MUON geometry framework

I.Hrivnacova
IPN, Orsay

ALICE Offline week, CERN
3 -7 October 2005

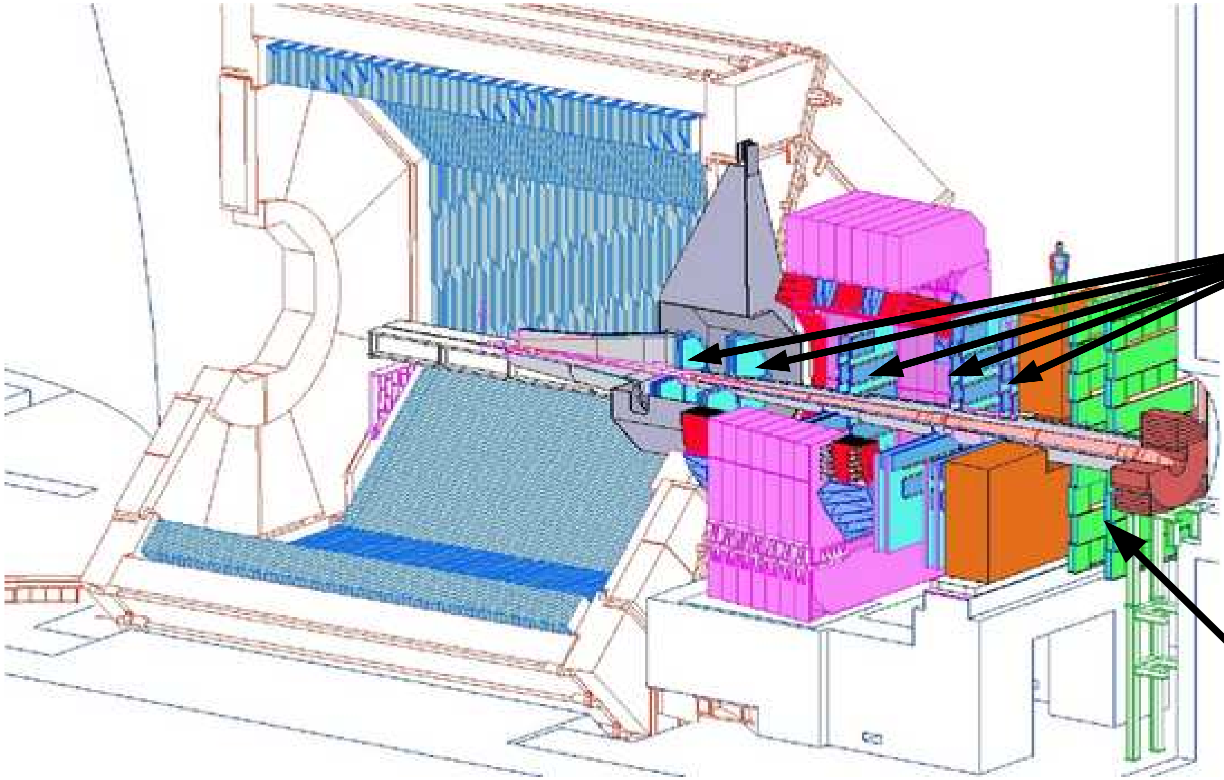
Introduction

- Parametrisation of geometry
  - Consistent use of geometry parameters (= detection element transformations) over the whole MUON code
- Presentations at the last Offline weeks
  - September 2004 – concentrated on the applied method
  - February 2005 - a more detailed description of the introduced framework classes and their implementation for MUON
- This presentation
  - A short overview of what has been done

Detection Element

- Represents a rigid part of a detector which is an object of alignment
  - In MUON: Quadrants, Slats, Trigger Chambers
- Has the unique ID in the whole detector
- Provides transformation between the global and its local frames

