Forward jet resolution evaluation

May 3, Chong Kim

- Evaluated forward going jets' resolutions
  - Parameters: energy, ϕ, and η
  - Produced 0.5 M Pythia + Geant4 events, then used truth particle level jets (ntp_truthjet)
  - Original goal: reproduce sPHENIX proposal resolution plot ($0.7 < \eta < 2.9$, in Backup)

    → changed to $2.3 < \eta < 4.0$ (true jet E > 20 GeV + enabled only do_fwd_jet flags)

    → evaluated jet for anti-k_T R = 0.4 and R = 0.6

- Most of results are same to previous mini report

Definitions/Cuts/Procedures

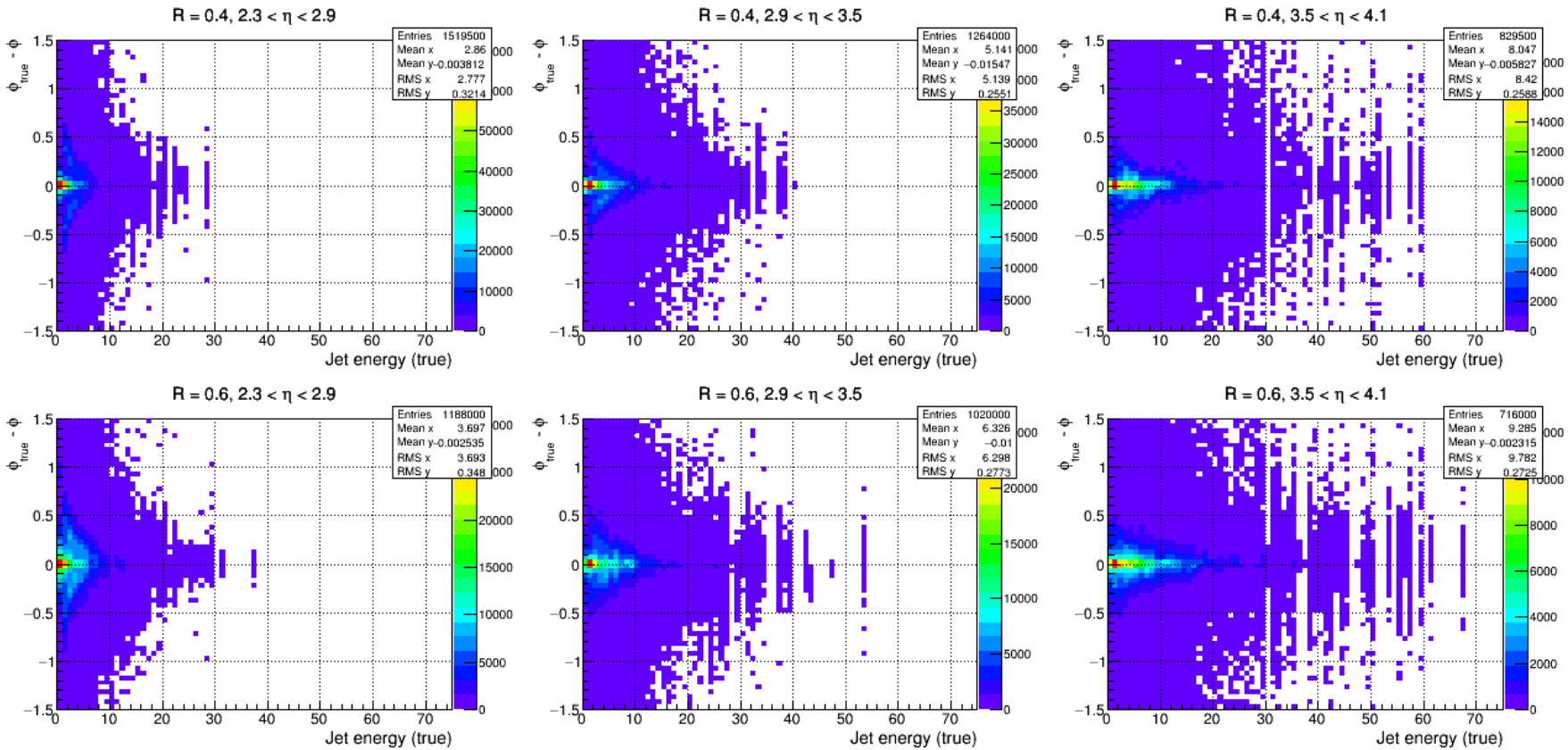
- Definitions
  - Energy resolution = (e_true – e_reco) / e_true
  - ϕ resolution = (ϕ_true – ϕ_reco)
  - η resolution = (η_true – η_reco)

