

# Physics performance with SB2009

## Progress report of a study by QuickSimulator

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# Introduction

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- As a quick check of physics performance, a study of Higgs signal has been performed using QuickSimulator. A preliminary report of the study are reported.
- Samples were produced and analyzed by JSF/SimTools tools.

# Generator and QuickSimulator

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## ■ Event generator

- ◆ Pythia 6.416
- ◆ Beam polarization 0
- ◆ Convolved with luminosity spectrums simulated by CAIN.

## ■ QuickSimulator

- ◆ gld\_v3.com , but no Intermediate Tracker ( to avoid a problem in vertexing )
- ◆ Consists of 3 layers of VTX, TPC, ECAL/HCAL
- ◆ Expected performance: ( not tested in recent code )
  - Momentum resolution :  $\Delta p_t/p_t^2 \sim 5 \times 10^{-5}$  at high momentum, worse than ILD performance.
  - Jet energy resolution :  $\Delta E/E \sim 30\%/ \text{Sqrt}(E)$

# Beam parameters

from GDE WG's table

Private parameter

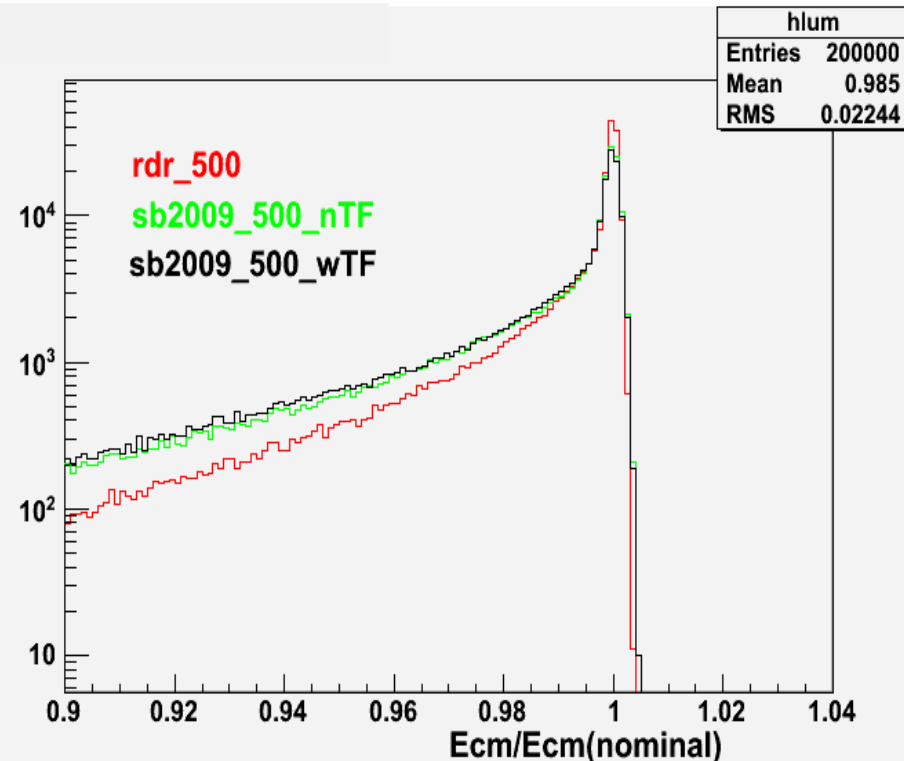
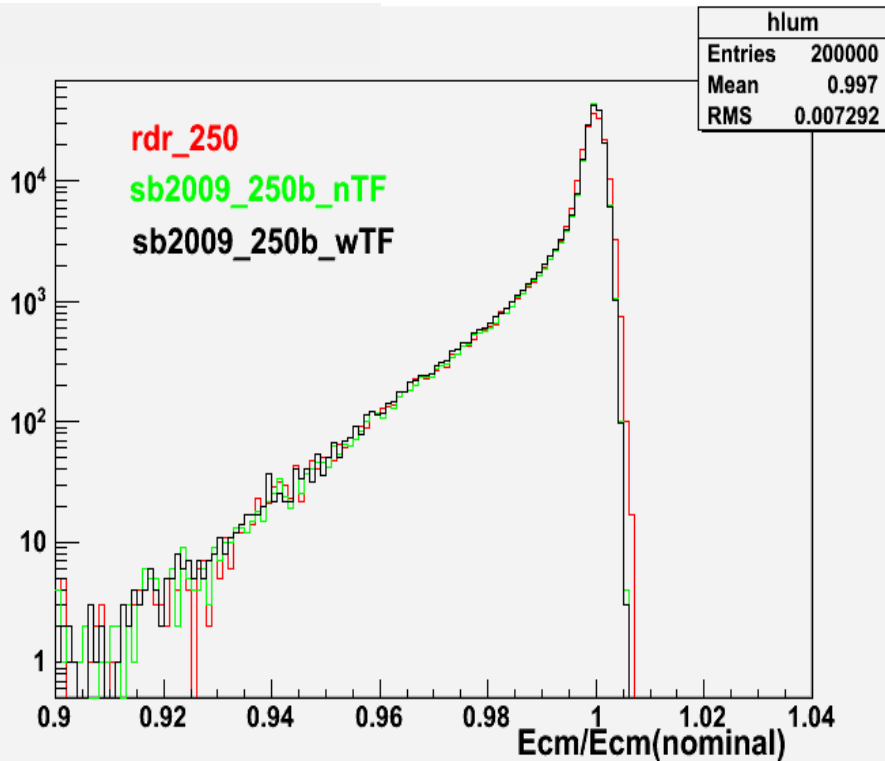
	RDR			SB2009 w/o TF				SB2009 wTF				RDR	SB2009 wTF
