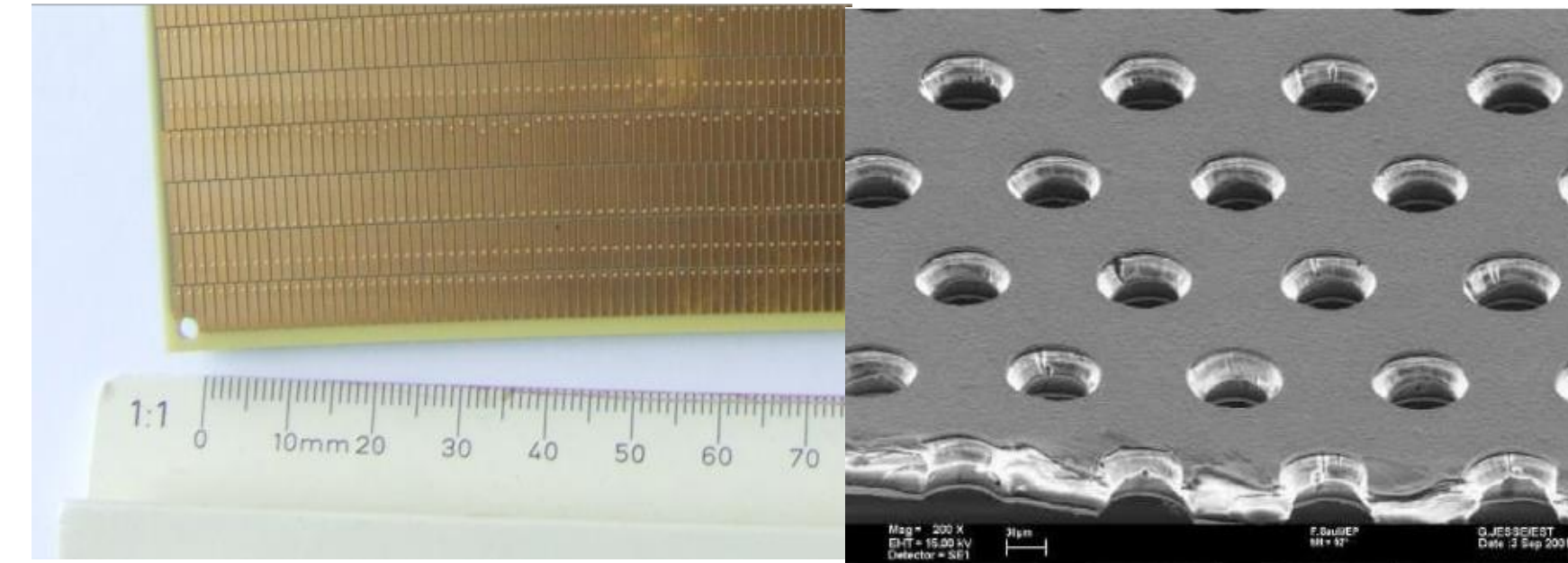
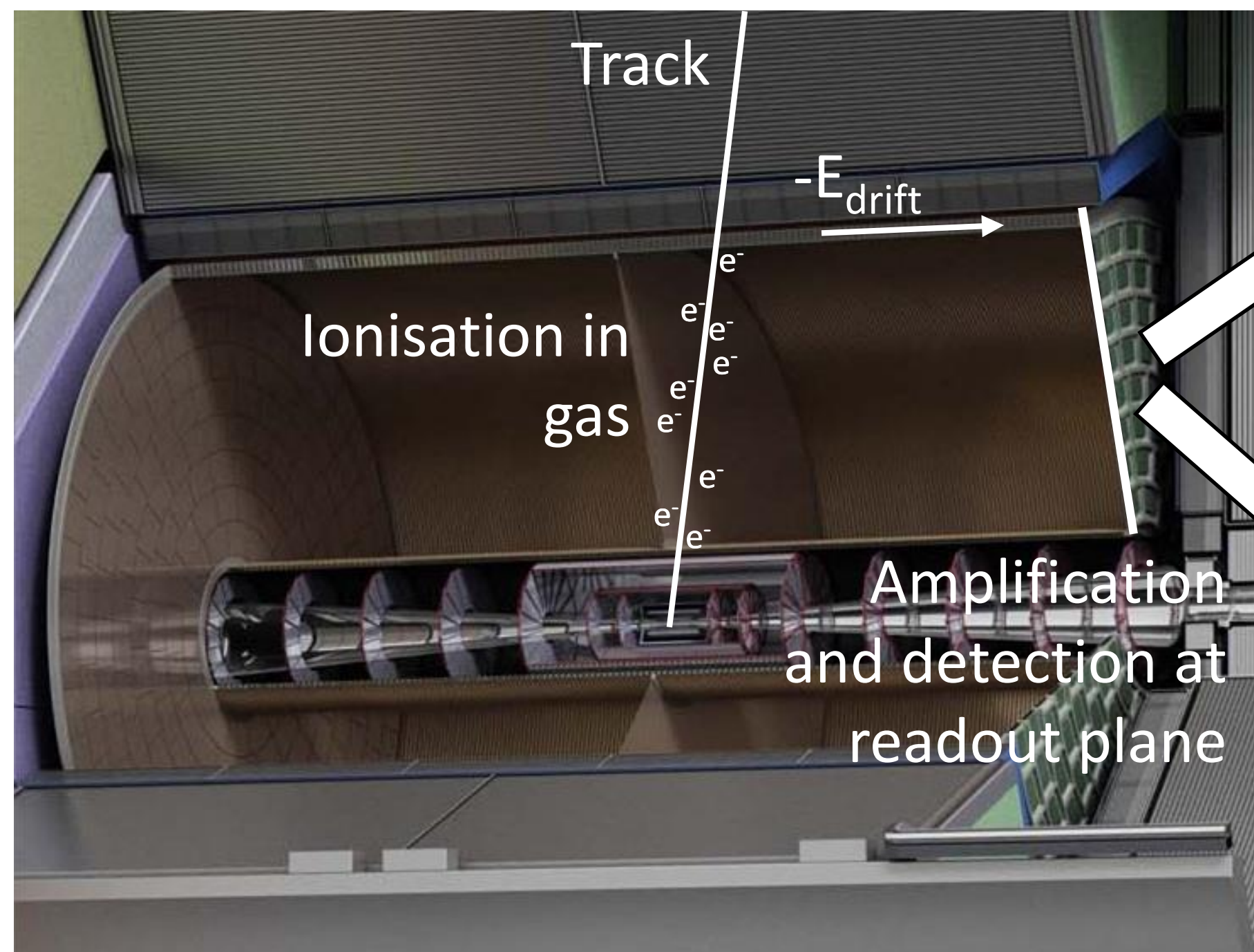
