General Meeting vol. 7

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Motivation

- My target is measurement of Higgs mass and cross section using recoil method in Zh events at 250GeV.

Higgs mass	Center of Mass Energy	Integrated Luminosity	Spin Polarization	Detector Simulation
125 [GeV]	250 [GeV]	250 fb^{-1}	P(e^-, e^+) =(−0.8, +0.3)	ILD_01_v05 (DBD ver.)

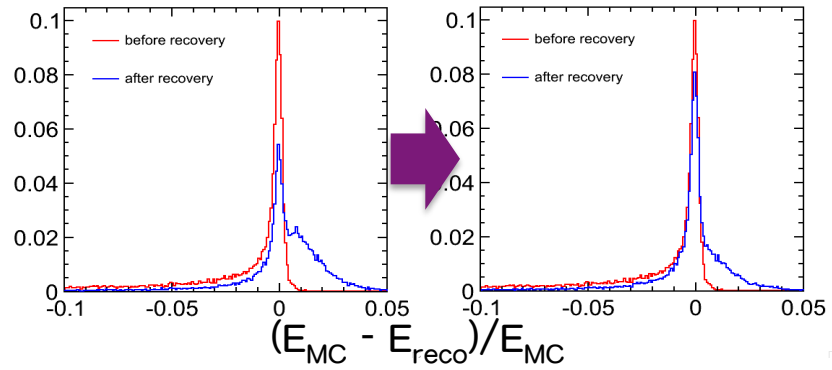
- Method :
  - Reconstruct Higgs mass of Zh events by recoil
  - Reject BG events
  - Fit recoil mass distribution
  - Do toy-MC study and estimate statistical error

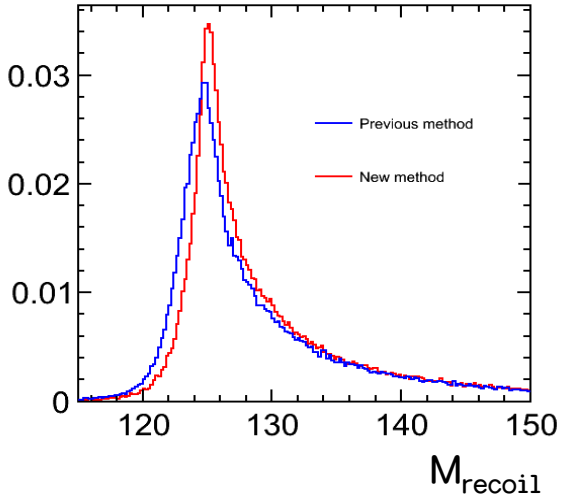
Current Status of Recoil Study

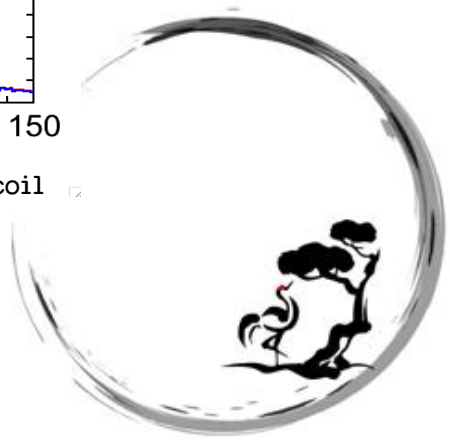
- Outline (cut & basic fitting strategy) is finished.
- Fitting for eeX recoil distribution after brems recovery is now investigated.
  - Kernel estimation seems to work well.
  - CBS x Novosibirsk fitting also worked.
  - Both these 2 methods have a problem about mass analysis.
- About Higgs CP mixture study, now I have samples which have anomalous coupling.

