

Resistive Plate Chambers Detector

IRTG Fall School 2006
Heidelberg, 07.10.2006



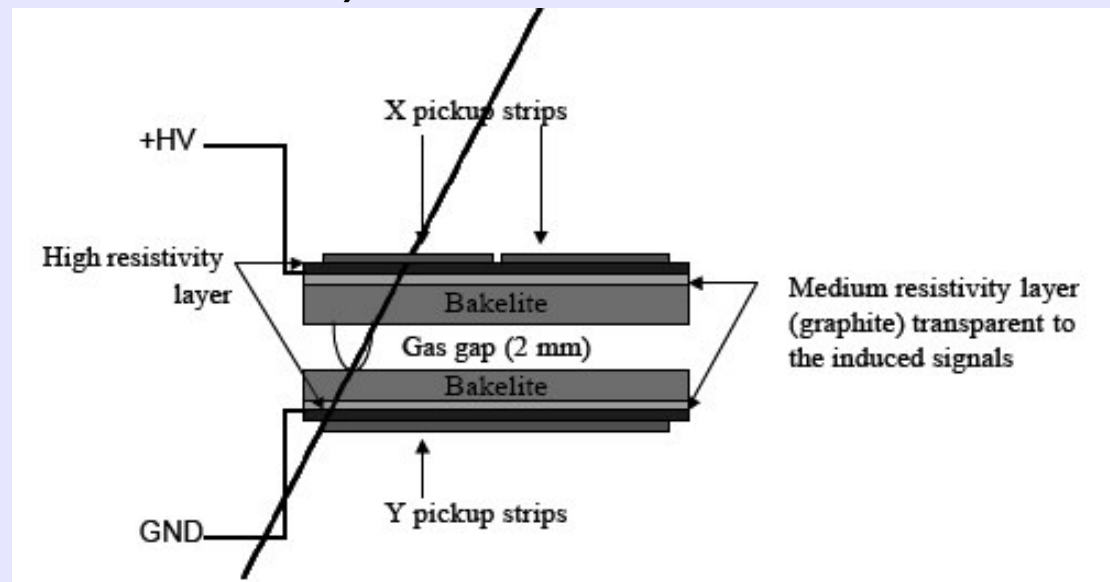
Overview

- Introduction
- Setup and Realization
- Results

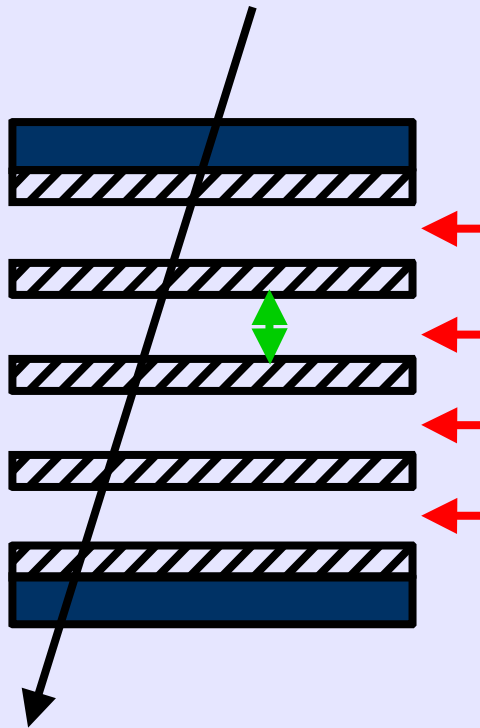


Main Features

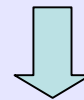
- Combines spatial resolution of wire chambers & time resolution typical for a scintillation counter
- Reduced cost per unit area / simple buildup
- Good (about 1ns) time resolution



Functionality of multigap-RPCs



- ▶ Stack of equally-spaced resistive plates with voltage applied to external surfaces
- ▶ Internal plates are electrically floating at a voltage given by electrostatics, and are then kept at correct voltage by the flow of positive ions and electrons
- ▶ Number of plates increase signals
- ▶ Avalanches in different gaps independent: Signal = sum of all micro-avalanches
- ▶ The charge distribution follows a \sim Landau distribution



Stable condition: equal gain in all gas gaps

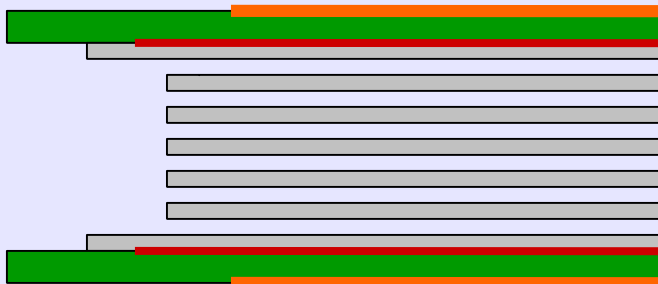


Timing

- First gap give rising edge
- Small gap provides good time resolution
- Minimum gap size 200-250 μm due to construction efforts



