Searches for electroweak production of supersymmetric gauginos and sleptons with the ATLAS detector

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on behalf of ATLAS collaboration

Aug.26th, 2015

ICNFP-2015, Crete, Greece

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Outline

- SUSY introduction

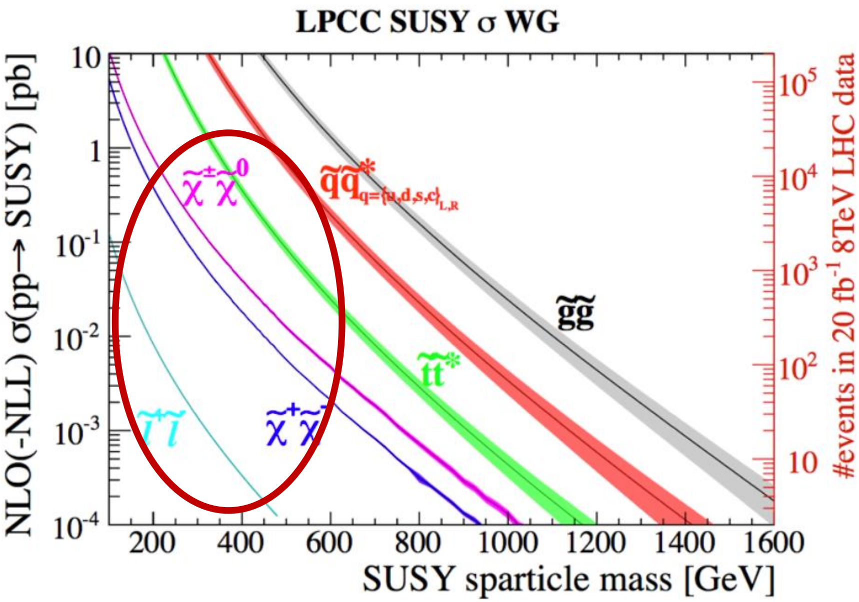
- Recent ATLAS EWK SUSY results:
  - ✓ Direct stau production
  - ✓ Same-sign chargino pair production via vector boson fusion(VBF)
  - ✓ Compressed spectra in direct production

- Conclusion

SUSY at LHC

- **Remaining issues after higgs-boson discovery:**
  - Hierarchy problem, Dark Matter , Gravity, No gauge unification at higher scale
- **SuperSymmetry(SUSY) : very appealing extension of SM to answer these questions.**
- **Limits of most models probe masses up to ~900 GeV (squarks) and ~1.4 TeV (gluinos).**

- SUSY searches in the EWK sector provide a promising approach for new physics :
  - ✓ low production cross-section but low hadronic activity.
- **Experimental Parameters**
  - ✓ 1 -4 leptons, missing transverse energy (E_T^{miss}), 0-2 jets (or b-jets)



EWK summary paper: ATLAS-SUSY-2014-05

Search for direct stau production in events with at least two hadronic taus and missing transverse momentum using multivariate analysis technique

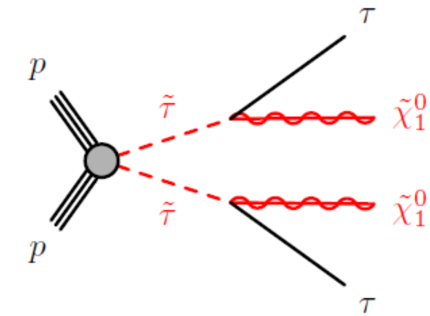
Update of JHEP 1410 (2014) 96, arXiv:1407.0350 [hep-ex]

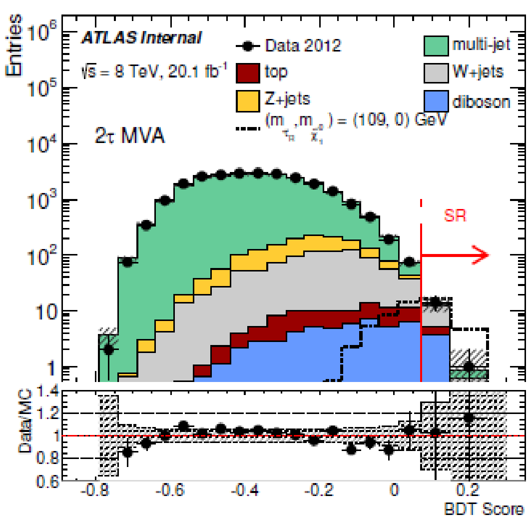
Direct stau production

- **R-parity conservation scenario**
- **Experimental signature:**
  - **2 opposite-sign taus, E_T^{miss}**
- **Using multivariate analysis(MVA) technique due to low cross-section**
- **Main backgrounds:**
  - **W+jets(1real+1fake)->normalized to data in dedicated WCR**
  - **multi-jet ->ABCD estimation**
  - **Other sub-dominant ->simulation**

Signal region (SR)

== 2 medium OS taus
>= 1 tight tau
b-jet veto
Z-veto
m_{T2}> 30 GeV
t_{cut} > 0.07





(a) BDT response prior to t_{cut} selection

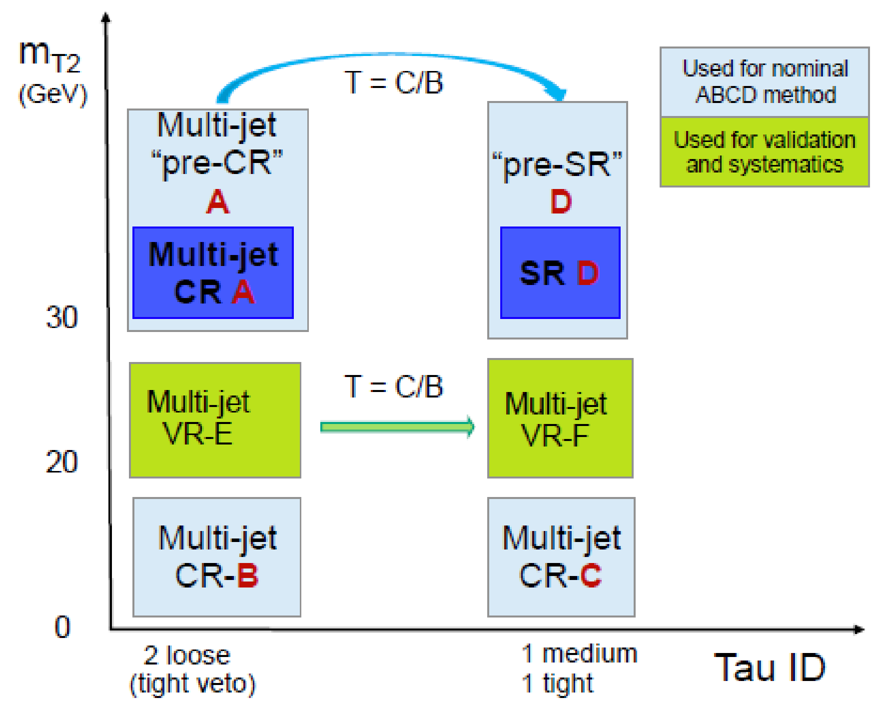
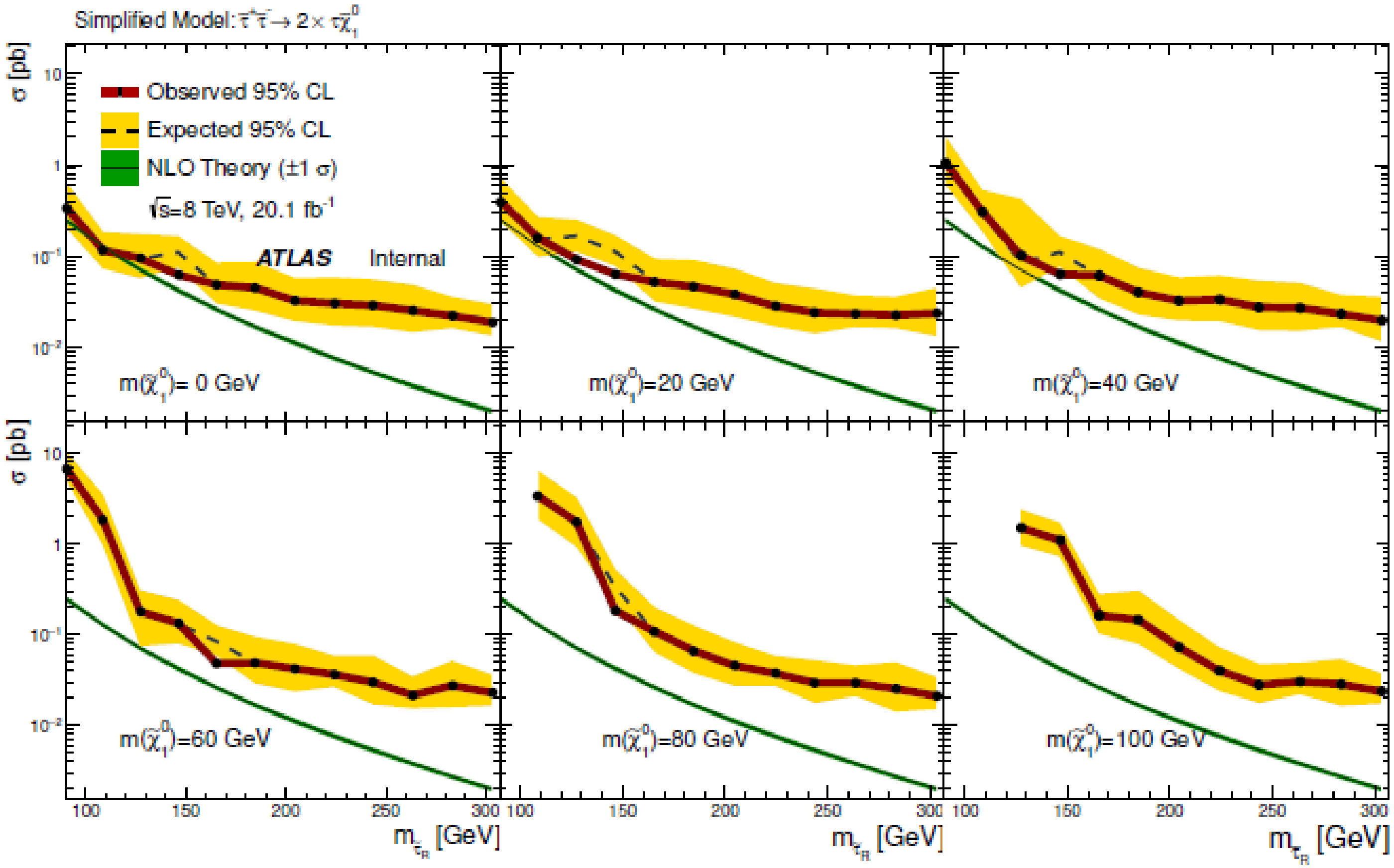