Bremsstrahlung Recovery

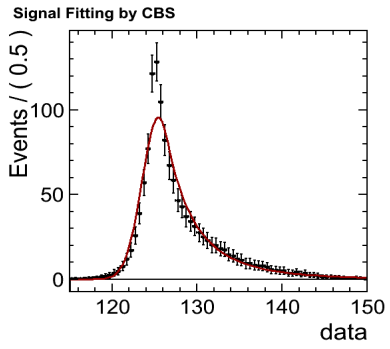
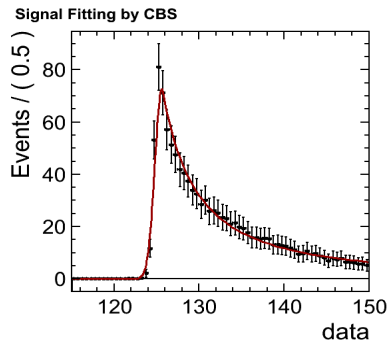
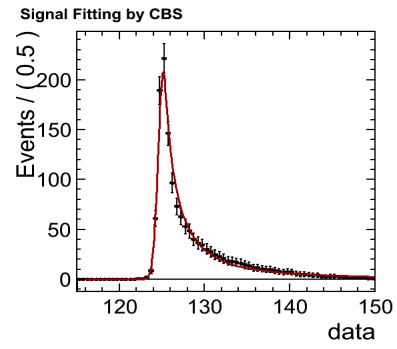
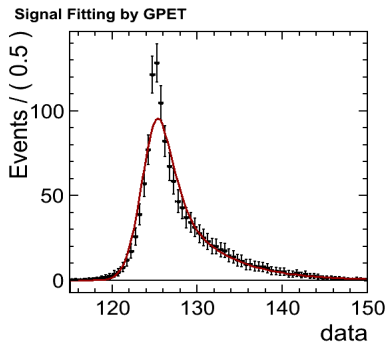
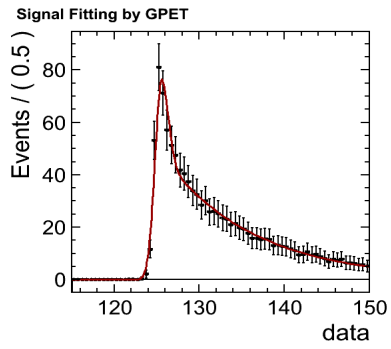
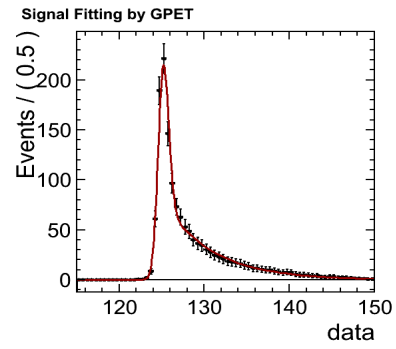
- I tried new brems recovery method.
- Recoil mass distribution was changed sharper.
- But statistical error did not change better while significance increased.
- This is because fitting by GPET and CBS does not work well for distribution after brems recovery. (not only new method, always)







Fitting Function

	eeX w/ brems recovery	eeX w/o brems recovery	μμX
CBS			
GPET			

- Fitting seems to work except eeX with brems recovery.
- After recovery, is not the shape of peak Gaussian?
  (for example, effect from photons worse resolution?)

