Search for new physics in events with opposite-sign dileptons and missing transverse energy with the CMS experiment

- CMS Collaboration -

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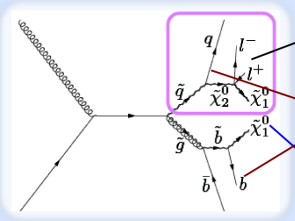
Introduction

A search for physics beyond the standard model in final states with opposite-sign isolated lepton pairs accompanied by hadronic jets and missing transverse energy is presented. The search is based on LHC data recorded with the CMS experiment corresponding to an integrated luminosity of 0.98 fb^{-1}.

Two complementary search strategies are performed. The first search probes models with heavy, colored objects which decay to final states including invisible particles, leading to very large hadronic activity and missing transverse energy. The second search probes models with a specific dilepton production mechanism, which leads to a characteristic kinematic edge in the dilepton mass distribution.

[CMS-PAS-SUS-11-011]

Signature

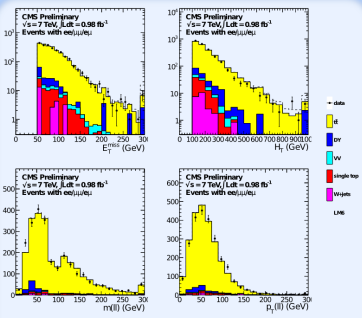


2 leptons with opposite charge
The leptons are produced from a decaying Neutralino and are flavour-correlated. Only light leptons (electrons and muons) are selected in this analysis.

High hadronic activity (HT)
SUSY particles are produced in pairs, have to be heavy, and decay via jets into leptons.

High missing transverse energy (MET)
Assuming R parity conservation, two LSPs escape undetected, resulting in a transverse-energy imbalance.

Counting Experiment



Control distributions of important quantities in pre-selection region. Data shows reasonable agreement with MC expectation.

Event selection

- dileptonic trigger
- two leptons with opposite charge
- p_T of first (second) lepton greater than 20 (10) GeV
- veto against low resonances
- veto against Z events

Signal regions

Two signal regions are defined:

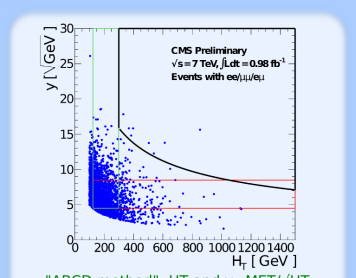
High HT region
HT > 600 GeV
MET > 200 GeV

High MET region
HT > 300 GeV
MET > 275 GeV

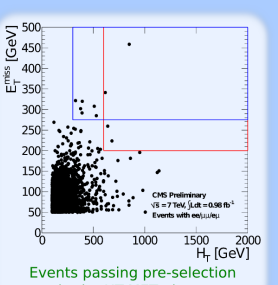
Background estimation

"ABCD method"
Background in the signal regions is predicted by measuring the HT and y=MET/√HT distribution in a control region and extrapolating it.

"p_T(ll) method"
MET in ttbar events can be modelled using the p_T distribution of charged leptons. Extrapolate ttbar background in signal region with this model.



"ABCD method": HT and y=MET/√HT dependence of the background yield is measured in the green and red region, respectively. The high-MET signal region is marked in black.



Events passing pre-selection in the HT-MET plane.

	high E_T^{miss} signal region	high H_T signal region
observed yield	8	4
MC prediction	7.3 ± 2.2	7.1 ± 2.2
ABCD' prediction	4.0 ± 1.0 (stat) ± 0.8 (syst)	4.5 ± 1.6 (stat) ± 0.9 (syst)
p_T(tt) prediction	14.3 ± 6.3 (stat) ± 5.3 (syst)	10.1 ± 4.2 (stat) ± 3.5 (syst)
N_{bkg}	4.2 ± 1.3	5.1 ± 1.7
non-SM yield UL	10	5.3
LM1	49 ± 11	38 ± 12
LM3	18 ± 5.0	19 ± 6.2
LM6	8.1 ± 1.0	7.4 ± 1.2

Search for Kinematic Edge

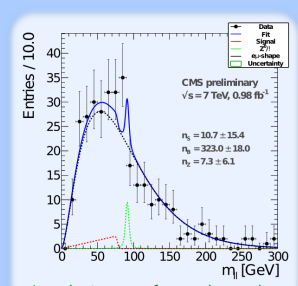
Model-specific Search

The invariant mass spectrum is searched for a characteristic edge, which is caused by the decay of a Neutralino 2 into two leptons and a Neutralino 1.

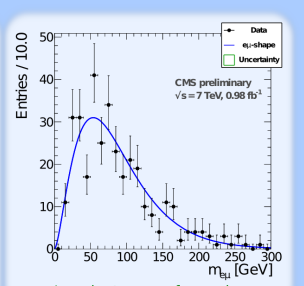
A combined fit is performed to estimate the number of signal events on top of the background by ttbar and Z events. The fit consists of

- background component estimated from eμ invariant mass distribution
- Z peak component modelled by a Bright-Wigner convolved with a Gaussian
- triangular shaped mass-edge signal component
  (an edge at an invariant mass of 78 GeV is assumed, as in benchmark point LM1)

Control region
Defined by 100 GeV < HT < 300 GeV and MET > 100 GeV.

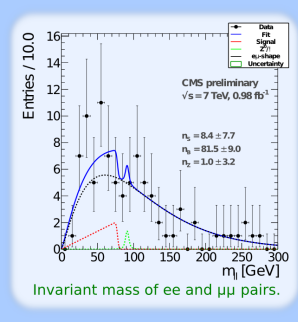


Invariant mass of ee and μμ pairs.

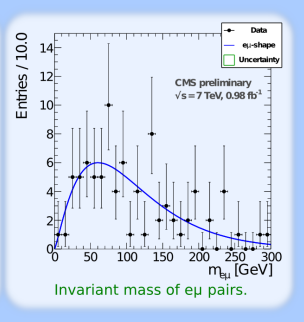


Invariant mass of eμ pairs.

Signal region
Defined by HT > 300 GeV and MET > 100 GeV.



Invariant mass of ee and μμ pairs.



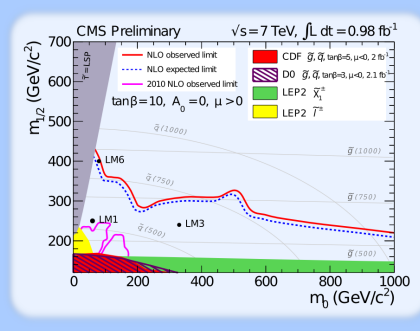
Invariant mass of eμ pairs.

Result
Fit results in the control as well as the signal region are compatible with background-only hypothesis.

Generic Limit

Since no evidence for a signal is found, limits on the cMSSM parameters are derived.

For the estimation of the limits a hybrid frequentist-bayesian CLs method is used.



Model-specific Limit

After performing the fit for a mass edge with a cut-off at 78 GeV, the range between 20 GeV and 300 GeV is scanned for other possible mass-edge cut-off points. No evidence for a kinematic edge is found in this range.

Thus, limits on the production cross section of corresponding processes are set. The limits are estimated using a hybrid frequentist-bayesian CLs method and are derived as a function of the cut-off parameter of the mass edge.