

# HCAL Analysis

Yalcin Guler

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# Some Info.

24 new PMTs is at HF- (iphi= 43)

- We use
  - CMSSW\_7\_1\_7
  - /MinimumBias/Run2012D-22Jan2013-v1/RECO
  - RunList:  
203912, 203987, 203992, 203994, 204100, 204101,  
204113, 204250, 204541, 204544, 204553, 204555,  
204563, 204564, 204576, 204577, 204599,  
204601, 205111, 205158, 205193, 205217, 205311,  
205233, 205236, 205238, 205303, 205311, 205339,  
205344, 205519, 205526, 205617, 205620, 205666,  
205667, 205683, 205694, 205718, 205781, 205826,  
205833, 205921, 206187, 206208, 206210, 206246,  
206302, 206304, 206331, 206389, 206401, 206446,  
206448, 206466, 206476, 206478, 206484, 206512,  
206542, 206595, 206745, 206476, 206595, 206745,  
206869, 206897, 206906, 206940, 207099, 207231,  
207233, 207269, 207273, 207279, 207372, 207454,  
207488, 207491, 207886, 207898, 207905, 207921,  
208339, 208351, 208353, 208427, 208428, 208487,  
208541, 208551

seqId	eta	phi	depth
0001	-41	43	1
0002	-40	43	1
0003	-39	43	1
0004	-38	43	1
0005	-37	43	1
0006	-36	43	1
0007	-35	43	1
0008	-34	43	1
0009	-33	43	1
0010	-32	43	1
0011	-31	43	1
0012	-30	43	1
0013	-29	43	1
0014	-41	43	2
0015	-40	43	2
0016	-39	43	2
0017	-38	43	2
0018	-37	43	2
0019	-36	43	2
0020	-35	43	2
0021	-34	43	2
0022	-33	43	2
0023	-32	43	2
0024	-31	43	2
0025	-30	43	2
0026	-29	43	2

# Energy and Time Plots for iphi=43 ita=-41

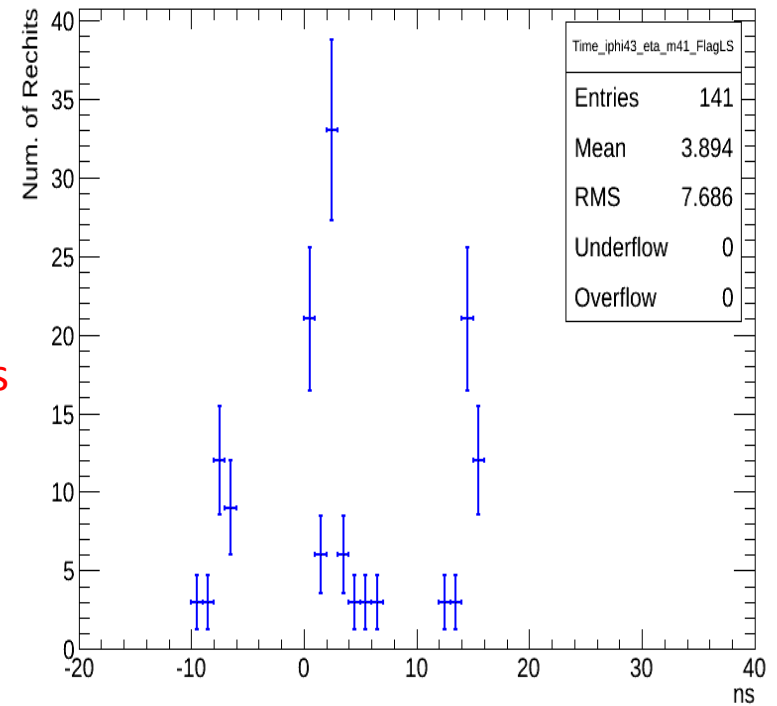
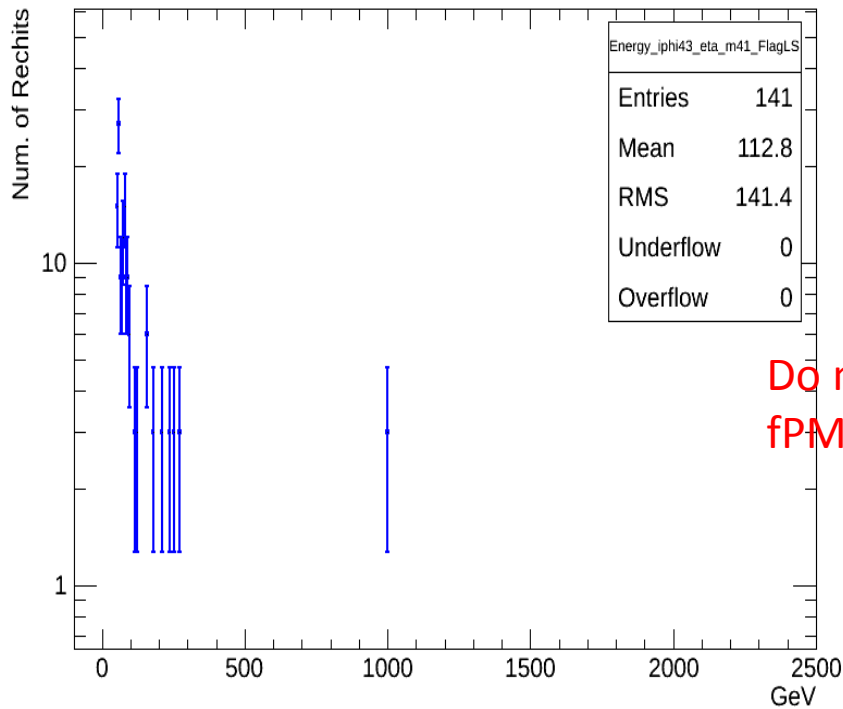
flag fPMTHitLS

“polynomial energy threshold” (PET)

$$R = \frac{E_L - E_S}{E_L + E_S},$$

Long fiber RecHits are flagged if  $R > R_L$  AND  $E_L > E_{\text{PET,L}}(|\eta|) = 162.4 - 10.19|\eta| + 0.21(|\eta|)^2$ , 118, 119 where  $R_L$  is the R cut applied to the long fiber RecHits;

Short fiber RecHits are flagged if  $R < R_S$  AND  $E_S > E_{\text{PET,S}}(|\eta|) = 129.9 - 6.61|\eta| + 0.1153(|\eta|)^2$ , 120, 121 where  $R_S$  is the R cut applied to the short fiber RecHits.



# Energy and Time Plots for iphi=43 ita=-41

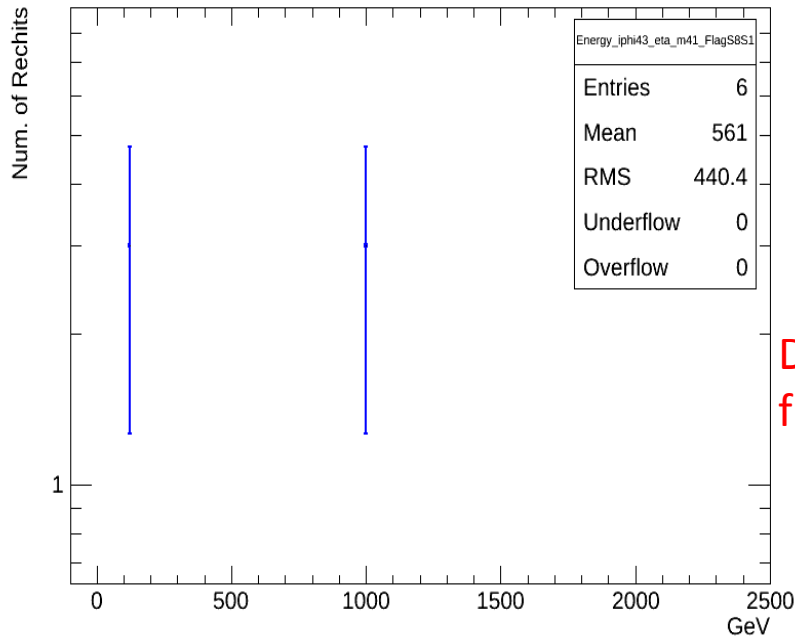
## fPMTHitS8S1

$$\left(\frac{S9}{S1}\right)_L = \frac{E_S + \sum_{i=1}^4 E_{L,i} + \sum_{i=1}^4 E_{S,i}}{E_L},$$

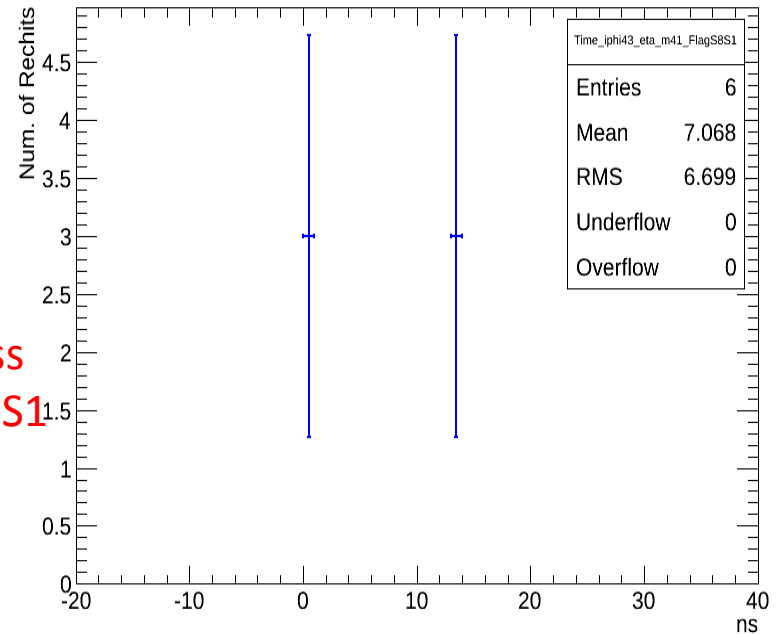
The S9/S1 cleaning algorithm is only applied to the long fiber RecHits and it uses the same energy threshold parametrization as the PET algorithm. Long fiber RecHits are flagged by the S9/S1 algorithm if:

1.  $E_L > E_{PET,L}(i)$  AND
2.  $S9/S1 < Y(E_L, i)$ , where  $Y(E_L, i)$  is a variable threshold value.

