Search for charged Higgs bosons in the CMS experiment

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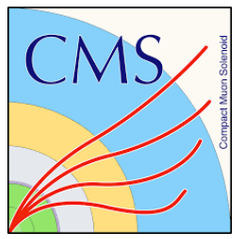
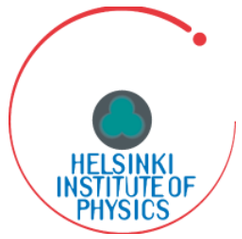
Particle Physics Days 20.10.2017

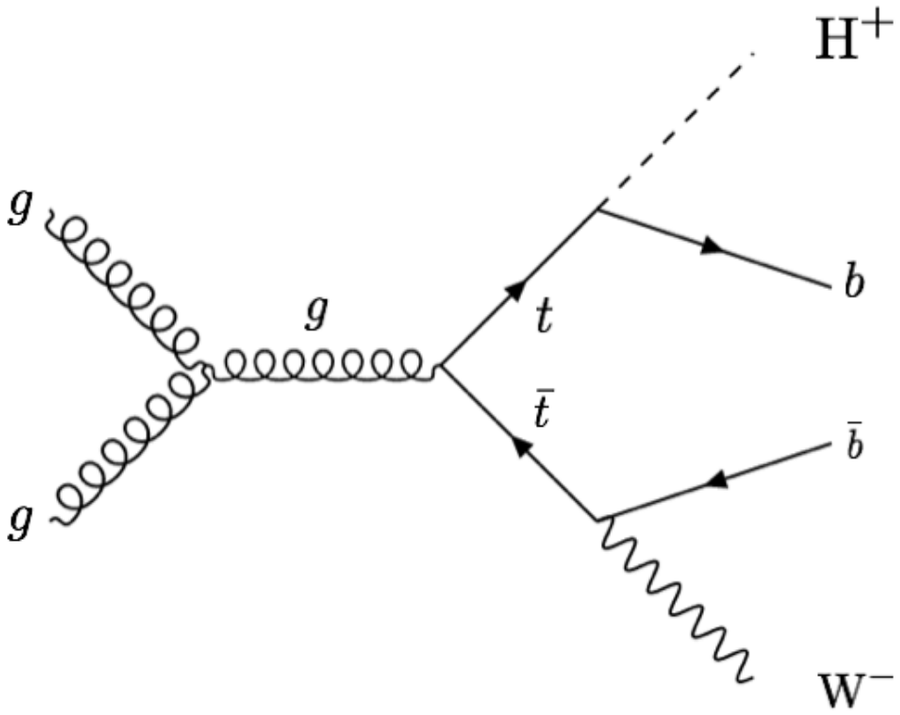




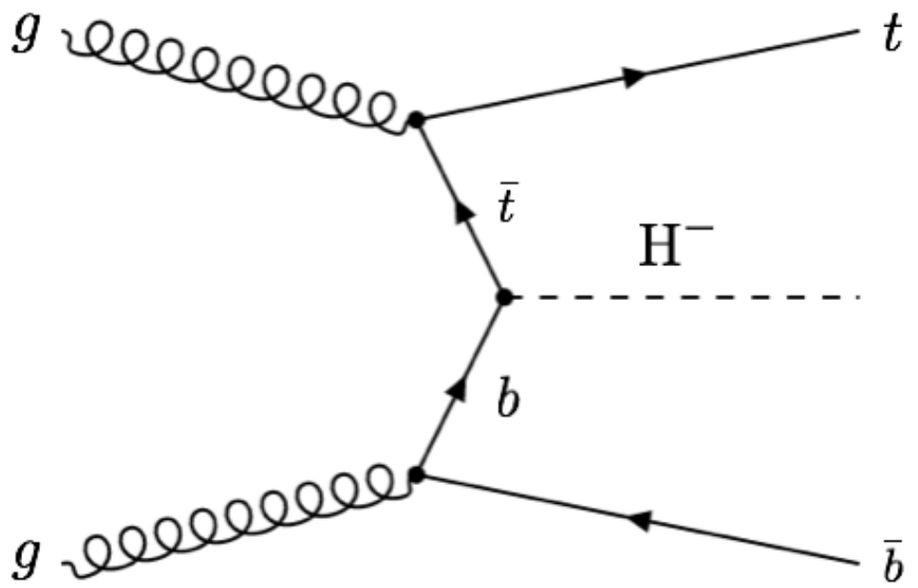
Two-Higgs-doublet models

- 2HDM predicts five physical scalar Higgs bosons:
  - Neutral, CP-even H and h
  - Neutral, CP-odd A
  - Two charged Higgs bosons $H^{\pm}$
- Two VEVs: $\tan\beta = v_2 / v_1$

