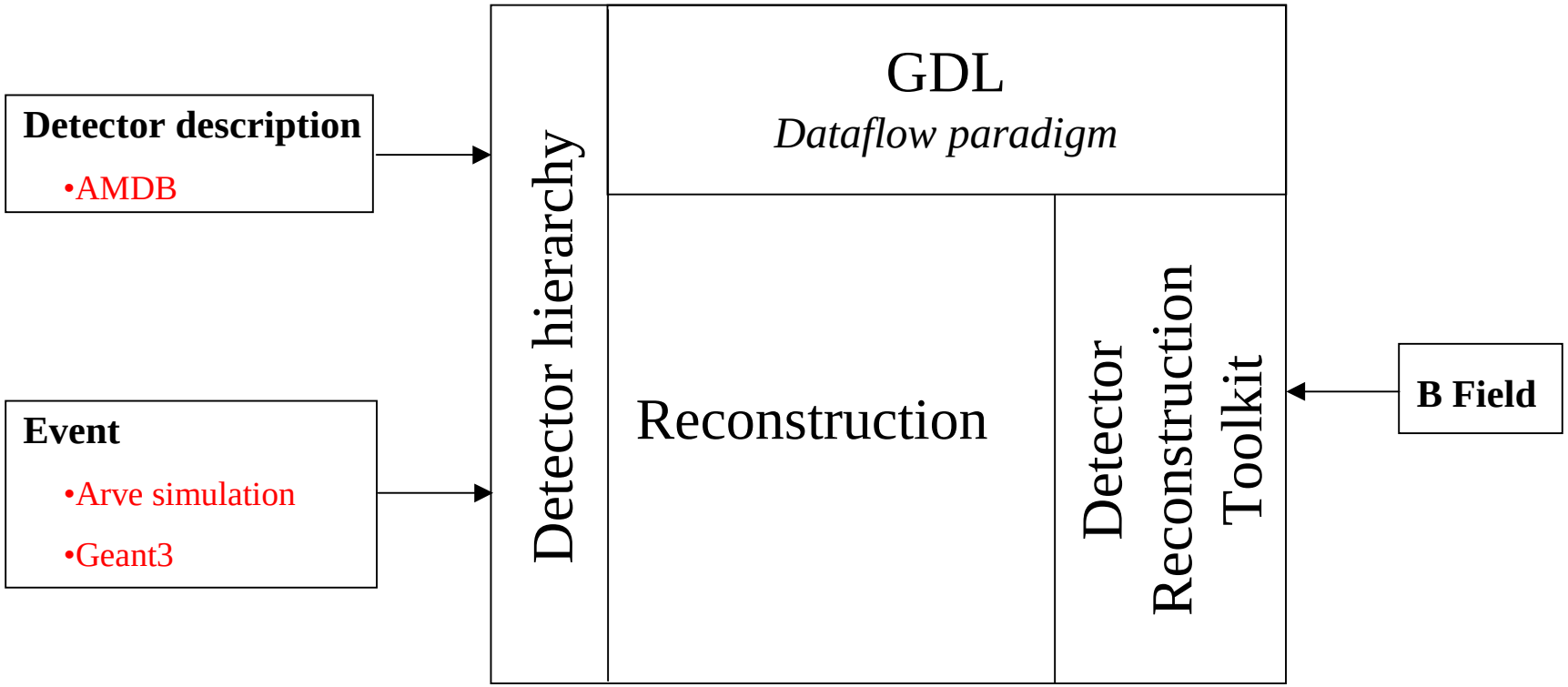
AMBER

ATLAS Muon Barrel and Endcap Reconstruction

An Arve based program for the reconstruction of tracks

in the muon spectrometer.

