Recovering jets in dead region

Status Report

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Quick Reminder

- If LAr (or TileCal) has a dead region,
  - Can we recover the true jet from tracks?
  - Can we guess its energy, with any information left?

Things done so far

- Used ESD dijet MC08 events (`J4, J6, J8`).
- Defined "*cones*" made of tracks (`TrackParticleCandidate` container), using a cone-0.4 algorithm. To group tracks around a seed, they are required to start from the same vertex.
- Studied how pure & efficient these cones are at locating true jets.
- Compared track cones efficiency & purity to calorimeter topocluster jets with cone-0.4.

Things doing currently

- Running on more JX samples.
- We have code to zero-out chosen calo cells.
- Study ways to improve purity & efficiency.
- Try to combine the following to extract true p:
  - Cone track Σp
  - Tile energy behind the cone
  - LAr energy behind the cone
  - ΔR of two highest p_T tracks in cone

Immediate Future

- Estimate purity & efficiency bin-by-bin
- Produce true p calibration bin-by-bin
- Repeat the above with detector damage put in by hand. (We have a tool for this.)
- Demonstrate energy resolution with damaged detector.
- See how MET measurement is improved if we add back the lost jet's energy.

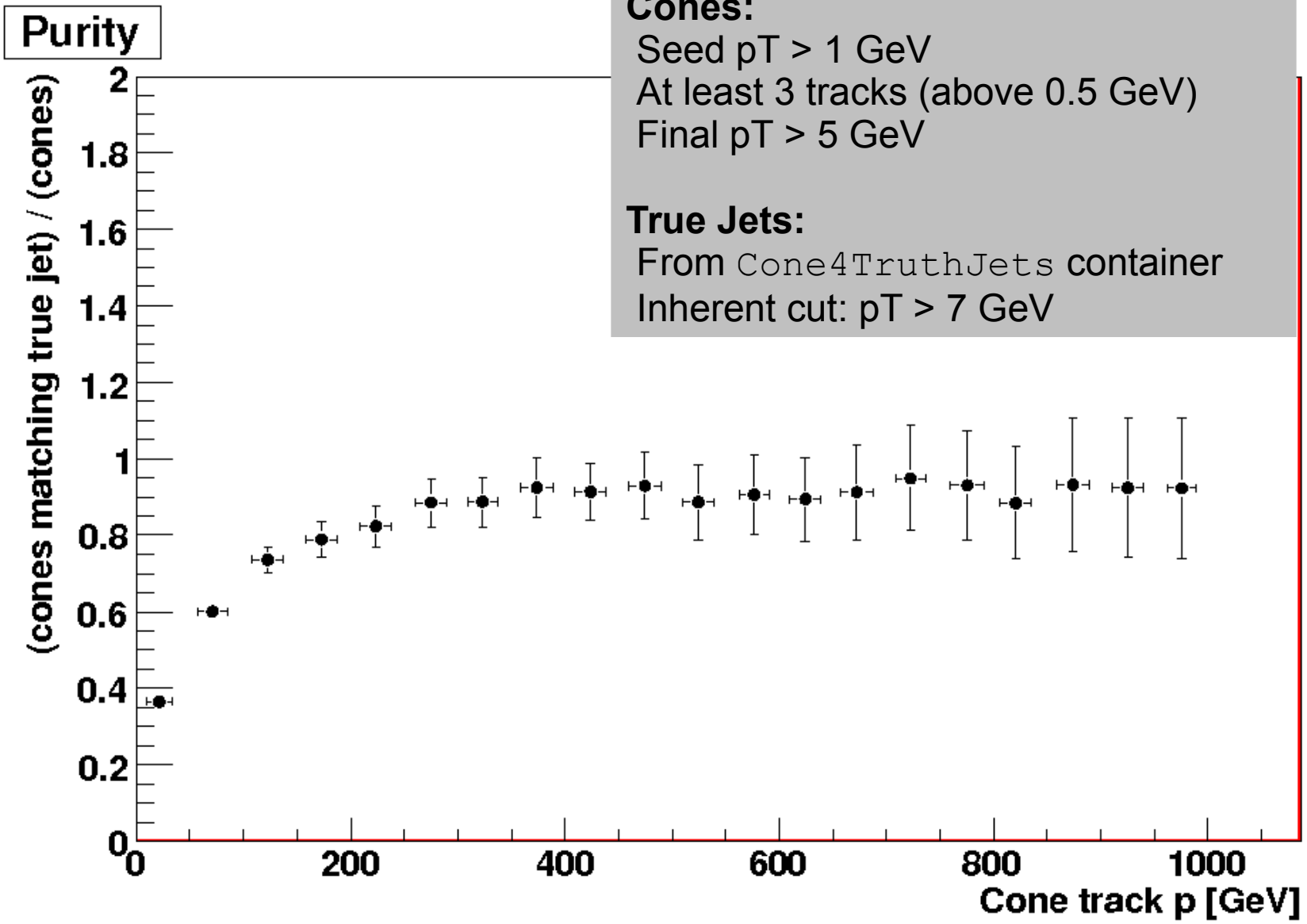
- Working together with Stephanie Majewski to re-reconstruct jets and MET with a damaged detector. Our thanks to David Miller for his help!

Warning

The following plots will change when all JX samples are used.

We assume no dead region in the detector (yet).

