Prospects for a search for direct pair production of top squarks in scenarios with compressed mass spectra at the High Luminosity LHC with the ATLAS Detector.

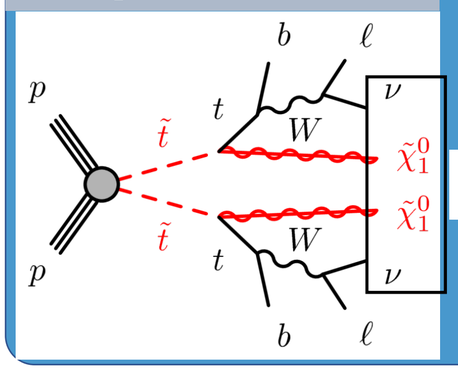
Marco Rimoldi- AEC-LHEP Universität Bern, Bern, Switzerland

b UNIVERSITÄT BERN

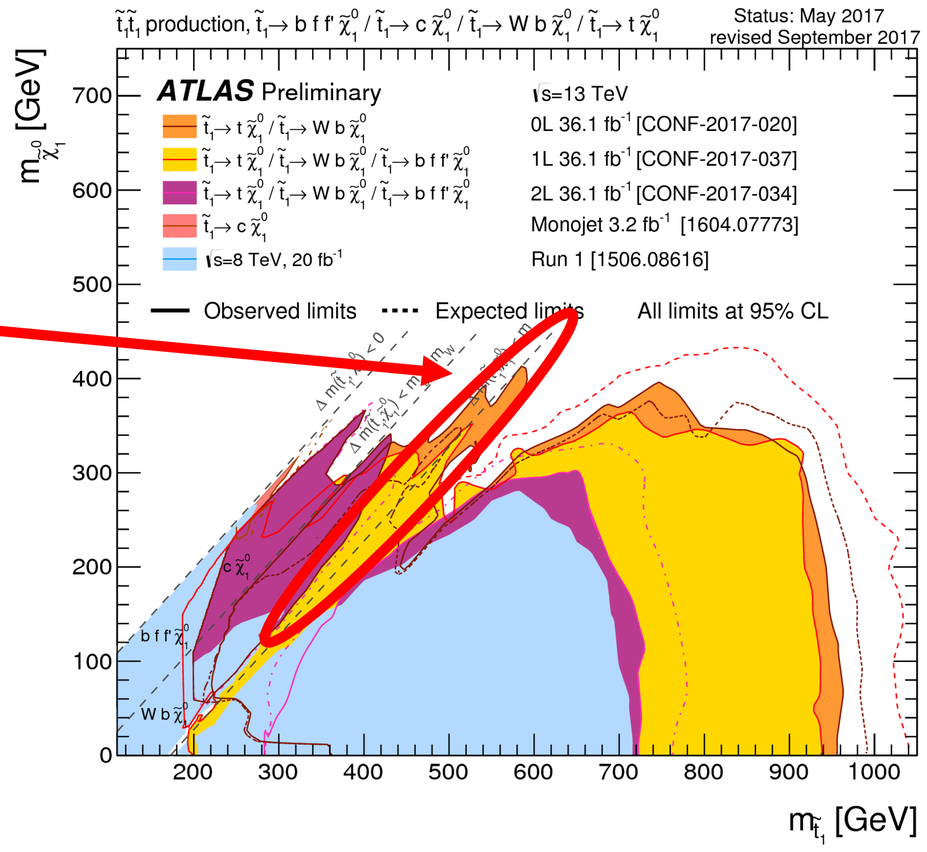
AEC ALBERT EINSTEIN CENTER FOR FUNDAMENTAL PHYSICS

The sensitivity to top squark pair production is expected to increase in the High Luminosity Phase of the LHC, in particular in the compressed mass spectra.

Simplified Model



- **Two SUSY particles:**
  stop $\tilde{t}_1$ **and**
  its daughter *neutralino* $\tilde{\chi}_1^0$
- **Mass difference**
  between the $\tilde{t}_1$ **and the** $\tilde{\chi}_1^0$
  is about the mass of the top quark



Signature and Detection

- **Two Isolated Leptons**
  (electrons or muons)with opposite electric charge.
- **Large Missing Momentum (E_T^{miss}).**
- **Analysis done on simulated data (3000 fb^{-1}) using a smearing function to mimic the detector response.**

Signal Region (SR) optimised for DISCOVERY with cut and count approach.

Small mass splitting between stop and neutralino implies that top quarks are produced with very small momentum.
Select event where the stop-stop system recoil of at least one energetic ISR jet to enhance the missing transverse momentum.