CM Energy (GeV)	250	350	500	250a	250b	350	500	250a	250b	350	500	300	300
Ne-(*10 <sup>10</sup> )	2.05	2.05	2.05	2	2	2	2.05	2	2	2	2.05	2.05	2
Ne+(*10 <sup>10</sup> )	2.05	2.05	2.05	1	2	2	2.05	1	2	2	2.05	2.05	2
nb	2625	2625	2625	1312	1312	1312	1312	1312	1312	1312	1312	2625	1312
F(Hz)	5	5	5	5	2.5	5	5	5	2.5	5	5	5	5
$\gamma\epsilon_x(*10^{-6})$	10	10	10	10	10	10	10	10	10	10	10	10	10
$\gamma\epsilon_y(*10^{-8})$	4	4	4	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	4	3.5
$\beta_x$	22	22	20	21	21	15	11	21	21	15	11	22	17.5
$\beta_y$	0.5	0.5	0.4	0.48	0.48	0.48	0.48	0.2	0.2	0.2	0.2	0.5	0.2
$\sigma_z(\text{mm})$	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
L(10 <sup>34</sup> cm <sup>-2</sup> s <sup>-1</sup> ) by GDE	0.75	1.2	2	0.2	0.22	0.7	1.5	0.25	0.27	1	2		
dE/E(e-, %)	0.272	0.194	0.136	0.220	0.220	0.218	0.207	0.220	0.220	0.218	0.207	0.230	0.240
dE/E(e+, %)	0.180	0.129	0.090	0.130	0.130	0.093	0.065	0.130	0.130	0.093	0.065	0.150	0.108
L(10 <sup>34</sup> cm <sup>-2</sup> s <sup>-1</sup> ) by CAIN	0.97	1.36	2.15	0.24	0.26	0.9	1.68	0.3	0.34	1.2	2.3	1.17	0.93
L(10 <sup>34</sup> cm <sup>-2</sup> s <sup>-1</sup> ) by GP	0.901	1.291	2.07	0.221	0.238	0.859	1.655	0.288	0.324	1.178	2.342		

