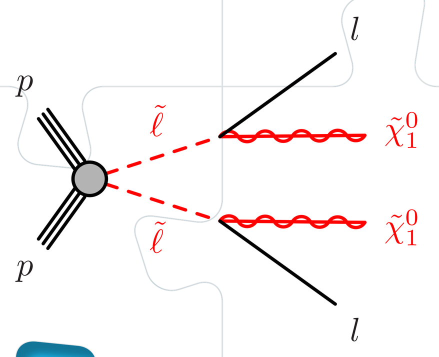
SIGNATURES

In SUSY models where the masses of the first two generations of squarks and the gluinos are heavier than a few TeV, the direct production of non-coloured sparticle pairs such as gauginos (charginos and neutralinos) and the sleptons via electroweak interactions may be dominant.

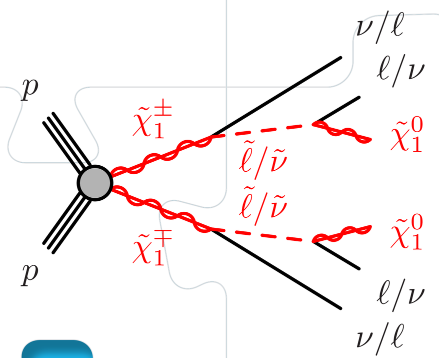
SLEPTON PAIR PRODUCTION

Sleptons can be produced directly in a process similar to Drell-Yan production. Each slepton decays into a lepton and a neutralino1, the LSP.
The undetected neutralinos give rise to large missing transverse momentum in the event.



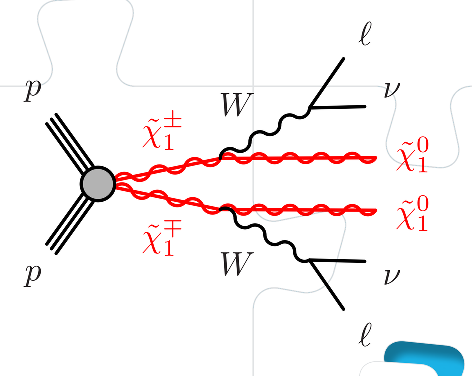
CHARGINO-TO-SLEPTON SCENARIO

Charginos can decay into leptonic final states via sneutrinos or charged sleptons into a neutralino1 (LSP).



CHARGINO-TO-W SCENARIO

If the lightest chargino is next-LSP, the chargino decays to a neutralino1 producing an on- or off-shell W boson.



SLEPTON PAIR PRODUCTION MODELS
The sensitivity of the SUSY search is determined for models that are based on the pMSSM with a production cross-sections between 0.5-127 fb for left-handed sleptons and 0.2-49 fb for right-handed sleptons.

CHARGINO-TO-SLEPTON MODELS
Simplified models, in which the LSP, slepton, sneutrino and chargino 1 mass are the only free parameters and the squark masses are set to values beyond the kinematic reach, are simulated. The charginos decay via left-handed sleptons (incl. staus, sneutrinos) with equal BR. The production cross section varies between 5 pb and 9 fb.

CHARGINO-TO-W MODELS
Simplified models, where the sleptons are mass decoupled and the BR for the chargino-to-W decay is assumed to be 100% are simulated. The production cross section is between 5 pb and 9 fb.

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SUPERSYMMETRY
Weak-scale Supersymmetry (SUSY) is one of the best motivated extensions to the Standard Model (SM), providing a possible solution to the hierarchy problem and a viable dark matter candidate.
It postulates for each known boson or fermion the existence of a SUSY particle whose spin differs by one-half unit from the SM partner. If R-parity is conserved, sparticles can only be pair-produced and each subsequently undergoes cascade decays into final states with SM particles and the lightest SUSY particle (LSP) which is stable.

