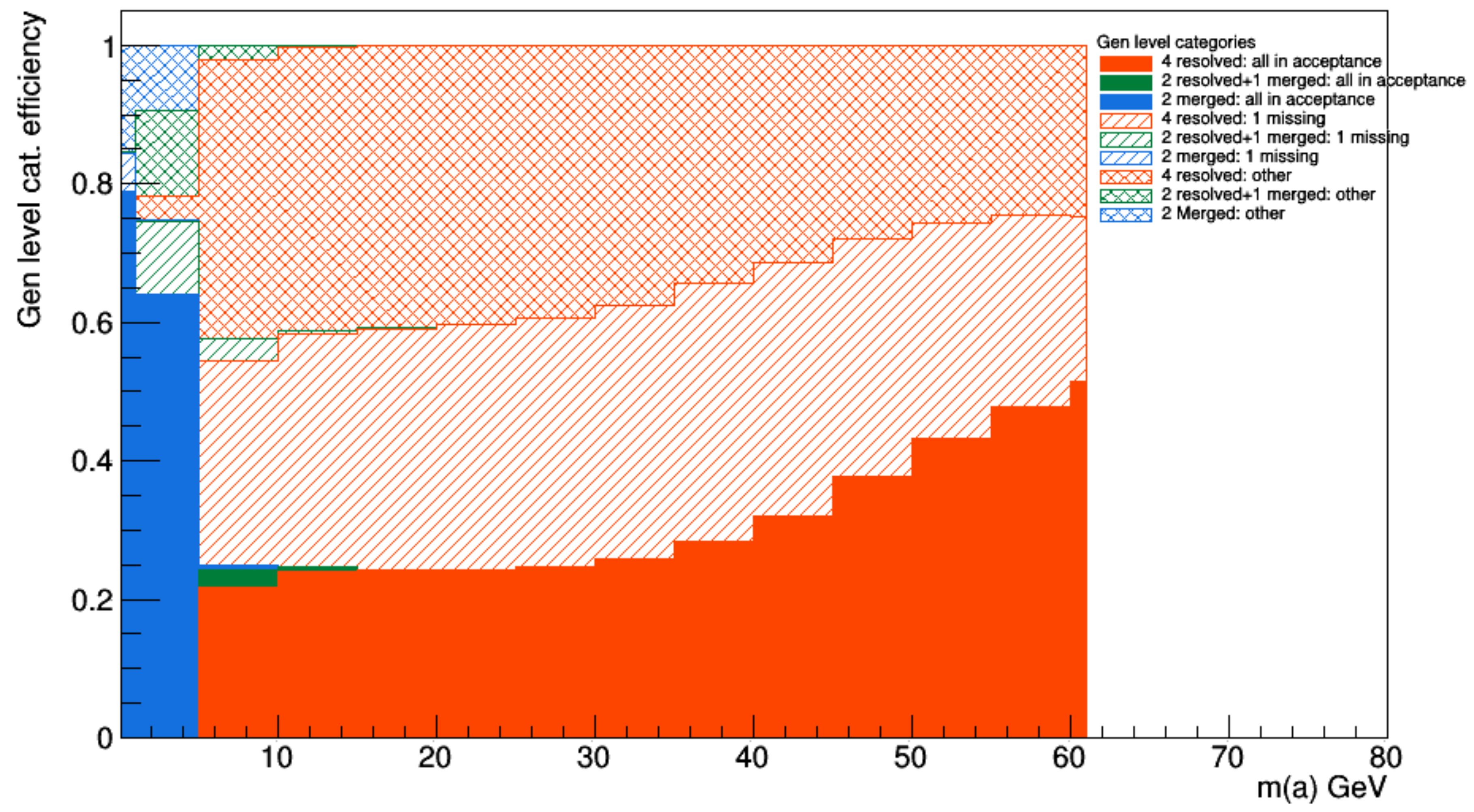


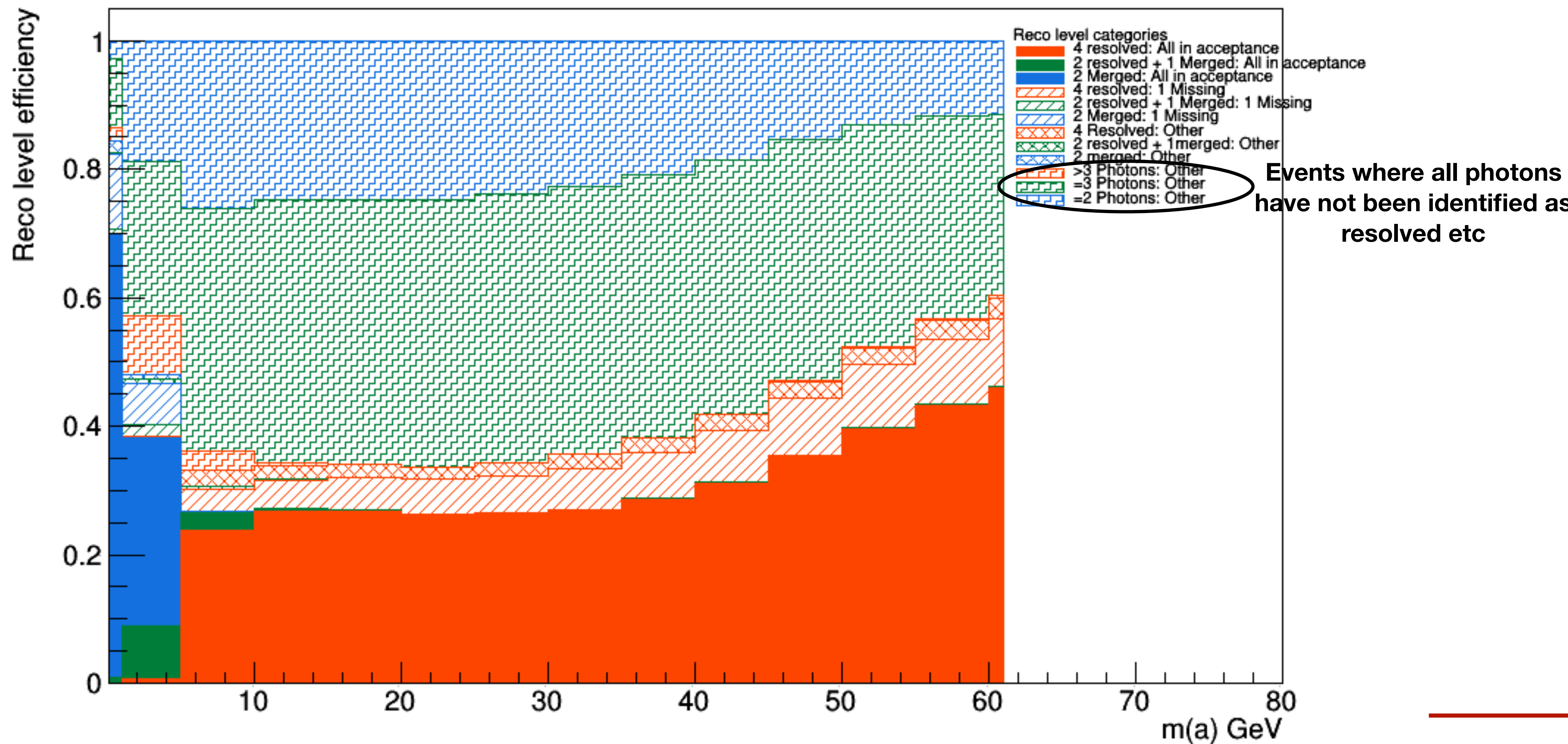
12th June '18

Gen level categorization



12th June '18

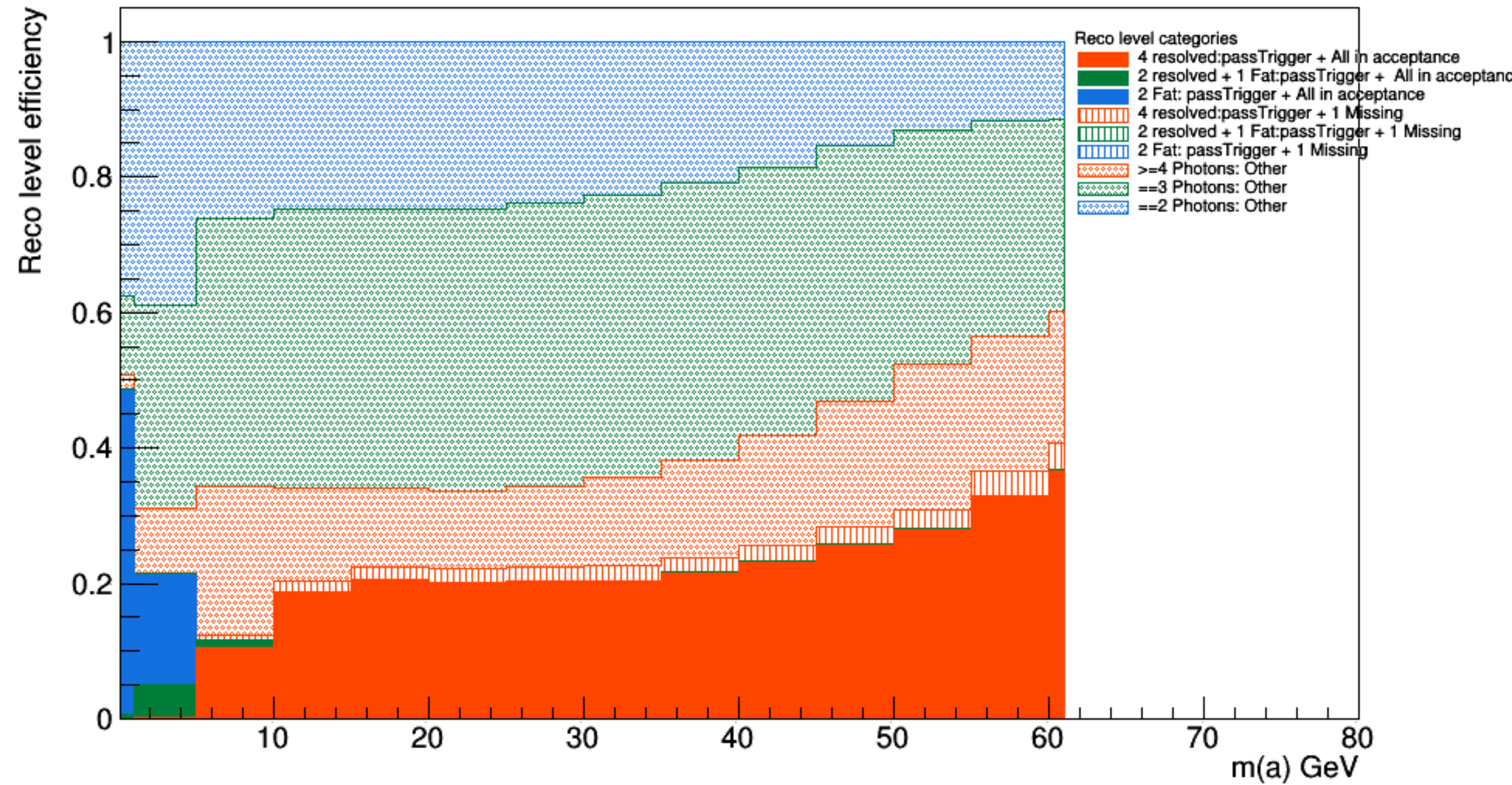
Reco level categorization : Resolved and Merged



“Other” (dotted region)

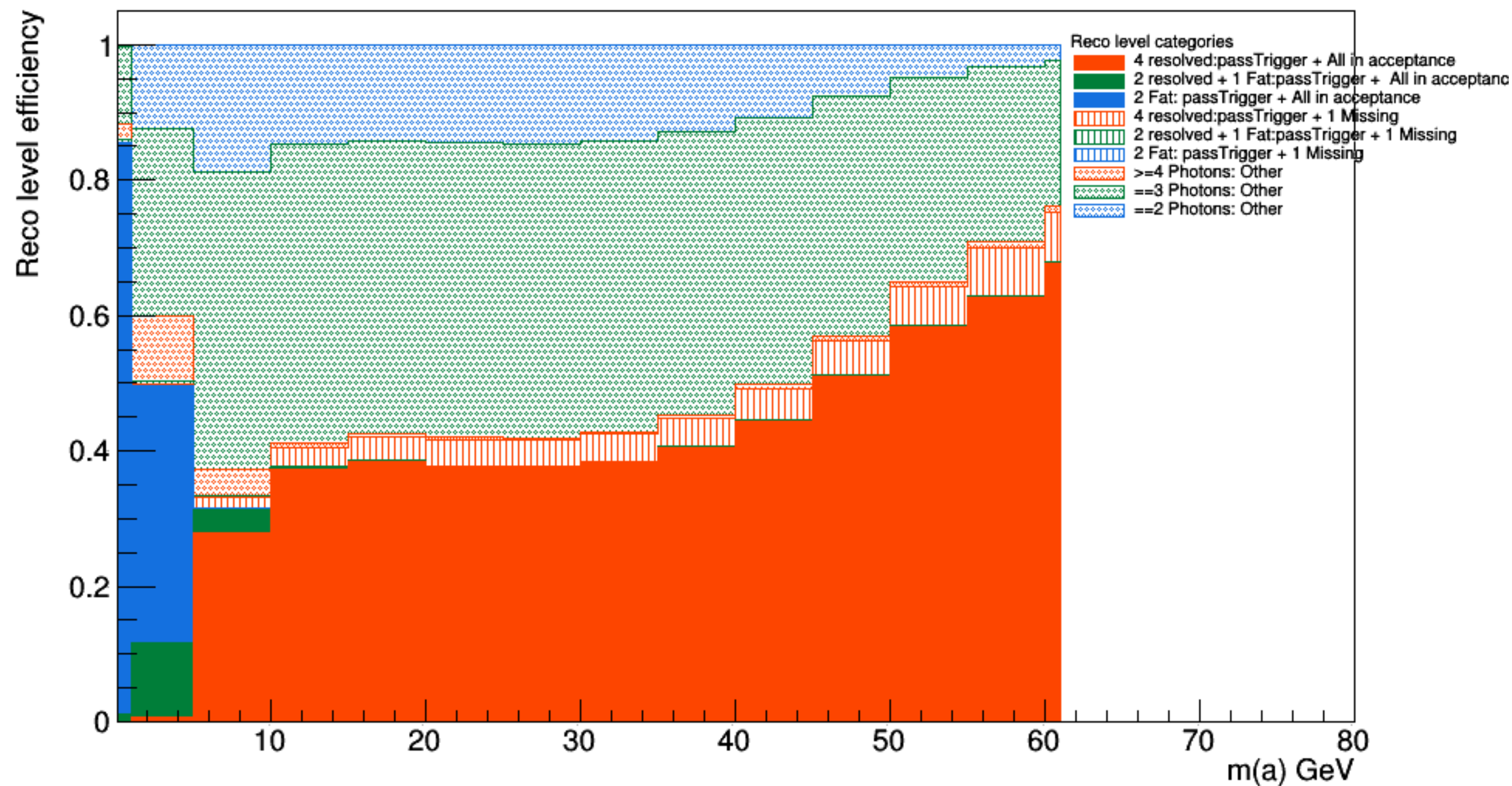
Eg : Red Dotted Region - **Does not** contain events with just 4 resolved photons (it really is everything left after categorization for events with at least 4 photons)

Reco level categorization



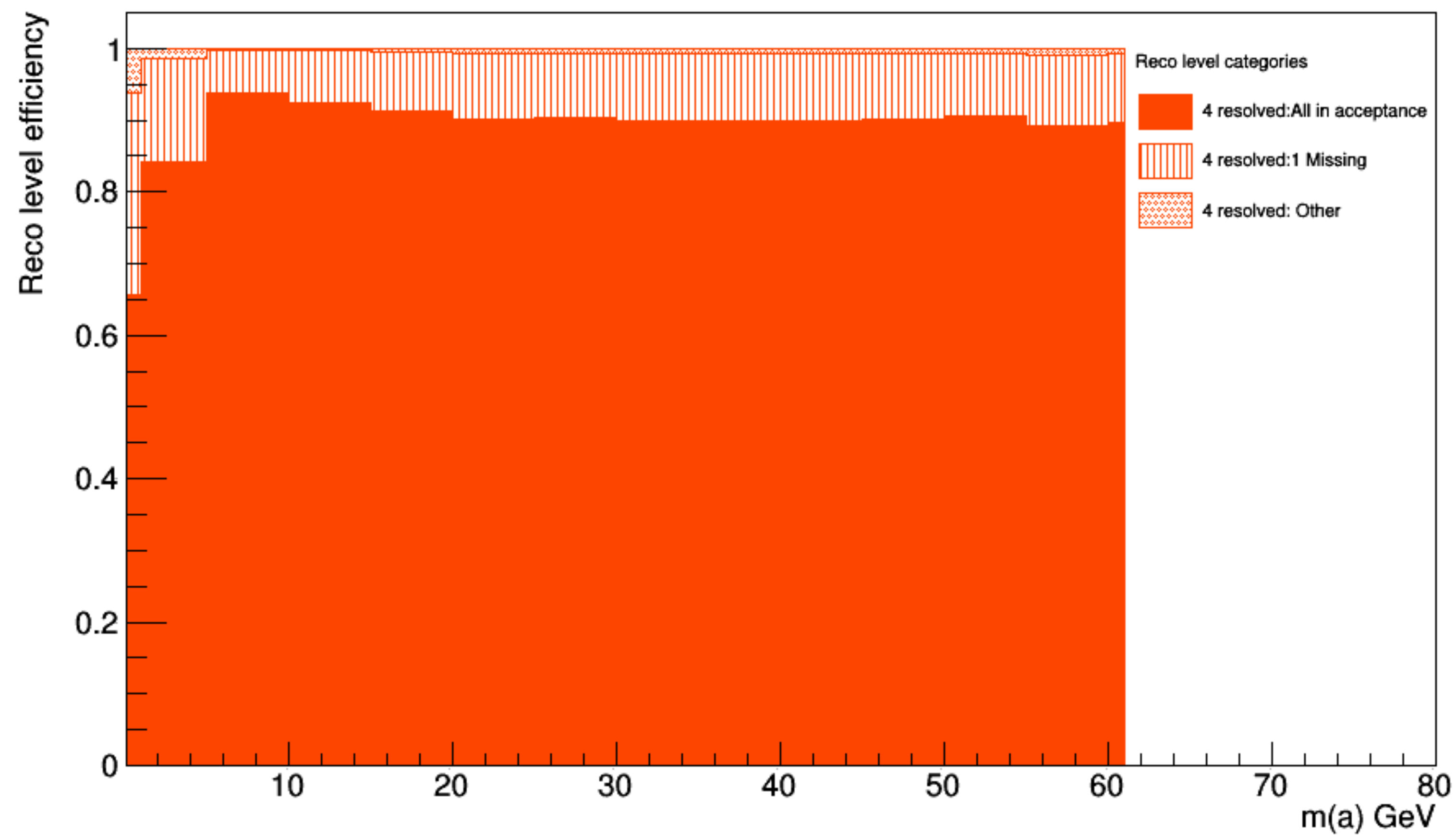
Reco level categorization : Only events that pass trigger requirements

Same plot but only with for events that pass Trigger



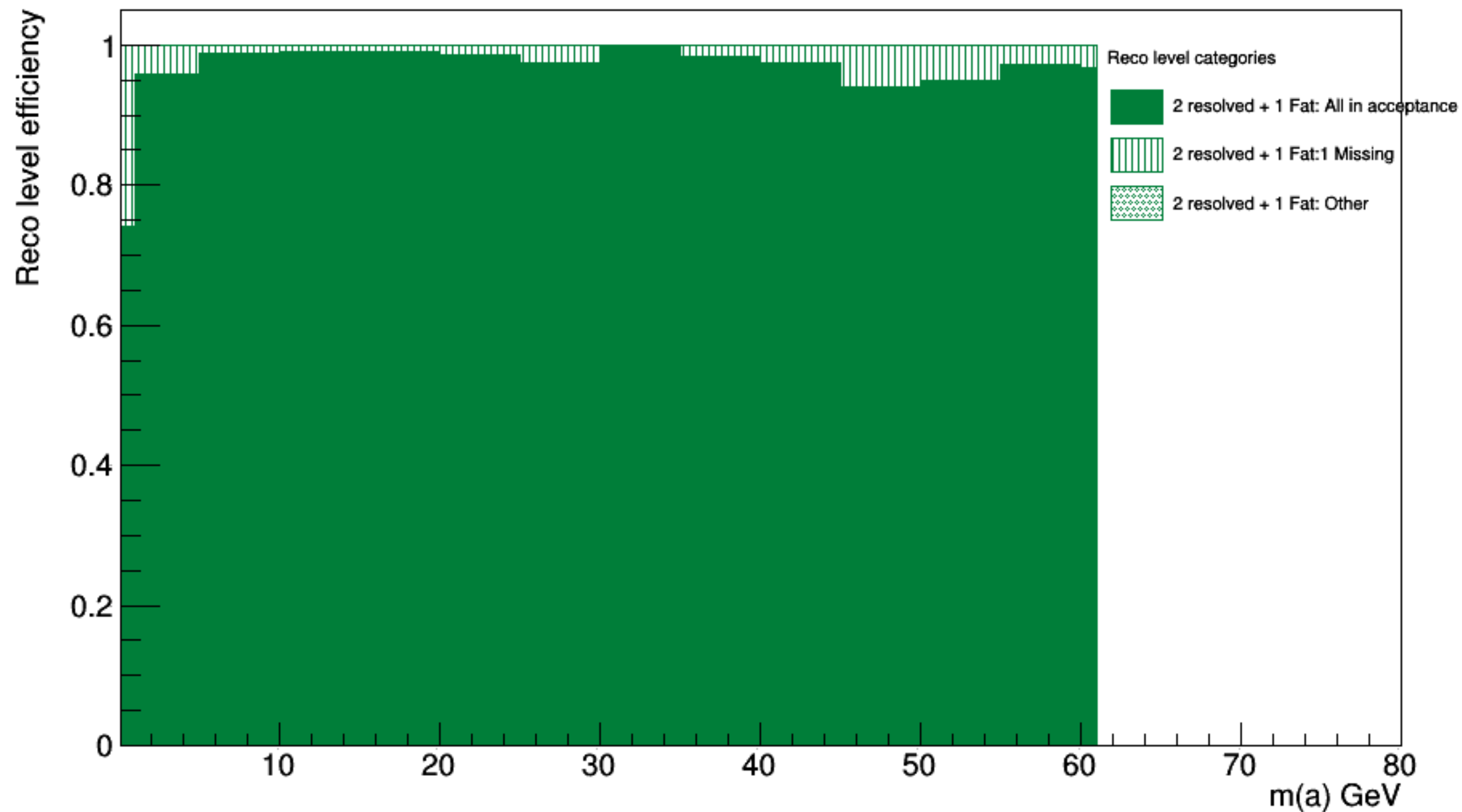
Start with events with at least 4 photons
 + pass trigger requirements
 + Photons are gen matched to resolved

Reco level categorization : Only events that pass trigger requirements : 4 Photon case

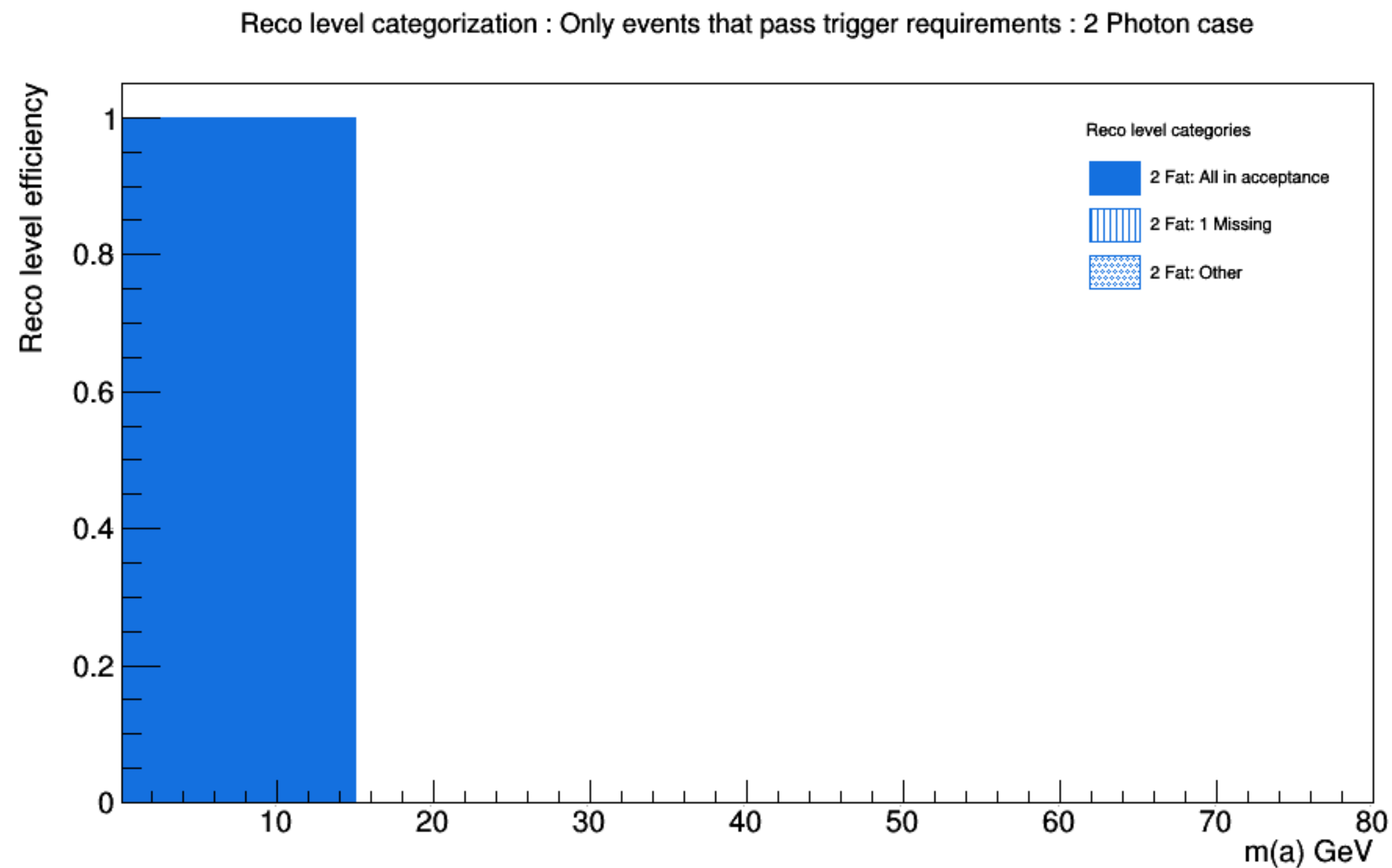


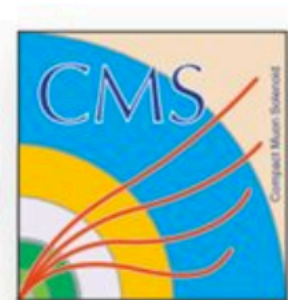
Reco level categorization : Only events that pass trigger requirements : 3 Photon case

Start with events with exactly 3 photons
+ pass trigger requirements
+ Photons are gen matched
such that in an event there are
2 resolved + 1 merged photon



Start with events with exactly 2
photons
+ pass trigger requirements
+ Photons are gen matched
such that in an event there are
2 merged photons



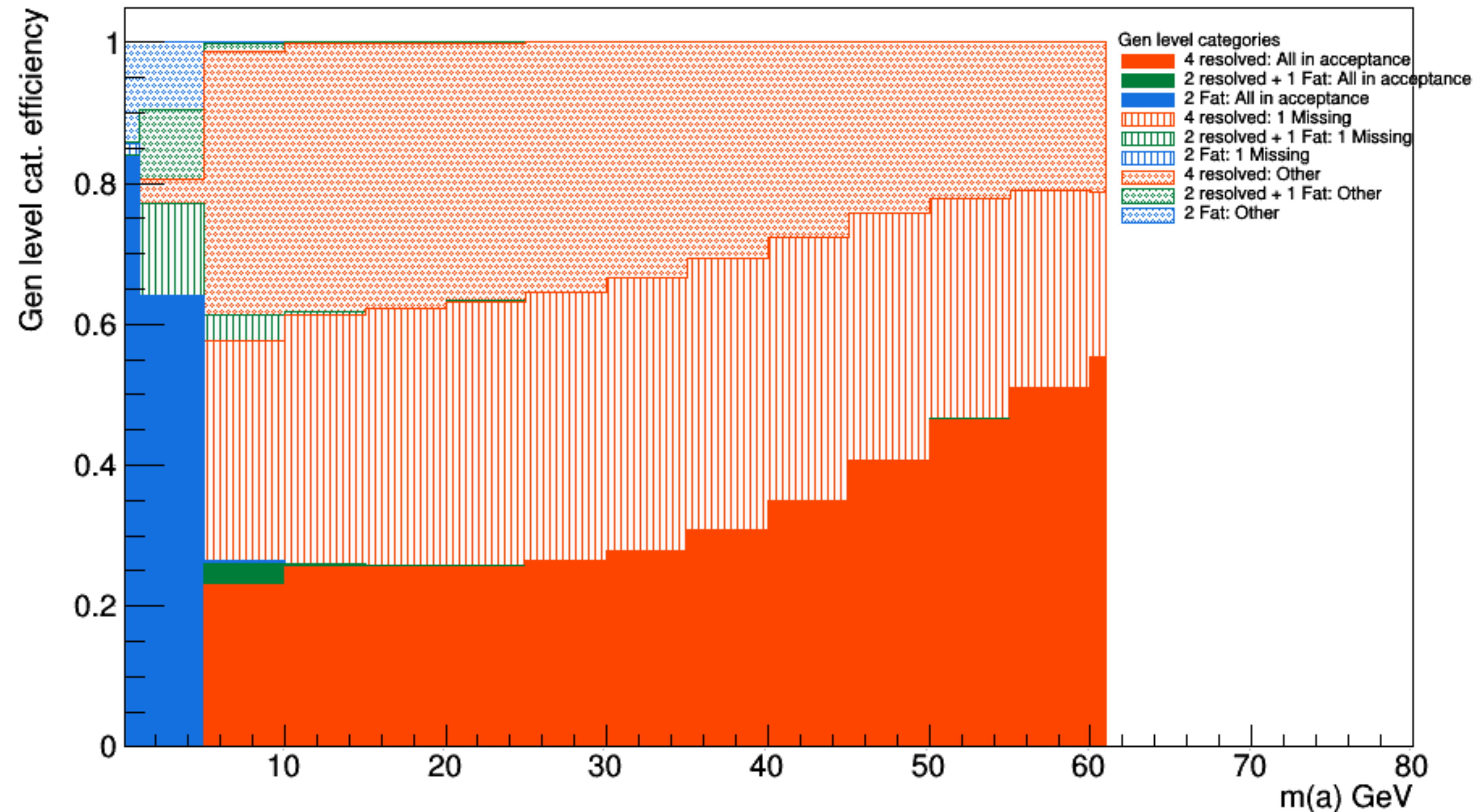


Changes since last chat on 24 Apr '18 (older slides in backup)

