

MSSM CHARGED HIGGS

Michael Spira (PSI)

Theory convenors: Robert Harlander, Michael Krämer, Pietro Slavich,
Michael Spira

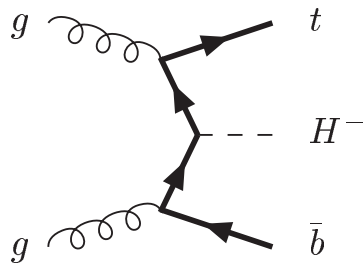
Experimental convenors: Monica Vazquez Acosta (CMS), Martin Flechl
(ATLAS), Sami Lehti (CMS), Trevor Vickey (ATLAS)

Group members: S. Dittmaier, M. Flechl, R. Harlander, S. Heinemeyer,
R. Klees, M. Krämer, S. Lehti, M. Spira, M. Ubiali

$pp \rightarrow t\bar{b}H^- + X$

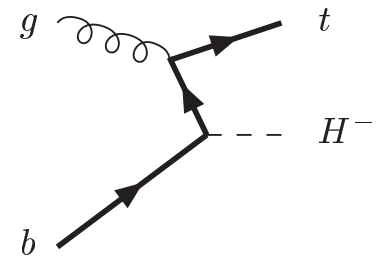
- $M_{H^\pm} < m_t - m_b$: $\sigma_{t\bar{b}H^-} = \sigma_{t\bar{t}} \times BR(\bar{t} \rightarrow \bar{b}H^-)$
[off-shell effects? threshold effects? sufficient for exclusion?]

- $M_{H^\pm} > m_t - m_b$:



NLO

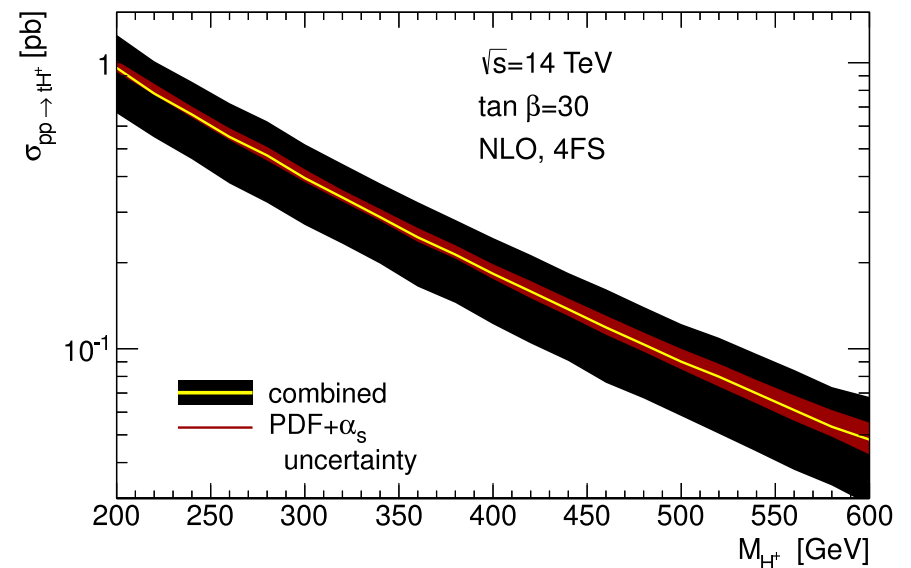
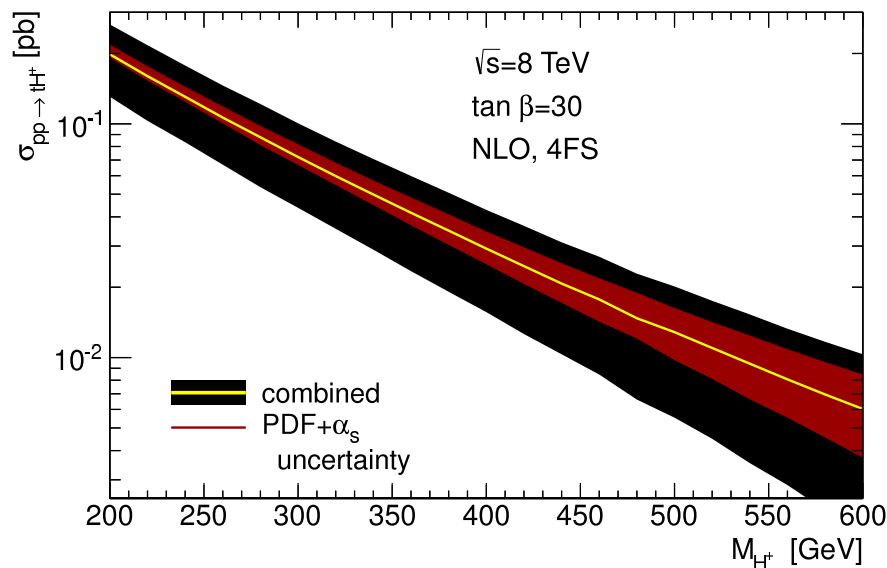
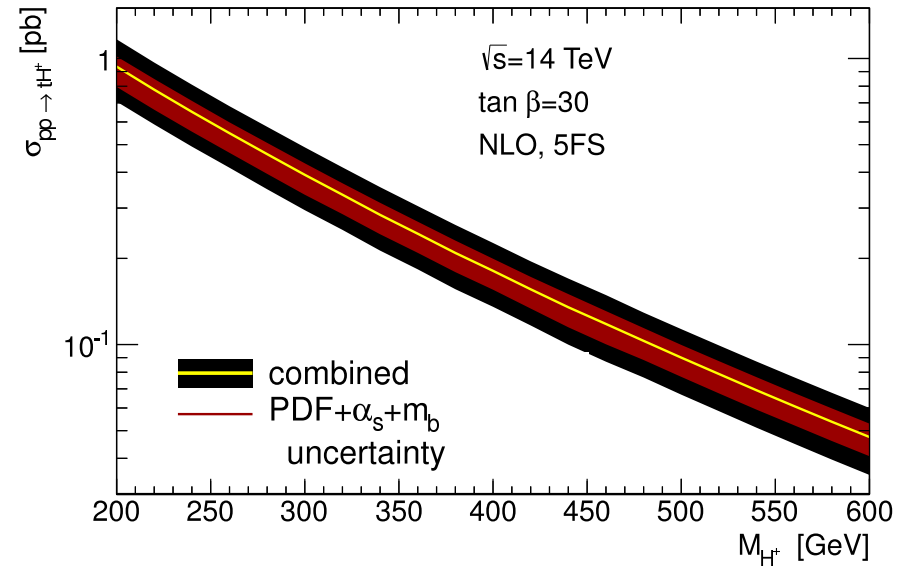
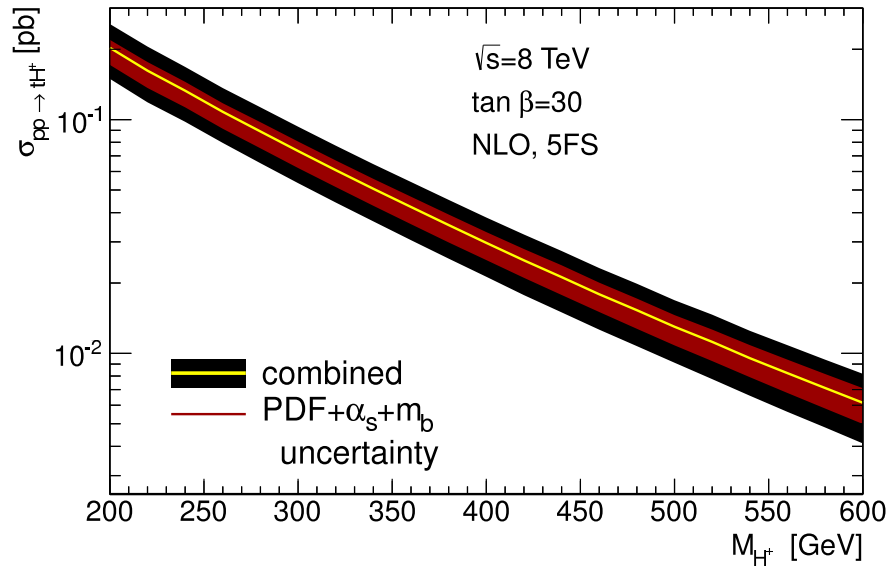
exact $g \rightarrow b\bar{b}$ splitting & mass/off-shell effects
no resummation of $\log M_{H^\pm}^2/m_b^2$ terms



NLO

massless/on-shell b 's, no p_{Tb}
resummation of $\log M_{H^\pm}^2/m_b^2$ terms

$\alpha_s(M_Z) = 0.1183 \pm 0.0012$, $m_b = (4.75 \pm 0.25)$ GeV (not in Yukawa)
 linear addition of scale $[\frac{1}{3}, 3]$ & parametric uncertainties
 [5FS: dynamical scale choice [Maltoni, Ridolfi, Ubiali](#)]