Cain/GuineaPig calculation

# Luminosity Spectrum

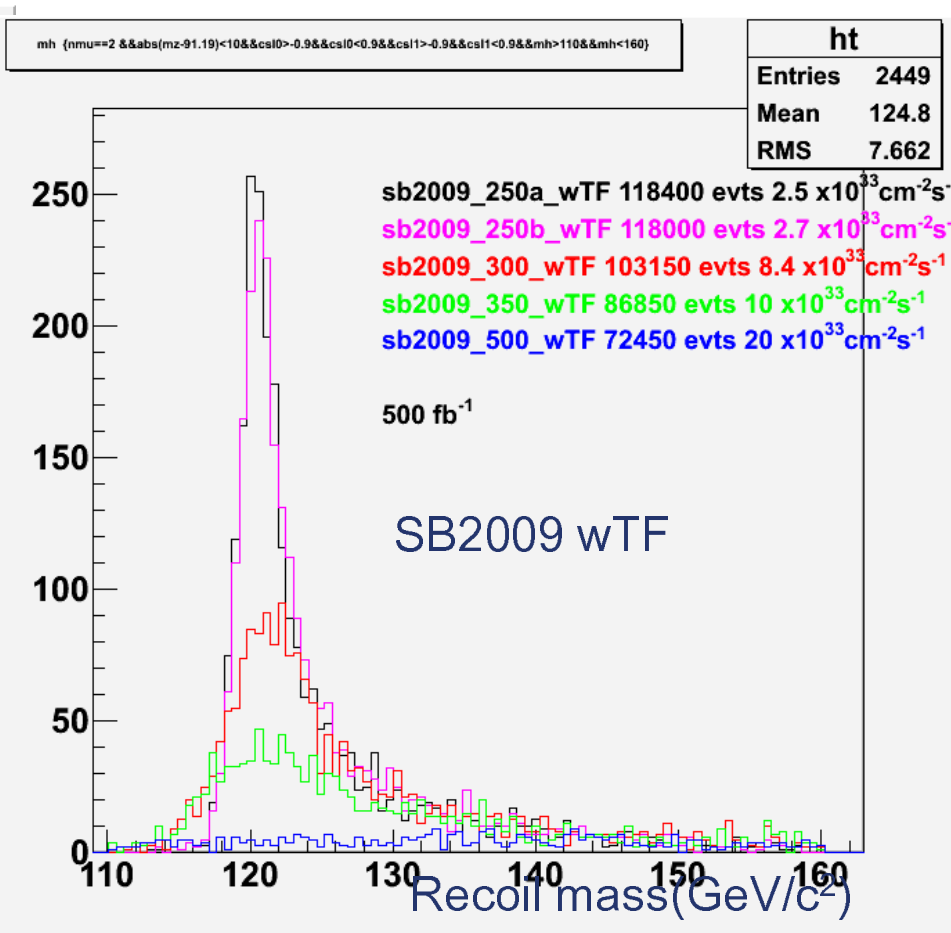
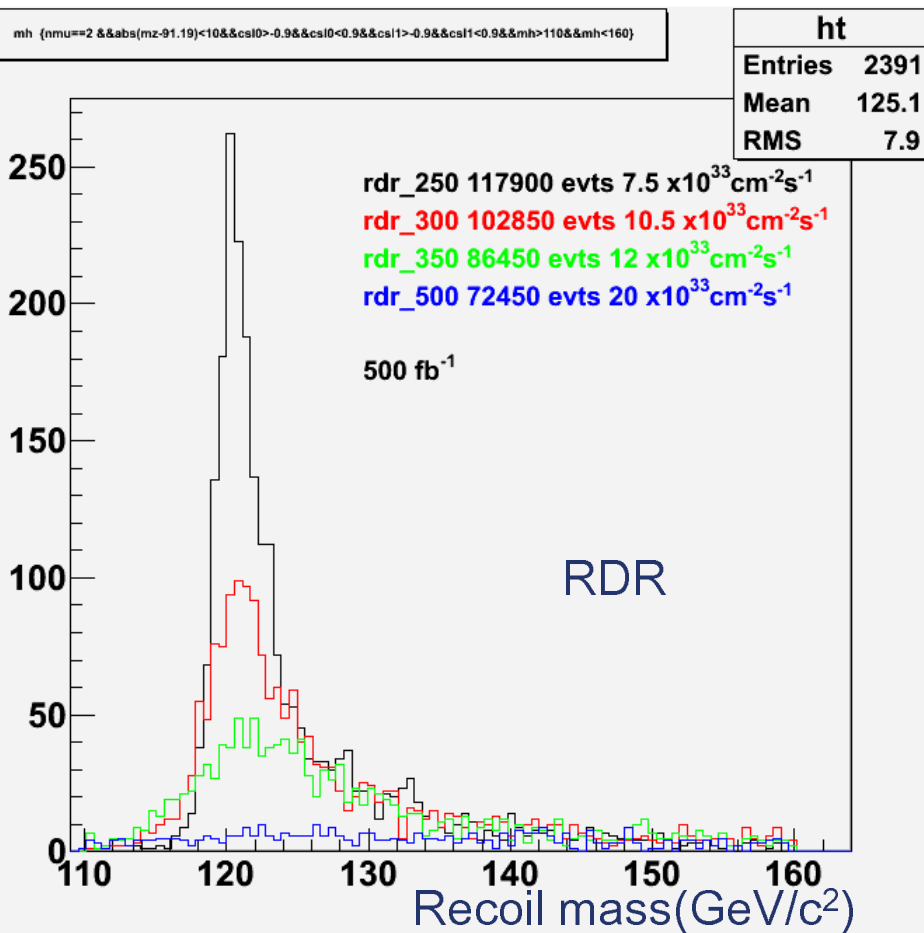
- 2 dimensional luminosity spectrum generated by CAIN are fitted to get functions

Typical spectrum including initial beam energy spread and beamstrahlung for 250 GeV and 500 GeV center of mass energy