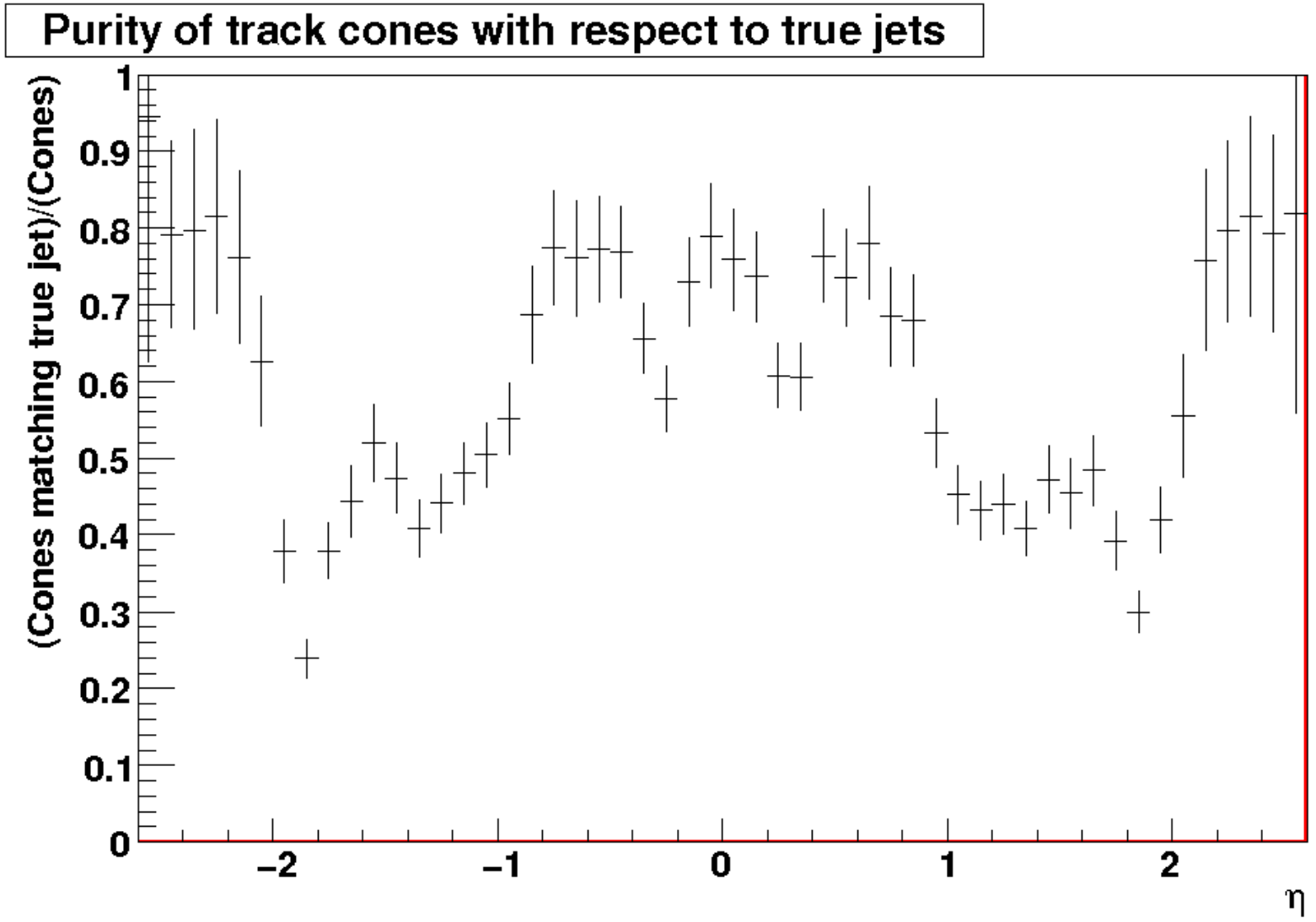
Purity of Cones vs their p



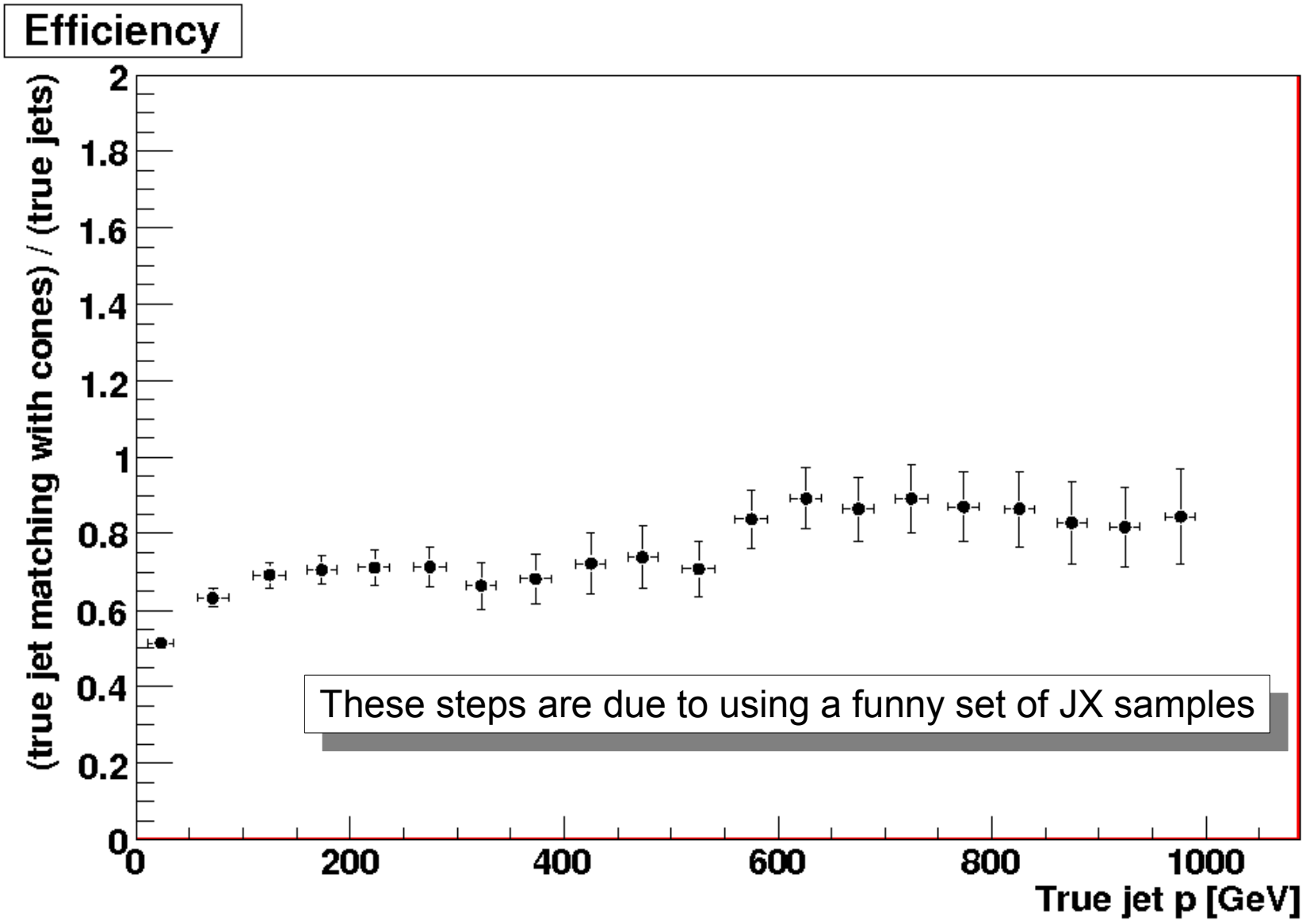
Cones:
Seed pT > 1 GeV
At least 3 tracks (above 0.5 GeV)
Final pT > 5 GeV

