

# Weekly report

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# VBF Higgs CP measurement

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## Binning optimization

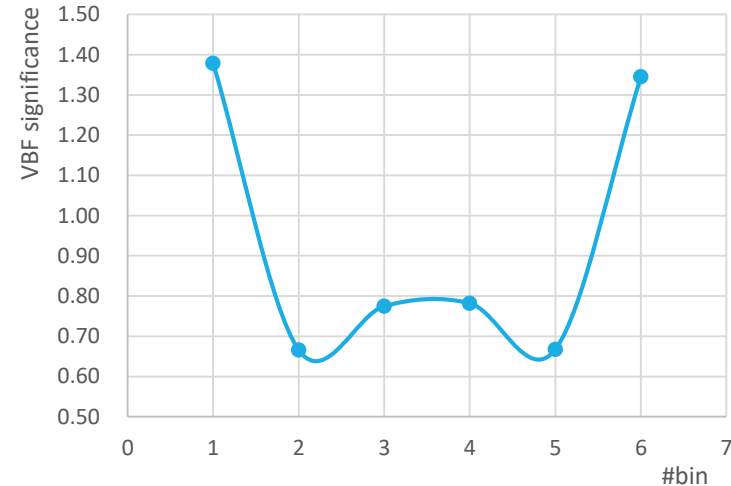
- 6 bins in  $OO \in [-20, 20]$ , symmetry in negative-positive.
- Get  $N_{evt}$  from 2d  $m_{\gamma\gamma} - OO$  histogram, requiring  $m_{\gamma\gamma} \in [120, 130]$ ,  $OO$  bin width 0.5
- $$\sigma_{vbf} = \sqrt{2 \left[ (N_{vbf} + N_{ggh} + N_{bkg}) \cdot \ln \left( 1 + \frac{N_{vbf}}{N_{ggh} + N_{bkg}} \right) - N_{vbf} \right]}$$
- Loop in full  $OO$  range to determine cuts (only 2 independent cuts).

# VBF Higgs CP measurement

## Binning optimization

- Criteria 1: maximum combined VBF significance:  $\sigma = \sqrt{\sum_{bin} \sigma_{vbf}^2}$
- Binning: [-20, -1.5, -1, 0, 1, 1.5, 20],  $\sigma = 2.41$

	Nvbf	Nggh	Nbkg	sigma
<b>(-20, -1.5)</b>	31.67	14.63	502.50	1.38
<b>(-1.5, -1)</b>	11.19	7.79	271.25	0.67
<b>(-1, 0)</b>	22.05	25.40	777.75	0.77
<b>(0, 1)</b>	22.04	25.48	762.00	0.78
<b>(1, 1.5)</b>	11.28	7.72	274.25	0.67
<b>(1.5, 20)</b>	31.63	14.55	527.75	1.35



# VBF Higgs CP measurement

## Binning optimization

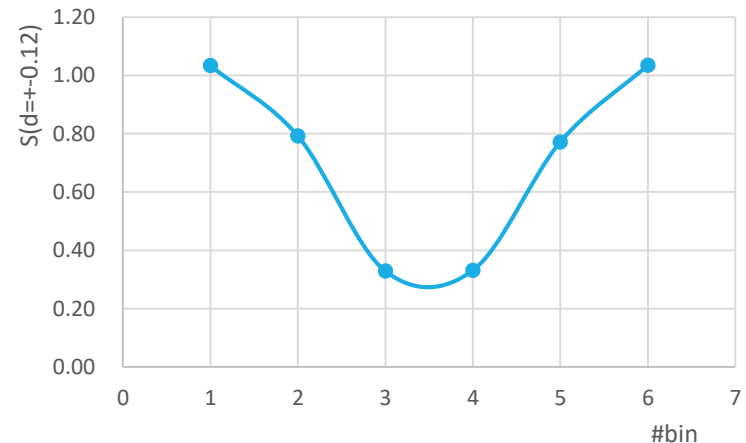
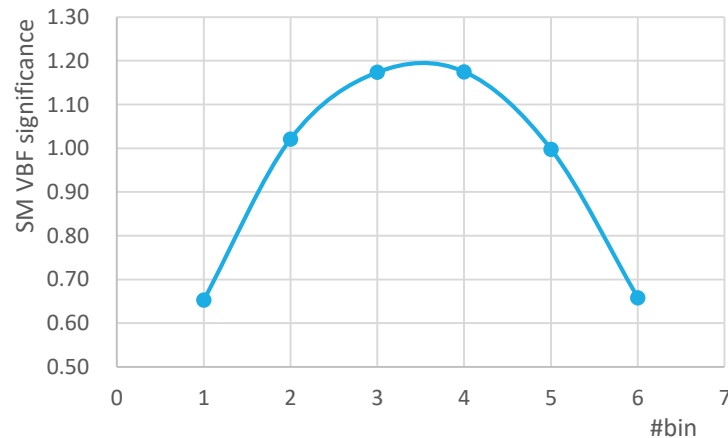
- Criteria 2:  $S(\tilde{d}) = \sqrt{\sum_{ibin} \left( (\sigma_{SM}^{ibin} - \sigma_{d^+}^{ibin})^2 + (\sigma_{SM}^{ibin} - \sigma_{d^-}^{ibin})^2 \right)}$
- Maximum S with working point  $\tilde{d} = \pm 0.12$
- Binning: [-20, -4.5, -2, 0, 2, 4.5, 20], maximum S=1.89

