Status Report
TTbar resonances
Angular Distributions

NTUA

GEORGE BAKAS

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 > 500*, |partonEta|< 2.4, mTTbarParton > 1000
  - Reco: jetPt>500, |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 {1,2,3,4,5,6,8,10,13,16} as variable binning

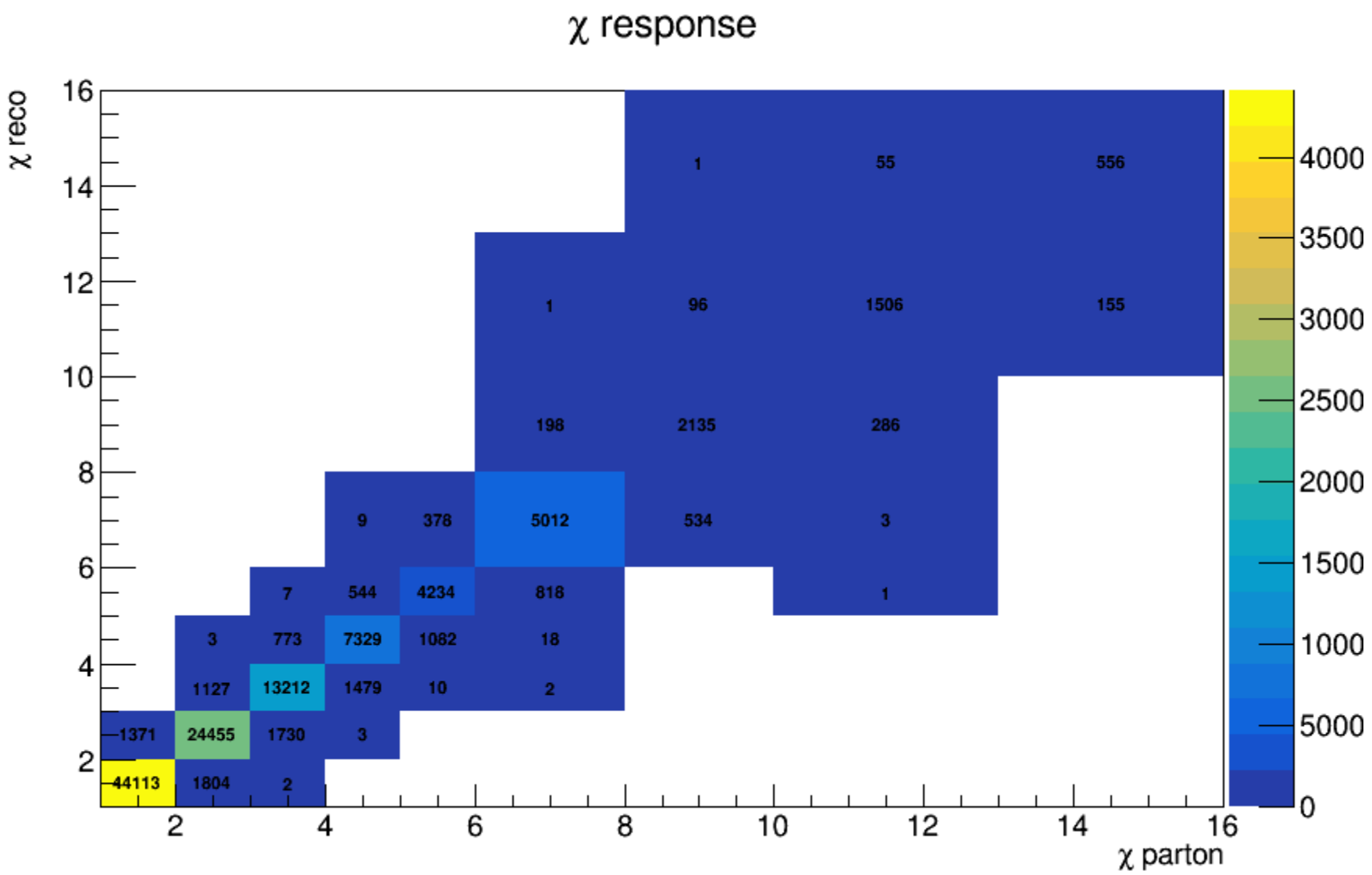
- The same binning is then used to find the response matrices in different mass (mTTbar) regions
  - [1000-1600]GeV
  - [1600-2200]GeV
  - [2200-3000]GeV
  - [3000-3600]GeV
  - [3600-6000]GeV

