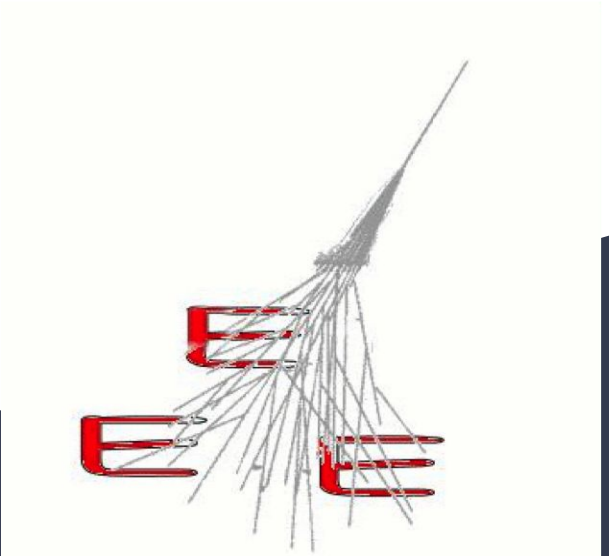
Extreme Energy Events
the science into schools

FRAS-01 Recommissioning



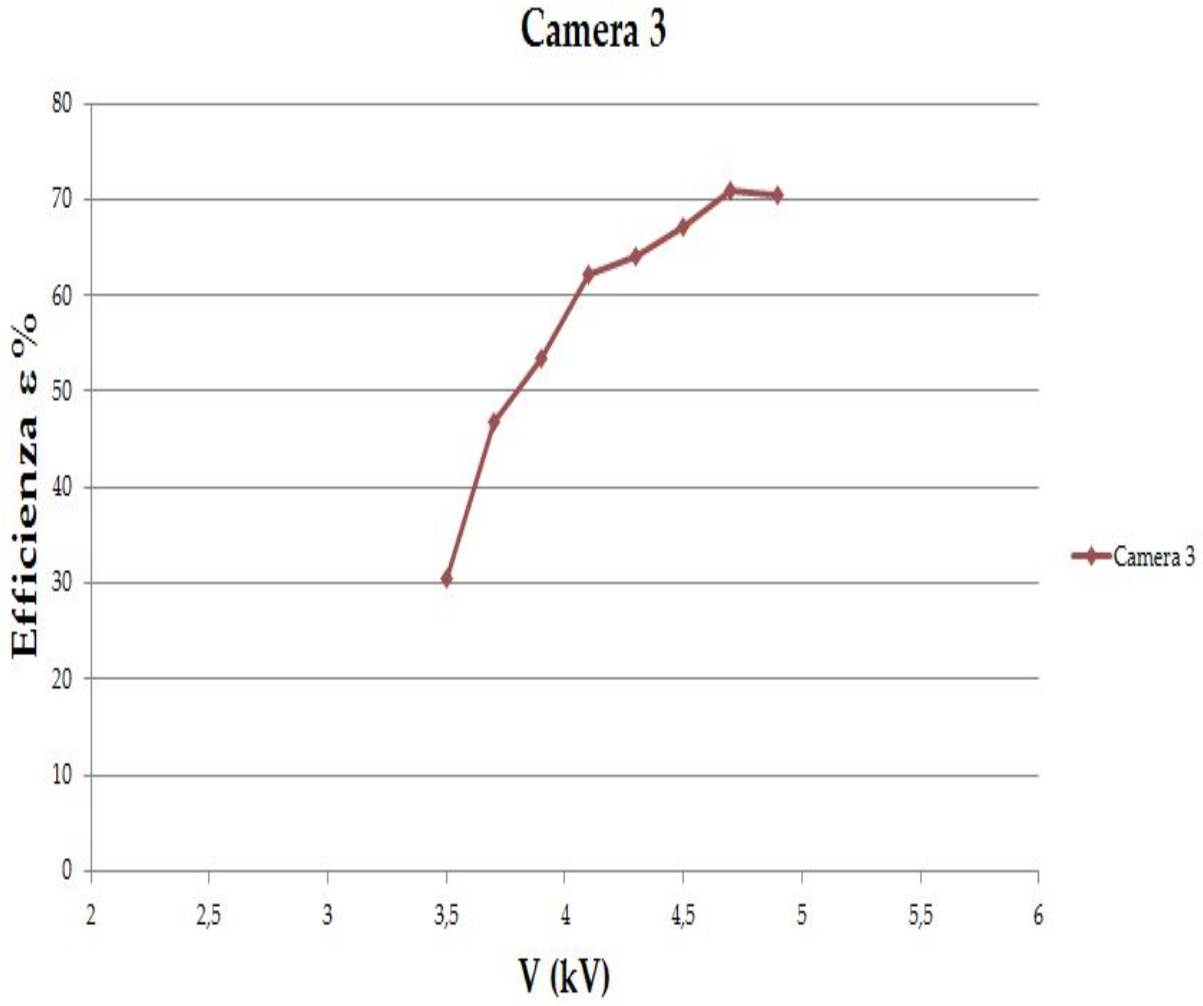
ERICE 2018

Liceo Scientifico Statale Bruno Touschek,
Grottaferrata (RM)

Where did we leave off?

