Inclusive CaloJet Properties from 900 GeV collisions

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Outline

- Event & jet quality criteria
- Jet kinematic properties
- Jet internal structure
- Data vs MC comparisons

Motivation

✦ Inclusive jet analysis: p + p → Jet + X.

✦ Select an inclusive jet sample which is as pure as possible and compare the jet properties between data and MC.

✦ Revisit the basic jet quality criteria (“jet ID”) for inclusive jets @ 900 GeV.

✦ The material presented here will be included in an AN-Note (under preparation).

Data Samples

✦ Data sample (primary dataset):
/MinimumBias/BeamCommissioning09-Dec19thReReco_336p3-v2/RECO

✦ Data sample (secondary dataset):
/MinimumBias/BeamCommissioning09-SD_AllMinBias-Dec19thSkim_336p3-v1/RAW-RECO
The skim is requiring that the **HLT_PhysicsDeclared** bit is true (stable LHC beams & tracker HV at nominal values).

✦ MC sample:
/MinBias/Summer09-STARTUP3X_V8I_900GeV-v2/GEN-SIM-RECO

IMPORTANT: the Data and MC reconstruction is not identical !!!!

Event Selection

✦ Runs:

122314, 123575, 123586, 123587, 123591,123592, 123596, 123600, 123603, 123606, 123608, 123615, 123732, 123740, 123801, 123815, 123818, 123893, 123906, 123908-123910, 123997, 124008, 124009, 124017, 124019, 124020, 124022-124027, 124029, 124030, 124108

✦ Technical Trigger Bits:

1. TT0 (consistent timing with LHC bunch crossing)
2. TT40 (activity in beam scintillators in both sides of CMS)
3. NOT (TT36 OR TT37 OR TT38 OR TT39) reject beam halo events

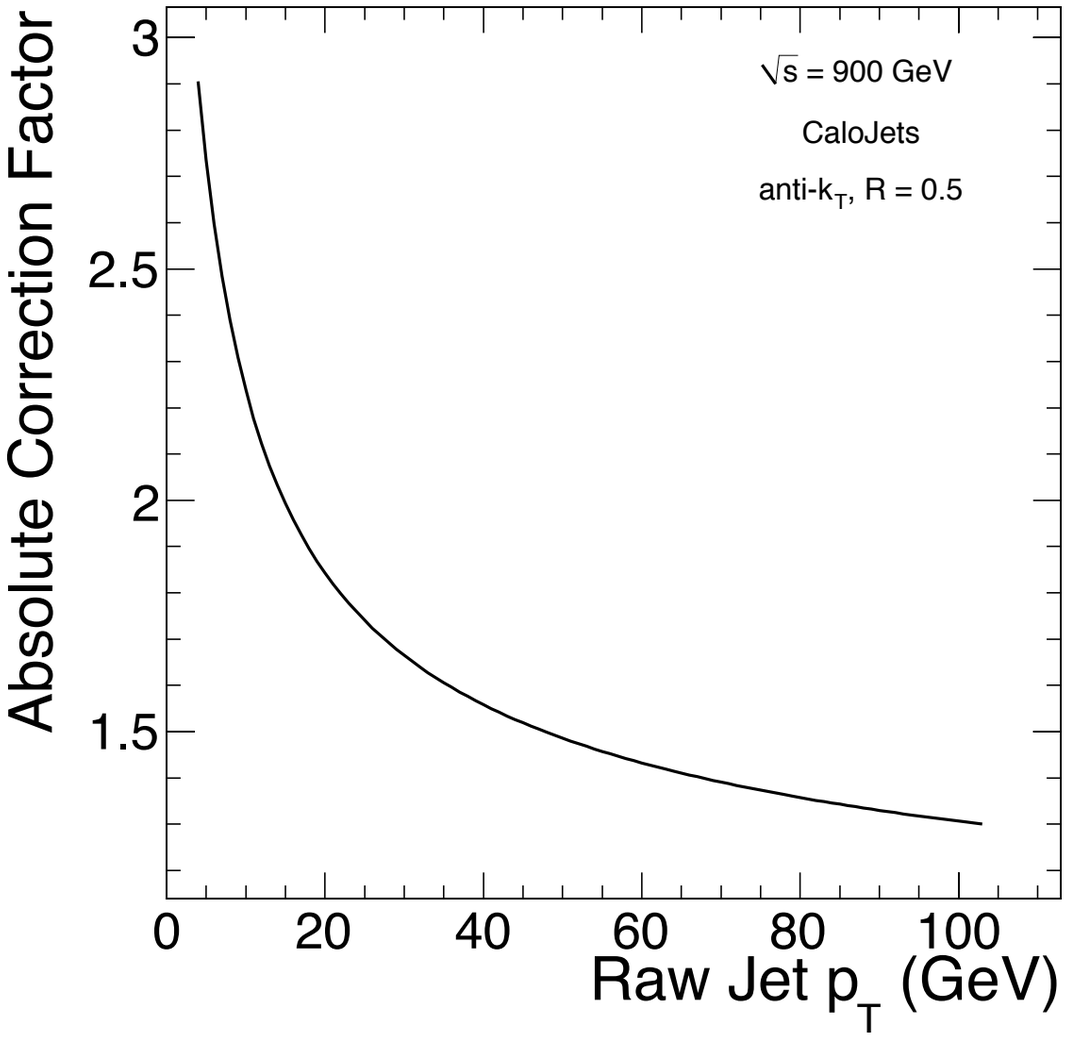
✦ Primary Vertex (PV) requirements:

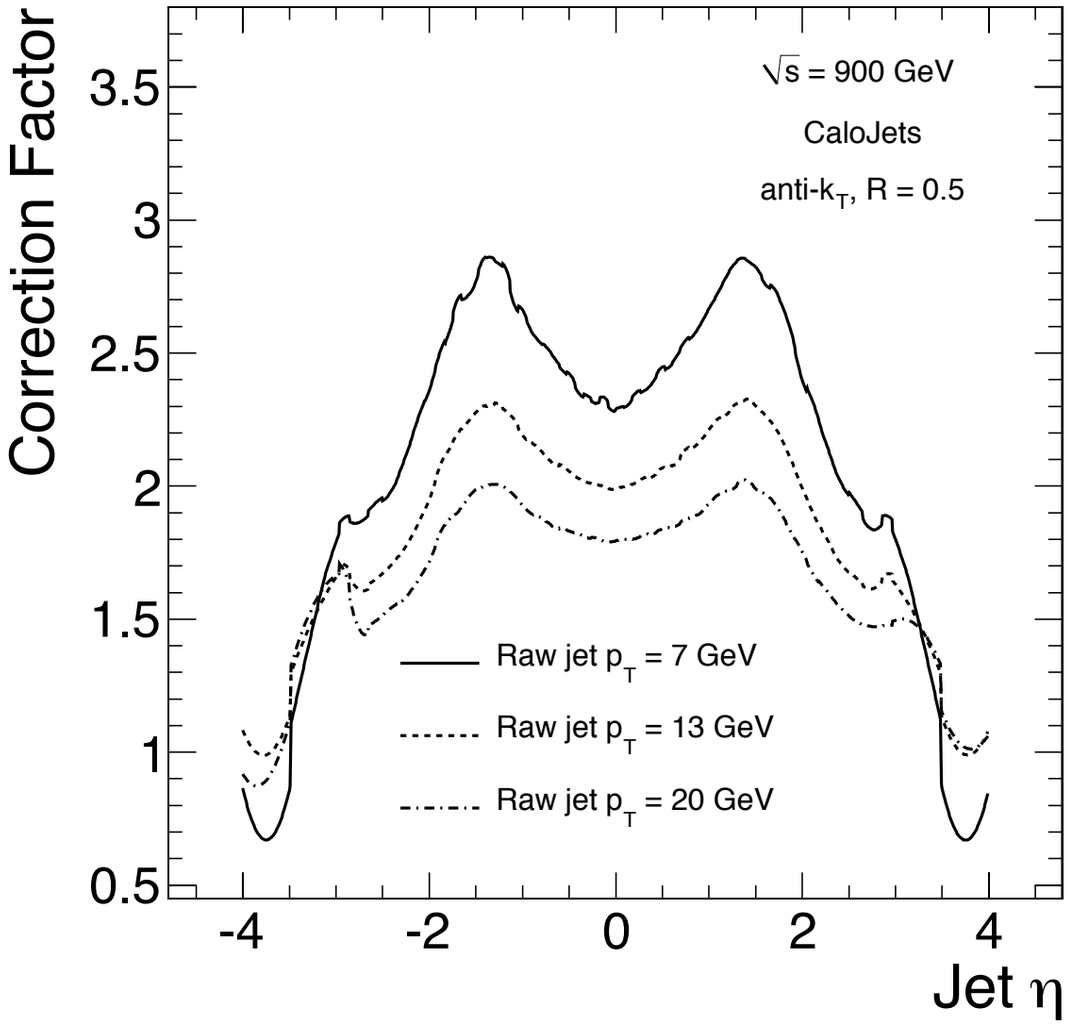
1. At least one valid PV
2. $|PVz| < 20$ cm

Jet Definitions

1. EMF (electromagnetic energy fraction)
2. N90hits (number of rechits carrying 90% of the jet energy)
3. Physics η (pseudo-rapidity calculated with respect to the PV)
4. Detector η (pseudo-rapidity calculated with respect to (0,0,0))
5. fHPD (fraction of jet energy carried by the “hottest” HPD)
6. fRBX (fraction of jet energy carried by the “hottest” RBX)
7. N90 (number of CaloTowers carrying 90% of the jet energy)
8. σ_η,σ_ϕ (E_T weighted spread of the jet energy inside the jet cone)
9. NtrkVtx (number of tracks associated to a jet at the vertex)
10. NtrkCalo (number of tracks associated to a jet at the calo face)

Jet Energy Calibration





Jet Selection

"Loose" jet id: (EMF > 0.01 & N90hits > 1 & fHPD < 0.98)

