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Triggers for Higgs Searches

High Mass Higgs ($M_{Higgs} > 135$ GeV) where $H \to W^+W^-$ or ZZ

1. All hadronic channels : give up
2. e/μ ($W \to e/\mu + \nu$ or $Z \to ee/\mu\mu$) + jet channels : inclusive high P_T lepton triggers
   $\Rightarrow$ item # 1 from the low mass Higgs triggers
3. Missing E_T ($Z \to \nu\nu$) + jet channels
   $\Rightarrow$ item # 2 from the low mass Higgs triggers
4. τ ($W \to \tau + \nu$ or $Z \to \tau\tau$) + jet channels : inclusive high P_T lepton triggers
   $\Rightarrow$ item # 4 from the low mass Higgs triggers

Low Mass Higgs ($M_{Higgs} < 135$ GeV) where $H \to \bar{b}b$ or $\bar{\tau}\tau$

1. WH or ZH where $W \to e/\mu + \nu$ and $Z \to ee/\mu\mu$: all Higgs decay modes
   - Physics Significance
   - Trigger cross sections and rates
     L2 muon trigger cross sections are estimated based on L2-muon board specs

Trigger	σ_{L1} (nb)	σ_{L2} (nb)	σ_{L3} (nb)
High Et CEM	1,500	170	59
$\not{E}_t$ + PEM	771	55	19
High Pt muon (CMUP)	1,773	200	8
High Pt muon (CMX)	1,773	200	8
Total	5,817	625	94
Total (rates at 4×10^{32})	2,327 Hz	250 Hz	38 Hz

2. ZH where $Z \to \nu\bar{\nu}$: $H \to \bar{b}b$ and part of $H \to \bar{\tau}\tau$
   - Physics Significance
   - Trigger cross sections and rates

Trigger	σ_{L1} (nb)	σ_{L2} (nb)	σ_{L3} (nb)
$\not{E}_t$ + 2 jets	163	126	13
$\not{E}_t$ + 2 bjets	?	?	?(135)
Total	163	126	13
Total (rates at 4×10^{32})	65 Hz	50 Hz	5 Hz

3. WH or ZH where $W \to \bar{q}'q$ and $Z \to \bar{q}q$: $H \to \bar{b}b$ and part of $H \to \bar{\tau}\tau$

   - Physics Significance
   - Trigger cross sections and rates
     High Pt b-jet L2 = 200 nb justification ?

Trigger	σ_{L1} (nb)	σ_{L2} (nb)	σ_{L3} (nb)
High Pt b-jet	10,840	200	97
Higgs multijet (W/Z + Higgs)	1,850	59	22
Total	12,690	259	119
Total (rates at 4×10^{32})	5,076 Hz	104 Hz	48 Hz

4. WH with $W \to \tau\nu$ (all Higgs decay modes), ZH with $Z \to \bar{\tau}\tau$ (all Higgs decay modes), WH/ZH with $H \to \bar{\tau}\tau$

   - Physics Significance
   - Trigger cross sections and rates
     (L2 triggers need explanation since it is not coming from the extrapolation of the current triggers)

Trigger	σ_{L1} (nb)	σ_{L2} (nb)	σ_{L3} (nb)
Di-tau	5,700(4,800)	200	4
$\not{E}_t$ + tau	$\not{E}_t > 25$ GeV (overlap)	50	4
Total	5,700	250	8
Total (rates at 4×10^{32})	2,280 Hz	100 Hz	3 Hz

5. Calibration / Cross-check Triggers

   - Physics Significance
   - Trigger cross sections and rates

Trigger	σ_{L1} (nb)	σ_{L2} (nb)	σ_{L3} (nb)
$Z \to \bar{b}b$	(overlap)	100	8
Jets			
$\not{E}_t > 45$ GeV	$\not{E}_t > 25$ GeV (overlap)	163	3
Photons			
$J/\psi \to \mu\mu$			
Total			
Total (rates at 4×10^{32})	Hz	Hz	Hz

- Higgs Summary

Trigger	Rates at 4×10^{32}		
	L1	L2	L3
item #1 (high P_T e/μ	2,327 Hz	250 Hz	38 Hz
item #2 (ν)	65 Hz	50 Hz	5 Hz
item #3 (hadronic)	5,076 Hz	104 Hz	48 Hz
item #4 (τ)	2,280 Hz	100 Hz	3 Hz
item #5 (calibration)			
Total	9,748 Hz	504 Hz	94 Hz

