Available on CMS information server

CMS CR -2013/121

The Compact Muon Solenoid Experiment

Conference Report

Mailing address: CMS CERN, CH-1211 GENEVA 23, Switzerland

15 May 2013 (v2)

Search for new physics with same-sign isolated dilepton events in CMS

Aniello Spiezia for the CMS Collaboration

Abstract

An inclusive search for the presence of new physics in events with two isolated same sign leptons, using the first 4.98 fb^{-1} of certified CMS data taken in 2011 is presented. The topology is sensitive to many models beyond the standard model like supersymmetric models, extra dimensions, heavy majorana neutrinos and double charged higgs. No excess of data with respect the Standard Model predictions is seen and the results are interpreted as limits on the parameters of the CMSSM model, in the framework of the susy search.

Presented at *IFAE 2012 Incontri di Fisica delle Alte Energie*

Search for new physics with same-sign isolated dilepton events in CMS

Aniello Spiezia(1),
on behalf of the CMS Collaboration
(1) *INFN and Università degli Studi di Perugia*

Summary. — An inclusive search for the presence of new physics in events with two isolated same sign leptons, using the first 4.98 fb^{-1} of certified CMS data taken in 2011 is presented. The topology is sensitive to many models beyond the standard model like supersymmetric models, extra dimensions, heavy majorana neutrinos and double charged higgs. No excess of data with respect the Standard Model predictions is seen and the results are interpreted as limits on the parameters of the CMSSM model, in the framework of the susy search.

1. – Introduction

One of the main goal of LHC is the discovery of new physics (NP) beyond the standard model (BSM). Many strategy to get an hint of NP have been proposed and studied: one of this is to search for events in which two same-sign leptons are present ([1]). The production of two leptons with the same charge is very rare in the Standard Model, while it is present in many BSM models, as susy models, universal extra dimensions models or models with heavy Majorana neutrinos. It is presented here a search for NP in events with two same sign isolated leptons (including ee, $e\mu$, $\mu\mu$, $e\tau$, $\mu\tau$ and $\tau\tau$), missing transverse energy and hadronic activity in the final state on an integrated luminosity of 4.98 fb^{-1}, with the CMS detector ([2], [3]). To maximize the sensitivity to the presence of NP, four search regions in the (H_T, E_T^{miss}) plane have beed defined, where the presence oh high hadronic activity H_T is sensitive to the production of colored *sparticles*, while the presence of missing energy is sensitive to the presence of massive stable particles. These regions are: Reg. 1 (H_T >80 GeV, E_T^{miss} > 120 GeV), Reg. 2 (H_T >200 GeV, E_T^{miss} > 120 GeV), Reg. 3 (H_T >450 GeV, E_T^{miss} > 50 GeV), Reg. 4 (H_T >450 GeV, E_T^{miss} > 120 GeV). In each of these regions different lepton p_T threshold are chosen, *i.e.* *low* p_T ($p_T^{e,\mu} > 10,\ 5$ GeV), *high* p_T ($p_T^{l_1,l_2} > 20,\ 10$ GeV) and *tau-channels* ($p_T^{e,\mu,\tau} > 10,\ 5,\ 15$ GeV).

2. – Results

In these four search regions a comparison between observation and background prediction is performed. Leptons that pass the selection can be divided in two categories: *fake leptons* are leptons that are considered as background and can be both objects that are wrongly reconstructed as leptons or genuine leptons from heavy-flavor decay; *prompt leptons*, that is leptons from W, Z or NP particles decay, which are properly the signal we are looking for. From this definitions, we can categorize the background in three different categories and evaluate it using different techniques. Irreducible background from rare SM processes in which two prompt leptons are present are estimated using MC simulation and a 50% of systematic uncertainty is associated to it. Events with *fake leptons*, mainly originating from jets (genuine leptons originating from heavy-flavor decay or hadrons reconstructed as leptons), have been evaluated using a data-driven technique, that is the *tight-to-loose* ratio; within this method the probability that a fake lepton passes the selection is measured in a control sample loose in lepton requirements and used to estimate the fake lepton background. Finally background events with two opposite sign leptons in which one of these is reconstructed with a wrong charge have been estimated, measuring the charge mis-identification rate from same sign dielectron or ditau events in the Z mass peak. These various background estimation methods have been tested in background dominated regions, where good agreement have been found between observation and prediction. In figure 1 (left) the background predictions in the various search regions defined above are shown and compared with the observations. The observations are also shown in figure 1 (center) in the $(H_T,\ E_T^{miss})$ plane.
No excess of observed events is seen compared with the predicted background events, so that these results, together with the uncertainty on the signal acceptance have been used to exclude a region in the $(m_0, m_{1/2})$ plane in the contest of the CMSSM model (*Constrained Minimal Supersymmetric extension of the Standard Model.*) The excluded region is shown in figure 1 (right).

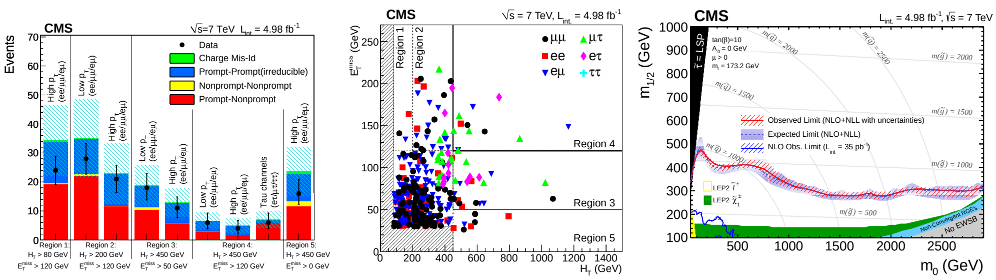

Fig. 1. – Predictions for the different sources of background events, compared with the observations in the various search regions (left) and selected same sign dilepton in the $(H_T,\ E_T^{miss})$ plane (center). On the right the exclusion region for the CMSSM model in the $(m_0, m_{1/2})$ plane is shown.

REFERENCES

[1] R. Barnett, J. Gunion, and H. Haber, *Discovering supersymmetry with like sign dileptons*, Phys. Lett. B 315 (1993) 349.

[2] The CMS Collaboration, *Search for New Physics with Same-Sign Isolated Dilepton Events with Jets and Missing Transverse Energy*, Phys. Rev. Lett. 109, 071803 (2012).

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