Displaced Photon Background Studies Update LL Meeting Nov 02 2012

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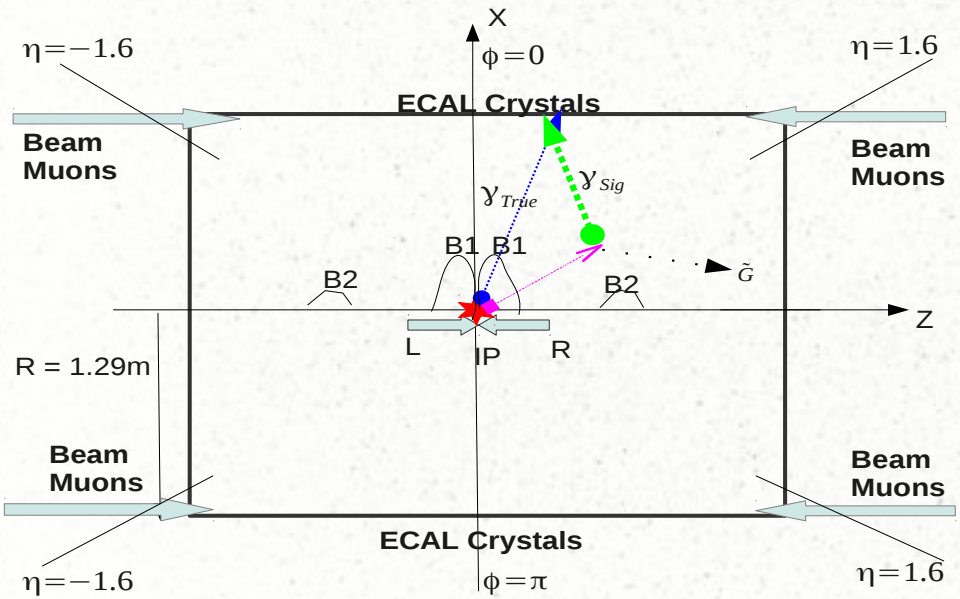
DataSet & Triggers

- **DataSets:**
  - /SinglePhoton/Run2012C/Prompt-Reco V1&2
  - Int Lumi = 6.7 /fb
- **HLT Trigger:**
  - HLT_DisplacedPhoton65_CaloIdVL_IsoL_PFMET25

Signal from Background



- **Ecal Time Calibration:**

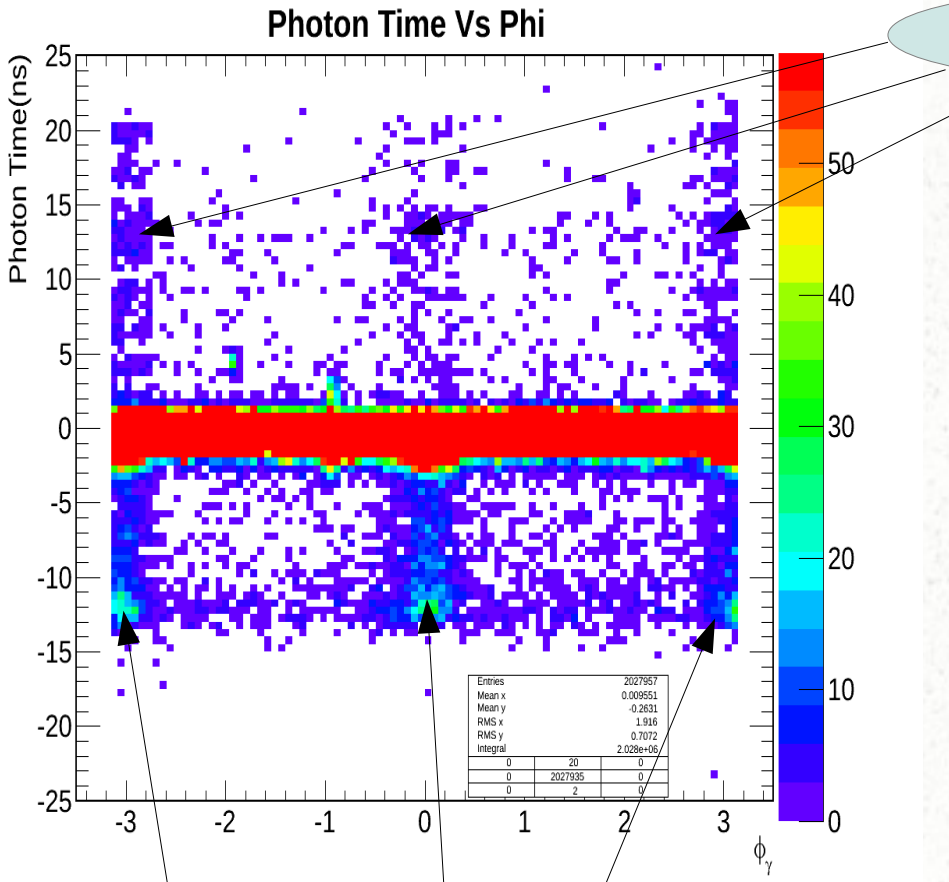
$$\langle t_{\gamma_{true}} \rangle \simeq 0 \quad \text{but} \quad t_{\gamma_{Sig}} \neq 0$$

- **2 Types of Backgrounds**
  - **Collision：**
    - Left B1 w/ Right B2
    - Left B2 w/ Right B1
    - LeftB2 w/ Right B2
  - **Non-Collision:**
    - Beam halo (beam dump or P+Gas -> muons which Brem/shower in ECAL.
    - Cosmic muons.

Event Selection

- **Selection** :
  - Gamma_Pt1(2) > 60(45)GeV
  - |eta| < 2.5, Jet_pt > 35 GeV
  - Egamma VL Iso cuts,
  - MET > 0 GeV
- **Photon Tagging:**
  - CSC Segment |eta| > 1.6
  - Halo tagged if dphi(cscSeg, gamma) < 0.6

Photon time vs Phi

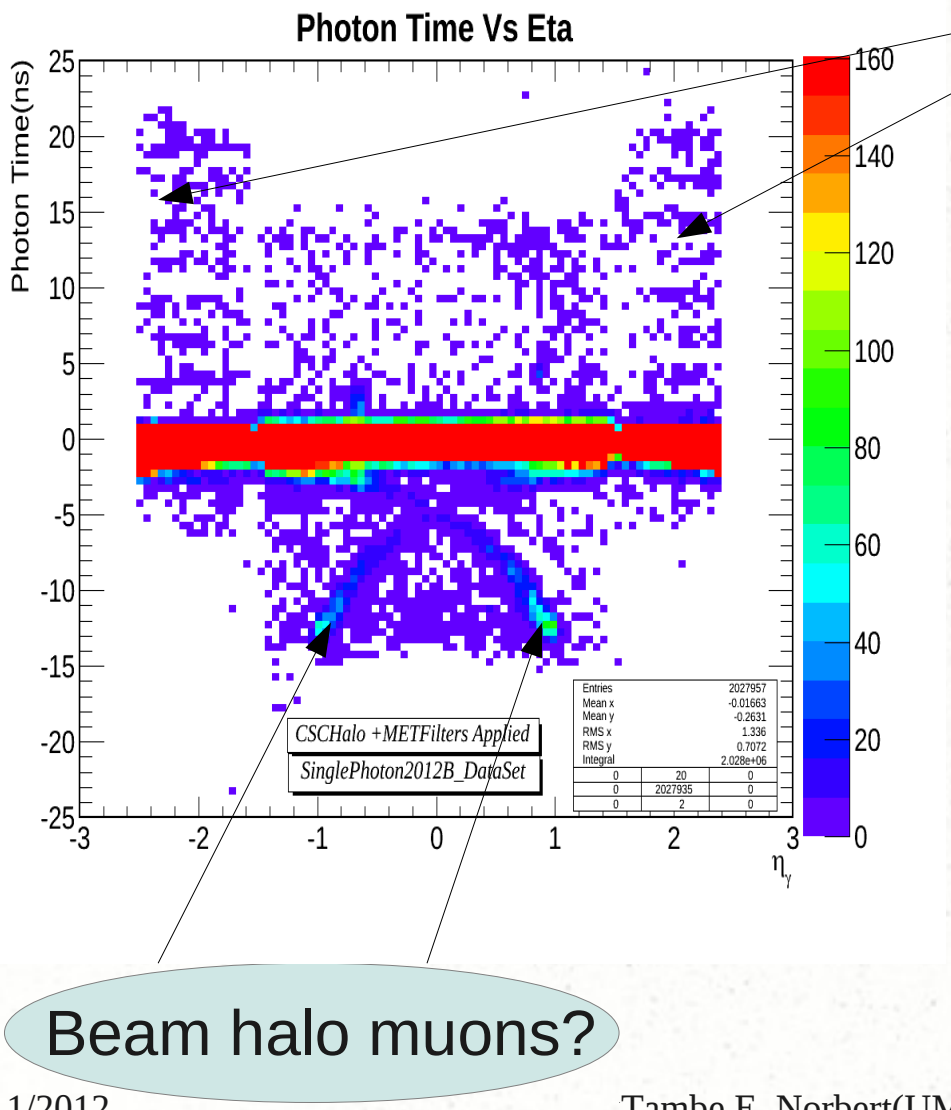


Cosmic muons?

Beam halo muons?

- Observed in **2012B dataset**
- High intensity in phi = 0, +/- pi
- Most photons arriving early in Ecal time indicate source could be beam halo muons.