Overall Architecture



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 :

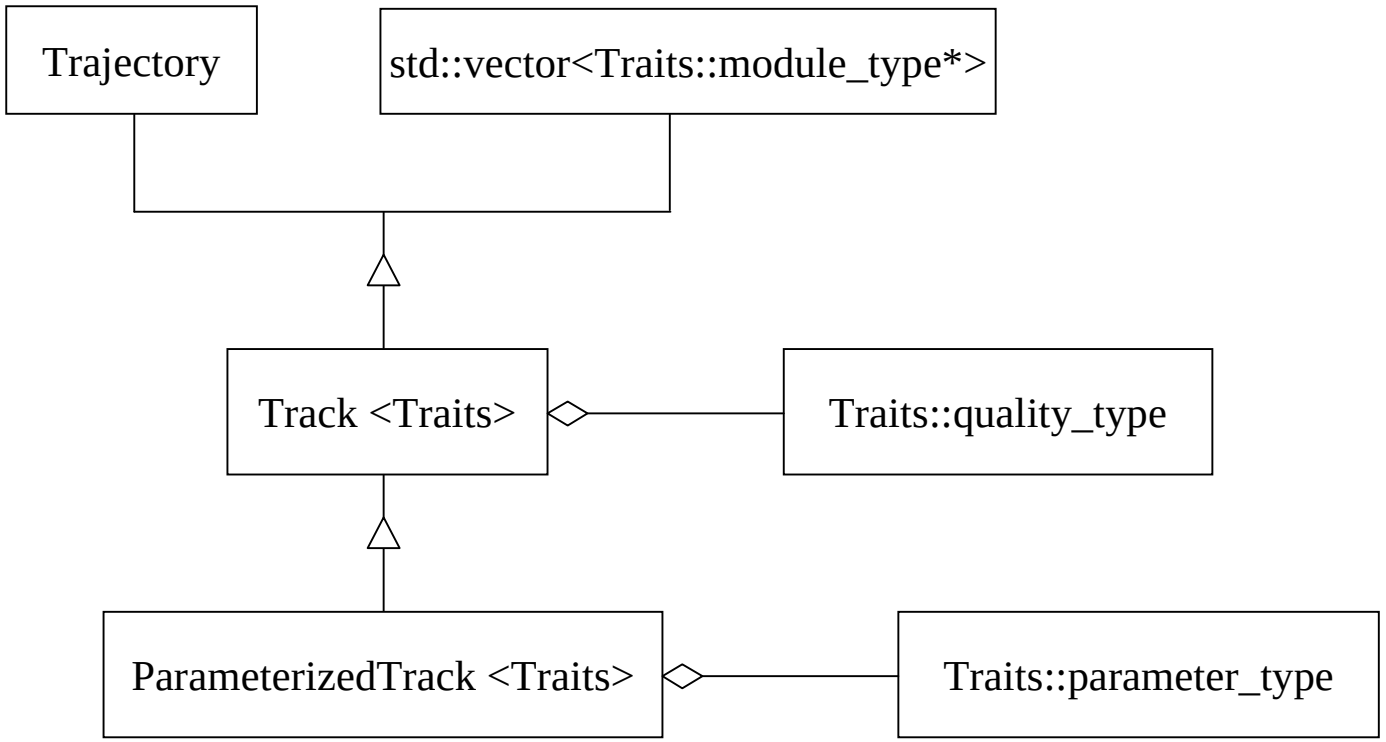
- Tracking in Magnetic Field (former Magnetic Field domain).
- Geometrical entities :
  - region of activity (ROA)
  - error cone and error point.
- Tracks, vertices, etc. (first draft; will be discussed next week).
- Track fits :
  - Straight line, least squares fit.

