

# A Pixel-TPC for the Linear Collider: A Testbeam with the demonstrator

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On behalf of the LCTPC Collaboration

DPG, Wuppertal 09.03.2015

GEFÖRDERT VOM



Bundesministerium  
für Bildung  
und Forschung



# Example: ALICE TPC



universität**bonn**

# Pixel-TPC?



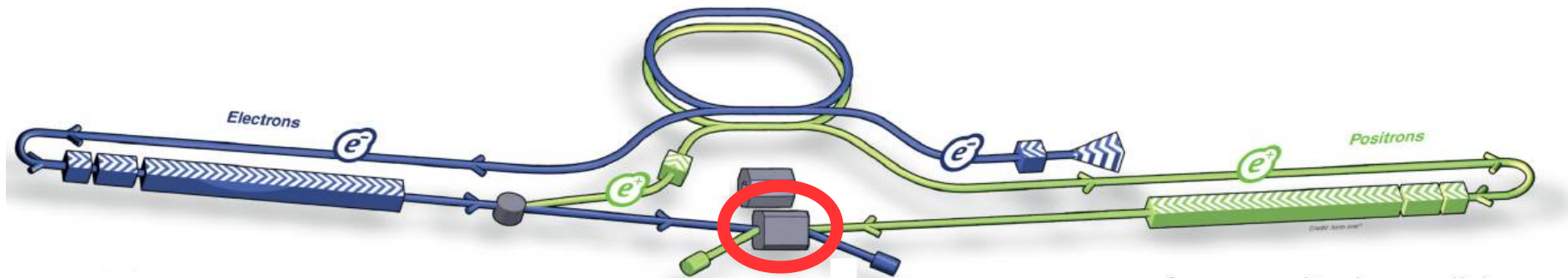
# Outline



- International Linear Collider
- TPC concepts
- The Pixel-TPC
- Intermediate stage Testbeam
- Demonstrator module
- Outlook

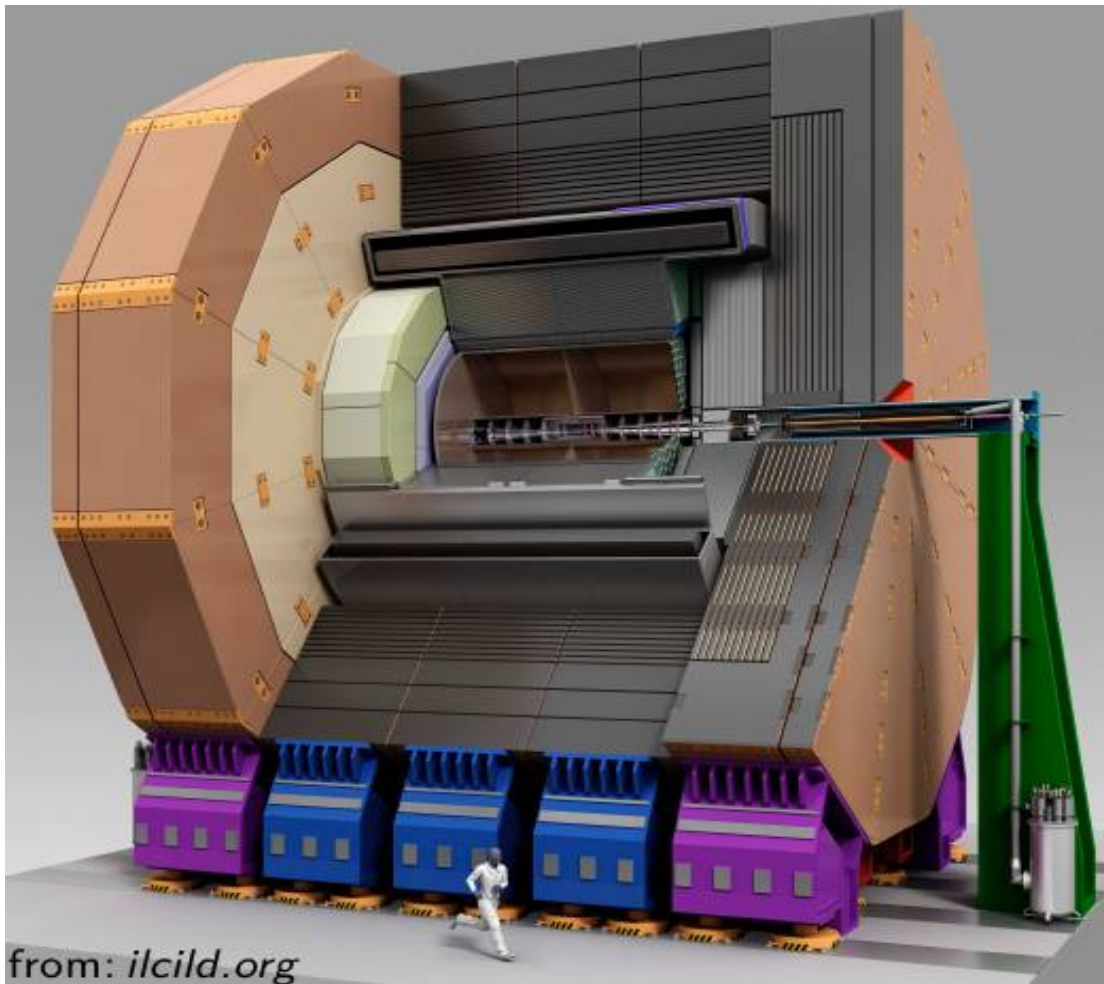
## International Linear Collider

- $e^+ e^-$  accelerator of the next generation
- Centre of mass energy: 250 GeV  $\rightarrow$  500 GeV  $\rightarrow$  1 TeV
- Interest of the Japanese HEP community to host the experiment
- Precision measurements to investigate many open questions in particle physics



from: [newline.linearcollider.org](http://newline.linearcollider.org)

- International Large Detector
  - One of the two detector concepts for ILC
  - TPC as tracker

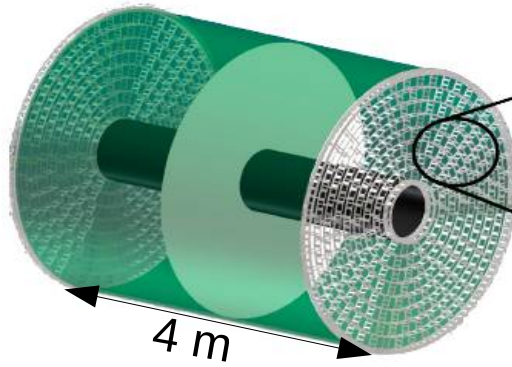


# LCTPC Prototype

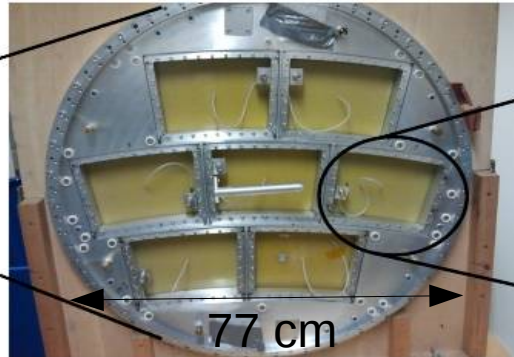


## Setup at DESY

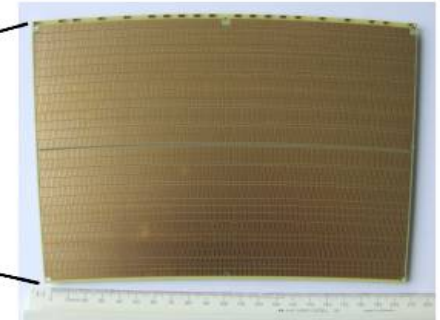
ILD TPC



Large Prototype (LP)