- Stability, Efficiency for χ distribution

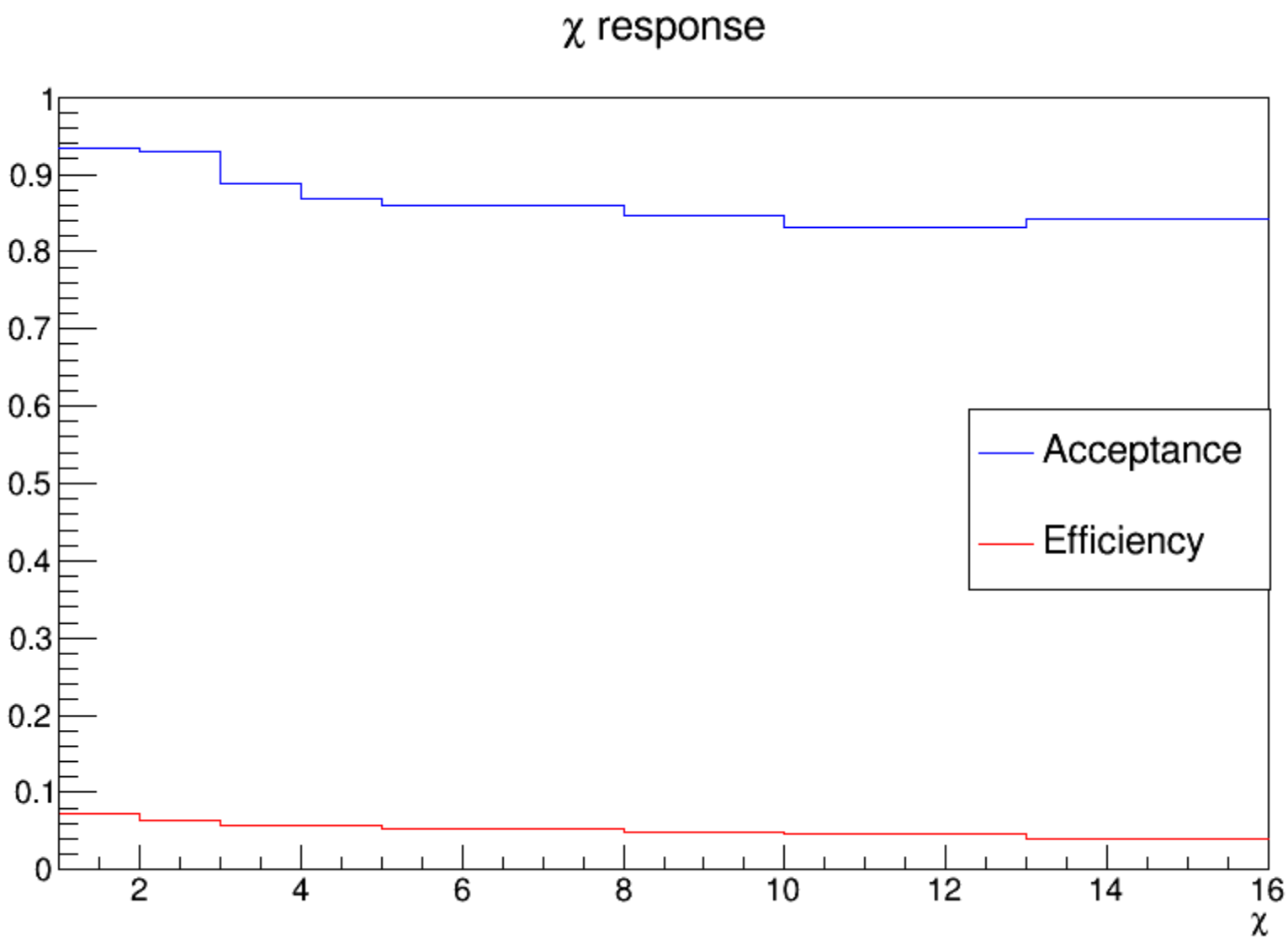
- Acceptance and purity for χ

*By applying the Pt to be more than 500, we get more similar results with ATLAS

