# Status on $e^+e^-$ -> γZ process
# Jet Energy Calibration

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# Recent Progress

**1. Method 3 resolution θ, φ and E dependence**

**1.1. RMS90 of the relative difference of the reconstructed jet energy**

**1.2. FWHM of the relative difference of the reconstructed jet energy with an error**

**2. Consideration of a realistic cut to exclude wrong photon selection events**

# Analysis Conditions

**1. Correct photon selection cut:**

**For the all plots below (in section 1.), MC level cut "abs(photonthetaAnl-photonthetaMC)<0.01" is imposed.**

**2. Determination the value of the RMS90**

**① Find the bin with the highest entries "bin[i]"**

**I could not use the bin which includes the mean value of the x-axis "bin[k] = mean"**

**because mean value is largely shifted due to the overlay (Next Page)**

**② Add bins next to the center bin symmetrically "bin[i+1]" and "bin[i-1]"**

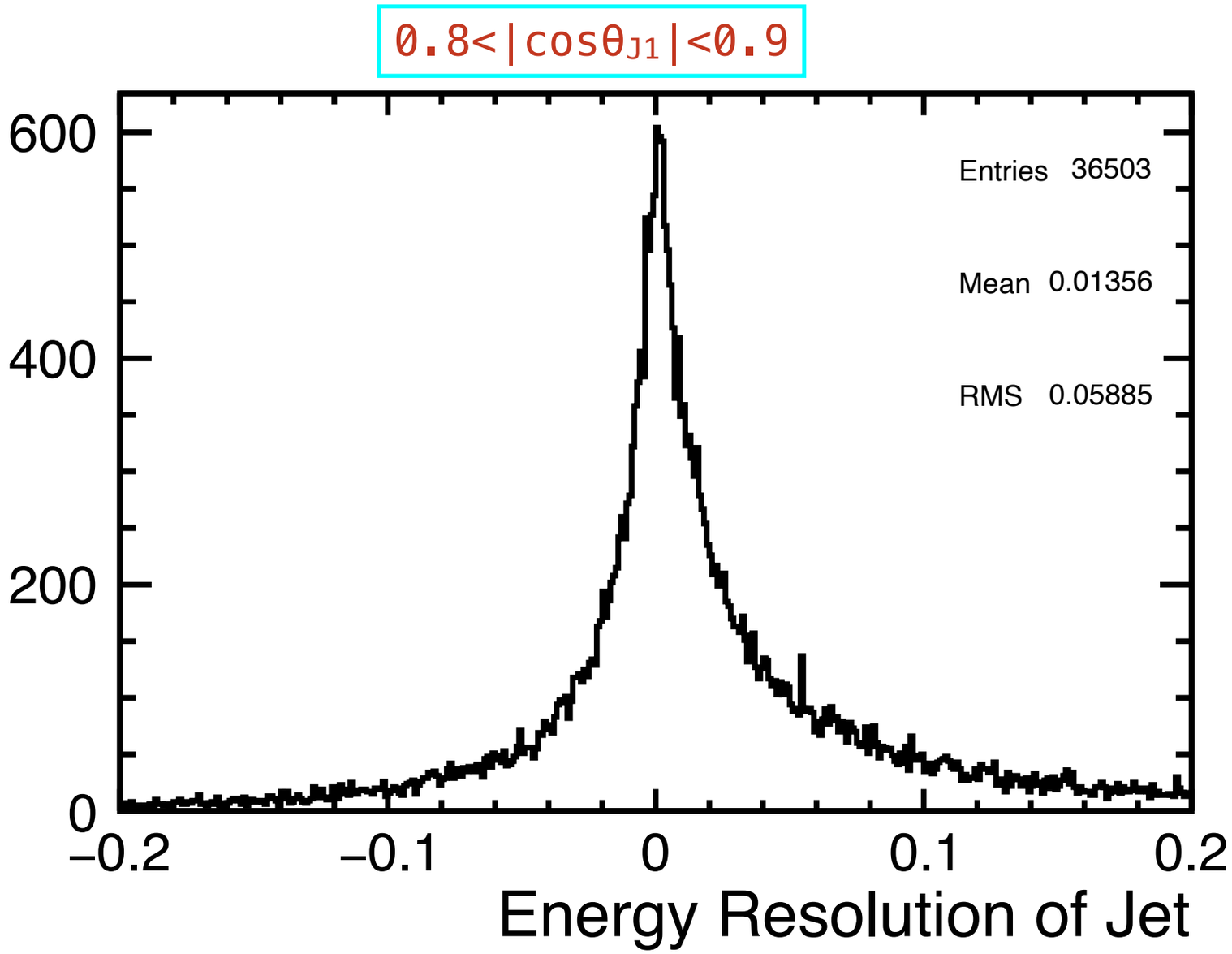
**③ Add bins next to the end bins symmetrically "bin[i+2]" and "bin[i-2]"**

