



中国科学院高能物理研究所  
*Institute of High Energy Physics*  
*Chinese Academy of Sciences*



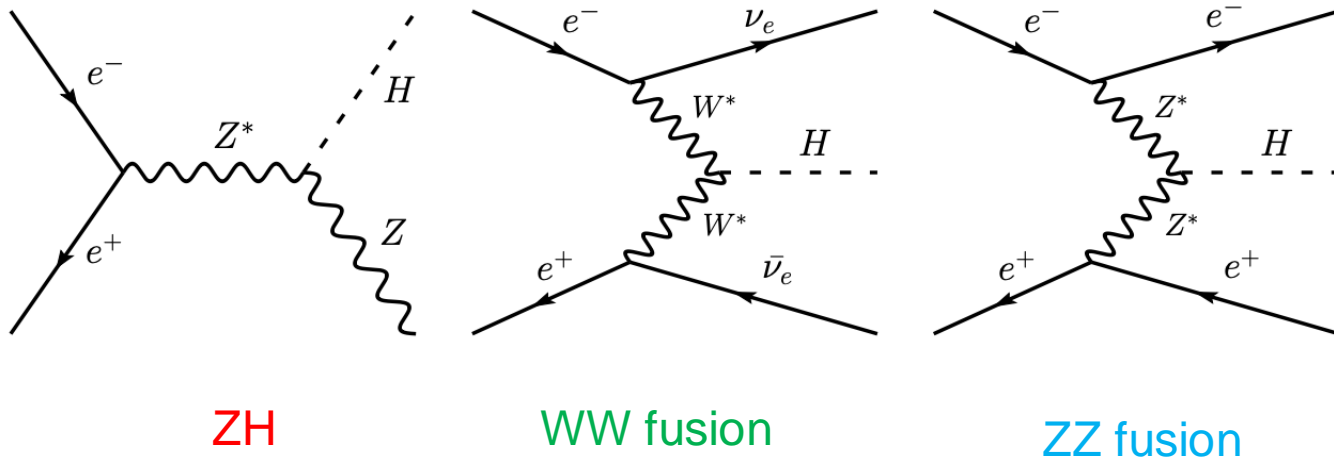
# Measurement of $WW$ fusion, $H \rightarrow bb$ cross section at CEPC, $\sqrt{s} = 360$ GeV

Hongbo Liao, Taozhe YU, Yingqi Hou

CEPC RefTDR meeting

10<sup>th</sup> March 2025

- In CEPC, Three are three main production of Higgs: **ZH**, **WW fusion** and **ZZ fusion**
- One indirect method to measure Higgs width is relate to **ZH** and **WW fusion** process
- So Higgs width measured precision is relate to WW fusion,  $H \rightarrow bb$  process



$$\Gamma_H / \Gamma_H^{SM} = \frac{\mu_{ZH}^2 \mu_{WW \text{ fusion}, H \rightarrow bb}}{\mu_{ZH, H \rightarrow WW^*} \mu_{ZH, H \rightarrow bb}}$$

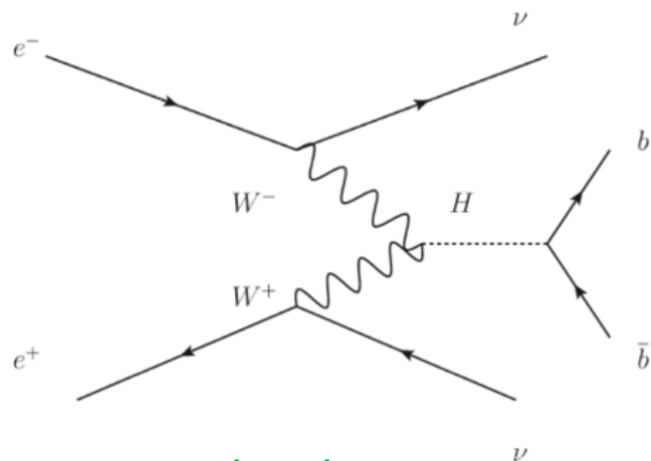
$\Gamma_H^{SM}$ : Higgs width predicted by SM  
 $\mu$ : the signal strength