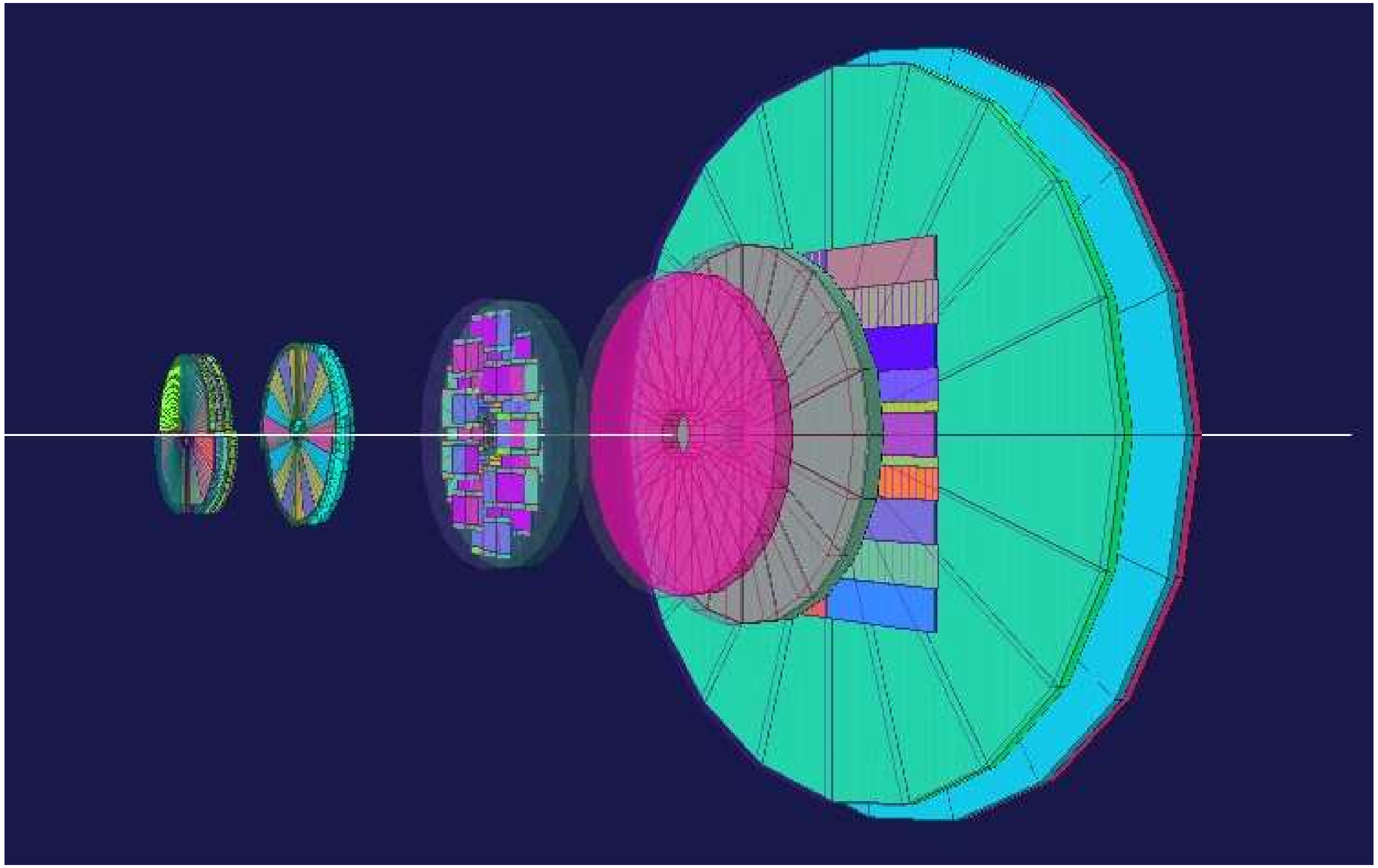
Detection Elements in Dimuon Arm



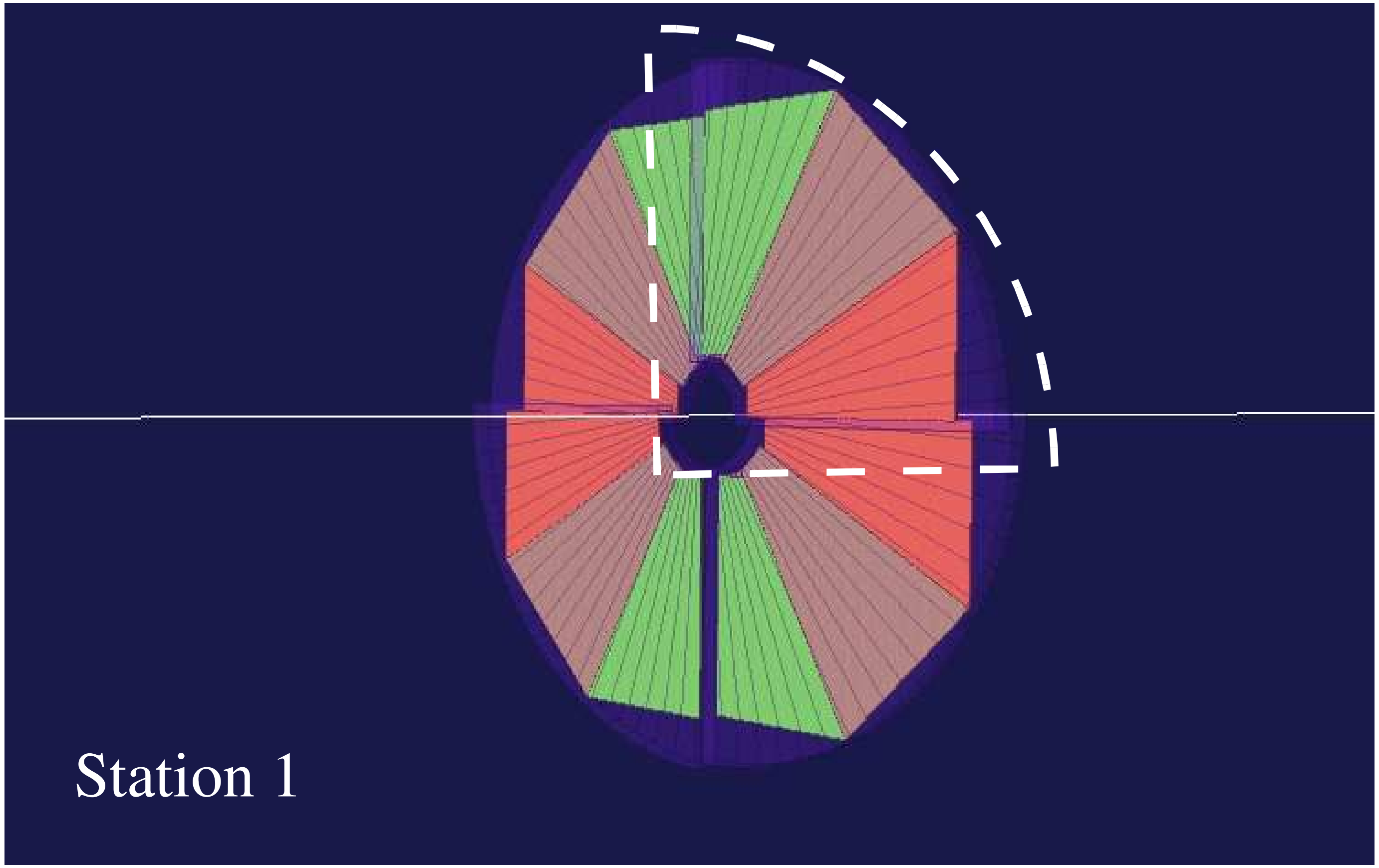
Geometry Parametrisation

- Requirements: to have a possibility to displace
  - The whole chamber
  - The detection element
- Geometry parameters:
  - The positions of chambers in the global frame – Tch
  - The positions of detection elements wrt module - Tde
  - As a position we should understand 3D transformation
- MUON Geometry parametrisation
  - 14 chambers
  - 156 detection elements

