Contribuições para os Sistemas de Trigger do ATLAS em Operação no Run 3

Micael V. de Araújo [1], Hans P. Beck [2], Augusto S. Cerqueira [3], Isabela S. Ferreira [1], Fernando P. Marciano [1], Juan L. Marin [4], Bernardo S. M. Peralva [5], João V. F. Pinto [1], Meinrad Schefer [2], José M. de Seixas [2], Eduardo F. de Simas Filho [4], Edmar E. P. de Souza [4], Rafael R. Vianna [1]

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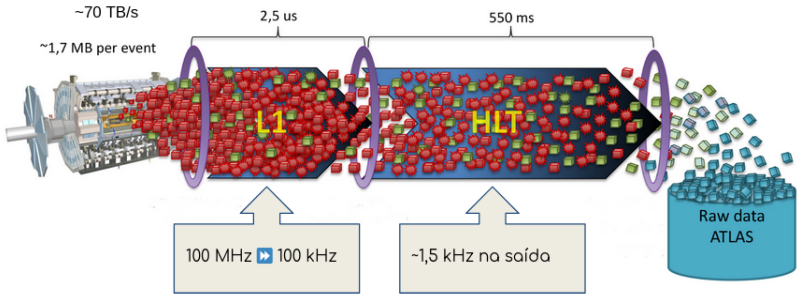
Outline

Introduction

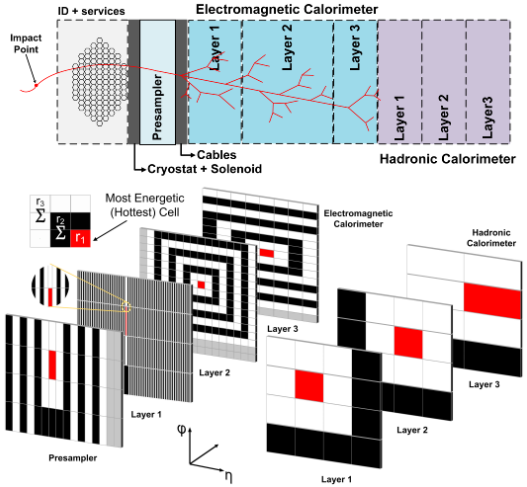
- The ATLAS trigger systems needs a high rejection background rate;
- Due to the big amount of information, a data quality and monitoring system are also needed
- The Brazilian group aims to obtain classification methods to proper handle with electron and photons on the ATLAS High Level Trigger (HLT) and monitor the information to proper detect problem during the collisions;



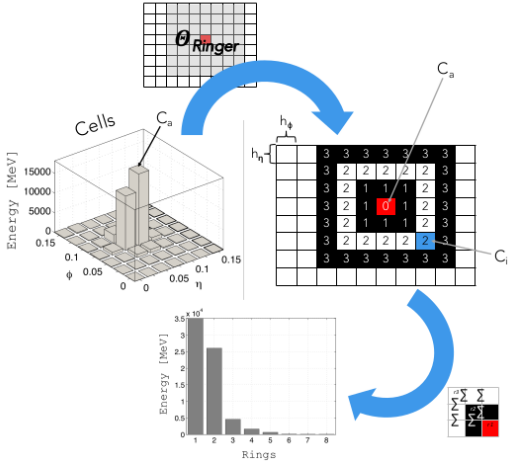
Electron and Photon Identification

- Since 2017, the NeuralRinger algorithm is the standard technique for fast electron detection at HLT for electrons with $E_T > 15$ GeV, operating with an essemble of neural networks;
- The method uses the energy deposition information on the calorimeter (LAr and TileCal) cells as an input for a MultiLayerPerpectron classifier;
- From its success, some extensions have been studied:
  - Electron with $E_T < 15$ GeV;
  - Electrons on Forward Region ($2.5 < |\eta| < 3.2$) and
  - Photons