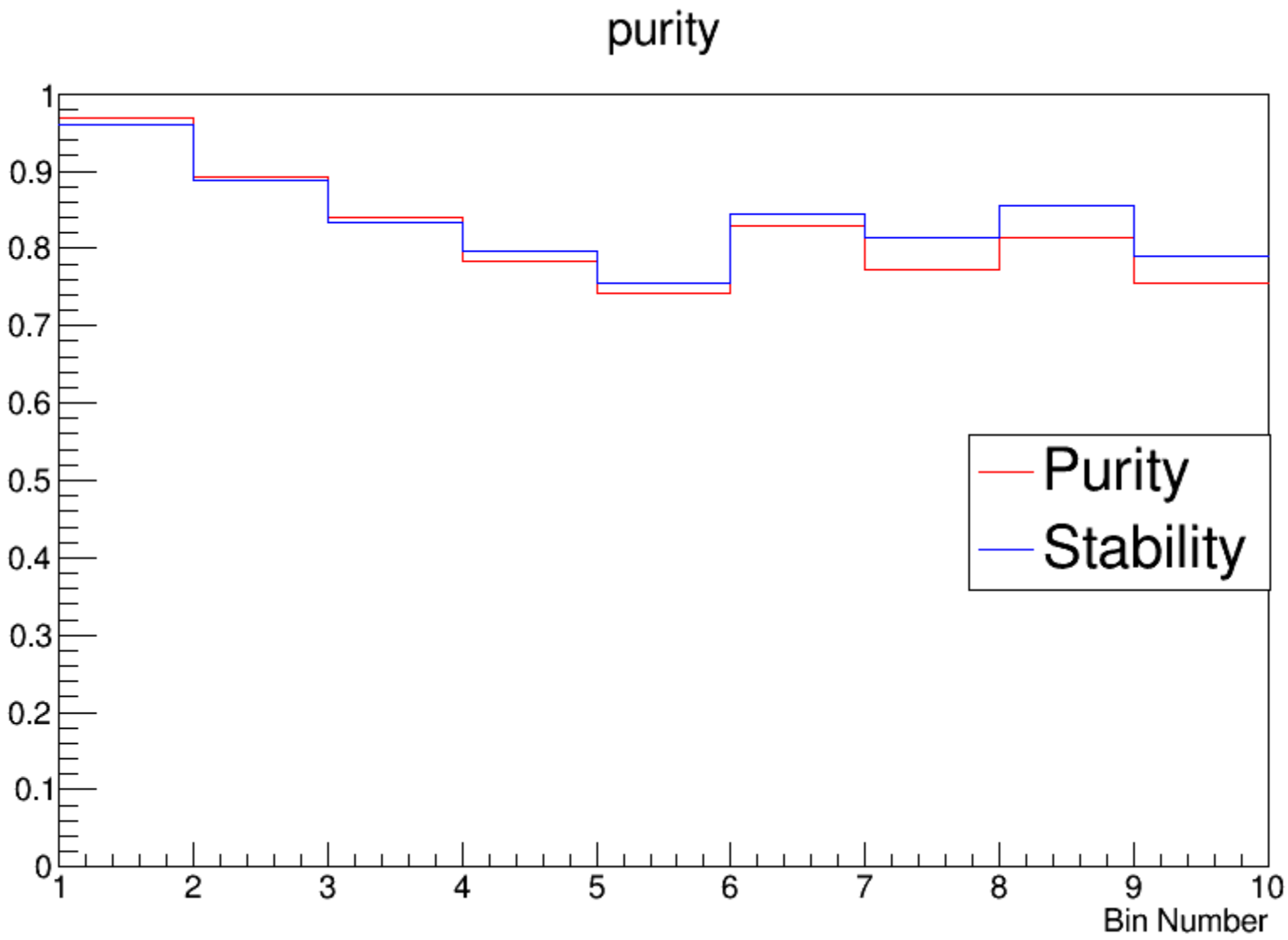
Response Matrix for χ

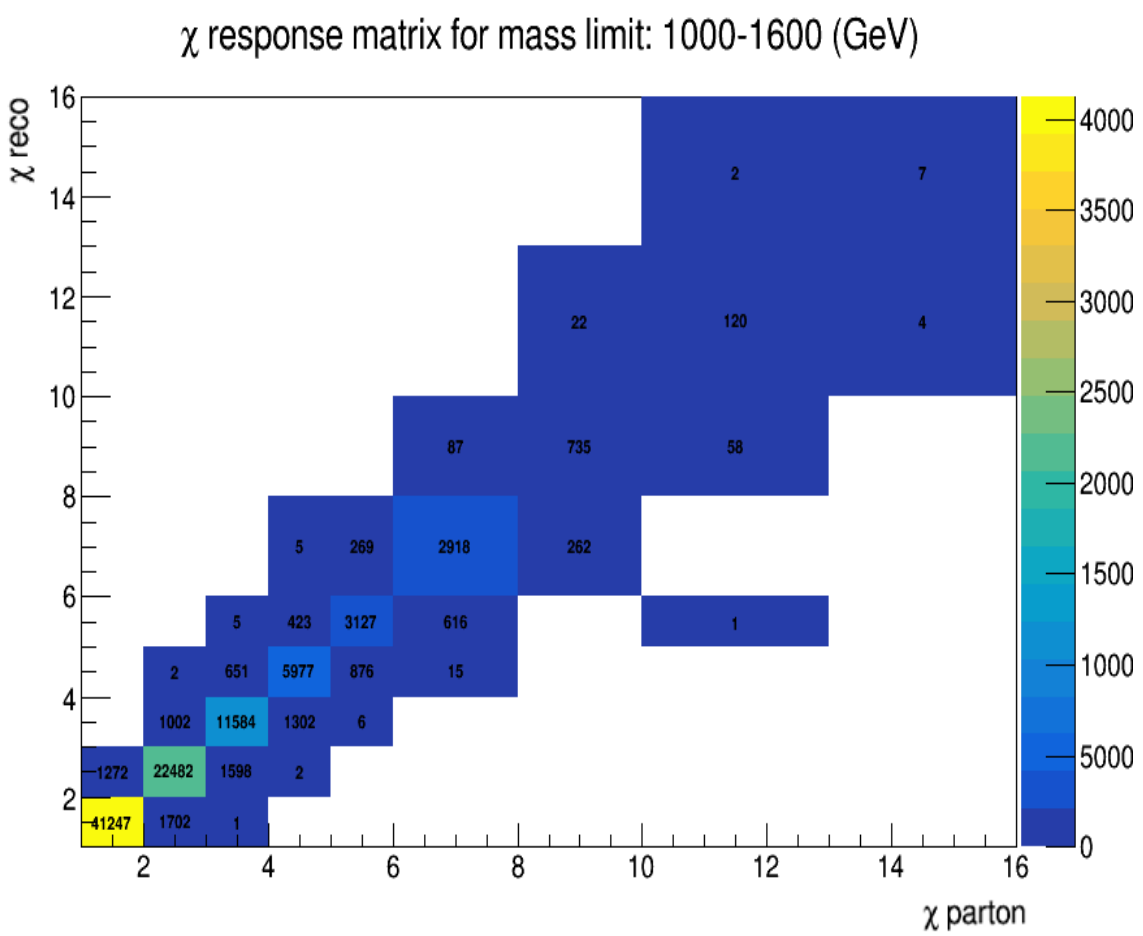


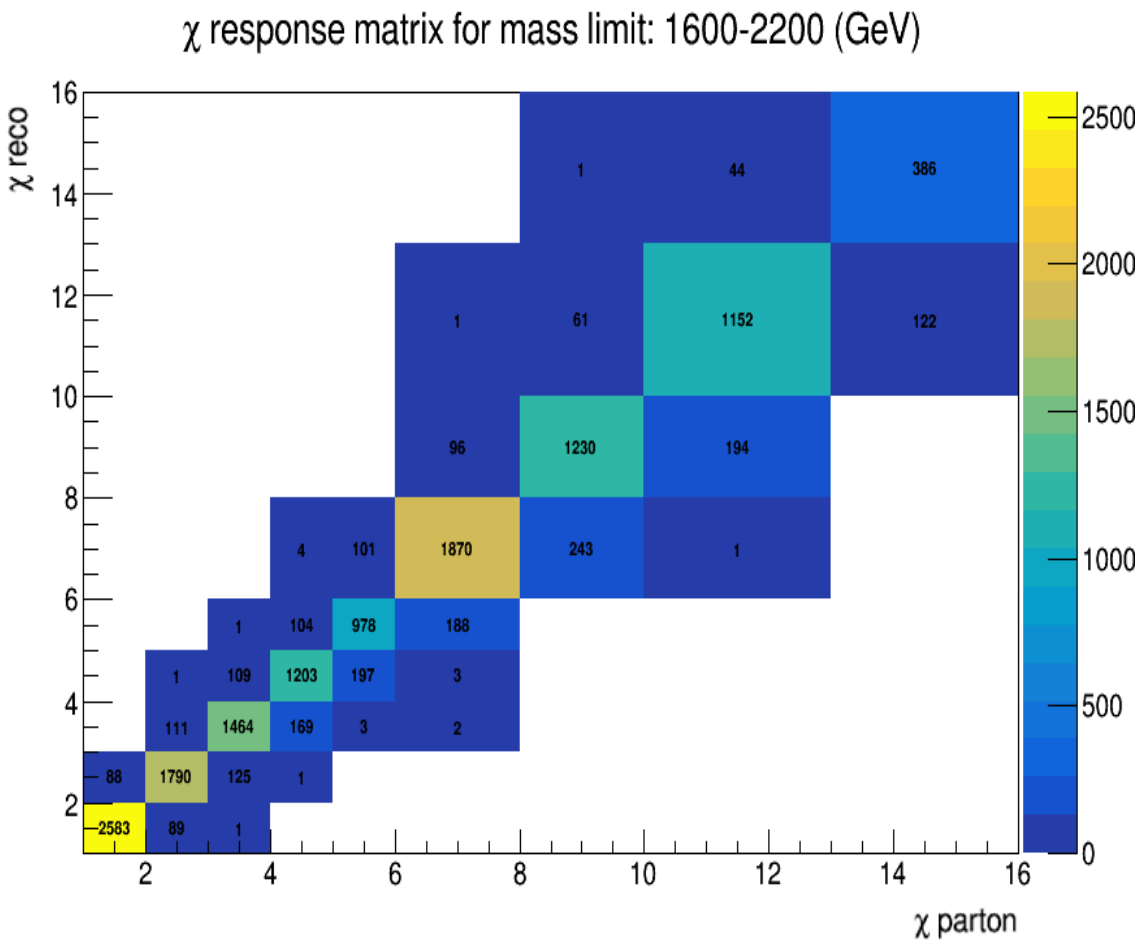
Efficiency and Acceptance for chi distribution