## ➤ Measure the WW fusion @ 360GeV

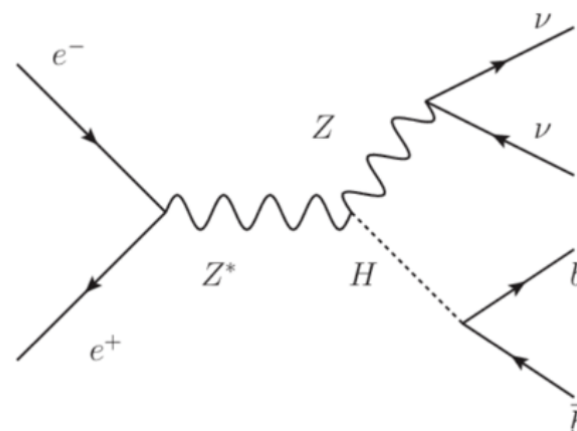
- Standalone 240GeV 20ab<sup>-1</sup> gives **1.5%**, while 360GeV 1ab<sup>-1</sup> alone gives **3.3%**
- These 2 points are independent, combine these two mass point giving <1%
- Adding one mass point would significantly improve the constrain



- The most challenge is how to measure the irreducible background:  $ZH, Z \rightarrow \nu\nu, H \rightarrow bb$
- These two process have absolutely same final state and have **interference term**



signal  
WW fusion,  $H \rightarrow bb$



irreducible background  
 $ZH, Z \rightarrow \nu\nu, H \rightarrow bb$

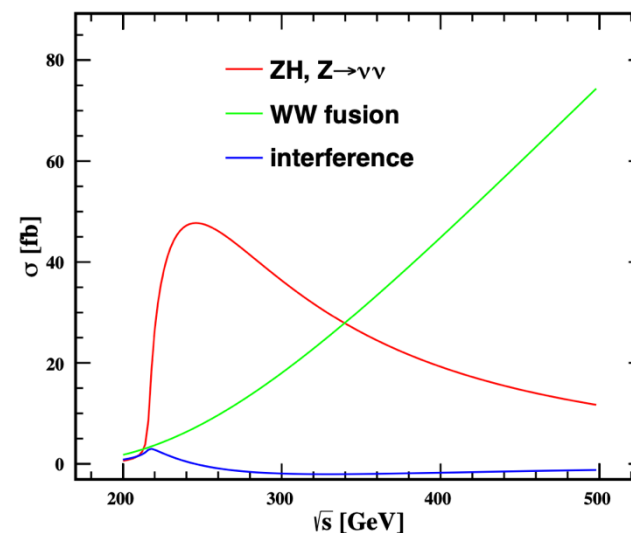


table: the fraction of ZH, WW fusion and Inter. in total

$\sqrt{s}(\text{GeV})$	ZH(%)	WW fusion(%s)	Inter.(%s)	Inter./WW fusion
240	87.5	11.7	0.8	6.8%
250	86.3	14.3	-0.6	-4.3%
360	43.7	59.8	-3.5	-5.8%

- In 360GeV, Inter./WW fusion is -5.8%
- So if we want to make Higgs width measured precision  $\sim 1\%$ , the inter. can't be ignore



# Monte Carlo Sample



➤ Center of mass energy: 360GeV

CEPCSW version:tdr25.1.1

➤ Higgs sample

- 100k, WW fusion, H→bb:
- 100k , ZH, Z→vv, H→bb
- Samples for interference can't not be generated by current software, but we can produce the inclusive vvH,H→bb sample, so the interference term can be calculate:

$$\sigma_{\text{interference}} = \sigma_{\text{inclusive}\nu_e\nu_e H} - \sigma_{WW\text{fusion}} - \sigma_{ZH\rightarrow\nu_e\nu_e H}$$

➤ Other background

- 2 fermions + 4 fermions

➤ Now all the sample stdhep format file is ready and we will produce the analysis root file

