Displaced Photon Background Studies Update LL Meeting Nov 02 2012

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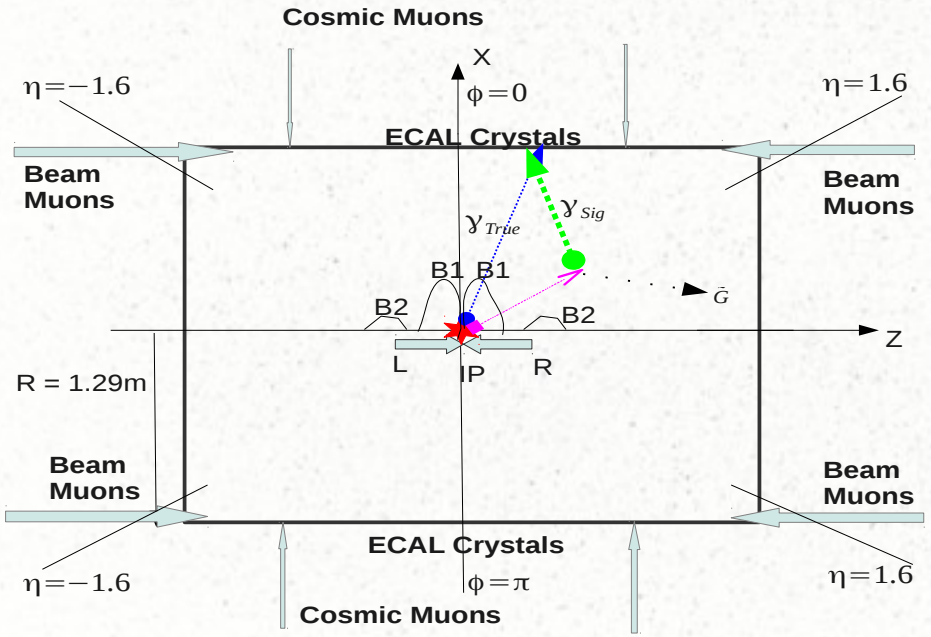
DataSet & Triggers

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

Signal from Background



- **Ecal Time Calibration:**

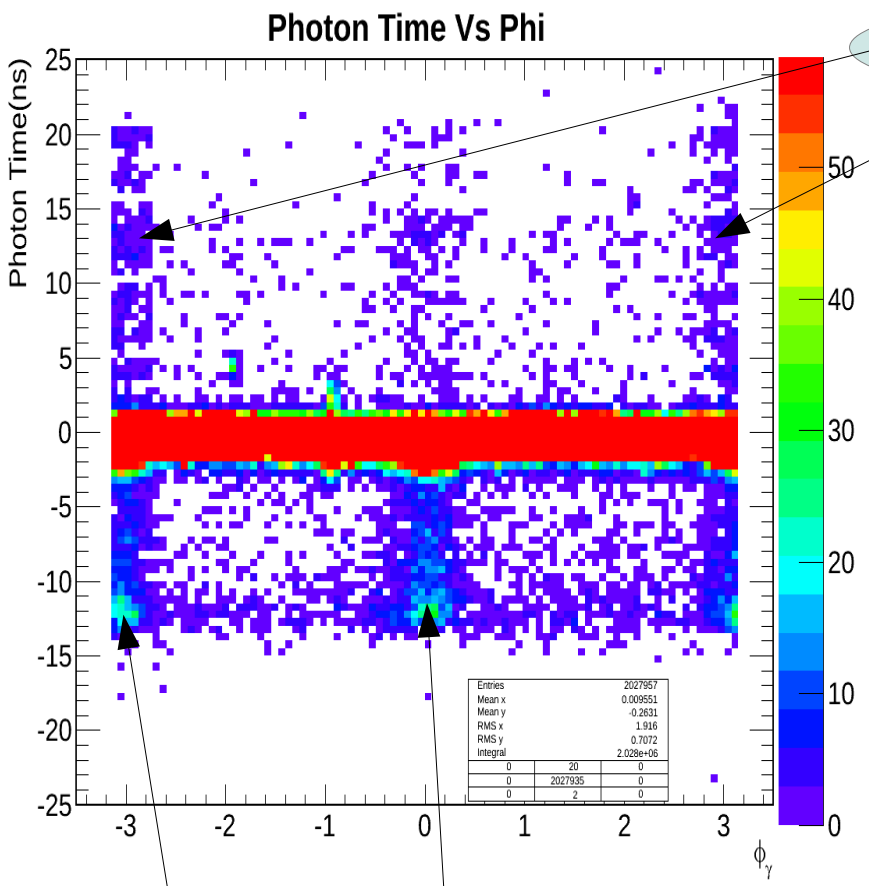
$$\langle t_{\gamma_{true}} \rangle \simeq 0 \quad \text{but} \quad t_{\gamma_{Sig}} \neq 0$$

- **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



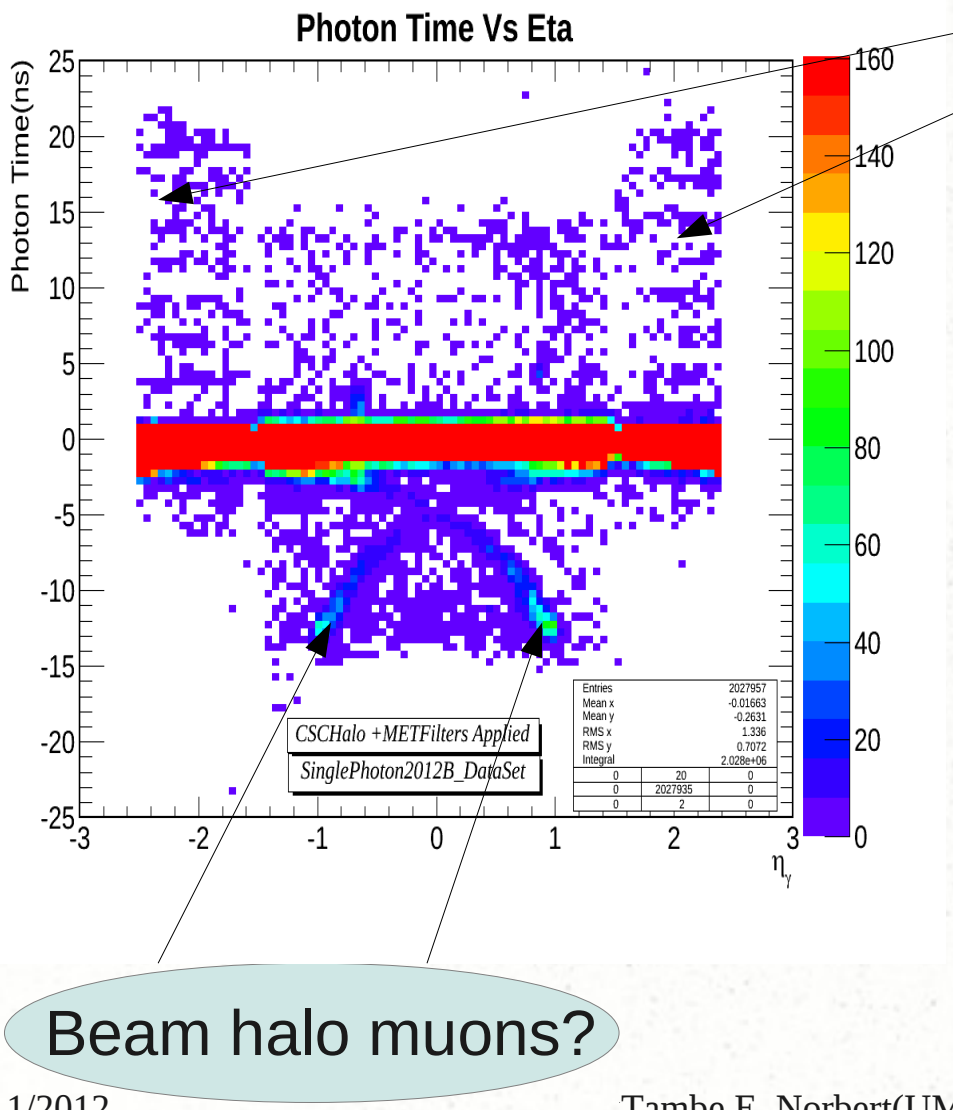
Cosmic muons?

Beam halo muons?

- Observed in **2012B dataset**
- High intensity in

  Phi = 0 +/- pi
- Most arriving early in Ecal time.
- +ve and -ve might not all come from same source.

Photon time vs Eta

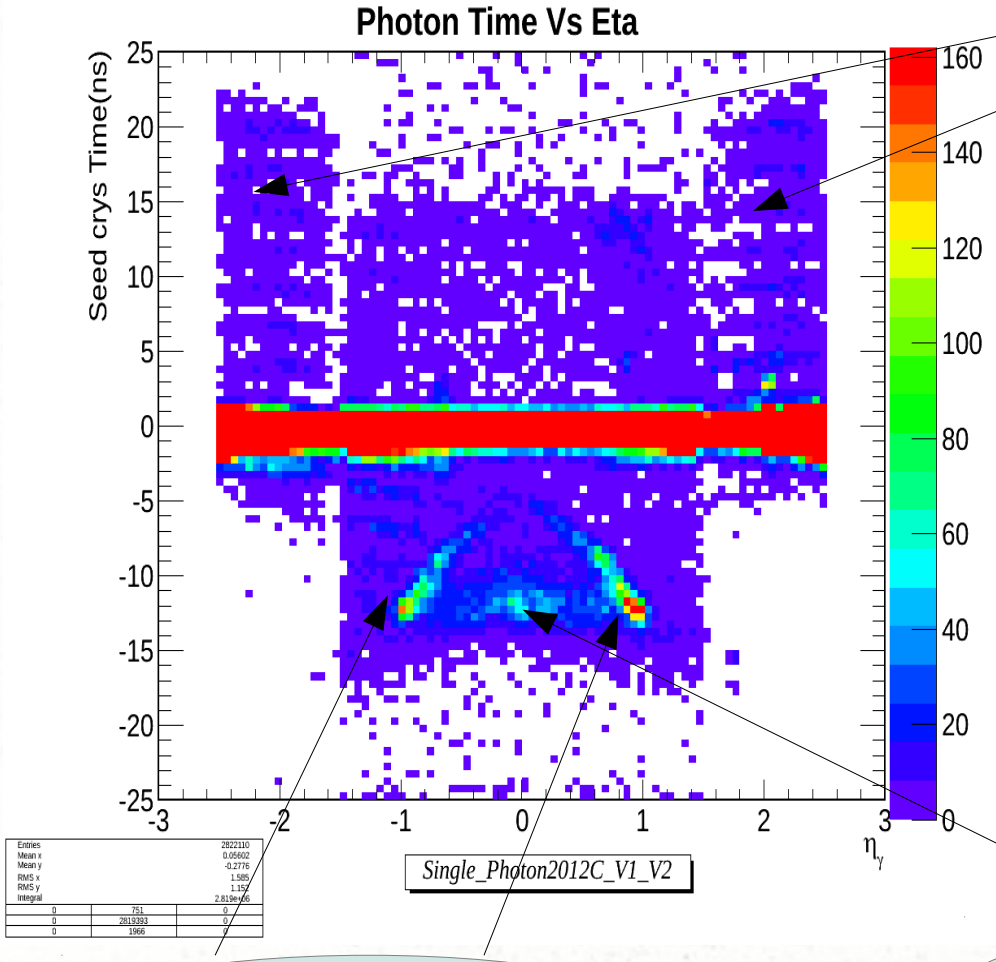


Cosmic muons?

Beam halo muons?

- Intense at impact point in EB then slowly decreases towards IP.
- Eta dependence in early Ecal time.
- Surely +ve and -ve cannot all come from a **unique** source.

