Smearing Method for generator level data

WG6 meeting

CERN

5/05/2011

Outline

- The need and what already exists
- A new solution envisionned
- Description of the principle
- Results on ttbar events
- Results on WW events
- Conclusion
- Outlook

The need and what already exists

- Why smearing ?
  - Huge amount of background events
  - Long time to fully simulate every single event
  - Generation is fast
  - Smearing can give a realistic approximation the full simulation

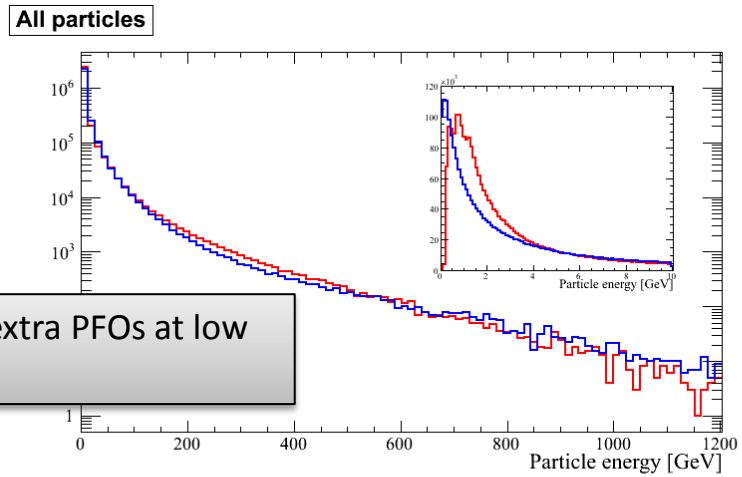
The need and what already exists

- Available yet: Lars Weuste Marlin driver
  - Developped for a specific channel (ee -> squark squark -> qq XX)
  - Based on the smearing of jets (Durham dijet)
  - Rely on 2009 PFA paper results, not updated for later improvement
- I needed more:
  - Optimized for ttbar events
  - Smearing of non-jet-related variables
  - Various jet deffinitions (kt, hemispheres)
  - Mimic of the DST PFA performance

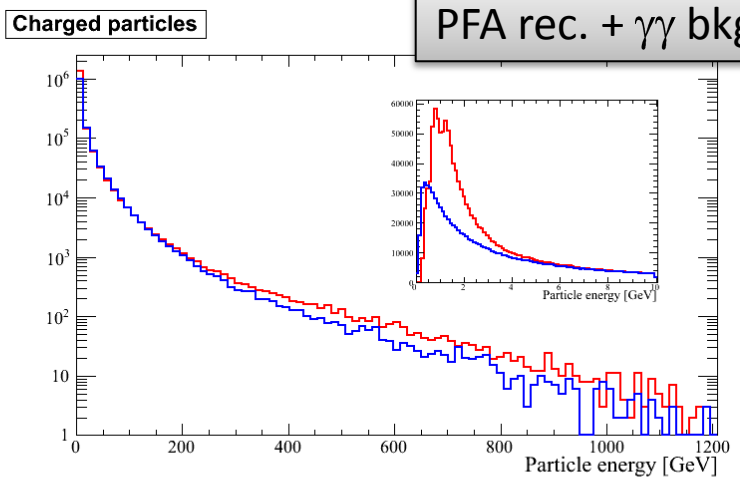
A new solution envisionned

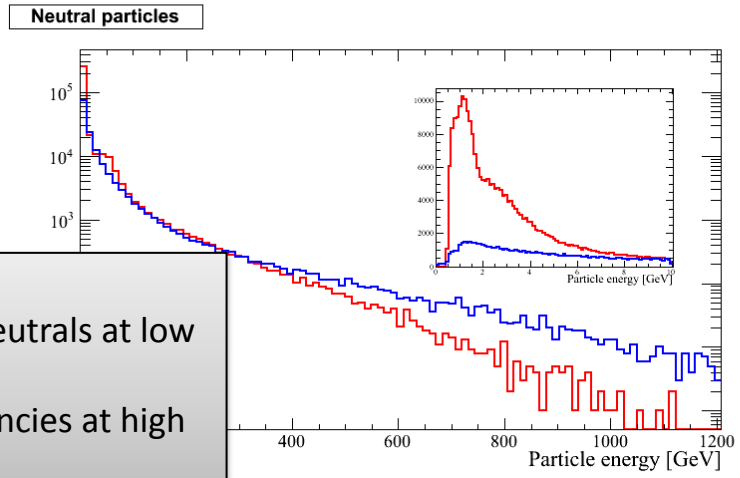
- Smearing at PFO level ?

