VBF Theoretical Systematics

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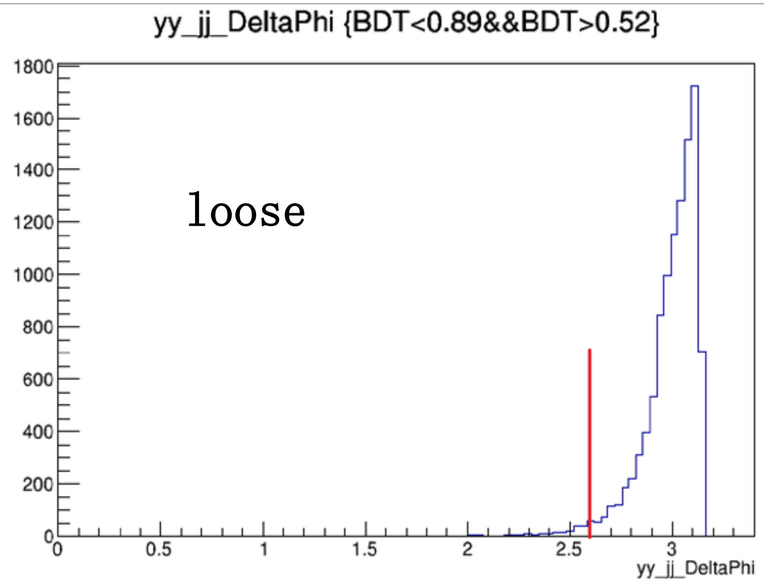
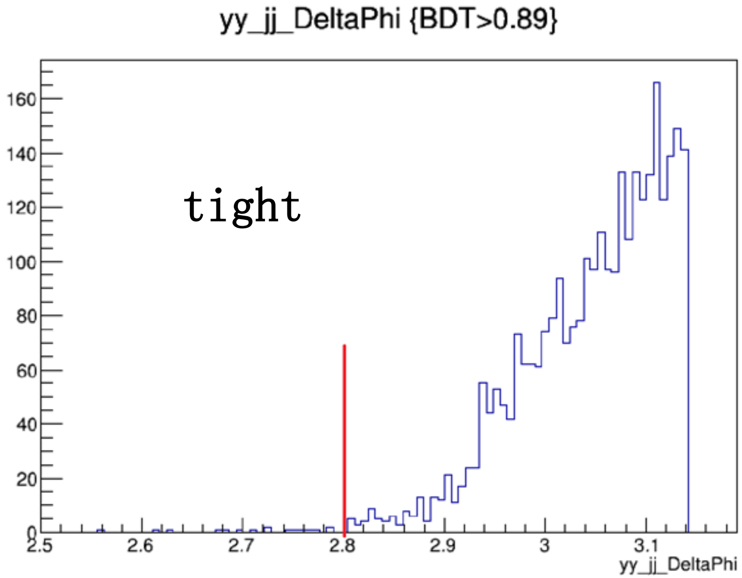
ggF+2jets cross section uncertainty

- Higher-order perturbative correction uncertainty for ggF+2jets cross section
  - missing higher-order perturbative corrections to the ggF+2jets prediction
- Vary the scale between mH=2 to 2mH in MCFM to evaluate the uncertainty
  - use Stewart-Tackmann method
    - differential cross section covariance matrix in 29 bins of $\Delta\varphi_{\gamma\gamma,jj}$ generated using MCFM at NLO : uncert_i*corr(i,j)*uncert_j gives uncertainty
    - the covariance between the total cross section, the exclusive 2 jet cross section (= the cumulant), and the inclusive 3 jet cross section (= the inverted cumulant) are fully determined
  - the cumulant uncertainties are translated into differential uncertainties in $\Delta\varphi_{\gamma\gamma,jj}$
    - $\Delta\varphi_{\gamma\gamma,jj}$ is binned up for > 2.94 to avoid the highest uncertainty and negative cross section
  - need to find the $\Delta\varphi_{\gamma\gamma,jj}$ region with current BDT cuts

