Fysikum

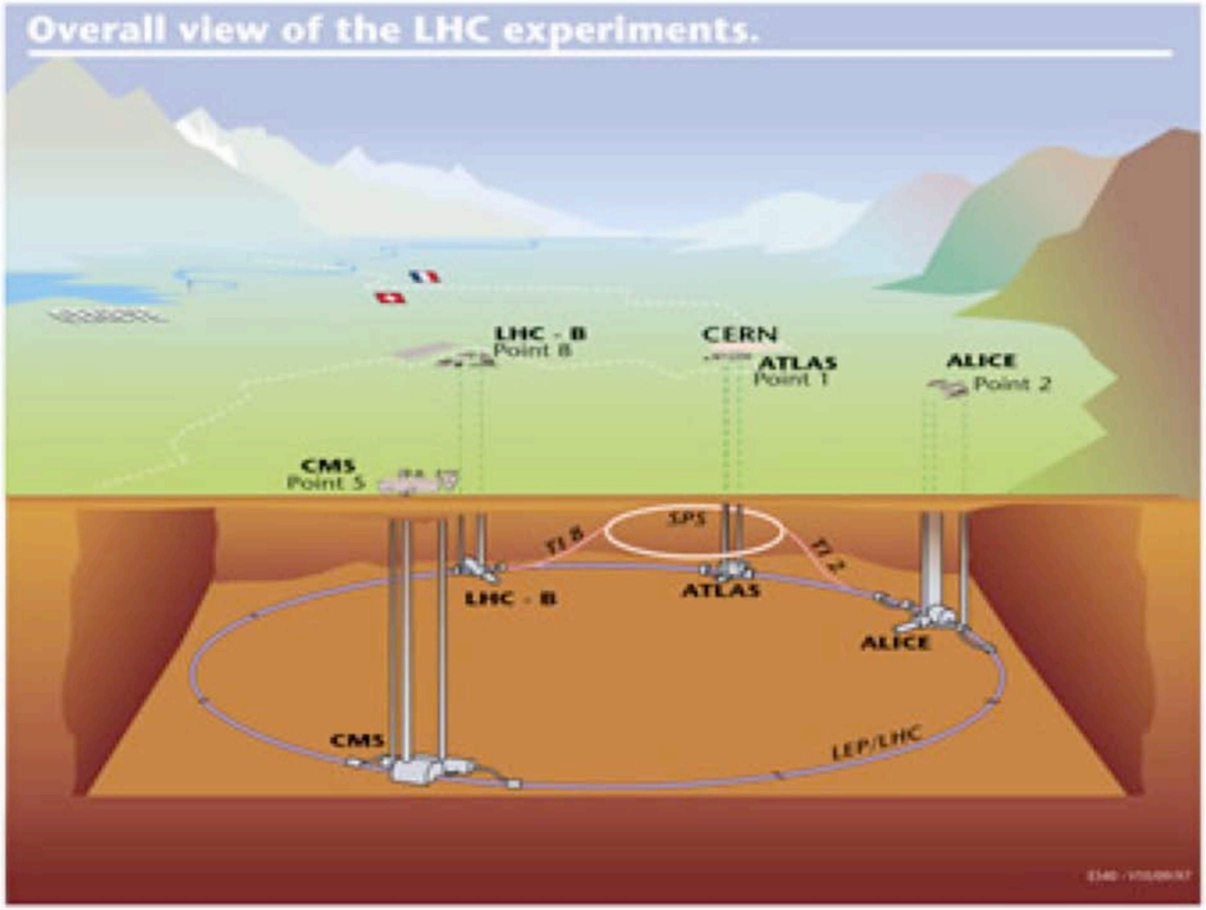
ATLAS First Level Calorimeter Trigger

Marianne Johansen

Stockholm University

LHC and ATLAS

LHC and ATLAS



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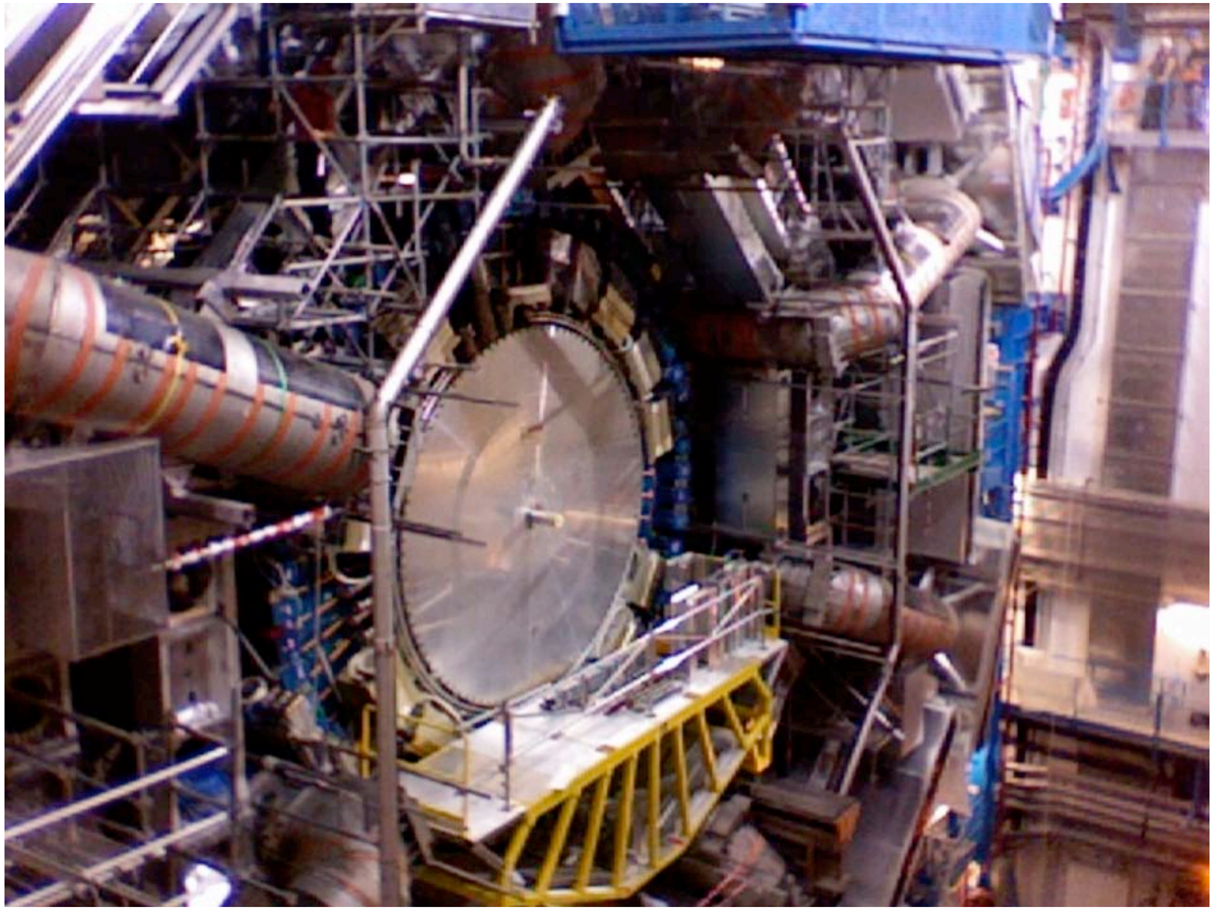

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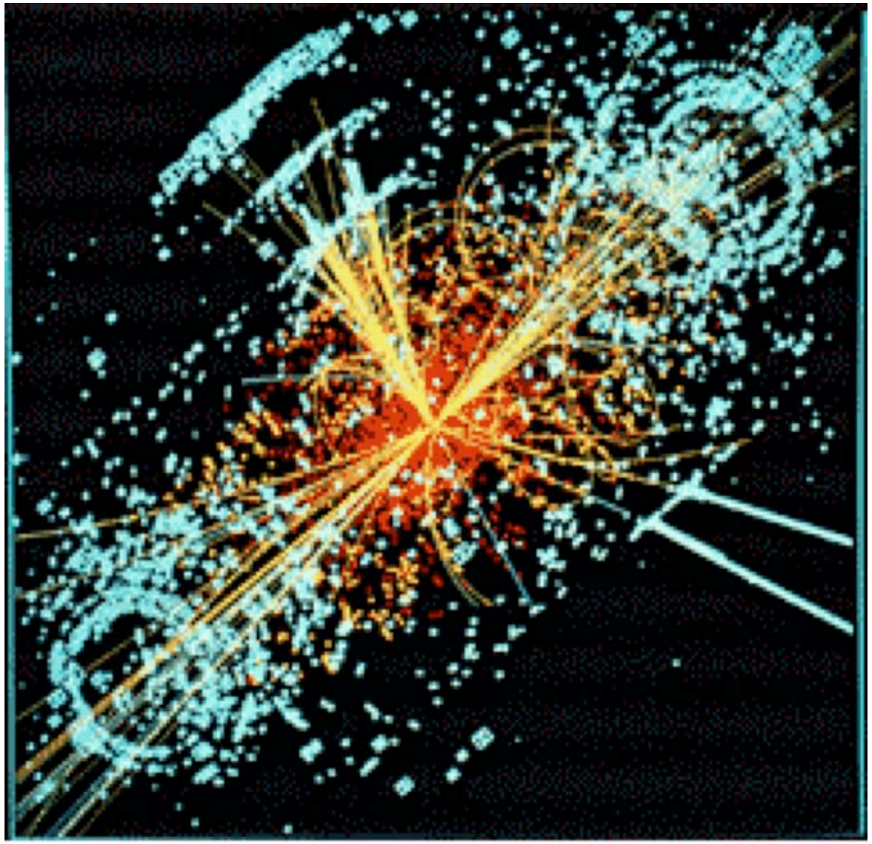

- Nearly 1 billion events per second.

