

# Performance study -- BMR

❖ Perform BMR study in  $ZH \rightarrow \nu\nu + gg/bb/cc/uu/dd/ss$

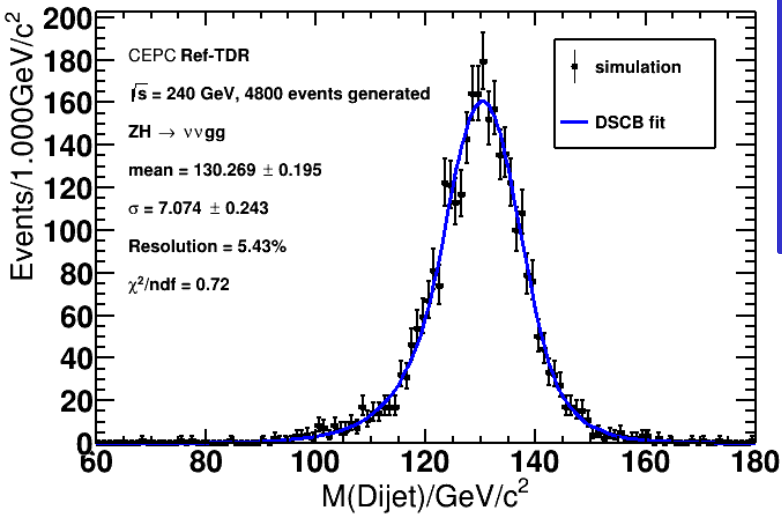
❖ Comparisons between tdr24.9.1 and tdr24.10.0 Also apply truthmatch cut

Release	BMR/Efficiency	$ZH \rightarrow \nu\nu gg$	$ZH \rightarrow \nu\nu bb$	$ZH \rightarrow \nu\nu cc$	$ZH \rightarrow \nu\nu uu$	$ZH \rightarrow \nu\nu dd$	$ZH \rightarrow \nu\nu ss$
CEPCSW_tdr24.9.1	$ \cos\theta_{jet}  < 0.85$	5.43%/0.65	5.49%/0.65	5.46%/0.65	5.68%/0.71	5.15%/0.70	5.79%/0.70
	$ \cos\theta_{jet}  < 0.7$	5.28%/0.50	5.34%/0.50	5.28%/0.50	5.39%/0.54	4.93%/0.51	5.45%/0.52
CEPCSW_tdr24.10.0	$ \cos\theta_{jet}  < 0.85$	5.27%/0.76	7.08%/0.76	6.09%/0.76	5.13%/0.76	5.28%/0.76	5.92%/0.75
	$ \cos\theta_{jet}  < 0.7$	4.98%/0.57	6.49%/0.56	5.64%/0.57	4.86%/0.57	4.94%/0.57	5.57%/0.56

❖ Samples used:

- /cefs/higgs/zhuyf/workspace/whizard360/WhizardAis/data/higgs/E240.Pn2n2h\_uu.e0.p0.whizard195/
- /cefs/higgs/maxiaotian/CEPCSW/sample/24.9.1/
  - gen\_Rec\_E240\_nnHgg\_5000.root, gen\_Rec\_E240\_nnHbb\_5000.root, gen\_Rec\_E240\_nnHcc\_5000.root
  - gen\_Rec\_E240\_nnHuu\_5000.root, gen\_Rec\_E240\_nnHdd\_5000.root, gen\_Rec\_E240\_nnHss\_5000.root
- /cefs/higgs/zhangkl/Production/
  - E240\_nnHgg/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHgg.root
  - E240\_nnHbb\_1105v2/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHbb.root
  - E240\_nnHcc/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHcc.root
  - E240\_nnHuu/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHuu.root
  - E240\_nnHddv2/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHdd.root
  - E240\_nnHss/ -> /cefs/higgs/maxiaotian/CEPCSW/sample/Jets\_E240\_nnHss.root

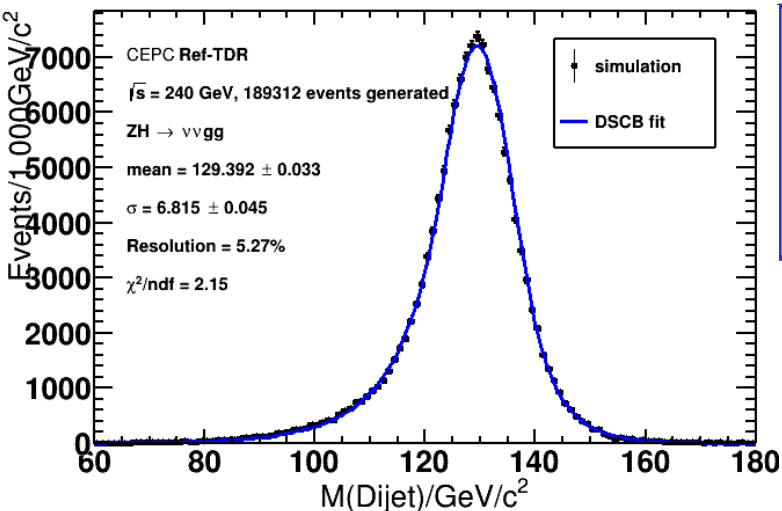
# Performance study -- BMR



$ZH \rightarrow vv gg$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 130.269 \pm 0.195$   
 Resolution **5.43%**

**Efficiency cutflow**

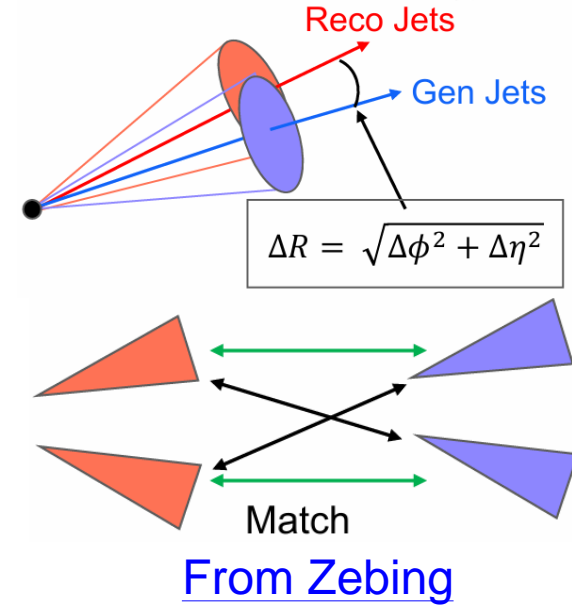
$ \cos\theta_{jet}  < 0.85$	0.710
Match & $\Delta R < 0.6$	0.650
Fit region	0.649



$ZH \rightarrow vv gg$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 129.392 \pm 0.033$   
 Resolution **5.27%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.85$	0.798
Match & $\Delta R < 0.6$	0.758
Fit region	0.757



