Elastic Lidars

Cloud DB comparisons

HW : new Standa Laser

R.Mussa, AtmoSession Auger Italia Meeting 4 Feb 2025

Cloudcut Meaning

CloudCut=-3 COV>25% (Lidar)

CloudCut=-2 CLOUDY SKY for GOES16

CloudCut=-1 CLOUDY SKY for ClCam&Lidar

CloudCut= 0 No data

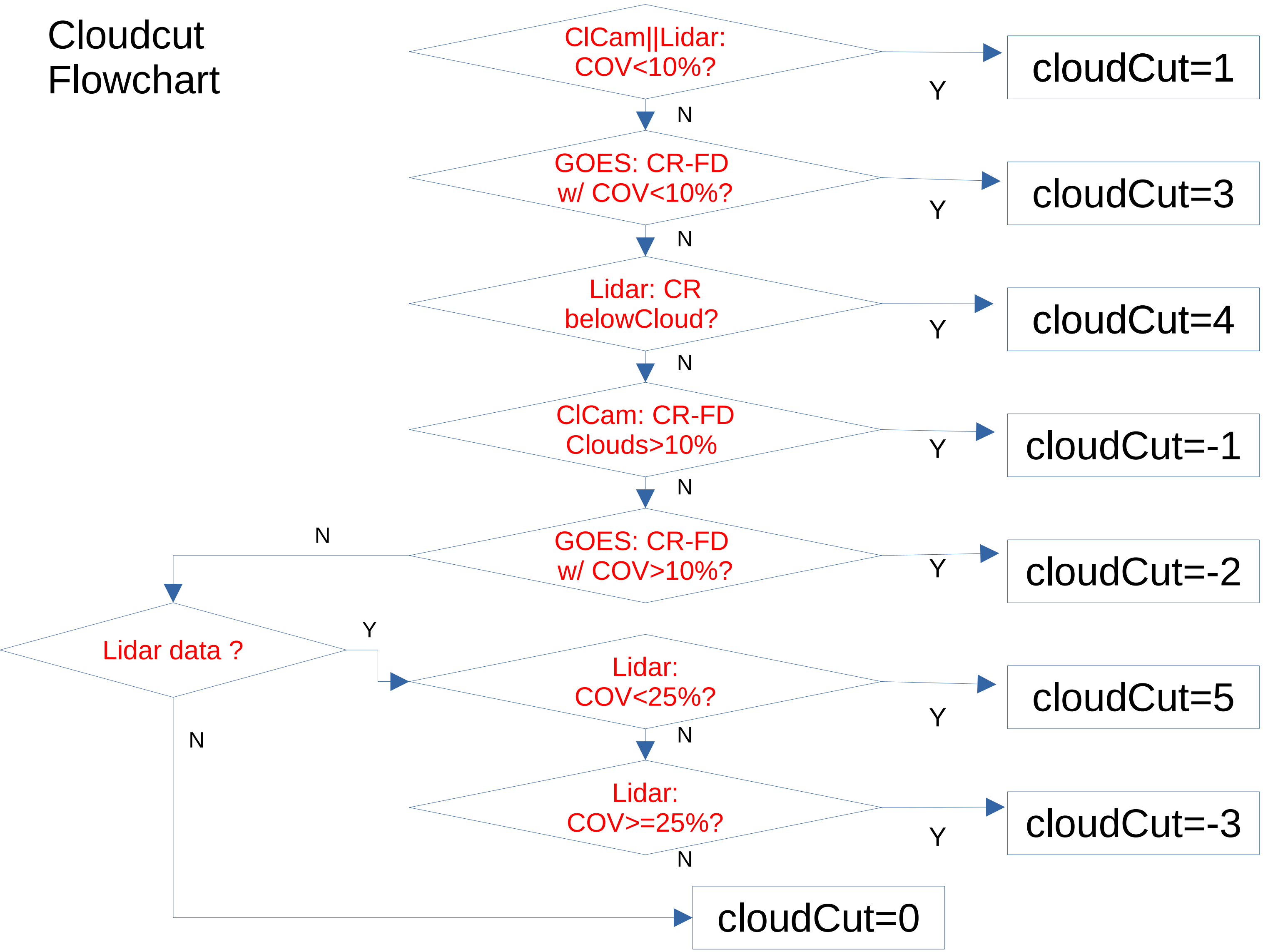
CloudCut= 1 CLEAR SKY for ClCam&Lidar

CloudCut= 2 CLEAR SKY for ClCam only (unused)

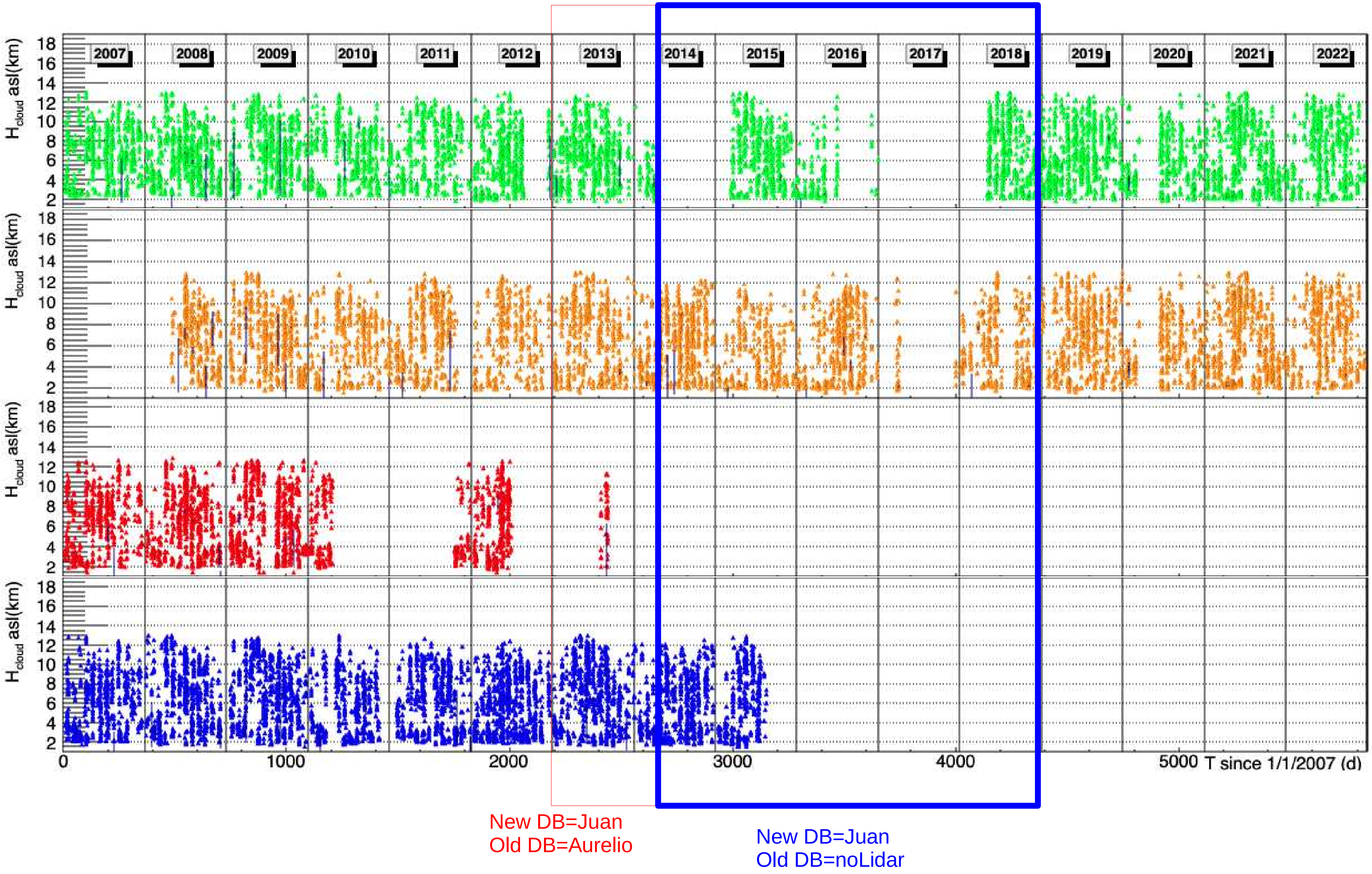
CloudCut= 3 CLEAR SKY for GOES

CloudCut= 4 ShowerBelowClouds (Lidar||CXLF)

CloudCut= 5 COV<25% (Lidar)



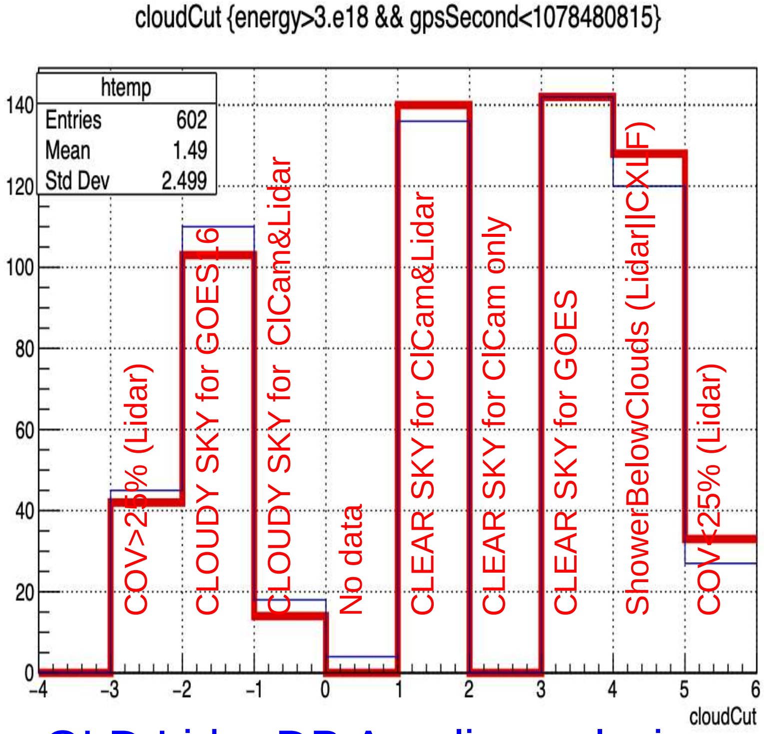
Cloudcut
Flowchart
ClCam||Lidar:
COV<10%?
cloudCut=1
Y
N
GOES: CR-FD
w/ COV<10%?
cloudCut=3
Y
N
Lidar: CR
belowCloud?
cloudCut=4
Y
N
ClCam: CR-FD
Clouds>10%
cloudCut=-1
Y
N
N
GOES: CR-FD
w/ COV>10%?
cloudCut=-2
Y
Lidar data ?
Y
Lidar:
COV<25%?
cloudCut=5
Y
N
N
Lidar:
COV>=25%?
cloudCut=-3
Y
N
cloudCut=0



