LHCC Poster Session - CERN, 13 March 2013

Search for direct production of the top squark in the all-hadronic $t\bar{t} + E_T^{miss}$ final state in 21 fb^{-1} of pp collisions at $\sqrt{s}$ = 8 TeV with the ATLAS detector

Introduction

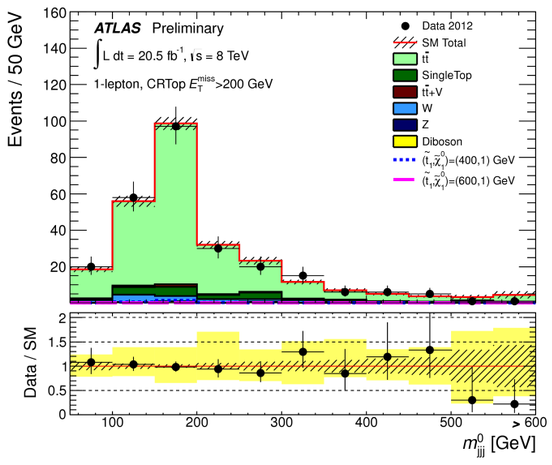
A search targeting stop pair production in the all hadronic + E_T^{miss} channel has been performed, considering a stop decaying with 100% BR in $\tilde{t}_1 \to t\tilde{\chi}_1^0$.

The analysis has been performed on the full dataset collected by the ATLAS experiment at $\sqrt{s}$=8 TeV, and extends the range of stop and neutralino masses explored.

Backgrounds

The main background processes to the search are semi-leptonic $t\bar{t}$ and $Z \to \nu\nu$ + b-jets.

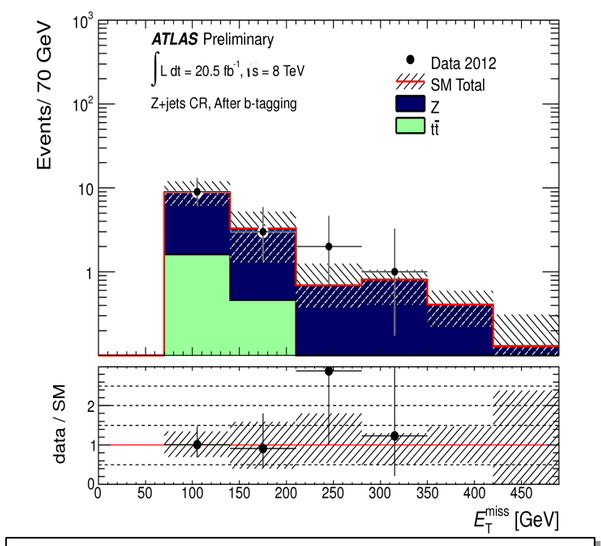
Their contribution in the signal regions is extrapolated by normalizing the Monte Carlo to data in a control region.



Semileptonic $t\bar{t}$

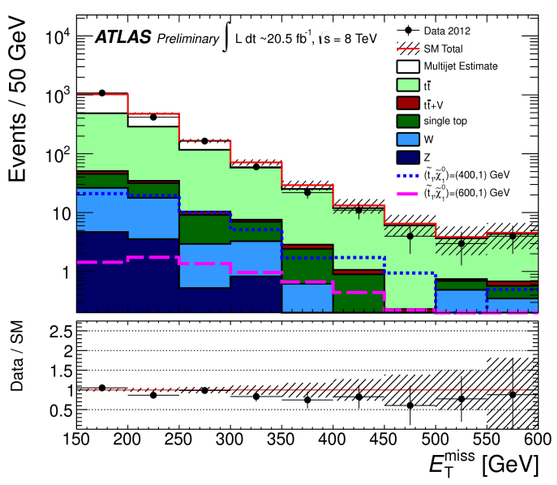
Semileptonic $t\bar{t}$ can enter the signal regions if the lepton is a τ, is lost or misidentified with a jet.

An almost pure control sample is selected requiring one lepton with $M_T(l,E_T^{miss})$ between 40 and 120 GeV (compatible with a W decay).



$Z \to \nu\nu$ + b-jets

$Z \to \nu\nu$ events with b-jets are estimated using a $Z \to ll$+ jets control sample (80 < M(ll) < 100 GeV), where leptons are treated as neutrinos in the final computation of E_T^{miss}.



