

MASTERCLASS

Correlation of cosmic-rays flux and pressure

F. Noferini

INFN Bologna



MUSEO
STORICO DELLA FISICA
E
CENTRO
STUDI E RICERCHE
ENRICO FERMI



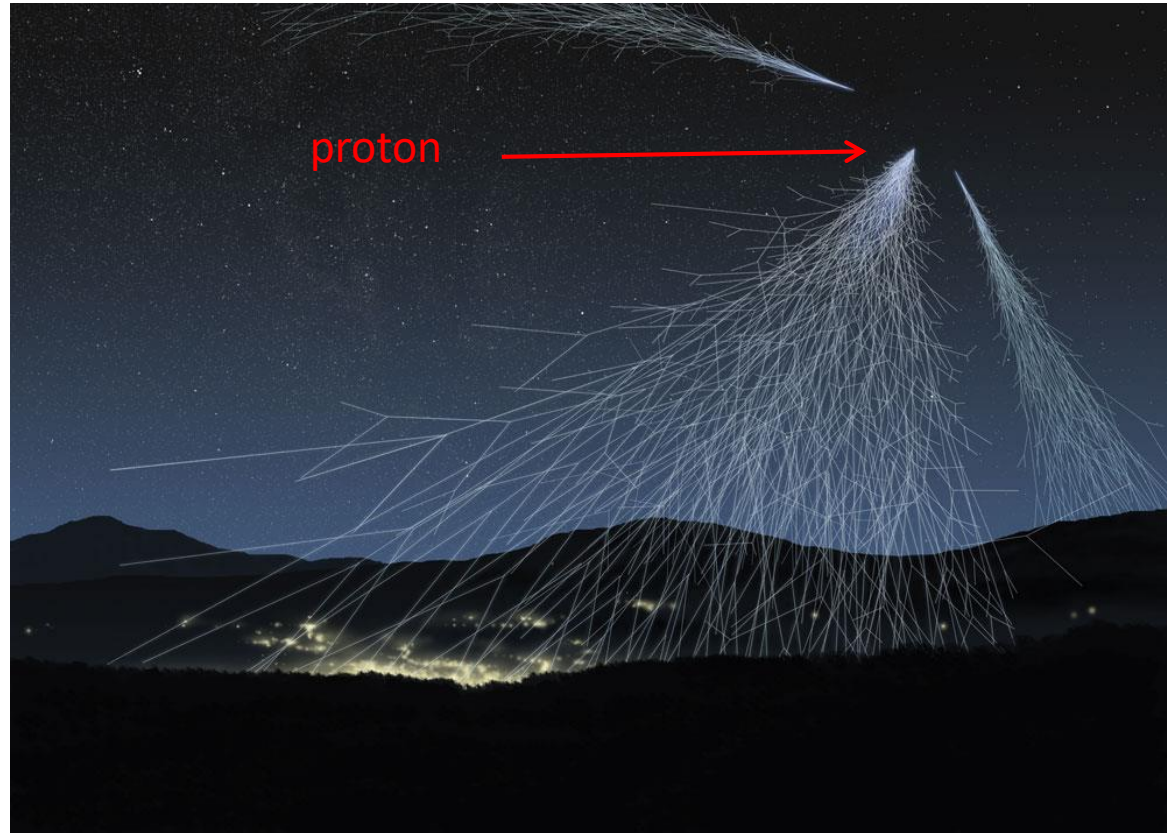
A Cosmic Ray shower

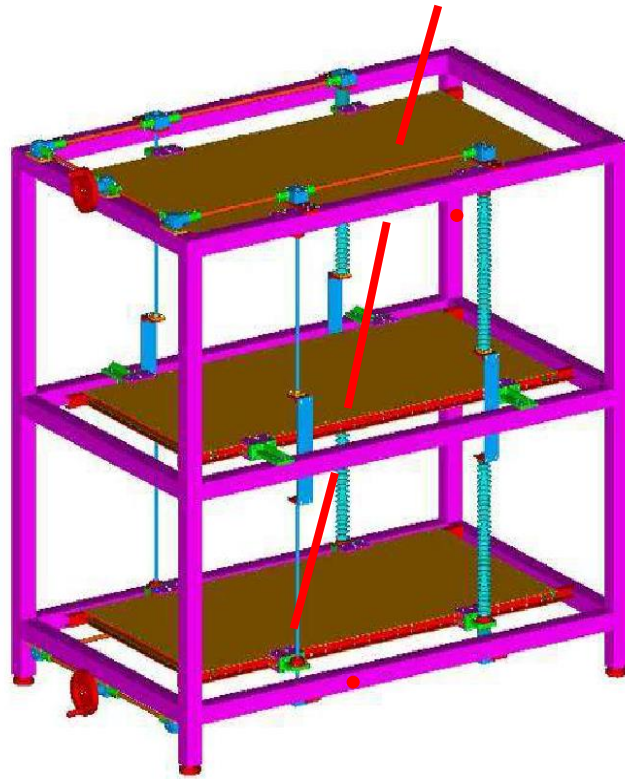
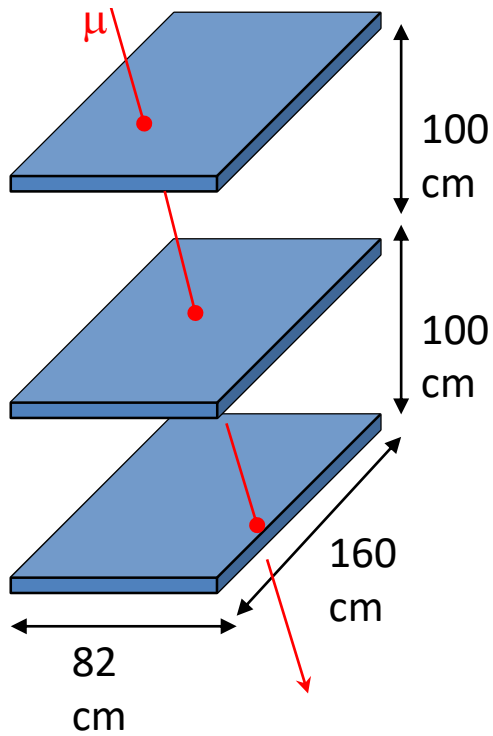
Cosmic rays are high-energy particles originating outside the Solar system.

They are mainly composed of protons but also light nuclei are present.

When a primary cosmic ray interacts with the atmosphere starts to produce many other particles (secondaries) which propagate close to the initial direction of the primary
→ Shower development.

At ground we observe a flux of charge particles of about 1 per cm² per minute (mainly muons).





The EEE telescope geometry

An EEE telescope is realized by the combination of three chambers (MRPC).

If a muon goes through all the three chambers a signal is released in each one allowing the reconstruction of its trajectory.