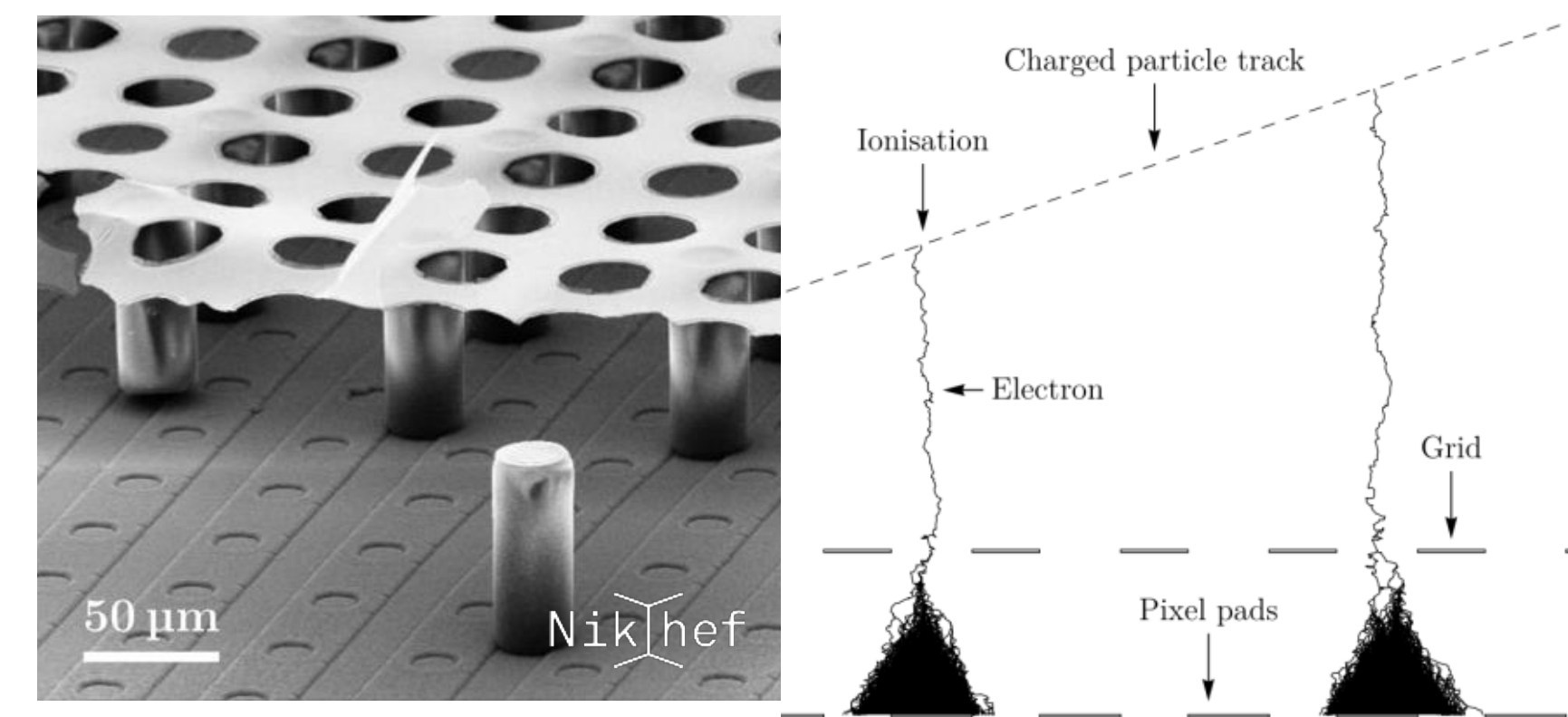