PFA rec. + $\gamma\gamma$ bkg

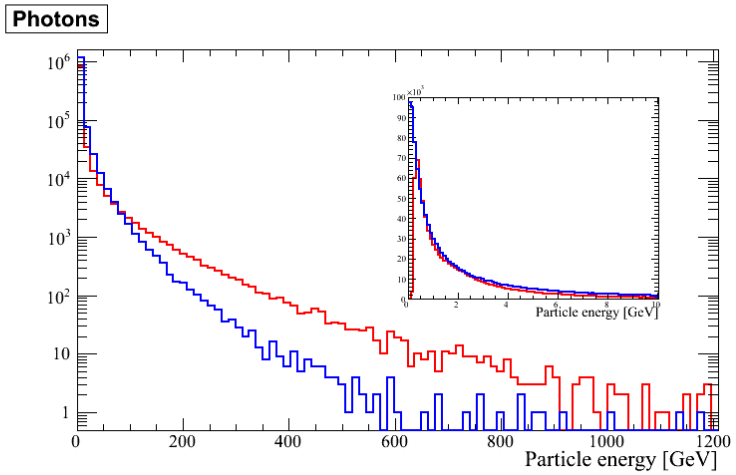


$\gamma\gamma$ bkg -> extra PFOs at low energy



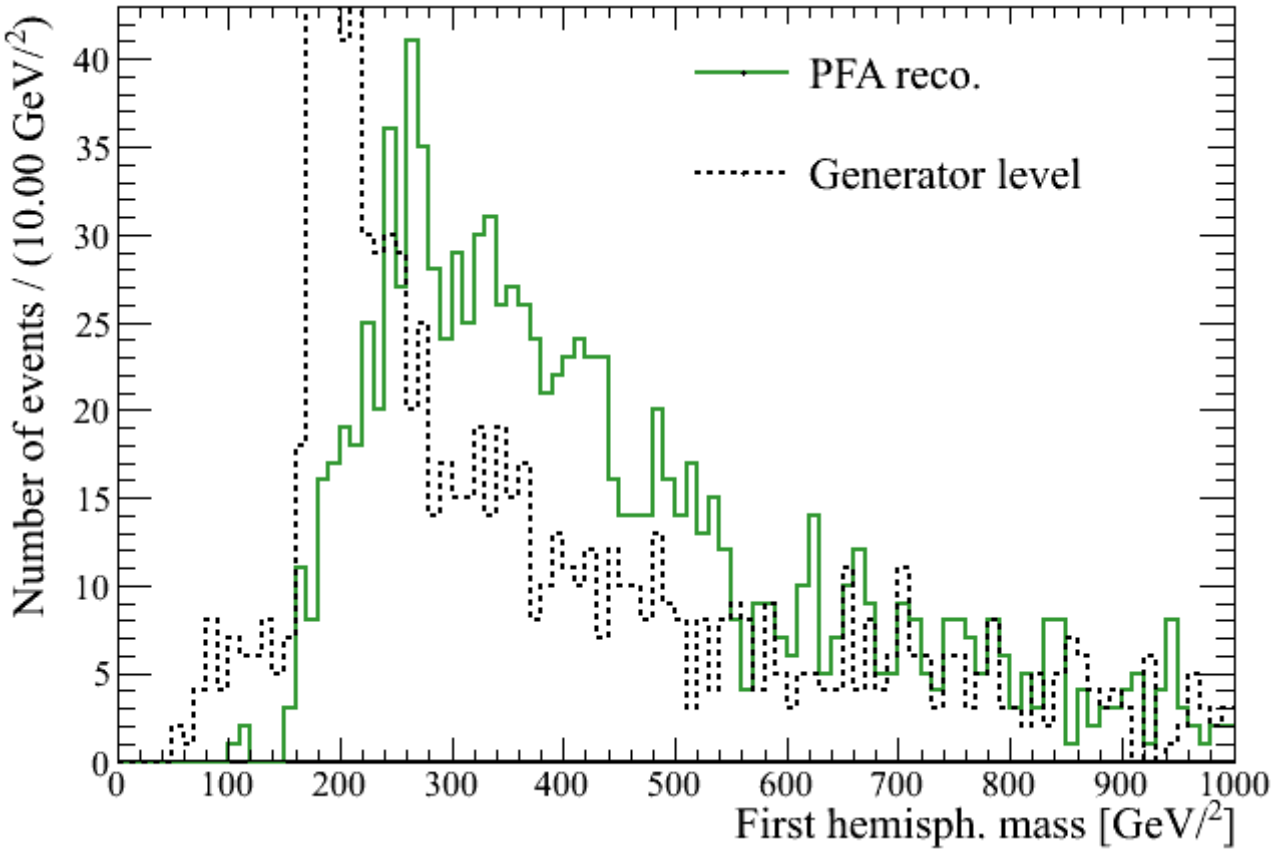


PFA rec.
-> extra neutrals at low energy
-> dicrepancies at high energies



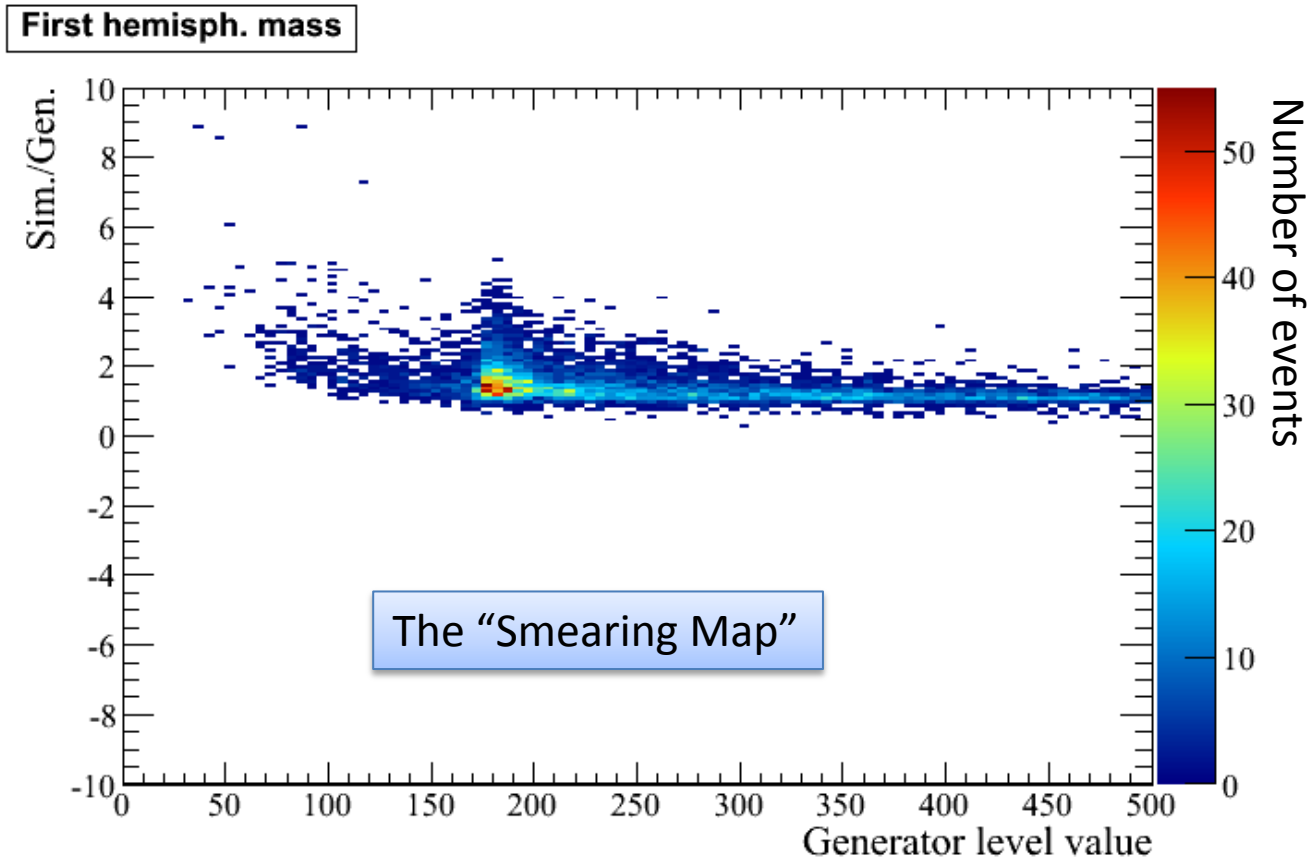
A new solution envisionned

- Smearing at the level of observables or finalstate analysis variables (PFA + $\gamma\gamma$ + TightCut)