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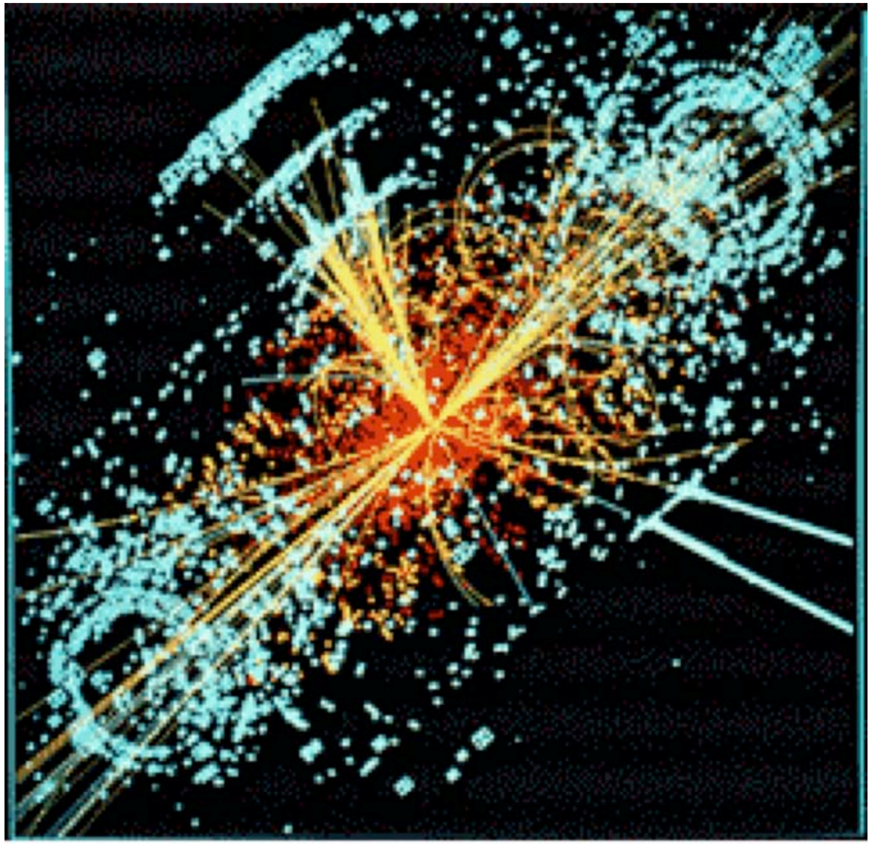

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- Storage capacity: 100 events per second.

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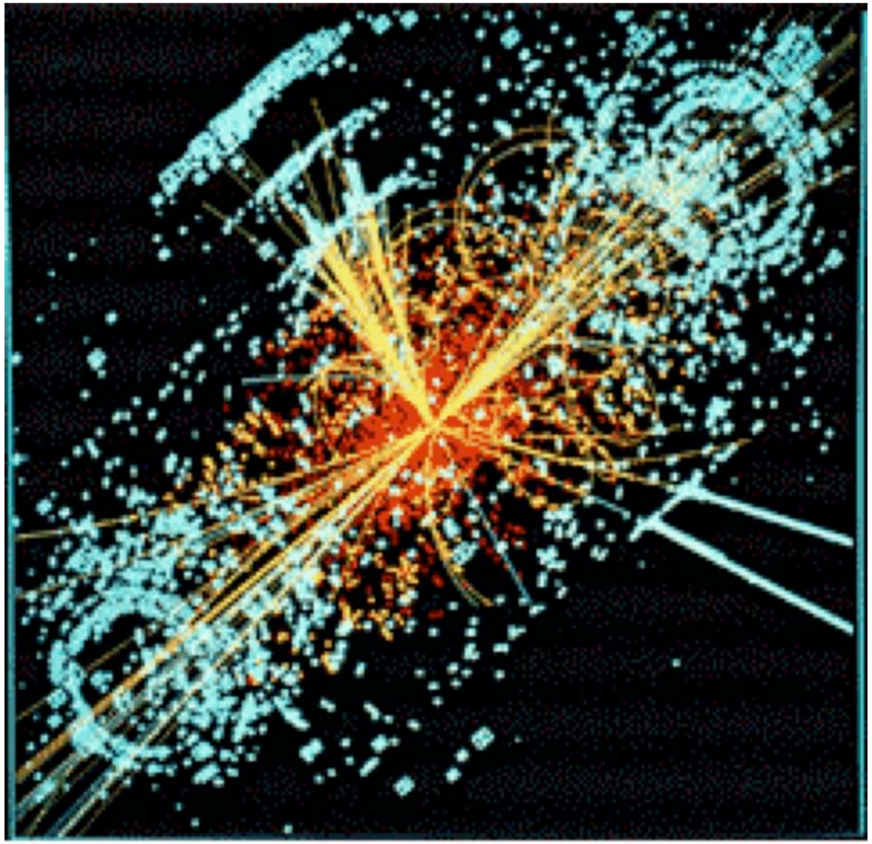

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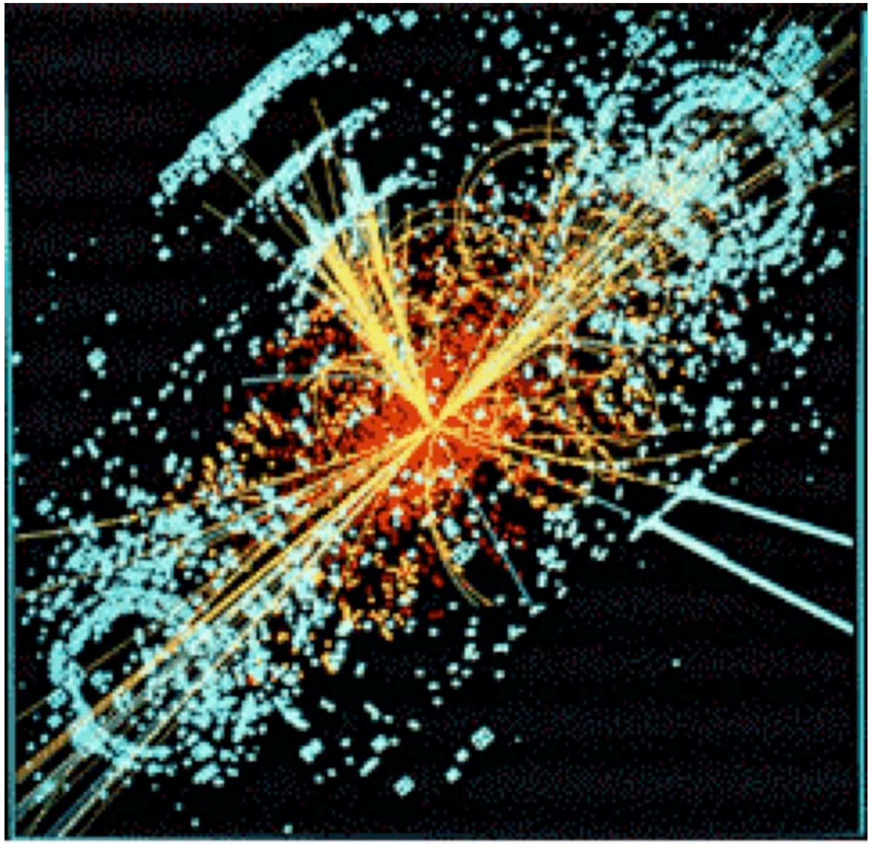

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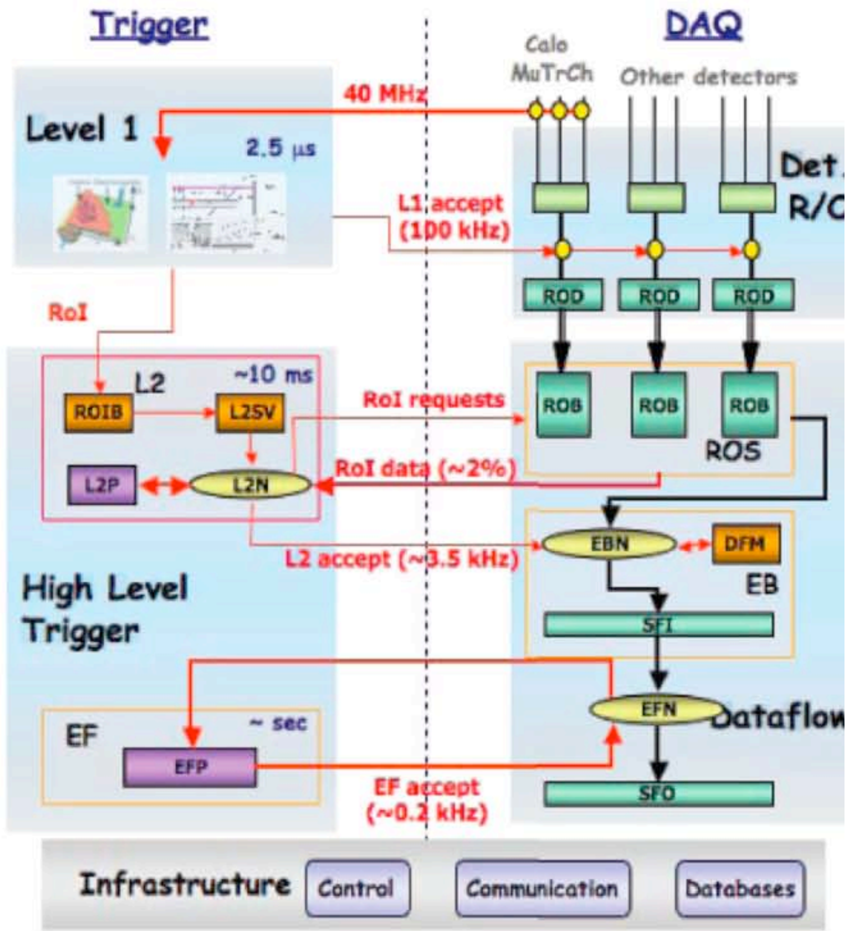
- A job for the ATLAS trigger system.