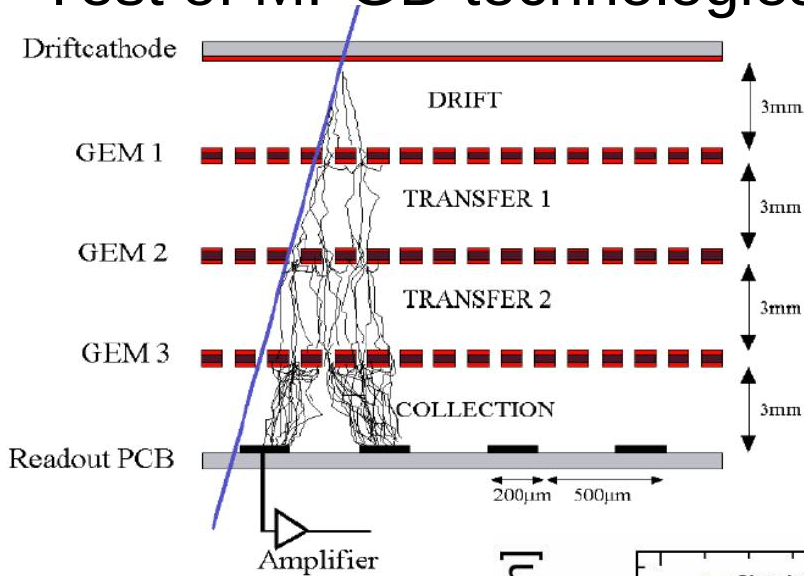
Trapezoid Readout Module  
(230 mm × 170 mm)



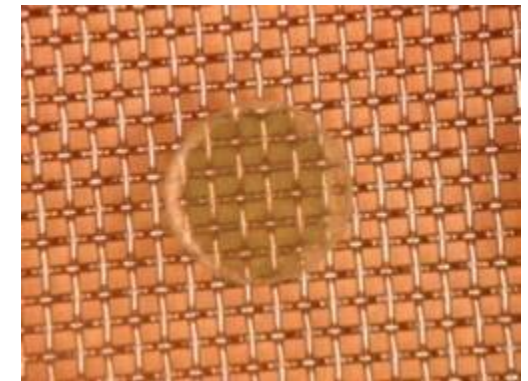
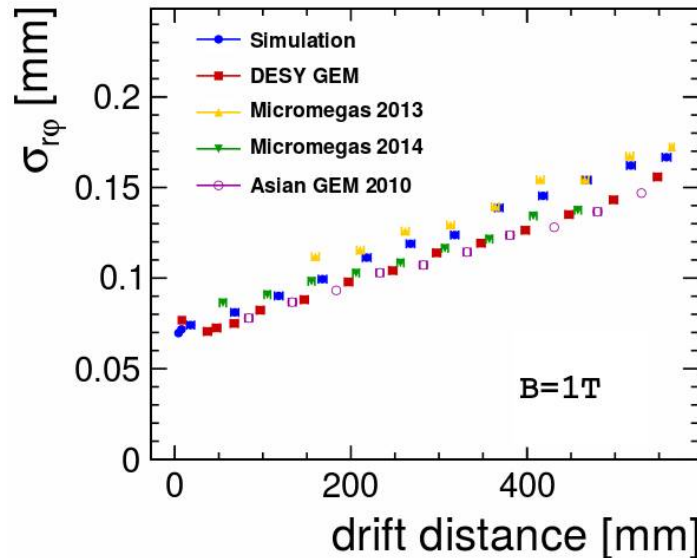
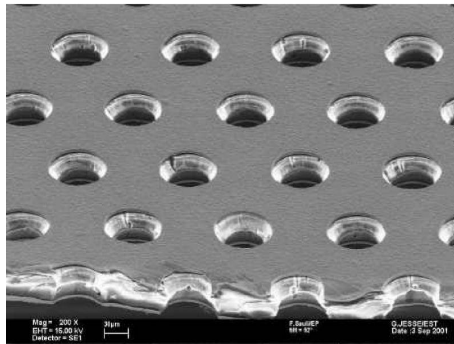
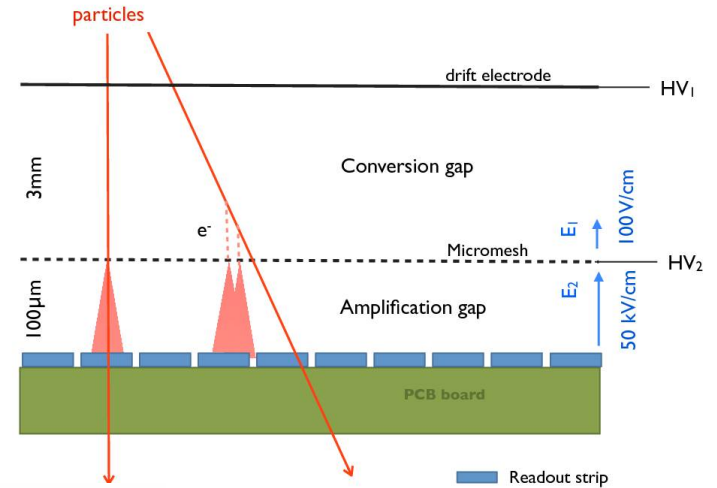
# TPC endplate