2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
H_cloud asl(km)
T since 1/1/2007 (d)
0
1000
2000
3000
4000
5000
New DB=Juan
Old DB=Aurelio
New DB=Juan
Old DB=noLidar

Comparison of OLD and NEW DB 2013-2018:

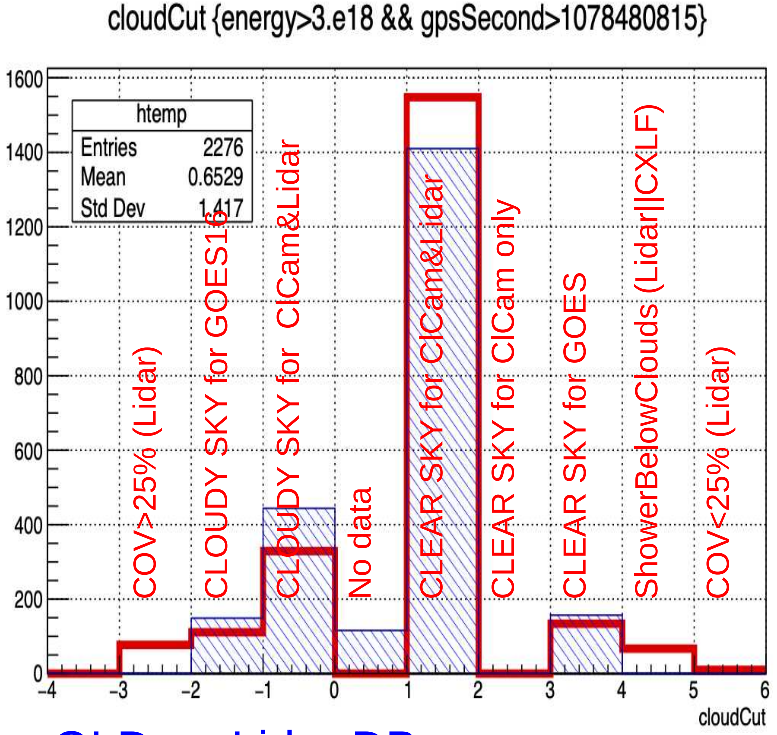
BEFORE GPS=1078480815



OLD Lidar DB Aurelio analysis

NEW Lidar DB Juan analysis

AFTER GPS=1078480815



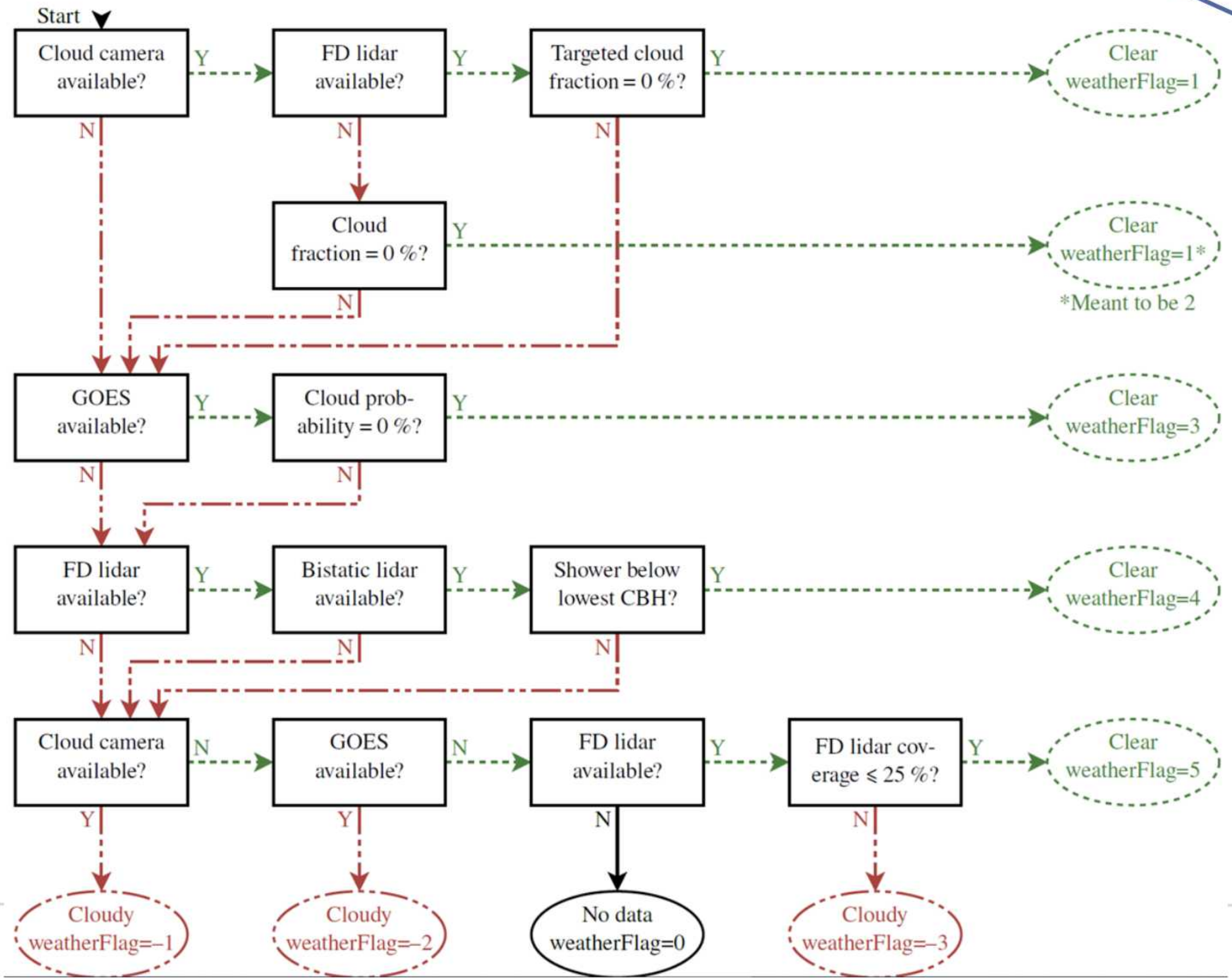
OLD no Lidar DB

NEW Lidar DB Juan analysis

From OLD to NEW DB we see that NoData bin is now empty, and also the Cloudy from CloudCam is reduced, in favor of : ClearSky, COV>25%, and ShowerBelowClouds

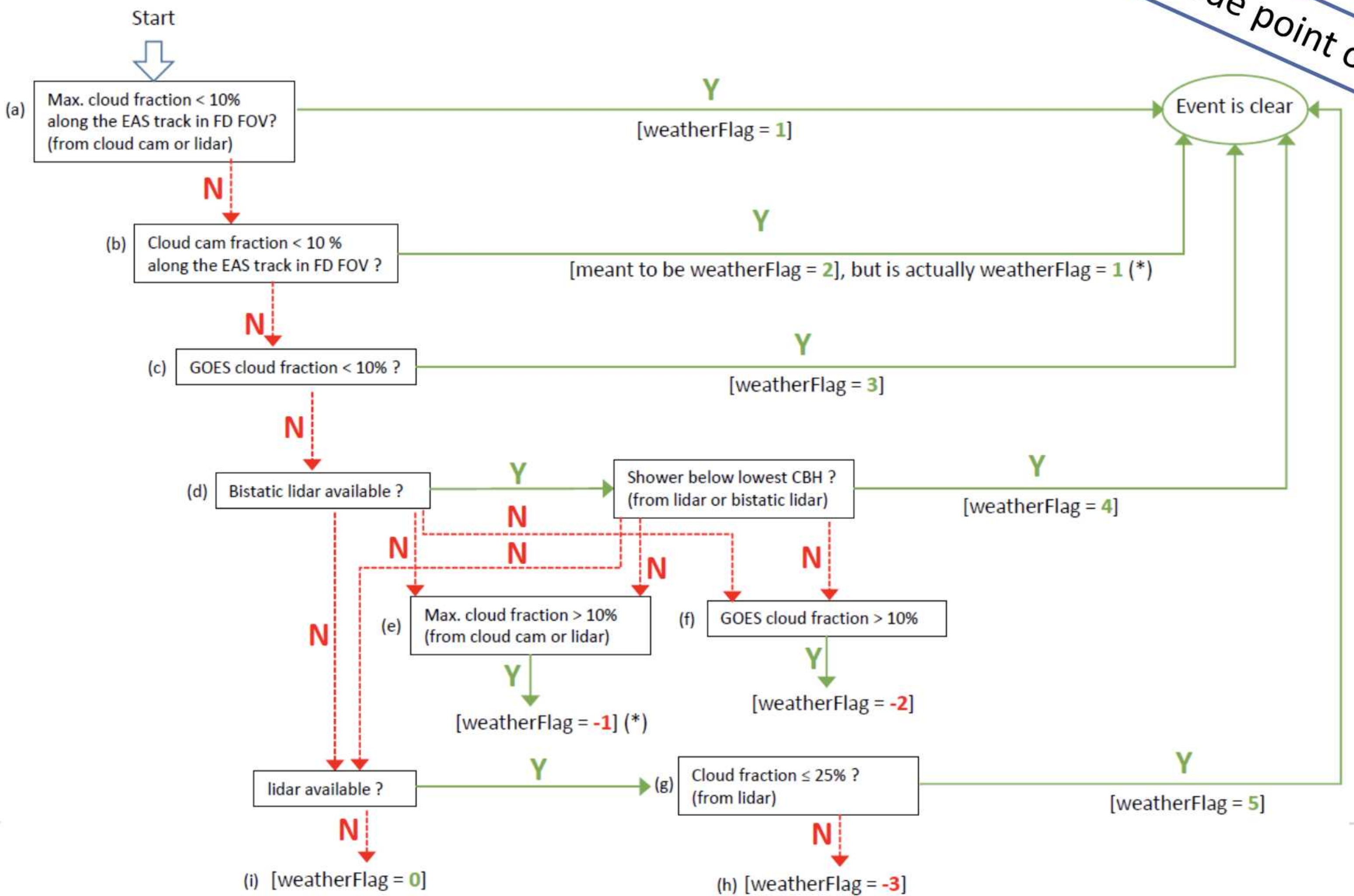
Updates of Flow Charts of Cloud Cut procedure

„physics point of view“



Updates of Flow Charts of Cloud Cut procedure

„code point of view "



(*) Currently, ALWAYS HasData = true is returned for LidarCloudDB, so the two indicated weatherFlags are slightly wrong. For (e), -1 is also returned in case of no lidar data.

