A Study of Higgs Recoil Mass at Ecm=350GeV based on Fast Simulation

Hengne LI

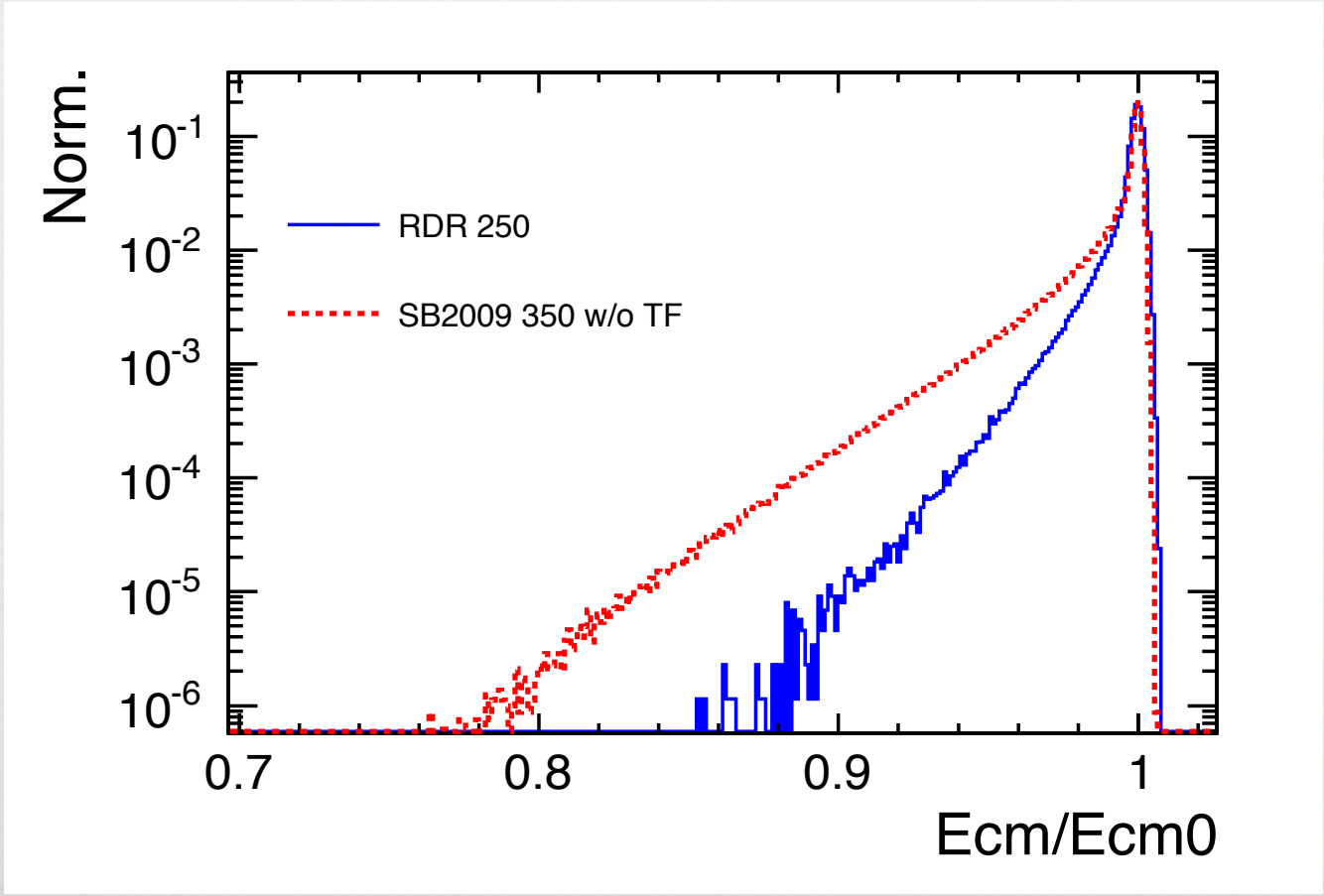
Hengne.Li@in2p3.fr

Outline

- Intent of this work: predict results at Ecm=350GeV with SB2009 beam parameters, serving as inputs to the discussion of the impacts of the SB2009 beam parameters on ZH study.
- Work Flow:
  - GUINEA-PIG Beam Simulation
  - PYTHIA Event Generation
  - Fast Simulation of ILD
  - Analysis
- Further reading: accompany notes of this work are provided on the agenda

Beam Simulation

- Using GUINEA-PIG with SB2009 Beam parameters given by Brian Foster's talk on SB2009 Meeting at DESY 2009



Event Generation

- Event generation using PYTHIA:
  - Beam Pol. (e-: -80%, e+: +30%) at Ecm=350GeV

Reaction	Cross-Section
$\boldsymbol{ZH \to \mu\mu X}$	**7.1 fb**
WW	346 fb
ZZ	165 fb

- Estimate the Integrated Luminosity for various sets of beam parameters according to Peak Luminosities: taken RDR 500 as reference

$$\mathcal{L}_{\rm int} = \frac{\mathcal{L}_{\rm peak}}{\mathcal{L}_{\rm peak,RDR500}} \cdot \mathcal{L}_{\rm int,RDR500}$$

