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# DESIGN OF A GAS EFFLUENT MONITORING SYSTEM FOR THE $^{18}$F PRODUCTION LINE

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## ABSTRACT

One way to measure gas effluent released in the operation of a Cyclotron during the production of $^{18}$F is to monitor its gas filtering system using fiber filters, which can be sampled after each operation cycle in order to measure photons produced in the annihilation of positrons from the $^{18}$F decay. The monitoring of these photons by singles spectroscopy, though, results in an overestimation in the calculation of the $^{18}$F, as the measured photons can also come from annihilation of background positrons, or in the decay of other radionuclides that may have been produced and got trapped in the fiber filter.

A safe way to make this measurement more accurate consists in the use of the gamma-gamma coincidence spectroscopy technique. A detection system of this type can eliminate the influence of unwanted events, as the system's logic only accepts coincident photons, emitted in a time interval smaller than the time resolution of the system. As in the annihilation process two 511keV photons are produced simultaneously, the quantification of the coincidence rate between these two gamma rays can be used to measure the amount of $^{18}$F trapped in the fiber filter.

In the present work, the project of a simple, low-cost system developed exclusively for this type of measurement is described.

## 1. INTRODUCTION

$^{18}$F is an important radioisotope produced in a Cyclotron and used in the diagnosis of illnesses of the brain and heart through technique PET (Positron Emission Tomography). During the production of $^{18}$F, the Cyclotron releases gas effluent that are filtered through of fiber filters, which can be sampled after each operation cycle in order to measure photons produced in the annihilation of positrons from the $^{18}$F decay. The monitoring of these photons by singles spectroscopy, though, results in an overestimation in the calculation of the $^{18}$F, as the measured photons can also come from annihilation of background positrons, or in the decay of other radionuclides that may have been produced and got trapped in the fiber filter.

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The project of this monitor is based on the electronics of a multipurpose coincidence circuit, used for measures of annihilation radiation[1]. However some electronic modules (amplifiers, TSCA´s, coincidence and pulse counter) used in the conventional arrangement had been reduced in a just one circuit. This simplified circuit provides the counting and the measurement of the rate of coincidences between two radiations of same energy, same origin, emitted in the same instant. The result is a low-cost system developed exclusively for this type of measurement, mainly if we applied scintillation plastic detectors to the detection of the annihilation radiations.

## 2. GENERAL DESCRIPTION OF THE $^{18}F$ MONITOR

A block diagram of the electronic circuit of the $^{18}F$ monitor is shown in fig. 1. The $^{18}F$ monitor is adapted to two scintillators detectors (DET1 e DET2) duly polarized (HV). The detectors are arranged in a planar configuration with 180º between them perpendicularly to the filters. The signals from the photomultipliers (PM) are amplified and applied to the inputs of the $^{18}F$ monitor. Two identical amplifiers (AMP) of the input circuit shape the energy signals. Two single channel analyzers (SCA) select the 511 keV energies for each gamma, furnishing an amplitude signal for a coincidence circuit (AND). The output pulse is the clock of a digital counter (CONT). The display indicates the counting in time or the rate of coincidence pulses (TIME). Four exits (OUT1 - OUT4) allow the visualization of the energy signals. One another exit (OUT5) shows the coincidence signal. The adjustment of the gain of the amplifiers and the window of the single channel analyzers is possible by four trimpots.

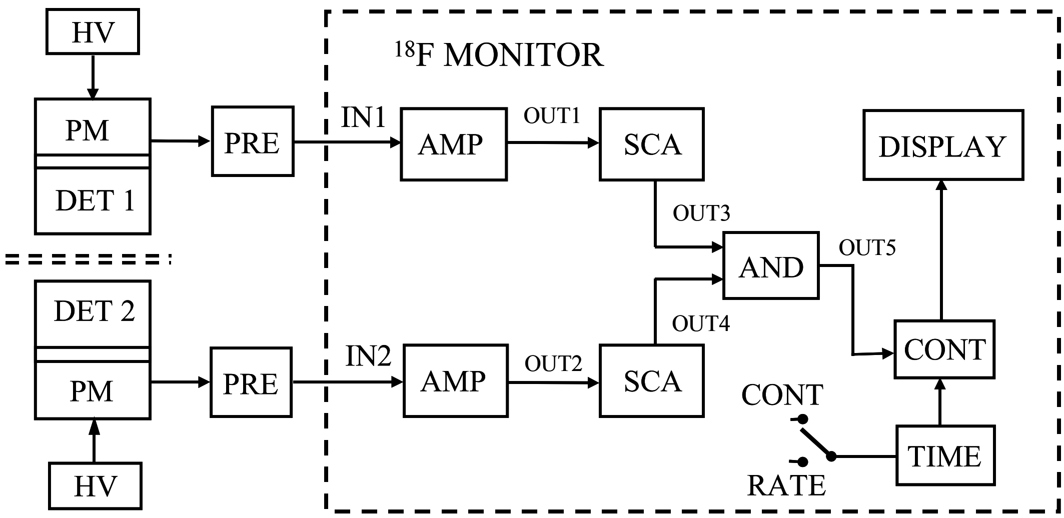


**Figure 1. Block diagram of the electronic circuit of the $^{18}F$ monitor.**

## 3. CONCLUSIONS

A $^{18}F$ monitor project was presented. This circuit, when assembled, will be used in the measurement of effluent gas released in the operation of a Cyclotron during the production of $F^{18}$. Some advantages of this project are: low cost (estimated in US$ 150,00), simplicity and versatility in comparison to a traditional system of coincidence measurement. The prototype will be developed at the IPEN laboratories in collaboration with CRCN/CNEN-PE.

## REFERENCES


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