# Readout technologies for ILD TPC



Pads with GEMs or Micromegas for amplification → Detect charge spread



Pixels readout with integrated aligned amplification grid (Gridpix)  
→ detect each single electron  
Maximal possible information from track

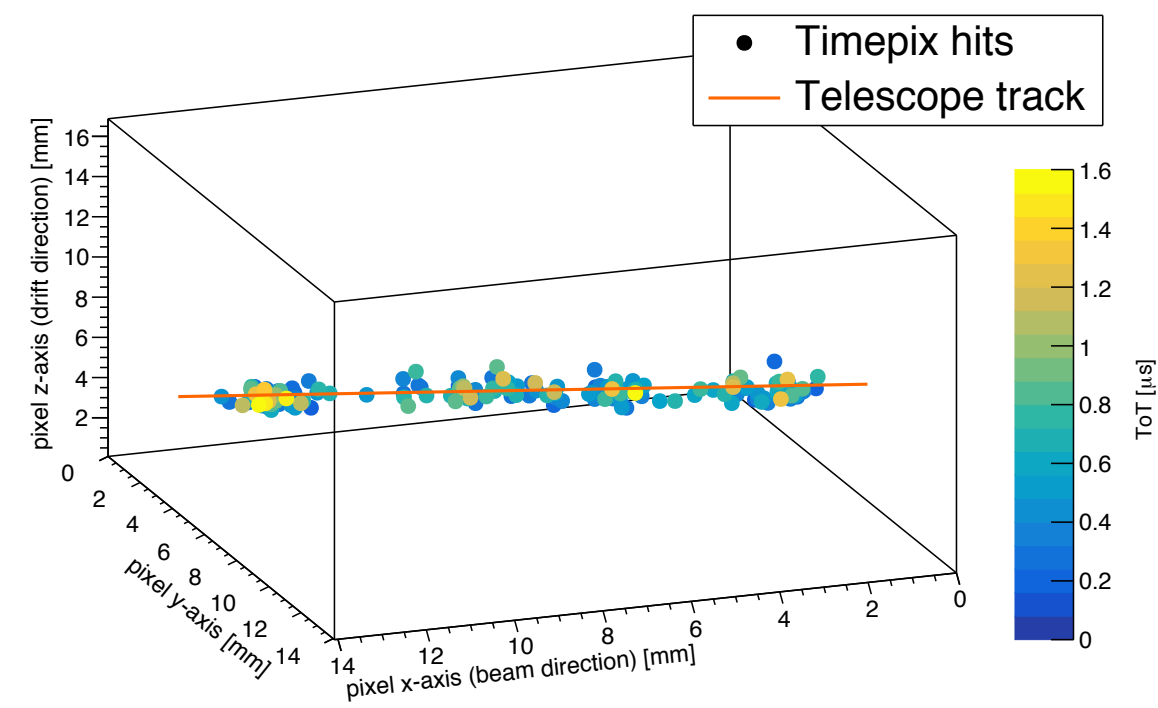


# Performance of a Gridpix detector based on the Timepix3 chip

C. Ligtenberg<sup>a,\*</sup>, K. Heijhoff<sup>a,b</sup>, Y. Bilevych<sup>b</sup>, K. Desch<sup>b</sup>, H. van der Graaf<sup>a</sup>, F. Hartjes<sup>a</sup>, P.M. Kluit<sup>a</sup>, G. Raven<sup>a</sup>, T. Schiffer<sup>b</sup>, J. Timmermans<sup>a</sup>

