ICHEP 2020 | PRAGUE

Posters session

Search for lepton flavour violating decays of the Higgs boson with Run II data

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Analysis overview

Motivation

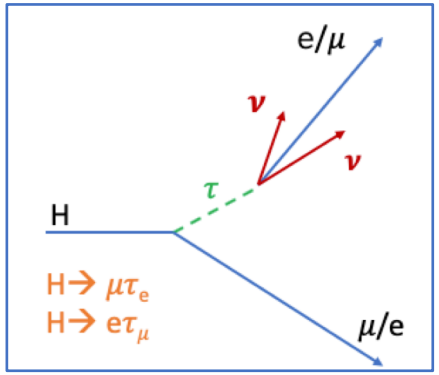
Search for off-diagonal Yukawa couplings that allow Lepton Flavour Violating Higgs Boson decays

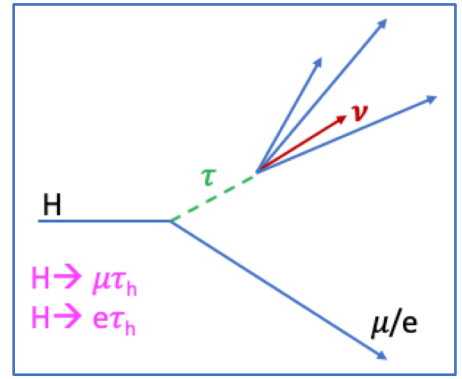
LFV decays of the Higgs boson have been searched for in two channels forbidden in the SM: **H → μτ and H → eτ** [1]

Analysis strategy

Data set: pp-collisions ($\sqrt{s} = 13\ TeV$) collected in 2016 by CMS detector.

- Topologies of the studied LFV decay signal →
- The events are divided into categories : 0 jets, 1 jet, 2 jets, and VBF enhanced.



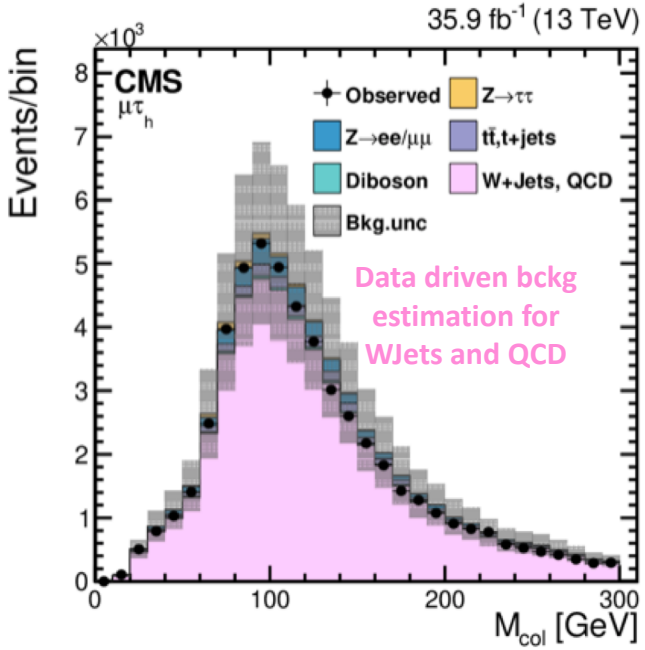


Higgs production and main backgrounds

Each MC sample is **weighted** in order to match the **pileup** distribution observed in data.

Higgs production mechanisms → ggH and VBF

1. Z+Jets ($Z \rightarrow \tau\tau$).
2. Misidentified leptons (W+Jets, QCD) .
3. ttbar and single-top quark.
4. Dibosons.
5. SM Higgs.



Signal extraction

Input: Kinematic variables as leptons p_t, MET p_t, angle between leptons, etc.

