TRIUMF THEORY

Canada's national laboratory for particle and nuclear physics
Laboratoire national canadien pour la recherche en physique nucléaire
et en physique des particules

The Bestest Little Higgs Model in a post-Higgs era

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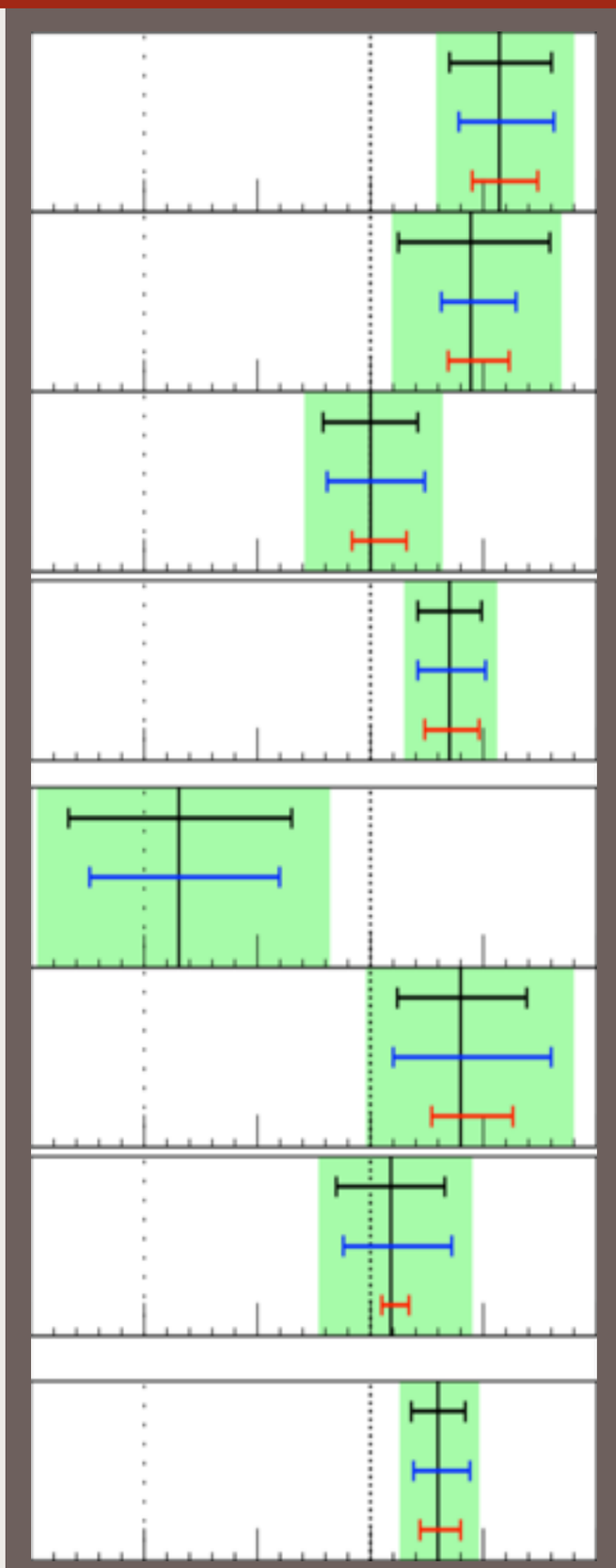
Pittsburgh

Based on arXiv:1310.5130



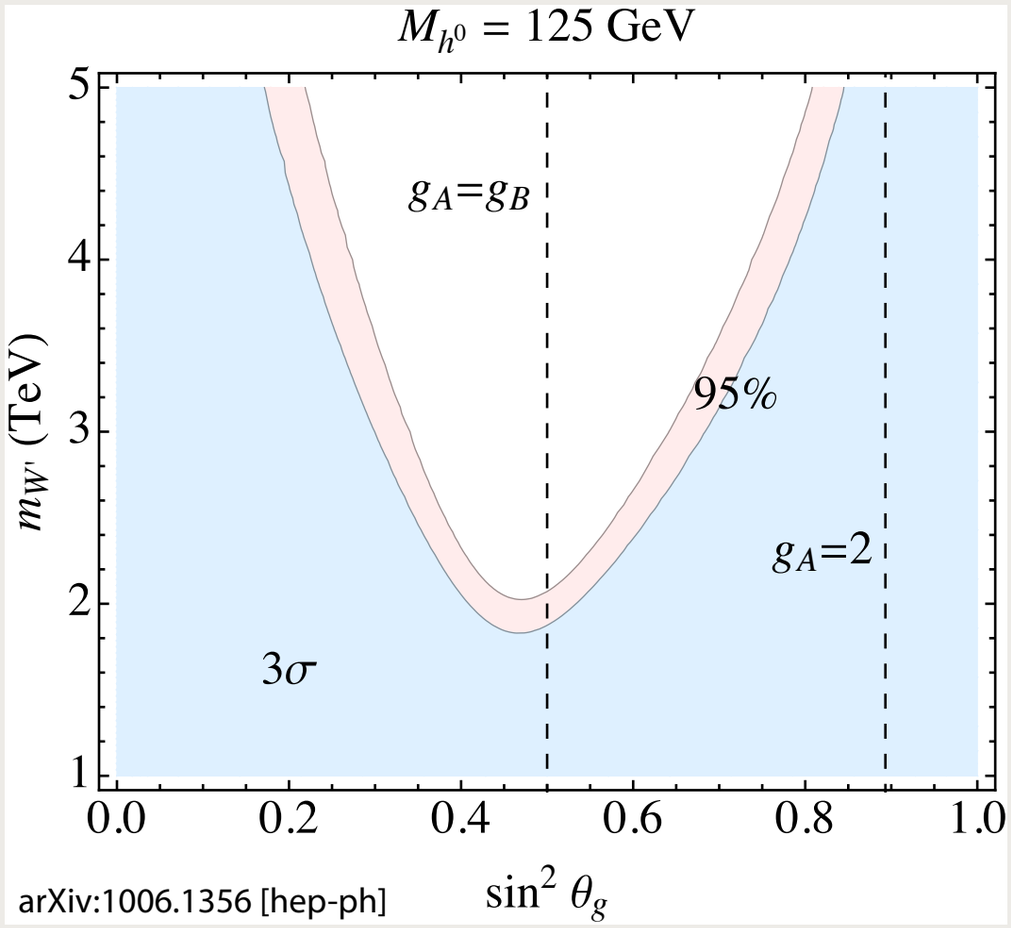
Bestest Little Higgs

- Special Features:
  - Two Higgs Doublet Model
  - Two non-linear sigma fields (<Σ>=f, <Δ>=F, F > f)
  - Custodial Symmetry

$$M_{W'}{}^2 \sim f^2 + F^2$$
$$M_T{}^2 \sim f^2$$

- Reduced constraints from precision data
  - Corrections to EW couplings ~ $v^2/(f^2+F^2)$

- 15-1 “free” parameters



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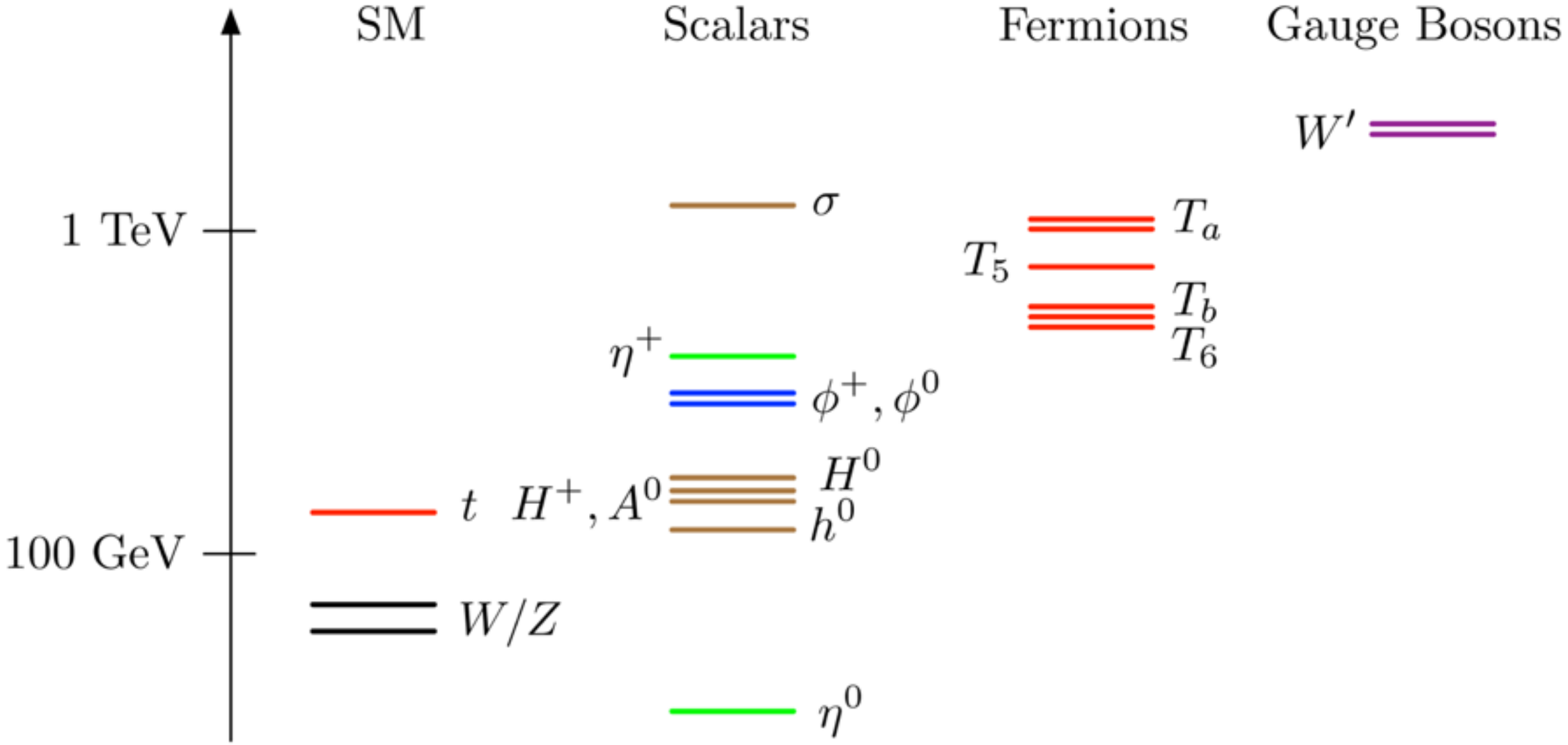

v	m_h	f	F
g	m_A	$tan\theta_{12}$	$tan\theta_g$
c_w	$tan\beta$	$tan\theta_{13}$	
y_T			