Draft Design of Track

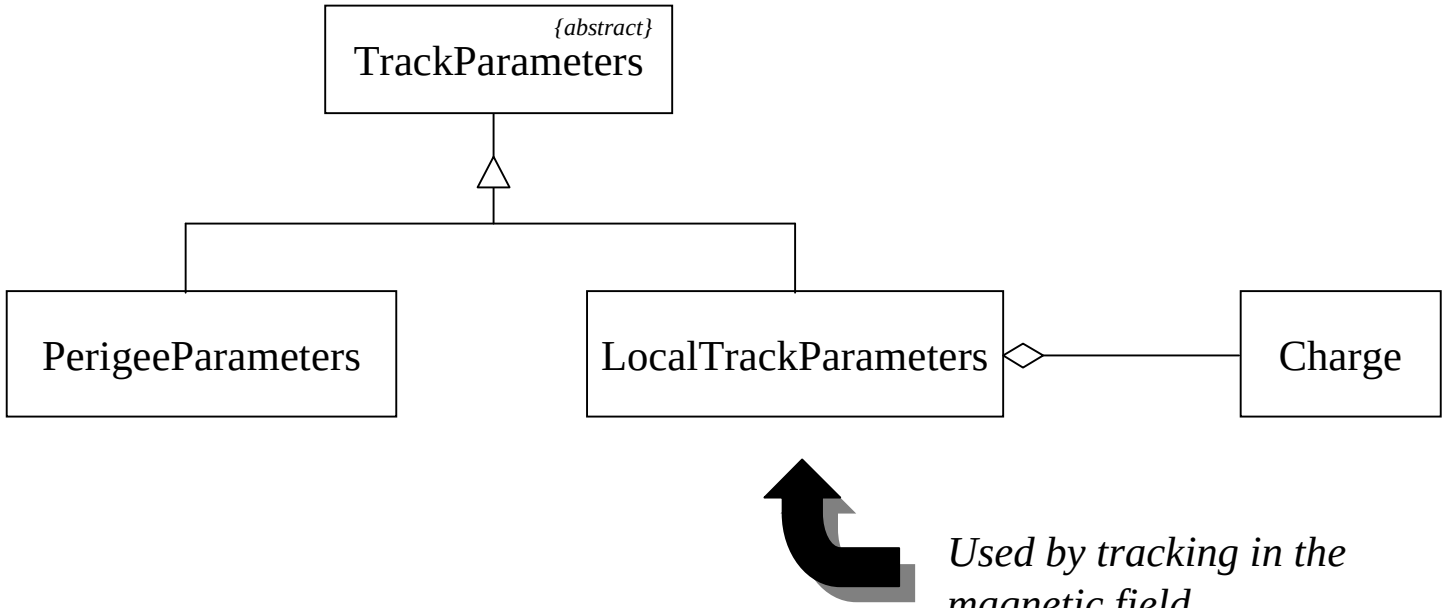
- Defines only the different classes involved and their relationships.
- The contents of the classes will be defined next week.

