

# Event display in ATLAS

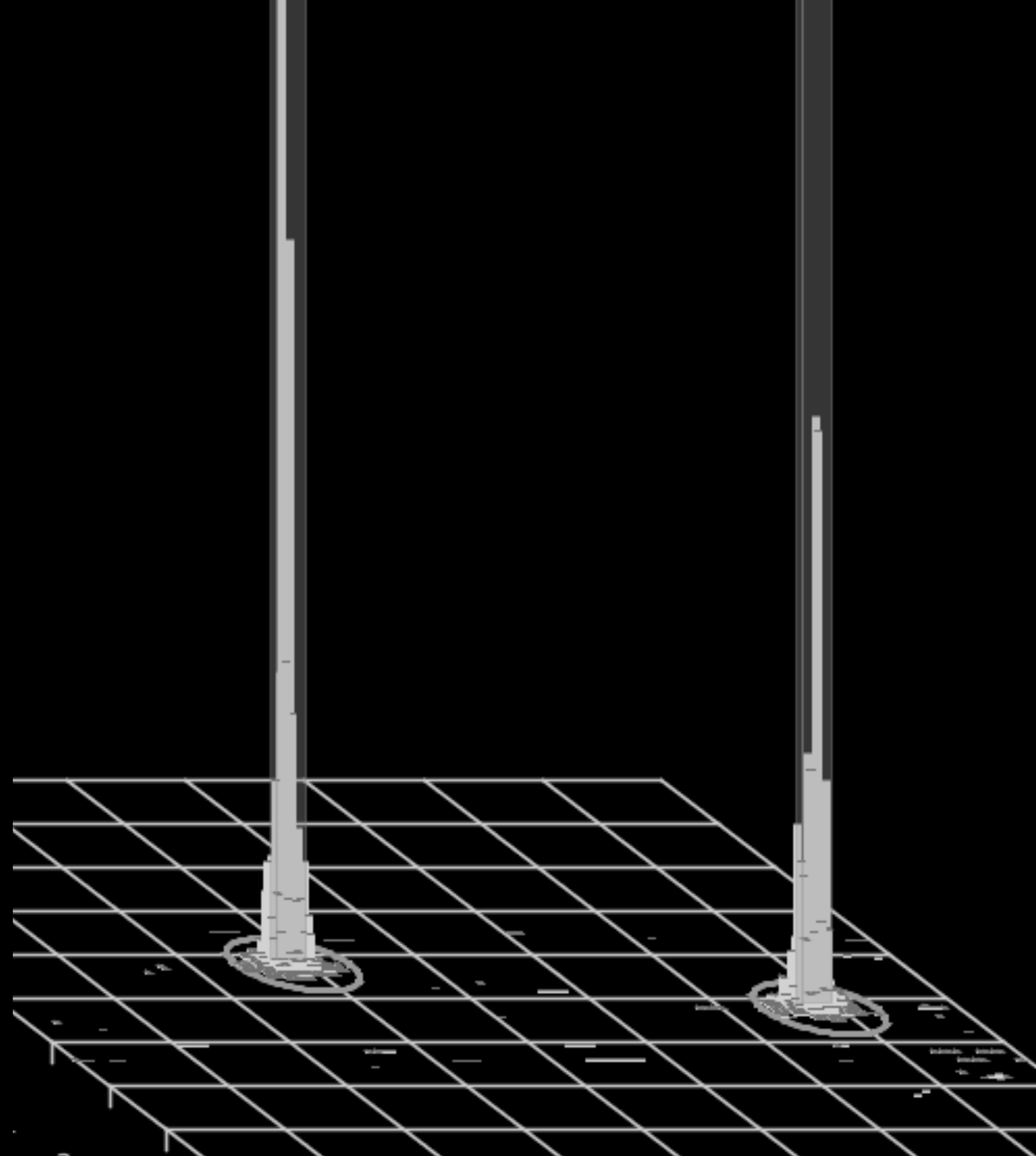
Part II - Current technology and future trends

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*on behalf of the ATLAS Collaboration*

CHEP 2016, San Francisco, 10-14 October 2016



# Event displays in ATLAS





# ATLAS

Atlantis

VP1

Persint

TADA

Tracer

two  
major  
tools in  
ATLAS  
today

and  
three  
other  
tools for  
specific  
needs



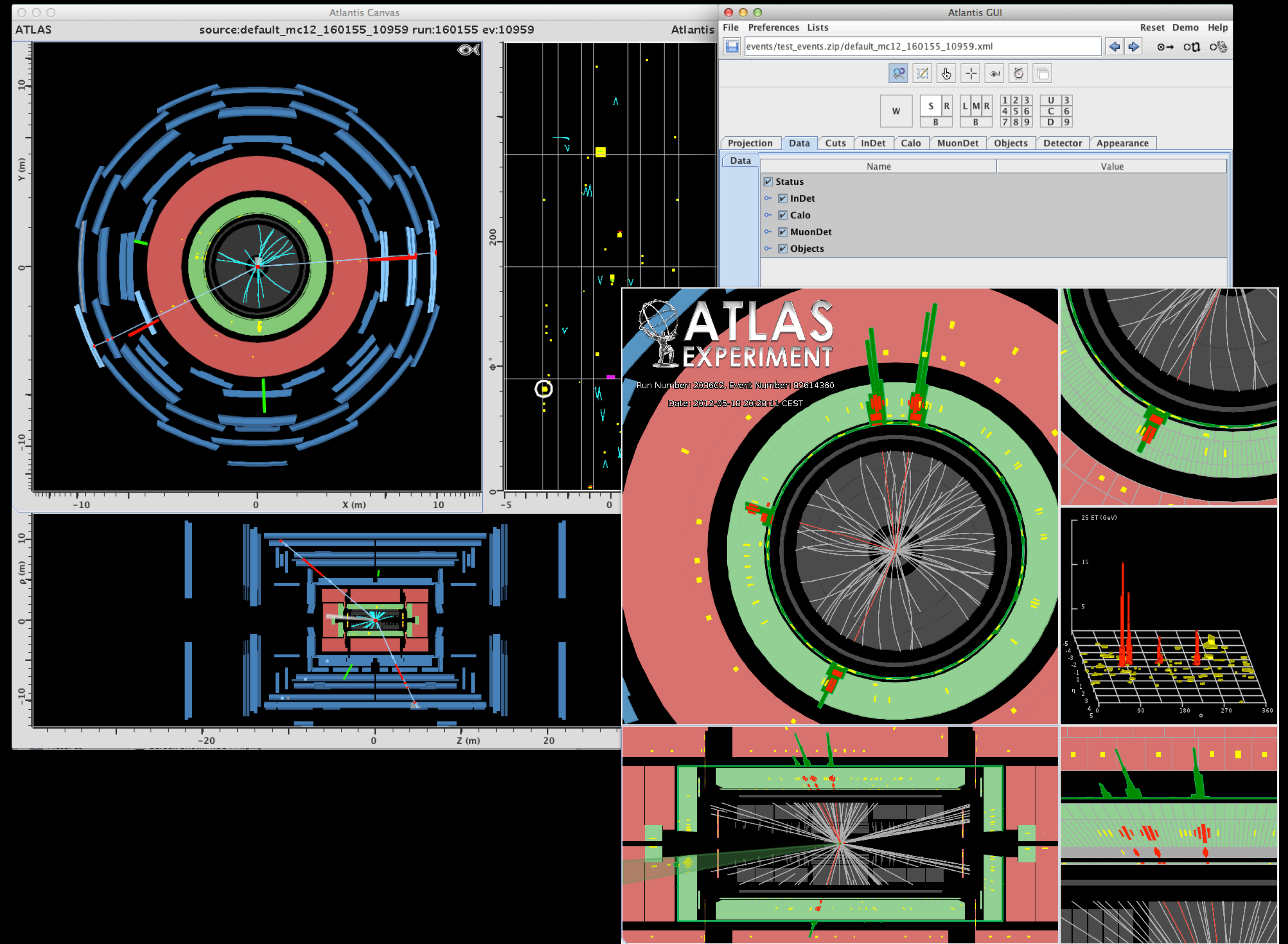
Atlantis

VP1



# Atlantis

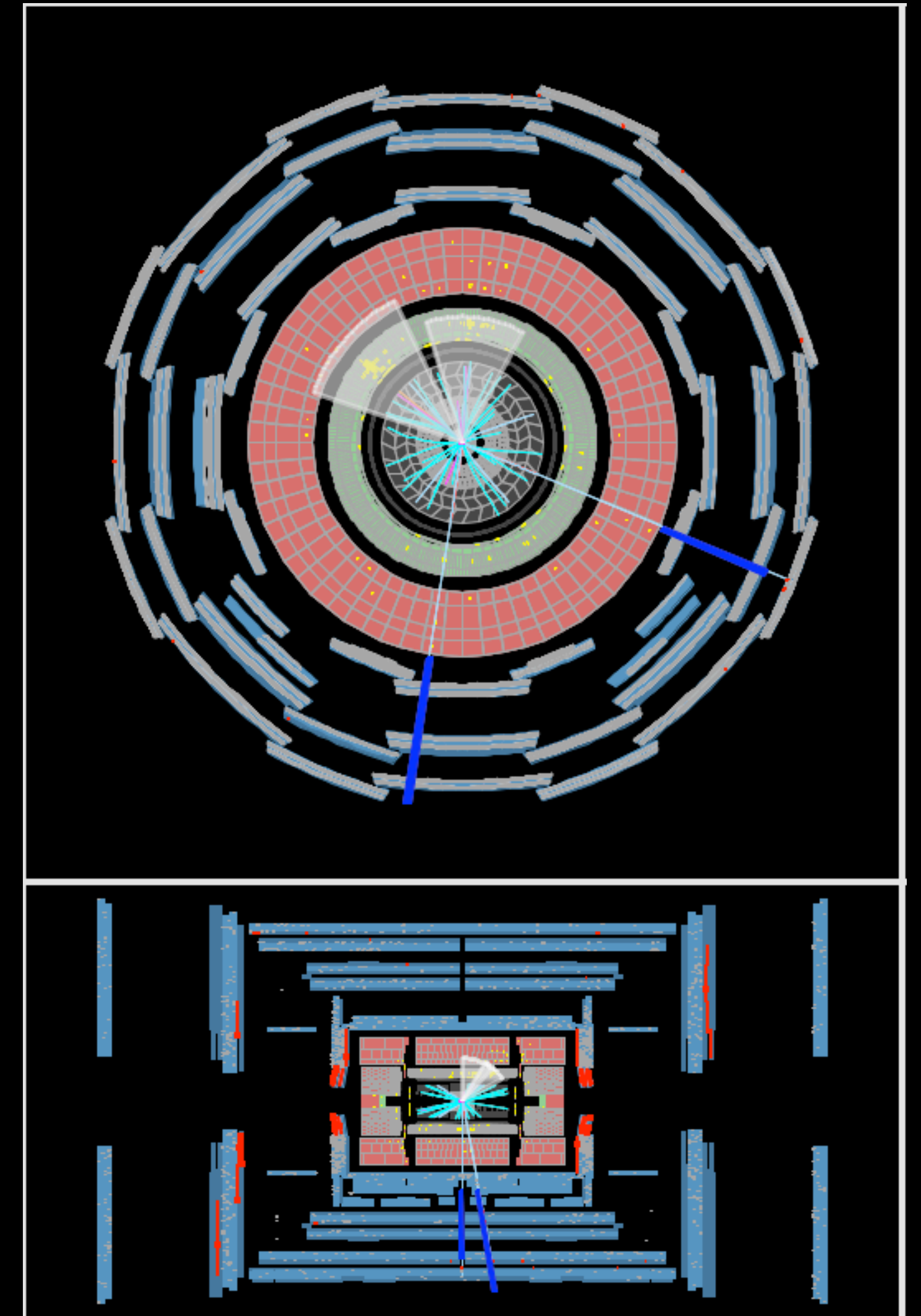
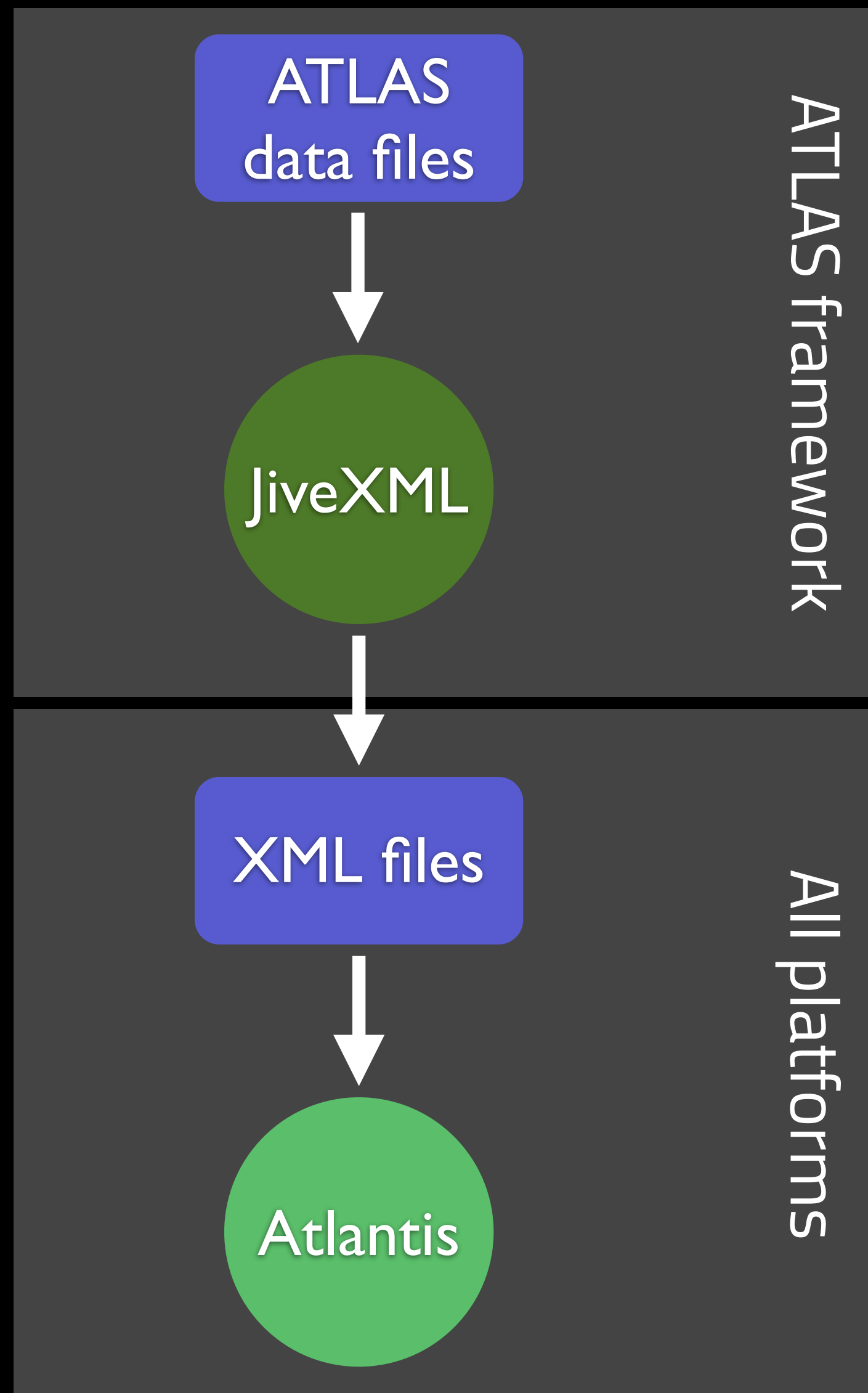
- stand-alone application
- Java-based package
- aimed at visualizing physics objects for physics analysis



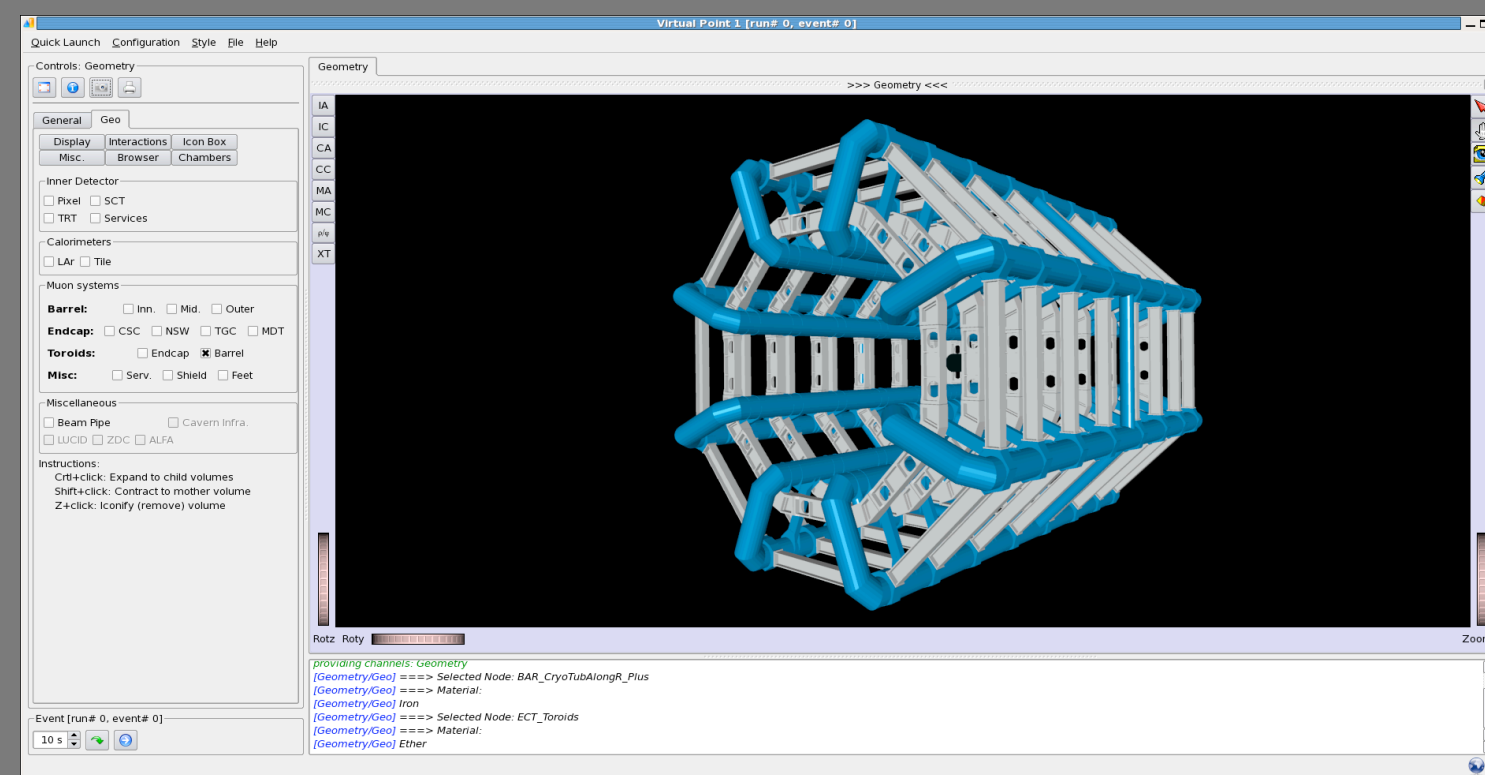
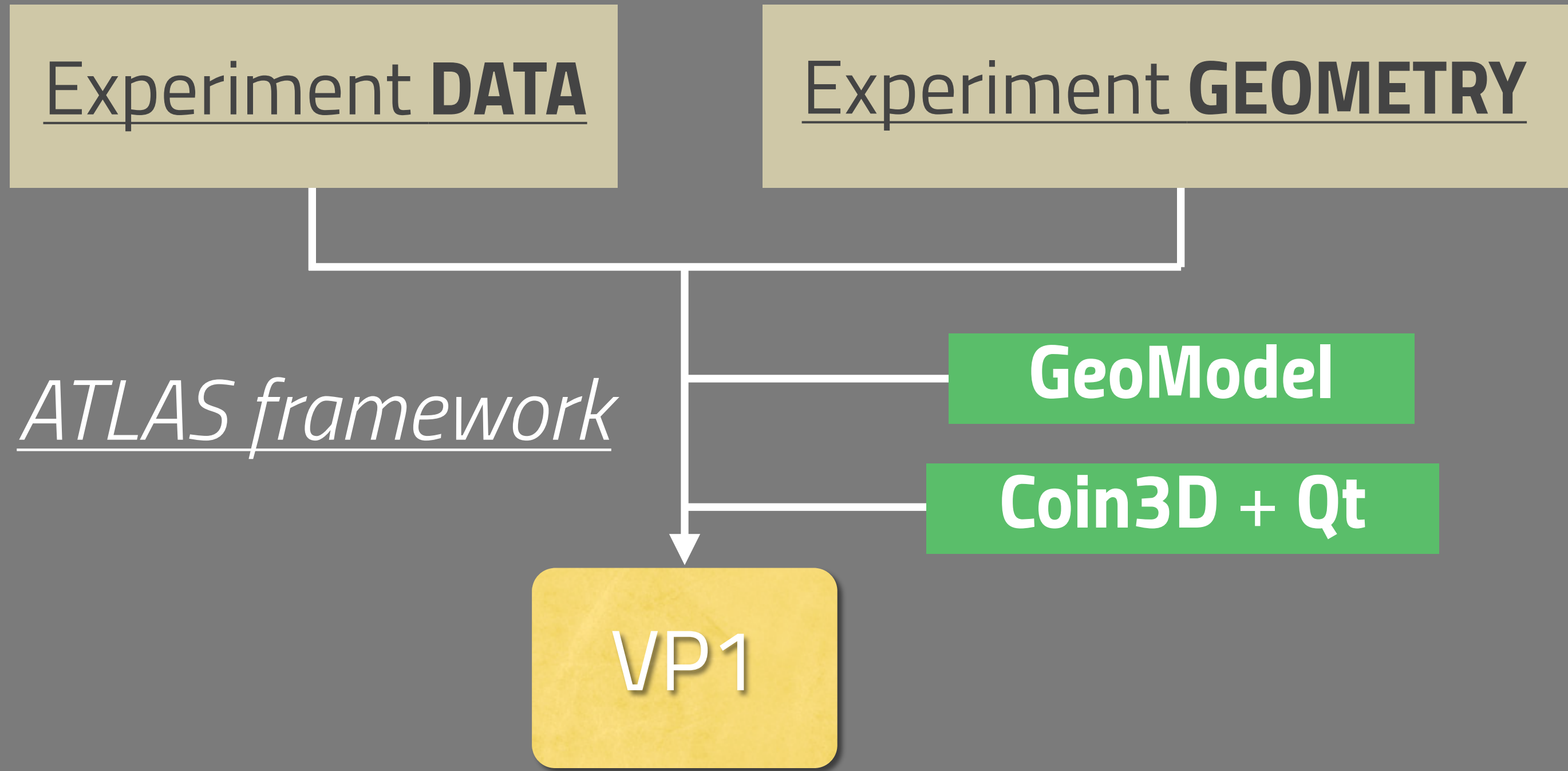


