Benchmark study on WIMP search

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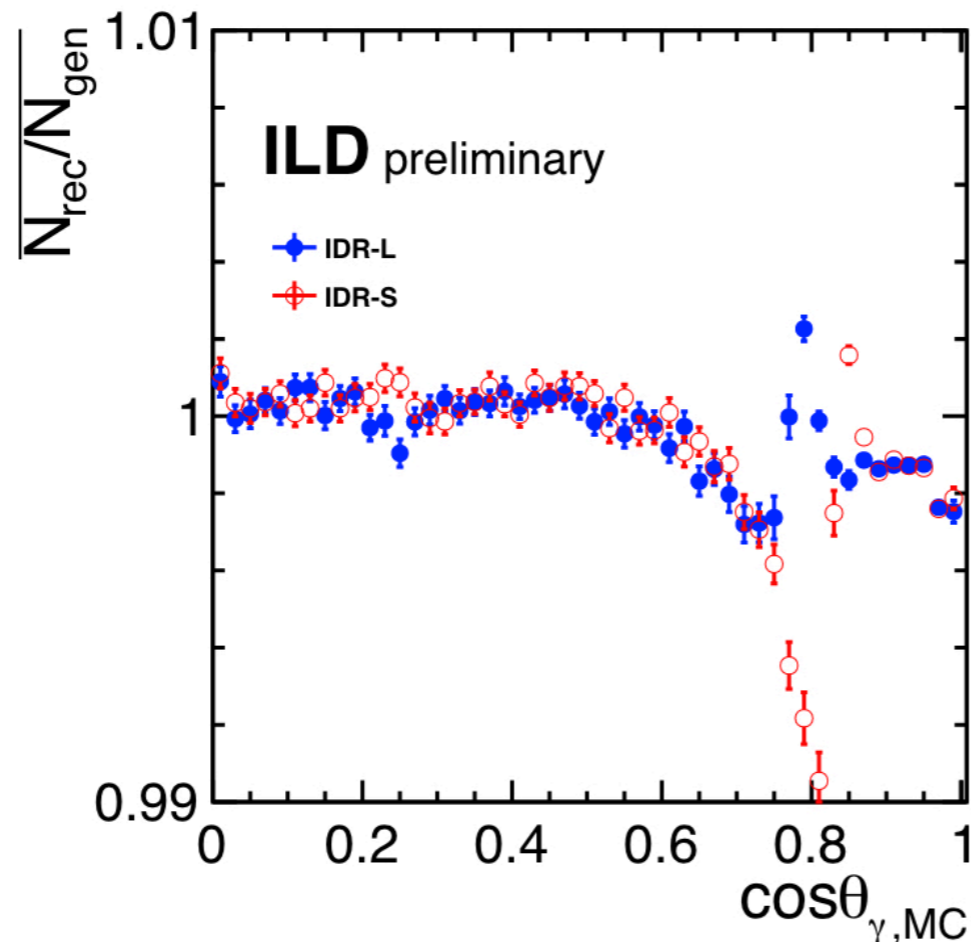
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Current status

- ❖ **Rerun BCal reconstruction**
  - ▸ It is underway. Roughly 70% has been completed.
  - ▸ Preliminary results with a limited statistics look comparable to the previous results (See some preliminary results in the backup).

- ❖ **Try to understand what's going on at $\cos\theta \sim 0.8$.**

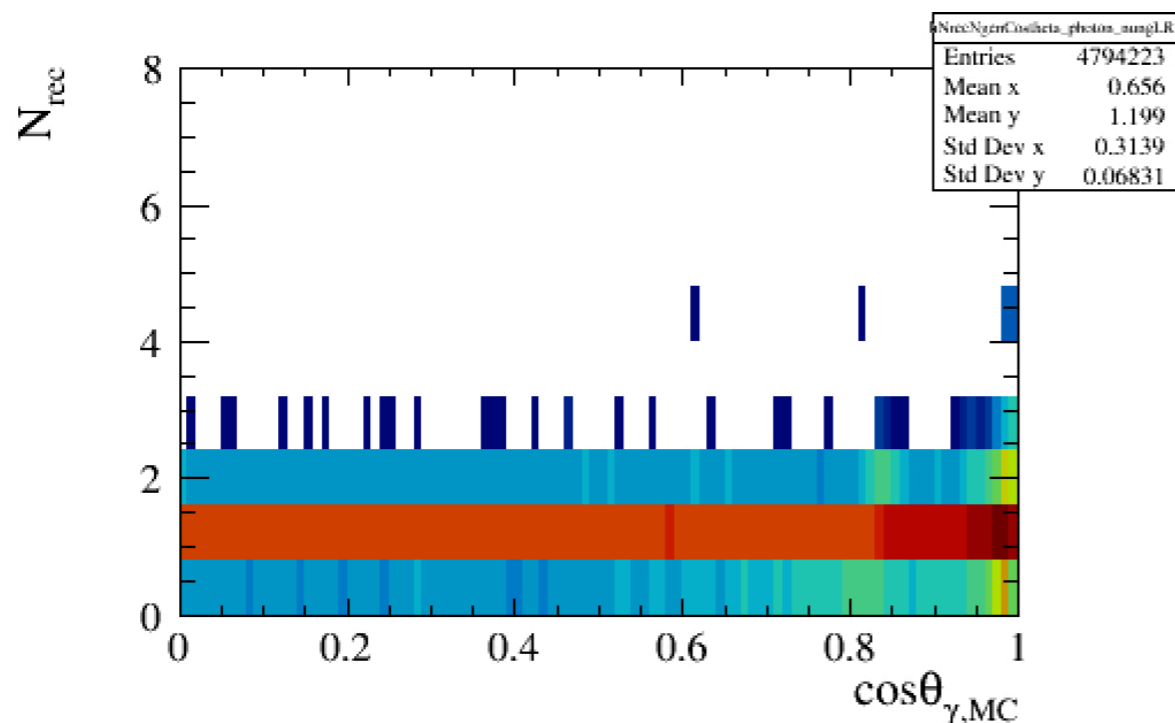Averaged number of reconstructed ISR photons per number of generated ISR photon

Detecting ISR photons is the key for WIMP search.
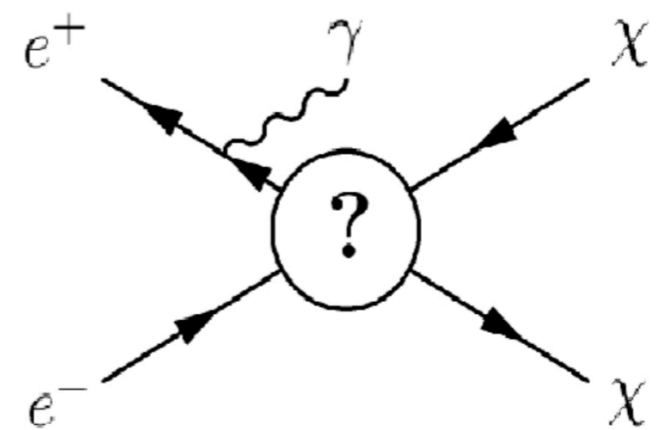
θ : ISR photon polar angle

Definition of $\overline{N_{rec}/N_{gen}}$

❖ **Ngen:**
  ▸ Number of generated ISR photons after an event selection (see below)

❖ **Nrec:**
  ▸ Number of reconstructed photons matching to the generated ISR photon after an event selection (see below).

