Constraint for a light charged Higgs boson and its neutral partners from top quark pairs at the LHC

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A joint work with Jun Gao (高俊)

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- We consider $m_{H^\pm} = 100\text{–}160\,\mathrm{GeV}, \ m_{H_i} = 10\text{–}110\,\mathrm{GeV}.$

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- Prior assumptions:
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    - e.g., the pseudoscalar A, and the extra scalar H, in two-Higgs-doublet models (2HDM).

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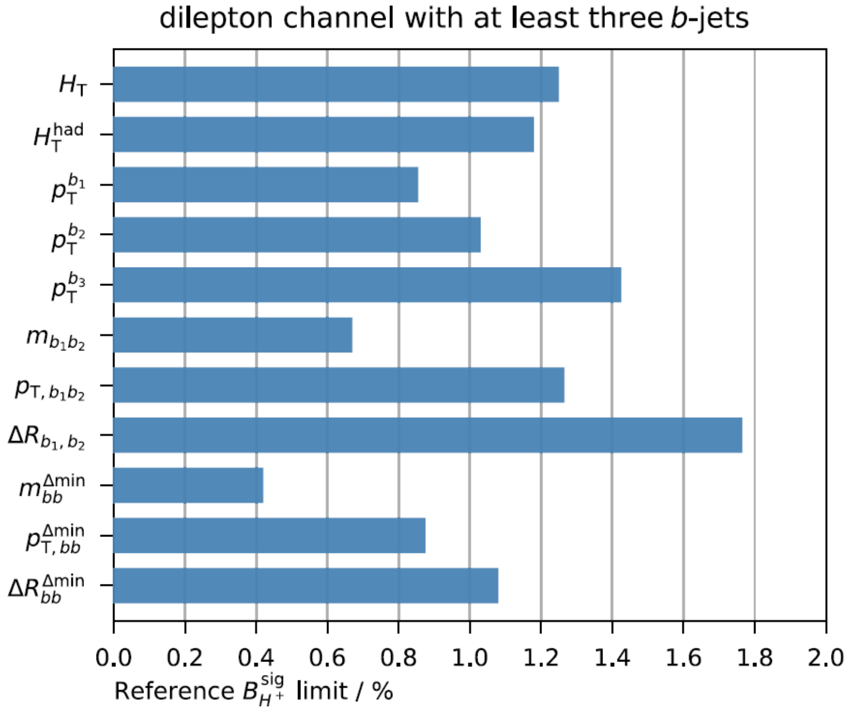