Acceptance cuts

1. | Detector η | < 2.6
2. Corrected Jet p_T > 20 GeV

3. EMF > 0.01
4. N90hits > 2
5. fHPD < 0.98
6. fRBX < 0.98
7. σ_η, σ_ϕ > 0.01

Id cuts

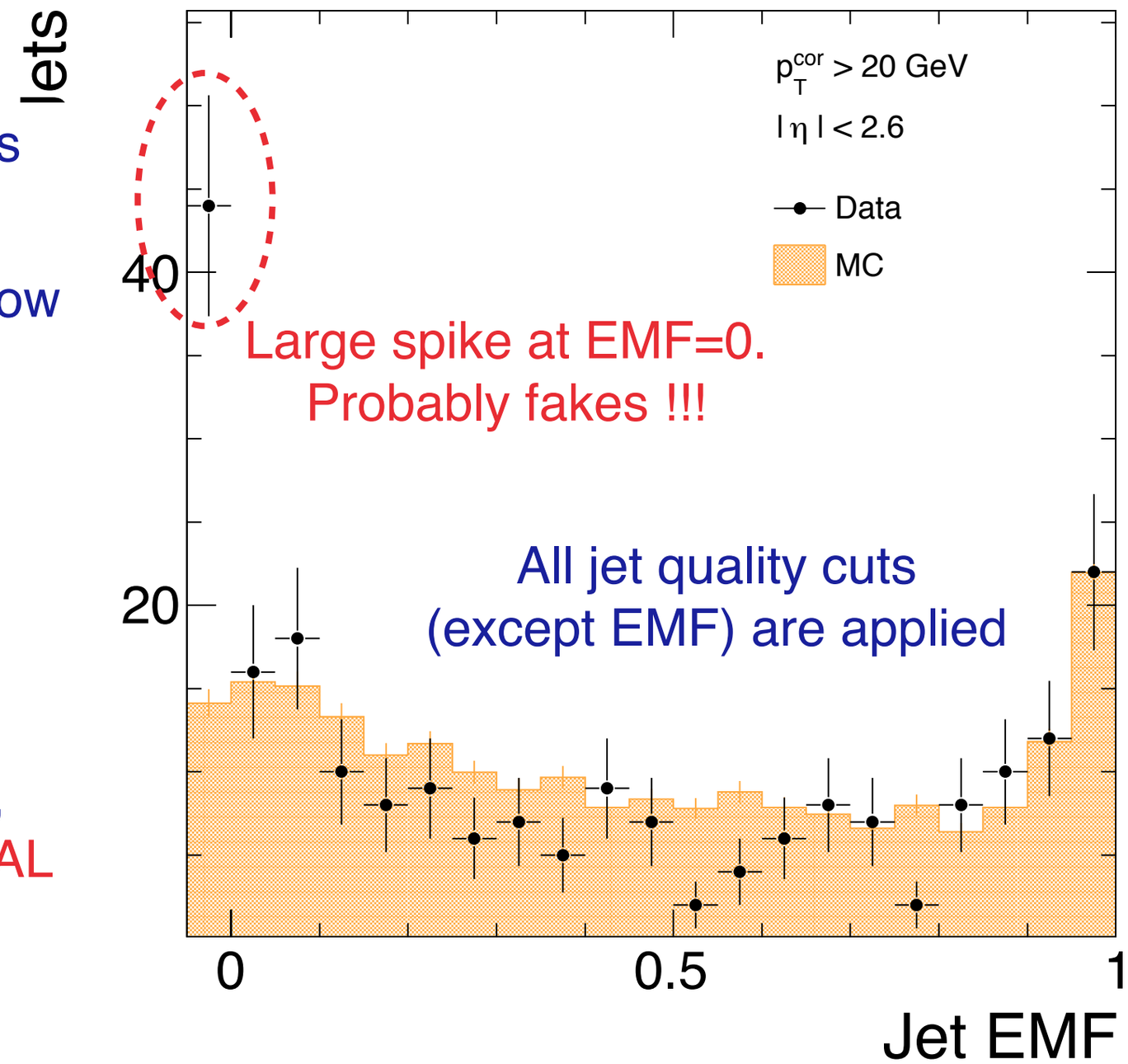
Selection	Data	MC
η, p_T	415 (100%)	6,036 (100%)
EMF	282 (67%)	4,620 (76%)
N90hits	180 (43%)	4,258 (70%)
fHPD,fRBX	179 (43%)	4,208 (69%)
σ_η, σ_ϕ	176 (42%)	4,192 (69%)

✦ The inclusive jet selection criteria cannot rely on "good jet enrichment" based on Physics selection (e.g. dijet topology).

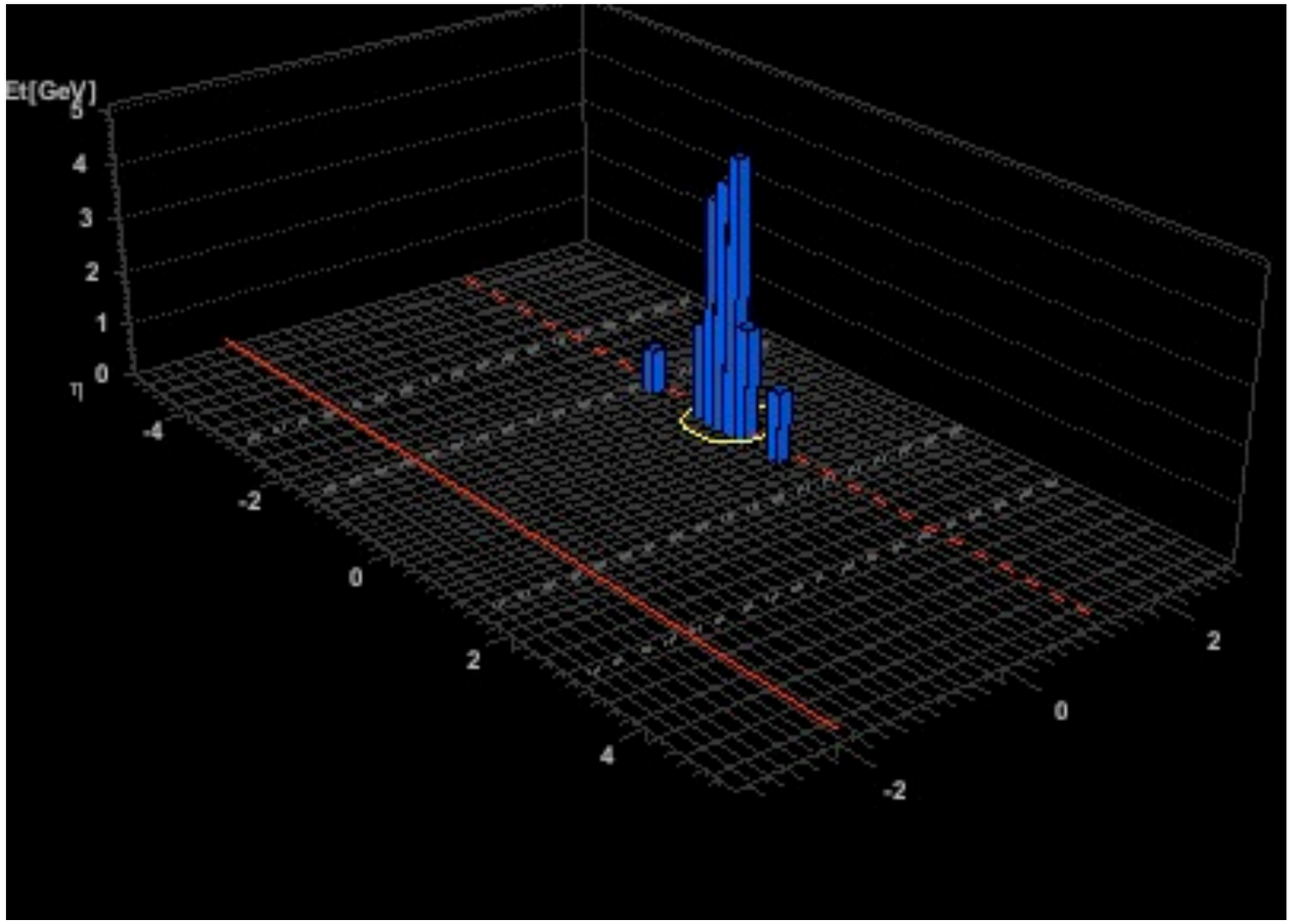
✦ For the inclusive jet analysis, the existing standard Jet ID definition ("loose") must be extended.

Jet Selection Justification (I)

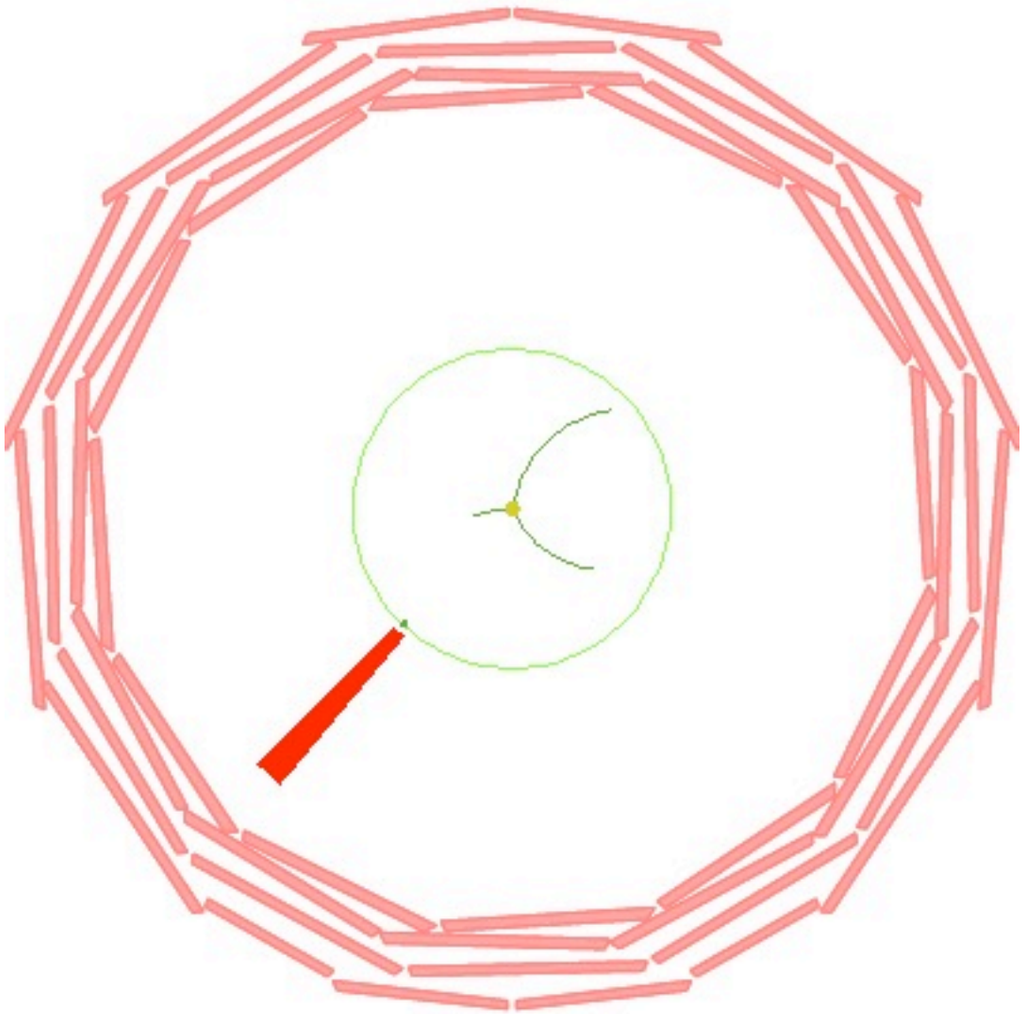
- ✦ The EMF > 0.01 cut removes jets from HCAL noise.
- ✦ Recent studies indicate that for low p_T jets this cut may introduce inefficiency.
- ✦ The large spike at EMF=0 in the data cannot be eliminated, even if every other cut is applied.
- ✦ Despite the possible inefficiency, this cut is ABSOLUTELY ESSENTIAL for a pure data sample.



