How John computes his optimal cut:

- wiki: *https://private.hawc-observatory.org/wiki/index.php/High_Energy_Paper_Pretz_Optimization*

Phases:

1. Define the bins: fbin & ebin
2. Quality Cuts
3. Compute optimal delAngle
4. Get 2D histogram: PINC Vs LiC of Signal and Bkg
5. Integrate the histogram
6. Find the maximum Q factor.

1. Define the bins: fbin & ebin

- fbin in nHitSP20/nChAvail in step of 0.1
- ebin is log NNenergy in step of 0.25 from 10 ^2.5 - 10^5.25

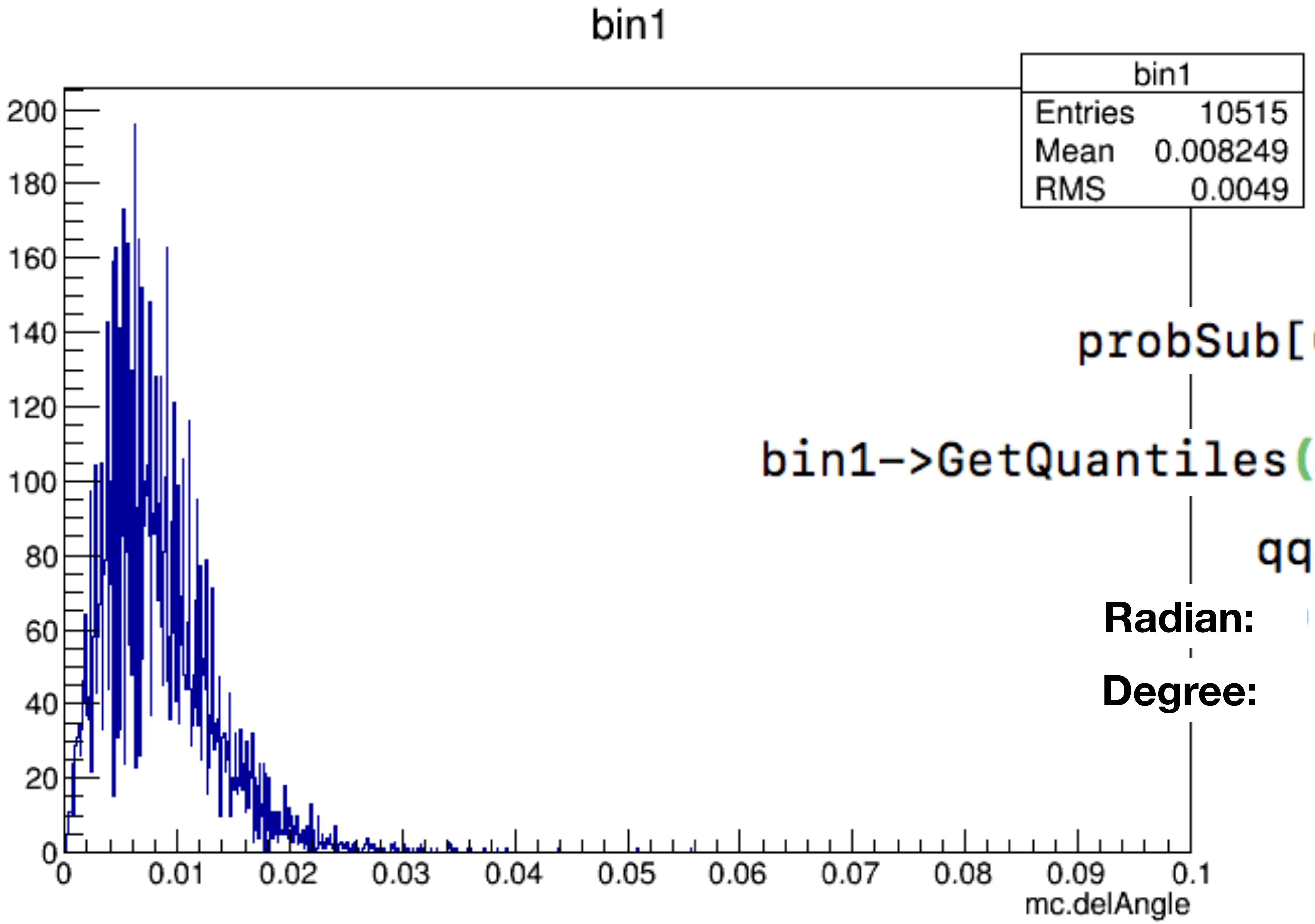
2. Quality Cuts

- rec.angleFitStatus==0
- rec.coreFitStatus==0
- rec.nChAvail>=700
- rec.coreFiduScale<=100
- rec.zenithAngle<0.785

Note: 0.785 is approx. 45°

3. Compute optimal delAngle: One value per fbin & ebin

```
TH1F bin1= TH1F ("bin1","bin1",1000,0,0.1)
```




```
probSub[0]=0.68
bin1->GetQuantiles(1,qq,probSub)
qq[0]
```