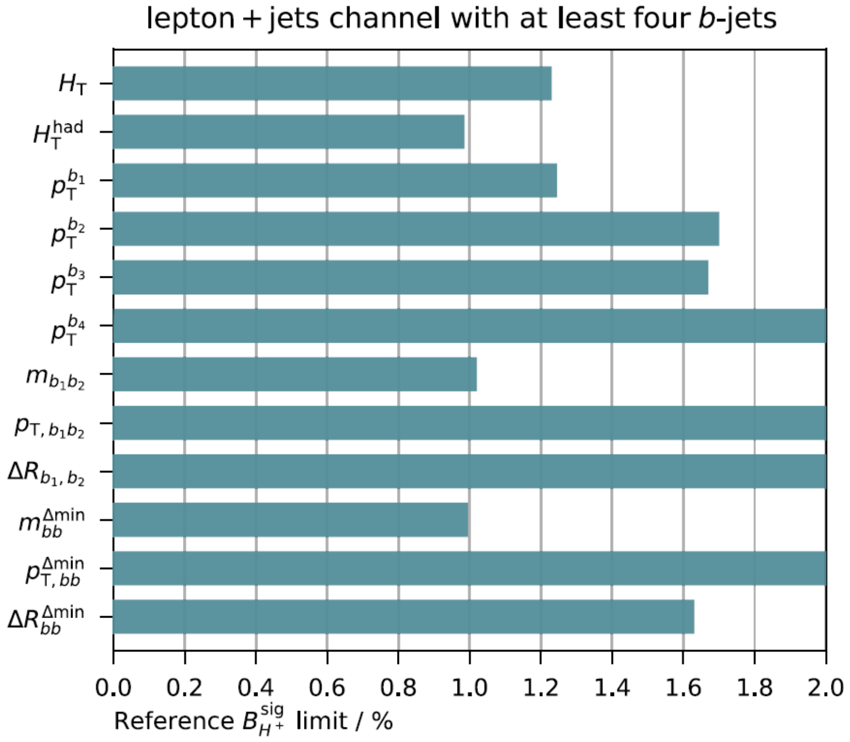

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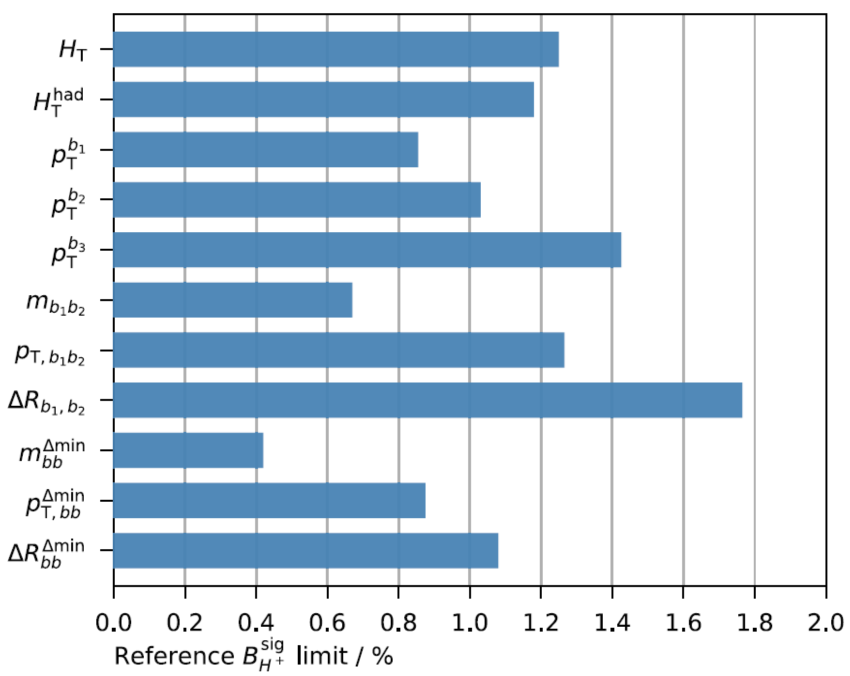