Photon time vs Eta



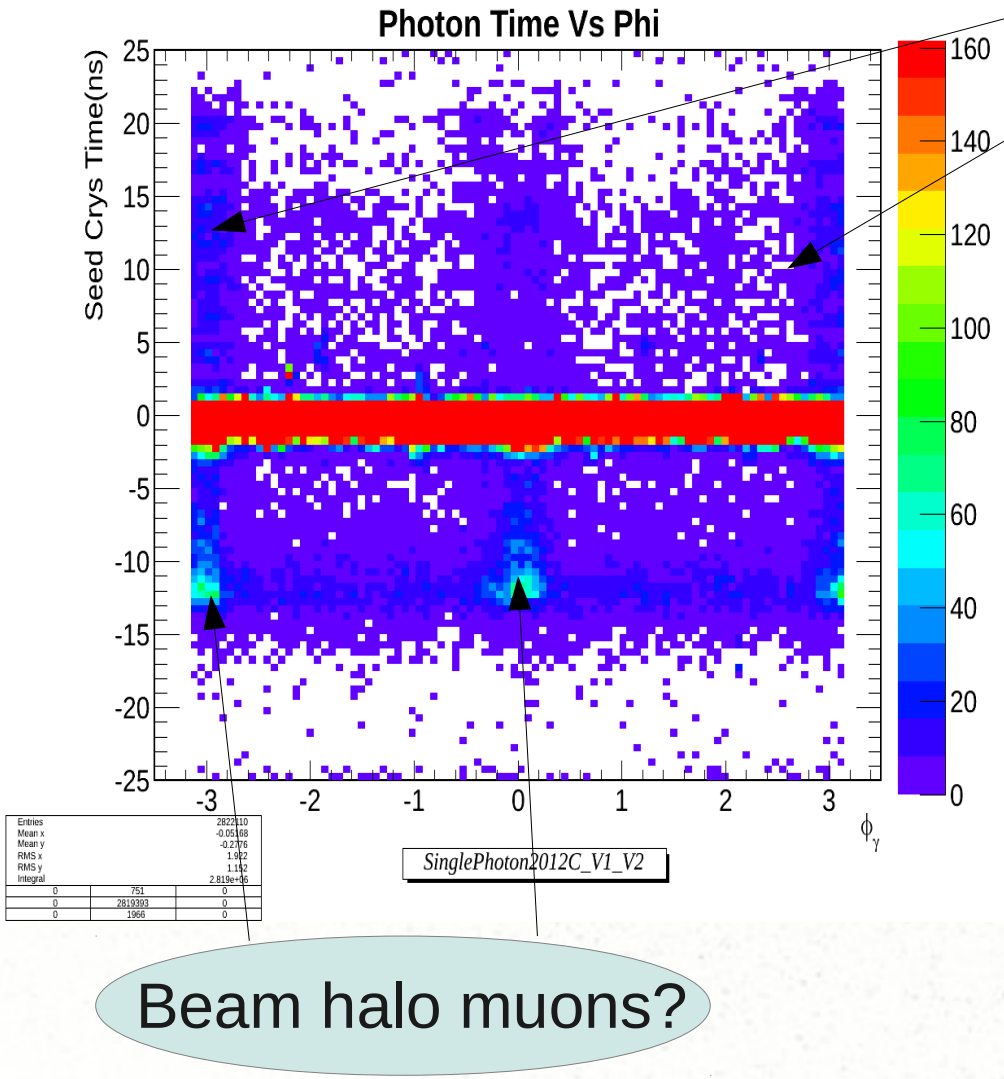
Cosmic muons?

- Similar phenomenon in **2012C dataset**.
- Increased intensity with luminosity
- The fore it must be real.

Beam halo muons?

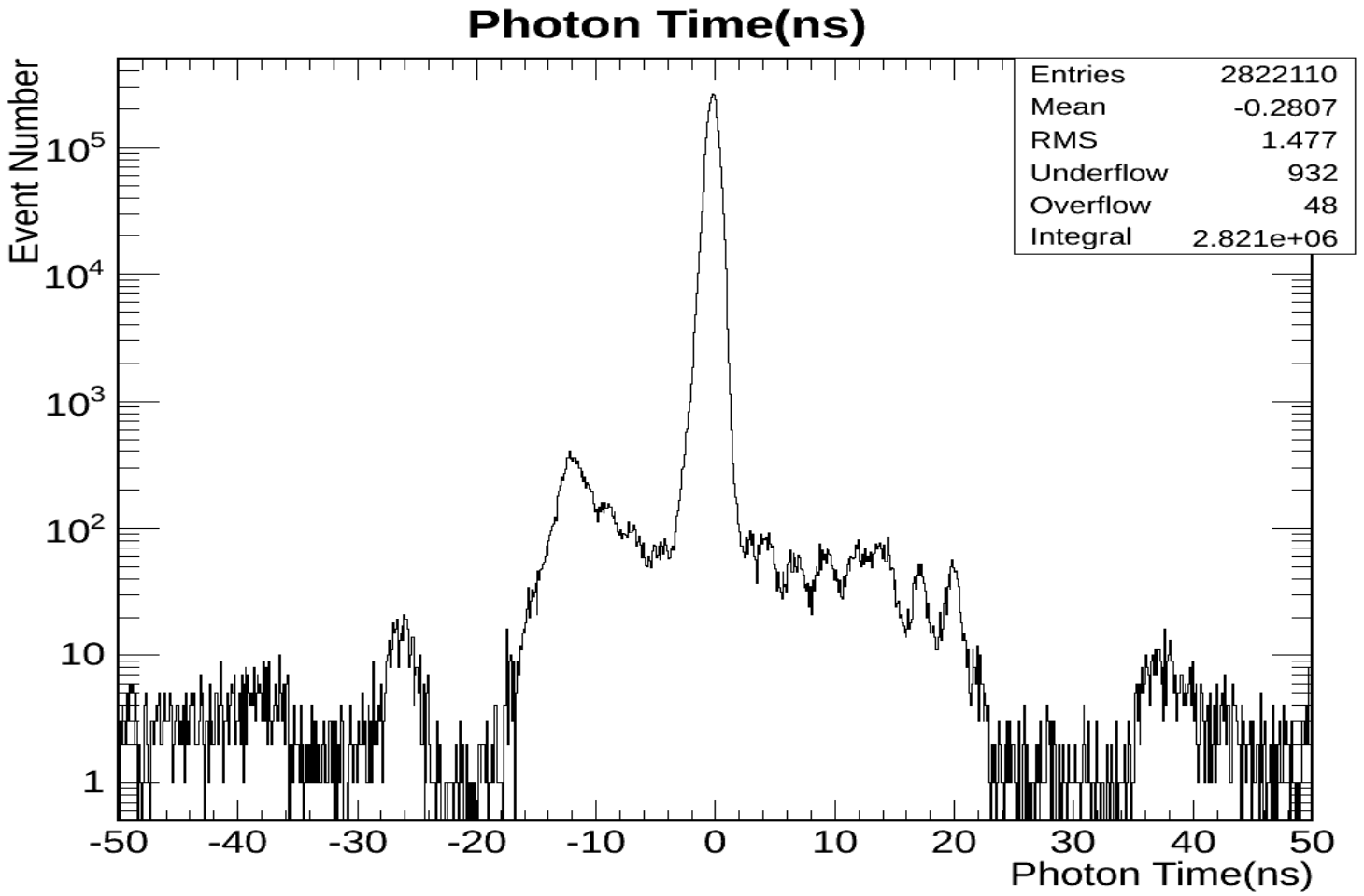
Must be spikes failing spike cleaning.

Photon time vs Phi



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

Photon Time



Cosmic, spikes, halo, and what else? All here!

Definition

- **Egamma Photon** :

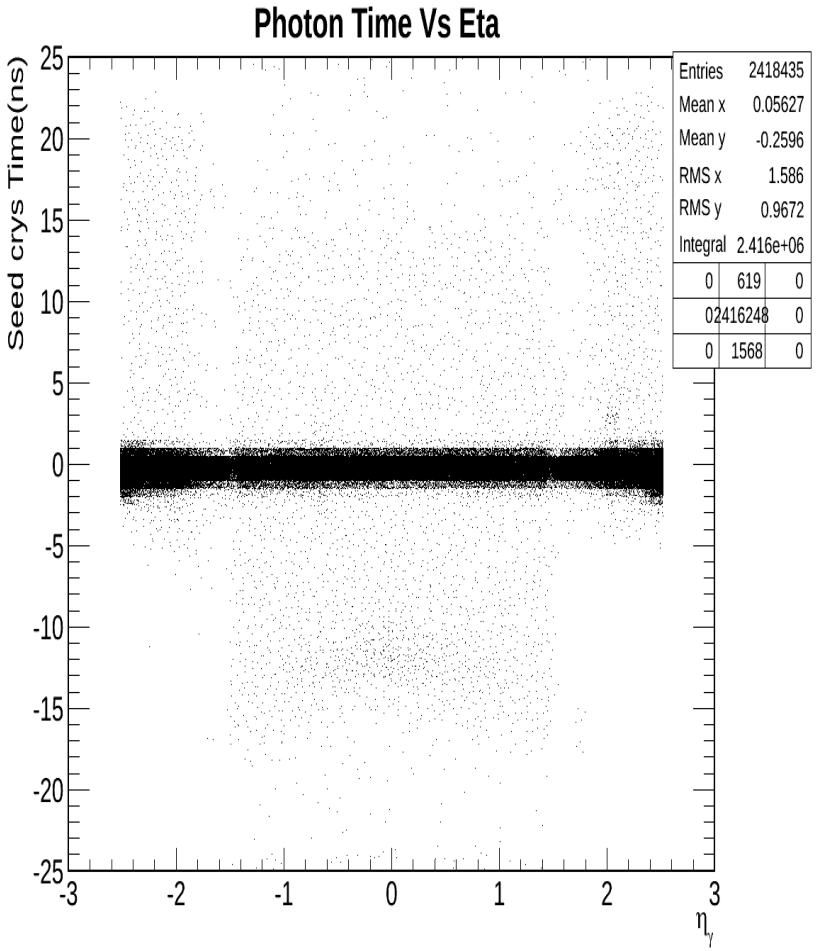
  * Egamma + VL Iso selection criteria + Sminor.

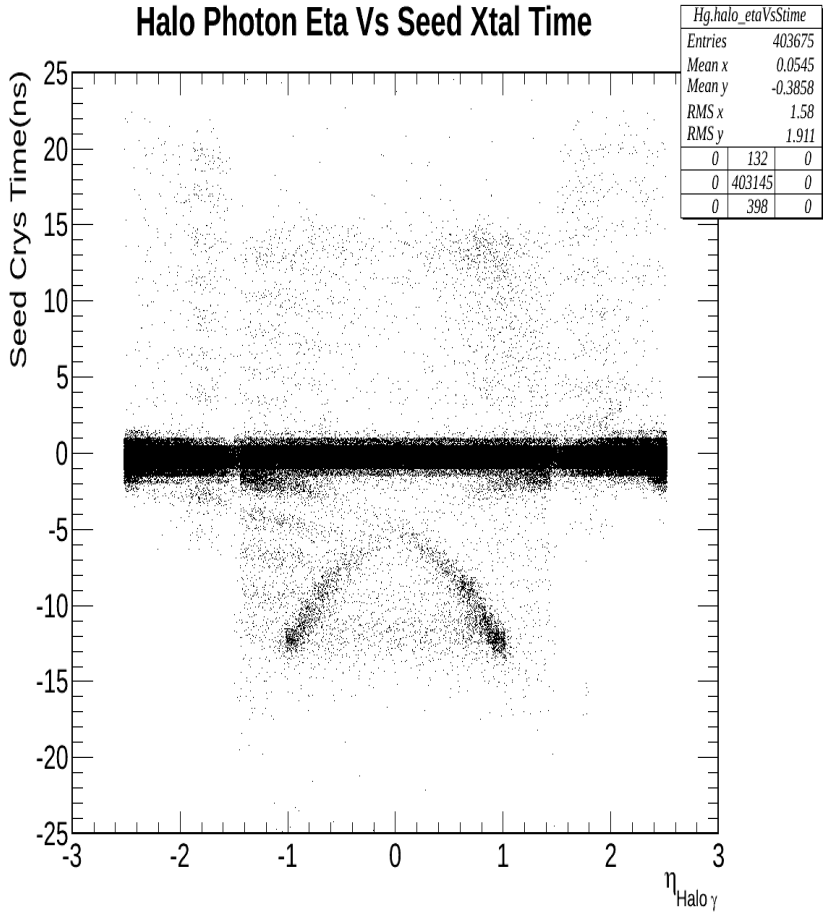
- **Halo Photon** :

  Tag as Halo photon if:

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

EB & EE Photons

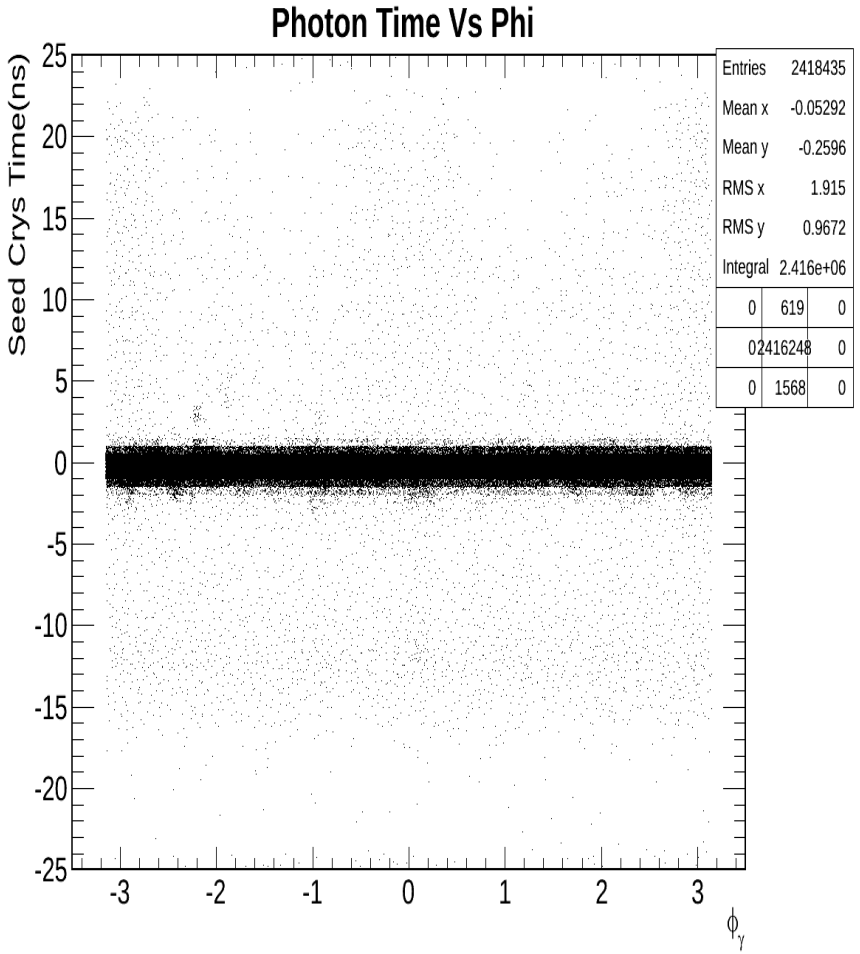


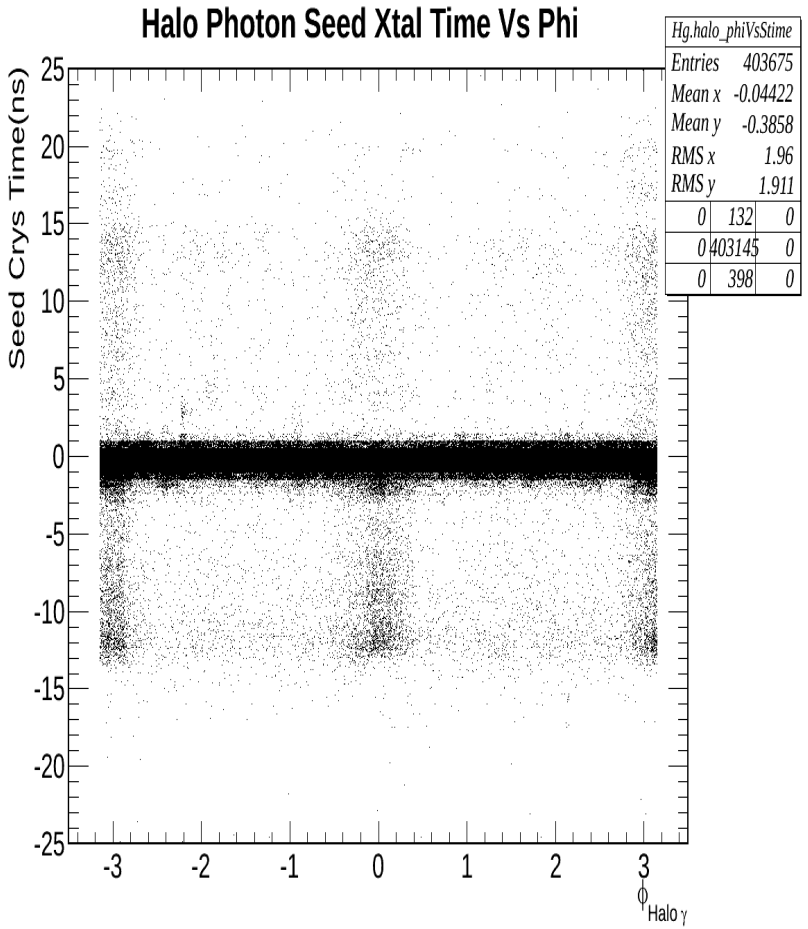


Egamma Photon

Halo Photon

EB & EE Photons

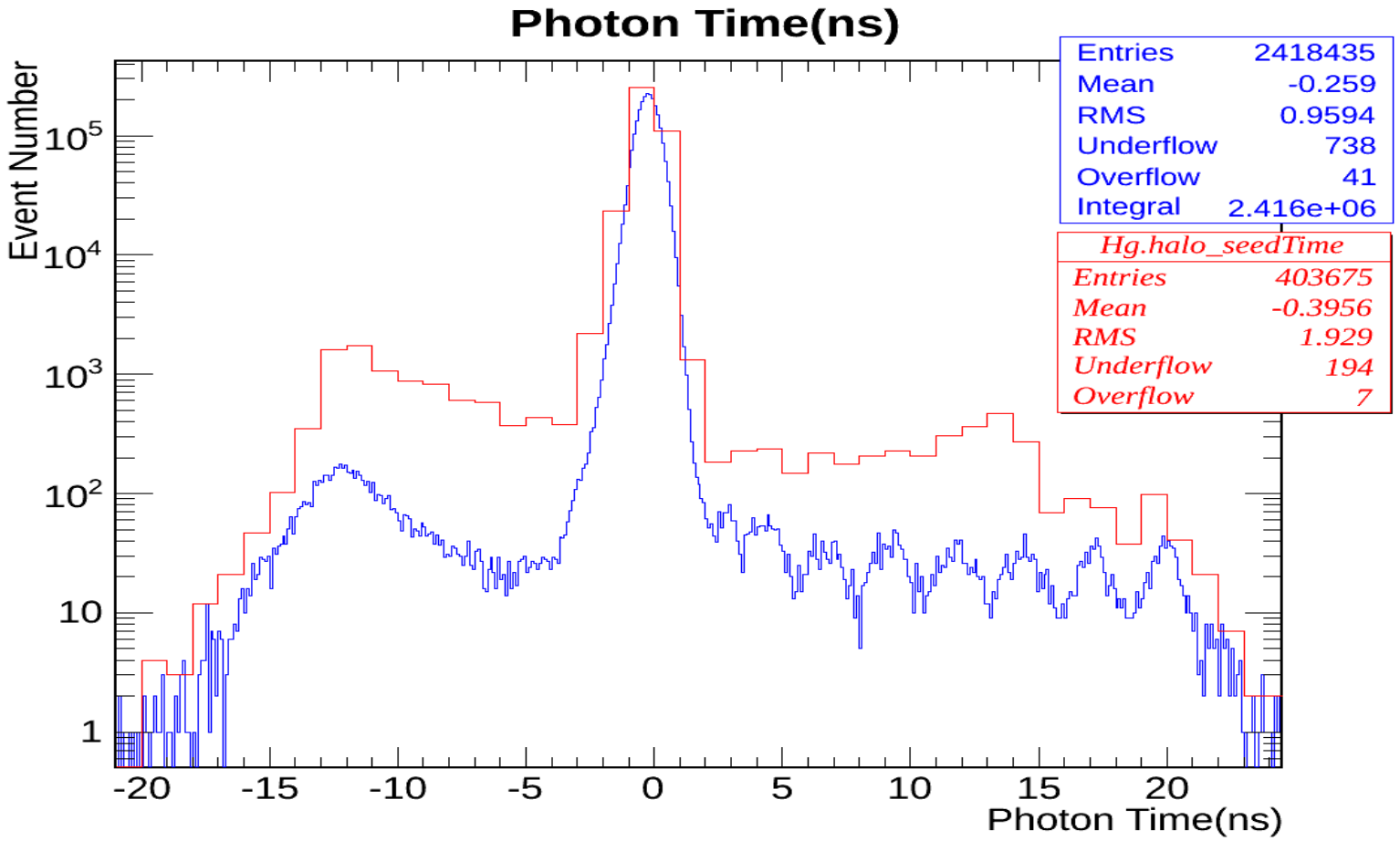




Egamma Photon

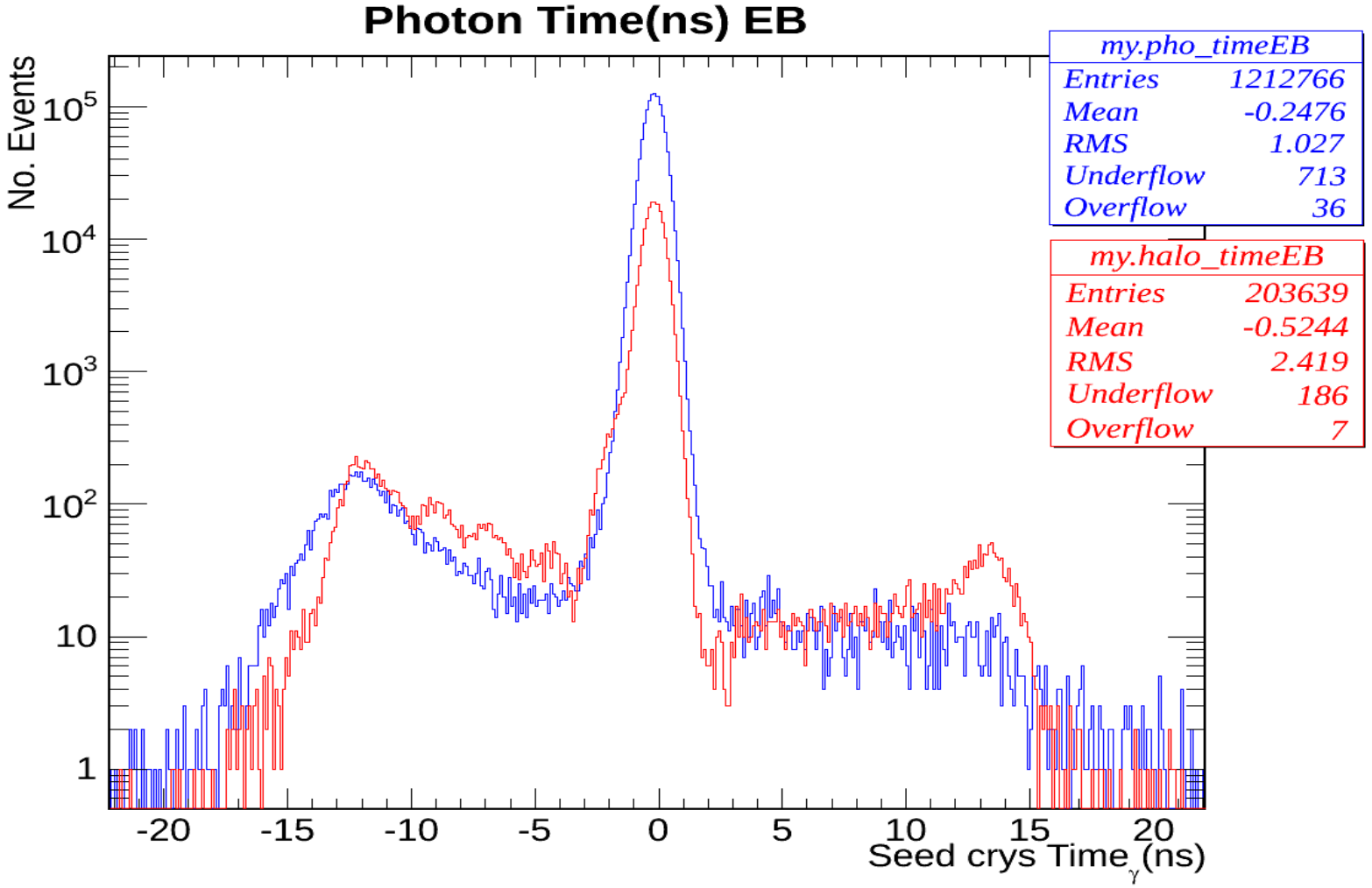
Halo Photon

EB & EE Photon Time



