EMC Fastsim Validation/Tuning

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Caltech
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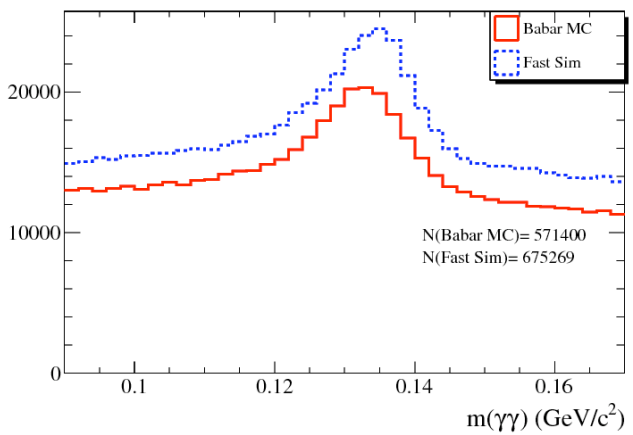
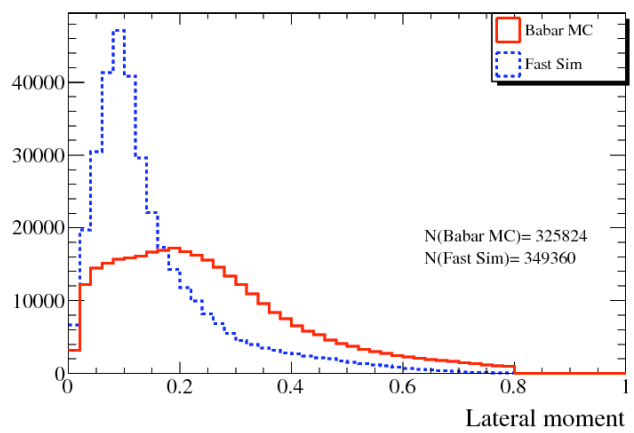
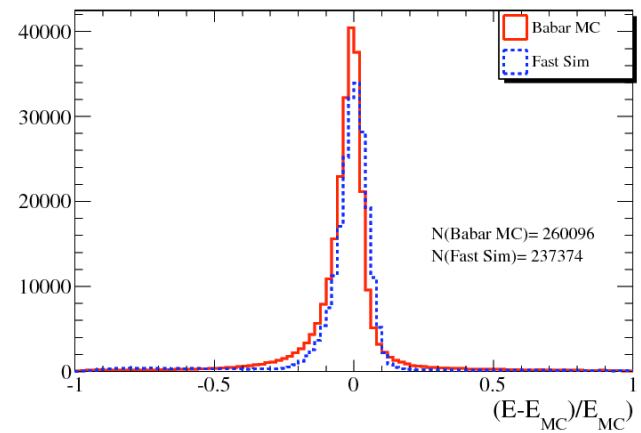
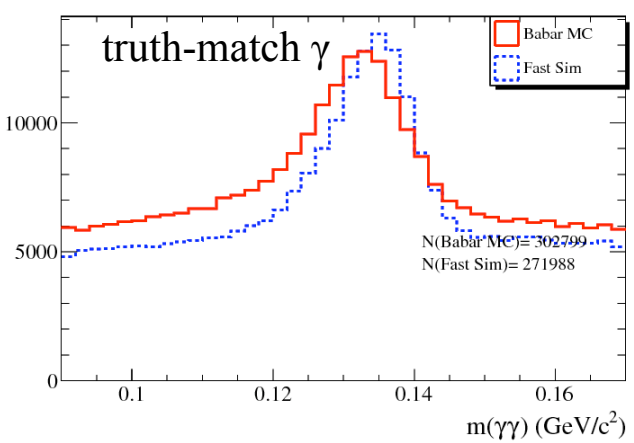
Comparison with BaBar MC

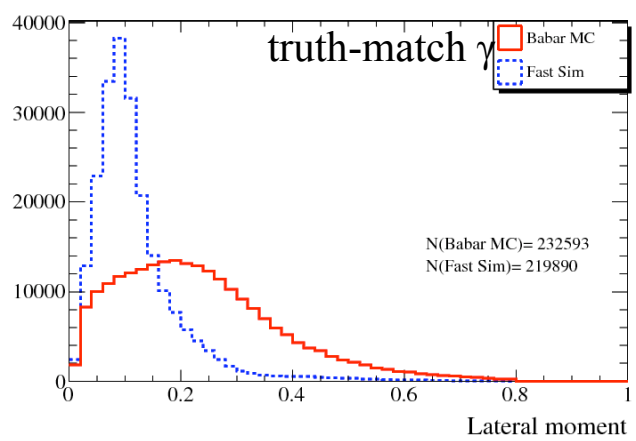
- Using fastsim V0.0.4, reconstruct $\pi^0 \rightarrow \gamma\gamma$ in generic B events
  - GoodPhotonLoose, 0.001<LAT<0.8, E_γ>0.3.







