New astropix algorithm (again)

18/8/2026

Background

- Was told that using location of astropix pixel with max Edep gives better position than average of astropix hits (default).

- Wanted to verify this hypothesis.

- Test new algorithms as well!

Background

- Current: Weighted average of all hits in astropix, weighted by energy.
- Was told that taking position of the pixel with max-e-dep in a cluster improves resolution.
- Test astropix algorithm with gamma single track simulation.
- Gamma is neutral, doesn't bend in B-field. Phi and eta of cluster center can be compared to initial gamma phi.

Test condition

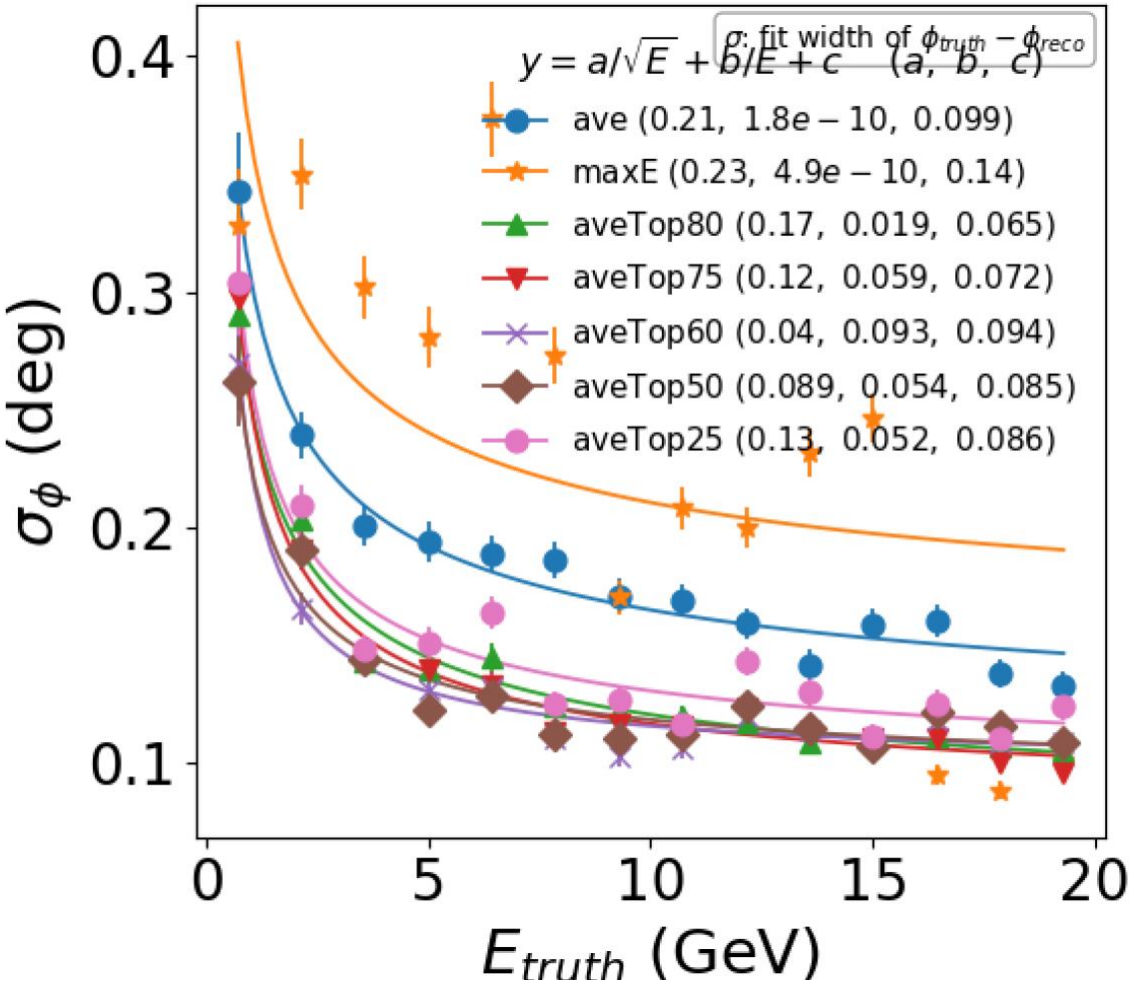
- Single track gamma, originates from origin (0, 0, 0).
- 80 deg < theta < 100 deg.
  - The most performant phase space.
- 2pi azimuth, uniform.
- 0.01 < E < 20 GeV, uniform.
- Standard clustering algorithm.

