

Gas detector in **ATLAS** experiment

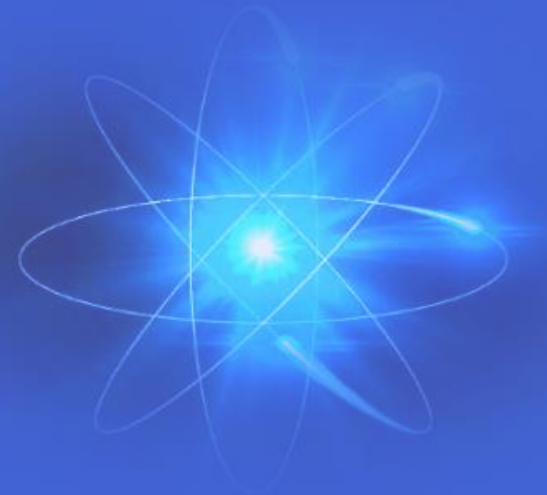
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ITALIAN HSSIP 2022



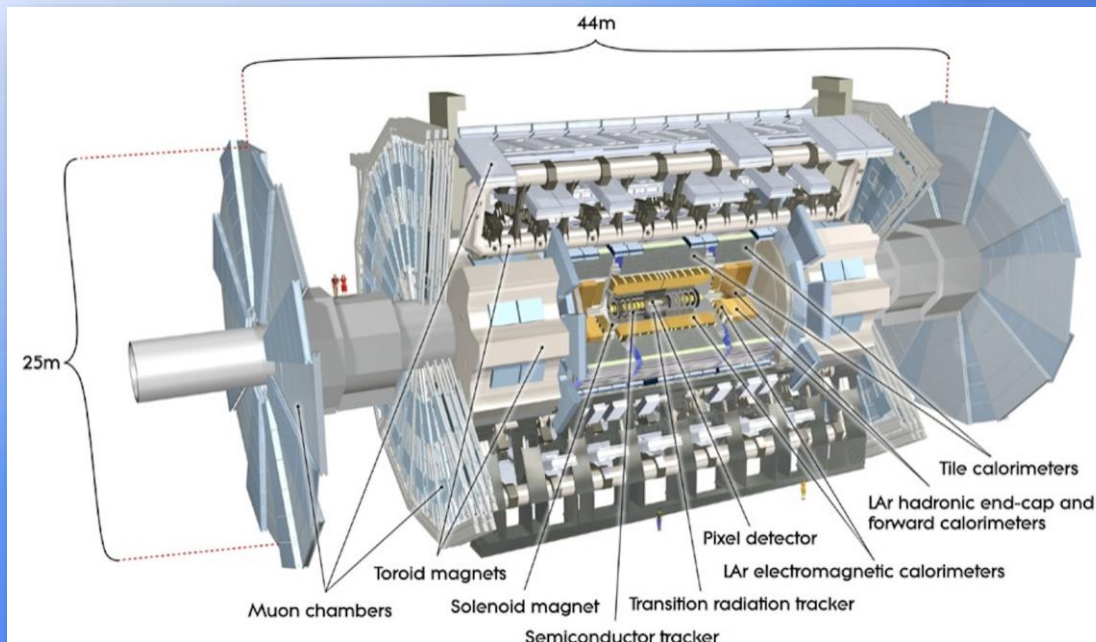
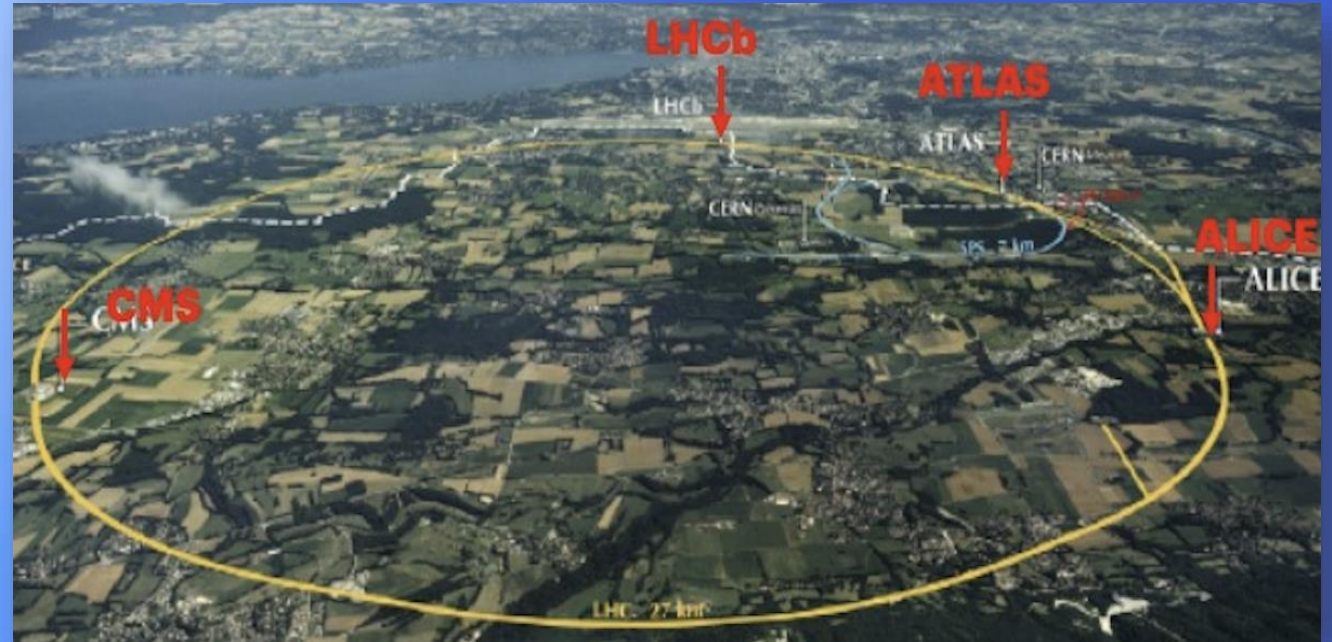
Overview