- Top chamber malfunctioning
- low signal-to-noise ratio

Grosseto 2016



low efficiency
suggested problems in
internal electronic

confirmed by diagnostic

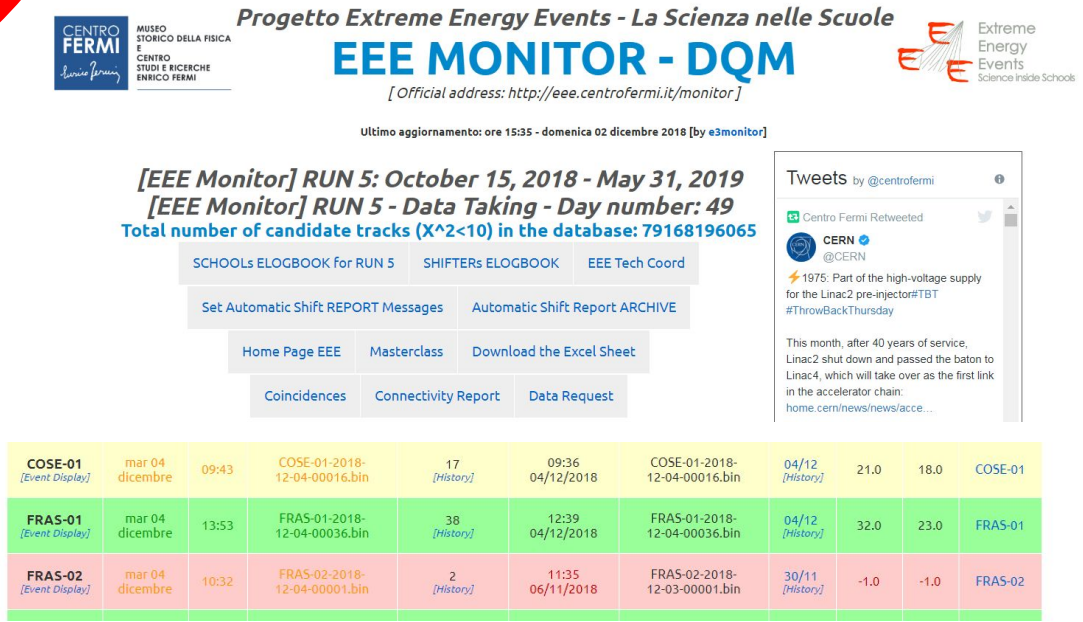
EEE project in Bruno Touschek

2016/2017

requested substitution of defective chamber

new chamber available and installed in October 2018

the telescope starts running again

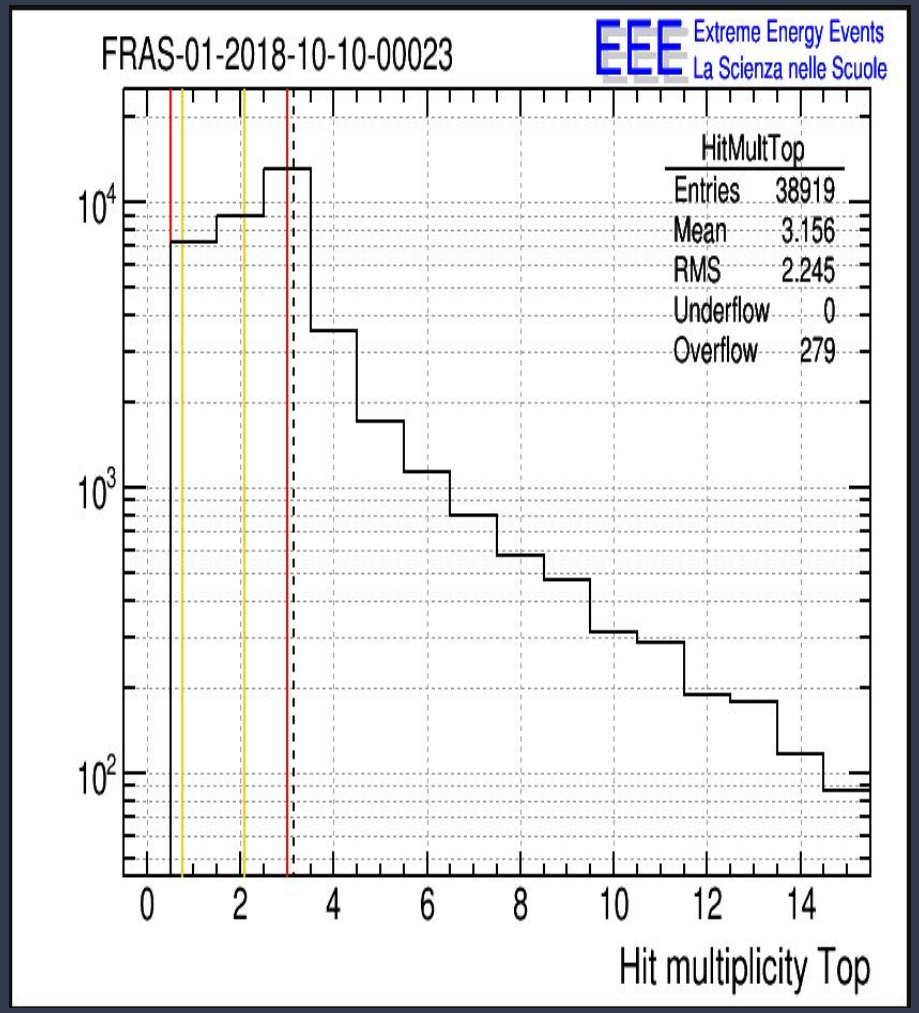


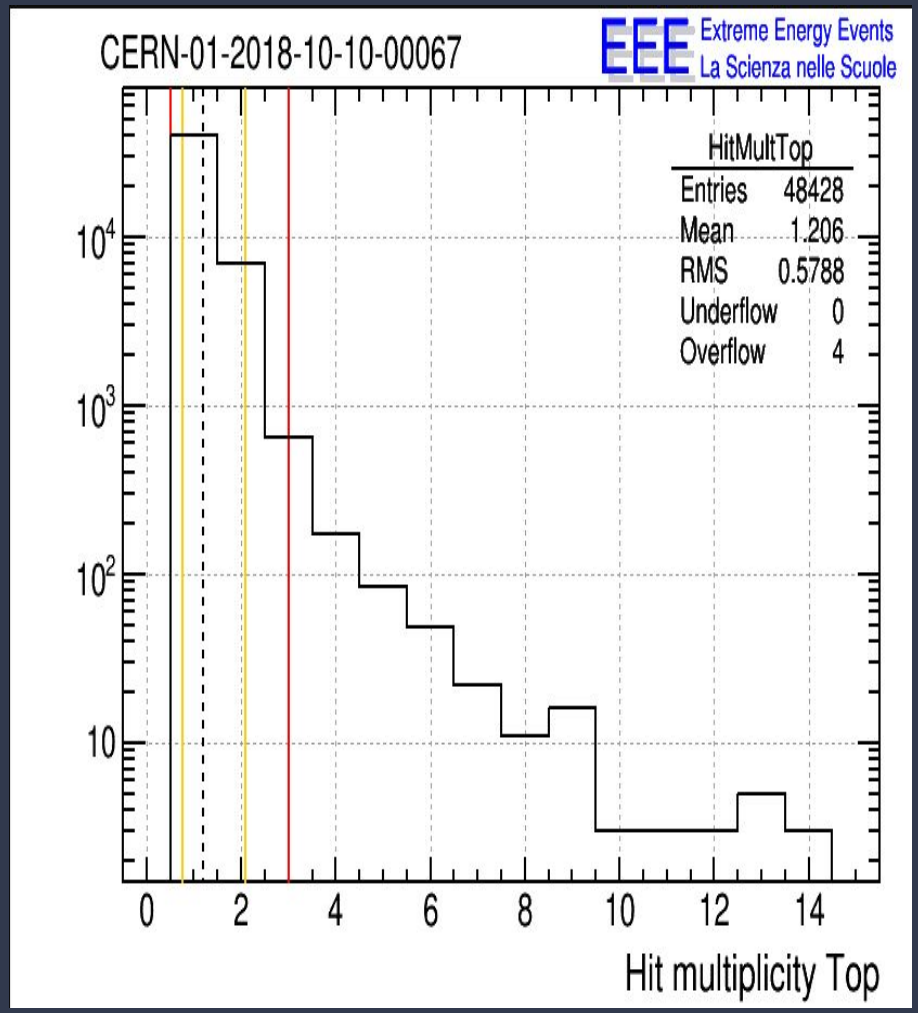
Date: 2018/10/10 - Just active

ALARM SUMMARY

