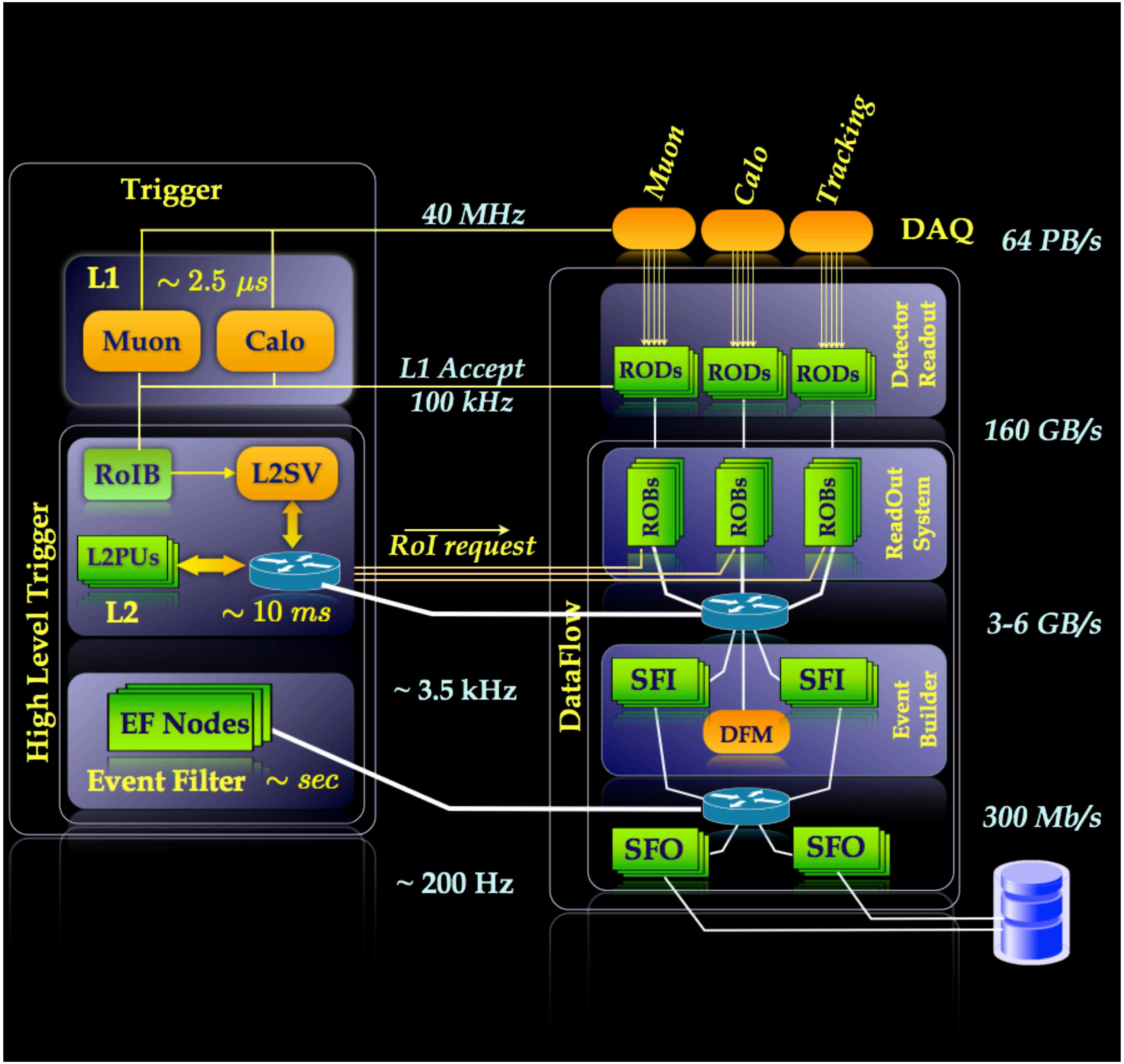
