Branching ratio study in ZH→qqcc/bb

ILC physics and software meeting

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Current status

- Last week
  - Background reduction can achieve the almost consistent result with SiD, except for the last highest photon energy.
  - Template fitting looks dependence of template sample binning

- This week
  - Check the templates binning dependence to achieve the final results.

Previous result in different bins

# of bins in template sample	nbins=40	nbins=100
ΔBr(H→bb)	2.80 ± 0.07 %	1.24 ± 0.03 %
ΔBr(H→cc)	16.61 ± 0.42 %	8.92 ± 0.20 %

Relative branching ratio is calculated from the fitted parameters $r_{bb/cc}$ and the selection efficiency of $\varepsilon_{bb/cc}$ from the reduction table

$$\frac{Br(H \to c\bar{c})}{Br(H \to b\bar{b})} = \frac{r_{cc}/\varepsilon_{cc}}{r_{bb}/\varepsilon_{bb}}$$

Preliminary result

# of bins in template sample	nbins=40	nbins=100
Ratio of Br(H→cc)/Br(H→bb)	0.058±0.009	0.055±0.005
Measurement accuracy of ratio	16.85 %	9.00 %

Need to optimize template fitting method

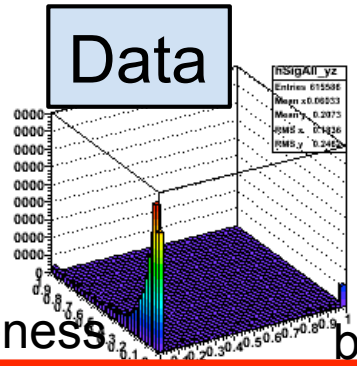
Template samples and χ^2

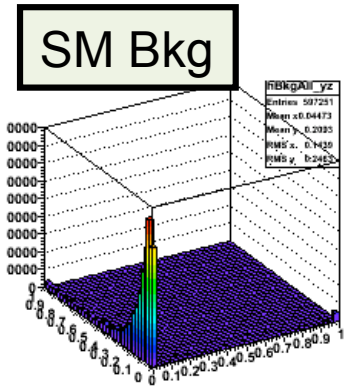
$$\chi^2 = \sum_{i=1}^{n_b}\sum_{j=1}^{n_c}\sum_{k=1}^{n_{bc}} \frac{\left(N_{ijk}^{data} - \sum_{s=bb/cc/others} r_s \left(\frac{N^{ZH}}{N^s}\right) N_{ijk}^{s} - r_{bkg} N_{ijk}^{bkg} \right)^2}{N_{ijk}^{data}}$$

$$r_{others} = 1 - r_{bb} - r_{cc}$$
$$r_{bkg} = \text{free or fixed } (=1)$$

$$r_{others} = 1 - r_{bb} - r_{cc}$$
$$N^{ZH} = \sum N^{data} - r_{bkg} \cdot \sum N^{bkg}$$
$$N^{s} = \sum N_{ijk}^{s}$$

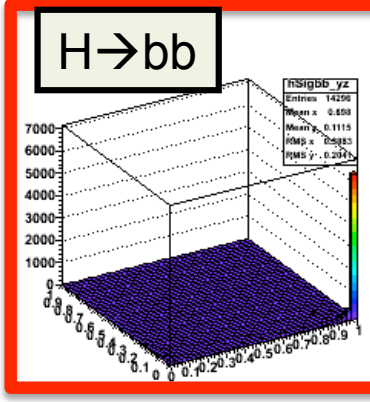
Template samples

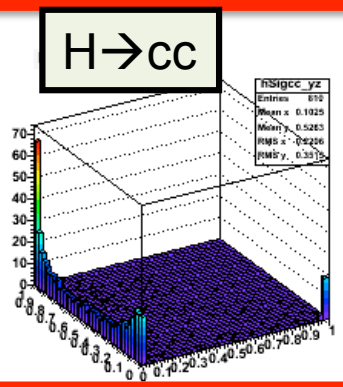


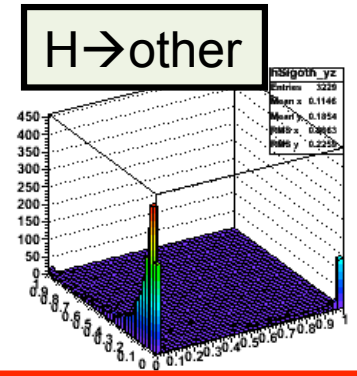


c-likeness

b-likeness





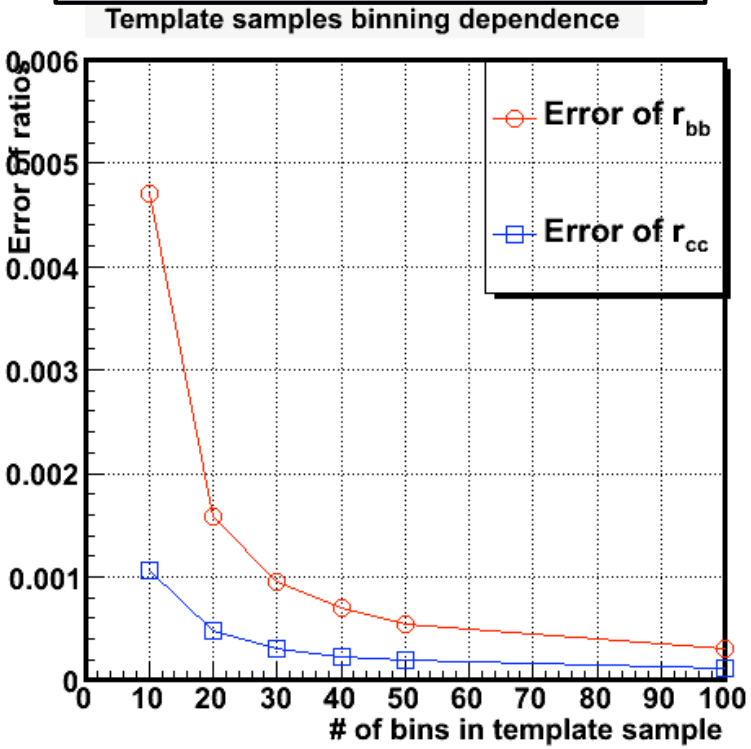


Example of the template sample (40 bins) with b/c/bc likeness.

