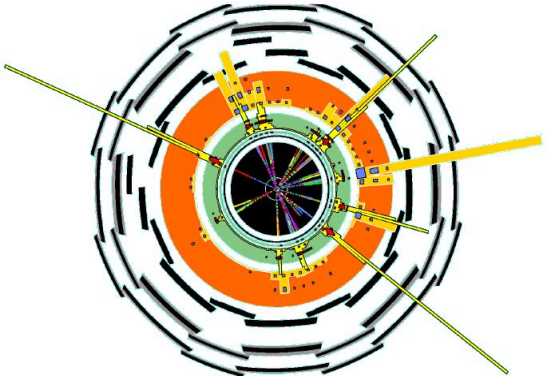
Event visualisation for the ATLAS experiment - the technologies involved

CHEP 06, Mumbai, India



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Outline

- Project overview
- Why visualisation?
- Structure of ATLAS Atlantis visualisation, communication with Athena framework
  - online event access
  - Atlantis – Interactive Athena
- Input files
- Main current and future developments

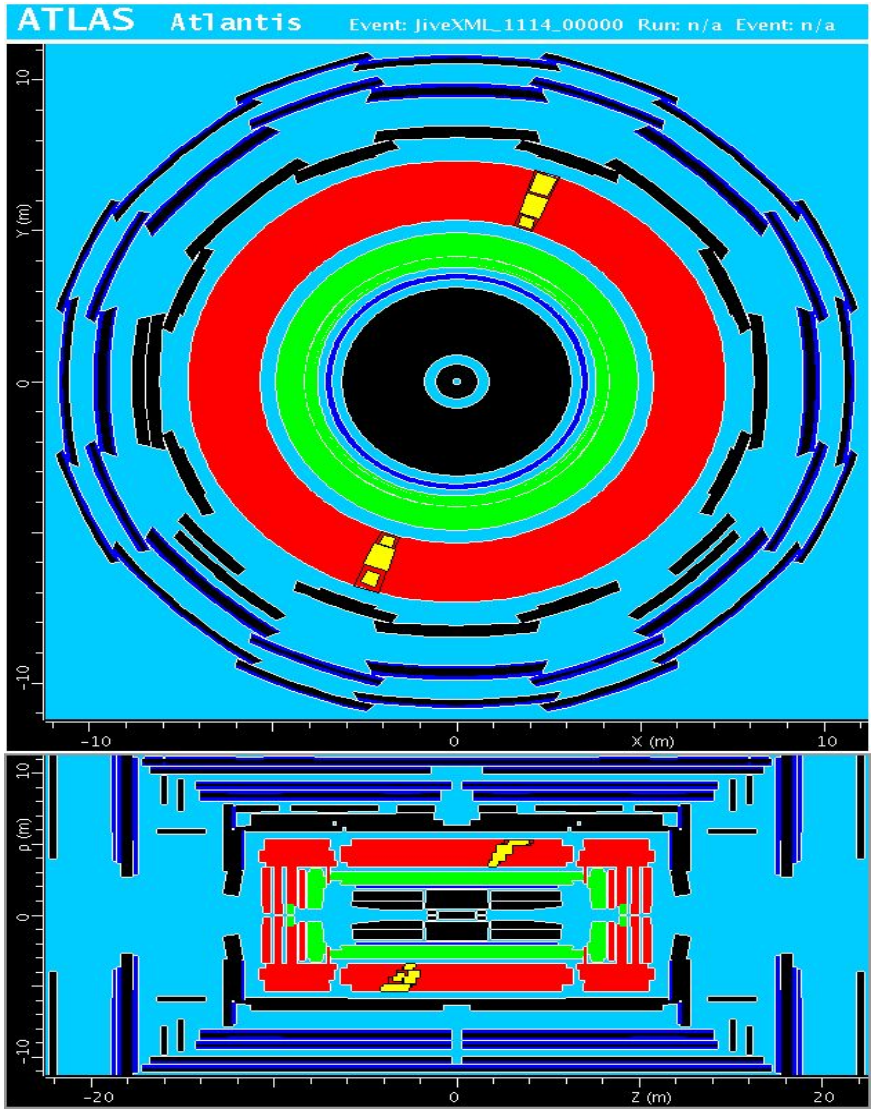
Atlantis visualisation overview

- Atlantis event display is a stand-alone Java application
- Uses variety of 2D projections, multiple views (windows) on canvas
- A part of the ATLAS SW, depends only on Java
- Uses simplified detector geometry (not a detector display)
- JiveXML (written in C++) interfaces ATLAS SW framework Athena (its event store) and Atlantis