True Jets:
From `Cone4TruthJets` container
Inherent cut: pT > 7 GeV

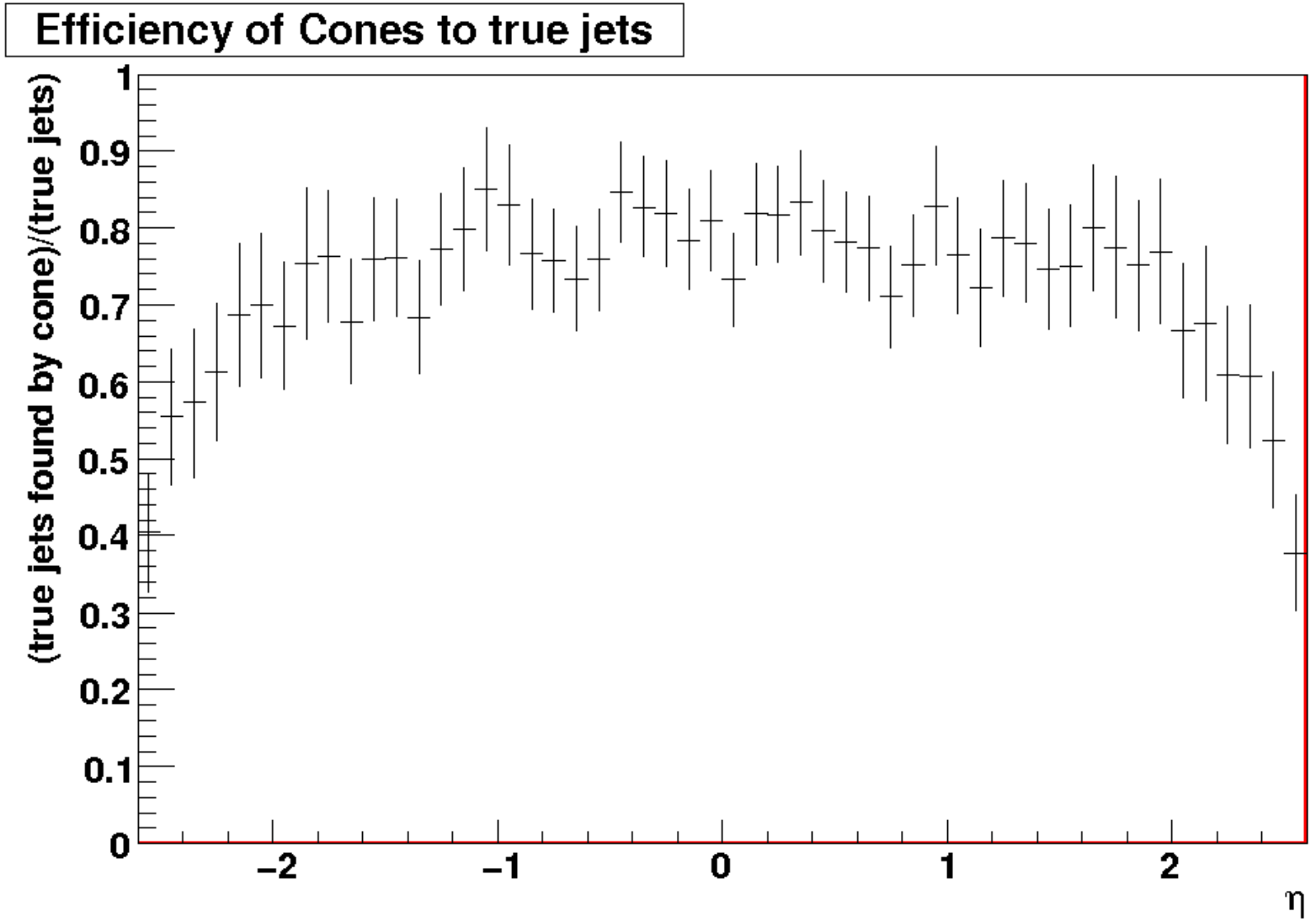
Purity of Cones vs η



Cone Efficiency in finding true jets



Cone Efficiency vs η



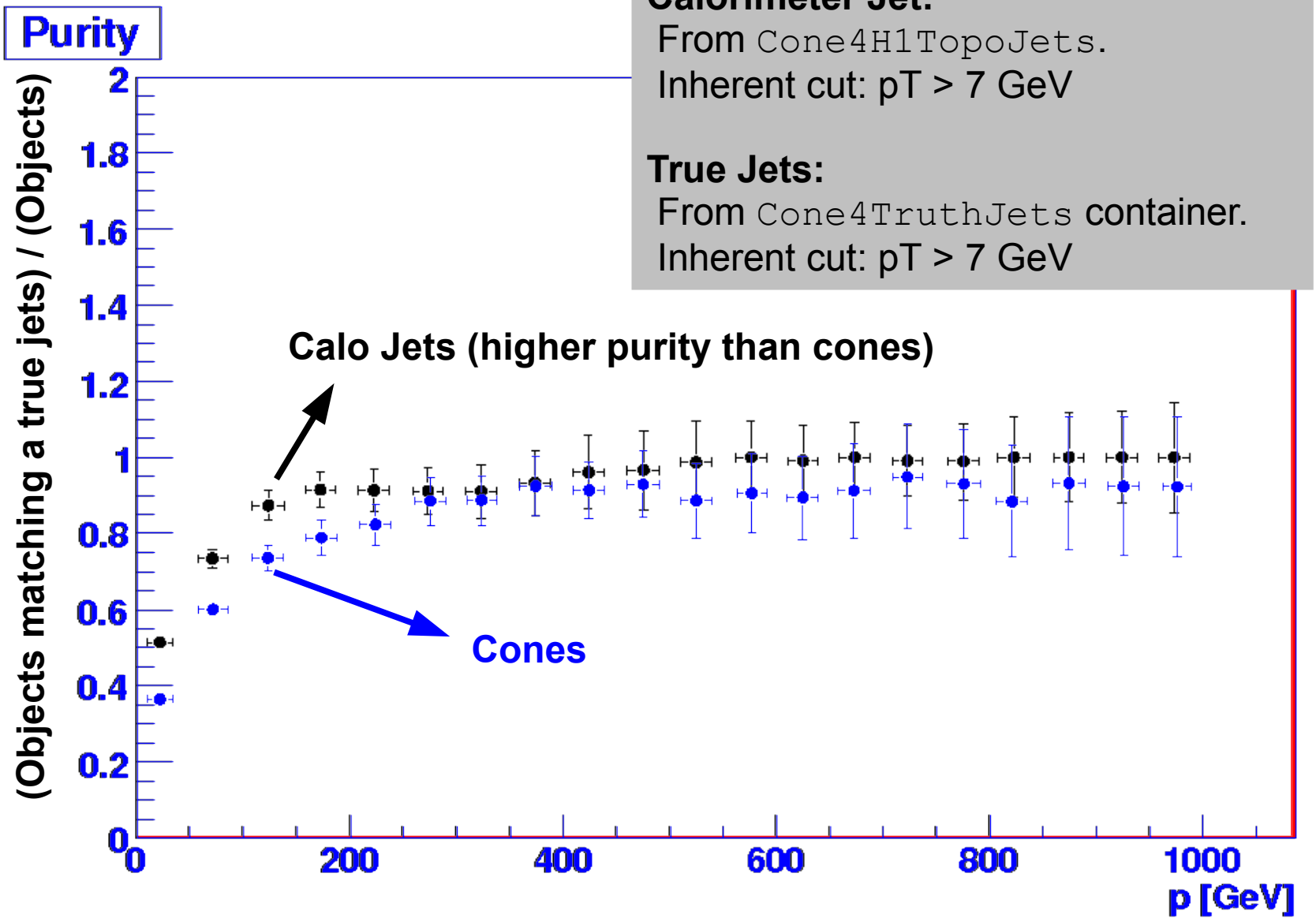
In the following slides we compare
track Cone
to
Topocluster Cone4 Calorimeter jet

to see who is more pure and more efficient

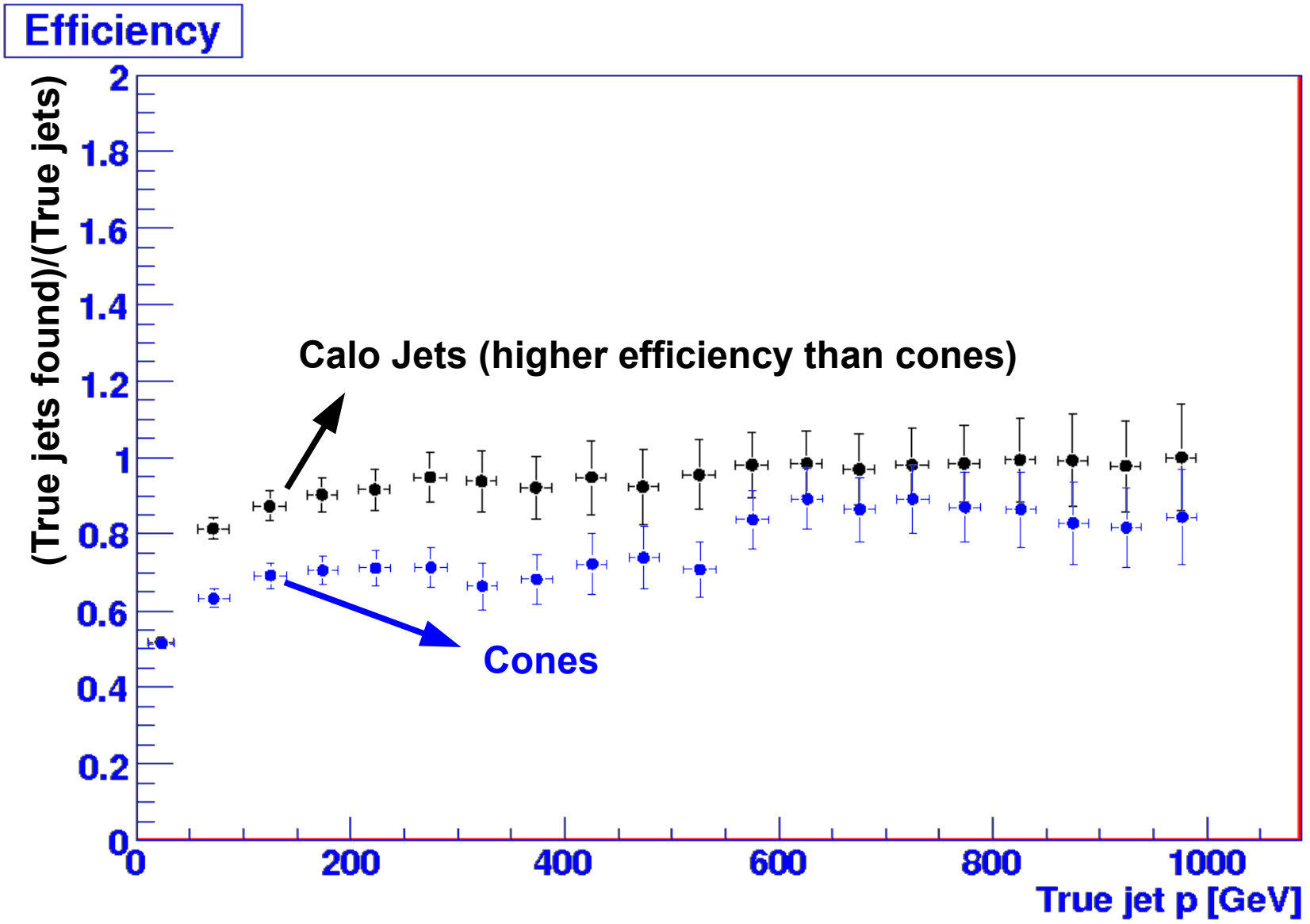
Purity Comparison

Calorimeter Jet:
From `Cone4H1TopoJets`.
Inherent cut: pT > 7 GeV

True Jets:
From `Cone4TruthJets` container.
Inherent cut: pT > 7 GeV



Calo Jet Efficiency



conclusion #1

`Cone4H1TopoJets` identify true jets more faithfully than track cones do.

That was expected.

But that assumes the calorimeter works!

If not, then track cones perform reasonably well, especially in terms of purity.

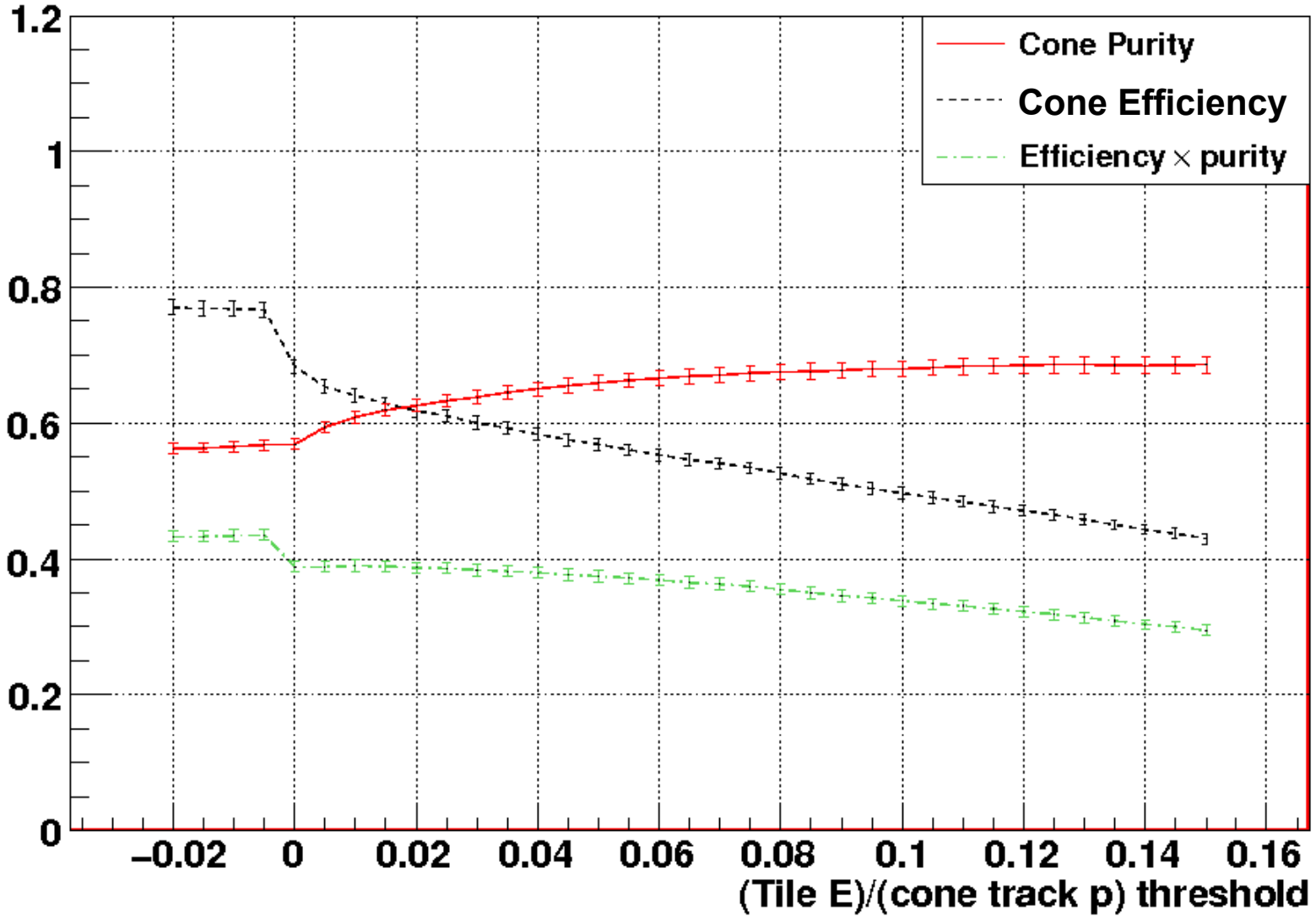
When is purity & efficiency higher?

