STA Activity in Beamline for schools

El-sewedy technical academe team

Outlines

- Introduction about the project (proposal).
- Plan and Preparations In Egypt
- Arrive At CERN
- Test Beam Activities
- Data Analysis
- Results.
- Prospects

STA Project

Aim: Using eco-friendly gas (CF_3I + eco-Freon) mixture instead of (SF6) in order to reduce the global warm.

How?

- By measuring the efficiency of **M**ulti gap **R**esistive **P**late **C**hamber (MRPC) using the eco-friendly gas (CF_3 I (50%) + eco-Freon (50%) and compare the results with the efficiency when using standard gas mixture (Freon + SF6).
- Due to the negative effect of (CF_3I) on DNA we decide to use (CO_2 + eco-Freon) mixture.
- Due to the un-availability of CO_2 we use the (He + eco-Freon) mixture.

➔ *The results presented in these slides for the (Helium + eco-Freon) mixture*

Eco-freon

Work in Egypt

- In the preparation stage: We learned some aspects on glass-MRPC and learning software needed for Data Analysis.
- Follow zoom STA-CERN classes where support scientists from CERN presented the the experimental setup of the MRPC and electronics.

Arrive at CERN

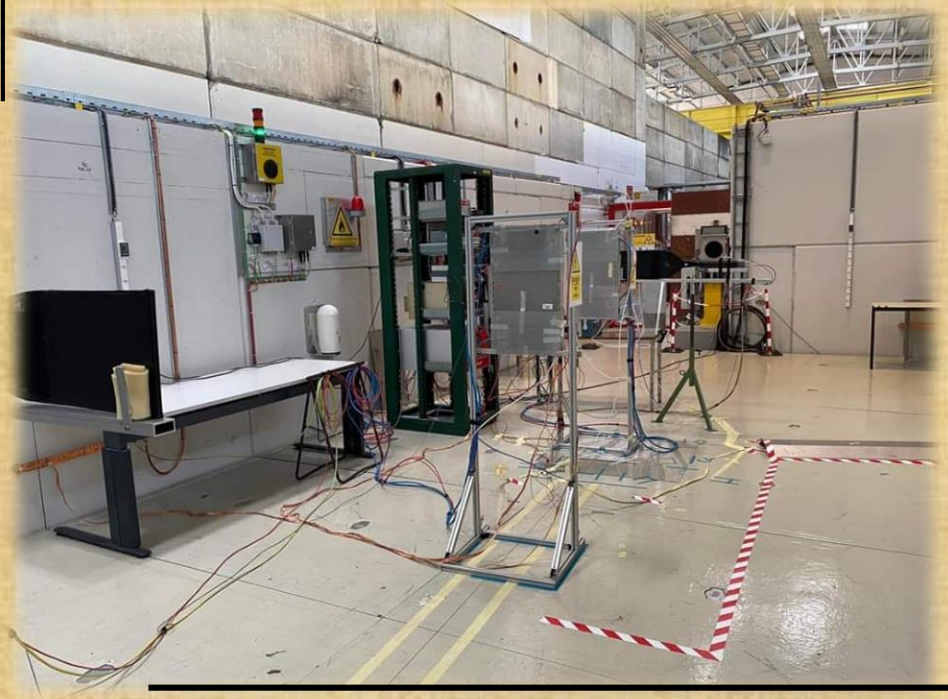
- Registration at CERN
- Following safety courses to be able to work in radiation zone.
- Visit different CERN facilities (ATLAS experiment – computing rooms - etc.)

Day At Geneva

Visit Site seen places at Geneva city

Test Beam Activities

1. Exploring the test beam area and the instructions to follow.
2. Gas room: learning how to adjust the gas mixture.
3. Setup place
4. Control room (Where the data are taken and recorded)