Cross check of lidar DB

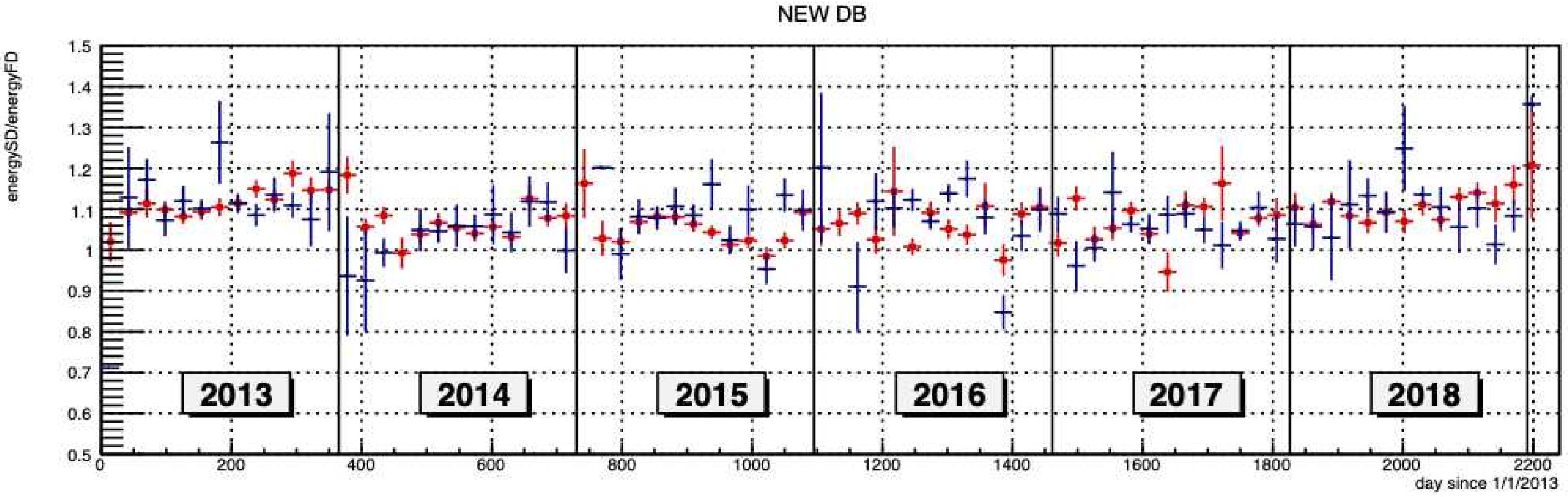
Preliminary conclusions

- Current cloud cut behaves at 2 steps differently than expected, but this inhibits only the identification of two types of „surviving“ events
- Unfortunately, the period with overlapping lidar data (old and new analysis) coincides with a transition phase of the very early cloud IR cameras to the newer type (2012-2013)
- Final plots for conclusion are being prepared, but only for the limited period of overlapping lidar data
- From advanced energy comparisons no “surprises” are expected

E(SD)/E(FD) from standard reconstruction

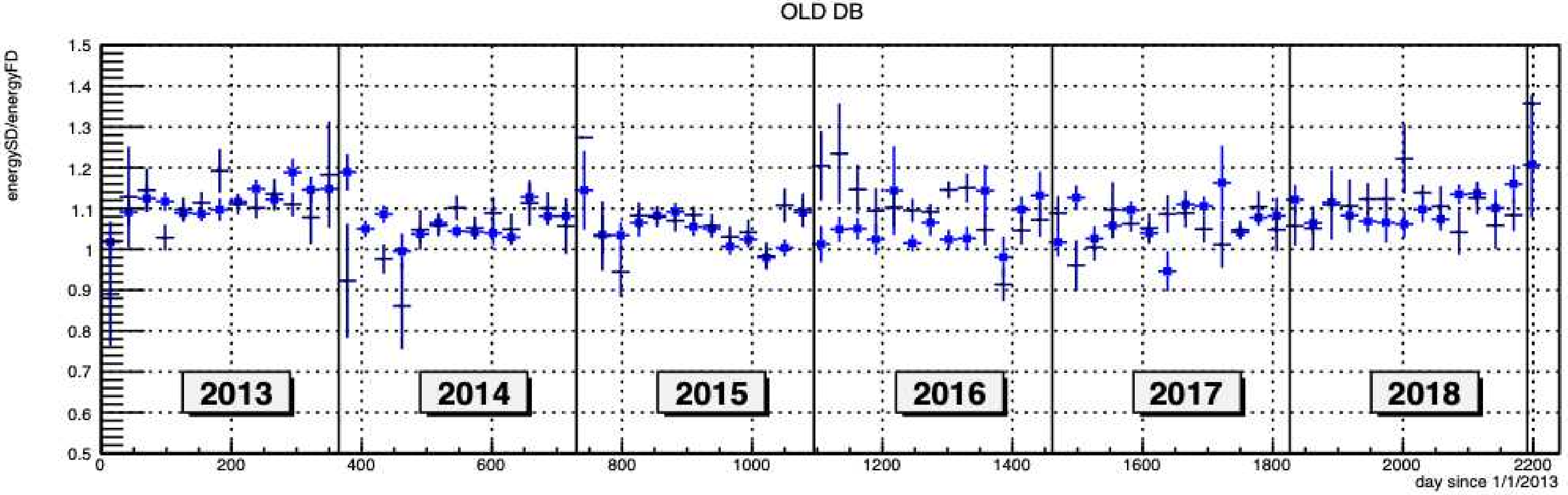
CloudCut>0 RED

CloudCut<=0 BLACK

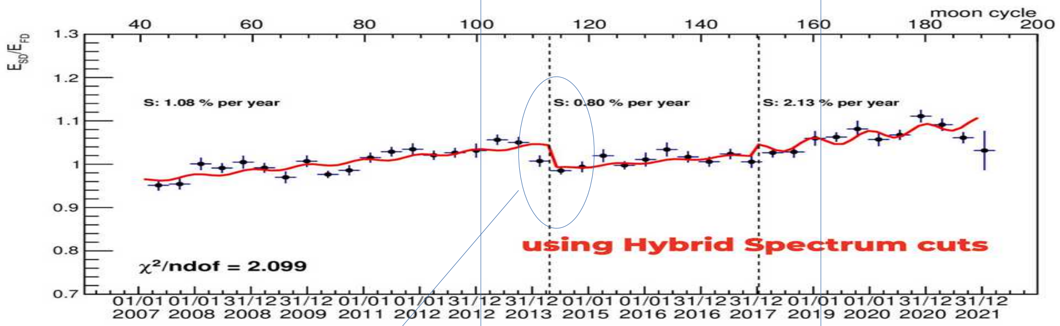


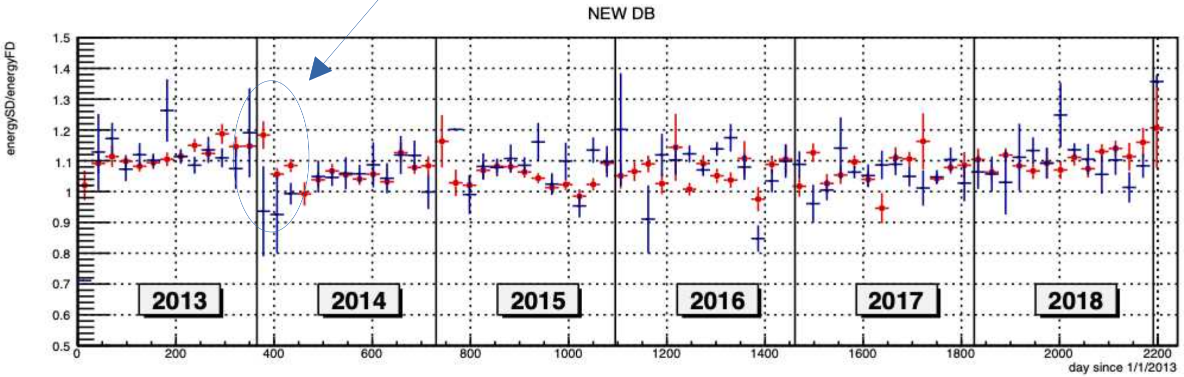
CloudCut>0 BLUE

CloudCut<=0 BLACK

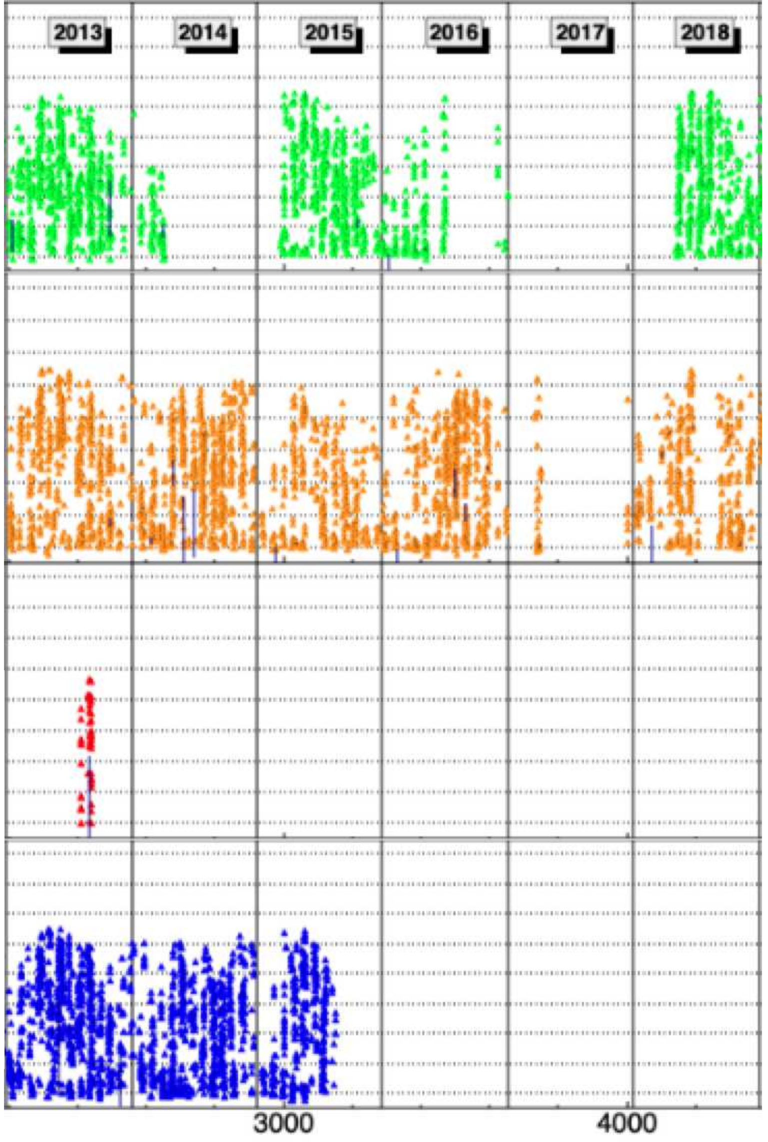


Energy spreads: see features shown also by F.Salamida, but step is amplified . I may not be including CIC corrections on SD energy