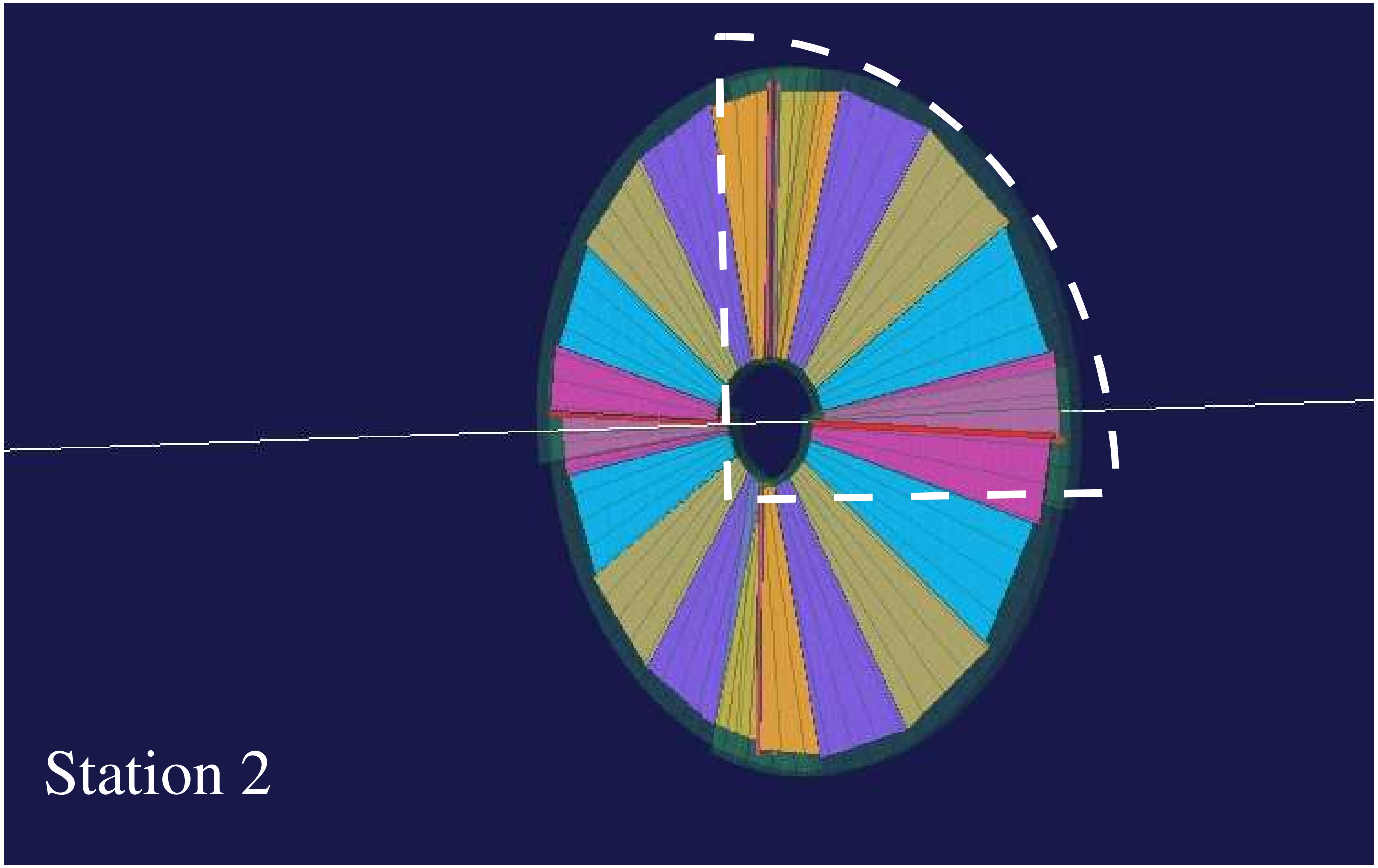
Detection elements & Volumes



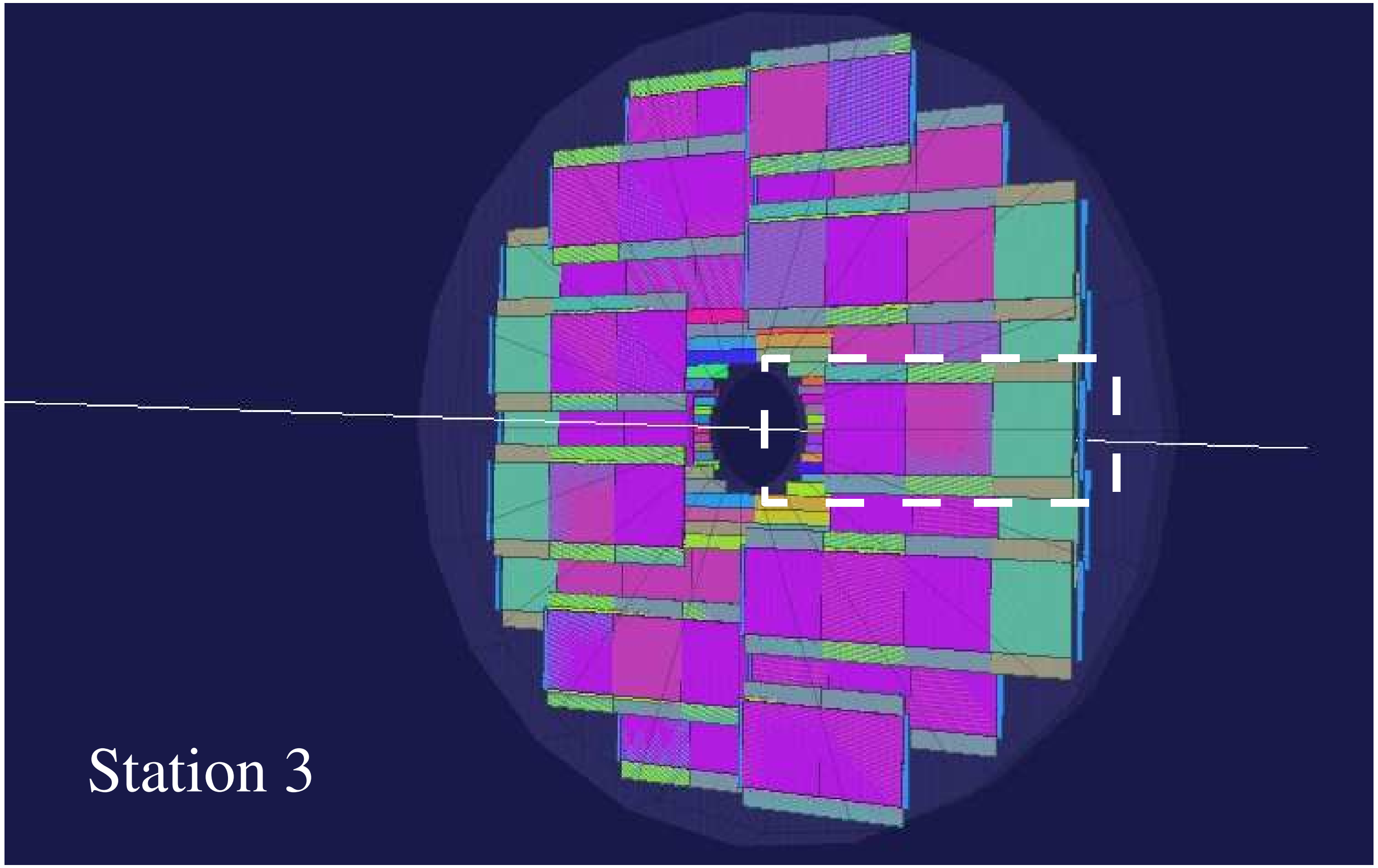
Detection elements & Volumes



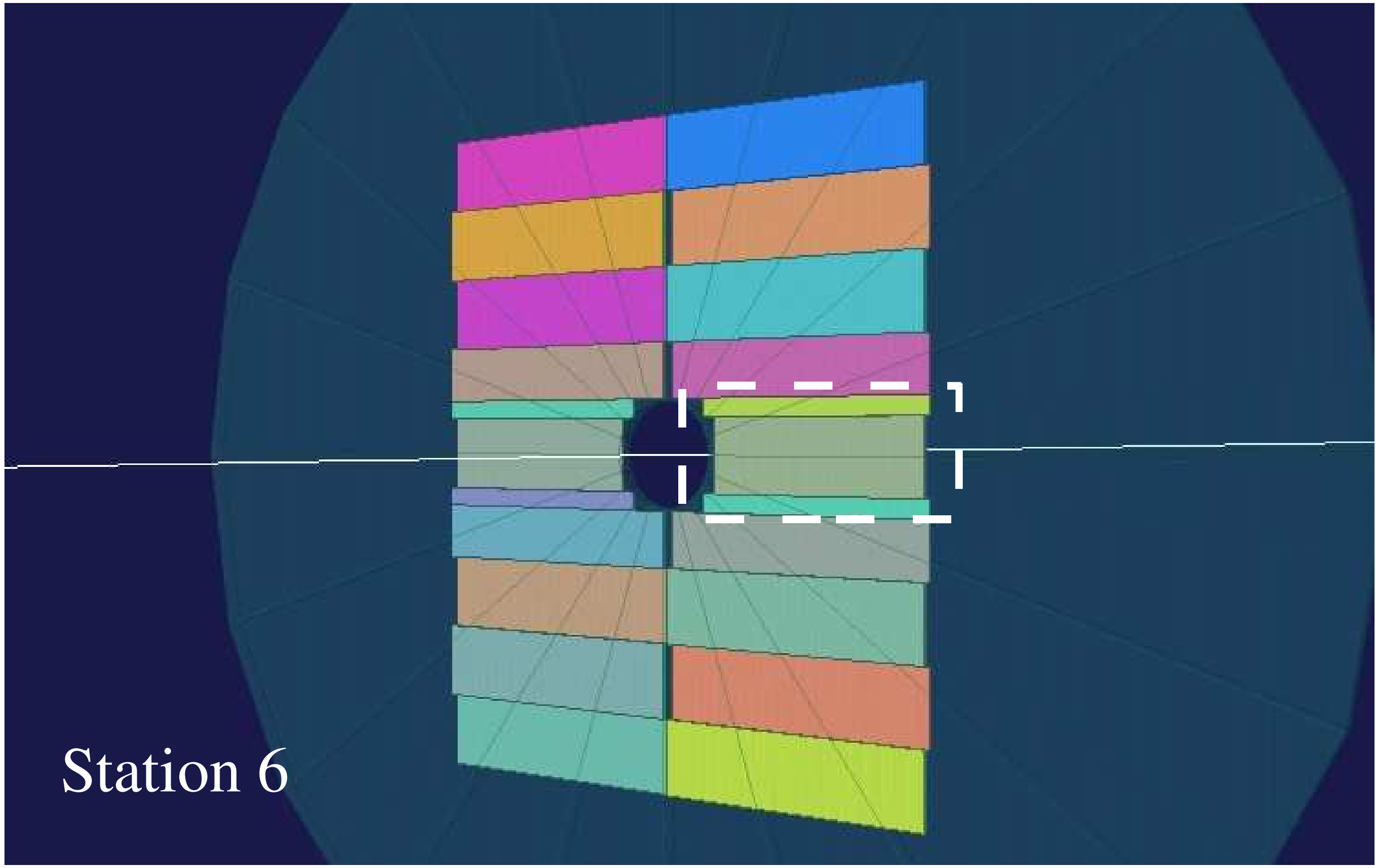
Detection elements & Volumes



Detection elements & Volumes



Detection elements & Volumes



Geometry Parametrisation

- In Geant3 / VMC geometry
  - Both chambers and detection element may be but may be not associated with a concrete volume
  - In case the chamber or detection element are not represented by a volume, their constituent volumes placements have to take into account the parameters above: Ttot = Tch * Tde * Tvol
- Implementation:
  - Helper classes to read / write /store / (de) compose the parametrizing transformations
  - Geometry fully defined via TVirtualMC calls

Geometry Parametrisation I/O

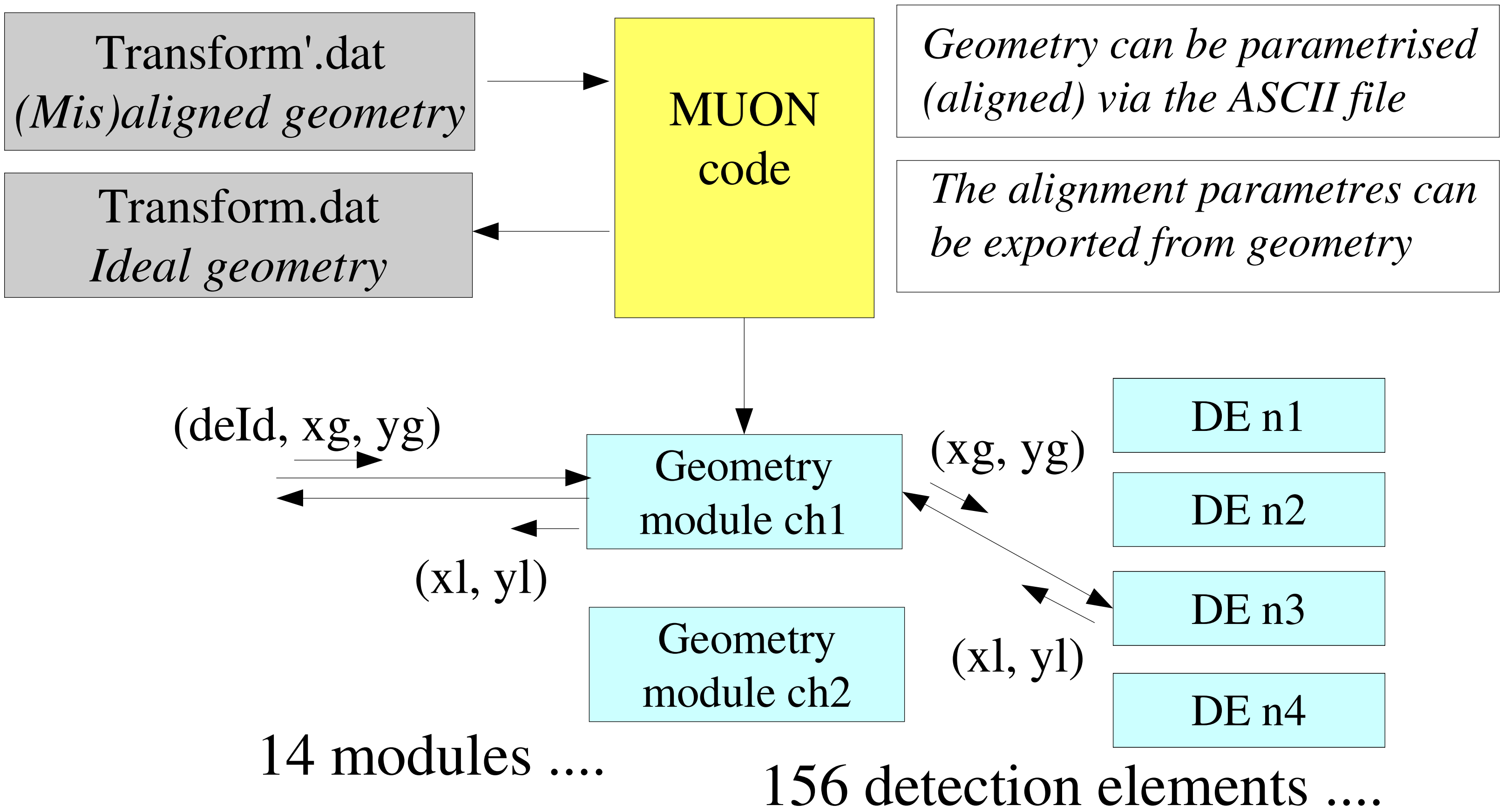
Requirement: the positions of chambers and detection elements can be easily modified outside the code

Implemented via import/export from/to ASCII files

The Align option can be set in Config.C:

```
void Config.C {
  // ...
  AliMUON* MUON = new AliMUONv1("MUON", default);
  // if align = true detection element transformations
  // are taken from the input files and not from the code
  MUON->SetAlign(true);
  // ...
}
```