NeuralRinger Algorithm

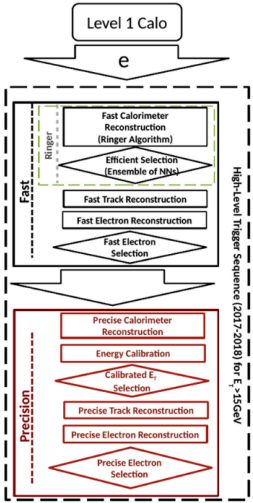


(a): Built rings for each calorimeter layer

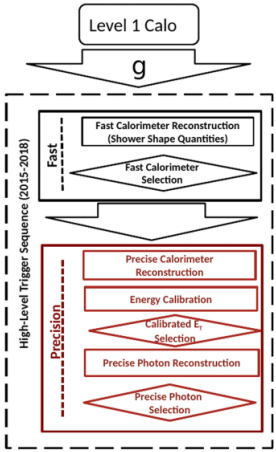


(b): Ringer algorithm

Electron and Photon Identification



HLT Electron sequence during Run2



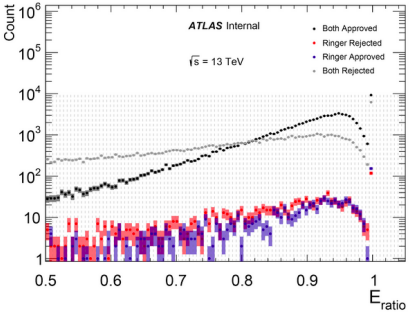
HLT photon sequence during Run2

Electron Identification

Electron Triggering for $E_T < 15$ GeV

- Tunned with 2017 collision data using the tag-and-probe method at $J/\Psi \rightarrow ee$ decay;
- Progress: evaluation on ATLAS computational environment;

$$E_{ratio} = \frac{E_{max,1} - E_{max,2}}{E_{max,1} + E_{max,2}}$$



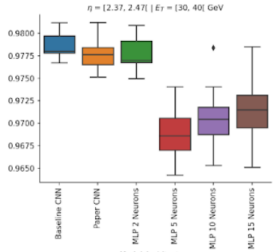
Agreement/Disagreement between Cut-Based and Ringer ($E_T < 15$ GeV)

Electron Identification on Forward Region

- Brazil-Bern collaboration;
- Electron identification for $2.5 < |\eta| 3.2$;
- Two approaches: forward emulation with trigger data and neural network tuning with forward offline data

Resultado Integrado

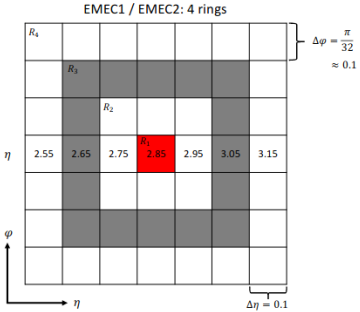
	P_D[%]	F_a[%]
Ref.	96.44	60.62
cnn.baseline	96.44±0.01	1.49±0.05
cnn.paper	96.44±0.01	1.40±0.04
mlp2.baseline	96.44±0.02	1.99±0.01
mlp5.baseline	96.44±0.00	4.01±0.37
mlp10.baseline	96.44±0.00	3.57±0.36
mlp15.baseline	96.44±0.00	3.34±0.32

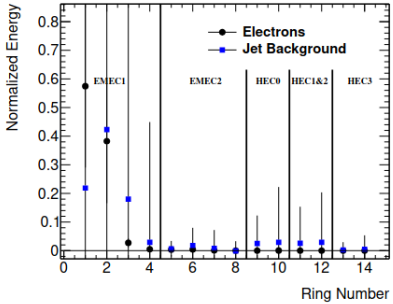


Forward trigger emulation using $Z \rightarrow ee$ 2017 data preliminary results

Electron Identification on Forward Region

- Electron Identification using offline data (since we do not have L1 data);
- Due to large cells, using 14 rings instead of the standard 100 rings;



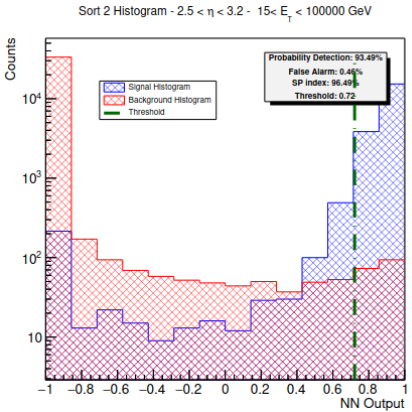


Electron identification using offline MC data preliminary results

Electron Identification on Forward Region

- Preliminary results shows a good fake rate reduction;
- Energy binning studies are in progress

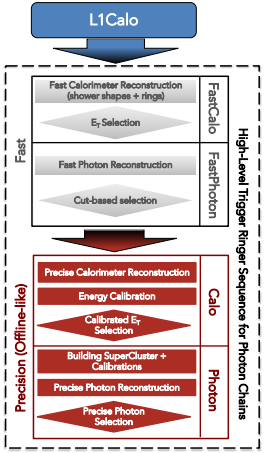
	P_D[%]	F_a[%]
Ref.	94.17	9.14
fwd_egun.mlp2	94.22±0.17	0.81±0.61
fwd_egun.mlp3	94.17±0.09	0.56±0.35
fwd_egun.mlp4	94.14±0.11	0.56±0.43
fwd_egun.mlp5	94.21±0.16	0.56±0.43
fwd_egun.mlp6	94.11±0.21	0.68±0.55
fwd_egun.mlp7	94.20±0.09	0.55±0.38
fwd_egun.mlp8	94.17±0.12	0.53±0.36
fwd_egun.mlp9	94.11±0.07	0.66±0.51
fwd_egun.mlp10	94.22±0.19	0.55±0.39



