction

Detector Reconstruction Toolkit

B Field

Detector Hierarchy

- Serves as a buffer between the different input formats and the reconstruction algorithms.
- Provides access to the digits.
- Uses the official names, e.g. *ATL.MMC.BIL.3.01A.ML1*

- Accessor classes are provided to select specific detectors.

Will be replaced by the detector description domain.

Detector Reconstruction Toolkit

A set of general classes used by the reconstruction.

Contains :

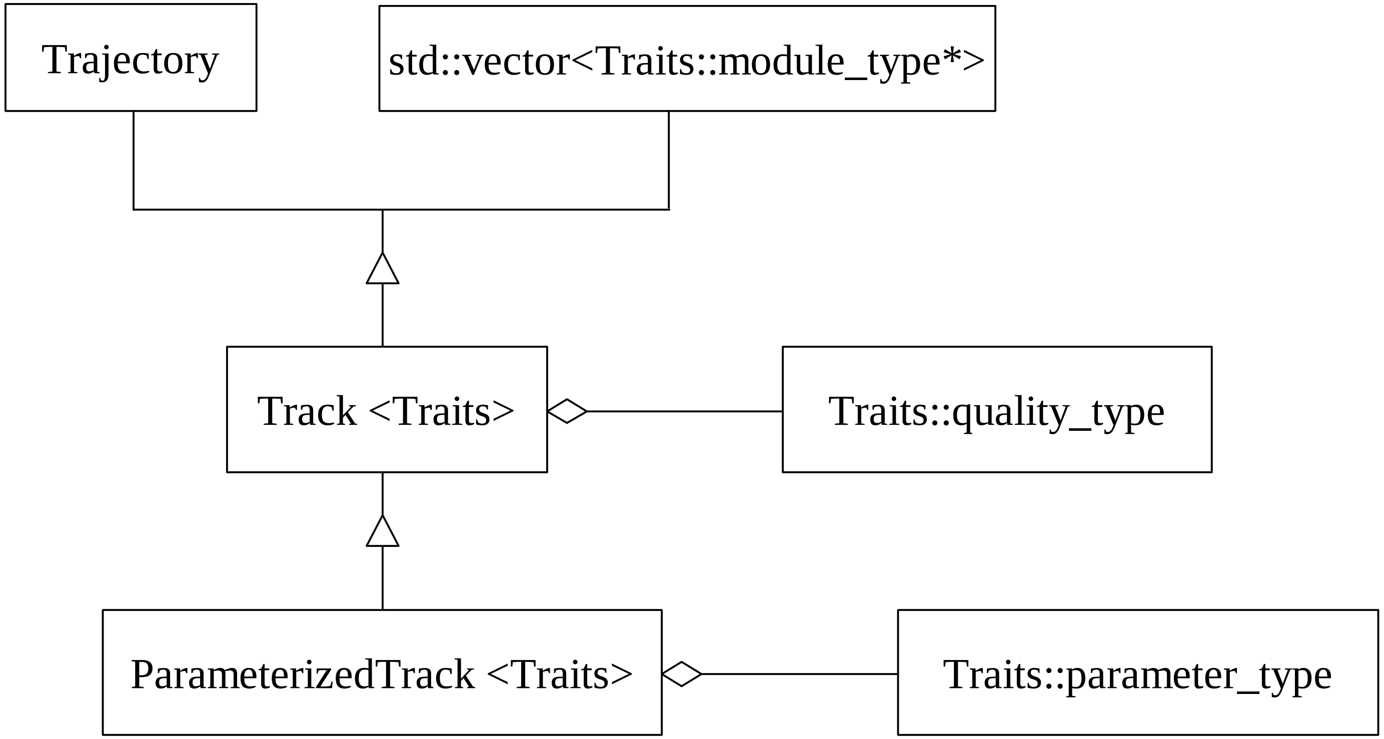
- Tracking in Magnetic Field (former Magnetic Field domain).
- Geometrical entities :
  - region of activity (ROA)
  - error cone and error point.
- Tracks, vertices, etc. (first draft; will be discussed next week).
- Track fits :
  - Straight line, least squares fit.

