Investigation of Geometry Modeling Precision Influence on quality of Physics Analysis in ATLAS Experiment

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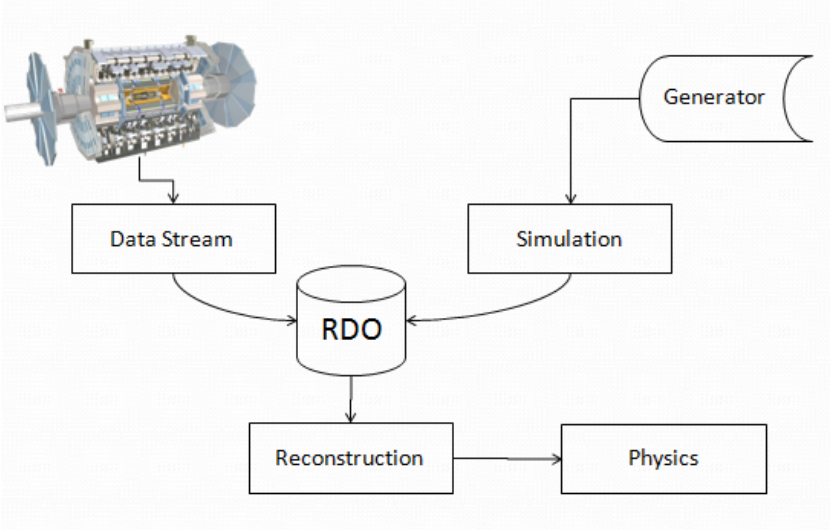
CERN Cognitive Festival in Georgia.