$$Y(E_L, i\eta) = a(i\eta) \ln(E_L/b(i\eta)),$$



Do not pass  
fPMTHitS8S1



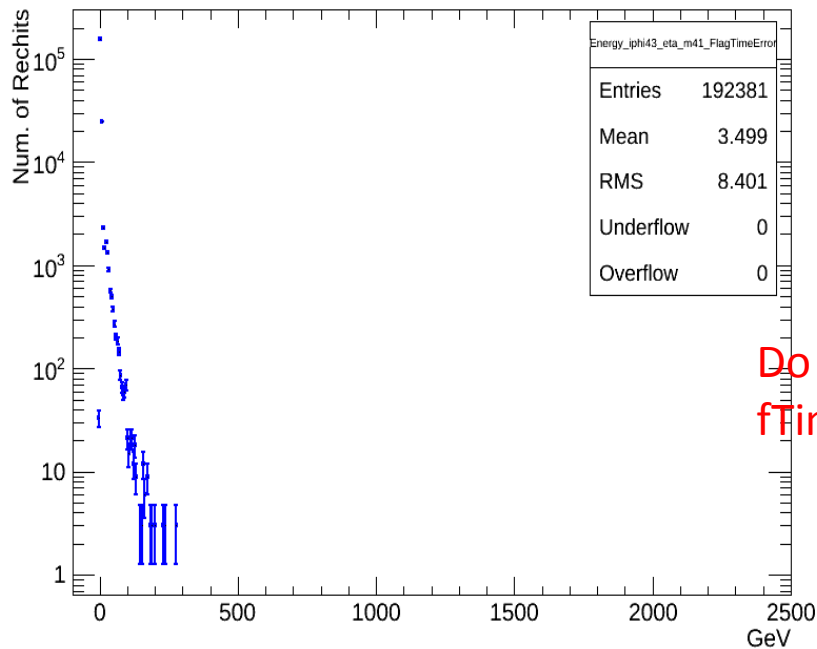
# Energy and Time Plots for iphi=43 ita=-41

## fTimingError

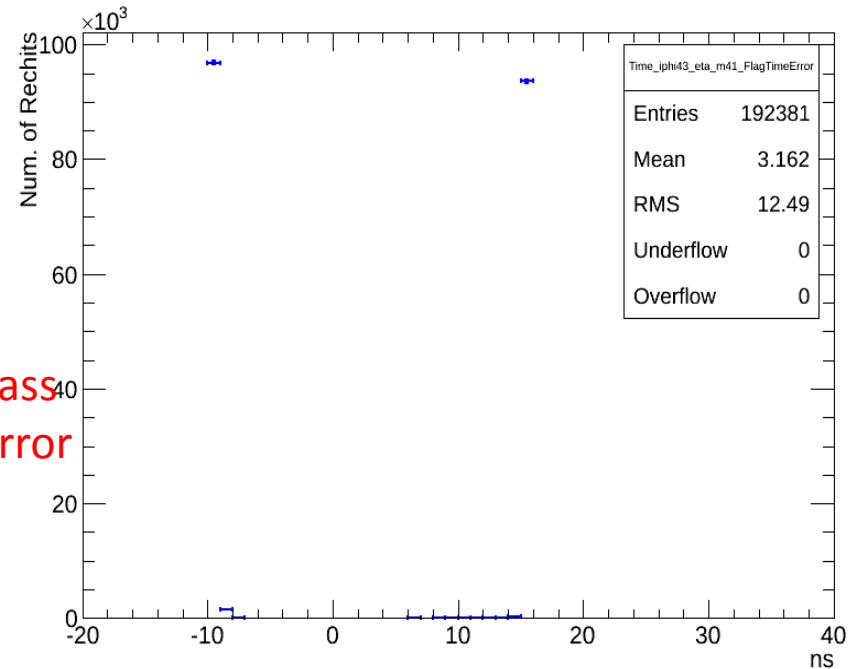
The timing based cleaning algorithm is defined as follows:

Long fiber RecHits are flagged if  $E > 40$  GeV AND ( $t < -10$  ns OR  $t > 10$  ns);

Short fiber RecHits are flagged if  $E > 40$  GeV AND ( $t < -12$  ns OR  $t > 10$  ns).



Do not pass  
fTimingError



# Energy and Time Plots for iphi=39 ita=-41

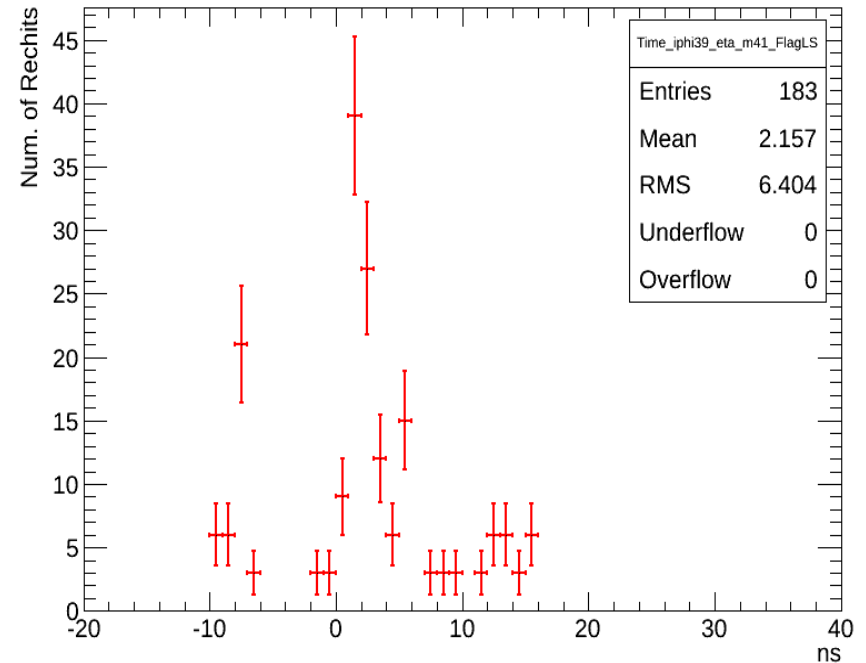
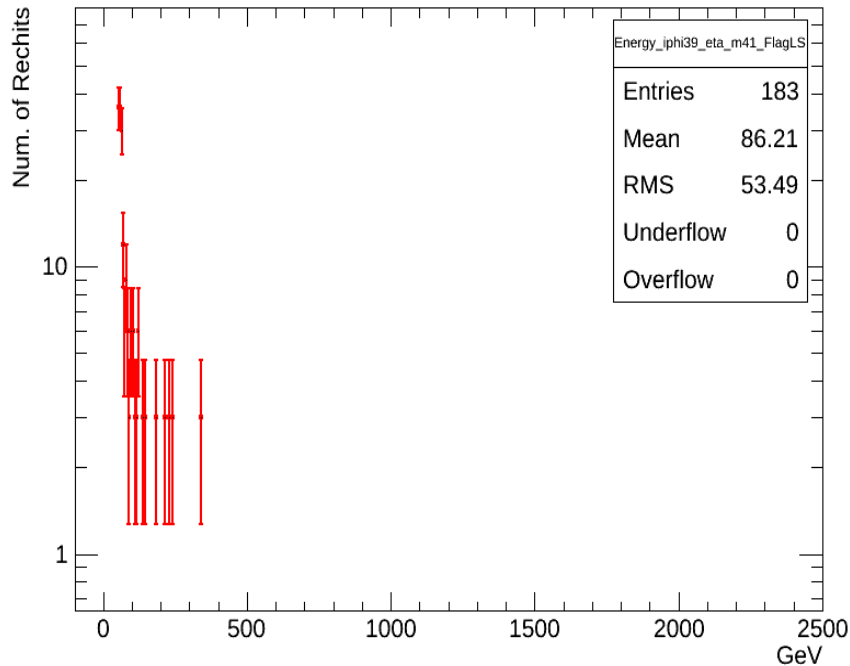
flag fPMTHitLS

“polynomial energy threshold” (PET)

$$R = \frac{E_L - E_S}{E_L + E_S},$$

Long fiber RecHits are flagged if  $R > R_L$  AND  $E_L > E_{\text{PET,L}}(|\eta|) = 162.4 - 10.19|\eta| + 0.21(|\eta|)^2$ , 118, 119 where  $R_L$  is the R cut applied to the long fiber RecHits;

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# Energy and Time Plots for iphi=39 ita=-41

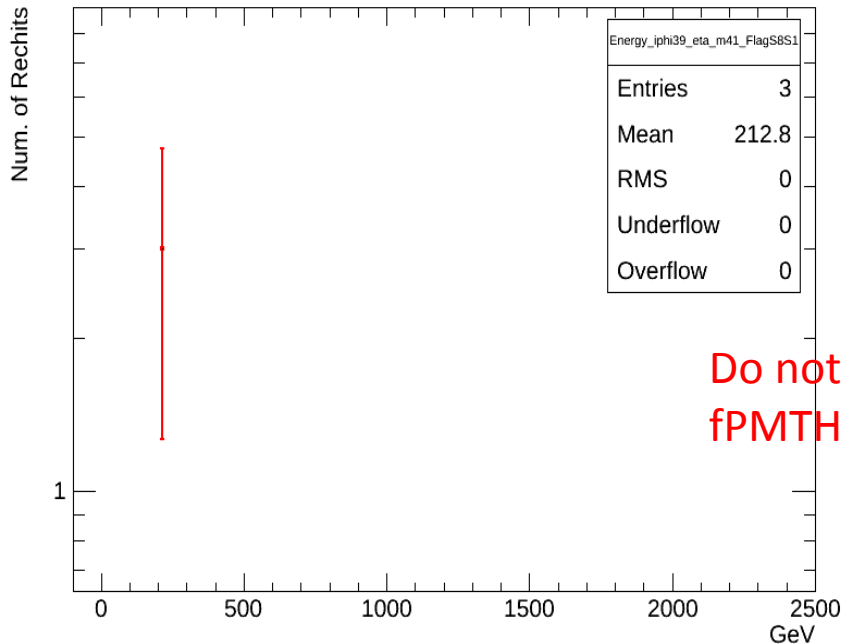
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$$\left(\frac{S9}{S1}\right)_L = \frac{E_S + \sum_{i=1}^4 E_{L,i} + \sum_{i=1}^4 E_{S,i}}{E_L},$$

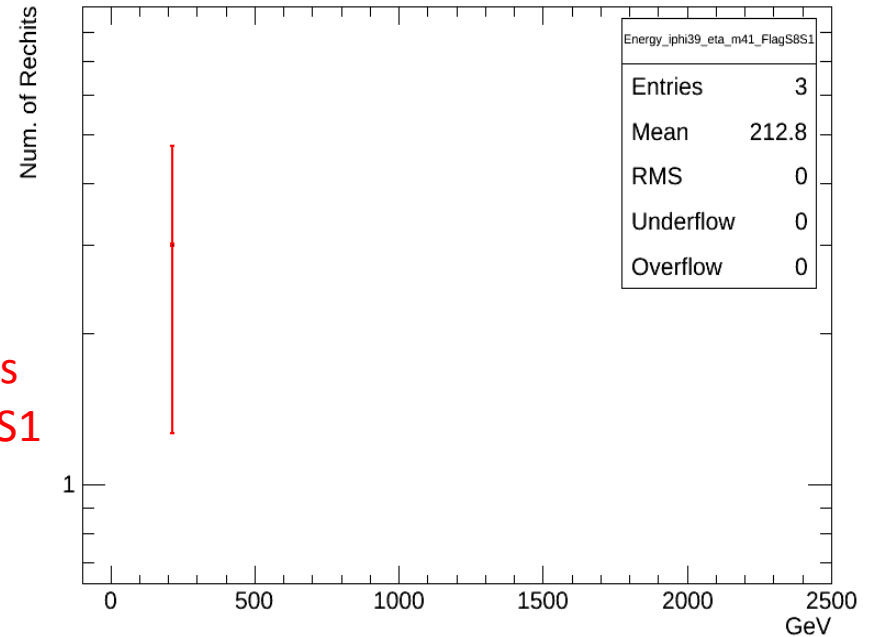
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$$Y(E_L, i\eta) = a(i\eta) \ln(E_L/b(i\eta)),$$



