

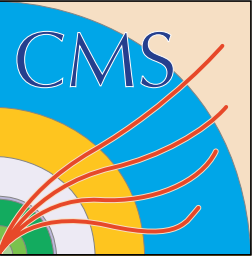
VBF H(invisible)

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for the VBF H(inv) team

VBF H(invisible)

- ▶ H->invisible search is inspired by dark matter
- ▶ 2012 result (HIG-13-013) most sensitive direct search for this decay mode
- ▶ 2012 offline selection
 - ▶ Two jets $p_T > 50$ GeV, fwd/bkwd
 - ▶ $\Delta\eta(jj) > 4.2$, $M(jj) > 1100$ GeV, $\Delta\phi < 1.0$
 - ▶ $MET > 130$ GeV
- ▶ 2012 Trigger
 - ▶ L1_ETM40
 - ▶ HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v*
 - ▶ Dijet $p_T > 40$ GeV, fwd/bkwd, $\Delta\eta > 3.5$, $M_{jj} > 800$ GeV
 - ▶ METNoMu > 65 GeV
 - ▶ Efficiency measured in data with single mu triggers
- ▶ Efficiency wrt total signal cross section (for $m_H=125$, $BF=100\%$)
 - ▶ L1 : $\sim 47\%$, HLT : $\sim 9\%$

Study Details



- ▶ CMSSW 7_2_0

- ▶ Samples : Fall13 TSG 62X, PU40 bx25 ($L_{\text{inst}} = 1.4\text{E}34$)
 - ▶ L1 rates : neutrino gun
 - ▶ HLT rate : binned QCD
 - ▶ Signal eff : VBF H125->invisible

- ▶ L1
 - ▶ Re-emulation of stage 1
 - ▶ L1Menu_Collisions2015_25ns_v1/L1T_Scales_20101224/Imp0

- ▶ HLT
 - ▶ Setup : /dev/CMSSW_7_2_0/GRun/V14
 - ▶ Paths : /users/jbrooke/vbfHinv/dev/V10
 - ▶ (Jet/MET reco and MET noise cleaning copied from master above)

L1 Seeds for 2015

- ▶ Starting point is lowest unprescaled MET trigger
 - ▶ L1_ETM70
- ▶ Try to increase signal yield by adding jet requirements
- ▶ Additional rate wrt existing L1 menu, still to be calculated

Increase wrt L1_ETM70



	Ind rate	Extra rate	Ind eff	Extra yield
ETM70	7kHz	-	28%	-
Dijet30 + fwd/bkwd + $\Delta\eta(jj)>3.5$ + Jet96	4.6 kHz	?	15%	21%
Dijet30 + fwd/bkwd + $\Delta\eta(jj)>3.5$ + ETM50	5.0kHz	?	14%	14%
ETM60 + jet veto ($p_T>40$ GeV, $\Delta\phi<1.0$) ¹	5.5kHz	?	14%	11%
HTT70 + MHT/HTT >0.7 ²	9 kHz	?	22%	11%

1 - proposed by Z(vv)H(bb)

2 - proposed by SUSY

- ▶ Strategy
 - ▶ PFMET170 will provide high MET sample
 - ▶ Obtain medium MET sample by adding jet requirements
 - ▶ Control trigger obtains very low MET sample for measuring trigger turn-ons

- ▶ Paths include
 - ▶ Calo MET noise cleaning a la PFMET170
 - ▶ Calo MET > 80 GeV
 - ▶ Calo jet requirements : dijet $p_T > 40$ GeV, $\Delta\eta(jj) > 2.5$, $M_{jj} > 500$ GeV

Signal Triggers	L1 seed	Rate	Eff.	Total eff
HLT_PFMET170_NoiseCleaned	L1_ETM70	?	9%	9%
HLT_DiPFJetVBF40_DEta3p5_MJJ600_PFMETNoMu140	L1_ETM70	4.7 Hz	?	10.5%
HLT_DiPFJetVBF60-40_DEta3p5_MJJ600_PFMETNoMu140	L1_ETM70	4.5 Hz	?	10.5%
Control Trigger				
HLT_DiPFJetVBF40_DEta3p5_MJJ600_PFMETNoMu80	L1_ETM50	0.5 Hz	-	-

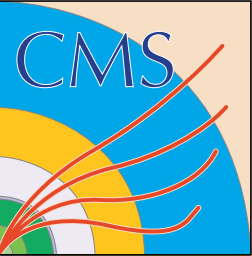
To Do



- ▶ Additional rate/efficiency by including dedicated L1 seeds
- ▶ CPU timing

Backup

L1 MET Issues



- ▶ 2012 analysis showed significant loss of efficiency in trigger
 - ▶ MC signal yield after all cuts = **209 events**
 - ▶ MC signal yield after all cuts, *but no trigger* = **247 events**

**Trigger loses 15%
of potential signal**

- ▶ Plots below show :
 - ▶ Events in signal region, no trigger & Events in signal region, failing trigger
 - ▶ Loss of efficiency entirely due to L1 MET cut
 - ▶ Tag jet η distribution shows majority of failing events have a jet in HF
 - ▶ **L1 MET calculation is configured to use only $|\eta| < 3$**