Photon time vs Eta

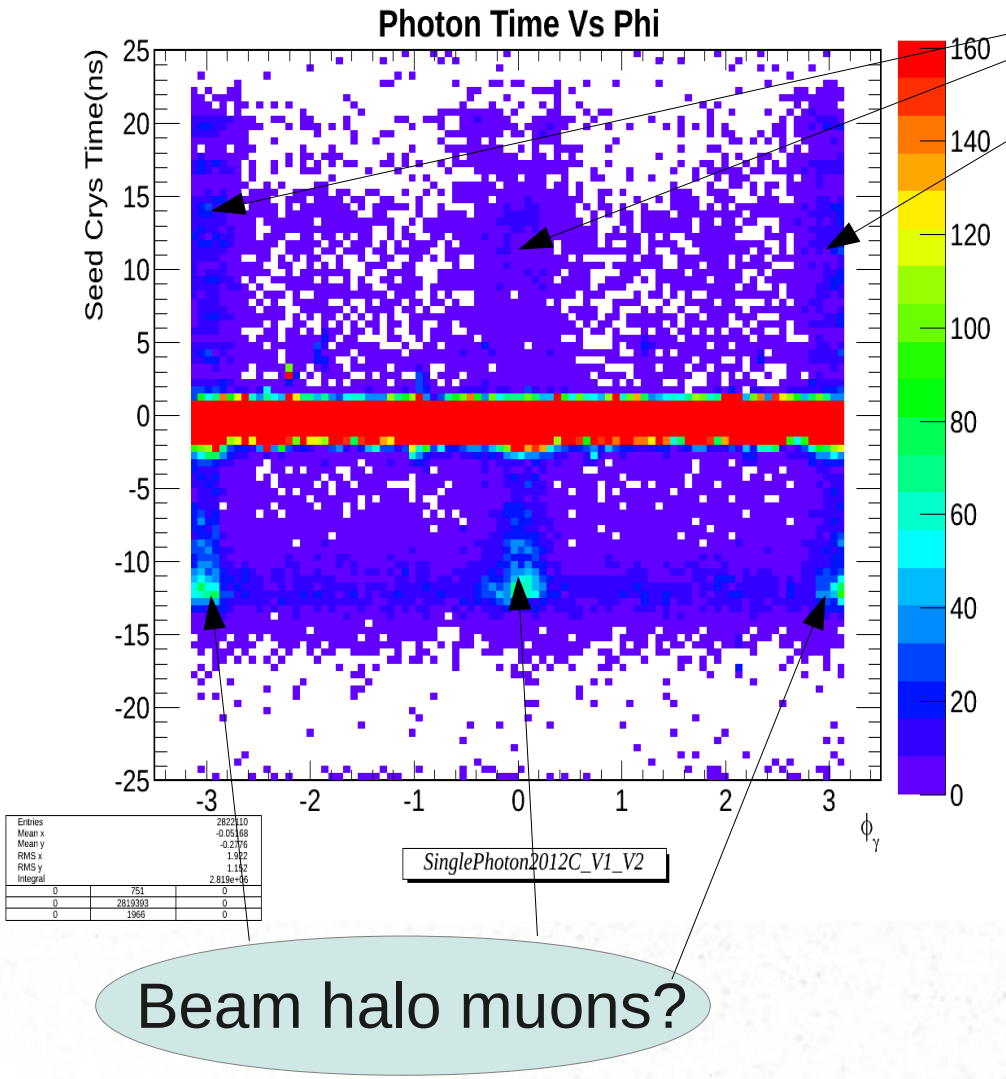


Cosmic muons?

Beam halo muons?

- Intense at impact point in EB then slowly decreases towards IP.
- Eta dependence in early Ecal time.
- Surely photons do not all come from a **unique** source.

Photon time vs Phi

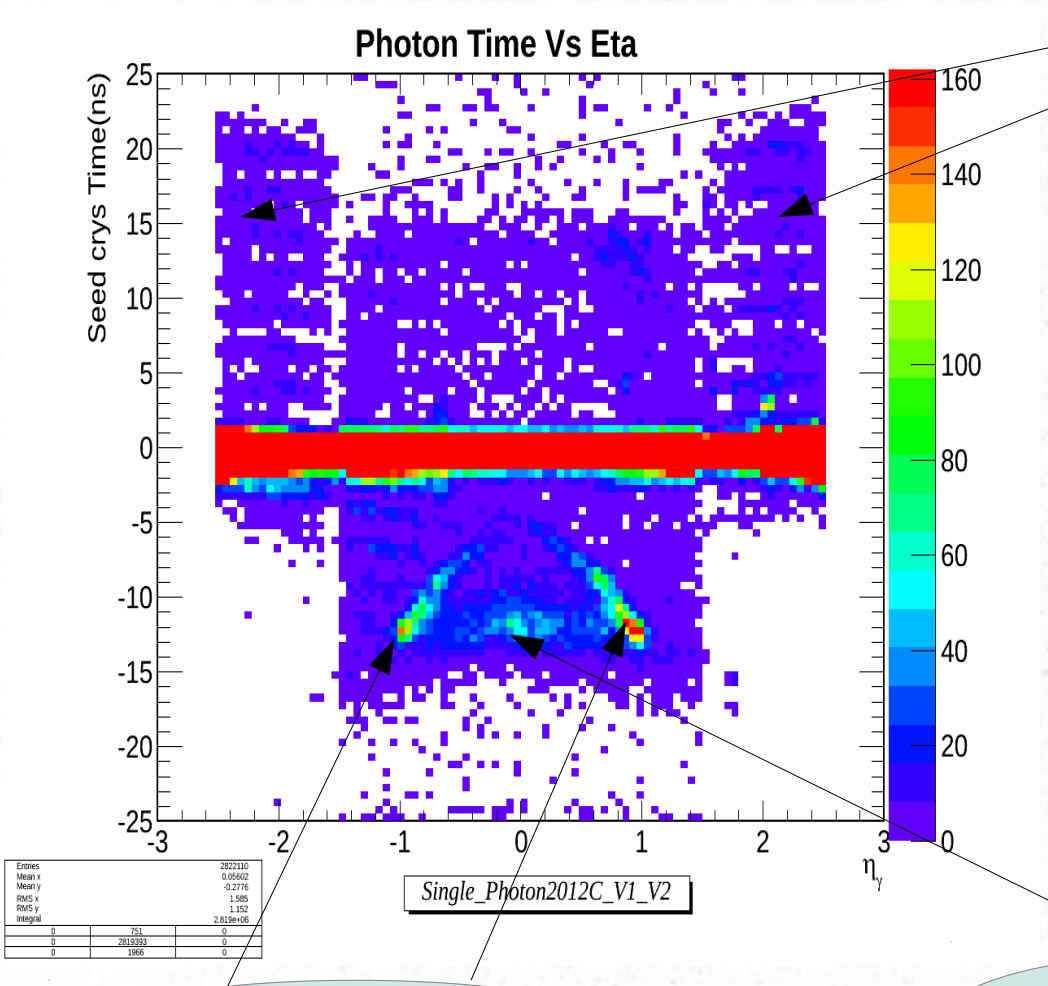


Cosmic muons?

Beam halo muons?

- Similar phenomenon in **2012C dataset**.
- Increased intensity with luminosity.
- Phi dependence in Ecal time of photons.

Photon time vs Eta



Cosmic muons?

- **2012C dataset.**
- Increased intensity with luminosity.
- Spikes with time between -10 and -15ns.

Beam halo muons?

Spikes failing spike cleaning.

Definition

- **Egamma Photon** :

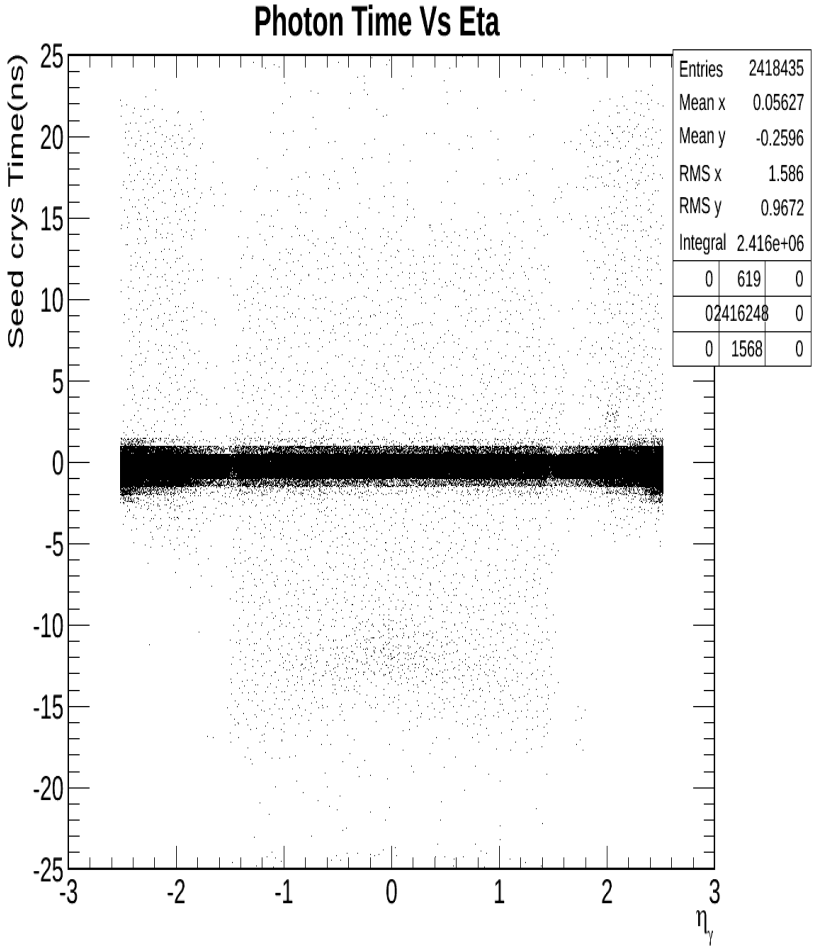
  * Egamma + VL Iso selection criteria + Sminor.