Working days

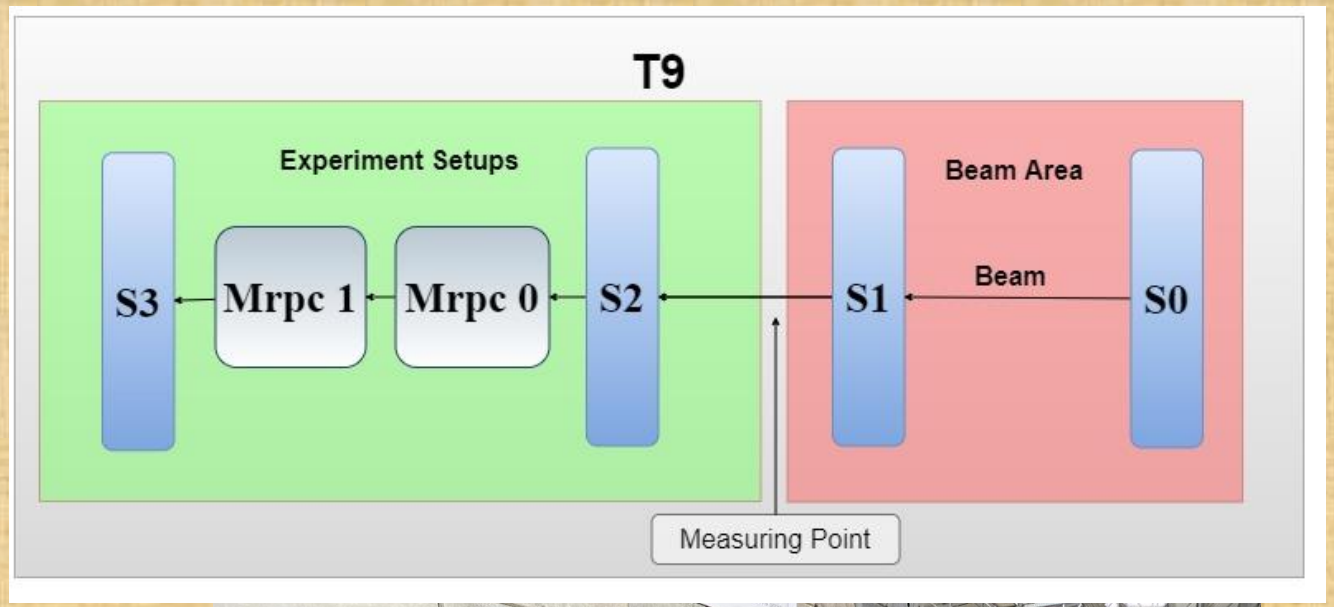
Shifts for Data-Taking
(Test beam control room)

Data Analysis
(Room 13-2R13)

For 8 days working were going parallel in both sites (Test beam control room & Data analysis room)

Test-Beam setup

Schematic diagram of test beam



Real photo of test beam

Calibration of Scintillators I

- In order to calculate the MRPC efficiency, we relay on scintillator detectors.
- As a first step we need to calibrate the scintillator detectors:
  - by calculating the Time of Flight (ToF) theoretically and experimentally and calculate a calibration constant.

Calibration constant = ToF (Theoretical – Experimental)

