

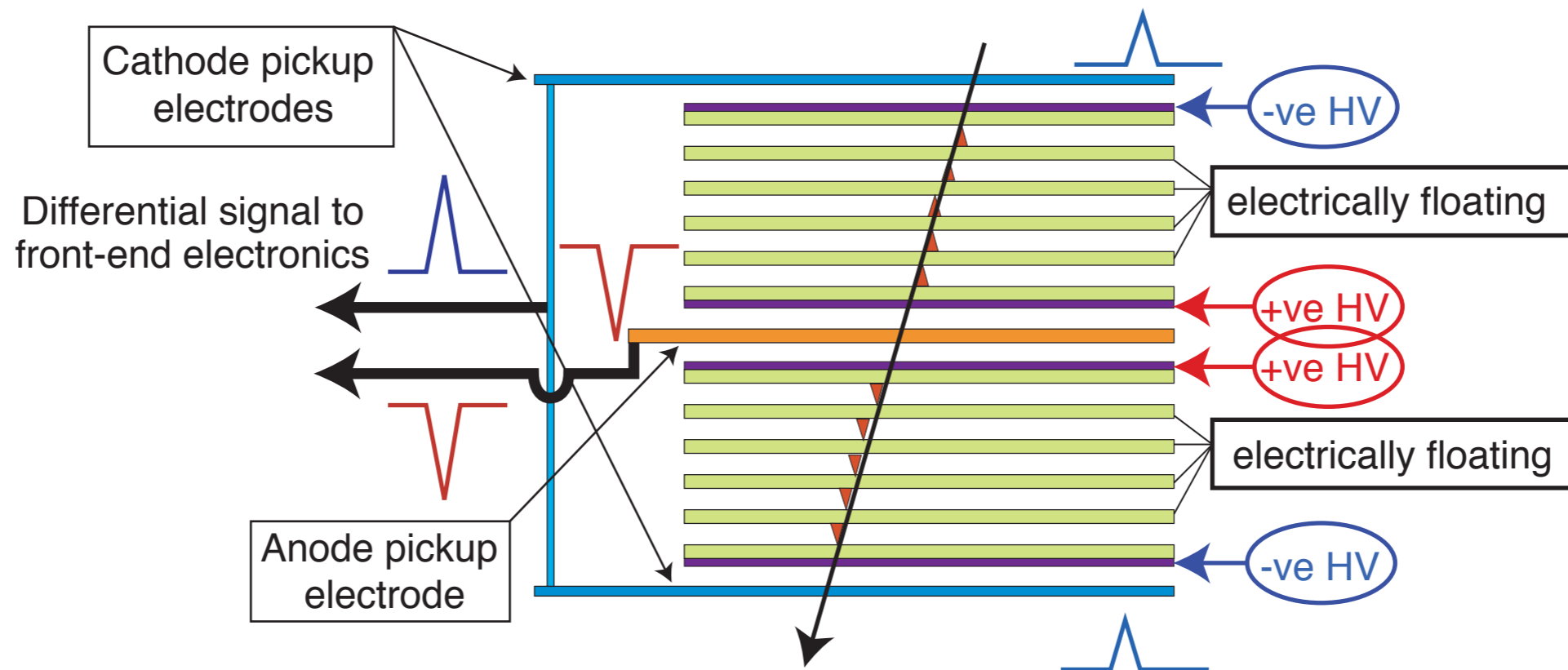
Some thoughts  
after building the  
ALICE TOF