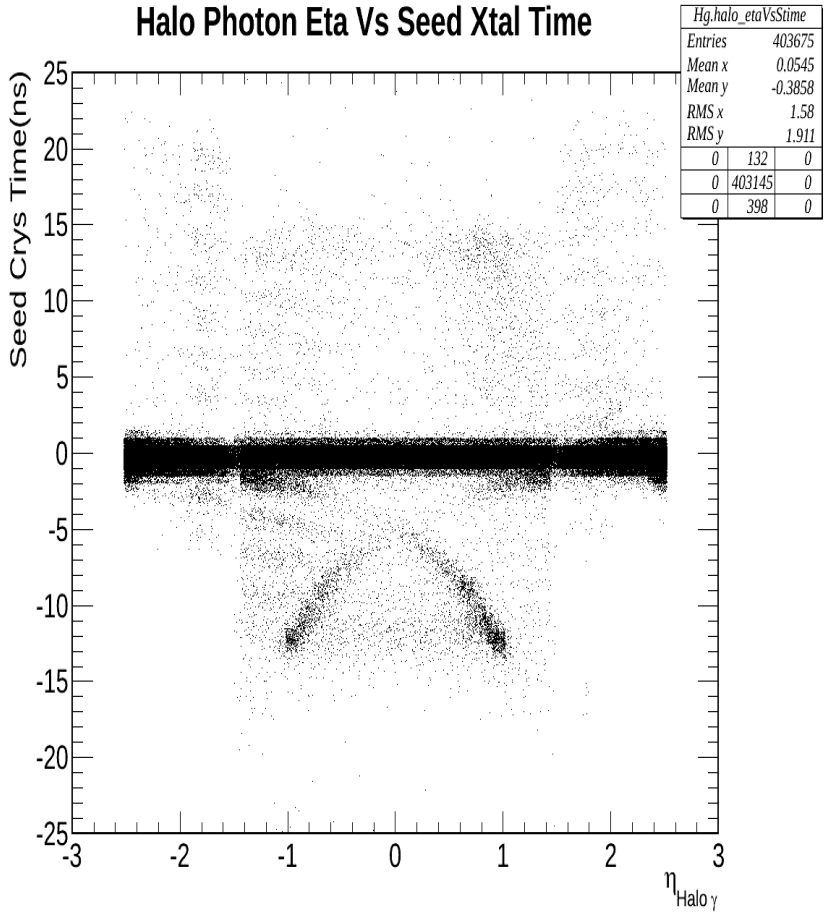
- **Halo Photon** :

  Tag as Halo photon if:

  * CSC Segment matching: dphi (cscsegment, gamma) < 0.6

Photon Time Vs Eta

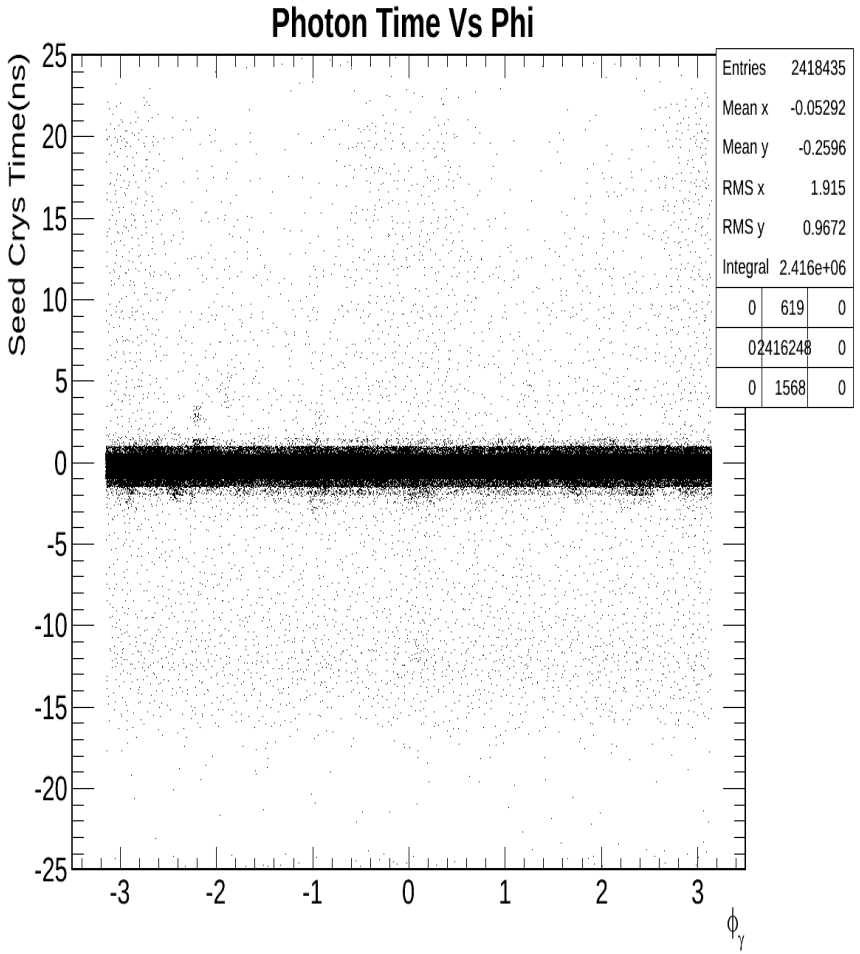


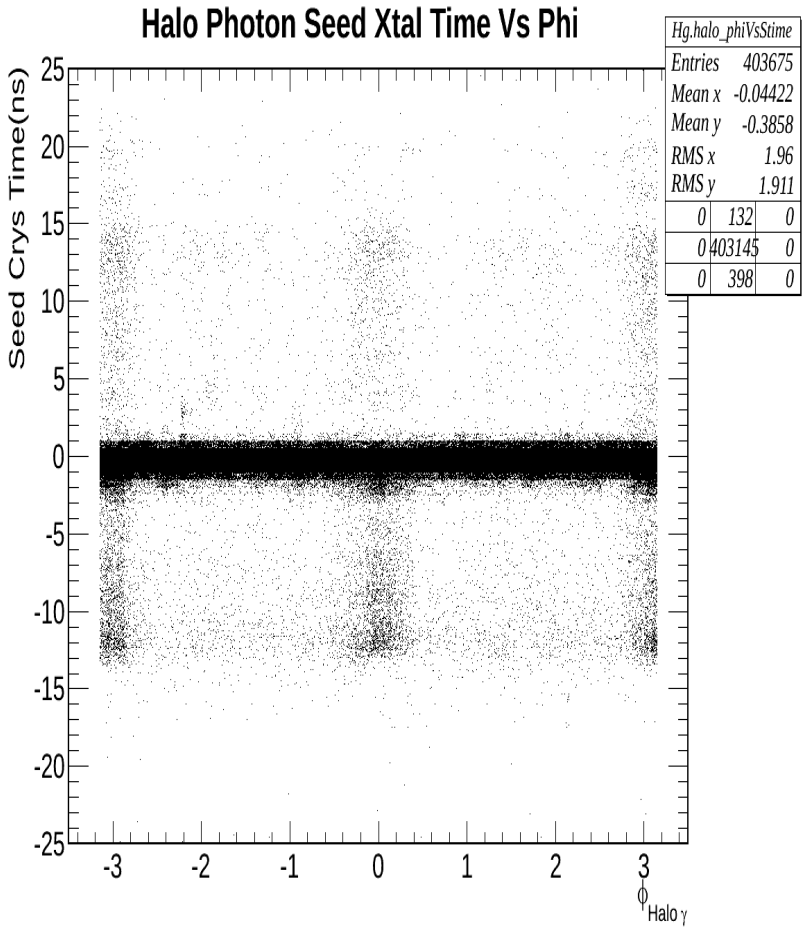


Egamma Photon

Halo Photon

Photon Time Vs Phi

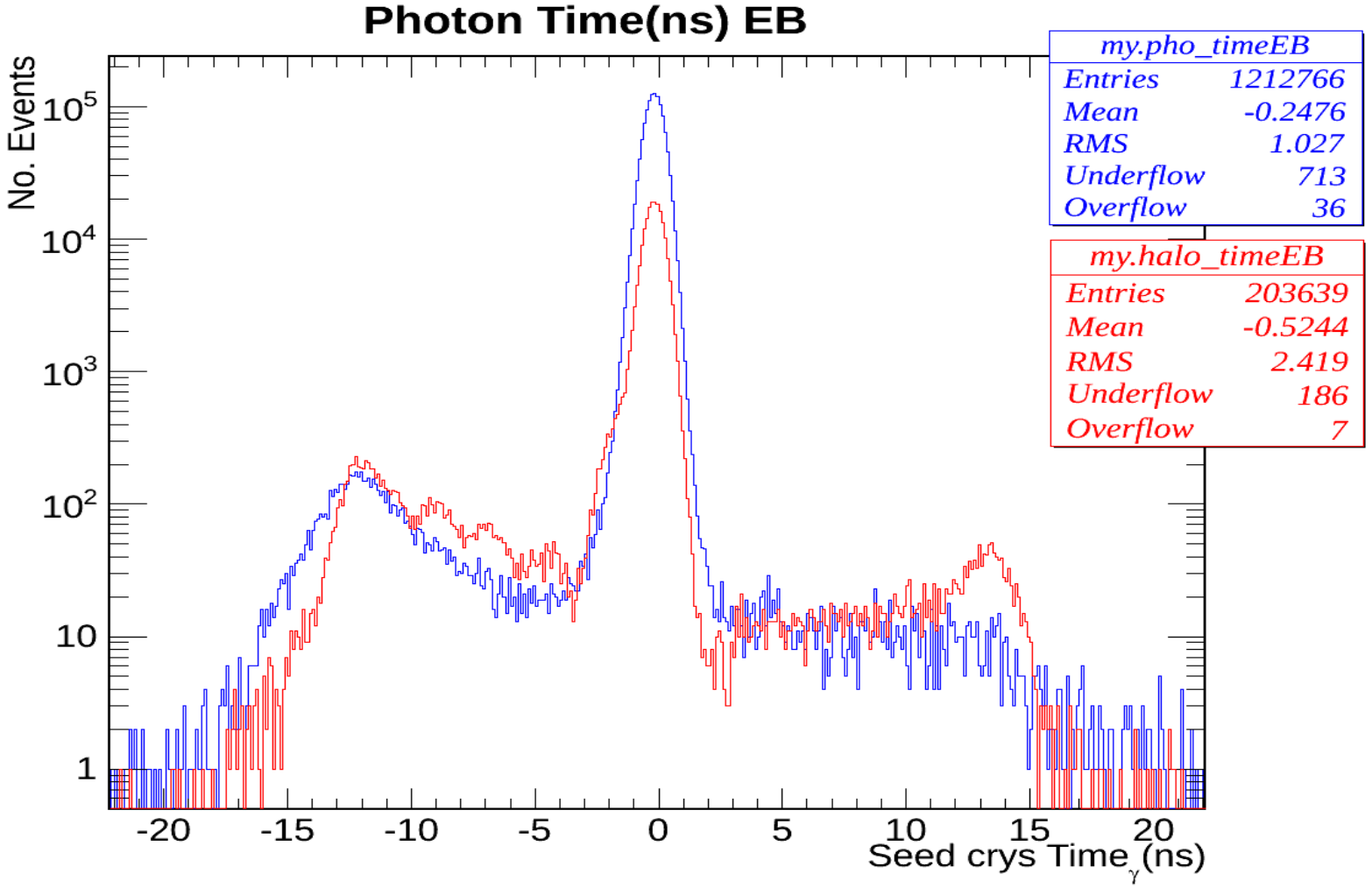




Egamma Photon

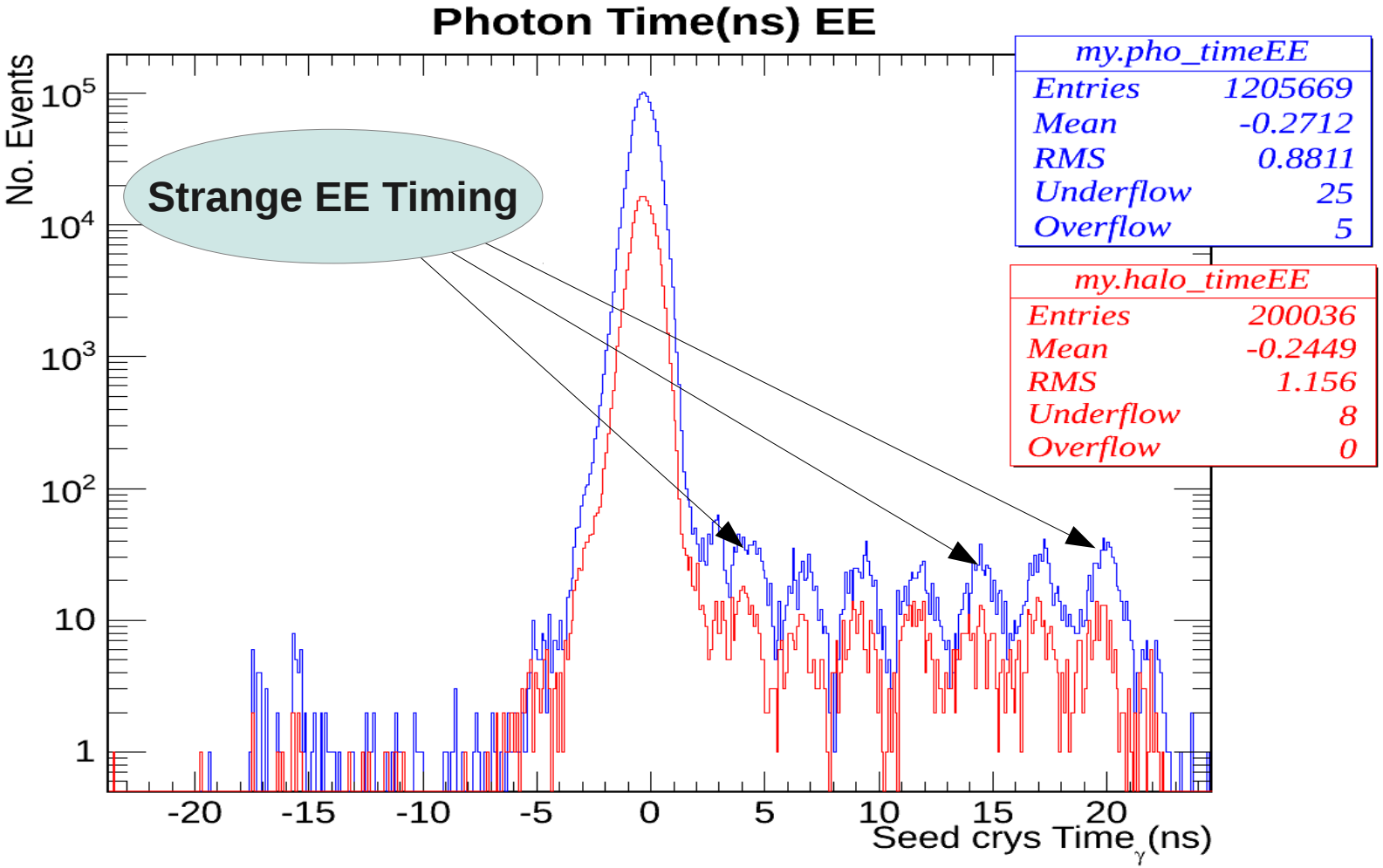
Halo Photon

Photon Time EB



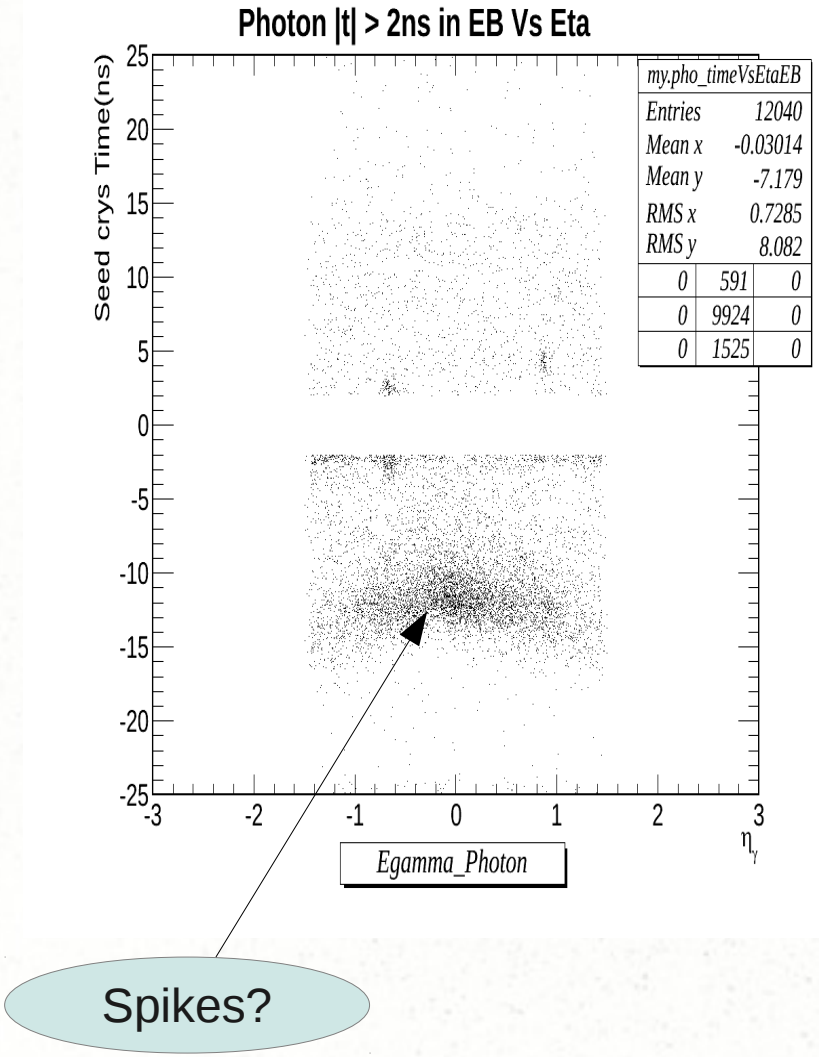
