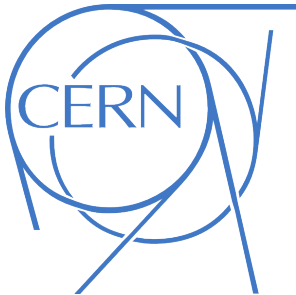# Acts for ATLAS

Corentin Allaire
Paul Gessinger-Befurt
Fabian Klimpel
Bastian Schlag

Acts in ATLAS

- Athena is the ATLAS software framework that manages almost all ATLAS production workflows

- The Acts has been imported as an external module to replace progressively some aspect of the reconstruction

- Interfaces to use the Acts with the ATLAS detector have been and are being implemented in :
  https://gitlab.cern.ch/atlas/athena/tree/master/Tracking/Acts

- For now are available (or will be soon) :
  - Conversion of the geometry Athena ->Acts
  - Material mapping (surfaces and volumes)
  - Propagation through the geometry
 - Vertexing

ATLAS geometry with the Acts

- To use the Acts with the ATLAS detector one first need to extract the ATLAS detector as an Acts geometry

- This is achieved by extracting the ATLAS detector elements from the athena Detector Manager and then converting them into Acts detector element

- Those new element can then be used to create layer then volume builder and thus obtain an Acts geometry

- Similarly the ATLAS event context is converted into an Acts one for alignment purpose

- This has been implemented for the Pixel, SCT and TRT

- The resulting geometry is shown on the right for the Pixel + SCT
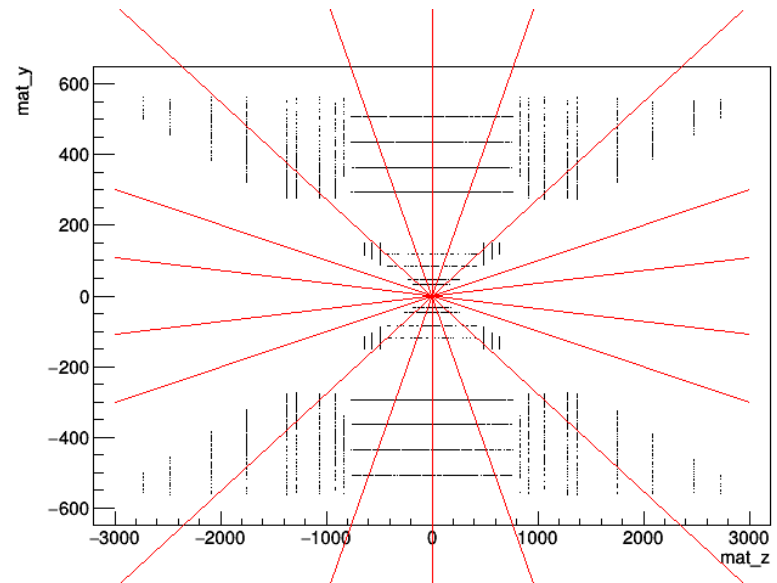
ATLAS geometry with the Acts

- The geometry can also be extracted as 3D object for visualisation

- They can also be extracted as json files than can be used to initialise the binning used in the material mapping
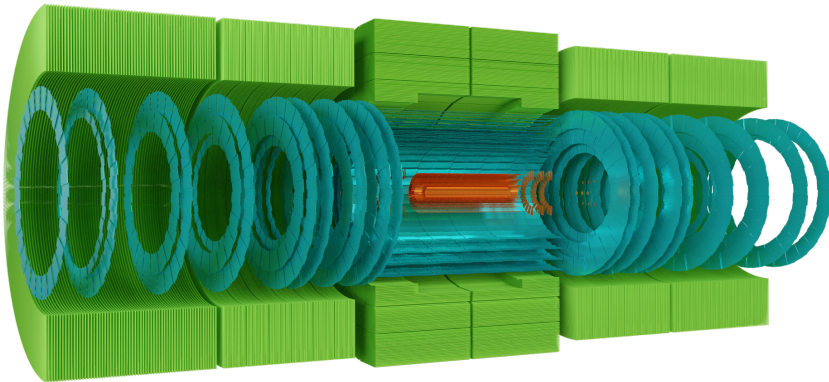
Atlas ID with the Acts
(render using blender)

```
"11": {
    "Geoid": "[ 11 |  0 |  0 |  0 |   0 ]",
    "Name": "SCT::Barrel",
    "layers": {
        "2": {
            "Geoid": "[ 11 |  0 |  2 |  0 |   0 ]",
            "approach": {
                "1": {
                    "SGeoid": "[ 11 |  0 |  2 |  1 |   0 ]",
                    "bin0": [
                        "binPhi",
                        "closed",
                        40
                    ],
                    "bin1": [
                        "binZ",
                        "open",
                        60
                    ],
                    "matSurface": true,
                    "sposition": 293.205745900435,
                    "srange": [
                        -763.2730430706547,
                        763.2730430706547
                    ],
                    "stype": "Cylinder",
                    "type": "proto"
                }
            }
        },
```