Draft Design of Track

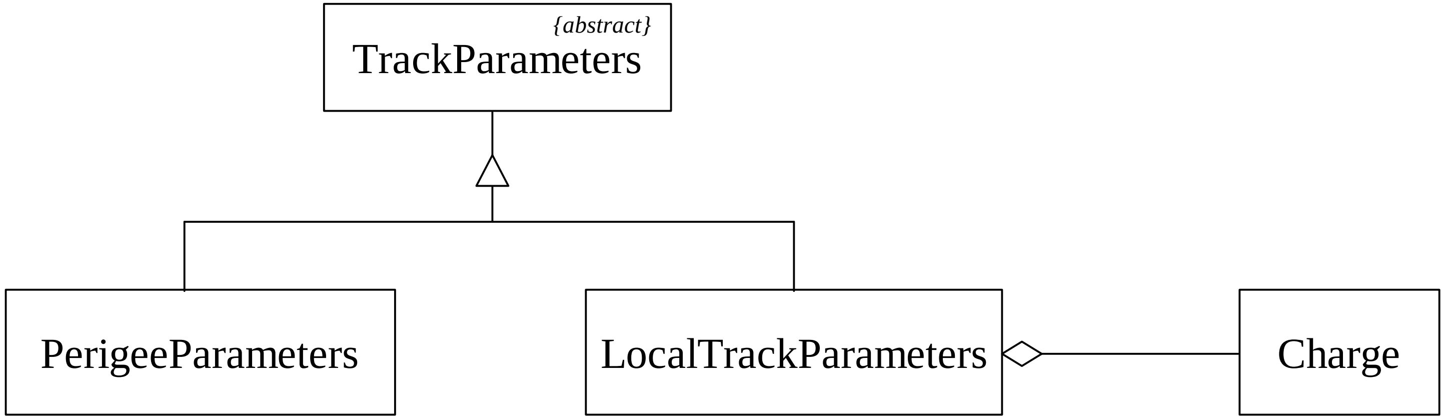
- Defines only the different classes involved and their relationships.
- The contents of the classes will be defined next week.

- The classes are based on a *Traits* parameter which consists of :
  - identifier_type
  - module_type
  - quality_type
  - parameter_type