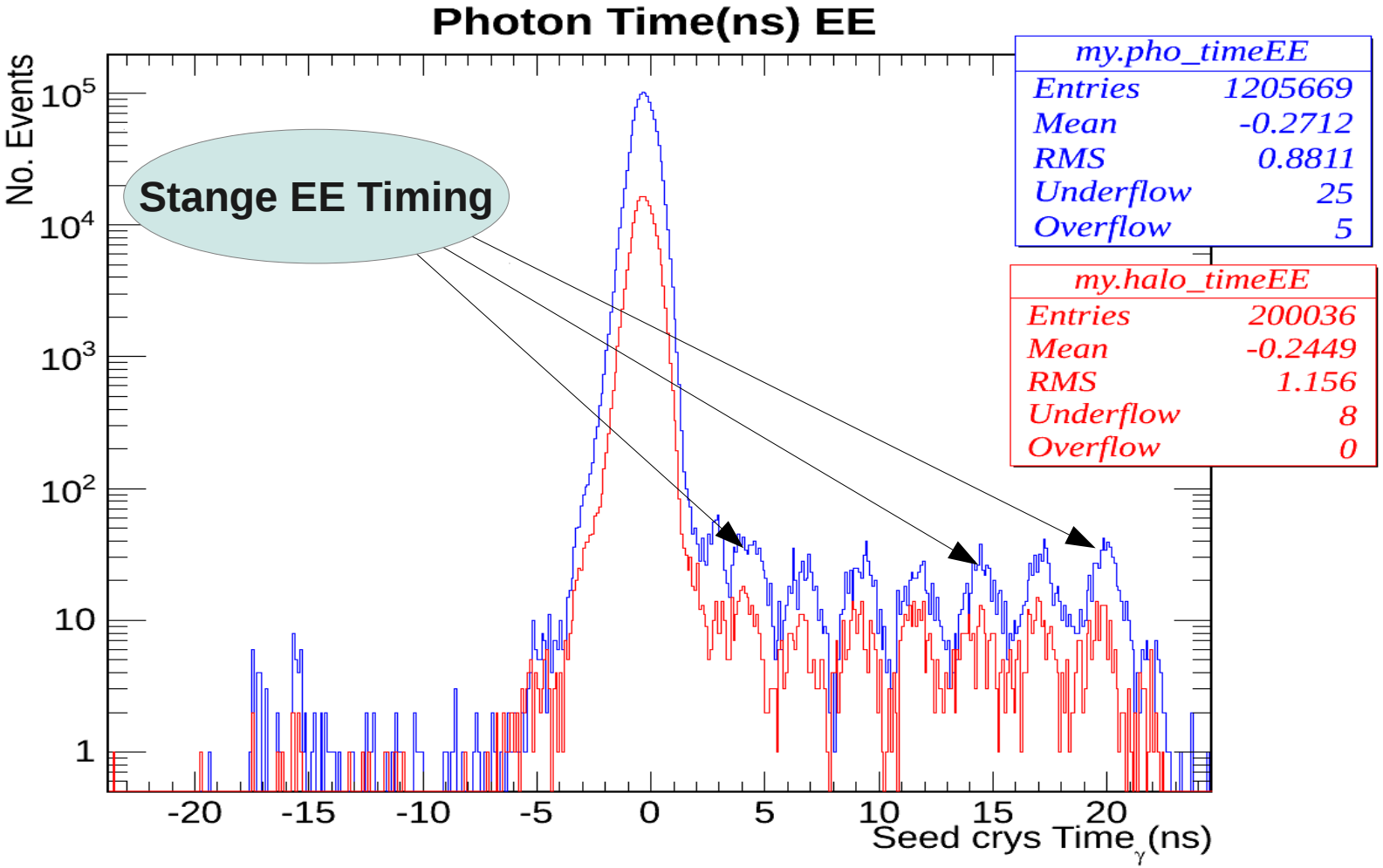
- Strange structure in later time

Photon Time EB



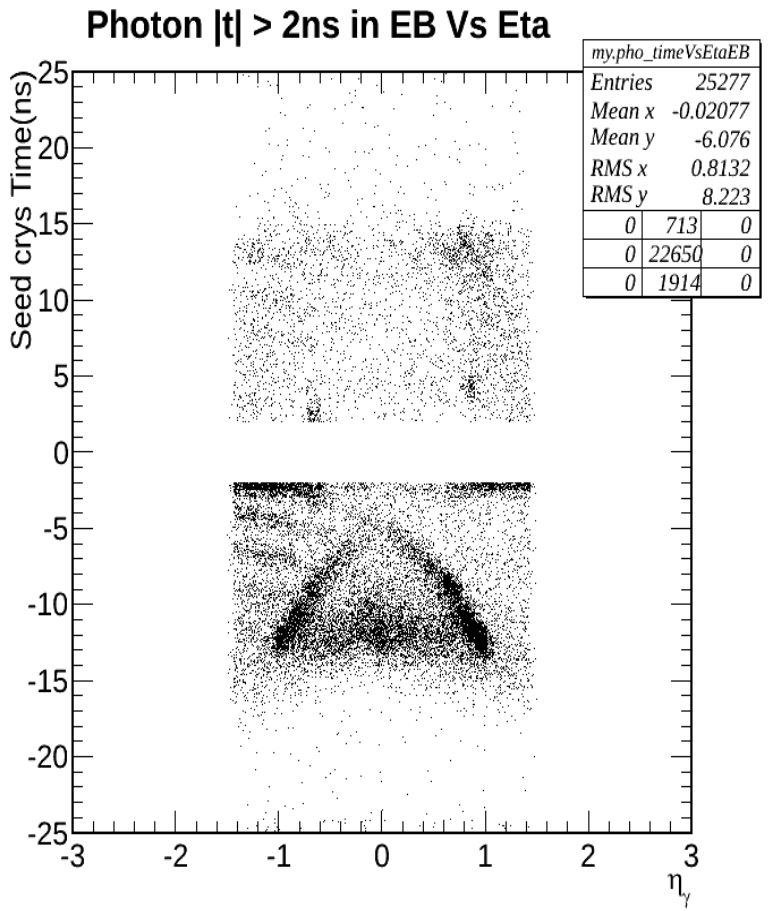
Egamma(Blue) Halo(Red) Photon Ecal time

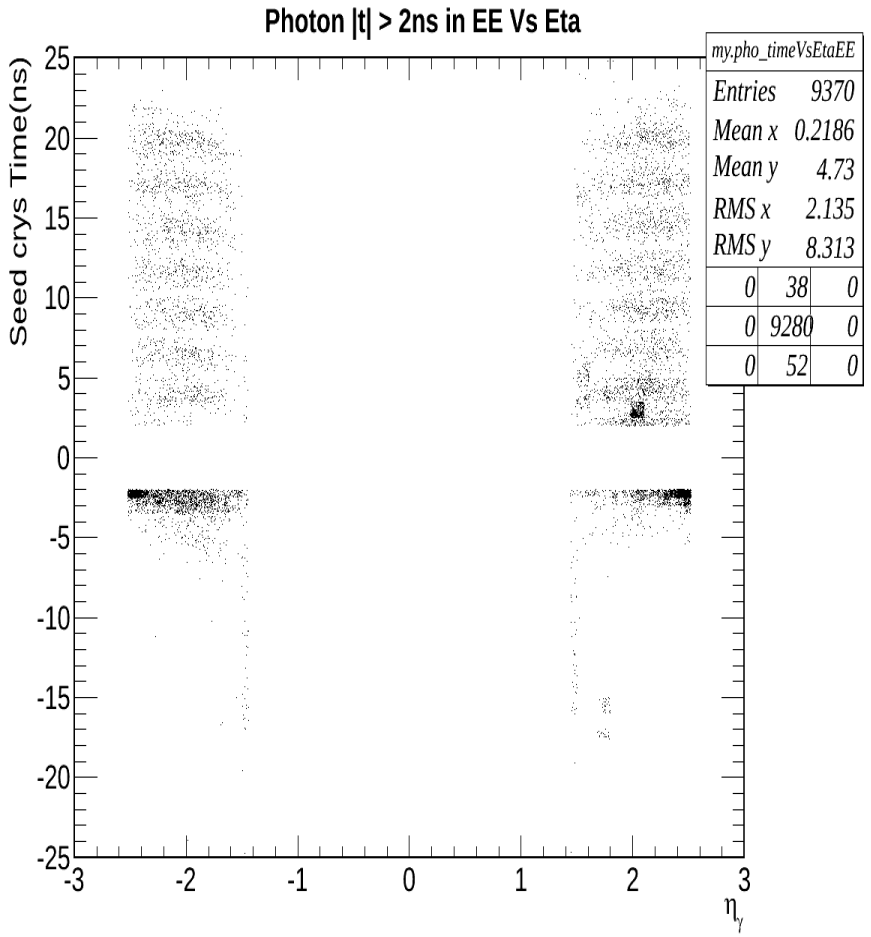
Photon Time EE



Egamma(Blue) Halo(Red) Photon Ecal time

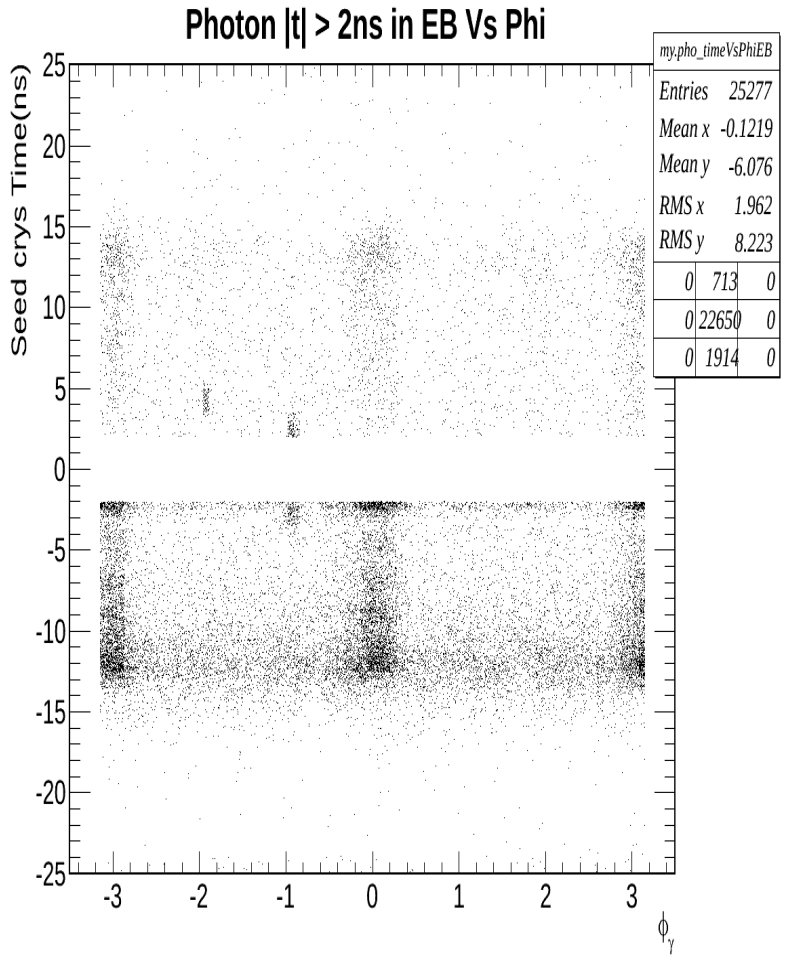
Region of Interest EB & EE

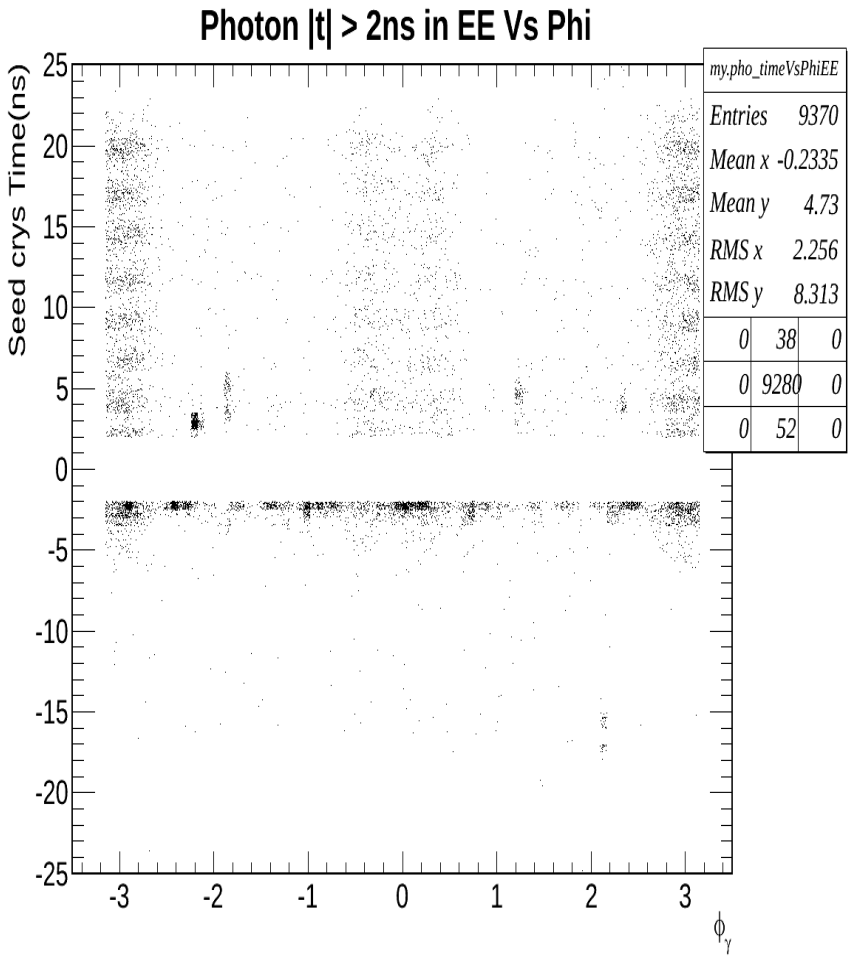