Algorithm tested

1. Ave: weighted average of all astropix points.
2. MaxE: Pixel location of the largest E-dep in a cluster.
3. AveTop50: Truncated average, only consider hits with top 50% percentile in edep.
4. AveTop<other numbers>: Truncated average with different truncation averages

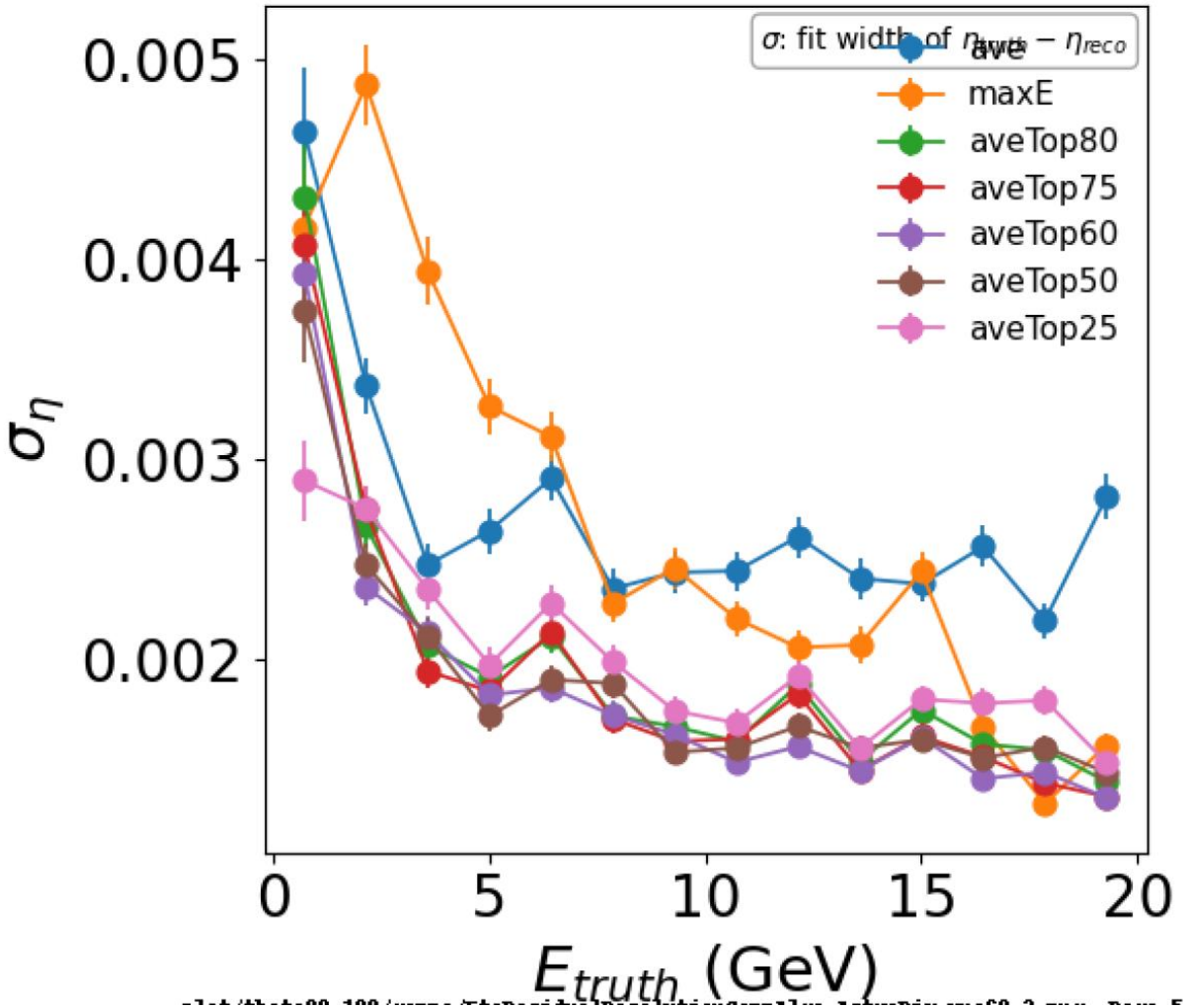
Tests for other truncation fractions

- Top 75% hit gives (marginally) better performance than all others.
- 50-80% all gives similar performance -> 75% is inside this plateau region.
  - Truncation fraction 75% is robust.



What about eta?

