WG3 MSSM/2HDM Charged Higgs Subgroup Report
Experimental Perspectives

Stephen Jacob Sekula
Southern Methodist University

Presented at The 10th Workshop of the LHC Higgs Cross Section Working Group
WG3: Charged Higgs Session
July 15, 2015

Theory Conveners: Maria Ubiali
Experimental Conveners: Martin Flechl (CMS) and Steve Sekula (ATLAS)
Special thanks: *to the ATLAS and CMS H^+ communities for their valuable input and insights!*

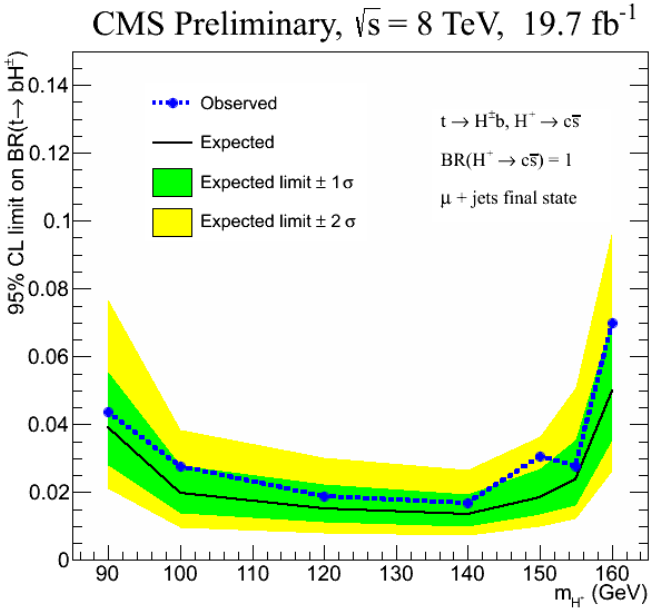
Overview

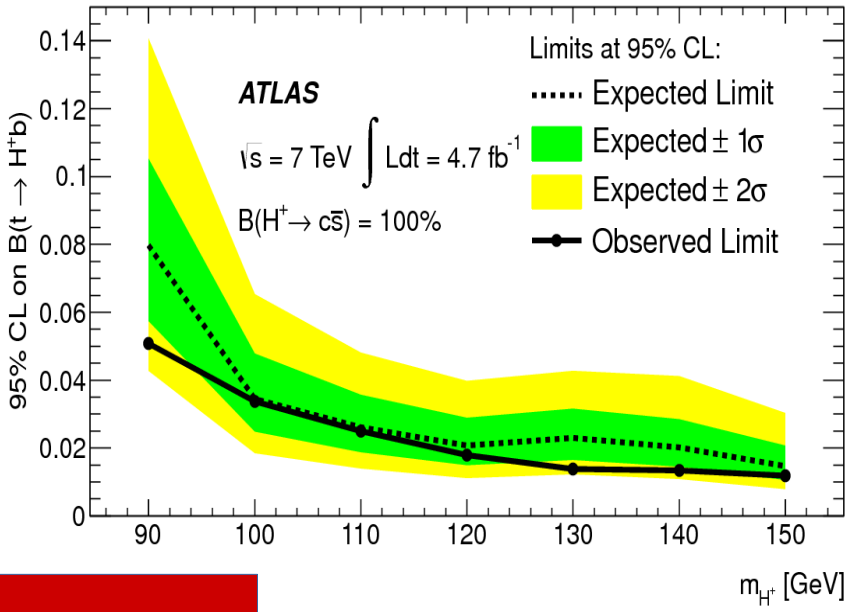
- Review of Run 1 LHC Results
- Status of Production Cross-Sections
- Experimental Issues for Run 2
  - Theoretical prescriptions and systematics
  - s-channel production in the MSSM/2HDM
- Conclusions and Outlook