Oct 24, 2018

Data vs. MC Discrepancies

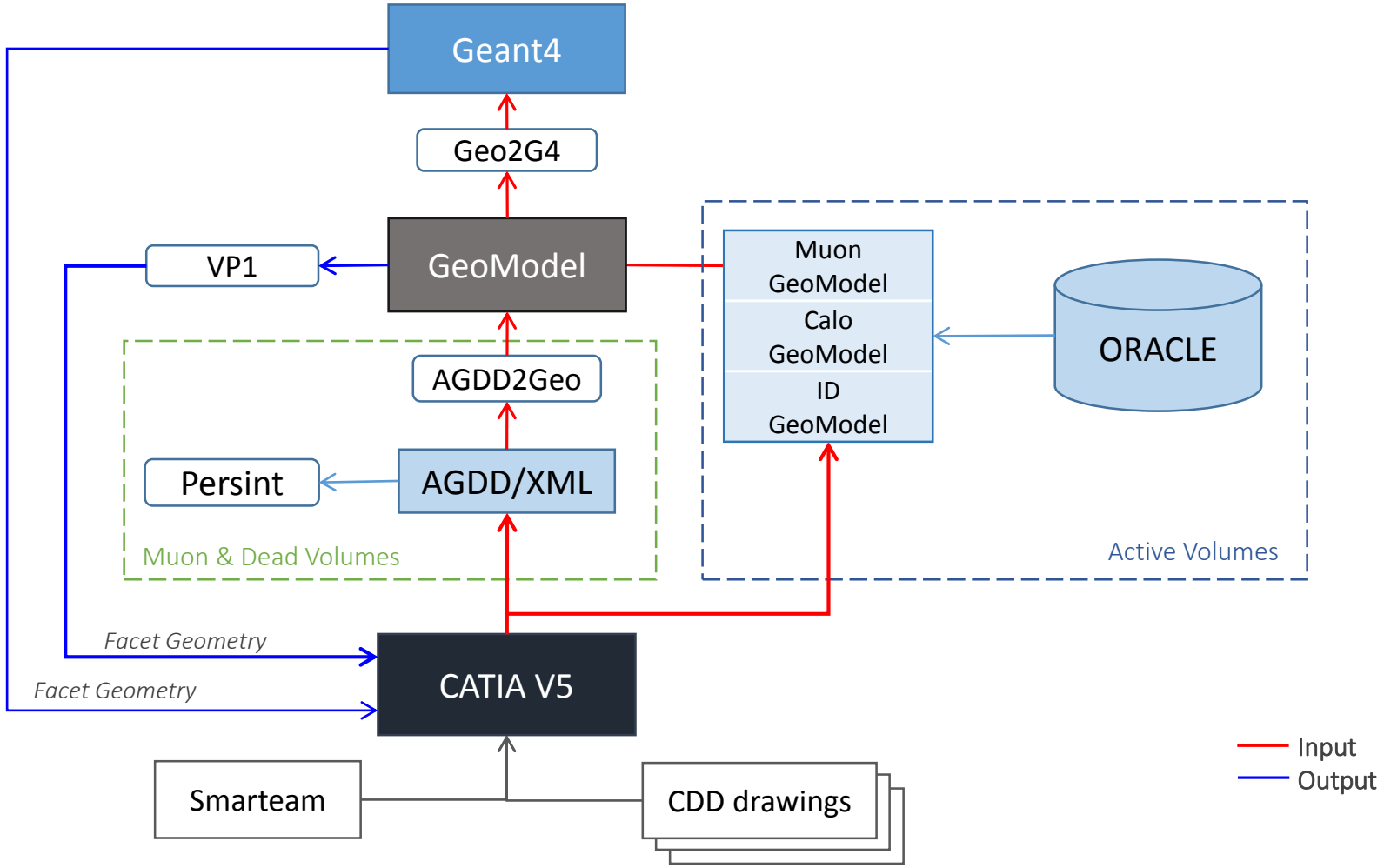


The difference may be caused by Geometric Inaccuracies

It is possible to predict 2 hypothesis why faults are exist in geometry descriptions:

1. Hypothesis #01: Inaccuracies added by geometry transactions within the simulation software infrastructure
2. Hypothesis #02: Discrepancies between as-built and the geometry implementation inside the simulation