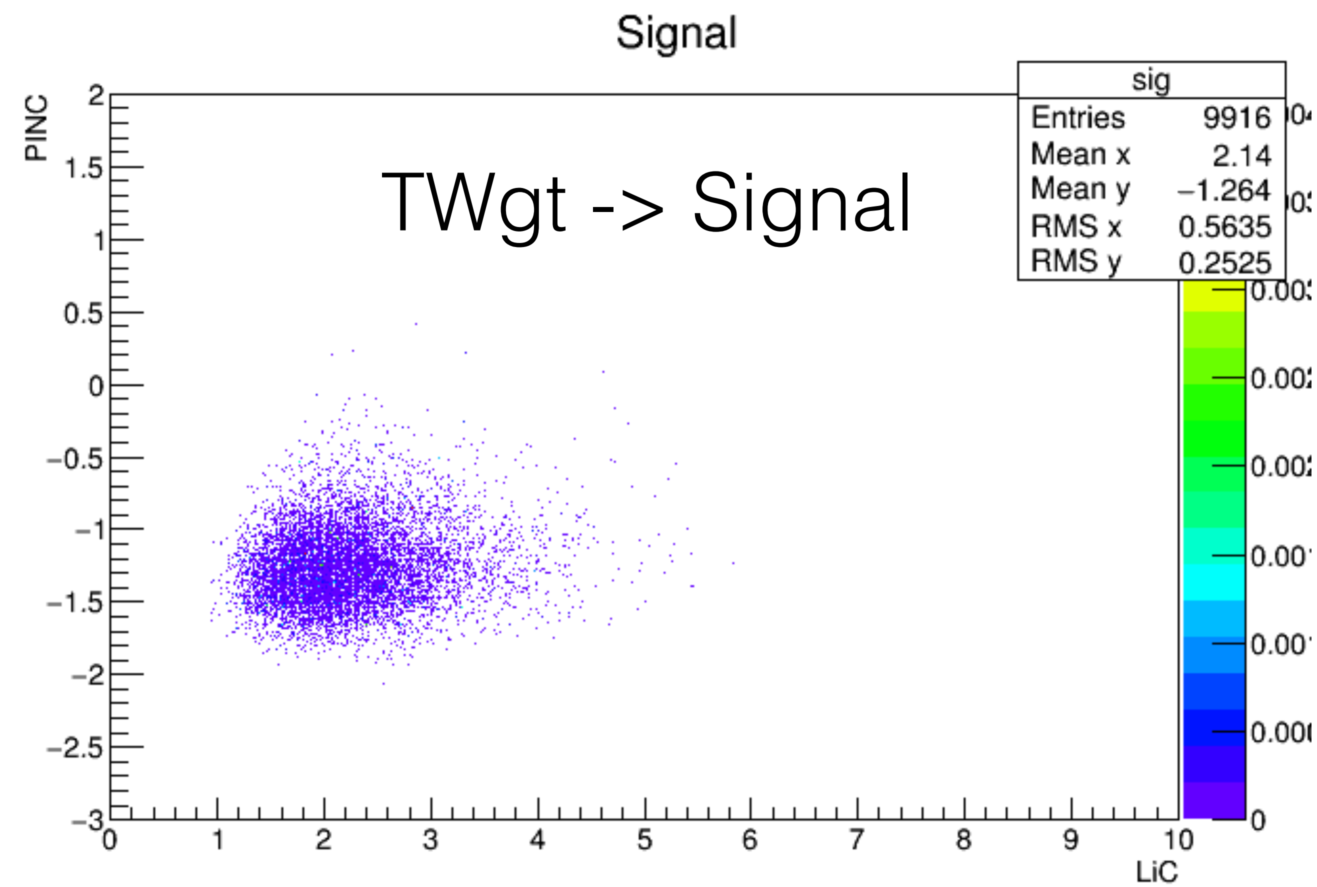
Radian: 9.7067e-03

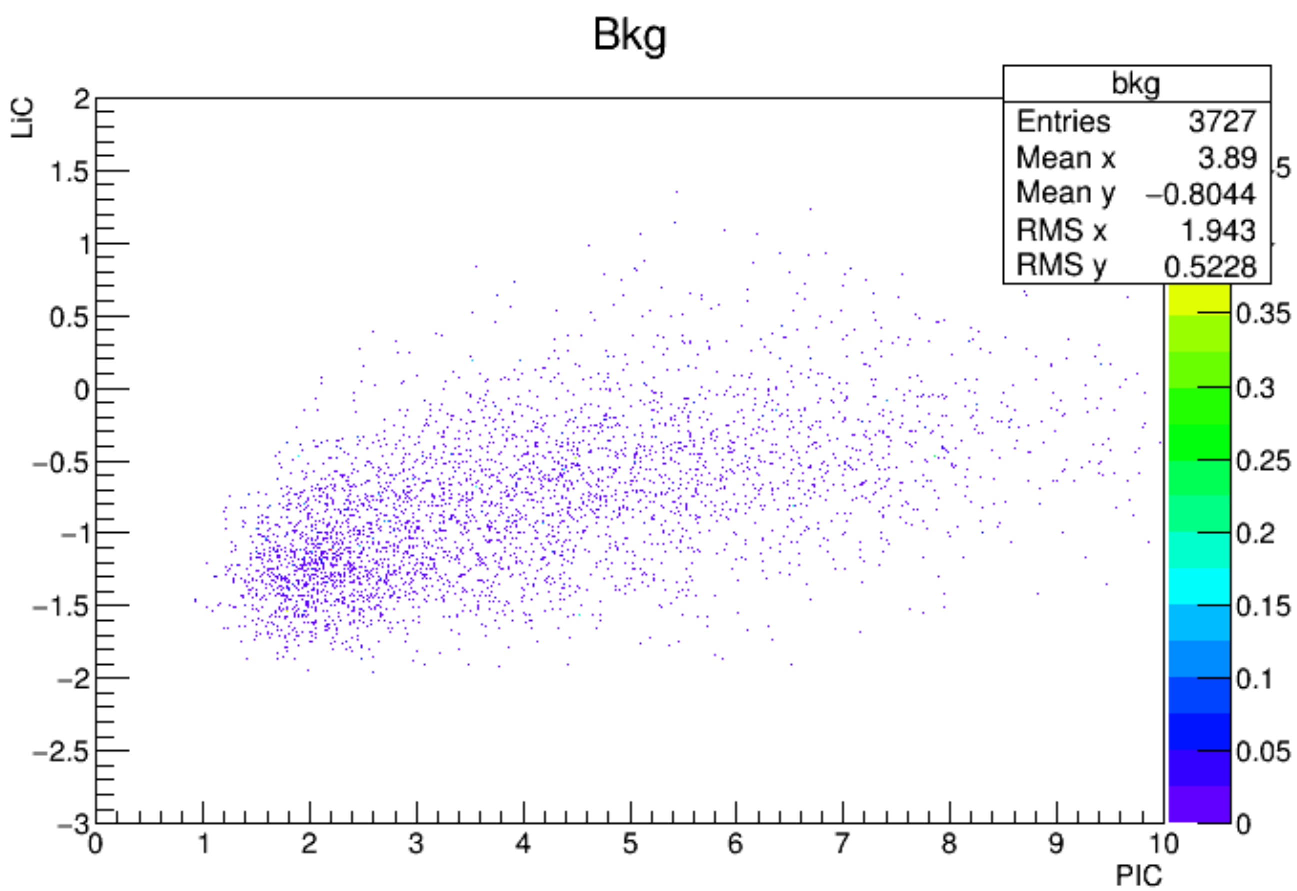
Degree: 0.556157

4. Get 2D histogram: PINC Vs LiC of Signal and Bkg

Example of bin 1: bin 1 && ebin 0

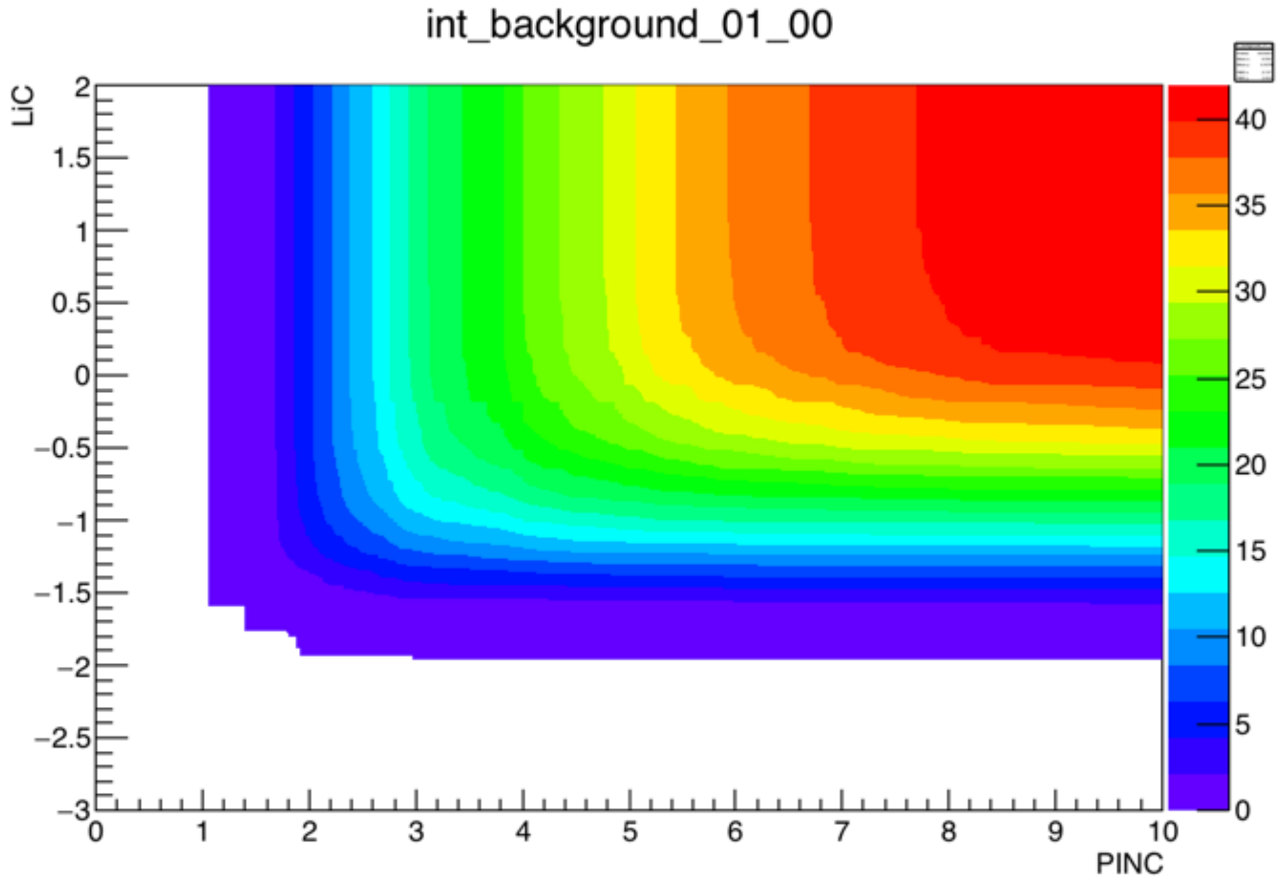
TWgt -> Signal

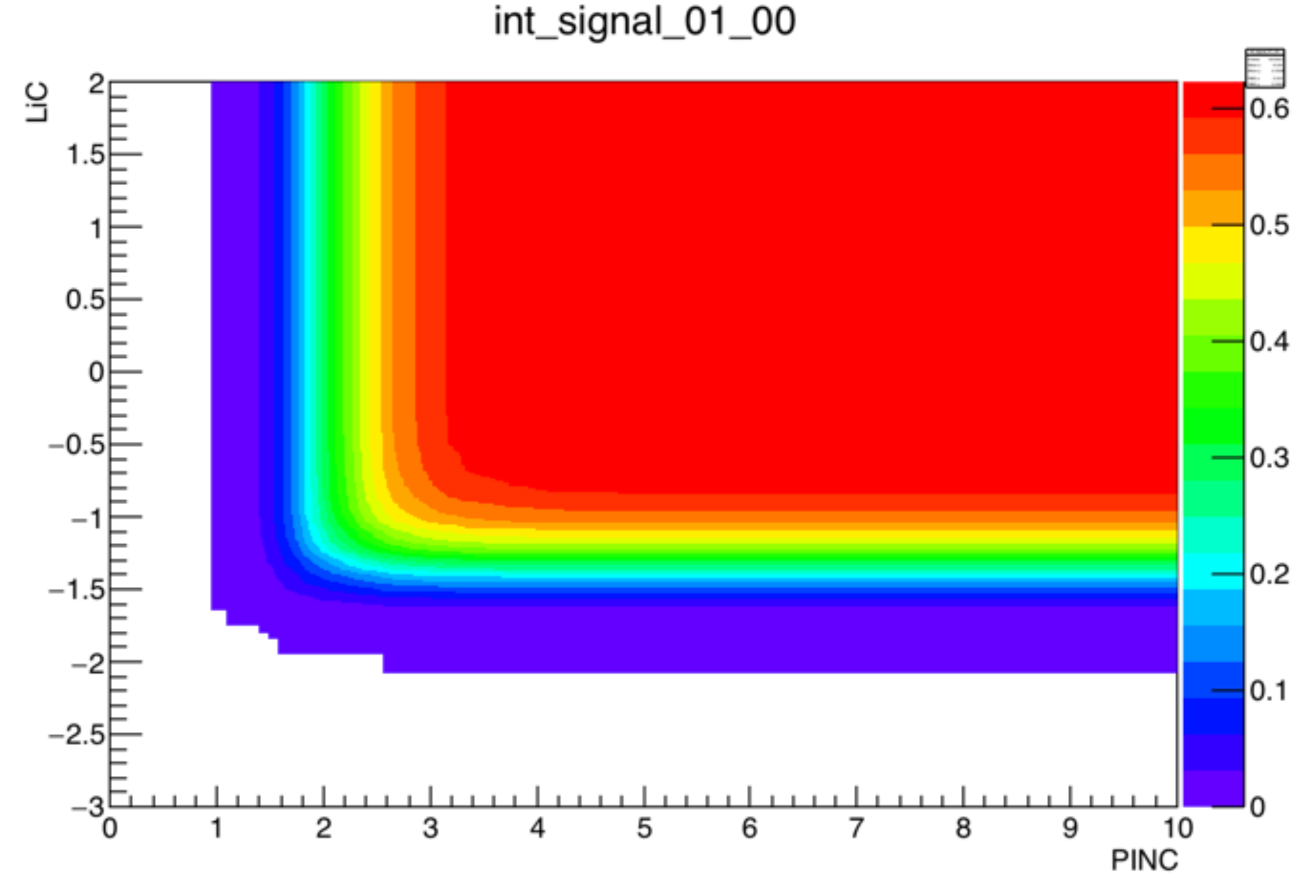




TWgt * SWgt * 2 * pi * (1 - Cos optdelangle)