Photon Identification

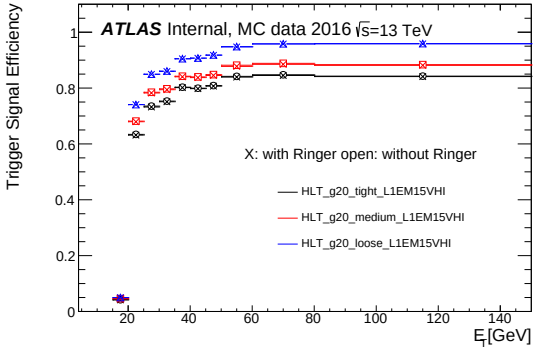
Photon Triggering

- NeuralRinger tunned with MC Run2 data;
- Photon Jet discrimination;
- Keeps the HLT efficiency, reducing the fake rate in 45%;

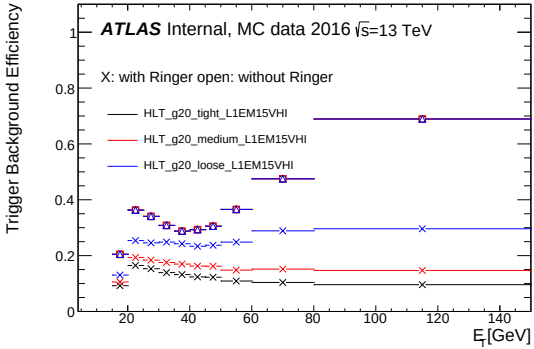


Run3 trigger proposal

Photon Triggering



(a): Signal Efficiency of the entire HLT



(b): Background accept in fast step

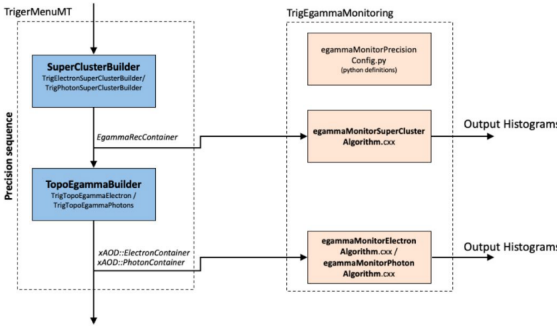
Photon Triggering

- The NeuralRinger for photons were migrated to ATLAS software environment;
- Preliminary analysis shows a high efficiency on fast step for signal samples;
- Also, preliminary results shows that convolutional neural networks can increase the performance;
- The framework to use data from $Z \rightarrow ll\gamma$ decay is almost ready;

Data Quality and Monitoring

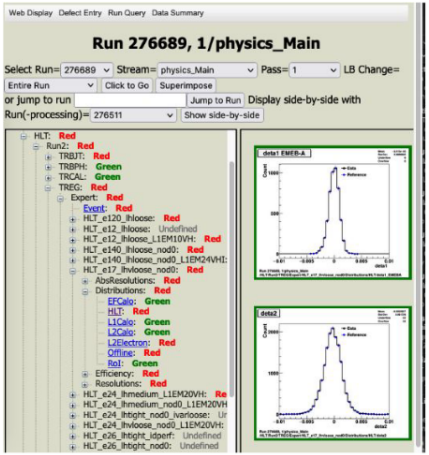
Data Quality and Monitoring

- Due to amount of data, a monitor system is needed;
- This type os system is necessary to detect hardware and software problems during collisions;
- In the ATLAS experiment, each trigger decision and the respective shower shape are stored;



Data Quality and Monitoring

- Before physics analysis, the data acquired in the collisions needs validation;
- Due to new ATLAS software releases, the data are reprocessed in order to validate those new releases;
- Single and combined e/γ triggers are monitored;



Conclusions

- The ATLAS Brasil collaboration contributes in many different ways on the ATLAS trigger system;
- The NeuralRinger algorithm plays an important role on e/γ chains;
- Also, the development of the online monitoring system is vital to proper validate the data acquired by the experiment;
- The international collaboration, with Sorbone and Bern universities reinforces the Brazil positioning at the ATLAS experiment, providing new solutions to the Run3 demands;

Thank you!
Questions?

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