# Atlantis

- **stand-alone** application
- **Java**-based package
- aimed at visualizing physics objects for **physics analysis**
- input files: **custom XML files** generated from ATLAS data files
- it shows a **simplified geometry** of ATLAS
- **2D** graphics





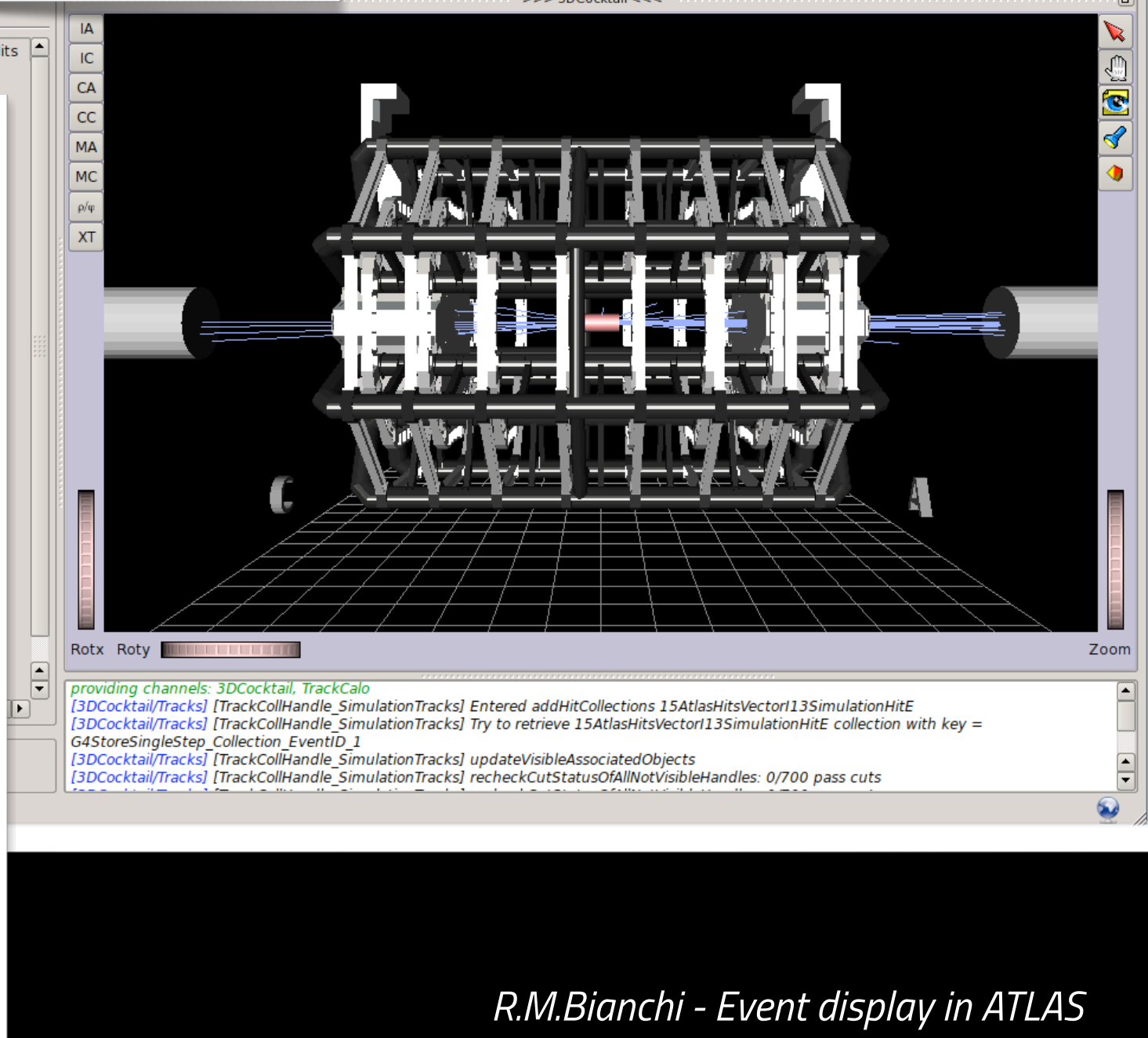
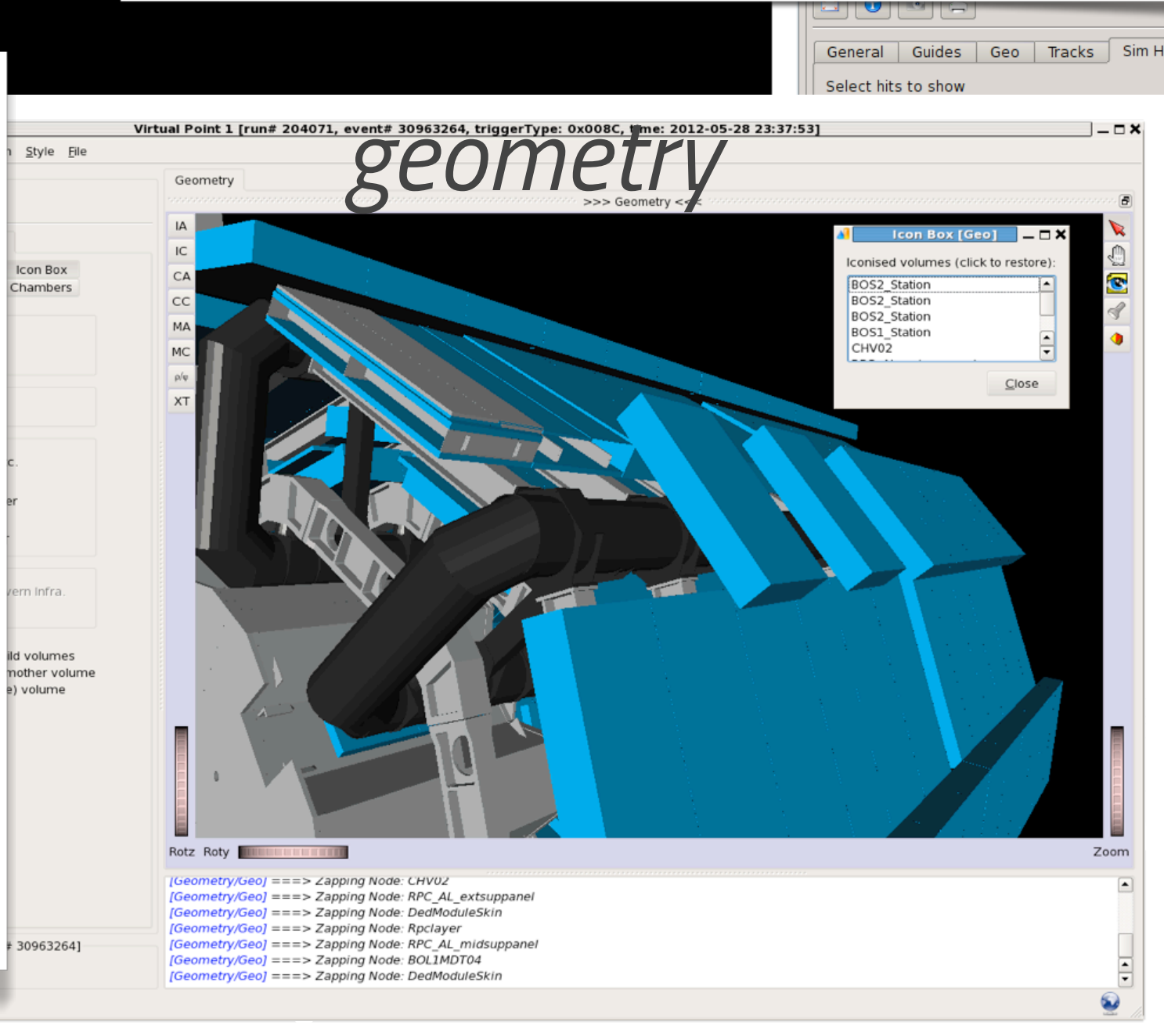
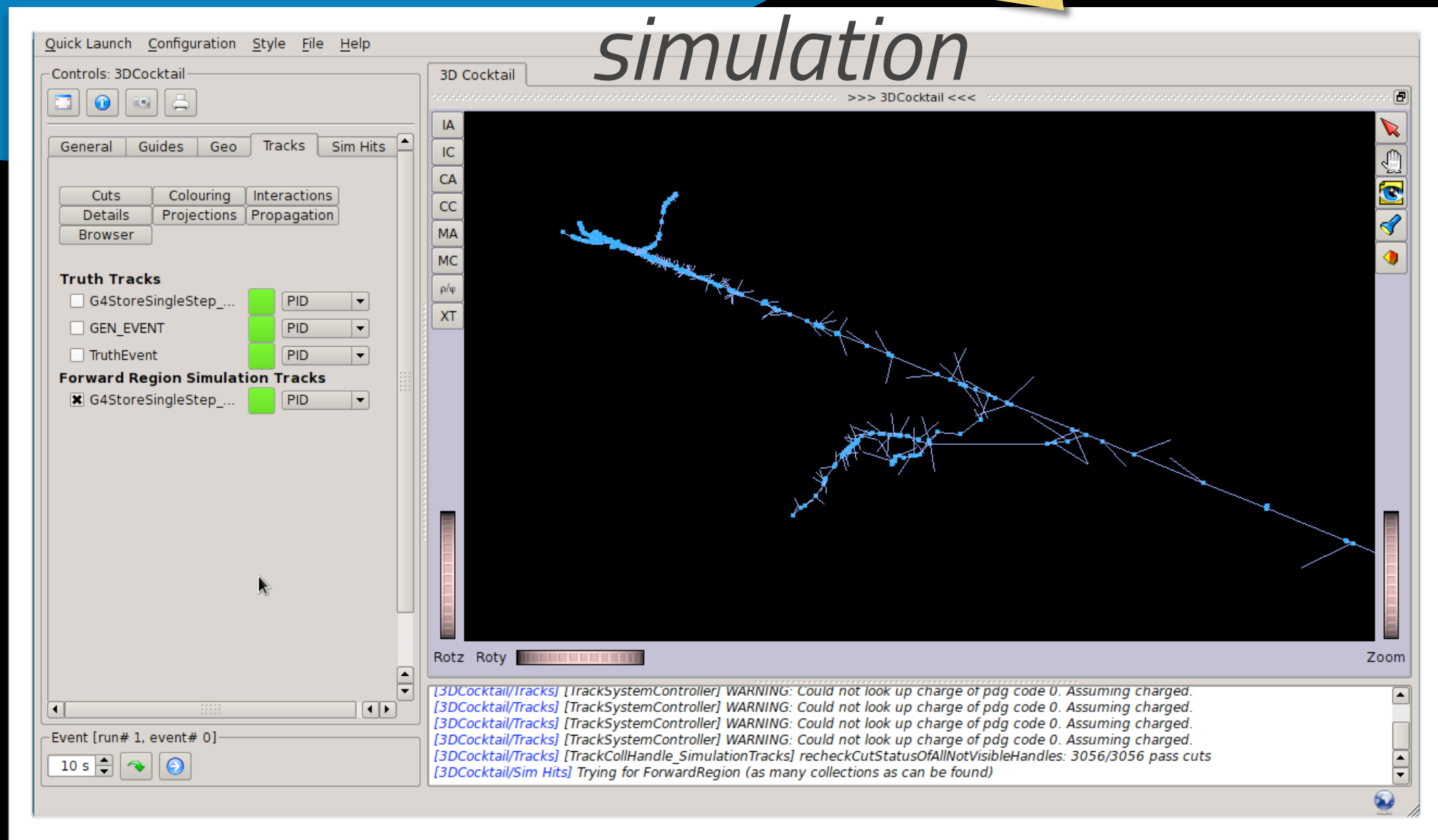
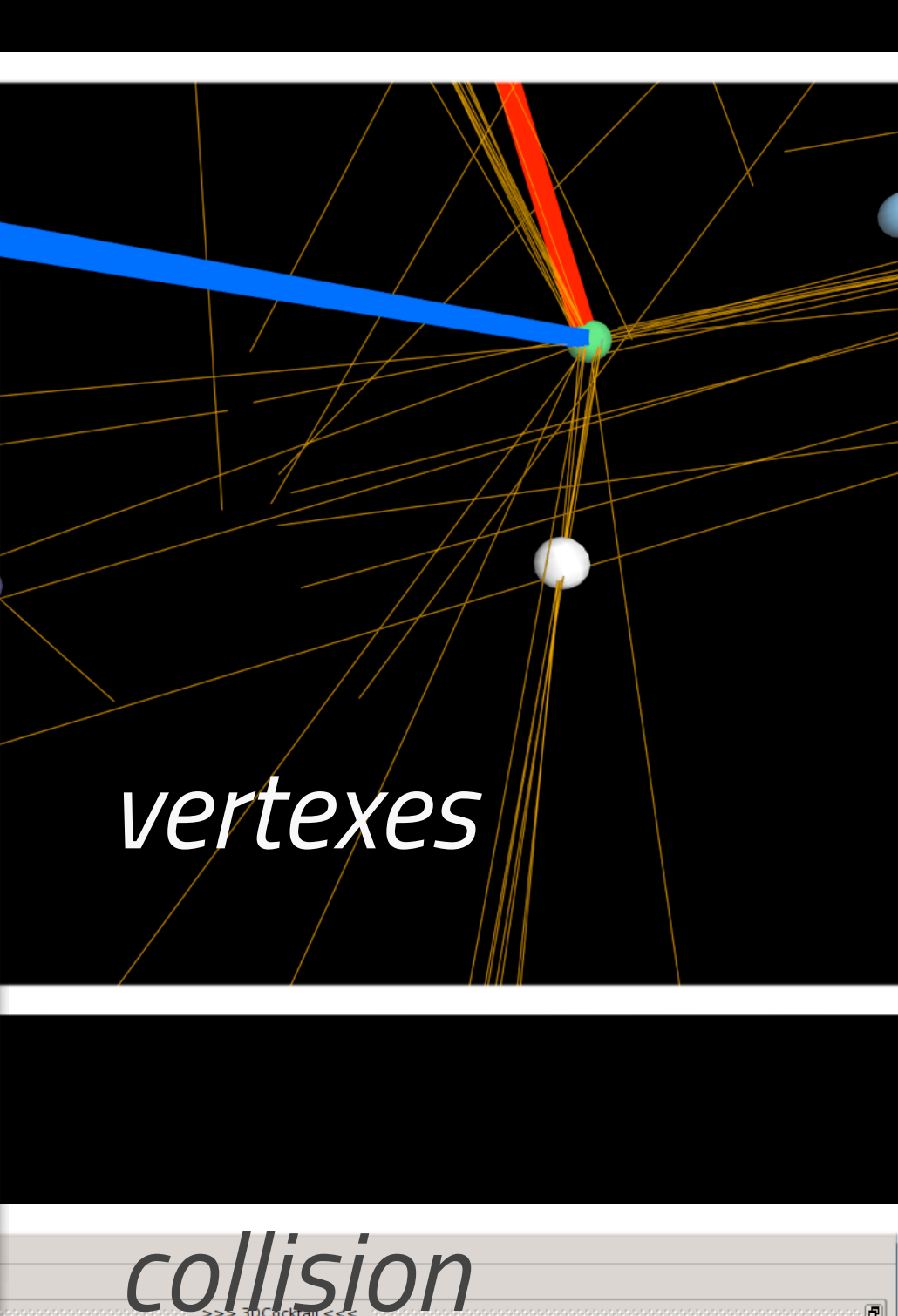
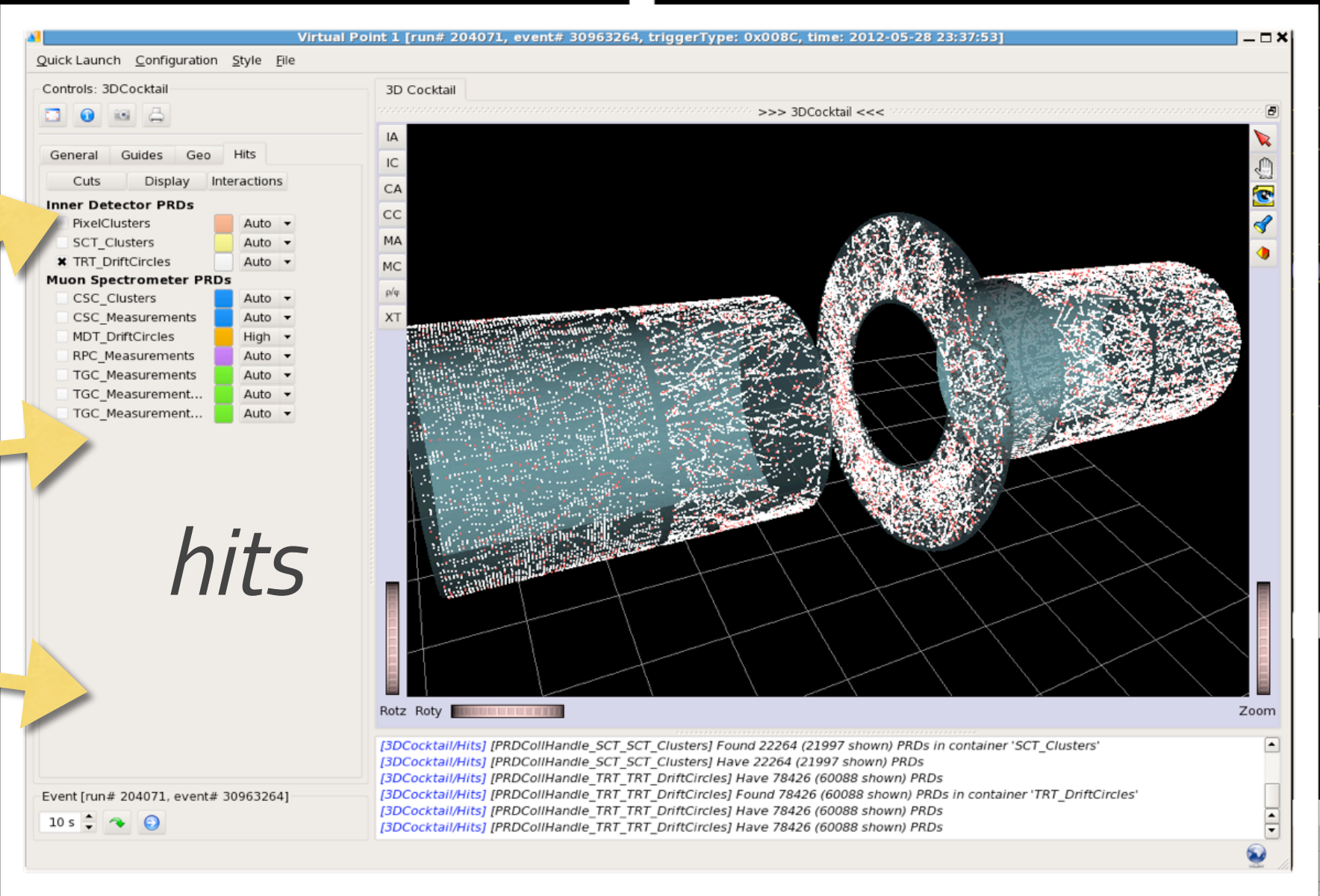
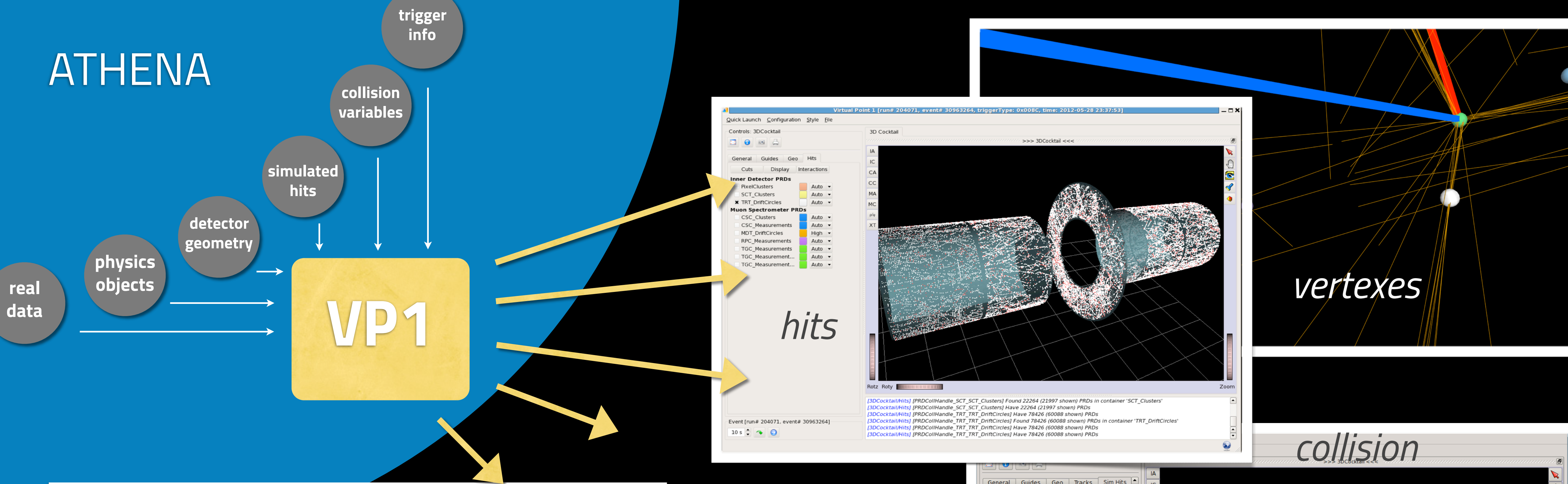


