JES using Z(→e⁺e⁻) + jet events

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Fermilab

using full 35 pb^{-1} data

JEC meeting
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Data sample and trigger

	Run-range	Data sample	Trigger path
Run 2010 A	132440−137028	/EG/Run2010A-Sep17ReReco_v2/RECO	HLT_Photon10_L1R
	138564−140401	„	HLT_Photon15_Cleaned_L1R
	141956−144114	„	HLT_Ele15_SW_CaloEleId_L1R
Run 2010 B	146428−147116	/Electron/Run2010B-PromptReco-v2/RECO	HLT_Ele17_SW_CaloEleId_L1R
	147196−148058	„	HLT_Ele17_SW_TightEleId_L1R
	148819−149064	„	HLT_Ele17_SW_TighterEleIdIsol_L1R_v2
	149181−149442	„	HLT_Ele17_SW_TighterEleIdIsol_L1R_v3

- These are the lowest p_T unprescaled single electron triggers
- Used release for analysis:
  CMSSW_3_8_5_patch3
- JSON file:
  Cert_132440-149442_7TeV_StreamExpress_Collisions10_JSON_v2.txt

Z+jet p_T–balance

Event selection:

- Jet in the control region: $|\eta| < 1.3$
- Use standard Z ($\rightarrow e^+e^-$) reconstruction
- Select clean Z+1 jet event events
  - require $(\Delta\phi - \pi) < 0.2$,
  - extrapolate $p_T^{2nd} / p_T^{Z} \rightarrow 0$

Jet:

- ak5 Calo, PF, JPT jets
- require loose/minimal jet Id

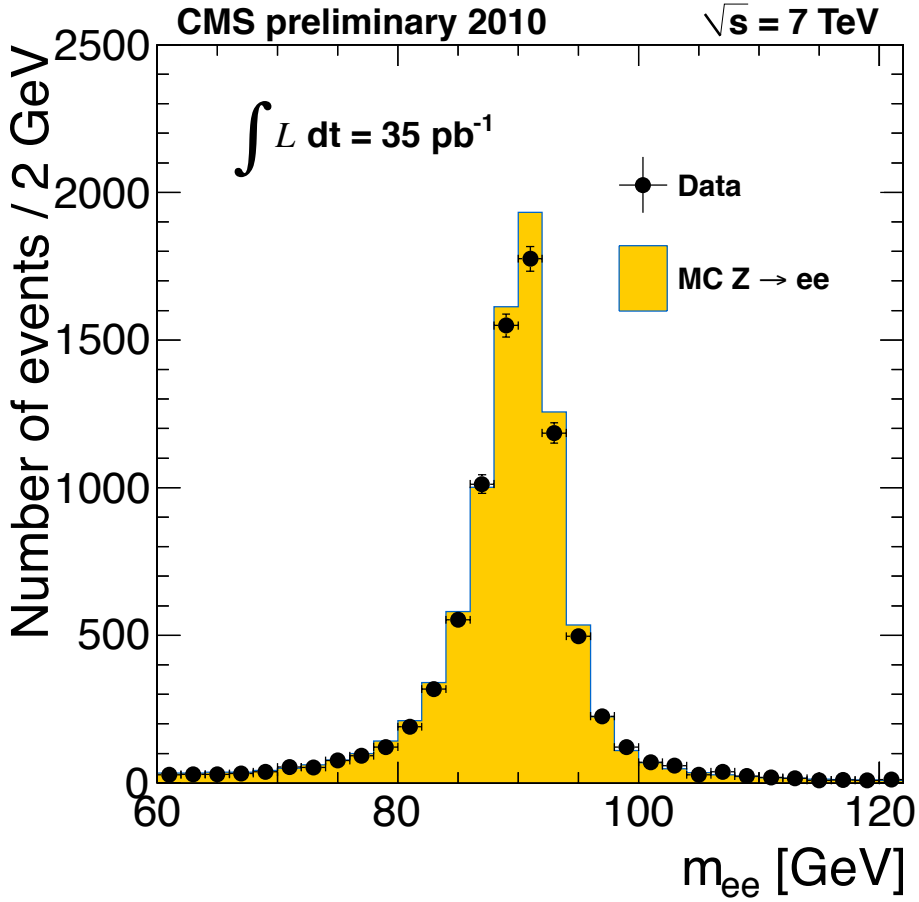
Z:

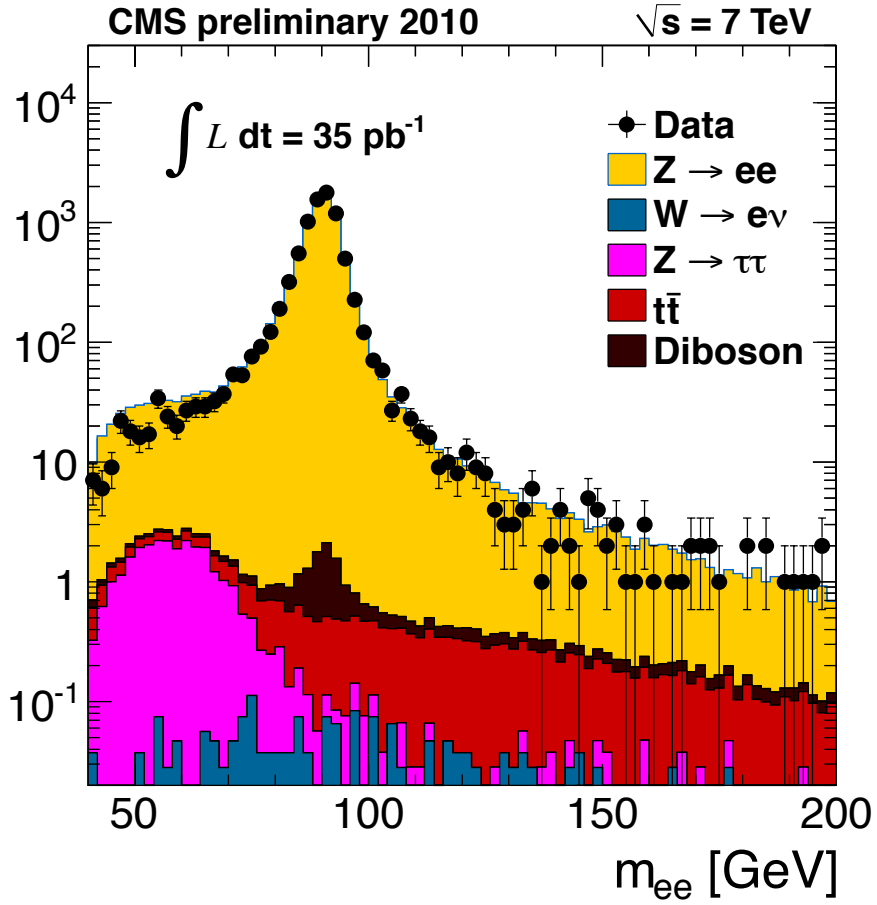
- $60 < M_{ee} < 120$ GeV
- Signal purity about 98%
- Electrons
  - $E_T > 20$ GeV, within ECAL fiducial acceptance
  - "Loose" electron Id (VBTF - WP95)