Egamma + Halo Photons time Vs Eta

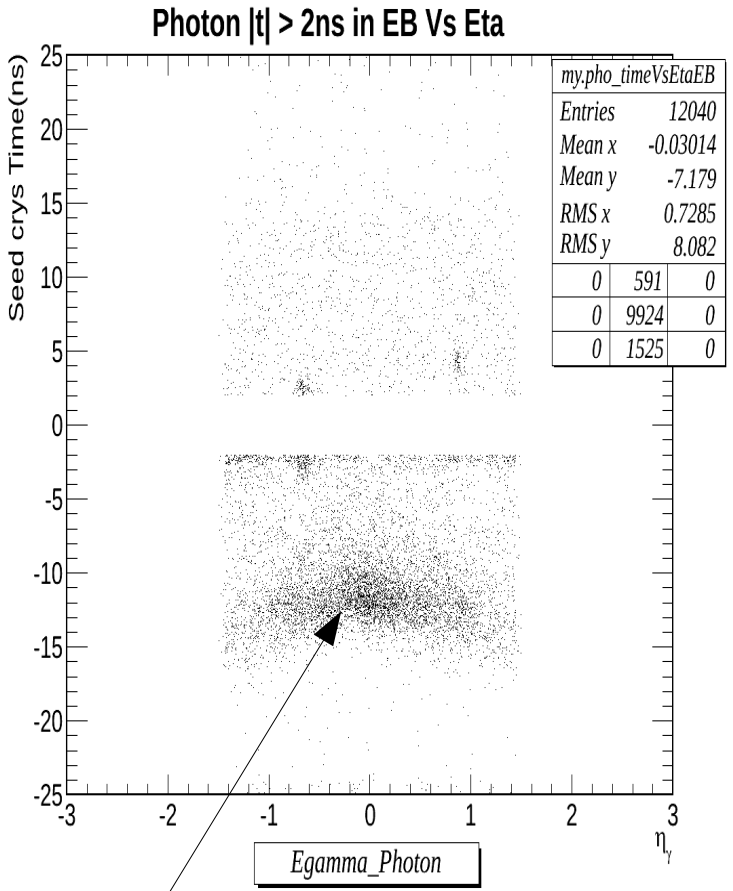
Region of Interest EB & EE

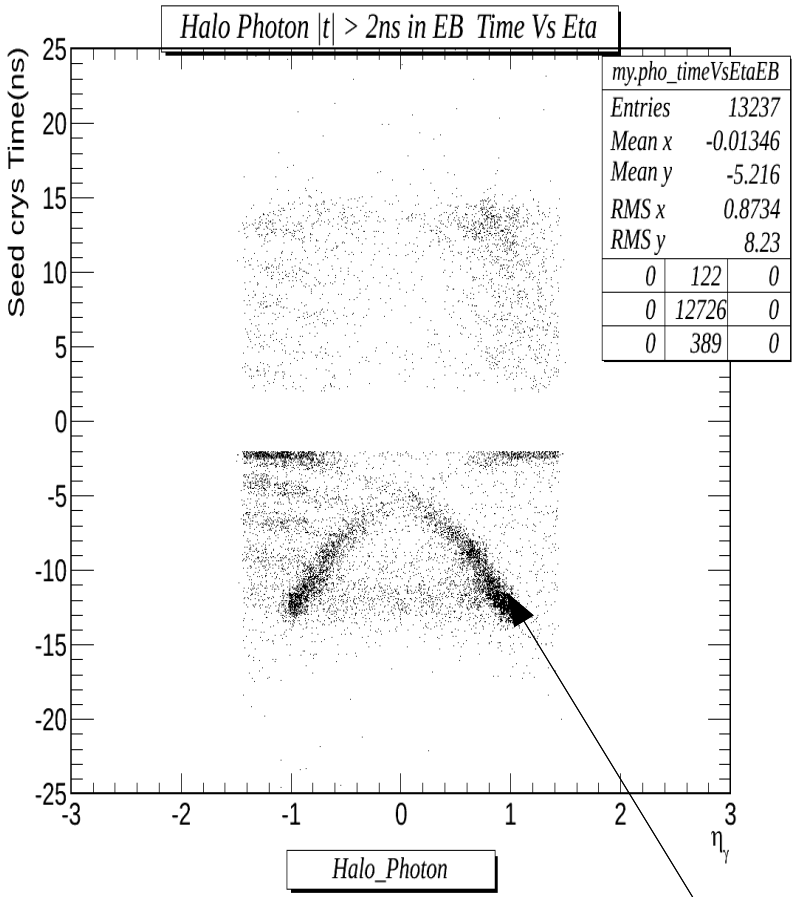




Egamma + Halo Photons time Vs Phi

Region of Interest: EB





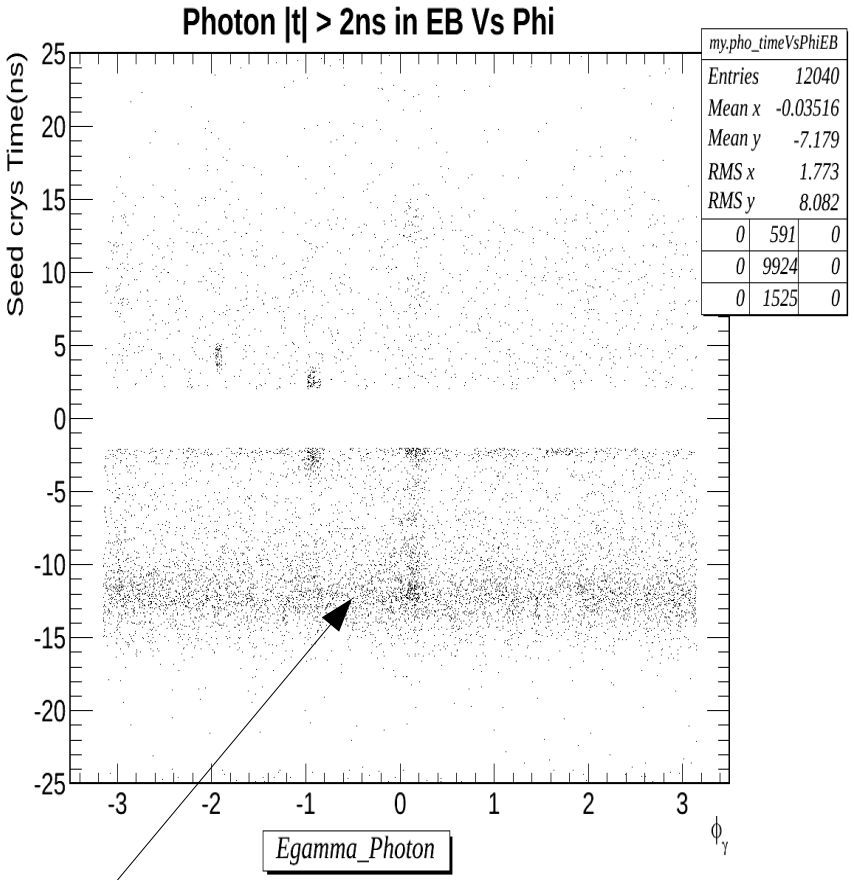
Spikes?

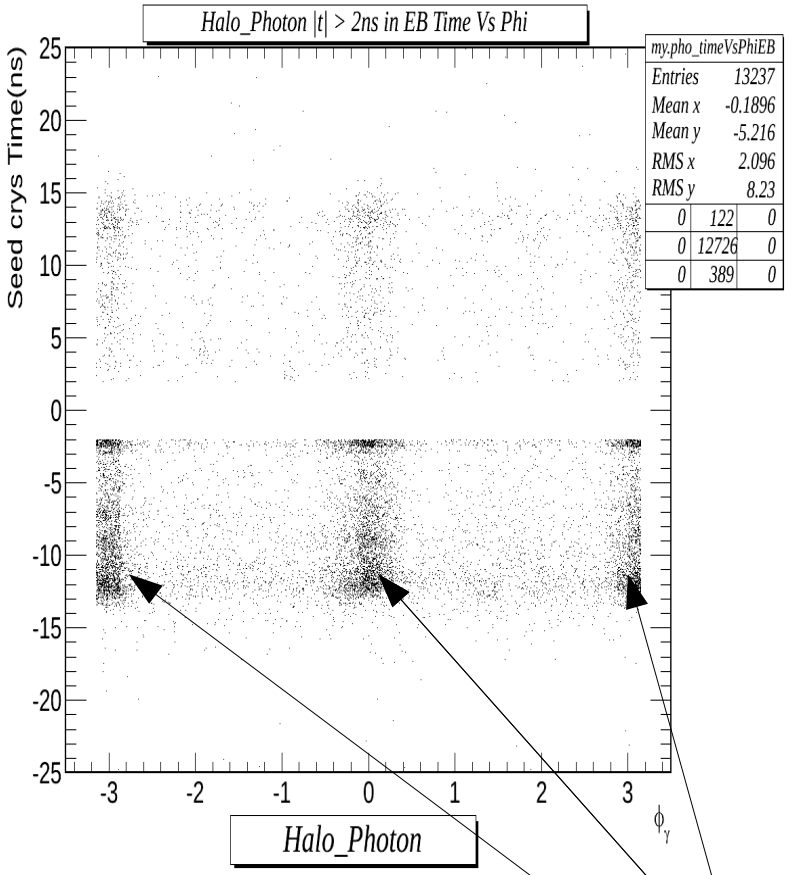
Beam Halos

Egamma photons

Halo photons.