Binning that can then be edited

Should this surface be mapped onto

Material mapping with the Acts

- With the Geometry extracted it then need to be decorated with material

- The material is collected for a Geantino scan with the output converted into Acts Material track

- This material is then mapped onto the different surfaces using the Acts surface material mapping

- A default binning is set for the different surfaces at the creation of the geometry but this can be changed by editing the geometry json file

- The mapped material is stored as a json file that can then be used to decorate the tracking geometry

- For the TRT and the calorimeter we plan to use volume mapping to extract the material.
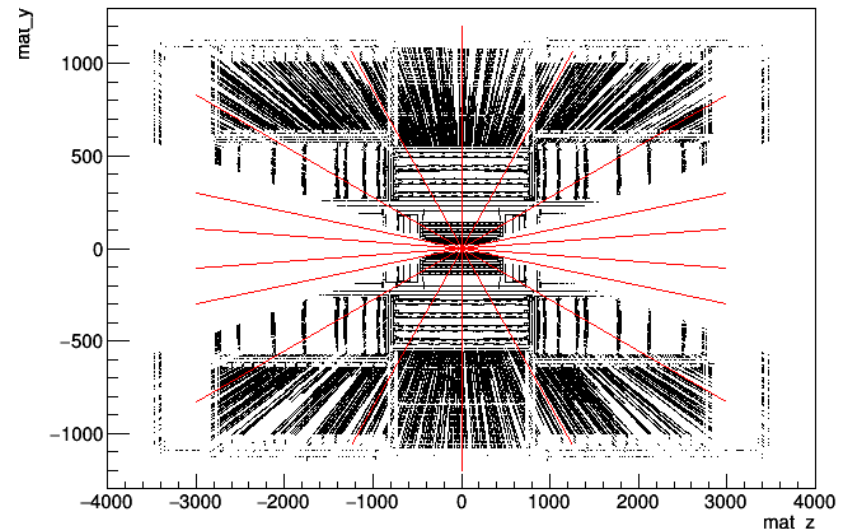
Extrapolation and validation with the Acts

- The extrapolation algorithm from Acts have also been interface with athena and can use directly the ATLAS magnetic field

- This can be used to validate the material mapping by comparing the material encountered during random propagation through the geometry and the material collected by the geantino