Because of an unannounced long computing outage at Fermilab I cannot access PF & JPT jet results at the moment, therefore I will show only Calo jet results today.

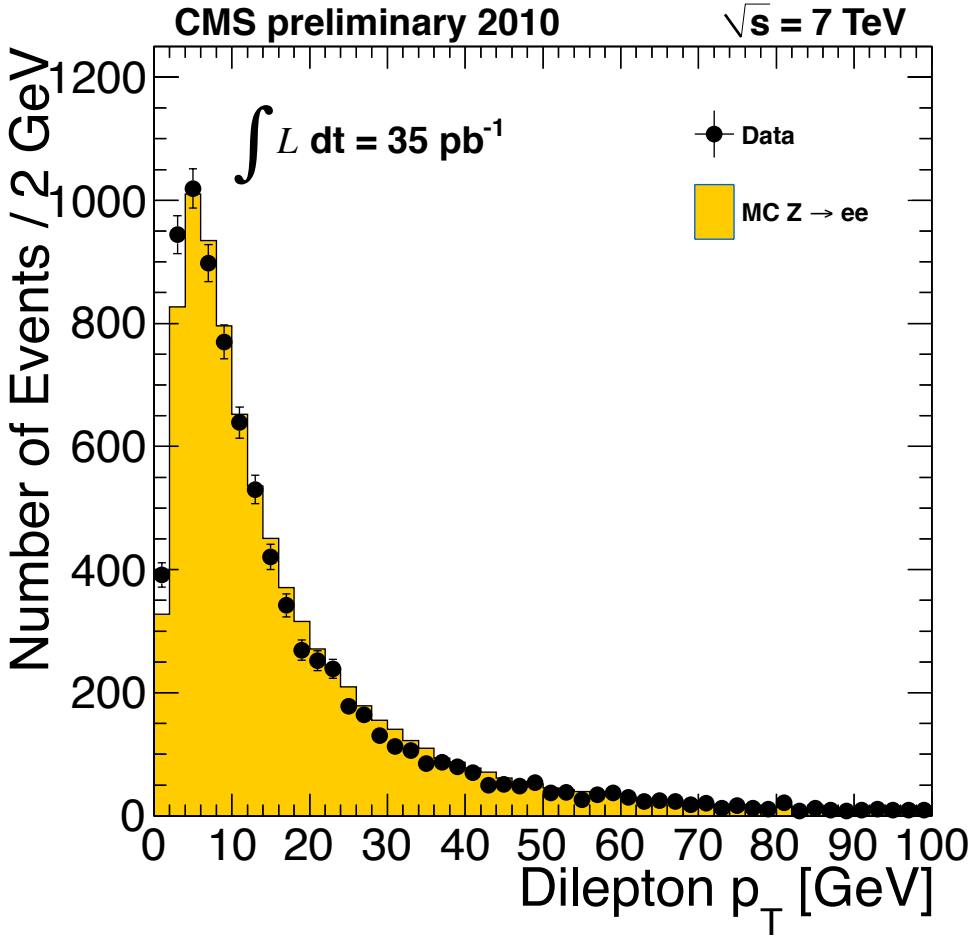
Have ~10k Zee events using 35 pb^{-1} 2010 data

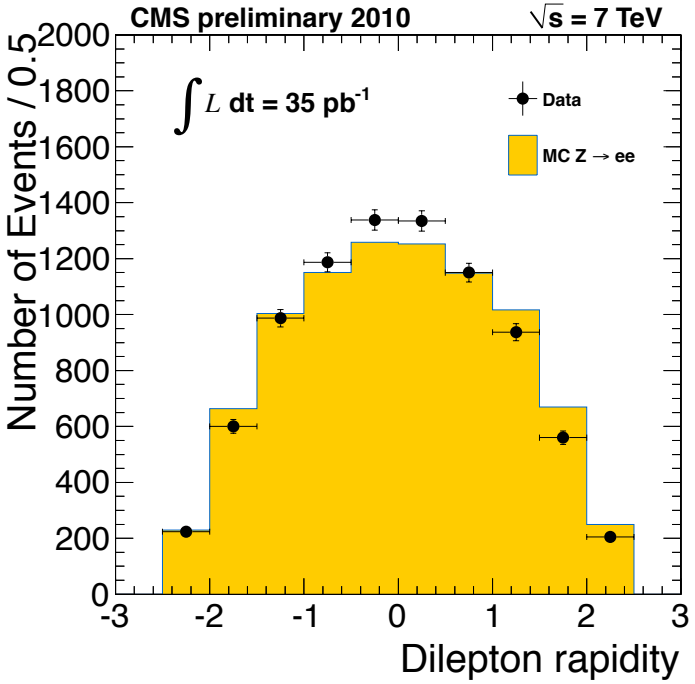
- Good quality data, understood kinematic distributions
- Excellent source of calibration for jet, MET, and luminosity

