atlas_conf_2013_047 Validation

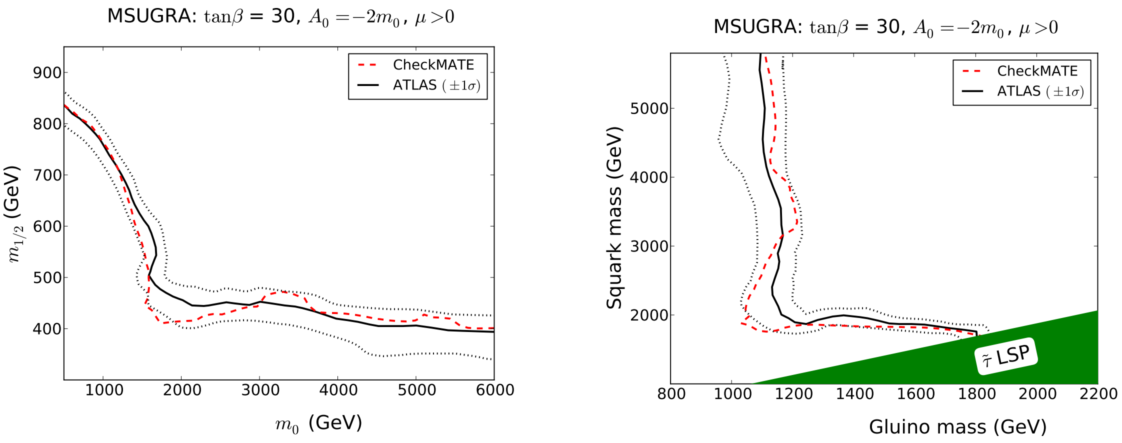

Figure 1: Exclusion curve for the CMSSM (mSUGRA) model for analysis atlas_conf_2013_047. The exclusion in the parameter space M_0, $M_{1/2}$ (left) and $m_{\tilde{q}}$, $m_{\tilde{g}}$ are shown (right).

0 lepton + $\geq$ 2-6 jets + E_T^{miss}, [1]
Energy: 8 TeV
Luminosity: 20.3 fb^{-1}
Validation notes:

- Validation has been performed versus all published cutflows, Tables 1 to 3, simplified model scans, Figures 1 to 3 and with a parameter scan of the CMSSM (mSUGRA) model shown in Figure 1.
  - The Monte-Carlo generator was Herwig++ 2.5.2 [2] for the mSugra and minimal Universal Extra Dimensions (mUED) scan, see Figures 1 and 3. In addition, the mUED model generation was also peformed by Herwig++ 2.5.2.
  - The Monte-Carlo generator was MadGraph5-v1.5.12 [3] and showered with Pythia 6.420 [4] with upto 2 additional QCD partons using the MLM [5] matching algorithm in the final state for all cutflows and other parameter scans.
  - Cross-sections calculated with NLL-Fast 2.1 [6, 7, 8, 9, 10].
  - SUSY spectrum generated with SOFTSUSY 3.3.9 [11].
- Trigger is fully efficient for all signal regions.

