

# ZH $\rightarrow$ qqcc/bb branching ratio measurement

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ILC physics and soft meeting

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H. Ono (NDU), Y. Takubo, K. Yoshida (Tohoku)

# Status of BR measurement

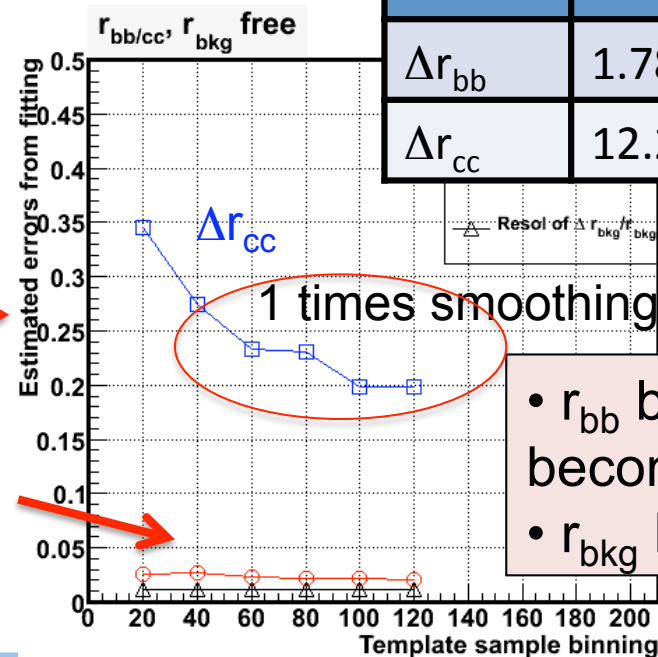
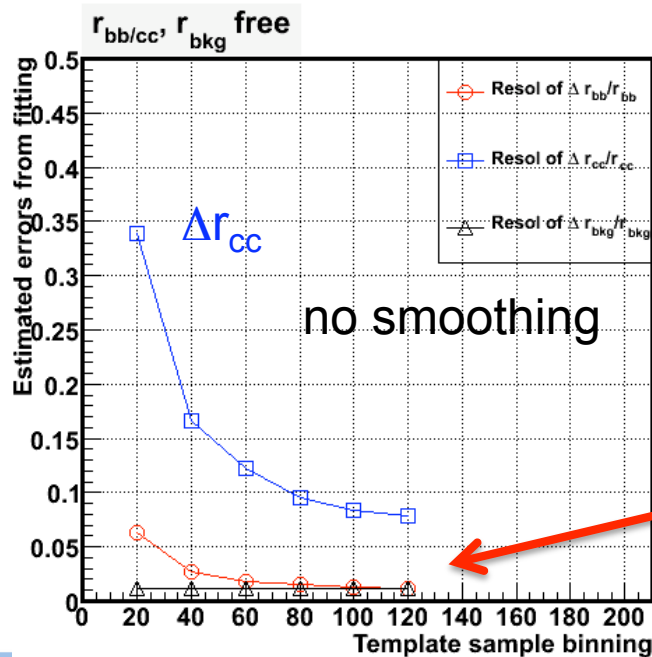
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- Previous meeting
  - Remove template sample binning dependence with smoothing
  - Distortion of large statistic template by smoothing makes  $r_{cc}$  error to be large
  - Non uniform binning template samples are suggested
- Today's topic
  1. Optimize smoothing threshold to reduce template sample binning dependence
  2. Non uniform binning template samples are tested
    - Not yet finish this point.

