OCRA report
Bari Group

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ICD2019 @Bari

Booklet per DESY

Abstract

Our activity consisted in the measurement of the cosmic ray rate as a function of the zenith angle, performed at sea level. We used a cosmic ray telescope composed by two scintillators read out in coincidence, which have been aligned with the zenith angle direction. In the following sections, we will discuss the experimental setup, the measurements, the data analysis and finally our results.

Experimental Setup

The experimental apparatus, shown in Fig.1, consists of a cosmic muon telescope, composed by a pair of plastic scintillators capable of emitting a luminous signal when charged particles go through them. Scintillators can be oriented with different inclinations to explore zenith angles from θ=0° (vertical muons) to θ=90° (horizontal muons). The light is then conveyed by the light guide into the photomultipliers, in which the photons are converted into electrons, and then multiplied to obtain the analog electrical signals. A converter transforms the pulses into digital signals, sending them to a computer, and an acquisition program in the LABVIEW language collects and records the data (see Fig.2).


Fig.1

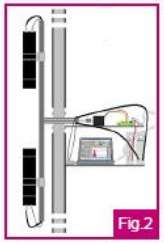
Fig.2

Analysis

We placed the plastic scintillators at different angles and performed two measurements (θ=0° and θ=30°) for a period of half hour. The muon rate is given by the number of detected particles divided by the measurement time. During the past weeks, six more measurements (2 hours long) were taken at other angles (7°, 15°, 45°, 60°, 75°, 90°). All measurements are plotted as a function of θ in Fig.3. It is worth noting that the associated errors get smaller with longer acquisition periods, according to Poisson's statistics. Finally data were collected in an Excel file, then exported to Python. Data between 0° and 60° were first fitted with a linear fit, then with following phenomenological function:

$$R = R_0 \cos^2(\theta) + K$$

Here we fit two parameters, R_0 and K, whose best-fit values are given in the pink box.

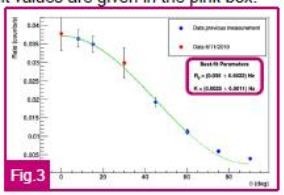
Fig.3

Results

We found that the linear function didn't fit the data properly, while the $\cos^2(\theta)$ function well fitted the data, as shown in Fig. 3. Moreover, we also tried to relax a third parameter, the index of the cosine, obtaining a value that is compatible with 2, in agreement with previous measurements found in literature.

INTERNATIONAL COSMIC DAY NOVEMBER 6 | 2019

Schools involved

1. Liceo Scientifico "Fermi" – Bari (BA)
2. Liceo Scientifico "C. Cafiero" – Barletta (BT)
3. Liceo Scientifico "Einstein" – Molfetta (BA)
4. Liceo Classico "Da Vinci" – Molfetta (BA)
5. Liceo Statale "Cagnazzi" – Altamura (BA)
6. Liceo Scientifico "Simone-Morea" – Conversano (BA)
7. Liceo Classico "De Sanctis" – Trani (BT)
8. Liceo Scientifico "Amaldi" – Bitetto (BA)
9. Liceo Scientifico OSA "Ferraris" – Molfetta (BA)
10. Liceo Scientifico "Salvemini" – Bari (BA)
11. Liceo Scientifico "Scacchi" – Bari (BA)
12. Liceo Classico "Flacco" – Bari (BA)

Group pictures

- Attività al **Dipartimento di Fisica** dalle 9 alle 14
- 31 studenti (16 femmine, 15 maschi)
  - Scientifico, Classico, ISTT
  - Terza (2), quarta (11), quinta (18)
- Call con DESY alle 13
- Kahoot: i primi 10 in classifica prepareranno una relazione entro il 12 gennaio 2020 per giocarsi la partecipazione allo stage OCRA

Nuovo detector per ICD 2020

- 60 barre di scintillatore estruso (1.0x1.5x20 cm) lette con fibra WLS (ϕ 1 mm)
  - 4 layer da 15 barre l'uno
  - Ogni fibra WLS è letta da un SiPM AdvanSid - ASD-RGB1S-P
  - I SiPM sono letti da due moduli CITIROC CAEN A1702 che permettono di realizzare differenti configurazione di trigger
- Costi
  - Scintillatori e fibre WLS gratis (grazie ad Erik Vallazza e Michela Prest)
  - 60 SiPM ASD-RGB1S-P ➔ 0,5 k€
  - 2 schede CAEN A1702 ➔ 5.0 k€
    - Finanziamento OCRA ➔ 1 k€ ☹
- In costruzione…