EXPERIMENT PURPOSE

PLACES	HEIGHTS
Savona	(0±5)m
Carcare	(365±5)m
Bardineto	(720±5)m
Colle del Melogno	(1050±5)m
Limone Piemonte	(1523±5)m

EXPERIMENTAL SETUP AND COSMIC BOX
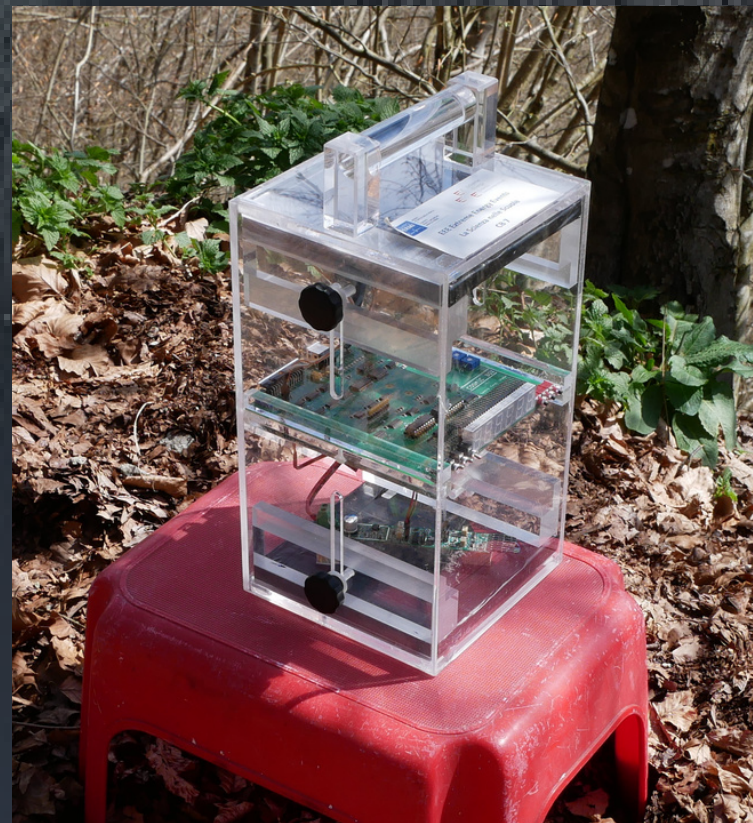
- **The cosmic box is composed by**:
  - **Two scintillators working in coincidence;**
  - **Light is collected by a photosensor**
  - **A display showing the result of the measure;**
- During the data taking:
  - **The chamber must stand horizontally**
  - **No contact with the ground**
  - **Covered with a thin metallic foil**

Ref: https://avbc.me/jUE3ZFEj
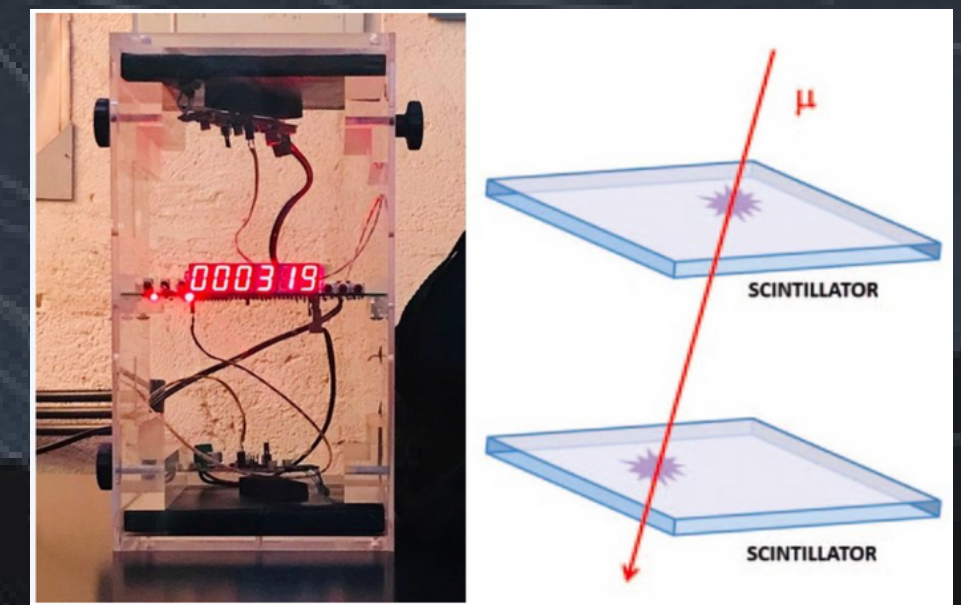
MEASUREMENTS TECHNIQUES AND ERROR ESTIMATION

