# Status of Trigger deliverables
## (WP1.a)

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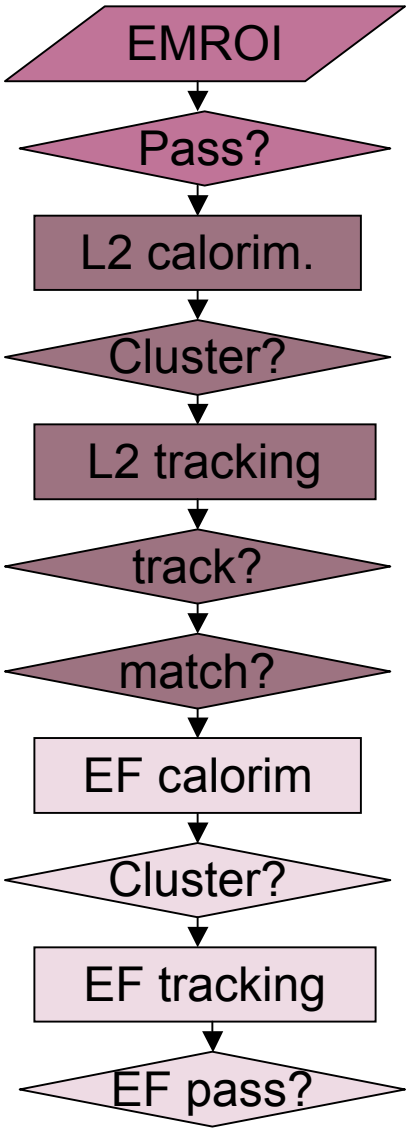
# Outline

- Introduction: ATLAS trigger and L2 tracking
- Artemis deliverables
- Ongoing work in L2 tracking (IDScan)
- Summary and Outlook

# Introduction

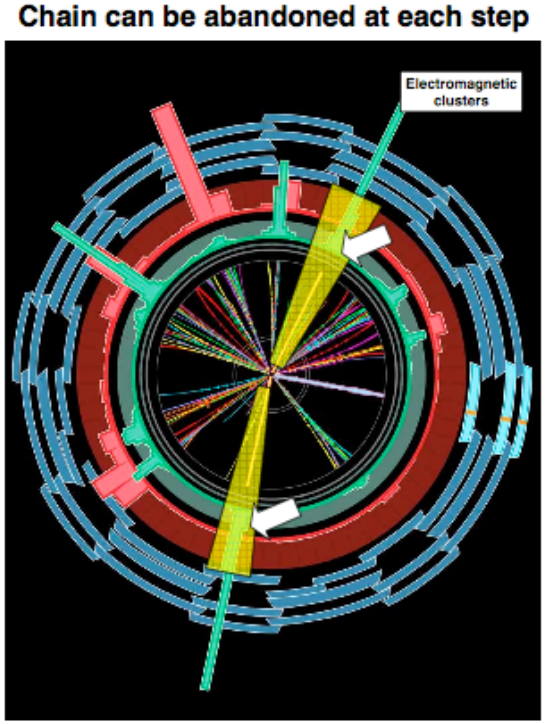
Example: e/gamma




Level 1: **Region of Interest** is found with **coarse granularity** and position in EM calorimeter is passed to Level 2
Latency 2.2μs

Level 2 seeded by Level 1
**Fast** reconstruction algorithm (calorimetry and tracking)
**Full granularity** for reconstruction in RoI's used
Latency ~10ms

Event Filter seeded by Level 2
**Offline** reconstruction algorithms using full alignment and calibration
Latency ~1s



# Tracking at LVL2

- LVL2 is the earliest stage where
  - data from tracking detectors is available
  - it is possible to combine information from different sub-detectors (full granularity calorimeter and precision muon information)