Bestest Little Higgs

- Type I 2HDM features - h_0, A_0, H_0, $H^{\pm}$
  - $\tan\beta$, $\tan\alpha = f(v,\beta,m_A,m_h)$

$$y_{hff} = \lambda_{hff} \; v/m_f$$

$$y_{hSS} = \lambda_{hSS} \; v/2m_S{}^2$$

$$y_{hVV} = g_{hVV} \; v/2m_V{}^2$$

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H_0 –

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H_0 $\quad$ –

$$y_{h_0 f\bar{f}} = \frac{c_\alpha}{s_\beta}$$

$$y_{H_0 f\bar{f}} = -\frac{s_\alpha}{s_\beta}$$

$$y_{A_0 u\bar{u}} = \frac{c_\beta}{s_\beta}$$

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Bestest Little Higgs

- Non-linear sigma model with heavy quarks, scalars

$$\Gamma(h \to gg) = \frac{\alpha_s^2 m_h^3}{32\pi^3 v^2}\left|\sum_i -\frac{1}{2} y_i F_{1/2}(\tau_i)\right|^2$$

$$\Gamma(h \to \gamma\gamma) = \frac{\alpha^2 m_h^3}{256\pi^3 v^2}\left|\sum_i y_i N_{ci} Q_i^2 F_i(\tau_i)\right|^2$$

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$$F_1 \to 7$$
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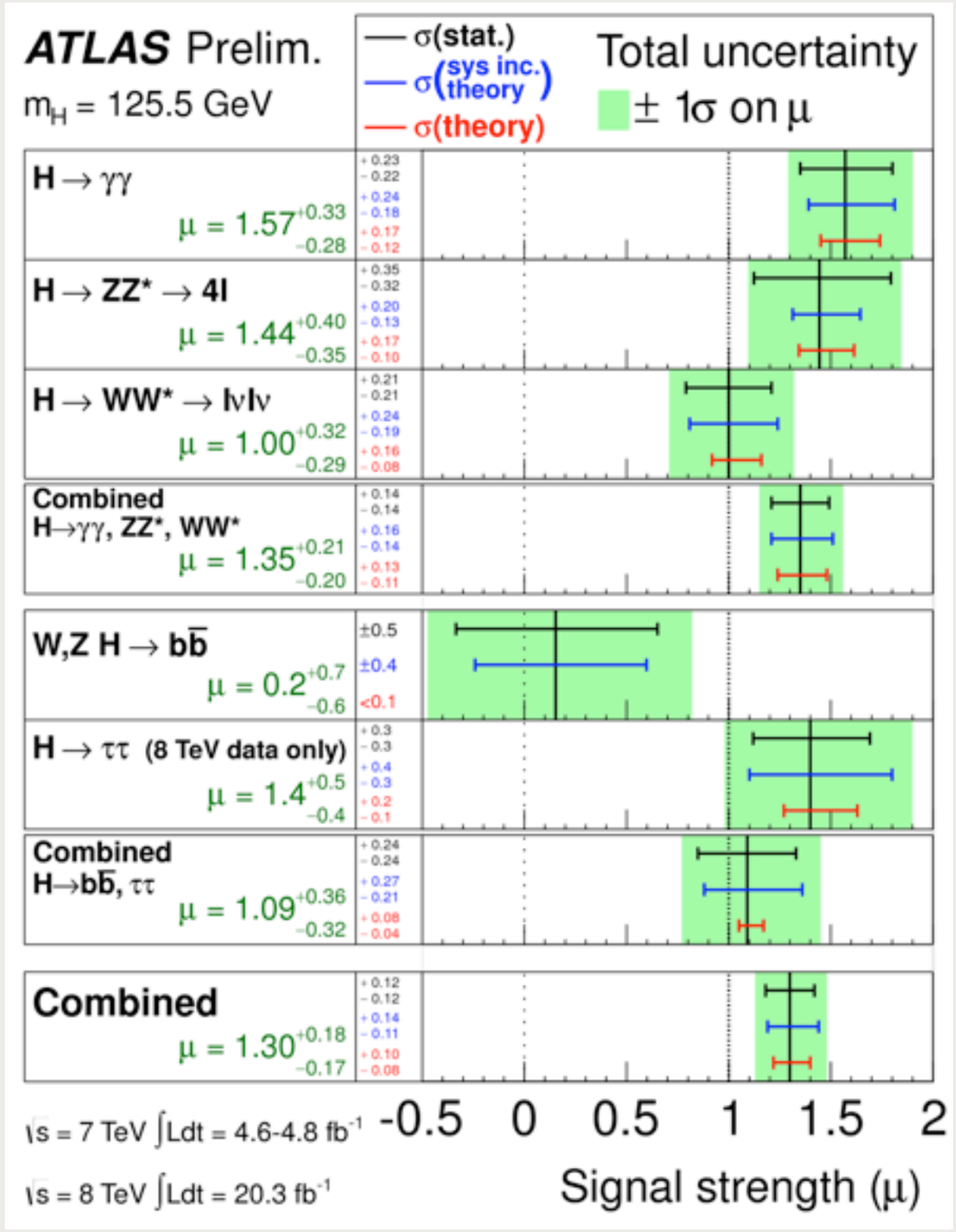
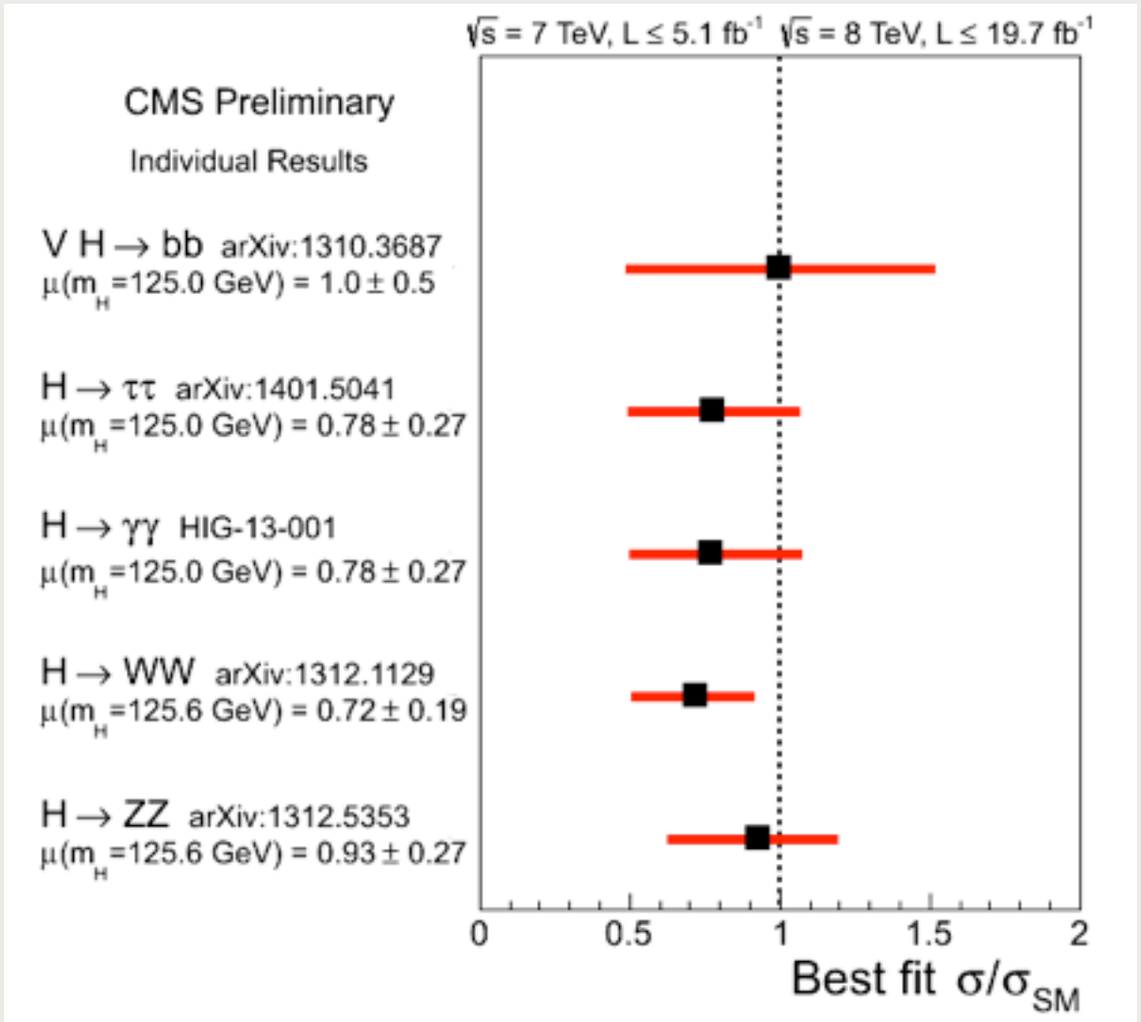
$$y_T = \mathrm{O}(\lambda_T)\ \frac{v^2}{f^2}$$

$$y_{W'} = \mathrm{O}(g)\ \frac{v^2}{f^2+F^2}$$

Higgs Results





General vs Degenerate

- General
  - $m_h \in (124.5, 126.5)$
  - $m_A \in (m_h, 700)$
  - $\tan\beta > 1$
  - $f > 700$, $F > f$