1. Calculating ToF theoretically for positrons (e+) by knowing the particle's momentum, mass

Where

Energy (E) = $(P^2C^2 + m^2C^4)^{1/2} = (P^2 + m^2)^{1/2}$, C =1

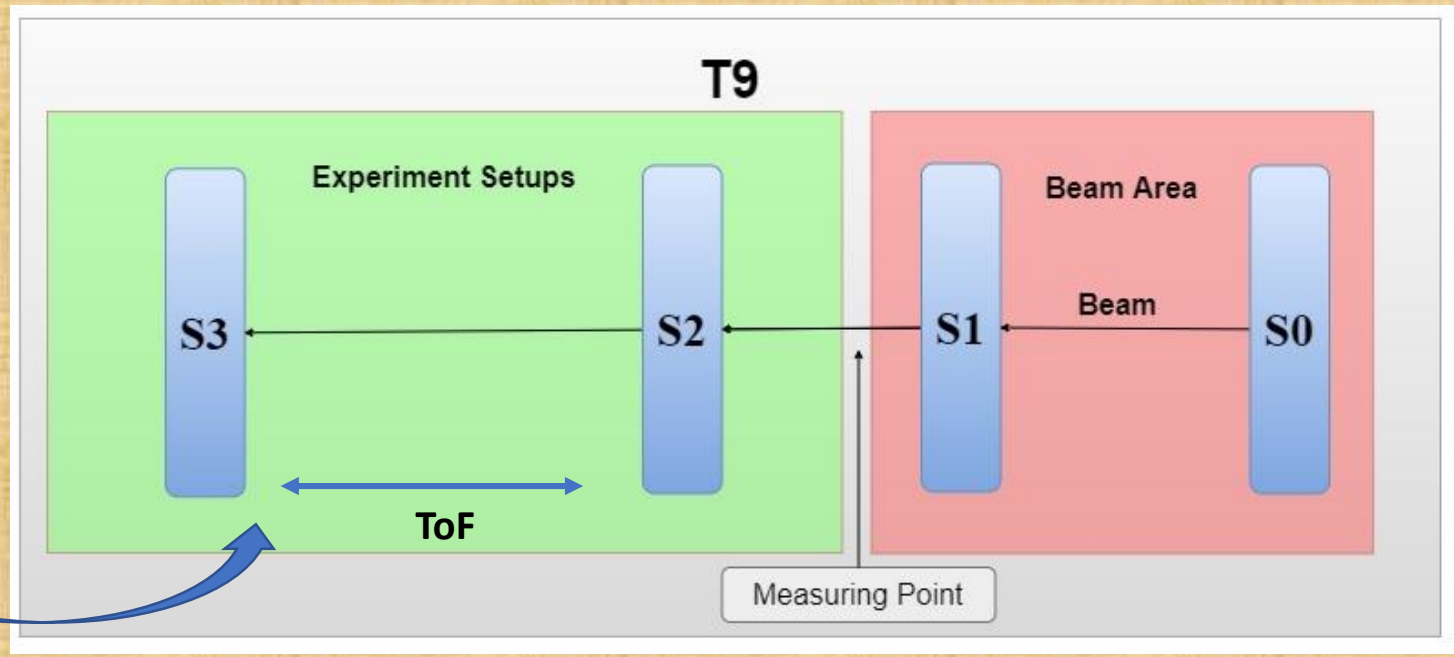
Speed (v) = P/E

Time of Flight (ToF) = detector distance/(v * c) * 10^9

Calibration of Scintillators II

2. Calibration of scintillators done experimentally by using Positron beam at different distances between scintillators (S1, S2 and S3)

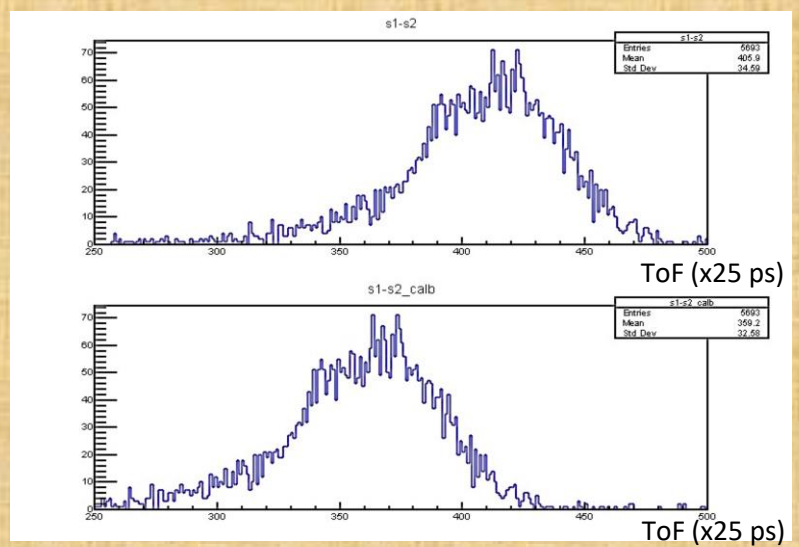
- Distance between S1- S2 is 268 cm & S1-S3 is 269.4 cm (standard)
- Distance between S1- S2 is 218 cm & S1-S3 is 294.7 cm (Case1)
- Distance between S1- S2 is 220.1 cm & S1-S3 is 295.6 cm (Case2)



