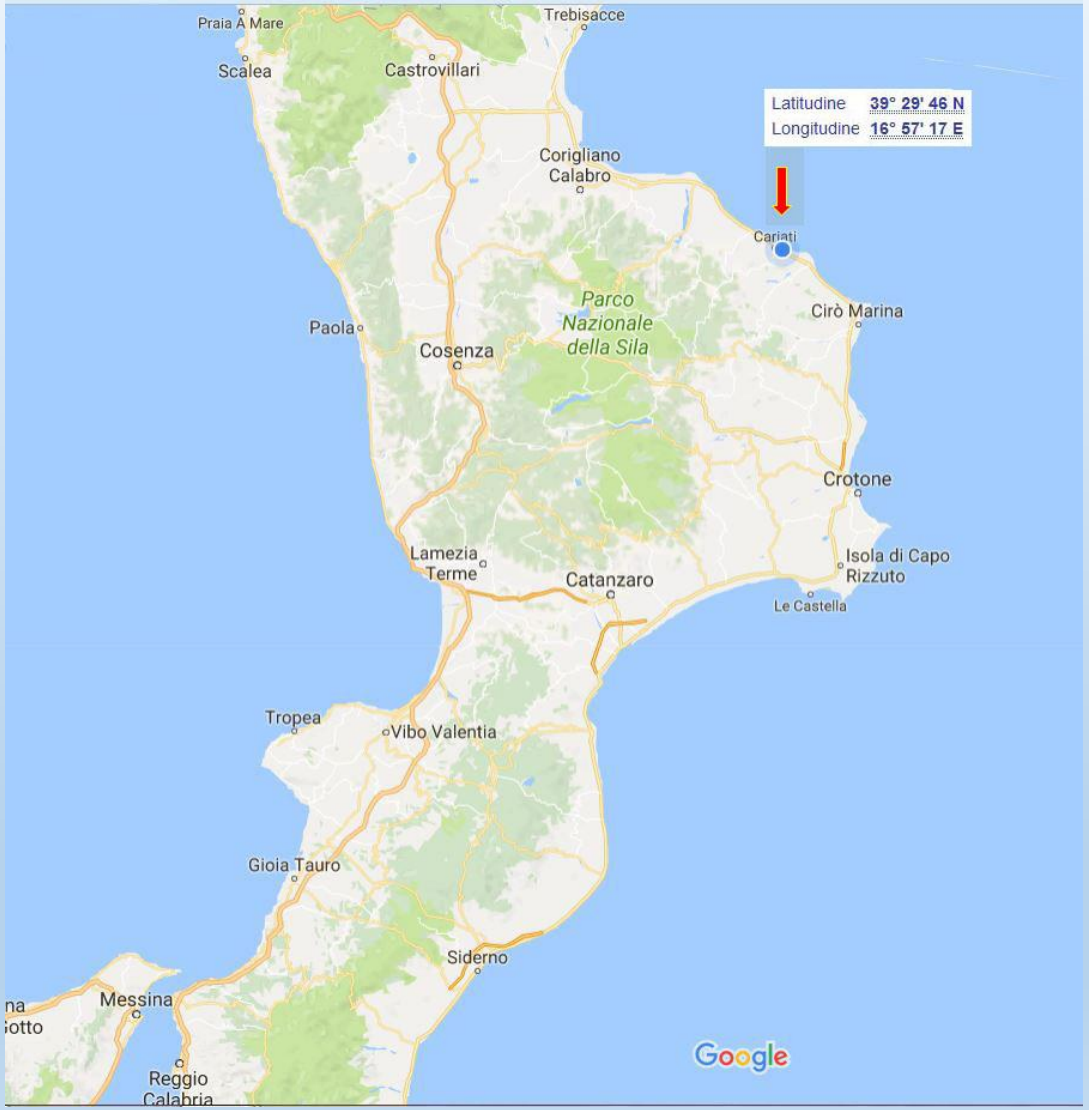
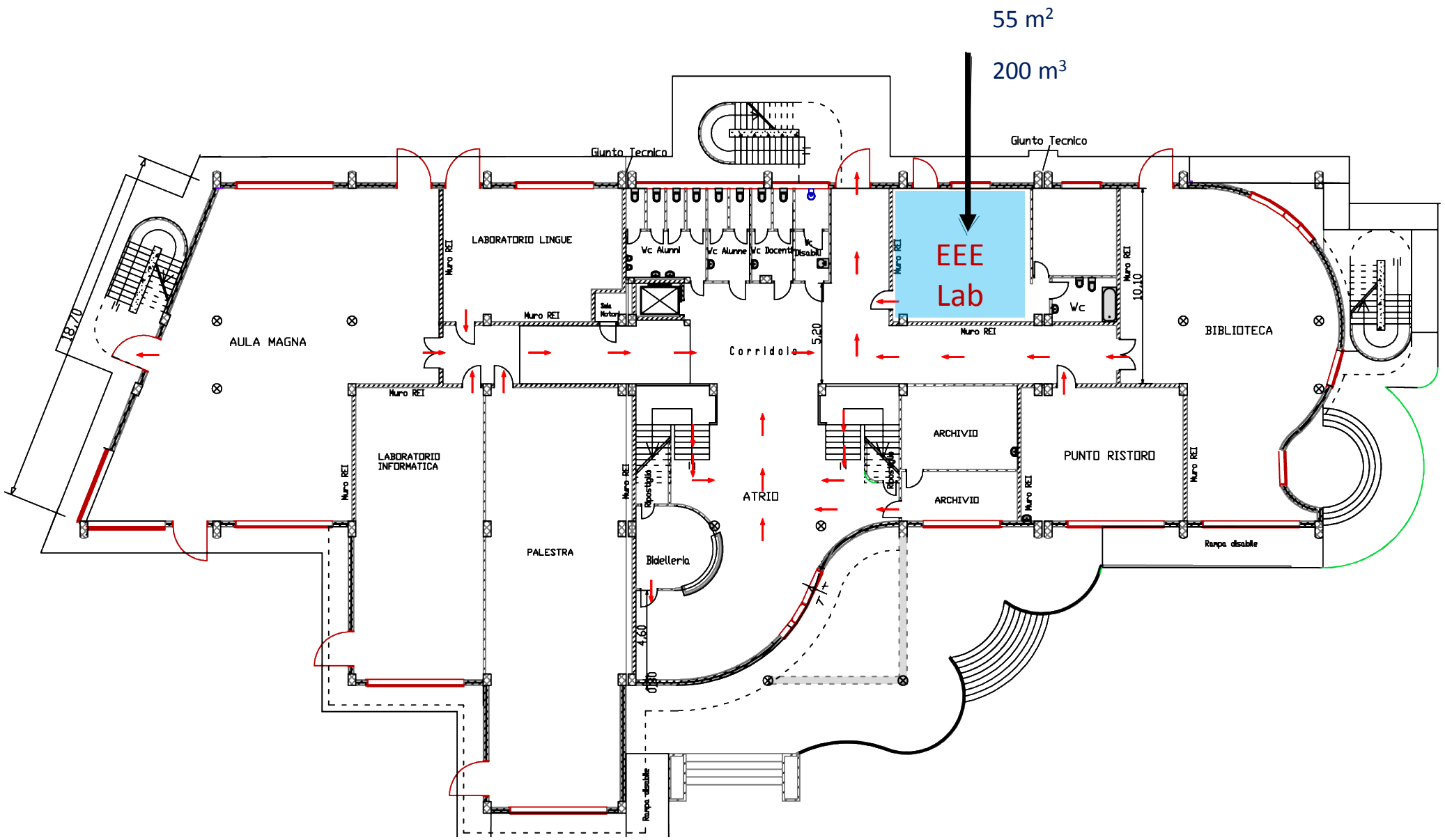
X Conferenza dei Progetti del Centro Fermi – March 6th-8th 2019 - Turin