**CDR reference**

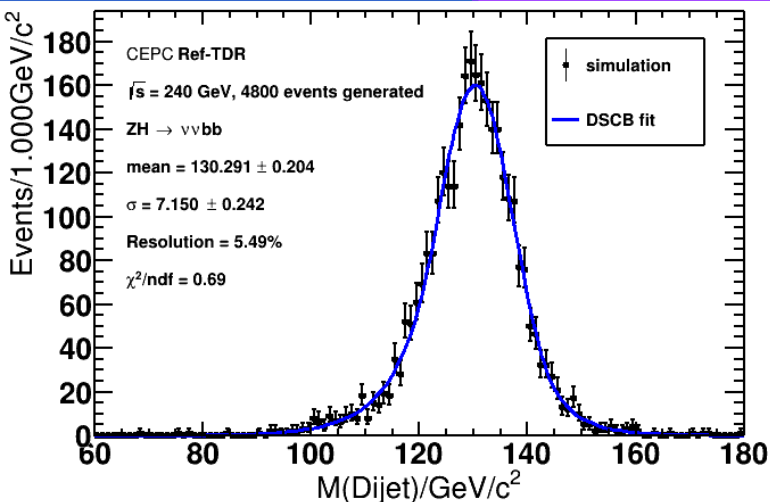
Table 1. Event cumulative efficiency for Higgs boson exclusive decay at the CEPC with  $\sqrt{s} = 240$  GeV.

	gg(%)	bb(%)	cc(%)	WW*(%)	ZZ*(%)
Pt_ISR < 1 GeV	95.15	95.37	95.30	95.16	95.24
Pt_neutrino < 1 GeV	89.33	39.04	66.36	37.46	41.39
Cos(Theta_Jet)  < 0.85	67.30	28.65	49.31	-	-

Table 3. Higgs boson mass resolution (sigma/Mean) for different decay modes with jets as final state particles, after event cleaning.

$H \rightarrow bb$	$H \rightarrow cc$	$H \rightarrow gg$	$H \rightarrow WW^*$	$H \rightarrow ZZ^*$
3.63%	3.82%	3.75%	3.81%	3.74%

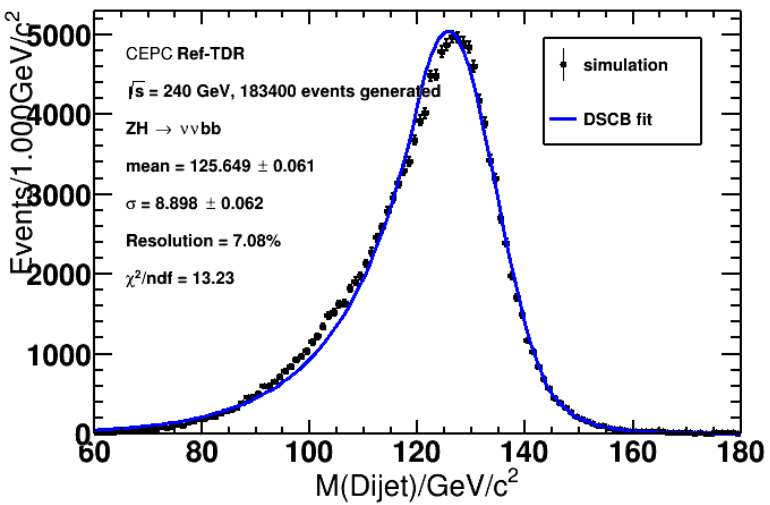
# Performance study -- BMR



$ZH \rightarrow \nu\nu b\bar{b}$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 130.291 \pm 0.204$   
**Resolution 5.49%**

**Efficiency cutflow**

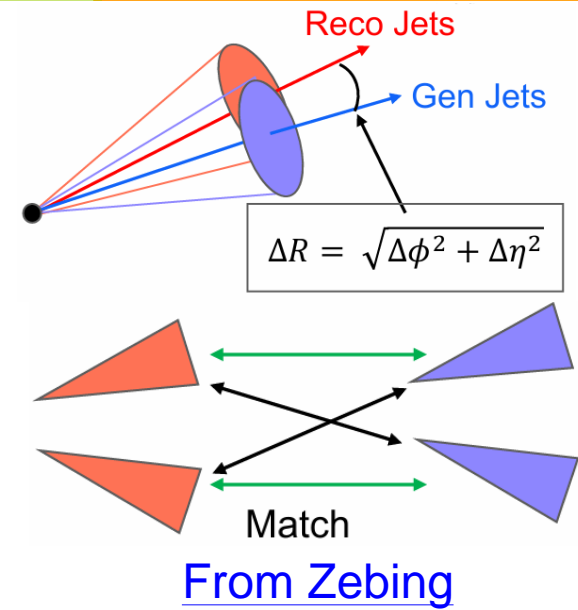
$ \cos\theta_{jet}  < 0.85$	0.709
Match& $\Delta R < 0.6$	0.651
Fit region	0.650



$ZH \rightarrow \nu\nu b\bar{b}$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 125.649 \pm 0.061$   
**Resolution 7.08%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.85$	0.780
Match& $\Delta R < 0.6$	0.760
Fit region	0.759



## CDR reference

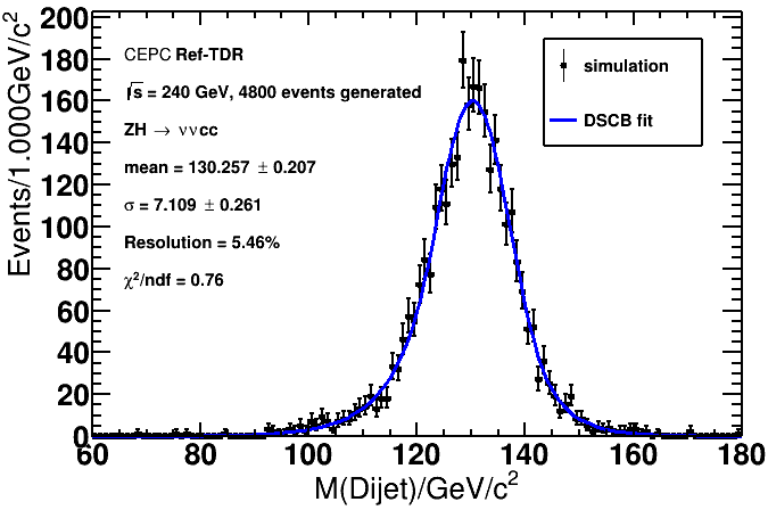
Table 1. Event cumulative efficiency for Higgs boson exclusive decay at the CEPC with  $\sqrt{s} = 240$  GeV.

	gg(%)	bb(%)	cc(%)	WW*(%)	ZZ*(%)
Pt_ISR < 1 GeV	95.15	95.37	95.30	95.16	95.24
Pt_neutrino < 1 GeV	89.33	39.04	66.36	37.46	41.39
Cos(Theta_Jet)  < 0.85	67.30	28.65	49.31	-	-

Table 3. Higgs boson mass resolution (sigma/Mean) for different decay modes with jets as final state particles, after event cleaning.

