

Search for Fermiophobic Higgs

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On behalf of the CMS Collaboration

SEARCH 2012: SUSY, Exotics, And Reaction to Confronting the Higgs

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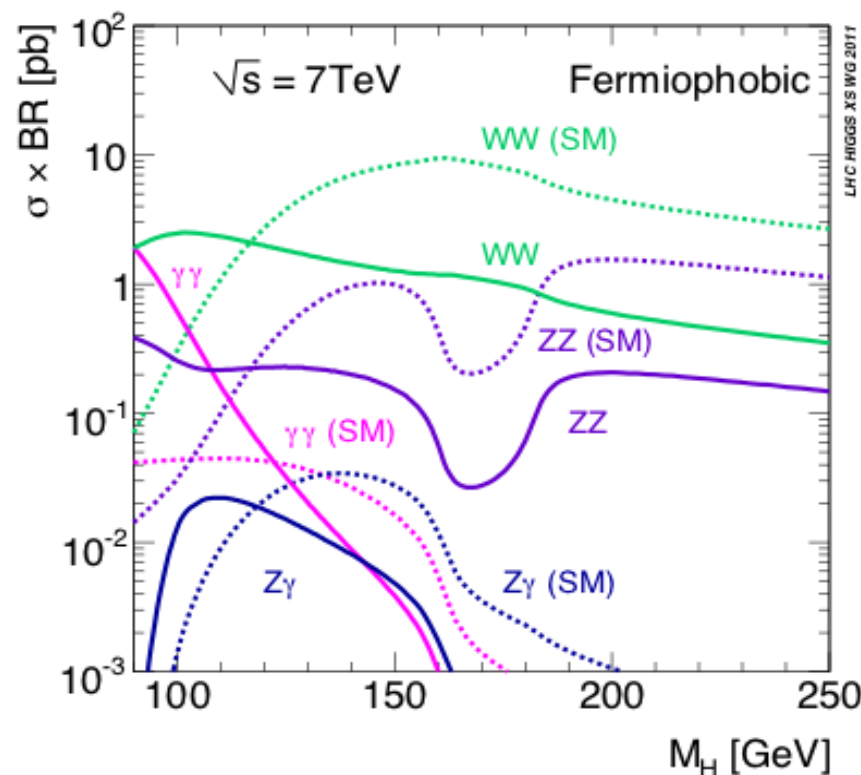
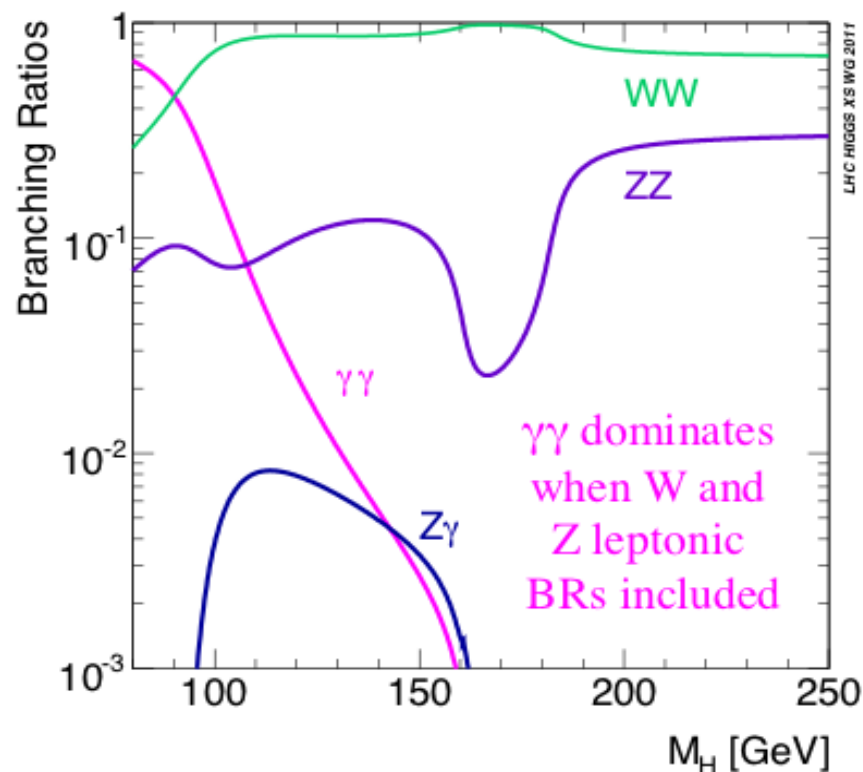
*Higgs \equiv Brout-Englert-Higgs scalar boson

