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Possibility of Multiple Higgs Bosons

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Contents

- Theories that introduce new Higgs bosons
- MSSM & NMSSM
- Search at CMS

Theories

- Two-Higgs-Doublet Models

  $h, H, A, H^{\pm}$

- Composite Higgs Models

  Pseudo-Nambu-Goldstone boson H

Theories

- Minimal Supersymmetric SM

$$h, H, A, H^{\pm}$$

- Next-to-Minimal Supersymmetric SM

$$H_1\ H_2\ H_3\ A_1\ A_2\ H^{\pm}$$

MSSM & NMSSM

- "μ-Problem"

$$W_{MSSM} \sim \mu \hat{H}_u \cdot \hat{H}_d$$

$\mu = 0$ No Higgsino mass, no EWSB.
$\mu \gg 1$ TeV EWSB spoiled.

μ has to be chosen by hand ~ 246 GeV !

MSSM & NMSSM

- Superfield $\hat{S}$

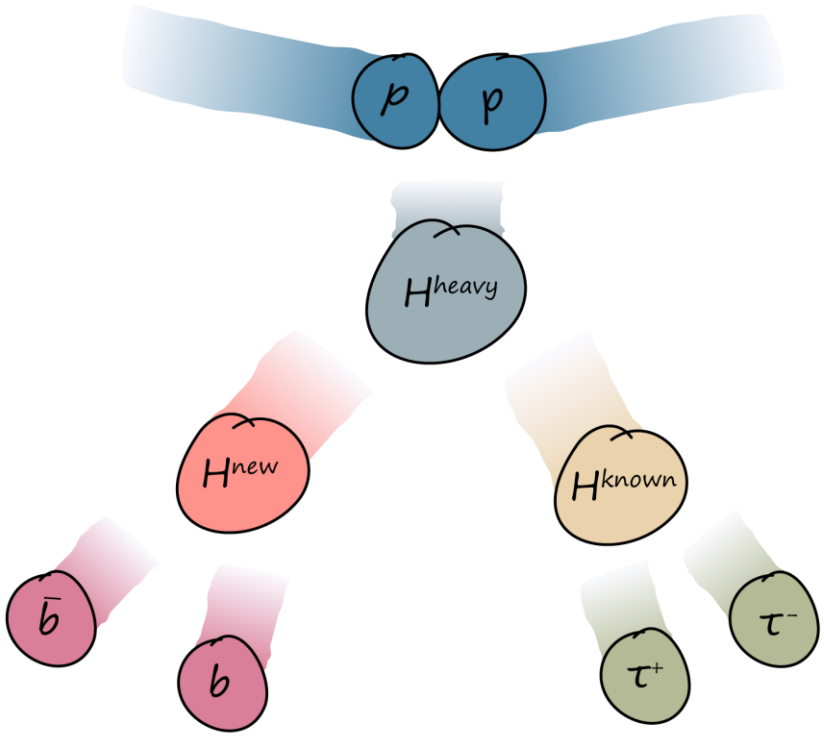
$$W_{NMSSM} \sim \lambda \hat{S} \hat{H}_u \cdot \hat{H}_d + \frac{\kappa}{3} \hat{S}^3$$

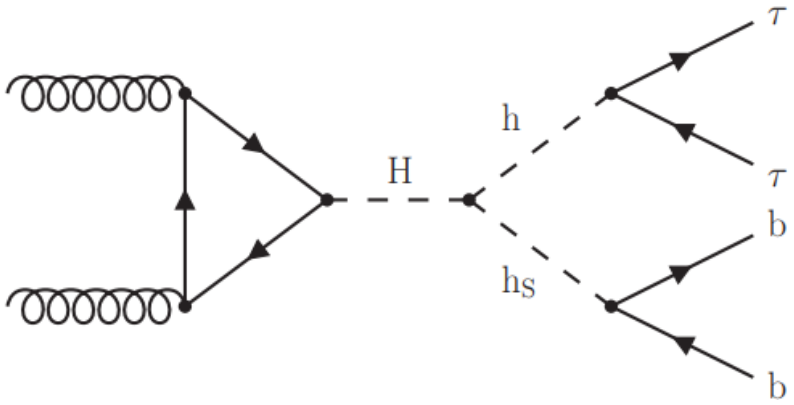
$$\mu = \lambda < S > \sim 246 \text{ GeV}$$