Egamma(Blue) Halo(Red) Photon Ecal time

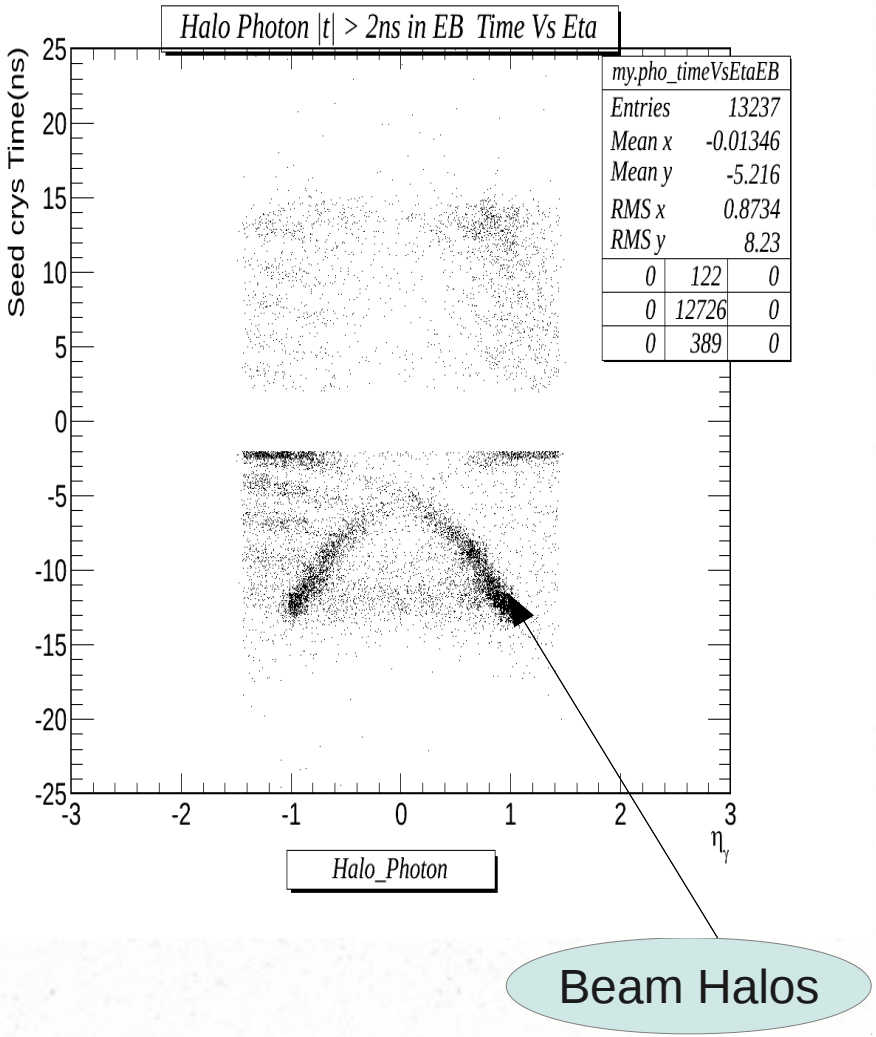
Photon Time EE



Egamma(Blue) Halo(Red) Photon Ecal time

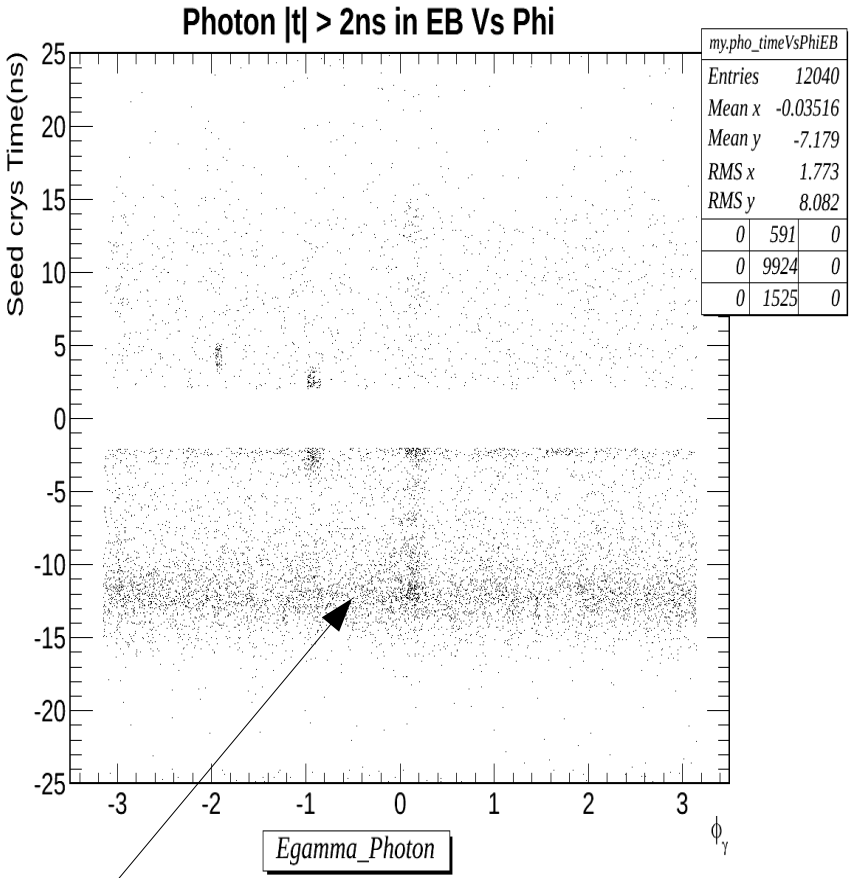
Region of Interest: EB

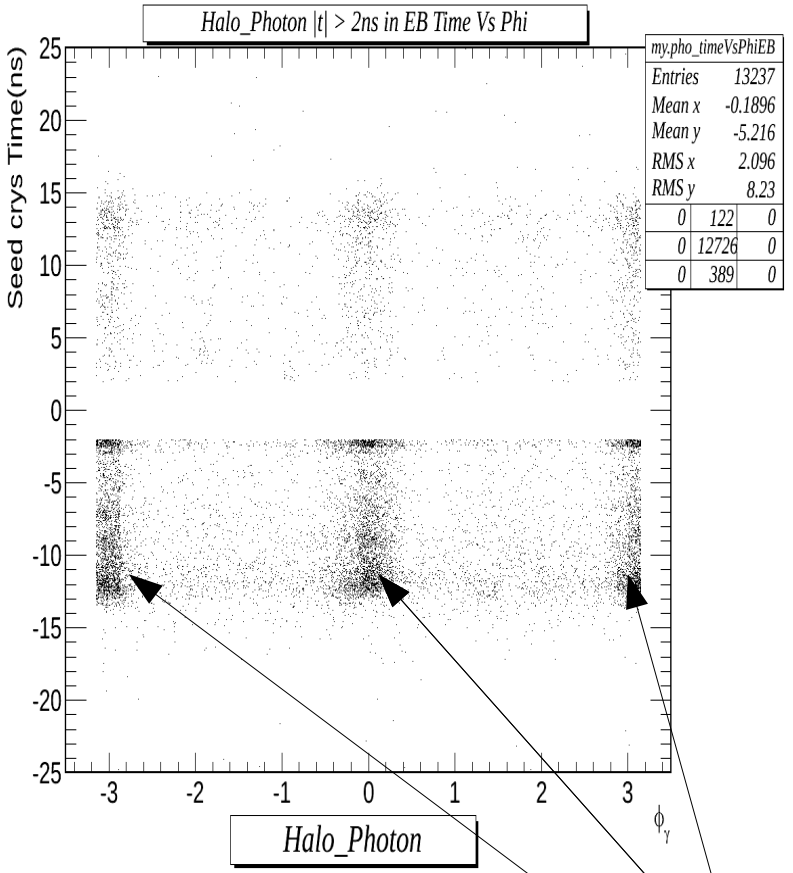




Egamma photons Halo photons.

Region of Interest: EB





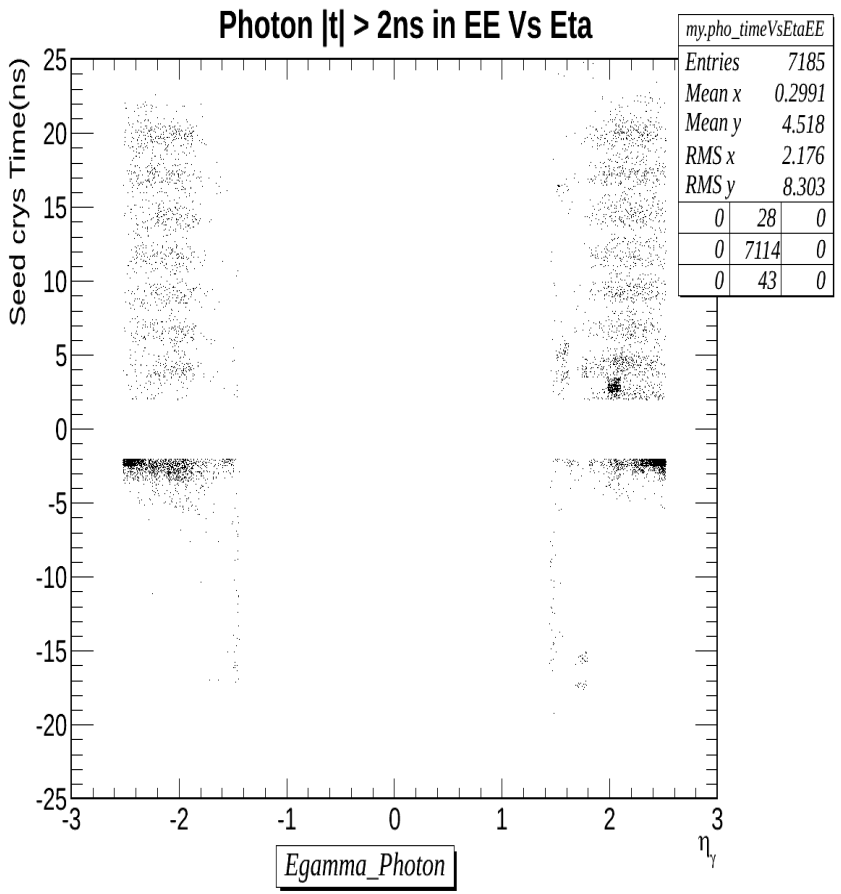
Spikes?