Double Stacks



Solution:
Double stack MRPC



ADVANTAGES:

Lower HV applied

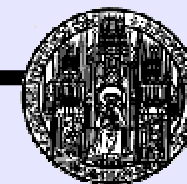
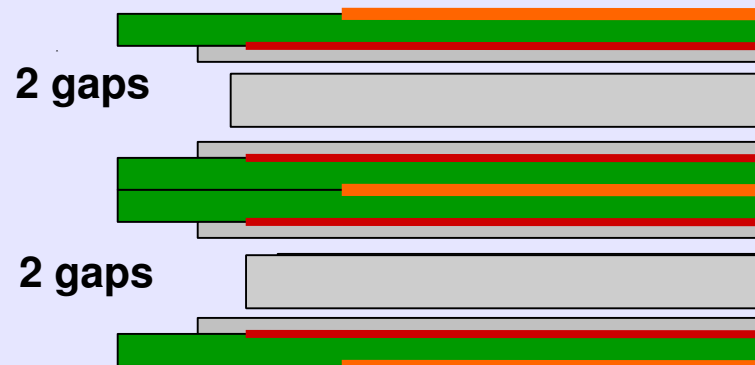
Signal increased by a factor

2

Charge footprint on the
pad more defined

(reduced distance between
electrodes)