Review of Run 1 LHC Results: MSSM/2HDM Charged Higgs

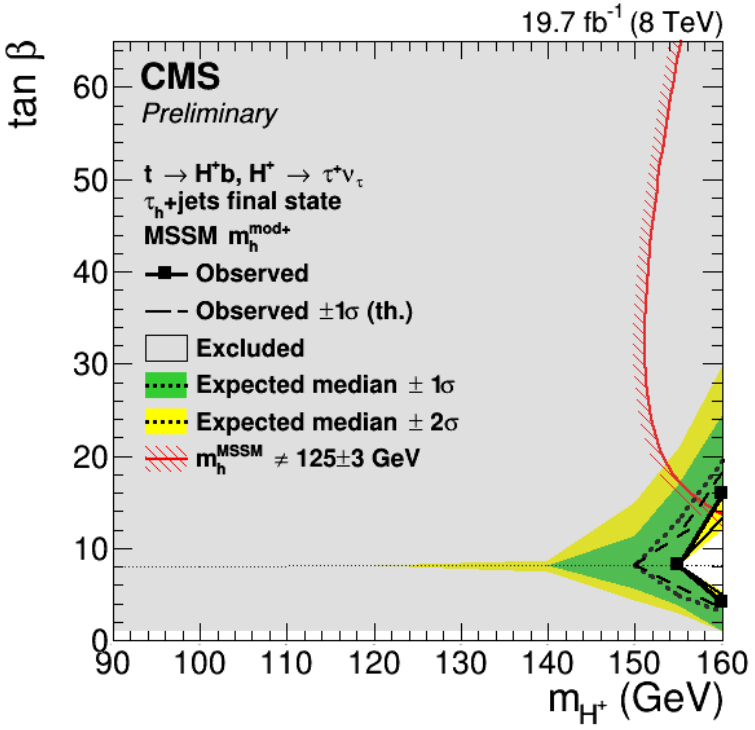
LOW-MASS MSSM-LIKE H+

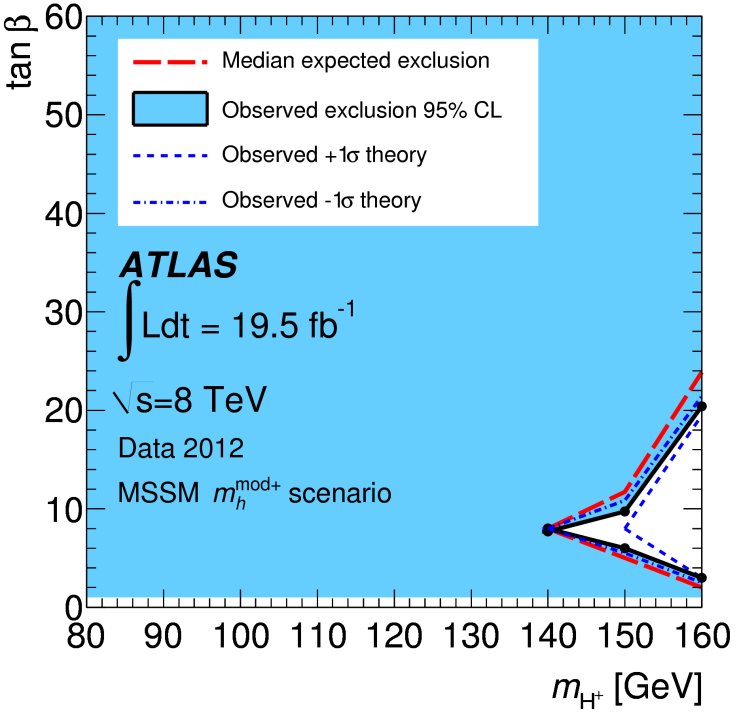
$H^+ \rightarrow c\bar{s}$