❖ **Event selection:**
  ▸ $\nu\bar{\nu}\gamma$ events (single ISR photon event only. —> Ngen = 1)
  ▸ The ISR photon is not converted to e+e- pairs (N_daughters < 2).

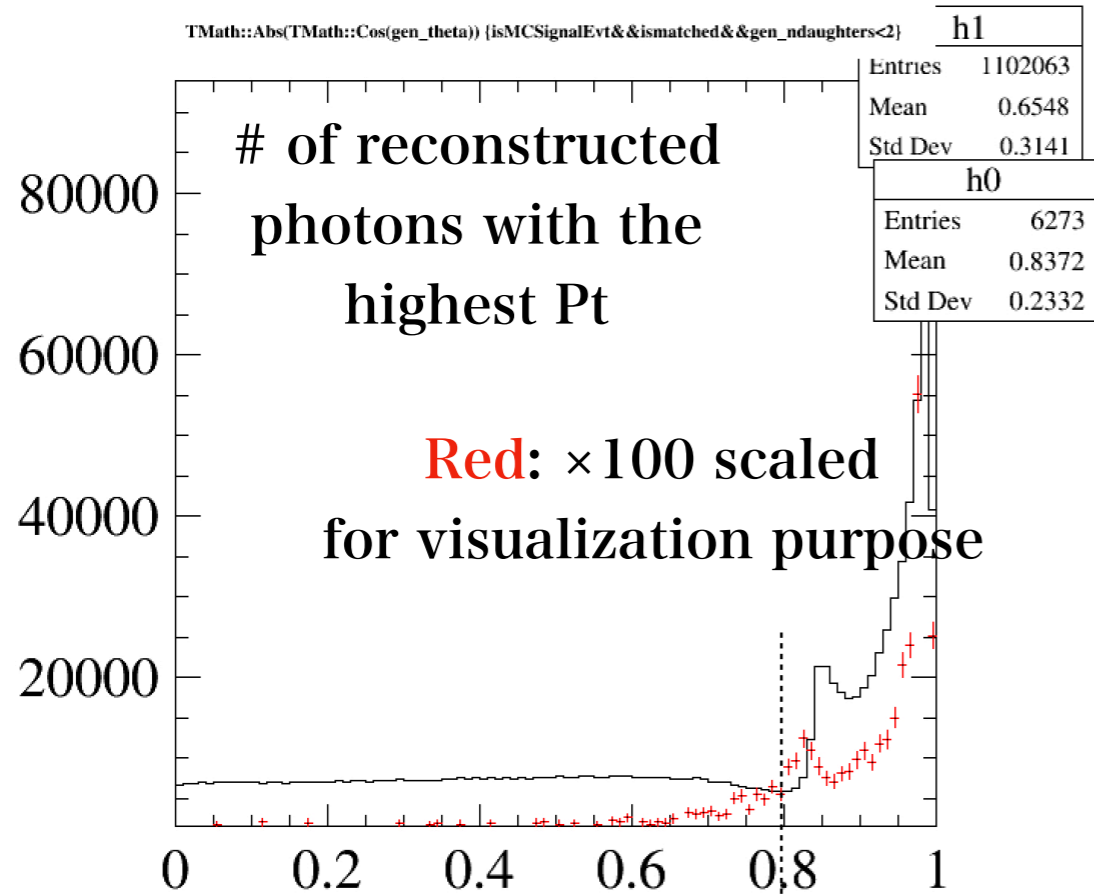| NrecNgenCostheta_photon_aungLR	
Entries	4794223
Mean x	0.656
Mean y	1.199
Std Dev x	0.3139
Std Dev y	0.06831

2D histogram of Nrec vs $\cos\theta$ MC

From the projection to Y for each X-bin, the average of Nrec can be plotted.
This corresponds to $\overline{N_{rec}/N_{gen}}$
(because Ngen=1)

MCParticle-PFO matching (LCRelation)