Possibility to increase the
number of gaps



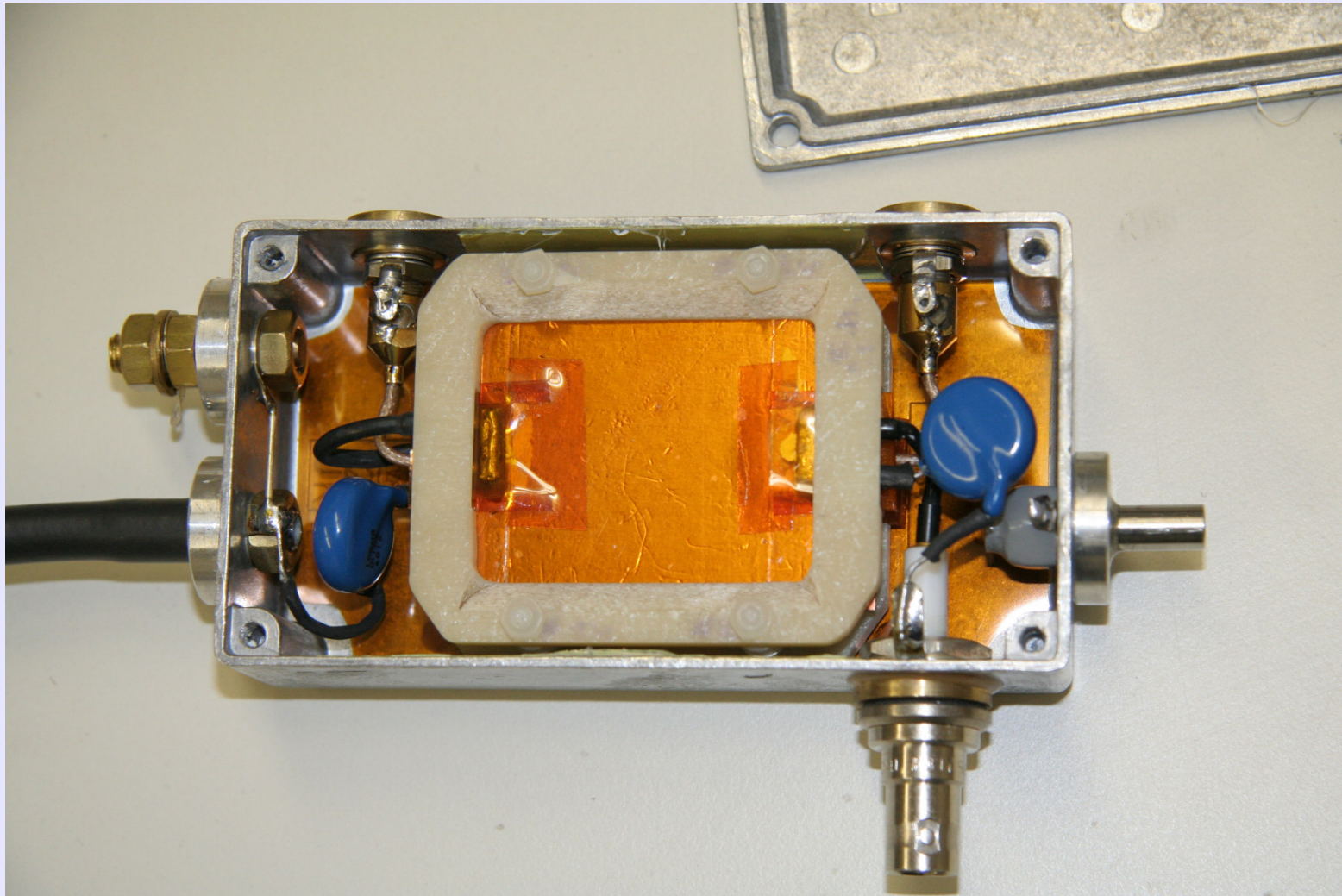
Gas Mixture

- Typical mixture in avalanche Mode:
 - Tetrafluoroethane ($C_2H_2F_4$) Base
 - 2% to 5% isobutane (C_4H_{10}) – quencher
 - 0.4% to 10% sulphur hexafluoride (SF_6) e-quencher
- Our Mixture:
 - Freon (85%)
 - Sulphur hexafluoride (10%)
 - Isobutane (5%)