**:**

**ⓝ Continue until the total number of events gets more than the 90% of the total events (-∞ to ∞) and calculate RMS**

# Analysis Conditions

**Could not use the bin with the mean value of the x-axis**
**"bin[k] = mean"**
**because mean value is largely shifted due to the overlay**




**Mean value with all events = 0.240**

**(Center value of) the bin with the highest entries = 0.001**

# Analysis Conditions

**3. Estimation of the error of FWHM**

**(error) =sqrt((error1)²+(error2)²)**

**※error is estimated asymmetrically**

**(error1)=(FWHM)'-(FWHM)**

**(FWHM)' is the FWHM when the highest bin height is changed like**

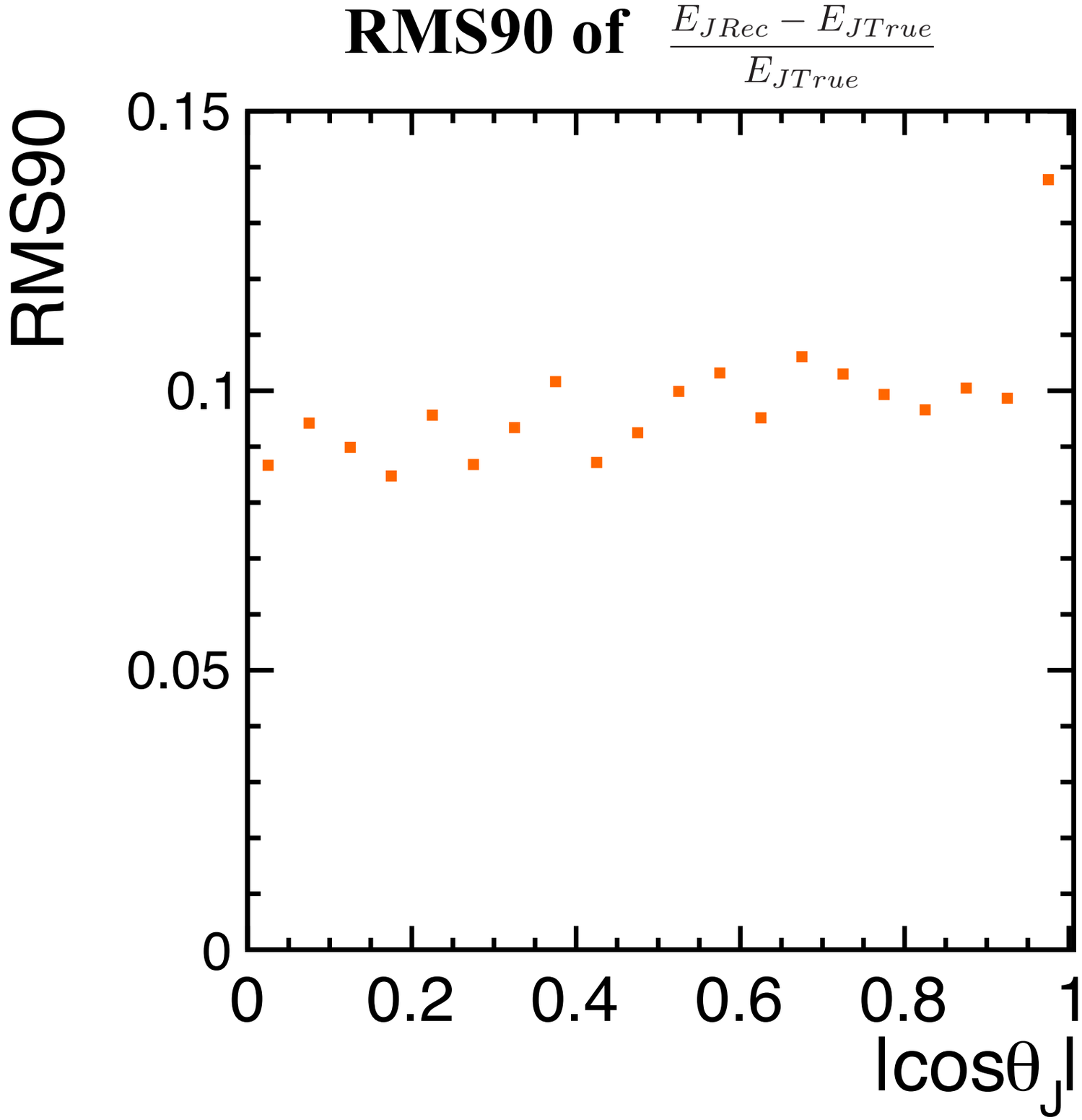
**(lower error): from (the true peak height) + sqrt(the true peak height)**