- Cuts
  - True η windows: {2.3, 2.9, 3.5, 4.1}
  - True energy windows: {20, 22, 24, 26, 28, 30, 34, 38, 42, 46, 50, 60, 70, 100}

- Procedures
  1. Collected 1st and 2nd leading (highest/2nd highest true energy) jets for an event
  2. Separate jets by their true energy and true η
  3. Fill target parameters (ex. ϕ_true – ϕ_reco) into a TH1, get RMS value
  4. Draw RMS value vs. true energy for given η window

Sanity check

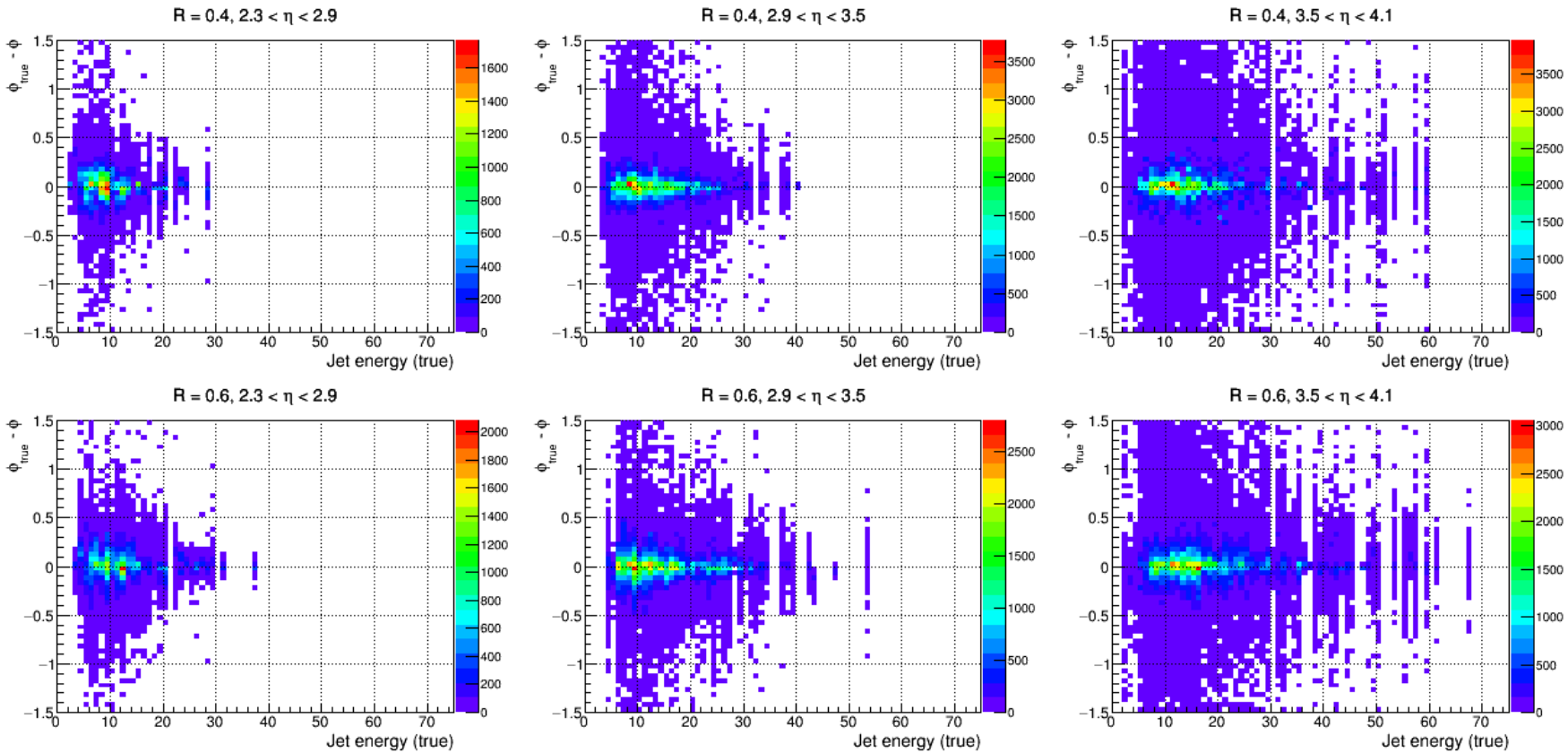
Δϕ vs. true jet energy, all jets



- All jets + η cut
- No true energy cut

Sanity check

Δϕ vs. true jet energy, leading jets

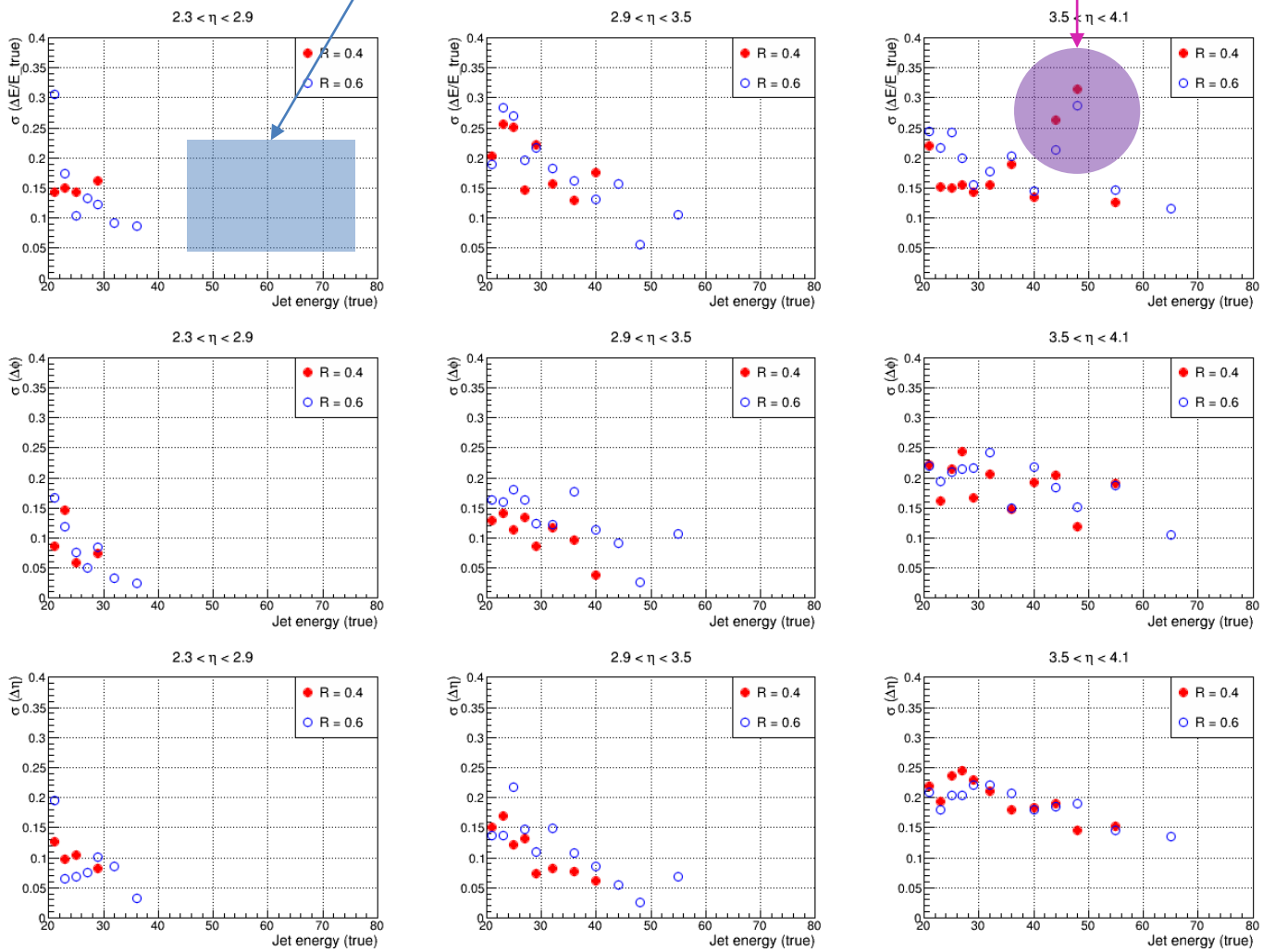


- 1st/2nd leading jets + η cut
- No true energy cut (but remember I apply true E > 20 GeV for resolution study)