Production depends on the mass

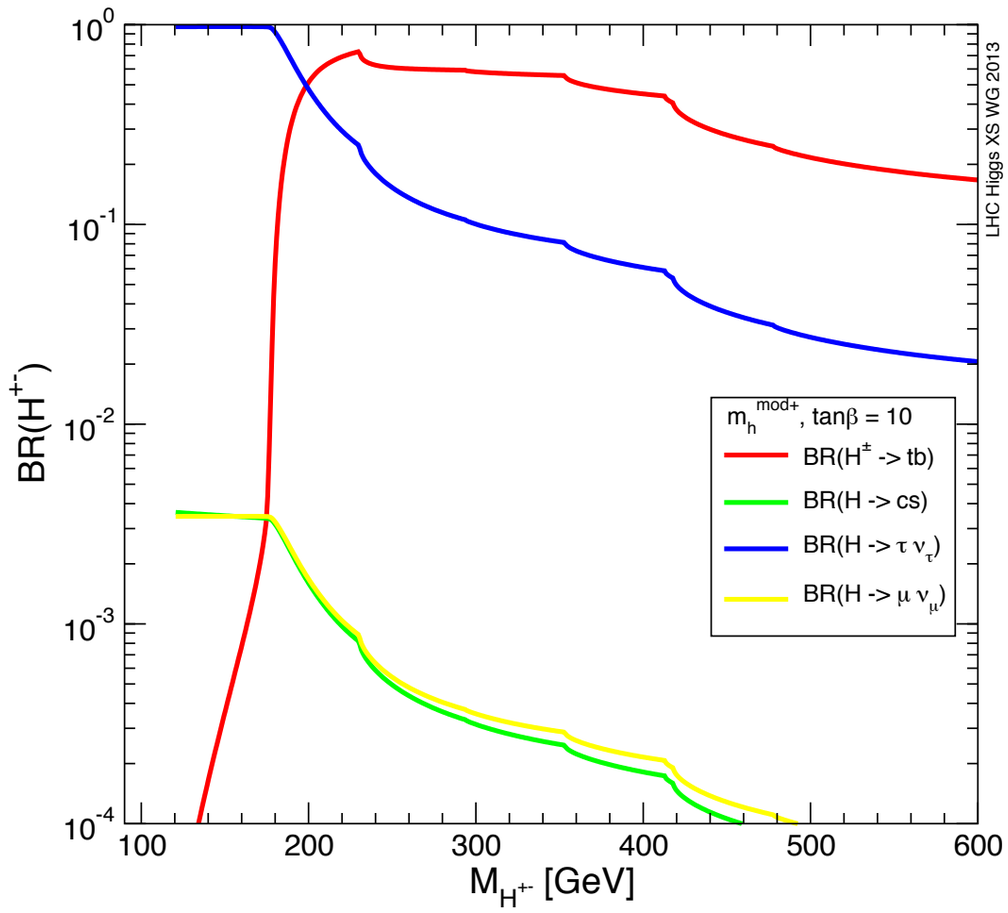


Light: $\mathbf{m_{H^\pm} < m_t - m_b}$

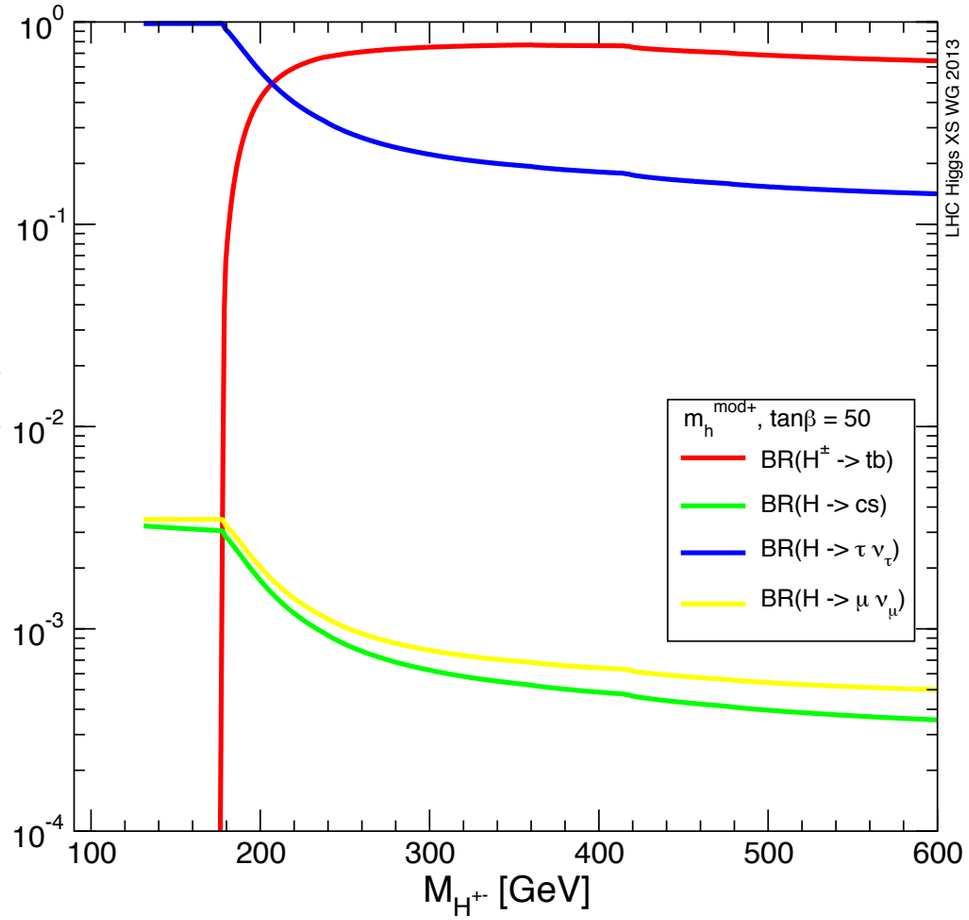


Heavy: $\mathbf{m_{H^\pm} > m_t - m_b}$

Decay mechanism

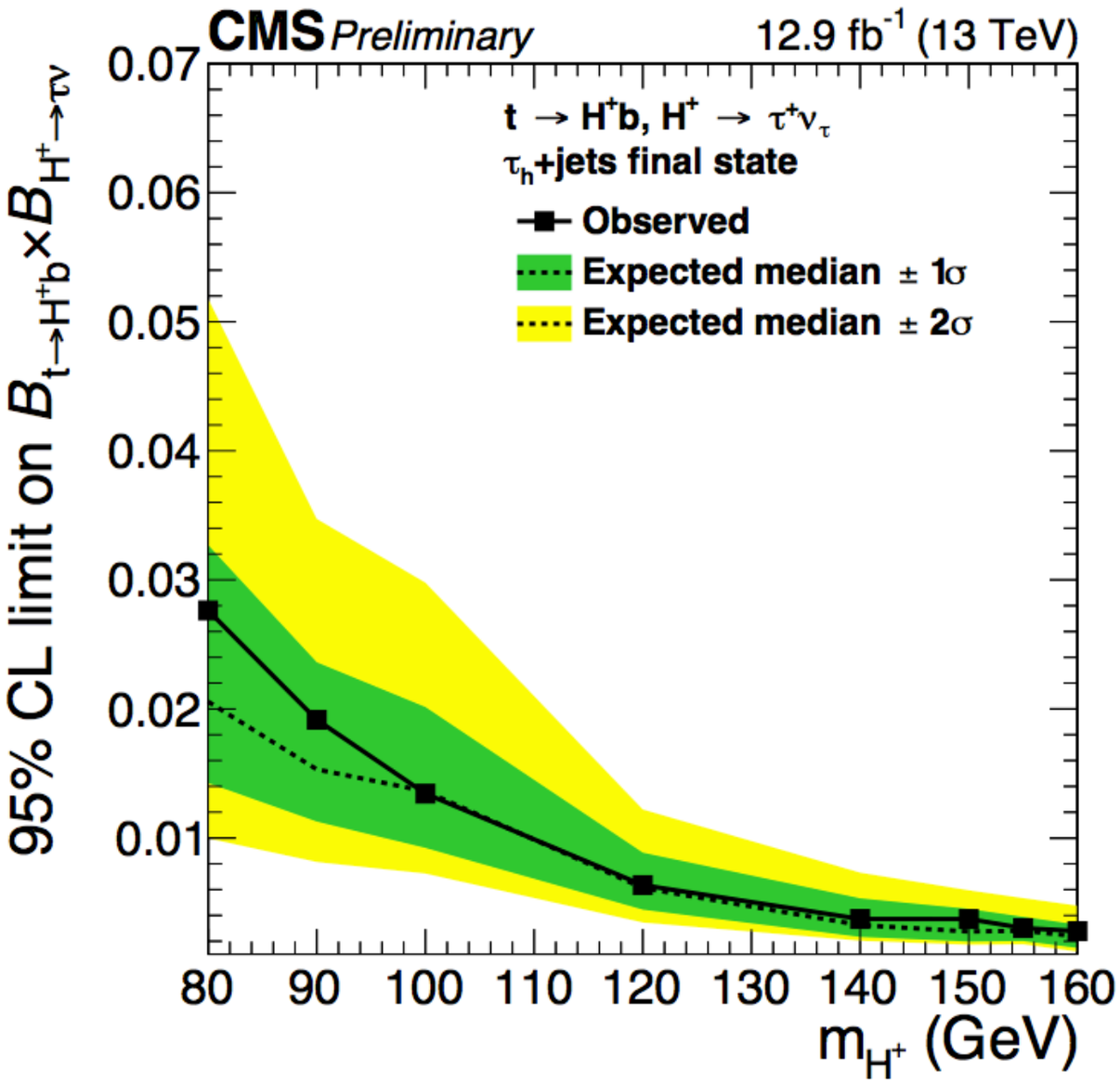