ATLAS Trigger System

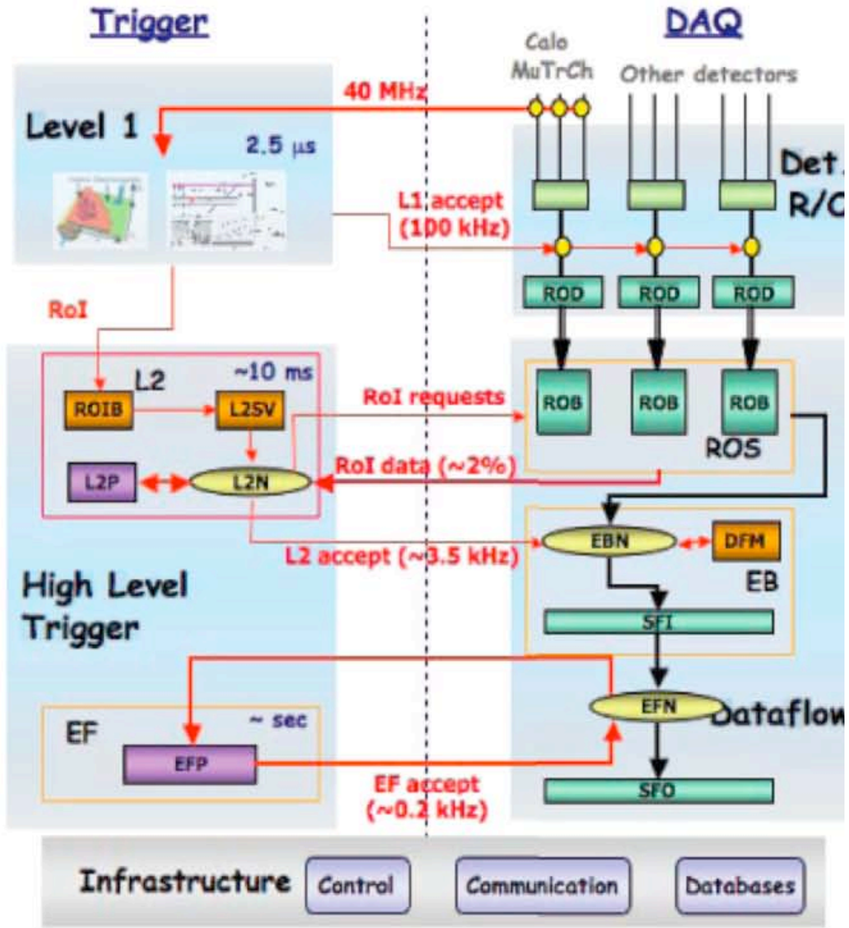
Three trigger levels



ATLAS Trigger System

Three trigger levels

- Level 1: using coarse grained information from calorimeters and muon system only. (max rate 100 kHz)



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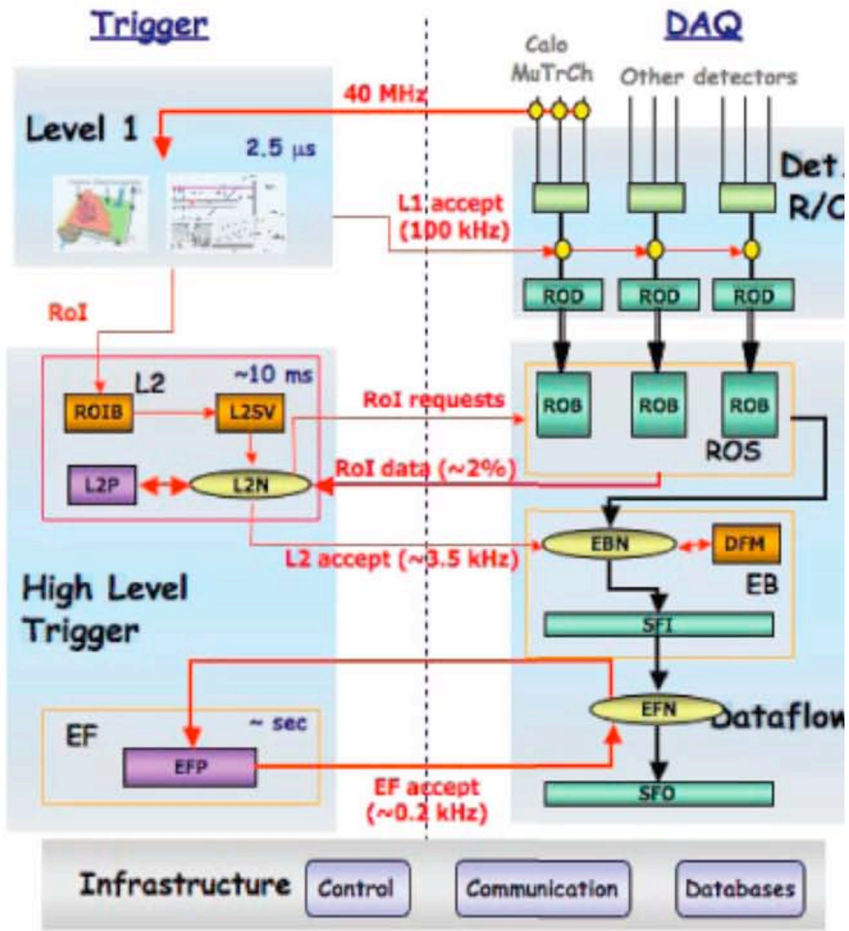
- Level 2:use full detector granularity in Region of Interest provided by level 1. (max rate 3.5 kHz)



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Three trigger levels

- Level 1: using coarse grained information from calorimeters and muon system only. (max rate 100 kHz)
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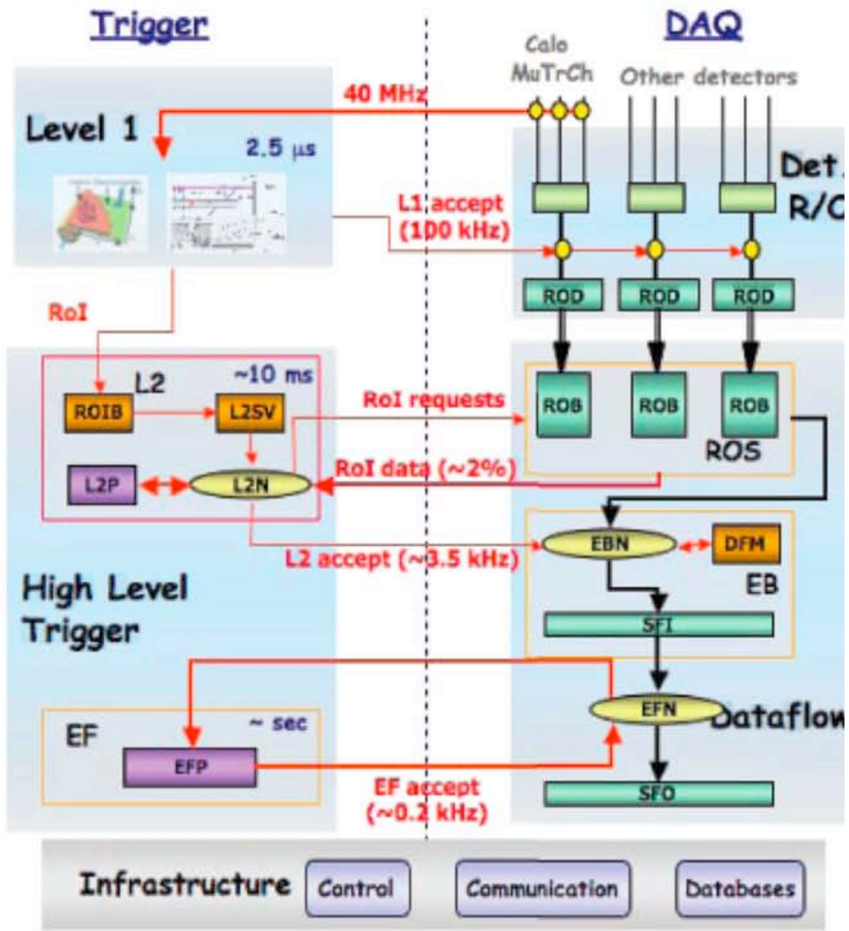
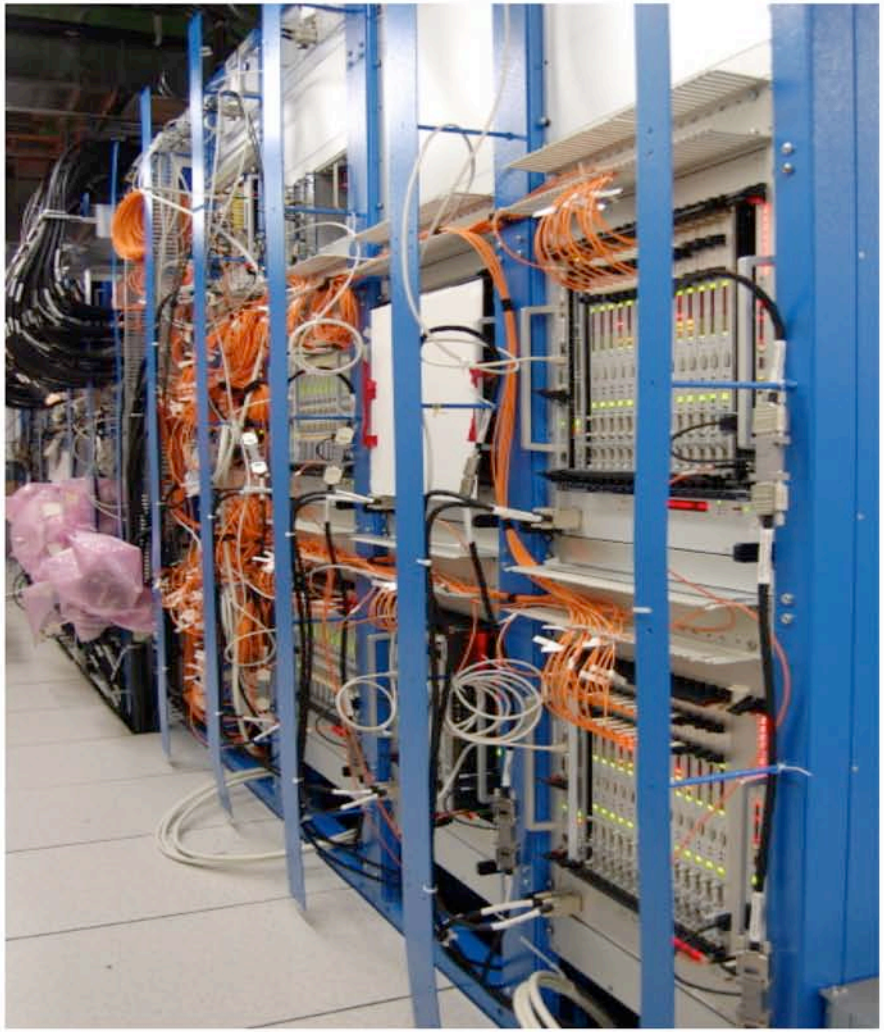
- Event Filter:uses offline analysis procedures on fully built events (max rate 200 Hz)



