

# W Mass Measurement in CEPC

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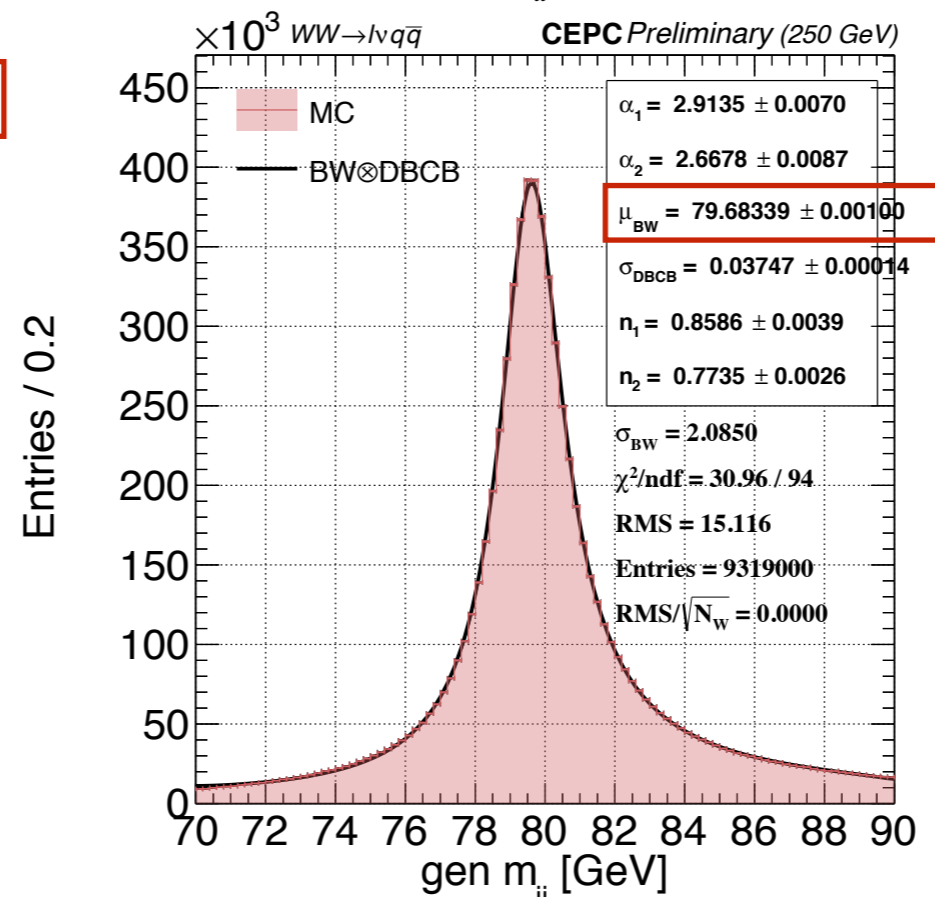
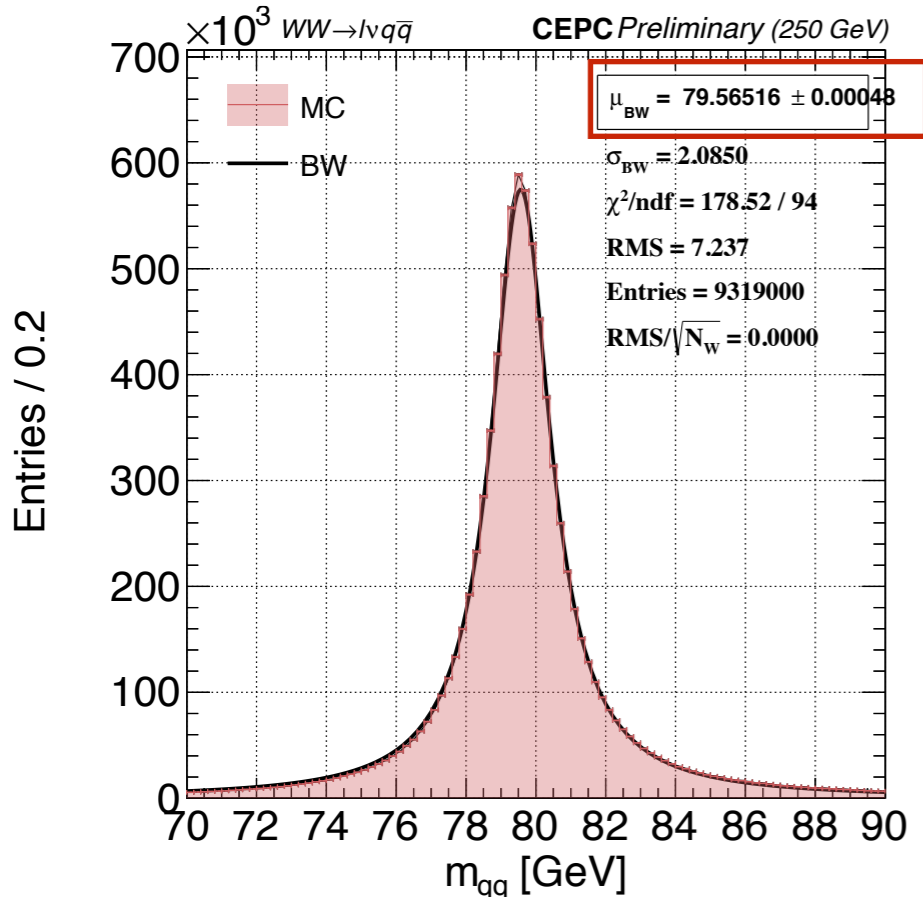
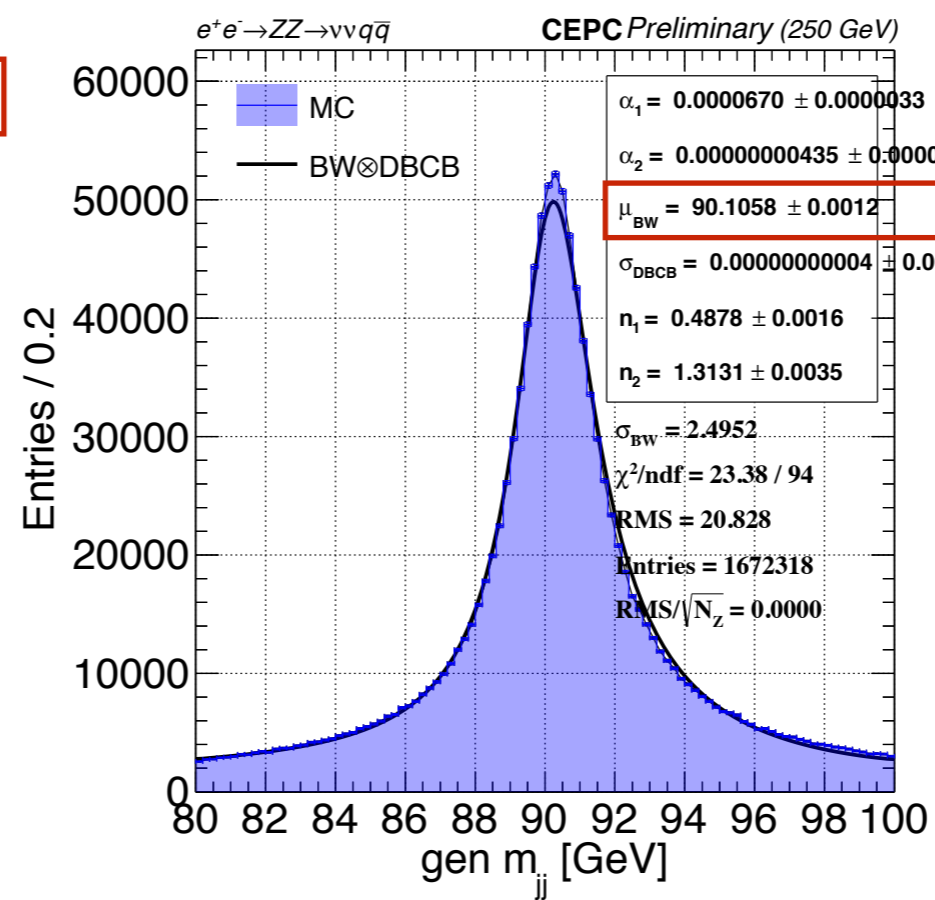
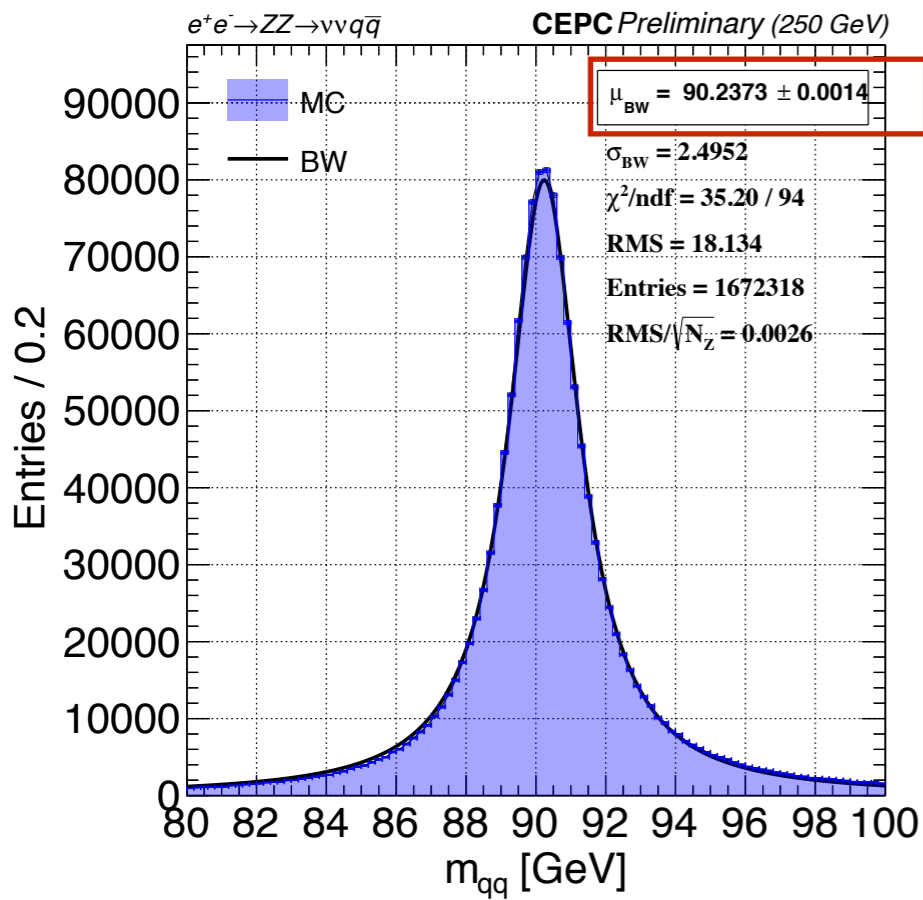
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EW Meeting

