



# Moore status

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Niels van Eldik on behalf of the Moore group



# Overview

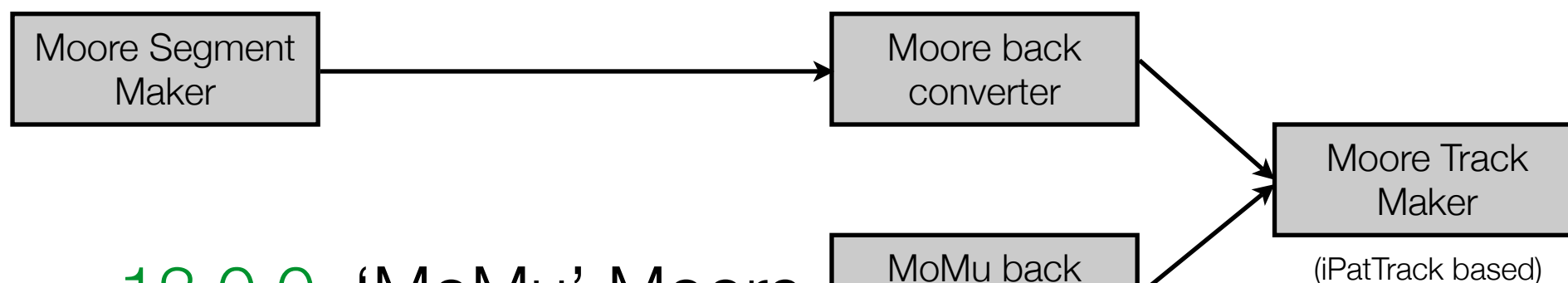
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- Migration of Moore to Trk::Track
  - Integration with trigger
- Improvements for cavern background
- Developments in track analysis
- Deliverables for 14