The EEE station

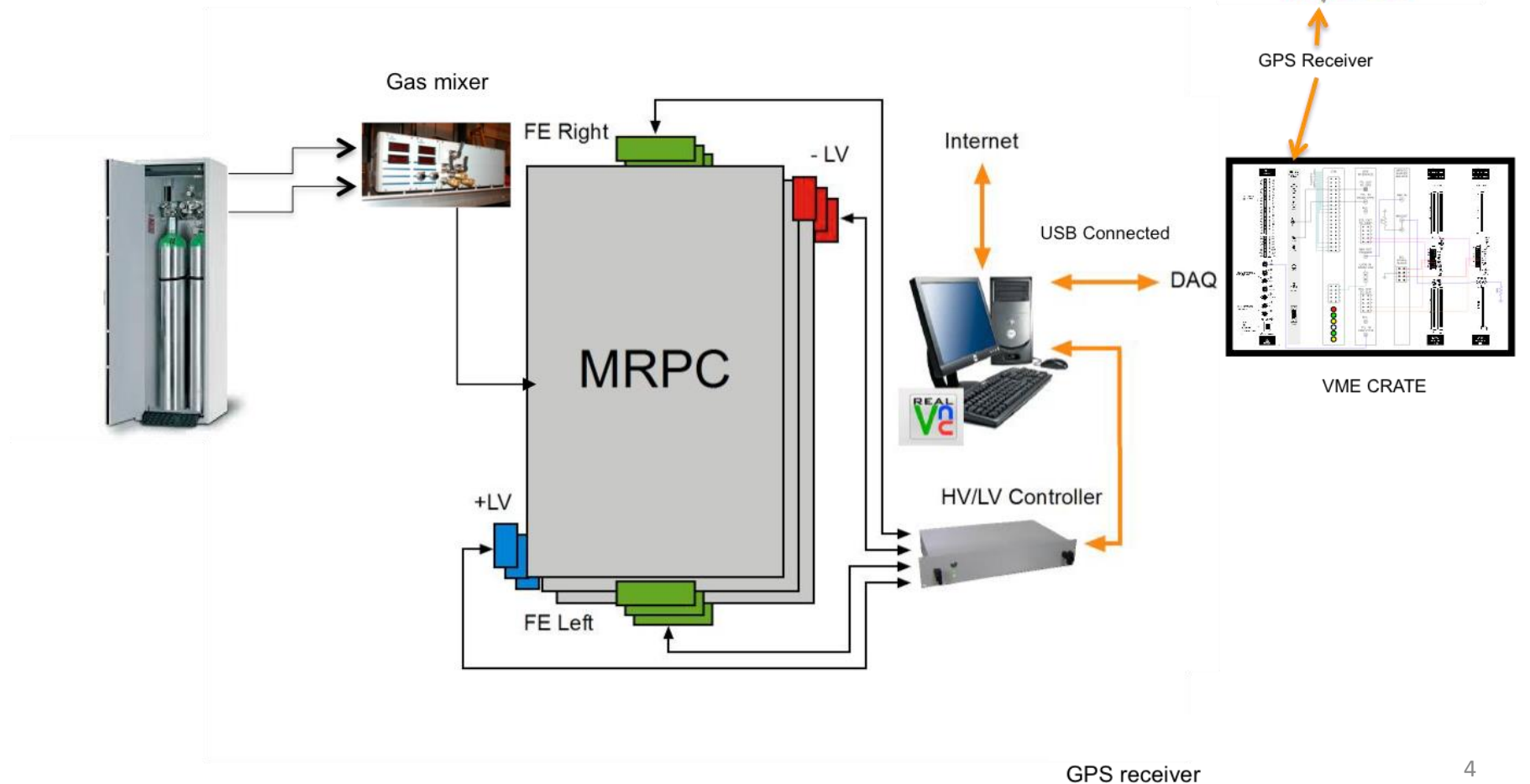
The EEE station

An EEE station is composed by:

A telescope (+ gas system + electronics) → to trigger and reconstruct the muon trajectory

A GPS Receiver → to associate a time to the event with high precision

A Desktop PC where the Data Acquisition software is running



What we can measure

- 1. The point of passage of the cosmic ray (i.e. muon)***
- 2. The cosmic ray direction***
- 3. The time of flight of the cosmic ray***
- 4. We can discover if our cosmic ray is in coincidence with particles detected by other telescopes***

Now we know how the telescope works and what we can get from it.

Before to analyze data we need to be sure that the quality is good.

1. we can check if the data we are acquiring are of “good” quality...

2. Take action if they are not!

...to do this, we should analyze the data locally or...use a centralized procedure → DQM

The EEE Project DQM

Extreme Energy Events Monitor

Ultimo aggiornamento: ore 15:21 - ven 12 dicembre 2014

[ELOGBOOK delle SCUOLE](#)

[ELOGBOOK dello SHIFTER](#)

[Stato trasmissione CNAF](#)

EEE Main Monitoring Table

Questa tabella mostra la situazione dei telescopi in acquisizione

In **verde** sono indicati i telescopi in presa dati e trasferimento nelle ultime 4 ore.

In **giallo** sono indicati i telescopi in cui trasferimento e/o acquisizione sono sospesi da più di 4 ore.

In **rosso** sono indicati i telescopi in cui trasferimento e/o acquisizione sono sospesi da più di un giorno.

Scuola	Giorno	Ora	Nome dell'ultimo File trasferito	Numero Files trasferiti oggi	Ultima Entrata nell'e-logbook delle Scuole	Report giornaliero DQM	RATE of Triggers for the last Run in DQM	RATE of Tracks for the last Run in DQM	Link DQM
ALTA-01	mer 10 dicembre	08:06	ALTA-01-2014-12-10-00020.bin	20 [History]	10:56 21/11/2014	11/12 [History]	27.4	21.0	ALTA-01
BARI-01	ven 12 dicembre	15:06	BARI-01-2014-12-12-00024.bin	24 [History]	09:59 06/12/2014	12/12 [History]	21.7	18.8	BARI-01
BOLO-01	ven 12 dicembre	15:02	BOLO-01-2014-12-12-00024.bin	26 [History]		12/12 [History]	47.4	26.9	BOLO-01
BOLO-03	gio 11 dicembre	18:08	BOLO-03-2014-12-11-00054.bin	54 [History]	13:22 12/12/2014	12/12 [History]	40.2	29.6	BOLO-03
CAGL-01	ven 12 dicembre	15:07	CAGL-01-2014-12-12-00020.bin	20 [History]	08:25 11/12/2014	12/12 [History]	18.8	15.5	CAGL-01
CAGL-02	ven 12 dicembre	14:48	CAGL-02-2014-12-12-00044.bin	44 [History]	12:01 03/12/2014	12/12 [History]	37.9	33.3	CAGL-02

We will have soon also the polar statistics in the same page!!!!!!!

Link: eee.centrofermi.it/monitor

DQM daily report

Information are reported day by day!

The EEE Project DQM-Report giornaliero

di acquisizione ragionevoli nell'ultimo run analizzato.
e o con tracce ($X^2 < 10$) minori di 10 Hz, all'ultimo run analizzato.
giorni o con tracce ($X^2 < 10$) minori di 5 Hz, all'ultimo run analizzato.

Name of the last File analyzed by DQM	DQM daily report	Rate of Triggers for the last Run in DQM	Rate of Triggers for the last Run in DQM
ALTA-01-2017-12-05-00002.bin	*	27.0	24
ANCO-01-2017-12-05-00009.bin	*	16.0	13
	*	-2.0	-2
	*	-2.0	-2
BOLO-01-2017-12-05-00025.bin	05/12 [History]	11.0	40

Once per day relevant summary plot are automatically produced

And you have some history too



BOLO-01 Daily Report History

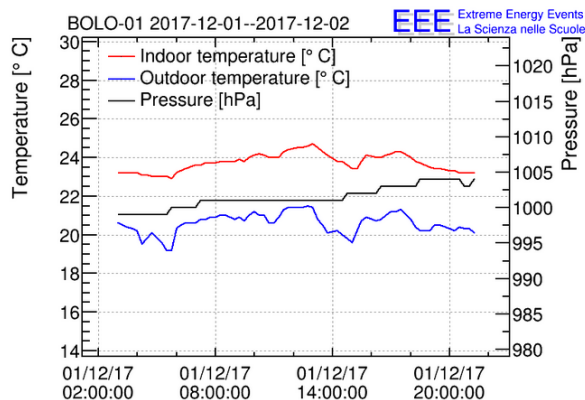
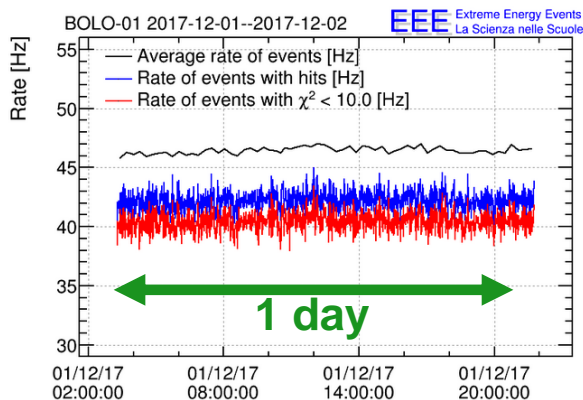
2018-05-21	2018-05-19	2018-05-18	2018-05-17	2018-05-16
2018-05-15	2018-05-14	2018-05-13	2018-05-12	2018-05-11
2018-05-10	2018-05-09	2018-05-08	2018-05-07	2018-05-06
2018-05-05	2018-05-04	2018-05-03	2018-05-02	2018-05-01
2018-04-30	2018-04-29	2018-04-28	2018-04-27	2018-04-26
2018-04-25	2018-04-24	2018-04-21	2018-04-20	2018-04-19
2018-04-18	2018-04-17	2018-04-16	2018-04-15	2018-04-14
2018-04-13	2018-04-12	2018-04-11	2018-04-10	2018-04-09
2018-04-08	2018-04-07	2018-04-06	2018-04-05	2018-04-04
2018-04-03	2018-04-02	2018-04-01	2018-03-31	2018-03-30
2018-03-29	2018-03-28	2018-03-27	2018-03-26	2018-03-25
2018-03-24	2018-03-23	2018-03-22	2018-03-21	2018-03-20
2018-03-19	2018-03-07	2018-03-06	2018-03-05	2018-03-04
2018-03-03	2018-03-02	2018-03-01	2018-02-28	2018-02-27
2018-02-26	2018-02-25	2018-02-24	2018-02-23	2018-02-22
2018-02-21	2018-02-20	2018-02-19	2018-02-18	2018-02-17