Jet Selection Justification (II)

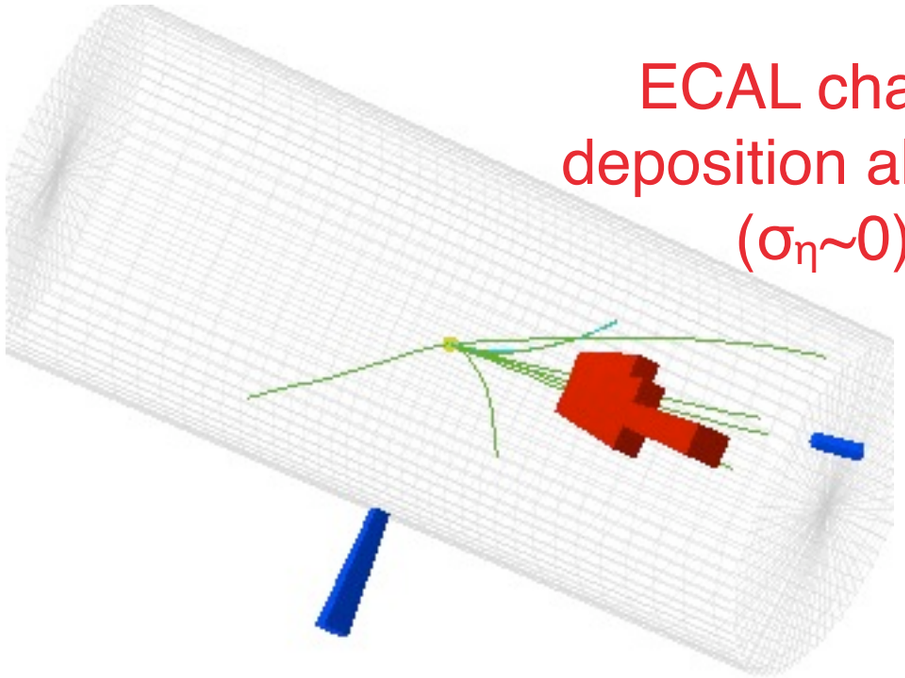


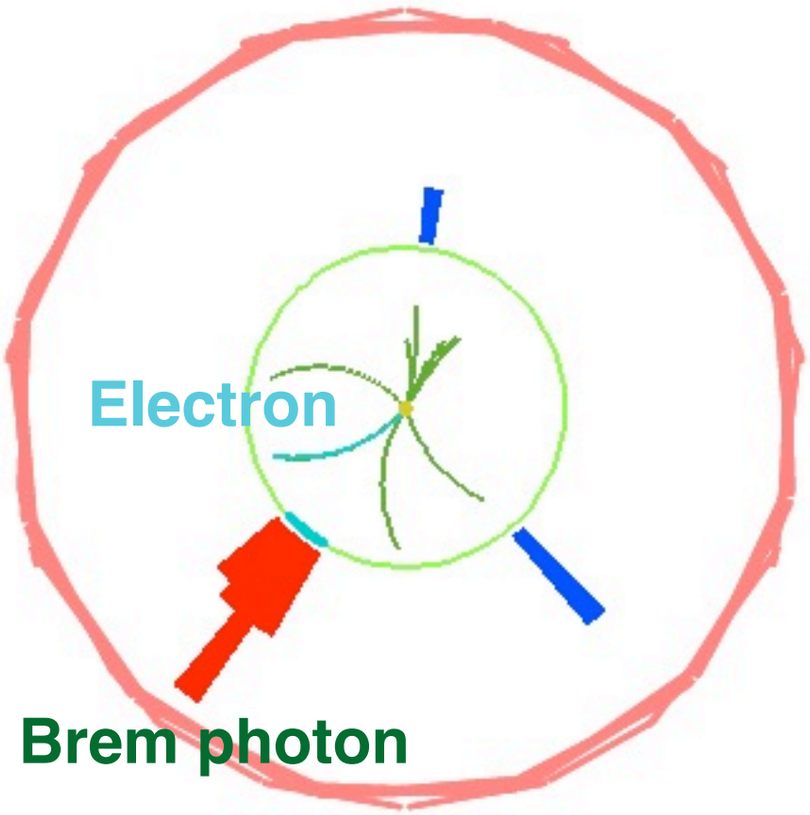
ECAL "spike": removed by N90hits



- ✦ HPD noise: extended HCAL only signal in fixed ϕ
- ✦ RBX noise: extended HCAL only signal in 4 ϕ slices
- ✦ Removed by EMF, fHPD, fRBX

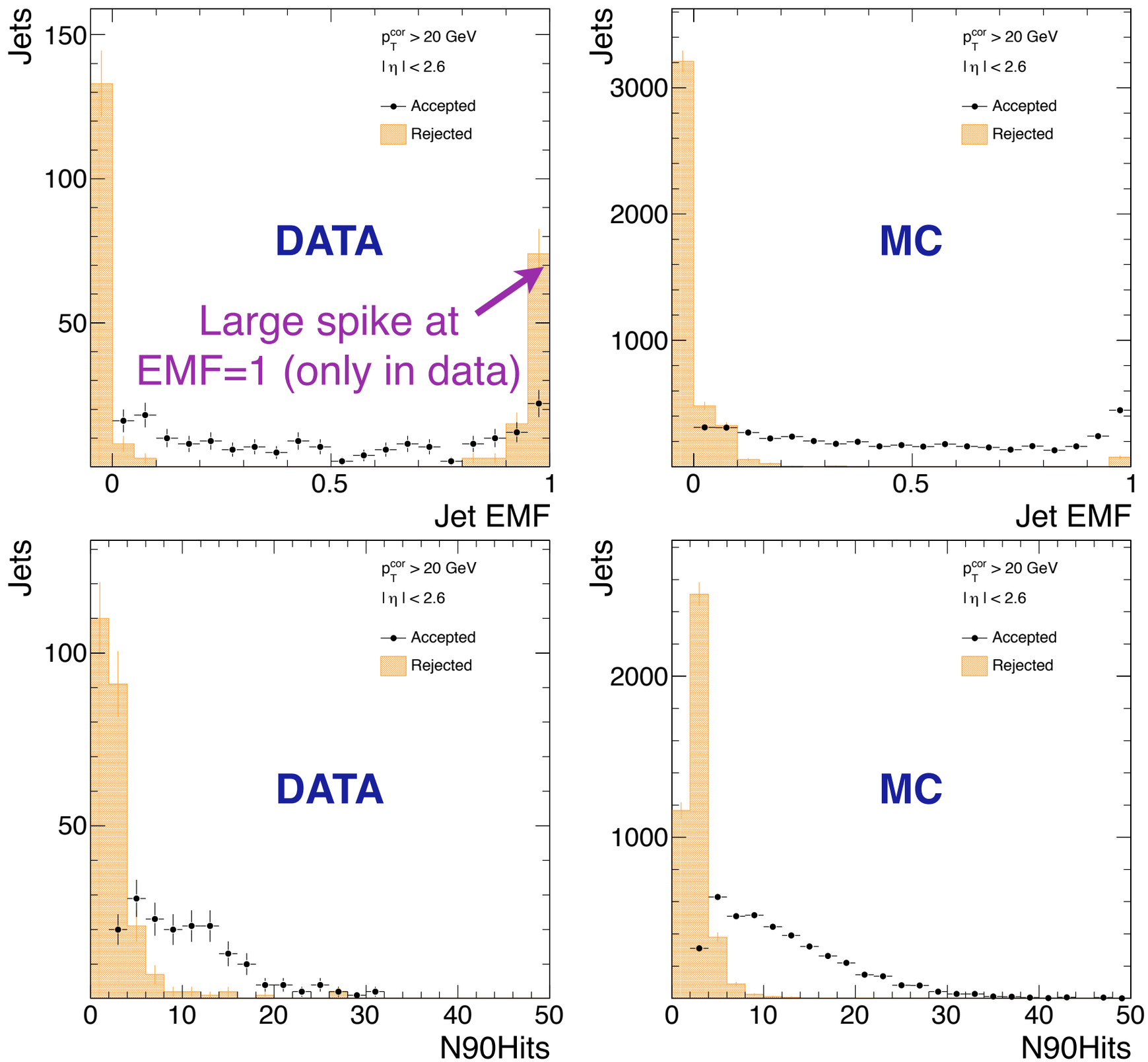
Jet Selection Justification (III)



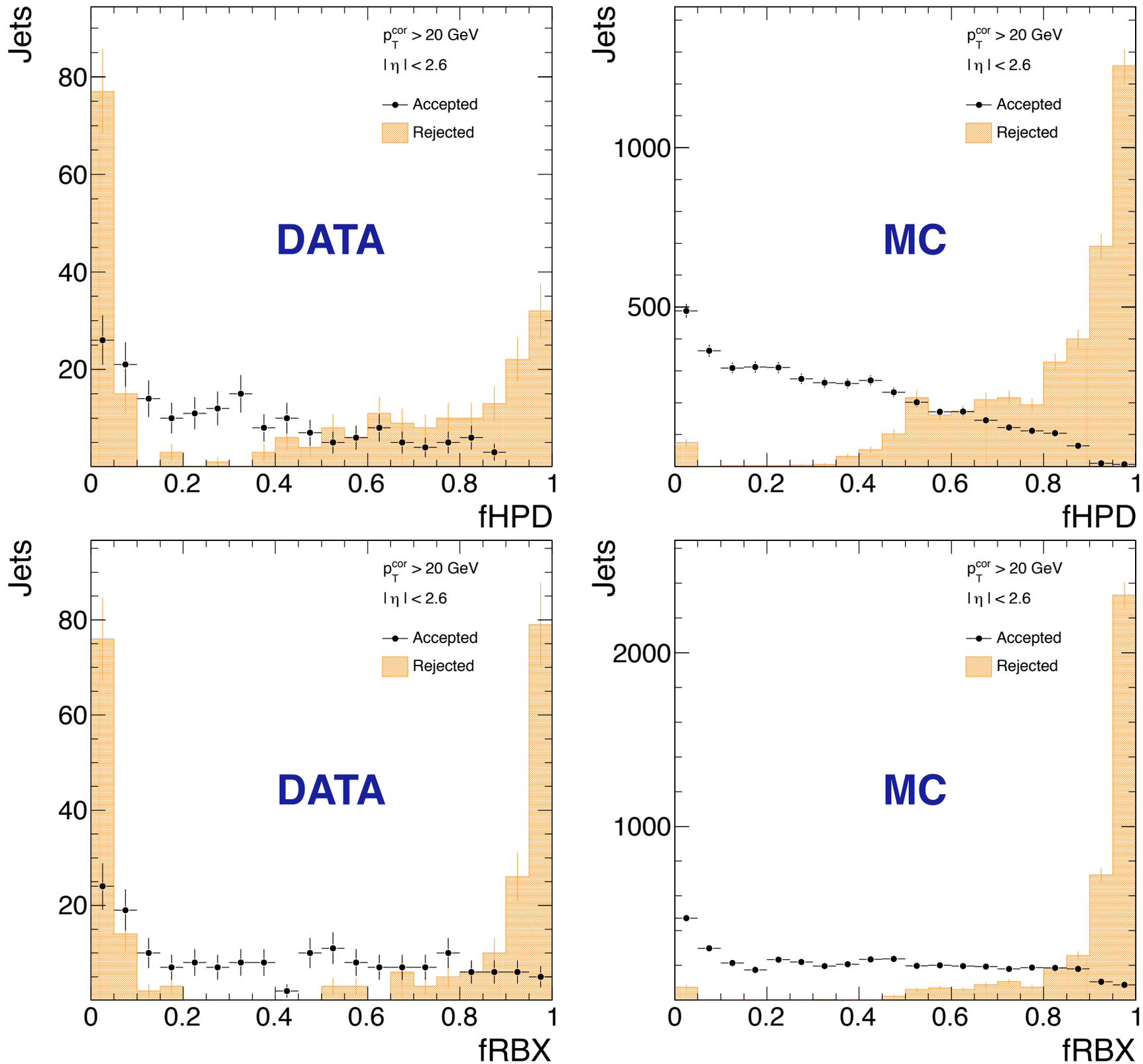


- ✦ Photon candidates have different shape than jets.
- ✦ A minimum cut on σ_η, σ_ϕ can eliminate them.

