# Development of a muon measurement system

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Recently, the international press was caught up in the news of the existence of a fifth force derived from the interaction between muons. Uninterruptedly everything that exists on the planet's surface is crossed by muons that are formed from the interaction between cosmic rays with elements of the atmosphere. In addition to the scientific relevance of the study of muons, muography appears as a possible technological and commercial alternative in the analysis of materials and even industrial equipment [1]. However, understanding the interaction between muons and matter is relatively complicated even for modeling techniques such as Monte Carlo [2]. The detection of muons is of interest to astrophysicists and amateur astronomers alike. In both cases, dedicated circuits are used for this purpose. The simplest electronic circuits used in muon detection is made up of two overlapping Geiger tubes as shown in Figure 1 [3].

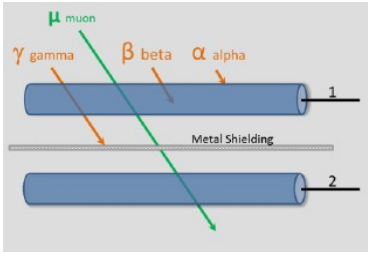


Figure 1. Behavior of the different types of radiation (alpha, beta and gamma) incident on two Geiger tubes separated by a metallic shield.

In order to study the absorption of muons by materials and the use of the muography technique in a more elementary stage in the industrial area, an electric circuit proposed that works by coincident detection of signals was chosen [3] and it was then assembled as shown in Figure 2 with the use of two Geiger tubes model 713 manufactured by the company LND, INC and two step-up voltage power supplies capable of supplying a minimum voltage of 500 V. In addition to these components and modules, a NodeMcu module will be included in order to serve as a data logger and remote data sending to a dedicated server. The power supply of the whole set is made by means of batteries of a set of the type power bank of 10.000 mAh.

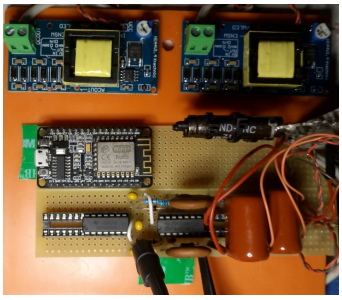

Figure 2. Built circuit picture

As expected, the detection of ambient radiation by one of the Geiger tubes can be seen in Figure 3, which is observed by the voltage measured in one of these Geiger tubes using a mini oscilloscope equipped with a high voltage tip.

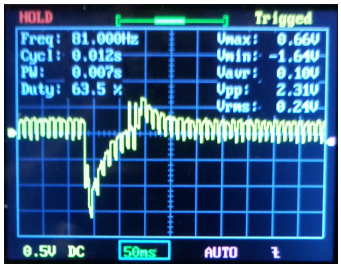


Figure 3. Oscilloscope screen photo

However, in Figure 3 it is also possible to notice the presence of noise in the measured signal. The suspicion is that the noise originates from the power supply.
The next step is to replace these with two other models of power supplies from the manufacturer XPPOWER-EMCO in order to reduce the noise of the signal conducted to the next stages of the circuit and that aim to record the practically simultaneous events of muon interaction the internal gases in the tubes. The intention is to achieve a significant reduction in noise that makes it possible to measure muons.

**References**

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