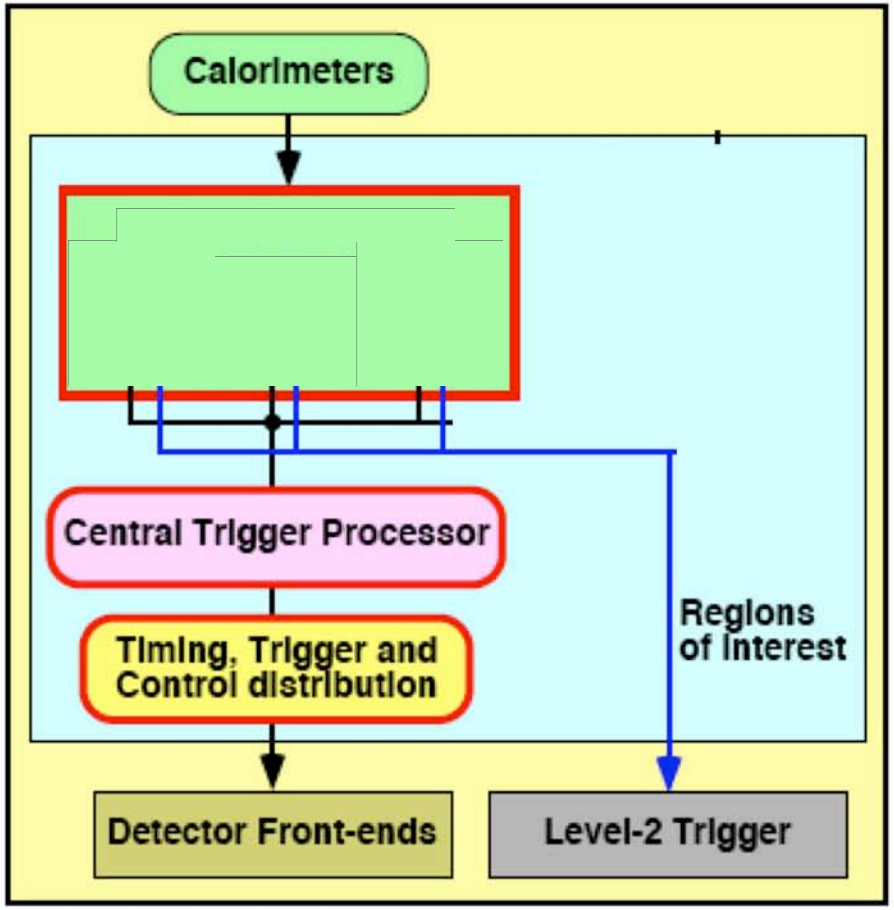
Level 1 Calorimeter Trigger



Main purposes:

- Reduce event rate by a factor 10^3.
- Identify electron, photon, tau, hadron and jet candidates.
- Find total and missing energy of the event.
- Pass on information to the Centr Trigger Processor.
- Provide the level 2 trigger with Regions of Interest and the DAQ stream with data produced in the system.

L1Calo Layout



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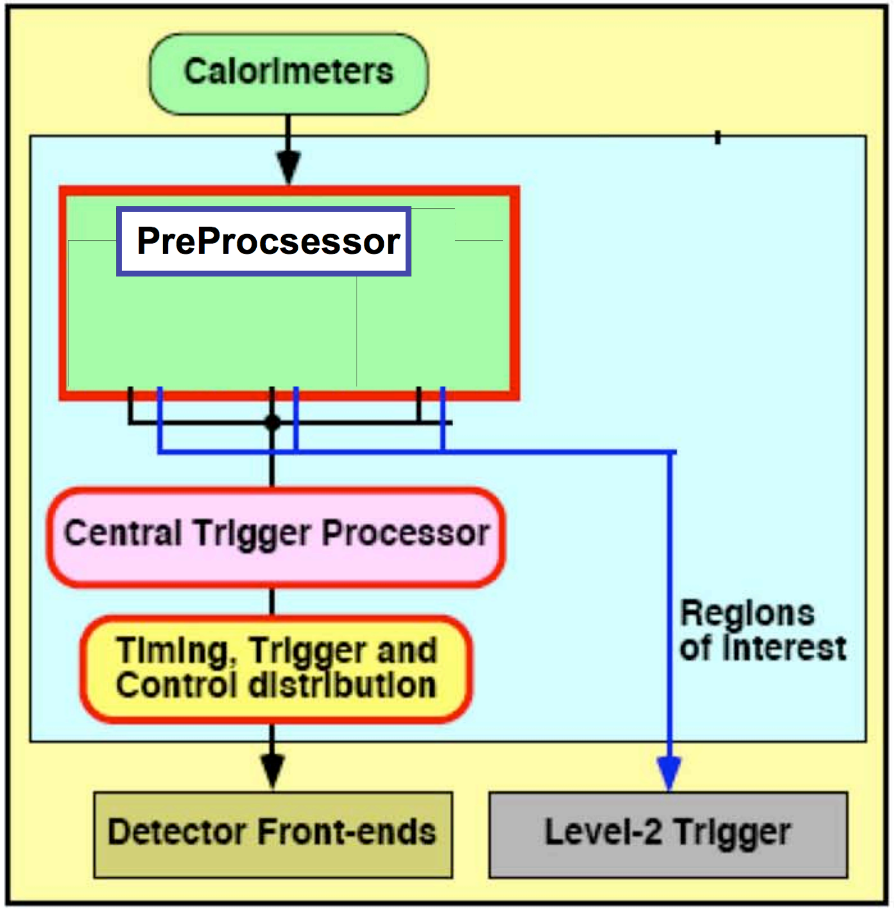
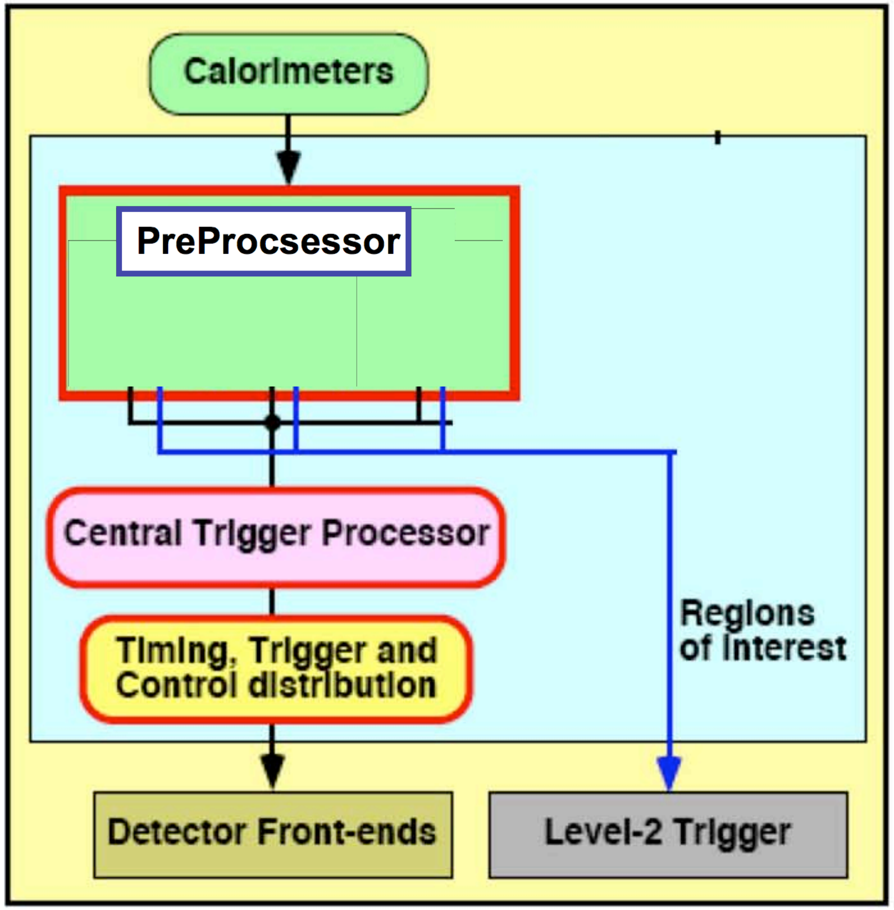