Track

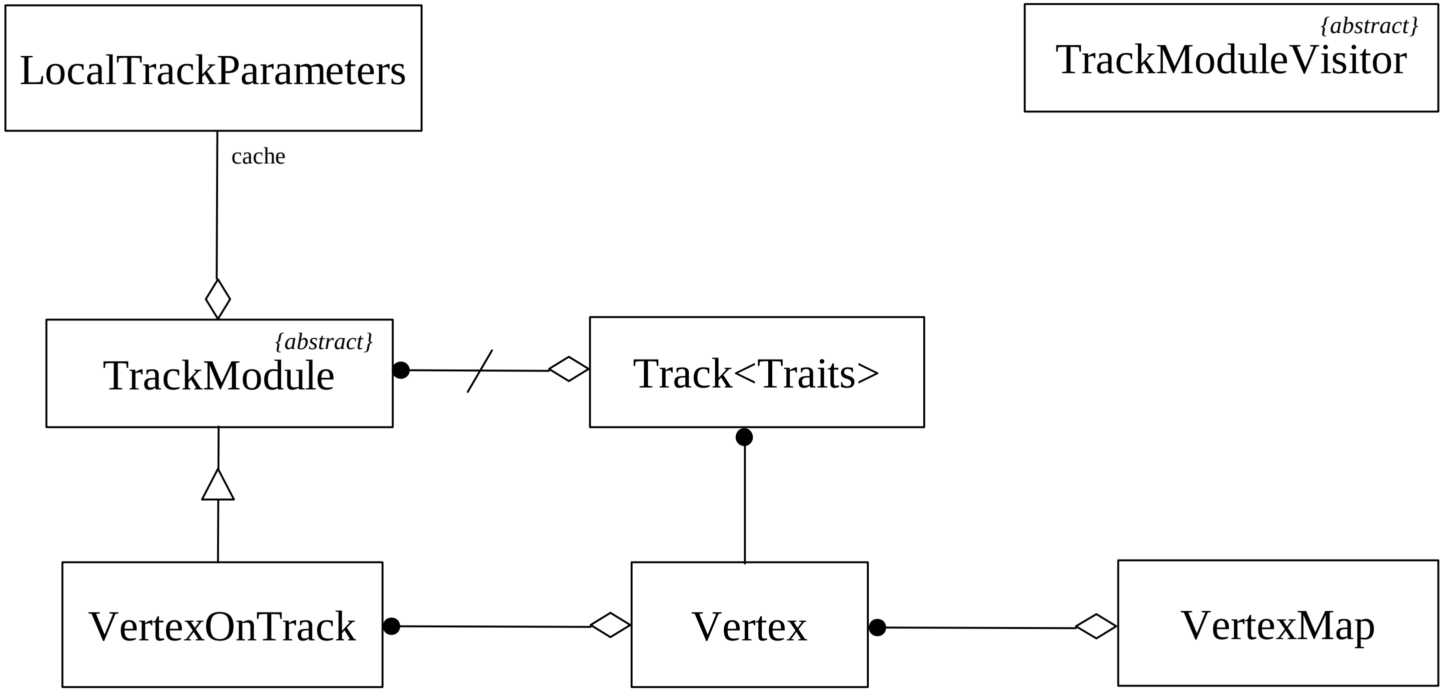

Trajectory
std::vector<Traits::module_type*>
Track <Traits>
Traits::quality_type
ParameterizedTrack <Traits>
Traits::parameter_type

Track Parameters



Used by tracking in the magnetic field

Vertices & Track Modules



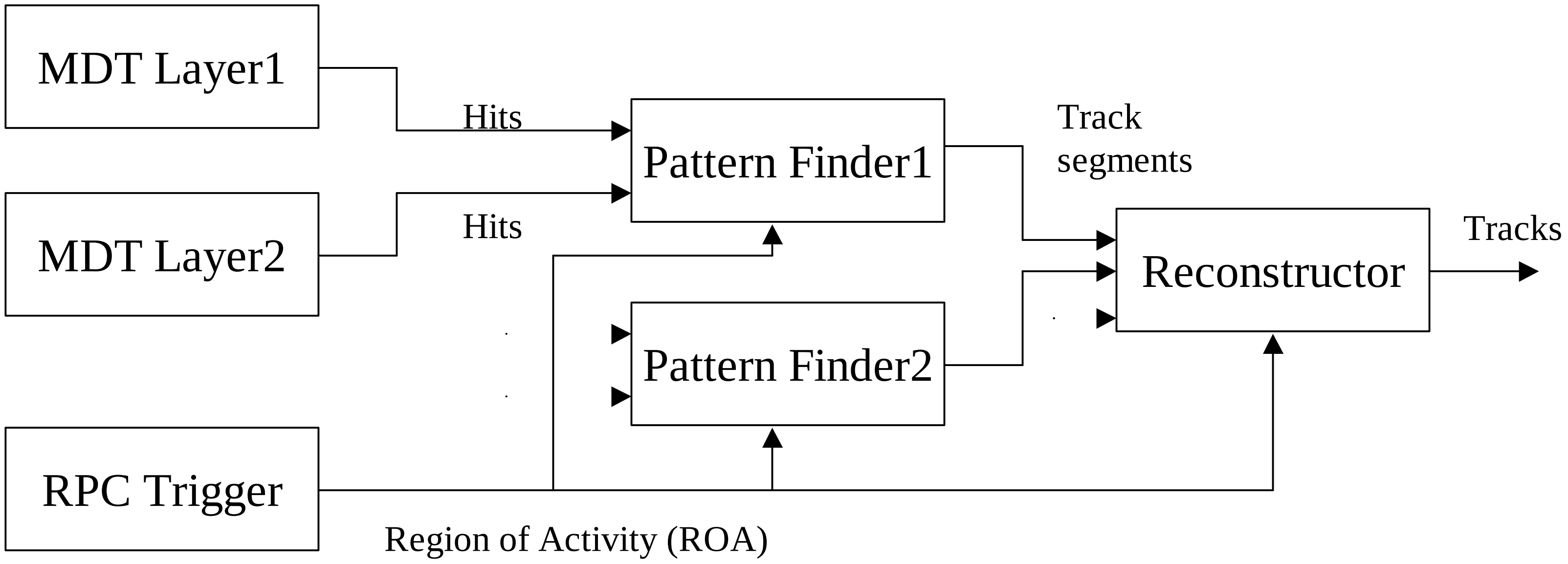
Dataflow Architecture

- For the reconstruction a dataflow model is the most natural choice.
- In Amber this is implemented as a sequence of iterators and iterator adaptors.

