Development and Analysis of Double gap Glass Resistive Plate Chambers (RPC)

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Outline

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- Resistive Plate Chambers (RPC)
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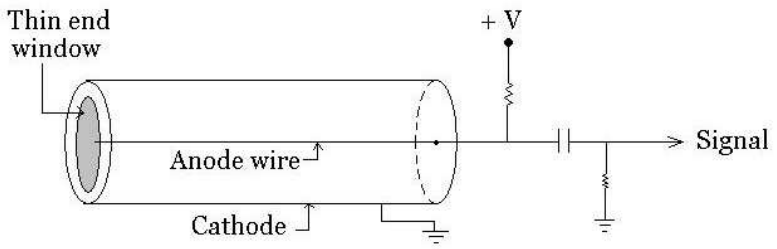
  - Circuit
- Results and Discussion
  - Oscilloscope Output
  - Time Resolution
  - Efficiency
- Summary

Basic Detectors

- Gaseous Ionisation Detector



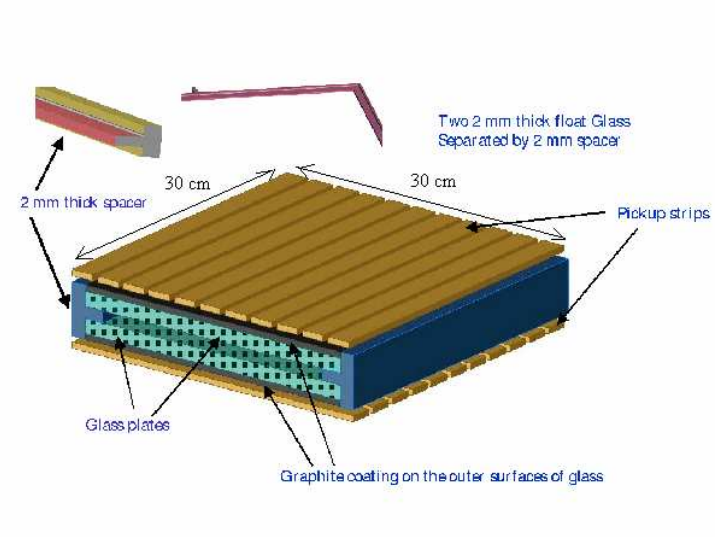
- Scintillator: Plastic Scintillator

▷ Motivation for building RPCs

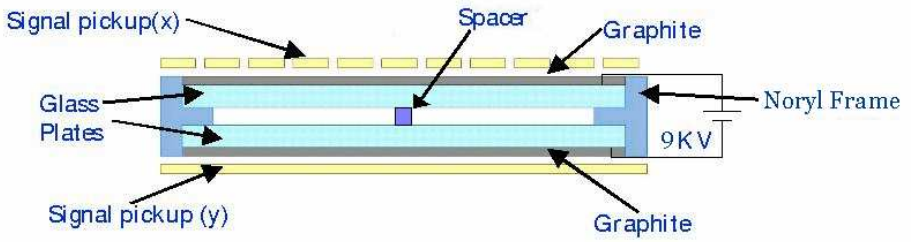
Advantages of RPCs over Scintillators :

- Easy to assemble and possess a simple read-out electronics.
- Exhibit better time resolution than scintillators.
- Good position resolution and good detection efficiency.
- Large area detector at a minimal material cost.

Resistive Plate Chambers (RPC)



(a) Top view



(b) Cross-sectional view

- Glass plates (high volume resistivity $\sim 10^{12}\,\Omega\,\mathrm{cm}$).
- Nozzles (for gas inlet/outlet).
- Graphite coating on the outer surface (Reistivity $\sim 300\,\mathrm{k}\,\Omega/\square$).
- Electric supply (HV) given to the plates through copper tapes.
- Sheets of foam with aluminium strips to pick up pulses.
- Mylar sheet in between Al strip and graphite, for insulation.