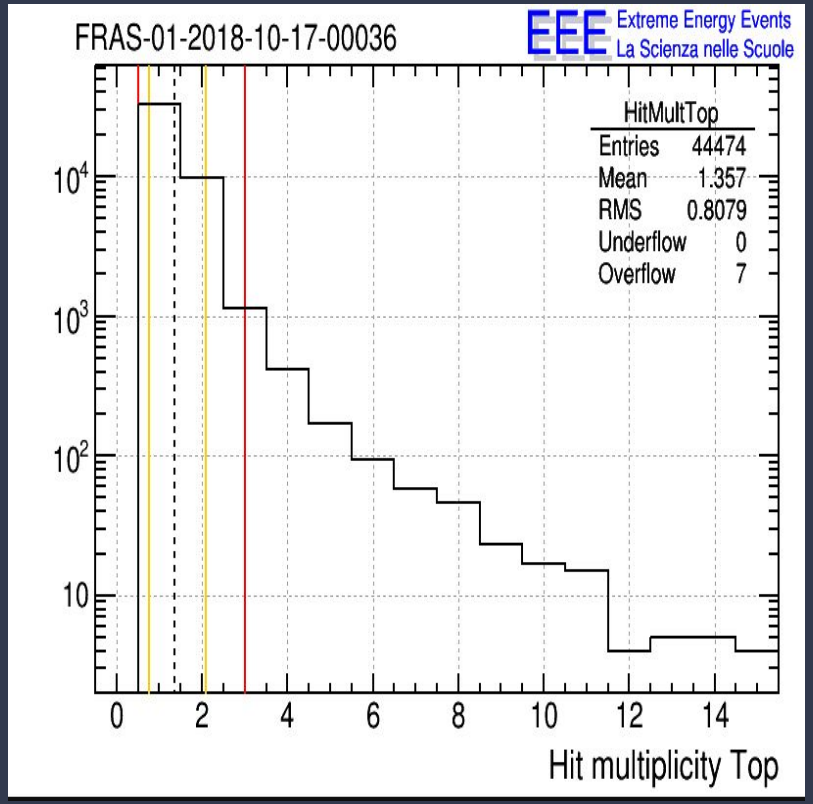
PLOT	ALARM	STATUS	OUTPUT	LIMITS
RateHitEvents	y_values	Clean	59.8 +- 1.0	[4 / 8 - 80 / 100]
DeltaTime	exp_fit_lambda	Clean	59.29 +- 0.30	[4 / 8 - 80 / 100]
HitMultTop	x_average	Error	3.156 +- 0.011	[0.500 / 0.750 - 2.10 / 3]
HitMultMid	x_average	Clean	2.0811 +- 0.0063	[0.500 / 0.750 - 2.10 / 3]
HitMultBot	x_average	Clean	1.2871 +- 0.0035	[0.500 / 0.750 - 2.10 / 3]
HitMultTotal	x_average	Warning	6.588 +- 0.017	[1.50 / 2.50 - 6 / 9]
ClusterMultTop	x_average	Clean	2.0005 +- 0.0088	[0.500 / 0.750 - 2.10 / 3]
ClusterMultMid	x_average	Clean	1.2432 +- 0.0037	[0.500 / 0.750 - 2.10 / 3]
ClusterMultBot	x_average	Clean	1.0929 +- 0.0022	[0.500 / 0.750 - 2.10 / 3]
ClusterMultTotal	x_average	Clean	4.330 +- 0.011	[1.50 / 2.50 - 6 / 9]
ChiSquare	x_average	Clean	3.145 +- 0.031	[1 / 2 - 6 / 10]
RateTrackEvents	y_values	Clean	51.21 +- 0.92	[4 / 8 - 80 / 100]
FractionTrackEvents	y_values	Clean	0.8393 +- 0.0062	[0.400 / 0.800 - 1 / 1]
Phi				
Theta				
TimeOfFlight				
TrackLength				