TMath::Abs(TMath::Cos(gen_theta)) {isMCSignalEvt&&ismatched&&gen_ndaughters<2}

h1	
Entries	1102063
Mean	0.6548
Std Dev	0.3141

h0	
Entries	6273
Mean	0.8372
Std Dev	0.2332

# of reconstructed photons with the highest Pt
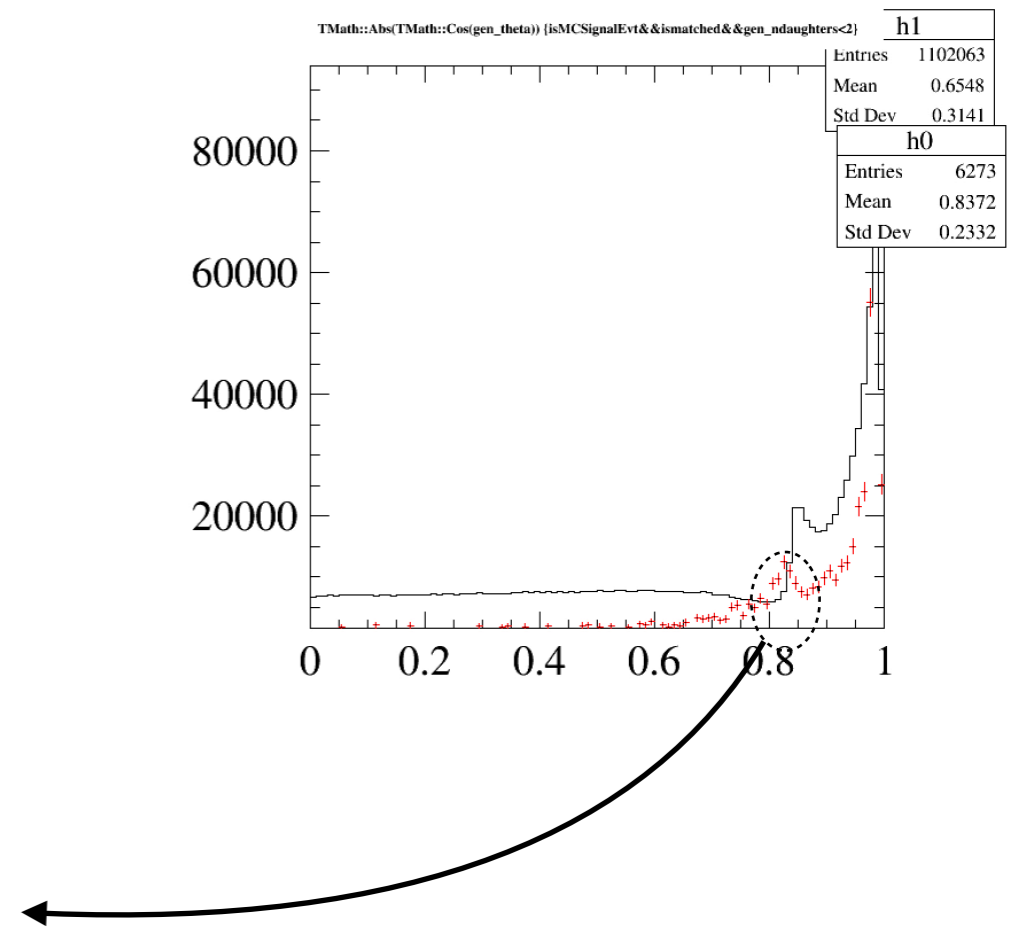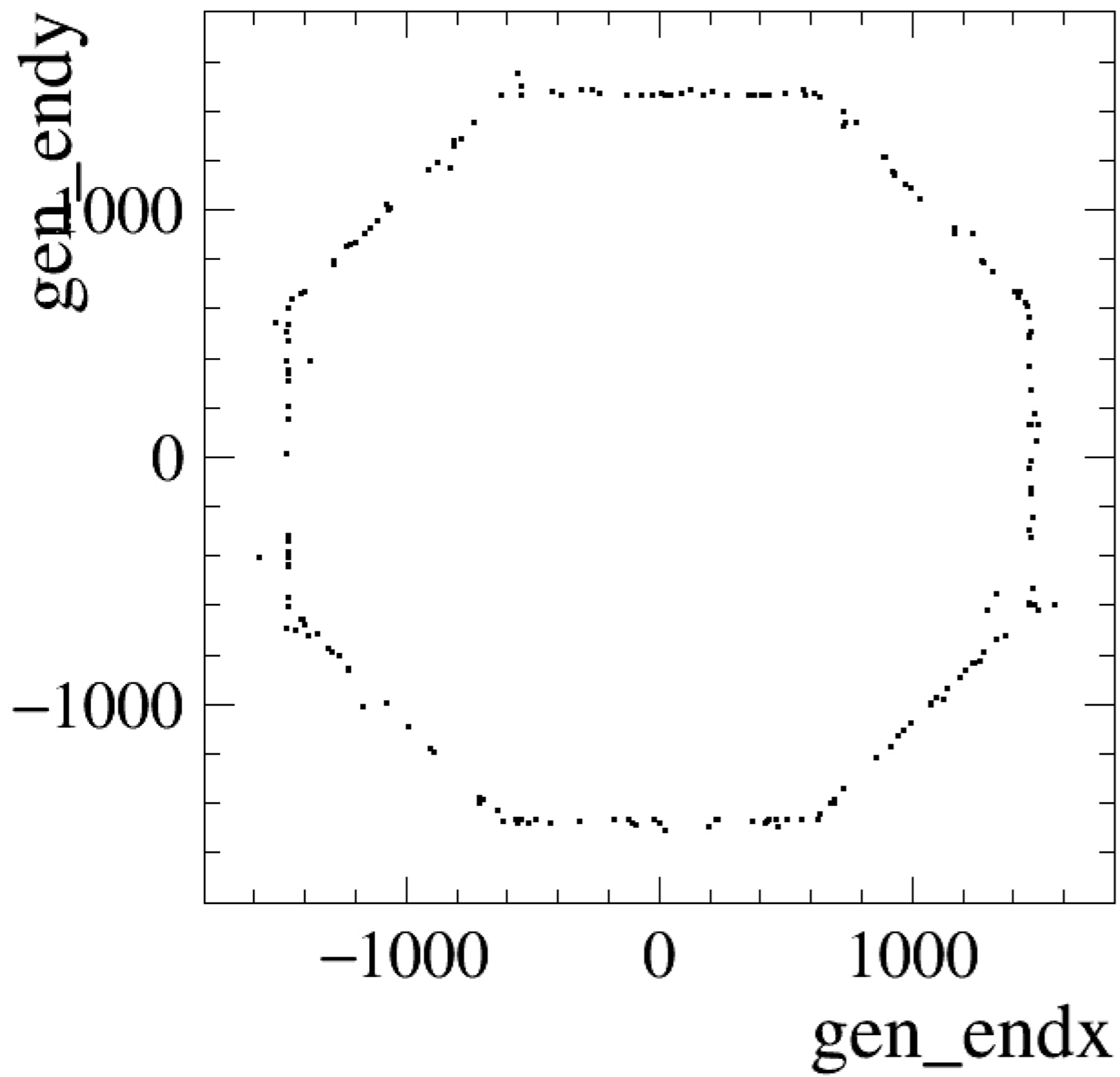
Red: ×100 scaled for visualization purpose

Black : Successfully ISR photon reconstructed case.

Red : ISR photon reconstructed but there is no matching to the MCParticle
(and thus it is recognized as reconstruction failure.)

