Muon Software Validation , scope and status

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on behalf of the Muon Software Validation TF

Motivation

- ☐ Core Software suffers from sufficient validation
  - -> Insufficient Manpower
  - -> Slow feedback for Software Development
- ☐ Validation becomes critical
  - -> Need to focus on Validation of Detector, Physics performance
- ☐ Priority for Computing system commissioning
  - -> Realistic Detector description
- ☐ Proposal:
  - -> Creation of Student-Run Muon Software Validation Team
  - -> This would complement existing efforts
    (Ahmimed, Stephane for Reco / Daniela, Nectarios for Simulation)

Who?

- A pure student-run team
  (Muon Software Validation TF):

  Kostantinos Bachas (Thessaloniki)

  Lashkar Kashif (Harvard)

  Matthias Schott (Munich)

  G.D. (MPI)

Works under the guidance of:

 Nectarios Benekos (MPI)

 Daniela Rebuzzi (Pavia, INFN)

Scope

- ❑ Many changes for release to release

  we want a <u>fast check</u> for serious bugs in each step

  (gen – sim –digi -reco)

- ❑ Next step is focusing more to suspicious effects

  a <u>detailed check</u> on an event by event basis for each step

- ❑ Finally, indicating/forwarding the problem

  a <u>thorough check</u> on single event and single subdetector module
  (ie MDT single tube)

- ❑ The scope/purpose of this series of test is:

  to be standardized and rapidly applicable on every new release

  to identify bugs/problems (even the very detailed ones) within a few days

  to make these problems publicly known and

  NOT to fix these bugs but delegate them to the responsible person/team

Current Tasks

☐ Validation of the Muon Software from Geometry to Simulation and Digitization (started already almost half year ago)

☐ Development of a MuonValidation Package inside ATHENA which tests the consistency of :

-> Chamber positions using simulated hits

-> Hits/Digits and Hits to Digits validation on event by event basis

-> Recursive Geometry Test to detect clashes down to chamber level

-> Compare different performance aspects between different releases

-> Performance of different segment finding algorithms

-> Each Algorithm provides an AANtuple (std after Rel 12.0.0)

-> Frequent reports at: weekly muon sw meeting and after each
   ATHENA – Update/Release

Current Tasks
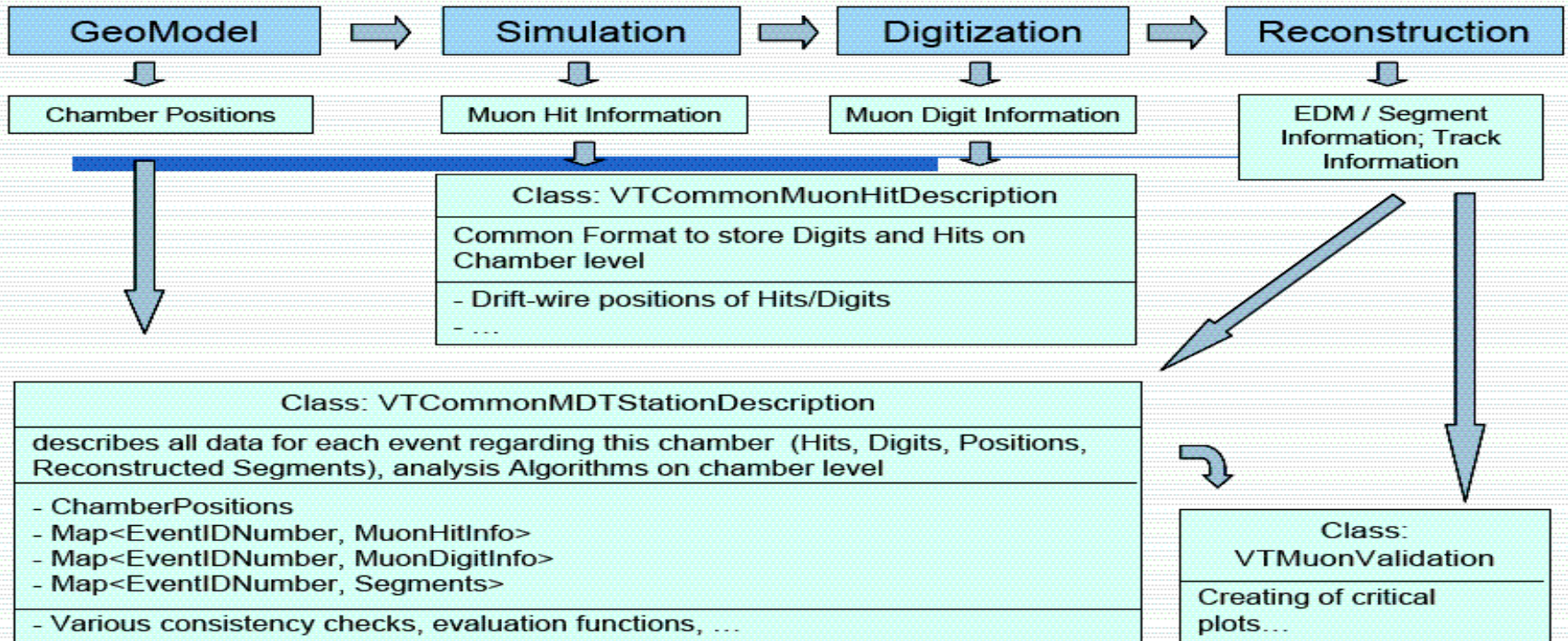
☐ Package will be placed in atlas cvs_offline:

📁 offline/MuonSpectrometer/MuonValidation
↳ MuonGeomTest
↳ MuonHitTest
↳ MuonDigitTest
↳ ....

http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/offline/MuonSpectrometer/MuonValidation/

