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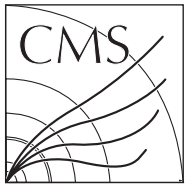

The Compact Muon Solenoid Experiment

Conference Report

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

09 October 2013 (v2, 15 October 2013)

Search for new physics in lepton + MET final states

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Abstract

A search for new physics in final states with an electron or a muon and a low mass neutrino is presented based on the full 2012 data set at sqrt(s)=8TeV. The analysis searches for an excess of events above the SM expectation in the l+MET transverse mass spectrum. The results are interpreted in several different models, such as a new, heavy SM-like boson W with and without interference with the SM W-boson, split UED and a four-fermion contact interaction as a sign of fermion compositeness. We also present a model independent cross section limit.

Presented at *HEP 2013 EPS HEP 2013 Stockholm*

PROCEEDINGS OF SCIENCE

Search for new physics in lepton + MET final states

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A search for new physics in final states with an electron or a muon and a low mass neutrino is presented based on the full 2012 data set at $\sqrt{s} = 8\,\text{TeV}$. The analysis searches for an excess of events above the SM expectation in the l+MET transverse mass spectrum. The results are interpreted in several different models, such as a new, heavy SM-like boson W' with and without interference with the SM W-boson, split UED and a four-fermion contact interaction as a sign of fermion compositeness. We also present a model independent cross section limit.

The European Physical Society Conference on High Energy Physics -EPS-HEP2013
18-24 July 2013
Stockholm, Sweden

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The presented analysis searches for new physics in events with missing transverse energy and either an electron or a muon in the final state [1].

In the sequential standard model (SSM) [2], a heavy charged boson W' is postulated. It has the same coupling as the standard model W, though interference effects between the two bosons are neglected. As the SSM is an established model, it often serves as a benchmark model, allowing the comparison of similar analyses at different experiments.

As the W and the W' boson production are indistinguishable, interference between the two processes should be considered [3]. In the same-sign model (SSMS), the couplings of the W' boson to leptons and to quarks are the same, whereas in the opposite sign (SSMO) model, the couplings are different by a factor of -1. Both consider interference effects with the SM W. They are generalized by allowing the W' coupling to be different from the SM W coupling.

The split universal extra dimension model (split-UED) introduces an additional compact space dimension [4]. For each SM particle, Kaluza-Klein partners are postulated. This analysis looks for the $W^{\mathrm{n}}_{\mathrm{KK}}$, where n enumerates the Kaluza-Klein excitation state. The lightest of these states coupling to SM fermions is the $n = 2$ mode. Like the SSM W' , this particle decays into a lepton and a neutrino.

The $qq \rightarrow \ell\nu$ process can be described by a four fermion contact interaction (CI) instead of a boson exchange [5]. In this model, the helicity is assumed to be not conserved which excludes interference effects with the SM W. A possible scenario for this would be that quark and leptons are composited objects. At energies much lower than their binding energy Λ, the decay can be desribed by a four-fermion contact interaction.

This analysis is performed using events recorded by the CMS experiment [6] at a center of mass energy of 8 TeV during the 2012/2013 proton-proton runs, corresponding to an integrated luminosity of $20\,\mathrm{fb}^{-1}$. Only those events are selected that include one electron with $E_{\mathrm{T}} > 100\,\mathrm{GeV}$ or one muon with $p_{\mathrm{T}} > 45\,\mathrm{GeV}$. Quality criteria are applied in order to ensure a reliable reconstruction of the event. All events are required to fulfill the kinematic signature of $0.4 < p_{\mathrm{T}}/E^{\mathrm{miss}}_{\mathrm{T}} < 1.5$ and $\Delta\phi(\ell, E^{\mathrm{miss}}_{\mathrm{T}}) > 0.8\pi$.

The transverse mass distributions for the electron and muon channel is shown in Fig. 1. No significant deviation between the data and Monte Carlo prediction can be observed. The derived limits on the SSM, SSMS, SSMO, and the split-UED model are depicted in Fig.2. Also shown there is the model independent single bin limit. For the CI model, $\Lambda > 11.5\,\mathrm{TeV}$ (expected 11.9 TeV) in the electron channel and $\Lambda > 11.4\,\mathrm{TeV}$ (expected 11.9 TeV) in the muon channel can be excluded.

