Simulation of CMS Resistive Plate Chamber (RPC) performance under different conditions.

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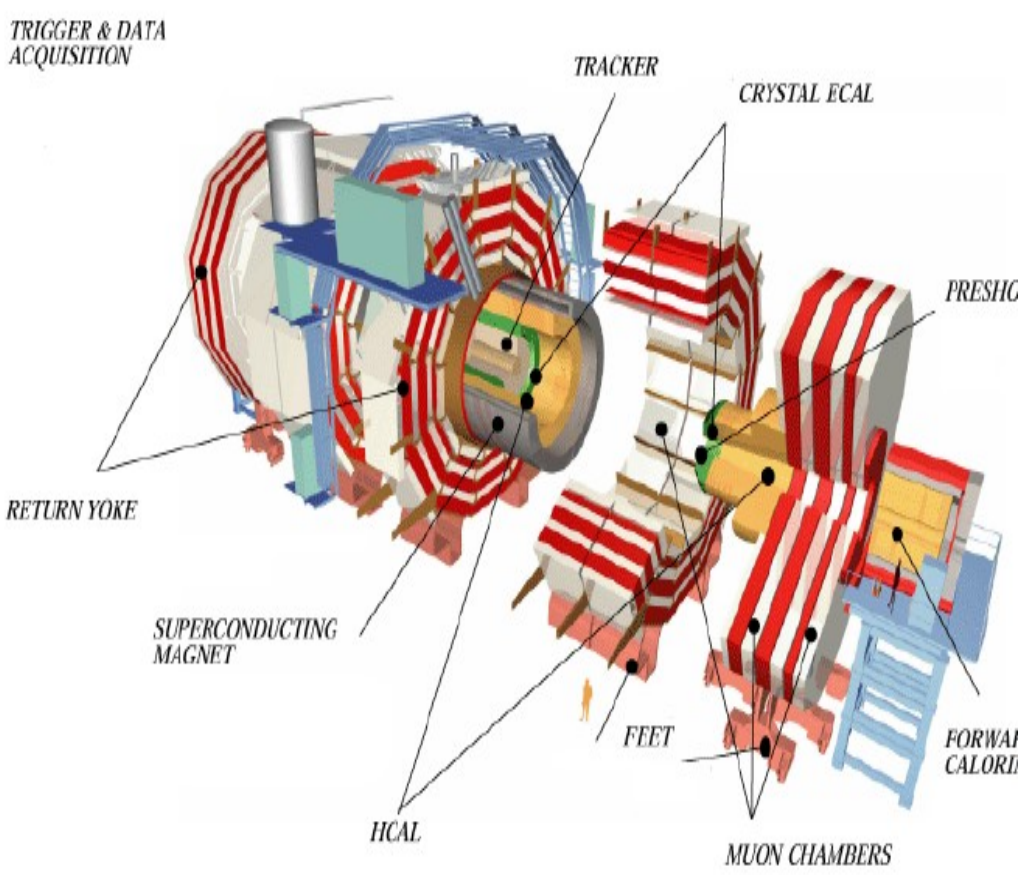
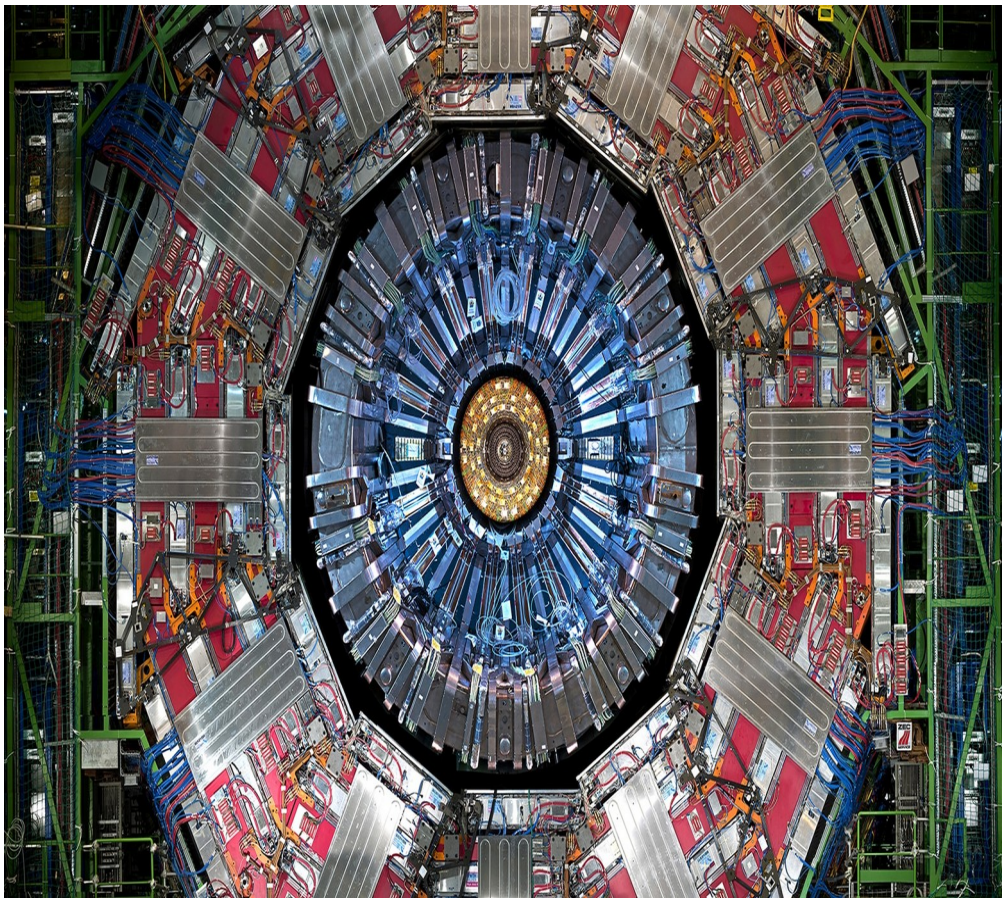
First Pan-African Astro-Particle and Collider Physics Workshop.