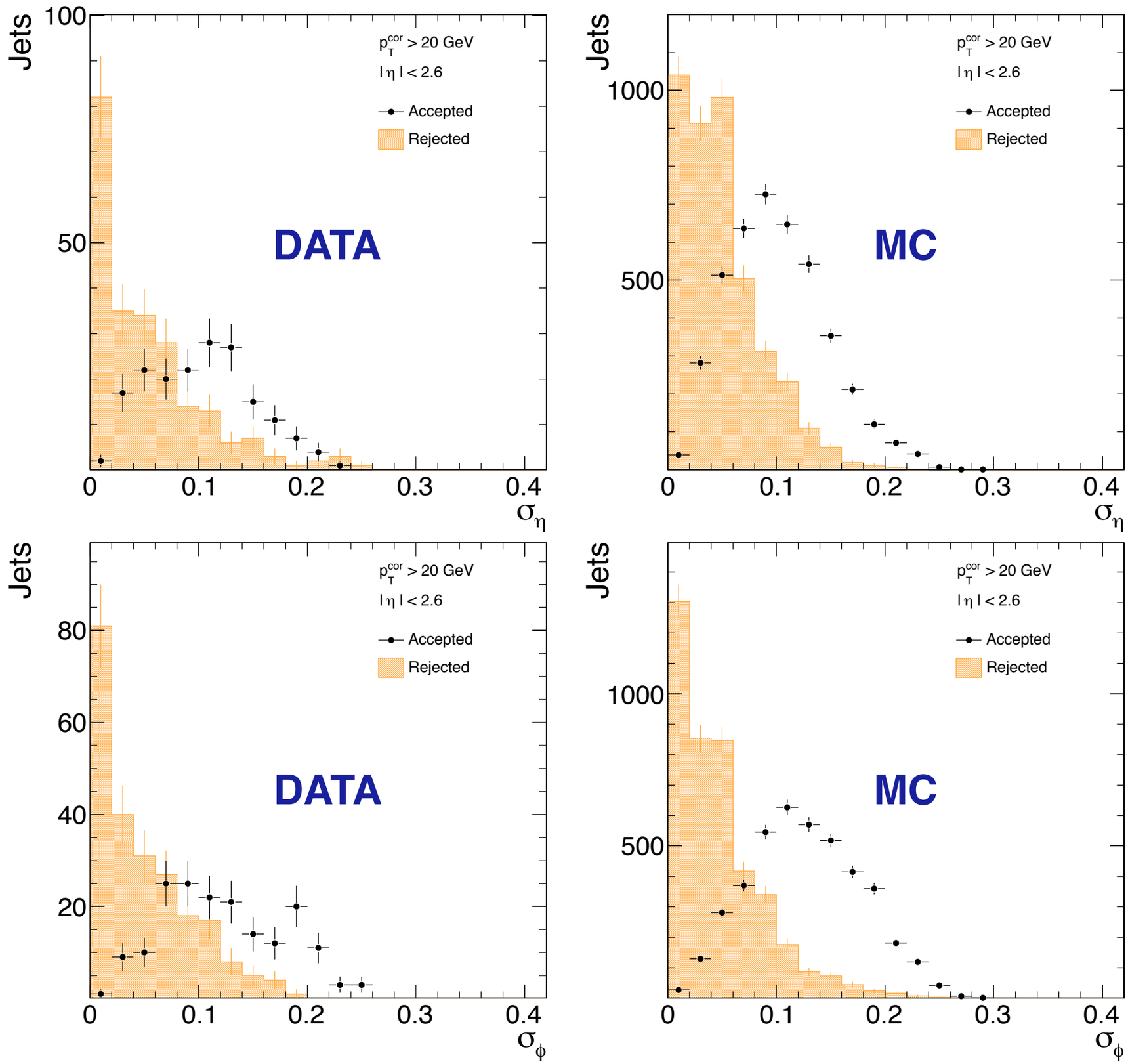
Accepted vs Rejected (EMF, N90Hits)



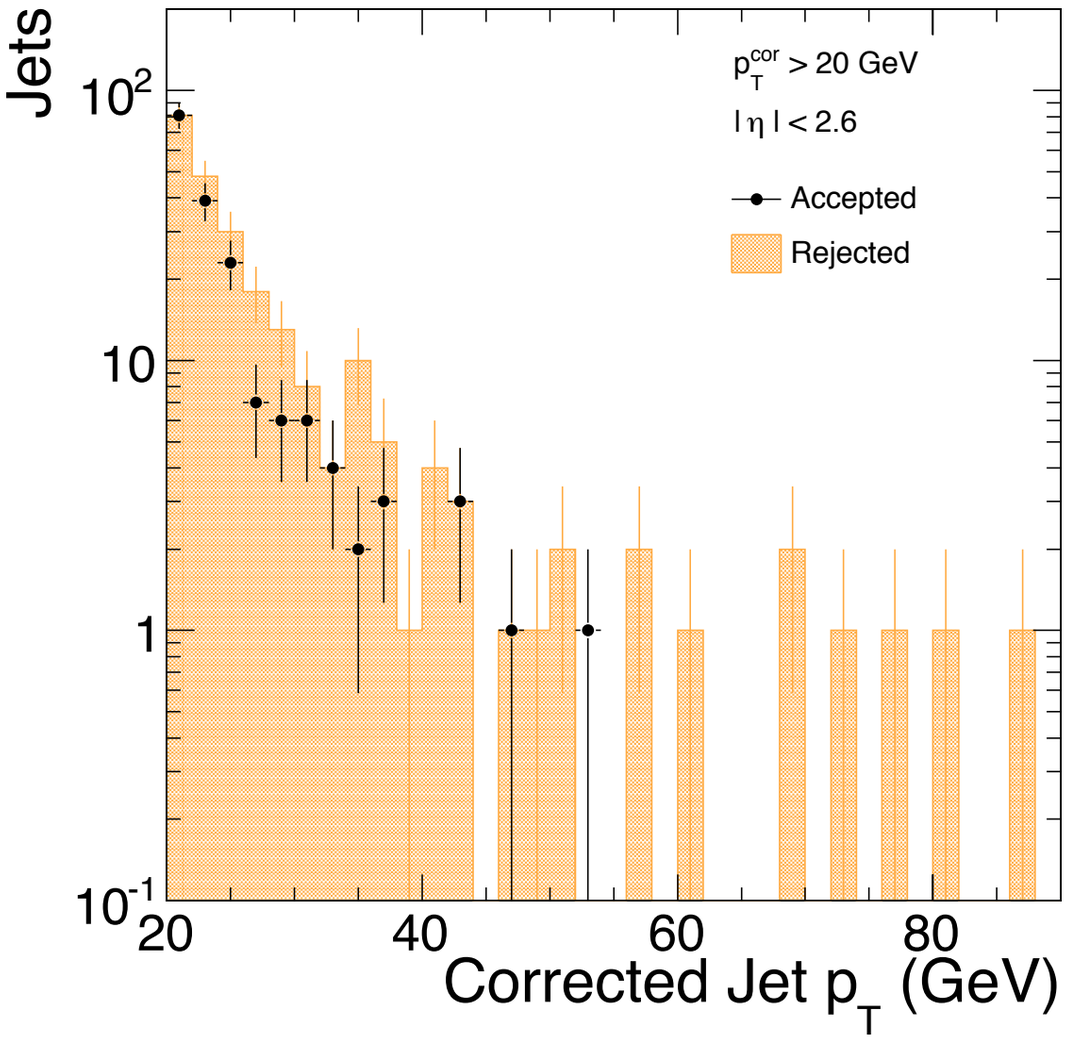
Accepted vs Rejected (fHPD,fRBX)

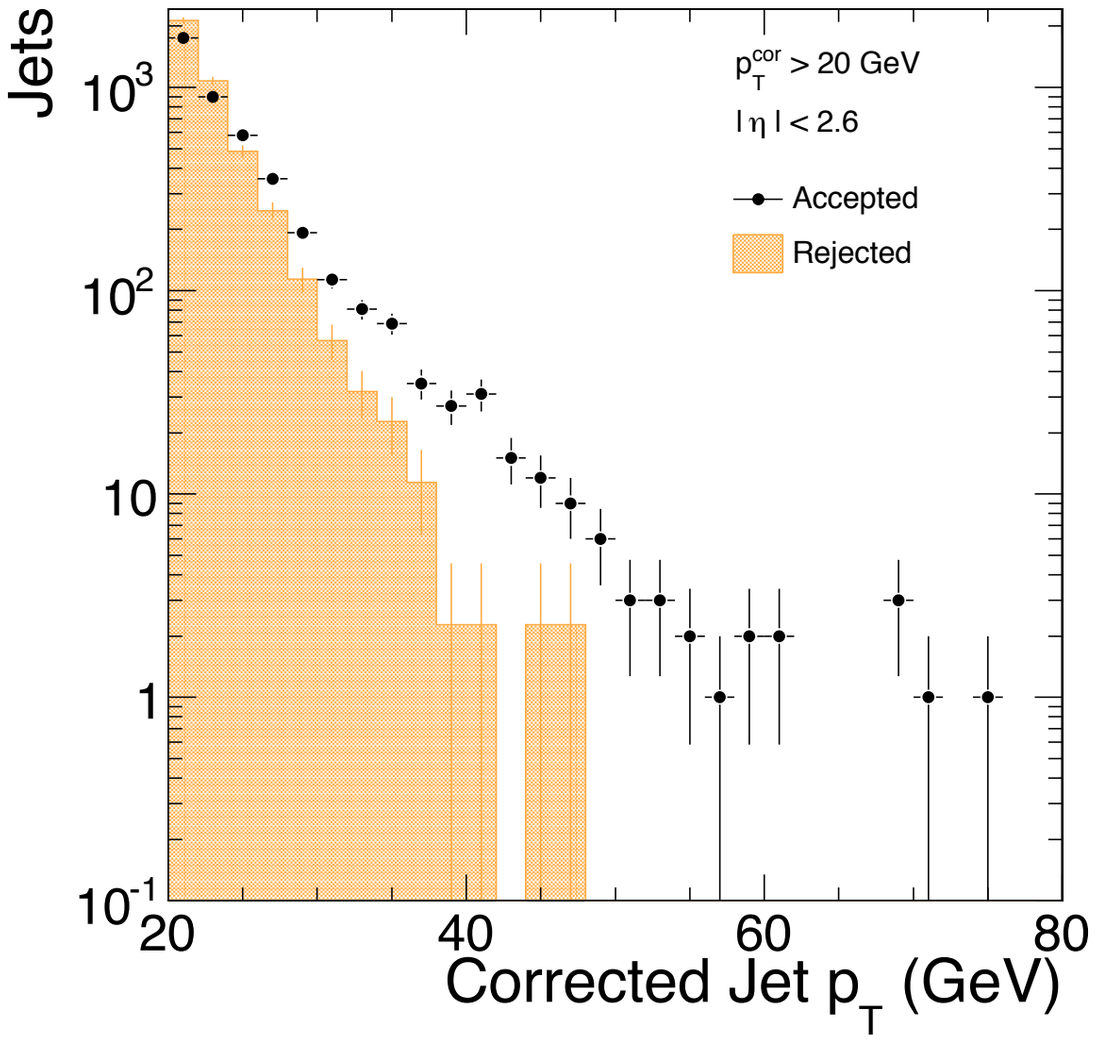


Accepted vs Rejected (σ_η,σ_ϕ)