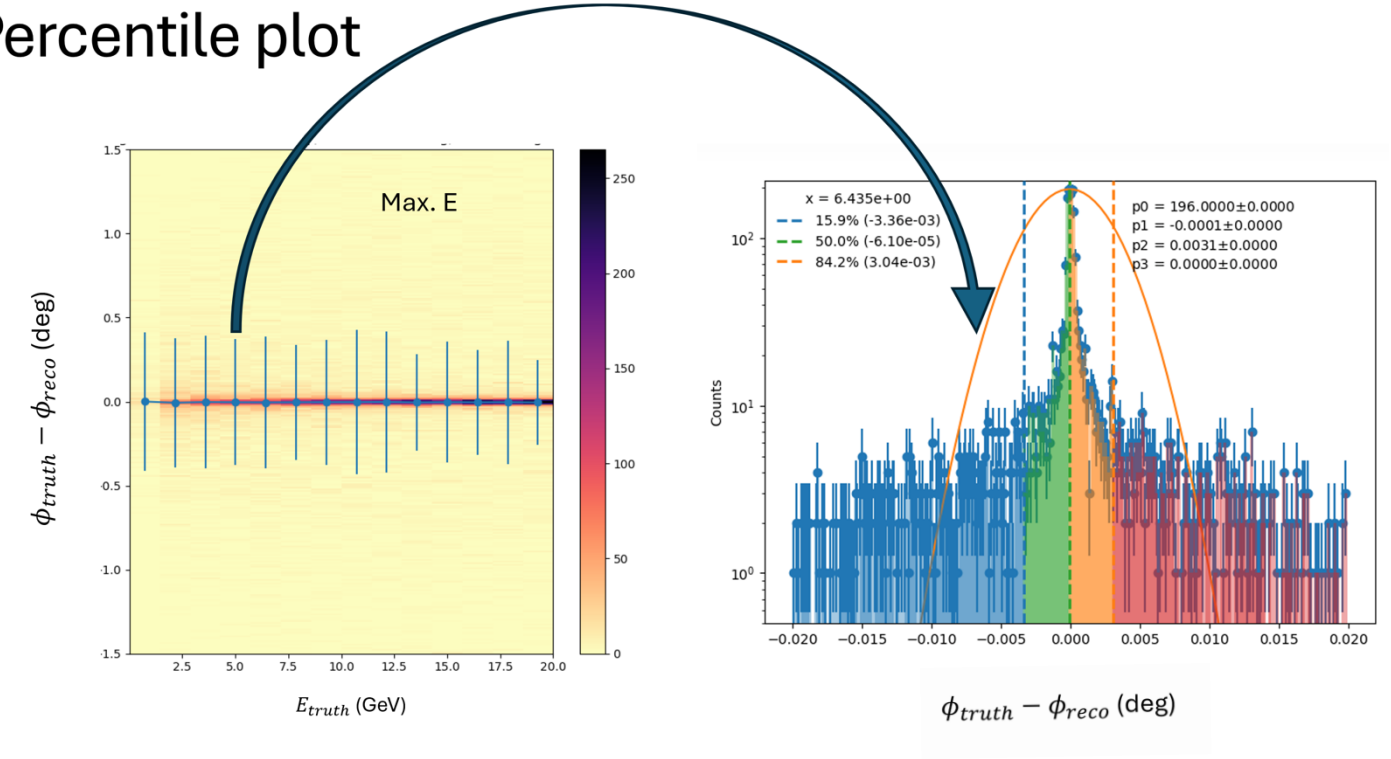
- 75% is still one of the best



So aveTop75 is the best? Not so fast

- Definition of error bar = 68.3% confidence interval.
- Shape of phi-residual for maxE is HIGHLY non-Gaussian.
- maxE perform worst because of long tail, but the central region actually looks nice!

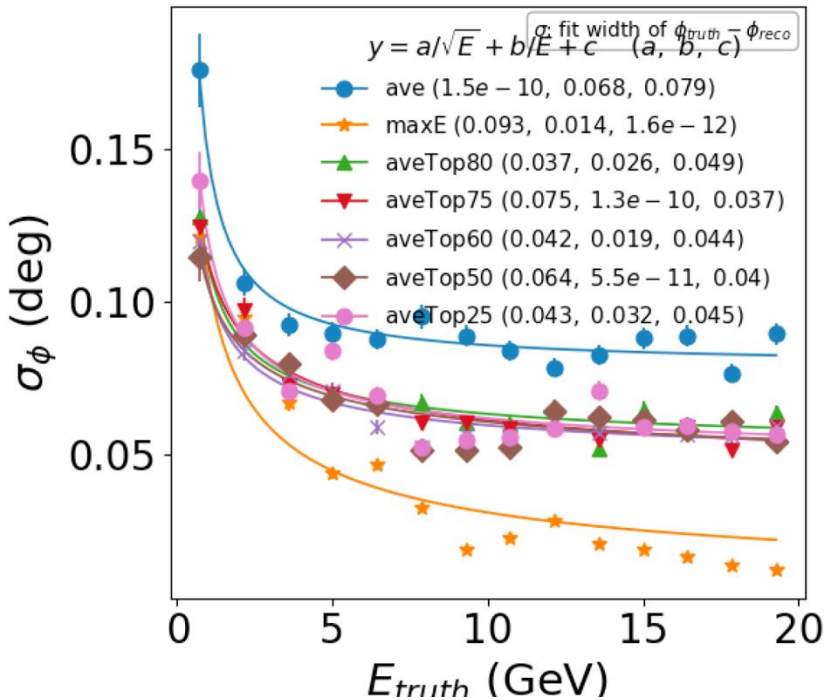
Percentile plot



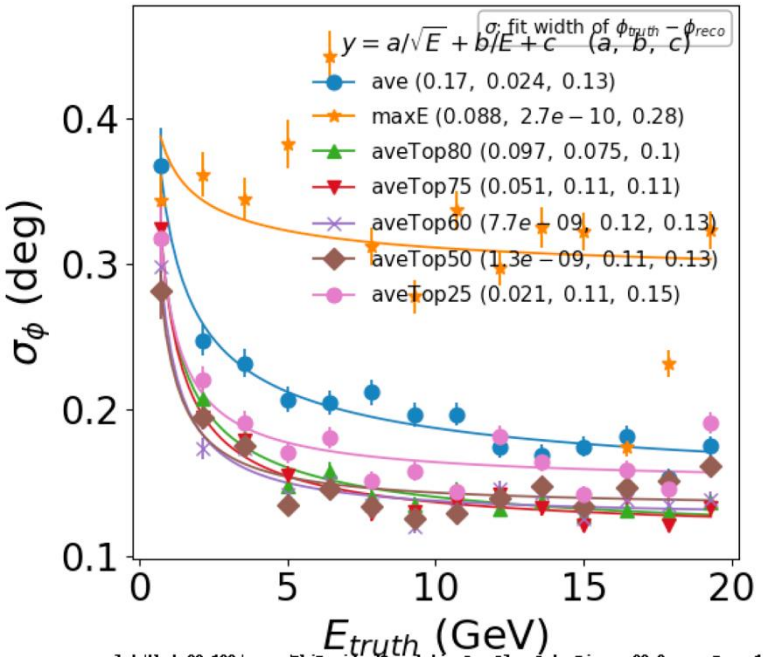
aveTop75 is the best? Not so fast

- maxE out-performs if definition of error is 38.3 (0.5 sigma) C.I.
- Any way to get the best of both worlds?