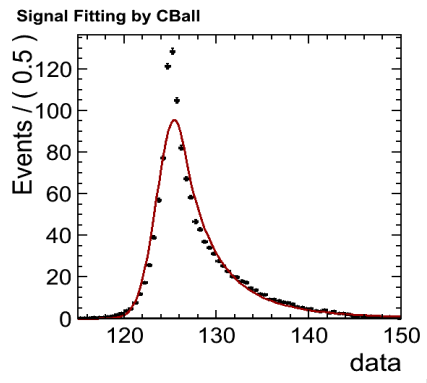
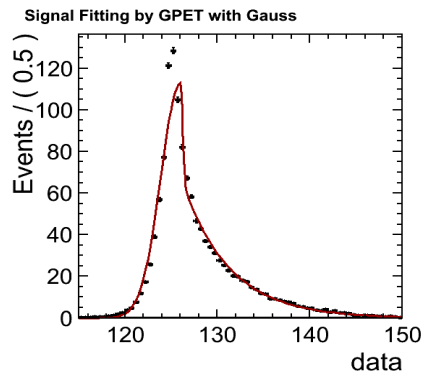
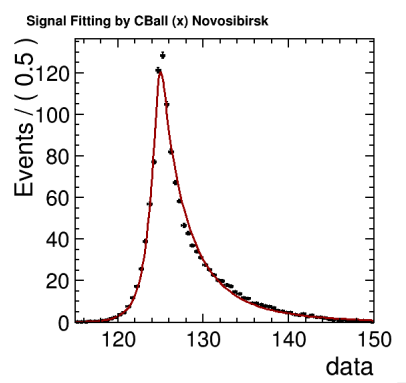
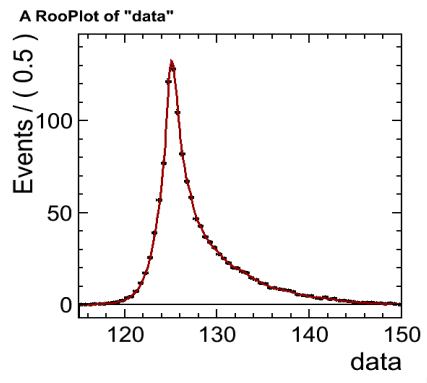
Substitution

- The substitute for CBS (GPET)
  - GPET with another Gaussian at left part

$$\begin{cases} e^{-\frac{1}{2}\left(\frac{x-\bar{x}}{\sigma_1}\right)^2} & (x \le \bar{x}) \\ e^{-\frac{1}{2}\left(\frac{x-\bar{x}}{\sigma_2}\right)^2} & (\bar{x} < x \le \sigma_2 k + \bar{x}) \\ be^{-\frac{1}{2}\left(\frac{x-\bar{x}}{\sigma_2}\right)^2} + (1-b)e^{-k\frac{x-\bar{x}}{\sigma_2}} e^{\frac{k^2}{2}} & (x > \sigma_2 k + \bar{x}) \end{cases}$$

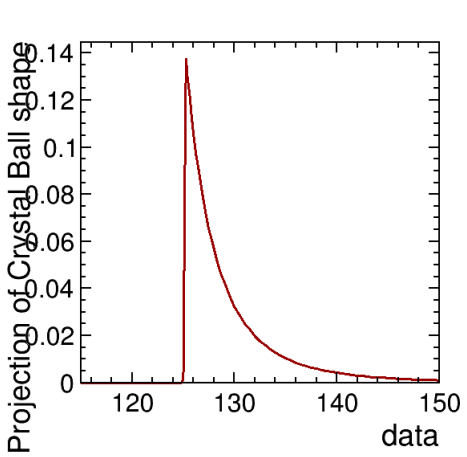
    ➡ Shape will be gross
  - Convolution of CBS and Novosibirsk
    ➡ Fit will work well
  - Kernel Estimation
    ➡ Shape is the best, but since it is not fitting using parameters, treatment is difficult (for mass analysis)

