

A Simpler Induction Signal Measurement for a TPC with a GEM Readout

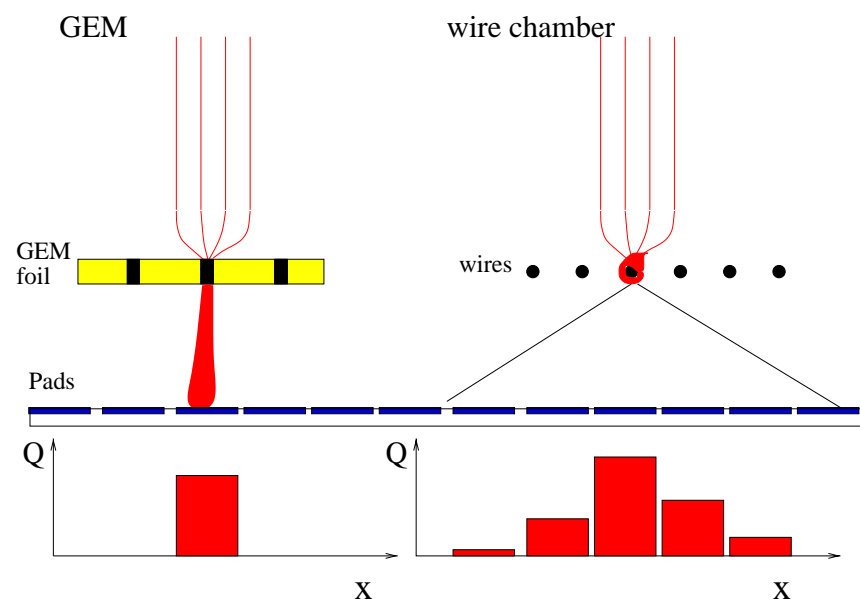
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- ◆ In an ideal TPC, the spatial resolution should be limited only by diffusion
- ◆ In a proportional wire/pad readout TPC, the induced cathode pad signals have similar shape
Position from centroid of pad signals
Resolution approaches diffusion limit only
when the track angle and ExB systematics cancel
- ◆ The spatial resolution for a TPC with GEM readout should be close to the diffusion limit for all tracks & angles using the induction and charge signals
- ◆ If the charge signal is collected by only 1 pad (small transverse diffusion @ 3-4 T)
 $\sigma \sim \text{pad width (1-2 mm)} / \sqrt{12}$
~ worse with increasing track angle
- ◆ But, the induction signals are quite small
Shape different from that for charge signal
Resolution improvements from induction may be difficult to realize for high track density jets