Geometry Parametrisation



Geometry Parametrisation I/O

transform_st1V2.dat

Data format:

```
CH  moduleId  nofDEs      pos: x y z  rot: thex, phix, they, phiy, thez, phiz
DE  deId  envName copyNo pos: x y z  rot: thex, phix, they, phiy, thez, phiz
```

Example of station1 V2 data:

```
CH   1  4    pos:  0. 0. -526.16  rot: 90. 0. 90. 90. 0. 0.
CH   2  4    pos:  0. 0. -545.24  rot: 90. 0. 90. 90. 0. 0.

DE  101  SE10  1  pos: -0.185 -0.520  -3.75  rot: 90.   0. 90.  90.   0. 0.
DE  100  SE11  1  pos:  0.185 -0.520   3.75  rot: 90. 180. 90.  90. 180. 0.
DE  103  SE12  1  pos:  0.185  0.520  -3.75  rot: 90. 180. 90. 270.   0. 0.
DE  102  SE13  1  pos: -0.185  0.520   3.75  rot: 90.   0. 90. 270. 180. 0.

DE  201  SE20  1  pos: -0.185 -0.520  -3.75  rot: 90.   0. 90.  90.   0. 0.
DE  200  SE21  1  pos:  0.185 -0.520   3.75  rot: 90. 180. 90.  90. 180. 0.
DE  203  SE22  1  pos:  0.185  0.520  -3.75  rot: 90. 180. 90. 270.   0. 0.
DE  202  SE23  1  pos: -0.185  0.520   3.75  rot: 90.   0. 90. 270. 180. 0.
```

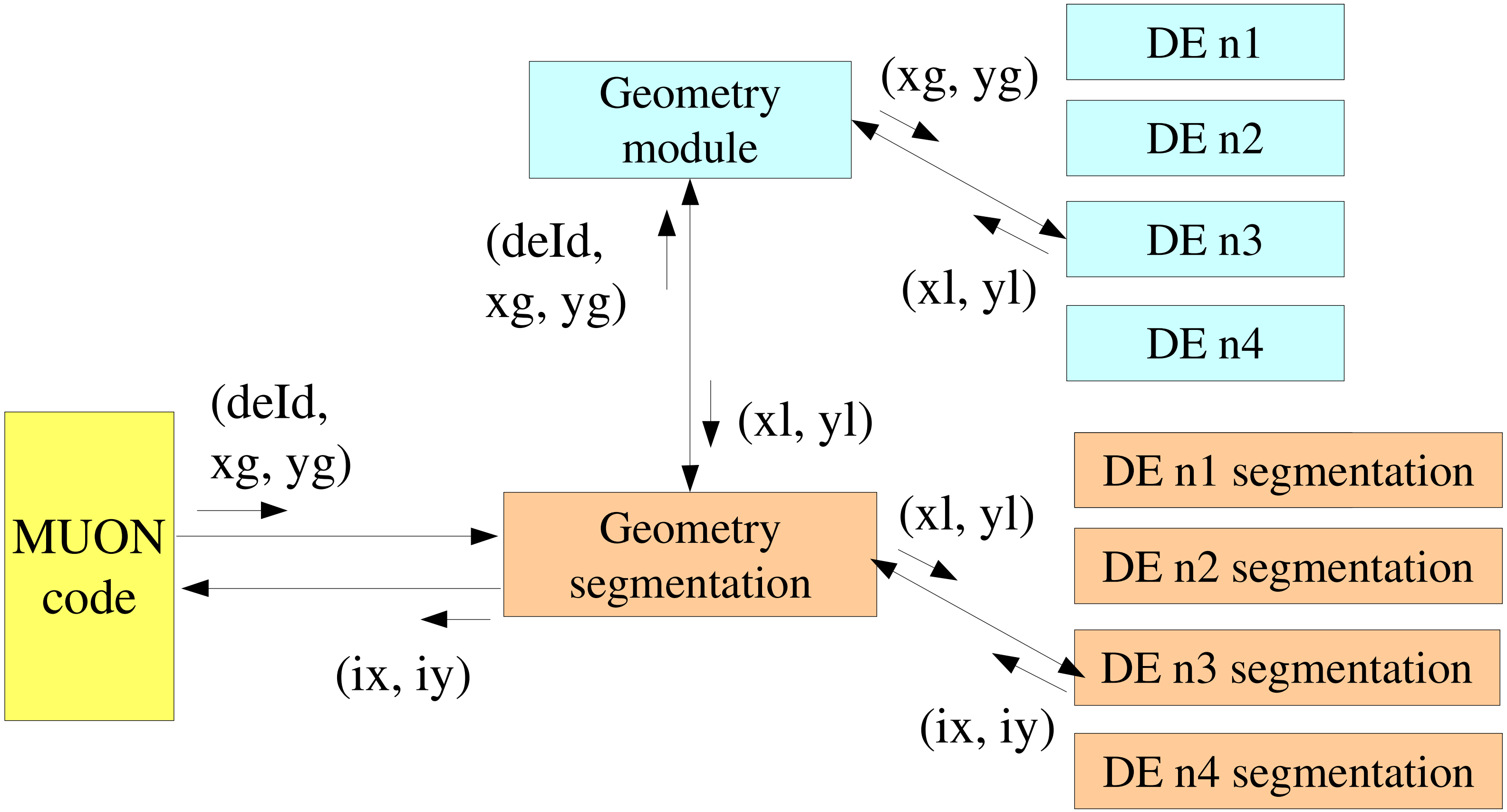
Segmentation (Old)

- Segmentation defines the detector layout, topology of pads, which is not present in the geometry definition
- In the old framework
  - User defined segmentations implemented geometry functions ("get pad position") in the global reference frame
  - Disconnected from geometry definition

