

Searches for electroweak production of supersymmetric particles with compressed mass spectra in $\sqrt{s} = 13$ TeV pp collisions with the ATLAS detector, arXiv:1911.12606

1. Selection S-low

Process: $pp \rightarrow \tilde{e}_L \tilde{e}_L + \tilde{\mu}_L \tilde{\mu}_L$

$m_{\tilde{e}} = 150$ GeV, $m_{\tilde{\chi}_1^0} = 140$ GeV

Events generated with MG5_aMC 2.7.3 interfaced to Pythia8 with up to two extra partons. 100000 MC events for each flavour weighted to 86.58 fb each.

Selection	ATLAS	CheckMATE
Initial events	24069	24069
E_T^{miss} trigger	2355	2763
2 leptons	1014	829
veto J/ψ	1013	828
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}}) > 0.4$	970	794
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	961	777
$1 < m_{\ell\ell} < 60$ GeV	828	775
$\Delta R_{\ell_1\ell_2}$	826	775
leading lepton $p_T > 5$ GeV	824	774
number of jets ≥ 1	811	757
leading jet $p_T > 100$ GeV	706	610
b -jet veto	611	511
$m_{\tau\tau} < 0$ or $m_{\tau\tau} < 160$ GeV	533	457
ee or $\mu\mu$	532	457
$150 < E_T^{\text{miss}} < 200$ GeV	146	132.2
$0.8 < R_{\text{ISR}} < 1.0$	108	92.7
sub-leading lepton $p_T > \min(15.0, 7.5 + 0.75 \cdot (m_{T2}^{100} - 100))$	53	52.6

2. Selection S-high

Selection	ATLAS	CheckMATE
Initial events	24069	24069
E_T^{miss} trigger	2355	2763
2 leptons	1014	829
veto J/ψ	1013	828
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}}) > 0.4$	970	794
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	961	777
$1 < m_{\ell\ell} < 60$ GeV	828	775
$\Delta R_{\ell_1\ell_2}$	826	775
leading lepton $p_T > 5$ GeV	824	774
number of jets ≥ 1	811	757
leading jet $p_T > 100$ GeV	706	610
b -jet veto	611	511
$m_{\tau\tau} < 0$ or $m_{\tau\tau} < 160$ GeV	533	457
ee or $\mu\mu$	532	457
$E_T^{\text{miss}} < 200$ GeV	229	187
$\max(0.85, 0.98 - 0.02 \cdot m_{T2}^{100}) < R_{\text{ISR}} < 1.0$	160	108
sub-leading lepton $p_T > \min(20.0, 2.5 + 2.5 \cdot (m_{T2}^{100} - 100))$	70.7	60.2

3. Selection E-low

Process: $pp \rightarrow \tilde{\chi}_2^0 \tilde{\chi}_1^0 + \tilde{\chi}_1^\pm \tilde{\chi}_1^0, \quad \tilde{\chi}_2^0 \rightarrow \ell + \ell^- \tilde{\chi}_2^0$

$m_{\tilde{\chi}_2^0} = -155$ GeV, $m_{\tilde{\chi}_1^\pm} = 152.5$ GeV, $m_{\tilde{\chi}_1^0} = 150$ GeV

Events generated with `MG5_aMC 2.7.3` interfaced to `Pythia8` with one extra parton $p_T > 50$ GeV. Two separate batches of 50000 MC events for neutral ($\sigma = \sigma_{\text{MG5}} \cdot K \cdot BR = 134 \cdot 1.4 \cdot 0.0894 = 15$ fb) and charged ($\sigma = 26.9$ fb) process. Three body neutralino decays included in hard ME in MG5. $\text{BR}(\tilde{\chi}_2^0 \rightarrow \ell^+ \ell^- \tilde{\chi}_2^0) = 3.92\%$, $\ell = e, \mu$. In the ATLAS cutflow BR seems to be 10%, but this is not in agreement with SUSYHIT. Filters: 1 jet $p_T > 50$ GeV, at least 2 truth leptons $p_T > 2$ GeV, truth $E_T^{\text{miss}} > 75$ GeV.

Selection	ATLAS	CheckMATE
Initial events \times BR	25328	5824
Initial events, 1 jet $p_T > 50$	5909	4933
Filters	1273	1592
E_T^{miss} trigger	715	1118
2 leptons	105	77.1
veto J/ψ	99.2	73
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}})) > 0.4$	95.4	70.5
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	94.4	69
$1 < m_{\ell\ell} < 60$ GeV	83.9	57.8
$\Delta R_{\ell_1 \ell_2}$	73.3	57.8
leading lepton $p_T > 5$ GeV	60.0	49.8
number of jets ≥ 1	59.4	49.8
leading jet $p_T > 100$ GeV	53.9	42.4
b -jet veto	46.3	35.5
$m_{\tau\tau} < 0$ or $m_{\tau\tau} < 160$ GeV	39.2	31.1
ee or $\mu\mu$	37.5	29.3
$120 < E_T^{\text{miss}} < 200$ GeV	14.8	12.3
$E_T^{\text{miss}}/H_T^{\text{lep}} < 10$	4.19	3.08
$0.8 < R_{\text{ISR}} < 1.0$	3.20	2.46
sub-leading lepton $p_T > 5 + m_{\ell\ell}/4$	2.15	1.60
$10 < m_T^{\ell_1} < 60$ GeV	1.54	1.12