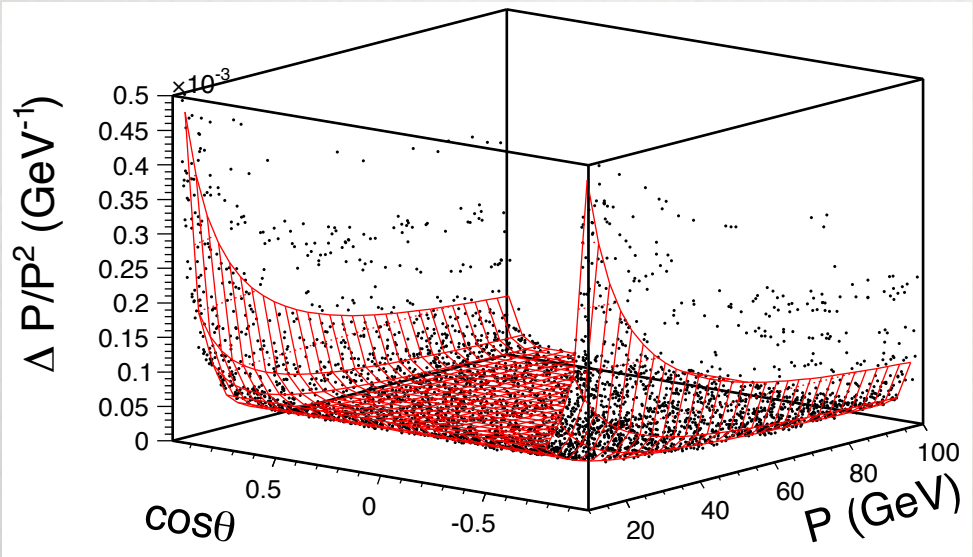
- Resulting numbers:

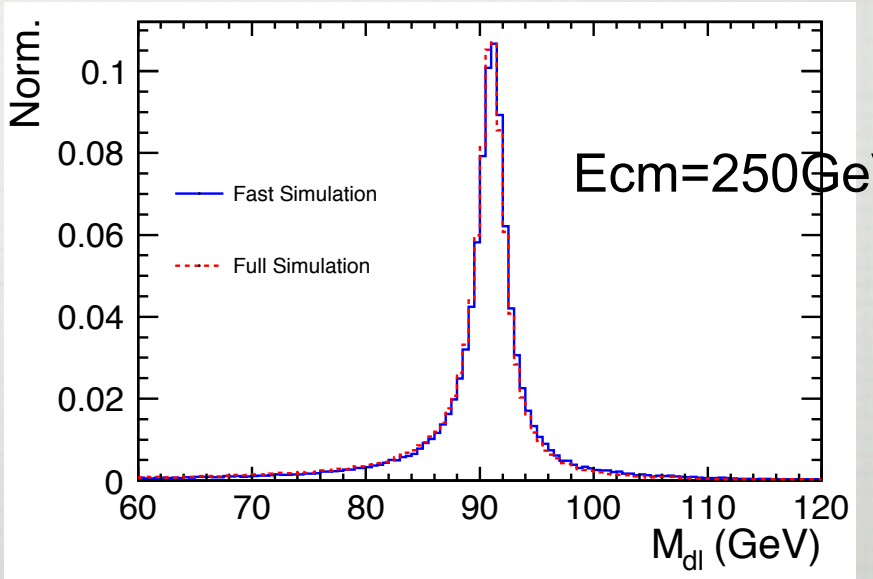
	RDR			SB2009 w/o TF				SB2009 w/ TF			
$\sqrt{s}$ (GeV)	250	350	500	250.a	250.b	350	500	250.a	250.b	350	500
Peak L (10^{34}cm^{-2}s^{-1})	0.75	1.2	2.0	0.2	0.22	0.7	1.5	0.25	0.27	1.0	2.0
Integrated L (fb^{-1})	188	300	500	50	55	175	375	63	68	250	500

Fast Simulation

- A dedicated Fast Simulation Algorithm is developed for the ILD concept
- Parameterize the Momentum Resolution as a function of P and cosθ
- The MC true momentum of a given muon is smeared according to this parameterization.