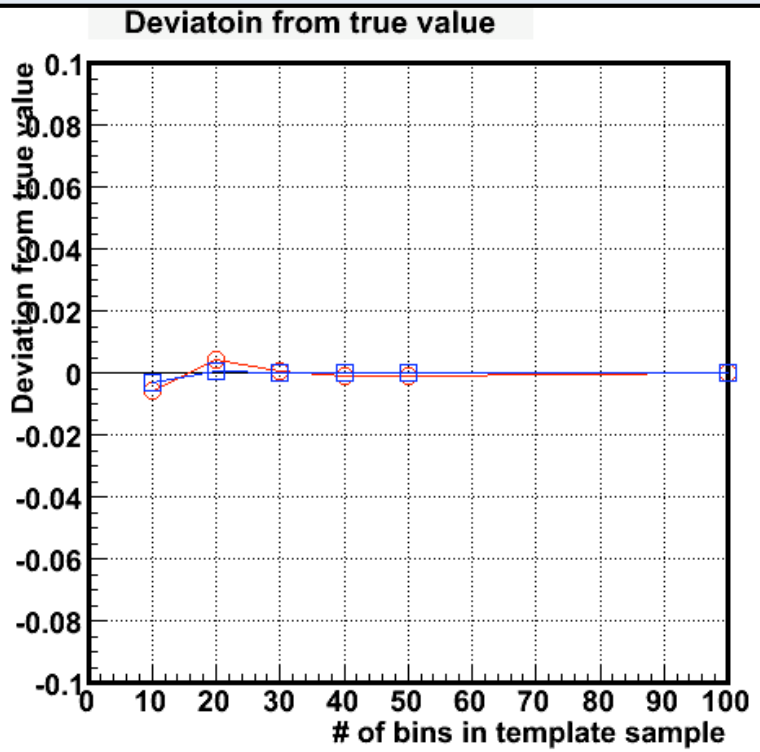
2D projected images in qqH

Estimated error from the fitting

Error of $r_{bb/cc}$ from the fitting



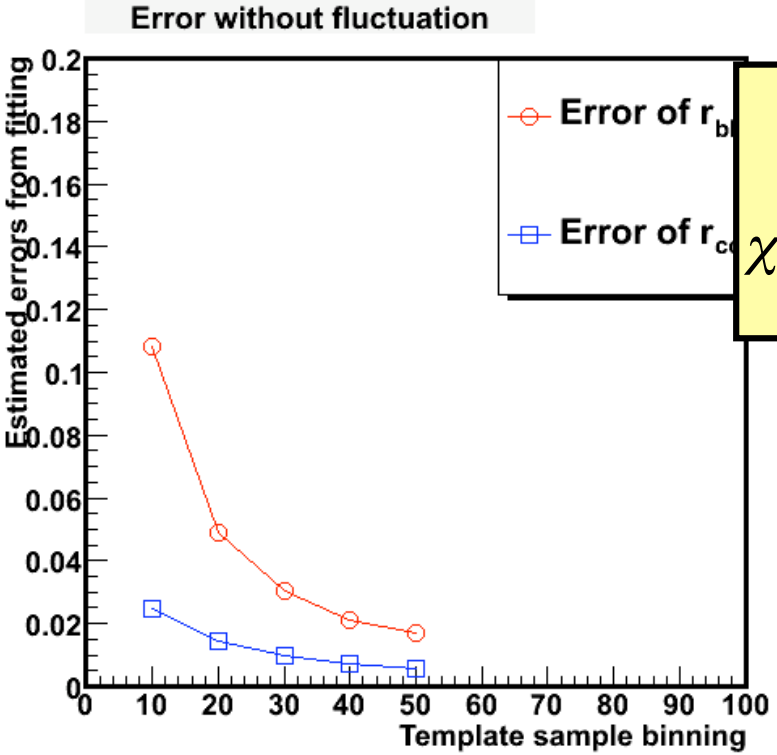
Deviation of the fitted $r_{bb/cc}$ from the true value



- $r_{bb/cc}$ itself does not have any dependence of the sample's binning
- Estimated rbb/cc errors from fitting has binning dependence

Without the fluctuation of data

Without the fluctuation for N^{data}



$N^{data} = N^{all}$ no fluctuation case

$$\chi^2 = \sum_{i=1}^{n_b}\sum_{j=1}^{n_c}\sum_{k=1}^{n_{bc}} \frac{\left(N_{ijk}^{all} - \sum_{s=bb/cc/others} r_s \left(\frac{N^{ZH}}{N^s}\right) N_{ijk}^s - r_{bkg} N_{ijk}^{bkg} \right)^2}{N_{ijk}^{all}}$$

Now I am checking my code
which comes from bugs or not…

Even without the fluctuation, errors of fitted $r_{bb/cc}$ has also binning dependence…
I think errors should not depend on the template fitting sample.
Dependence with the # of template entries?