Search for electroweak supersymmetric particles with the ATLAS detector

ATLAS-CONF-2013-049

Janet Dietrich (DESY) on behalf of the ATLAS collaboration

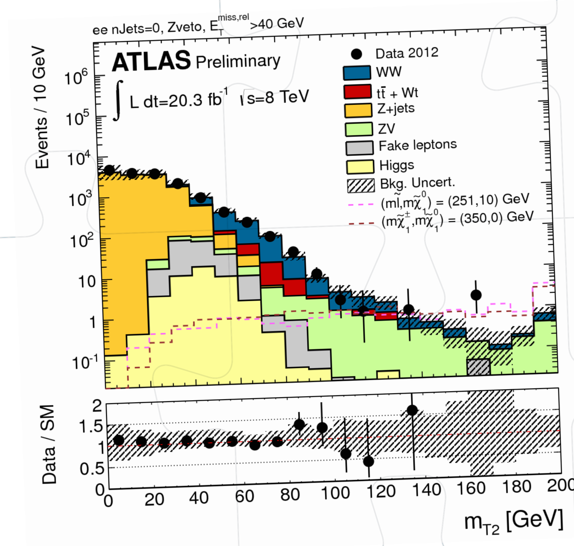
Searches for the production of electroweak supersymmetric particles decaying into final states with exactly two isolated, oppositely-charged leptons (electrons, muons), no reconstructed jets and missing transverse momentum are performed using 20.3 fb^{-1} of proton-proton collision data at a centre-of-mass energy of 8 TeV recorded with the general purpose detector ATLAS at the Large Hadron Collider at CERN.
In the absence of any significant excess with respect to the prediction from Standard Model processes, limits are set on the masses of the slepton and the lightest chargino for different lightest-neutralino mass hypotheses.

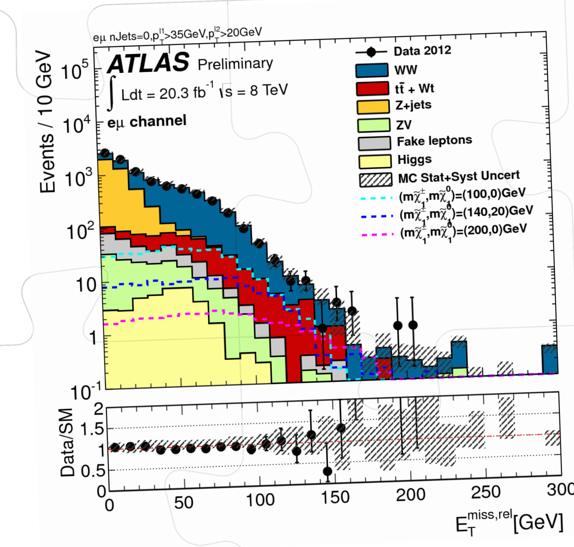
SIGNAL REGIONS

Five signal regions (SR) are defined, targeting the different chargino- and slepton production scenarios decaying into exactly two oppositely charged isolated leptons, no jets and missing transverse momentum.

SR $m_{T2,90}$ and SR $m_{T2,110}$ are designed to provide sensitivity to sleptons either through direct production or in chargino decays. SR-WWa, SR-WWb and SR-WWc target chargino-and neutralino-pair production followed by on-shell W decays.

	SR-$m_{T2,90}$	SR-$m_{T2,110}$	SR-WWa	SR-WWb	SR-WWc
lepton flavour	e^+e^-, $\mu^+\mu^-$, $e^\pm\mu^\mp$		$e^\pm\mu^\mp$		
$p_T^{\ell 1}$	> 20GeV		> 35GeV		
$p_T^{\ell 2}$	> 20GeV		> 20GeV		
$m_{\ell\ell}$	Z veto		< 80GeV	< 130GeV	—
$p_{T,\ell\ell}$	—		> 70GeV	< 170GeV	< 190GeV
$\Delta\phi_{\ell\ell}$	—			< 1.8 rad	
$E_T^{miss,rel}$	> 40GeV		> 70GeV	—	
m_{T2}	> 90GeV	> 110GeV	—	> 90GeV	> 100GeV





RESULTS

No significant excesses with respect to the prediction from the Standard Model expectation are observed, limits are set on the masses of the slepton and of the lightest chargino for different lightest-neutralino mass hypotheses.

