

Resistive Plate Chamber for HE

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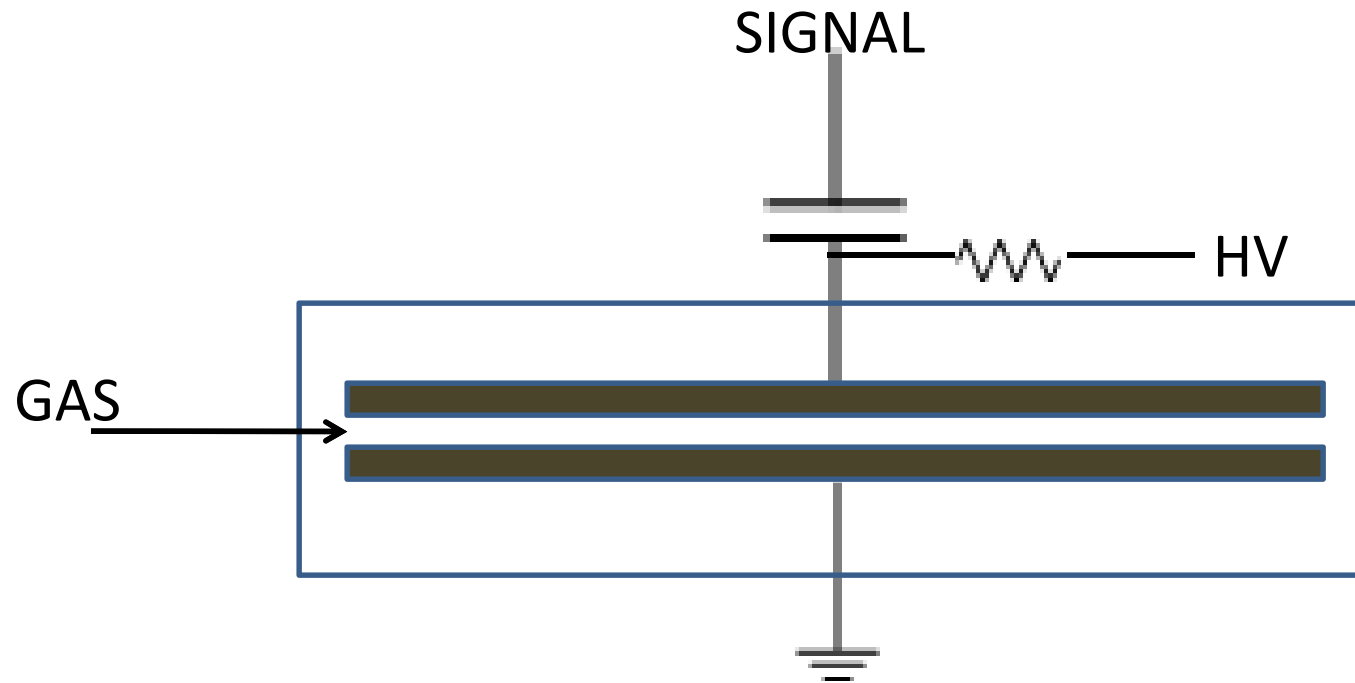
University of Iowa