tan β = 10

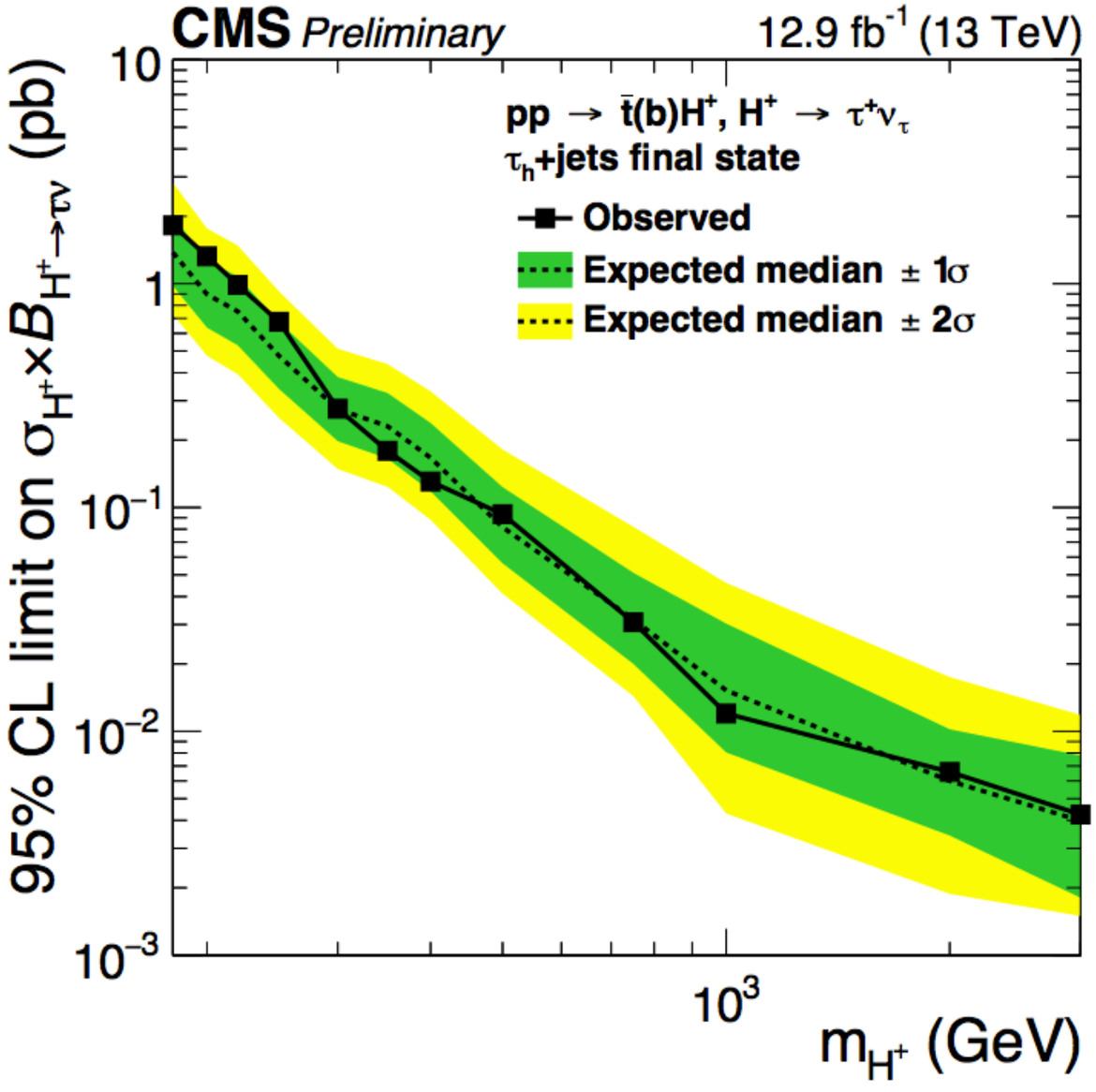


tan β = 50

Run 2

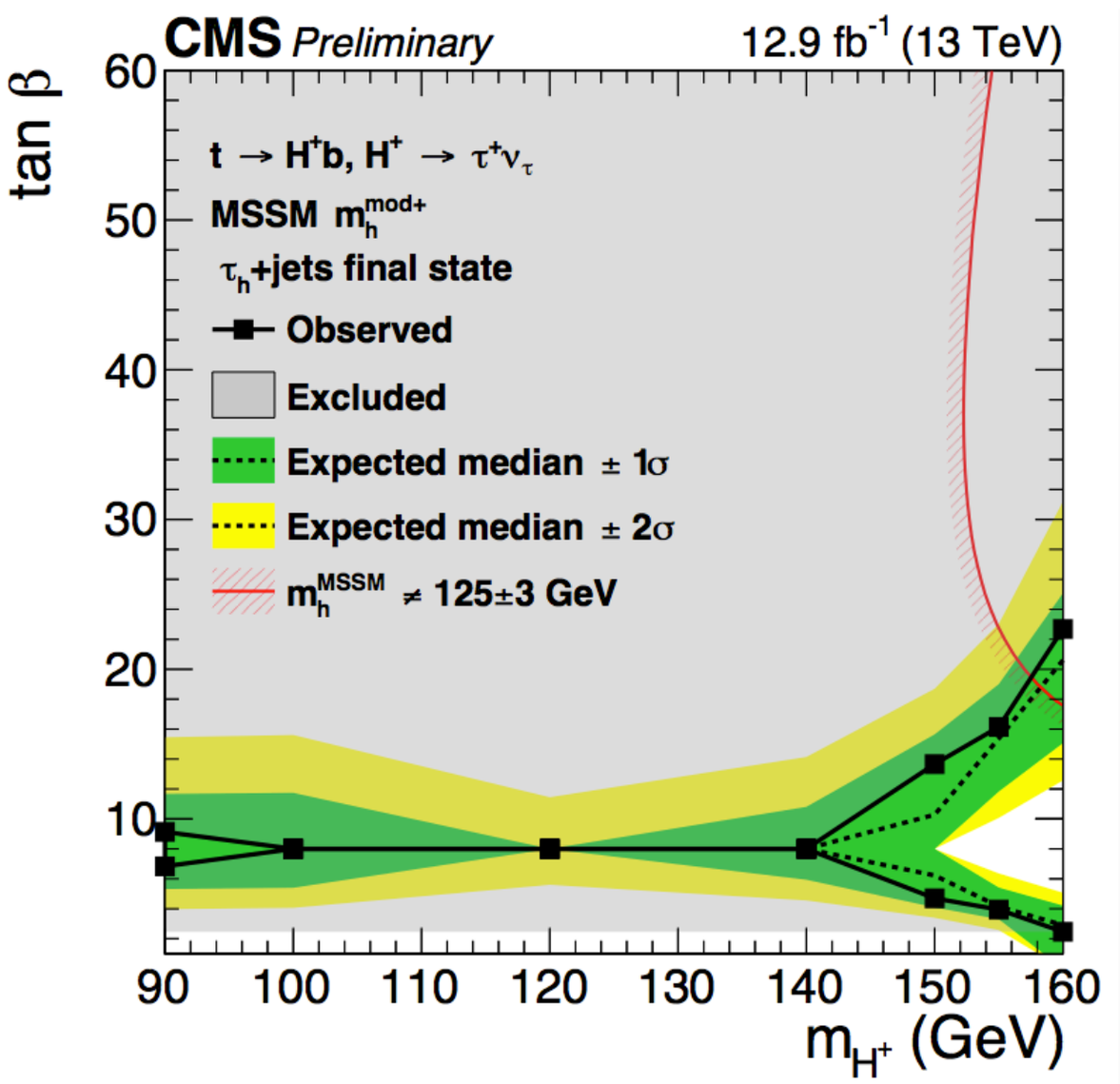


Light

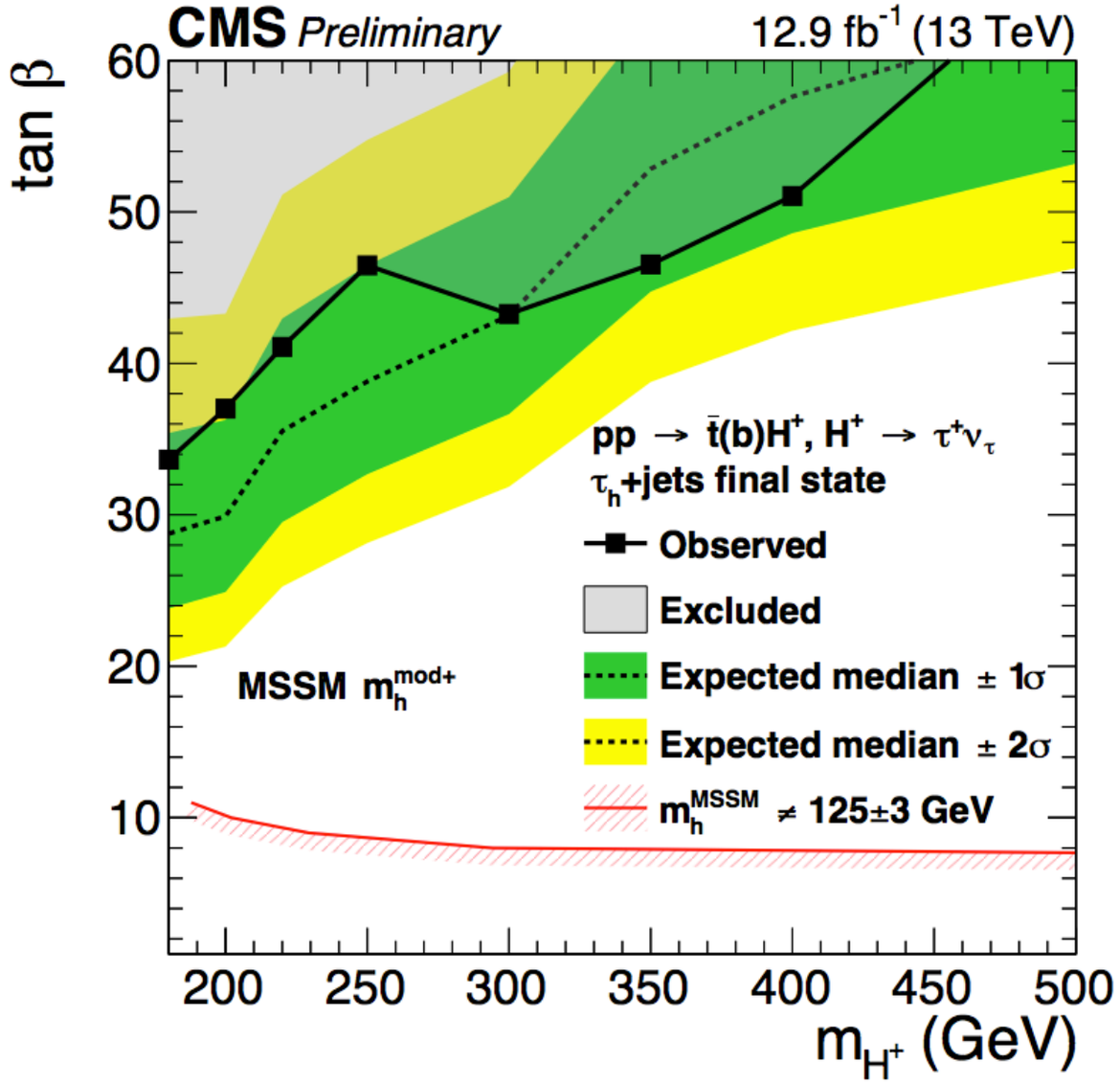


Heavy

Run 2



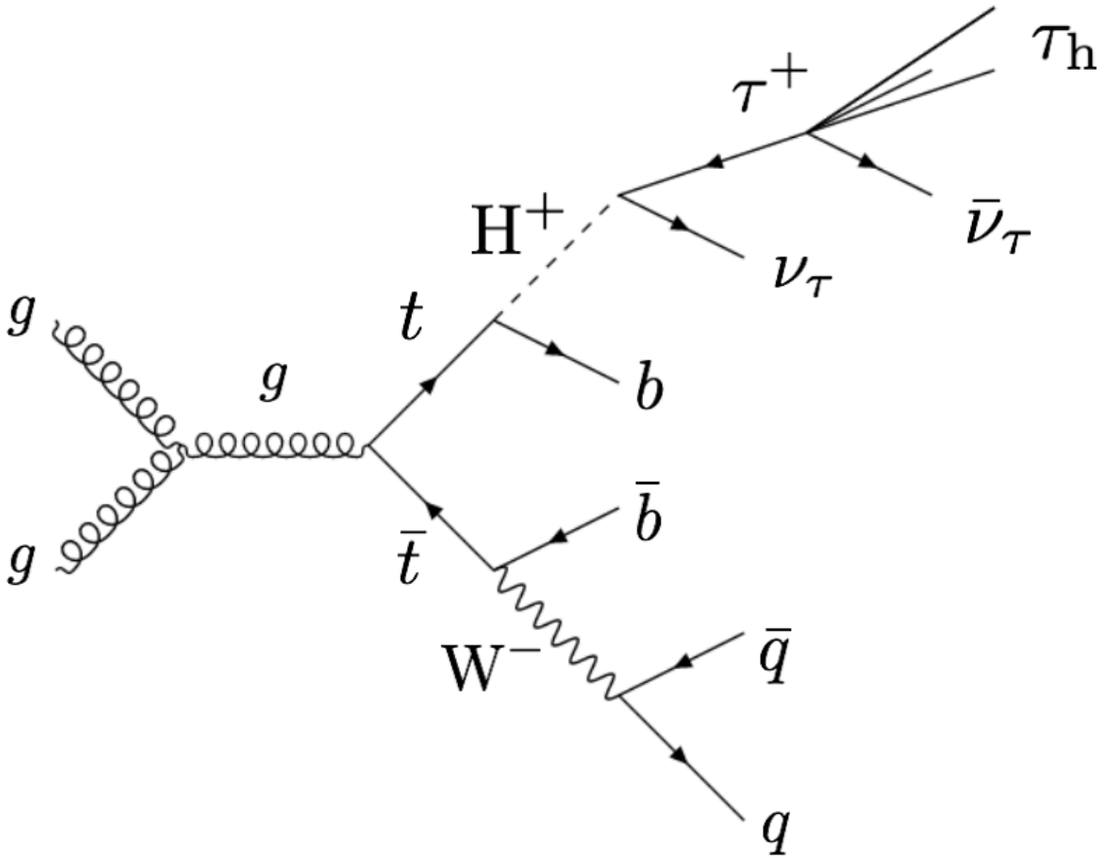
Light



Heavy

Signal