- Degenerate
  - $m_h \in (124.5, 126.5)$
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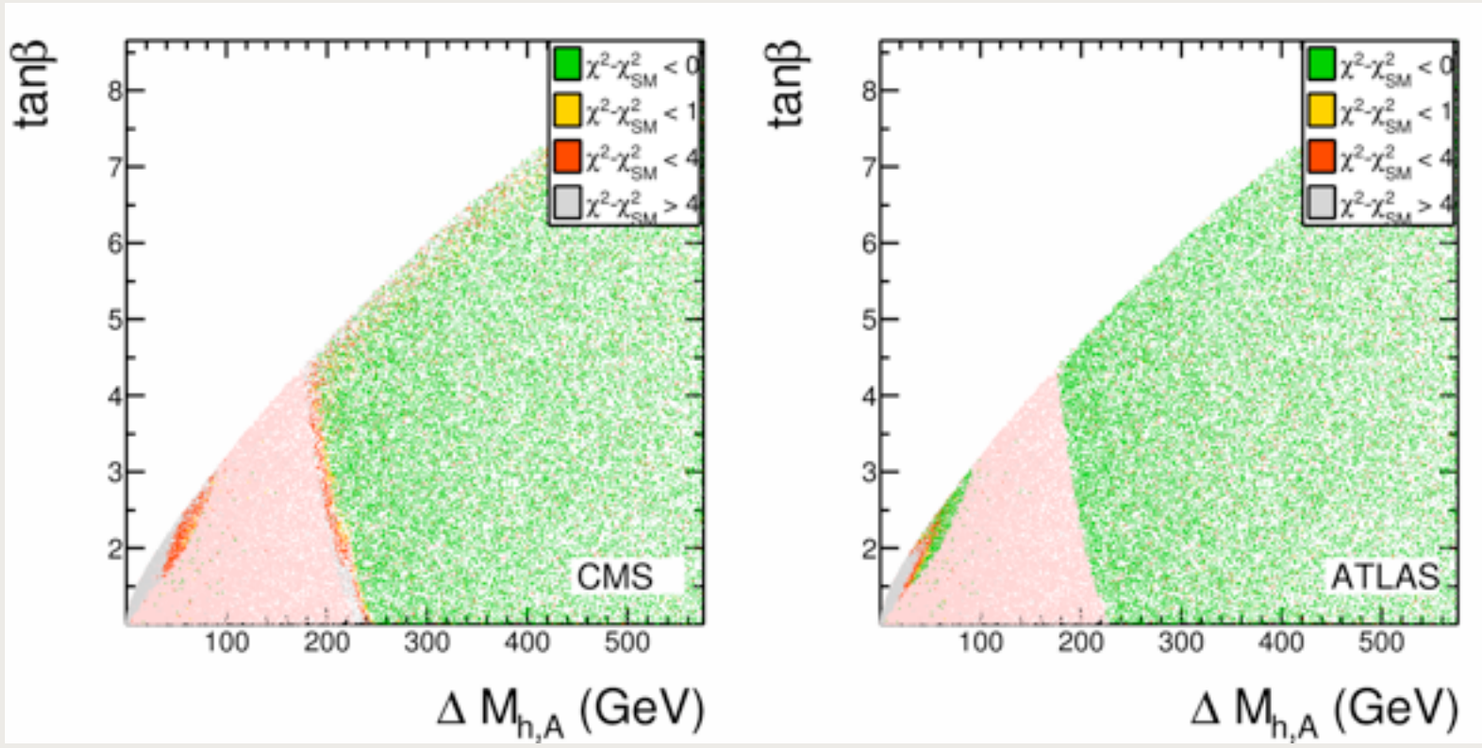

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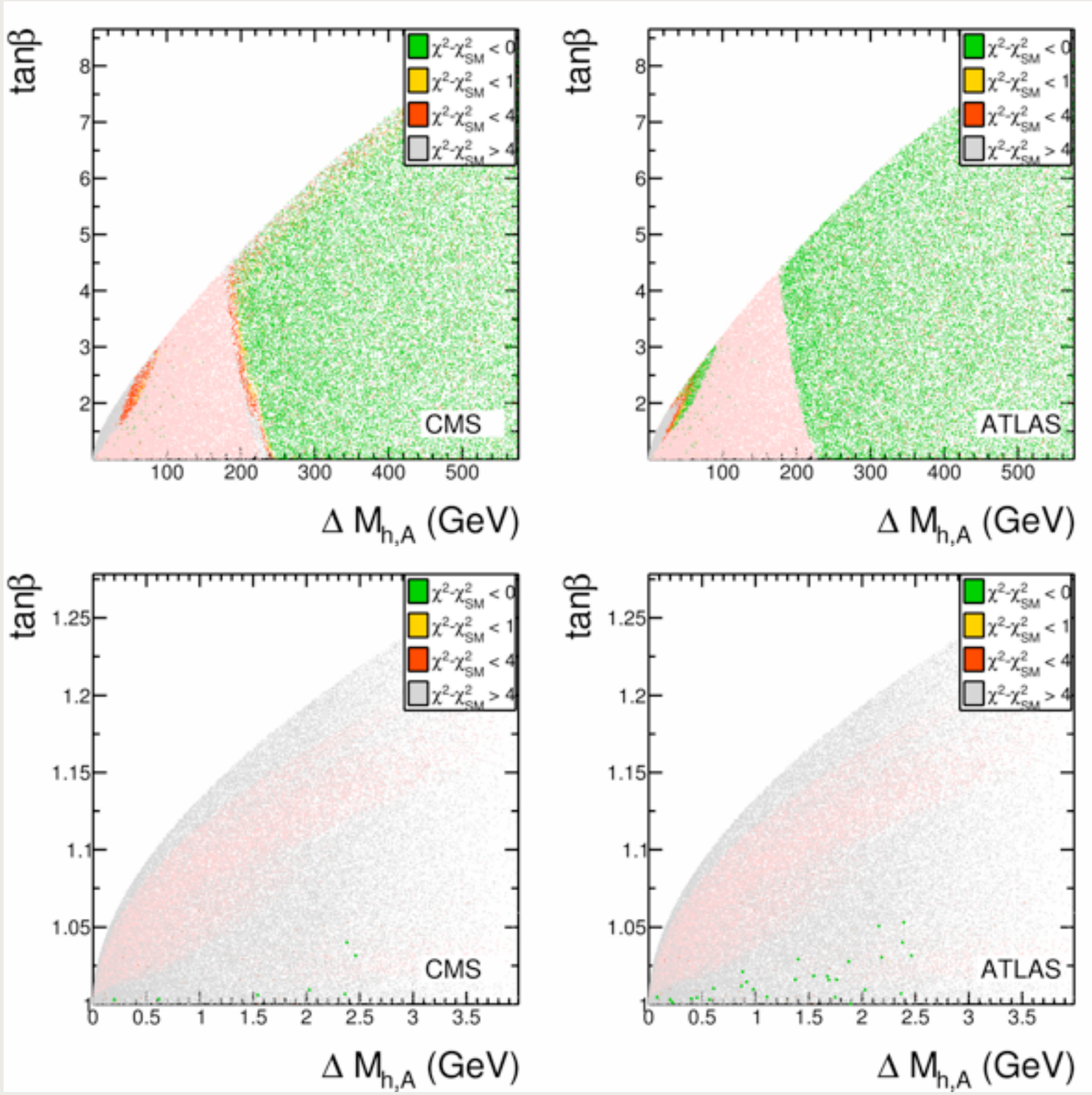
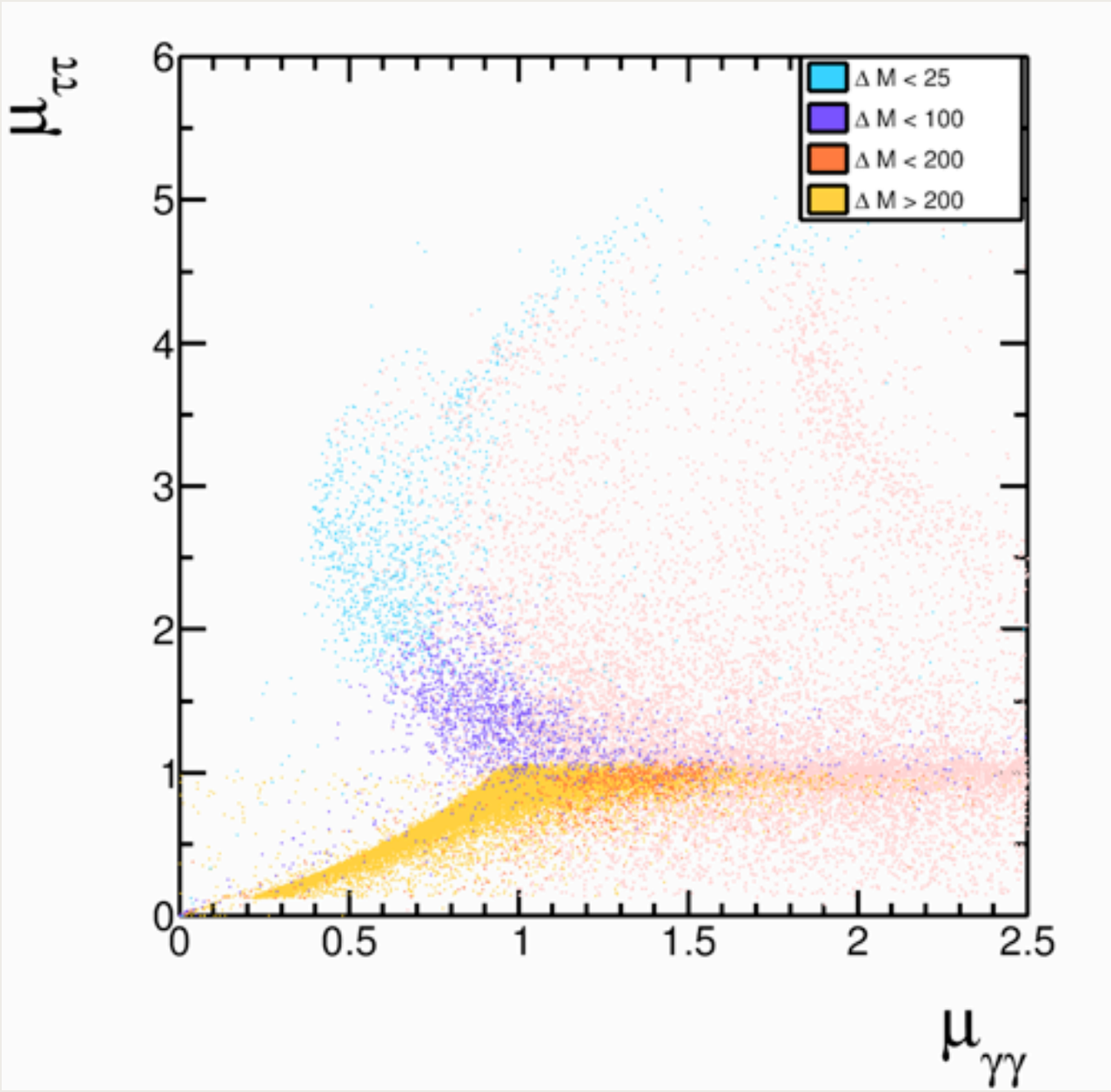