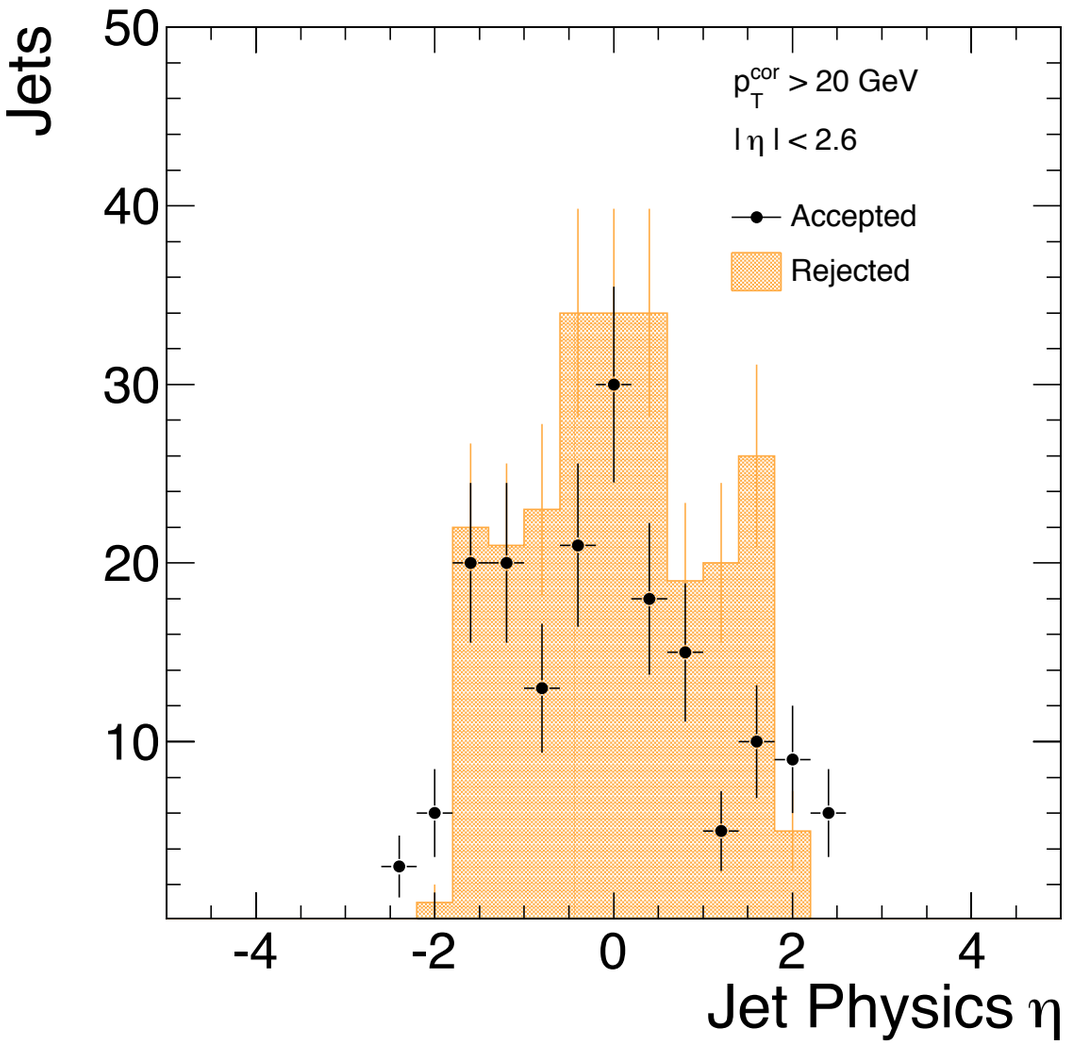
Accepted vs Rejected (p_T spectrum)

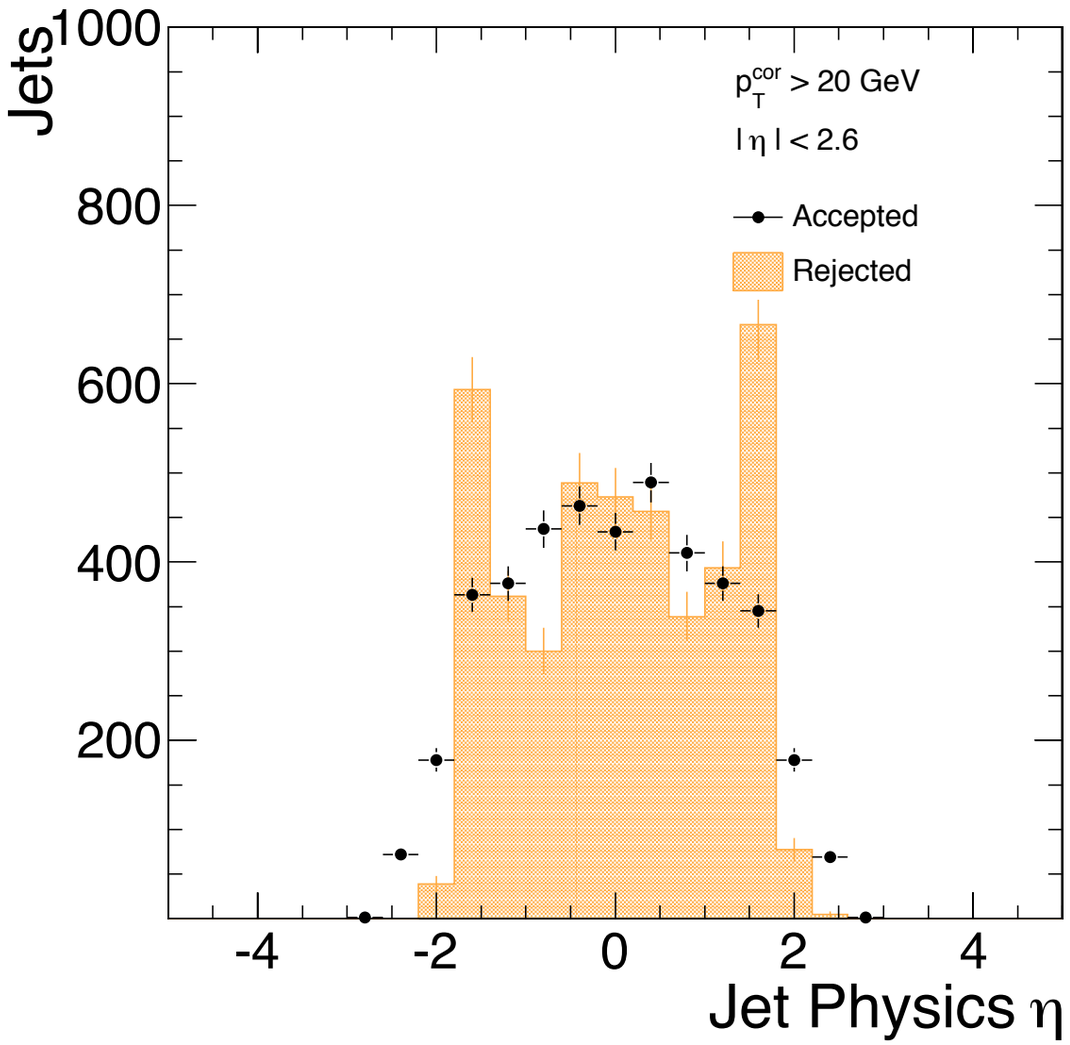




The rejected jets' p_T spectrum in the data is considerable harder than the MC.

Accepted vs Rejected (η)