Do not pass  
fPMTHitS8S1



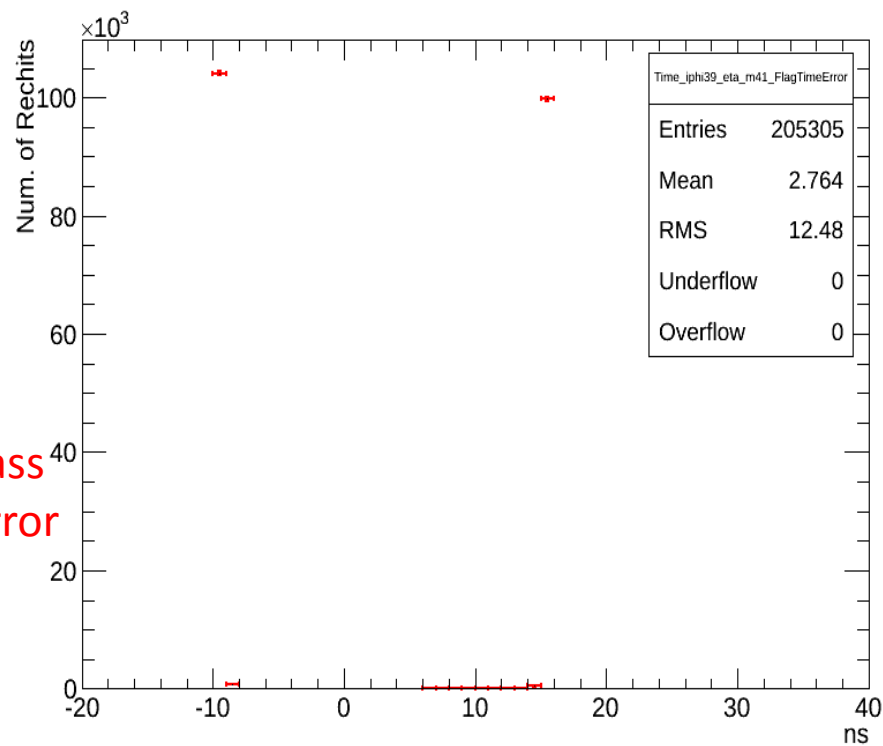
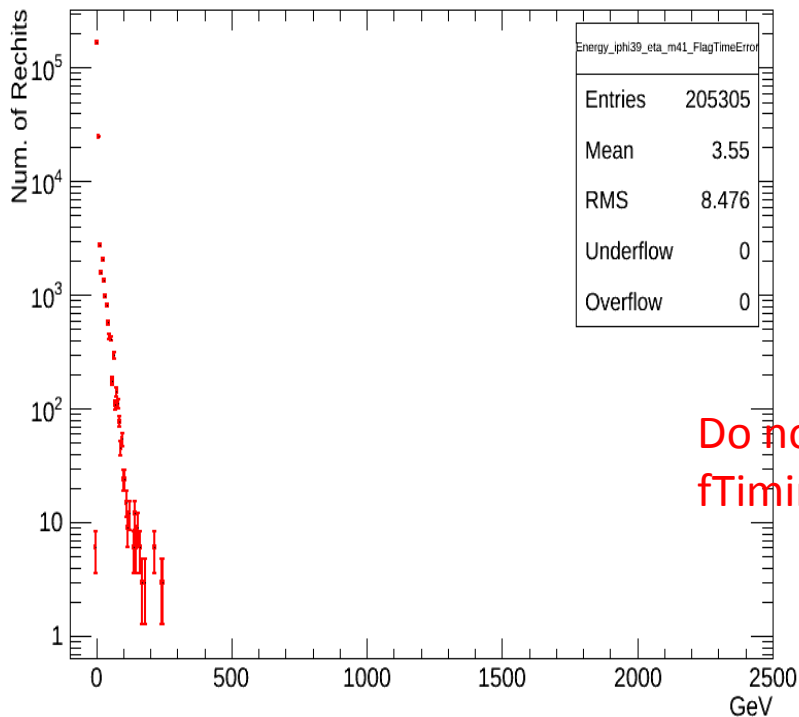
# Energy and Time for iphi=39 ita=-41

## fTimingError

The timing based cleaning algorithm is defined as follows:

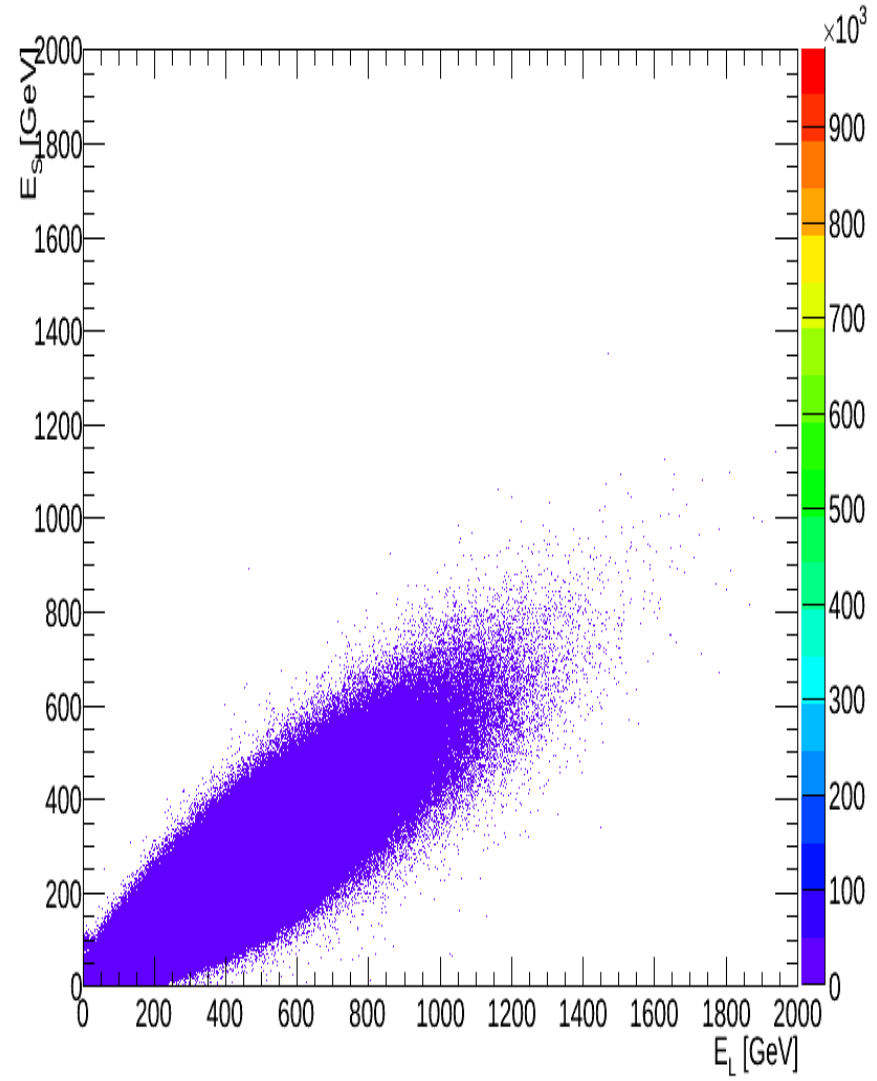
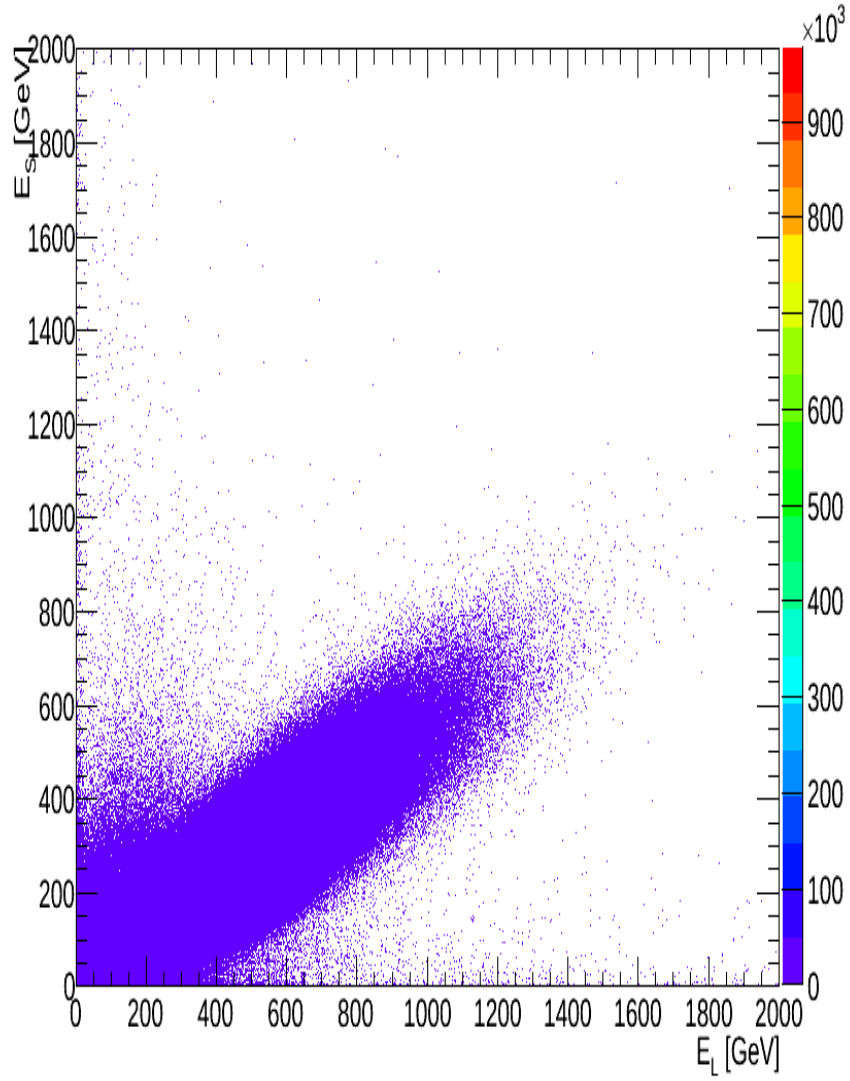
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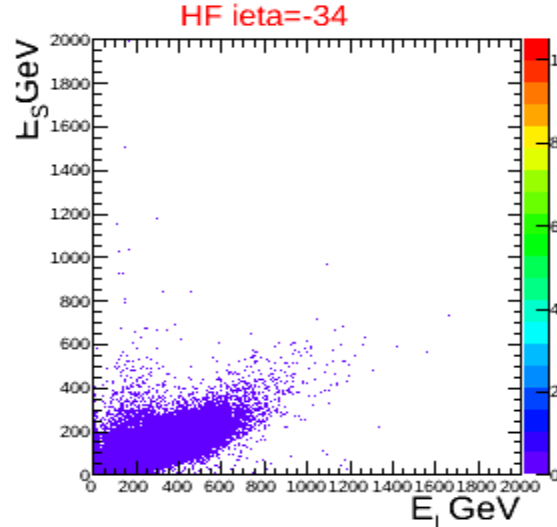
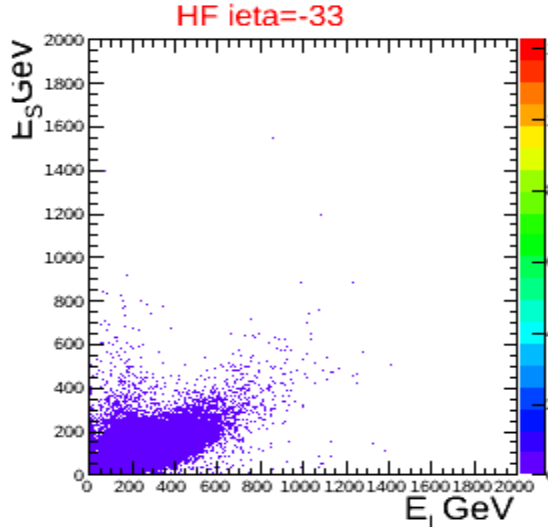
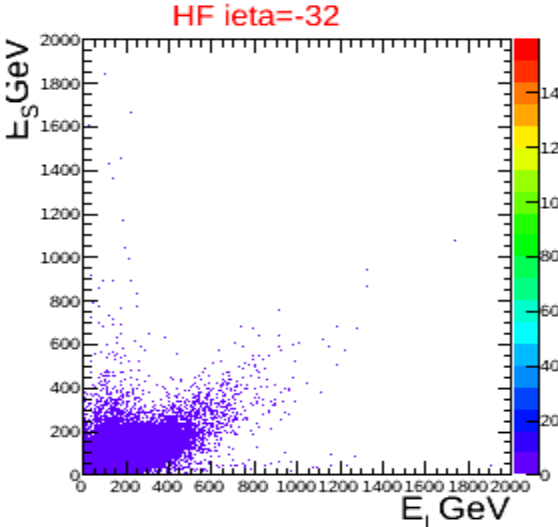
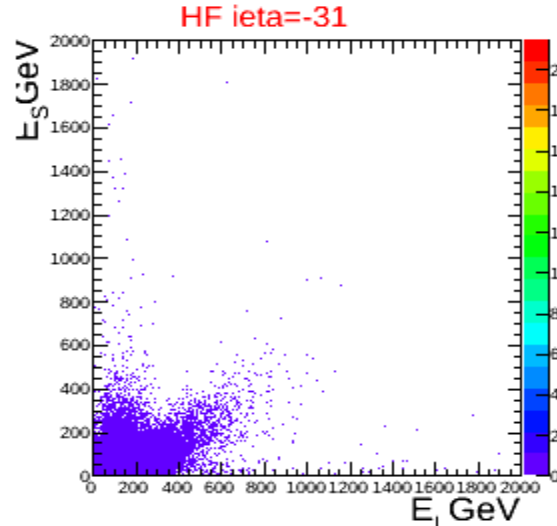
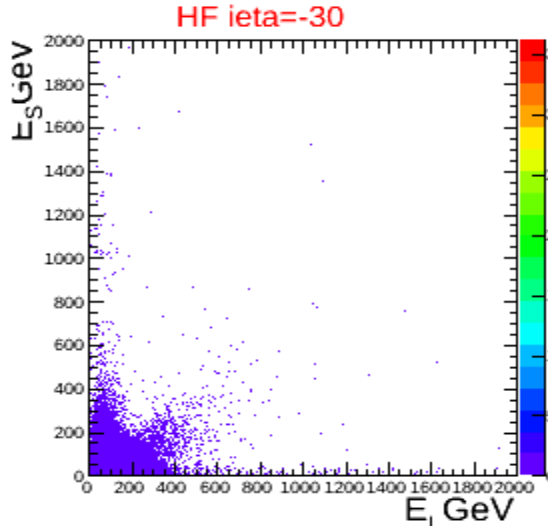
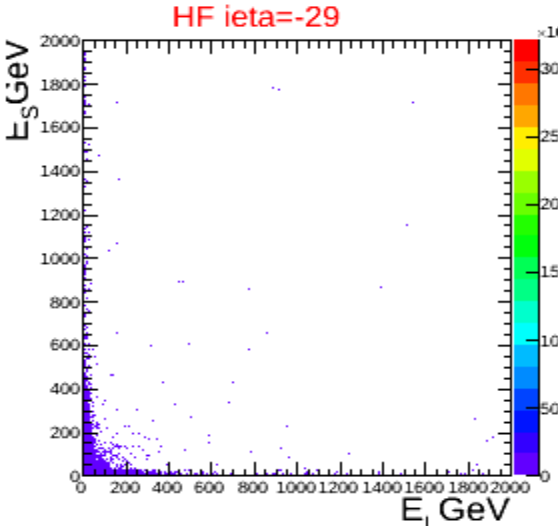