$H^+ \rightarrow \tau^+ \nu$



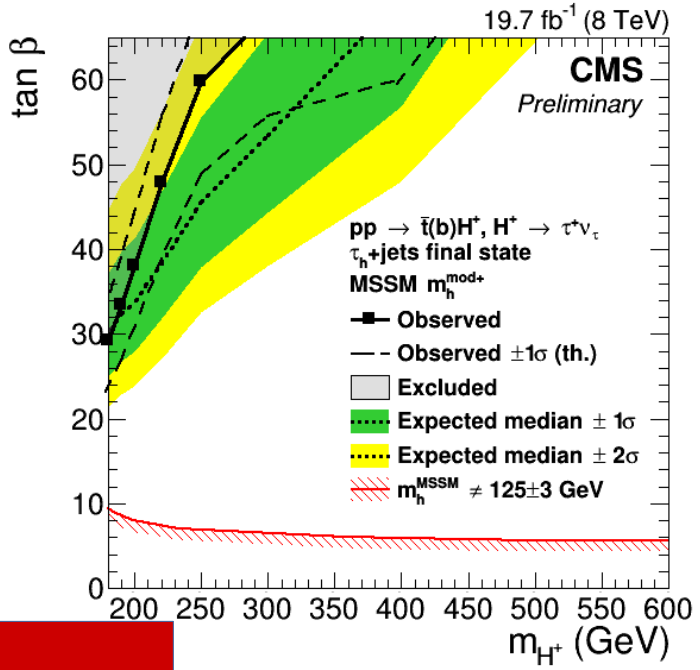


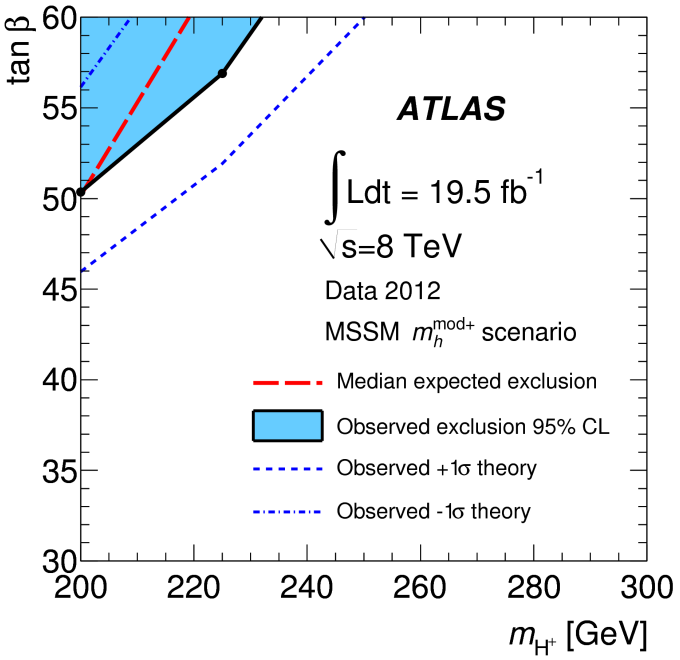
No evidence of a low-mass H^+

Significant exclusion of parameter space.