Gas system

- Choice of Gas.
  - low working voltage ($\sim$ 10 KV)
  - good proportionality
  - high rate capability
- Noble gas : Argon.
  - Higher specific ionisation
  - Lower cost
- Quenching gas : Isobutane
- Electronegative Gas : Freon
- For present experiment

$$\boxed{\textbf{Freon : Isobutane : Argon} = 62 : 8 : 30}$$

RPC Principles of Operation

Passing charged particles induce an **avalanche**

$\Downarrow$

Develops into a spark

$\Downarrow$

Avalanches increase in number

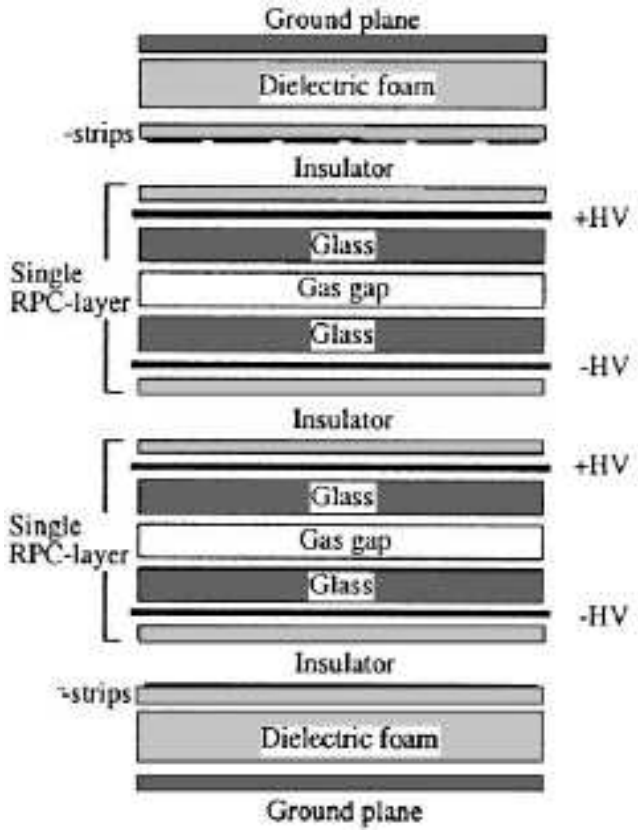
$\Downarrow$

Form a **streamer**

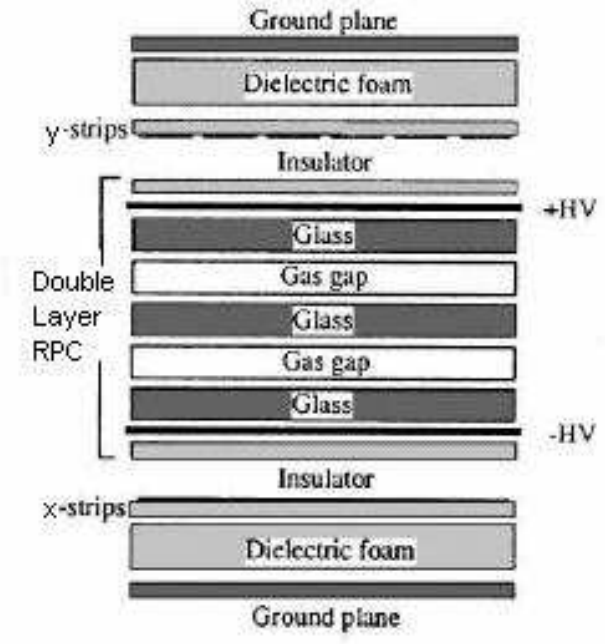
$\Downarrow$

Collected as a pulse by pick up strips.

