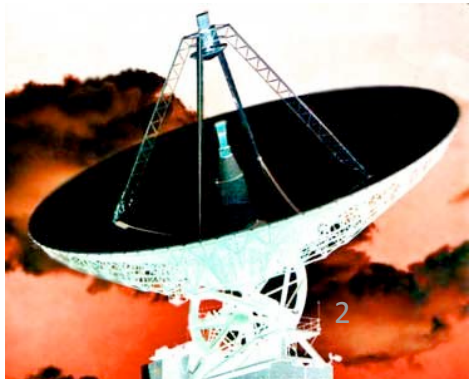
Preparation for the Beatenberg Trigger Workshop

Ricardo Gonçalo

Higgs WG Meeting during ATLAS Week - 4 Dec.08

Some Trigger News

- Trigger Menus:
  - There are currently several trigger menus:
    - E.g. lumi1E31_no_Bphysics_no_prescale, lumi1E32, online menu (with HLT in spy mode)
  - Current "Monte Carlo" menus for L=10^{31} $cm^{-2}s^{-1}$ contain a lot of triggers, for different luminosities
  - Plan to have separate menus for L=10^{31} $cm^{-2}s^{-1}$, L=10^{32} $cm^{-2}s^{-1}$, and for testing new triggers
  - Should make it easier to calculate rates, decide what triggers go to MC productions, make it simpler and more realistic, think …
  - Concentrate on the year ahead! (i.e. 10TeV at 0 to $10^{31}cm^{-2}s^{-1}$)
  - Current understanding of menu justification: https://twiki.cern.ch/twiki/bin/view/Atlas/L31TriggerMenu
- TrigDecisionTool
  - Replaced old TriggerDecision object from rel.12 – and adds much functionality
  - New interface being designed:
  - Simplify interface and improve user-friendliness
  - Add possibility of retrieving groups of objects (e.g. μ and τ combination which satisfies EF_tau20i_mu20)
  - See: https://twiki.cern.ch/twiki/bin/view/Atlas/NewTrigDecisionToolInterface
- Re-running prescaled chains
  - Possible to re-run prescaled-away chains on events where some other trigger fired
  - Consensus seems to be that this is useful; currently evaluating possibilities
- Slimming trigger data on disk
  - Now possible to slim down part of the trigger data; useful for DPD & etc
  - See: https://twiki.cern.ch/twiki/bin/view/Atlas/HLTTrigNavigationSlimming



Trigger Rates

- Trigger rates, and unique rates, are determined by the trigger group
- Soon to have 10 TeV rates (preliminary numbers available)
- See http://www-hep.uta.edu/~brandta/ATLAS/Rates/trigger%20rates.html

TRIGGER RATES

Trigger Rates Group:

Andrew Brandt (UT-Arlington), Seth Caughron (Columbia), Bilge Demirkoz (CERN), Marc-Andre Dufour (McGill), Arnab Pal (UT-Arlington)

14 TeV Luminosity = 10^{31}

Rates below calculated using Trigger-rate tool run on Enhanced Bias samples (user.SethCaughron.misal1_mc12.EnhancedBias_1031.digit.RDO.v13004004; you can daq/user/SethCaughron). These are derived from the 14 TeV 6.8 million event PYTHIA

Trigger rates for 14.4.0 10^{31} (html)

Trigger rates for 14.4.0 10^{31} (xls)
Allows sorting and access to unique rates

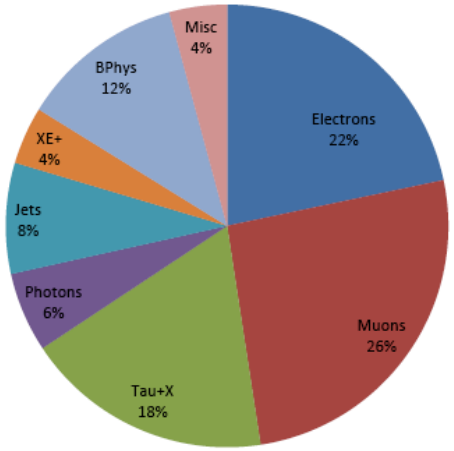
Trigger rate pie charts and summary tables

