Motivation

Lepton Flavour Violation (LFV) is allowed in the standard model extended to include neutrino mass. LFV has never been observed as of yet.

Suppressed n the Standard Model:

\[ \tau \rightarrow 3\mu (SM) \sim 0(10^{-5}) \]  [1]

Enhanced BR in SUSY, 2HDM:

\[ \tau \rightarrow 3\mu (BSM) \sim 0(10^{-7} \div 10^{-9}) \]  [2][3]

Analysis Strategy

Search for a bump at nominal \( \tau \) mass peak in the invariant mass of the 3\( \mu \) system.

Heavy Flavour (HF)

Signal MC: Online : Dedicated Trigger

Low \( p_T \) pairs + 1 track forming displaced common vertex

Offline Selections: Reproduce HLT, Reconstruction of final-state muons

Event categories based on mass resolution \( m(3\mu) \)

Train Boosted Decision Tree for signal-background seperation. Signal: MC Bkg.: Data in mass sidebands

Limit on \( \mathcal{B}(\tau \rightarrow 3\mu) \) from maximum likelihood fit on invariant mass shape.

W Channel

Signal MC: Online : Dedicated Trigger

\( \mu \) pairs + 1 track forming isolated \( \tau \) candidate

Efficiency corrections (trigger, \( \mu ID \)) applied to MC

Event categorization:Barrel and endcap

Train Boosted Decision Tree for signal-background separation. Signal: MC Bkg.: Data in mass sidebands

Limit on \( \mathcal{B}(\tau \rightarrow 3\mu) \) from maximum likelihood fit on invariant mass shape.

Perspectives

Run II, pp @ 13 TeV: Analysis at final stages

2017: 38 fb-1 2018: 59.7 fb-1

• Higher statistics \( \rightarrow \) Higher sensitivity and larger statistics to train Multi-Variate discriminators

• CMS detector in 2017 and 2018: improved pixel detector \( \rightarrow \) improved vertex reconstruction and track momentum resolution

Results – 2016 Data

Heavy Flavour (HF)

Signal extracted from a maximum likelihood fit in each category.

MC \( \rightarrow \) Crystal Ball

Background \( \rightarrow \) Exponential + Polynomial

Systematics \( \rightarrow \) Nuisance Parameters

Dedicated trigger path in place:

• Goal: lowering the \( p_T \) threshold to enhance the signal acceptance while keeping similar rates as 2018.

New tools in Run 3:

• Level-1 trigger: implementation of a 3-\( \mu \) invariant mass object

• CSC-GEM segment (1.6 < |\( \eta \)|< 2.1) (Not yet completed)

Bibliography:


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