

# STUDY OF COSMIC RAYS RATE DEPENDENCE IN FUNCTION OF PRESSURE

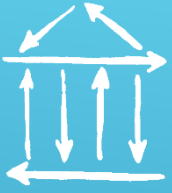
LICEO STATALE S. G. CALASANZIO CARCARE (SV)

Presented by:

**Parodi Silvia**

**Grenno Marta**

**Prof.<sup>ssa</sup> Occhetto Michela**



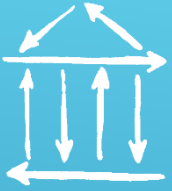
# THEORY

If the pressure decreases, the cosmic rays rate increases.

This formula describes the rays rate dependence on the pressure

$$I_0 = I_0 e^{-\mu(P - P_0)}$$

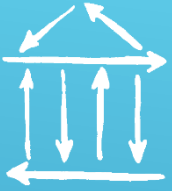
$$\frac{I_0 - I}{I_0} = -\mu(P - P_0)$$



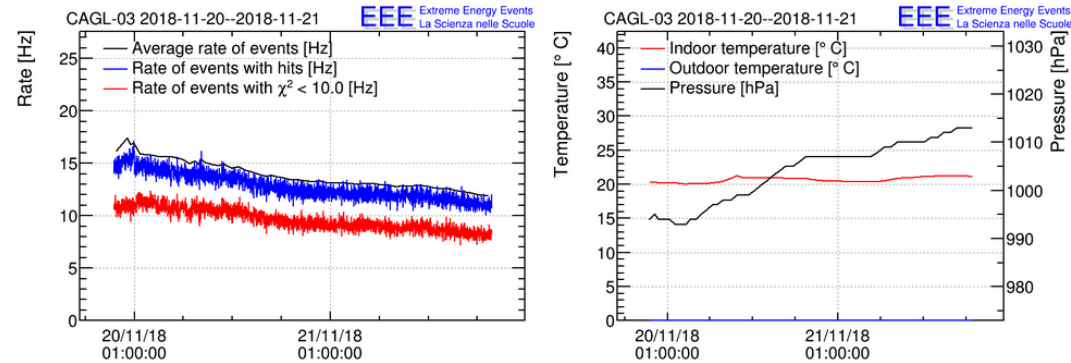
To start our research we used the weather Online website ([www.woitalia.it](http://www.woitalia.it)), more precisely the weather station.

We wanted to observe how the pressure influences the flow by finding the days in which it occurs a wide variation of pressure.