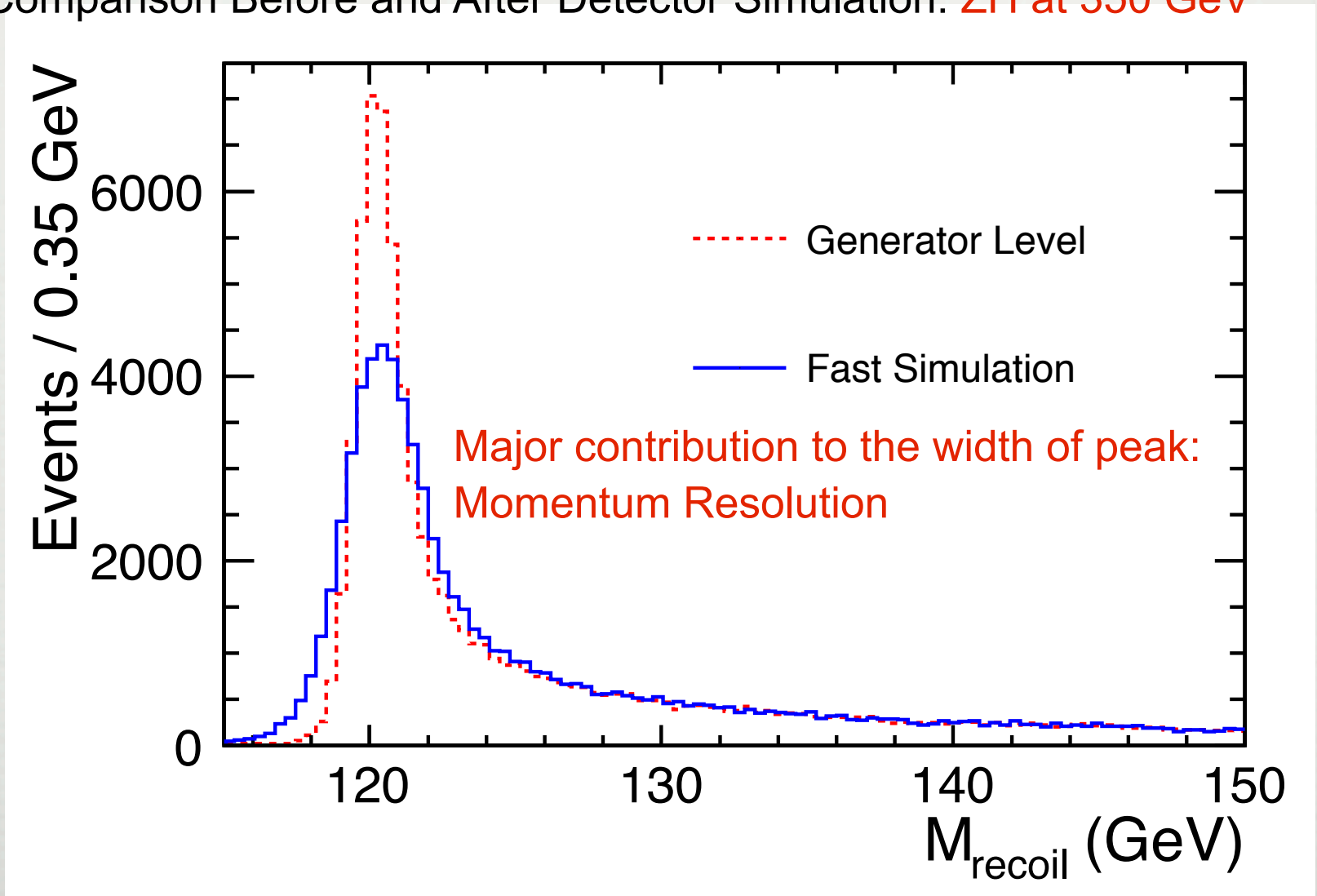
$$\frac{\Delta P}{P^2} = \begin{cases} a_1 \oplus b_1/P & : \ |\cos\theta| < 0.78 \\ (a_2 \oplus b_2/P) \Big/ \sin\left(1 - |\cos\theta|\right) & : \ |\cos\theta| > 0.78 \end{cases}$$





