Angular resolution and bias in MC

$\Delta\phi$ plots resolution and smearing

New $\Delta\phi$ plots

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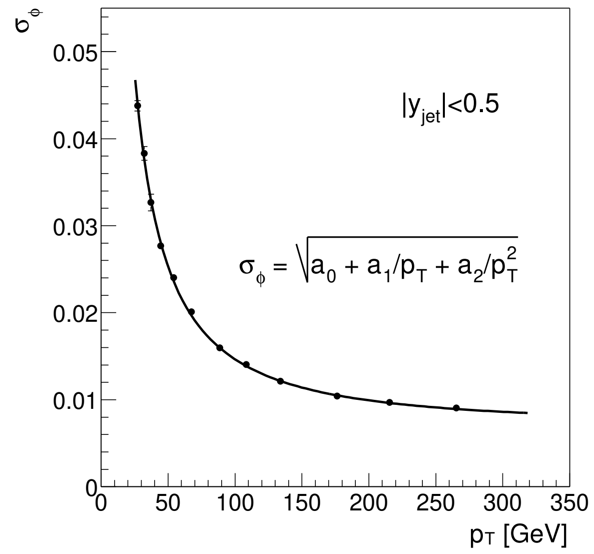
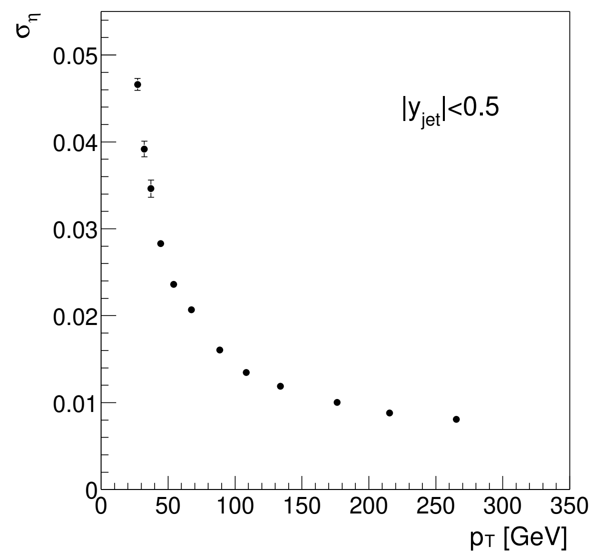
Jet angular resolution

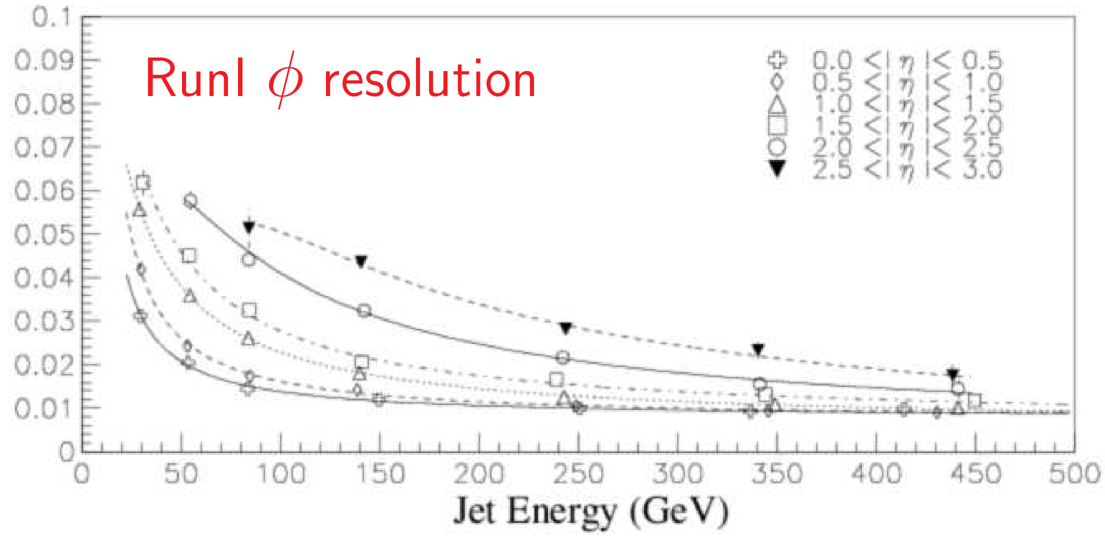
- mcp14 QCD samples
  - 20, 40, 80, and 160 GeV p_T thresholds
  - generated with 0.8 minimum bias
- jet angular resolutions for cone $R = 0.7$
  - matching particle and detector jets (only above the sample p_T threshold)
  - similar to RunI numbers for $p_T > 50$ GeV
  - higher in the low-p_T region

