Status Report
TTbar Angular Distributions

NTUA

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Variables

- We employ the dijet angular variable χ from the rapidities of the two leading jets
- Why χ?
  - The distributions associated with the final states produced via QCD interactions are relatively flat in comparison with the distributions of the BSM models or new particles, which typically peak at low values of x

- We can measure the variable χ in two ways

1. By measuring the difference of the rapidities of the two leading jets such as the corresponding rapidity in the ZMF is:

$$y^* = \frac{1}{2}(y_1 - y_2)$$

X is defined as $\chi = e^{|2y^*|} = e^{|y_1 - y_2|}$ (1) and can be measured by creating the TLorentzVector, boost it to the ZMF and find the rapidity difference of the two leading jets

We also define $y_{Boost} = 0.5(y_1 + y_2)$ which specifies the longitudinal boost by which the dijet CM frame is boosted with respect to the detector frame

2. By measuring the scattering angle θ* (angle between top quark and z-axis in the Zero Momentum Frame)

We define as $y^* = \frac{1}{2}\ln(\frac{1+|cos\theta^*|}{1-|cos\theta^*|})$ and from (1) we can find that:

$$\chi = \frac{1 + |cos\theta^*|}{1 - |cos\theta^*|}$$

Response Matrices

- Selection:
  - Parton: partonPt > 400, |partonEta|< 2.4, mTTbarParton > 1000
  - Reco: jetPt>400, |jetEta| < 2.4, nLeptons ==0
  - Btagging Medium working point
  - Top tagger mva > 0.3
  - Jet mass soft Drop (120, 220)GeV
  - Jets are matched

- Response matrix of χ_{reco}, χ_{parton} with {1,2,3,4,5,6,7,8,9,10,13,16} as variable binning
- Response matrix of $|\cos(\theta)|_{reco}$, $|\cos(\theta)|_{parton}$ 10 bins in [0,1] region

- Stability, Efficiency for χ, $|\cos(\theta)|$ distributions

- Acceptance and purity for χ and $|\cos(\theta)|$distributions

- I measure the χ using the exponential

Response Matrices

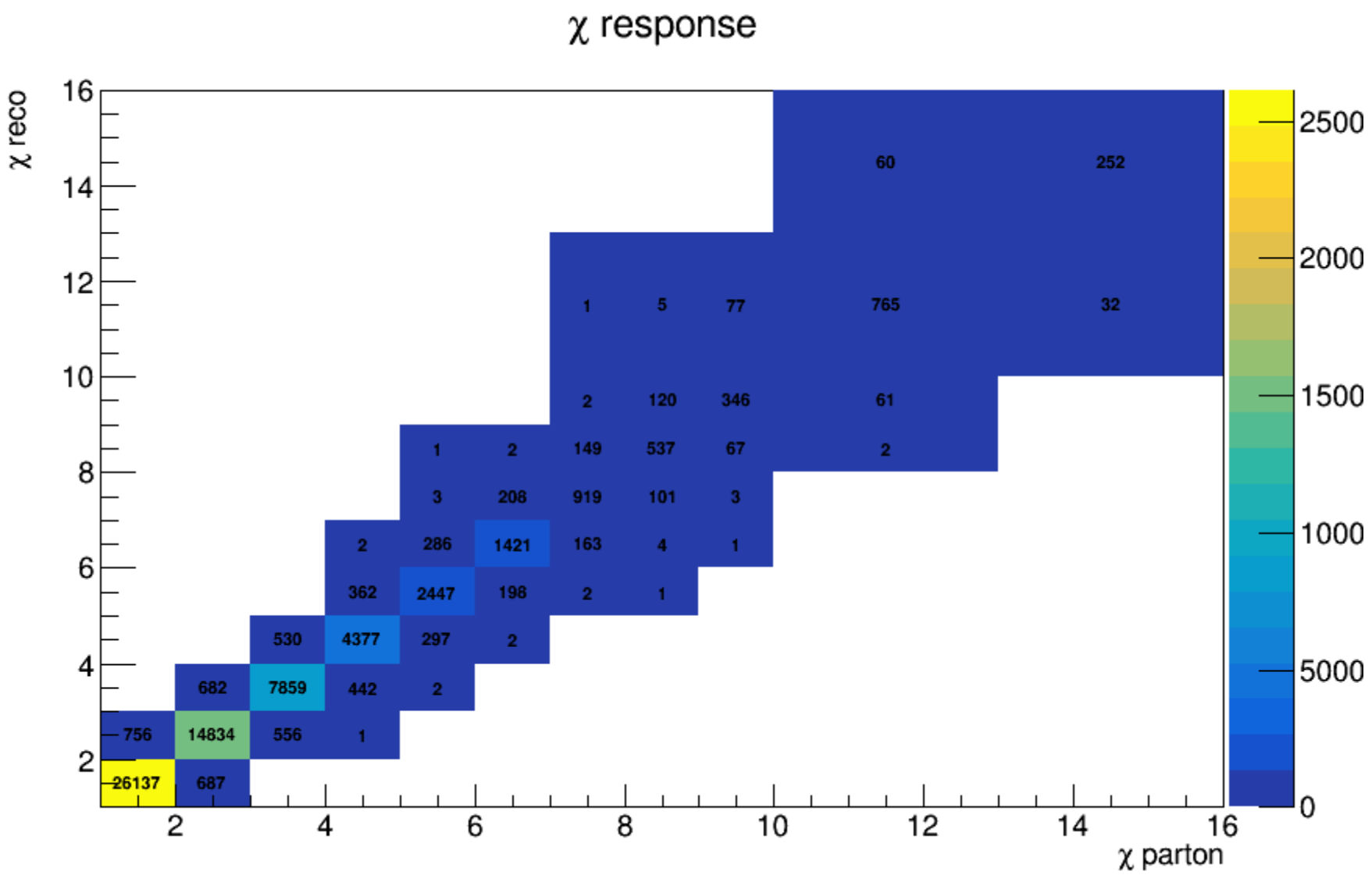
- Selection:
  - Jet Matching
  - Parton cuts:
    - partonPt[0],[1] > 400
    - |partonEta[0],[1]| < 2.4
    - mTTbarParton > 1000
- Reco cuts:
  - nJets > 1
  - nLeptons = 0
  - mJJ > 1000
  - jetPt[0],[1] > 400
  - |jetEta[0],[1]| < 2.4
  - bTagging (Medium WP)
  - Tagger cut (event mva, top Tagger, deepAK8)
  - JetMassSoftDrop > 120 and < 220

Definitions:

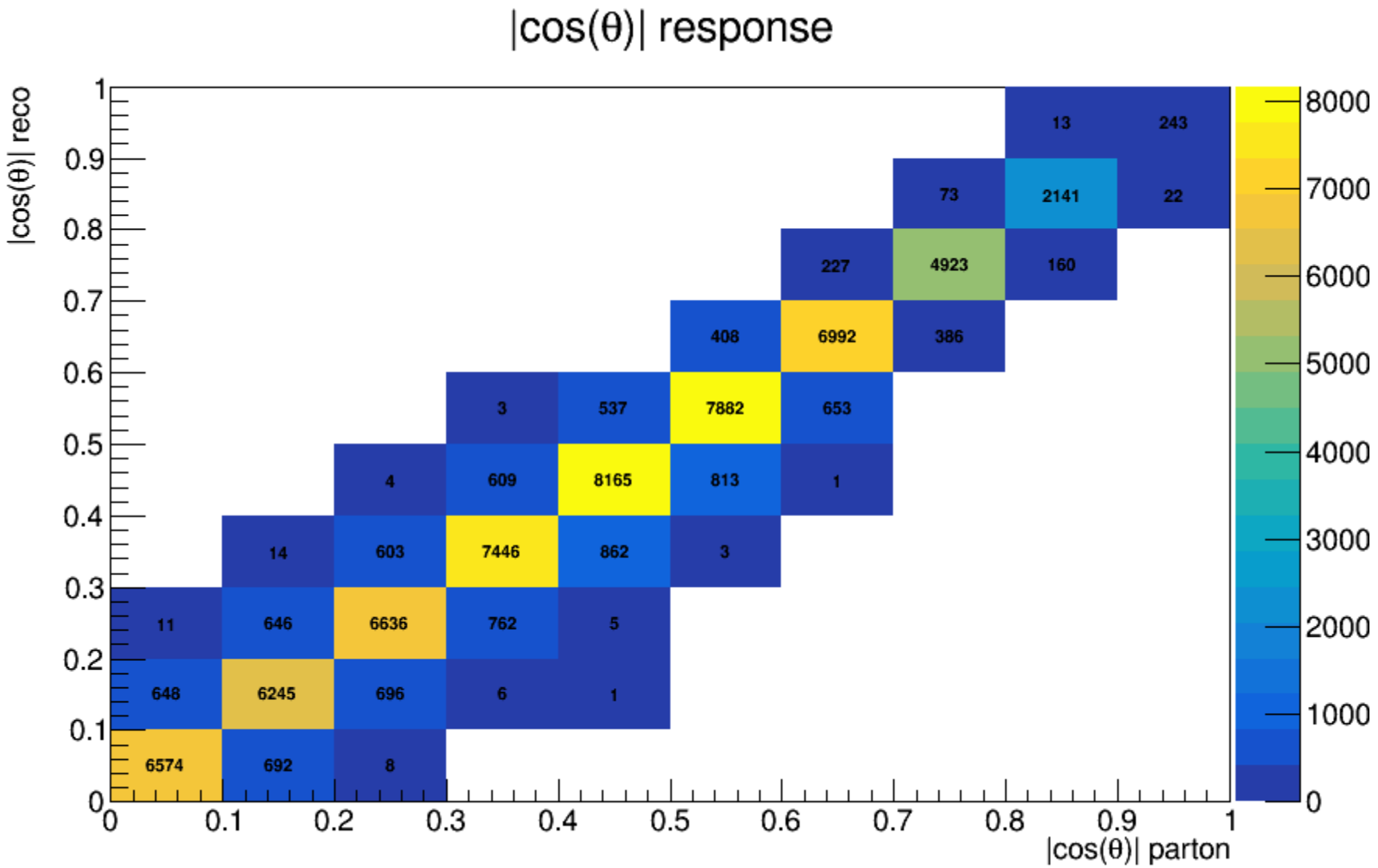
$$Efficiency = \frac{\#events\ passing\ reco\ and\ parton\ cuts}{\#events\ passing\ parton\ cuts\ from\ EventCounter}\ (vs\ Parton)$$