ggF+2jets cross section uncertainty

- $\Delta\varphi_{\gamma\gamma,jj}$ in loose and tight VBF category

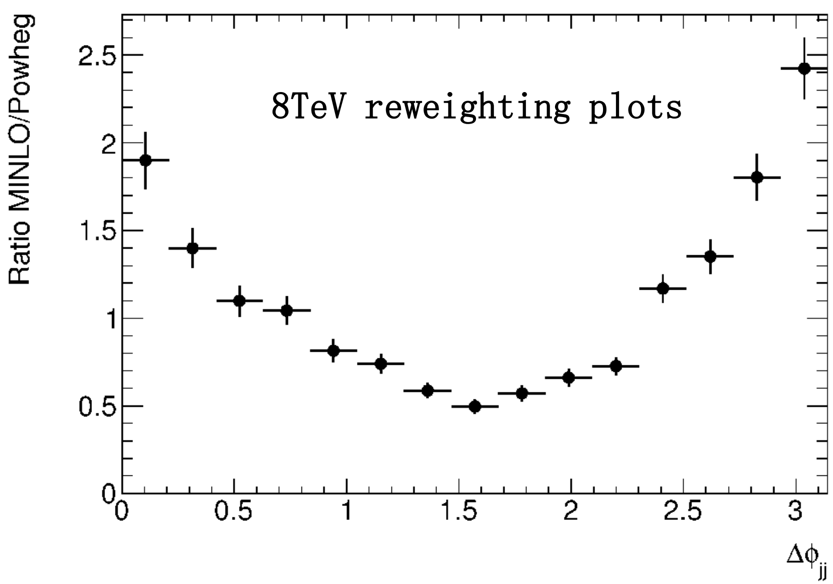


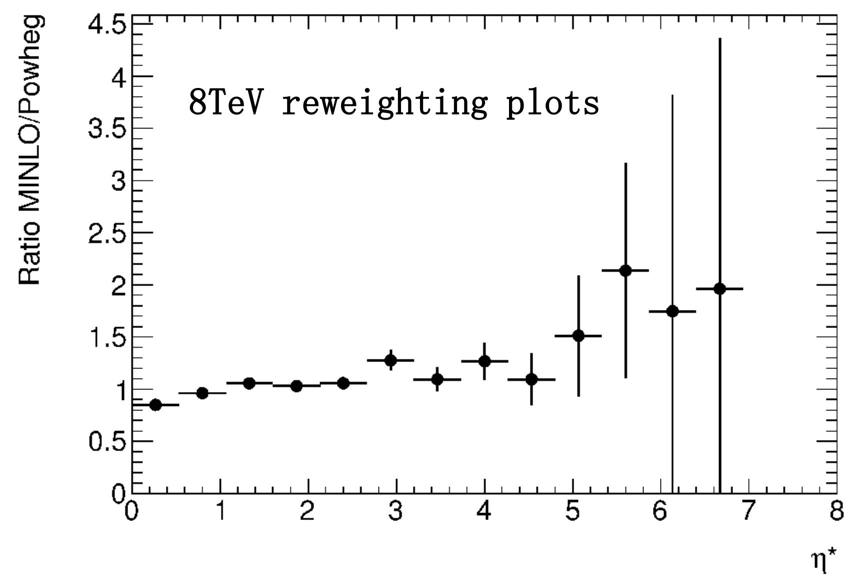


- Obtained ggF+2jets cross section uncertainty
  - loose VBF: 25.5%
  - tight VBF: 39.5%

Mis-modeling of $\Delta\varphi_{jj}$ and η^*

- The angular correlation between the two jets is not well modeled by powheg+pythia8
  - the second jet in the generation of ggF events by powheg-box+pythia8 predominantly comes from the parton shower generated by pythia8
  - reweighting the nominal gluon fusion POWHEG sample to MINLO HJJ, which models the second jet in gluon fusion to NLO accuracy





Variable comparison between 8TeV and 13TeV

- Simple propagation from 8TeV reweighting function does not look like a good solution due to the difference between 8TeV and 13TeV
  - need MinoNLO jj samples from 13TeV