## EEE DQM summary report

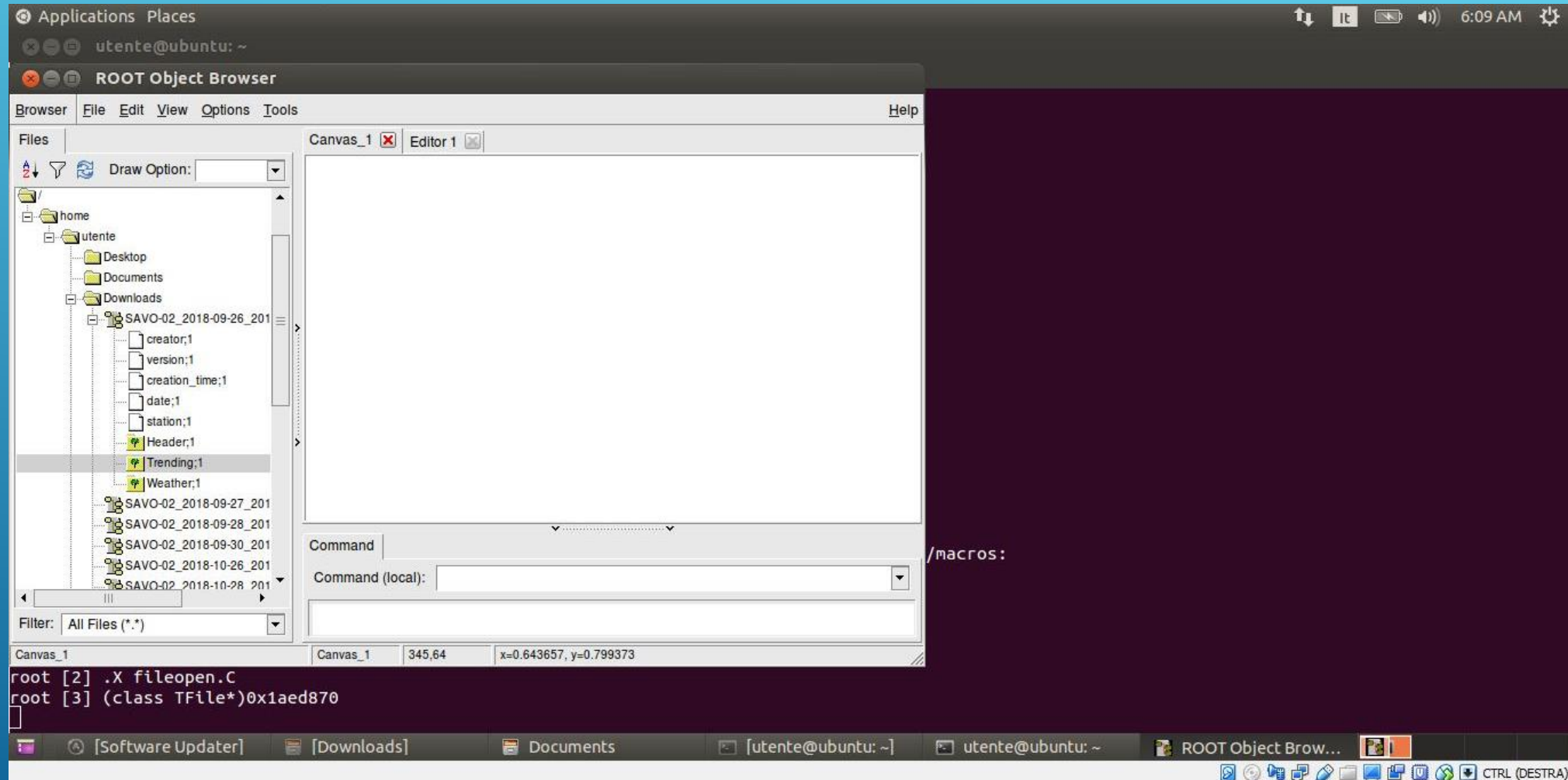
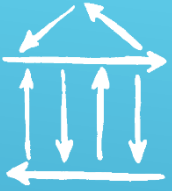


### SUMMARY

- Station: CAGL-03
- Time period: 2018-11-20–2018-11-21
- Number of runs processed: 57
- Total number of events: 2306684
- Number of events with hits: 2129692
- Number of events with a track: 1601463
- Data files: [root](#), [csv header](#), [csv trending](#), [csv weather](#)

We took those days' data from the EEE monitor  
([www.eee.centrofermi.it](http://www.eee.centrofermi.it)).

And precisely from the “History” of some telescopes.



Applications Places

utente@ubuntu: ~

ROOT Object Browser

Browser File Edit View Options Tools Help

Files

Draw Option:

home

utente

Desktop

Documents

Downloads

SAVO-02\_2018-09-26\_201

- creator;1
- version;1
- creation\_time;1
- date;1
- station;1
- Header;1
- Trending;1
- Weather;1

SAVO-02\_2018-09-27\_201

SAVO-02\_2018-09-28\_201

SAVO-02\_2018-09-30\_201

SAVO-02\_2018-10-26\_201

SAVO-02\_2018-10-28\_201

Filter: All Files (\*.\*)

