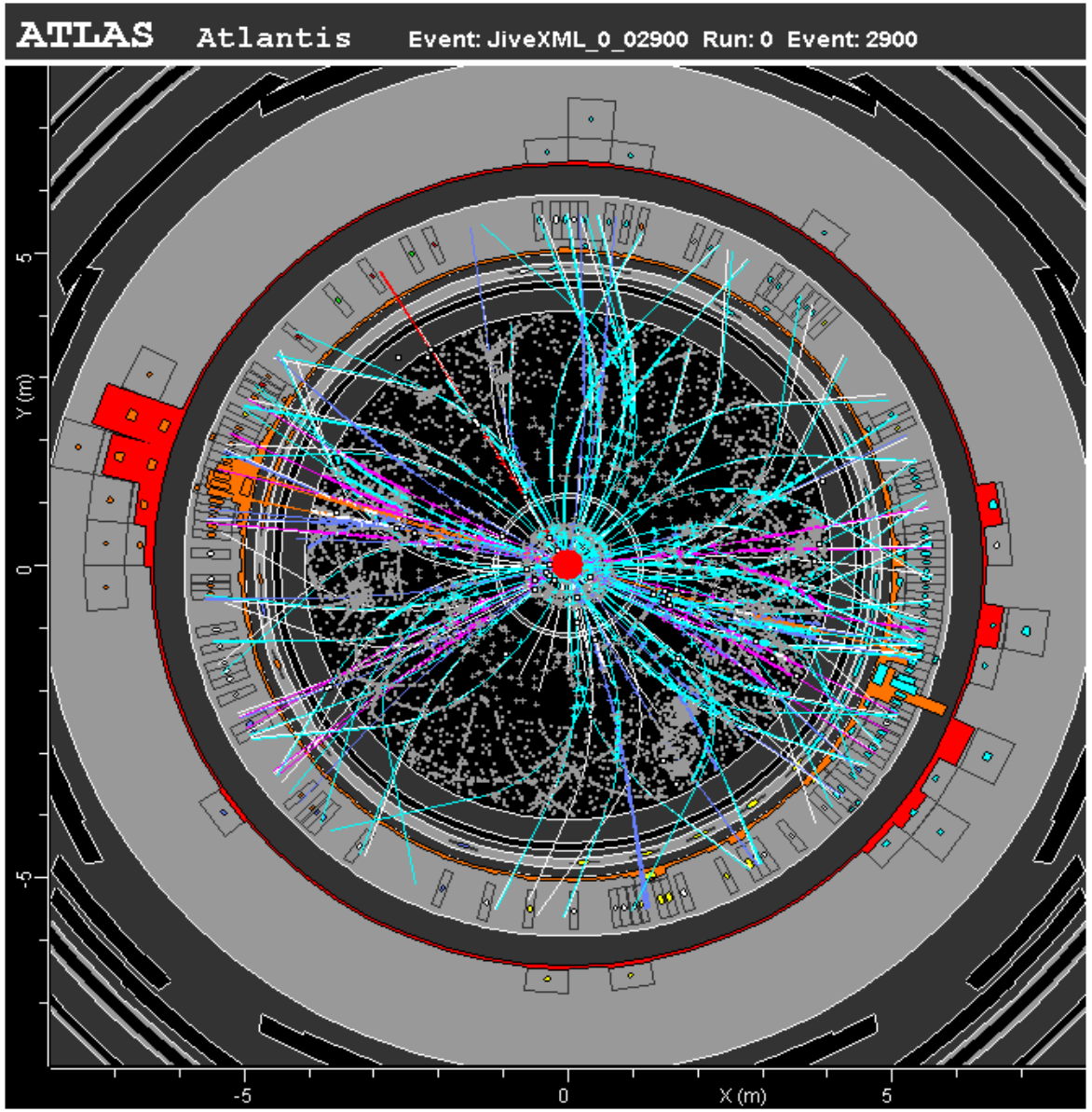
An Overview of Atlantis



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ATLAS @ BNL
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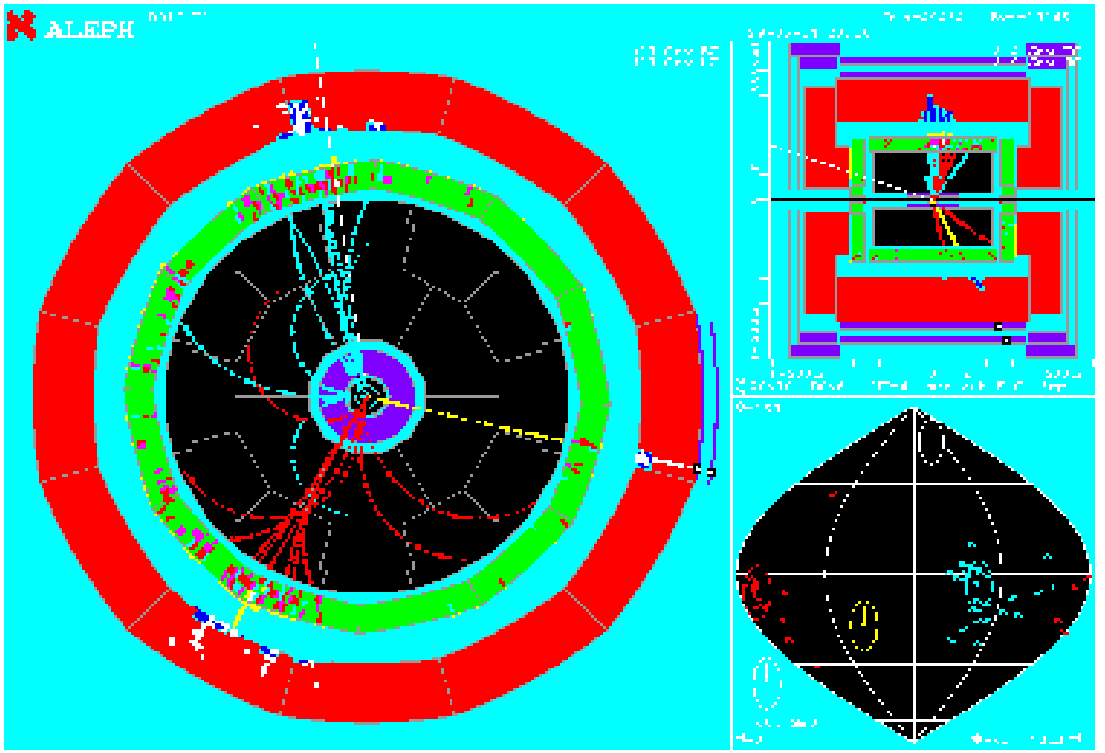
Introduction

- Displays are needed in various ways at different stages of the experiment:
  - Software development: understanding offline & trigger algorithms
  - During commissioning: cosmics, cabling, noise
  - Data taking: online monitoring, offline monitoring, weird problems
  - Physics: understanding event topologies, backgrounds processes
  - Outreach: picture of SUSY for the front page of the New York Times!
- Atlantis was born from DALI, a very successful display, from a very successful experiment, ALEPH