Illustration of the ABCD method

Direct stau production - results



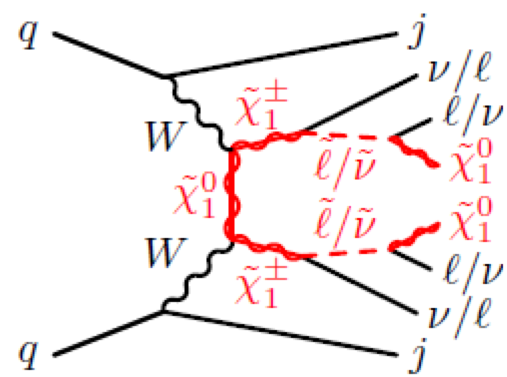
- **95% CL exclusion limits on the cross-section for production of left-handed and right-handed stau pairs for various $\tilde{\chi}_1^0$ masses**
- **These limits on direct production of stau pairs improve upon the previous limits, particularly for stau masses below ~150 GeV.**

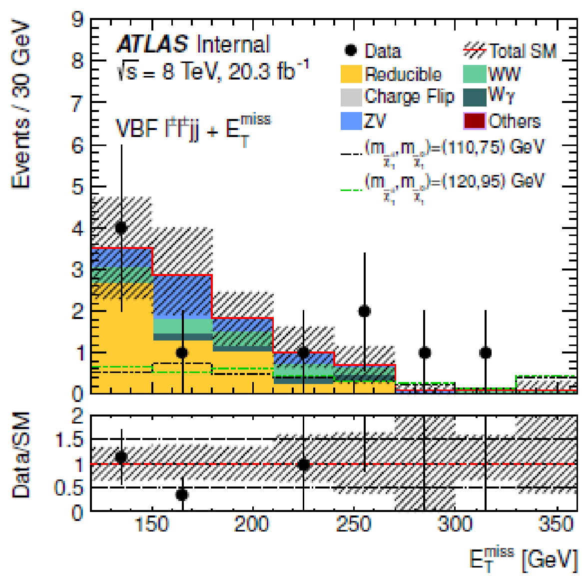
EWK summary paper: ATLAS-SUSY-2014-05

Search for supersymmetry in compressed scenarios with two and three leptons and missing transverse momentum in the final state

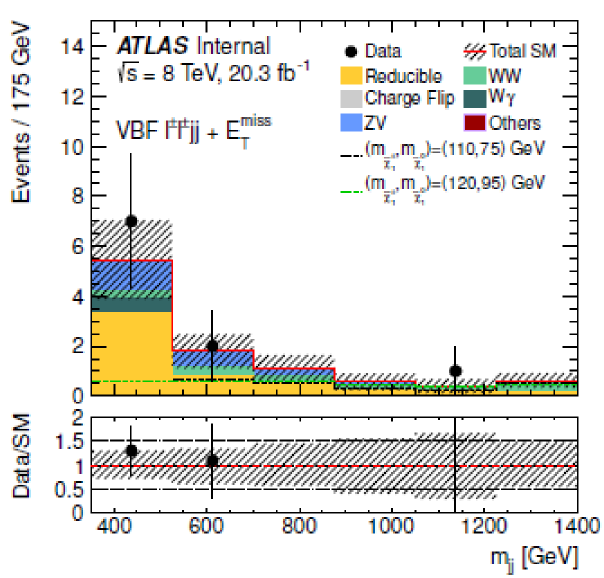
SS C1C1 production via VBF

- **Experimental signature:**
  - **2SS-leptons, >=2jets, E_T^{miss}**
- **SM backgrounds:**
  - **“prompt” leptons (diboson, H) -> MC simulation**
  - **Non-prompt(Fake) leptons(W+jets, $t\bar{t}$) -> Fake Factor Method**
  - **Charge-misID leptons -> measured from dedicated control region(CR)**





(c) E_T^{miss} in SR2ℓ-2

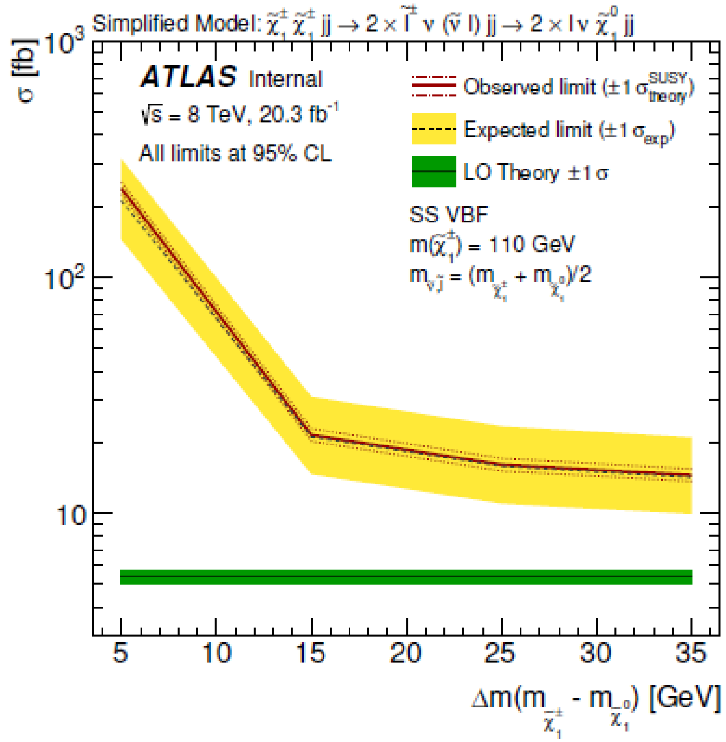


(a) m_{jj} in SR2ℓ-2

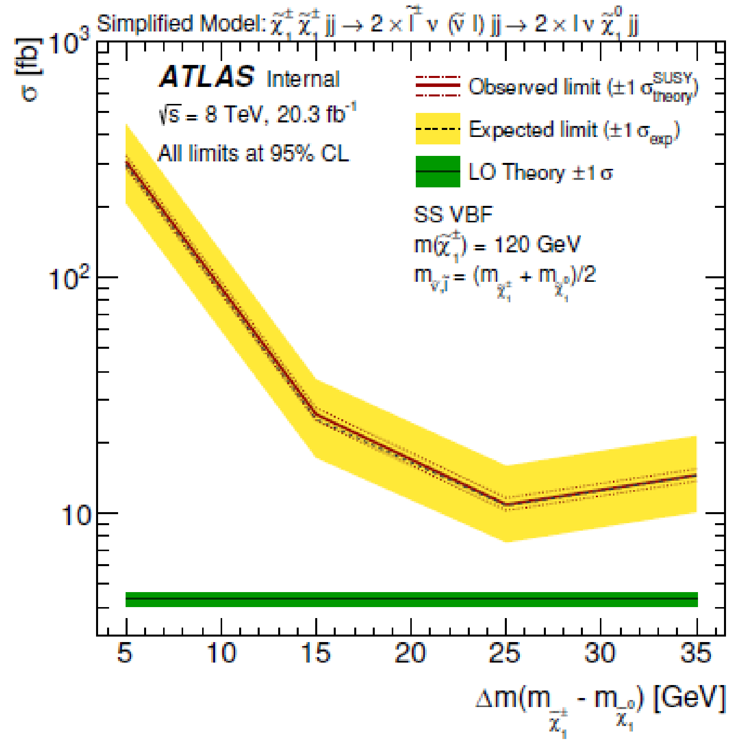
	SR2ℓ-2
ℓ flavor/sign	$\ell^\pm\ell^\pm$, $\ell^\pm\ell'^\pm$
jets	$\geq$ 2
central b-jets	veto
E_T^{miss} [GeV]	> 120
m_{T2} [GeV]	< 40
$m_{\ell\ell}$ [GeV]	< 100
$p_T^{jet\,1}$ [GeV]	> 95
m_{jj} [GeV]	> 350
$\eta^{jet1}\cdot\eta^{jet2}$	< 0
$\lvert\Delta\eta_{jj}\rvert$	> 1.6
$p_T^{\ell\ell}/E_T^{miss}$	< 0.4
$p_T^{jet\,1}/E_T^{miss}$	< 1.9
$p_T^{\ell\ell}/p_T^{jj}$	< 0.35

Signal selections

SS C1C1 production via VBF - results



(a) m($\tilde{\chi}_1^{\pm}$)=110 GeV



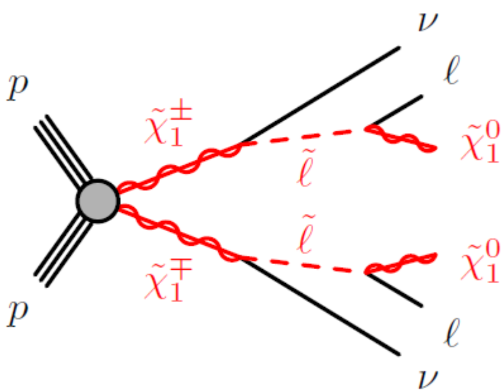
(b) m($\tilde{\chi}_1^{\pm}$)=120 GeV

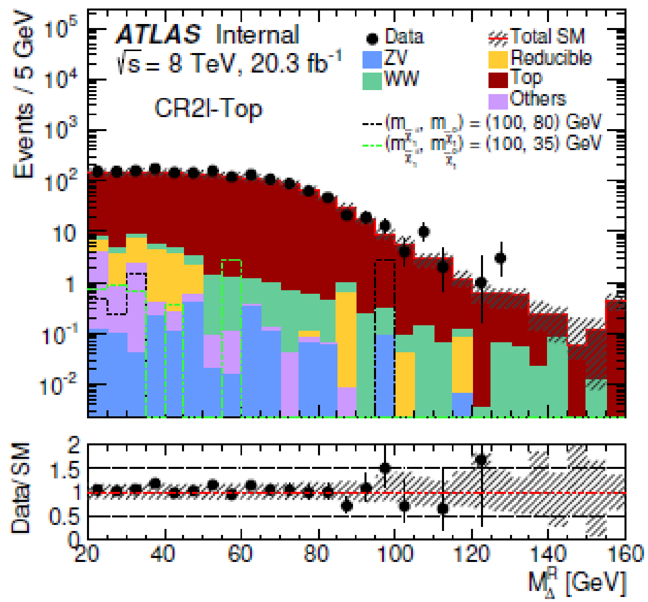
- **95% CL exclusion limits on the cross-section for VBF production of $\tilde{\chi}_1^{\pm}\,\tilde{\chi}_1^{\pm}$. The limits have been set with respect to the mass difference between the $\tilde{\chi}_1^{\pm}$ and $\tilde{\chi}_1^0$.**
- **The best observed upper limit is found for $\tilde{\chi}_1^{\pm}$ mass of 120 GeV and m($\tilde{\chi}_1^{\pm}$)-m($\tilde{\chi}_1^0$)= 25 GeV.**
- **Slightly stronger sensitivity for higher $\tilde{\chi}_1^{\pm}$ masses**