# Template histogram smoothing

- Smoothing procedure applied 1 times
- Smoothing degrade the measurement accuracy to be worse at the finer binning samples



	60 bins	No smooth	After smooth
$\Delta r_{bb}$		1.78%	2.28%
$\Delta r_{cc}$		12.2%	23.3%

- $r_{bb}$  binning dependence becomes negligible
- $r_{bkg}$  has no binning effect

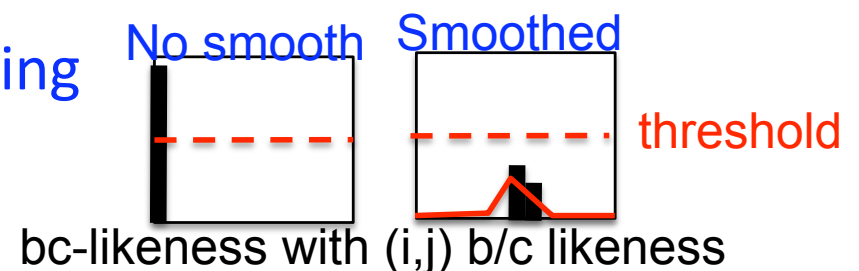
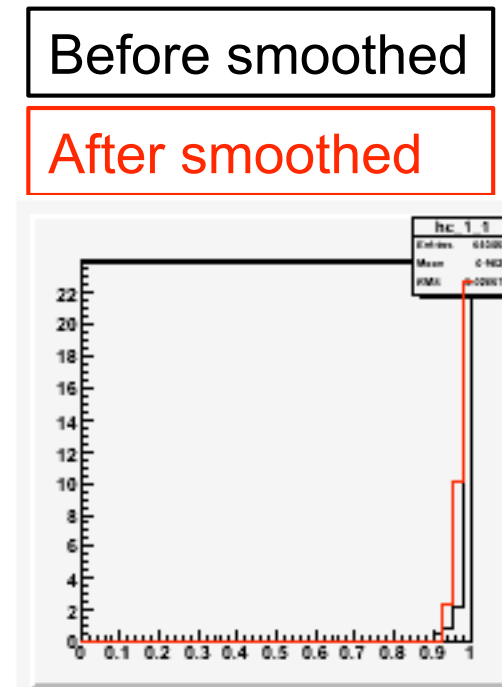
# Threshold optimization

- Distortion of the template sample shape by large statistics samples smoothing increase the error of  $r_{cc}$