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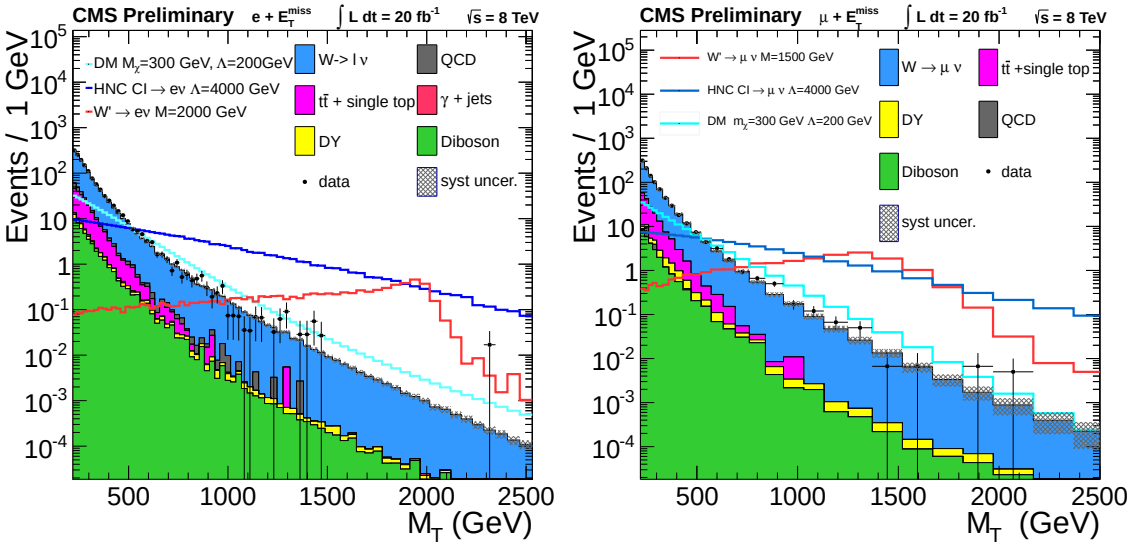

Figure 1: Transverse mass distribution of the electron (left) and muon (right) channel.

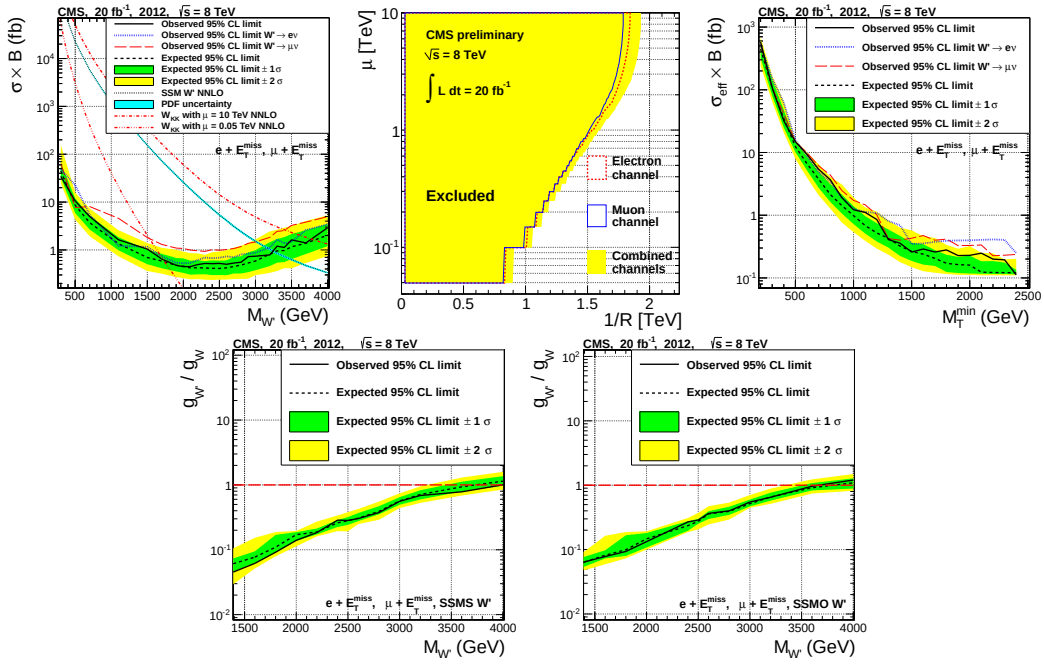

Figure 2: Limits for the combination of the $e + E_{\mathrm{T}}^{\mathrm{miss}}$ and $\mu + E_{\mathrm{T}}^{\mathrm{miss}}$ channels. In the first plot, the SSM W' mass limit is displayed. The second figure shows the excluded region in the μ-$1/R$-plane for the split-UED model. The model independent cross section limit is presented in the third plot. The last two plots show the limits for the SSMS and SSMO models.