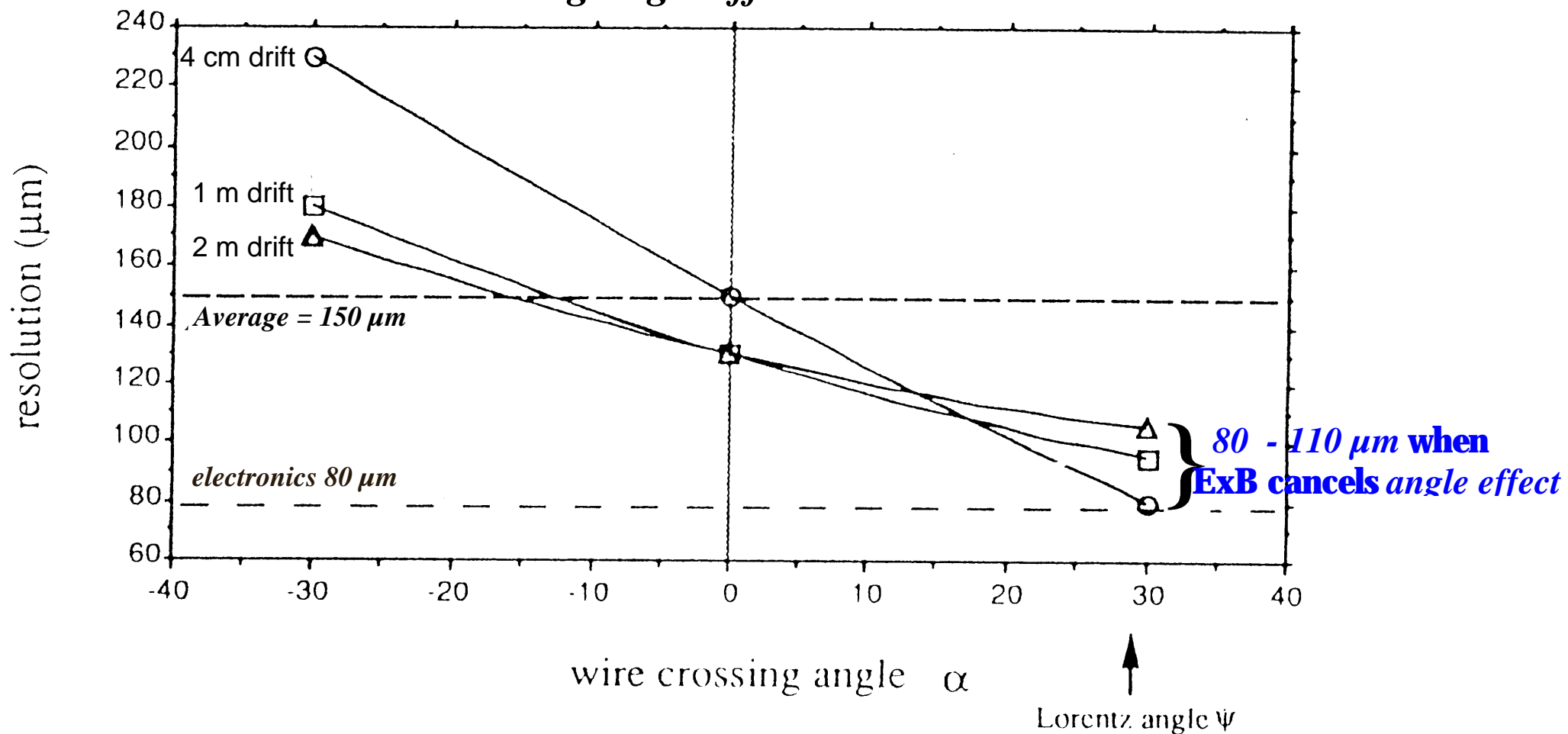


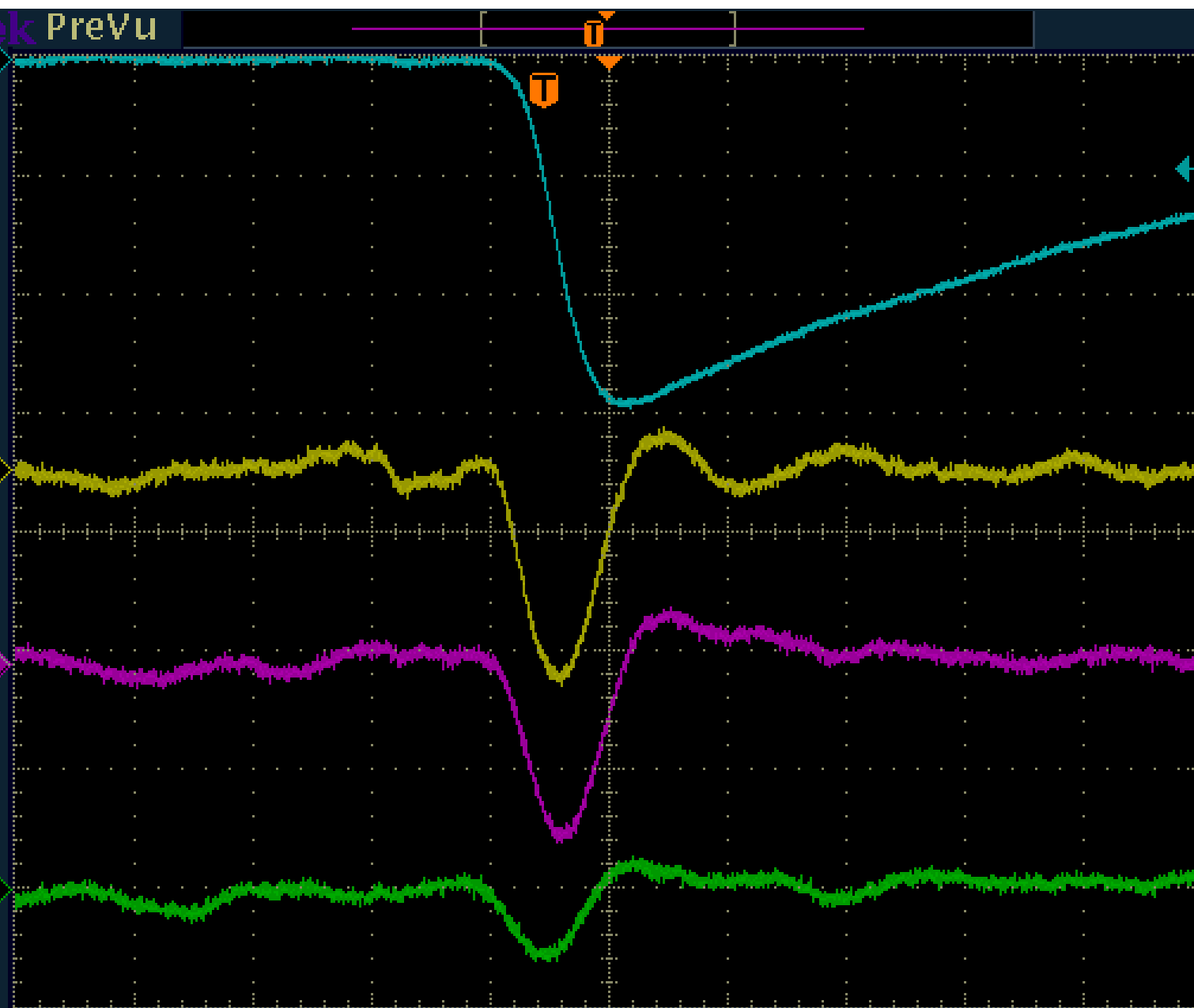
S.R. Amendolia et al. / The spatial resolution of the ALEPH TPC