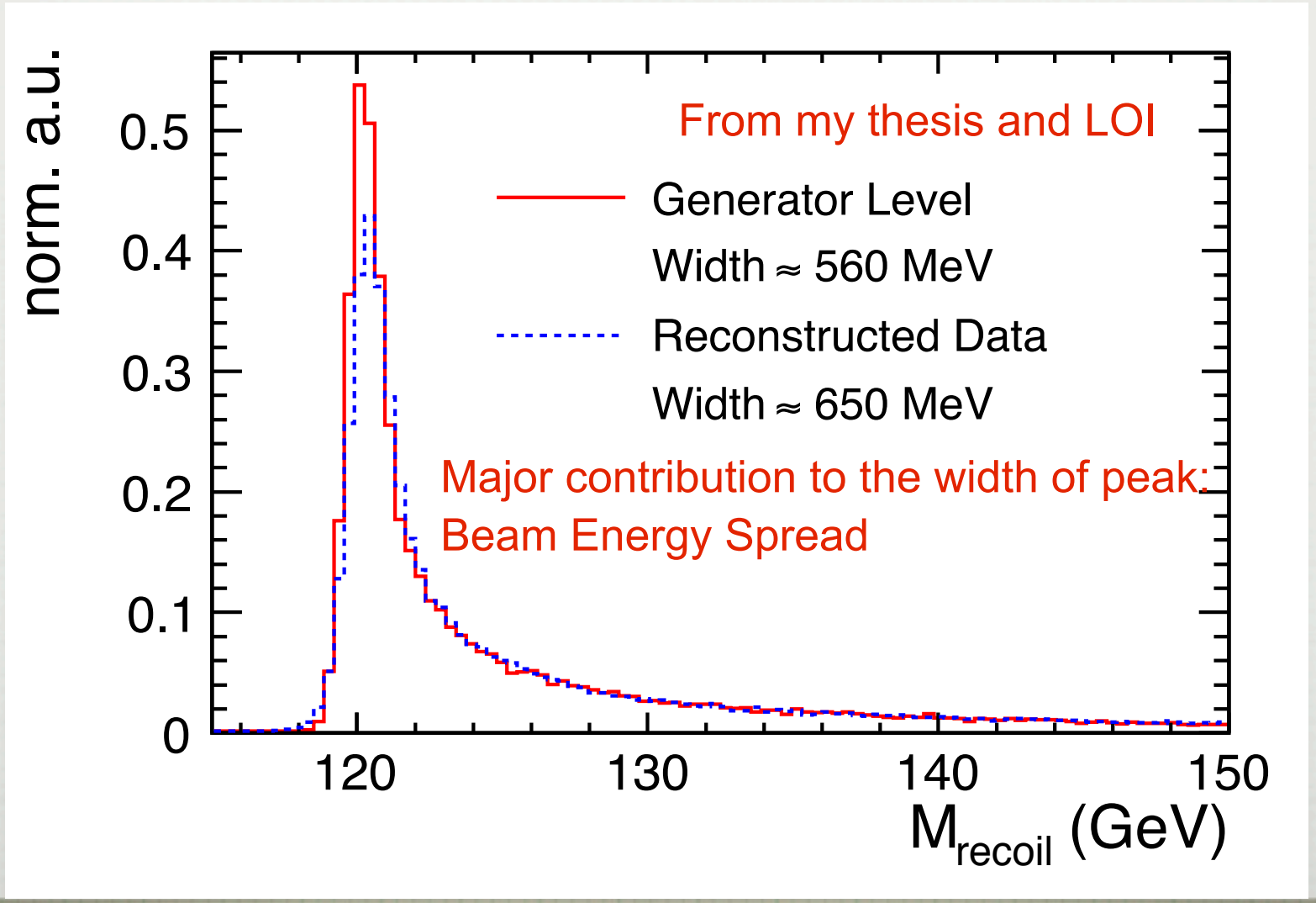
Fast Simulation

- Comparison Before and After Detector Simulation: ZH at 350 GeV



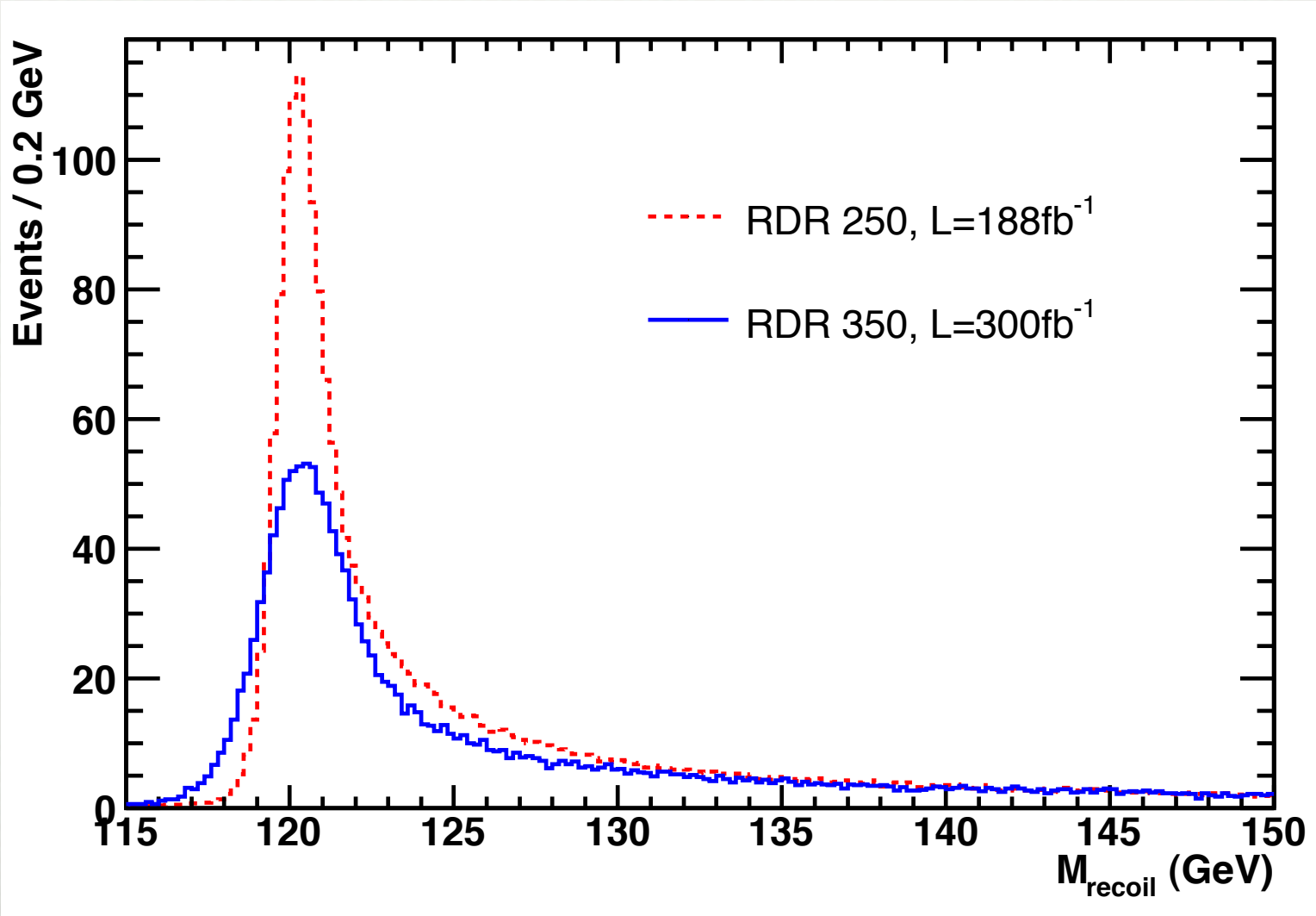
Fast Simulation