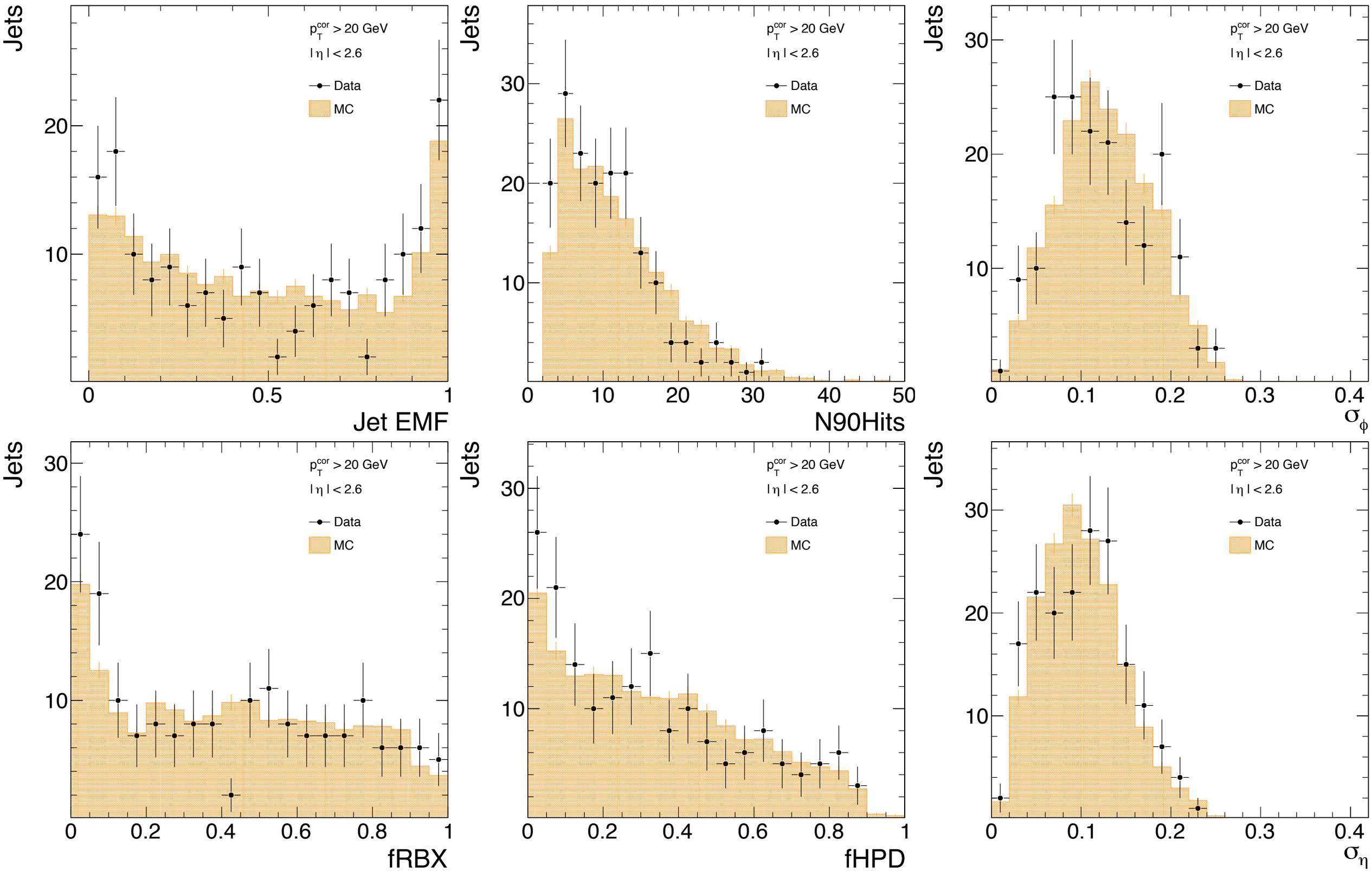




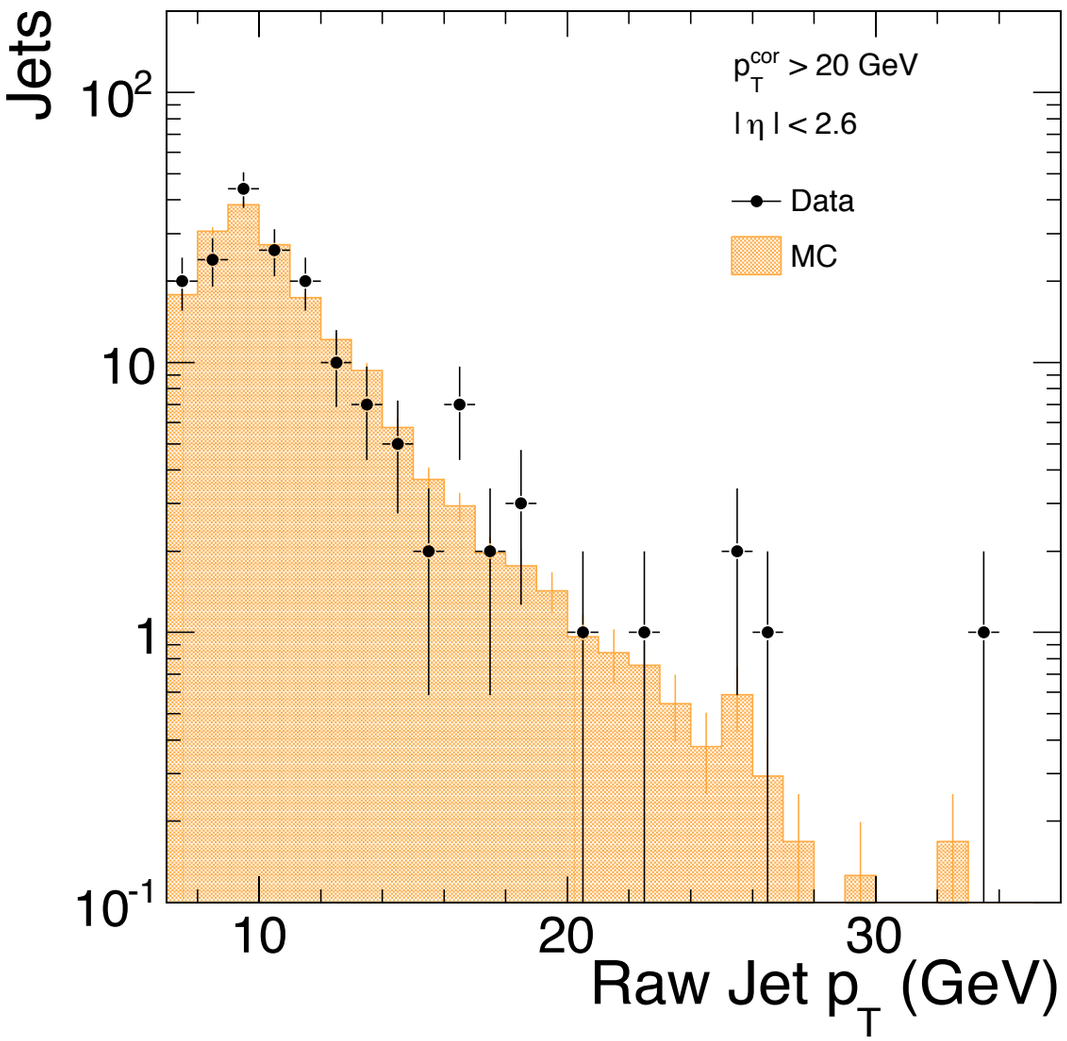
✦ The jet η distribution in the data is asymmetric for the accepted jets (not for the rejected ones).

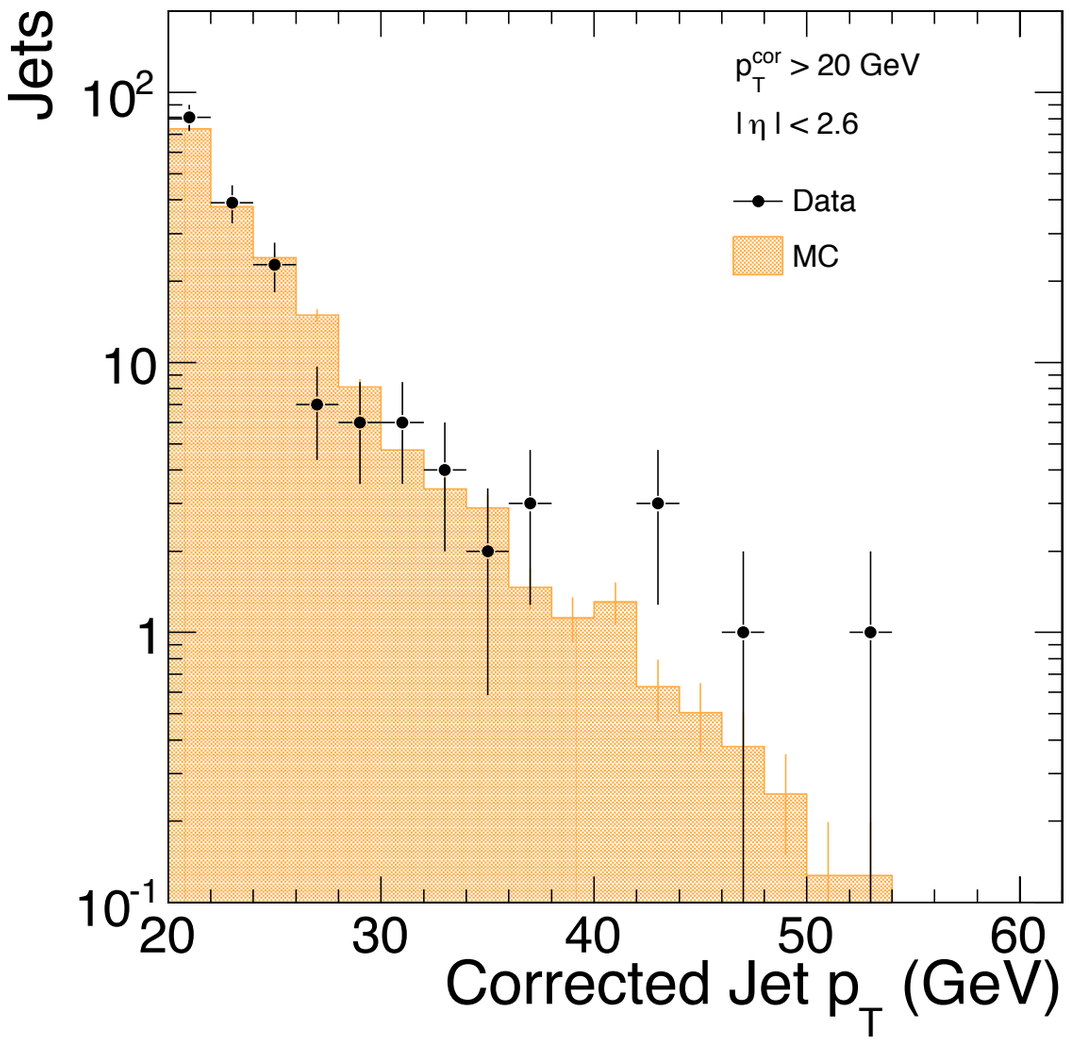
✦ Possible sources of the are: possible asymmetric response, the asymmetric ambient ECAL noise in the endcaps, the displaced vertex.