	Nvbf_SM	Nvbf_d+	Nvbf_d-	Nggh	Nbkg	sigma_SM	sigma_d+	sigma_d-	S
<b>(-20, -4.5)</b>	6.61	3.24	16.78	2.96	97.25	0.65	0.32	1.63	1.03
<b>(-4.5, -2)</b>	16.91	11.07	28.89	7.45	261.00	1.02	0.67	1.73	0.79
<b>(-2, 0)</b>	41.40	36.99	52.24	37.41	1193.25	1.17	1.05	1.48	0.33
<b>(0, 2)</b>	41.50	52.43	37.10	37.42	1196.25	1.17	1.48	1.05	0.33
<b>(2, 4.5)</b>	16.87	28.73	10.99	7.43	272.75	1.00	1.69	0.65	0.77
<b>(4.5, 20)</b>	6.59	16.65	3.23	2.89	95.00	0.66	1.64	0.32	1.04

# VBF Higgs CP measurement

## Binning optimization

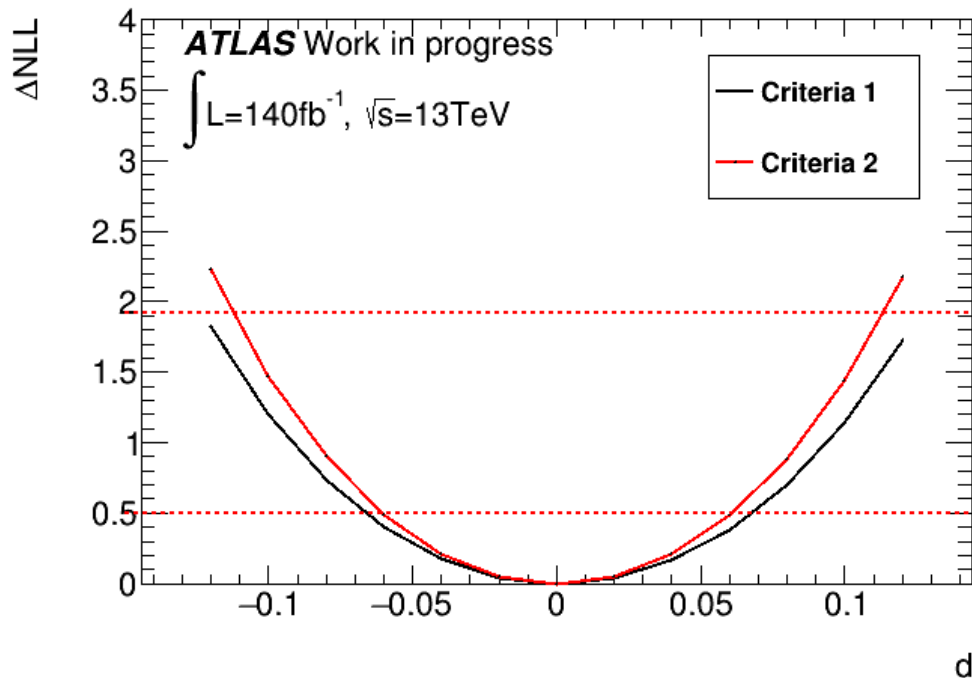
- Criteria 3: maximum global  $S$  for  $\tilde{d} = \pm 0.02, 0.04, 0.06, 0.08, 0.10, 0.12$
- Global  $S = \sqrt{\sum_{\tilde{d}} S(\tilde{d})^2}$ . Average effect of different BSM.
- Result is same as Criteria 2.



# VBF Higgs CP measurement

Binning optimization.

- Extract expected NLL curve for 3(2) criteria, statistics only.



Next step: try to add MVA categories (Not all 4 cates in HGam), decide the final categorization (before Wednesday).