- Comparison Before and After Detector Simulation: ZH at 250 GeV



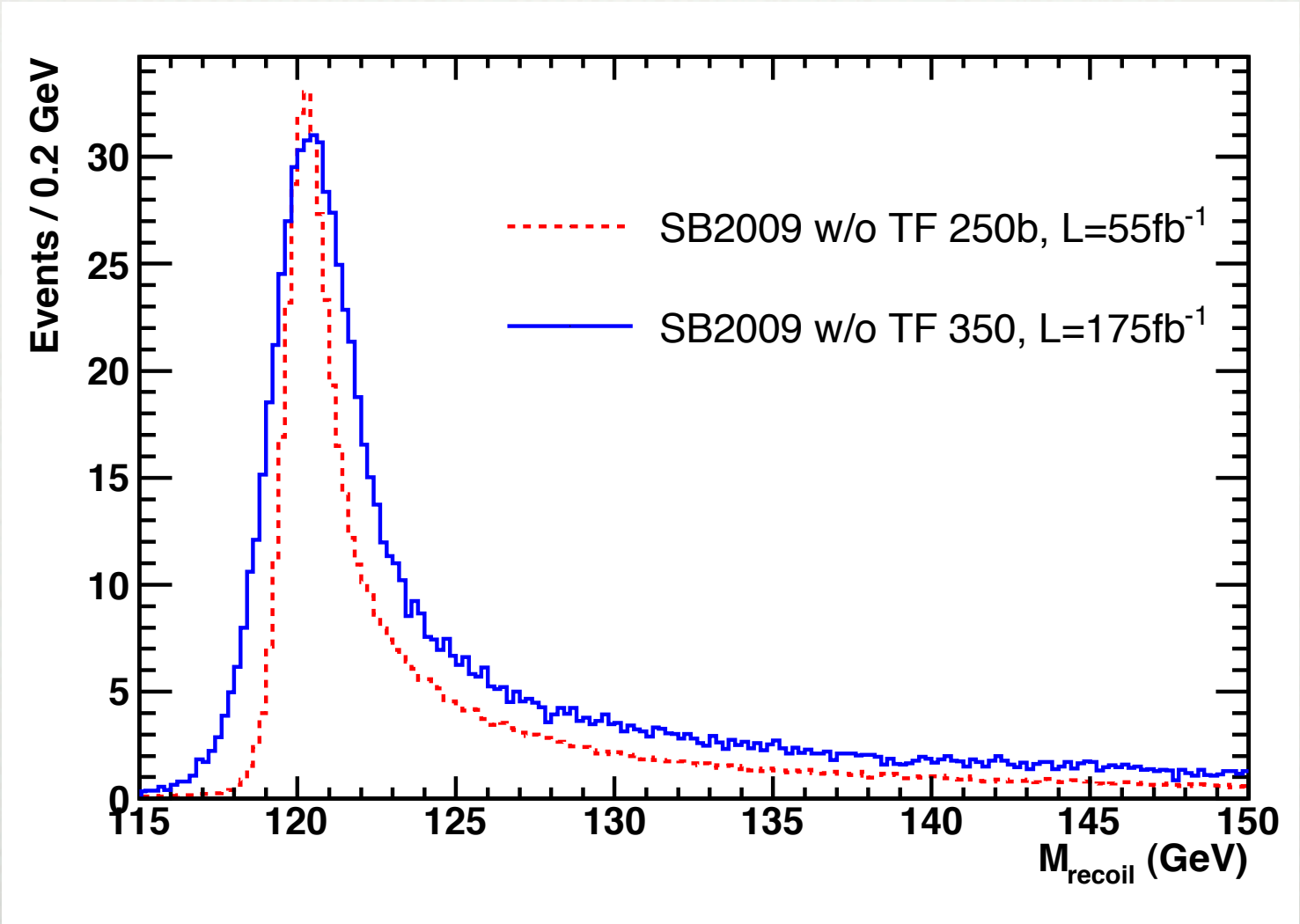
Fast Simulation

- Comparison RDR 250 vs. 350



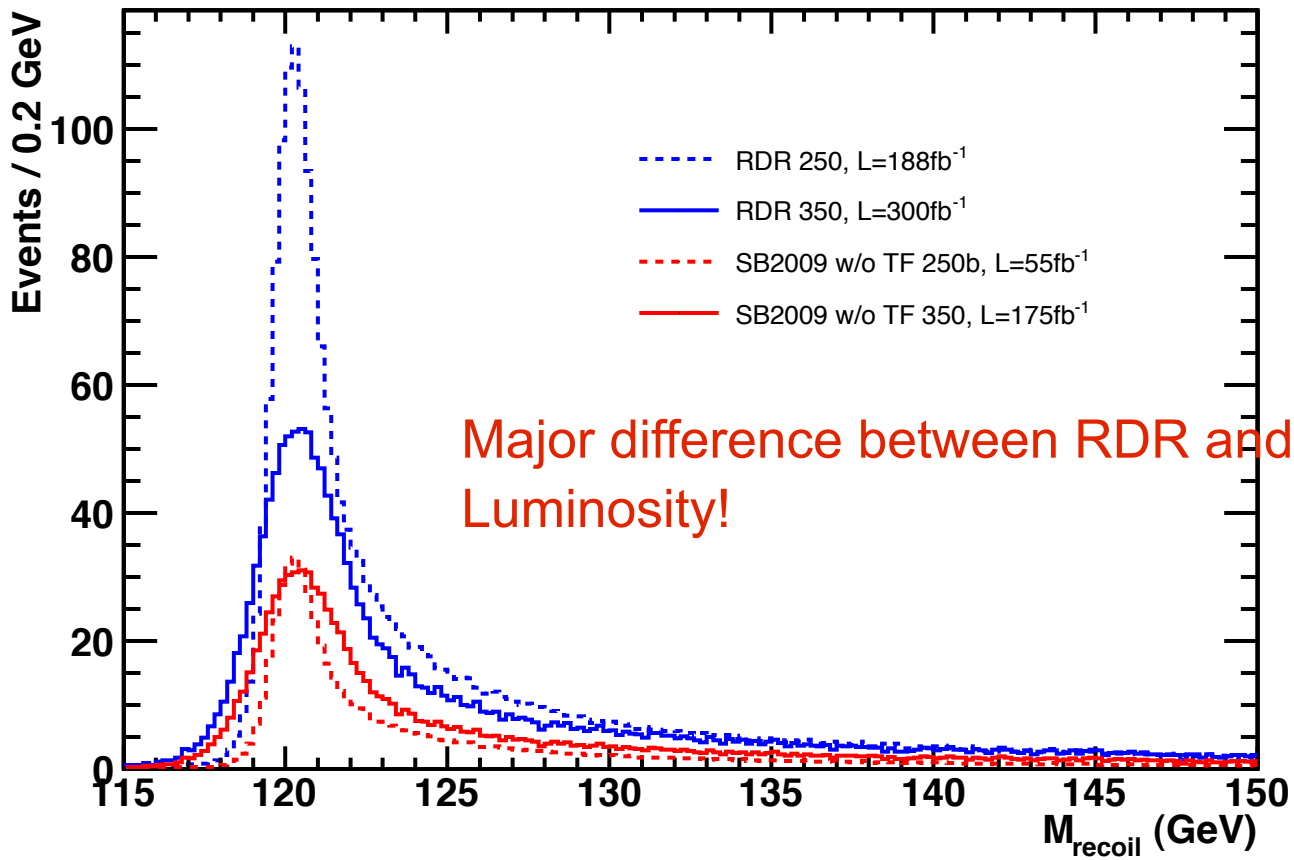