Compressed scenarios

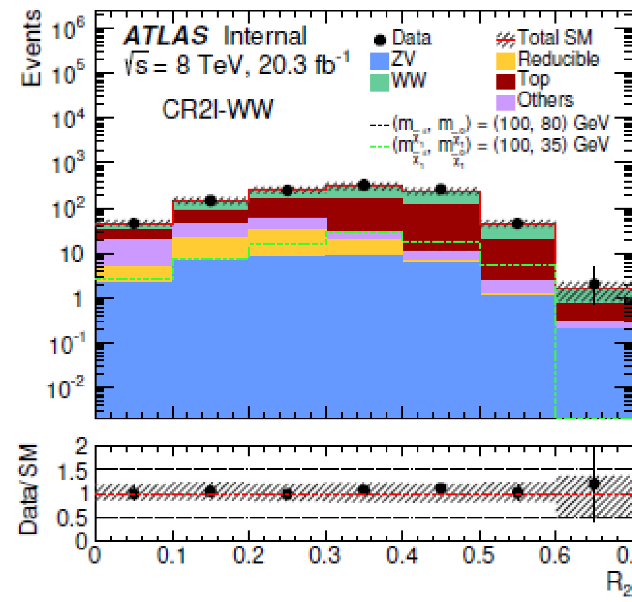
- SUSY scenarios which have **small mass difference** between sparticles and neutralinos**:**
  - Final state with low-momentum leptons
- **Difficulties:**
  - **Low mass splitting**
  - **Soft decay products**
  - **SM-like**
- **Re-optimized ATLAS analysis targeting compressed spectra:**
  - **2 OS light leptons**
  - **2 SS light leptons**
  - **3 light leptons**

OS 2l – event selection & BG estimation





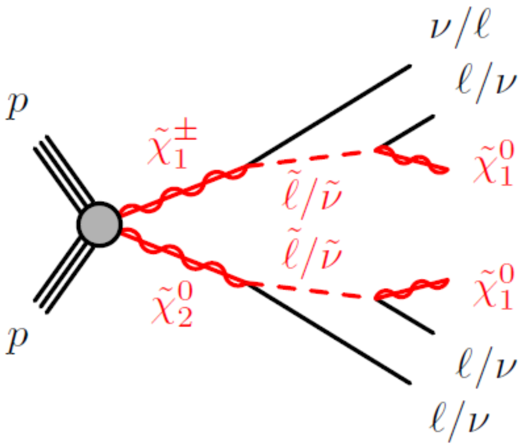
(a) M_Δ^R in the top CR

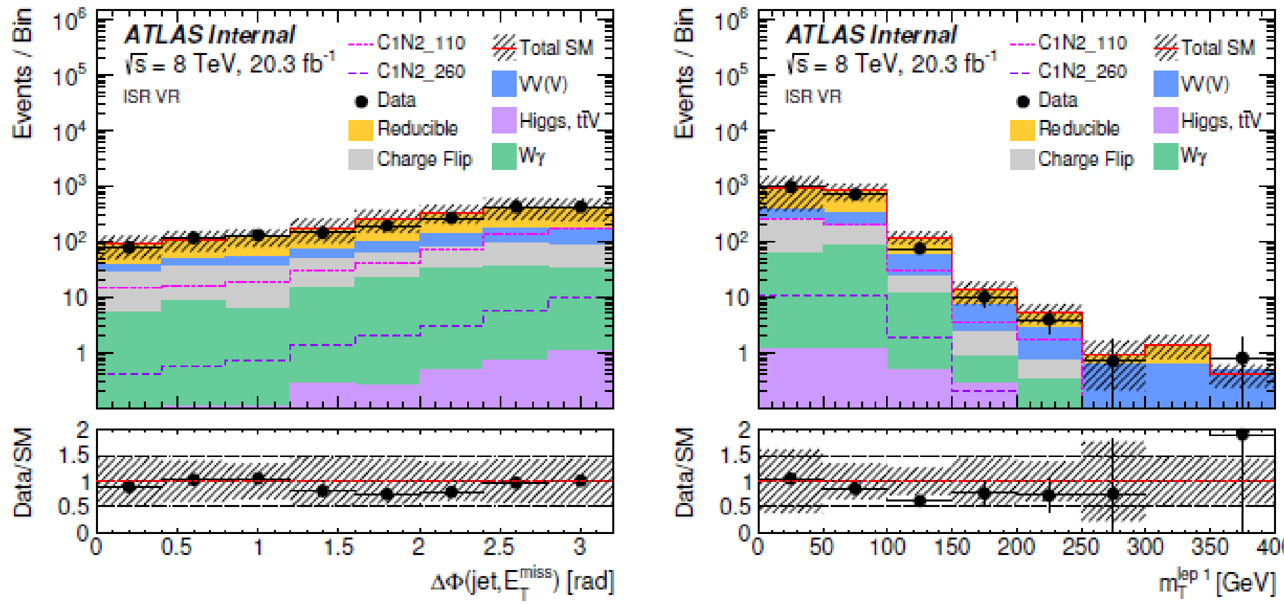


(c) R_2 in the WW CR

- **Experimental signature: 2OS-lepton, E_T^{miss}**
- **Two SRs requiring a high pT ISR jets, sensitive to small and moderate mass splittings**
- **Discriminate variable "super-razor" used**
- **SM backgrounds:**
  - **irreducible background (WW, top, ZV) -> normalized MC in dedicated CRs**
  - **Reducible background (all fake sources) -> Matrix Method**
  - **Others (Higgs, Z+jets) -> MC simulation**

SS 2l – event selection & BG estimation





(a) $\Delta\phi(\text{jet}, E_T^{\text{miss}})$ in ISR VR

(b) m_T^{lep1} in ISR VR

- **Experimental signature: 2SS-lepton, E_T^{miss}**
- **Eight BDTs are trained to cover four different mass splittings for $m(\tilde{\chi}_1^\pm) - m(\tilde{\chi}_0^\pm)$=20, 35, 60, 100GeV.**
- **One region for each mass splitting requires an ISR jet, the others apply a jet-veto.**
- **SM backgrounds:**
  - **"prompt" leptons (diboson, triboson, $t\bar{t}V$, tZ, H) -> MC simulation**
  - **Non-prompt(Fake) leptons -> Matrix Method(except $W\gamma$ by MC prediction)**
  - **Charge-Flip leptons -> charge misID rate measured from CRs**

3l – event selection & BG estimation

- **Experimental signature:**

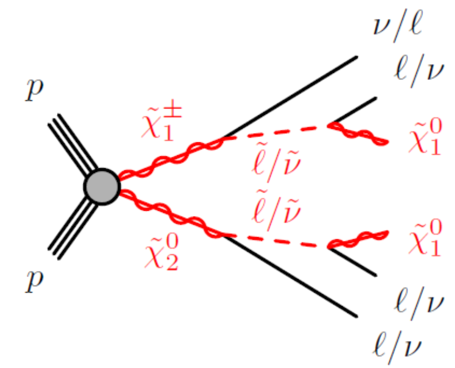
  ==3leptons(1 same-flavor OS pair), E_T^{miss}

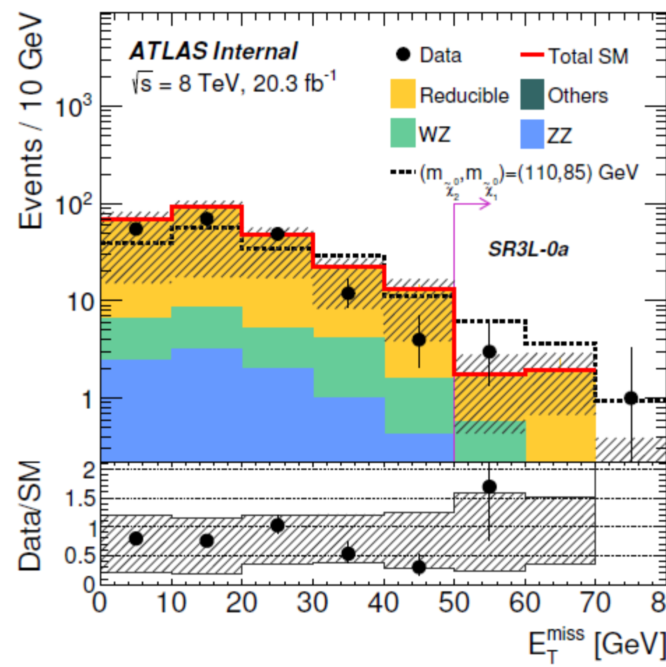
- **2 SRs with low pT leptons to target mass splittings of 4-15 and 15-25GeV, 2 SRs which request a jet with pT>50GeV to target ISR events for both splitting regions**

- **SM backgrounds:**
  - **Irreducible (prompt) leptons**

    ->diboson, triboson, H -> MC simulation
  - **Reducible (Fake) leptons**

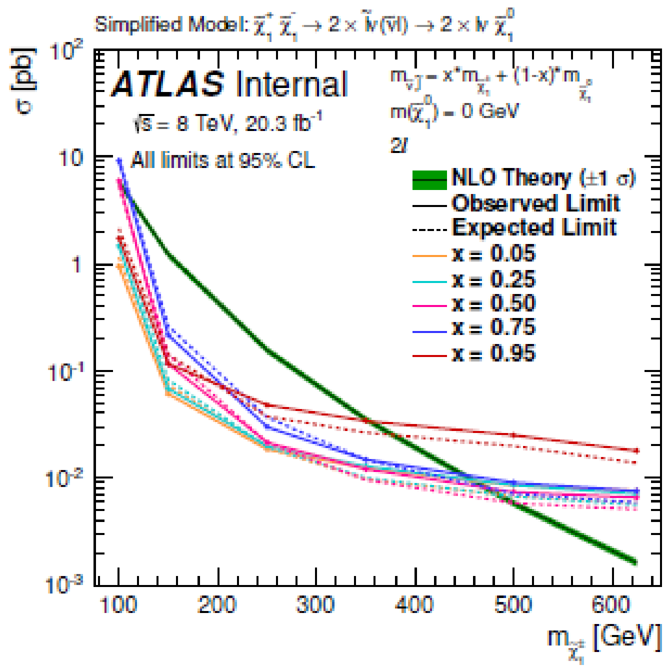
    -> V+jets, WW, top, $t\bar{t}$ -> Matrix Method