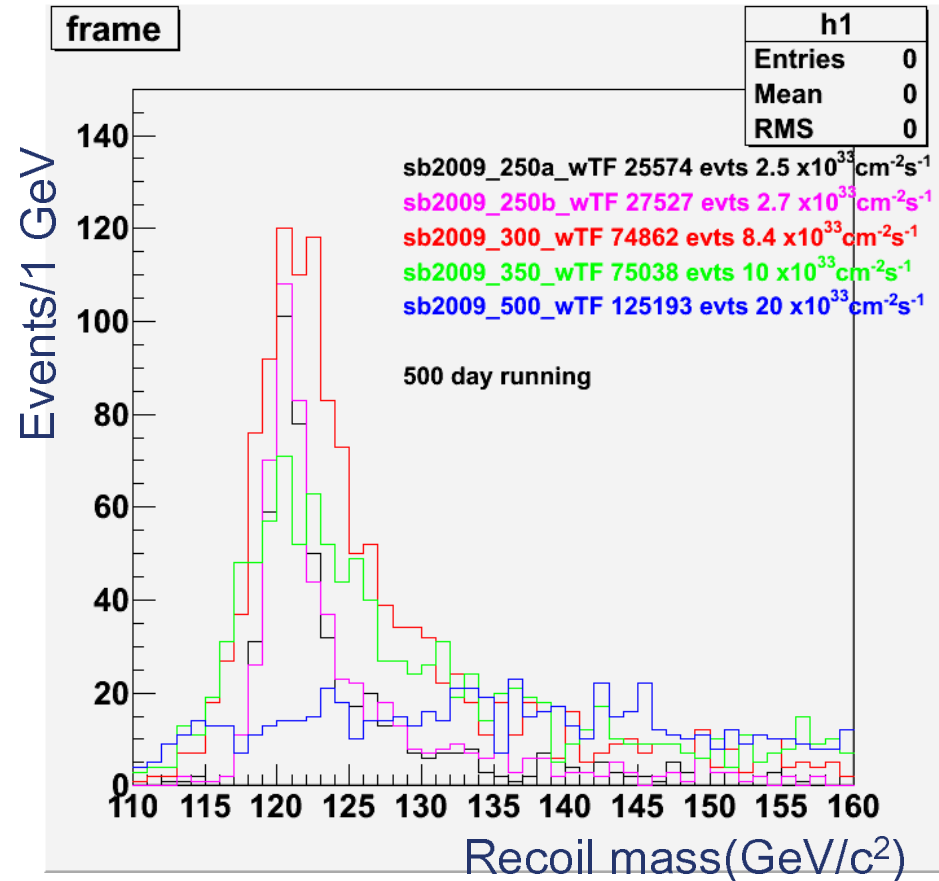
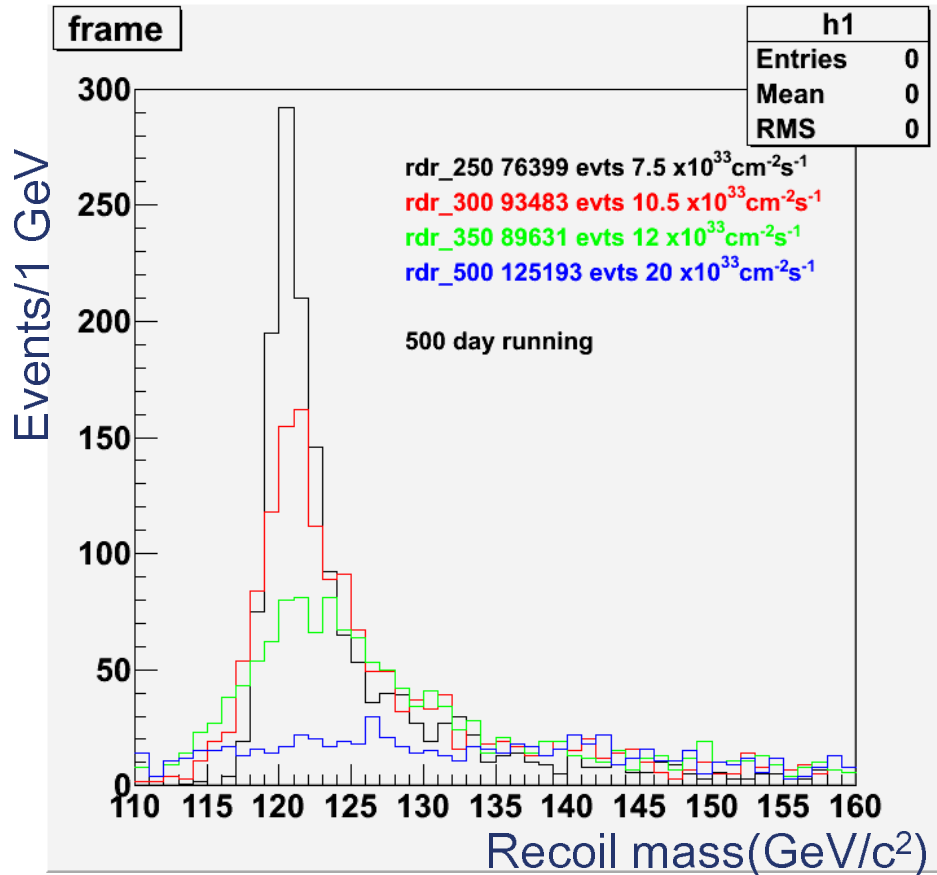
# Recoil Mass – 500fb<sup>-1</sup>