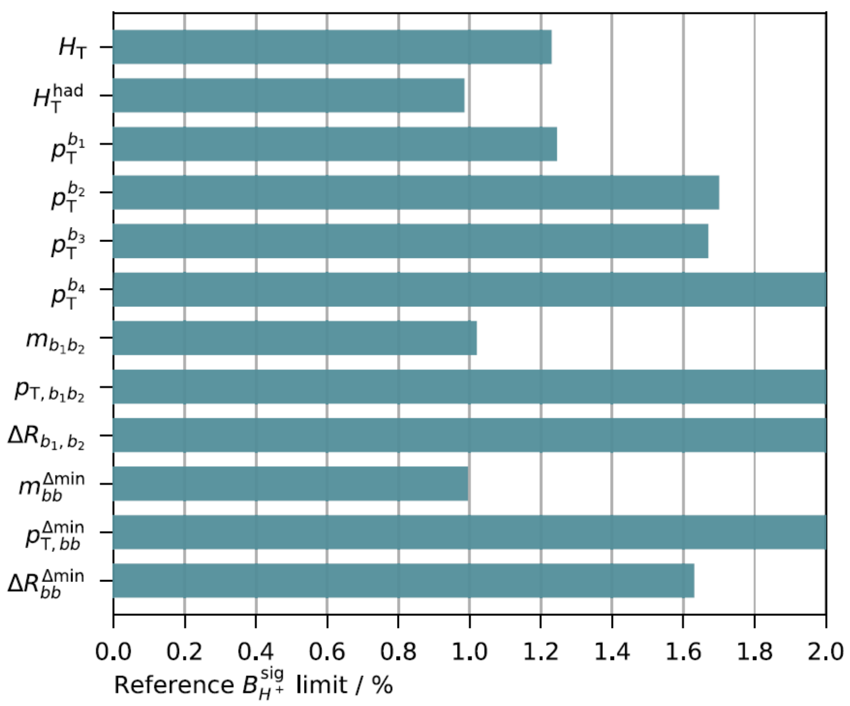
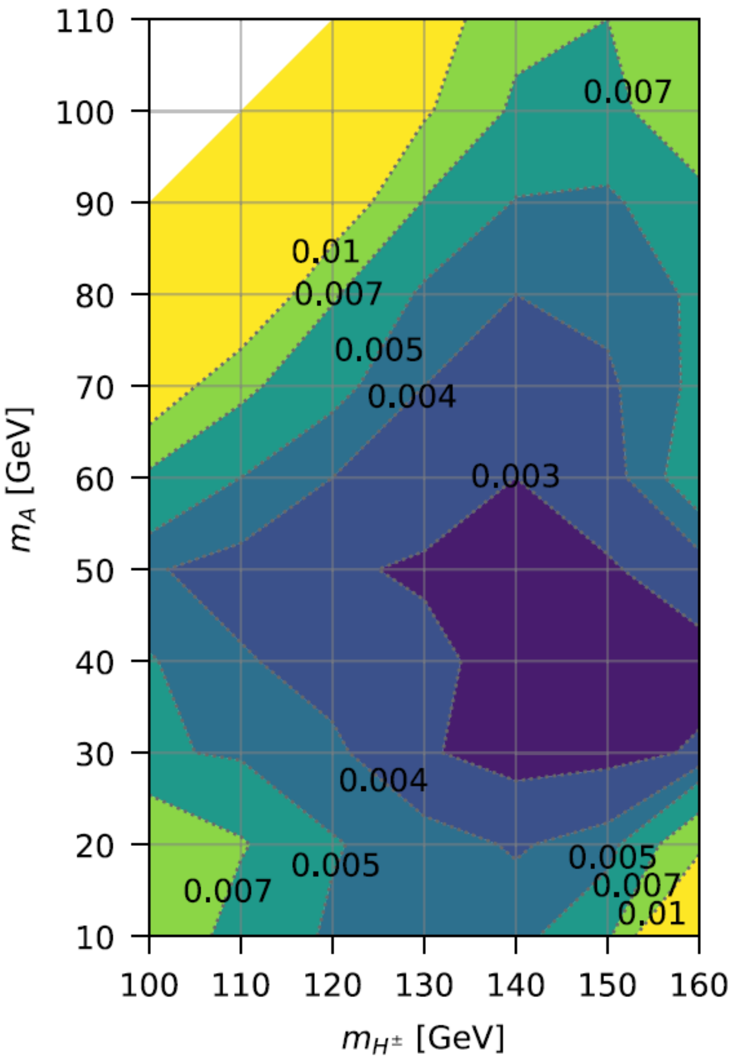
Exception for $m_{H^\pm} \leq 130\,\text{GeV}$, $m_A \geq 70\,\text{GeV}$