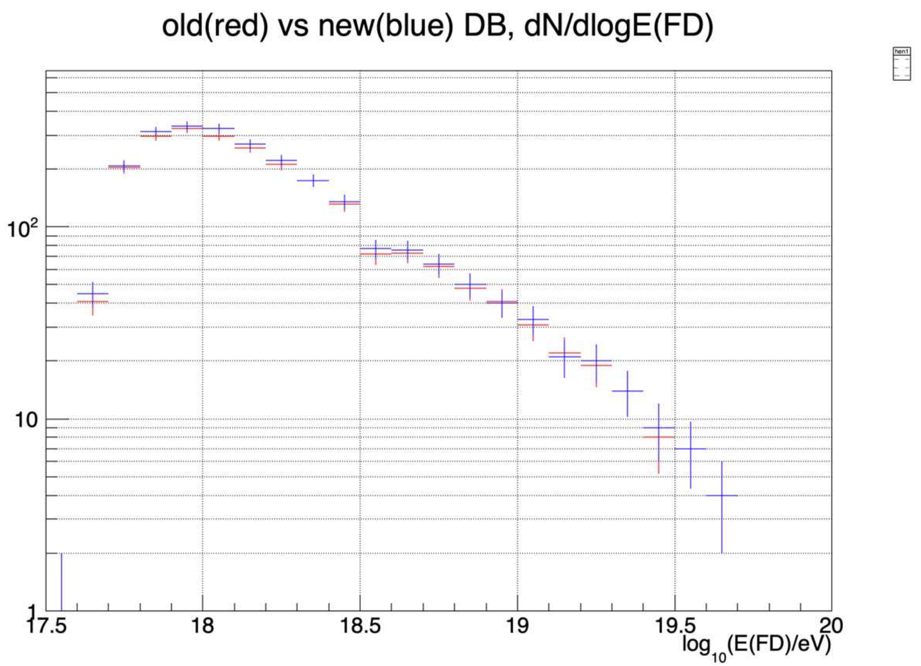


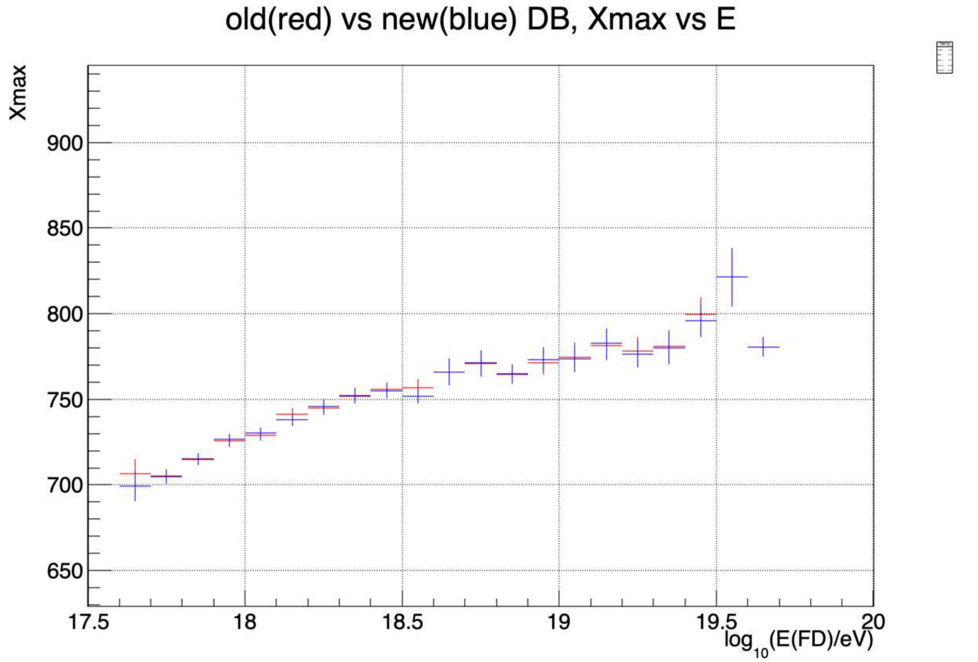


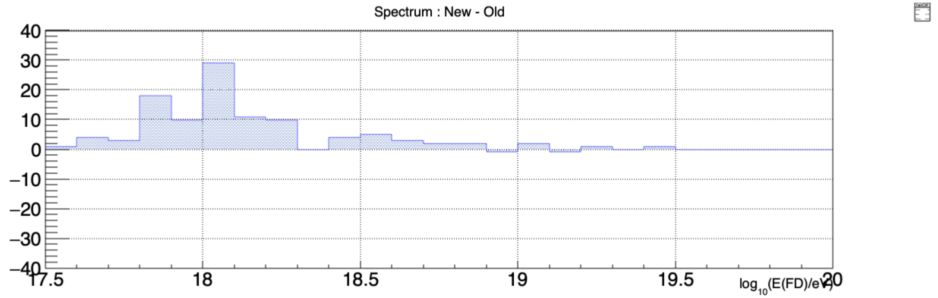
RED : clear, BLUE : cloudy

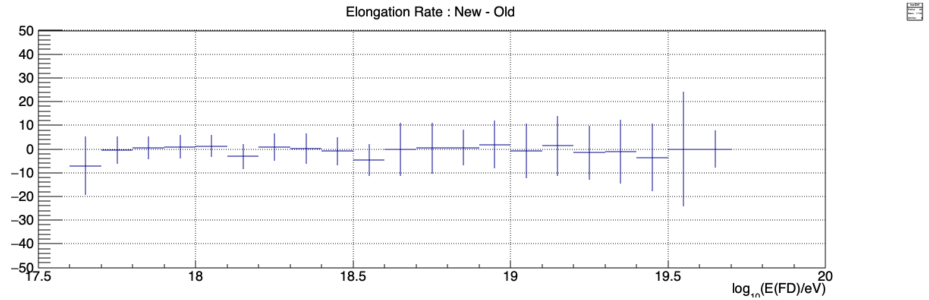


Before GPS 1078480815, CloudCut>0: good conditions

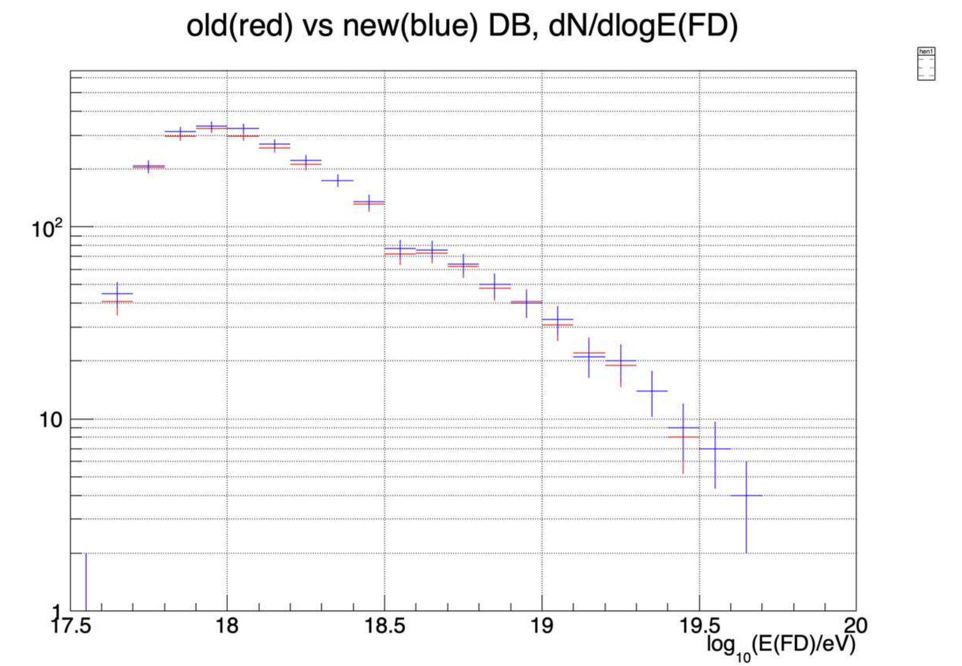


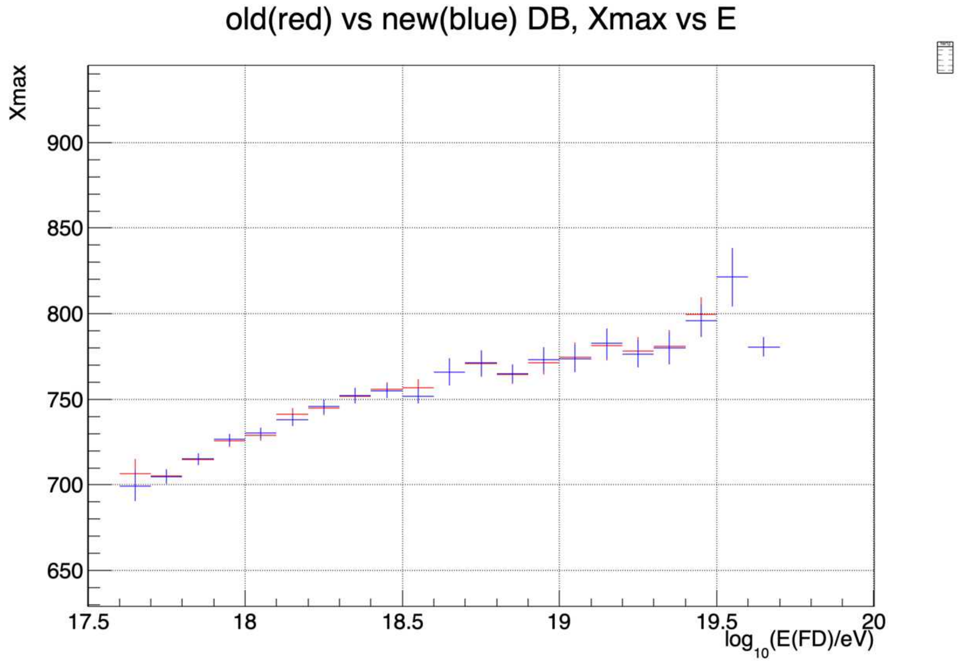