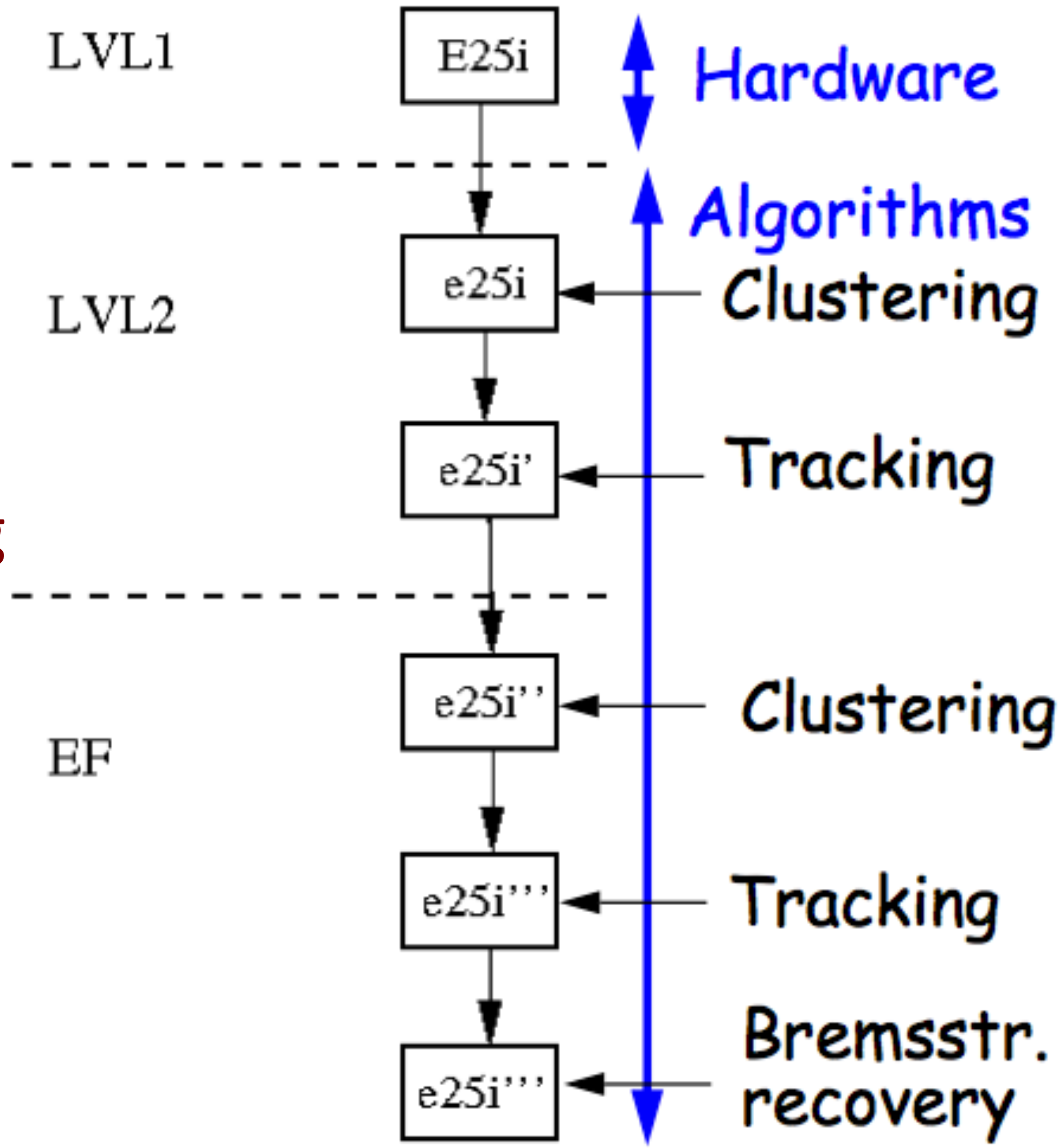
Introduction to ATLAS HLT Calo

