TEST BEAM 2022 (PROTOV @ H8)

ALESSANDRO ROCCHI
INTRODUCTION

Small RPC detector prototypes have been tested in the H8 beam dump platform. Most of the infrastructure have been provided by GIF++ staff.

Two prototypes have been tested extensively:

- New Resistive Cylindrical Chamber with 0.3 mm gas gap and 1 mm bakelite electrodes
- RPC detector with 0.2 mm gas gap and 0.4 mm phenolic glass electrodes
THE RCC DETECTOR (0.3 MM GAS-GAP)

The RCC detector is a device consisting of two concentric cylinders of resistive material. The detector's stratigraphy is like that of an RPC, but the cylindrical geometry introduces new control parameters on the detector's response, as well as extending its use to hostile environments thanks to the high strength mechanical structure.

Gas pressurization:
1. Increase the gas target density, with a consequent increase in intrinsic efficiency → MRPC time response with thin single gap configuration
   → light eco-friendly CO$_2$ based gas mixtures
2. Use the detector in hostile environments

The electric field gradient, depending on the polarization allows to
1. Contribute to the gas discharge quenching → new eco-friendly gas components
2. Increase the charge collection efficiency enhancing the multiplication in the initial part of the gas gap
3. Study the dependencies and optimize the time resolution

Double gap:
1. Tracking capability
2. Improvement in time resolution and efficiency

\[
E(r) = \frac{V}{r \ln \frac{R_o}{R_i}} \sim \frac{V}{R_i \ln \frac{R_o}{R_i}} - \frac{V}{R_i} \frac{r - R_i}{R_i} \\
R_o - R_i \ll R_i
\]

An R&D collaboration is ongoing between Tor Vergata Atlas group, MPI MDT group and University of Geneve
The internal detector made it possible to close the angle of acceptance and discriminate the tangential traces.

Features:
- Gas-gap 0.3 mm
- Outer electrode 1 mm
- Inner electrode 0.7 mm
- Outer Radius 18 mm
- Inner Radius 15.3 mm
- Outer pickup 7 strips 1 cm pitch
- Inner pickup 1 pad

[Thanks to Alessandro Paolini for the e’ hamamatsu S14160-6050HS  6*6 detector and electronics]
RPC 0.2 mm PROTOTYPES

The double gas gap RPC detector in single readout configuration (Tested ad Gif ++ during 2021) was disassembled and two identical detectors were built with the single gas volumes to evaluate the time performance. Each detector has 8 read-out strips located on the ground side of the gas volume. The gas volume dimensions are about 10 cm x 30 cm, with very thick spacers matrix.

It can be observed that, despite the gap of only 0.2 mm, the cooperation between the two volumes of gas allows to achieve an efficiency of more than 90% for 180 GeV / c muons. The reported measurement was carried out by setting the discrimination threshold at 15 mV (on the amplified signal), about 5 fC.
H8 BEAM DUMP EXPERIMENTAL AREA AND SETUP

The setup was installed on the RD51 trolley, sharing trigger scintillators.

Two gas lines from GIF++:
- Line 1 -> wet
- Line 2 -> dry

- 94.7% TFE + 5% iC4H10 + 0.3% SF6

CO2 gas line from H8 gas rack

DAQ System:
- CAEN V1718 USB Bridge
- CAEN V1742 32 Ch Digitizer

Trigger System:
- Logic & between RD51
- 15 x 15 cm² scintillators and Protov 4 x 2 cm² Cerenkov detector
PRELIMINARY RESULTS

0.2 mm RPC detector Time response

Gas mixture
94.7% TFE + 5% iC4H10 + 0.3% SF6

About 170 ps raw time resolution

RCC detector efficiency response

Gas mixture
94.7% TFE + 5% iC4H10 + 0.3% SF6

<table>
<thead>
<tr>
<th>htemp</th>
<th>Entries</th>
<th>8356</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>-1.152</td>
<td></td>
</tr>
<tr>
<td>Std. Dev</td>
<td>0.3947</td>
<td></td>
</tr>
<tr>
<td>$\chi^2$/ndf</td>
<td>38.34/34</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>290 ± 4.8</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>-1.153 ± 0.003</td>
<td></td>
</tr>
<tr>
<td>Sigma</td>
<td>0.2424 ± 0.0036</td>
<td></td>
</tr>
</tbody>
</table>
CONCLUSIONS

For the second consecutive year the PROTOV project took data at the H8 dump platform.

- This position has proved particularly useful for the study of early-stage prototypes, as it allows continuous access to the experimental setup without any restrictions.

- The beam intensity is high enough to allow the characterization of even small detectors and there is easy access to dedicated gas lines.

- The installation of large setups like that of RD51, made the installation more complicated due to the blocking of the passage from one side of the platform to the other. We solved the problem by moving the setup on the RD51 trolley, but it would be useful for the next few years to install a ladder on both sides of the platform to be able to exploit the full platform width.