## Test of MPGD technologies: GEM ↔ Micromegas



Gain  
 ~20  
 ~20  
 ~20  
 ~8000

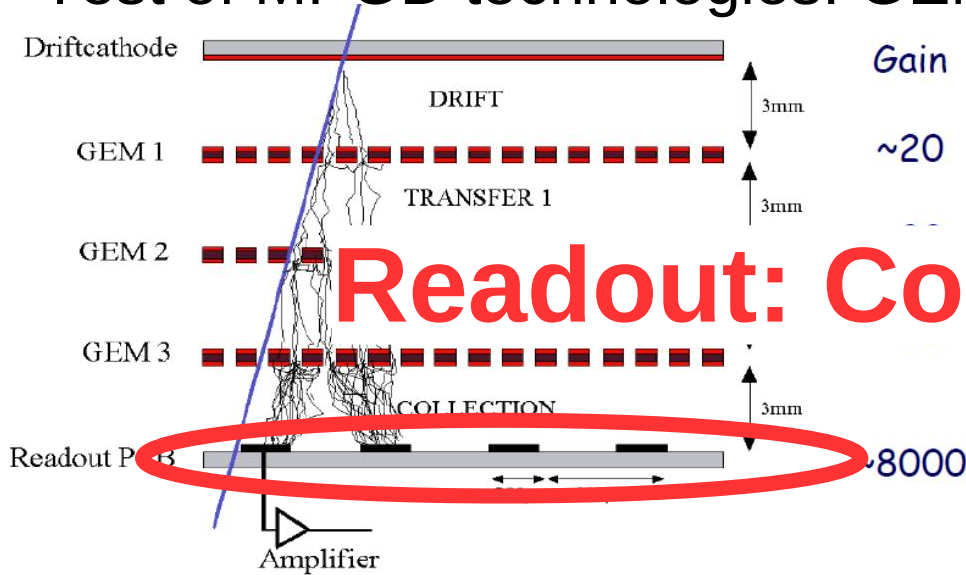




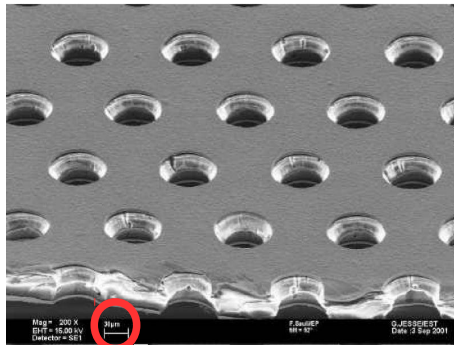
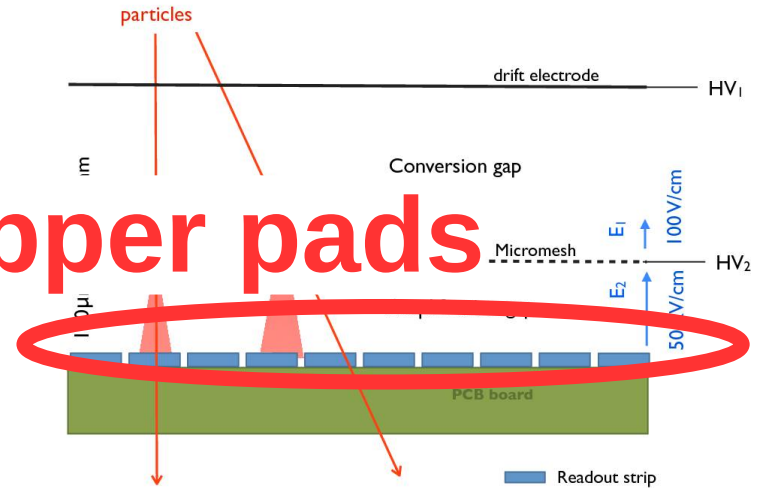
# Readout anode



Test of MPGD technologies: GEM  $\leftrightarrow$  Micromegas

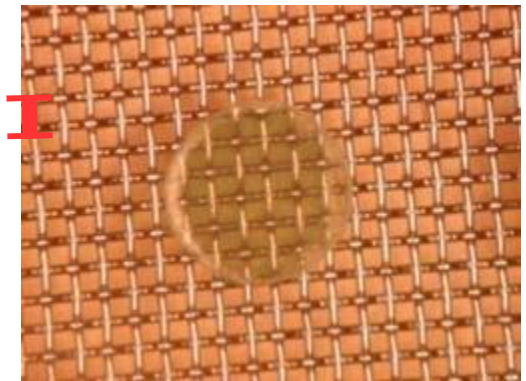


**Readout: Copper pads**

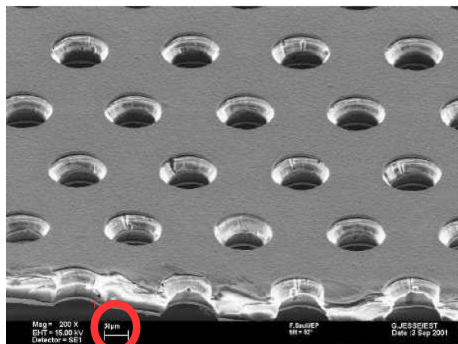


Pad ?

50  $\mu m$ !



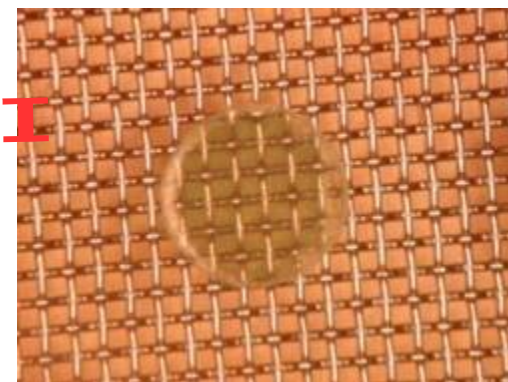
# Readout anode



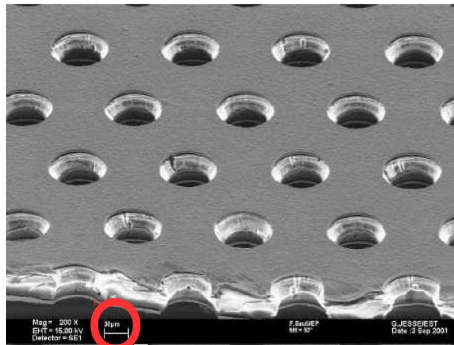
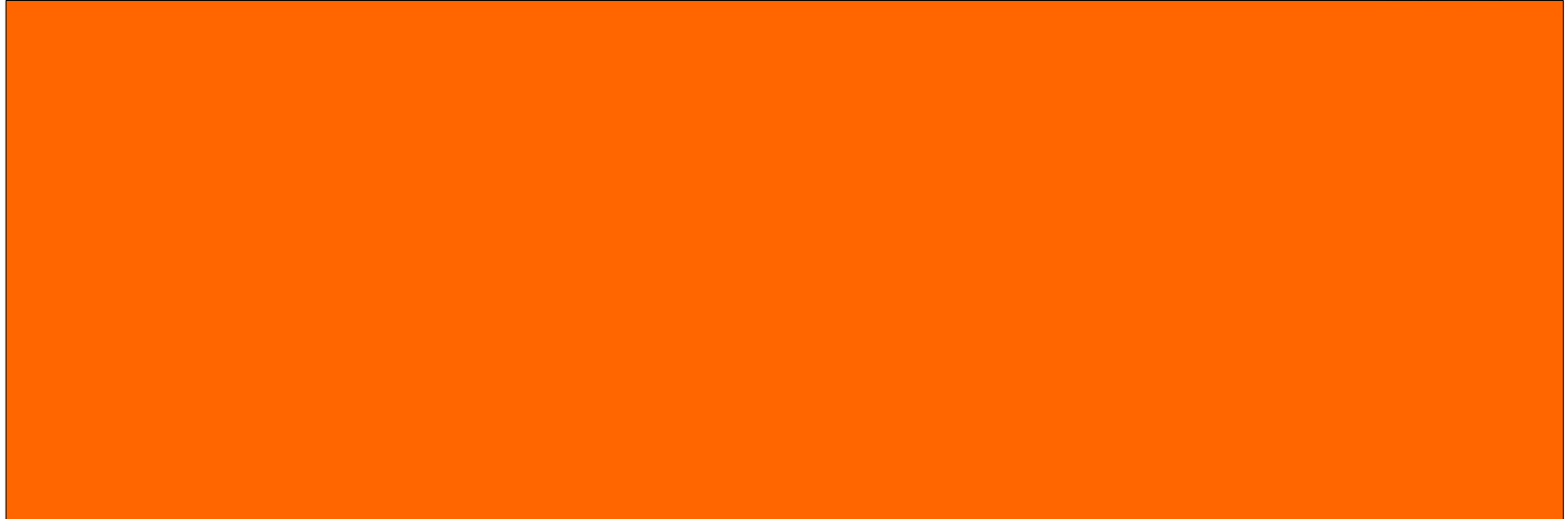
30  $\mu\text{m}$ !

Pad  
1x3 mm!

50  $\mu\text{m}$ ! I



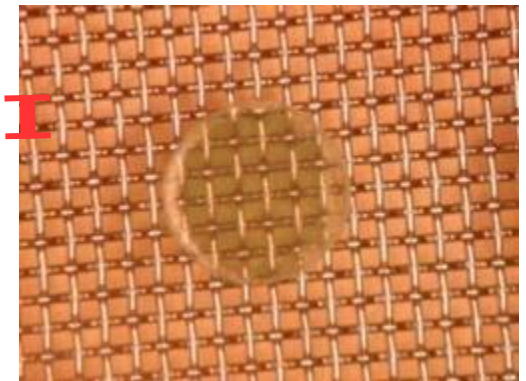
# Readout anode



30 μm!