Selection:  $\#\mu=2$ ,  $|Mz(\mu\mu)-91.19|<10.0$ ,  $|\cos\theta(\mu)|<0.9$



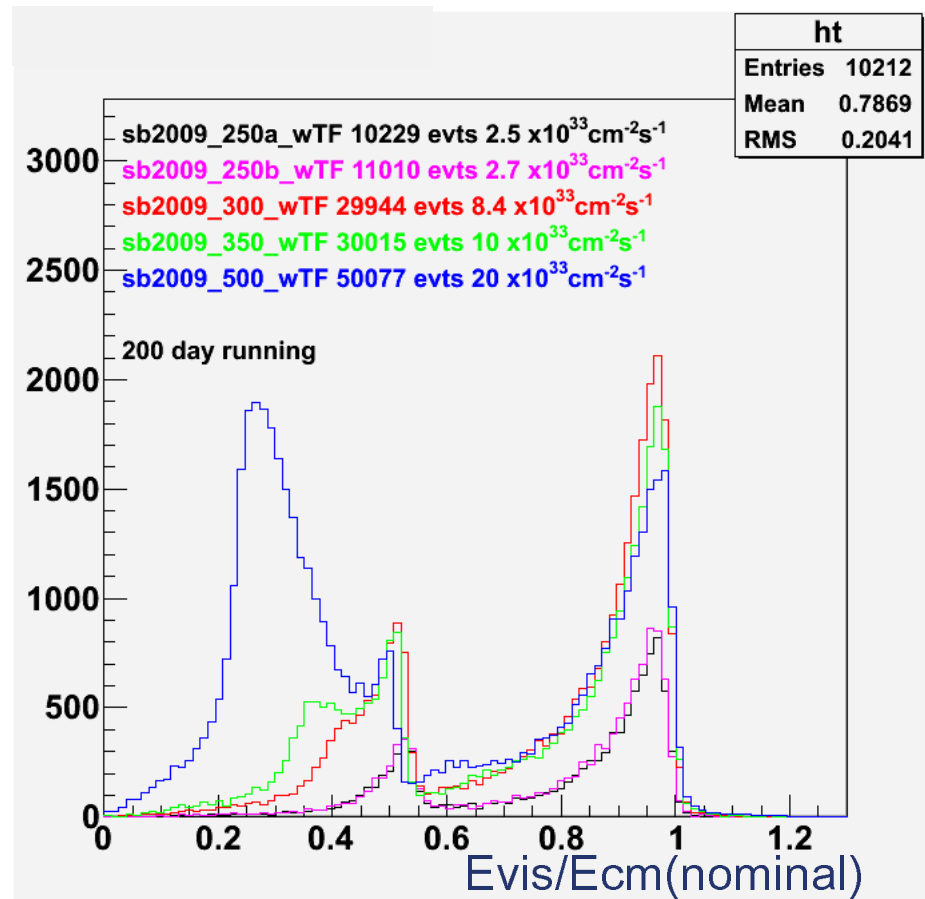
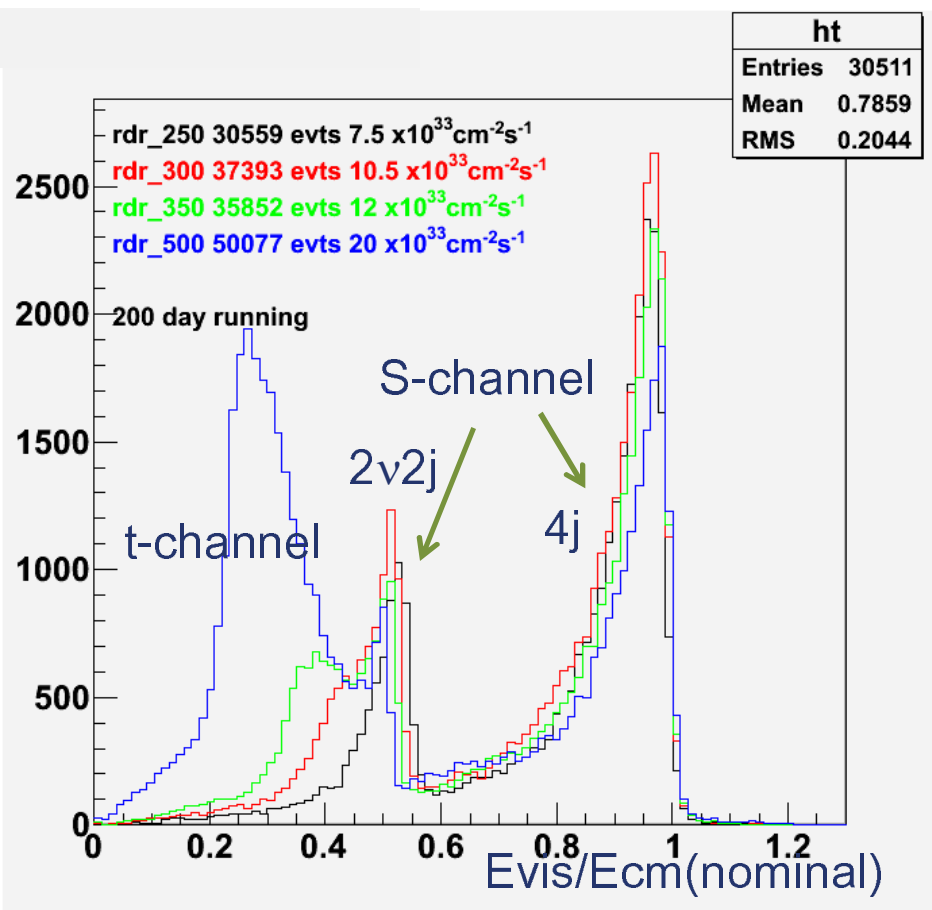
Measurement near threshold is the best for Higgs recoil mass study