- Gen level categorization

- $|\text{abs}(\eta)| < 2.5$
- Photon1 Pt > 10
- Photon2 Pt > 10
- Photon3 Pt > 10
- Photon4 Pt > 10

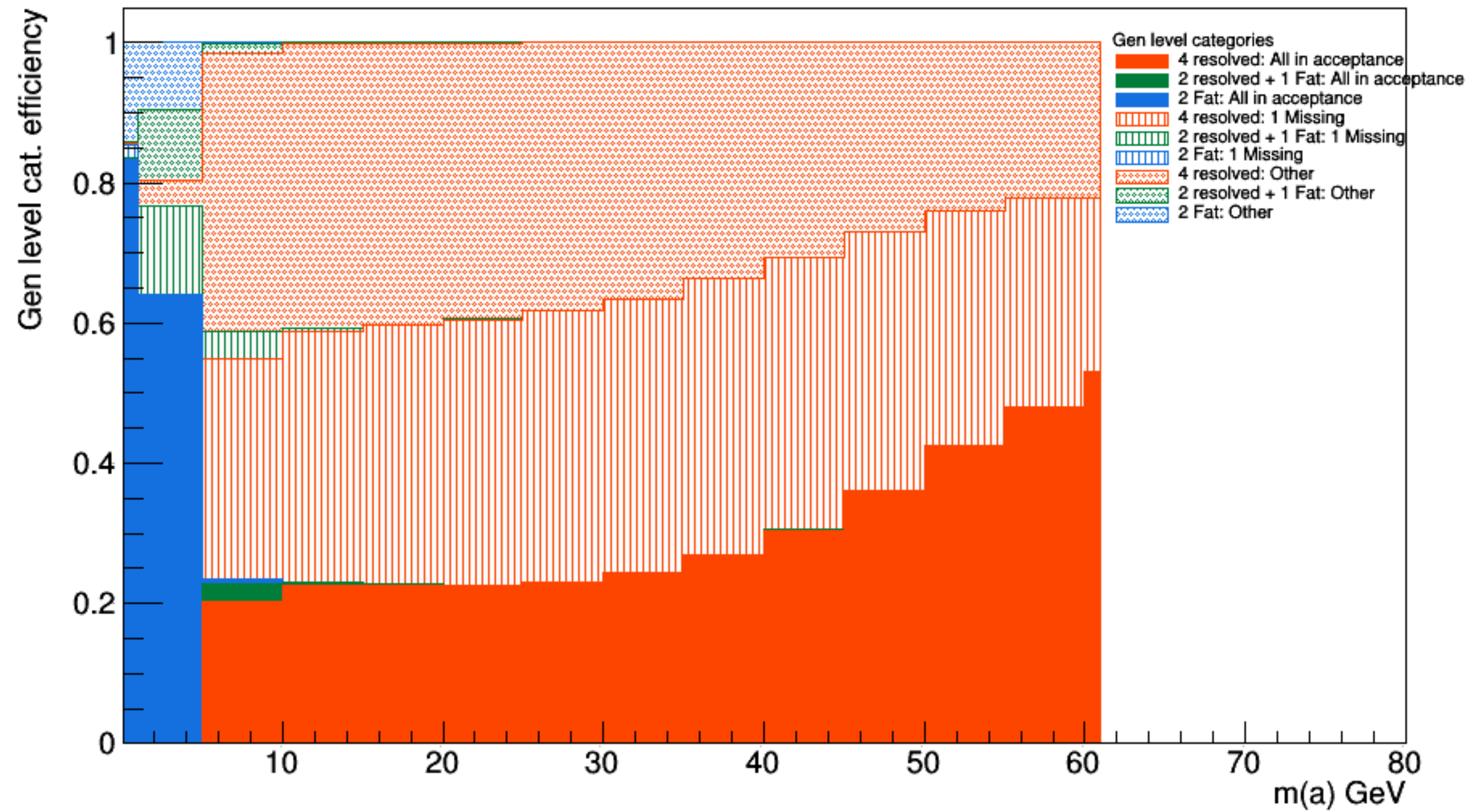
Gen level categorization



- Gen level categorization

- $abs(eta) < 2.5$
- Photon1 Pt > 11
- Photon2 Pt > 11
- Photon3 Pt > 11
- Photon4 Pt > 11

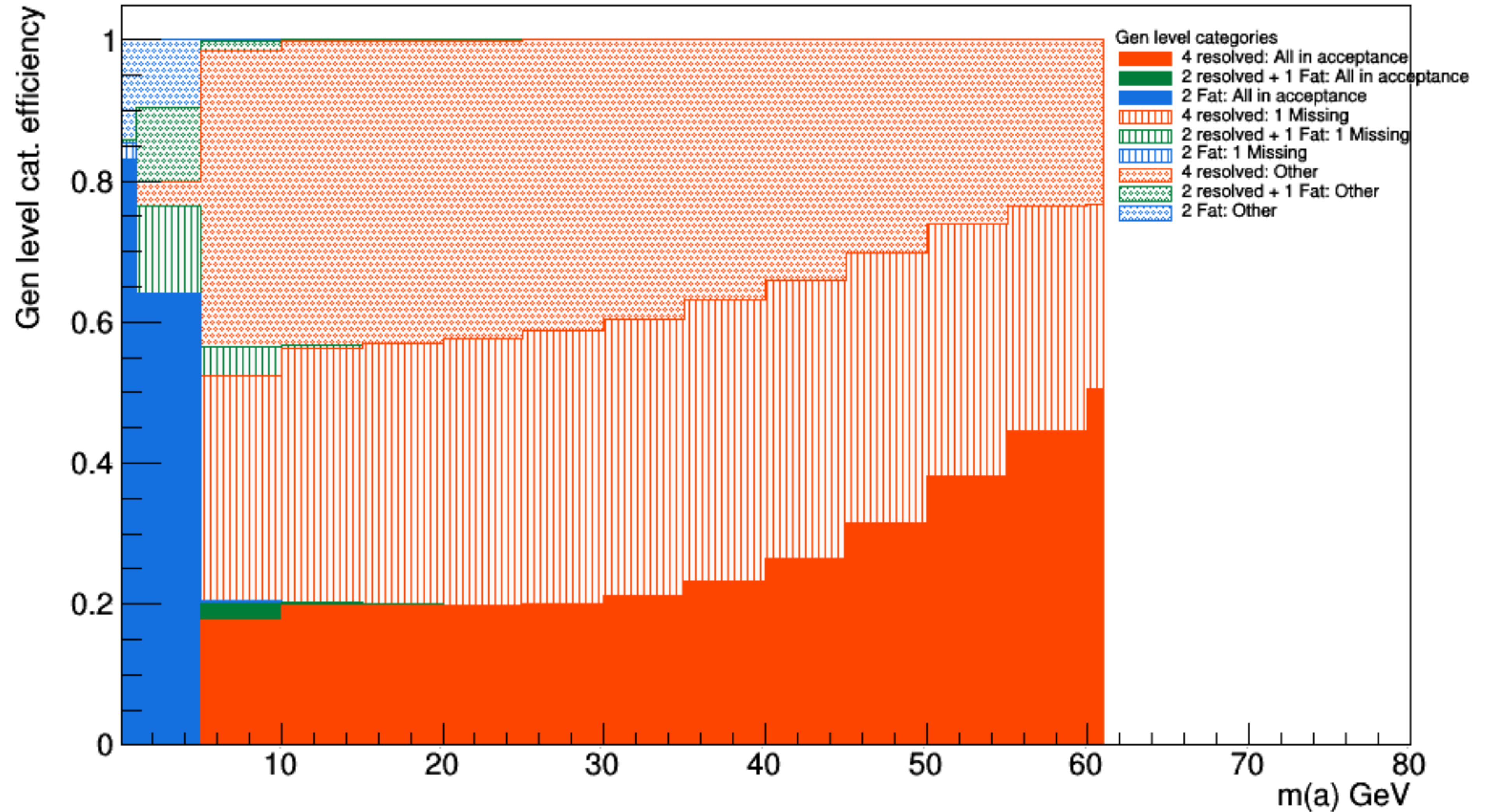
Gen level categorization



Gen level categorization

- Gen level categorization

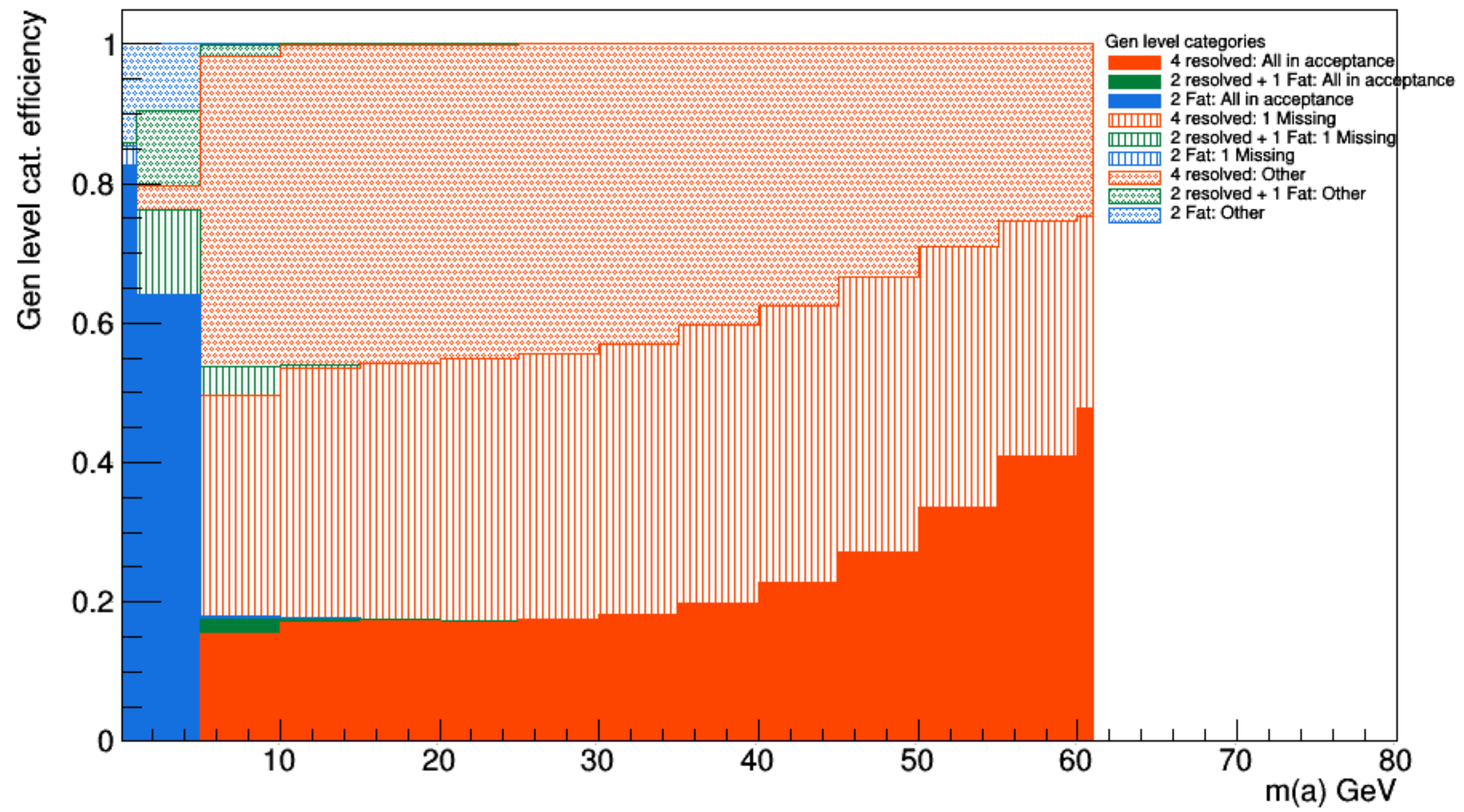
- $abs(eta) < 2.5$
- Photon1 Pt > 12
- Photon2 Pt > 12
- Photon3 Pt > 12
- Photon4 Pt > 12



- Gen level categorization

- $abs(eta) < 2.5$
- Photon1 Pt > 13
- Photon2 Pt > 13
- Photon3 Pt > 13
- Photon4 Pt > 13

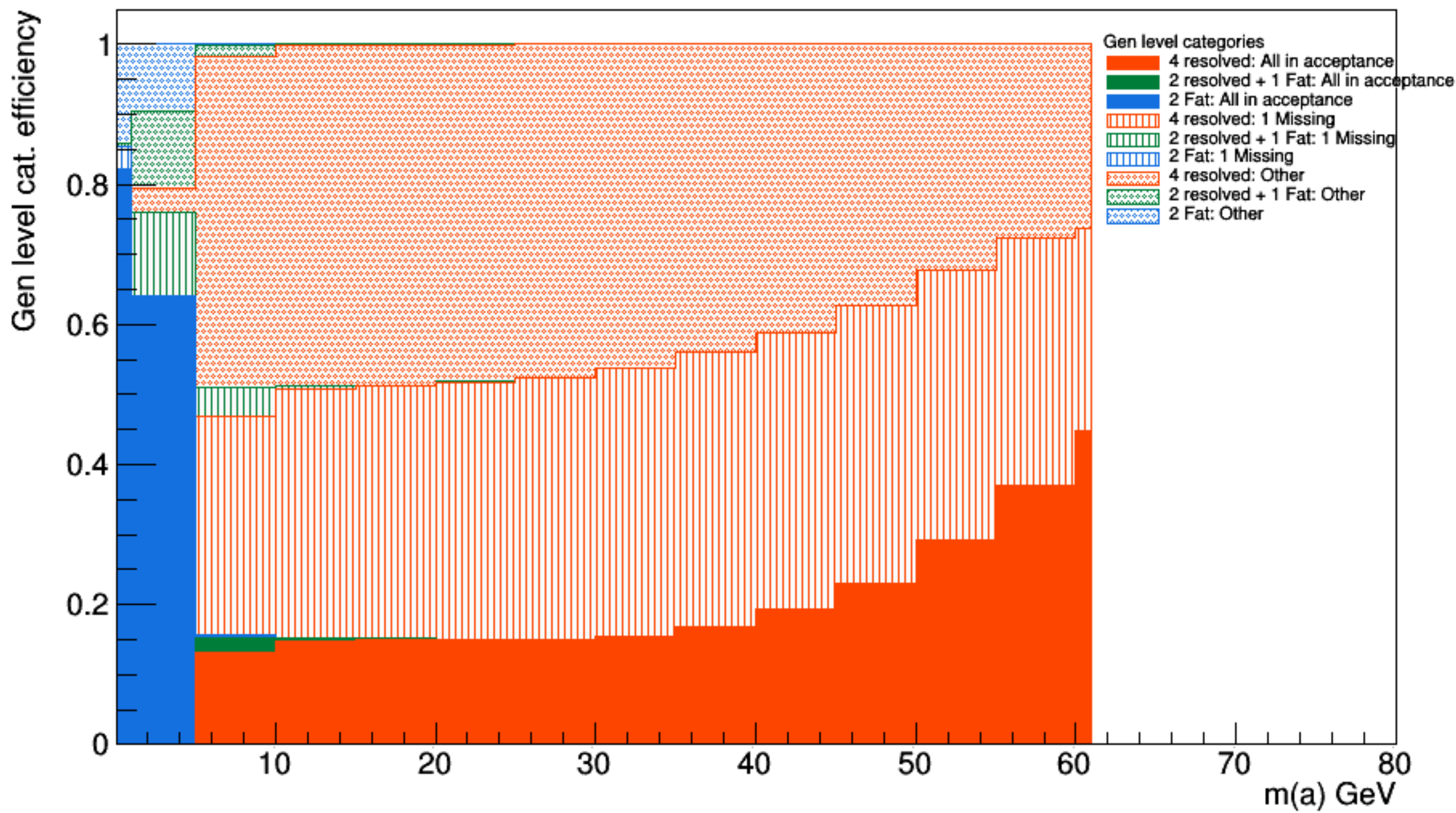
Gen level categorization



- Gen level categorization

- $abs(eta) < 2.5$
- Photon1 Pt > 14
- Photon2 Pt > 14
- Photon3 Pt > 14
- Photon4 Pt > 14

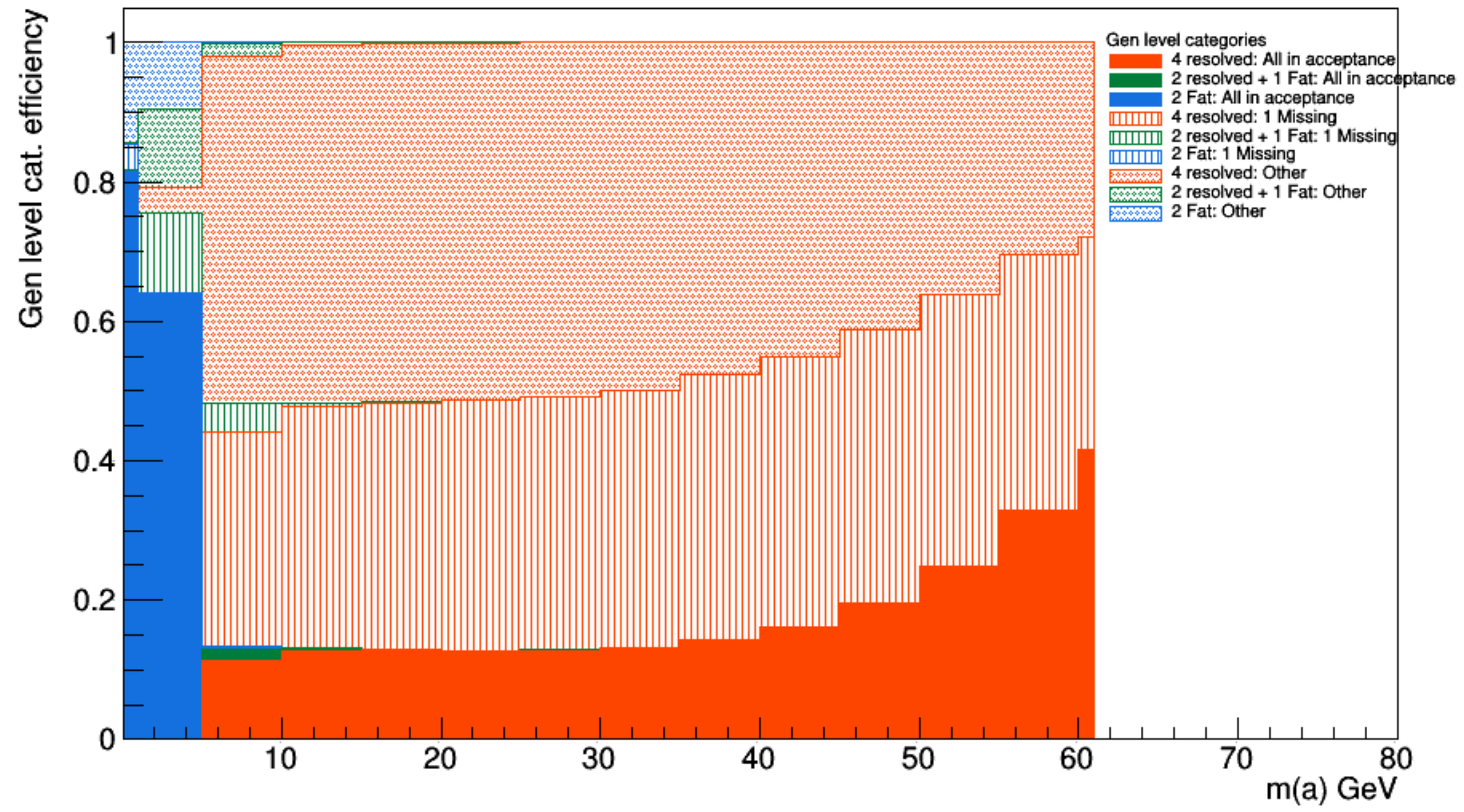
Gen level categorization



- Gen level categorization

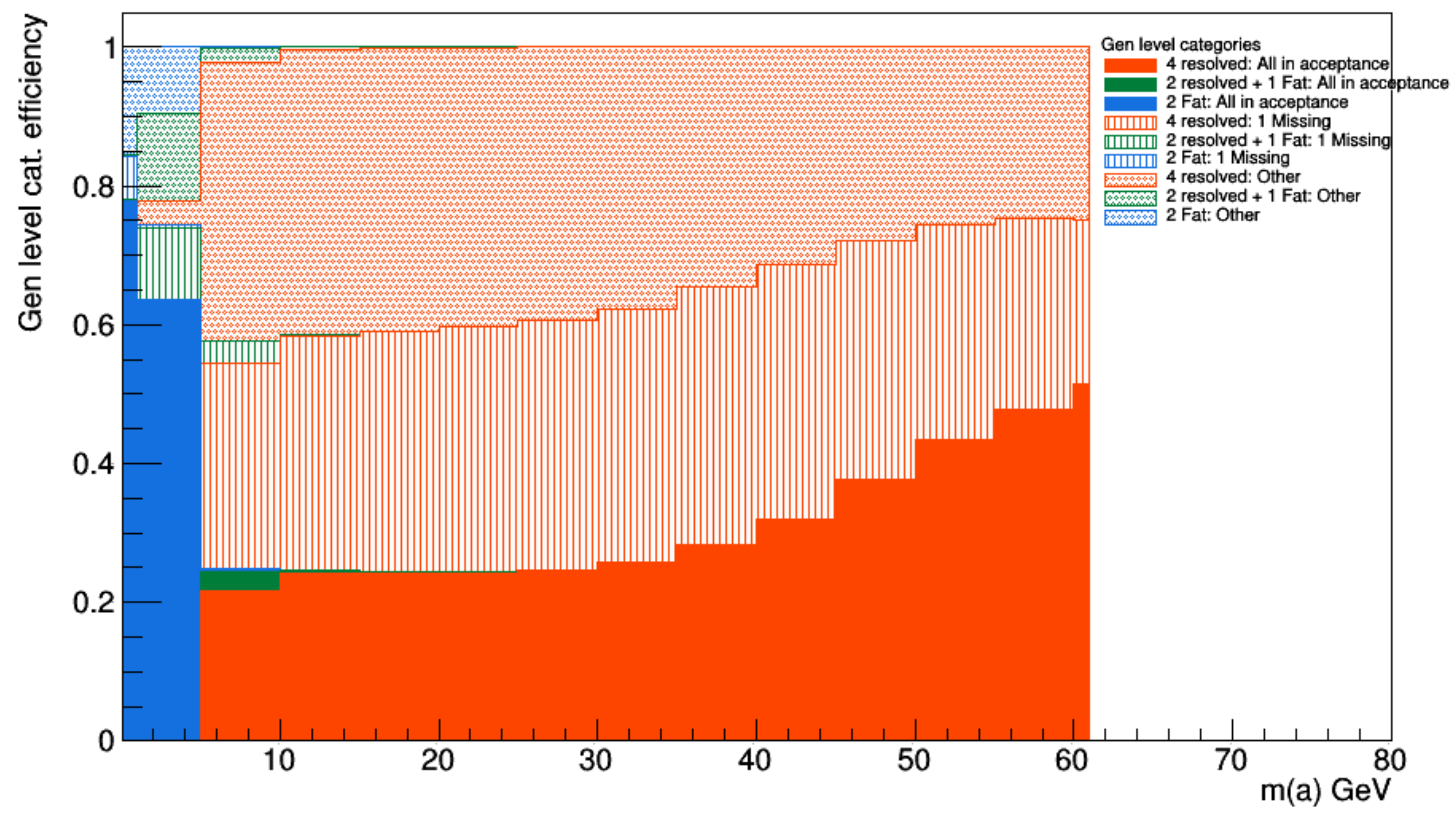
- $abs(eta) < 2.5$
- Photon1 Pt > 15
- Photon2 Pt > 15
- Photon3 Pt > 15
- Photon4 Pt > 15

Gen level categorization



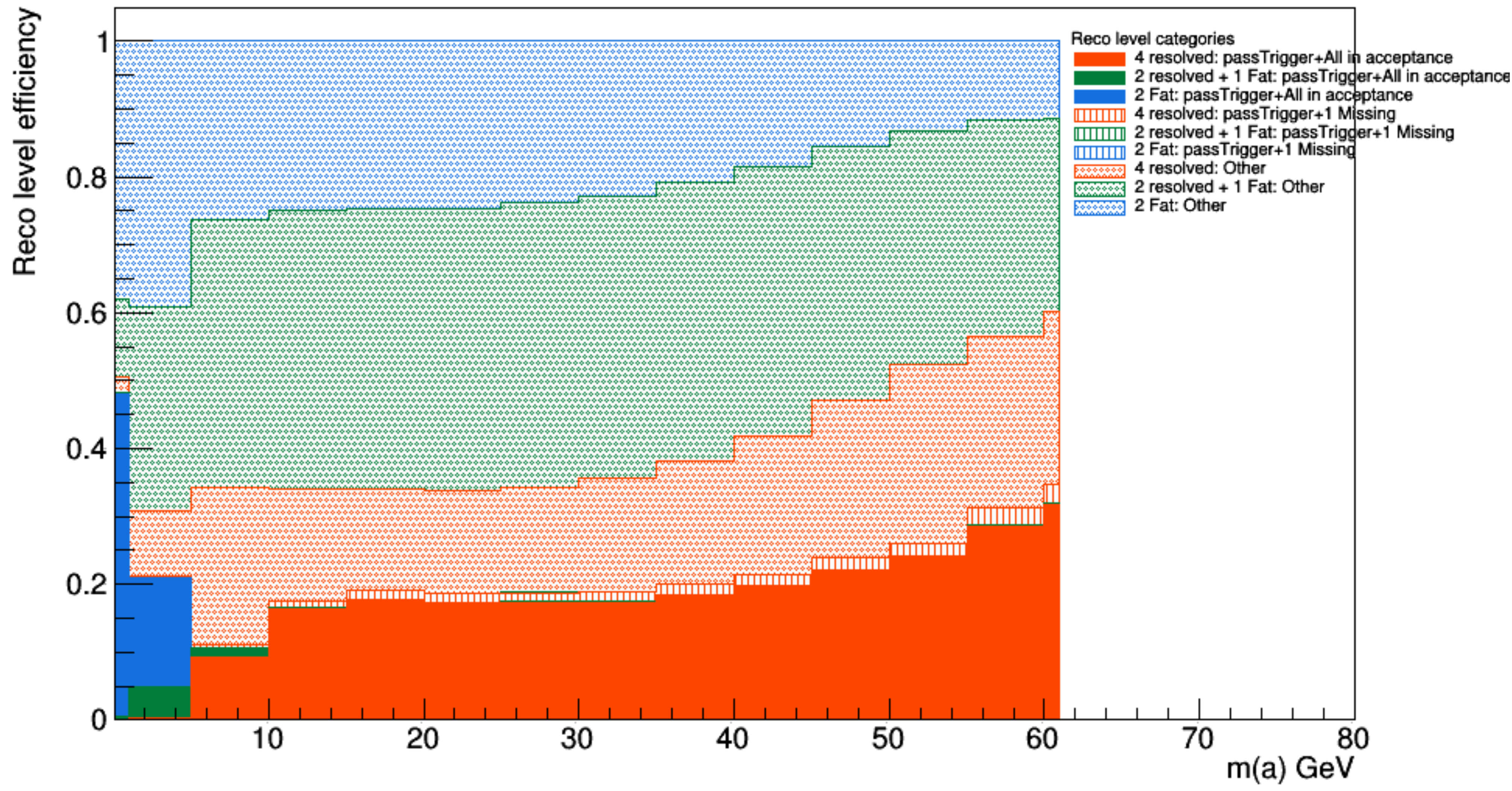
- Gen level categorization
 - $abs(eta) < 2.5$
 - Photon1 Pt > 30
 - Photon2 Pt > 18
 - Photon3 Pt > 10
 - Photon4 Pt > 10