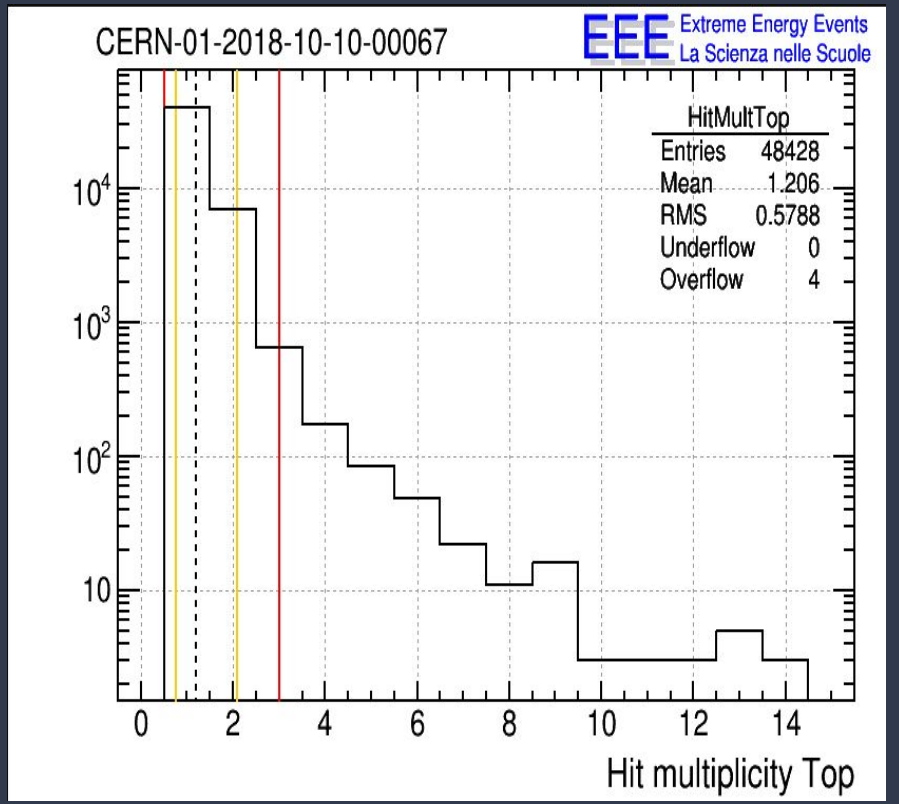
Good for a start, but needs adjustments


FRAS-01-2018-10-10-00023
EEE Extreme Energy Events
La Scienza nelle Scuole
HitMultTop
Entries 38919
Mean 3.156
RMS 2.245
Underflow 0
Overflow 279
10^4
10^3
10^2
0 2 4 6 8 10 12 14
Hit multiplicity Top


CERN-01-2018-10-10-00067
EEE Extreme Energy Events
La Scienza nelle Scuole
HitMultTop
Entries 48428
Mean 1.206
RMS 0.5788
Underflow 0
Overflow 4
10^4
10^3
10^2
10
0 2 4 6 8 10 12 14
Hit multiplicity Top

Date: 2018/10/17 - After tuning, everything is clear





Date: 2018/10/29 - Meteo alert

ALARM SUMMARY

PLOT	ALARM	STATUS	OUTPUT	LIMITS
RateHitEvents	y_values	Clean	35.93 +- 0.77	[4 / 8 - 80 / 100]
DeltaTime	exp_fit_lambda	Clean	39.43 +- 0.19	[4 / 8 - 80 / 100]
HitMultTop	x_average	Clean	1.3580 +- 0.0038	[0.500 / 0.750 - 2.10 / 3]
HitMultMid	x_average	Clean	1.2998 +- 0.0038	[0.500 / 0.750 - 2.10 / 3]
HitMultBot	x_average	Clean	1.2233 +- 0.0031	[0.500 / 0.750 - 2.10 / 3]
HitMultTotal	x_average	Clean	3.8760 +- 0.0085	[1.50 / 2.50 - 6 / 9]
ClusterMultTop	x_average	Clean	1.2421 +- 0.0033	[0.500 / 0.750 - 2.10 / 3]
ClusterMultMid	x_average	Clean	1.1443 +- 0.0027	[0.500 / 0.750 - 2.10 / 3]
ClusterMultBot	x_average	Clean	1.1544 +- 0.0026	[0.500 / 0.750 - 2.10 / 3]
ClusterMultTotal	x_average	Clean	3.5365 +- 0.0069	[1.50 / 2.50 - 6 / 9]
ChiSquare	x_average	Warning	6.802 +- 0.048	[1 / 2 - 6 / 10]
RateTrackEvents	y_values	Clean	15.72 +- 0.51	[4 / 8 - 80 / 100]
FractionTrackEvents	y_values	Warning	0.435 +- 0.011	[0.400 / 0.800 - 1 / 1]
Phi				
Theta				
TimeOfFlight				
TrackLength				

Something requires attention!!!