Fermiophobic Higgs

Fermiophobic higgs – perhaps, fermion mass matrices have a different origin from the higgs mechanism

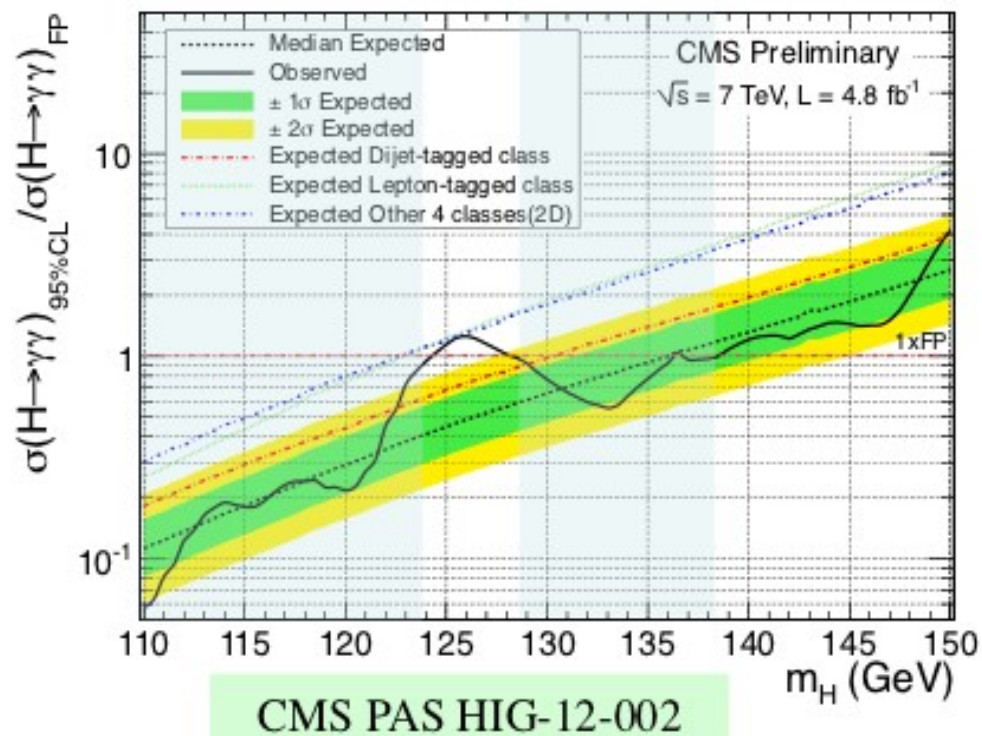
- Changes low mass higgs production and decay significantly

- **Vector boson fusion or associated production only**
 - Exploit presence of two tag jets in forward region or associate W and Z (leptons)
- **Low mass higgs decays change dramatically**



Fermiophobic Higgs

No significant excess observed – limit set CMS expected exclusion: $M_H > 135$ GeV



Small excess of local (global) significance at 3σ (2σ)

More data needed for any conclusive statement

Is the excess due to SM Higgs or FB Higgs?