I ■  
PIXELS

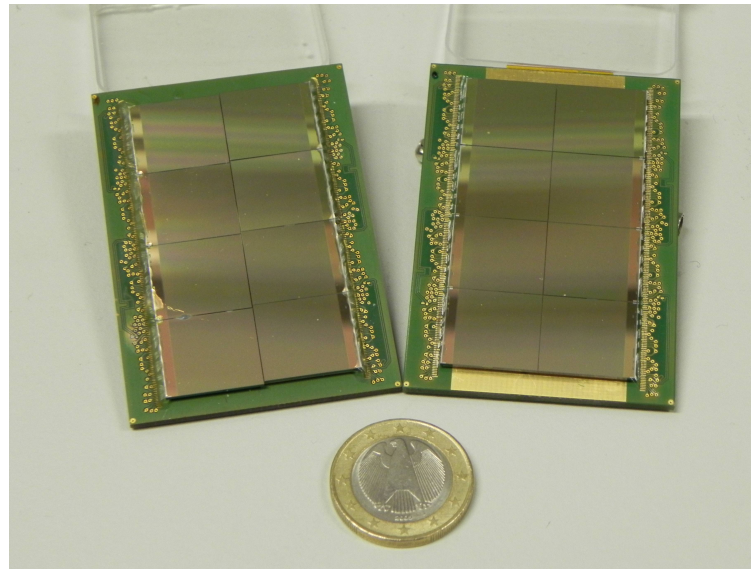
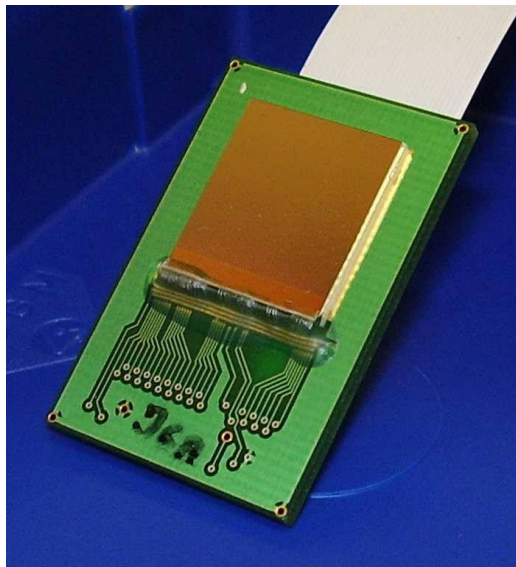
50 μm! I



# Timepix chip



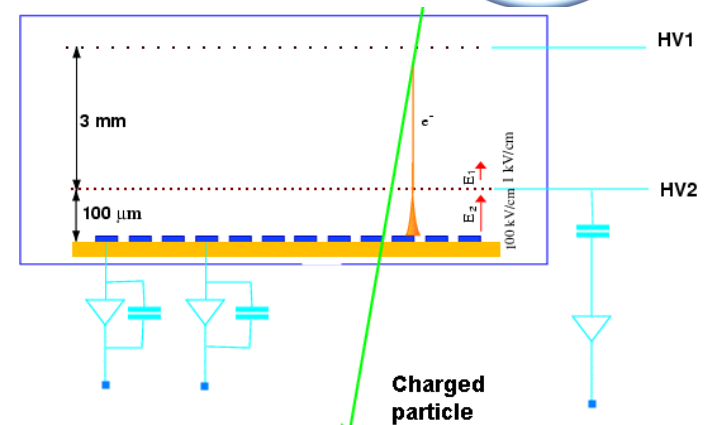
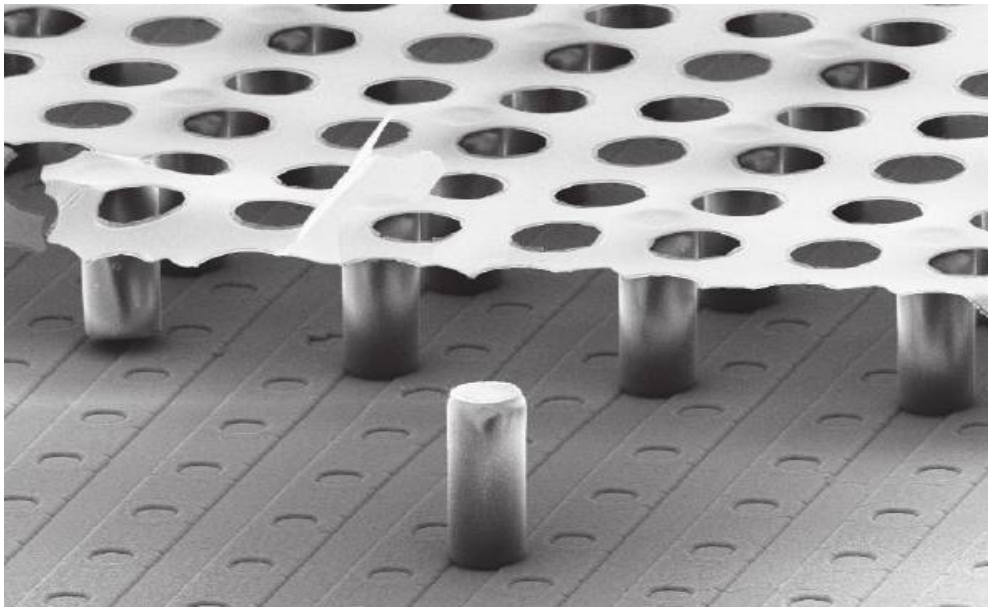
- Universal readout chip
- Properties:
  - active surface:  $1.4 \times 1.4 \text{ cm}^2$
  - pixel size  $55 \times 55 \mu\text{m}^2$
  - $256 \times 256$  pixel array
  - 14 bit counter in each pixel (ToA or ToT)
  - Noise threshold  $\sim 500e^-$  (ENC  $\approx 90e^-$ )



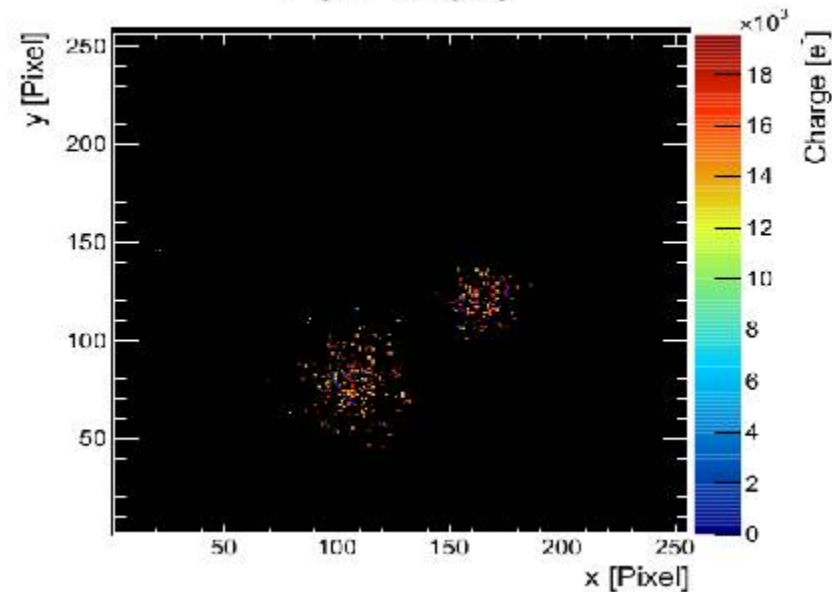
# Timepix+Micromegas=InGrid



- Aluminium mesh on chip
- Use photolithographic process
  - Hole to pixel alignment
  - Pillar height uniformity