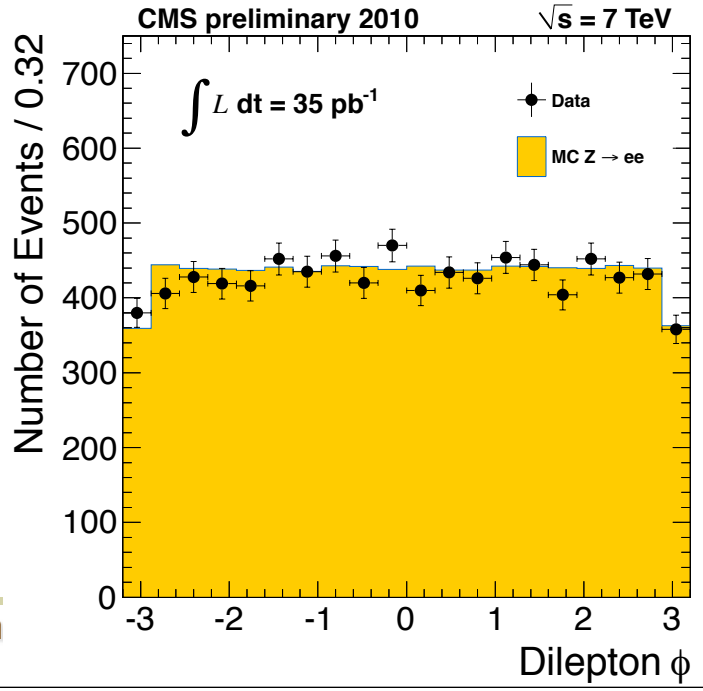




Z p_T, rapidity, azimuth

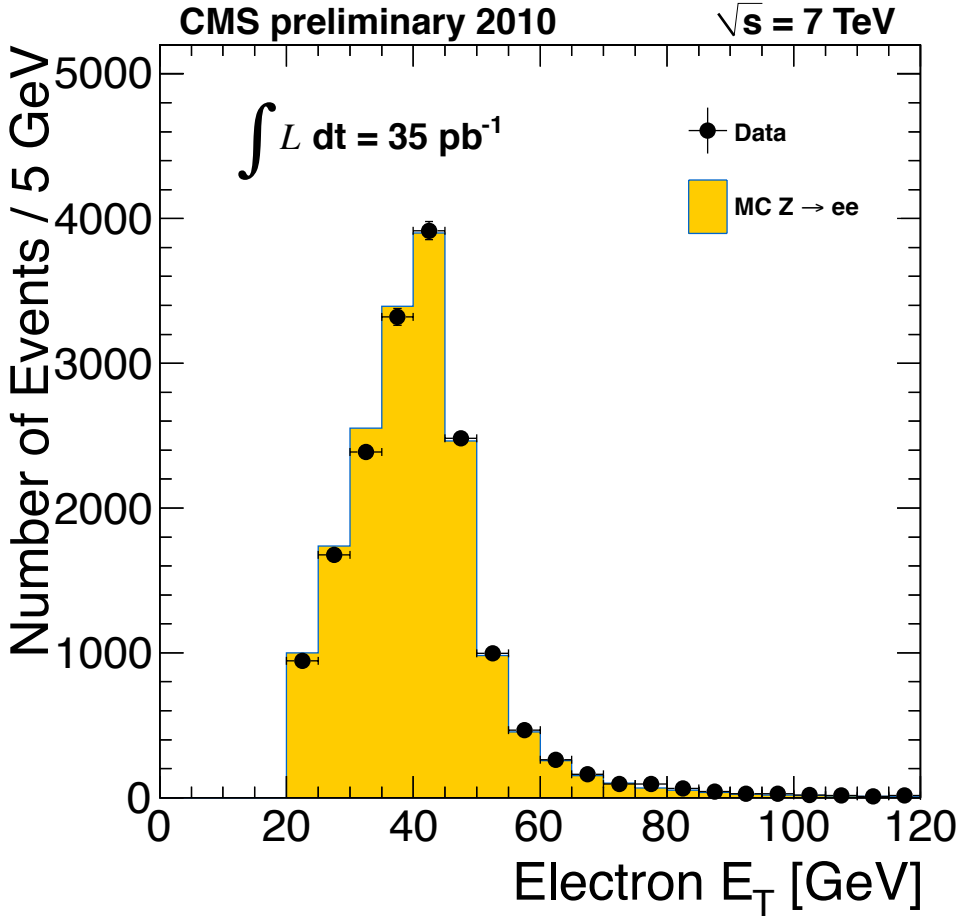


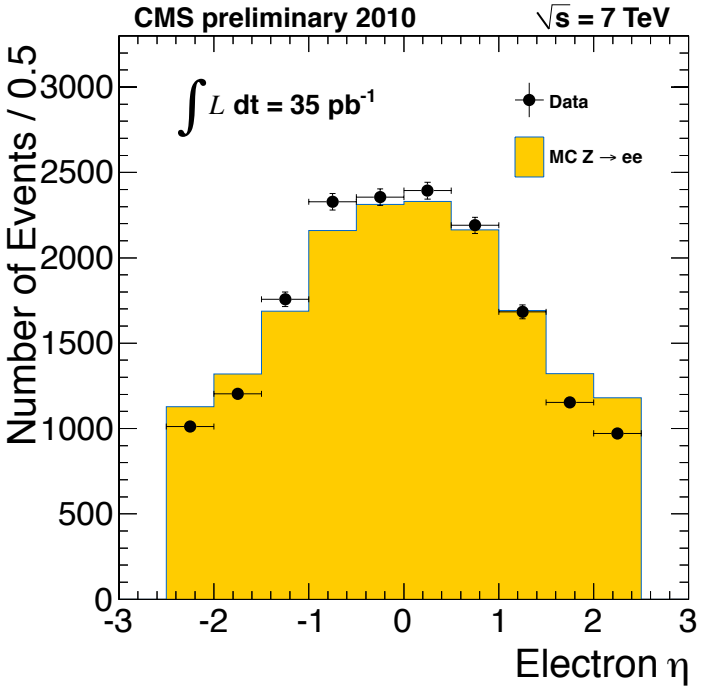


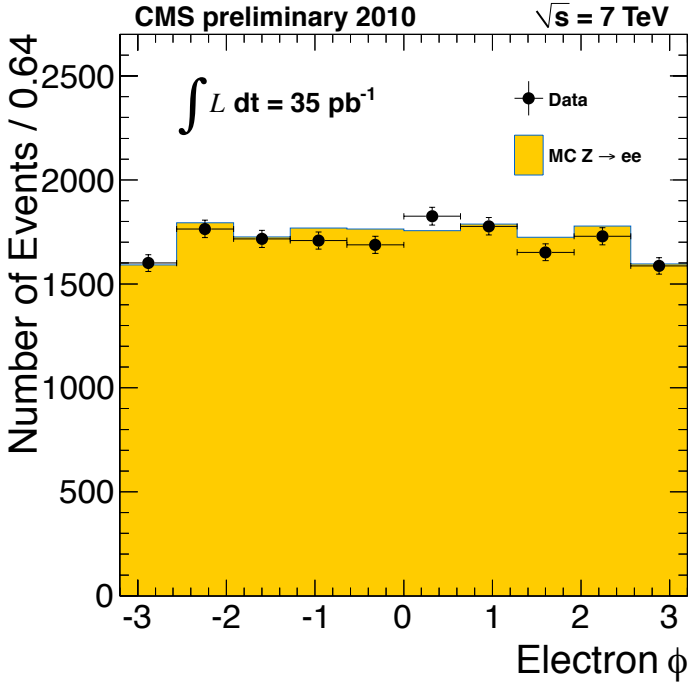