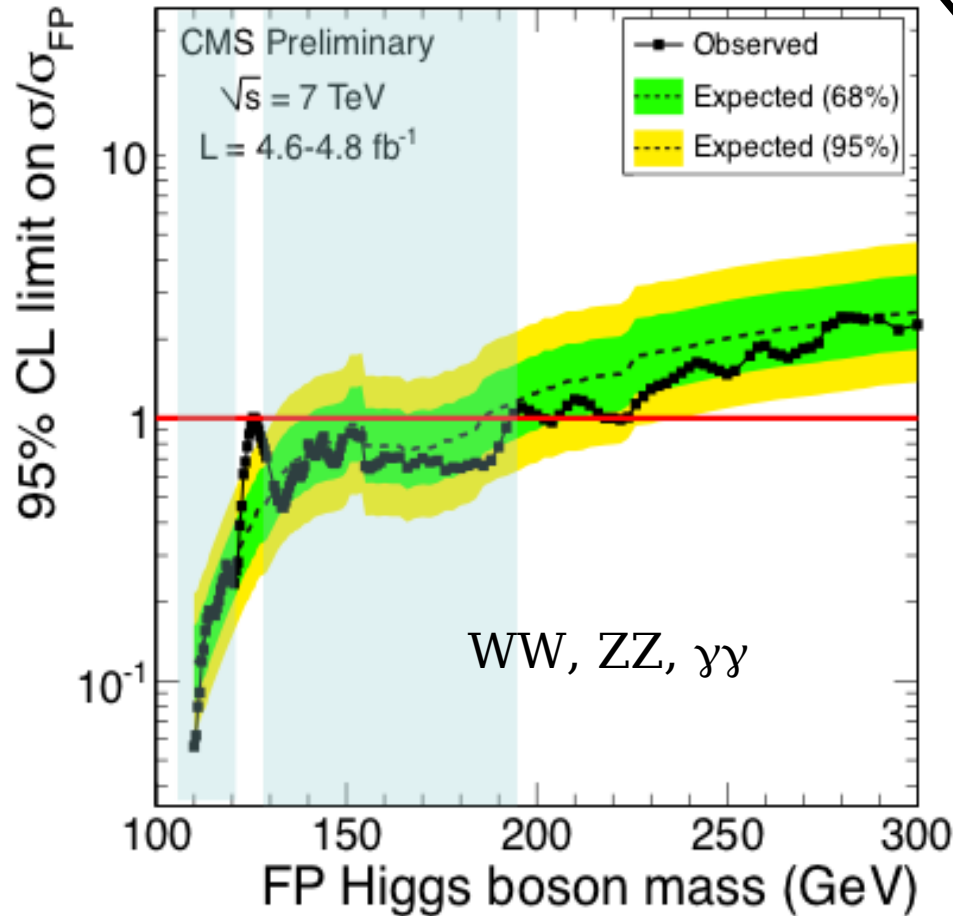
- Gamma-Gamma channel alone cannot distinguish between the two

Let us add WW and ZZ channels (See next)