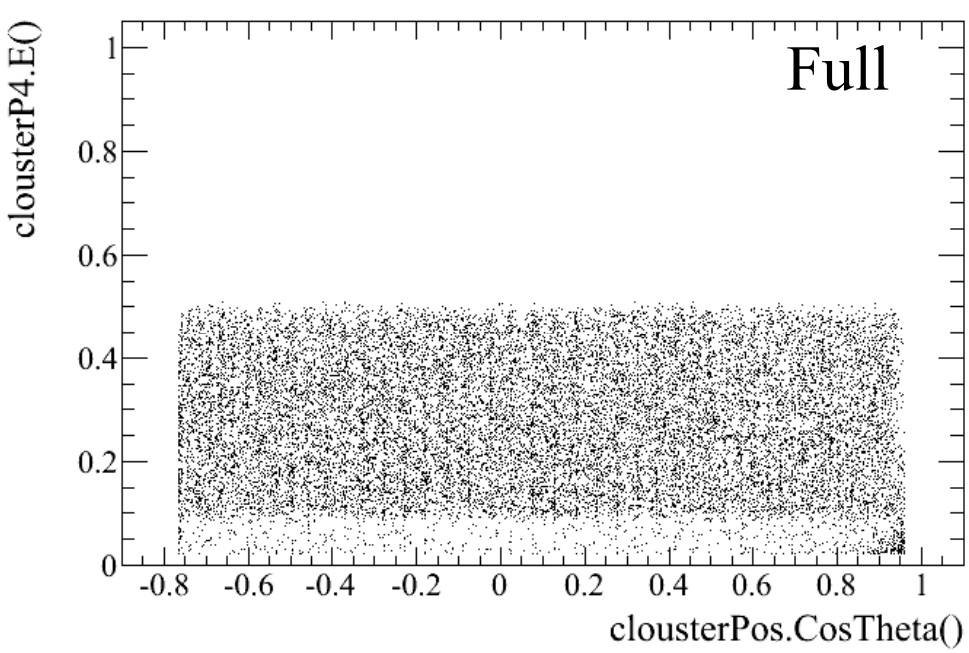


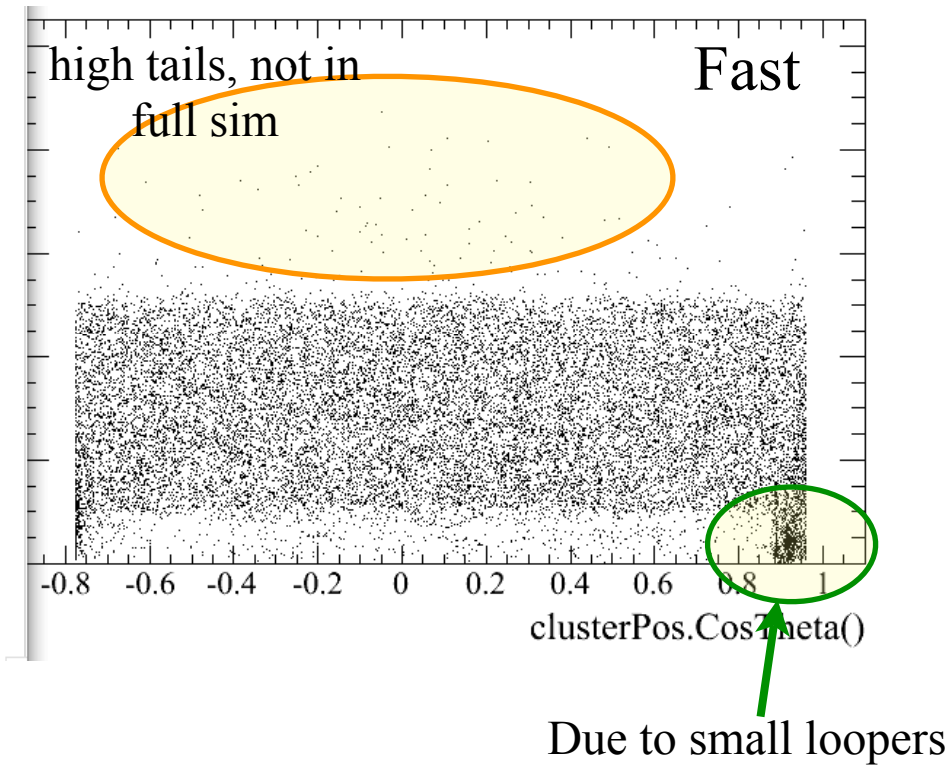


- Energy resolution is a little too good; mean is a bit higher in fastsim.
- LAT is too small.
- γ efficiency is smaller (after truth match)
- Too many neutrals?