4. Selection E-med

Selection	ATLAS	CheckMATE
Initial events \times BR	25328	5824
Initial events, 1 jet $p_T > 50$	5909	4933
Filters	1273	1592
E_T^{miss} trigger	715	1118
2 leptons	105	77.1
veto J/ψ	99.2	73
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}}) > 0.4$	95.4	70.5
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	94.4	69
$1 < m_{\ell\ell} < 60$ GeV	83.9	57.8
$\Delta R_{\ell_1\ell_2}$	73.3	57.8
leading lepton $p_T > 5$ GeV	60.0	49.8
number of jets ≥ 1	59.4	49.8
leading jet $p_T > 100$ GeV	53.9	42.4
b -jet veto	46.3	35.5
$m_{\tau\tau} < 0$ or $m_{\tau\tau} < 160$ GeV	39.2	31.1
ee or $\mu\mu$	37.5	29.3
$120 < E_T^{\text{miss}} < 200$ GeV	14.8	12.3
$E_T^{\text{miss}}/H_T^{\text{lep}} > 10$	10.7	9.21
$M_T^S < 50$ GeV	6.71	6.51

5. Selection E-high

Selection	ATLAS	CheckMATE
Initial events \times BR	25328	5824
Initial events, 1 jet $p_T > 50$	5909	4933
Filters	1273	1592
E_T^{miss} trigger	715	1118
2 leptons	105	77.1
veto J/ψ	99.2	73
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}}) > 0.4$	95.4	70.5
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	94.4	69
$1 < m_{\ell\ell} < 60$ GeV	83.9	57.8
$\Delta R_{\ell_1\ell_2}$	73.3	57.8
leading lepton $p_T > 5$ GeV	60.0	49.8
number of jets ≥ 1	59.4	49.8
leading jet $p_T > 100$ GeV	53.9	42.4
b -jet veto	46.3	35.5
$m_{\tau\tau} < 0$ or $m_{\tau\tau} < 160$ GeV	39.2	31.1
ee or $\mu\mu$	37.5	29.3
$E_T^{\text{miss}} > 200$ GeV		15.9
$m_T^{\ell_1} < 60$ GeV	32.3	12.7
$E_T^{\text{miss}} > 200$ GeV	16.6	
$\max(0.85, 0.98 - 0.02 \cdot m_{\ell\ell}) < R_{\text{ISR}} < 1$	12.5	9.5
sub-leading lepton $p_T > \min(10, 2 + m_{\ell\ell}/3)$	12.0	8.8

6. Selection E-1L1T

Note: according to ATLAS the majority of events before the invariant mass cut originates from pile-up. Filters: 1 jet $p_T > 50$ GeV, at least 1 truth lepton $p_T > 2$ GeV, truth $E_T^{\text{miss}} > 50$ GeV.

Selection	ATLAS	CheckMATE
Initial events \times BR	25328	5824
Initial events, 1 jet $p_T > 50$	5909	4929
Filters	3141	3955
E_T^{miss} trigger	1217	2171
1 lepton and \geq track	443	78
veto J/ψ	440	75
$E_T^{\text{miss}} > 200$ GeV	179	31
$\min(\Delta\phi(\text{jet}, \vec{p}_T^{\text{miss}}) > 0.4$	171	30
$\Delta\phi(j_1, \vec{p}_T^{\text{miss}}) > 2.0$	169	30
$0.5 < m_{\ell, \text{track}} < 5$ GeV	15.3	24
$\Delta R_{\ell, \text{track}} > 0.05$	15.3	24
number of jets ≥ 1	15.3	24
leading jet $p_T > 100$ GeV	15.2	23
$E_T^{\text{miss}} / H_T^{\text{lep}} > 30$	8.60	10.5
$\Delta R_{\ell, \text{track}} < 1.5$	8.40	10.2
lepton $p_T < 10$ GeV	7.88	9.2
track $p_T < 5$ GeV	7.88	8.0
$\Delta\phi(\ell, E_T^{\text{miss}}) < 1.0$	5.81	5.8
same flavour lepton-track pair	5.62	5.2
opposite charge lepton-track pair	5.39	4.7
$m_{\ell, \text{track}} < 5$ GeV	5.39	4.7
$m_{\ell, \text{track}} < 4$ GeV	5.03	4.2
$m_{\ell, \text{track}} < 3$ GeV	3.66	3.3
$m_{\ell, \text{track}} < 2$ GeV	1.55	1.74
$m_{\ell, \text{track}} < 1.5$ GeV	0.55	1.2
$m_{\ell, \text{track}} < 1$ GeV	0.00	0.5