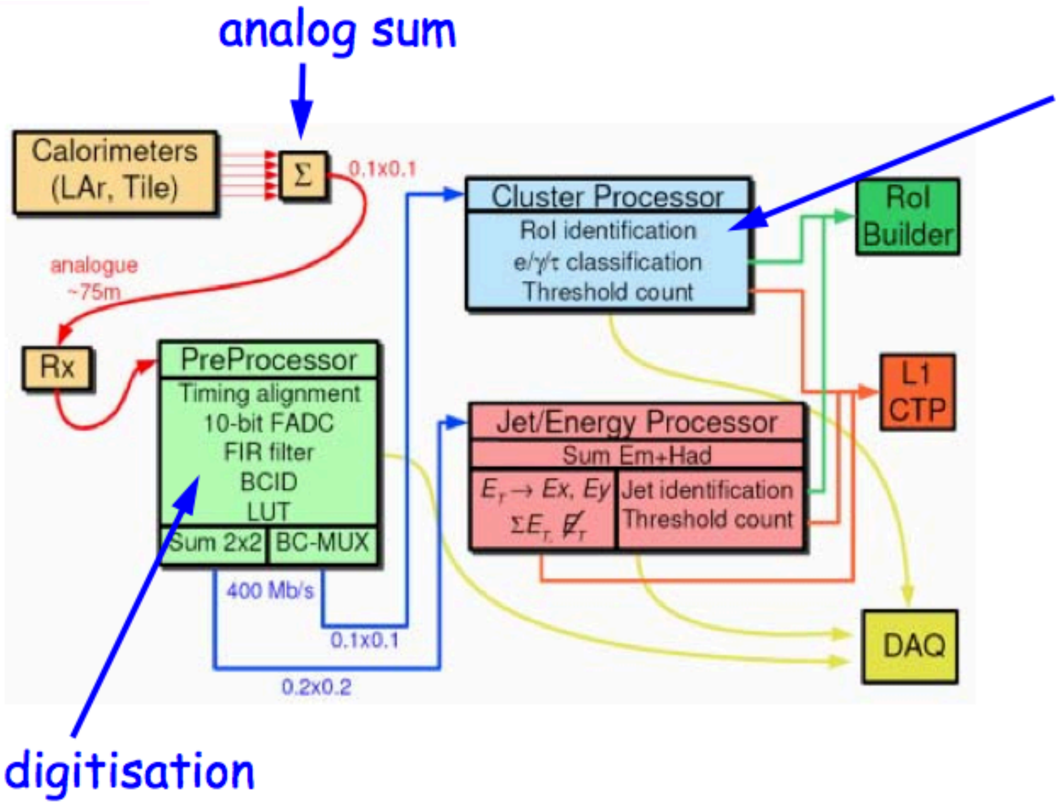


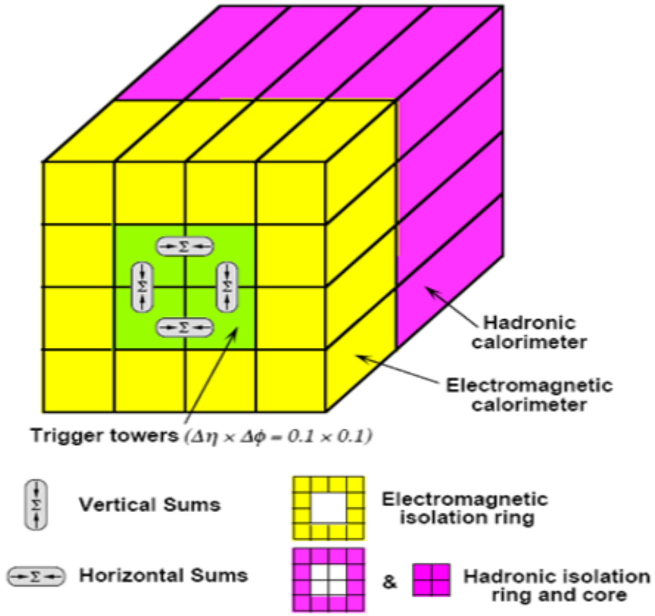
HLT general

- High Level Trigger is a collection of algorithms which refine the L1 trigger decision by including more and more detailed information from an increasing fraction of the detector