crispin williams INFN bologna

# ALICE MRPC for TOF

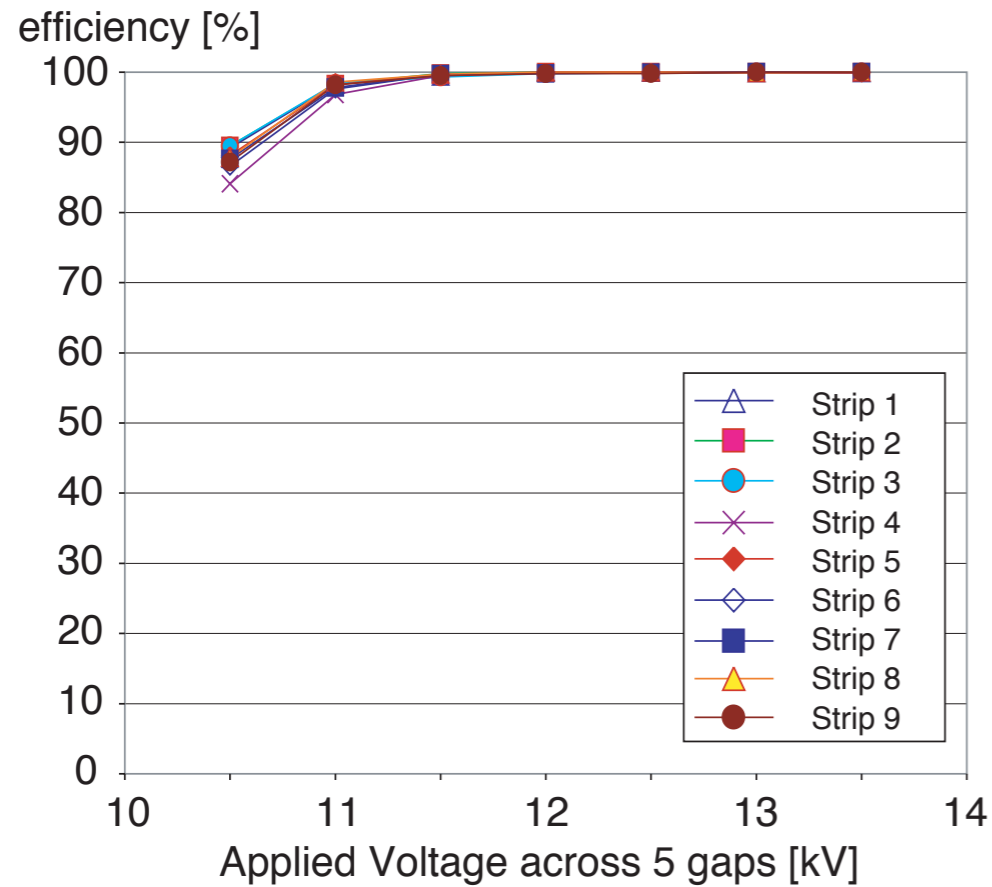
## schematic view

ALICE-TOF has 10 gas gaps (two stacks of 5 gas gaps) each gap is 250 micron wide  
Built in the form of strips, each with an active area of  $120 \times 7.2 \text{ cm}^2$ , readout by 96 pads