Geometry clashes I

- ☐ The purpose is to detect possible bugs/clashes in muonspectrometer geometry
- ☐ The clashes could be either the overlap of different volumes or overshooting of a daughter volume out of the mother volume
- ☐ The test consist of scripts that run in ATHENA and check:

  -> Separately Barrel and Endcap regions

  -> Clashes within/between different Stations

  -> Detector parts and inert material

  -> Produce lists with all clashes and their coordinates

  -> Visualize the clashes (VRML viewer)

- ☐ Forward the bugs/clashes to the GeoModel people

https://twiki.cern.ch/twiki/bin/view/Atlas/MuonGeometryDC3

Geometry clashes II

☐ Plots from clashes found in R-layout (perfect detector layout)
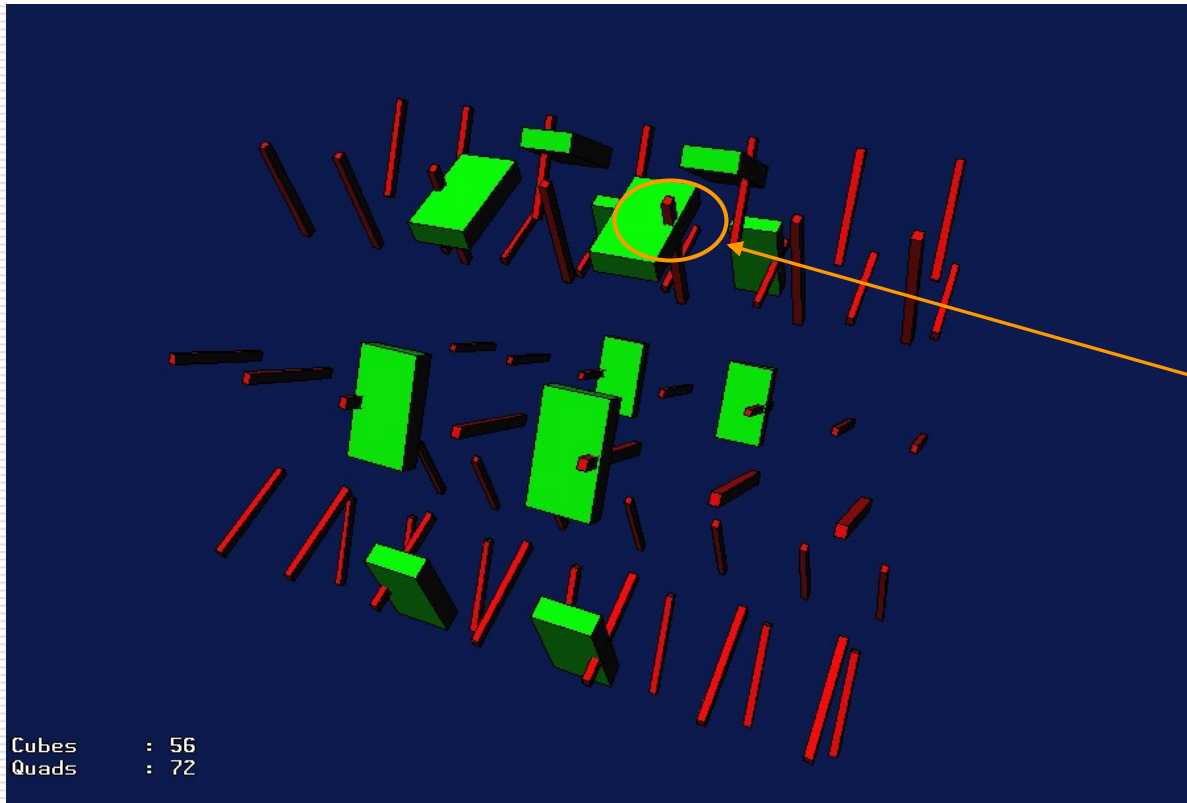
Clash between BMS chambers and support structures

Cubes   : 56
Quads   : 72

Error: Overlapping daughter volumes

The volumes BMS5_station[-202] and Muon::BTRibEnvelope[16969], both daughters of volume
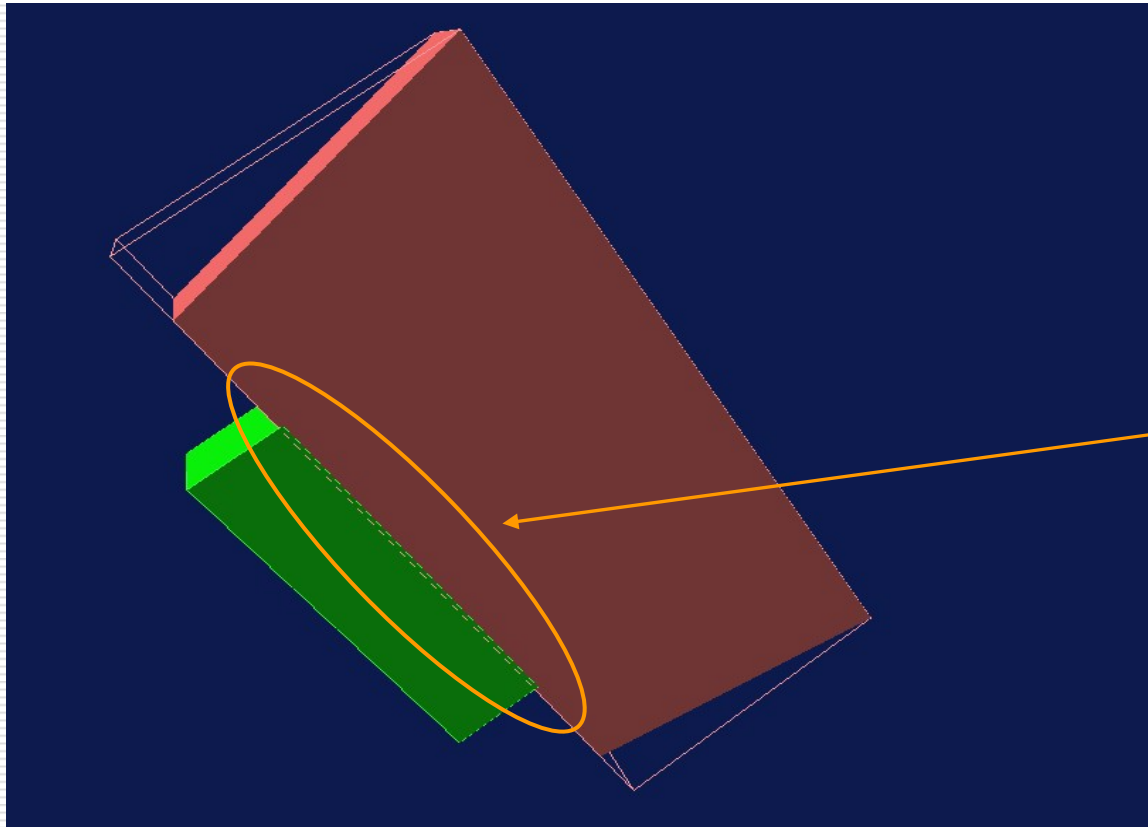Muon::MuonSys[0], appear to overlap at the following points in global coordinates: (list truncated)