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- **Fit dijet invariant mass by Breit-Wigner(BW) convoluted double-sided crystal ball(DBCB), and then check the Gen level invariant mass.**
- **Use reliable quantity in the future to study the Z and W mass performance.**  
(Switch to b-/c- veto working point)

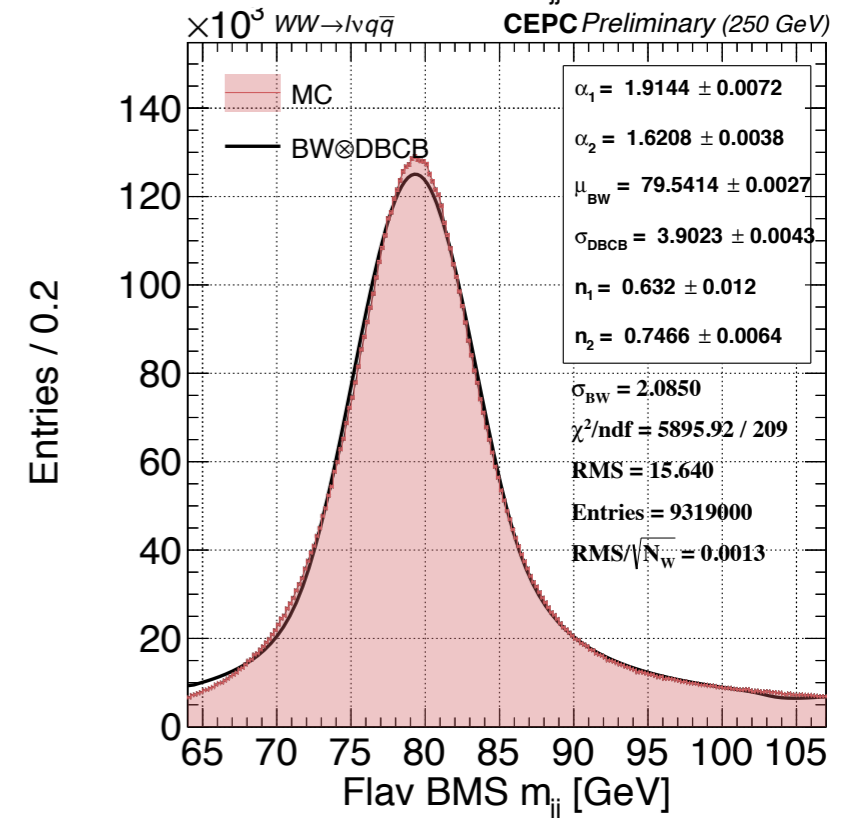