- LHC and the ATLAS experiment
- Detector used: *Micromegas*
- Measurement of the *Gain*
- Collection of the *Data*
- *Data Analysis*
- *Conclusions*

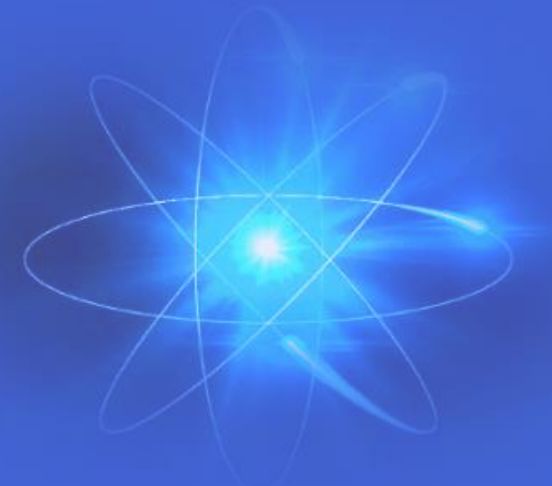


LHC AND ATLAS EXPERIMENT

LHC is the Large Hadron Collider, with a diameter of 27 km. One of its collision point is where the ATLAS experiment lies



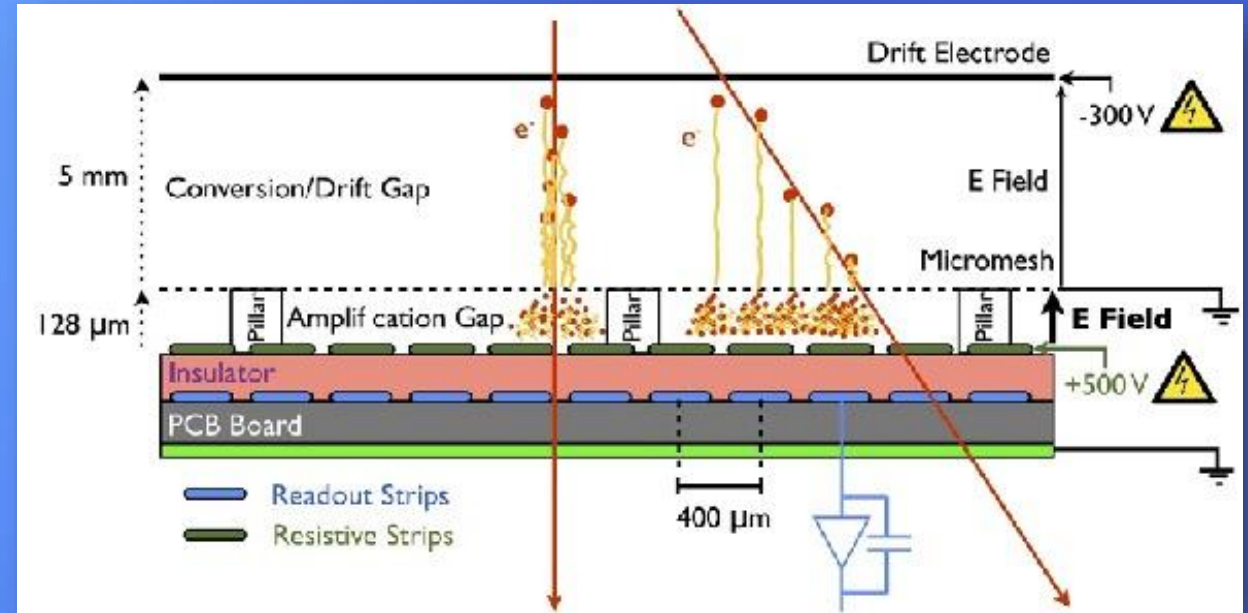
ATLAS (A Toroidal LHC ApparatuS) is a general purpose experiment. It consists in several different detectors, including trackers, calorimeters and the muon spectrometer system.



Micromegas

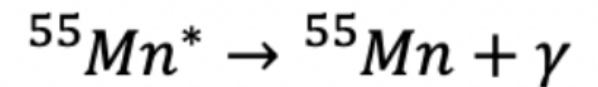
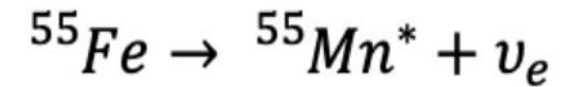
‘Micro Mesh Gaseouse Structure’

- **Micro pattern** gas detector with 1024 read-out strips
- It contains **Argon (Ag)** and **Carbonic Dioxide (CO₂)** that come in different proportions
- It is made of **3 planes**: the drift electrode, the mesh and the read-out strips
- It detects particles with a **high spatial precision**

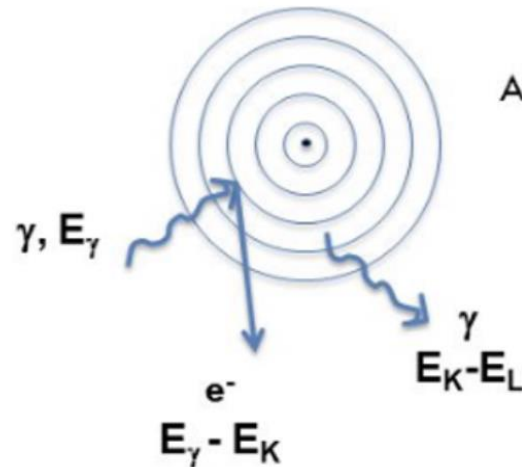


THE RADIOACTIVE SOURCE

- The ^{55}Fe is the radioactive source used.
Since it is instable, it decades in ^{55}Mn
- The physics process that happens inside the chamber is the following: when the **photon** enters the **drift region** it ionizes the gas and forms an **electron-ion** couple

