

COMPASS GEM Detectors: Update Report

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Short Motivation

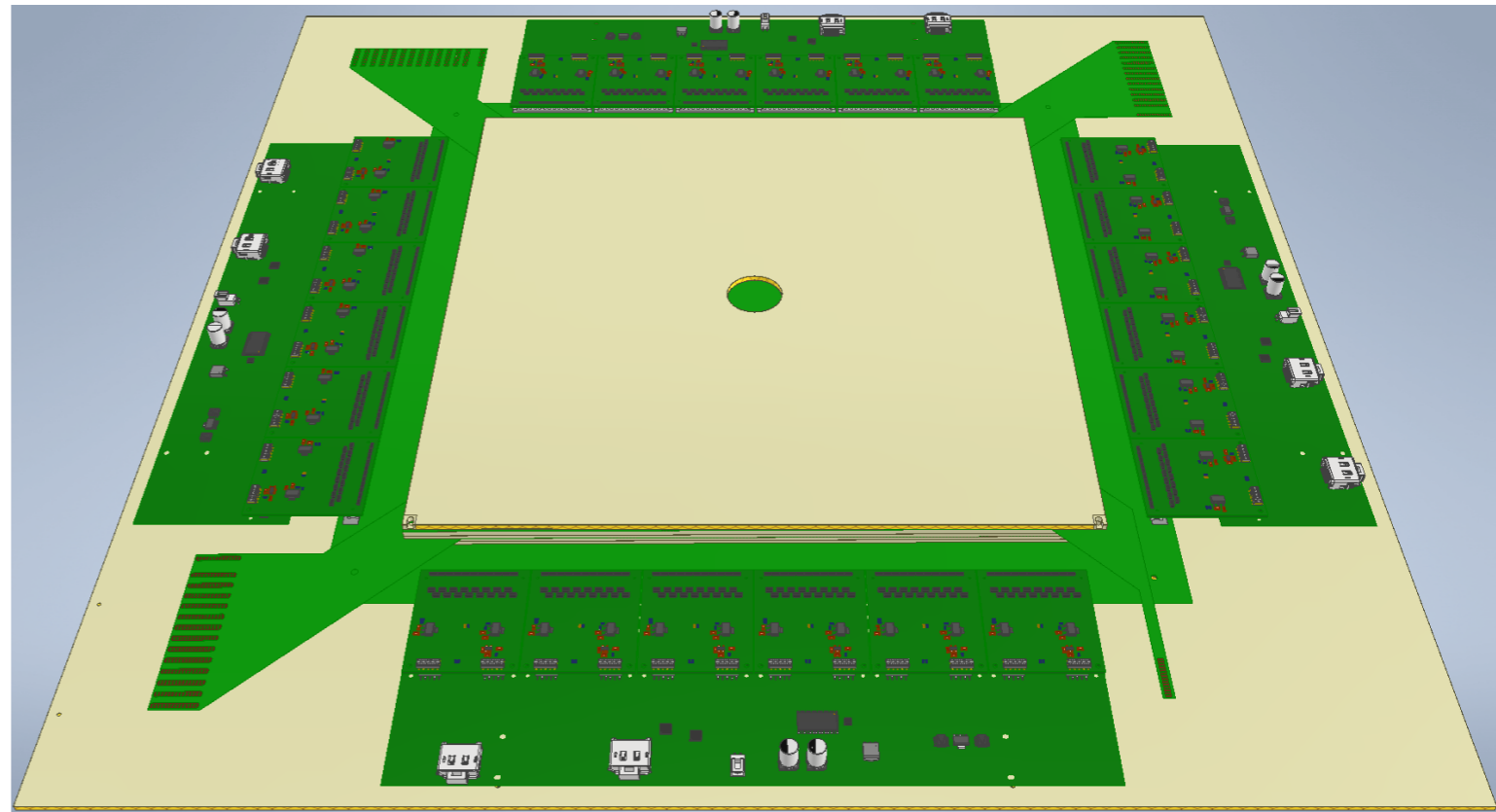
- Need of tracking detectors
- Rebuild large-size GEM detectors
- Replacement and spares
(until 2021)
- Self triggered readout
(e.g. compare VMM & APV)
- Upgrade of electronics
(e.g. exchange outdated connectors)



„Flying GEM“

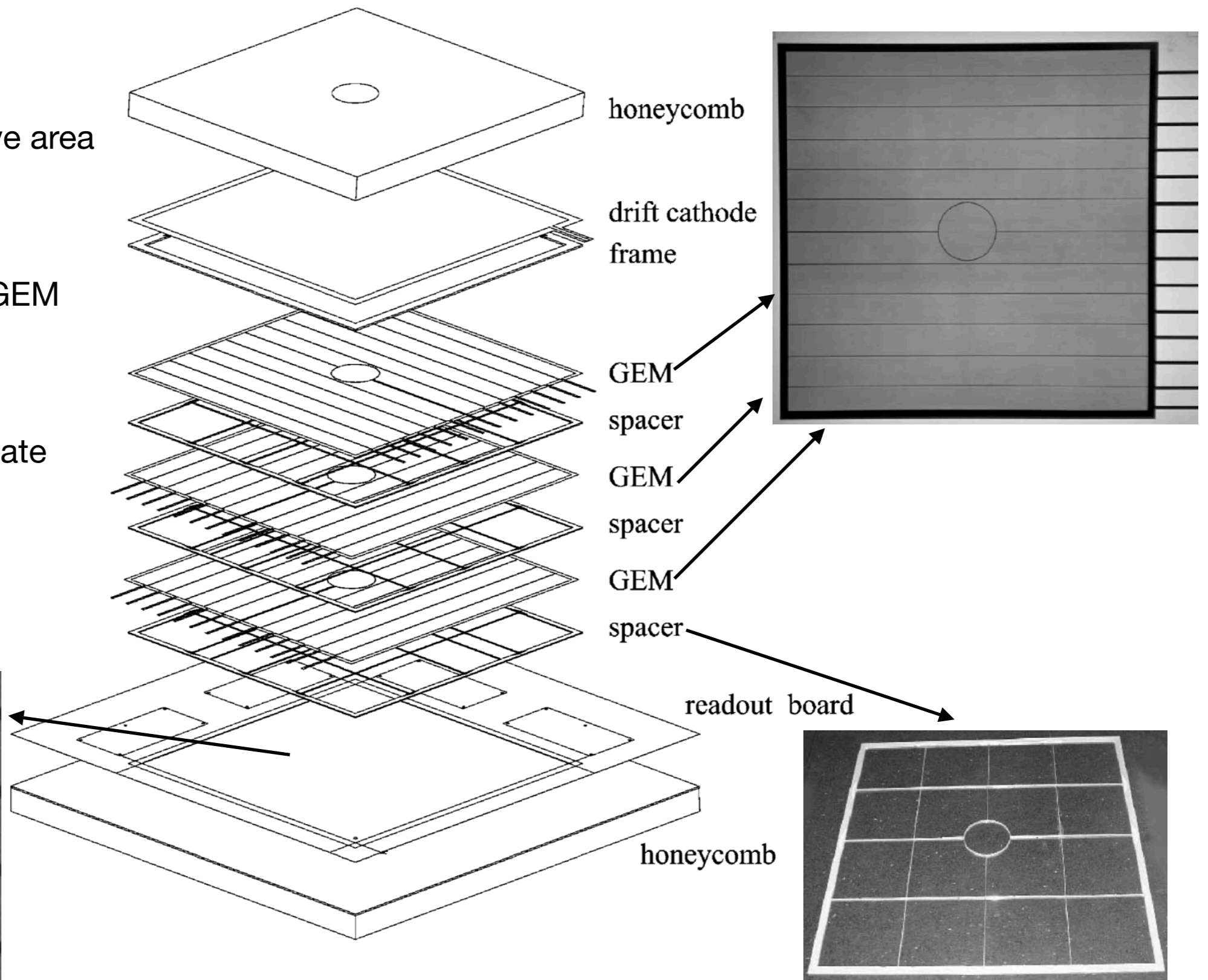
Large-Size Strip Detector

- Triple GEM tracking detector
- 30.7 cm x 30.7 cm active area (backward compatible)
- Strip without centre pixels (extendable in future?)
- No major modifications
- Modular readout (e.g. APV - VMM)
- Use knowledge from previous production & ALICE upgrade