Level 1 Calo



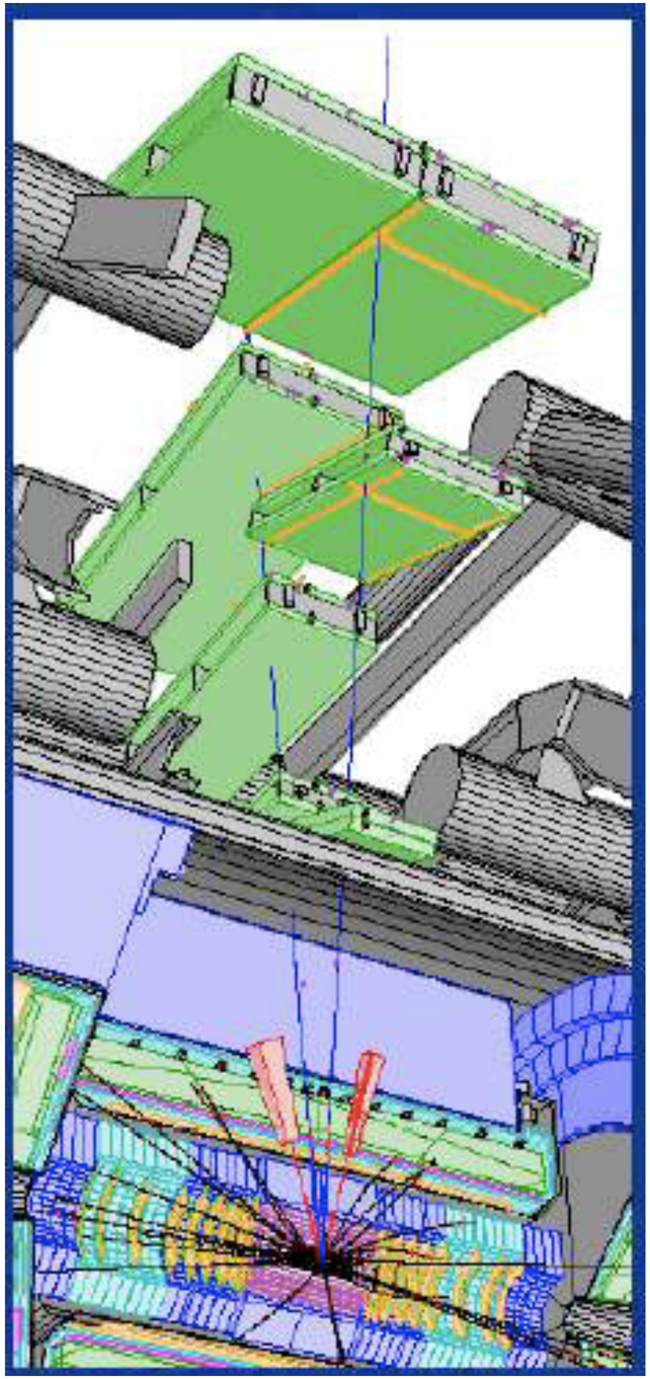


LVL1 Calo trigger based on the energy sum of cells belonging to a trigger tower reconstructed online
1TT = 0.1×0.1 $\eta\times\varphi$

