

Summer 2020 online learning initiative remote project :

Determination of the gamma current at GIF++ from MM electrical current measurements

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1 Introduction

The MicroMegas chambers for Atlas New Small Wheel upgrade are submitted to a series of meticulous tests. At the GIF++ facility the stability of the chambers is tested in a condition of gamma irradiation produced by the a Cesium 137 source with a dominant decay mode at 662 keV.

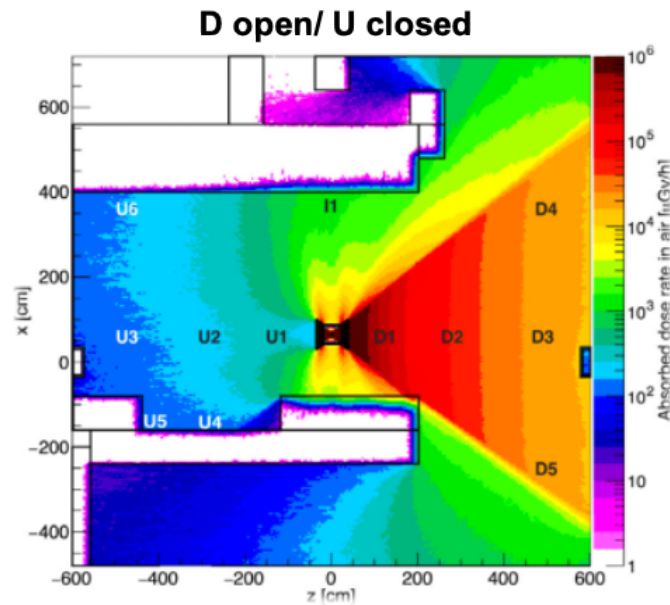


Figure 1: GIF++ gamma irradiation at different positions.

This chambers are subjected to an elevated gamma flux which provoke discharges inside the gas gaps. My summer student project was to evaluate, through the simulation of the MM chambers, the gamma current and the stability.

2 Simulation

In order to perform the simulation, the framework Geant4 was used. I have simulated a sample of the quadruplet as in figure 2 with some simplifications for some materials.

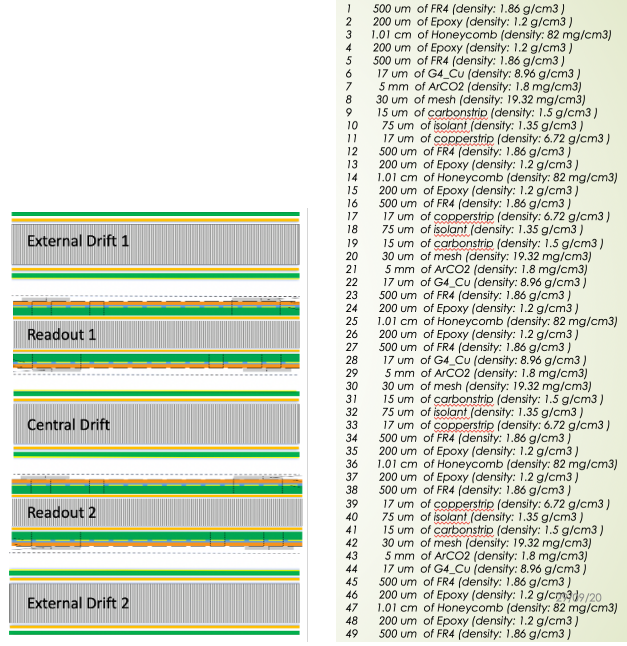


Figure 2: Left: The MicroMegas layers. Right: all the material simulated with Geant4.

The sample is an area of 9 cm x 9 cm where the gamma flux generated is distributed in a 1 cm x 1 cm surface which is centered in the bigger one as in figure 3 .

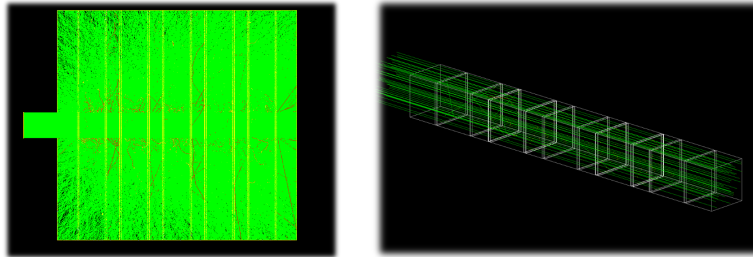


Figure 3: Left: Lateral section of the simulation where all the gammas (green lines) are centered in the 1x1. Right: Simulation of the 1x1 sample used for the leakage evaluation.

This is because of the leakage of particles from the lateral side of the detector. By doing the ratio between the energy deposited in the 1x1 and the one in the 9x9 I could evaluate that almost the 40% of the particles ended out of the 1x1.

From the energy deposited in the four gas gaps given by Geant4 (Figure 4), it was possible to determine the gamma current and compare it with the value given by the test.

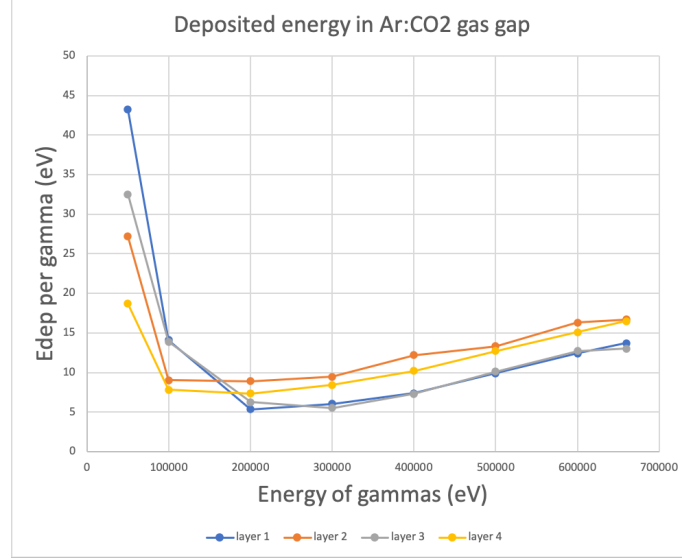


Figure 4: Energy deposited in the four gas gaps.

The simulation underline a pattern in the data of the energy deposited with the even layers (2 and 4) that have an higher deposit than the odd ones (1 and 3). This behavior is due to the presence of an high concentration of gamma reflected from the following layers. In addition, the reason because the even layers are the one with high energy and not the odd ones is due to the presence of the readout panels which absorb more energy than the drift panels because they have more materials that could stop reflected gammas before they can enter the gas gap.

3 Conclusions and Additional

This kind of approach finds confirmation in the data and underline the presence of secondary effects that cannot be underestimated. For that reason it will be extended to the study of the behavior of the RPC system. Simultaneously, I have developed a program with Root that produce automatically reports for both BB5 and GIF++. From the data of each sector, this program produce a complete report of current and tension of the quadruplets and it can count the number of current spikes during both the tests. With better current value it will be possible to improve the comparison of the simulation with the real data while it provides useful reports to all.

This software was used on quadruplets already tested in order to eventually tweak it and as soon as possible it will be tried on new data in order to be implemented as part of the test process.