Implementation and Performance of the Seeded Reconstruction for the ATLAS Event Filter Selection Software

Cibrán Santamarina and Patricia Conde Muíño
on behalf of the ATLAS High Level Trigger group*

High Level Trigger Group
ATLAS Collaboration

Cibran.Santamarina.Rios@cern.ch

1 Introduction

- ATLAS is one of the four LHC experiments that will start data taking in 2007.
- The ATLAS trigger system has to cope with a rate of 40 MHz and 25 interactions per bunch crossing.
- It is divided in three different levels. The last two are software based. They run a sequence of reconstruction algorithms on the event and validate the signal step by step.
- Whereas the second level has very limited processing time ($10ms$) and hence needs special fast reconstruction algorithms the third level or Event Filter disposes of enough time ($1s$) to apply the full power of the offline reconstruction algorithms specially adapted to be executed by the High Level Trigger Steering.
- The ATLAS HLT needs to reduce the event rate by a 1000 factor from the first level input.

2 Physics Goals

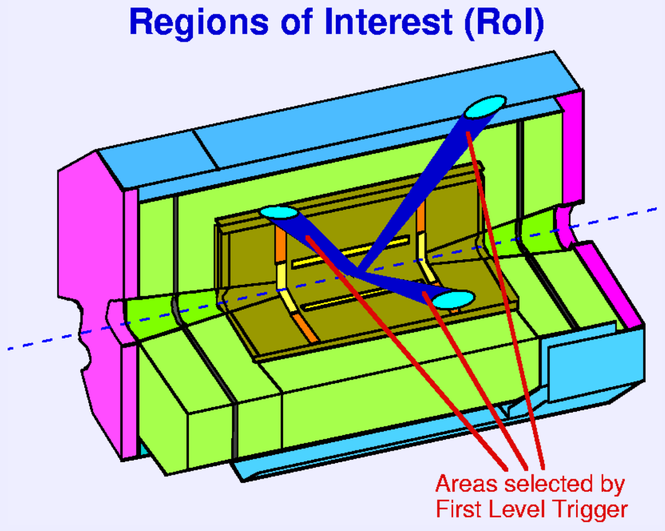
In this poster we present the performance of one Event Filter algorithm sequence that aims to identify electrons and photons of high transverse momentum. It is based on Cluster reconstruction in the ATLAS Liquid Argon Electromagnetic Calorimeter, tracking in the Inner Detector system and matching is applied between the electromagnetic clusters and a reconstructed tracks. Some of its main physics goals are given in the next table.

Selection signature	Examples of physics coverage
e25i	$W \to e\nu$, $Z \to ee$, top production, W', Z', $H \to WW^*/ZZ^*$
2e15i	$Z \to ee$, $H \to WW^*/ZZ^*$
γ60i	direct photon production, $H \to \gamma\gamma$
2γ20i	$H \to \gamma\gamma$

3 The ATLAS High Level Steering

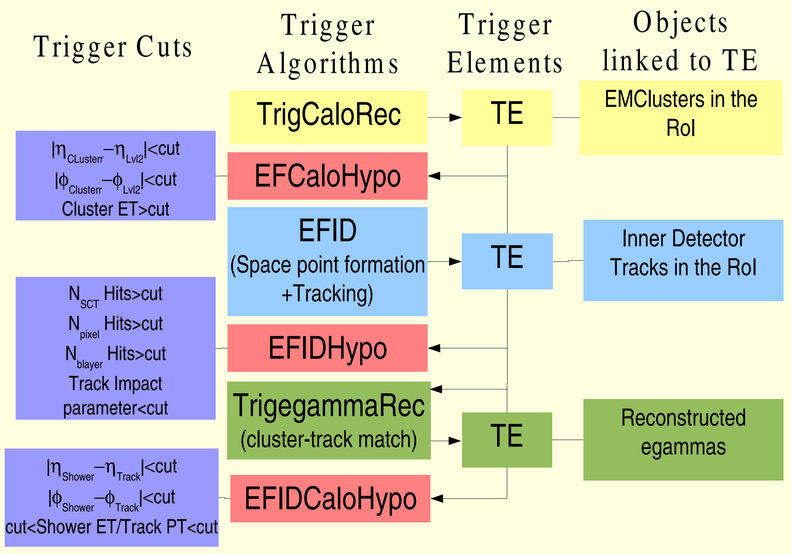
The ATLAS High Level Trigger (HLT) is guided by the Level1 hardware based trigger. The HLT only access data in a small region in the neighborhood of a given position initially provided by LVL1 and subsequently refined by the successive HLT algorithms separeted in two types, Level2 (LVL2) and Event Filter (EF) ones.