- **The integration time is 60 minutes:**
  - **Uncertainty on time: ± 5 s**

- **Theoretical flux of 0.5 particles/s:**
  - **we expect 1800 particles/h**
  - **Poisson uncertainty on counts: 2.3 %**

- **Height uncertainty : ± 5 m**
  - **Estimated comparing various altimeters**

THEORETICAL VALUE

$$0.5\ \text{Hz}\cdot(3600\pm5)\text{s}= (1800\pm2)$$

https://www.sif.it/riviste/sif/gdf/econtents/2018/059/03/article/6

ACCEPTANCE

- **In order to calculate the Cosmic Box's acceptance, we use data taken at sea level compared to the theoretical flux.**

$$e = \frac{\left(\dfrac{\sum x_i}{n} \pm \sqrt{\dfrac{\sum(x_i - \bar{x})^2}{n(n-1)}}\right)}{0.5Hz \cdot (3600 \pm 5)s} = (0.42 \pm 0.03)$$

Number of counts Savona	Avarage time measurements
1020±30	
930±30	
900±30	
890±30	
870±30	
860±30	(3600±5)s
770±30	
670±20	
660±20	
640±20	
510±20	
420±20	

THEORETICAL VALUE

$$0.5 \text{ Hz} \cdot (3600 \pm 5)s = (1800 \pm 2)$$

DATA ANALYSIS

Location			Measurements				
Place	Geographic coordinates	Altitude (m)	Date	Medium temperatures (°C)	Medium pressure (KP$_a$)	Flux of muons (Hz)	Flux normalized to the acceptance (Hz)
Savona	44° 18' 29" N - 8° 28' 52" E	0±5	08/05/23	19.8±0.1	101.9±0.1	0.21±0.01	0.50±0.04
Carcare	44º 21' 37" N - 8º 17' 03" E	365±5	26/04/23	17.2±0.1	97.3±0.1	0.26±0.01	0.63±0.08
Bardineto	44° 11' 32" N - 8° 08' 06" E	720±5	17/04/23	15.4±0.1	92.8±0.1	0.29±0.01	0.68±0.07
Colle del Melogno	44° 13' 44" N - 8° 11' 07" E	1050±5	14/04/23	13.6±0.1	88.5±0.1	0.36±0.01	0.82±0.08
Limone Piemonte	44° 09' 44" N - 7° 34' 07" E	1523±5	20/04/23	10.0±0.1	84.2±0.1	0.40±0.01	0.90±0.08