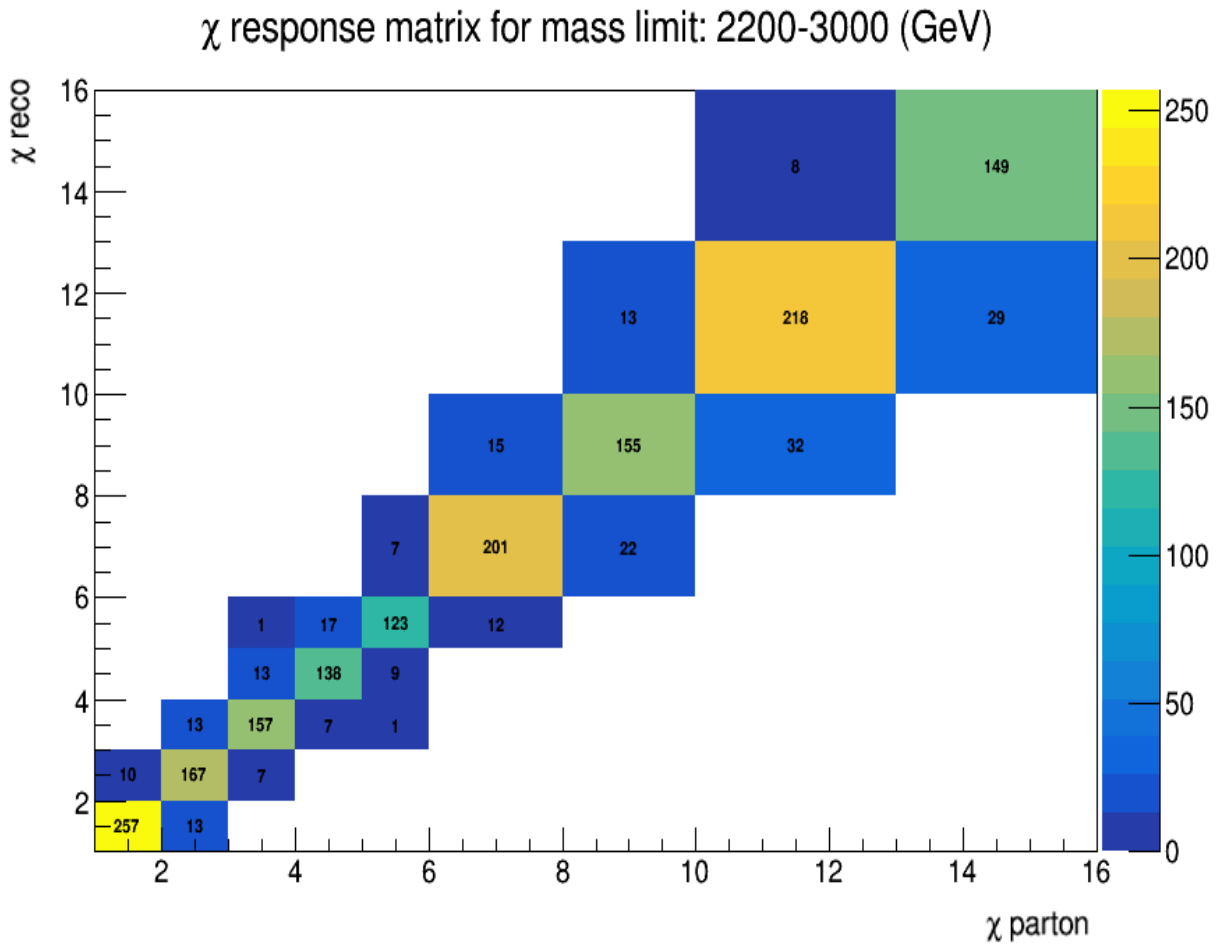


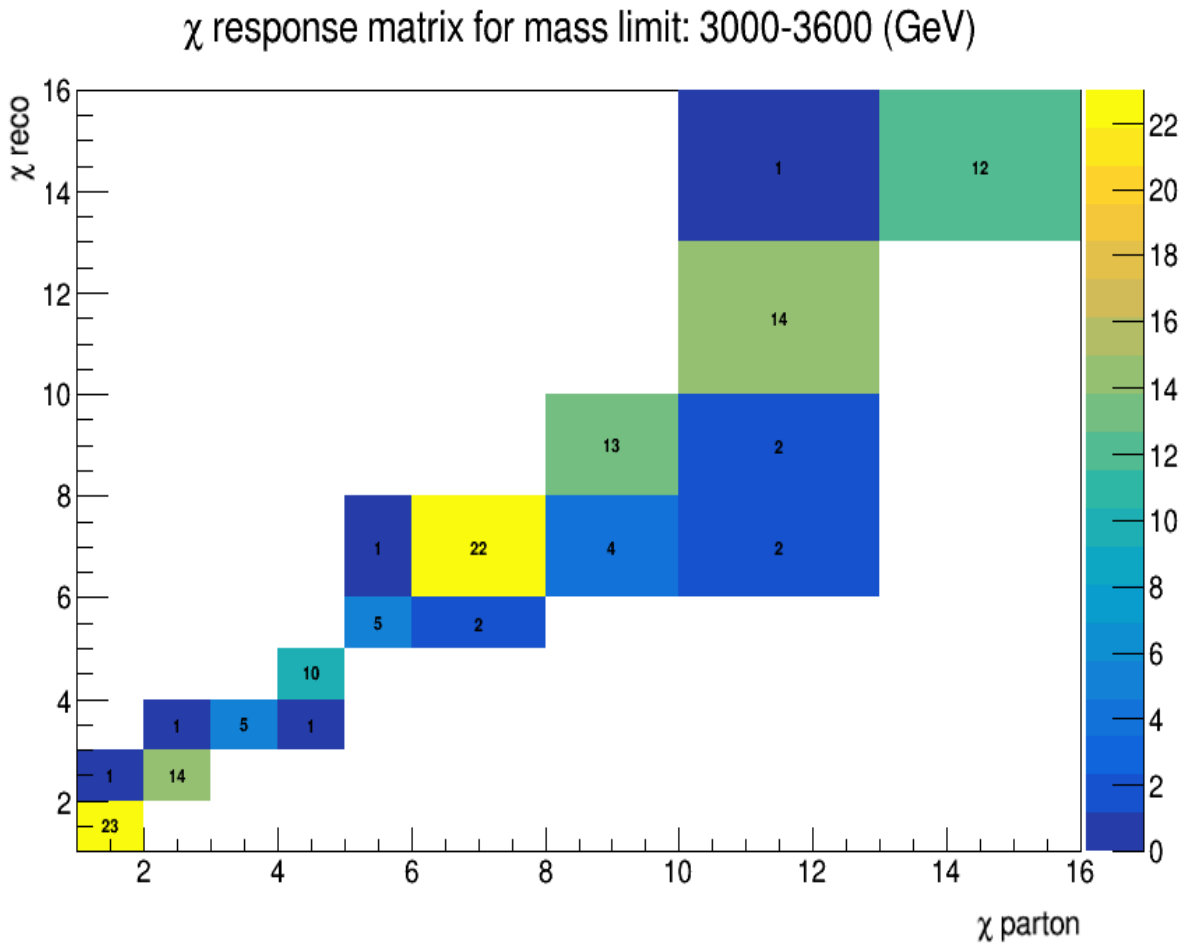
Purity and Stability for chi distribution