- PreProcessor

L1Calo Layout



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  - digitize analog calorimeter signa

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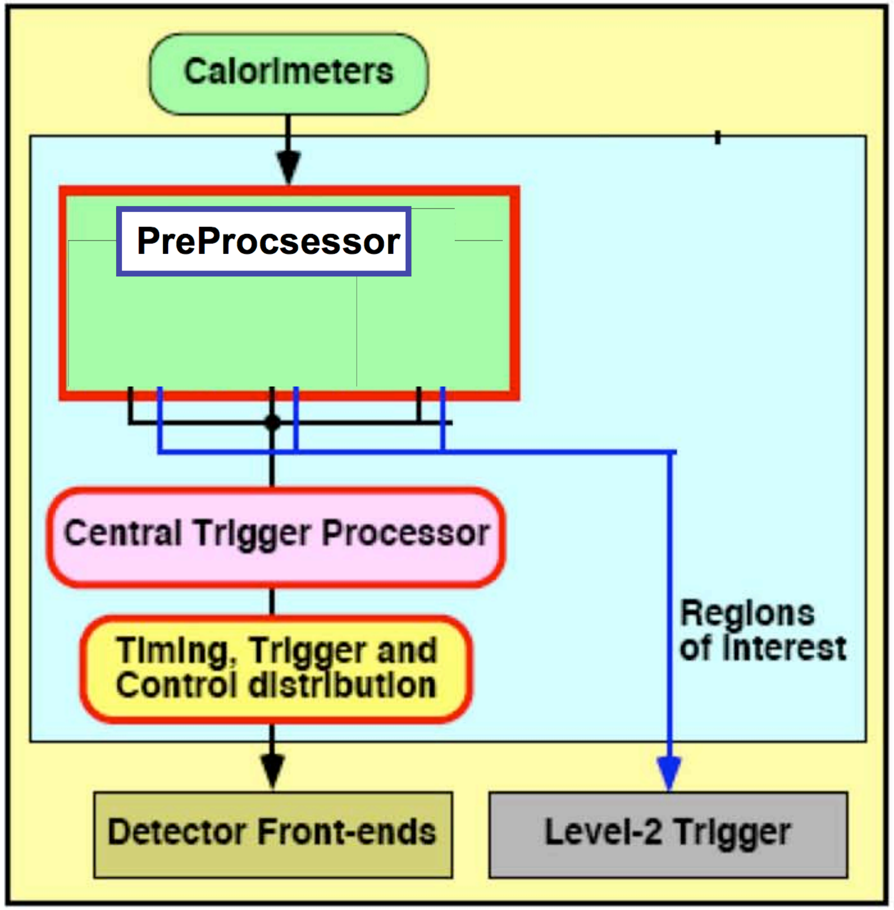

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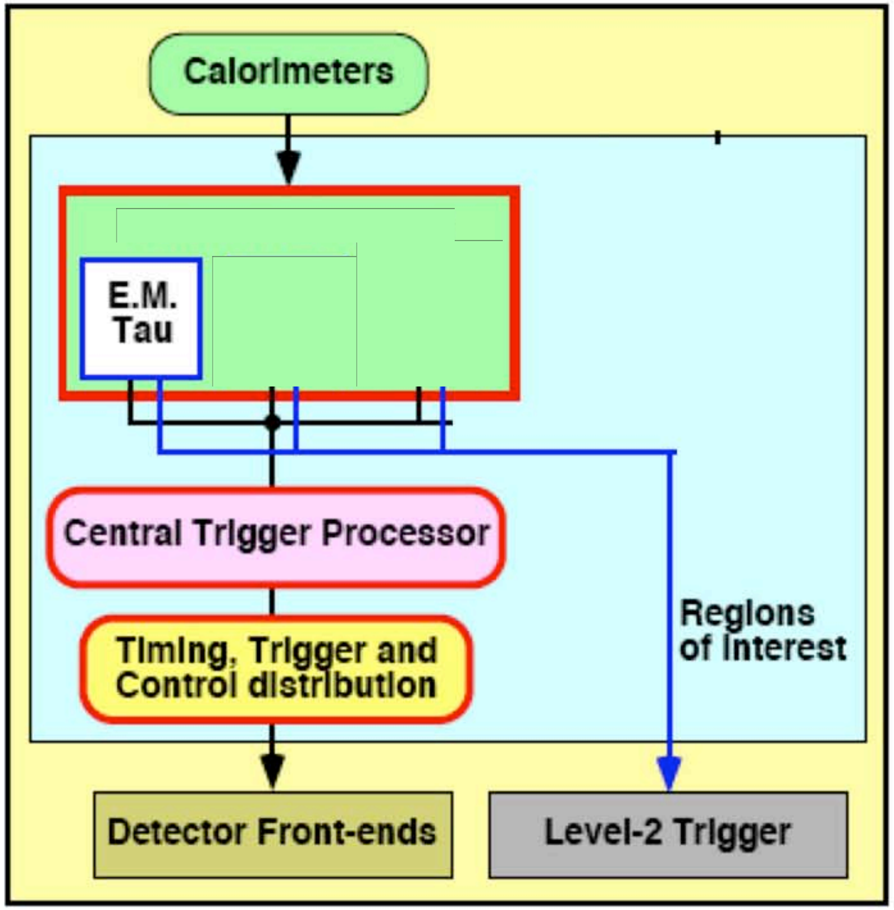

- PreProcessor
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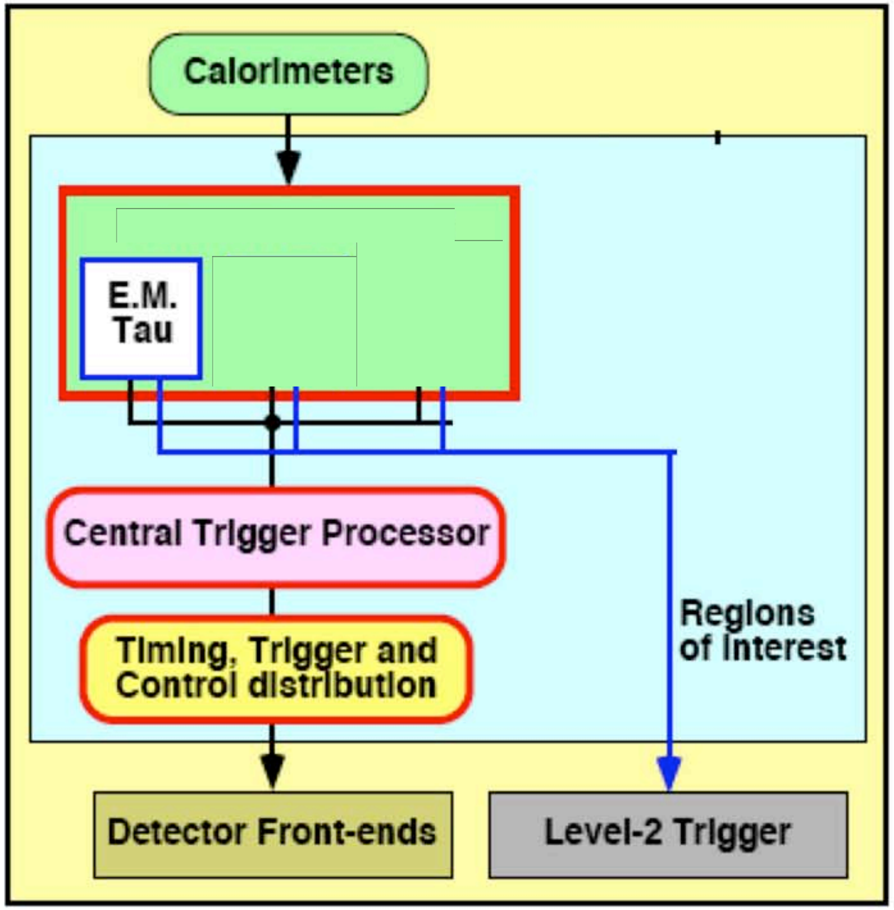