How about requiring TileCal energy behind our cone to be relatively high?

That would likely increase the purity of our track cones, at the expense of some efficiency.

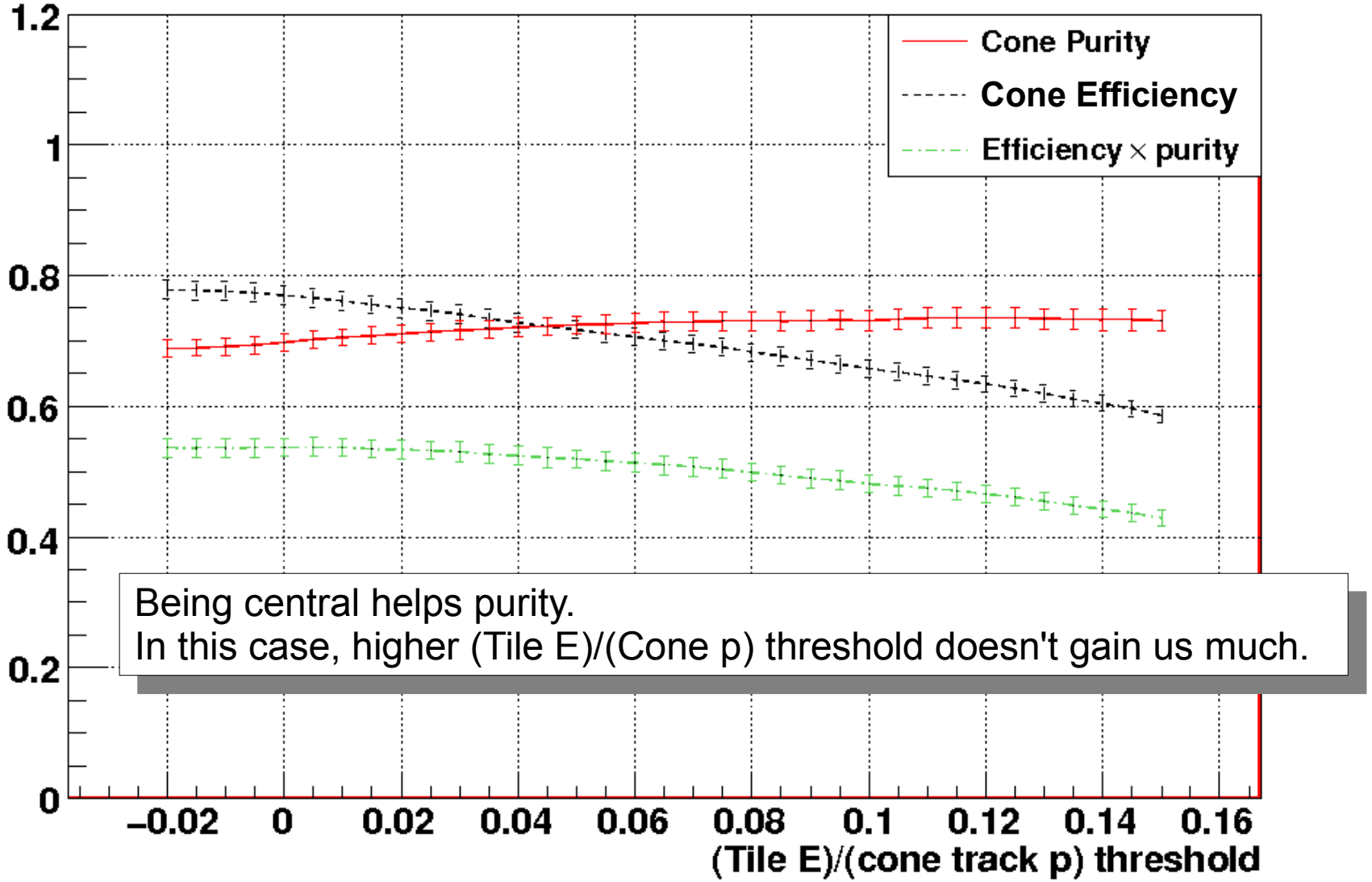
Improving Cone purity & efficiency

No momentum or η selection. Average over all η, φ, p.



Improving Cone purity & efficiency

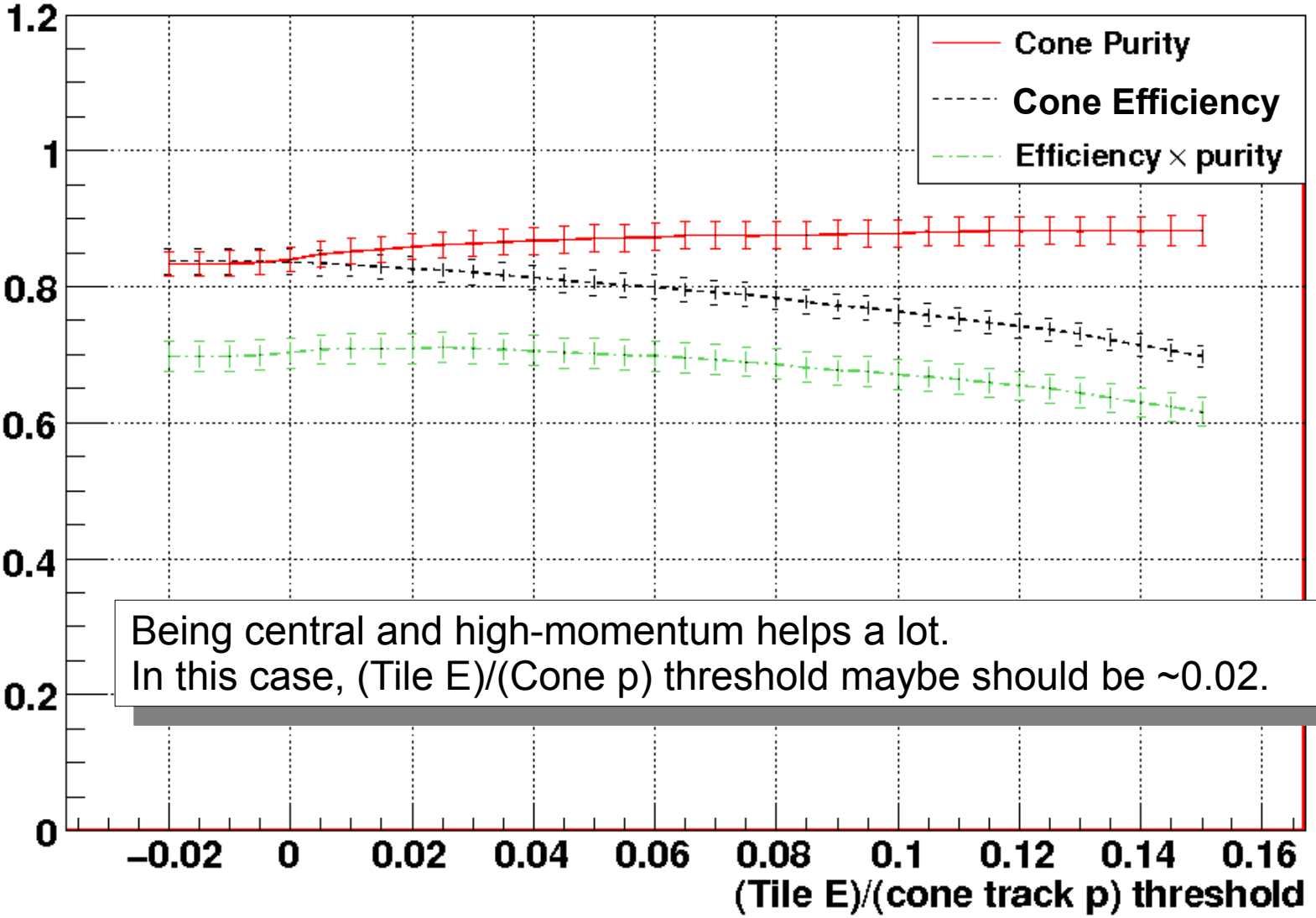
Central: |η| < 1.0



Being central helps purity.
In this case, higher (Tile E)/(Cone p) threshold doesn't gain us much.