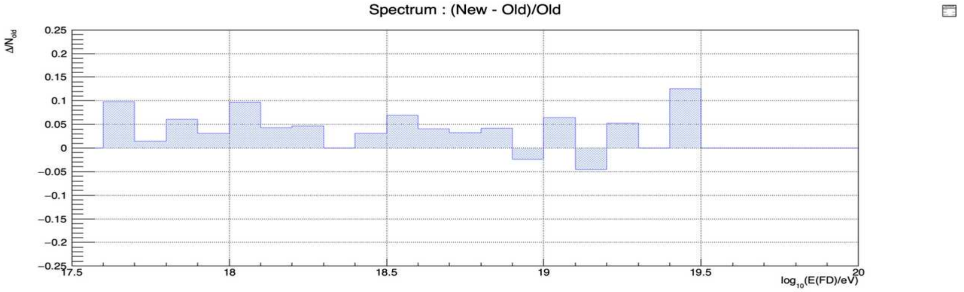


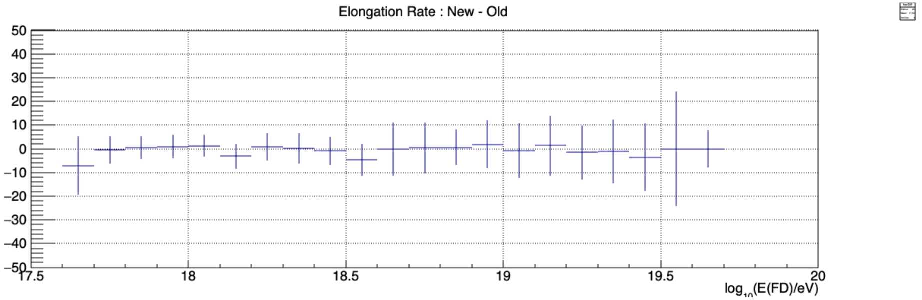


Before GPS 1078480815, CloudCut>0: good conditions



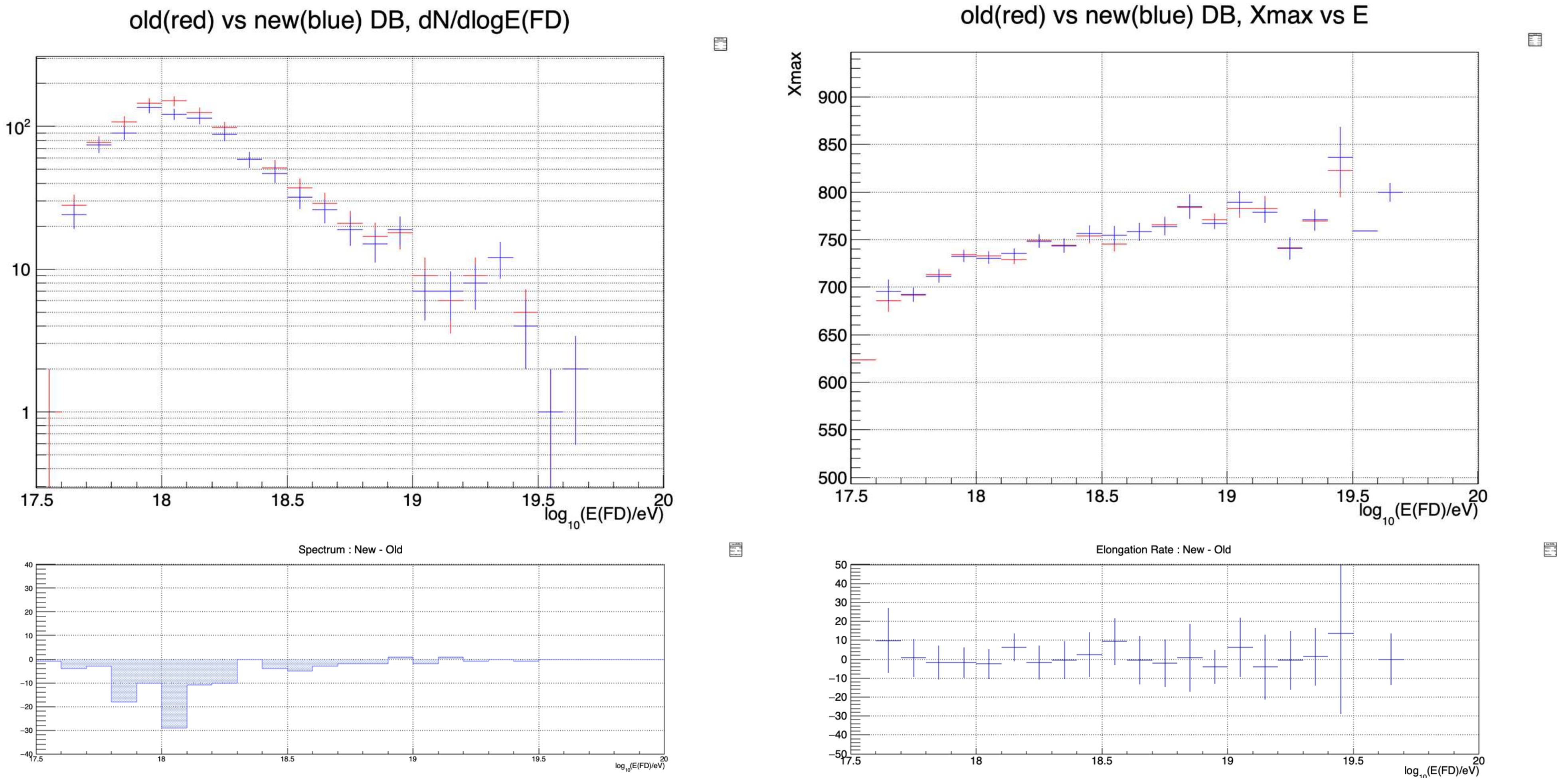




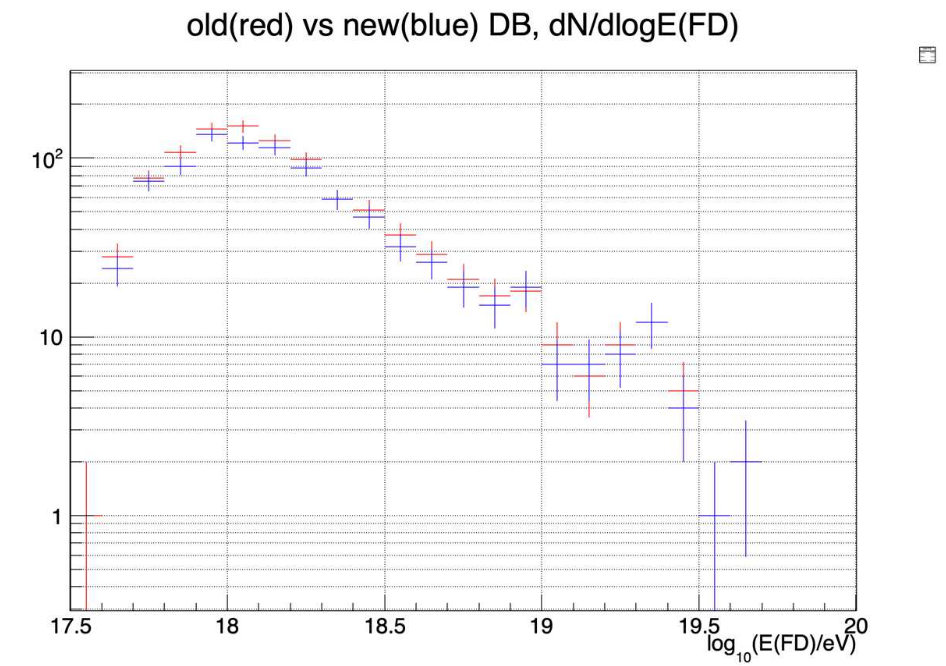


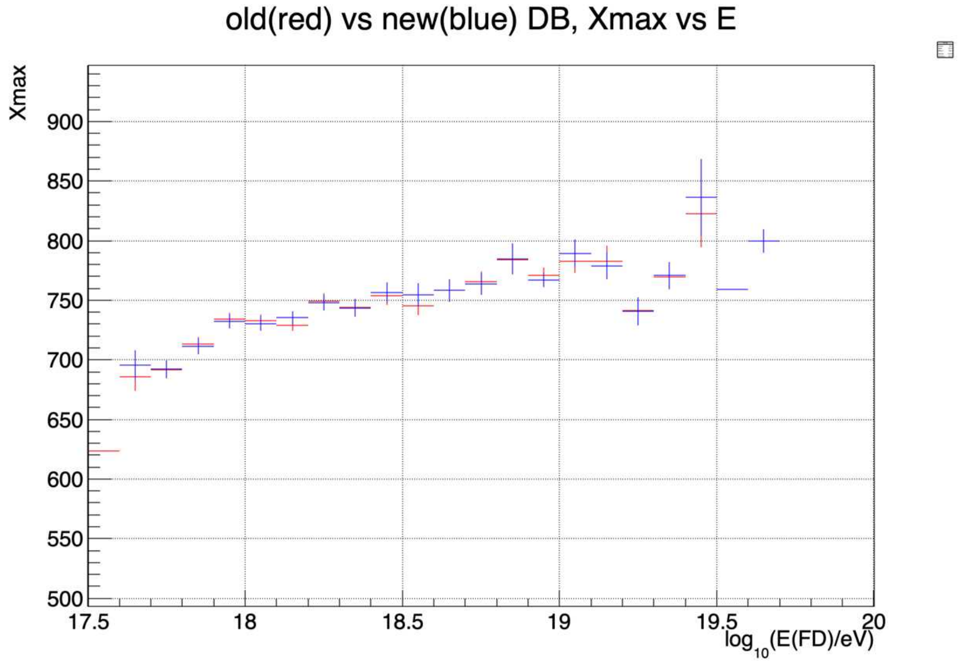
Approximately, ~5% more good data, homogeneous in Energy, and in Elong.Rate