Freon is highly environmentally-unfriendly

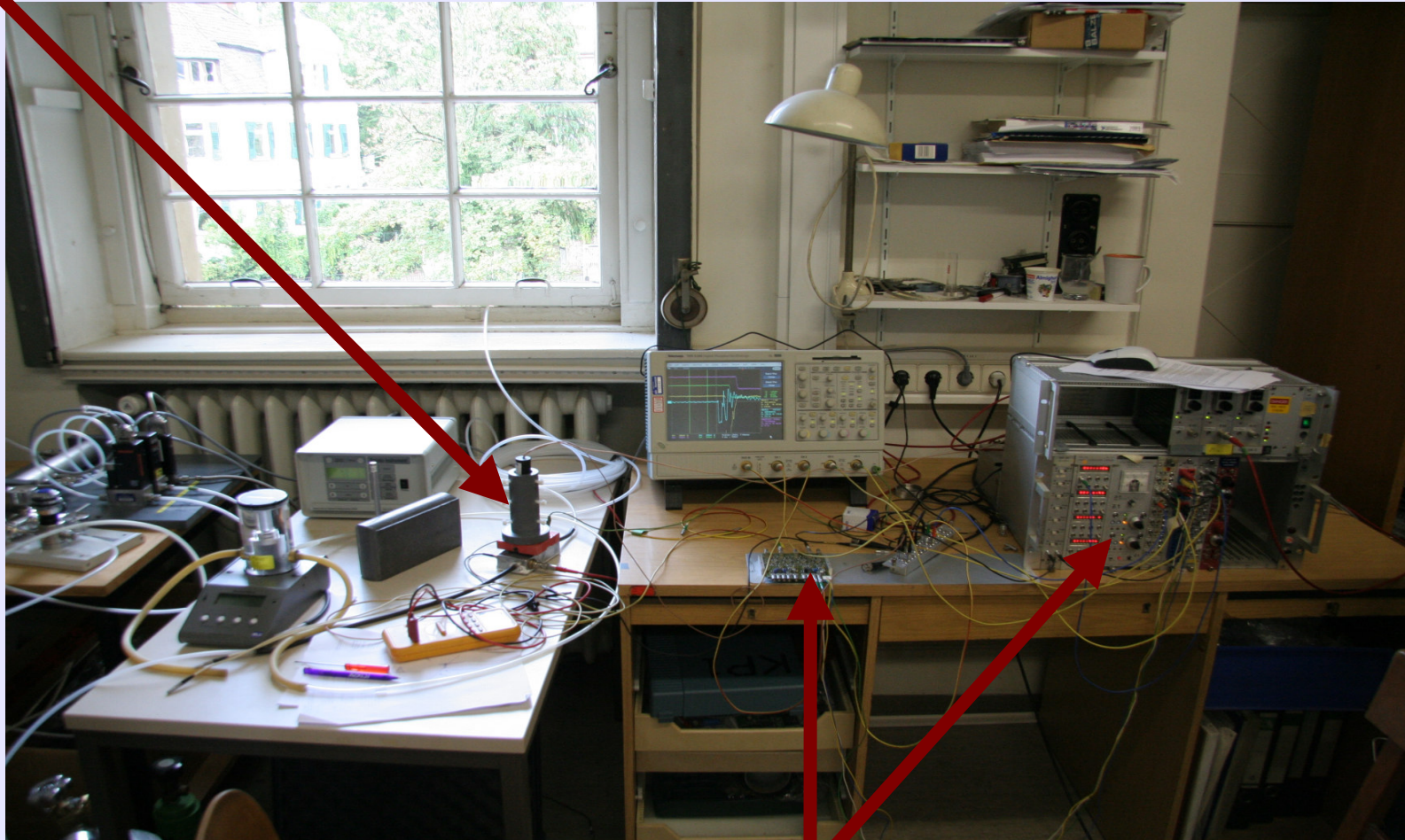


RPC



Setup & Realization

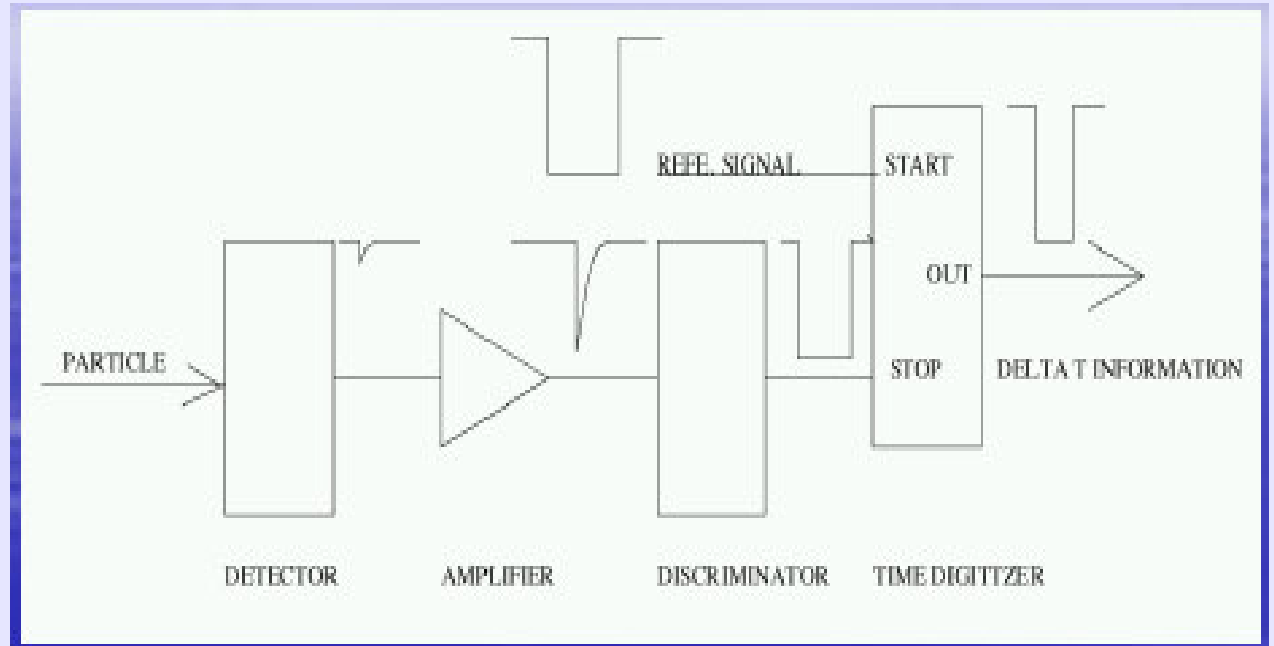
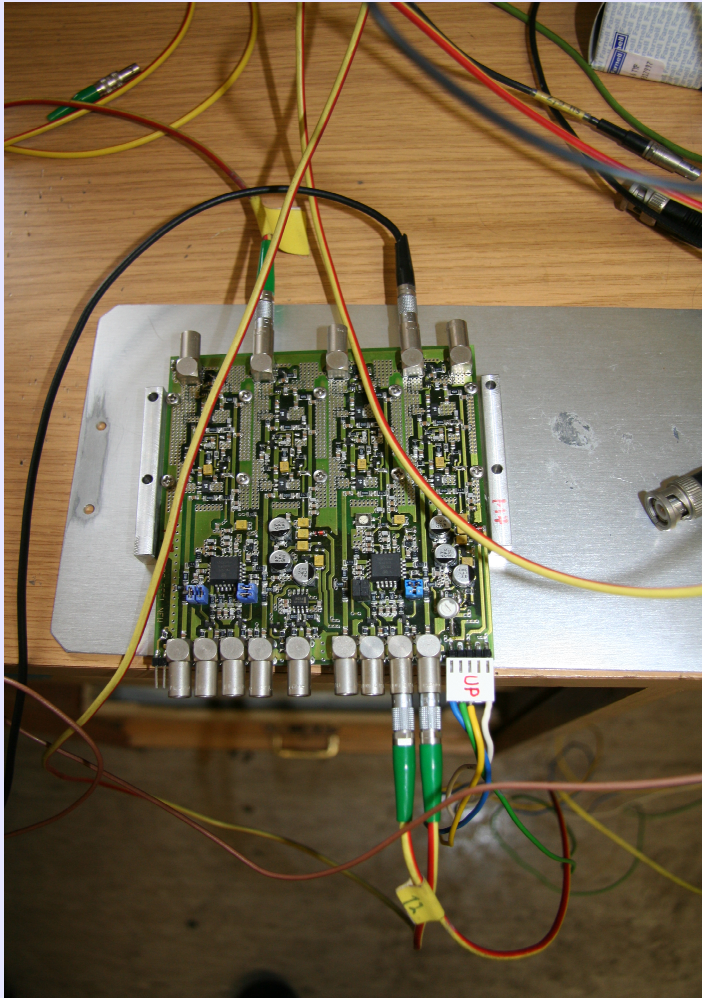
RPC & scintillator



