

Search for Heavy Majorana Neutrinos in Events with Same-Sign Lepton Pairs and Jets Using the CMS Detector in pp Collisions at $\sqrt{s} = 13$ TeV

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We present searches on Heavy Majorana neutrinos in events with same-sign lepton pairs and jets, using the collision data collected with the CMS detector at a centre-of-mass energy 13 TeV. The search range is extended to 20 GeV and 1500 GeV, lower and upper bound respectively, compared to the previous analysis using 8 TeV data. The vector boson fusion production channel is considered as well as the s-channel, which improves the sensitivities for mass above by several hundreds of GeV. We set upper limits on muon mixing squared, electron mixing squared, and muon-electron cross mixing.

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1. Introduction

The discovery of neutrino oscillations [1] is a clear evidence of physics beyond the standard model. The Type-I seesaw mechanism is one of the simplest models which explains both the origin and the smallness of the mass of neutrinos. We performed a new search for type-I seesaw heavy Majorana neutrinos in the ee , $\mu\mu$, and $e\mu$ channels using CMS [2] data collected in 2016 at $\sqrt{s} = 13$ TeV.

2. Event Selection

We used dilepton triggers, and collected events which contain two same-sign leptons with jets. We further defined two signal regions which are more sensitive to low- and high-mass signals. Additional optimized selections are applied for each signal mass hypothesis.

3. Backgrounds

Prompt same-sign lepton backgrounds coming from multibosons, pair-produced top quarks associated with vector bosons, and double-parton scattering are estimated from simulation. Fake leptons generated by hadron decays, photon conversions, or punch through to the muon systems are estimated with a data-driven method. Finally, the mismeasured-sign background is also measured with a data-driven method, and is found to be negligible except for the ee channel.

4. Result and Interpretations

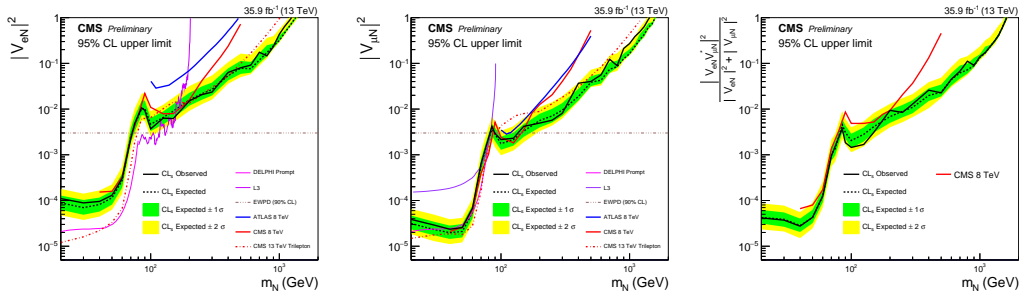


Figure 1: Exclusion limits at 95% confidence level for dielectron, dimuon and electron-muon channels [3].

Exclusion limits at 95% confidence level are set on the heavy Majorana neutrino mixing matrix elements as a function of the mass of the neutrino. Results for each channel are shown in Fig. 1.

References

- [1] Super-Kamiokande Collaboration, *Evidence for Oscillation of Atmospheric Neutrinos*, Phys. Rev. Lett., 81 (1998) 1562.
- [2] CMS Collaboration, *The CMS experiment at the CERN LHC*, JINST 3:S08004, 2008.
- [3] CMS Collaboration, *Search for heavy Majorana neutrinos in the same-sign dilepton channel in proton-proton collisions at $\sqrt{s} = 13$ TeV*, CMS-EXO-17-028, [hep-ex/1806.10905].