Simulation Loop



Geant4 – Toolkit for the simulation of the passage of particles through matter

GeoModel – Toolkit to describe detector geometries

AGDD – Toolkit for ATLAS generic detector description

Virtual Point 1 (VP1) – Interactive 3D event display for the ATLAS experiment

CATIA – CAD System. We use CATIA for investigation of ATLAS detector geometry

SmarTeam – Official engineering database at CERN

CDD – CERN Drawing Directory

Investigation of Hypothesis 01

1. Hypothesis #01: Inaccuracies added by geometry transactions within the simulation software infrastructure

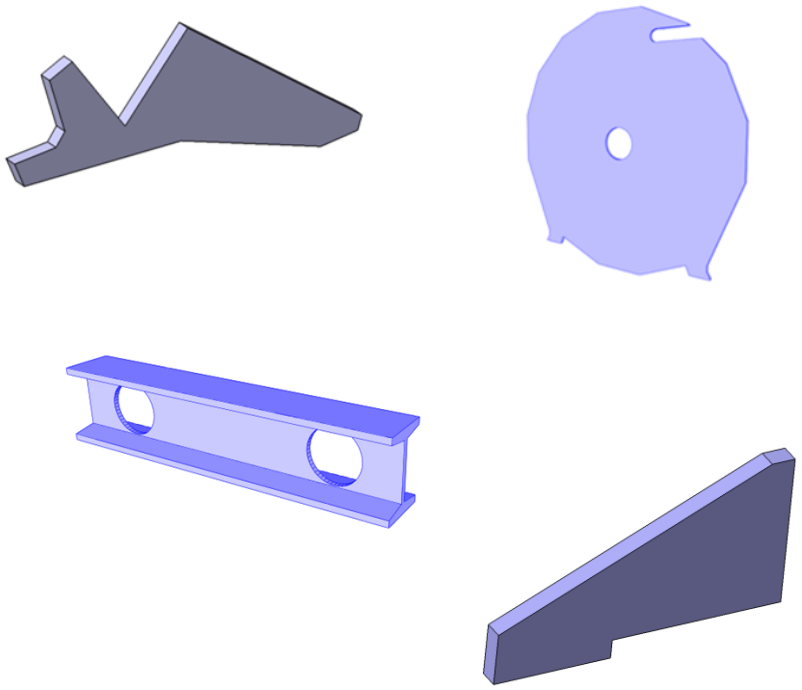
I. Case Study of Primitives

II. Case Study of Boolean Operations

III. Case Study of Transactions (Moving/Rotation) after Boolean Operations

IV. Case Study of Transactions (Moving/Rotation) before Boolean Operations

Geometric primitives



Investigation of Hypothesis 01 - Conclusions

1. Hypothesis #01 has been confirmed: The simulation software infrastructure introduces geometrical inaccuracies

2. For all type of detector geometries the faults in dimension, form and positioning are caused by Boolean operations

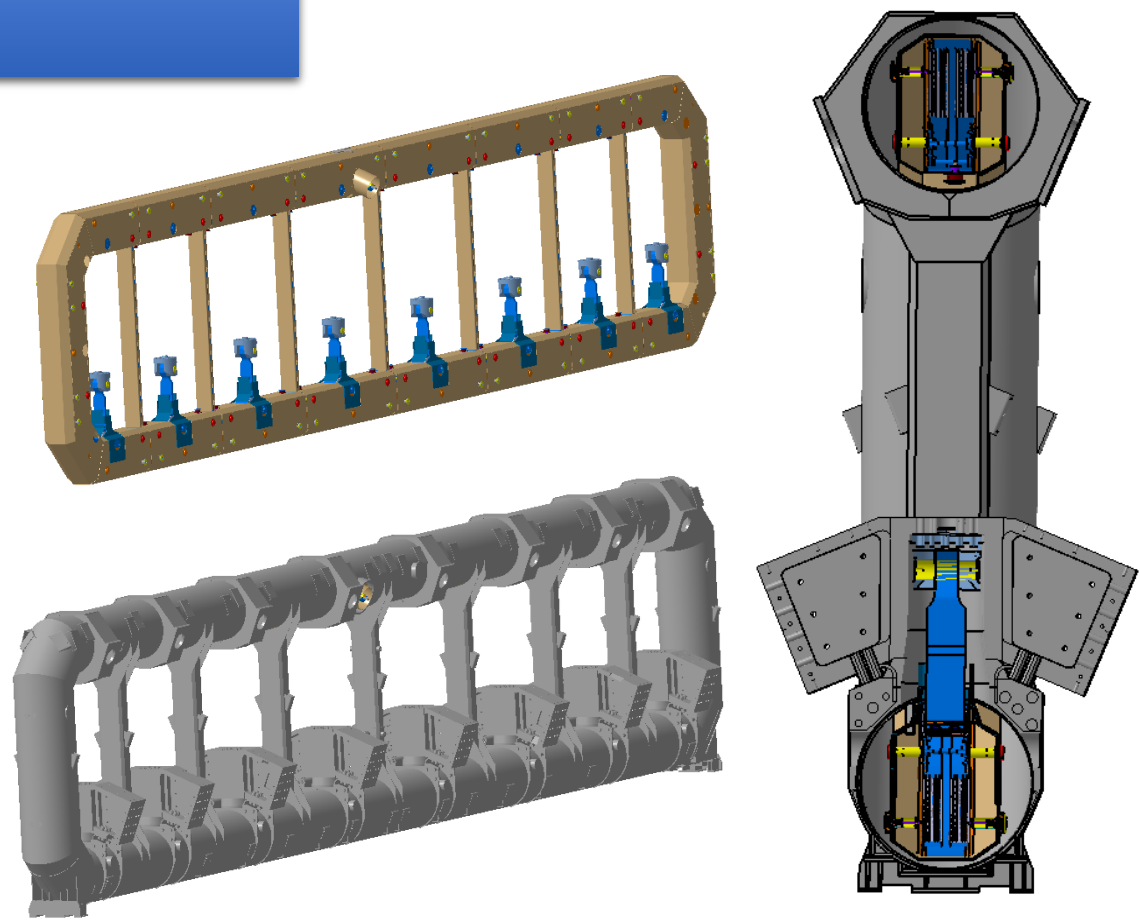
3. All internal surfaces received by Boolean subtraction of parametrical primitives from a Box result in zero faults