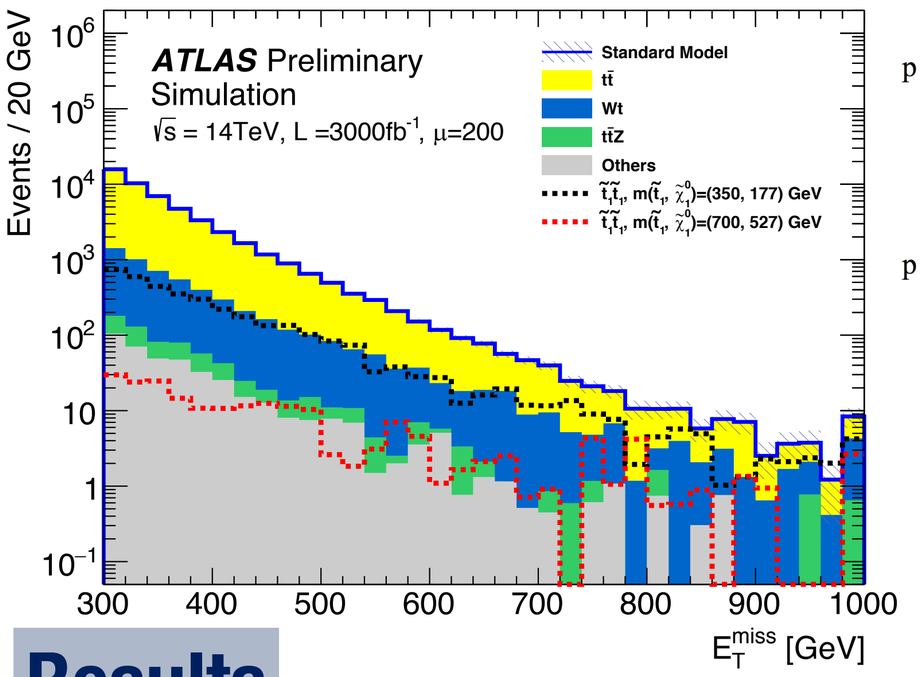
- **Stop System:** the 2 OS leptons + the 2 leading b-jets in the event.
- **ISR System:** all the other jets.

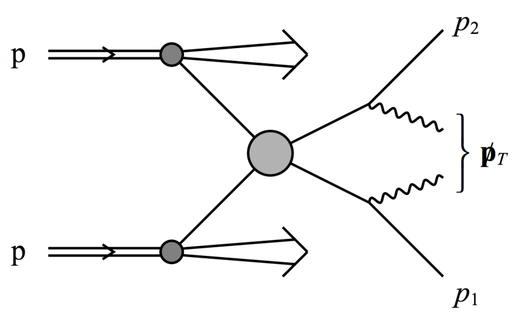
The final discriminant variable is the **stransverse mass (m_{T2}).**
Most of SM Backgrounds bound by the W mass, while signal extend above that.

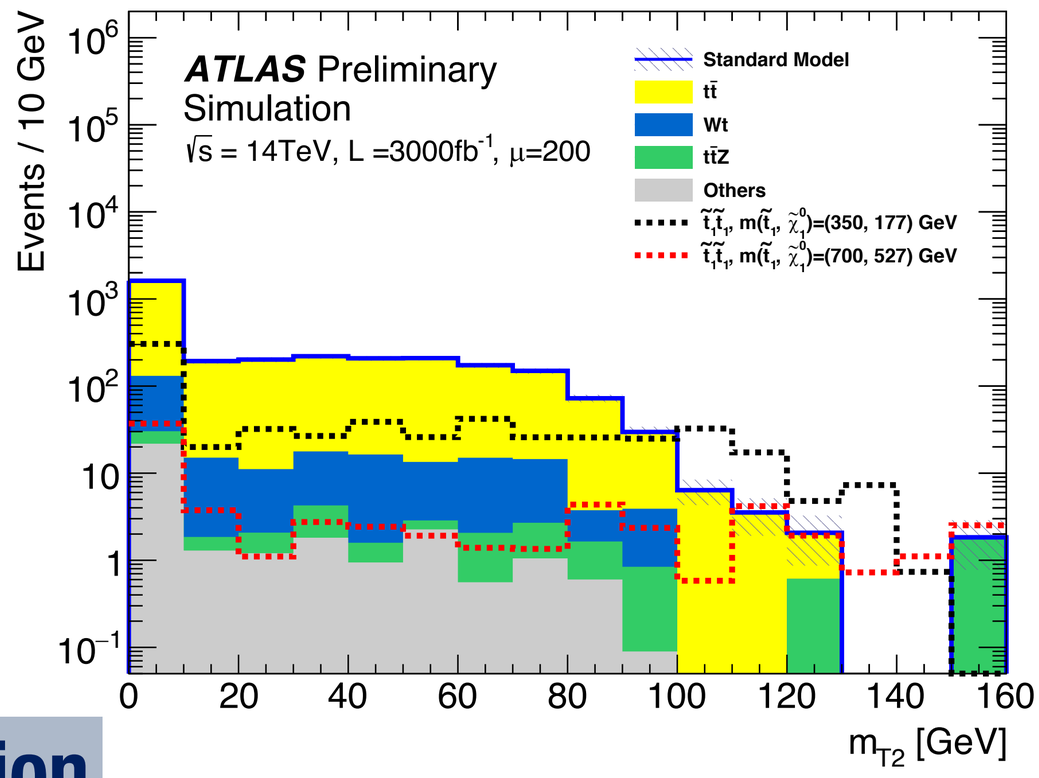
$$m_{T2}^2(\vec{p}_T^{\,l_1}, \vec{p}_T^{\,l_2}, \vec{p}_T^{\,\mathrm{miss}}) = \min_{\vec{p}_T^{\,\mathrm{miss1}} + \vec{p}_T^{\,\mathrm{miss2}} = \vec{p}_T^{\,\mathrm{miss}}} \max(m_T^2(p_T^{\,l_1}, \vec{p}_T^{\,\mathrm{miss1}}), m_T^2(p_T^{\,l_2}, \vec{p}_T^{\,\mathrm{miss2}}))$$