Atlantis philosophy

- Principles

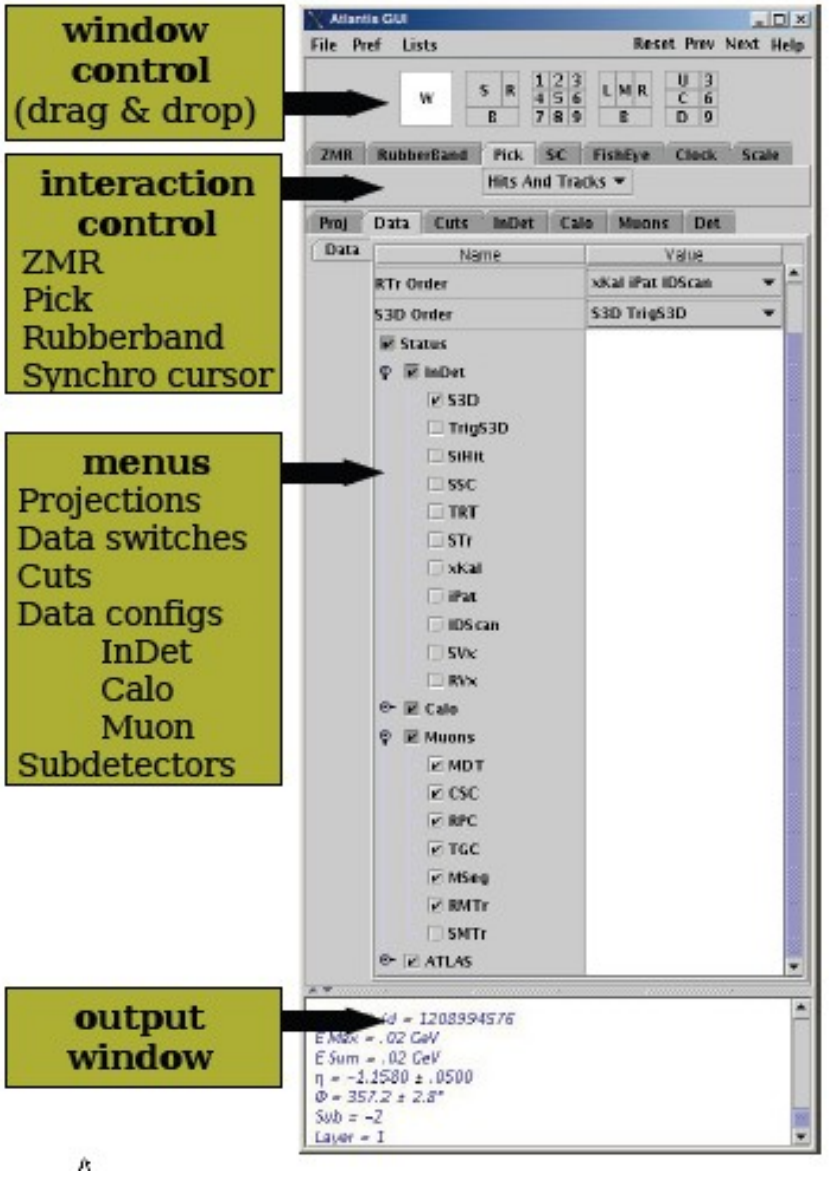
1. Visualise & understand complete ATLAS events in all their complexity

2. Hide the detector details in favour of clarity for the event data

3. No operation (zoom, rotate, plot…) should take more than a second (and most should take “no time”)

Overview

- Atlantis is 2D (for now…)
- Multiple “data-oriented projections” : XY, eta-phi, RZ, Lego, etc.
- Loosely coupled to Athena
  - Athena ->JiveXML (C++) -> XML files
  - XML files -> Atlantis (Java)
- XML “files” can also be XML “pipes” for online monitoring
- Can also be run interactively with Athena
- Strong support team (~8 FTE)
- Very flexible configuration options
- Runs on all computing platforms (Java)



Geometry

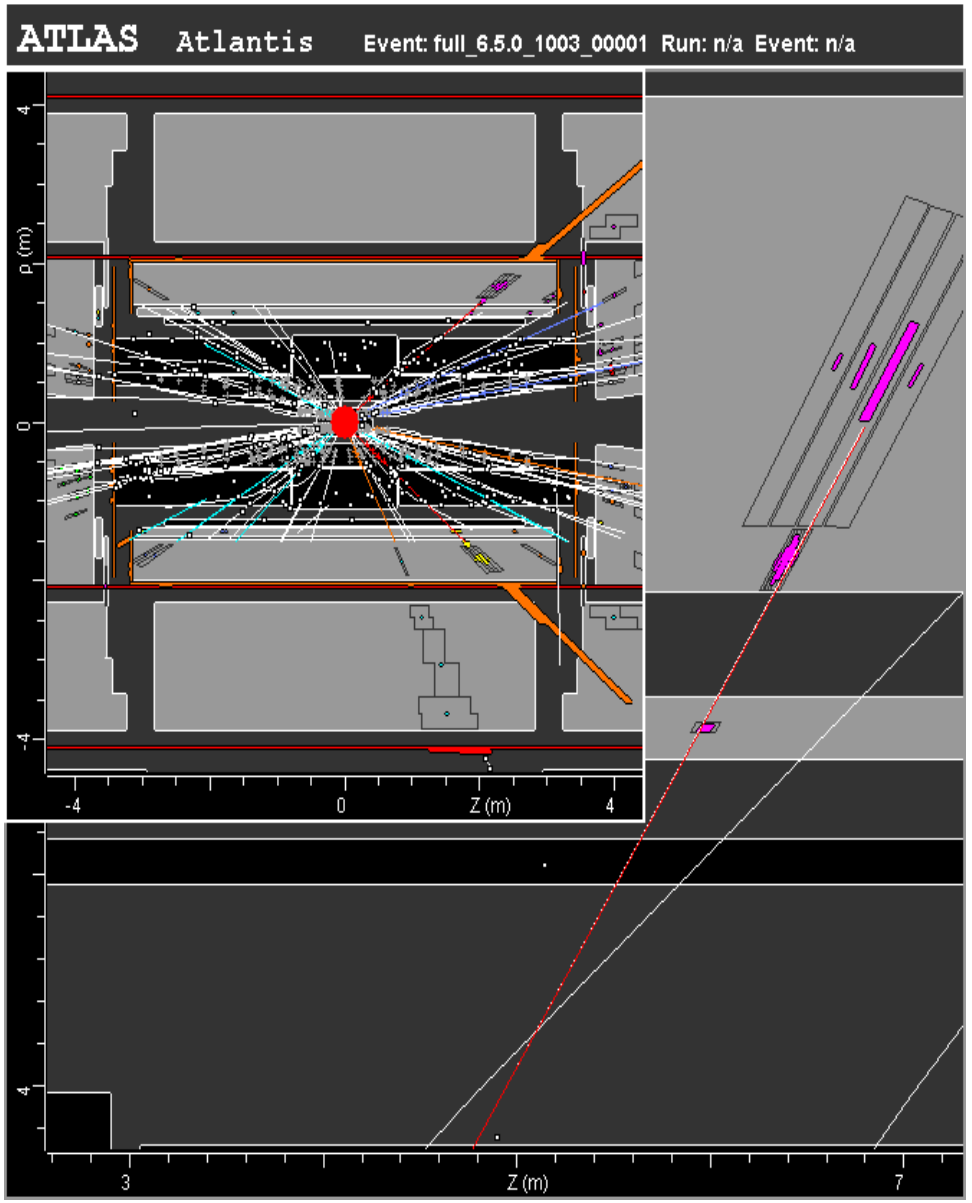
- The simplified Atlantis geometry is produced by JiveXML in athena at initialization (using GeoModel)
  - Set in jobOs (really only for experts):