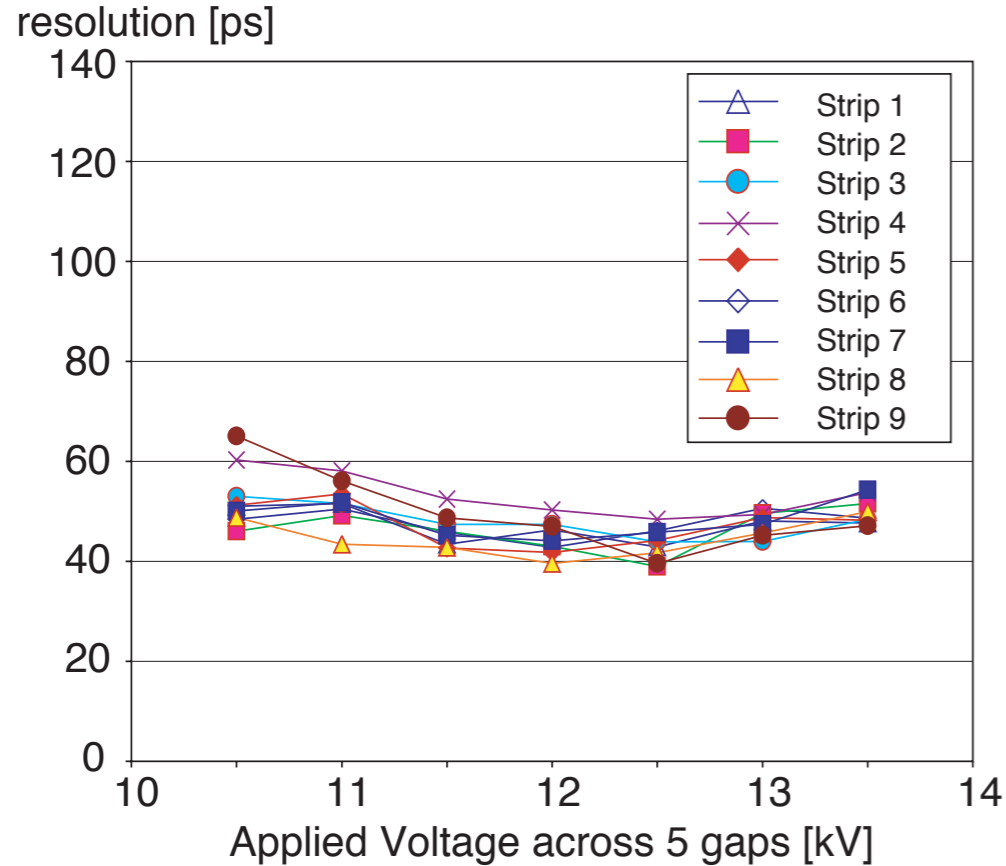


Note : HV only applied to outer surfaces of each stack of glass (internal glass sheets electrically floating) this makes it very easy to build.

# Uniformity of ALICE Time-of-Flight



(a) long efficiency plateau



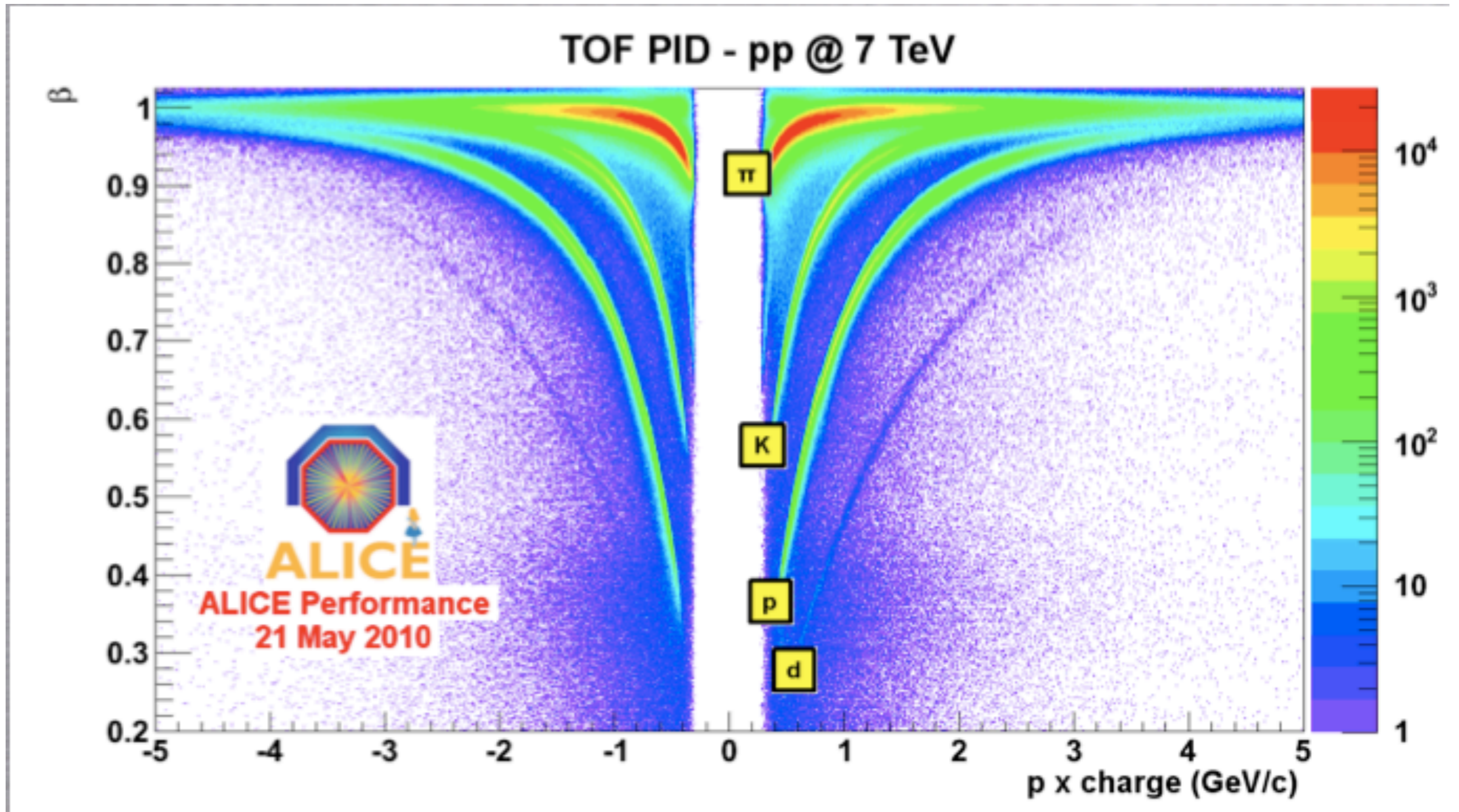
(b) time resolution 40-50 ps (after slewing corrections)