Previous large-size GEM

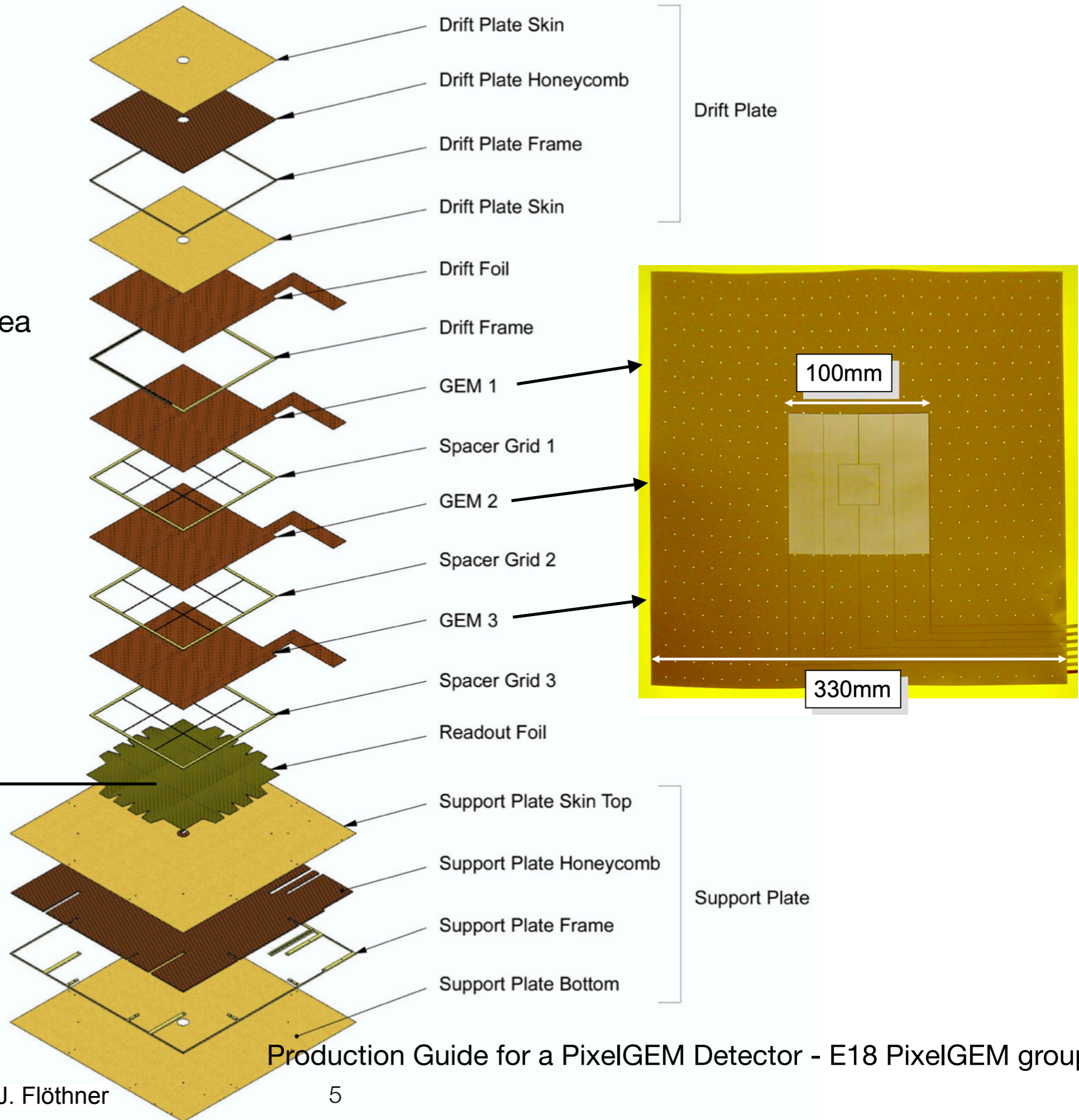
- 30.7 cm x 30.7 cm active area
 - Continuous strips
- 13 times top-sectored GEM
- Spacer with grids
- Gas-inlet via Support Plate
- Honeycomb Plates



Nuclear Instruments and Methods in Physics Research Section A - C. Altunbas et al.

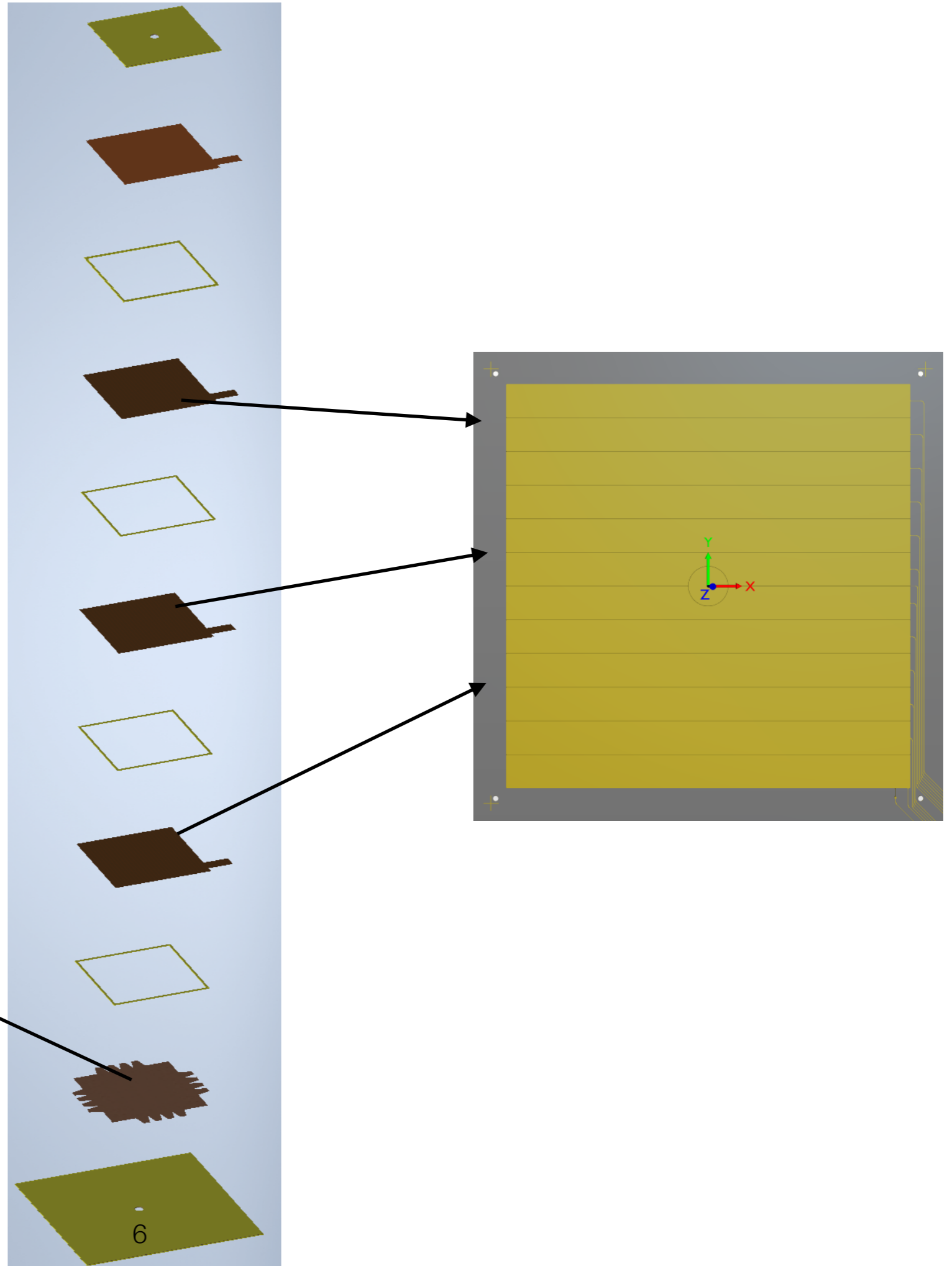
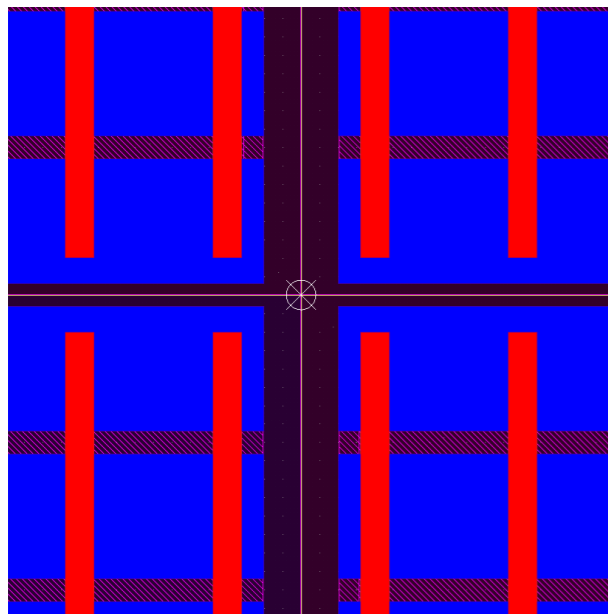
Previous PixelGEM