**and**

**(upper error): from (the true peak height) - sqrt(the true peak height)**

**(error2)=(bin width)/sqrt(12.)**

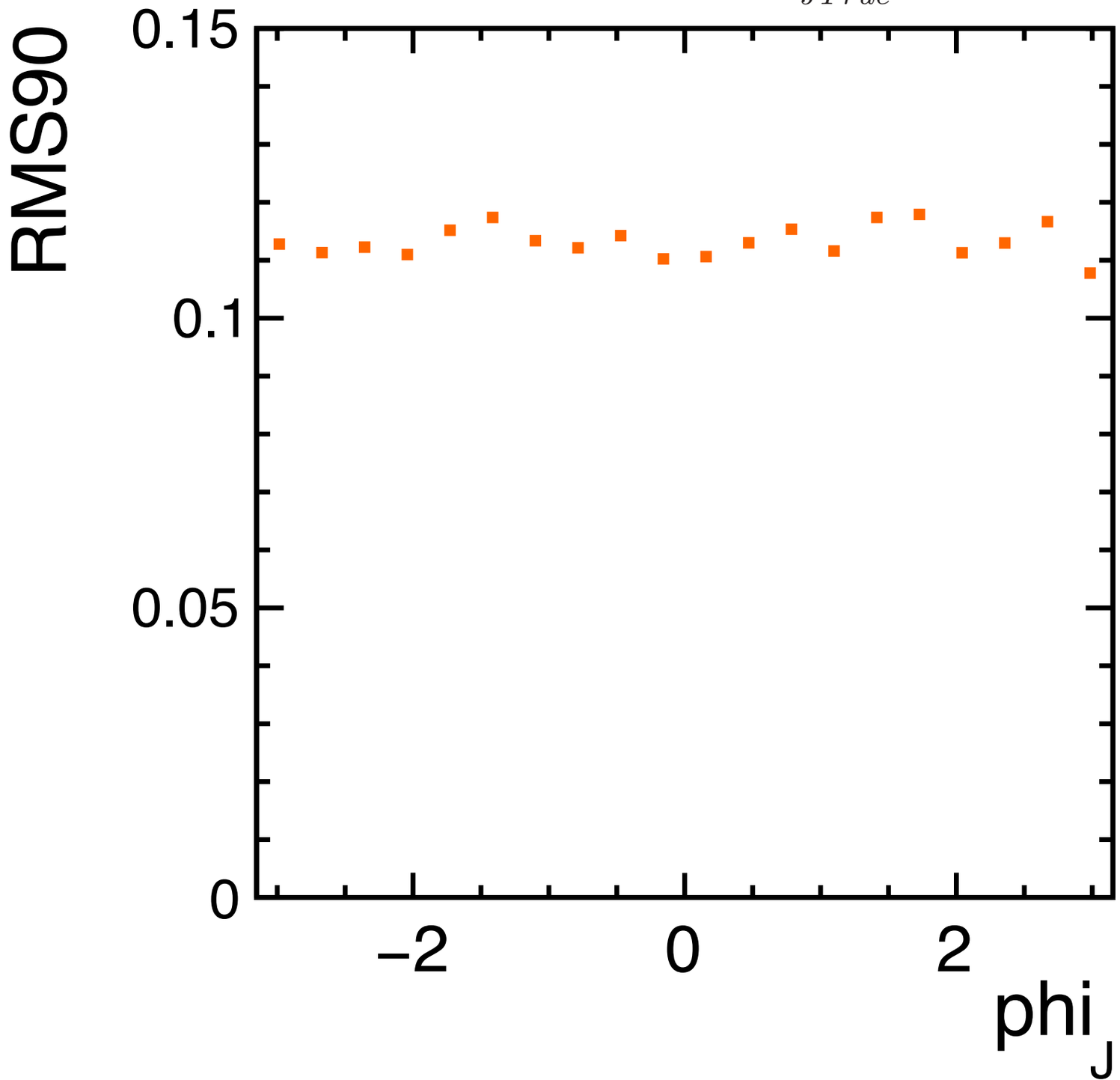
# 1.1. Method 3 Jet 1 energy resolution θ dependence




- We can see θ dependence.
- Forward JER is worse.