Comparisons using single γ

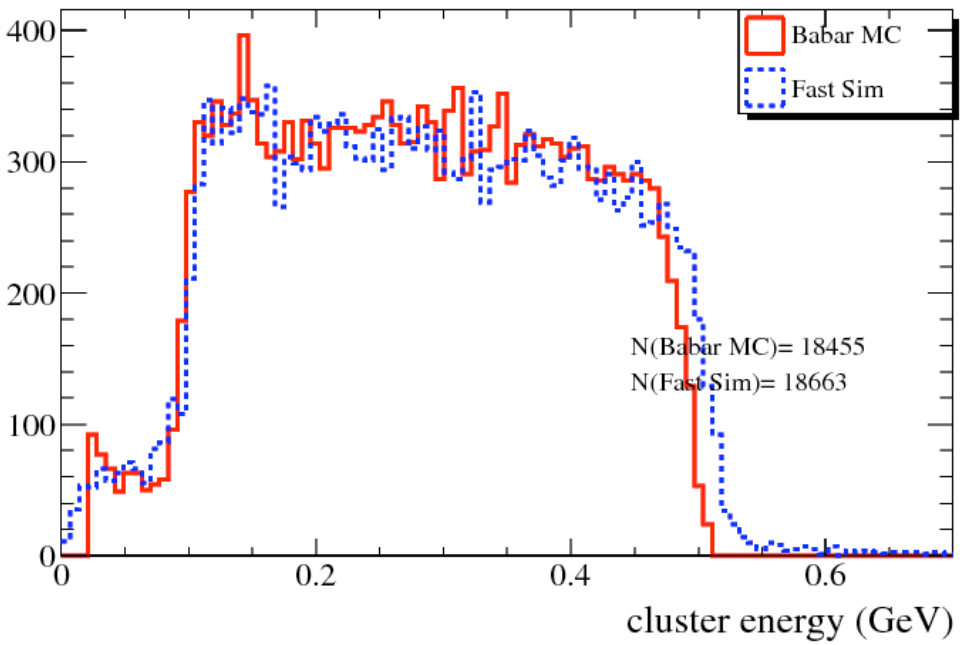
- Generate 100MeV<Eγ<500MeV, flat in Eγ,cosθ,φ. No background mixing in full sim.