Charged particle  
 $^{55}\text{Fe}$  - Event

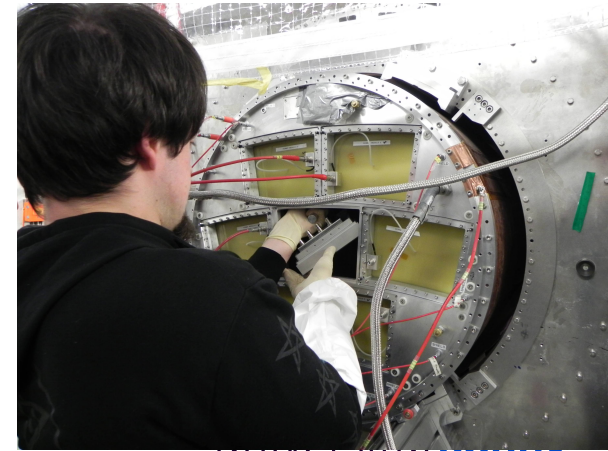
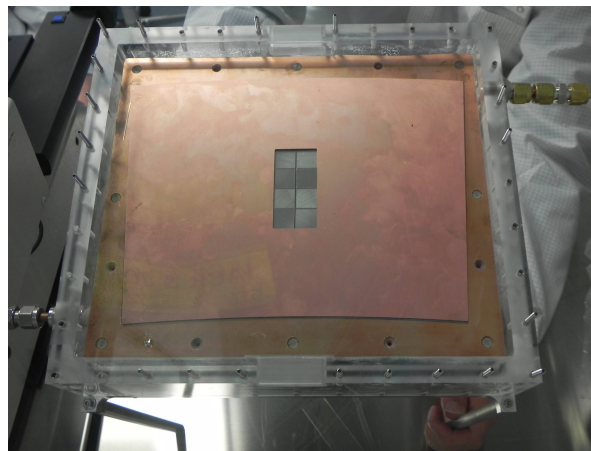
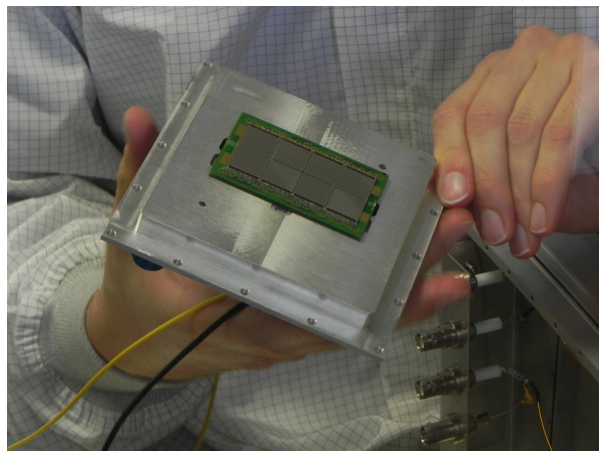
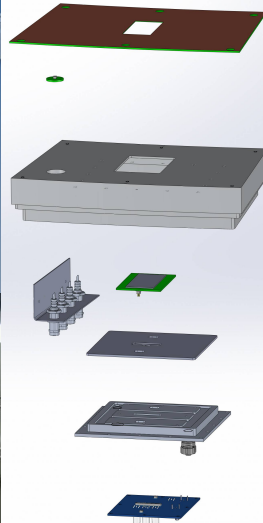
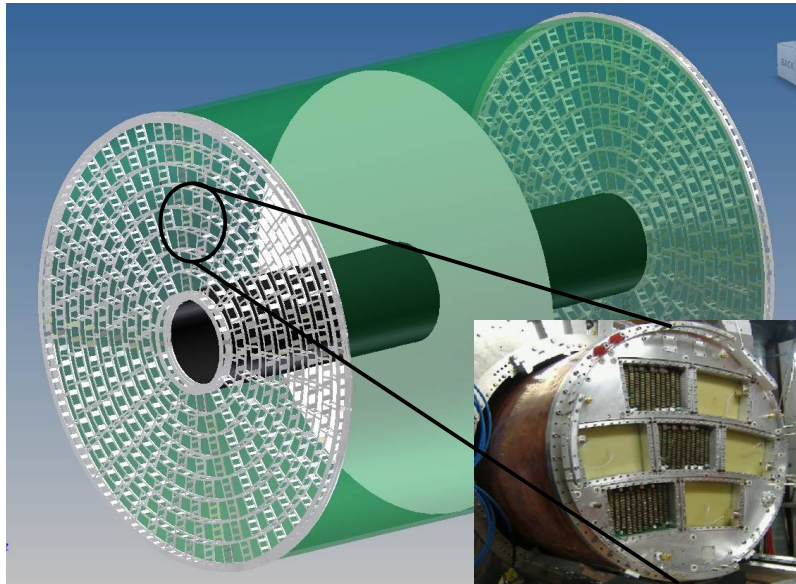


# 2013 Testbeam

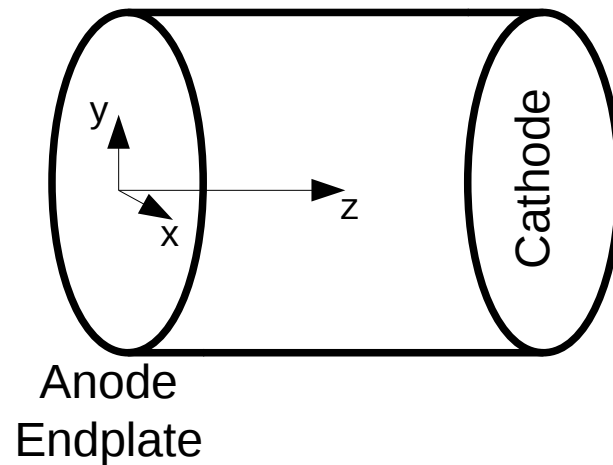
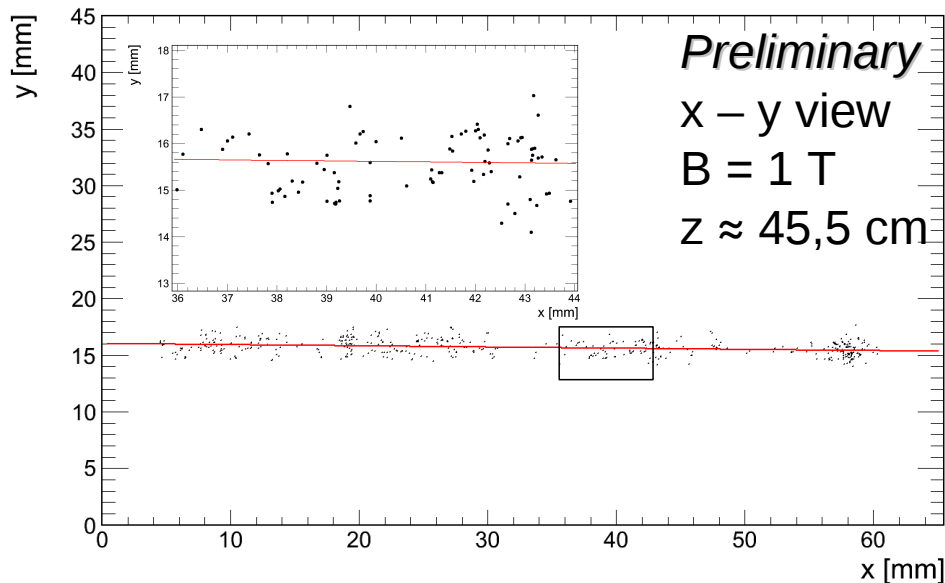
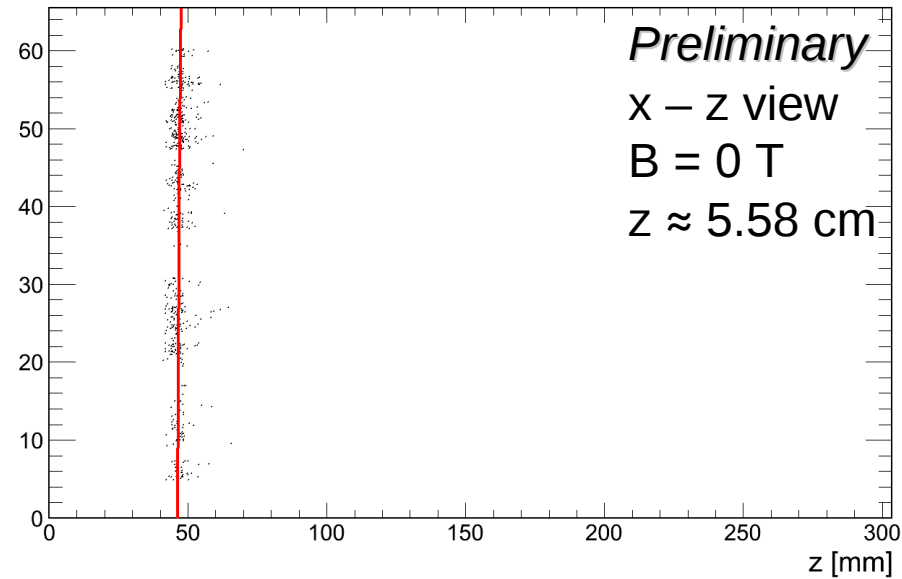
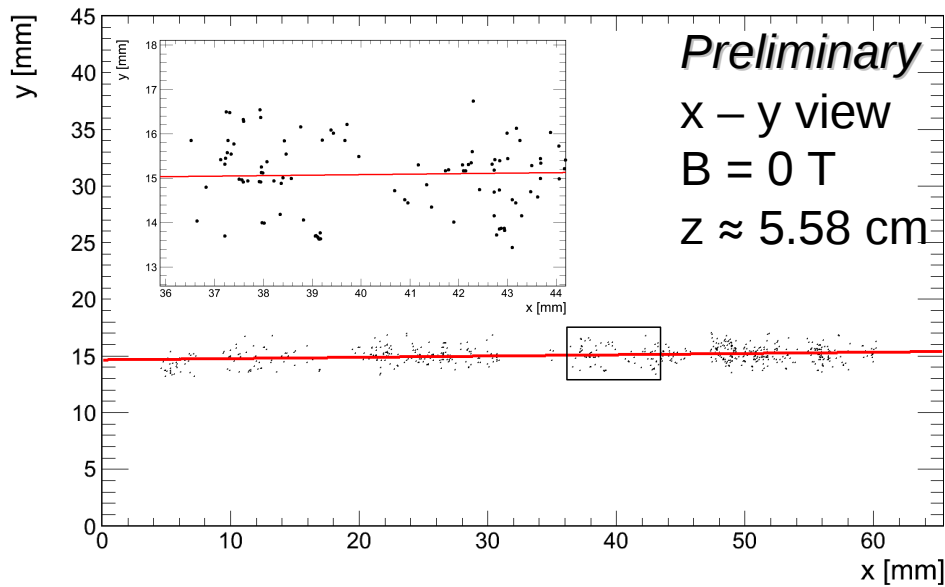