atlas_conf_2013_047 Validation

Process	$\tilde{q}\tilde{q}$ direct					
Point	$m(\tilde{q}) = 450$ GeV $m(\tilde{\chi}_1^0) = 400$ GeV		$m(\tilde{q}) = 850$ GeV $m(\tilde{\chi}_1^0) = 100$ GeV		$m(\tilde{q}) = 662$ GeV $m(\tilde{\chi}_1^0) = 287$ GeV	
Signal Region	A-medium		A-medium		C-medium	
Source	ATLAS	C.–MATE	ATLAS	C.–MATE	ATLAS	C.–MATE
Generated events	20000	50000	5000	50000	5000	50000
Jet Cleaning *	99.7 ± 0.0	-	99.6 ± 0.1	-	99.6 ± 0.1	-
0-lepton *	89.9 ± 0.2	-	98.5 ± 0.2	-	98.2 ± 0.2	-
$\not{E}_T > 160$ GeV*	15 ± 0.3	-	89.9 ± 0.4	-	80.7 ± 0.6	-
$p_{\mathrm{T}}(j_1) > 130$ GeV	12.9 ± 0.2	12.9 ± 0.2	89.7 ± 0.4	89.5 ± 0.1	80.0 ± 0.6	79.3 ± 0.2
$p_{\mathrm{T}}(j_2) > 60$ GeV	9.0 ± 0.2	8.4 ± 0.1	87.4 ± 0.5	87.1 ± 0.2	75.6 ± 0.6	75.3 ± 0.2
$p_{\mathrm{T}}(j_3) > 0\text{-}60$ GeV	9.0 ± 0.2	8.4 ± 0.1	87.4 ± 0.5	87.1 ± 0.2	35.3 ± 0.7	35.6 ± 0.2
$p_{\mathrm{T}}(j_4) > 0\text{-}60$ GeV	9.0 ± 0.2	8.4 ± 0.1	87.4 ± 0.5	87.1 ± 0.2	11.5 ± 0.5	11.3 ± 0.1
$\Delta\phi_{j40,\not{E}_T} > 0.4$	7.0 ± 0.2	6.8 ± 0.1	79.2 ± 0.6	79.0 ± 0.2	10.1 ± 0.4	9.9 ± 0.1
$\Delta\phi_{j40,\not{E}_T} > 0 - 0.2$	7.0 ± 0.2	6.8 ± 0.1	79.2 ± 0.6	79.0 ± 0.2	9.3 ± 0.4	9.2 ± 0.1
$\not{E}_T/\sqrt{H_T} > 0 - 15$	2.6 ± 0.1	1.8 ± 0.1	49.9 ± 0.7	48.0 ± 0.2	9.3 ± 0.41	9.2 ± 0.1
$\not{E}_T/m_{\mathrm{eff}}(N_j) > 0.15 - 0.4$	2.6 ± 0.1	1.8 ± 0.06	49.9 ± 0.7	48.0 ± 0.2	7.2 ± 0.37	6.8 ± 0.1
$m_{\mathrm{eff}}(\text{incl.}) > 1 - 2.2$ TeV	0.1 ± 0.02	0.08 ± 0.01	16.5 ± 0.5	18.3 ± 0.2	3.0 ± 0.24	3.1 ± 0.1

Table 1: Cutflow validation for atlas_conf_2013_047 considering squark pair production with direct decay. The cutflow is given as an absolute efficiency in % for each step of event selection. Final error is from Monte Carlo statistics for both ATLAS and CheckMATE. $\Delta\phi_{j40,\not{E}_T} \equiv \Delta\phi(j_i > 40\text{ GeV}, \not{E}_T)$. **Variable trigger efficiencies mean that the results are only comparable after both an* $\not{E}_T$ *and jet* p_T *cut have been applied.*

atlas_conf_2013_047 Validation

Process	$\tilde{q}\tilde{g}$ direct				$\tilde{g}\tilde{g}$ direct	
Point	$m(\tilde{g}) = 1425$ GeV $m(\tilde{\chi}_1^0) = 525$ GeV		$m(\tilde{g}) = 1612$ GeV $m(\tilde{\chi}_1^0) = 37$ GeV		$m(\tilde{g}) = 1162$ GeV $m(\tilde{\chi}_1^0) = 337$ GeV	
Signal Region	B-medium		B-tight		D	
Source	ATLAS	C.–MATE	ATLAS	C.–MATE	ATLAS	C.–MATE
Generated events	5000	50000	5000	50000	5000	50000
Jet Cleaning *	99.7 ± 0.1	-	99.6 ± 0.1	-	99.8 ± 0.1	-
0-lepton *	98.0 ± 0.2	-	98.8 ± 0.2	-	98.5 ± 0.2	-
$\not\!\!E_T > 160$ GeV*	93.3 ± 0.4	-	95.9 ± 0.3	-	88.9 ± 0.4	-
$p_{\mathrm{T}}(j_1) > 130$ GeV	93.3 ± 0.4	93.9 ± 0.1	95.8 ± 0.3	96.0 ± 0.1	88.8 ± 0.5	88.1 ± 0.2
$p_{\mathrm{T}}(j_2) > 60$ GeV	92.4 ± 0.4	92.7 ± 0.1	95.2 ± 0.3	95.1 ± 0.1	88.8 ± 0.5	88.1 ± 0.2
$p_{\mathrm{T}}(j_3) >$ 0-60 GeV	68.5 ± 0.7	67.0 ± 0.2	75.7 ± 0.6	73.5 ± 0.2	87.1 ± 0.5	86.8 ± 0.2
$p_{\mathrm{T}}(j_4) >$ 0-60 GeV	68.5 ± 0.7	67.0 ± 0.2	75.7 ± 0.6	73.5 ± 0.2	74.1 ± 0.6	74.4 ± 0.2
$p_{\mathrm{T}}(j_5) >$ 0-60 GeV	68.5 ± 0.7	67.0 ± 0.2	75.7 ± 0.6	73.5 ± 0.2	40.9 ± 0.7	36.0 ± 0.2
$\Delta\phi_{j40,\not E_T} > 0.4$	60.4 ± 0.7	58.7 ± 0.2	66.2 ± 0.7	64.2 ± 0.2	34.2 ± 0.7	30.1 ± 0.2
$\Delta\phi_{j40,\not E_T} > 0 - 0.2$	60.4 ± 0.7	58.7 ± 0.2	66.2 ± 0.7	64.2 ± 0.2	28.6 ± 0.6	25.9 ± 0.2
$\not\!\!E_T/m_{\mathrm{eff}}(N_j) > 0.15 - 0.4$	44.8 ± 0.7	41.8 ± 0.2	31.8 ± 0.7	28.1 ± 0.2	22.1 ± 0.6	18.9 ± 0.2
$m_{\mathrm{eff}}(\mathrm{incl.}) > 1 - 2.2$ TeV	27.5 ± 0.6	25.8 ± 0.2	22.8 ± 0.6	20.5 ± 0.2	13.4 ± 0.5	13.0 ± 0.2