A Double Gap RPC



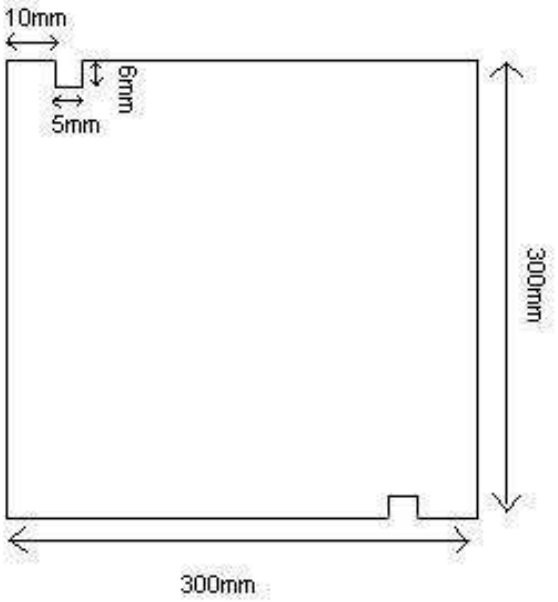
(a)As proposed in BELLE

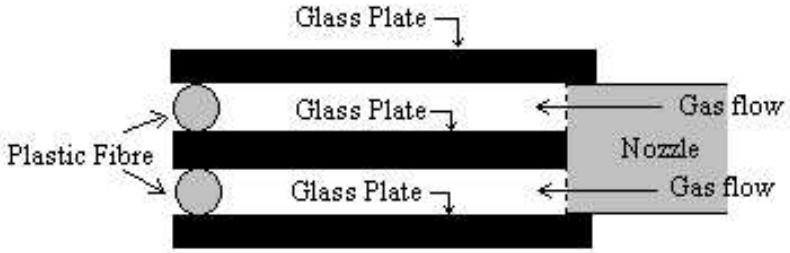


(b) Our modification

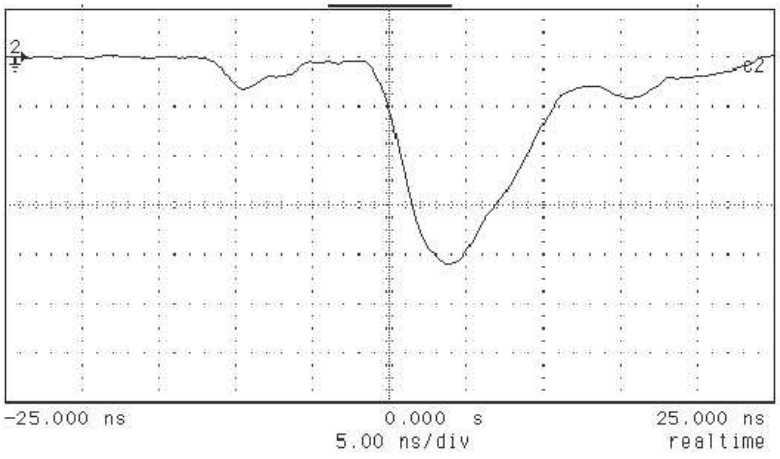
How to make a double gap Chamber?

- Noryl frames replaced by Fibres.
- The middle glass cut to accommodate the nozzle.
- Nozzle opens out in both the up and down layers.