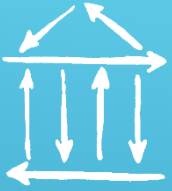
Canvas\_1

Canvas\_1 345,64 x=-0.643657, y=-0.799373

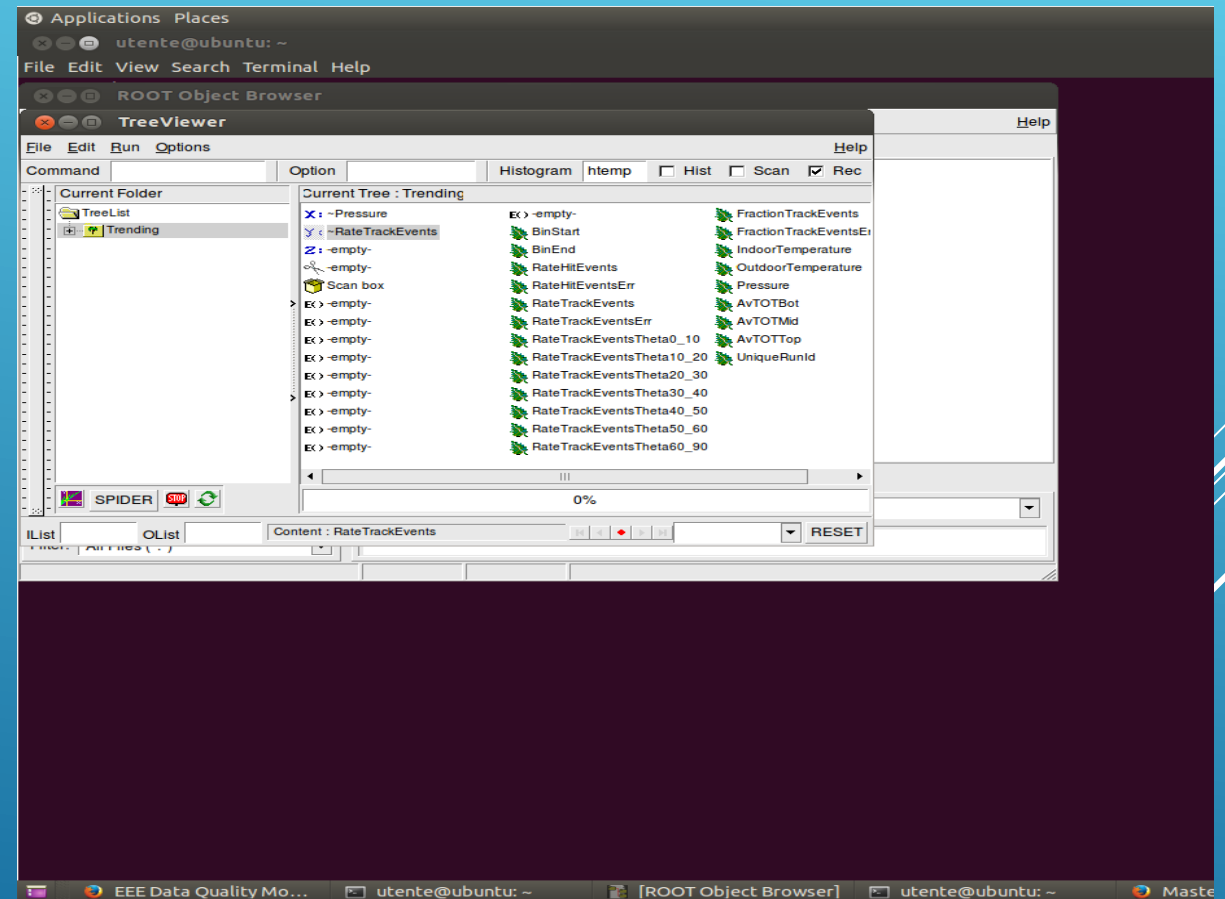
```
root [2] .X fileopen.C
root [3] (class TFile*)0x1aed870
```

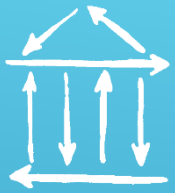
/macros:

[Software Updater] [Downloads] Documents [utente@ubuntu: ~] utente@ubuntu: ~ ROOT Object Brow... CTRL (DESTRA)



After downloading a file data from the EEE monitor, we created a graphic representation of the rate depending on the pressure with Root. Using the terminal, we entered the macro ".X fileopen.C".





When the graph appeared on the screen, we were interested in fitting it with a function, so we clicked on “tools” and then we chose the “fit panel” option.