Improving Cone purity & efficiency

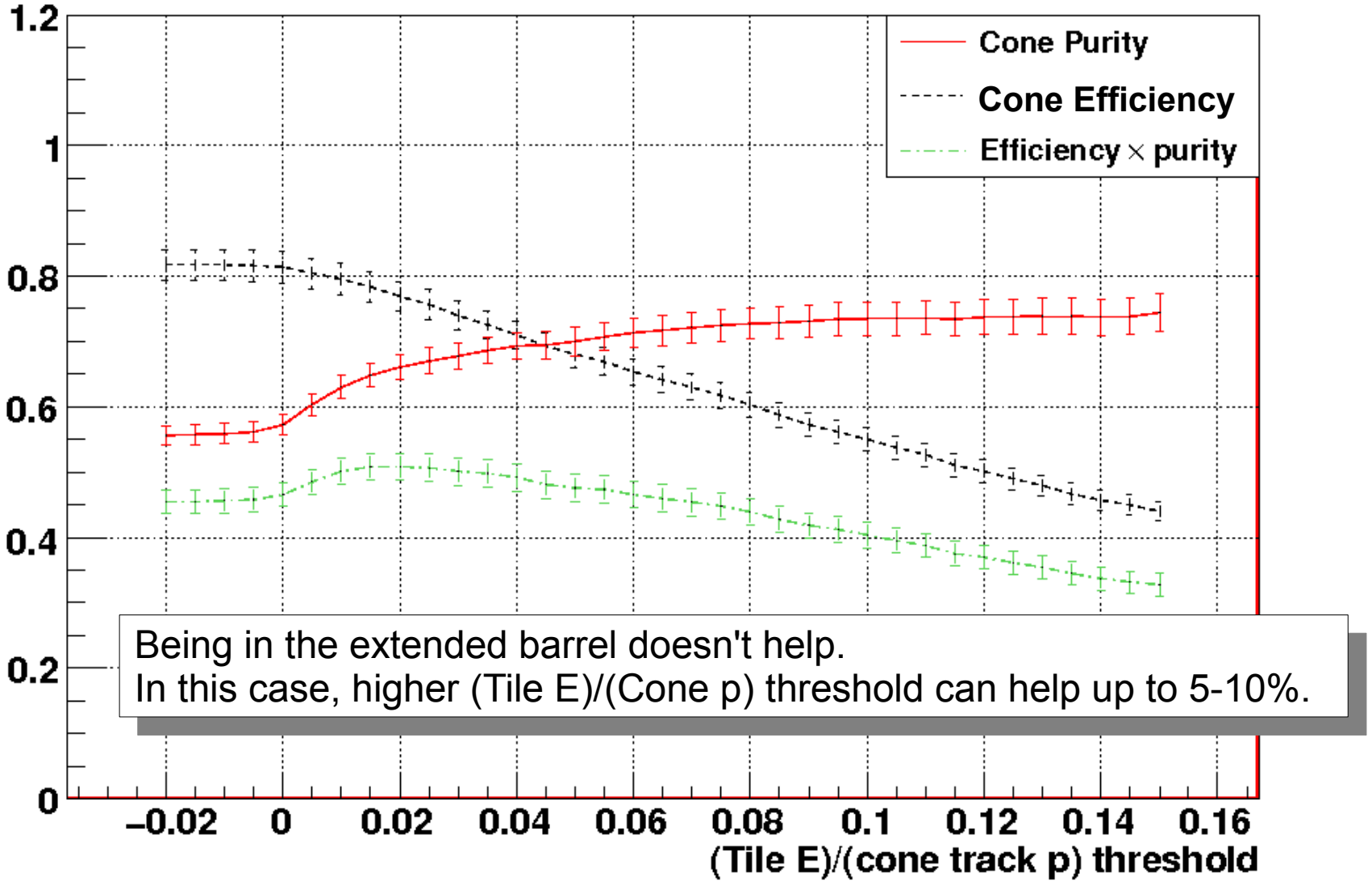
Central: |η| < 1.0 AND p > 20 GeV



Being central and high-momentum helps a lot.
In this case, (Tile E)/(Cone p) threshold maybe should be ~0.02.

Improving Cone purity & efficiency

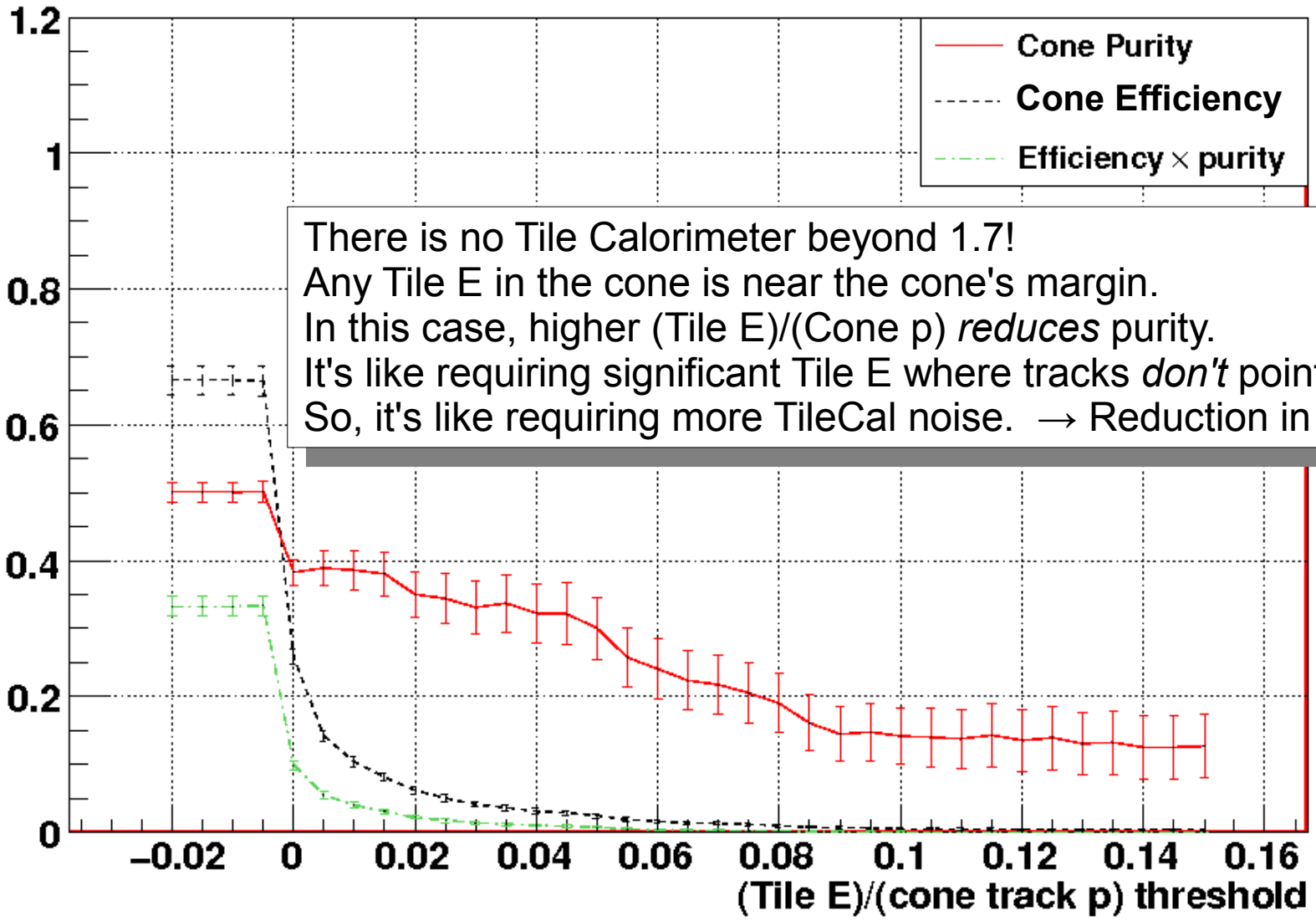
Extended barrel: 1.0 < |η| < 1.7 AND p > 20 GeV



Being in the extended barrel doesn't help.
In this case, higher (Tile E)/(Cone p) threshold can help up to 5-10%.

Improving Cone purity & efficiency

Forward: 1.7 < |η| < 2.6 AND p > 20 GeV



There is no Tile Calorimeter beyond 1.7!
Any Tile E in the cone is near the cone's margin.
In this case, higher (Tile E)/(Cone p) *reduces* purity.
It's like requiring significant Tile E where tracks *don't* point.
So, it's like requiring more TileCal noise. → Reduction in purity.

conclusion #2

We are able to estimate purity bin-by-bin.