The Outlines

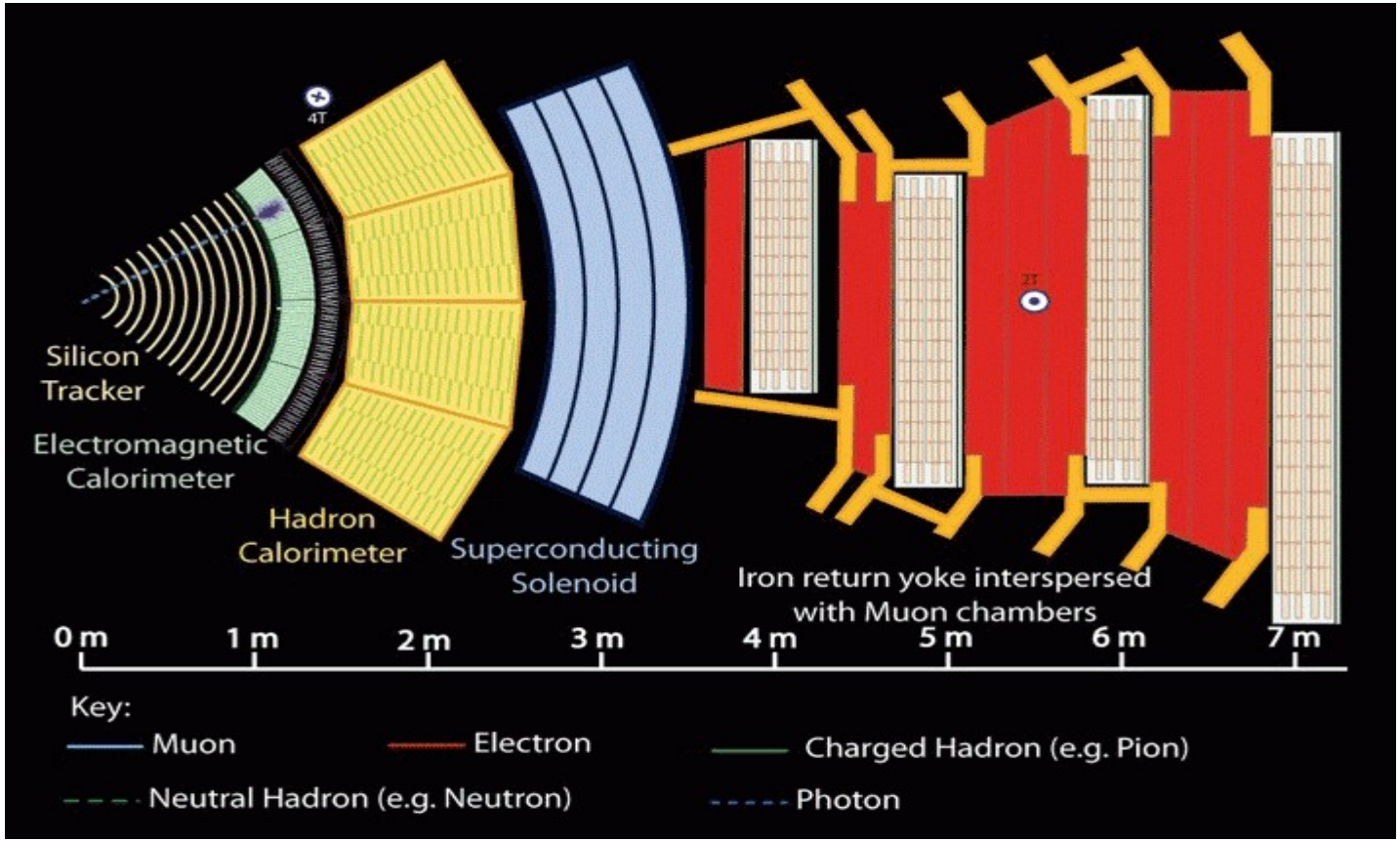
- Introduction
- Aim of the work
- Method
- Results
- Conclusion

The composition of CMS experiment



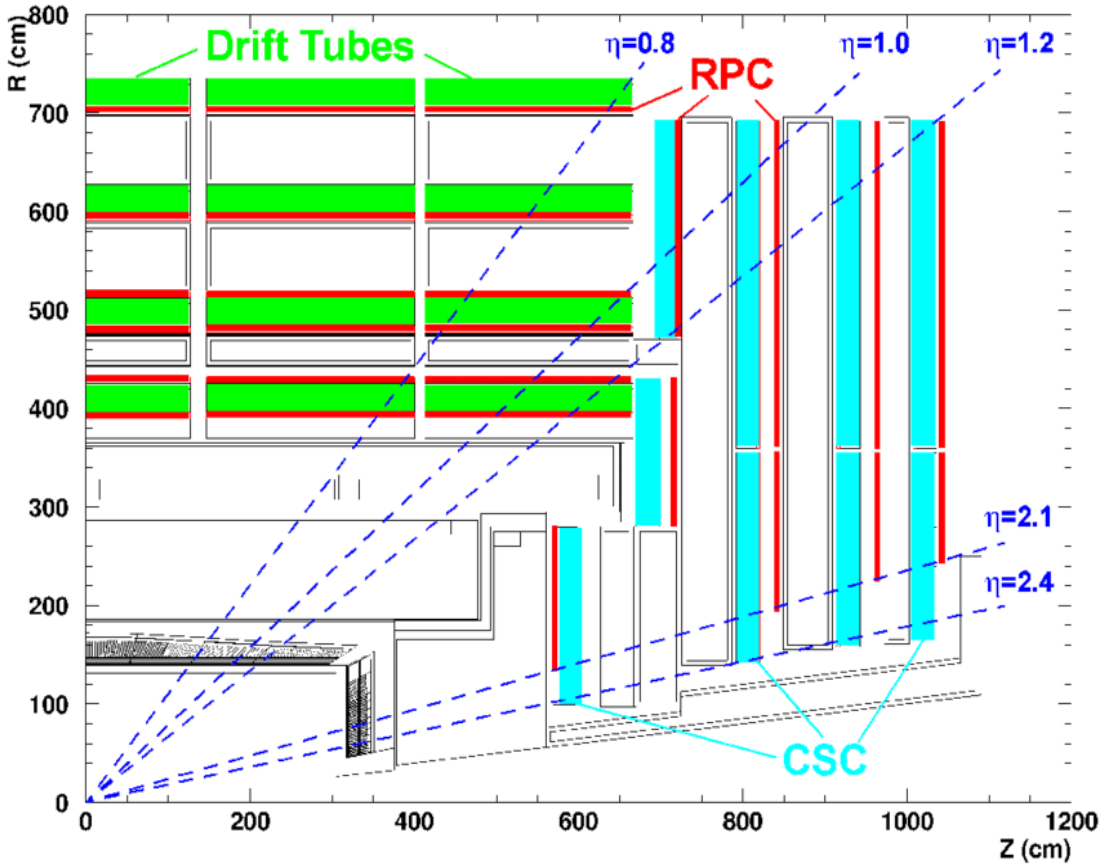


The Detection of Particle Inside CMS Experiment



The Muon sub-detectors inside CMS

- Drift tubes(DT).
- Cathode strip chambers(CSC).
- Resistive plate chamber(RPC).