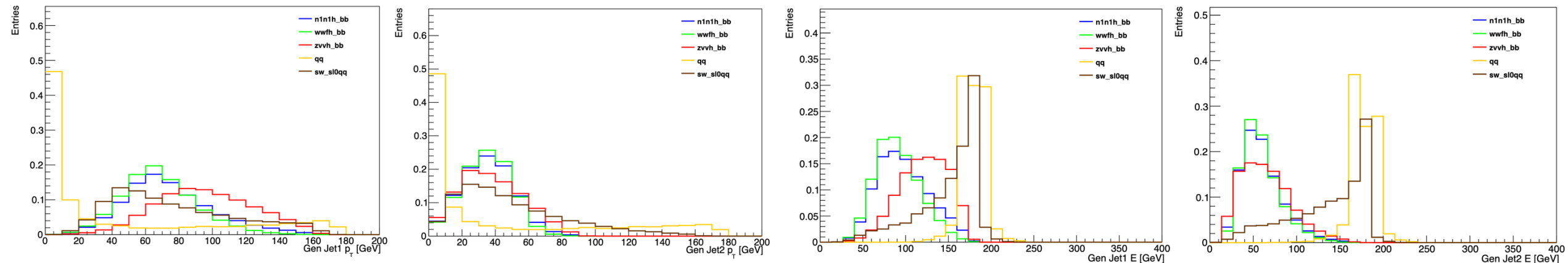
- all Higgs sample analysis root file is ready
- 2fermion analysis root file is ready
- 4fermion analysis root file are still in producing