The τ Conundrum

General



Degenerate

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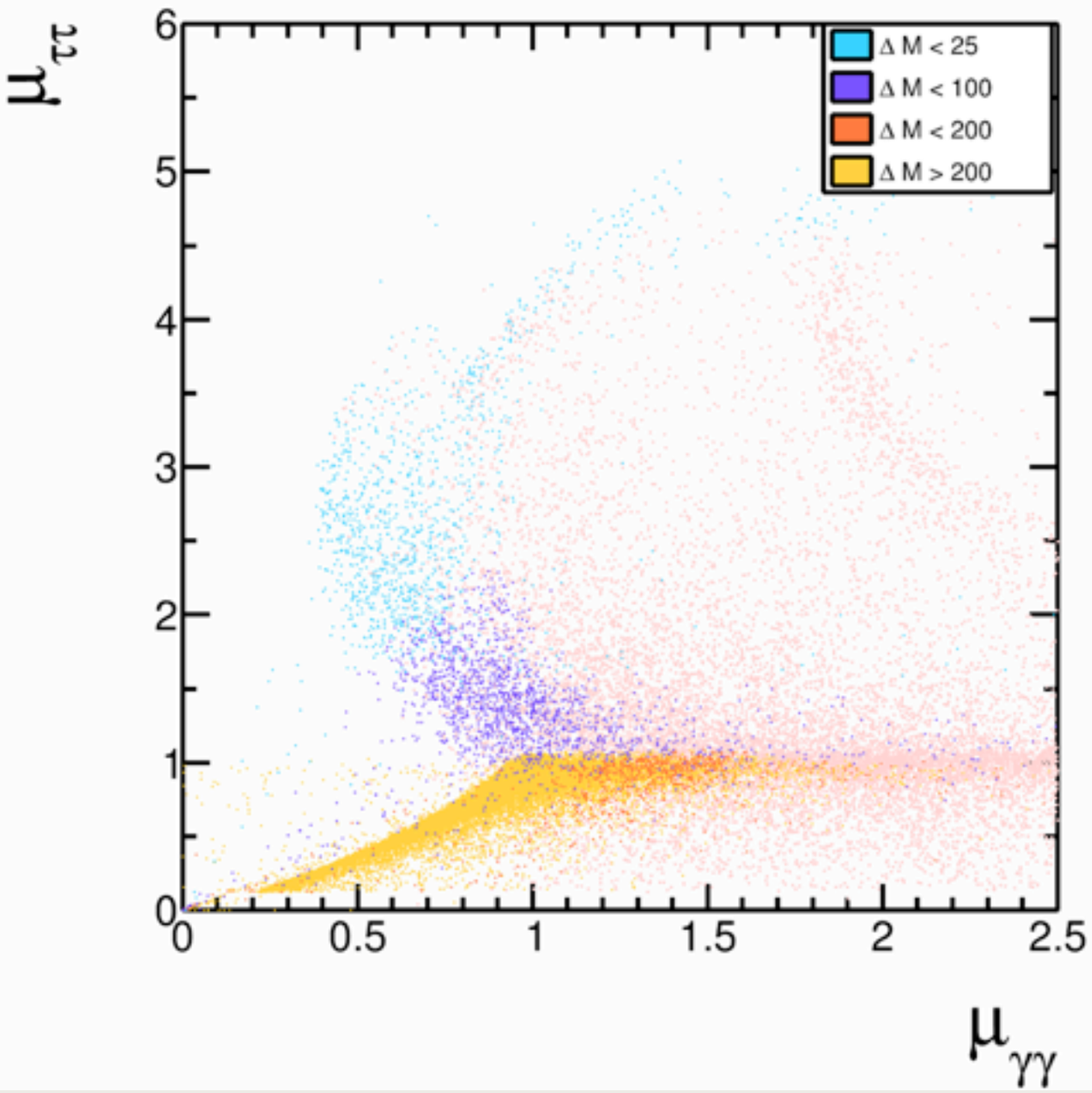
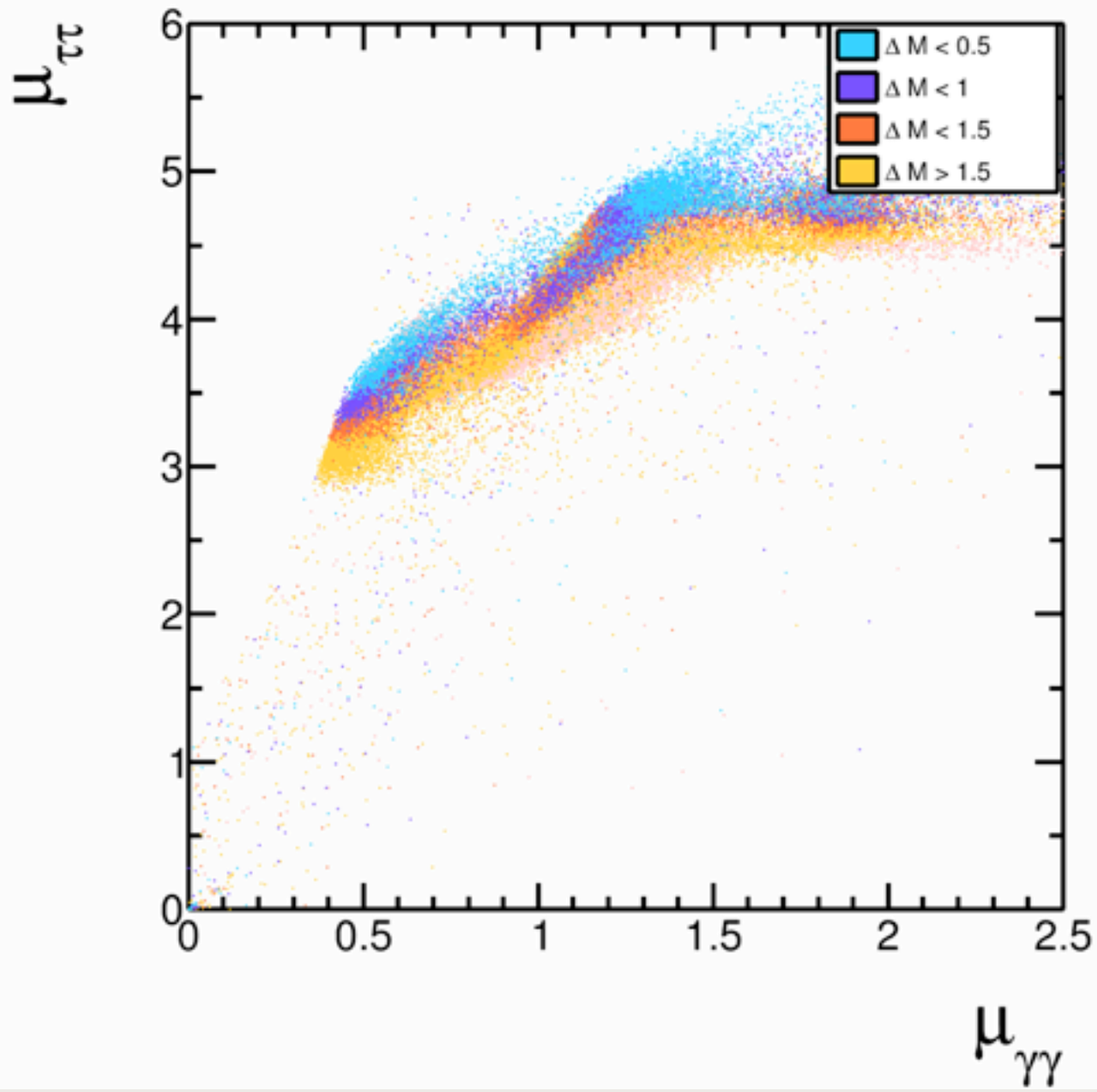
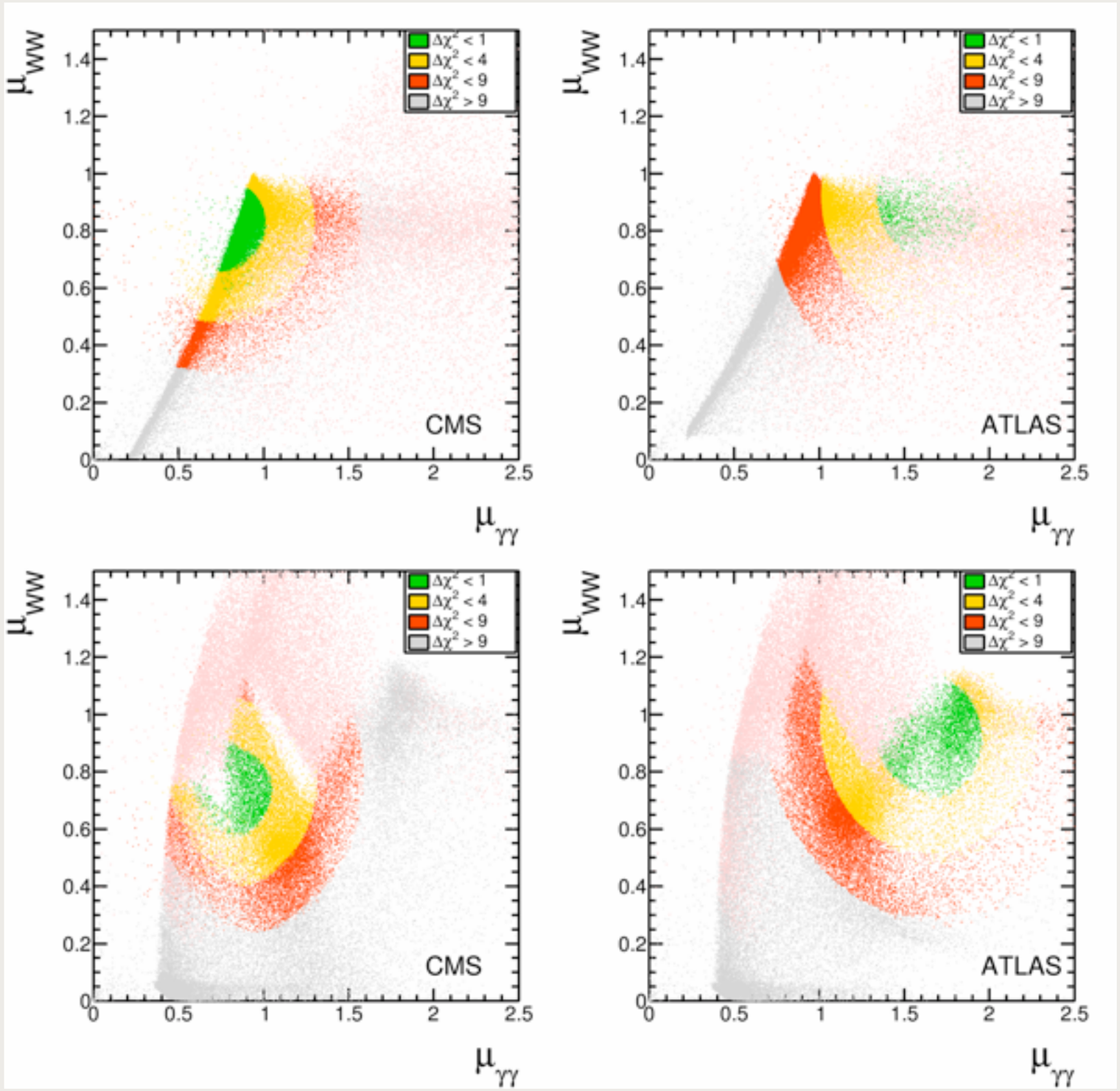