Region of Interest: EB





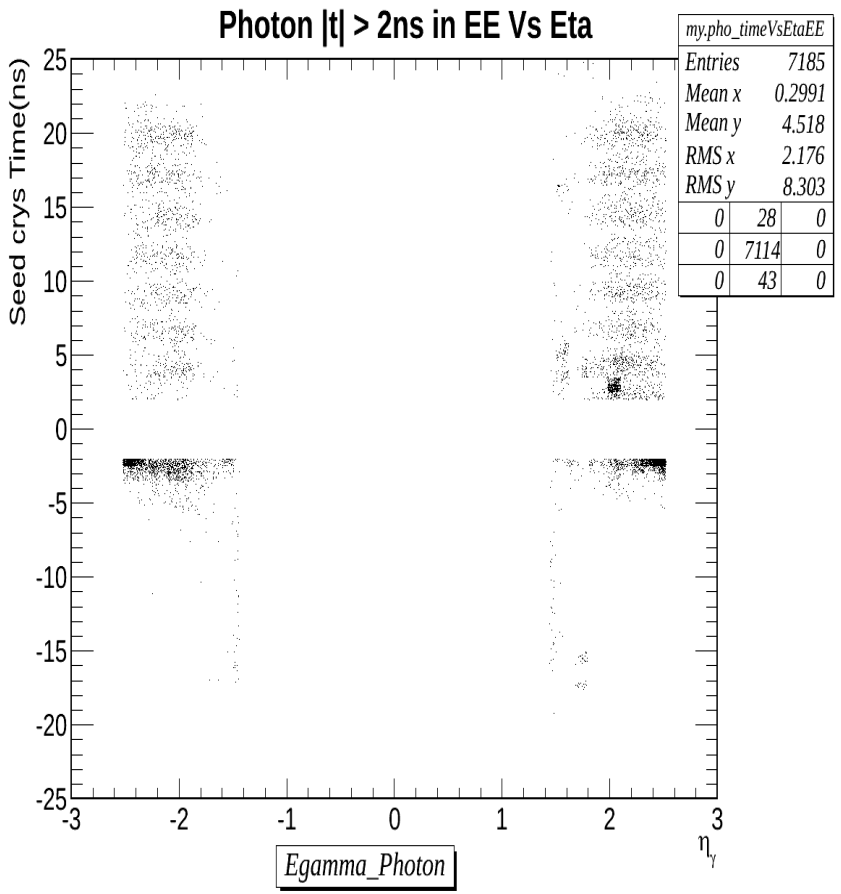
Spikes?

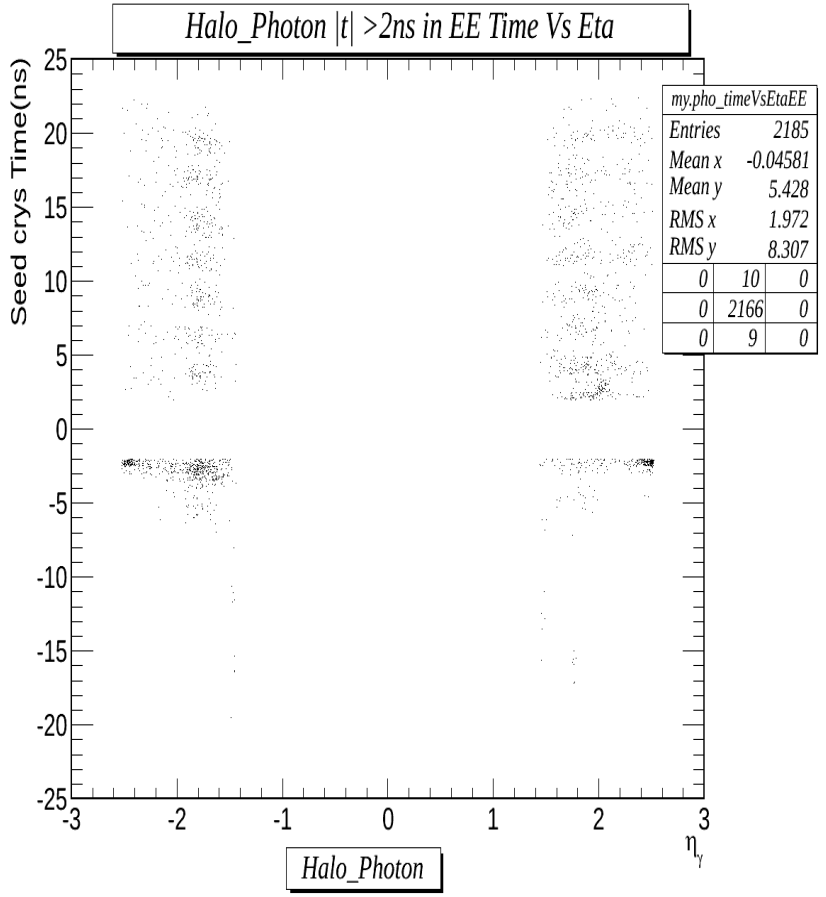
Beam Halos

Egamma photons

Halo photons.

Region of Interest: EE

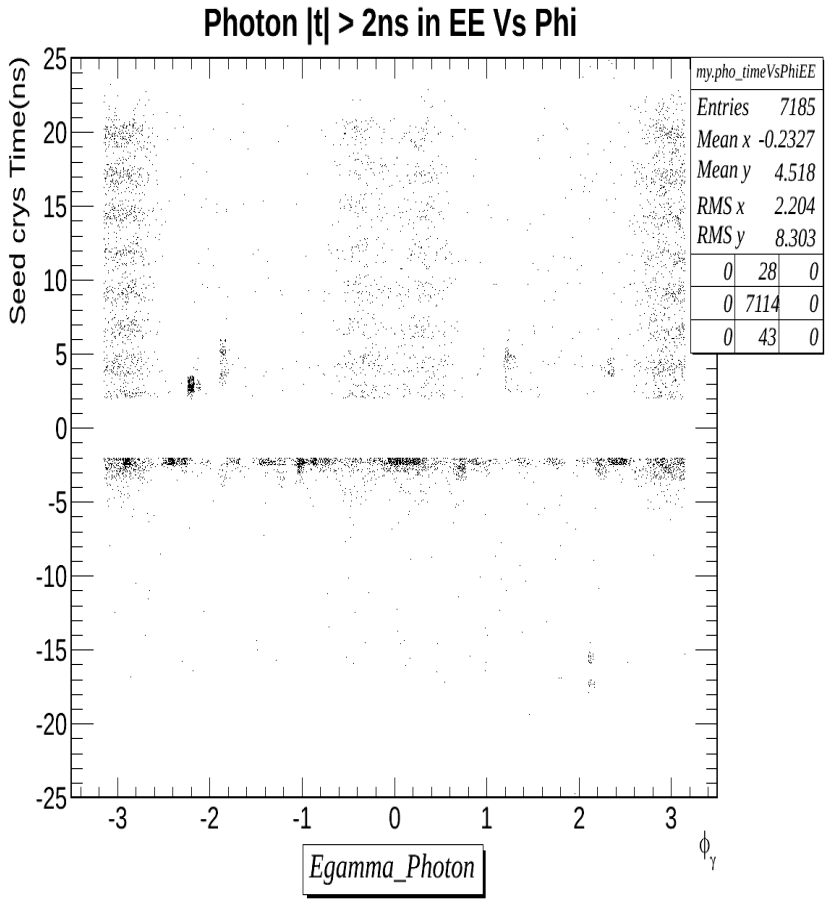


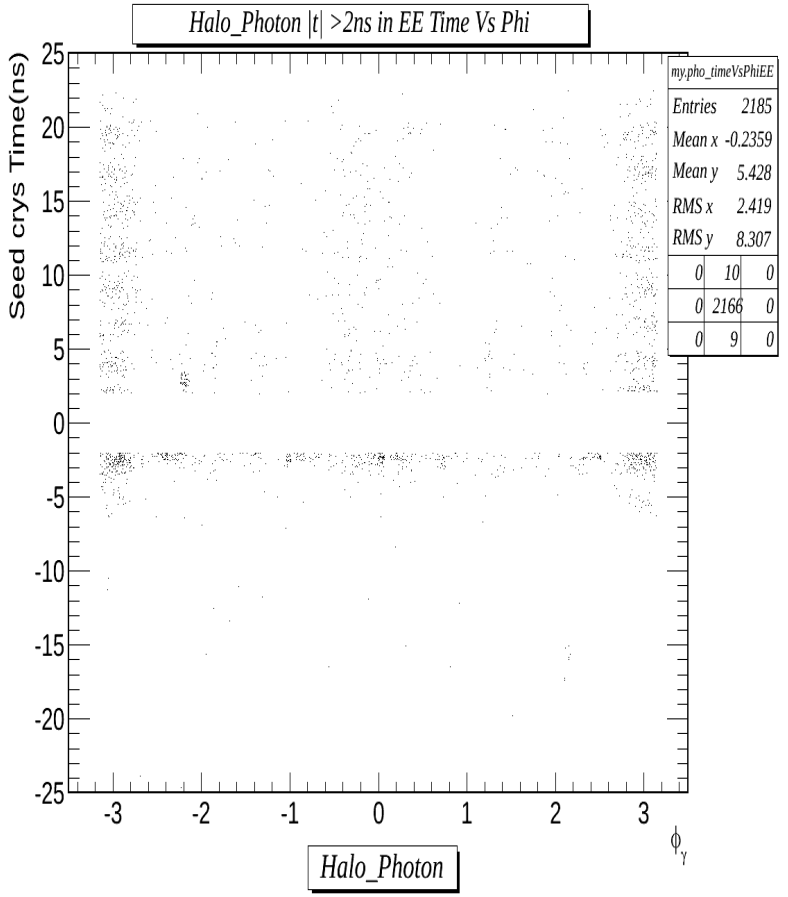


Few early time Halo photon than in EB

Egamma photons Halo photons.

Region of Interest: EE





Few early time Halo photon than in EB

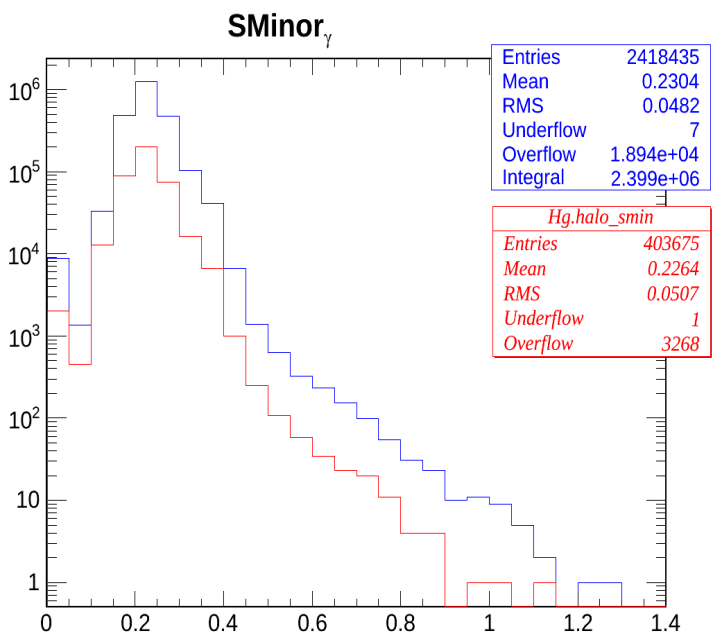
Egamma photons Halo photons.

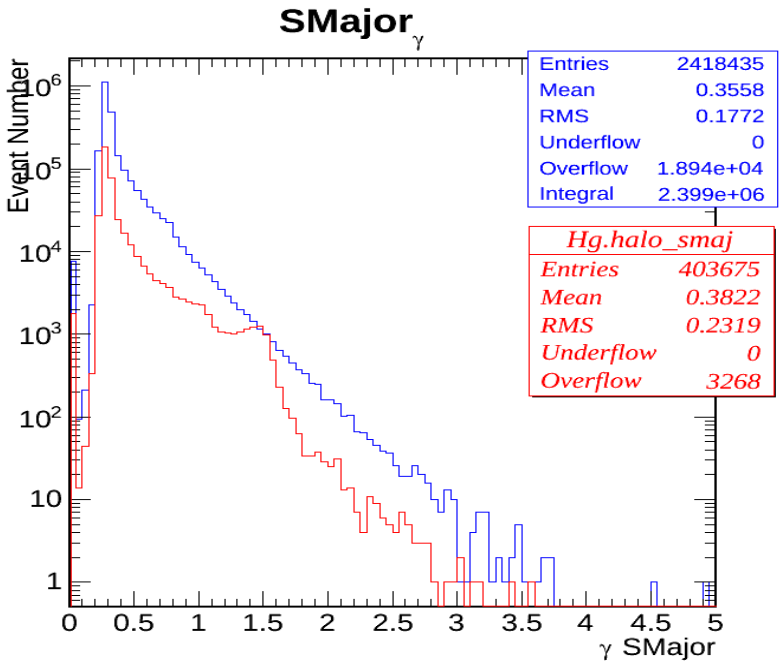
Halo Tagging & Egamma Photon Selection Efficiency.

|t| > 2ns	Total Number of Photons	Egamma Photons	Selection Efficiency(%)	CSC Halo Tagged Photons	Tagging Efficiency
EB	25277	12040	**47.6**	13237	**52.36**
EE (|eta| < 2.5)	9370	7185	**76.68**	2185	**23.3**

- For photons with time outside 2ns window:
  - Halo tagging efficiency : **EB(EE) = 52.36(23.3)%**
  - Egamma selection efficiency: **EB(EE) = 47.6(76.68)%**

Photon Iso and Id variables.