VP1

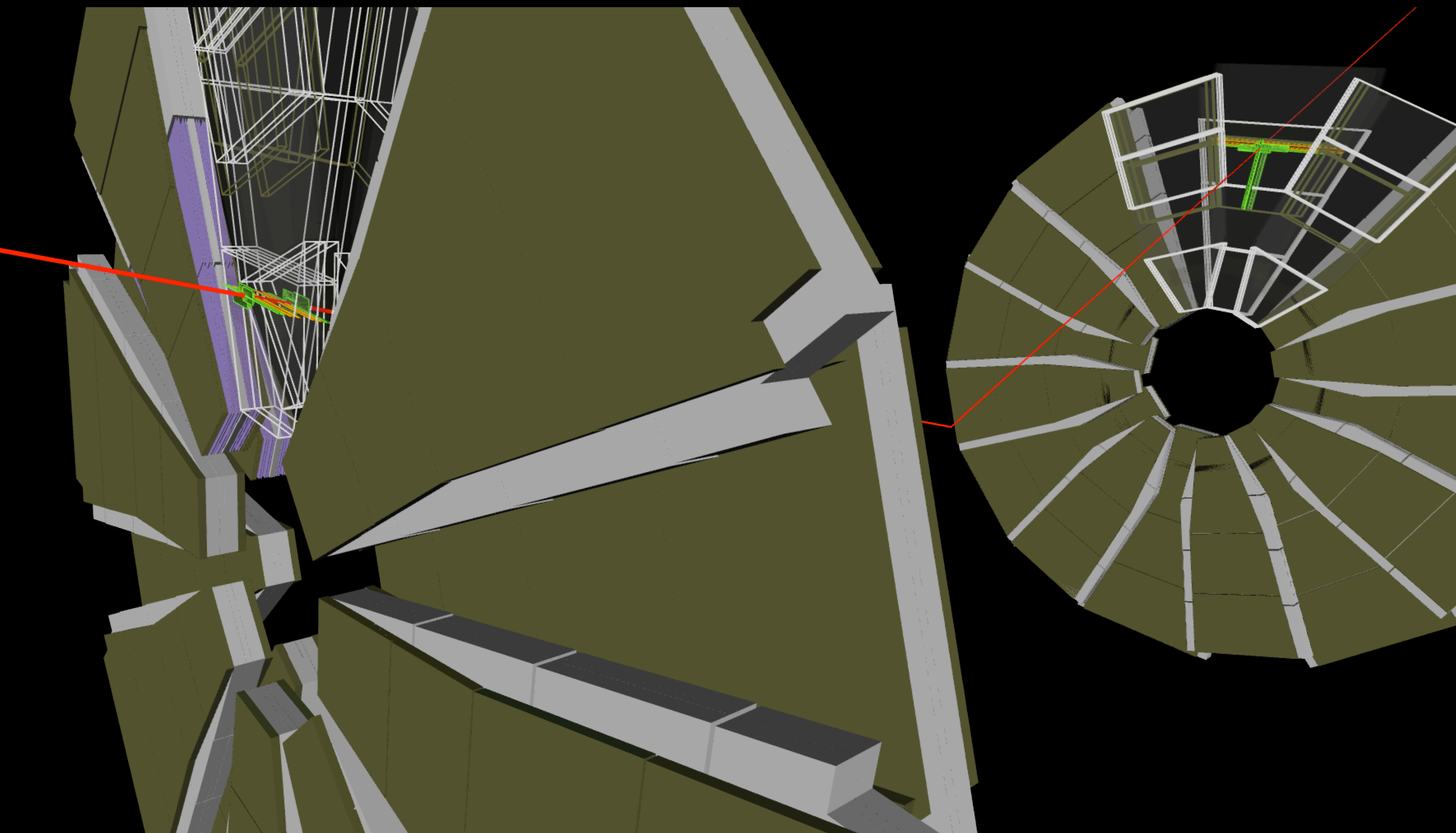
- it is **part** of the **ATLAS Core SW**, it runs in the experiment **framework**
- input data: **all ATLAS data** files, services and DBs
- **C++**-based **framework**
- **Coin3D/OpenInventor** (3D engine) + **Qt** (GUI) + **SoQt** (glue package)



# ATHENA







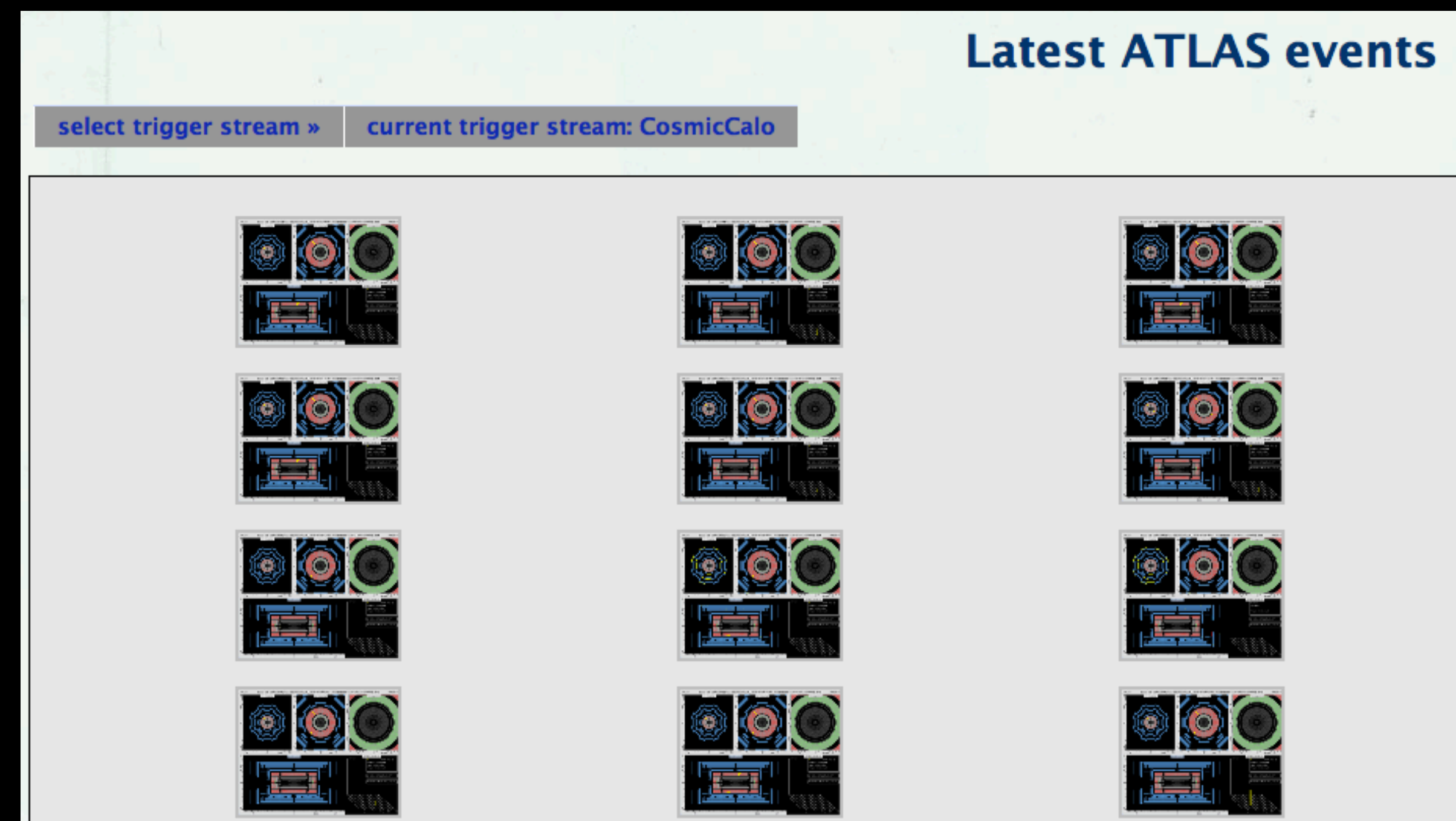
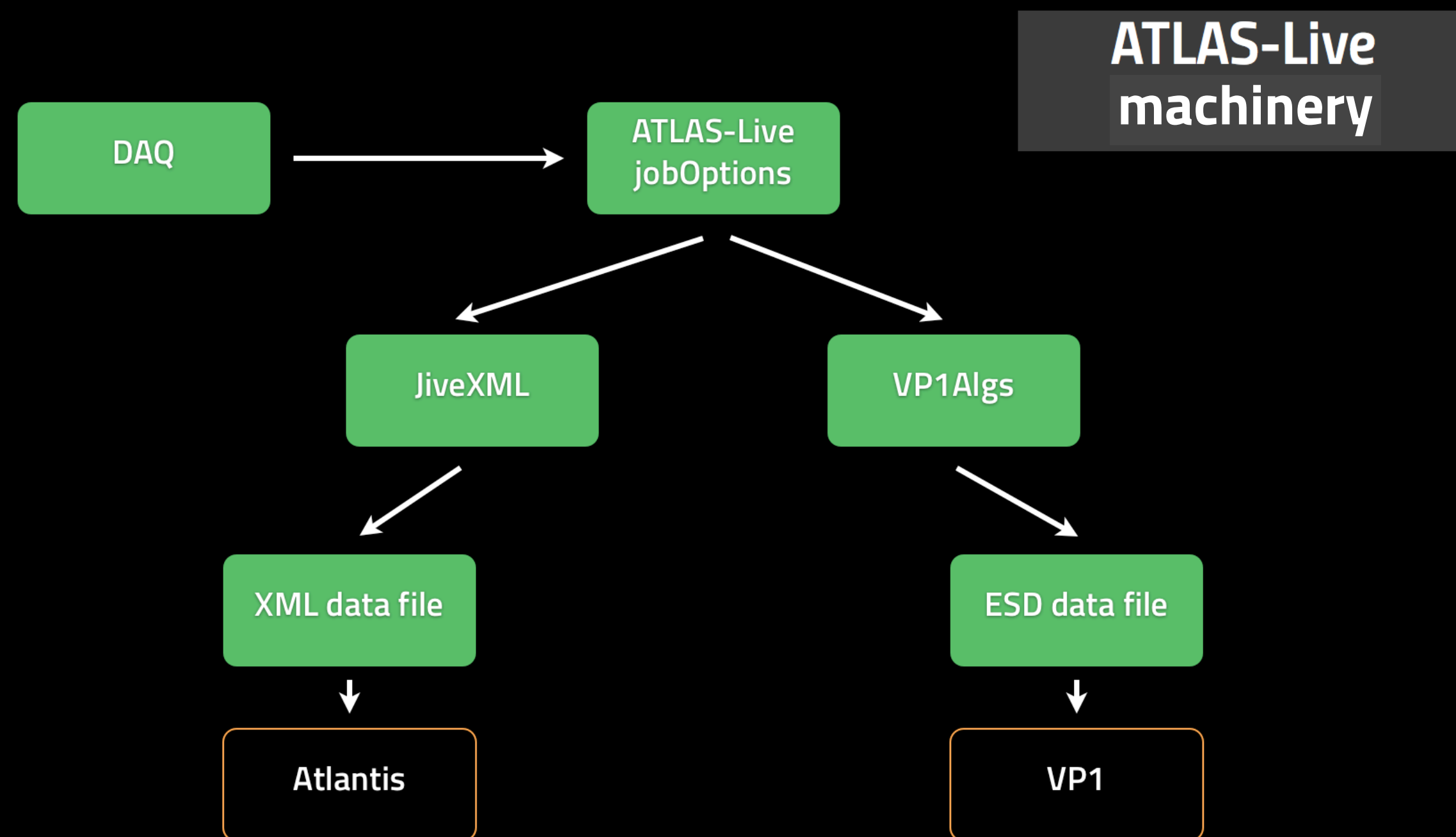
VP1

- general purpose tool: analysis, geometry, simulation
- it shows the **actual ATLAS geometry**
- **2D** and **3D** graphics

*detector development - study for a new ATLAS muon detector*

# ATLAS Live event display

<https://atlas-live.cern.ch>



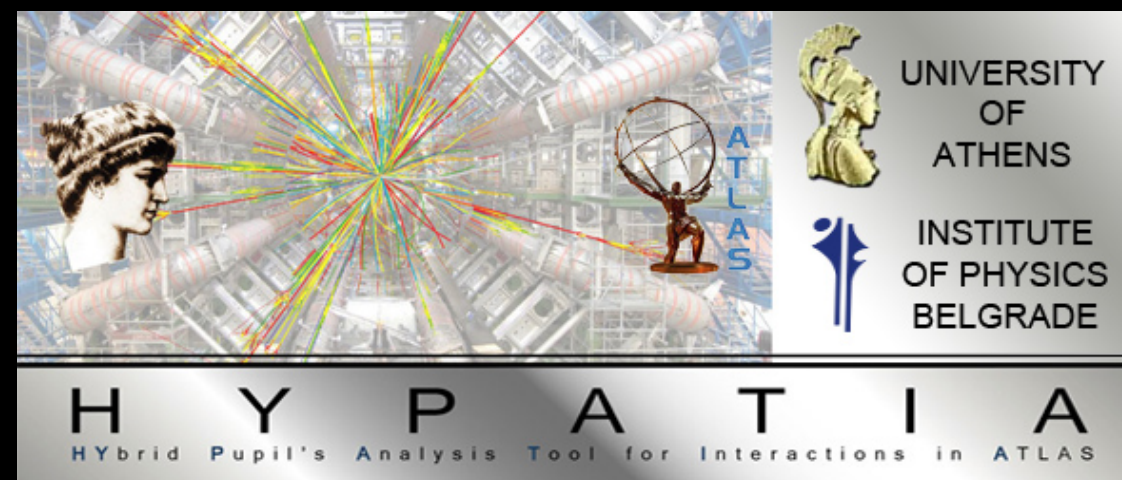
- **Dedicated online reconstruction**, to produce both Atlantis (XML) and VP1 (ESD) data files *on-the-fly*, from the **ATLAS DAQ**

- Until now only Atlantis images are **automatically produced**; VP1 will follow
- Future optimization for **high pileup** foreseen

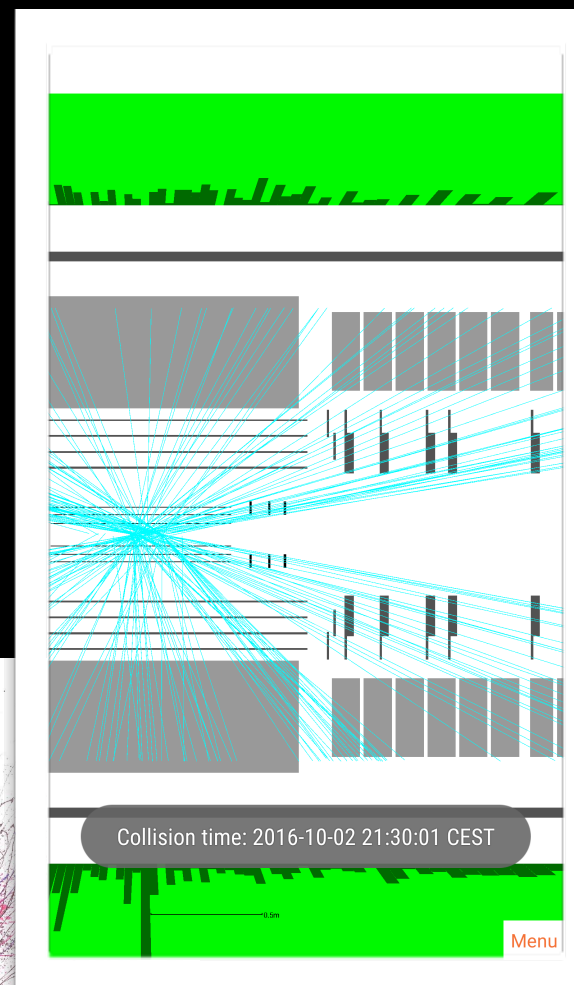
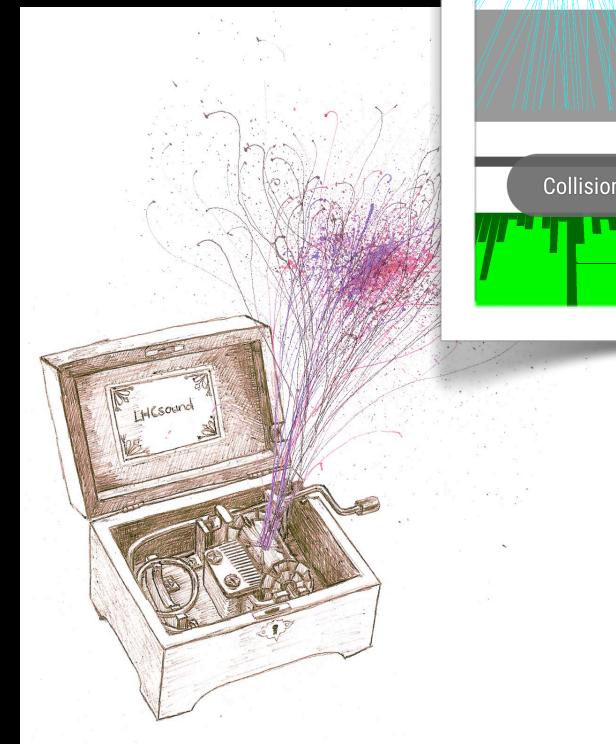


# Event displays for Outreach & Education

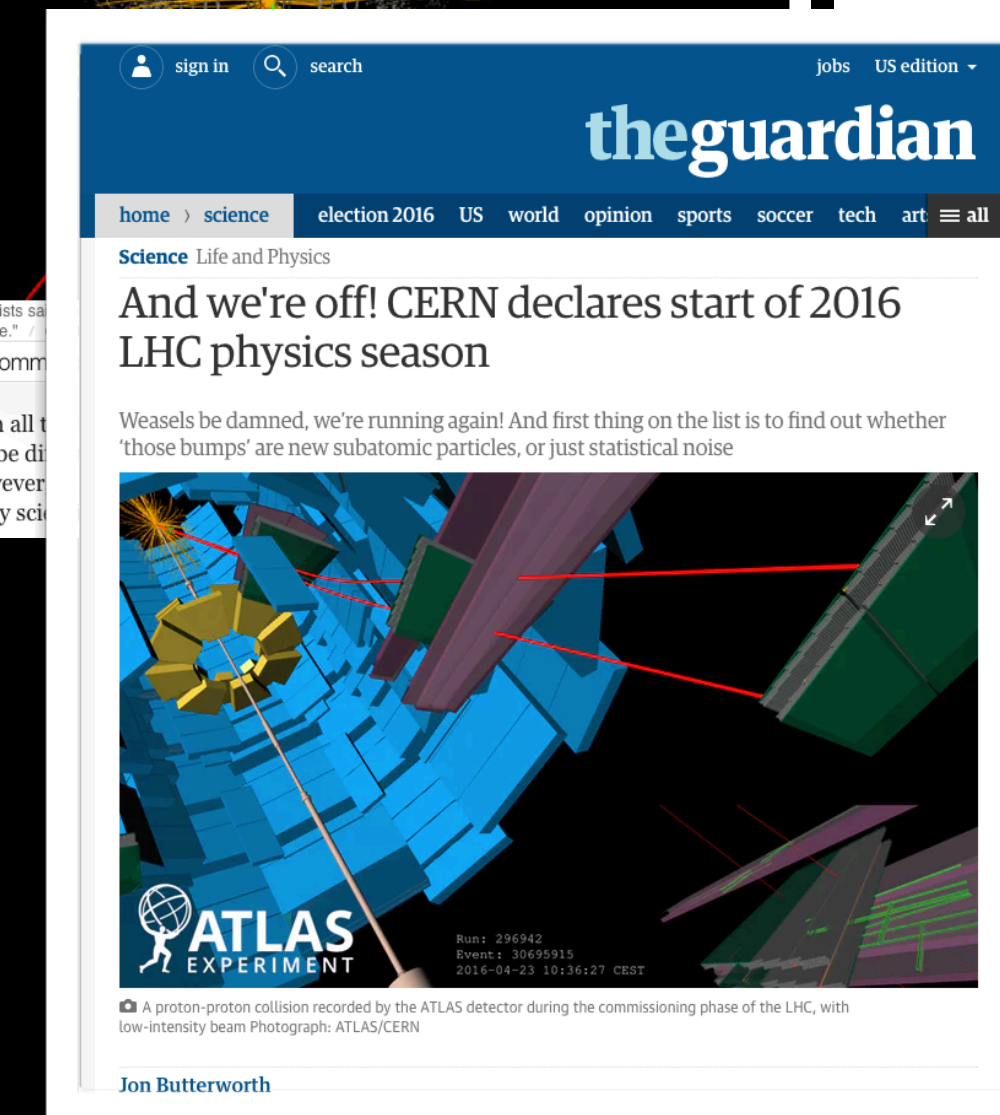
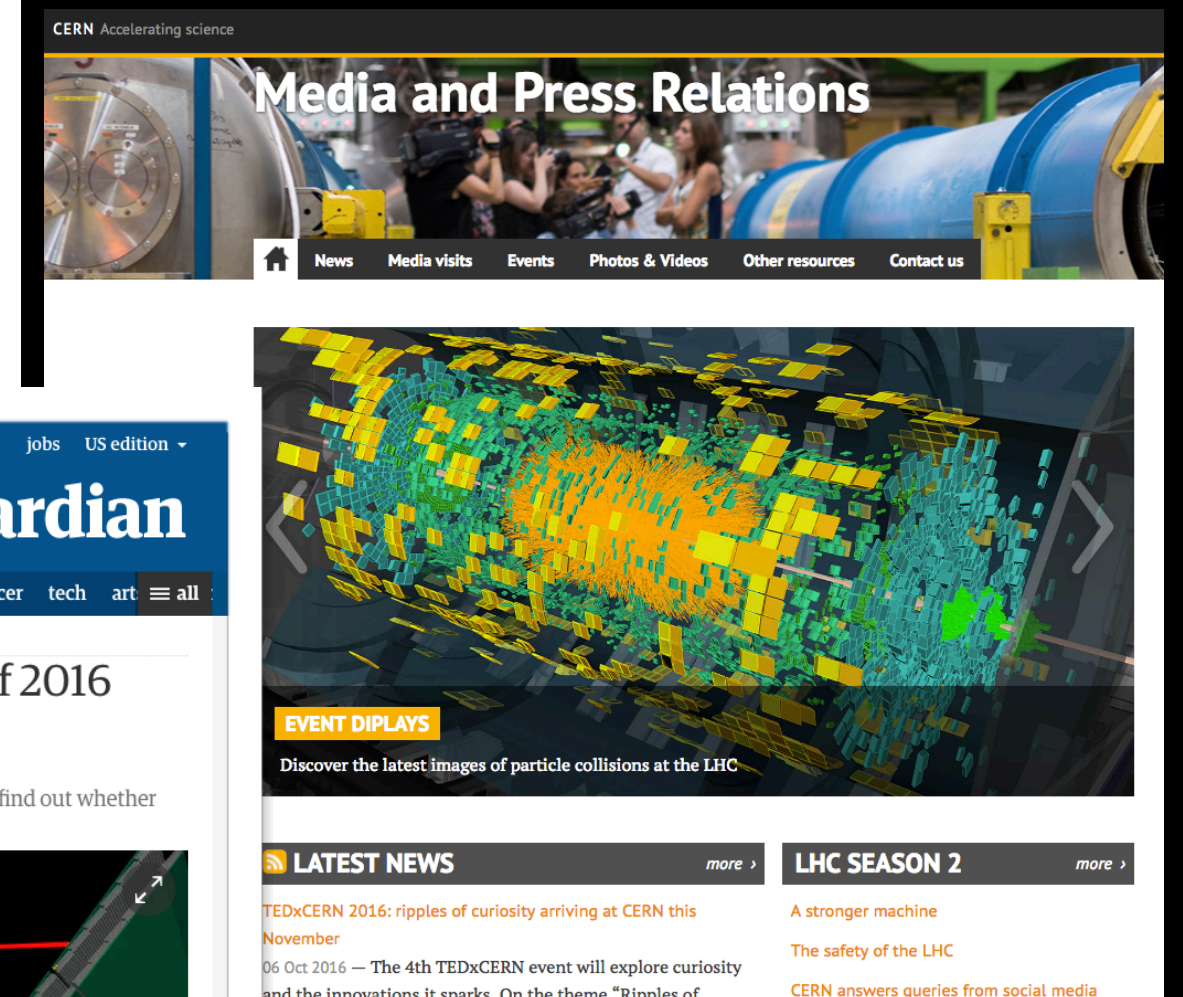
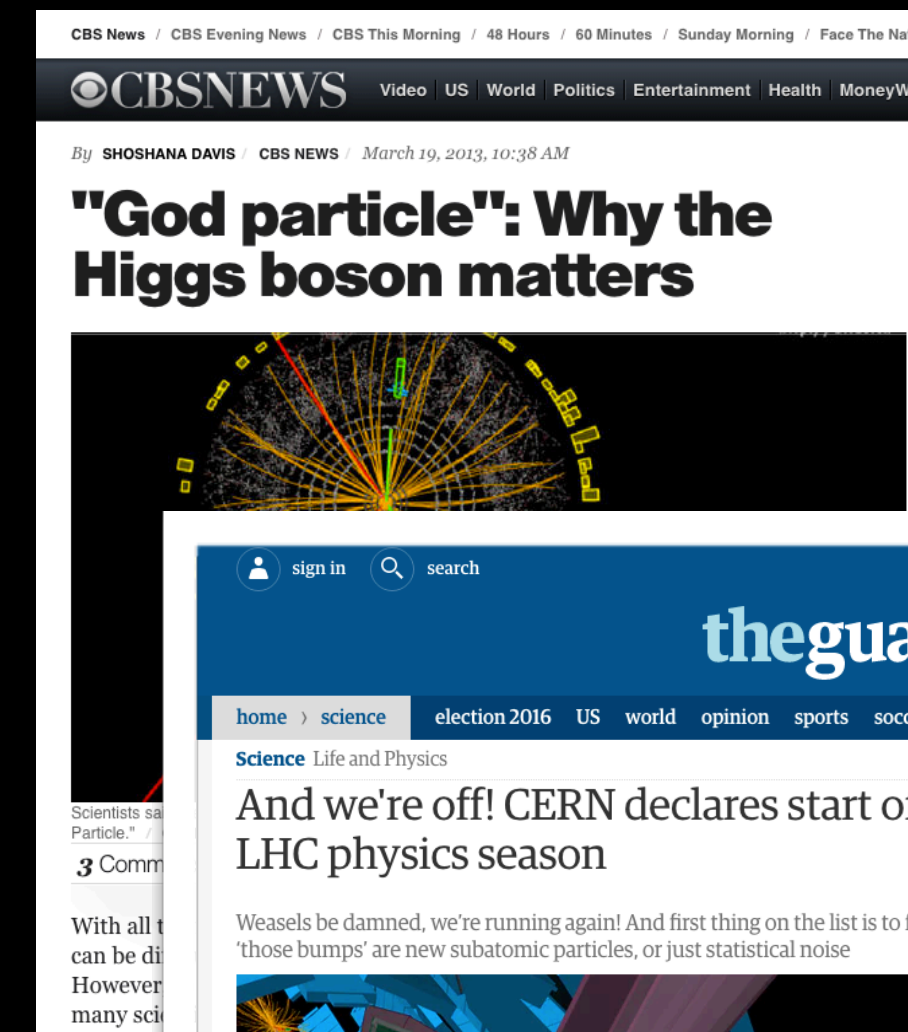
- Customised versions of **Atlantis** (Minerva and Hypatia) used in **masterclasses** for school students