Resolutions

Empty points: no entries in TH1

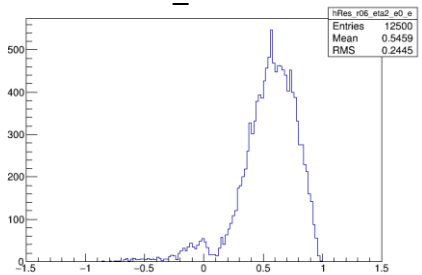
Outliers: next page



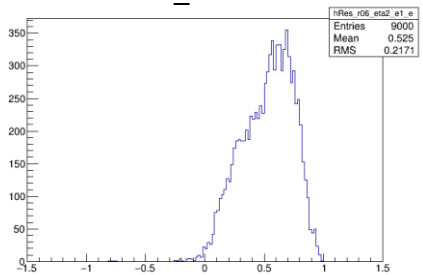
- This is in fact same to previous mini report result (all jets)
- It seems most of surviving jets after true jet E > 20 GeV are 1st/2nd leading jets

Outliers ΔE/E_true, R = 0.6, 3.5 < η < 4.1

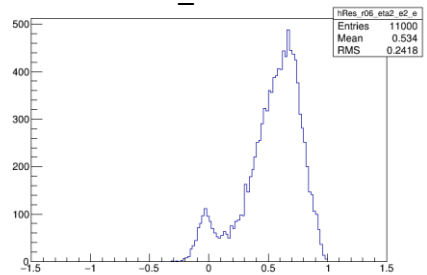
20 < e_true < 22



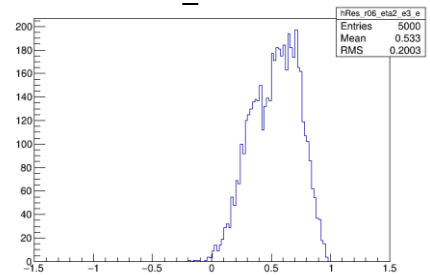
22 < e_true < 24



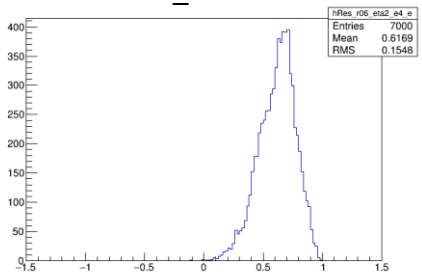
24 < e_true < 26



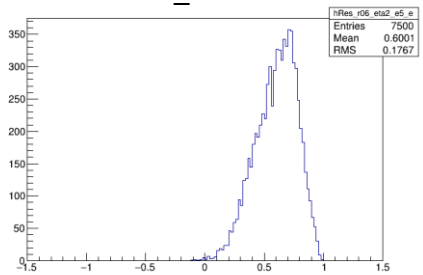
26 < e_true < 28



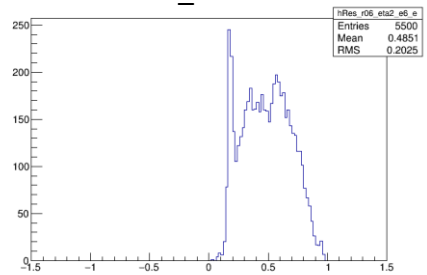
28 < e_true < 30



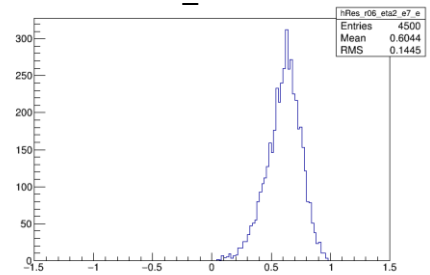
30 < e_true < 34



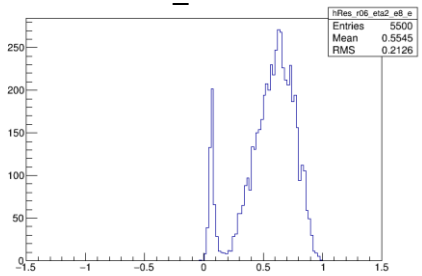
34 < e_true < 38



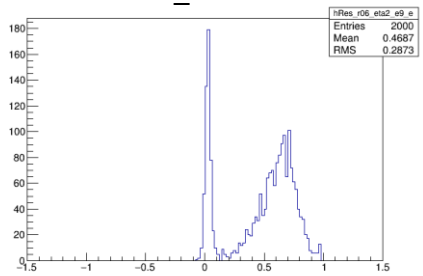
38 < e_true < 42



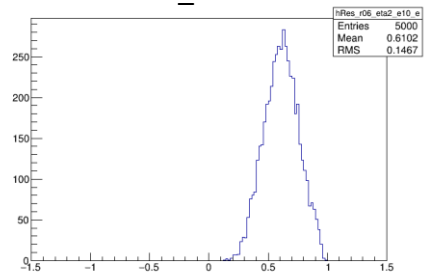
42 < e_true < 46



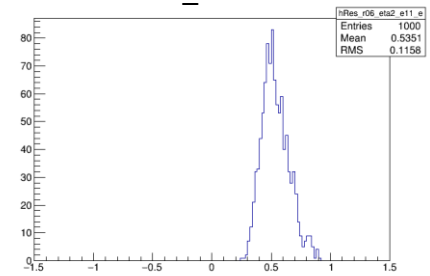
46 < e_true < 50



50 < e_true < 60



60 < e_true < 70



Summary and To do

- First evaluation
  - Rugged distribution: possibly induced from low statistics problem related to Pythia6
  - Different η coverage ($2.3 < \eta < 4.0$) from sPHENIX proposal
    → should I stick to same ($0.7 < \eta < 2.9$) rapidity?
  - I use RMS value (ex. RMS of η_true – η_reco) directly. Would Gaussian fit appropriate?