Muon's proper life time

Liceo Scientifico di Cariati



Liceo Scientifico di Cariati (CS) **EEE laboratory planimetry- ground floor**



Some work steps at CERN april 24th - 28th 2017

A.S.L.
school years 2017/18, 2018/19

- Elogbook compilation
- Spreadsheet for the duration of gas tank
- Telescope orientation measurement
- Realization of the meteorological hut
- Gas tightness of the chambers
- Telescope's efficiency

CARI-01 Summary

2017, April: chambers construction at CERN

2017, August: incoming of chambers at school

2018, April: incoming of the trigger card

2018, October: replacement request of bottom chamber

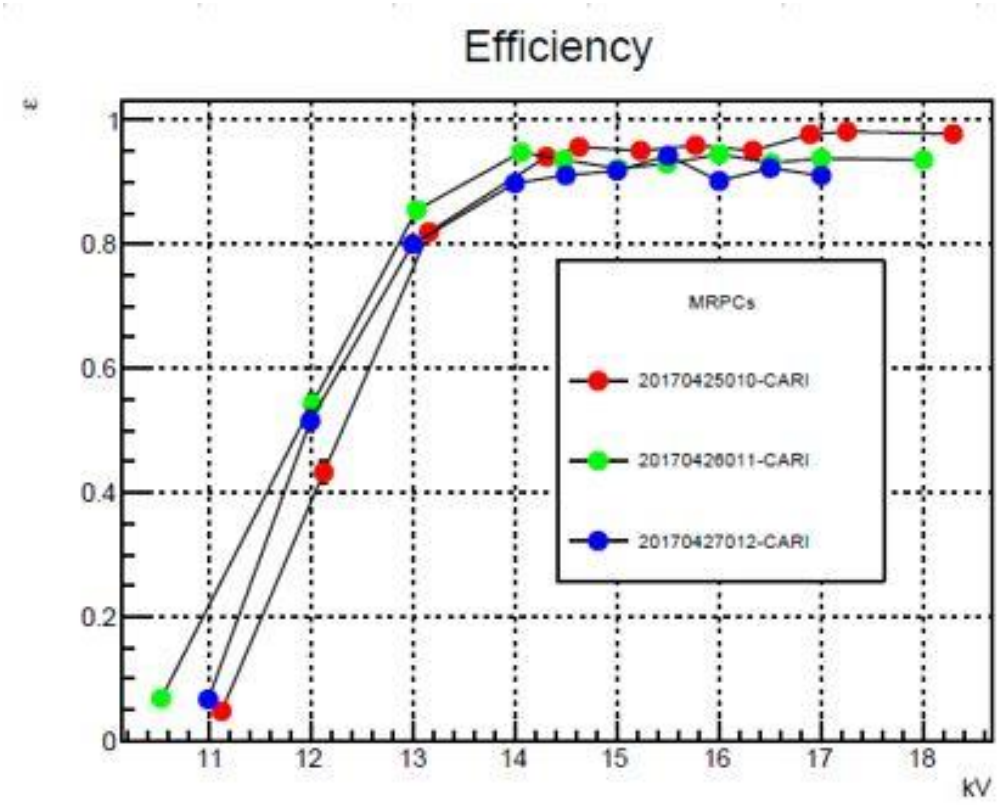
2019, January 26th: arrival of the replacement chamber

