HXSWG 2HDM Benchmark discussion
Fermiophobic 2HDM

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Motivation & description

♠ Motivation

A WARNING SIGN! – **No signal ≠ No new state**

♠ Parameter choice

♣ Physical basis

$\tan\beta$	α/π	m_{H^0} [GeV]	m_{A^0} [GeV]	$m_{H^\pm}$ [GeV]	m_{12}^2 [GeV^2]
20.00	0.0000	200	500	500	2000

♣ Hybrid basis [Haber, Stål]

m_{h^0}	m_{H^0}	$\cos(\beta-\alpha)$	$\tan\beta$	Z_4	Z_5	Z_7
125.03	200	4.994×10^{-2}	20	-3.465	-3.465	3.286×10^{-2}

- Fermiophobic limit: $\sin\alpha = 0$ for type I 2HDM
- LHC Higgs signal strenght: $\sin(\beta-\alpha) \lesssim 1 \Rightarrow \tan\beta \gg 1$
- Unitarity: moderate m_{12}^2

Phenomenology

Phenomenological portray

- Lightest neutral *CP*–even state: h^0 with $m_{h^0} = 125.03$ GeV & SM–like couplings
- Heavier neutral *CP*–even state: H^0
  - Fully decoupled from fermions
  - Fully decoupled from gluons
  - Barely coupled to VV, h^0h^0

♣ An experimental challenge

***Low–mass** heavy scalar, yet very **elusive** to direct searches*

Example: $pp \to h^0h^0$: SM $\simeq$ fermiophobic 2HDM Hespel, DLV, Vryonidou ['14]

Opportunities

♠ Exploit $g_{hVV} - g_{HAV}$ complementarity

♠ Pairwise or associated production: $ZH^+H^-, ZA^0H^0, W^\pm H^\mp H^0$

♠ Electroweak precision