Signal Region Selection

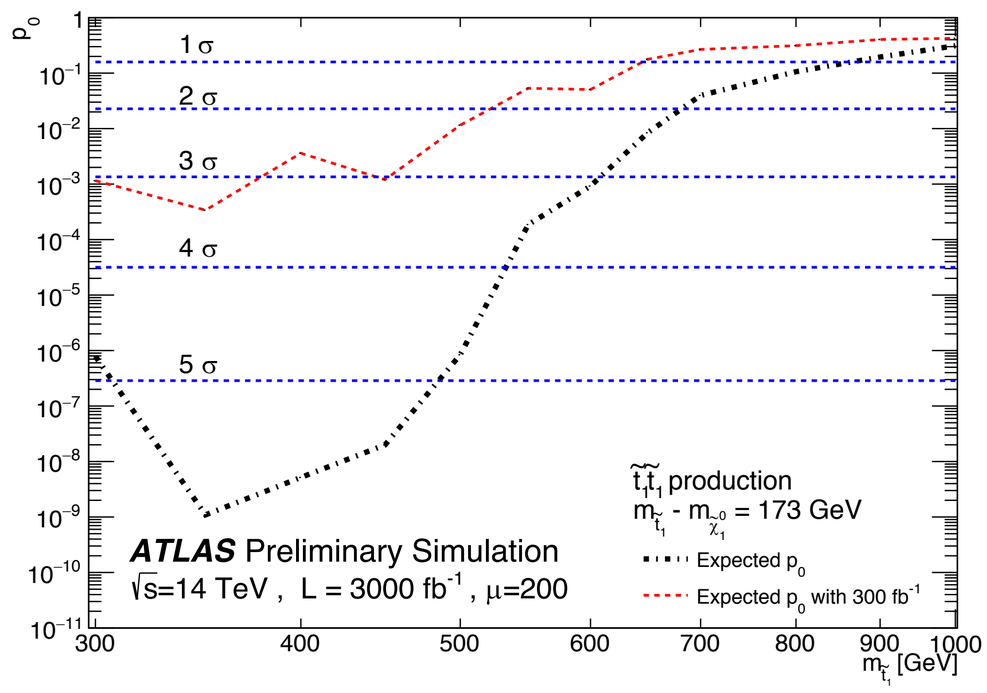
	SR
$m_{\ell\ell}$ [GeV] (SF lepton pairs only)	$81.2 < m_{\ell\ell} < 101.2$
$\min\{\Delta\phi(\mathrm{jet}_{\mathrm{ISR}}, E_{\mathrm{T}}^{\mathrm{miss}})\}$	> 0.4
$\Delta\phi(\mathrm{jet}_{\mathrm{ISR1}}, E_{\mathrm{T}}^{\mathrm{miss}})$	> 2
$R_{\ell\ell}$	> 6
$E_{\mathrm{T}}^{\mathrm{miss}}$ [GeV]	> 350
Leading ISR jet p_{T} [GeV]	> 300
m_{T2} [GeV]	> 100







Results



Conclusion

The sensitivity to heavy SUSY particles will be increased significantly with the analysis of ATLAS data collected in proton-proton collisions at the LHC design centre-of-mass-energy of $\sqrt{s}$ = 14 TeV.
A dataset of 3000 fb^{-1} extends the discovery potential for $\tilde{t}_1\,\tilde{t}_1$ production up to **480 GeV** and the exclusion sensitivity up to masses of about **700 GeV**, assuming $\tilde{t}_1 \to t + \tilde{\chi}_0^1$ and $m(\tilde{t}_1) - m(\tilde{\chi}_0^1) = 173\ GeV$ with both top quarks decaying leptonically.

ATL-PHYS-PUB-2016-022