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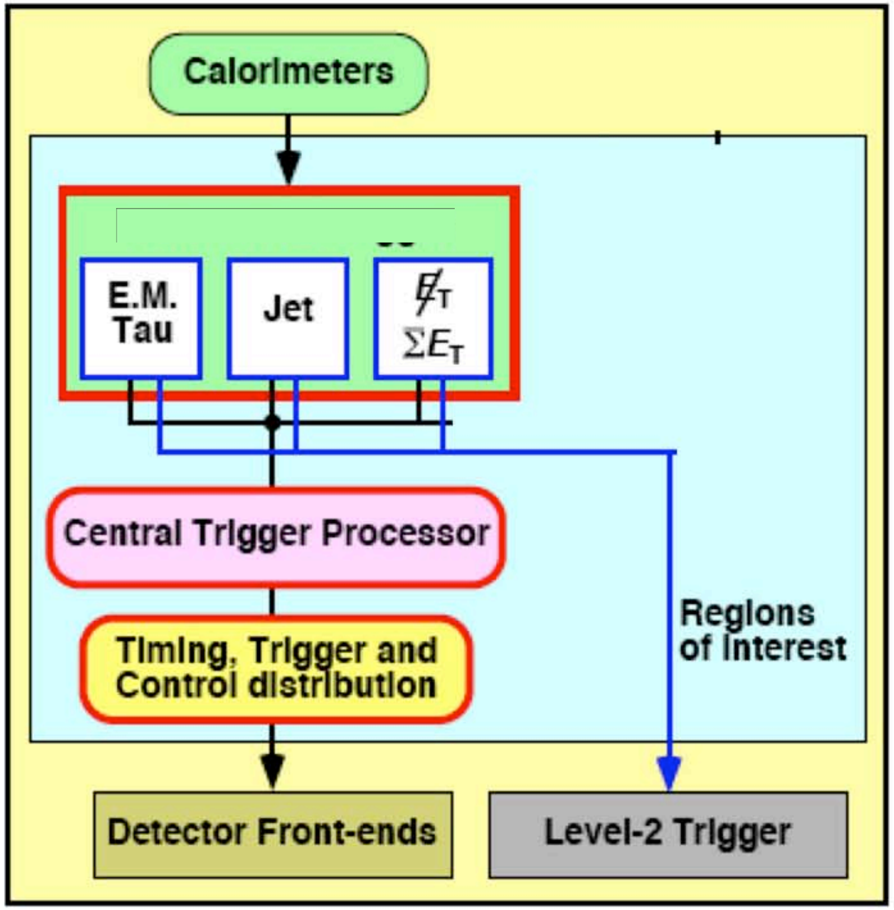

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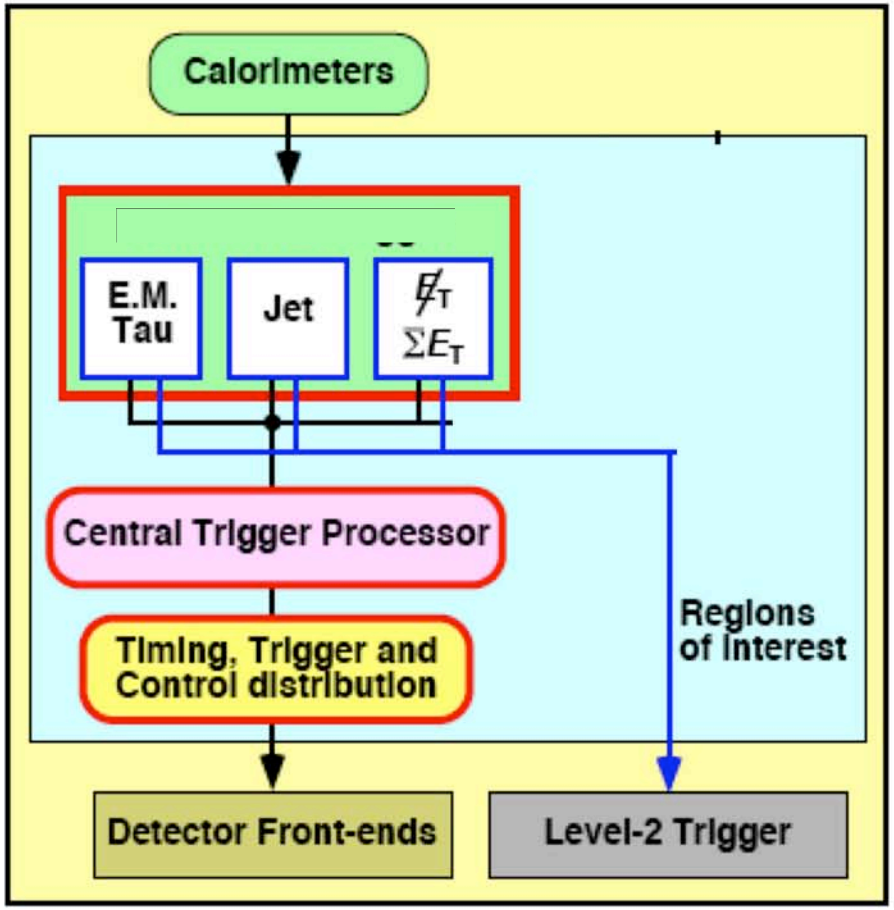

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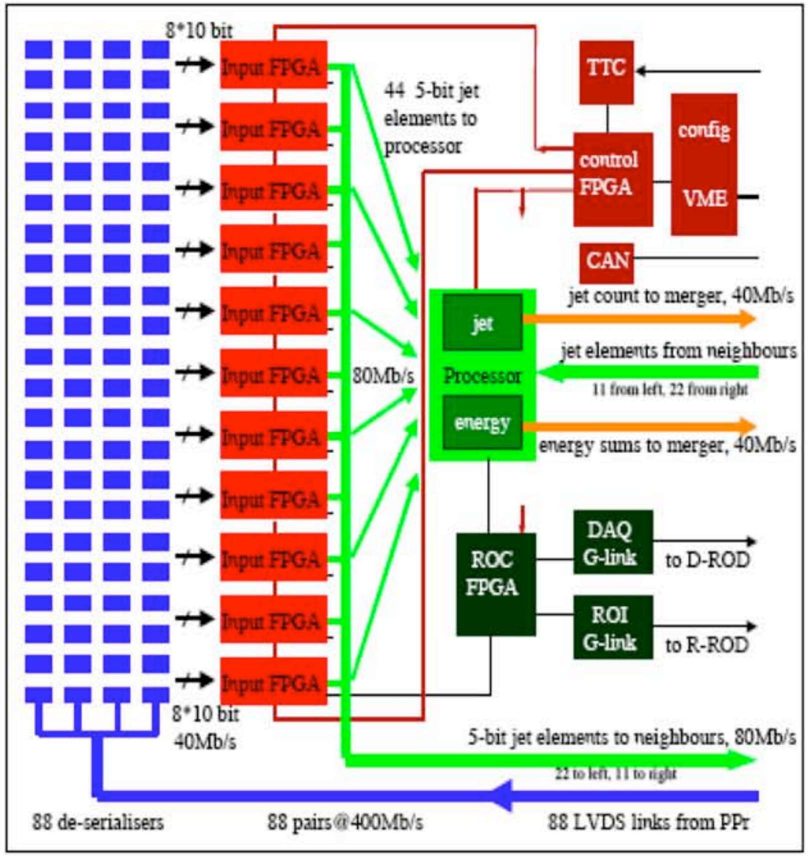
- Cluster Processor
  - Identify electron, photon, tau and hadron candidates using isolatio criteria on clusters of trigger towers (0.1 X 0.1 in eta-phi)
- Jet/Energy Processor
  - Find total energy, missing transverse energy and jet candidates using clusters of jet elements (0.2 X 0.2 in eta-phi)

Jet/Energy Module (JEM)



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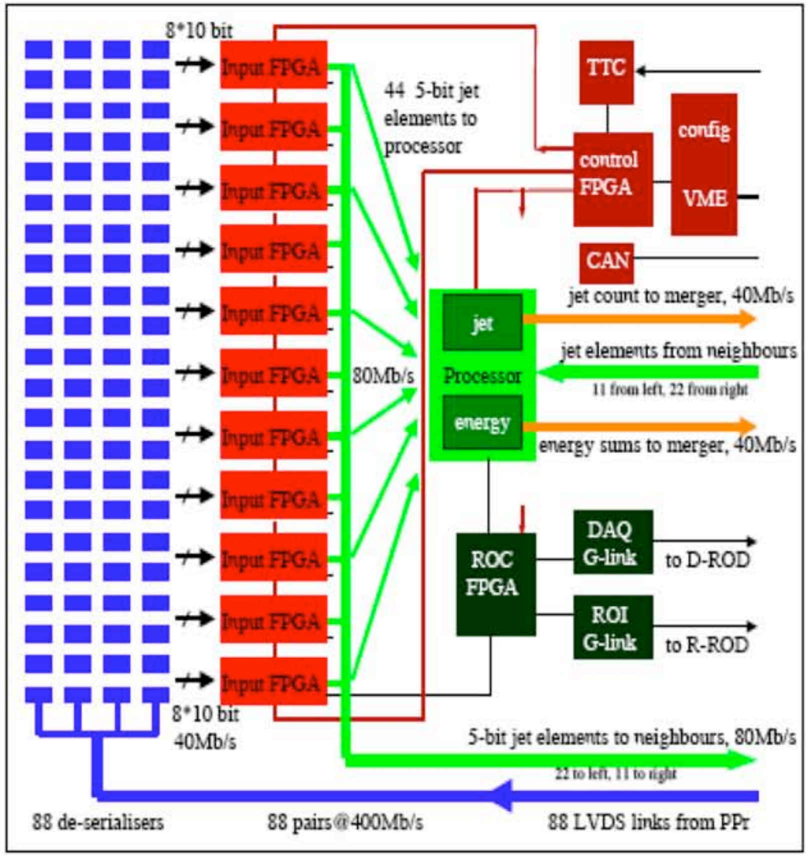