- The data naturally flows from its “creator” (e.g. a MDT layer) to a user (e.g. the reconstructor). However, the flow of control is in the other direction.
- This means automatic looping over inputs: One call to ‘reconstructor::execute’ is sufficient to process all possible combinations of hits, roa’s, tracks, etc. in an event.

- A set of basic modules has been created.

Dataflow Example



MDT Layer1

MDT Layer2

RPC Trigger

Hits

Hits

Pattern Finder1

Pattern Finder2

Track segments

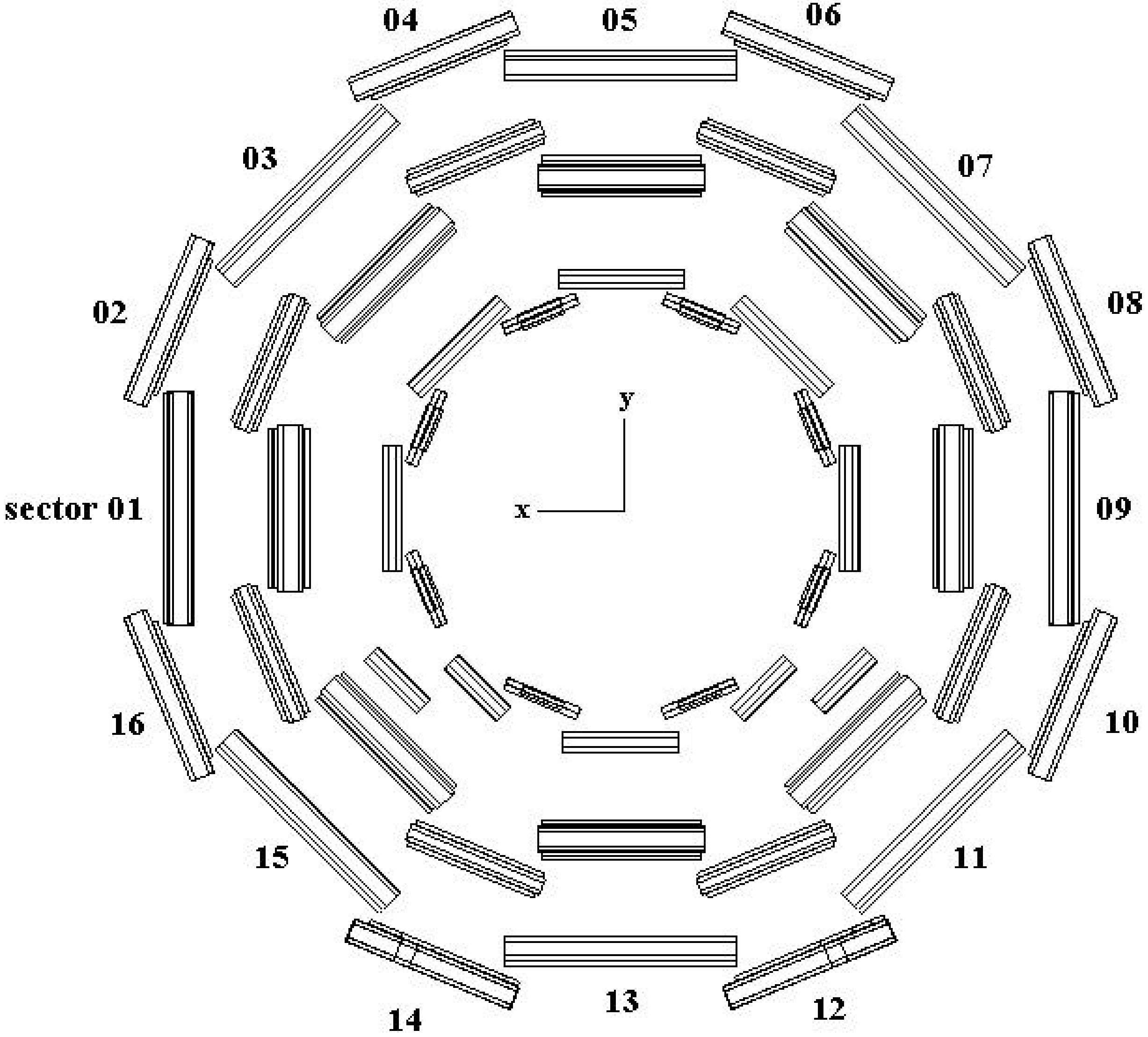
Reconstructor

Tracks

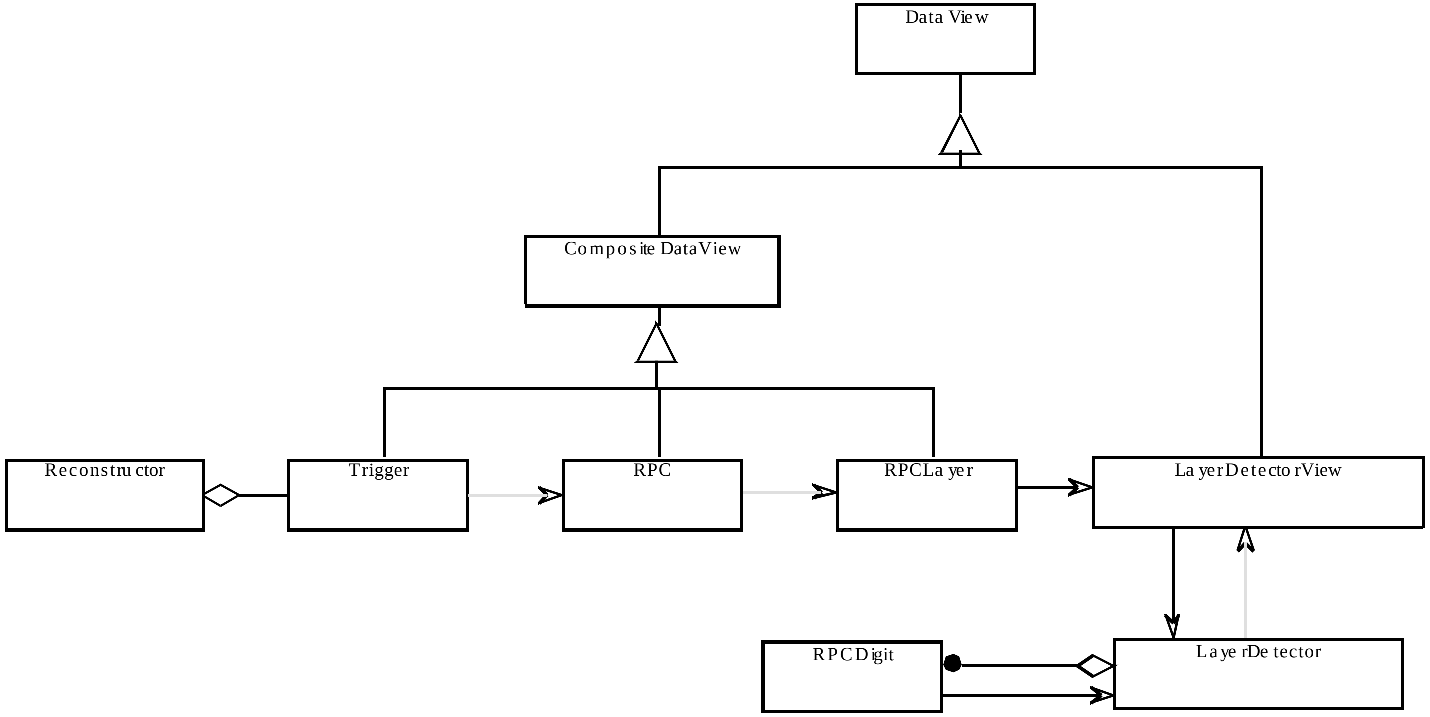
Region of Activity (ROA)

Dataflow code example

```
gdl::Merger<gdl::bidirectional, TriggerRoad>* merger;
merger = gdl::merge(”Merger",
   gdl::transform(”Build road",
         gdl::filter(”Filter on z",
                 gdl::sorted_combinatorials(”Combine",
                                            _layer1, _layer2,
                                            MatchClustersInPhiBegin(),
                                            MatchClustersInPhiEnd()),
                 MatchClustersInTheta()),
         BuildRoad()));
merger->add(gdl::transform(”Build default road",
         gdl::filter(”Layer not used", _layer1,
                    gdl::not_used<TriggerCluster>()),
         BuildDefaultRoad()));
```