Degenerate



Reducing the measurements

- General
  - $\delta\mu<0.4$



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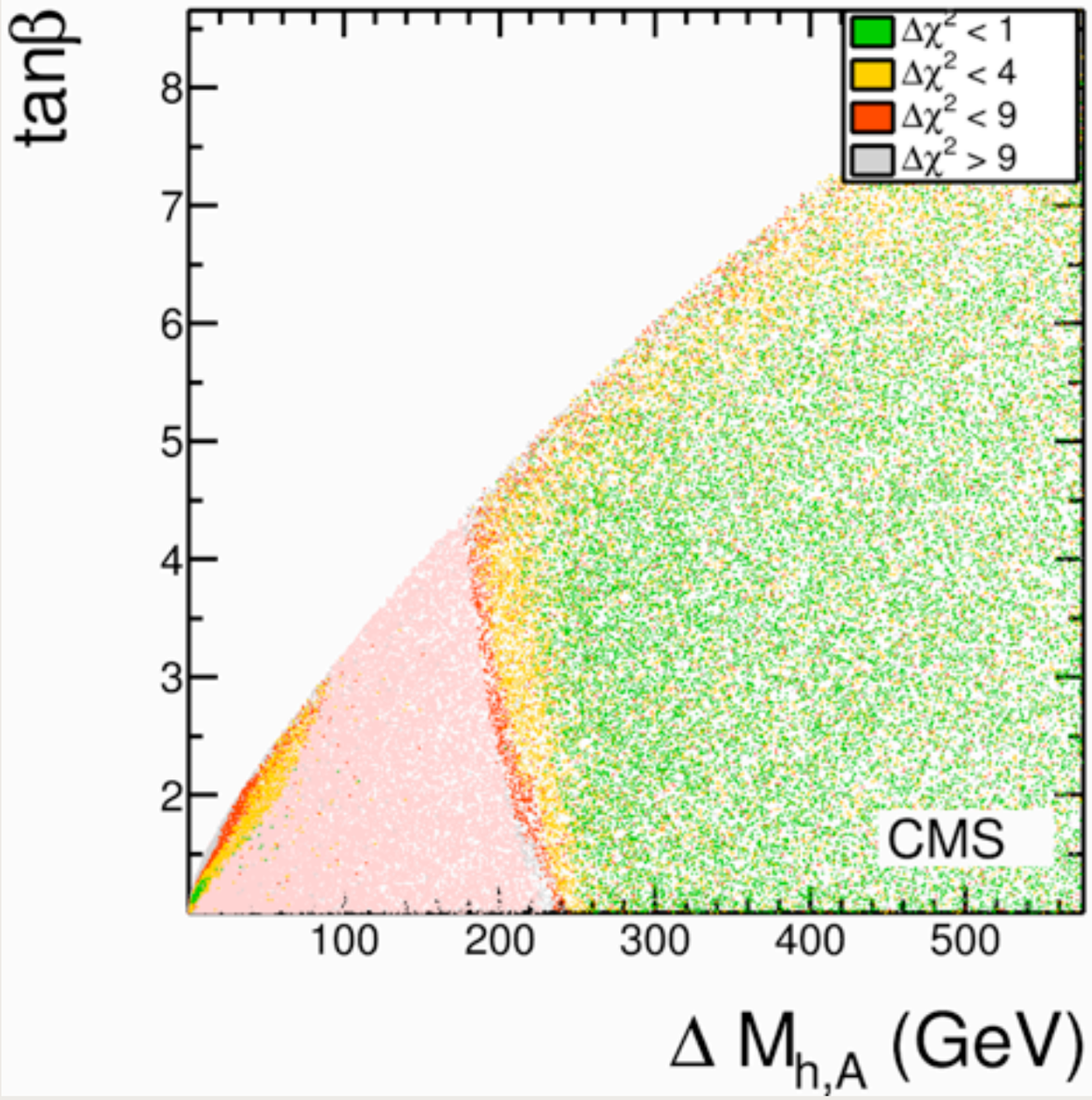
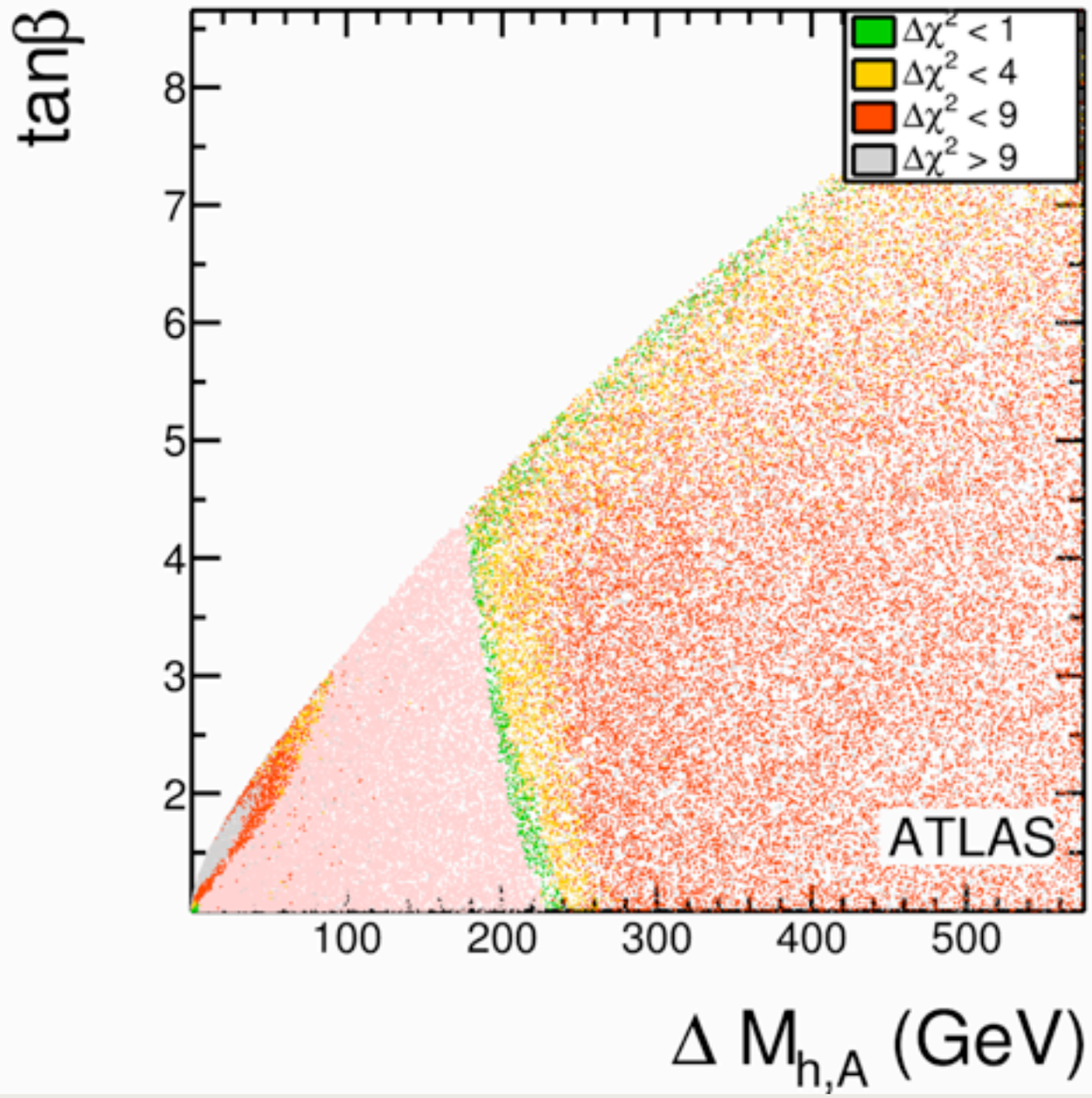