<sup>a</sup>*Nikhef, Science Park 105, 1098 XG Amsterdam, The Netherlands*

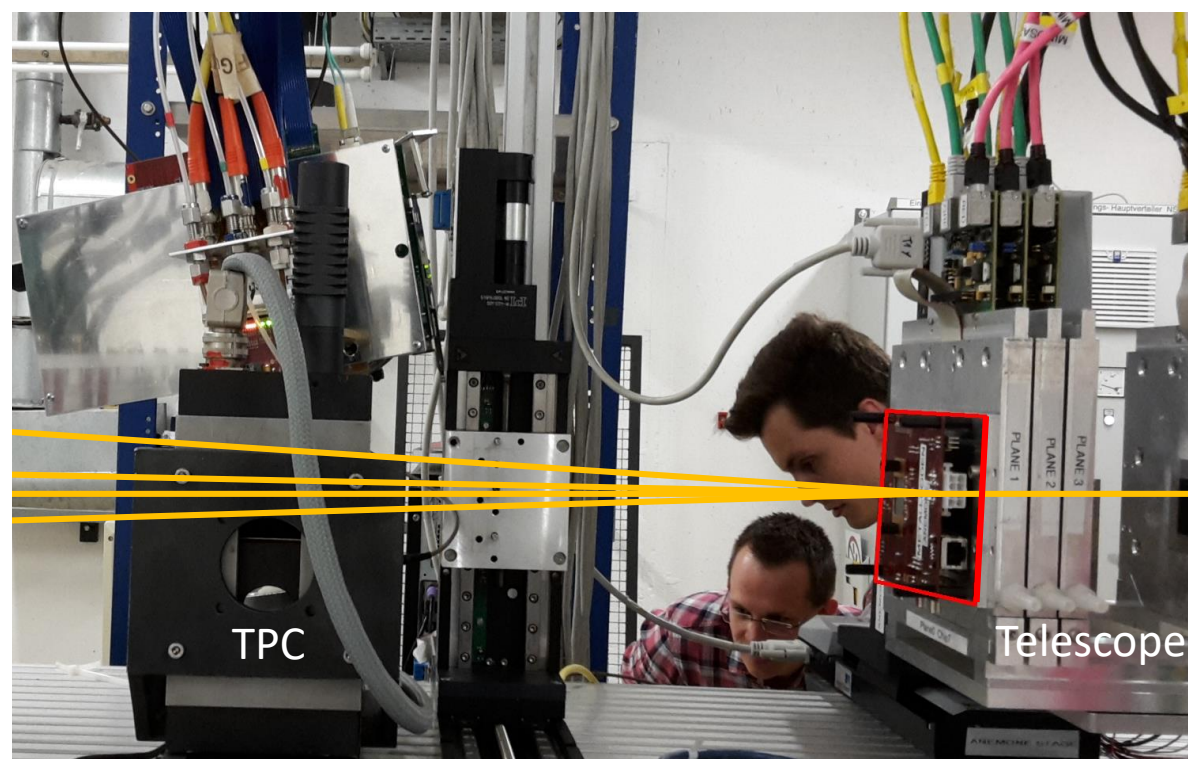
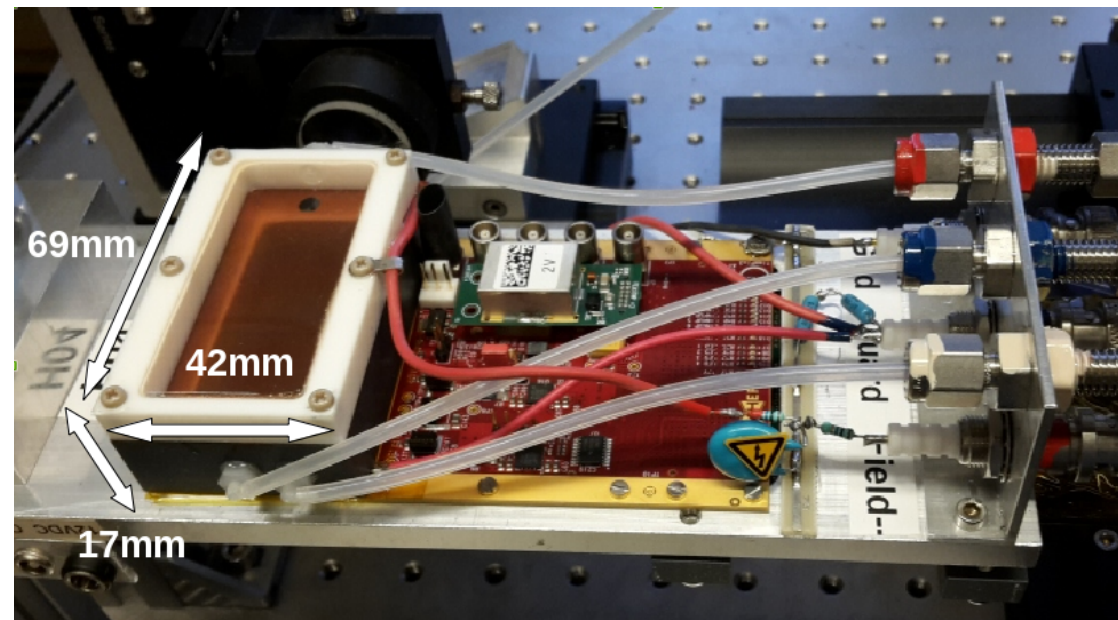
<sup>b</sup>*Physikalisches Institut, University of Bonn, Nussallee 12, 53115 Bonn, Germany*