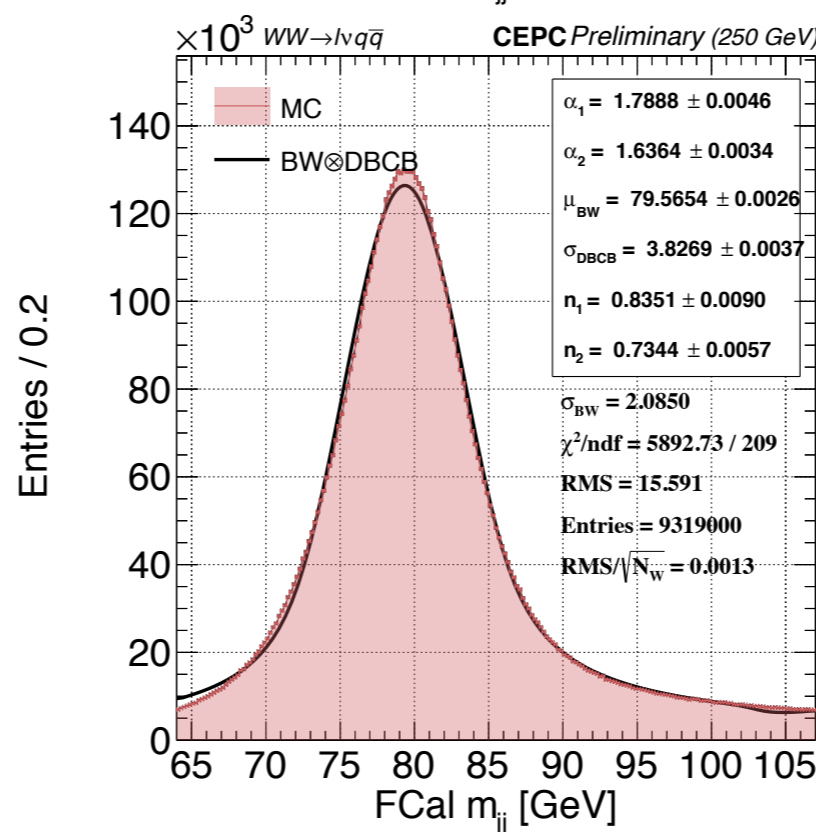
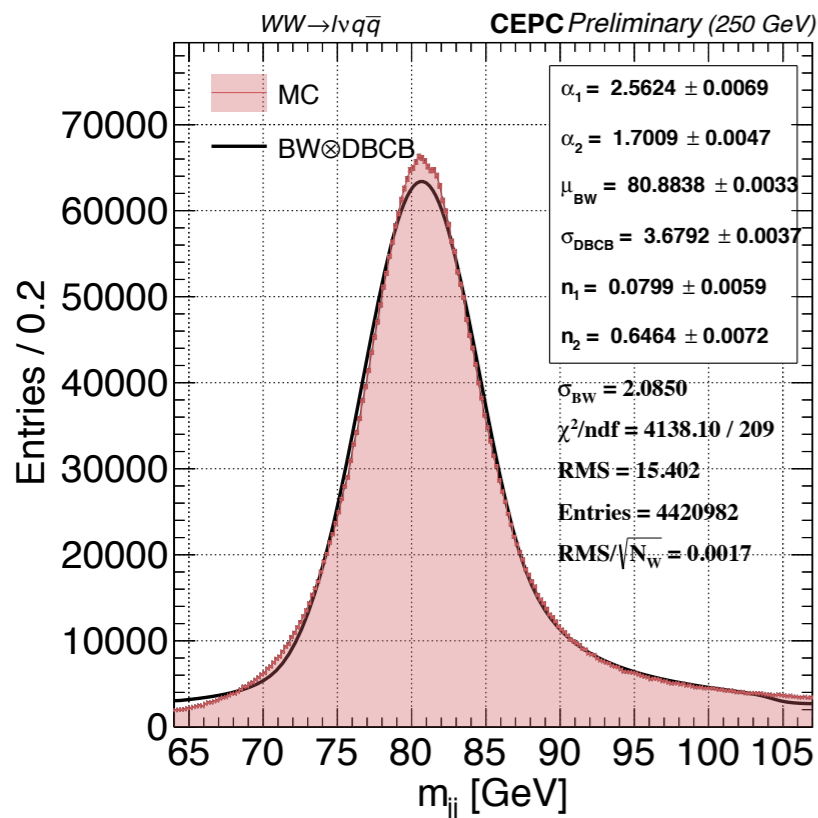
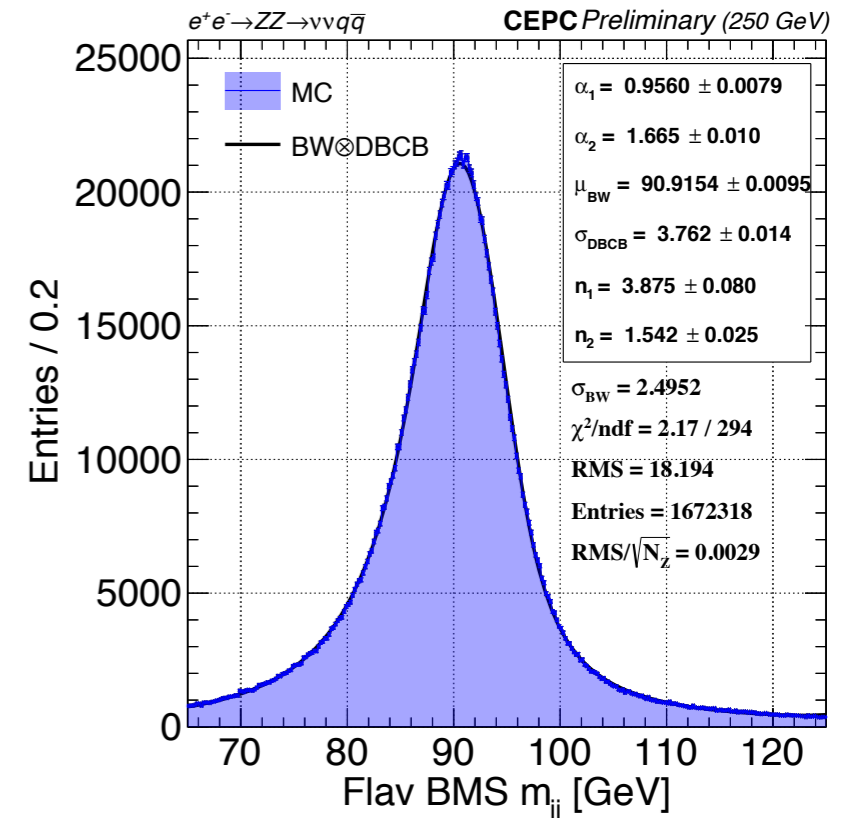
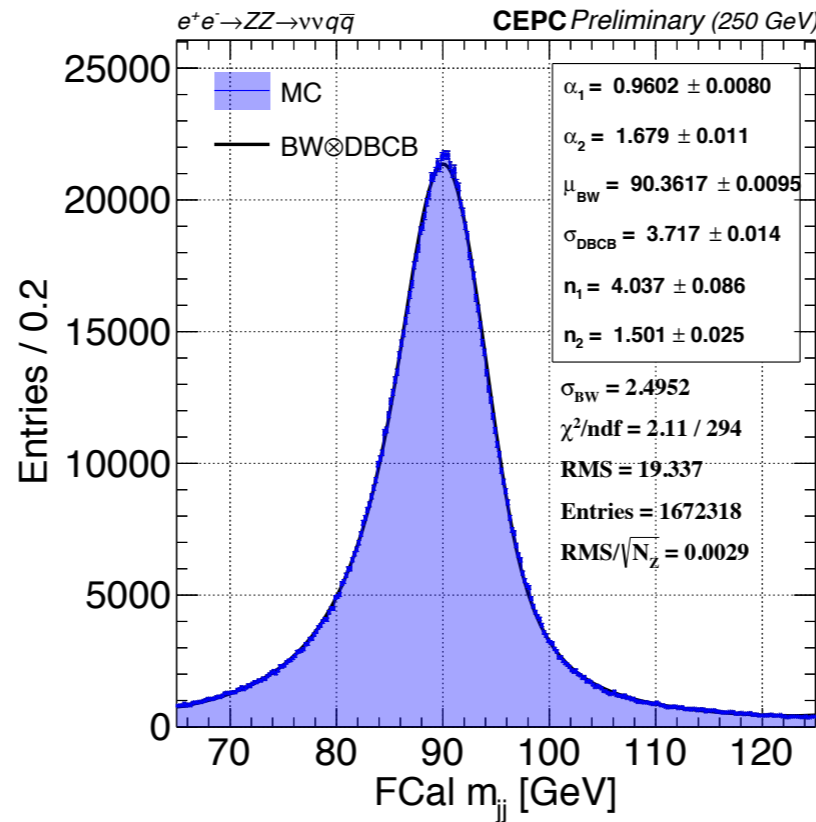
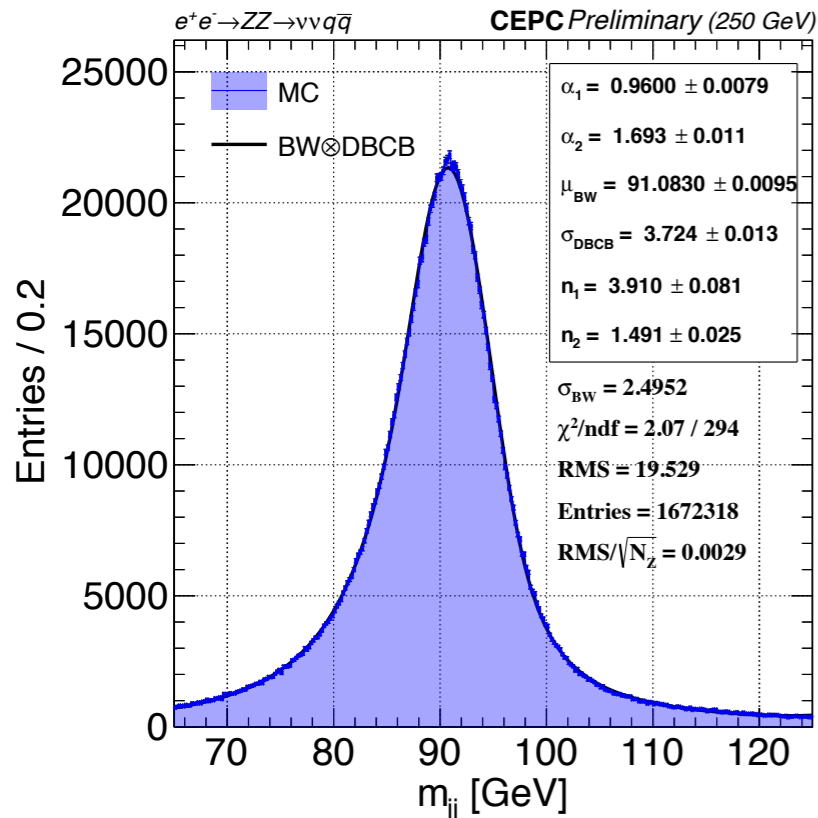


■ The di-parton invariant mass was fitted by BW, and di-gen jet invariant mass was fitted by BW convoluted DBCB.