4. Boolean operation inaccuracies are correlated with Moving/Rotation transactions in GEANT4

5. For all external surfaces created by the subtraction of parametrical primitives from a Box, Boolean operation Inaccuracies do not correlate with Moving/Rotation transactions

Investigation of Hypothesis 02

Hypothesis 02: discrepancies between as-built and the geometry implementation inside the simulation



I. Reproduction of Geometrical Model of COIL in CATIA

II. Decomposition and Mass analysis of COIL

III. Compare analysis between CATIA and Geant4 COILs

IV. Integration conflict checking

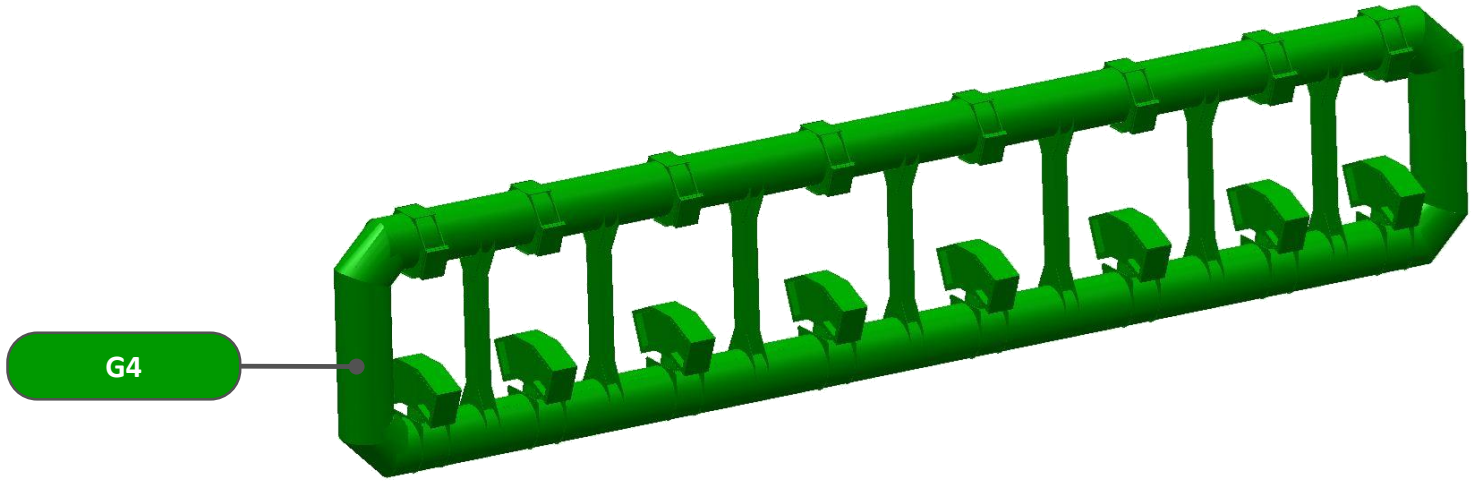
1. Source geometry has been taken from Smarteam Engineering Database