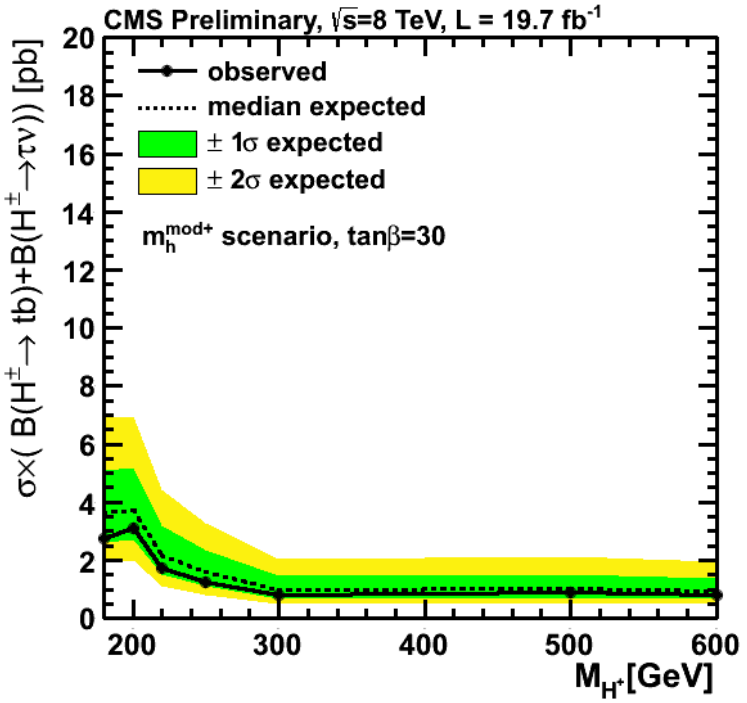
HIGH-MASS MSSM-LIKE H+

$H^+ \rightarrow \tau^+ \nu$





$H^+ \rightarrow t\bar{b}$



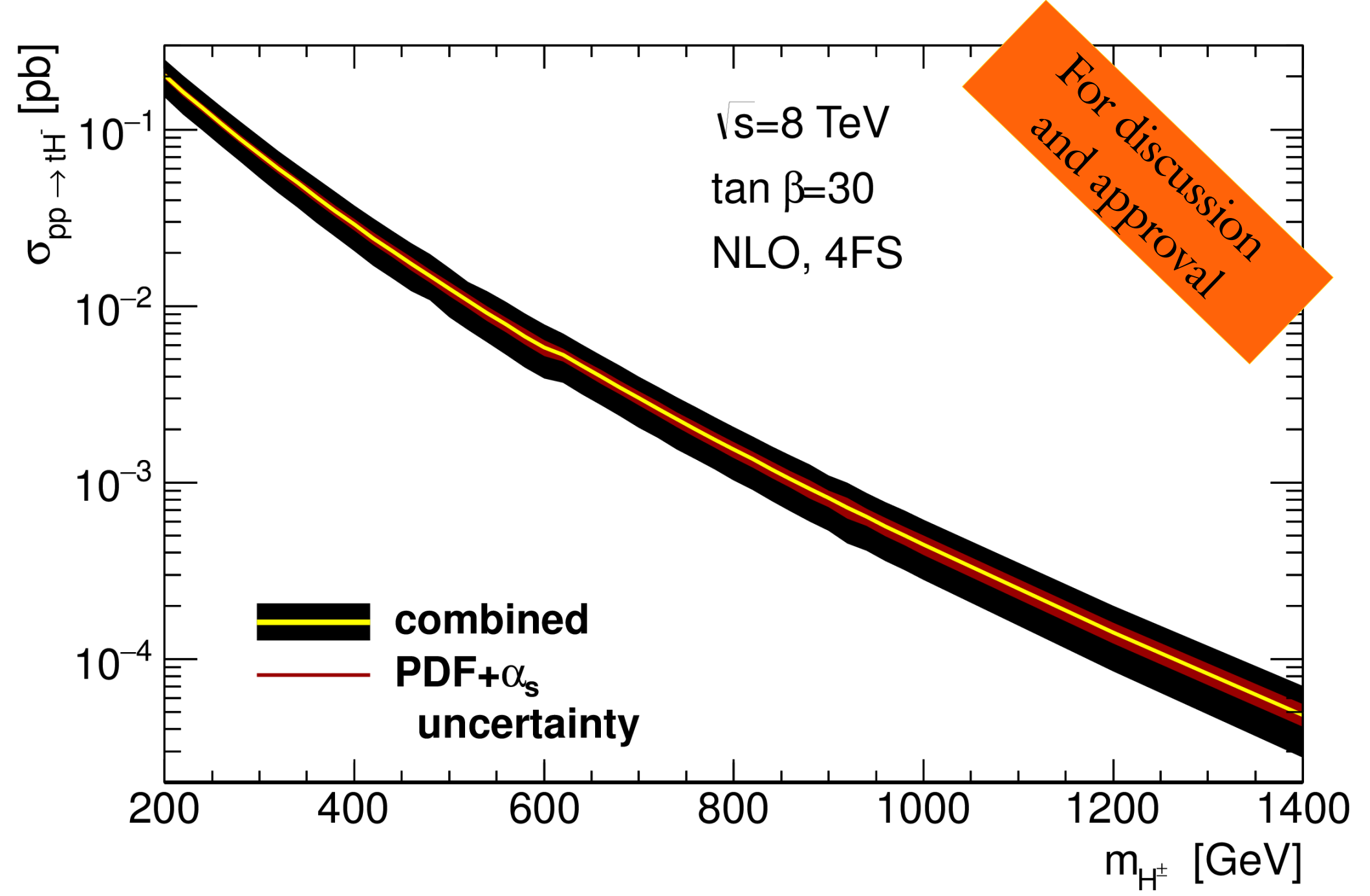
First excursions into this region.