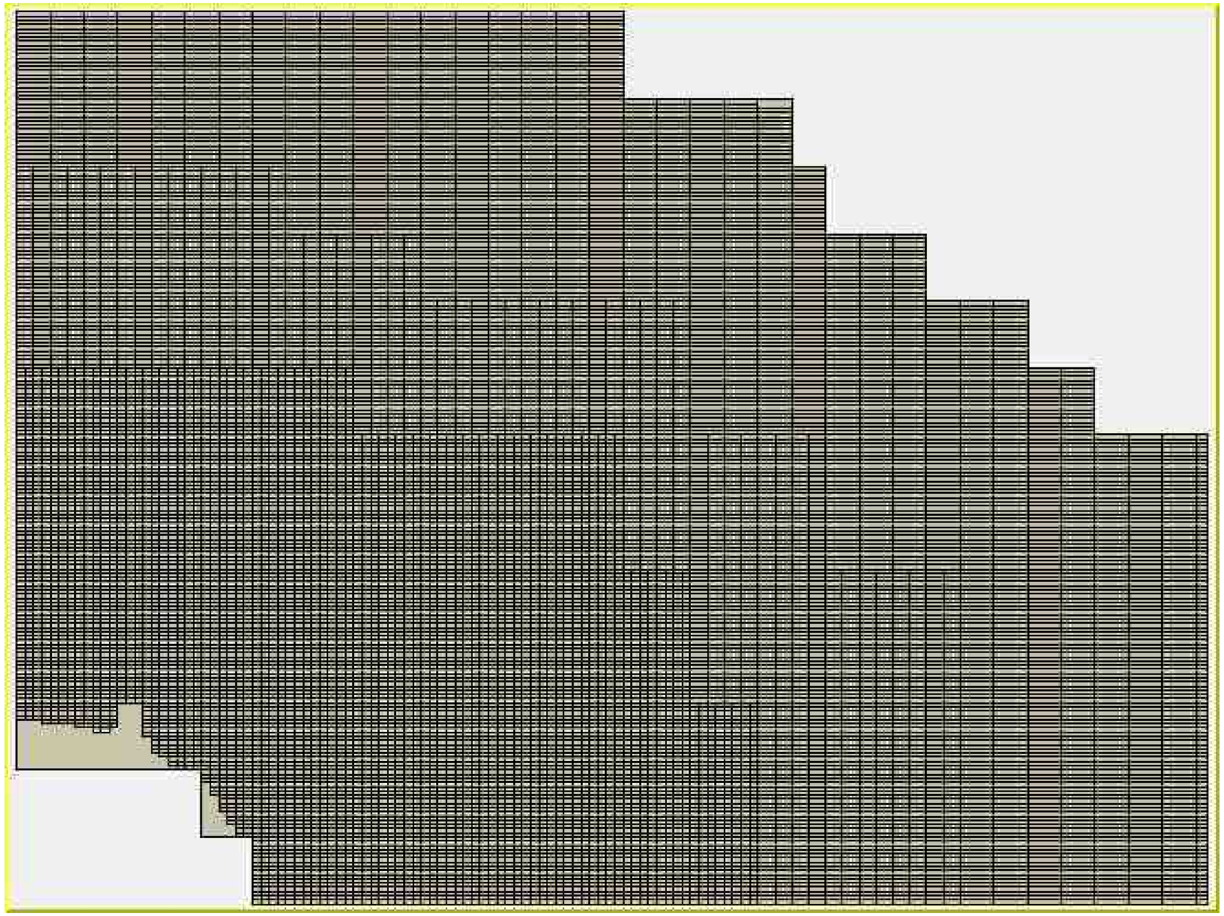
Geometry Segmentation (New)

- Detection element segmentations - implement geometry functions in the local detection element frame
  - No dependence on the placement in geometry
  - Based on realistic mapping (geometry, electronics)
  - One instance per DE type
- Geometry segmentation – implements geometry functions in the global reference frame
  - One instance per chamber & cathod (of the same class)
  - Used by MUON code
  - Different API from the old segmentation => the code in MUON had to be adapted to this new API