SMinor SMajor

Egamma and Halo have very similar isolation criteria.

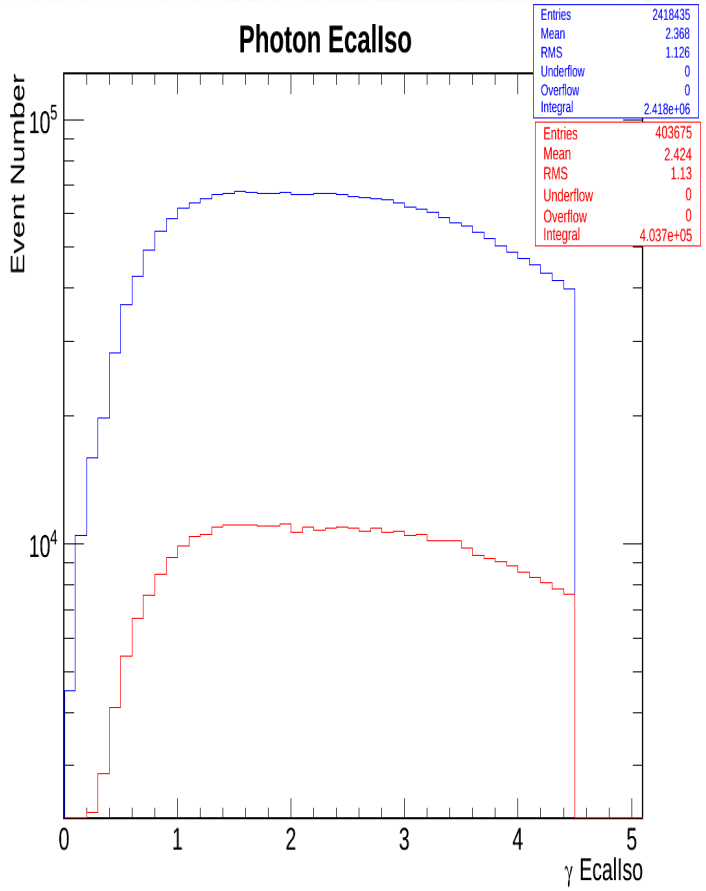
Egamma(Blue) Halo(Red) Photon

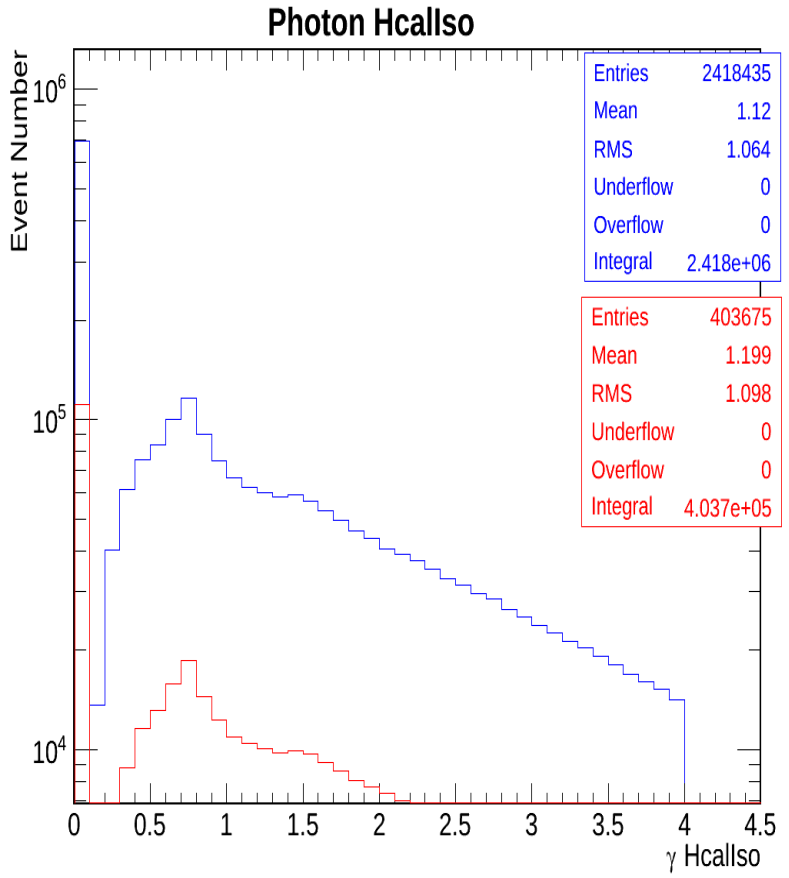
Summary

- 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.
- Egamma photon Isolation variable cannot reject these background photons(see BU slide).
- 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

Egamma Photon Id variables.



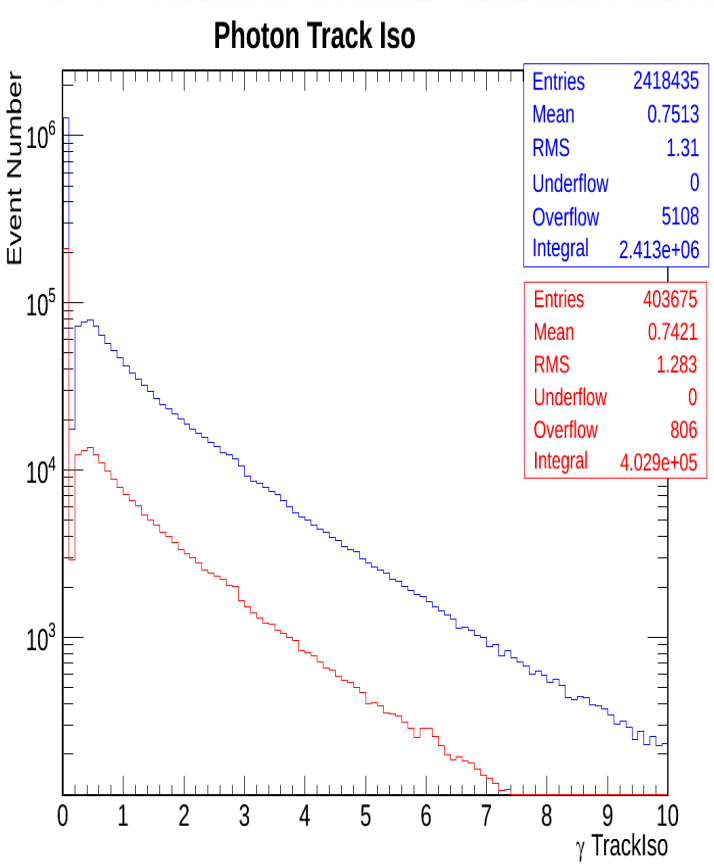


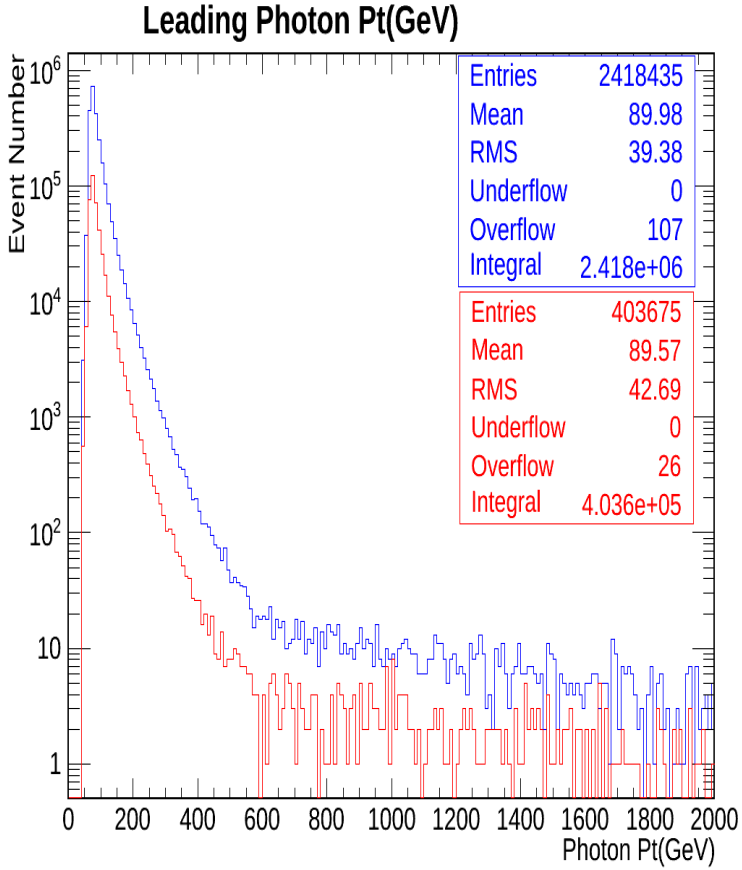
Ecal Isolation

Hcal Isolation

Egamma(Blue) Halo(Red) Photon

Egamma Photon Id variables.



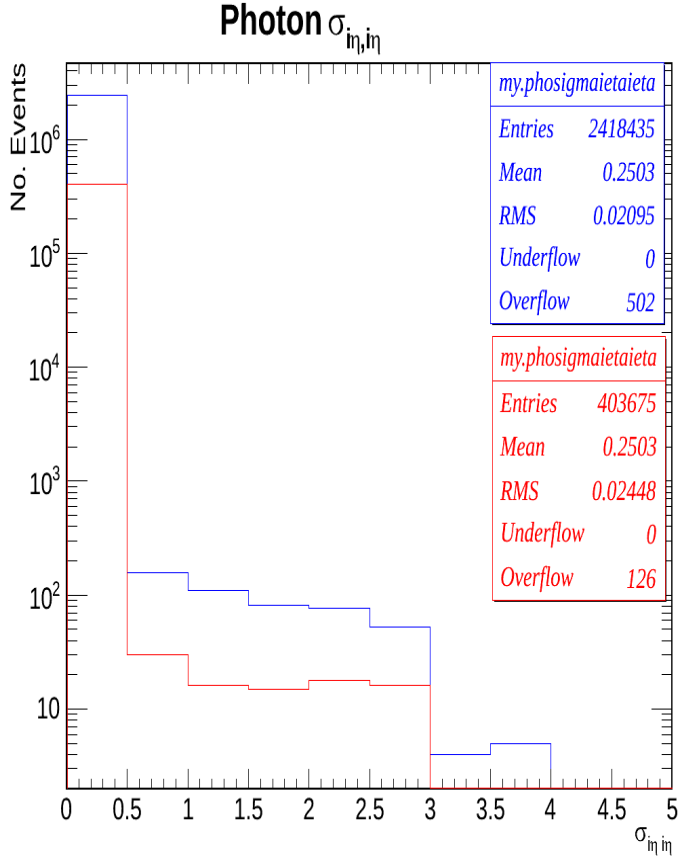


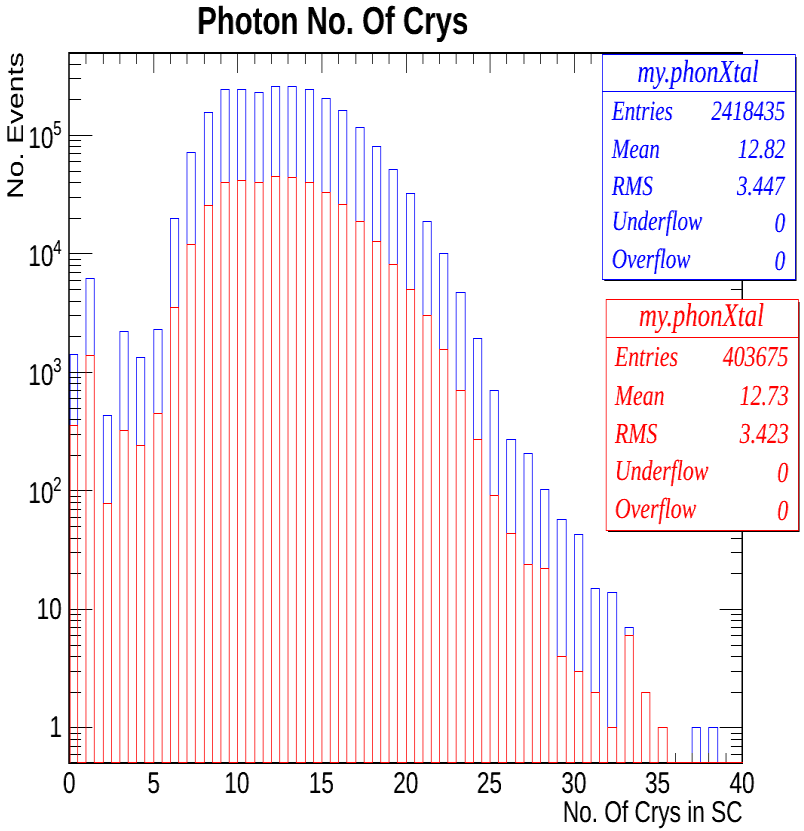
Track Isolation

Leading photon pt

Egamma(Blue) Halo(Red) Photon

Egamma Photon Id variables.