Top 10 triggers in rate and unique rate at each level

Trigger rate comparisons of 14.4.0 (red) with 14.2.24 (black)
tau+b rates are lower in new version (expected)

EF Rates 10^{31} 14.4.0

EF output rate 10^{31}
(Total Rate 310 Hz)



Trigger Group	Rate (Hz)
Muons	80
Electrons	67
Tau+X	56
BPhys	37
Jets	25
Photons	18
XE+	13
Misc	13
TOTAL	310

91 Hz total is in prescaled triggers;
51 Hz of prescaled triggers is unique rate

Total estimated EF Rate with overlaps removed is ~250 Hz

Proposed policy for new/updated trigger request

1. Proposal:
   - Through Savannah "feature request" including documentation of purpose (benefit), expected cost, etc
   - Analysis, discussion and approval
2. Implementation:
   - Together with trigger slice experts and trigger meisters
3. Testing:
   - Include in test Monte Carlo menu
   - Evaluation of efficiency for signal sample
   - Rate/CPU/memory cost estimation by trigger group
4. Deployment:
   - Include in online menu and deploy after final testing

To be discussed in Beatenberg

Justification:

- What is the purpose of this trigger? Which physics/ detector/combined performance group needs it?
- What is the estimated trigger rate [at which luminosity], including unique rate, for this trigger.
- In which streams does this belong?
- Specify all requirements for this trigger including L1 configuration.
- HLT algorithmic configuration.
- Is this trigger relevant for all luminosities?
- Can this trigger be pre-scaled? At which luminosities?
- What if the rate is too high? Do we pre-scale? Tighter selections?
- What are the backup triggers if this needs to be prescaled?
- How do you plan to monitor the trigger performance?
- Timing and memory requirements for this trigger?
- How do you calculate the trigger efficiencies? What additional triggers do you need?
- What tests have been done so far? What release? What are the results of this test?

See: http://indico.cern.ch/conferenceDisplay.py?confId=43234

Trigger Workshop, 2-6 February

2-6 February 2009 | Dorint Blüemlisalp, Beatenberg, Interlaken

- Session 1: operations (including experience from 2008 run)
  - Review of menu-wide issues related to actual operation: what happened/how long it took to implement, test, deploy new menus? What problems affected the trigger operation?
- Session 2: trigger motivation(s)
  - Understand what is at stake in each trigger: What physics/detector commissioning/monitoring do they serve? What can be prescaled? How rates can be controlled? What other triggers are related and how?
- Session 3: trigger menu evolution
  - How to get a trigger online? How it evolves with changing luminosity? Who decides and based on what information?
- Session 4: trigger efficiency
  - How to determine the efficiency and bias for each trigger? What analysis data is needed for this? How much luminosity is needed for this?
- Session 5: rate measurement and management
  - Review the existing tools to estimate resource usage: how much does a new trigger cost? How close are we to the limit? How best to predict the cost of a new trigger?
- Higgs contribution can be useful for several sessions, especially 2 and 3 (4 and 5 at a later stage?)
  - More info here: https://twiki.cern.ch/twiki/bin/view/Atlas/TriggerWorkshop2009

Session 2: Motivation of new triggers

See G. Brooijmans talk in http://indico.cern.ch/conferenceDisplay.py?confId=43235

Chair: TBA, main panel contact: Katsuo Tokushuku

Questions:

- Which physics/performance/calibration studies use this trigger?
- What are the physics control channels for these studies? Will these use the same trigger? If not, how will the control sample(s) be triggered and "mapped" to the physics channel?
- Which parameters (threshold, isolation, etc.) are more important given the trigger's purpose? What is the impact of changes in the values of these parameters on the physics goals?
- Can this trigger be prescaled? Why not? What should its priority be in terms of prescaling? Only at highest luminosities?
- If this trigger cannot run for some reason, what are the primary and secondary fallback triggers? Why?
- Does this physics/performance/calibration topic have a specific range of application? For example, are 10^6 events all that's needed? Or is this only useful at low luminosity? (What is then the relevant critical luminosity?)
- How stable is this trigger expected to be if pile-up effects or other backgrounds are different from expectation?

