Request for More MC Statistics of vvh at 350 GeV

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Software and Analysis meeting
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DESY

LOI Likelihood Template Fit

- Determination of the accuracy of the Higg's hadronic branching ratio measurements
- Create 3D-Templates with b,c and bc likeness of the events
- LOI study used the fit function:

$$N_{ijk}^{Data} = \sum_{x=b,c,g,other} \frac{\sigma \cdot BR(h \to x)}{(\sigma \cdot BR(h \to x))^{SM}} \cdot N_{ijk}^{h \to x} + N_{ijk}^{bkg}$$

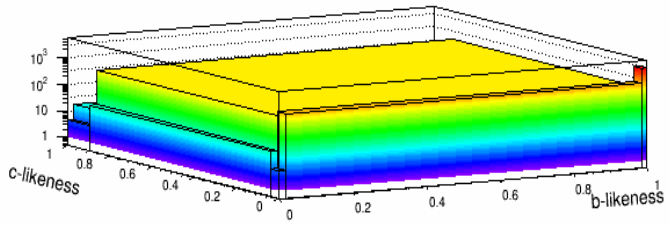
  with N_{ijk} the number of events in the bin ijk

- h → other was fixed
- σ includes Higgs Strahlung and WW-fusion
  - Disentangling both processes done by hand
- Binned log likelihood fit ignoring zero entry bins
  - Bias of the fit results (Output not consistent with Input)
- 60x60x60 bins with only ~1000 mc events for cc

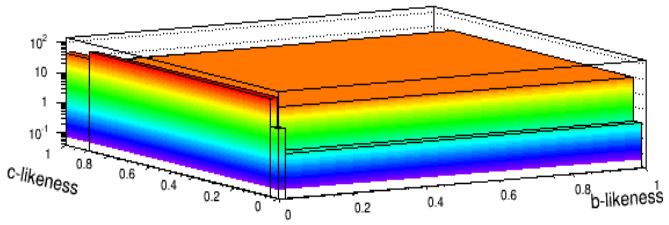
Template Fit

- Task: 3D template fit of b-likeness, c-likeness and missing mass to extract the Higg's hadronic branching ratios
- Previously shown results were greatly biased due to using too many bins in each dimension
- Redo the fit with fewer number of bins
- Junpin's/Jenny's suggestion: use a variable binning with only three bins in the flavor likeness dimensions (65% signal):
  - A small bin at a likeness of 0
  - A small bin at a likeness of 1
  - And the rest in another bin

