VBF H(inv) - Trigger Strategy 2015

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2012 Trigger

- We ran a suite of triggers with different thresholds and variations in logic
  - With the main goal of robustness

- The trigger used for the signal region was :
- L1
  - MET > 40 GeV
- HLT
  - Di-jet pair : p_T > 40 GeV, fwd/bkwd, $\Delta\eta$ > 3.5, M_{jj} > 800 GeV
  - METNoMu > 65 GeV

- Use of METNoMu provides samples of W(mu) and Z(mumu) for background estimation

- We also ran parked triggers with reduced jet pT and Mjj thresholds
  - Will not replace these in 2015

2015 Strategy

- Signal Trigger
  - *HLT*
    - As for 2012 with raised thresholds
    - Some possible additions to minimise threshold increase :
      - PU jet removal
      - QCD rejection using Δϕ(jet, MET)
  - *L1*
    - Need to add jet conditions to reduce MET threshold
    - See next slides
- Control Trigger
  - One issue from 2012 analysis was stat. uncertainty in trigger efficiency measurement
  - Anticipate prescaled control trigger for measuring signal trigger efficiency
    - eg. di-jet + MET (with no VBF conditions)
  - Need to study requirements : sample size, thresholds, prescale

Level 1

- 2012 signal trigger seeded by L1_ETM40
  - Slow trigger turn-on results in offline threshold of 130 GeV
  - Anticipate threshold of 70 in 2015 (PU40bx25)

- Many options
  - MET
  - Jet + MET
  - Jet + MET + Δϕ(jet, MET)
  - Dijet + MET + Δη(jet, jet) ?
  - Dijet + MET + Δϕ(jet, MET) ? ← VBF selection, may be ineffective due to PU
  - MHT/HTT ← QCD rejection

- Upgrades
  - L1 will be upgraded during 2015 and 2016, increasing capabilities at each step
  - Aim to study 1-2 options for each scenario (Legacy, 2015, 2016)

Legacy system (baseline)

- We can define a baseline by just updating the seed of our HLT paths to the lowest unprescaled L1 ETM available trigger.
  - In the current draft menu this is L1_ETM70
- With the help of neutrino gun samples we can calulare VBF H(inv) signal efficiency:

L1+HLT	PU20bx25	PU40bx50	PU40bx25
L1_ETM40 + HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	0.1079	0.1092	0.1168
L1_ETM70 + HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	0.0761	0.0774	0.0841
L1_ETM40 + HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	0.0850	0.0879	0.0920
L1_ETM70 + HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	0.0615	0.0634	0.0677

- By raising the seed from L1_ETM40 to L1_ETM70 we lose ~30% signal efficiency.
  - This is a tolerable efficiency loss but we aim at improving algorithms both on the L1T and HLT sides
- We can now calculate the expected pure HLT rates for this paths.

L1+HLT	PU20bx25	PU40bx50	PU40bx25
L1_ETM40 + HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	113.48	179.95	1903.08
L1_ETM70 + HLT_DiPFJet40_PFMETnoMu65_MJJ600VBF_LeadingJets_v	21.62	57.78	308.35
L1_ETM40 + HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	78.36	127.12	1087.03
L1_ETM70 + HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	18.91	42.92	263.97

- HLT pure rates drop significantly to ~20Hz on first scenario
  - HLT PU subtraction should further lower this rates.
- At the last PU scenario rates become too high. We can again do the exercise of raising the seed, but at this point we should have in place a better trigger with more options.

Plan

- Study L1 seed options — Joao
- Implement the path in HLT ConfDB — Jim
- Run on data / MC — Jim / Chayanit
  - Trigger efficiency
  - Purity after analyses cuts
  - Rate estimates
  - CPU timing measurements
- Strategy & code for validation of the triggers — Expand existing VBF DQM code - Phat
  - how ? if not using DQM, why not ?
- Strategy for efficiency estimates from data — Single muon + our own control trigger
  - which samples will be used ?
  - which other triggers will it rely on ?
- Aim for baseline triggers & implementation by October TSG Workshop