- The Steering is embedded within the ATLAS offline framework.
- It steers algorithm execution based on existing boolean Trigger Element combinations. An algorithm is executed if its corresponding Input Trigger Element is active.
- The main final task of an HLT Algorithm is to activate its Output Trigger Element to validate an hypothesis (i.e. e25i 2e15i).
- The Steering provides a data navigation system to link every trigger object back to the initial RoI (seeded reconstruction).
- It decides upon event fate at every step/event to provide early rejection.
- The Trigger decision is based on combination of active Trigger Elements (conditions) and information from Signatures.
- As a final step the steering creates the Event detailed Trigger results.



4 An Event Filter Seeded Chain For e/γ Detection

- The Event Filter algorithms chain for $e^{\pm}$ and γ reconstruction is summarized in the figure.
- The algorithm sequence combines feature extraction algorithms, retrieving and processing information from the detector, and hypothesis algorithms, performing the trigger selection on the relevant variables.



5 EF Slice performance on the $Z \to e^+e^-$ channel

To test the previous section algorithms slice we have studied the efficiency on the $Z \to e^+e^-$ channel. This channel will be used for the electromagnetic calorimeter calibration and for cross section measurements. An important characteristic of the channel is that two different signatures are sensitive to it (see next Table) e25i and 2e15i. Running two signatures running simultaneously in the HLT Steering where the efficiencies refer to the previous algorithm.

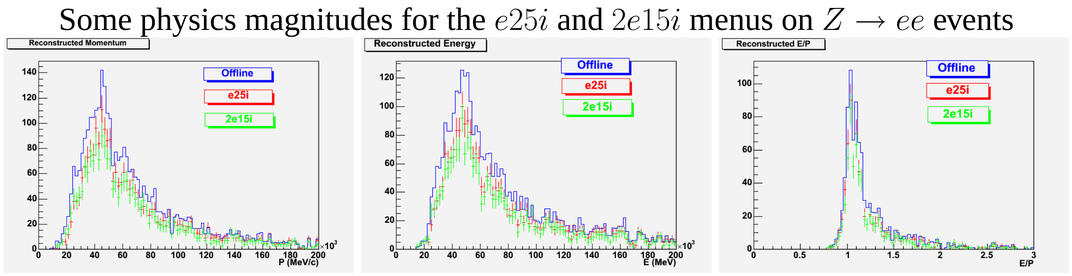
Signature	e25i	2e15i	e25i+2e15i
EFCaloHypo	71.15%	97.72%	99.99%
EFIDHypo	82.83%	96.67%	95.88%
EFIDCaloHypo	93.95%	94.60%	95.24%

We can also quote the timing for the algorithms where a 2.8 GHz cpu was used.

	Unpacking		Total	
	Time (ms)	**RMS**	**Time (ms)**	**RMS**
TrigCaloRec	4.1	1.4	7.6	1.6
EFID	34.8	7.8	88.8	40.2
TrigegammaRec	-	-	43.3	7.0

It is evident that the Unpack and Data Access consumes most of the available time but that the average time consumption well below the maximum allowed of 1 second.

Some physics magnitudes for the $e25i$ and $2e15i$ menus on $Z \to ee$ events



6 Conclusions

For the first time a seeded algorithm set has been implemented and run by the ATLAS High Level Trigger Steering at the Event Filter level.
We have used successfully the ATLAS HLT steering in which several signatures were run simultaneously. Tests have been carried out using simulated physics events which could be accepted by either of these signatures

[1] ATLAS Collaboration. ATLAS High-Level Trigger Data Acquisition and Controls Technical Design Report. *CERN/LHCC/2003-022 ATLAS TDR 16* June 2003.

[2] ATLAS Collaboration. ATLAS Detector and Physics Performance Technical Design Report. *CERN/LHCC/99-15 ATLAS TDR 15* May 1999.