Gen level categorization



$\Delta R(\text{Reco}, \text{Gen}) < 0.10$

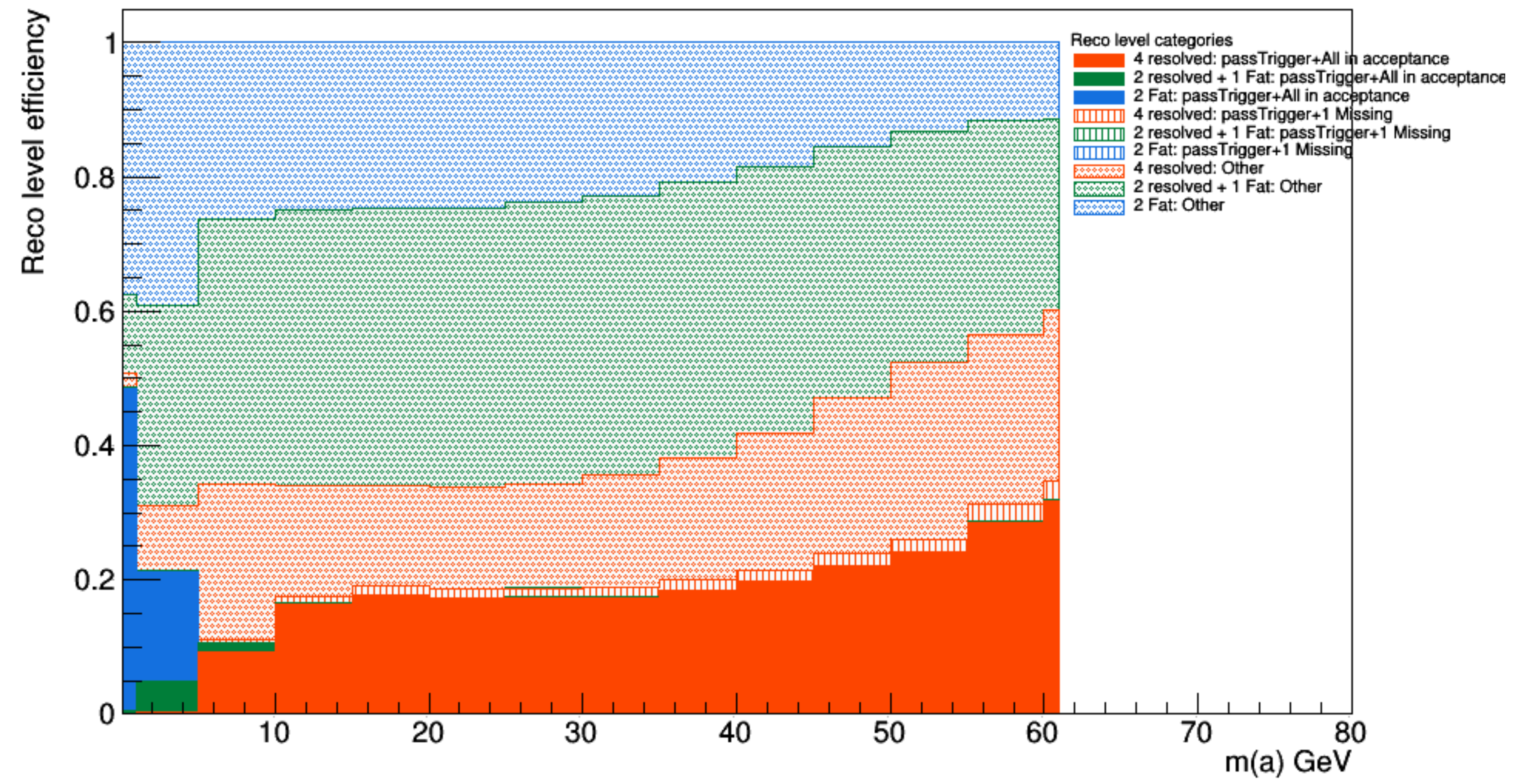
Reco level categorization



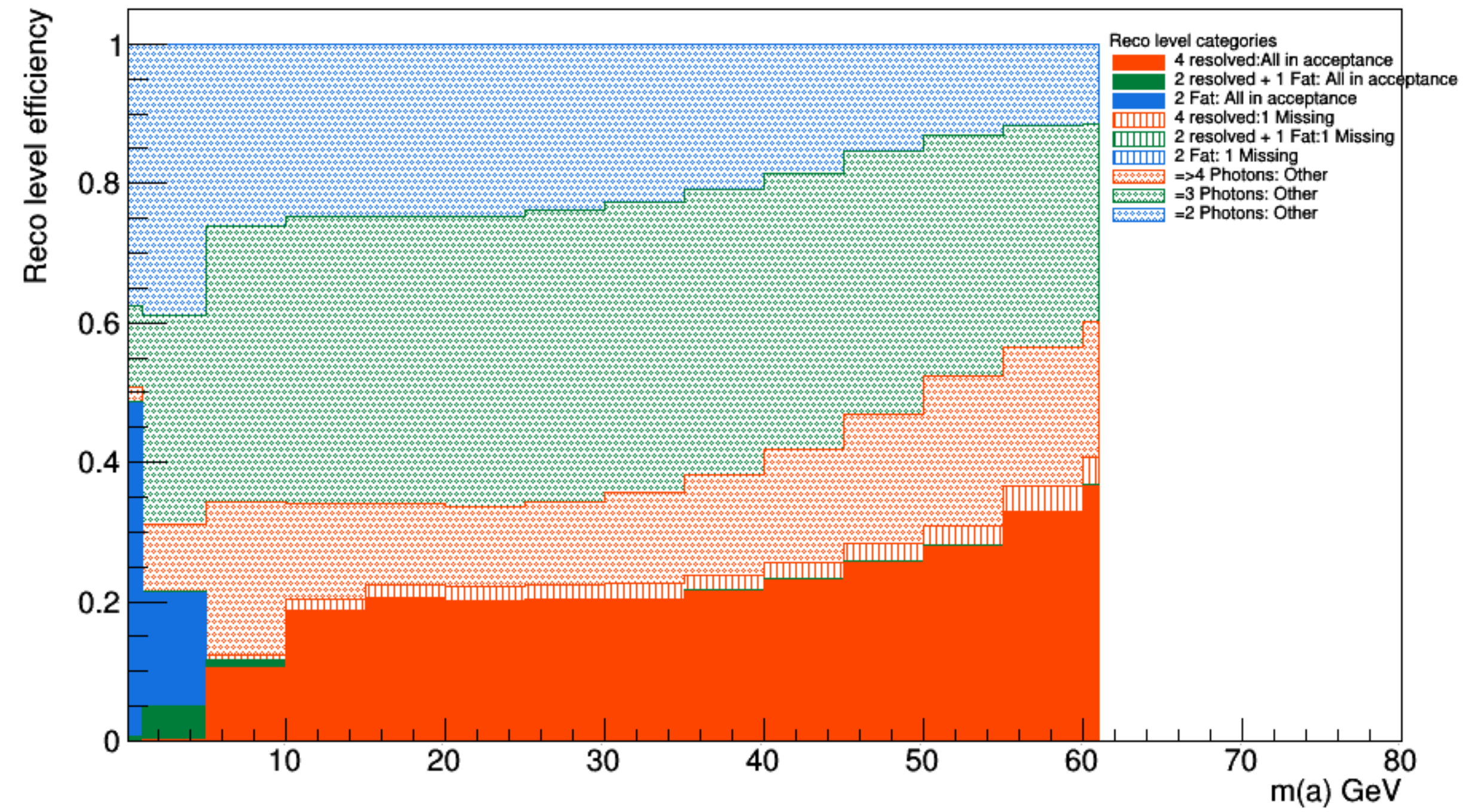
Others (dotted region) also contains events that have not passed trigger

$\Delta R(\text{Reco}, \text{Gen}) < 0.15$

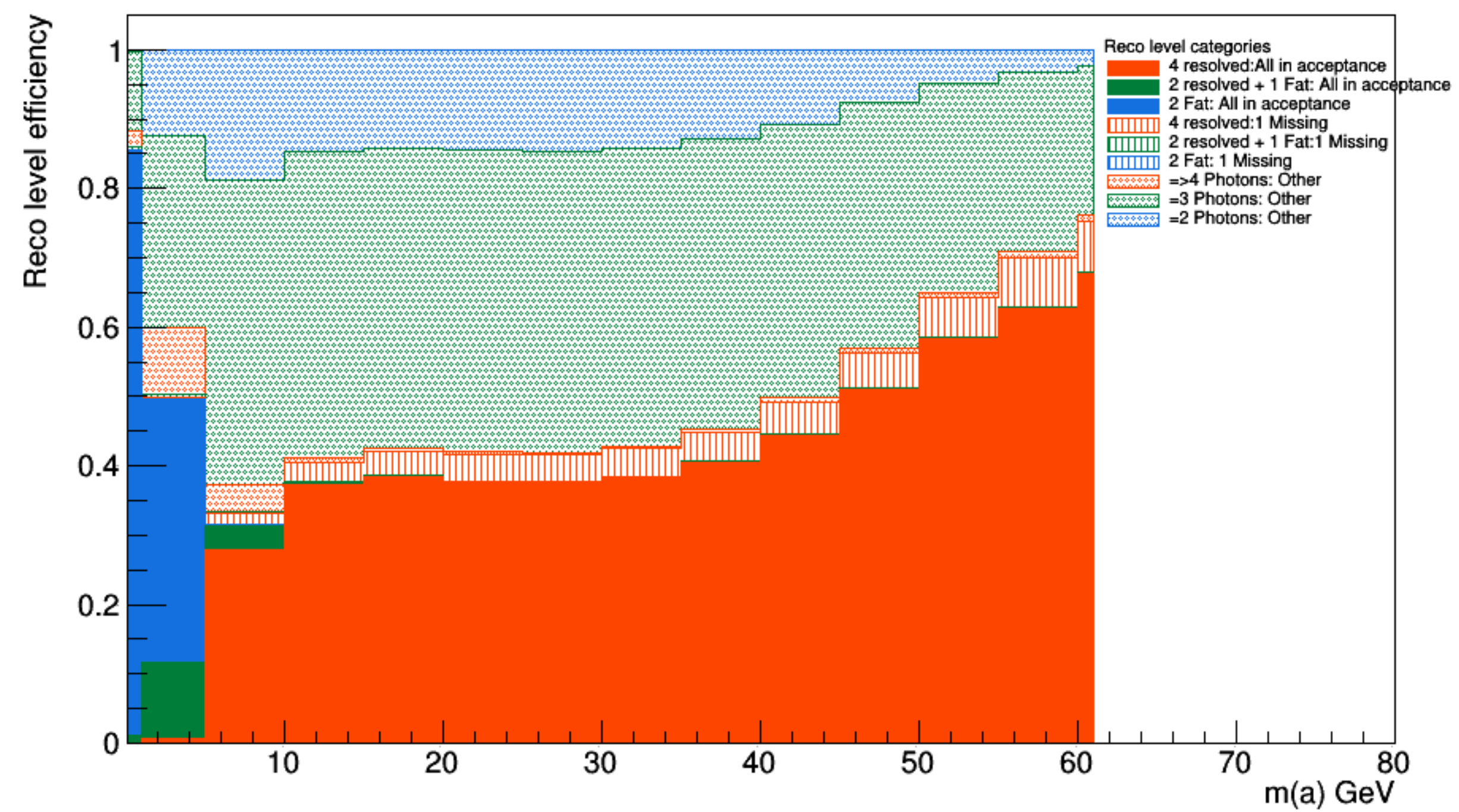
Reco level categorization



Reco level categorization

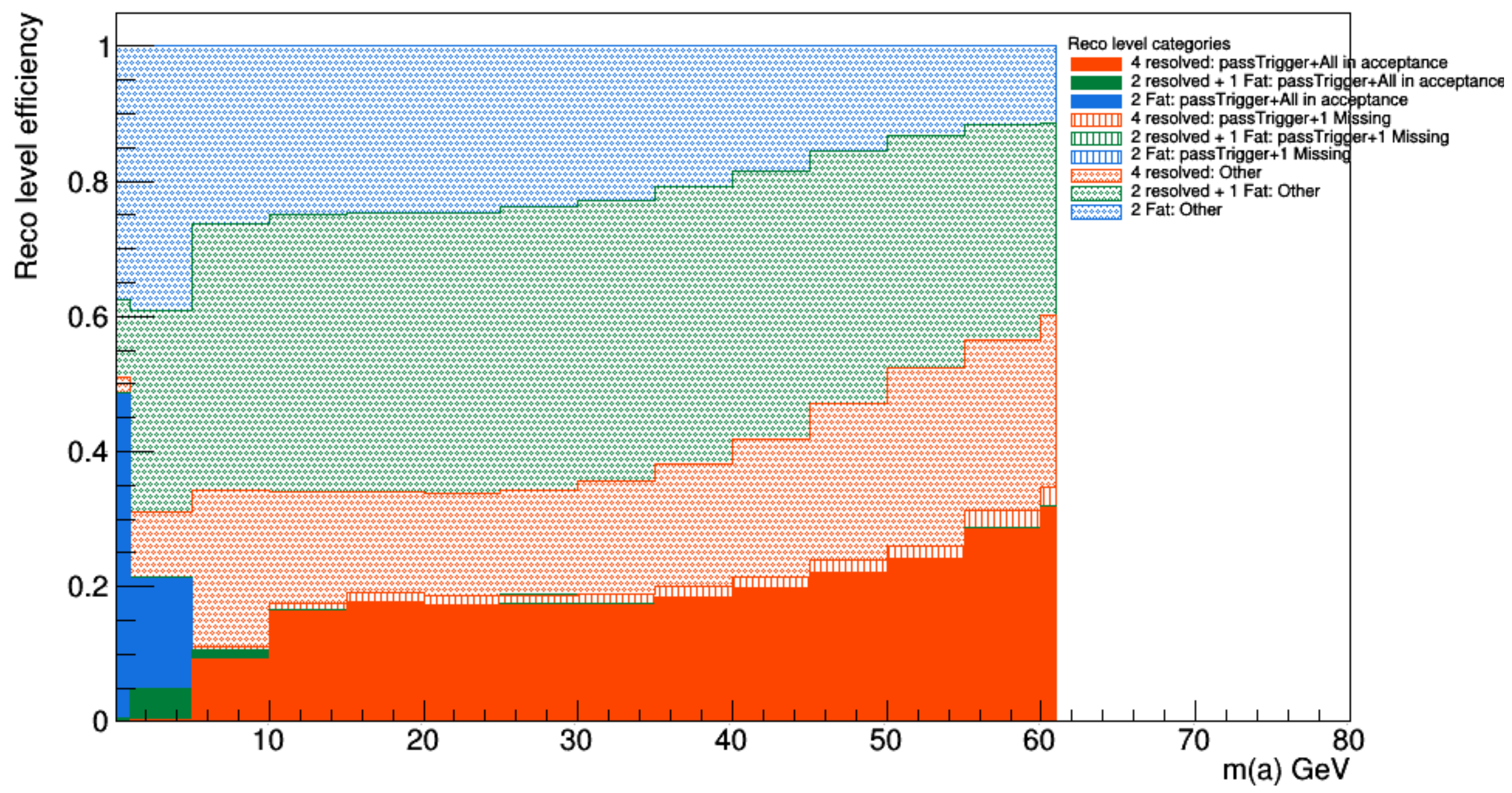


Reco level categorization : Only events that pass trigger requirements



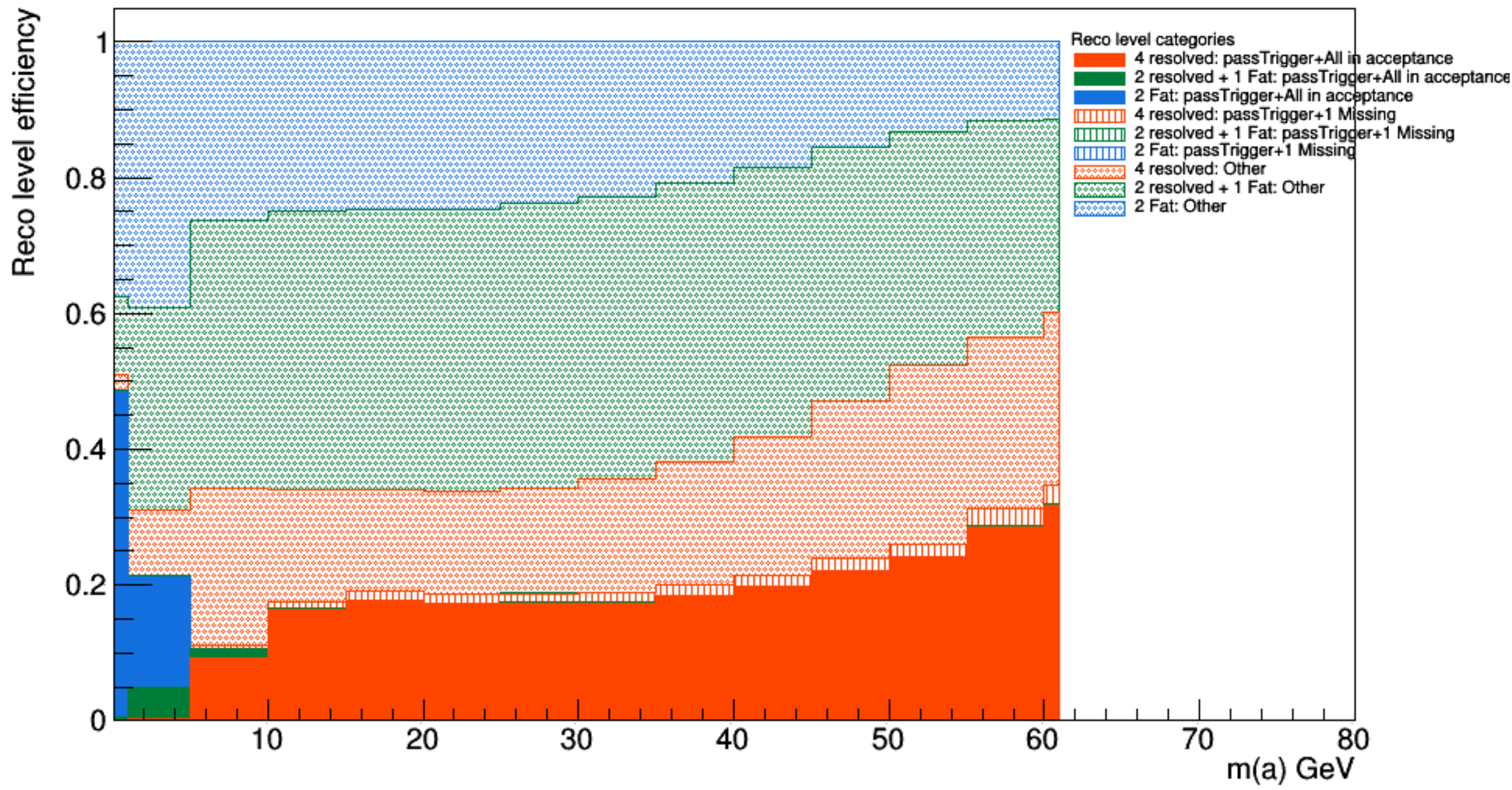
$\Delta R(\text{Reco}, \text{Gen}) < 0.2$

Reco level categorization

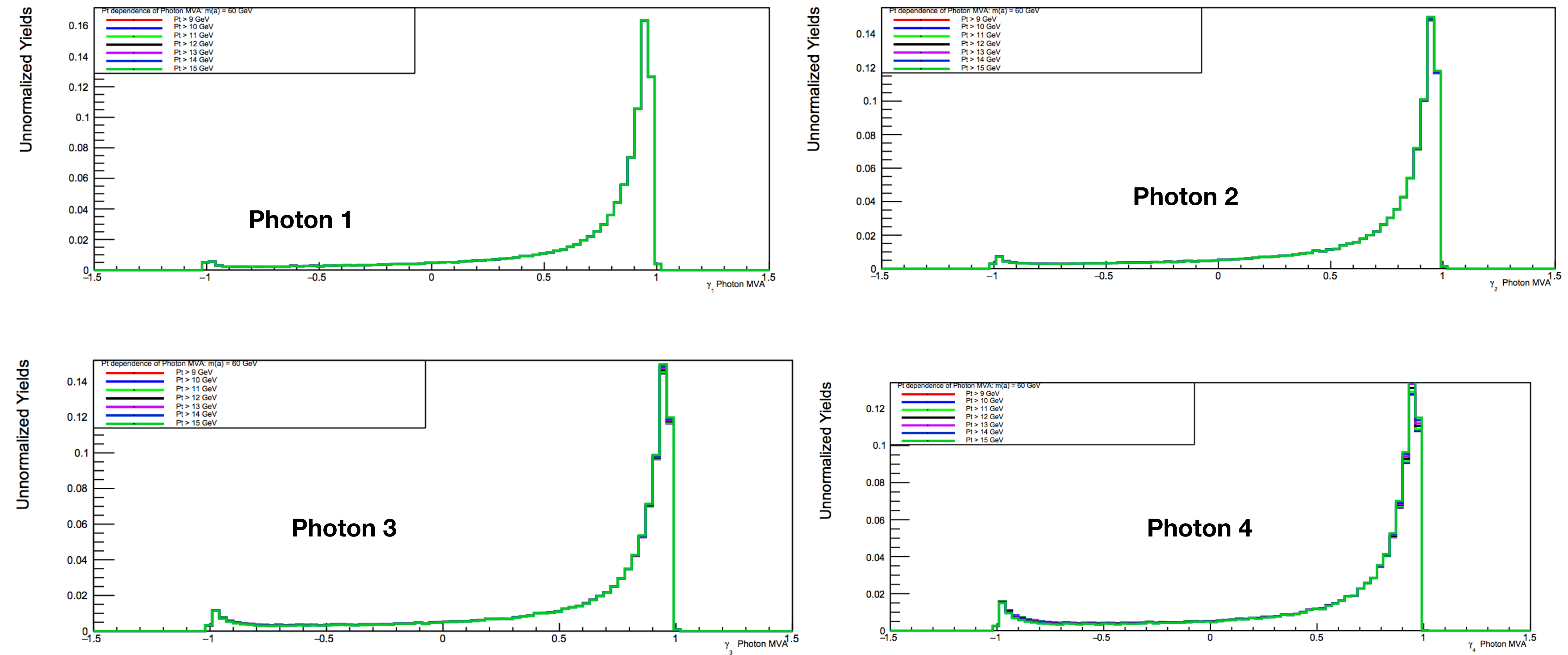


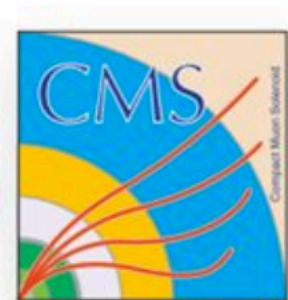
$\Delta R(\text{Reco}, \text{Gen}) < 0.3$

Reco level categorization

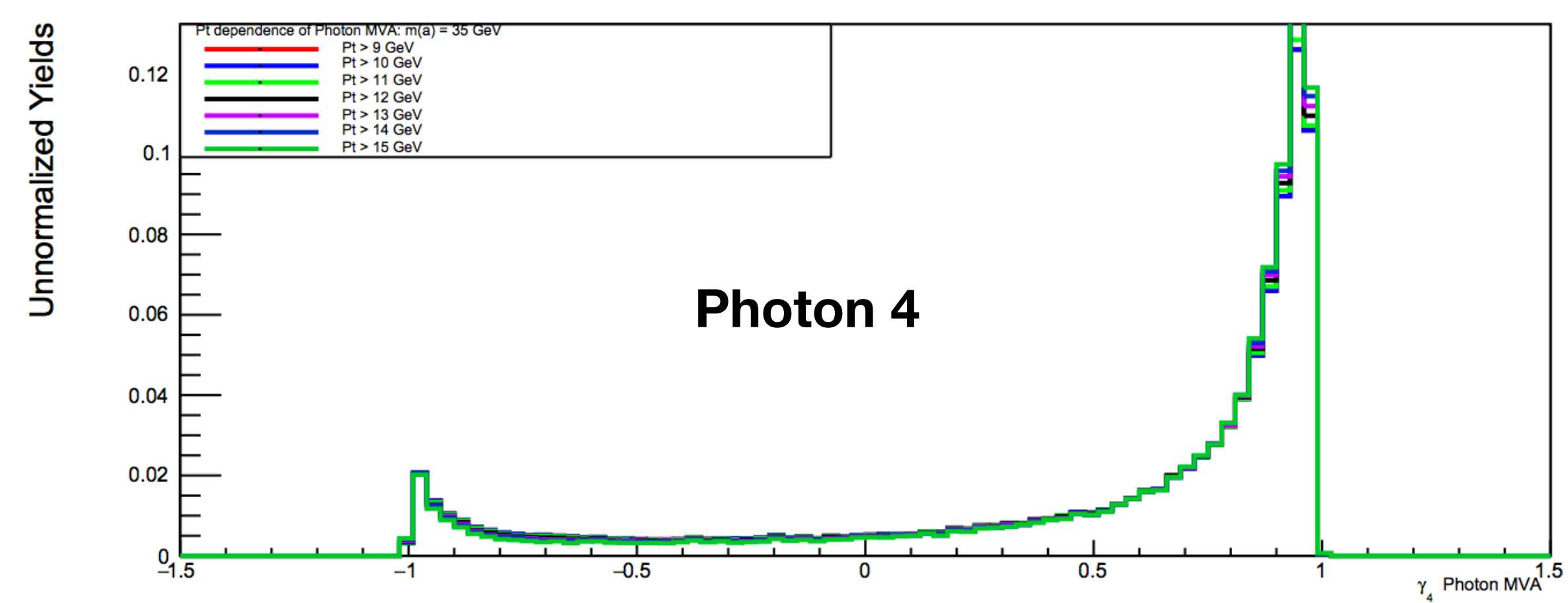
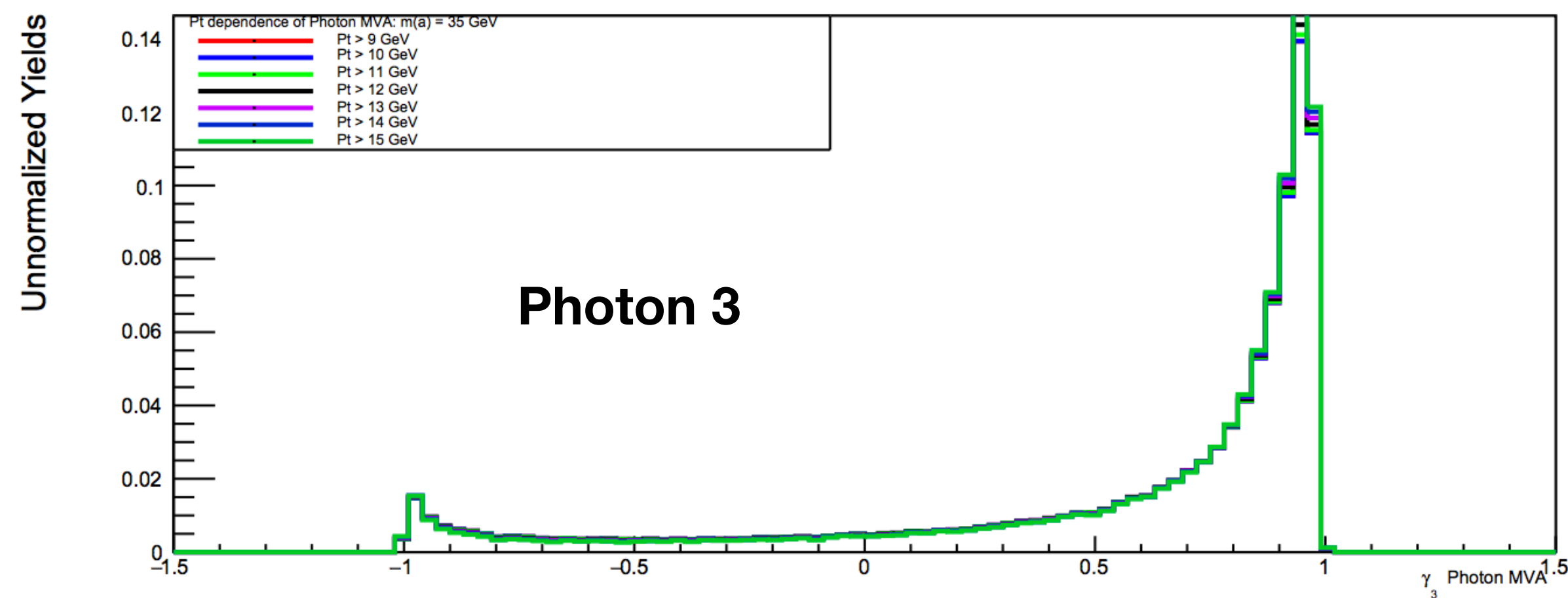
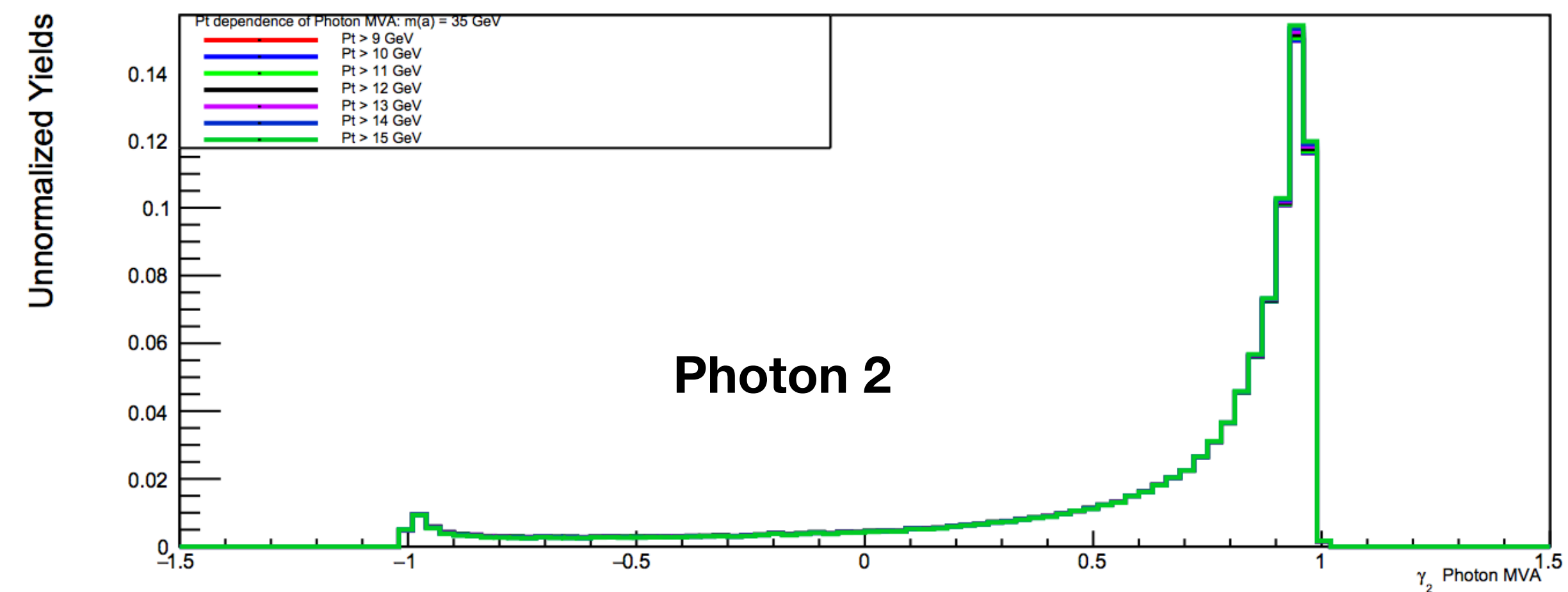
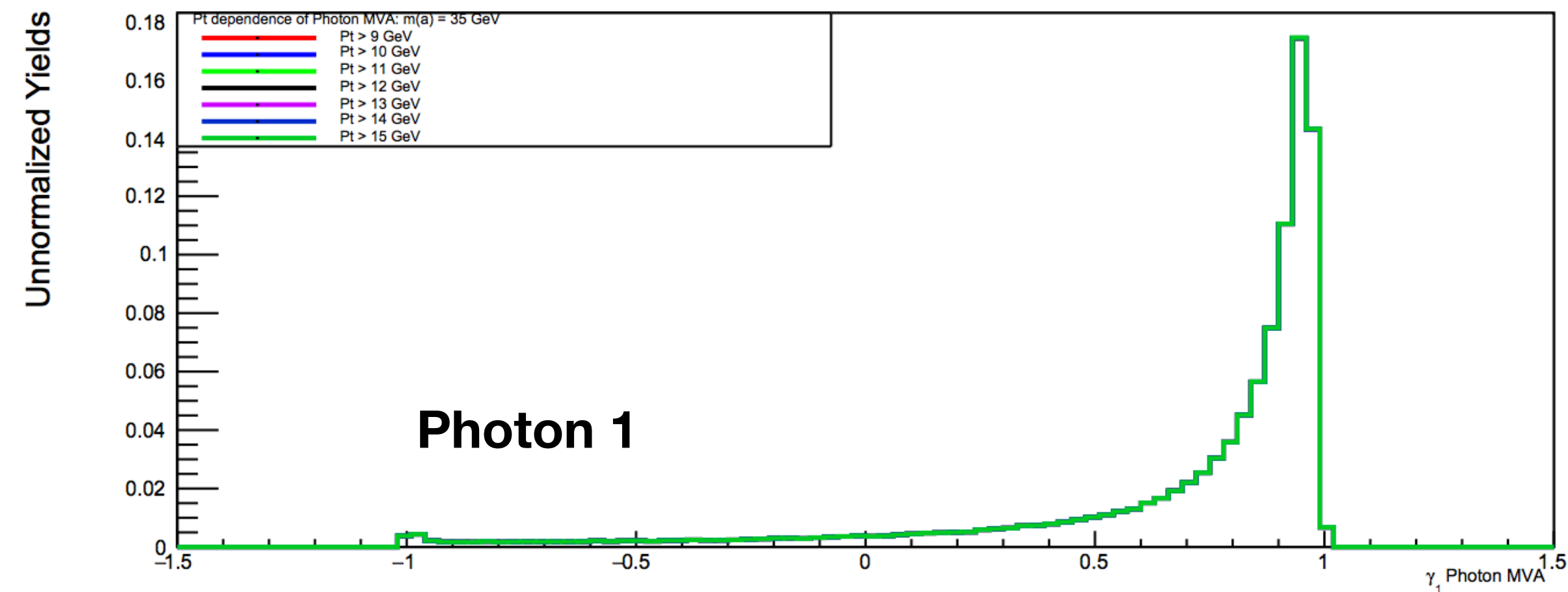