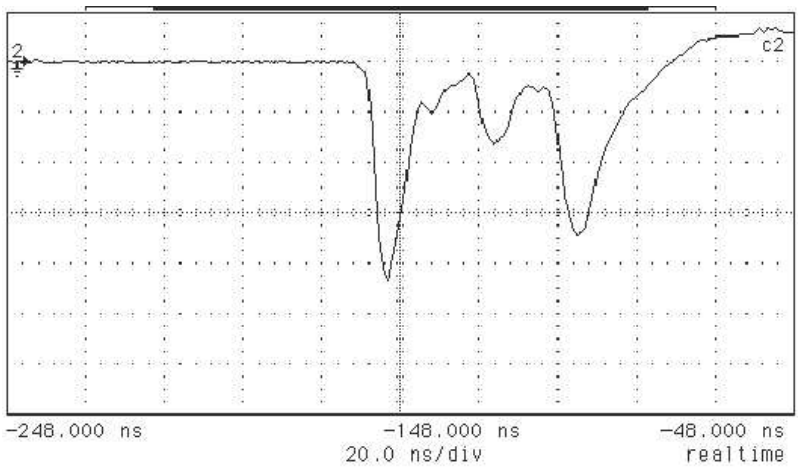




Oscilloscope output

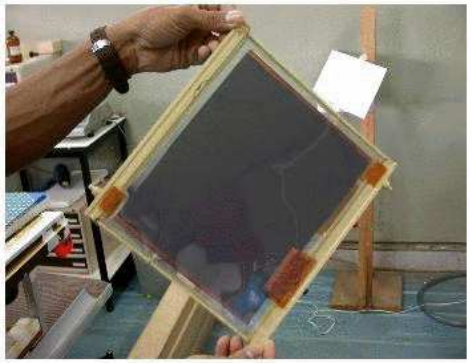


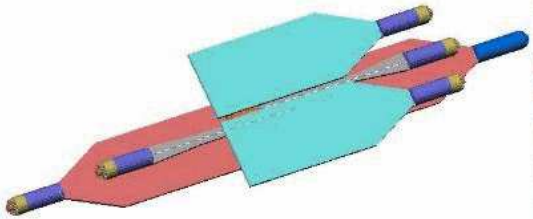
(a) Avalanche + Streamer Pulses



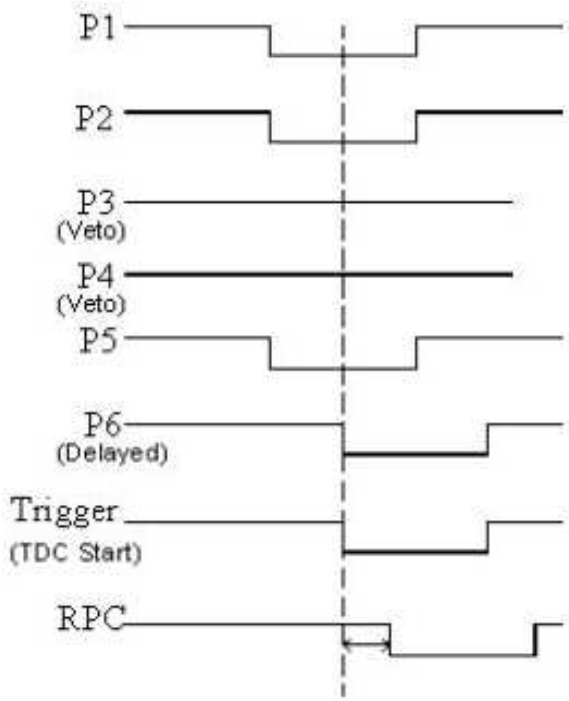
(b) Multiple streamer Pulses

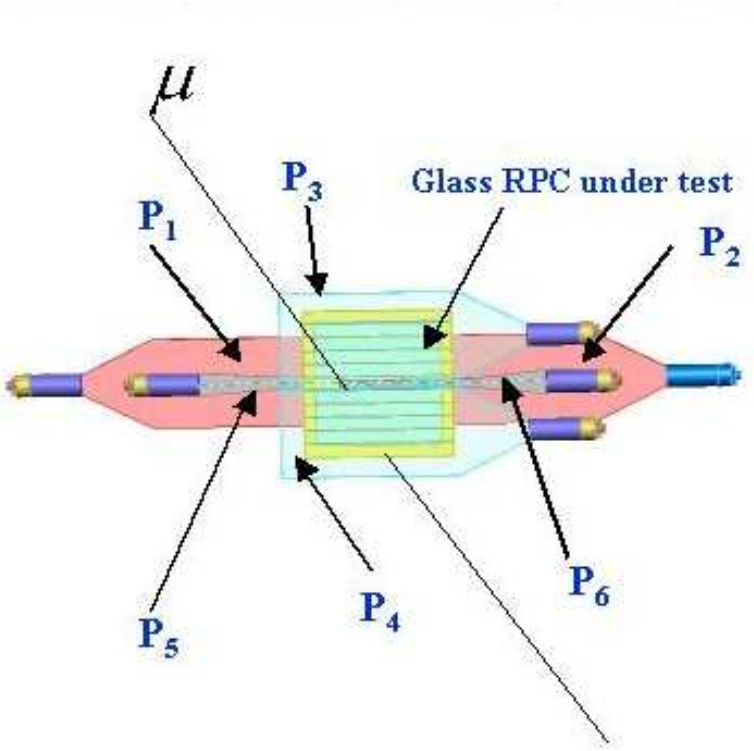
This is what you actually see in the Lab ...