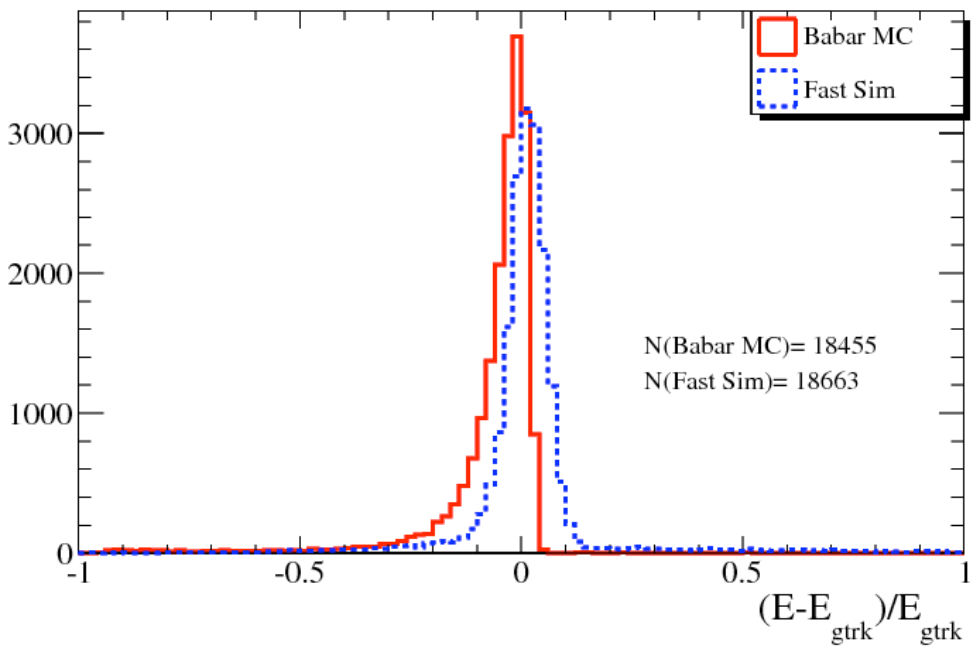




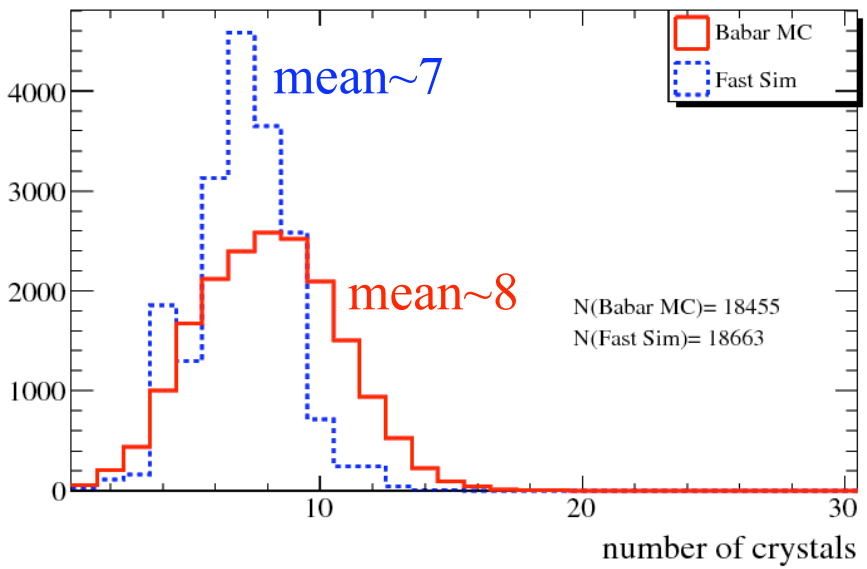
Single γ continues - E resolution

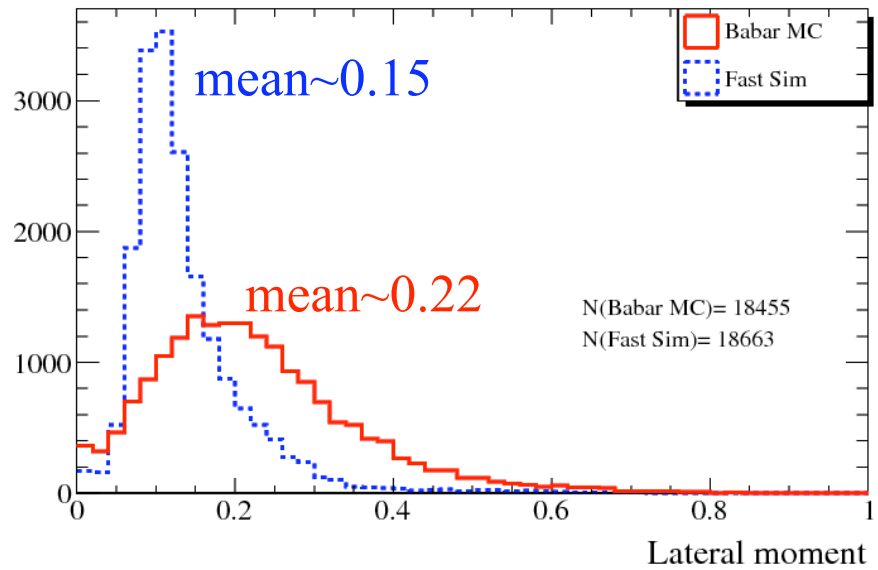
- Only look at the barrel from now on.

