Search for Charged Higgs Bosons Decaying via H+ -> τν in 7 TeV pp Collisions with the ATLAS Detector

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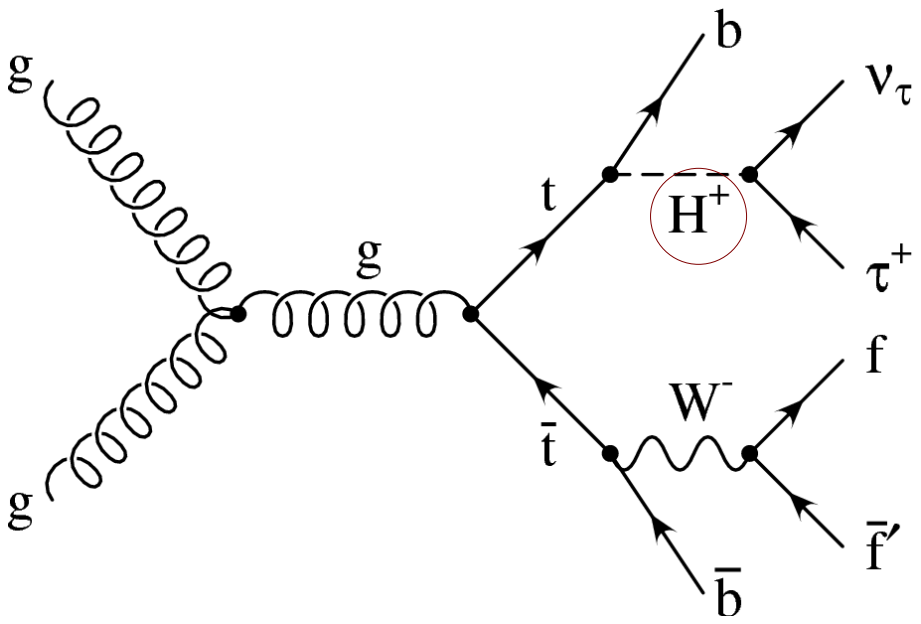
Introduction

- charged Higgs bosons (H^+, H^-) would be clear evidence for New Physics
- predicted by several non-minimal Higgs scenarios (e.g. MSSM)
- if $m_{H+} < m_{top}$: main production mode in MSSM via t -> bH^+
- for tan β > 2: $H^+ \rightarrow \tau\nu$ dominant decay mode
- 3 different final states investigated:
  - lepton + jets : $H^+ \rightarrow \tau$(lep)ν, W -> qq
  - + lepton : H^+ ->τ(had)ν, W -> lν
  - + jets : H^+ -> τ(had)ν, W -> qq



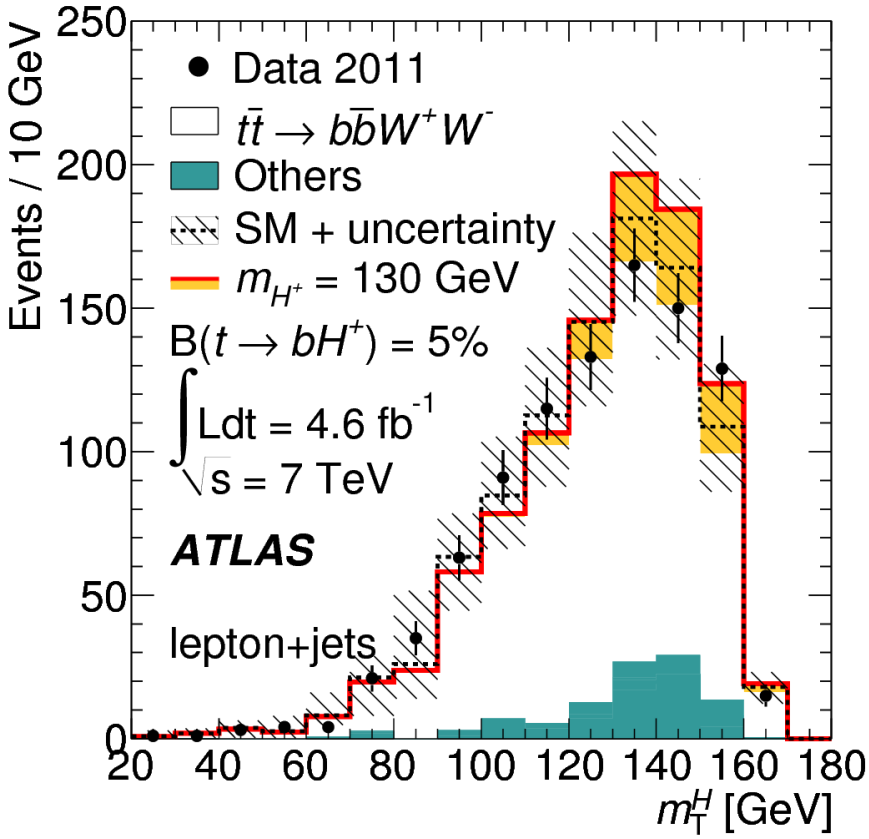
for more information: http://arxiv.org/abs/1204.2760

lepton + jets

data-driven background estimation:

- non-isolated/misidentified leptons:
  matrix method with efficiency to pass tight selection criteria measured for
  - real leptons using tag-and-probe method
  - misidentified leptons in control region

all other background contributions estimated using simulation



important discriminating variable:

$$\cos\theta_l^* = \frac{2m_{bl}^2}{m_{\text{top}}^2 - m_W^2} - 1 \simeq \frac{4\,p^b \cdot p^l}{m_{\text{top}}^2 - m_W^2} - 1$$

final discriminating variable:

$$(m_{\text{T}}^H)^2 = \left(\sqrt{m_{\text{top}}^2 + (\vec{p}_{\text{T}}^{\,l} + \vec{p}_{\text{T}}^{\,b} + \vec{p}_{\text{T}}^{\,\text{miss}})^2} - p_{\text{T}}^b \right)^2 - \left(\vec{p}_{\text{T}}^{\,l} + \vec{p}_{\text{T}}^{\,\text{miss}} \right)^2$$

τ + lepton

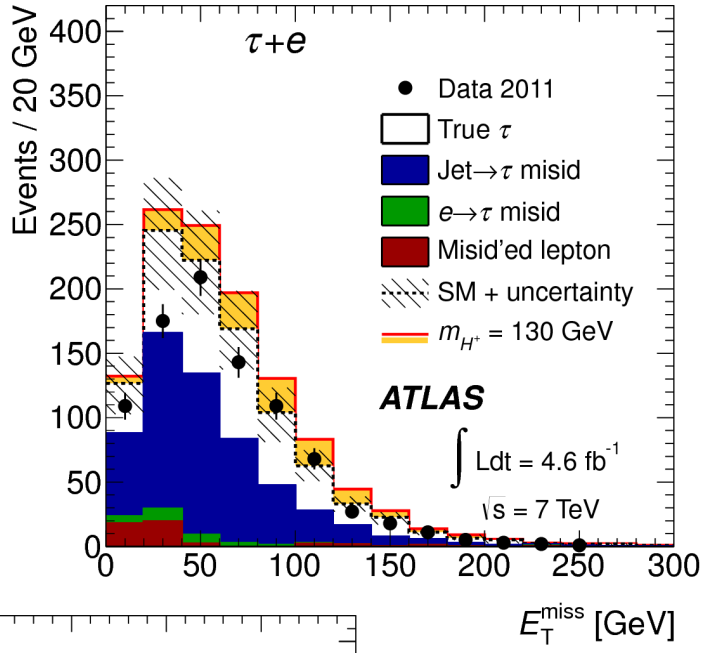
data-driven background estimation:

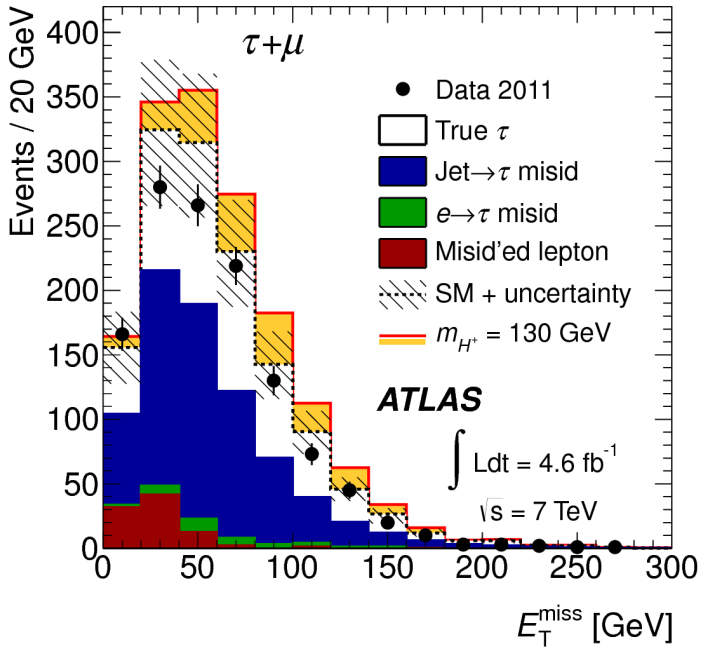
- misidentified leptons: matrix method as for lepton + jets
- electrons misidentified as τ jets: misidentification probability measured from data
- jets misidentified as τ jets: misidentification probability measured from data