04
05
06
03
07
02
08
y
sector 01
x
09
16
10
15
11
14
13
12

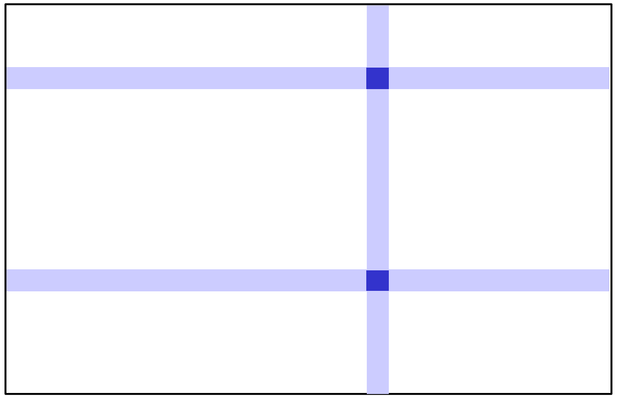
Trigger Reconstruction Architecture



Reconstruction

RPC chamber

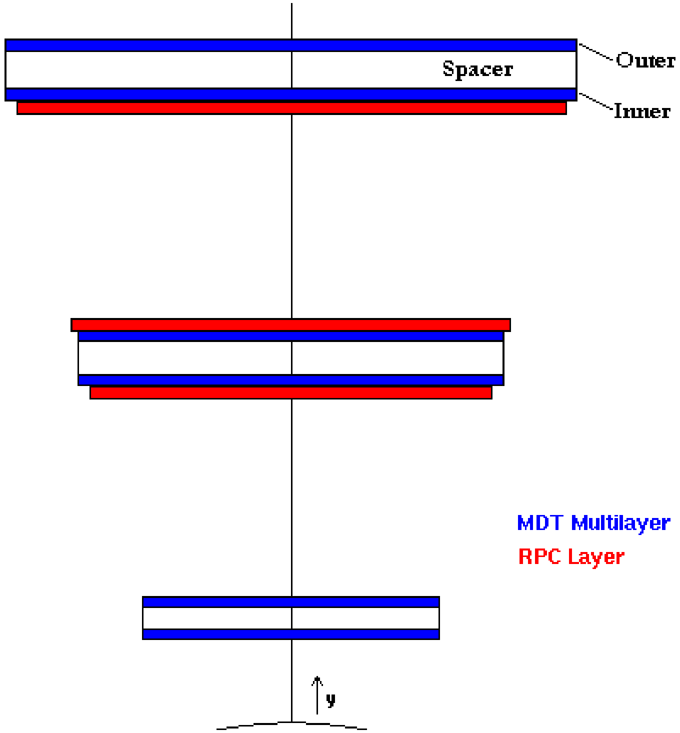
- Each chamber consists of 4 layers, 2 in x and 2 in z.
- First the hits in the two identical layers are combined when possible, but all non-matched hits are also kept.
- Then all possible clusters are formed.



Reconstruction Details

RPC Layer

- An RPC layer consists of all RPC chambers with the same radius (= the same station and type).
- The points from all chambers in a layer are merged into a single list, sorted in phi