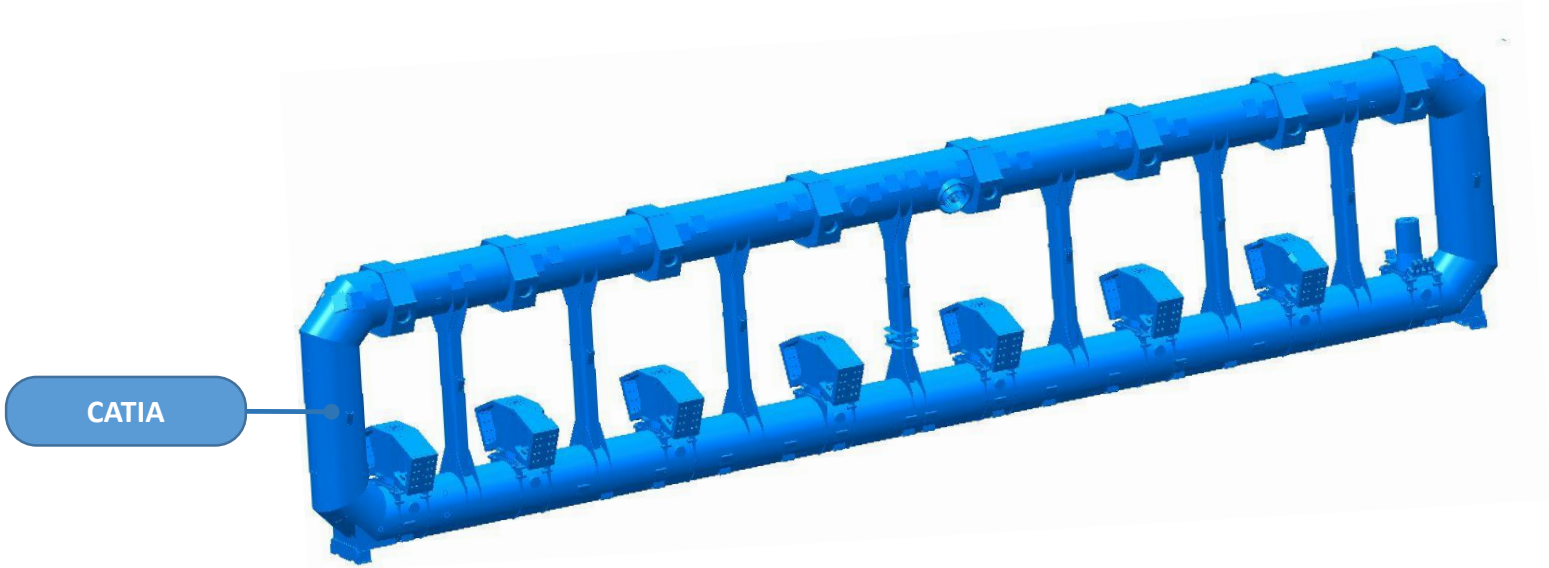
2. 225 manufacturing drawings have been founded on CDD and missing parts was added to primary Smarteam geometry

Investigation of Hypothesis 02

Compare analysis between CATIA and Geant4 COILs

Model	Volume (m3)	**Mass (kgs)**	Difference (kgs)
CATIA	24.75	**91’914.5**	
G4	22.13	**80’452**	-11’462.5





Investigation of Hypothesis 02 - Conclusions

1. Hypothesis #02 has been confirmed: The geometry descriptions in the simulation are not consistent with as-built
2. The COIL was divided into 21 separate volume
3. Volume and Weight analyses of the COIL have been implemented; Comparison of the volume and weight between CATIA and XML descriptions have been implemented
4. Important differences have been discovered for the following volumes: Cryostat Bottom missing 1’738 kg., Rib missing 1’248 kg., Thermal Shielding missing 2’020 kg., Inner parts of the COIL missing 5’297.5 kg
5. It is was found that there was not Thermal Shielding in the Geant4 description
6. 11.5 tones missed materials were discovered for Geant4 geometry

What is Geometry Modeling Precision Influence on quality of Physics Analysis?