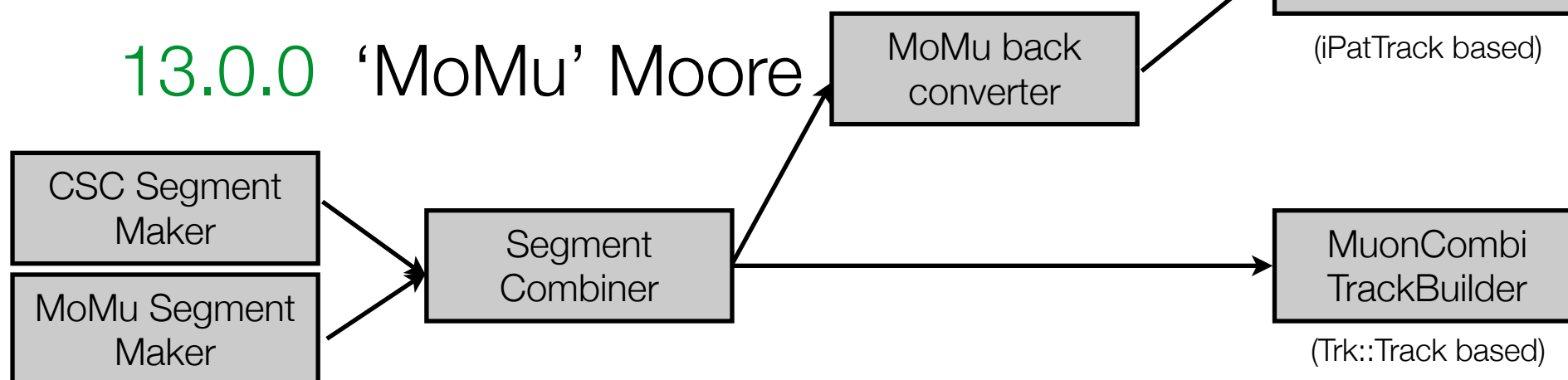


# Algorithmic sequence in the three Moore chains

## 12.0.0 'old' Moore



## 13.0.0 'MoMu' Moore



## 14.0.0 MoMu + MuonCombiTrackBuilder



# Integration with the high level trigger

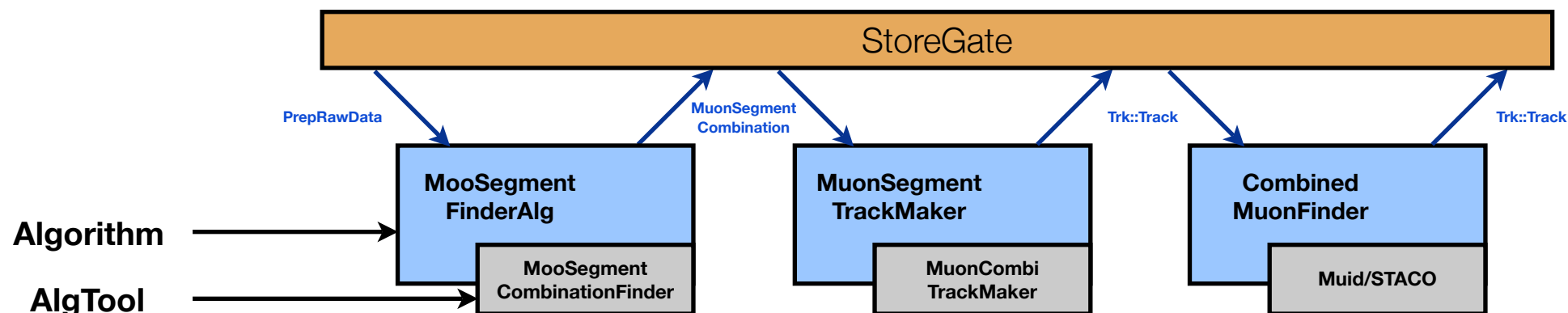
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- Moore algorithm used by HLT muon trigger (TrigMoore)
  - Old design Algorithm based, difficult to integrate in trigger
    - data driven instead of RIO driven
  - TrigMoore duplicated part of the Moore code
    - potential source of bugs
    - trigger not always in sink with latest offline version
- Solution: move algorithmic code into AlgTools
  - Algorithms purely read and write data
  - Scheme already successfully used by the Inner Detector
- Introduce three reconstruction 'phases'
  - Segment finding, track finding, combined reconstruction