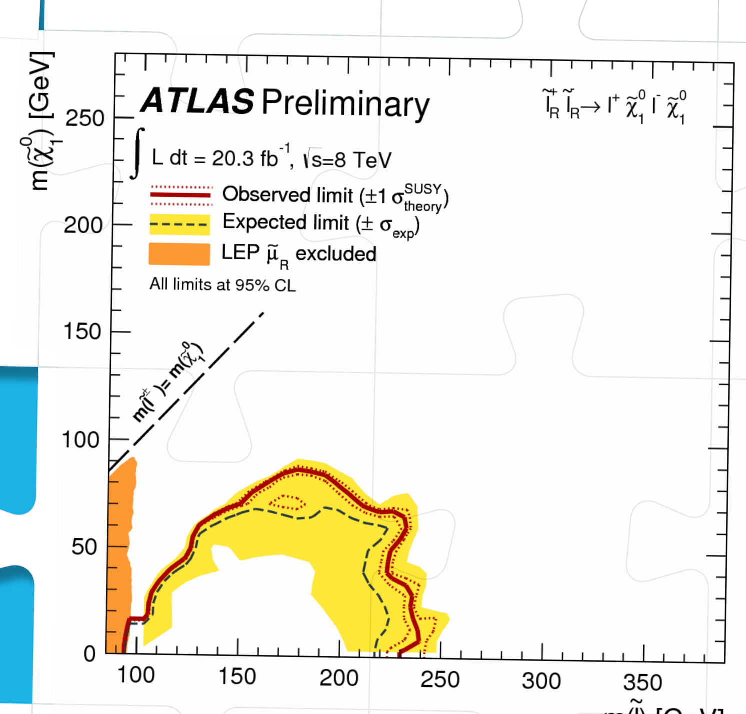
DIRECT-SLEPTON SCENARIO

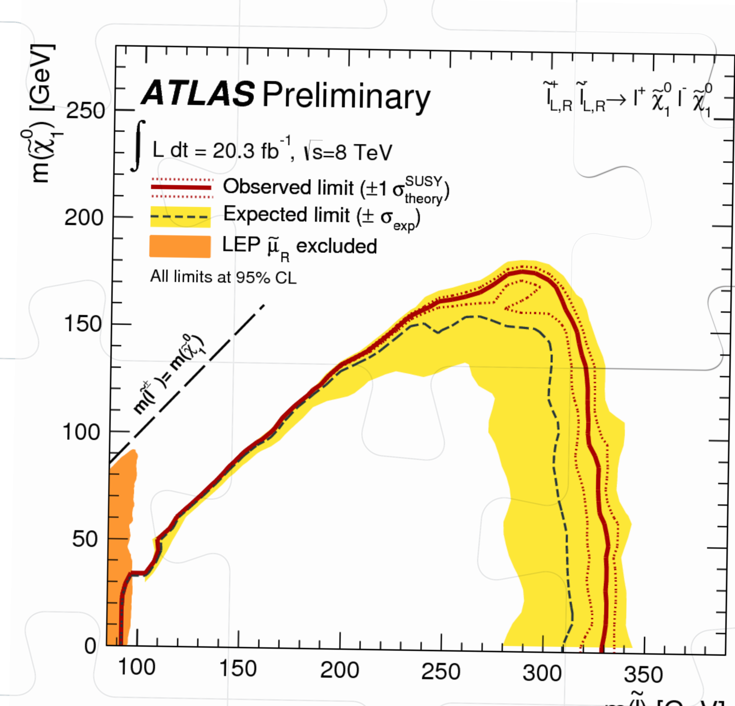
A common value for left- and right-handed selectron and smuon masses between 90 GeV and 320 GeV is excluded at 95% confidence level for a massless neutralino. The sensitivity decreases as a value of the mass difference between the slepton and LSP mass. For a 100 GeV neutralino, slepton masses between 160 GeV and 320 GeV are excluded.

