Searching for SUSY in events with Jets and Missing Transverse Energy using α_T with the CMS Detector at the LHC

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Contents

Chapter 1

Extending the μ Control Sample to a Signal Sample

In Chapter 1, the μ control sample was used effectively to predict the background contribution from W and $t\bar{t}$ events. The μ likelihood's incorporation into the overall likelihood in order to interpret the hadronic results allowed for some small signal contamination. However it was in general viewed as a constraint on the "signal" region of the hadronic selection.

The cuts outlined in Section **??** are designed to select events from Standard Model W decays, hence minimising the contamination from signal. However, as the simultaneous fit includes the signal efficiency in the μ control sample it is possible to relax the cuts and allow more potential signal into the μ yield. The following work represents the author's personal investigation into the effect of increasing the chance for signal contamination on the eventual limit.

1.0.1 Relaxing the Cuts

The primary cut in the μ control sample responsible for restricting the signal is the M_T requirement, as it puts a restriction on boosted W decays. The first step is to remove this cut. Having done so there are three possible scenarios with respect to the α_T cut

- Use the α_T cut from the hadronic analysis, where the muon is ignored
- Take out the α_T cut to increase statistics in the μ sample (the MHT/HT cut ensures the elimination of QCD background)

- Adapt the definition of the α_{T} to include the lepton, the validity of which is shown in Section **??**

The one muon requirement cuts remain

1.0.2 Event Yields

1.0.3 Fit Results

	H_{T} Bin (GeV)	275–325	325–375	375–475	475–575
2011 Selection	B (SM)	407.5	179.1	131.6	48.7
	S (LM6)	0.15	0.15	0.53	0.82
	S / B	0.000	0.001	0.004	0.017
No M_T Cut & $\alpha_{\mathrm{T}} > 0.55$	B (SM)	549.93	243.33	179.51	63.80
	S (LM6)	0.19	0.20	0.59	0.92
	S/B	0.000	0.001	0.003	0.0014
No M_T Cut & $\alpha_{\mathrm{T}\ lep} > 0.55$	B (SM)	163.95	70.64	39.87	16.38
	S (LM6)	0.13	0.17	0.51	0.79
	S/B	0.001	0.002	0.013	0.048
No M_T Cut & No α_{T}	B (SM)	1335.81	603.61	485.62	192.61
	S (LM6)	0.26	0.32	0.89	1.43
	S/B	0.000	0.001	0.002	0.007

	H_{T} Bin (GeV)	575–675	675–775	775–875	875–∞
2011 Selection	B (SM)	13.32	7.95	3.20	0.97
	S (LM6)	1.09	1.17	0.95	1.21
	S / B	0.082	0.147	0.297	1.343
No M_T Cut & $\alpha_{\mathrm{T}} > 0.55$	B (SM)	18.53	8.59	3.34	0.97
	S (LM6)	1.23	1.35	1.08	1.42
	S/B	0.066	0.157	0.324	1.5747
No M_T Cut & $\alpha_{\mathrm{T}\ lep} > 0.55$	B (SM)	7.85	1.76	0.05	0.05
	S (LM6)	1.05	1.13	0.89	1.06
	S/B	0.134	0.641	19.282	22.982
No M_T Cut & No α_{T}	B (SM)	67.64	30.04	12.77	3.26
	S (LM6)	1.87	2.04	1.77	3.07
	S/B	0.028	0.068	0.139	0.940

Appendix A

HT 1.1fb^{-1} Data

/HT/Run2011A-May10ReReco-v1/AOD
/HT/Run2011A-PromptReco-v4/AOD

Photon 1.1fb^{-1} Data

/Photon/Run2011A-May10ReReco-v1/AOD
/Photon/Run2011A-PromptReco-v4/AOD

Standard Model Background Monte Carlo

/QCD_Pt_*_TuneZ2_7TeV_pythia6/Spring11-PU_S1_START311_V1G1-v1/AODSIM
/QCD_TuneD6T_HT-*_7TeV-madgraph/Spring11-PU_S1_START311_V1G1-v1/AODSIM
/TTJets_TuneZ2_7TeV-madgraph-tauola/Summer11-PU_S4_START42_V11-v1/AODSIM
/TToBLNu_TuneZ2_*-channel_7TeV-madgraph/Spring11-PU_S1_START311_V1G1-v1/AODSIM

/WJetsToLNu_TuneZ2_7TeV-madgraph-tauola/Summer11-PU_S4_START42_V11-v1/AODSIM

/ZinvisibleJets_7TeV-madgraph/Spring11-PU_S1_START311_V1G1-v1/GEN-SIM-RECO

/GJets_TuneD6T_HT-40To100_7TeV-madgraph/Spring11-PU_S1_START311_V1G1-v1/AODSIM

SUSY Signal Reference Monte Carlo

/LM4_SUSY_sftsht_7TeV-pythia6/Spring11-PU_S1_START311_V1G1-v1/AODSIM
/LM6_SUSY_sftsht_7TeV-pythia6/Spring11-PU_S1_START311_V1G1-v1/AODSIM

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