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

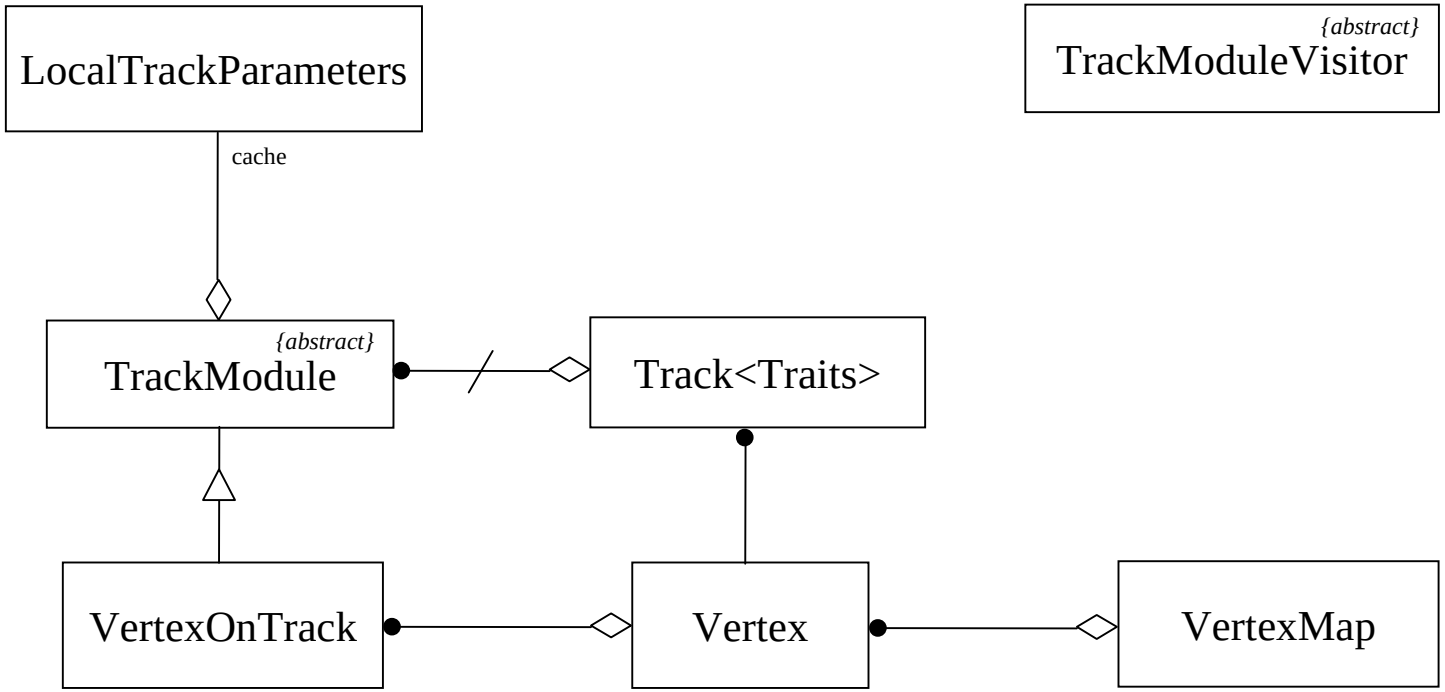
Track


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

