

Higgs BR study

ILC physics and software meeting

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Current status

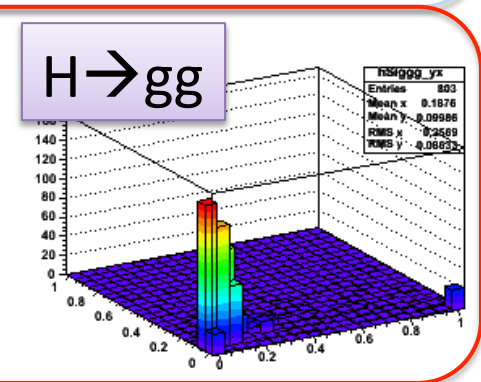
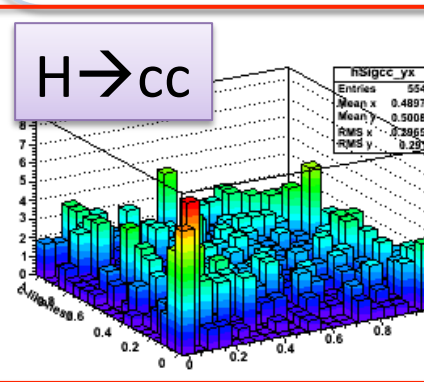
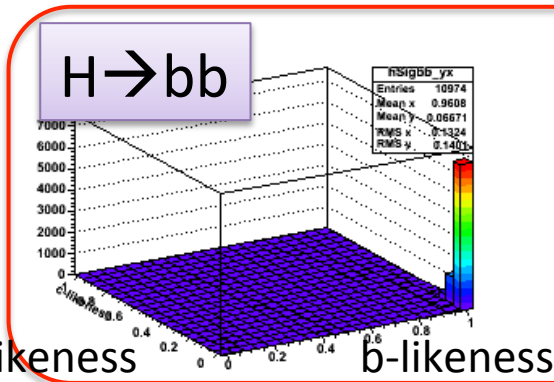
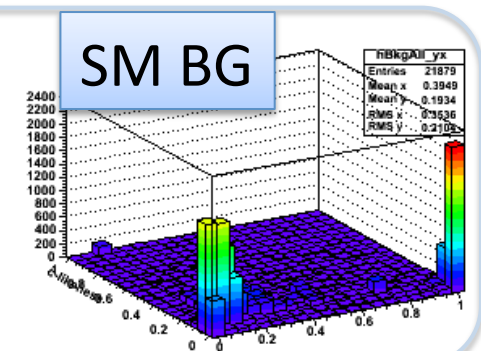
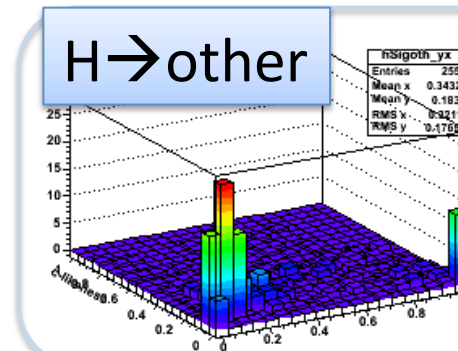
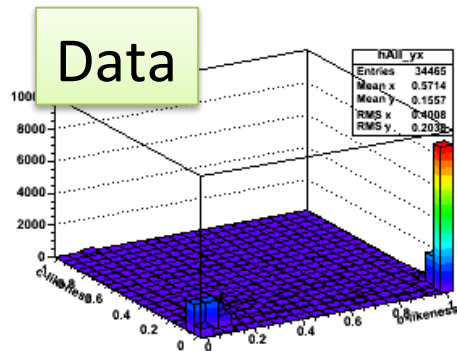
- Template fitting χ^2 formula is modified to extract the relative uncertainty of BR (previous one is BR ratio uncertainty)
- Try to include $H \rightarrow gg$ BR toward the DBD
- Modify to include $H \rightarrow gg$ results to paper

Template fitting to evaluate BR accuracy

Template fitting is applied to evaluate the measurement accuracy of BR

Prepare $H \rightarrow bb, cc, gg$ template with 3 flavor-likeness (b, c, bc) ($L=500\text{fb}^{-1}$)

$$\sigma \cdot BR(H \rightarrow s) = r_s \times \sigma^{SM} \cdot BR(H \rightarrow s)^{SM} \quad \mu = \sum_{s=bb,cc,gg,bkg} r_s N_{ijk}^s$$



c-likeness b-likeness

C.L.

