AthenaROOTAccess Tutorial

1st Artemis Annual Meeting

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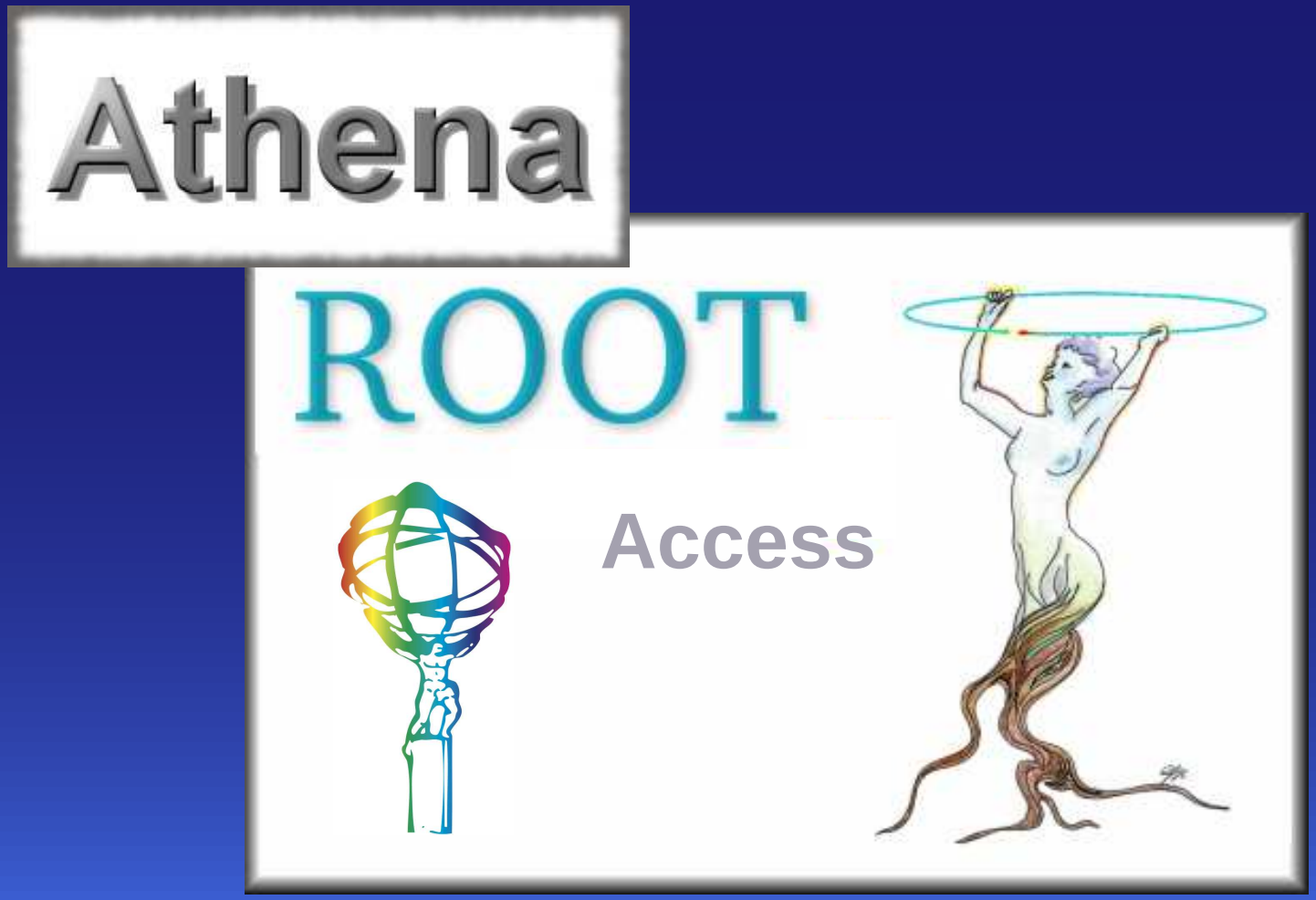


Motivation

- Scott's `AthenaROOTAccess` should make the use of AOD's as easy as analyzing a CBNT or SAN
- aim of this tutorial is to get started with the 3 different ways of doing analysis this way:
  - CINT macros
  - C++ compiled code
  - Python scripts
- new package `AthenaROOTAccessExamples` has been created to collect simple (skeleton) examples
- the tutorial should enable and encourage you to write your own
- feedback is very welcome