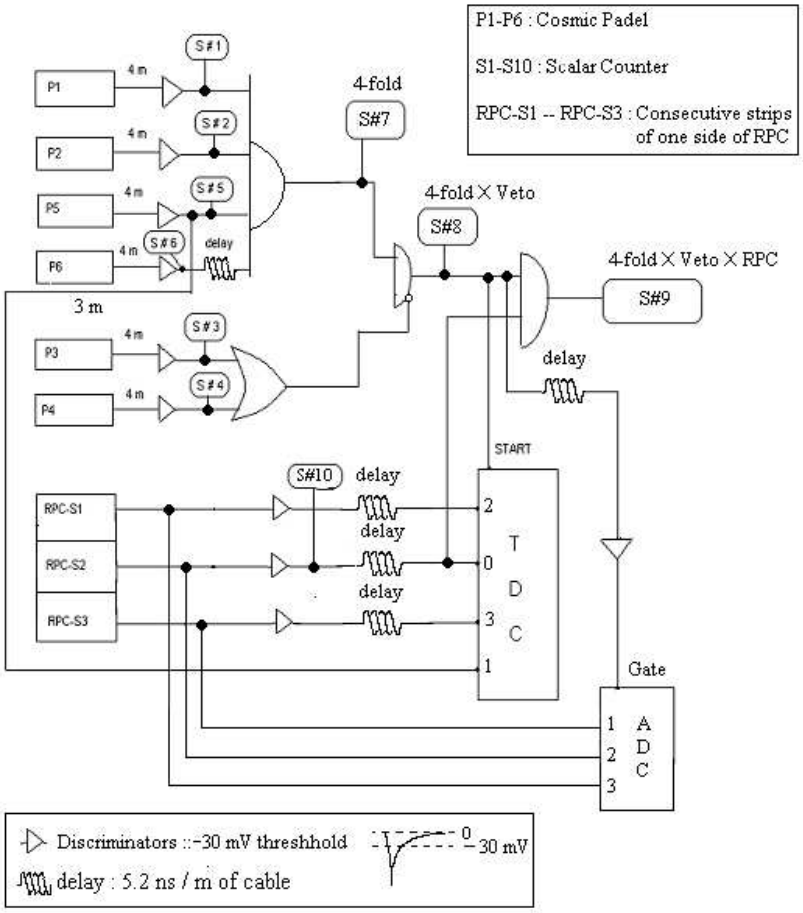
Schematic of the RPC test set up in the Laboratory