- simplified XML files used for "**LHSee**" Android **app** and "**LHCsound**" **sonification** project



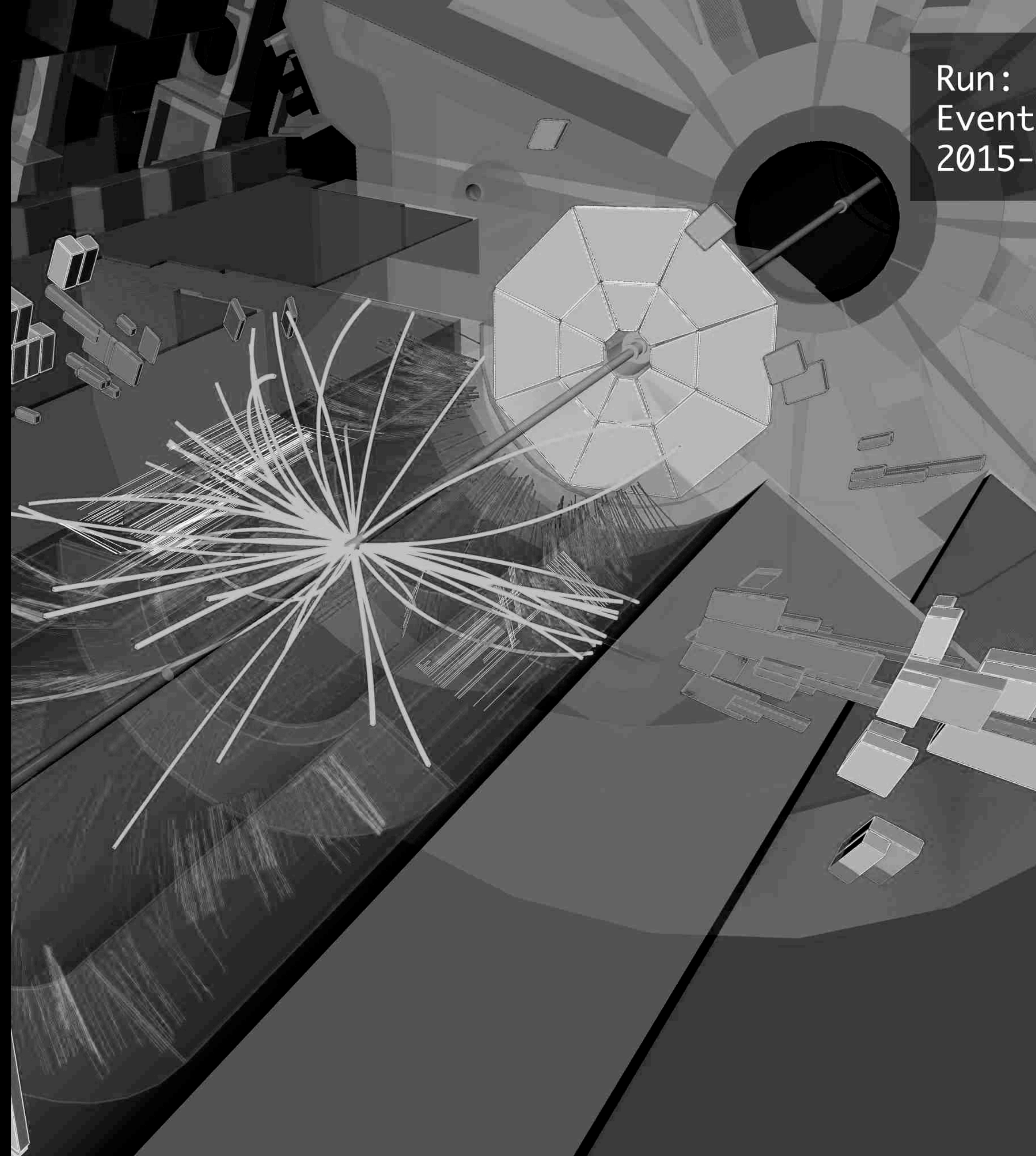
- **VP1** is used to produce images for **press releases**, **multimedia**, news, **textbooks**, **newspapers**





# Development

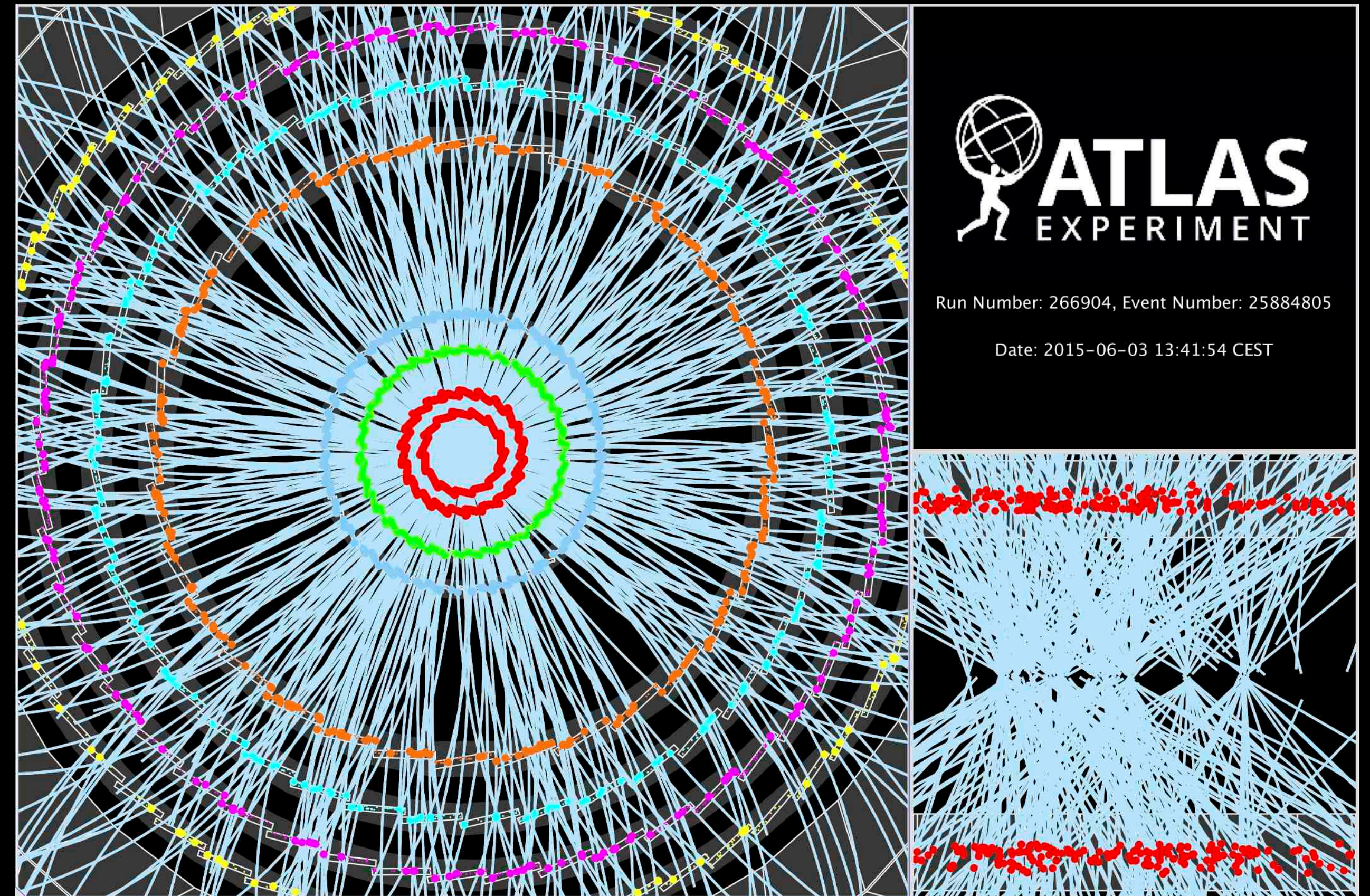
Run:  
Event  
2015-





# Atlantis: future development

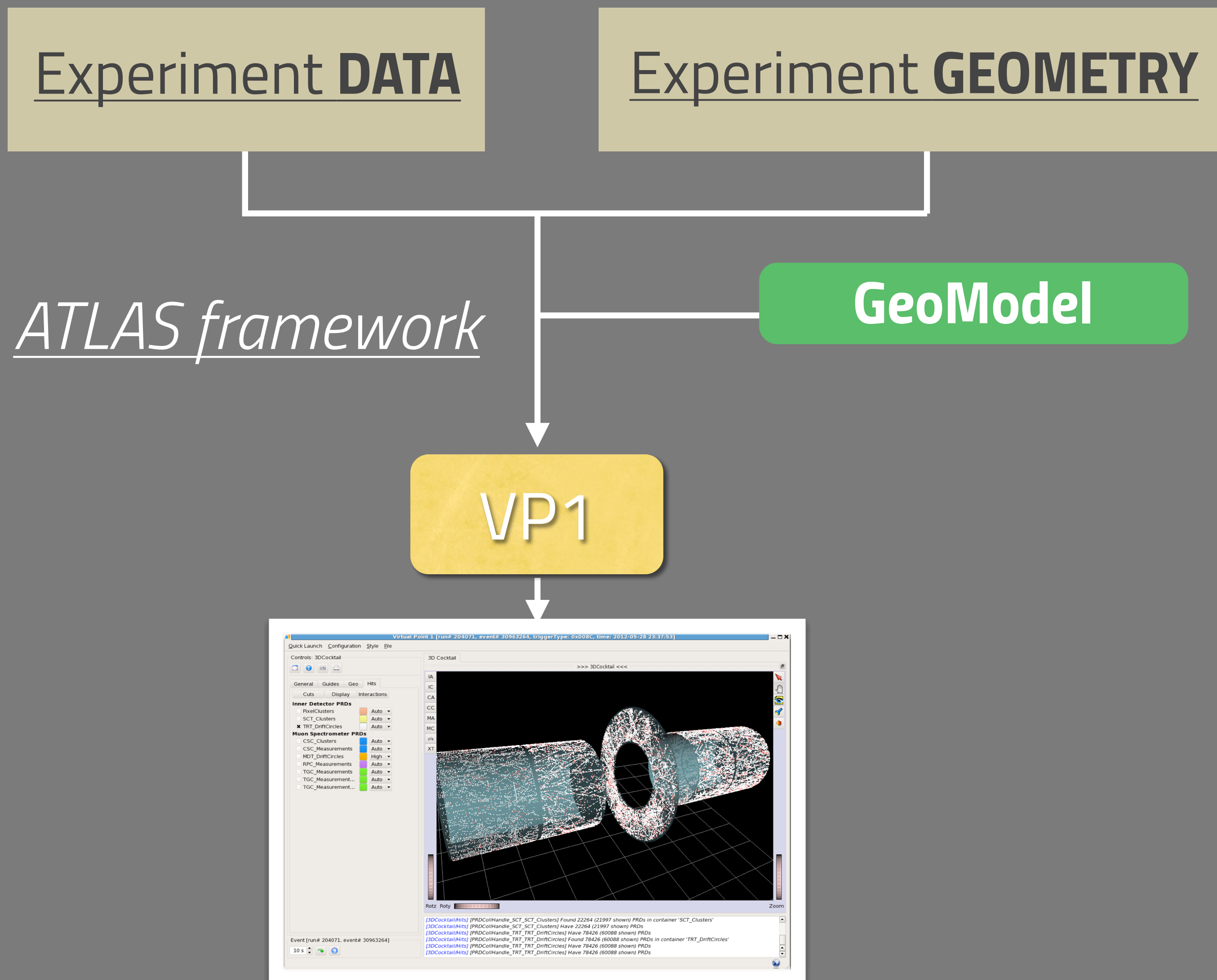
- Preparing for **higher luminosities**:
  - optimise display for **high pile-up**, i.e. events with  $\sim 120++$  vertices (e.g. colour coding vertex quality, improve display of trigger conditions and objects)
  - optimise **data format** and access:
    - designing **slim XML** files
    - test of **alternative formats** and access methods to the experiment's data
- Allow **full association** of detector hits through to final physics objects
- Smoother recovery of **single events** for **physics publications**. This is a common problem for both Atlantis and VP1



*high pile-up event in ATLAS*



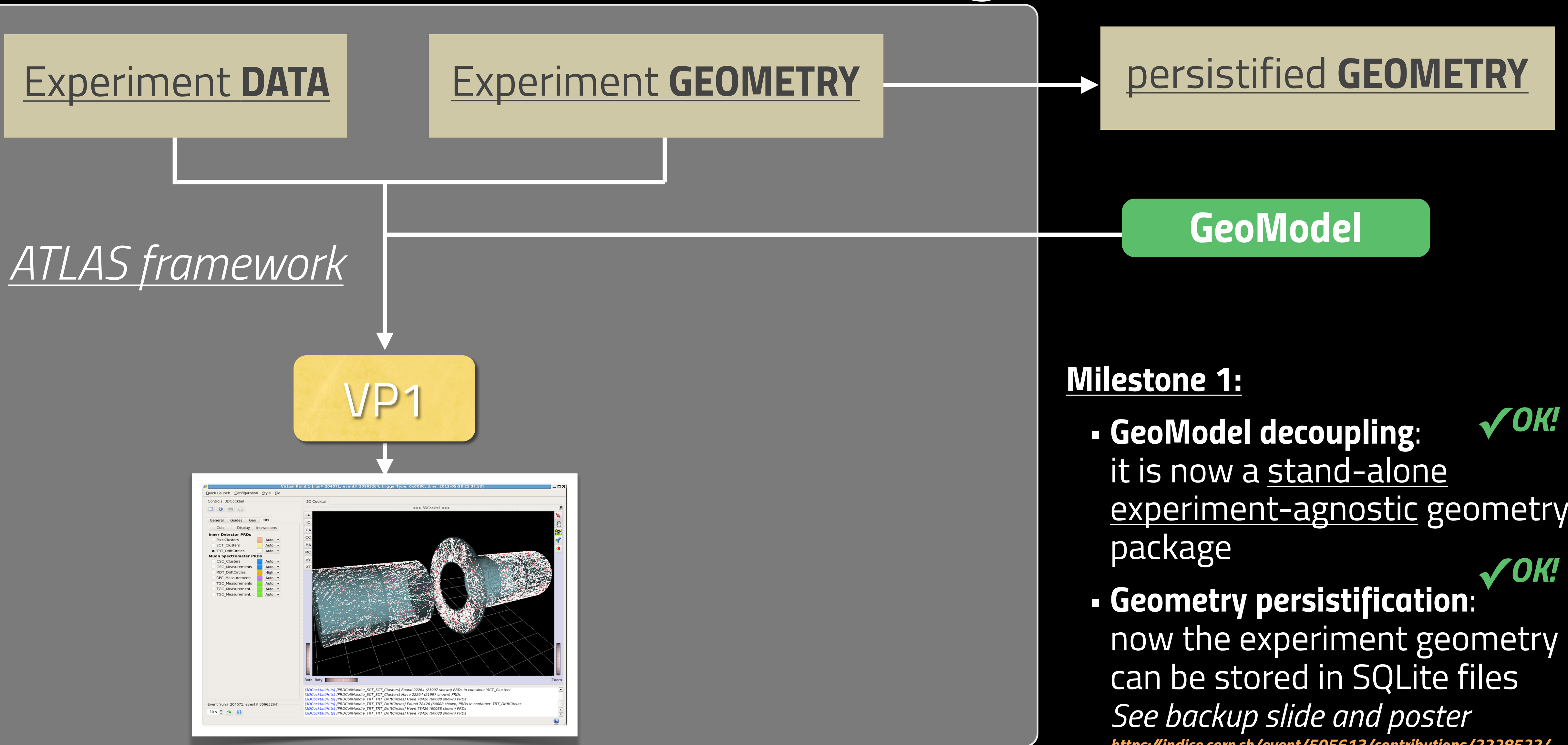
# Towards VP1Light



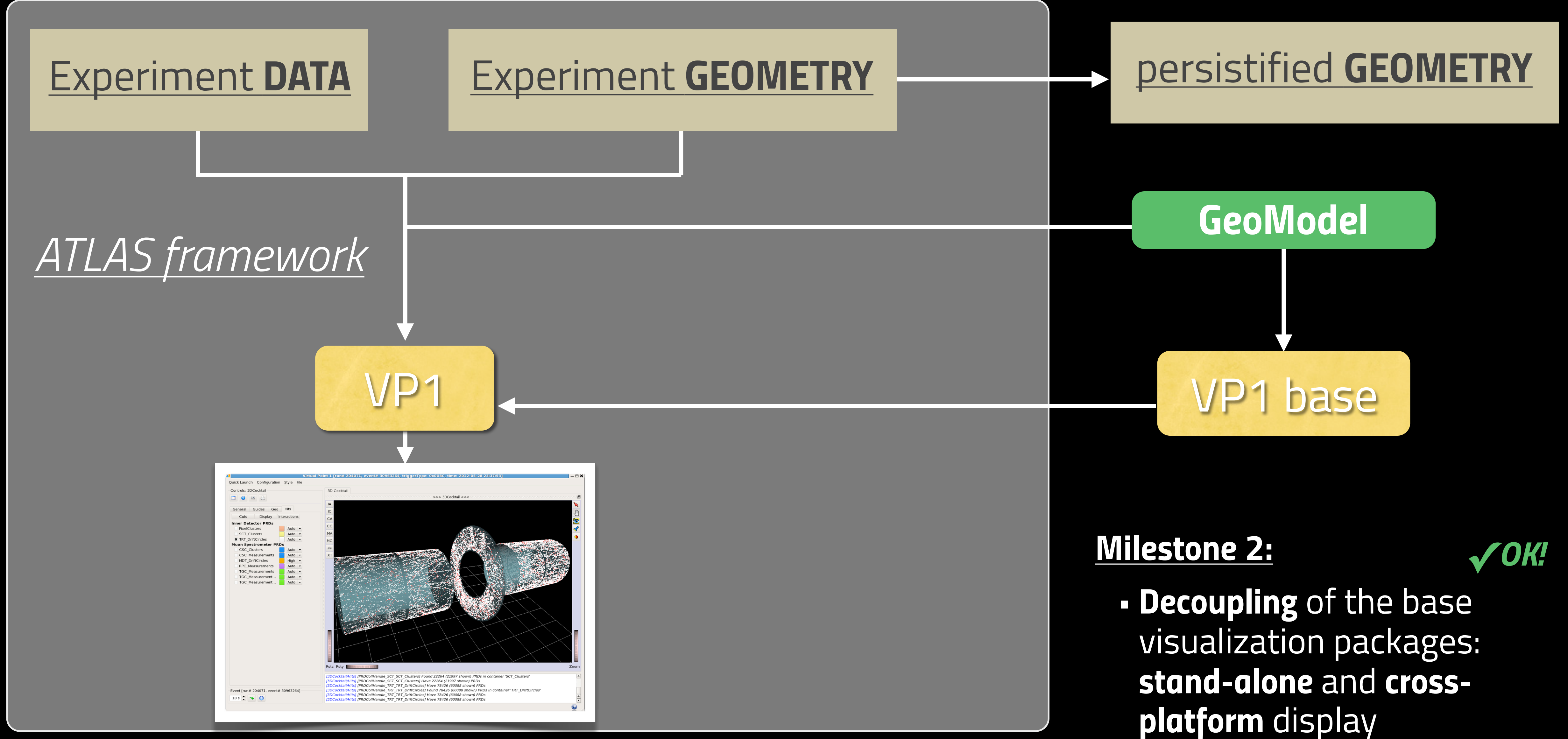
- Being part of the experiment framework, users **must run VP1** on **SLC6** machines
- Many users, specially for physics analysis, **wanted to run VP1** on **laptops**