Track Parameters



Vertices & Track Modules



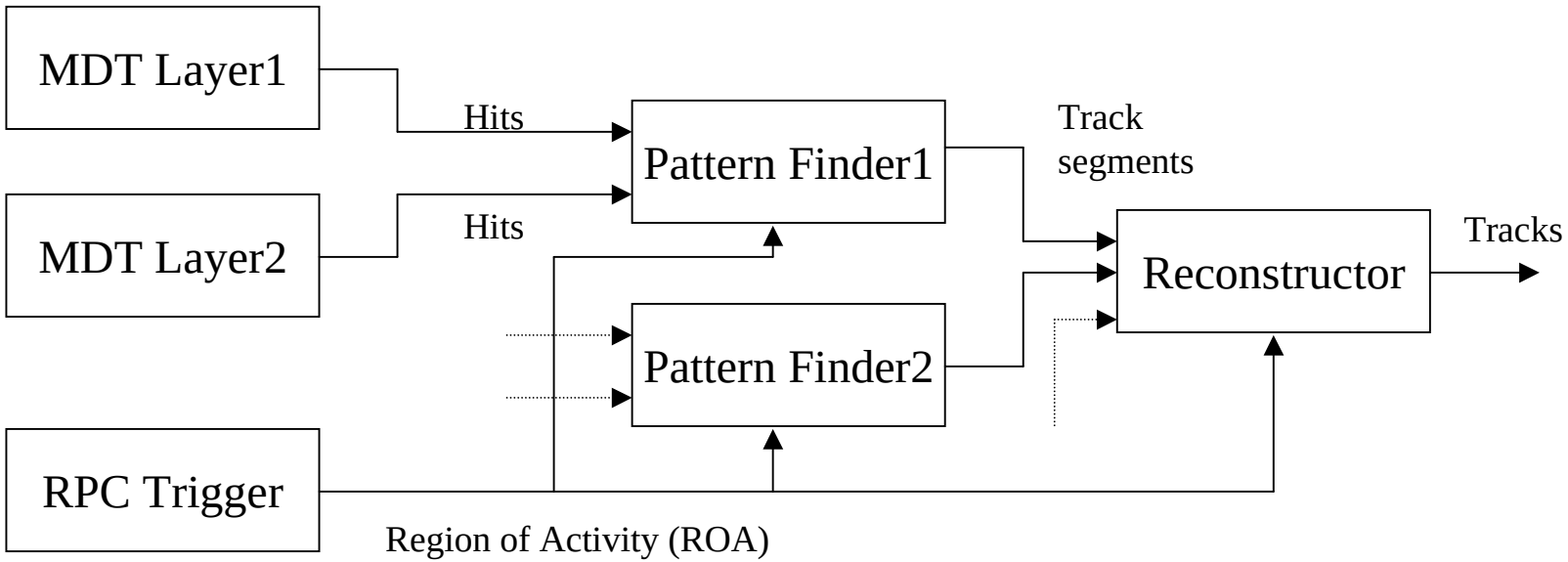
Dataflow Architecture