ϕ resolution

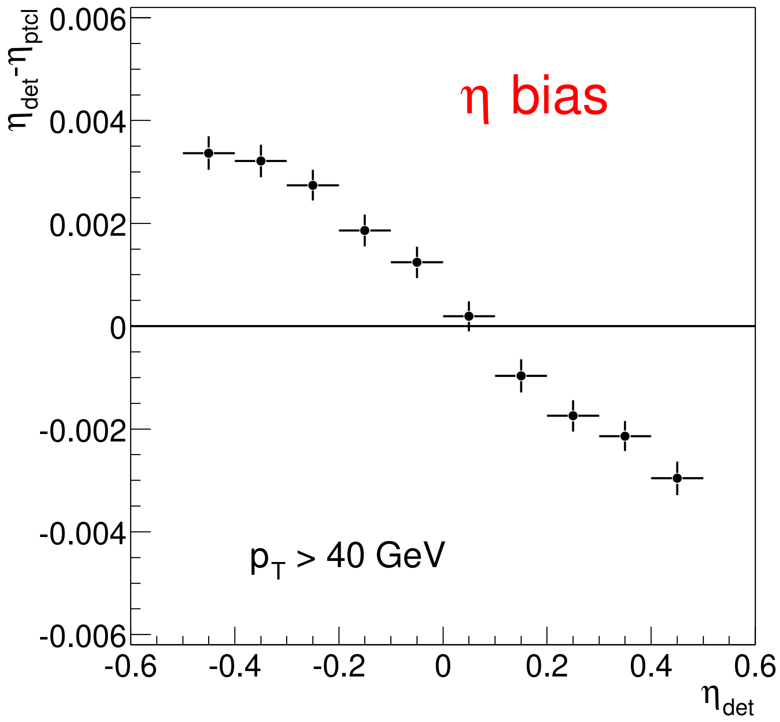


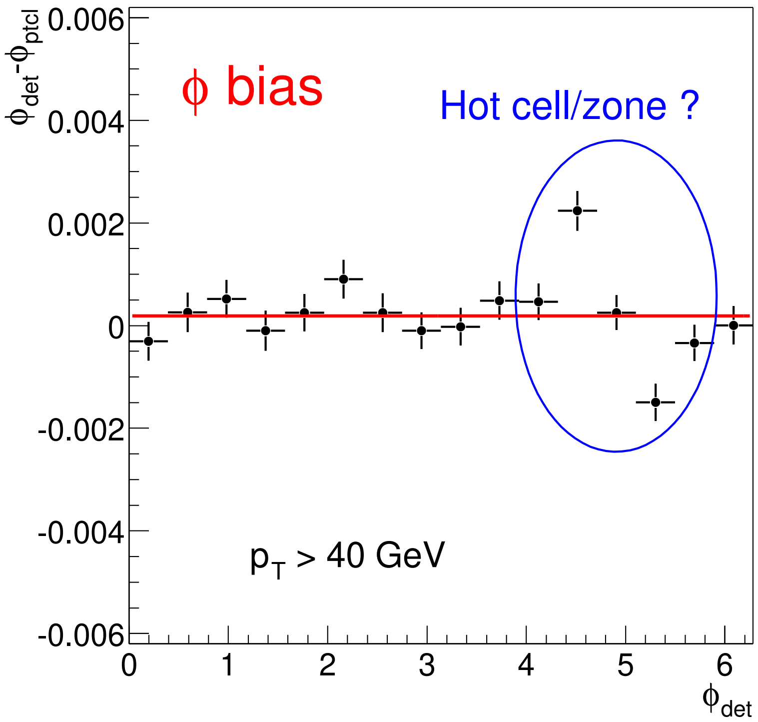
η resolution





ϕ and η bias





- η bias is ~ 0.0035 at $\eta_{det} = 0.5$ (0.7%)
  - 0.7% effect on p_T spectrum, 1.4% effect on dijet mass spectrum
  - goes in the same direction as in RunI but it is smaller (~ 0.007 at $\eta_{det} = 0.5$, but this is compared to the parton level)
- very small ϕ bias except the region with $\phi_{det} \sim 5$