Y-axis = **38.3%** confidence interval



Y-axis = **68.3%** confidence interval



Tail clipping

- Idea: Cut away the tail of maxE.

- What doesn’t have long tail? aveTop75.

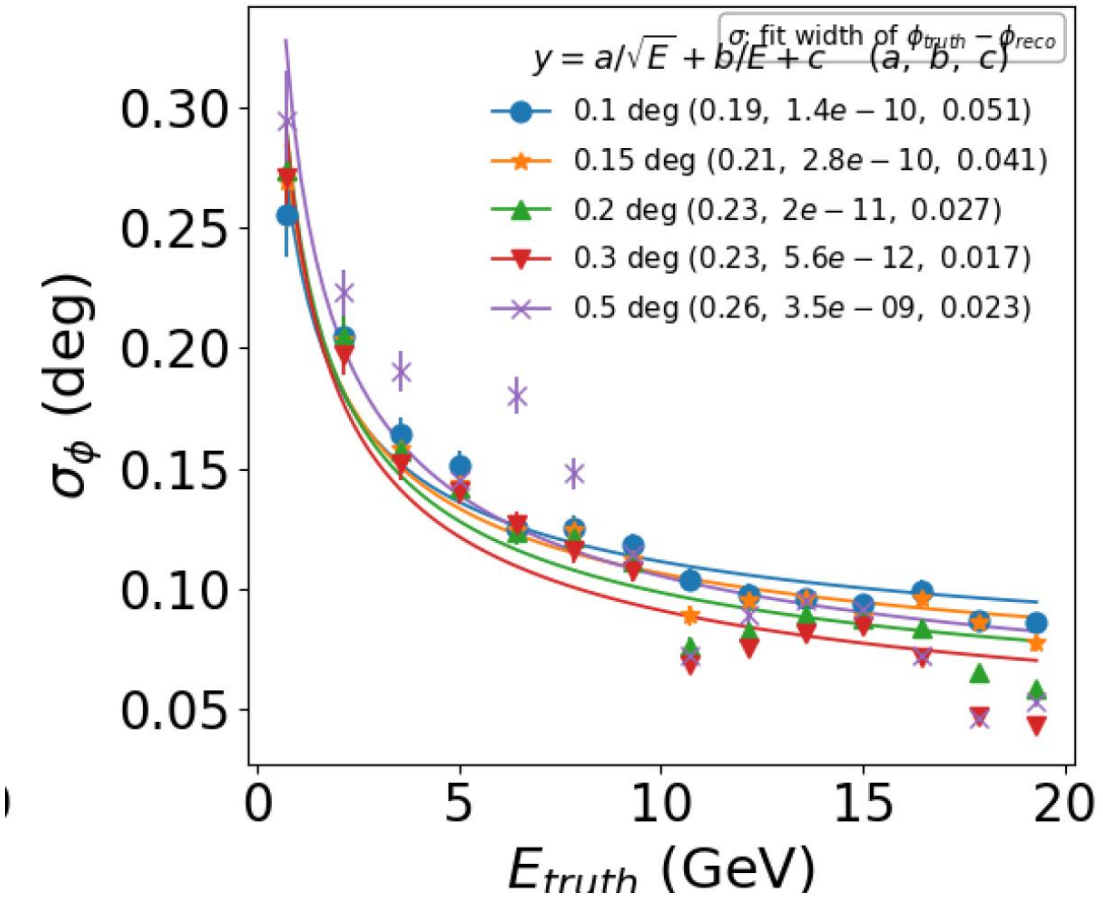
- Proposed “tail clipping” algorithm:
  1. Calculate position from both maxE and aveTop75.
  2. If phiDiff(maxE, aveTop75) < threshold:

     use maxE

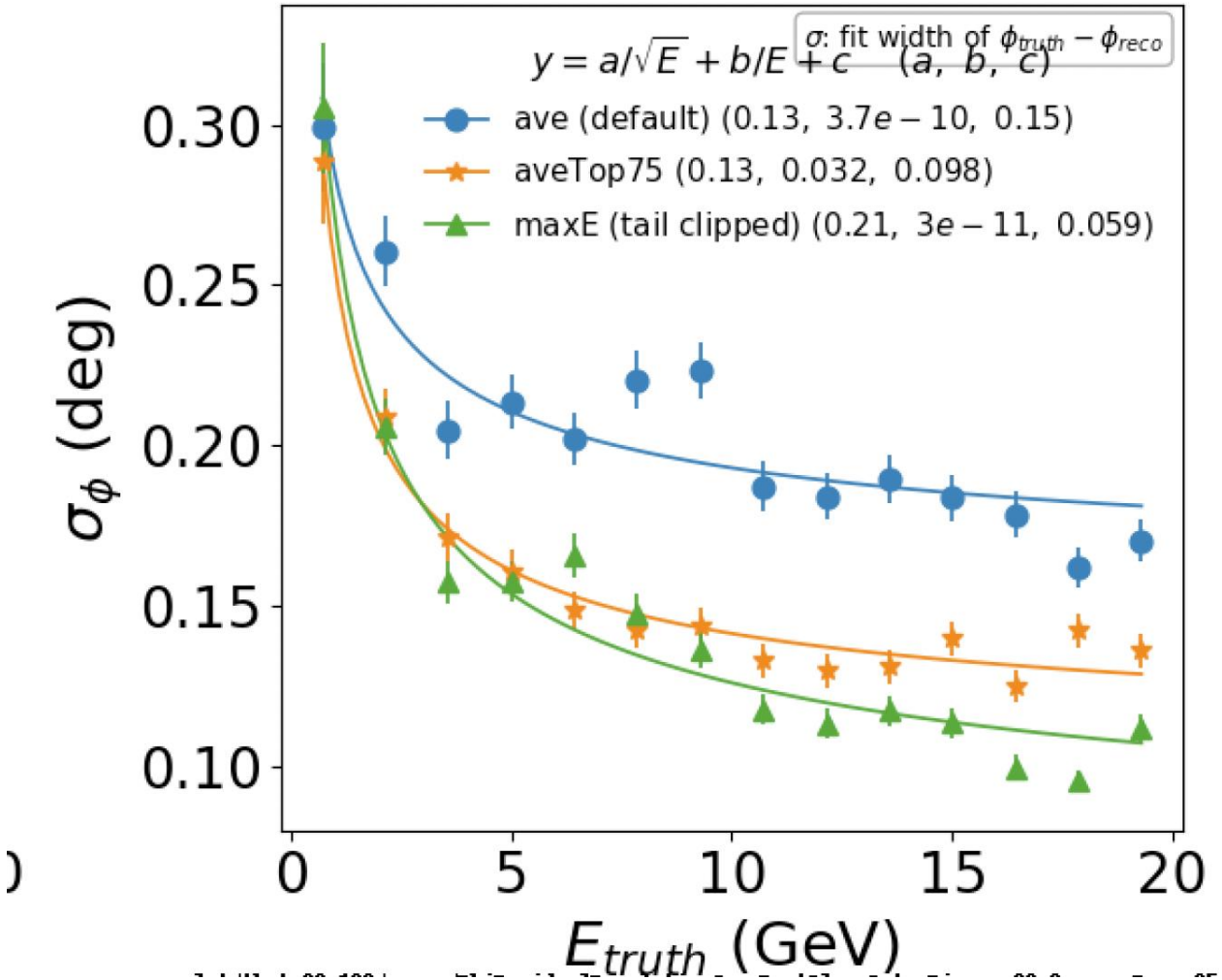
     Else use aveTop75

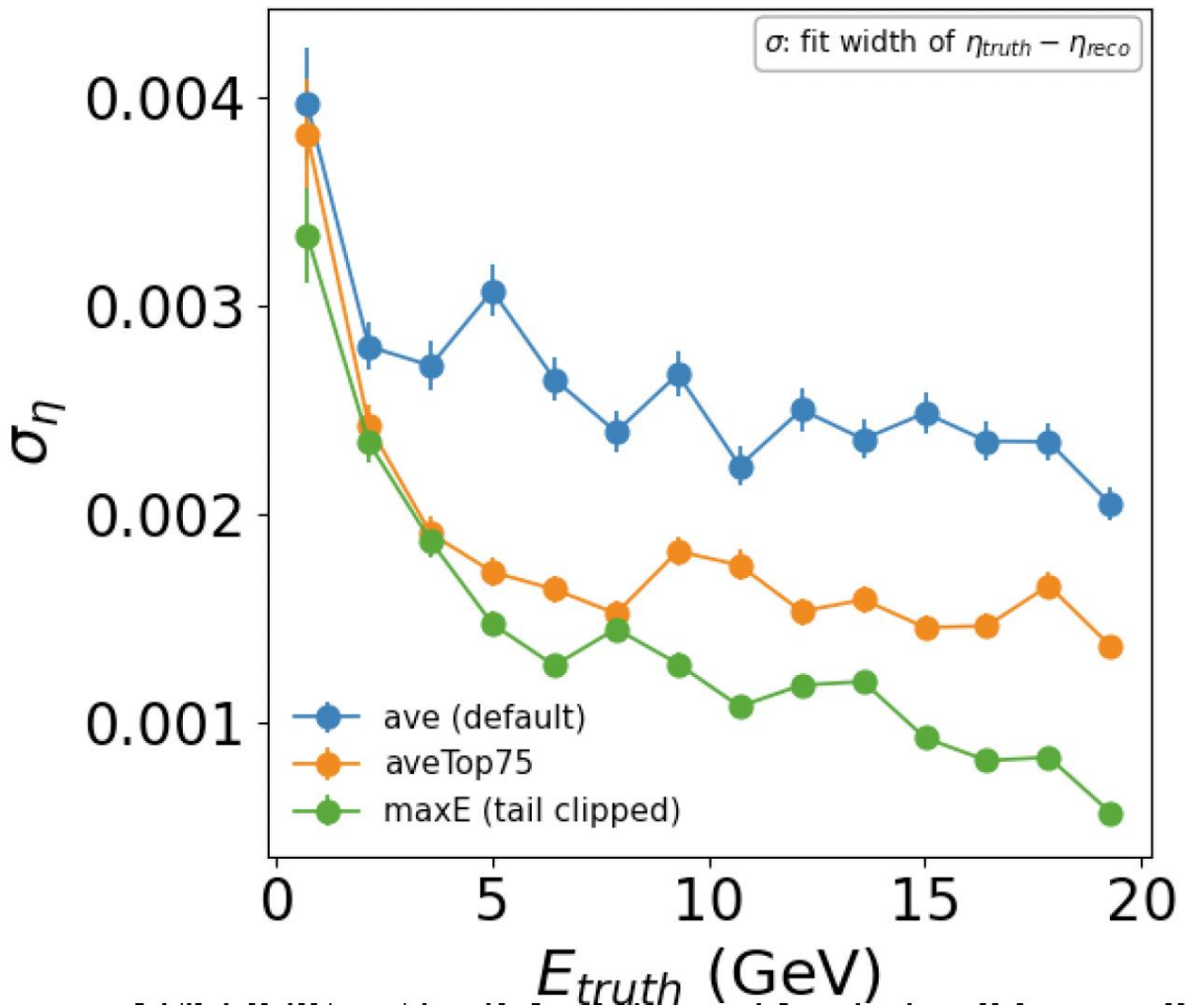
Test for optimal phi-diff threshold

- Tested 0.1 – 0.5 deg.
- Range chosen as sigma of aveTop75 is 0.1-0.3 deg depending on Etruth.
- Threshold of 0.3 deg is the optimum.
- But the value is robust. Any threshold in between 0.1-0.5 performs similarly.