2019, February 2nd: bottom chamber replacement

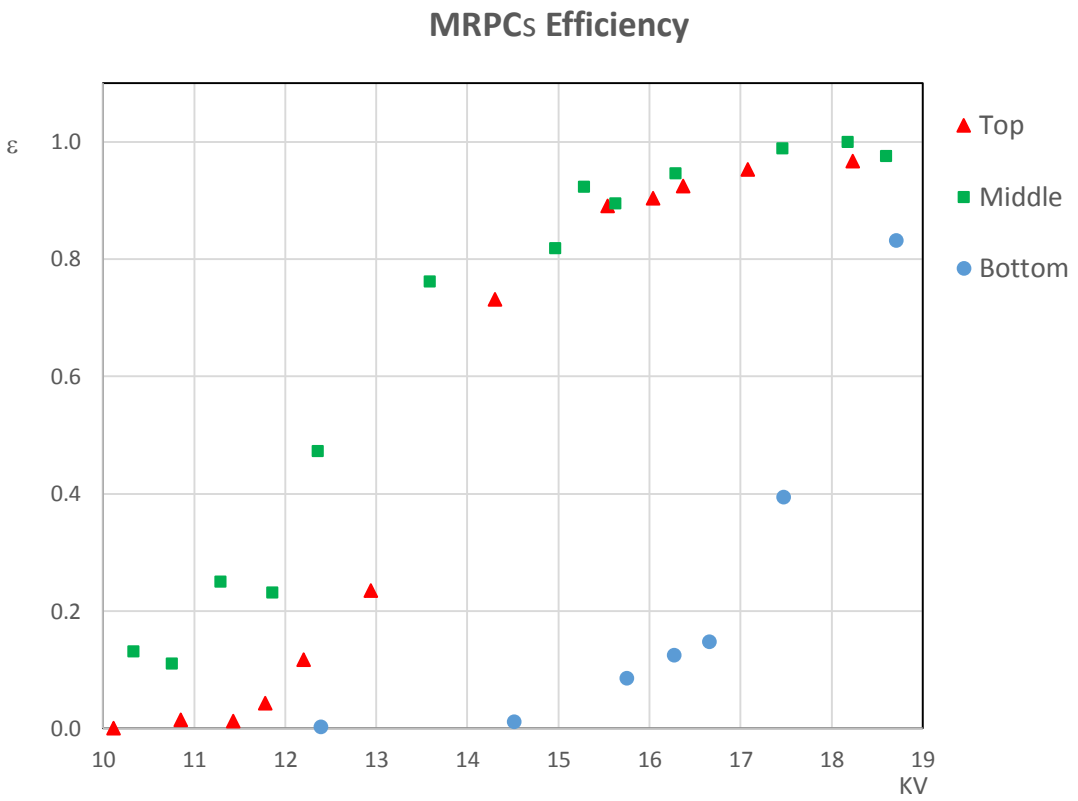
2019, February 22th: present on EEE monitor

2019, March 4th: green on EEE monitor

Some replacement's moments



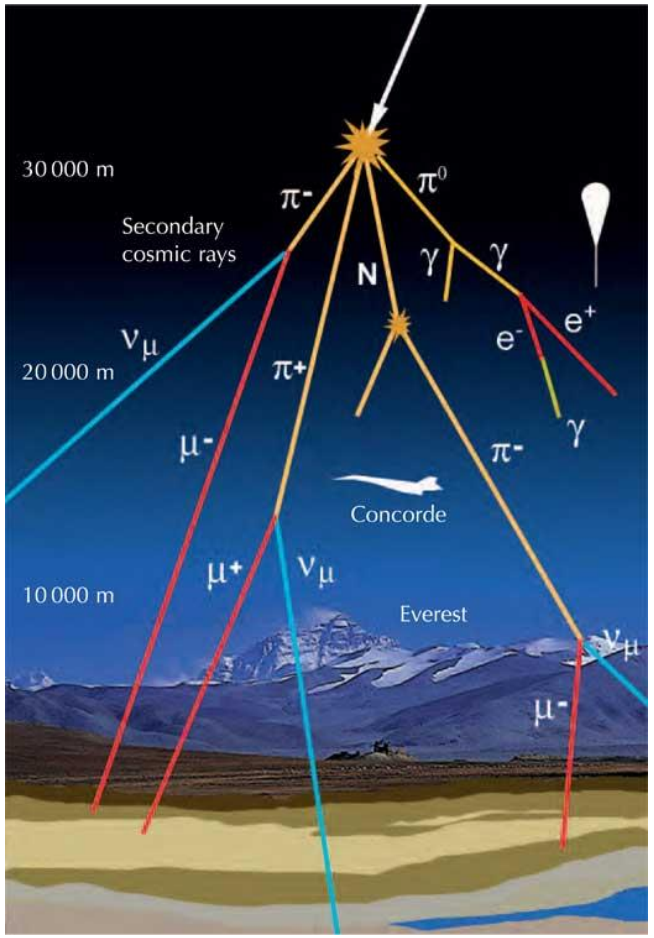
Before Transport



After Transport

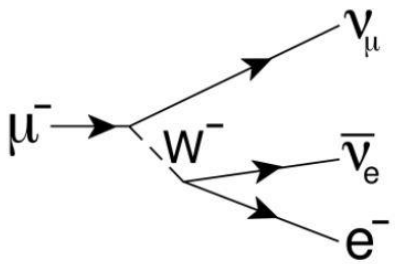
MUON IDENTITY CARD

Data from PDG- J. Beringeret al.(Particle Data Group), PRD86, 010001 (2012)
http://pdg.lbl.gov/2012/listings/rpp2012-list-muon.pdf



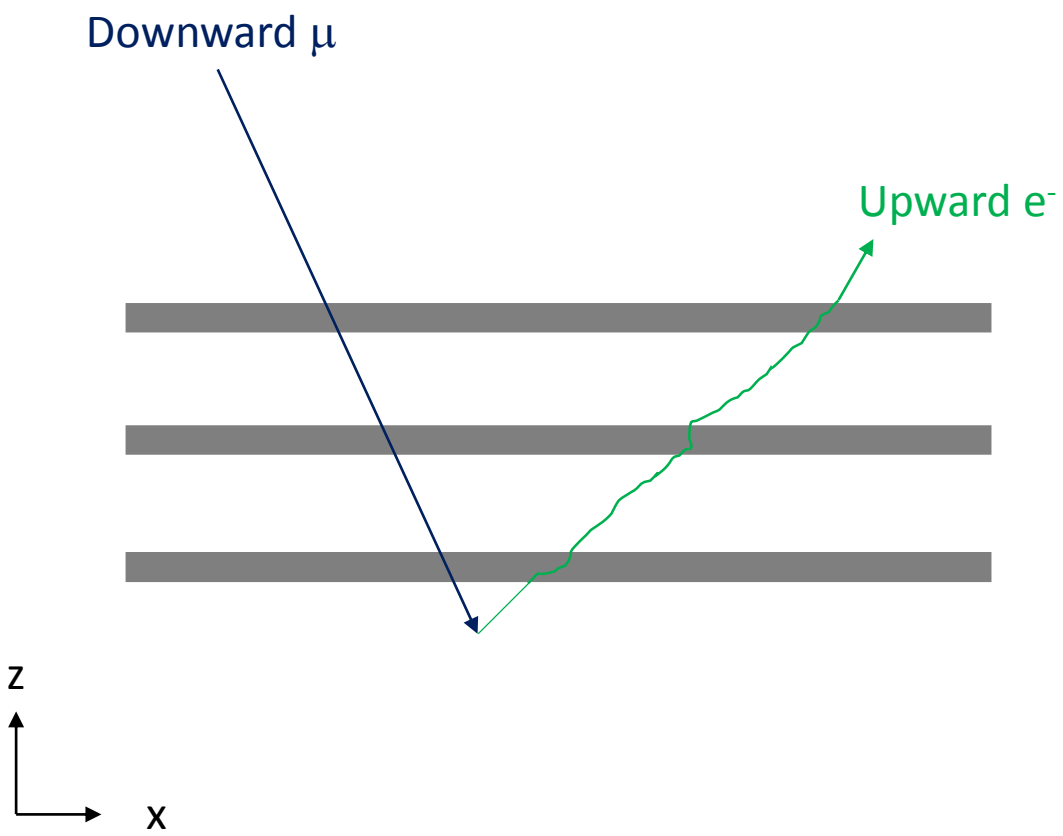
Family: Lepton
Presence: secondary cosmic rays
Spin = 1/2
Mass = 105.6583715±0.0000035 MeV
LifeTime = 2.1969811±0.0000022 μs
Decays:

$$\mu^+ \to e^+ + \bar{\nu}_\mu + \nu_e$$
$$\mu^- \to e^- + \nu_\mu + \bar{\nu}_e$$



Decay law $N(t) = N_0 e^{-t/\tau}$ LifeTime $\tau \approx 2.2$ μs

Upward going event



Query on EEE monitor

TimeOfFlight<0 && ChiSquare<50 && RunNumber < 60

Cut on excel analisys

ChiSquare>10 && β<0.83

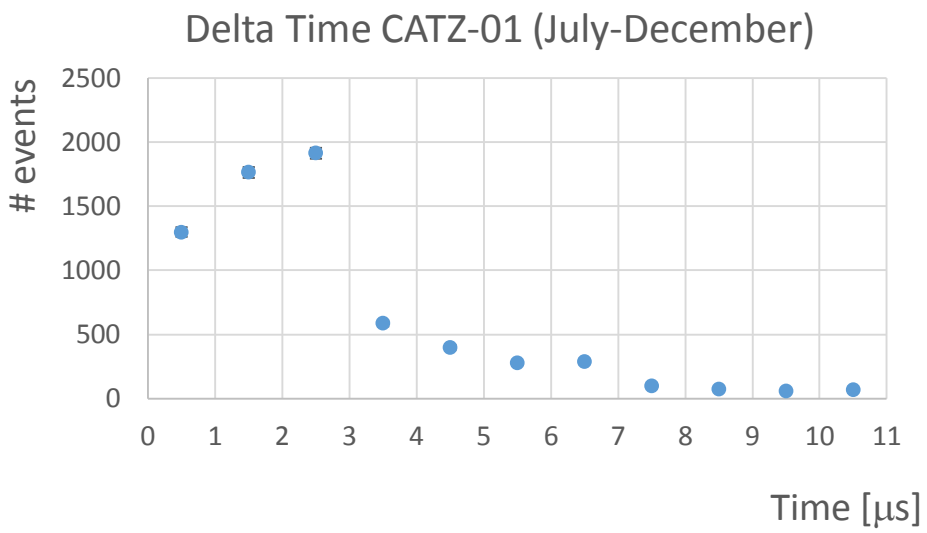
$\beta = v/c$

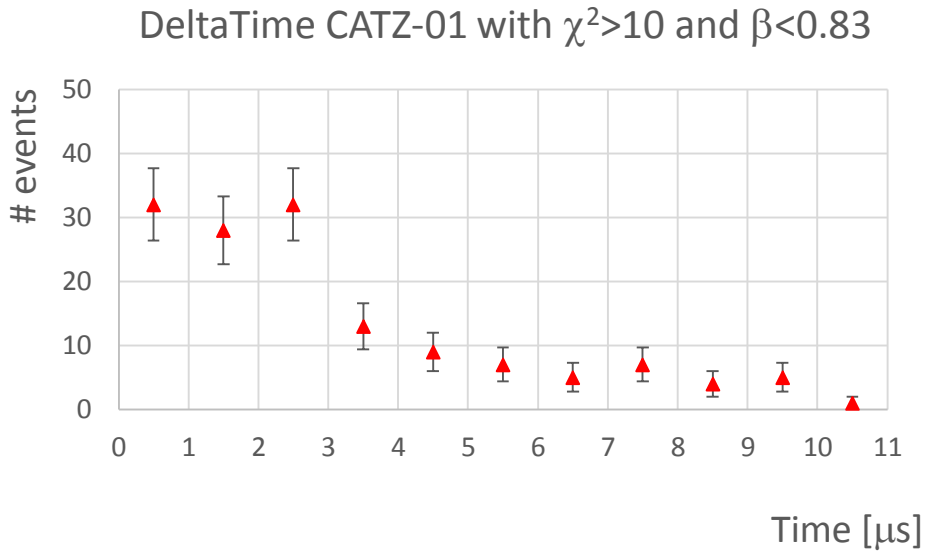
The traces of the electrons are not rectilinear because of the impacts, so they have a "bad" chi square and a low speed with respect to the speed of light.