$$Acceptance = \frac{\#events\ passing\ reco\ and\ parton\ cuts}{\#eventsing\ pass\ reco\ cuts}(vs\ Reco)$$

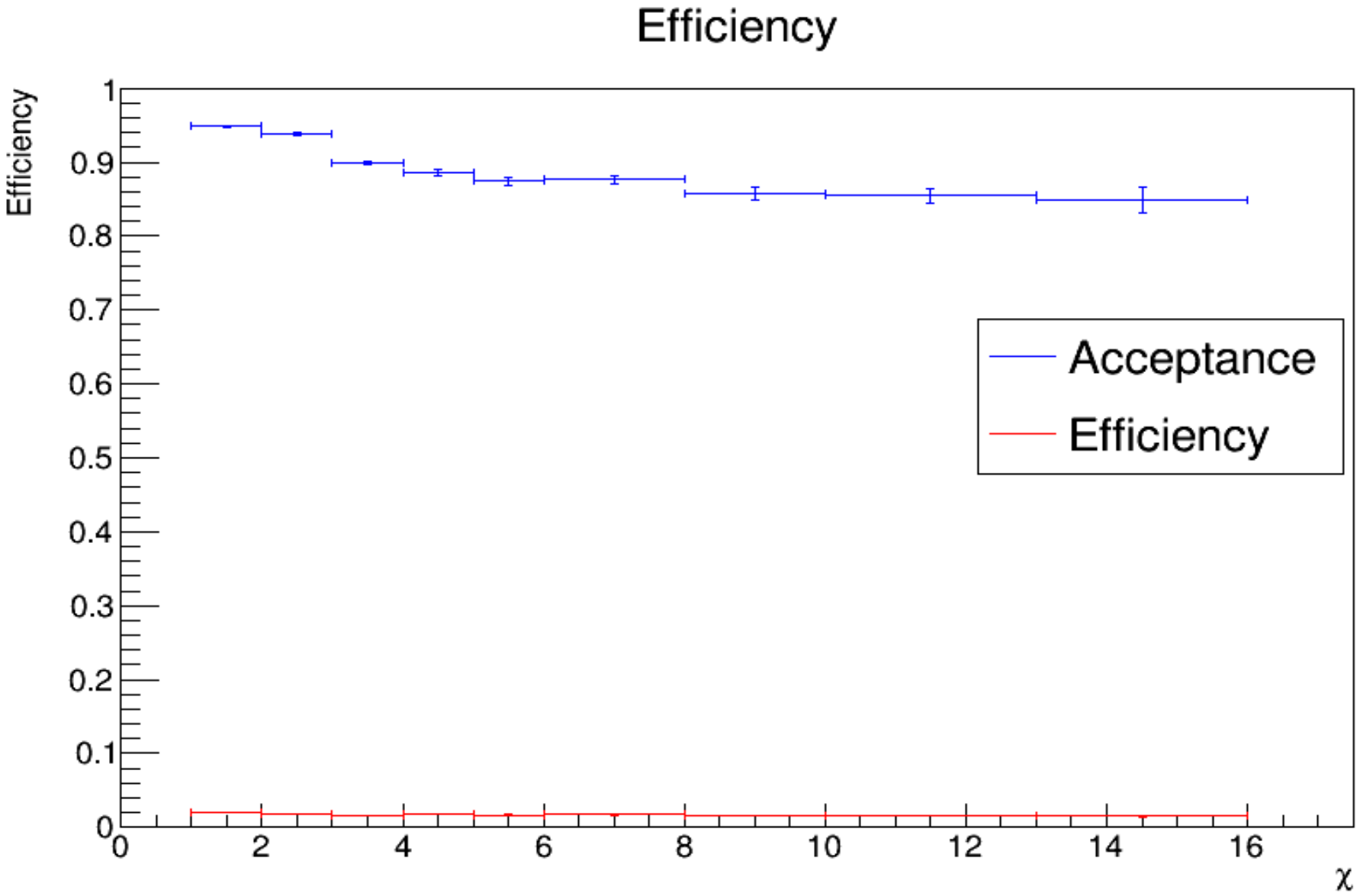
Response Matrix for χ



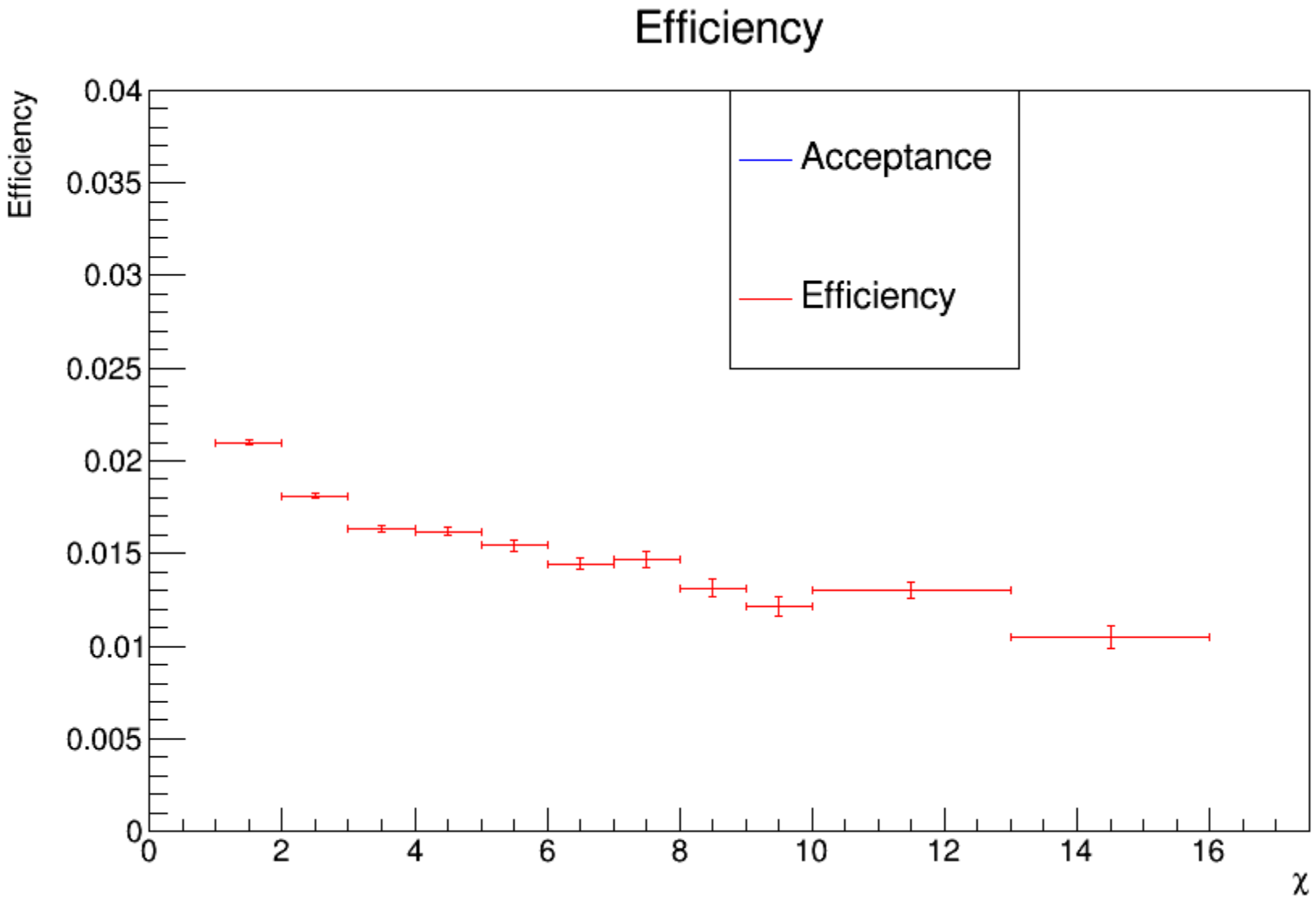