Data vs MC

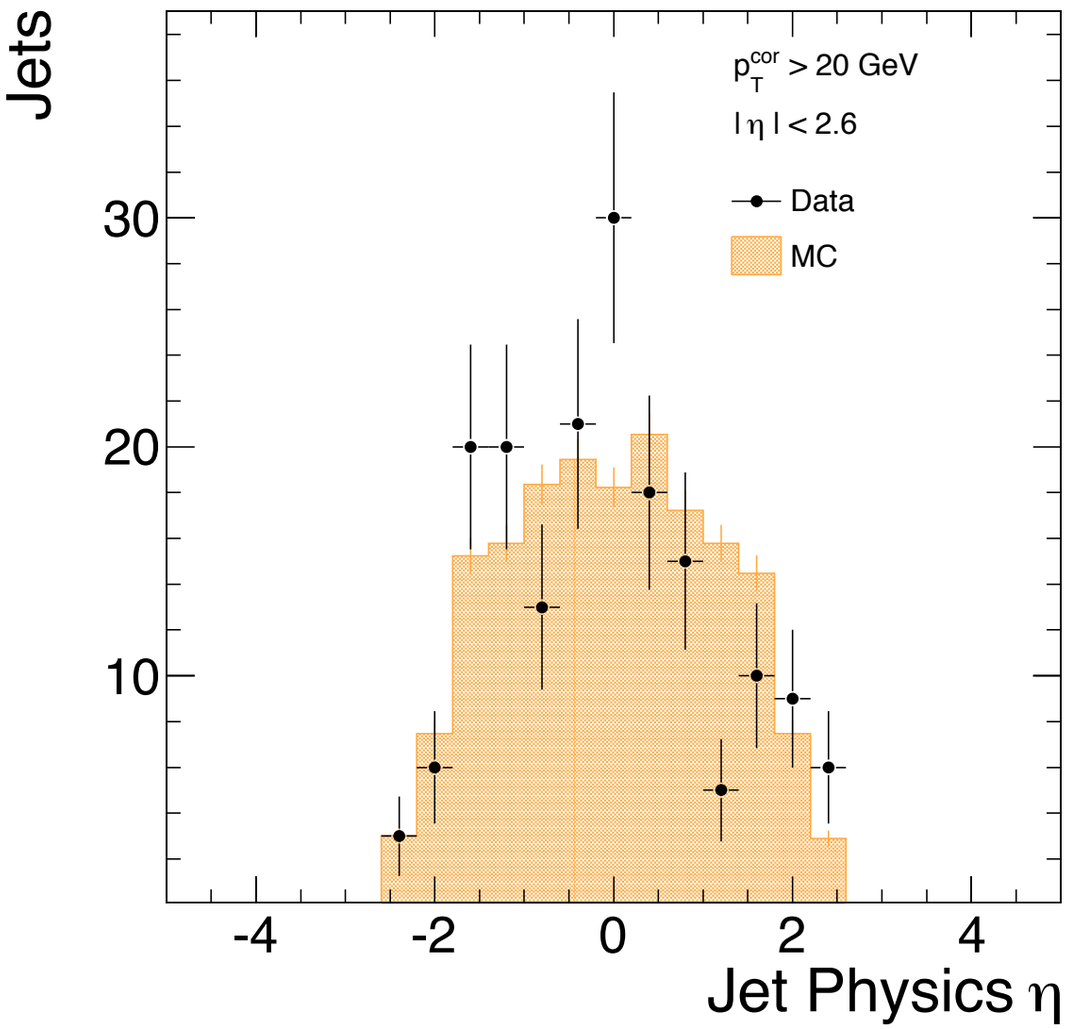

Jets
p_T^{cor} > 20 GeV
| η | < 2.6
Data
MC
Jet EMF
N90Hits
σ_ϕ
fRBX
fHPD
σ_η

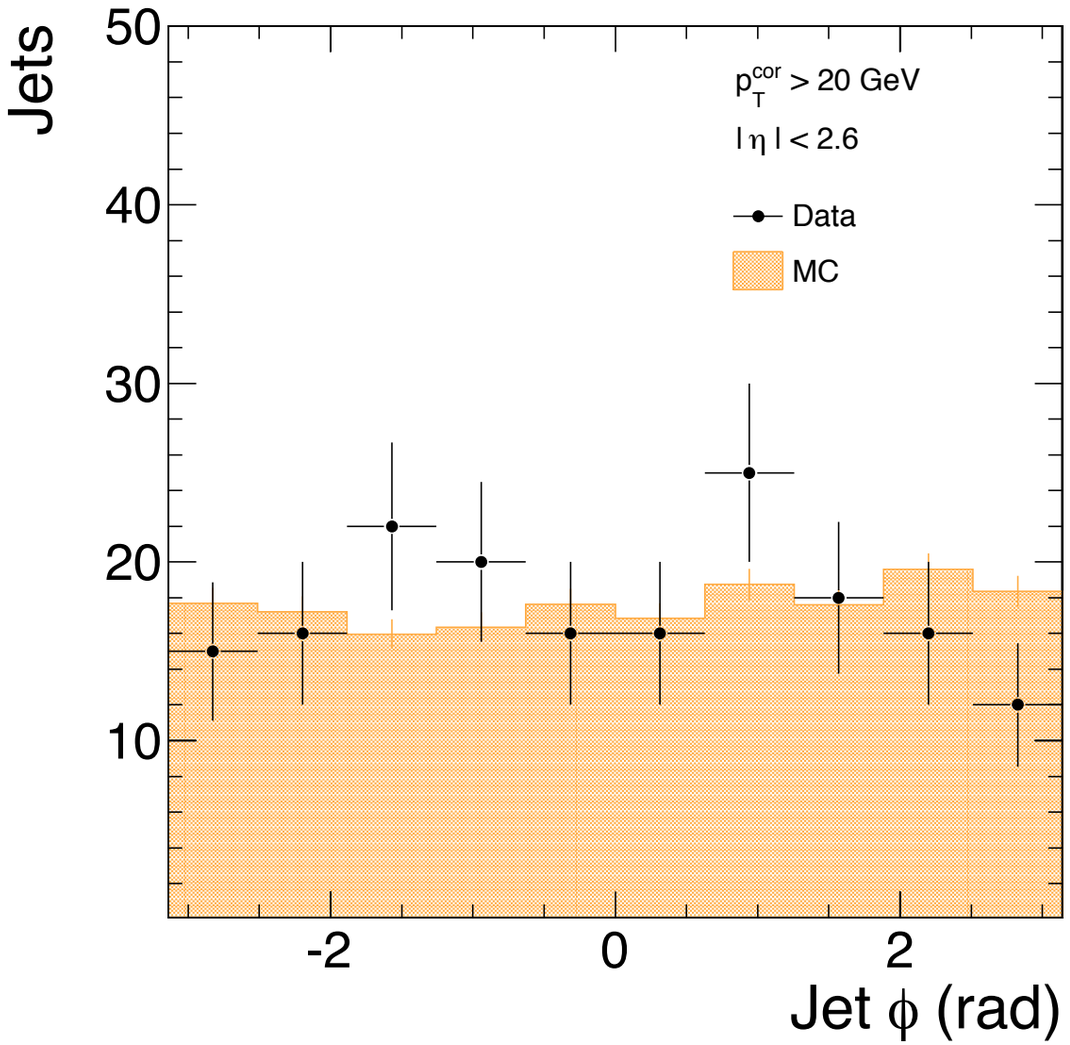
Data vs MC (p_T spectrum)



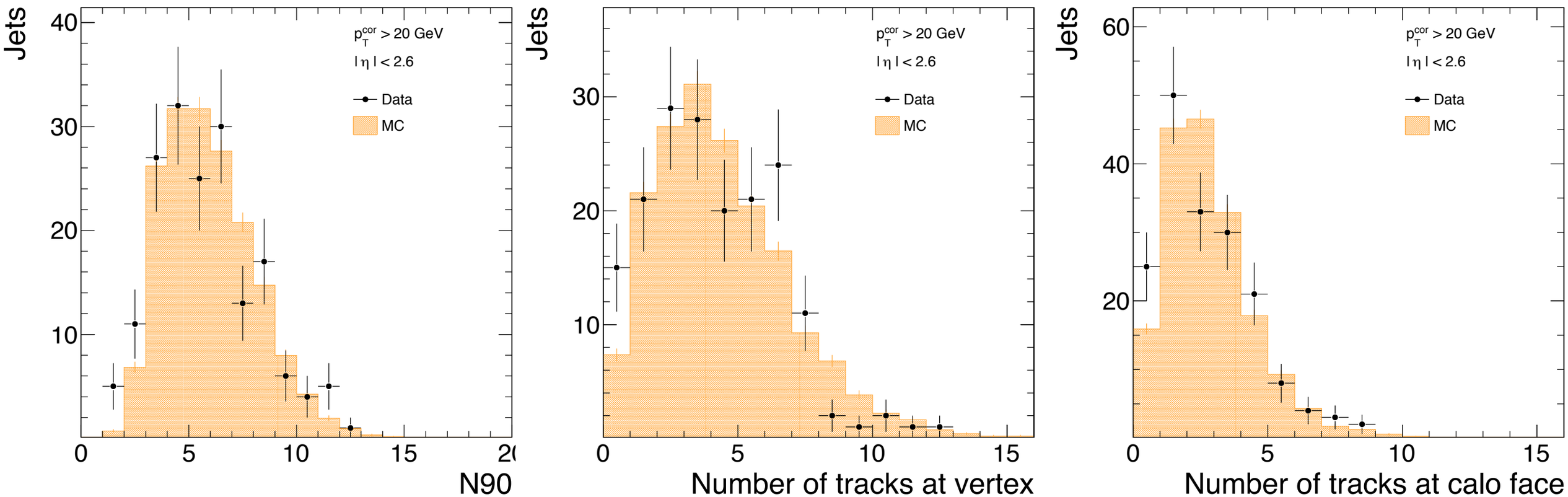


Data vs MC (η & ϕ)

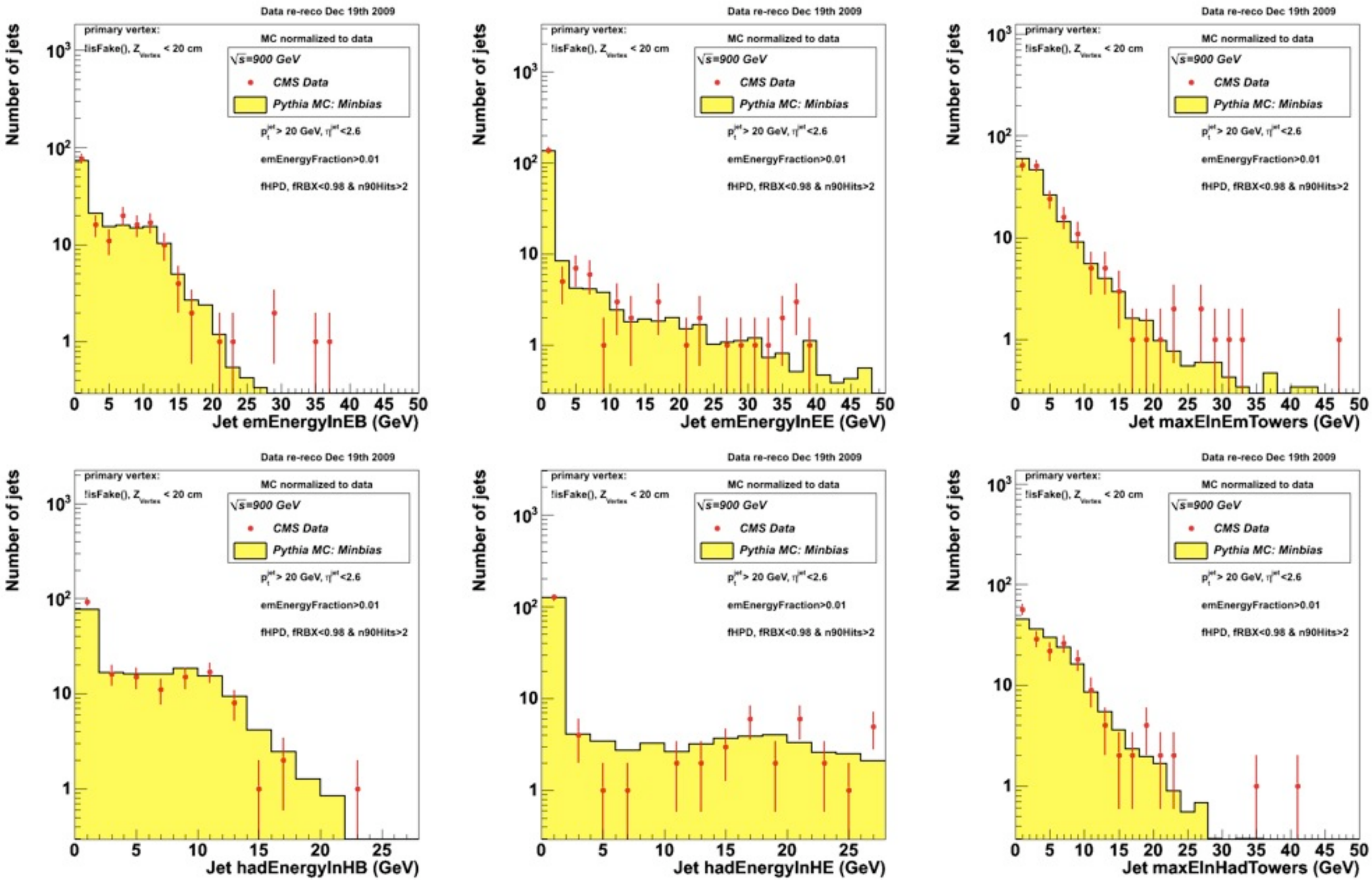

Jets
p_T^{cor} > 20 GeV
| η | < 2.6
Data
MC
30
20
10
-4
-2
0
2
4
Jet Physics η


Jets
p_T^{cor} > 20 GeV
| η | < 2.6
Data
MC
50
40
30
20
10
-2
0
2
Jet ϕ (rad)