DESY II

# 8 InGrid module

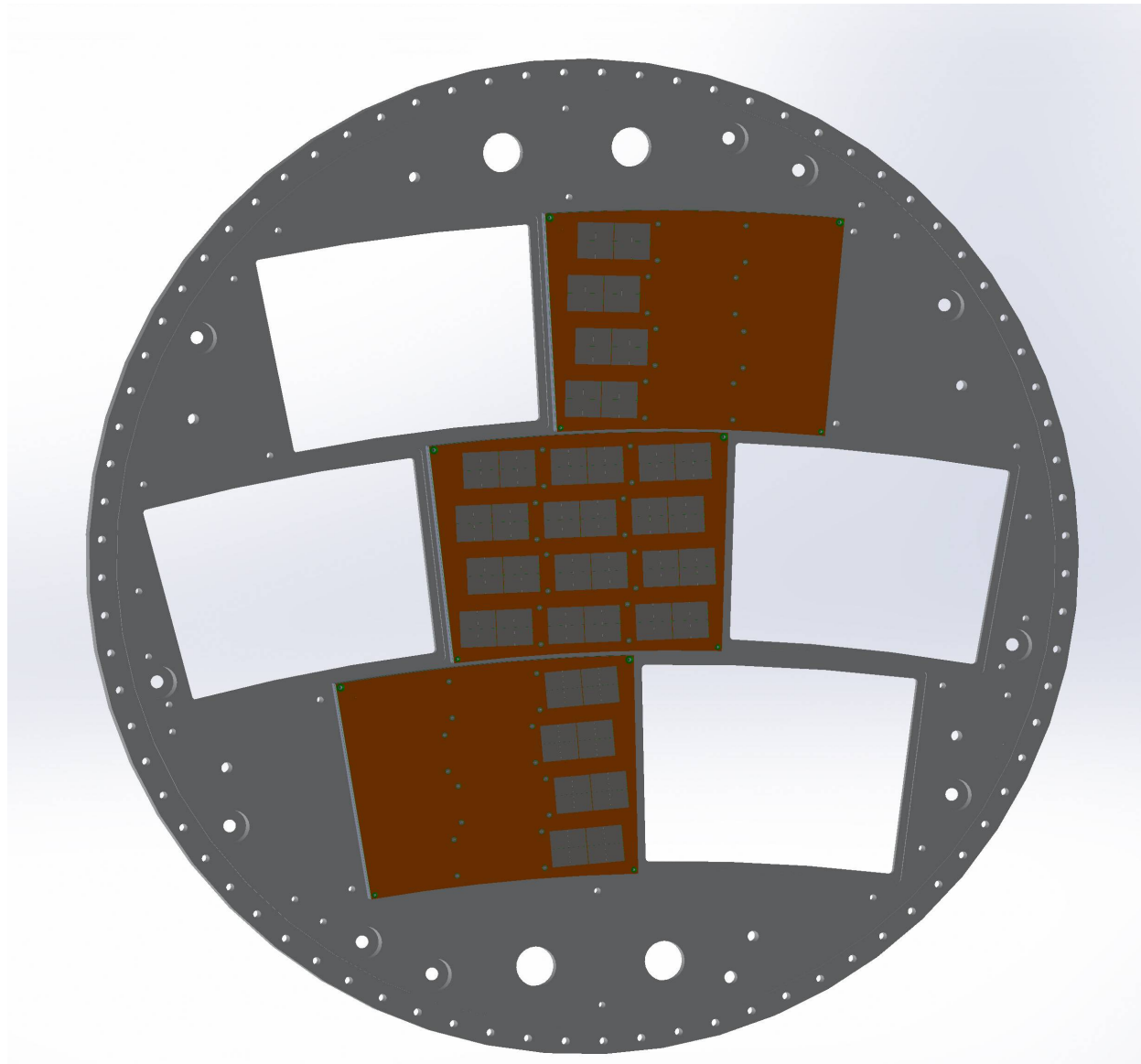


# Reconstructed tracks



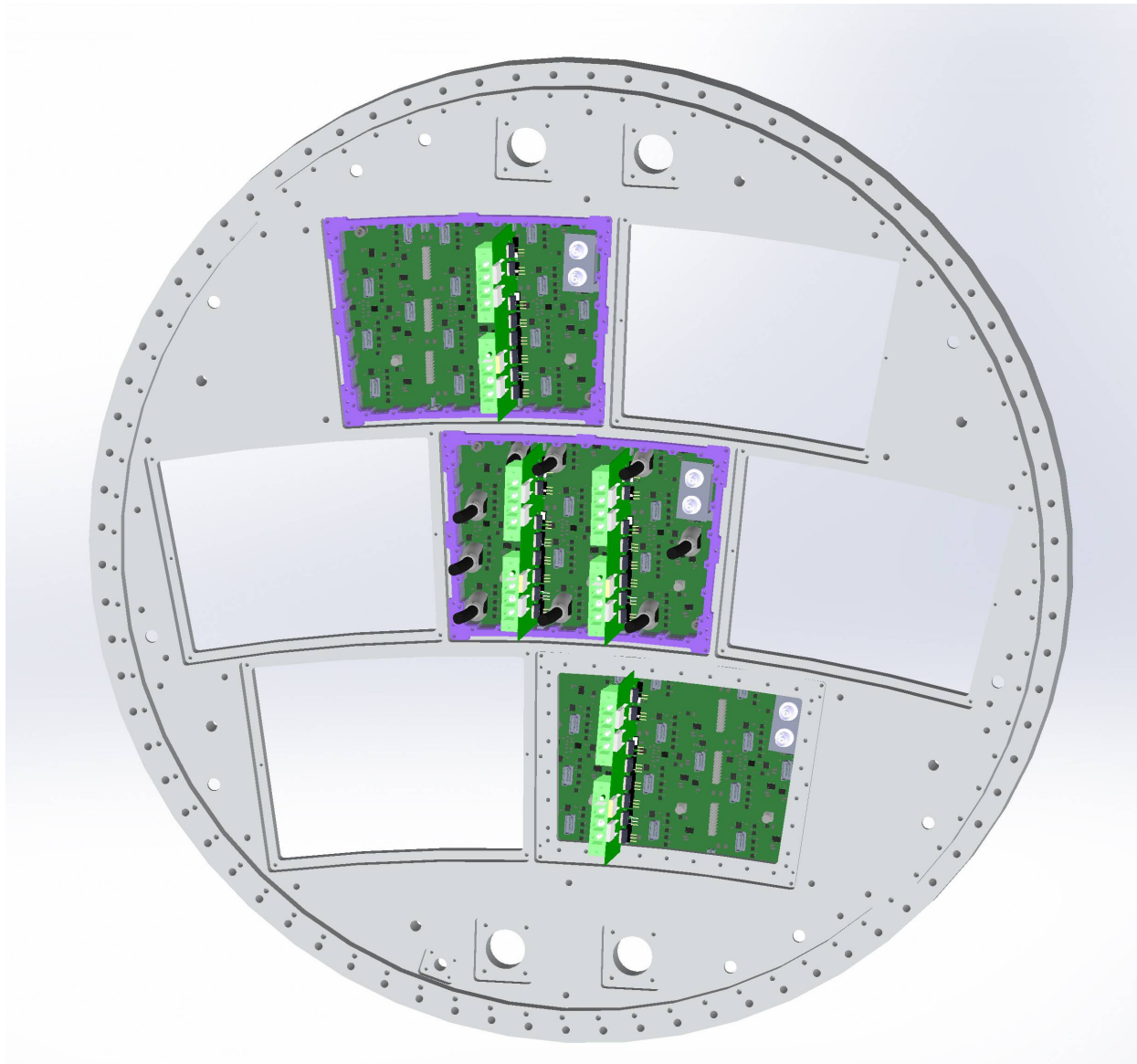


# 2015 Testbeam



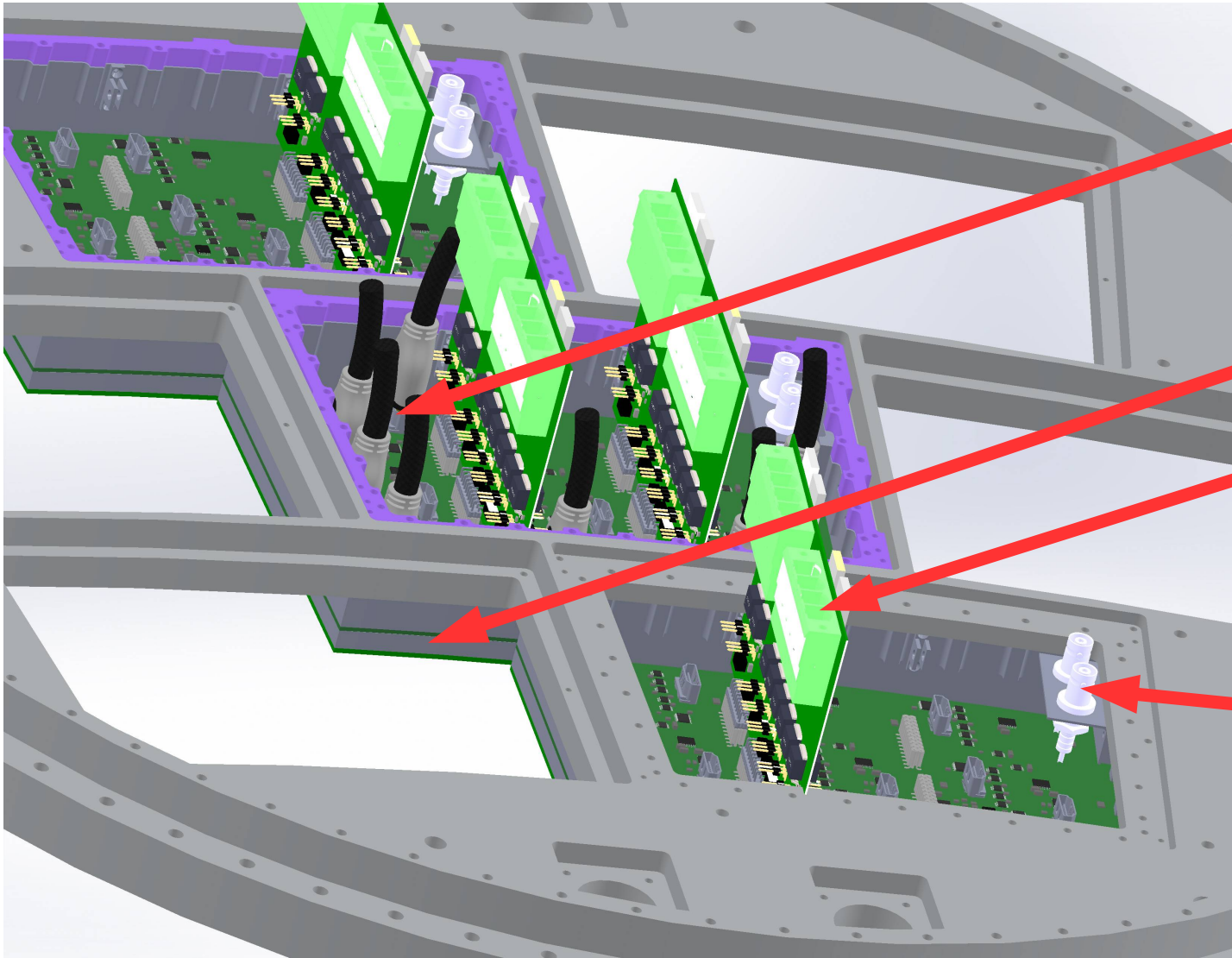
3 modules  
20 octoboards  
160 InGrids

# 2015 Testbeam



3 modules  
20 octoboards  
160 InGrids

# 2015 Testbeam



Readout:  
HDMI cables  
to SRS based  
Timepix readout

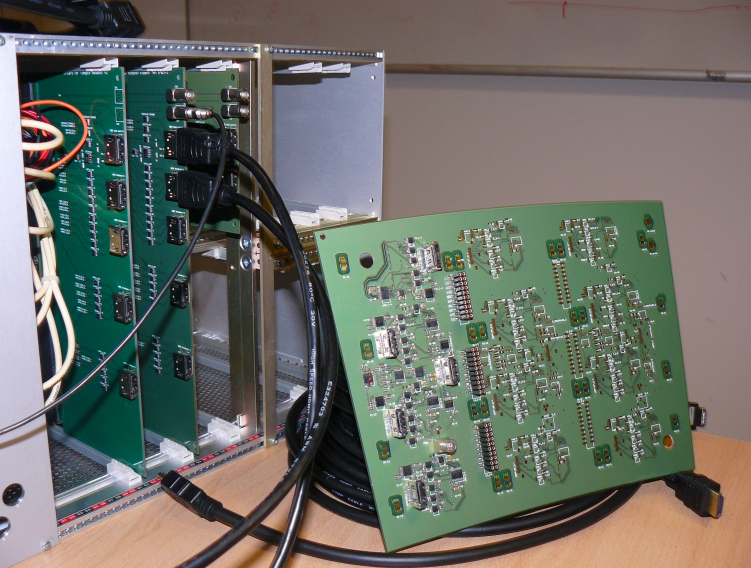
Water cooling

Power supply  
by dedicated  
boards  
→ T 29.3

High voltage  
for grids



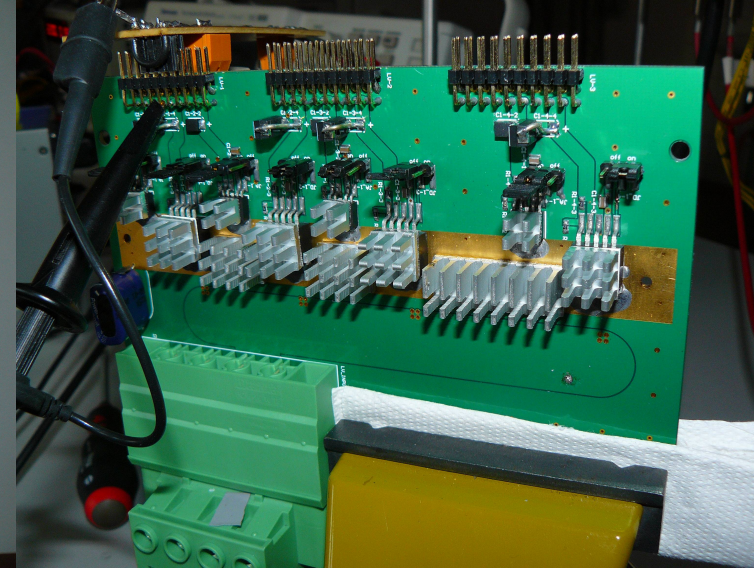
# 2015 Testbeam



Readout system with board



Frames



Power board



20 Octoboards: Dedicated InGrid production,  