Resistive Plate Chamber(RPC)

- High resistive bakelite layers with a bulk resistivity of

  10^{10} - 10^{11} Ωcm.

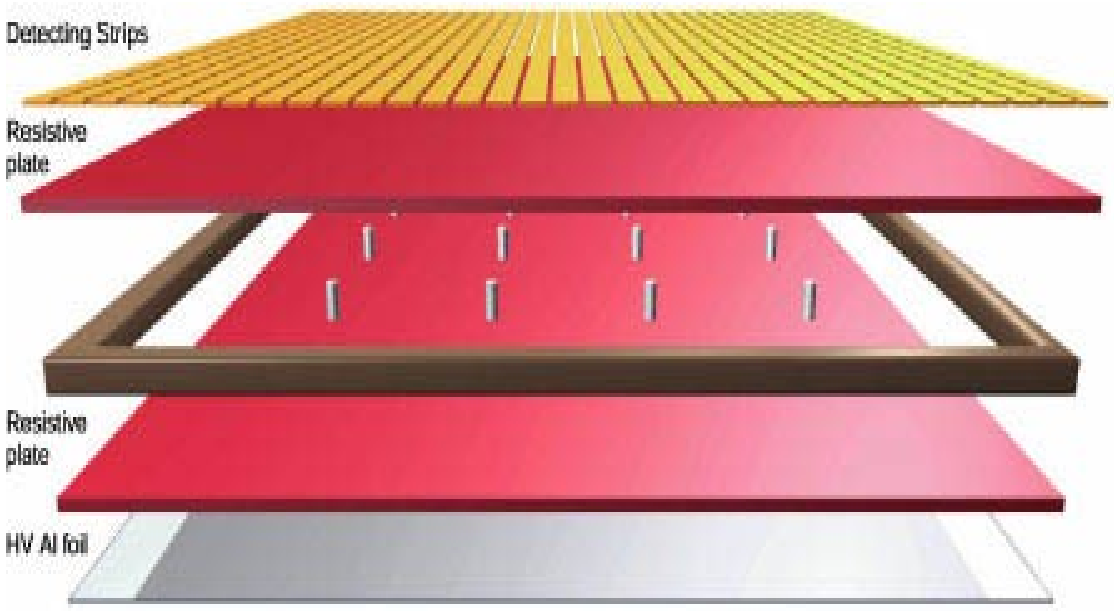
- Graphite layers with applied

  H.V of 10kv.

- Gas mixture

  Freon/isobutan/SF6(95.2/4.5/0.3)

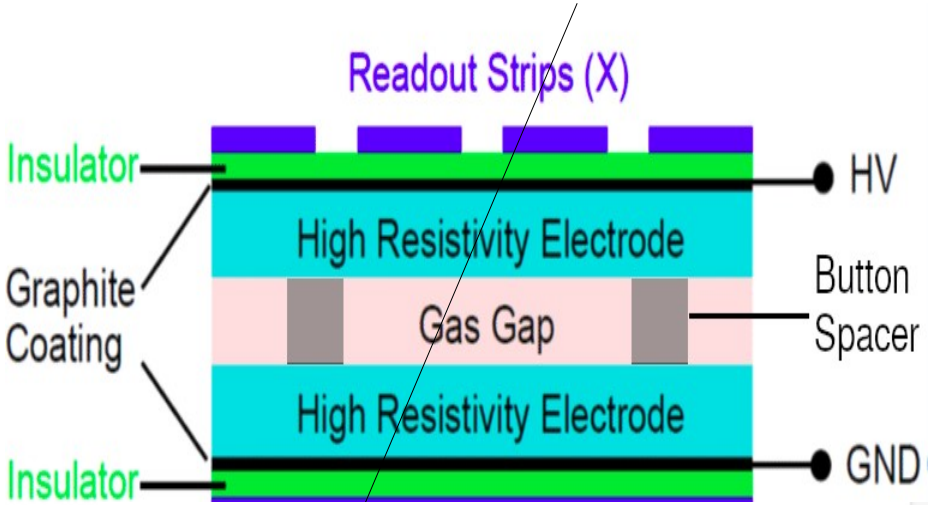
- Readout strips

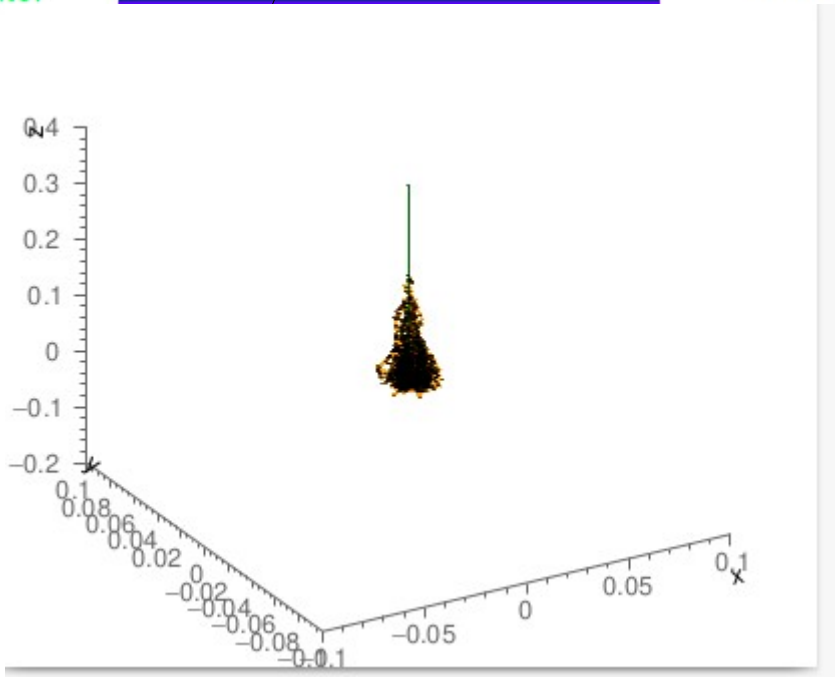


The Motion of The Charged Muon into The Gas Gap

Some Factors affect on the avalanche process:

- Type of the used gas mixture
- Temperature , pressure
- Energy of the incident particle
- The gap width





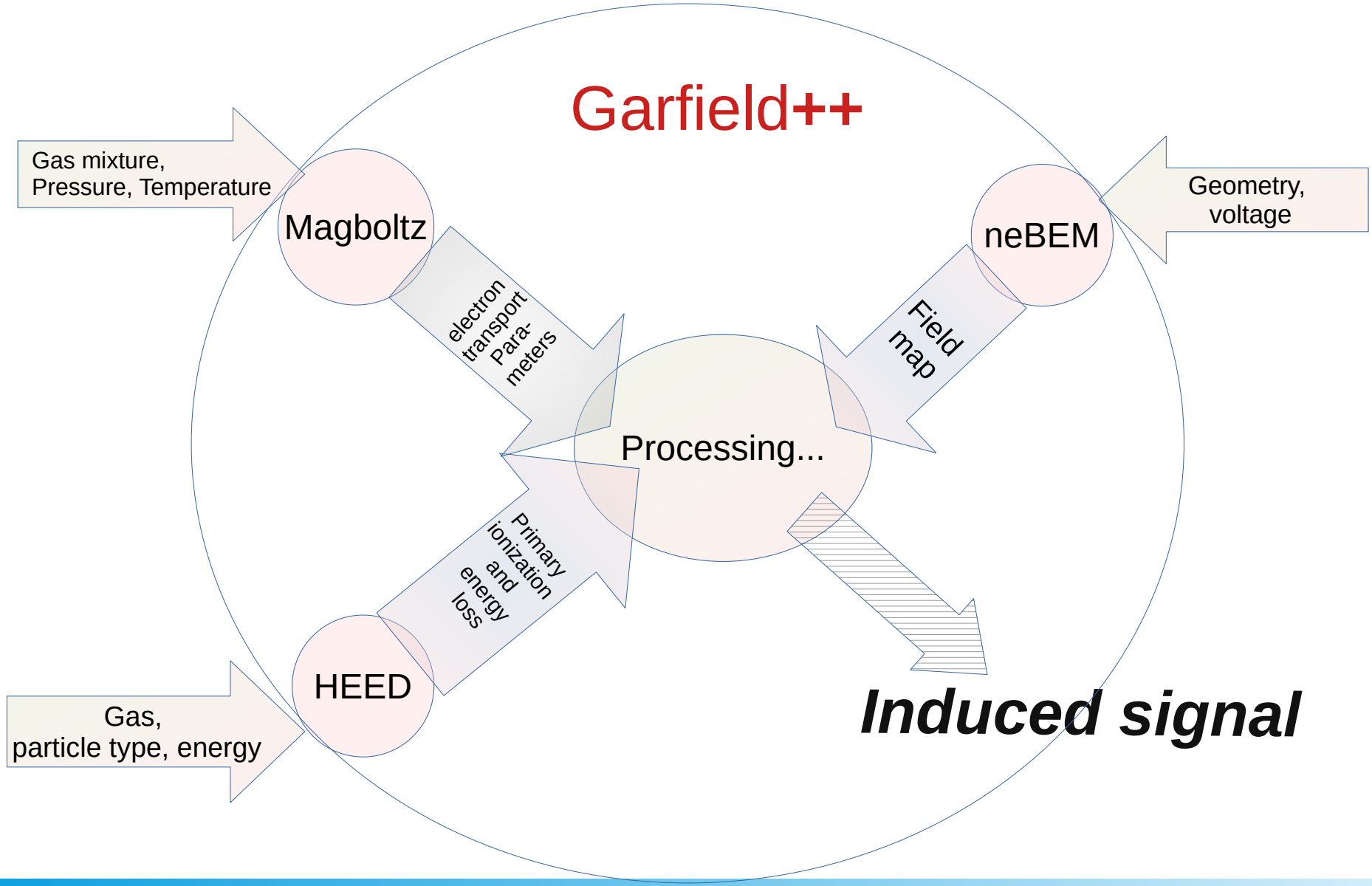
Aim of the work

To find the optimal working conditions of the CMS RPCs by:

- Studying the influence of different gas mixtures and temperatures on gas transport parameters.
- Studying the primary number of electrons and energy loss of the incident Moun under different temperature.
- Studying the induced signal under different temperature.

Garfield++

- Is a toolkit for a detailed simulation of particle detectors that use gas and semi-conductors as sensitive medium.
- It makes an interface with different packages like:
  - **Magboltz**
  - ***HEED***(High Energy ElectroDynamics)
  - ***neBEM*** *(*nearly exact Boundary Element Method)


Garfield++
Gas mixture,
Pressure, Temperature
Magboltz
neBEM
Geometry,
voltage
electron
transport
Para-
meters
Field
map
Processing...
Primary
ionization
and
energy
loss
HEED
Gas,
particle type, energy
Induced signal

MAGBOLTZ

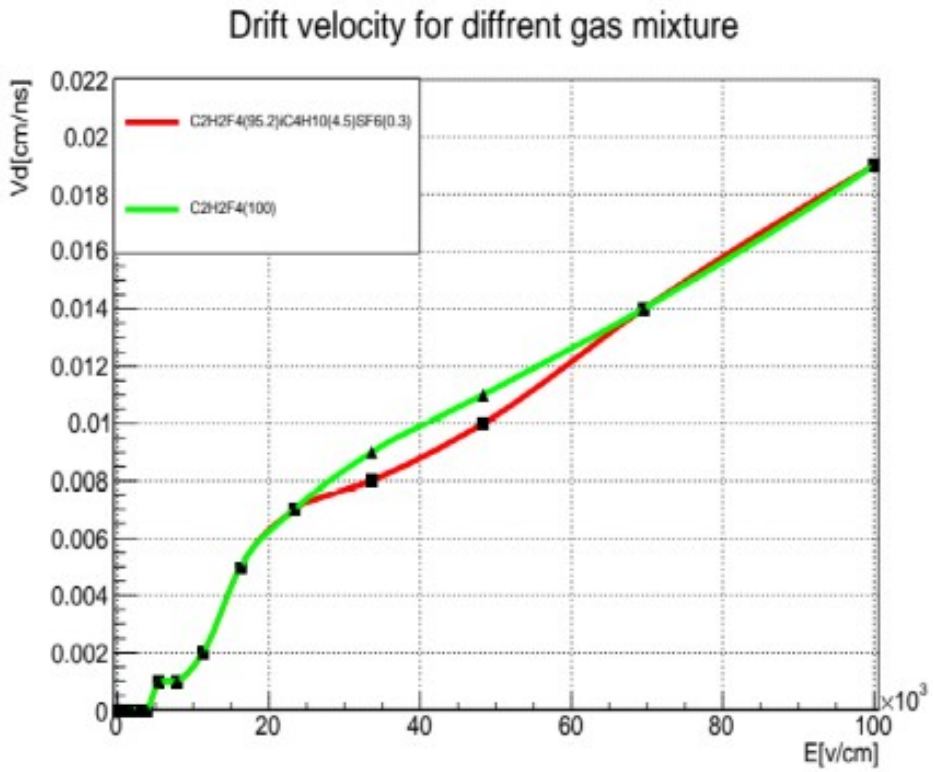
Magboltz solves the Boltzmann transport equations for electrons in gas mixtures under the influence of electric and magnetic fields.