Template fitting procedure

Fitter parameters r_s : ratio of $N^s/(\sigma^*BR(H\rightarrow s))^{SM}$

$r_{bkg}=1$ (SM background will be understood well)

Each bin, probability of the Poisson statistics is expected

$$P_{ijk} = \frac{\mu^{N_{ijk}^{data}} e^{-\mu}}{N_{ijk}^{data} !} \quad \mu = \sum_{s=bb,cc,gg,bkg} r_s N_{ijk}^s$$

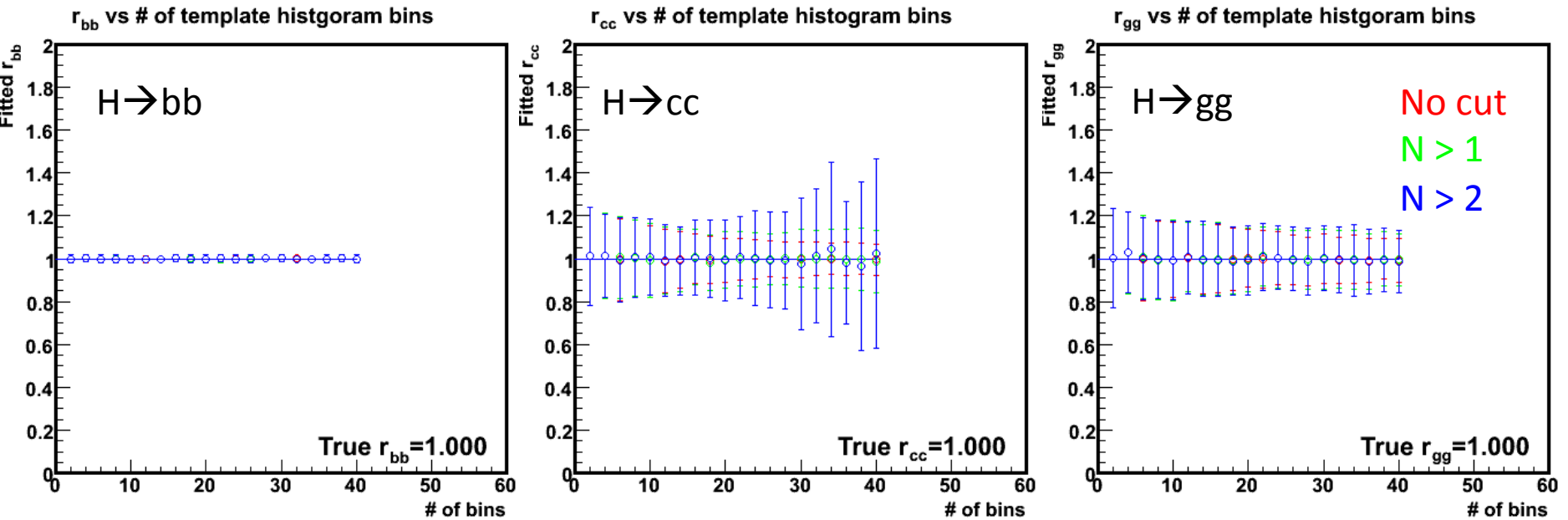
Template fitting is applied with minimizing following log likelihood function

$$-\log L = -\sum_{i,j,k} \log P_{ijk}$$

$\sigma^*BR(H\rightarrow s)$ is extracted with the fitted parameter r_s

$$\sigma \cdot BR(H \rightarrow s) = r_s \times \sigma^{SM} \cdot BR(H \rightarrow s)^{SM}$$