$$m(a) = 60 \text{ GeV}$$



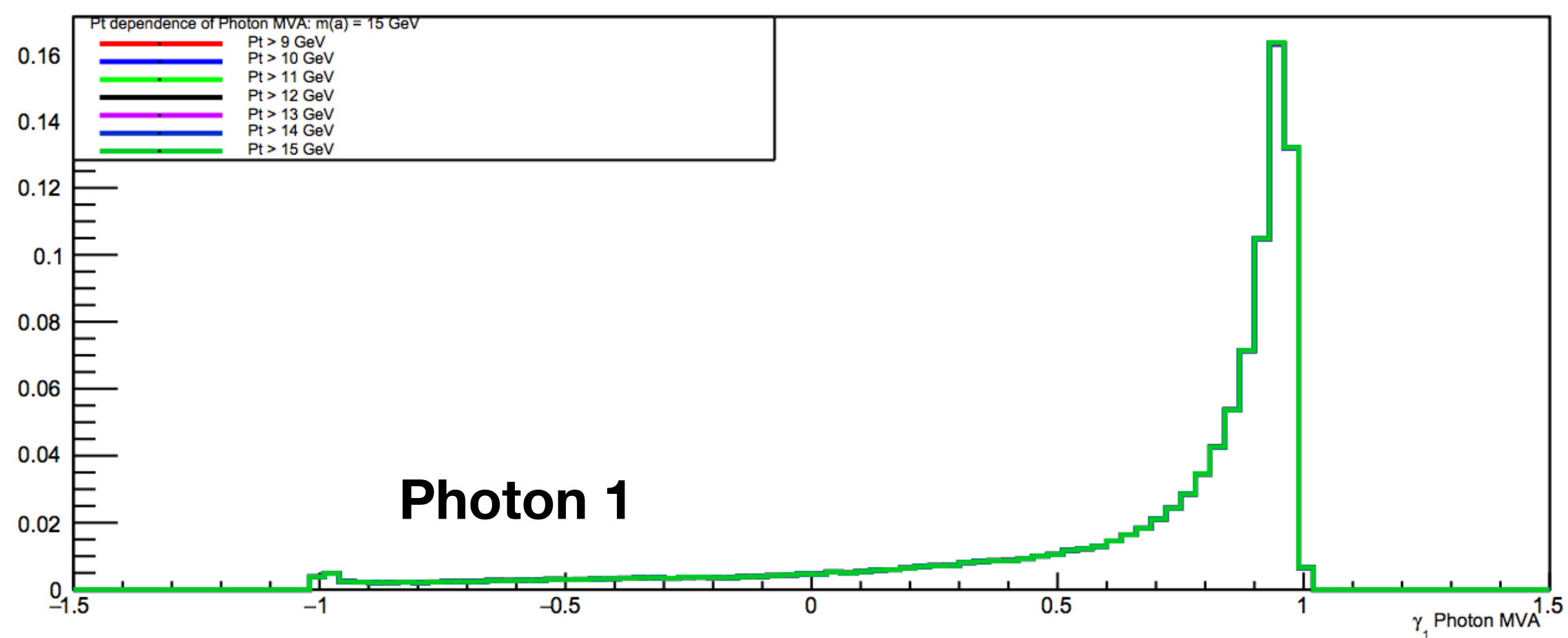


$m(a) = 35 \text{ GeV}$

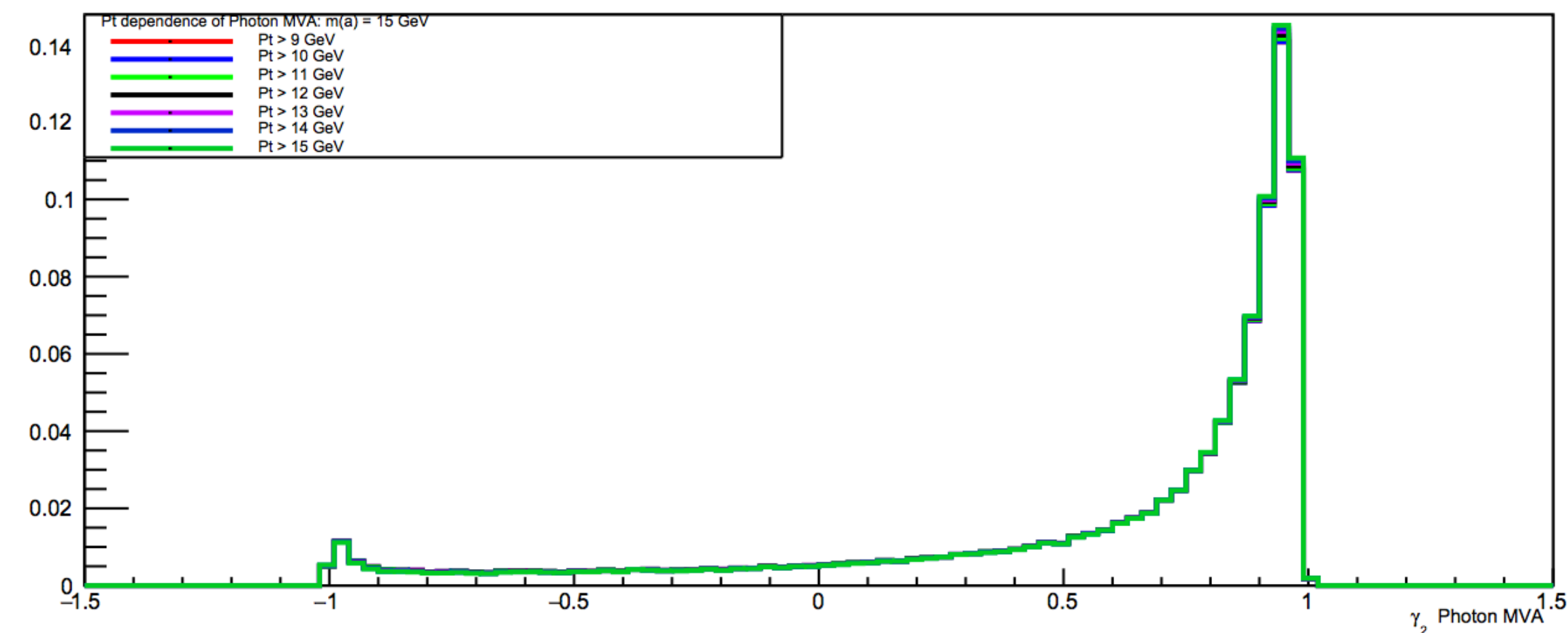


$$m(a) = 15 \text{ GeV}$$

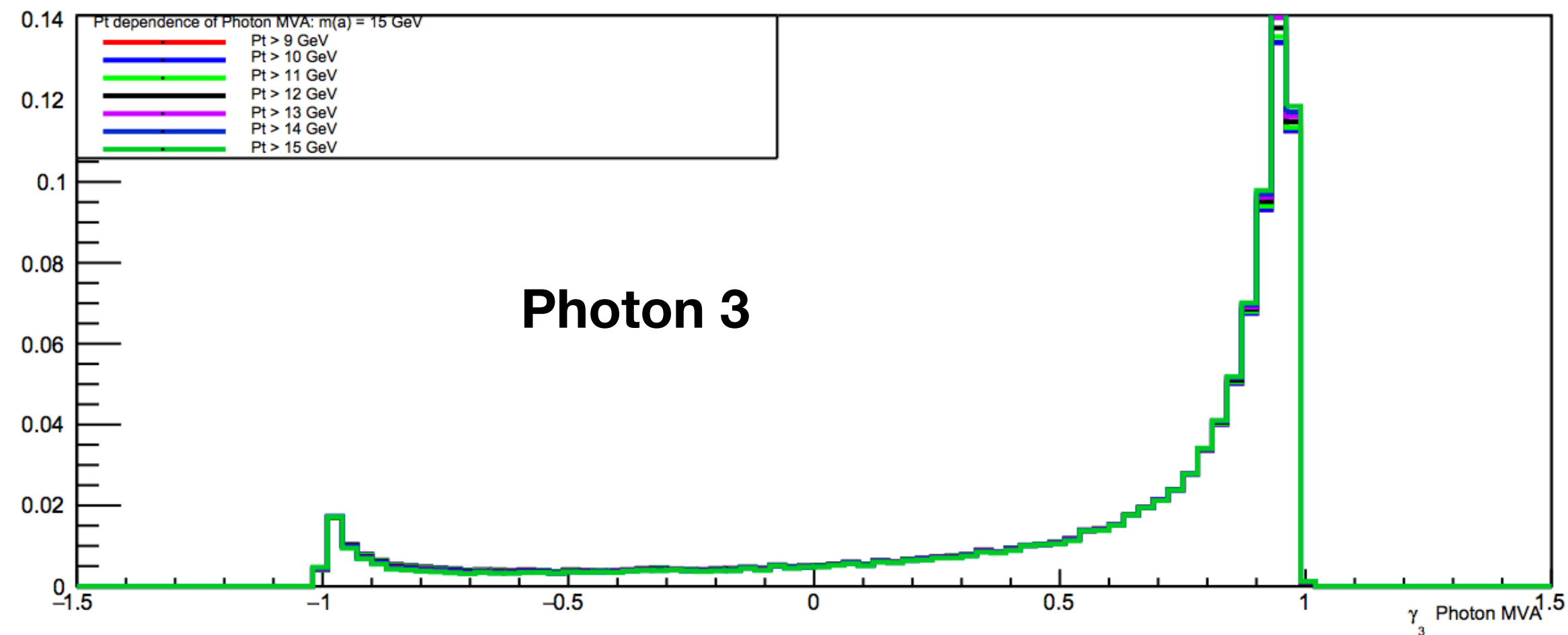
Unnormalized Yields



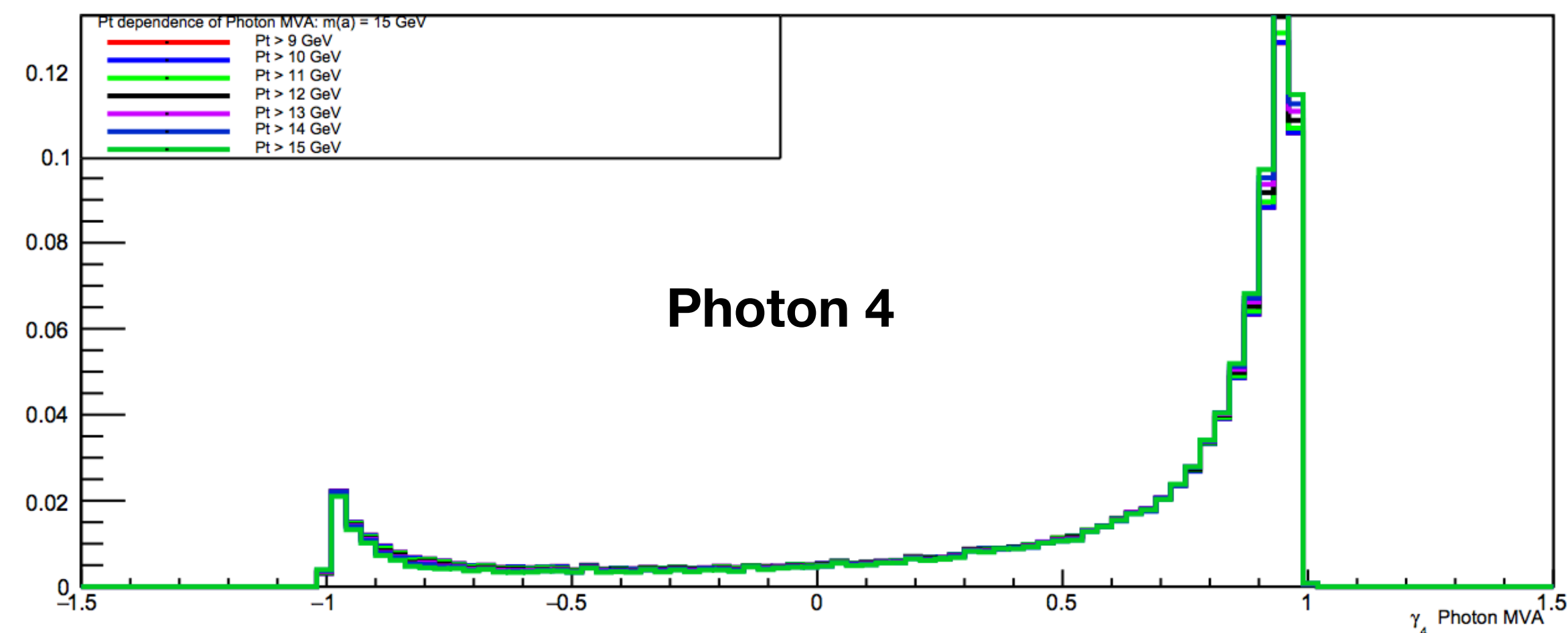
Unnormalized Yields

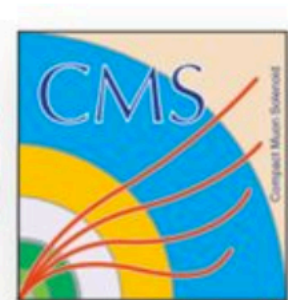


Unnormalized Yields

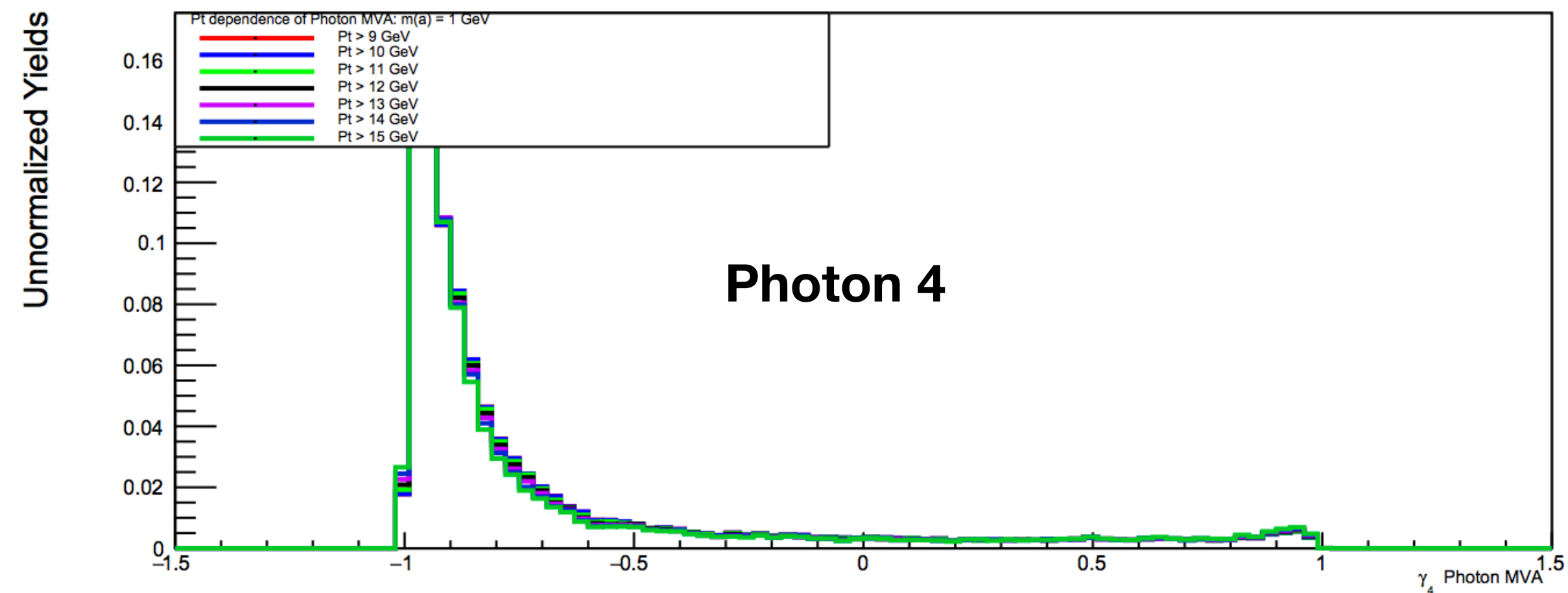
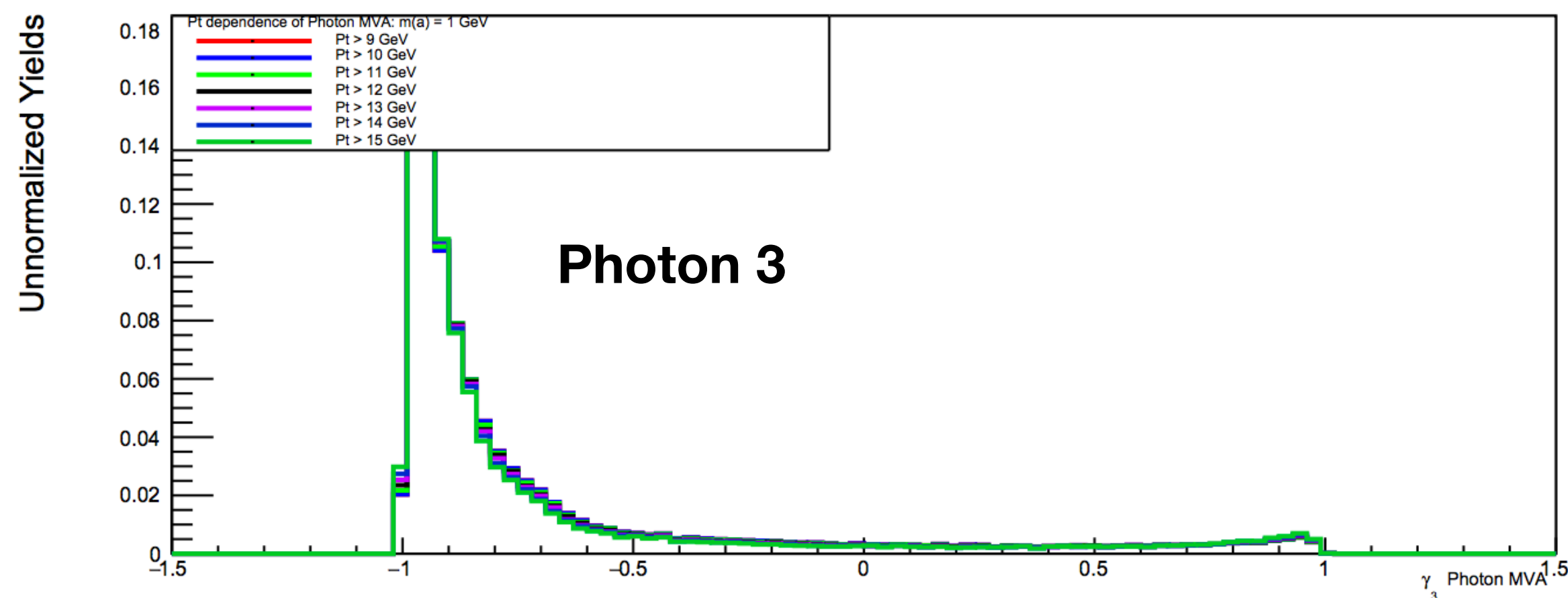
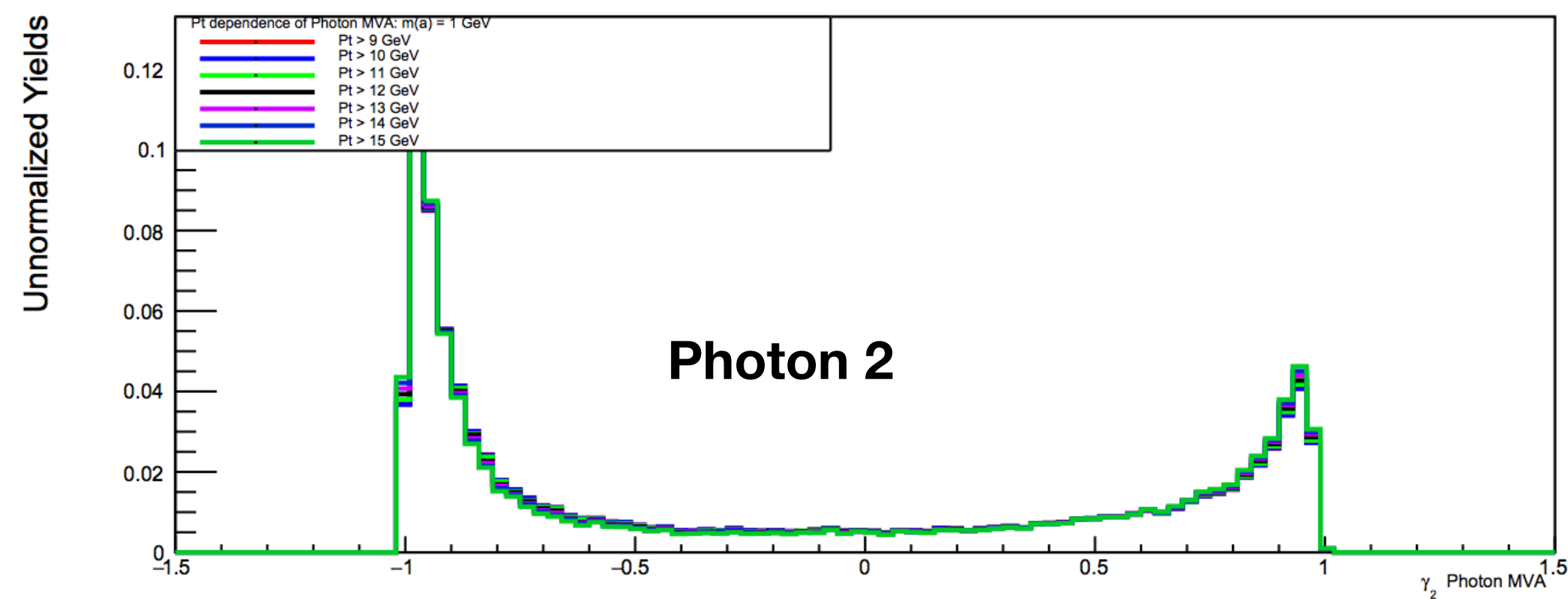
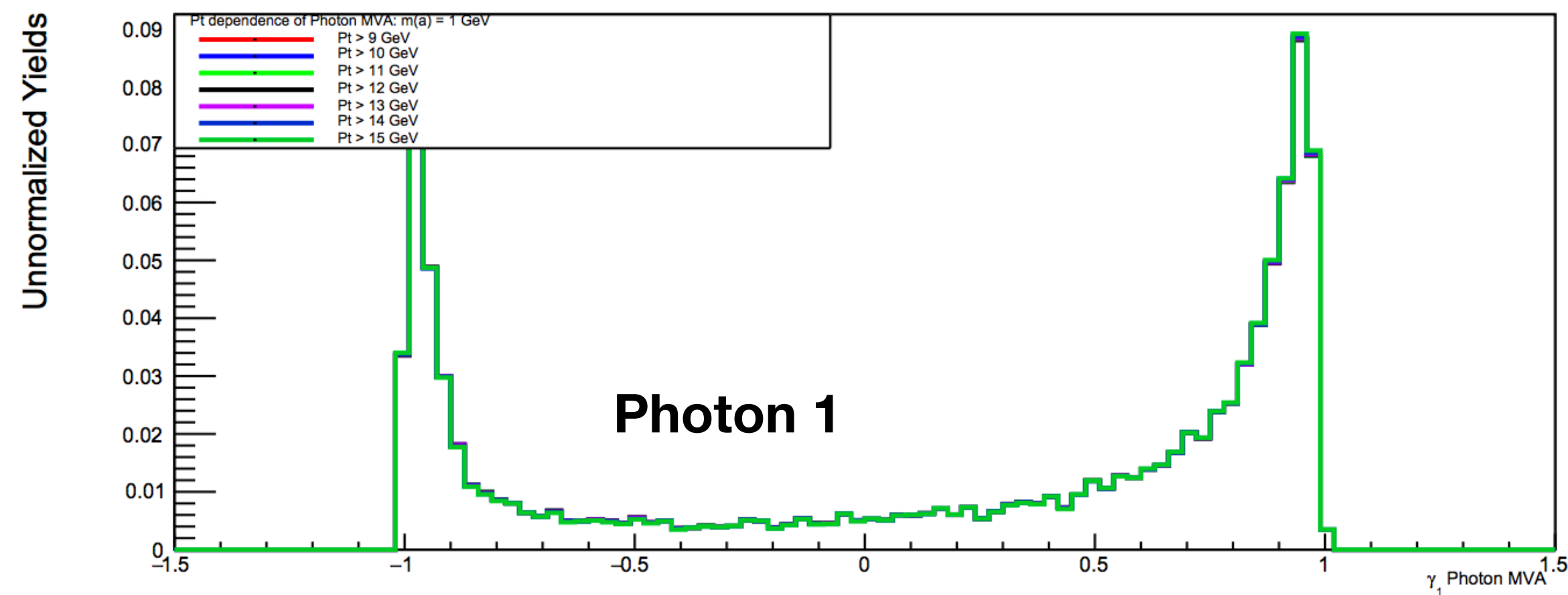