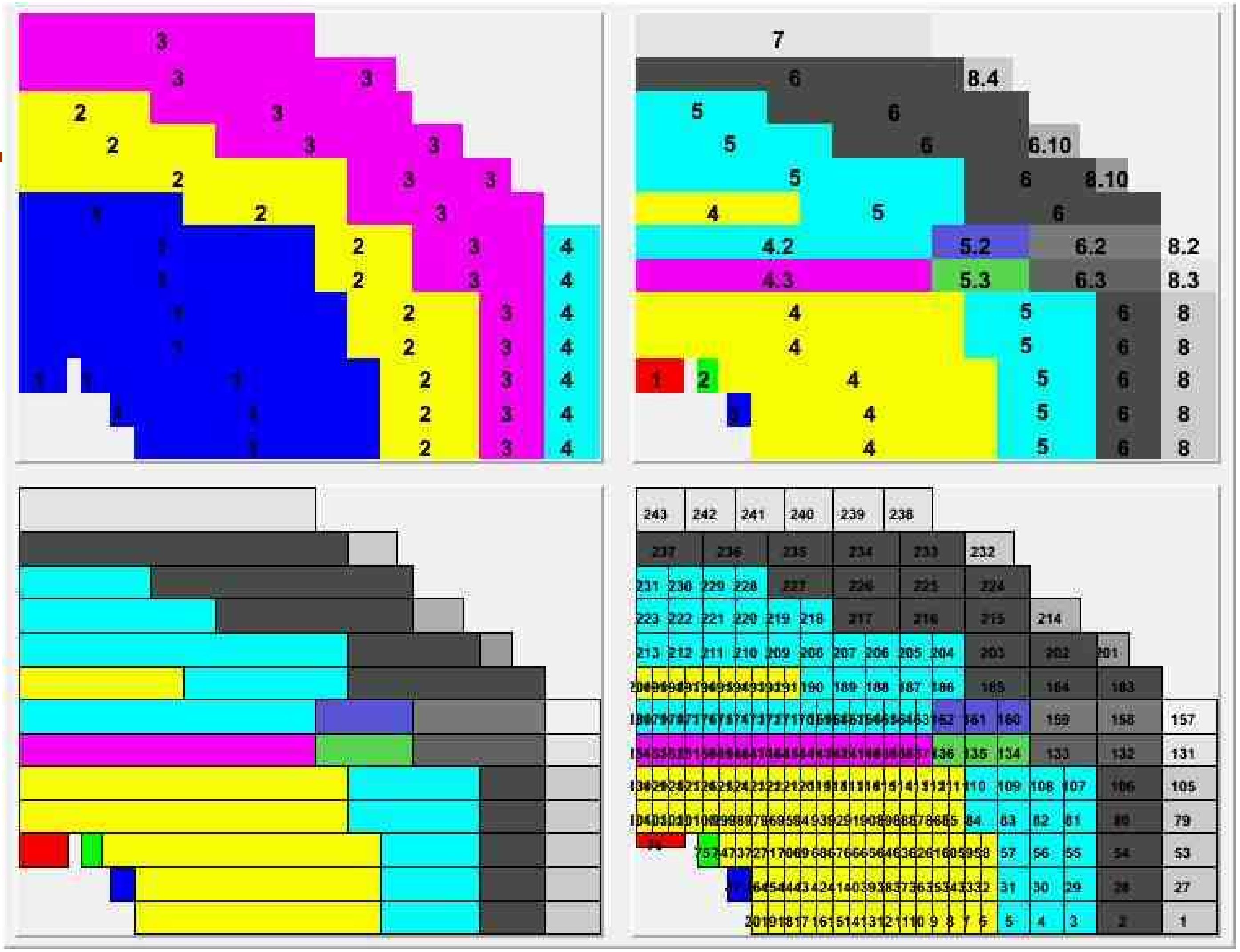
Geometry Segmentation



DE Segmentation & Mapping

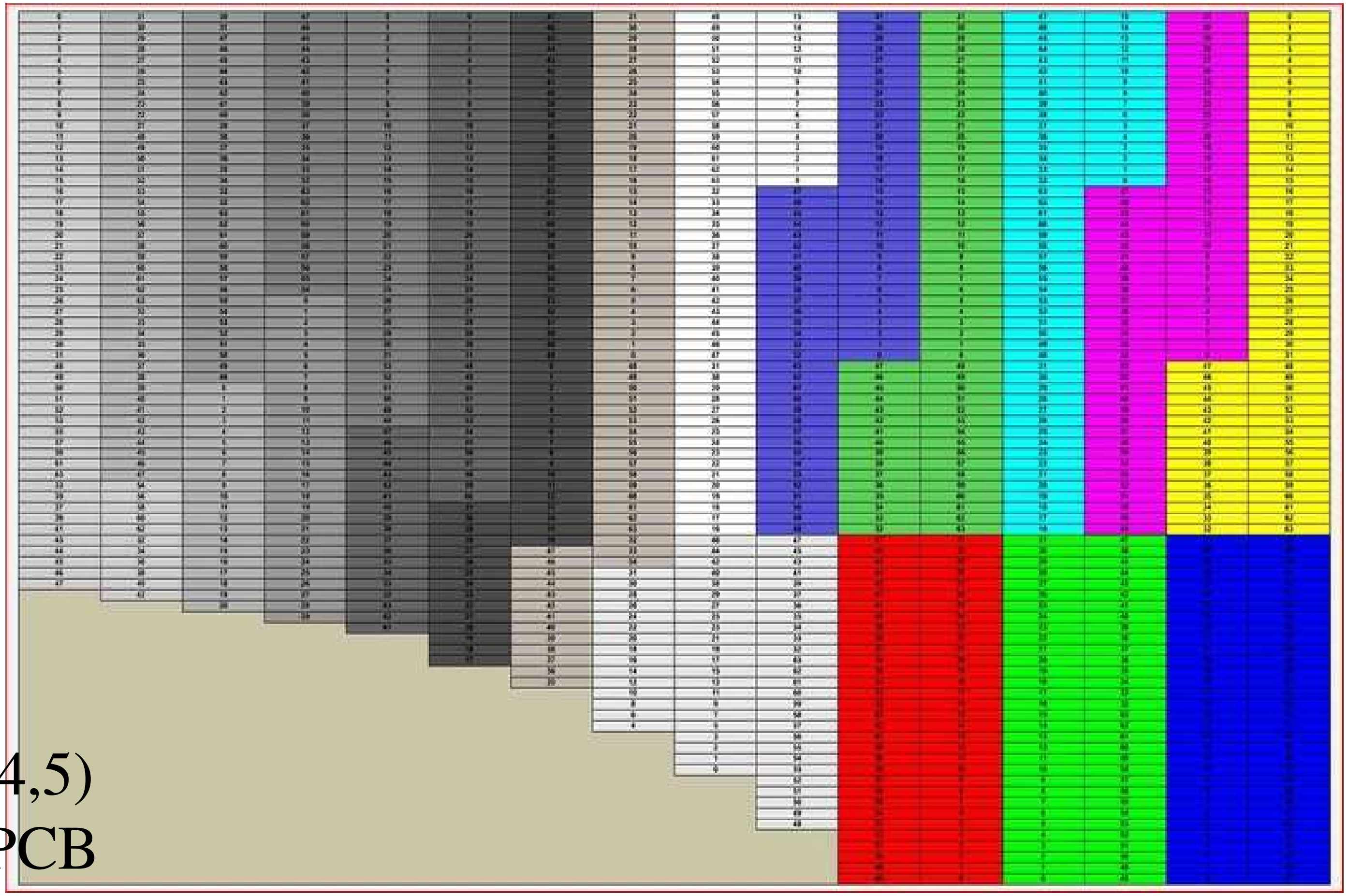


Station 1
Pads



Station 1
Zones,
SubZones
Motifs, ...

DE Segmentation & Mapping



Station 3 (4,5)
Motifs in PCB

Alignment scenario

Alignment (~30 microns precision):

- 1 TGeoHMatrix per tracking detection element: 156 detection elements (23KB)
- At most, an alignment per day.
- Physics alignment algorithm need around 60000 tracks without magnetic field (~ 1-5 minutes of beam).
- GMS need 5 minutes after switching on the magnet.
- One physics (straight tracks) and GMS alignment per beam fill should be possible.
- Algorithm in AliRoot (Bruce BECKER from Saclay) convert STL to Root

Alignment & performance studies:

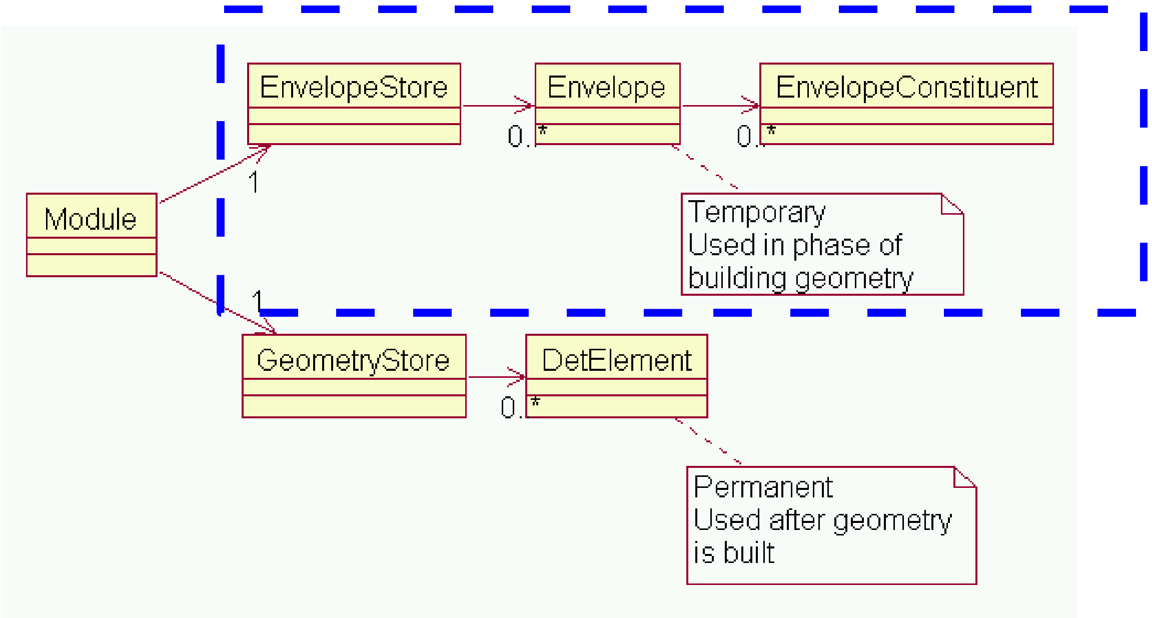
- Thesis by E. Dumonteil

Conclusions

- Geometry framework in place since Nov 04
- Old segmentations has been dropped in June 05
- Now the effort is put on realistic mapping
  - Mapping package (developed at Orsay) was extended for slat chambers (L.Aphecetche) – already committed in CVS
  - Mapping for trigger chambers within this framework now in progress (L.Aphecetche, P. Crochet, R. Guernane)
- (Mis)Alignment is possible via MUON geometry framework
- Modifications towards AliRoot general framework on our "to do" list
  - We were waiting for Andrei's and Raphaelle's presentations/tutorials to get clear what functions could be covered by general framework and how