$$S = \frac{1}{\sqrt{2}} \left(S_R(x) + i S_I(x) \right),$$

After EWSB, H_1 H_2 H_3 A_1 A_2 $H^{\pm}$

CMS Search

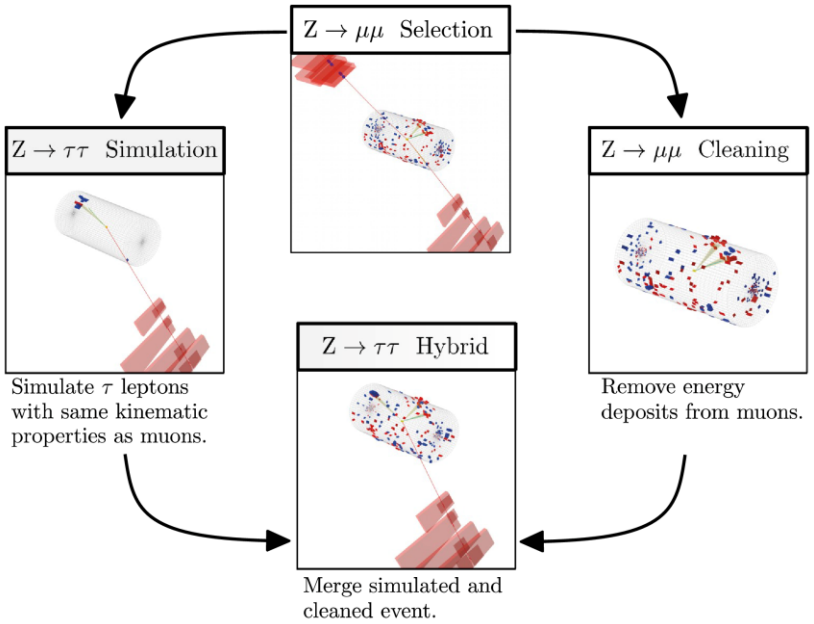


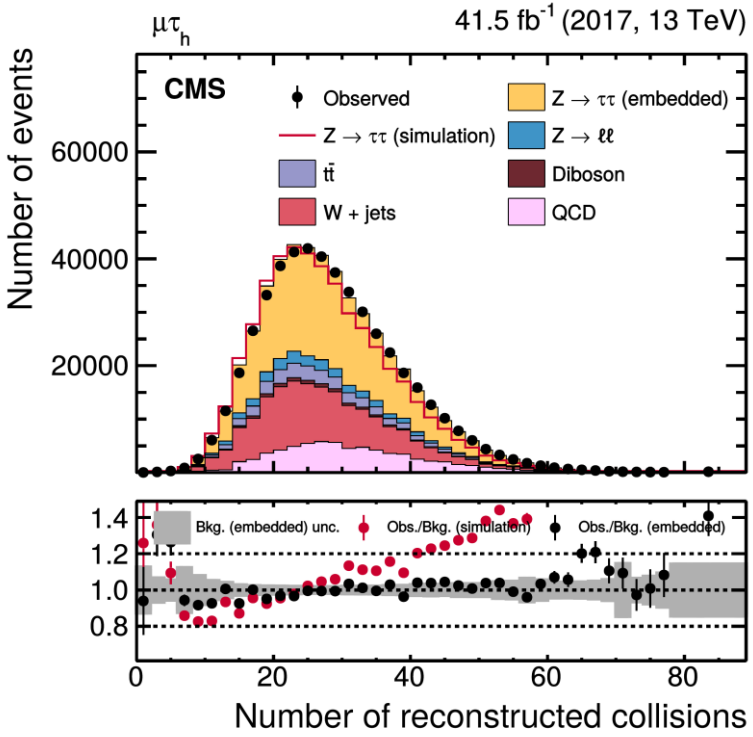


Luminosity: 137 fb^{-1}
ECM: 13 TeV

CMS Search

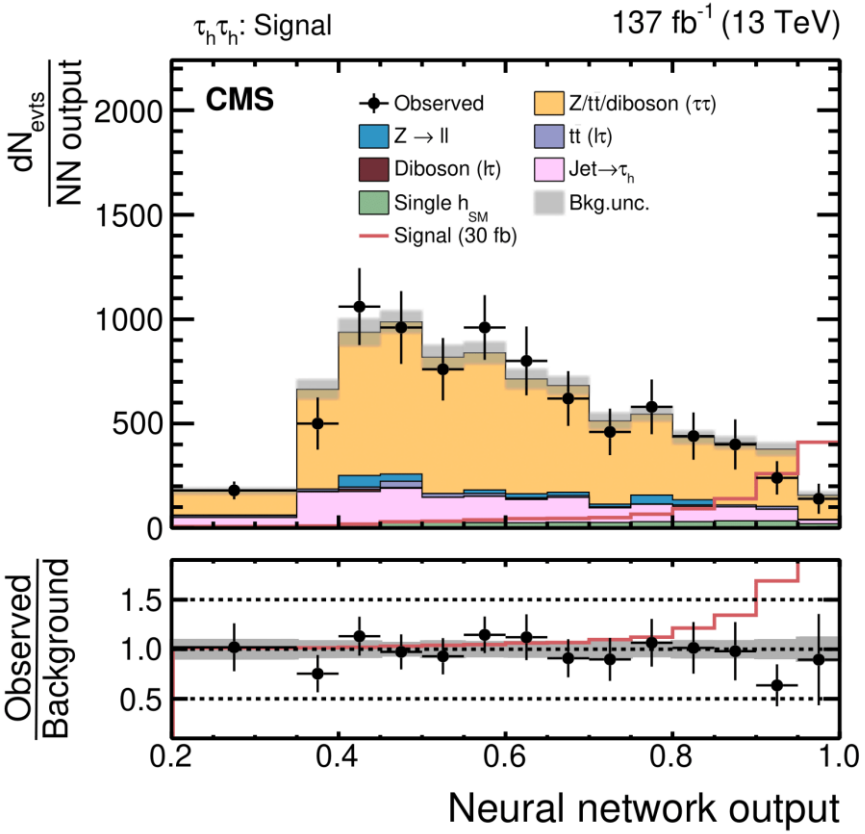
- The τ-Embedding Method





CMS Search

- Results



In a mass range of $240 - 3000$ GeV for m_H and a mass range of $60 - 2800$ GeV for m_{h_S}, possibility of H and h_S has been ruled out on a confidence level of 95%.

Thank you!