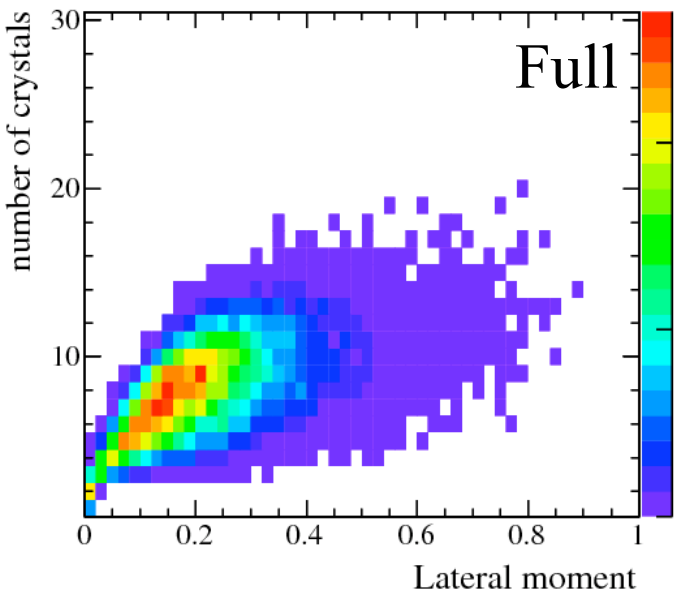


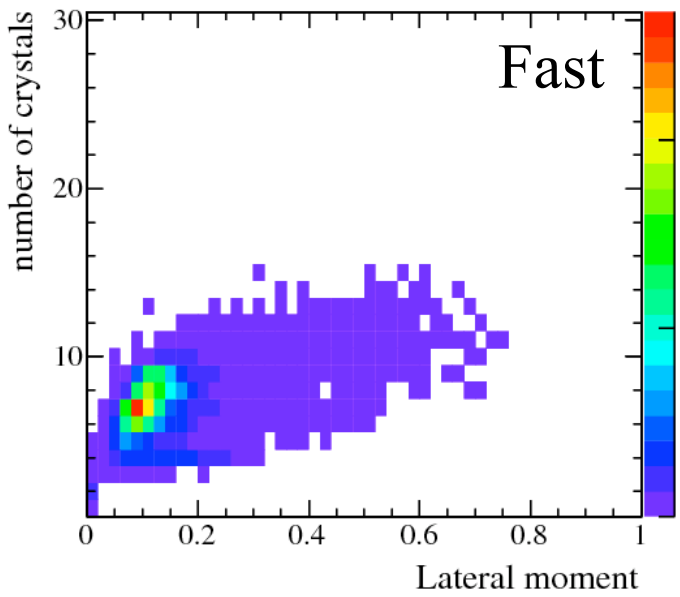


Number of crystals & LAT



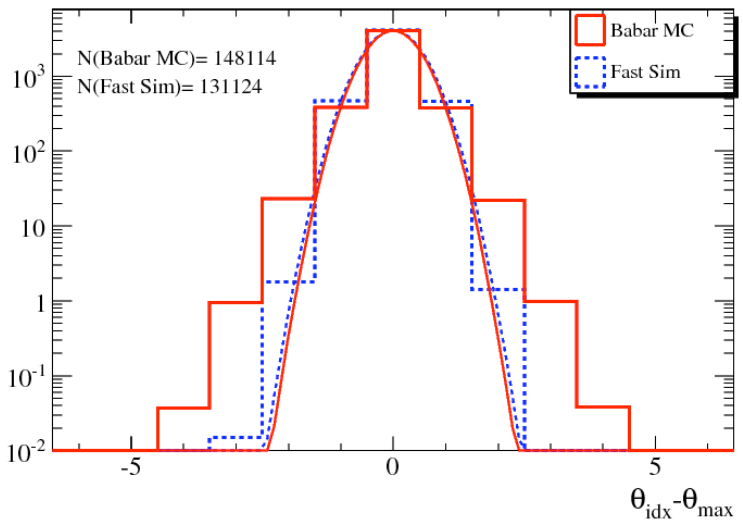


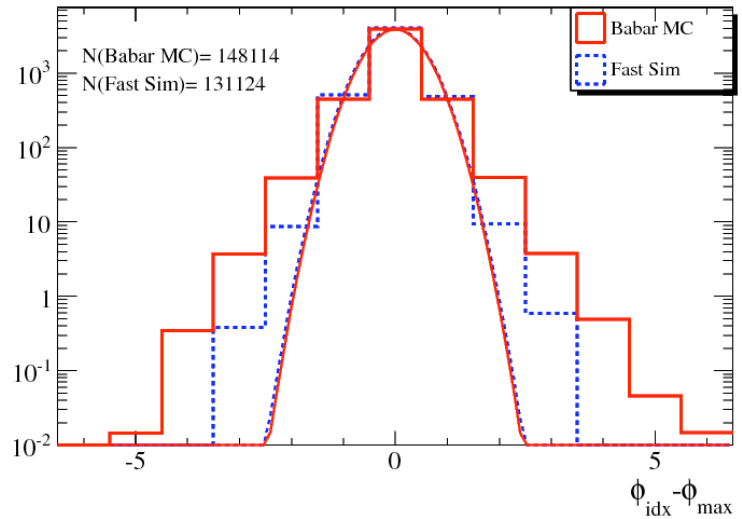




Crystal distribution

- Accumulate all clusters; crystal weighted by its energy; plot the θ and φ indexes with respect to the peak crystal.





- ✦ Fits to Gaussian are very similar, indicating core is simulated well
  - ➡ however, lateral moment is sensitive to tails.

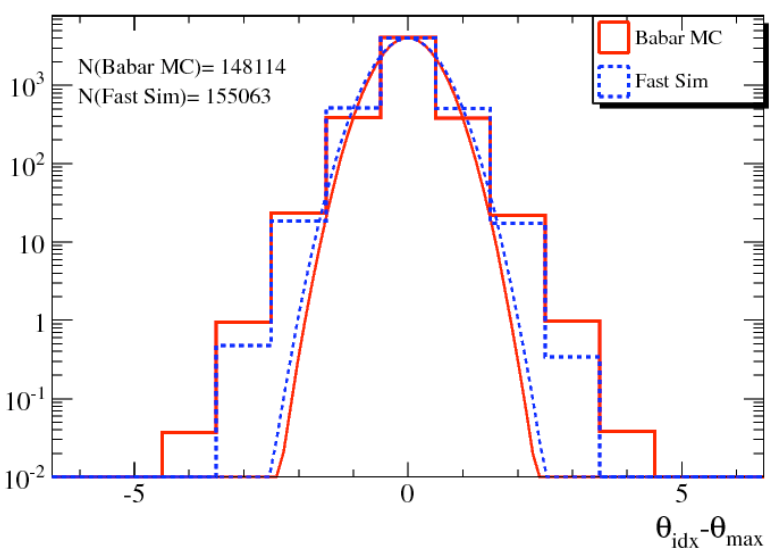
Moliere radius= 3R = 3.7cm for CsI

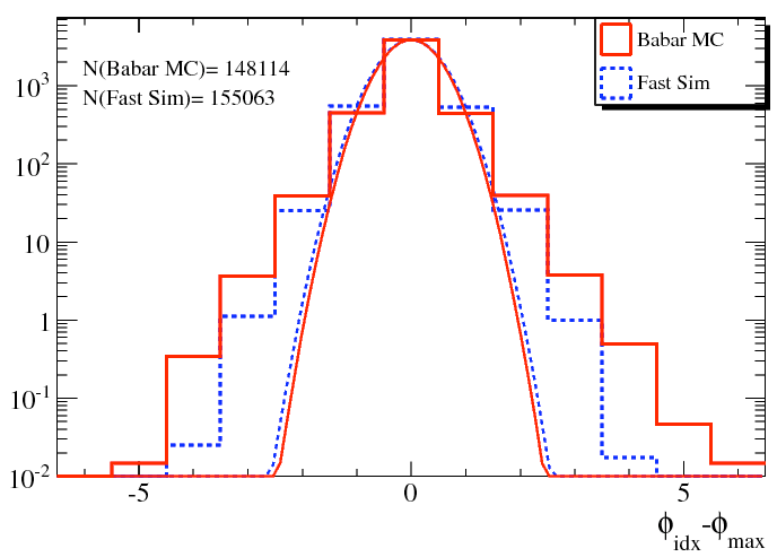
- ✦ Fastsim is based on $f(r)=2rR^2/(r^2+R^2)^2$ [PDG], whose tail falls much slower than shown here, but crystal energy has a 1 MeV cutoff.
- ✦ What is causing the full sim's tail? Electronic noise?