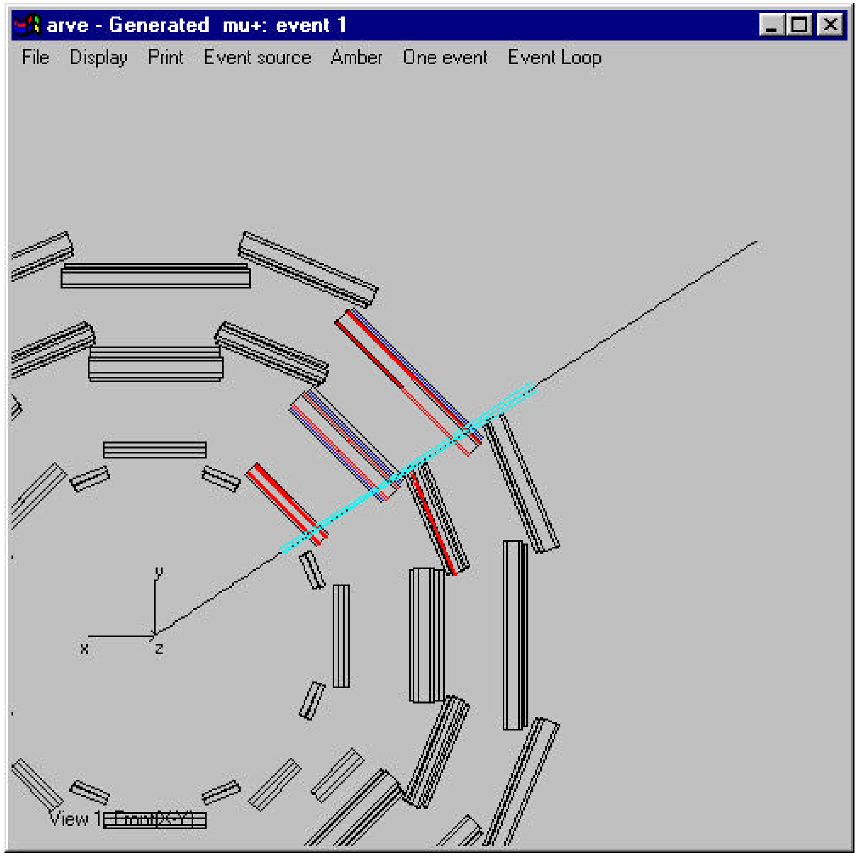


Reconstruction Details

Construction of trigger roads

- The two inner most layers of each type are then used to build trigger roads.
- If there is only a cluster in one layer a default (wider road) is created.
- Roads from the two station types are combined when possible.
- Clusters in the outer layers are added when they match.

RPC Reconstruction - Result



Reconstruction Details

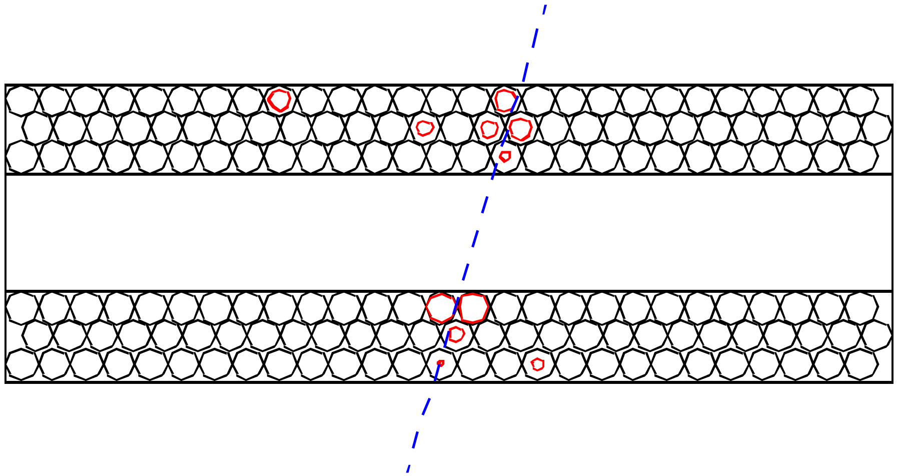
MDT Ladder

- A MDT ladder consists of all MDT chambers in the same layer, sector and side of the barrel of the muon spectrometer.
- The corresponding tube layers of all chambers in the ladder are merged.
- The hits in the layers are then filtered based on a region of activity (e.g. a trigger road) and merged into one list.
- This list is used by the pattern recognition.

Reconstruction Details

MDT Ladder - Pattern Recognition

- The pattern recognition algorithm creates straight track segments based on requirements of the hit layout (identical to Datcha!).



Reconstruction Details

Building tracks

- Track segments from MDT chambers that are created based on the same region of activity and which match in orientation are combined into tracks.
- The hits of the track are passed to a fitter for a single pass.
- Based on this first guess, multiple scattering points (dead material) are picked up.
- Finally the fit is rerun until it converges.

In progress

Future Additions

- Next version :
  - Read RPC digits from Geant3
  - Variable step size for magnetic field tracking
  - Port to a Unix platform (HP or Linux; take your pick!)

- Subsequent versions :
  - Endcaps
  - Material
  - ...