- Local sum
- Isolation
- Digitization

RoI and HLT

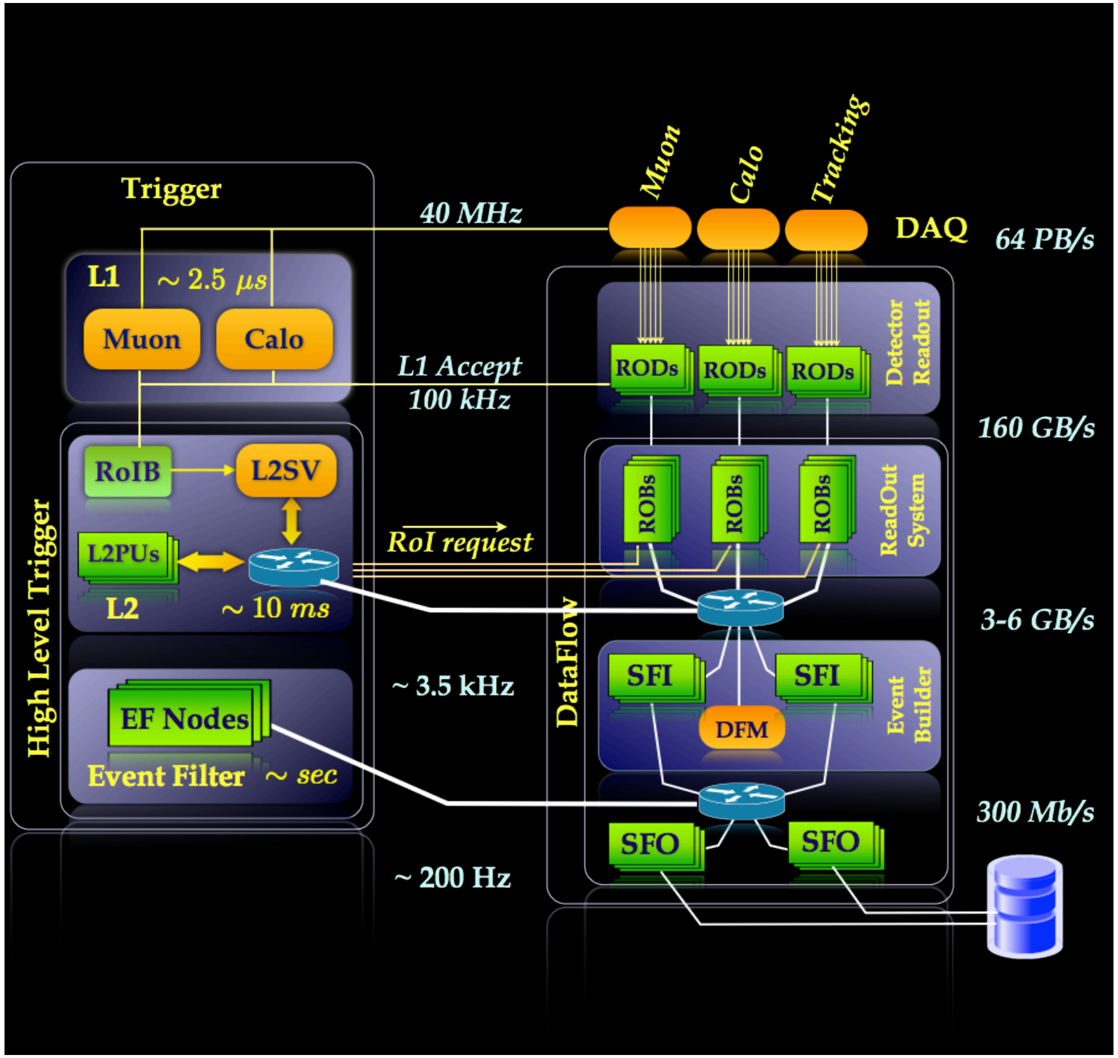
- L1 trigger elements (jets, muon, e/γ, MET) etc. determine regions of interest (RoI) that seed further trigger decisions
- RoI size $\Delta\eta x \Delta\phi \approx 0.1x0.1$ (larger for jets) based on coarse, fast information
- Identify regions based on local areas of activity at L1 and pass on to HLT
- Only RoI data readout to first part of HLT → reduce stress on DataFlow