Scripts ► tags to checkout on top of 13.0.20

- Preparation for the tutorial:
  - working setup of athena-13.0.20 plus some tags from Scott's AthenaROOTAccess wiki page

```
cmt co -r RecExCommon-00-08-08 Reconstruction/RecExample/RecExCommon
cmt co -r AnalysisTriggerEvent-00-02-05 PhysicsAnalysis/AnalysisTrigger/AnalysisTriggerEvent
cmt co -r AnalysisTriggerEventTPCnv-00-00-04 PhysicsAnalysis/AnalysisTrigger/AnalysisTriggerEventTPCnv
cmt co -r AthenaROOTAccess-00-00-29 PhysicsAnalysis/AthenaROOTAccess
cmt co -r AthenaROOTAccessExamples-00-00-04 PhysicsAnalysis/AthenaROOTAccessExamples
cmt co -r EventCommonTPCnv-00-02-03 Event/EventCommonTPCnv
cmt co -r RecTPCnv-00-00-21 Reconstruction/RecTPCnv
cmt co -r TrigConfigSvc-00-00-73-01 Trigger/TrigConfiguration/TrigConfigSvc
cmt co -r TrigDecision-00-01-14 Trigger/TrigEvent/TrigDecision
cmt co -r TrigEventAthenaPool-00-01-08 Trigger/TrigEvent/TrigEventAthenaPool
cmt co -r DetDescrConditions-00-01-17 DetectorDescription/DetDescrCond/DetDescrConditions
cmt co -r NavFourMom-00-01-08 Event/NavFourMom
cmt co -r DataModel-00-12-05-01 Control/DataModel
cmt co -r GeneratorObjects-01-02-37 Generators/GeneratorObjects
cmt co -r TrkTrackSummary-00-18-03 Tracking/TrkEvent/TrkTrackSummary
cmt co -r Particle-02-04-03 Reconstruction/Particle
cmt co -r TrigSteeringEvent-01-00-22 Trigger/TrigEvent/TrigSteeringEvent
cmt co -r TrigConfHLTData-00-00-33 Trigger/TrigConfiguration/TrigConfHLTData
cmt co -r TrigConfL1Data-00-00-36 Trigger/TrigConfiguration/TrigConfL1Data
cmt co -r TrigInDetTruthEvent-00-00-18 Trigger/TrigTruthEvent/TrigInDetTruthEvent
cmt co -r JetTagInfo-00-02-25 PhysicsAnalysis/JetTagging/JetTagInfo
cmt co -r PyParticleTools-00-00-25 PhysicsAnalysis/PyAnalysis/PyParticleTools
cmt co -r PyAnalysisCore-00-00-21 PhysicsAnalysis/PyAnalysis/PyAnalysisCore
cmt co -r PyTriggerTools-00-00-06 PhysicsAnalysis/PyAnalysis/PyTriggerTools
cmt co -r TrkTrack-04-32-05 Tracking/TrkEvent/TrkTrack
cmt co -r TrkTrackLink-00-00-03 Tracking/TrkEvent/TrkTrackLink
cmt co -r TrkParticleBase-00-06-04 Tracking/TrkEvent/TrkParticleBase
cmt co -r TrkGeometry-00-10-03 Tracking/TrkDetDescr/TrkGeometry
cmt co -r TrkSurfaces-00-10-06-01 Tracking/TrkDetDescr/TrkSurfaces
cmt co -r VxMultiVertex-00-01-09-01 Tracking/TrkEvent/VxMultiVertex
```