Table 2: Cutflow validation for atlas_conf_2013_047 considering squark–gluino or gluino–gluino pair production with direct decay. The cutflow is given as an absolute efficiency in % for each step of event selection. Final error is from Monte Carlo statistics for both ATLAS and CheckMATE. $\Delta\phi_{j40,\not E_T} \equiv \Delta\phi(j_i > 40 \text{ GeV}, \not\!\!E_T)$. * *Variable trigger efficiencies mean that the results are only comparable after both an $\not\!\!E_T$ and jet p_T cut have been applied.*

atlas_conf_2013_047 Validation

Process	$\tilde{g}\tilde{g}$ one-step ($\tilde{g}$ decay via $\tilde{\chi}^{\pm}$)			
Point	$m(\tilde{g}) = 1065$ GeV $m(\tilde{\chi}_1^{\pm}) = 785$ GeV $m(\tilde{\chi}_1^0) = 525$ GeV		$m(\tilde{g}) = 1265$ GeV $m(\tilde{\chi}_1^{\pm}) = 865$ GeV $m(\tilde{\chi}_1^0) = 465$ GeV	
Signal Region	D		E-tight	
Source	ATLAS	CheckMATE	ATLAS	CheckMATE
Generated events	20000	50000	20000	50000
Jet Cleaning *	99.8 ± 0	-	99.8 ± 0	-
0-lepton *	63.7 ± 0.3	-	63.5 ± 0.3	-
$\not{E}_T > 160$ GeV*	50.0 ± 0.4	-	55.6 ± 0.4	-
$p_{\mathrm{T}}(j_1) > 130$ GeV	49.3 ± 0.4	47.7 ± 0.2	55.6 ± 0.4	54.4 ± 0.2
$p_{\mathrm{T}}(j_2) > 60$ GeV	49.2 ± 0.4	47.6 ± 0.2	55.6 ± 0.4	54.4 ± 0.2
$p_{\mathrm{T}}(j_3) >$ 0-60 GeV	48.6 ± 0.4	47.1 ± 0.2	55.4 ± 0.4	54.2 ± 0.2
$p_{\mathrm{T}}(j_4) >$ 0-60 GeV	44.5 ± 0.4	43.8 ± 0.2	53.4 ± 0.4	52.8 ± 0.2
$p_{\mathrm{T}}(j_5) >$ 0-60 GeV	34.4 ± 0.3	34.8 ± 0.2	46.3 ± 0.4	46.6 ± 0.2
$p_{\mathrm{T}}(j_6) >$ 0-60 GeV	34.4 ± 0.3	34.8 ± 0.2	31.7 ± 0.3	33.0 ± 0.2
$\Delta\phi_{j40,\not{E}_T} > 0.4$	29.2 ± 0.3	29.5 ± 0.2	26.5 ± 0.3	27.5 ± 0.2
$\Delta\phi_{j40,\not{E}_T} > 0 - 0.2$	24.6 ± 0.3	24.7 ± 0.2	21.3 ± 0.3	22.4 ± 0.2
$\not{E}_T/m_{\mathrm{eff}}(N_j) > 0.15 - 0.4$	21.6 ± 0.3	21.2 ± 0.2	12.0 ± 0.2	11.2 ± 0.1
$m_{\mathrm{eff}}(\mathrm{incl.}) > 1 - 2.2$ TeV	2.0 ± 0.09	1.9 ± 0.06	7.9 ± 0.2	8.2 ± 0.1