Simulating electronic noise is probably too much for fast sim.

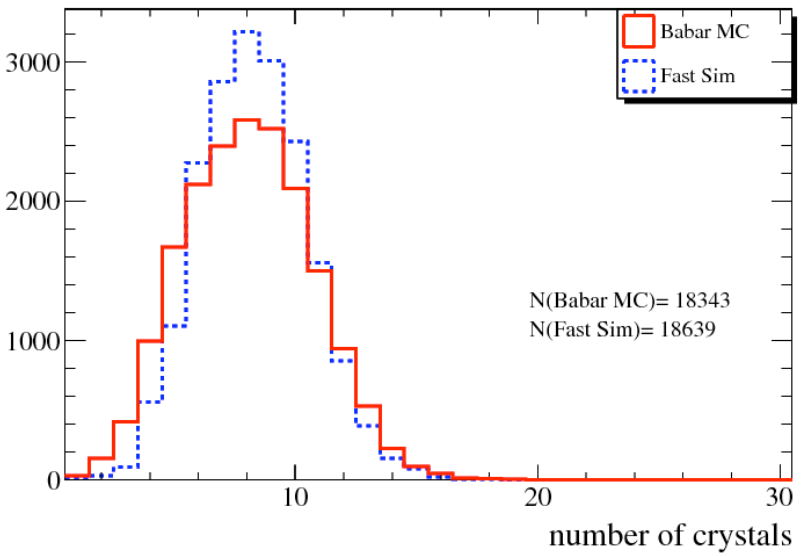
The solution

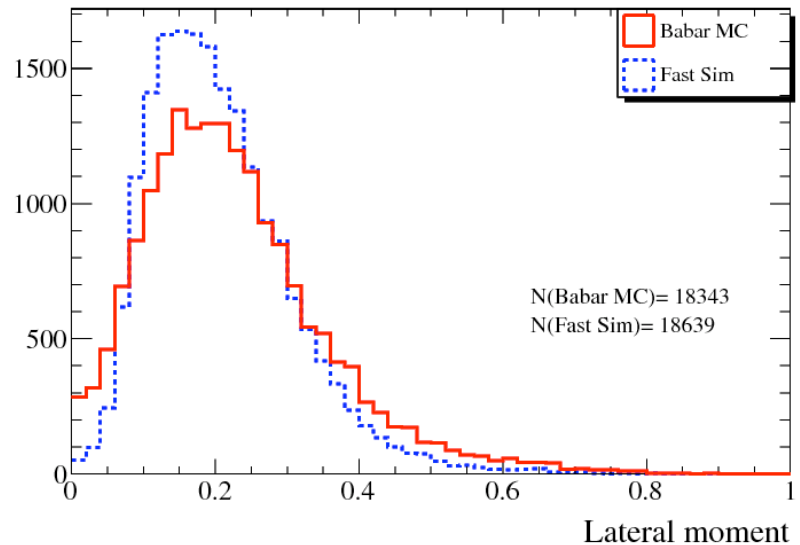
- I tried several modifications (add left-right asymmetry, add a tail that falls slower than f(r), etc.). None of these that based on a smooth function are satisfactory.
- The solution that seems to work is to add a small fraction of "random-walk" cluster.
  - Add (10±10)% of random-walk cluster, that on average has a Gaussian profile of σ=7.5cm.