    EventData2XML.WriteGeometry = True

  - Produces XML geometry files

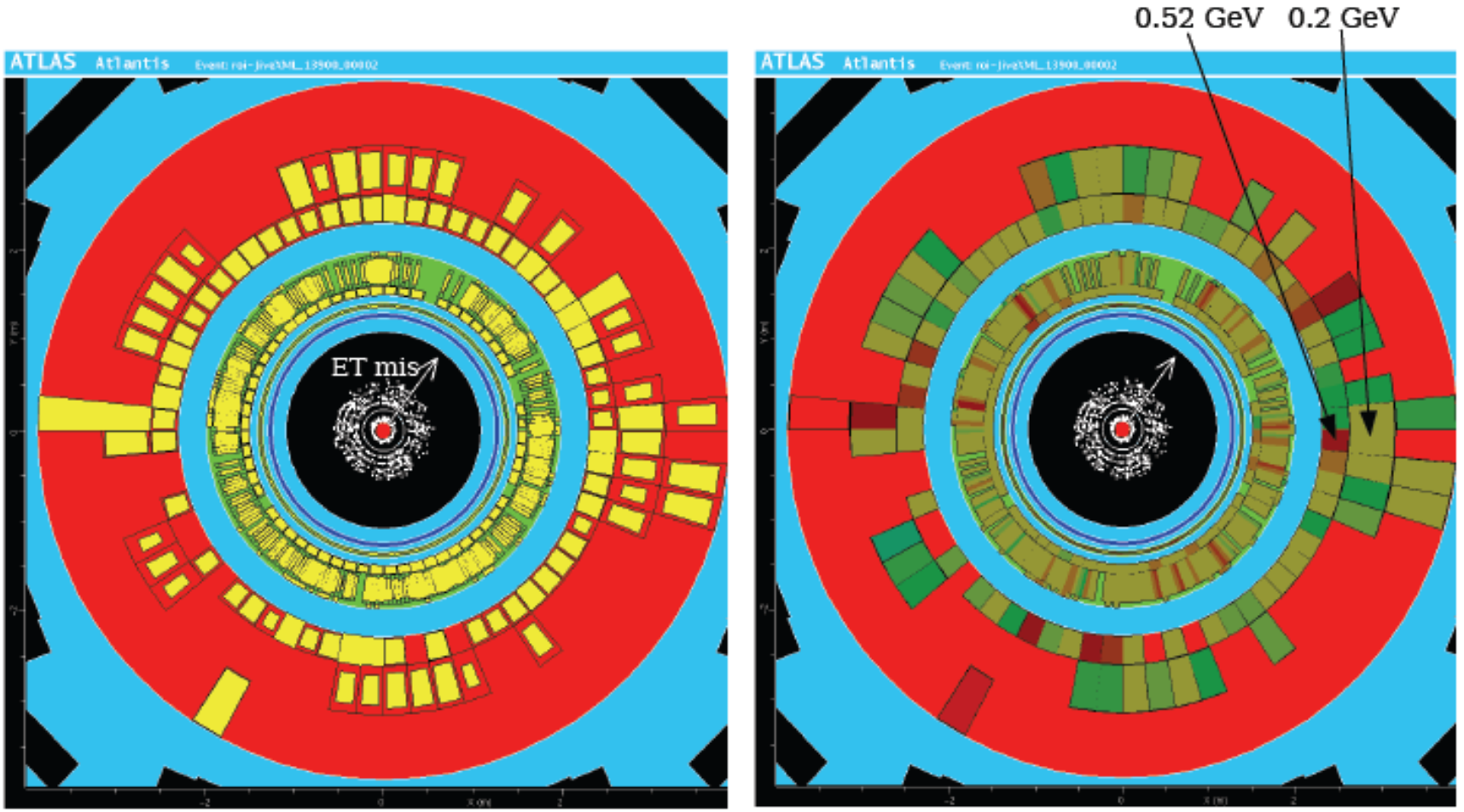
Understanding the Detector and Reco

- Reconstructed calorimeter objects (electrons, photons, jets, MET, etc.) and associations to cells in very clever ways
  - jet, elec. / photon, tau
  - reco. & trig.
- Histograms of cumulative energy
- Tracks, pixel/sct/trt hits, vertices, MC inifo, cal. cells, muon hits, muon segments, muon tracks
- Pick objects for detailed info
- Can zoom / pan / rotate / fisheye / cut / stretch / etc...
- Multiple views at once in windows
- Syncrocursors between the views