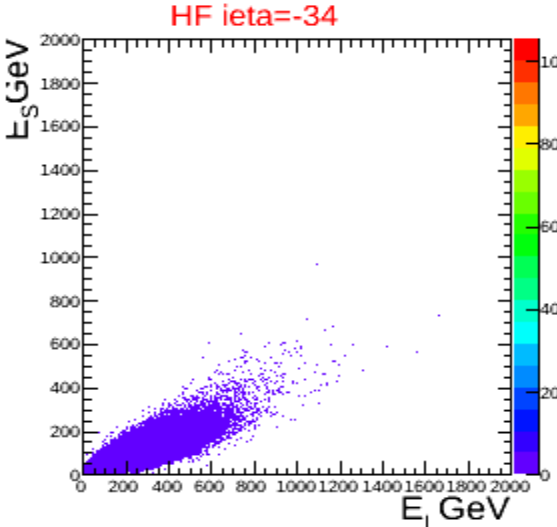
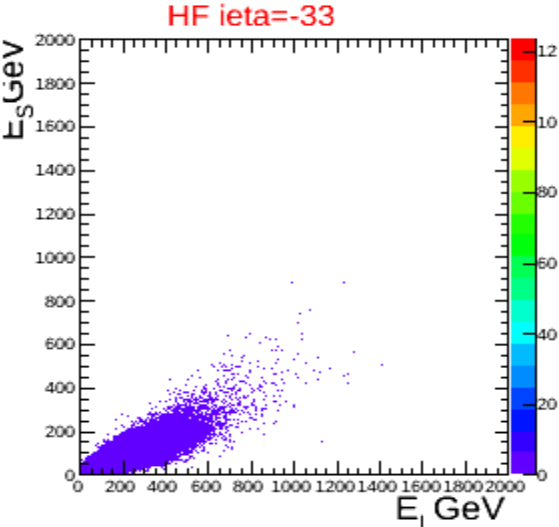
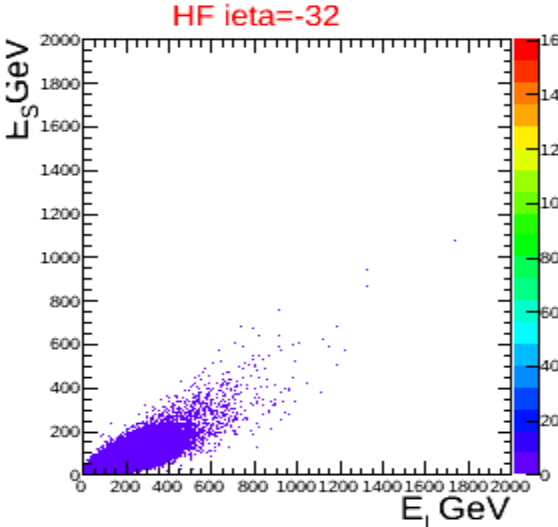
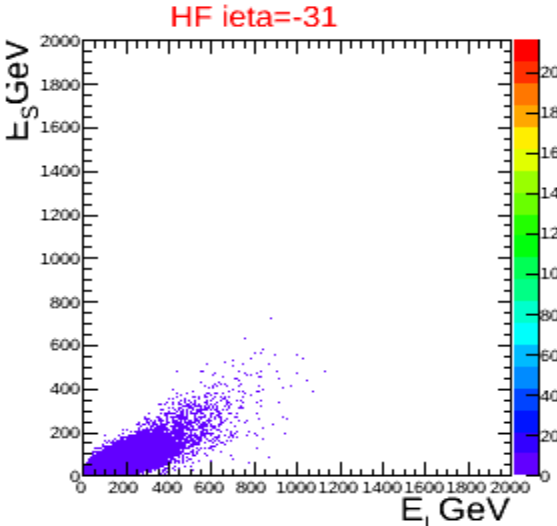
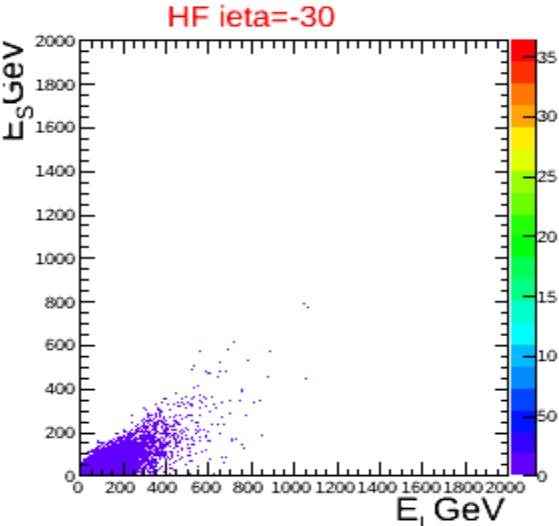
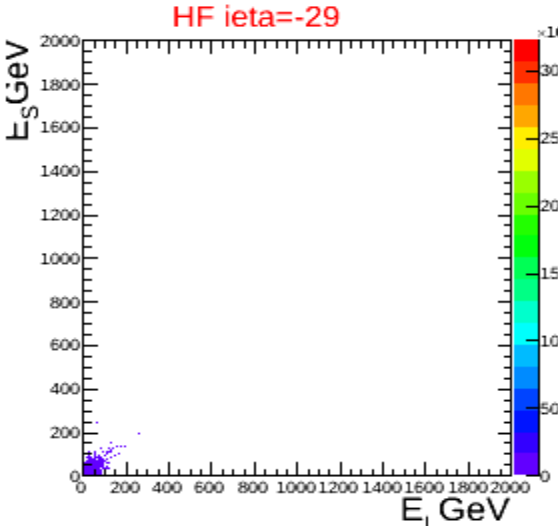
# Long fiber RechHit energy vs. short fiber RechHit energy