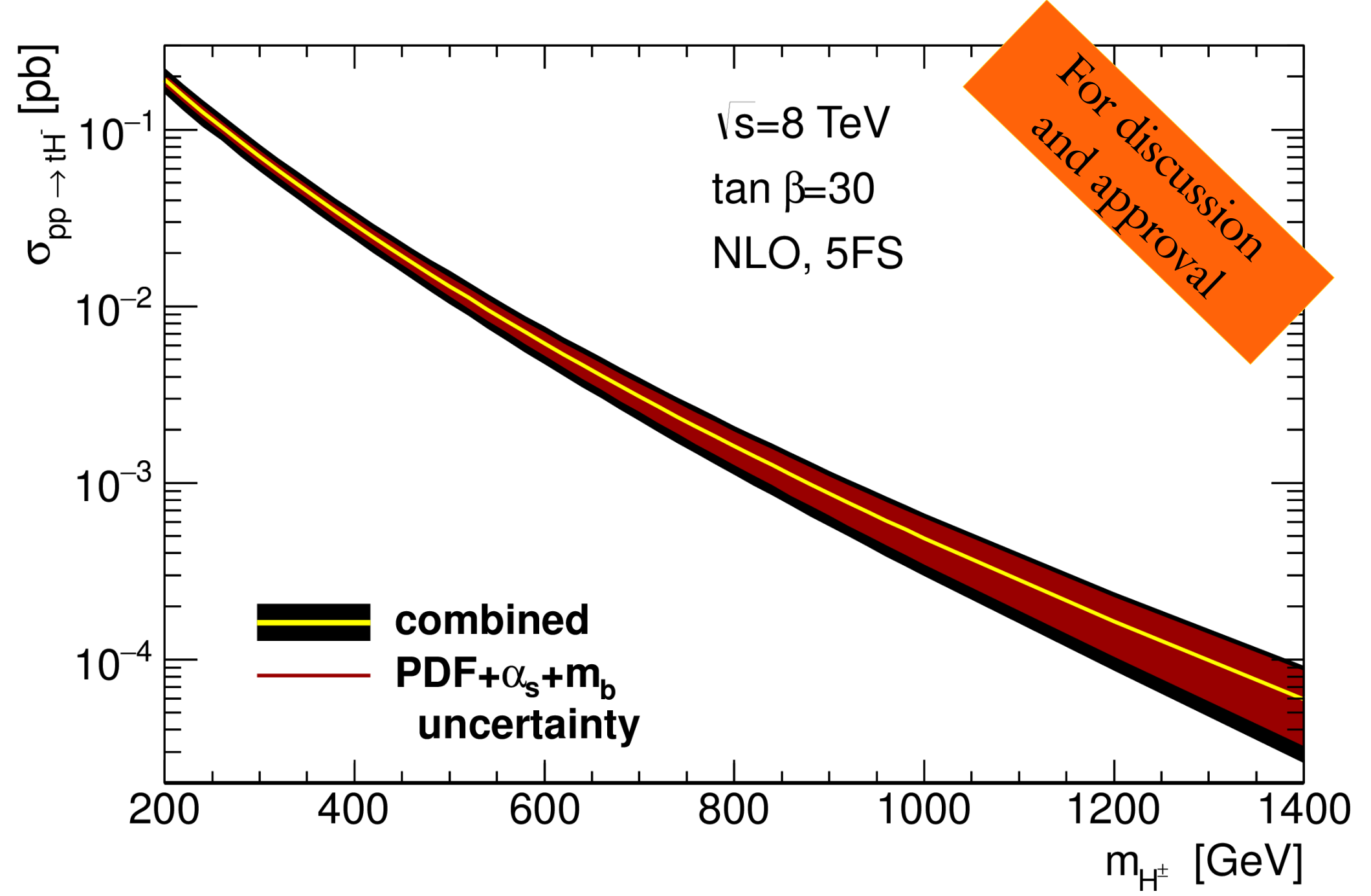
Run 2 will be an exciting time to further this advance.