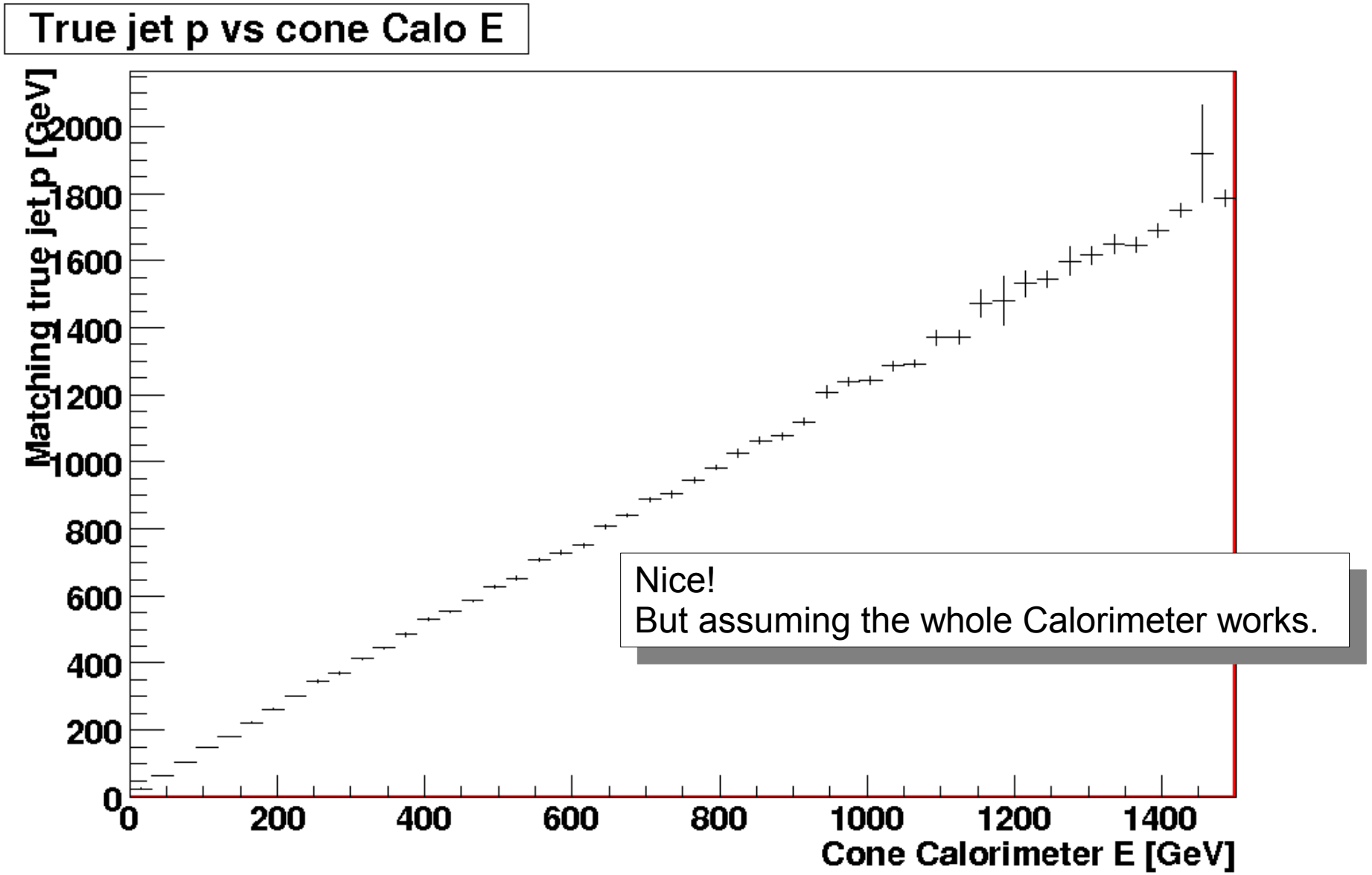
In each bin, it may OR may NOT help to have significant Tile E behind the cone.

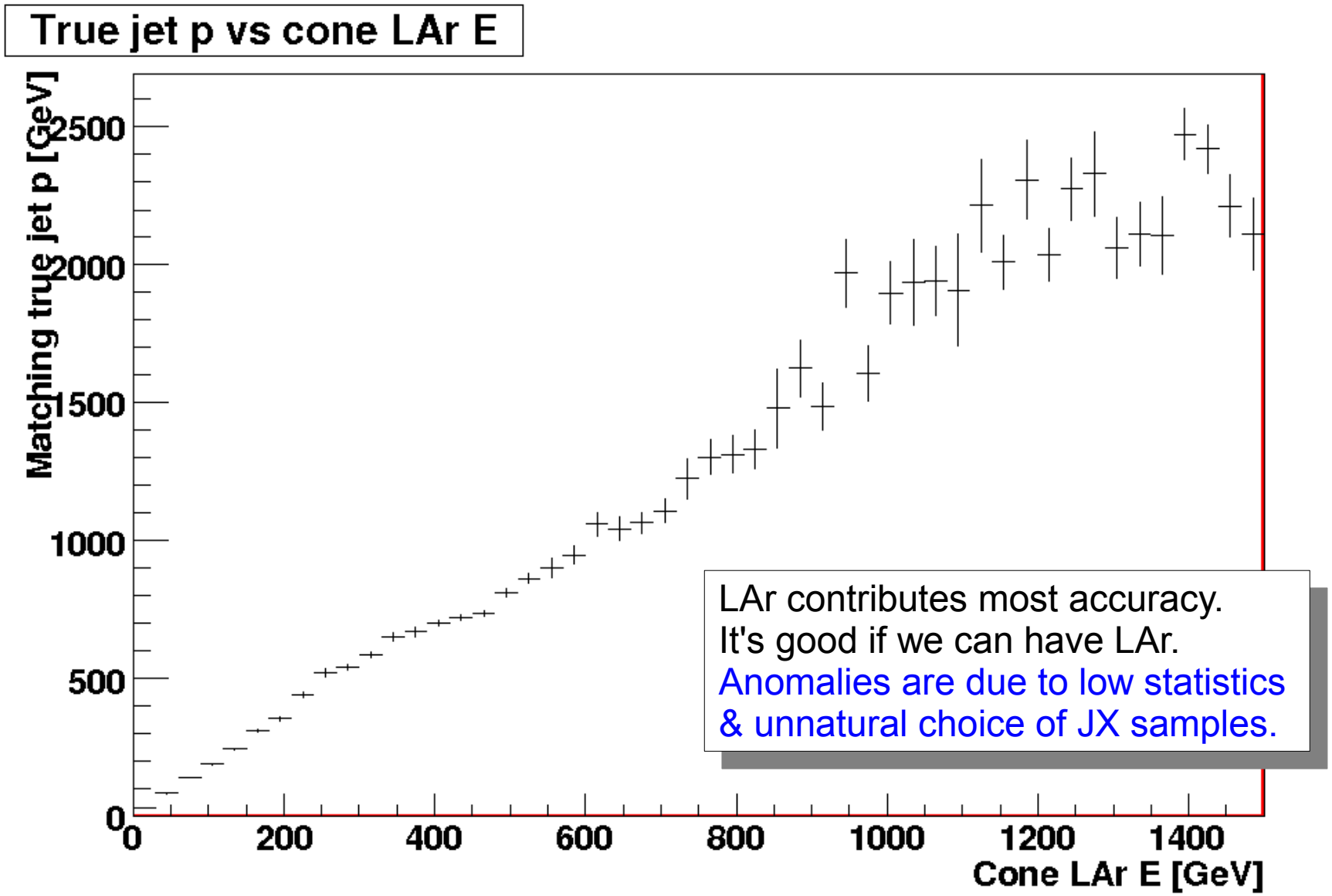
Given a tracks cone in some η, φ, with some track p and some Tile E behind it, we can estimate how likely it is to be a true jet.

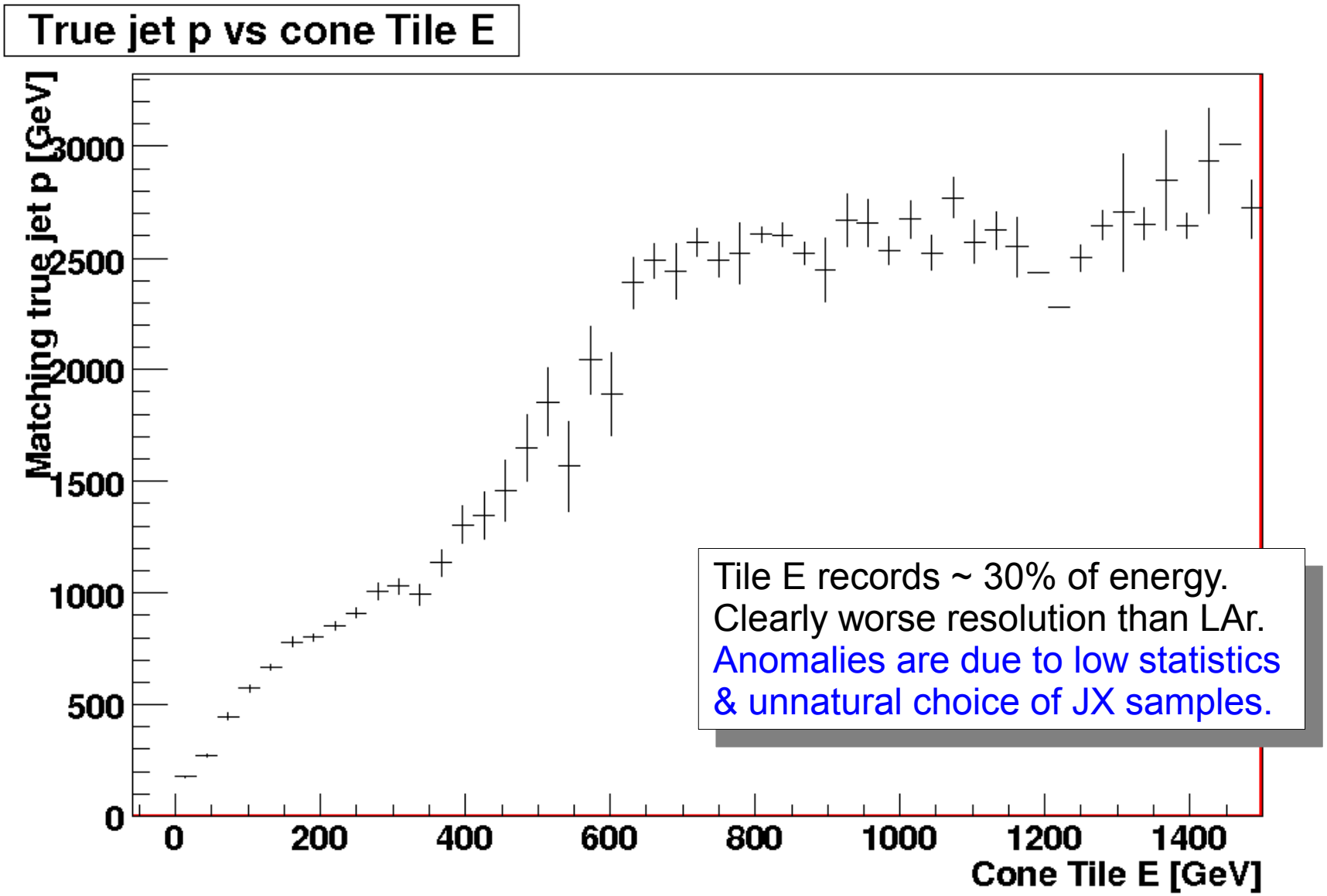
If we decide to use only cones that are at least A% pure, we know what minimum TileE and/or tracks p to require, at each given η and φ.