Geometry clashes III
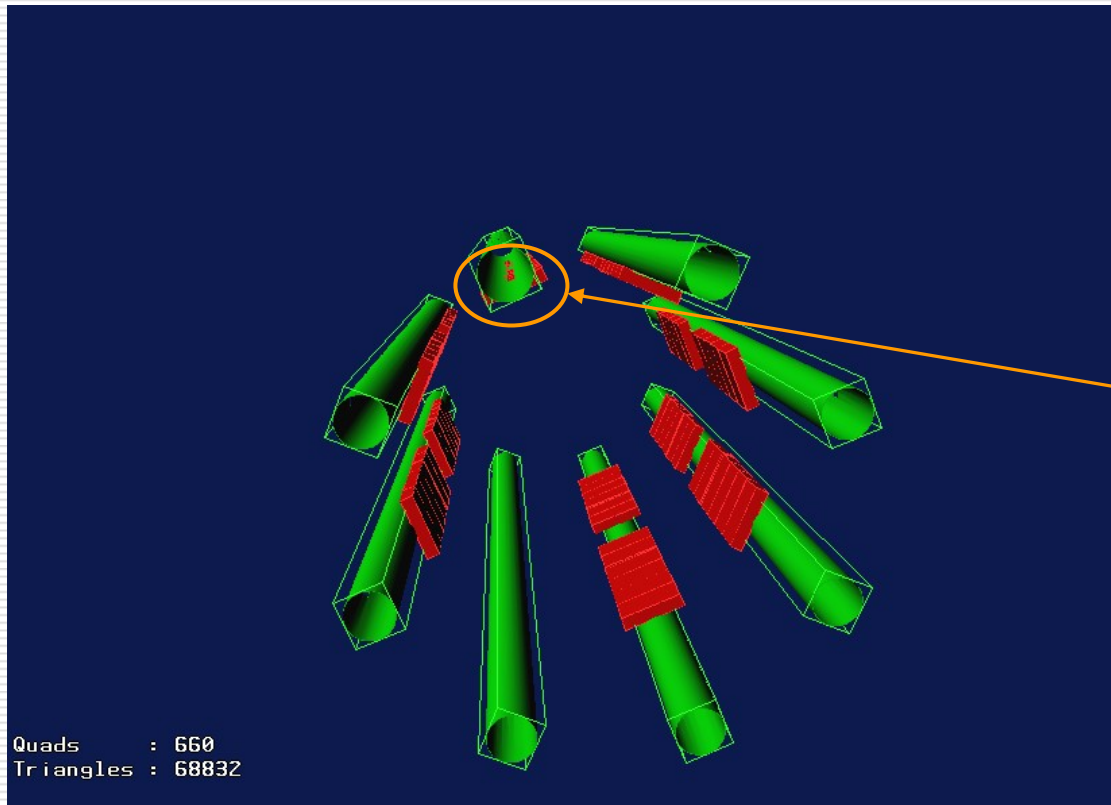
Clash between BIS chambers and Toroids