- Add Pythia6 interface similar to Pythia8
  - Pythia6 events I produced includes many negative rapidity events & low energy jets, which end up in lack of statistics in target region ($\eta > 2.3$, $E > 20$ GeV)
  - Necessity of Pythi6 interface similar to Pythia8's Gen/Jet trigger
    → would it be difficult "porting" the module for Pythi6?
- Near term plan
  - Add η/min jet p_T trigger to Pythia6, then repeat today's study with richer statistics
  - Compare Pythia8 under same condition

Backup Used macros/output tree

- Used macros
  - /macros/macros/g4simulations/Fun4All_G4_fsPHENIX.C

    → used pythia6

    → used cfg with ckin 50 and produced 0.5 M events (cfg in next backup page)
  - /macros/macros/g4simulations/G4_FwdJets.C

    → used r = 0.4 and r = 0.6 to compare with Figure A.2 of sPHENIX proposal (in backup)

- Used output
  - g4fwdjet_eval.root by JetEvaluator
  - Used ntp_truthjet (ntuple for truth particle level jets)

Backup pythia6 cfg

```
roots   200
proj    p
targ    p
frame   cms

pytune  100     // tune A
msel 0 // turn on all prod. mechanisms manually
msub 10 1
msub 11 1 // QCD jets
msub 12 1
msub 13 1
msub 28 1
msub 53 1
msub 68 1
msub 83 1

ckin    3  50  // min parton pt
```

Backup Reference (sPHENIX proposal)