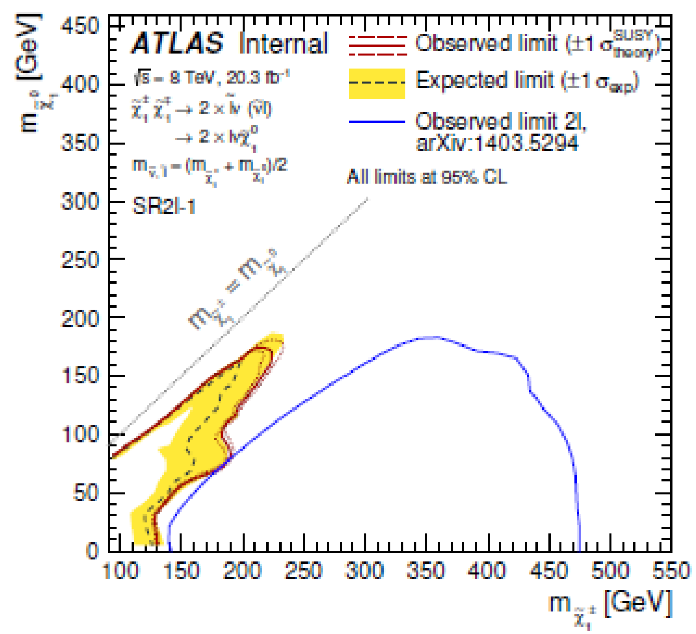


(a) E_T^{miss} in SR3ℓ-0a

results and interpretation – OS 2l



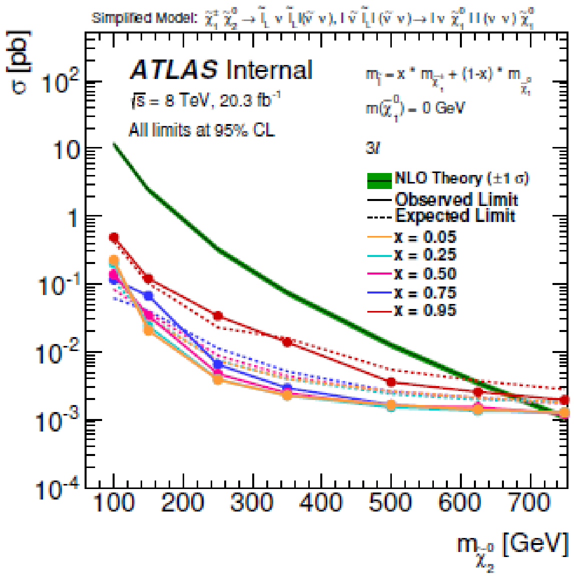
(a) Variable $\tilde{\ell}_L$ mass

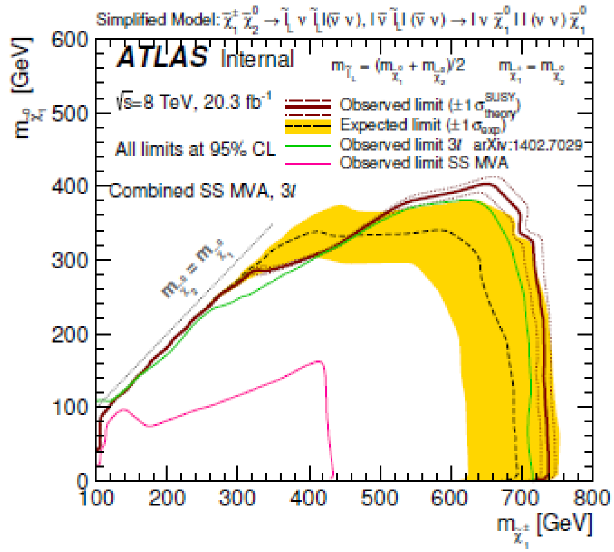


(b) $m(\tilde{\ell}_L)=0.5\times m(\tilde{\chi}_1^\pm)+0.5\times m(\tilde{\chi}_1^0)$

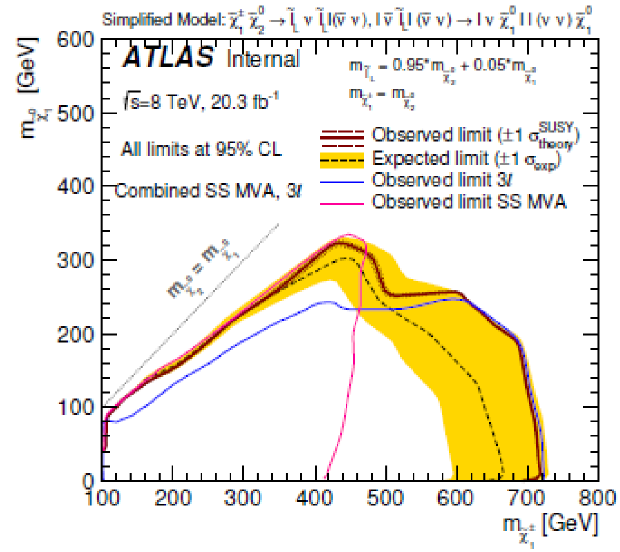
- **Re-optimized analysis nicely complements the already published one in the region of low mass splittings close to the diagonal.**

results and interpretation – SS2l & 3l





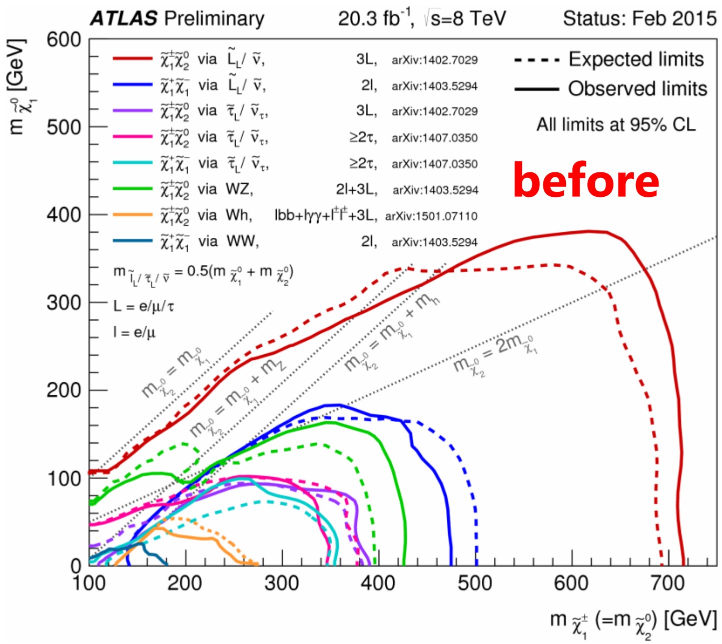
(a) $m(\tilde{\ell}_L)=0.5\times m(\tilde{\chi}_1^{\pm})+0.5\times m(\tilde{\chi}_1^0)$

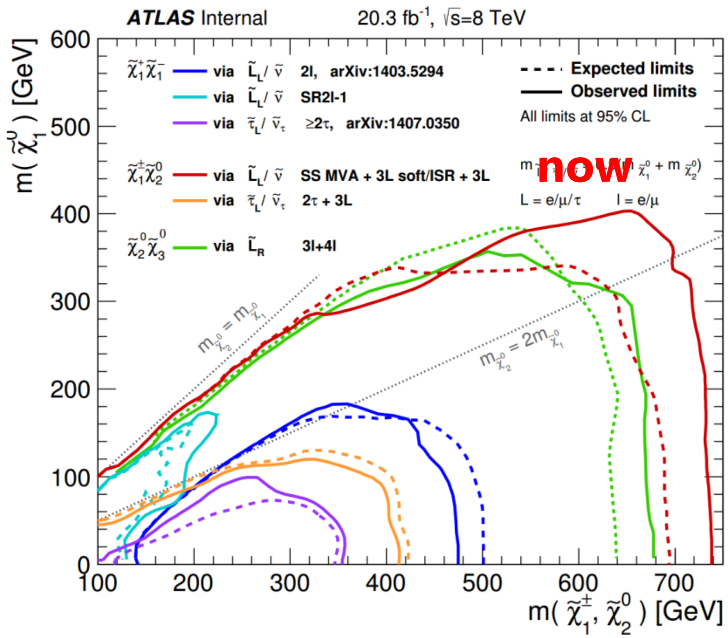


(b) $m(\tilde{\ell}_L)=0.95\times m(\tilde{\chi}_1^{\pm})+0.05\times m(\tilde{\chi}_1^0)$

- **Re-optimized analysis nicely complements the already published one in the region of low mass splittings close to the diagonal.**
- **The combination of the new analyses give an improved sensitivity to compressed scenarios up to $\tilde{\chi}_1^{\pm}$ masses of 250 GeV.**

Conclusion





- Various searches in EWK SUSY sector at ATLAS:

  https://twiki.cern.ch/twiki/bin/view/AtlasPublic/SupersymmetryPublicResults

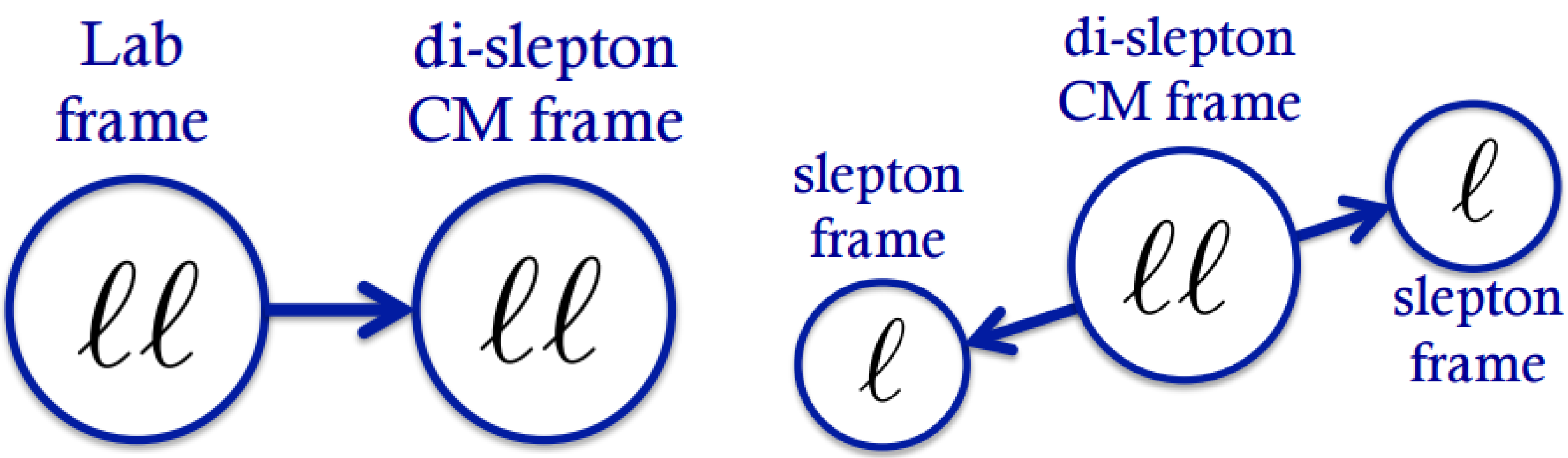
- Newly updated results for EWK SUSY searching presented.
- No significant excess observed beyond SM expectation.
- Higher sensitivity and expanding exclusion/discovery contour is expected with 13/14TeV LHC RUN2 data

Extra slides

Super razor variables

- **Iteratively transformed observable momenta.**
- **At each step, determine the next transformation by making boost invariant guesses for unknown parameters.**
  - ✓ **1st transformation: extract variable sensitive to invariant mass of total event**
  - ✓ **2nd transformation: extract variable sensitive to invariant mass of squark**

$$M_{\Delta} \equiv \frac{m_{\tilde{l}}^2 - m_{\tilde{\chi}^0}^2}{m_{\tilde{l}}}$$



Search for direct pair production of a chargino and a neutralino decaying to the 125 GeV Higgs boson

Eur.Phys.J.C(2015)