Quads   : 660
Triangles : 68832

Error: Overlapping daughter volumes
The volumes BIS2_station[-704] and Muon::BTBevelledLongTubeIn[16969],
both daughters of volume Muon::MuonSys[0],appear to overlap at the following points in global coordinates:
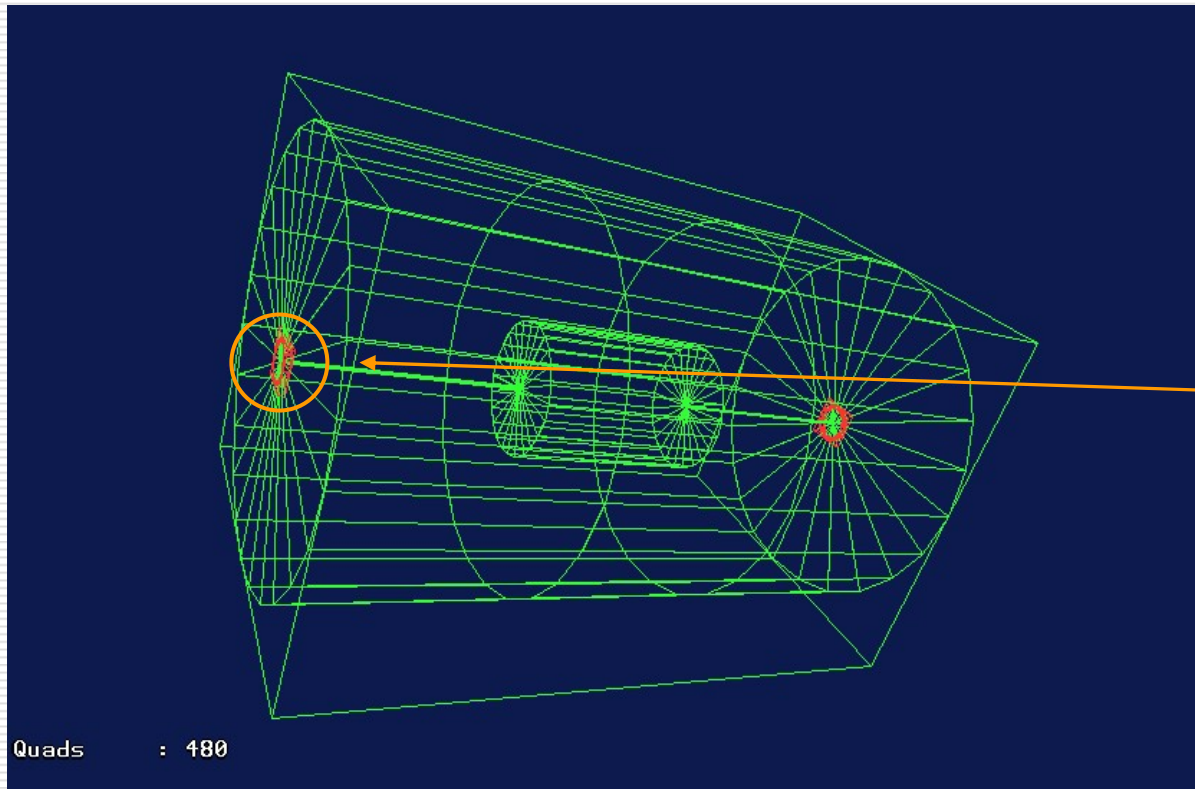
Geometry clashes IV

Clash between two
EIL chambers

Error: Overlapping daughter volumes
The volumes EIL8_station[-401] and EIL9_station[-501], both daughters of volume Muon::MuonSys[0],appear to
overlap at the following points in global coordinates:

Geometry clashes V

Overshooting of a detector part out of MotherVolume

Quads : 480

Error: Overshooting daughter volume
The volume Muon::ForwardShieldingTX1STMCone[16969] appears to extend outside the mother volume
Muon::MuonSys[0] at the following points in global coordinates: (list truncated)

Chambers position I

- ☐ Purpose: Want to know the ATLAS (global) coordinates of each corner of every chamber
- ☐ Why:
  - -> Want to verify that GeoModel is built correctly from AMDB
  - -> From Simulation/Digitization we get wire position corresponding to each hit or digit.
  - -> With enough statistics we check if the chamber volume as reproduced from hits/digits lies within volume reproduced from AMDB

Chambers position II

How:

- ☐ Existing code MuonGMCheck in MuonGeoModelTest package, outputs global coordinates of the center of each multilayer

- ☐ Using the dimensions of each multilayer and the chamber's phi position (sector), the coordinates of each corner are calculated

- ☐ In current status the algorithm produces txt file as well as an Ntuple

- ☐ Works for Barrel, needs to be extended soon to include Endcap chambers

Chambers position III

- [ ] Example plot for BIS chamber corner coordinates

3D coords of ML corners (BIS)
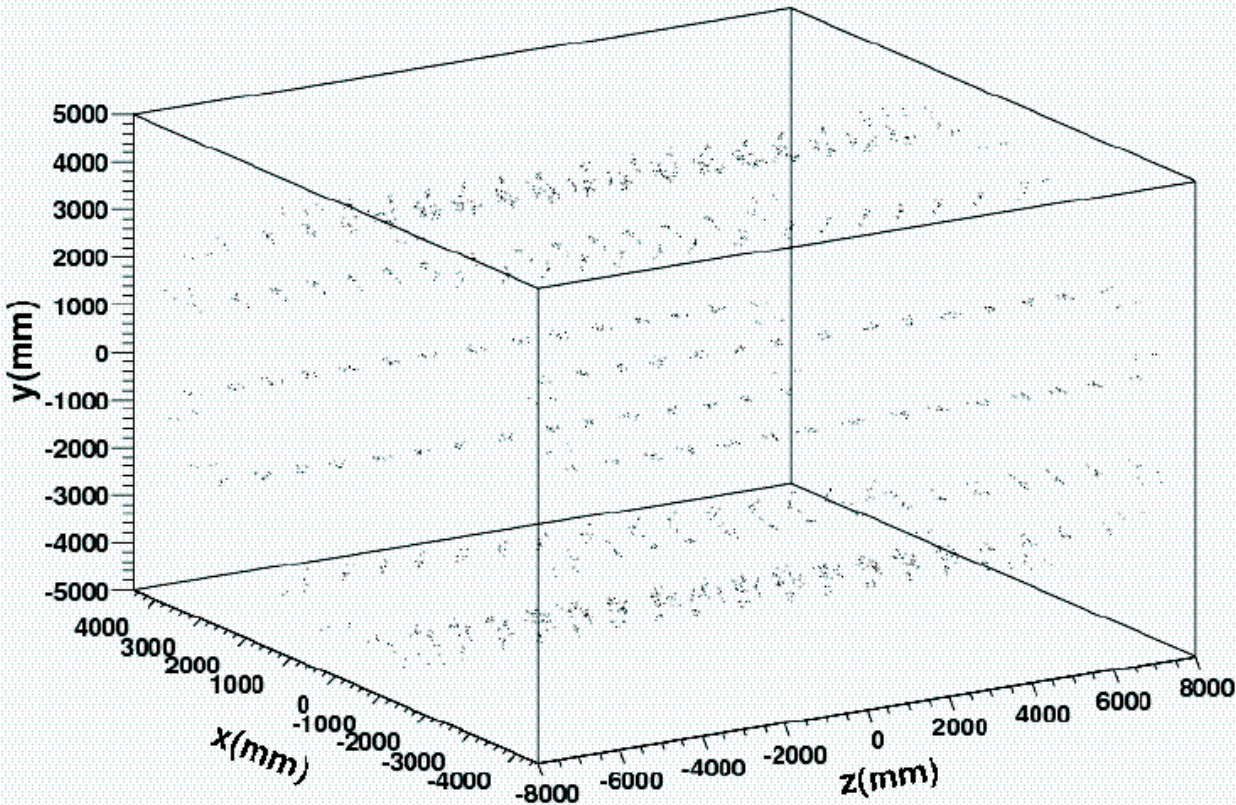
- [ ] Note that the apparent irregularity of the points is due to binning in ROOT