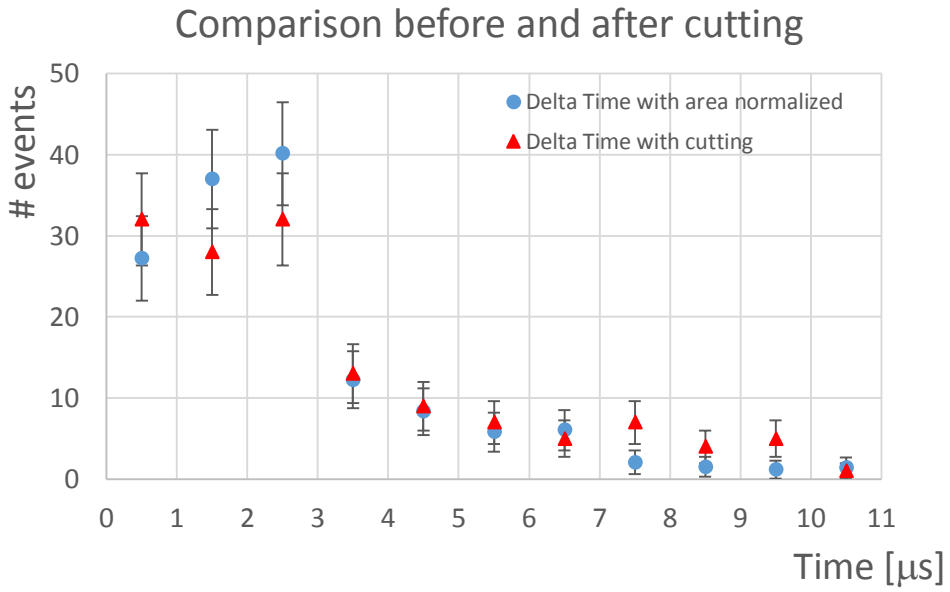
τ-estimate with EEE data

CATZ-01
TORI-04
BARI-01
SAVO-01
FRAS-02

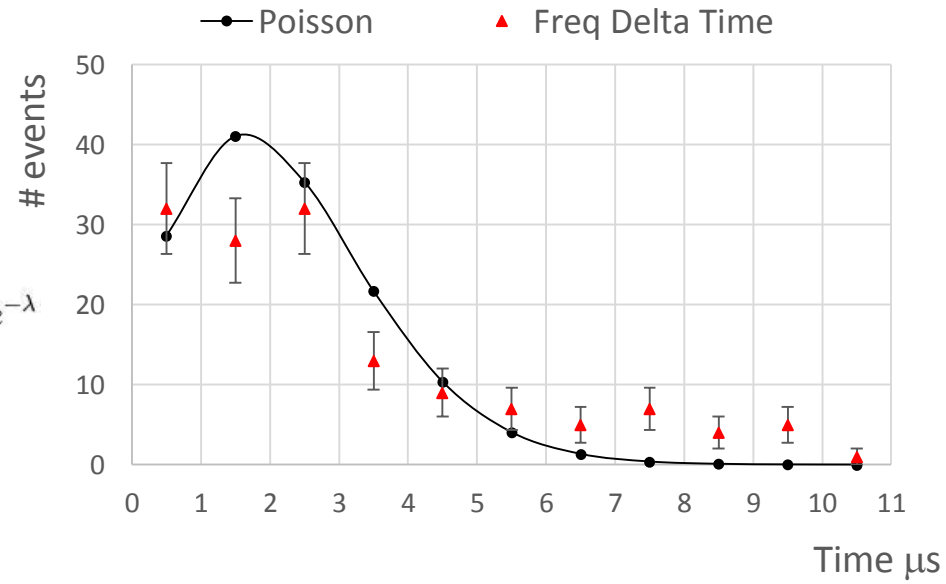
CATZ-01

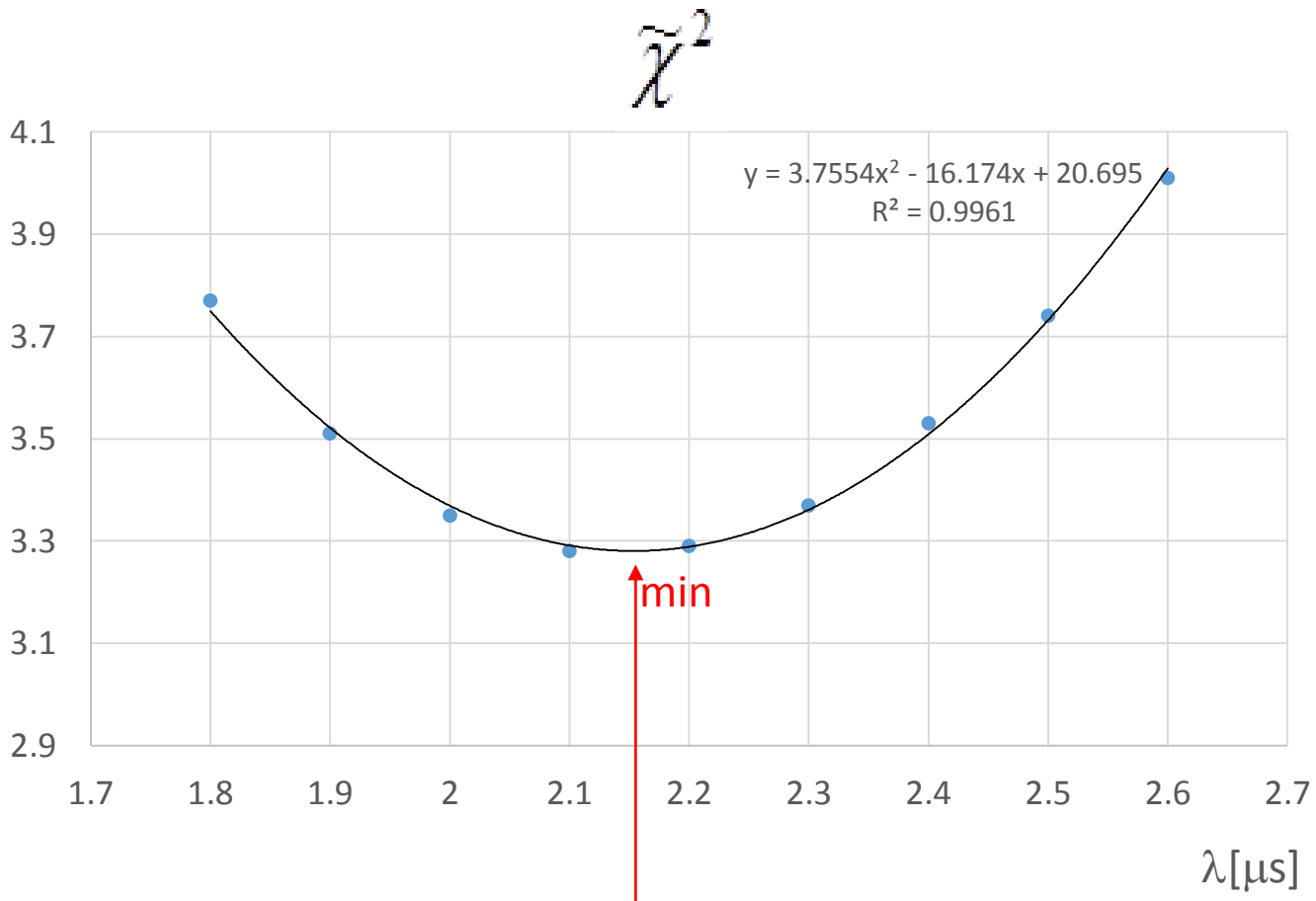






$$P_\lambda(n) = \frac{\lambda^n}{n!} e^{-\lambda}$$

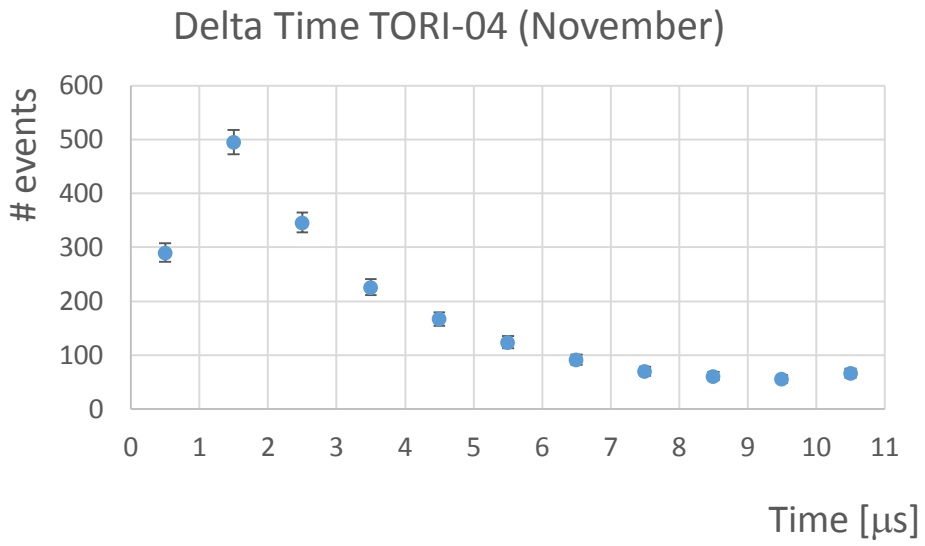


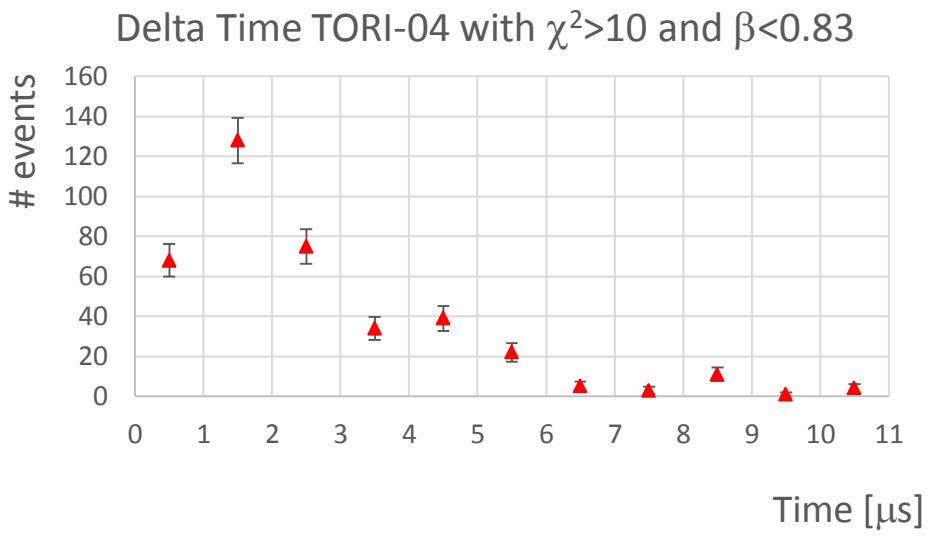


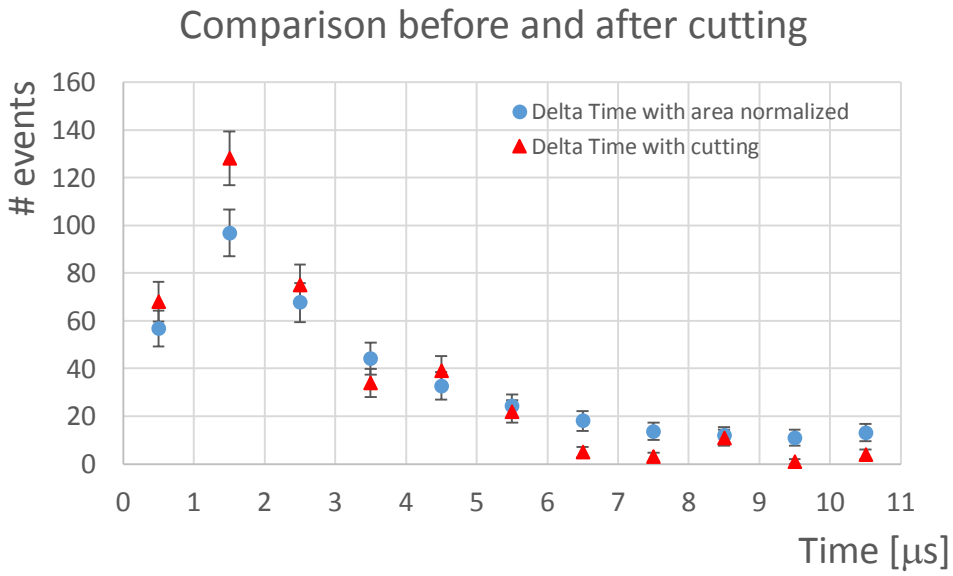
$$\tilde{\chi}_{\min}^{2} = 3.27$$

$$\tau = \lambda = 2.15 \pm 0.51\ \mu s$$

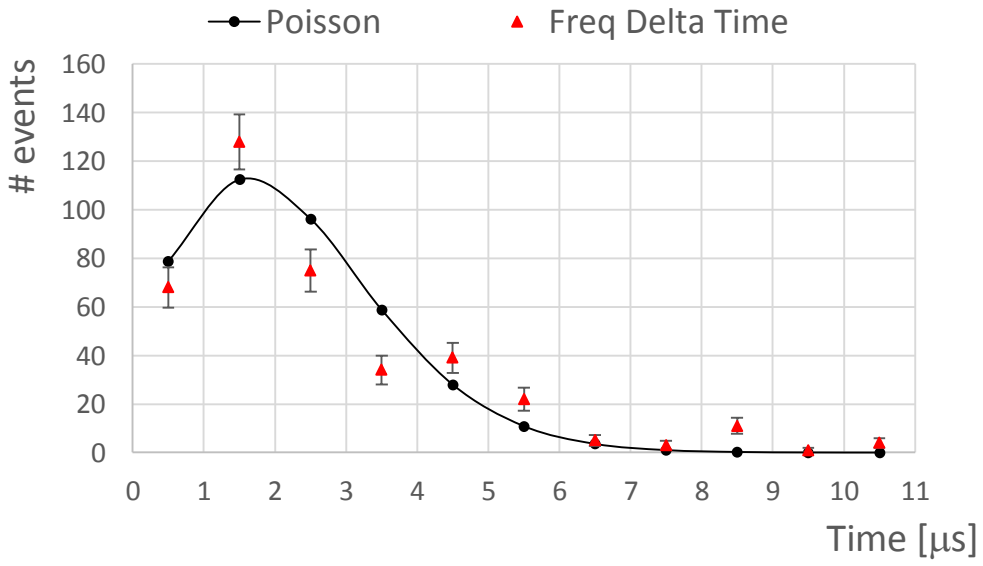
TORI-04

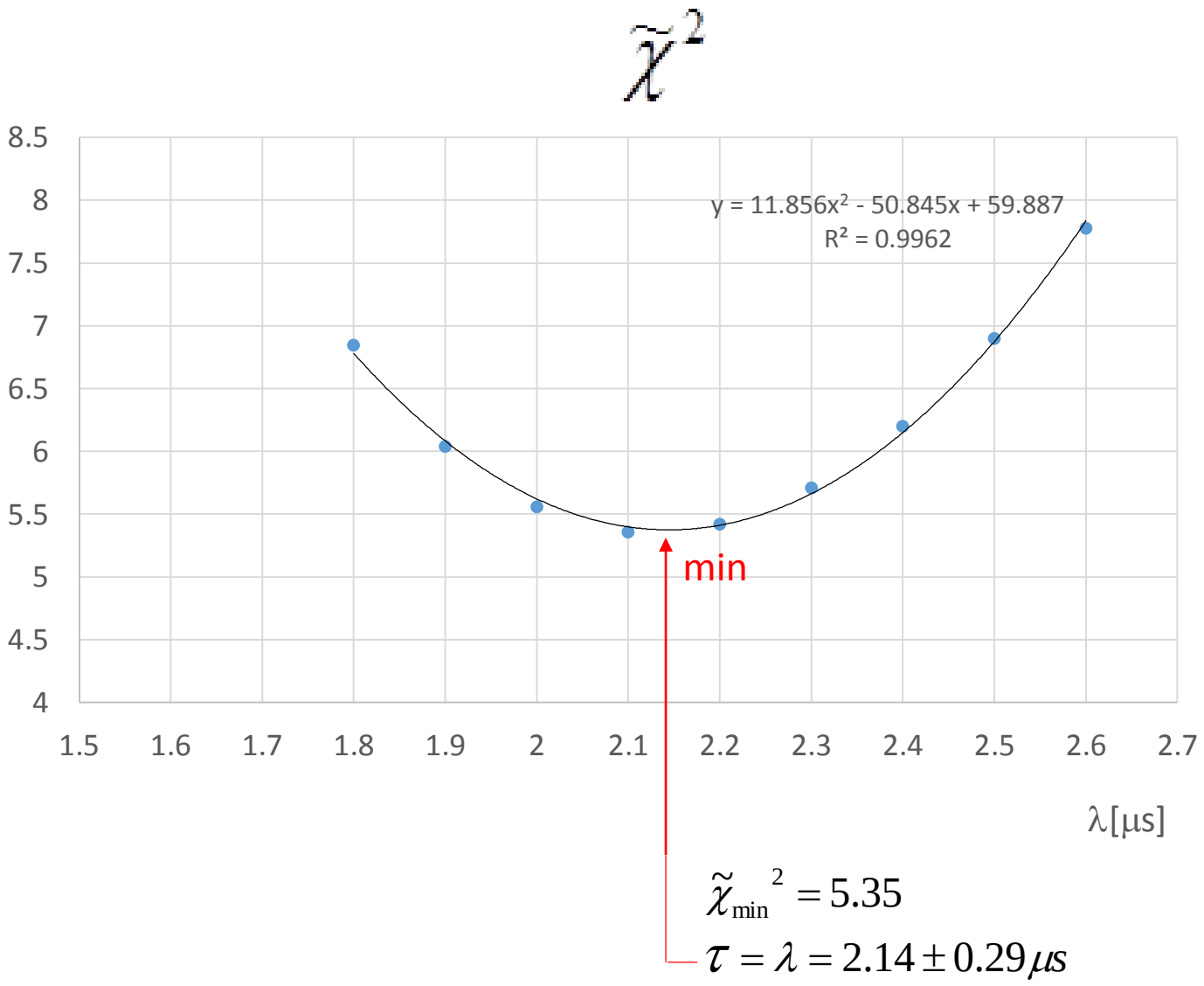






$$P_\lambda(n) = \frac{\lambda^n}{n!} e^{-\lambda}$$