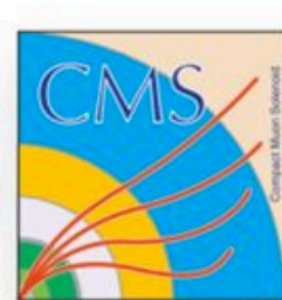
Unnormalized Yields



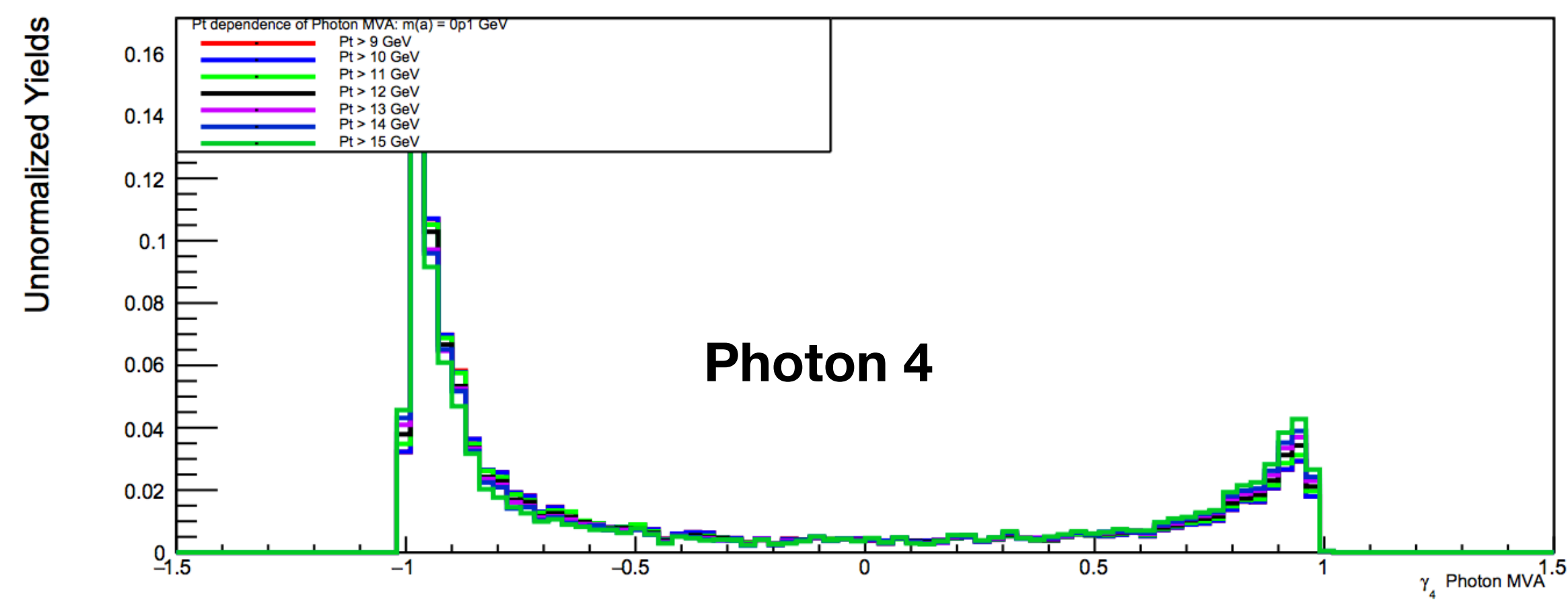
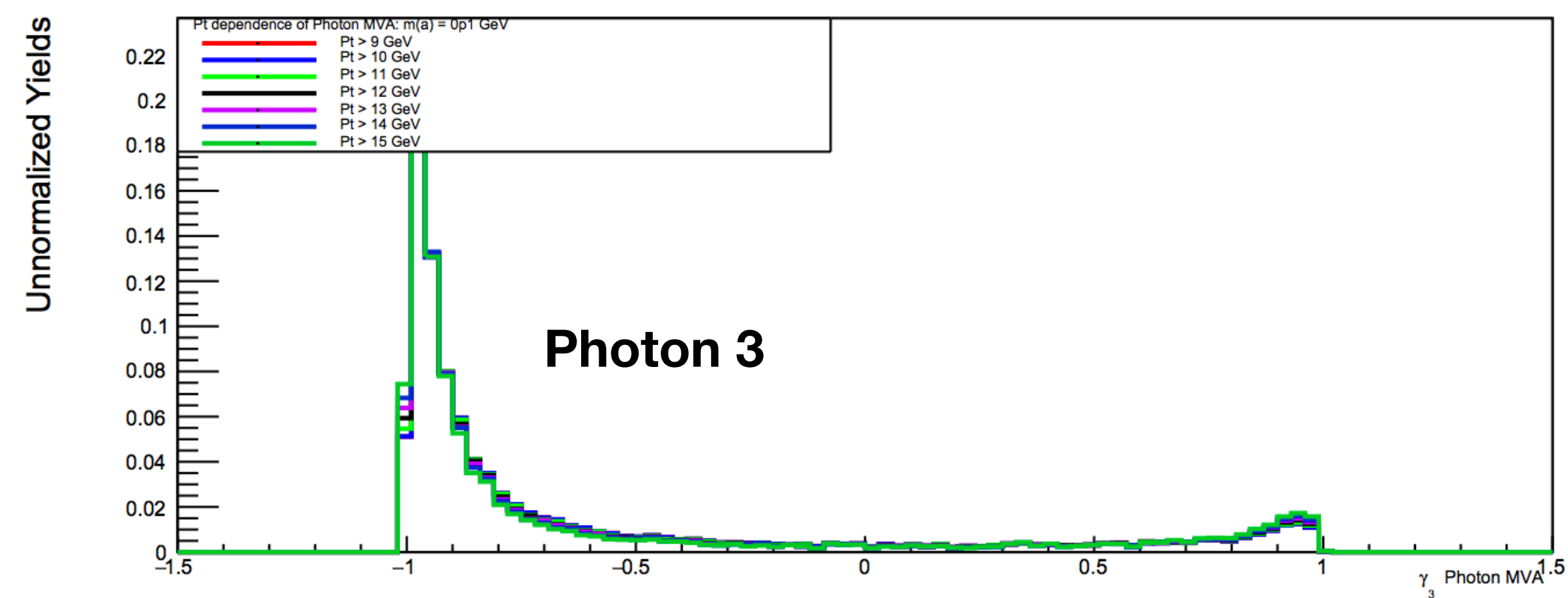
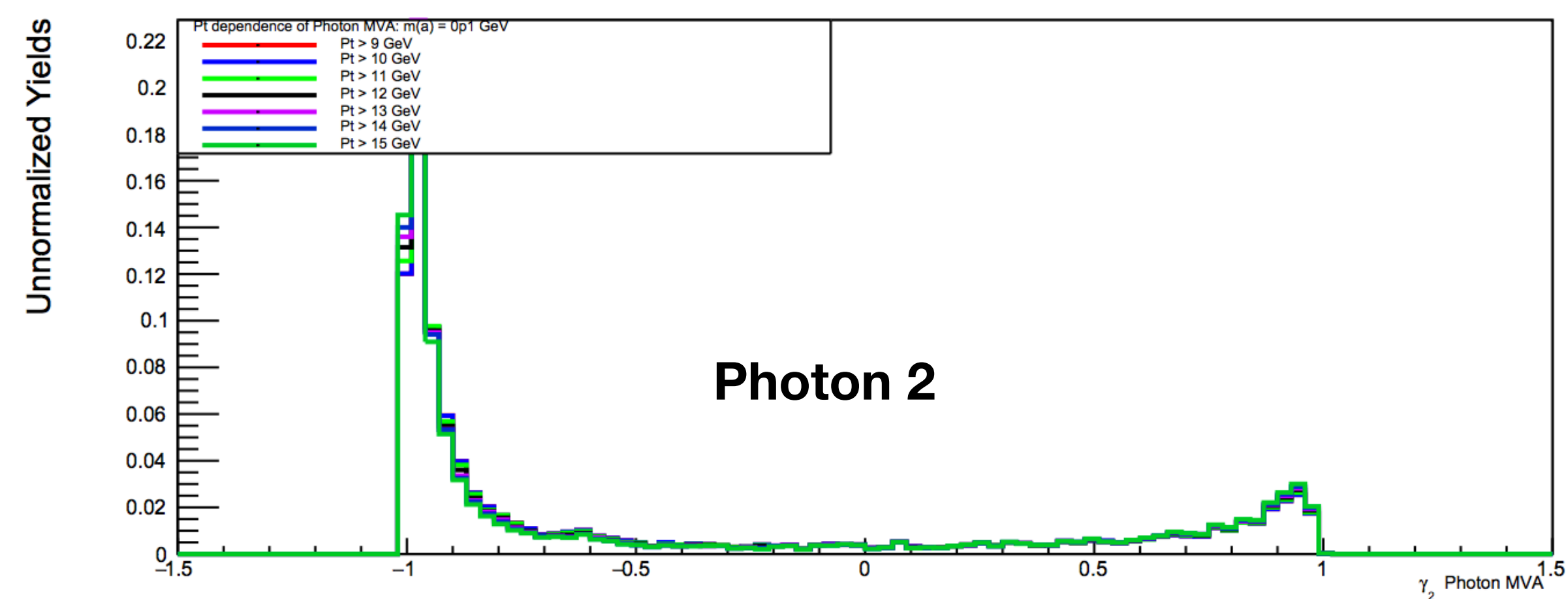
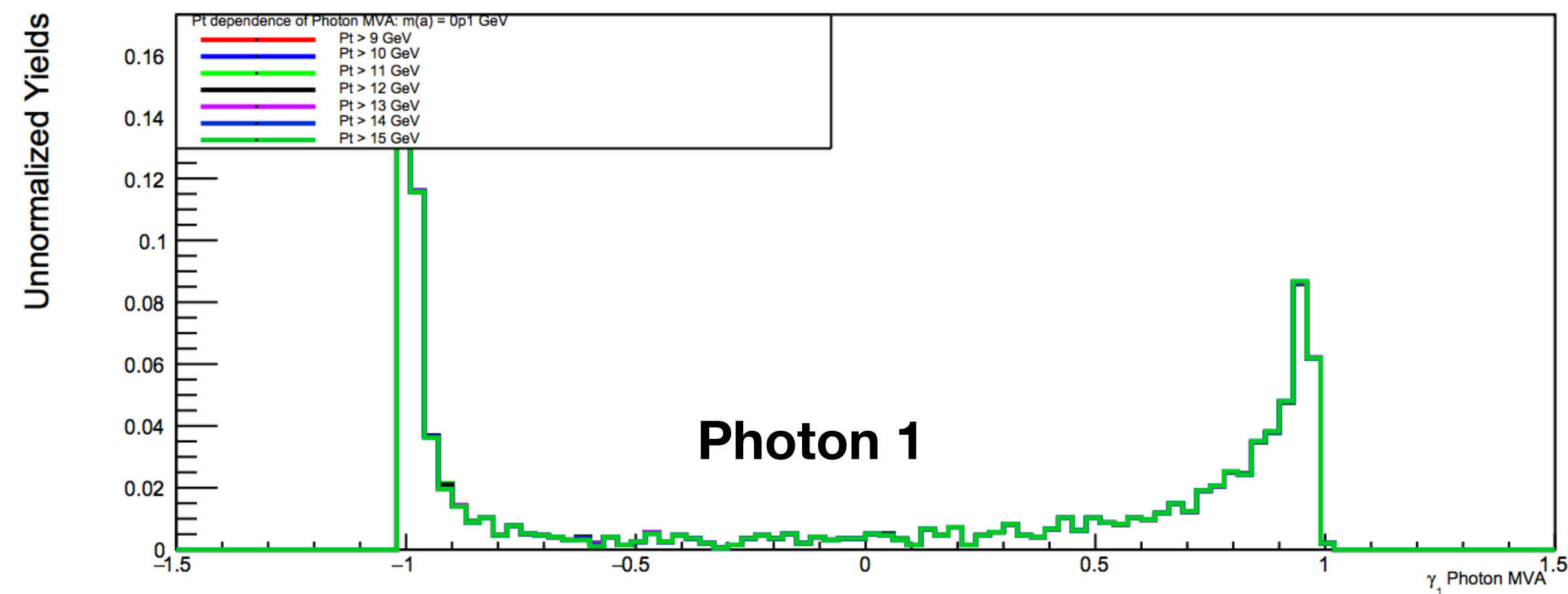


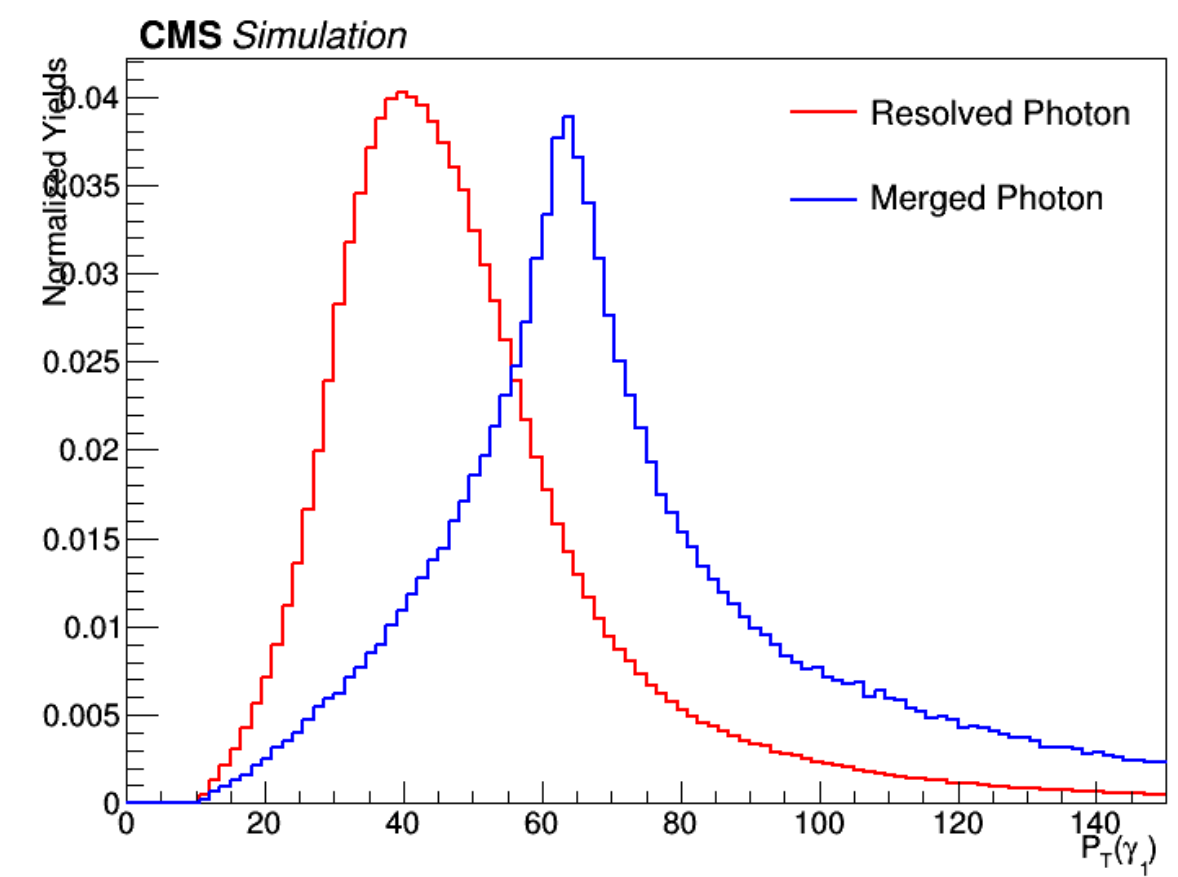
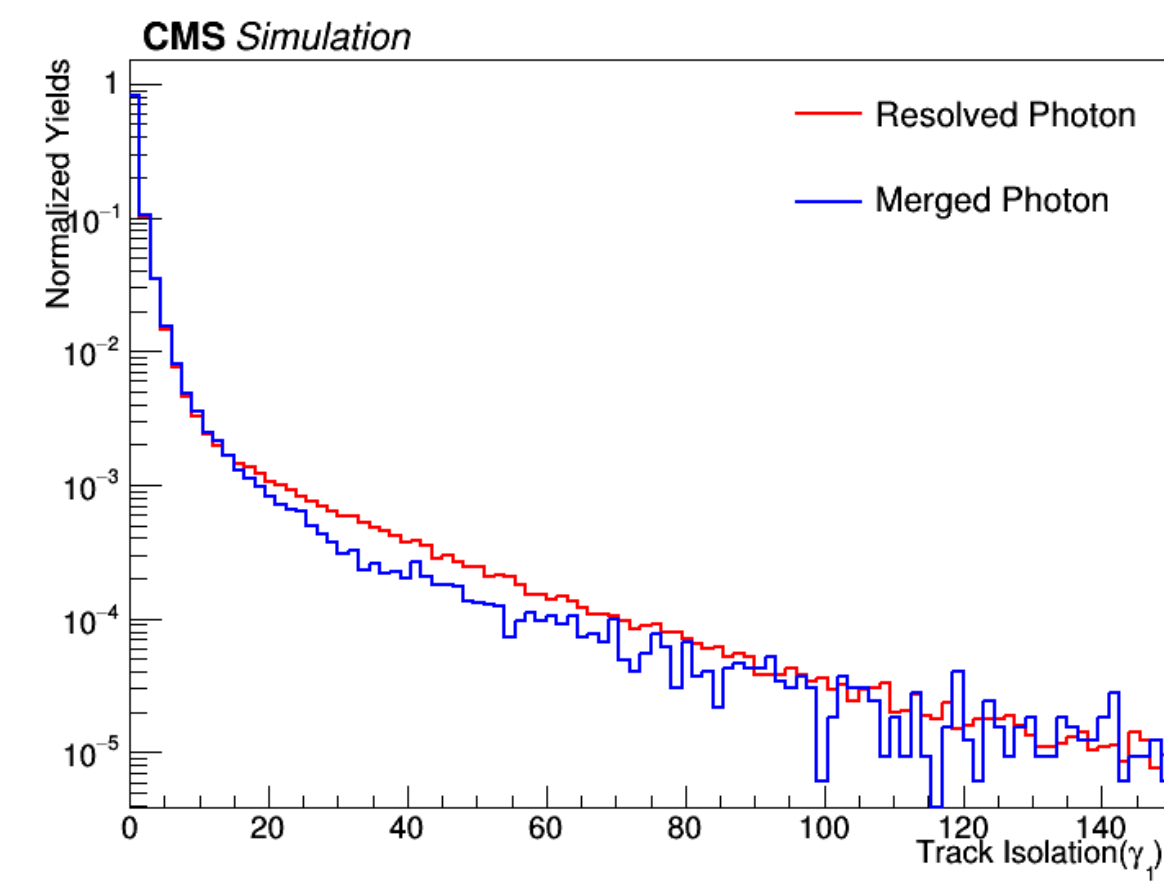
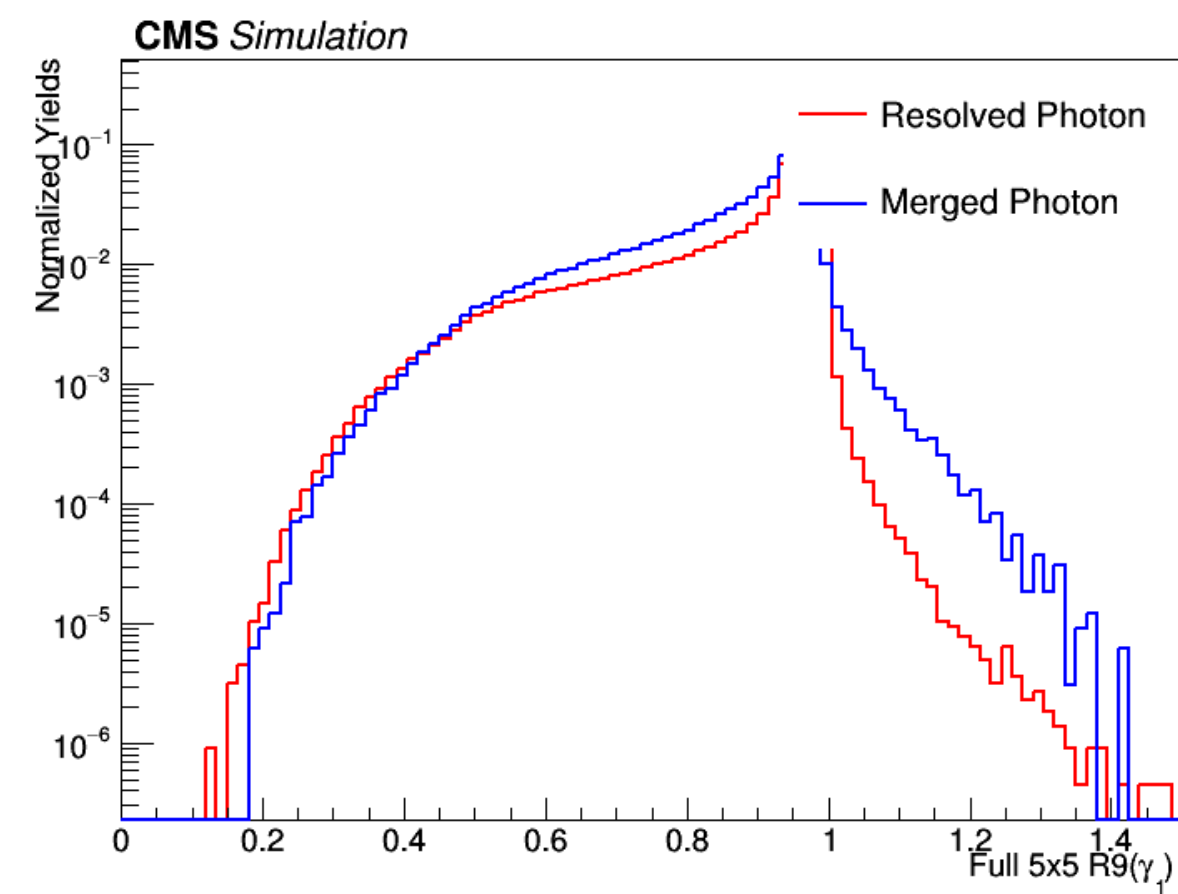
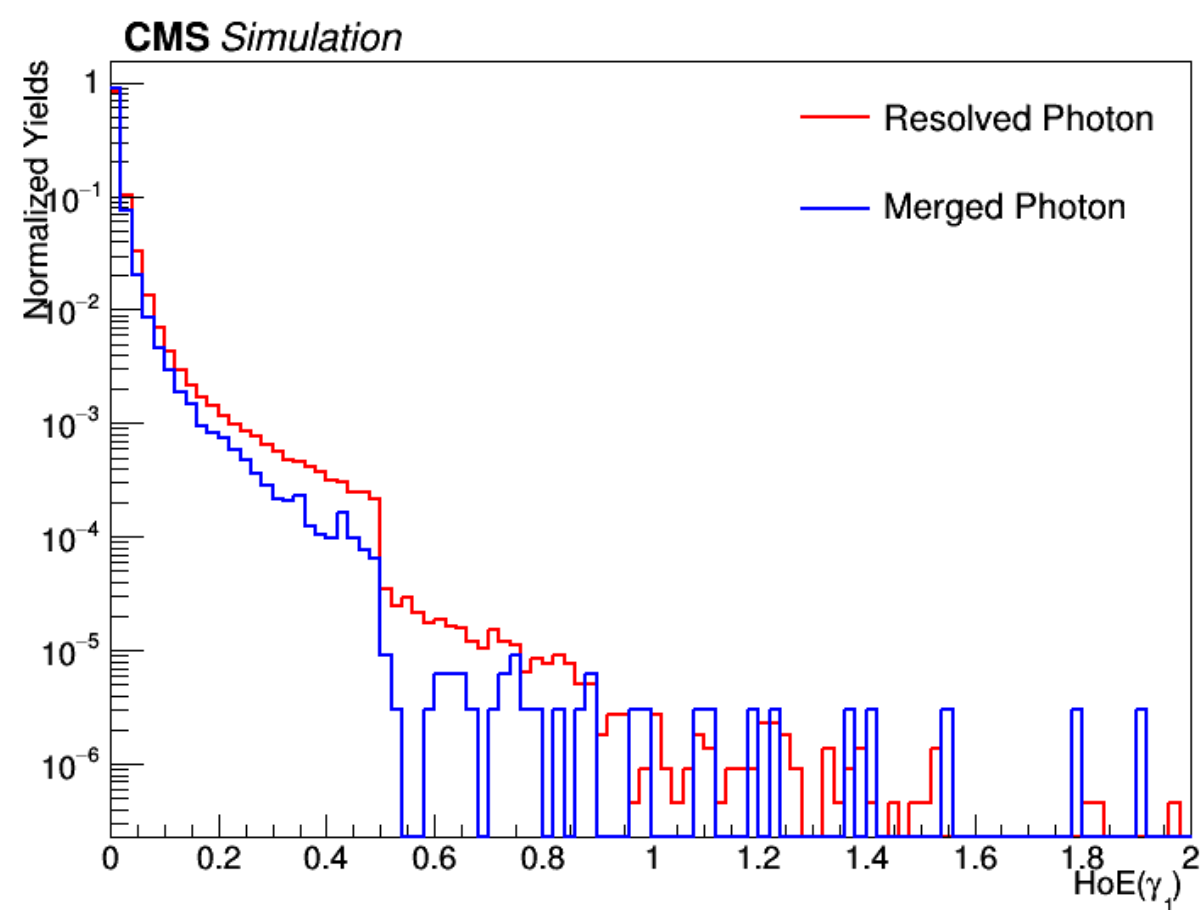
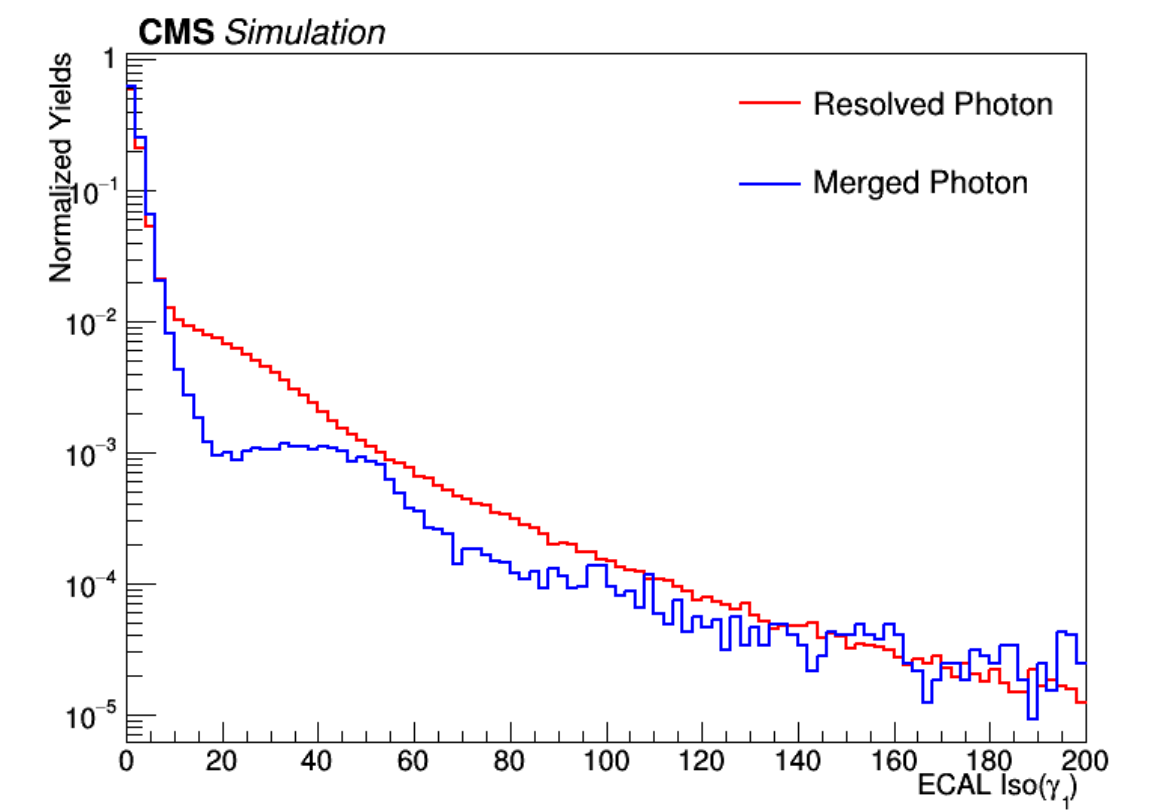
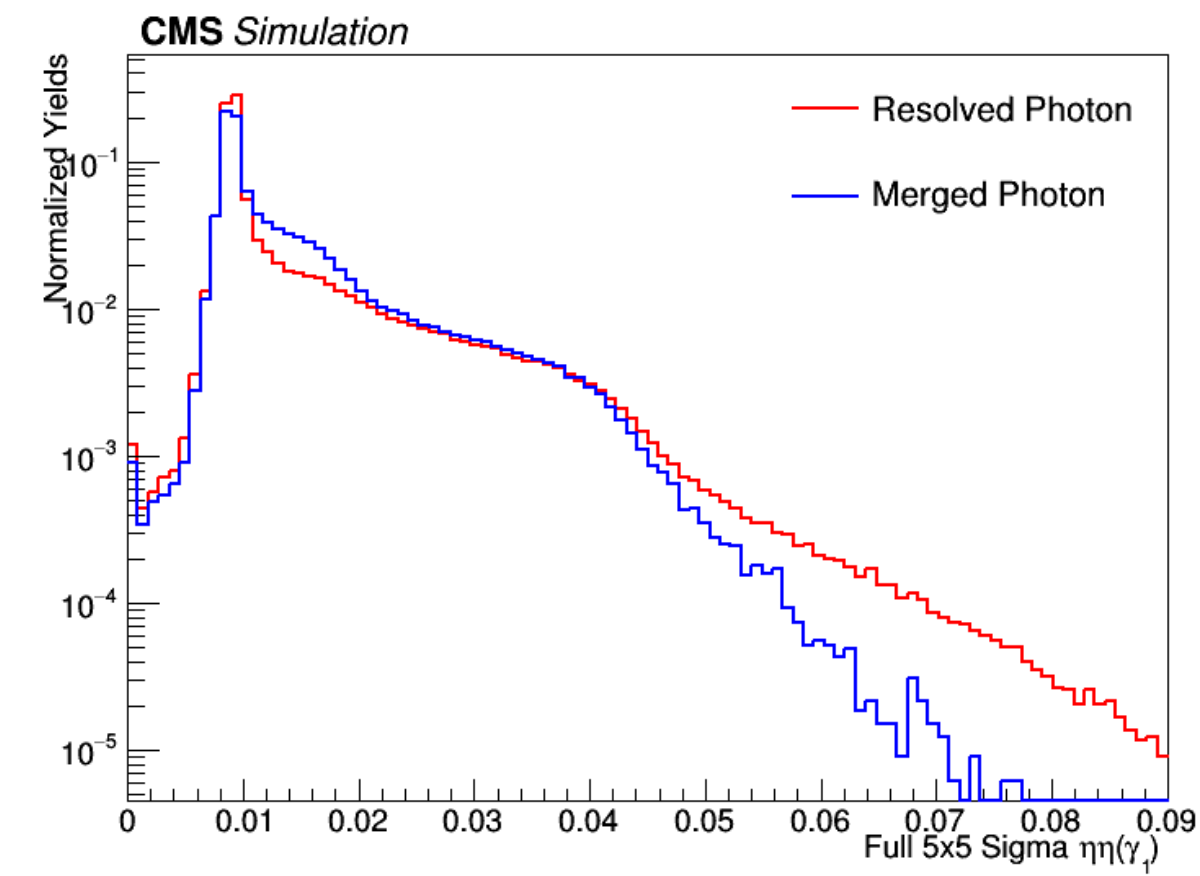
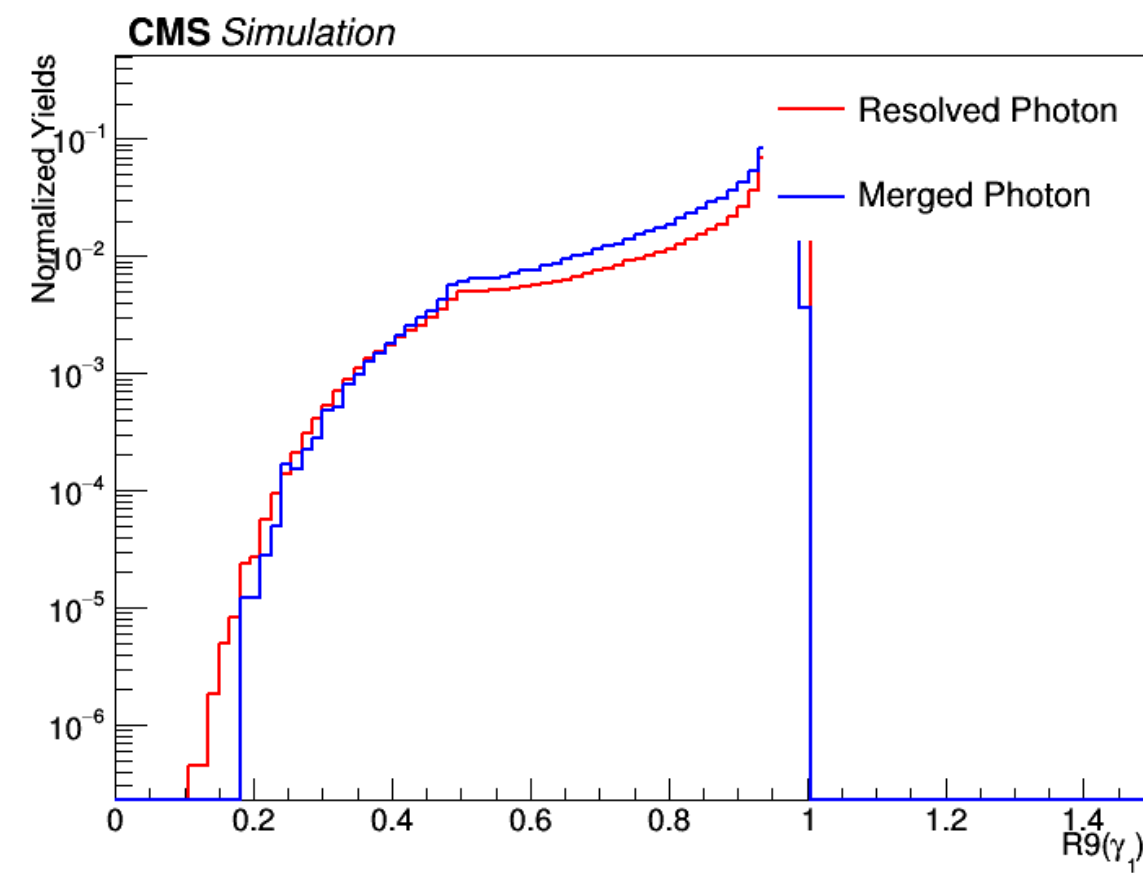
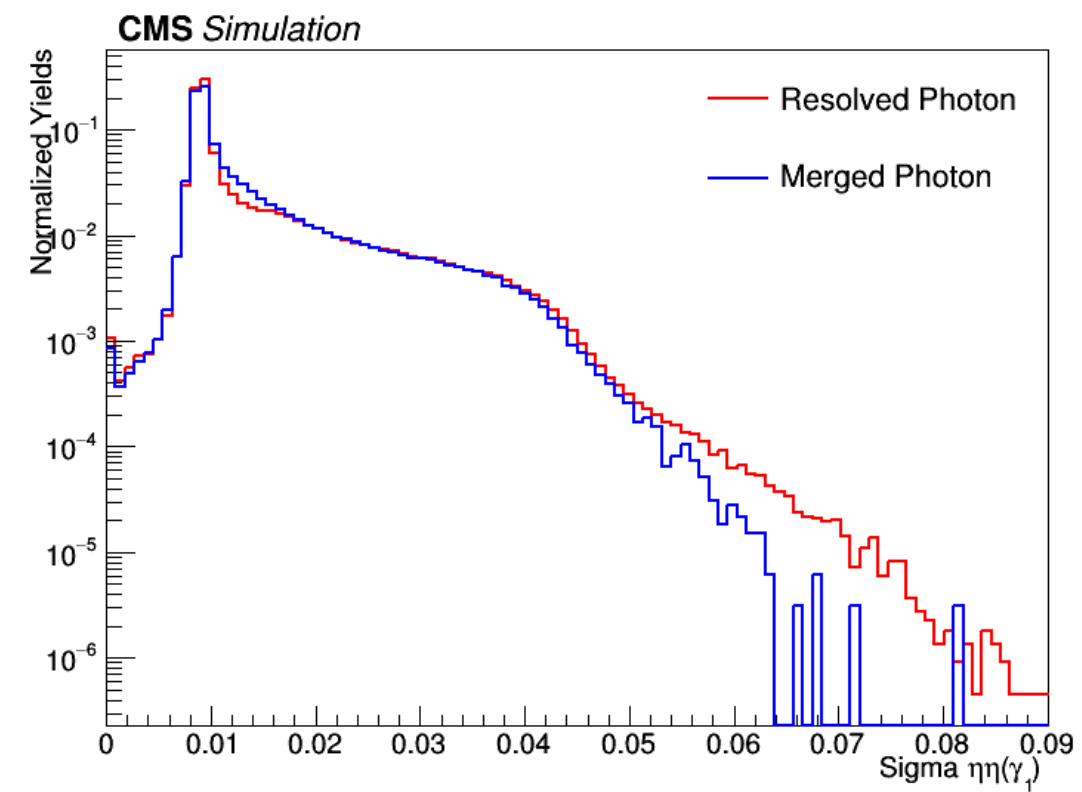
$$m(a) = 1 \text{ GeV}$$