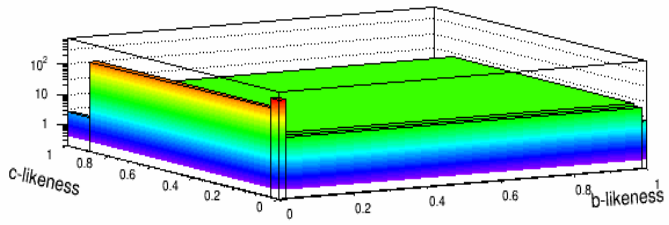
Zh → νν$b\bar{b}$



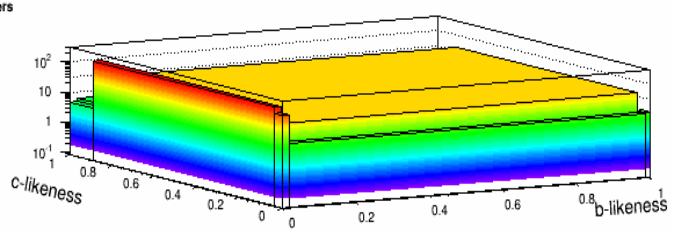
Zh → νν$c\bar{c}$



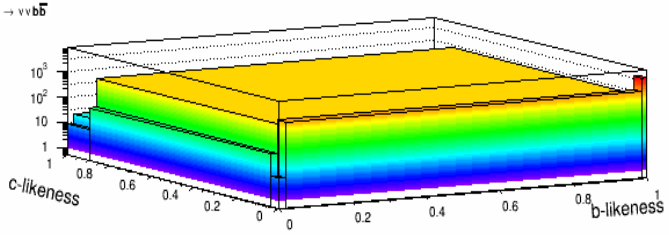
Zh → ννgg



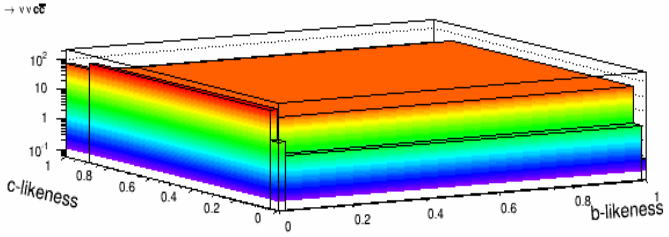
Zh → νν others



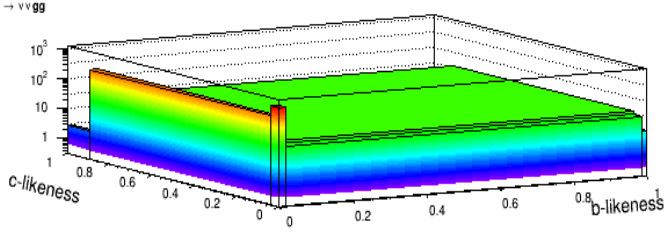
ννWW → ννh → νν$b\bar{b}$



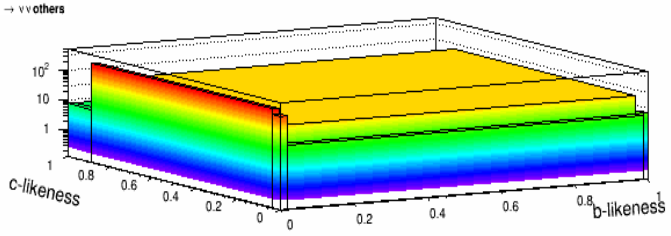
ννWW → ννh → νν$c\bar{c}$



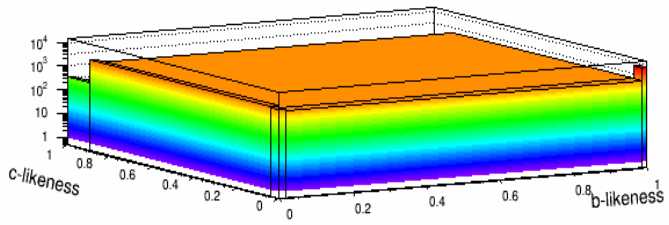
ννWW → ννh → ννgg