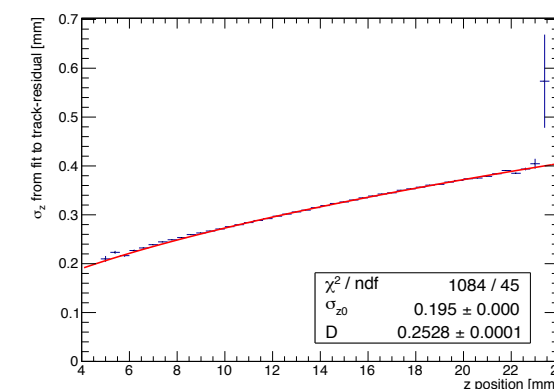
## Abstract

A Gridpix readout for a TPC based on the Timepix3 chip is developed for future applications at a linear collider. The Gridpix detector consists of a gaseous drift volume read-out by a single Timepix3 chip with an integrated amplification grid. Its performance is studied in a test beam with 2.5 GeV electrons. The Gridpix detector detects single ionization electrons with high efficiency. The Timepix3 chip allowed for high sample rates and time walk corrections. Diffusion is found to be the dominating error in the pixel plane and in the drift direction, and systematic distortions in the pixel plane are below 10 μm. Using a truncated sum, an energy loss dE/dx resolution of 4.1% is found.

**Keywords:** Micromegas, gaseous pixel detector, Micro-pattern gaseous detector, Timepix, Gridpix



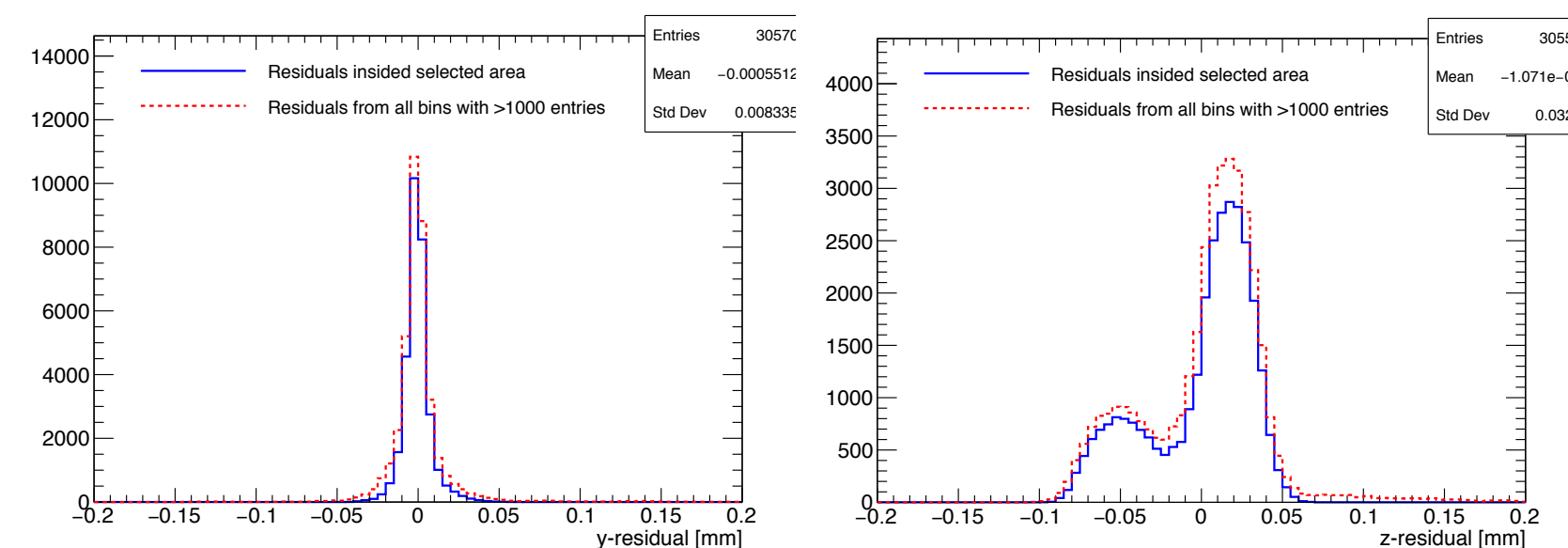
## Diffusion in drift direction



Fix grid position with value from y-fit  $z_0 = 4.027$  mm  
 $D_L = 252 \mu\text{m}/\sqrt{\text{cm}}$  ( $\sim 230 \mu\text{m}/\sqrt{\text{cm}}$  calculated<sup>1</sup>)

From laser test without time walk correction  $D_L = 254 \mu\text{m}/\sqrt{\text{cm}}$  at  $V_{\text{grid}} = 330$  V and  $v_{\text{drift}} = 66.4 \mu\text{m}/\text{ns}$