Table 3: Cutflow validation for atlas_conf_2013_047 for gluino pair production with one–step decay. The cutflow is given as an absolute efficiency in % for each step of event selection. Final error is from Monte Carlo statistics for both ATLAS and CheckMATE. $\Delta\phi_{j40,\not{E}_T} \equiv \Delta\phi(j_i > 40\text{ GeV}, \not{E}_T)$ **Variable trigger efficiencies mean that the results are only comparable after both an $\not{E}_T$ and jet p_T cut have been applied.*

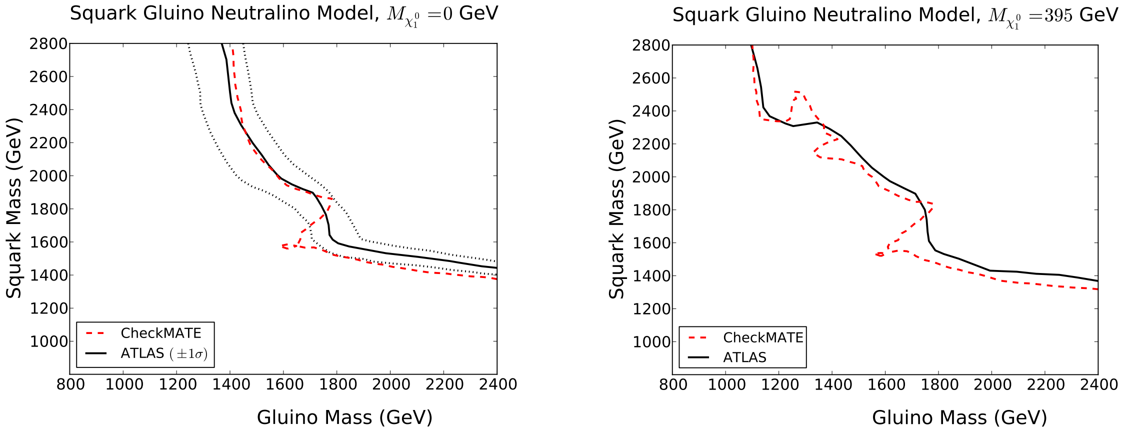

Figure 2: Exclusion curve for a simplified model with only strong production of gluinos and first- and second-generation squarks for atlas_conf_2013_047. The lightest supersymmetric particle has mass, $(m_{\tilde{\chi}_1^0}) = 0$ GeV(left) or $(m_{\tilde{\chi}_1^0}) = 395$ GeV(right). Jumps in exclusion limit of CheckMATE are due to the change of signal region.

atlas_conf_2013_047 Validation

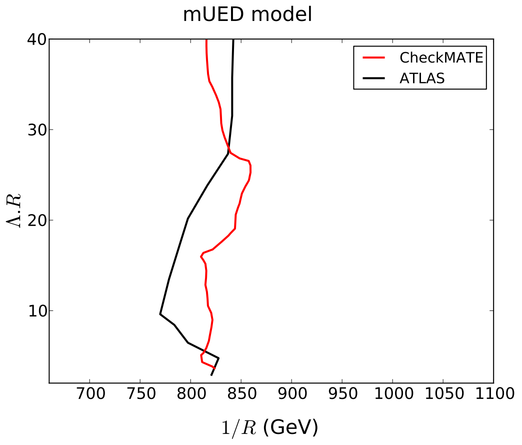

Figure 3: Exclusion curve for a minimal Universal Extra Dimensions (mUED) model using atlas_conf_2013_047. Jumps in exclusion limit of CheckMATE are due to the change of signal region.

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