WG3 Extended Scalars - top priority benchmark

$H_3 \to H_1 H_2$, where all three Higgs bosons have different masses. h_{125} could be any of these three.

Neighbouring searches:

$h_{125} \to aa$, assuming the two a's have the same mass

$\to$ instead consider $h_{125} \to a_1 a_2$

$X \to h_{125} h_{125}$ (X = scalar)

$X \to aa \to 4\gamma$ and $X \to SS \to 4W$ (ATLAS)

$\to$ instead consider $X \to h_{125} S$ (or $X \to h_{125} a$)

Models in which this appears:

- 2HDM with explicit CP violation (C2HDM)

  3 mixed-CP neutral scalars, H_1, H_2, H_3 (one is 125 GeV)

- 2HDM + singlet (N2HDM)

  3 CP-even neutral scalars H_1, H_2, H_3 (one is 125 GeV)

BACKUP SLIDES

WG3 Extended Scalars - top priority benchmark

$H_1 \to H_2 H_3$, where all three Higgs bosons have different masses. h_{125} could be H_1 or H_2. (our #1 priority for a new search)

$H^{\pm\pm} \to W^\pm W^\pm$: extend search to masses below 200 GeV (off-shell Ws). Production via Drell-Yan in pairs or with $H^\mp$.

$H \to H^+ H^- \to \tau\nu\tau\nu$ $(H \neq h_{125})$

$H \to W^+ H^-$ $(H \neq h_{125})$

$H^+ \to W^+\gamma$: search for fermiophobic charged Higgs including at low mass (below 200 GeV); production via Drell-Yan.

$H_{125} \to \tau\tau$ CP measurement from τ polarization kinematic distributions [this belongs to SM Higgs Characterization]

2HDM with explicit CP violation (C2HDM)

Physical spectrum: H_1, H_2, H_3, $H^\pm$

3 neutral scalars H_1, H_2, H_3 are CP admixtures in general
- Motivated by need for new sources of CP violation to explain baryon asymmetry of the universe
- Constrained by null searches for electric dipole moments

New processes not present in Real 2HDM:
- $H \to SS \to 4W$ ($S \neq h_{125}$): $\to$ ATLAS
- $H_3 \to H_1 H_2$: one of these must be h_{125}; motivates $H \to h_{125} S$ selection ($m_S \neq 125$ GeV) $\to$ not being done

Both of these can also happen in CP-conserving 2HDM + real singlet ("N2HDM"), which has 3 CP-even neutral Higgs bosons.