Higgs Recoil Mass General Meeting vol.6

Tohoku University

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About My Study

- *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.)

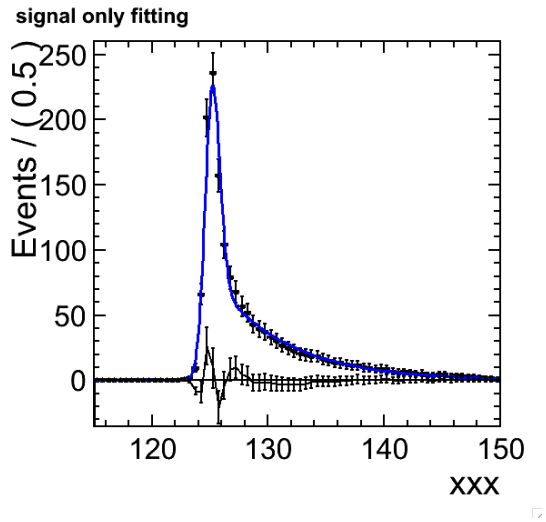
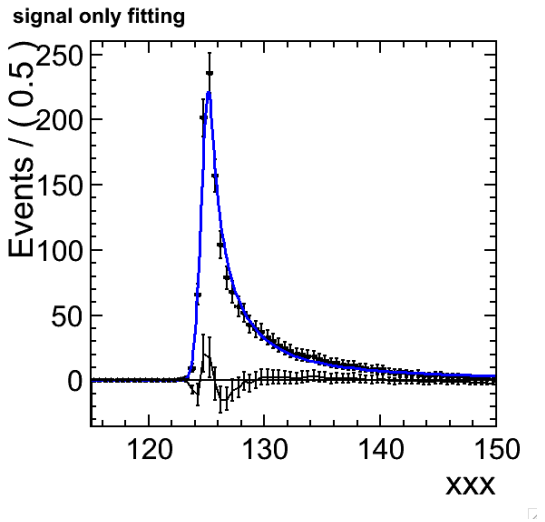
- *Method :*
  - *Reconstruct Higgs mass of Zh events by recoil*
  - *Reject BG events*
  - *Fit recoil mass distribution*
  - *Do toy-MC study and estimate statistical error*
- *Currently, I investigate fitting method further.*

Current Status

- *Different fitting methods are compared :*
- *Fitting function*
  - *GPET*
  - *Crystal Ball*
  - *Kernel Estimation (not yet)*
  - *Physics motivated function (?)*
- *Binning*
  - *Small bins (nbin = 175)*
  - *Large bins (nbin = 70)*
  - *Unbinned likelihood fit*
- *BG yields*
  - *I've fixed all of parameters except height and mean of GPET.*
  - *Now, BG (3rd order polynomial) yields of fitting function is floated (it should be argued).*

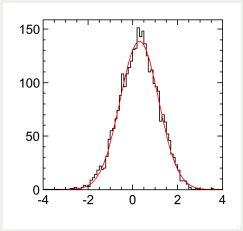
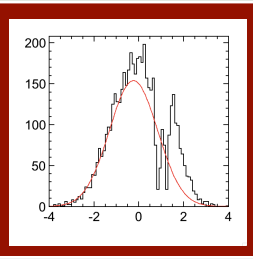
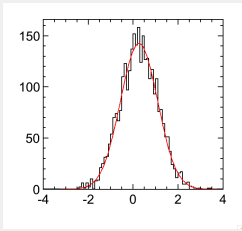
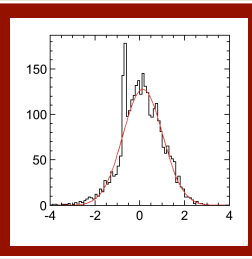
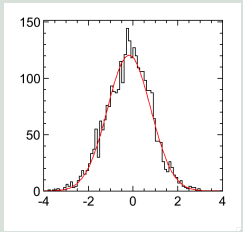
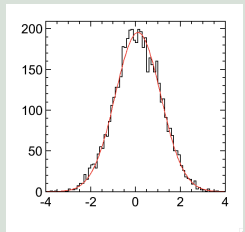
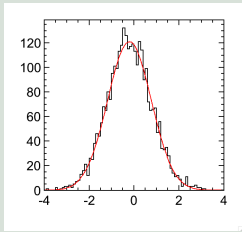
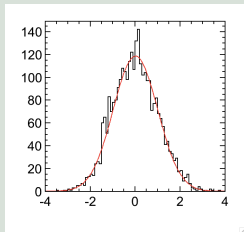
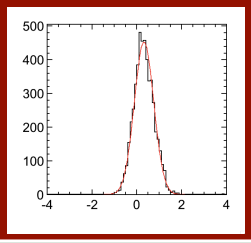
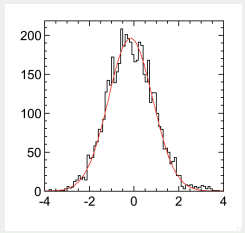
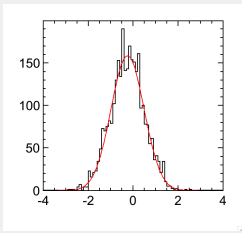
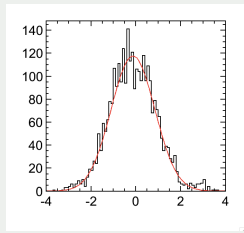
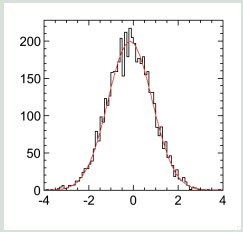
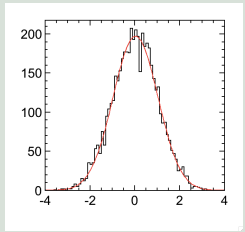
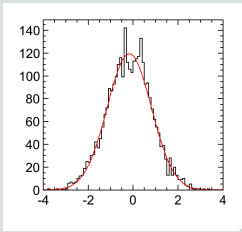
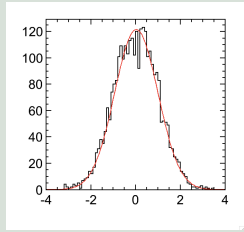
※ Floating BG yields leads strange behavior of pull dist.