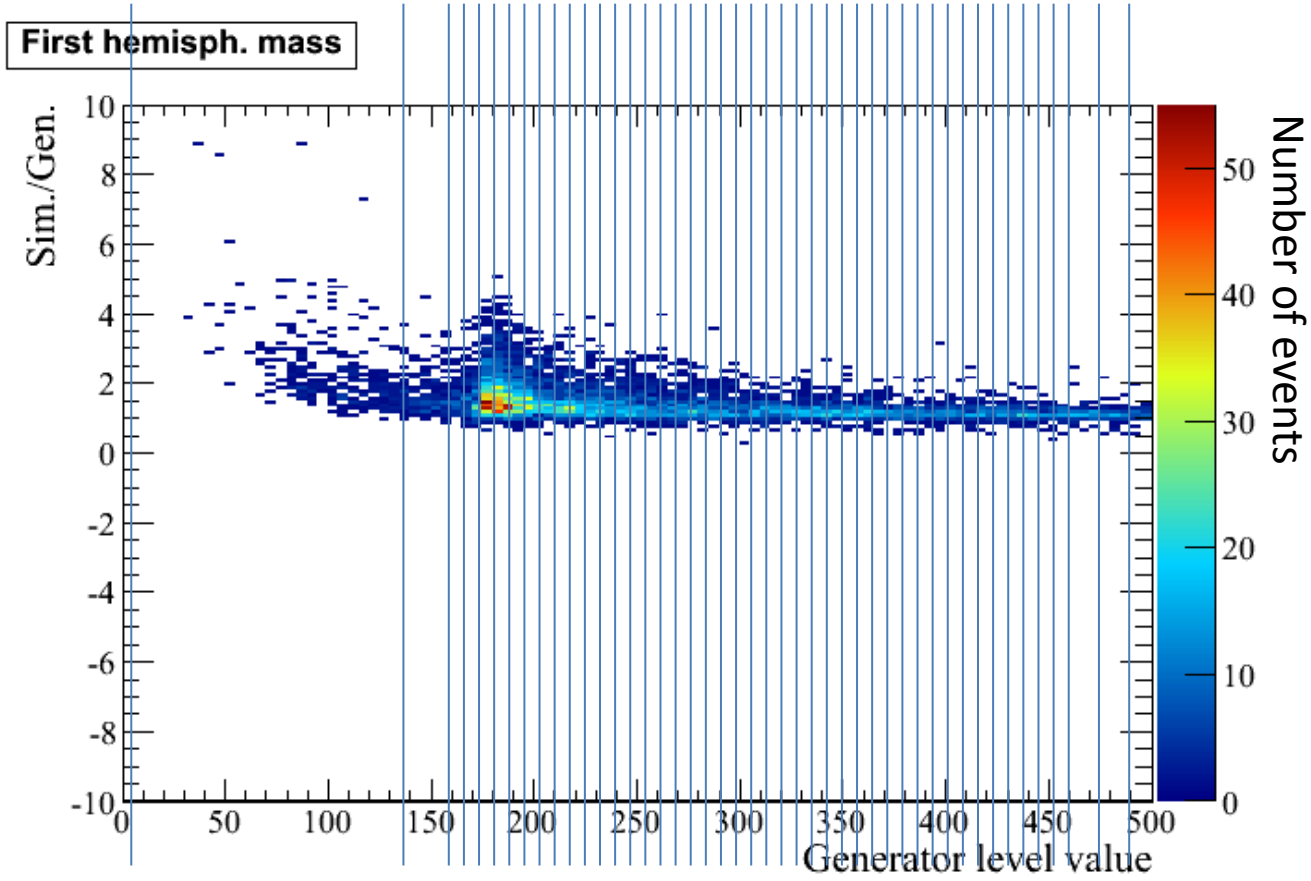
Description of the Principle

- For each variable to smear plot:
  Reco. value/ Gen. value VS. Gen Value



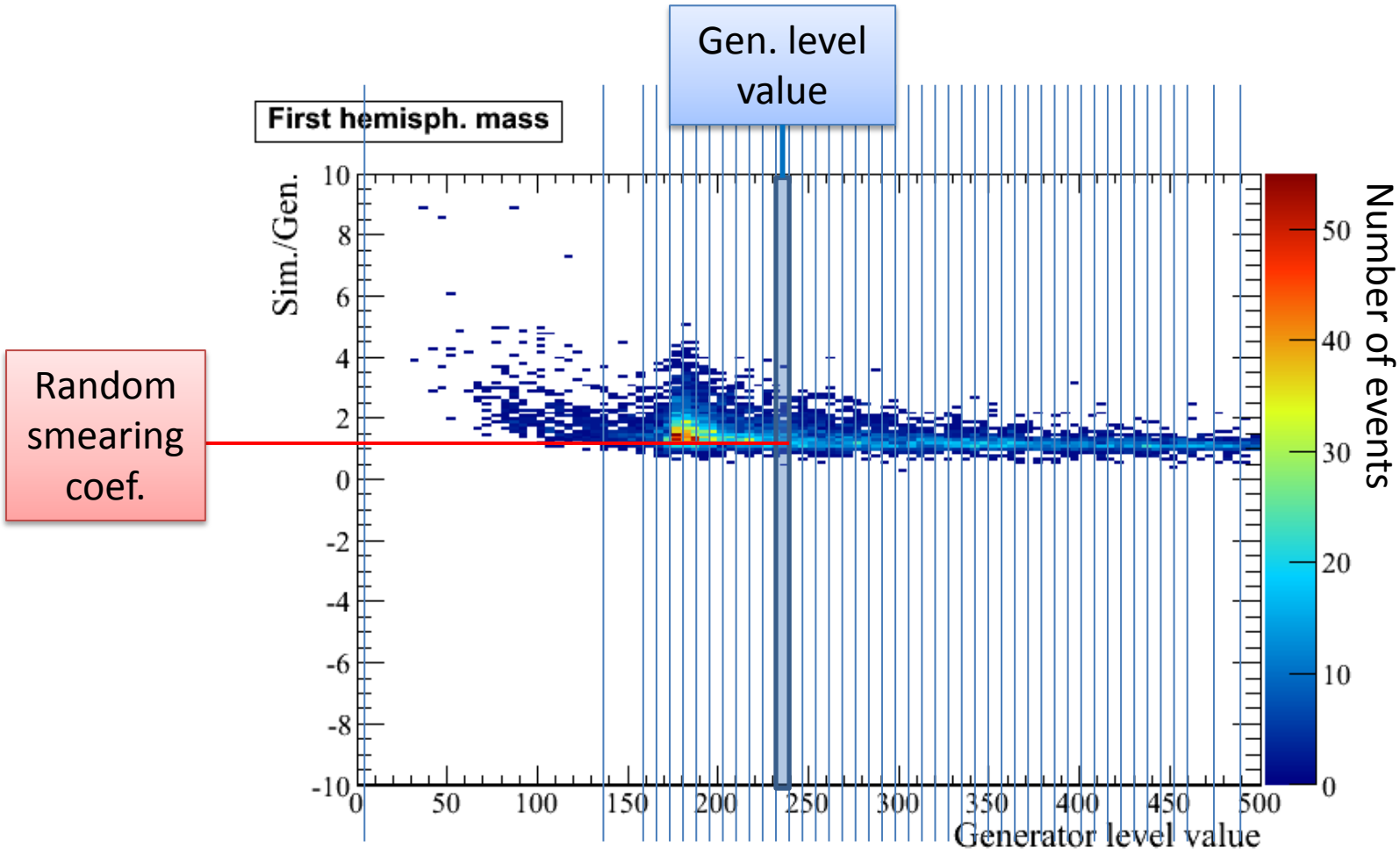
Description of the Principle

- Cut vertical slices (mind the stat, min=250)



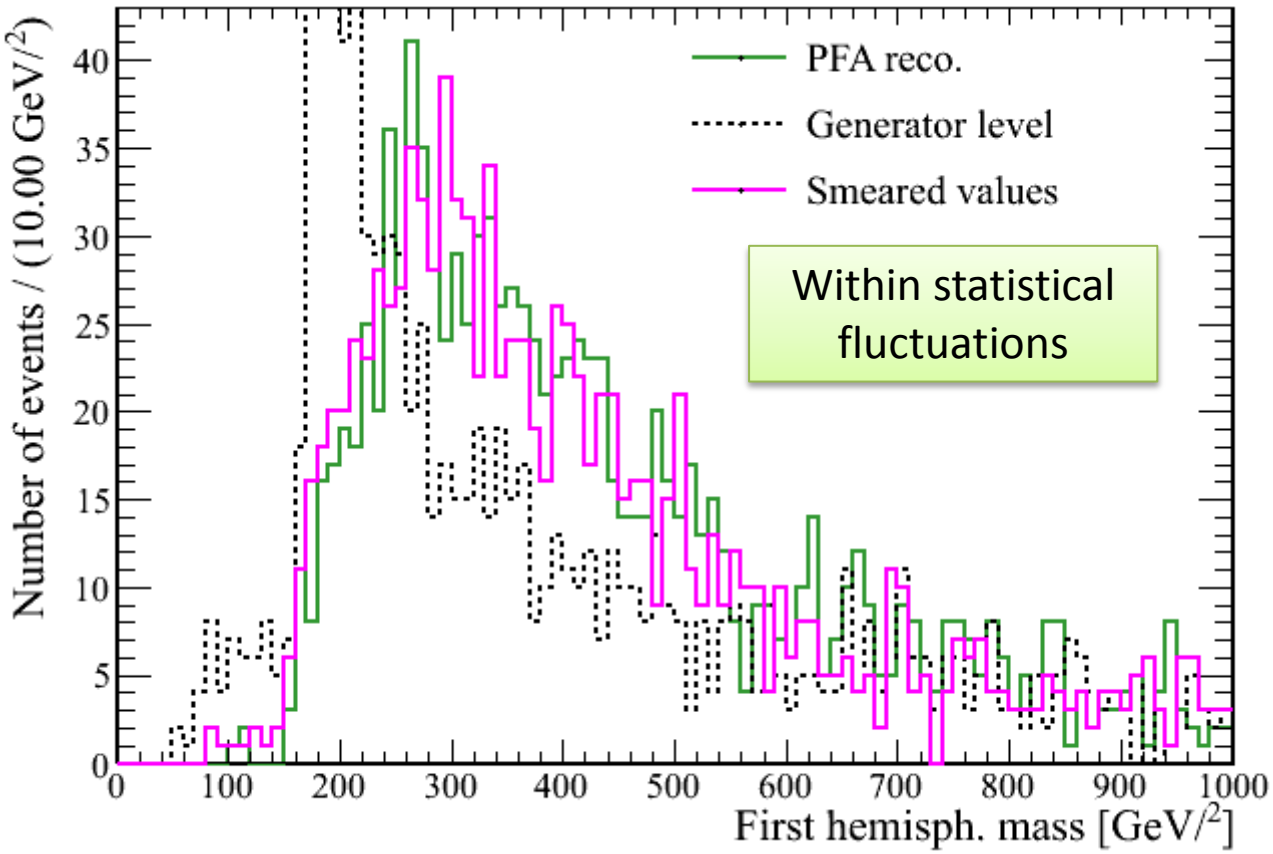
Description of the Principle

- Take generator level value to smear:
  - Select the corresponding slice
  - Generate a random coef. with the corresponding distribution.



Description of the Principle

- Multiply the generator level value by the smearing coef.