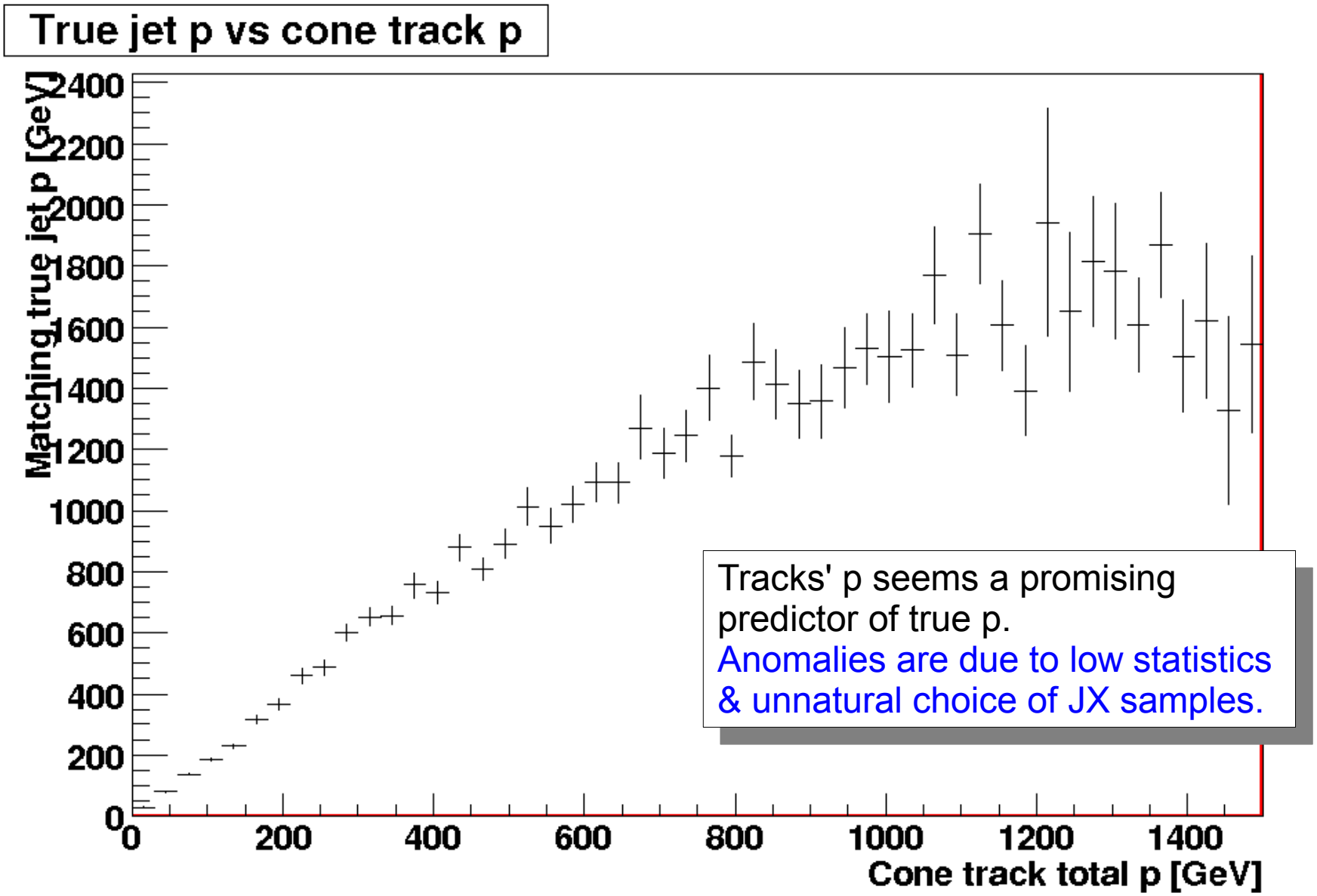
What can we then say about the true jet's momentum?

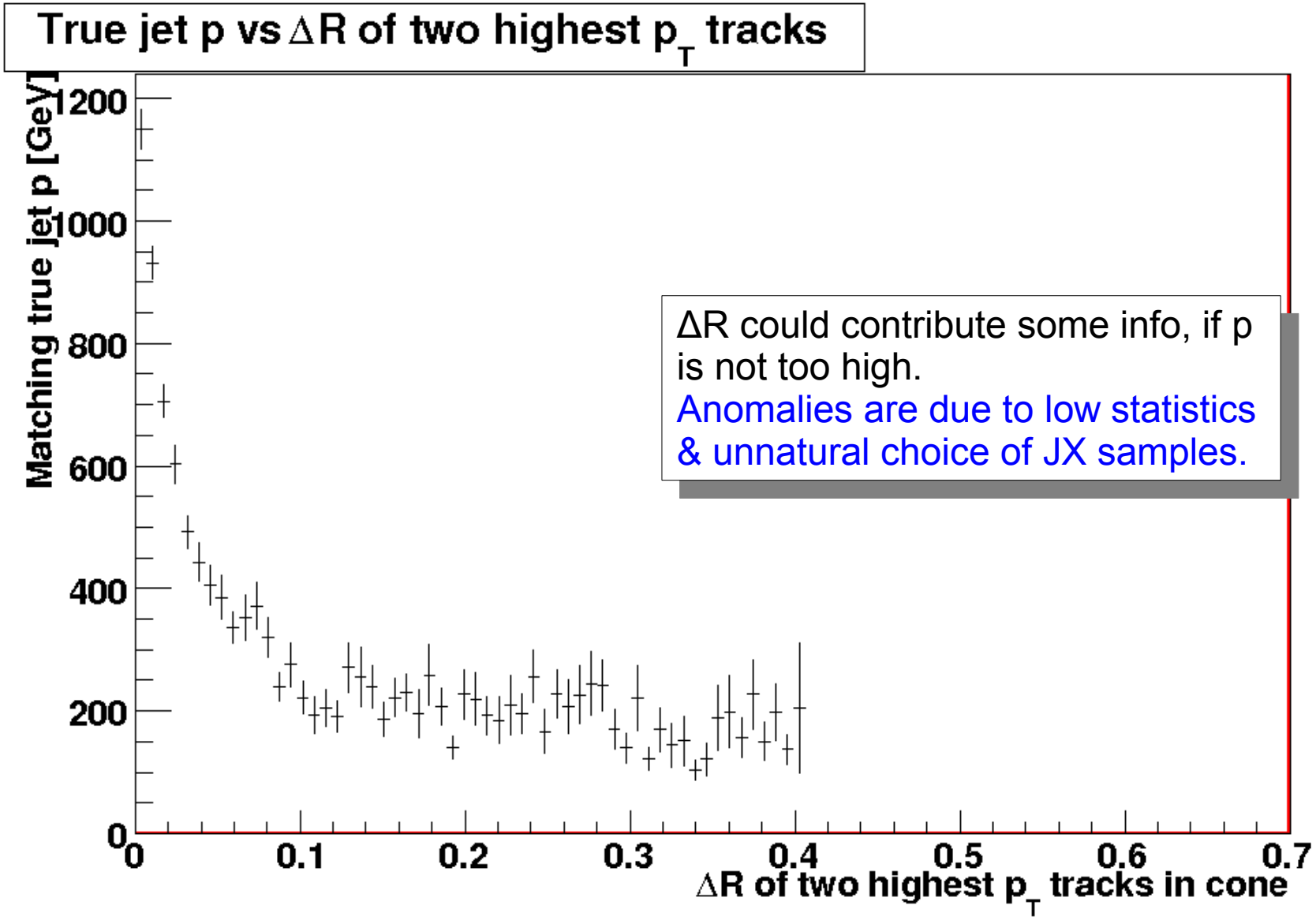
Note: Calorimeter energies below are EM scale


True jet p vs cone Calo E
Matching true jet p [GeV]
0
200
400
600
800
1000
1200
1400
1600
1800
2000
0
200
400
600
800
1000
1200
1400
Cone Calorimeter E [GeV]
Nice!
But assuming the whole Calorimeter works.


True jet p vs cone LAr E
Matching true jet p [GeV]
2500
2000
1500
1000
500
0
0
200
400
600
800
1000
1200
1400
Cone LAr E [GeV]
LAr contributes most accuracy.
It's good if we can have LAr.
Anomalies are due to low statistics
& unnatural choice of JX samples.


True jet p vs cone Tile E
Matching true jet p [GeV]
0
500
1000
1500
2000
2500
3000
0
200
400
600
800
1000
1200
1400
Cone Tile E [GeV]
Tile E records ~ 30% of energy.
Clearly worse resolution than LAr.
Anomalies are due to low statistics
& unnatural choice of JX samples.


True jet p vs cone track p
Matching true jet p [GeV]
Cone track total p [GeV]
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
Tracks' p seems a promising predictor of true p.
Anomalies are due to low statistics & unnatural choice of JX samples.