- Access to the event data from Atlantis
  - using the event files produced by JiveXML (offline)
  - reading the event data over network from JiveXML server (online)

Motivation

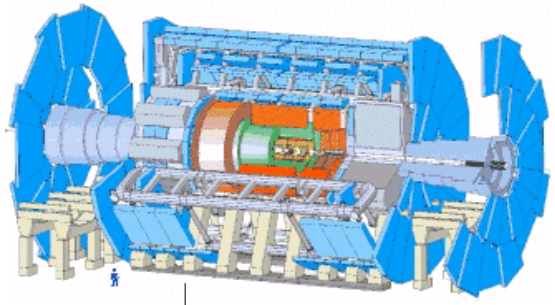
- Helps to understand complete events
- Debugging reconstruction
- Test Beam display (cabling issues)
- Commissioning
- Producing plots

Cosmics data recorded by TileCal in the ATLAS pit (June 2005)



Atlantis/JiveXML visualisation

ATLAS detector



byte stream

digi files
ESD, AOD

offline / online / interactive
mode of running with respect to the Athena framework

1

XML event files read offline (20kB cosmics, 20MB/4MB full luminosity)

2

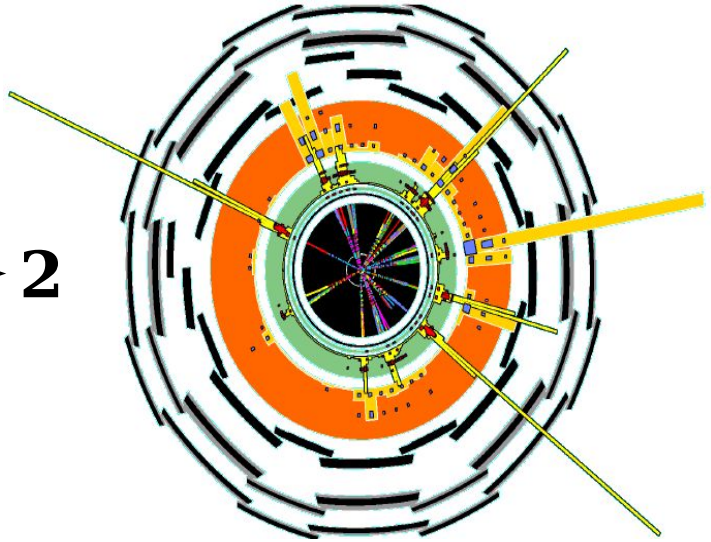
XML event data read online over network using XMLRPC

