

Search for Supersymmetry in Final States with a Single Lepton, B-jets and \cancel{E}_T at CMS.

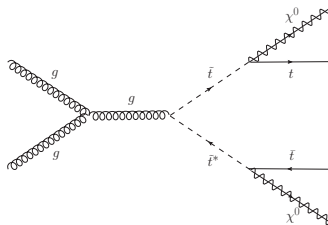
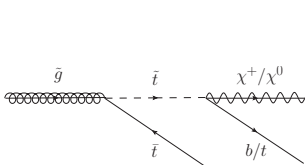
Niklas Pietsch for the CMS collaboration

Physics at the LHC, Vancouver, 10th June 2012



Motivation

- Top and bottom squark may be (significantly) lighter than 1st and 2nd generation squarks
- May result in an excess of events with large b-jet multiplicities from gluino decays and $\tilde{t}\tilde{t}^*$ or $\tilde{b}\tilde{b}^*$ pair production
- In addition: Expect significant amount of \cancel{E}_T from stable LSP and isolated lepton from top, chargino or neutralino decay



Event Selection

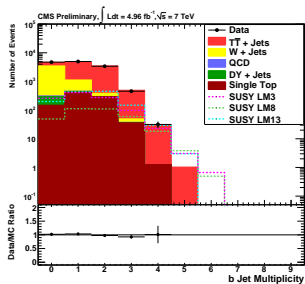
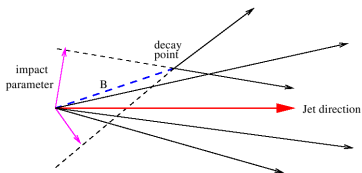
- > 1 isolated lepton
 - > Muon: $p_T > 20 \text{ GeV}$, $\eta < 2.1$
 - > Electron: $p_T > 20 \text{ GeV}$, $\eta < 2.4$
- > Veto on events with 2nd lepton fulfilling looser criteria
- > ≥ 4 selected jets*
- > $H_T > 375 \text{ GeV}$ (scalar sum of the p_T of all selected jets)
- > $\cancel{E}_T > 60 \text{ GeV}$
- > 1, 2 or ≥ 3 b-jets

Results are based on an integrated luminosity of $\mathcal{L} = 4.96 \text{ fb}^{-1}$

* Jets with $p_T > 40 \text{ GeV}$, $\eta < 2.4$ and $\Delta R(\text{jet}, \text{lepton})_{\min} > 0.3$ reconstructed with the anti- k_T algorithm (distance parameter of 0.5) from particle flow objects

Event Selection

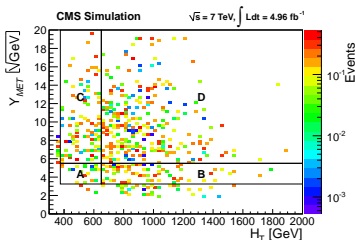
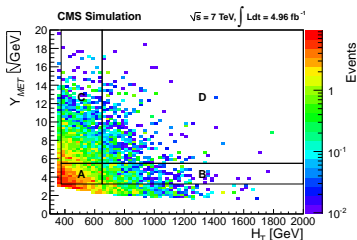
- Selected jets are tagged as b-jet if they have two tracks with an impact parameter significance ≥ 3.3 (track counting algorithm)



→ Very good agreement between data and simulated events

Background Estimation from Data

- > Main background after b-tag requirement originates from $t\bar{t}$ events (> 90%)
- > For these H_T and $Y_{\text{MET}} \equiv \cancel{E}_T / \sqrt{H_T}$ are nearly uncorrelated
- Use factorization method with H_T and Y_{MET} to estimate SM background in signal enriched region D from control regions A, B and C



- > $\frac{N_C}{N_A} = \kappa \frac{N_D}{N_B} \Rightarrow N_D = \kappa N_B \frac{N_C}{N_A}$, where the slight correlation between H_T and Y_{MET} is taken into account by factor κ