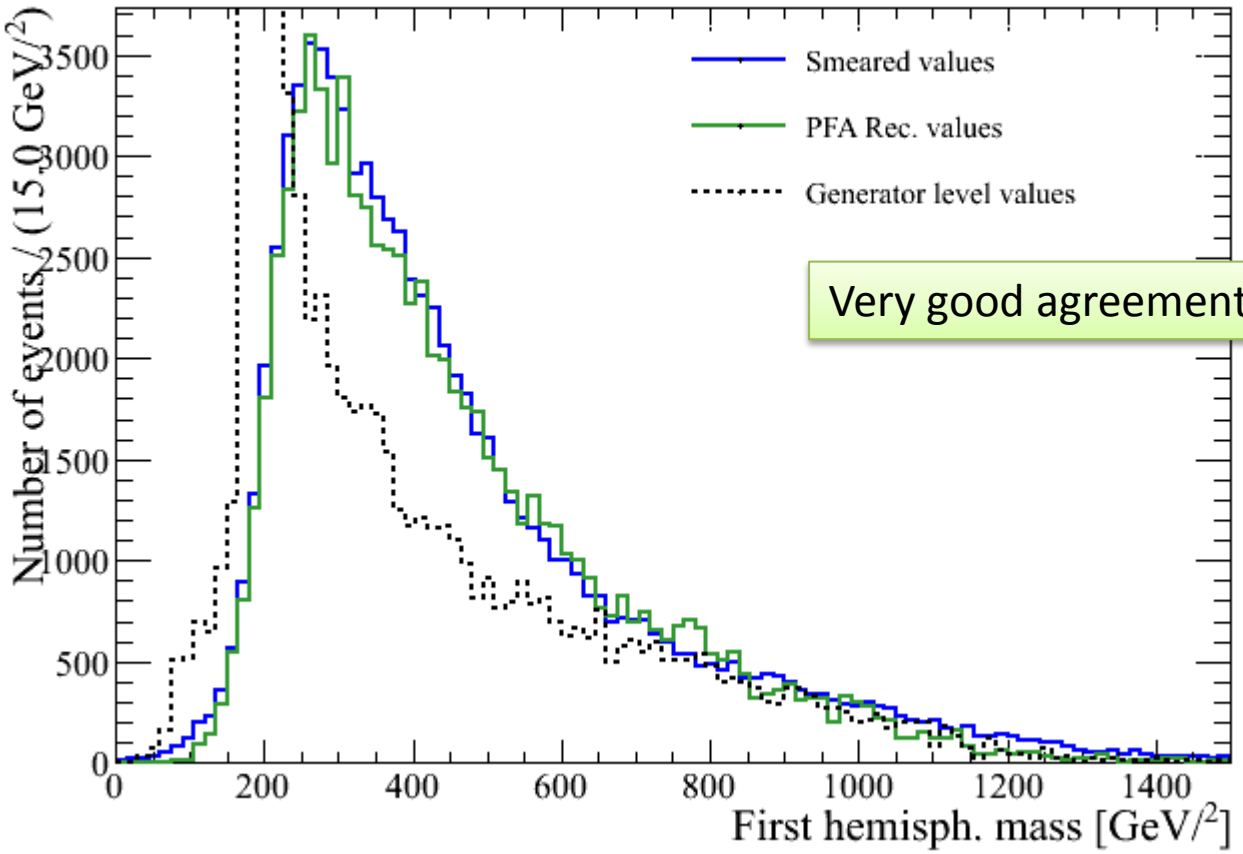
Results on ttbar events

- Smeared data obtained by looping on generator level data sample:

  -> Each gen. lev. event give many independent smeared events.
  -> The full desired statistics is obtained (e.g. 180k smeared ttbar out of 19k gen.)

- Generator level and Full. Sim. data are scaled to match area.

Results on ttbar events



Very good agreement achivable

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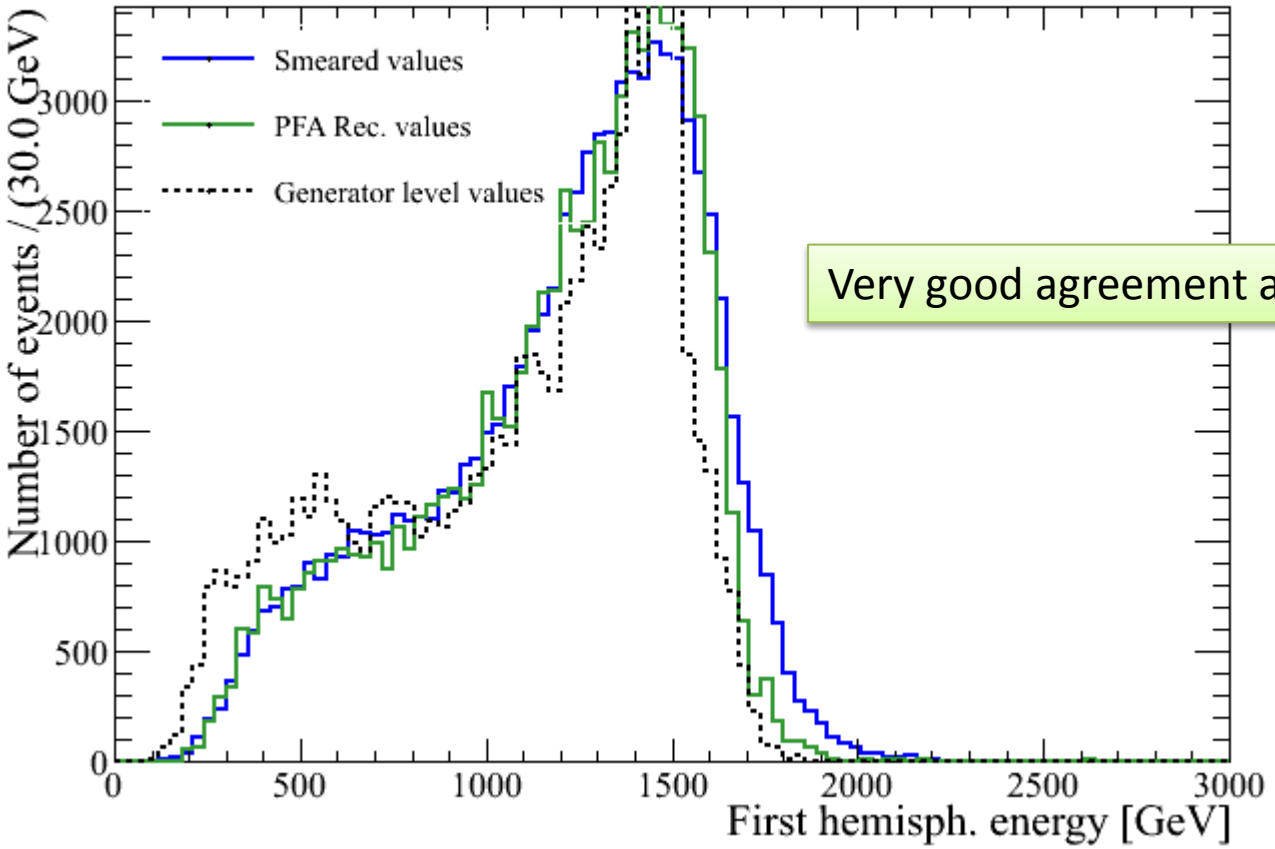

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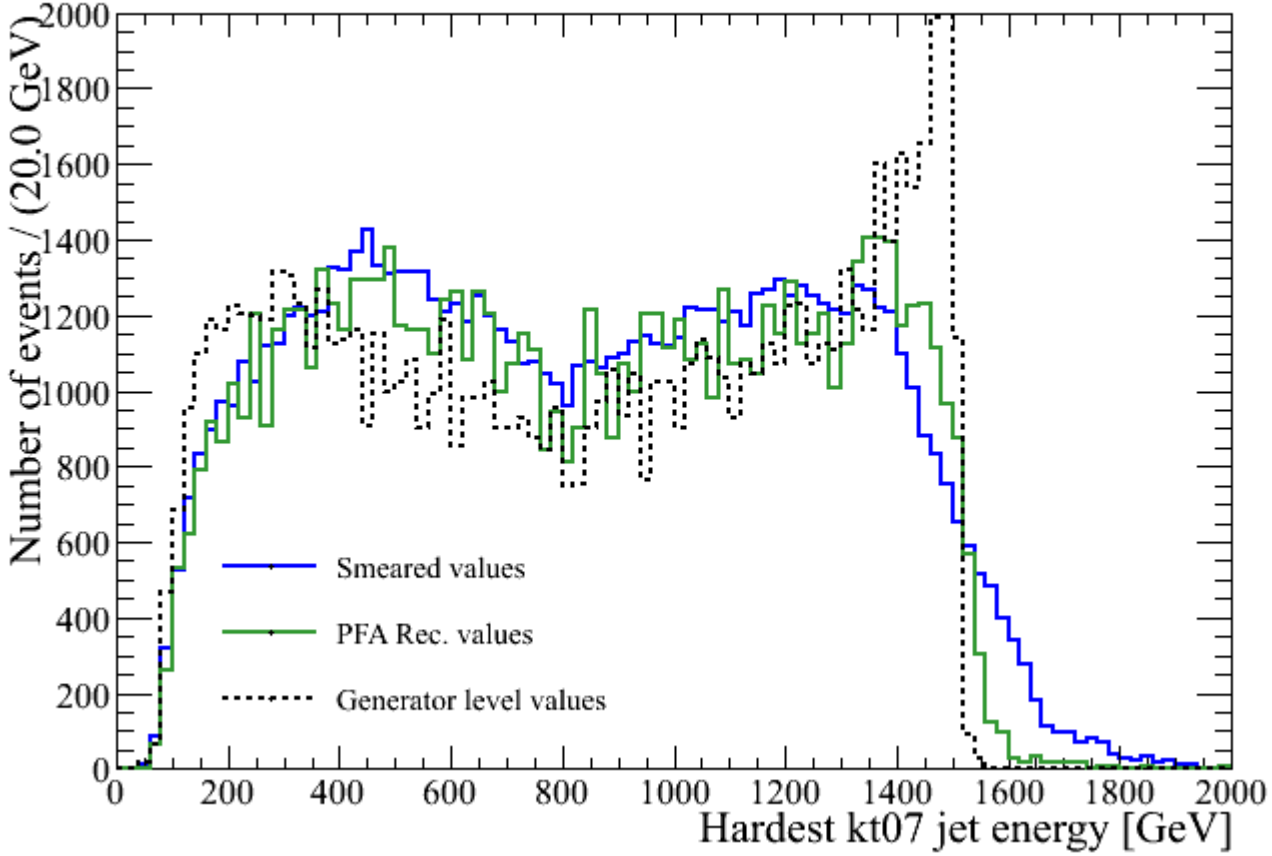
Results on ttbar events