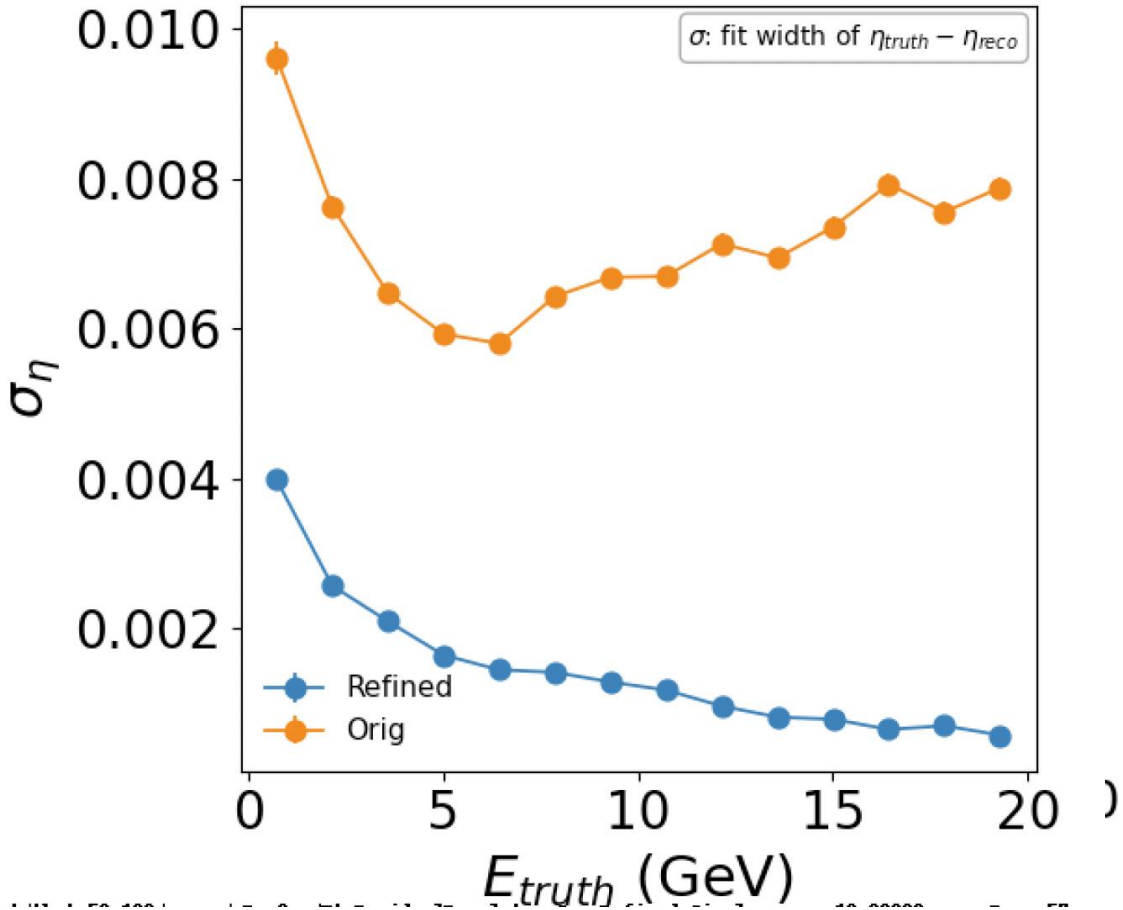
Improvement caused by tail-clipping

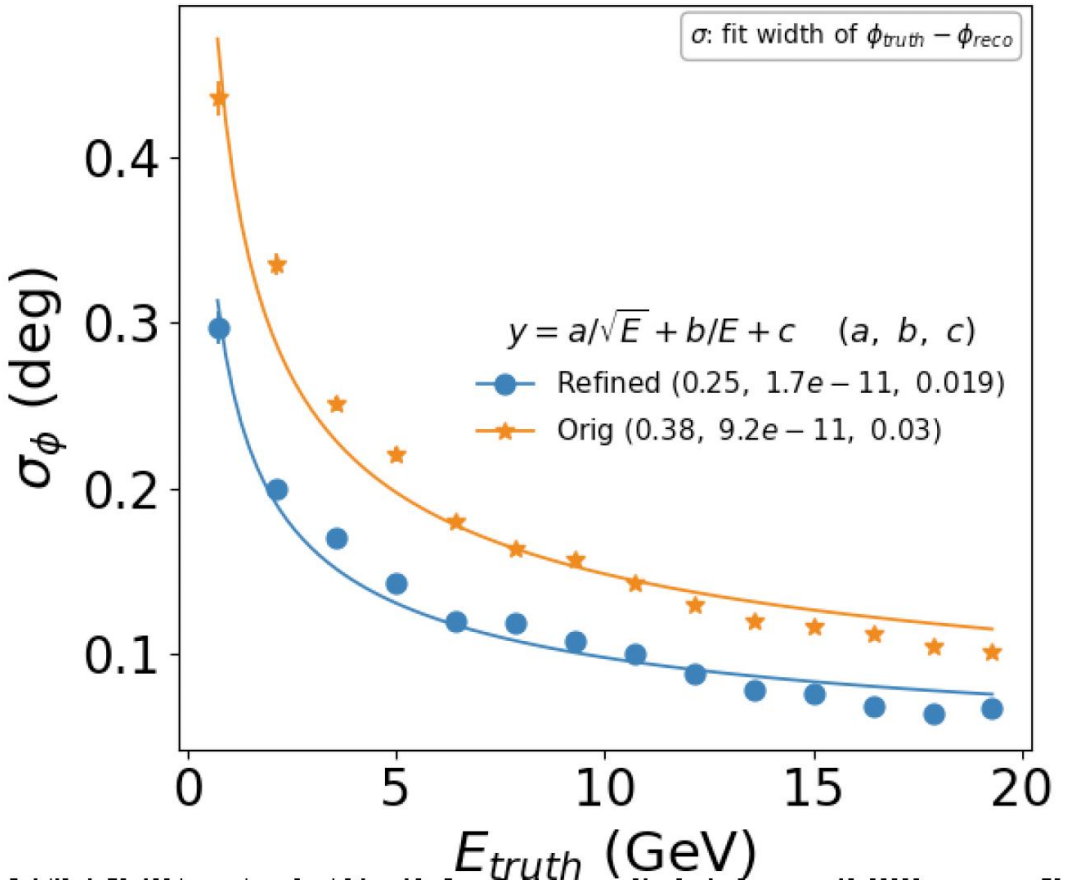