- Apply threshold to smooth or not smooth the histogram with its entry

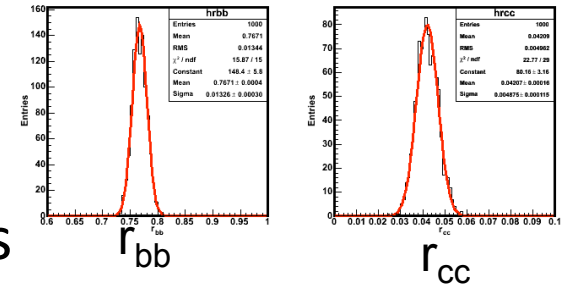
- Entries < 30 : Apply smoothing

- Entries  $\geq 30$  : Not apply smoothing



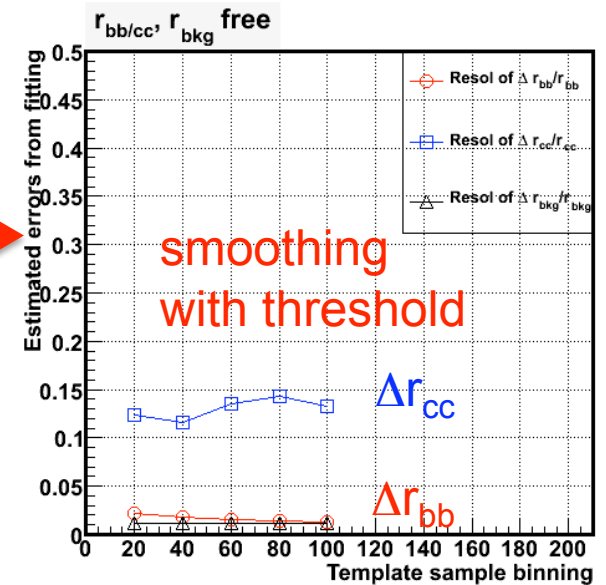
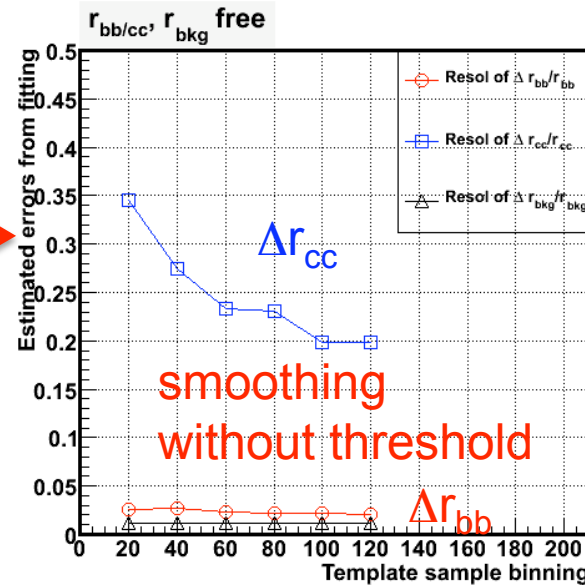
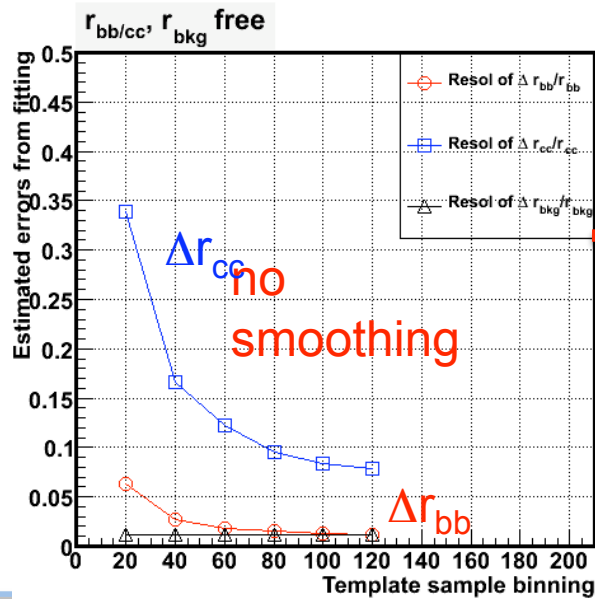
# Template fitting binning dependence

- Toy MC with 1000 times are applied
- Template samples are smoothed
  - bc-likeness 1D hist at b/c likeness of (i,j) bins



Smooth : maximum bin < 30 entries histogram

Binning dependence can be disappeared



# Fitted results and summary

Smoothing for histogram with the threshold below 30 entries

nbins = 40	$r_{\text{bkg}}=\text{free}$	$r_{\text{bkg}}=1$ (fixed)
$r_{\text{bb}}$	$0.7671\pm 0.013$ (0.7665)	$0.7675\pm 0.012$
$r_{\text{cc}}$	$0.0421\pm 0.005$ (0.0422)	$0.0420\pm 0.005$
$\Delta r_{\text{bb}}$	$1.73\pm 0.039$ %	$1.51\pm 0.034$ %
$\Delta r_{\text{cc}}$	$11.59\pm 0.28$ %	$11.39\pm 0.28$ %
$\text{Br}(H\rightarrow\text{cc})/\text{Br}(H\rightarrow\text{bb})$	$0.0581\pm 0.0068$	$0.0581\pm 0.0067$
$\Delta\text{Br}(H\rightarrow\text{cc})/\text{Br}(H\rightarrow\text{bb})$	$11.71$ %	$11.49$ %

- $\Delta\text{Br}(H\rightarrow\text{cc})/\text{Br}(H\rightarrow\text{bb})\sim 12\%$  has achieved with template fitting smoothing
- Template fitting binning dependence can be reduced with histogram smoothing
- SiD group (8.8%) and ILD (12%) difference should be considered

# Non uniform binning template

- Make non uniform binning template
  - Next I will report next meeting