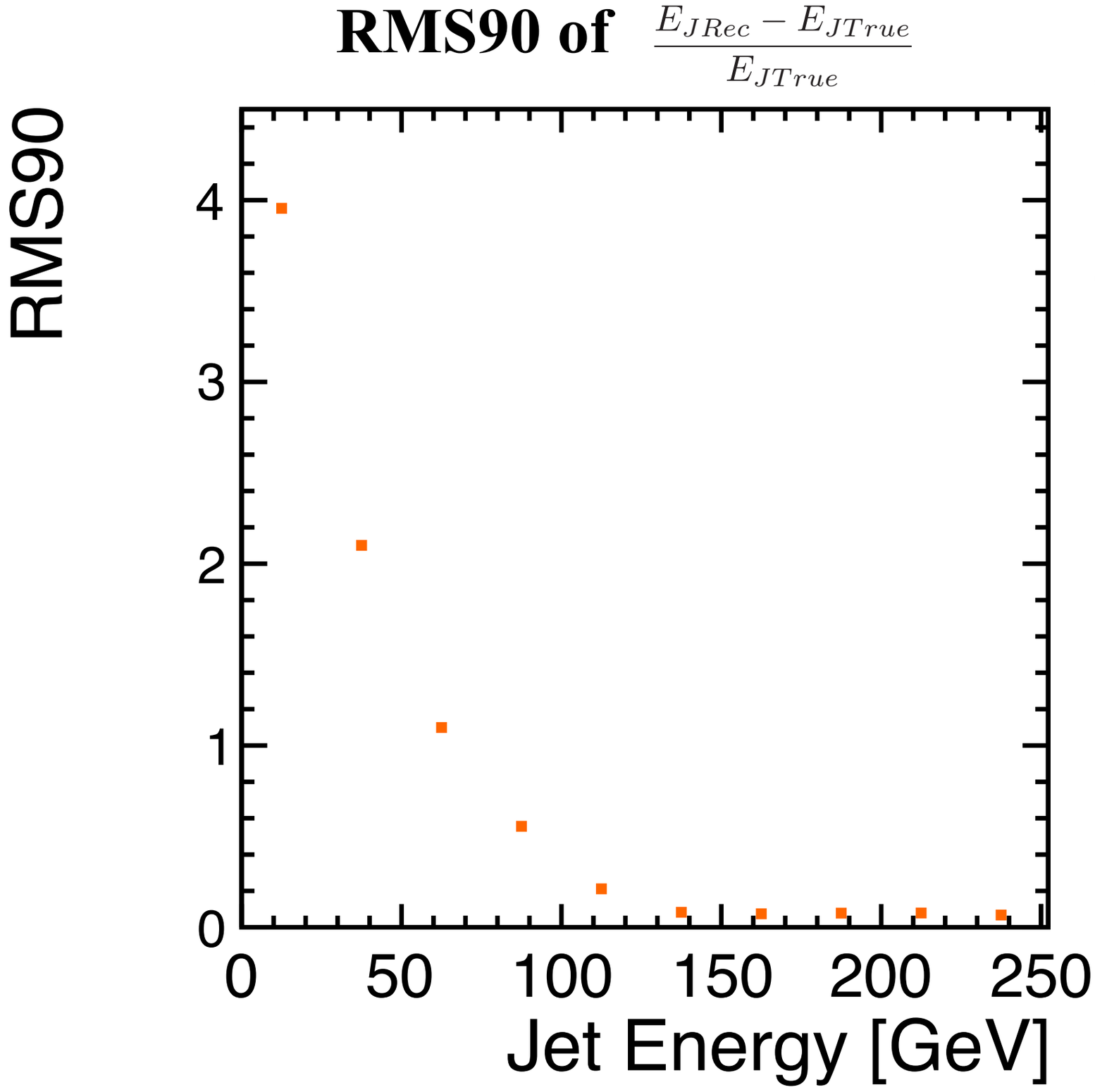
# 1.1. Method 3 Jet 1 energy resolution φ dependence