$$M_a = \frac{1}{n}\sum_{i=1}^{n} x_i$$

$$e = \sqrt{\frac{\Sigma^n_{i=1}(\bar{x}-x_i)^2}{n(n-1)}}$$
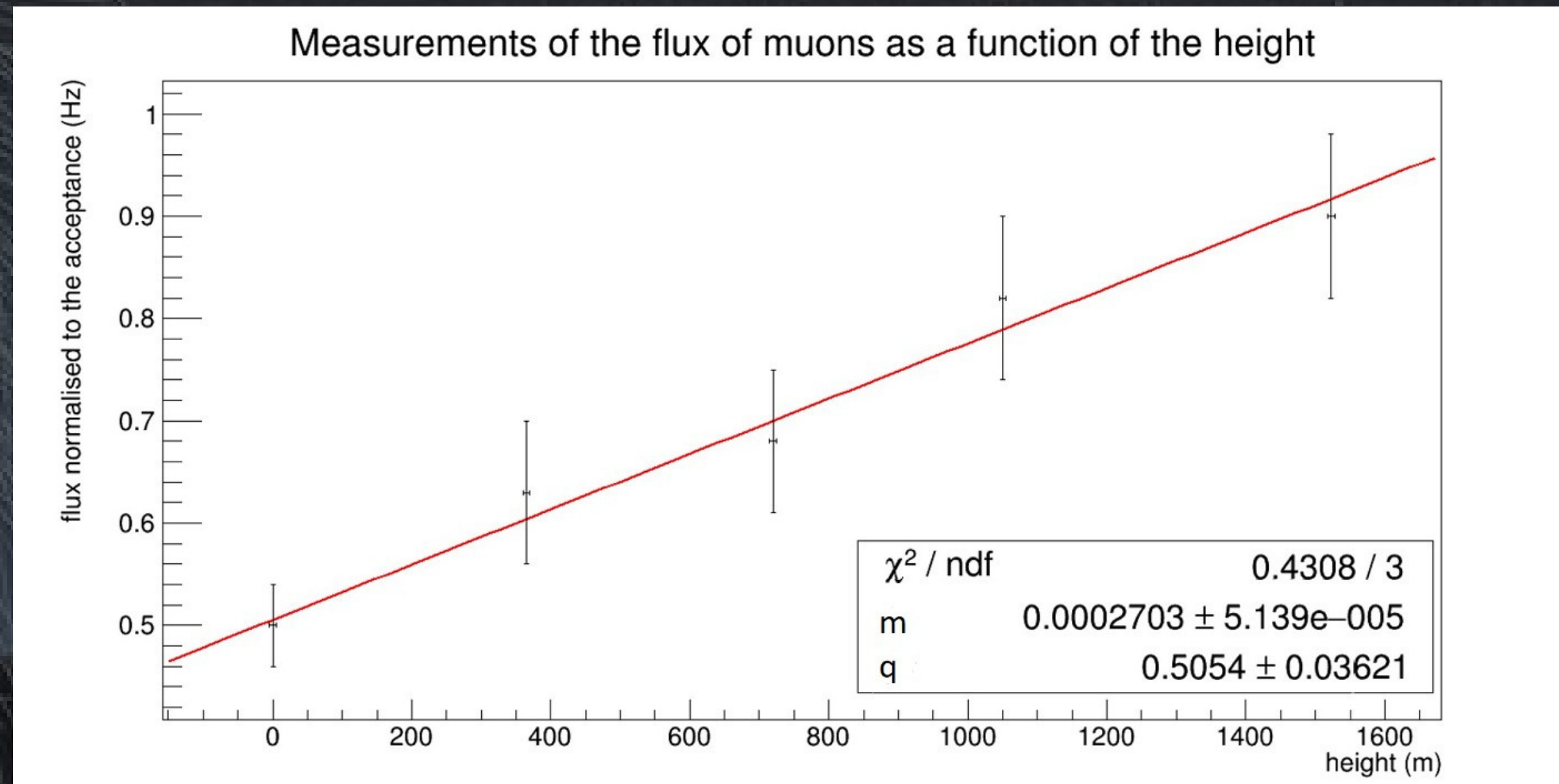
$$\phi = \frac{n}{t}$$

LINEAR REGRESSION AND PLOTS

- **The plot shows the flux as a function of the height, as calculated in slide 7**

