



23 August 2024

correlation of the intensity of the MMG detector in ATLAS with the luminosity of the LHC.

AISSATA LY

Supervisor: Dr.Dialo Boye

Summary

In this work, we studied the evolution of the current delivered by an ATLAS micromegas detector (MMG) over a 24-hour period, in relation to its luminosity. We took a module with 5 PCBs and 4 layers.

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1 Introduction

ATLAS is a gigantic particle detector used to observe the particle collisions produced by the LHC. ATLAS is designed to explore a wide range of physical phenomena. It is made up of several layers of sub-detectors that analyze the different properties of the particles created in the LHC's high-energy collisions. These sub-detectors include a trace detector, calorimeters and a muon spectrometer.

The muon spectrometer is a Micromegas detector designed to record muon trajectories with high spatial and temporal accuracy.

In this project, we are studying the variation of the recorded current intensity as a function of the luminosity of the LHC for a module composed of different layers.

In the first part we study how intensity follows luminosity for one layer across the 5 PCBs. Then in the second part we'll see how current is put into the 4 layers for a given PCB.

2 Presentation of MMG of ATLAS

The Micromegas (Micro-Mesh Gaseous Structure) detector plays a crucial role in the ATLAS experiment at CERN as part of the New Small Wheel system (NSW). there are 16 sectors in each NSW : 8 small and 8 large.

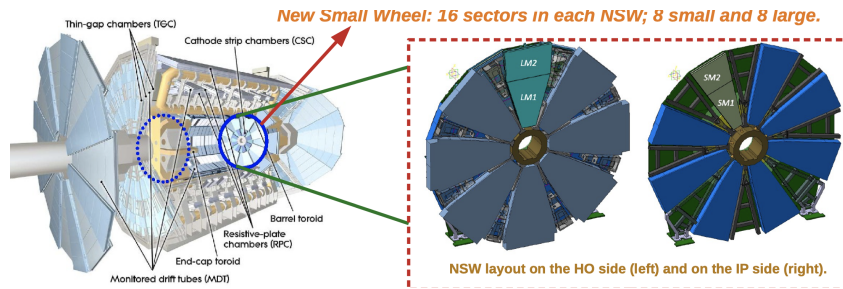


Figure 1: NSW

In each sector we have two MMG between two sTGC as shown in figure 2

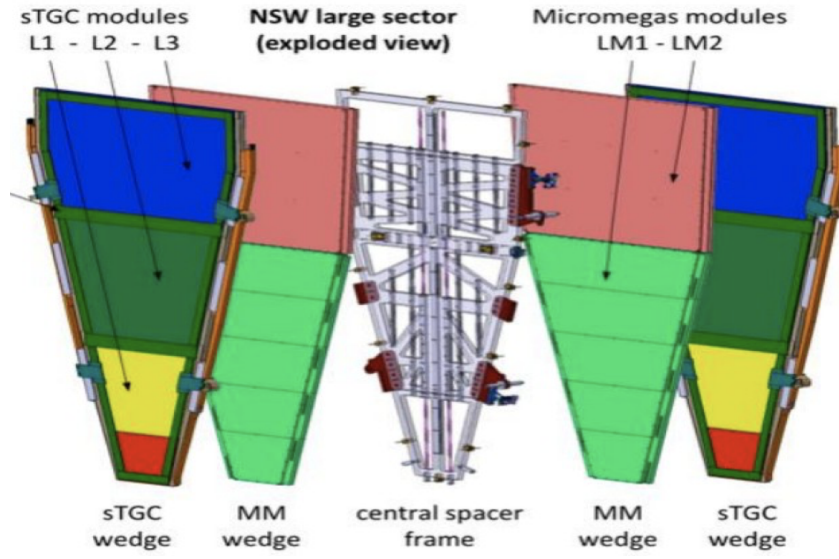


Figure 2: sector of NSW

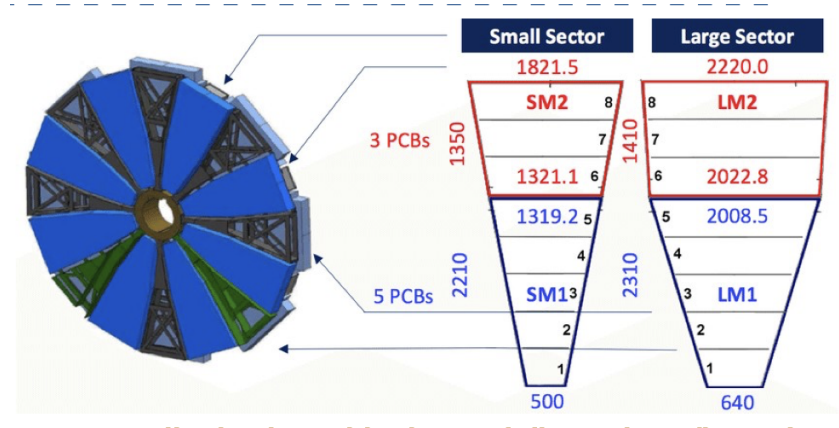


Figure 3: MMG

Each sector of micromegas is divided by two the red part that has 3 PCBs and the blue part has 5 PCBs.