background contribution with true τ jets estimated using simulation

final discriminating variable:

$$E_{\mathrm{T}}^{\mathrm{miss}}$$

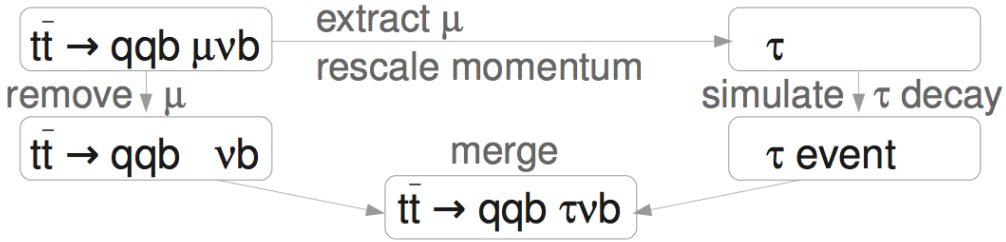




τ + jets

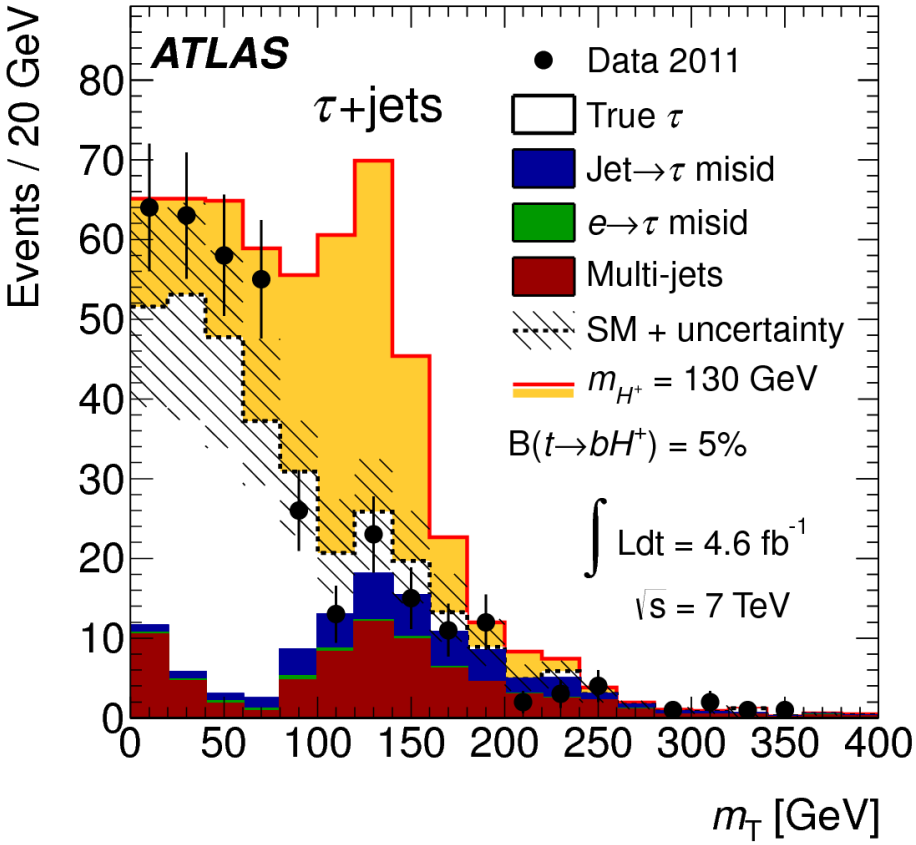
data-driven background estimation for all background contributions:

- multi-jets: template fit in E_T^{miss}
- electrons misidentified as τ jets: misidentification probability measured from data
- jets misidentified as τ jets: misidentification probability measured from data
- true τ jets: embedding method



final discriminating variable:

$$m_{\mathrm{T}} = \sqrt{2 p_{\mathrm{T}}^{\tau} p_{\mathrm{T}}^{\mathrm{miss}} (1 - \cos \Delta\phi)}$$



Results

- no evidence for charged Higgs bosons
- set upper limits on branching ratio B(t Hβ) asuming B($H^+ \to \tau\nu$) = 1
- interpret limit in MSSM (no assumption on B($H^+ \to \tau\nu$))