Applications Places  
utente@ubuntu: ~  
File Edit View Search Terminal Help

ROOT Object Browser  
Browser File Edit View Options Tools Help

Files  
Draw Option: [v]  
utente  
Desktop  
Documents  
Downloads  
ANCO-01\_2018-11-27\_201  
BOLO-04\_2018-09-24\_201  
BOLO-04\_2018-11-27\_201  
CAGL-03\_2018-10-29\_201  
CAGL-03\_2018-11-20\_201  
creator:1  
version:1  
creation\_time:1  
date:1  
station:1  
Header:1  
Trending:1  
BinStart  
BinEnd  
RateHitEvents

Filter: All Files (\*.\*)

Canvas\_1 Editor 1  
RateTrackEvents:Pressure  
 $\chi^2 / \text{ndf}$  532.1 / 2696  
 $p0$  152.3 ± 1.345  
 $p1$  -0.1421 ± 0.00134

Command  
Command (local):

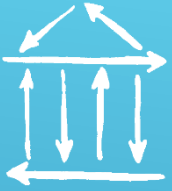
Fit Panel  
Data Set: TGraph:Graph  
Fit Function  
Type: Prefdef-1D pol1  
Operation  
 Nop  Add  Conv  
pol1  
Selected:  
pol1  
Set Parameters...

General Minimization  
Fit Settings  
Method  
Chi-square User-Defined...  
 Linear fit  Robust: 0.95  
Fit Options  
 Integral  Use range  
 Best errors  Improve fit results  
 All weights = 1  Add to list  
 Empty bins, weights=1  Use Gradient  
Draw Options  
 SAME  
 No drawing  
 Do not store/draw  
Advanced...

X 991.00 1015.00

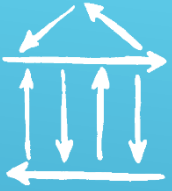
Update Fit Reset Close  
TGraph:Grp LIB Minuit MIGRAD Itr: 0 Pm: DEF

EEE Data Quality Mo... utente@ubuntu: ~ [ROOT Object Browser] utente@ubuntu: ~ MasterClass Forbus... ROOT Object Browser

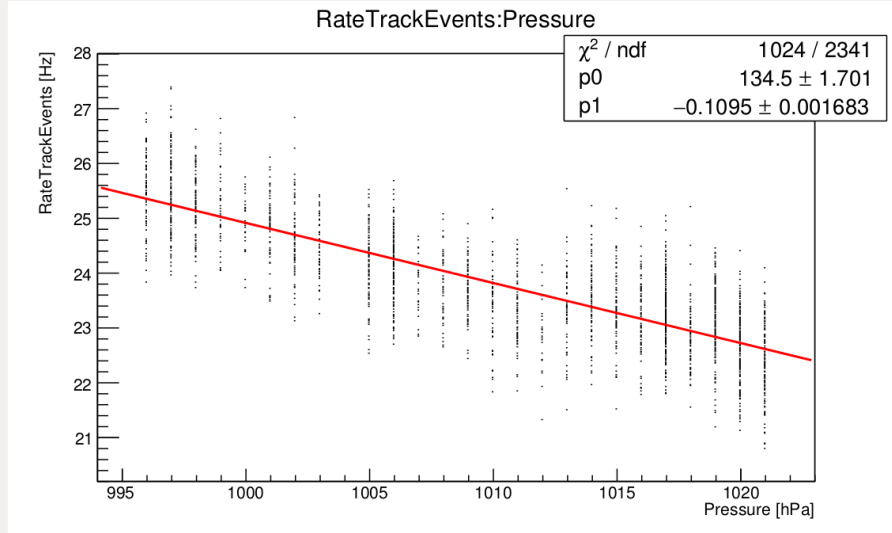


The screenshot displays the ROOT software interface. The main window shows a plot titled "RateTrackEvents:Pressure" with a red linear fit line. The plot axes are labeled "RateTrackEvents" (y-axis, 7 to 12) and "Pressure" (x-axis, 995 to 1015). A text box in the plot area displays fit parameters:  $\chi^2 / \text{ndf}$  532.1 / 2696,  $p0$   $152.3 \pm 1.345$ , and  $p1$   $-0.1421 \pm 0.00134$ . The ROOT Object Browser on the left shows a tree structure with a "Trending;1" folder containing "BinStart", "BinEnd", and "RateHitEvents". The Fit Panel on the right is open, showing the "Data Set" as "TGraph::Graph" and the "Fit Function" as "pol1". The "Fit Settings" section shows "Chi-square" as the method, with "Linear fit" checked. The "Fit" button is circled in blue. The terminal at the bottom shows the fit parameters:  $p0 = 152.310 \pm 1.34510$  and  $p1 = -0.14212 \pm 0.00133979$ .