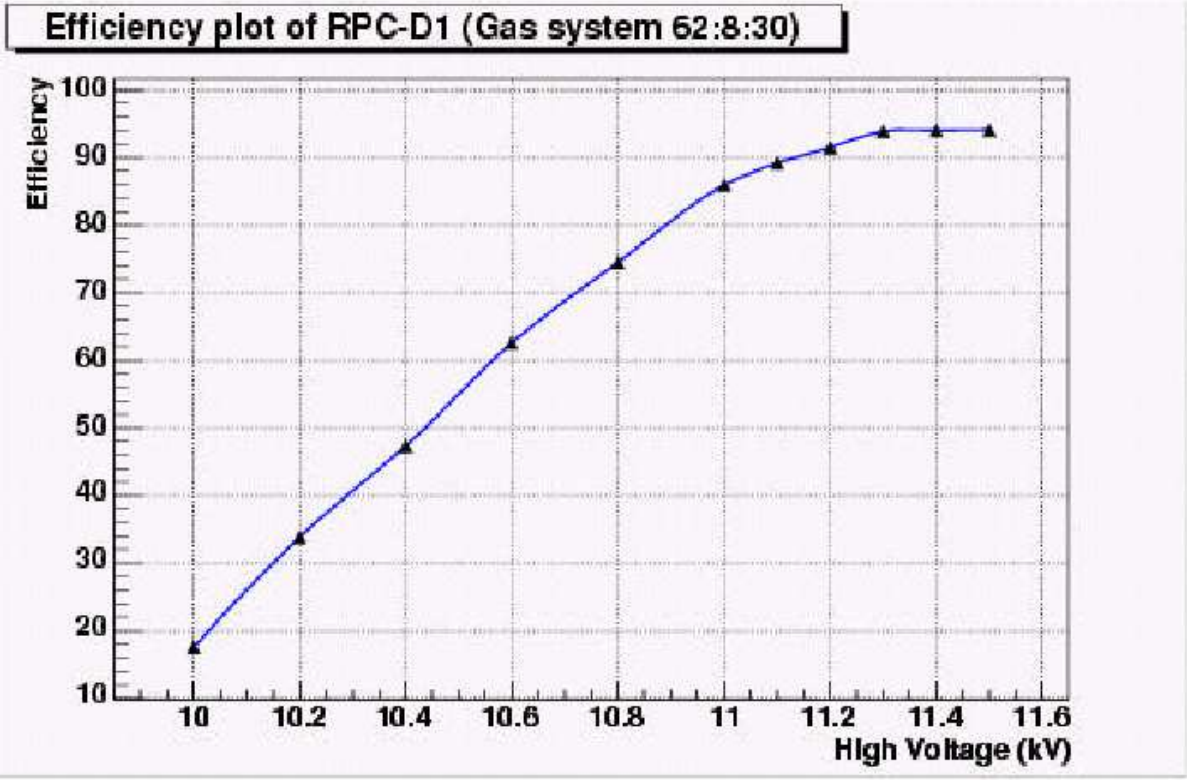
$$\text{Muon Trigger} = P_1 \cdot P_2 \cdot \bar{P}_3 \cdot \bar{P}_4 \cdot P_5 \cdot P_6.$$