True jet p vs ΔR of two highest p_T tracks
Matching true jet p [GeV]
1200
1000
800
600
400
200
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
ΔR of two highest p_T tracks in cone
ΔR could contribute some info, if p is not too high.
Anomalies are due to low statistics & unnatural choice of JX samples.

Summary

- Track cone Purity & Efficiency are being understood.
- Track cones are a compromise, but don't always performing too poorly.
- Next time we will try to have something about MET and true jet p determination, with and without calorimeter damage.

Backups

p_T cuts on dijet samples

Sample Tag	P_T cut
J1	$17\ \text{GeV} < P_T < 35\ \text{GeV}$
J2	$35\ \text{GeV} < P_T < 70\ \text{GeV}$
J3	$70\ \text{GeV} < P_T < 140\ \text{GeV}$
J4	$140\ \text{GeV} < P_T < 280\ \text{GeV}$
J5	$280\ \text{GeV} < P_T < 560\ \text{GeV}$
J6	$560\ \text{GeV} < P_T < 1120\ \text{GeV}$
J7	$1120\ \text{GeV} < P_T < 2240\ \text{GeV}$
J8	$P_T > 2240\ \text{GeV}$

J0 | 8-17 GeV

Dijet ESD samples to use

mc08.105009.J0_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105010.J1_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105011.J2_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105012.J3_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105013.J4_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105014.J5_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105015.J6_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105016.J7_pythia_jetjet.recon.ESD.e344_s456_r456

mc08.105017.J8_pythia_jetjet.recon.ESD.e344_s456_r456

All are:

Generated in release 14.2.0.1

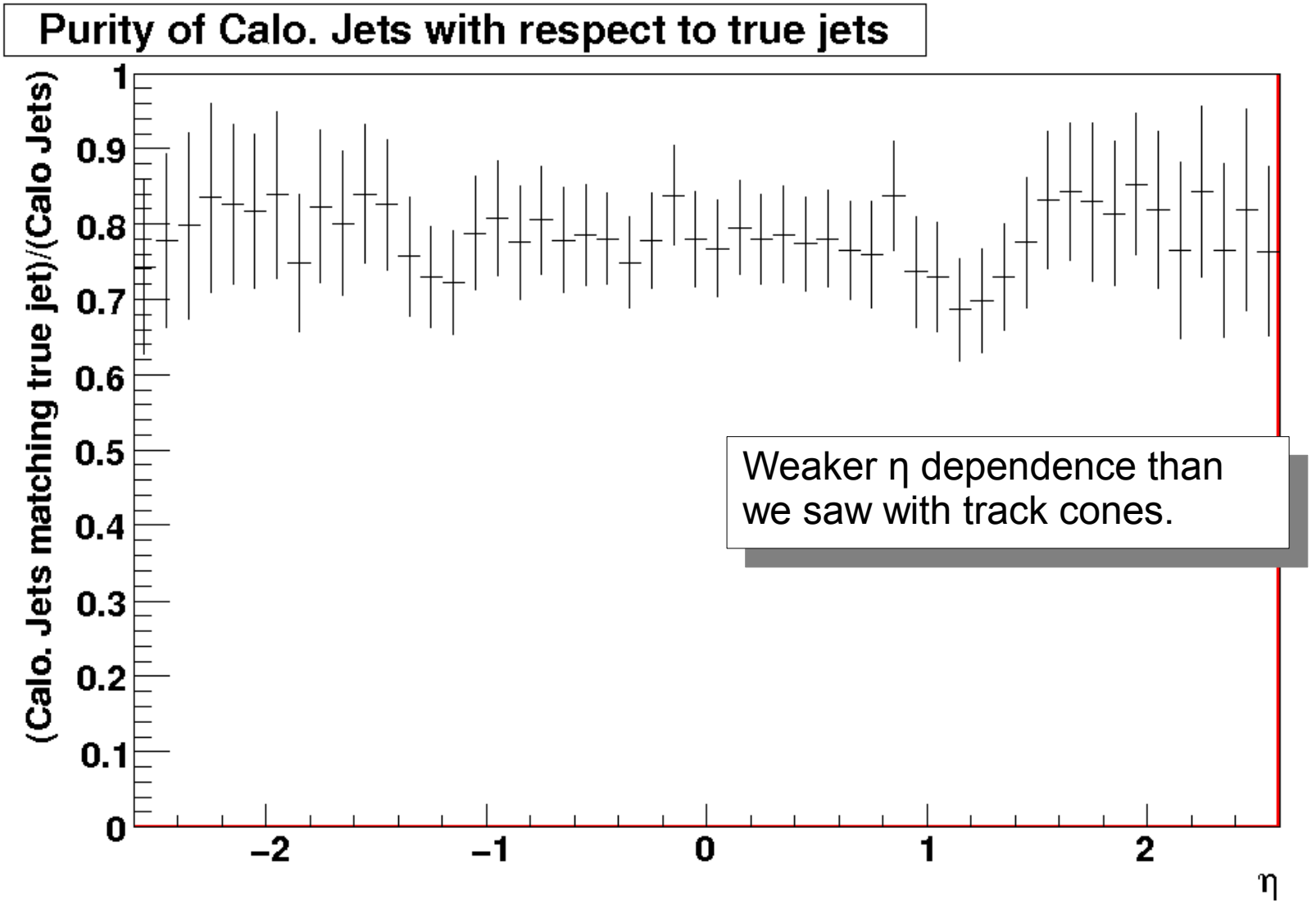
Simulated in release 14.1.0.3

Reconstructed in release 14.1.0.3

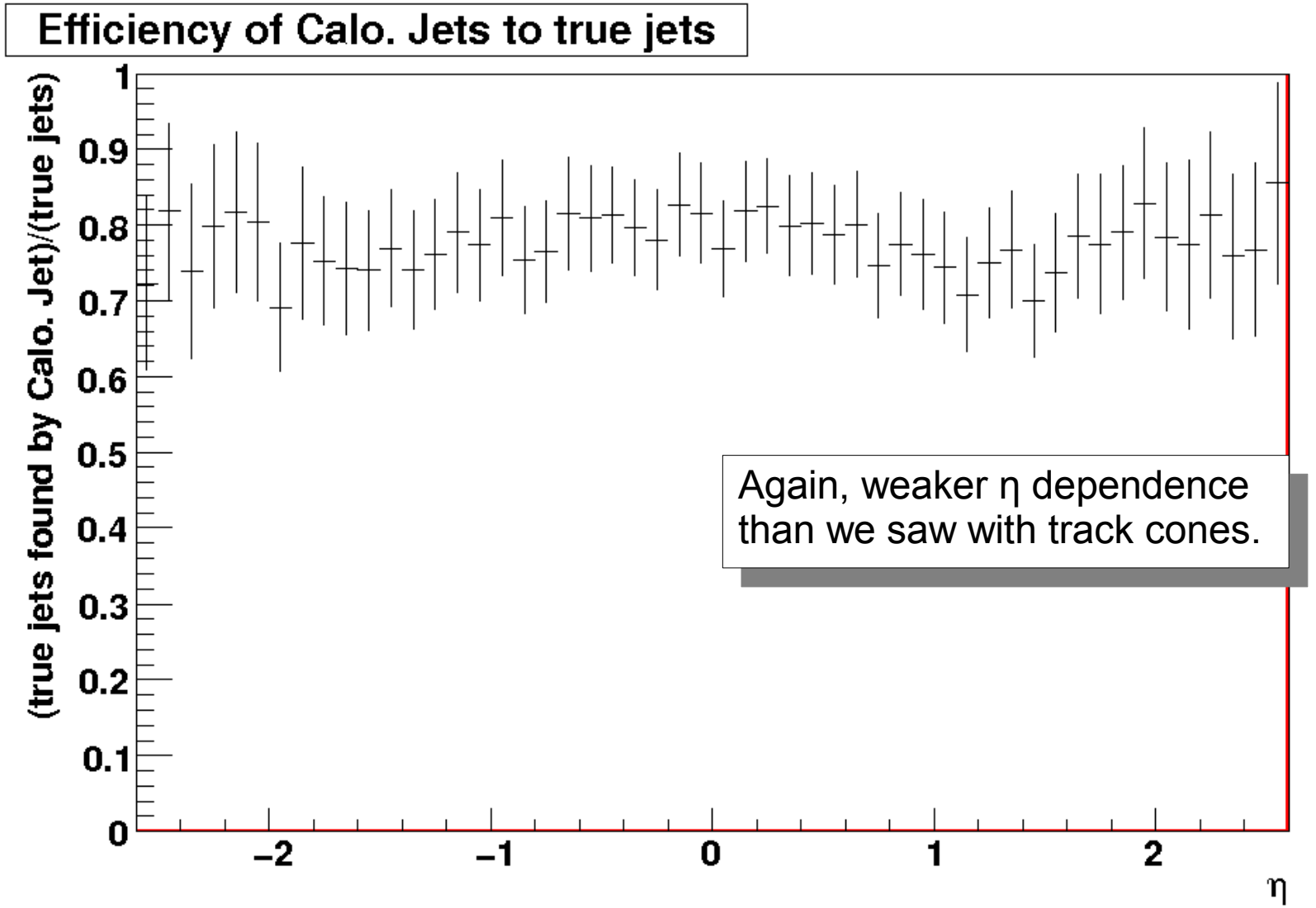
Geometry tag = ATLAS-CSC-05-01-00

https://twiki.cern.ch/twiki/bin/view/Atlas/AtlasGeomDBTags#ATLAS_Geom_DB_Tag

Calo jet purity vs η



Calo Jet Efficiency vs η



No offset of axis wrt truth