BDT fit analysis

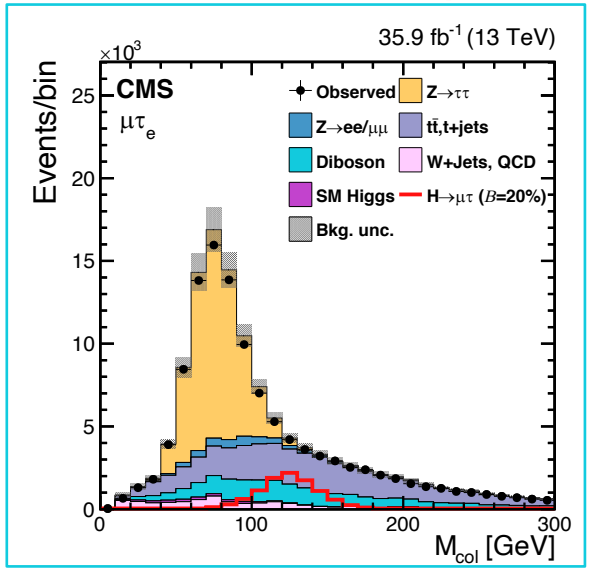
Fit the distribution of a BDT discriminator for the signal and the background contributions.

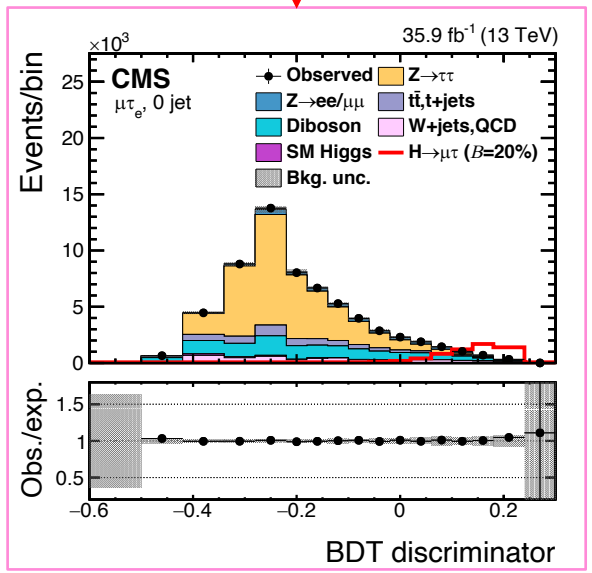
M_{col} fit analysis

Selection requirements on kinematic variables + fit to the M_{col} distribution.

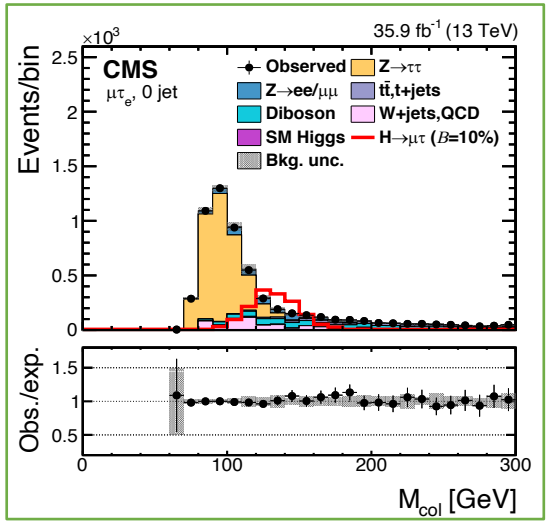
The collinear mass provides an estimate of m_H using the visible decay products of the Higgs boson candidate.

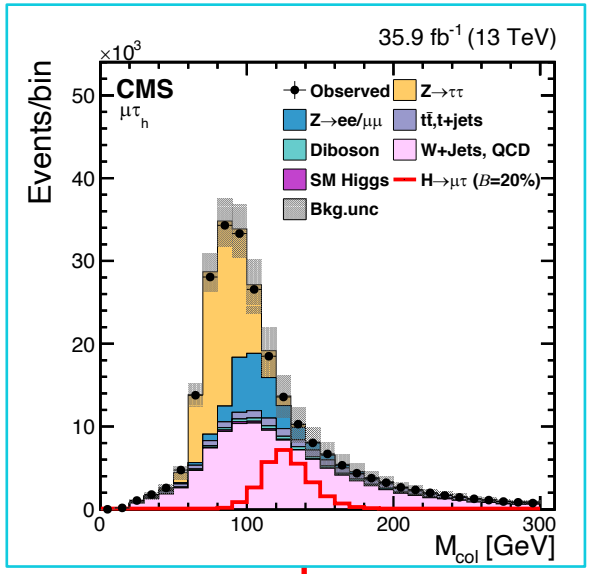
A maximum likelihood fit is performed to derive the expected and observed limits on the Branching Ratios.