Nikhef

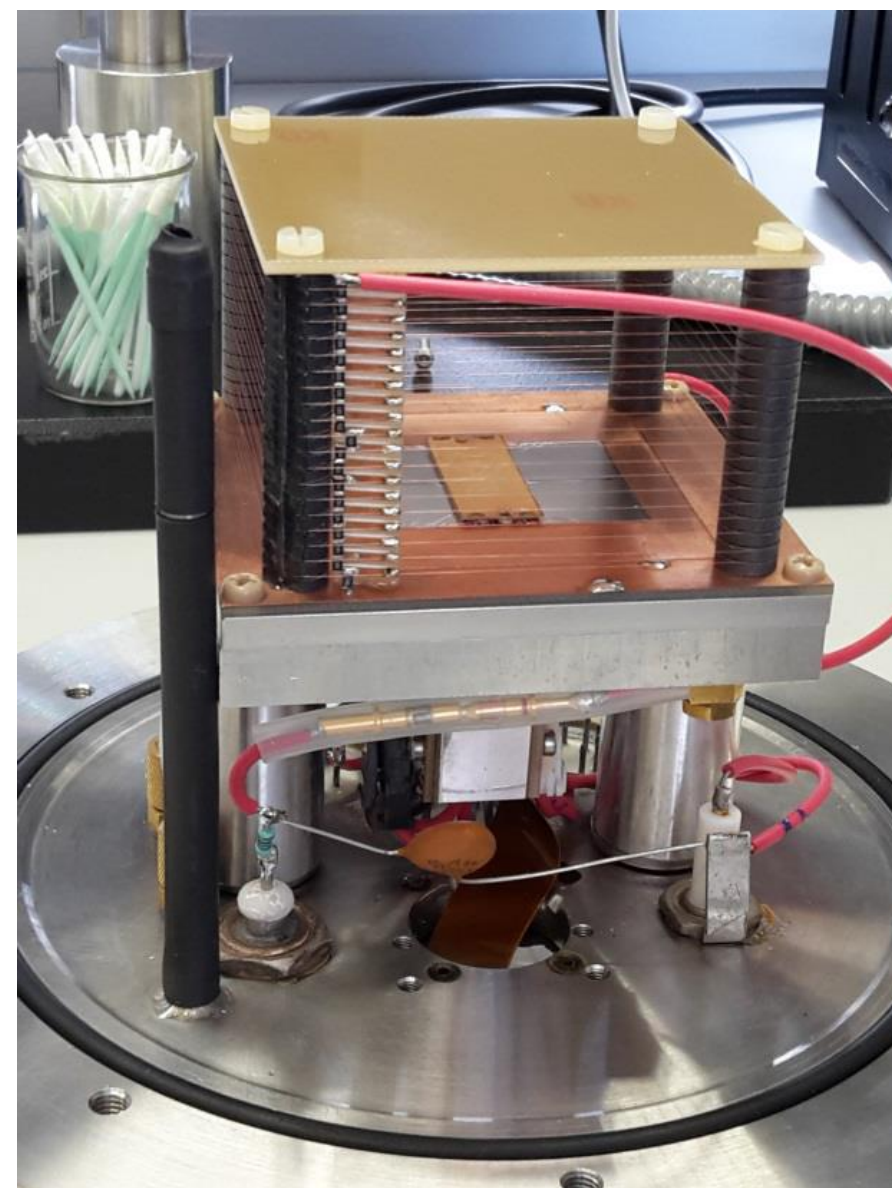
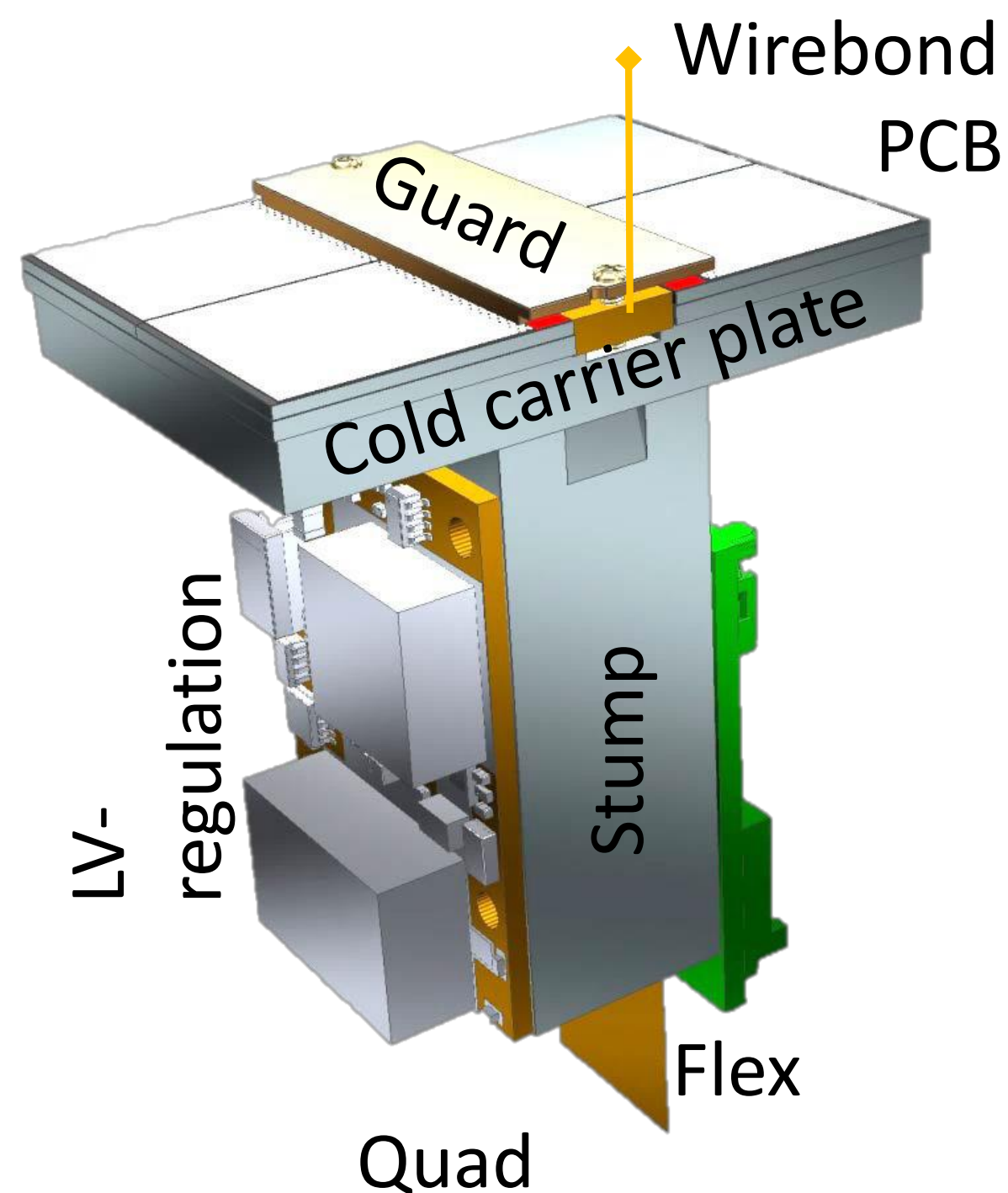