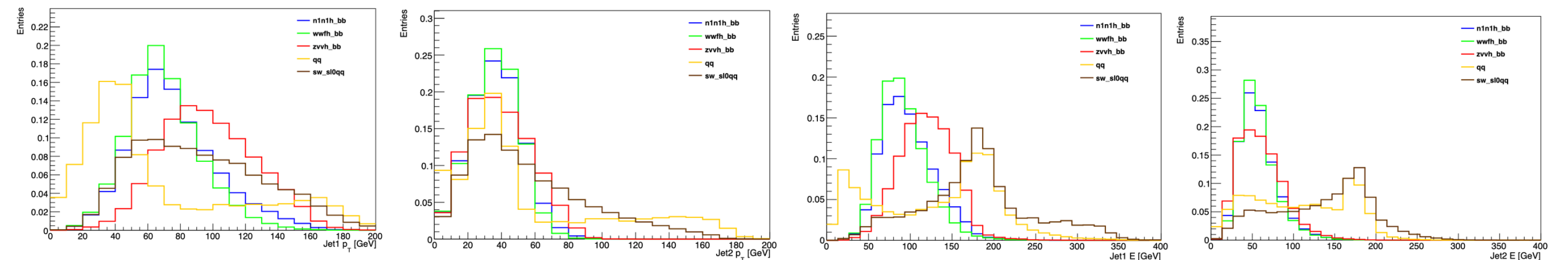
# Variable distribution



## Gen level



## Reco level



Jet1 pt

Jet2 pt

Jet1 energy

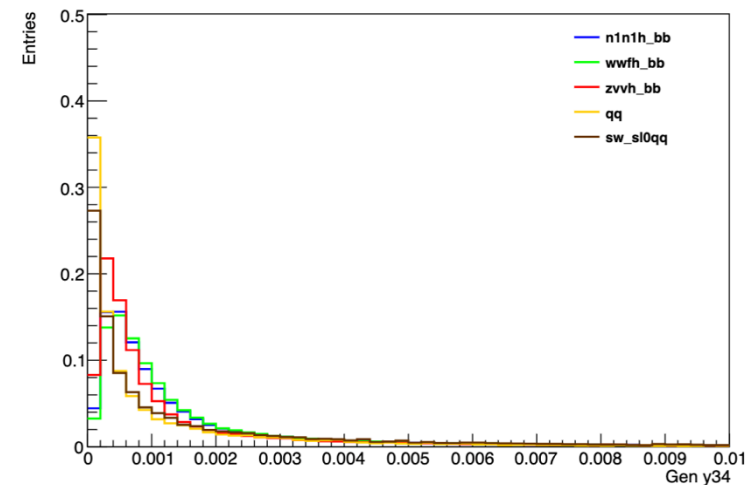
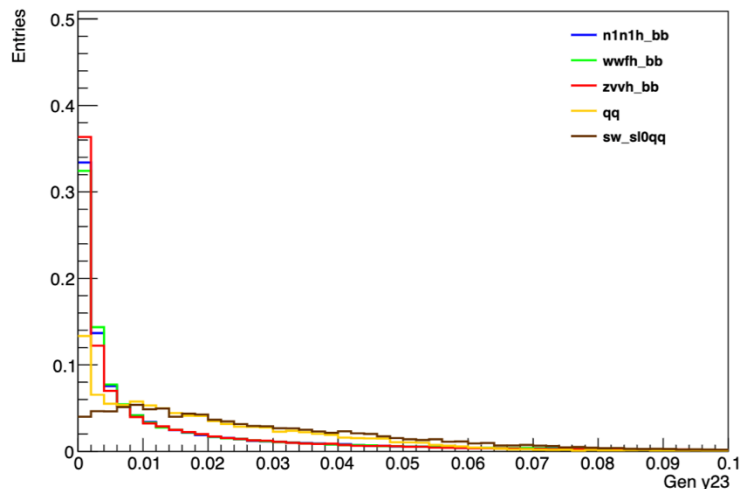
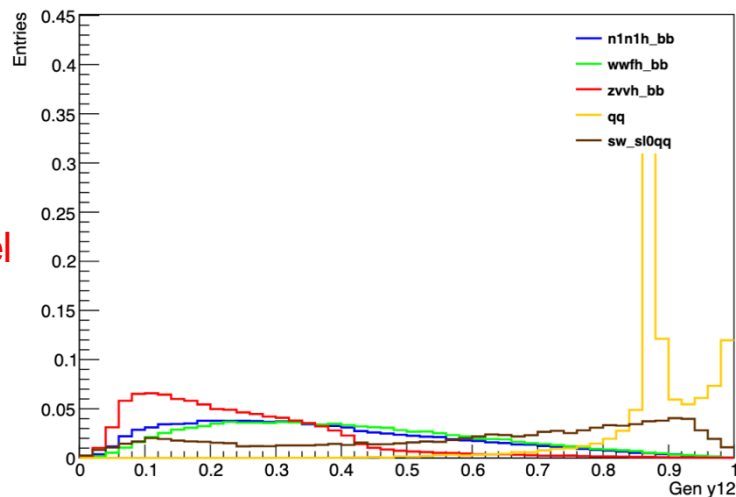
Jet2 energy



