Two-hit seperation

Outline:

Intro: stand alone simulation

RC parameters

Validation of several cases
- single hit resolution (r-phi and Z)
- Two-hit separation in r-phi and Z
- Plan for 3D two-hit separation

Summary

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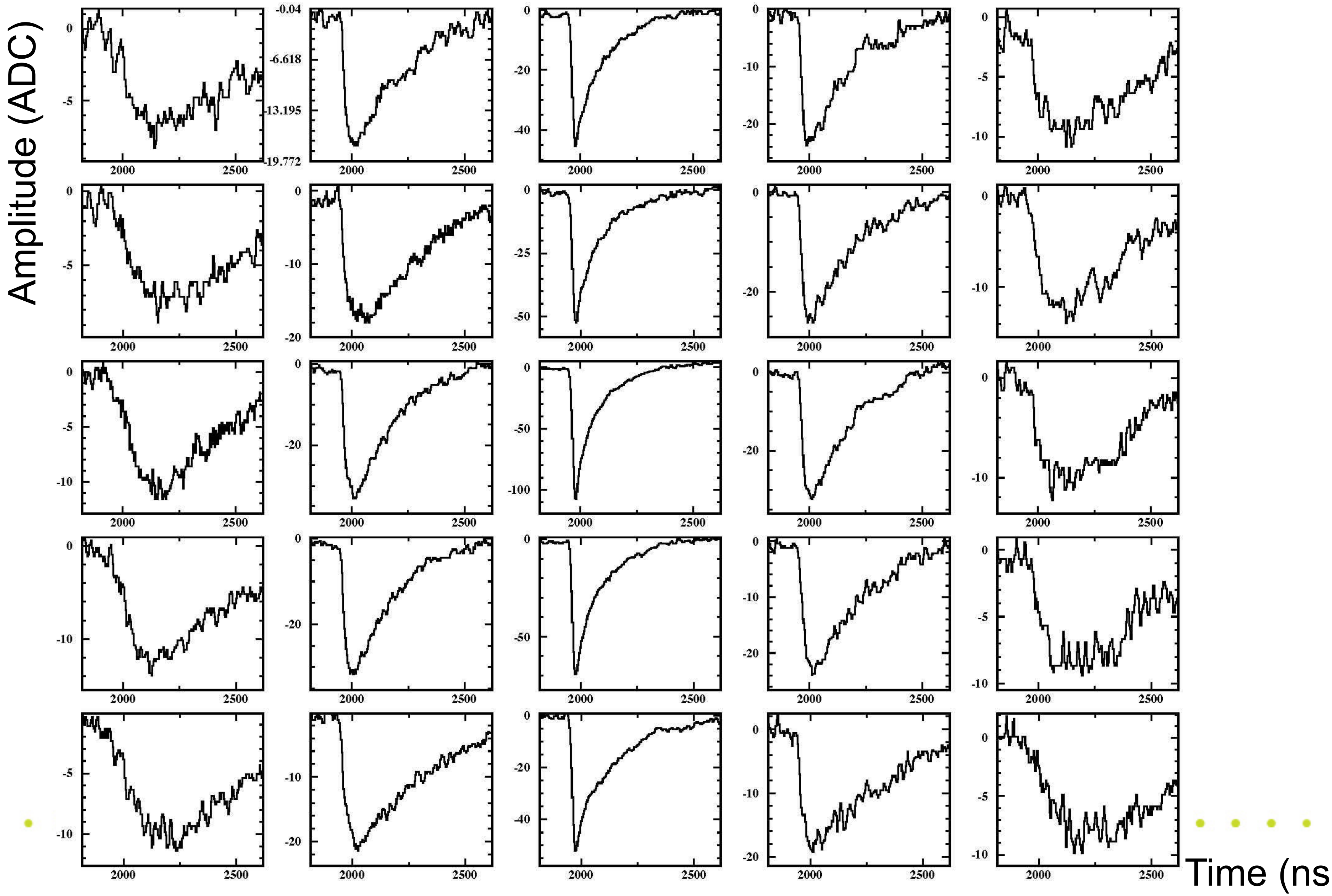
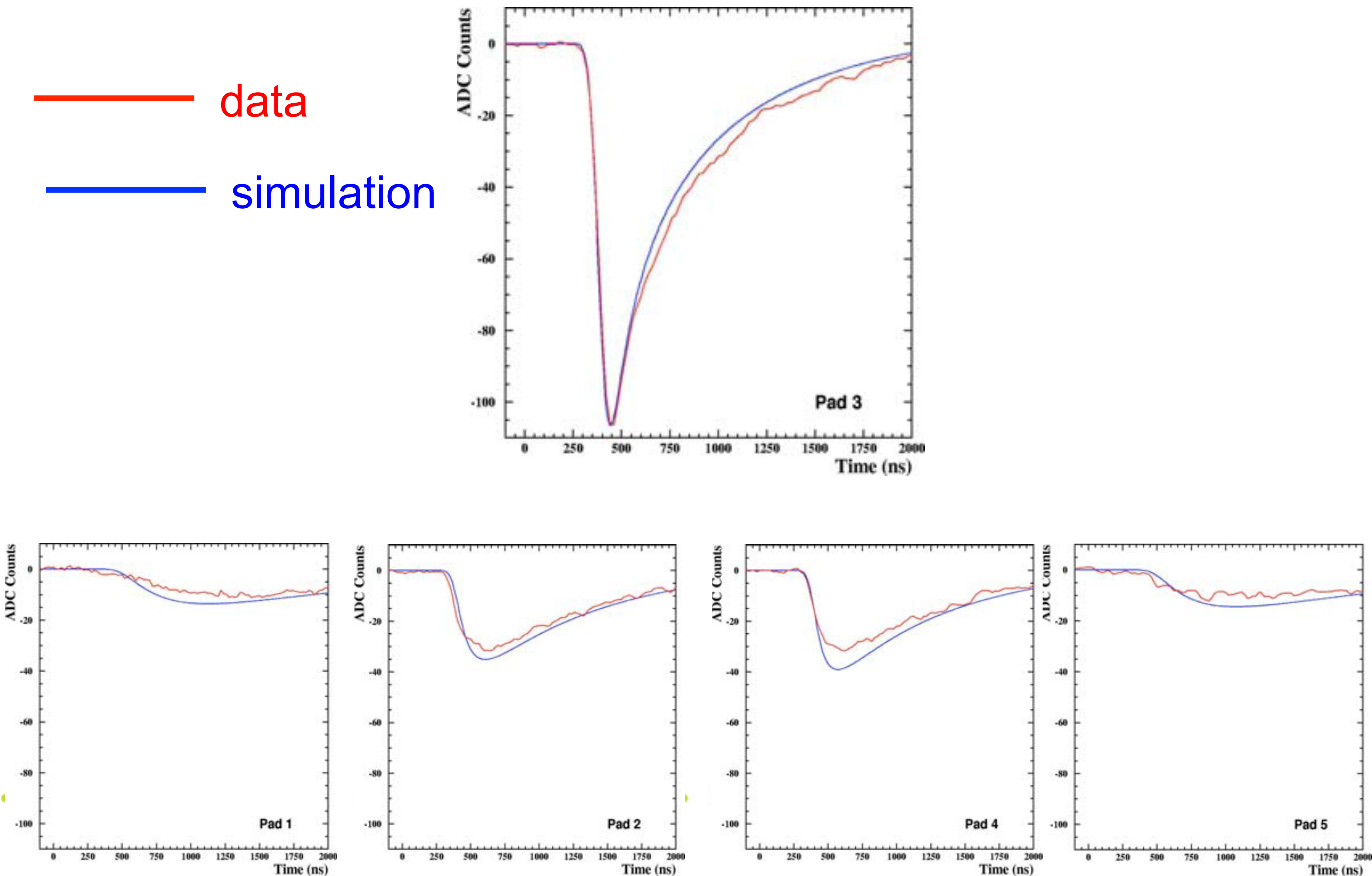
Introduction: stand alone simulation