$\Delta\phi_{1,2}$ resolution from full detector simulation

- QCD sample with 40 GeV cut
- central dijet events ($|\eta_{jet}| < 0.5$) with $M_{JJ} > 110$ GeV
- 817 events out of 100000
- nice correlation between $\Delta\phi_{1,2}$ at detector and particle levels
- only one event with $\Delta\phi_{1,2} < 2$
- need of about 10 million MC events

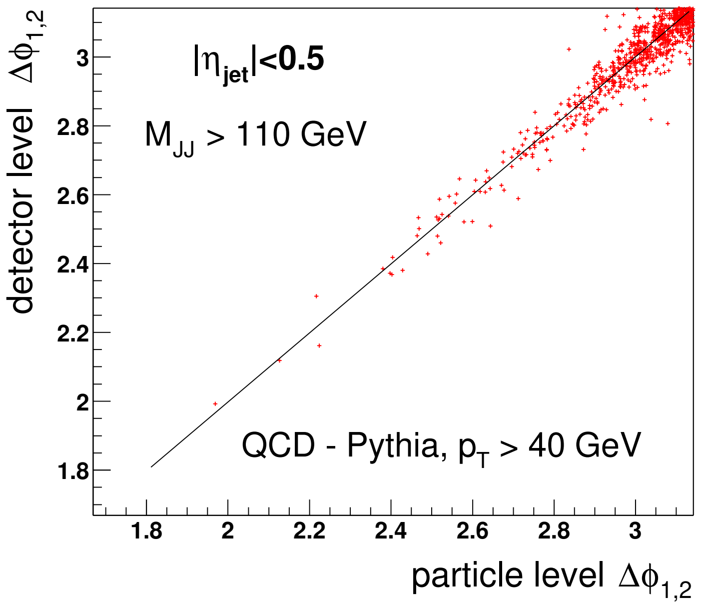
Questions

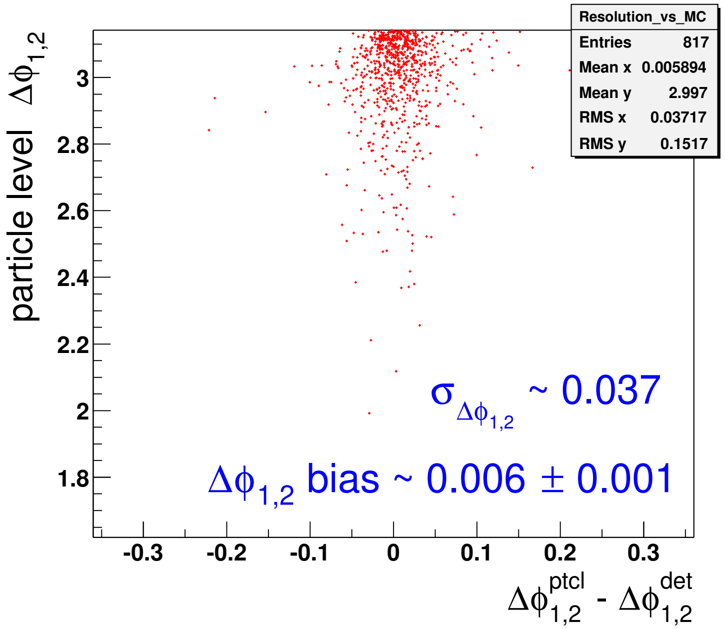
- Can Pythia generate processes with hard matrix element

$$2 \text{ partons} \rightarrow 3 \text{ partons ?}$$

- Is there a control on $\Delta\phi_{1,2}$?
- Do we trust Pythia at $\Delta\phi_{1,2} < 2$?