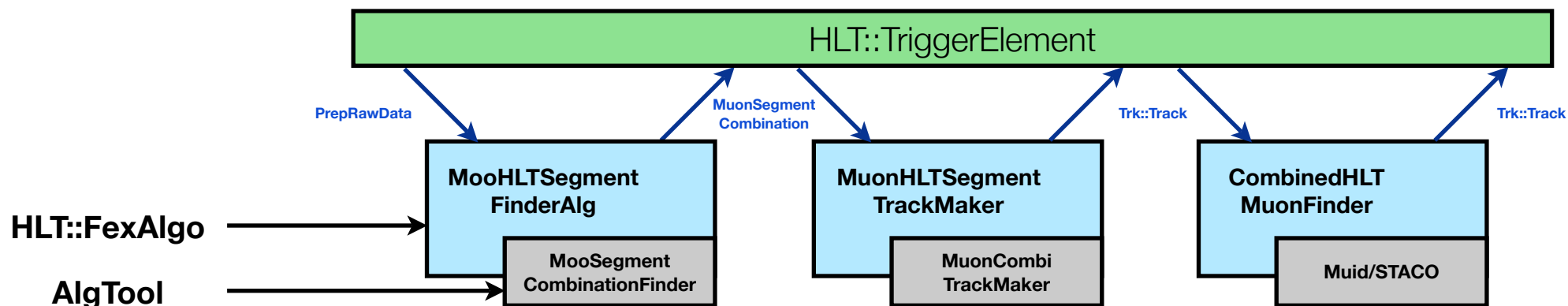


# Data flow new design

## Offline

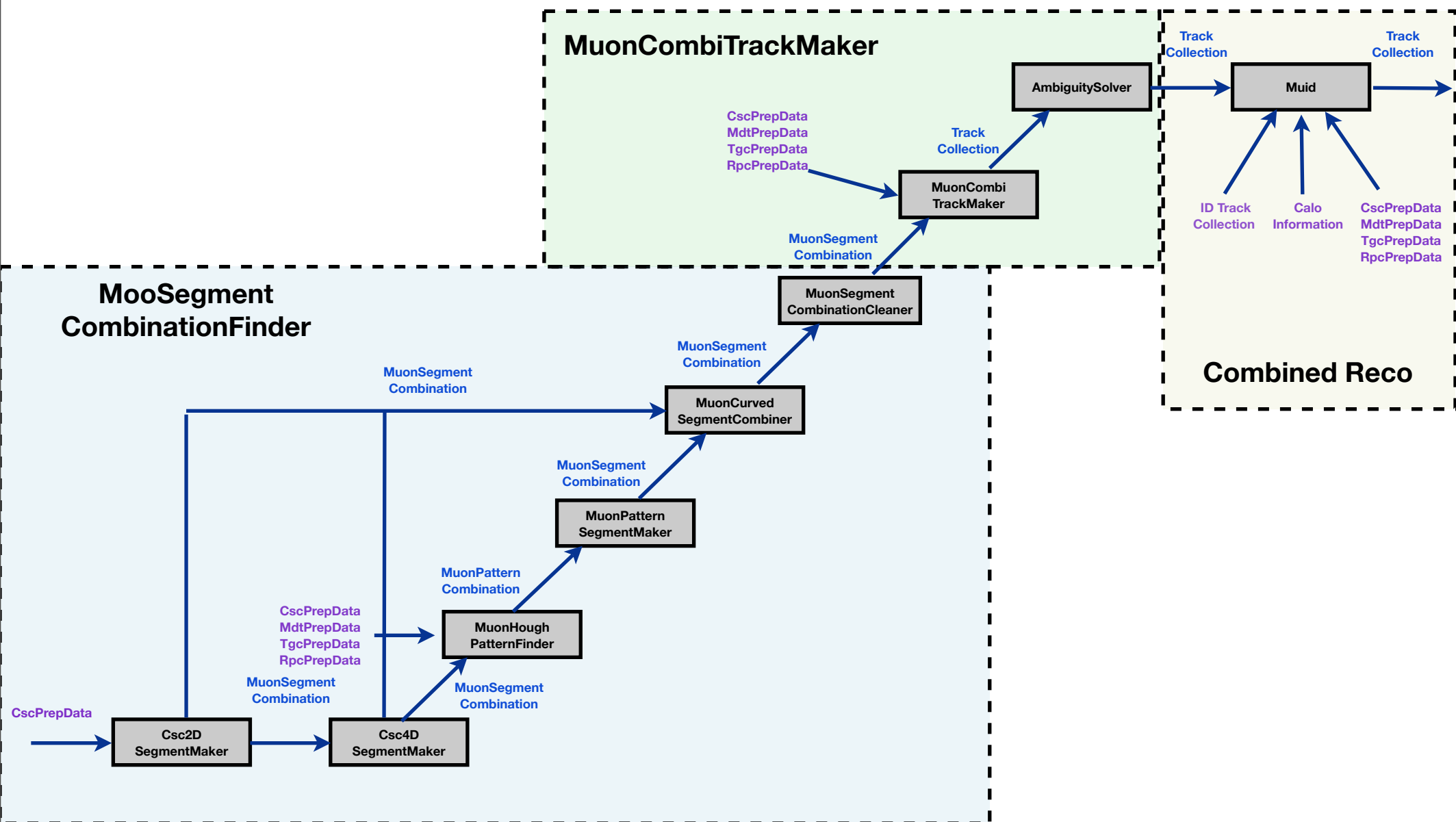


## Online





# Detailed overview of AlgTool sequence





# Status of migration

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- Prototypes for Segment and Track finding available for testing
  - Code available in CVS since last week (thanks to Ed and Woonchun)

- many packages modified:

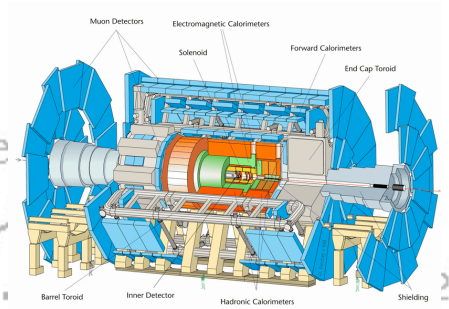
MuonSpectrometer/MuonReconstruction/MuonSegmentMakers/MuonSegmentMakerAlgs/CscSegmentMakers  
MuonSpectrometer/MuonReconstruction/MuonRecTools/MuonRecToolInterfaces  
MuonSpectrometer/MuonReconstruction/MuonPatternFinders/MuonPatternFinderTools/MuonHoughPatternTools  
MuonSpectrometer/MuonReconstruction/MuonTrackMakers/MuonTrackMakerTools/MuonCombiTrackMaker  
MuonSpectrometer/MuonReconstruction/MuonTrackMakers/MuonTrackMakerAlgs/MuonSegmentTrackMaker  
MuonSpectrometer/MuonReconstruction/MuonRecTools/MuonAssociationTools  
MuonSpectrometer/MuonReconstruction/MuonSegmentCombiners/MuonSegmentCombinerTools/MuonSegmentCombinationFinder  
MuonSpectrometer/MuonReconstruction/MuonSegmentCombiners/MuonSegmentCombinerTools/MuonCurvedSegmentCombiner  
MuonSpectrometer/MuonReconstruction/MuonSegmentCombiners/MuonSegmentCombinerTools/MuonSegmentCombinerToolInterfaces  
MuonSpectrometer/MuonReconstruction/MuonSegmentMakers/MuonSegmentMakerTools/MuonSegmentMakerToolInterfaces  
MuonSpectrometer/MuonReconstruction/MuonSegmentMakers/MuonSegmentMakerTools/MuonPatternSegmentMaker

- Currently undergoing testing in MIG4 nightly
  - Will go into 14.0.0 branch as soon as 13.2.0 is build
  - Full migration + integration with trigger foreseen before 14.0.0



extrapolation

Refere



# Moore Cavern background Improvements

Peter Kluit

Jochem Snuverink  
(NIKHEF)

Reference surface

Linear extrapolation

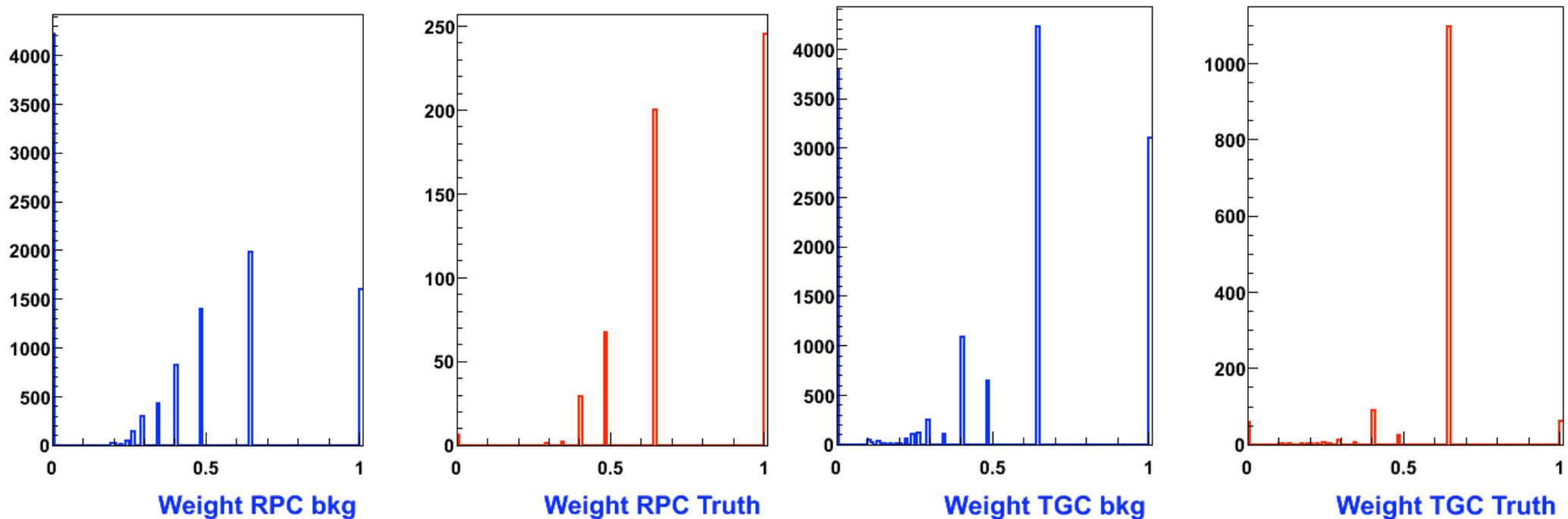
# Performance of RPC and TGC

Method: Clustering the trigger hits

Can remove background  $w = 0$  (unclustered)