Introduction: stand alone simulation



Resistive layer parameters

Resistive anode readout parameters

Parameter definitions and units

K = Dielectric constant **Dielectric constant is not always known - estimated value**

t = Total dielectric gap size in microns

R = Resistivity in k-Ohms per square

Capacitance density(pF/mm^2) = 8.854K/t

Time constant(ns/mm^2) = 8.854 KR/ **This is the figure of merit for charge dispersion readout**

Detector	Film	Type conductor	R k-Ohm/sq	Thickness microns	Glue/spacer microns	t microns	K guess	Capacitance density	Time constant (ns/mm^2)
Carleton GEM TPC	C loaded Kapton	Bulk	530	25	50	50	1.5	0.266	141
DESY - 5 T test	Al CERMET	Surface	1000	25	50	70	1.6	0.202	202
DESY beam test	C loaded Kapton	Bulk	5000	25	76	76	4.5	0.524	2621
New CERN Kapton	C loaded Kapton	Bulk	3200	25	76	76	4.5	0.524	1678
ATLAS TGC process	Graphite coating	Bulk	1000	15	100	102	4.5	0.391	391
TGC process 500k	Graphite coating	Bulk	500	15	100	102	4.5	0.391	195
TGC process 200 k	Graphite coating	Bulk	200	15	100	102	4.5	0.391	78
TGC process 100 k	Graphite coating	Bulk	100	15	100	102	4.5	0.391	39

The optimum figure of merit ~ 300 ns/mm^2

C=K*ε0*A/d (in SI units)

where

C is the capacitance in Farads, F

A is the area in square metres.

K is the the dielectric constant

ε0 is the permittivity of free space, ε0 = 8.854x10-12 F/m

d is the dielectric gap size in metres.