What if you choose one of them?

The EEE Project

DQM-Daily Report

EEE DQM summary report



SUMMARY

- Station: BOLO-01
- Time period: 2017-12-01--2017-12-02
- Number of runs processed: 65
- Total number of events: 3079214
- Number of events with hits: 2797984
- Number of events with a track: 2681009
- Data files: root, csv header, csv trending, csv weather

Set of trending files

The files we will analyze

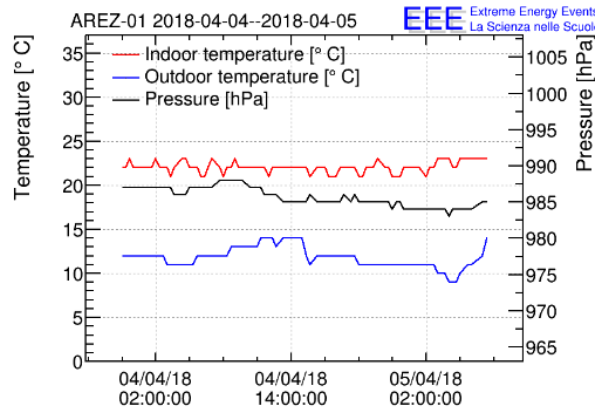
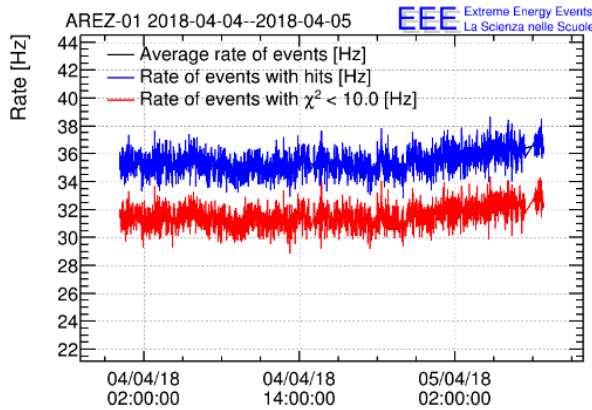
SUMMARY PLOTS

- RunDuration
- NumEvents
- AverageRate
- NumTrackEvents
- NumMalformedEvents
- NumBackwardEvents
- NumNoHitsEvents
- NumNoHitEvents
- RateHitEvents
- RateTrackEvents
- FractionTrackEvents
- IndoorTemperature
- OutdoorTemperature
- Pressure

Set of trending plots...click and see

Daily data

EEE DQM summary report



SUMMARY

- Station: AREZ-01
- Time period: 2018-04-04--2018-04-05
- Number of runs processed: 86
- Total number of events: 4037606
- Number of events with hits: 4036590
- Number of events with a track: 3594300
- Data files: [root](#), [csv header](#), [csv trending](#), [csv weather](#)

Data are available in two formats (ROOT and CSV).

Trending info → how observables (flux rate, temperature, pressure, ...) evolve with time.

Available infos:

- Time (timestamp)
- Rates
- Pressure
- Temperature IN
- Temperature OUT

Our time reference system

Event time is reported in terms of seconds elapsed since a given time reference (timestamp). Usually the reference for the Unix timestamp is taken on the 1st January 1970 (<https://www.unixtimestamp.com/index.php>).

In our case we take the reference at the 1st January 2007 (when EEE started to take data).

Timestamp Converter

1167609600

Is equivalent to:

01/01/2007 @ 12:00am (UTC)

The correspondence between EEE and Unix time stamp is very simple. The 0 time in EEE corresponds to a unix timestamp of **1167609600 s!**

In general to convert the EEE timestamp in a date you need to follow two steps.

- 1) Converting it in a Unix timestamp simply adding the **offset**.
- 2) Converting the Unix timestamp by using a service on the web

Let's move to the our topic
→ CR flux-pressure correlation

Why we expect the pressure influences the measured flux?

We want to understand the effect of the matter in front of our telescope.

What do we expect?

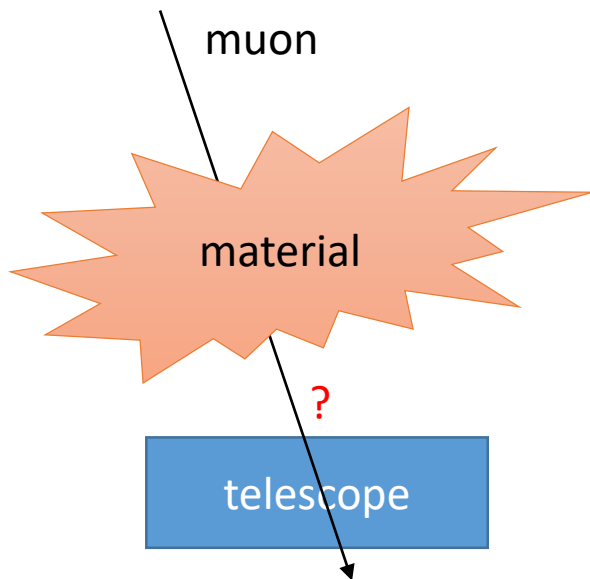
If we put some matter in front of our telescope the muon may be absorbed during its propagation in the material → we expect to reduce the arrival probability to the telescope.

→ Pressure is an indirect measurement of the matter above our telescope.

Why we want to measure it?

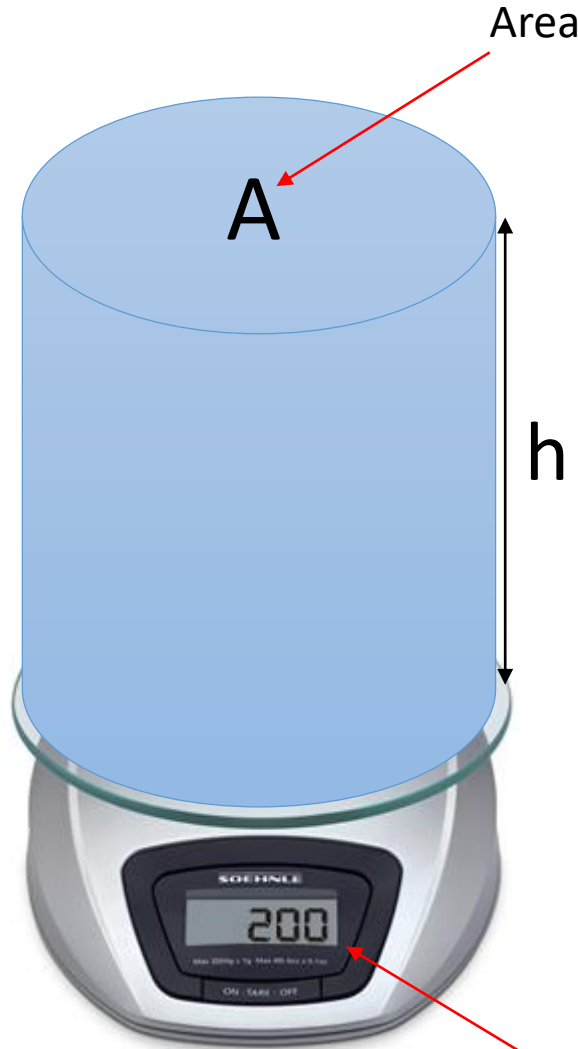
The variation in the cosmic ray flux can be a signature of particular phenomena we are interested to: solar activity, change in the geomagnetic field (i.e. polar!).