Detector vs. particle level

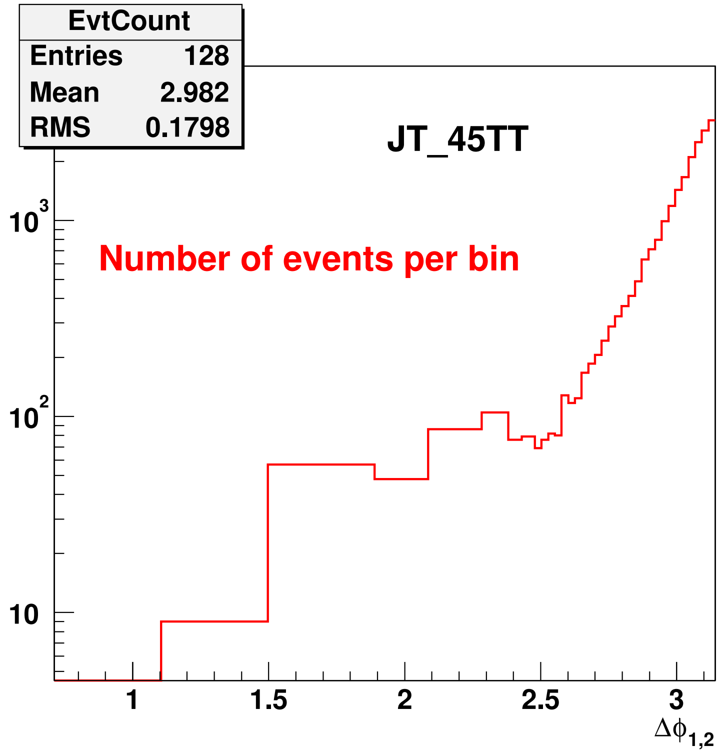




$\Delta\phi_{1,2}$ binning

- consider the trigger JT_45TT only ($180\,\text{GeV} < M_{JJ} < 250\,\text{GeV}$)
  - the case with the largest statistics
- Bin size
  - if possible, make it roughly as is the actual resolution (~ 0.02)
  - in case of lower statistics, make the bin to contain about 100 events

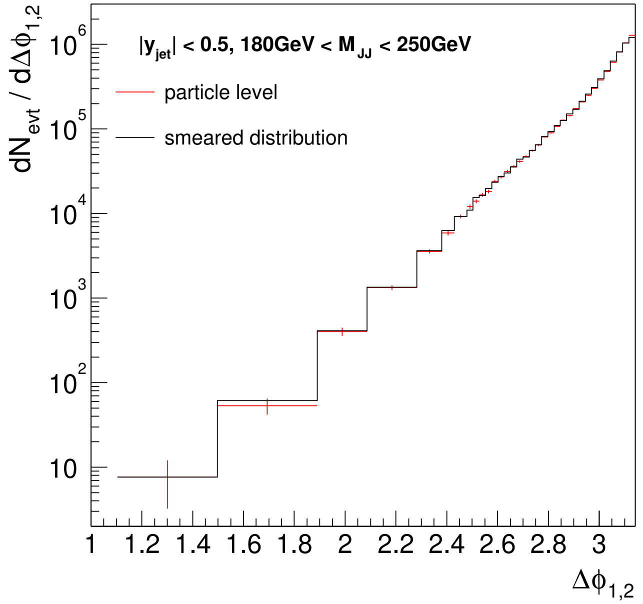
$\Delta\Phi_{1,2}$	bin size
< 1.90	$\pi/8 \sim 0.4$
$1.90 - 2.30$	$\pi/16 \sim 0.2$
$2.30 - 2.40$	$\pi/32 \sim 0.1$
$2.40 - 2.50$	$\pi/64 \sim 0.05$
$2.50 - \pi$	$\pi/128 \sim 0.025$