Material	K	
FR4	4.5	
Kapton	3.5	
Mylar	3.2	
Scotch 467MP 3M	3.4	at 1 kHz

Pad: 2 cm x 6 cm

Charge deposited right above MM mesh

25 MHz sampling rate & 100ns peaking time

Basic results (validation)

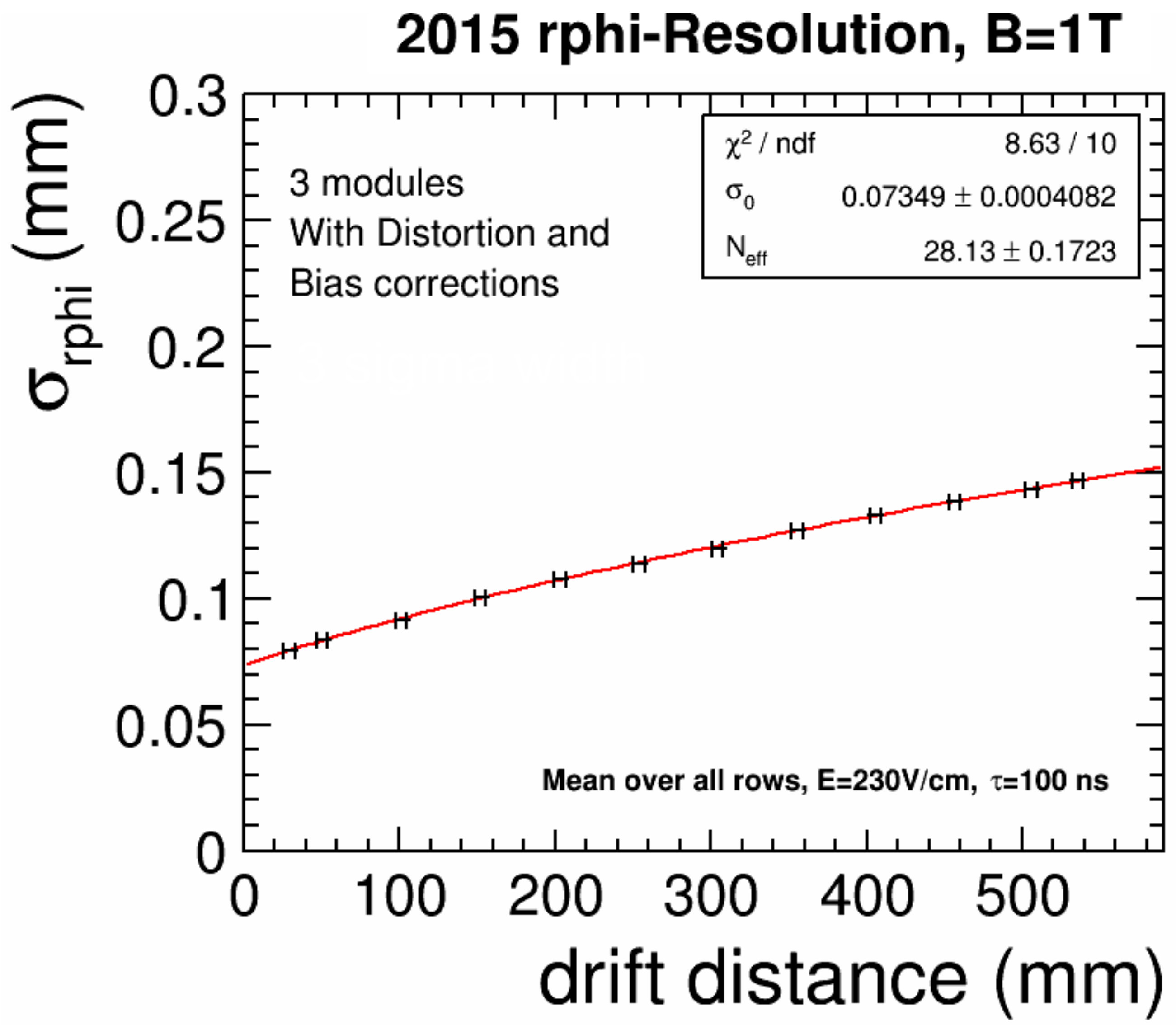
- Force charge on **ONE** pad: no resistive layer & no diffusion

σ(xy) ~ 570 μm
σ(Z) ~ 175 μm (~2.3 ns)
Δ(2-hit xy) ~ 2000 μm
Δ(2-hit Z) ~ 7600 μm (~100 ns)

- Resistive layer (BD) & no diffusion

σ(xy) ~ 50 μm
σ(Z) ~ 300 μm (~4 ns)
Δ(2-hit xy) ~ 1600 μm
Δ(2-hit Z) ~ 8500 μm (~112 ns)

rphi- resolution fit, 100 ns data



Summary

- Stand alone validation validated in r-phi and Z

- Conclusion r-phi:
  1. resistive layer allows for a better single hit resolution
  2. PRF allows two-hit separation better than pad width

- Conclusion Z
  1. Resistive layer slightly degrade the single hit resolution as well as the two-hit separation (in time only)
  2. Still well within the ILD specification

- Next step to do 3D separation (pattern recognition)

- Based on occupancy versus radius in ILD get optimal pad width and electronics sampling frequency