# Recoil mass – 500 days



Background processes are yet to be included  
rdr\_250 parameter gives the sharpest distribution.

# Visible Energy – 200days running



Obvious difference in spectrum between RDR and SB2009\_wTF is not seen



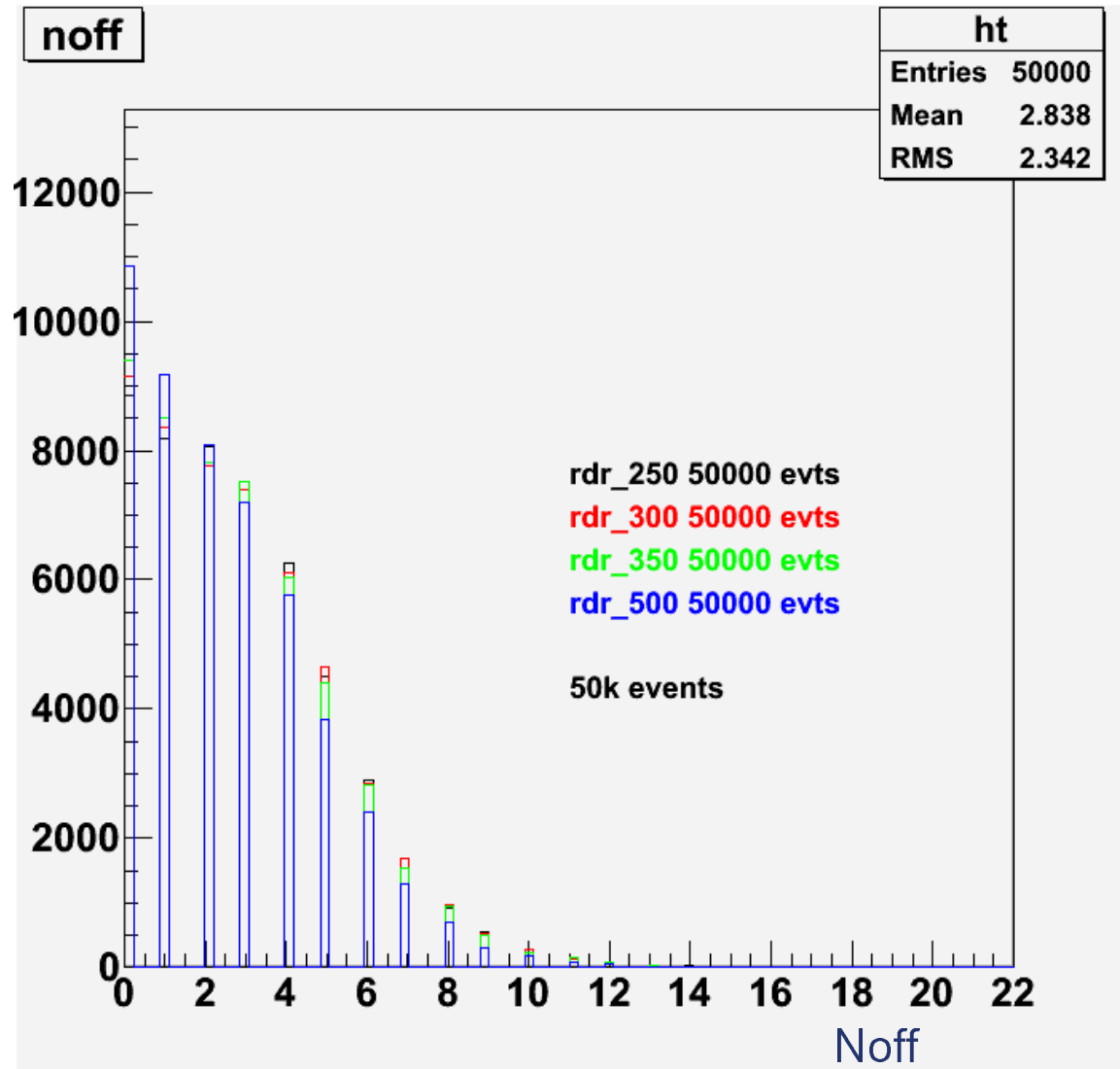
# Other observables for $2\nu 2j$ selection

noff:  
Number of charged track  
whose closest approach to  
ip (3D) is more than 4 sigma.