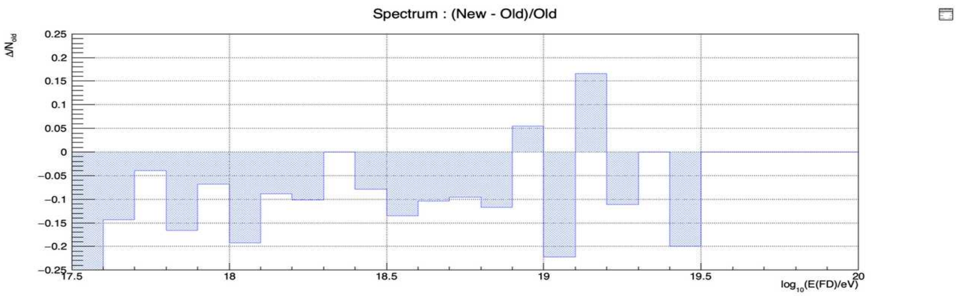
Before GPS 1078480815, CloudCut<=0: bad conditions

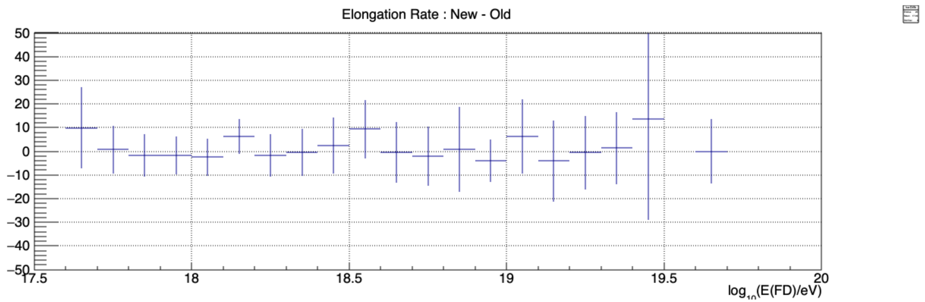


Before GPS 1078480815, CloudCut<=0: bad conditions

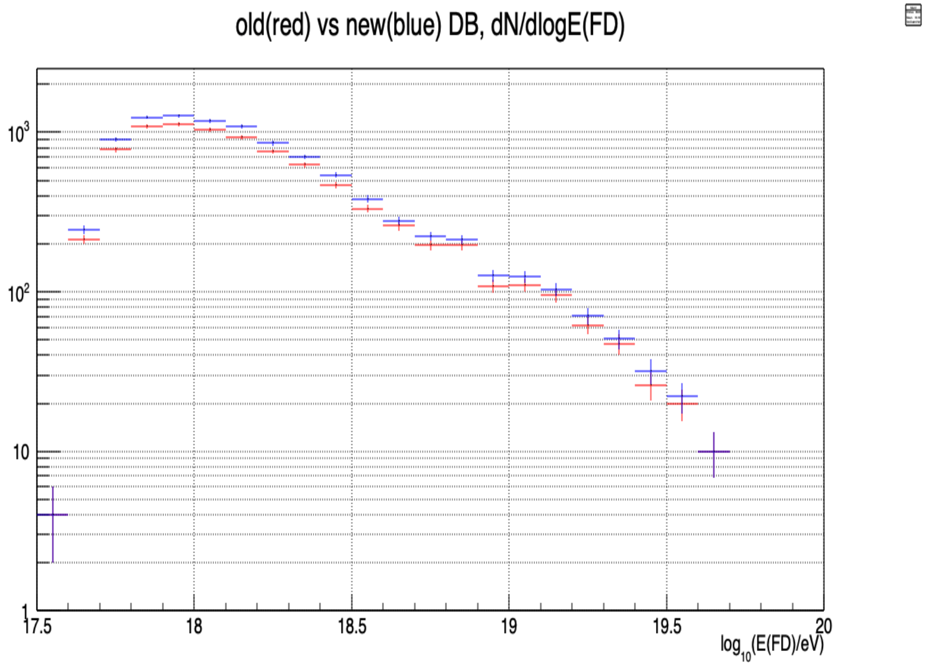


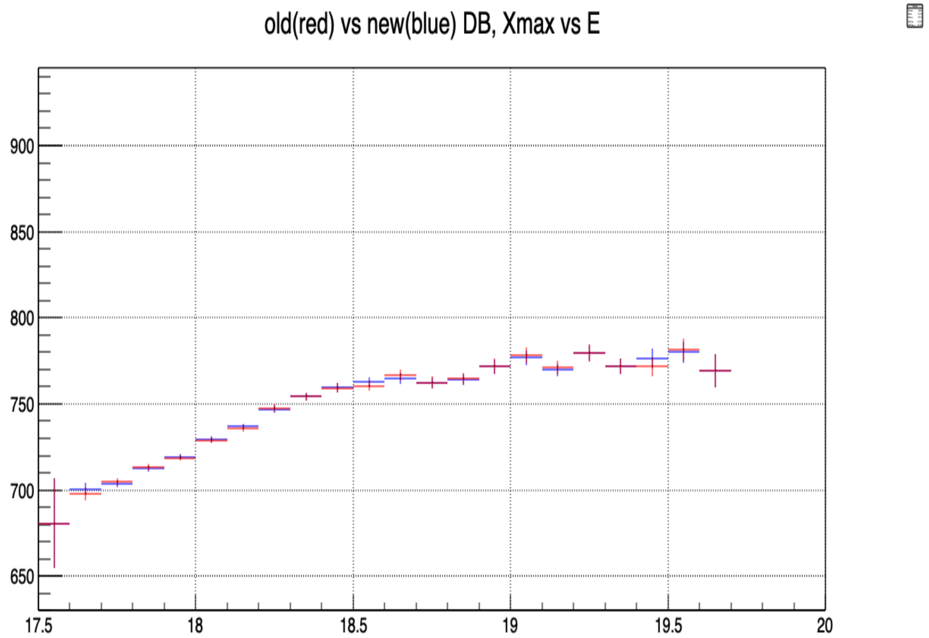


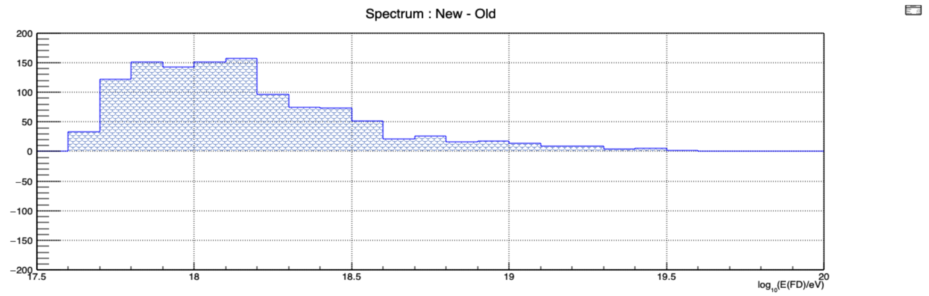


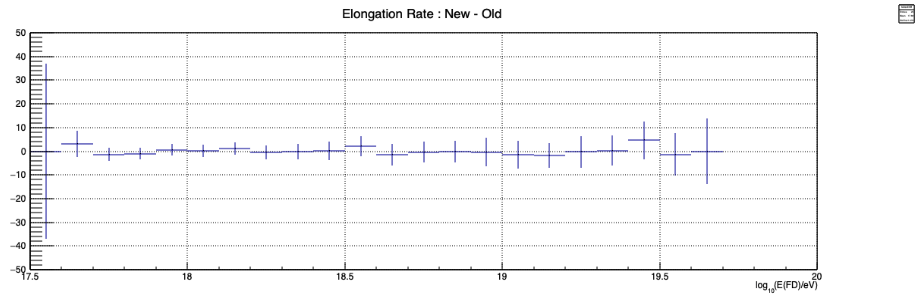


AFTER GPS 1078480815 (until 2018), CloudCut>0: good conditions

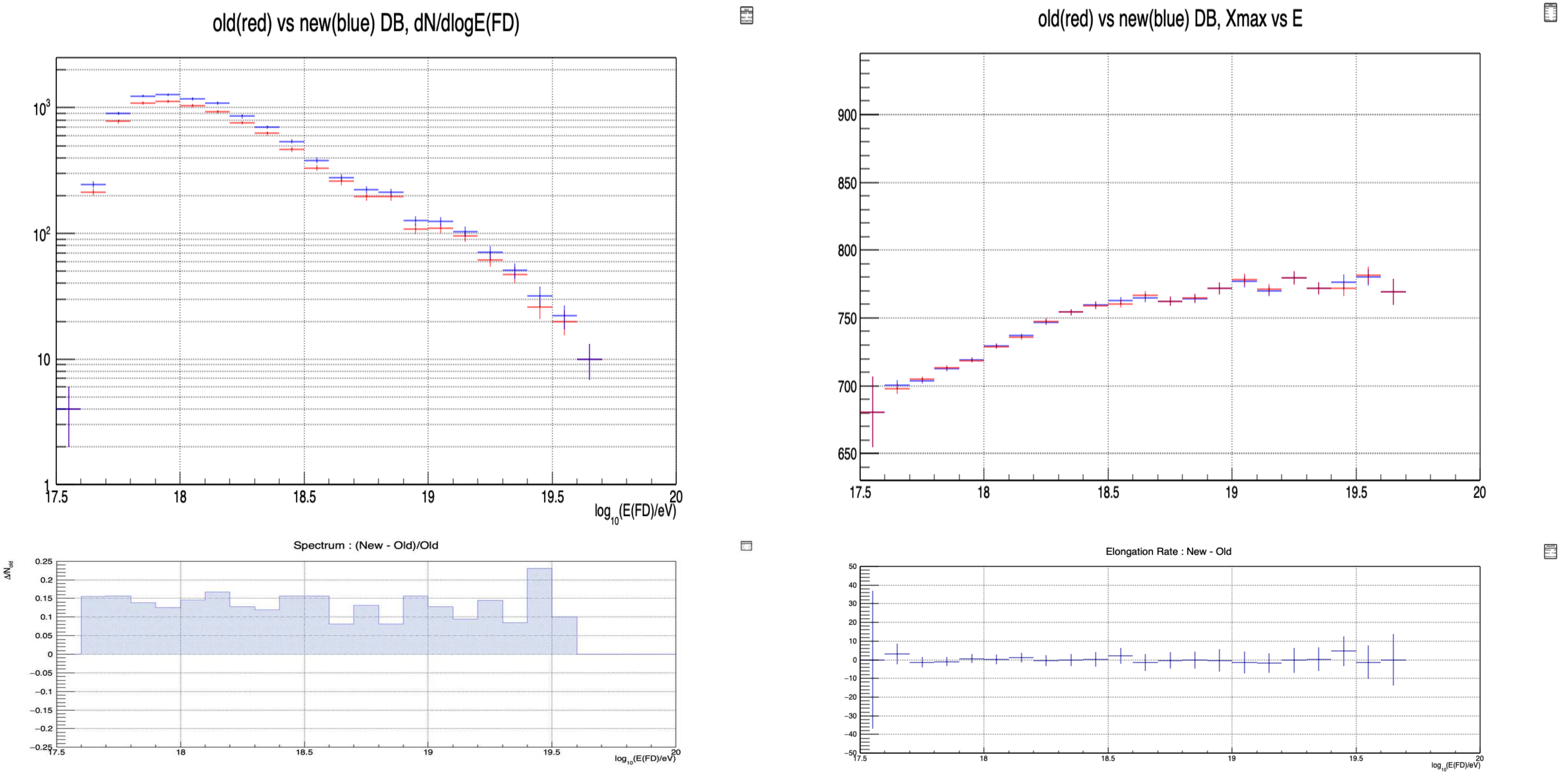






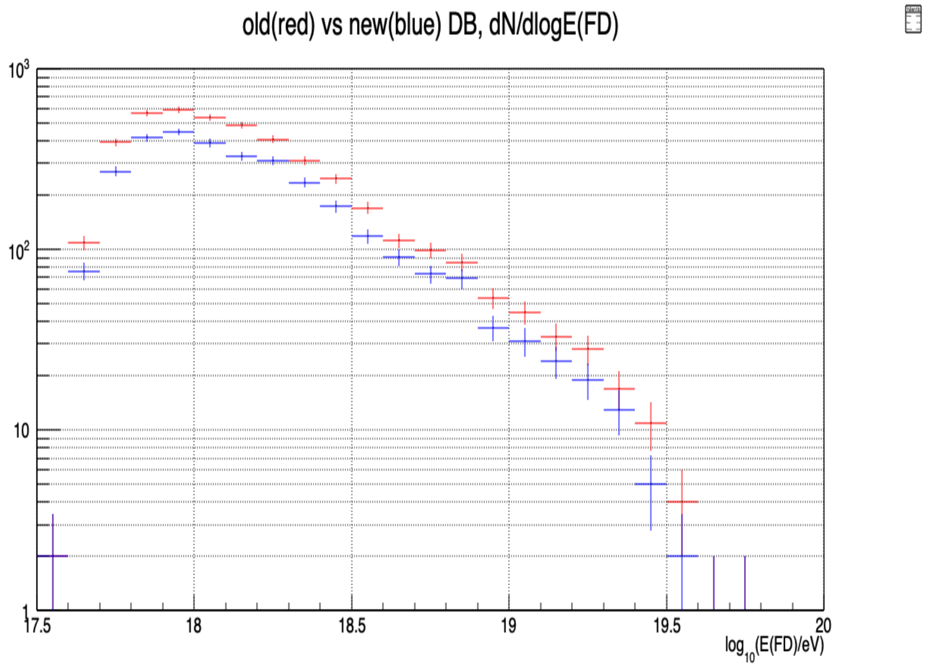


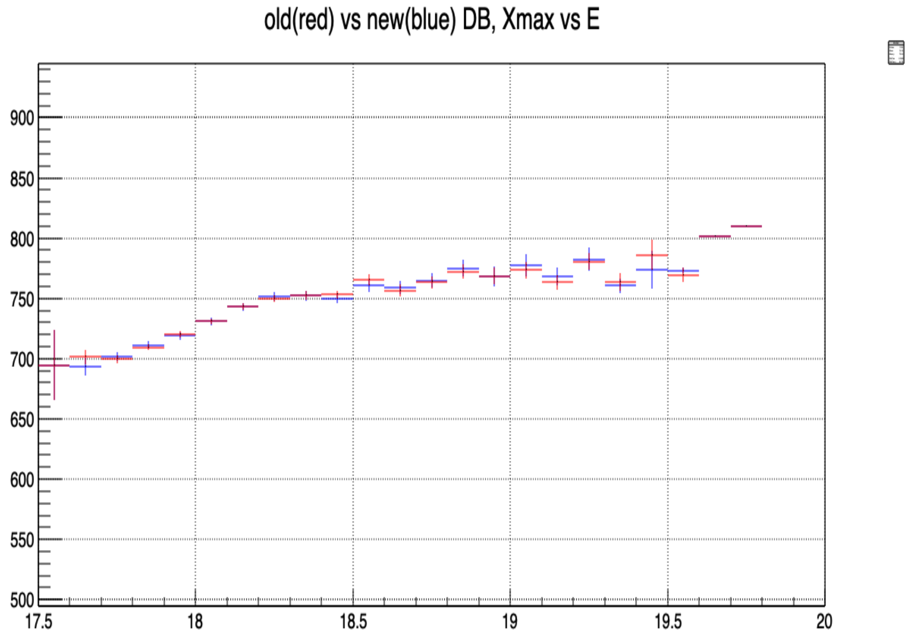
AFTER GPS 1078480815 (until 2018), CloudCut>0: good conditions

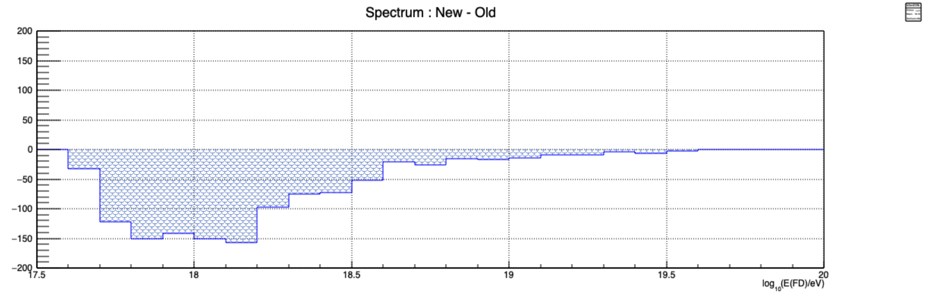


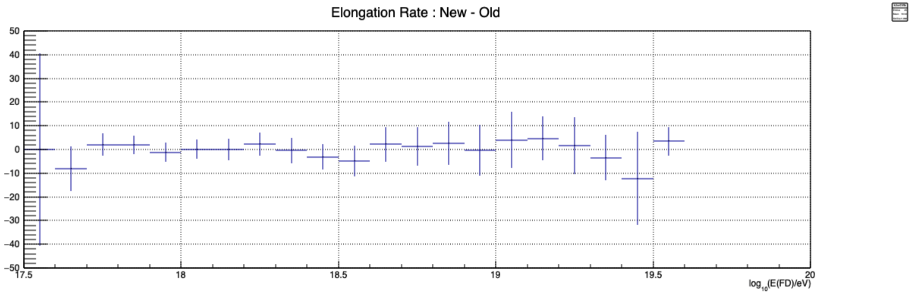
Essentially , ~12% more data, homogeneous in Energy, and in Elong.Rate

AFTER GPS 1078480815 (until 2018), CloudCut<=0: bad conditions









Lidar Analysis : summary and prospects