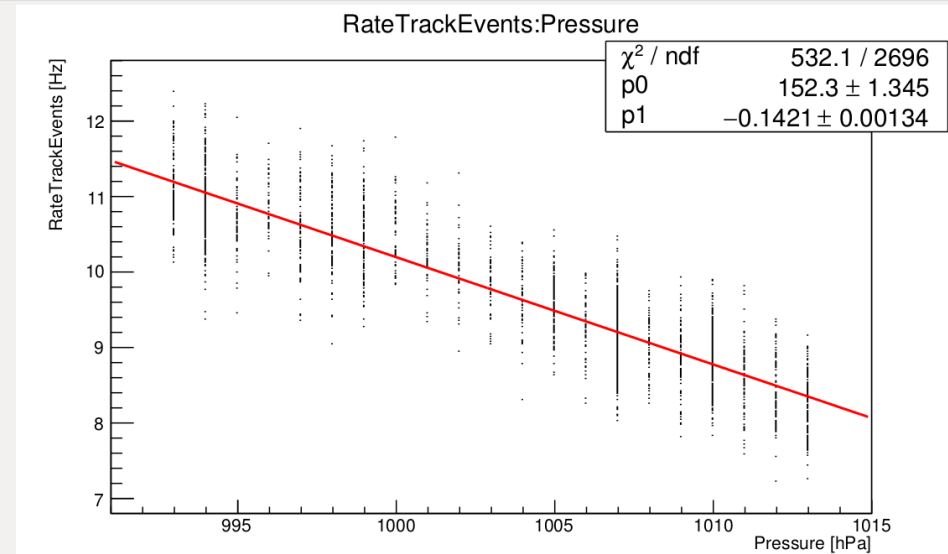


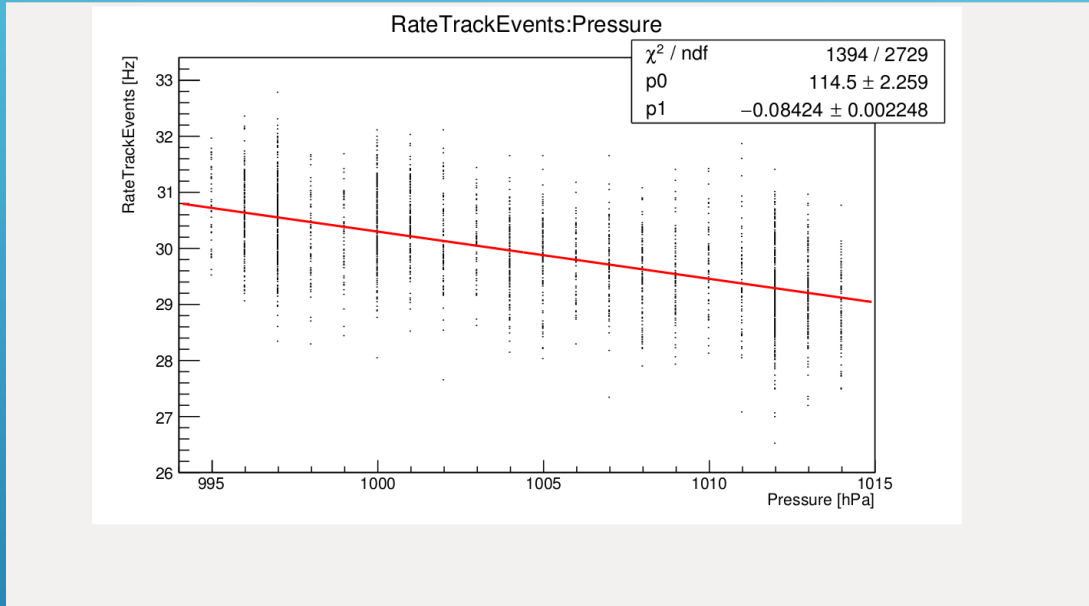
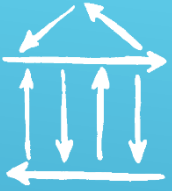