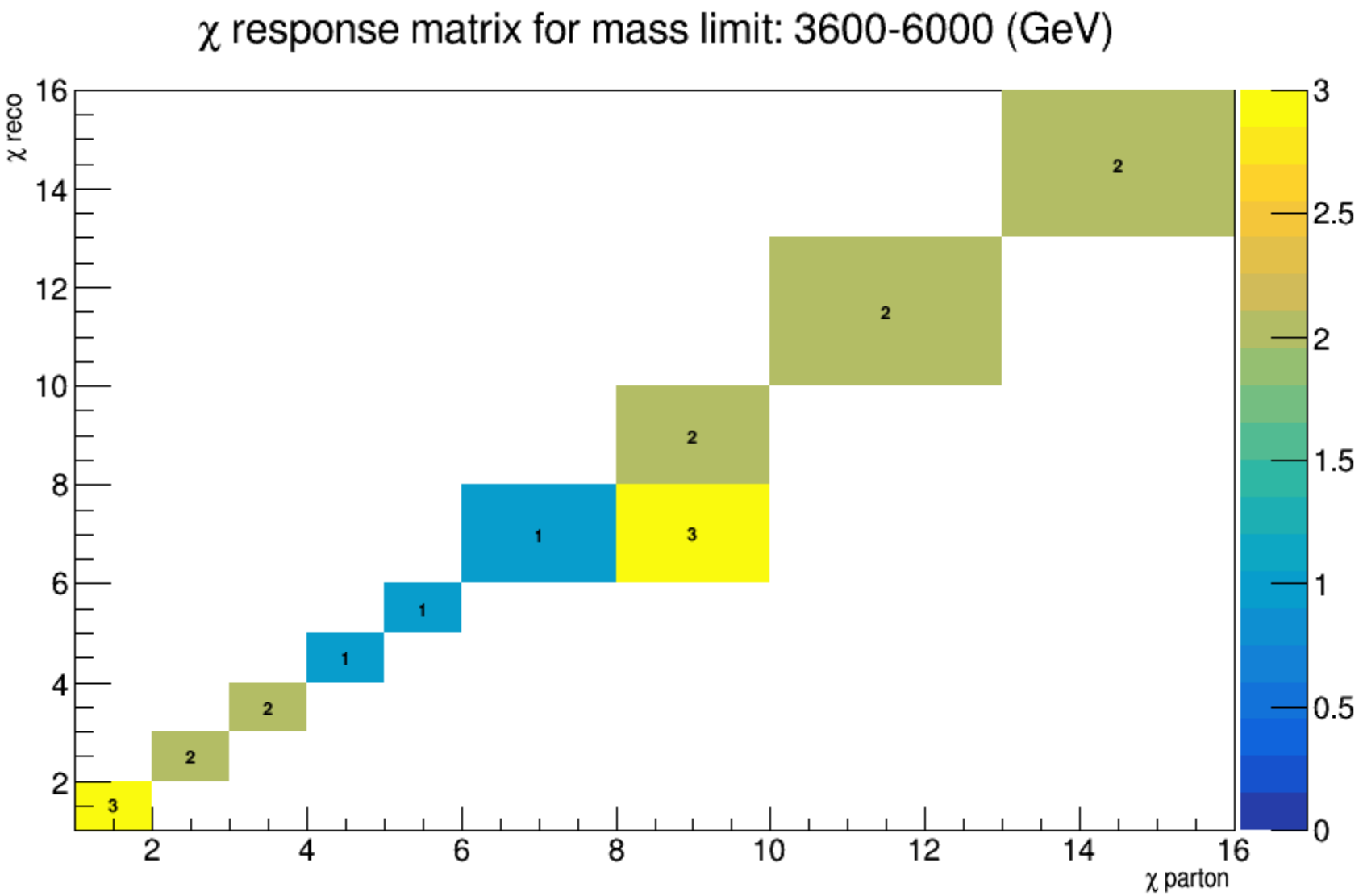



χ response matrix for mass limit: 1000-1600 (GeV)
χ reco
χ parton
2 7
22 120 4
87 735 58
5 269 2918 262
5 423 3127 616 1
2 651 5977 876 15
1002 11584 1302 6
1272 22482 1598 2
41247 1702 1
0 500 1000 1500 2000 2500 3000 3500 4000