To quantify such effects we need to be sure that external conditions (i.e. pressure) don't influence our measurement, otherwise we need to correct for known effects.



Pressure

$$\rho = \text{density} = M_{\text{block}} / V$$



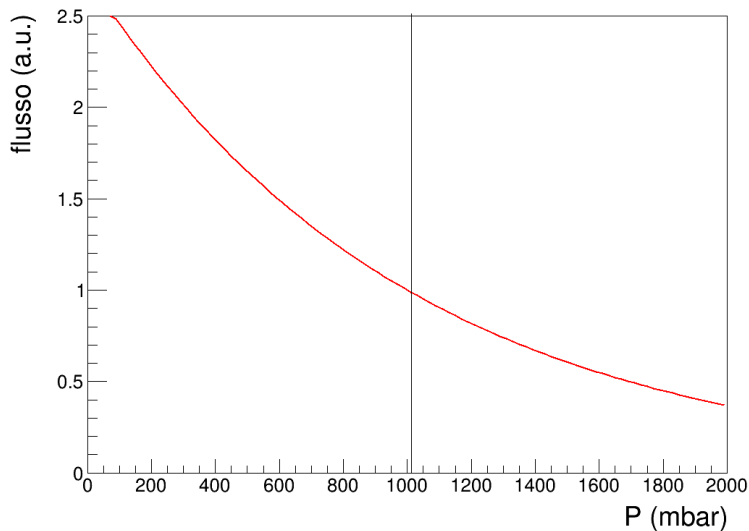
The pressure is proportional to the amount of matter weights on an unit surface.
 Then it depends on the matter density and on the height of the block.

→ We can use the pressure measurement to measure the amount of matter above our head → the amount of matter seen by the muon in its propagation!

$$\text{Weight} = mg = \rho ghA = P \times A$$

The absorption law (I)

$$\text{flusso}(P) = \text{flusso}(P = 0) e^{-\alpha P}$$



The coefficient in the exponent (α) is called barometric coefficient.

We want to measure it using our telescope network.

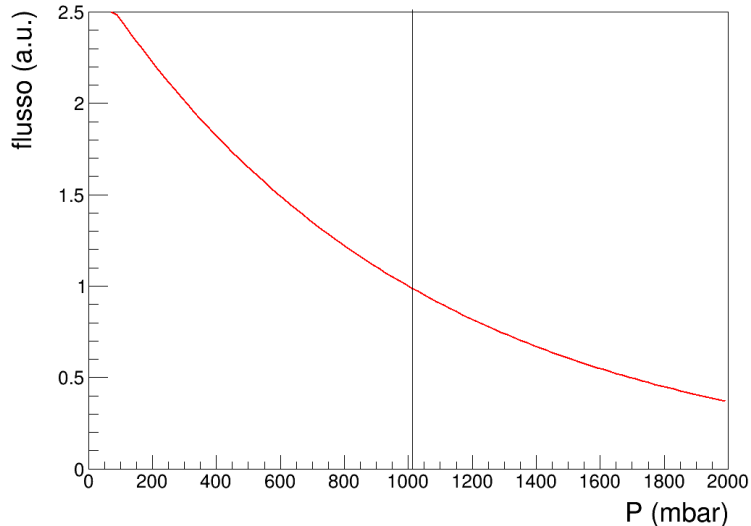
Since our measurement is affected also by other effects (for instance by the interaction with the building hosting the telescopes) we would like to test if this coefficient is the same for all the telescopes or not.

Absorption follows an exponential law \rightarrow the number of particles which survives after a block of matter decreases exponentially with the amount of matter.

The pressure is proportional to this amount so we expect a flux at ground which depends exponentially on the pressure.

The absorption law (II)

$$flusso(P) = flusso(0)e^{-\alpha P}$$



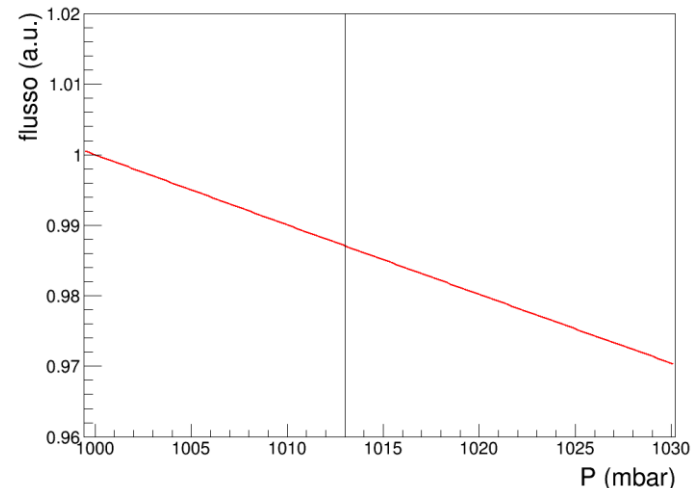
Since $P=0$ is not a realistic case it is convenient to represent the same law referred to a P_0 physical value (i.e. 1 atm).

$$flusso(P) = flusso(P_0)e^{-\alpha(P-P_0)}$$

We just used the relation:

$$flusso(P_0) = flusso(0)e^{-\alpha P_0}$$

Usually we are collecting data with small variation of pressure around 1 atm. If we zoom the exponential curve around 1 atm (1013 mbar) the trend looks linear.



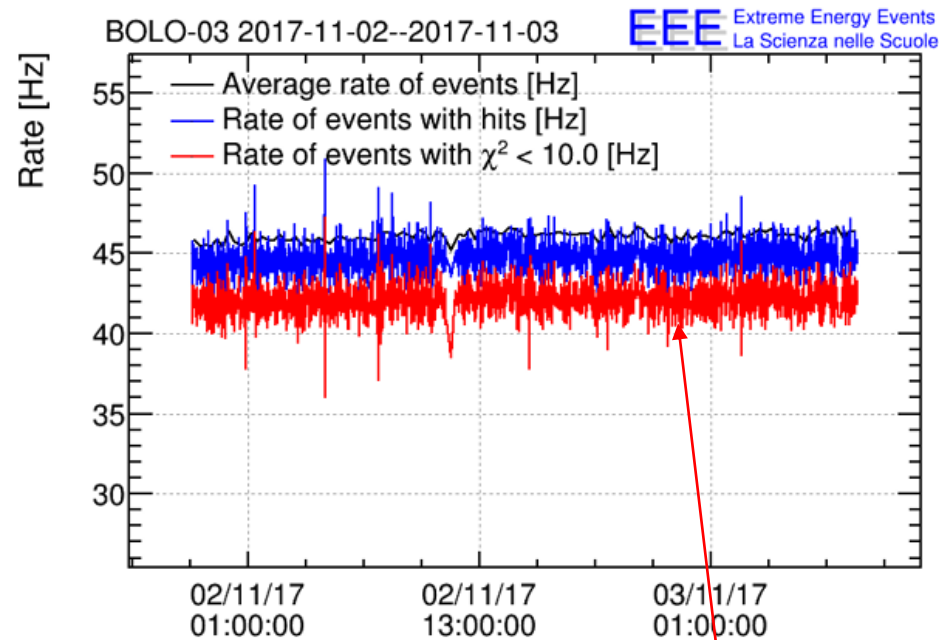
For small variation the exponential law can be approximated by:

$$\begin{aligned}flusso(P) &= flusso(P = P_0 = 1013 \text{ mbar})e^{-\alpha(P-P_0)} = \\ &= flusso(P = P_0) \cdot (1 - \alpha\Delta P)\end{aligned}$$