**RMS90 of** $\frac{E_{JRec} - E_{JTrue}}{E_{JTrue}}$



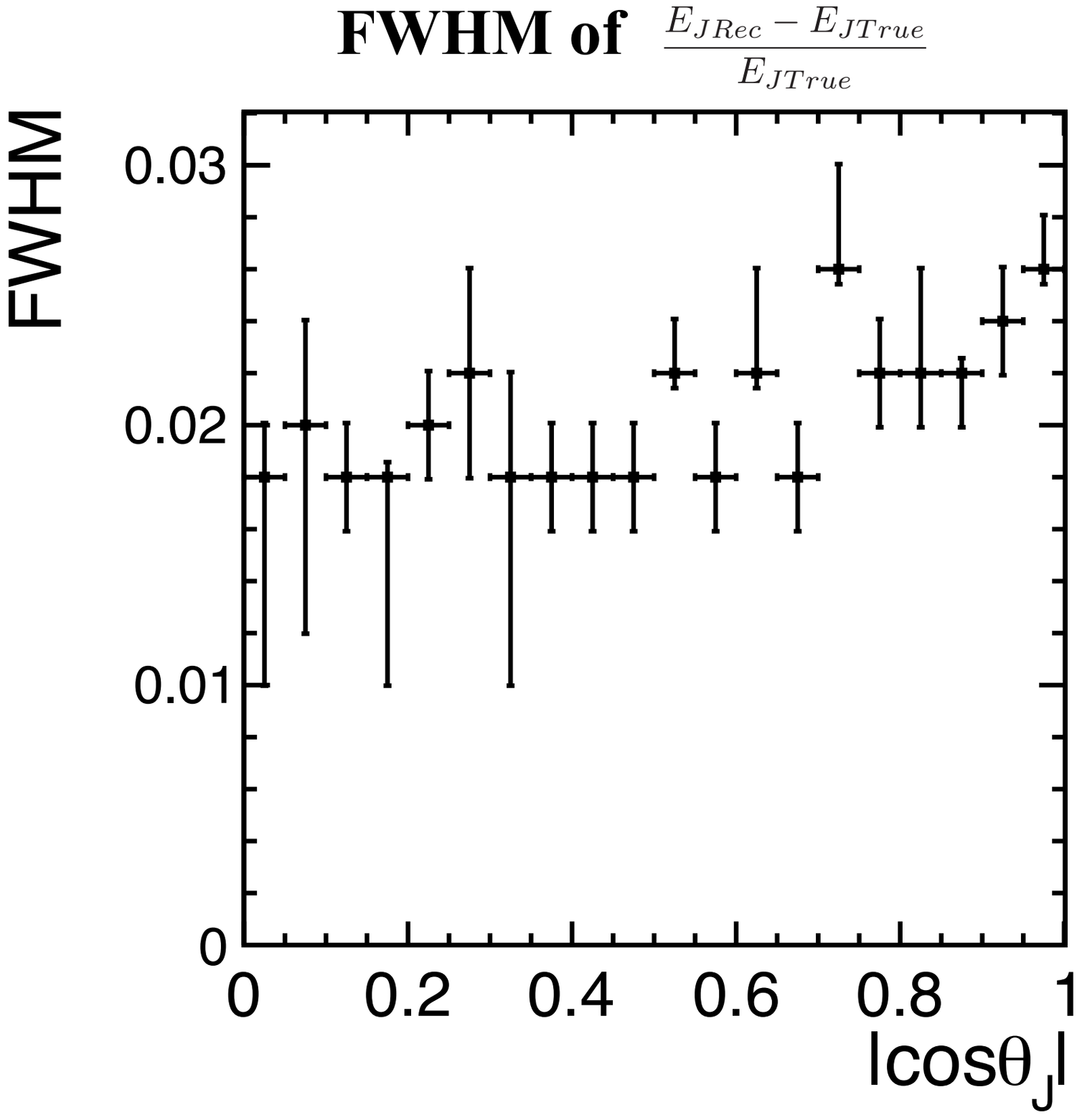

- **We can see no φ dependence.**

# 1.1. Method 3 Jet 1 energy resolution E dependence




- We can see clear jet energy dependence.
- For the lower energy jets, JER is worse.