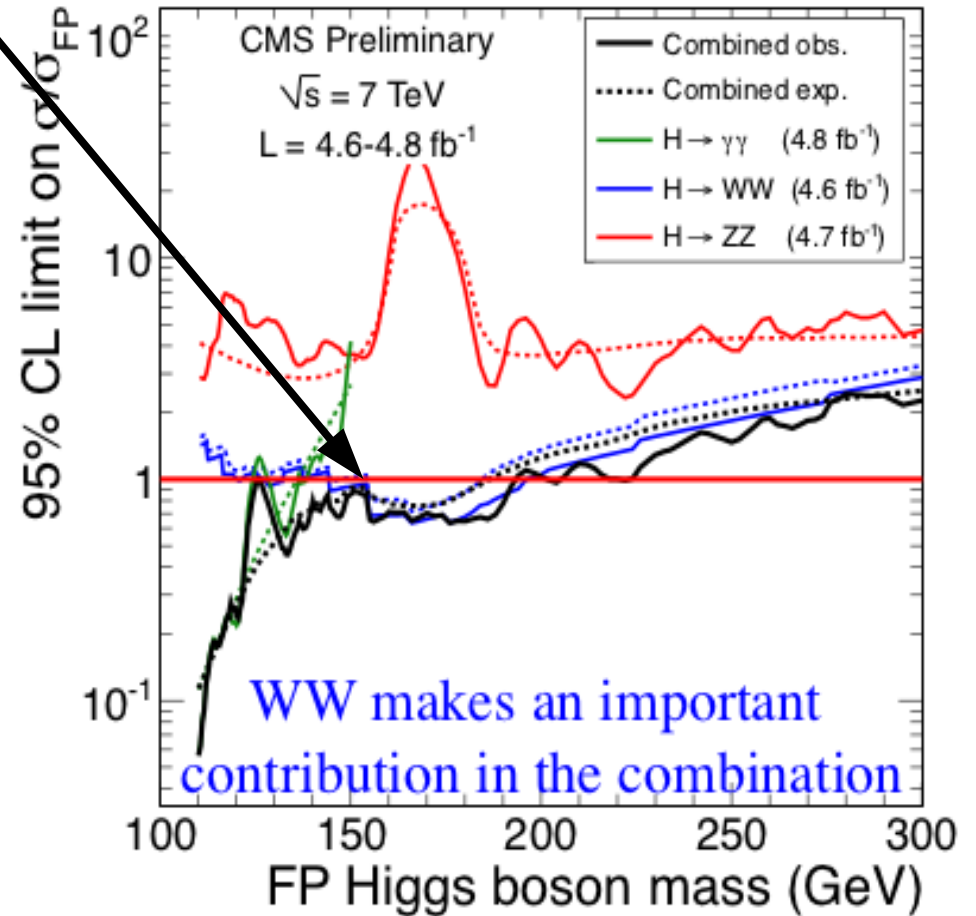
CMS FB Higgs combination

Adding WW/ZZ allows to “exclude” the pure FP Higgs hypothesis

CMS PAS HIG-12-008



Adding WW (published) and new WH (3l3 ν)



CMS analysis clearly points towards SM interpretation rather than FP if 125 GeV peak is real

Backup

Fermiophobic Higgs

CMS PAS-HIG-12-002

- $\gamma\gamma$ selection & categories
(Like in published $\gamma\gamma$ non-MVA paper)

- $E_{T\gamma 1} > 45-55 \times M_{\gamma\gamma}/120 \text{ GeV}$,
 $E_{T\gamma 2} > 25 \text{ GeV}$

- Three tag classes + inclusive

- Dijet (VBF – same as SM case)

$$E_{Tj1} > 30 \text{ GeV}, E_{Tj2} > 20 \text{ GeV},$$

$$\Delta\eta > 3.5, M_{jj} > 350 \text{ GeV}$$

$$|\langle\eta_j\rangle - \eta_{\gamma\gamma}| < 2.5, |\phi_{jj} - \phi_{\gamma\gamma}| > 2.6$$

- Electron or Muon Tag

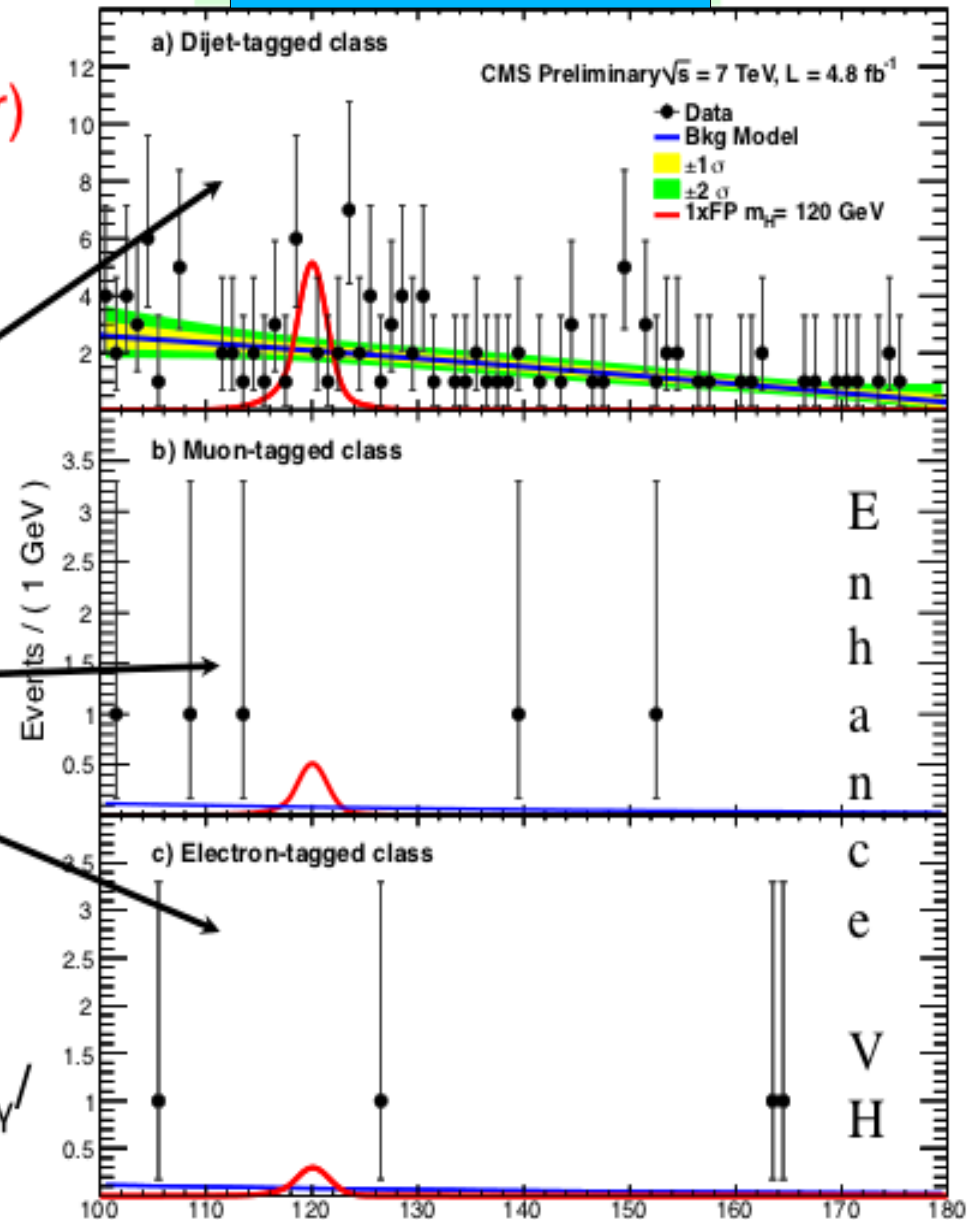
(New ; enhances VH)