Session 3: Evolution of the Trigger Menu

- Chair: Alan Watson, main panel contacts: Hans-Christian Schultz-Coulon, Mel Shochet

- Questions specific to existing triggers:
  - What are specific plans for adapting to a rate increase/instability? Increase of threshold? Extra conditions?
  - How shall a trigger evolve with increasing luminosity?
  - How is the trigger performance validated?

- General questions:
  - When do we call a trigger a 'new' trigger? (In case of any modification? Only if major modifications are made? What are major modifications?)
  - What are the steps for introducing a new trigger? (Motivation? What analyses? Calibration? Gain wrt to existing trigger mix? …)
  - What are the steps for modifying a trigger? Who decides and when?
  - How/to what extend should we share trigger algorithms?
  - What are the validation steps after introduction of a new trigger? (Is regular proof of stability needed? What are the time scales for proving trigger performance?...)
  - Are fast reactions to changing background conditions possible?
  - How do we handle impacts on other triggers when modifying the trigger mix? How do we identify all analyses using a particular trigger?

Proposed contribution from Higgs WG - I

For each analysis/channel:

- Determine the trigger efficiency for **signal** samples with respect to the offline selection (or reasonable preselection)?
  - **Be quantitative and clear**
  - Take **prescales** into account – see slide on available data below
  - Apply no truth/fiducial cuts at trigger level (don't make it look nice, make it real)
  - **Use several possible triggers** even if not optimal – The interesting question is: "How much data do we loose if we have to use this trigger?"
  - Useful to know: what is the offline (pre-)selection efficiency?

- What (if any) bias do you find in which distributions/measurements? (e.g. shift in estimated m_H with /without trigger)
  - Would help to understand if something needs to be improved on a given trigger

- How much luminosity will you need to have some sensitivity? (e.g. 1-2fb^{-1} for H -> WW; 10 fb^{-1} for ttH … approximate numbers are ok here)
  - Helps to understand what plan should be as luminosity increases

Proposed contribution from Higgs WG - II

The first priority is described in the previous slide, but…

- Most of the work next year will be on:
  - Studying and understanding the backgrounds
  - Discovering methods to determine bias, systematic uncertainties, and efficiencies (incl. trigger efficiencies), etc from real data

- It would be very useful to understand:
  - What triggers will be used to select any control samples, samples needed for performance studies, samples to study trigger and reconstruction efficiency
    - e.g. use electron and muon triggers to select ttbar background sample
  - How much statistics (i.e. integrated luminosity) will be needed to achieve the required precision
  - Most important issue is to suppress bias: don't use b-tag trigger if you need to study offline b-tagging efficiency

- As much quantitative information as you can provide: this will make it more likely that the right trigger will be there when you need it

Data for trigger studies

- In principle, there's no time to re-do data samples before workshop
- Use trigger menu available in data currently being produced (See Junichi's talk today)
- Data produced with release 14.2.20.3; centre of mass energy: 10TeV
- Geometry: ATLAS-GEO-02-01-00
  - http://atlas.web.cern.ch/Atlas/GROUPS/OPERATIONS/dataBases/DDDB/show_branch_tag_comments.php?tag_name=ATLAS-GEO-02-01-00
- Trigger Menu: lumi1E31_no_Bphysics_no_prescale
  - Prescales **not** applied in AOD – can be found from "lumi1E31_no_Bphysics" page: and corrected by hand (easy for single triggers, ask when in doubt)
  - Trigger menu pages: lumi1E31_no_Bphysics : http://tbold.web.cern.ch/tbold//view_menu.php?name=lumi1E31_no_Bphysics_14.2.20&tag=
  - lumi1E31_no_Bphysics_no_prescale : http://tbold.web.cern.ch/tbold//view_menu.php?name=lumi1E31_no_Bphysics_no_prescale_14.2.20&tag=