- **A linear regression is performed**

- **The results obtained are:**

$$m = (0.00027 \pm 0.00005)\,{}^{Hz}/_{m}$$

$$q = (0.51 \pm 0.04)\,Hz$$

$$\chi^2/ndf = 0.4308/3 = 0.144$$

Measurements of the flux of muons as a function of the height

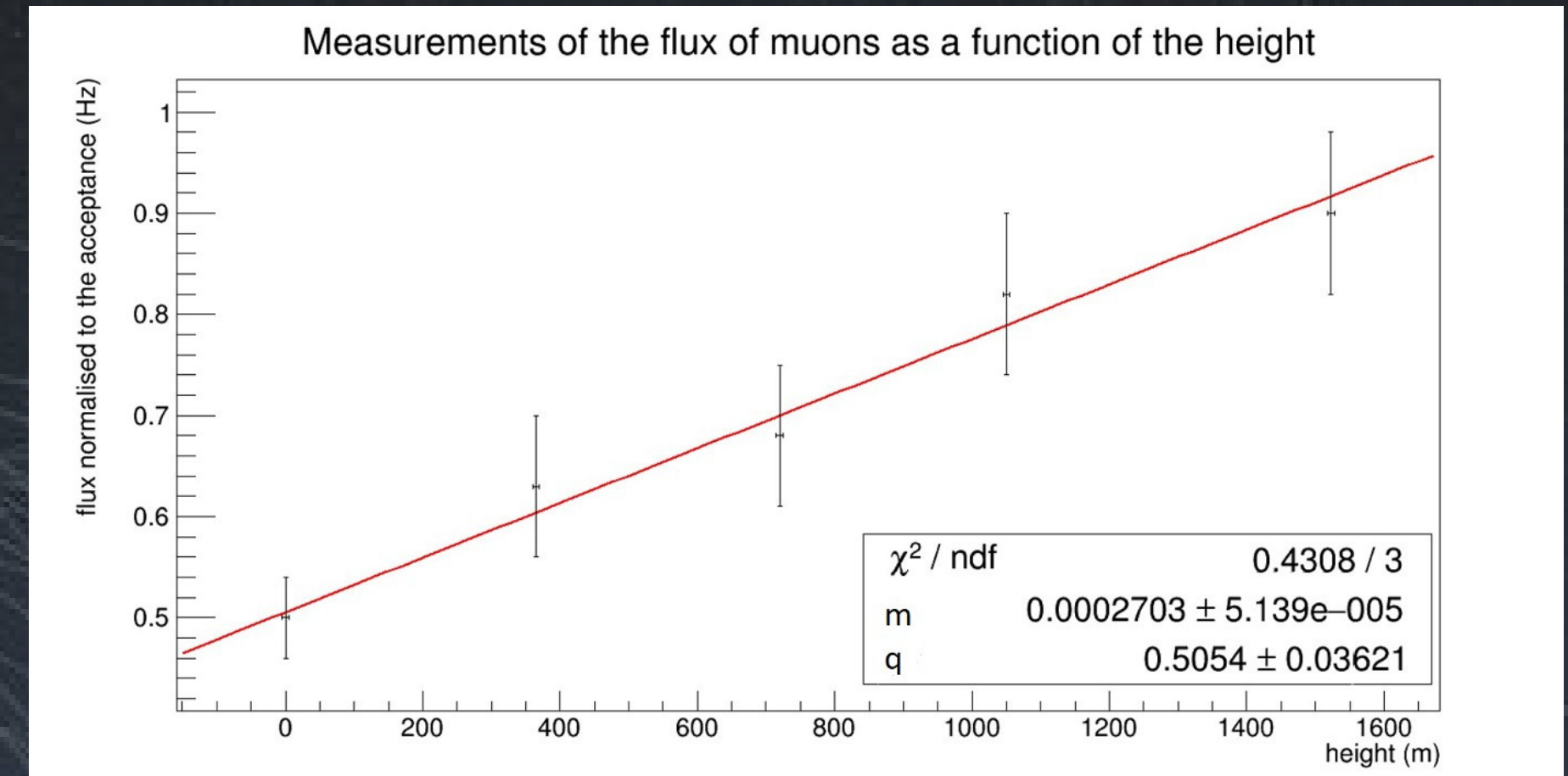| χ^2 / ndf	0.4308 / 3
m	$0.0002703 \pm 5.139e{-}005$
q	0.5054 ± 0.03621

PERSPECTIVES

- **Conclusions**:
  - **Linear trend**
  - **Angular coefficient (0.27±0.05) Hz/km**
  - **In line with theoretical expectations (0.25±0.01) Hz/km**

- **Future developments**:
  - **Measurements at:**
    - **More measures in Savona;**
    - **Monesi;**
    - **Colle di Tenda;**
    - **Other latitudes (Liguria, Toscana, Lisbona, Messina);**
  - **Barometric correction.**

Measurements of the flux of muons as a function of the height

χ^2 / ndf	0.4308 / 3
m	$0.0002703 \pm 5.139e{-}005$
q	0.5054 ± 0.03621

Thanks to:

- **Dott. Matteo Pisano, professor at the university of Lisboa**
- **Prof.ssa Michela Occhetto, Prof.ssa Angela Vigna and Prof. Luca Bovio**
- **CREF**
- **EEE collaboration**
- **The head teachers Prof.ssa Maria Morabito and Prof. Domenico Buscaglia**
- **All the students involved in this project**

BACKUP