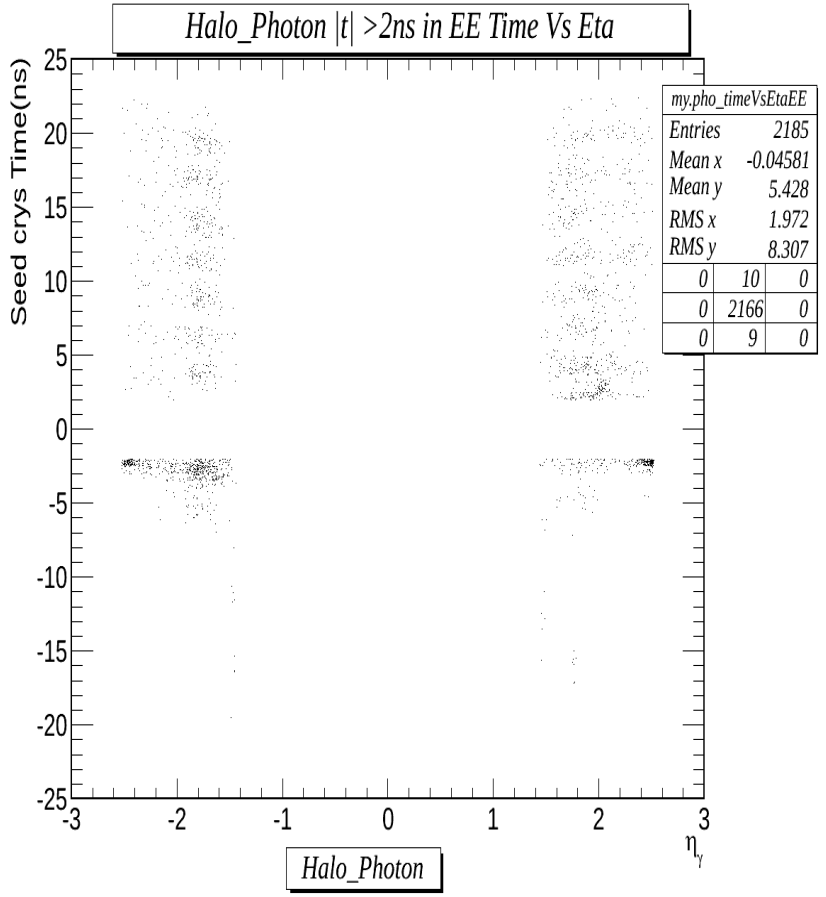
Beam Halos

Egamma photons

Halo photons.

Region of Interest: EE

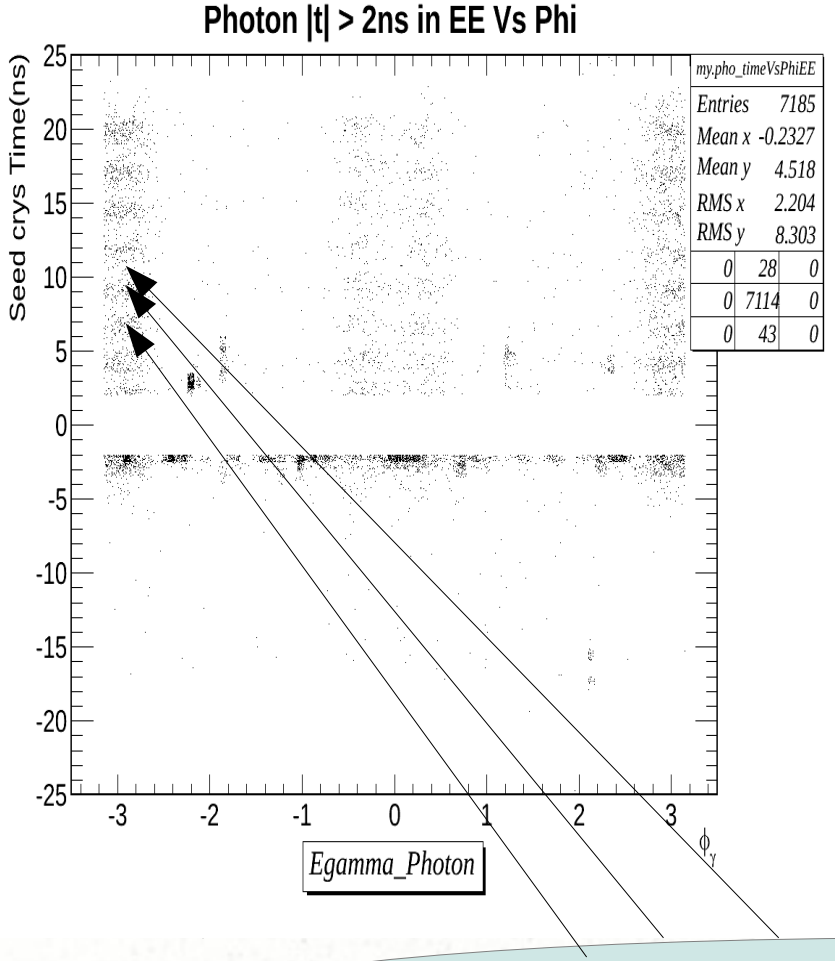


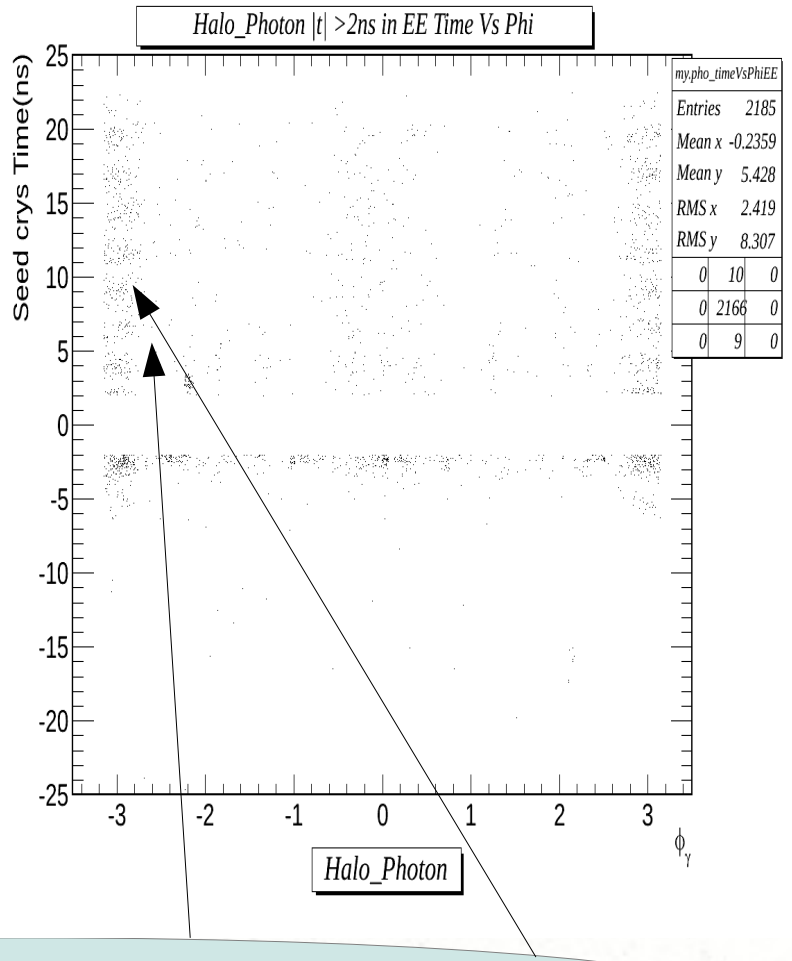


Few early time Halo photon than in EB

Egamma photons Halo photons.

Region of Interest: EE





Not quit clear origin of structure, satellite bunch collision?

Egamma photons

Halo photons.

Halo Tagging & Egamma Photon Efficiency.

|t| > 2ns	Total Number of Photons	Egamma Photons	% of Non-Halo-candidates	CSC Halo Tagged Photons	% of Halo candidates.
EB	25277	12040	**48**	13237	**52**
EE (|eta| < 2.5)	9370	7185	**77**	2185	**23**

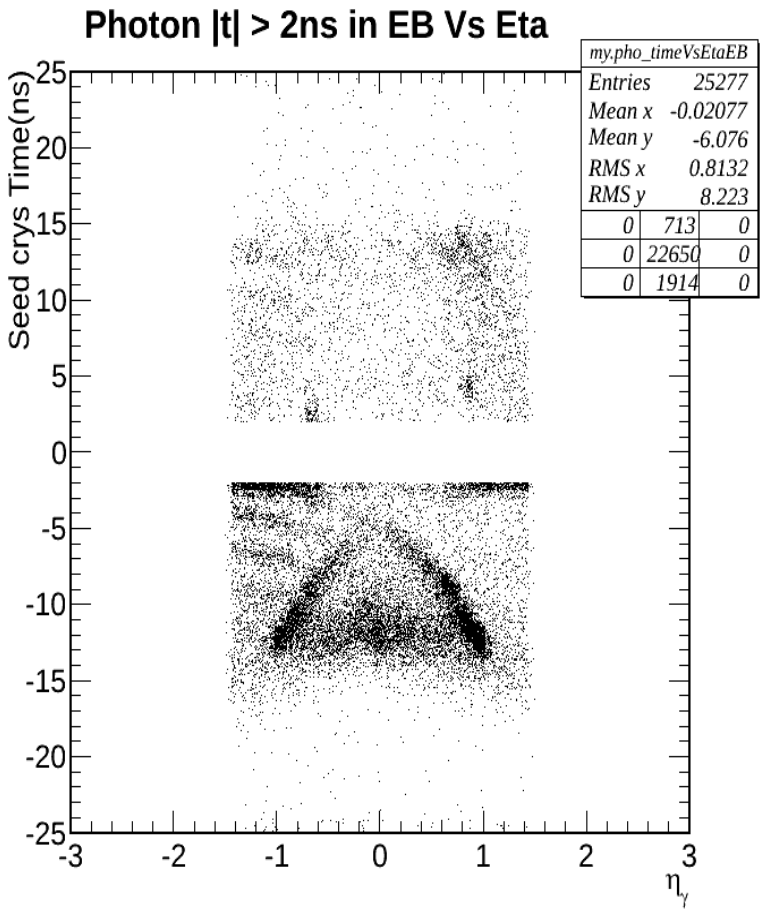
- For photons with time outside 2ns window:
  - Halo tagging efficiency : **EB(EE) = 52 (23)%**
  - Egamma non-Halo photon % : **EB(EE) = 48 (77)%**