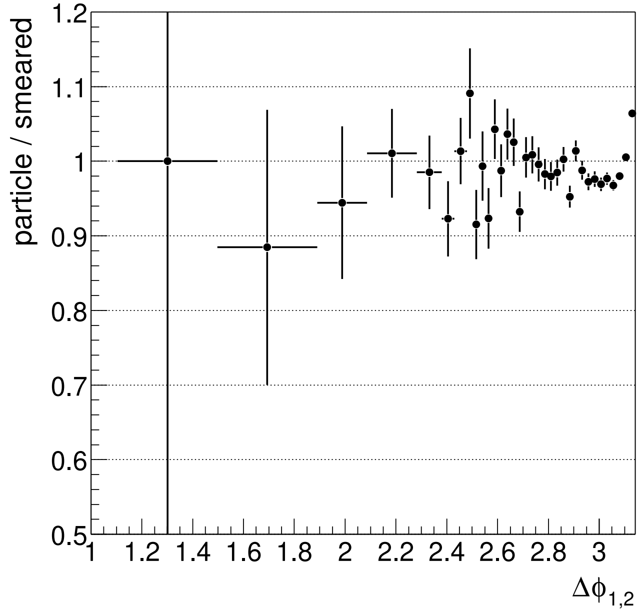


$\Delta\phi_{1,2}$ unsmearing from particle level MC

Only angular smearing

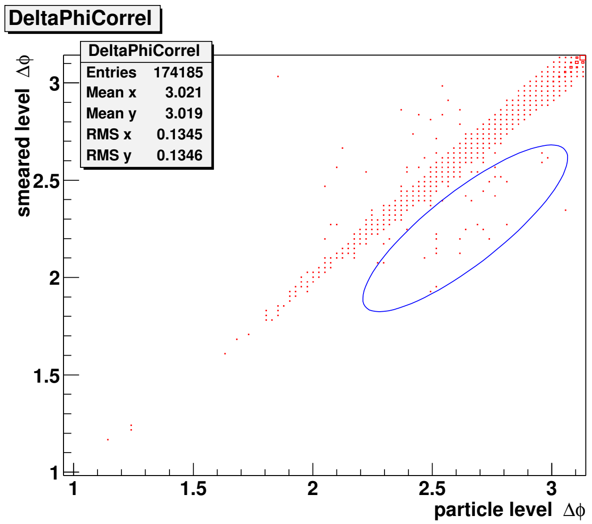
- QCD sample with 60 GeV cut (18M events)
- central dijet events $|y_{jet}| < 0.5$
  with 180 GeV $< M_{JJ} < 250$ GeV
- corresponds to the JT_45TT trigger
- about 180k events survived (1%)
- particle MC jets are smeared in ϕ according to the angular resolution
- enough statistics only for $\Delta\Phi_{1,2} > 2.8$
  unsmearing correction is small ($< 5\%$)
- angular smearing is not the whole story





Effect of jet p_T resolution

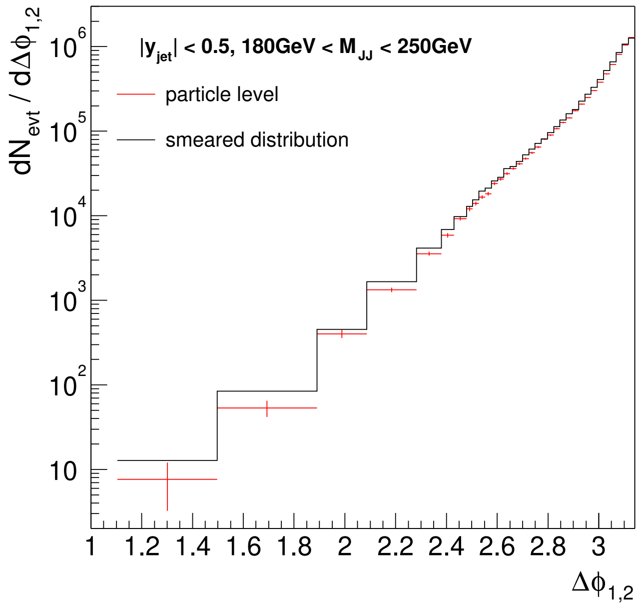
- particle jets are also smeared according to the measured p_T resolution
- small shift in normalization
  - the same origin as in case of dijet mass cross section
- different trend at small $\Delta\phi$
  - Caused by jet reordering?