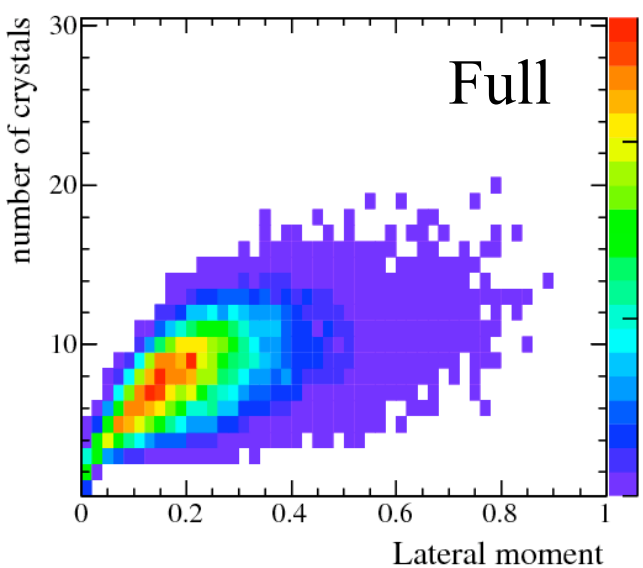


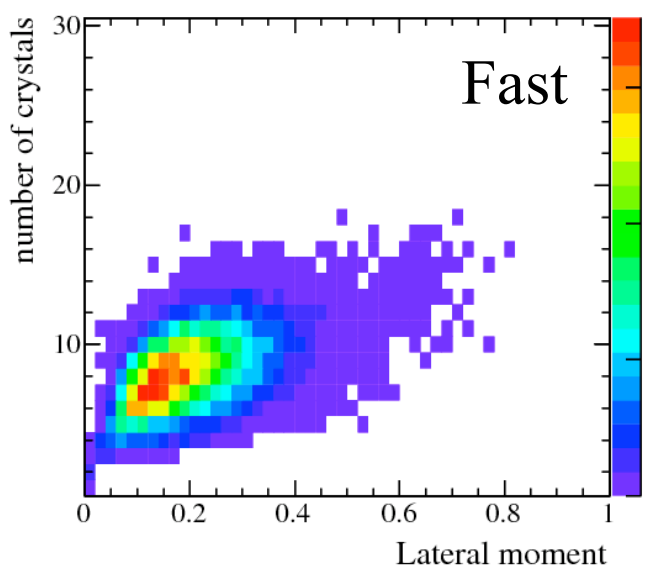


Much better agreement in n&LAT

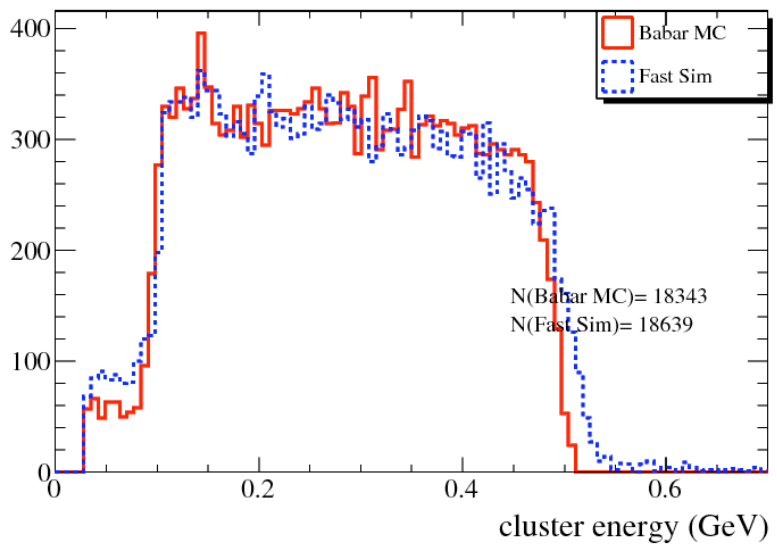


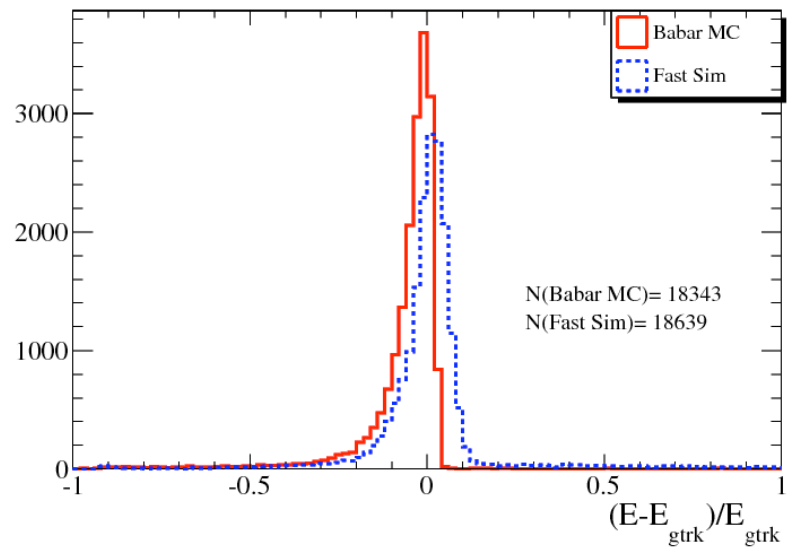


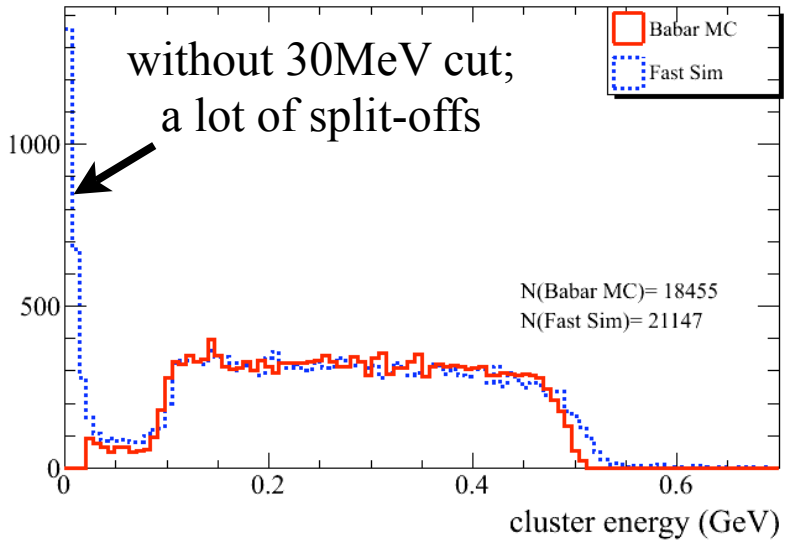




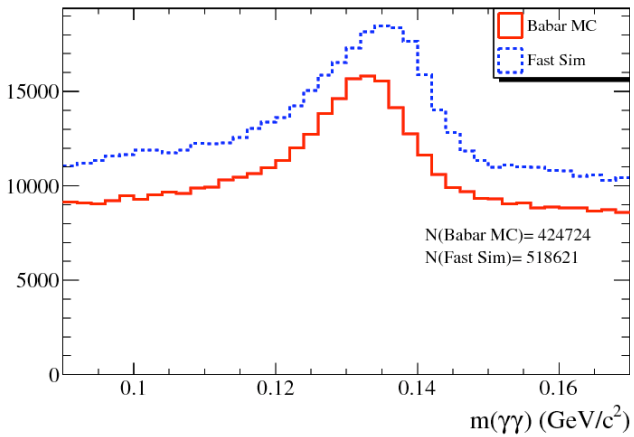
Energy resolution

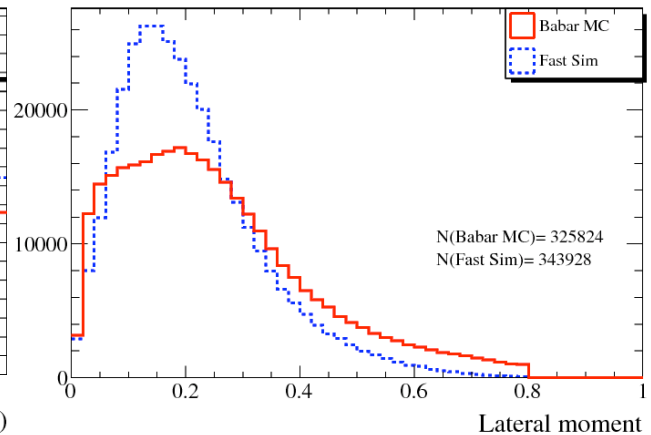


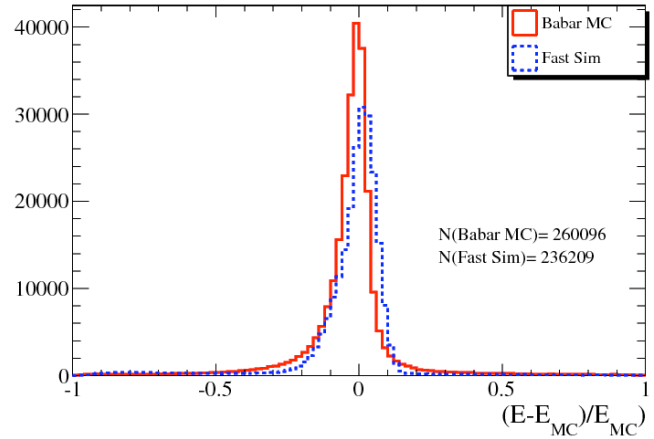


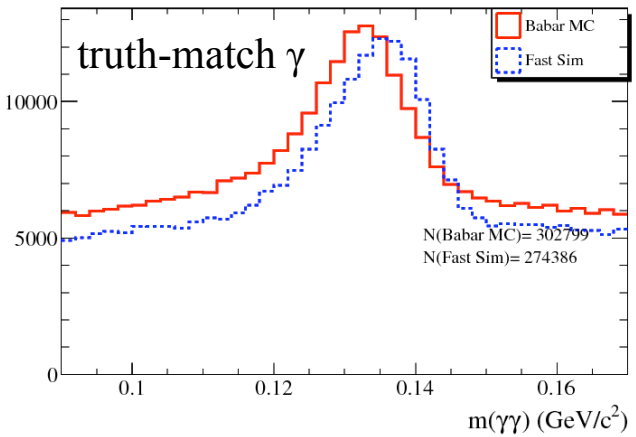