- 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.

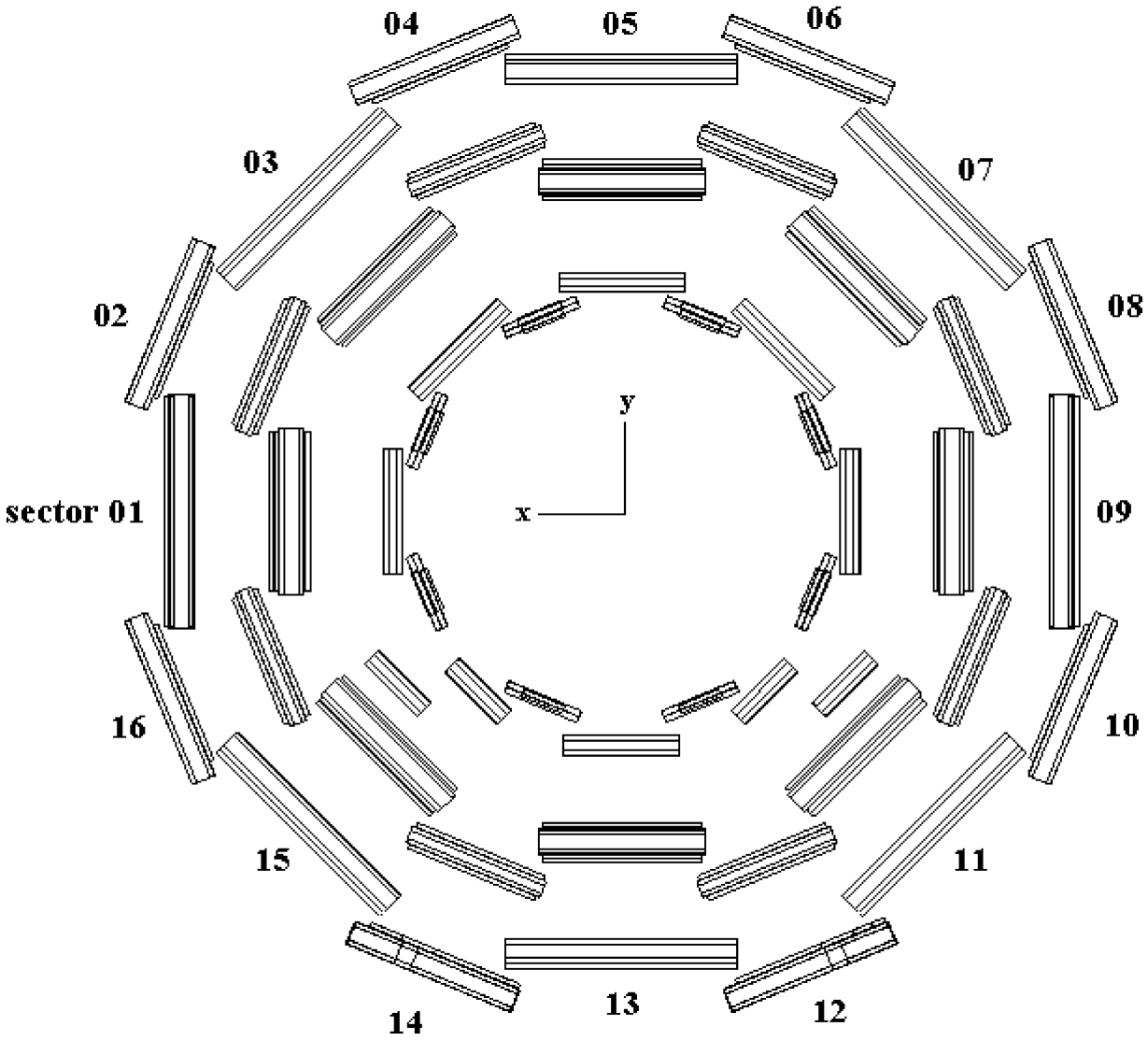
A set of basic modules has been created.