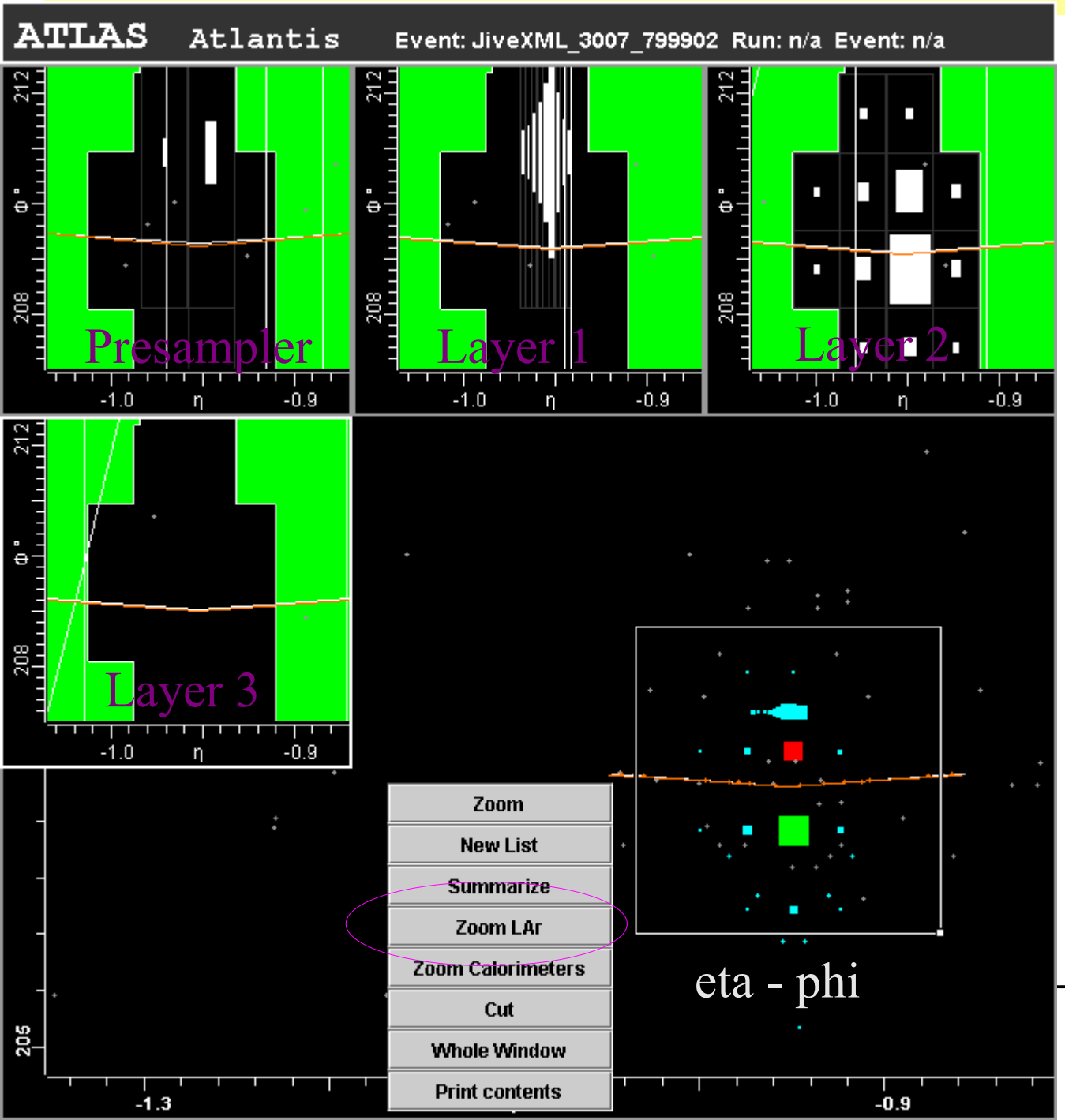


Lots of Options...

