Trigger Studies Update

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Introduction and Motivation

Motivation

- Understand the possible improvement brought by lower threshold from parked data triggers
- Quantify the possible loss of signal efficiency by selecting only $L1T\_ETM40/50$ seeded HLT triggers
- Compare at parked/prompt datasets at first few cuts (QCD dominated) to check how much more data slips in from addition trigger efficiency over offline variables.

Notes:

Last signal efficiency study:

- Did not include PU weighting of sample.
- Was over Pythia 120 GeV mass point, not POWHEG 125 GeV.
- Only HLT and no other cuts.

MC POWHEG Signal $m_H = 125$ [GeV]

Total processed events 100047.

HLT (no L1 selection)

HLTMetClean			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	11867	0.118617
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	7840	0.0783716
	$Y\&\&B$	7363	0.0736024
	$NOT(Y)\&\&B$	4503	0.0450147

JetPair			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	7611	0.368179
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	5174	0.250319
	$Y\&\&B$	5060	0.244792
	$NOT(Y)\&\&B$	2550	0.123387

MET			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	2994	0.852396
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	2762	0.786315
	$Y\&\&B$	2755	0.784286
	$NOT(Y)\&\&B$	239	0.0681106

TightMjj			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	1769	0.897424
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1766	0.895625
	$Y\&\&B$	1766	0.895625
	$NOT(Y)\&\&B$	3	0.0017983

HLT + $L1\_ETM40$

HLTMetClean			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	11838	0.118328
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	7840	0.0783716
	$Y\&\&B$	7363	0.0736024
	$NOT(Y)\&\&B$	4474	0.0447255

JetPair			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	7584	0.366863
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	5174	0.250319
	$Y\&\&B$	5060	0.244792
	$NOT(Y)\&\&B$	2523	0.12207

MET			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	2993	0.852052
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	2762	0.786315
	$Y\&\&B$	2755	0.784286
	$NOT(Y)\&\&B$	238	0.0677662

TightMjj			
Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	1768	0.89681
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1766	0.895625
	$Y\&\&B$	1766	0.895625
	$NOT(Y)\&\&B$	2	0.00118482

Signal loss by cut

Some conclusions:

- By selecting HLT + L1_ETM40 the signal losses are very small.
  - We can ignore safely L1_HTT* seed, events and have only L1_ETM(40/50) seeded events.
- Extra signal captured by parked HLT paths gets completely cut at TightMjj level.

By selection cut:

Cut	Extra parked data only
HLTMetClean	+57.06%
JetPair	+36.60%
MET	+8.62%
TightMjj	+0.11%

- Extra signal loss happens over Dijet selection, MET and TightMjj.
- Biggest losses in order MET, Dijet and TightMjj.

Looking at parked data

HLT (no L1 selection)

HLTMetClean

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	440729619	0.662568
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	235130753	0.353483
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	189001007	0.284134
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1814693	0.00272811
	$Y\&\&(B\|\|D)$	1790408	0.0026916
	$NOT(Y)\&\&(B\|\|D)$	544396898	0.818416

JetPair

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	310907131	0.712993
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	132694485	0.304304
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	124121953	0.284645
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1283460	0.00294331
	$Y\&\&(B\|\|D)$	1268120	0.00290814
	$NOT(Y)\&\&(B\|\|D)$	351204890	0.805406

MET

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	20359	0.933043
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	8216	0.376535
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	8419	0.385839
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	14987	0.686847
	$Y\&\&(B\|\|D)$	14897	0.682722
	$NOT(Y)\&\&(B\|\|D)$	5902	0.270486

TightMjj

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	14622	0.973372
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	5830	0.388097
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	6243	0.41559
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	11531	0.767608
	$Y\&\&(B\|\|D)$	11525	0.767208
	$NOT(Y)\&\&(B\|\|D)$	3145	0.20936

HLT + L1_ETM40

HLTMetClean

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	345421106	0.519287
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	178551498	0.268424
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	151920851	0.228389
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1814693	0.00272811
	$Y\&\&(B\|\|D)$	1790408	0.0026916
	$NOT(Y)\&\&(B\|\|D)$	426594673	0.641319

JetPair

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	241908346	0.55476
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	97093083	0.22266
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	98087820	0.224941
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	1283460	0.00294331
	$Y\&\&(B\|\|D)$	1268120	0.00290814
	$NOT(Y)\&\&(B\|\|D)$	271250542	0.62205

MET

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	18499	0.8478
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	7345	0.336618
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	7555	0.346242
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	14987	0.686847
	$Y\&\&(B\|\|D)$	14897	0.682722
	$NOT(Y)\&\&(B\|\|D)$	4031	0.184739

TightMjj

Ref	Algorithm	Count	Eff [%]
B	HLT_DiJet35_MJJ700_AllJets_DEta3p5_VBF_v	13045	0.868393
D	HLT_DiJet20_MJJ650_AllJets_DEta3p5_HT120_VBF_v	5059	0.336773
E	HLT_DiJet30_MJJ700_AllJets_DEta3p5_VBF_v	5471	0.364199
Y	HLT_DiPFJet40_PFMETnoMu65_MJJ800VBF_AllJets_v	11531	0.767608
	$Y\&\&(B\|\|D)$	11525	0.767208
	$NOT(Y)\&\&(B\|\|D)$	1565	0.104181

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Conclusions

- All extra parked data passing TightMjj cuts of current analysis is most likely only background.
- Assuming the number of event from prompt data analysis at TightMjj level (12118 events) we have additionally in parked:
  - Without L1 selection: +25.95%
  - With $L1T\_ETM$ seed: +12.91%
- This difference is most likely due to recovered events with offline variables passing the requirements of parked data only.
  - Implies (something we already knew) current working point is not where trigger is fully efficient.
- Need to optimize at least variables up to TightMjj level, to even recover signal to background ration at TightMjj level.