Hits – Digits Validation I

- ☐ Purpose:

  - -> Check for regions with inefficiencies on Simulation or Digitization level, using small standardized single-muon samples

  - -> Check if chamber volumes as reproduced from Hits and GeoModel agree with each other

  - -> Validate the "step" between Simulation and Digitization

- ☐ Implementation:

  - -> Two sets of algorithms (Hits/Digits) inside ATHENA

  - -> For each event, read G4Hits/Digits and retrieve global and local coordinates

  - -> Already available for MDTs , RPCs , TGCs , CSCs

  - -> Produce general plots (2D histograms of the detector layout/ eta-phi distributions) and an AANtuple
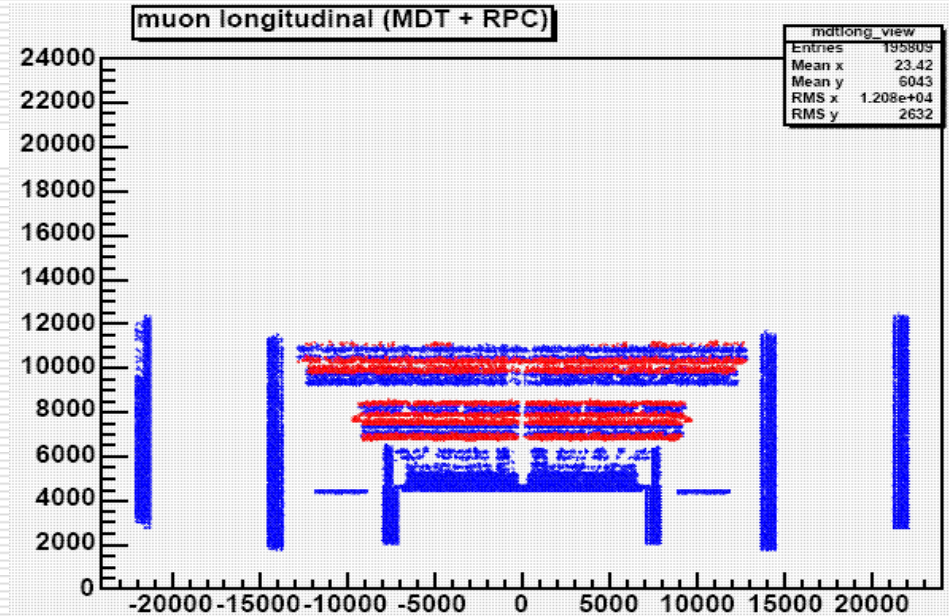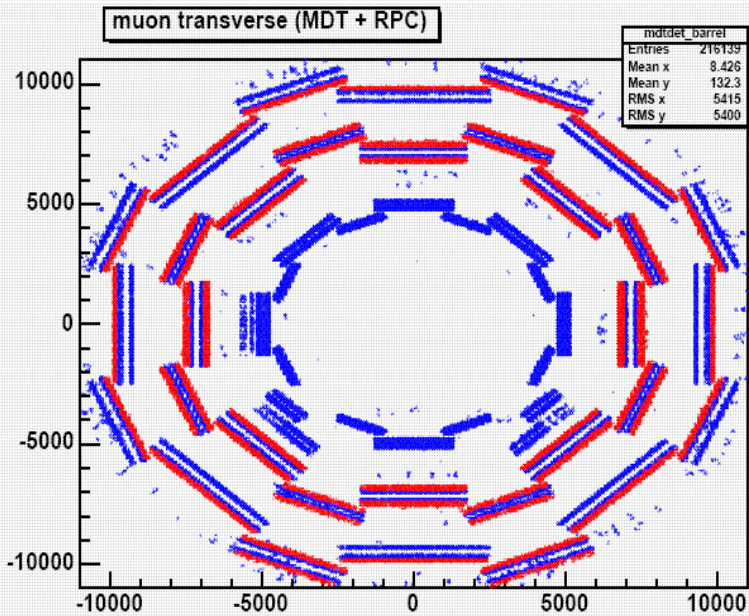
Hits – Digits Validation II

☐ Implementation:

-> In AANtuple all the available information is stored

-> A monitoring algorithm combines all the Ntuple files

Event Collection

Hits/Digits Collection

Val_HitID

Val_X(Y/Z/R)