$H \rightarrow b\bar{b}$	$H \rightarrow c\bar{c}$	$H \rightarrow g\bar{g}$	$H \rightarrow WW^*$	$H \rightarrow ZZ^*$
3.63%	3.82%	3.75%	3.81%	3.74%

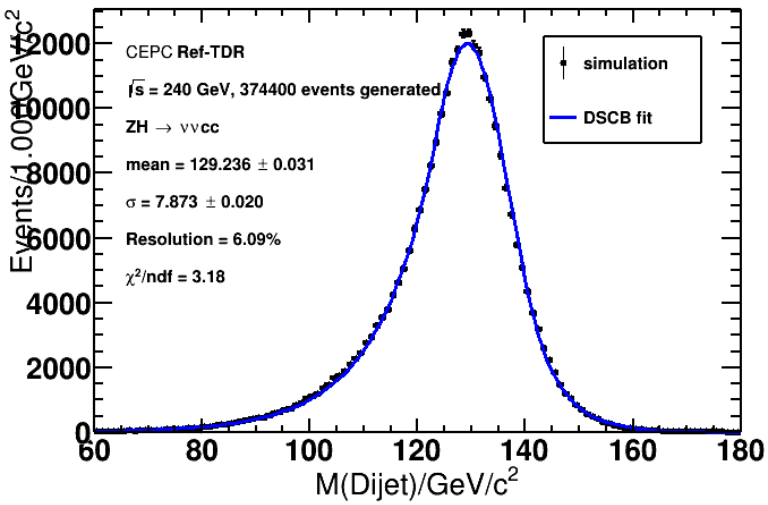
# Performance study -- BMR



$ZH \rightarrow vvcc$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 130.257 \pm 0.207$   
 Resolution **5.46%**

**Efficiency cutflow**

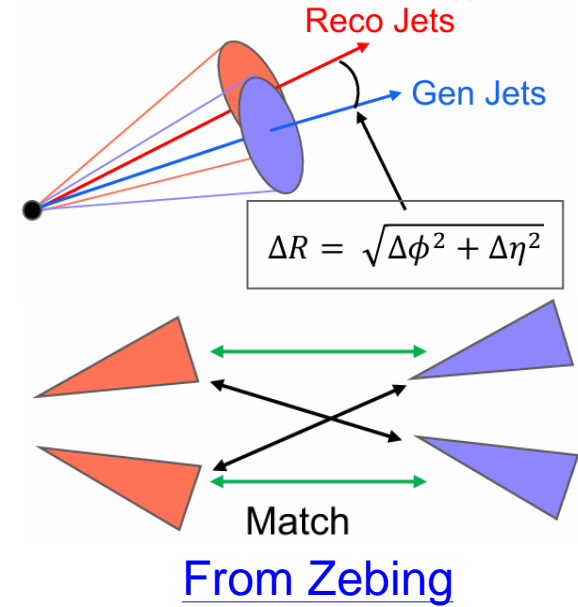
$ \cos\theta_{jet}  < 0.85$	0.709
Match& $\Delta R < 0.6$	0.650
Fit region	0.650



$ZH \rightarrow vvcc$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 129.236 \pm 0.031$   
 Resolution **6.09%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.85$	0.784
Match& $\Delta R < 0.6$	0.762
Fit region	0.761



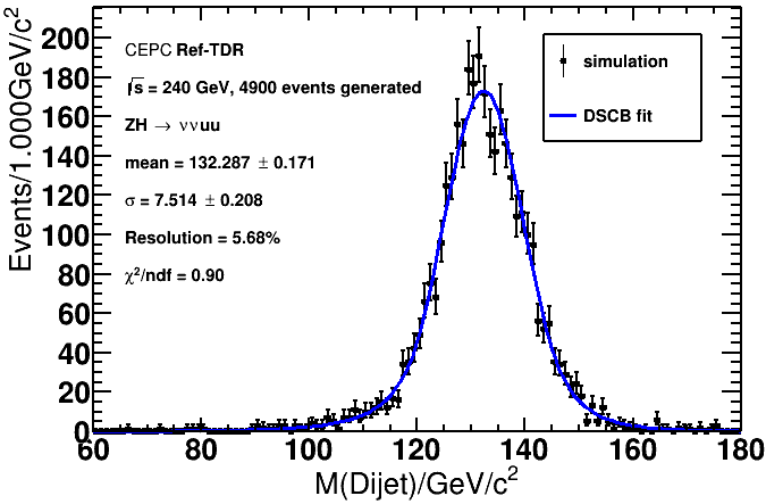
**CDR reference**  
 Table 1. Event cumulative efficiency for Higgs boson exclusive decay at the CEPC with  $\sqrt{s} = 240$  GeV.

	gg(%)	bb(%)	cc(%)	WW*(%)	ZZ*(%)
Pt_ISR < 1 GeV	95.15	95.37	95.30	95.16	95.24
Pt_neutrino < 1 GeV	89.33	39.04	66.36	37.46	41.39
Cos(Theta_Jet)  < 0.85	67.30	28.65	49.31	-	-

Table 3. Higgs boson mass resolution (sigma/Mean) for different decay modes with jets as final state particles, after event cleaning.

$H \rightarrow bb$	$H \rightarrow cc$	$H \rightarrow gg$	$H \rightarrow WW^*$	$H \rightarrow ZZ^*$
3.63%	3.82%	3.75%	3.81%	3.74%

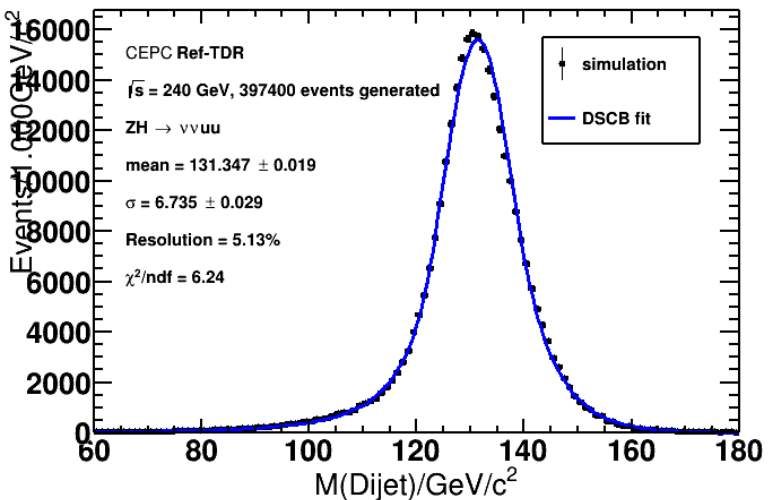
# Performance study -- BMR



$ZH \rightarrow vvuu$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 132.287 \pm 0.171$   
 Resolution **5.68%**