For CMS Upgrade Workshop

5:30 PM Thursday

October 29 , 2009

A simple gas detector



Parallel plate avalanche chamber (PPAC)
Two plates with gas between them

A Problem

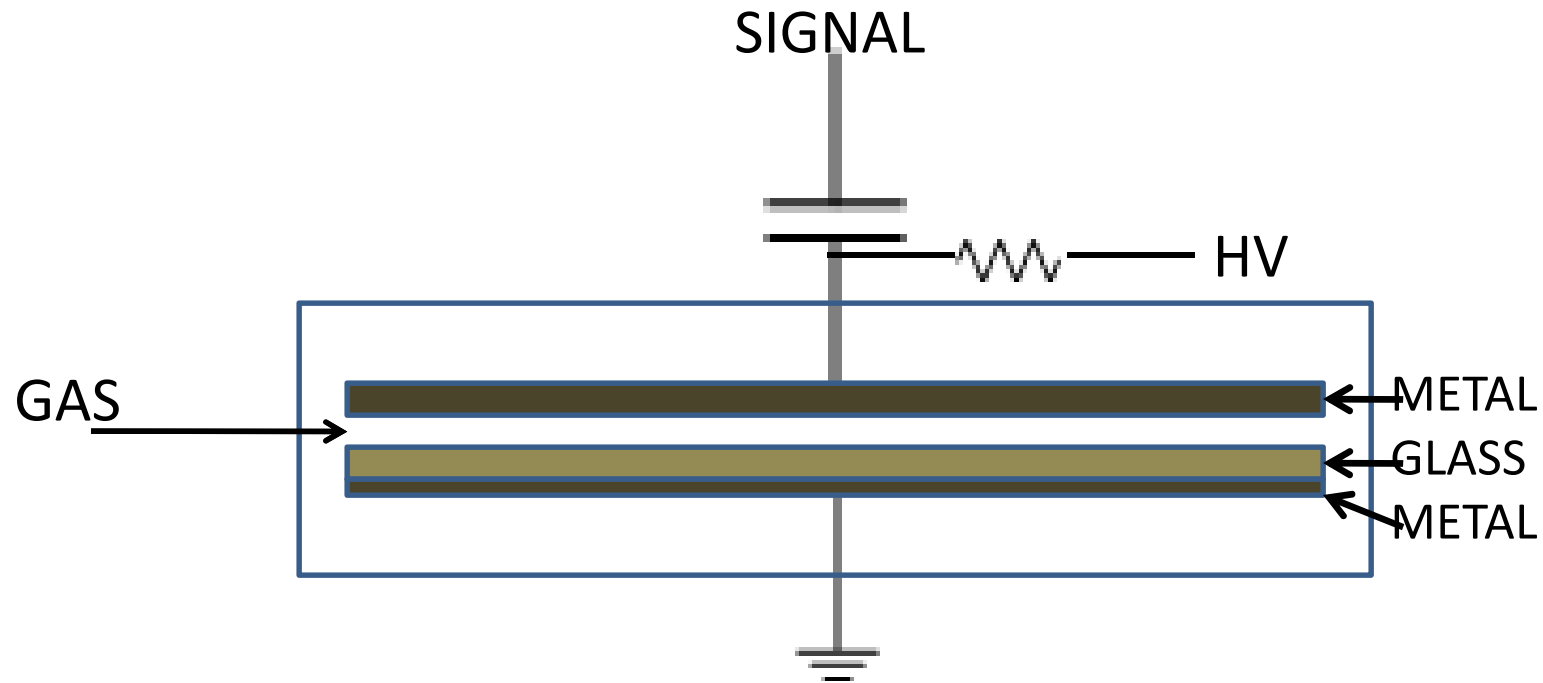
If the avalanche develops into a spark the entire charge on the plates goes through the spark.

The result is damage to the smooth surface of the plate.

Solution: Make plates of material with large resistivity.

However, surface must recharge before the next avalanche.