Used for b/c quark selection

All Higgs events

noff is smaller at  
higher energies.



# Selection of $\nu\nu H$ (RDR parameters)

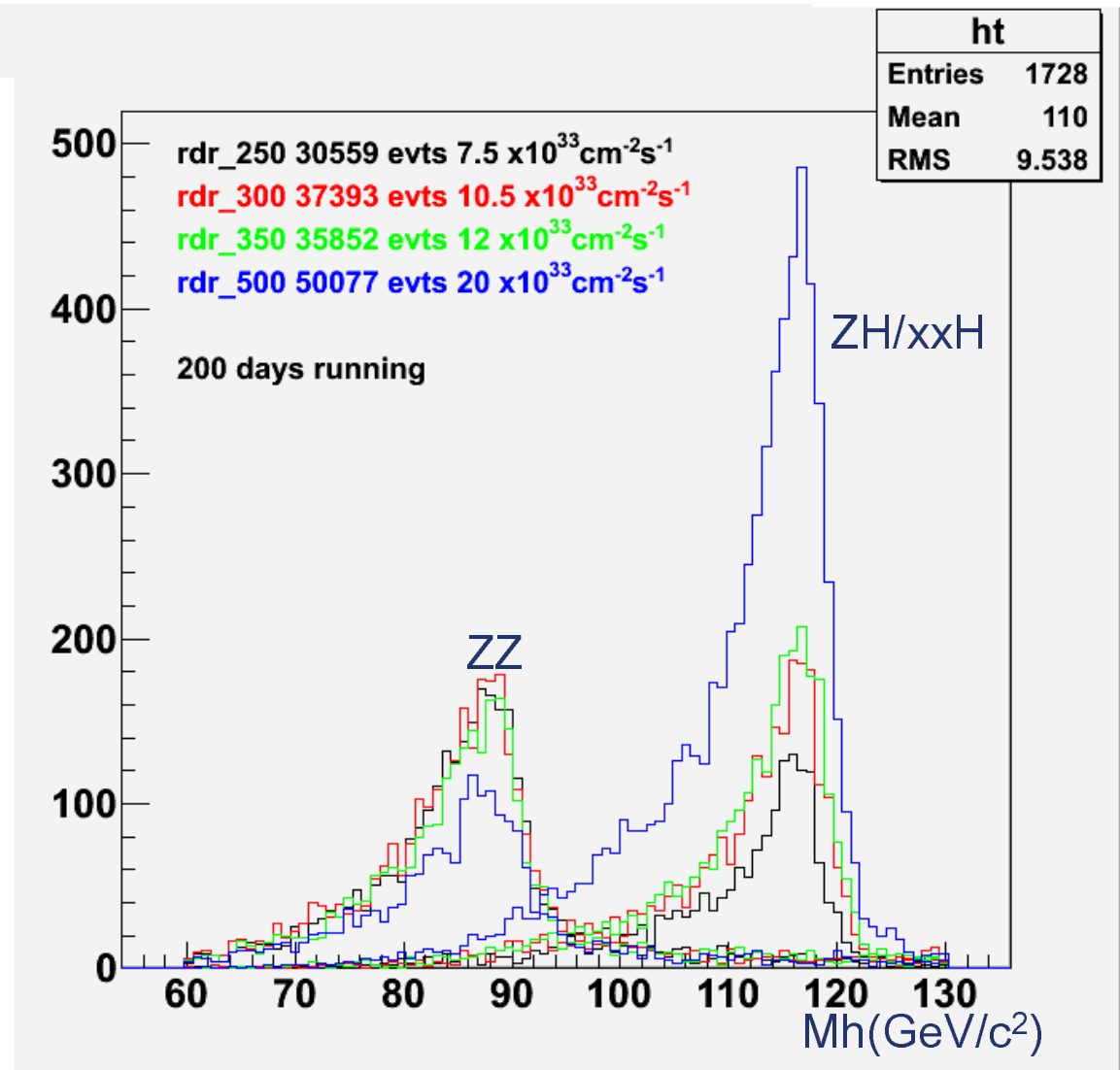
## Selection Criteria

1.  $0.2 < X_{\text{evis}} < 0.55$   
(  $X_{\text{evis}} = E_{\text{vis}} / E_{\text{cm}}(\text{nominal})$  )
2.  $\text{noff} > 3$

- As background process, only ZZ process is considered.

- Largest statistics at 500 GeV, but other background channel and tight selection should be considered !