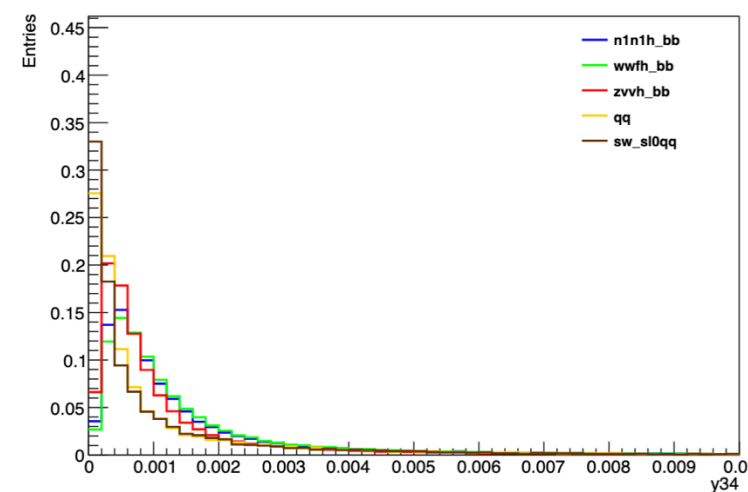
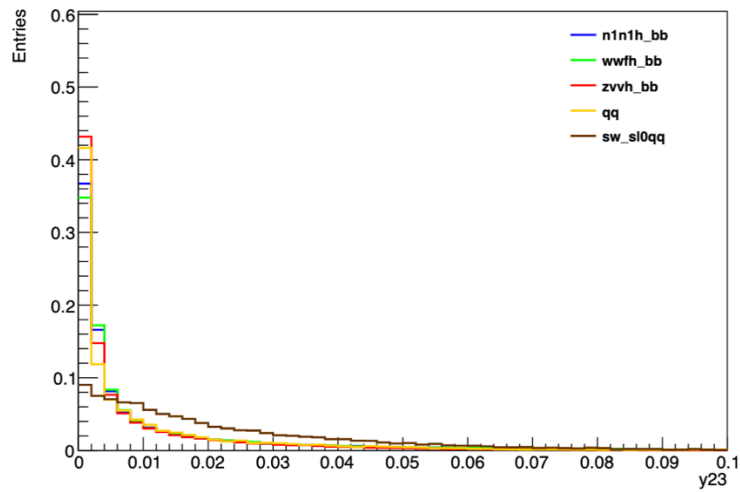
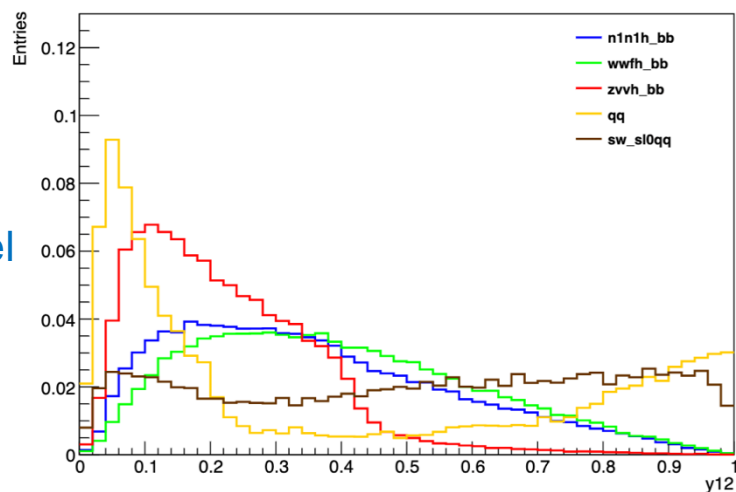
# Variable distribution



Gen level



Reco level



y12

y23

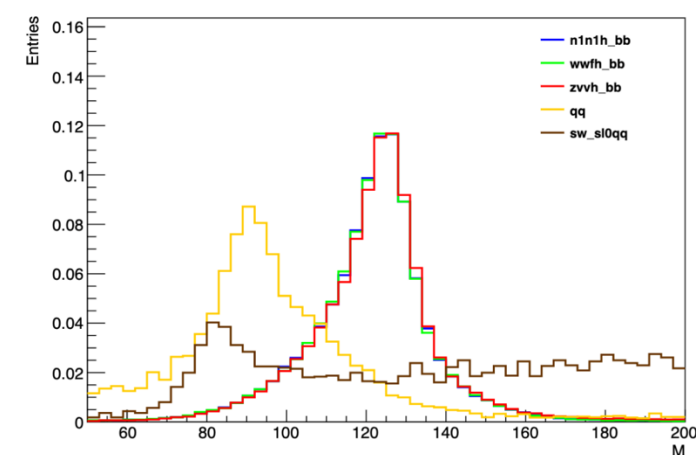
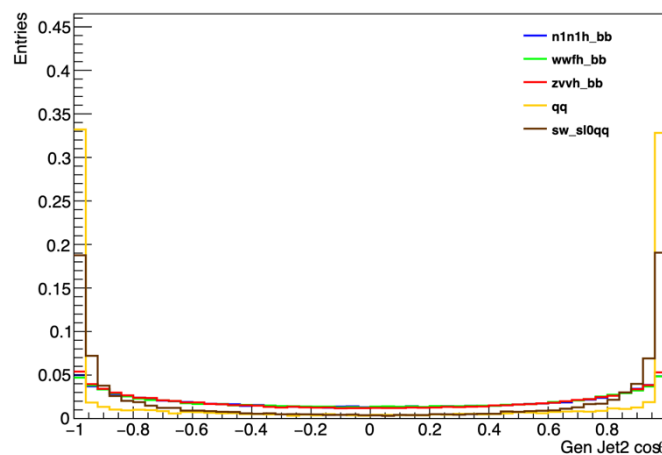
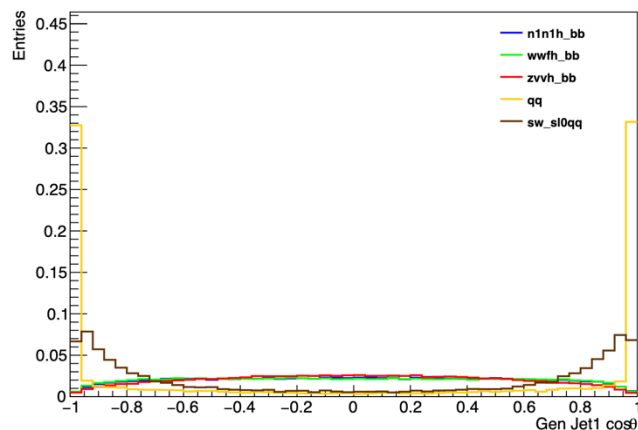
y34