Binning dependence of fitted r_{xx}



fitting procedure are succeeded to reproduce the true value $r_{xx}=1.0$

Summary of BR measurement accuracy

	vvH		qqH		Combined	
Ecm (GeV)	250	350	250	350	250	350
r_{bb}	1.00 ± 0.016	1.00 ± 0.012	1.00 ± 0.015	1.00 ± 0.015	1.00 ± 0.012	1.00 ± 0.010
r_{cc}	1.00 ± 0.12	1.00 ± 0.10	1.00 ± 0.12	0.99 ± 0.11	1.00 ± 0.09	1.00 ± 0.07
r_{gg}	0.99 ± 0.14	1.00 ± 0.10	1.00 ± 0.13	1.00 ± 0.13	1.00 ± 0.10	1.00 ± 0.08
$\sigma_{BR}(bb)/\sigma^{SM}$	$65.7 \pm 1.1\%$	$65.7 \pm 0.8\%$	$65.7 \pm 1.0\%$	$65.7 \pm 1.0\%$	$65.7 \pm 0.7\%$	$65.7 \pm 0.6\%$
$\sigma_{BR}(cc) / \sigma^{SM}$	$3.59 \pm 0.43\%$	$3.60 \pm 0.35\%$	$3.61 \pm 0.44\%$	$3.58 \pm 0.39\%$	$3.60 \pm 0.31\%$	$3.59 \pm 0.26\%$
$\sigma_{BR}(gg) / \sigma^{SM}$	$5.46 \pm 0.76\%$	$5.48 \pm 0.53\%$	$5.48 \pm 0.76\%$	$5.49 \pm 0.74\%$	$5.47 \pm 0.54\%$	$5.48 \pm 0.43\%$
$\Delta BR/BR(bb)$	3.0%	2.8%	2.9%	2.9%	2.7%	2.7%
$\Delta BR/BR(cc)$	12.2%	10.1%	12.3%	11.2%	8.9%	7.7%
$\Delta BR/BR(gg)$	14.2%	9.9%	14.1%	13.7%	10.2%	8.2%

Preliminary results with gg

BR(bb)=65.7%, BR(cc)=3.6%, BR(gg)=5.8% in Pythia

$\Delta BR/BR(s)$ includes 2.5% uncertainty of σ^{ZH} from recoil study

Summary table of Higgs BR after LOI

$E_{cm}=250 \text{ GeV}$ and $L=250\text{fb}^{-1}$, $P(e^+,e^-)=(+30\%, -80\%)$

Higgs mass	120 GeV					140 GeV		
Cross section	$\sigma=354.3 \text{ fb}$					$\sigma=203.1 \text{ fb}$		
Higgs decay	BR	$\sigma \times \text{BR}$	$\Delta\text{BR}/\text{BR}$			BR	$\sigma \times \text{BR}$	$\Delta\text{BR}/\text{BR}$
			ILD	SiD	Avg.			Scaled
$H \rightarrow bb$	66.5%	235.6	2.7% (2.7%)	4.8%	3.8%	33.0%	67.1	7.0%
$H \rightarrow cc$	2.9%	10.4	8.9% (7.7%)	8.4%	8.7%	1.5%	3.0	16.2%
$H \rightarrow WW^*$	13.6%	48.3	15.7%		15.7%	49.2%	99.8	10.9%
$H \rightarrow gg$	8.2%	29.2	10.2% (8.2%)	12.2%	11.2%	5.7%	11.5	17.8%
$H \rightarrow \tau\tau$	6.8%	24.1				3.5%	7.1	
$H \rightarrow ZZ^*$	1.5%	5.3				6.7%	13.6	

ILD results are preliminarily combined with vvH and qqH at 250 GeV (\rightarrow):350GeV

$\Delta\text{BR}/\text{BR}$ include 2.5% (ILD) and 4.7% (SiD) uncertainties of σ_{ZH}

SiD ZH study: Physical Review D 82, 03013 (2010)

$H \rightarrow WW^*$ anomalous coupling 1011.5805v2