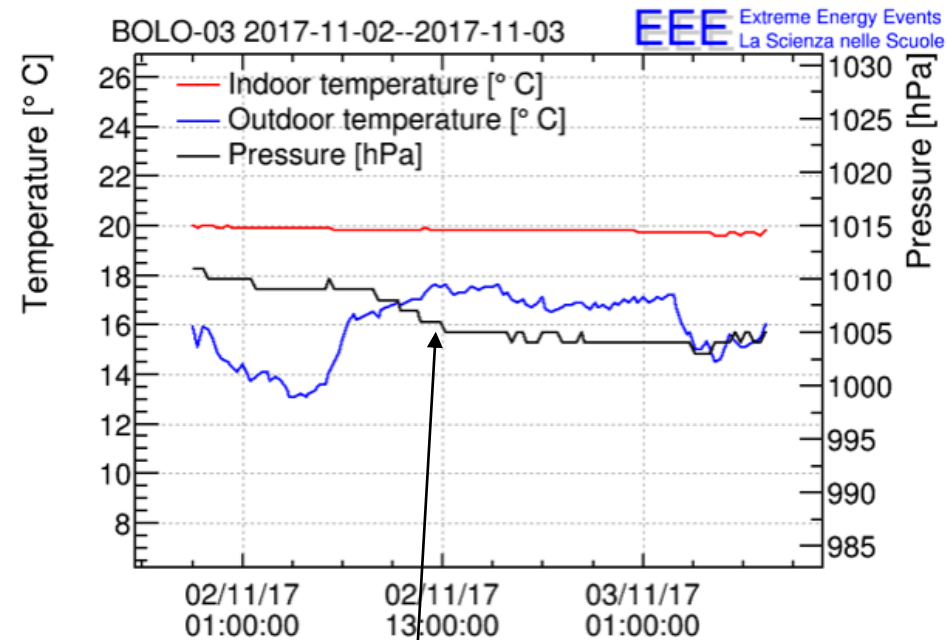
Daily report data

First of all:

- choose a telescope and a day
- check that the data are good
- The pressure variation is high enough (>10 mbar) 1 hPa = 1 mbar



The muon flux (number of muon per second) can be found for EEE each telescope in the daily report.

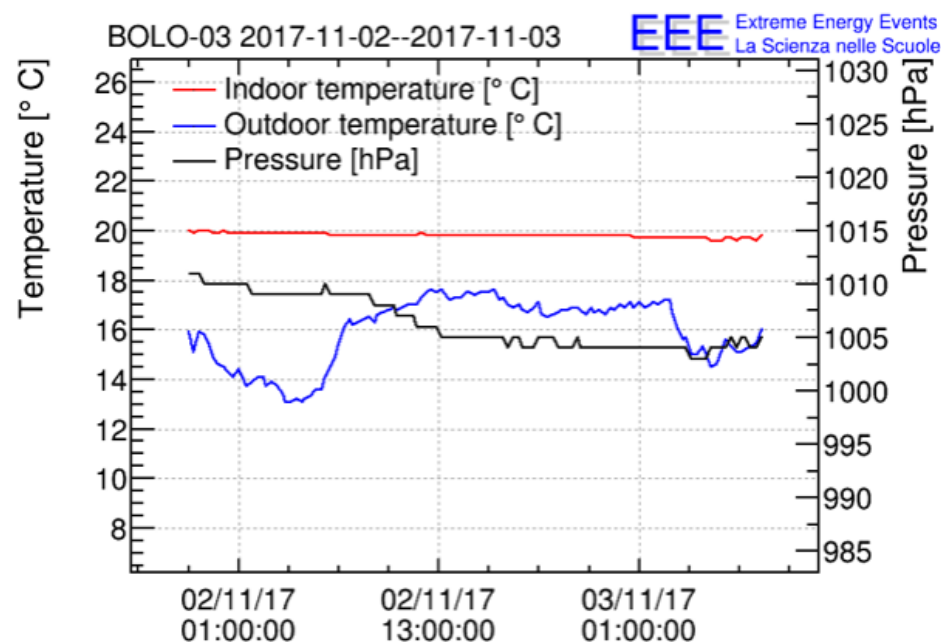
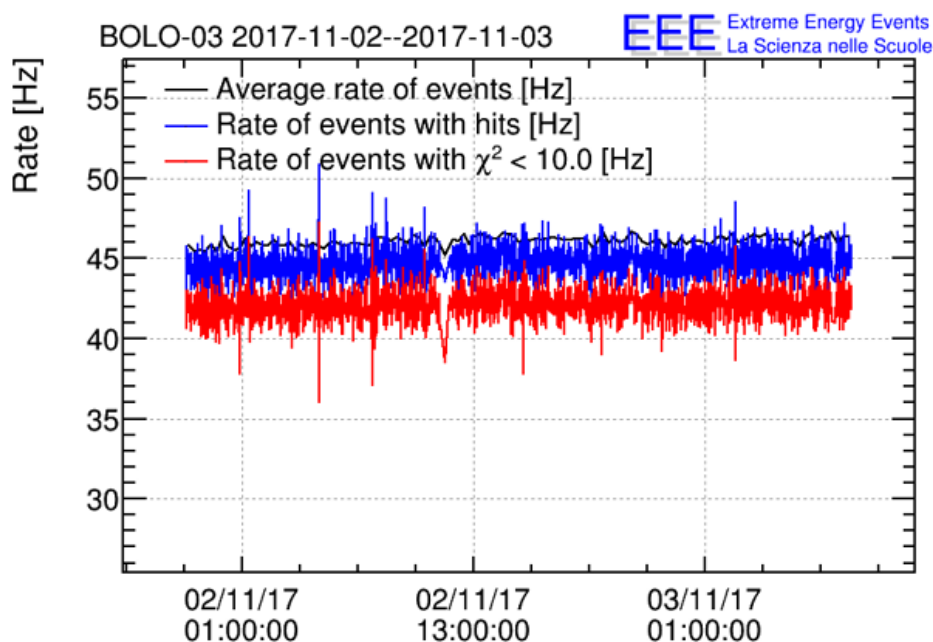


Weather information also available!

Daily report data

First of all:

- choose a telescope and a day
- check that the data are good
- The pressure variation is high enough (>10 mbar) 1 hPa = 1 mbar



- Number of events with hits: 4036590
- Number of events with a track: 3594300
- Data files: [root](#), [csv header](#), [csv trending](#), [csv weather](#)

Then, click to download trending data

Import data in Excel (I)

The image shows a screenshot of the Microsoft Excel application interface. The 'DATI' (Data) ribbon is active, with a red arrow pointing to it. The ribbon contains several groups of icons: 'Carica dati esterni' (Import Data from External Sources), 'Connessioni' (Connections), 'Ordina e filtra' (Sort & Filter), and 'Strumenti dati' (Data Tools). The 'Strumenti dati' group includes icons for 'Testo in colonne' (Text to Columns), 'Anteprima suggerimenti' (Data Suggestions), 'Rimuovi duplicati' (Remove Duplicates), 'Convalida dati' (Data Validation), 'Consolida dati' (Consolidate Data), and 'Analisi di simulazione' (Simulation Analysis).

Overlaid on the Excel window is the 'Importa file di testo' (Import Text File) dialog box. The dialog shows the file explorer view of the Desktop, with a search bar set to 'Questo PC > Desktop'. A red arrow points to a file named 'BOLO-03_2018-01-21_2018-01-22_summary_Trendi ng' (note the typo in the original image). The file is highlighted in blue. The dialog also shows other files and folders on the Desktop, including 'Corso Sicurezza - Screenshots dei test by Lolli', 'EEEtheta', 'gps', and 'teamviewer port'. At the bottom of the dialog, the 'Nome file' field contains 'BOLO-03_2018-01-21_2018-01-22_sui' and the 'File di testo' dropdown is set to 'File di testo'. The 'Importa' button is highlighted in blue.