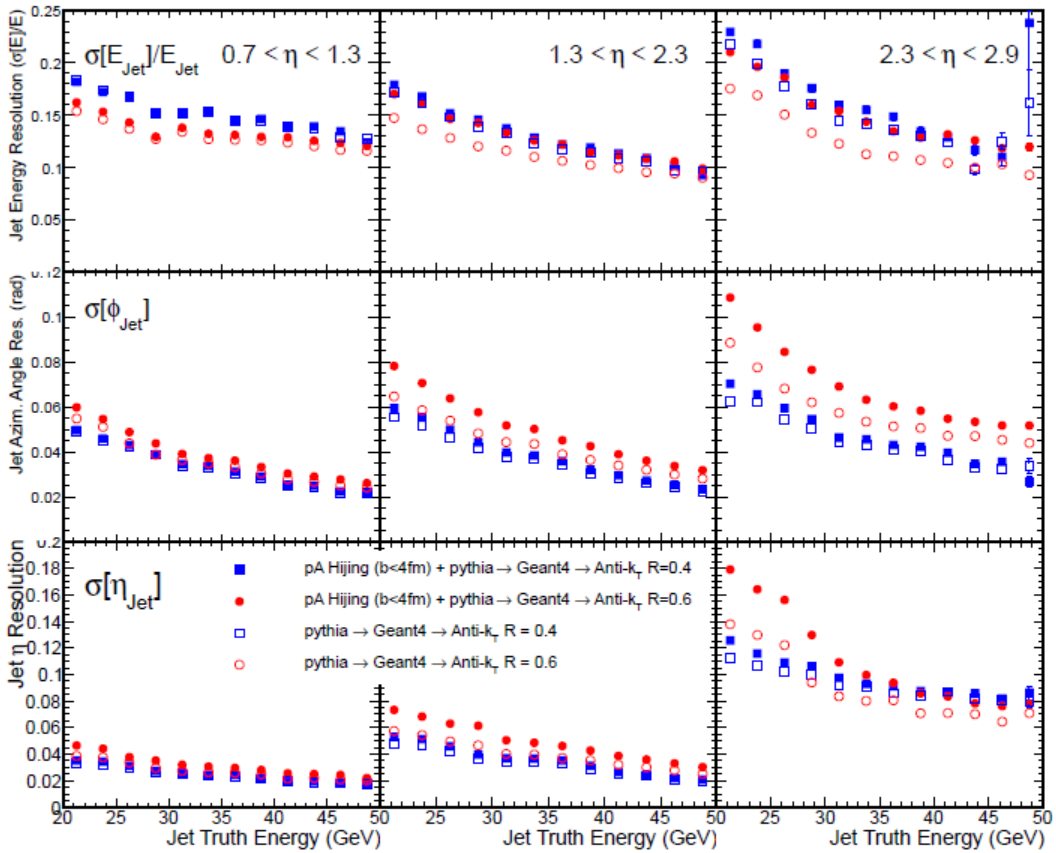
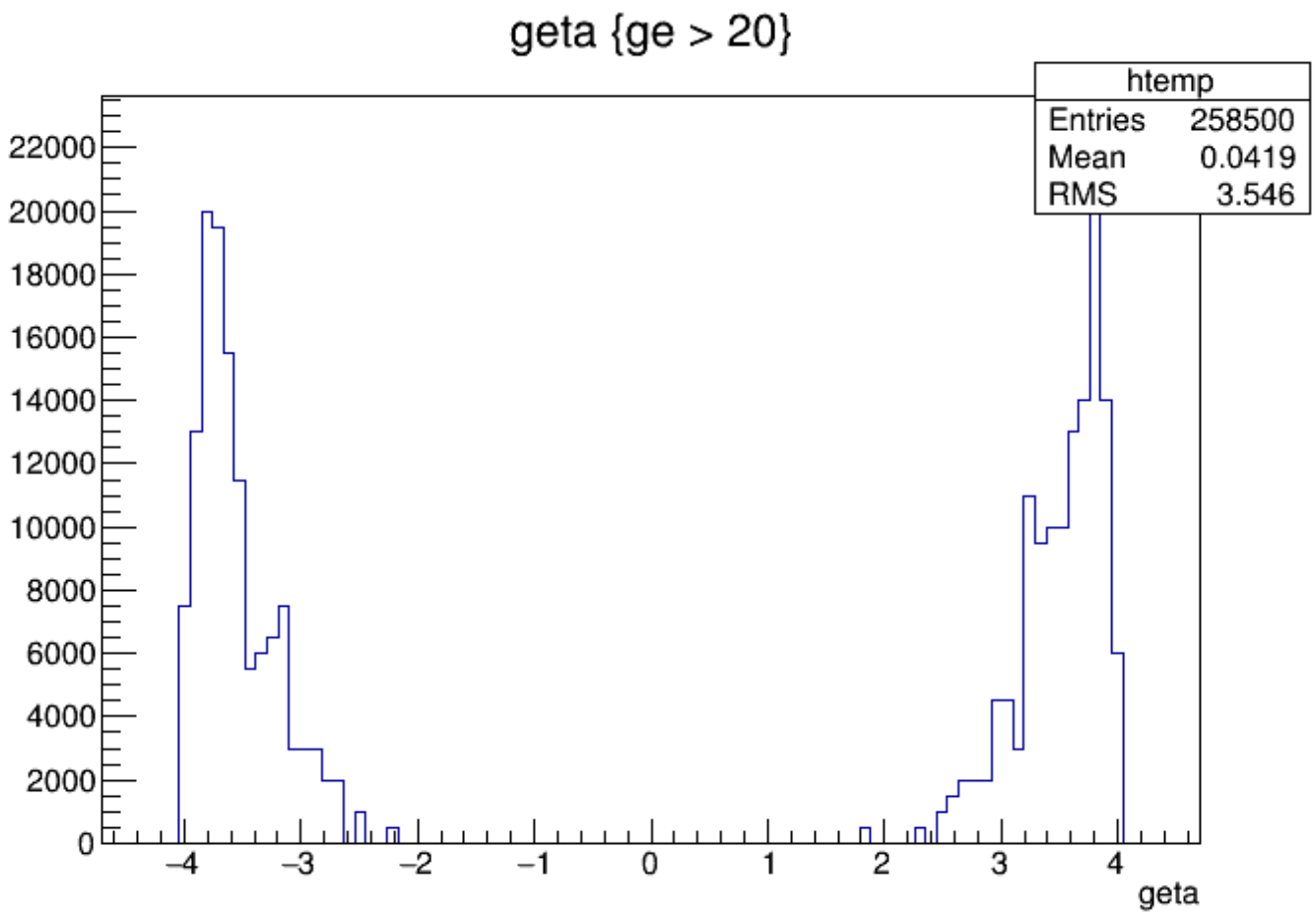