From Cagliari telescope



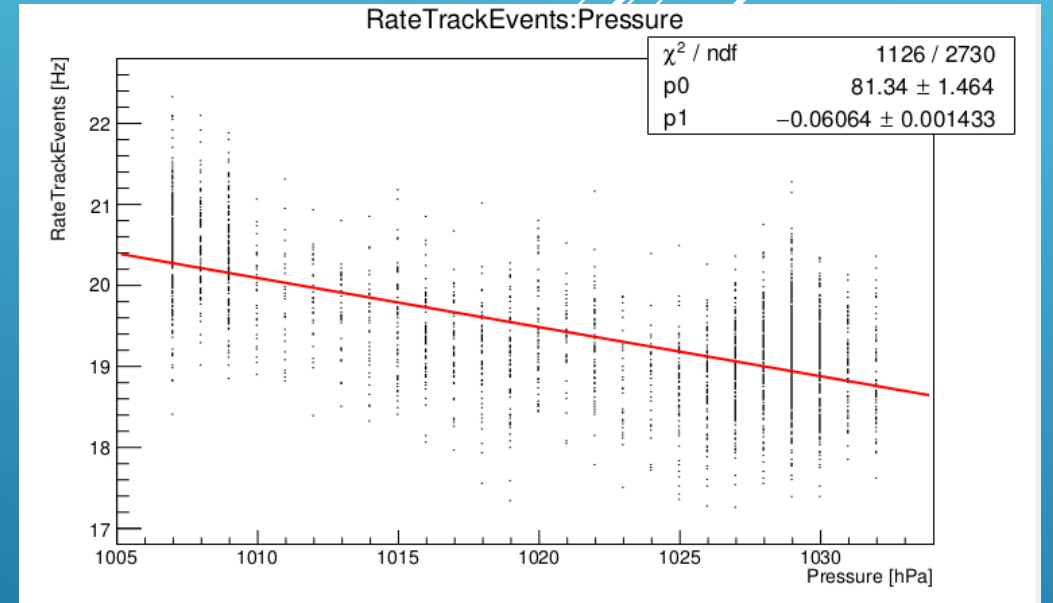
From Treviso telescope.

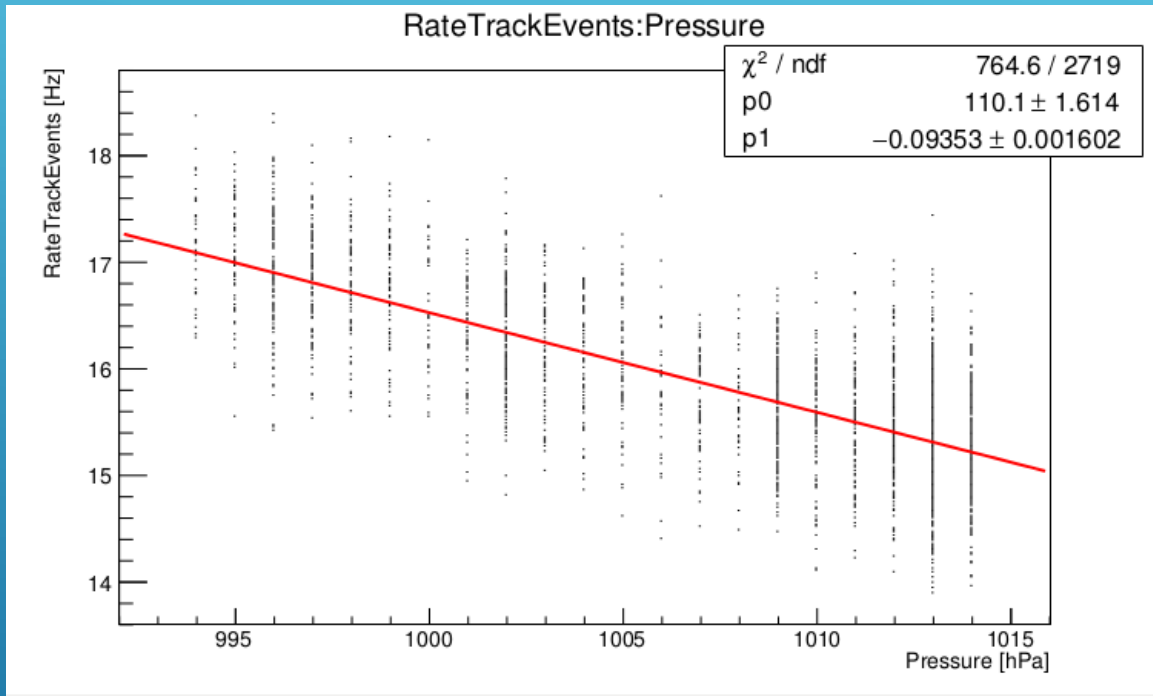
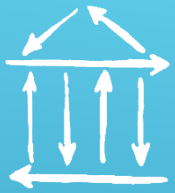