Dataflow Example

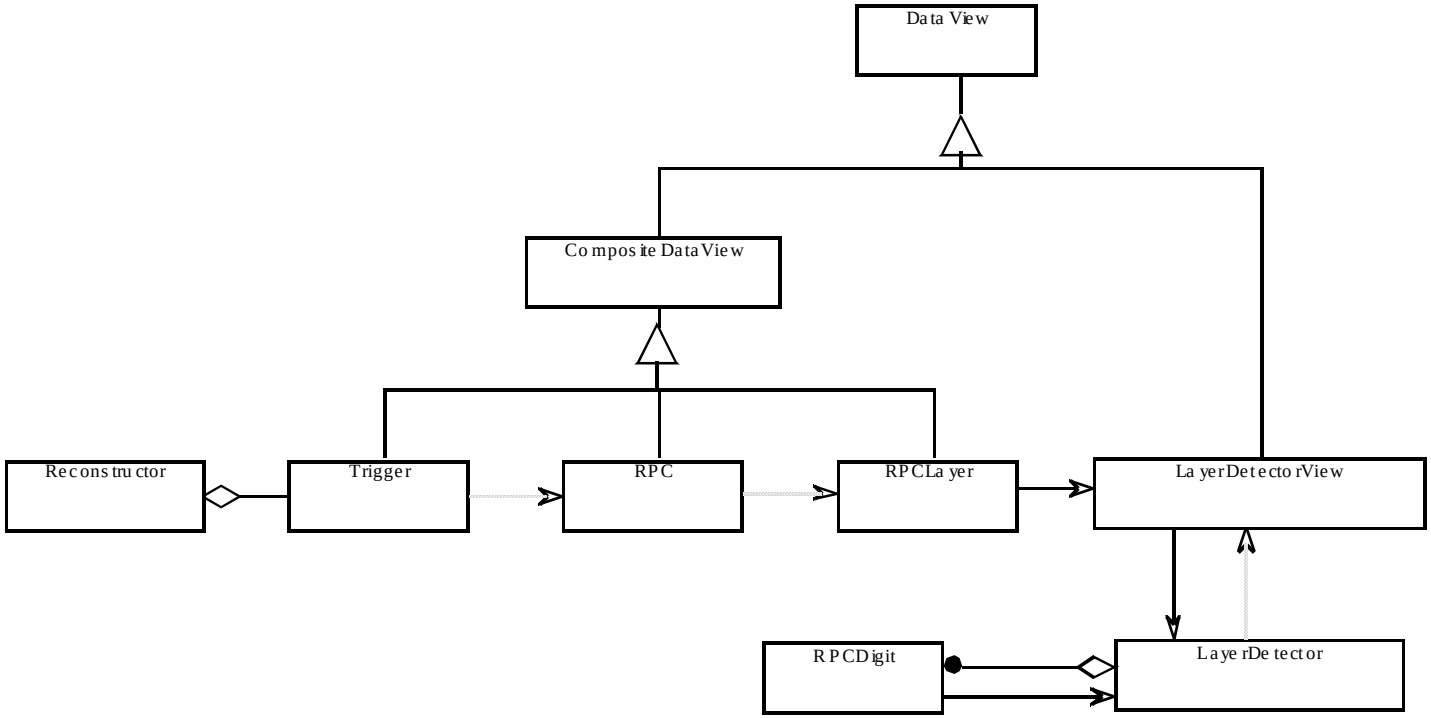


Dataflow code example

```
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

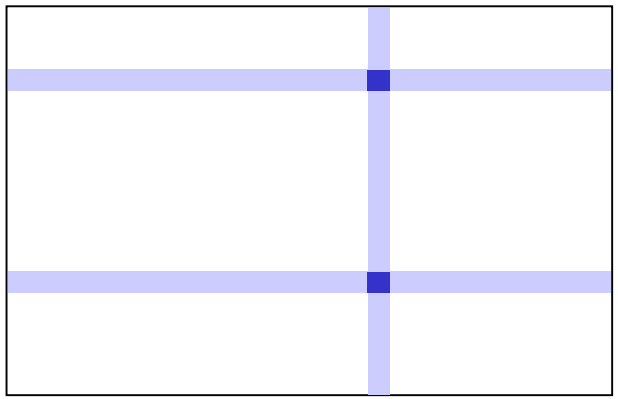
Trigger Reconstruction Architecture



Reconstruction

RPC chamber

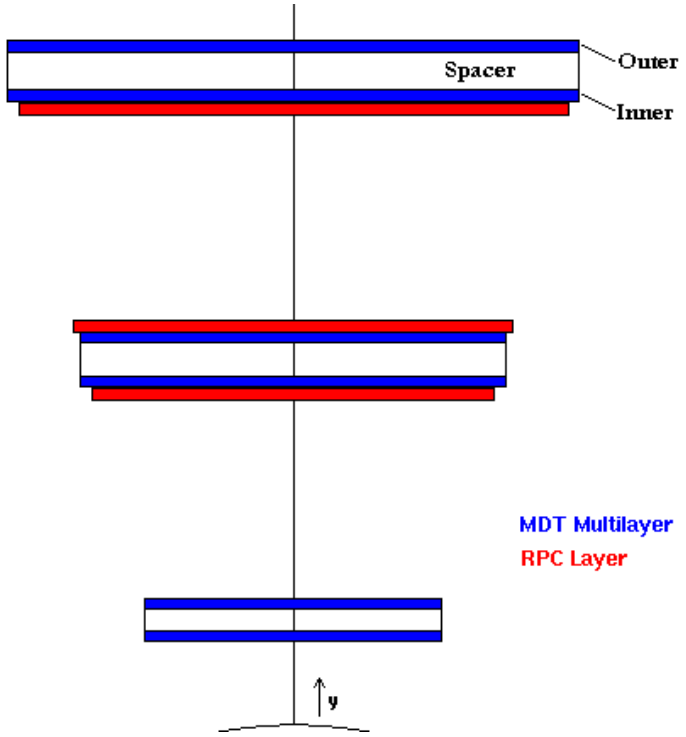
- Each chamber consists of 4 layers, 2 in x and 2 in z.