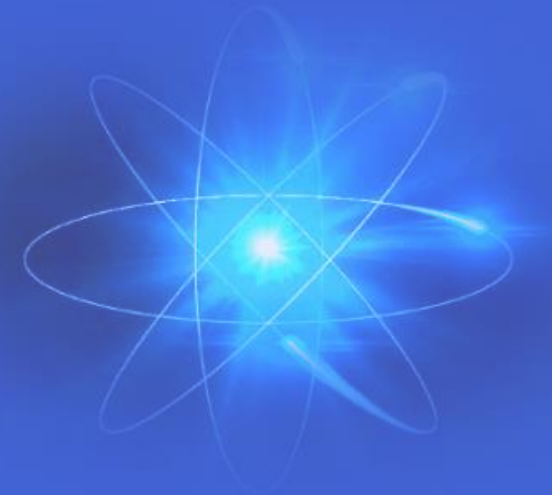
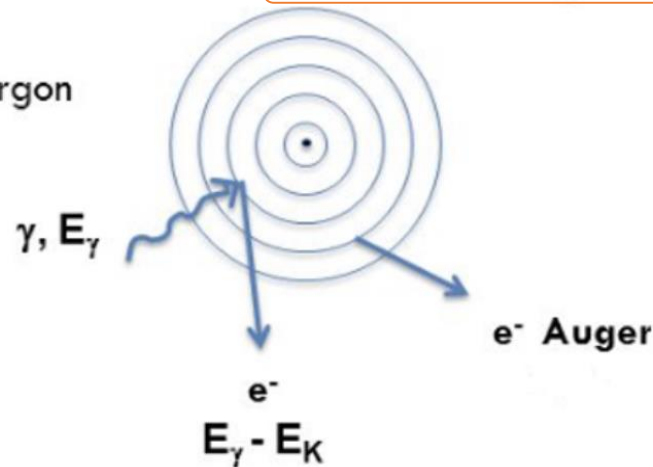


fotoelettrico+fluorescenza : 15%



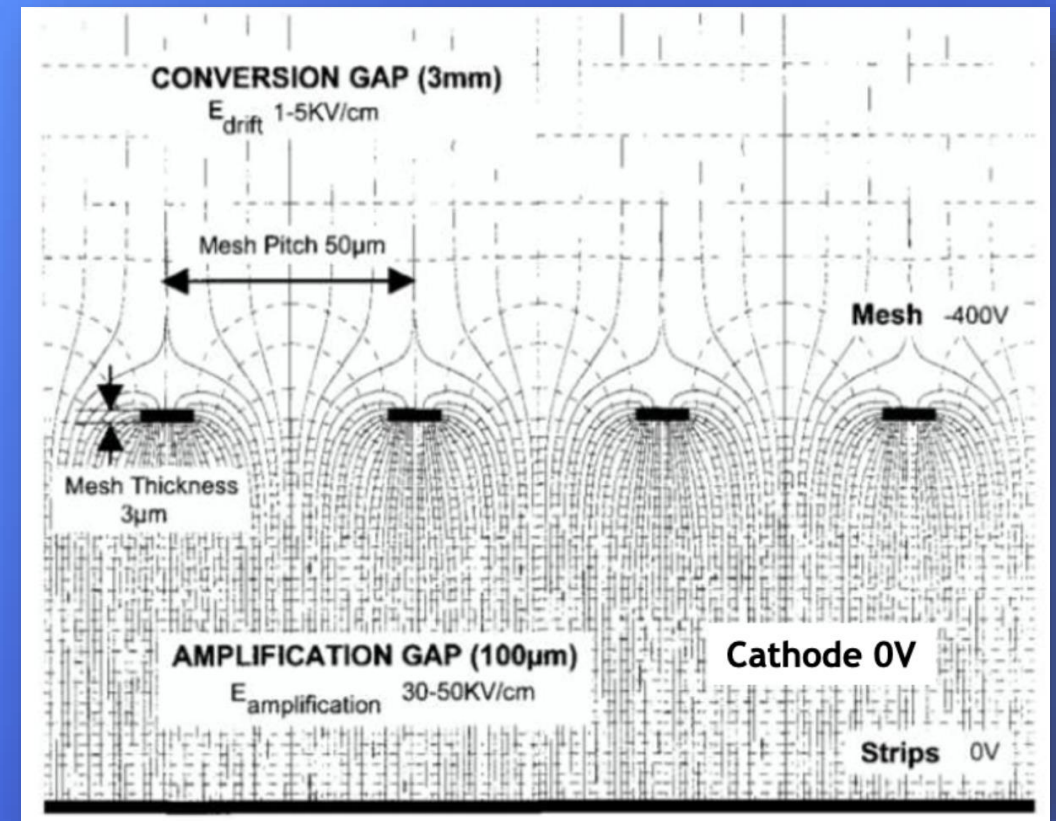
Atomo di Argon

fotoelettrico+Auger : 85%



The electric field

Once the electrons are in the **amplification region** additional electron-ion couples are formed so an **electron avalanche** is created because of the strong acceleration of the particles due to the electronic field.