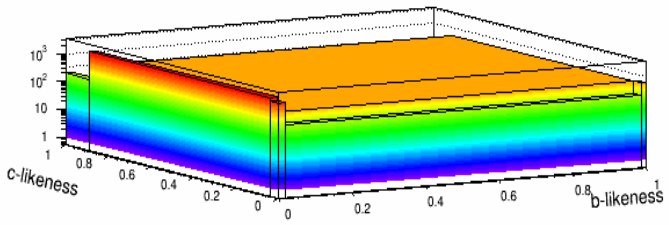
ννWW → ννh → νν others



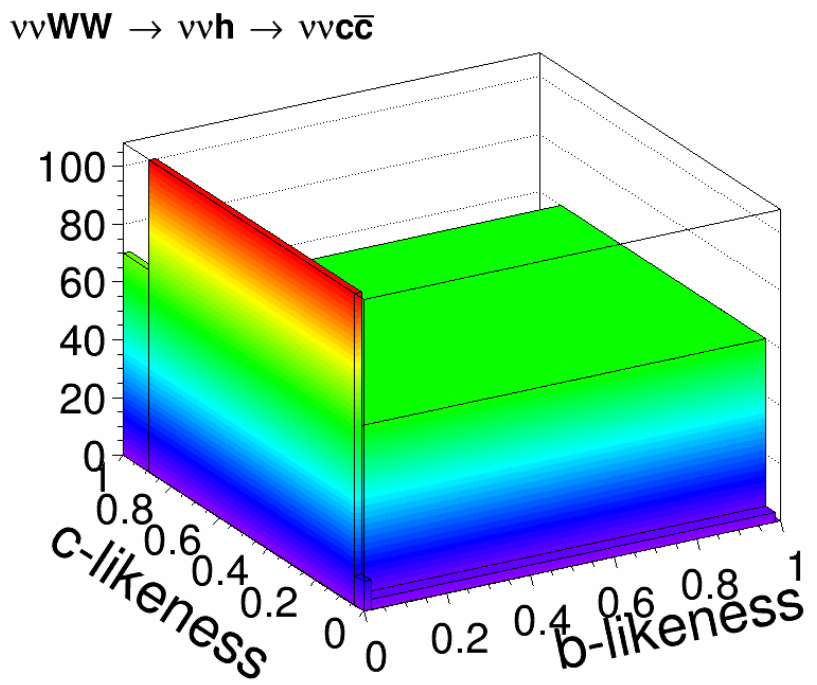
Data

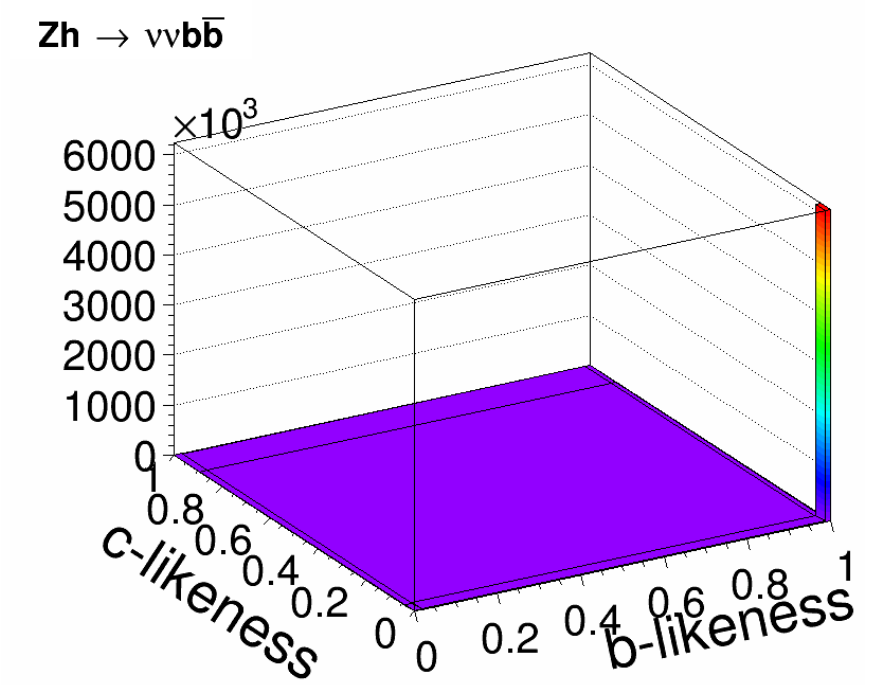


SM BKG



Template Histograms





Results

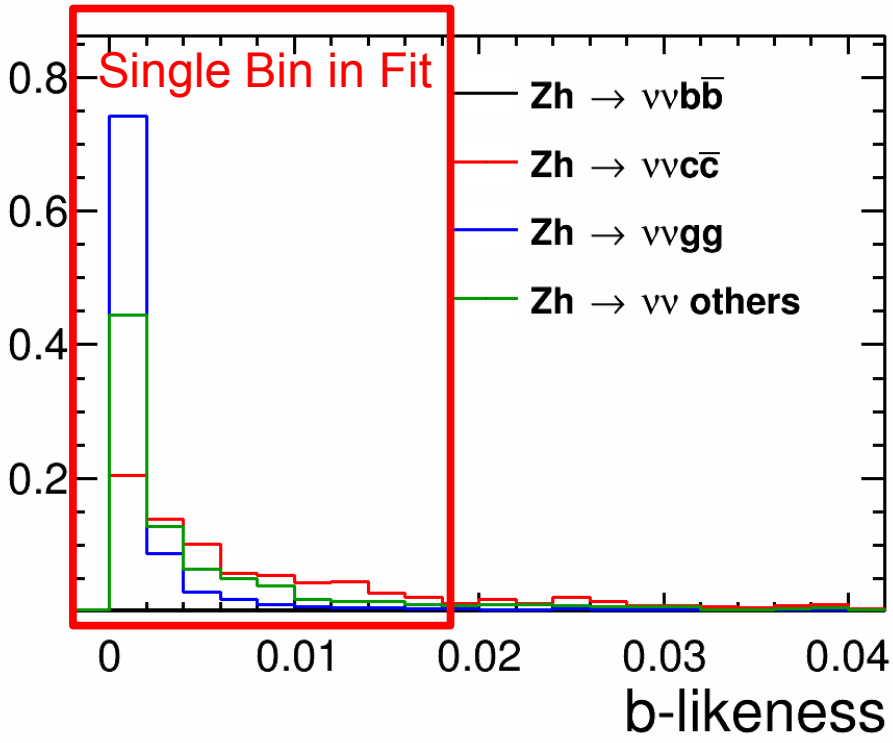
- Same data set for the toy MC histogram (Data histogram) and the Template histograms
- Splitting the MC events into two subsets, the SM could not be reproduced for cc and other (fit values deviated from 1)