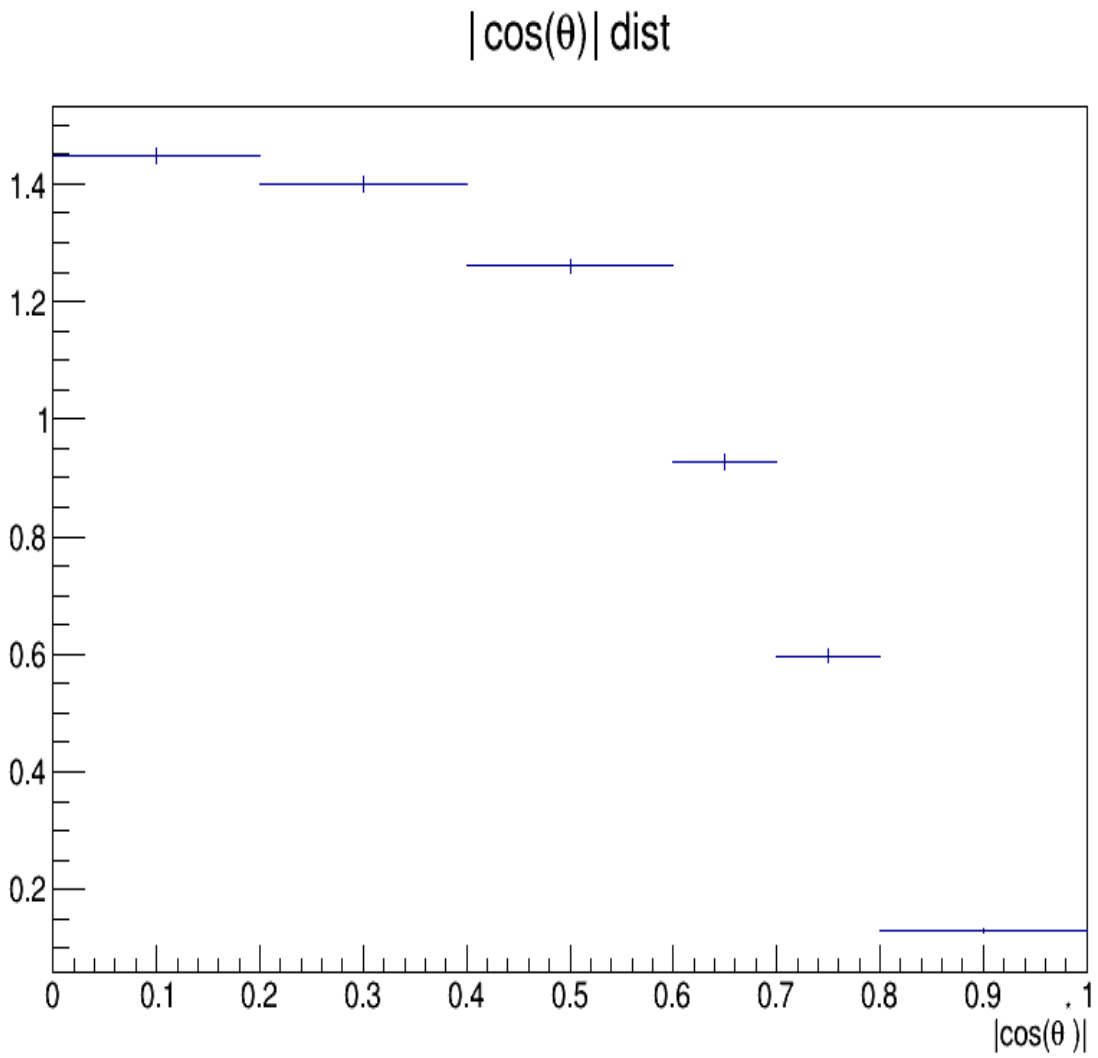

χ response matrix for mass limit: 1600-2200 (GeV)
χ reco
χ parton
1 44 386
1 61 1152 122
96 1230 194
4 101 1870 243 1
1 104 978 188
1 109 1203 197 3
111 1464 169 3 2
88 1790 125 1
2583 89 1
0 500 1000 1500 2000 2500

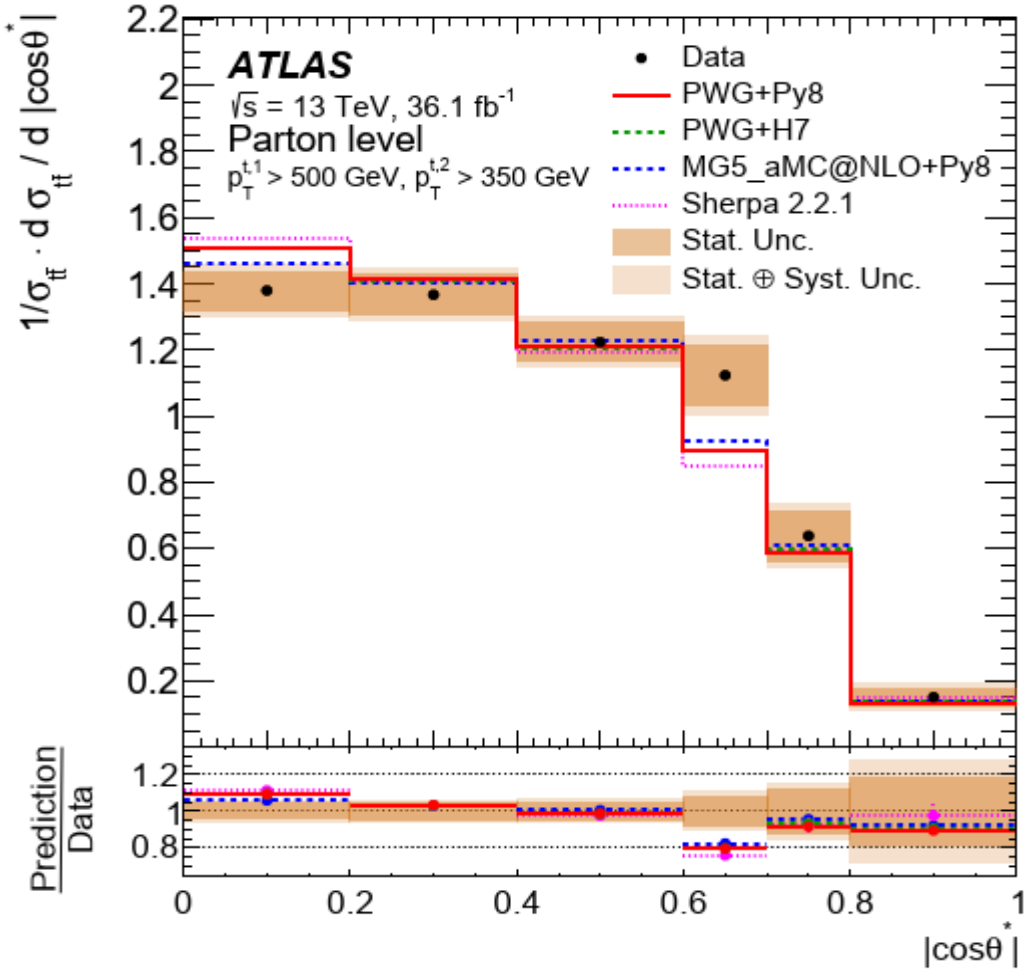

χ response matrix for mass limit: 2200-3000 (GeV)
χ reco
χ parton
8
149
13
218
29
15
155
32
7
201
22
1
17
123
12
13
138
9
13
157
7
1
10
167
7
257
13