Upper limits on $B_{H^+}^{\text{sig}}$ at 95% confidence level



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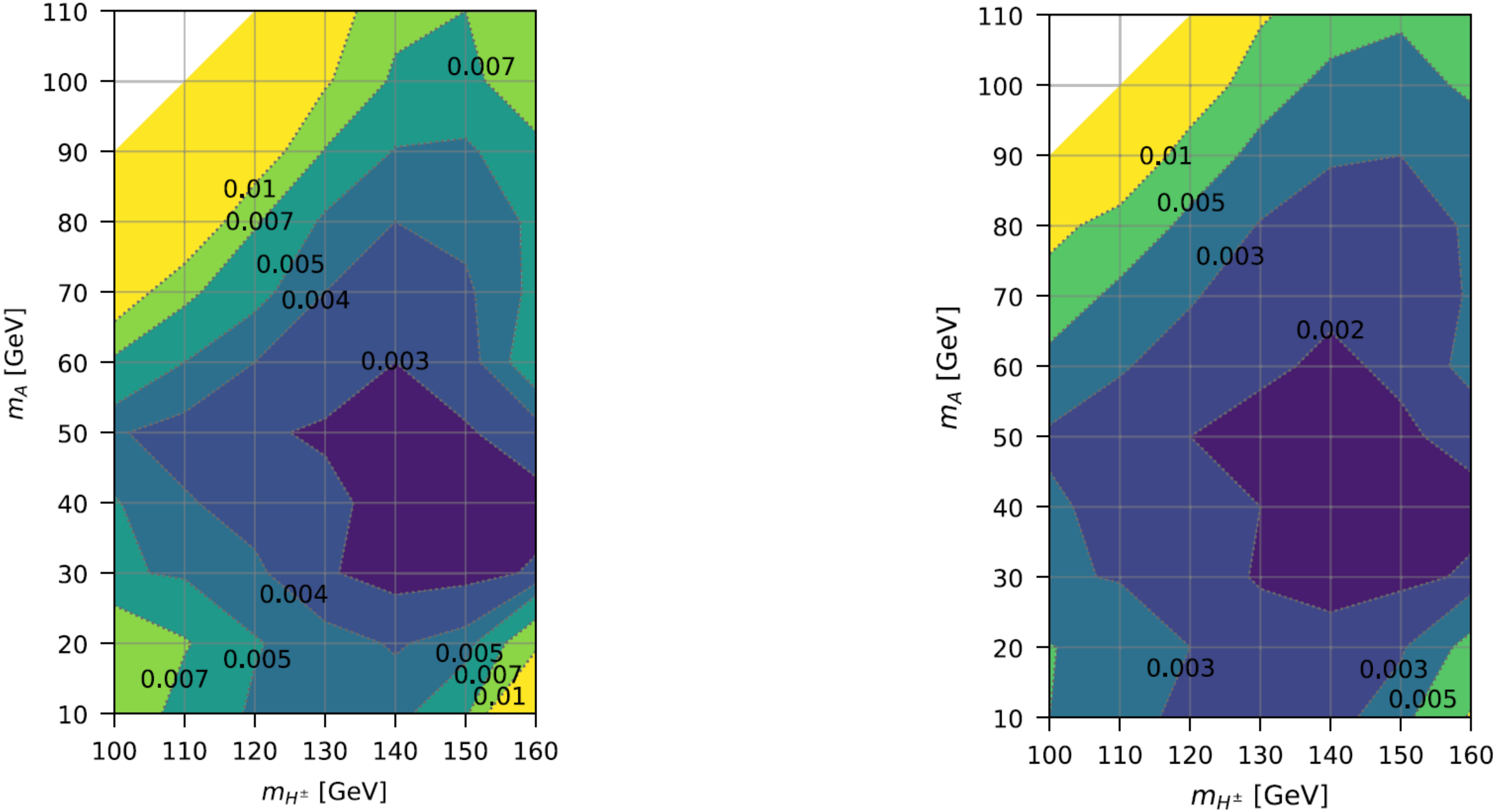
High-luminosity LHC @900 fb^{-1}



↓ 32%–45%

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- On the mass space $(m_{H^\pm}, m_A, m_H)$:
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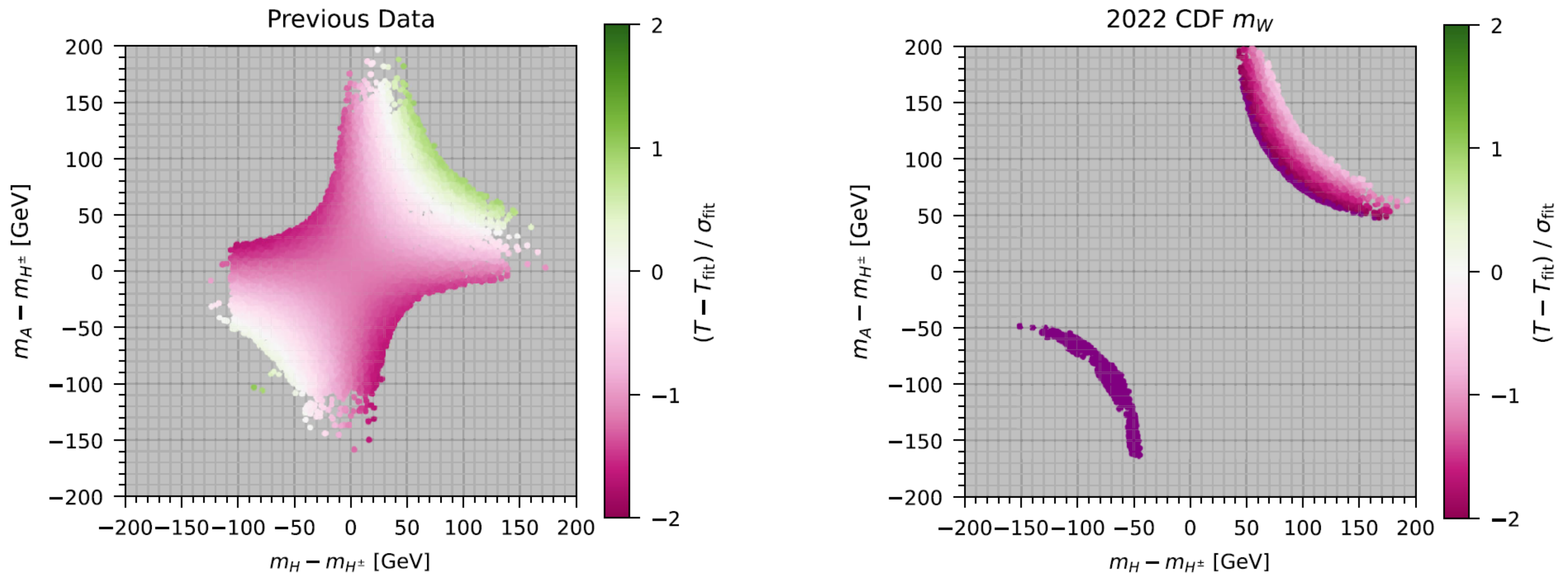