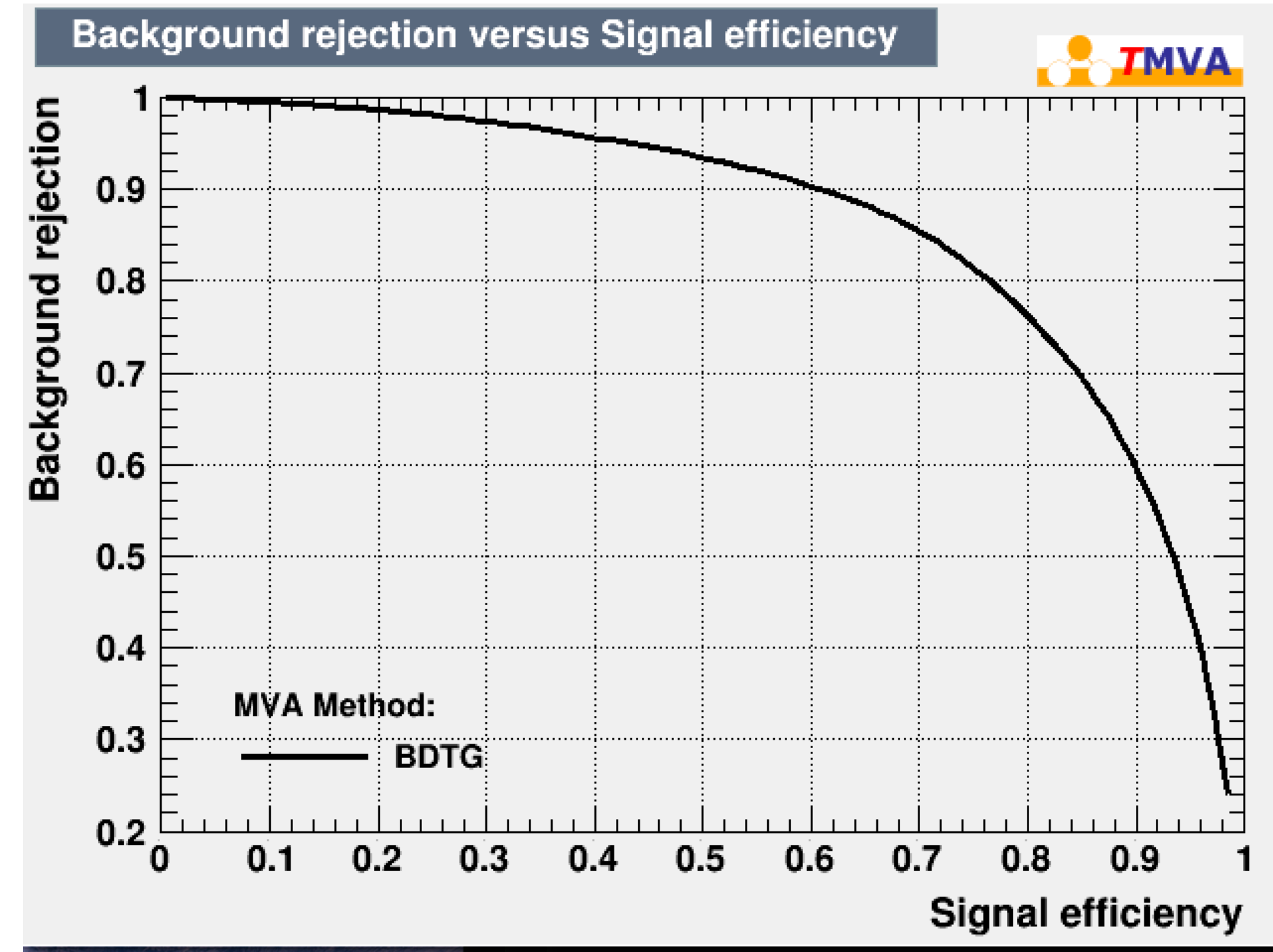
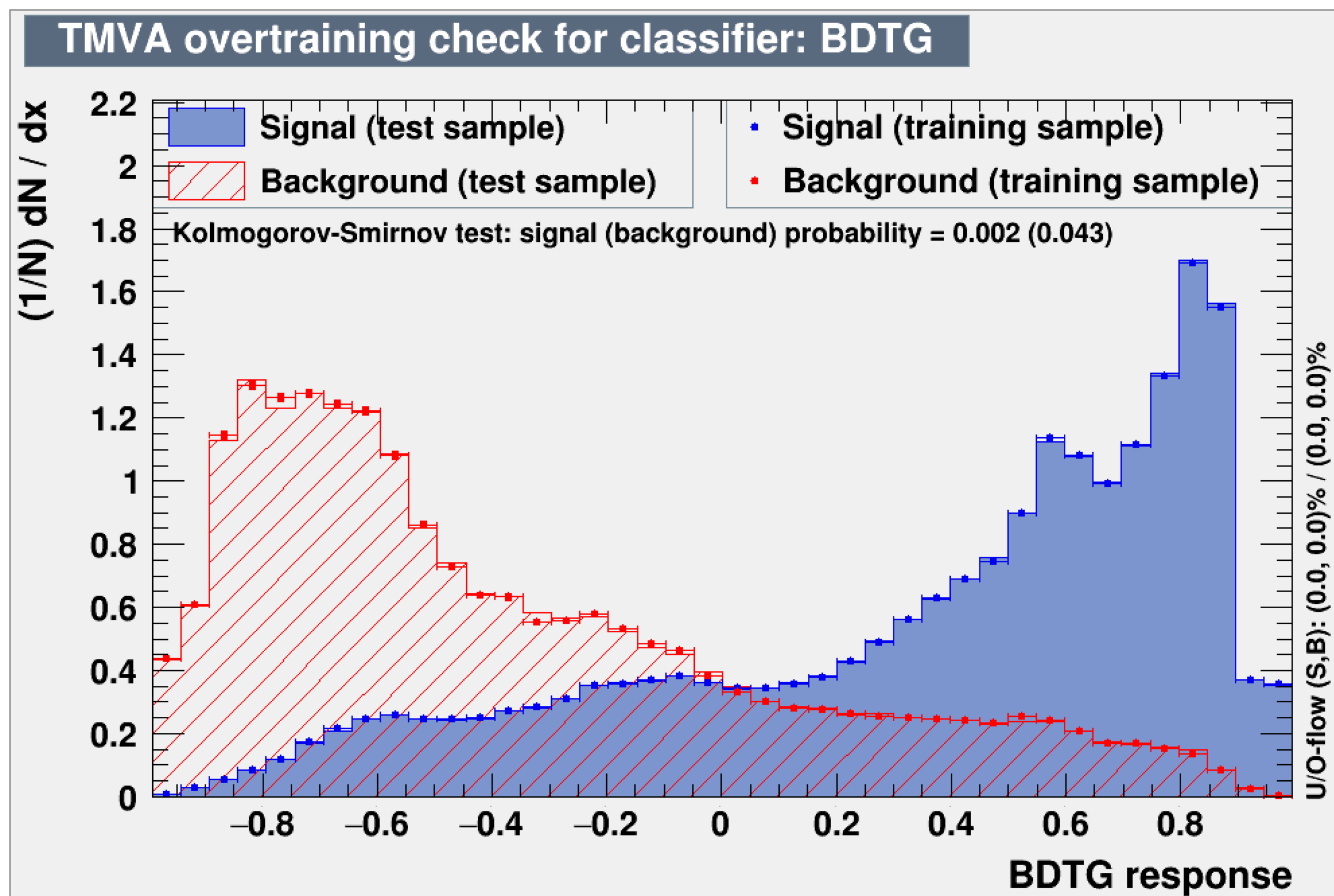




$$m(a) = 0.1 \text{ GeV}$$

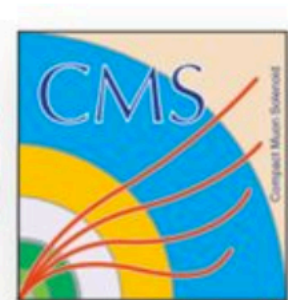








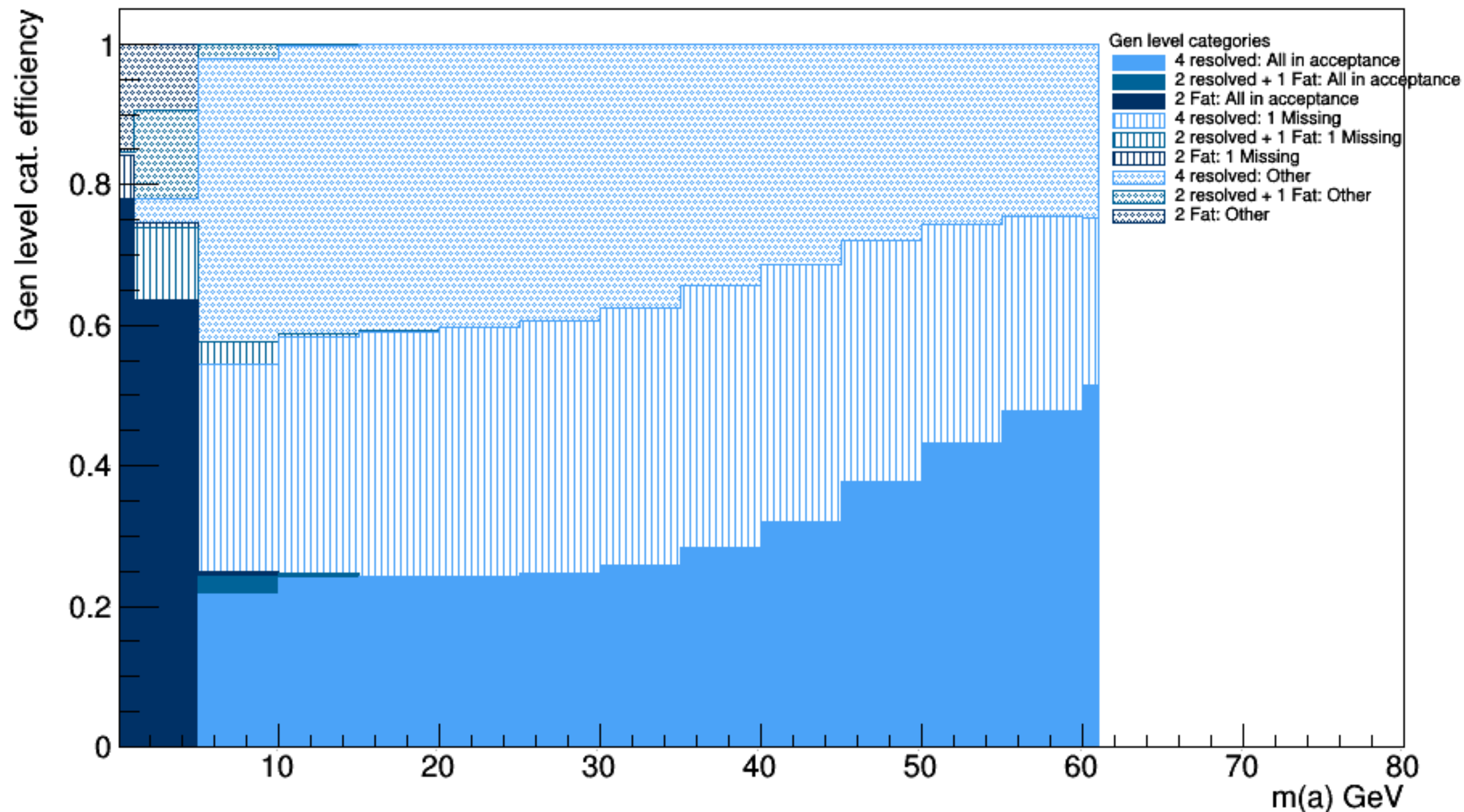
Backup - older slides



Merged photon definition: $dR < 0.1$ (old value was 0.3)

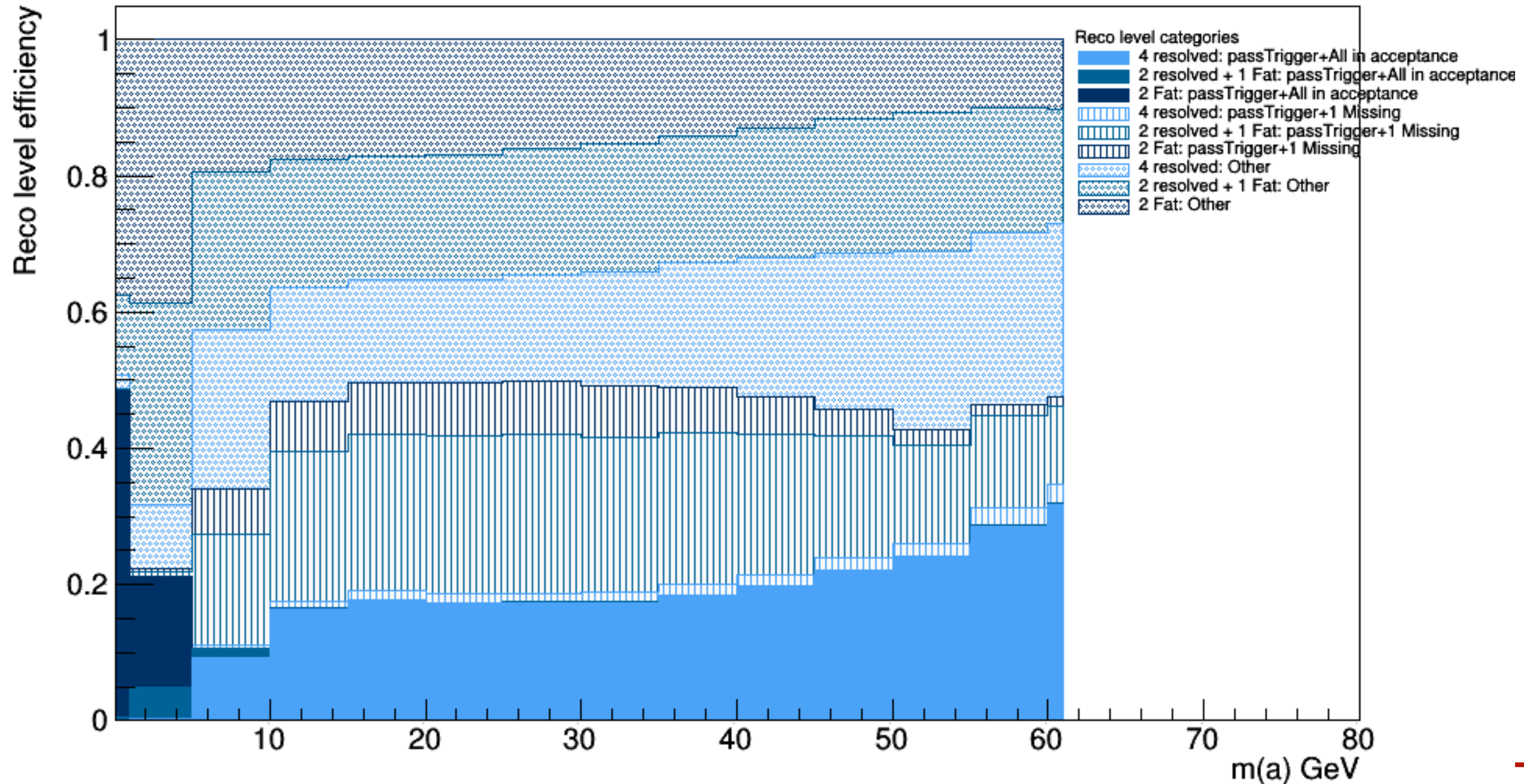
- $abs(eta) < 2.5$
- Photon1 Pt > 30
- Photon2 Pt > 18
- Photon3 Pt > 10
- Photon4 Pt > 10

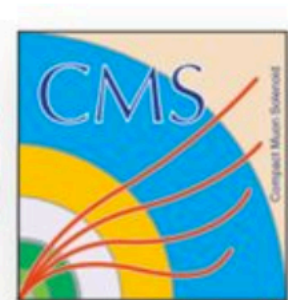
Gen level categorization



For matching:
Require $\Delta R(\text{Reco}, \text{Gen}) < 0.3$ (old value was 0.1)

Reco level categorization

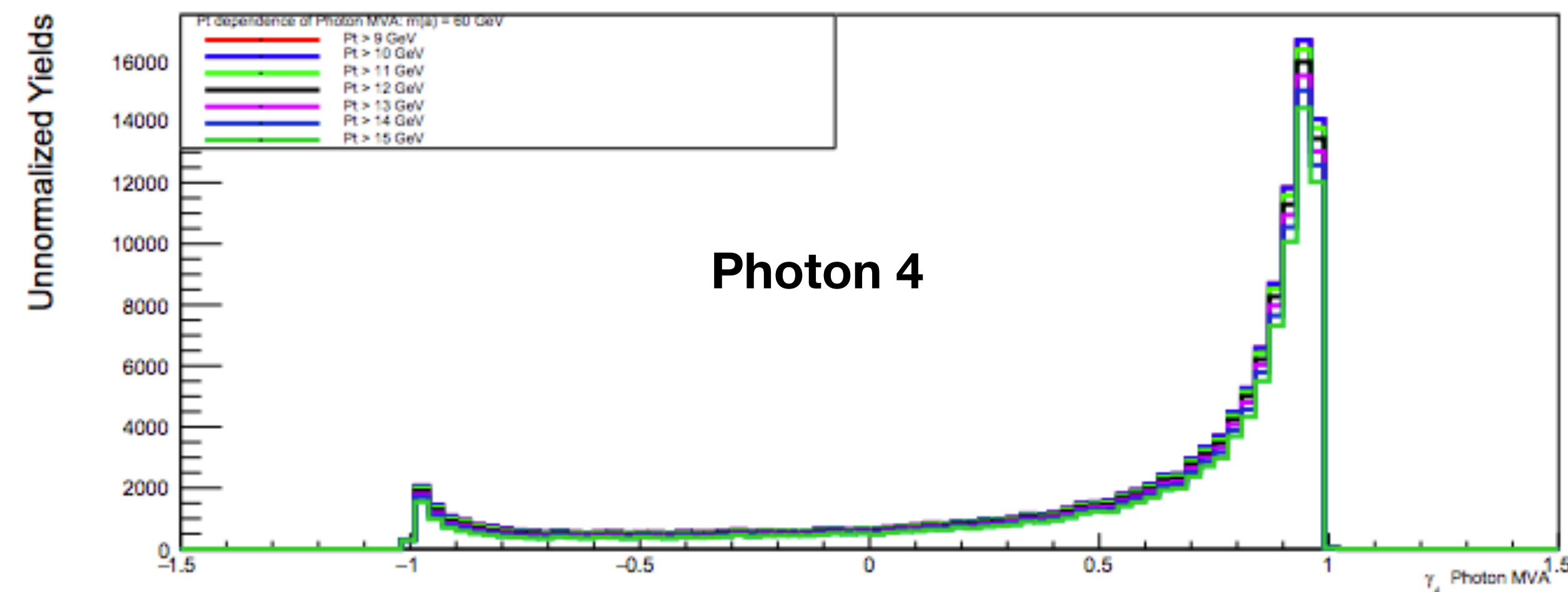
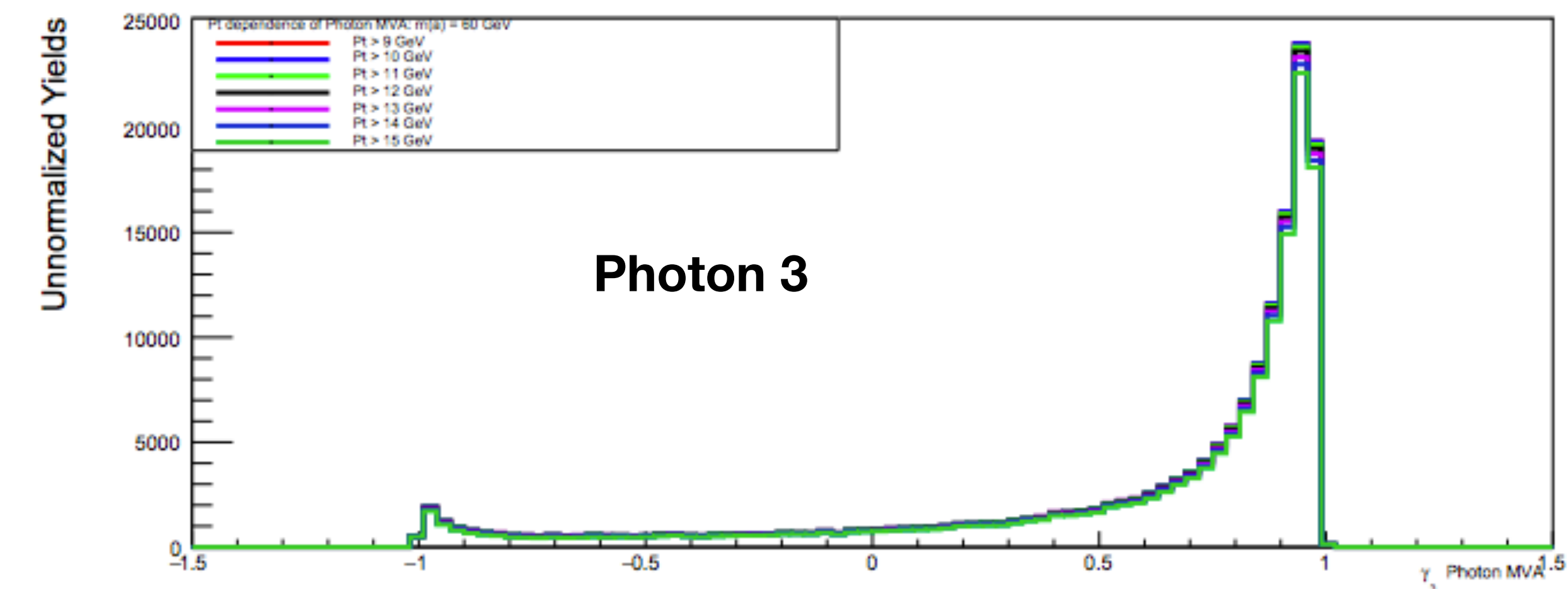
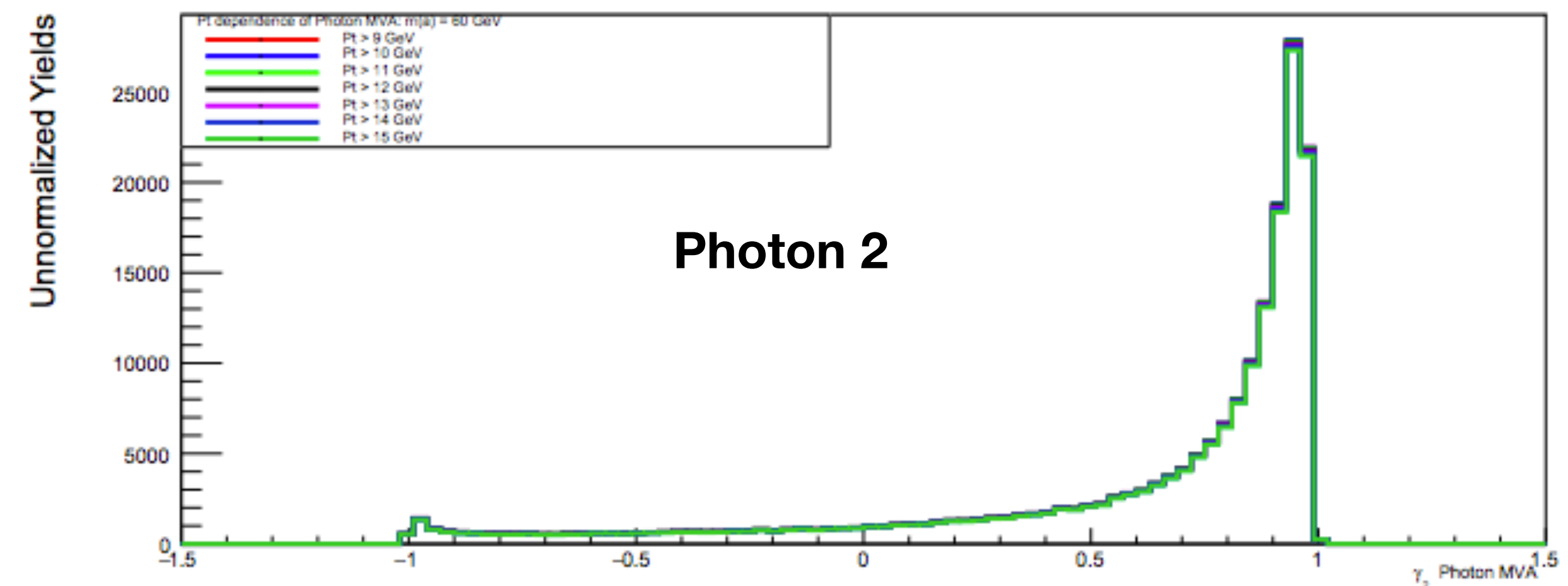
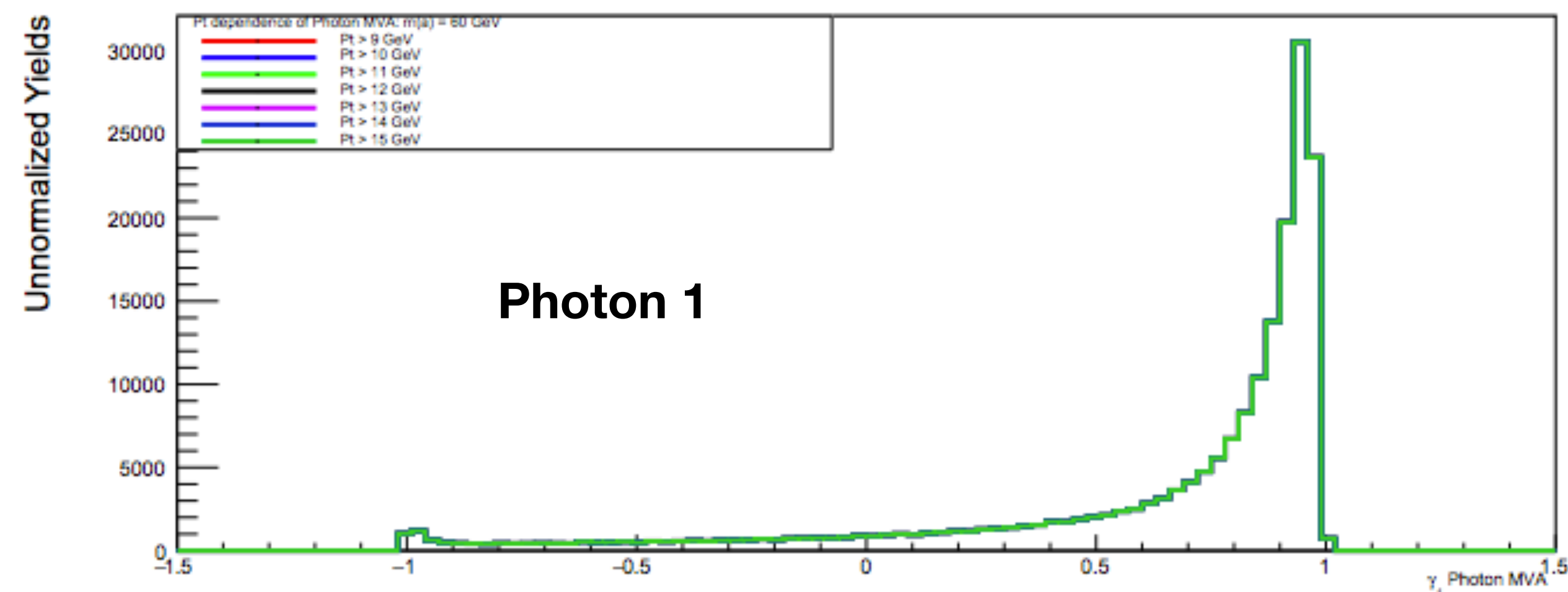