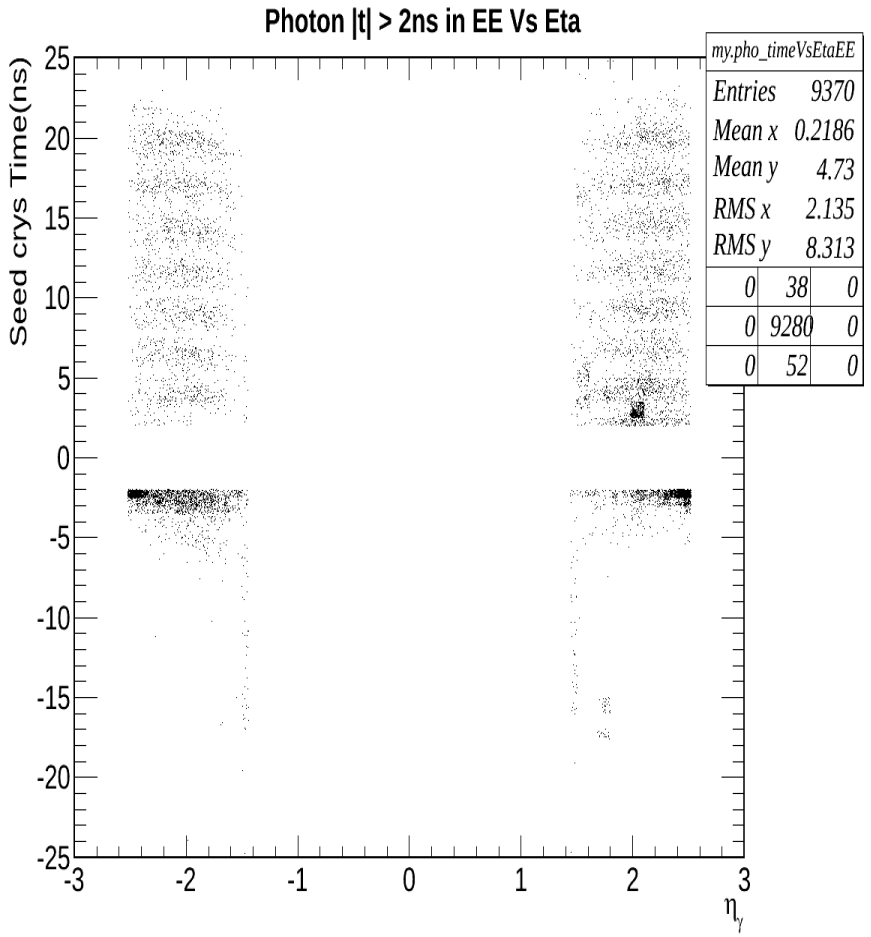
Summary

- There are many non trivial background sources to delayed photon.
- CSC tagging can be use to reject beam halo photons with good efficiency, however not every background photon.
- With current background understanding, we are ready for Moriond although identifying the different sources is yet to come, nevertheless, we are working on it.

BACK UP

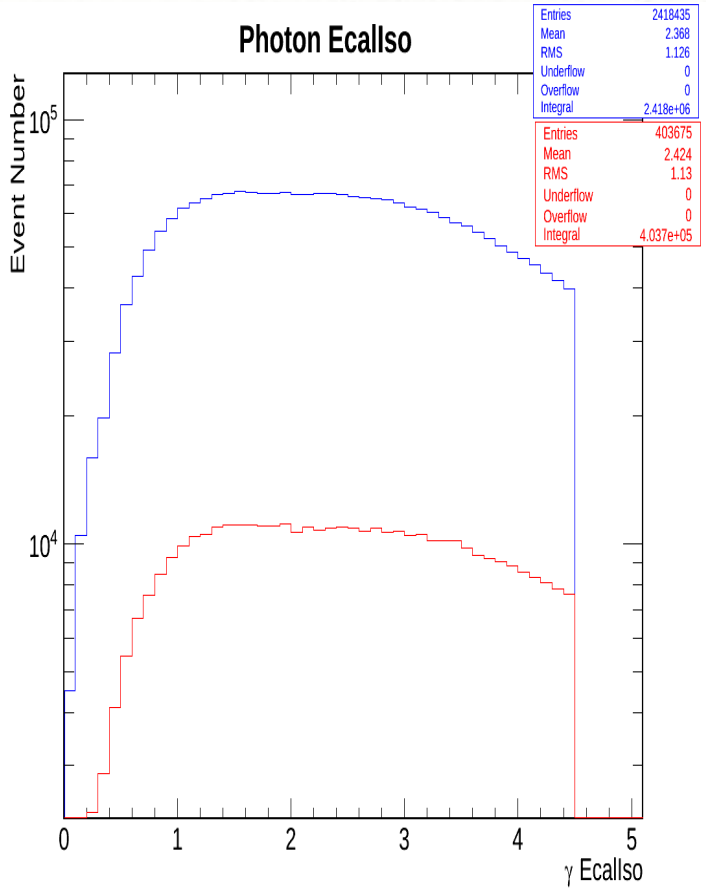
Region of Interest EB & EE

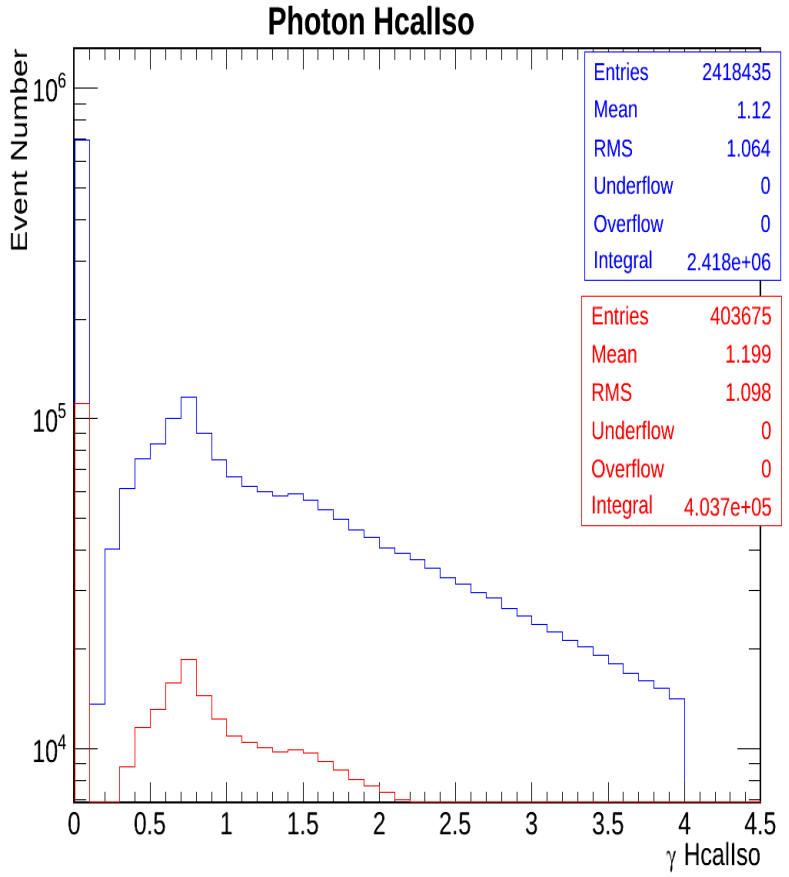




Egamma + Halo Photons time Vs Eta

Egamma Photon Id variables.



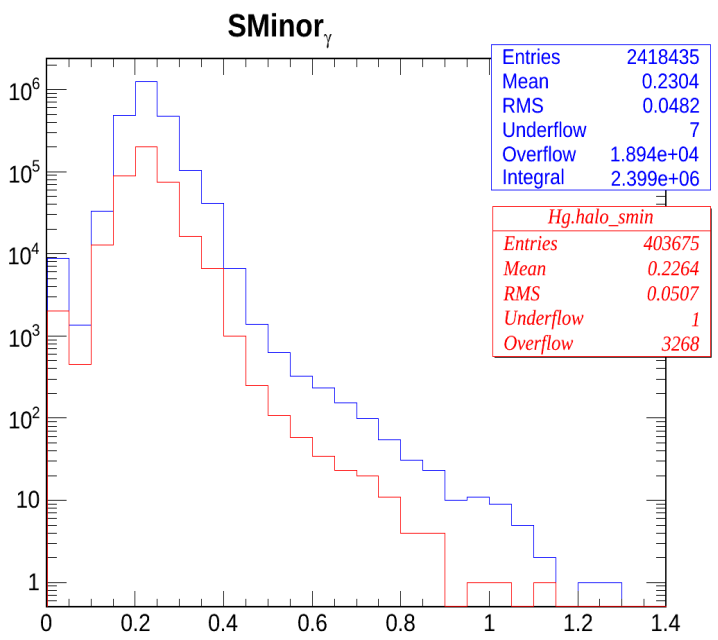


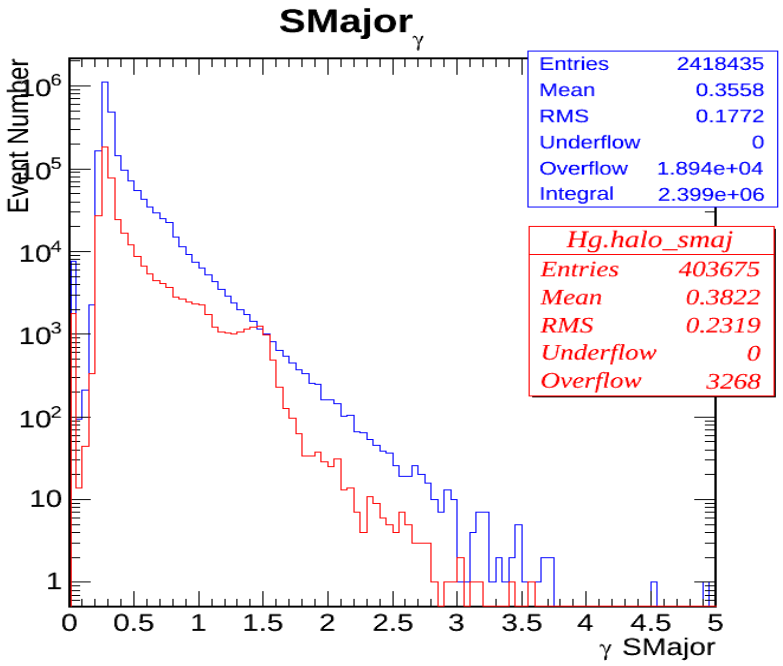
Ecal Isolation

Hcal Isolation

Egamma(Blue) Halo(Red) Photon

Photon Iso and Id variables.



