Introduction

08/11/2007

Higgs WG – Trigger meeting

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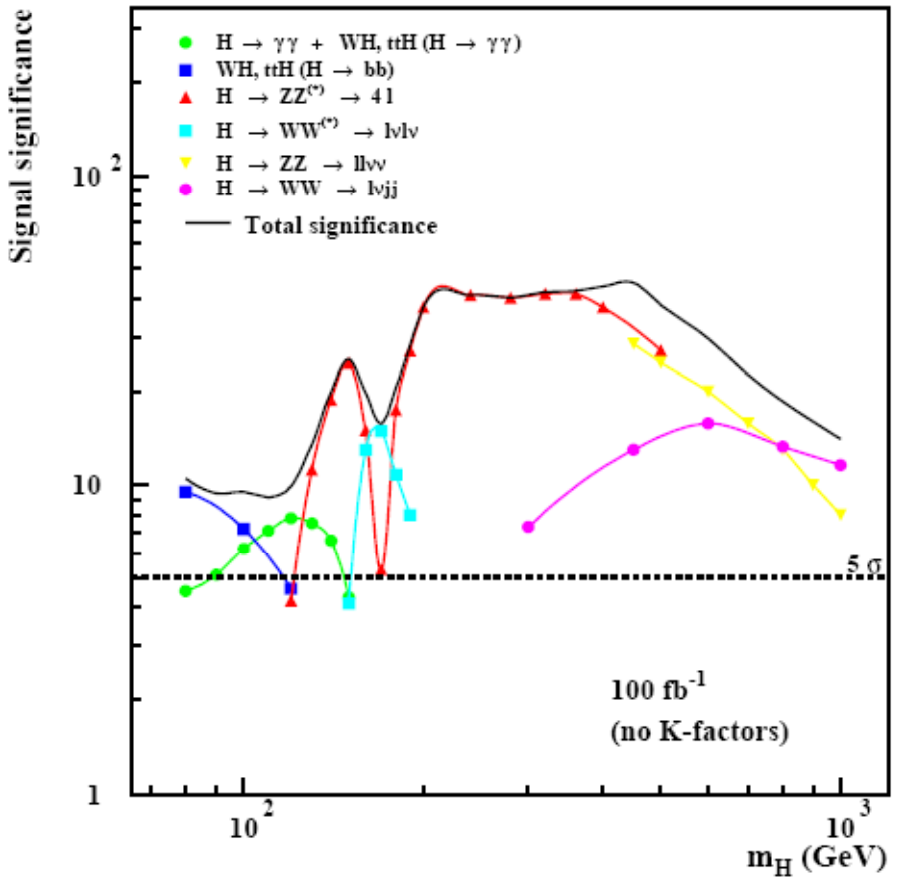
From Menus Workshop - September

- Higgs analyses are mostly interested in 10^{33} and 10^{34} $cm^{-2}s^{-1}$
  - A few channels interesting at medium Lumi: $H \rightarrow WW$, $H \rightarrow ZZ$, $H^{\pm} \rightarrow \tau\nu$, etc
  - Early on, accumulate samples for background & performance studies
- Higgs analyses are searches:
  - Good efficiency for signal essential
  - Any prescaled trigger quickly becomes useless
  - On the plus side: usually interested in high-p_T objects that stand out from background



- Move towards increasingly realistic analyses
- Menu in 12.0.6 not very realistic, but a good starting point (not for all notes)
- More recent menus not very useful for high-lumi analyses
  - Clearly needed for background (and signal!) studies early on, but thresholds too low (rates too high) for most of our dataset
- The menu will evolve and we will use a mix of several menus – ideally these should be stable for long periods to ease analysis – won't always happen
- Need for a complex trigger must be balanced against more complex analysis and systematic uncertainties
- The aim right now is to determine how tight our margin is, i.e. how sensitive we are to systematic errors coming from the trigger, changing thresholds, etc
- How do we determine the trigger efficiency and its uncertainty?
  - What do we need to measure? Tightly coupled with what trigger we use

Questions asked for this meeting

0) What kind of trigger items of the Trigger Menu you intend to use to select your channel;

1) Trigger (LVL1&LVL2&EF) efficiencies with respect to your selection cuts; in case you have multivariate analysis, this efficiency should be evaluated wrt the preselection cuts – no point in worrying about the phase space that is unreachable to the analysis

2) Analysis of some critical distribution done without and with the trigger selection: here the idea is to check what kind of "bias" the online selection introduces in the variables crucial for the final analysis; Please choose a few of them and show with no trigger selection, and with it;

3) The dependence of your analysis on the selection threshold you suggest to use: with this we would like to see "how much" space we have in moving the trigger threshold around the values suggested, without inducing a strong deterioration on the final result.

Points 1) and 2) can worked out with the current data. More problematic is the point 3), where we don't have all possible thresholds we want in the AODs of release 12.0.6. In any case we suggest a preliminary analsyis of this point using the offline reconstruction algorithms (correspondent to those used at the HLT, for example at the Event Filter) and varying the selection cut(s) around the nominal thresholds.