Val_X(Y/Z/R)_local

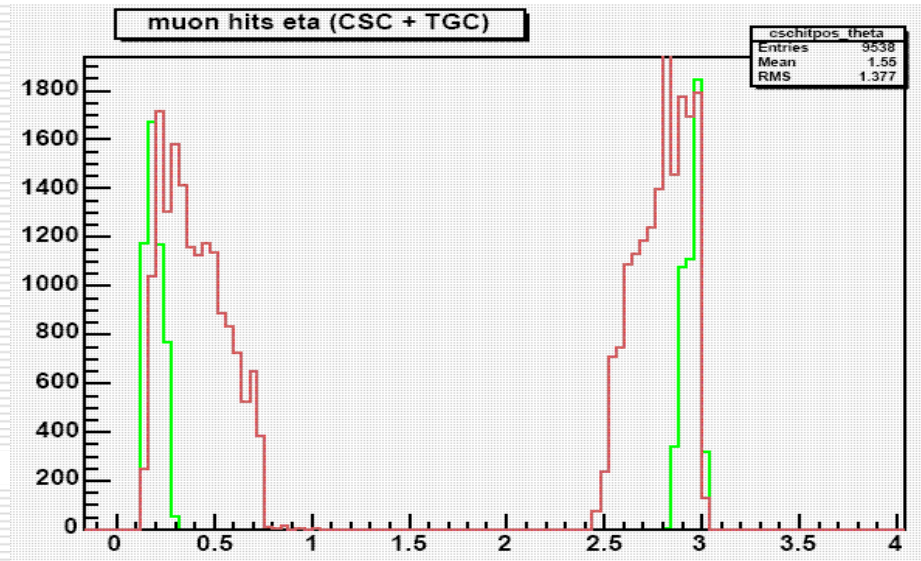Val_StName
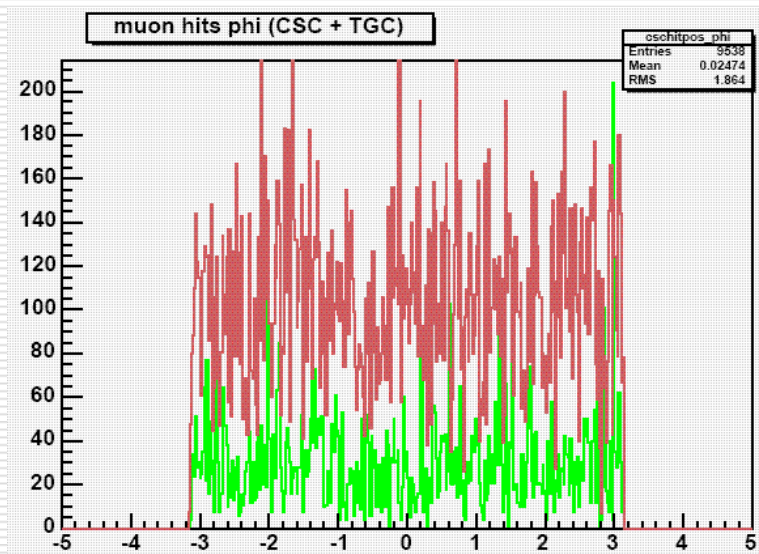
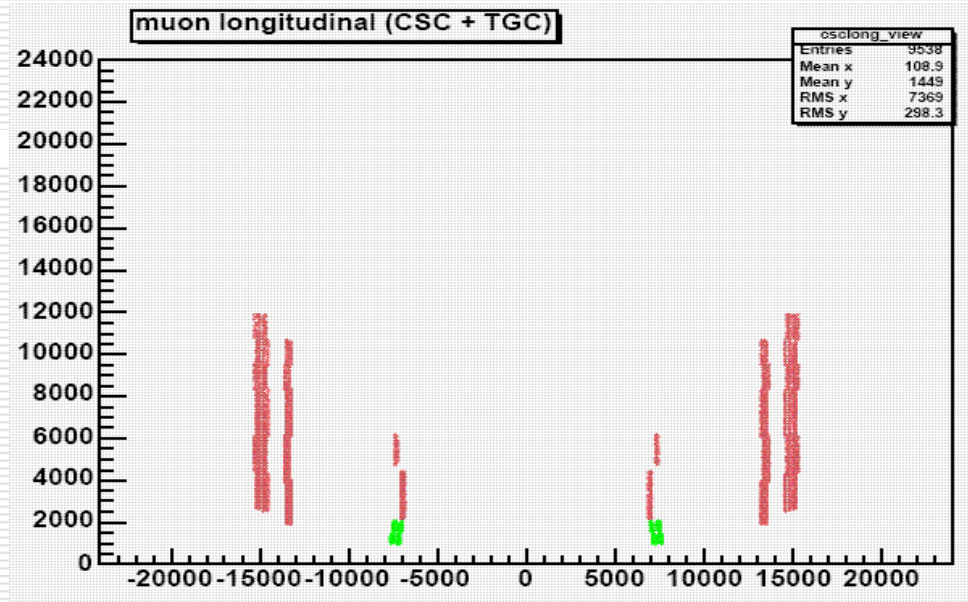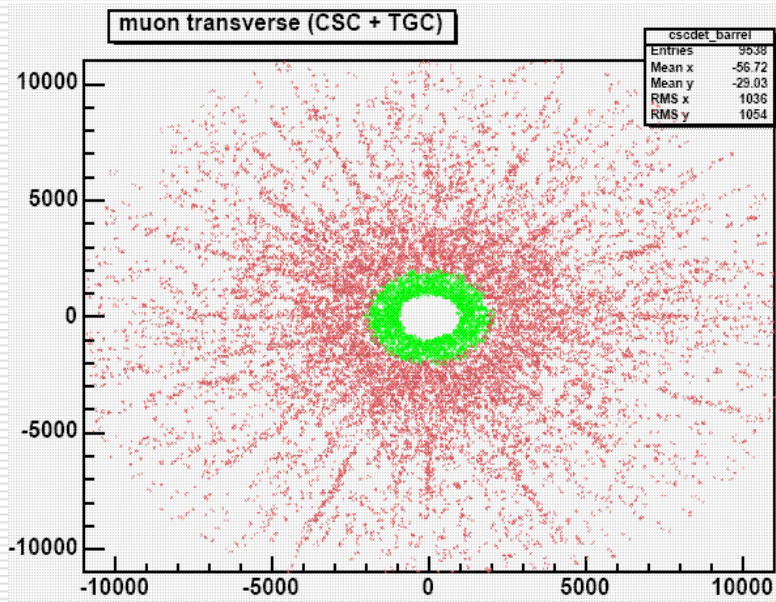Val_StEta(Phi)