✦Distributions are in agreement with NLO predictions.

Electron P_T, rapidity, azimuth

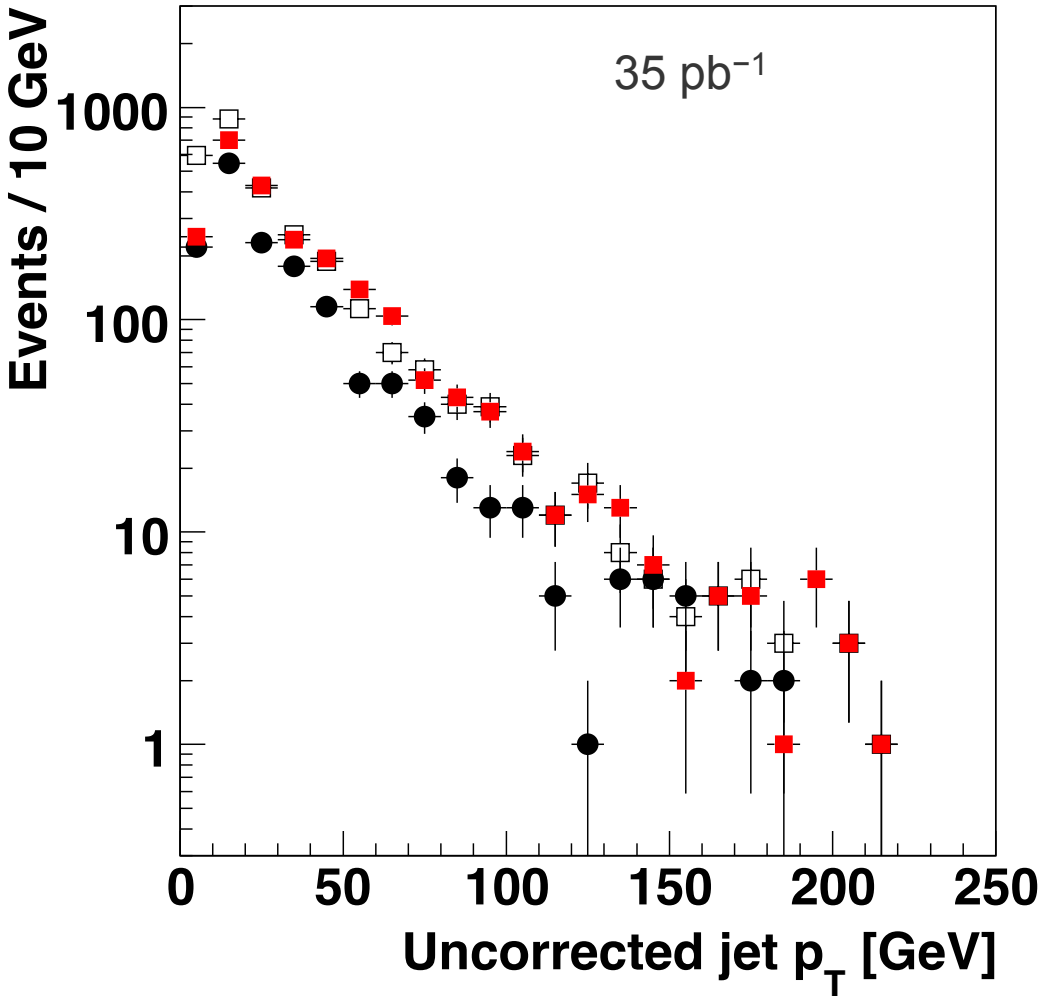






✦Distributions are in agreement with NLO predictions.