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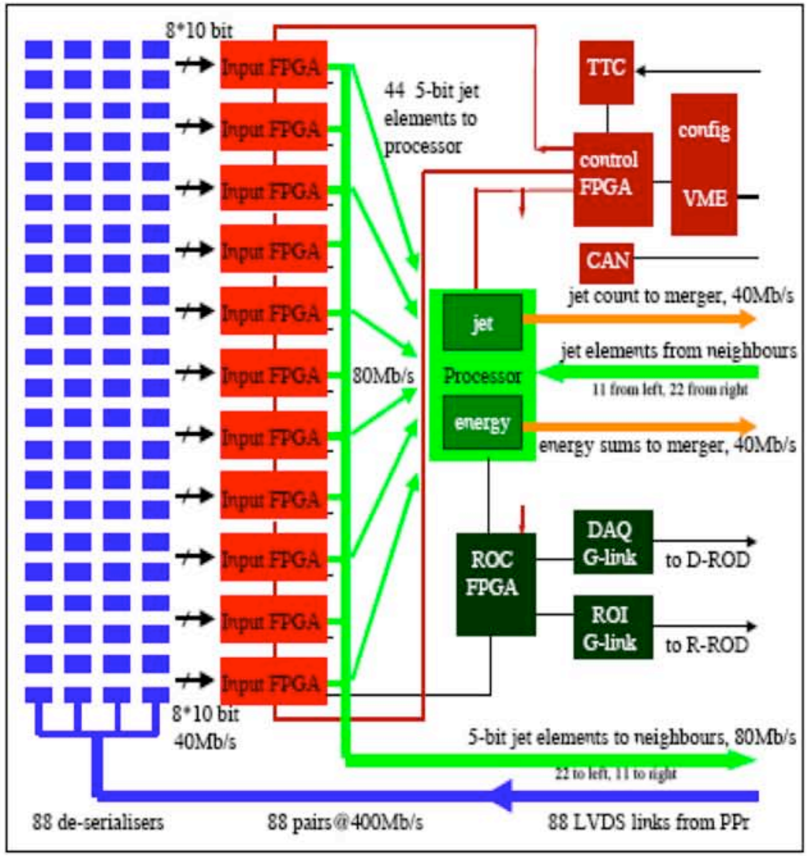

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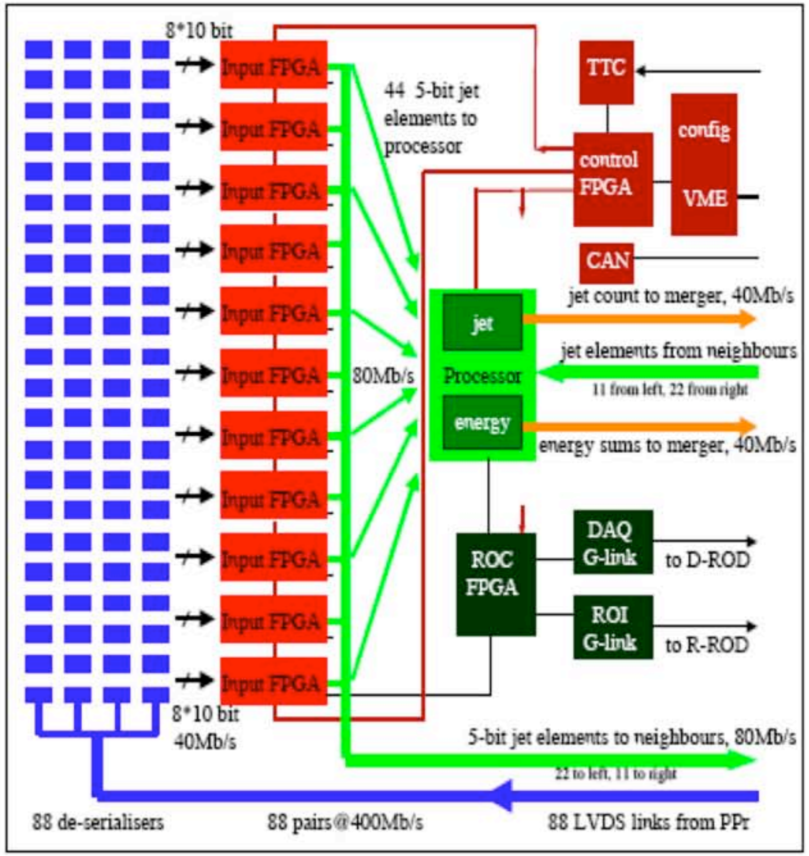

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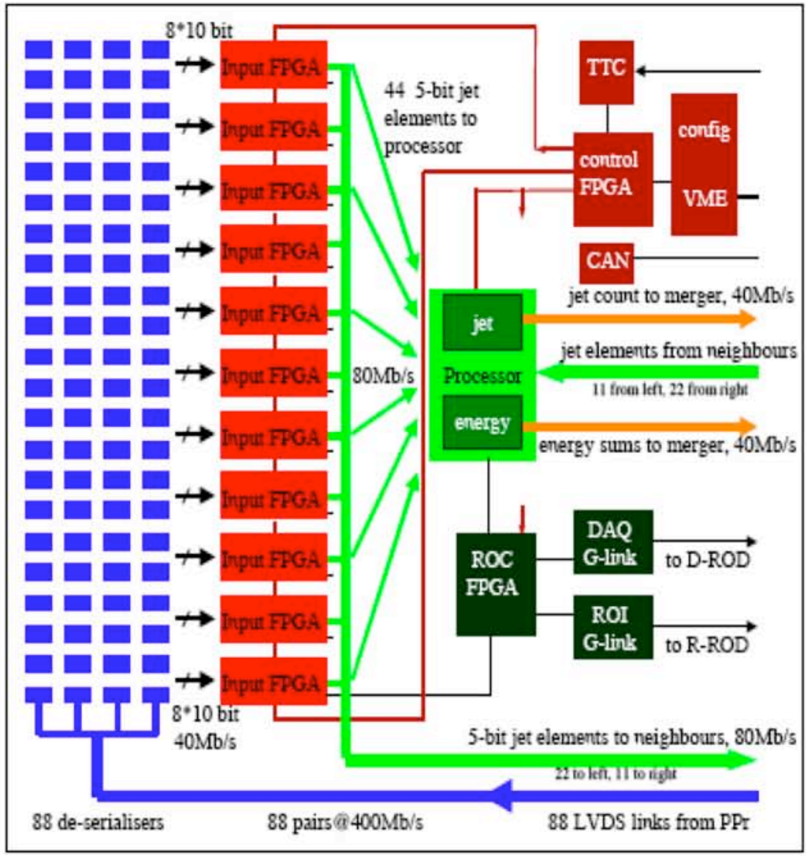

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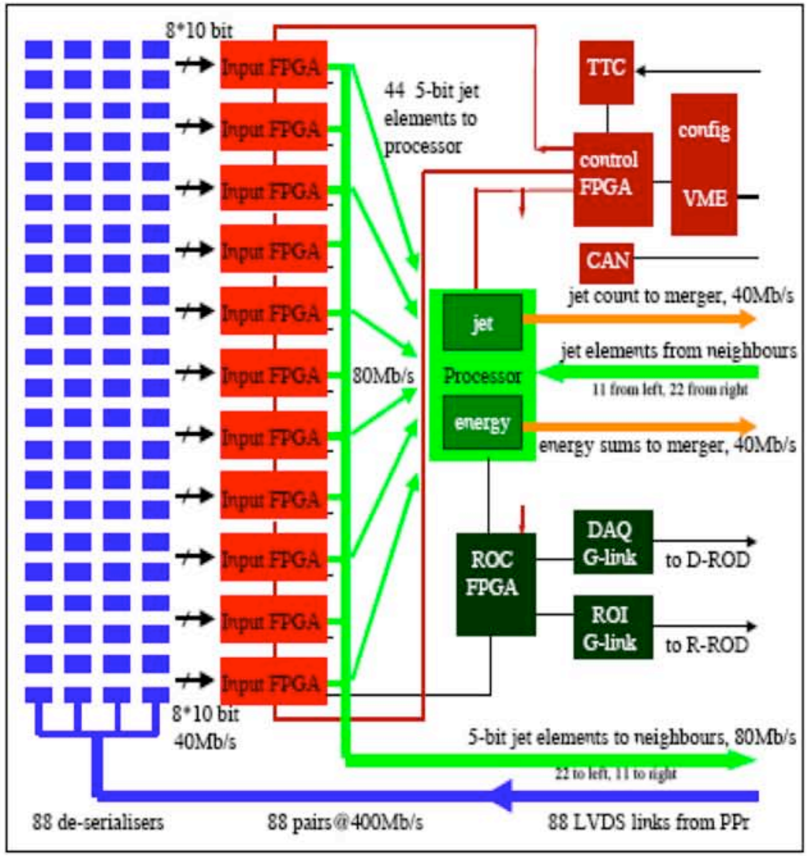