- 10 cm x 10 cm active area
 - 3.2 cm x 3.2 cm pixel area
- Fivefold top-sectored GEM
- Spacer with grids
- Gas-inlet via Support Plate
- Honeycomb Plates



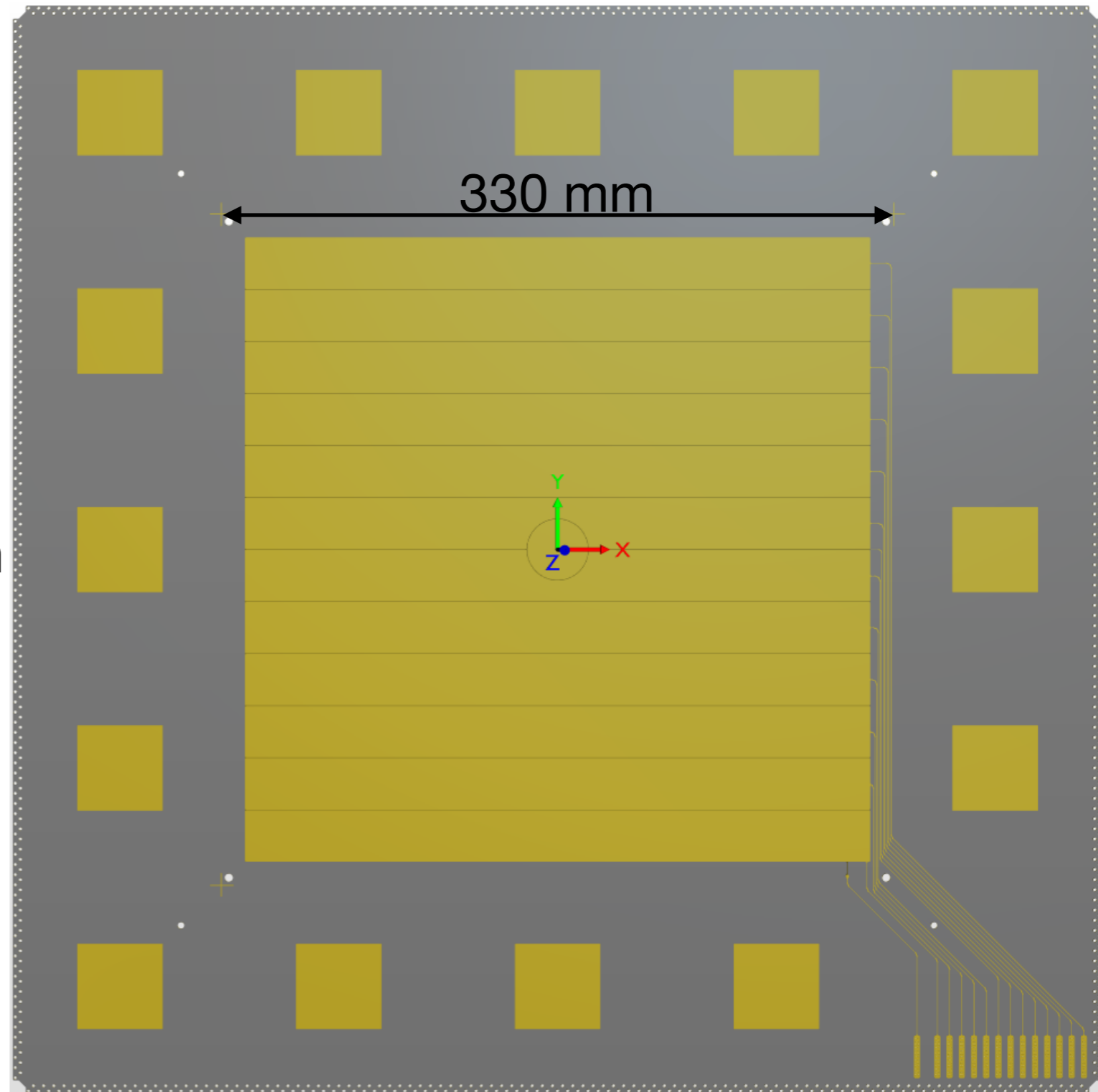
Ongoing large-size GEM

- 30.7 cm x 30.7 cm active area
 - Strips divided in the centre to reduce occupancy
- 13 times top-sectored GEM
- Spacer without grids
- Gas-inlet via Drift Plate
- Honeycomb Plates?