Uncorrected jet p_T spectrum

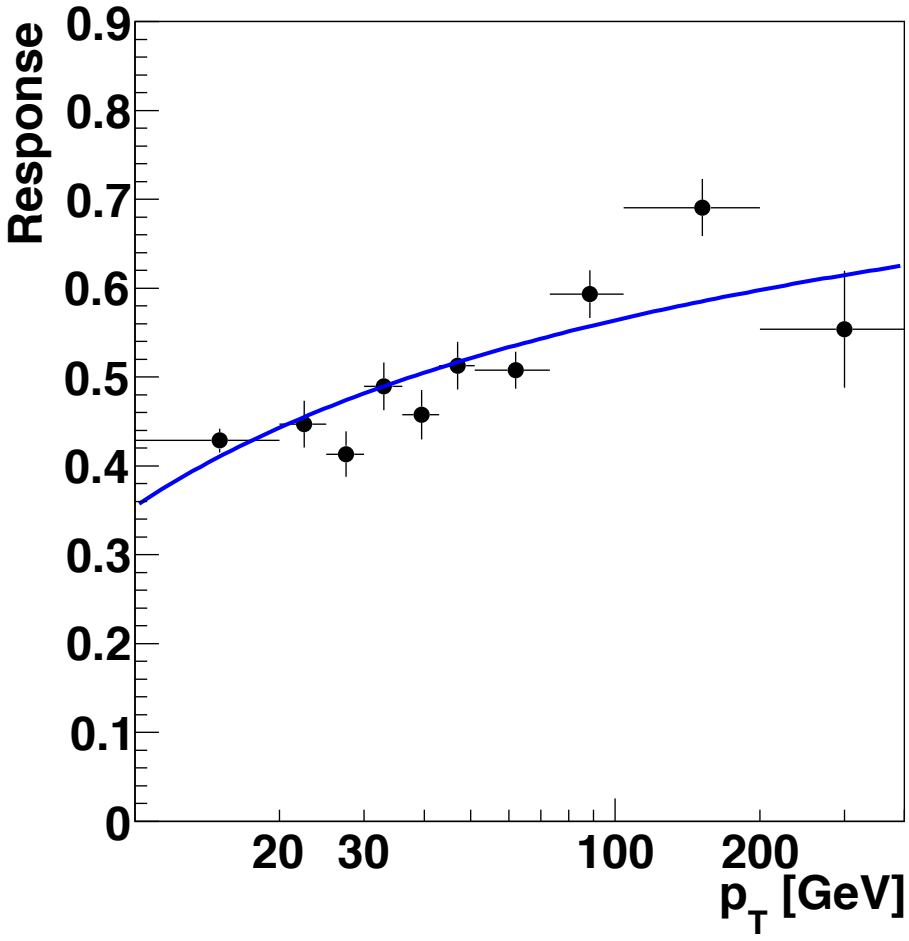


- At least one identified Z boson in the event
- Leading jet in $|\eta| < 1.3$
- ak5 algorithm

solid circles: Calo jets
Open boxes: PF jets
Solid boxes: JPT jets

About 1500 events have good Z+jet p_T balance ➜ only these events are useful for our purpose

Calo jet response: p_T^{jet}/p_T^Z in the bins of Z p_T



- Fix $|\Delta\phi - \pi| < 0.2$.
- Then extrapolate response for 2nd jet pt $\rightarrow 0$.
- Will illustrate the procedure in two slides later.

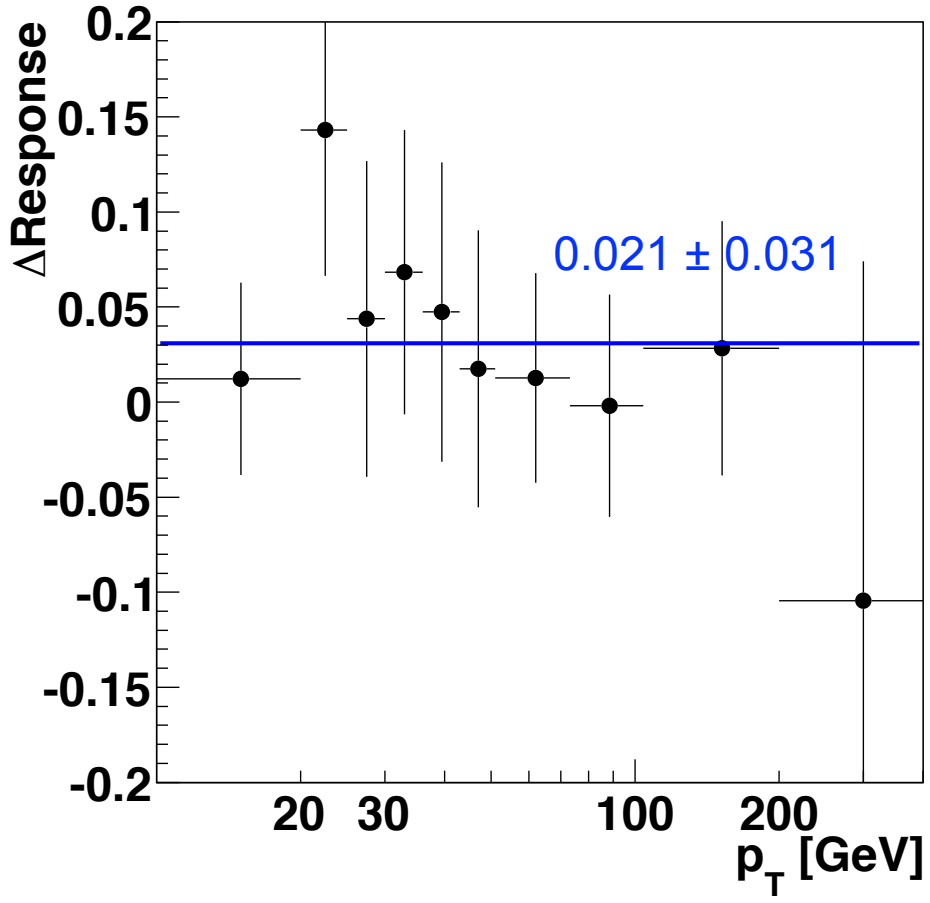
A somewhat poor-looking fit to

$$R(p_T^{\gamma/Z}) = a_0 - \frac{a_1}{[log(p_T^{\gamma/Z})]^{a_2}}$$

gives: a0=1.05, a1 = 0.695352, a2 = 0.516409

I didn't have the equivalent response in current MC ready for comparison

Systematic uncertainty in calo jet response



- Estimated conservatively
- Vary Z+jet p_T balance condition in two orthogonal ways
  - Fix $|\Delta\phi-\pi| < 0.2$. Then vary 2nd jet pt cut in the range 0.05−0.3 in steps of 0.05.
  - Fix 2nd jet pt cut <0.2. Then vary $|\Delta\phi-\pi|$ cut in the range 0.1−0.4 in steps of 0.1.
- Take the largest deviation as systematic uncertainty