- Comparison of NEW and OLD Cloud DB before march 2014, shows a ~6% increase in good available data
- After march 2014 we have a ~12% increase in good data with biases on Energy or Xmax.
- Cloud DB (Juan) ready until 4/23; processing until 12/23 was completed a week ago, but JP found a mistake and is reprocessing them. Will be ready by end February. During March shift we'll probably finish automatization.
- Horizontal analysis 2024 in Torino: after VM upgrade, I have problems re-compiling some library. Hope to restart soon.

Hardware news : Laser Standa

UNIVERSITÀ DI TORINO

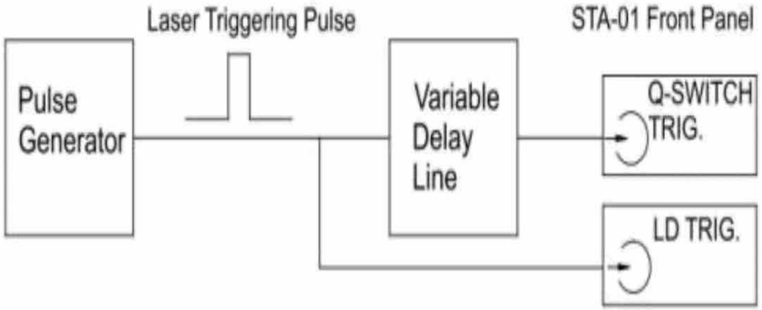
Università degli Studi di Torino
Corso di Laurea in Fisica
Anno Accademico 2023/2024

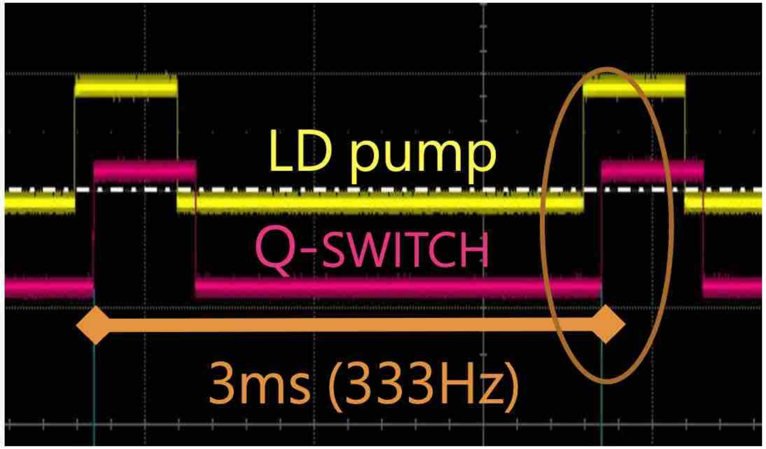
Ottimizzazione di laser ultravioletto per applicazioni Lidar.

Relatori:
Roberto Mussa;
Marco Aglietta.

