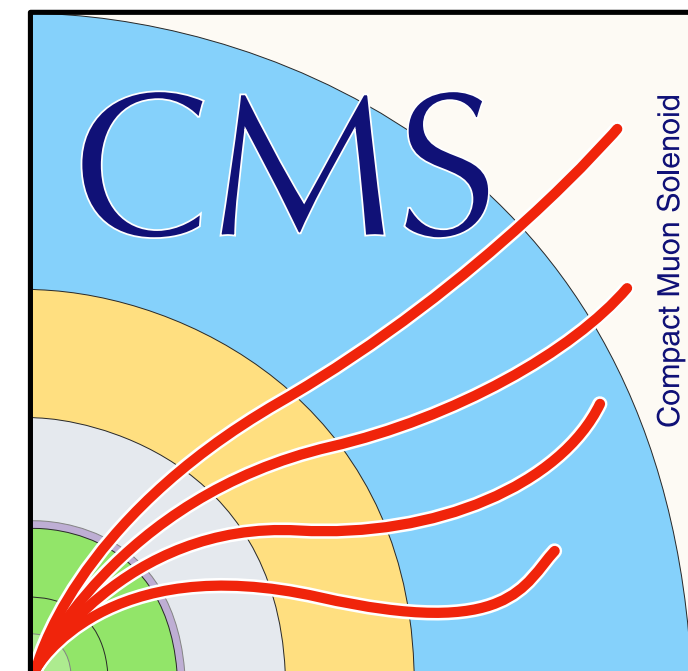


Exotic Higgs decays at CMS

Summary

Higgs 2021

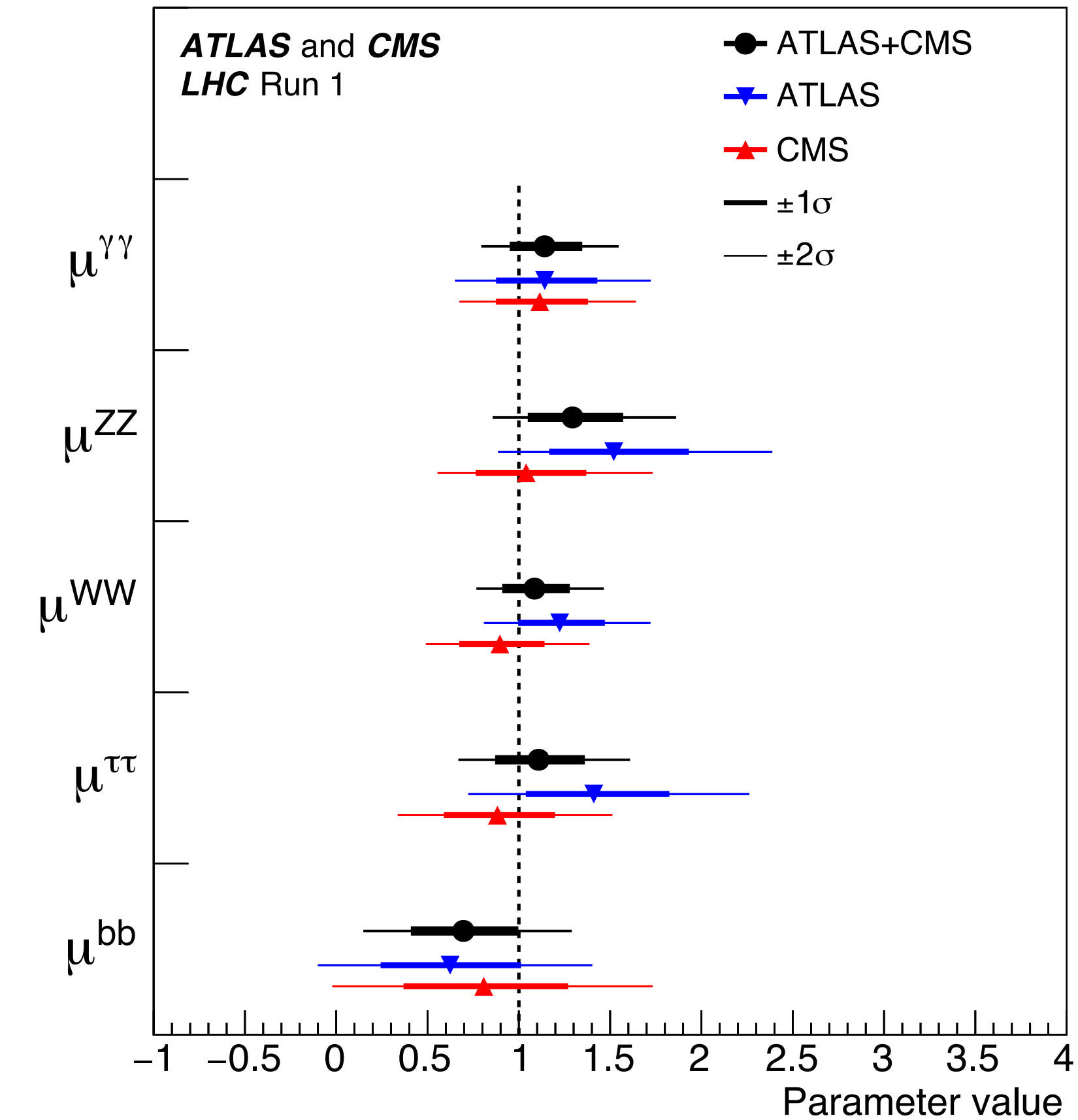
Tanvi Wamorkar
on behalf of the CMS collaboration