See next three slides for details

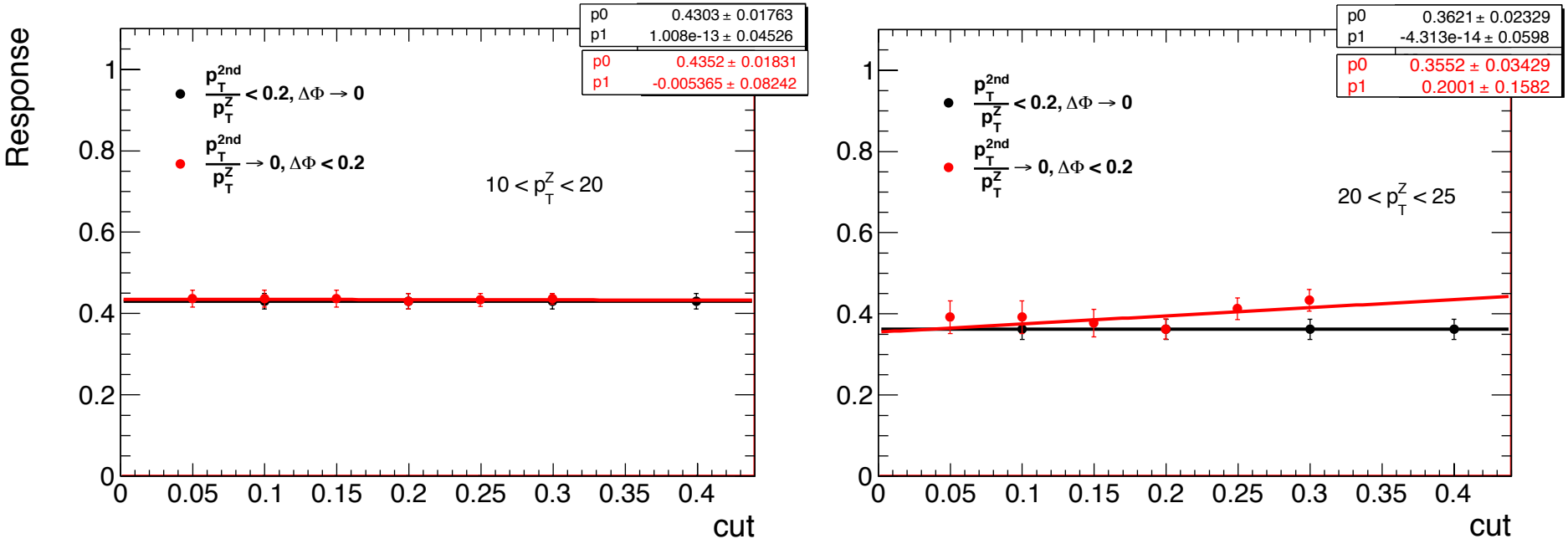
Bin-by-bin extrapolation of response

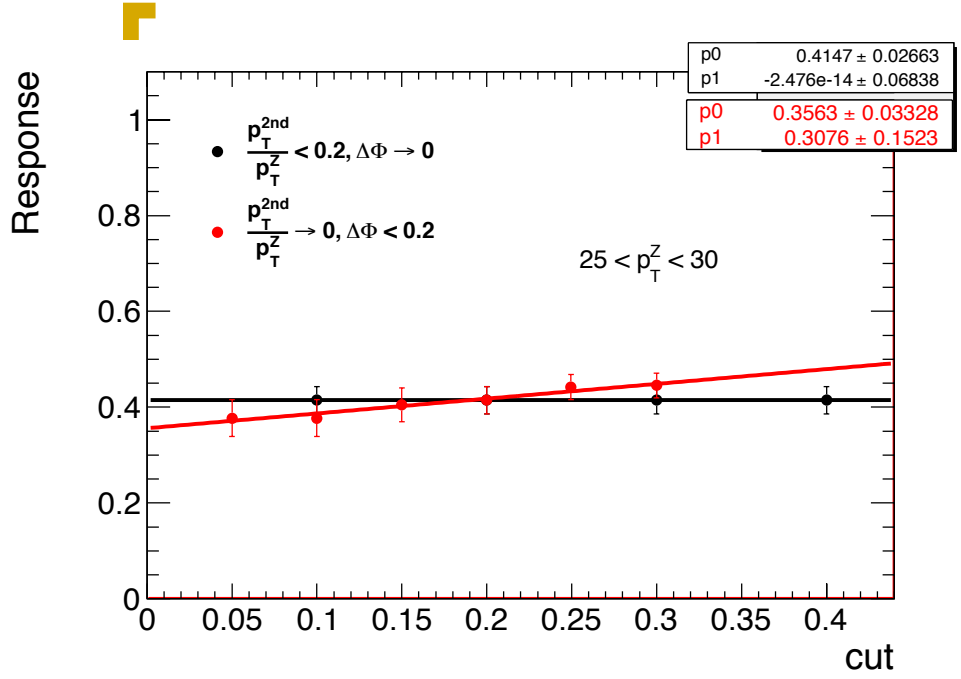
To estimate central value:

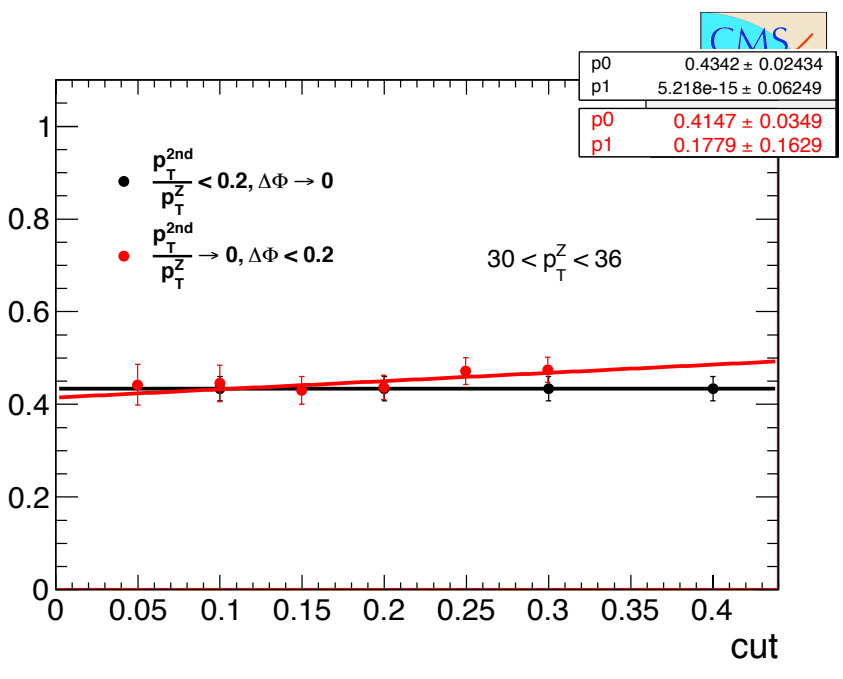
- Fix $|\Delta\phi - \pi| < 0.2$. Then extrapolate response for 2nd jet pt $\rightarrow 0$.

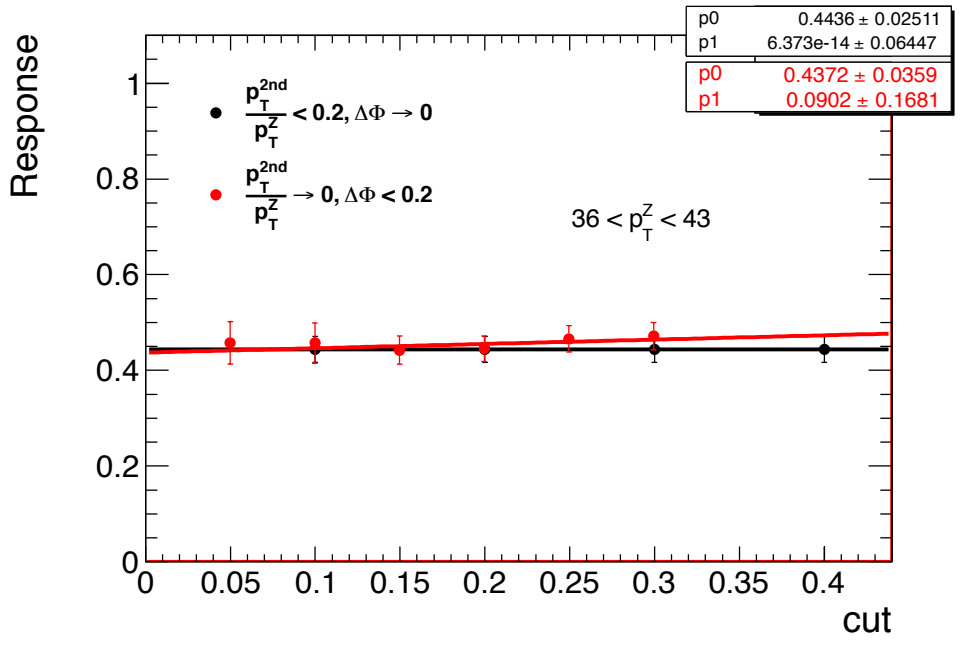
To estimate systematics:

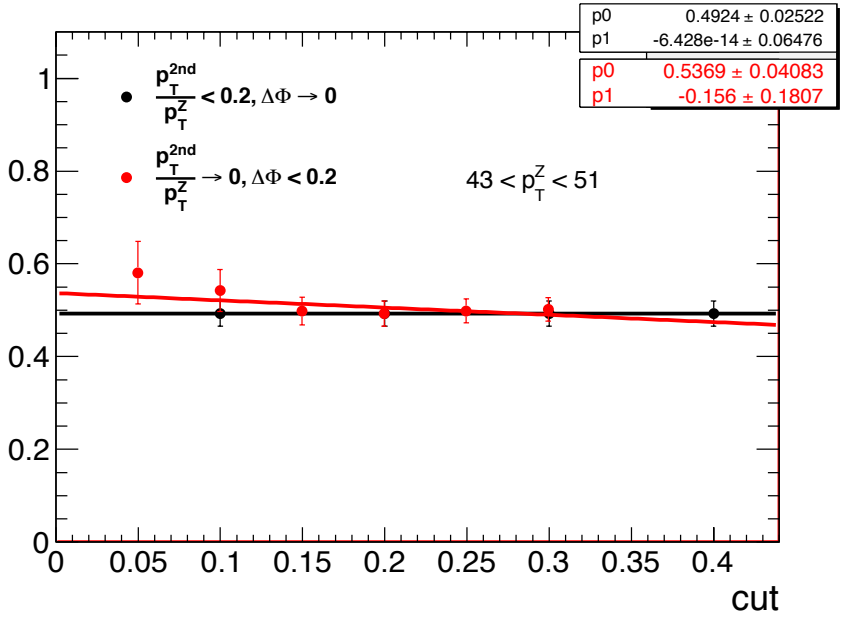
- Fix $|\Delta\phi - \pi| < 0.2$. Then vary 2nd jet pt cut in the range 0.05−0.3.
- Fix 2nd jet pt cut <0.2. Then vary $|\Delta\phi - \pi|$ cut in the range 0.1−0.4.