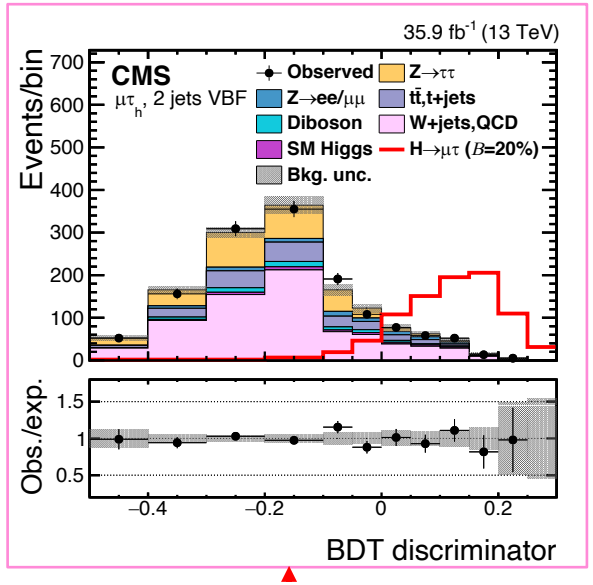


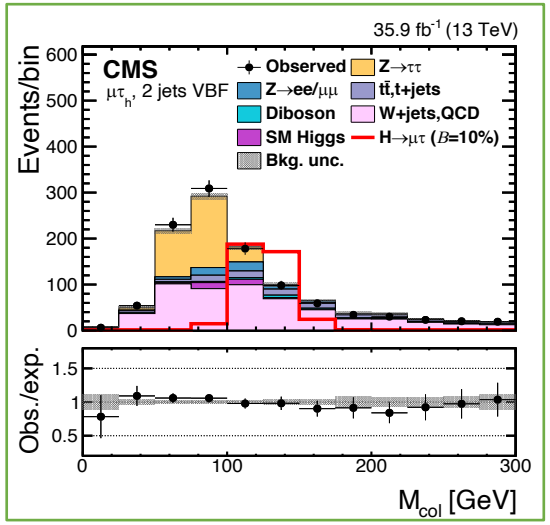


(cross-check)