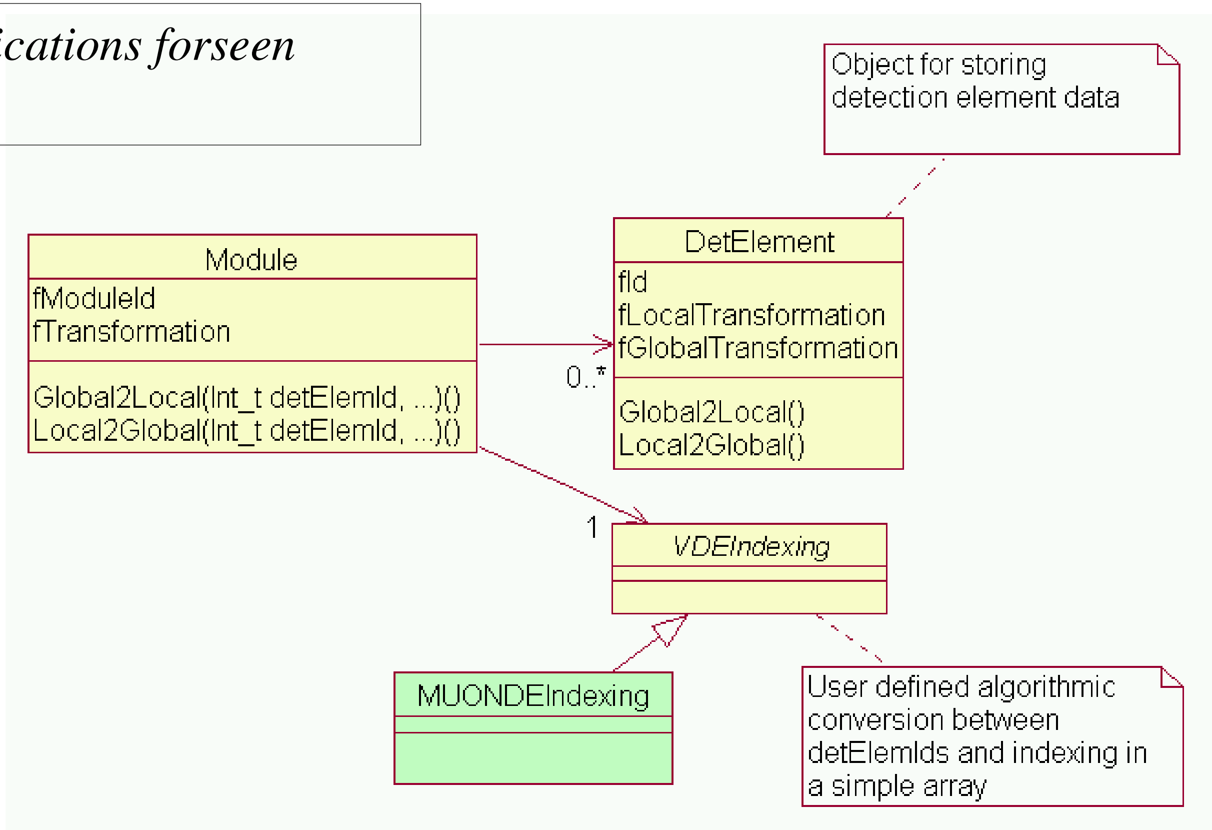
Modifications towards AliRoot Framework

Replace the Envelope classes with direct use of TGeo



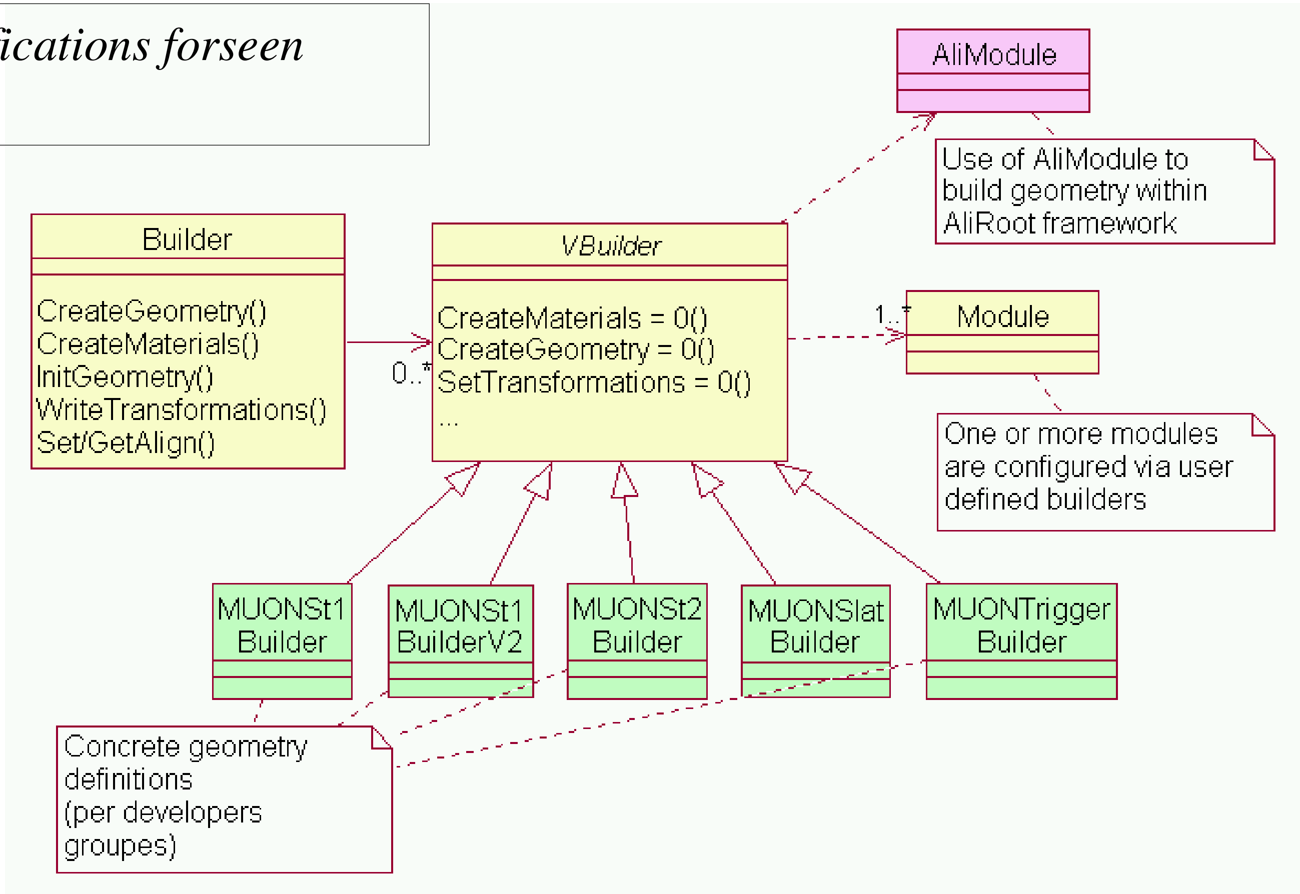
Modifications towards AliRoot Framework

No modifications forseen



Modifications towards AliRoot Framework

No modifications forseen



Modifications towards AliRoot Framework

No modifications forseen