# 1.2. Method 3 Jet 1 energy resolution θ dependence

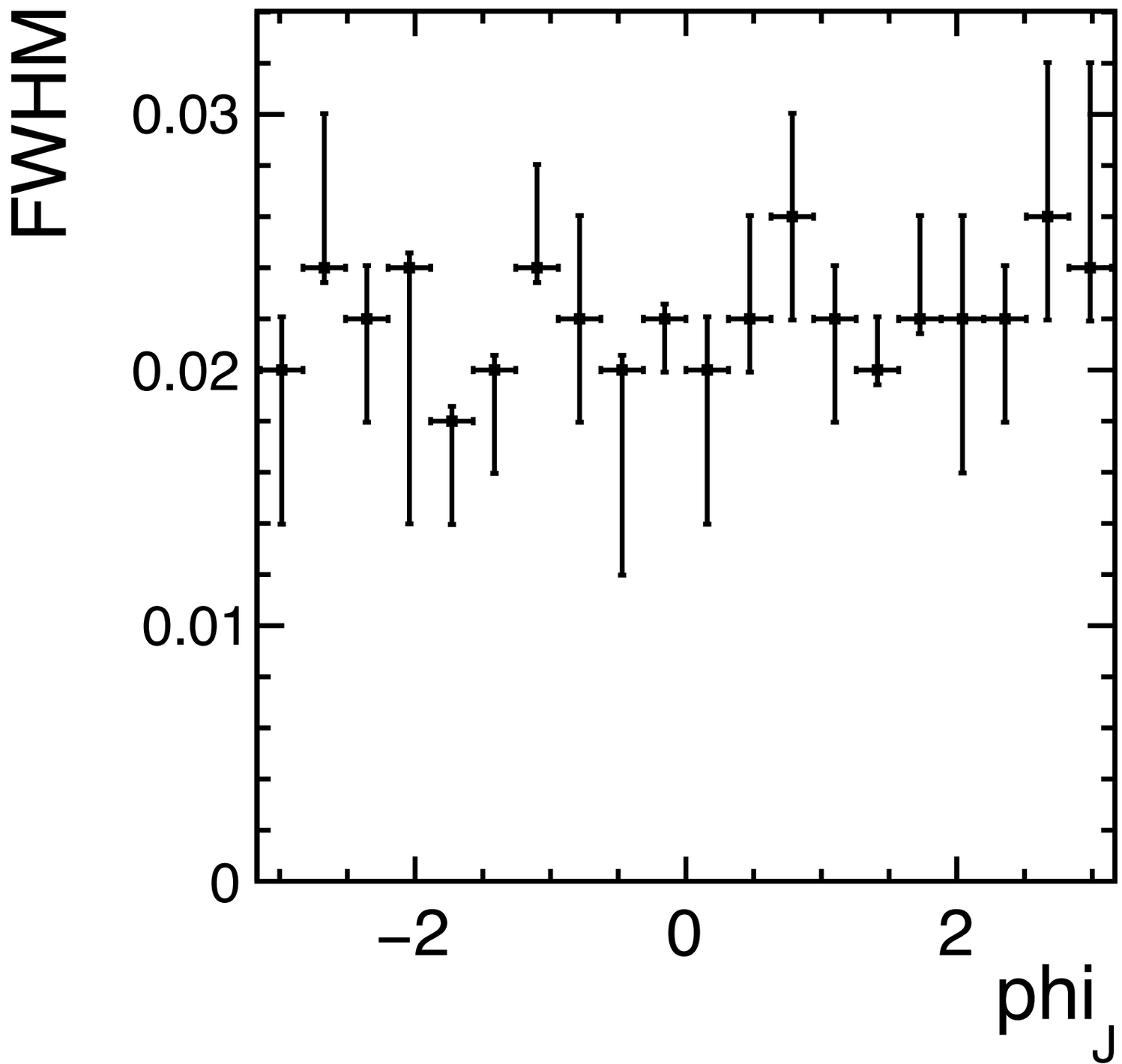



- We can see θ dependence.
- Forward JER is worse.

# 1.2. Method 3 Jet 1 energy resolution φ dependence

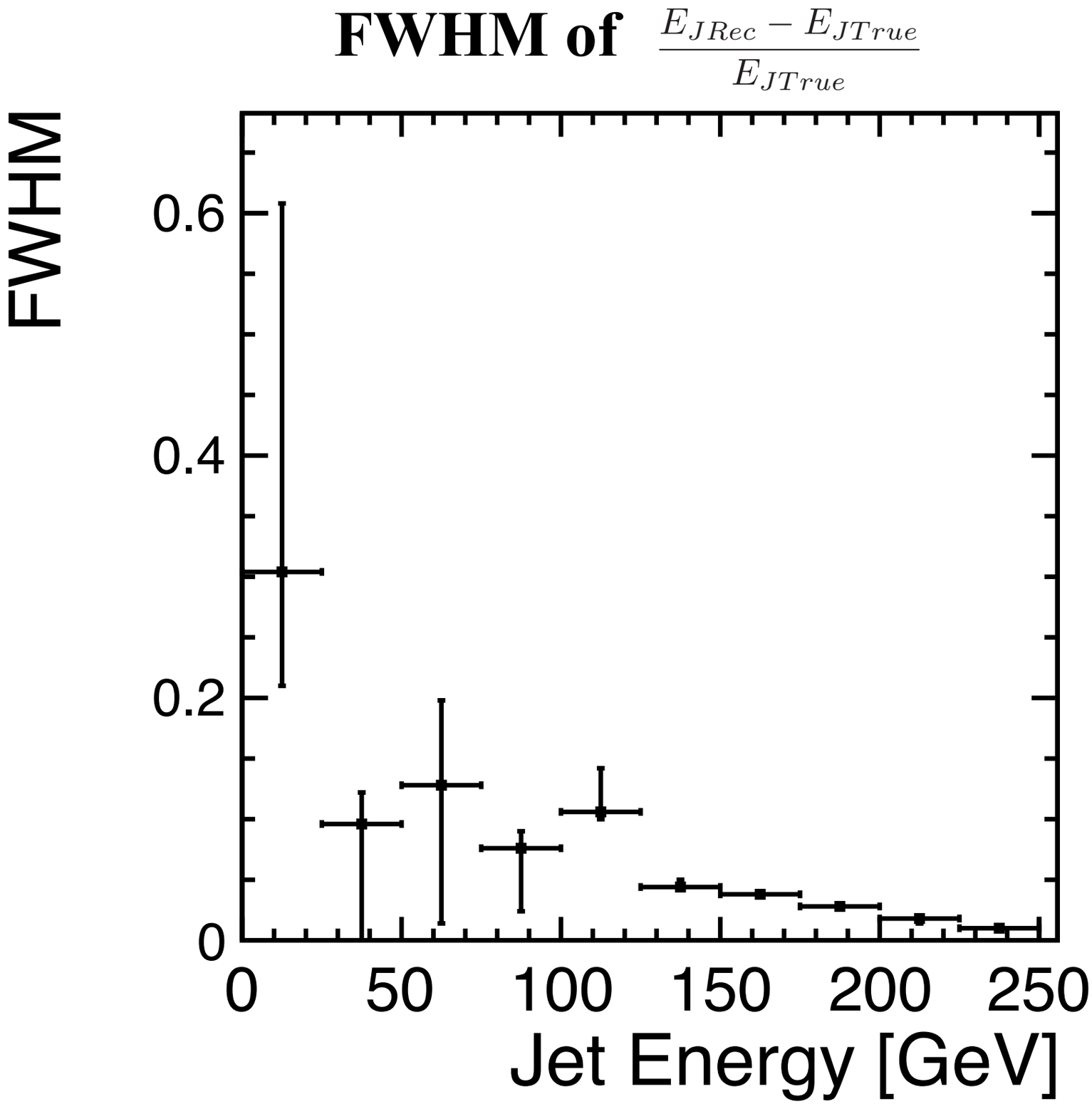


**FWHM of** $\frac{E_{JRec} - E_{JTrue}}{E_{JTrue}}$




- **We can see no φ dependence.**

# 1.2. Method 3 Jet 1 energy resolution E dependence




- We can see clear jet energy dependence.
- For the lower energy jets, JER is worse.