Val_IDMultilayer

Val_IDLayer

Val_IDTube
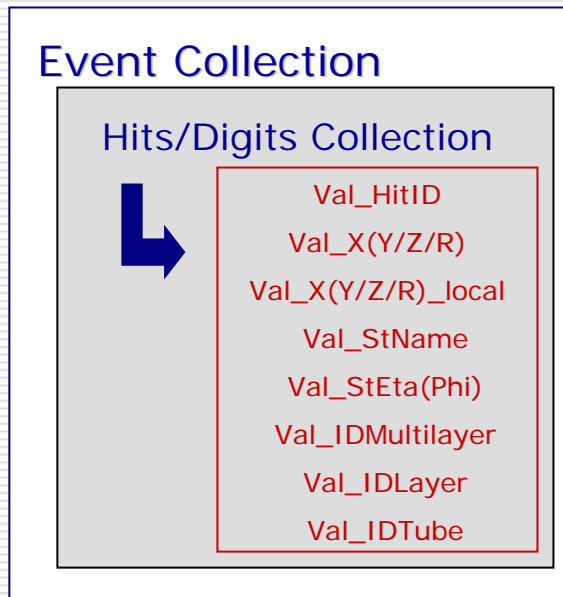
☐ Functionality:

-> Can follow the muon through its passage in the detector using hits/digits

-> Using bigger samples we can "draw" the detector layout

-> Check if for every hit we get a digit

-> We can focus to a single chamber, even to look to a single tube if necessary
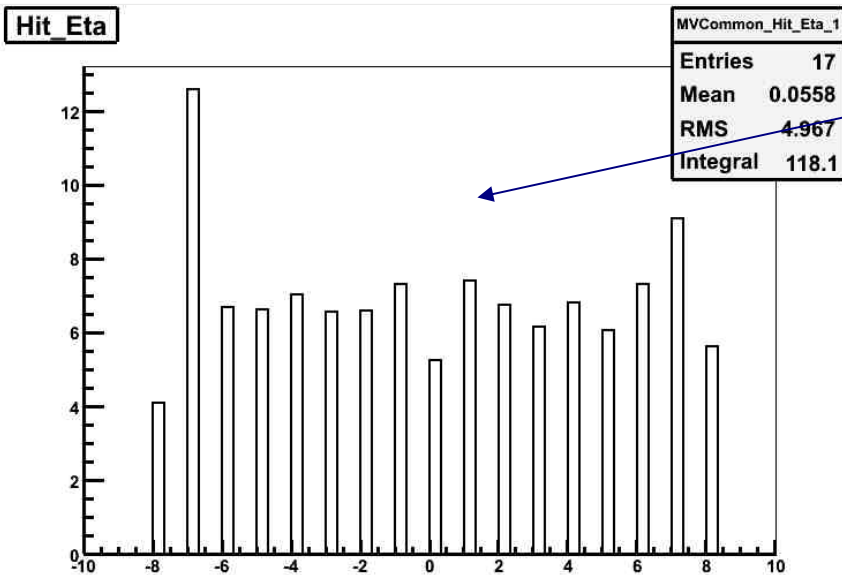
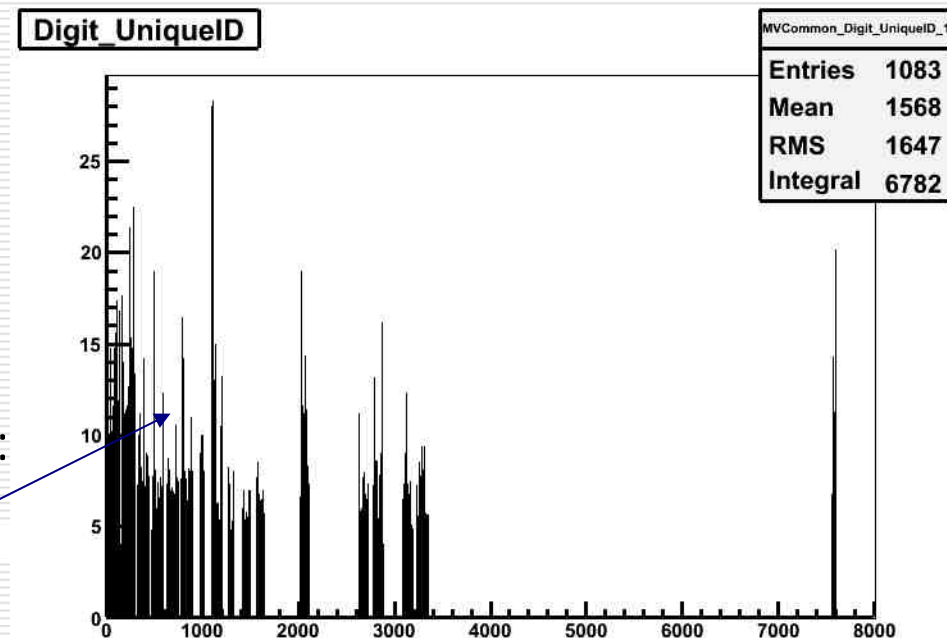# Muon Hits plots I
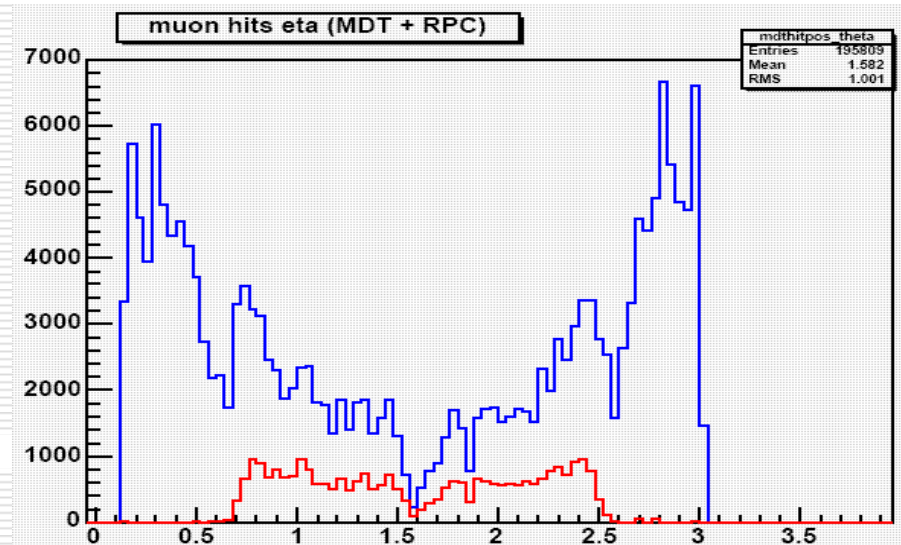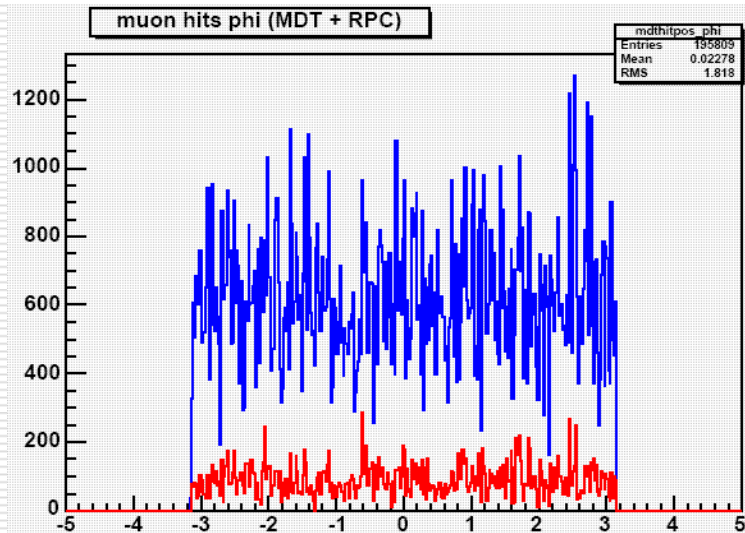
Muon Hits plots II