„Readout electronics“



Setup & Realization

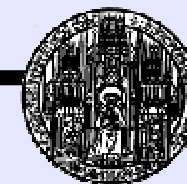
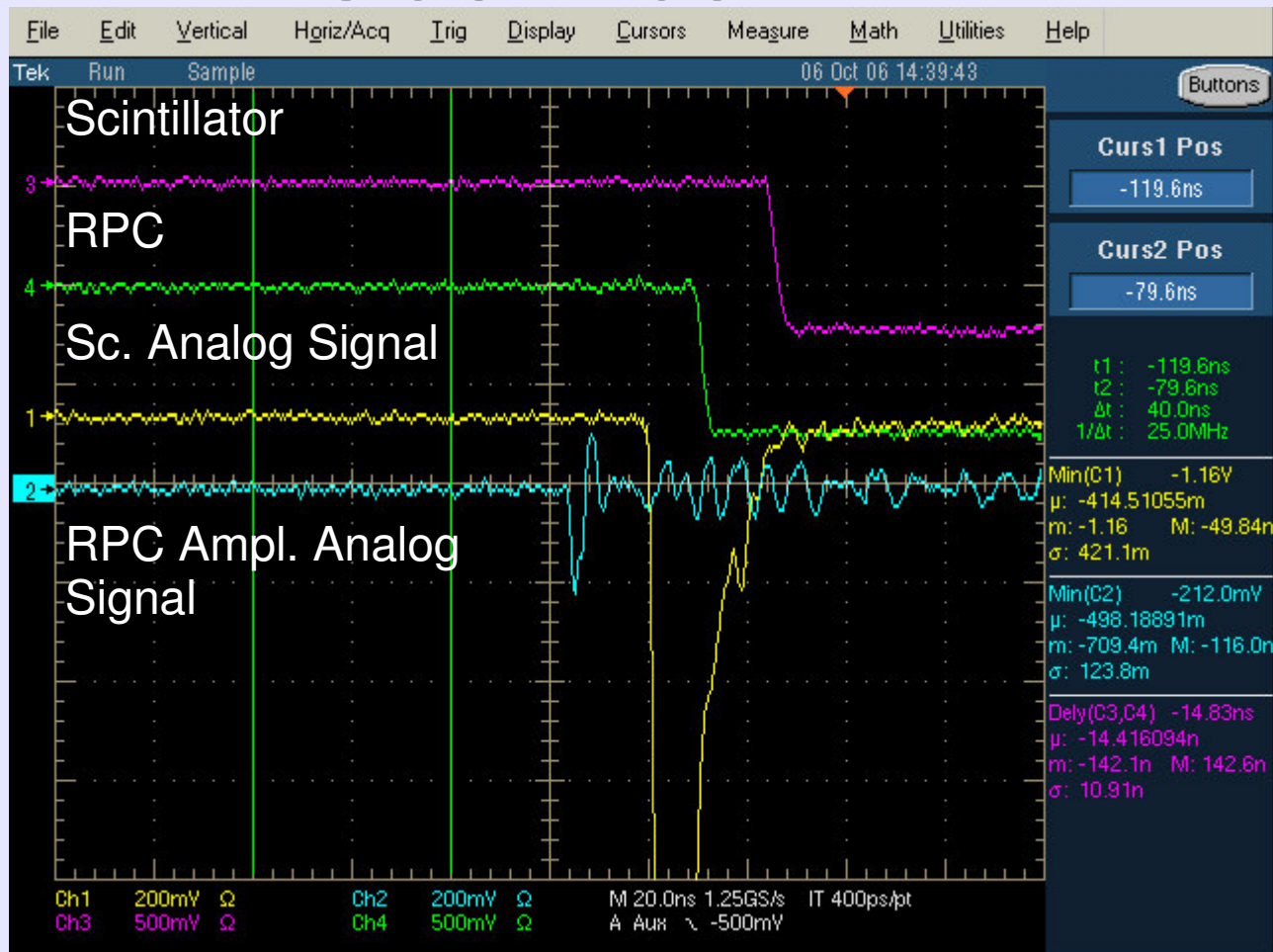