Circuit for our experiment

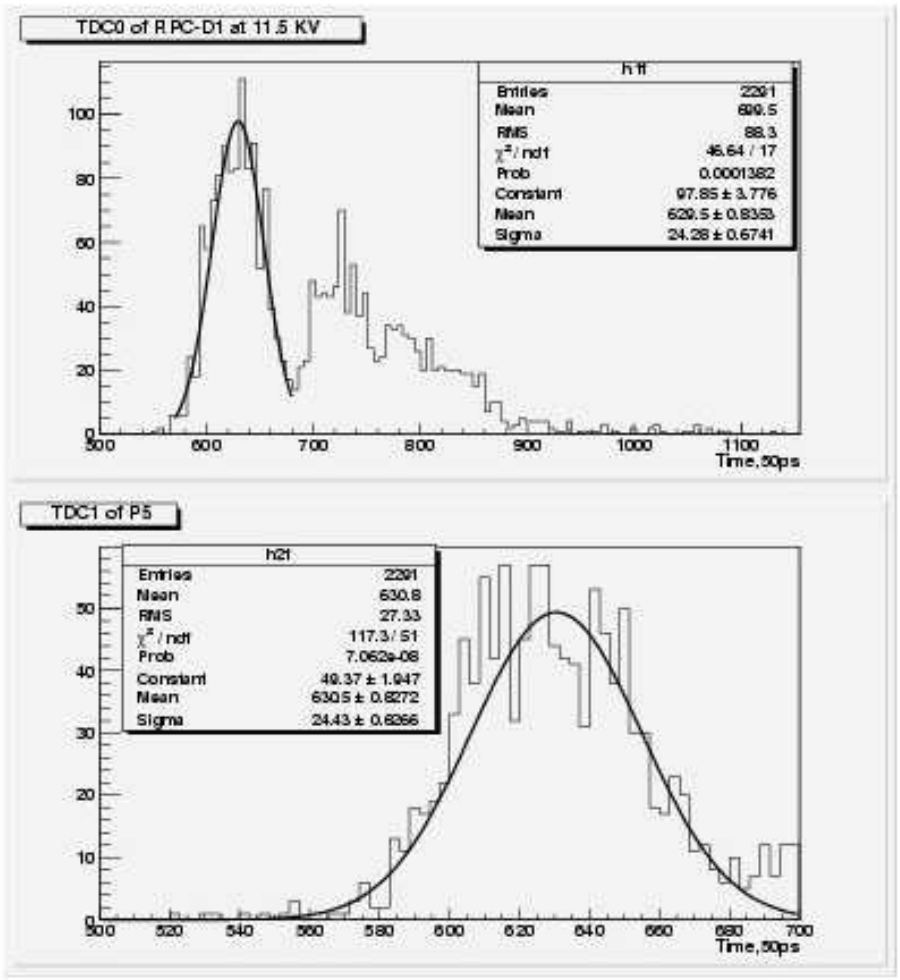


$$\text{Efficiency of RPC} = \frac{(4-\text{fold} \times \text{Veto} \times \text{RPC})}{(4-\text{fold} \times \text{Veto})}$$

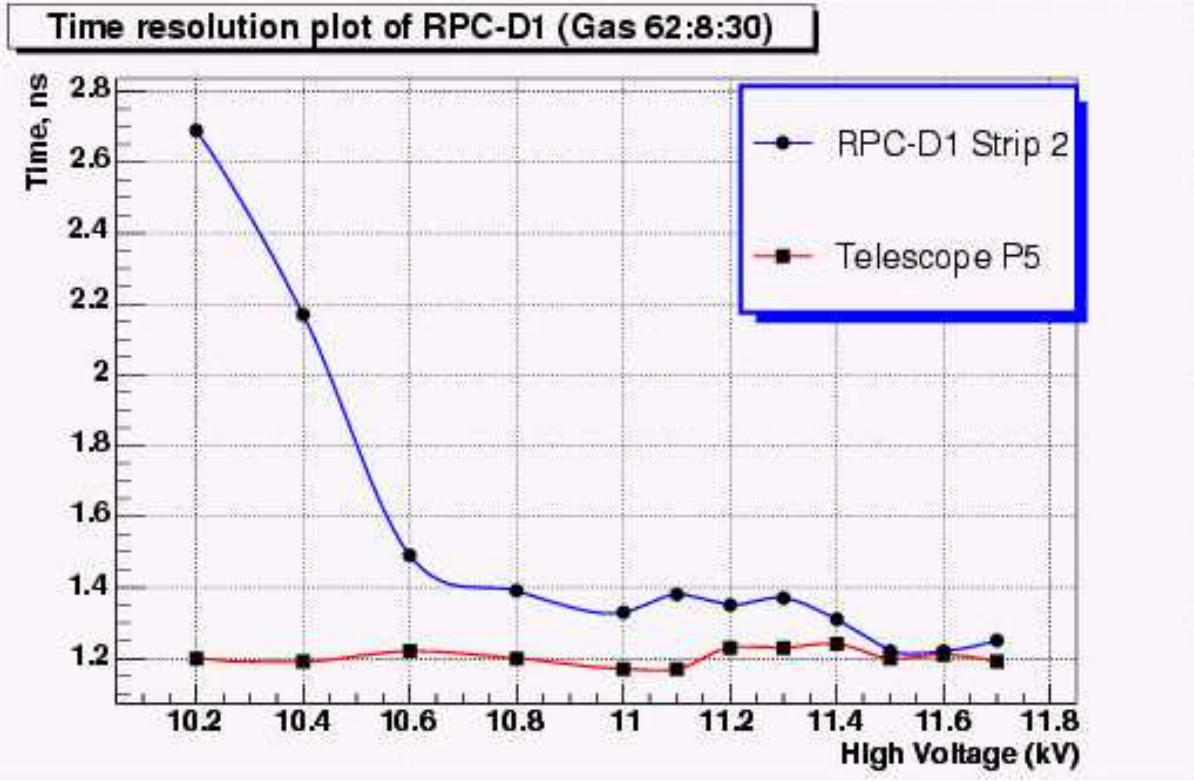
Efficiency Plot of Double gap RPC



TDC distribution plot of Double gap RPC and Cosmic Paddle



Time resolution Plot of Double gap RPC



Summary

- Discussed the Fabrication of a Double gap RPC.
- Analysed the Efficiency of a Double gap RPC.
- Talked about the pulse shapes.
- Studied the Time Resolution of a Double gap RPC.
- Compared with the Single gap chamber.

Thank You !