- As function of eta and phi a good agreement can be observed between the two

- This mapping was not optimised yet, a larger geantino statistics and a more optimised binning should result in better agreement
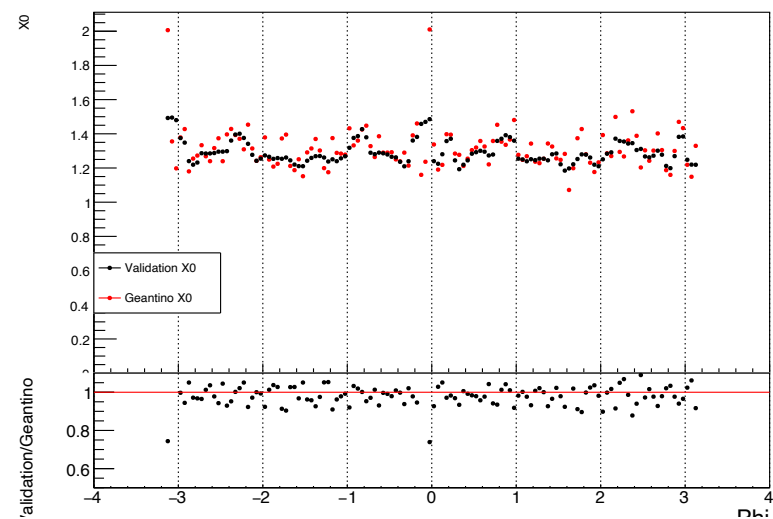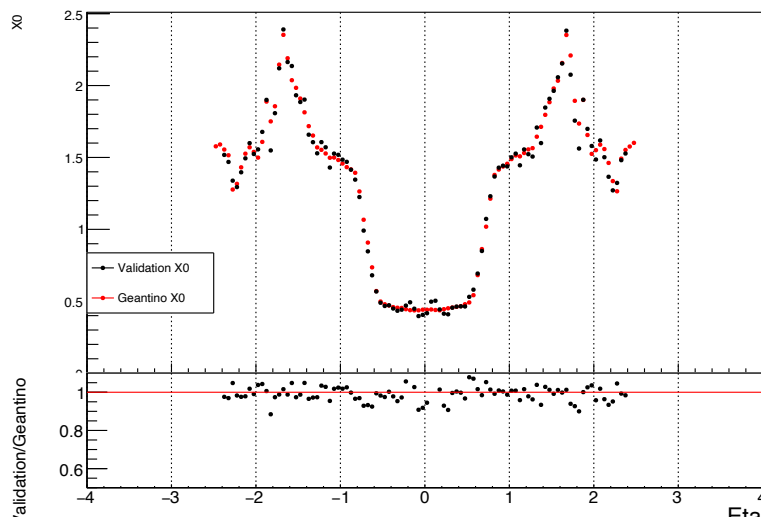
ATLAS tracking in the TRT

- TRT is a special environment
  - Dense packed gas filled straw tubes
- How to perform
  - Detector description
  - Track extrapolation ?
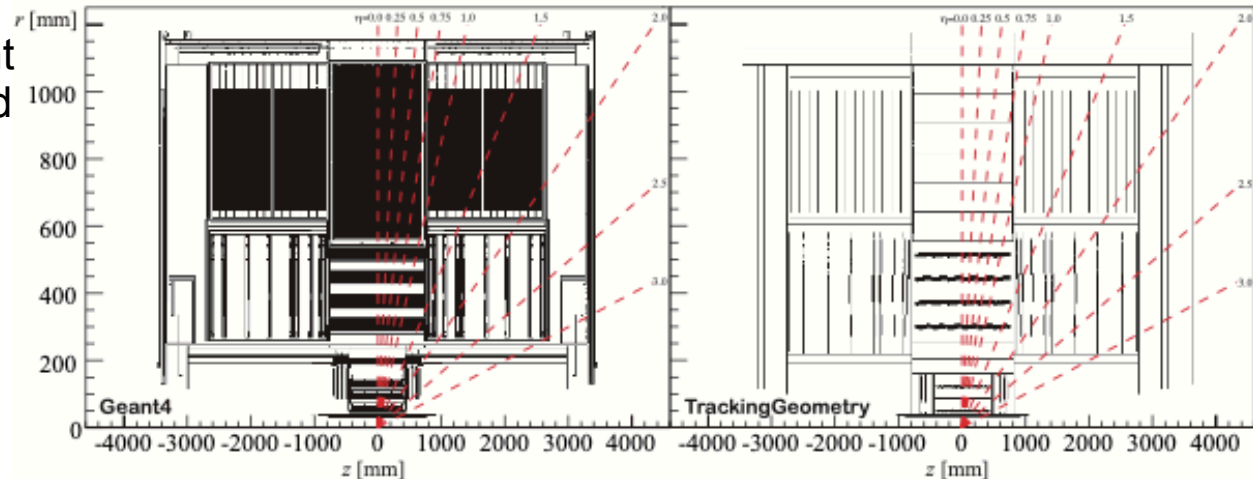
Distinction between Inner Detector and Calorimeter →