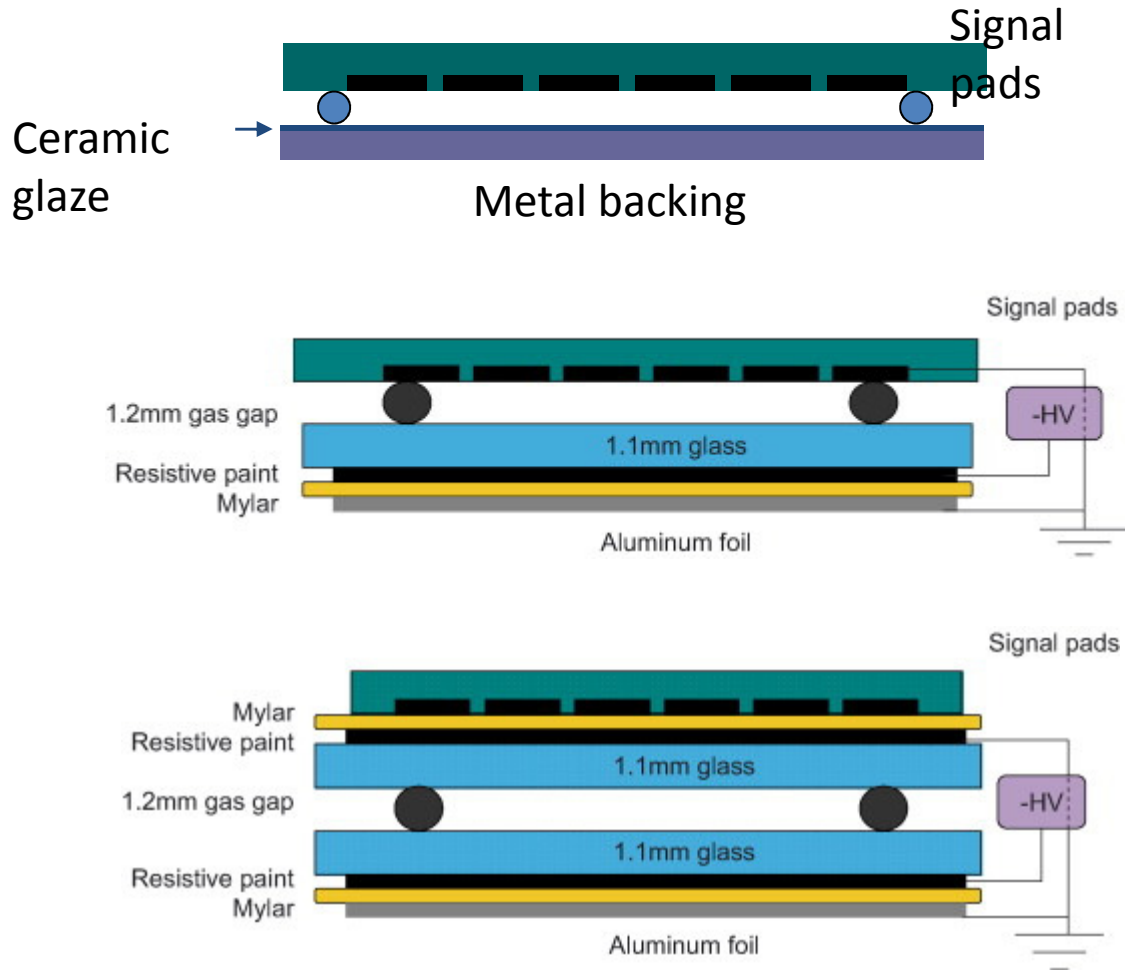
A simple Resistive Plate Chamber (RPC)



The detector can have the same area as the present scintillator tiles.

Can be made RAD hard!

Types of (RPCs)



Composition of resistive plate

Glass: Excessively high resistivity

Bakelite: Often used, but has many problems

Glass of a suitable resistivity does exist. We are currently working on getting it in the form of sheets of the needed area and thickness.

Some types of ceramic glaze have ideal resistivity.

Need to have flat, smooth layer of correct thickness.

Glass conductivity

- Most types of glass are a good insulators.
- Small currents are carried by ions (such as Na^+).
- Add iron to get electronic conduction.
- Want equal amounts of Fe^{2+} and Fe^{3+}
- No energy required to change $\text{Fe}^{3+} + \text{Fe}^{2+}$ to $\text{Fe}^{2+} + \text{Fe}^{3+}$.
- Hopping electrons can carry larger currents.
- Might expect a rust colored opaque glass.