χ response matrix for mass limit: 3000-3600 (GeV)
χ reco
χ parton
1
12
14
13
2
1
22
4
2
5
2
10
1
5
1
1
14
23

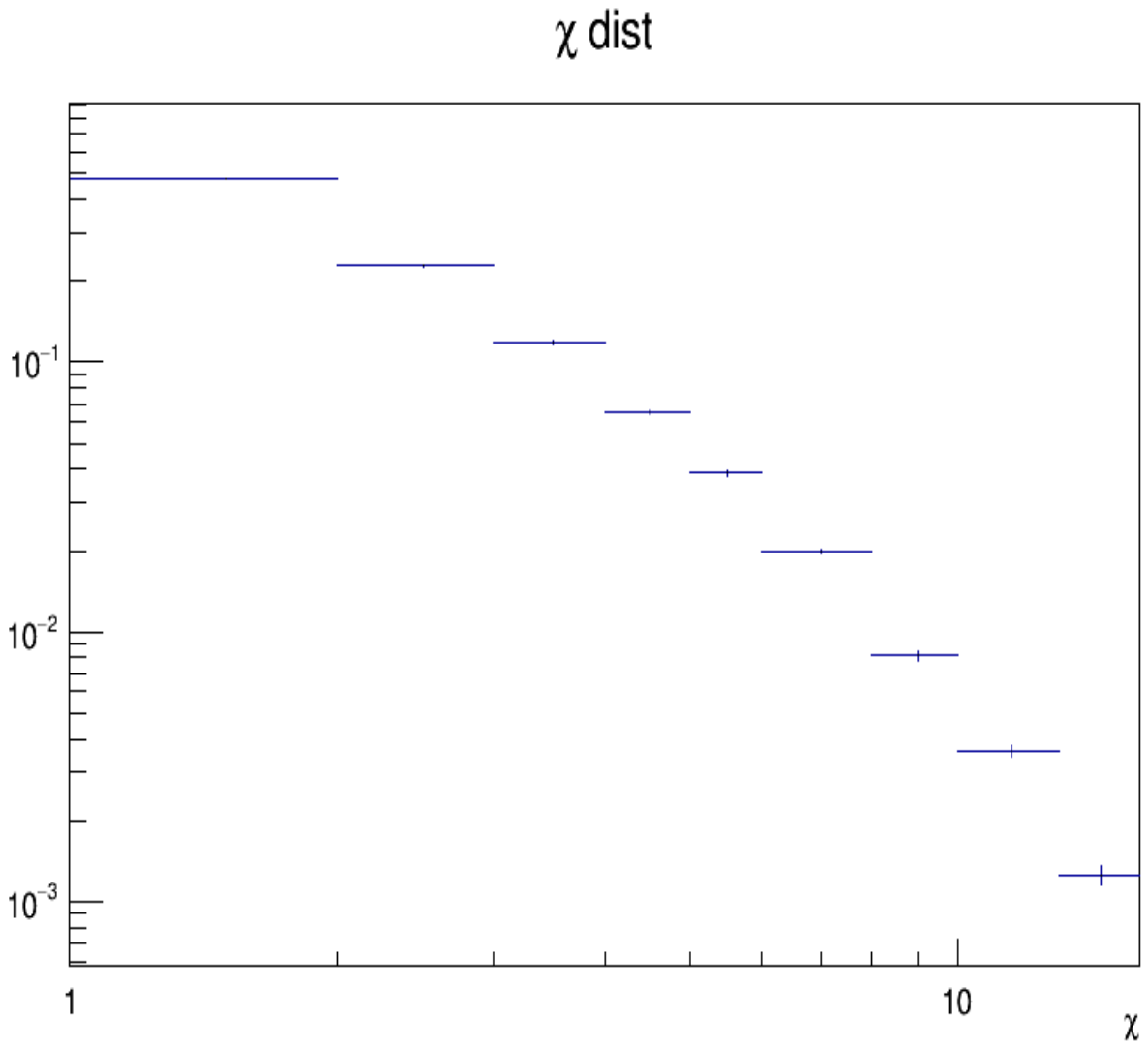

χ response matrix for mass limit: 3600-6000 (GeV)
χ reco
χ parton
16
14
12
10
8
6
4
2
2
4
6
8
10
12
14
16
3
2.5
2
1.5
1
0.5
0
3
2
2
1
1
1
3
2
2
2