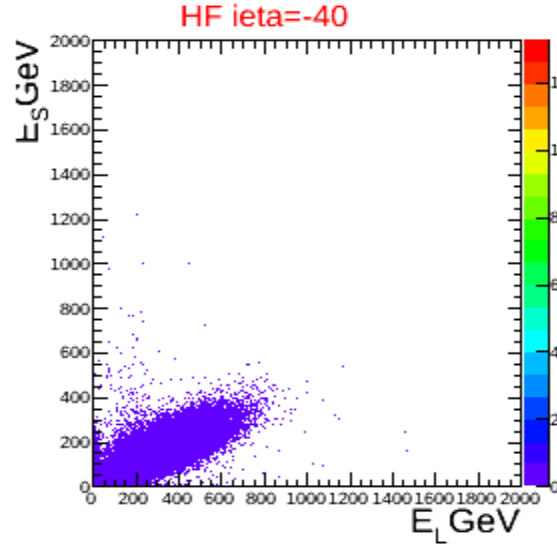
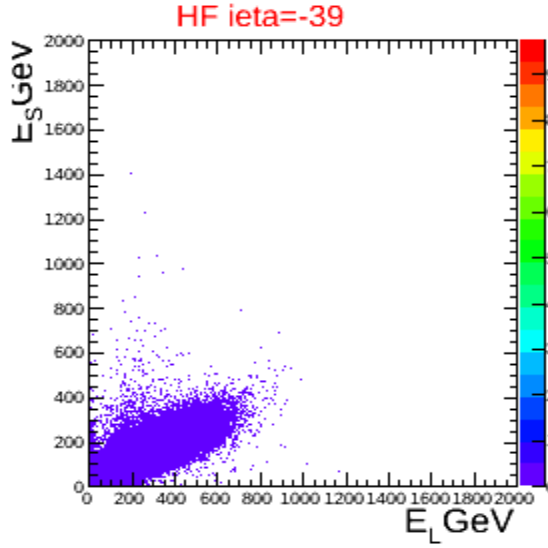
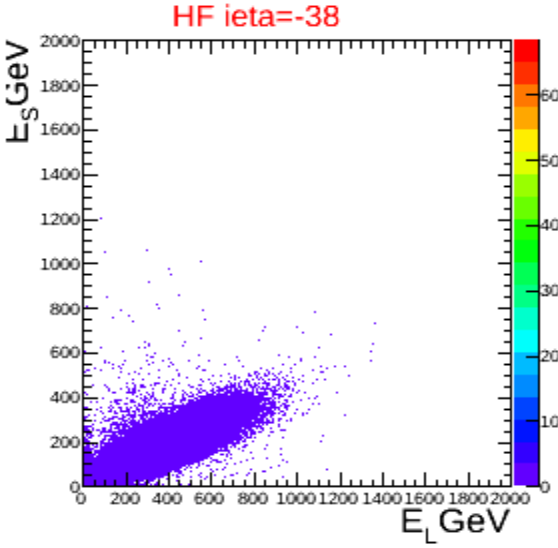
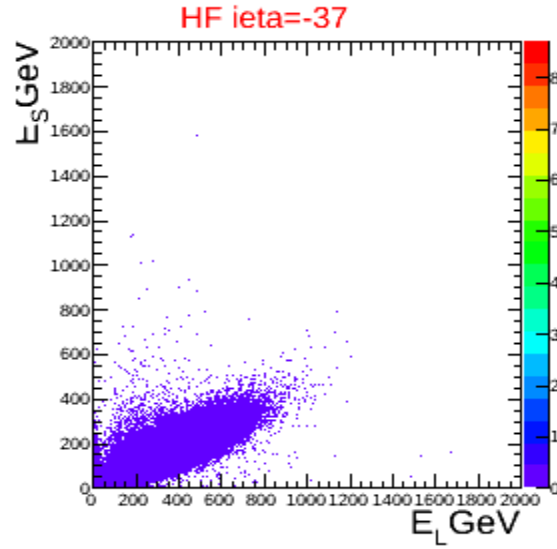
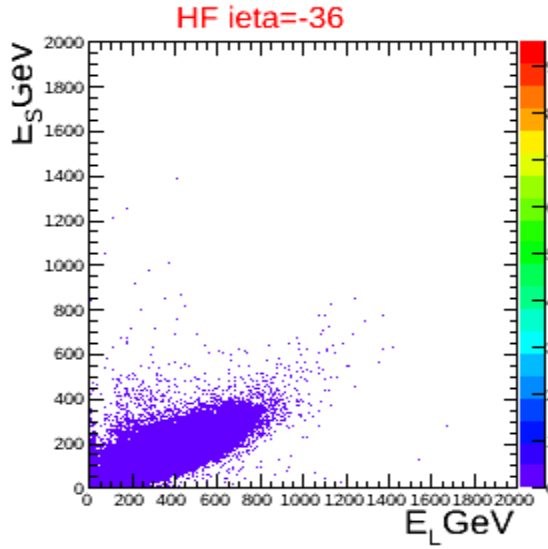
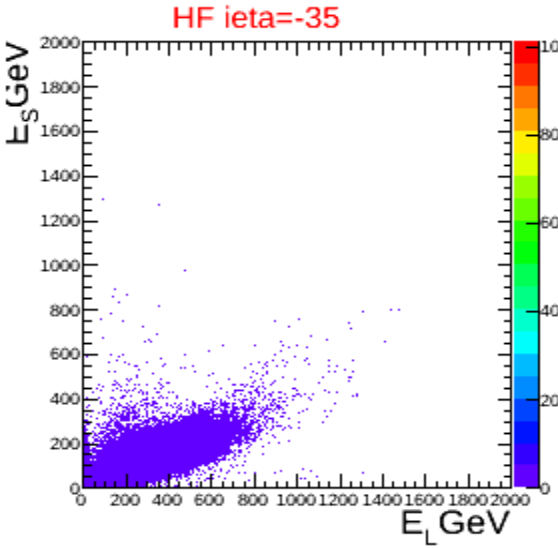
# Long fiber RecHit energy vs. short fiber RecHit Noise energy $\eta = -29$ -34



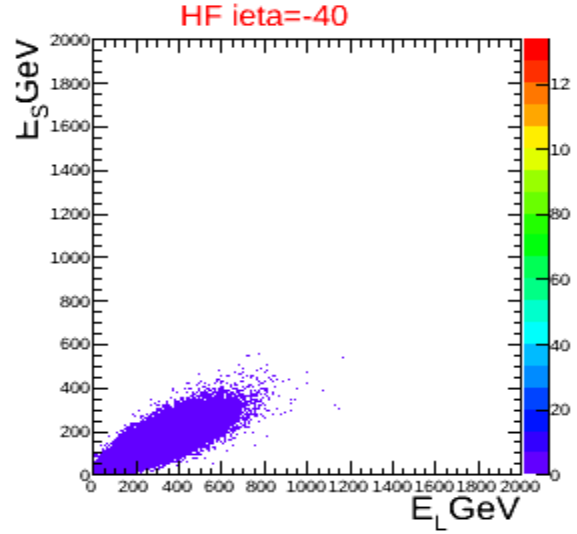
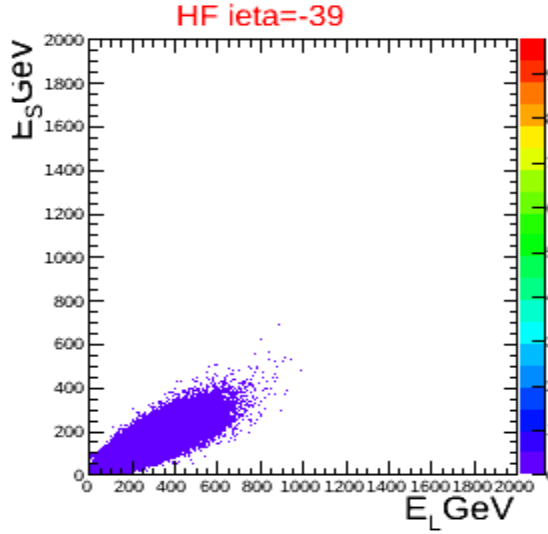
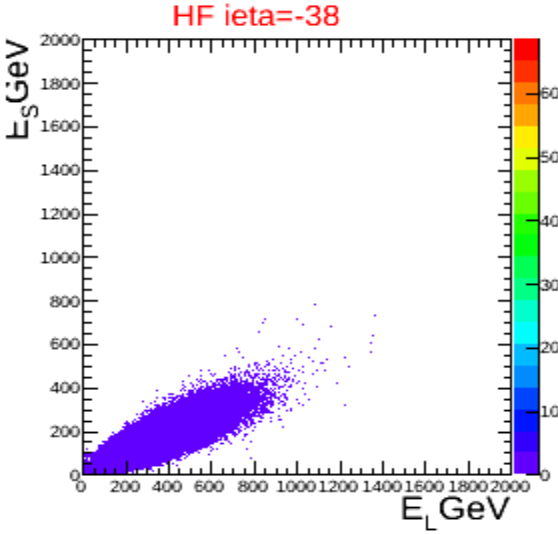
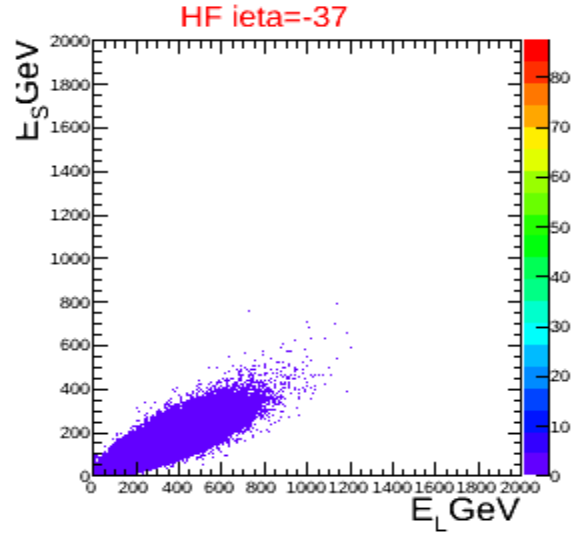
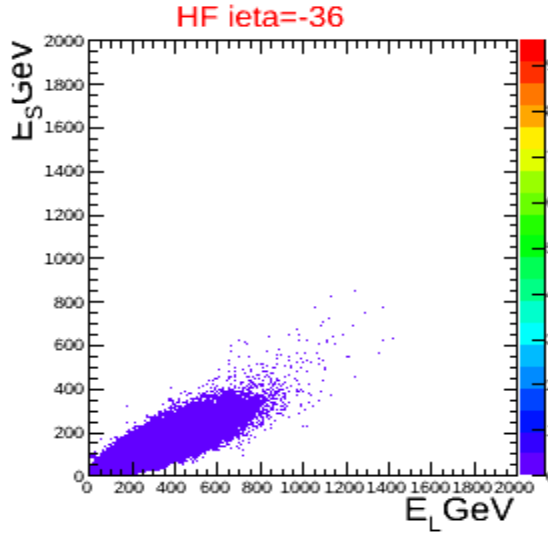
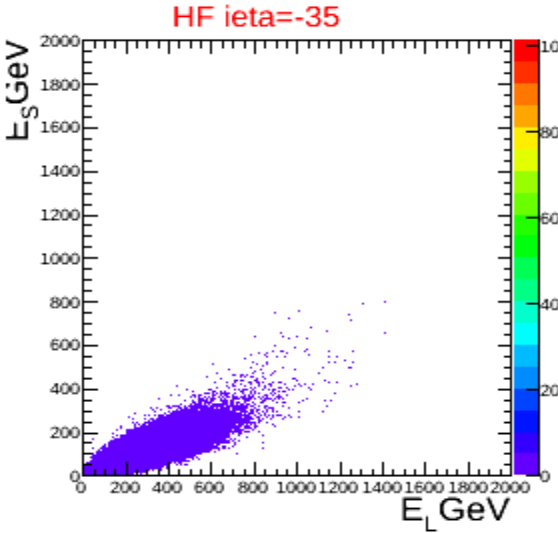
# Long fiber RecHit energy vs. short fiber RecHit **Clean energy** $\eta = -29$ -34