glueing, bonding, testing:  
→ T 85.3

# Summary



- TPC for the ILD at the International Linear Collider
- Micromegas / GEM with pad readout as baseline solution for endplate spoil MPGD intrinsic resolution
- Pixel-TPC: readout by an ASIC, Timepix as prototype
- InGrid = Micromegas with pixel readout
- Testbeam 2013: 8-InGrid module
- 160 InGrid detector Testbeam soon

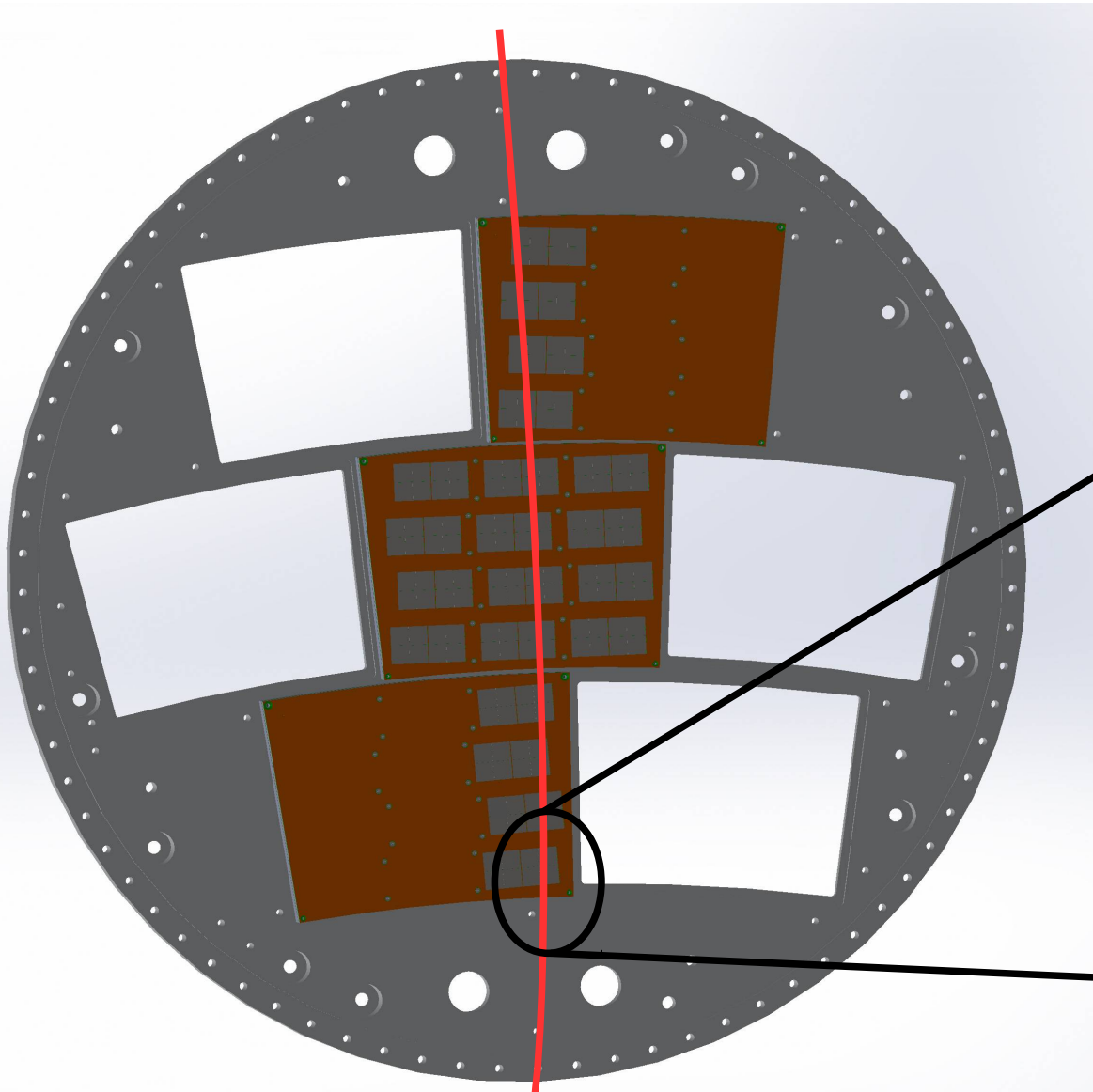


## DESY Testbeam Schedule 2015 - Version 9 - 11/02/2014

Ralf Diener, Norbert Meyners, Marcel Stanitzki - DESY Test Beam Coordinators

	Week	TB21		TB22		TB24/1		TB24	Announce
		DATURA	none	ACONITE/DURANTA	none	EUDET in PCMAG	PCMAG	none	
5-Jan-15	2								
12-Jan-15	3	Startup		Startup		Startup			
19-Jan-15	4	CMS-Pixel-Ph1							
26-Jan-15	5			Goettingen-CMOS					
2-Feb-15	6			TOTEM					
9-Feb-15	7	ALICE-ITS							
16-Feb-15	8								
23-Feb-15	9	CMS-Pixel-Ph1			CALICE-AHCAL				
2-Mar-15	10			Mue3		LCTPC-Micromegas			
9-Mar-15	11	ATLAS-Strip-CMOS		TOTEM		LCTPC-Micromegas			
16-Mar-15	12			ATLAS ITK Pixel				PICSEL	
23-Mar-15	13	Bonn-CMOS		ATLAS ITK Pixel		LCTPC96-InGrid			
30-Mar-15	14			ATLAS ITK Pixel		LCTPC96-InGrid			
6-Apr-15	15	CMS-Pixel-Ph1							

Set up the system in Bonn: Now  
 Setup at DESY: next week  
 Testbeam: 23 March – 6 April



Thanks to the  
whole group !!!