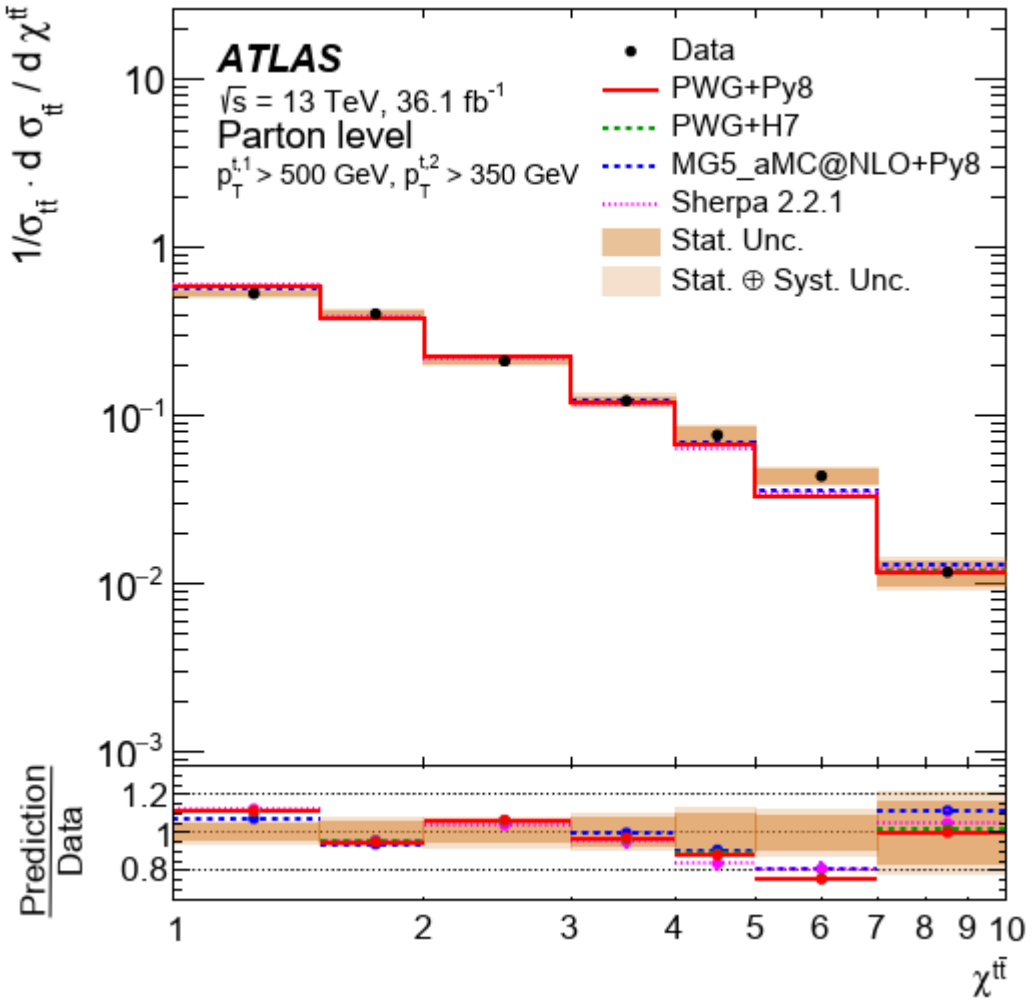
Comparisons with ATLAS |cosθ| distributions





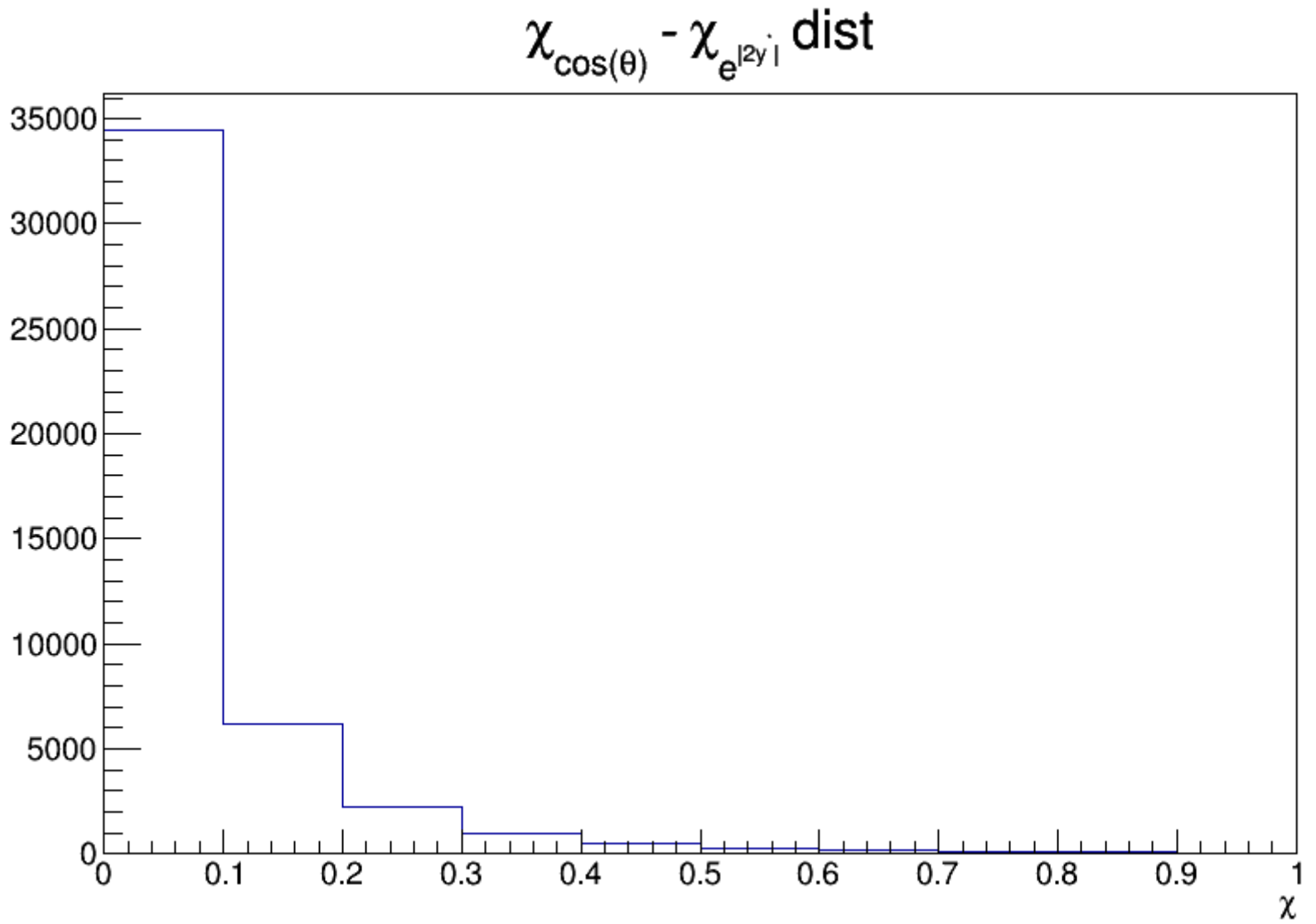
Comparisons with ATLAS χ distributions





Comparison on how to measure x value

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



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?