EF chains details

name	PS	PT	counter	Lower Chain	stream	signatures
EF_te650	1	0	141	L2_te650	physics. jetTauEtmiss x 1 physics. express x 1	2: EF_te650 x1
EF_g25_xe30	1	0	243	L2_g25_xe30	physics. egamma x 1 physics. express x 1	1: EF_g25calo x1 2: EF_g25id x1 EF_xe30 x1 3: EF_g25 x1 EF_xe30 x1
EF_mu4_j10_matched	1	1	457	L2_mu4_j10_matched	physics. jetTauEtmiss x 1	1: EF_mu4_j10_matched x1
EF_e10_mu6	1	0	241	L2_e10_mu6	physics. muons x 1 physics. egamma x 1	1: EFID_mu6 x1 EF_e10_loosecalo x1 2: EF_mu6 x1 EF_e10_looseid x1 3: EF_mu6 x1 EF_e10_loose x1
EF_MU4_Upsimumu_FS	1	0	322	L2_MU4_Upsimumu_FS	physics. muons x 1	1: EF_FStracks x1 2: EF_MU4_Upsimumu_FS_FStracks x1 3: EF_MU4_Upsimumu_FS x1
EF_g20_xe15	1	0	242	L2_g20_xe15	physics. egamma x 1	1: EF_g20calo x1 2: EF_g20id x1 EF_xe15 x1 3: EF_g20 x1 EF_xe15 x1

Review of CSC analysis and some suggestions

H→γγ

- CSC: used 2g17i OR g55
- lumi1E31:
  - EF_g20 (8Hz)
  - EF_g20i (7Hz)
  - EF_g25 (4Hz)
  - EF_g25i (3.3Hz)
  - EF_g105
  - EF_g150
  - EF_g55_tight
  - EF_2g10
  - EF_2g15
  - EF_2g17i_tight
  - EF_2g20

H→4l

- CSC: e22i, mu20, 2mu10, 2e15i, ORs of the above
- EF_e12_medium (13 Hz)
- EF_e15_medium (3Hz)
- EF_e15i_medium (2.6Hz)
- EF_e10_mu6 (0.3Hz)
- EF_e5_e10_medium (0.1 Hz)
- EF_e55_loose1 (0.5Hz)
- EF_e20_g20
- EF_Zee
- EF_e20_loose
- EF_e20i_loose
- EF_e22i_tight
- … and many muon signatures

Many more triggers to choose from than in rel.12
Not all of the above are interesting… and many will be for initial running only
Note: a cleanup of the e/gamma menu is currently underway

H→ττ

- CSC:
  - ll and lh: e22i or mu20
  - hh: L1_TAU30_xE40_softHLT
- lumi1E31:
  - lh: tau16i_e15i, tau20i_e10, tau20i_e15i, tau16i_mu10, tau20i_mu6, tau16i_mu10
  - hh: 2tau29i, tau29i_tau38i, tau38i_xe40, tau38i_EFxe40
- See Soshi's talk in Tau meeting yesterday

Same for other channels…

VBF H→inv.

- CSC: used approximations and a lot of "manual" work
  - XE60, XE70, XE80, XE100, XE120, FJ23_XE70, J23_XE70, J23_XE100, FJ23_XE100, FJ23_J23_XE70, FJ23_J23_XE100
- Forward jets and missing ET triggers are now properly implemented in the menu

Conclusions and outlook

- There is work to do to prepare for the Trigger Workshop in February
  - Make sure we have the triggers we need for the 2009 run
  - The data is ready or on the way
  - Minimal example code for querying the trigger is available
    - http://atlas-sw.cern.ch/cgi-bin/viewcvs-atlas.cgi/users/jgoncalo/iCount/
    - To get it: set up Athena and do

      `cvs co users/jgoncalo/iCount`

- Pre-workshop meeting to gather information:

  Phone meeting on the 22nd January

  Details later from Leandro and Ketevi

  Studies should be done by then

- When in doubt…

  Ask a friendly trigger contact person near you