In the background, the Excel spreadsheet is visible, showing a grid with columns A, B, and C, and rows 1 through 22. The 'Ripristino documenti' (Document Recovery) pane is open on the left, showing a list of available files, including 'partecipantiAll (version 1).x...', 'partecipantiAll.xlsx', 'Cartel1 (version 1).xlsb', 'Cartel1 (version 2).xlsb', and 'risorseGruppo.xlsx'.

Import data in Excel (II)

Importazione guidata testo - Passaggio 2 di 3

In questa finestra di dialogo è possibile impostare i delimitatori contenuti nei dati. L'anteprima mostra come si presenta il testo.

Delimitatori

- Tabulazione
- Punto e virgola
- Virgola
- Spazio
- Altro:

Considera delimitatori consecutivi come uno solo

Qualificatore di testo:

Anteprima dati

#BinStart	BinEnd	RateHitEvents	RateHitEventsErr	RateTrackEven
3.489169140000e+08	3.489169750000e+08	4.509836e+01	8.598357e-01	4.255738e+01
3.489169750000e+08	3.489170360000e+08	4.527869e+01	8.615530e-01	4.278688e+01
3.489170360000e+08	3.489170970000e+08	4.744262e+01	8.819002e-01	4.457377e+01
3.489170970000e+08	3.489171580000e+08	4.622951e+01	8.705520e-01	4.344262e+01

Buttons: Annulla, < Indietro, **Avanti >**, Fine

Comma separation!

Be sure that decimal separation is set to “.”

Importazione guidata testo - Passaggio 3 di 3

Qui è possibile selezionare ciascuna colonna ed impostare il Formato dati.

Formato dati per colonna

- Generale
- Testo
- Data:
- Non importare colonna (salta)

'Generale' converte valori numerici in numeri, valori data in date e i restanti valori in testo.

Avanzate...

Impostazioni avanzate importazione testo

Impostazioni utilizzate per riconoscere i dati numerici

Separatore decimale:

Separatore delle migliaia:

Nota: i numeri verranno visualizzati utilizzando le impostazioni specificate nella finestra Opzioni internazionali nel Pannello di controllo.

Segno meno prima dei numeri negativi

Buttons: **OK**, Annulla

Anteprima dati

Standard	Standard
#BinStart	BinEnd
3.489169140000e+08	3.489169750000e+08
3.489169750000e+08	3.489170360000e+08
3.489170360000e+08	3.489170970000e+08
3.489170970000e+08	3.489171580000e+08

Buttons: Annulla, < Indietro, **Avanti >**, Fine

Import data in Excel (III)

A lot of columns are available. We are interested to few of them

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	#BinStart	BinEnd	RateHitEvents	RateHitEventsErr	RateTrackEvents	RateTrackEventsErr	FractionTrackEvents	FractionTrackEventsErr	IndoorTemperature	OutdoorTemperature	Pressure	UniqueRunId	
2	3.49E+08	3.49E+08	4.51E+01	8.60E-01	4.26E+01	8.35E-01	9.44E-01	4.40E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
3	3.49E+08	3.49E+08	4.53E+01	8.62E-01	4.28E+01	8.38E-01	9.45E-01	4.34E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
4	3.49E+08	3.49E+08	4.74E+01	8.82E-01	4.46E+01	8.55E-01	9.40E-01	4.43E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
5	3.49E+08	3.49E+08	4.62E+01	8.71E-01	4.34E+01	8.44E-01	9.40E-01	4.48E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
6	3.49E+08	3.49E+08	4.55E+01	8.63E-01	4.27E+01	8.37E-01	9.39E-01	4.54E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
7	3.49E+08	3.49E+08	4.70E+01	8.78E-01	4.39E+01	8.49E-01	9.34E-01	4.62E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
8	3.49E+08	3.49E+08	4.66E+01	8.74E-01	4.38E+01	8.47E-01	9.39E-01	4.48E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
9	3.49E+08	3.49E+08	4.82E+01	8.89E-01	4.48E+01	8.57E-01	9.28E-01	4.76E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
10	3.49E+08	3.49E+08	4.71E+01	8.79E-01	4.41E+01	8.51E-01	9.37E-01	4.53E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
11	3.49E+08	3.49E+08	5.43E+01	9.44E-01	5.13E+01	9.17E-01	9.45E-01	3.96E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
12	3.49E+08	3.49E+08	4.58E+01	8.59E-01	4.33E+01	8.35E-01	9.45E-01	4.29E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
13	3.49E+08	3.49E+08	4.13E+01	8.23E-01	3.88E+01	7.98E-01	9.40E-01	4.72E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
14	3.49E+08	3.49E+08	4.23E+01	8.33E-01	3.98E+01	8.07E-01	9.40E-01	4.66E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
15	3.49E+08	3.49E+08	4.63E+01	8.71E-01	4.37E+01	8.47E-01	9.45E-01	4.29E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
16	3.49E+08	3.49E+08	4.77E+01	8.84E-01	4.52E+01	8.61E-01	9.49E-01	4.09E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
17	3.49E+08	3.49E+08	4.58E+01	8.67E-01	4.33E+01	8.42E-01	9.45E-01	4.33E-03	1.62E+01	1.20E+01	9.93E+02	7403800001	
18	3.49E+08	3.49E+08	4.61E+01	8.69E-01	4.33E+01	8.43E-01	9.40E-01	4.47E-03	1.62E+01	1.18E+01	9.93E+02	7403800002	
19	3.49E+08	3.49E+08	4.77E+01	8.84E-01	4.46E+01	8.55E-01	9.36E-01	4.54E-03	1.62E+01	1.18E+01	9.93E+02	7403800002	
20	3.49E+08	3.49E+08	4.58E+01	8.66E-01	4.27E+01	8.37E-01	9.33E-01	4.73E-03	1.62E+01	1.18E+01	9.93E+02	7403800002	

Timestamp

Rate of good-quality tracks

Pressure

Have a look to the data

INSERISCI | LAYOUT DI PAGINA | FORMULE | DATI | REVISIONE | VISUALIZZA | TEAM | **STRUMENTI GRAFICO** | Cartel1 - Excel

FILE | HOME | **INSERISCI** | LAYOUT DI PAGINA | FORMULE | DATI | REVISIONE | VISUALIZZA | TEAM | **STRUMENTI GRAFICO** | PROGETTAZIONE | FORMATO

Tabella pivot | Tabelle pivot consigliate | Tabelle | Immagini | Immagini online | Forme | SmartArt | Schermata | Store | App personali | Bing Maps | People Graph | Grafici consigliati | Grafico pivot | Linee | Istogramma | Positivi/negativi | F

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Grafico 1 | X | ✓ | fx

Ripristino documenti
 Excel ha ripristinato i seguenti file. Salvare i file desiderati.

File disponibili

- partecipantiAll (version 1).x...
Versione creata dall'ultimo...
10/05/2018 03.00
- partecipantiAll.xlsx [Origin...
Versione creata all'ultimo s...
09/05/2018 10.38
- Cartel1 (version 1).xlsb [Sal...
Versione creata dall'ultimo...
07/03/2018 10.13
- Cartel1 (version 2).xlsb [Sal...
Versione creata dall'ultimo...
14/03/2018 21.31
- risorseGruppo.xlsx [Origin...
Versione creata all'ultimo c...