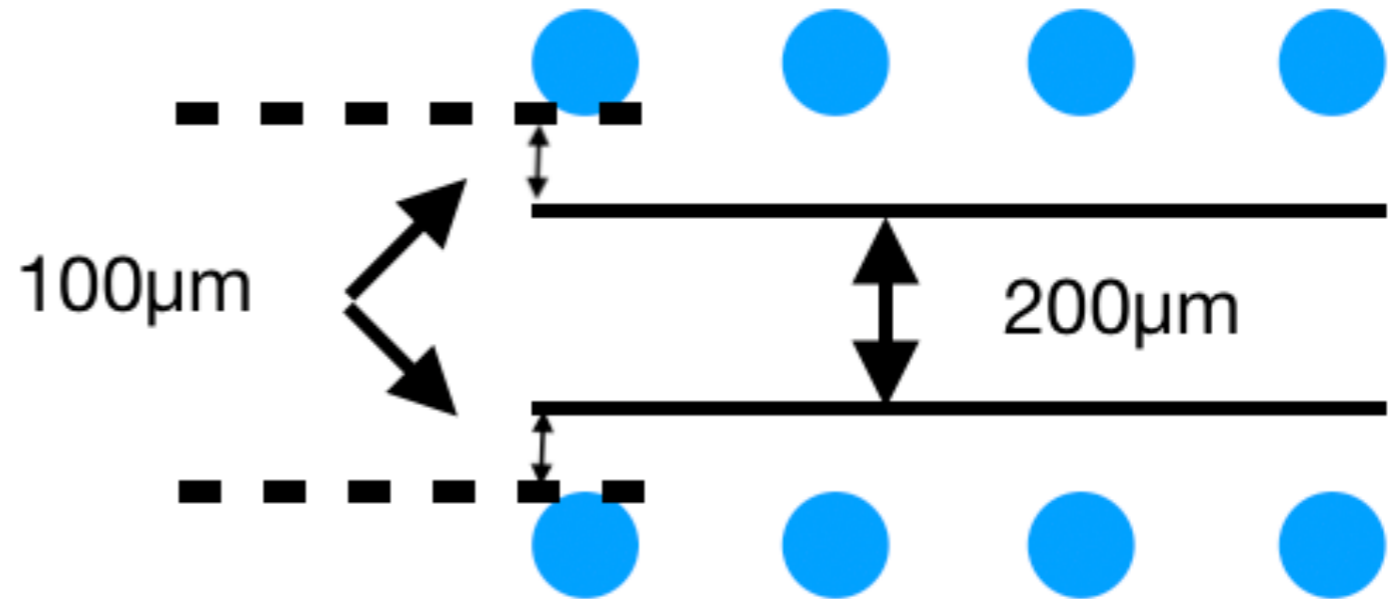
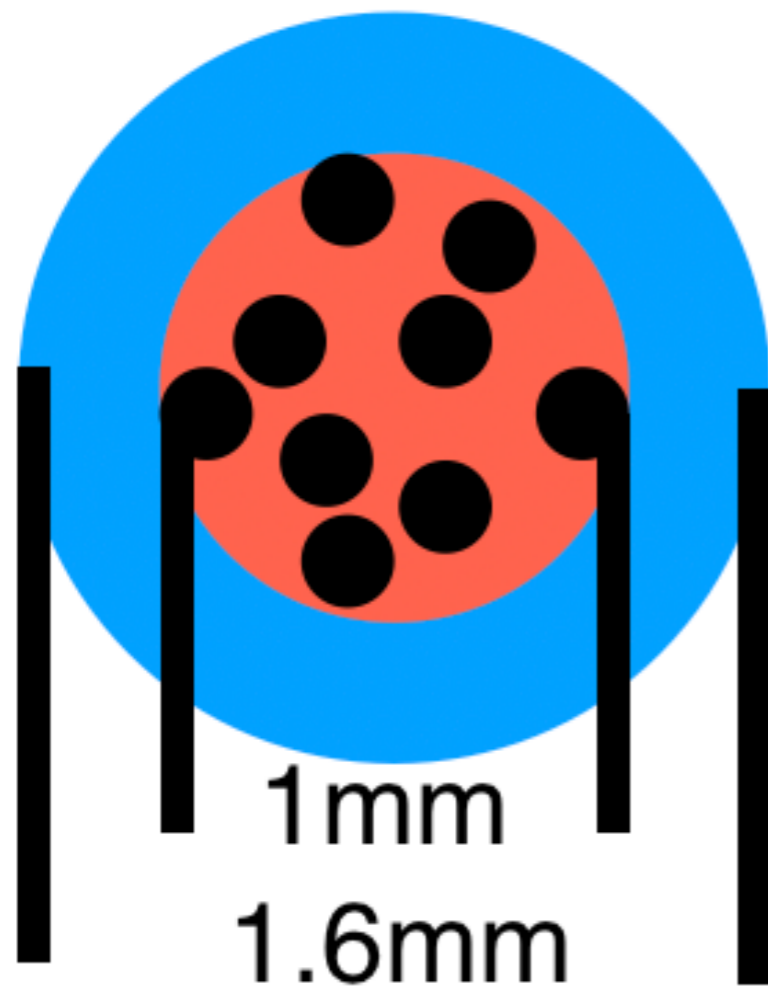


GEM Foil Design

- Triple GEM stack
- Foils segmented on one side: 12 sectors + centre
- All tracks guided through one corner with coverlay protection
- Foils rotated by 90 degree
- Cu thickness reduced
- Silver connections (Via)