Response Matrix for |cos(θ)|



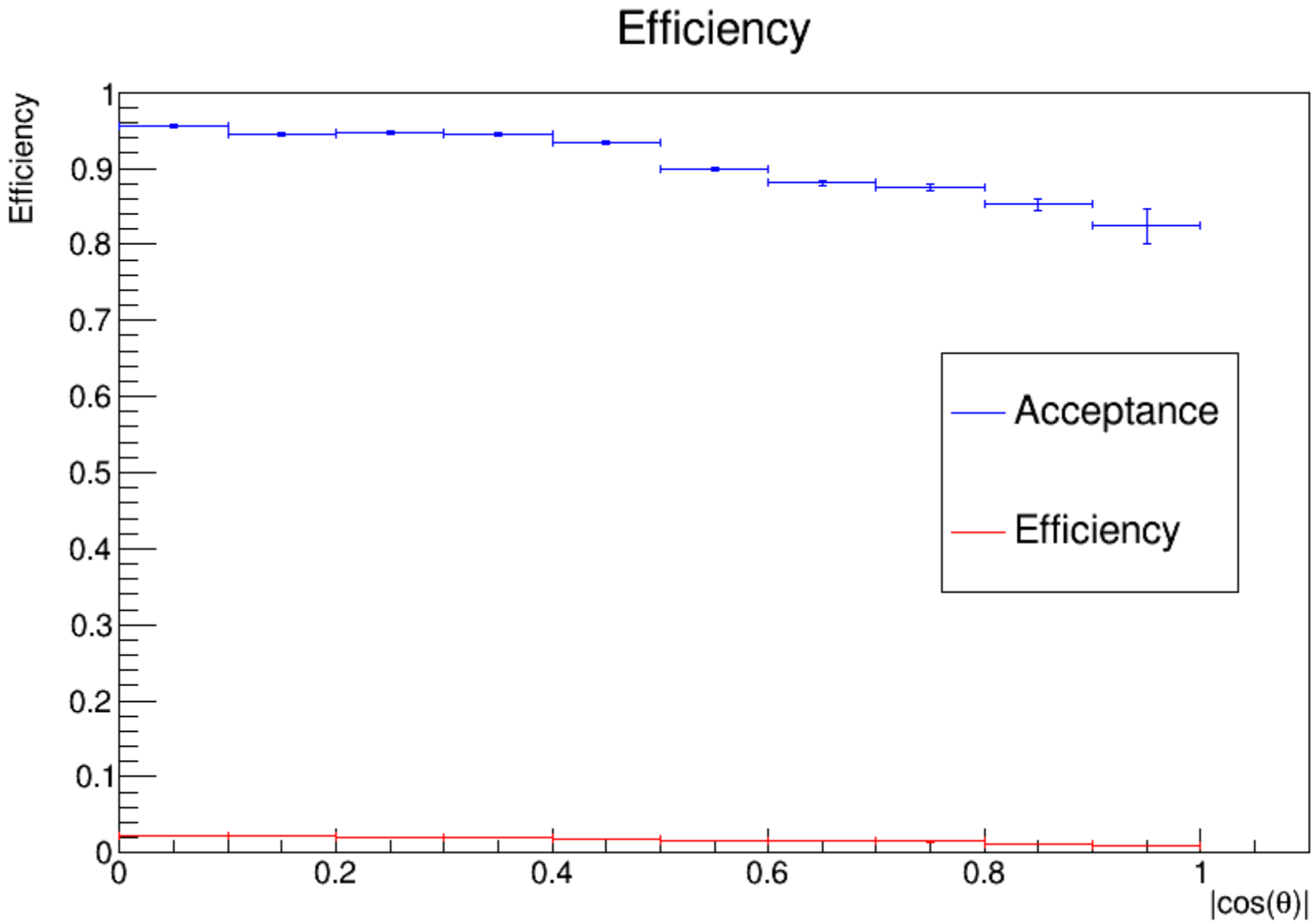
Efficiency and Acceptance for chi distribution



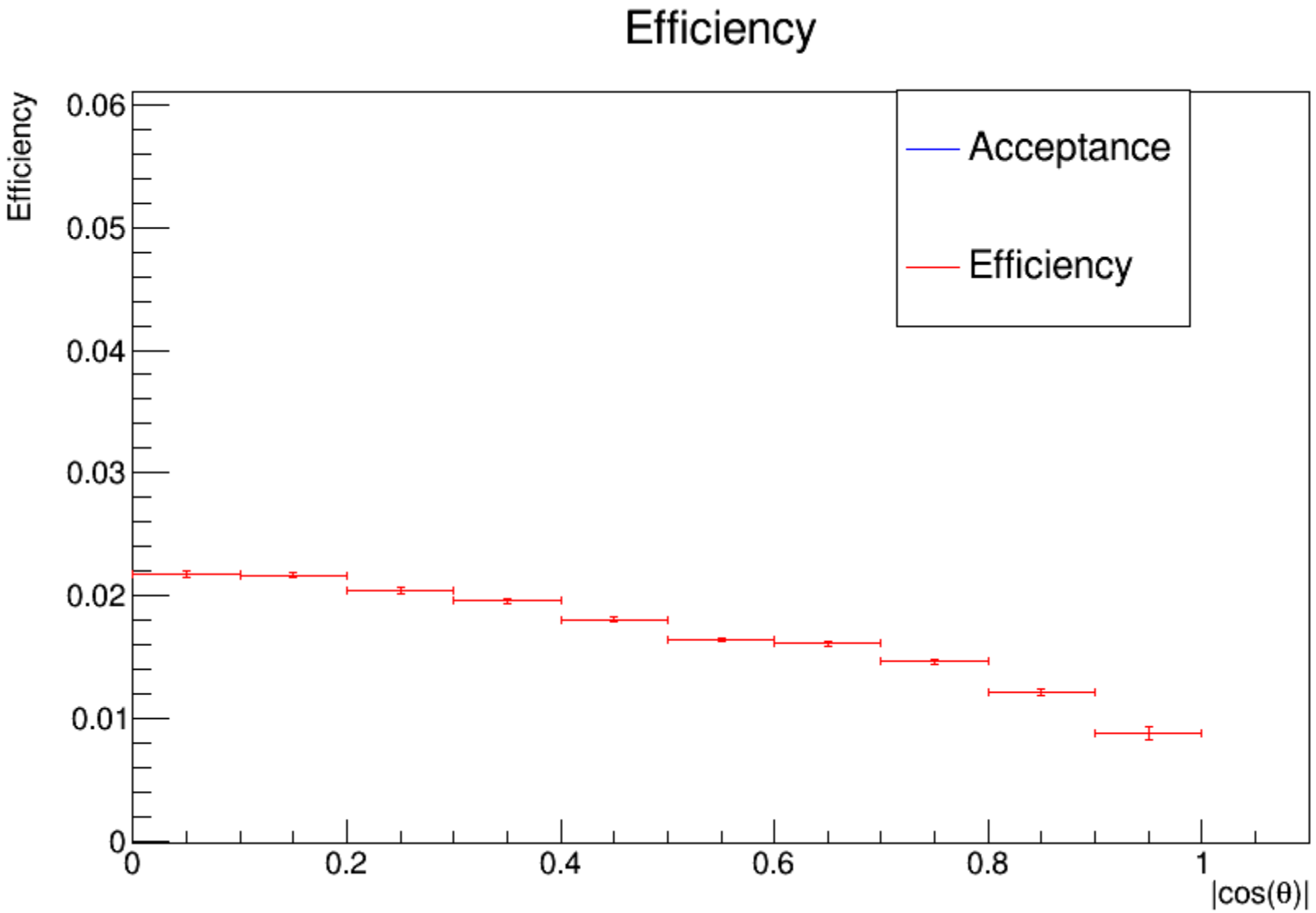
Efficiency for chi distribution (zoomed)