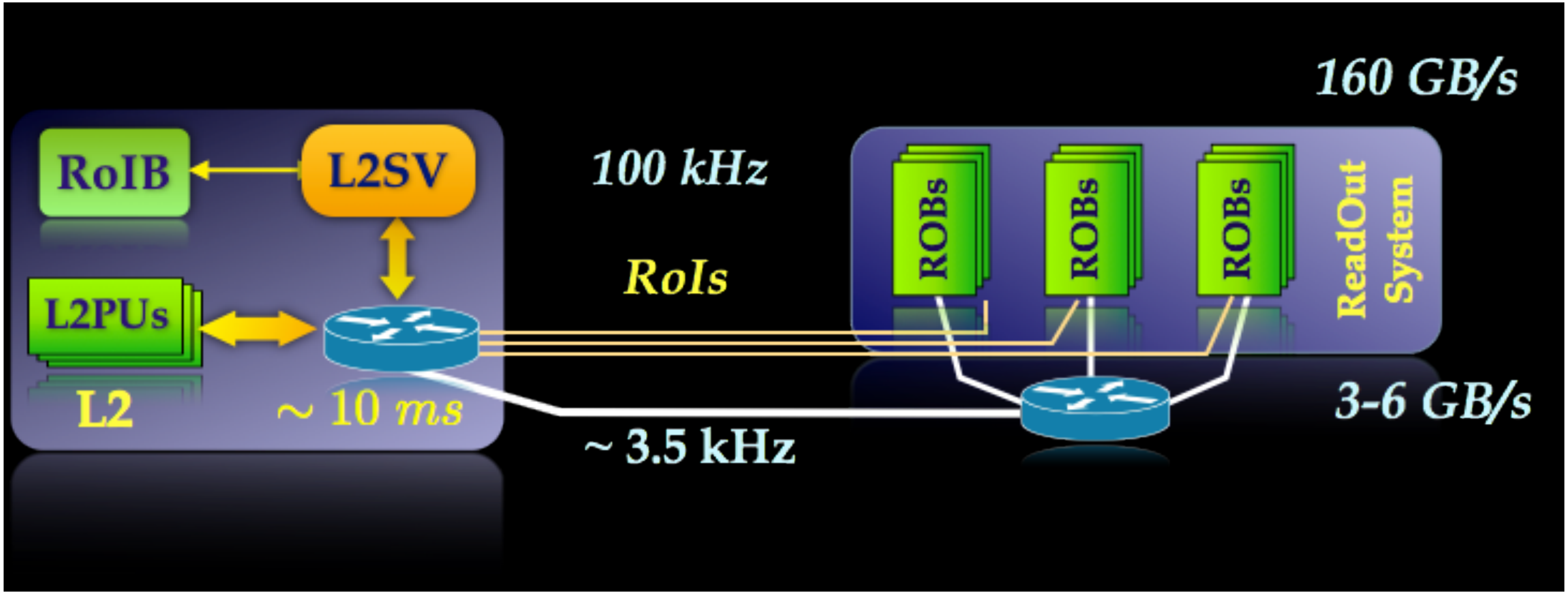
HLT

HLT: PC farms

- LVL2: special fast algorithms
  - Access data directly from the ROS system
  - Partial reconstruction seeded with L1 Regions of Interest (RoIs)
- EF: offline reco. algorithms
  - Access to fully built event
  - Seeded with LVL2 objects (full event reconst. possible)
  - Up to date calibrations



Level 2 trigger



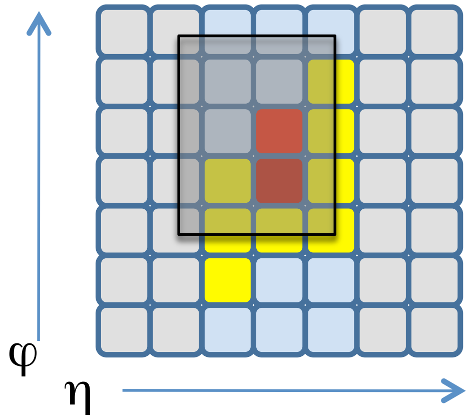
- Data are buffered into the ReadOut System (ROS)
- L2 requests RoI data from ROS and refine L1 results
  - Only 1-2% of data collected at L2
  - Relaxes request on ROS system and network bandwidth

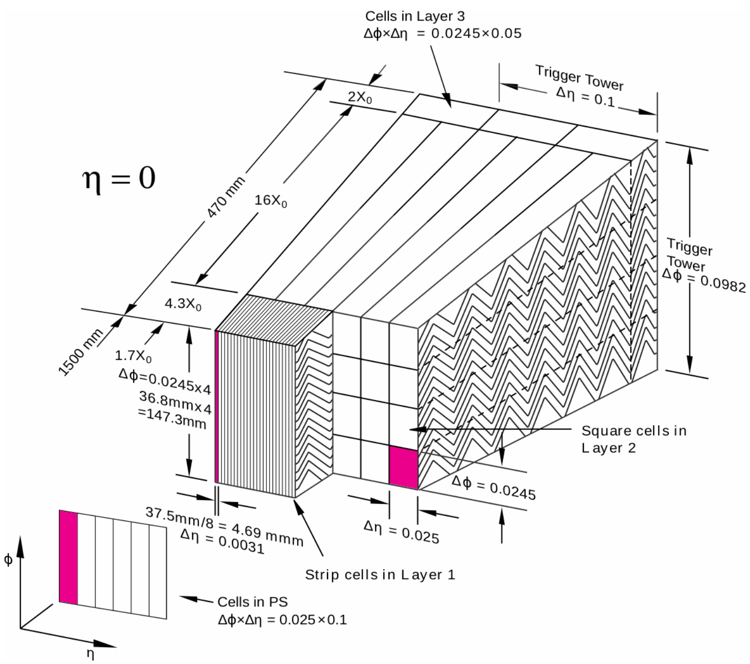
HLT algorithm

- HLT use reconstruction/identification algorithm close to offline ones
- Remind: e/γ reco/Id use Calo with full granularity+ ID information