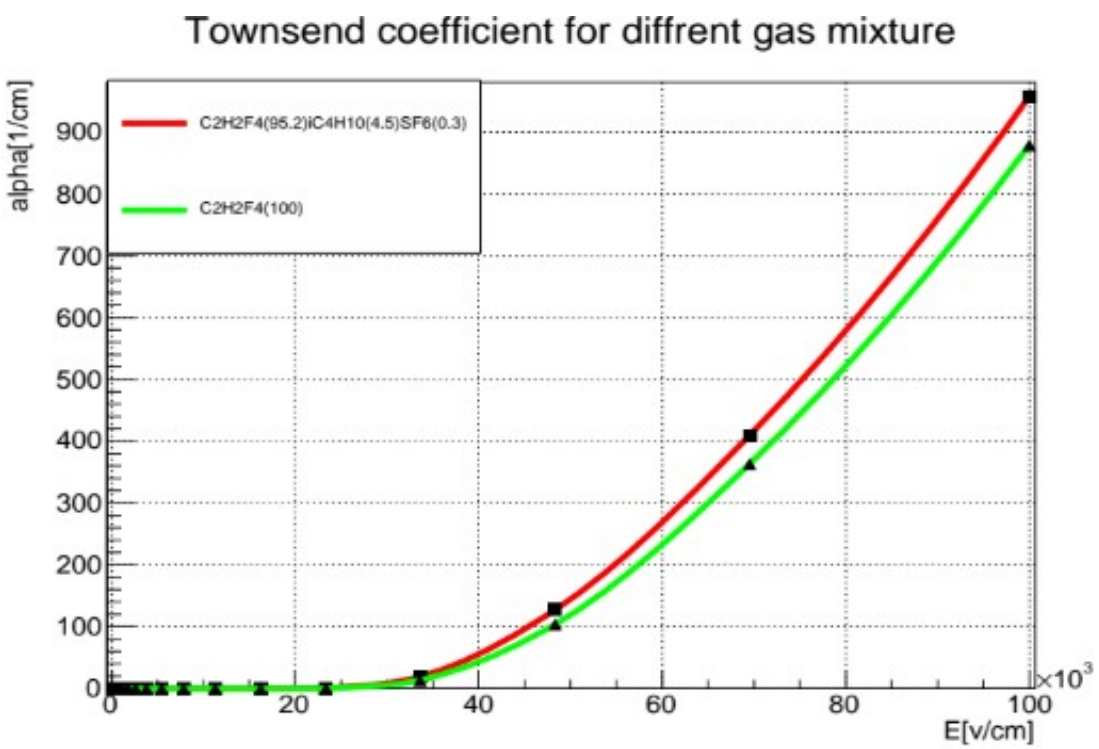
The transport parameters like:

- Drift velocity.
- Diffusion coefficient(longitudinal and transverse).
- Multiplication(Townsend) coefficient.