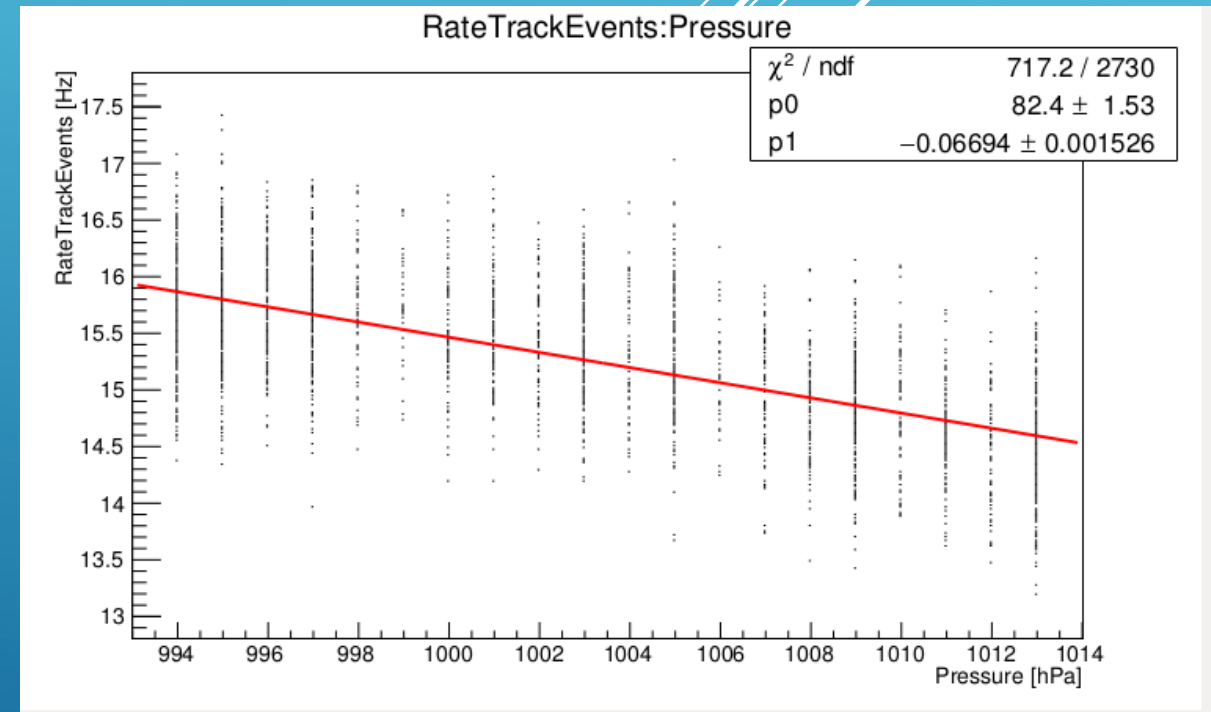
From Genova telescope.

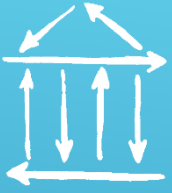
From Treviso telescope.