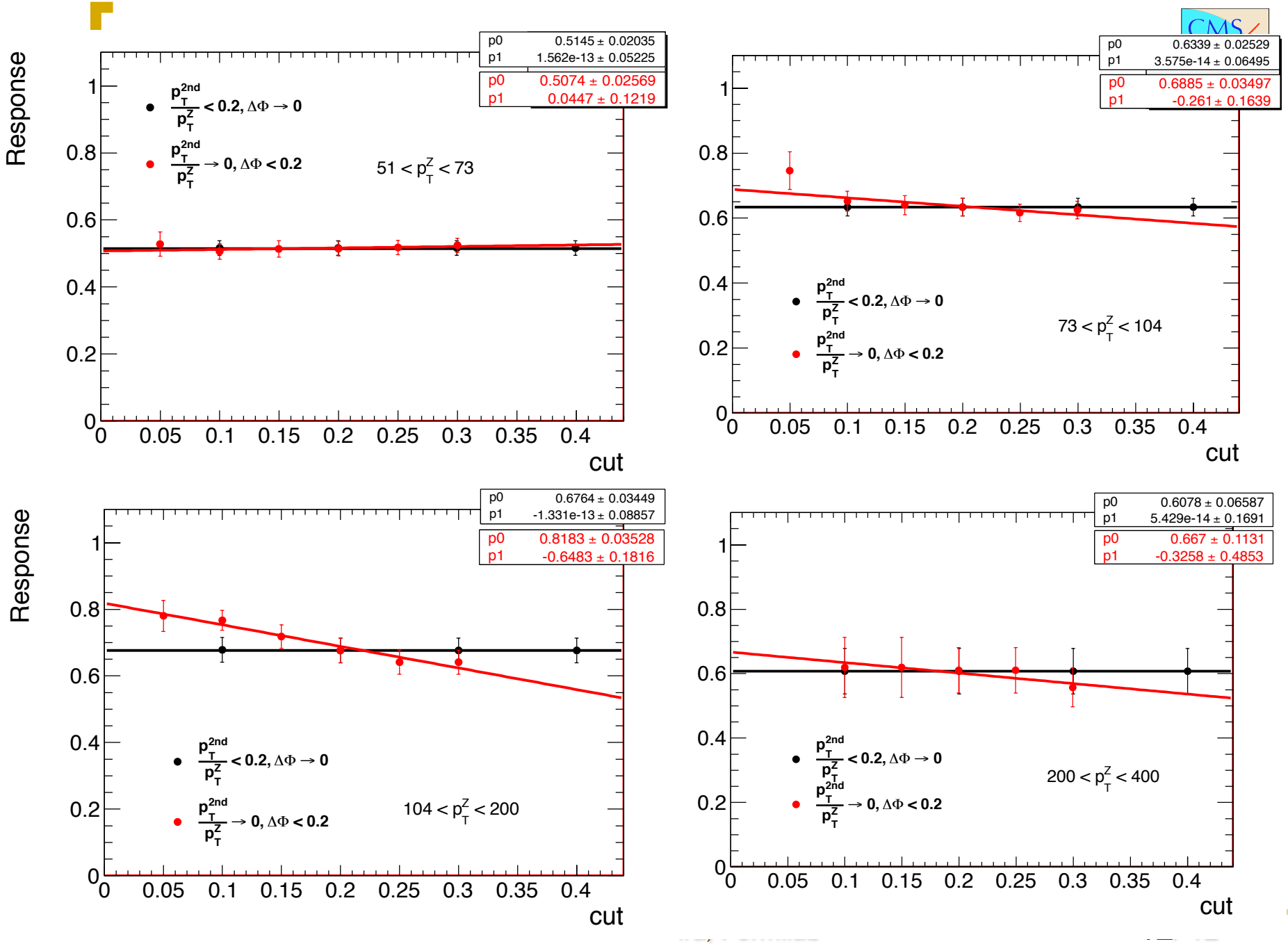



Response
cut
$\frac{p_T^{2nd}}{p_T^Z} < 0.2, \Delta\Phi \to 0$
$\frac{p_T^{2nd}}{p_T^Z} \to 0, \Delta\Phi < 0.2$
$25 < p_T^Z < 30$
p0 0.4147 ± 0.02663
p1 -2.476e-14 ± 0.06838
p0 0.3563 ± 0.03328
p1 0.3076 ± 0.1523


cut
$\frac{p_T^{2nd}}{p_T^Z} < 0.2, \Delta\Phi \to 0$
$\frac{p_T^{2nd}}{p_T^Z} \to 0, \Delta\Phi < 0.2$
$30 < p_T^Z < 36$
p0 0.4342 ± 0.02434
p1 5.218e-15 ± 0.06249
p0 0.4147 ± 0.0349
p1 0.1779 ± 0.1629


Response
cut
$\frac{p_T^{2nd}}{p_T^Z} < 0.2, \Delta\Phi \to 0$
$\frac{p_T^{2nd}}{p_T^Z} \to 0, \Delta\Phi < 0.2$
$36 < p_T^Z < 43$
p0 0.4436 ± 0.02511
p1 6.373e-14 ± 0.06447
p0 0.4372 ± 0.0359
p1 0.0902 ± 0.1681


cut
$\frac{p_T^{2nd}}{p_T^Z} < 0.2, \Delta\Phi \to 0$
$\frac{p_T^{2nd}}{p_T^Z} \to 0, \Delta\Phi < 0.2$
$43 < p_T^Z < 51$
p0 0.4924 ± 0.02522
p1 -6.428e-14 ± 0.06476
p0 0.5369 ± 0.04083
p1 -0.156 ± 0.1807


Response
cut
p0 0.5145 ± 0.02035
p1 1.562e-13 ± 0.05225
p0 0.5074 ± 0.02569
p1 0.0447 ± 0.1219
$\frac{p_T^{2nd}}{p_T^Z} < 0.2, \Delta\Phi \to 0$
$\frac{p_T^{2nd}}{p_T^Z} \to 0, \Delta\Phi < 0.2$
$51 < p_T^Z < 73$
p0 0.6339 ± 0.02529
p1 3.575e-14 ± 0.06495
p0 0.6885 ± 0.03497
p1 -0.261 ± 0.1639
$73 < p_T^Z < 104$
p0 0.6764 ± 0.03449
p1 -1.331e-13 ± 0.08857
p0 0.8183 ± 0.03528
p1 -0.6483 ± 0.1816
$104 < p_T^Z < 200$
p0 0.6078 ± 0.06587
p1 5.429e-14 ± 0.1691
p0 0.667 ± 0.1131
p1 -0.3258 ± 0.4853
$200 < p_T^Z < 400$