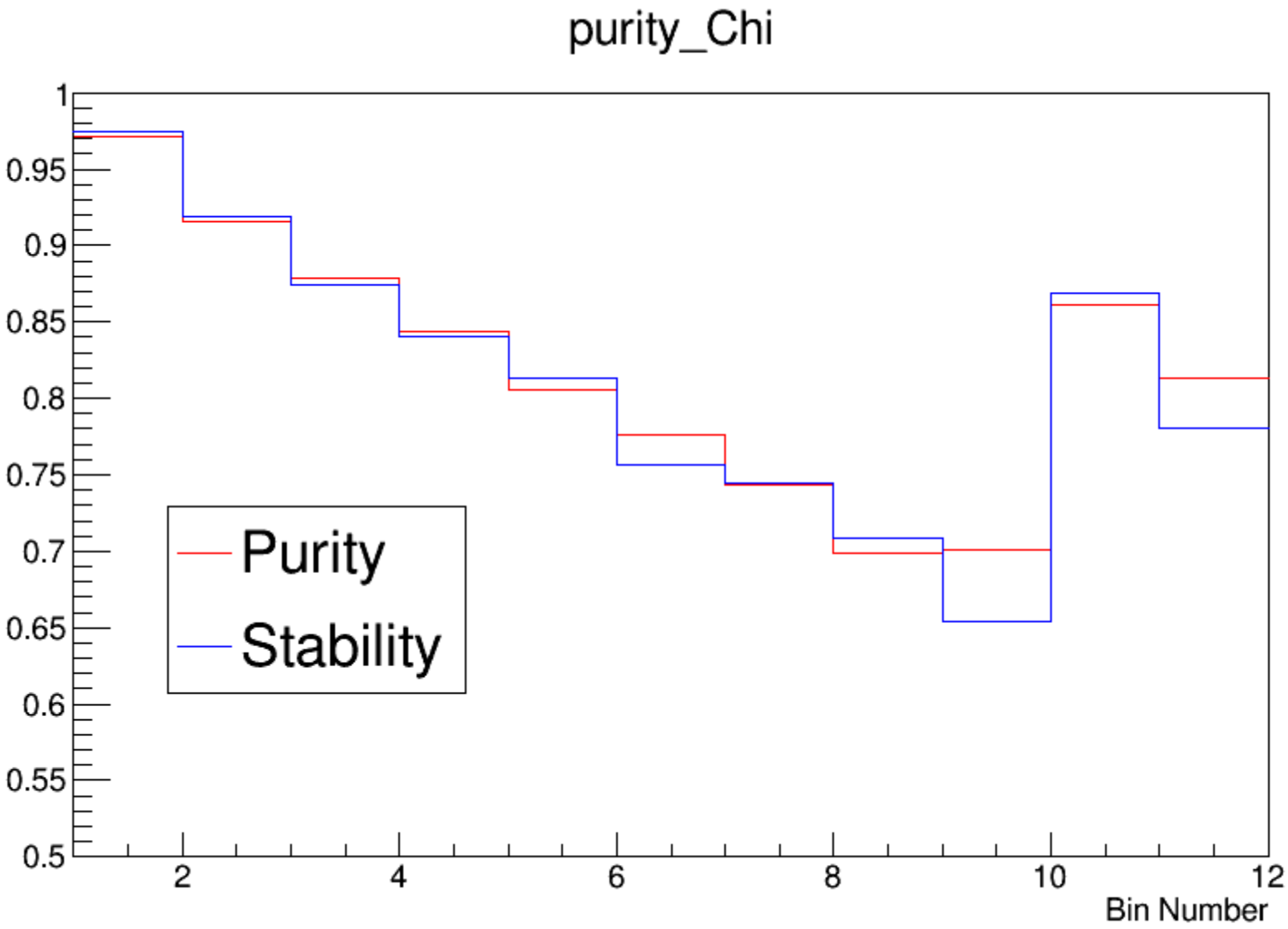
Efficiency and Acceptance for |cos(θ)| distribution



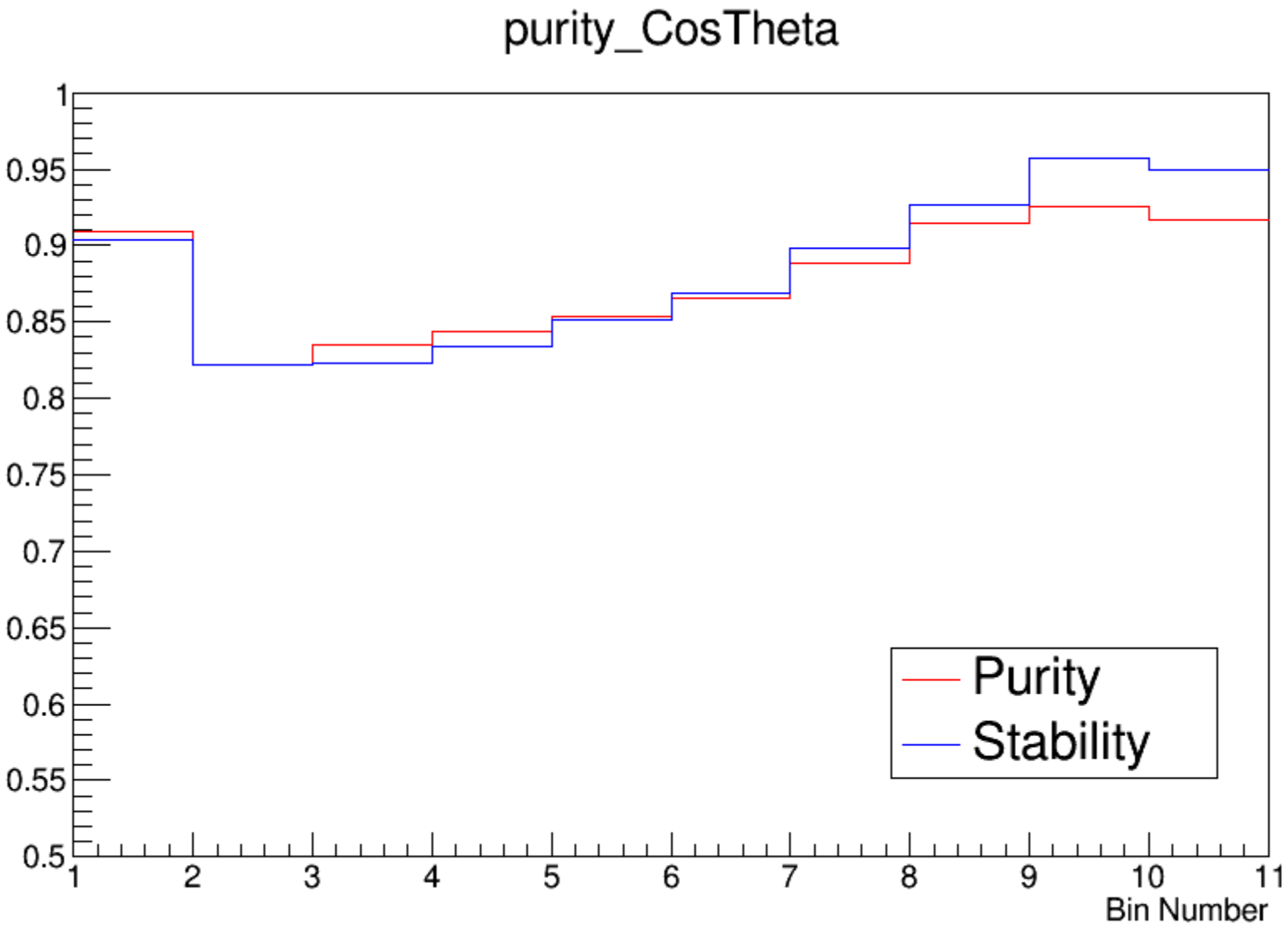
Efficiency for|cos(θ)| distribution (zoomed)