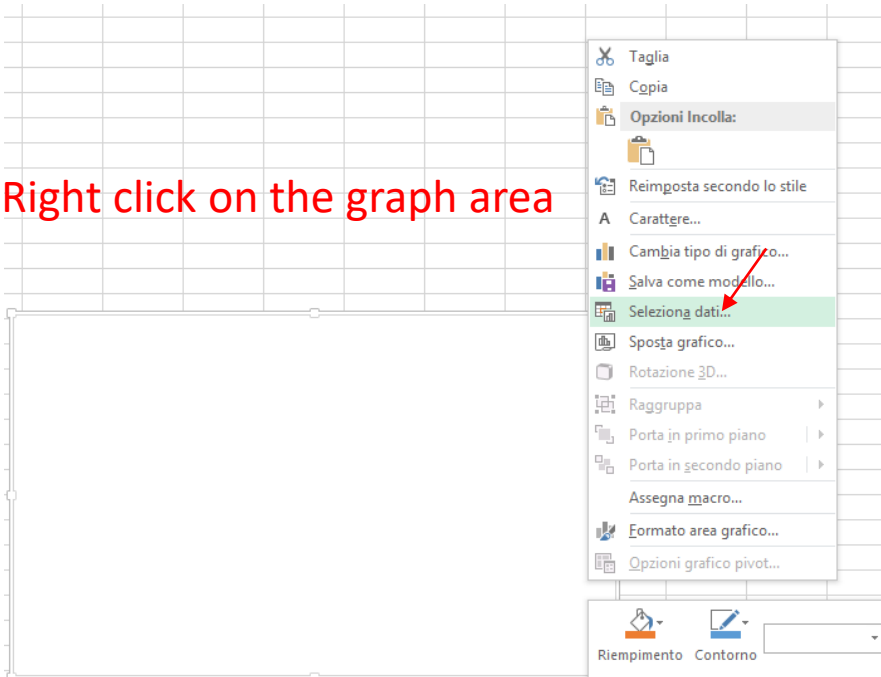
	A	B	C	D	I
1	#BinStart	RateTrackEvents	Pressure		
2	3.49E+08	4.26E+01	9.93E+02		
3	3.49E+08	4.28E+01	9.93E+02		
4	3.49E+08	4.46E+01	9.93E+02		
5	3.49E+08	4.34E+01	9.93E+02		
6	3.49E+08	4.27E+01	9.93E+02		
7	3.49E+08	4.39E+01	9.93E+02		
8	3.49E+08	4.38E+01	9.93E+02		
9	3.49E+08	4.48E+01	9.93E+02		
10	3.49E+08	4.41E+01	9.93E+02		
11	3.49E+08	5.13E+01	9.93E+02		
12	3.49E+08	4.33E+01	9.93E+02		
13	3.49E+08	3.88E+01	9.93E+02		
14	3.49E+08	3.98E+01	9.93E+02		
15	3.49E+08	4.37E+01	9.93E+02		
16	3.49E+08	4.52E+01	9.93E+02		
17	3.49E+08	4.33E+01	9.93E+02		
18	3.49E+08	4.33E+01	9.93E+02		
19	3.49E+08	4.46E+01	9.93E+02		
20	3.49E+08	4.27E+01	9.93E+02		

Dispersione
 Usare questo tipo di grafico per:
 • Confrontare almeno due set di valori o coppie di dati.
 • Visualizzare le relazioni tra set di valori.
 Usarlo quando:
 • I dati rappresentano misurazioni distinte.

We can start by inserting a graph showing the trend of the track rate vs pressure

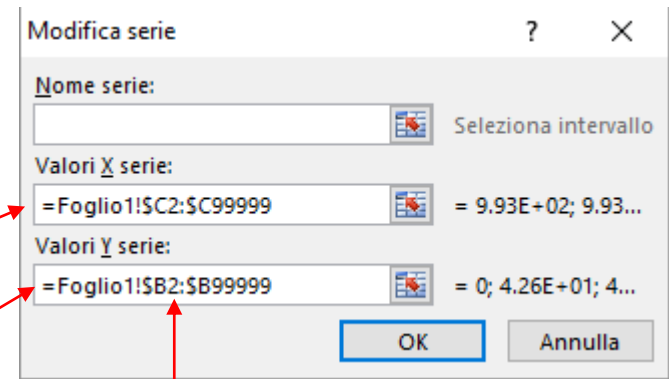
Select data

Right click on the graph area



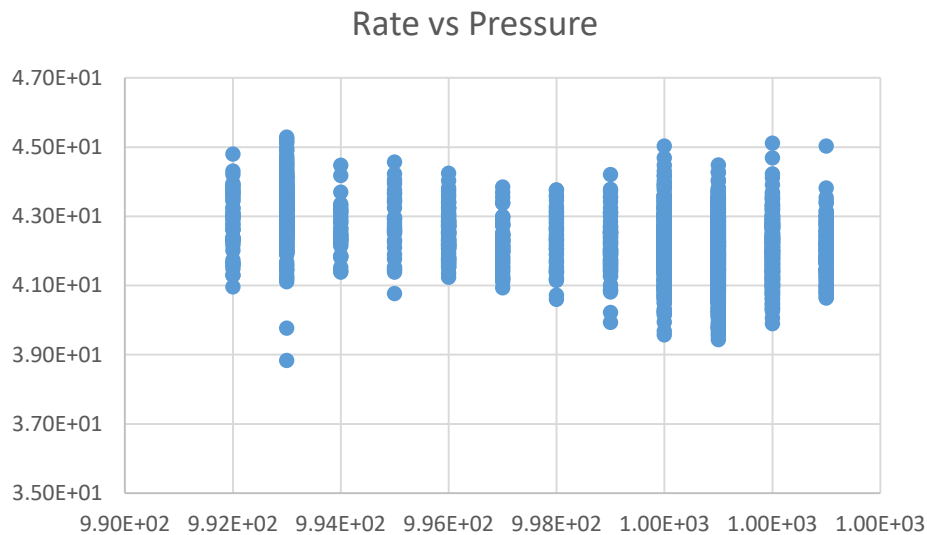
Pressure column

Rate column



We skip the first row

Scatter plot



It is quite difficult to appreciate variation in the flux in a scatter plot because of the large fluctuations (the statistics of each point corresponds to 1 minute of data acquisition)

We are interested to the mean value for a given value of the pressure.

Make a plot with the mean values of the rates

E	F	G	H	I
	Pressure	N events		
	9.90E+02	=CONTA.SE(
	9.91E+02	CONTA.SE(intervallo; criterio)		
	9.92E+02	COUNT.IF(
	9.93E+02			
	9.94E+02			
	9.95E+02			
	9.96E+02			
	9.97E+02			
	9.98E+02			
	9.99E+02			
	1.00E+03			
	1.00E+03			
	1.00E+03			
	1.00E+03			
	1.00E+03			
	1.01E+03			
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	1.01E+03			
	1.01E+03			
	1.01E+03			
	1.01E+03			
	1.01E+03			
	1.01E+03			

Define a column with the possible value of the pressure

Counts the events with the correspondent value of the pressure:
 Interval → Pressure column
 Criterion → Correspondent pressure value