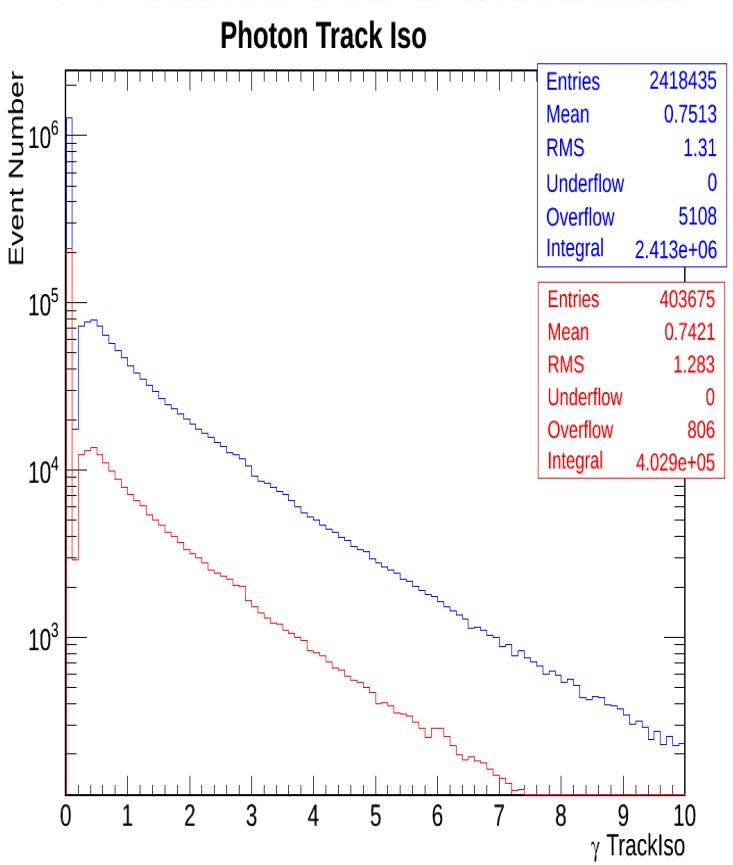


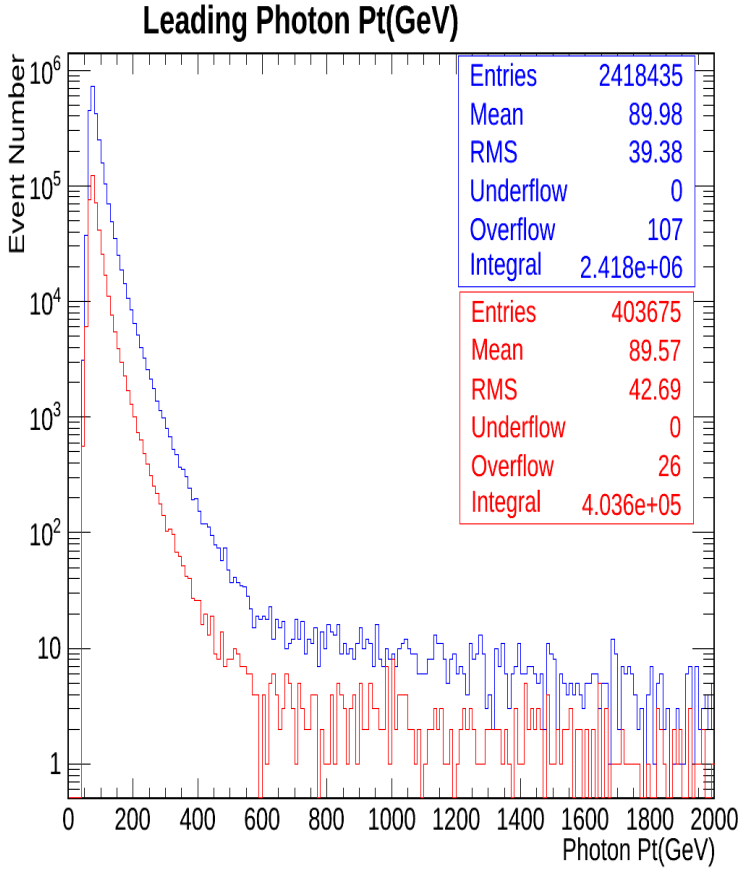
SMinor SMajor

Egamma and Halo have very similar isolation criteria.

Egamma(Blue) Halo(Red) Photon

Egamma Photon Id variables.



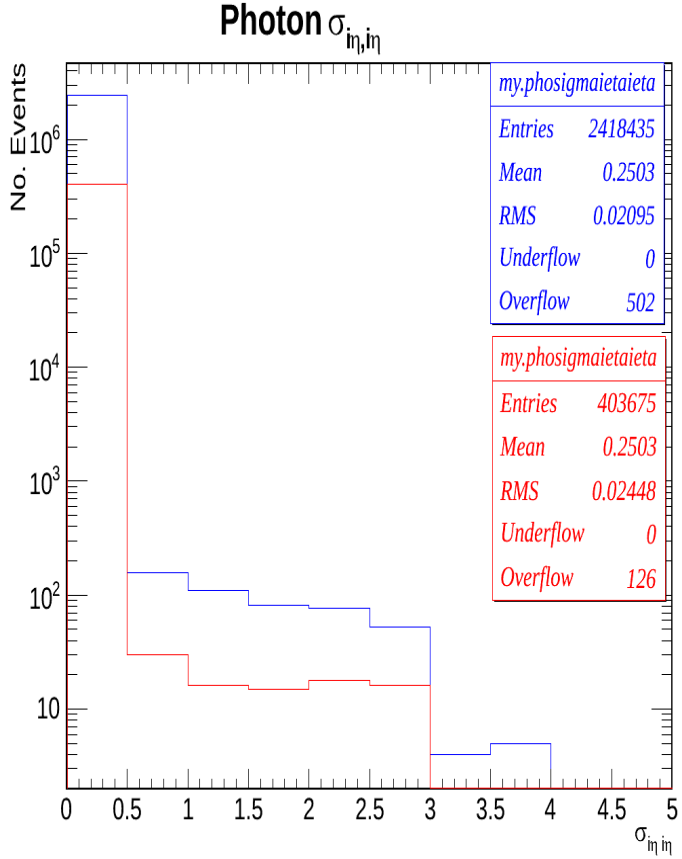


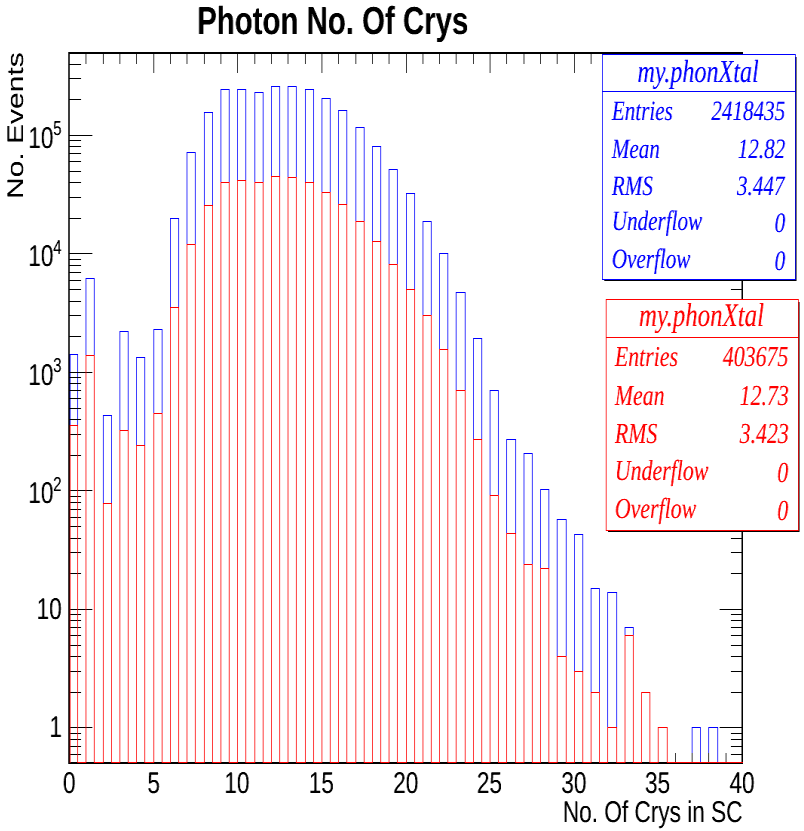
Track Isolation

Leading photon pt

Egamma(Blue) Halo(Red) Photon

Egamma Photon Id variables.





Sigma Ieta Ieta

Number of Crystals in BC

Egamma(Blue) Halo(Red) Photon