Nuclear Instruments and Methods in Physics Research A283 (1989) 573–577

North-Holland, Amsterdam

ExB and wire crossing angle effects dominate TPC resolution

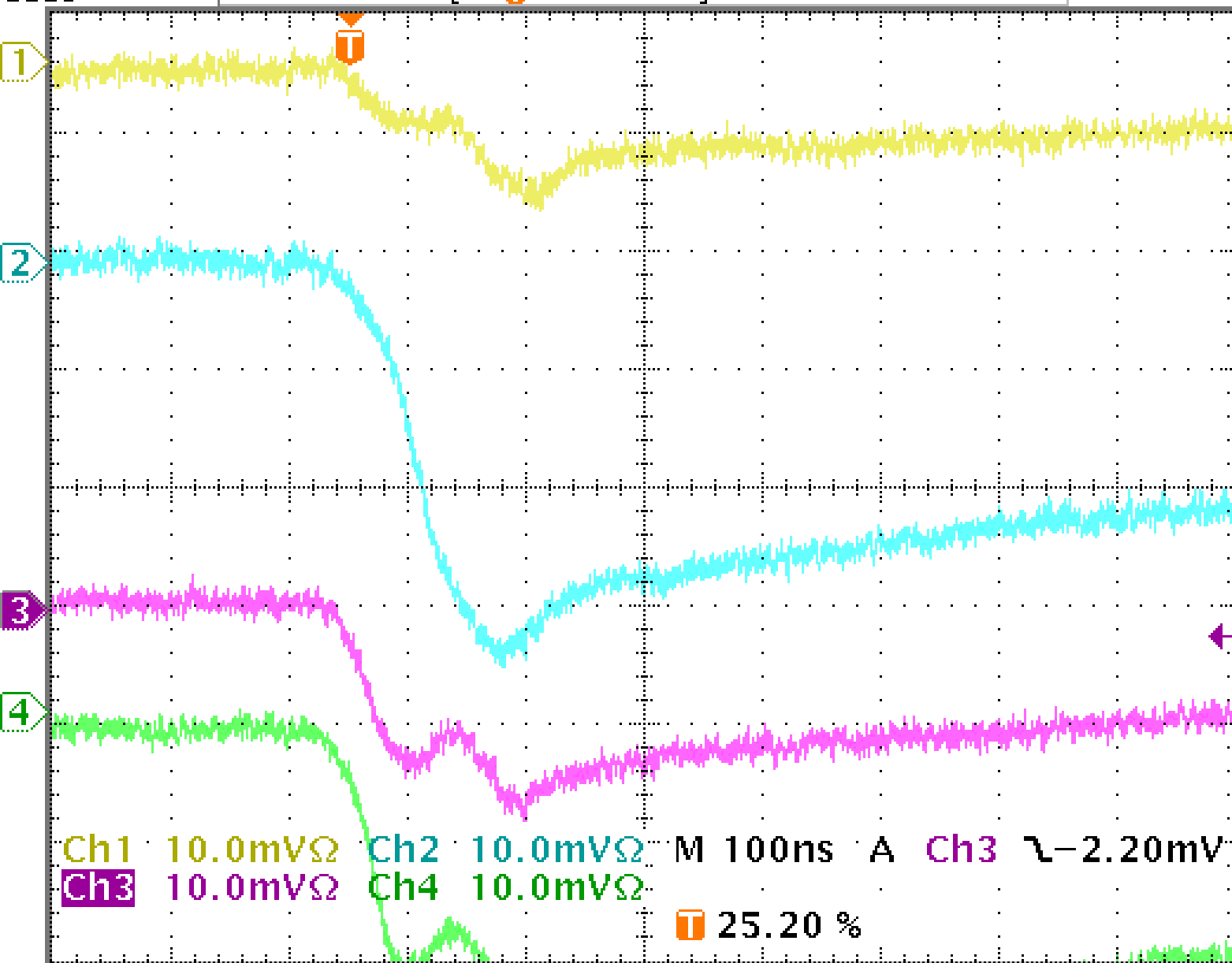




Ch1 20.0mVΩ Ch2 100mVΩ M 100ns A Ch2 \sim -92.0mV
Ch3 20.0mVΩ Ch4 20.0mVΩ

1 → 54.0000ns

24 Mar 2000
11:47:31



TRIGGER

A Trig Type

Edge
Video

Mode

Auto
Normal

Source

Ch: 1 2 3 4
AC Line

Coupling

DC Noise
HF Reject
LF Reject

Slope

↗ ↘

VERTICAL (CH3)

Coupling

DC AC ⌘

Impedance

1MΩ 50Ω

Bandwidth

↓ Full

ACQUIRE

Fast Trig

Normal

Mode

↓ Sample

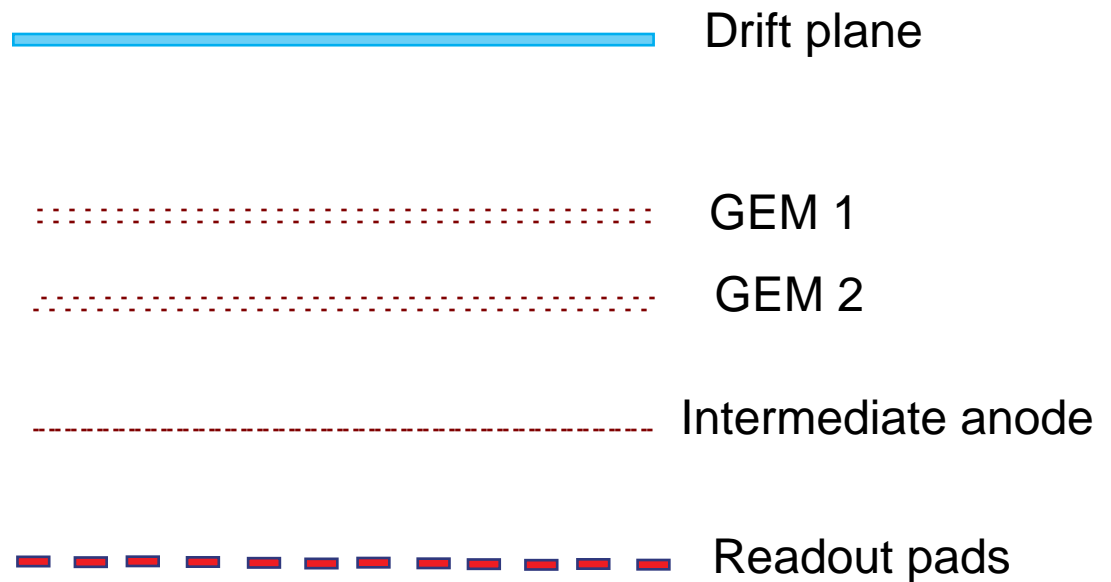
CURSOR

Off

HBar VBar

A Simpler Induction Signal for a TPC **Read Out with a GEM**

- ◆ **Introduce an intermediate anode layer above readout pads to hold/collect avalanche charge**
 - I. Resistive glass intermediate anode layer holds the charge until measured – Nygren**
Choose resistivity to minimize charging & count rate limitations
 - II. Thin metallic anode layer of thickness small compared to RF skin depth for the avalanche signal**
- ◆ **Induction signals on the readout pads below should have the same shape and relatively more equal amplitudes as in a wire/pad system simplifying analysis**
- ◆ **Concept applicable to Micromegas as well**
- ◆ **Electronics protected from discharges**
- ◆ **Slower STAR type electronics can be used**
- ◆ **Tests of concept with prototype GEM test cell**



Double GEM test cell with intermediate anode plane. All the readout pads below see induced pulses identical in shape as in a wire/pad TPC