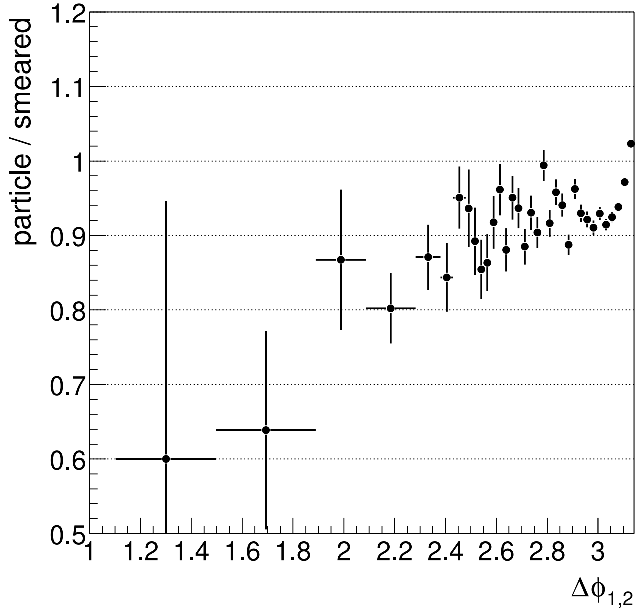


Only one part of the contribution

  - Different mass smearing?

