The Compact Muon Solenoid Experiment
Conference Report

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CMS results on Exotic searches

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Abstract

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1 Introduction

The Compact Muon Solenoid (CMS) experiment [1] at the CERN Large Hadron Collider (LHC) has a wide ranging physics program covering, but not limited to, studies of the Higgs boson, measurements of the standard model (SM), flavour physics, and a large program for searching for physics beyond the standard model (BSM).

The CMS experiment continues with its physics program at the second run of the LHC (Run 2) with proton-proton collisions at center-of-mass energy of 13 TeV from 2015 through to 2018. The increase in the center-of-mass energy provides access to wider regions in the phase space for searches for new physics and search analyses also benefit from a significantly larger dataset collected at 13 TeV, corresponding to close to 150 fb^{-1} .

This document presents recent results from physics analyses searching for exotic new physics phenomena. This is only a small subset of the physics analyses at CMS, a complete list of publications of the CMS collaboration can be found in Ref. [2].

2 Recent physics results on searches for exotic new physics phenomena from CMS

2.1 High mass resonant and non-resonant phenomena

Searches for high mass resonances or non resonant phenomena are described in this section.

The search for narrow or broad resonances with a mass greater than 1.8 TeV that decay to a pair of jets has been conducted [3]. This search targets resonances that might decay to a pair of gluons or quarks, or a combination, that results in the final state of two jets. The analysis searches for resonances in the spectrum of dijet invariant mass. The observed dijet invariant mass spectrum is found to be well described by the background expectation, and no significant evidence for the production of new particles is observed. The search result is interpreted in terms of placing exclusion limits for a number

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of different BSM models such as: scalar diquarks below 7.5 TeV, axigluons and colorons below 6.6 TeV, RS Gravitons below 2.6 TeV, and dark matter mediators below 2.8 TeV.

Search for high mass resonance is also conducted for the case where the resonance decays into electron or muon pairs [4]. The analysis searches for deviations from the SM predictions in the dilepton invariant mass spectrum for both dielectron and dimuon events. No significant deviation from SM expectation is observed and limits are set in context of a sequential standard model for a heavy Z'_{SSM} boson, and also in terms of a superstring-inspired model for Z'_ψ particle, with the lower mass limits set at 5.15 TeV and 4.56 TeV for the two respectively.

2.2 Low mass resonances

Searches have also been conducted for resonances in the lower mass range for which special data taking technique, known as data scouting, is employed using special triggers and storing significantly smaller amount of event information.

A search for a low mass narrow resonance, with a mass between 350 and 700 GeV and decaying into a pair of jets, is performed using events with at least three jets in the final state [5]. The data sample corresponds to an integrated luminosity of 18.3 fb^{-1} , where the data are collected at a high rate in a compact form. The spectrum of the dijet invariant mass, from the two leading jets, is searched for a bump arising from a dijet resonance. No significant excess is found and limits are presented on the production cross section of narrow resonances with limits on coupling of a vector particle interacting only with quarks set between 0.10 and 0.15 depending on the resonance mass.

A search has been performed for a narrow resonance decaying to a pair of muons in the 11.5 - 75 and 110 - 200 GeV resonance mass ranges [6]. The search in the 45 - 75 and 110 - 200 GeV resonance mass ranges uses fully reconstructed event data, whereas the search in the 11.5 - 45.0 GeV mass range data collected using a dedicated set of high rate dimuon triggers with low thresholds that store a reduced amount of information. The dimuon invariant mass distribution is scanned and no significant resonant peaks are observed. The search sets the strongest constraints on a hypothetical dark photon heavier than 11.5 GeV.

2.3 Long-lived particles

Searches targeting long-lived particles, which are hypothetical particles with a lifetime large enough so that they can traverse through a part of the detector before decaying into final state particles, are described below.

A search has been conducted for long-lived particles decaying to displaced, non-prompt jets and missing transverse momentum [7]. The search uses the timing of energy deposits in the CMS electromagnetic calorimeter to select

delayed jets. The results of the search are consistent with the background prediction and limits are set in terms of gauge-mediated supersymmetry breaking models for gluino masses up to 2100, 2500, and 1900 GeV for proper decay lengths of 0.3, 1, and 100 m, respectively.

Long-lived particles decaying to photons have also been searched for [8]. Photons from decays of long-lived particles are expected to enter the CMS electromagnetic calorimeter at a non-normal impact angles and with delayed times, and this feature is exploited for selecting signal and suppressing backgrounds. No significant excess is found over the estimated background. Results are interpreted in the context of supersymmetry with gauge-mediated supersymmetry breaking. Previous best limits are extended significantly, with limits for neutralino proper decay lengths of 0.1, 1, 10, and 100 m, set at masses up to 320, 525, 360, and 215 GeV respectively.

3 Conclusions

Recent important results on searches for new physics beyond the standard model conducted by the CMS experiment have been presented. These searches cover a wide range of potential signal signatures, however no signs of new physics have been found yet. These results represent only a small subset of the large BSM physics search program of the CMS experiment. One can look forward to several more important searches for new physics using the large dataset collected that is yet to be analysed completely.

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