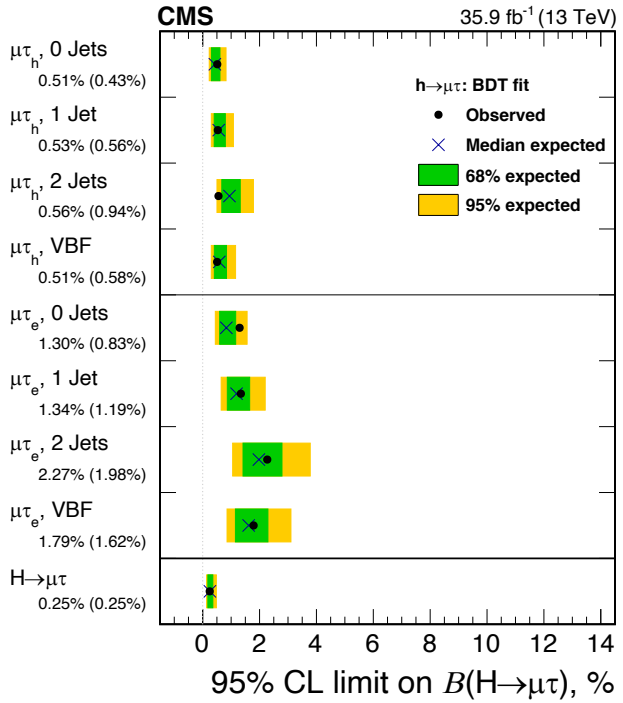


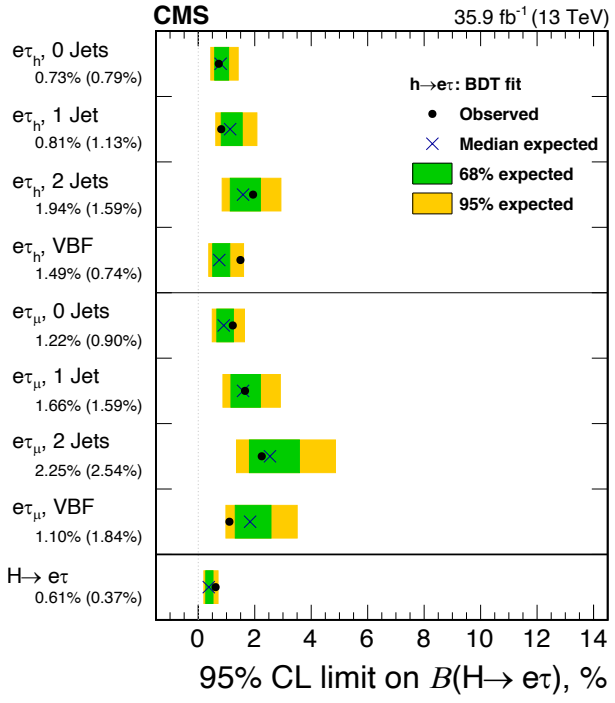




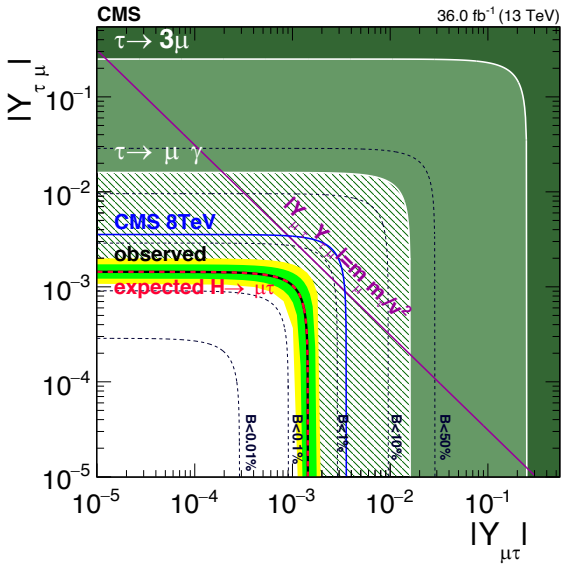
Results

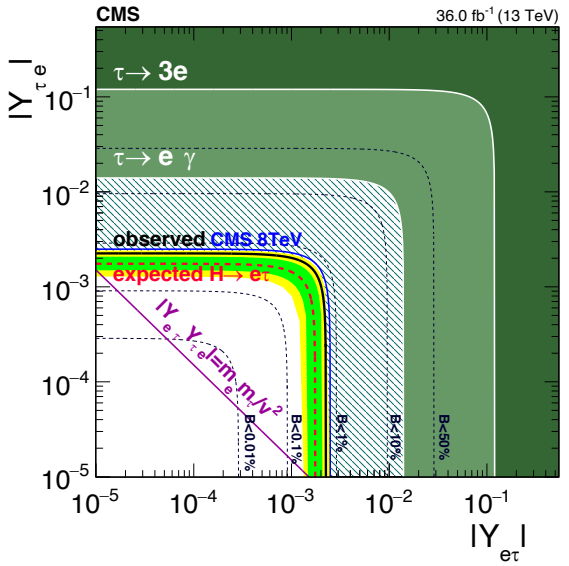
Graphical view of the observed and expected BDT results:





Results in terms of Yukawa couplings:





	BDT fit	M_{col} fit
$\sqrt{\lvert Y_{\mu\tau}\rvert^2 + \lvert Y_{\tau\mu}\rvert^2}$	$< 1.43 \times 10^{-3}$	$< 2.05 \times 10^{-3}$
$\sqrt{\lvert Y_{e\tau}\rvert^2 + \lvert Y_{\tau e}\rvert^2}$	$< 2.26 \times 10^{-3}$	$< 2.45 \times 10^{-3}$

Conclusions

1. **No evidence is found** for Lepton Flavour Violating Higgs Boson decays: *BR(H-> τμ) < 0.25 (0.25) and BR(H-> τe) < 0.61 (0.37) at 95 % CL*
2. The new limits constitute a **significant improvement** over the previously obtained constraints by CMS.
3. Analysis of the full Run2 data set **ongoing**.

References:

[1] CMS Collaboration, "Search for lepton flavour violating decays of the Higgs Boson" CMS-HIG-17-001 ; CERN-EP-2017-292; arXiv:1712.07173v3