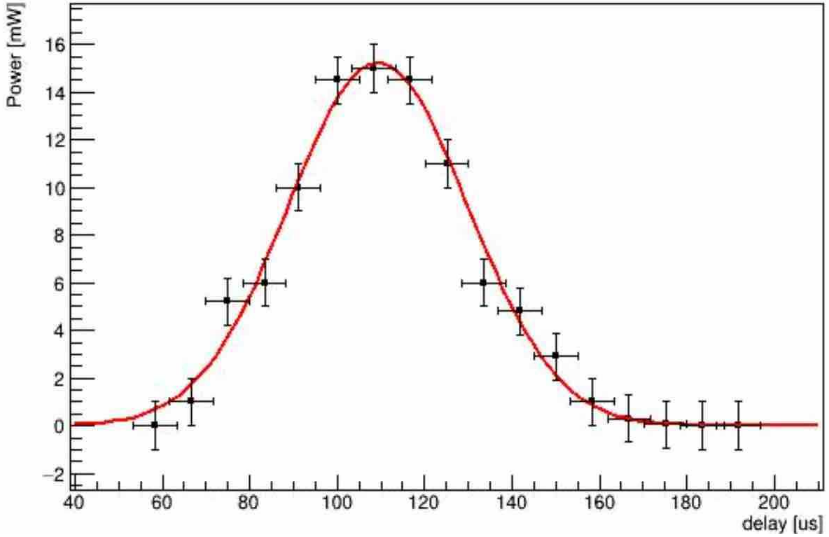
di
Helian Beltrami
(#944950)

Ottimizzazione del trigger esterno.





radiometro
THORLABS S120VC

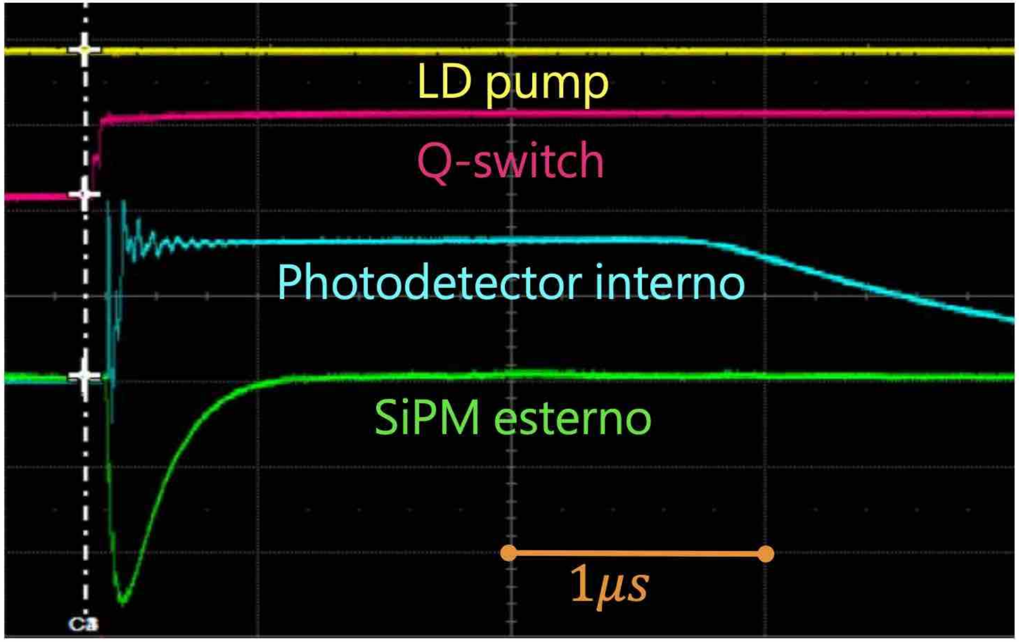


Il tempo che intercorre tra l' accensione del LD e il segnale LOW al Q-switch (inizio risonza) permette la stimolazione del cristallo.

Ritardo ottimale: $110\ \mu s$

Time Jitter.

Lo scarto temporale tra l' accensione del Q-switch e l' effettivo lasing in spari consecutivi.



Il Q-Switch verrà utilizzato per sincronizzare il Lidar al FD (GPS time)

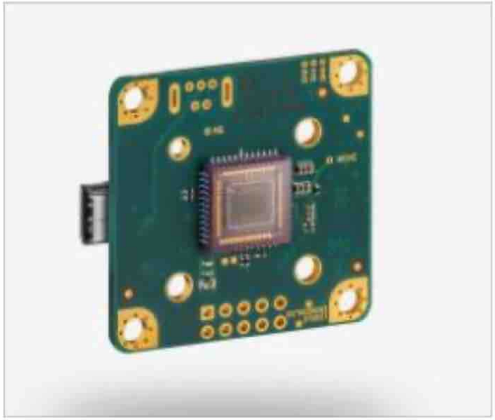
Il segnale del Q-switch è il trigger della misurazione

un elevato Time Jitter porterebbe ad errori di sincronizzazione con FD e nel calcolo delle distanze (es. nuvole)

1 ns porta un errore di 15cm

Time Jitter	< 10 ns
errore in metri	< 1.5 m

Misura divergenza del fascio.



Fotocamera uEye LE
conversione 7.7 µm/pxl

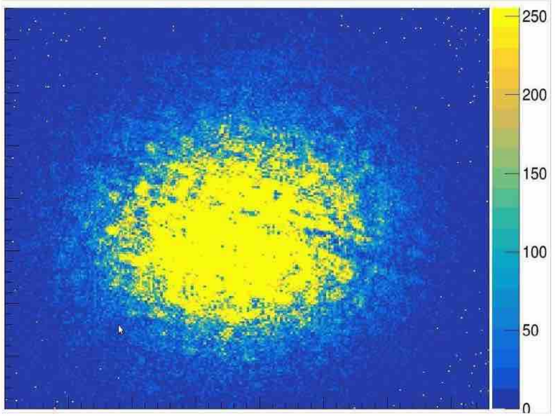
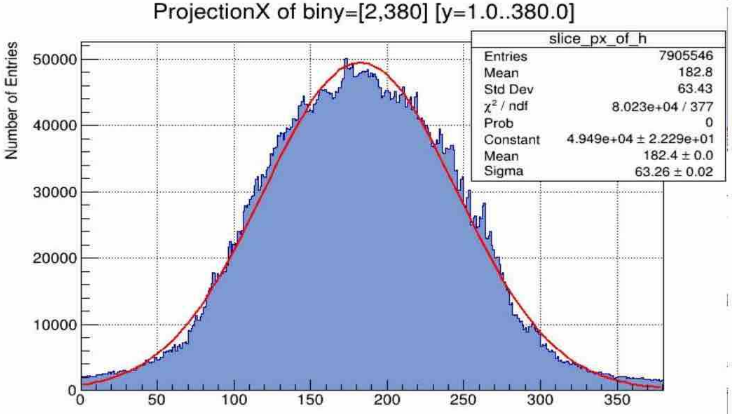
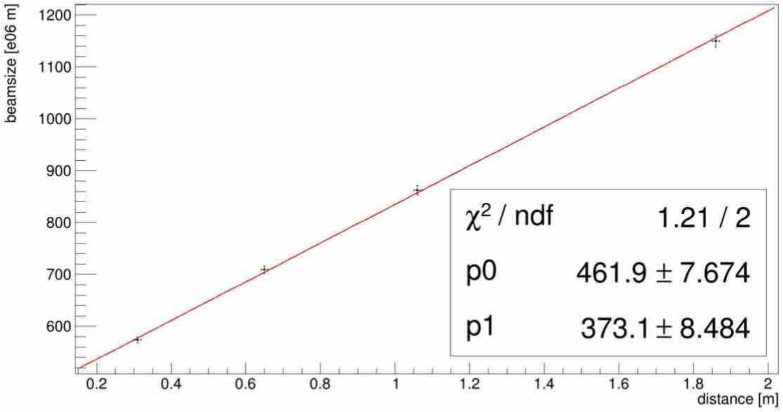


Immagine fotocamera,
profilo di intensità luminosa



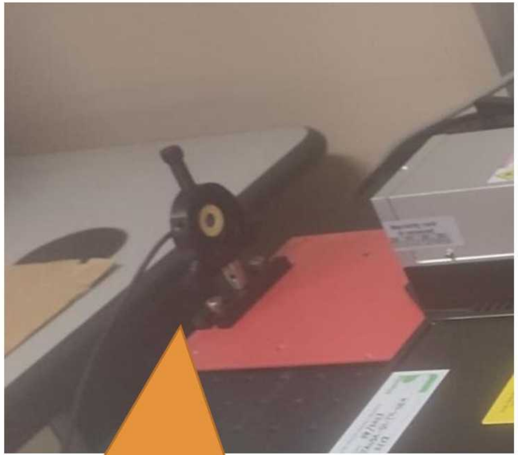
intregrazione intensità luminosa
per bin (orizzontale)

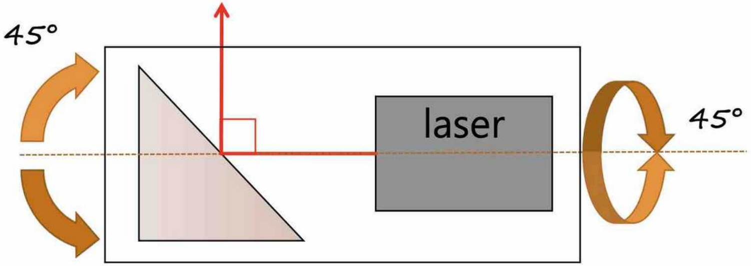


Beam Divergence	0.37 mrad (37cm al km)
Beam Size	~400 µm

La divergenza, ottenuta a HWHM, è più che ottimale essendo la metà di quelle dei lidar finora utilizzati.

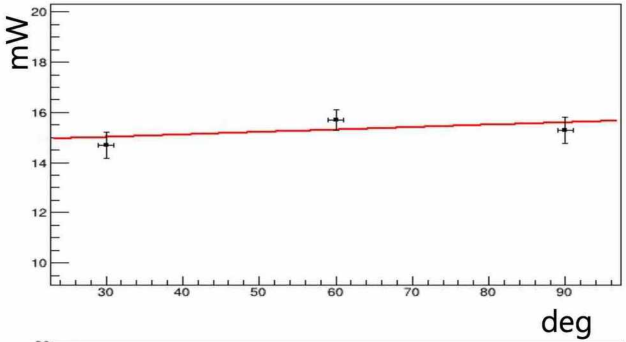
Test inclinazione.





Distribuzione di potenza

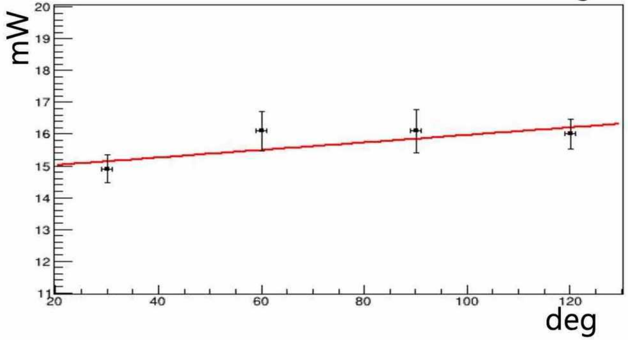
Potenza in funzione dell' inclinazione



ANGOLO ZENITALE

COEFF.ANGOLARE

$9.7 \cdot 10^{-3}\ mW/_{deg}$



ASSE LONGITUDINALE

COEFF.ANGOLARE

$1.2 \cdot 10^{-2}\ mW/_{deg}$