ATLAS setup
- TRT material is **mapped on surfaces**
  - Like in the Pixel/SCT
- Stepwise track extrapolation through vacuum
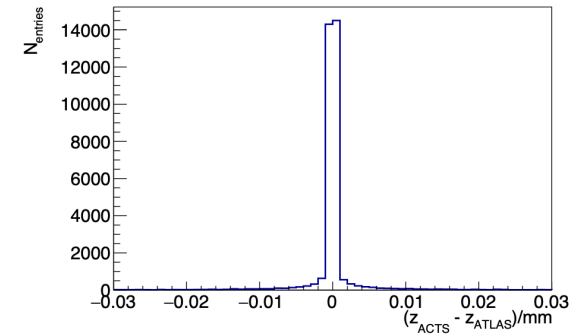- **Pointwise** material interactions between steps

Same objects with context aware application →

ACTS setup
- TRT material is **mapped on volumes**
  - Like in a Calorimeter
- Stepwise track extrapolation through matter
- **Continuous** material interactions along steps

Acts Vertexing in Athena

Adaptive Multi-Vertex Finder (AMVF)
Vertex z-position resolution

- Acts primary vertexing integrated in Athena:

  - Dedicated interfaces and tools available in Athena

  - Seamless EDM conversion from Athena → Acts (and back after vertexing)

  - Enable ATLAS algorithm for primary vertex reconstruction to use ACTS tool

- Ongoing validation of Acts AMVF algorithm against Athena implementation:

  - Using tracking validation tool to study performance: number of vertices, vertex resolution, vertex categories, …

- After full validation: migrate to ACTS vertexing (→ switching to reentrant algorithm, needed for AthenaMT)
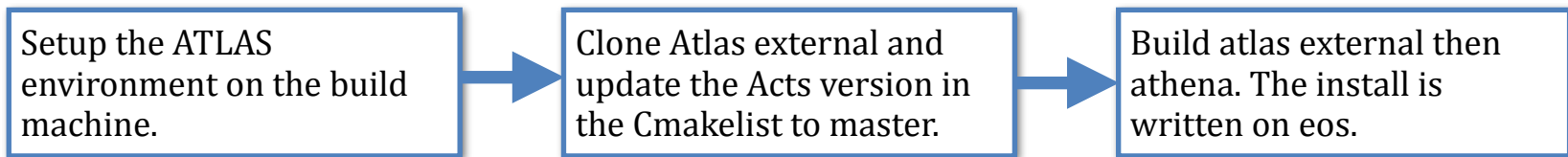
AMVF - Difference in number of
reconstructed vertices
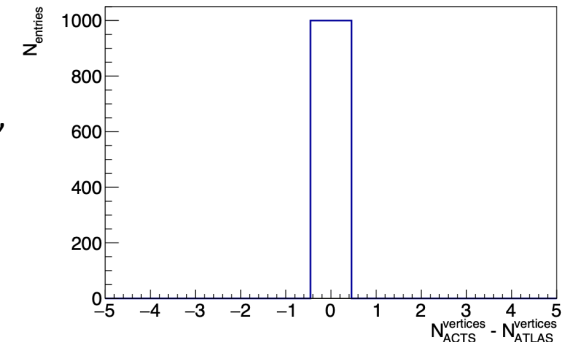
Acts in Athena nightly release

- One of the biggest constraint we have encountered while integrating Acts in Athena was the long time it can take to have access to the latest core development in athena master

- To circumvent that problem we plan on building a nightly realise of athena using the latest Acts master

- Wiki page on how to build athena with the latest Acts realise (require at least 300Gb) : https://gitlab.cern.ch/acts/acts-wiki/-/wikis/howto/BuildAthena

- Plan to use gitlab CI runner to build the nightly every night (can also be done on push) :

Setup the ATLAS environment on the build machine.	→	Clone Atlas external and update the Acts version in the Cmakelist to master.	→	Build atlas external then athena. The install is written on eos.

- At least a week worse of build can be kept on eos (plus the couple of last realise tag)

- If someone wants to work on the Acts implementation in athena they can now build only the athena/Tracking/Acts directory against the full athena build on eos

Outlook

- Some of the Acts algorithms and tools have been implemented in athena

- To facilitate future implementation we plan to start to release soon nightly athena build with the latest Acts version

- This will help us implement more algorithm

- We will then be able to compare the performances of the Acts algorithm with their athena equivalent.