# Towards VP1Light



# Towards VP1Light



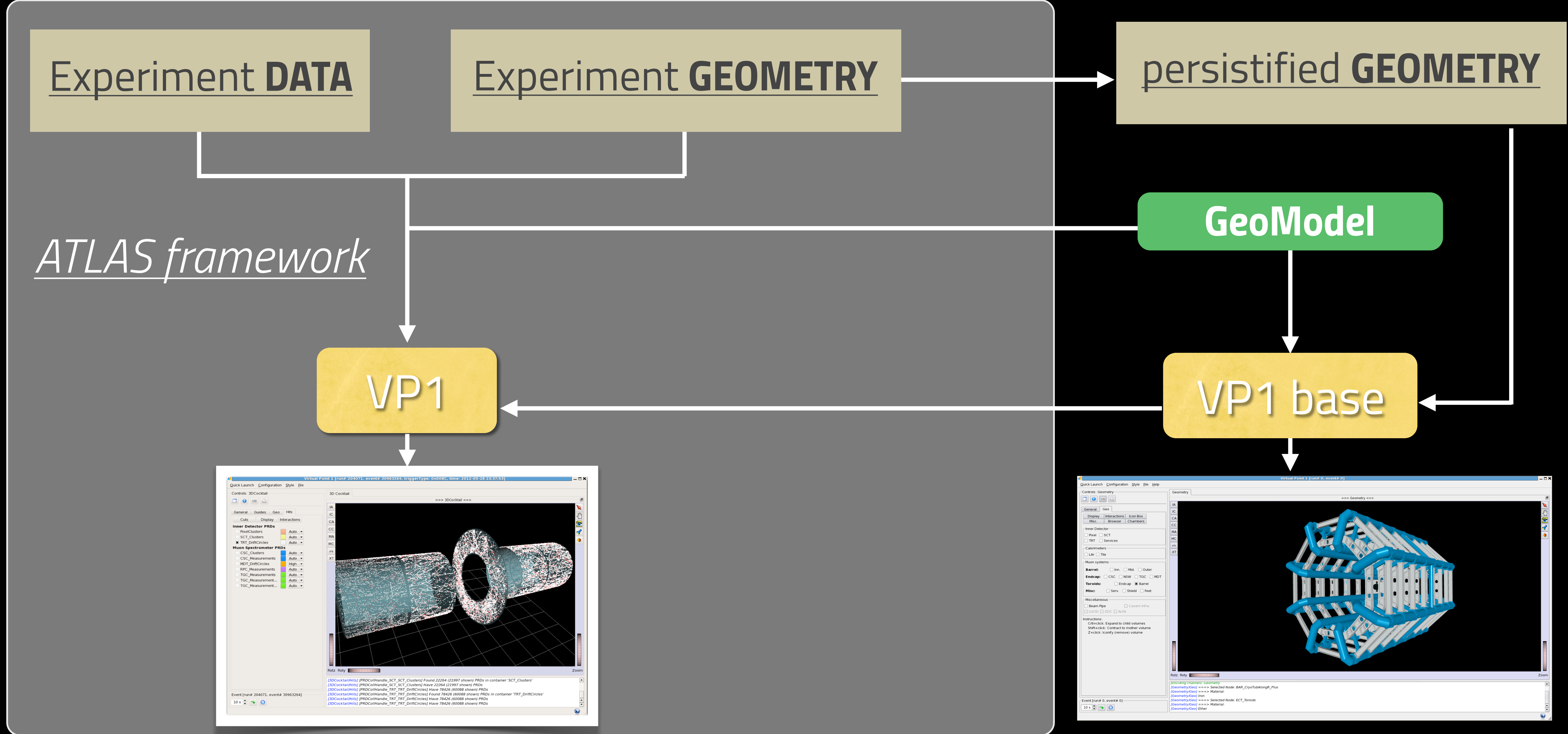
## Milestone 2:

✓OK!

- **Decoupling** of the base visualization packages: **stand-alone** and **cross-platform** display



# Towards VP1Light





# Other event displays in ATLAS

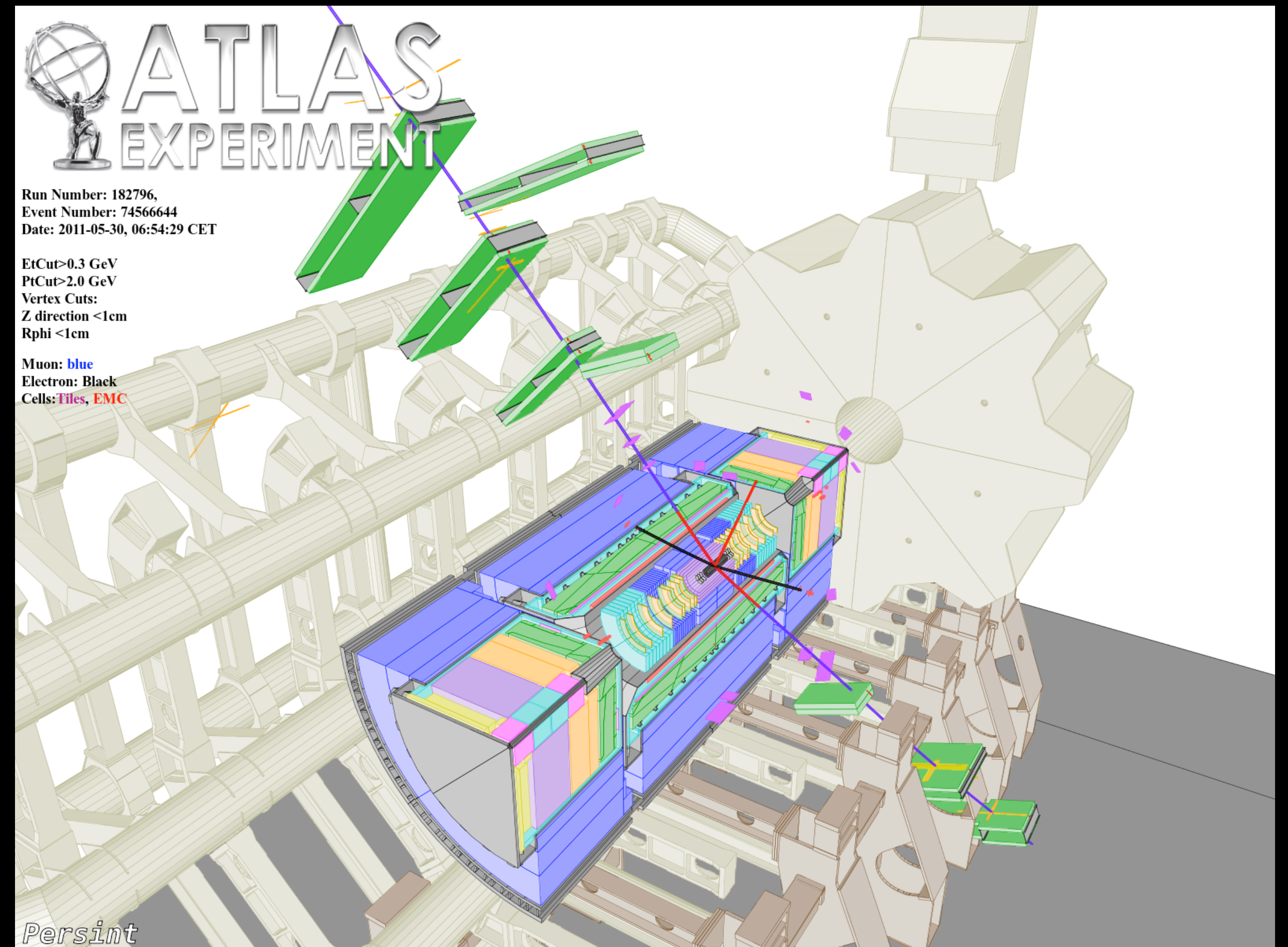




# Other ATLAS event display tools

Desktop app

- **Persint** – **fortran**-based, 2D/3D tool specialized for Muon/Tracks; no longer actively developed





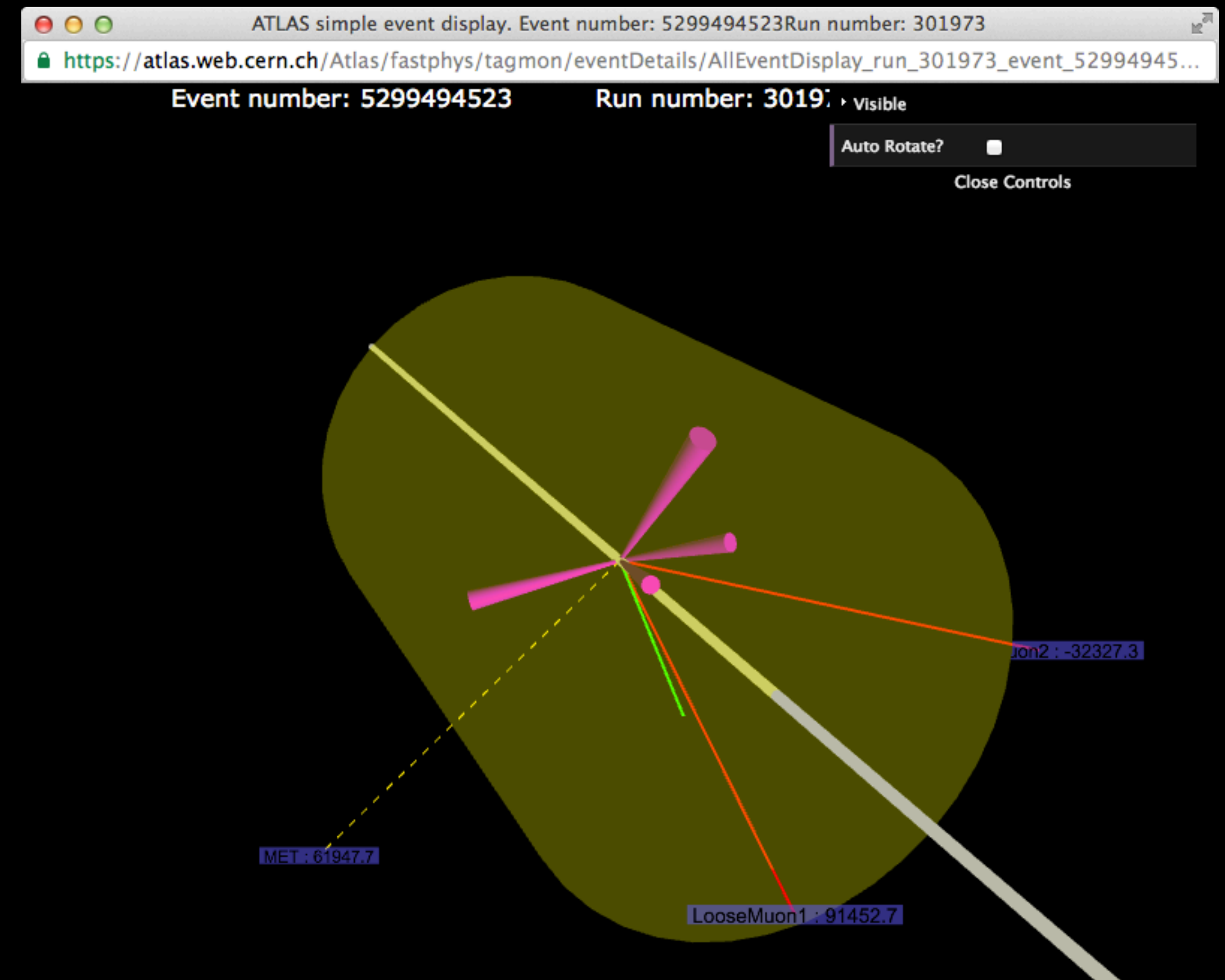
# Other ATLAS event display tools

Desktop app

- **Persint** – **fortran**-based, 2D/3D tool specialized for Muon/Tracks; no longer actively developed

Web apps

- **TADA display** – light-weight **WebGL** display for fast online analysis; under development





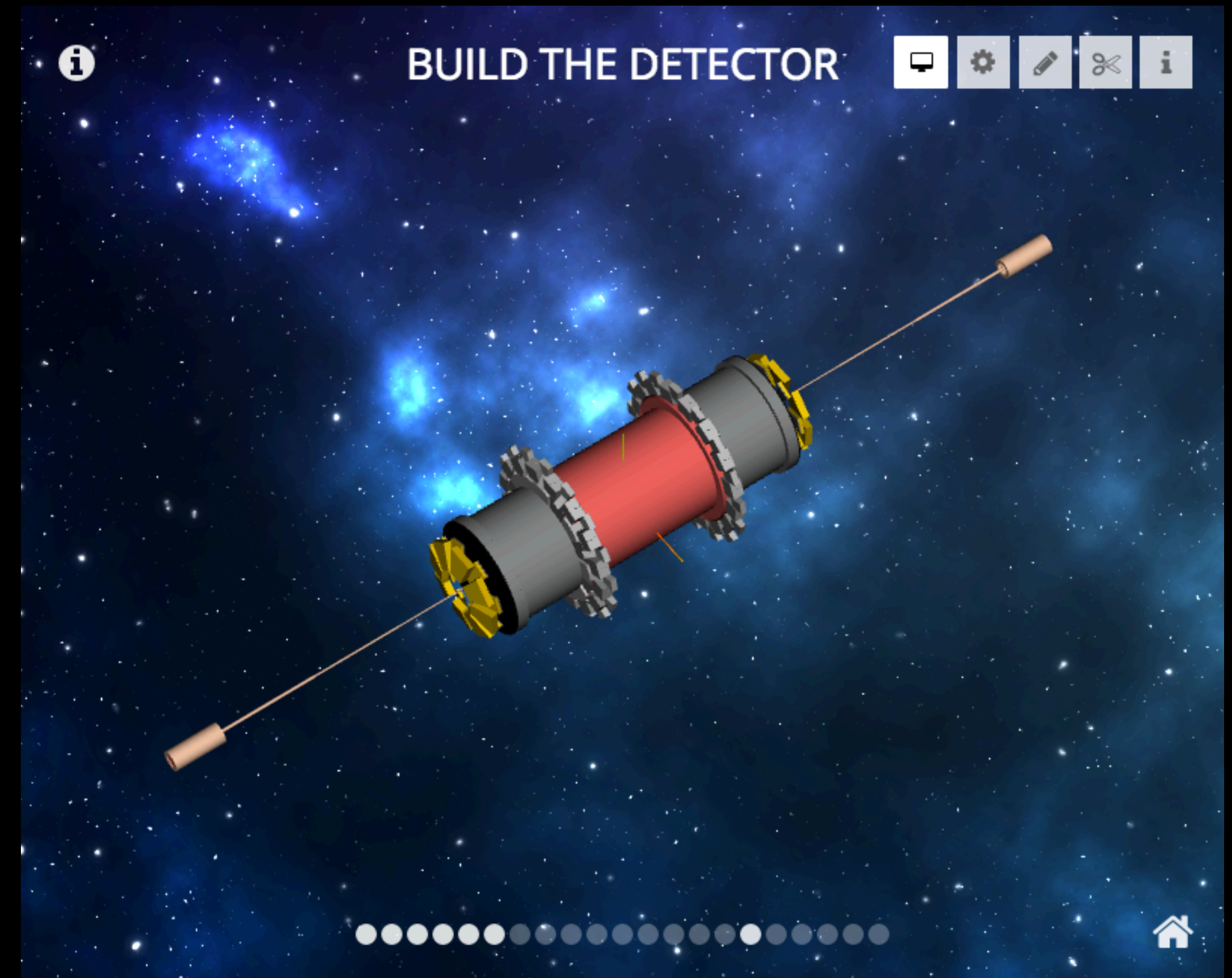
# Other ATLAS event display tools

Desktop app

- **Persint** – fortran-based, 2D/3D tool specialized for Muon/Tracks; no longer actively developed

Web apps

- **TADA display** – light-weight **WebGL** display for fast online analysis; under development
- **ATLAS Tracer** – **WebGL** viewer for outreach/educational programs; under development

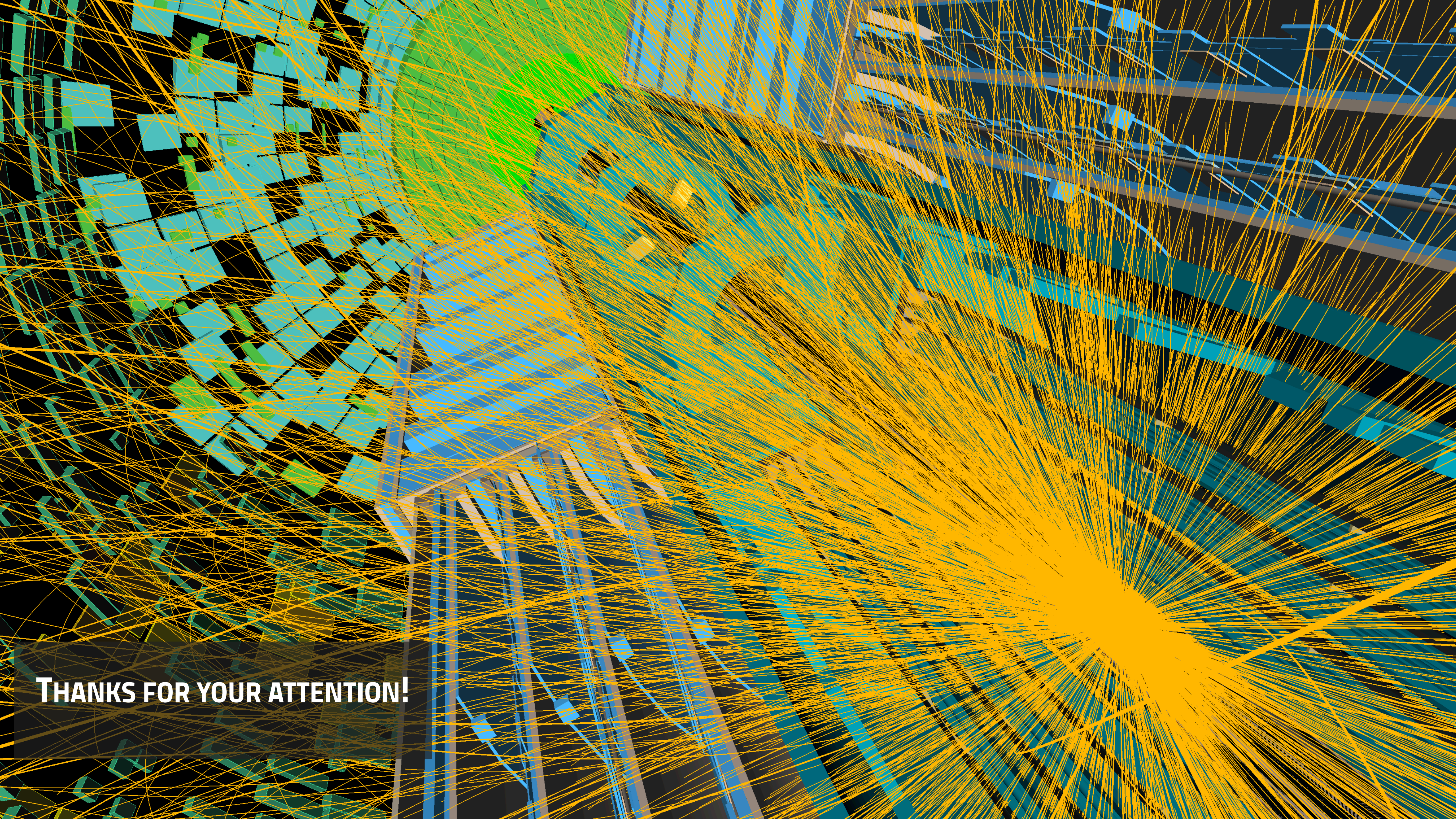




# References

- Public ATLAS event displays:  
<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/EventDisplayPublicResults>
- ATLAS event display software tools:  
<https://twiki.cern.ch/twiki/bin/view/AtlasComputing/EventDisplays>
- Atlantis: <http://atlantis.web.cern.ch/>
- VP1:
  - <http://atlas-vp1.web.cern.ch/>
  - [https://inspirehep.net/record/859441/files/jpconf10\\_219\\_032012.pdf](https://inspirehep.net/record/859441/files/jpconf10_219_032012.pdf)
- ATLAS Live event display: <http://atlas-live.cern.ch/>