3 comparison of different plots on a module

In this project, we have taken as an example a module from the sector shown in blue in figure 3 called EIZ2R1A04 . This module is made up of a readout panel and a drift panel. For the readout panel, we have 5 PCBs in each of the module's 4 layers.[1]

3.1 intensity variation for a layer across the readout panel and drift panel

As we have 4 layers, we therefore have 4 scenarios, for each of which we plot the current intensity in the readout panel and the drift.

The screenshot shows the DDV tool interface with the following configuration:

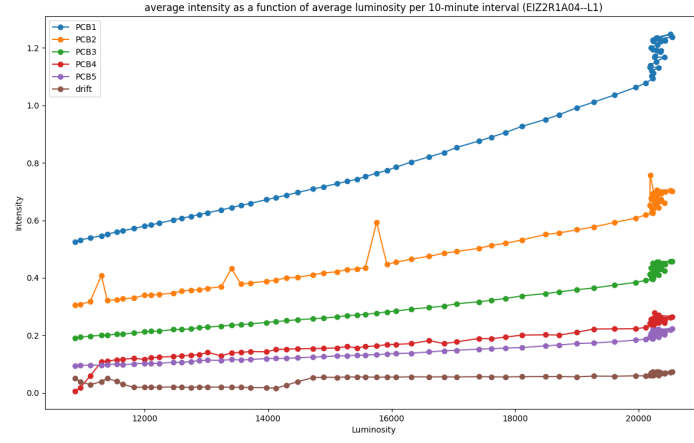
- Data Selection:** Data, Alarms, Log, Descriptor, Element name, Alias.
- Select Period:** Start Time: 2024-07-21 15:40, Stop Time: 2024-07-22 13:31.
- Select Hours Period:** Last Hours: 24.
- Filters:** Select Invalids, Select NaNs, Use RdbAPI, Local Time, UTC Time.
- Navigation:** Search, Configure Data Request, Show Deleted Elements, Metadata History, System Archiving Rate, DPE Archiving Rate.
- Table:**

AFP	ATLMMGELTXA	MMG	HV	A	EIZ2R1A01	Drift	L1	PCB1	CalibrationError
CSC	ATLMMGELTXC		STG		EIZ2R1A02	RO	L2	PCB2	On
DCS	ATLMMGHVA				EIZ2R1A03		L3	PCB3	OverCurrent
DSS	ATLMMGHVC				EIZ2R1A04		L4	PCB4	OverVoltage
IDC	ATLMMGLVA				EIZ2R1A05		Layer1	PCB5	OverVoltageProtection
IDSR	ATLMMGLVC				EIZ2R1A06		Layer2		PowerFail
IS	ATLMMGSCS				EIZ2R1A07		Layer3		Status
LAR					EIZ2R1A08		Layer4		TemperatureError
LARSR					EIZ2R1A09				Tripped
LUC					EIZ2R1A10				UnderVoltage
MDT					EIZ2R1A11				Unplugged
MMG					EIZ2R1A12				IMon
MUO					EIZ2R1A13				readBackSettings
- Table with 4 columns:** id, Delete, Configuration, History Track.

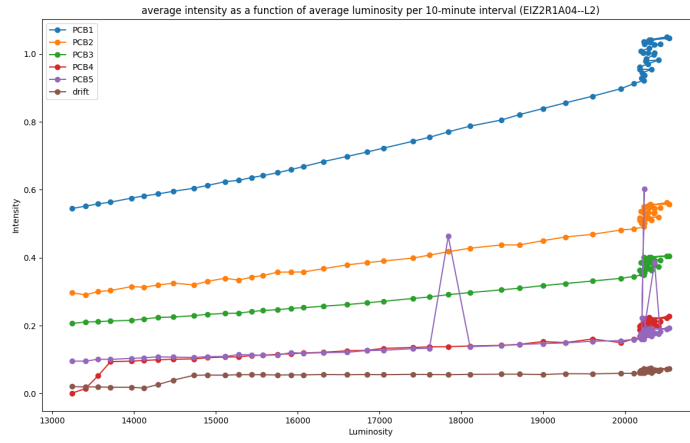
id	Delete	Configuration	History Track
MMG HV A EIZ2R1A04 RO L1 PCB1 iMon	[Delete Icon]		[History Icon]
MMG HV A EIZ2R1A04 RO L1 PCB2 iMon	[Delete Icon]		[History Icon]
MMG HV A EIZ2R1A04 RO L1 PCB3 iMon	[Delete Icon]		[History Icon]
MMG HV A EIZ2R1A04 RO L1 PCB4 iMon	[Delete Icon]		[History Icon]
MMG HV A EIZ2R1A04 RO L1 PCB5 iMon	[Delete Icon]		[History Icon]
- Query Data As:** Text file, Query Data, Clear Selected Items.
- Selected Items:** 5