The gain measurement

- The **gain** is the multiplicative factor of the **primary ionization charge**
- The gain depends on **electrical fields ratio** between the two regions, therefore it can be measured as the ratio of the voltage provided to the drift and read-out plans

$$\bullet \quad \text{Gain} = \frac{N}{N_0}$$

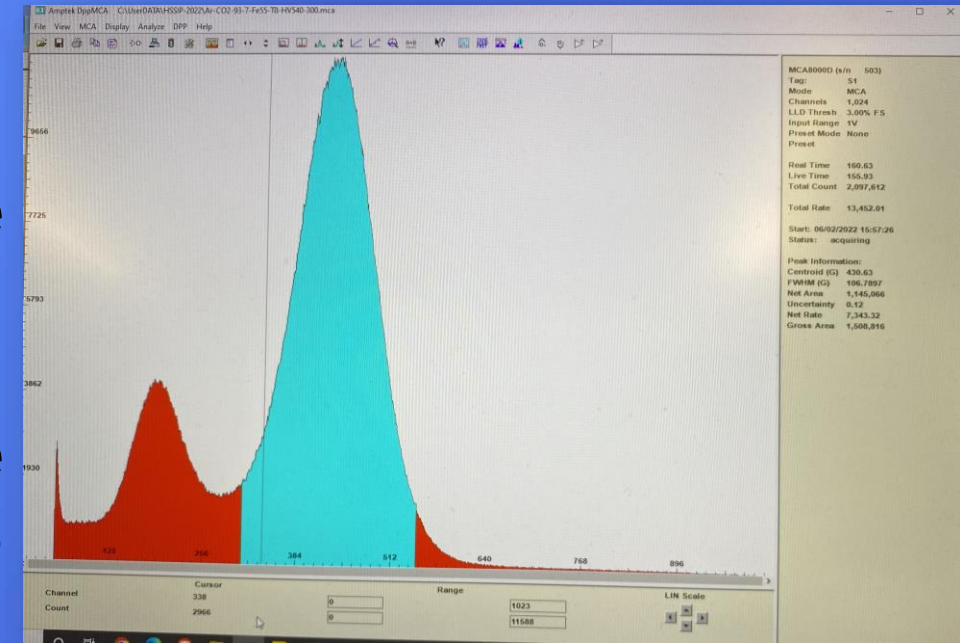
N₀ stands for the number of the primary electron-ion couples in the drift region

N stands for the number of electrons that are formed in the amplification region



Collecting data

- By fixing the drift voltage to **-300 V** the read-out voltage has been changed with steps of 10 V
- Four different proportion of gas were used: **Ag 93%- CO2 7%, Ag 90%-CO2 10%, Ag 85%-CO2 15%, Ag 80%- CO2 20%**
- For every proportion it has been measured the signal corresponding to the **Auger effect**
- Then the gain trend as a function of the read-out voltage has been calculated