LAr, TILE – constant / energy colour coding with log scale

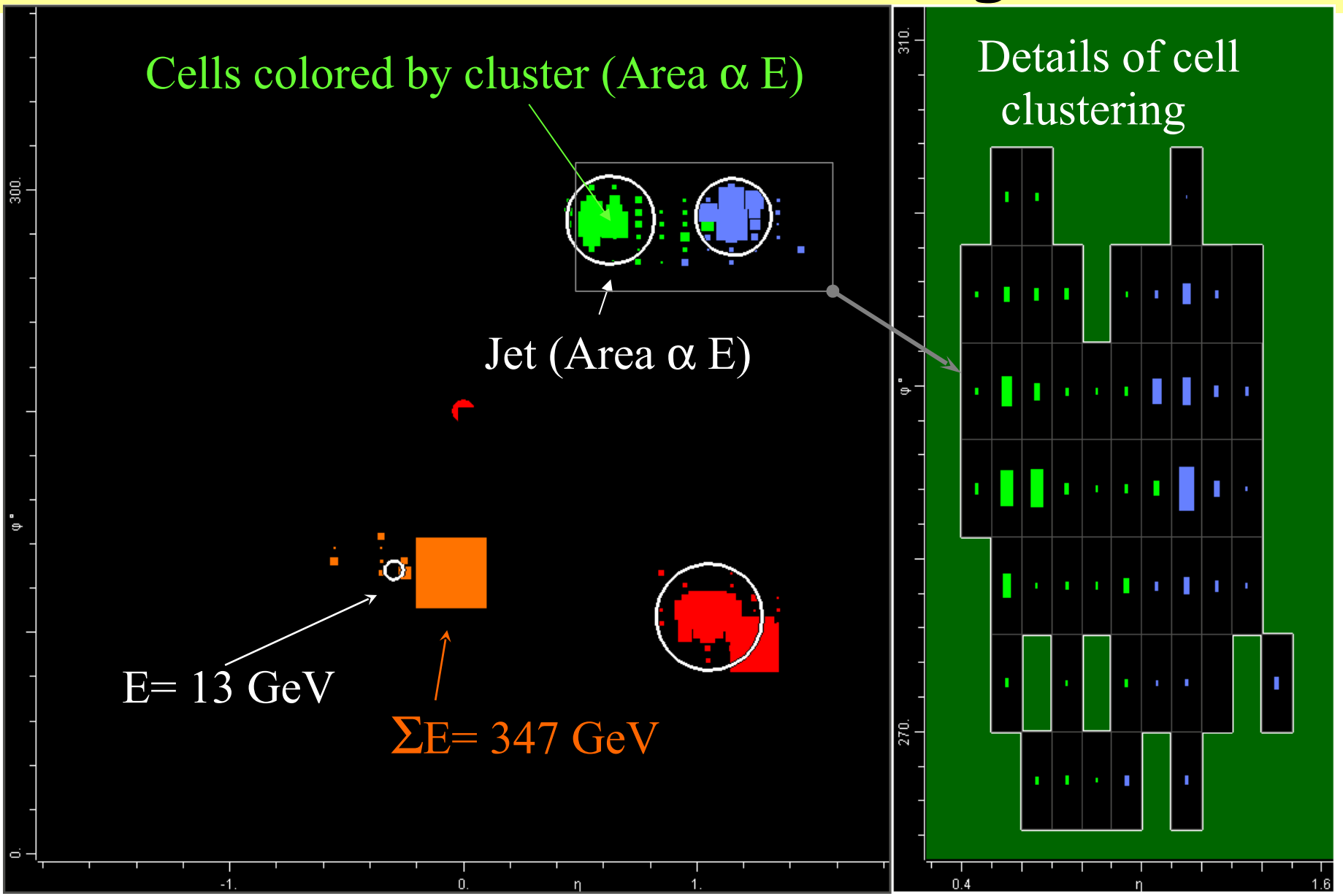


Atlantis v-plot for LArg



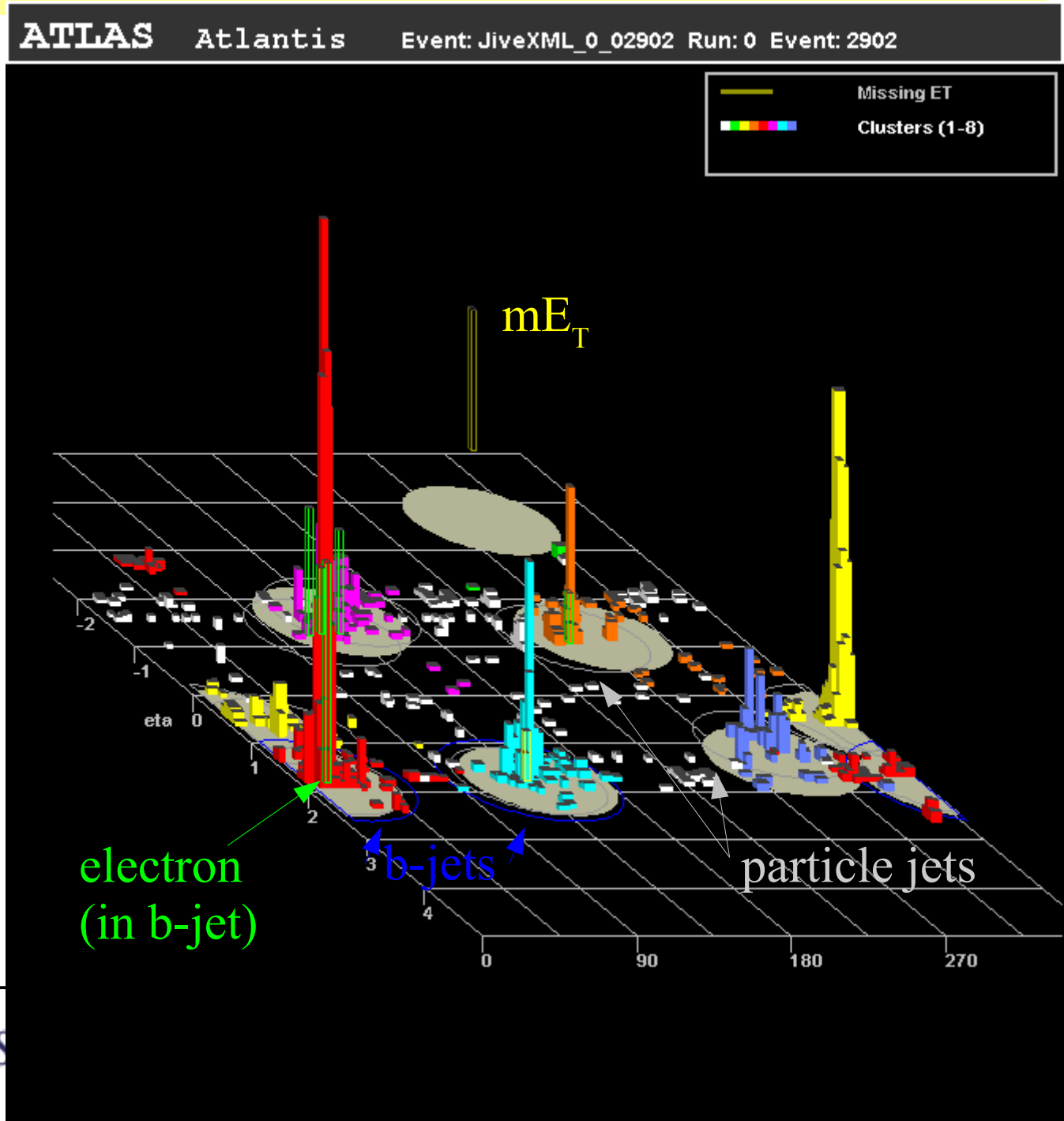
- Match of electron to each calorimeter layer
- Can see response / geometry in each layer
- Can also display details of calorimeter clustering algorithms / jets / matches to track jets, etc.

Cell clustering in Atlantis



AOD's – Reco-level Information

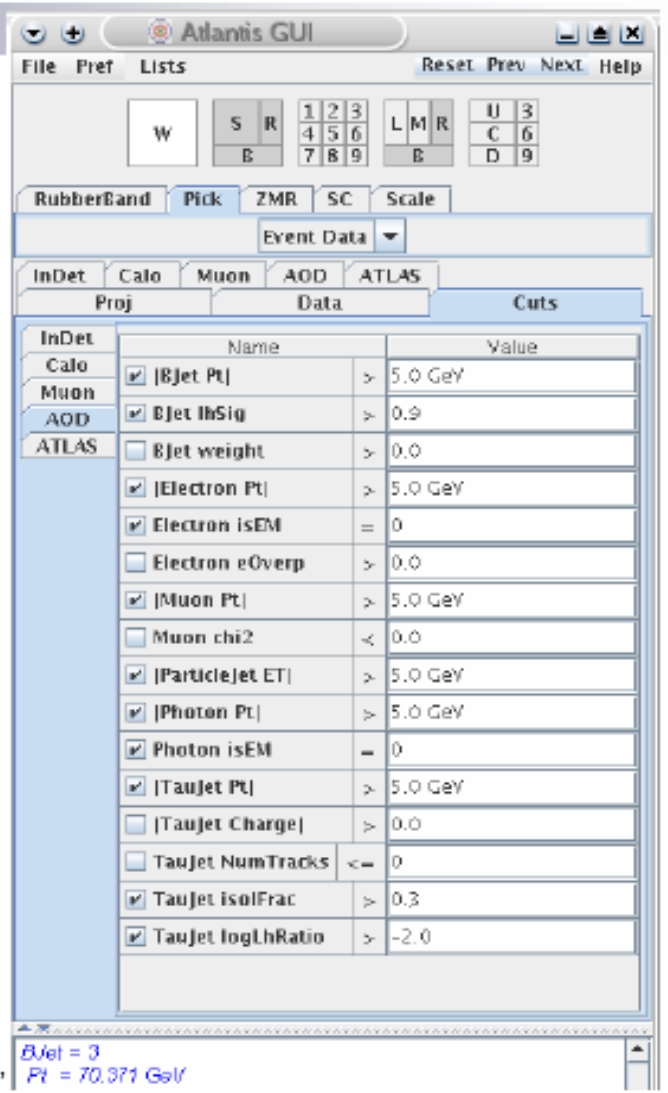
- Draw reco objects from AOD's
  - Jets
  - B-jets
  - Tau-jets
  - Particle-jets
  - Electrons
  - Photons
  - Muons
  - Various mE_T
- Can place cuts on these objects
  - E_T
  - Significance
  - Isolation
  - etc...