- First the hits in the two identical layers are combined when possible, but all non-matched hits are also kept.
- Then all possible clusters are formed.



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

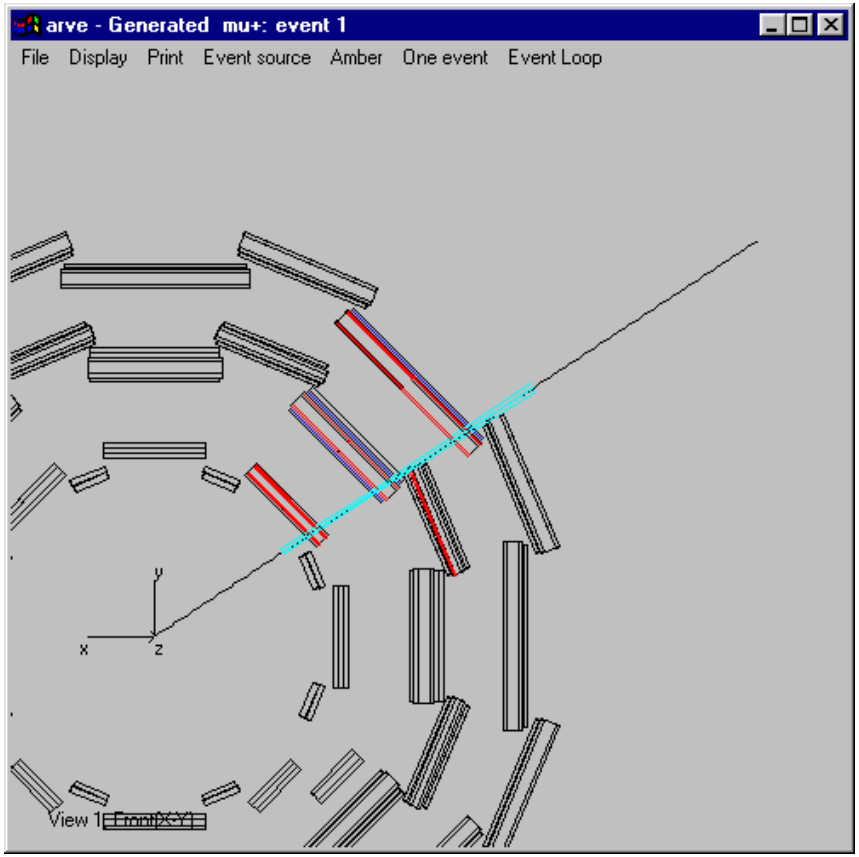


Reconstruction Details

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

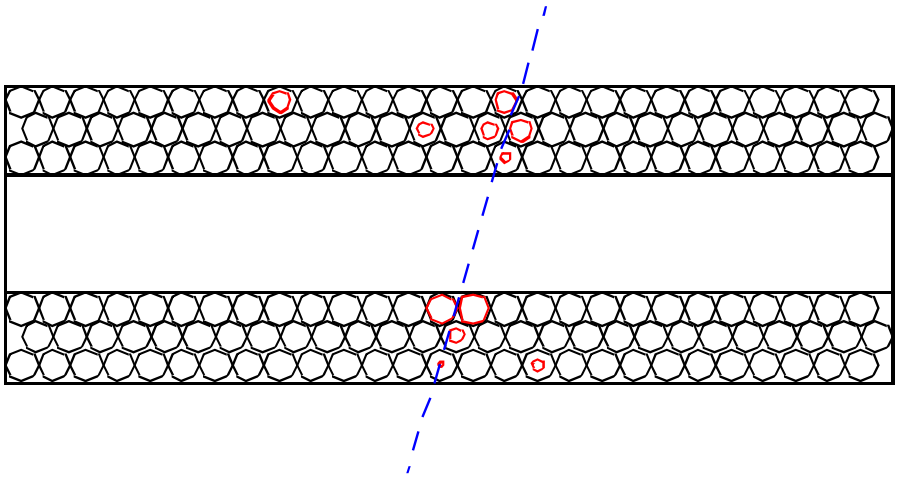
MDT Ladder

- 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
  - ...