# Time jitter - ALICE TOF

- tdc time resolution (time difference between two channels) 30 ps
- beam spot 1 cm in size ( $50 \text{ ps}/\sqrt{12}$ ) 14 ps
- NINO ASIC + cables + interface card 21 ps
- intrinsic MRPC time resolution 20 ps
- total  $\sqrt{(30^2 + 14^2 + 21^2 + 20^2)} = 44 \text{ ps}$

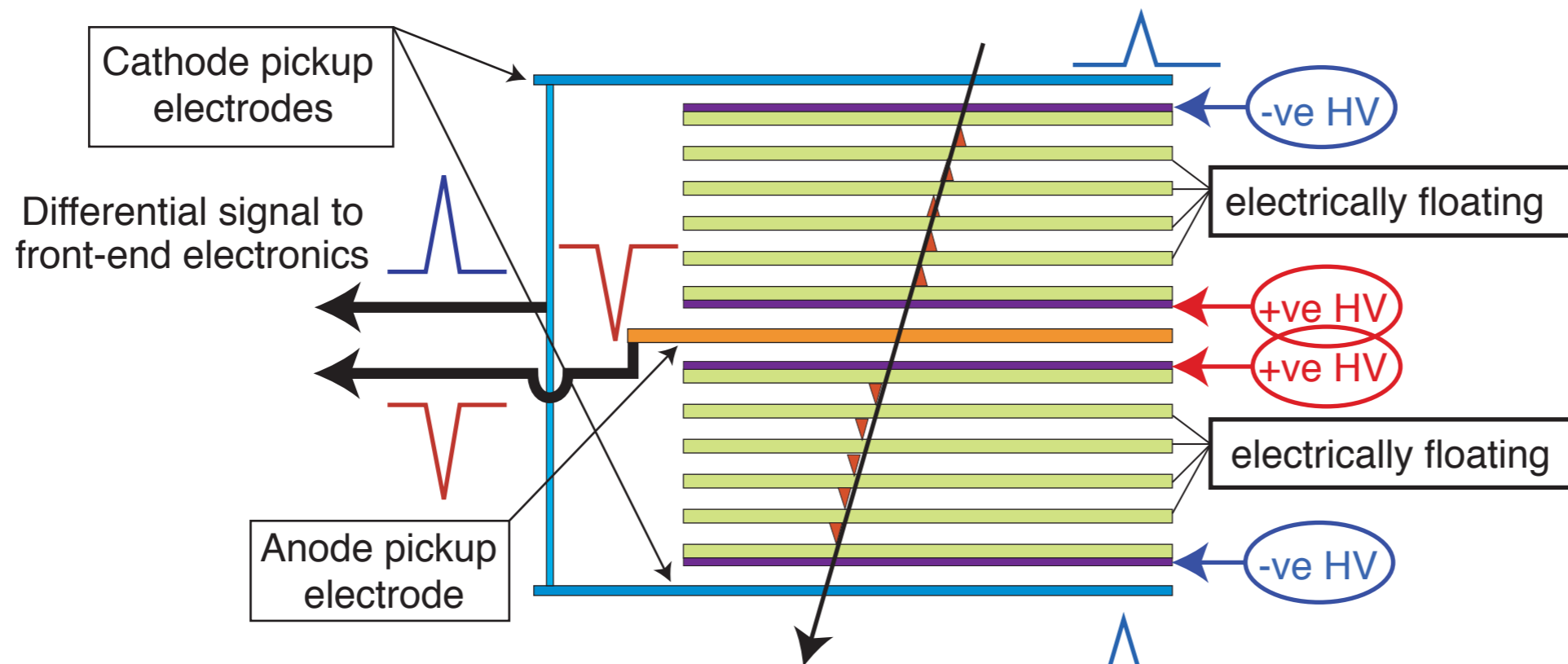
(would drop to 33 ps if TDC had 10 ps time resolution)