Gas for the PRCs

Ambient pressure (1 atm)

Could possibly share gas supply with the muon RPCs
(94.5% R134A (F3C2FH2), 5% isobutane 0.5% SF₆)

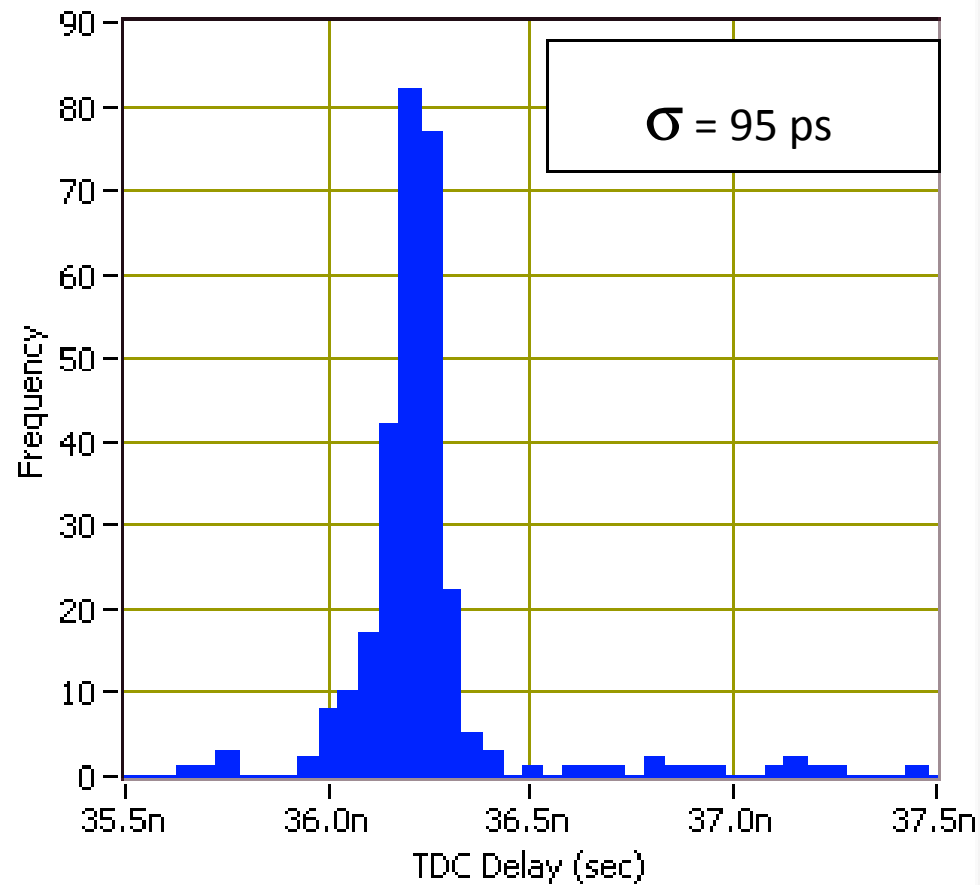
Pure C₄F₈ may be better.

A double PPAC for testing time and energy resolution.



