Implementation of the Trigger computation in the AthenaROOTAccess framework

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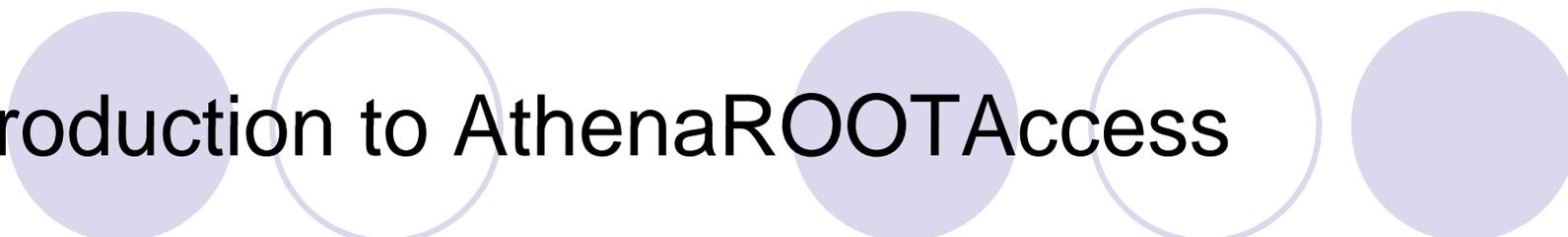
Introduction to AthenaROOTAccess

- AthenaROOTAccess (ARA) allows reading data in ROOT directly
  - No need to access Athena framework (StoreGate, Gaudi)
- ARA can read AOD (Analysis Object Data) as well as DPD (Derived Physics Data)
- Access the objects directly
  - "containers"
- Limitations:
  - Detector description, Magnetic field etc cannot be accessed
  - Trigger information
- Documentation
  - https://twiki.cern.ch/twiki/bin/view/Atlas/AthenaROOTAccess
- Tutorials on ARA (how to setup and run, examples etc):
  - New: C. Anastopoulos and B. Lenzi Friday 4 July, afternoon.
  - Previous: https://twiki.cern.ch/twiki/bin/view/Atlas/PhysicsAnalysisTools

Access Trigger in ARA

- Access the trigger information via TrigDecisionTool (since release 13.)
  - Athena Tools and services
    - Configuration (XML, Trigger DB, Condition DB, data header (Meta Data))

- In ARA, missing tools and services
  - to access the configuration and decode the trigger information
  - To look prescale/pass through factors

- Release 13.0.30, S. George provided quick solution
  - Talk on "AthenaROOTAccess: trigger information", Nov 2007

Access Trigger in ARA (cont'd)

- Trigger decision : via hard coded map
  - Trigger/TrigEvent/TrigEventARA
  - Map of names and bits
    - Bits are stored in TriggerInfo (part of EventInfo)
    - Check the menus for the trigger name
    - 140 LVL1 items 285 chains/HLT
      - LVL1 can be accessed in release 13.0.40

- Caveats
  - Check the menus:
    - For existing chains for a particular release
    - Presscale/ pass through factors
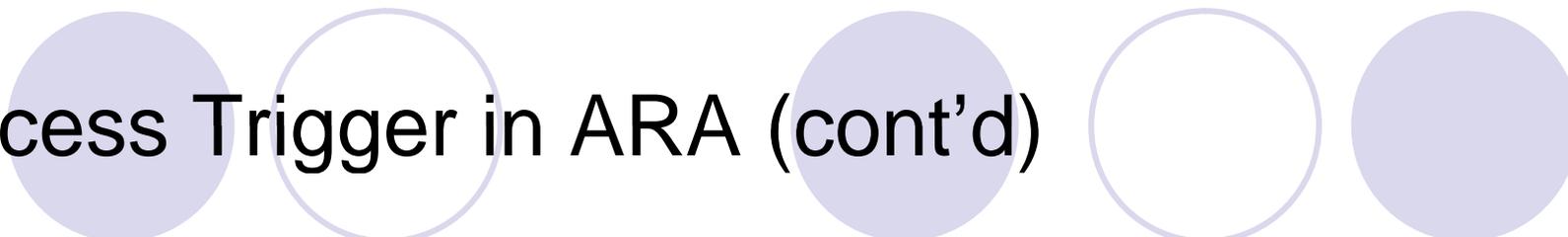
Access Trigger in ARA (cont'd)

- In order to get an answer if an event passes a particular trigger:
  - Setup the branch "McEventInfo"
  - Instantiate TriggerBitDecoder
    - isPassed (<trigger item/chain>, <pEventInfo>)

- No information on due to which track, trigger is fired.