Purity and Stability for chi distribution

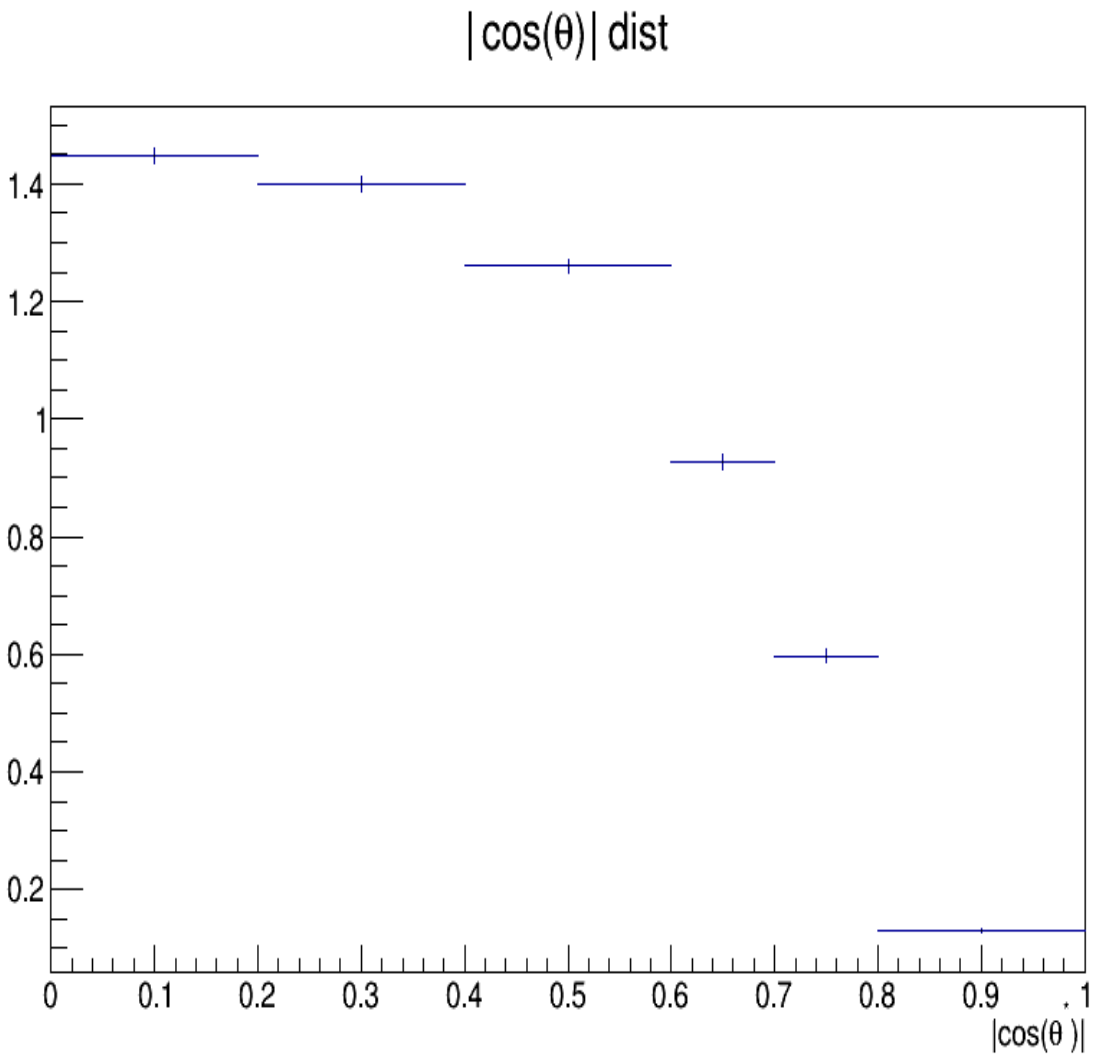


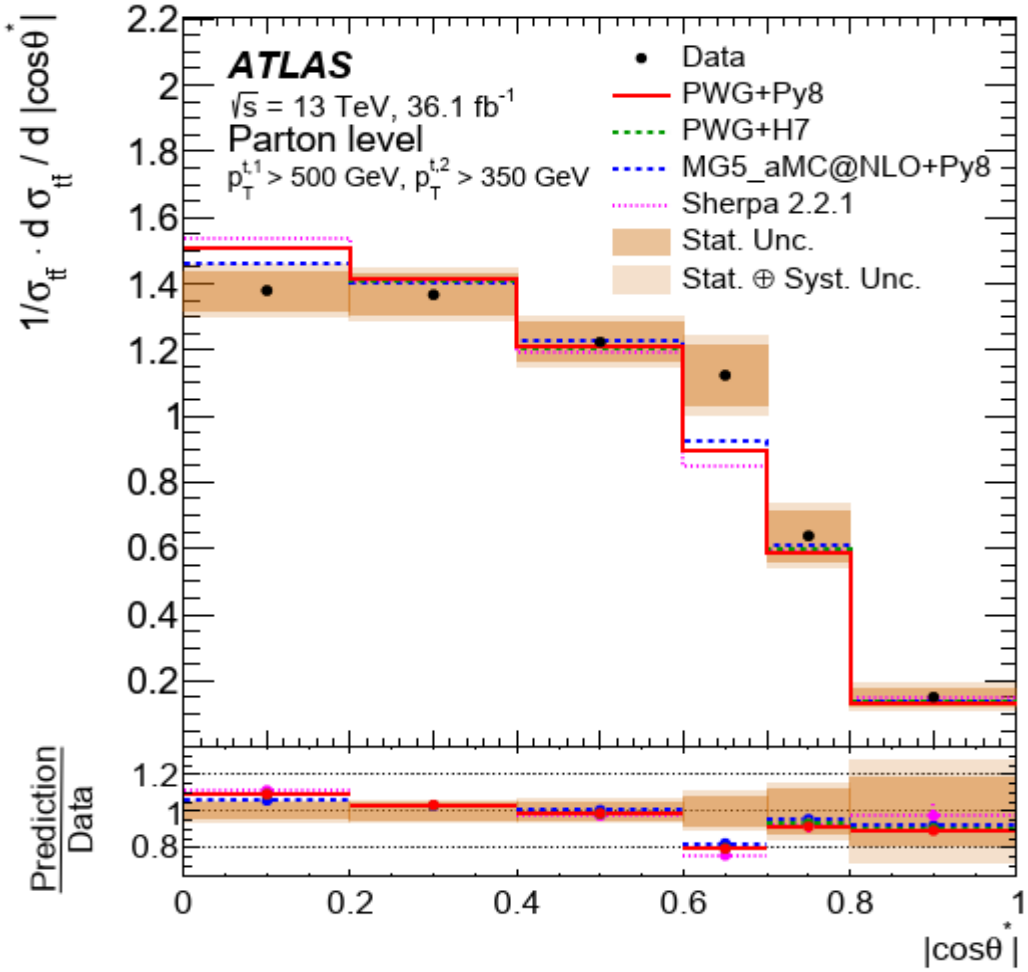
Purity and Stability for |cos(θ)| distribution