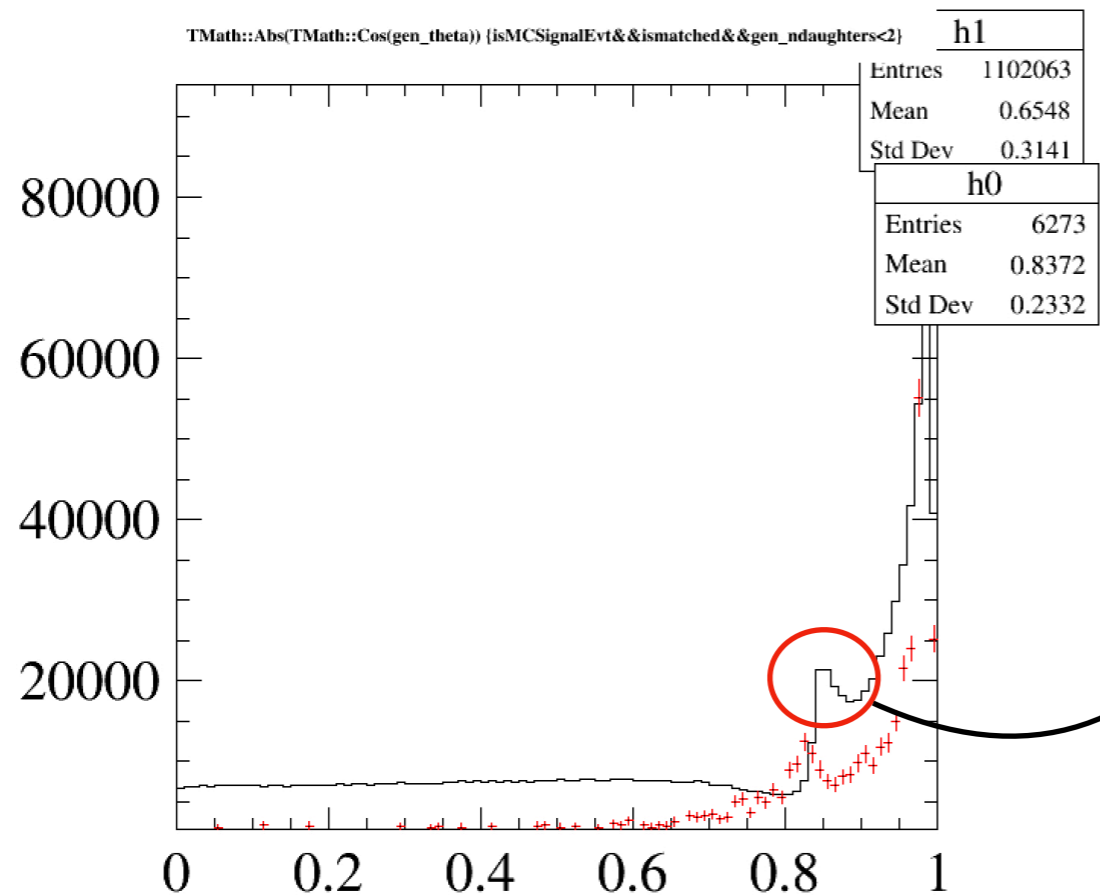It looks the fraction of the red points around $\cos\theta$ =0.8 is almost 1%.

ILD preliminary

- IDR-L
- IDR-S

Plo

$\cos\theta_{\gamma, MC}$
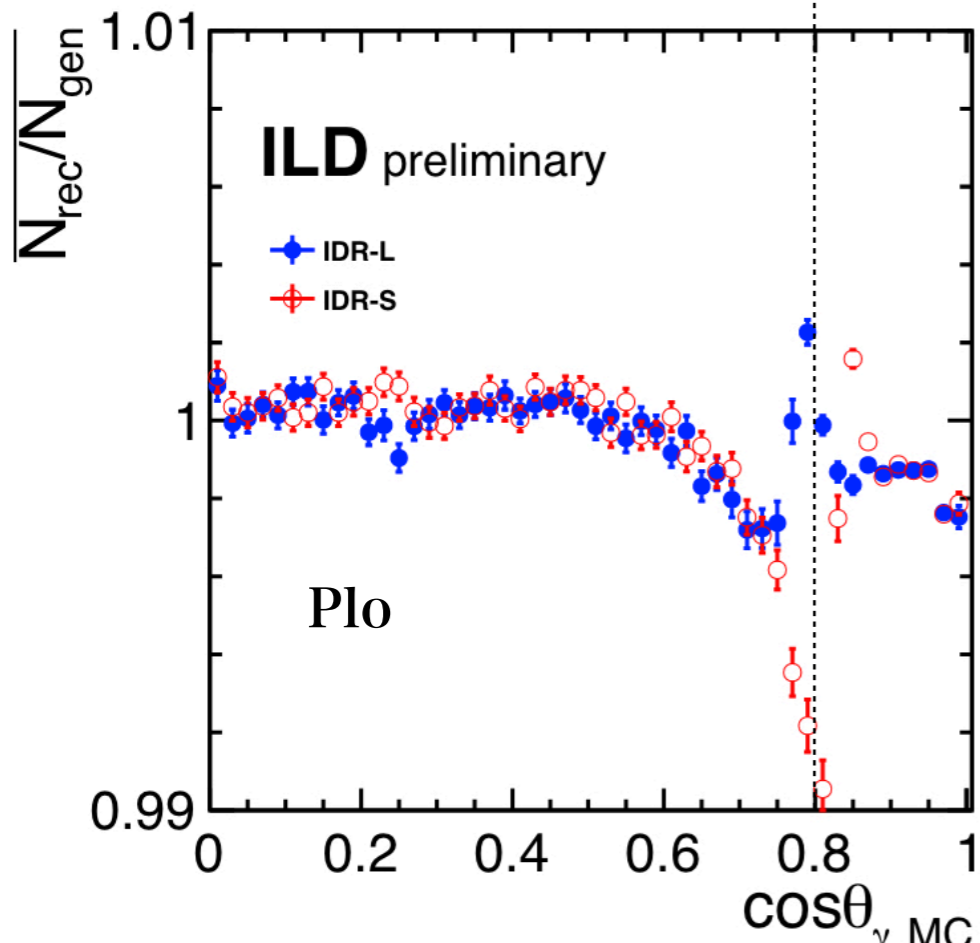
XY position of endpoint

Selecting the ISR photon MCs from the Red entries in the previous page with requiring
$0.81 < \cos\theta < 0.84$