Scripts ► compiling the tags

- insert the following lines in the requirements file in `Reconstruction/RecExample/RecExCommon/cmt`
- and do a `cmt broadcast gmake` in `Reconstruction/RecExample/RecExCommon/cmt` (takes about 1 hour on average laptop)

```
use AthenaROOTAccessExamples AthenaROOTAccessExamples-* PhysicsAnalysis
use AthenaROOTAccess AthenaROOTAccess-* PhysicsAnalysis
use EventCommonTPCnv EventCommonTPCnv-* Event
use RecTPCnv RecTPCnv-* Reconstruction
use TrigConfigSvc TrigConfigSvc-* Trigger/TrigConfiguration
use TrigDecision TrigDecision-* Trigger/TrigEvent
use TrigEventAthenaPool TrigEventAthenaPool-* Trigger/TrigEvent
use DetDescrConditions DetDescrConditions-* DetectorDescription/DetDescrCond
use NavFourMom NavFourMom-* Event
use DataModel DataModel-* Control
use GeneratorObjects GeneratorObjects-* Generators
use TrkTrackSummary TrkTrackSummary-* Tracking/TrkEvent
use Particle Particle-* Reconstruction
use TrigSteeringEvent TrigSteeringEvent-* Trigger/TrigEvent
use TrigConfHLTData TrigConfHLTData-* Trigger/TrigConfiguration
use TrigConfL1Data TrigConfL1Data-* Trigger/TrigConfiguration
use TrigInDetTruthEvent TrigInDetTruthEvent-* Trigger/TrigTruthEvent
use JetTagInfo JetTagInfo-* PhysicsAnalysis/JetTagging
use PyParticleTools PyParticleTools-* PhysicsAnalysis/PyAnalysis
use PyAnalysisCore PyAnalysisCore-* PhysicsAnalysis/PyAnalysis
use PyTriggerTools PyTriggerTools-* PhysicsAnalysis/PyAnalysis
use TrkTrack TrkTrack-* Tracking/TrkEvent
use TrkTrackLink TrkTrackLink-* Tracking/TrkEvent
use TrkParticleBase TrkParticleBase-* Tracking/TrkEvent
use TrkGeometry TrkGeometry-* Tracking/TrkDetDescr
use TrkSurfaces TrkSurfaces-* Tracking/TrkDetDescr
use VxMultiVertex VxMultiVertex-* Tracking/TrkEvent
```

- once `athena-13.0.20` and the additional tags or `athena-13.0.30` and `AthenaROOTAccessExamples-00-00-04` are setup you are ready to go
  - start with getting one AOD suitable for `13.0.20`
  - `dq2_get -r valid1_misal1_mc12.005200.T1_McAtNlo_Jimmy.recon.AOD.v13002002_tid013611 AOD.013611._00065.pool.root.14`
  - or link to my copy on lxplus scratch space: `ln -s /afs/cern.ch/user/m/menke/scratch0/athena/AtlasOffline-13.0.30/AOD.013611._00065.pool.root.14 .`
  - copy the file `AthenaROOTAccess/share/test.py` to your current directoy and edit the line
    `aodFile = 'AOD.pool.root'`
    to
    `aodFile = 'AOD.013611._00065.pool.root.14'`

- start a root session

```
laptop:~>   root
root [0]  TPython::ExecScript("test.py");
root [1]  CollectionTree_trans = (TTree *)gROOT->FindObjectAny("CollectionTree_trans");
root [2]  ClusterExample ce;
root [3]  ce.plot(CollectionTree_trans);
```

  - this should create two canvases and plot $\log_{10}(E/\mathrm{MeV})$ for positive cluster energies E and $-\log_{10}(-E/\mathrm{MeV})$ for negative E and the η distribution for the `CaloCalTopoCluster` collection

- A CINT macro for the cluster example can be executed like this:

```
laptop:~>   root
root [0]  TPython::ExecScript("test.py");
root [1]  CollectionTree_trans = (TTree *)gROOT->FindObjectAny("CollectionTree_trans");
root [2]  gROOT->LoadMacro("AthenaROOTAccessExamples/macros/cluster_example.C")
root [3]  plot(CollectionTree_trans);
```

  - this should also create two canvases and plot $\log_{10}(E/\mathrm{MeV})$ for positive cluster energies E and $-\log_{10}(-E/\mathrm{MeV})$ for negative E and the η distribution for the `CaloCalTopoCluster` collection

- but be aware of differences to C++ example
  - CINT is slower
  - iterators over `ClusterMoments` don't work in CINT (yet)

- A python script for the cluster example can be executed like this:

```
laptop:~>   python -i test.py
>>> import AthenaROOTAccessExamples.cluster_example
>>> AthenaROOTAccessExamples.cluster_example.plot(tt)
```