- A bit complicated and not supported way
  - Talk by Till Eifert, "TriggerAnalysis with ARA", on April 30.

H → 4l analysis in ARA

- Saclay and Sheffield group provided HiggsToFourLeptonARA package under PhysicsAnalysis/HiggsPhys/
  - HiggsToFourLeptonARA-00-00-14 in CVS
  - Details in P. Fleischmann talk on Friday WP3 session.
- Higgs to four lepton full analysis (H →4e / 4μ / 2e2μ / 2μ2e)
- Validation plots
  - Release/data
  - Aim : Observe any inefficiencies/variations in the data/release (reconstruction etc)
  - Electron : ControlPlotsElec.cxx
  - Muon: ControlPlotsMuon.cxx
  - Photon: ControlPlotsPh.cxx
  - Trigger: ControlPlotsH4lTrig.cxx
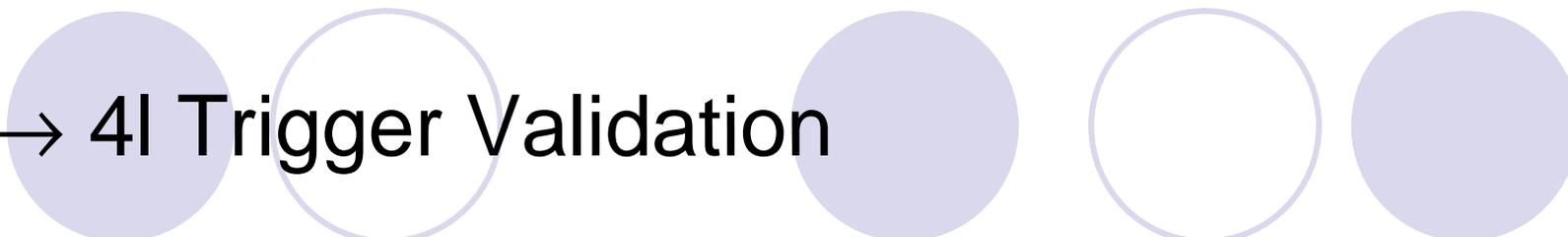
H $\rightarrow$ 4l Trigger Validation

- Main class is HiggsToFourLeptonARA/TriggerAlgorithms and several small classes
  - It can be called in any analysis for a given mode and trigger item(s)/chain(s) or combination of trigger items/chains
  - Compute the trigger efficiency for a given trigger item/chain
  - Provide validation plots : efficiency versus kinematic parameters p_T, η, ϕ, higgs mass, mass of Z and Z*
  - TriggerAlgorithms:: TriggerAlgorithmsInit()
  - TriggerAlgorithms:: getDecision (…)
  - TriggerAlgorithms::TriggerAlgorithmsTerminate()
- HiggsToFourLeptonARA/ControlPlotsH4lTrig.cxx class
  - README_triggerValidation : details how to run and obtain the efficiency and validation plots for H $\rightarrow$ 4l

H → 4l Trigger Efficiency

- Higgs to four leptons (4e, 4μ, 2e2μ and 2μ2e) analysis
  - Electron and muon trigger items/chains and their combinations (logical or/and)
    - μ20, e22i, μ20 or e22i
    - Naming convention : (level)_(mult)(type)(threshold)(additional info)
      - EF_e22i : selecting electrons with p_T > 22 GeV at EF level (i = isolation)
      - EF_2mu10 : Two muons p_T>10 GeV at EF level
   - Trigger Chain
      - EF_e22i → L2_e22i → L1_EM18I

Release

14.1.0

	Unbiased sampl·e			After Event Selection		
	4e	4μ	2e2μ	4e	4μ	2e2μ
μ20	0.1	95.3	71.4	0.3	98.2	71.2
e22i	94.7	0.4	68.6	99.5	0.1	79.6
2e15i	76.4	-	33.3	95.1	-	54.5
μ20 or e22i	94.7	95.3	95.8	99.5	98.2	98.8
X	76.5	93.3	87.9	95.1	97.3	96.1