## Efficiency cutflow

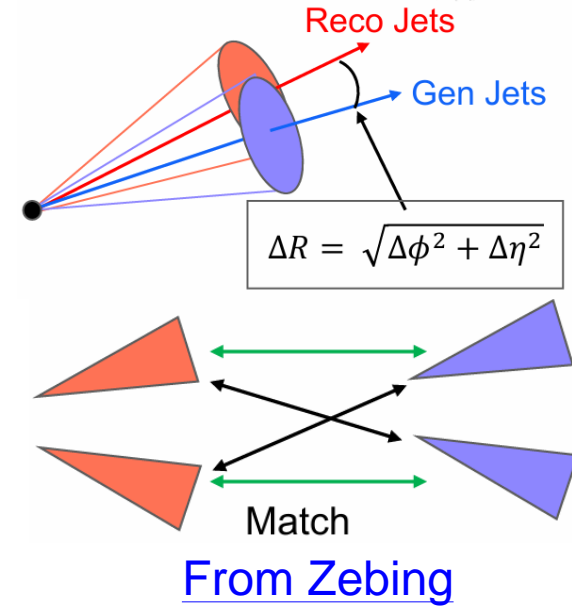
$ \cos\theta_{jet}  < 0.85$	0.733
Match & $\Delta R < 0.6$	0.708
Fit region	0.706



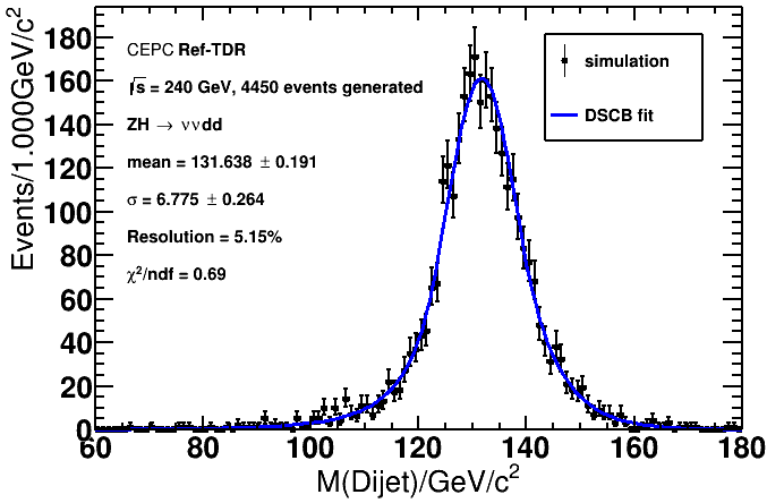
$ZH \rightarrow vvuu$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 131.347 \pm 0.019$   
 Resolution **5.13%**

## Efficiency cutflow

$ \cos\theta_{jet}  < 0.85$	0.785
Match & $\Delta R < 0.6$	0.764
Fit region	0.762



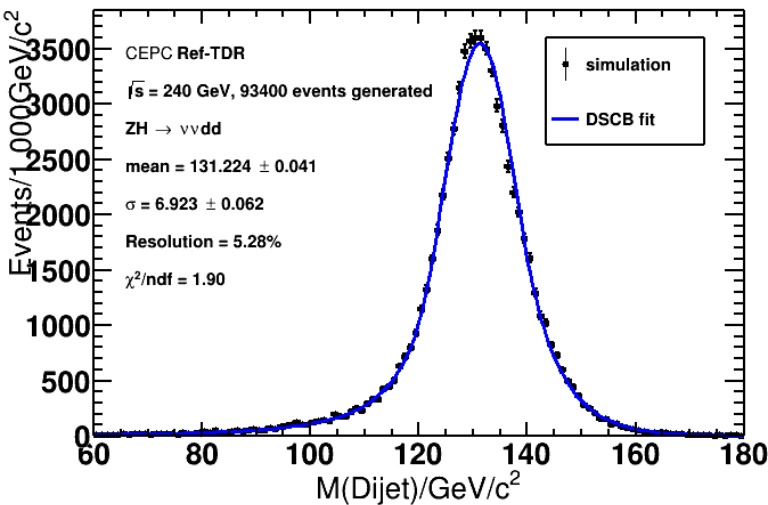
# Performance study -- BMR



$ZH \rightarrow vvdd$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 131.638 \pm 0.191$   
 Resolution **5.15%**

**Efficiency cutflow**

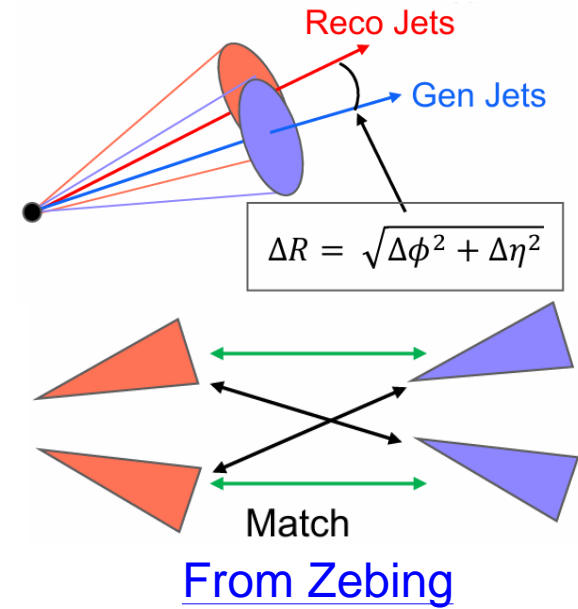
$ \cos\theta_{jet}  < 0.85$	0.731
Match & $\Delta R < 0.6$	0.697
Fit region	0.697



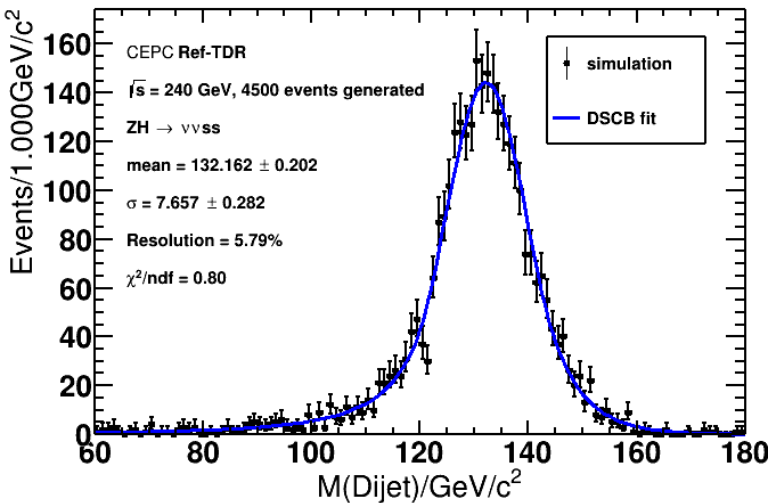
$ZH \rightarrow vvdd$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 131.224 \pm 0.041$   
 Resolution **5.28%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.85$	0.787
Match & $\Delta R < 0.6$	0.761
Fit region	0.759