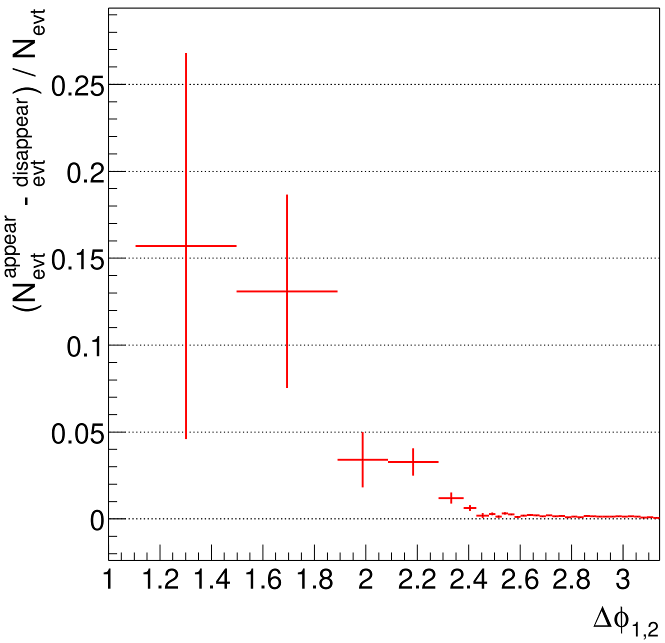
jet p_T smearing added



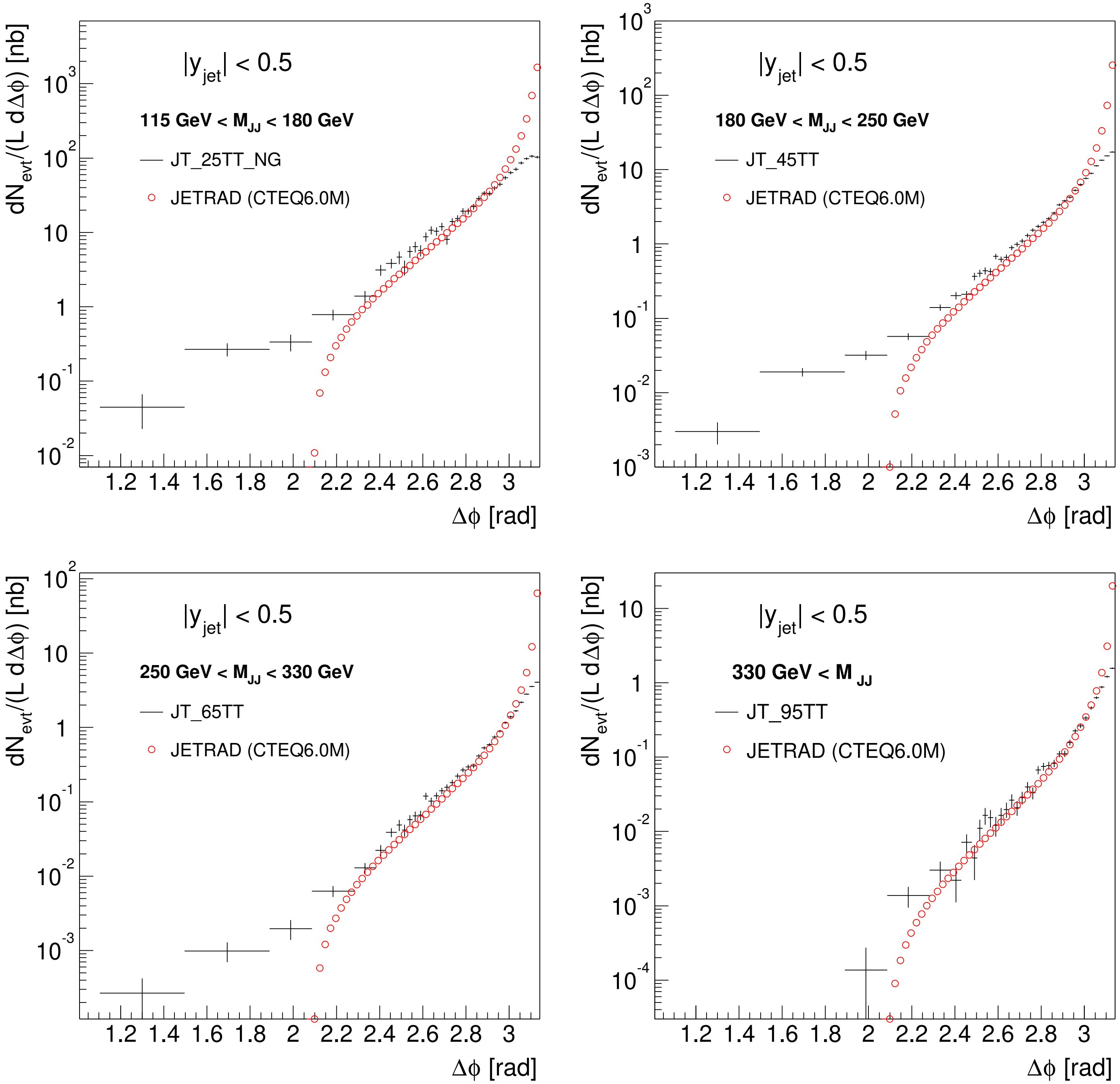


Mass smearing in different $\Delta\Phi_{1,2}$ bins

- In a given $\Delta\Phi_{1,2}$ bin
  - count events that appeared after smearing but the event on particle level was not satisfying selection criteria N_{evt}^{appear}
  - count events that disappeared after smearing $N_{evt}^{disappear}$
- the events at $\Delta\Phi_{1,2} < 2.2$ migrates above the dijet mass threshold more often
- due to different event topology
  - $\Delta\Phi \sim \pi$ - two back-to-back jets
  - $\Delta\Phi \sim 2.3$ - 3 jets, Mercedes-like events
  - $\Delta\Phi < 2\pi/3$ - 4+ jets events