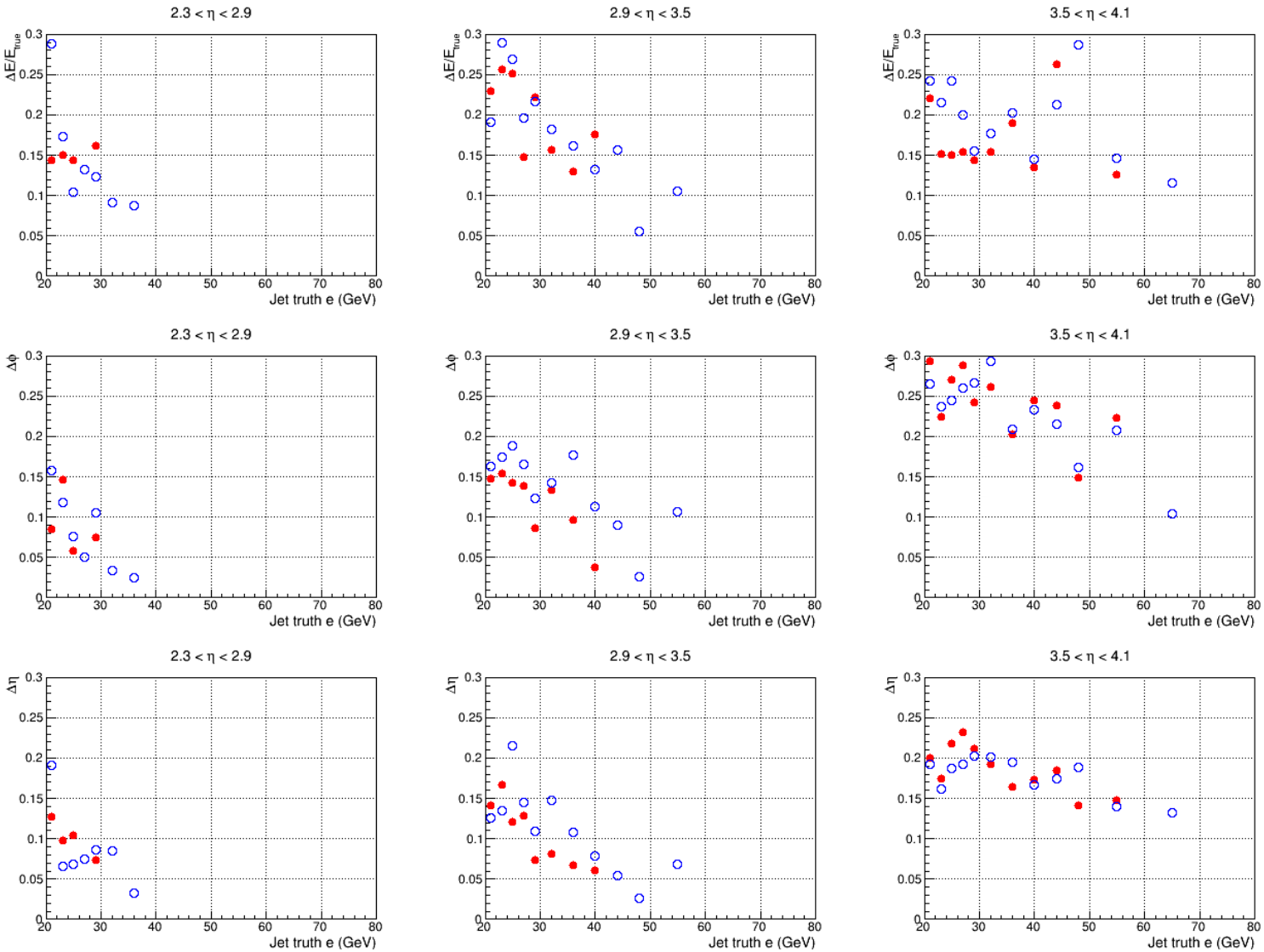