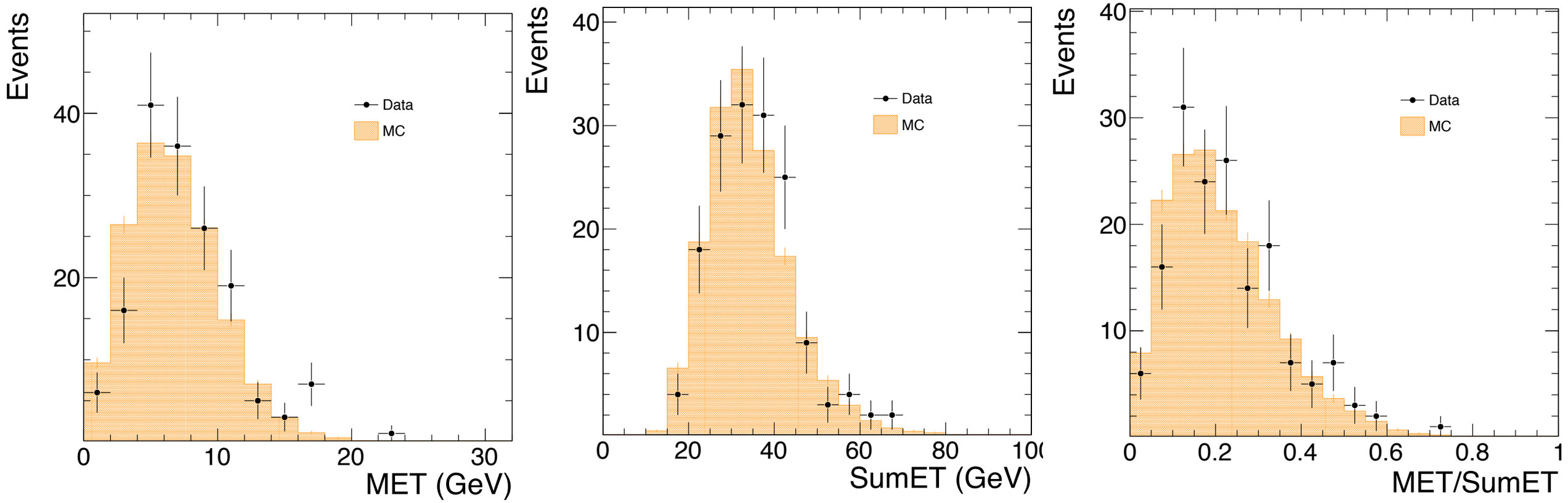
Data vs MC (constituents)



Data vs MC (calorimetry)

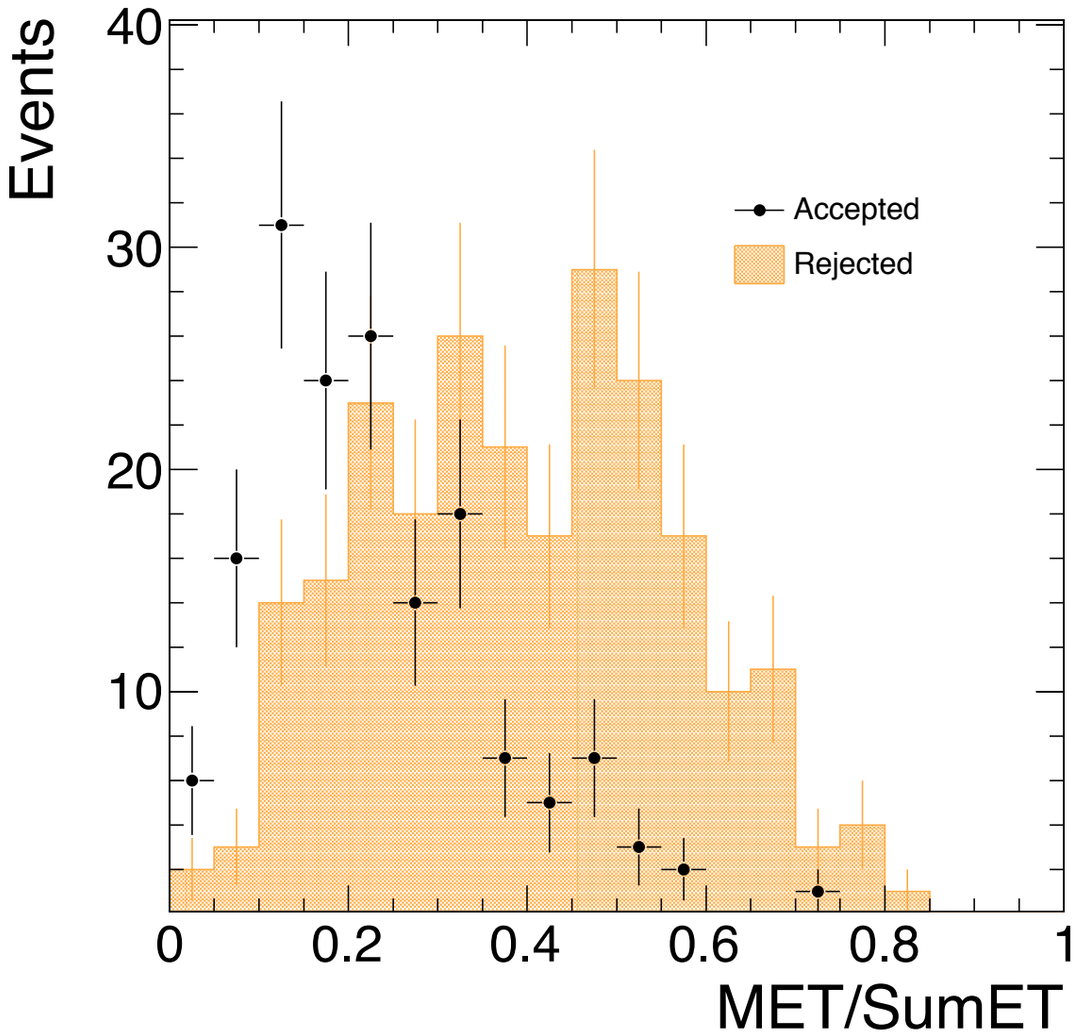


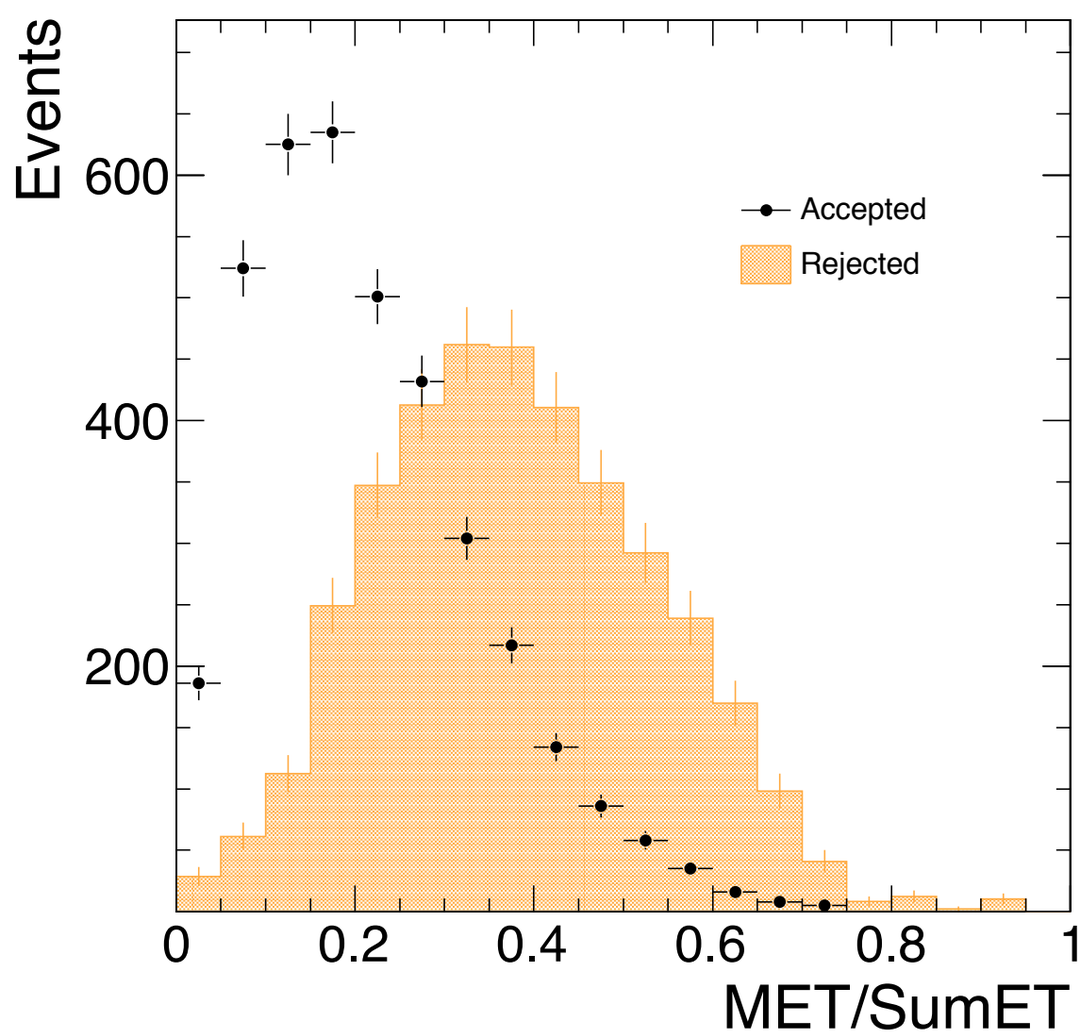
Data vs MC (event variables)



MET, SumET and MET/SumET distributions for events with at least one accepted jet.

About the MET/SumET cut





✦ Events with no accepted jets are on average more unbalanced (larger MET/SumET).

✦ A global event cut on MET/SumET doesn't seem to have much rejection power for the inclusive jet analysis @ 900 GeV.

Summary

✦ An inclusive CaloJet analysis on 900 GeV collision data has been presented for jets in the kinematic region $p_T > 20$ GeV (corrected) and $|\eta| < 2.6$.

✦ The default "loose" jet id requirements were slightly extended for the inclusive jet analysis.

✦ Despite the fact that the reconstruction between MC and data is not identical, the majority of the MC jet distributions agree surprisingly well with the data. A new re-reco (identical for MC and data) is expected.

✦ The previously proposed MET/SumET event selection cut, should probably be dropped for inclusive jet analysis @ 900 GeV.

✦ There is clear asymmetry in the jet η distribution which is not evident for the rejected jets. The source of the asymmetry is under investigation.