Discrepancies are still conservative



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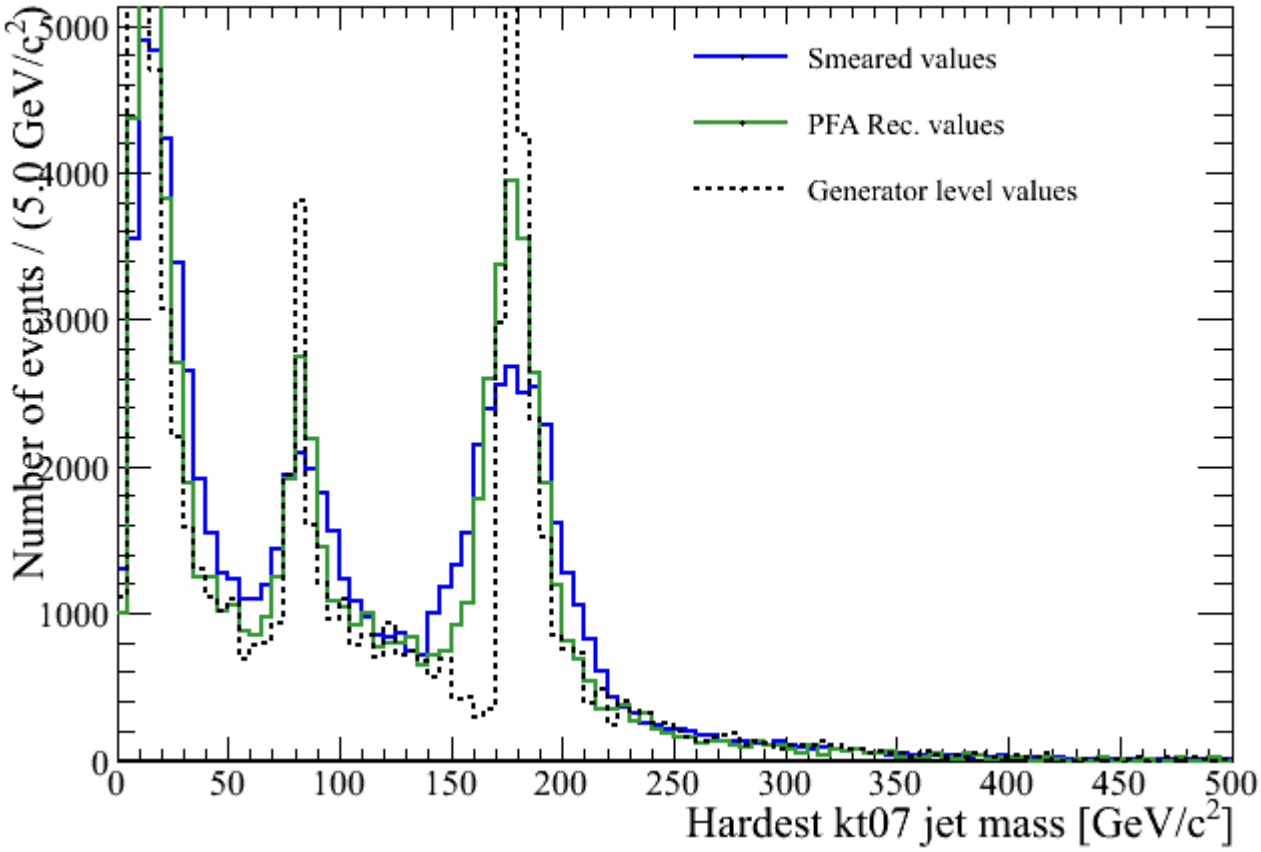
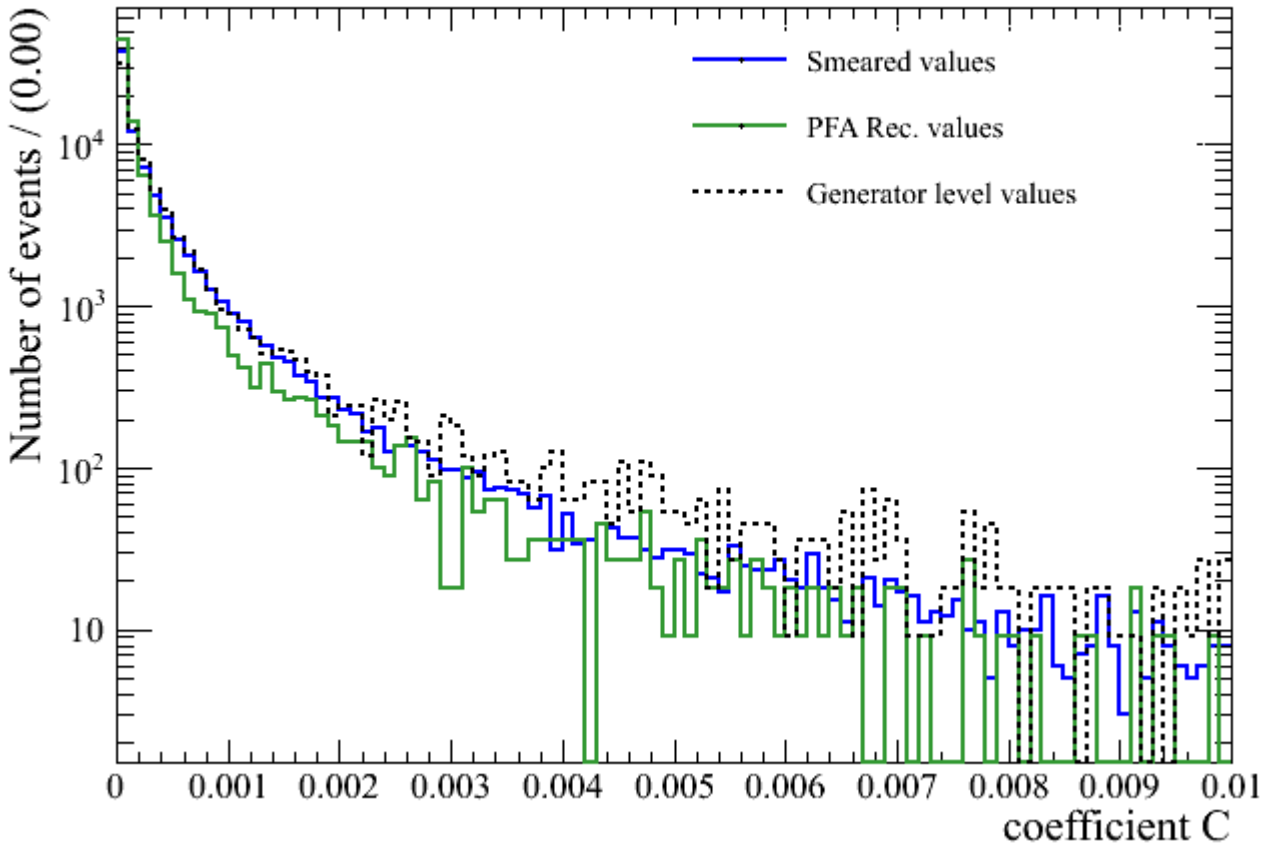


Results on ttbar events

Tails are populated (rather realistically)