■ The MC true Z and W mass value is not as same as what we measured.

■ Currently results (PDG):  
( $m_Z = 91.18$ ) ( $m_W = 80.38$ )

# Apply Calibration to $m_{reoc\ jj}$



Nominal(no calibration)

Calibrated by Flavor depended JES

Calibrated by Flavor depended BMS

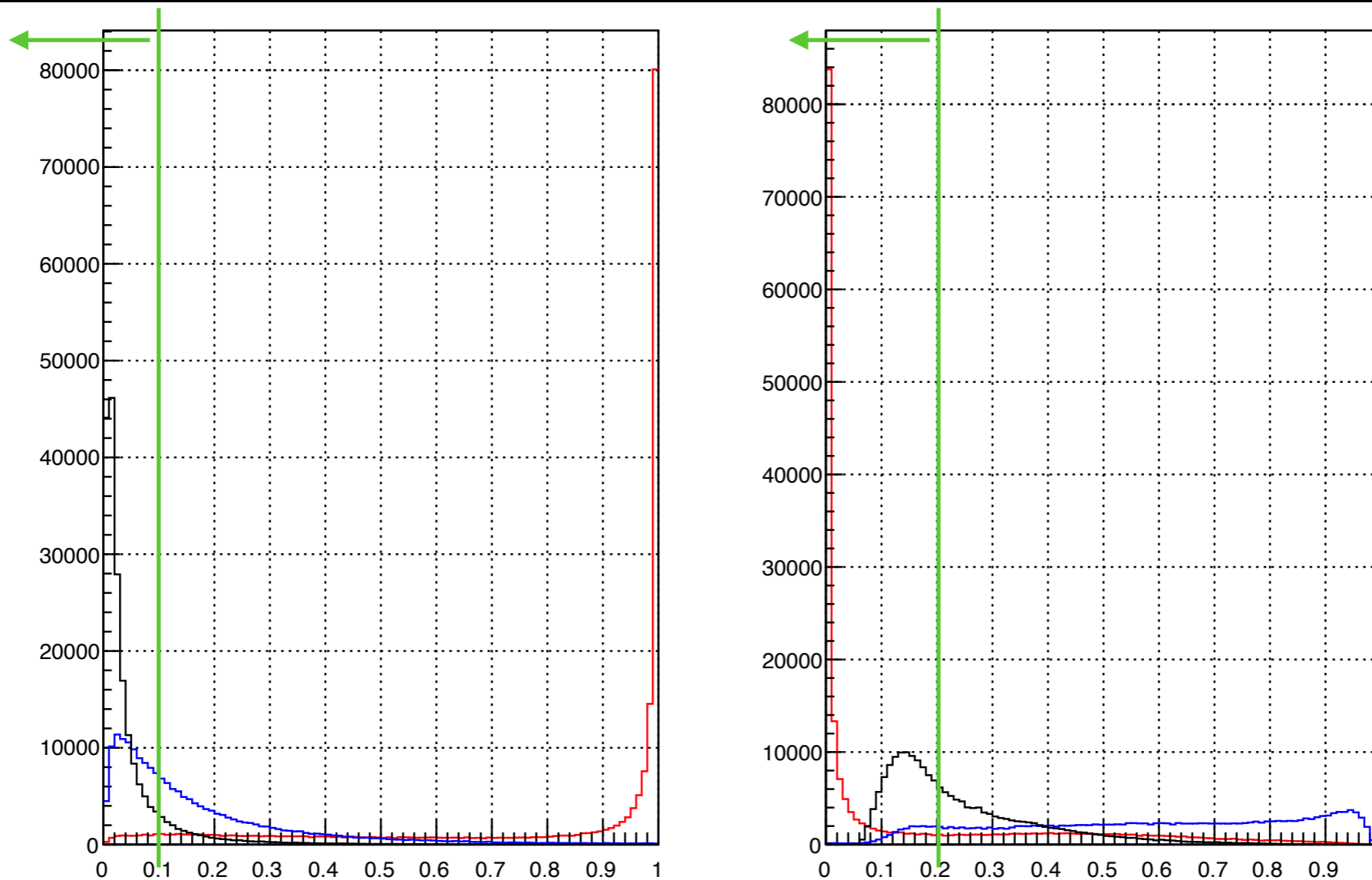
	Nominal $Z \rightarrow qq$	Applied JES $Z \rightarrow qq$	Applied BMS $Z \rightarrow qq$
Entries	1672318	1672318	1672318
$\sigma_{DBCB}$	3.724	3.717	3.762
$\mu_{BW}$	91.0830	90.3617	90.9154
Mean/ $m_z$	1.0108	1.0028 🍑	1.0089
	Nominal $W \rightarrow qq$	Applied JES $W \rightarrow qq$	Applied BMS $W \rightarrow qq$
Entries	9319000	9319000	9319000
$\sigma_{DBCB}$	3.679	3.826	3.902
Mean	80.8838	79.5654	79.5414
Mean/ $m_w$	1.0150	0.9985 🍑	0.9982

■  $\sigma_{DBCB}$  is similar. This implies the detector response to jet is similar.

■ If take our MC true as true  $m_z$  and  $m_w$ , my flavor dependent JES calibration is good !!  
 Additionally, BMS approach has some improvement. After fix the MC true value, the JES approach can work.

**Note:** Our MC true value: (Z gen  $m_{jj} = 90.1058$ ) and (W gen  $m_{jj} = 79.68339$ )

- Fit dijet invariant mass by Breit-Wigner(BW) convoluted double-sided crystal ball(DBCB), and then check the Gen level invariant mass(two gen jets and partons).
- **Use reliable quantity in the future to study the Z and W mass performance.**  
(Switch to b-/c- veto working point)