Northeastern University

Introduction and motivation

- 125 GeV Higgs boson discovered by CMS and ATLAS collaborations in 2012
- We know that SM, although highly successful, has several shortcomings
- Higgs Boson can help us probe deviations from the SM by searching for
 - exotic particles such as neutral, charged Higgses [1]
 - rare decays of the Higgs predicted by the SM [2]
 - invisible decays of the Higgs [3]
 - forbidden decays of the Higgs (LFV decays of the Higgs)
 - decays of the Higgs to non-SM particles ($H \rightarrow aa \rightarrow \gamma\gamma\gamma\gamma$)



Higgs appears to be the SM Higgs

[1] See Fabio's talk: Searches for additional scalar or Higgs-like particles

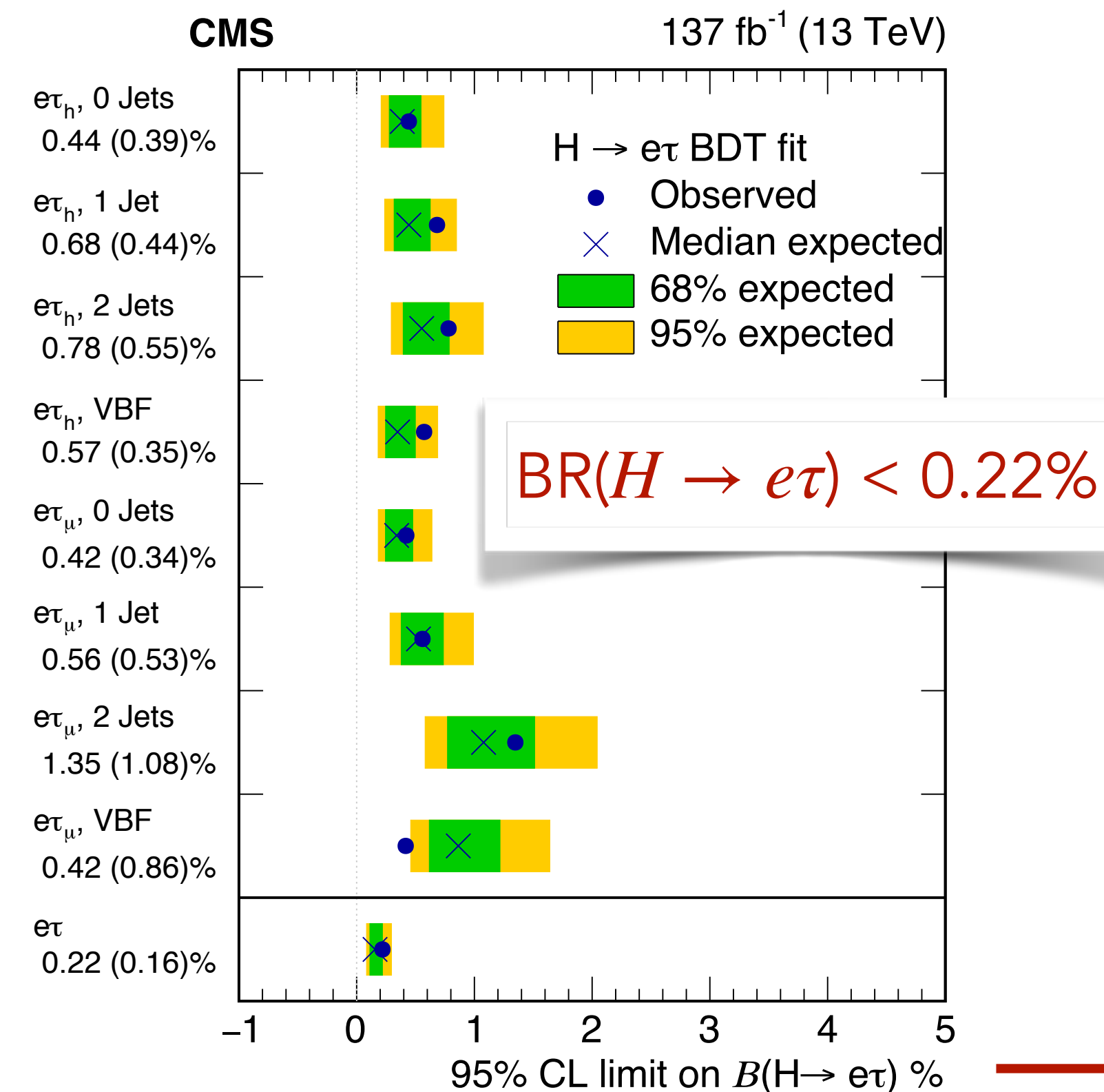
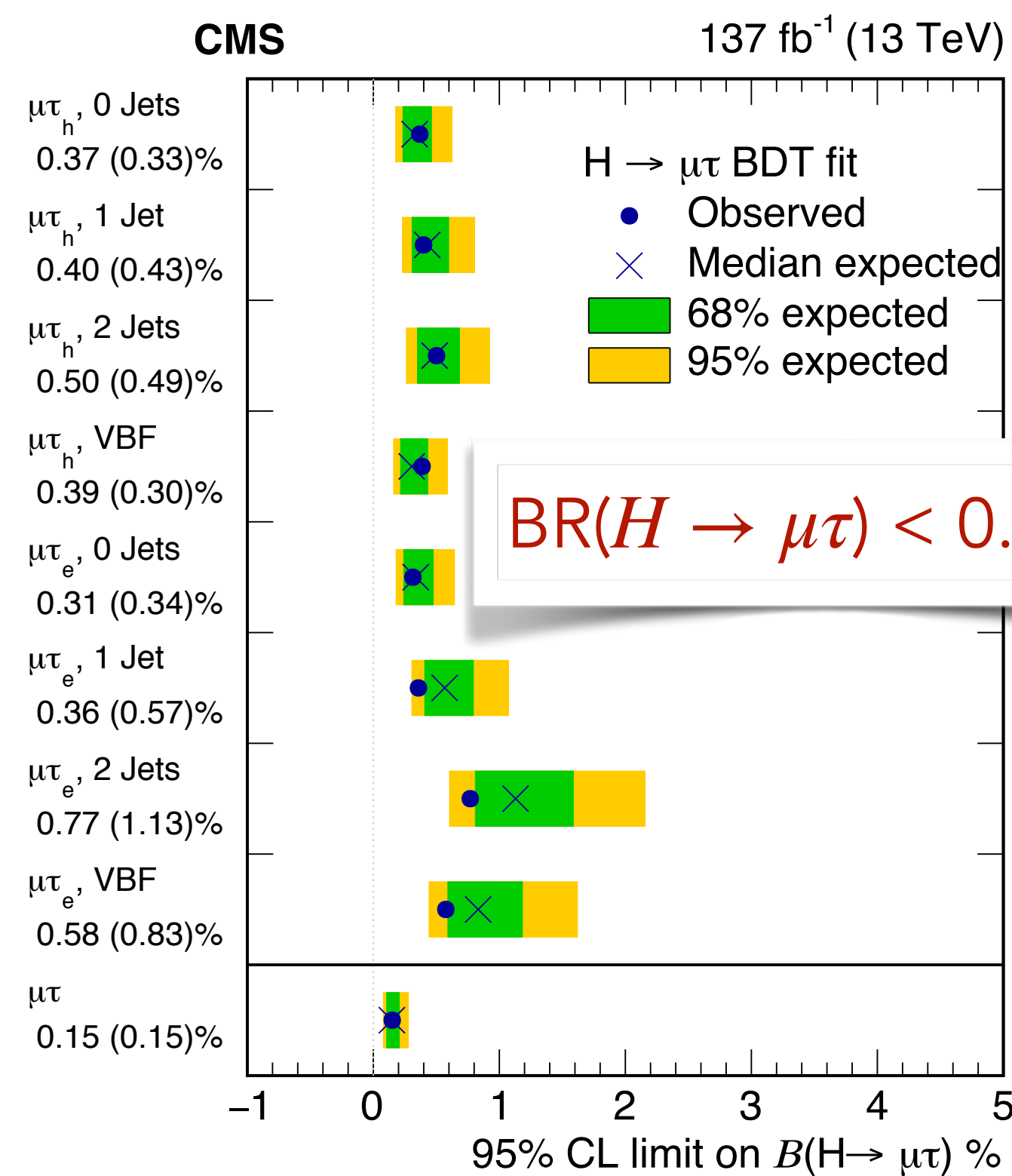
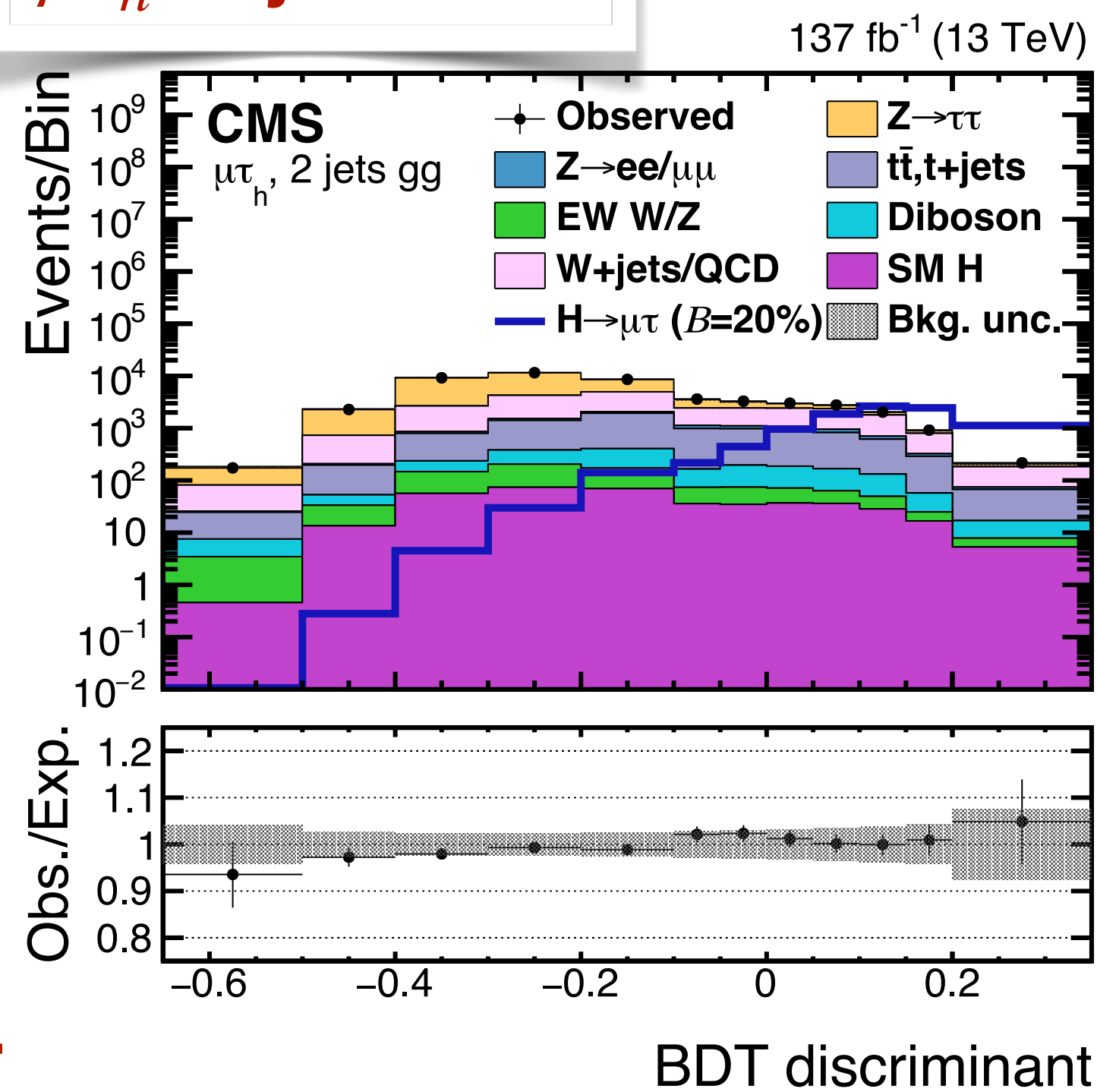
[2] See James's talk: Rare Higgs decays at CMS