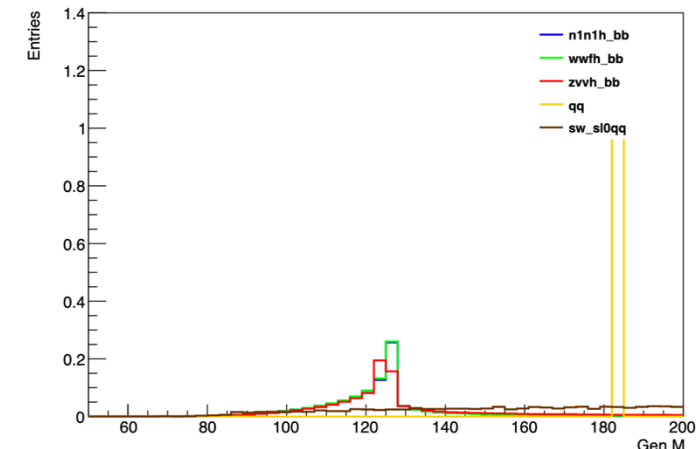
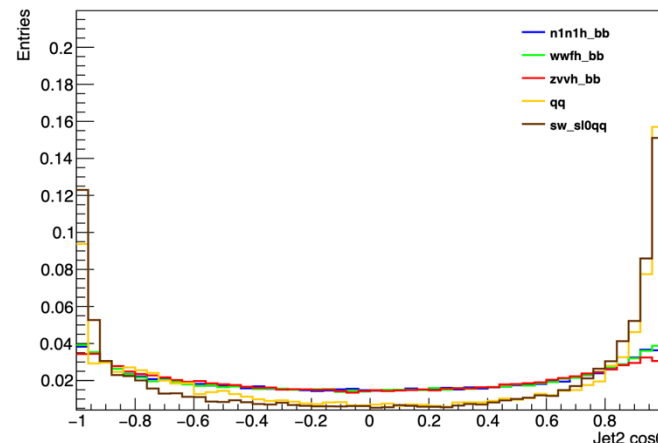
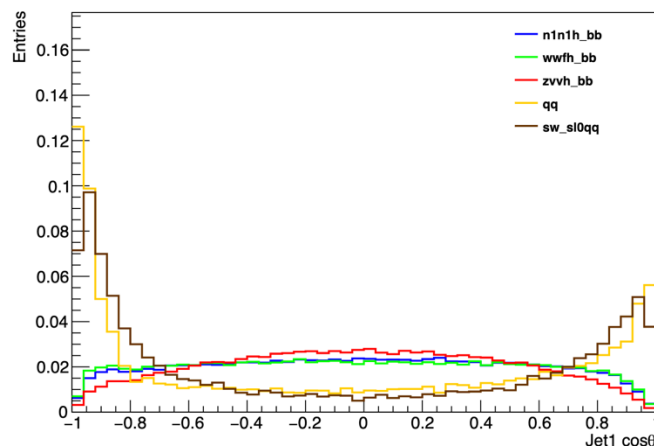
# Variable distribution



Gen level



Reco level



## ➤ Analysis plan

- Study and apply the events selection
- Make strategy (Maybe multi-dimension fit) to extract the **WW fusion**, **H→bb** and **interference term events**
- Get the precision of **WW fusion**, **H→bb** measurement and further get the precision of H width measurement