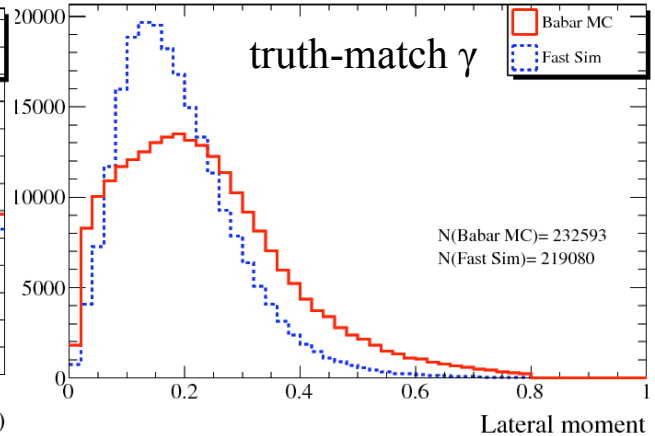
BBbar MC again











- LAT is better.
- Other symptoms are still there.

Conclusions

- Photon LAT distribution is improved.
  - However, it slows down a lot (>30% for BBbar events), need to optimize code.
- Many other discrepancies need investigation:
  - Long positive tail in single γ resolution.
  - Too many non-γ neutrals (track-matching inefficiency?).
  - Low γ efficiency (truth matching problem?).