[3] See Nicholas's talk: Search for invisible Higgs boson decays in VBF production at CMS

Results: LFV decays: $H \rightarrow e\tau/\mu\tau$

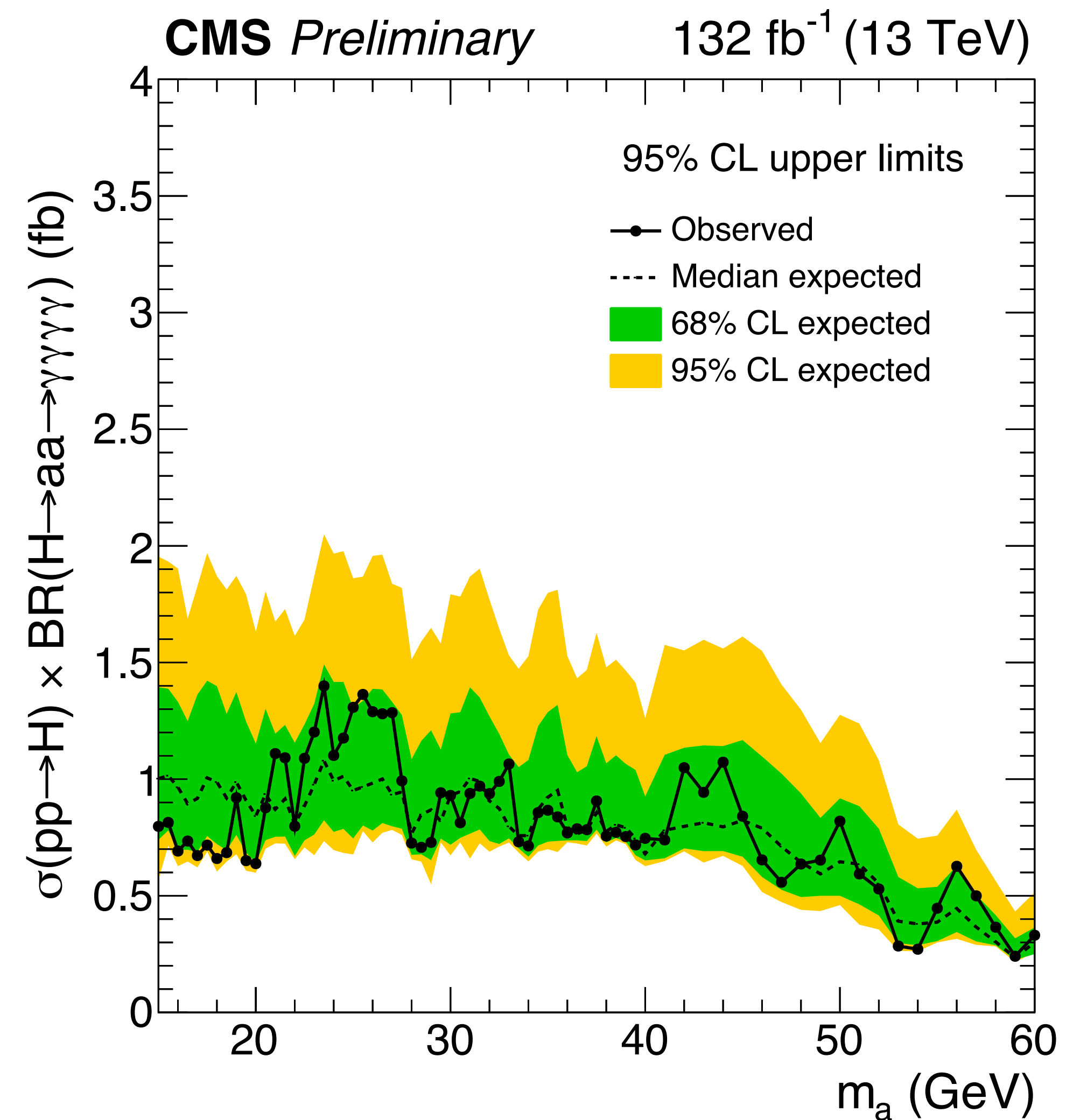
- SUSY and some composite Higgs model allow LFV Yukawa couplings $Y_{e\mu}, Y_{e\tau}, Y_{\mu\tau}$
- Previously known from electron and muon magnetic moments: $BR(H \rightarrow \mu\tau) \sim 10\%$ and $BR(H \rightarrow e\tau) \sim 10\%$
- Train BDT in different channels: $\mu\tau_h, \mu\tau_e, e\tau_h, e\tau_\mu$ and consider ggH and VBF production modes
- Fit to BDT to obtain final results

$\mu\tau_h, 2 \text{ jets VBF}$



Results: $H \rightarrow aa \rightarrow \gamma\gamma\gamma\gamma$

- In many models $\text{BR}(a \rightarrow \gamma\gamma)$ is low
 - But, 4γ final state has a clean signature (low background)
- Search for pseudoscalars (m_a : 15-60 GeV) with 4 fully resolved photons in final state
- Data-driven background estimation
- Use of BDT to separate signal from background
- Fit to $m_{\gamma\gamma\gamma\gamma}$ for obtaining results
- No significant deviation from expected limits
- First result from CMS in the 4γ final state



Summary

- Higgs is a very powerful tool to look for deviations from SM
- Presented latest full run 2 results by the CMS collaboration
 - LFV decays of the Higgs Boson [[arxiv:2105.03007](https://arxiv.org/abs/2105.03007)]
 - Decay of Higgs to pseudoscalars with photons in the final state [[CMS-HIG-21-003](https://arxiv.org/abs/2105.03007)]
- No significant excess or deviation from the SM found so far
- Plenty of room still exists for BSM physics!