Date: 2018/10/31 - Restoring correct alimentation

ALARM SUMMARY

PLOT	ALARM	STATUS	OUTPUT	LIMITS
RateHitEvents	y_values	Clean	30.72 +- 0.71	[4 / 8 - 80 / 100]
DeltaTime	exp_fit_lambda	Clean	34.86 +- 0.17	[4 / 8 - 80 / 100]
HitMultTop	x_average	Clean	1.3175 +- 0.0038	[0.500 / 0.750 - 2.10 / 3]
HitMultMid	x_average	Clean	1.2928 +- 0.0039	[0.500 / 0.750 - 2.10 / 3]
HitMultBot	x_average	Clean	1.1817 +- 0.0030	[0.500 / 0.750 - 2.10 / 3]
HitMultTotal	x_average	Clean	3.7887 +- 0.0086	[1.50 / 2.50 - 6 / 9]
ClusterMultTop	x_average	Clean	1.1390 +- 0.0027	[0.500 / 0.750 - 2.10 / 3]
ClusterMultMid	x_average	Clean	1.1441 +- 0.0028	[0.500 / 0.750 - 2.10 / 3]
ClusterMultBot	x_average	Clean	1.0890 +- 0.0021	[0.500 / 0.750 - 2.10 / 3]
ClusterMultTotal	x_average	Clean	3.3696 +- 0.0063	[1.50 / 2.50 - 6 / 9]
ChiSquare	x_average	Clean	3.007 +- 0.028	[1 / 2 - 6 / 10]
RateTrackEvents	y_values	Clean	26.90 +- 0.66	[4 / 8 - 80 / 100]
FractionTrackEvents	y_values	Clean	0.8576 +- 0.0080	[0.400 / 0.800 - 1 / 1]
Phi				
Theta				
TimeOfFlight				
TrackLength				

Quite similar to actual situation

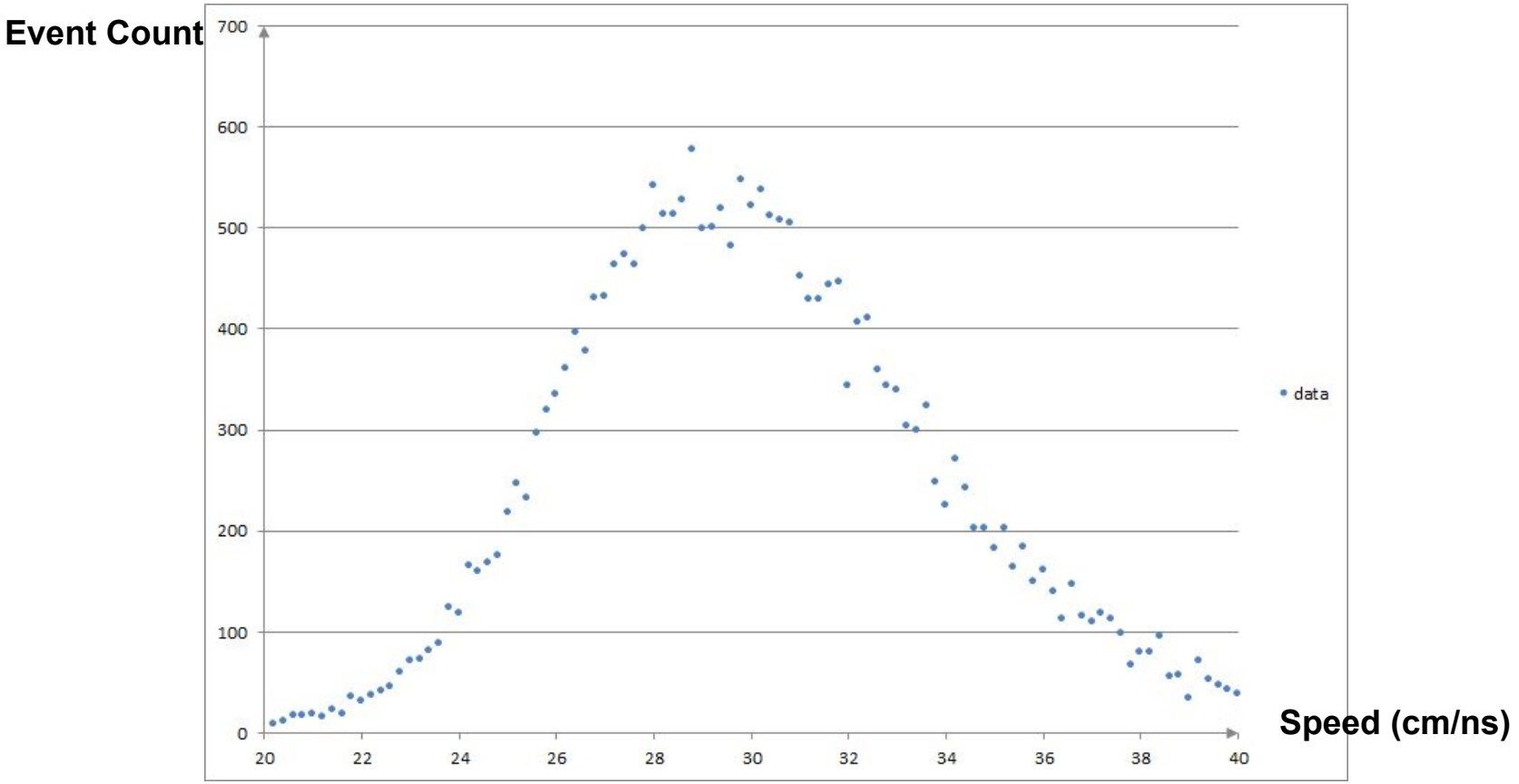
Using the data:

the speed of muons

Cut

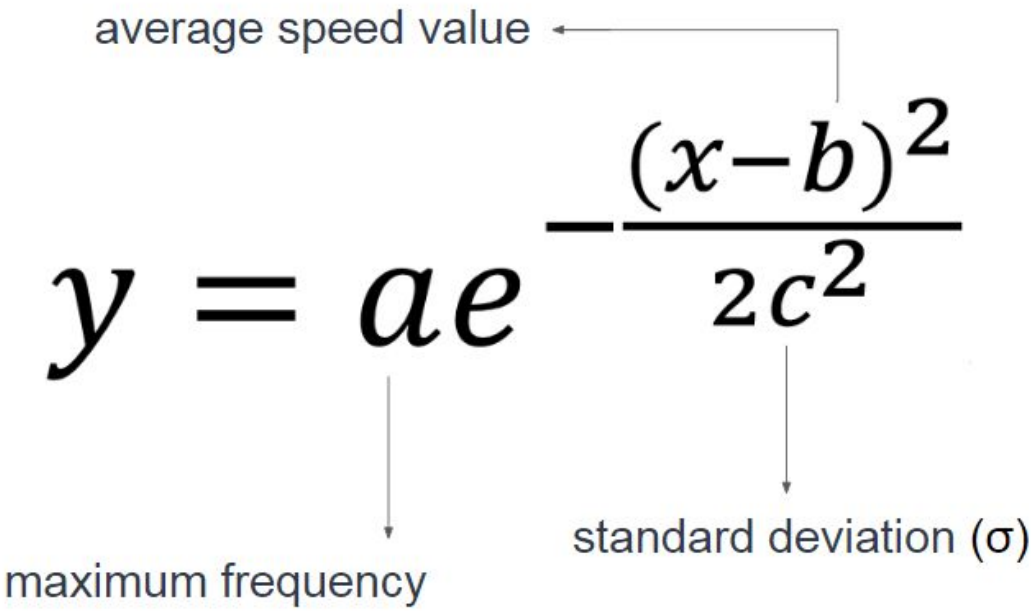
- DATE → 2018/11/30
- POSITIVE SPEED → Time Of Flight > 0
- NO EXCESSIVE DATA → Run Number = 22
- TRACK QUALITY → Chi Square < 3

2018/11/30


Event Count
700
600
500
400
300
200
100
0
20
22
24
26
28
30
32
34
36
38
40
data
Speed (cm/ns)

How to measure a, b and c?

We can estimate the maximum frequency (a), the average speed value (b) and the standard deviation (σ) (c) using the least squares method.