3

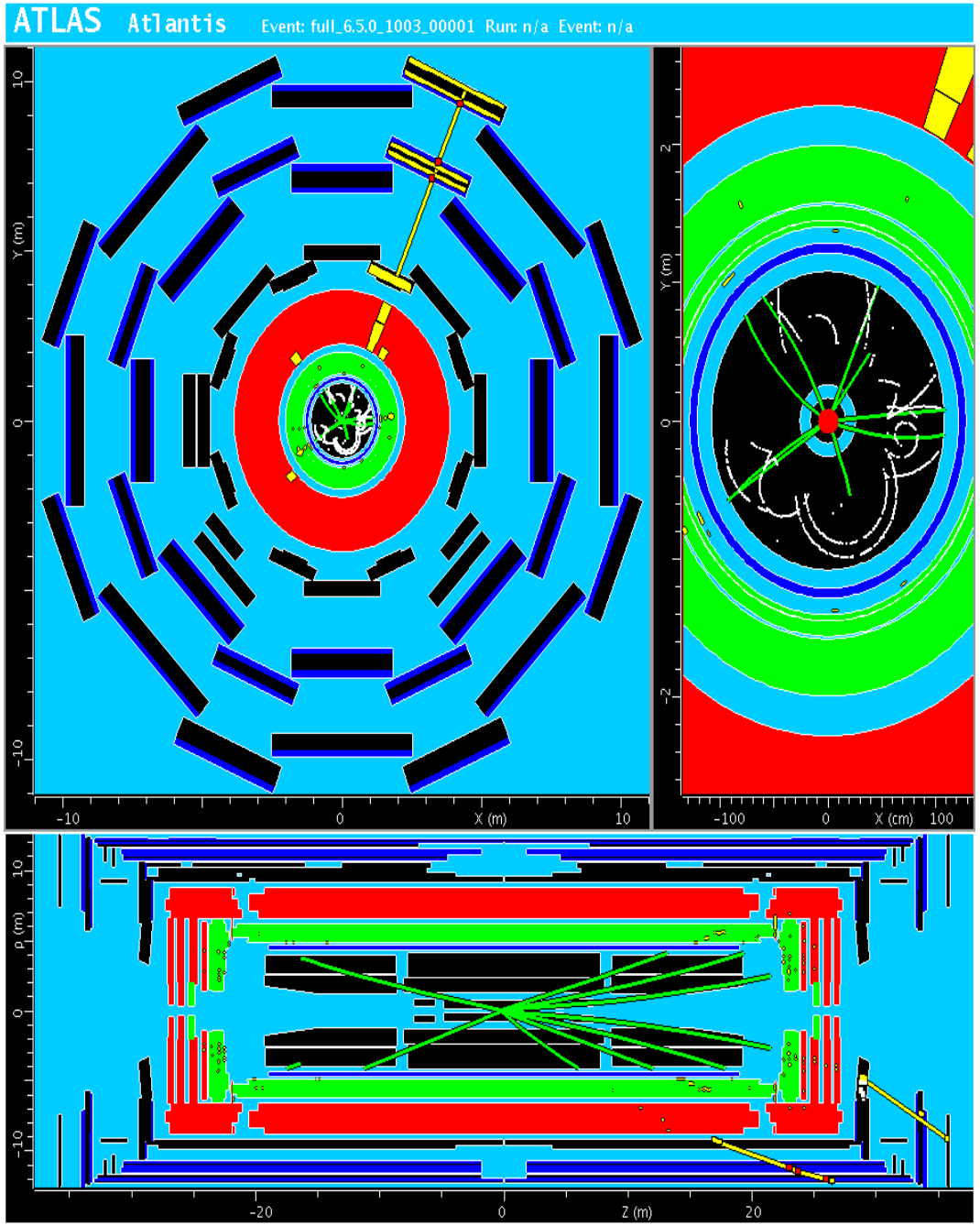
Athena – Atlantis interactively (two way, interactive analysis)

offline framework Athena runs recostruction chain and JiveXML converter

Atlantis Canvas
(XY view)