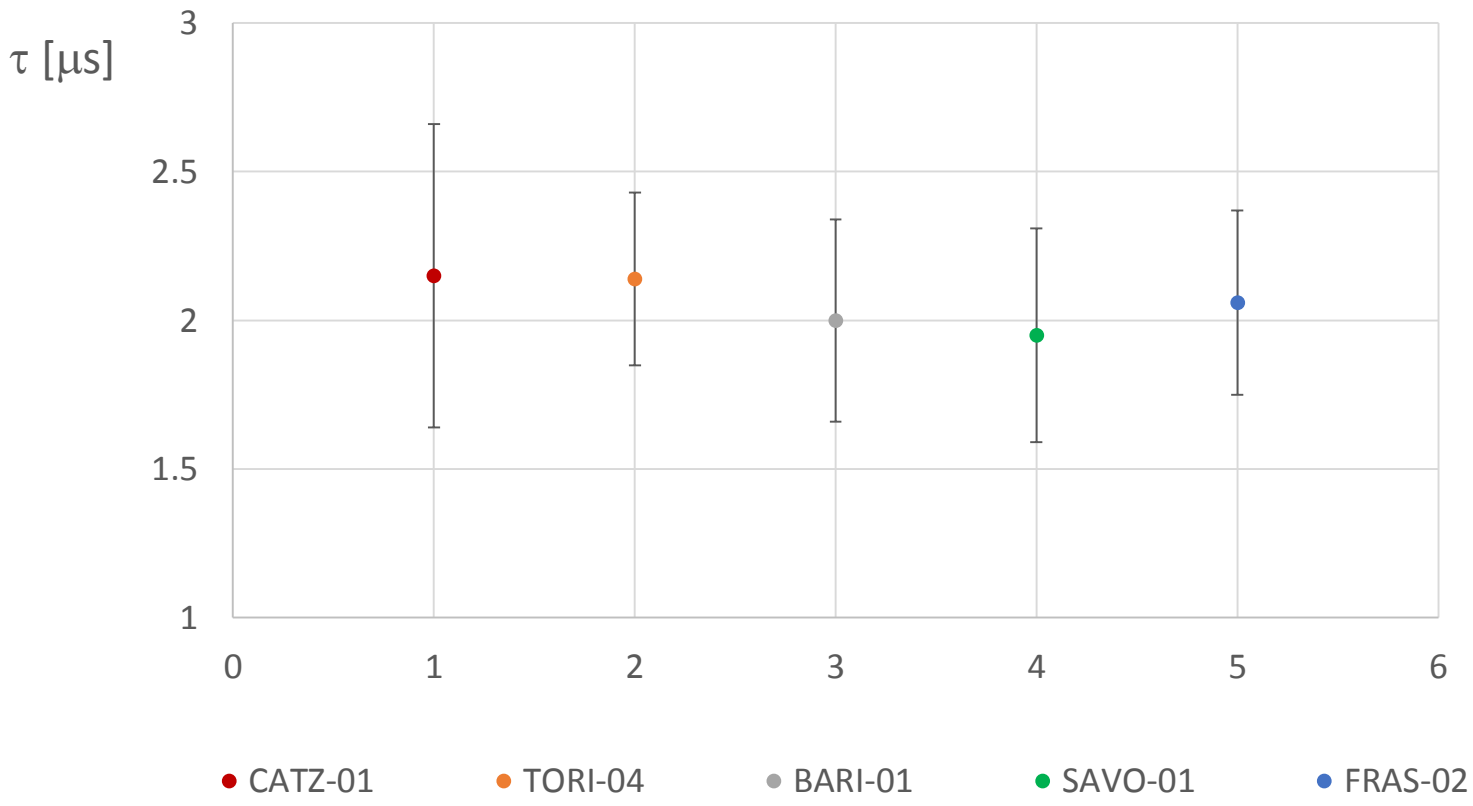



$\tilde{\chi}^2$
8.5
8
7.5
7
6.5
6
5.5
5
4.5
4
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
2.3
2.4
2.5
2.6
2.7
y = 11.856x² - 50.845x + 59.887
R² = 0.9962
min
λ[μs]
$\tilde{\chi}_{\min}^{2} = 5.35$
$\tau = \lambda = 2.14 \pm 0.29 \mu s$

Analysis Results

	Events after cutting	τ [μs]	$\tilde{\chi}^2$
CATZ-01	143	2.15±0.51	3.27
TORI-04	390	2.14±0.29	5.35
BARI-01	161	2.00±0.34	2.42
SAVO-01	215	1.95±0.36	4.49
FRAS-02	238	2.06±0.31	3.63

Conclusions



$$\tau_{best} = 2.06 \pm 0.15 \mu s$$

Short video of the stage at Ginevra CERN for the building of MRPC chambers of the cosmic rays telescope (EEE Project)