# Long fiber RecHit energy vs. short fiber RecHit Noise energy $\eta = -35$ -40



# Long fiber RecHit energy vs. short fiber RecHit **Clean energy** $\eta = -35$ -40



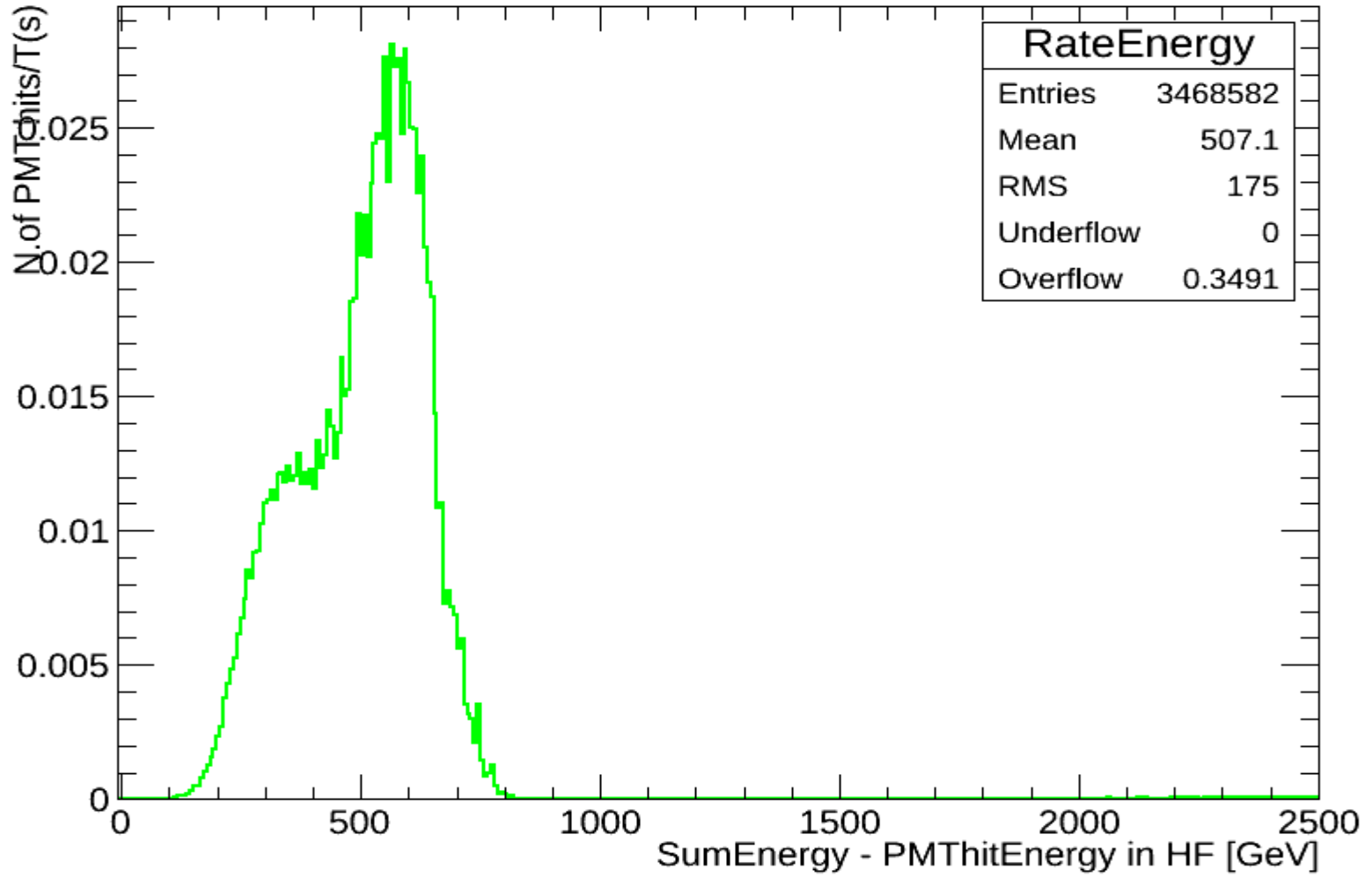
# Some Info.

Run No	integrated Lumi	Avarage Lumi	Time (sec)
203912	1.04E+38	3.50E+30	29640000
203987	9.26E+37	4.00E+30	23150000
203992	9.07E+35	3.00E+30	302363.667
203994	2.58E+37	3.50E+30	7383142.86
204100	3.43E+36	6.00E+30	571666.667
204101	1.07E+37	4.00E+30	2677750
204113	7.63E+37	6.00E+30	12708833.3
204250	7.96E+37	5.00E+30	15918000
204511	5.90E+36	4.00E+30	1475000
204541	2.79E+37	6.00E+30	4655333.33
204544	4.70E+37	5.00E+30	9394200
204553	6.55E+36	3.00E+30	2181666.67
204555	1.65E+37	2.00E+30	8272000
204563	5.92E+37	5.50E+30	10768909.1
204564	1.03E+38	4.00E+30	25729250
204576	3.43E+37	6.50E+30	5284000
204577	1.16E+38	4.00E+30	28970500
204599	3.57E+37	6.00E+30	5946333.33
204601	1.05E+38	4.00E+30	26361750
205111	4.70E+37	5.00E+30	9402200
205158	7.49E+37	5.00E+30	14971600
205193	9.19E+37	5.00E+30	18387000
205217	2.37E+37	3.00E+30	7901000
205233	8.51E+36	6.00E+30	1417666.67
205236	3.99E+37	5.00E+30	7978400

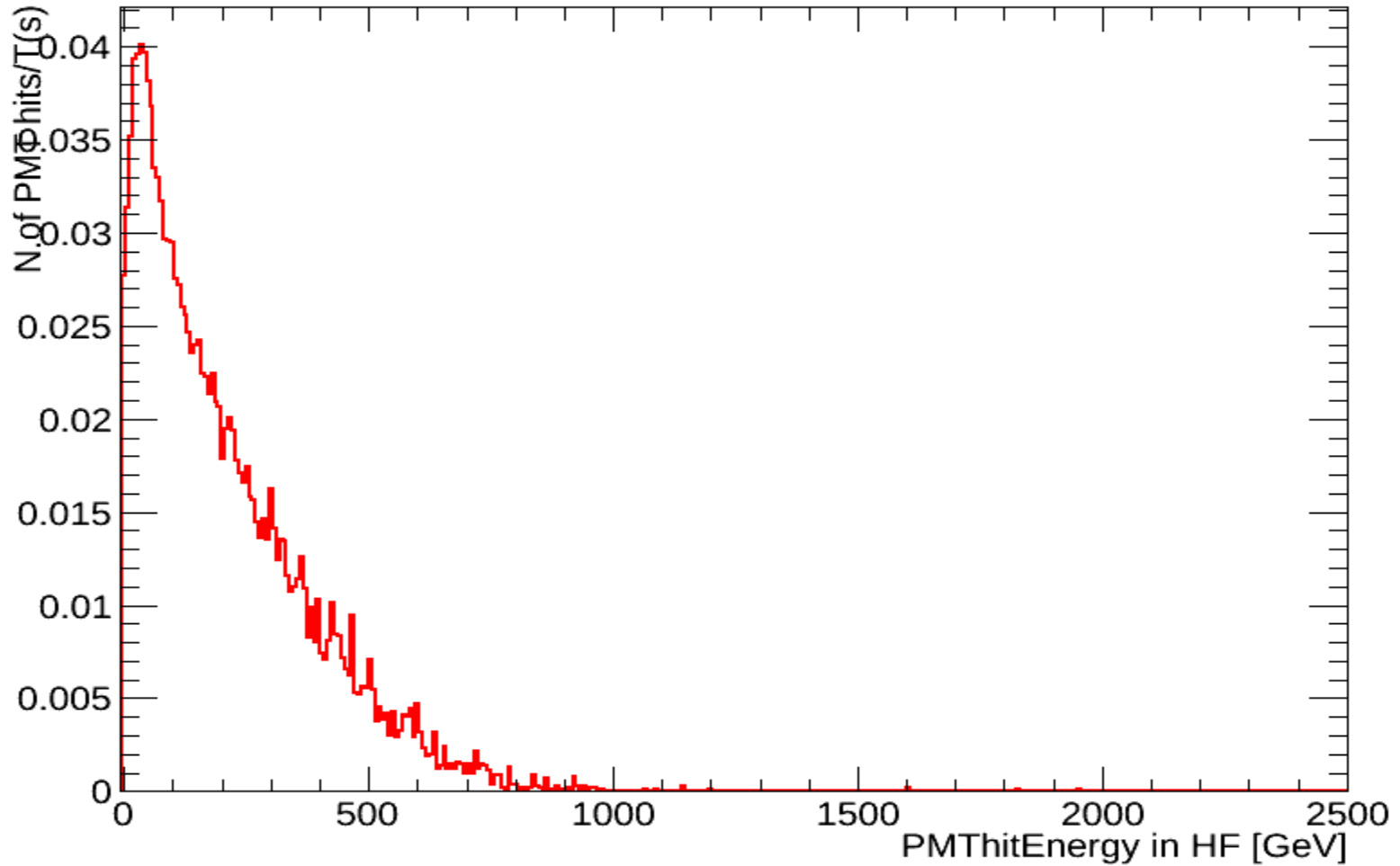
If we get N noise events in x [fb-1] of data, the average trigger rate is