SUSY Searches

Just for information

- High P_T b-jet (HIGH_PT_BJET)
  - L1_TWO_TRK2_&_TWO_CJET5
  - L2_TWO_TRK2_D100_&_L1_TWO_CJET5
  - L3_HIGHPT_B_JET
- $Z \to \bar{b}b$ (calibration)
  - L1 : 2 tracks with $P_T > 4$ GeV, $\Delta\phi > 150^o$ (L1_TWO_TRK4_DPHI150)
    σ (nb) = 9745 + 262 × L (10^{30}) = 114,545
  - L2 : 2 tracks with $P_T > 4$ GeV, $D_o > 120$ μm (L2_TWO_TRK4_D120)
    σ (nb) = 54 + 1.3× L (10^{30}) = 574
  - L3 : (L3_Z_BB)
- Higgs Multi-jet (HIGGS_MULTI_JET) : $WH, ZH \to q\bar{q}b\bar{b}$)
  - L1 : Jet $E_T > 10$ GeV, $\Sigma E_T > 90$ GeV (L1_JET10_&_SUMET90_&_CLC)
    σ (nb) = 446 + 3.5 × L (10^{30}) = 1,846
  - L2 : 2 tracks with $P_T > 2$ GeV, $D_o > 100$ μm
    (L2_TWO_TRK2_D100_L1_JET10_&_SUMET90)
  - L3 : 3 jets with $E_T > 10$ GeV, $\Sigma E_T > 100$ GeV, 2 SVT tracks.
    (L3_THREE_JET10_SUMET100_TWO_SVT)
- Top Multi-jet (TOP_MULTI_JET)
  - L1 : Jet $E_T > 10$ GeV (L1_JET10)
  - L2 : 4 jets with $E_T > 15$ GeV, $\Sigma E_T > 125$ GeV (L2_FOUR_JET15_SUMET125)
    σ (nb) = 9 + 0.08× L (10^{30}) = 41
  - L3 : 4 jets with $E_T > 10$ GeV (L3_FOUR_JET10)
    σ (nb) = 27 + 0.23× L (10^{30}) = 119

- PEM + Mising Et (MET_PEM)
  - L1_EM8_&_MET15
  - L2_PEM20_L1_EM8_&_MET15
  - L3_PEM20_MET15
- Missing Et + 2 Jets (MET35_&_TWO_JETS)
  - L1 : (L1_MET25)
  - L2 : (L2_JET15_L1_MET25)
  - L3 : (L3_MET35)
- Missing Et + tau (TAU_MET)
  - L1_MET25
  - L2_AUTO_L1_MET25
  - L3_TAU_MET
- Missing Et + 2 b jets (MET_BJET)
  - L1
  - L2
  - L3 : $\sigma = 7 + 0.32\times$ L $(10^{30}) = 135$
- Di-tau (DITAU)
  - L1_TWO_TRK6_DPHI30_&_TWO_CJET5
    σ (nb) = 1202 + (9$\times$ L(10^{30})) = 4,802
  - L2_TWO_JET15_L1_TWO_TRK6
    σ (nb) = 531 + 3.4$\times$ L (10^{30}) =1,891
  - L3_DITAU

Cross section (nb) at 4×10^{32}

Trigger	L1	L2	L3
Lepton(W/Z) + Higgs			
High Et CEM	1,500	170	59
$\not\!\!E_t$ + PEM	771	55	19
High Pt muon (CMUP)	1,773	?	8
High Pt muon (CMX)	1,773	?	8
Neutrino(Z) + Higgs			
$\not\!\!E_t$ + 2 jets	163	126	13
$\not\!\!E_t$ + 2 bjets			135
Jets(W/Z) + Higgs			
High Pt b-jet	10,840	506	97
Higgs multijet (W/Z + Higgs)	1,850	59	22
Higgs to $\bar{\tau}\tau$			
Di-tau	4,800	1,900	4
$\not\!\!E_t$ + tau	(overlap)	(overlay)	4
$\not\!\!E_t$	(overlap)	163	3
$Z \to \bar{b}b$	114,500	574	8
Top multijet	18,583	41	119
Total	156,553	3,594	499