After cut RPC: 544 truth / 6744 bkg  $S/B \sim 1/11$

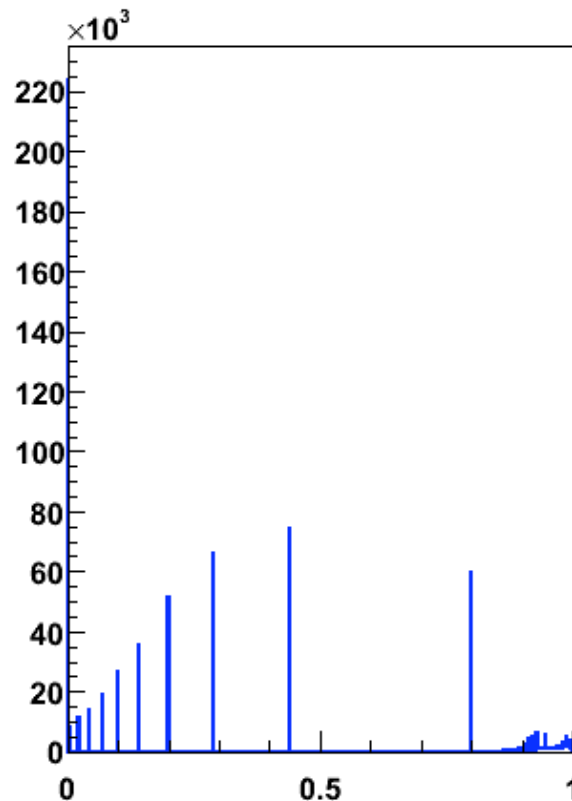
After cut TGC: 1311 truth / 9797  $S/B \sim 1/7$



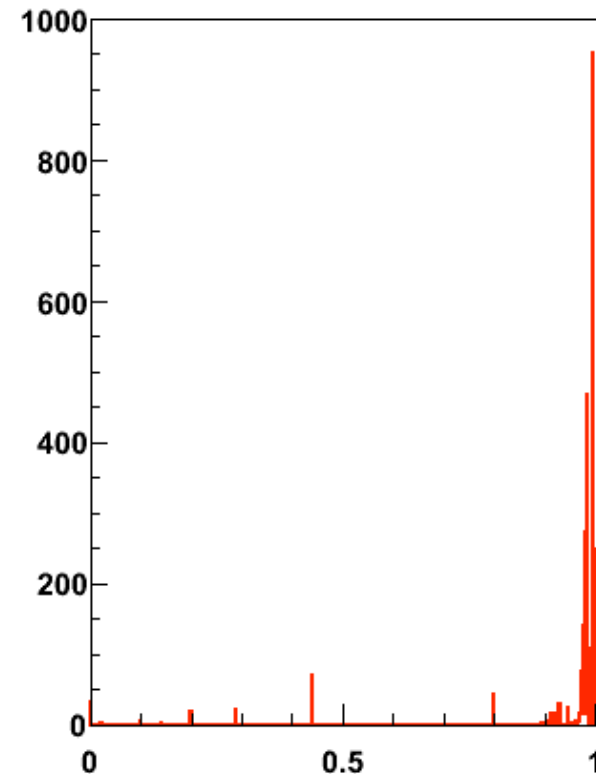
# Performance of MDT I

Ingredients: clustering, trigger confirmation,  
segment hit and angle in one combined weight variable

Can remove background  $w = 0$  (unclustered)  
after cut 3180/ 545000  $S/B \sim 1/170$