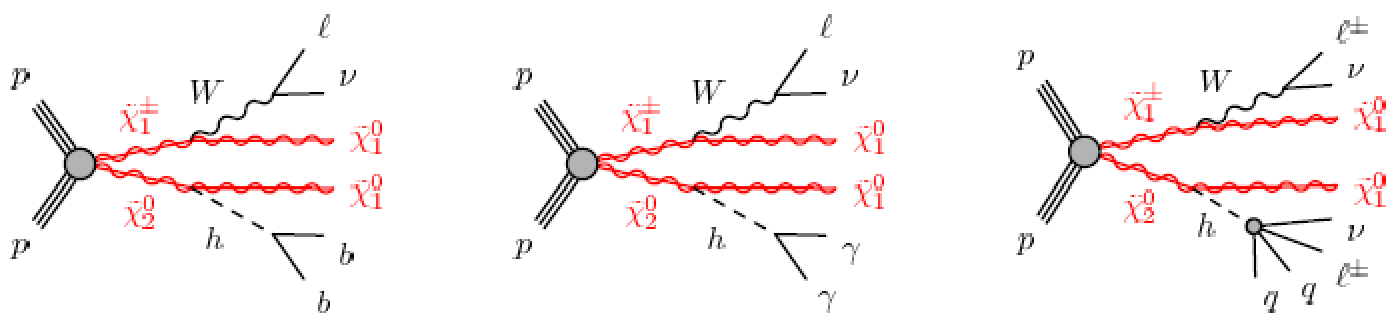
http://arxiv.org/abs/1501.07110

Electroweakino SUSY Searches via higgs decay

- **Direct pair production of $\tilde{\chi}_1^{\pm}\tilde{\chi}_2^0$ may be the dominant production of supersymmetric particles if the superpartners of the gluon and quarks are heavier than a few TeV.**

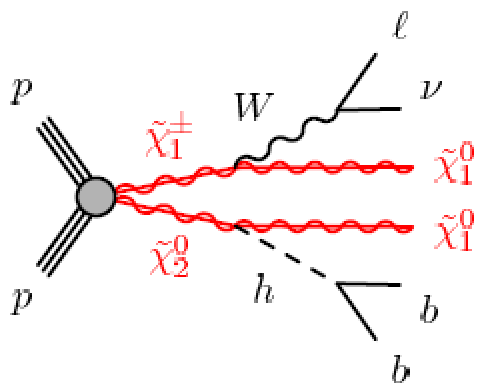
- **The decay to the Higgs boson dominants when:**
  - ✓ **the mass splitting between the two lightest neutralinos is larger than the Higgs boson mass**
  - ✓ **the higgsinos are much heavier than the winos, causing the composition of the $\tilde{\chi}_1^{\pm}$and $\tilde{\chi}_2^0$ to be wino-like and nearly mass degenerate.**

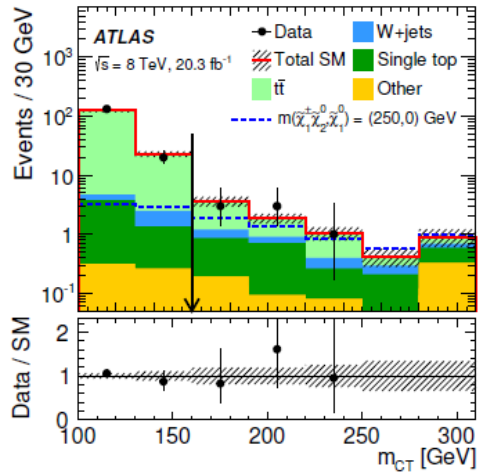
- **The analysis is based on 20.3 fb-1 of $\sqrt{S}$ = 8 TeV pp collision data.**



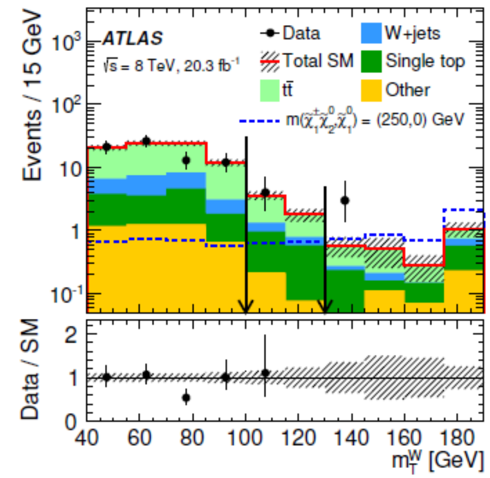
(a) One lepton and two b-quarks channel (b) One lepton and two photons channel (c) Same-sign dilepton channel

lbb channel – event selection & bkg estimation





(a) m_{CT} in CRℓbb-T, SRℓbb-1 and SRℓbb-2, central m_{bb} bin



(c) m_{T}^{W} in VRℓbb-2, SRℓbb-1 and SRℓbb-2, central m_{bb} bin

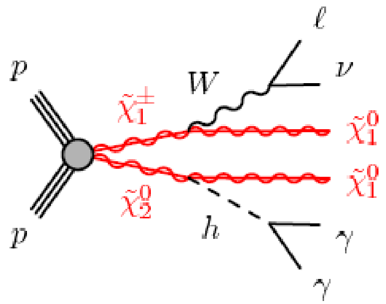
$$m_{\mathrm{CT}} = \sqrt{(E_{\mathrm{T}}^{b_1} + E_{\mathrm{T}}^{b_2})^2 - |\mathbf{p}_{\mathrm{T}}^{b_1} - \mathbf{p}_{\mathrm{T}}^{b_2}|^2},$$

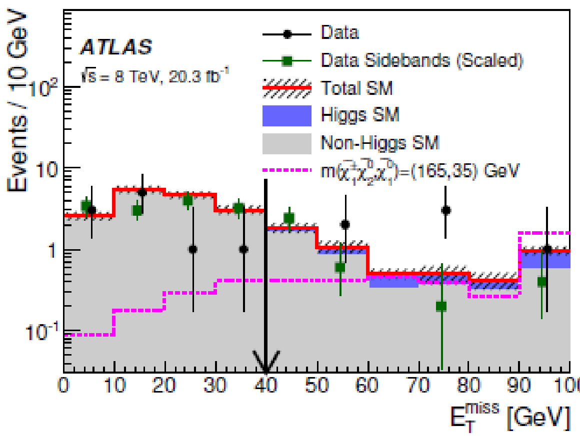
$$m_{\mathrm{T}}^{W} = \sqrt{2E_{\mathrm{T}}^{\ell}E_{\mathrm{T}}^{\mathrm{miss}} - 2\mathbf{p}_{\mathrm{T}}^{\ell}\cdot\mathbf{p}_{\mathrm{T}}^{\mathrm{miss}}},$$

- **Experimental signature: 2b-jets, 1lepton, E_T^{miss}**
- **Discriminating variables: $E_T^{miss}, m_{CT}, m_T^W$**
- **2 Signal Regions(SR) defined for the channel in 5 bins of M_{bb}**
- **Main background $t\bar{t}$ and W+jets taken from simulation and normalized to data from dedicated Control Regions(CR)**
- **Multi-jet BG is estimated from data using Matrix Method**

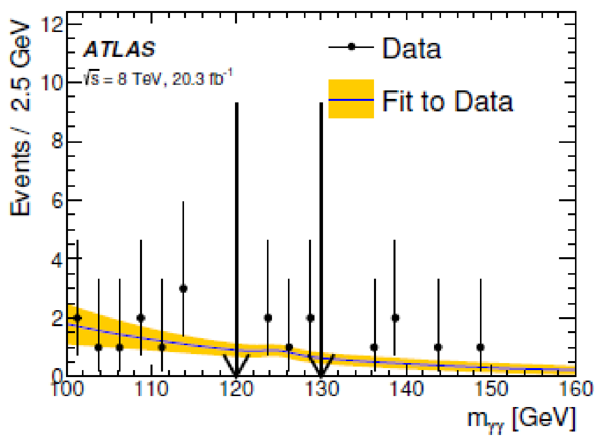
	SRℓbb-1	SRℓbb-2	CRℓbb-T	CRℓbb-W	VRℓbb-1	VRℓbb-2
n_{lepton}	1	1	1	1	1	1
n_{jet}	2–3	2–3	2–3	2	2–3	2–3
$n_{b\text{-jet}}$	2	2	2	1	2	2
$E_{\mathrm{T}}^{\mathrm{miss}}$ [GeV]	> 100	> 100	> 100	> 100	> 100	> 100
m_{CT} [GeV]	> 160	> 160	100–160	> 160	100–160	> 160
m_{T}^{W} [GeV]	100–130	> 130	> 100	> 40	40–100	40–100

$l\gamma\gamma$ channel – event selection





(a) E_T^{miss} in SR$\ell\gamma\gamma$-1 and SR$\ell\gamma\gamma$-2 without E_T^{miss} cut



(b) SR$\ell\gamma\gamma$-2

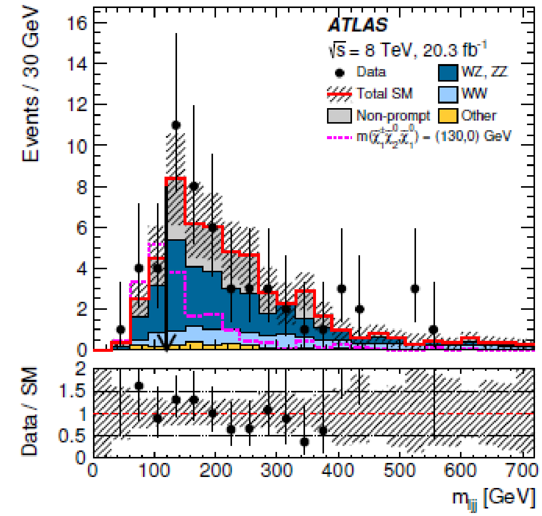
- **Experimental signature:**
  - **2γ, 1lepton, E_T^{miss}**
- **Diphoton or single-lepton trigger**
- **2SRs defined for this channel**
- **non-Higgs SM BG**
  - **template fit to the full $M_{\gamma\gamma}$ distribution**
- **Higgs SM BG:**
  - **simulation**

$$m_T^{W\gamma_i} = \sqrt{(m_T^W)^2 + 2E_T^W E_T^{\gamma_i} - 2\mathbf{p}_T^W \cdot \mathbf{p}_T^{\gamma_i}},$$

	SR$\ell\gamma\gamma$-1	SR$\ell\gamma\gamma$-2	VR$\ell\gamma\gamma$-1	VR$\ell\gamma\gamma$-2
$n_{\rm lepton}$	1	1	1	1
n_γ	2	2	2	2
E_T^{miss} [GeV]	> 40	> 40	< 40	—
$\Delta\phi(W,h)$	> 2.25	> 2.25	—	< 2.25
$m_T^{W\gamma_1}$ [GeV]	> 150	< 150		
	and	or	—	—
$m_T^{W\gamma_2}$ [GeV]	> 80	< 80		