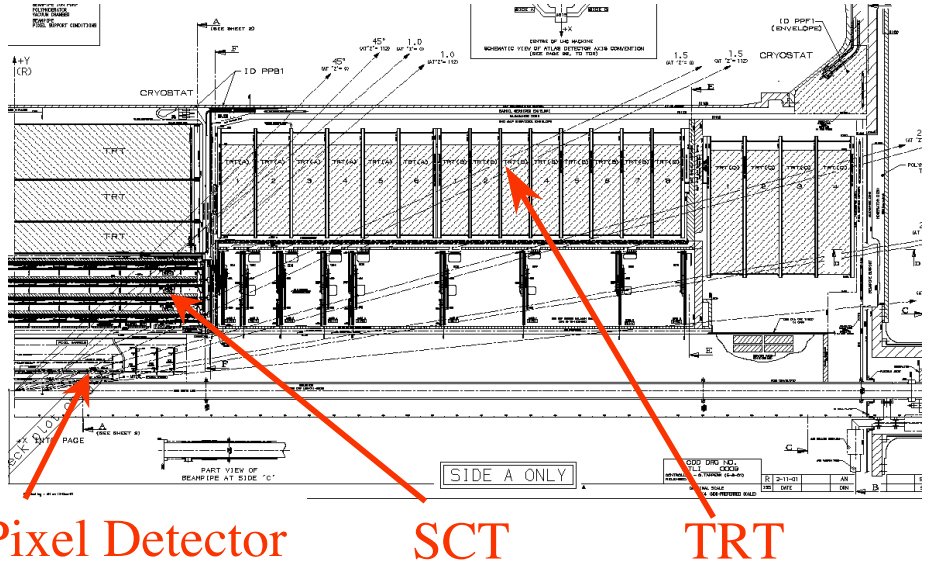
  ➔ High rejection power at L2

- Tracking is needed for verifying several signatures with different requirements:
  - Identification of high $p_T$ leptons with high efficiency
  - B-physics: high efficiency down to low $p_T$ (~2GeV/c) required for B hadron decays
  - Inclusive b-jet identification for new physics in fully hadronic final states.

    Also high purity tracking is then required down to low $p_T$ to avoid fake tracks.

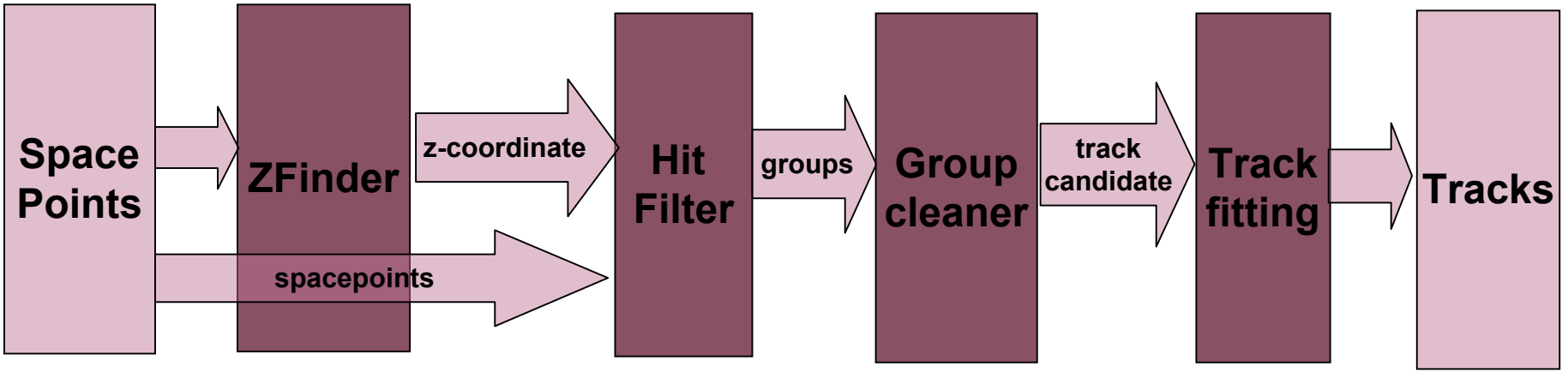
# Tracking at LVL2 - Algorithms

- Precision tracking at ATLAS mainly from the Inner Detector:
  - 3 layer Pixel Detector (3 layers in the end caps)
  - 4 layer Semi-Conductor Tracker (SCT) (9 layers in the end caps)
  - Transition Radiation Tracker (TRT)