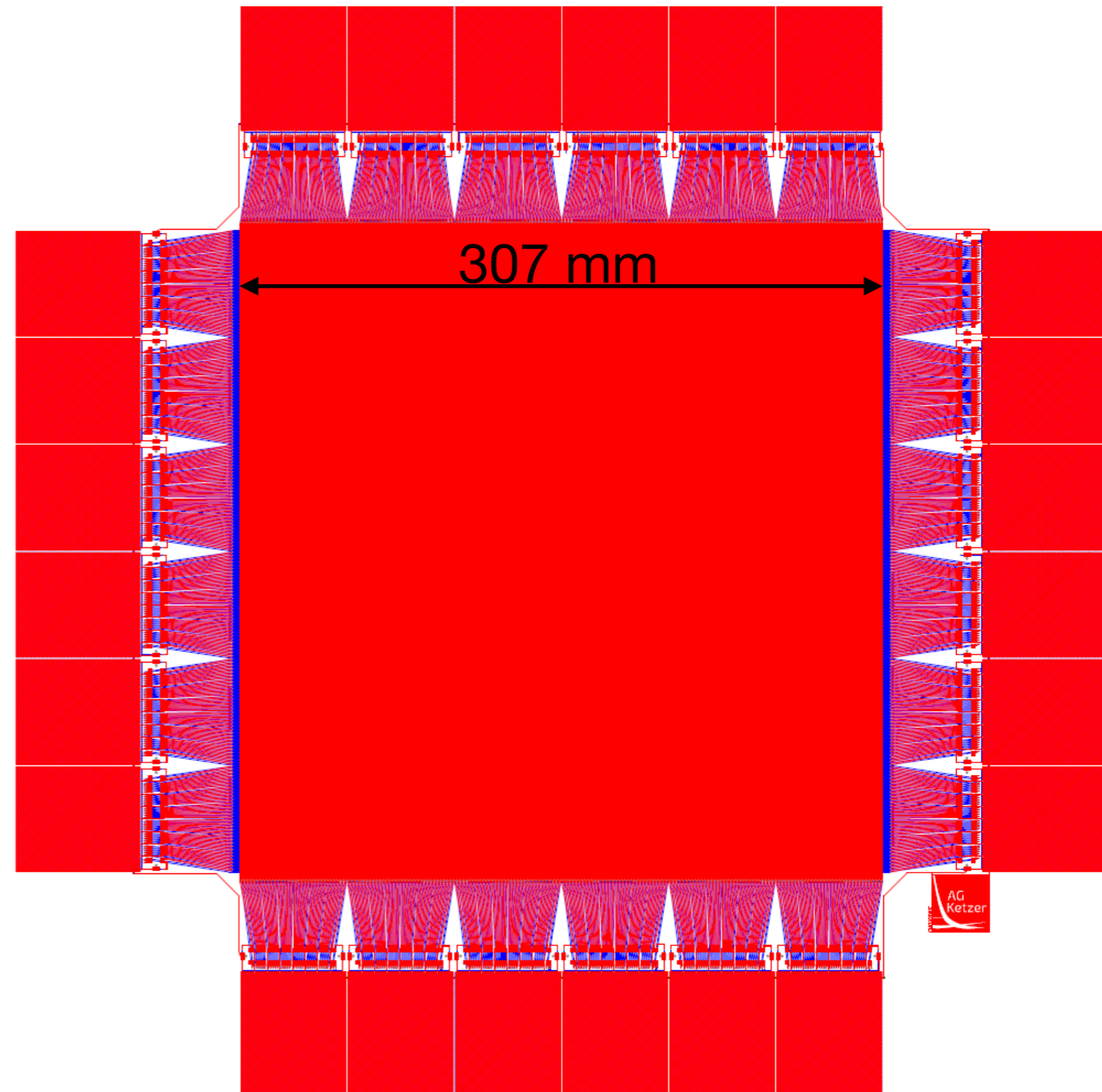


Hole Placement and Via

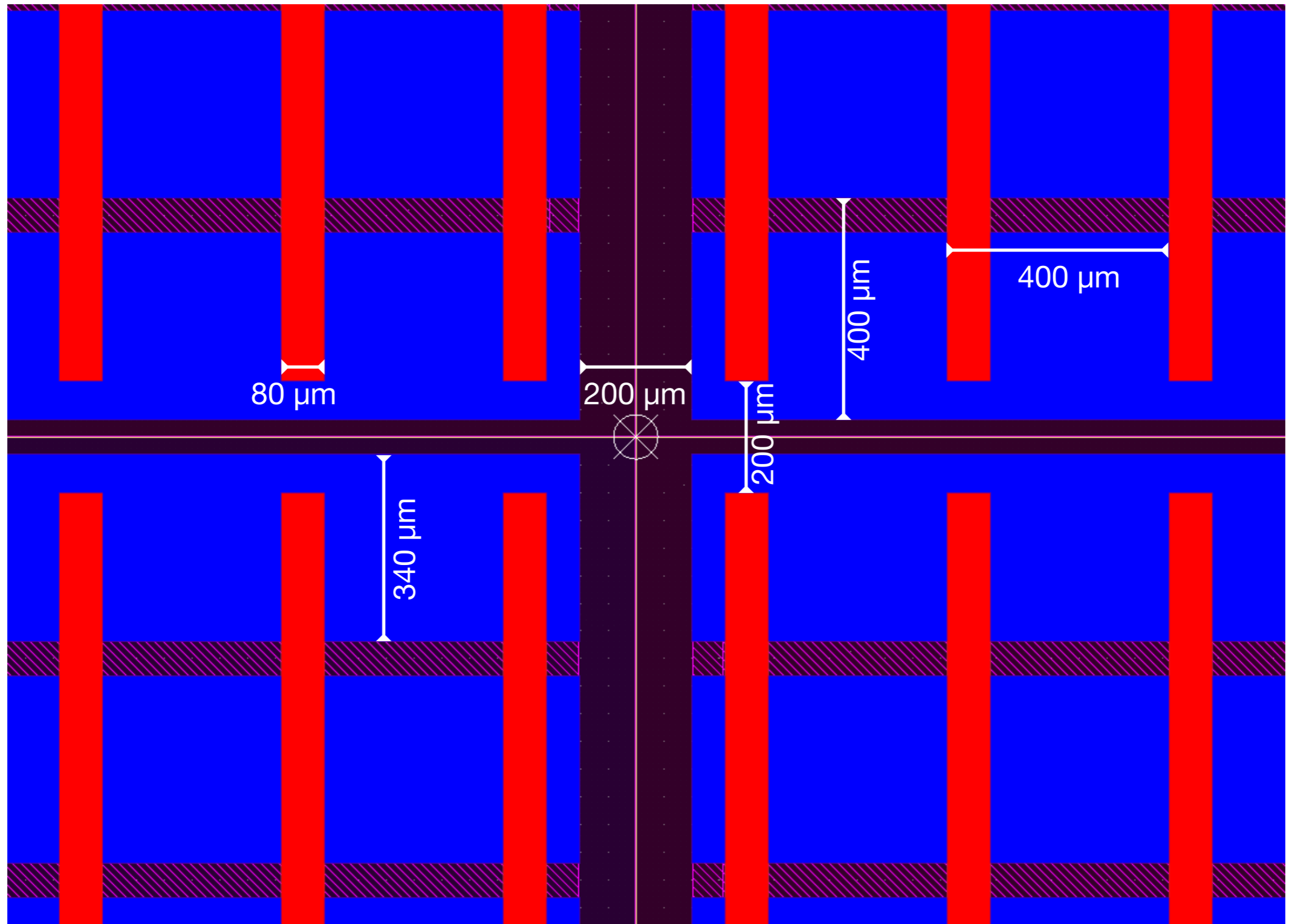


Readout Plane

- Readout from all sides
- 4x768 strips (cut in middle)
- I2C replaces Panasonic
- 400 μm pitch
- Stripwidth: 80/340 μm top/bot
- 200 μm „centre gap“



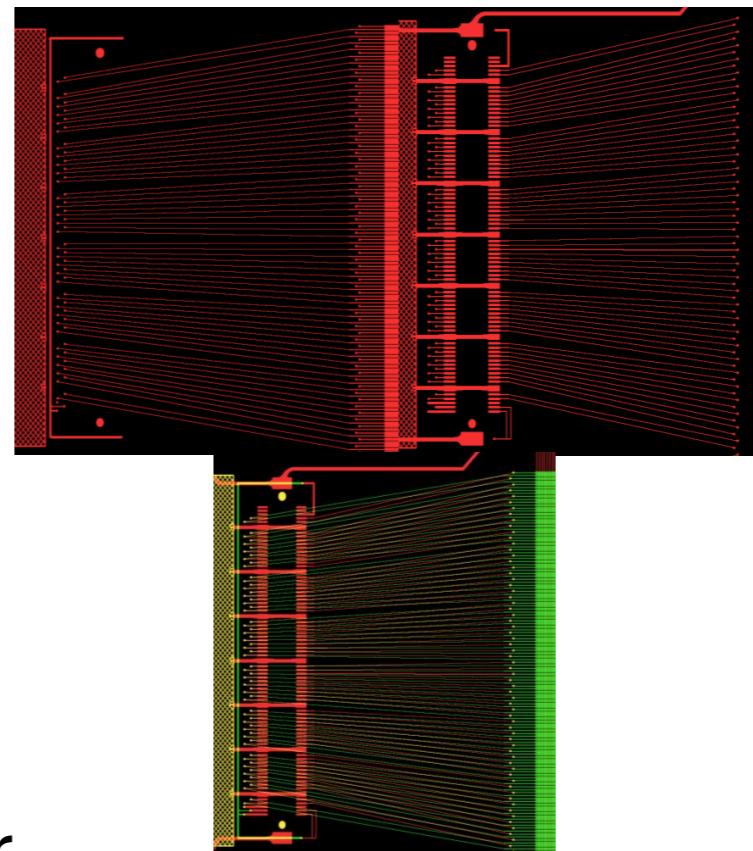
Readout Plane Centre



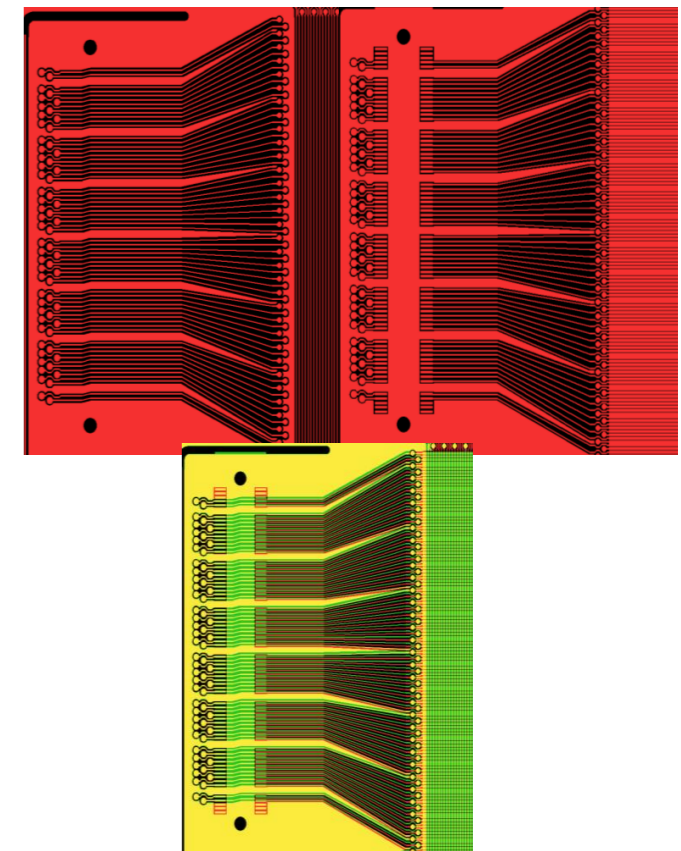
Status Foils

- Rui de Oliveira is working on it (Thanks!)
- Ordered with price per foil:
(+ 4200 CHF one time)
 - ▶ 3x Drift - 450 CHF
 - ▶ 3x Readout - 3876 CHF
 - ▶ 6x GEM - 1050 CHF
- Slight changes in operation for the Readout foil