Efficiency calculations

- The LHC will not provide the MC truth… need to get everything from data, at least until we can be sure that we can trust the simulation (and in which aspects we can trust it)

- Measure efficiencies from orthogonal triggers:
  - Jet trigger efficiency for each analysis from samples selected by muon triggers
  - Electron/muon trigger efficiency from tag-and-probe method

- Change (reweight, improve) MC description to reproduce what we see in data

- Use all the tools in the box to make sure we're leaving nothing to chance:
  - orthogonal triggers
  - Tag-and-probe
  - minimum bias
  - random triggers

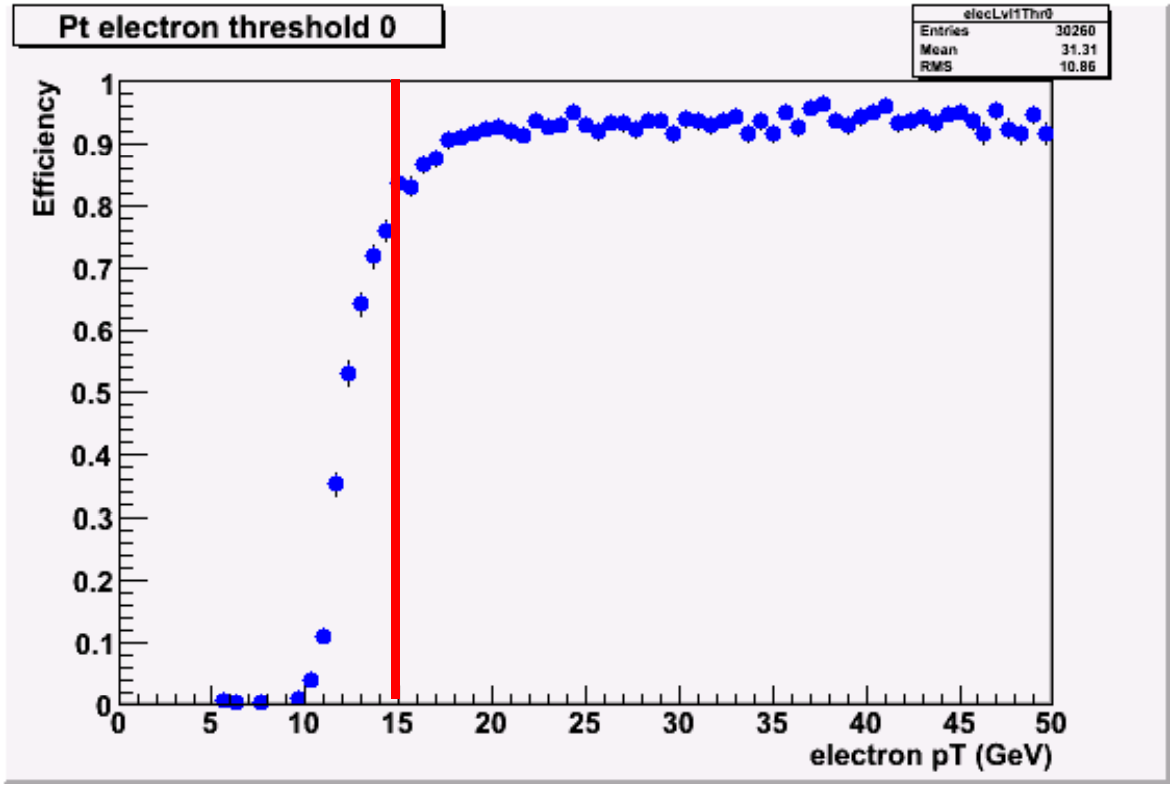
- What samples will be needed to study these things in your analysis? Are there triggers for these samples?

Silly example

- 40MHz bunch-cross rate
- 220Hz of accept rate with 20Hz reserved for unbiased events
  - Accept fraction for signatures is 5×10^{-6} of input rate
- 10% of accept rate – 20Hz – for unbiased events (random trigger)
- Menu of 100 signatures each with 2Hz at EF (exclusive)
  - i.e. each has 1% of accept rate
- Each signature is also satisfied 1% of the unbiased sample : 1% x 5×10^{-6} x 20Hz = 10^{-6} Hz
  - i.e. for each event accepted at EF by signature EF_X in the normal trigger there would be 10^{-6}Hz/2Hz = 5×10^{-6} events also passing EF_X in the unbiased sample
- To have 10% statistical uncertainty in the efficiency of EF_X we'd need ~100 events also passing EF_X from the unbiased sample
  - In the same time, the EF_X would have collected 2×10^6 x 100 = 2×10^8 events which would have taken 2×10^8/2Hz = 10^5s ≡ 1day
- 1% uncertainty in efficiency would need 10^4 unbiased events (100 days)
- And it keeps going quadratically…
  - Not very practical… use other methods instead:

Systematic uncertainties?

- Need to estimate effects from detector and trigger from real data
- Should minimize sources of systematic uncertainties



Stefano Rosati – this meet.

Conclusions

- What we need to address:
  - Is our trigger efficient for offline selection?
  - How are we going to estimate both efficiencies and systematic uncertainties?
  - Are preselection cuts adequate?
- I’ve seen some of the material from some CSC notes and I think we’re going in the right direction!