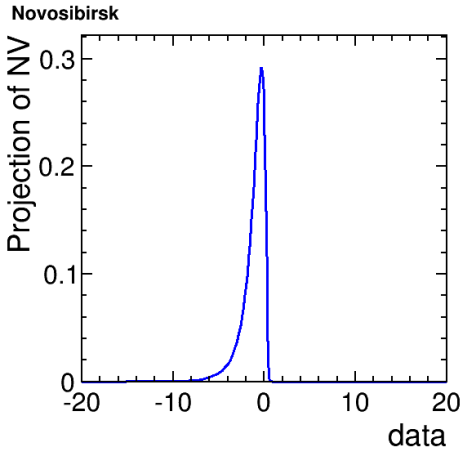
Comparison

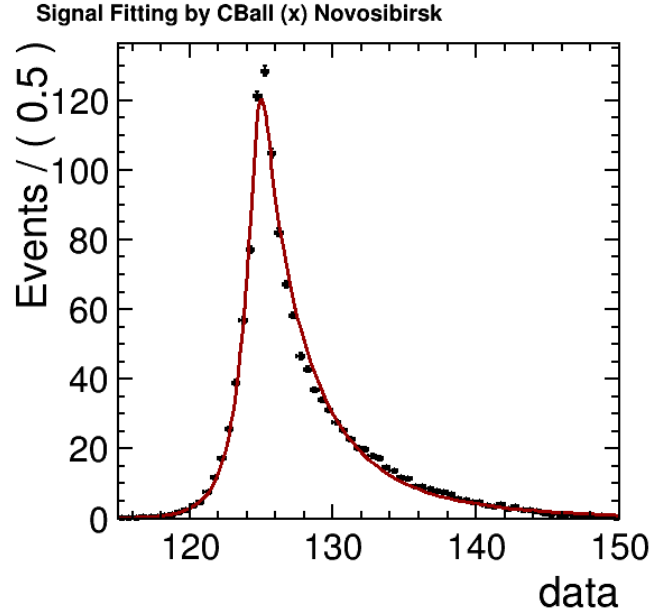
CBS	GPET w/ Gauss	CBS ⊗ Novosibirsk	Kernel Estimation
			
χ^2/NDF = 52.6	29.8	17.5	1.22

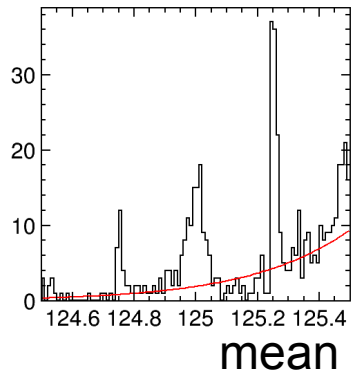
- Left 2 functions seems to be not relevant.
- CBS ⊗ Novosibirsk and KeysPdf can match the distribution.

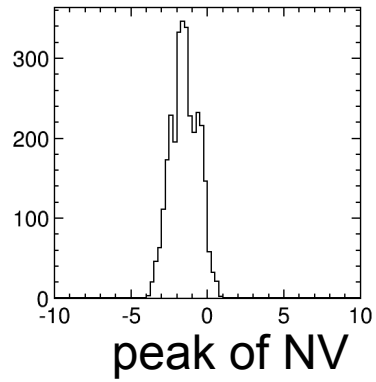
CBS⊗Novosibirsk Function







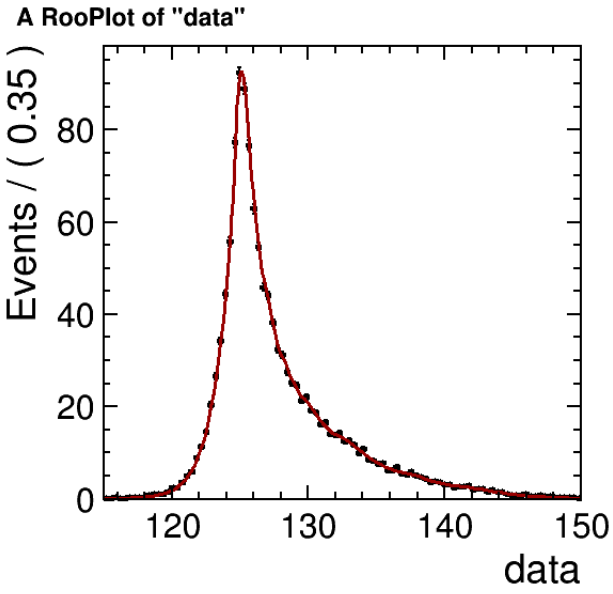




- Fitting seems to work, but CBS mean was strange even when NV "peak" is floated.
- Yields pull is OK.