Performance comparison to ScFi

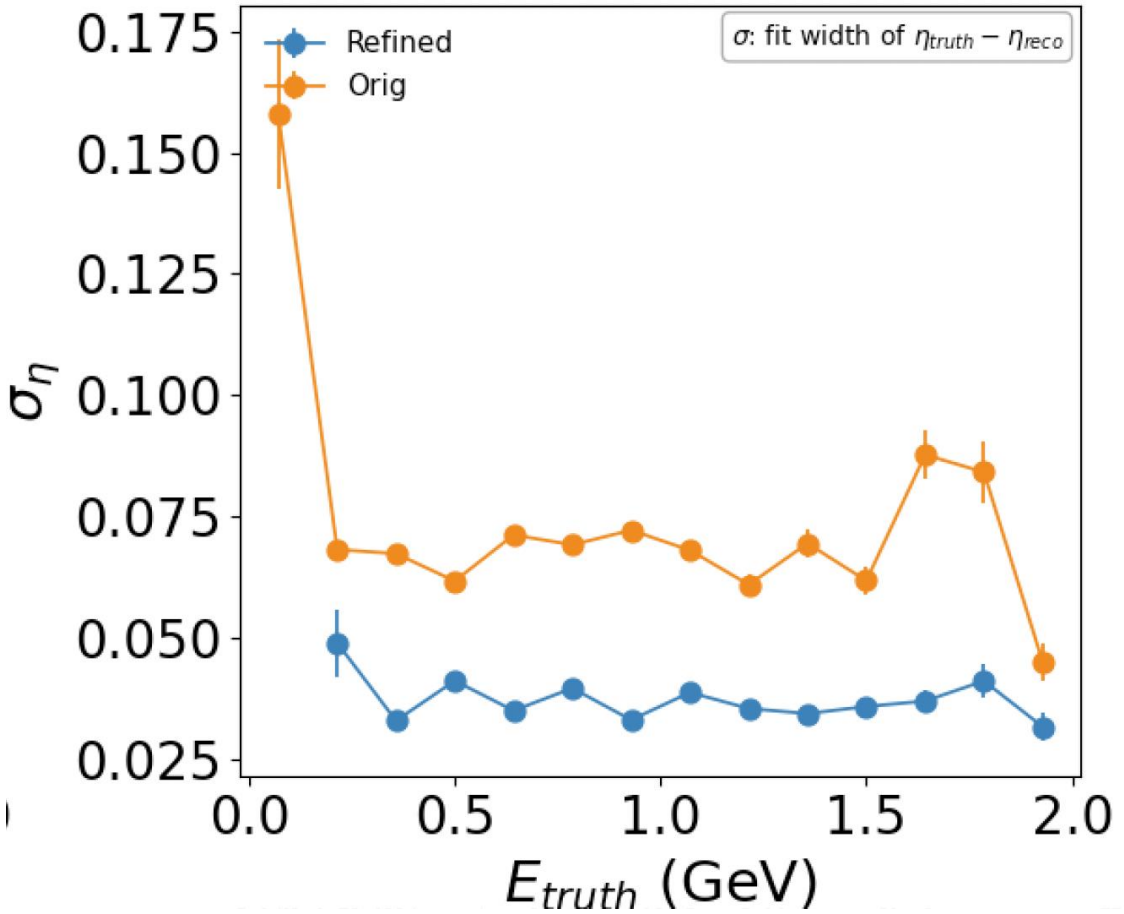
Orange: ScFi, Blue: ScFi + AstroPix (new algo)