Example: select an electron with E>25 GeV

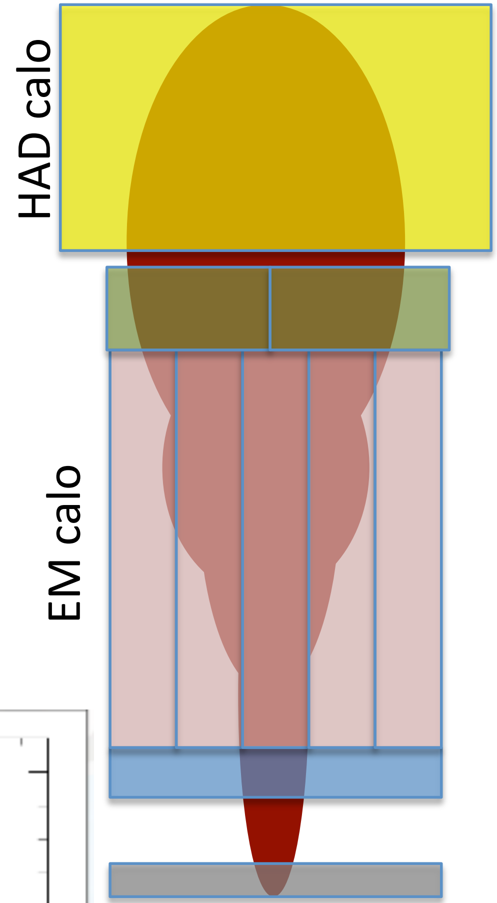
Find an energy deposit in EM calorimeter with E>25 GeV (from RoI at L1)

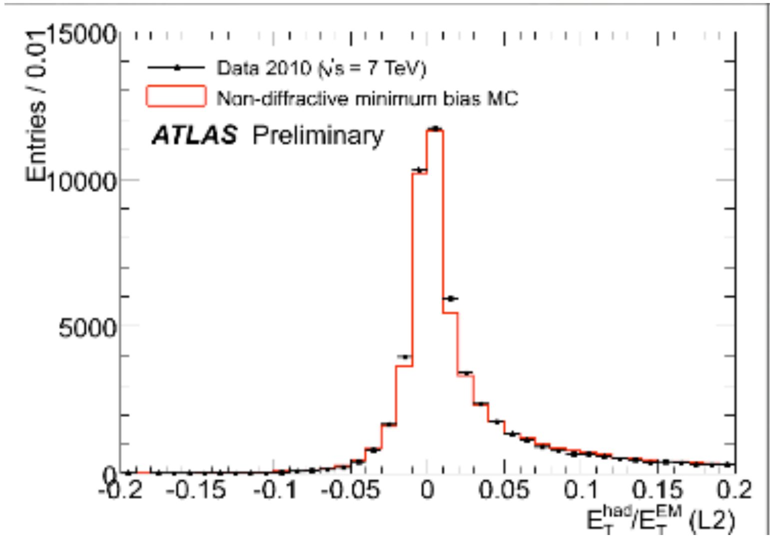


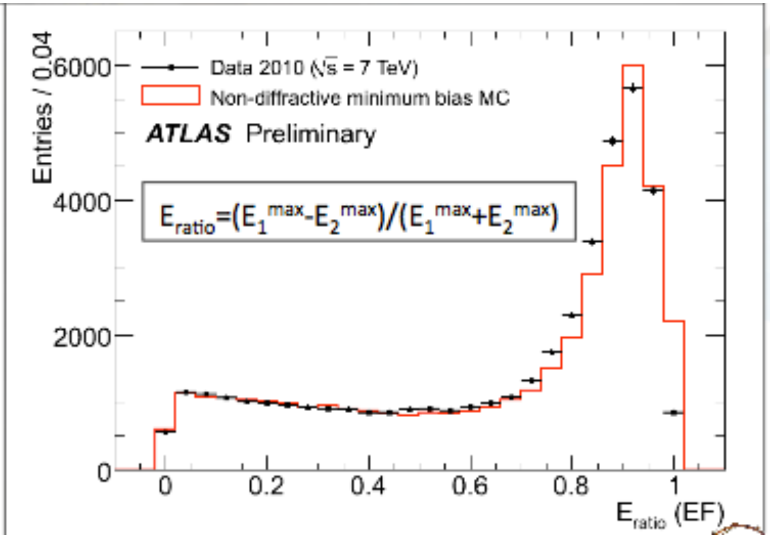


HLT algorithm

- Select an electron with E>25 GeV
- Apply cuts on calorimeter variables to refine e/γ identification:
  - Ratio of Had to EM cluster energy allows to reject objects with large hadronic leaks
  - Shower shape variables, e.g.: Eratio characterizes nearby maxima in the 1st layer of the EMCal to reject $\pi^0 \rightarrow \gamma\gamma$