Fast Simulation

- Comparison SB2009 w/o TF 250 vs. 350



Fast Simulation

- Comparison All the 4:



Analysis

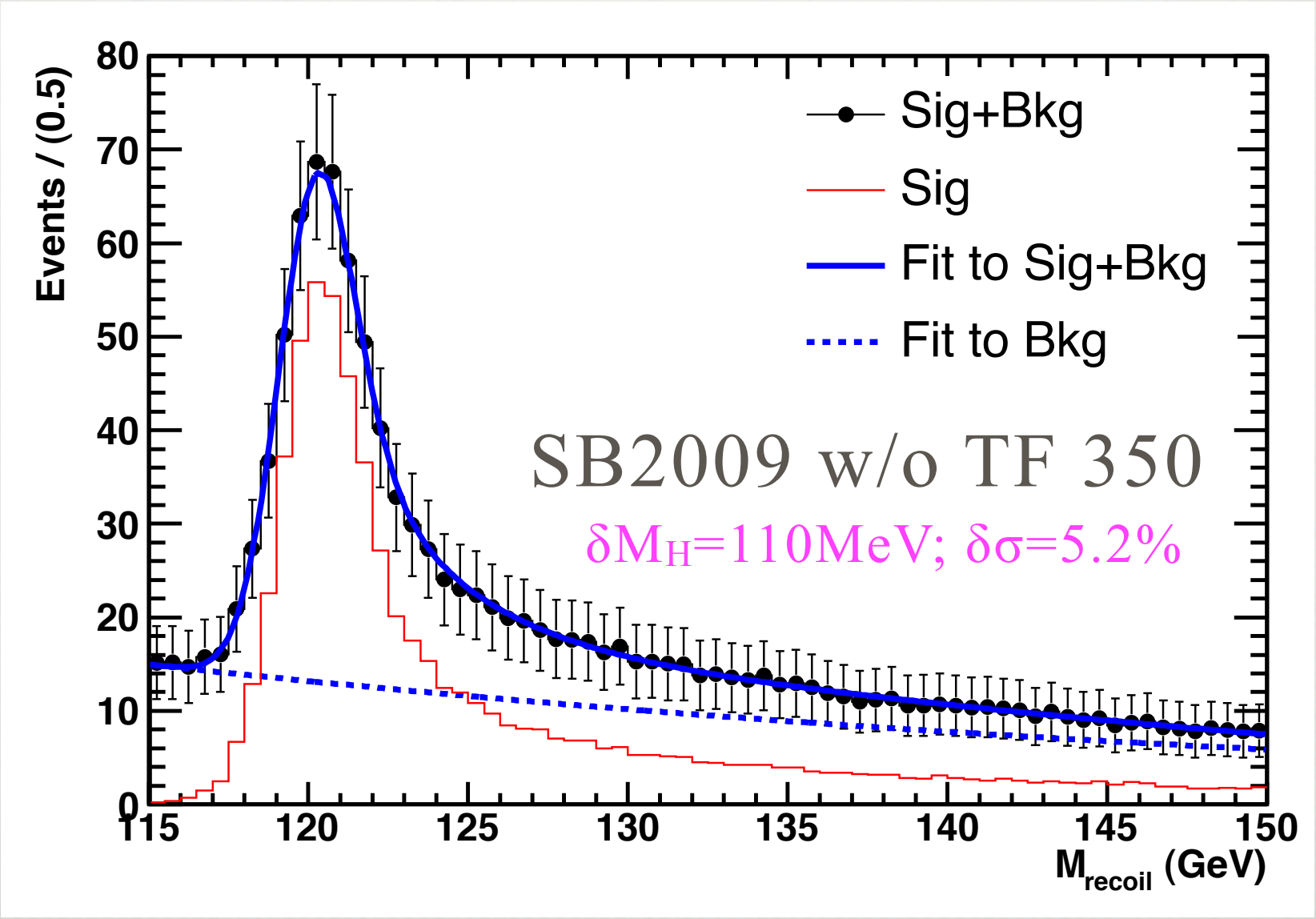
- Same analysis procedure as for the LOI:

Cut-Chain
(1) $\lvert\cos\theta_{\mu}\rvert < 0.99$
(2) $P_{Tdl} > 20$ GeV
(3) $M_{dl} \in (80,\ 100)$ GeV
(4) $acop \in (0.2,\ 3.0)$
(8) $M_{recoil} \in (115,\ 150)$ GeV
(9) Likelihood Further Rejection (using variables P_{Tdl}, $\cos\theta_{dl}$, M_{dl} and $acol$)

- Numbers of signal and bkgs: Ecm=350GeV

Reactions	$ZH \to \mu\mu X$	ZZ	WW
$N_{initial}$	1248	29k	61k
$N_{selected}$	633	658	30

Analysis


Events / (0.5)
80
70
60
50
40
30
20
10
0
115
120
125
130
135
140
145
150
M_{recoil} (GeV)
Sig+Bkg
Sig
Fit to Sig+Bkg
Fit to Bkg
SB2009 w/o TF 350
δM_H=110MeV; $\delta\sigma$=5.2%

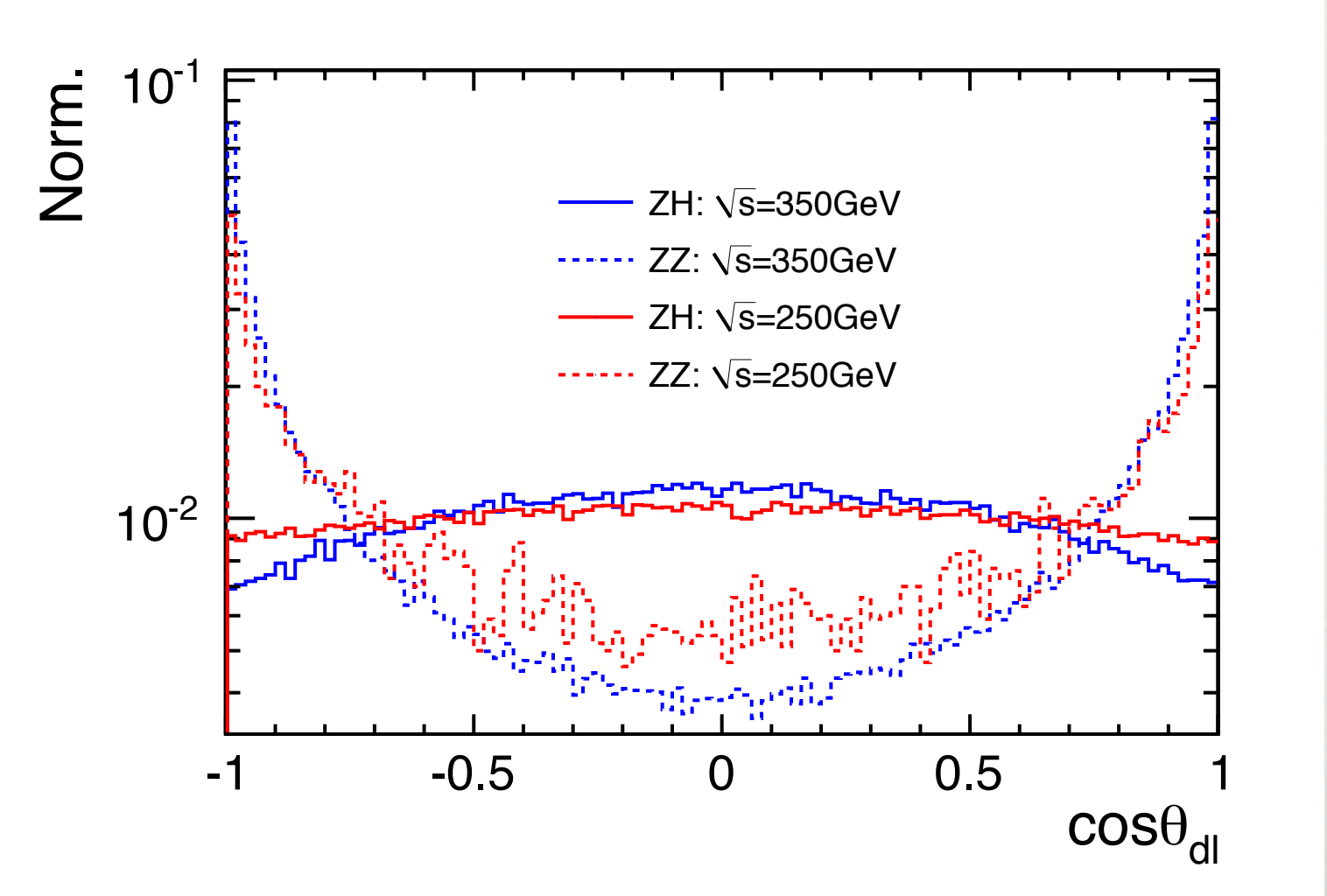
Results

Beam Par	$\mathcal{L}_{\rm int}$ (fb^{-1})	ϵ	S/B	M_H (GeV)	σ (fb) ($\delta\sigma/\sigma$)