Atlantis – Canvas & GUI

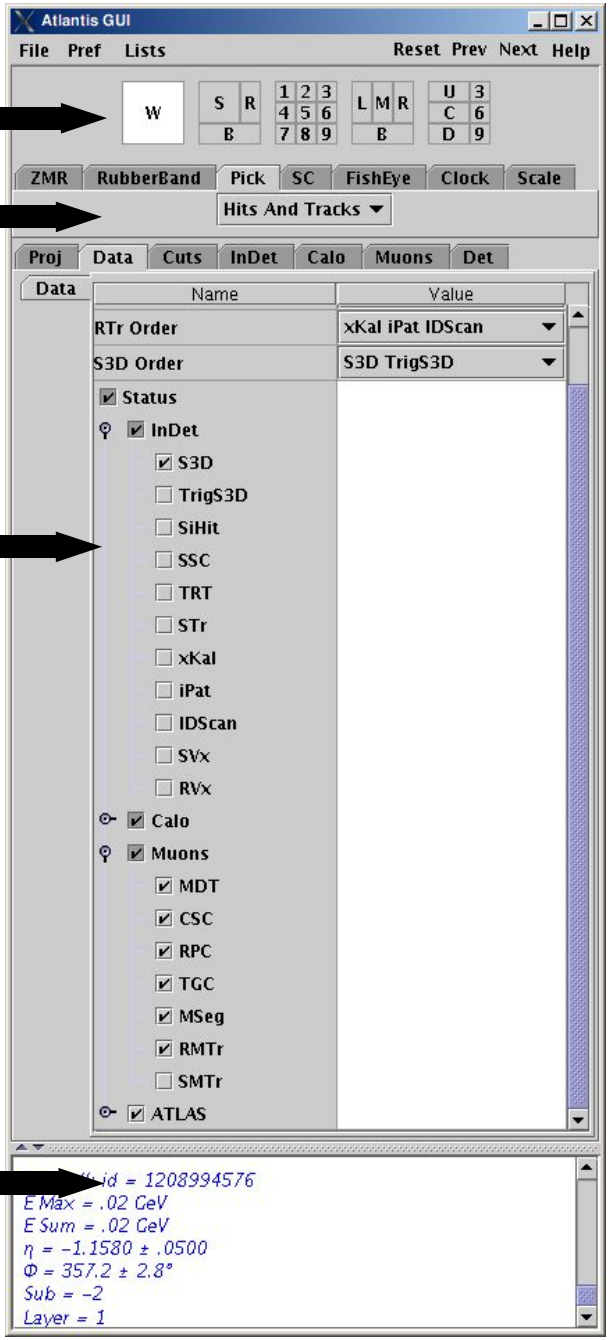


window control
(drag & drop)