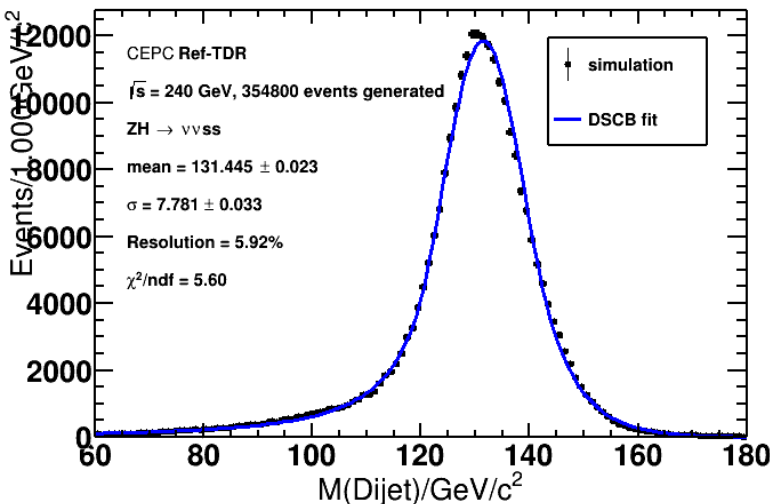
# Performance study -- BMR



$ZH \rightarrow \nu\nu ss$   
 CEPCSW\_tdr24.9.1  
 $m_H = 132.162 \pm 0.202$   
 Resolution **5.79%**

**Efficiency cutflow**

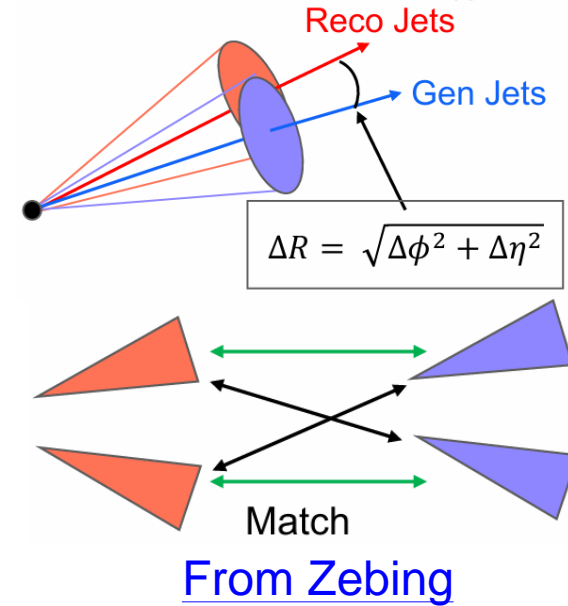
$ \cos\theta_{jet}  < 0.85$	0.733
Match & $\Delta R < 0.6$	0.699
Fit region	0.695



$ZH \rightarrow \nu\nu ss$   
 CEPCSW\_tdr24.10.0  
 $m_H = 131.445 \pm 0.023$   
 Resolution **5.92%**

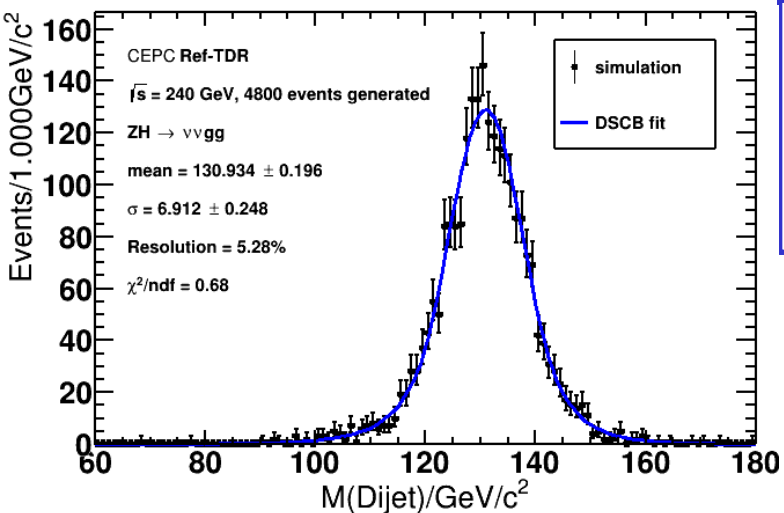
**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.85$	0.785
Match & $\Delta R < 0.6$	0.759
Fit region	0.754





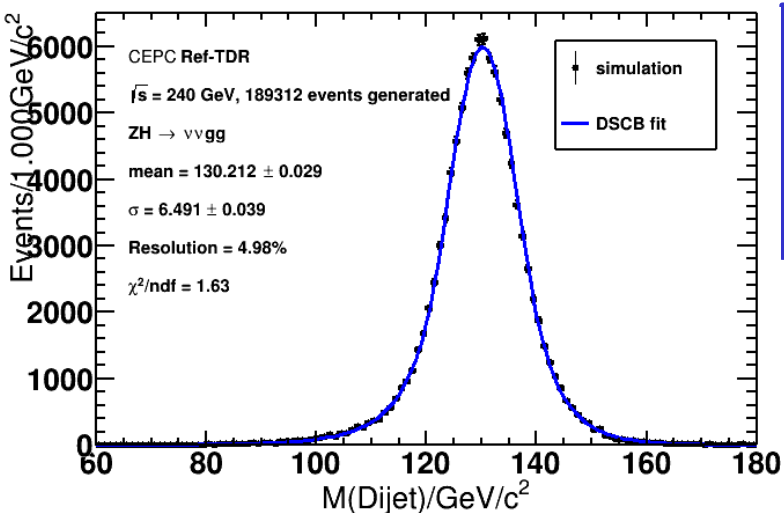
# Performance study -- BMR



$ZH \rightarrow \nu\nu gg$   
 CEPCSW\_tdr24.9.1  
 $m_H = 130.934 \pm 0.196$   
 Resolution **5.28%**

Efficiency cutflow

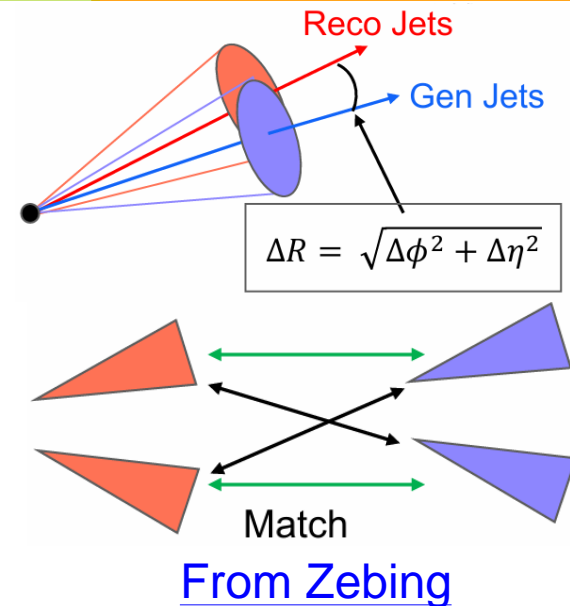
$ \cos\theta_{jet}  < 0.7$	0.541
Match & $\Delta R < 0.6$	0.499
Fit region	0.498