Hits - Digits Validation plots (preliminary)

- ☐ Generic plots (fast test) such as:
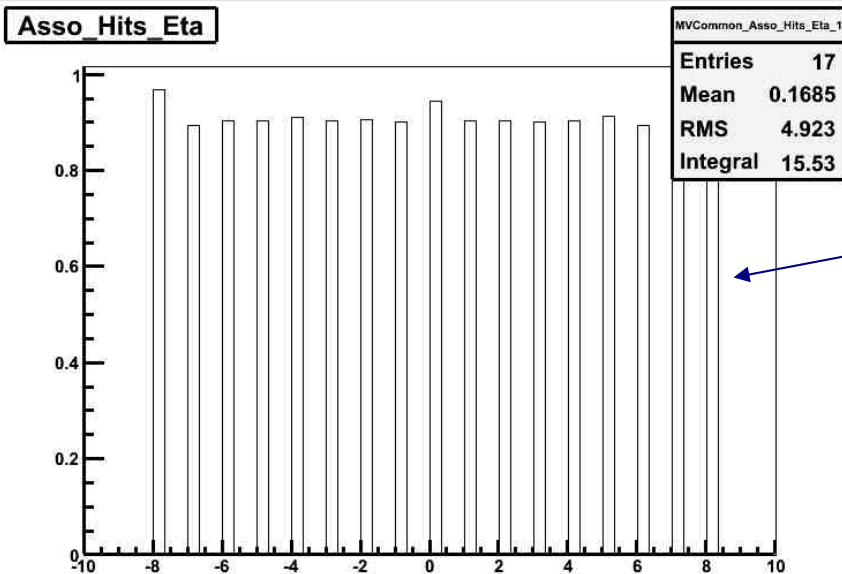
Hits distribution in all eta sectors

- ☐ Or a little bit more detailed as :

Digits distribution in all chambers

Hits – Digits Validation plots (preliminary)

□ And associating digits to hits

Hits matched to digits distribution in all eta sectors

□ It is really possible to track down problems in simulation and if necessary to point to chamber or even tubes

Summary - Plans

- ☐ Muon Software Validation TF formed and works from students and the Muon Simulation Coordinators

- ☐ Purpose is to validate (frequently) all steps from Detector Description to Reconstruction

- ☐ Already have large part of the required standardized code for regular validation (per Release/Update) and results as shown today

- ☐ Expanding code to include asap PrepRawData , Reconstruction

- ☐ A first version will be in ATHENA in Rel12 (10days from now)

- ☐ We will keep on maintaining and further developing the package according to the Muon community needs