RMS in selected area is 8 μm in plane and 31 μm (0.4 ns) in drift direction

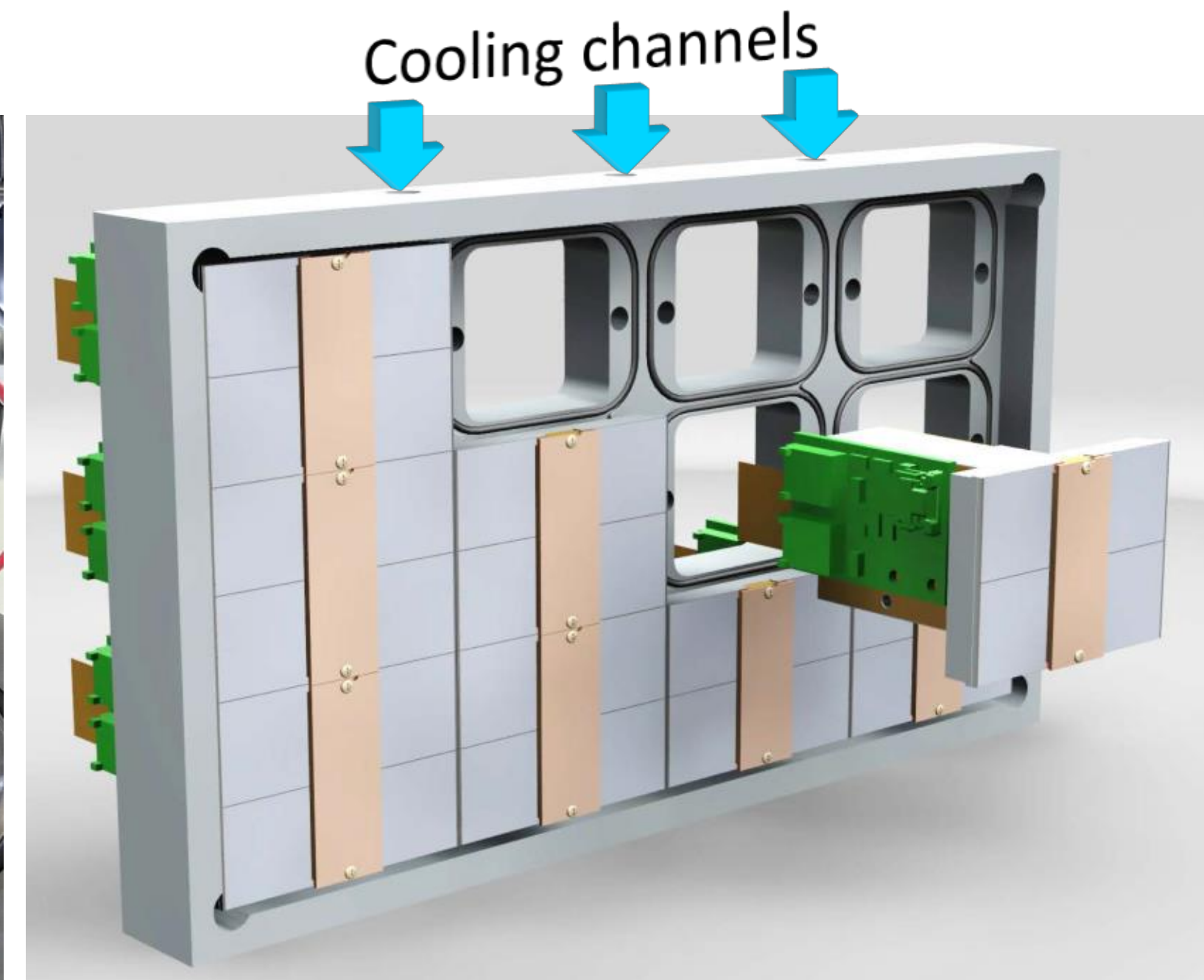


# Quad development

- 4 GridPix chips on one mechanical support (40×28 mm<sup>2</sup>)
- All services under large active surface (68.9% coverage)
- First electrical Quads assembled and functional



