Search for Supersymmetry in Final States with a Single Lepton, B-jets and Missing Transverse Energy at the CMS Experiment

Niklas Pietsch
Department of Experimental Physics
University of Hamburg
D-22761 Hamburg, GERMANY

1 Introduction

Searches for new physics in states with third generation quarks at the Large Hadron Collider are motivated by various extensions of the Standard Model (SM). Among these, supersymmetric models are regarded as attractive as they resolve the hierarchy problem and may yield the unification of the electroweak and strong interactions. Supersymmetry (SUSY) (see e.g. [1]) predicts that for each Standard Model particle there exists a partner particle (sparticle) with identical gauge quantum numbers, but a spin differing by 1/2. Assuming R-parity conservation, sparticles are produced in pairs and their decay chains terminate with the lightest supersymmetric particle (LSP), which is stable. In proton-proton collisions predominantly colored sparticles will be produced. In scenarios with light top and bottom squarks this may result in an excess of events with a large b-jet multiplicity.
The analysis outlined in the following is based on data recorded at the CMS experiment in proton-proton collisions at a center of mass energy of of $\sqrt{s} = 7\,\text{TeV}$ during 2011, corresponding to an integrated luminosity of 4.96 fb^{-1}. The complete CMS publication and a description of the CMS detector can be found elsewhere [2, 3].

2 Event Selection and Background Estimation

Events with exactly one isolated muon or electron with a transverse momentum of $p_T > 20\,\text{GeV}$ and at least four jets with $p_T > 40\,\text{GeV}$ reconstructed with the anti-k_T algorithm with a distance parameter of 0.5 are selected. In addition the missing transverse energy (E_T^{miss}) is required to be larger than 60 GeV and H_T, which is defined as the scalar sum of the p_T of the selected jets, to be larger than 375 GeV. Jets are identified as b-jets if they have at least two tracks with an impact parameter significance greater than 3.3 [4]. The decay of colored sparticles is expected to result in a large hadronic activity (as measured by H_T) and a significant amount of E_T^{miss},

which can be quantified by $Y_{MET} \equiv E_T^{miss}/\sqrt{H_T}$. As for the main background, $t\bar{t}$ events, H_T and Y_{MET} are nearly uncorrelated, the number of background events in a signal region at large values of E_T^{miss} and Y_{MET} is estimated from data in background enriched control regions at low values of E_T^{miss} or Y_{MET} using a factorization method.

3 Results and Interpretation

No excess of events has been observed. The obtained results are used to set limits upon the parameters of different SUSY models using the CLs technique [5]. Limits for the Constrained Minimal Supersymmetric Standard Model (cMSSM) with $\tan\beta = 10$, $A_0 = 0$, and $\mu > 0$ and a heavy flavor simplified model after the additional requirement of at least one b-jet and at least three b-jets, respectively, are shown in Fig. 1. The simplified model covers the pair production of gluon partner particles that decay into a $t\bar{t}$ pair and the LSP.

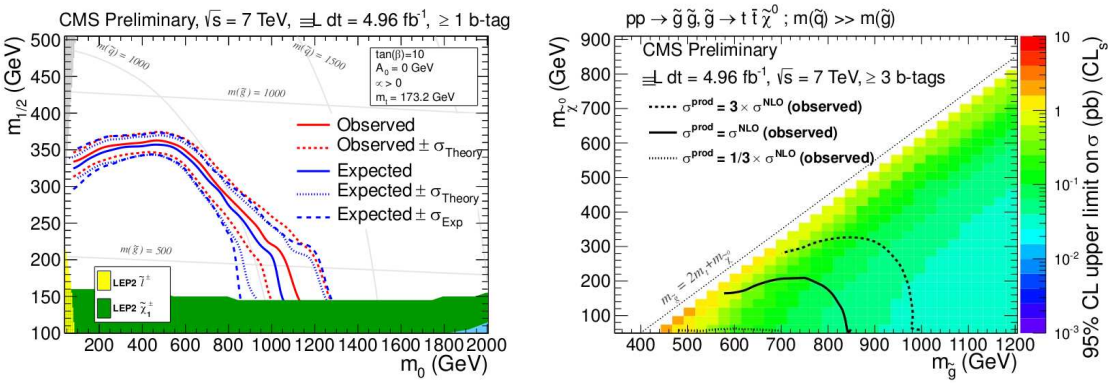

Figure 1: The 95% CL limits for the cMSSM and a heavy flavor simplified model.

References

[1] S. P. Martin, "A Supersymmetry primer," arXiv:hep-ph/9709356v6.

[2] CMS Collaboration, PAS SUS-11-028 (2012).

[3] CMS Collaboration, "The CMS experiment at the CERN LHC," JINST **3**, S08004 (2008).

[4] CMS Collaboration, PAS BTV-11-004 (2012).

[5] A. L. Read, J. Phys. G G **28**, 2693 (2002).