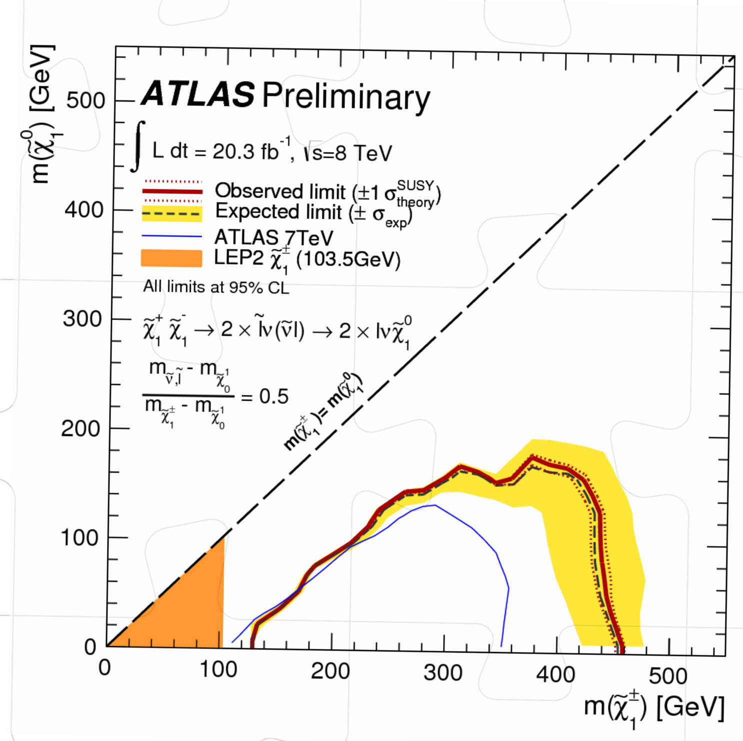
CHARGINO PAIR PRODUCTION

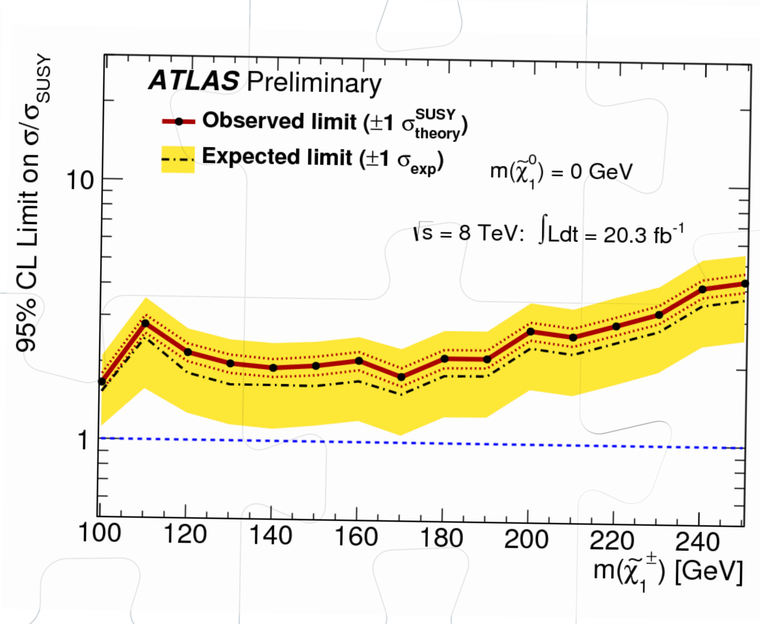
chargino-to-slepton scenario
Chargino masses between 130 GeV and 450 GeV are excluded at 95% confidence level for a 20 GeV neutralino.

chargino-to-W scenario
The most sensitive region is for chargino masses between 140-210 GeV and neutralino masses between 0-40 GeV where an average observed (expected) limit for σ/σ_{SUSY} = 2.5 (2.0).
The excluded cross-section is above the model cross-section by a factor 1.9-2.8 in the chargino mass range of 100-190 GeV and degrades gradually to 4.7 when reaching a chargino mass of 250 GeV for SUSY signals with a massless neutralino. The best sensitivity of σ/σ_{SUSY} = 1.79 is obtained for a model with a chargino mass of 100 GeV.









BACKGROUND

The Standard Model background is dominated by events with two leptonically-decaying W bosons coming from WW diboson and top production. Another significant background is ZV (WZ, ZZ) production.

IRREDUCIBLE BACKGROUNDS

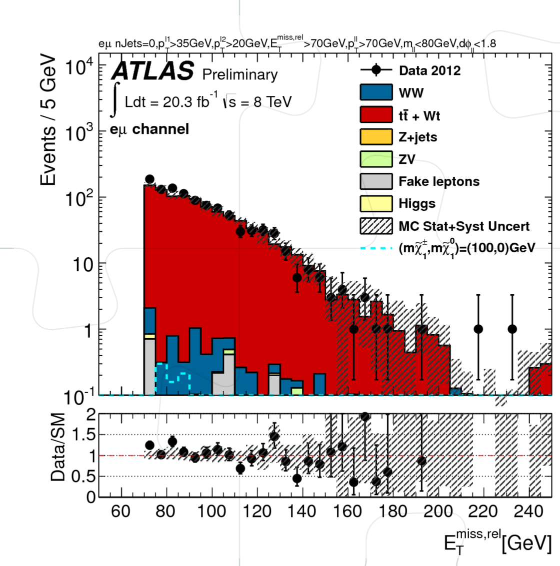
The background which contributes to two prompt and isolated leptons - mainly from top, WW and ZV processes is evaluated by normalizing the Monte Carlo to the data events in dedicated control regions and extracting a normalization factor for the simulations in the signal region. The background from Z+jets was found to be negligible and was determined using Monte Carlo.