Summary

- Near-degenerate scenario disfavoured by $\tau^+\tau^-$ measurements

- Can still achieve enhancement of diphoton rate due to non-SM field contributions to loops

- BLH passes EWPO, Higgs data

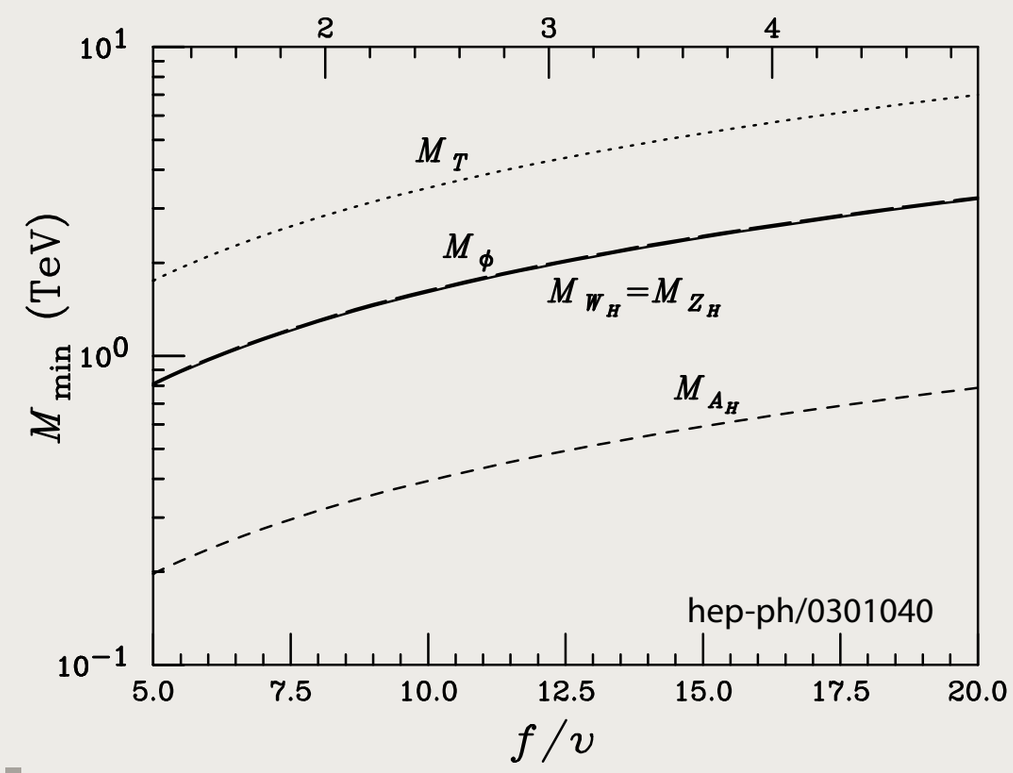
Backup Slides

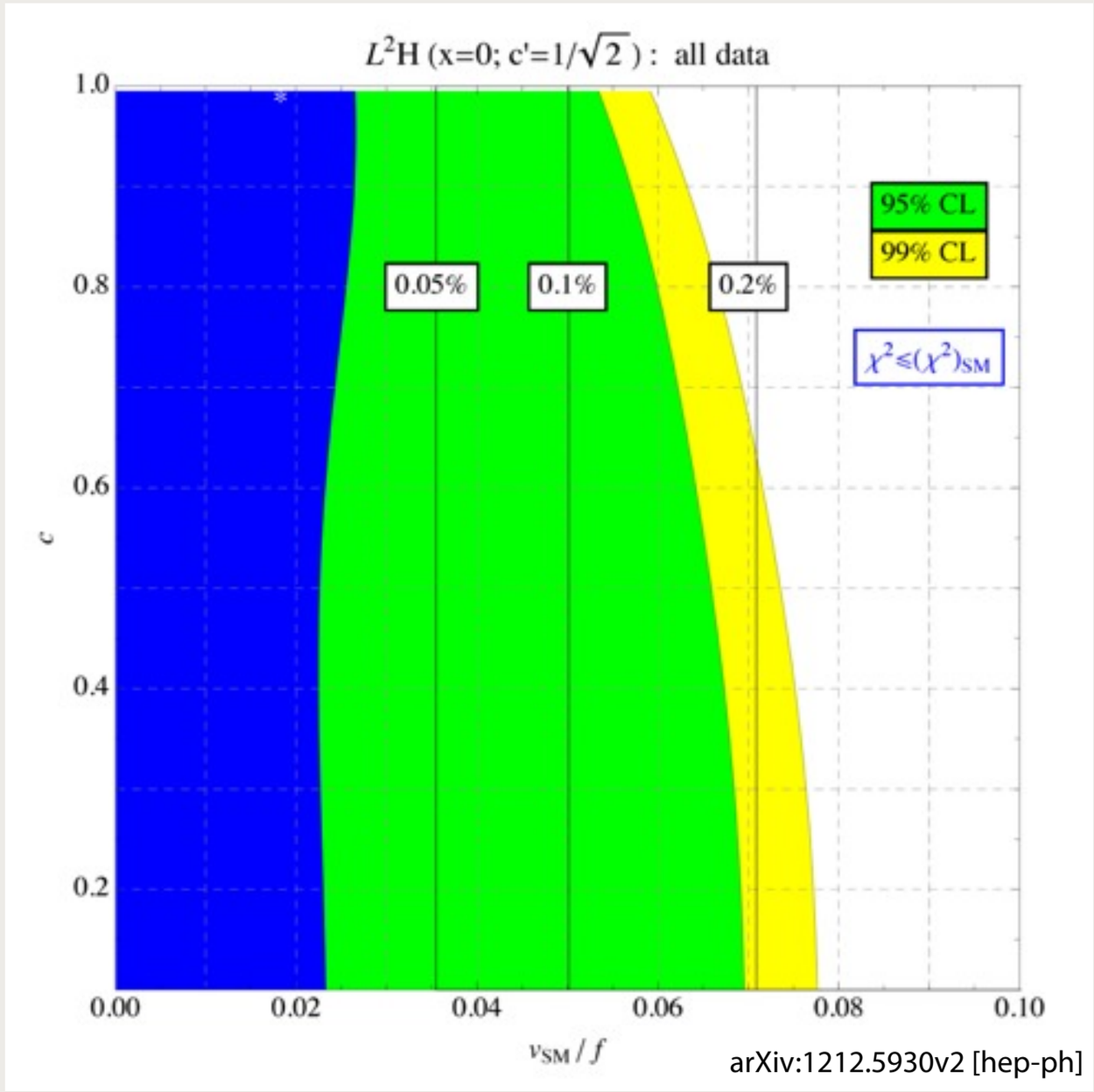