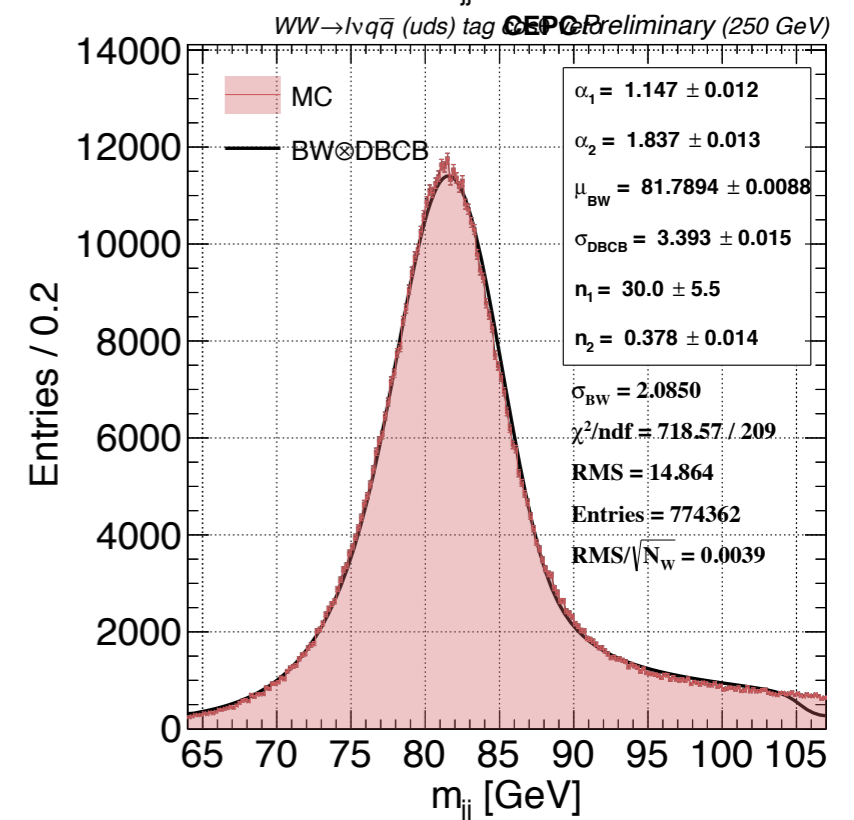
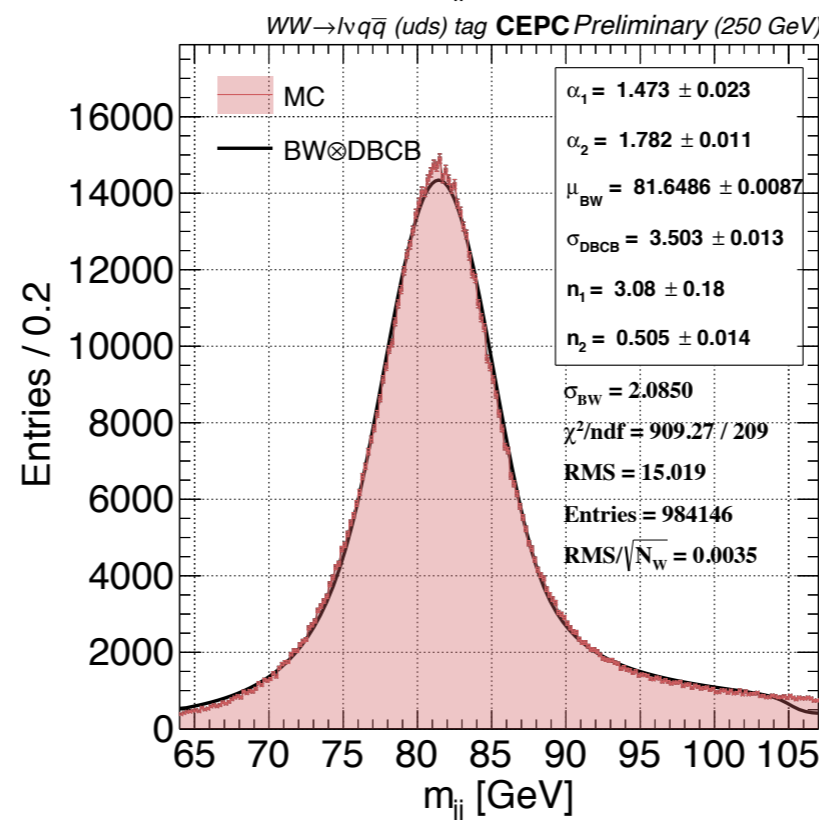
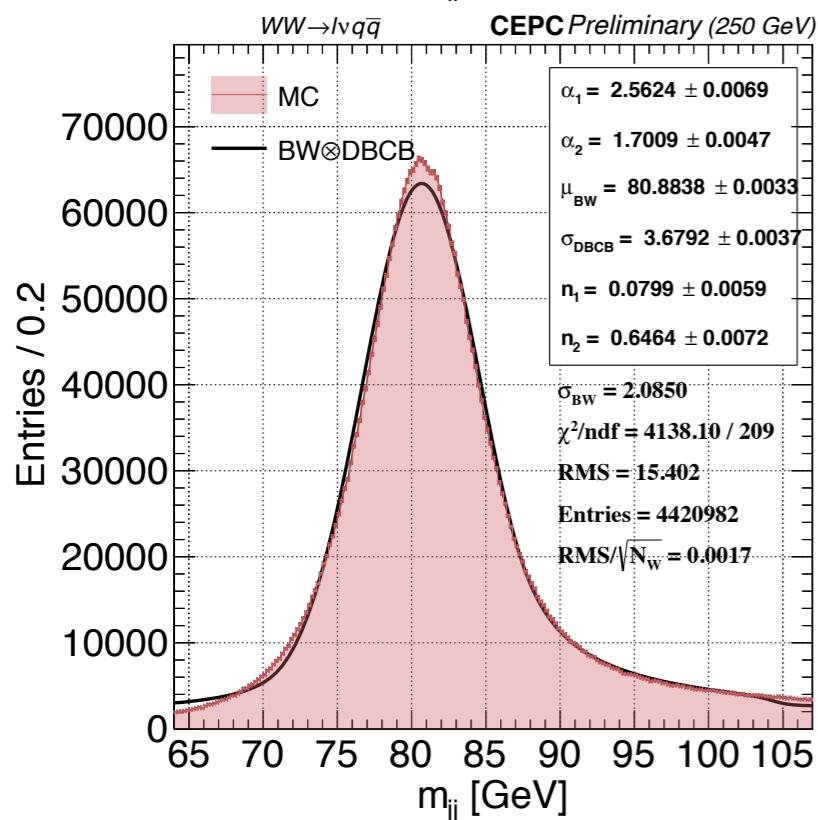
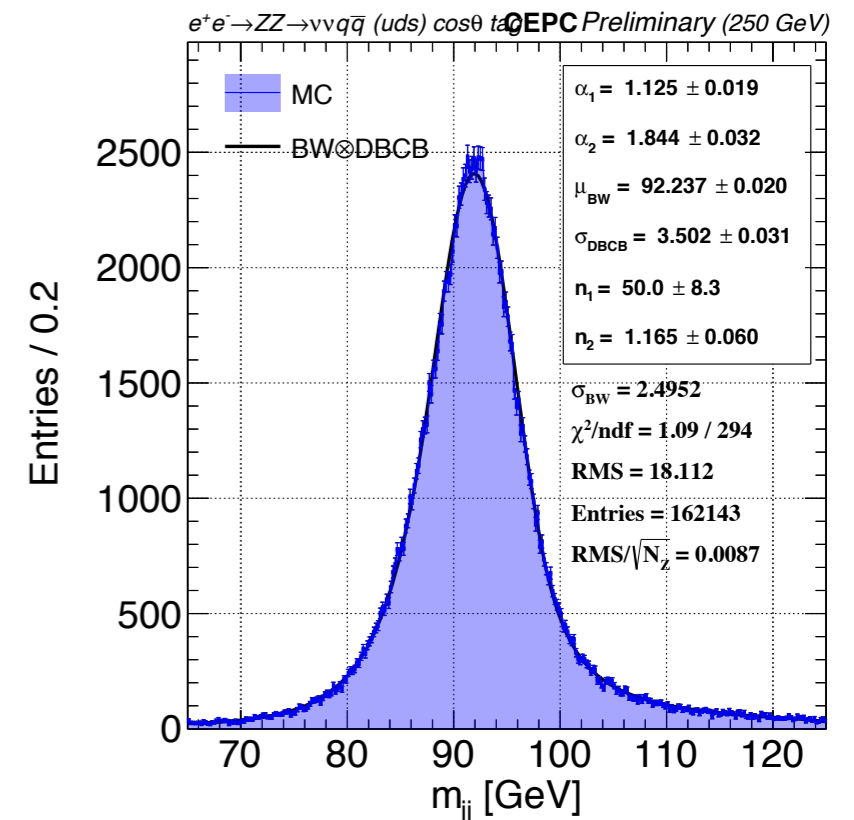
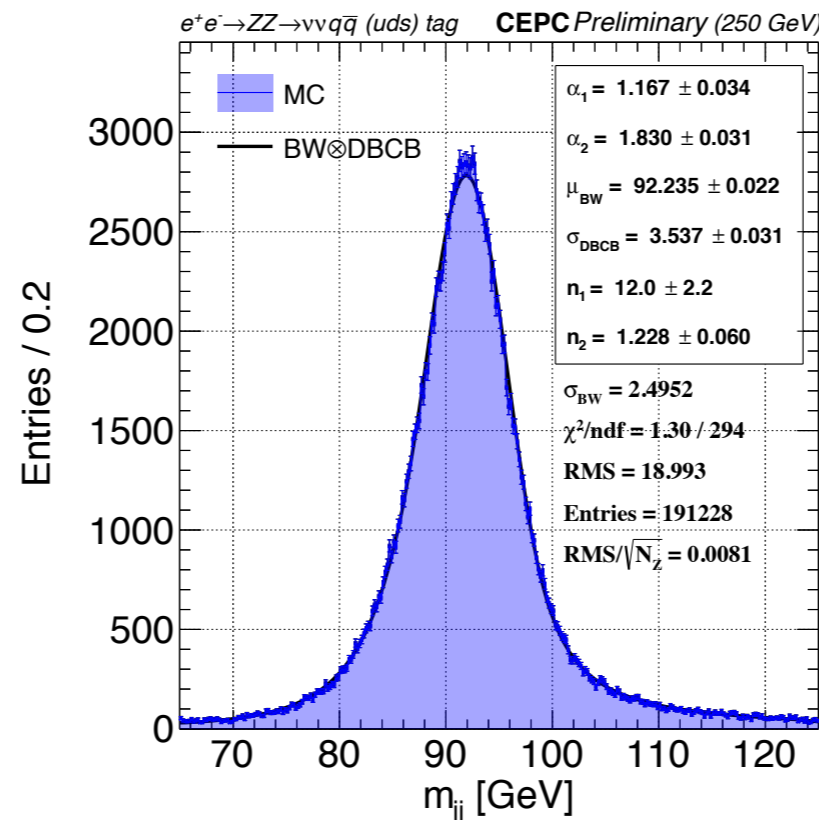
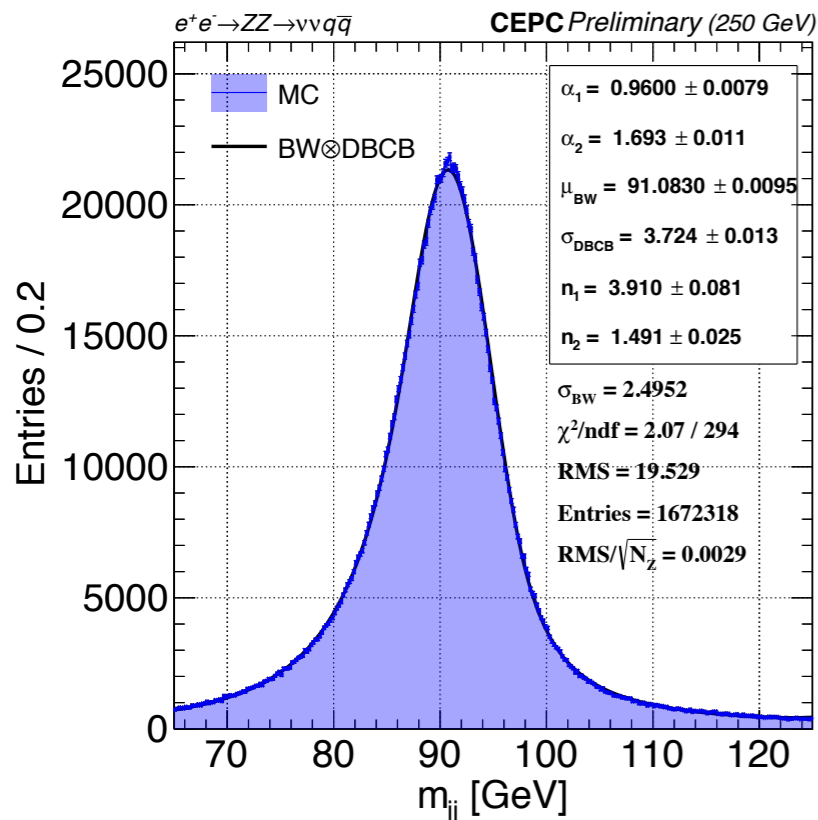