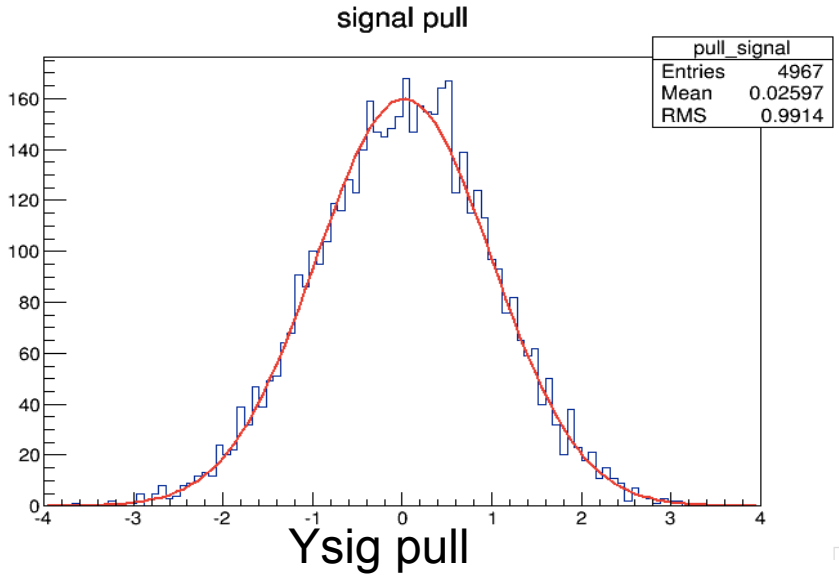
Kernel Estimation

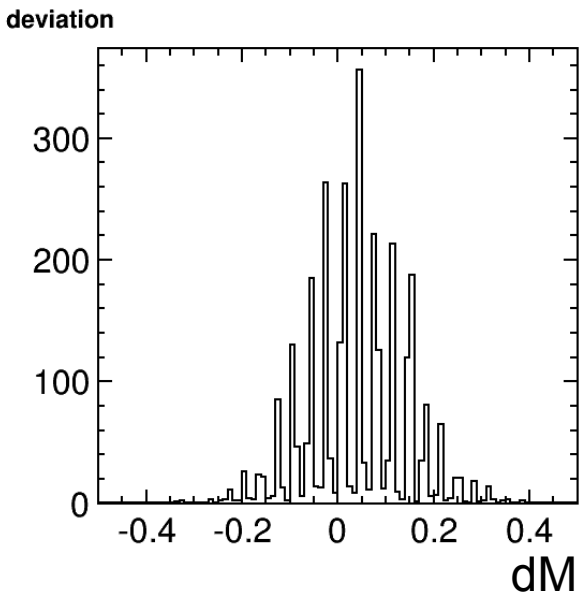
- KeysPdf worked well and stat. error of cross section can be estimated.
- Unfortunately, result of model independent analysis is not better (not worse) than previous CBS case which is not relevant to fit.
- But KeysPdf is fixed at x-axis, so mass analysis is difficult.



Floated KeysPdf

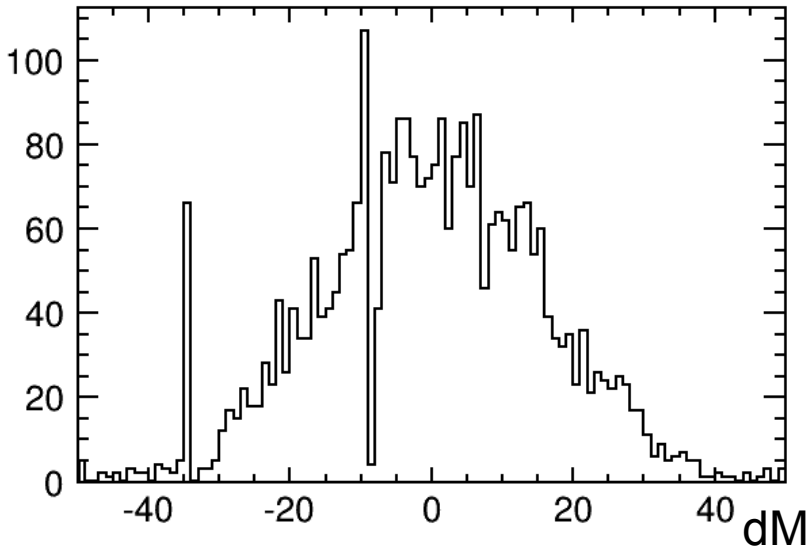
- To measure transverse fluctuation, I tried shifted axis;
  - $x' = x + dM$
- I expected dM corresponds to mass, but histogram of dM has discontinuous distribution?
- Pull of yields seems to be OK.