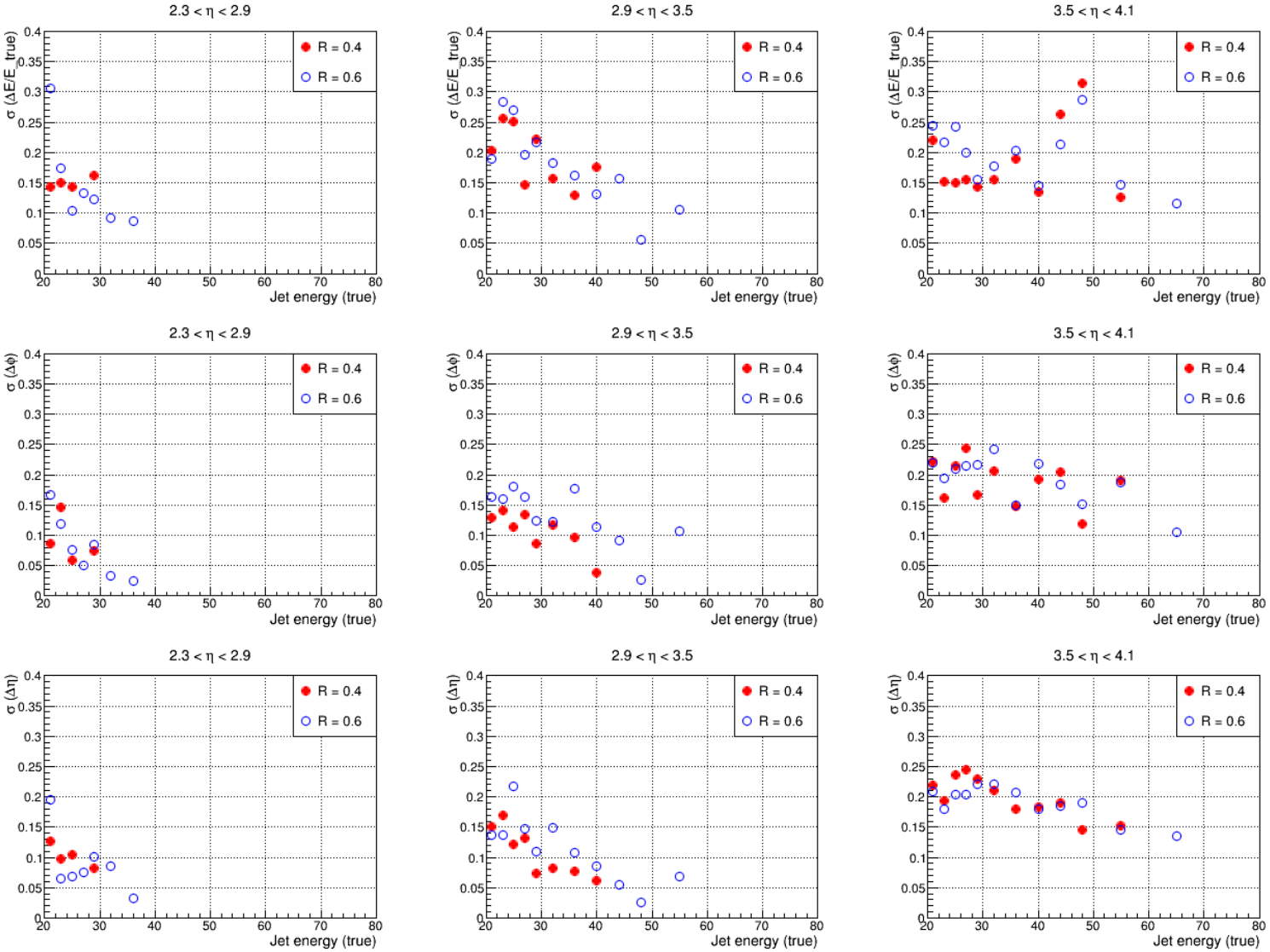
Figure A.2: The GEANT4 simulated jet resolution of single jets for energy (top row), ϕ (middle row) and η (bottom row) in $p+p$ (open markers) and $p+A$ (closed markers) collisions reconstructed with the FASTJET anti-k_T algorithm with $R = 0.4$ (blue) and $R = 0.6$ (red).

Backup η distribution of all events above E_true > 20



Backup Previous resolution results (all jets)



- r = 0.4
- r = 0.6

Backup Current resolution results (1st/2nd leading jets)