New question …

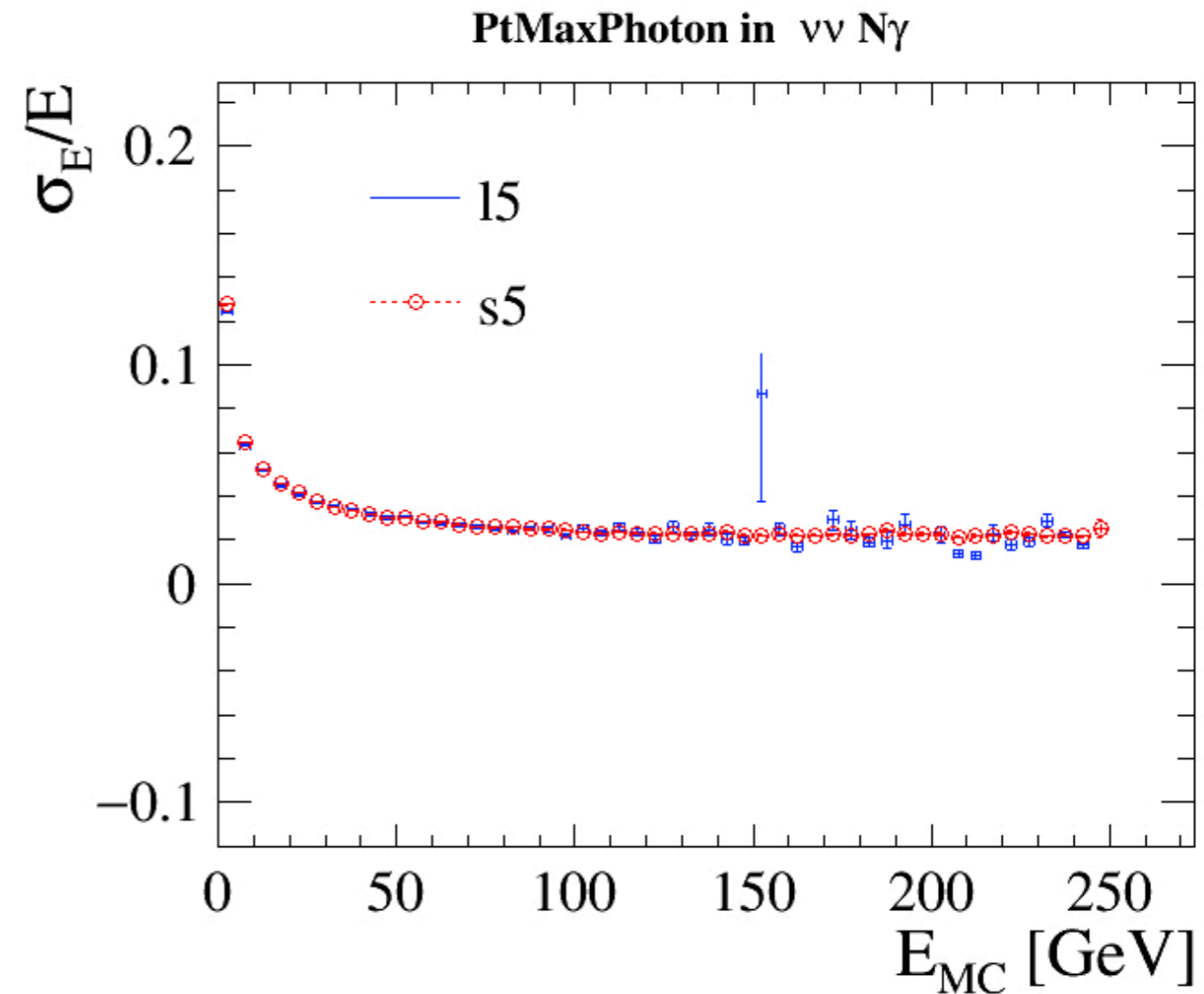TMath::Abs(TMath::Cos(gen_theta)) {isMCSignalEvt&&ismatched&&gen_ndaughters<2}

h1	
Entries	1102063
Mean	0.6548
Std Dev	0.3141

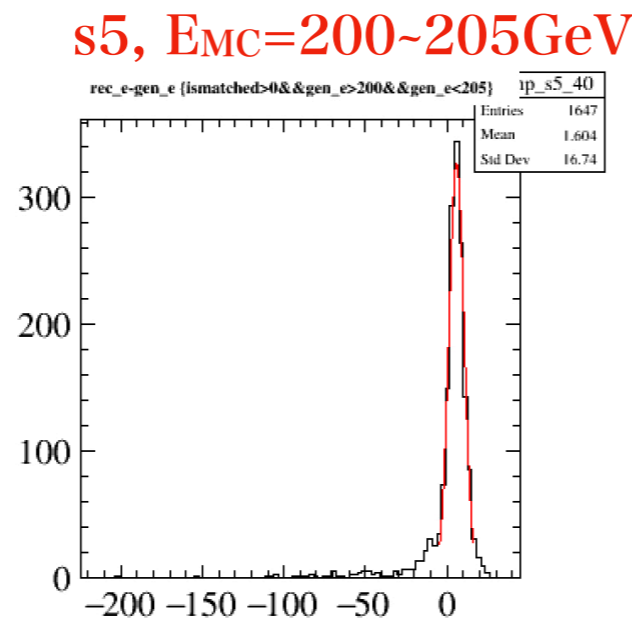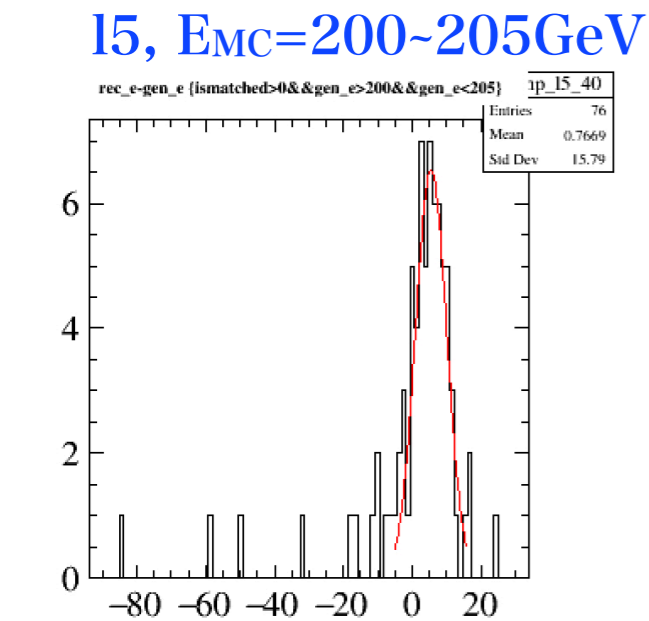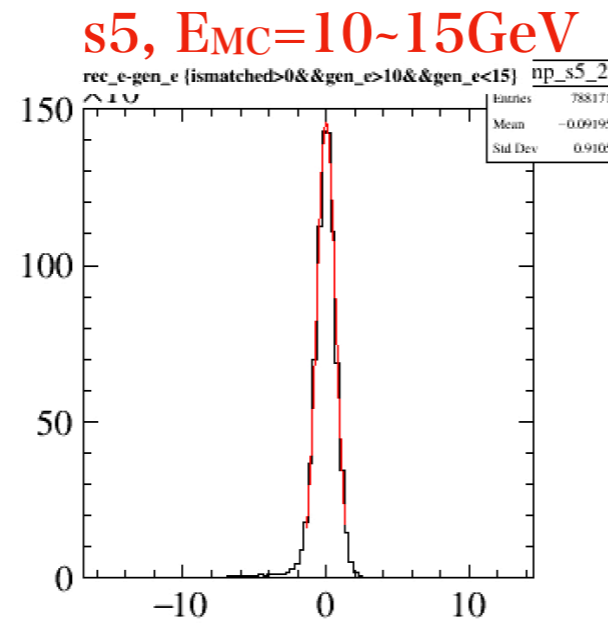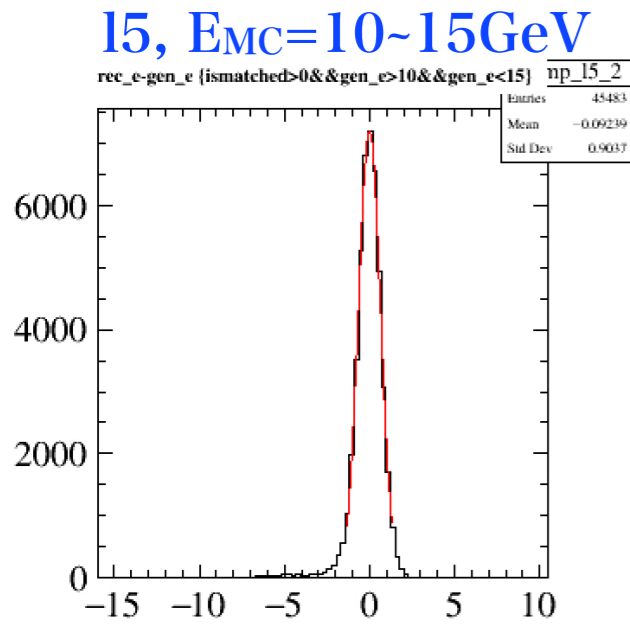| h0	
Entries	6273
Mean	0.8372
Std Dev	0.2332