Setup & Realization

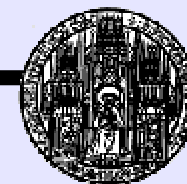
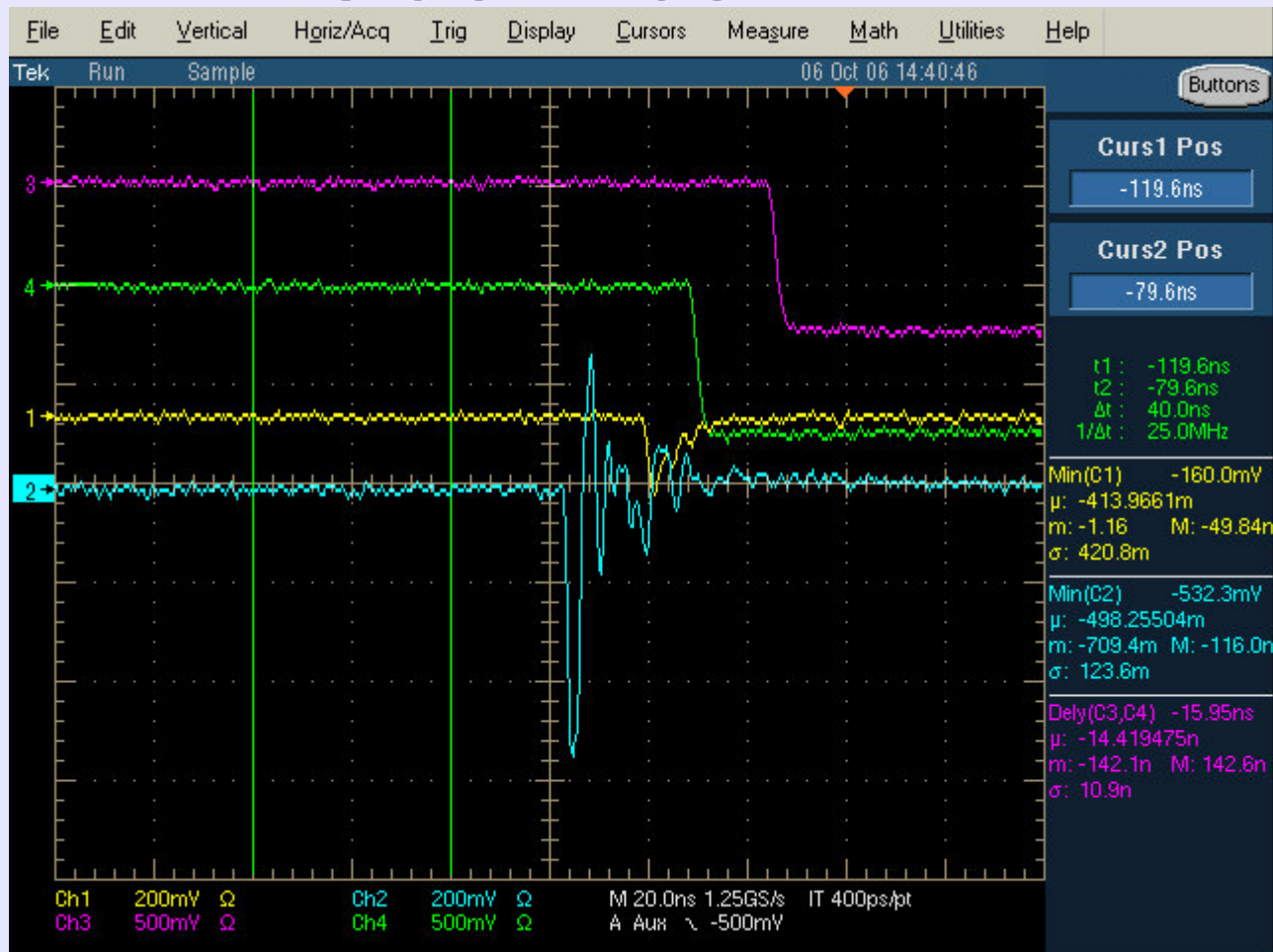
- RPC direct output
- RPC analog amplified
- Digital from FEE
- Digital from discriminator /pulswidth shaper