$$\text{Rate} = N/T. \quad [\text{Hz}]$$

# Number of PMTHits/T vs. Clean Energy



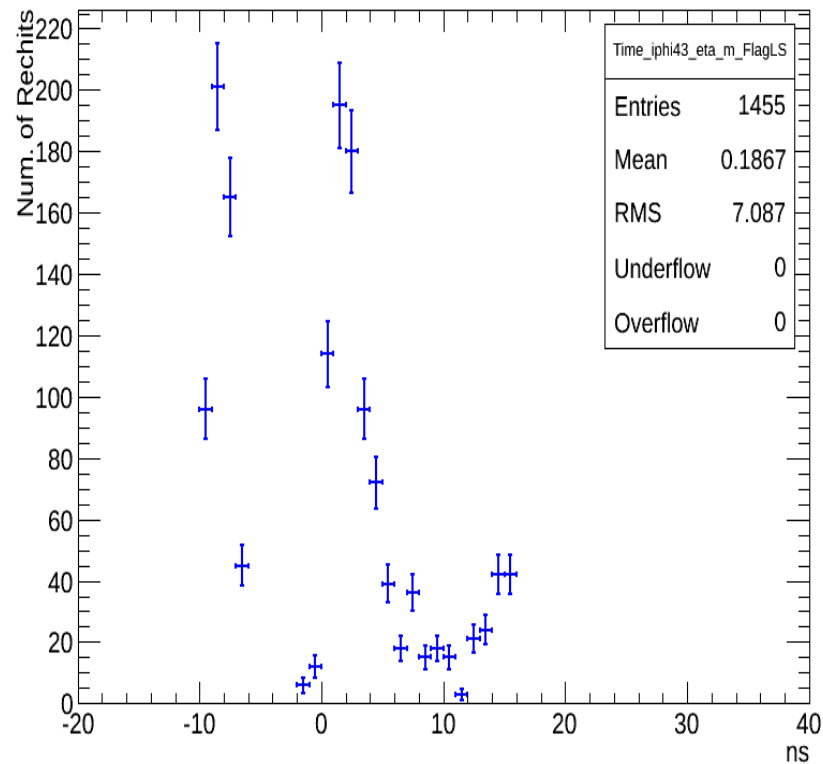
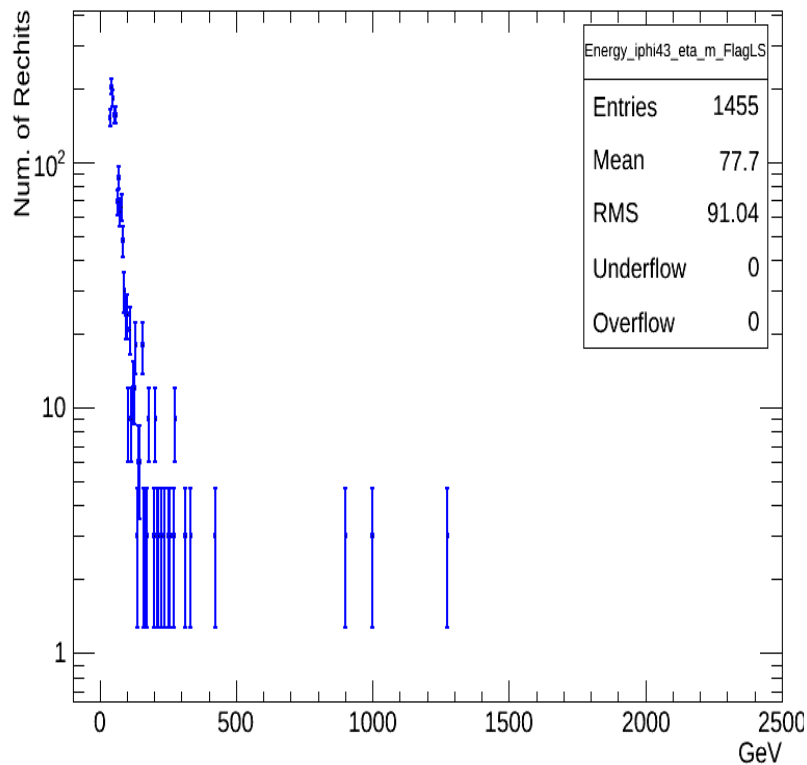
# Number of PMTHits/T vs. PMTHits Energy





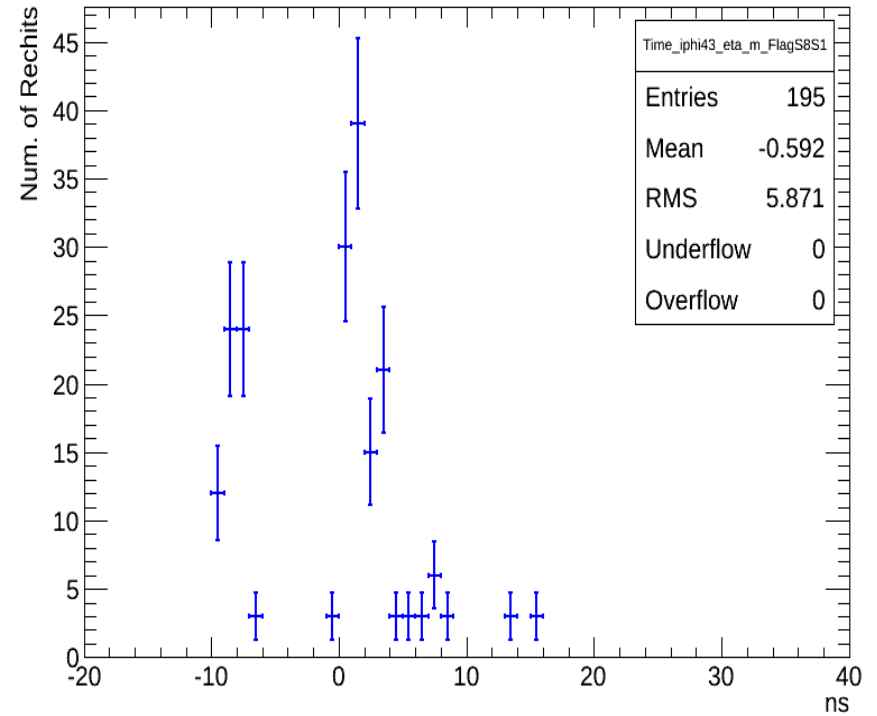
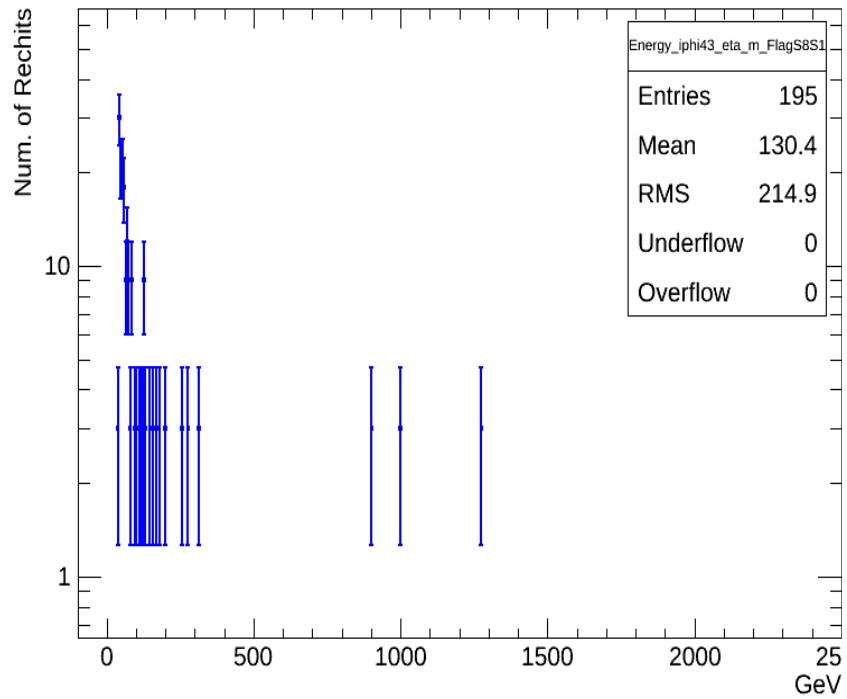
Back up

# Energy and Time distribution for iphi=43 HF-



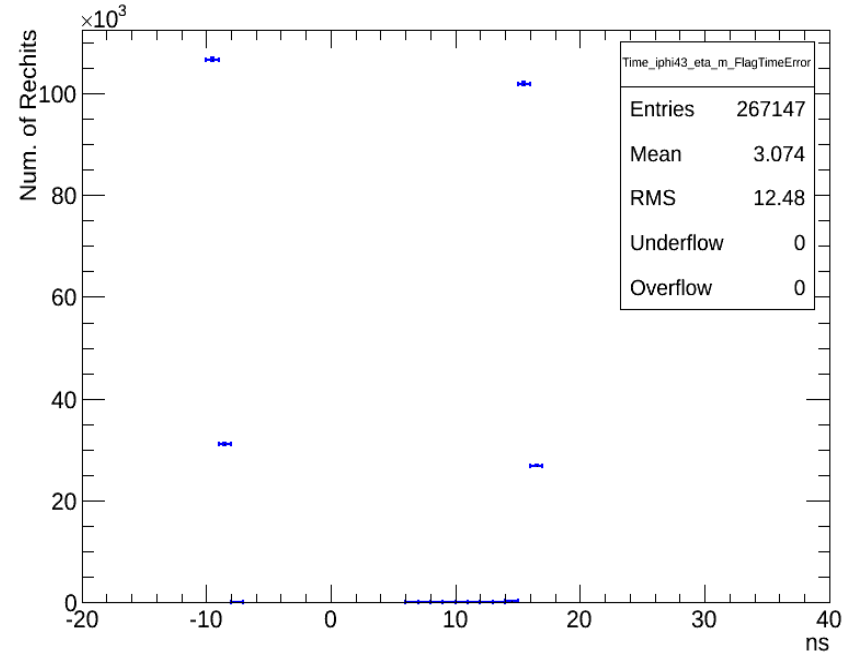
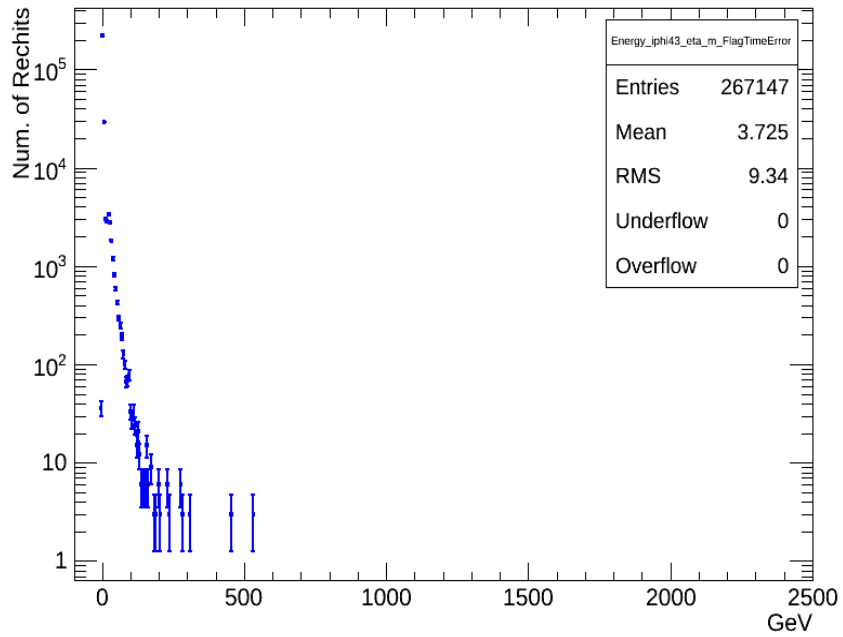
(FlagLS)