$ZH \rightarrow \nu\nu gg$   
 CEPCSW\_tdr24.10.0  
 $m_H = 130.212 \pm 0.029$   
 Resolution **4.98%**

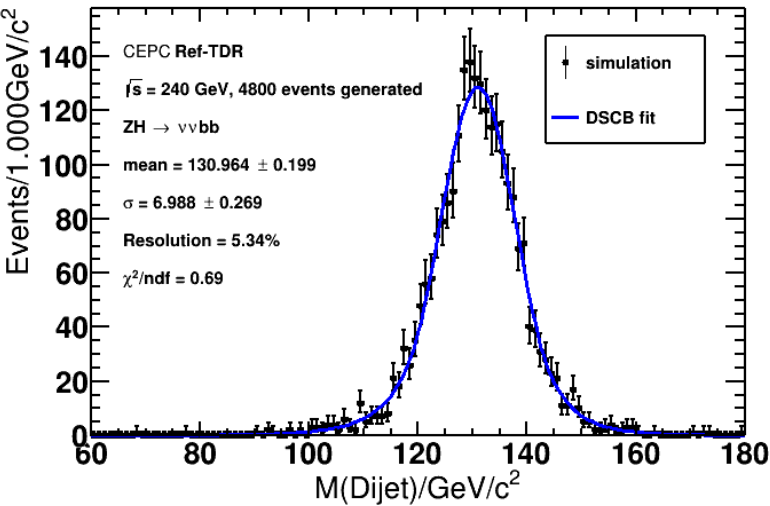
Efficiency cutflow

$ \cos\theta_{jet}  < 0.7$	0.592
Match & $\Delta R < 0.6$	0.566
Fit region	0.565





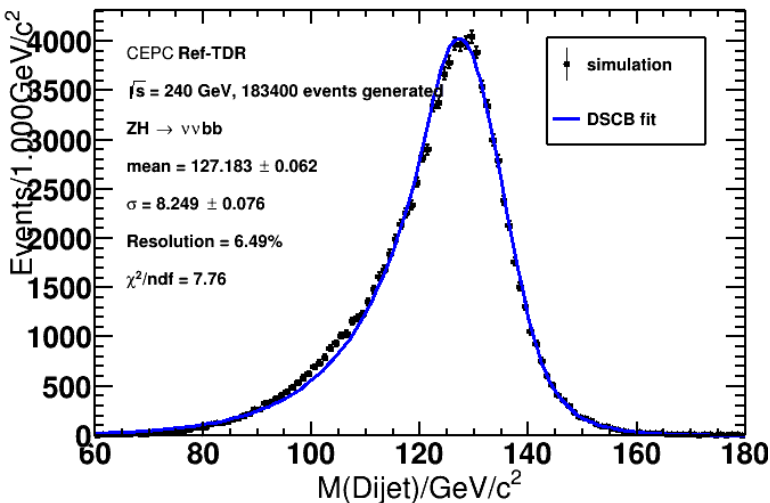
# Performance study -- BMR



$ZH \rightarrow vvbb$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 130.964 \pm 0.199$   
**Resolution 5.34%**

**Efficiency cutflow**

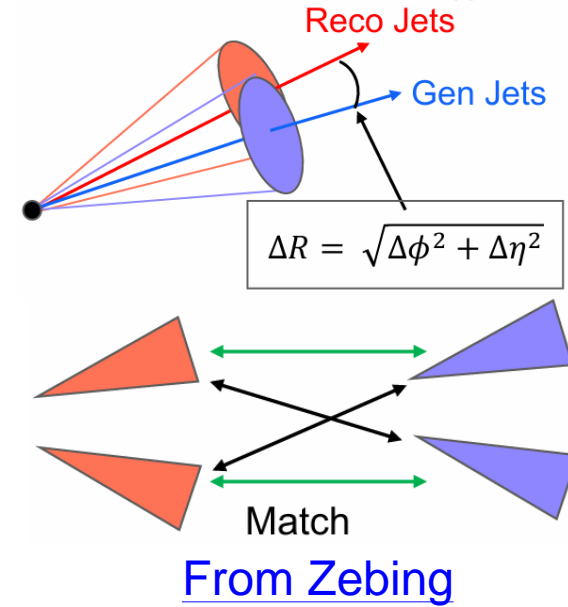
$ \cos\theta_{jet}  < 0.7$	0.539
Match & $\Delta R < 0.6$	0.500
Fit region	0.499



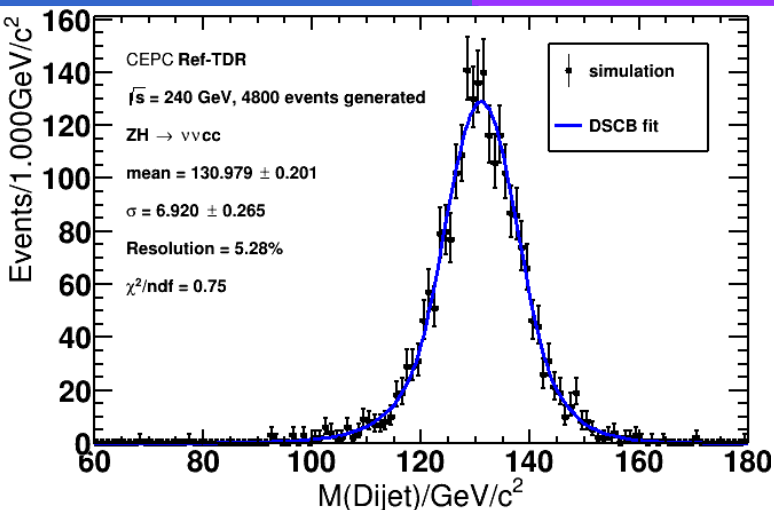
$ZH \rightarrow vvbb$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 127.183 \pm 0.062$   
**Resolution 6.49%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.7$	0.577
Match & $\Delta R < 0.6$	0.564
Fit region	0.563



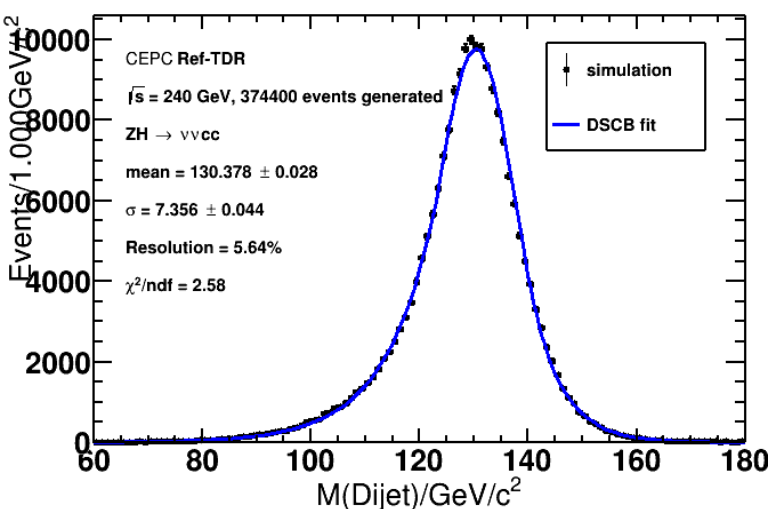
# Performance study -- BMR



$ZH \rightarrow vvcc$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 130.979 \pm 0.201$   
 Resolution **5.28%**