# Conclusion

**Method 3 resolution has slight θ dependence, no φ dependence and clear E dependence.**

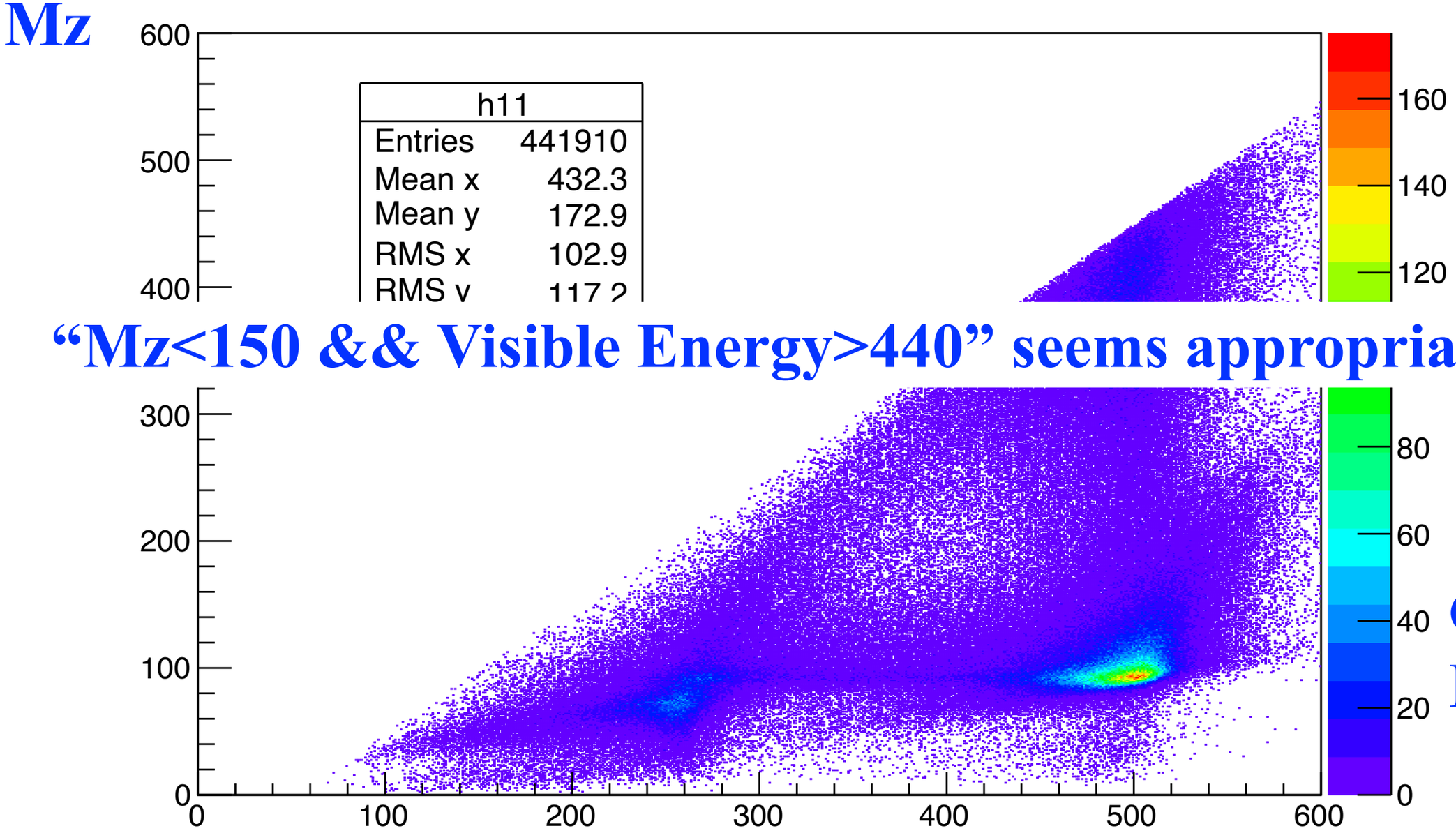
**JER is worse in the very forward region $|\cos\theta| > 0.95$.**