Littlest Higgs

- Constraints

$$M_T \gtrsim m_t \frac{2f}{v}$$

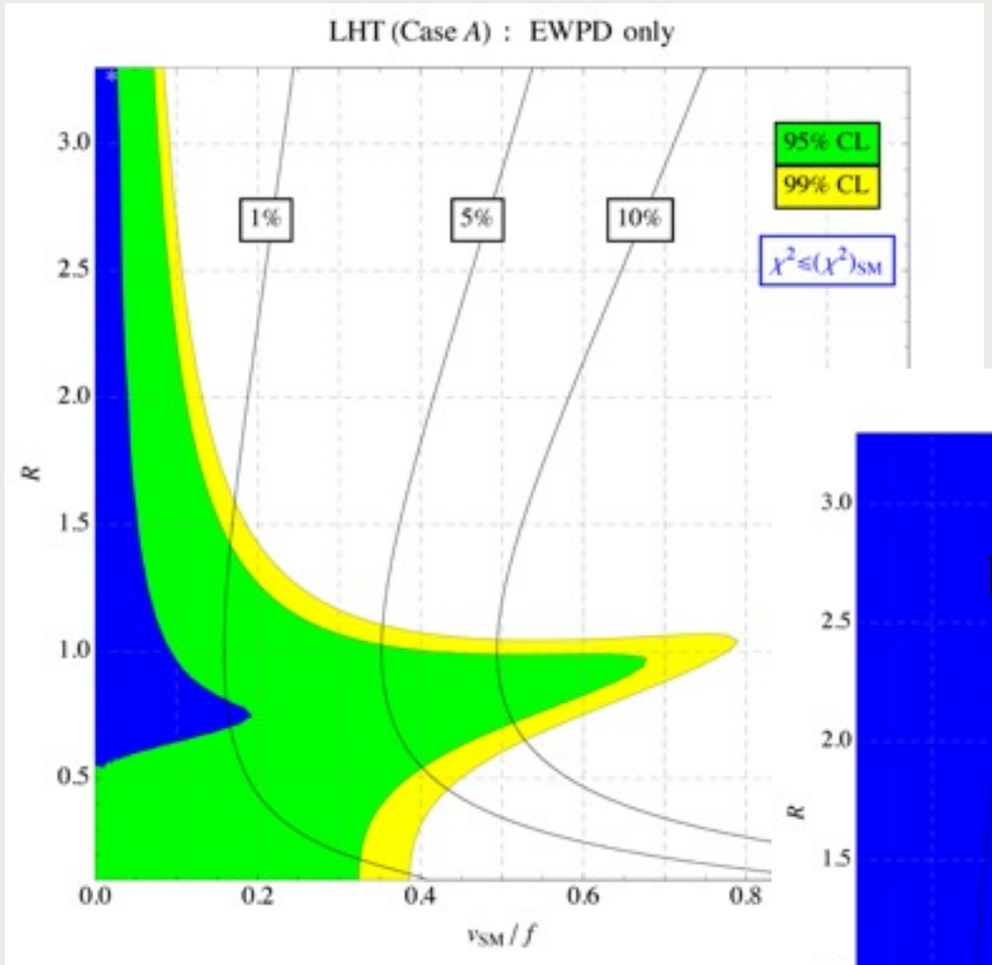
$$M_{W_H} \gtrsim m_w \frac{2f}{v}$$

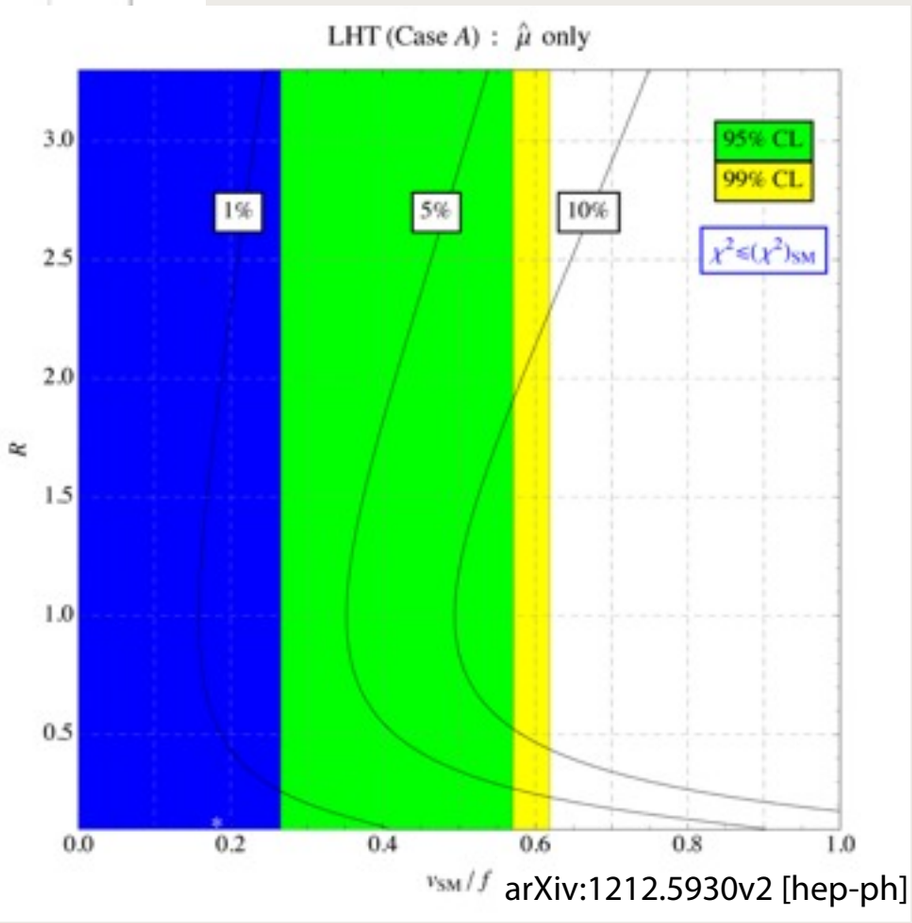


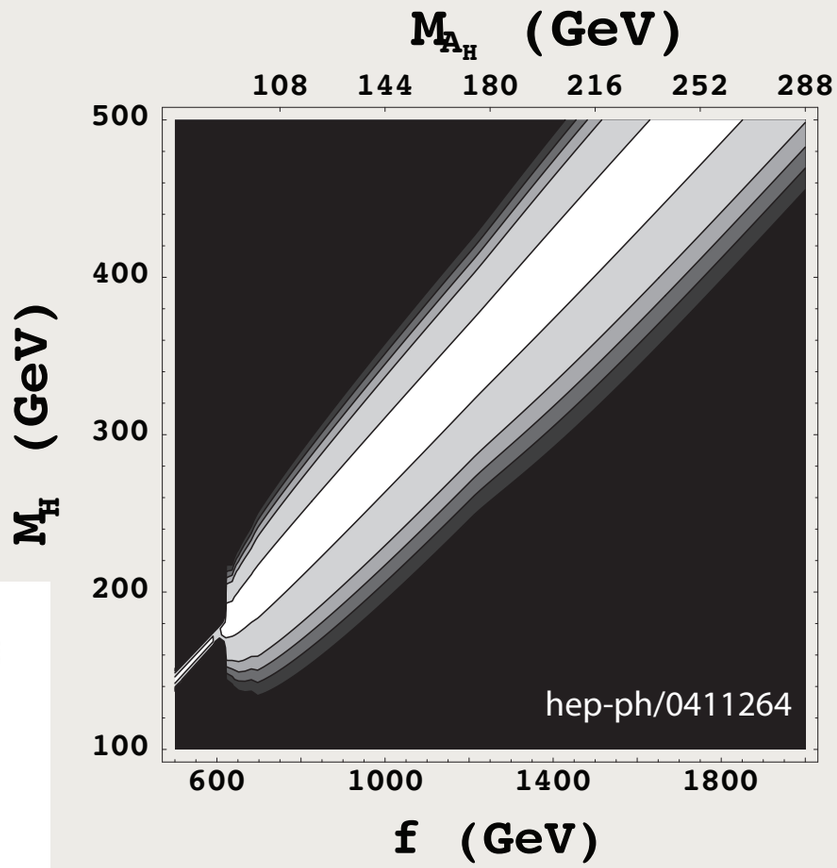


Littlest Higgs with T-Parity

- EWPO relaxed







arXiv:1212.5930v2 [hep-ph]