## Efficiency cutflow

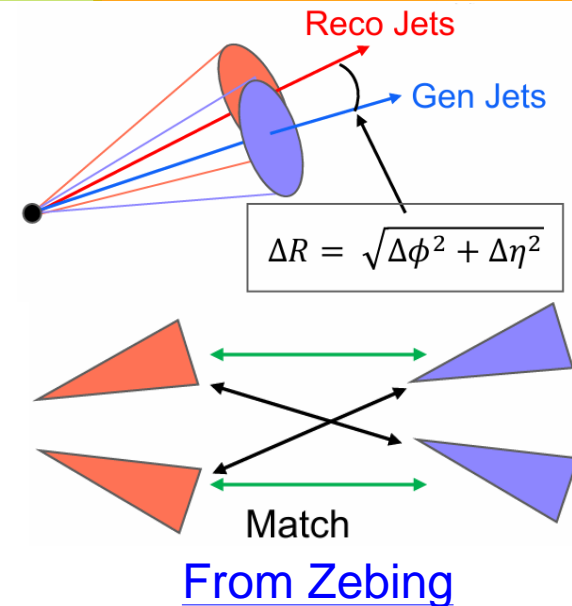
$ \cos\theta_{jet}  < 0.7$	0.539
Match & $\Delta R < 0.6$	0.499
Fit region	0.499



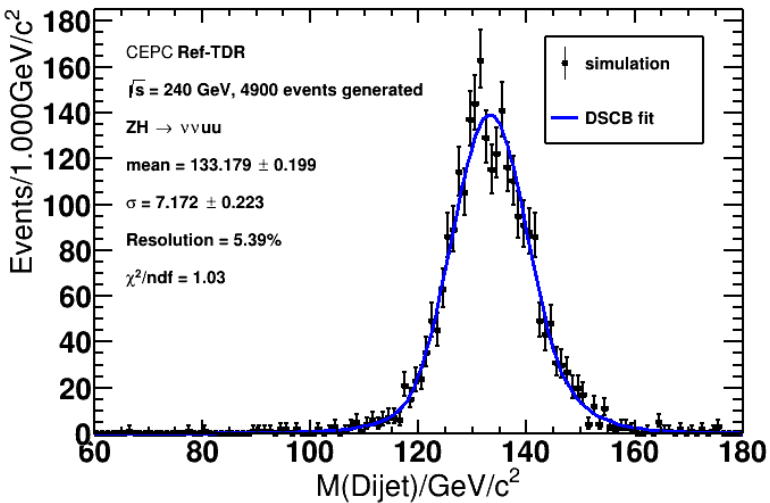
$ZH \rightarrow vvcc$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 130.378 \pm 0.028$   
 Resolution **5.64%**

## Efficiency cutflow

$ \cos\theta_{jet}  < 0.7$	0.581
Match & $\Delta R < 0.6$	0.568
Fit region	0.567



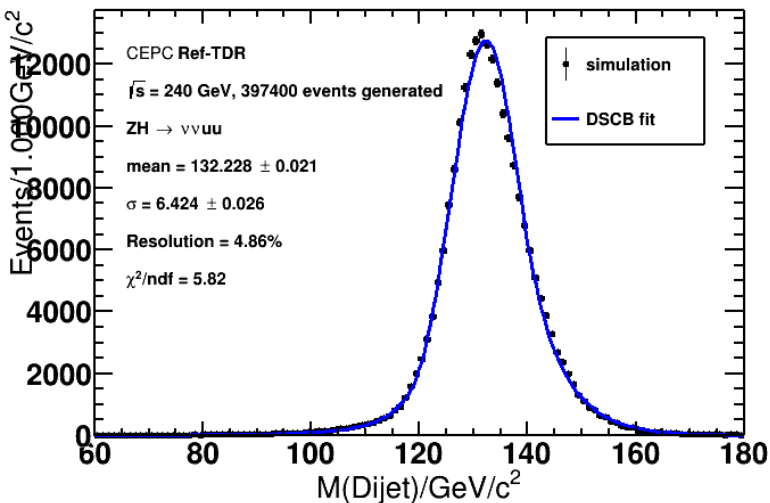
# Performance study -- BMR



$ZH \rightarrow vvuu$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 133.179 \pm 0.199$   
 Resolution **5.39%**

**Efficiency cutflow**

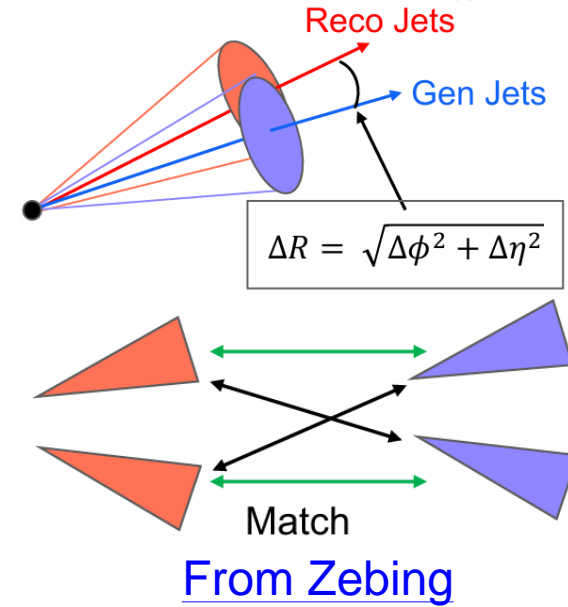
$ \cos\theta_{jet}  < 0.7$	0.553
Match & $\Delta R < 0.6$	0.537
Fit region	0.535



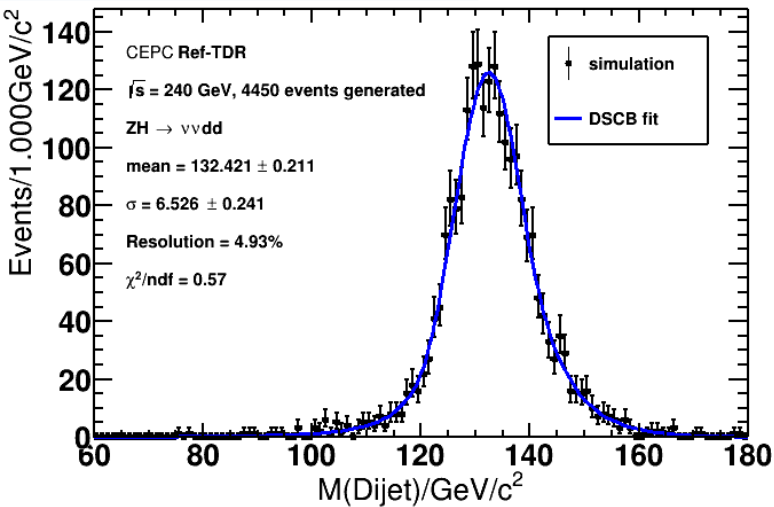
$ZH \rightarrow vvuu$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 132.228 \pm 0.021$   
 Resolution **4.86%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.7$	0.584
Match & $\Delta R < 0.6$	0.572
Fit region	0.570