Cuts, AOD Info

AOD Data in GUI (4): Cuts

- A 'reasonable' set of default cuts is applied, freely adjustable by the user:
  - *All:* pT > 5 GeV
  - *BJet:* lhSig > 0.9
  - *Electron:* isEM=0
    (note: we fix 2048 bug inside, set to 0)
  - *Muon:* chi2 < 0
    (this is 'matchChi2OverDoF')
  - *TauJet:*
    isolationFraction > 0.3,
    logLhRatio > -2

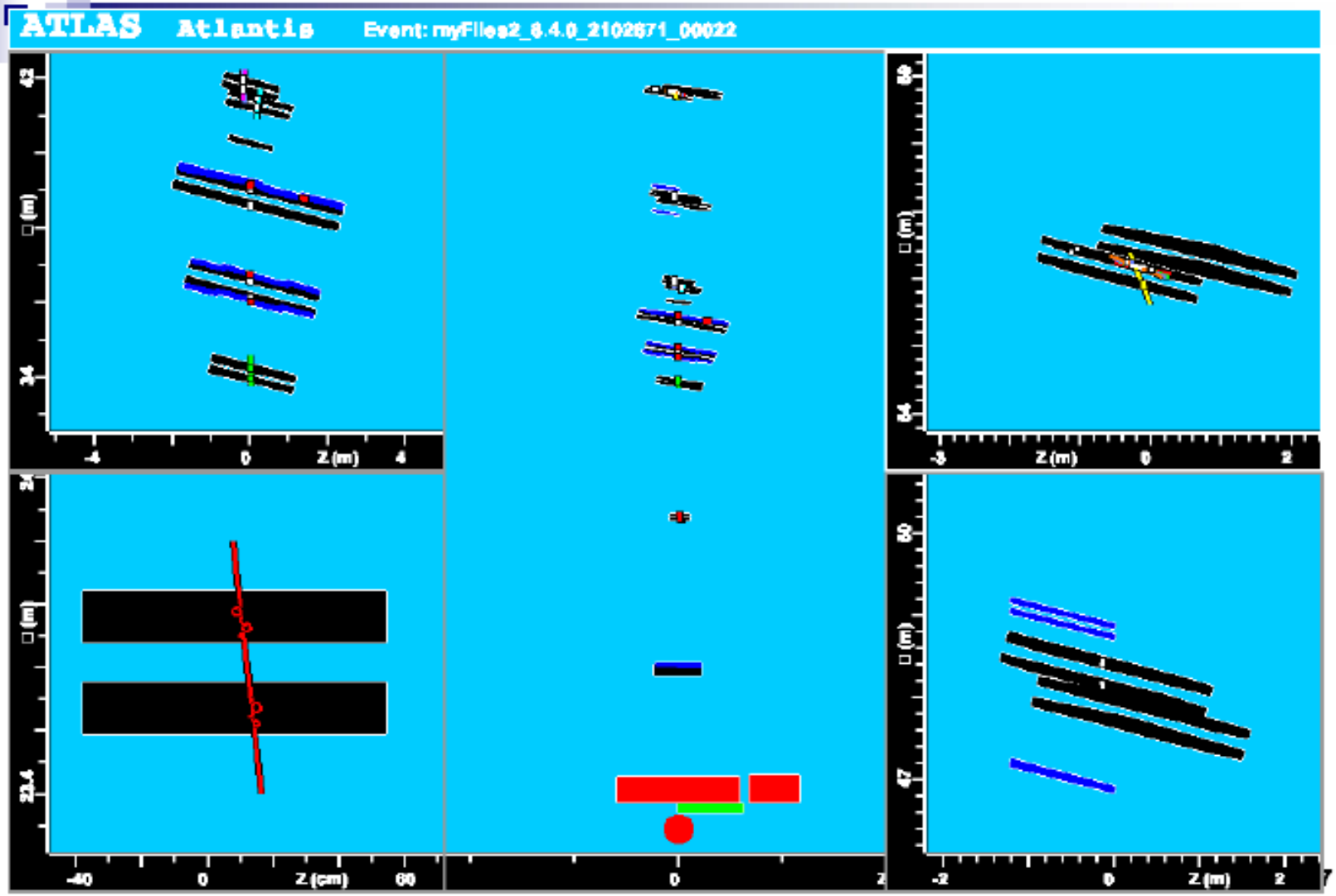


Atlantis with AOD data,

Atlantis.Support@cern.ch
http://cern.ch/atlantis

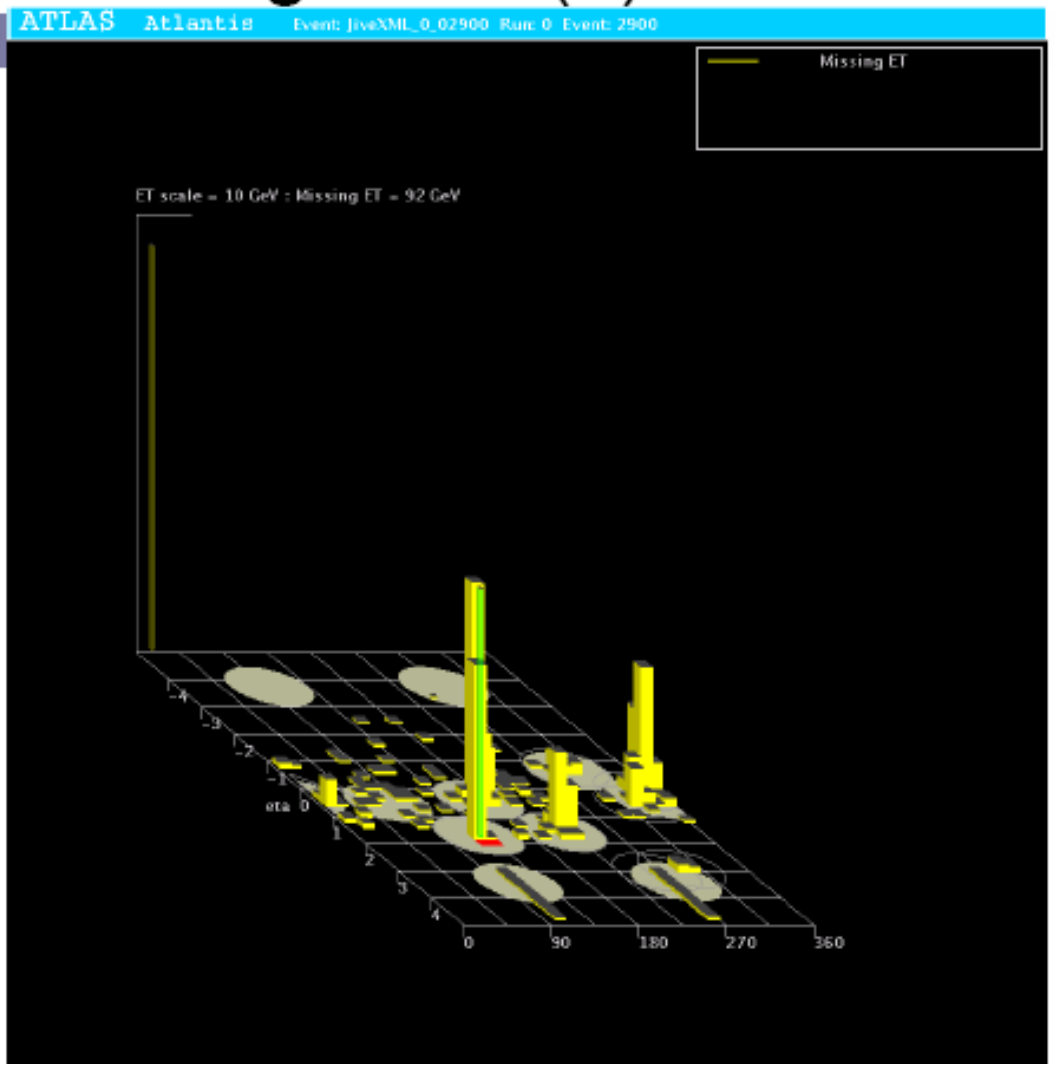
Test Beam

Muons in the CTB



Trigger data from Digi/ESD (2)