https://www.youtube.com/watch?v=ZlujnvaUrU4

EEE Liceo Scientifico Cariati

http://www.eeeliceocariati.altervista.org

Thanks for

Prof. Marco Schioppa

Dr. Ivan Gnesi

Prof. Domenico Liguori

Centro Fermi

!
Thank you
for your
attention!

Extreme Energy Events
Liceo Scientifico di Cariati

A study of upward going particles with the Extreme Energy Events telescopes

Nuclear Instruments and Methods in Physics Research A 816 (2016) 142–148

In order to investigate the parent–daughter scenario outlined at the beginning of this section, in Fig. 5 we restrict ourselves to the negative-β half-plane (that is, upward-going particles) and we plot the TDP as a function of the measured velocity of the *previous* event—i.e., the putative parent. It is clear that the small population of upward-going events with TDP ~μs in Fig. 4 is in a parent–daughter relationship with relatively slow down-going particles with $0.5 < \beta < 0.8$.

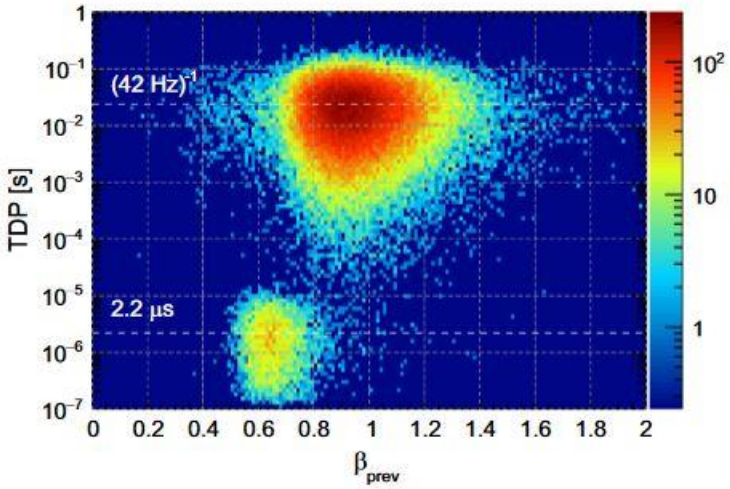


Fig. 5. Distribution of the TDP for our upward-going event sample (negative-β half-plane in Fig. 4) as a function of the measured β of the previous event (i.e., the putative parent). Note that the left half-plane is not shown, as the vast majority of the parent particles are downward-going.