**THANKS FOR YOUR ATTENTION!**



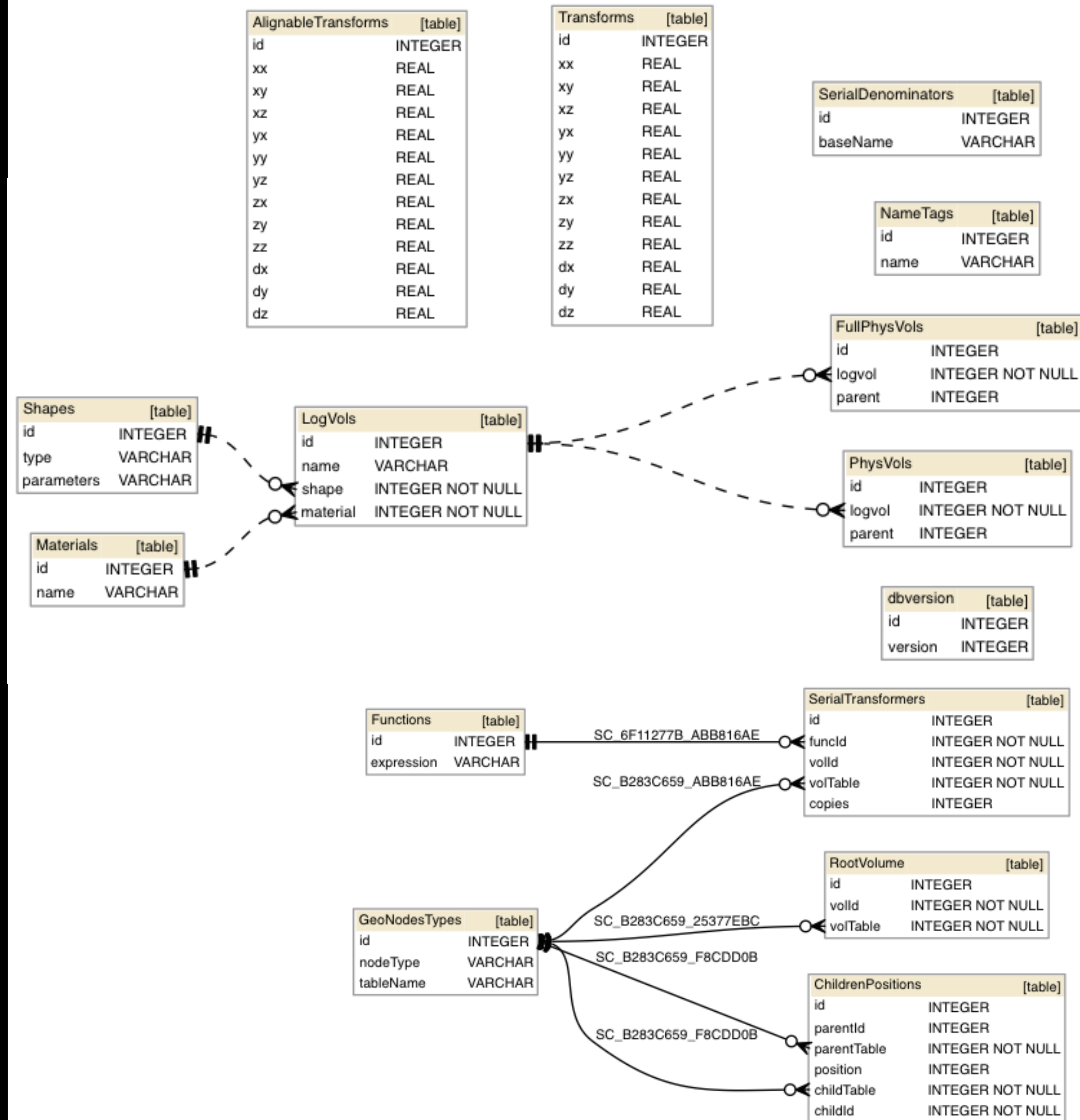
# backup slides



# Geometry persistification

## ■ MILESTONE 1 - GeoModel persistification

- persistification of the ATLAS detector geometry, to keep VP1 ability to show the **actual ATLAS geometry**
- **DONE!** GeoModel is now a stand-alone and experiment-agnostic detector description and geometry package
- See **poster** on “**Geometry persistification**” in the poster session (<https://indico.cern.ch/event/505613/contributions/2228522/>)





Atlantis

**Pro**

stand-alone, it runs on all platforms

**Cons**

cannot access ATLAS data directly, it needs an extra layer (XML)

VP1

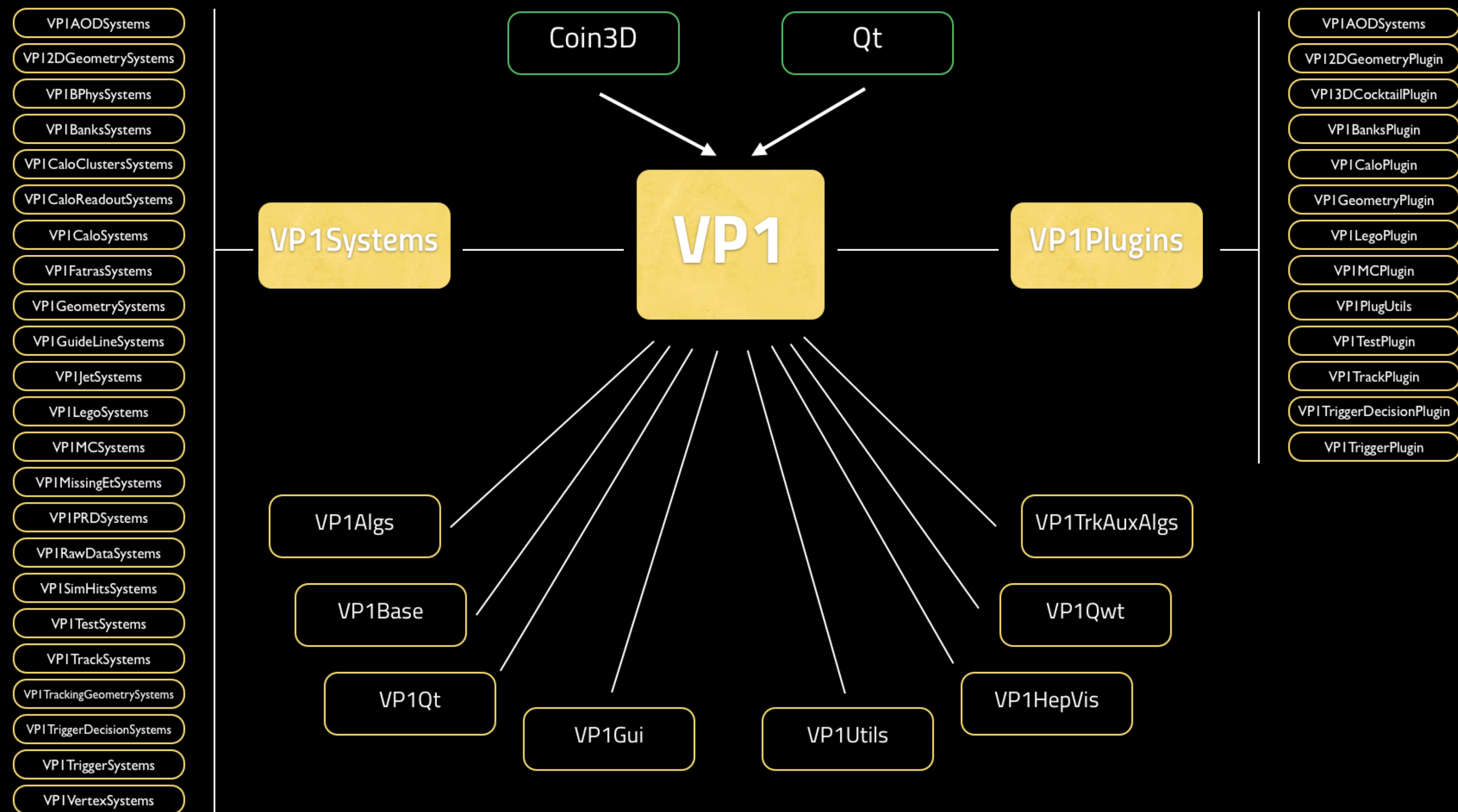
**Pro**

being part of ATLAS Core SW, it can access all ATLAS data

**Cons**

...being part of the ATLAS Core SW, it can run only on SLC platforms!





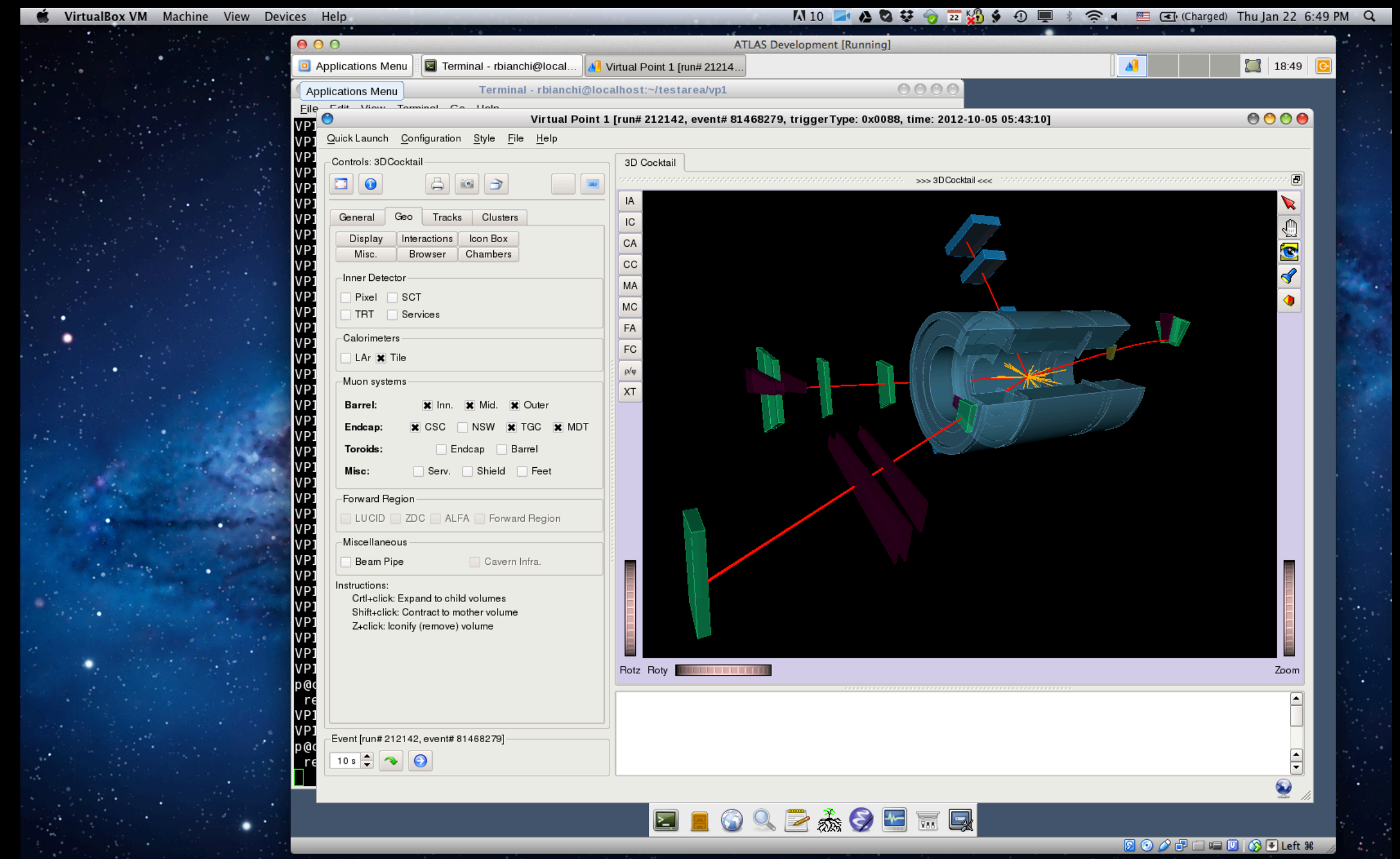
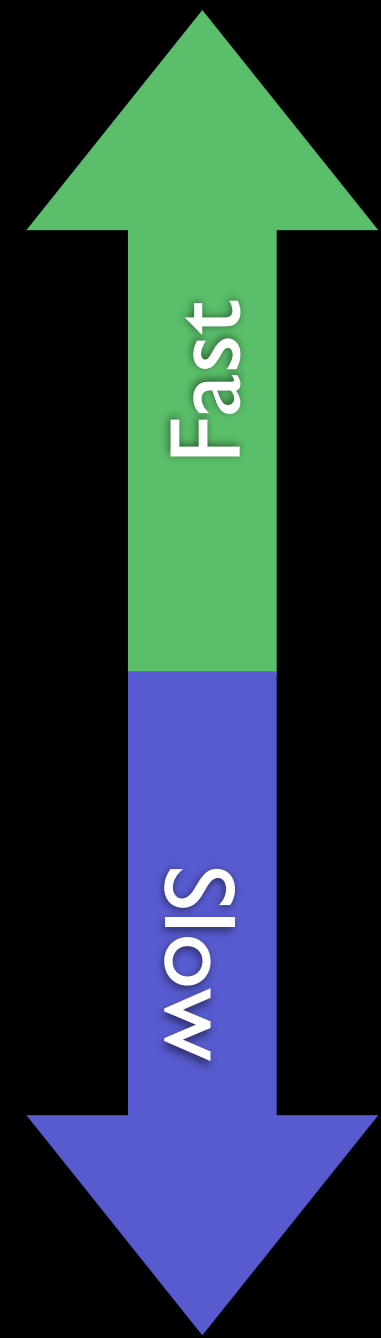
VP1

- part of the ATLAS Core SW
- input data: all ATLAS data files, services and DBs
- C++-based framework

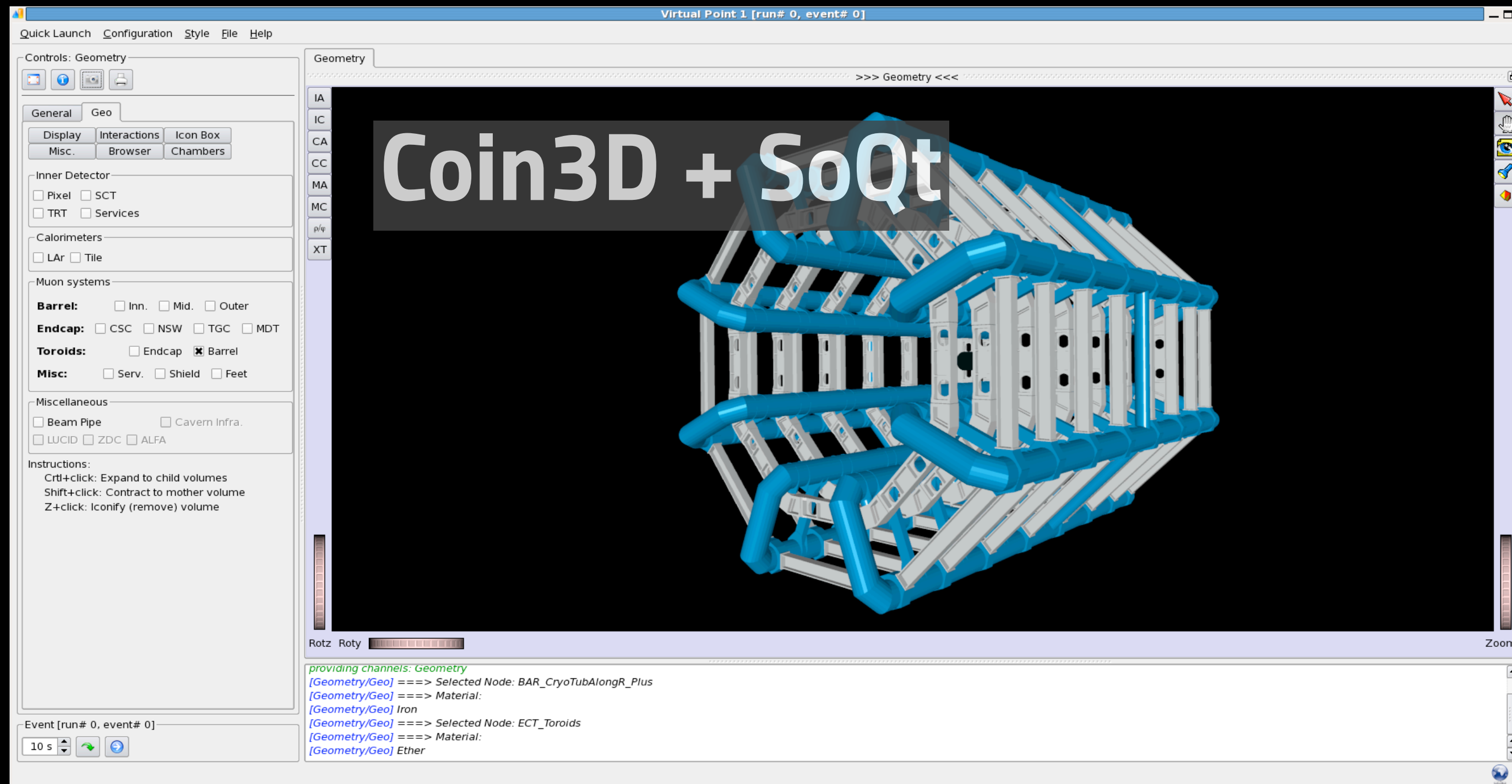


# How to run VP1

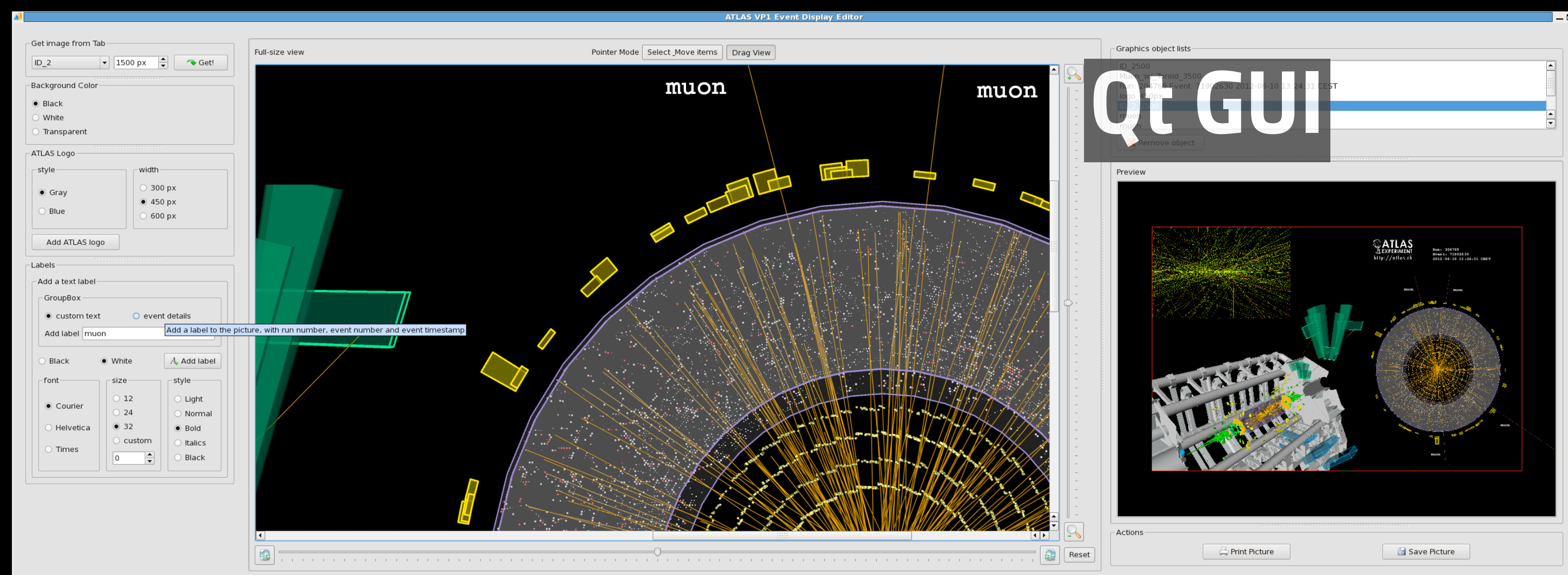
- Best ways to run VP1:
- on a local SLC6 machine
  - in a virtual machine
  - remotely, Ethernet cable
  - remotely, Wi-Fi







- part of the ATLAS Core SW
- input data: all ATLAS data files, services and DBs
- C++-based framework
- Coin3D/OpenInventor (3D engine) + Qt (GUI) + SoQt (glue package)





# VP1: graphics engines

- VP1 uses Coin3D, an OpenInventor clone, powerful and easy to use, but it is getting older.
- Not easy to find a replacement engine. We would like:
  - **open source**
  - “**scene graph**” architecture
  - **mature** and **stable** library
  - durable **maintenance**, with quite **large user base**
- **OpenSceneGraph** looks promising, but actual development activity is not clear
- **Qt3D** is very interesting, combining 3D and GUI in a single package; but it is still in a early development phase, and it is not clear if it will be further developed.
- Other graphics engines are used in academics, especially in medicine and chemistry, like **Paraview/KitWare**, but they are not ‘scene graph’ based.
- **Game engines**, like UnrealEngine or Unity, let us build 3D scenes easily; but it is hard to use ATLAS software with them. They need more tests.