Reducing the measurements

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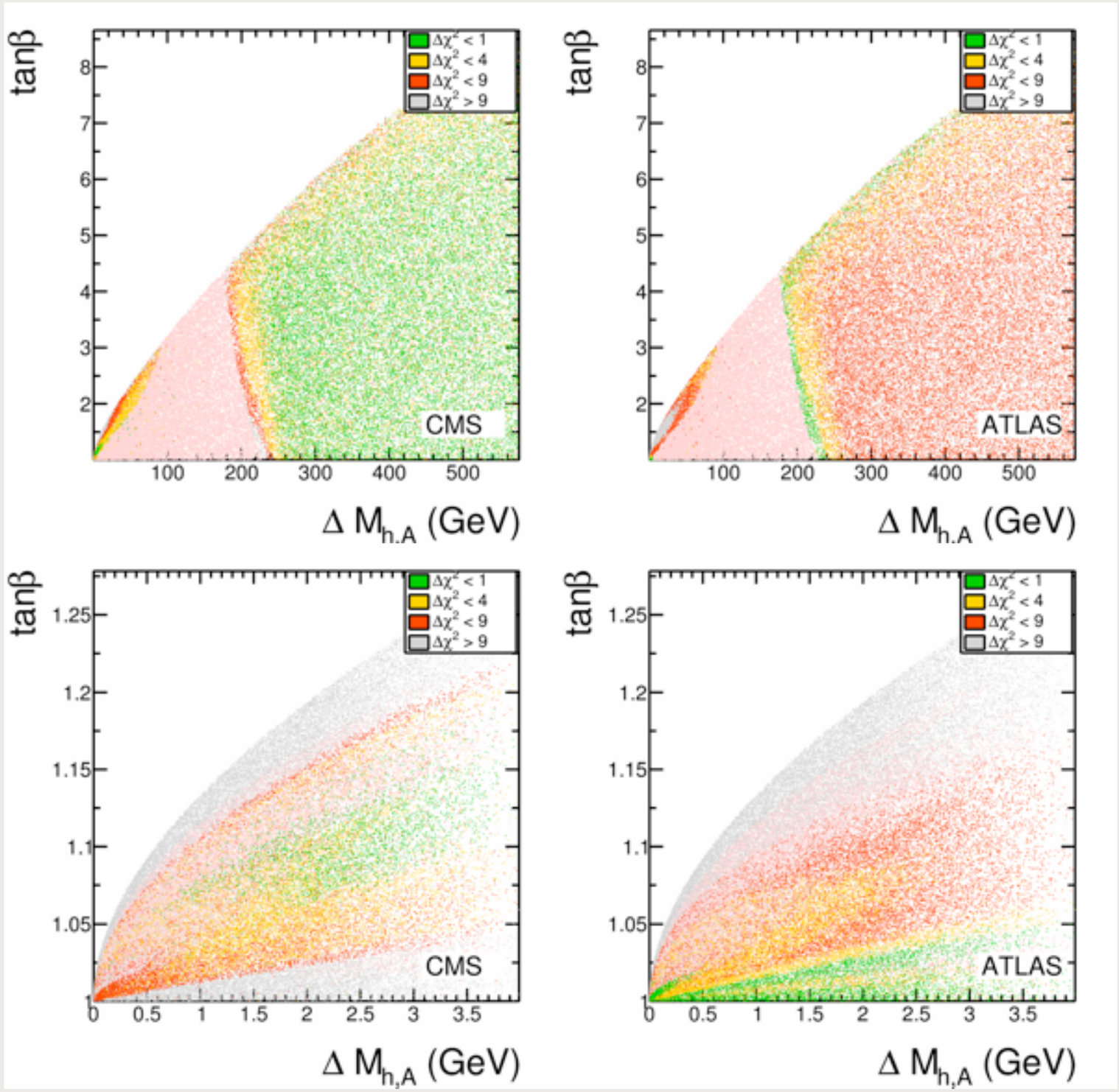

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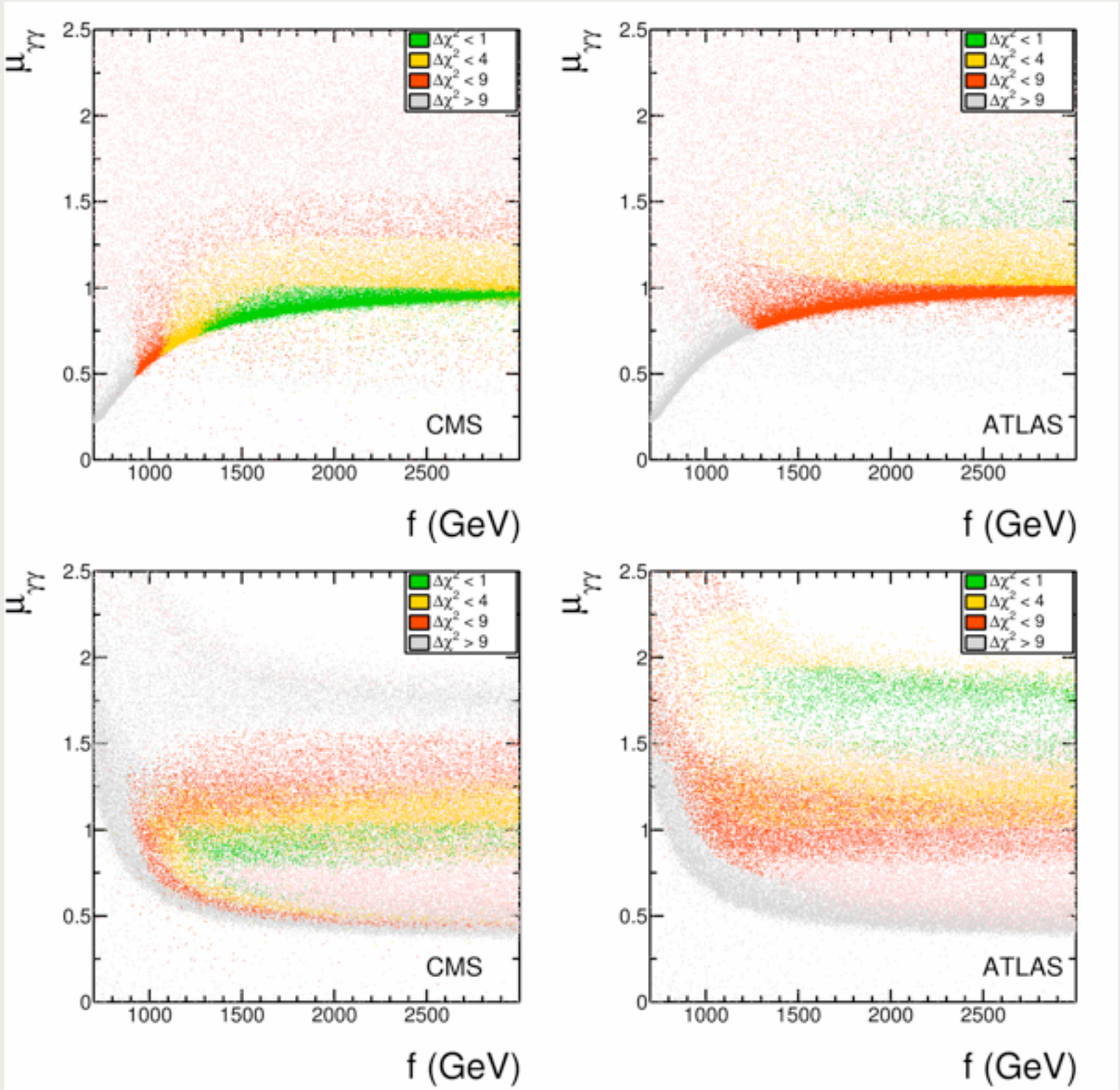

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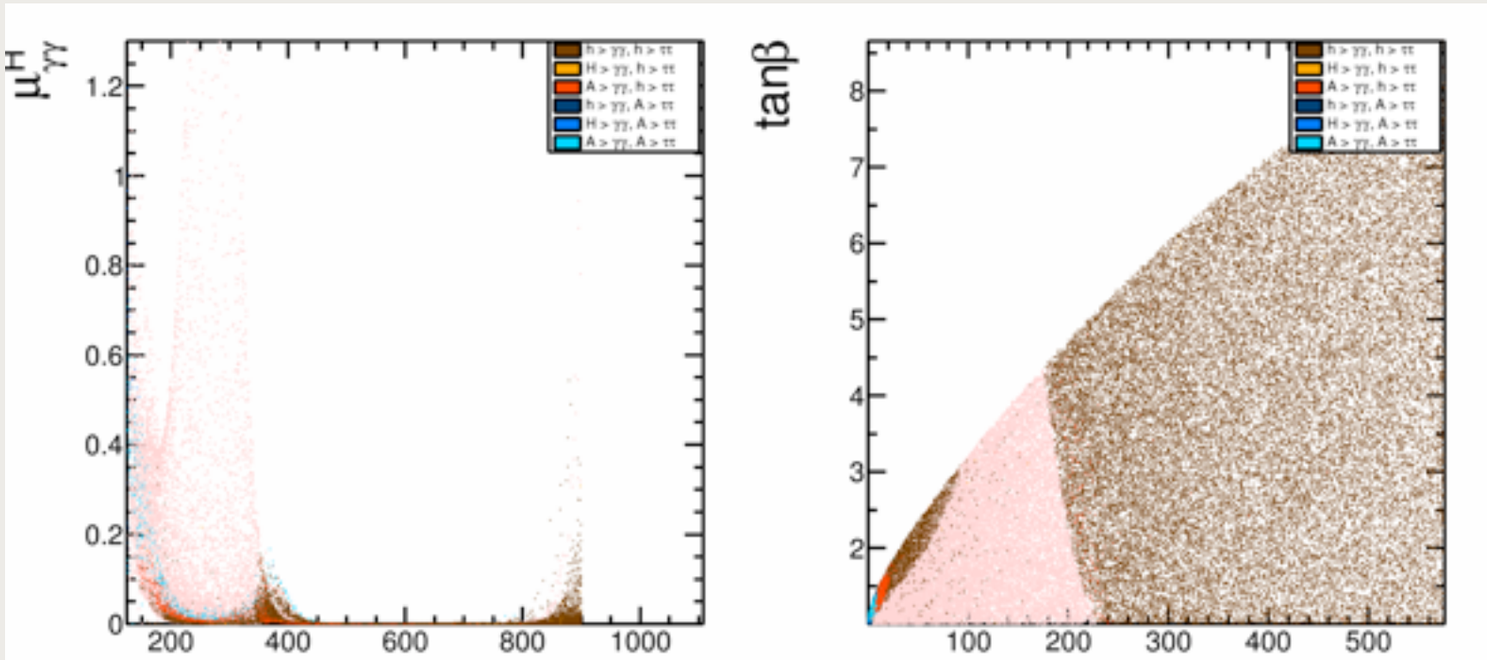
Other results

- Points ruled out because:
  - H > γγ
  - A > γγ
  - ~~H > WW~~



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