■ Red line is for b-jet, blue line is for c-jet, and black line is for light-jet.

■ According to left plot, if want to reject b-jet, the score is recommended less than 0.9; if want to select b-jet, the score is recommended greater than 0.8.

■ According to right plot, if want to reject c-jet, the score is recommended less than 0.6; if want to select c-jet, the score is recommended greater than 0.4.

# Apply typical b-/c- tagging $m_{reoc\ jj}$



■ Both jets are required b-jet tagging score < 0.1 and c-jet tagging score < 0.2.



	Z→qq	Z→qq(uds) tag	Z→qq(uds) cosθ veto
Entries	1672318 <b>11.4%</b>	191228 <b>84.7%</b>	162143
$\sigma_{DBCB}$	3.724	3.537	3.502
$\mu_{BW}$	91.0830	92.235	92.237
RMS/ $\sqrt{N_z}$	0.0029	0.0081	0.0087

	W→qq	W→qq(uds) tag	W→qq(uds) cosθ veto
Entries	4420982 <b>22.2%</b>	984146 <b>78.6%</b>	774362
$\sigma_{DBCB}$	3.6792	3.503	3.393
$\mu_{BW}$	80.8838	81.6486	81.7894
RMS/ $\sqrt{N_w}$	0.0017	0.0035	0.0039

■ These plots present the state of the boson mass resolution at CEPC because these approach can be reality.

- **Z and W dijet invariant masses are well modeled by BW convolution DBCB. It is better than just be modeled by DBCB.  $\sigma_{\text{DBCB}}$  is similar.**
- **My flavor dependent JES calibration approach is good. Next step, try to develop a data-driven calibration approach.**
- **Switch to the purity high b-/c- tagging score, the Z and W mass distribution are present in the reality way. The selection can be reliable in the future.**
  
- **Question: How do we fix the MC truth value?**

**Information for MC sample:**

**ee->ZZ->vvqq: Total number of event = 1772775**

**ee->WW-> $\mu\nu$ qq: Total number of event = 11176194**



# Back up

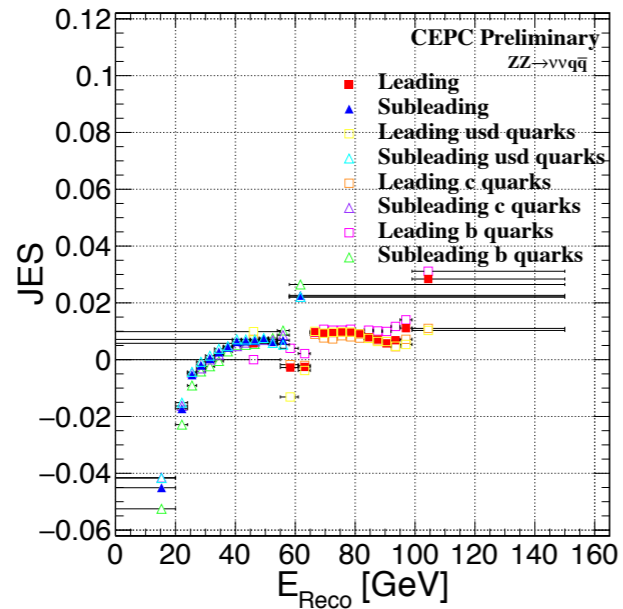
## Approach 1

Study the JES (energy, flavor)