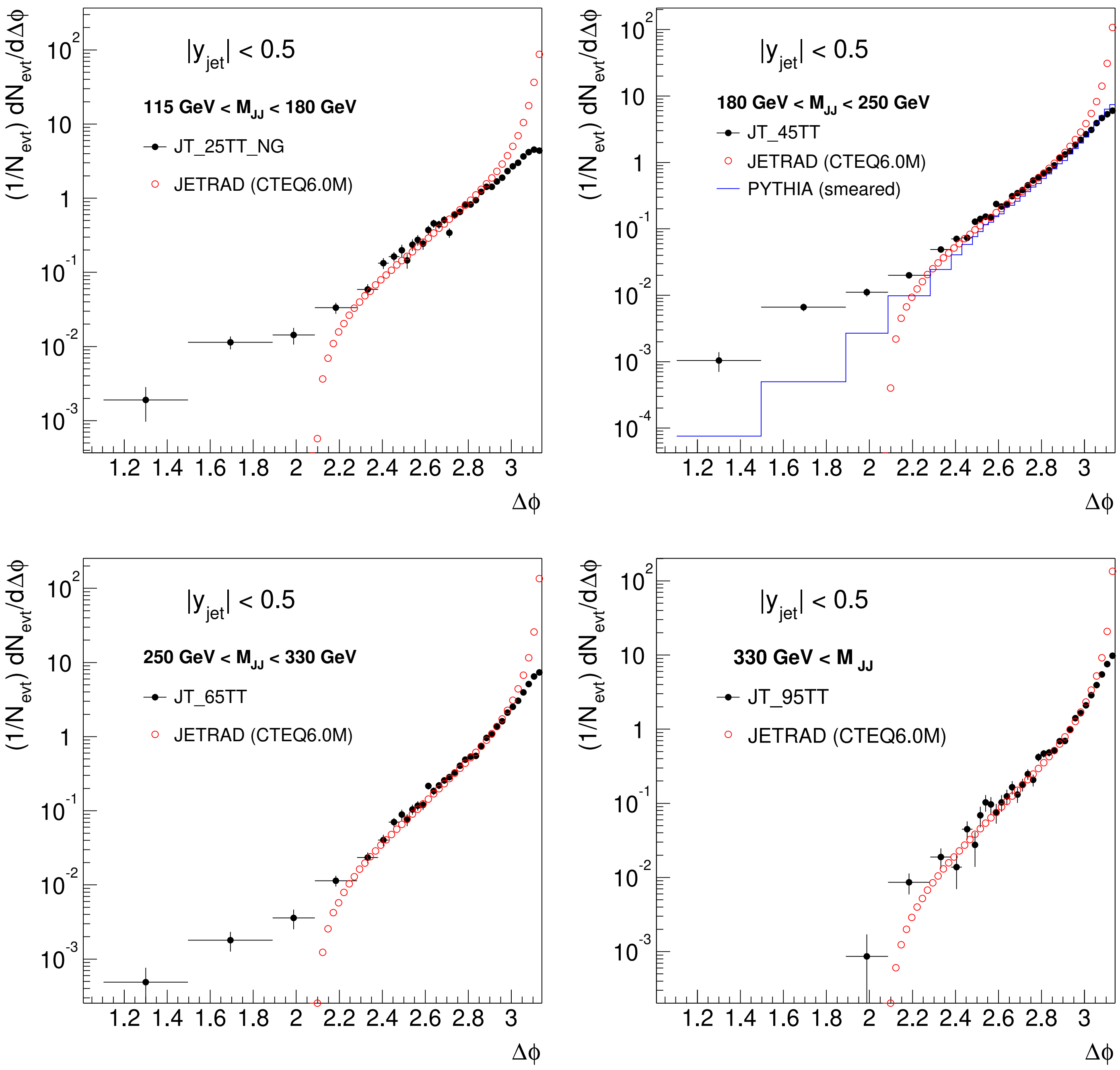


Comparison with the data



- normilized by luminosity
- all efficiencies are taken into account
- no unsmearing
- only statistical error

Comparison with the data II



- normilized by the number of events
- JETRAD is normalized using total σ_{NLO}
- PYTHIA does not diverge at $\Delta\phi \sim \pi$
- PYTHIA does not predict enough events at small $\Delta\phi$

Summary

- jet angular MC resolution in ϕ and η in the central calorimeter ($\eta < 0.5$) is almost the same as in the case of RunI
  - worse for jets with $p_T < 50\,\mathrm{GeV}$
- η bias goes in the same same direction as in RunI
- almost no ϕ bias (except one hot zone)
- impossible to obtain $\Delta\phi$ resolution from the full MC simulations at $\Delta\phi < 2.4$
- smearing MC jets shows that
  - smearing due to ϕ resolution is small ($\sim 5\%$)
  - smering due to jet p_T resolution is important, especially at $\Delta\phi < 2.4$ where it is dominant
- PYTHIA gives reasonable description of the $\Delta\phi \sim \pi$ region
  - it predicts less events at small $\Delta\phi$