- We'll focus on charged Higgs boson decaying to a fully hadronic tau and a tau neutrino



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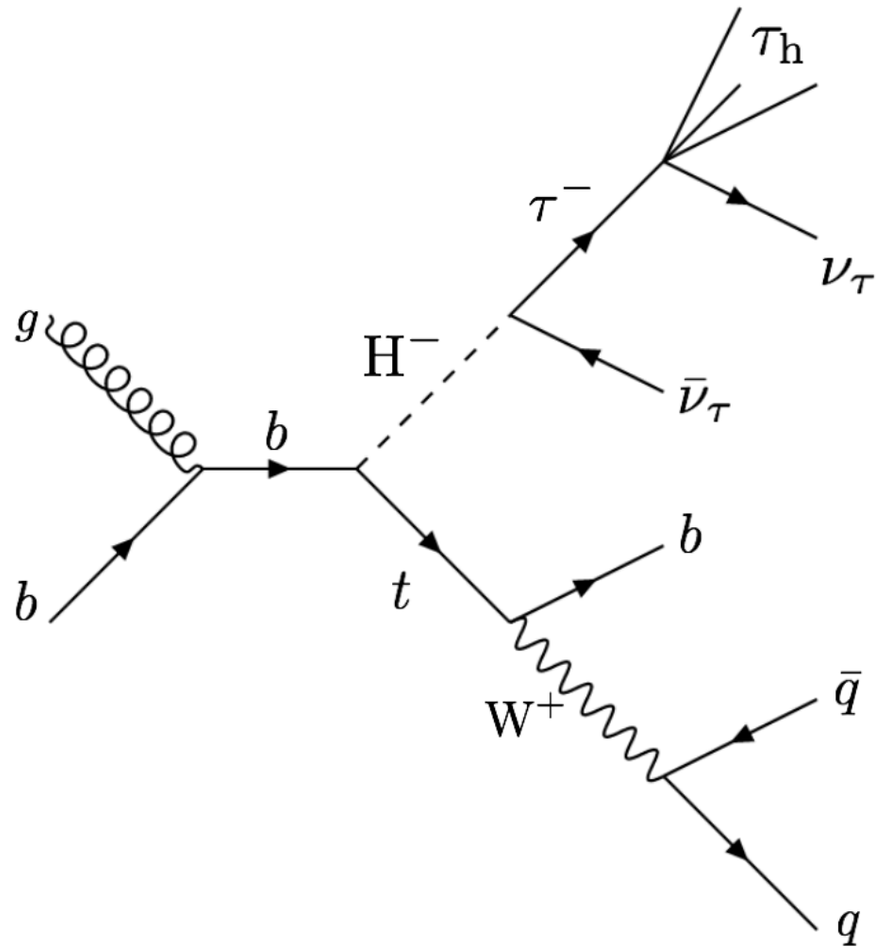

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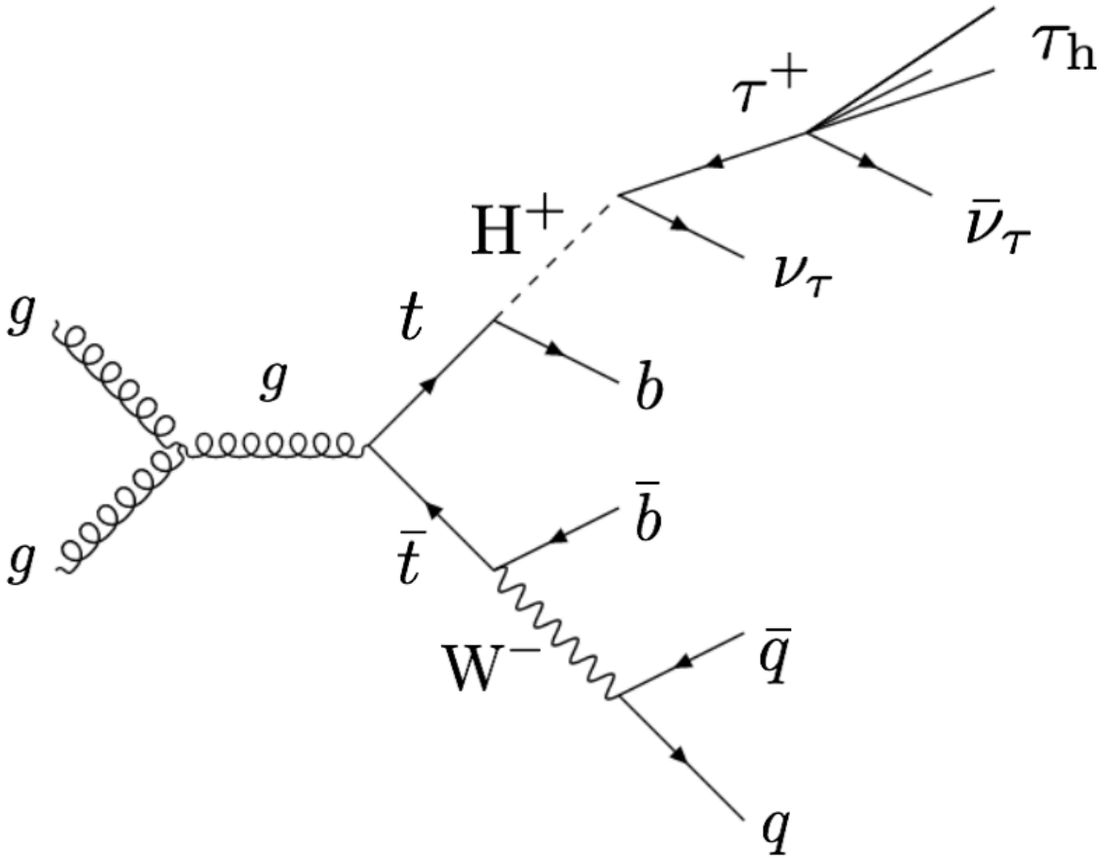
Signal