SSll channel– object selection

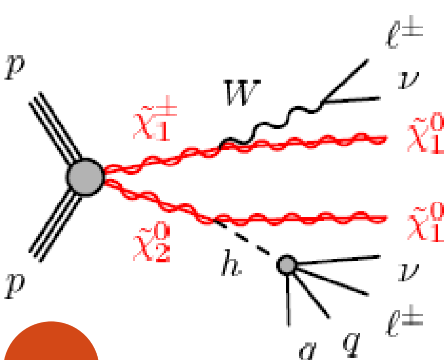
- **Experimental signature:**
  - **2jets, SS2l, E_T^{miss}**
- **Dilepton trigger**
- **SM background:**
  - **“prompt” leptons (WZ/ZZ) -> MC simulation**
  - **Non-prompt(Fake) leptons -> Matrix Method**
  - **Other: charge-misID leptons -> misID probability measured from data**



(f) $m_{\ell jj}$ in SR$\ell\ell$-2 without $m_{\ell jj}$ cut

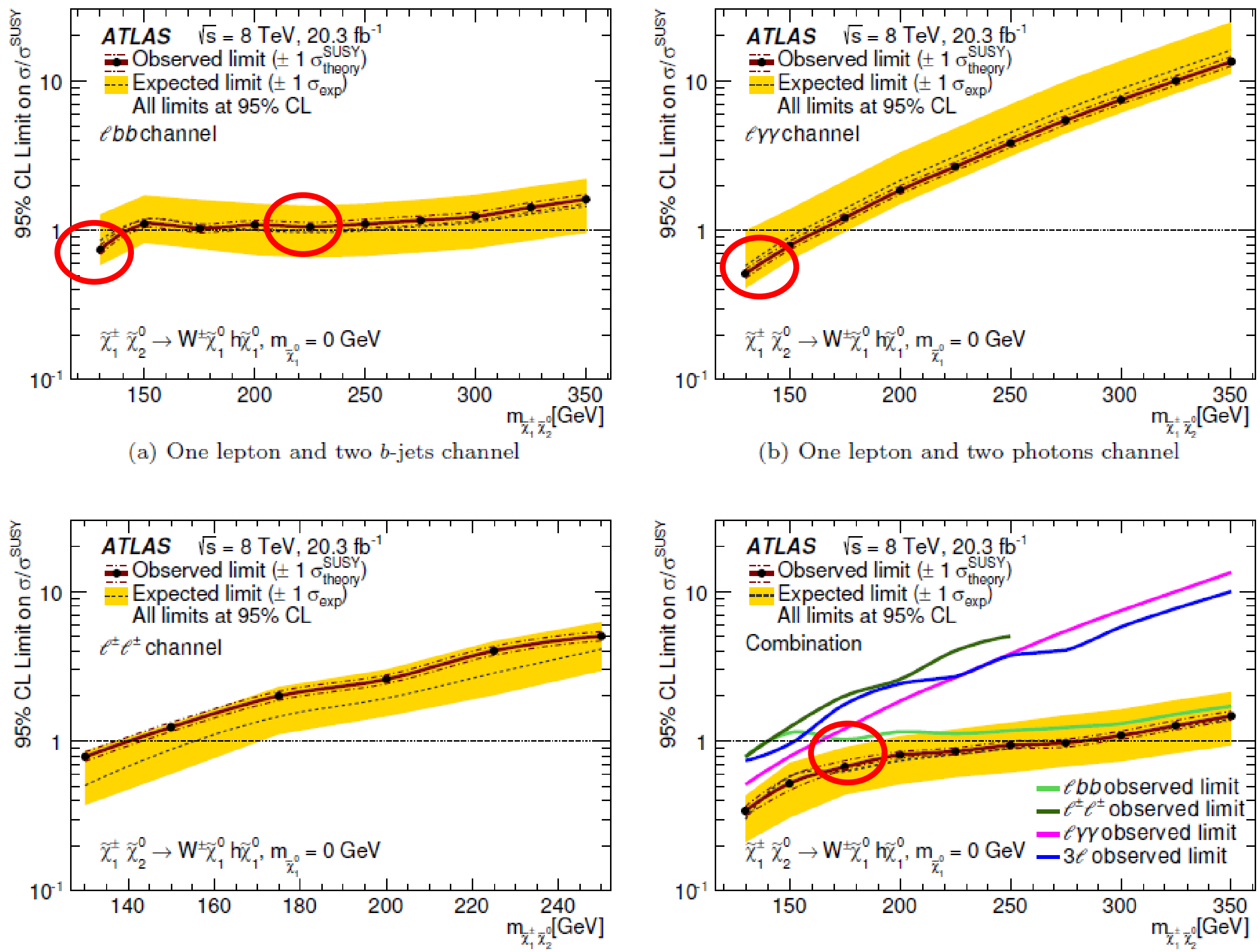
$$E_{\mathrm{T}}^{\mathrm{miss,rel}} = \begin{cases} E_{\mathrm{T}}^{\mathrm{miss}} & \text{if } \Delta\phi > \pi/2, \\ E_{\mathrm{T}}^{\mathrm{miss}} \sin(\Delta\phi) & \text{if } \Delta\phi < \pi/2, \end{cases}$$

Selection requirements for the signal regions of the same-sign dilepton channel.



	SRee-1	SRee-2	SR$\mu\mu$-1	SR$\mu\mu$-2	SR$e\mu$-1	SR$e\mu$-2
Lepton flavours	ee	ee	$\mu\mu$	$\mu\mu$	$e\mu$	$e\mu$
n_{jet}	1	2 or 3	1	2 or 3	1	2 or 3
Leading lepton p_{T} [GeV]	> 30	> 30	> 30	> 30	> 30	> 30
Sub-leading lepton p_{T} [GeV]	> 20	> 20	> 20	> 30	> 30	> 30
$\lvert m_{\ell\ell} - m_Z \rvert$ [GeV]	> 10	> 10	–	–	–	–
$\Delta\eta_{\ell\ell}$	–	–	< 1.5	< 1.5	< 1.5	< 1.5
$E_{\mathrm{T}}^{\mathrm{miss,rel}}$ [GeV]	> 55	> 30	–	–	–	–
m_{eff} [GeV]	> 200	–	> 200	> 200	> 200	> 200
$m_{\mathrm{T}}^{\mathrm{max}}$ [GeV]	–	> 110	> 110	–	> 110	> 110
$m_{\ell j}$ or $m_{\ell jj}$ [GeV]	< 90	< 120	< 90	< 120	< 90	< 120

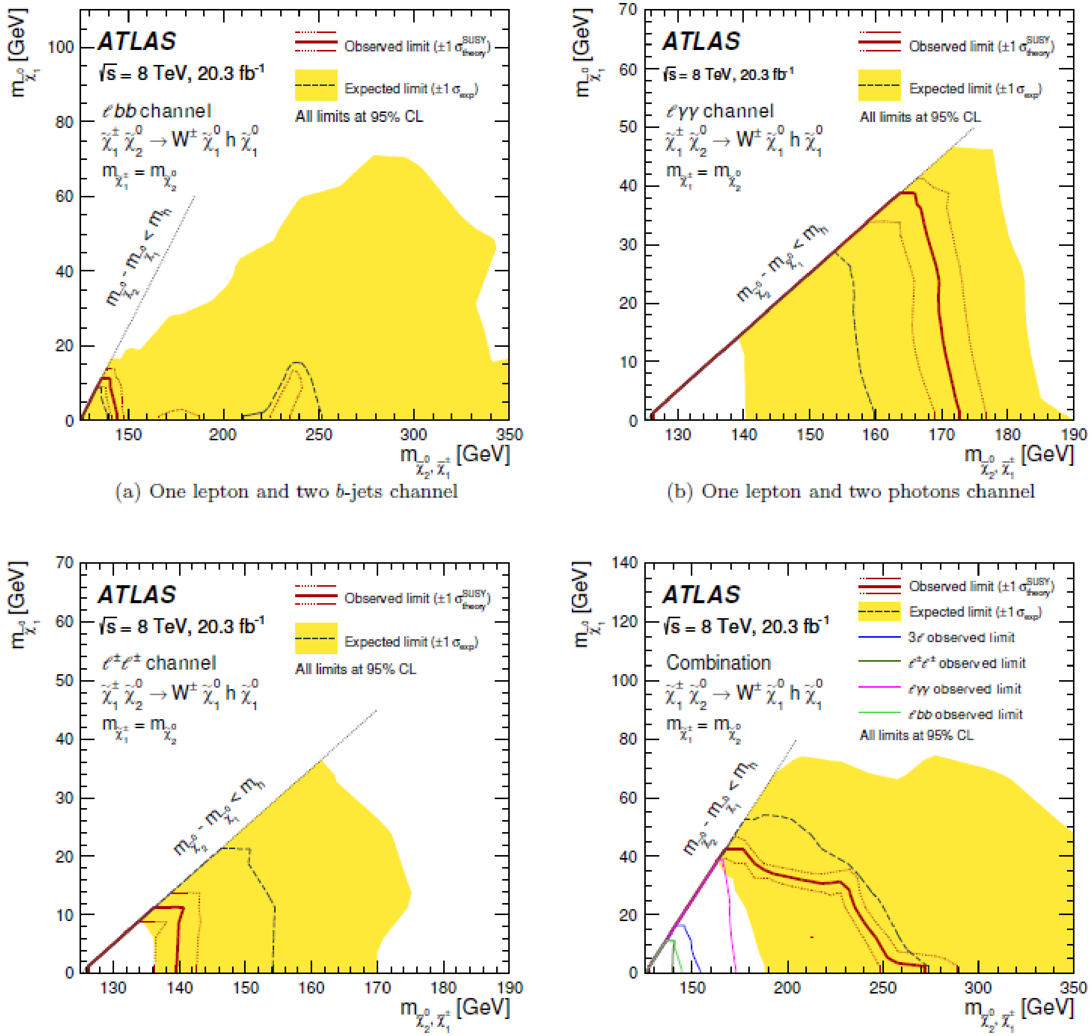
results and interpretation



(a) One lepton and two b-jets channel
(b) One lepton and two photons channel
(c) Same-sign dilepton channel
(d) Combination

- **Region $m(\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2) < 140$ GeV is largely due to SRlbb-1, while the $\gamma\gamma$ channel being the best:**
  - **targeting models with small mass splitting between the neutralinos**
- **Region $m(\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2) = 240$ GeV is driven by SRlbb-2**
  - **designed for larger mass splitting.**
- **Region $m(\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2) = 170$ GeV all channel shows close sensitivity.**
- **Observed and expected 95% CL upper limits on the X-section normalized by the simplified model prediction as a function of the common mass $m(\tilde{\chi}^{\pm}_1, \tilde{\chi}^0_2)$ at $m(\tilde{\chi}^0_1)$=0.**

results and interpretation



(a) One lepton and two b-jets channel

(b) One lepton and two photons channel

(c) Same-sign dilepton channel

(d) Combination

- **The combination of these independent searches improves the sensitivity significantly by extending the 95% CL exclusion region to $m(\tilde{\chi}_1^0)$=250 GeV.**

- **Observed and expected 95% CL exclusion region in the mass plane of $m(\tilde{\chi}_1^\pm,\ \tilde{\chi}_2^0)$ v.s. $m(\tilde{\chi}_1^0)$.**

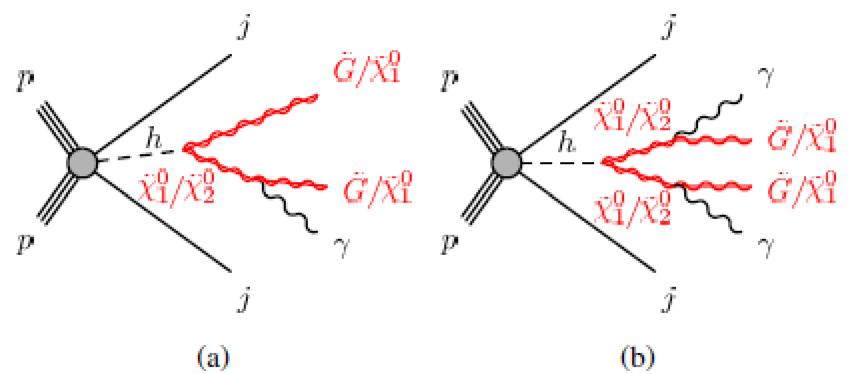
Search for exotic Higgs-boson decays in events with at least one photon, missing transverse momentum, and two forward jets

ATLAS-CONF-2015-001

Searches via exotic higgs decaying to $\gamma(\gamma\gamma) + LSP$

- Depending on the Higgs-boson production cross section, BF(h→BSM) could be O(50%). SUSY extensions to the SM can explain the mass of the Higgs-boson and address the hierarchy problem.
- In certain extensions the Higgs-boson is predicted to decay into SUSY particles.