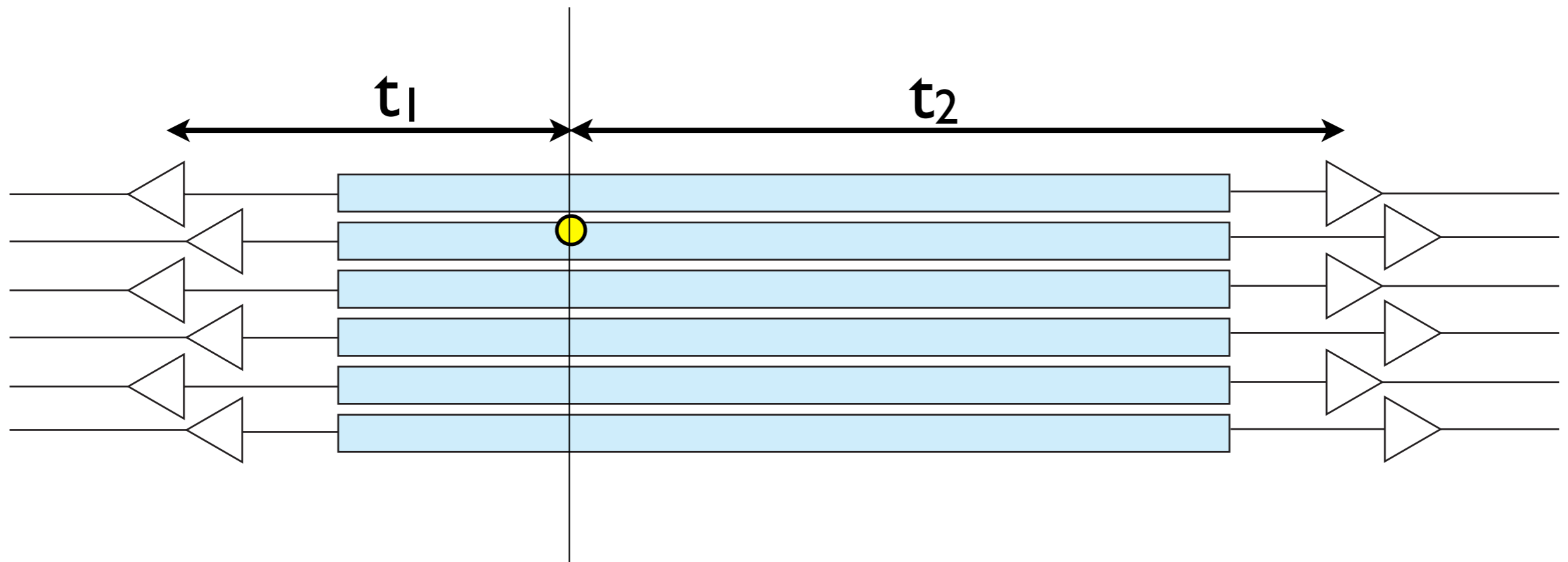
# Improvement to physics with TOF going from 50 ps to 30 ps is not so dramatic



- tdc time resolution (time difference between two channels) 30 ps
- beam spot 1 cm in size (50 ps/ $\sqrt{12}$ ) 14 ps
- NINO ASIC + cables + interface card 21 ps
- intrinsic MRPC time resolution 20 ps