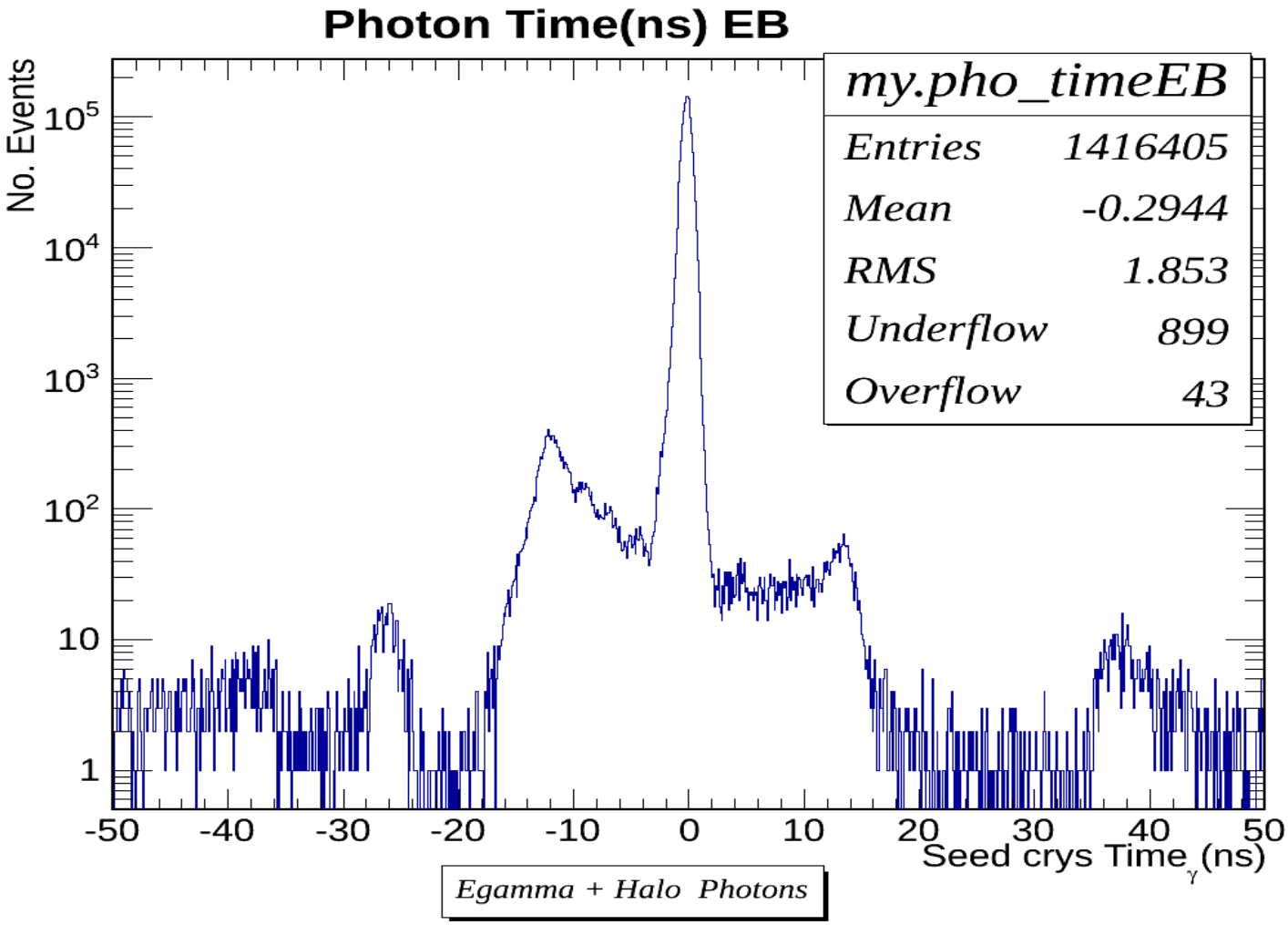


Sigma Ieta Ieta

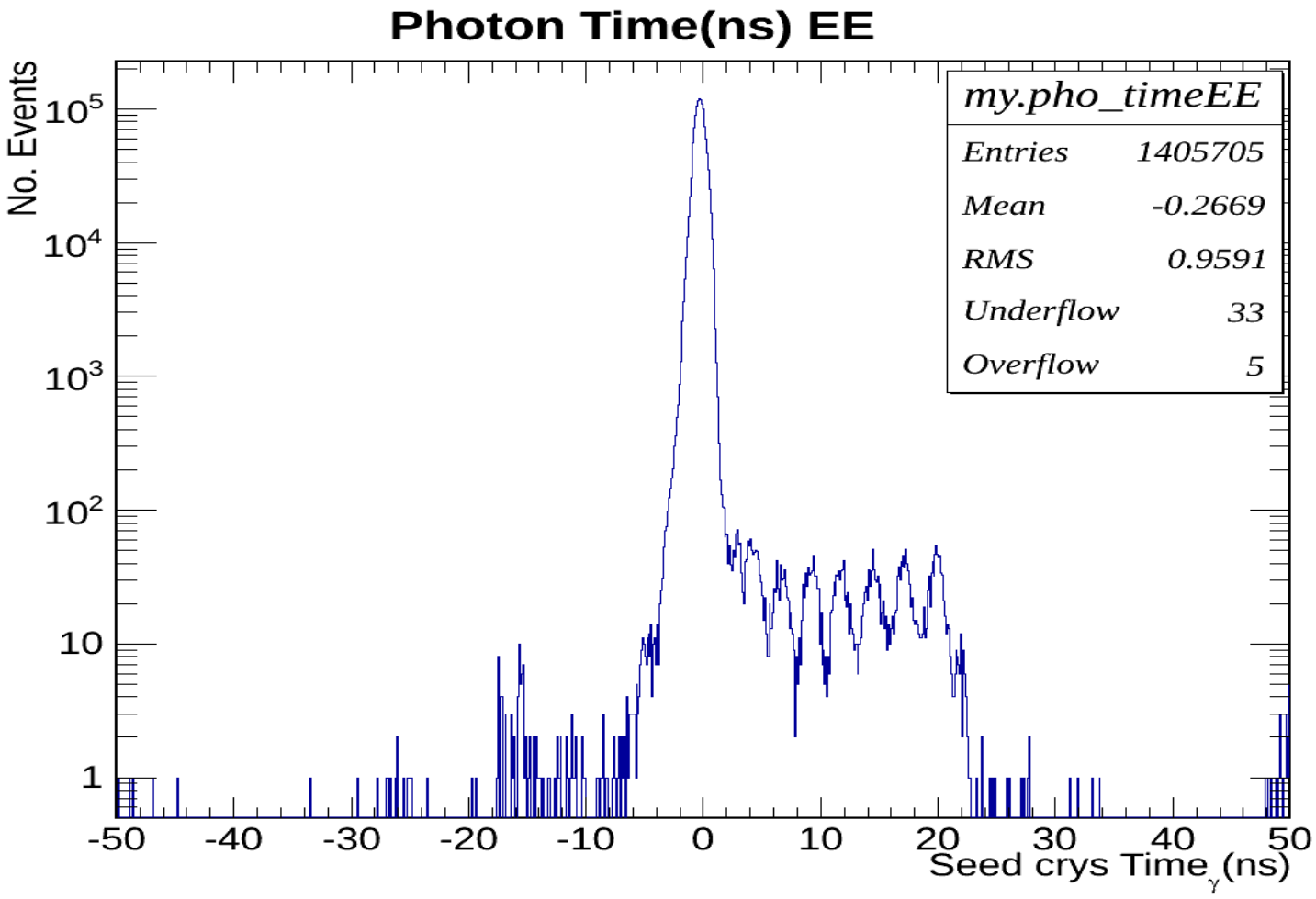
Number of Crystals in BC

Egamma(Blue) Halo(Red) Photon

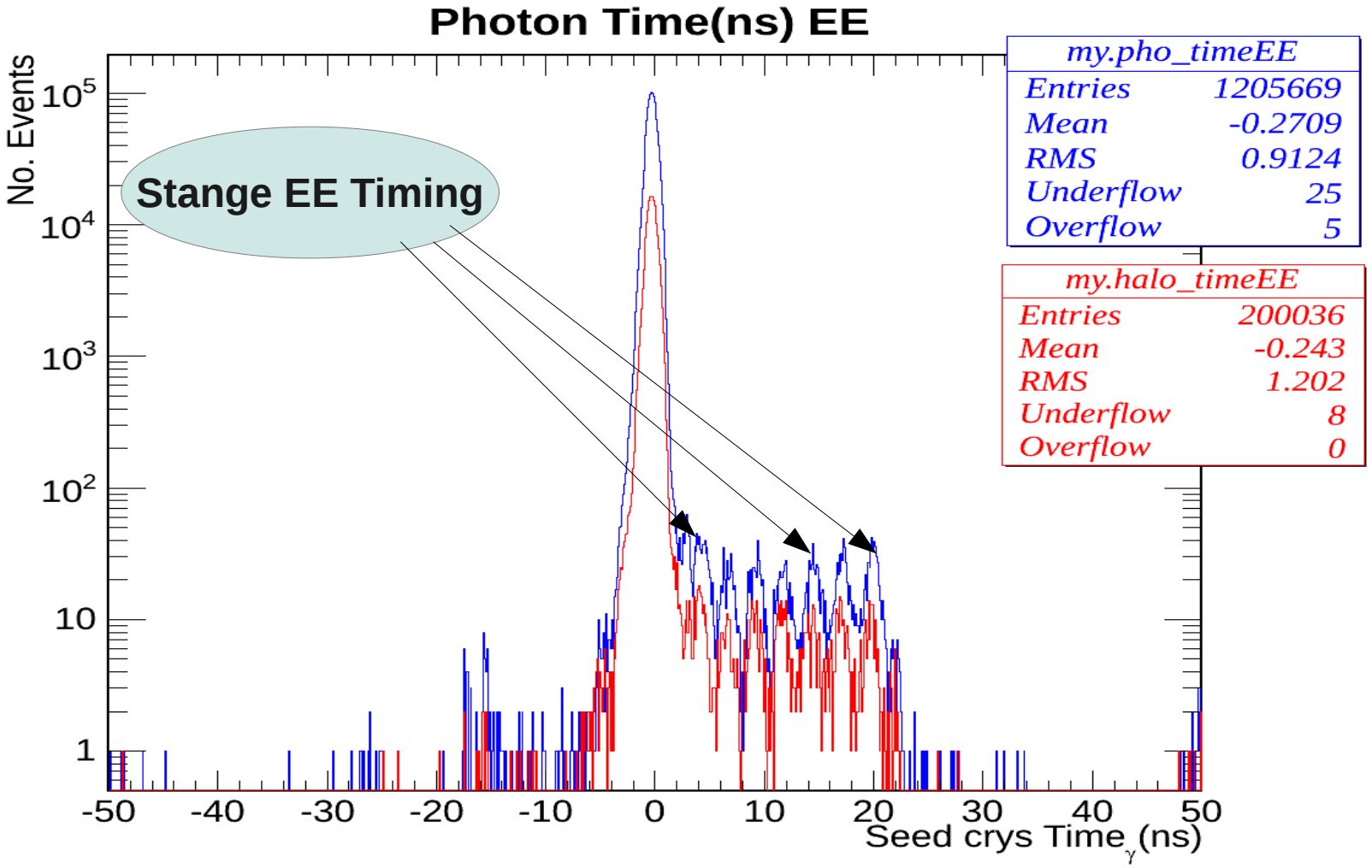
Halo + Egamma Photon time EB



Halo + Egamma Photon time EE



Photon Time EE



Strange structure occurs within 0 and 20ns.