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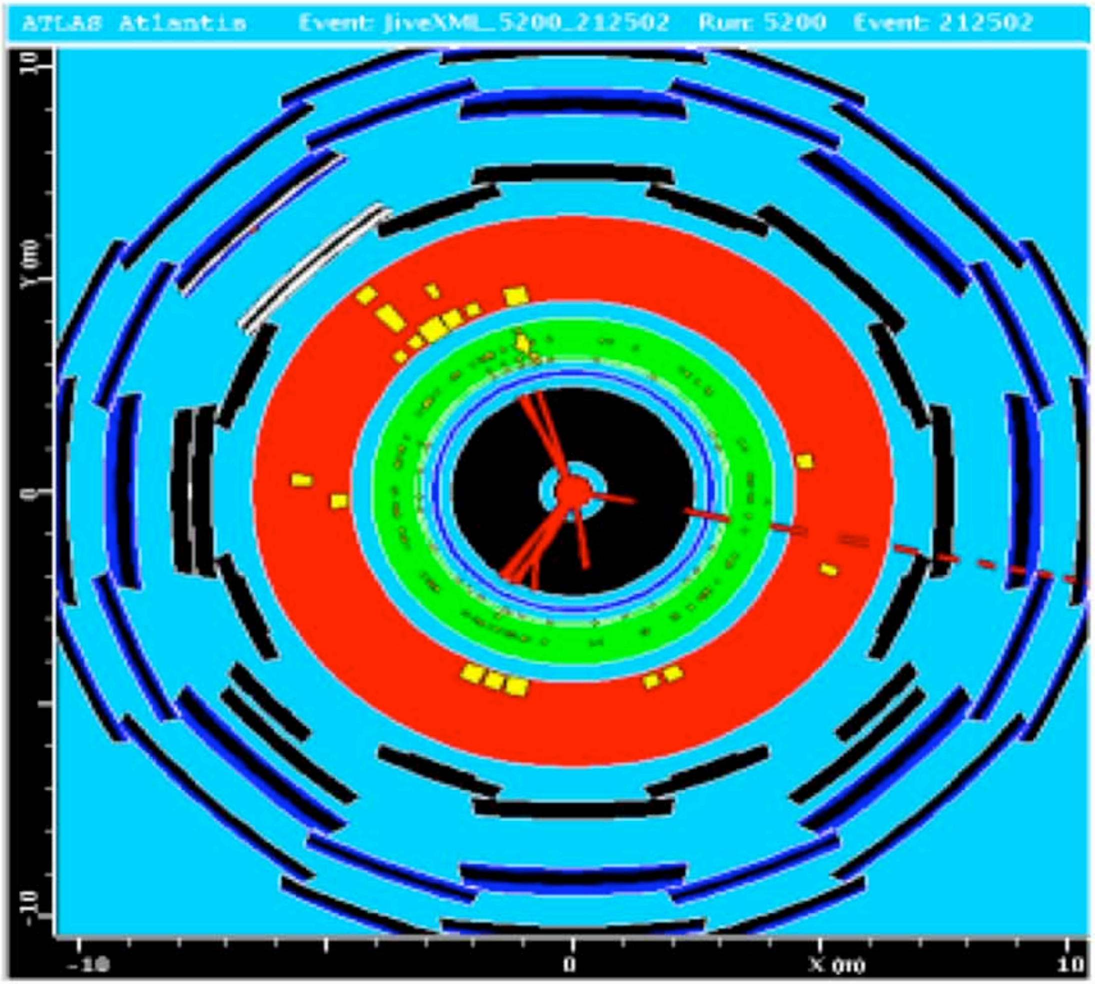
- Sum of electromagnetic and hadronic trigger towers into jet elements.
- Jet processor: identifies and counts clusters of different size around a local maximum
- Energy processor: calculate total energy and missing transverse energy

Trigger Chain in ATLAS



Online Monitoring

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- Need monitoring to check data quality, trigger performance and check for errors.

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Online Monitoring

- Need monitoring to check data quality, trigger performance and check for errors.
- Use various software to access and decode data.

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Online Monitoring for the Jet/Energy Module

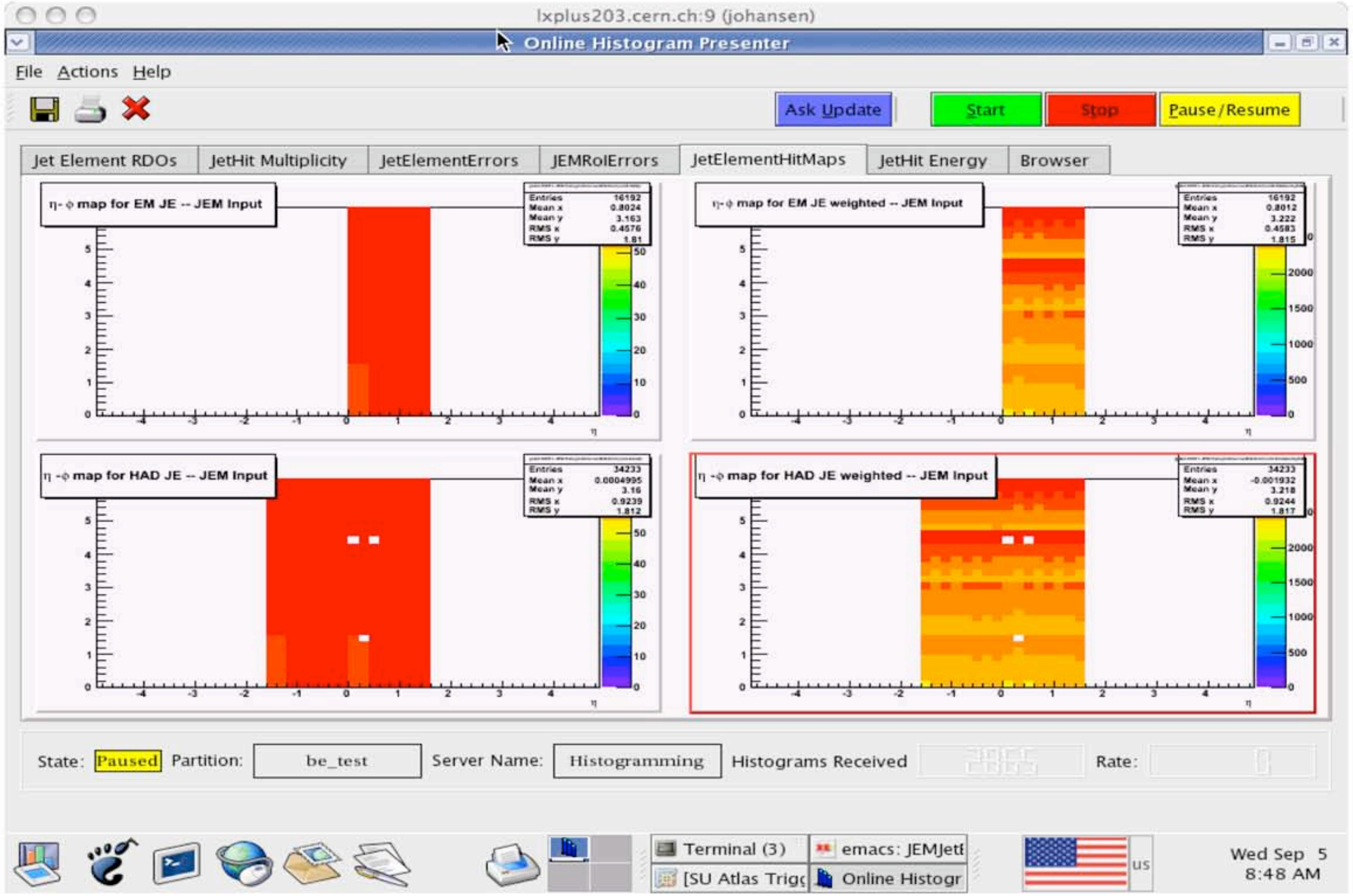
- Check input data for various error flags, look at $\eta - \phi$ coordinates and energy values.
- Use output data to check the performance of various algorithms, count jet multiplicities, check RoI data for errors and saturation.

ATLAS milestone weeks

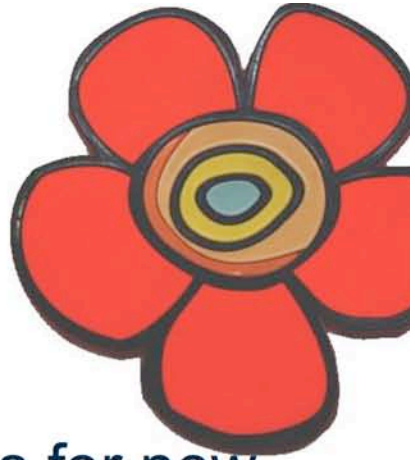
- Rehearsal ATLAS to run multiple systems together
- Learn about operation under stable conditions
- Implement and test systems across subdetector borders
- Eg:
  - DAQ, ATLAS control systems,
  - Tile calibration system,
  - L1Cal, L1Mu,
  - Global ATLAS timing, Synchronisation
  - Fast recovery after power cut
  - High rate tests with large scale system
  - ....
- <u>Start to run everything like one single experiment!</u>

Milestone week 4

- Online monitoring tested for the first time on real data!



Conclusion



- High collision rate and small cross sections for new physics require a fast an efficient trigger.
- ATLAS uses a three level trigger system.
- First level trigger consist of separate muon and calorimeter triggers.
- Calorimeter trigger consists of three main parts, PreProcessor, Cluster Processor and Jet/Energy Processor.
- Online monitoring of all processors necessary to assure satisfactory operation.