[3] Gesualdi Mello, Aline et al. Overview of the High-Level Trigger Electron and Photon Selection for the ATLAS Experiment at the LHC. IEEE Real Time 2005 Conference 2005, Poster P8-6

*A. dos Anjos[a], S. Armstrong[b], J.T.M. Baines[c], C.P. Bee[d], M. Biglietti[e], J.A. Bogaerts[f], M. Bosman[g], B. Caron[h], P. Casado[g], G. Cataldi[i], D. Cavalli[j], G. Comune[k], P. Conde[f], G. Crone[l], D. Damazio[b], A. De Santo[m], M. Diaz Gomez[n], A. Di Mattia[o], N. Ellis[f], D. Emeliyanov[c], B. Epp[p], S. Falciano[o], H. Garitaonandia[g], S. George[m], V. Ghete[p], R. Goncalo[m], J. Haller[a], S. Kabana[q], A. Khomich[r], G. Kilvington[m], J. Kirkc[a], N. Konstantinidis[l], A. Kootz[s], A.J. Lankford[t], A. Lowe[m], L. Luminari[o], T. Maeno[b], J. Masik[u], C. Meessen[d], R. Moore[h], P. Morettini[w], A. Negri[x], N. Nikitin[y], A. Nisati[o], C. Osuna[g], C. Padilla[f], N. Panikashvili[z], F. Parodi[w], E. Pasqualucci[o], V. Perez Reale[q], J.L. Pinfold[h], P. Pinto[f], Z. Qian[d], S. Resconi[j], S. Rosati[f], C. Sánchez[g], C. Santamarina[f], D.A. Scannicchio[x], C. Schiavi[w], E. Segura[g], J.M. de Seixas[1], S. Sivoklokov[y], A. Sobreira[f], R. Soluk[h], E. Stefanidis[l], S. Sushkov[g], M. Sutton[l], S. Tapprogge[aa], S. Tarem[z], E. Thomas[q], F. Touchard[d], G. Usai[bb], B. Venda Pinto[cc], A. Ventura[i], V. Vercesi[x], T. Wengler[f], P. Werner[f], S.J. Wheeler[h,t], F.J. Wickens[c], W. Wiedenmann[a], M. Wielers[c], G. Zobernig[a]

[a]Department of Physics, University of Wisconsin, Madison, Wisconsin, USA; [b]Brookhaven National Laboratory (BNL), Upton, New York, USA; [c]Rutherford Appleton Laboratory, Chilton, Didcot, UK; [d]Centre de Physique des Particules de Marseille, IN2P3-CNRS-Université d'Aix-Marseille 2, France; [e]Dipartimento di Fisica dell'Università degli studi di Napoli `Federico II' e I.N.F.N., Napoli, Italy; [f]CERN, Geneva, Switzerland; [g]Institut de Física d'Altes Energies (IFAE), Universidad Autónoma de Barcelona, Barcelona, Spain; [h]University of Alberta, Edmonton, Canada; [i]Dipartimento di Fisica dell'Università di Lecce e I.N.F.N., Lecce, Italy; [j]Dipartimento di Fisica dell'Università di Milano e I.N.F.N., Milan, Italy; [k]Department of Physics and Astronomy, Michigan State University, East Lansing, MI 48824, USA; [l]Department of Physics and Astronomy, University College London, London, UK; [m]Department of Physics, Royal Holloway, University of London, Egham, UK; [n]Section de Physique, Université de Genève, Switzerland; [o]Dipartimento di Fisica dell'Università di Roma 'La Sapienza' e I.N.F.N., Rome, Italy; [p]Institut für Experimentalphysik der Leopald-Franzens Universität, Innsbruck, Austria; [q]Laboratory for High Energy Physics, University of Bern, Switzerland; [r]Lehrstuhl für Informatik V, Universität Mannheim, Mannheim, Germany; [s]Fachbereich Physik, Bergische Universität Wuppertal, Germany; [t]University of California at Irvine, Irvine, USA; [u]Institute of Physics, Academy of Sciences of the Czech Republic, Prague, Czech Republic; [w]Dipartimento di Fisica dell'Università di Genova e I.N.F.N., Genoa, Italy; [x]Dipartimento di Fisica Nucleare e Teorica dell'Università di Pavia e INFN, Pavia, Italy; [y]Institute of Nuclear Physics, Moscow State University, Moscow, Russia; [z]Department of Physics, Technion, Haifa, Israel; [aa]Institut für Physik, Universität Mainz, Mainz, Germany; [bb]Dipartimento di Fisica dell'Università di Pisa e I.N.F.N. Pisa, Italy; [cc]CFNUL - Universidade de Lisboa, Faculdade de Ciências, Lisbon, Portugal

IEEE Real Time Conference 2005