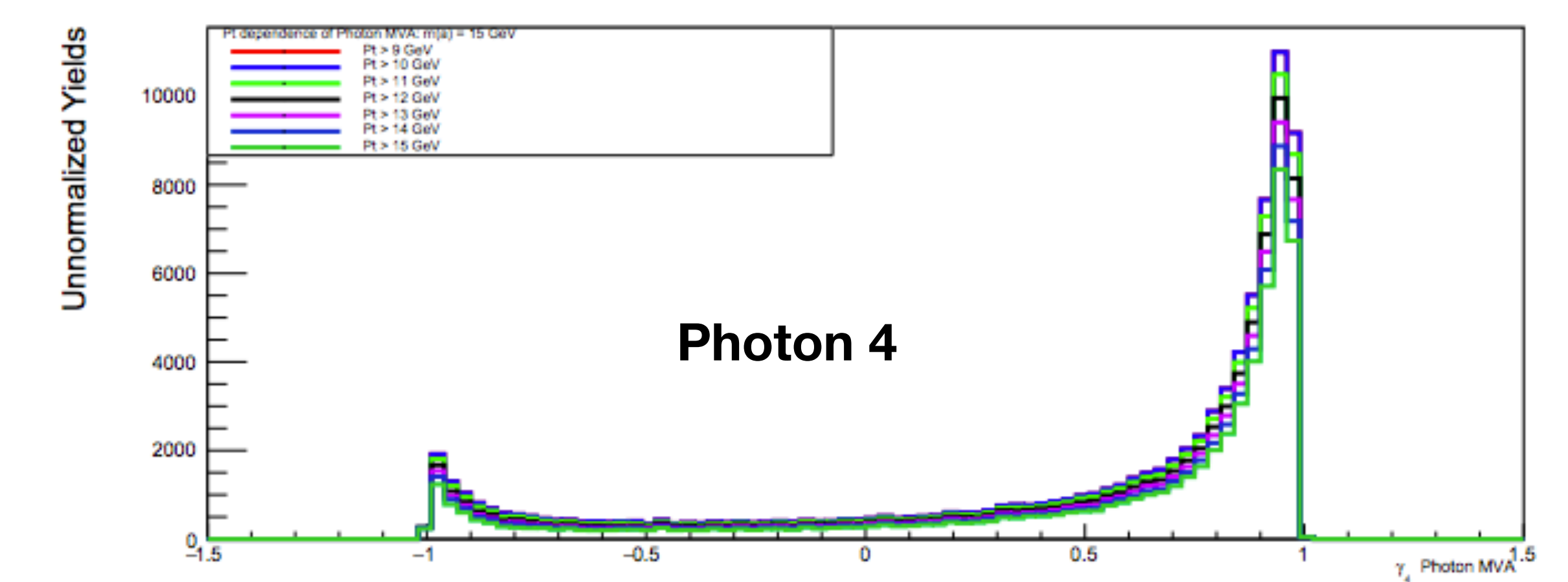
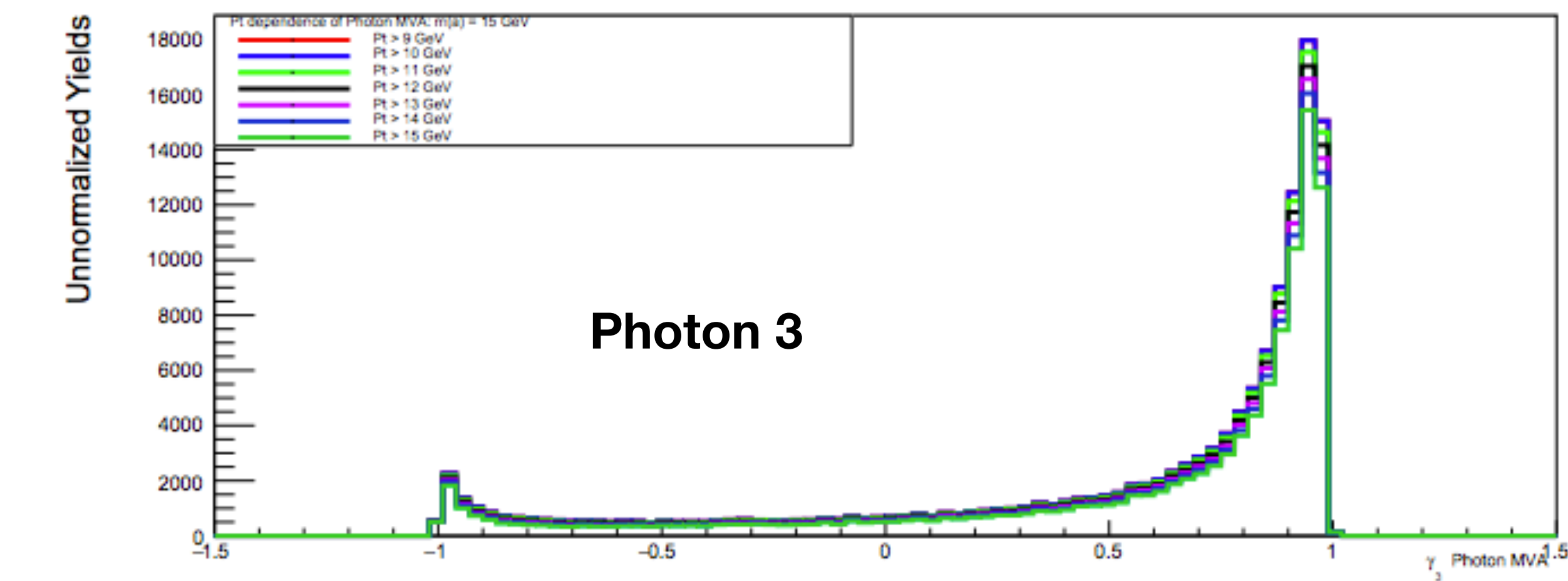
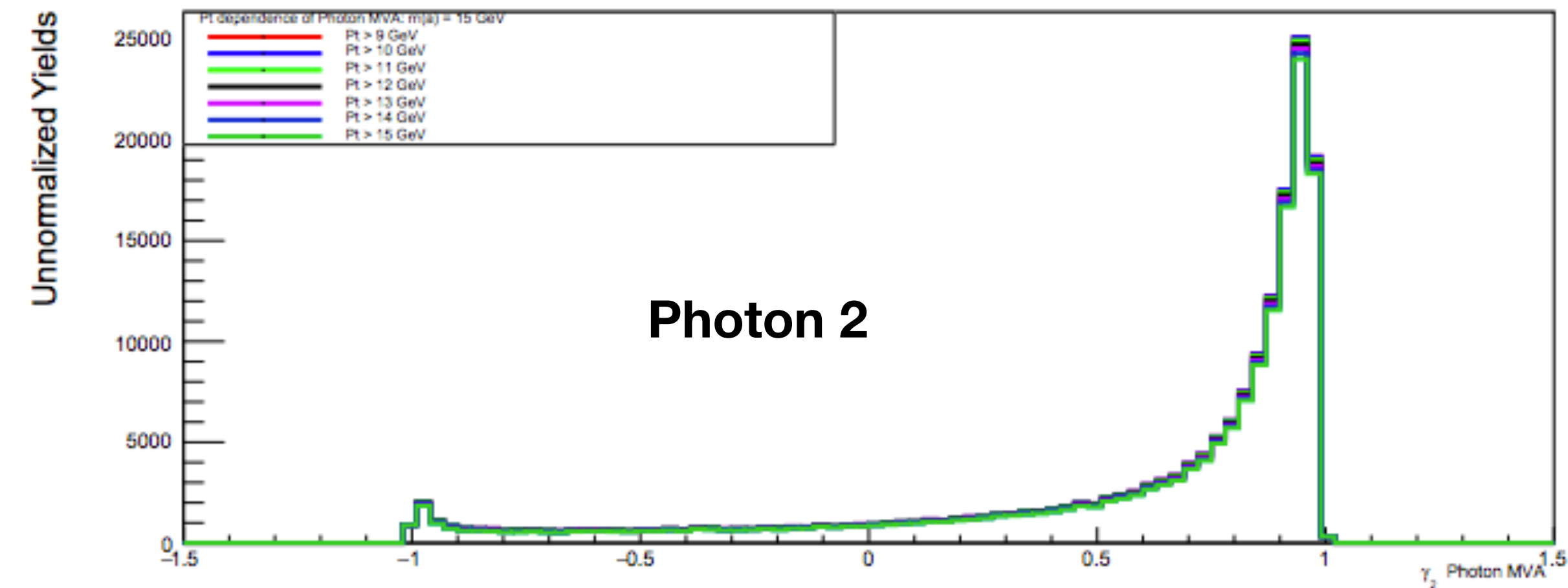
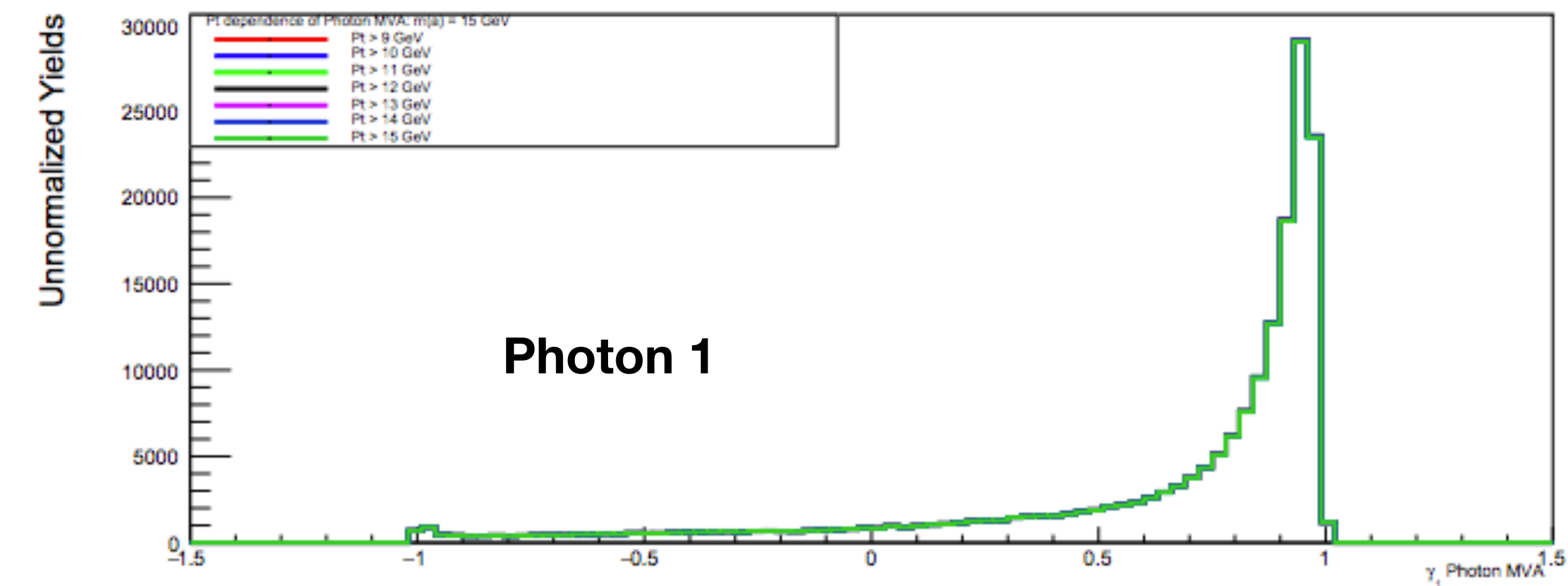
Pt dependence of Photon MVA ID

Plotted here are the Photon MVA ID values for photons for different Pt values (so selection applied on the photon)

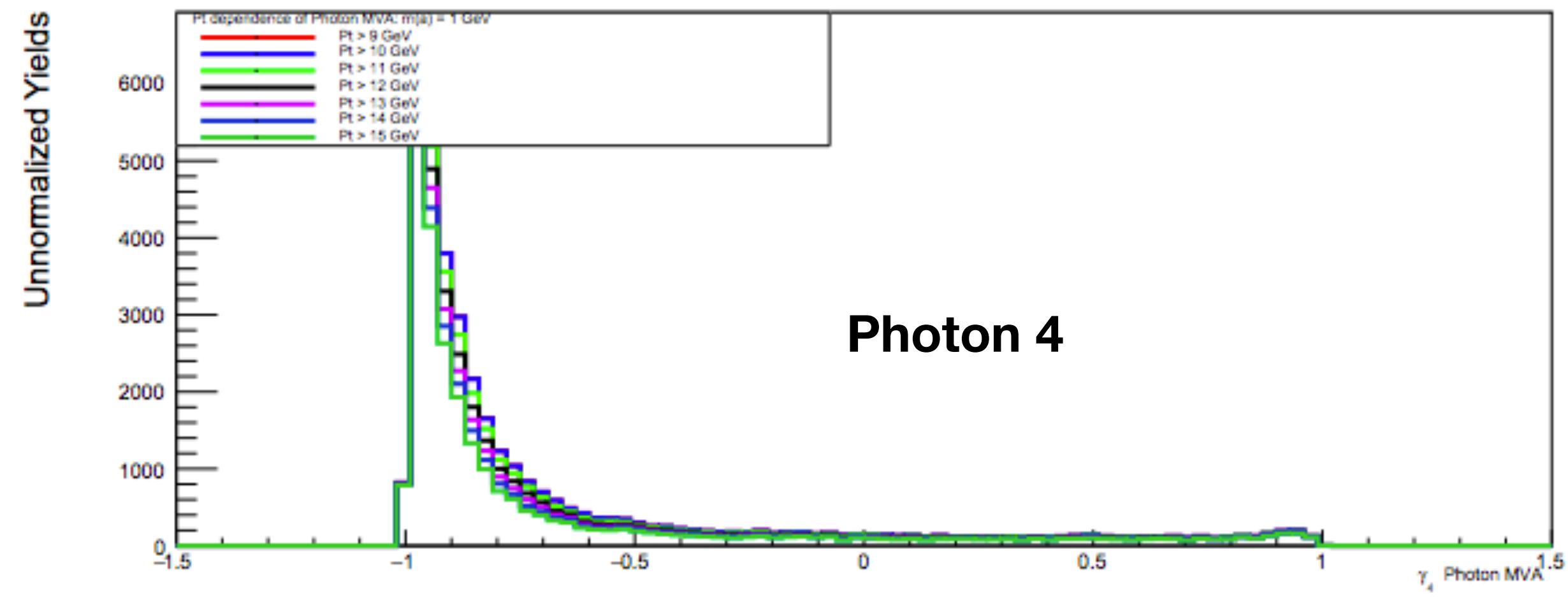
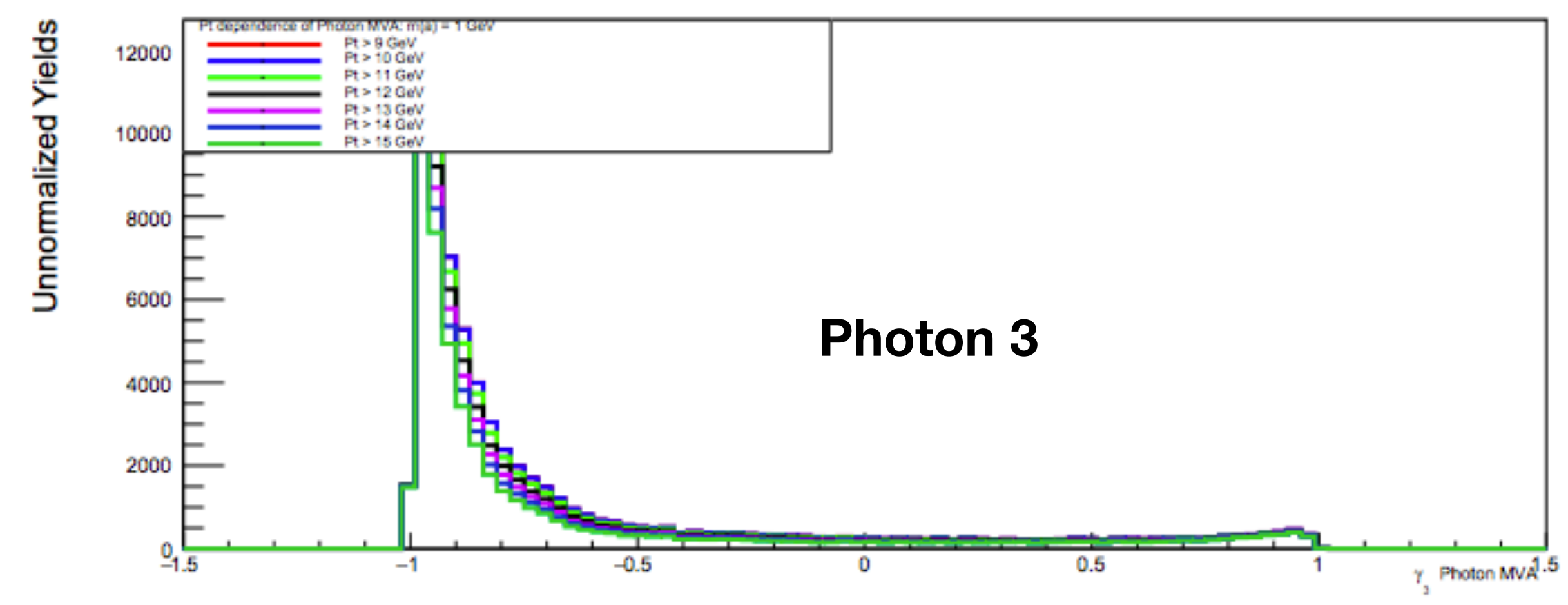
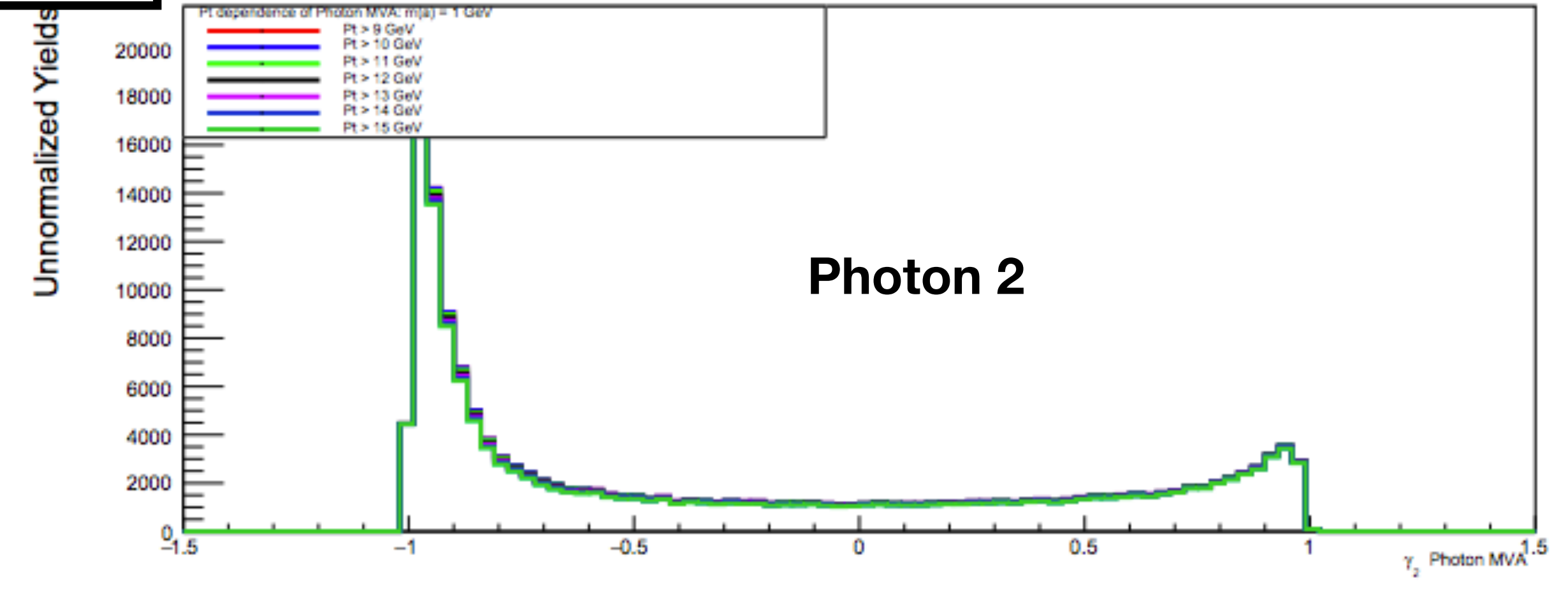
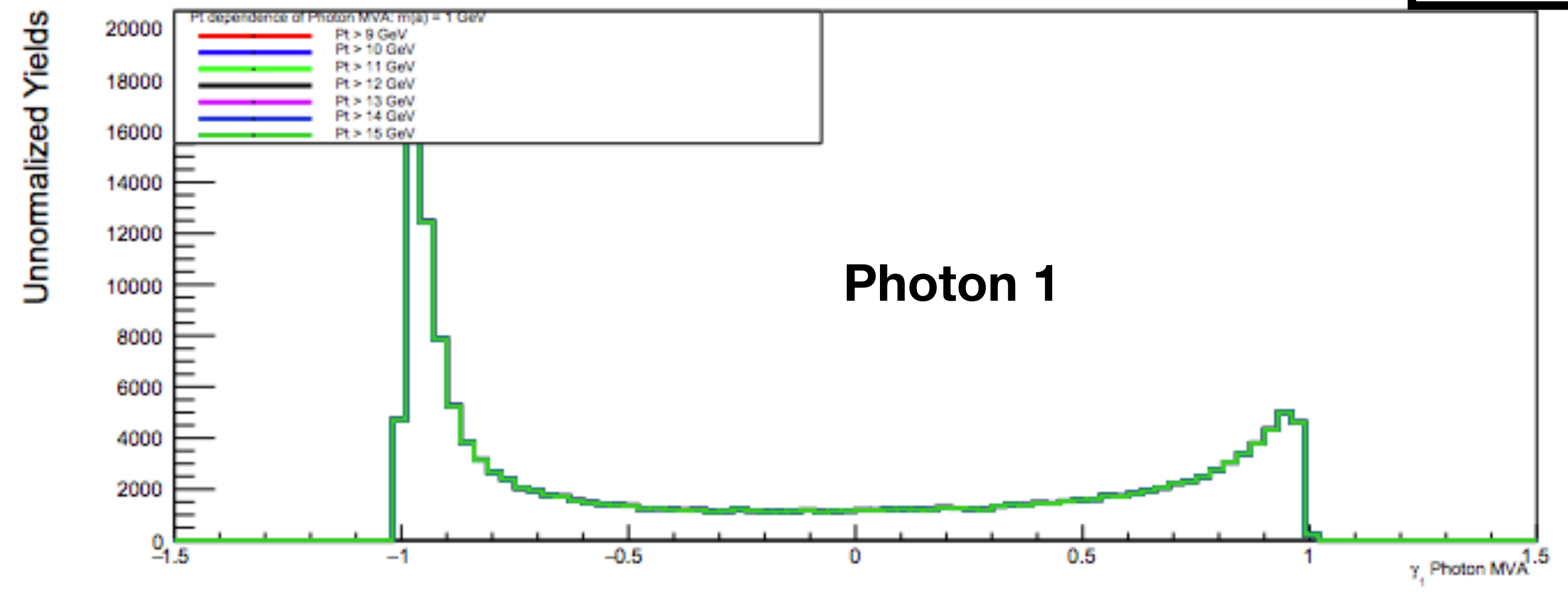
Reminder : Basic Pt cut on photons >10 GeV