Different Detector Responses to Cosmics #1

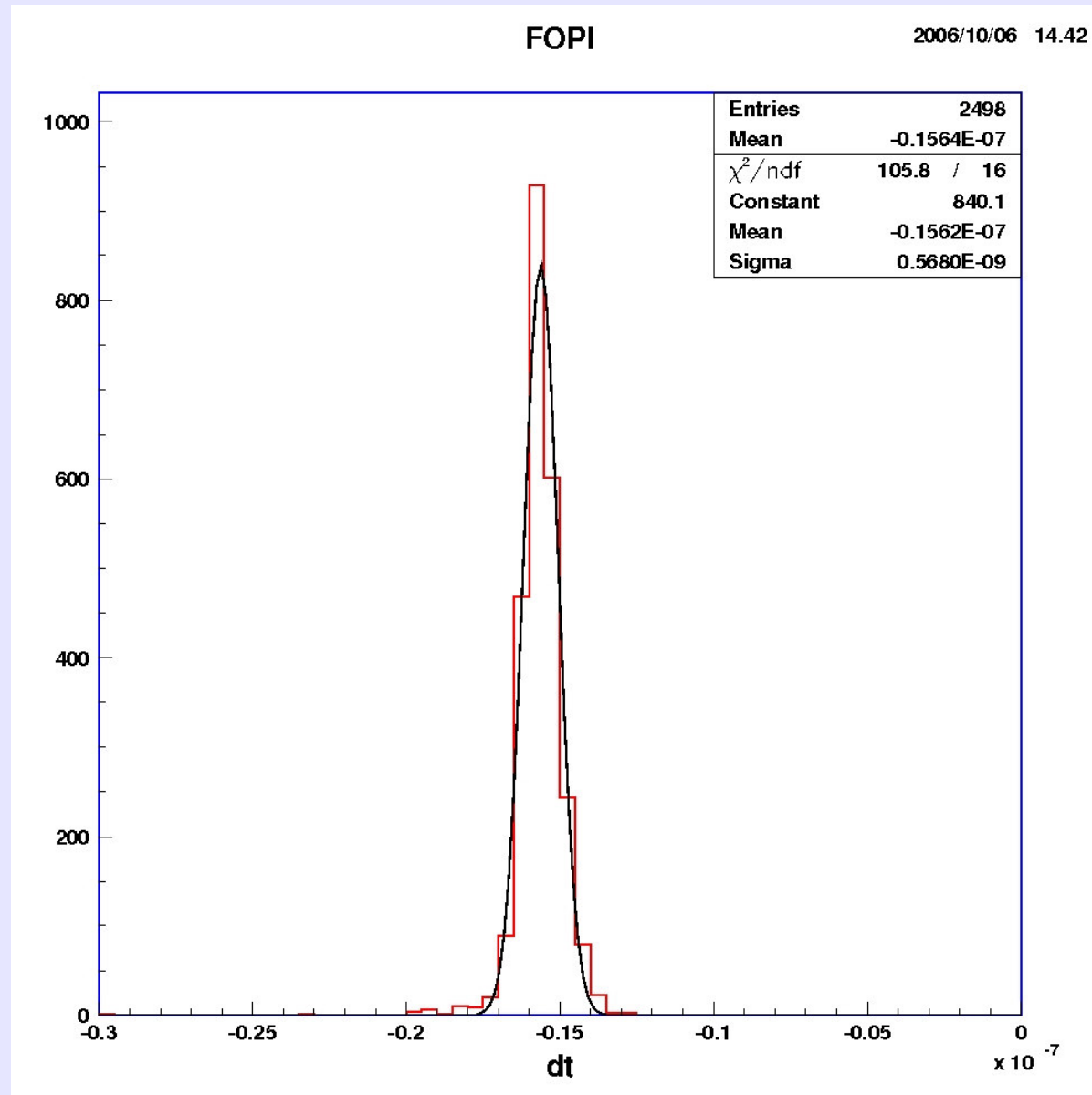


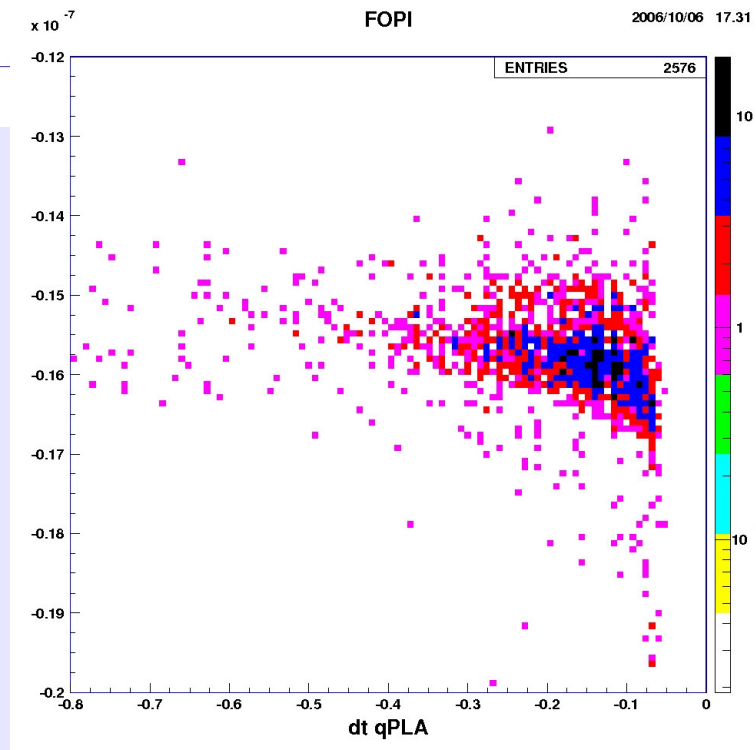
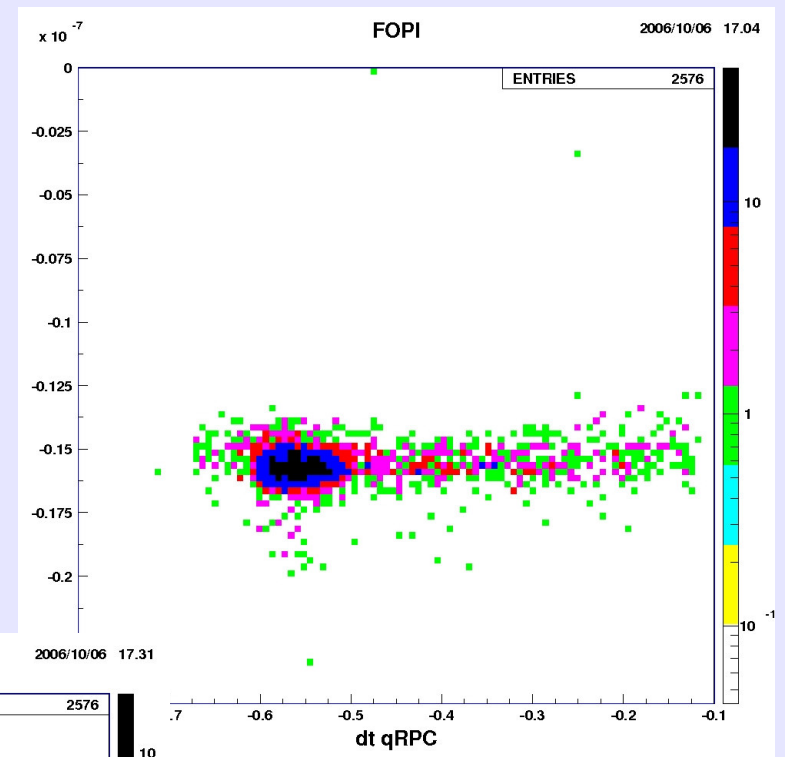