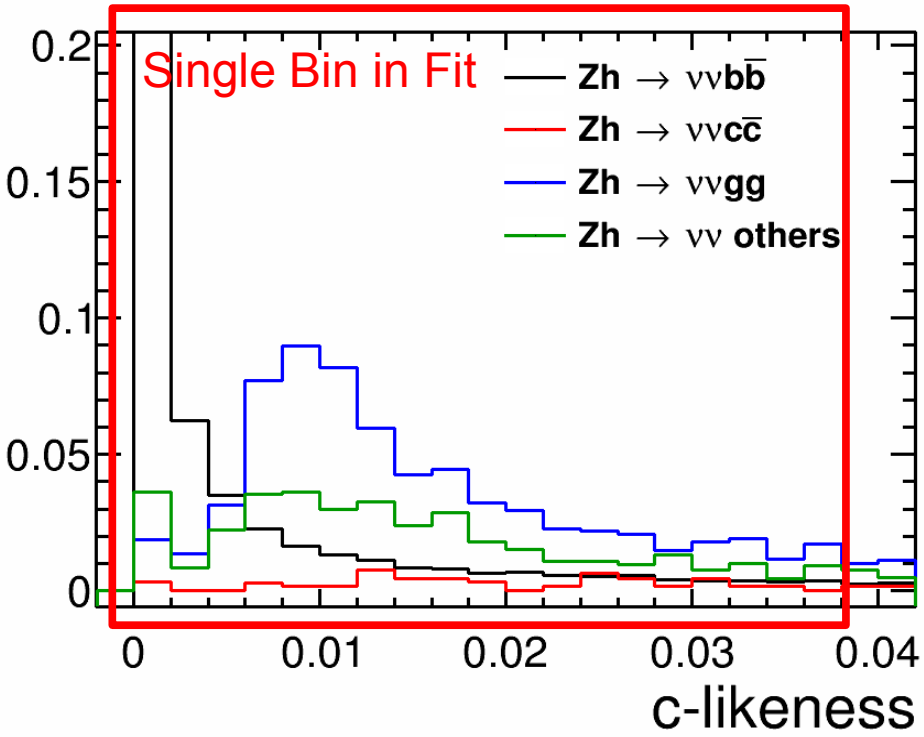
	PoI (e-;e+) = (-0.8;0.3) preliminary			LOI
	previously shown	with minmal binning	with minmal binning	
σ(ZH)BR(h->bb)	1.7	2.3	2.3	1.4
σ(ZH)BR(h->cc)	7.5	26.9	24.1	8.6
σ(ZH)BR(h->gg)	4.7	16.2	9.2	9.2
σ(ZH)BR(h->other)	5.9	38.5	fix	
σ(WW)BR(h->bb)	1.3	1.8	1.8	
σ(WW)BR(h->cc)	6.0	21.7	18.8	
σ(WW)BR(h->gg)	3.7	14.1	7.5	
σ(WW)BR(h->other)	4.8	32.7	fix	

DESY

More Bins

- Using a single bin for the main part of the data means losing information
  - Especially in the region for low flavor likeness (gluons)
- Different slopes for the single contributions visible in b-likeness
- bb separated from the rest for small c likeness