ToF: **the time taken by the particle to travel between the 2 scintillators.**

Calibration of Scintillators II

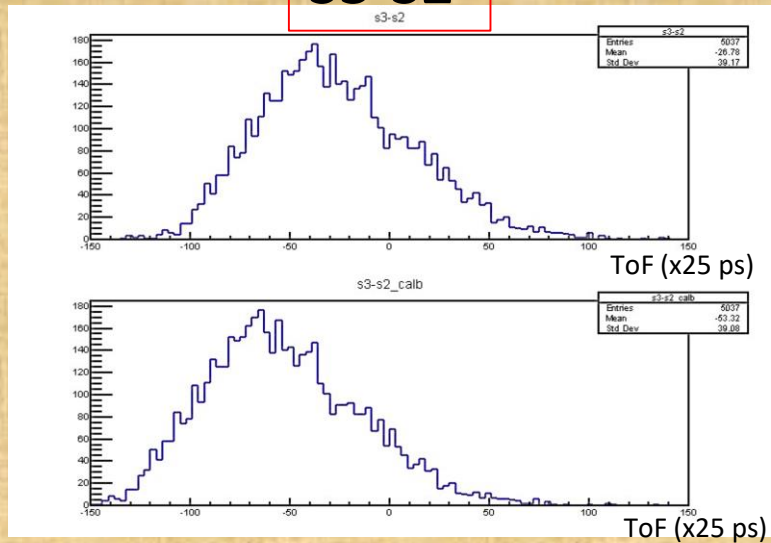
S1-S3



ToF

ToF calibrated

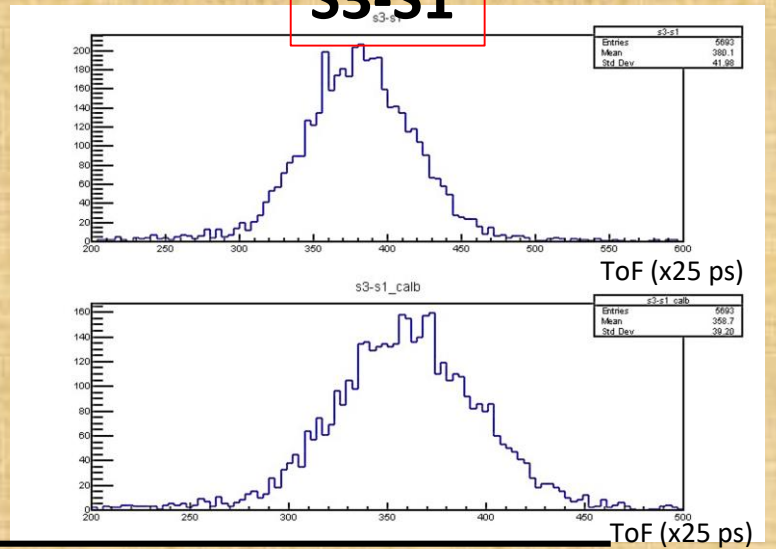
S3-S2



ToF

ToF calibrated

S3-S1



ToF

ToF calibrated

Lesson Learned:

- ✓ **When the distance between the scintillators increase we can distinguish between different charged particles because of different Time of Flight (ToF)**

Efficiency I

- Efficiency was calculated at working operation voltage = 5000 volt for MRPC (MRPC0, MRPC1) with Standard gas mixture (SF6) and with Helium+ eco-Freon mixture.
  - 8 strips of MRPC 0 (Channels) right (Ch0 to Ch7)
  - 8 strips of MRPC 0 (Channels) left (Ch8 to Ch15)
  - 8 strips of MRPC 1 (Channels) right (Ch16 to Ch23)
  - 8 strips of MRPC 1 (Channels) left (Ch24 to Ch31)