Comparisons with ATLAS |cosθ| distributions

- cut at Pt here is >500 as in ATLAS analysis





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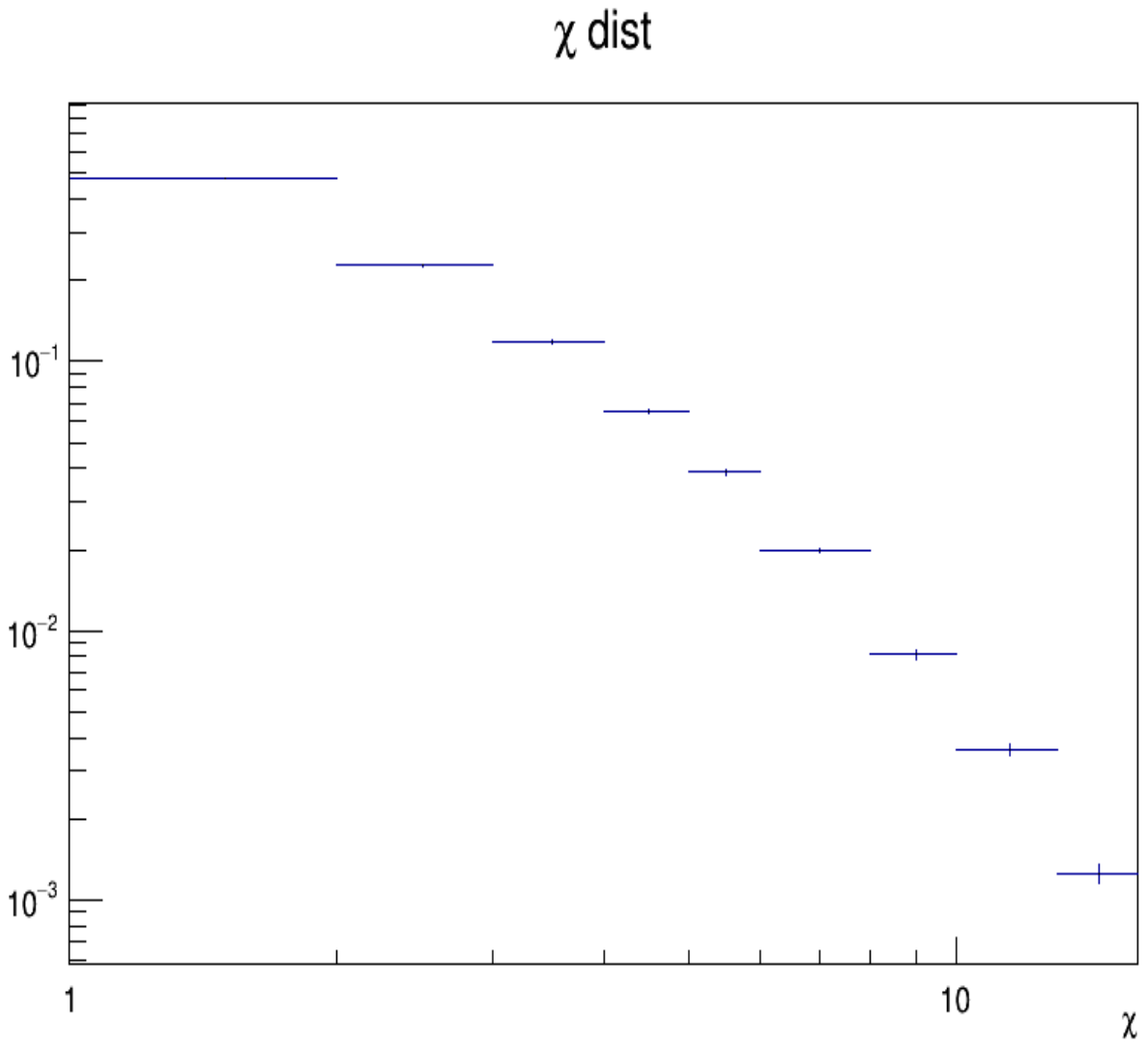
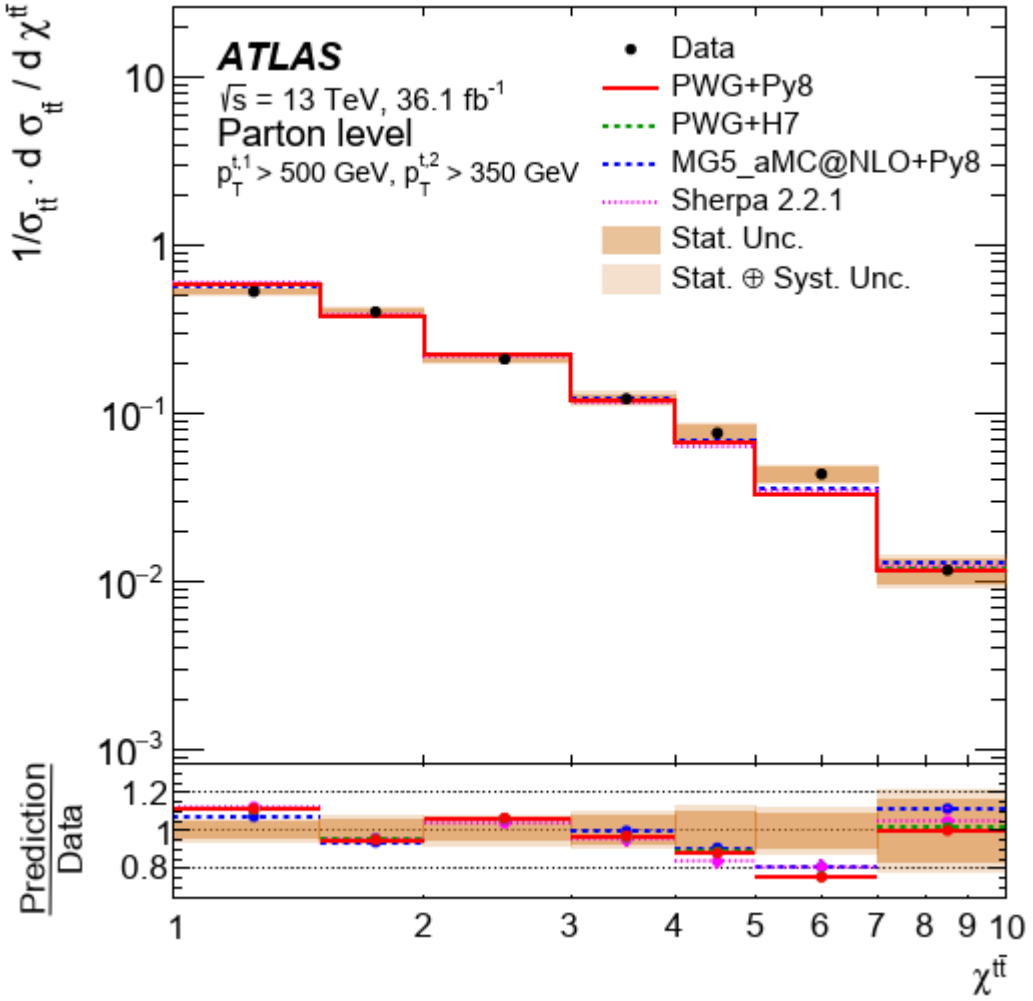
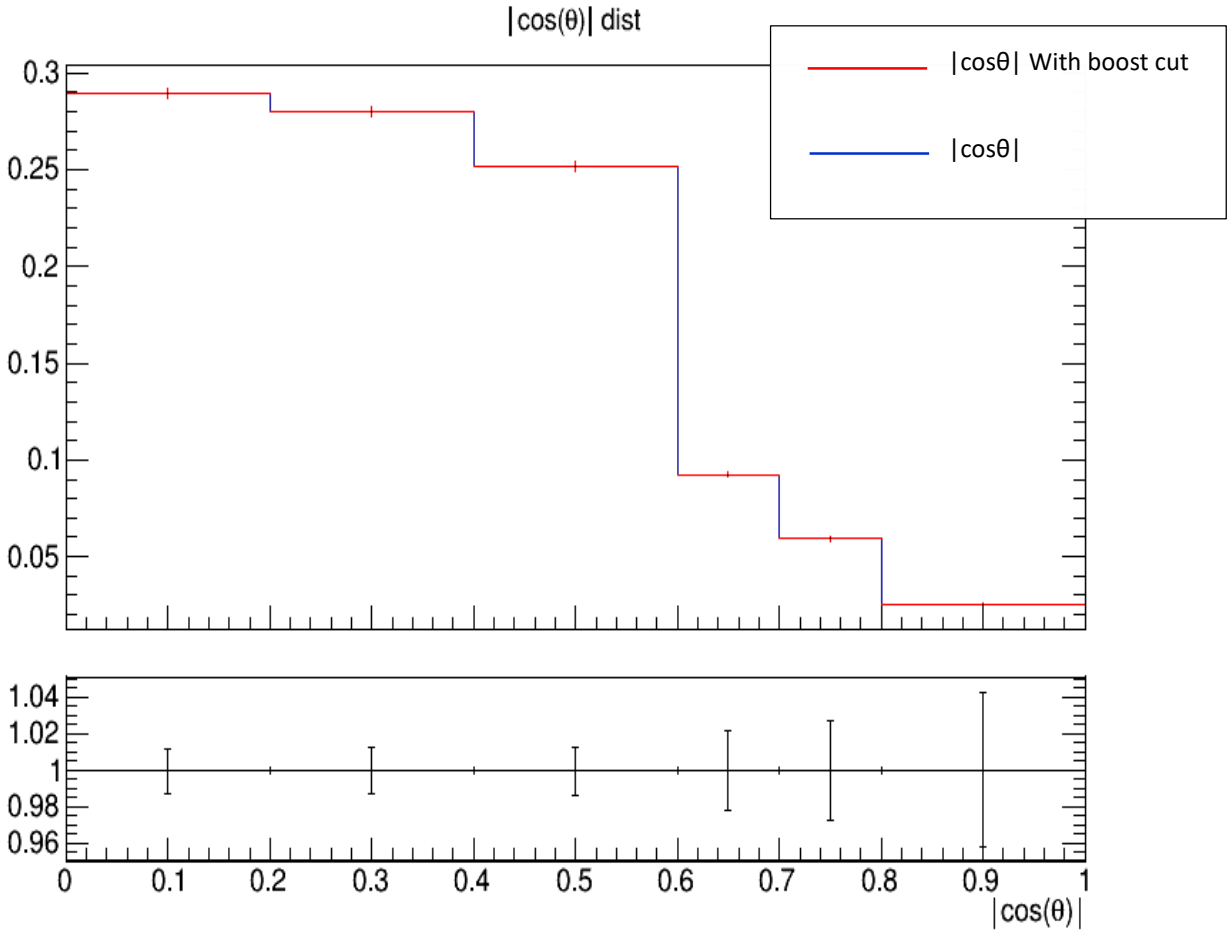
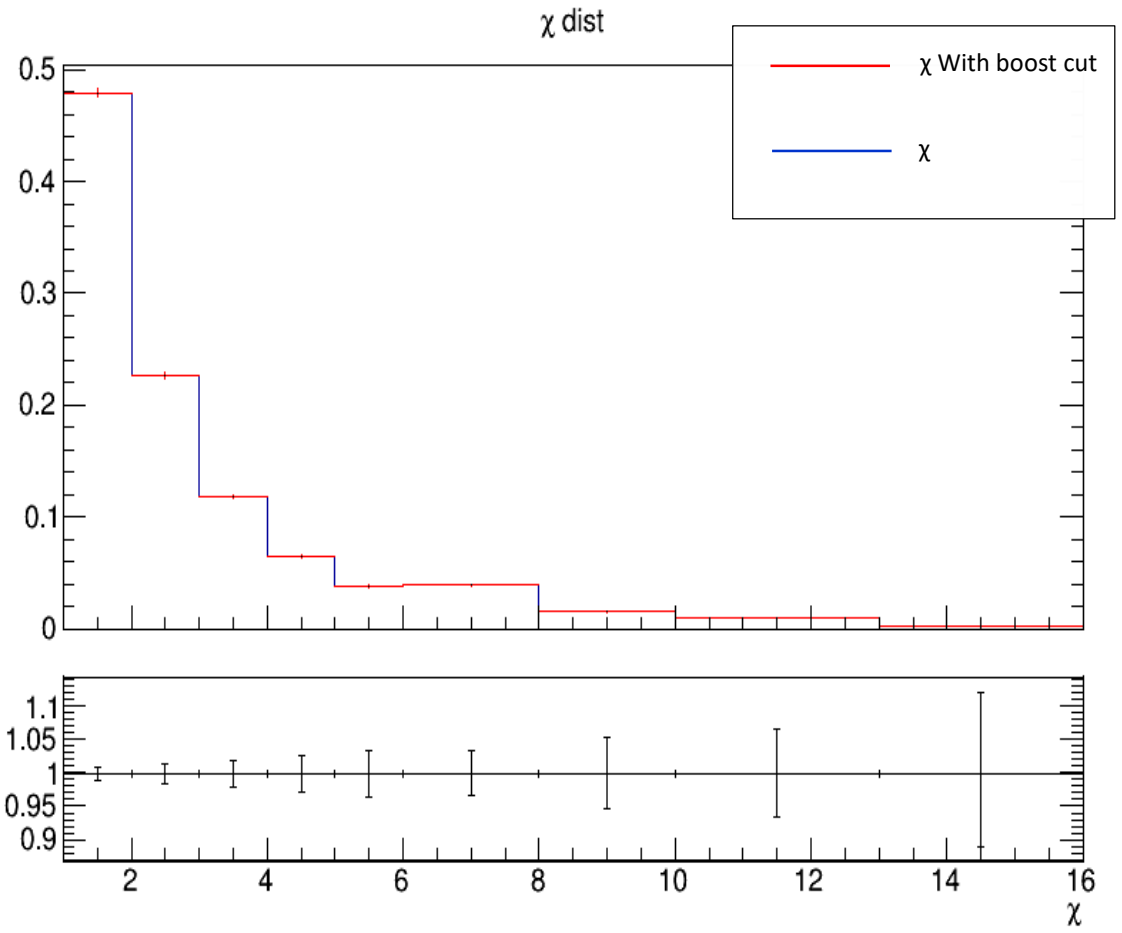