5. Integrate the histogram





6. Find the maximum Q factor.

signal efficiency > 0.5

How I compute my optimal cut:

Phases:

1. Define the bins: fbin & ebin
2. Quality Cuts
3. Compute optimal delAngle
4. Train RC: Configuration of the training
5. Look for the maximum Q factor

1. Define the bins: fbin & ebin

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- rec.zenithAngle<0.785

Note: 0.785 is approx. 45°

3. Compute optimal delAngle

1. liff-MakeDetectorResponse

- sweets files:

  /data/scratch/userspace/pretz/daqsim-reconstruction/output/daqsim-baseline-take4

- cuts file (New Johns cuts):

  https://private.hawc-observatory.org/wiki/index.php/File:Optimization-2017-12-20-logNNEnergy.txt

- centers of the declination bands (20°)

2. liff-MakeOptApertures

- Declination in degrees: 20°
- Detector response file with a PSF fit:

1	0.1	0.2	2.5	2.75	0.492
11	0.1	0.2	2.75	3.0	0.468
21	0.1	0.2	3.0	3.25	0.434
31	0.1	0.2	3.25	3.5	0.438
41	0.1	0.2	3.5	3.75	0.496
51	0.1	0.2	3.75	4.0	0.587
61	0.1	0.2	4.0	4.25	0.629
71	0.1	0.2	4.25	4.5	0.82
81	0.1	0.2	4.5	4.75	0.795
91	0.1	0.2	4.75	5.0	0.897

Optimal cut

5. Train RC: Configuration of the training

The most important input parameter:

- Input features: PINC & Log10(1/C)
- Number of the bin: fbin + ebin *10
- Quality cuts
- Optimal delAngle

Training configuration:

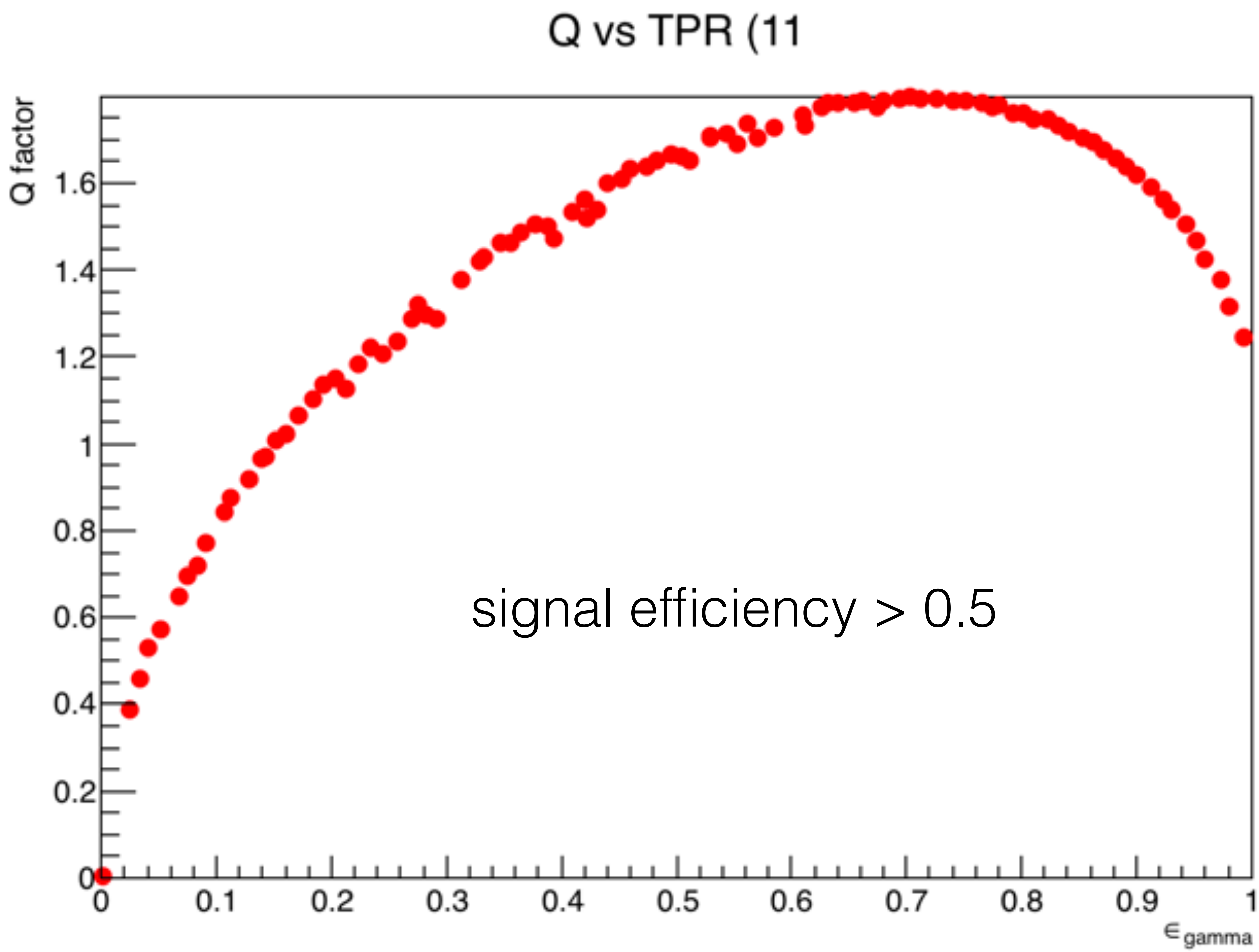
- Use all events.
- NormMode: EqualNumEvents
- SplitMode: Block

RC configuration:

- FitMethod: Genetic Algorithms
- VarProp[x]: FMin (1 cut value per feature)

Note: SplitMode define how the training and test sample are selected from the source tree

6. Look for the maximum Q factor



backslide

Bins:

1. fbin in nHitSP20/nChAvail in step of 0.1
2. ebin is log NNenergy in step of 0.25 from 10 ^2.5 - 10^5.25

ebin	min ebin	max	min ebin (GeV)	max bin (Gev)
0	2.50	2.75	316.23	562.34
1	2.75	3.00	562.34	1000.00
2	3.00	3.25	1000.00	1778.28
3	3.25	3.50	1778.28	3162.28
4	3.50	3.75	3162.28	5623.41
5	3.75	4.00	5623.41	10000.00
6	4.00	4.25	10000.00	17782.79
7	4.25	4.50	17782.79	31622.78
8	4.50	4.75	31622.78	56234.13
9	4.75	5.00	56234.13	100000.00
10	5.00	5.25	100000.00	177827.94
11	5.25	5.50	177827.94	316227.77

fbin	min fbin	max bin
0	0.0	0.1
1	0.1	0.2
2	0.2	0.3
3	0.3	0.4
4	0.4	0.5
5	0.5	0.6
6	0.6	0.7
7	0.7	0.8
8	0.8	0.9
9	0.9	1.0