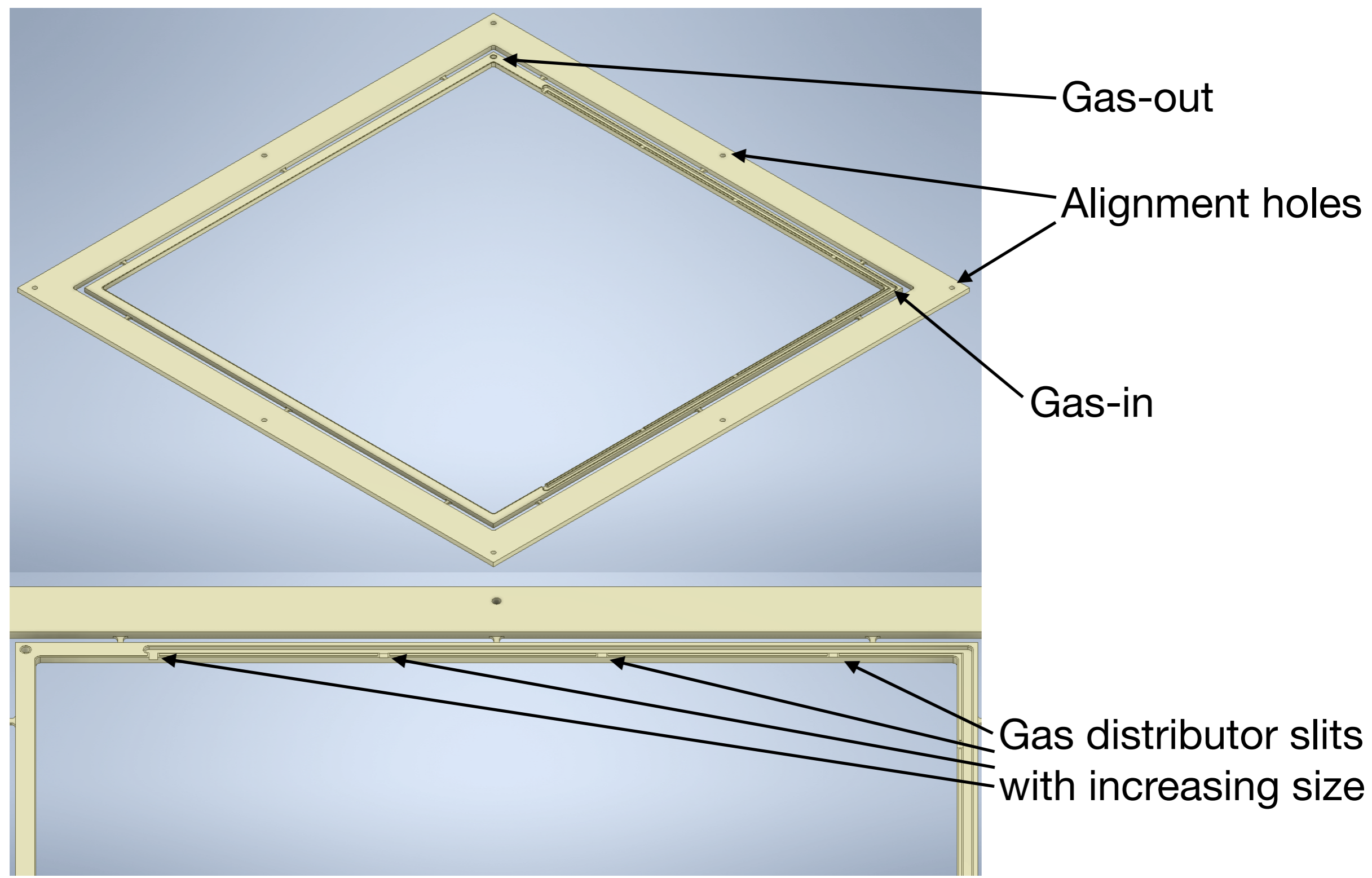
Layout of Compass & Hirose Connector



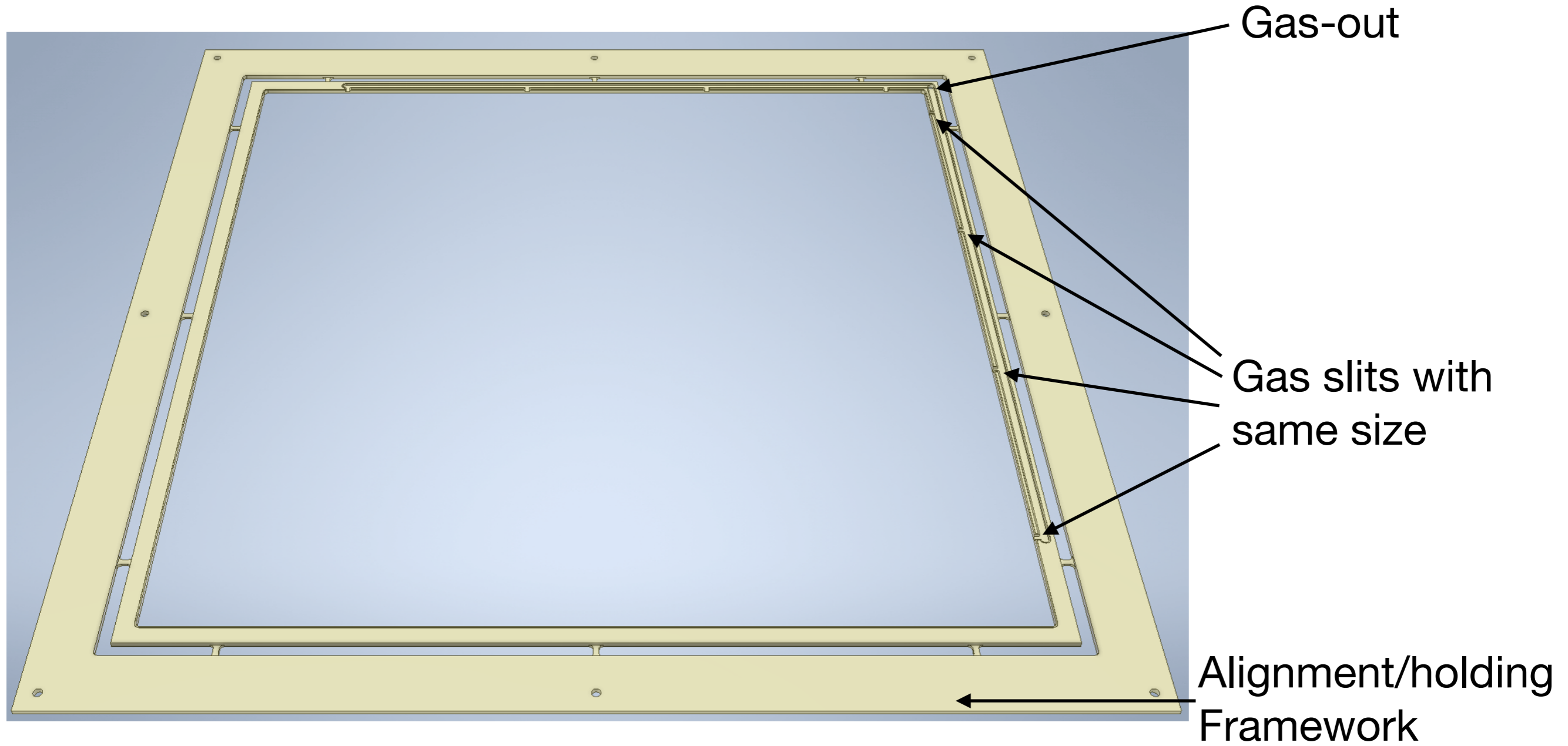
Suggested Layout for Hirose connector



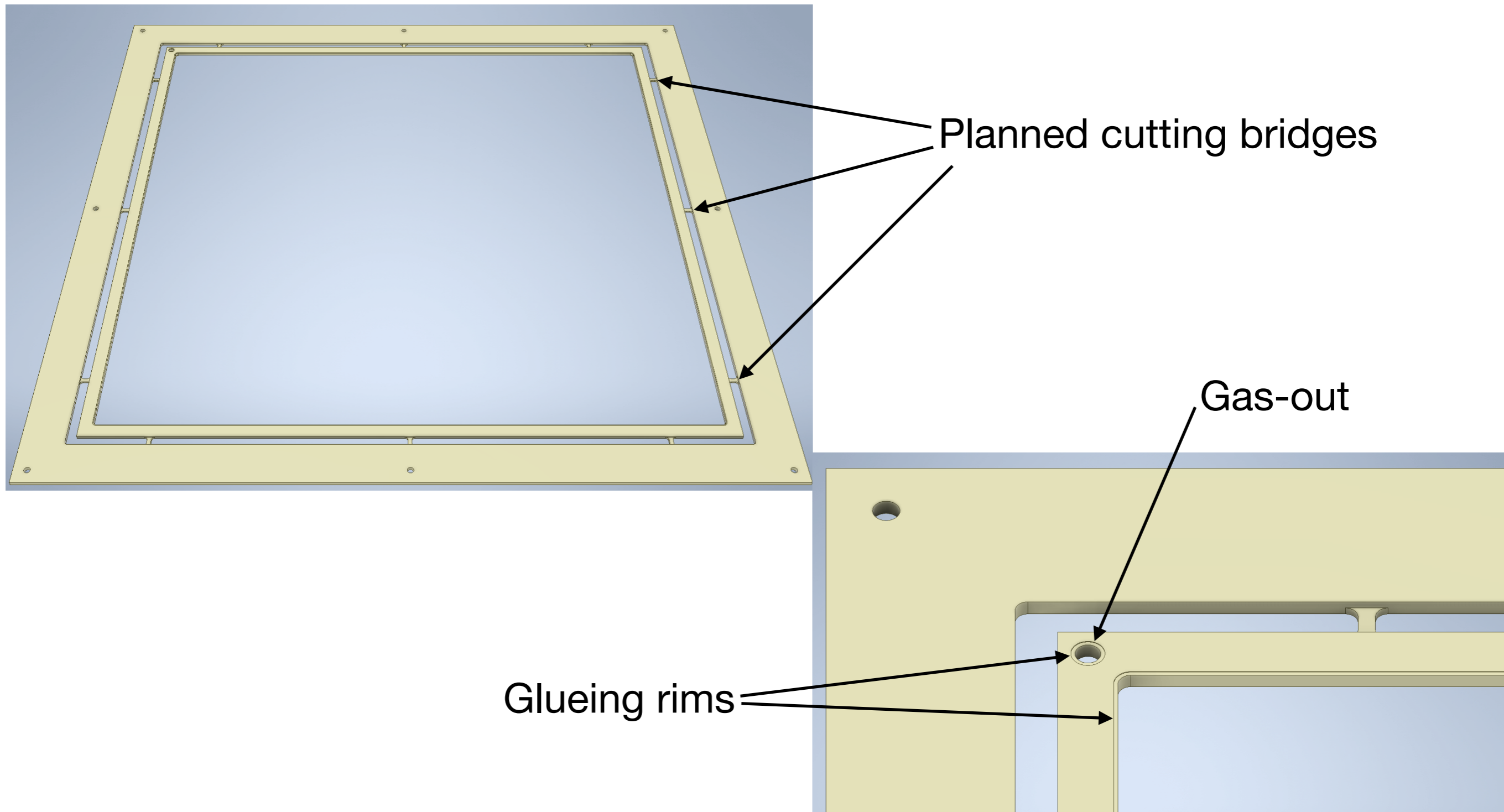
Drift Frame of 3 mm



Gas-out Frame of 2 mm

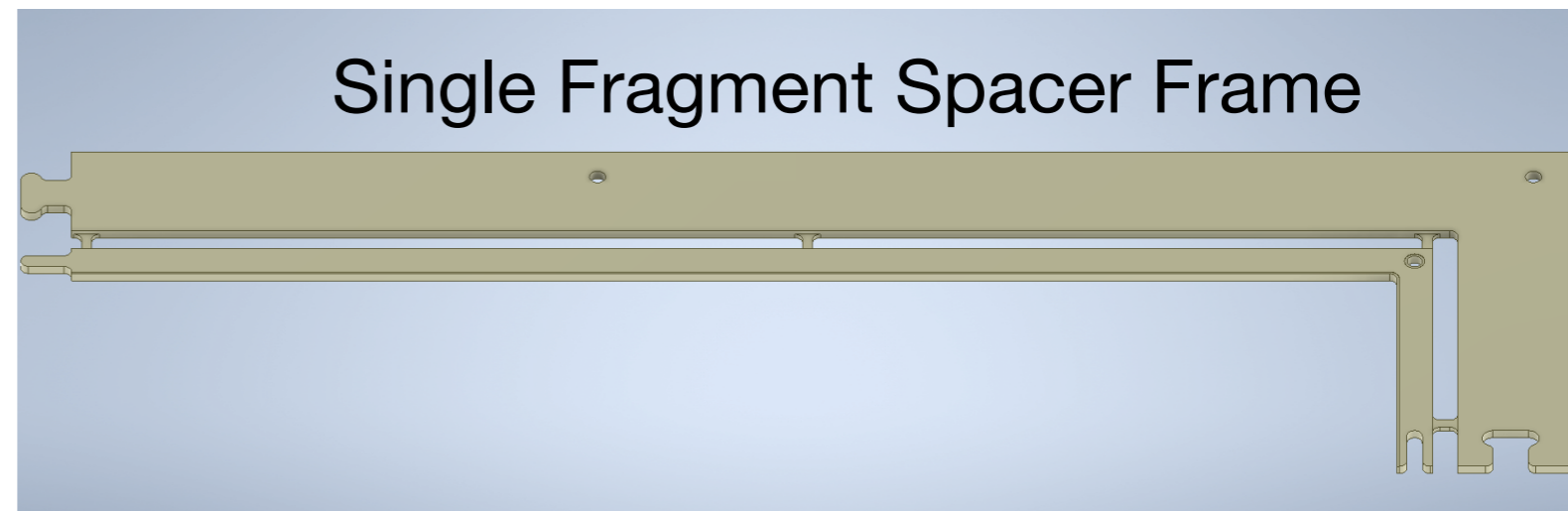


Spacer Frame of 2 mm



Status Frames

- Workshop is in (limited) operation
- Material cost per detector:
(VAT excluded)
 - ▶ No segmentation - 146.6 €
 - ▶ Segmentation - 76.2 €
- Reduce Manufacturing cost:
(waiting for first estimate)
 - ▶ 1.5 mm Radius
 - ▶ Oneside milling



Status Plates

- Honeycomb:
 - ▶ Searching for supplier

- Alternatives (?):