$$p_{Tl} > 20 \text{ GeV}, |\eta_l| < 2.4, \Delta R_{\gamma l} > 0.3$$

$$M_{e\gamma} \text{ Z-veto}$$

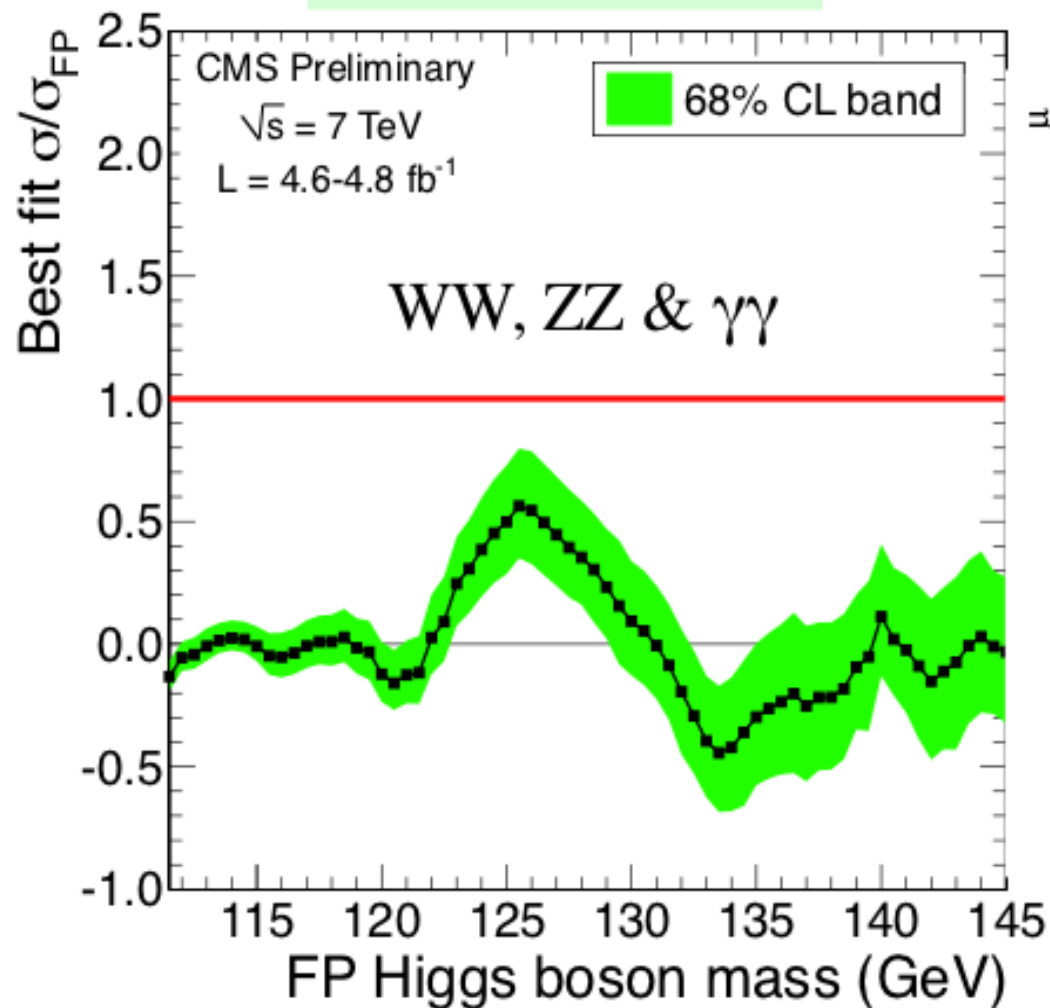
- Used $m_{\gamma\gamma}$ fit with data BG for dijet & MC BG shape for lepton