- Gauge mediated supersymmetry breaking (**GMSB**) model:
  - H decay to a nearly massless gravitino $\widetilde{G}$(LSP) and a $\tilde{\chi}_1^0$ (NLSP)
  - M(h)/2 < M($\tilde{\chi}_1^0$) < M(h)
- Next-to-Minimal Supersymmetric Standard Models (**NMSSM**):
  - H decay to a nearly massless $\tilde{\chi}_2^0$(NLSP) and a $\tilde{\chi}_1^0$ (LSP)
  - M(h)/2 < M($\tilde{\chi}_2^0$) < M(h)
- Case also considered as fig.b:
  - Diphoton-MET signature
  - M($\tilde{\chi}_1^0$) < M(h)/2 or M($\tilde{\chi}_2^0$) < M(h)/2



event selection & bkg estimation

- **Experimental signature:**
  - **>=1photon,**
  - **VBF production (2 forward well separated jets)**

- **Most selection requirements were optimized using the Validation Region**

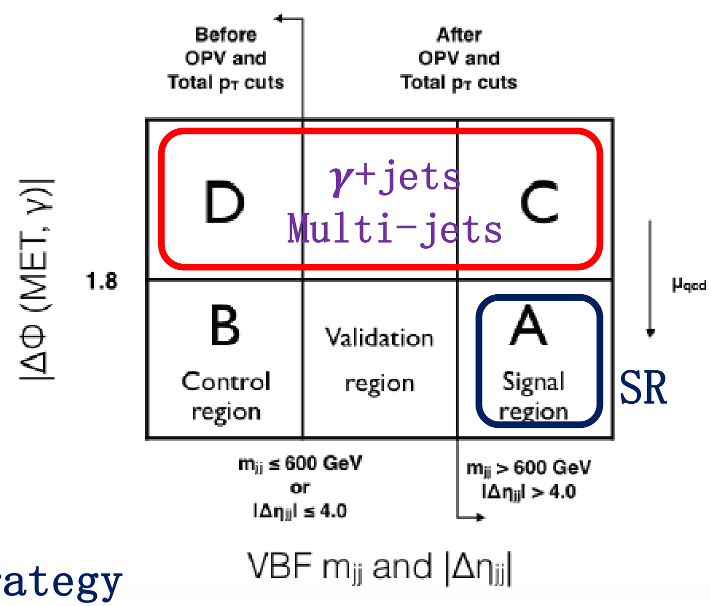
- **SM BG:**
  - γ+jets, multi−jets, W/Z+γ, W/Z+jets, W→ $e\nu$, others(WW, WZ, ZZ, ttbar)

- **Dominant BG from γ+jets, multi−jets background estimated using data-driven ABCD**

- **Other BG taken from simulation and normalized to data in dedicated CR.**

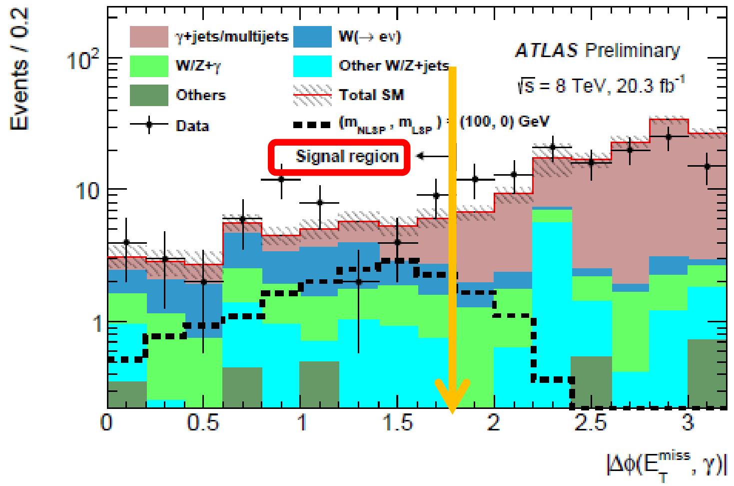
Signal selections

Requirement	Data	(m_{NLSP}, m_{LSP}) = (100, 0) GeV signal
Data quality and trigger	1.53× 10^7	337±4
Good vertex	1.53× 10^7	336±4
E_T^{miss} > 50 GeV	1.26× 10^7	279±3
Selected photon p_T > 40 GeV	7.41× 10^5	128±2
VBF m_{jj} >400 GeV and $\lvert\Delta\eta_{jj}\rvert$ >3.0	3.17× 10^4	96.4±1.9
VBF jet $p_T \geq$ 40 GeV	6870	58.0±1.5
Lepton veto	6040	57.2±1.5
≤ 1 non-VBF jet	4620	50.4±1.4
$\lvert\Delta\phi(E_T^{miss}, VBF\ jet)\rvert_{min}$ > 1.4	600	30.1±1.1
$\lvert\Delta\phi(E_T^{miss}, non-VBF\ jet)\rvert_{min}$ < 2.0	565	28.2±1.0
OPV	425	27.6±1.0
$\lvert\vec{p}_T^{\,TOT}\rvert \geq$ 50 GeV	337	26.9±1.0
$\lvert\Delta\phi(E_T^{miss}, \gamma)\rvert \leq$1.8	100	21.6±0.9
VBF m_{jj} >600 GeV and $\lvert\Delta\eta_{jj}\rvert$ >4.0	50	14.6±0.7



Background estimation strategy

results

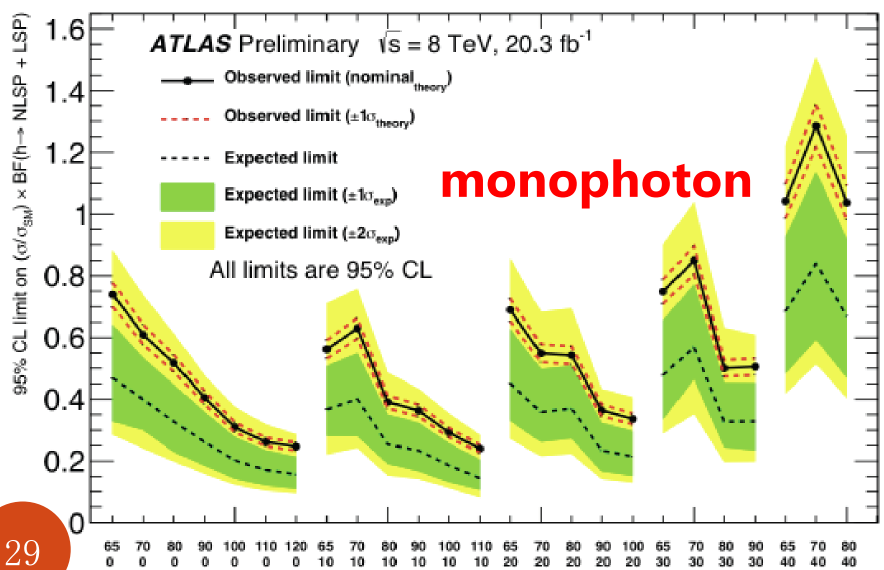


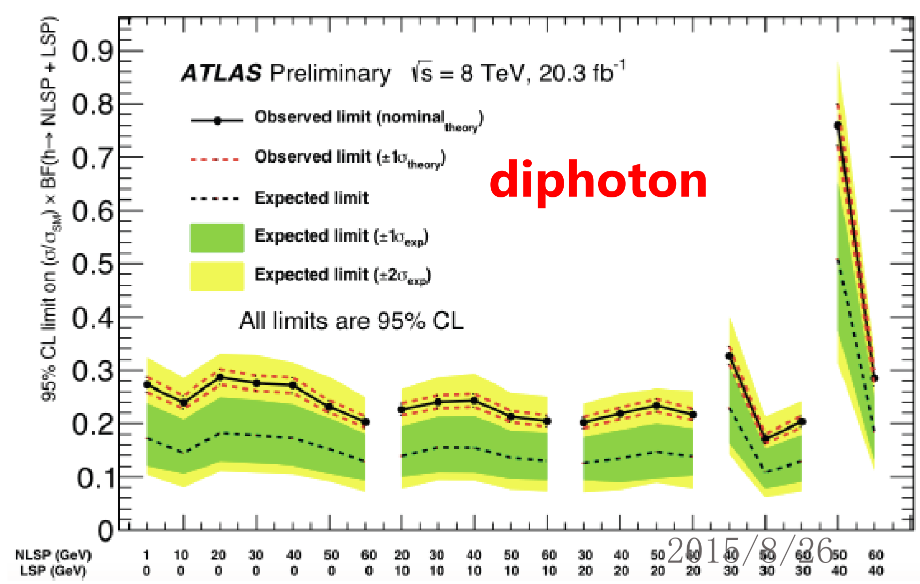
BG yield and Data in SR and BG control regions