- The tau and the neutrino can be used to calculate the transverse mass of the charged Higgs boson



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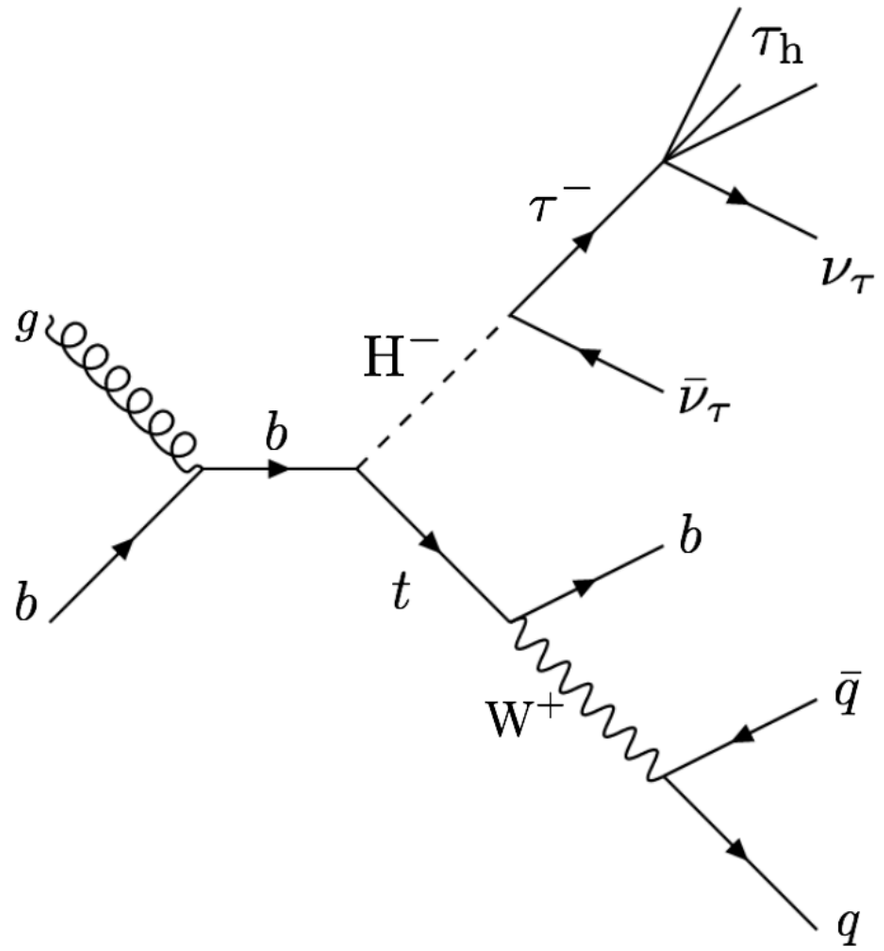

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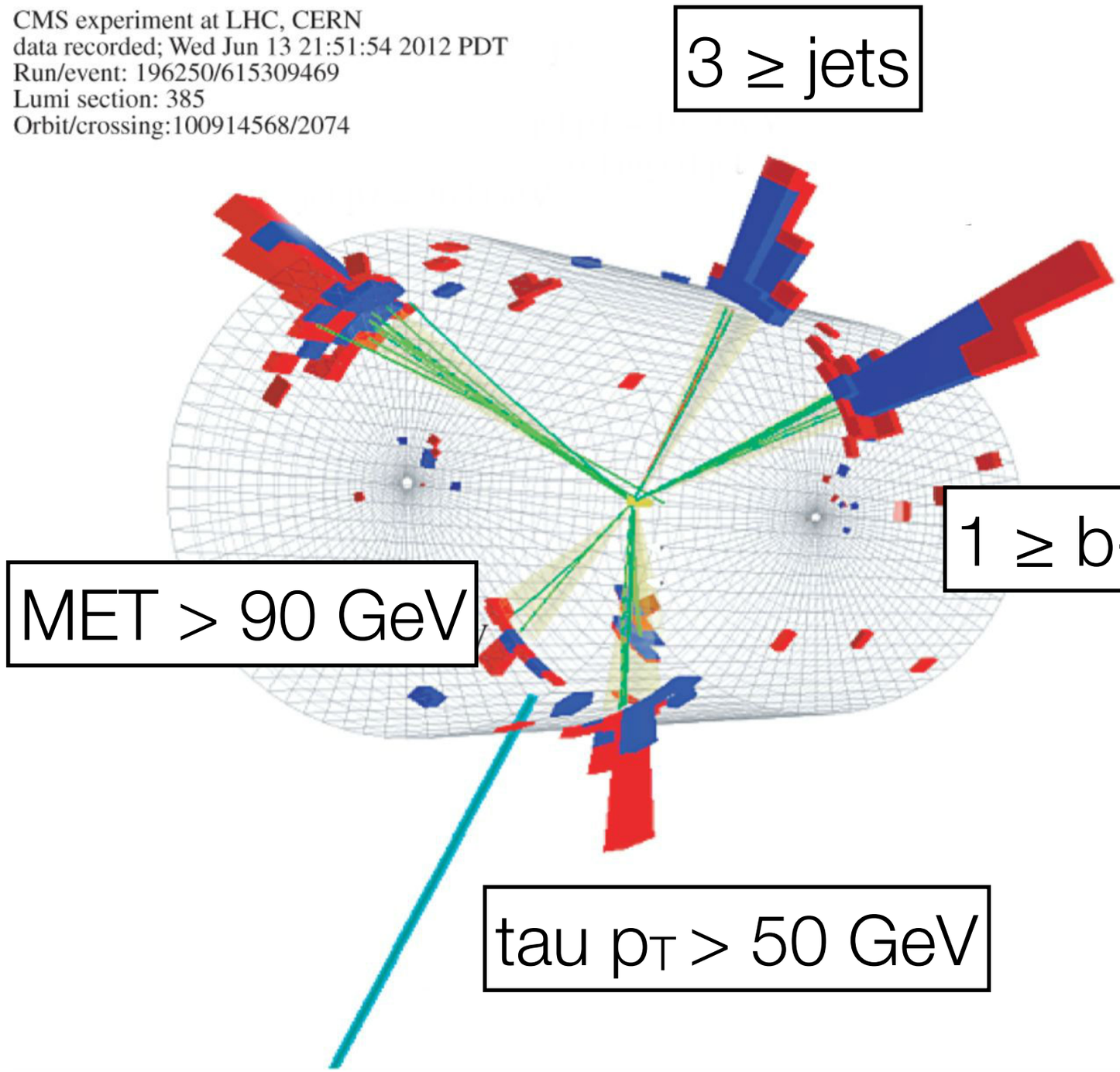
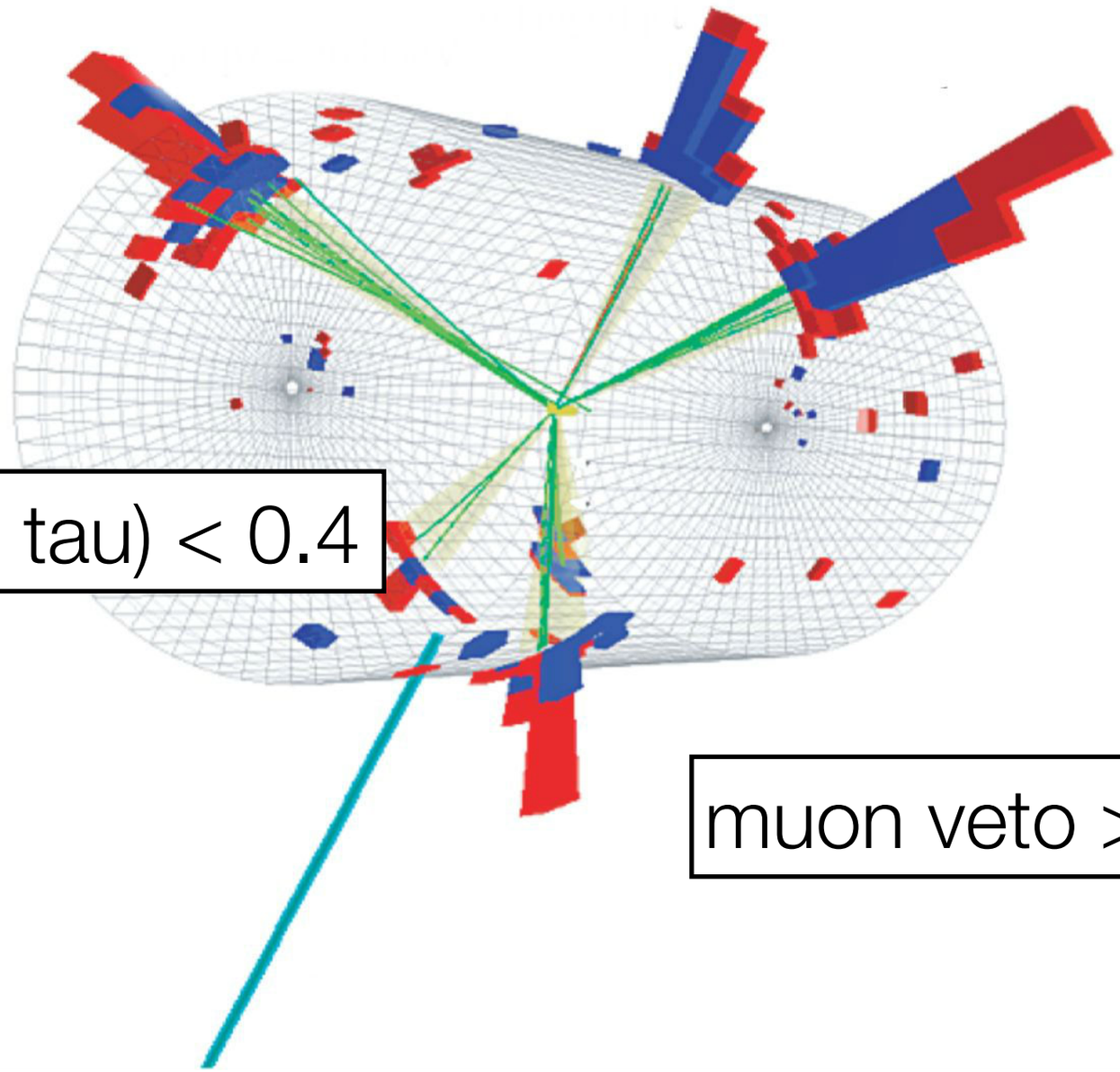
Event selection