interaction control
ZMR
Pick
Rubberband
Synchro cursor

menus
Projections
Data switches
Cuts
Data configs
InDet
Calo
Muon
Subdetectors

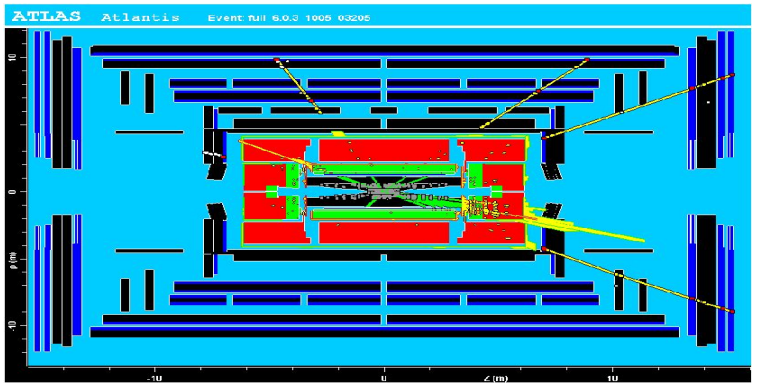
output window



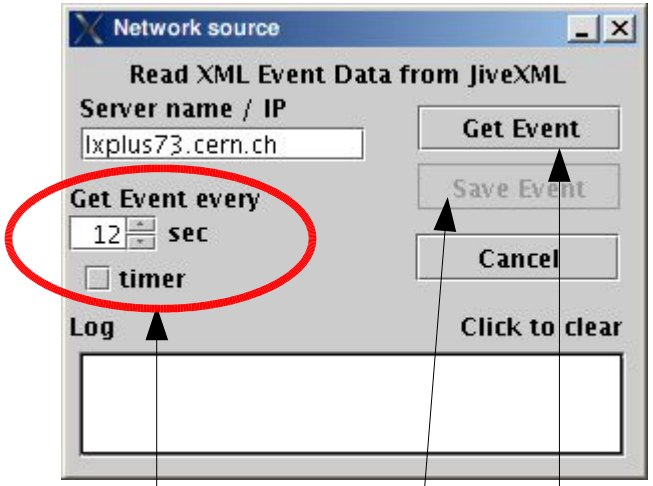
Online event access - XMLRPC

- XMLRPC – various implementations - eXtensible Markup Language Remote Procedure Call. We use ulxmlrpcpp C++ and Apache Java XMLRPC implementation
- Very simple, uses XML as the encoding and HTTP as the transport. It's a presentation and session ISO/OSI layer technology
- Atlantis sends event data requests over network (on demand / automatically - timer)
- JiveXML XMLRPC server (running as a posix thread in Athena) transmits XML event data

Atlantis Canvas – ρ Z view



Online event access dialog



XML event data in payload of XMLRPC message


```
<?xml version="1.0"?>
<methodResponse>
   <params>
      <param>
        <value>
          <string>  ...event data...  </string>
        </value>
      </param>
   </params>
<methodResponse>
```

Atlantis – Interactive Athena

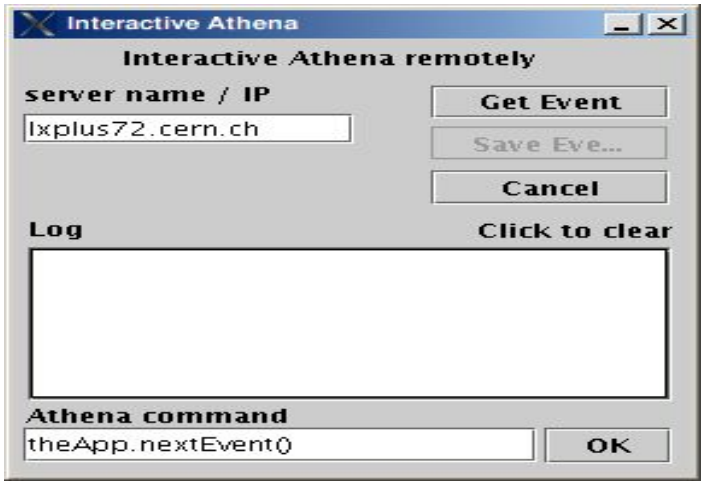
- Interactive (Python) prompt – facility of the Athena framework enabling to steer it interactively, performing interactive analysis using Athena commands
- InteractiveServer – counterpart of Atlantis on the Athena prompt
  - implemented in Python acts as XMLRPC server
  - receives Athena commands from Atlantis user, enables to steer Athena from Atlantis

Interactive Athena session

```
bash> athena -i <job_options.py>
athena> execfile ("InteractiveServer.py")
```

HTTP / XMLRPC

Atlantis – Interactive Athena dialog



- Atlantis user can instruct Athena to process next event, change / query job-options of the framework, execute algorithms, etc
- Use case: “In my display, I see three tracks which look like coming from a secondary vertex. I want to fit a vertex with the Athena vertexing tool”