# VP1 technology

- VP1 and VP1-Light
  - 3D graphics: Coin3D/OpenInventor (OpenGL)
  - SoQt as glue package: it let use Coin3D inside a Qt widget
  - Qt for the GUI:
    - 4.8 for VP1 (we are tied to the version used by LCG)
    - 5.7 for the stand-alone VP1-Light
  - Build engine:
    - CMT/CMake for VP1
    - QMake for VP1-Light --> we will move to CMake soon



## Atlantis

- stand-alone application
- Java-based package
- aimed at visualizing physics objects for physics analysis
- input files: custom XML files generated from ATLAS ESD/AOD files (*with JiveXML pkg*)
- it shows a simplified ATLAS geometry
- 2D graphics

## Persint

- stand-alone application
- Fortran-based package
- aimed at Muon/Tracks visualization
- input files: custom XML files generated from RAW and ESD files
- it shows the real ATLAS geometry
- 2D and 3D graphics
- **no current active development**

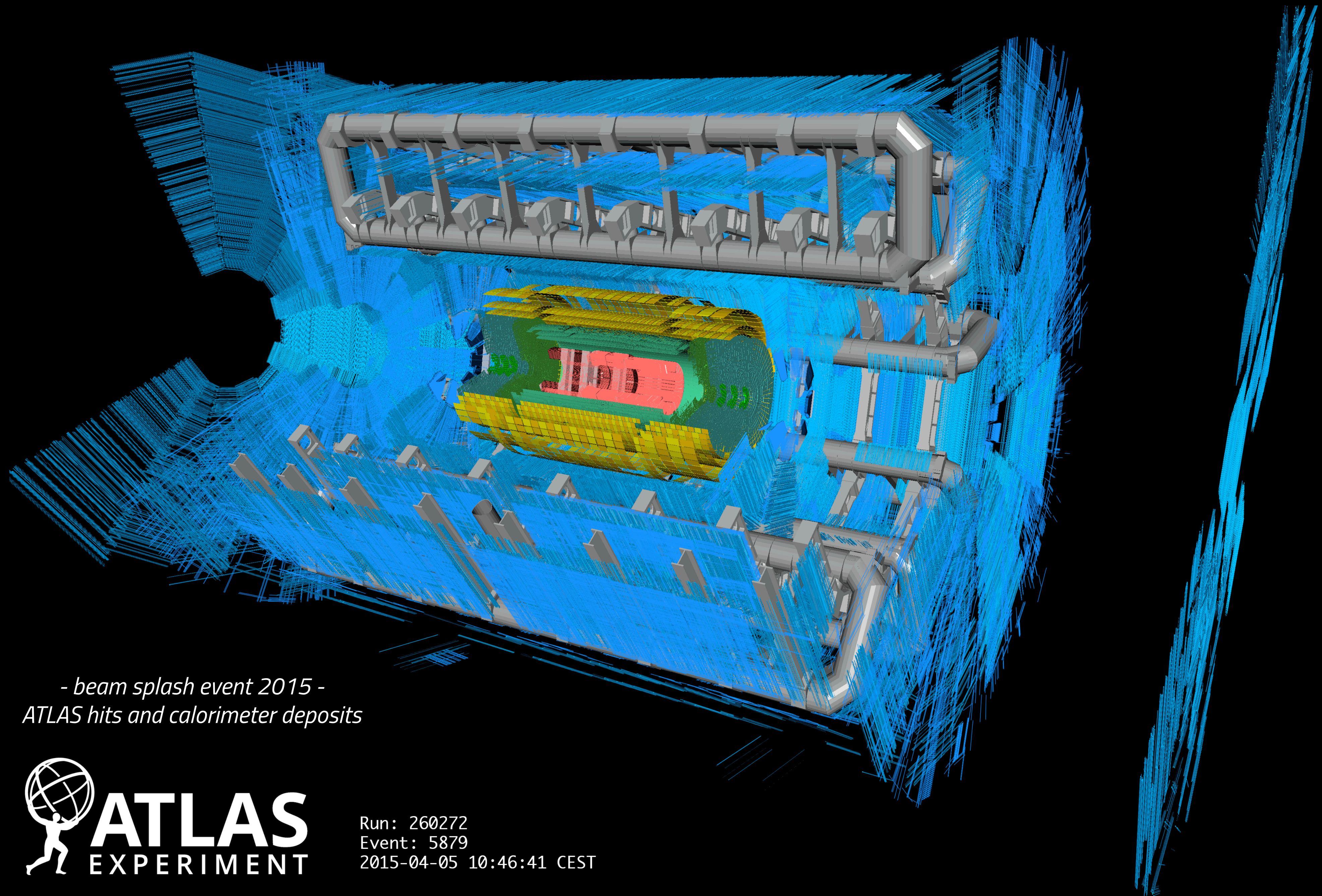
## VP1

- part of the ATLAS Core SW
- C++-based framework
- general purpose tool: analysis, geometry, simulation
- input data: all ATHENA data files (RAW,ESD,EVNT,HITS...), services and DBs
- it shows the actual ATLAS geometry
- 2D and 3D graphics



# **sources and additional images**





- beam splash event 2015 -  
ATLAS hits and calorimeter deposits



Run: 260272  
Event: 5879  
2015-04-05 10:46:41 CEST





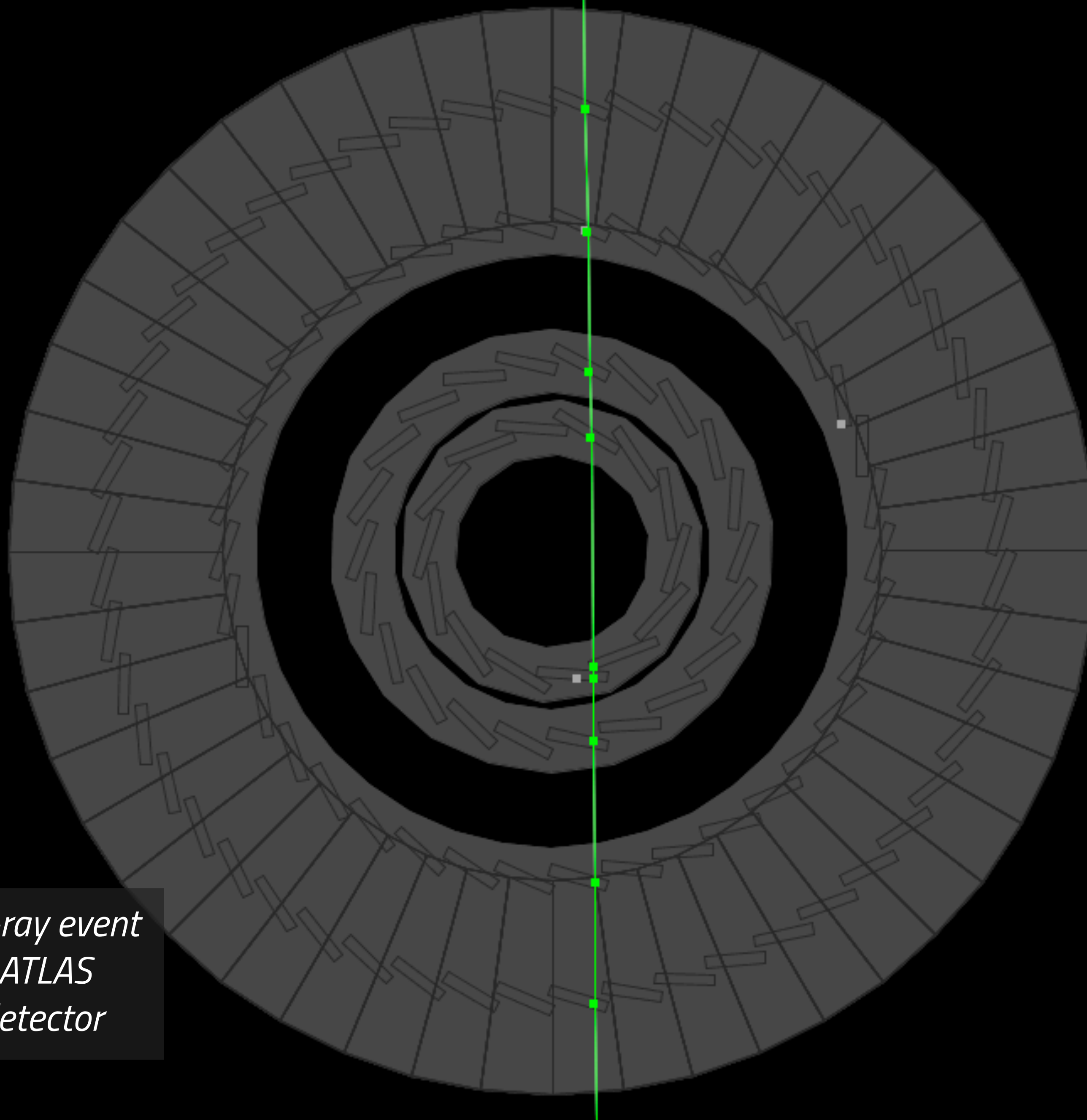
*live event display  
in the ATLAS  
control room*



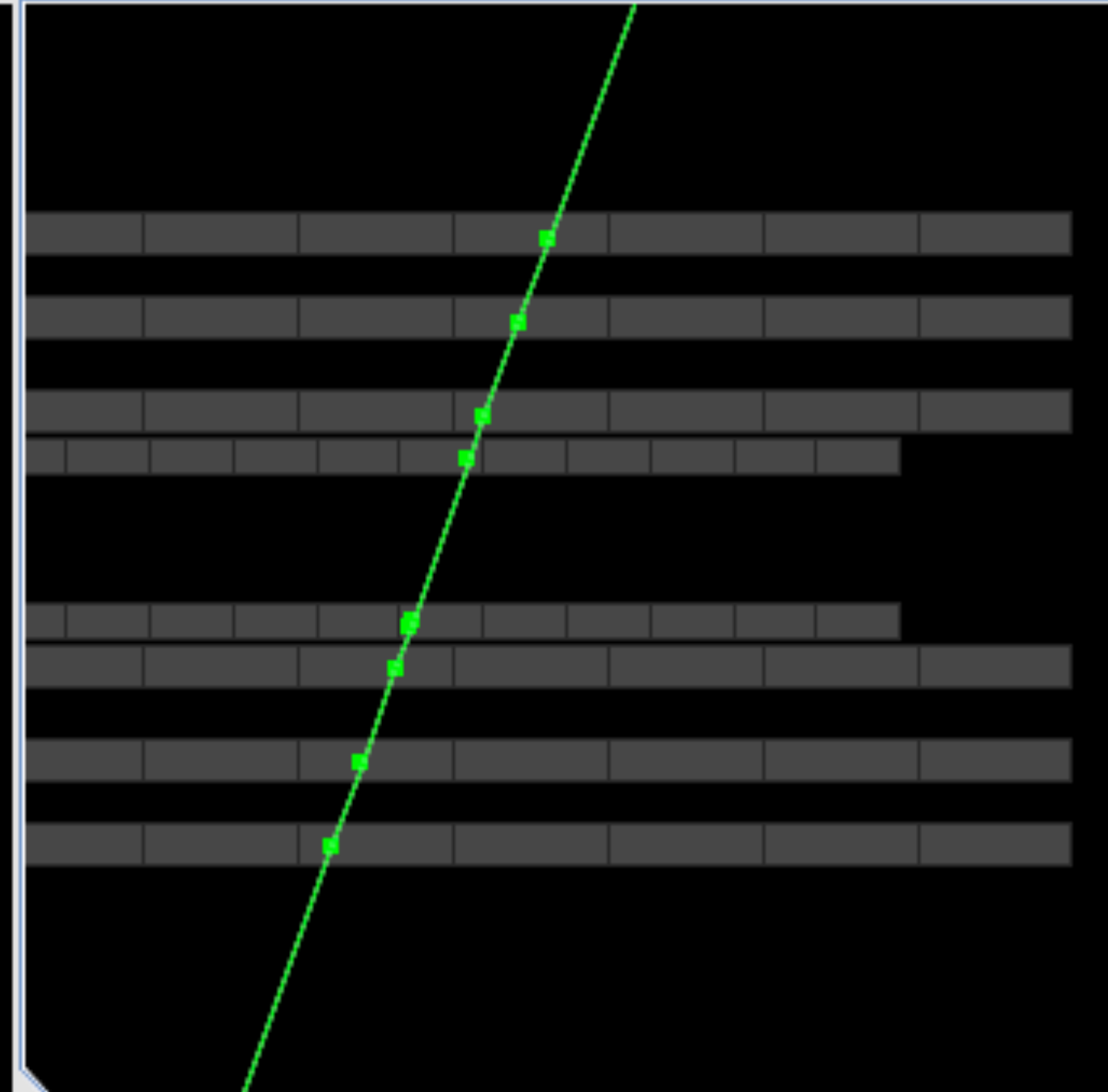
*a pile-up event  
in the ATLAS  
beam pipe*

Run: 296942  
Event: 34013839  
2016-04-23 10:51:30 CEST





*a cosmic-ray event  
in the ATLAS  
inner detector*



Run Number: 248371, Event Number: 492191

Date: 2014-12-07 23:56:30 CET

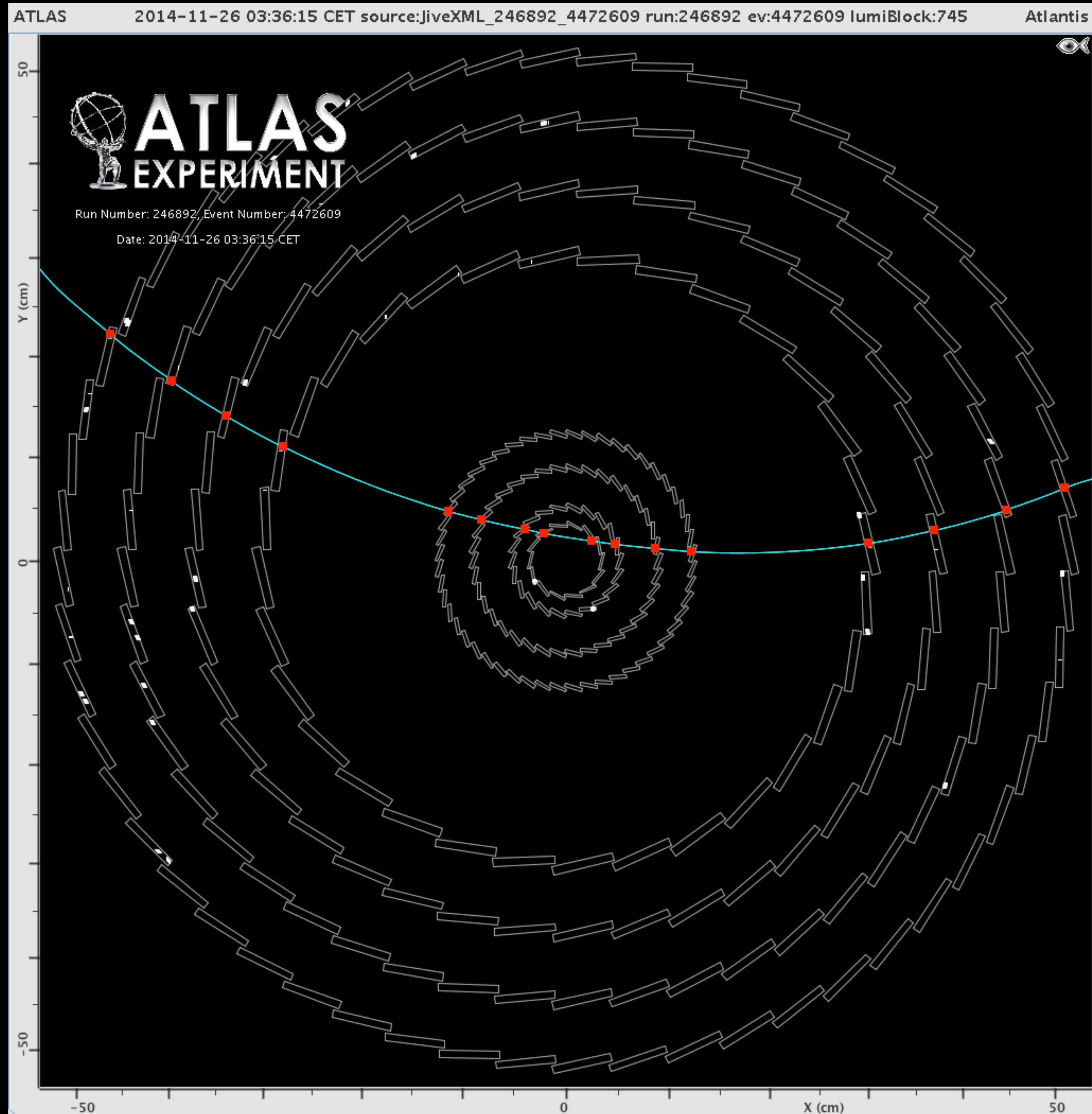




Run: 286665  
Event: 419161  
2015-11-25 11:12:50 CEST

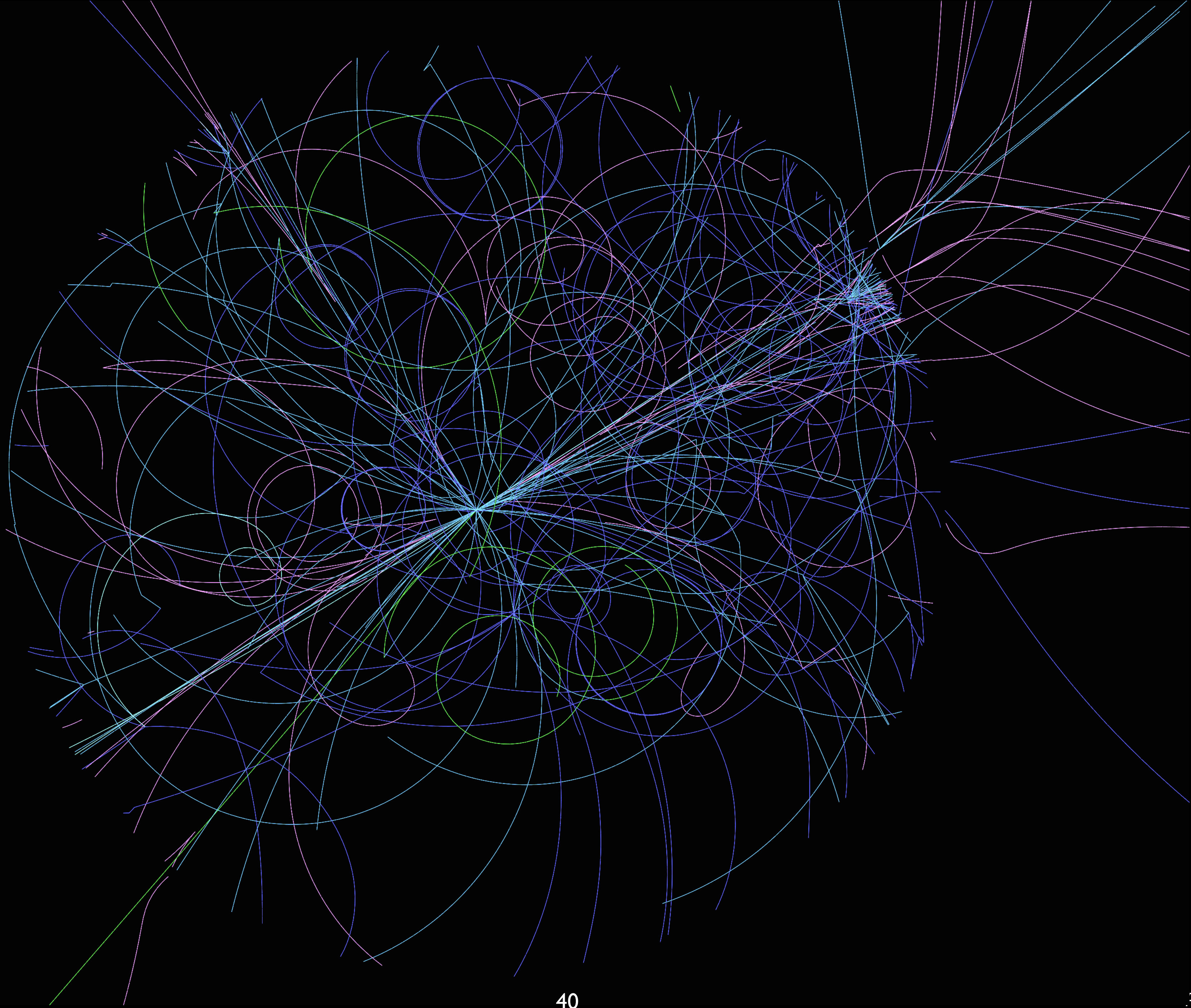
first stable beams heavy-ion collisions





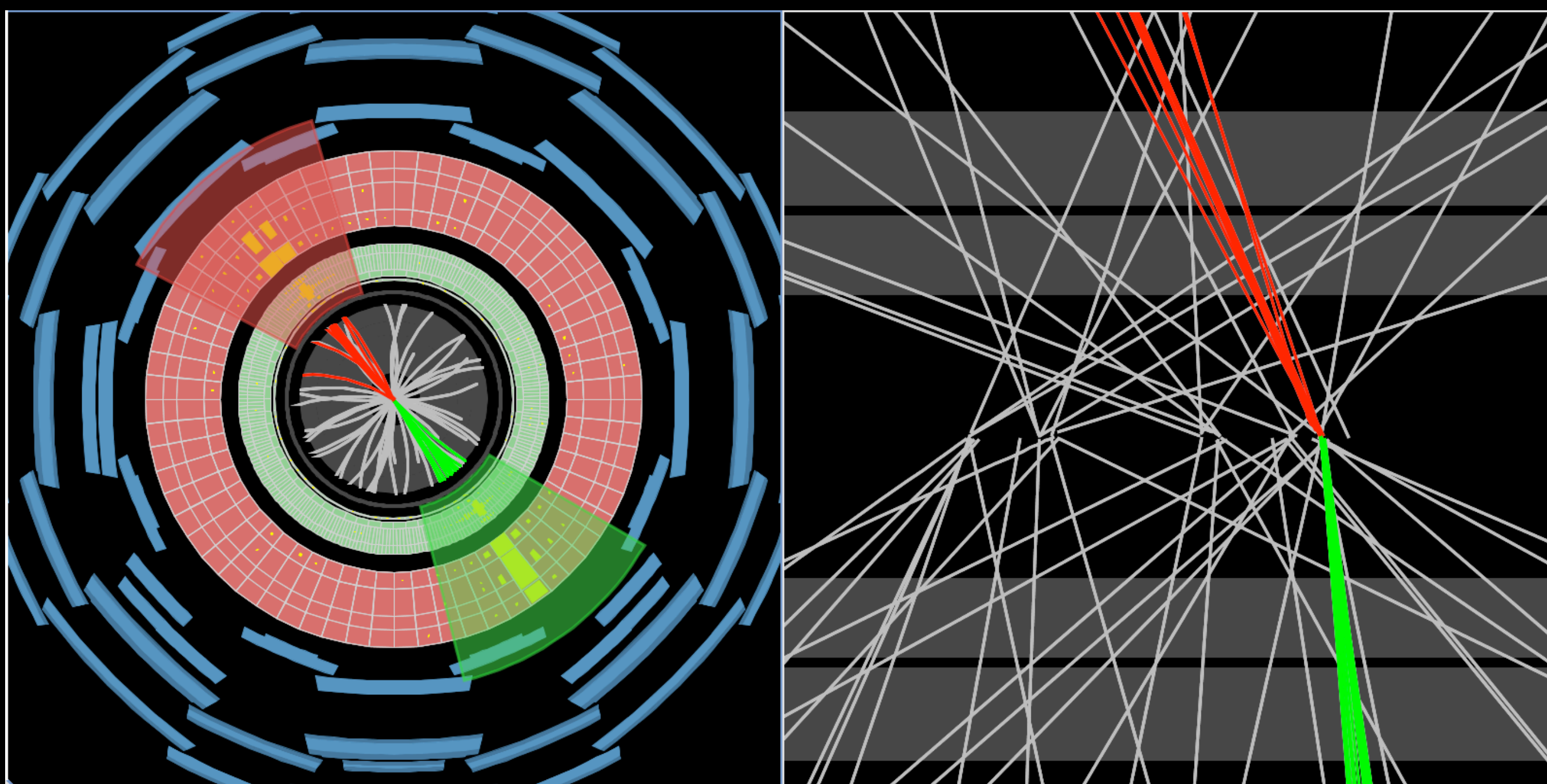
*a cosmic-ray event  
in the ATLAS  
inner detector*