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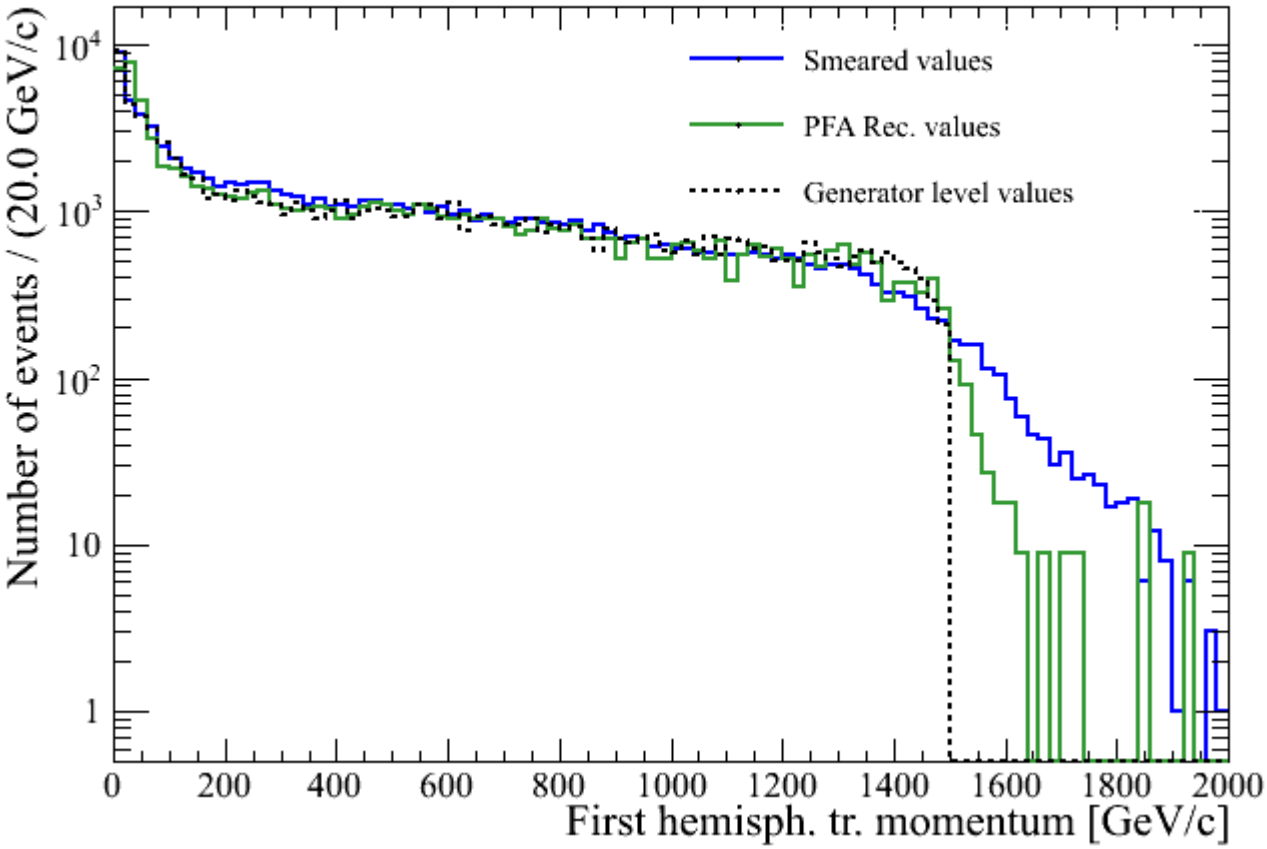


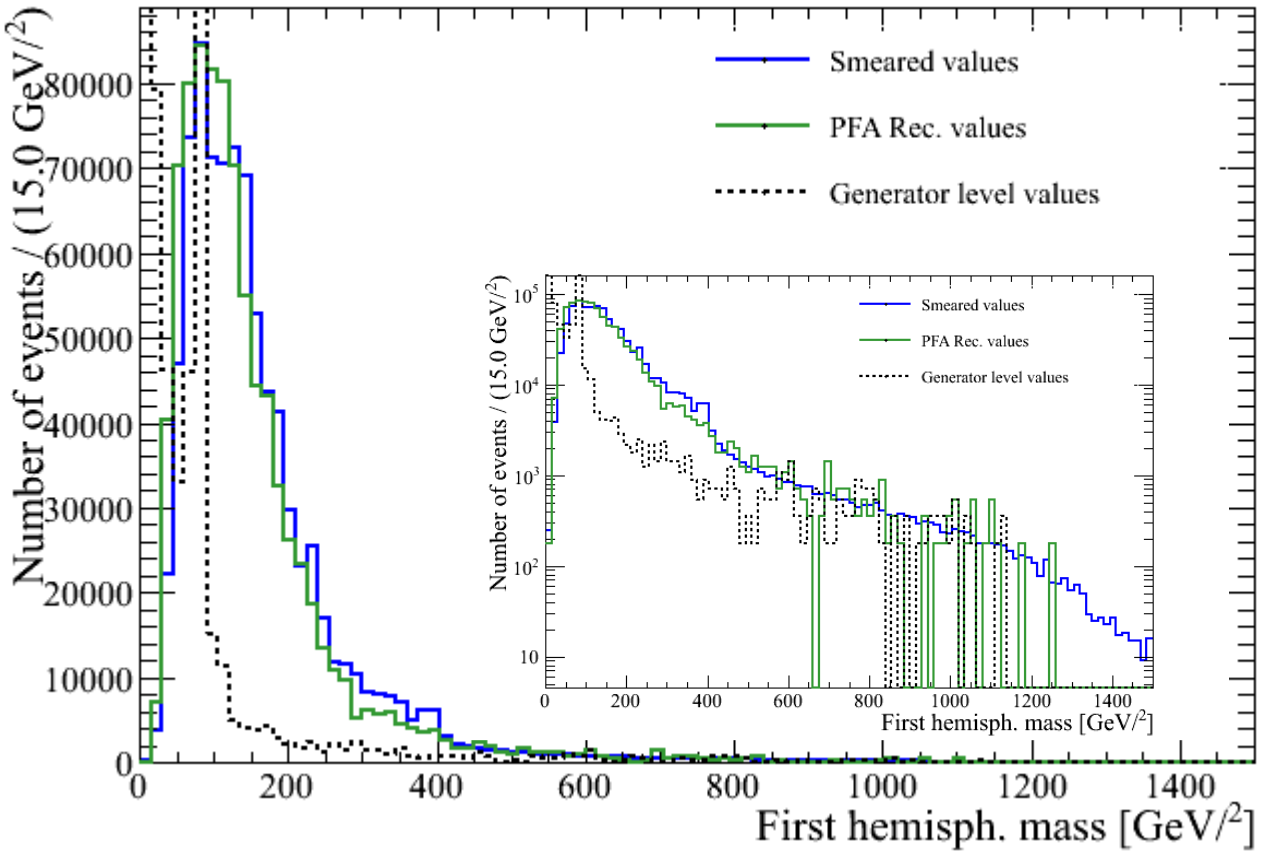
Results on WW events

- Same framework used
  - "Smearing Maps" may then not have optimized size or binning
  - Expect higher discrepancy

- 2M Smeared WW evts out of 10k generated !

Results on WW events

Non-optimized smearing works already quite well !