- Two approaches for the Silicon tracking
  - SiTrack:track reconstruction based on SP triplets in Pixel and SCT which are taken as track candidates; estimate parameters is extracted from equation of the circle connecting the points in the R/Phi plane
  - IDScan: Complete (all layer) silicon tracking, performs pattern recognition taking SP found in Pixel and SCT as input; consists of a series of subalgorithms

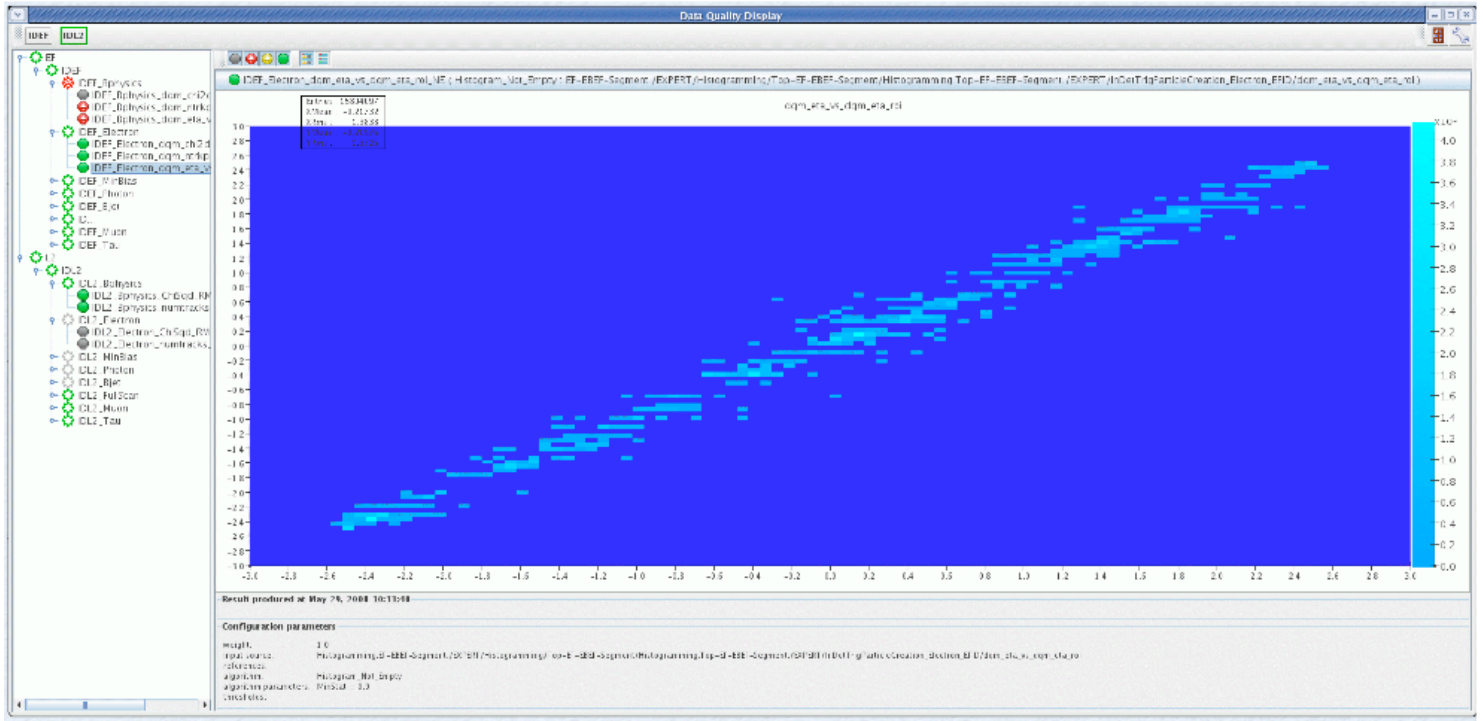
# IDScan




- IdScan (Inner Detector Scan) Algorithm in four stages
  - Z Finder: finds z position of primary interaction vertex (histogramming algorithm)
  - Hit Filter: finds groups of SPs compatible with tracks from z position (histogramming algorithm)
  - Group cleaner: splits group into tracks and removes noise from groups
  - Track fitter: verifies track candidates and determines track parameters using a Kalman filter fitter; extrapolation to the TRT