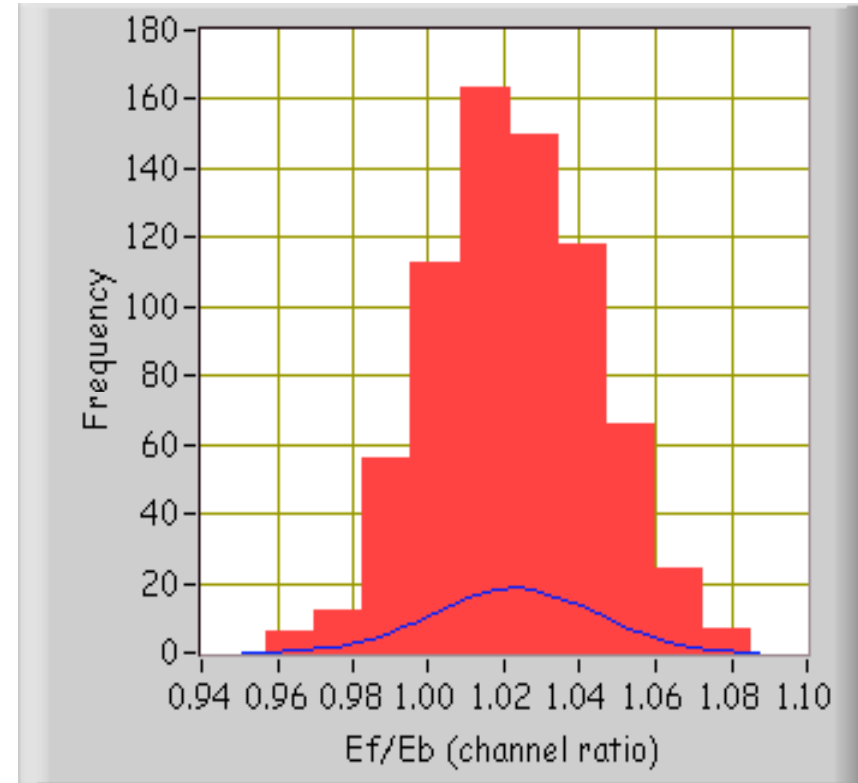
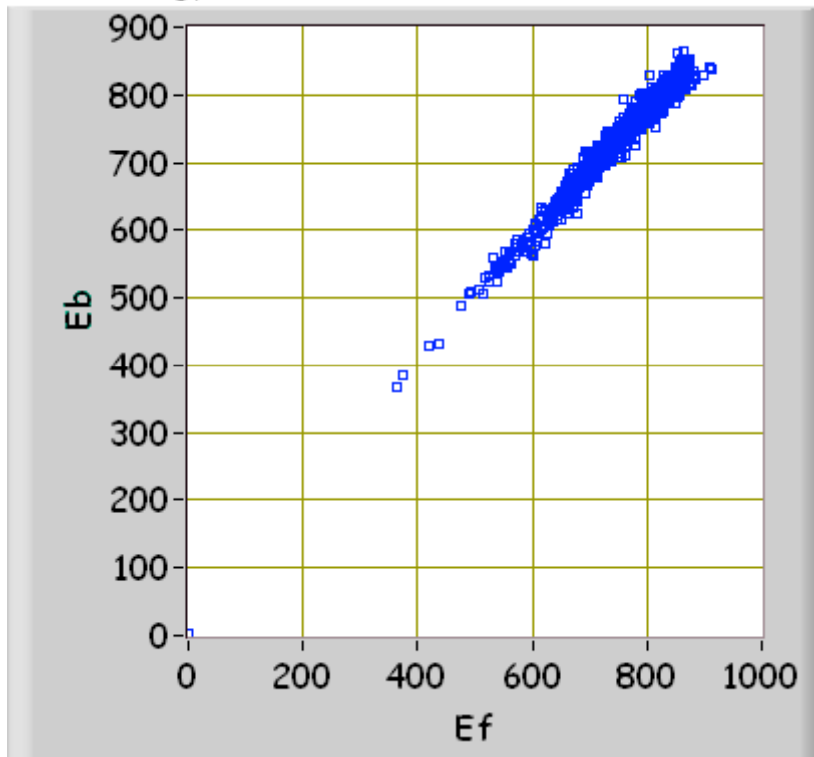
Timing resolution

TDC Histogram



Energy Resolution Data of PPAC Test at ANL

Raw Energy Data



Ratio E_{front} to E_{back} is constant to within $\pm 2\%$

Conclusions

An RPC provides a RAD hard alternative for the present scintillator detectors in HE

PROVIDED:

The resistive plate has optimum resistance (per sqcm)