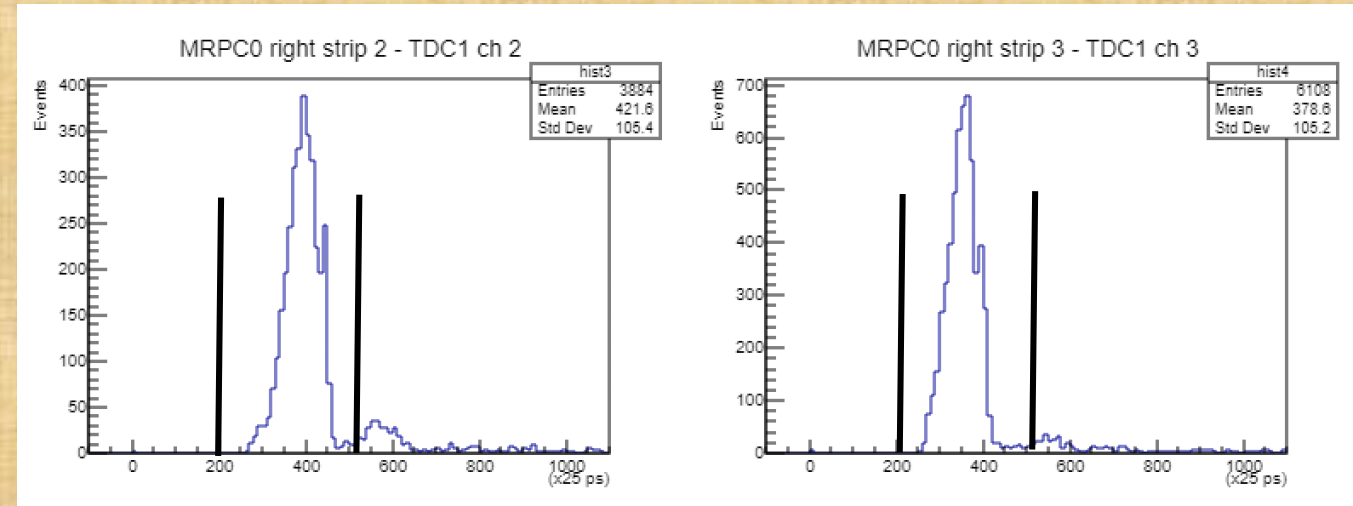
Mapping

$$\text{Efficiency } (\epsilon) = \frac{no.of\ hits\ in\ MRPC}{no.of\ hits\ from\ scintilattors\ coincidence\ (S1,S2,S3)}$$

Efficiency II

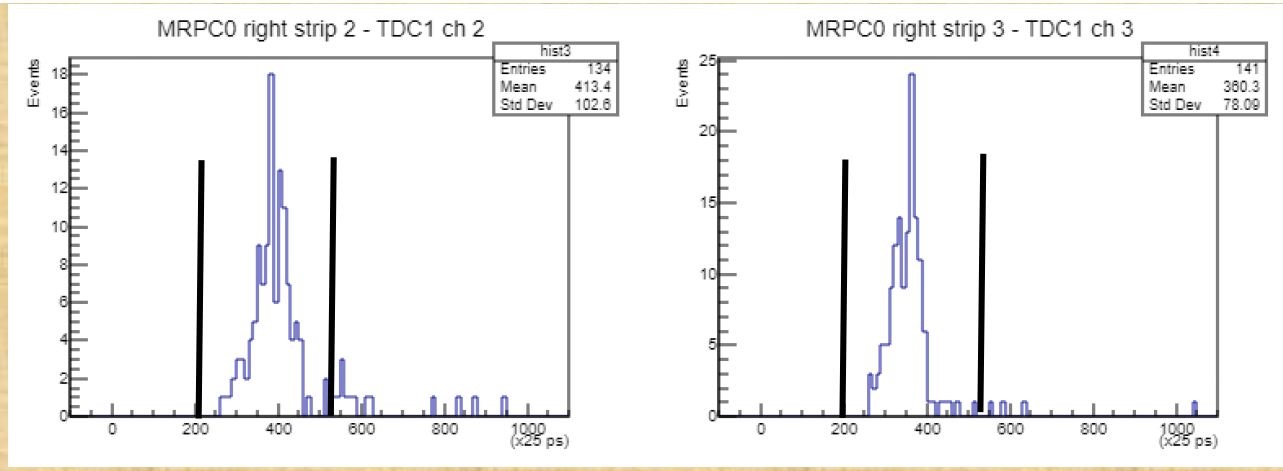
- To define the number of hits in MRPC, as a preliminary step,
  - ➢ we defined an algorithm by checking the Time of Threshold (ToT) of signal trailing and leading edges

Standard gas mixture



ToT = signal edge (trailing – leading)

Eco-friendly gas mixture



Results & lesson Learned

We calculate the efficiency for MRPC0 and MRPC1 and we found that:

- The efficiency obtained using SF6 gas is higher than the efficiency using eco-friendly gas (Helium 50% , 50% eco-freon) ⇨ But we collected data yesterday night with different percentage of eco-friendly gas mixture that would change the efficiency.
- The efficiency of MRPC0 is better than that of MRPC1 “approximately double”
  - We could increase the efficiency of MRPC1 by increase the high voltage since each detector can behave differently.
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Ongoing & Next Steps

- The conclusion we got is very preliminary:
- We have a huge amount of data that have been collected during test beam:
  - We need to define a solid algorithm to calculate the efficiency.
  - We will compare the efficiency at different High voltage points to define the detector working point.
  - Repeat the exercise of comparing data with different gas mixtures (standard gas and eco-friendly)
  - Comparing data with different percentage of eco-friendly gas mixture.

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Thank You