Compute the mean for each value of the pressure

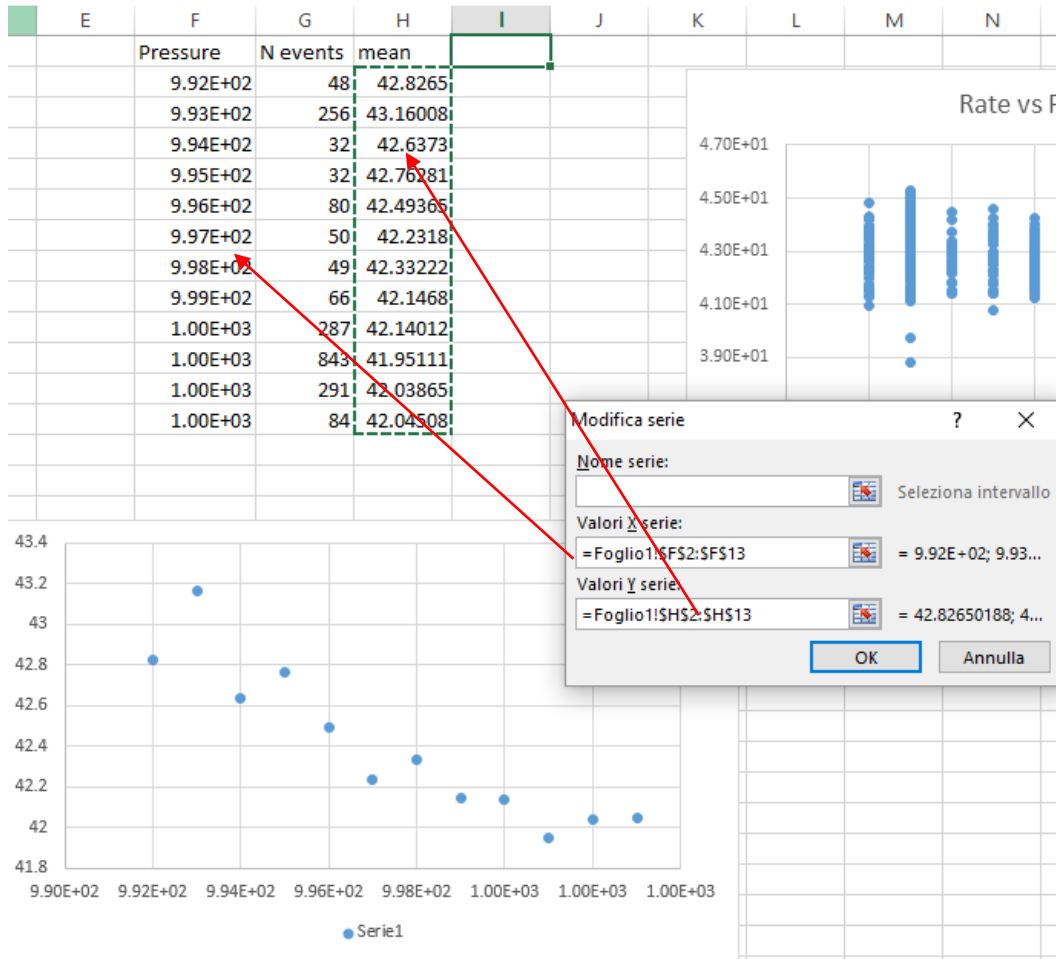
F	G	H	I	J
Pressure	N events	mean		
9.92E+02	48	=SOMMA.SE(C:C;F2;B:B)/G2		
9.93E+02	256	SUM.IF(
9.94E+02	32			
9.95E+02	32			
9.96E+02	80			
9.97E+02	50			
9.98E+02	49			
9.99E+02	66			
1.00E+03	287			
1.00E+03	843			
1.00E+03	291			
1.00E+03	84			

Sum the value of the rates with the correspondent value of the pressure:
 Interval → Pressure column
 Criterion → Correspondent pressure value
 Sum values → RateTrackEvents column

Then divide for the number of events with that value of pressure

Rate vs Pressure

We can make a new graph using the mean value.

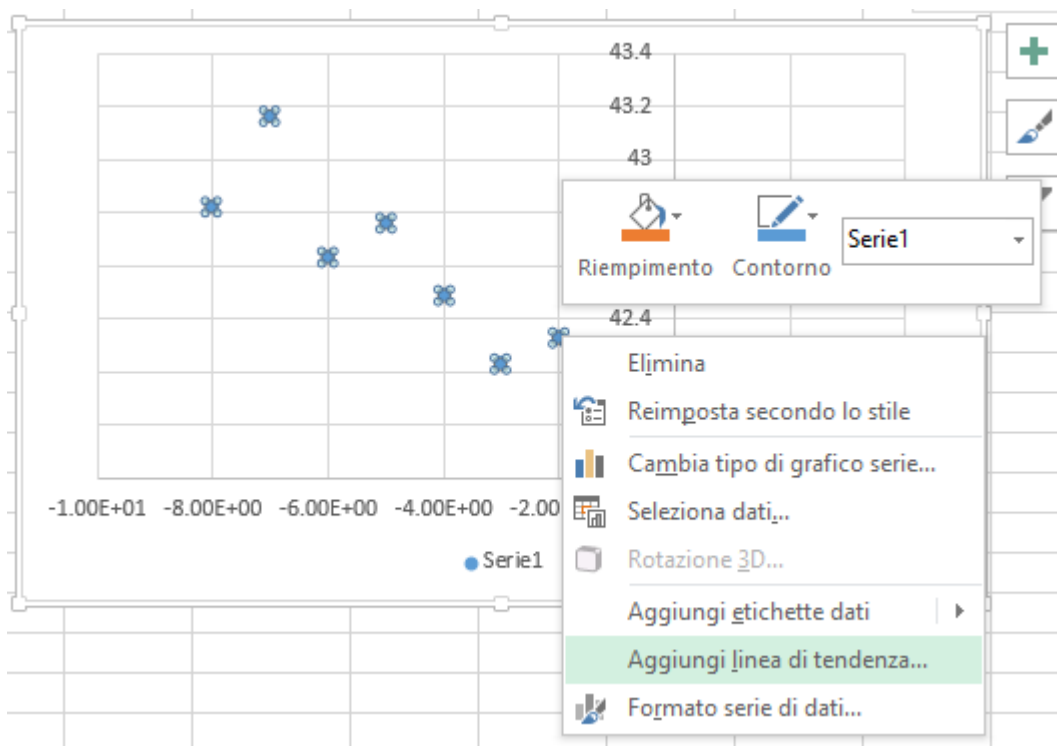


Now we want to extract the barometric coefficient by fitting with a line.

Before to do that we need to have ΔP on the x-axis respect to a realistic reference (1000 mbar is fine)

Pressure	N events	mean	DeltaP
9.92E+02	48	42.8265	=F2-1000
9.93E+02	256	43.16008	
9.94E+02	32	42.6373	
9.95E+02	32	42.76281	
9.96E+02	80	42.49365	
9.97E+02	50	42.2318	
9.98E+02	49	42.33222	

Perform the fit with a line



Formato linea di tende... ✕

OPZIONI LINEA DI TENDENZA ▾



OPZIONI LINEA DI TENDENZA

Esponenziale

Lineare

Logaritmica

Polinomiale Ordine

Potenza

Media mobile Periodo

Nome linea di tendenza

Automatica Lineare (Serie1)

Personalizza

Previsione

Futura per

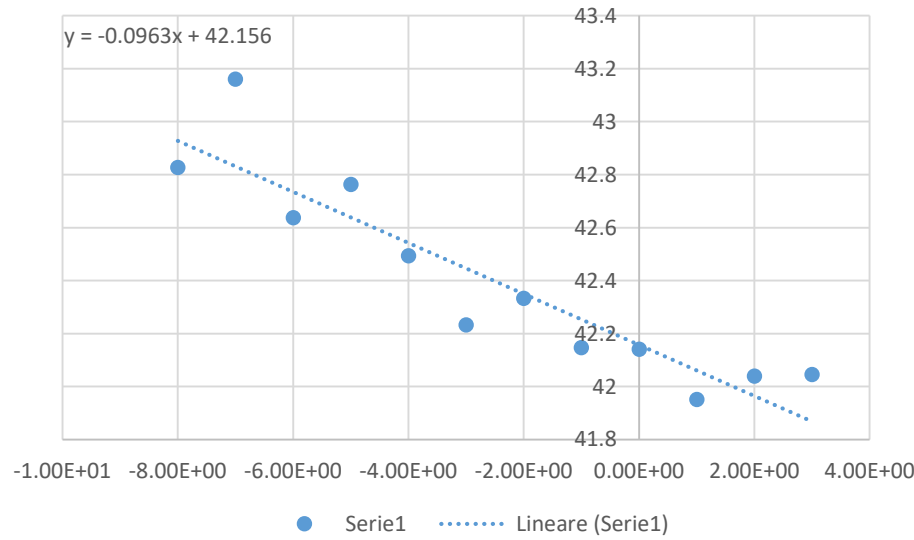
Verifica per

Imposta intercetta

Visualizza l'equazione sul grafico

Visualizza il valore R quadrato sul grafi

Interpretation of the results



Note that with Excel we cannot fit with our original function:

$$flusso(\Delta P) = flusso(P_0)(1 - \alpha \Delta P)$$

But we fitted with:

$$flusso(\Delta P) = a\Delta P + b$$

However we can rearrange the formula used to fit to extract the parameters we are interested to, since the same formula can be rewritten as:

$$flusso(\Delta P) = b \left(1 + \frac{a}{b} \Delta P \right)$$

Now, let's repeat the measurement for different telescopes and period to see how this coefficient change.

So in our case:

$$\alpha = -\frac{a}{b} = -\frac{-0.0963}{42.126} = 0.0023 \text{ mbar}^{-1}$$