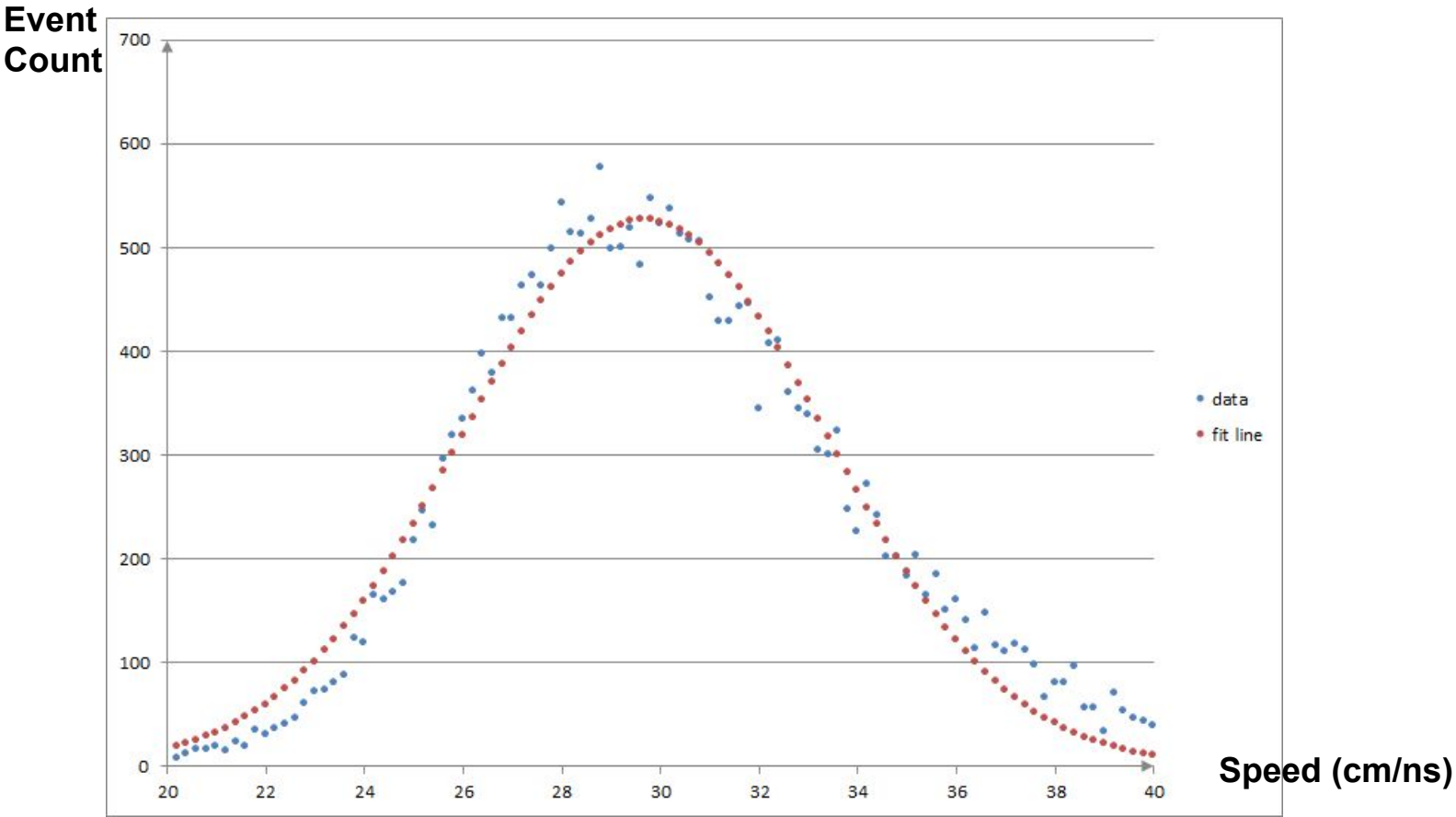


J	K	L
Max Frequency	Average Speed	Standard Deviation
526,5469573	29,69542903	3,684981168

Datas after Solver

G	H	I	J	K	L	M	N
			Max Frequency	Average Speed	Standard Deviation		Square Sum
			526,5469573	29,69542903	3,684981168		103885,1828
Class	*Frequency*						
20	388						
20,2	8		19,03753746		121,8272331		
20,4	12		21,86295296		97,27784112		
20,6	17		25,03384541		64,54267201		
20,8	17		28,58031477		134,1036901		
21	19		32,53322712		183,1482364		
21,2	15		36,92393508		480,6589294		
21,4	23		41,78395146		352,8368325		
21,6	19		47,14457597		792,1171563		
21,8	35		53,03647548		325,3144479		
22	31		59,48921979		811,635644		
22,2	37		66,53077565		872,0667105		
22,4	41		74,18696362		1101,374554		
22,6	46		82,48088305		1330,854828		
22,8	60		91,43231239		987,9902619		
23	72		101,057093		844,3146525		
23,2	73		111,3665061		1471,98879		
23,4	81		122,3666539		1711,200052		

2018/11/30


Event Count
700
600
500
400
300
200
100
0
20
22
24
26
28
30
32
34
36
38
40
data
fit line
Speed (cm/ns)

final measurement of speed

average speed value is
$v = (2.97 \pm 0.02) \cdot 10^8$ m/s

the measure is compatible with our knowledges

future possible goals

measure muons speed according to different factors like pressure, altitude, temperature or angle

Thank you for your attention!