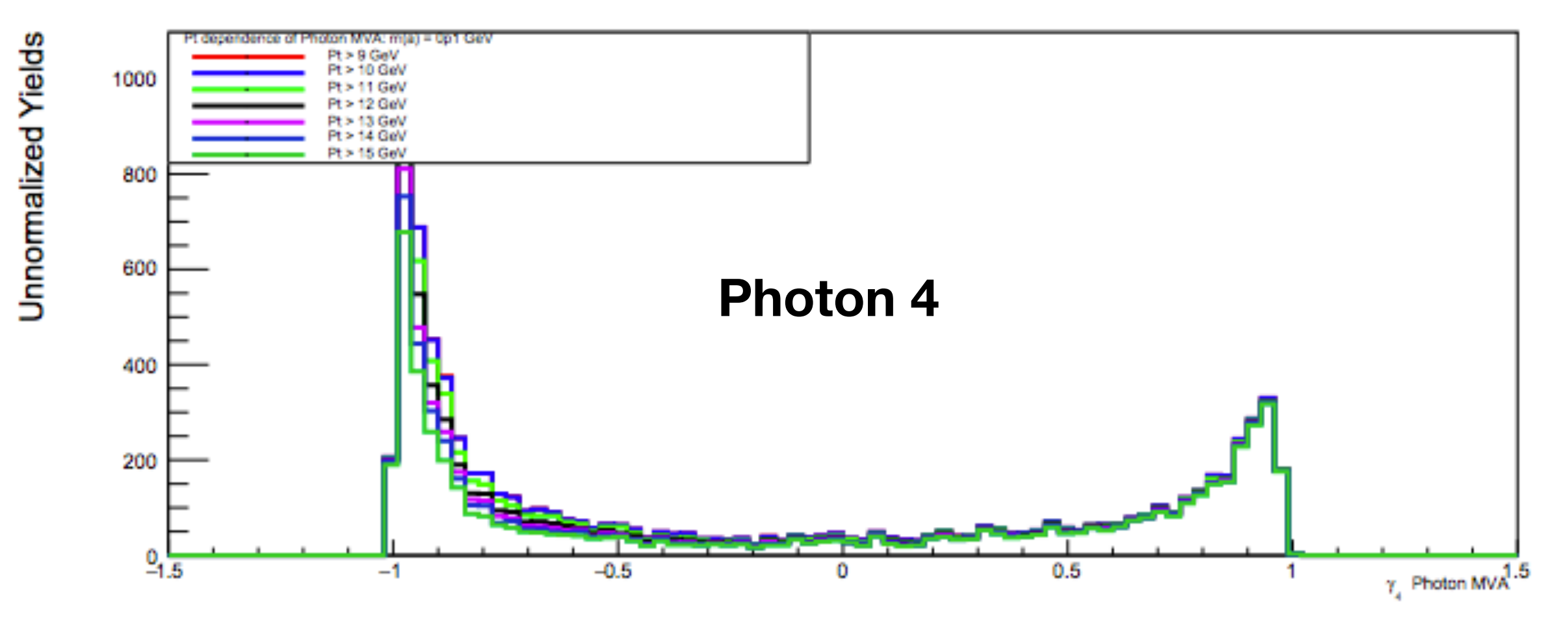
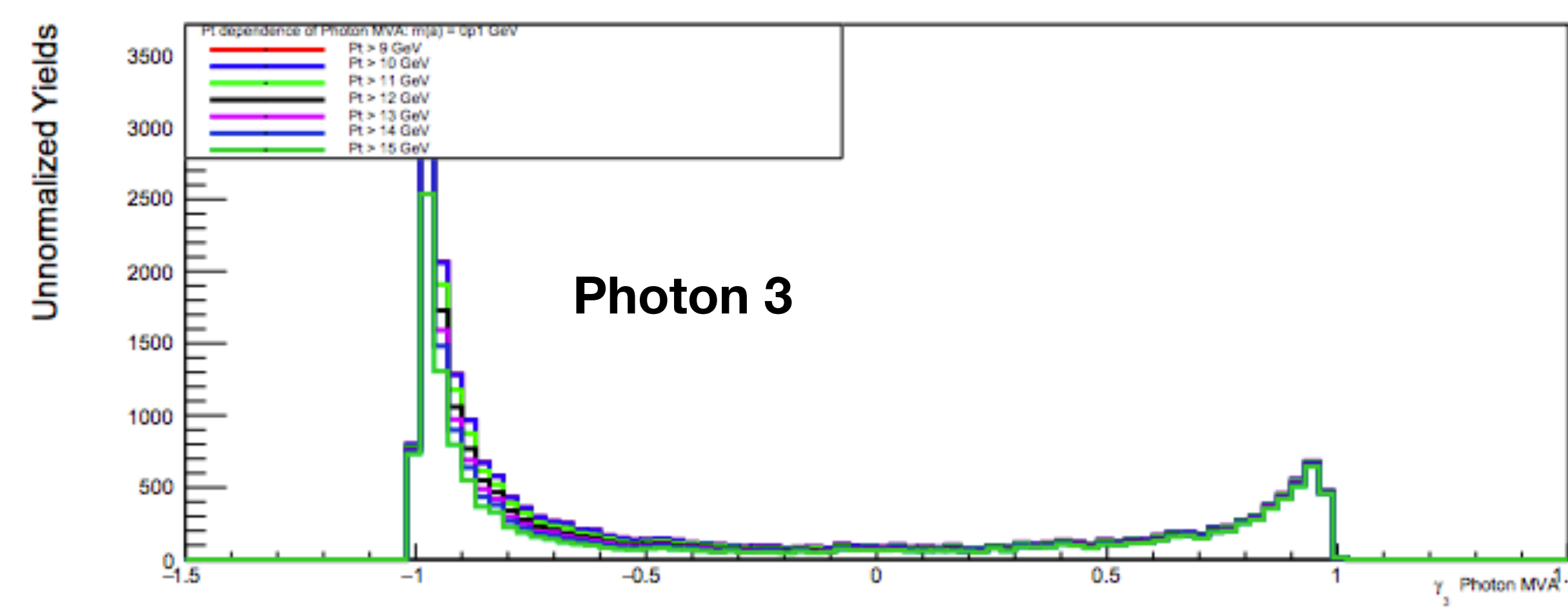
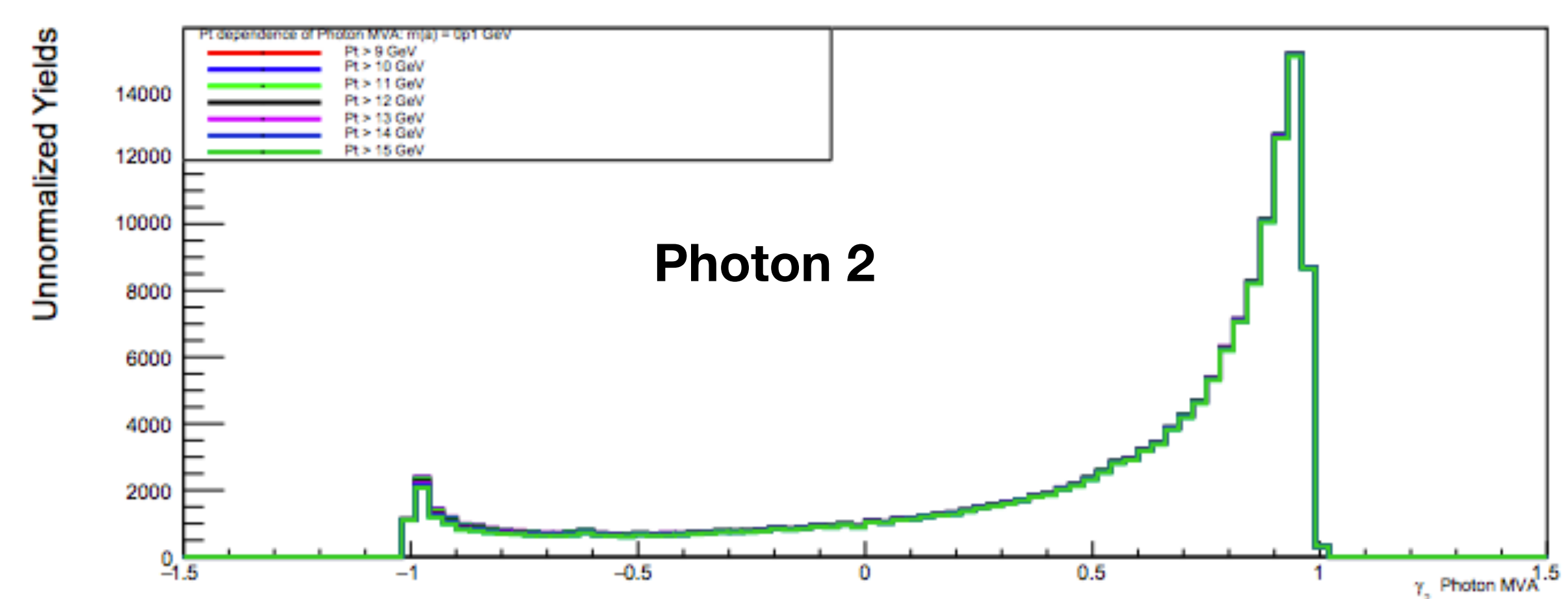
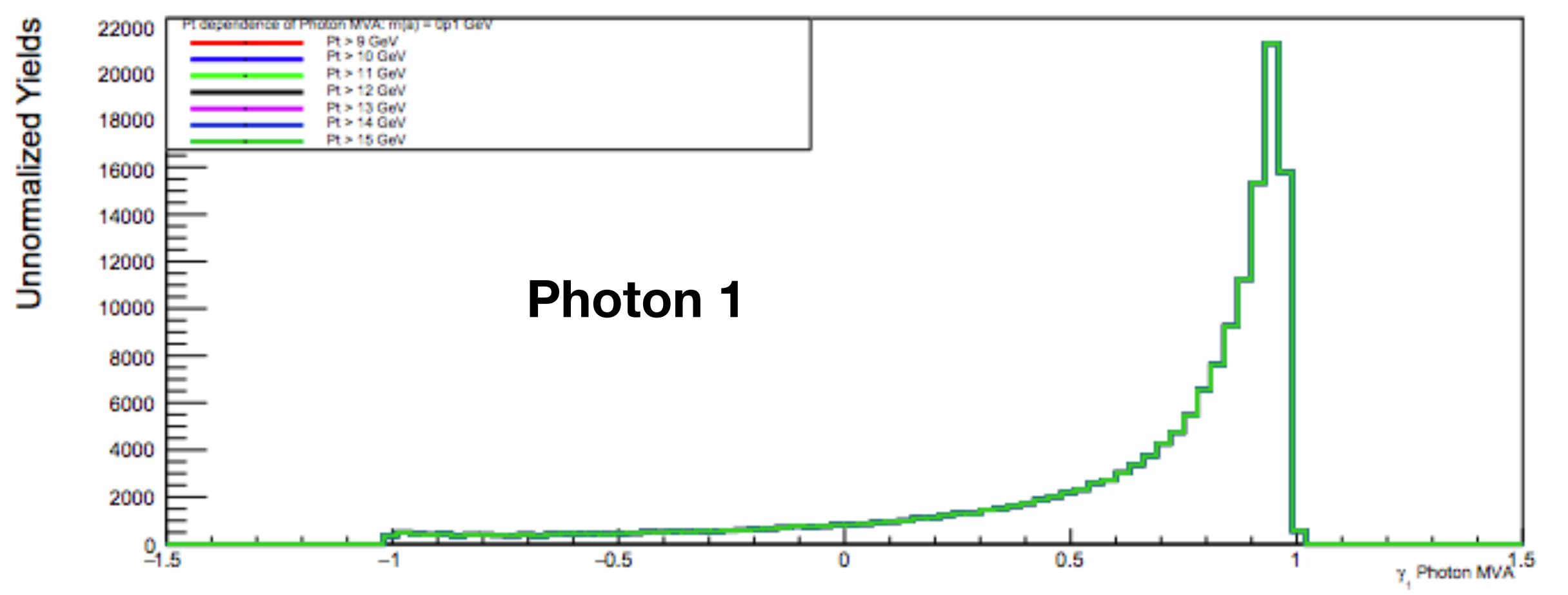
$m(a) = 15 \text{ GeV}$



$m(a) = 1 \text{ GeV}$



$$m(a) = 0p1 \text{ GeV}$$

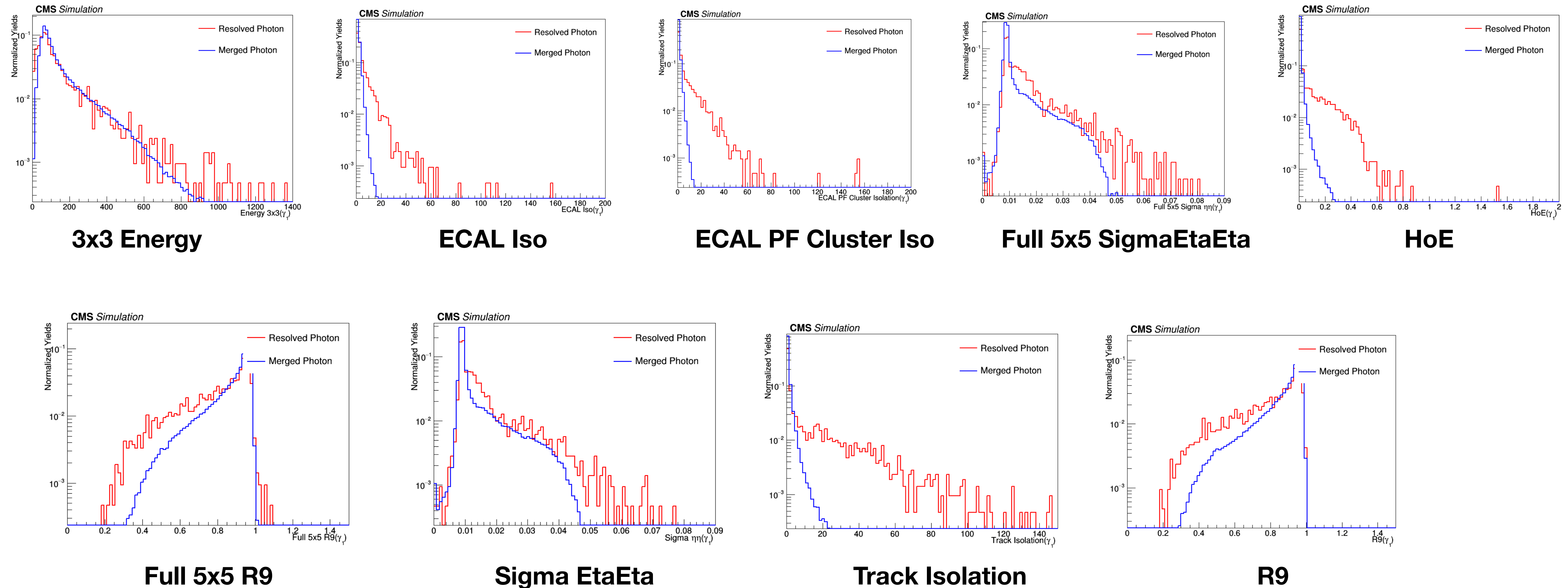


Distinction b/w Merged and Resolved Photons

Test Case : $m(a) = 100 \text{ MeV}$

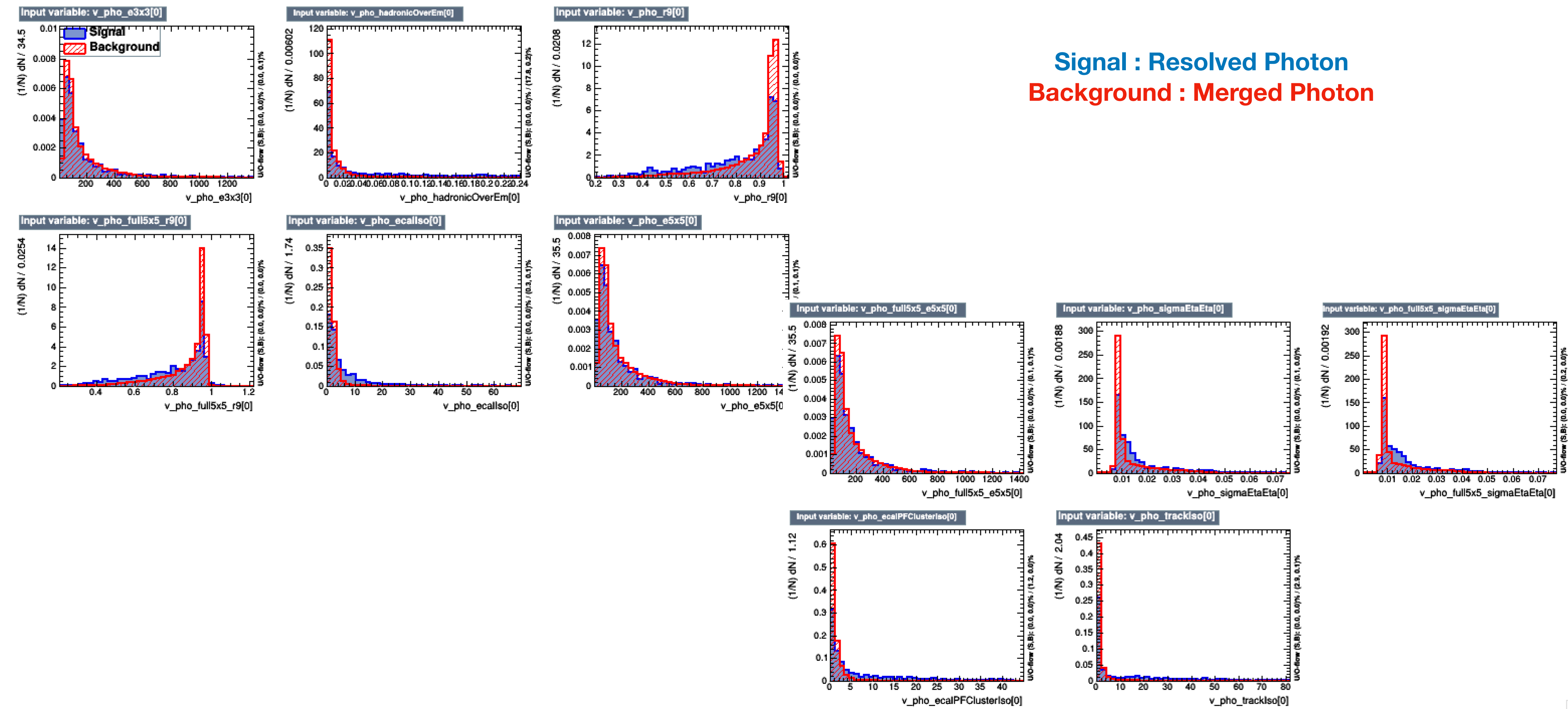
(I only put plots with good(distinction b/w merged and Isolated Photons here)

Full set of plots for every mass point are here : http://twamorka.web.cern.ch/twamorka/H4G_forPrelim/MergedIso/

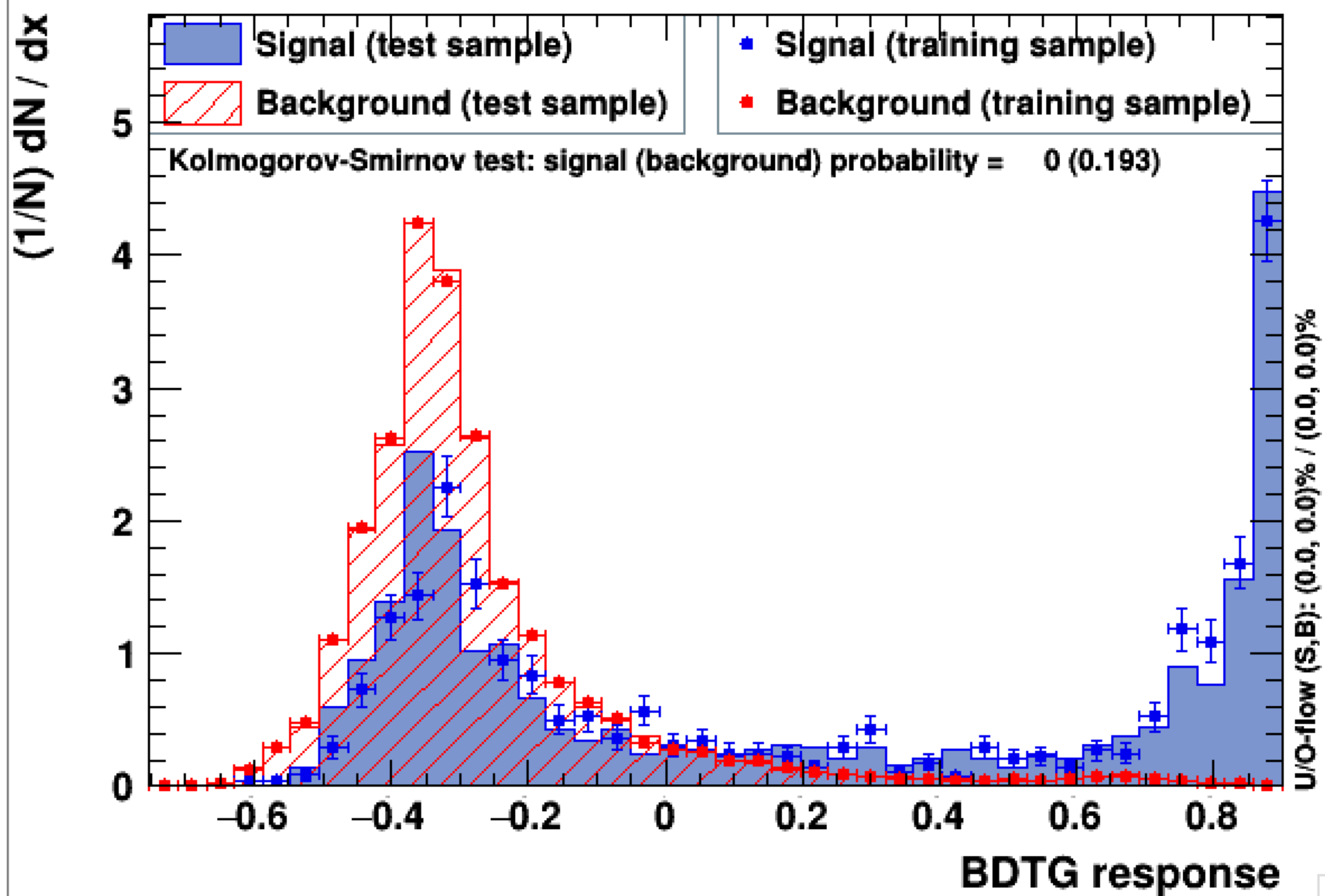


TMVA Study to differentiate Merged and Resolved Photons

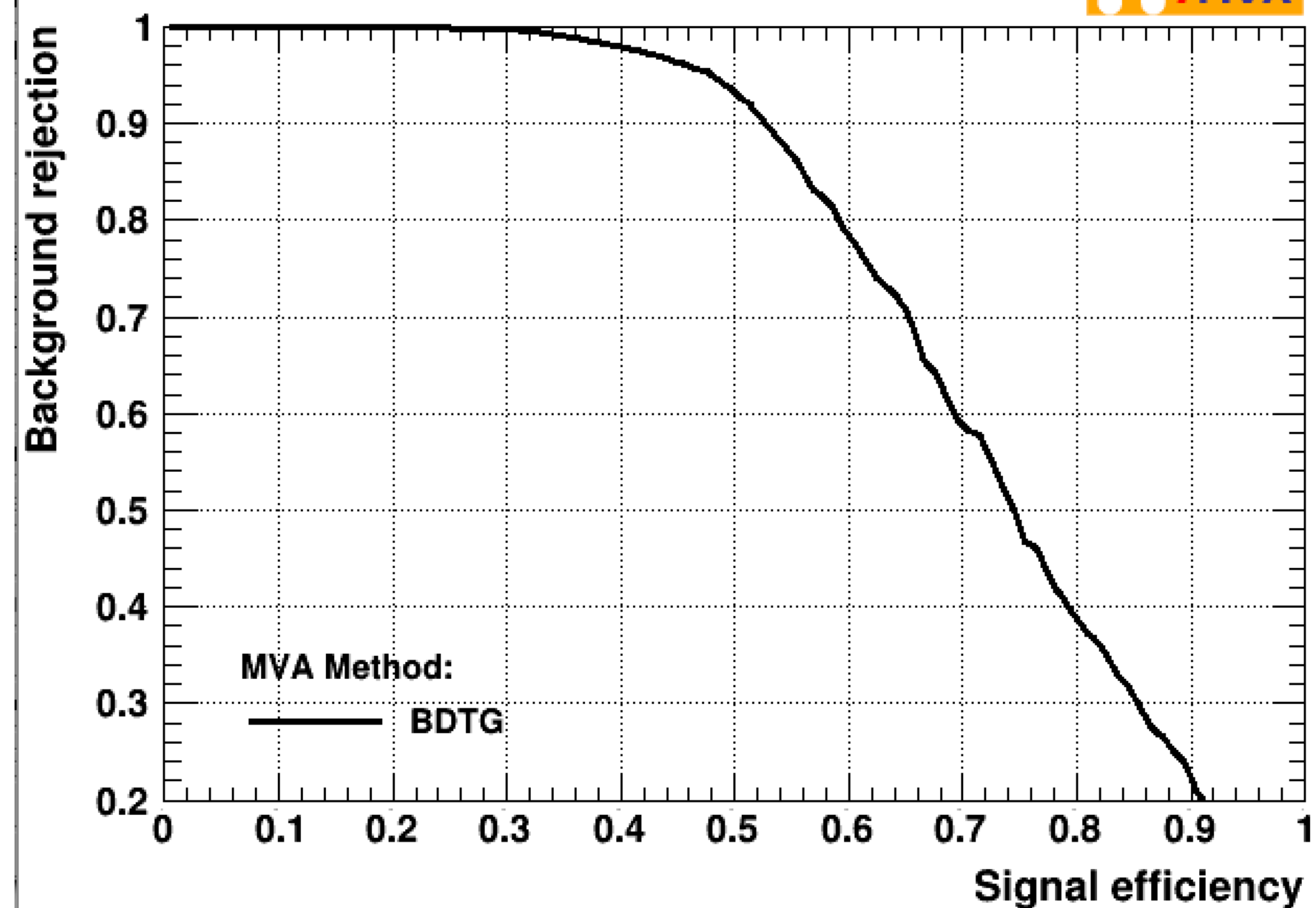
Signal : Resolved Photon
Background : Merged Photon

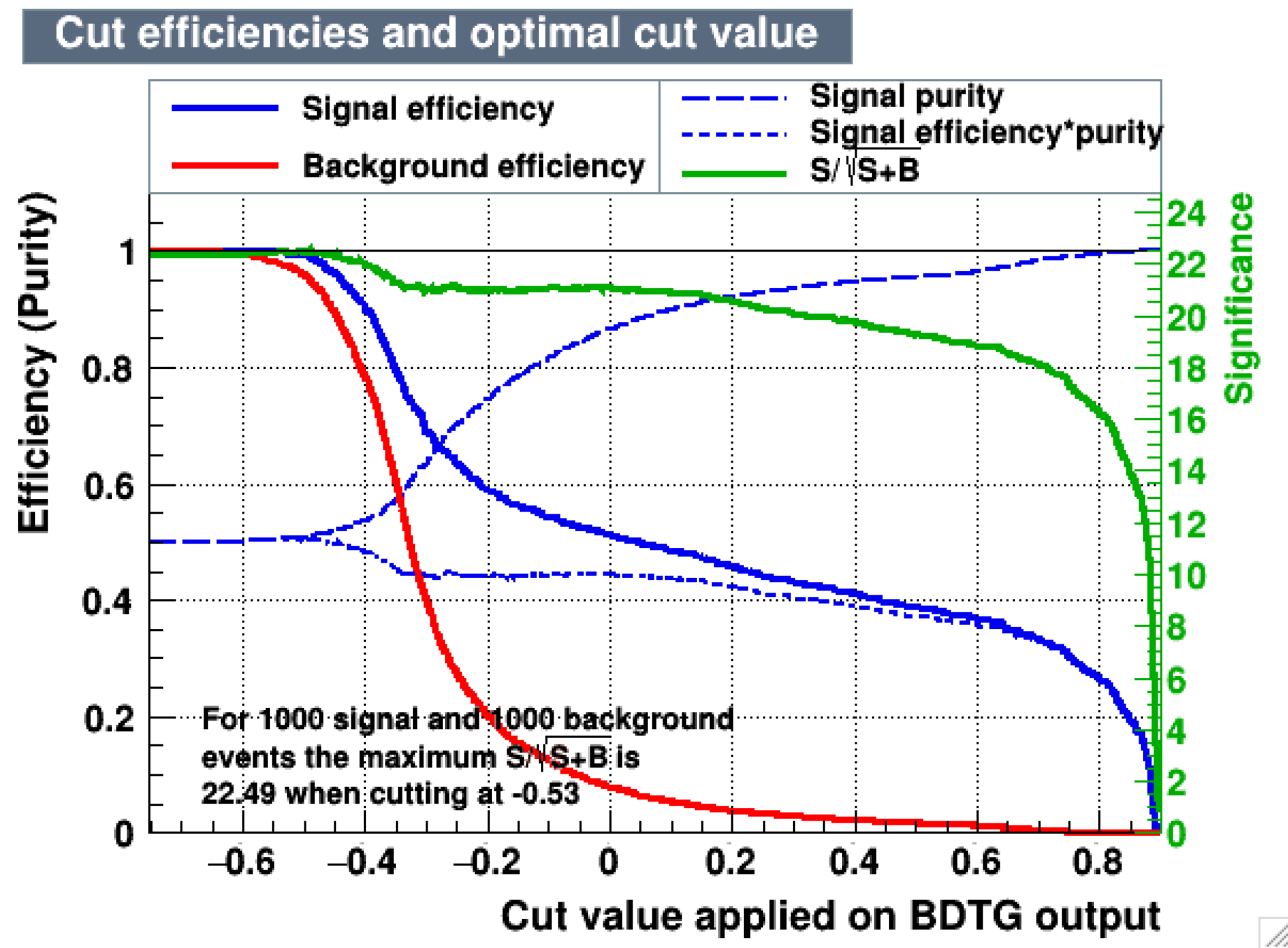


TMVA overtraining check for classifier: BDTG



Background rejection versus Signal efficiency





<https://arxiv.org/pdf/1208.4018v3.pdf>

- Would be interesting to see what these angles look like for H4gamma
- θ_1 , θ_2 should be different for merged and isolated photons (Looking into this!)