Why there is a peak just after the gap between barrel and end-cap?
(Or why there is a small drop around 0.9?)

This seems to be related to the requirement of the number of daughters (N_daughters<2), but need more investigation.

Extra slides
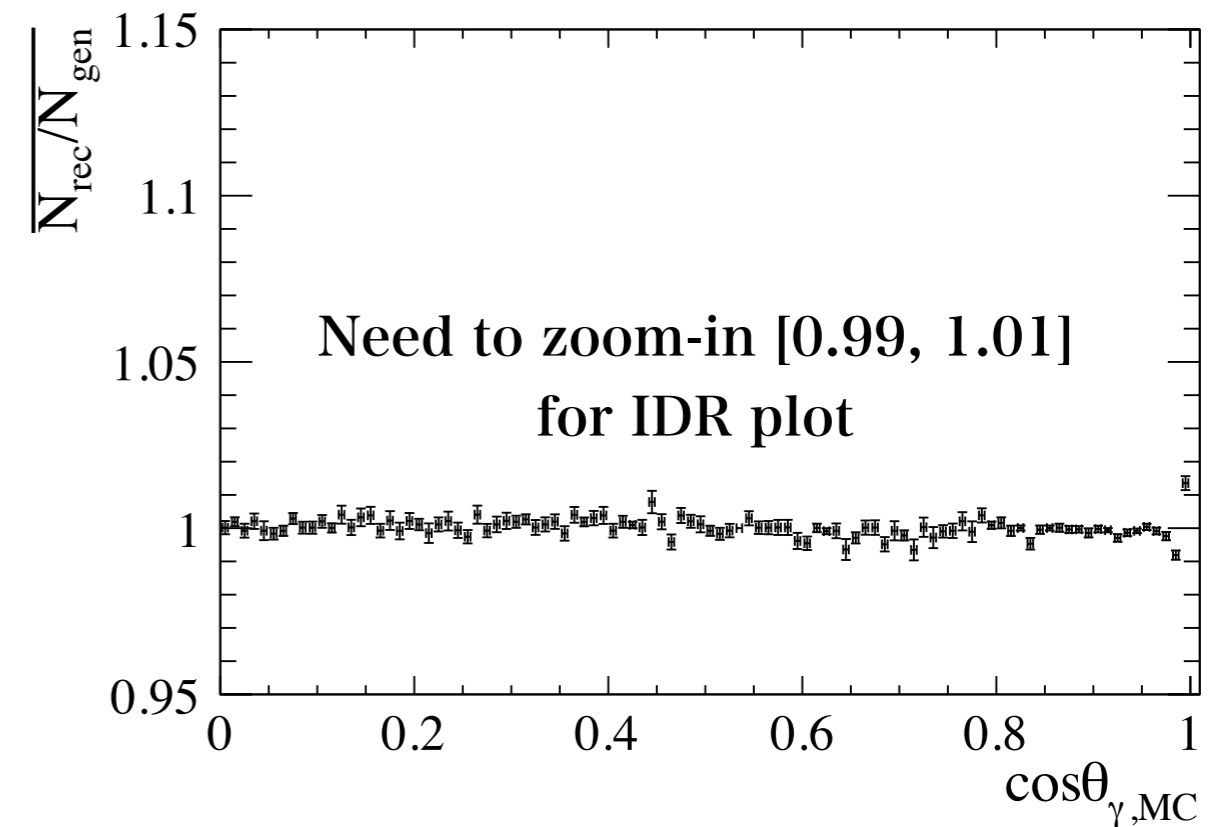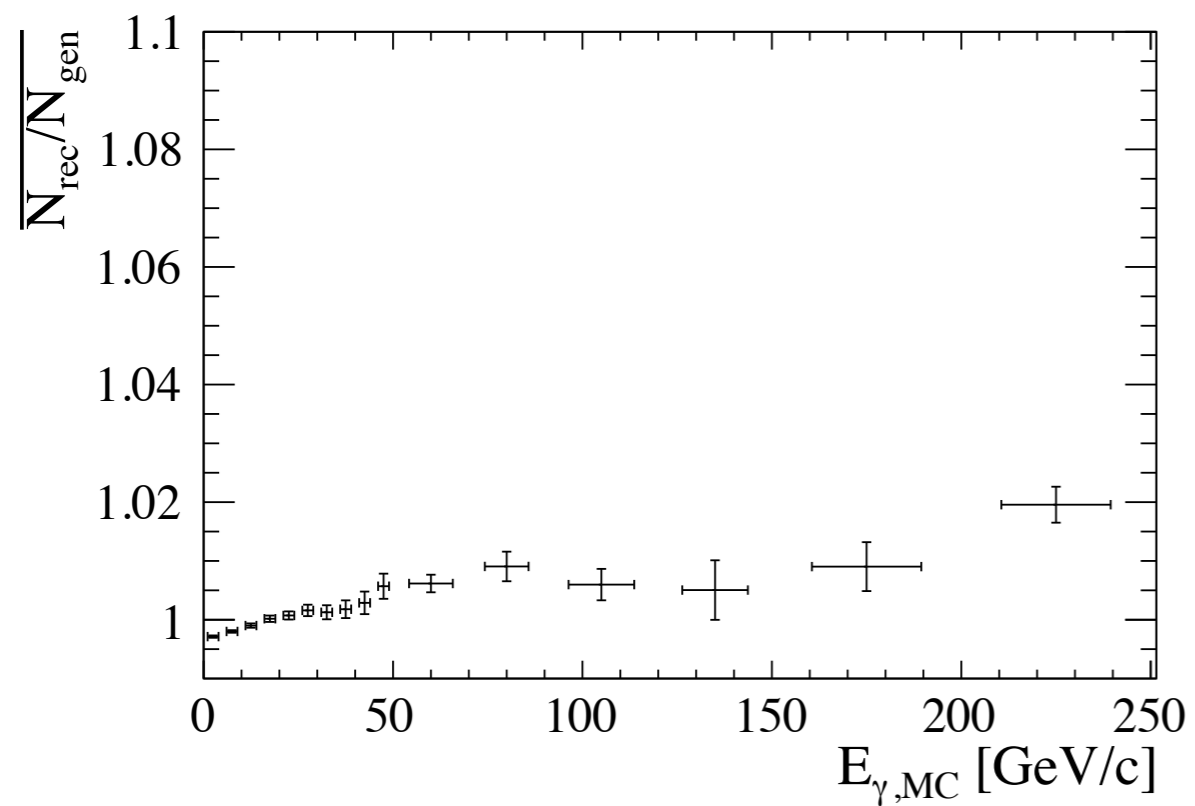# (Preliminary results from reruning BCal reconstruction for l5 samples.)