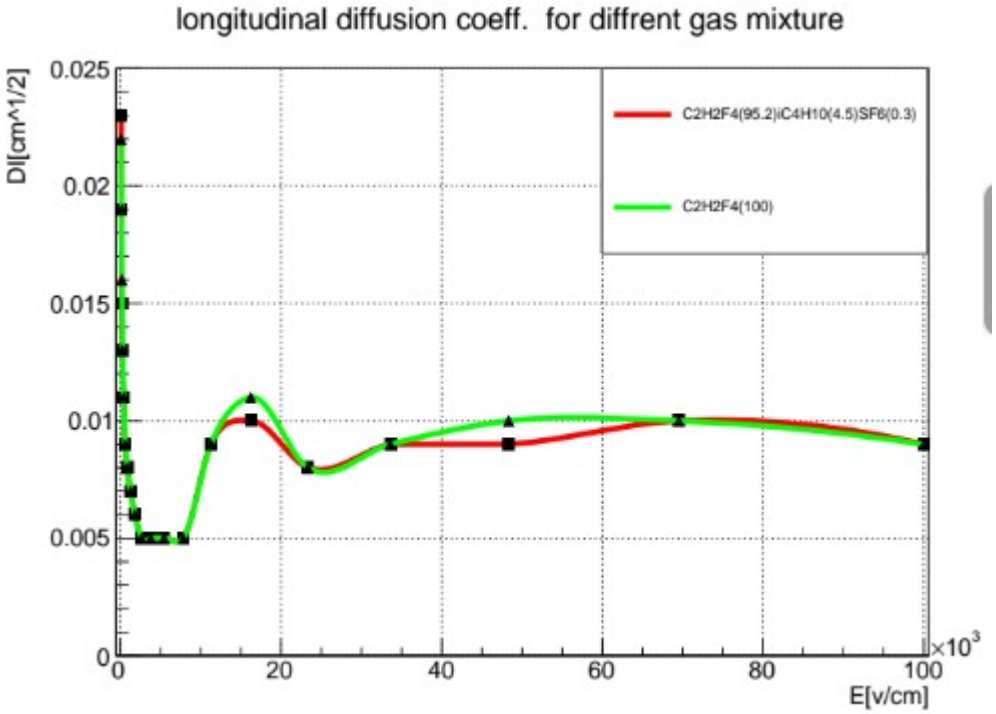
MAGBOLTZ

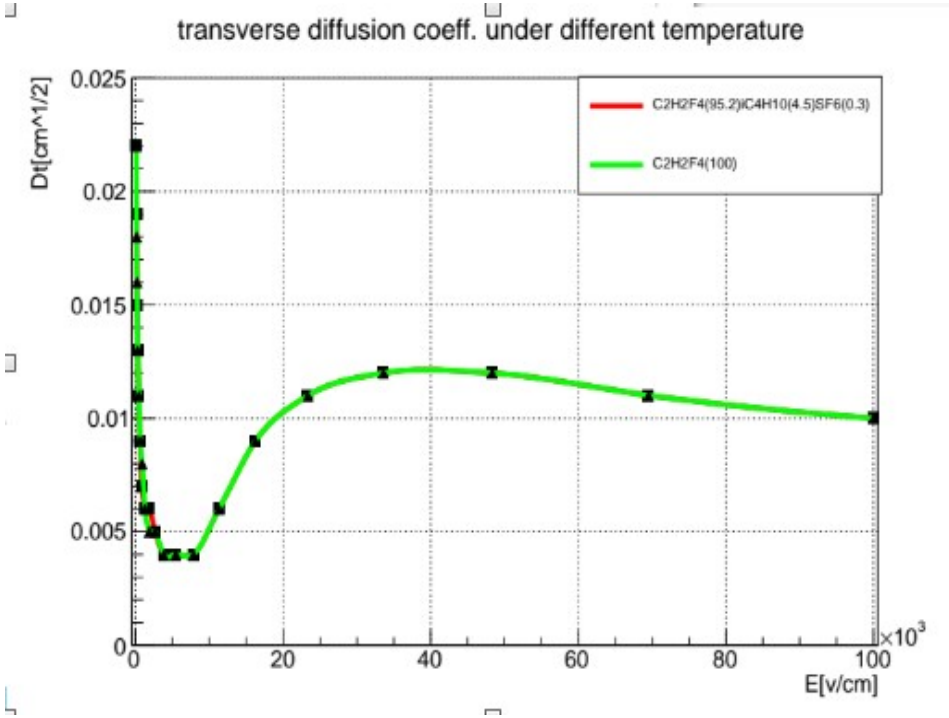
- comparison between different gas mixture C2H2f4 /iC4H10/SF6 (95.2/4.5/0.3) respectively, usually used in RPCs and C2H2f4 (100%) used in **Helwan lab** at 20c temperature and 1atm pressure.





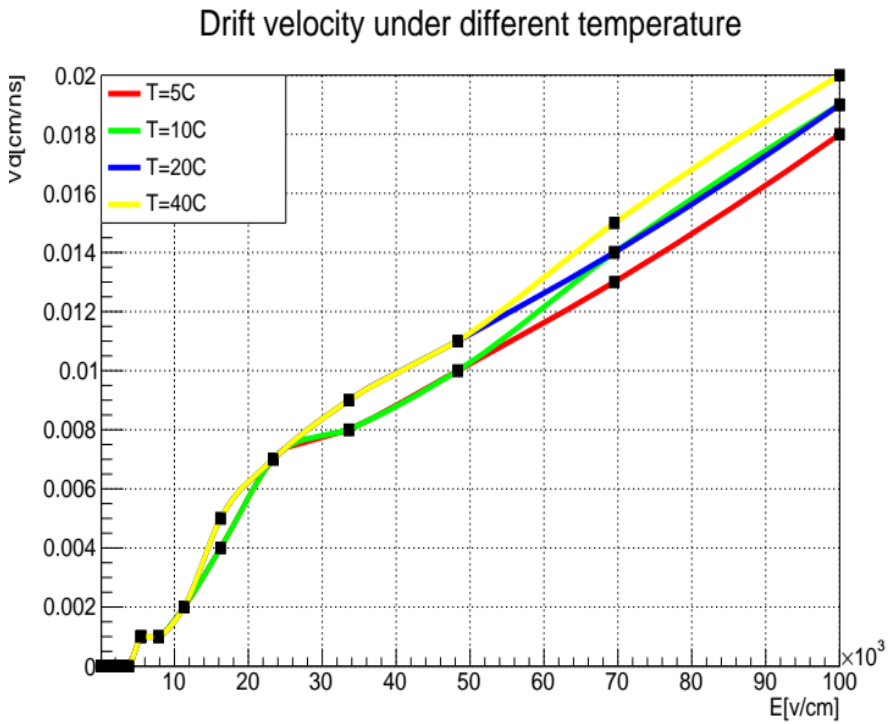
MAGBOLTZ

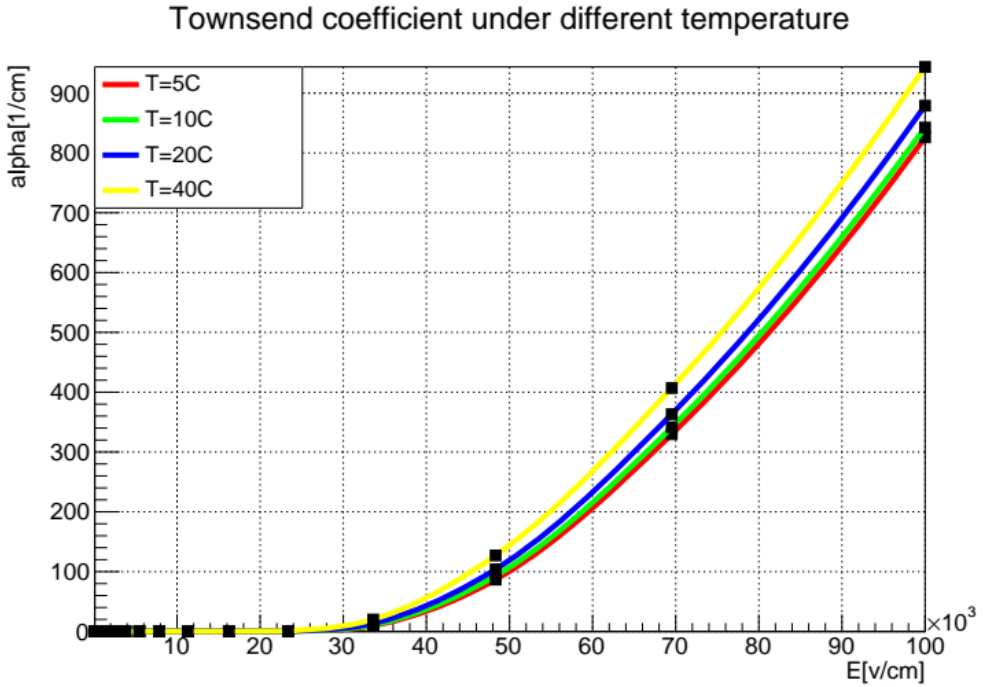

longitudinal diffusion coeff. for diffrent gas mixture
Dl[cm^1/2]
0.025
0.02
0.015
0.01
0.005
0
0
20
40
60
80
100
×10^3
E[v/cm]
C2H2F4(95.2)iC4H10(4.5)SF6(0.3)
C2H2F4(100)