**For the lower energy jets below 125 GeV, JER gets worse drastically.**

# 2. Realistic cut to exclude wrong photon selection events

## Mz vs. Visible Energy (=Ej1+Ej2+Eγ)

mz:j1EAnl+j2EAnl+photonEAnl

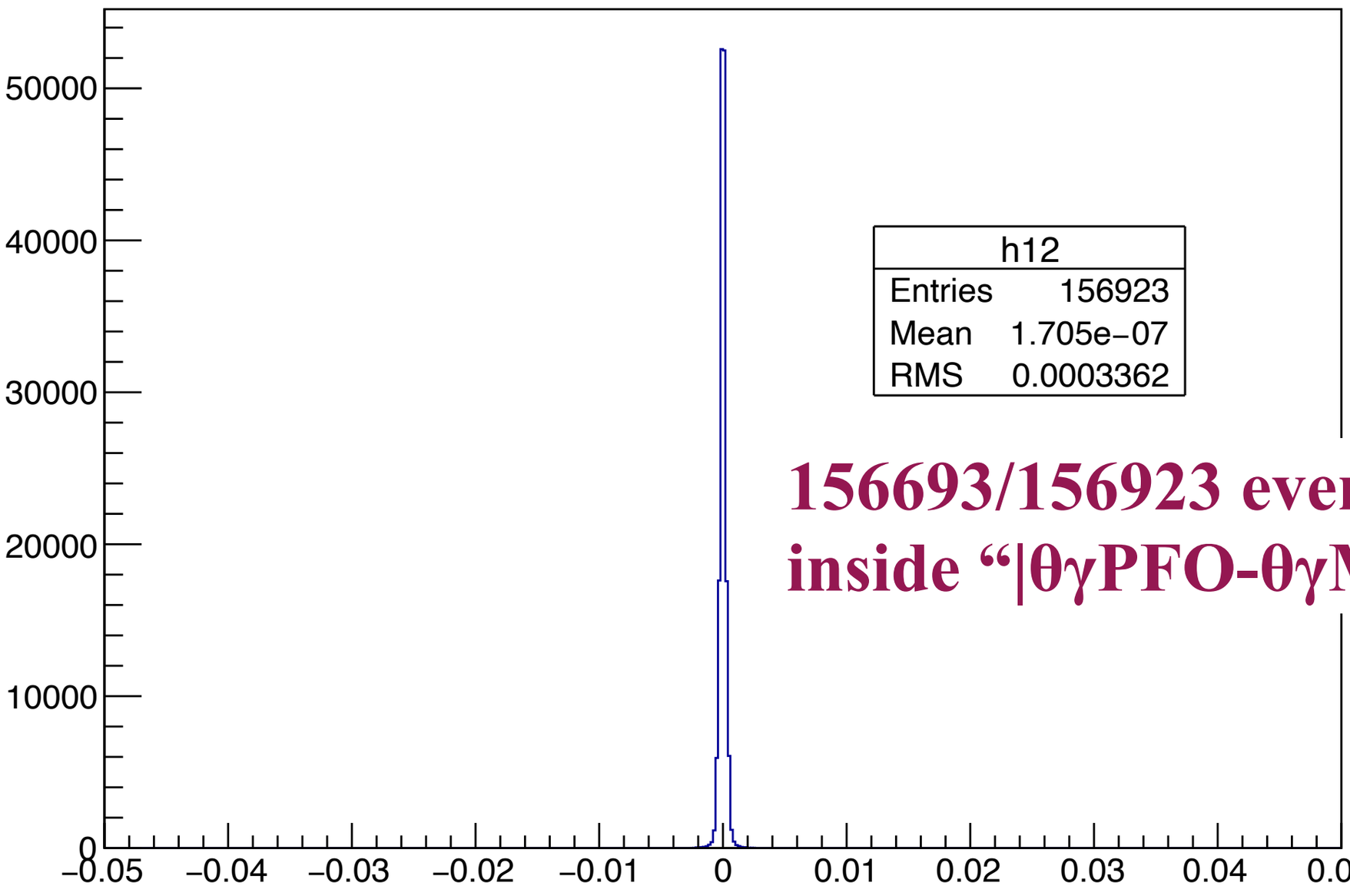



**“Mz<150 && Visible Energy>440” seems appropriate.**

# 2. Realistic cut

## “Mz<150 && Visible Energy>440” worked well.

## θ difference (rad)




**156693/156923 events are inside “|θγPFO-θγMC| <0.01”**

# 2. Realistic cut

**The cut conditions are changed slightly and the numbers of events outside "|θγPFO-θγMC| >0.01" are compared.**

**"Mz<150 && Visible Energy>440" : 230/156923**

**The number of events**

**Cut** **outside "|θγPFO-θγMC| >0.01"**

| Visible Energy/Mz | 150 | 160 | 170 | 180 |
|---|---|---|---|---|
| 440 | 230/156923 | 328/164163 | 434/170207 | 584/175124 |
| 430 | 246/162767 | 350/170175 | 460/176336 | 617/180724 |
| 420 | 259/167490 | 371/175018 | 487/181291 | 648/186377 |

# 2. Realistic cut

**The influence of Mz seems larger.**
**I should check wider region and decide the cut conditions.**

**The number of events**

**Cut** **outside “|θγPFO-θγMC| >0.01”**

| Visible Energy/Mz | 150 | 160 | 170 | 180 |
|---|---|---|---|---|
| 440 | 230/156923 | 328/164163 | 434/170207 | 584/175124 |
| 430 | 246/162767 | 350/170175 | 460/176336 | 617/180724 |
| 420 | 259/167490 | 371/175018 | 487/181291 | 648/186377 |


# Thank you for your attention!