Photon energy resolution

l5, E_{MC}=10~15GeV

s5, E_{MC}=10~15GeV

l5, E_{MC}=200~205GeV

s5, E_{MC}=200~205GeV

PtMaxPhoton in $\nu\nu$ Nγ

l5

s5
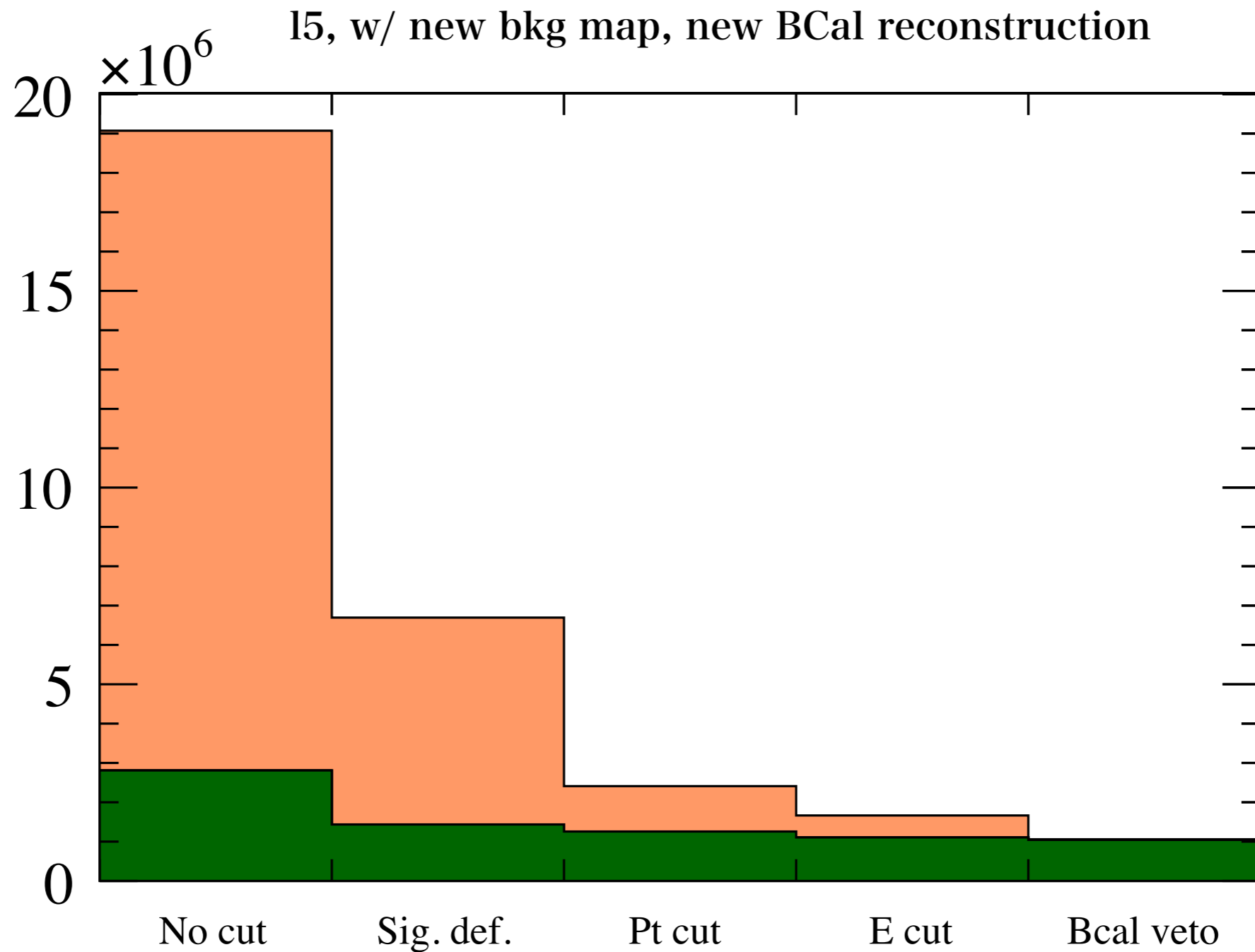
❖ **Left : Examples of E_{REC} - E_{MC} dist., Right : Summary of the σ_E/E vs E.**
  ‣ l5 points are produced by the new reconstruction (s5 is the same as before).
  ‣ Clear shift can be seen at high energies.