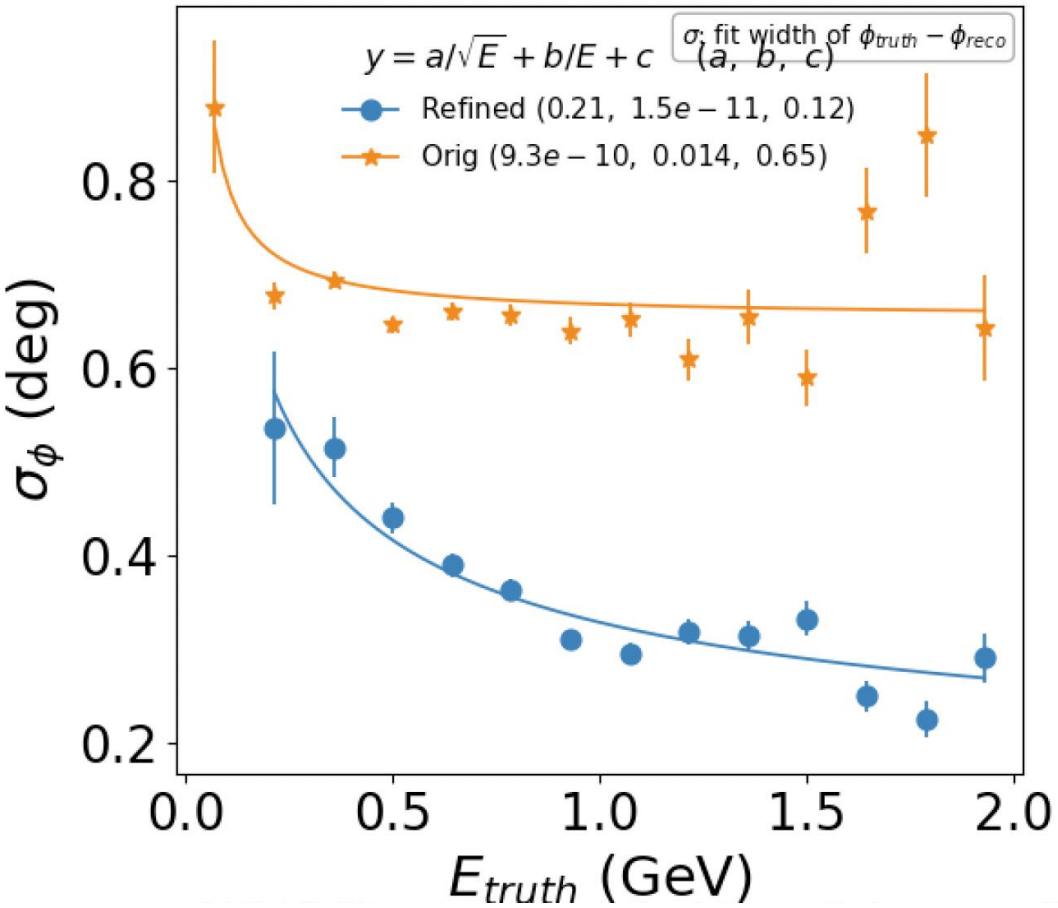




Performance comparison to ScFi (With DIS events)

Orange: ScFi, Blue: ScFi + AstroPix (new algo)





Conclusion: maxE with tail clipping

If phiDiff(maxE, aveTop75) < 0.3 deg:
  use maxE
Else
  use aveTop75

- I’ve read the pull request for new clustering algorithm. Should be compatible?