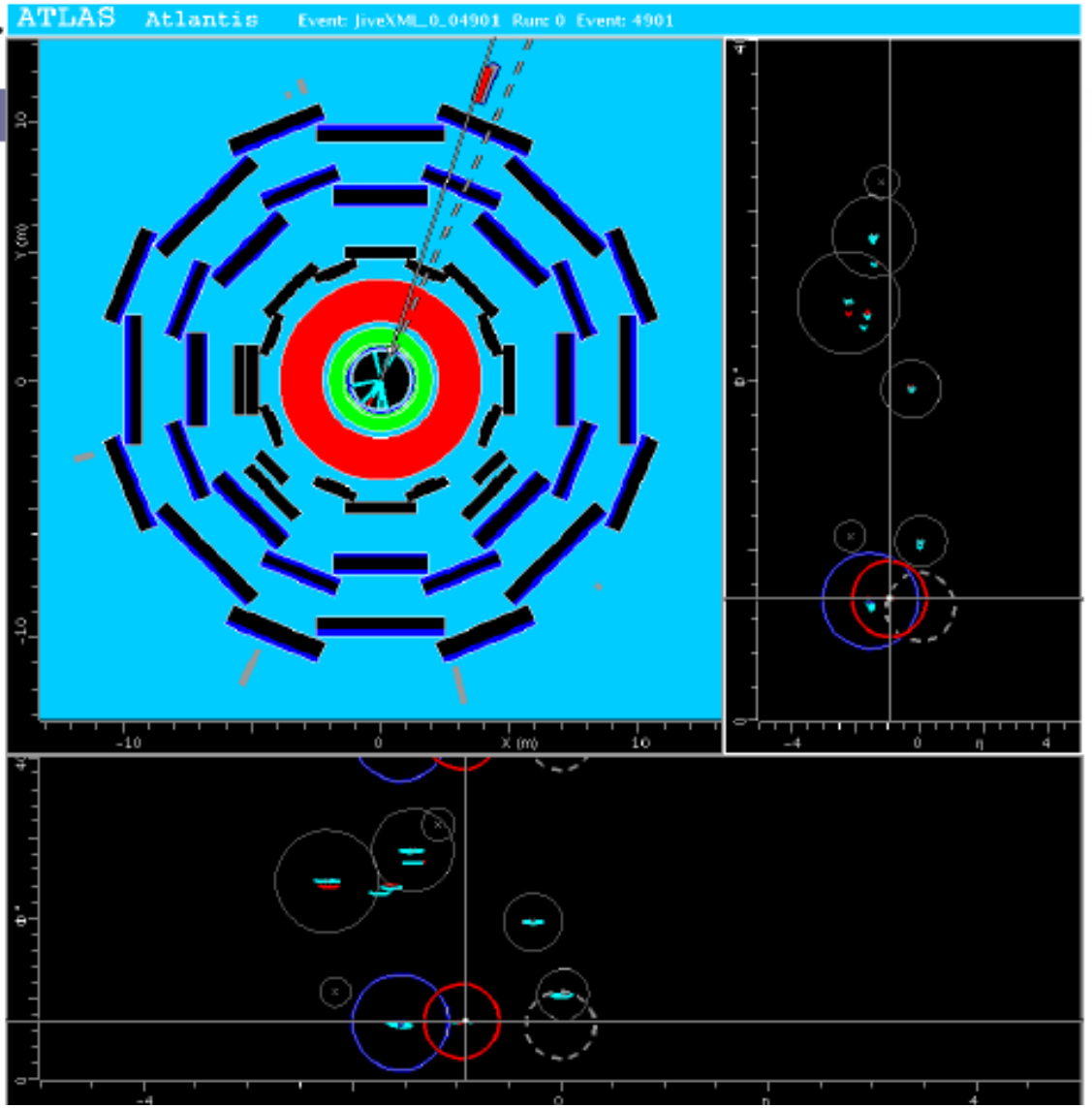
- **Level-1 Jet Elements**
- Added up over em and had (neutral colour: yellow)
- Geometry (Grid) as in real system (Barrel: 0.4x0.4)
- Visible also: red rectangle on Legoplot base: This is an RoI. Atlantis shows JetRoI, EmTauRoI
- Next: Add more trigger data, also HLT (CTP_Decision, TriggerDecision)



Tricks for Understanding Events

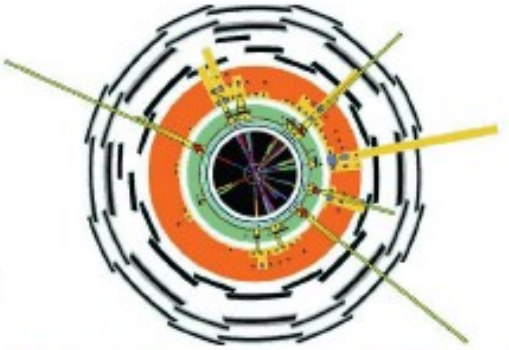
SynchroCursor

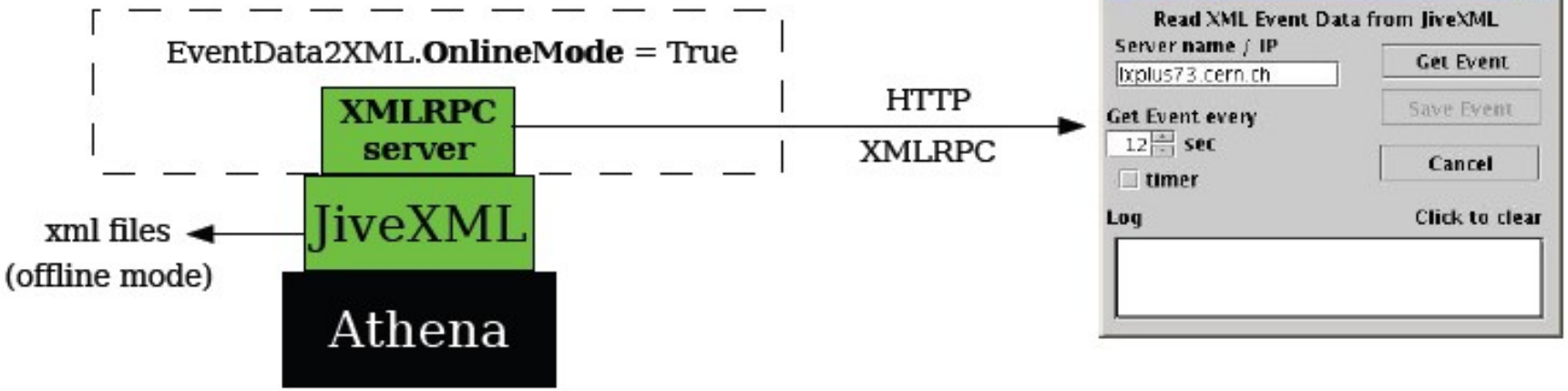
- **PICK output:**
- Muon = 0
  Pt = 83.985 GeV
  E = 124.684 GeV
  chi2 = 16.939386
  η = -.949
  Φ = 71.120°
- BJet = 1
  Pt = 133.344 GeV
  E = 325.092 GeV
  lhSig = 0.99873
  weight = 10.442425
  η = -1.539
  Φ = 70.179°
- STr barcode = 75
  Type = μ-
  d0 = -.002 cm
  z0 = .140 cm phi0 = 71.125 η = -.948
  tL = -1.097
  pT = -92.94
  p = -137.95 GeV
- ETMis: storegate key: CaloETMis
  Sum-ET = 589.050 GeV
  ET-Mis = 136.724 GeV
  ETx-Mis = 55.078 GeV
  ETy-Mis = 125.139 GeV
  Φ = 66.244°