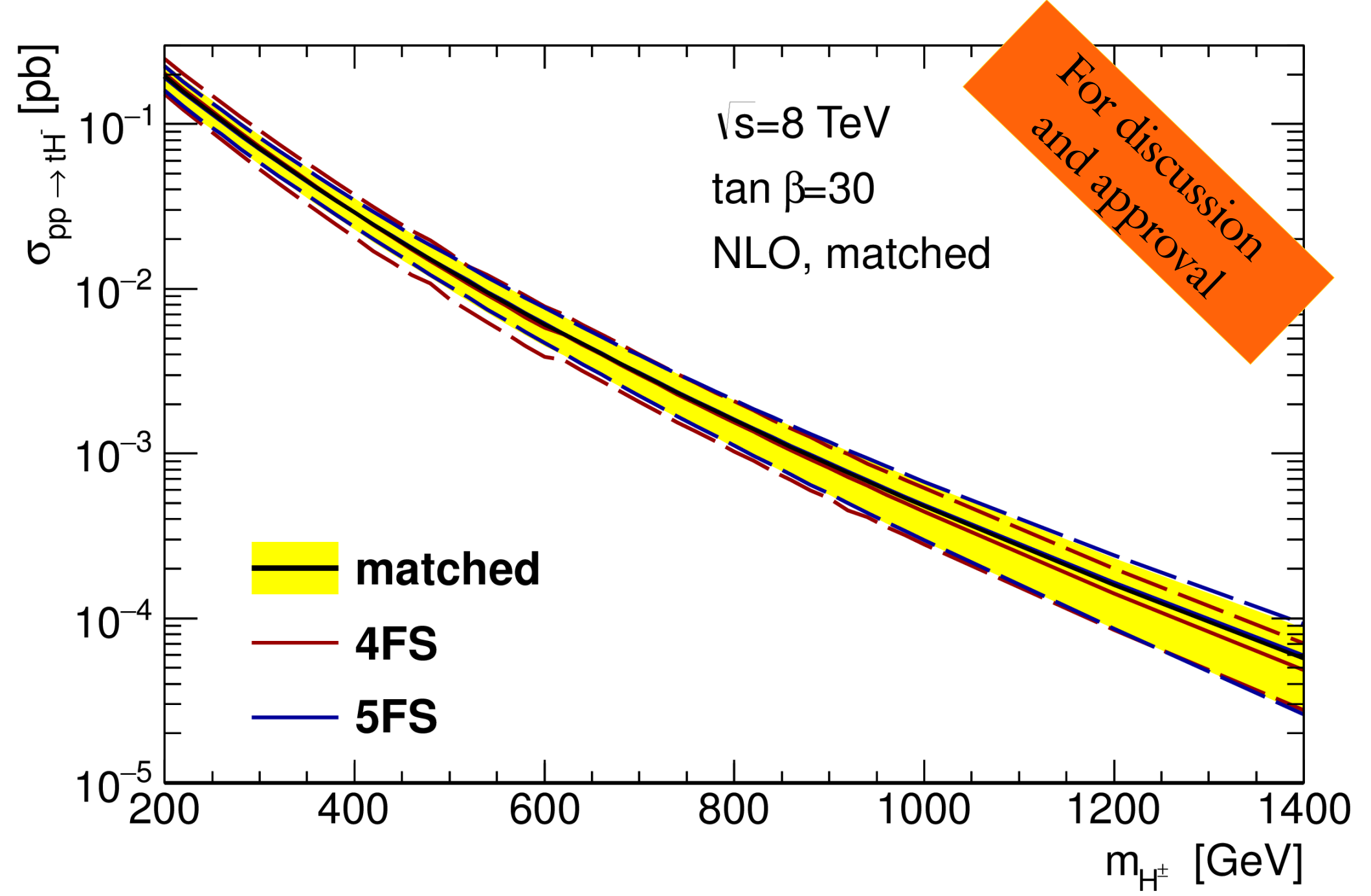
Status of Production Cross-Sections

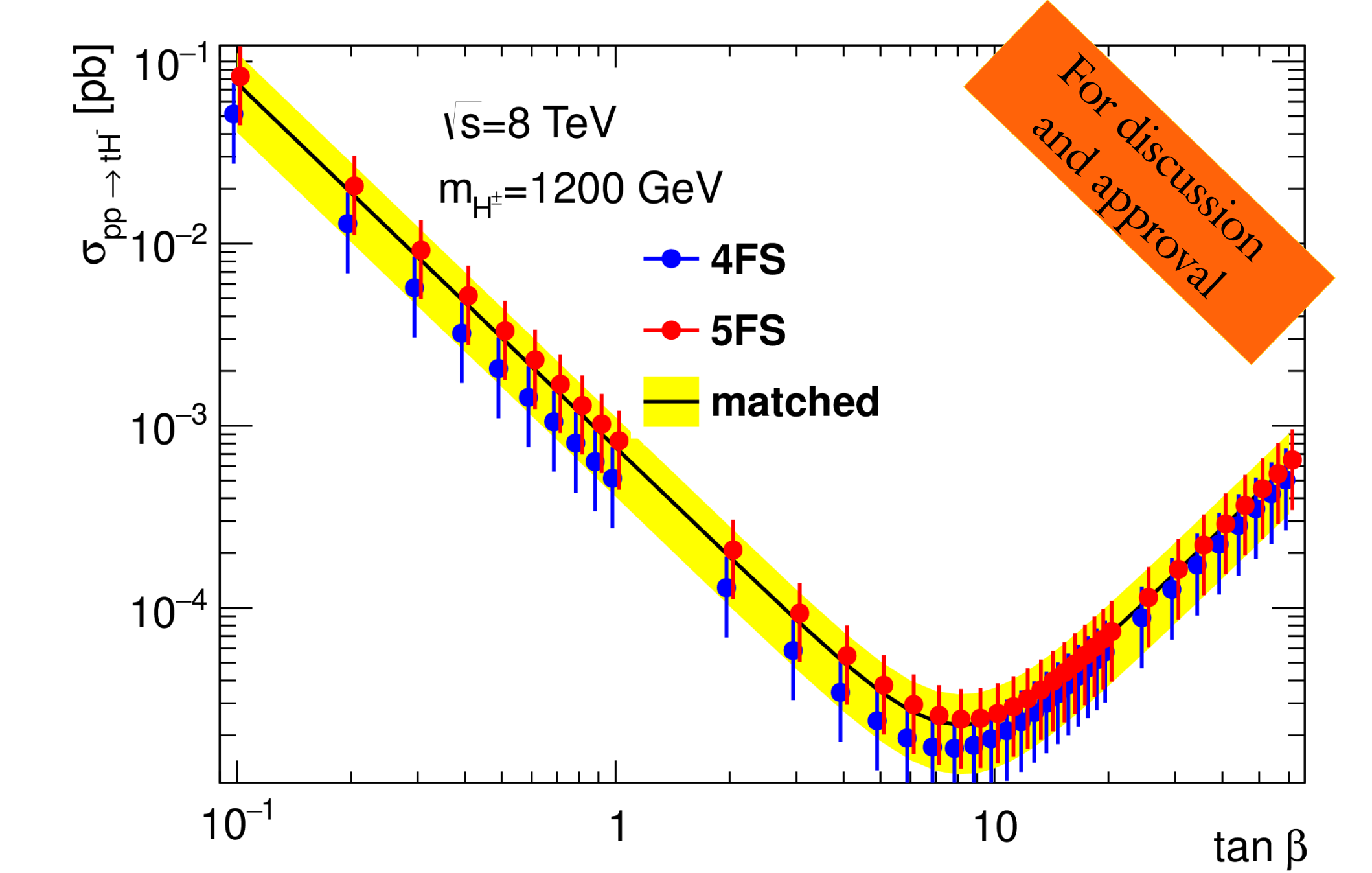
High-Mass Cross-Sections @ 8TeV

- Experiments requested additional mass points
  - 1200, 1400 GeV @ 8 TeV
- Next few slides show results from 4FS, 5FS, Santander Matching, and for $\tan\beta=[0.1, 60]$
- We request comments and feedback on these, with the aim of making these public and official ASAP
- Current machinery can be (and has been) run for 13 TeV