RDR 250	188	55%	62%	120.001 ± 0.043	11.63 ± 0.45 (3.9%)
RDR 350	300	51%	92%	120.010 ± 0.084	7.13 ± 0.28 (4.0%)
SB2009 w/o TF 250b	55	55%	62%	120.001 ± 0.079	11.63 ± 0.83 (7.2%)
SB2009 w/o TF 350	175	51%	92%	120.010 ± 0.110	7.13 ± 0.37 (5.2%)

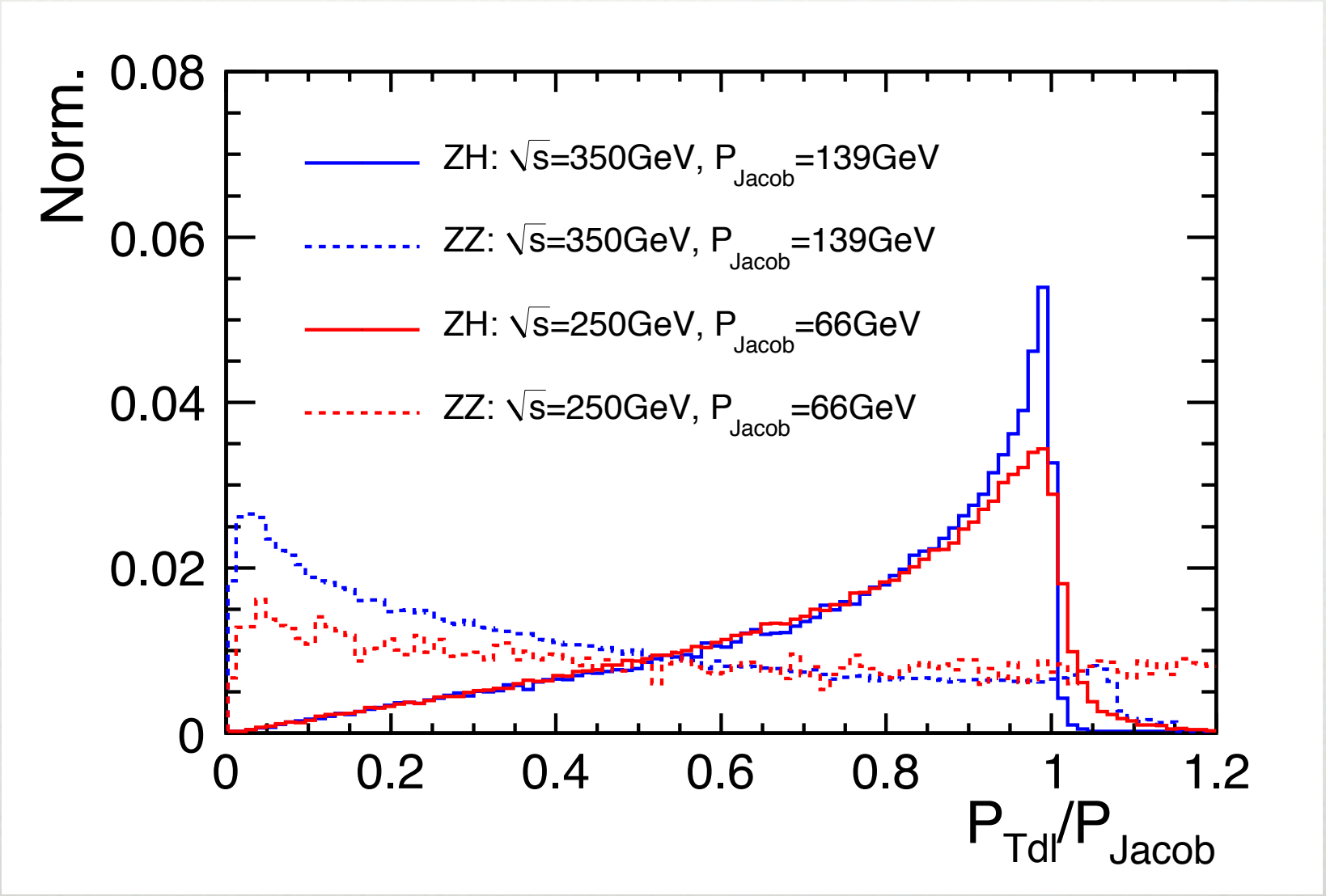
- Observation from me:
  - (1) S/B higher at 350 GeV than 250GeV: due to better bkg suppression
  - (2) RDR 250 vs. 350: Xsec - similar; mH - worse by a factor of 2 at 350GeV
  - (3) SB2009 w/o TF 250 vs. 350: Xsec - better at 350GeV; mH - worse by a factor of 1.4 at 350GeV
- From you: ....

Backups

BKG suppression



BKG Suppression



Higgs Recoil Mass 250 vs 350