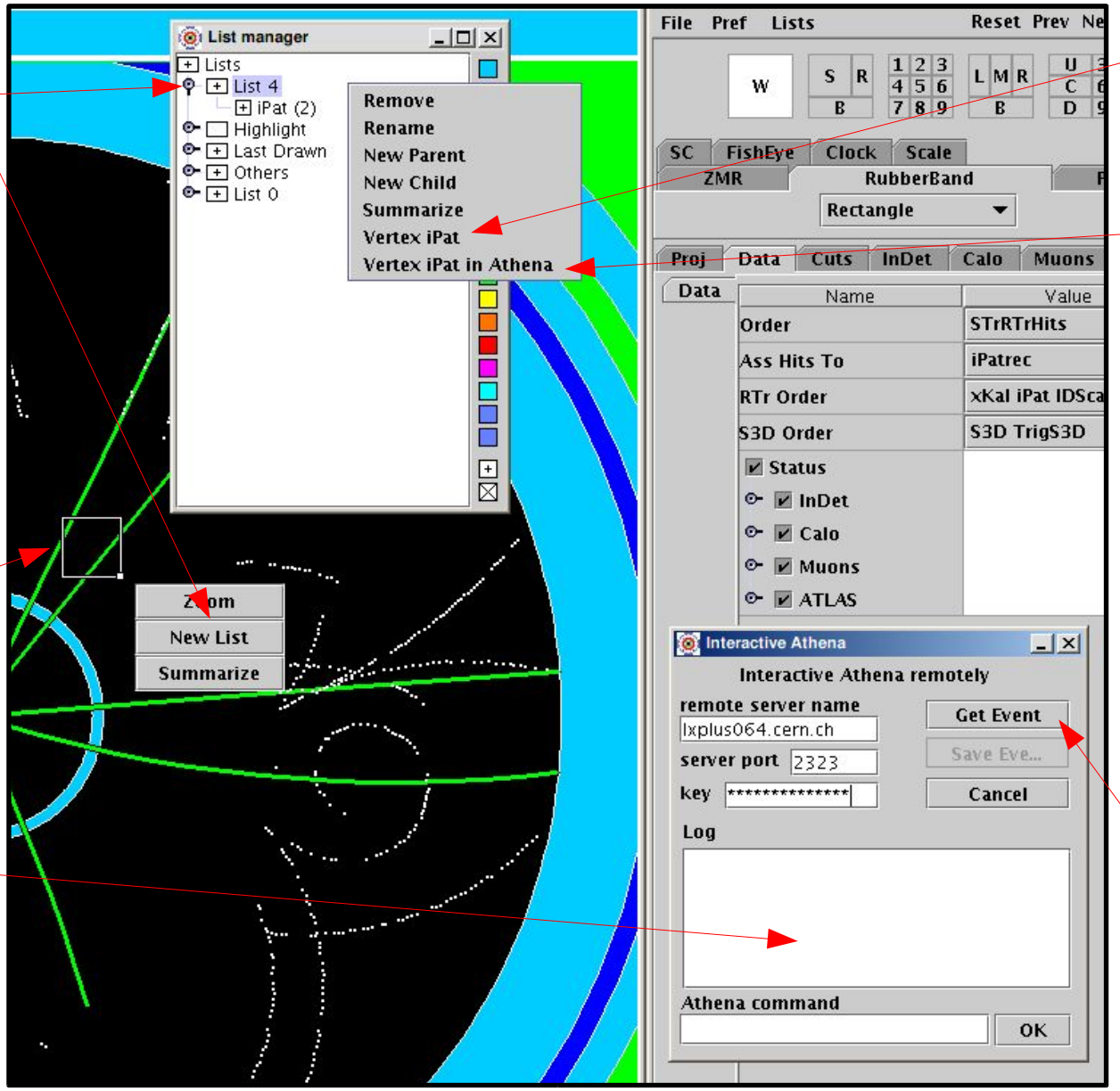
Interactive Athena - vertexing

XY view, zoomed into ATLAS Inner Detector

(2) put selected tracks into the list

(1) select (rubberband) few tracks

interactive Athena dialog



(internal Atlantis vertex fitter)

(3) call Athena vertex fitter

(4) at Athena, InteractiveServer receives tracks indices and calls the vertex fitter

(5) if found, vertex is stored into event store

(6) get updated event data

Input files / data

- XML files parsing
  - geometry files (Document Object Module - DOM)
  - event files / event data (Simple API for XML)
  - configuration files (DOM)
- Help files – JavaHelp system used for online help in Atlantis, content written in HTML

Current / future developments

- Inner Detector commissioning support
- Displaying all reconstructed objects (Analysis Object Data - AOD)
- Command mode – Atlantis controlled by keyboard commands in parallel to being mouse-driven (exhibition purposes)
- Animated events (MPEG – problem with encoding, animated GIF)
- Grid (retrieving full simulation data (digi))

Conclusion

- Summary
  - structure of the Atlantis visualisation project
  - communication with the Athena framework
- Further information
  - www.cern.ch/atlantis
  - atlantis.support@cern.ch