Other Backgrounds

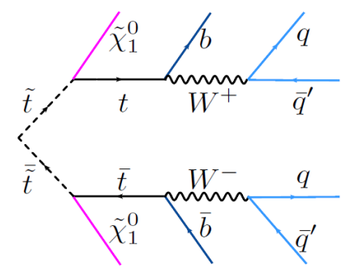
Multijets and fully hadronic $t\bar{t}$ events are evaluated with a jet smearing technique.

Other background processes are estimated from Monte Carlo.

Event Selection

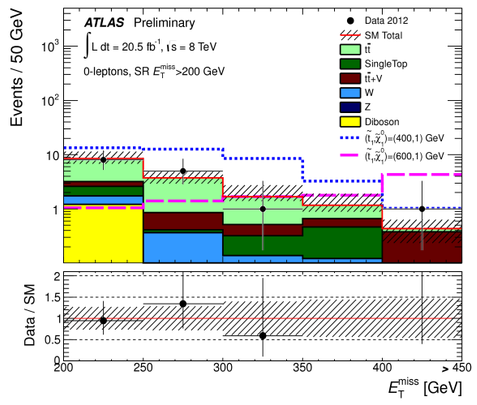
Minimum number of objects from a full hadronic $t\bar{t}$ decay

- Six jets, leading and subleading p_T > 80 GeV, others p_T > 35 GeV
- At least two jets tagged as b-jets, operating point corresponding to 70% average efficiency
- Veto leptons with p_T > 10 GeV.



Neutralinos in the final state

- E_T^{miss} > 130 GeV. Minimum threshold for high trigger efficiency, reduce hadronic $t\bar{t}$



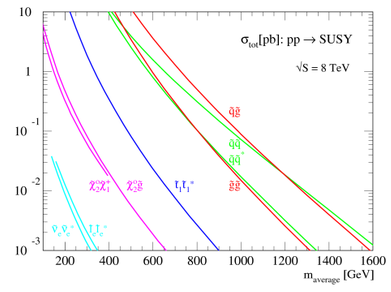
E_T^{miss} from multijets and mismeasured jets

Multijets production can have E_T^{miss} if

- Jet energy is mismeasured
- Real E_T^{miss} from heavy flavor decays

Strong suppression obteined by:

- $\Delta\Phi(E_T^{miss}, E_T^{miss\ track}) < \pi/3$
- $\Delta\Phi(E_T^{miss}, jets) < 0.2\pi$



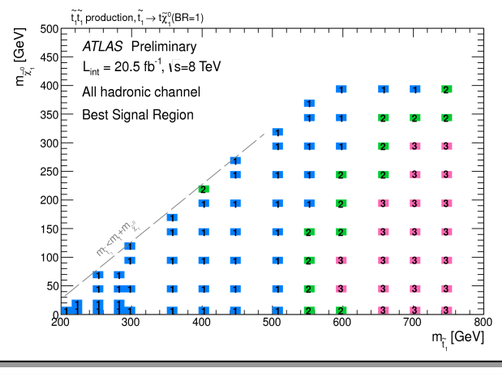
Rejection of $t\bar{t}$ and other electroweak backgrounds

- Veto events containing a tau candidate, against semi-leptonic $t\bar{t}$ with taus
- High transverse mass, M_T between b-jets and E_T^{miss}, against semi-leptonic $t\bar{t}$
- All hadronic top mass reconstruction: m_1(jjj) and m_2(jjj) within 80 and 270 GeV

Signal Regions

Final discriminating variable E_T^{miss}. Cuts optimized for best discovery significance

- SR1: E_T^{miss} > 200 GeV
  Targeting $m(\tilde{t})$ < 500 GeV and heavy LSP
- SR2: E_T^{miss} > 300 GeV,
  Targeting $m(\tilde{t})$ 500-600 GeV and heavy LSP
- SR3: E_T^{miss} > 350 GeV
  Targeting $m(\tilde{t})$ > 600 GeV



Systematic Uncertainties

Uncertainty	SR1	SR2	SR3
Total	18%	33%	45%
Background sample sizes (data and simulation)	10%	17%	21%
Jet energy scale and resolution	10%	10%	25%
$t\bar{t}$ theory	10%	19%	22%
Z+jets theory	4%	8%	8%
$t\bar{t} + W/Z$ theory	5%	8%	10%

$t\bar{t}$ theory: Fragmentation, hadronization, initial and final state radiation, higher order diagrams.