# Energy and Time distribution for iphi=43 HF-



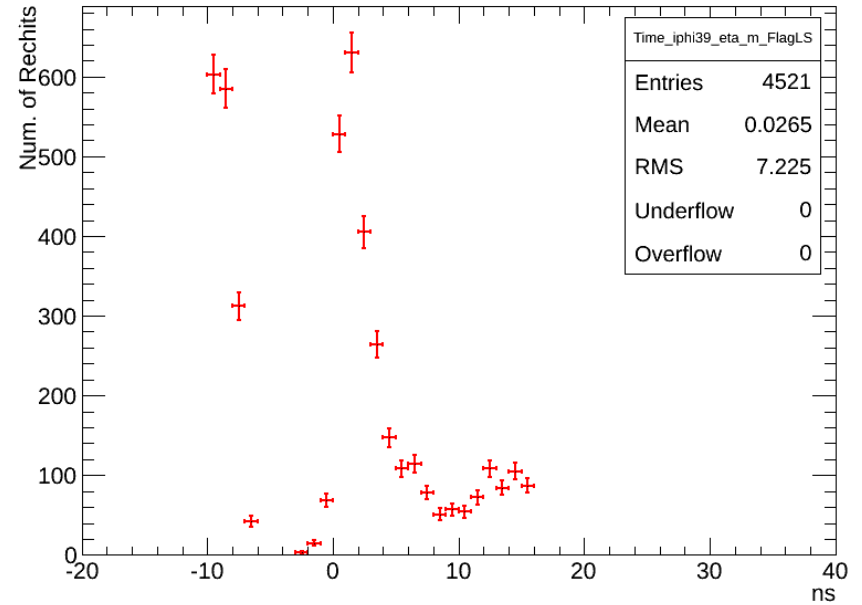
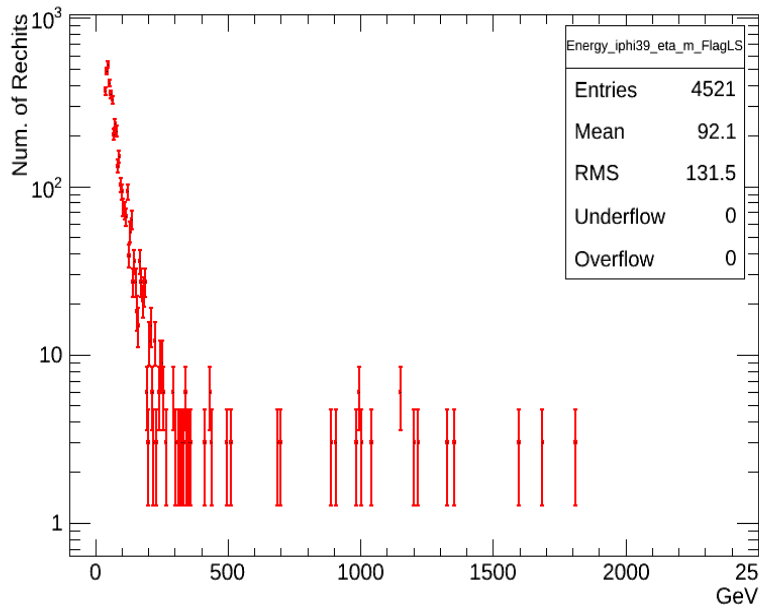
(FlagS8S1)

# Energy and Time distribution for iphi=43 HF-



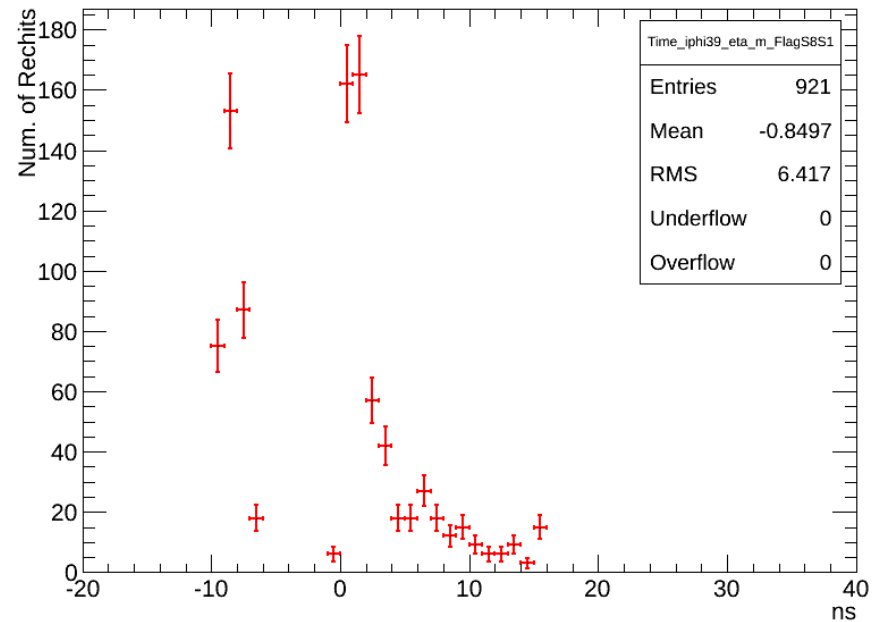
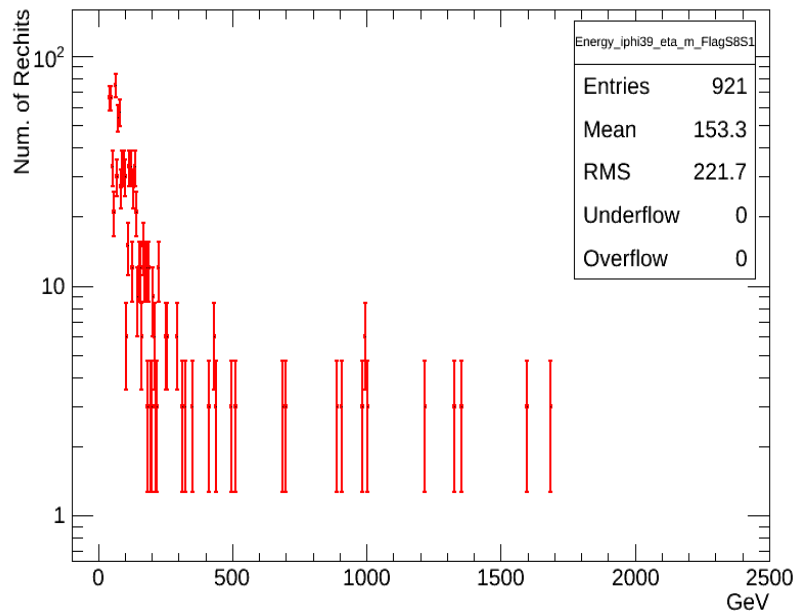
(FlagTimeError)

# Energy and Time distribution for iphi=39 HF-



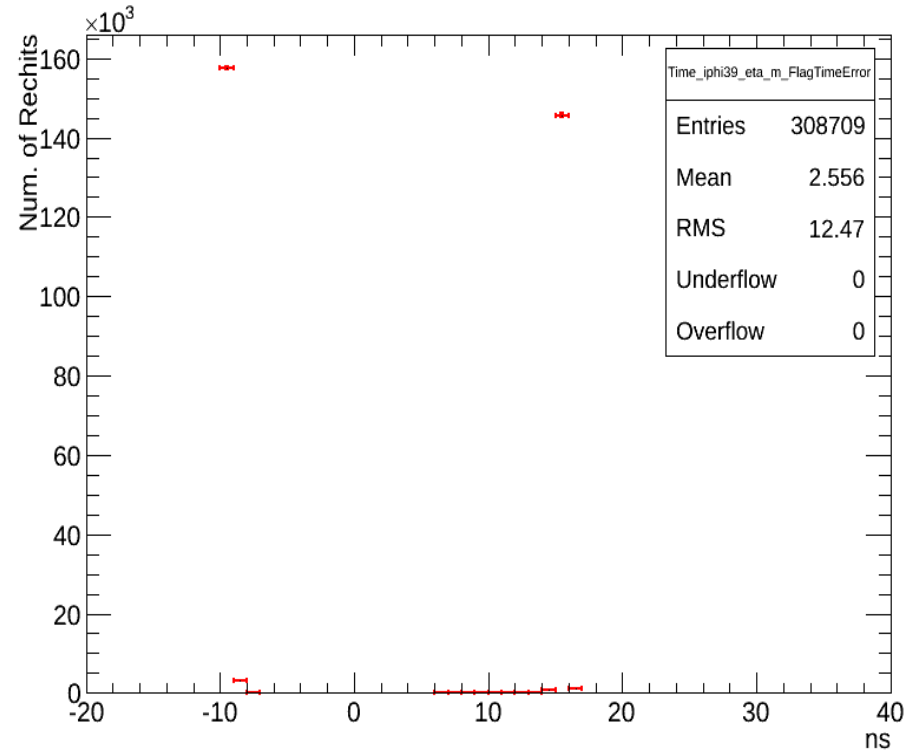
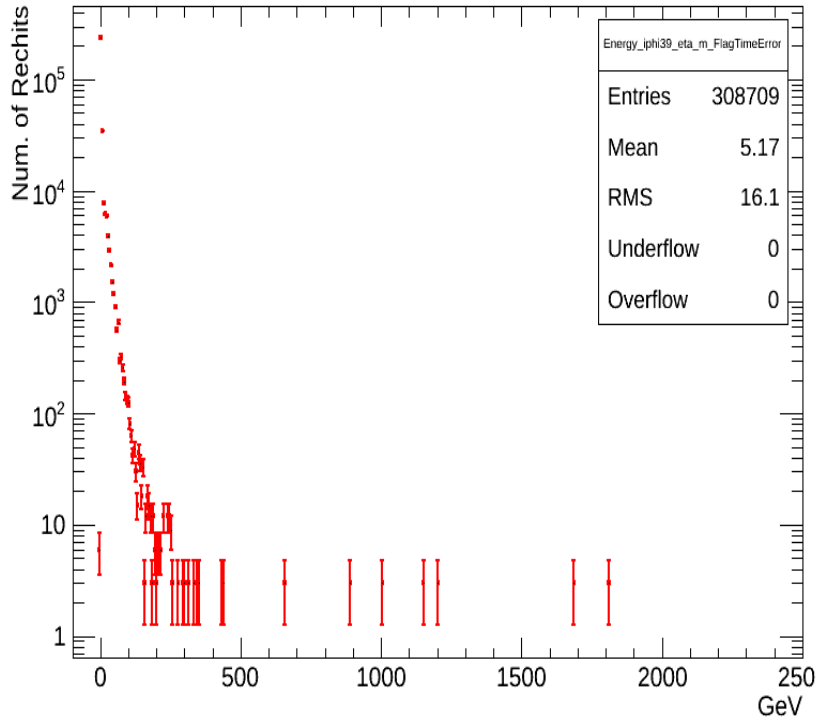
(FlagLS)

# Energy and Time distribution for iphi=39 HF-



(FlagS8S1)

# Energy and Time distribution for iphi=39 HF-



(FlagTimeError)