# Artemis deliverables for WP1.a (1)

- "Tools for monitoring the performance of track reconstruction in the ATLAS LVL2 Trigger" (due in month 13)
  - DQ monitoring for Tracking, e.g.
    - How many tracks/RoI were reconstructed
    - How many SiSpacepoints/track were used
    - Track parameters monitoring



# Artemis deliverables for WP1.a (1) (cont.)

- Monitoring and tuning tools:
  - Root package for producing standard plots
    - offline/Trigger/TrigAnalysis/TrigInDetAnalysis
  - Package for RTT tests
    - offline/Trigger/TrigValidation/TrinInDetValidation
    - To be extended to all slices, pile-up data sets etc.

# Artemis deliverables for WP1.a (2)

- "Measurement of the Trigger efficiencies from the data" (due in month 25, may be affected by LHC schedule)
  - Current analysis code being updated to use offline tracks instead of MC tracks → done
  - Planned Items:
    - Comparison of L2 vs EF vs offline
    - Comparison amongst different detectors: Tracks from muon system. TRT vs silicon tracks
    - Comparison Chains with L2/EF pass-thru
    - tag & probe: so far done only by physics groups

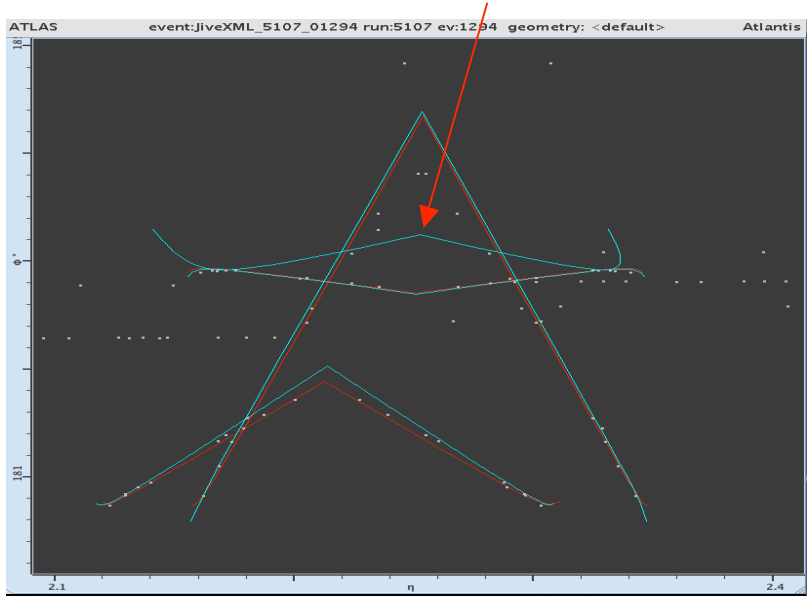
# Debugging Tools

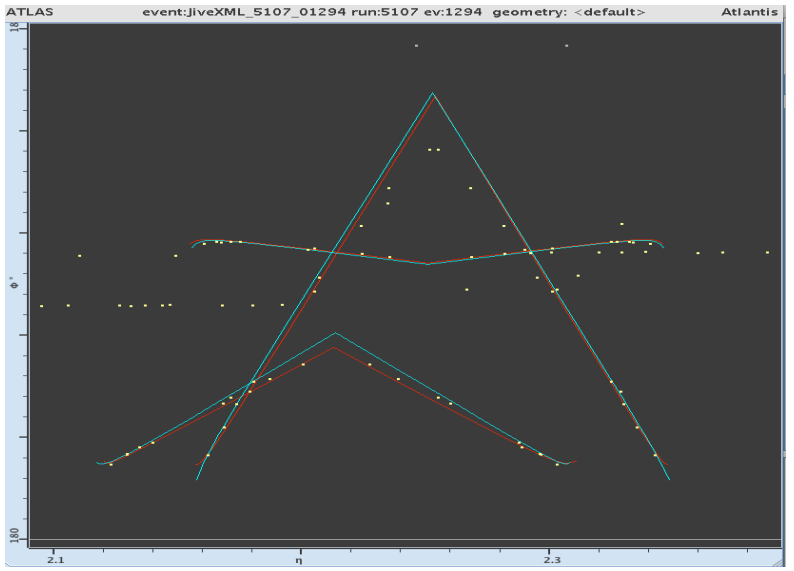
- Tools for fast identification of problems and quick solutions, e.g. for tau slice:
  - Write out events of interest from RDO dataset into a single RDO (https://www.hep.ucl.ac.uk/twiki/bin/view/HEPGroup/EventSelectionRDOtoRDO)
  - Various different options can be used in jobOptions:
    - Possible to run a specific Trigger slice/signature only
    - Possible to run only L2 tracking/switch on offline tracks
  - Produce JiveXML files from created RDO→ Atlantis