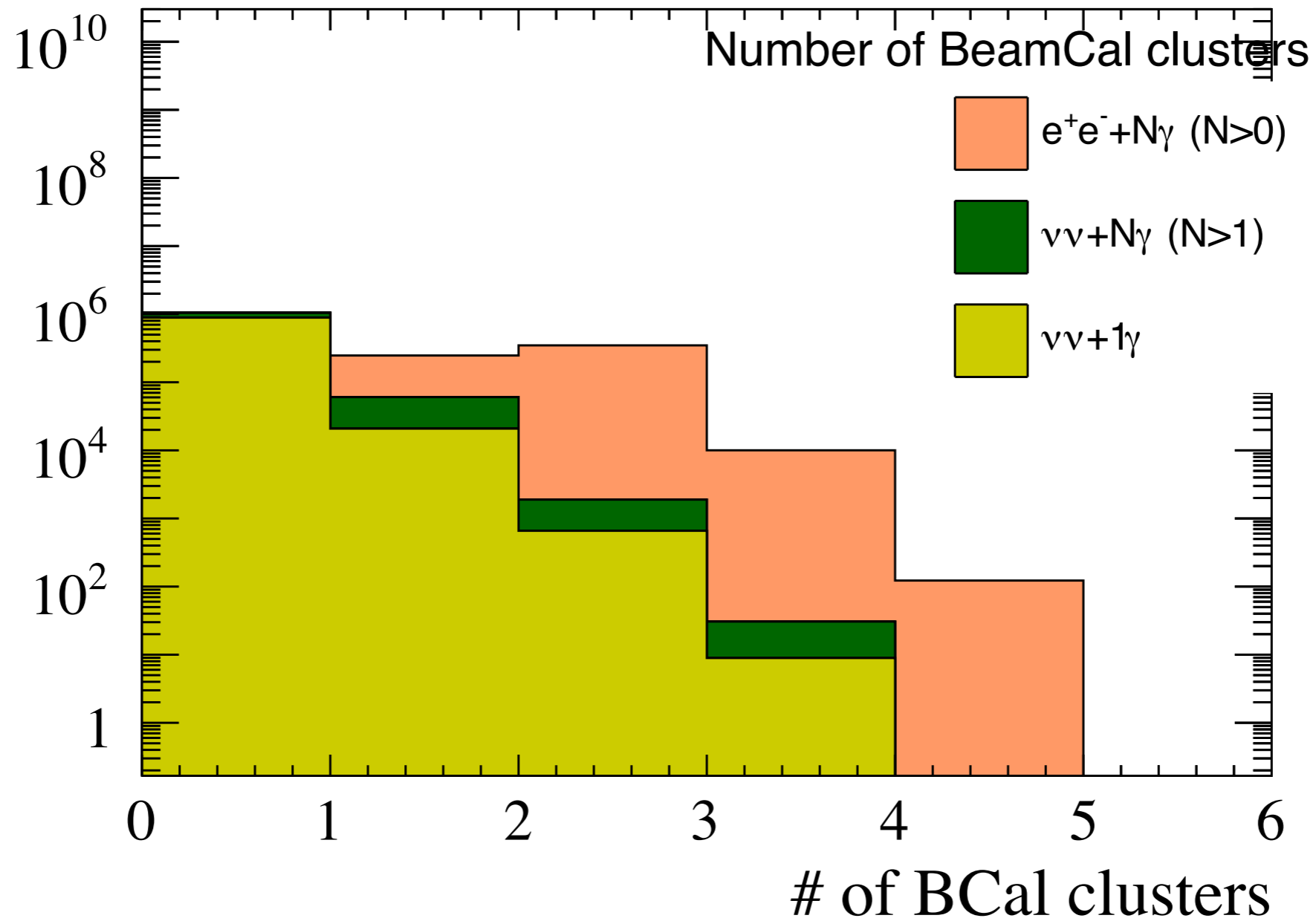# Number of reconstructed photon per MC photon

Need to zoom-in [0.99, 1.01] for IDR plot
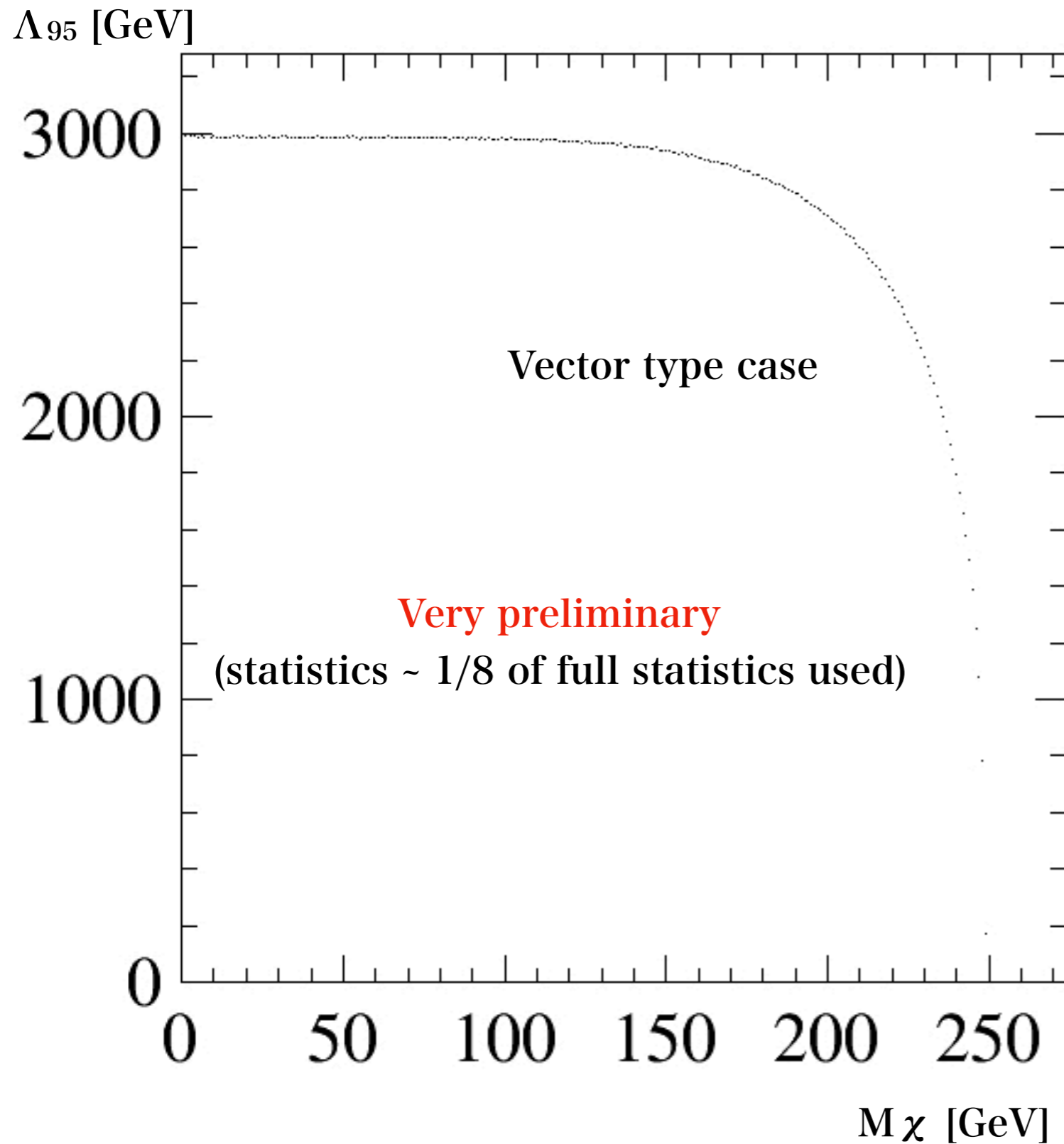
Looks good.

Cut reduction summary

l5, w/ new bkg map, new BCal reconstruction

Look good.

Number of BCal clusters

Look good.

Sensitivity plot

Λ_{95} [GeV]

3000

Vector type case

2000

2500

No big surprise
  ▸ Almost comparable to the previous result.

Very preliminary
(statistics ~ 1/8 of full statistics used)

1000

0

0   50   100   150   200   250

Mχ [GeV]