Test Box



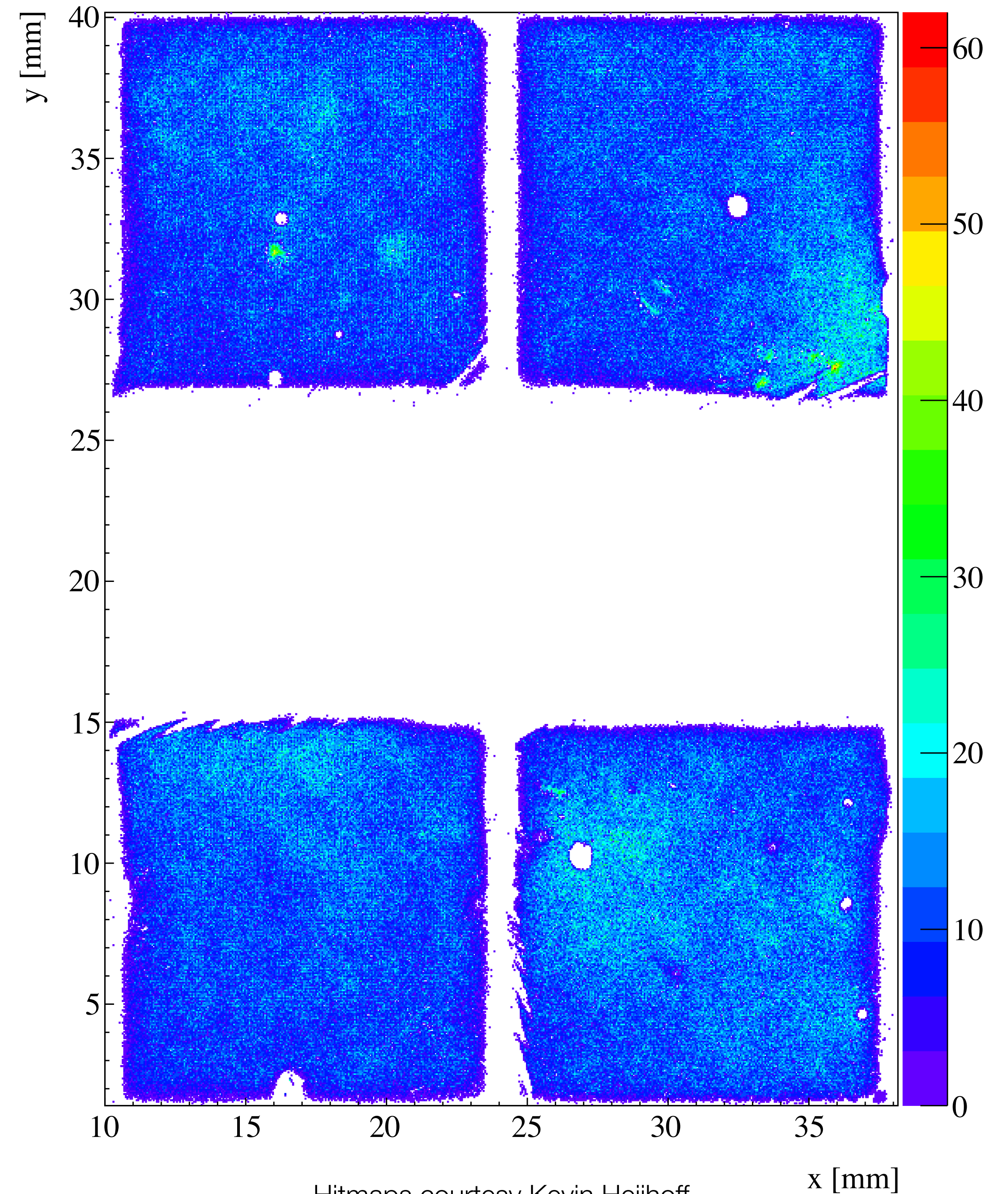
Quad base plate

+Bas van der Heijden, Charles Ietswaard, Auke Korporaal, Oscar van Petten, Joop Rövekamp 



# First Hit map with $\text{Sr}^{90}$ source

- First 'electrical' quad uses class B-D chips



# First Hit map with Laser

- First 'electrical' quad uses class B-D chips
- New batch of gridpix chips (with slightly adapted design) being prepared at IZM
- Next step: build 10+5 quads (5 ordered by Bonn) & equip a base plate