Constraining the parameter space

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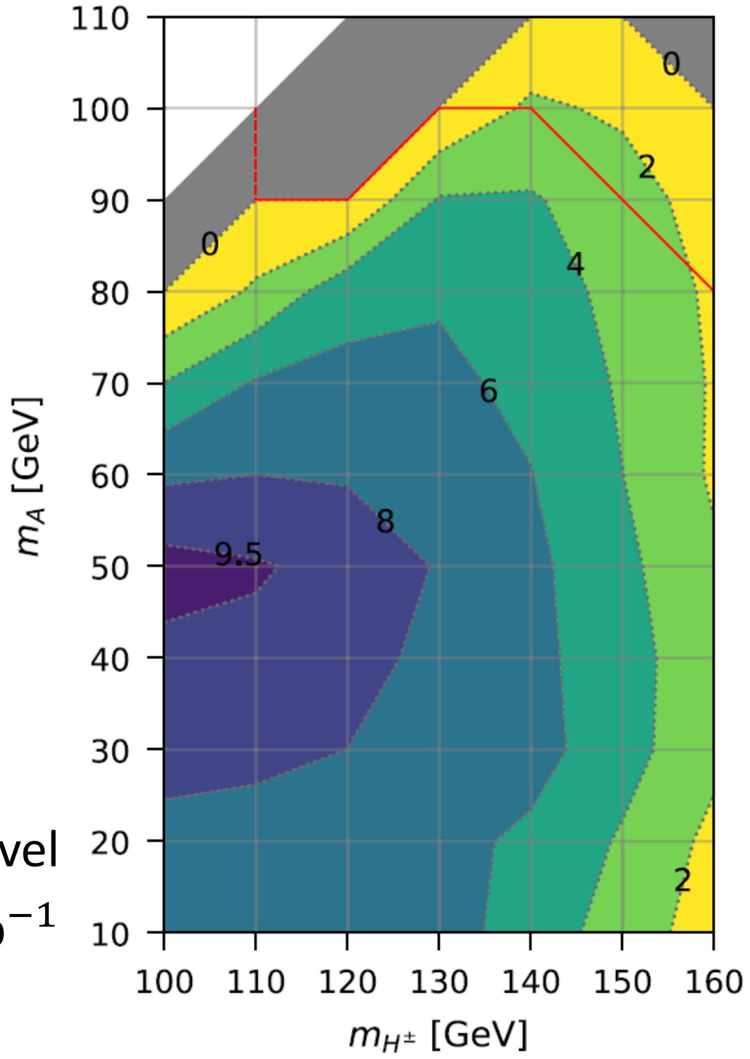
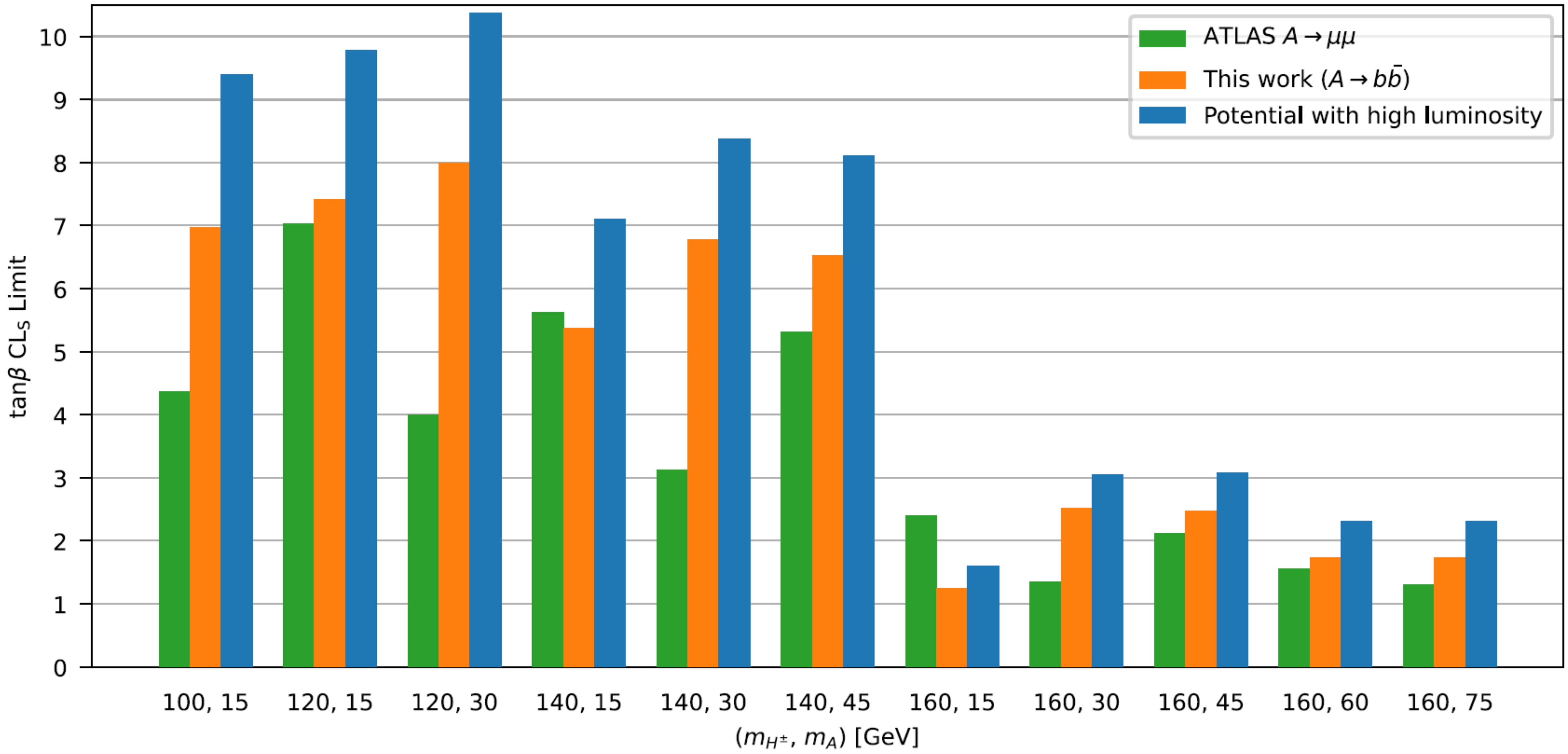


Lower limits on $\tan\beta$ at 95% confidence level

↑ 21%–38% @900 fb^{-1}

A generally stronger result



Other mass hierarchies

- $m_A > m_{H^\pm} > m_H$
  - $c(HH^+H^-)$ ⟶ $H \to \gamma\gamma$
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  - Suppress $H \to b\bar{b}$ with $H \to \gamma\gamma$:

  For $m_{H^\pm} = 100\text{–}170\,\text{GeV},\ m_H < m_A, m_{h_{125}}, m_{H^\pm},\ \tan\beta \sim 10^0, 10^1$,

$$\frac{m_H^{1.1}}{m_{H^\pm}^{2.1} \times 6\ \text{TeV}} \frac{m_{12}^2 \tan\beta}{|\tan 2\beta| \sin 2\beta} > 10 \quad \approx \quad B\big(H \to b\bar{b}\big) < 10\%$$

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