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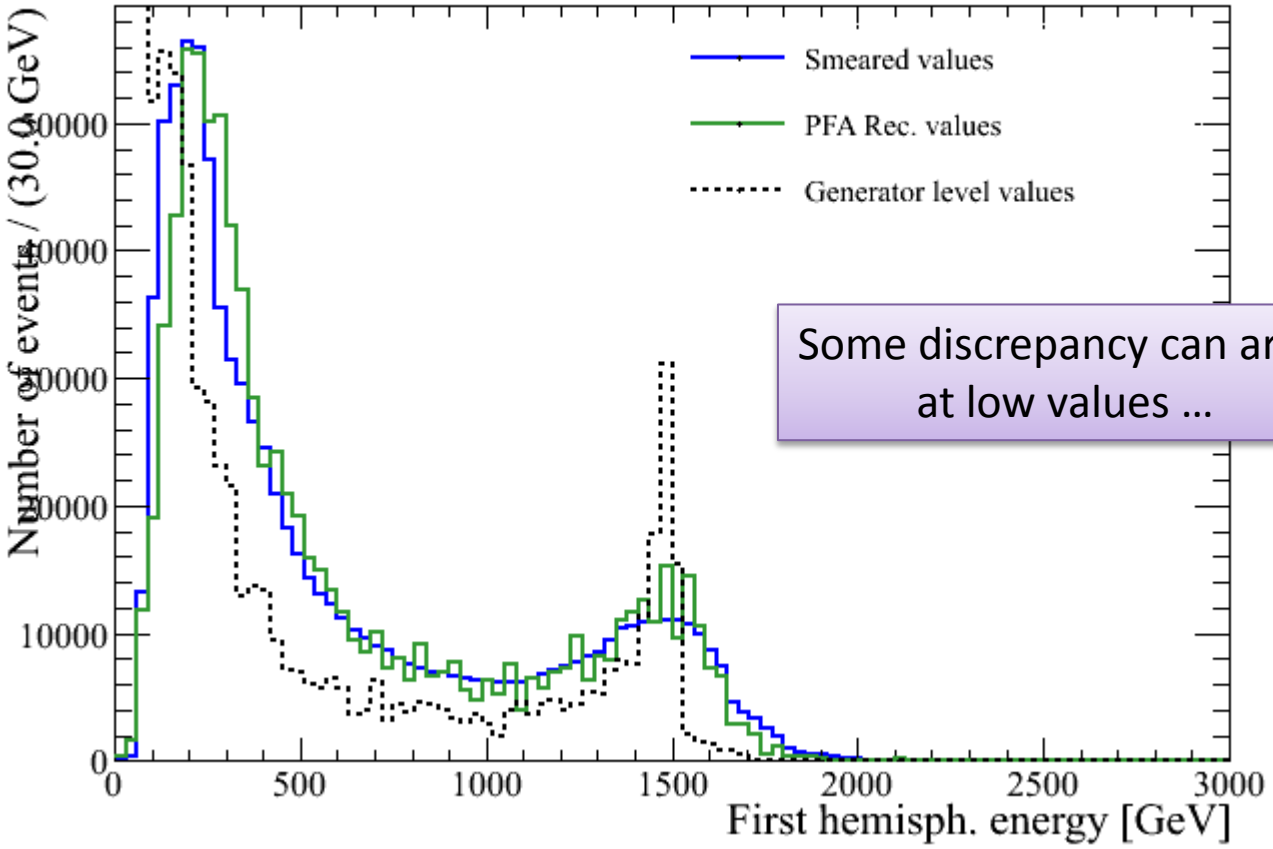

Some discrepancy can arise at low values …

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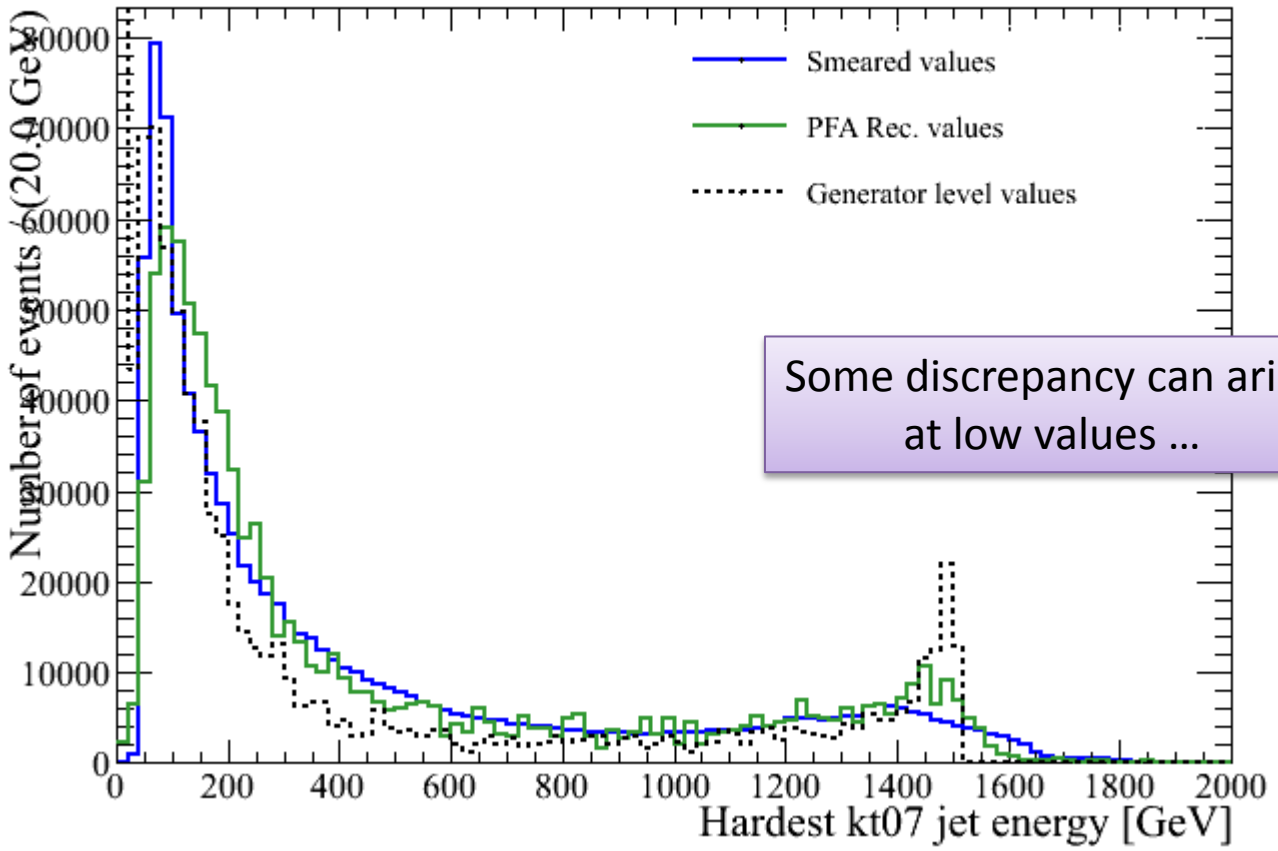