Combined weight bkg

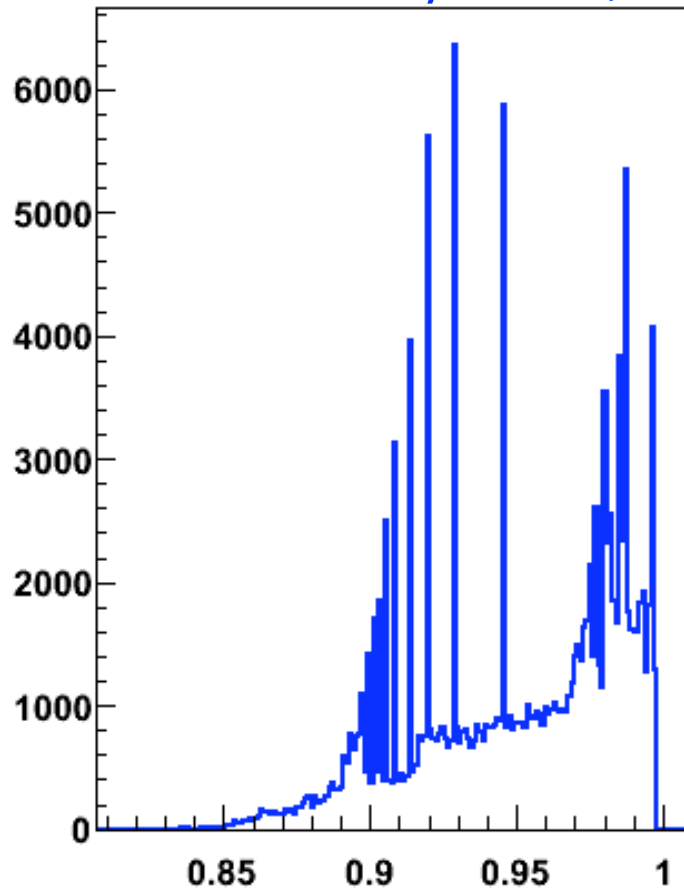


Combined weight Truth

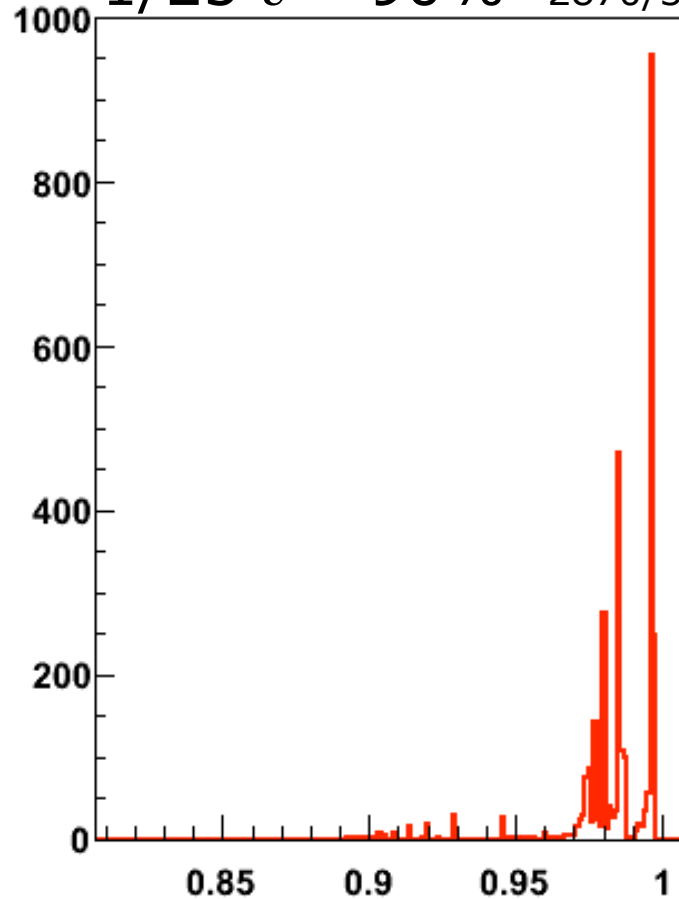
# Performance of MDT II

Cutting at 0.8 S/B  $2996/150000 \sim 1/50$   $\varepsilon = 93\%$   $2996/3215$

0.95 S/B  $2870/76000 \sim 1/25$   $\varepsilon = 90\%$   $2870/3215$



Combined weight bkg



Combined weight Truth

# Pattern reco changes I

## HoughPatternAlg:

- \* Implement new hit **weights for Cavern background**
  - fix bug in rpc/tgcloop in addmdtcollection()
- \* Add inner chambers (barrel) and outer chambers (endcap) to stationmaps
- \* doSummary flag