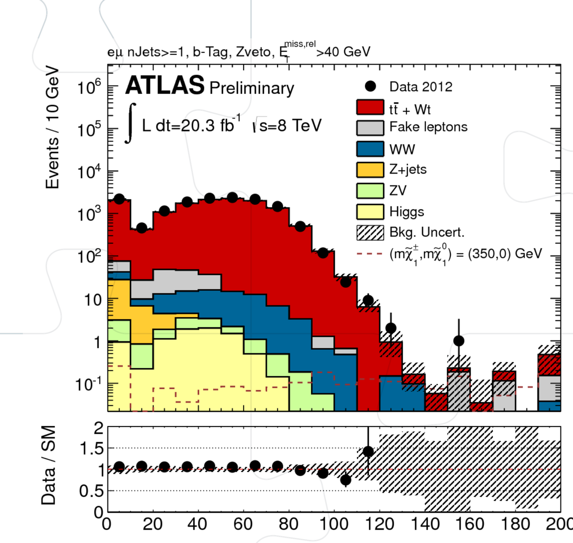
REDUCIBLE BACKGROUNDS

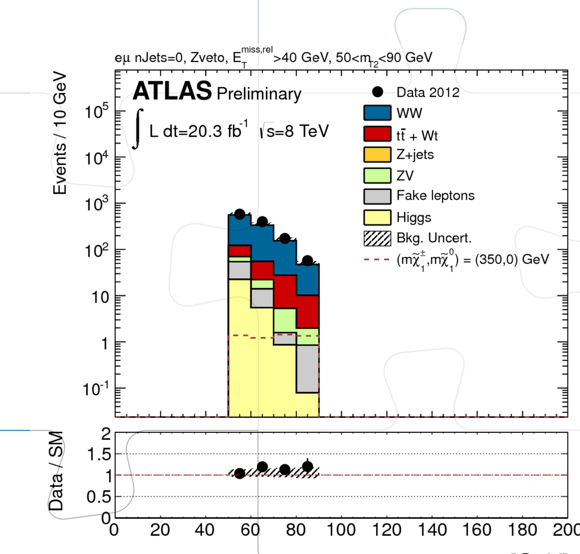
Non-prompt leptons originating from light or heavy-flavor jets or from conversion in W, Z or leptonic tau decays can be mis-identified as real leptons. This "fake" background is obtained by a data-driven matrix method.

SYSTEMATIC UNCERTAINTIES

The dominant experimental systematic uncertainties in the signal regions come from generator modelling uncertainties, the propagation of the jet energy scale calibration and resolution uncertainties and lepton uncertainties. The total systematic uncertainties are about 12-45% depending on the SR.







SR-$m_{T2,90}$	e^+e^-	$e^\pm\mu^\mp$	$\mu^+\mu^-$	all
Observed	15	19	19	53
Background total	16.6 ± 2.3	20.7 ± 3.2	22.4 ± 3.3	59.7 ± 7.3
SR-$m_{T2,110}$	e^+e^-	$e^\pm\mu^\mp$	$\mu^+\mu^-$	all
Observed	4	5	4	13
Background total	6.1 ± 2.2	4.4 ± 2.0	6.3 ± 2.4	16.9 ± 6.0
Observed σ_{vis}^{95} (fb)	0.27	0.35	0.28	0.54
Expected σ_{vis}^{95} (fb)	$0.33^{+0.16}_{-0.10}$	$0.33^{+0.16}_{-0.09}$	$0.33^{+0.16}_{-0.10}$	$0.62^{+0.23}_{-0.16}$

	SR-WWa	SR-WWb	SR-WWc
Observed	123	16	9
Background total	117.9 ± 14.6	13.6 ± 2.3	7.4 ± 1.5
Observed σ_{vis}^{95} (fb)	1.94	0.58	0.43
Expected σ_{vis}^{95} (fb)	$1.77^{+0.66}_{-0.49}$	$0.51^{+0.21}_{-0.15}$	$0.37^{+0.18}_{-0.11}$

Janet Dietrich / janet.dietrich@cern.ch / Deutsches Elektronen-Synchrotron Hamburg

to be continued ...