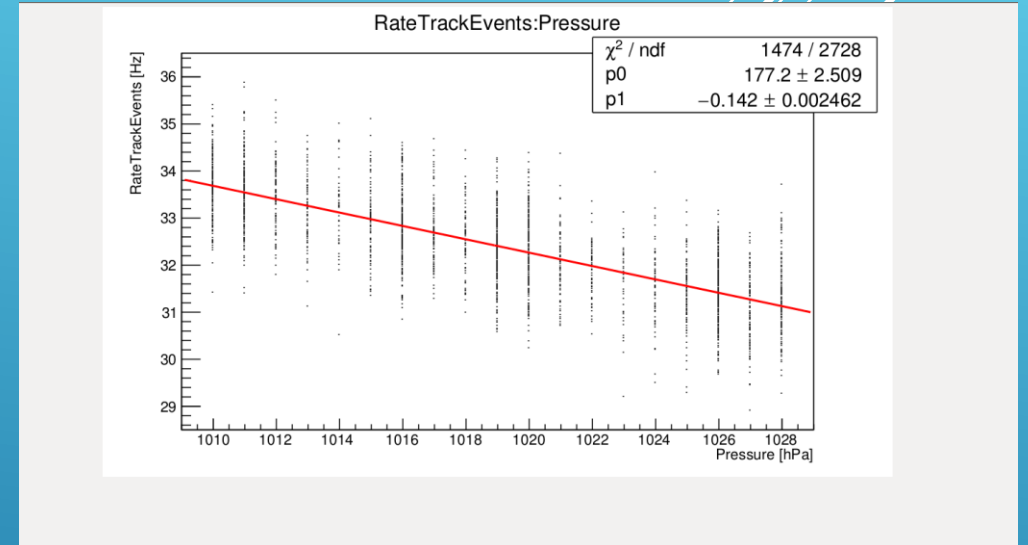
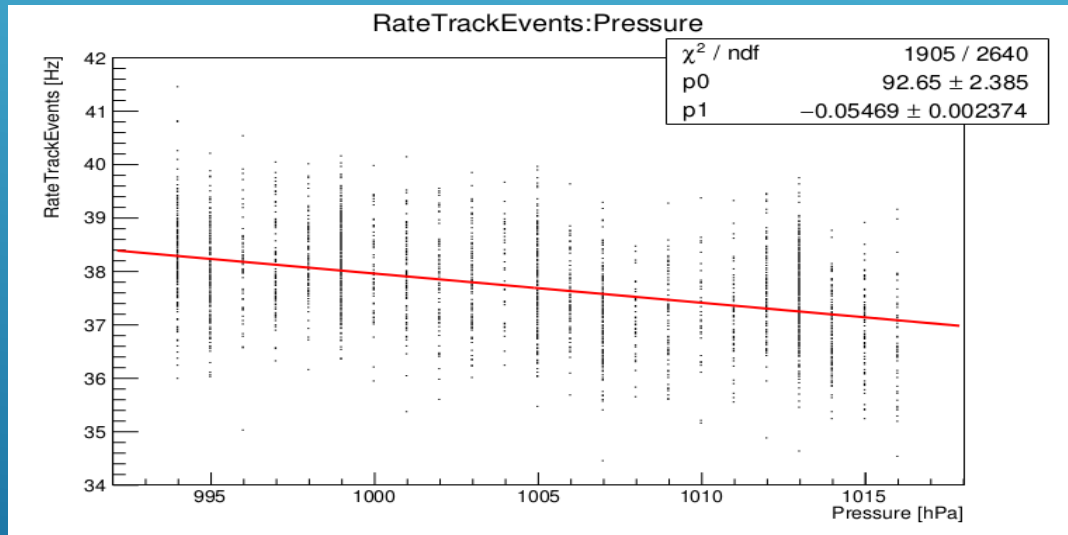


From Bologna telescope.

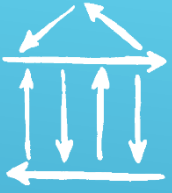




From Ancona telescope.



From Grosseto telescope.



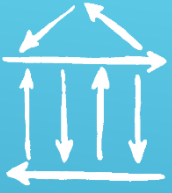
## CONCLUSIONS:

We've done this analysis to see if actually the rays rate dependence in function of pressure is described by a linear function.

Using Root we managed to analyze the data file from the EEE monitor and then to fit them demonstrating that they followed the thesis.

How can we improve our analysis?

- We should consider continuative data over a longer period.
- Searching a relation between other leaves by using Root and eventually pointing out their dependence.



## THANKS TO:

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- **Prof. Michela Occhetto**, dott. **Stefano Grazi** and dott. **Marco Battaglieri** who support us.
- **Devid Fichera** for supporting us in the Root using.
- **Centro Fermi** for giving us this wonderful oppurtunity.

## THANKS FOR YOUR ATTENTION!