## HoughPatternTool:

- \* Add method calculateWeights(), that recalculates (mdt) weights per event, based on rejection factor and number of mdt hits
- \* **Phi Cleaning**
  - phi cleaning rewritten on basis of distance instead of angle (didn't work for csc's /forward region)
  - only one hit per iteration cleaned for phi pattern
  - less stringent cleaning (62mm -> 125 mm)
- \* Phi patterns with only 1 hit possible
- \* Weight rescaling (reduced weights in later stages) is switched off
- \* Add possibility to cut on mdt weights, dependent on number of mdt hits in event (  $m\_weight_{mdt} = 1. - 5./std::sqrt(mdthits);$  )
- \* Add possibility to cut on weights for all technologies
- \* Change stepsize **rzcosmics** from 1 to 2 degrees

# Pattern Reco changes II

## MuonCombinePatternTool:

- \* **Associate phi hits to pattern:**

- always make eta pattern + phi pattern from associated hits (robustness)
- cleaning for newly created associated phi pattern
- \* only one hit per iteration cleaned for newly created associated phi pattern
- \* fix bug, no empty cleaned phi patterns
- \* fix for associated phi pattern charge
- \* require 25% of hits phi pattern within distance of eta pattern
- \* no duplication of associated hits

## MuonHoughPatternEvent:

- \* MuonHoughTransformer\_CurvedAtACylinder: new weighting factor based on eventsize and angle offset
- MuonHoughMathUtils: check in signedDistanceCurvedToHit() not too large rotation
- MuonHoughPattern: updateParameters() method (for rphi): remove weights and update formula for pattern with one hit case
- \* updateParameters() uses IP
- \* MuonHoughTransformer\_rzcosmics: small cpu improvements

# Changes MuonCalibExtraTreeAlg

## Stores tracks on CalibrationNtuple

- Including hits, pulls, scattering centra,  $X_0$
- Allows truth hit matching in muon system
- New joboption doRTT
  - runs TrackAnalysis code on ntuple and produces histogram file
  - Histograms use hit truth matching
  - Macro's make standard plots for segments/hits on track
  - Log file gives detailed diagnostics of reconstruction program:
    - patterns, segments and tracks
- New additions:
  - Backextrapolation of Trk from Muon System to IP using MuonTrackThroughCalo with/without calorimeter measurements
  - Acces container of Trks at vertex and store track parameters [Muonboy vtx, MuIdStandalone]
  - Acces Combined Muon Trks and store tracks + hits [Staco/MuId]
- Allows: study Eloss, combined reconstruction using hit truth
- Underway: truth matching for these tracks



# Remaining problems in 13.2.0 branch

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- Failing nightlies:
  - several memory leaks in segment and track finding
    - fixed in the latest versions in CVS
    - not all tags in 13.2.0 yet
  - one remaining assert in the fitter
    - fix expected soon



# Deliverables for 14.0.0: focus on performance

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- Segment Finding
  - Integrate DHough segment finder
  - Improve CSC segment finding
  - 3D segments in middle stations
- Track finding
  - Evaluate seeding + fake hit recreation
  - Refit with IP constraint
  - Seeded segment search
  - Hole recovery
  - CPU performance (propagation)
- Combined reco
  - Migration of Muid
  - Hit level evaluation of combined reco
- Validation
  - Improve RTT output
  - Add ATN tests
  - Add summaries (finalize) + counters
  - Add truth to MuonTrackNtuple/MooPerformance
  - Monitor memory usage
  - Finish hit level truth matching in Athena



# Conclusion

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- Major changes within Moore during release 13
  - new track and segment finding, large fraction of the algorithmic code replaced
  - move from Algorithms to AlgTools to improve integration in HLT
  - changes in place in the latest MIG4 nightlies
  - most functionality in place
- Towards 14.0.0
  - finish full chain: complete Muid migration
  - start focussing on performance
  - tune algorithms on simulation and cosmics
  - improve diagnostic tools
    - RTT, ATN, TrackAnalysis, MooPerformance