Identified individual jet's energy and flavor

Applied on individual jet  $E_{\text{reco jet}} / (1 + \text{JES})$

$$\frac{E_{\text{RecoJet}} - E_{\text{GenJet}}}{E_{\text{GenJet}}}$$



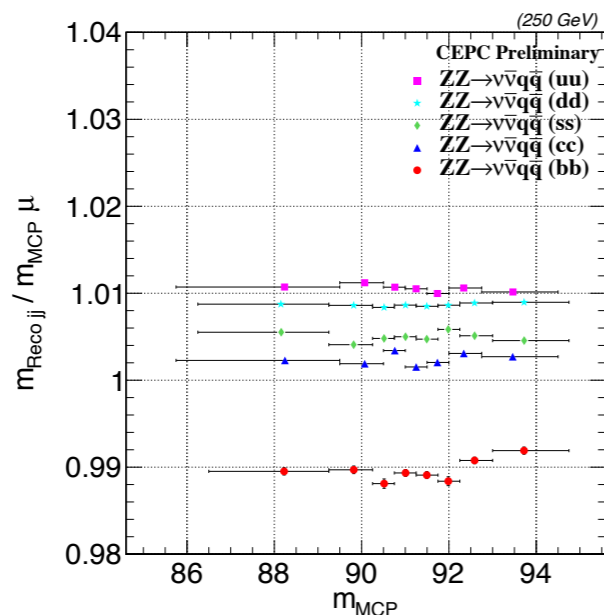
## Approach 2

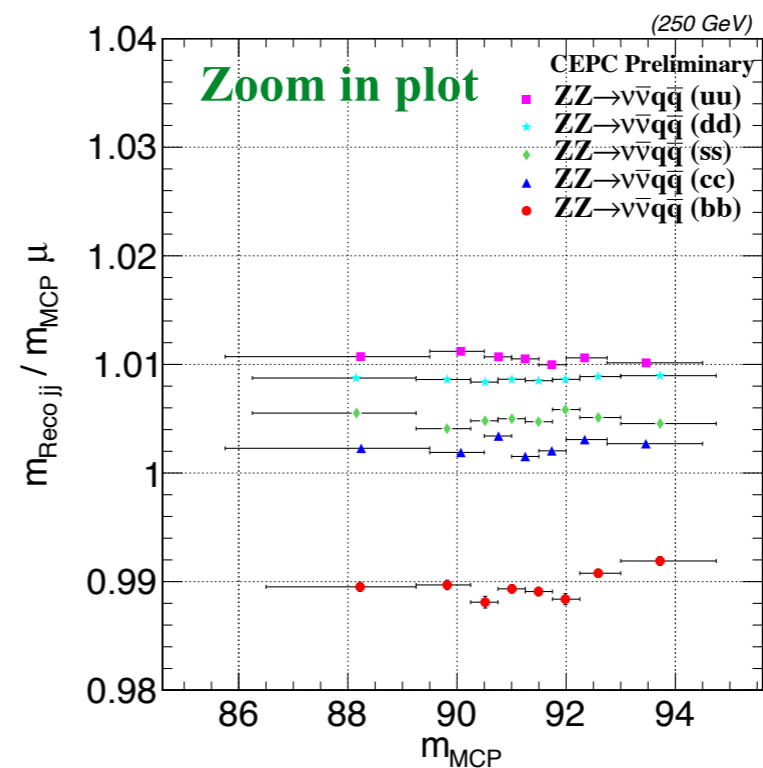
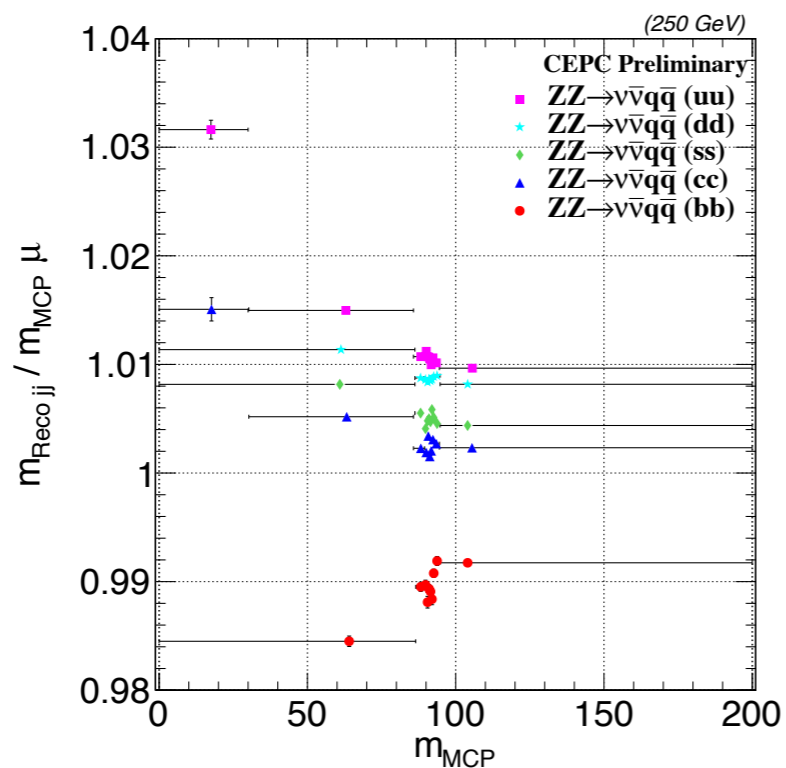
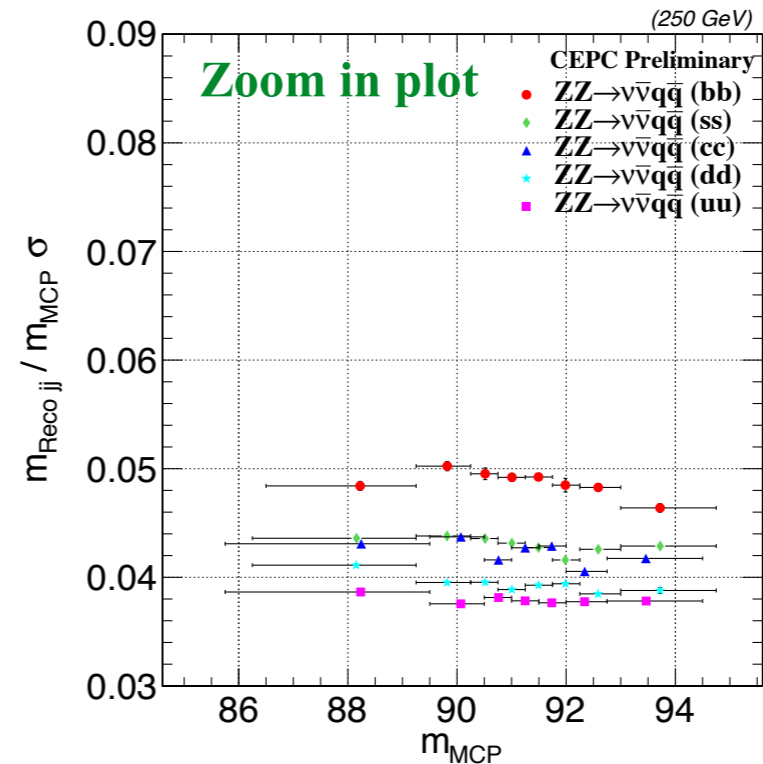
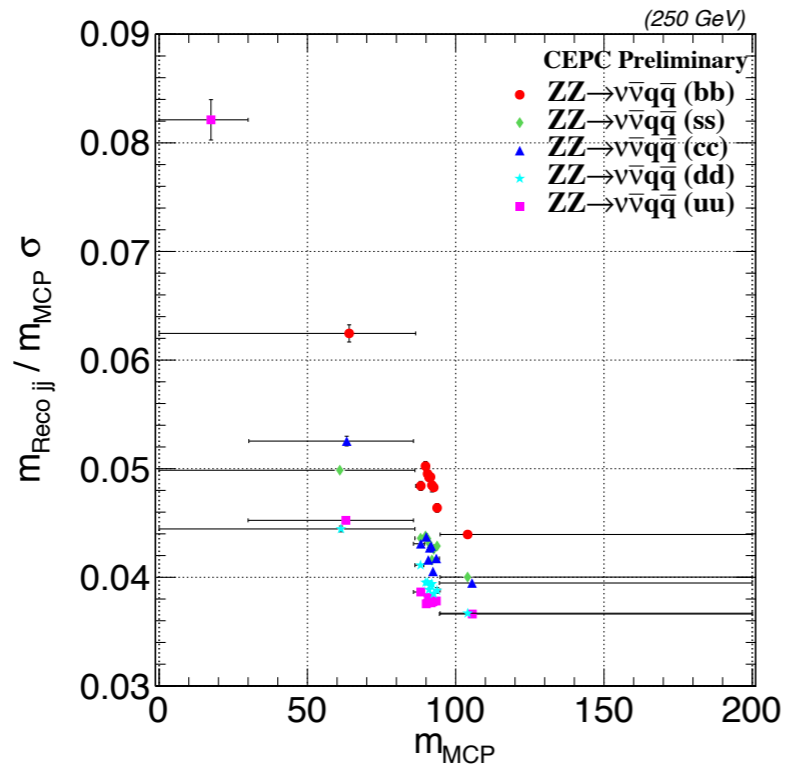
Study the BMS ( $m_{\text{MCP}}$ , flavor)