*ATLAS simulation*

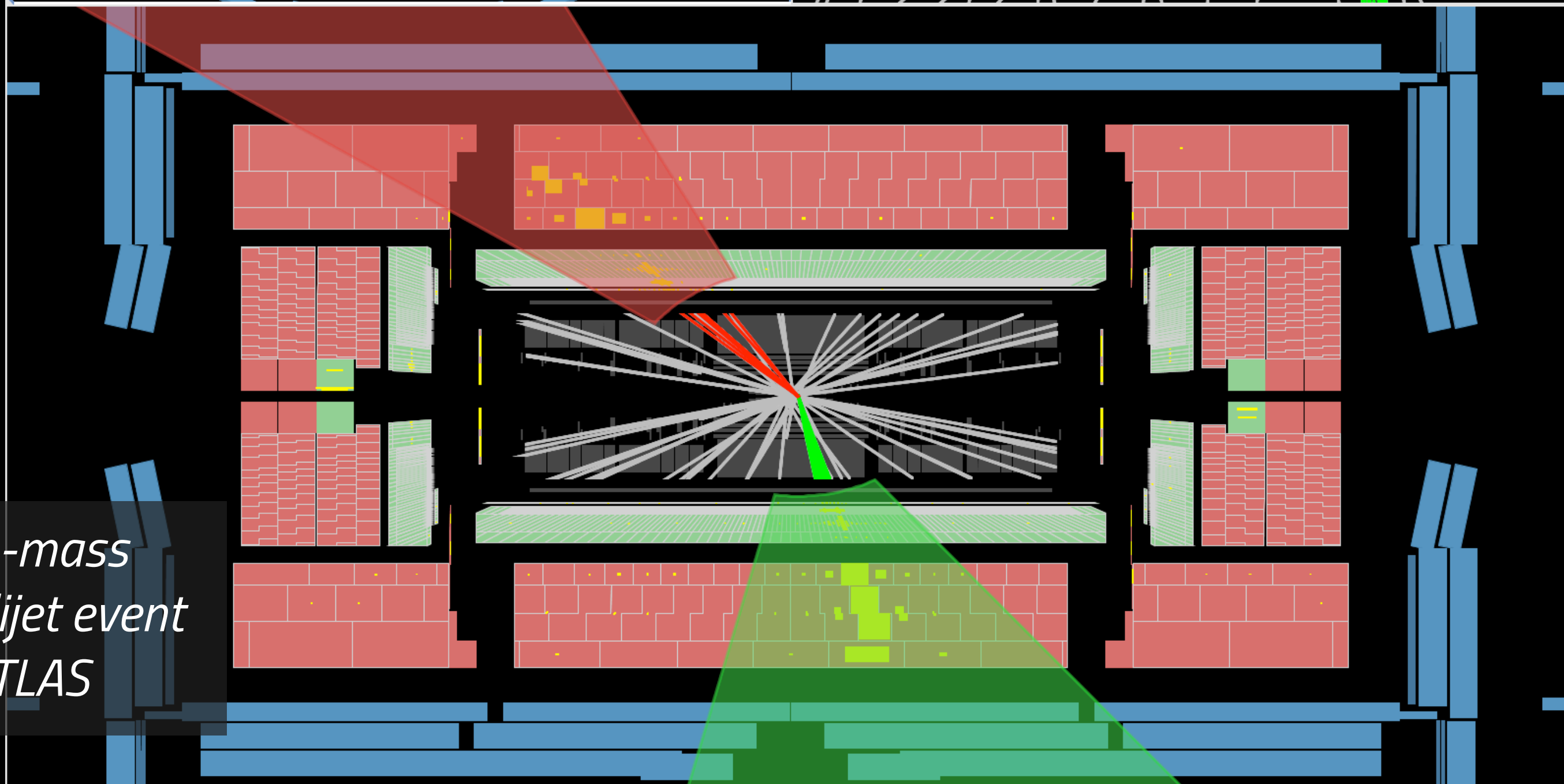




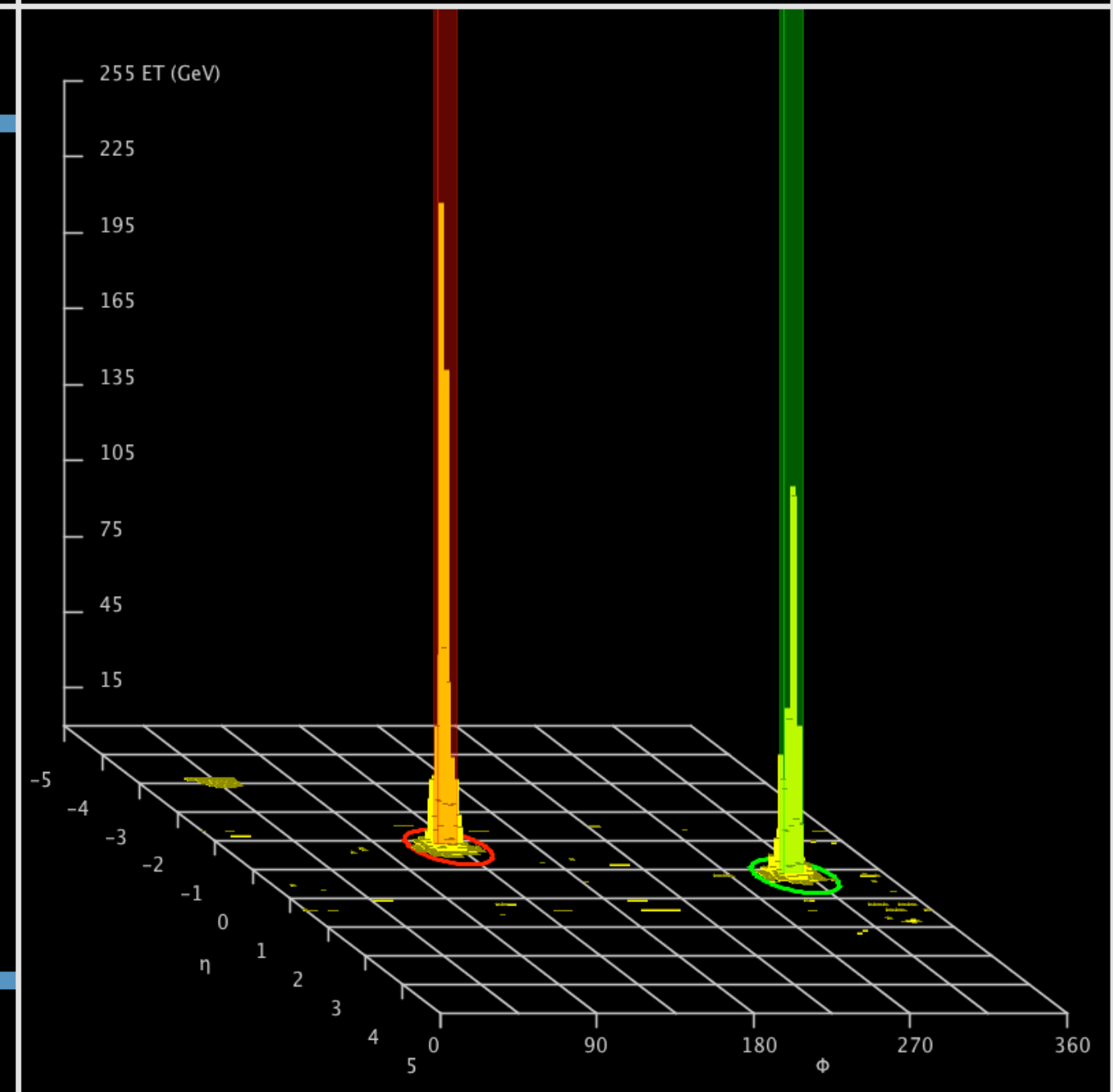
**ATLAS**  
EXPERIMENT

Run Number: 271298, Event Number: 403602858

Date: 2015-07-11 02:09:14 CEST

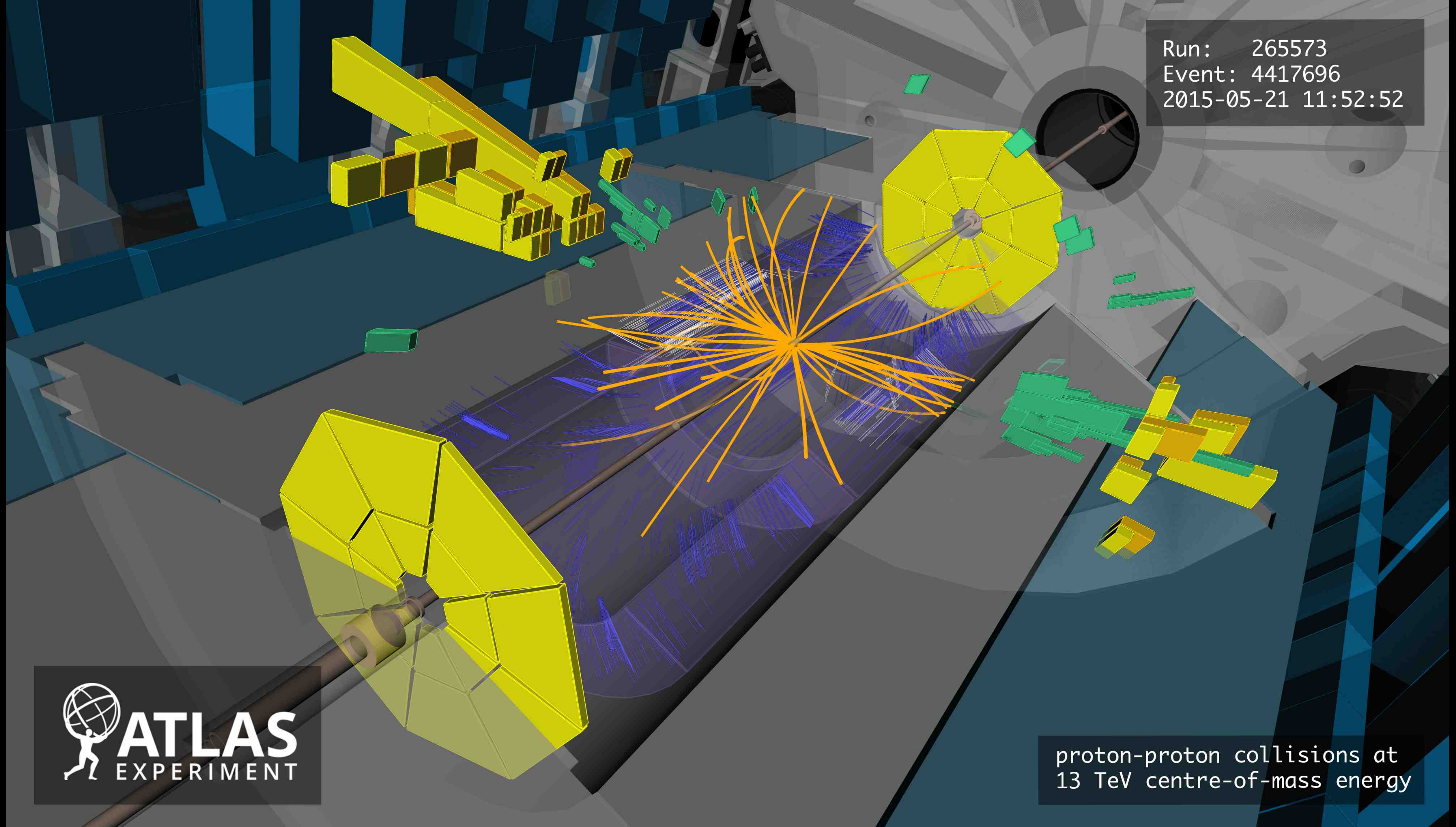


*a high-mass  
central dijet event  
in ATLAS*



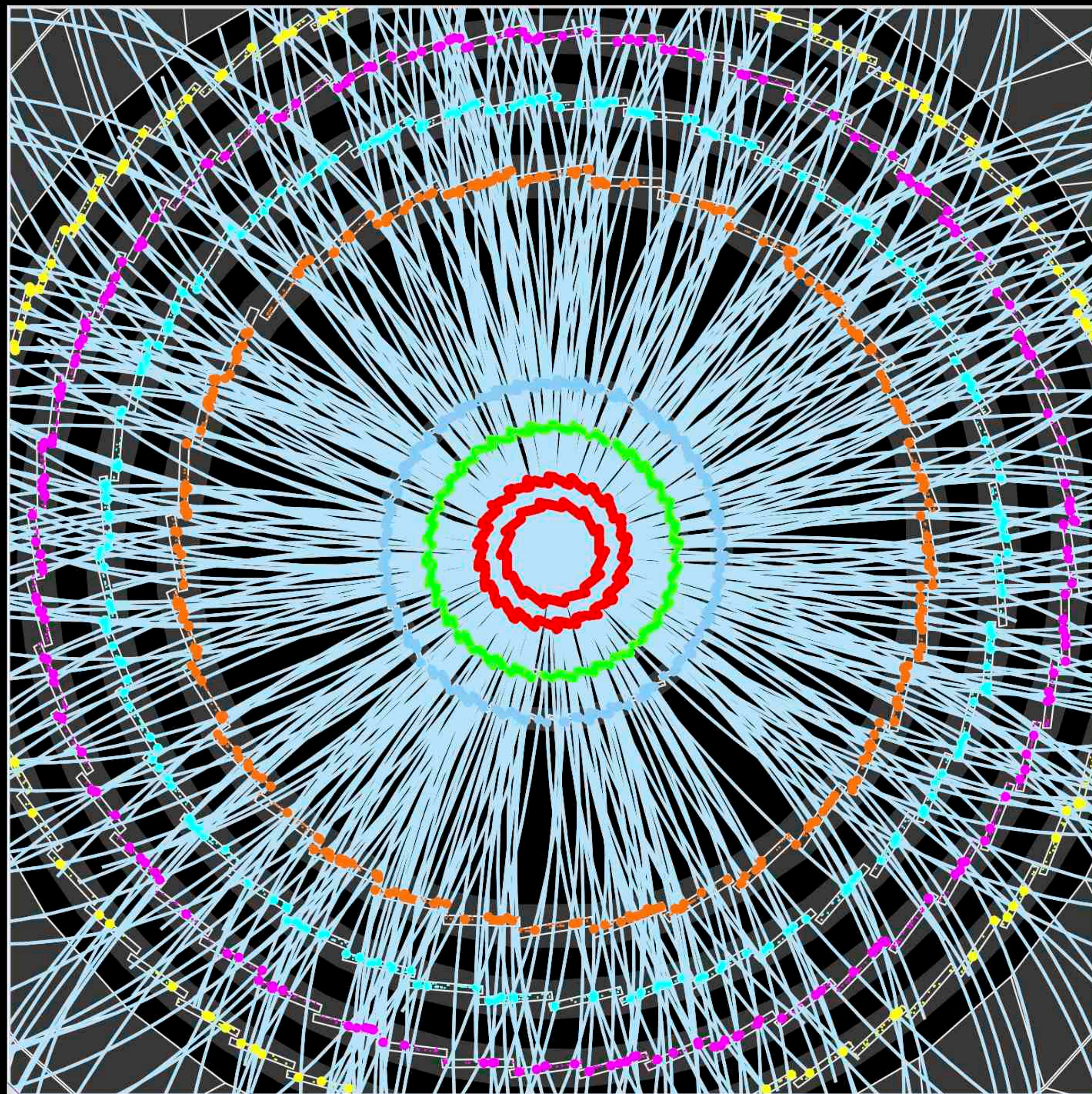


Run: 265573  
Event: 4417696  
2015-05-21 11:52:52



proton-proton collisions at  
13 TeV centre-of-mass energy

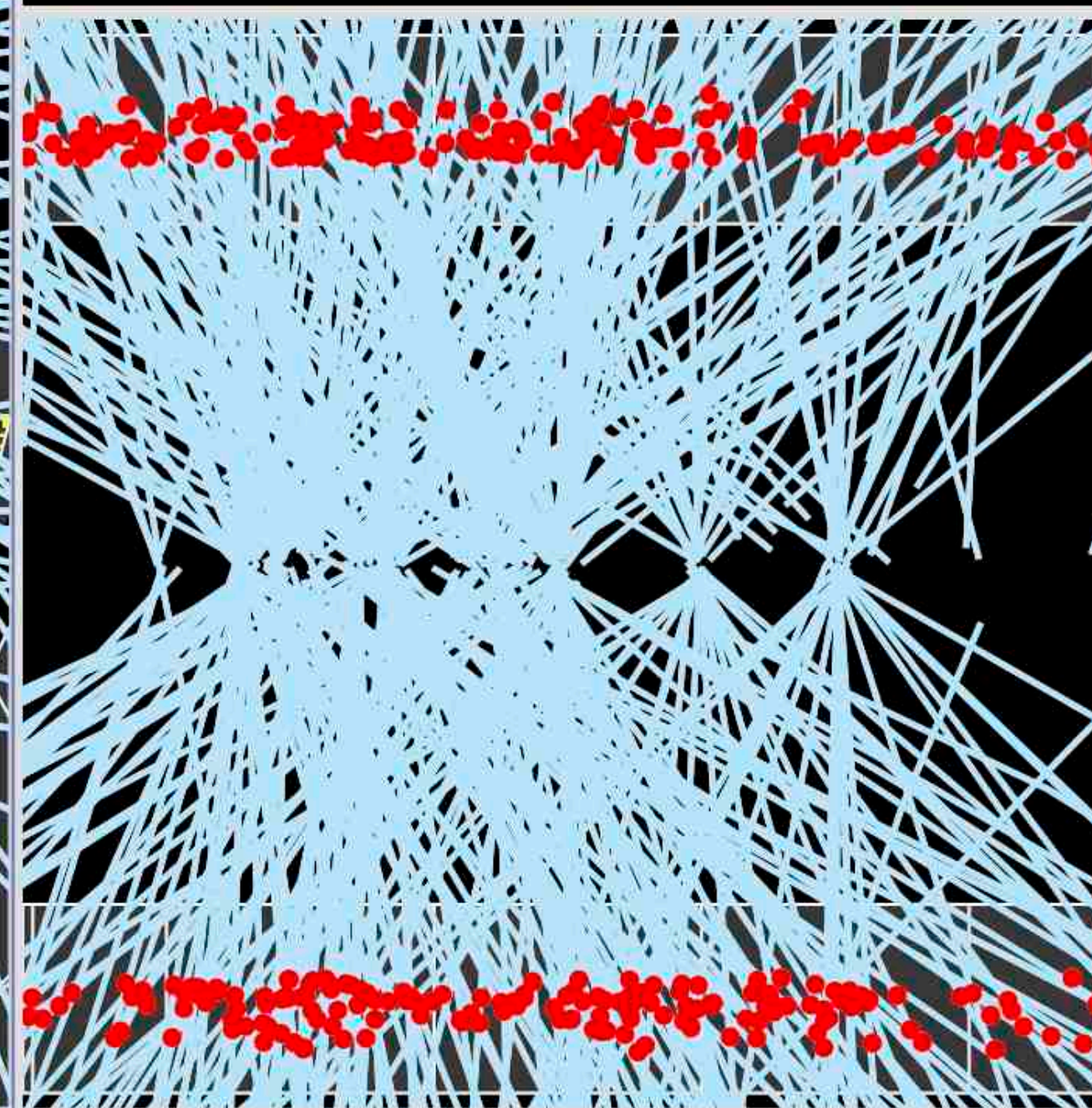




**ATLAS**  
EXPERIMENT

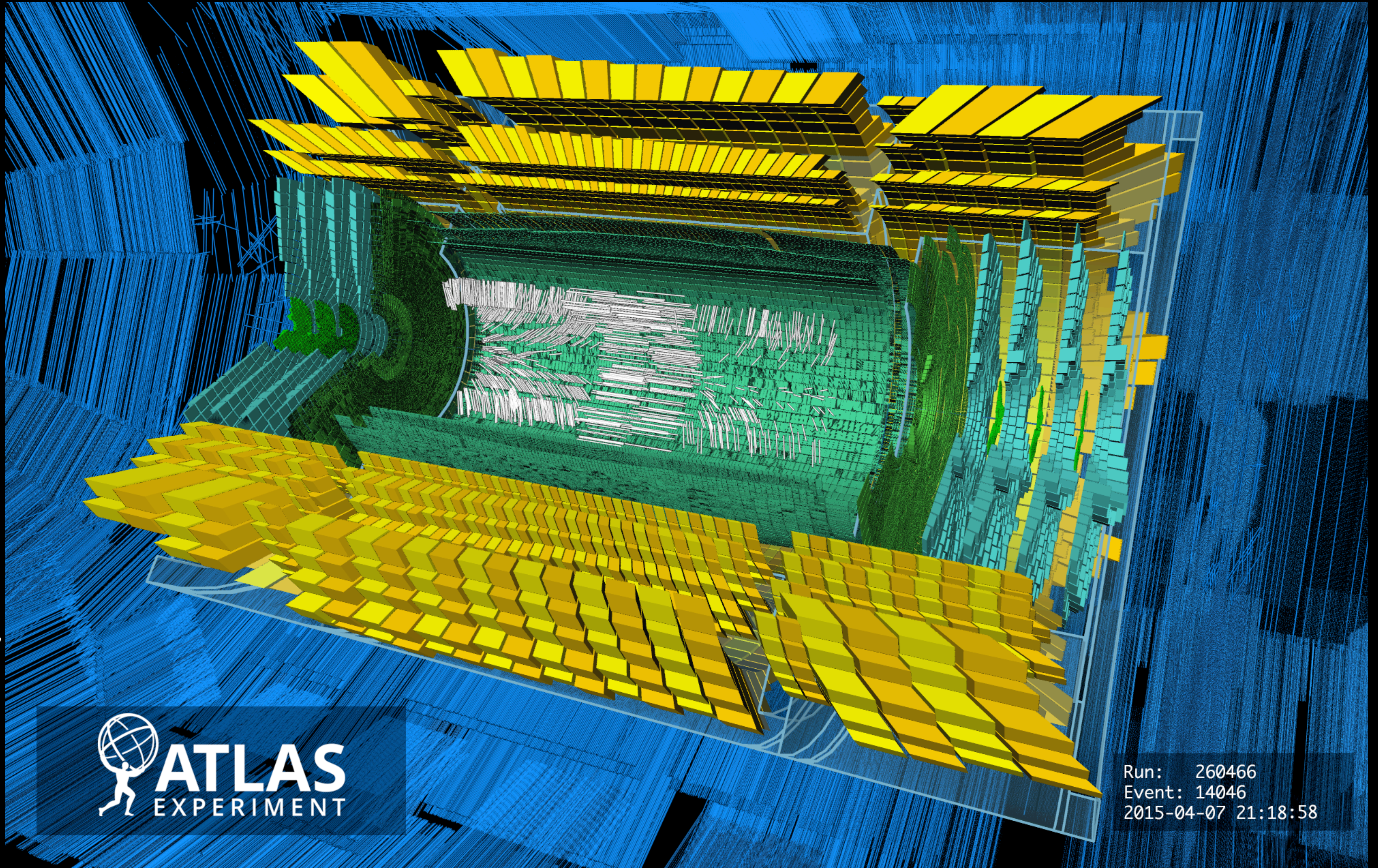
Run Number: 266904, Event Number: 25884805

Date: 2015-06-03 13:41:54 CEST



*high pile-up  
event in  
ATLAS*





*beam splash event in  
ATLAS  
muon hits and calo  
cells*

Run: 260466  
Event: 14046  
2015-04-07 21:18:58