QCD Measurement vs Search

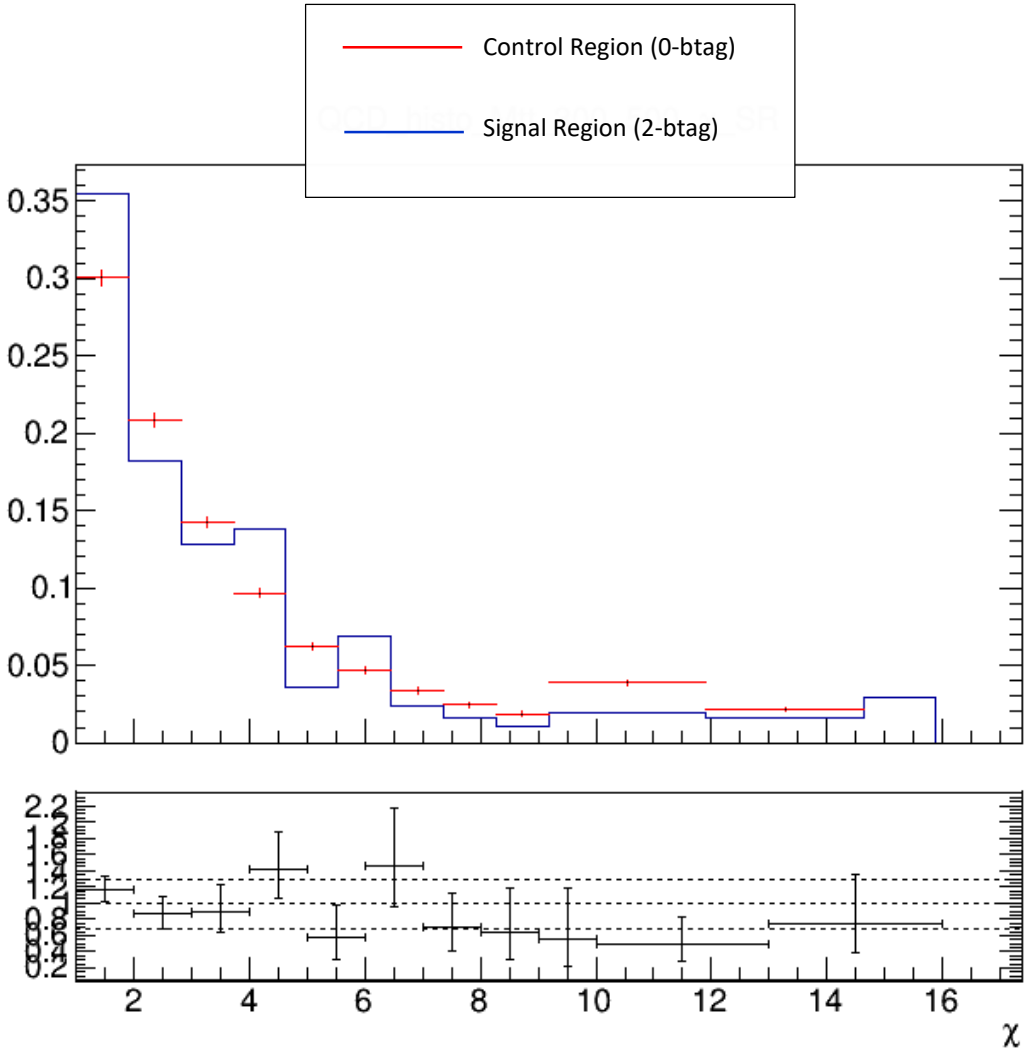
- In exotica searches, an $|y_{Boost}|<1.19$ cut is applied
- Are there any differences when we don't aply the cut?

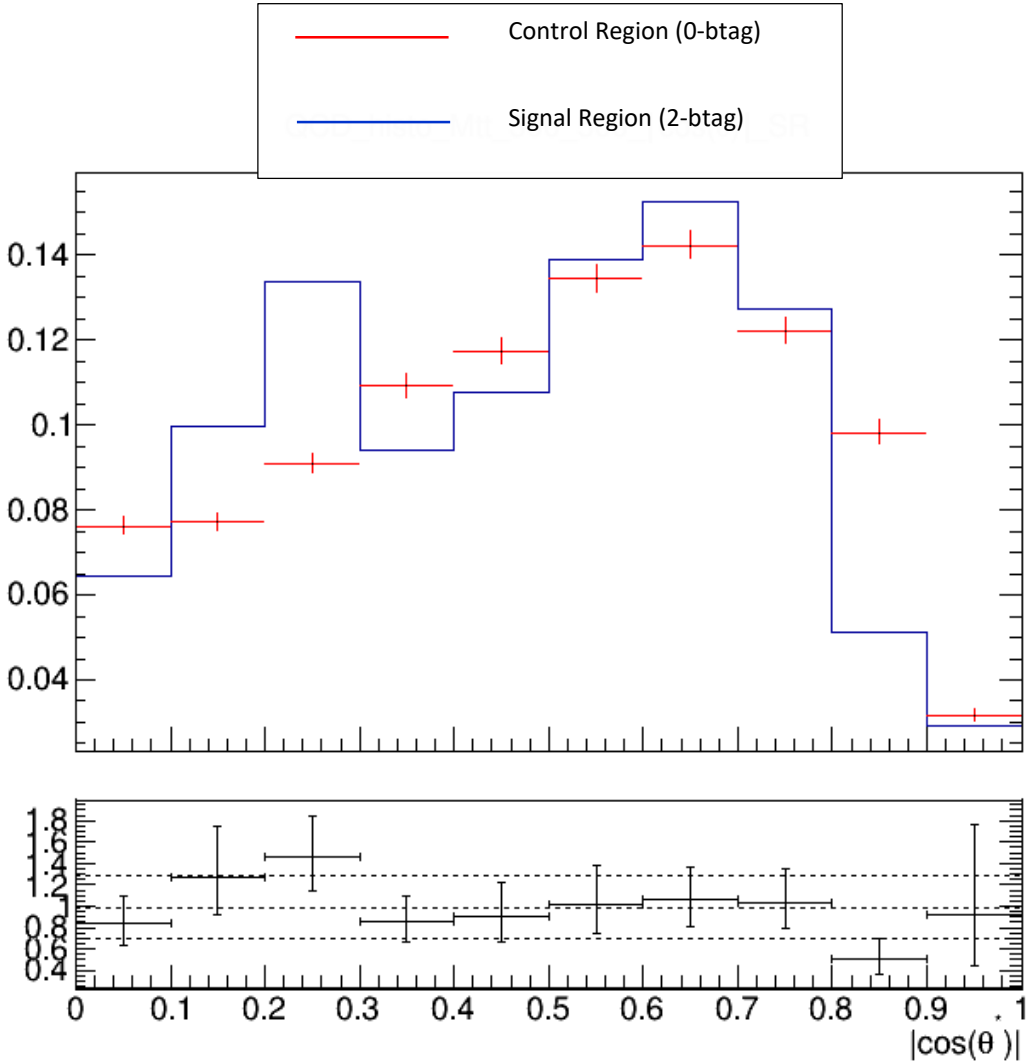




QCD Background MC closure tests

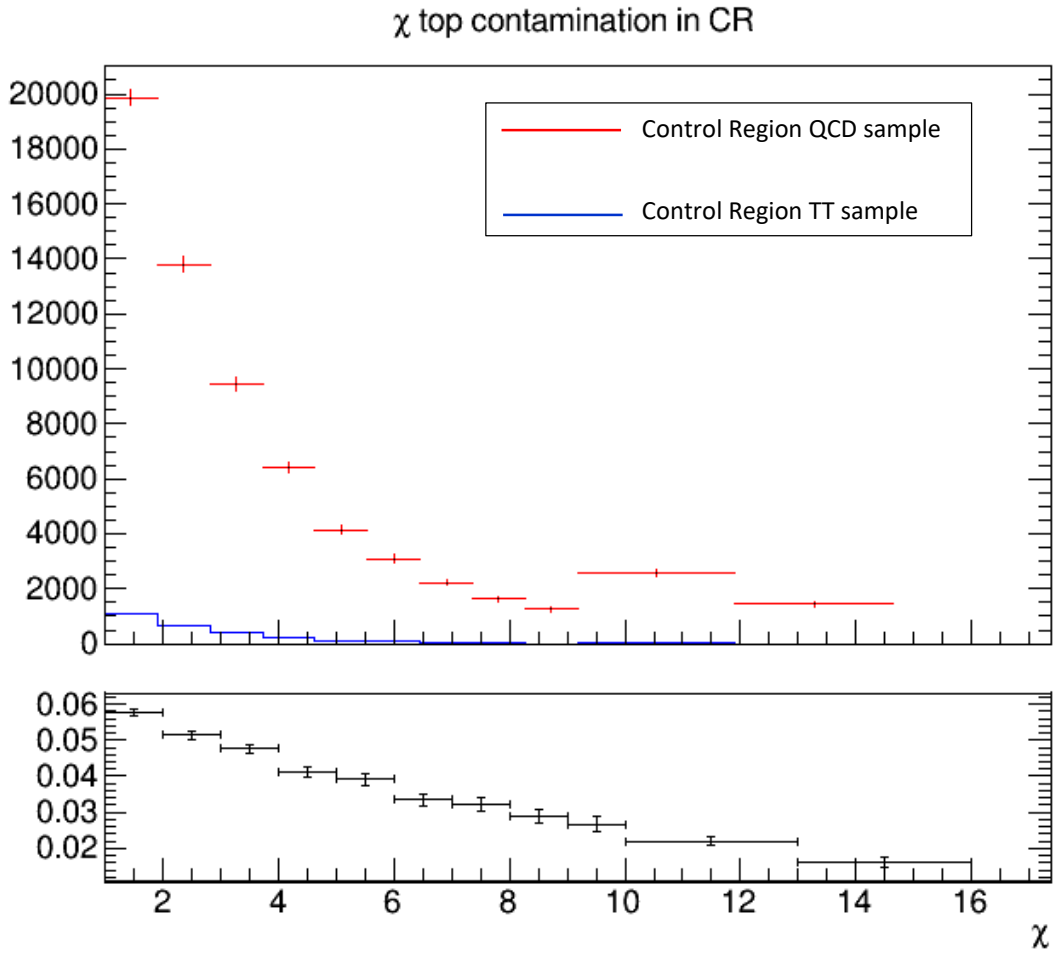
- Closure test for QCD samples in Control Region (SR but btagging is reverted (btag==0))