- Used fit of 2D model of $m_{\gamma\gamma}, \pi_{T\gamma\gamma} = p_{T\gamma\gamma}/M_{\gamma\gamma}$ with data BG for inclusive

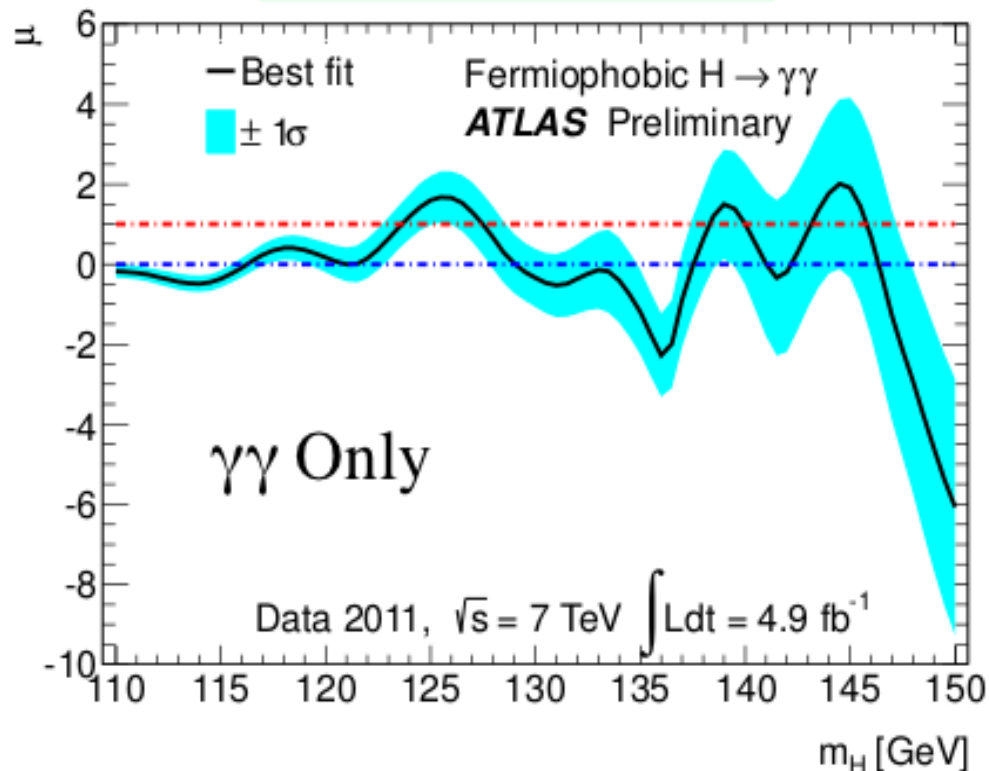


CMS FB Higgs combination

CMS PAS HIG-12-008



ATLAS CONF 2012-13



FP Higgs in multiple Higgs decay modes