read out pads from one side - so have to calculate transit from hit position





position of hit along the strip  $\sim t_1 - t_2$

$$\Delta(t_1 - t_2) \sim 100 \text{ ps/cm}$$

To obtain millimetre resolution need TDC time resolution of 10 ps

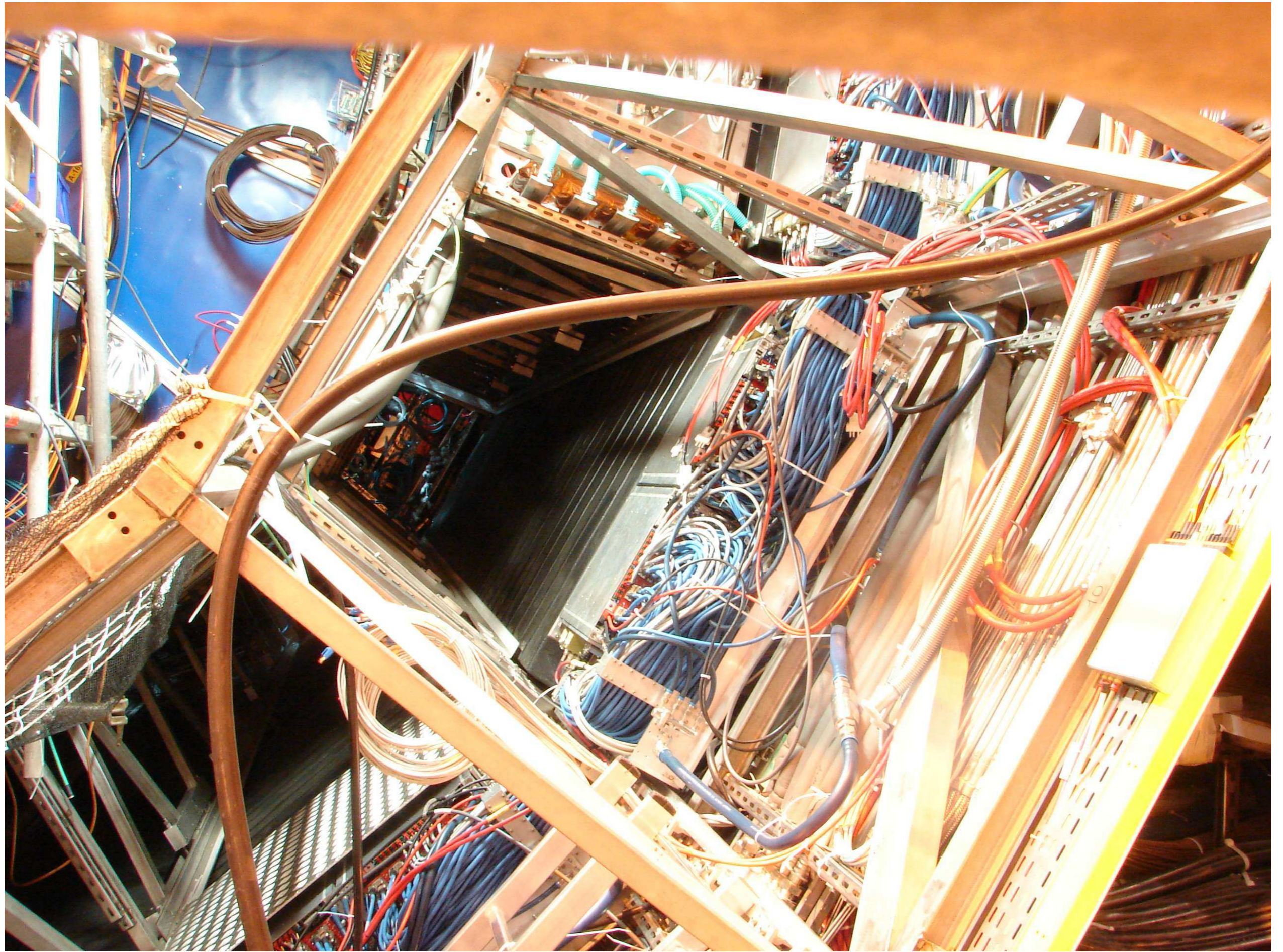
- tdc time resolution (time difference between two channels) 10 ps ~~30 ps~~
- beam spot 1 cm in size (50 ps/ $\sqrt{12}$ ) 5 ps ~~14 ps~~
- NINO ASIC + cables + interface card 5 ps ~~21 ps~~
- intrinsic MRPC time resolution 10 ps ~~20 ps~~

So TOF with a time resolution of :

$$\sqrt{(10^2 + 5^2 + 5^2 + 10^2)} = 16 \text{ ps}$$

is probably possible if a 10 ps TDC was available





# power

- ALICE TOF has 160,000 channels of HPTDC (high resolution mode)
- $\sim 100$  mW/channel 16 kW power
- water cooled - locate in the end caps to give access
- Most unreliable part of this system are the power supplies

In my opinion: essential to reduce power needs  
to a minimum

This will allow the TDC ASIC to be placed on  
the detector

(but then need a way to distribute the clock,  
etc)

high channel count per ASIC

# What I do I dream about?

- TDC with 10 ps time resolution (bin size probably also 10 ps)
- 32 or 64 channels per ASIC
- power consumption - 10 mW/channel