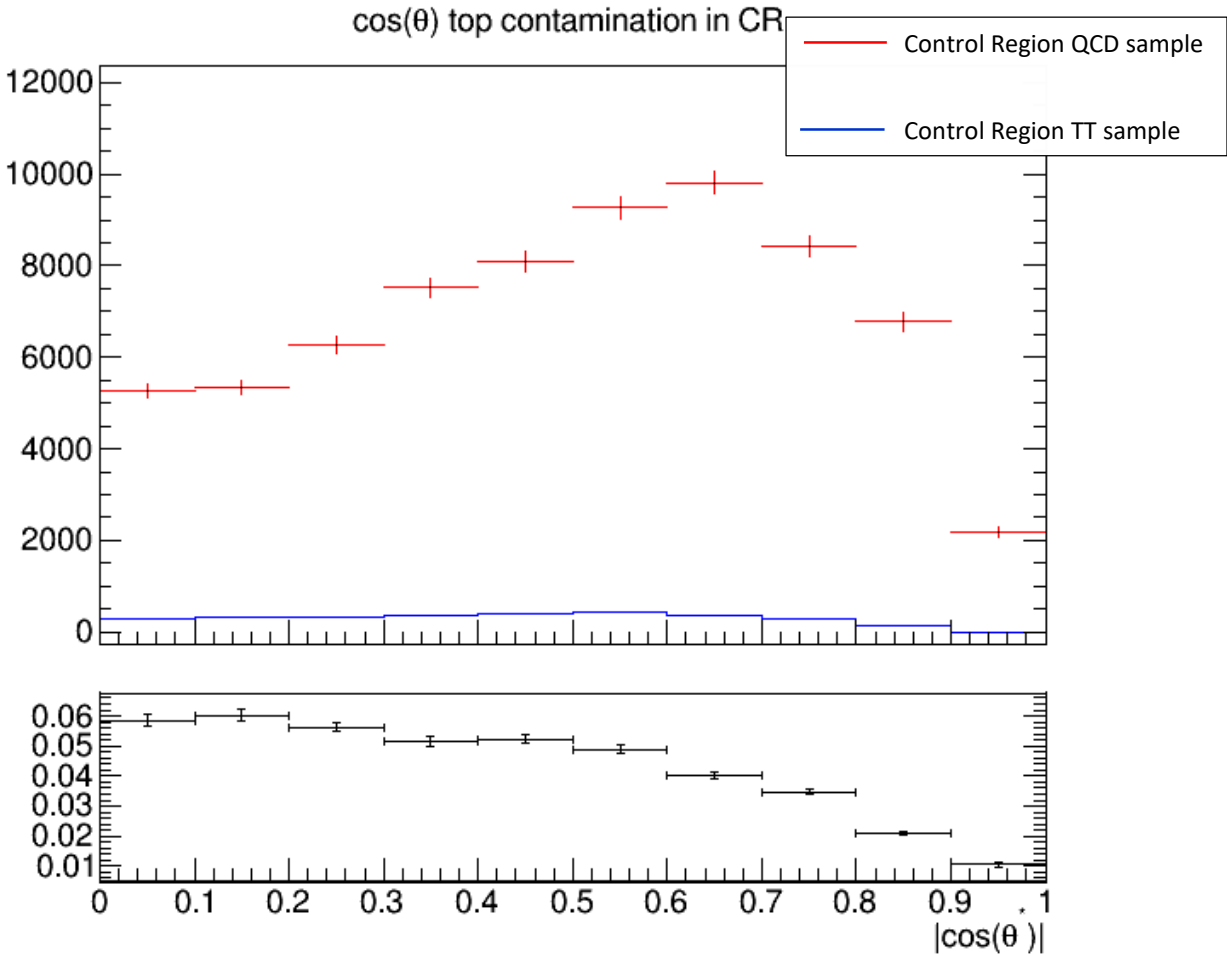




Control Region Contamination

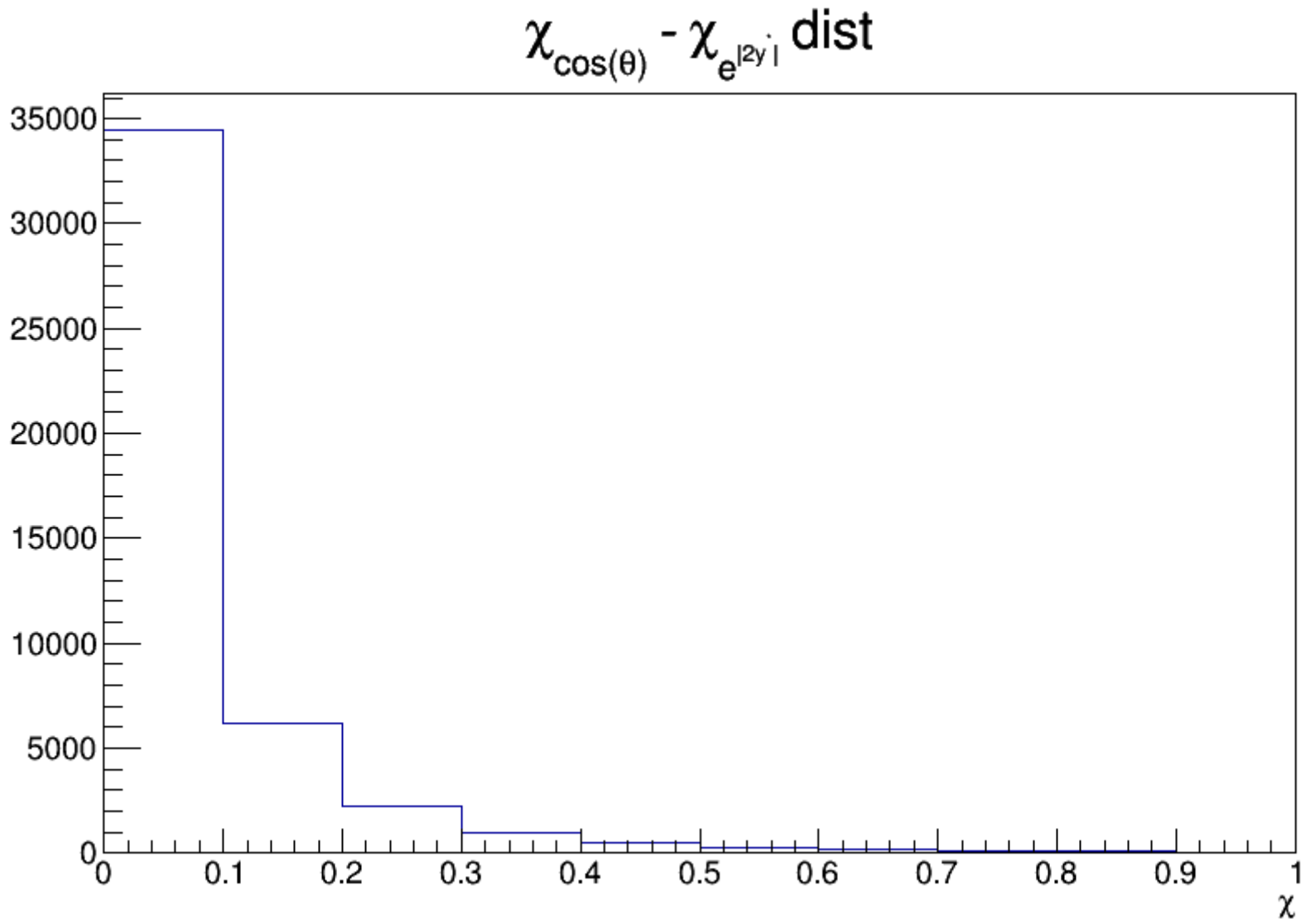
- Expected yield from QCD Bkg samples and TT Signal sample in the CR





Comparison on how to measure x value

- $e^{|2y^*|}$
- $\chi = \frac{1+|cos\theta^*|}{1-|cos\theta^*|}$



Measuring Chi in different ways in Parton and Reco Phase Space

- Measurement of chi
  - Using exponential and abs(y1-y2) in the Lab frame
  - Using exponential and abs(y1'-y2') in the ZMF
  - Using cos(theta)