

Design and commissioning with first Run 3 data of new triggers to search for the CLFV $\tau \rightarrow 3\mu$ decay at the CMS experiment

In the Standard Model (SM) there are no symmetries that would forbid lepton flavor violating (LFV) processes, which have been observed for the first time in the form of neutrino oscillations. However, to date no evidence for this kind of decays was found in the charged lepton sector. Although in principle possible, charged LFV (CLFV) decays, such as the $\tau \rightarrow 3\mu$ decay, are expected to have, in the SM with neutrino oscillations, a vanishingly small branching ratio (BR) ($O(10^{-54})$). Therefore, any observation of these kind of decays would be an unambiguous sign of new physics, since many BSM theories predict an enhancement of several orders of magnitude for their BR.

The CMS experiment has published a promising result for the search for the $\tau \rightarrow 3\mu$ decay, using the 2016 data, putting an upper limit on its BR equal to 8.0×10^{-8} at 90% C.L. . For the Run 3 data taking, started in summer 2022, new triggers have been developed to increase the acceptance of the experiment for this process and further exploiting the expected increased statistics. Indeed, the CMS experiment is equipped with a highly performant tracker and a muon spectrometer that allow to reconstruct the three final state muons and their vertex with high precision. However, since CMS has been designed to efficiently identify muons coming from electroweak boson decays, the search for $\tau \rightarrow 3\mu$ decays represents a challenge for the experiment, since the muons resulting from the decay of tau leptons coming from D and B mesons, which are the main source of tau lepton production at LHC, have very low momenta and are significantly boosted in the forward direction.

In this contribution, the status of the $\tau \rightarrow 3\mu$ search at CMS, with a particular emphasis on the newly developed triggers for the Run 3 data-taking, will be presented. In addition, the trigger performance with first 2022 data and the latest development for the 2023 data taking, will also be shown.

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