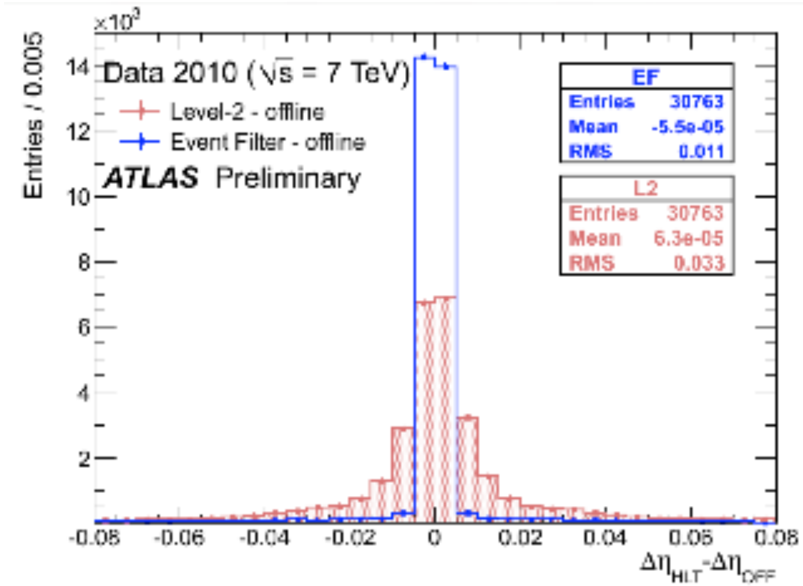


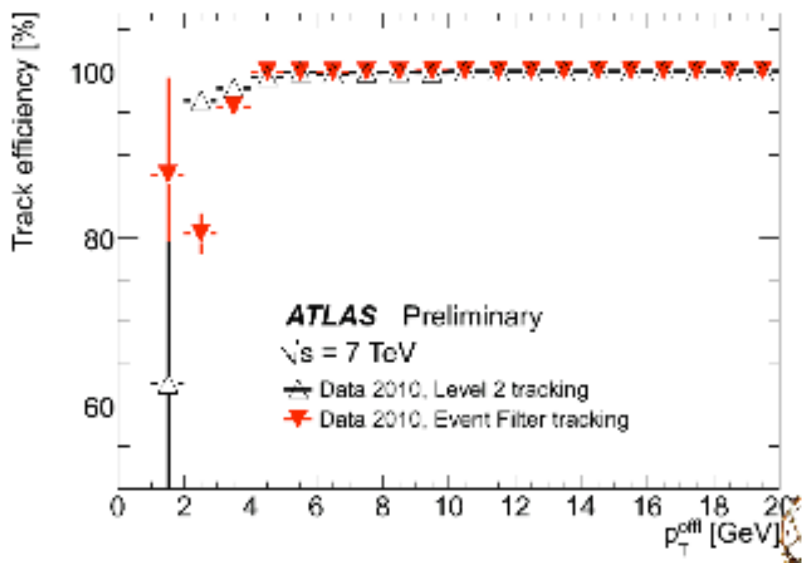


HLT algorithm

Example: select an electron with E>25 GeV

- e± identification also requiresthe HLT to geometrically match a track to a cluster
  - Δη : distance between the electron's track and its cluster
- L2 uses dedicated fast tracking algorithms with silicon detectors (Pixels + SCT)
- EF uses offline tracking algorithms, tuned for HLT timing and performance constraints
- Good HLT tracking efficiency for electrons





Concusions

- HLT algorithm for e/γ objects refine trigger decision from L1 by using full granularity of the Calorimeters and information of all ATLAS subdetectors
- EF uses offline reconstruction algorithm optimized for processing time
- ATLAS has tens of different trigger items (EM_x, Tau_x, Jet_X, FJet_x, MET_x, Mu_x etc.) which allow flexibility in reducing the amount of recorded data according to the physics requirement