- About 5 GeV shift in  $M_h$ , due imperfect  $E_{\text{jet}}$  calibration



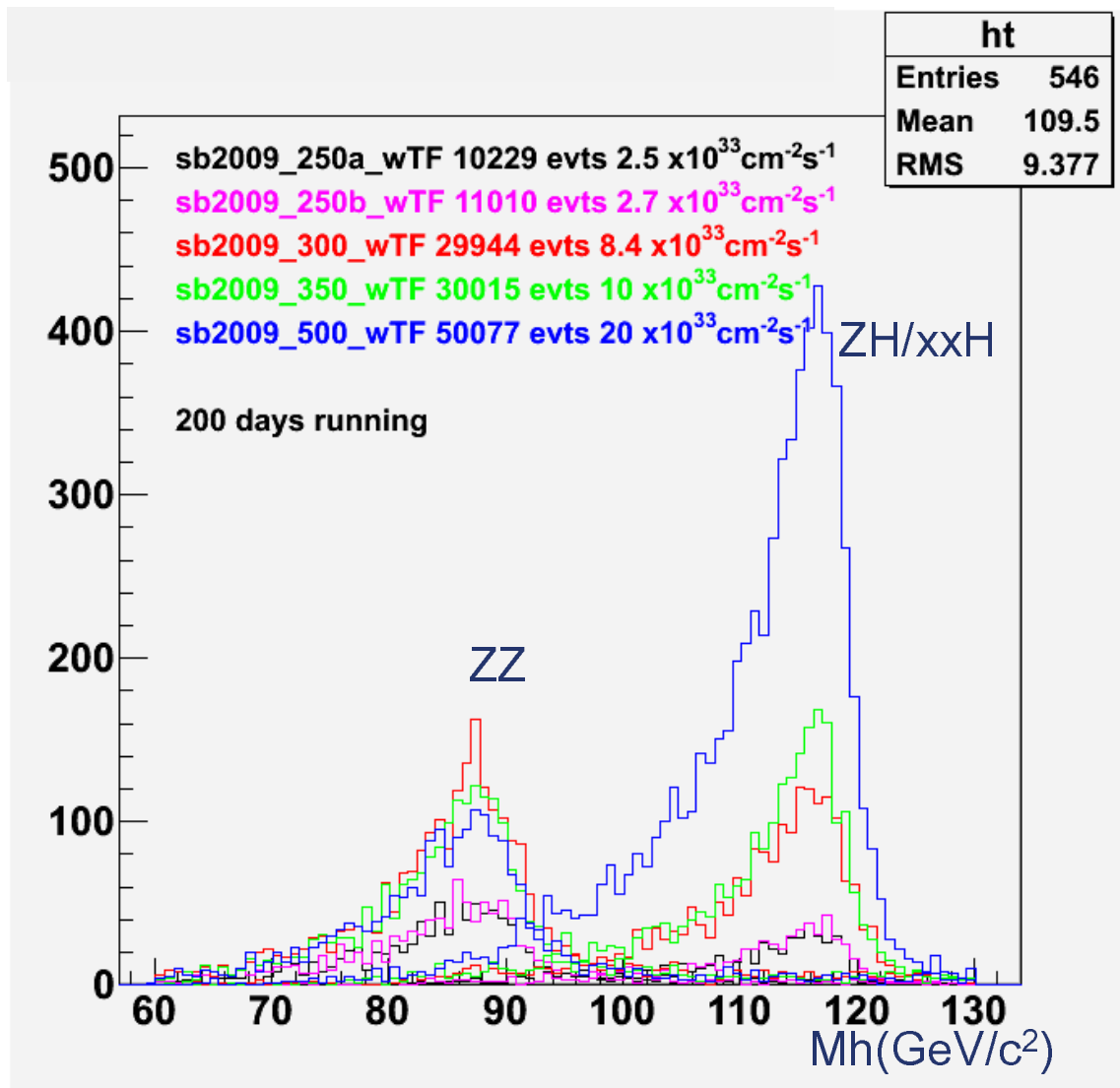
# Selection of $\nu\nu H$ (SB2009\_wTF)

## Selection Criteria

1.  $0.2 < X_{\text{evis}} < 0.55$   
(  $X_{\text{evis}} = E_{\text{vis}} / E_{\text{cm}}(\text{nominal})$  )
2.  $\text{noff} > 3$

For fixed running time,  
500 GeV running has  
the largest statistics.

Effect of other backgrounds,  
yet to be studied



# Summary

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- Physics performance with SB2009 beam parameters are being studied using QuickSimulator
- Higgs Recoil mass resolution
  - ◆ RDR\_250 provides the best performance as long as recoil mass resolution is concerned.
- nnH channel
  - ◆ 500 GeV running gives the largest statistics, but effect of other background needs to be studied
- Next
  - ◆ Analysis of 4 jets mode, improve analysis methods
  - ◆ Include analysis of Tim's new 350 GeV SM sample
  - ◆ Quantitative evaluation of performances, such as  $\Delta mh$ ,  $\sigma(\text{br})$
  - ◆ Comparison with full simulation based studies.
  - ◆ ...

# BACKUP SLIDES

# Recoil mass by generator only

To see only the kinematical effect, recoil mass were calculated by the generator information and plotted. No event selection

Histograms are scaled to have the same entries in  $110 < m_h < 160$  GeV