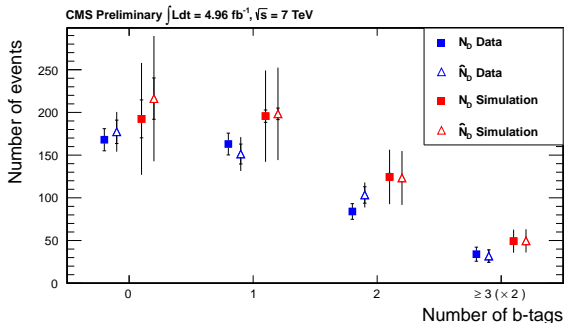
Systematic Uncertainties

Variation	$\Delta\kappa$ (1 b-tag)	$\Delta\kappa$ (2 b-tags)	$\Delta\kappa$ (≥ 3 b-tags)	$\Delta\kappa$ (≥ 1 b-tags)
Jet energy scale*	$\pm 2.2\%$	$\pm 1.4\%$	$\pm 4.0\%$	$\pm 1.5\%$
Jet energy resolution*	$\pm 1.7\%$	$\pm 1.8\%$	$\pm 5.5\%$	$\pm 1.1\%$
Lepton p_T *	$\pm 1.5\%$	$\pm 0.7\%$	$\pm 1.2\%$	$\pm 0.7\%$
Unclustered energy*	$\pm 0.3\%$	$\pm 0.7\%$	$\pm 0.8\%$	$\pm 0.4\%$
Pile-up	$\pm 0.5\%$	$\pm 1.1\%$	$\pm 0.9\%$	$\pm 0.8\%$
B-tag efficiency SF	$\pm 0.1\%$	$\pm 0.1\%$	$\pm 0.1\%$	$\pm 0.1\%$
Mis-tag rate SF	$\pm 0.1\%$	$\pm 0.0\%$	$\pm 0.1\%$	$\pm 0.1\%$
Cross-sect. var.	$\pm 1.0\%$	$\pm 2.0\%$	$\pm 1.4\%$	$\pm 0.4\%$
0 b data	10 %	10 %	10 %	10 %
Total syst. unc.	$\pm 10.6\%$	$\pm 10.5\%$	$\pm 12.3\%$	$\pm 12.4\%$
Stat. error	4.9 %	4.6 %	6.2 %	3.3 %

*Including the related change in \cancel{E}_T .

- > Systematic uncertainties on data prediction mostly cancel out
- > Correlation between H_T and Y_{MET} is cross-checked in data in exclusive 0 b-jet channel
 - Add additional uncertainty of 10 % on κ

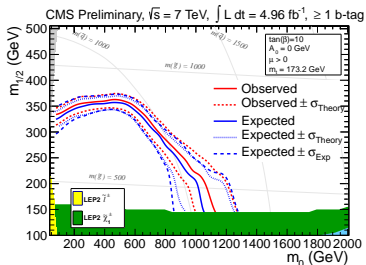
Results and Interpretation



- > Number of simulated and predicted simulated events agree well → **Test on simulated events closes**
- > Agreement between data and prediction from data within uncertainties → **No excess observed**

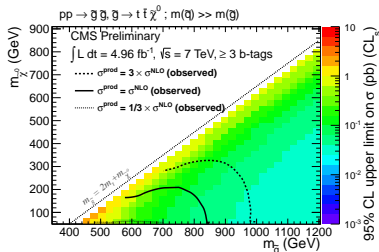
Results and Interpretation

- > Limits are set upon the parameters of the cMSSM and different heavy flavor simplified models (here 'T1tttt')



cMSSM

- > $A_0 = 0$, $\tan \beta = 10$, $\mu > 0$
- > ≥ 1 b-jet



T1tttt

- > $\tilde{g}\tilde{g} \rightarrow t\bar{t}t\bar{t}\tilde{\chi}^0\tilde{\chi}^0$
- > ≥ 3 b-jets

Summary and Outlook

- > Based on data of an integrated luminosity of $\mathcal{L} = 4.96 \text{ fb}^{-1}$ collected by the CMS during 2011 a search for SUSY with light 3rd generation squarks has been performed
- > No deviation from the SM has been found
- > Limits upon the parameters of the cMSSM and different simplified model have been set
- > Defining signal regions at larger values of H_T and Y_{MET} might increase the sensitivity of this analysis (work in progress)
- > Analysis of 2012 data is ongoing

Reference: CMS PAS SUS-11-028