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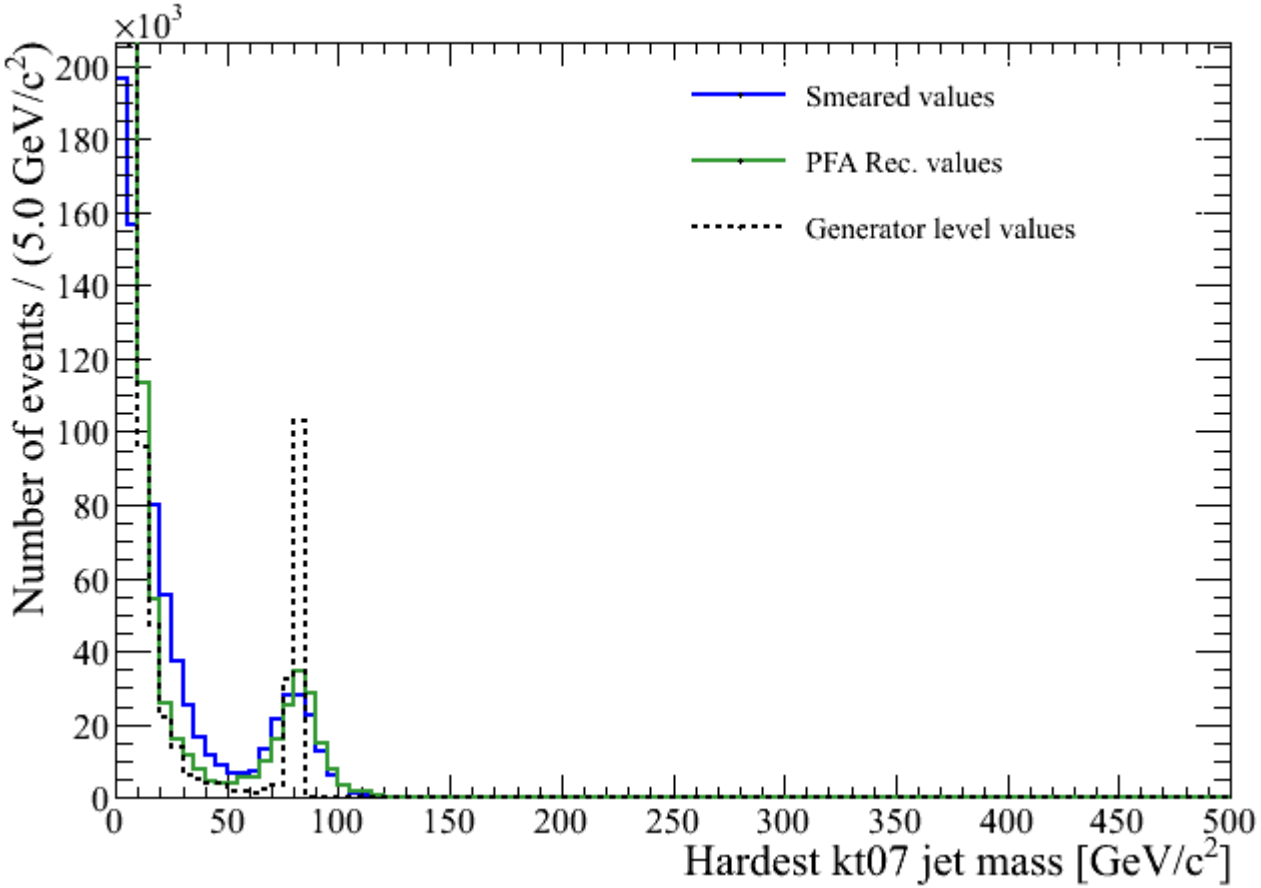
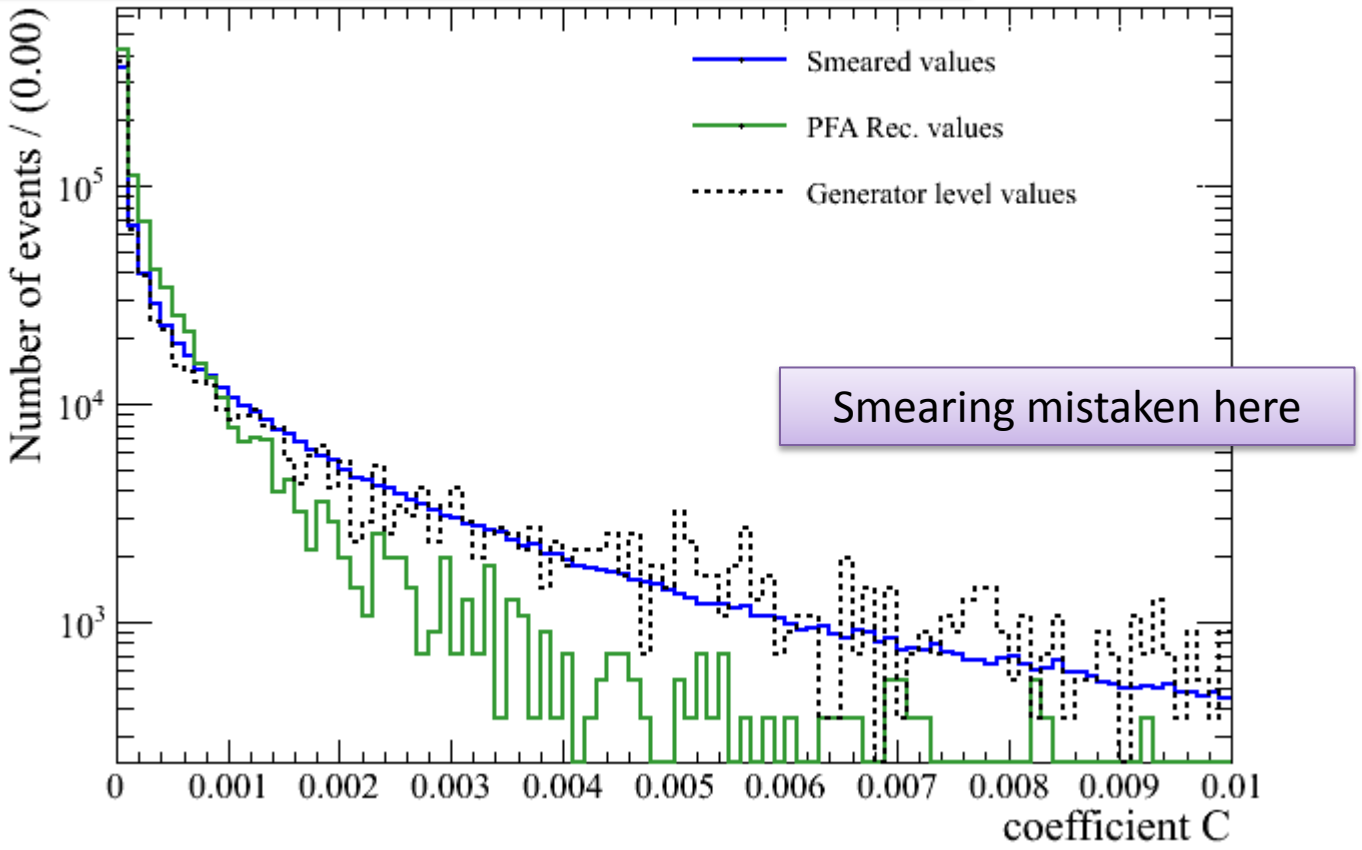


Results on WW events

Tail very nicely and smoothly populated at high statistics



Smearing mistaken here

Results on WW events

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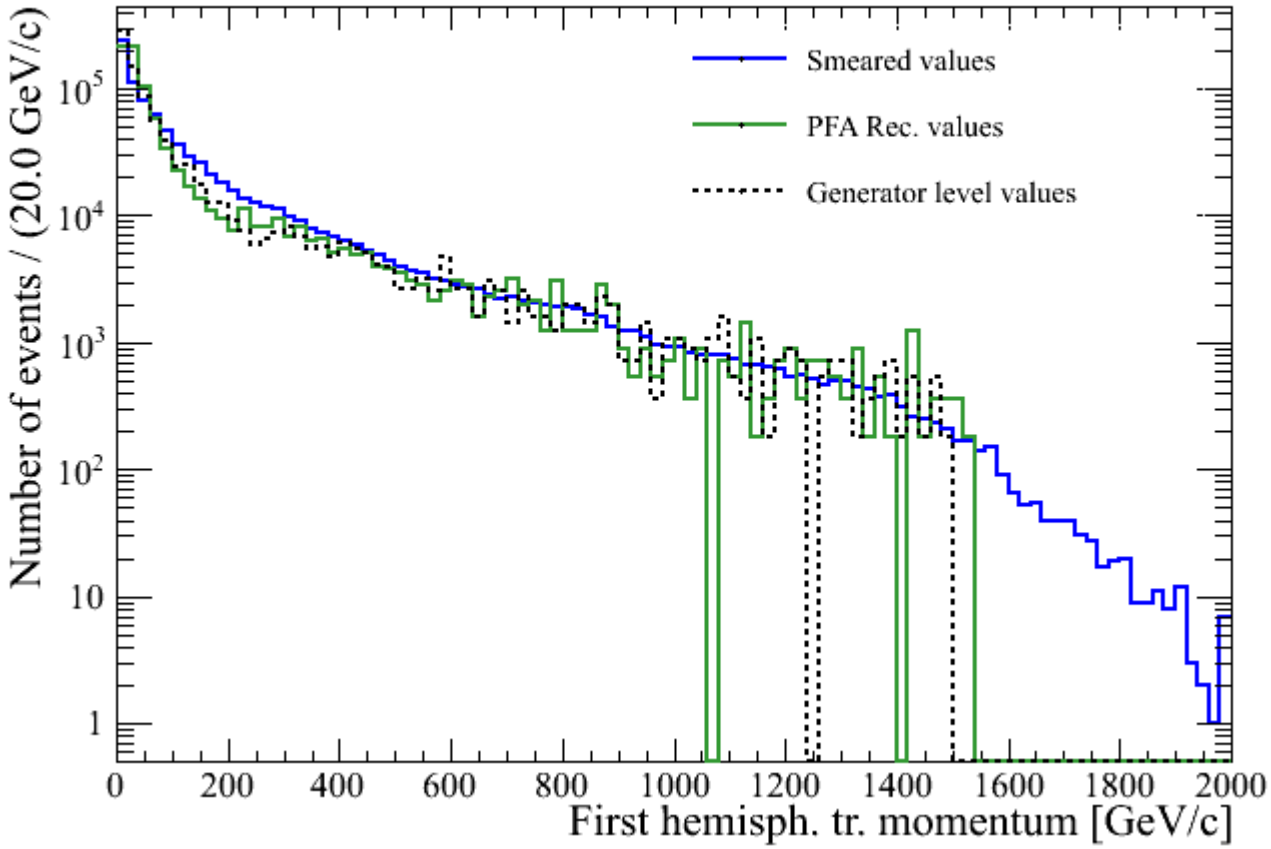

Conclusion

- Advantages
  - Technique very efficient
  - Can produce any amount of realistic data
  - Process mainly automatic
  - Optimisation for every channel possible

- Problems
  - Low values must be looked at and sometimes tricked
  - Each variable must be treated individually
  - Variable correlations have to be checked
  - Optimisation for each channel needed ?

Outlook

- Full Sim. Signal vs Smeared Background not checked yet
  - Lower separation should be expected OK
  - Higher separation may occur ! THEN ?

- If this technique is to be adopted for CLIC CDR Background data:
  - Precise requirements ?
  - Time scale ?
  - Can involve 1 person full time …