GPET and Crystal Ball

GPET	Crystal Ball
	
$\chi^2 = 0.41$	$\chi^2 = 0.63$

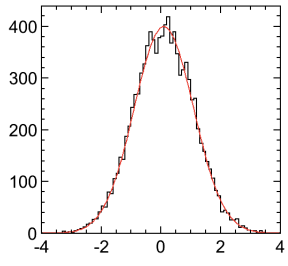
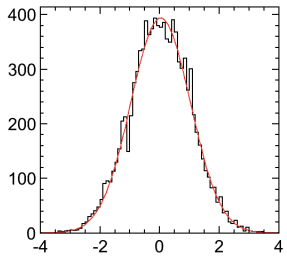
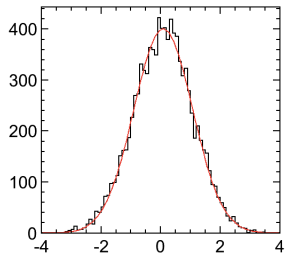
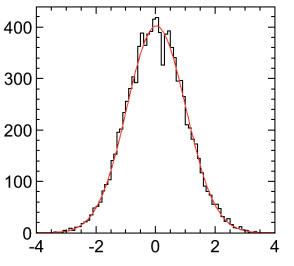
- *Both GPET and Crystal Ball are pure Gaussian in left side, and there seems to be no essential difference of choosing these functions.*

Pull Distributions in Binning Method

		Likelihood > 0.29		Likelihood > 0.33	
		Large bin (70)	Small bin (175)	Large bin (70)	Small bin (175)
Crystal Ball	mean				
	Y_signal				
GPET	mean				
	Y_signal				

※ BG yields is floated

Unbinned Likelihood Fit

GPET		Crystal Ball	
Y_signal	mean	Y_signal	mean
			

- *In some condition of binning method, pull distribution of mean value has strange behavior (e.g. spike, dent, too narrow width).*
- *In unbinned likelihood fit, such strange pull doesn't appear.*
  - *namely, strange pull came from floating number of BG and binning effect(?)*

Parameter Fixing (1/2)

	p1	p2	p3	mean	width	alpha	n	Y_sig	Y_BG
First fit	float	float	float	float	float	float	float	float	float
toy-MC	fix	fix	fix	float	fix	fix	fix	float	float

estimate mass and cross section error

- *Now, I float BG yields parameter of fitting function, because number of BG of toy is also floated.*
- *But if pull distribution is Gaussian whose width is 1, can I fix BG yields in toy-MC fitting also?*
  - *Now, anyway pull is correct Gaussian in unbinned fitting.*

Parameter Fixing (2/2)

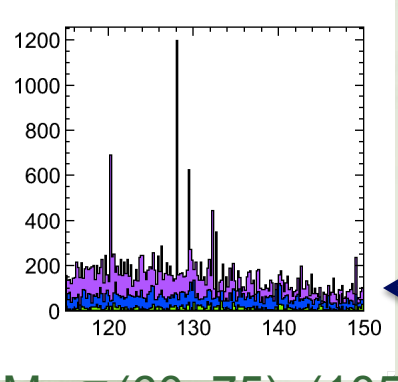
function	BG yields	cross section error	mean error
GPET	fix	3.66%	34MeV
	float	4.01%	34MeV
CBS	fix	3.52%	33MeV
	float	4.05%	34MeV

※ all unbinned method, $f_L > 0.31$, $N_{toy} = 3000$

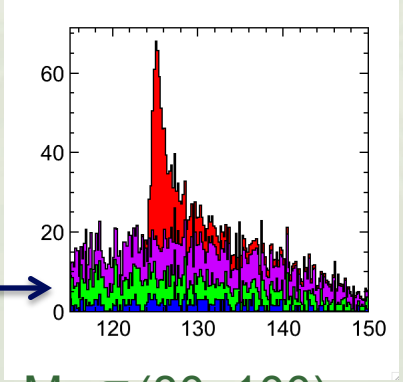
- *Fixing or floating BG yields of function affect results significantly.*
- *If I can fix number of BG in fitting, sure, it's better.*

Decide BG Shape

- *If possible, it's better to decide BG shape parameter from sideband distribution.*



should be compared



$M_{dl} \in (60, 75), (105, 120)$ $M_{dl} \in (80, 100)$

	p1	p2	p3	mean	width	alpha	n	Y_sig	Y_BG
First fit	fix?	fix?	fix?	float	float	float	float	float	float
toy-MC	fix	fix	fix	float	fix	fix	fix	float	float

Summary and Plan

- *Summary*
  - *I'm investigating fitting method further now.*
  - *If BG yields are floated, pull distribution sometimes has strange behavior in binning method.*
  - *In unbinned likelihood fit, such behavior doesn't appear.*
  - *Fixing or floating BG yields affect the results significantly, and if possible, fixing can result in better.*
- *Next plan*
  - *eeX channel fitting*
  - *BG shape parameter fixing*
  - *I'll try optimized bremsstrahlung recovery method (using Junping-san's function)*