Figure 4: collecting data from the DDV tool

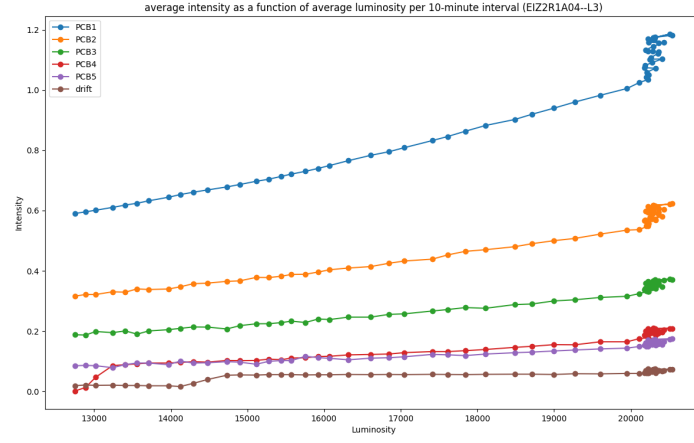
This tool enables us to collect data on both intensity and luminosity over a given period.



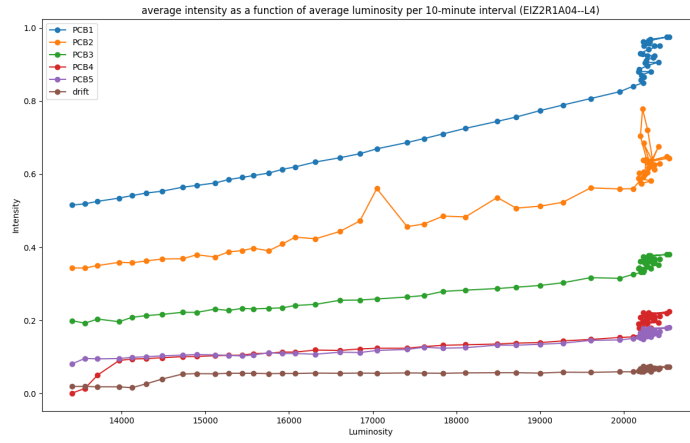
(a) Figure 1



(b) Figure 2



(c) Figure 3



(d) Figure 4

What we notice from these figures is that the intensity in PCB 1 (in blue) dominates in all layers, then decreases as we move from PCB 1 to PCB 5. However, the plots have almost the same behavior in all 4 figures. The intensity in the drift panel remains low compared to the others.

3.2 Following the current intensity through the different layers for a given PCB

In this section, we study the variation in the current intensity across the 4 module layers for each PCB.