Event selection

CMS experiment at LHC, CERN
data recorded; Wed Jun 13 21:51:54 2012 PDT
Run/event: 196250/615309469
Lumi section: 385
Orbit/crossing:100914568/2074



electron veto > 15 GeV

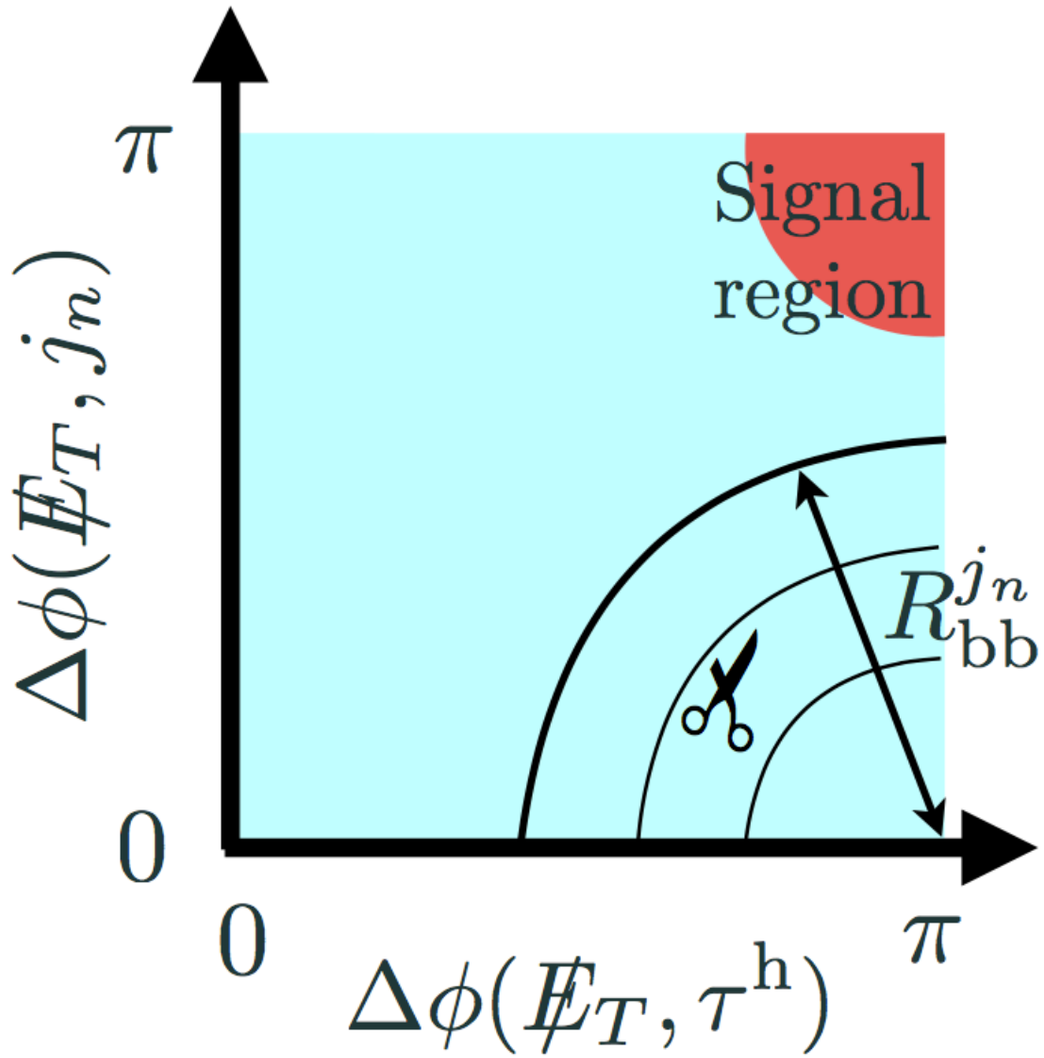
reject ΔR(jet, tau) < 0.4

muon veto > 10 GeV

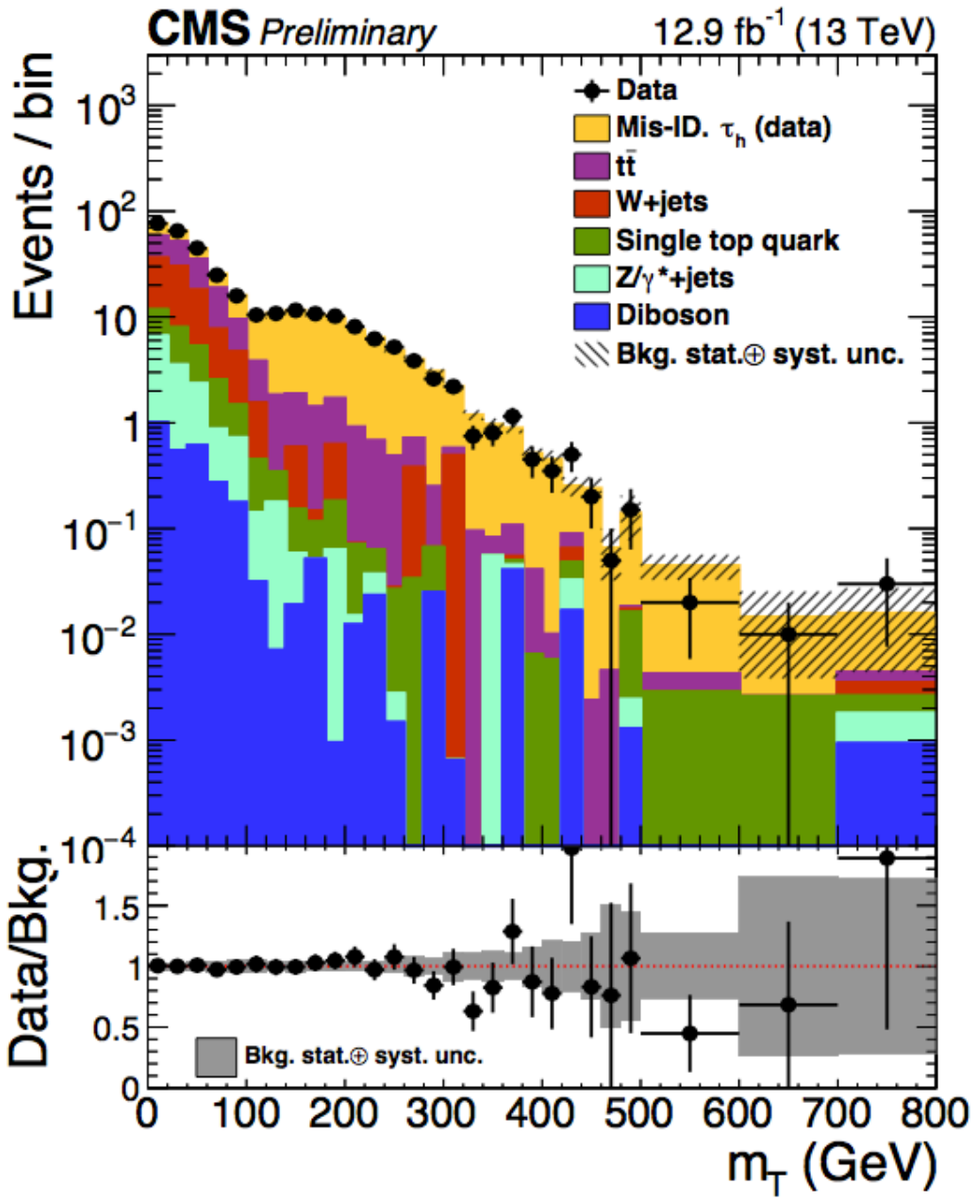
Angular cuts

$$R_{\mathrm{bb}}^{\mathrm{min}} = \mathrm{min}\sqrt{(180^{\circ} - \Delta\phi(\tau, E_{\mathrm{T}}^{miss}))^2 + \Delta\phi(\mathrm{jet}, E_{\mathrm{T}}^{miss})^2} > 40^{\circ}$$

- Cut to suppress QCD multijet background



Transverse mass distributions



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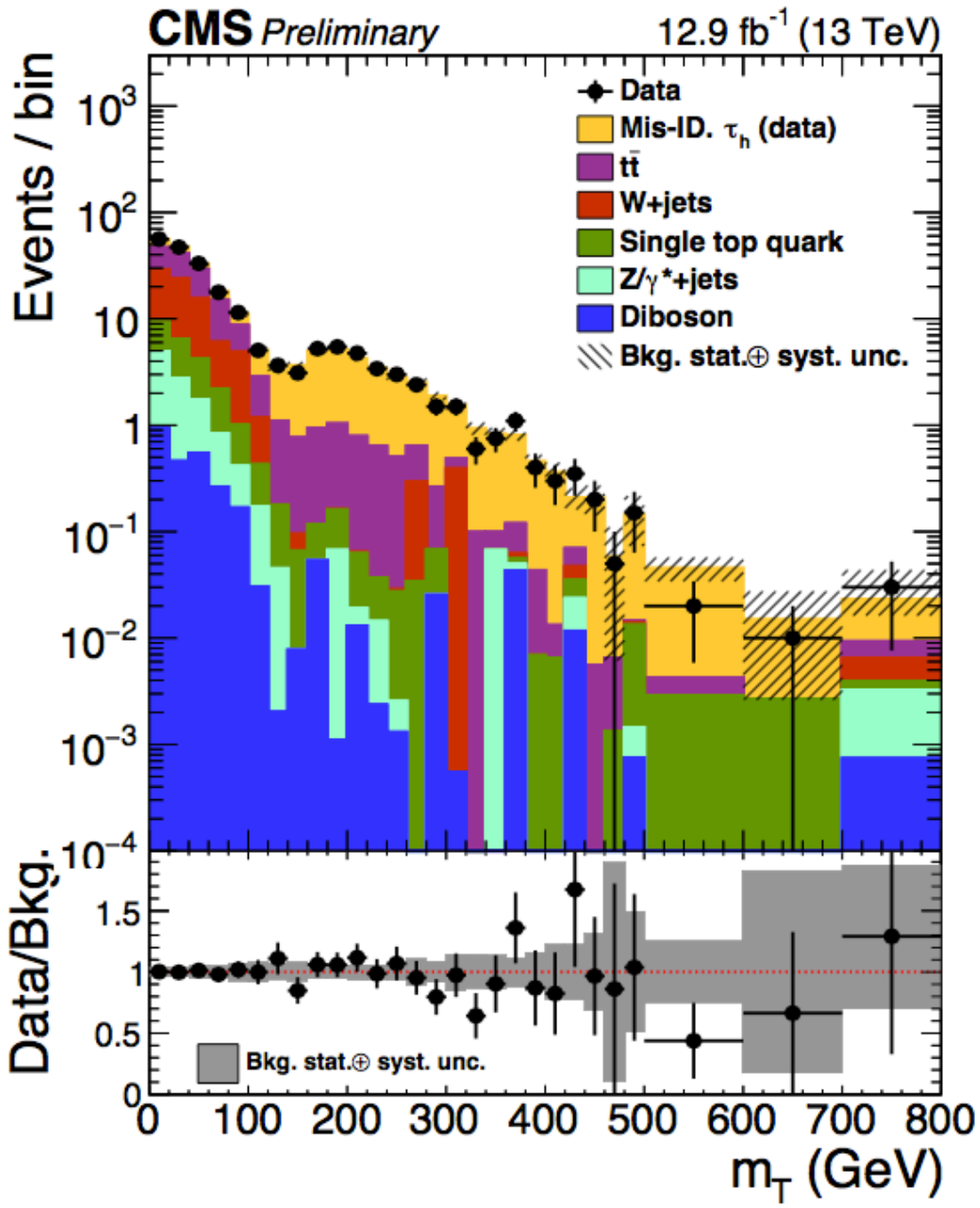

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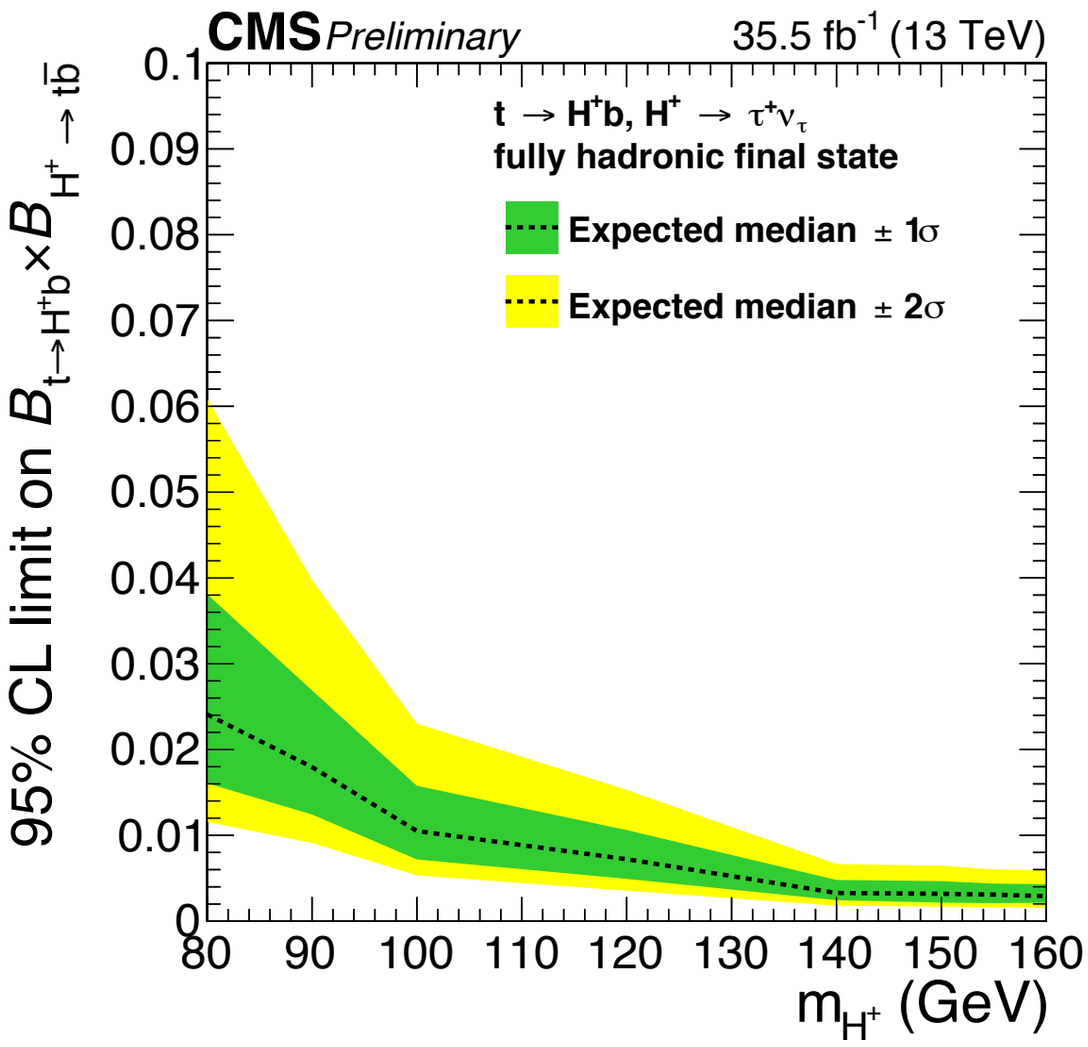
Expected limits