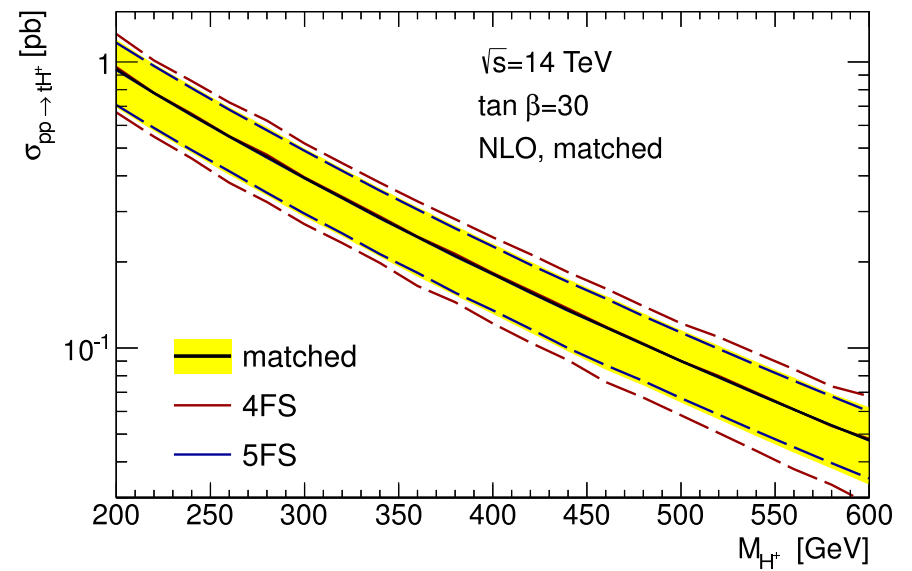
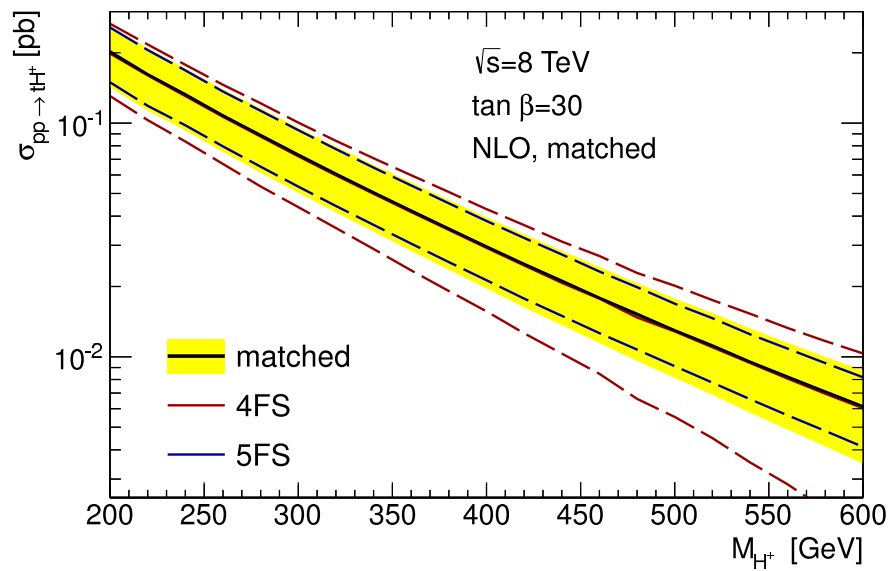


Santander matching:

$$\sigma = \frac{\sigma^{4FS} + w\sigma^{5FS}}{1 + w}$$

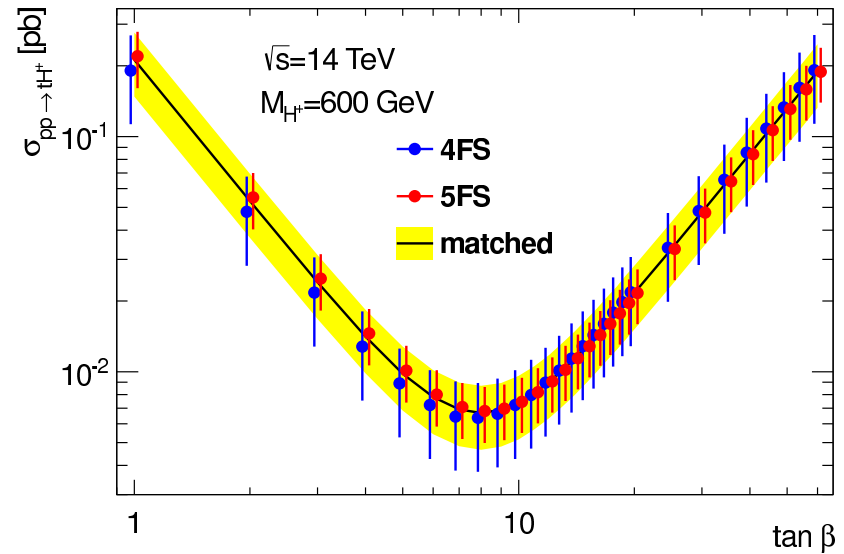
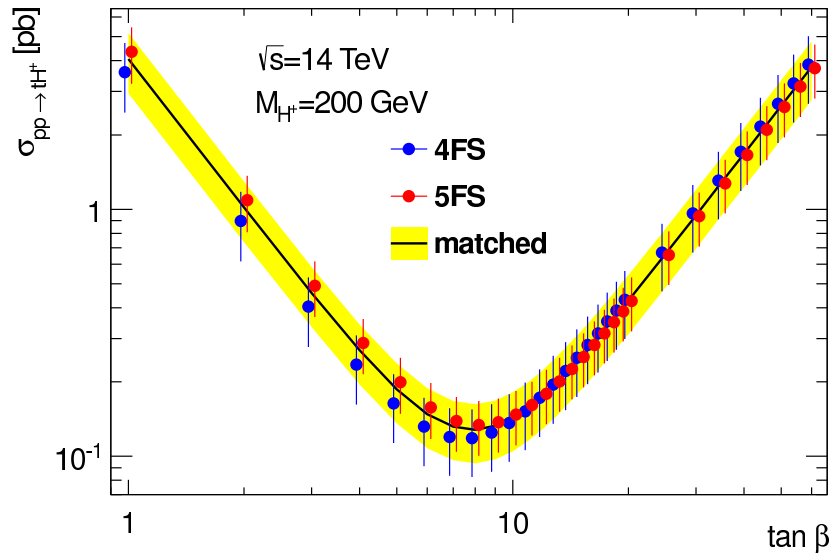
$$w = \log \frac{M_{H^\pm}}{m_b} - 2$$

Harlander, Krämer, Schumacher



Dittmaier, Krämer, S., Walser
Plehn
Flechl, Klees, Ubiali

minimum: $\text{tg}\beta \sim \sqrt{\frac{m_t}{m_b}} \sim 8$



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Plehn
Flechl, Klees, Ubiali

SUSY-QCD Corrections to $b\bar{b}\phi^0$

$$\mathcal{L}_{eff} = -\frac{m_b/v}{1 + \Delta_b} \bar{b} \left[g_b^h \left(1 - \frac{\Delta_b}{\text{tg}\alpha \text{tg}\beta} \right) h + g_b^H \left(1 + \Delta_b \frac{\text{tg}\alpha}{\text{tg}\beta} \right) H - g_b^A \left(1 - \frac{\Delta_b}{\text{tg}^2\beta} \right) i\gamma_5 A \right] b$$

$$\Delta_b = \frac{2}{3} \frac{\alpha_s}{\pi} m_{\tilde{g}} \mu \text{tg}\beta I(m_{\tilde{b}_1}^2, m_{\tilde{b}_2}^2, m_{\tilde{g}}^2)$$

$$I(a, b, c) = \frac{ab \log \frac{a}{b} + bc \log \frac{b}{c} + ca \log \frac{c}{a}}{(a-b)(b-c)(a-c)}$$

Carena, Garcia, Nierste, Wagner
Guasch, Häfliger, S.

Noth, S.
Mihaila, Reisser

⇒ resummed Yukawa couplings

- NNLO: $\mathcal{O}(10\%)$, $\mu = M_{SUSY}$
- approximation of NLO SUSY-QCD corrections $< 1\%$ @ large $\text{tg}\beta$

Dittmaier, Krämer, S., Walser

- analogous for charged Higgs: $\tilde{g}_b^{H^\pm} = \frac{\text{tg}\beta}{1 + \Delta_b} \left(1 - \frac{\Delta_b}{\text{tg}^2\beta} \right)$

$$\underline{pp \rightarrow t\bar{b}H^- + X}$$

$$\sigma_{NLO} = \sigma_{LO}|_{g_b^{H^\pm} \rightarrow \tilde{g}_b^{H^\pm}} \times \left\{ 1 + \delta_{QCD} + \delta_{SQCD}^{rem} \right\}$$

$\text{tg}\beta$	$\delta_{SUSY}^{rem} [\%]$
3	-5.7%
5	-7.9%
10	-4.8%
30	-0.13%

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SUMMARY

$t\bar{b}H^-$

- 4FS: QCD corrections $\lesssim 60\%$ for total cxn
 $\Rightarrow \Delta \lesssim 40 - 50\%$ [scale+PDF+ α_s + m_b]
- SUSY-QCD corrections: small after resummation [Δ_b] for large $\text{tg}\beta$
- 5FS: QCD corrections moderate for total cxn
 $\Rightarrow \Delta \lesssim 20 - 30\%$ [scale+PDF+ α_s + m_b]
- new scale setting procedure for 5FS
- Santander-matched results available