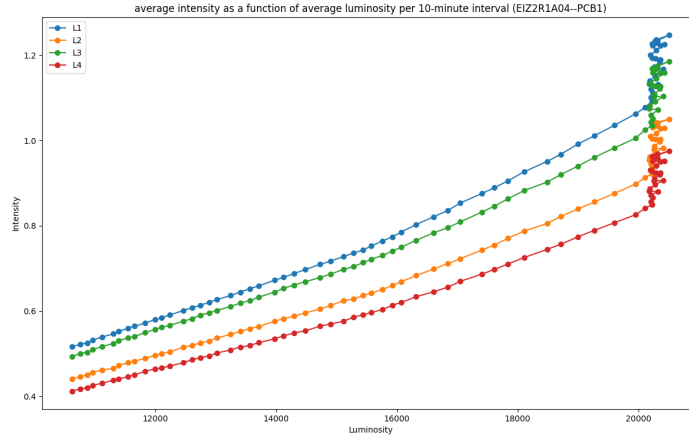


Figure 5: current in the PCB1

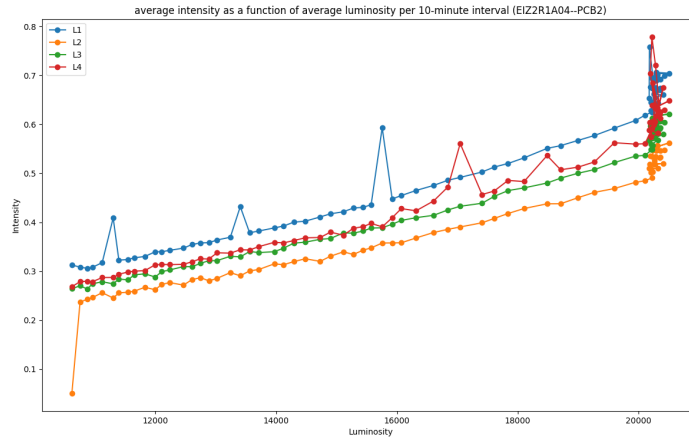


Figure 6: current in the PCB2

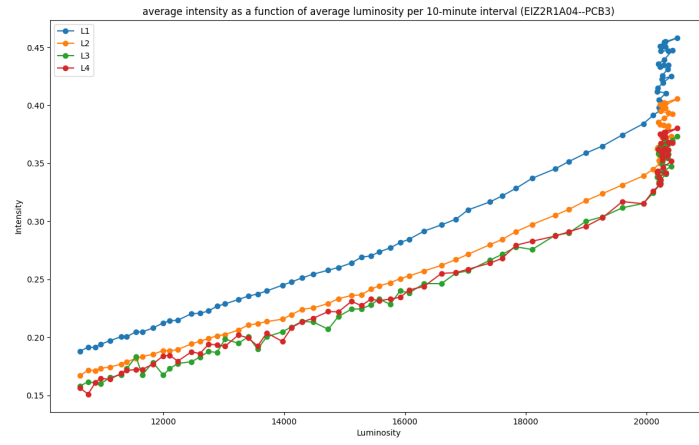


Figure 7: current in the PCB3

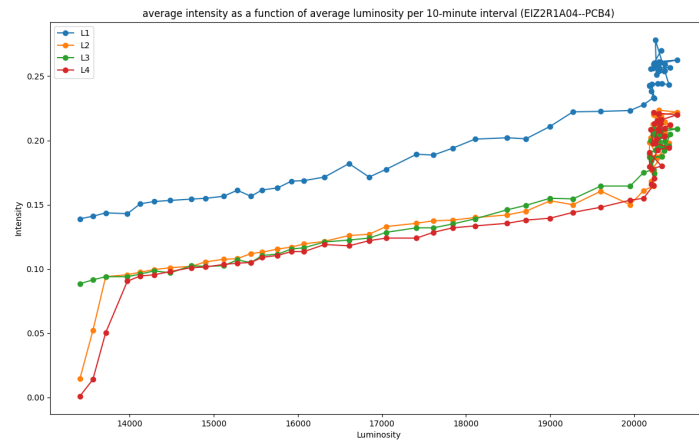


Figure 8: current in the PCB4

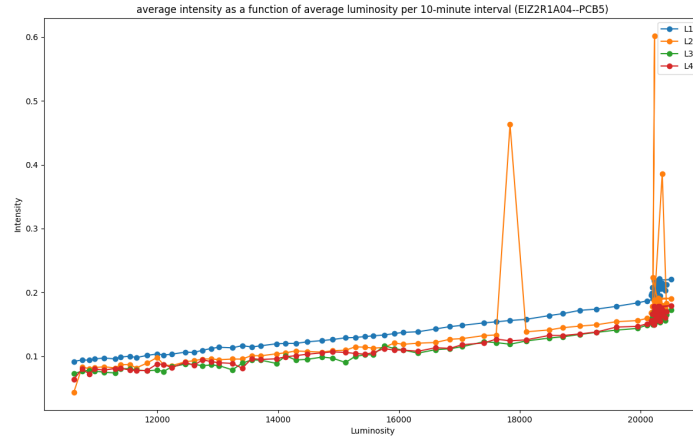


Figure 9: current in the PCB5

We note that the intensity of the current is highest in PCB1 and decreases towards the other PCBs.

4 Conclusions

The first 4 cases we observed show a good increase in intensity with increasing luminosity, suggesting that more particles interact with the detector as luminosity increases. In addition, the last 5 figures show that particles interact most in the first layer of a module.

References

- [1] Manisha Manisha. The Micromegas detectors for ATLAS New Small Wheel upgrade. Technical report, CERN, Geneva, 2020. 14 December, 2020: Conference start date.