Future Plans

Researching task is divided into two main steps:

1. Studding Simulation Resources. As a result following tasks will be implemented:

    1.1. Studding of MC algorithms using in physics processes simulation

    1.2. Discussing of MC Generator

    1.3. Preparing and running of MC Generator

    1.4. Showing and analyzing of results

Future Plans

2. Investigation of Data vs. MC differences

2.1. Researching of Data vs. MC differences for ***Feet*** component

2.2. Researching of Data vs. MC differences for ***Flexible Chain*** component

2.3. Researching of Data vs. MC differences for ***Services of Magnet system*** component

2.4. Researching of Data vs. MC differences for ***JD Services*** component

2.5. Researching of Data vs. MC differences for ***Platforms*** component

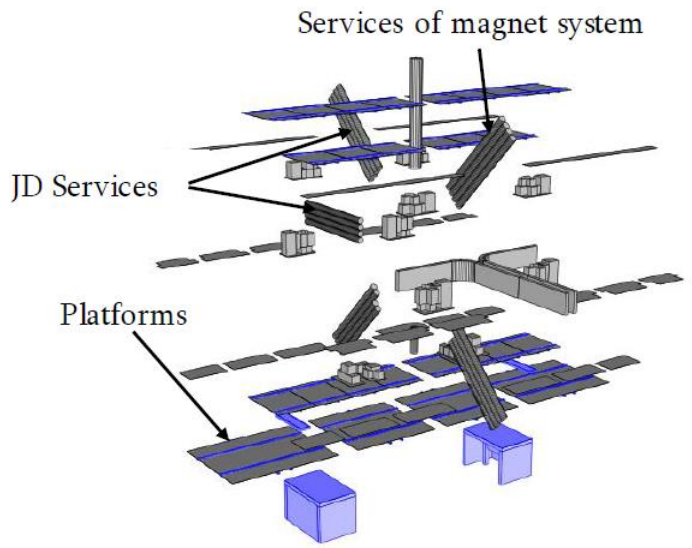
2.6. Researching of Data vs. MC differences for ***Coil*** component

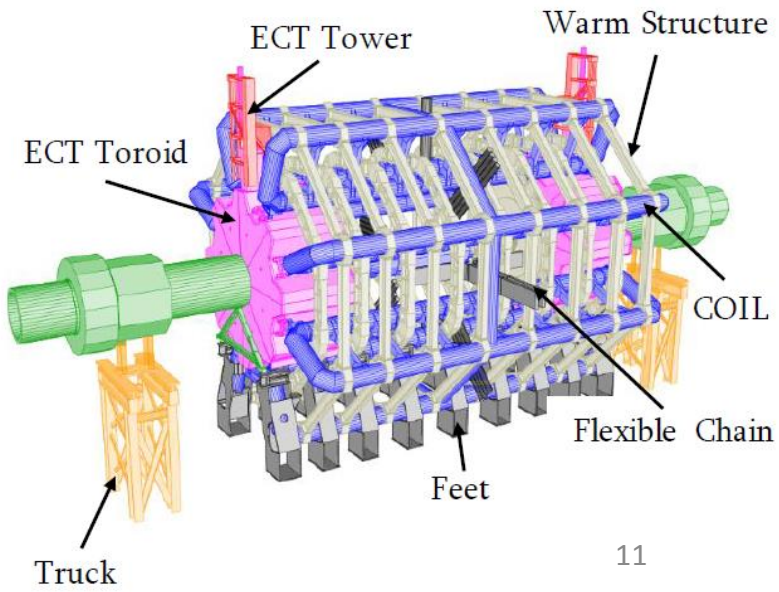
2.7. Researching of Data vs. MC differences for ***Truck*** component

2.8. Researching of Data vs. MC differences for ***Warm Structure*** component

2.9. Researching of Data vs. MC differences for ***ECT Toroid*** component

2.10. Researching of Data vs. MC differences for ***ECT Tower*** component





Thank You for Your Attention

მადლობთ ყურადღებისათვის

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