Problem of Shifted Axis

- I also tried to use shifted axis in case of CBS whose mean value was fixed.
- Events in which
  (result->status() == 0) && (result->covQual()==3)
  are used, then distribution of dM is following.
- The kind of strangeness is different from kernel estimation case.

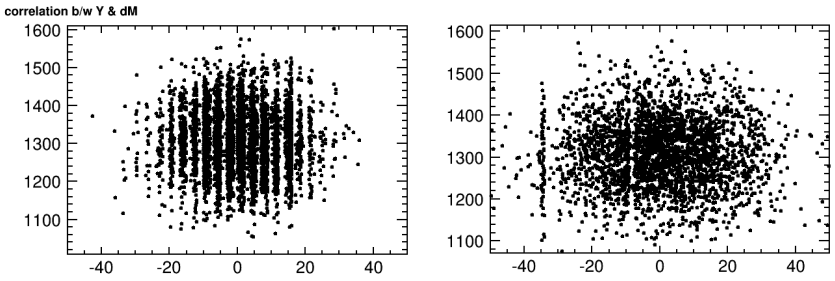


Comparison of Results

- Bottom table is summary of result of cross section analysis using various fitting pdf.
- Though crystal ball shape is not relevant, results are consistent in each case in MI analysis.
- In semi-MI case, result of kernel estimation and CBS⊗NV case seems to be better than CBS.

	Crystal Ball Shape	CBS⊗NV	Kernel Estimation
MI	5.9%	6.0%	5.9%
semi-MI	5.4%	5.2%	5.2%

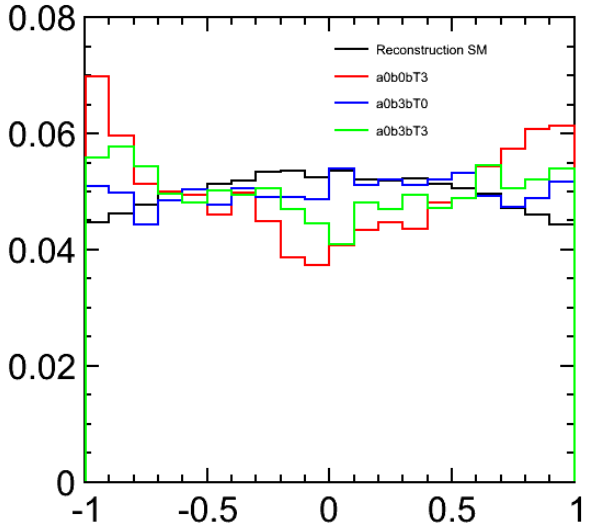
※correlation b/w dM and Ysig seems to be small.



KE CBS

About CP Mixture Study

- My method to calculate CP mixture η is following.
  - Reconstruct Z boson and measure production angle.
  - Divide it by MC distribution and obtain eff.
  - Multiple it with theoretical pol2 function.
  - Fit it by pol2 and calculate η value by theory.
- Now I have various samples in which there is anomalous coupling.



Are these necessary?

Next Plan

- Make it clear why dM has a strange distribution, and get result of mass analysis.
- I want to estimate how does Z reconstruction affect my final result.

- Get η value using anomalous coupling samples (relation between b~ and η?).
- BG study of sensitivity of CP mixture is needed (I wonder it is possible with BG).