	SR	Region B	γ+jets A	e A	lνγ A
$W(\to e\nu)$	10.7 ± 0.7 ± 1.5	24.5 ± 1.0 ± 3.3	5.2 ± 0.4 ± 0.6	956 ± 53 ± 133	0.02 ± 0.01 ± 0.00
$W(\to \mu\nu)$	0.21 ± 0.1 ± 0.24	1.4 ± 1.3 ± 0.3	0.1 ± 0.06 ± 0.06	0	0.66 ± 0.17 ± 0.09
$W(\to \tau\nu)$	4.2 ± 0.8 ± 0.6	4.7 ± 2.6 ± 2.4	1.7 ± 0.6 ± 0.8	62 ± 3.4 ± 37	0.9 ± 0.5 ± 0.33
$W(\to l\nu)\gamma$	7.2 ± 0.5 ± 2.3	11.9 ± 0.6 ± 4.1	3.6 ± 0.3 ± 1.2	4.0 ± 0.3 ± 0.2	6.0 ± 0.4 ± 0.4
Z+jets	0.52 ± 0.28 ± 0.54	3.7 ± 3.5 ± 3.5	0	12.3 ± 7.1 ± 2.9	0
$Z+\gamma$	0.61 ± 0.05 ± 0.2	2.6 ± 1.4 ± 1.4	1.1 ± 0.8 ± 0.8	0	0.37 ± 0.37 ± 0.09
Others	0.68 ± 0.4 ± 0.26	2.6 ± 0.8 ± 0.6	0.8 ± 0.4 ± 0.6	99.8 ± 5.1 ± 4.0	2.0 ± 0.7 ± 0.8
γ+jets and multijet	13.9 ± 1.7 ± 3.5	26.6 ± 2.2 ± 0.8	31.5 ± 6.7 ± 2.0	37 ± 11 ± 36	0
Total background	38.0 ± 2.2 ± 4.5	78 ± 5.4 ± 7	44 ± 6.8 ± 2.8	1170 ± 55 ± 143	10.0 ± 1 ± 0.9
Data	50	78	44	1079	12
(m_{NLSP}, m_{LSP}) (100, 0) GeV	14.6 ± 0.7 ± 1.2	8.5 ± 0.6 ± 0.6	3.0 ± 0.3 ± 0.5	0.3 ± 0.1 ± 0.1	0.11 ± 0.06 ± 0.07

1.1 σ excess is observed

- **Due to excess in SR, observed limits are higher than expected ones.**
- **Strong upper limits are obtained in $\gamma\gamma + E_T^{miss}$ final state also.**

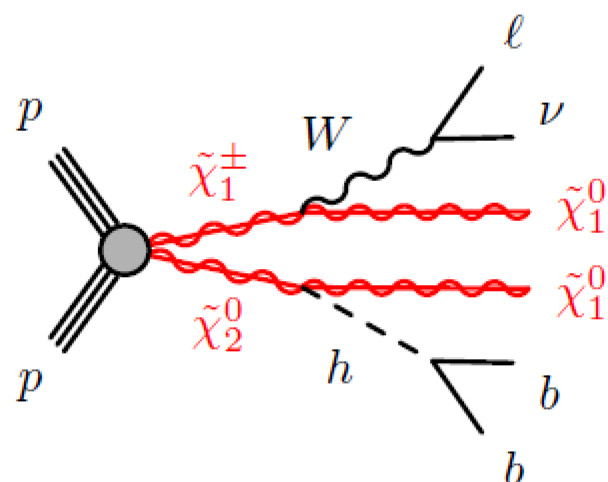




Upgrade study

Prospect for direct pair production of a chargino and a neutralino decaying via W and h in final states with one lepton, two b-jets and missing transverse momentum

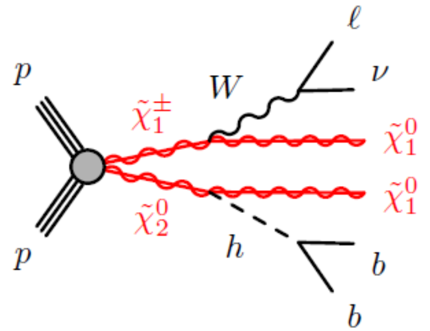
ATL-PHYS-PUB-2015-032

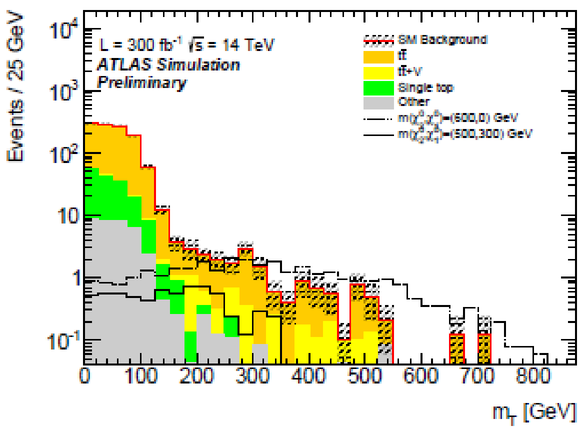


Wh production – event selection & background

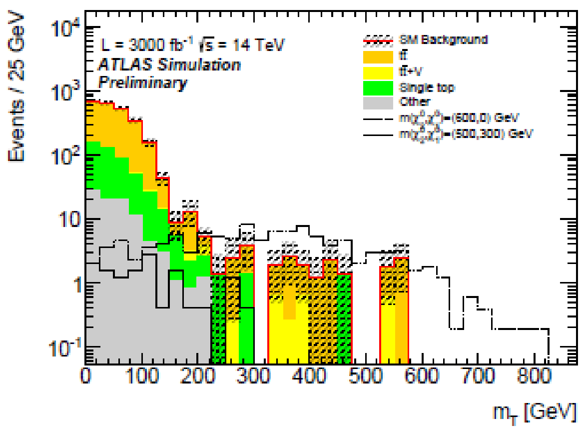
- **Experimental signature:**
  - **2b-jets, 1lepton, E_T^{miss}**
- **Cut-and count for LHC scenario**
- **BDT considered for HL-LHC scenario:**

Selection	SRA	SRB	SRC	SRD
# of leptons (e, μ)	1			
# b-tagged jets	2			
m_{bb} [GeV]	$105 < m_{bb} < 135$			
# jets	2 or 3			
m_{CT} [GeV]	> 200	> 200	> 300	> 300
m_T [GeV]	> 200	> 250	> 200	> 250
E_T^{miss} [GeV]	> 300	> 350	> 400	> 450
$\langle\mu\rangle$ = 60, 300 fb^{-1} scenario	yes	yes	–	–
$\langle\mu\rangle$ = 140, 3000 fb^{-1} scenario	–	–	yes	yes

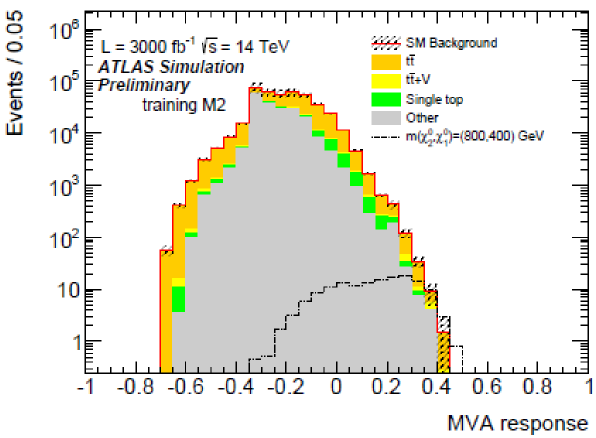




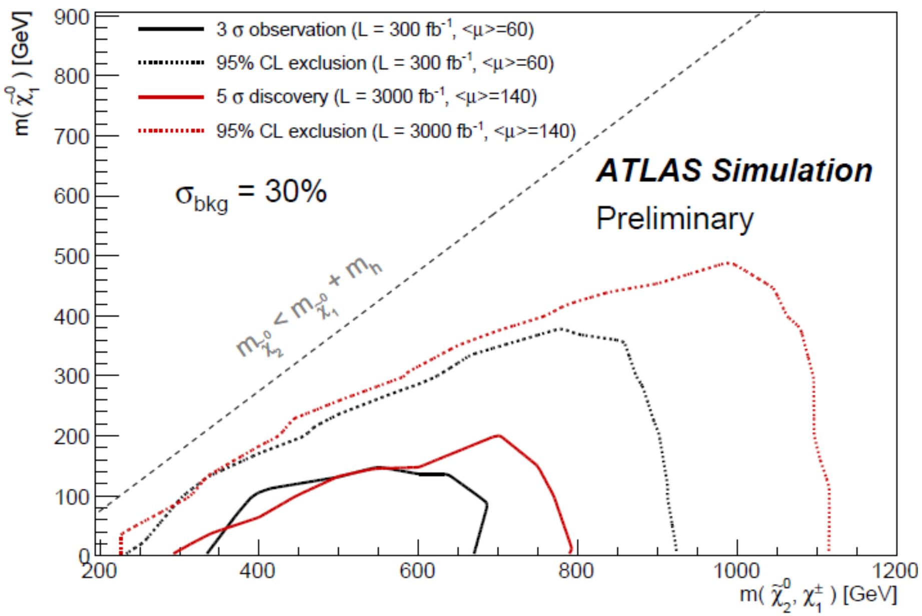
(a) 300 fb^{-1} < μ >= 60 scenario

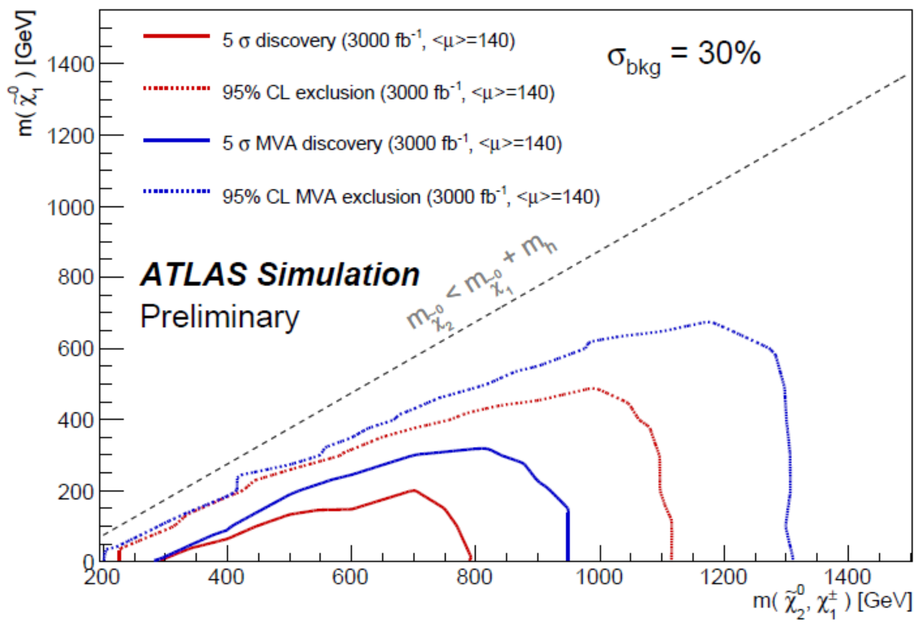


(b) 3000 fb^{-1} < μ >= 140 scenario



Wh production – sensitivity





$Z_n = \sqrt{2}\,erf^{-1}(1-2p)$ **30% systematic uncertainty in assumption**

- **Expected 95% exclusion and discovery contours in the m($\tilde{\chi}_1^0$) v.s. m($\tilde{\chi}_1^\pm$, $\tilde{\chi}_2^0$) plane.**
- **Comparing the cut and count and MVA approaches BDT.**
- **An increase of integrated luminosity from 300 fb-1 to 3000 fb-1 extends significantly the discovery sensitivity potential for $\tilde{\chi}_1^\pm\tilde{\chi}_2^0$ production and the exclusion sensitivity by about 200 GeV.**