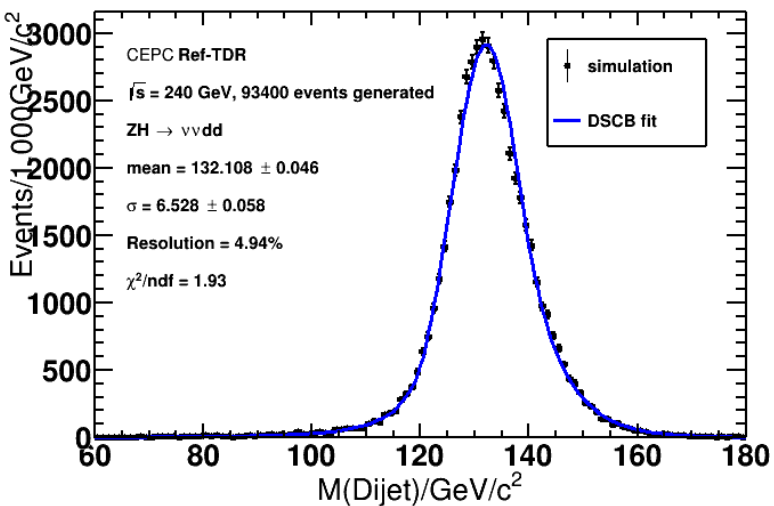
# Performance study -- BMR



$ZH \rightarrow vvdd$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 132.421 \pm 0.211$   
 Resolution **4.93%**

## Efficiency cutflow

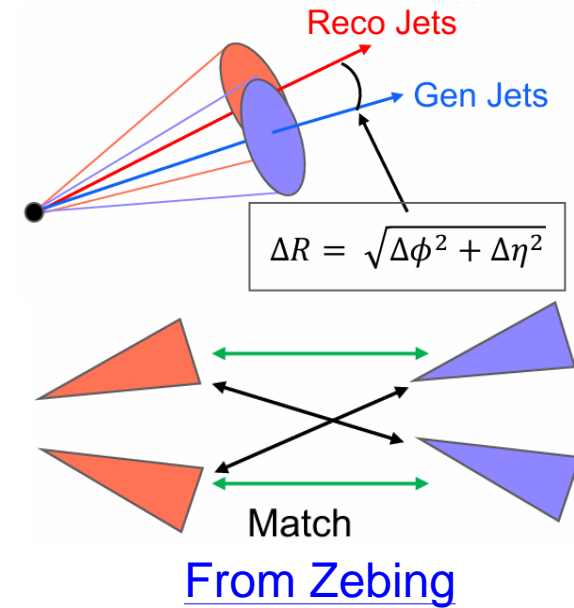
$ \cos\theta_{jet}  < 0.7$	0.536
Match & $\Delta R < 0.6$	0.515
Fit region	0.514



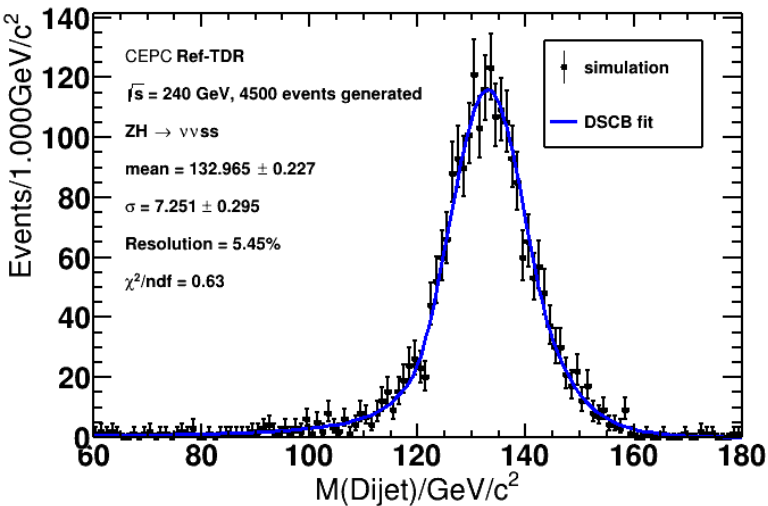
$ZH \rightarrow vvdd$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 132.108 \pm 0.046$   
 Resolution **4.94%**

## Efficiency cutflow

$ \cos\theta_{jet}  < 0.7$	0.582
Match & $\Delta R < 0.6$	0.568
Fit region	0.567



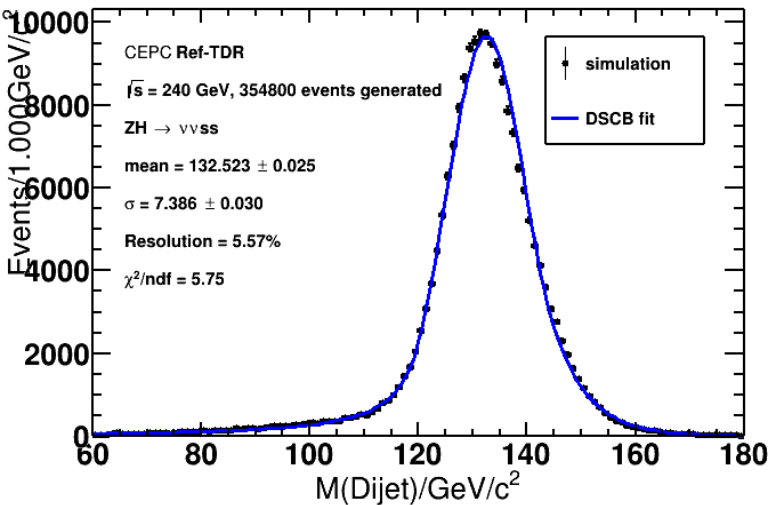
# Performance study -- BMR



$ZH \rightarrow \nu\nu SS$   
**CEPCSW\_tdr24.9.1**  
 $m_H = 132.965 \pm 0.227$   
 Resolution **5.45%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.7$	0.547
Match & $\Delta R < 0.6$	0.527
Fit region	0.524



$ZH \rightarrow \nu\nu SS$   
**CEPCSW\_tdr24.10.0**  
 $m_H = 132.523 \pm 0.025$   
 Resolution **5.57%**

**Efficiency cutflow**

$ \cos\theta_{jet}  < 0.7$	0.580
Match & $\Delta R < 0.6$	0.565
Fit region	0.563