For discussion and approval
√s=8 TeV
tan β=30
NLO, 4FS
combined
PDF+α_s uncertainty
σ_pp→tH⁻ [pb]
m_H± [GeV]
10⁻¹
10⁻²
10⁻³
10⁻⁴
200
400
600
800
1000
1200
1400


For discussion and approval
√s=8 TeV
tan β=30
NLO, 5FS
combined
PDF+α_s+m_b uncertainty
σ_pp→tH⁻ [pb]
m_H± [GeV]
10^−1
10^−2
10^−3
10^−4
200
400
600
800
1000
1200
1400


For discussion and approval
√s=8 TeV
tan β=30
NLO, matched
matched
4FS
5FS
$\sigma_{pp \to tH^-}$ [pb]
$m_{H^\pm}$ [GeV]
10^{-1}
10^{-2}
10^{-3}
10^{-4}
10^{-5}
200
400
600
800
1000
1200
1400


$\sigma_{pp \to tH^-}$ [pb]
10^{-1}
10^{-2}
10^{-3}
10^{-4}
$\sqrt{s}$=8 TeV
$m_{H^\pm}$=1200 GeV
4FS
5FS
matched
For discussion and approval
10^{-1}
1
10
tan β

Experimental Issues for Run 2

Theoretical Prescriptions and Systematics

- 4FS and 5FS
  - Maria has covered in her talk the current state of differential distributions in the 4FS
  - For discussion: should experiments then simulate the process using the 4FS and take the normalization from the Santander-matched cross-sections?
- Question
  - If we utilize the 4FS for simulation of the process, what are the recommended theory-based systematics that need to be assessed?

s-channel H^+ production

- Could be an important channel going forward in larger tanβ scenarios
  - 2HDM model currently used
- Questions
  - What is the state of predictions at NLO/NNLO in this channel?
  - What recommendations can be made to the experiments for generators, theoretical uncertainties, etc.?

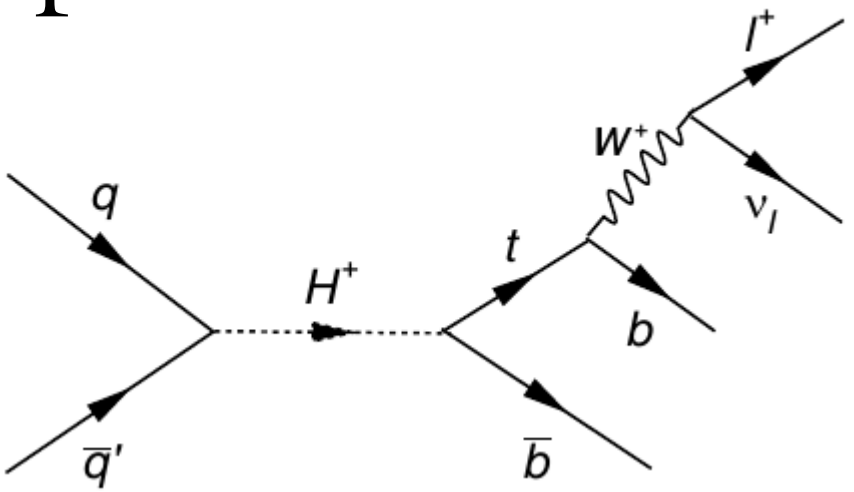


Figure from JHEP11(2013)005

Conclusions and Outlook

Conclusions and Outlook

- We welcome a healthy discussion on these and other issues during and after this meeting
- We aim for a meeting on the MSSM/2HDM charged Higgs topic specifically in September to discuss details and technical issues
- Our WG focuses on MSSM/2HDM H^+ issues
  - if you have questions/concerns about exotic branching fractions of the charged Higgs or alternative models, please initiate conversations with the Higgs Exotic Decays subgroup – we don't want interesting signatures to fall to the side if theory prescriptions are needed!