Identified dijet  $m_{\text{MCP}}$  and flavor of jet

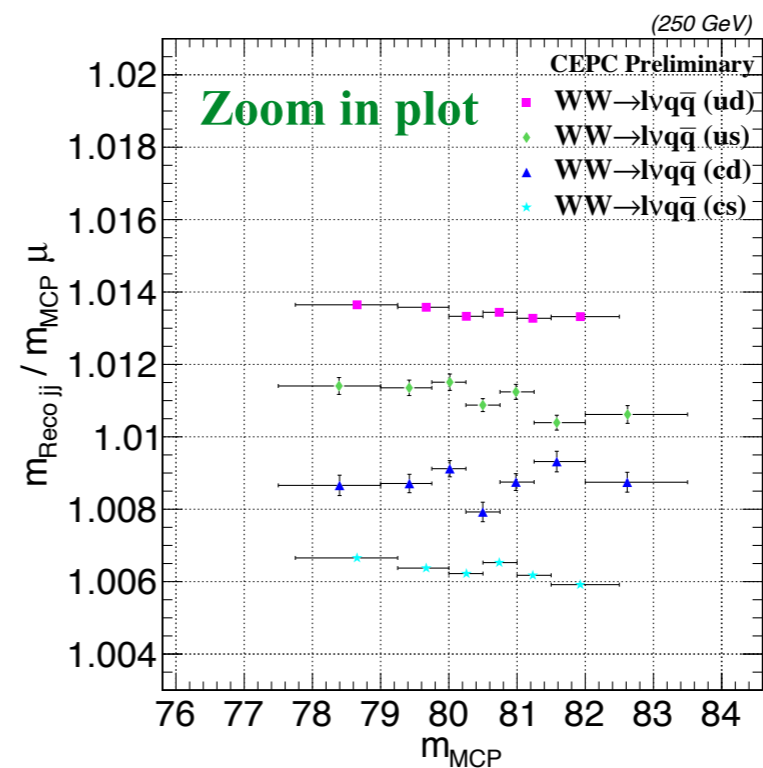
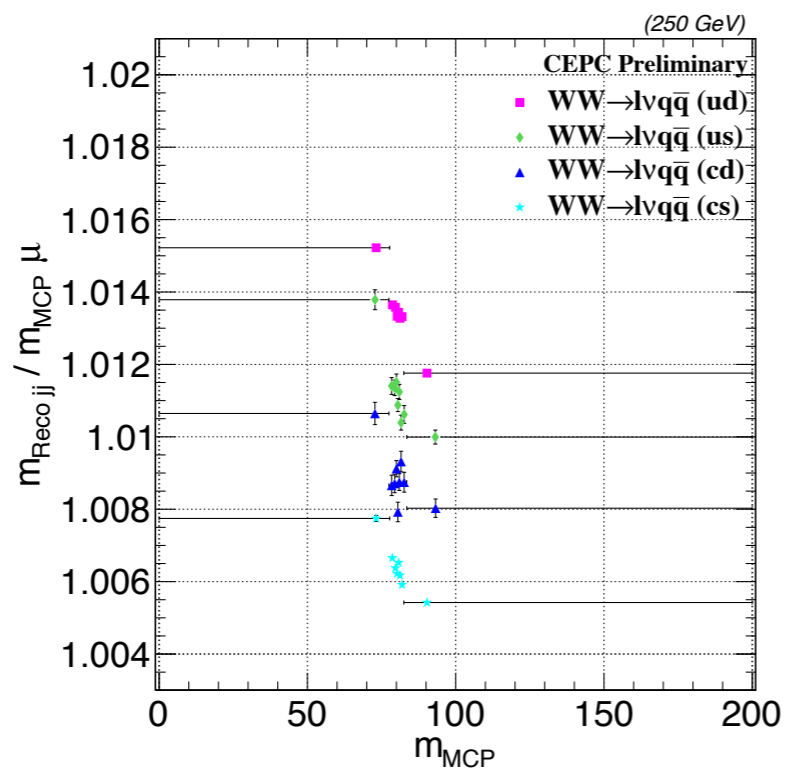
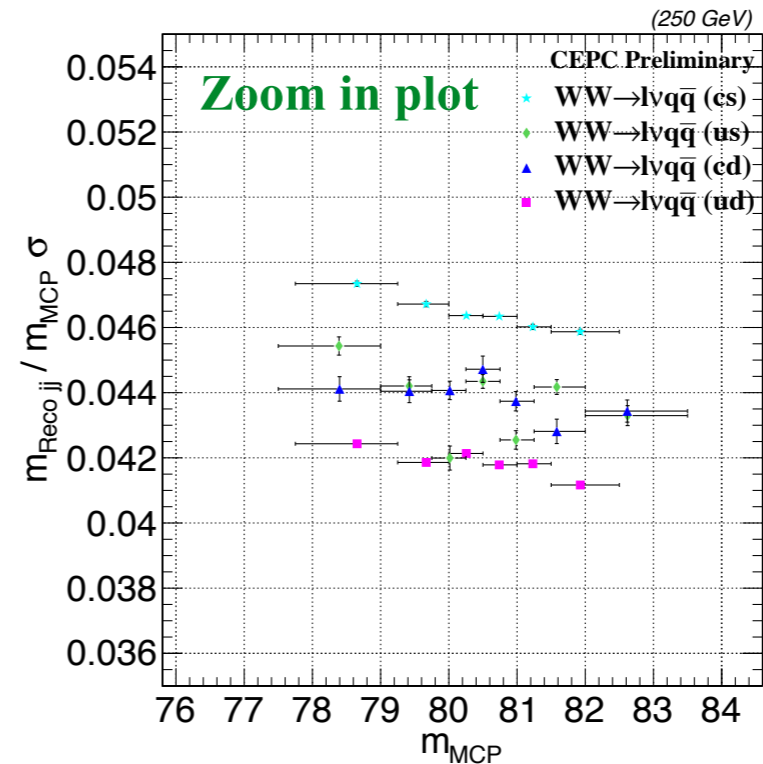
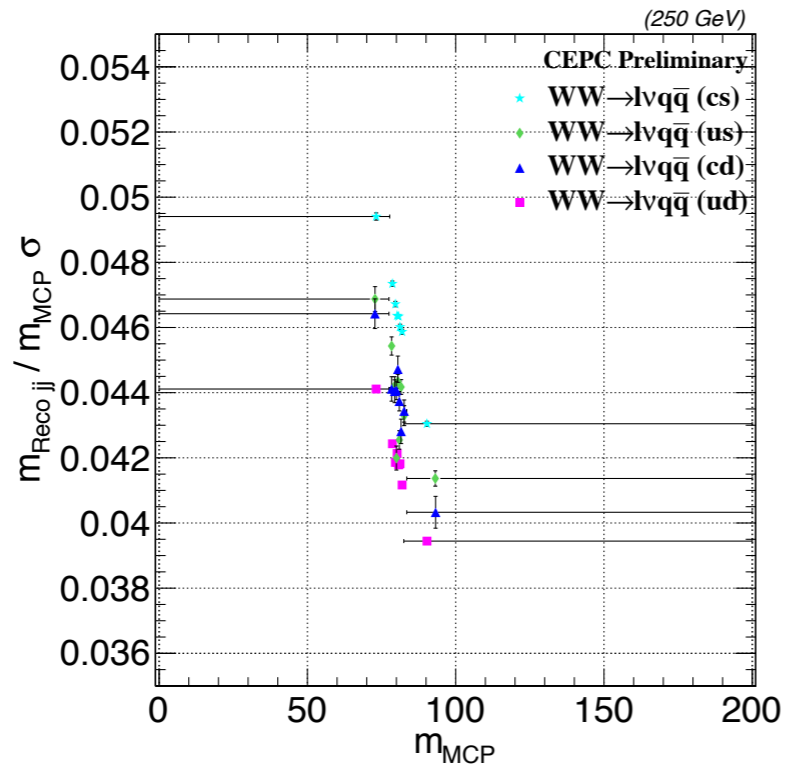
Applied on individual jet  $E_{\text{reco jet}} / (\text{BES})$

$$\frac{m_{\text{Reco diJet}}}{m_{\text{MCP}}}$$





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- The boson mass scale follows the neutrino productivity of quark.



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