    Possible to detect bugs, see example next slide
  - IDScan standalone:
    - independent from Athena, very fast and useful for debugging
  - Engaging the needs of individual slices to optimize performance
    - Actively using/learning performance tools for egamma, tau, b-jet and B-physics slices

# Bug fix with Atlantis' help

- Bug in HitFilter:
  - The requirement that more than 45% of hits shouldn't be shared was only applied for same-sign tracks
  - This caused a fake track

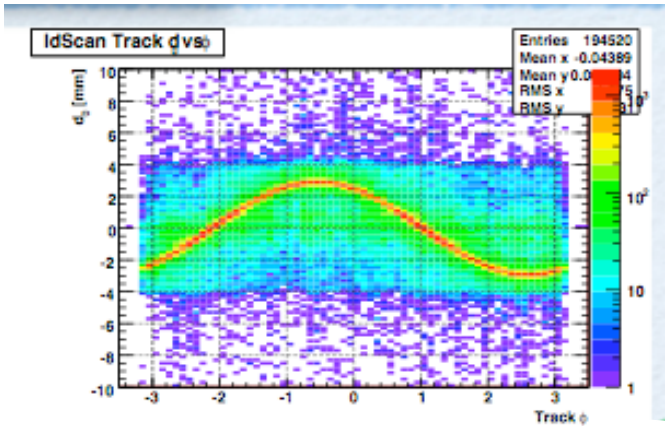


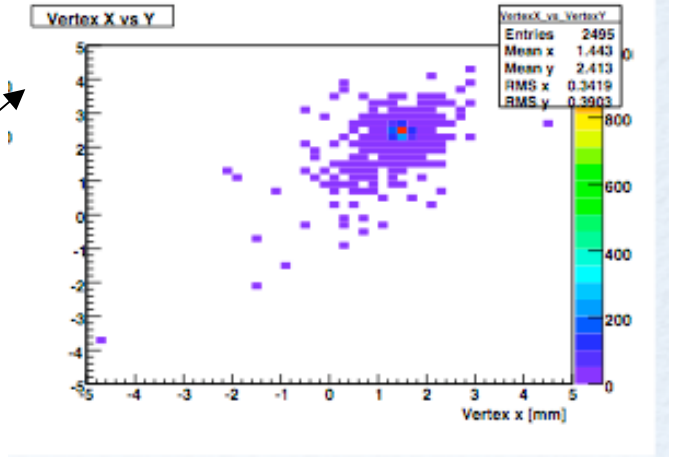

- Provides improvement over shared hits parameter (similar reduction in fake rates while still no drop in efficiency)
  - Previously: Allow only 2 shared hits with other tracks (at the moment 3)
    (see talk:http://indico.cern.ch/conferenceDisplay.py?confId=32796 )

# Further ongoing work

- Offline (tier 0, caf) monitoring of trigger (Erkcan Ozcan, Stefan Ask)
- Beamspot position:
  - Useful for constraining primary vertex, improving L2 tracking and L2 b-tagging
  - Two lines of work:
    - Robust tune of IDScan against highly displaced beamspots
    - Using identified beamspot position as feedback to IDScan




IDScan




$10^{33}$ lumi, misalinged geometry
Displaced vertex (1.5, 2.5, -9.0)mm

# Summary & Outlook

- Artemis deliverables:
  - Online monitoring tools ☑
  - Efficiencies from data ☒
- Tools for debugging in place
  - Selection events of interest to view Atlantis
  - IDScan standalone
  - Tools provided from working groups
- Ongoing work
  - Beamspot measurement
  - Offline monitoring
  - Continue tuning of trigger slices