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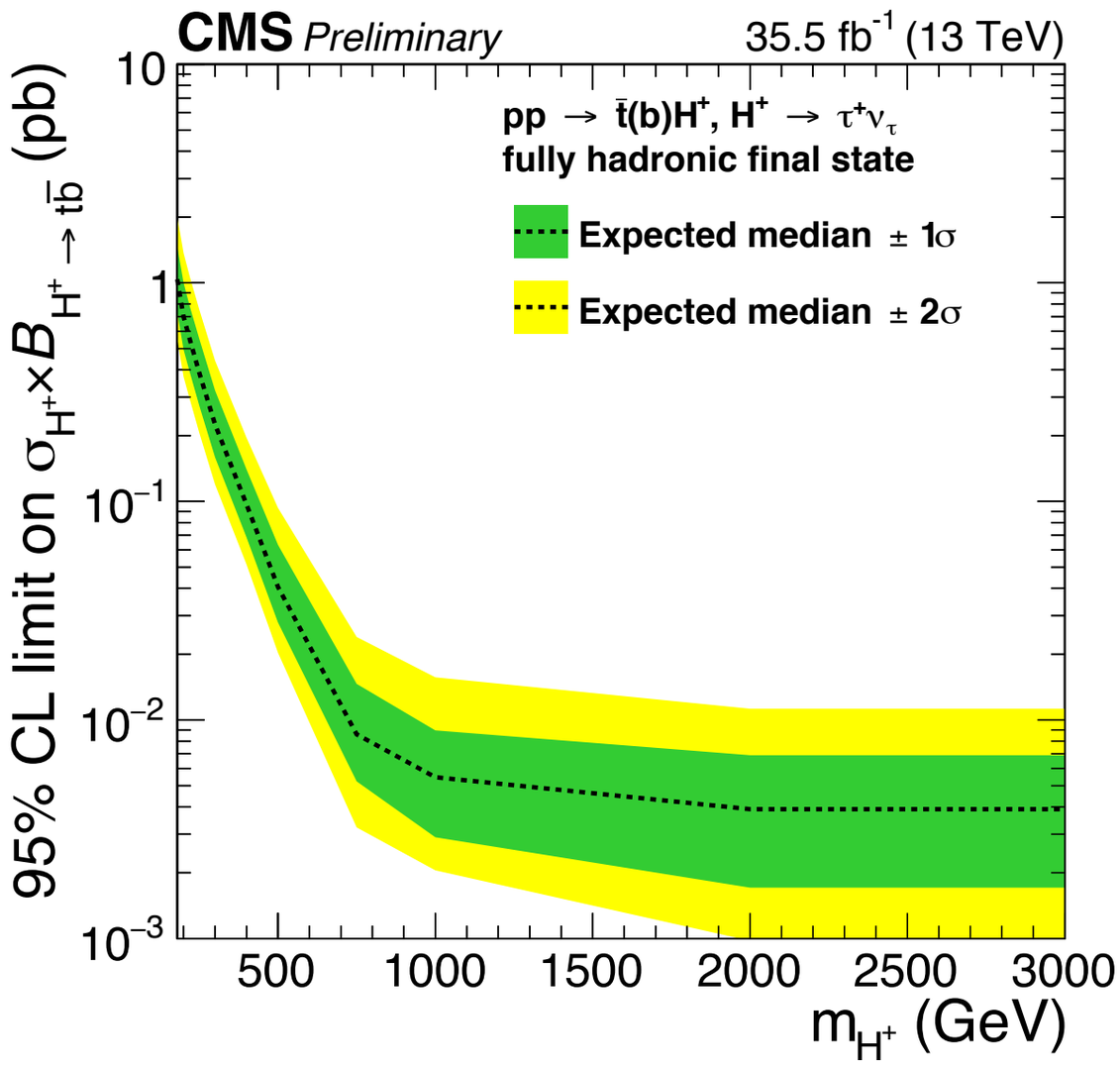

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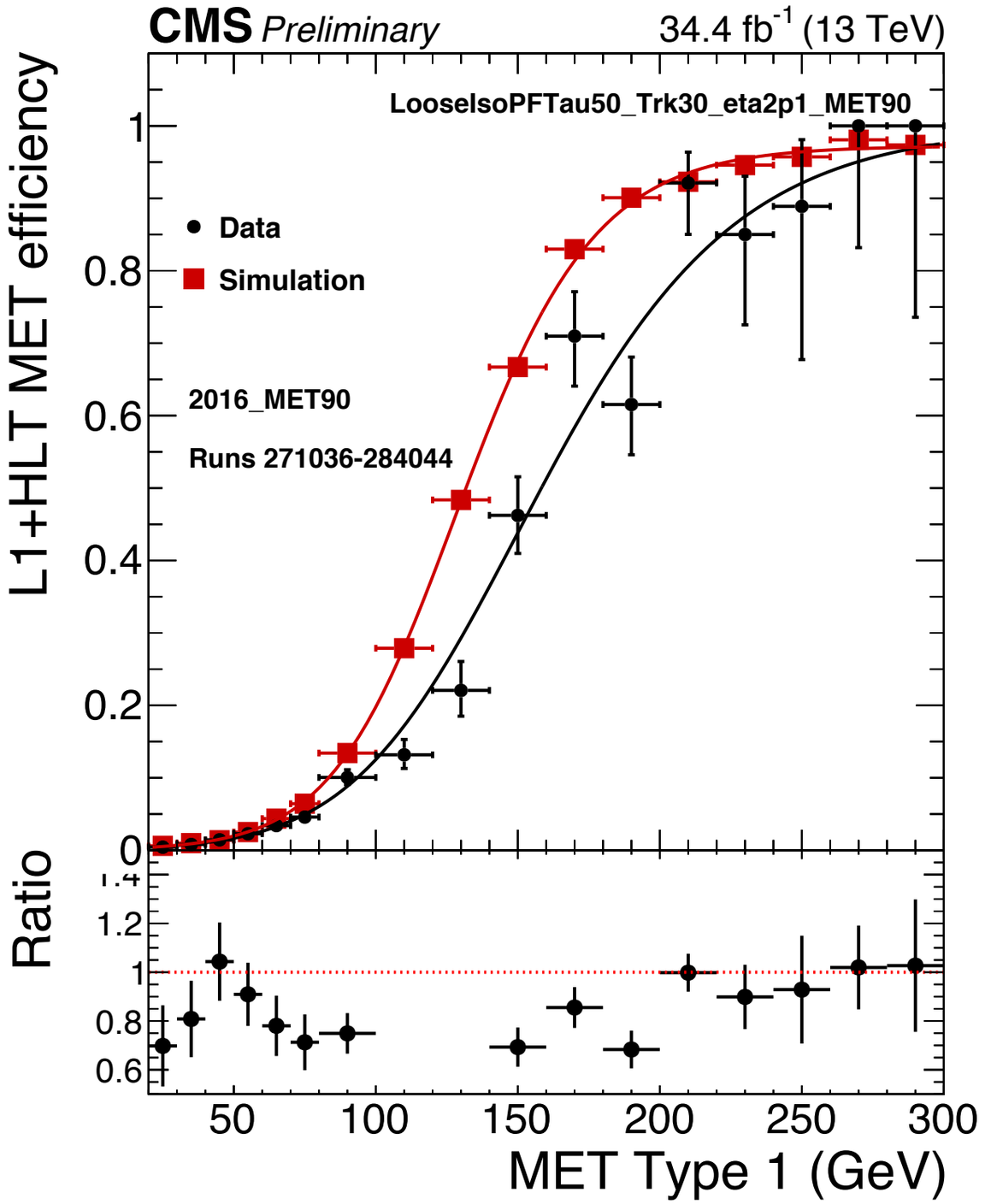
Trigger efficiency fitting

- One of the dominant sources of systematical uncertainties is the MET part of the trigger

- By fitting the efficiencies with a function we can reduce the systematical uncertainties



Outlook

- MVA methods
- Tau embedding
- Including the intermediate mass range