X = 2μ10 or 2e15i or (μ10 and e15i) ▪

H → 4l Trigger Validation

- We have spotted large inefficiency in the HLT (L2 and EF) electron trigger chains (e25i and 2e15i) from the pile up sample produced in 13.0.40.
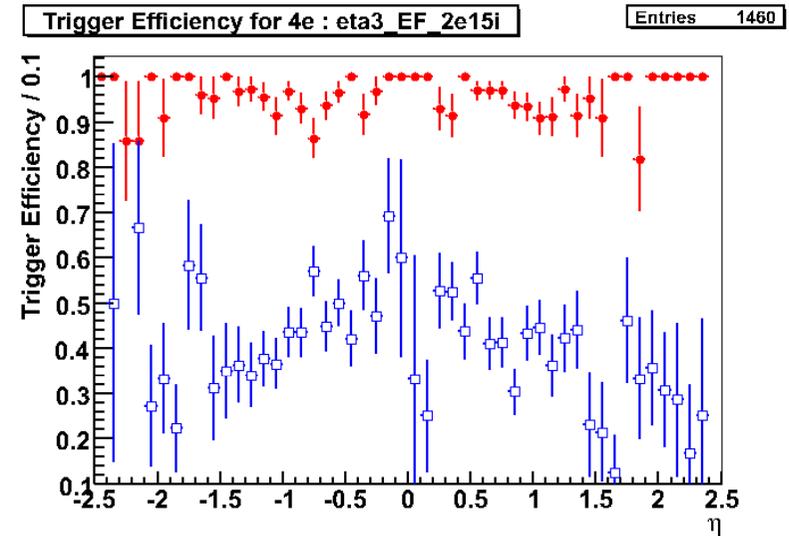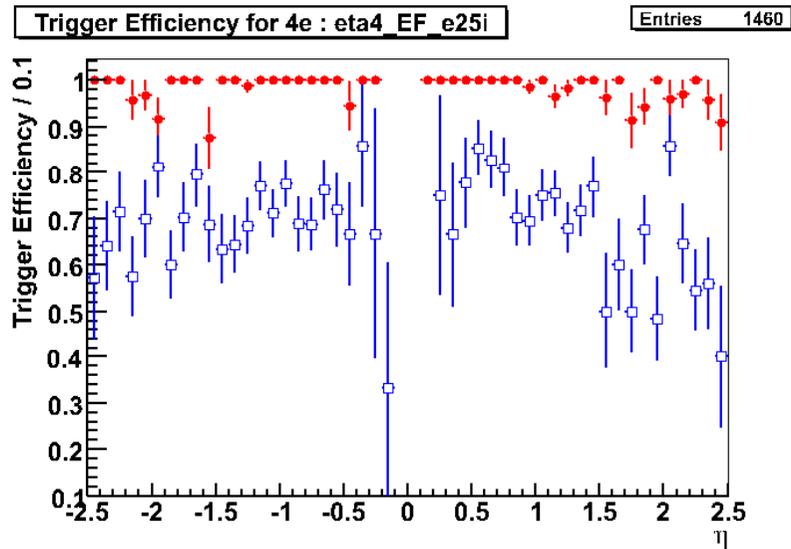
The problem was found in the pileup reconstruction and fixed
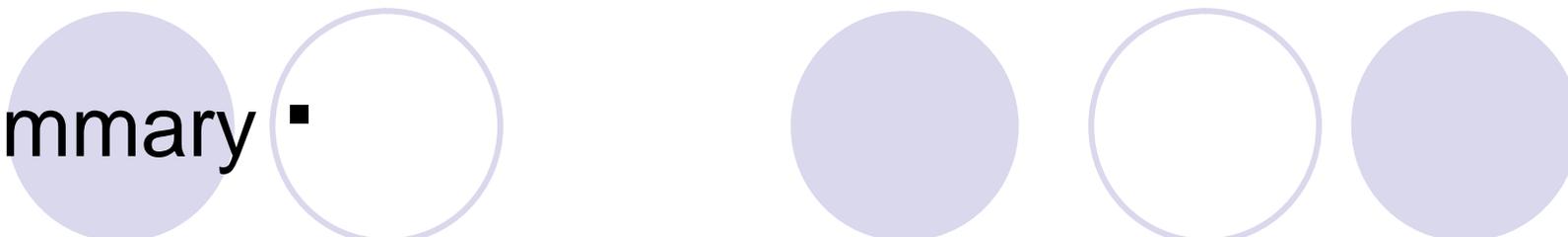
Summary

- Trigger information can be obtained in ARA (with limited features)
  - Near future, in release 14 accessing the trigger objects will be easier

- Saclay-Sheffield group delivered HiggsToForLeptonsARA package.
  - The package contains full H $\rightarrow$ 4l analysis and several validation classes including the trigger one.
  - We report our results in sevaral groups in ATLAS.