transverse diffusion coeff. under different temperature
Dt[cm^1/2]
0.025
0.02
0.015
0.01
0.005
0
0
20
40
60
80
100
×10^3
E[v/cm]
C2H2F4(95.2)iC4H10(4.5)SF6(0.3)
C2H2F4(100)

MAGBOLTZ

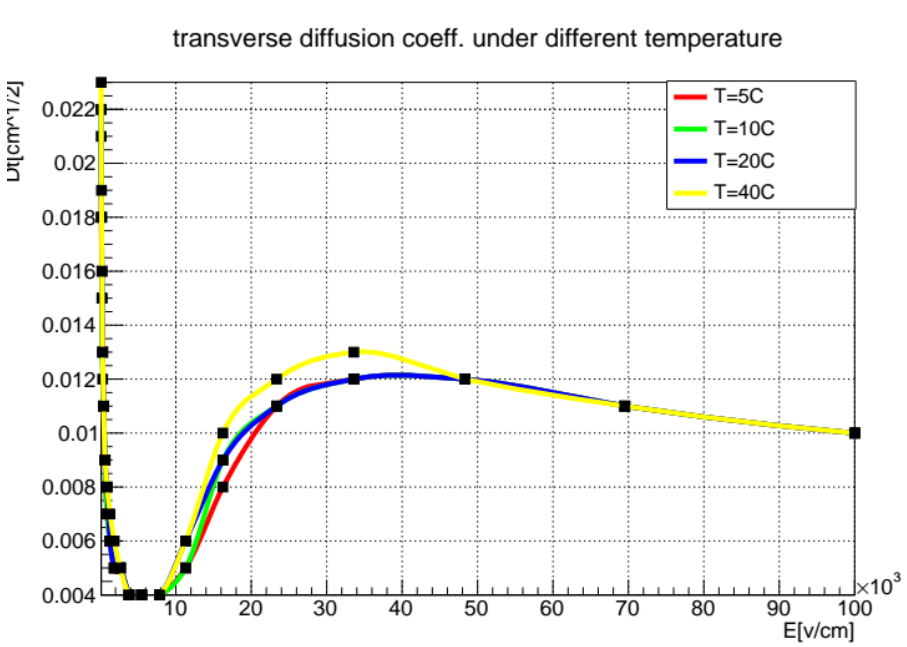
Transport parameters under different temperature for pure Freon

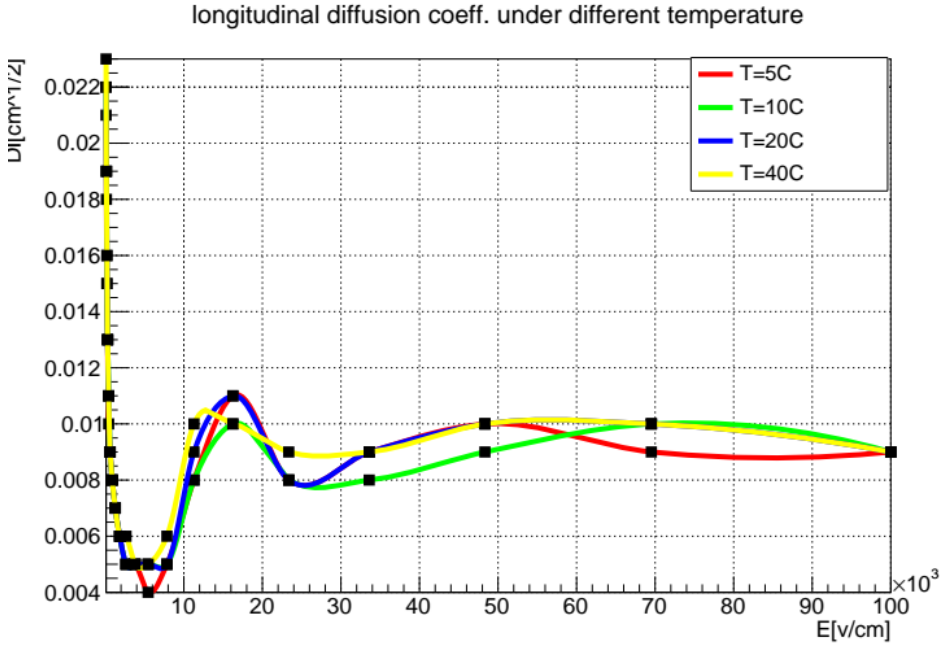




MAGBOLTZ

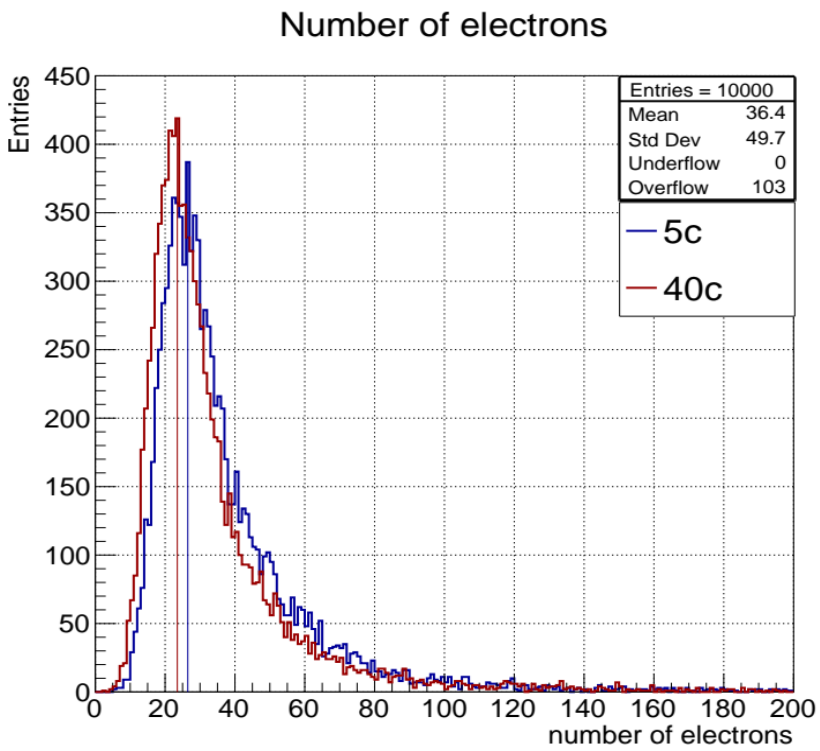
Transport parameters under different temperature for pure Freon:

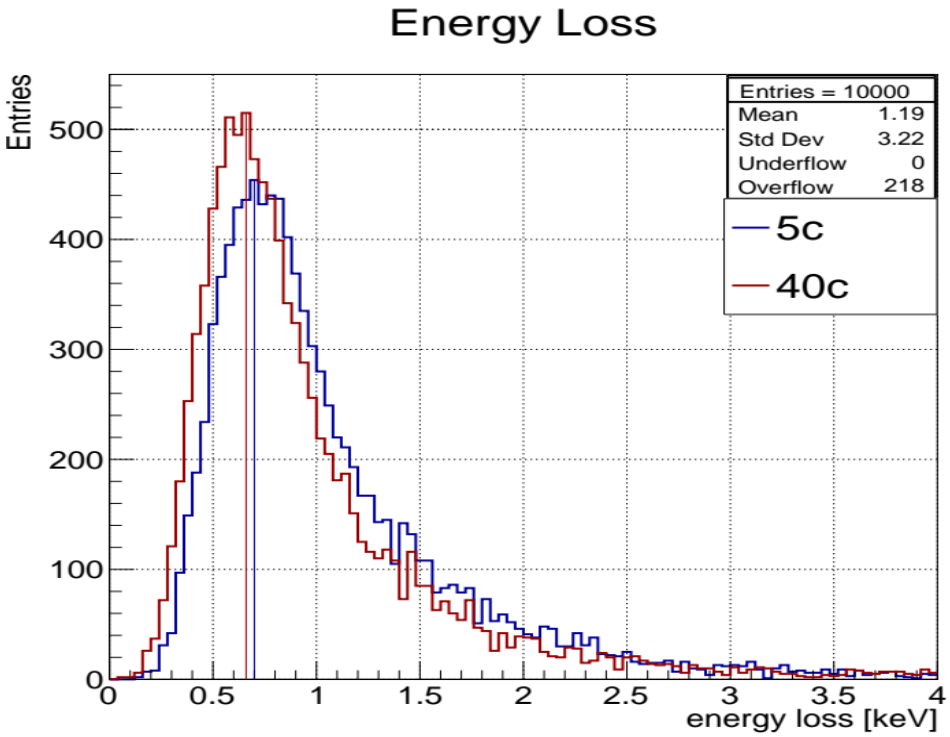




HEED (High Energy ElectroDynamics)

- *The PhotoAbsorption Ionization (PAI) model to calculate the primary number electron and energy loss of 2Gev incident Muon*

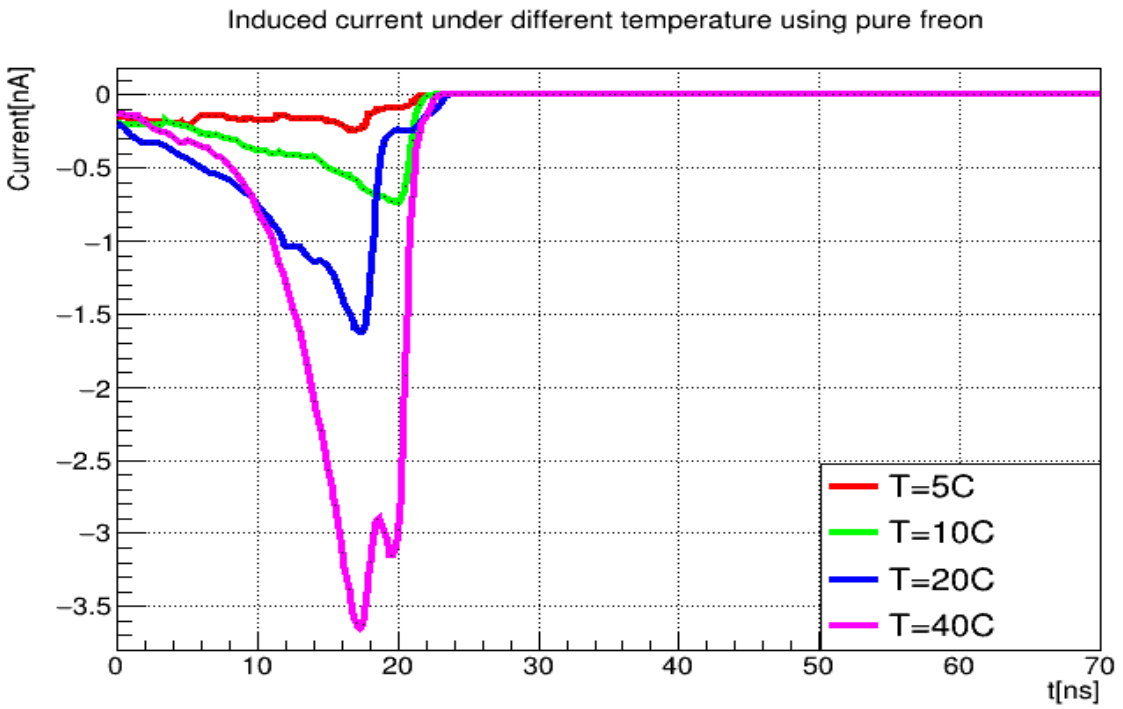




neBEM(nearly exact Boundary Element Method)

It computes the electric field and potential in nearly arbitrary 3-dimensional geometries taking the presence of conductors and dielectric media into account.

- The induced signal under different Temperature.



Conclusion

- Using only pure Freon affects on the transport parameters of the gas except for the transverse diffusion coefficient.
- All the gas transport parameters affects with the temperature change.
- The signal amplitude and timing also affected by changing Temperature.


Thank you!