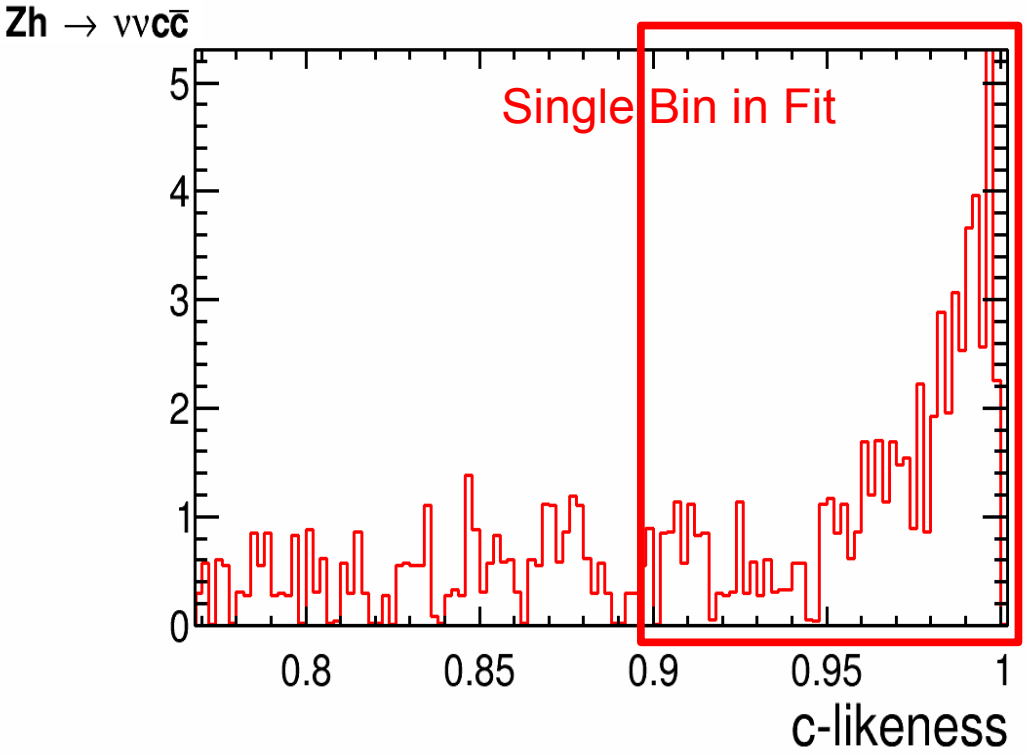




DESY

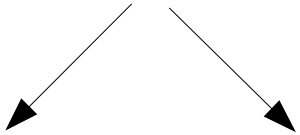
Limited MC Statistics

- Splitting the MC events into two subsets, the SM could not be reproduced for cc and other (fit values deviated from 1)
- Large fluctuations visible in the peak of the c-likeness due to limited MC statistics (also with courser binning, trust me)
- Reminder: this is smeared in two more dimensions for the fit



Limited MC Statistics

	Number of MC events (L=1/ab) P(e-e+)=(-1,1)
nnH	166000
H -> g,b,c	115000



	30 % for TMVA	70% for Fit	L=330/fb P(e-e+)=(-0.8,0.3)
H -> g,b,c	34500	80500	22300
H->bb	28950	67500	18700
H->cc	1300	3050	850
H->gg	4300	10000	2750
ZH->nnbb	10500	24500	6850
ZH->nncc	500	1100	320
ZH->nngg	1550	3600	1000
WW->H->bb	18400	43000	11800
WW->H->cc	850	1950	550
WW->H->gg	2700	6400	1750

~50% further reduction by event selection

DESY

Request for more statistics

- Every template should contain ~10^4 entries
- Selection efficiency ~50% -> $2*10^4$ events
- From BR: $2*10^4$ H->cc events would mean $42*10^4$ H->bb events
  - Even worse: I would like to have $2*10^4$ events for h->cc from higgs strahlung and WW-fusion
- Suggestion: production of the single Higgs decays
  - e+e- -> nnH -> nnbb Pol(e+,e-)=(-1,1) 20000 events
  - e+e- -> nnH -> nncc Pol(e+,e-)=(-1,1) 20000 events
  - e+e- -> nnH -> nngg Pol(e+,e-)=(-1,1) 20000 events
  - e+e- -> nnH -> nnbb Pol(e+,e-)=(1,-1) 40000 events
  - e+e- -> nnH -> nncc Pol(e+,e-)=(1,-1) 40000 events
  - e+e- -> nnH -> nngg Pol(e+,e-)=(1,-1) 40000 events
  - Total 180000 events
- Either way: new generator files needed

BACKUP

Results

- As a consistency check: Branching ratio from event counting of single processes (SID)

$$\sigma(H \to ff) = \frac{\sqrt{N_{Signal} + N_{BKG}}}{N_{signal}}$$

- The results are gained using the same data set for the toy MC histogram and the Template histograms
- Splitting the MC events into two subsets, the SM could not be reproduced for cc and other (fit values deviated from 1)

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DESY