Z theory: Variation of factorization and renormalization scales.

Results and Interpretation

Rate of data and background events in signal regions

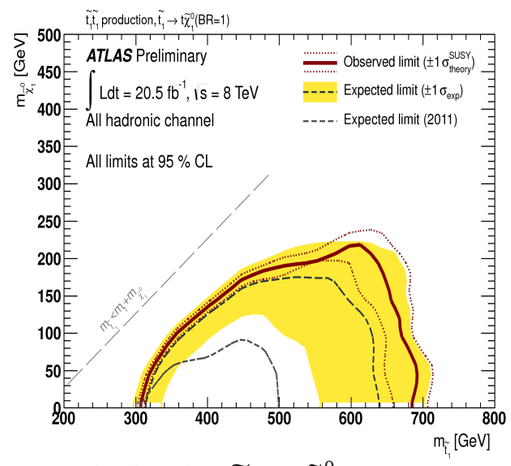
Number of events	SR1	SR2	SR3
Observed	15	2	1
Expected background	17.5 ± 3.2	4.7 ± 1.5	2.7 ± 1.2
Expected $t\bar{t}$	9.8 ± 2.6	1.9 ± 1.3	0.9 ± 0.7
Expected $t\bar{t} + W/Z$	1.7 ± 1.0	0.7 ± 0.4	0.51 ± 0.30
Expected Z+jets	2.1 ± 1.0	1.2 ± 0.5	0.8 ± 0.4
Expected W+jets	1.2 ± 0.8	0.32 ± 0.29	$0.19^{+0.23}_{-0.19}$
Expected single-top	1.5 ± 0.9	0.5 ± 0.4	$0.3^{+0.5}_{-0.3}$
Expected multijet	0.12 ± 0.12	0.01 ± 0.01	< 0.01
Expected diboson	1.2 ± 1.2	< 0.22	< 0.22
Fit input expectation $t\bar{t}$	9.9	1.7	0.6

Signal region	$\langle\varepsilon\sigma\rangle_{obs}^{95}$[fb]	S_{obs}^{95}	S_{exp}^{95}	CL_B
SR1	0.49	10.0	$10.6^{+5.5}_{-1.7}$	0.39
SR2	0.17	3.6	$5.3^{+3.2}_{-1.7}$	0.20
SR3	0.19	3.9	$4.5^{+1.9}_{-0.7}$	0.27

No excess over SM prediction observed.

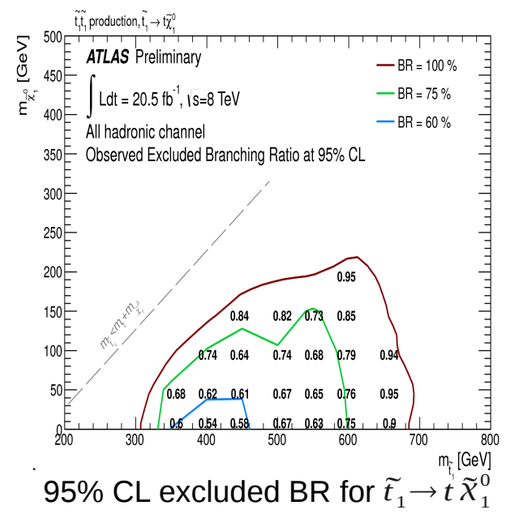
Derived model dependent exclusion limits.

Placed upper limit on visible cross section and number of signal events.



Exclusion for $\tilde{t}_R \to t\tilde{\chi}_1^0$

Equivalent sensitivity for $\tilde{t}_L \to t\tilde{\chi}_1^0$



95% CL excluded BR for $\tilde{t}_1 \to t\tilde{\chi}_1^0$

Conclusions

Search for direct stop pair production in final states with six jets and E_T^{miss}.

Observations are consistent with SM expectations, exclusion limits set on stop-neutralino plane.

Stop masses between 320 and 660 GeV are excluded at 95% CL for a nearly massless LSP. For a LSP mass of 150 GeV the exclusion interval is 400-620 GeV.

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