Early Run 2: $h \to AA$ Remarks
Searching for a BSM direction

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125 GeV Higgs

- Generally, there can be unseen, U, but not truly invisible, Higgs decays. At 95% C.L., fits to the LHC rates (the various μ cross section ratios to SM predictions) at Run1 imply the following:

  a) If couplings are SM-like, $C_U = C_D = C_V = 1$ and $\Delta C_\gamma, \Delta C_g = 0$, where ΔC_γ and ΔC_g are from BSM contributions to the $H\gamma\gamma$ and Hgg couplings — one finds $\mathcal{B}_U < 0.09$;
  b) If $C_U = C_D = C_V = 1$ but $\Delta C_\gamma, \Delta C_g$ are allowed for — $\mathcal{B}_U < 0.23$;
  c) When C_U, C_D are free, $C_V \leq 1$ and $\Delta C_\gamma = \Delta C_g = 0$, $\mathcal{B}_U < 0.22$ at 95% CL.;
  d) If C_U, C_D, and C_V are all free, then a limit from LHC data on $\mathcal{B}_U$ cannot be obtained (rescale all couplings-squared by $1/(1 - \mathcal{B}_U)$).

- From the direct $h \to aa$ analysis of our group, we find:

- Run 2 will bring larger production rates and increased precision and could either reveal deviations or strongly limit them.

	σ(pb) at 13 TeV	σ(pb) at 8 TeV
Gluon Fusion	43.9	19.27
Vector Boson Fusion	3.748	1.578
WH	1.38	.70
ZH	.87	.42
ttH	.51	.13
HH	.034	.008

Figure 1: Comparative cross sections for 13 TeV vs. 8 TeV, from Higgs xsec working group. **Cross sections ratios of at least 2, and as large as 4.**

- $m_{h_{SM}} \sim 125.5$ GeV is both maximally interesting (many competing final states) and maximally confusing [SM (Stable or Metastable Vacuum) or BSM (Multi-Higgs, MSSM Higgs, Composite Higgs, ...)].