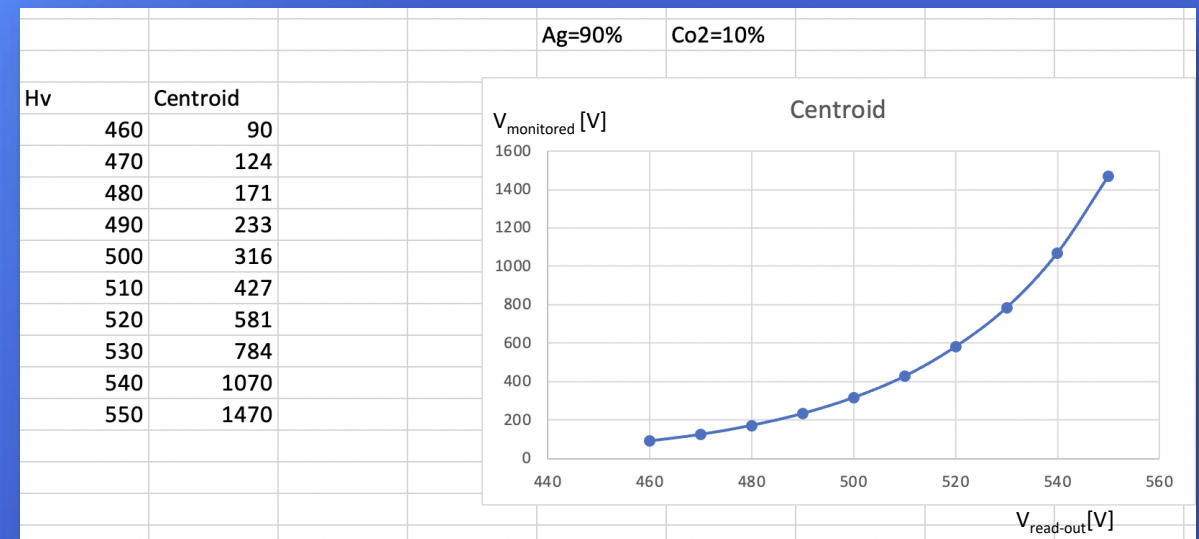
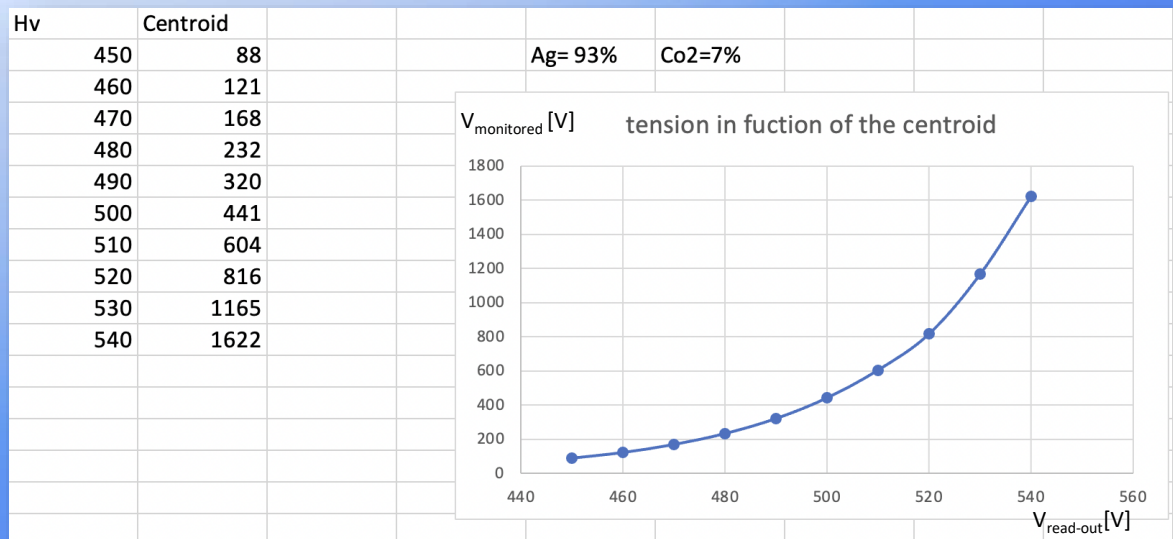


Data analysis

The data have been collected with a software used in the laboratory and analysed with Excel.

The analysis has been done in two different ways:

1. **Manually**, measuring the average value of the read signal

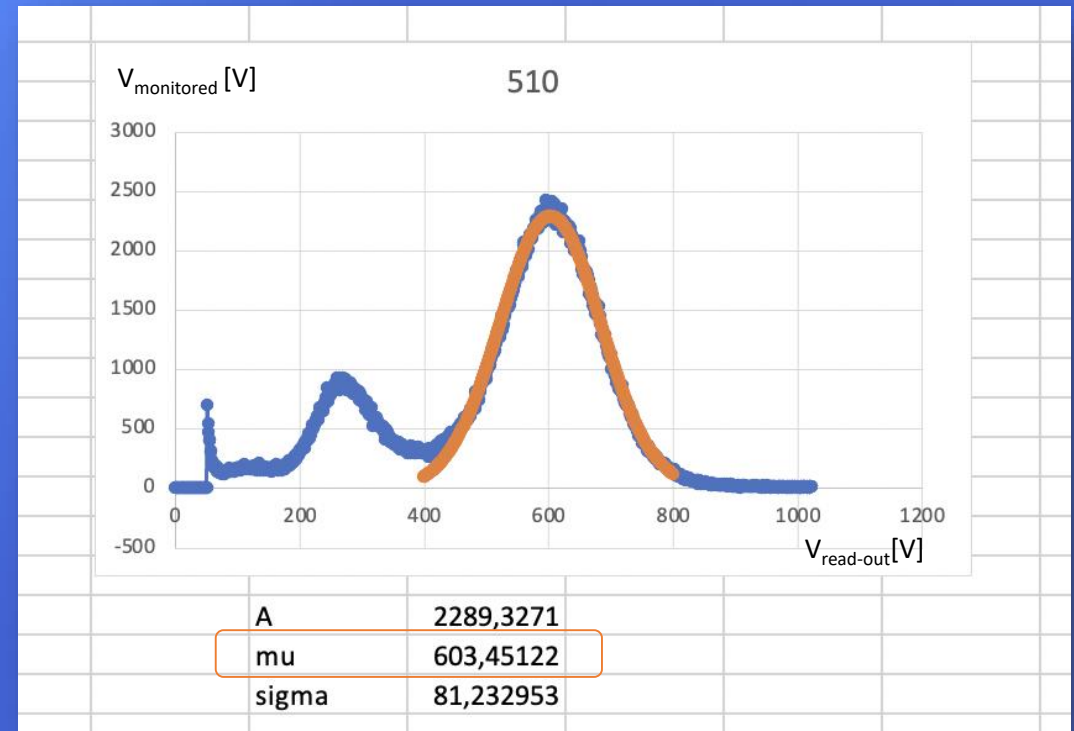


Data analysis

2. In a **mathematical** way, by fitting the signal with a gaussian function

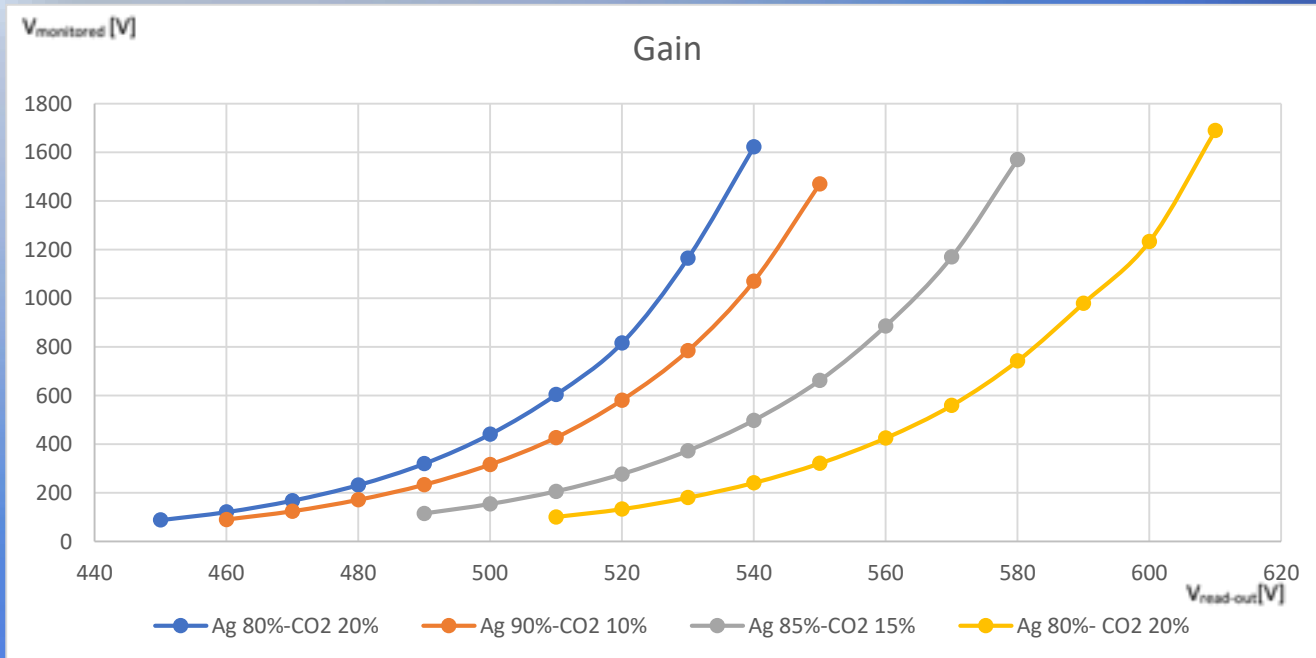
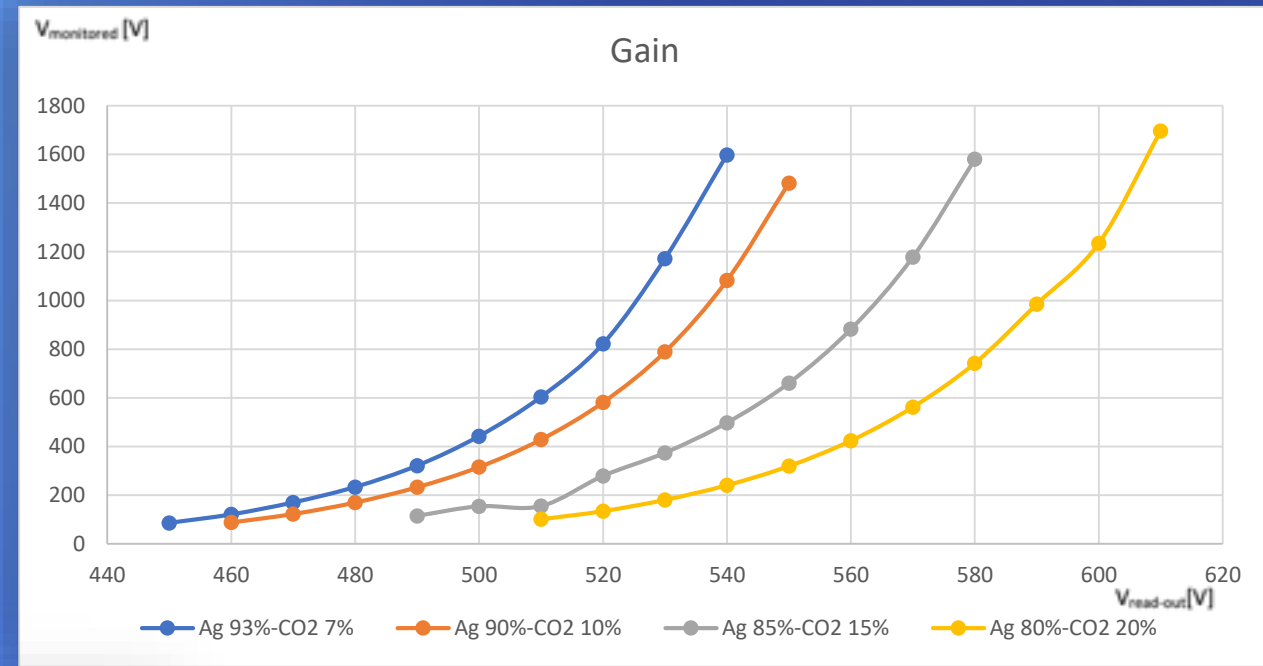
$$A e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Then the best fit of every gaussian function has been calculated and the mean parameter has been used for the gain calculation



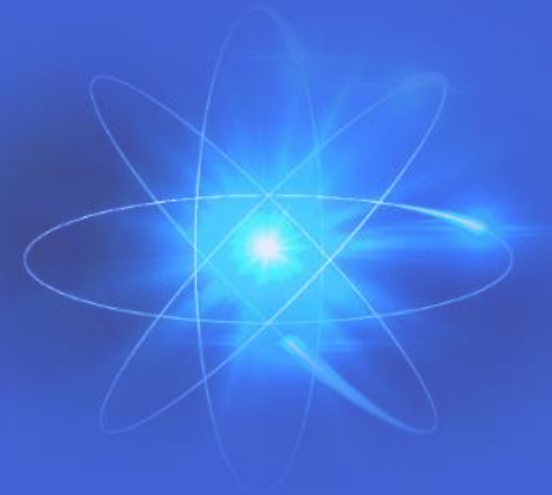
Gain measurement

- In conclusion the graphics of the two different analysis have been compared



The mathematical way

The approximated
manual way



conclusions

- What we have calculated it is not precisely the gain but it is a measurement that is **proportional** to it
- The data have an **esponential trend**
- It should be added a **sperimental error** to the data which is related to both the inaccurate manual measurement and the fit's parameter (μ) → but for practical impossibilities we didn't have the chance to get them



THANKS FOR THE ATTENTION!

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