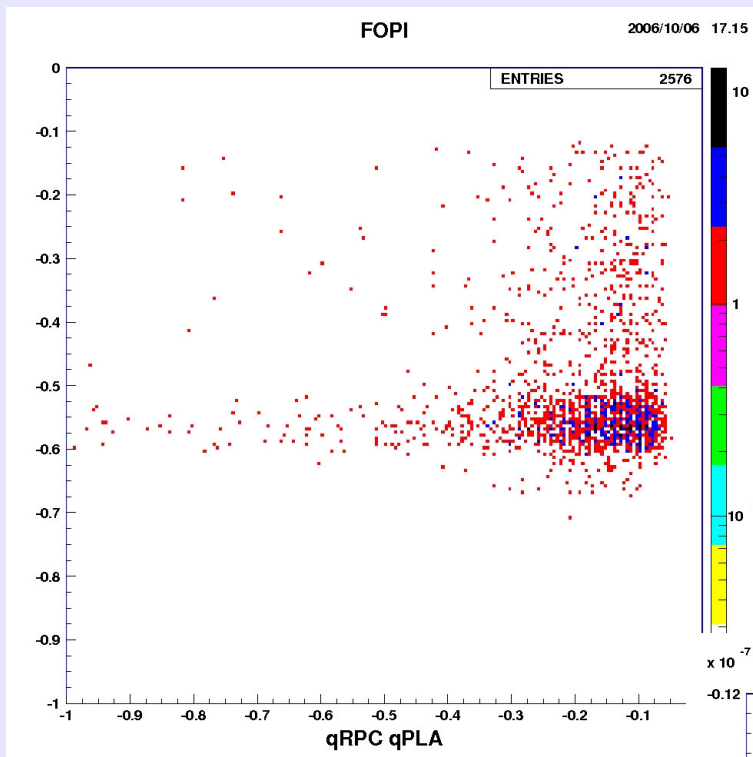
Different Detector Responses to Cosmics #2



Results of Cosmic Run

Before Cut





Time Resolution Cosmics

After Cut