  - this should again create two canvases and plot $\log_{10}(E/\mathrm{MeV})$ for positive cluster energies E and $-\log_{10}(-E/\mathrm{MeV})$ for negative E and the η distribution for the `CaloCalTopoCluster` collection

- python is (on a log scale) in between CINT and compiled C++ code for this example
  - will become faster once compiled python works
  - iterators over `ClusterMoments` don't work in python either – this is due to missing dictionaries
  - the ROOT version shipping with 13.0.20 forgets about enums and thus the script has to be modified for this release (see http://www.cern.ch/menke/cluster_example.py)

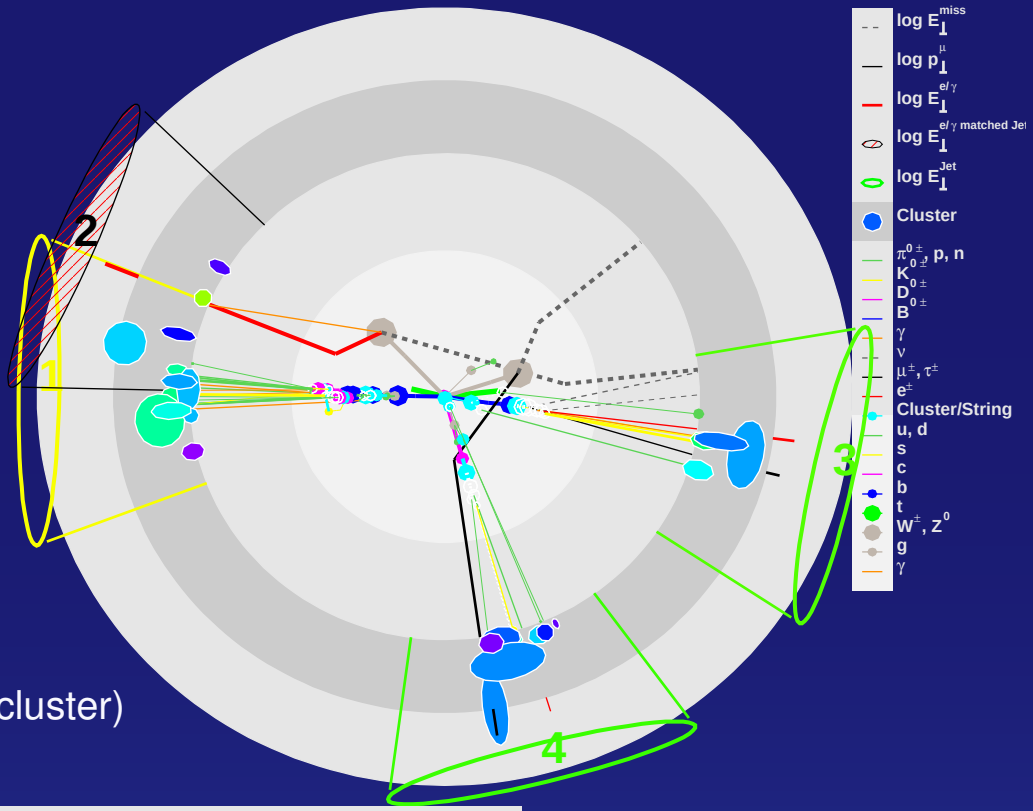
- Other C++ examples are all the classes mentioned in `AthenaROOTAccessExamples/AthenaROOTAccessExamples/selection.xml`:
  - `TruthInfo`
  - `ClusterExample`
  - `TauSelEff`
  - `tauEffTest`
- the can all be instantiated from `root` but differ in the name of the maim method to be called:
  - `void TruthInfo::truth_info(TTree * trans);`
  - `void ClusterExample::plot(TTree * trans);`
  - `void TauSelEff::tau_seleff(TTree * trans);`
  - `void tauEffTest::execute(TTree *trans);`