Online Operation

- JiveXML (Athena) produces event XML data
- Atlantis reads the data
  - from files (local disk, URL)
  - online (JiveXML server, Interactive Athena)





Atlantis (XMLRPC Java client) calls JiveXML (XMLRPC C++ server)

On click / automatic event data requests

Implemented for data taking CTB 2004

Interactive Athena / Atlantis

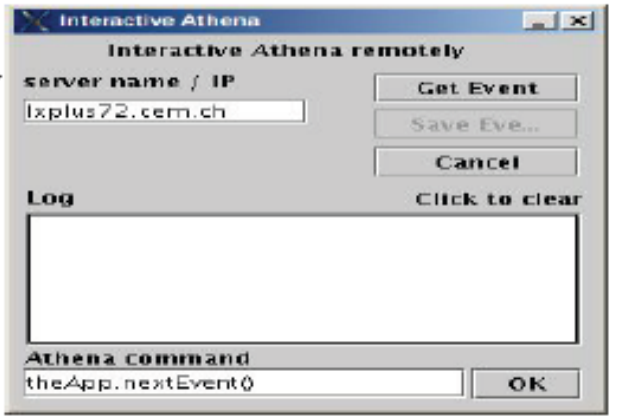
- Interactive (Python) prompt – facility of the Athena framework enabling to steer it interactively, performing interactive analysis using Athena commands
- InteractiveServer – counterpart of Atlantis on the Athena prompt
  - implemented in Python acts as XMLRPC server
  - receives Athena commands from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

Interactive Athena session

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

HTTP / XMLRPC

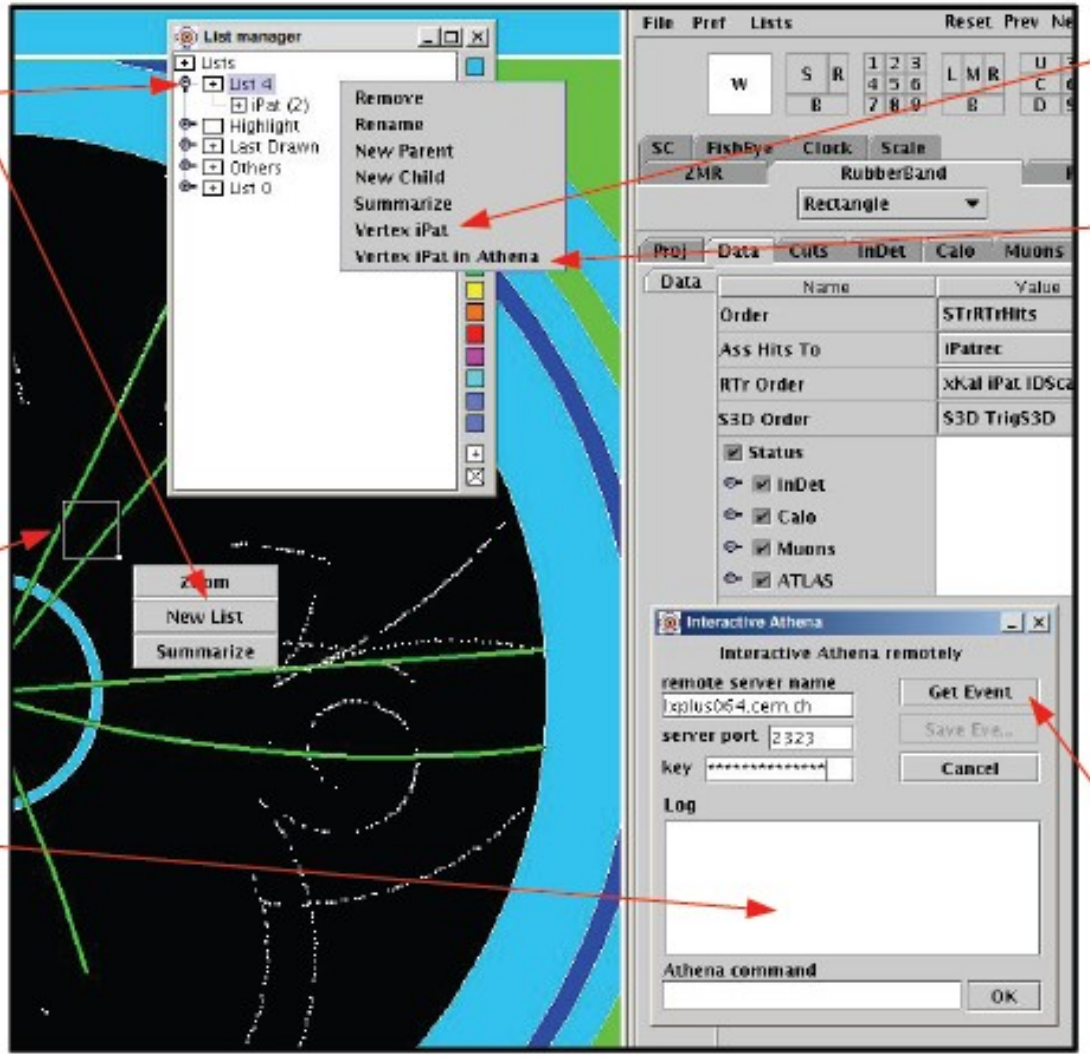
Atlantis – Interactive Athena dialog



- 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 / Atlantis

XY view, zoomed into ATLAS Inner Detector



(2) put selected tracks into the list

(internal Atlantis vertex fitter)

(3) call Athena vertex fitter

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

(1) select (rubberband) few tracks

interactive Athena dialog

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

(6) get updated event data

Summary

- Atlantis is a widely used, highly evolved, fully featured event display
- Aims to fulfill *most* needs of ATLAS
- Displays nearly everything we can think of
- Very flexible: can make pictures with incredible complexity and detail or great simplification
- Insulated from ATLAS software: standalone XML events and geometry
- But can be interfaced tightly:
  - interactive Athena use
  - online event display
- Java makes it easy