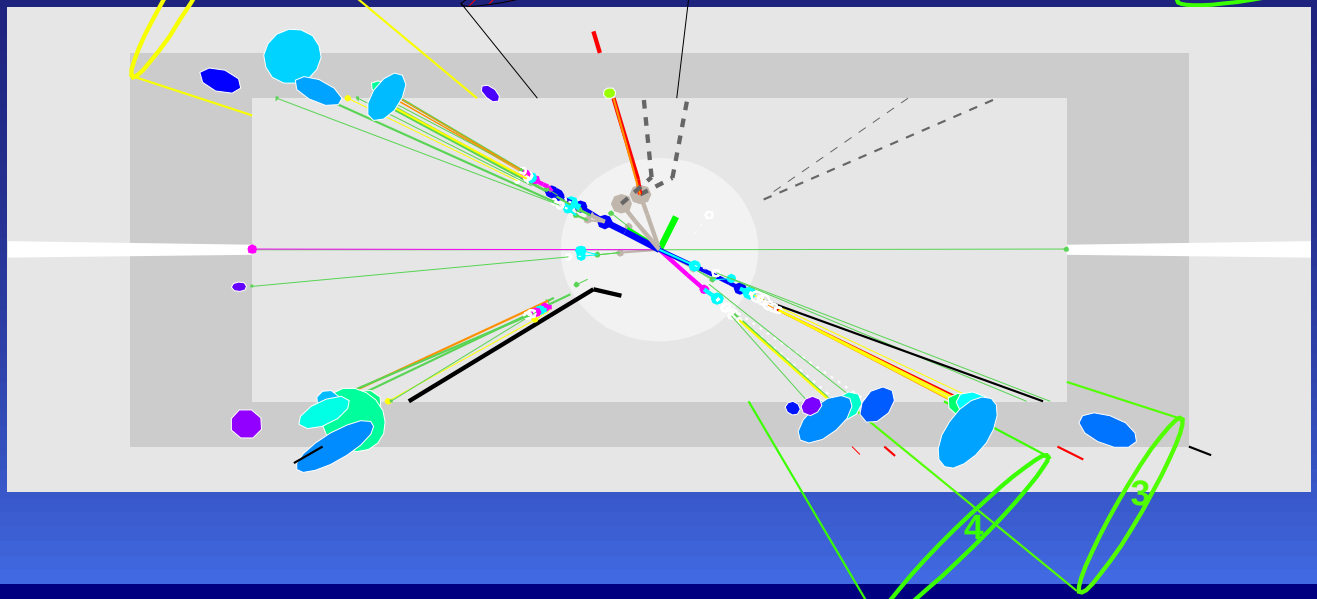
- visualization example for AOD based on the following containers:
  - MC truth on the AOD (`SpclMC`)
  - topo clusters (`CaloCalTopoCluster`)
  - Kt jets from topo clusters (`Kt4H1TopoParticleJets`)
  - Muons (`StacoMuonCollection`)
  - Electrons (`ElectronAODCollection`)
  - MET and tracks to be added in `13.0.30`
- http://www.cern.ch/menke/plotVerticesARA.C creates an $r - \phi$-view and an $r - z$-view of the objects in the above containers
  - for MC truth the displayed lines represent particles connecting production and decay vertex with η, ϕ at each vertex corresponding to the particle decaying there. Color indicates the pdgID, line width the energy and vertex size the mass
  - clusters are drawn as colored ellipses indicating the position, depth and width in the calorimeter (shape) and the energy (color)
  - jets are indicated by fixed size cones (so for Kt the outline is not exactly correct); numbers and color indicate transverse energy order; overlaps with electrons (with more than 50% of the jets energy carried by the matched electron) indicated by black cone with red strips
  - electrons (red) and muons (black) drawn as short lines (length indicates transverse energy) beyond cluster layer

Tutorial ► Pseudo Event Display

```
laptop:~>   root
root [0]  TPython::ExecScript("test.py");
root [1]  CollectionTree_trans = (TTree *)
          gROOT->FindObjectAny("CollectionTree_trans");
root [2]  gROOT->LoadMacro("plotVerticesARA.C")
root [3]  plotVerticesARA(CollectionTree_trans,7);
          // plot Event 7
```

- this event is a $t\bar{t}$ di-lepton example
  - 2 b-jets (1 and 3)
  - one jet (2) coinciding with 1 high energetic electron
  - one jet (4) from the UE
  - μ and e reconstructed (the μ even makes a cluster)
  - one b-jet with 2 softer leptons





Discussion

- Feedback on the Examples
  - are the examples useful?
  - what is missing, needed?
- Feedback on development of own examples
  - did you manage to run your own analysis with `AthenaROOTAccess`
  - if not, what was missing?
- Questions, Answers, Wishes ...