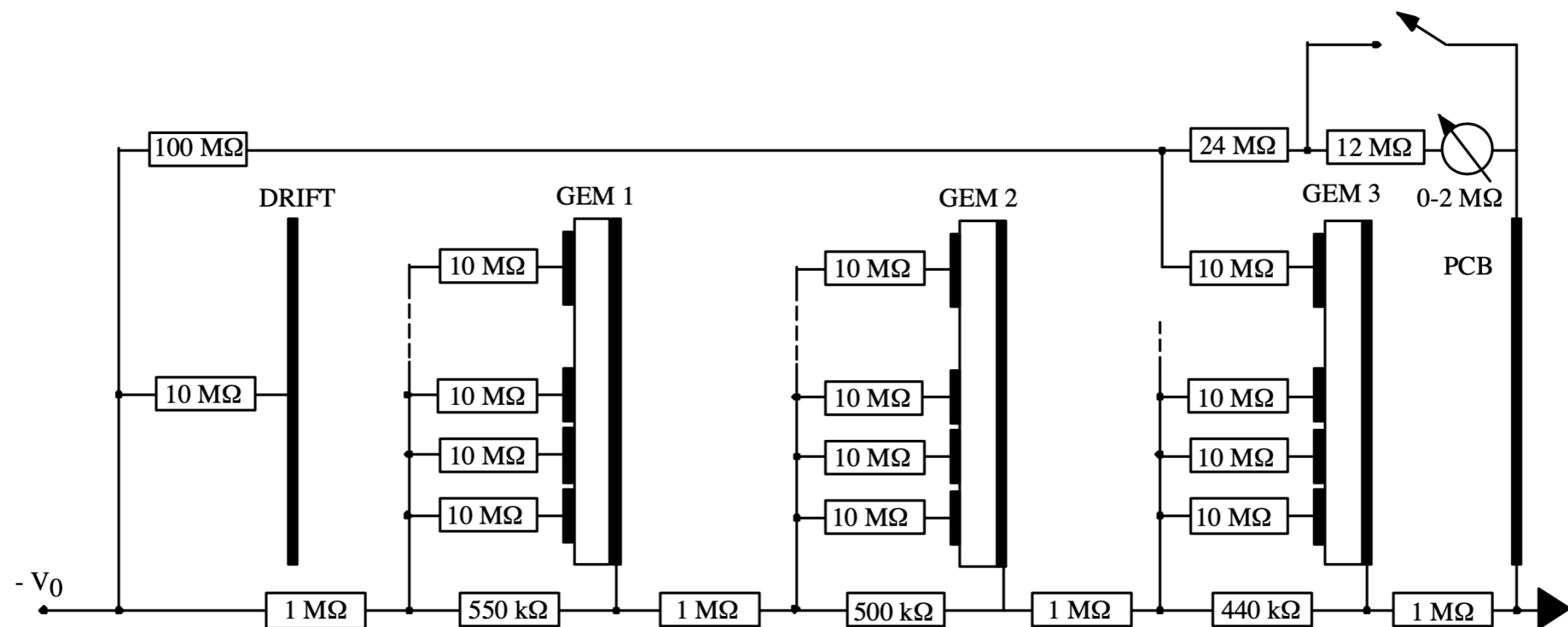
- ▶ Aerogels
- ▶ SIGATHERM

Part	Material	Thickness (um)	Fraction	Density (g/cm3)	Rad Length (g/cm2)	Nucl. Inter. Length (g/cm2)	Total detector thickness x (um)	x/X0 (‰)	x/λI (‰)	Total x/X0 (‰)
Honeycomb skin	G10	200	1	1,700	33	90,2	200,00	1,03	0,38	
Glue	Epoxy resin	62	1	2,000	49,25	81,2	62,00	0,25	0,15	
	NOMEX	3000	0,018	1,380	33	90	3000,00	0,23	0,08	
Glue	Epoxy resin	62	1	2,000	49,25	81,2	62,00	0,25	0,15	
Honeycomb skin	G10	200	1	1,700	33	90,2	200,00	1,03	0,38	2,79
Foamlite P	PP	6000	1	0,65	44,085			8,85		8,85
Slentite	Polyurethan	10000	1	0,135	44,64			3,02		3,02
Sigratherm LN	Carbon	15000	1	0,05	42,7			1,76		1,76

Status HV Board(s)

Further Improvement next Weeks

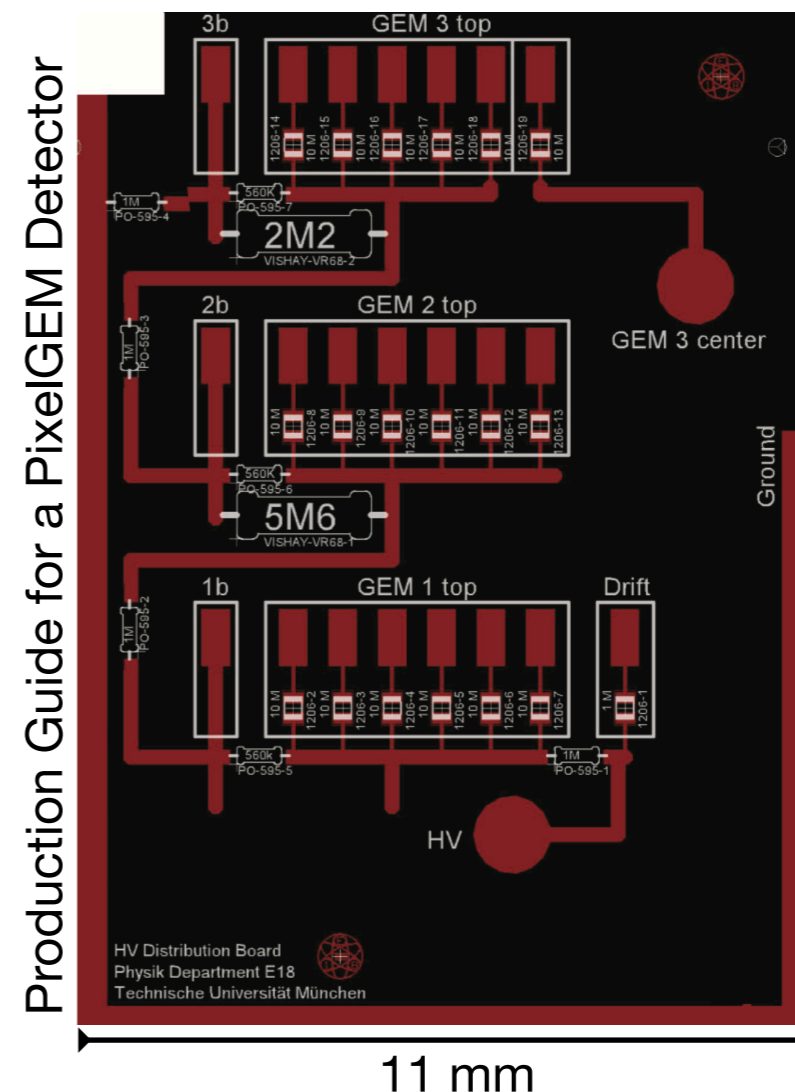
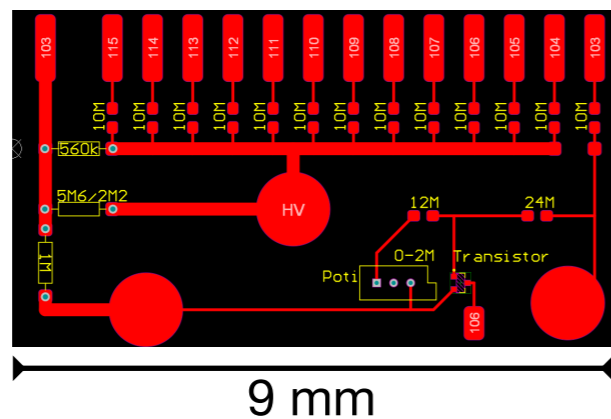
- Resistor chain for high voltage distribution
 - Remote-controlled switch to activate/de-activate central area



Status HV Board(s)

Further Improvement next Weeks

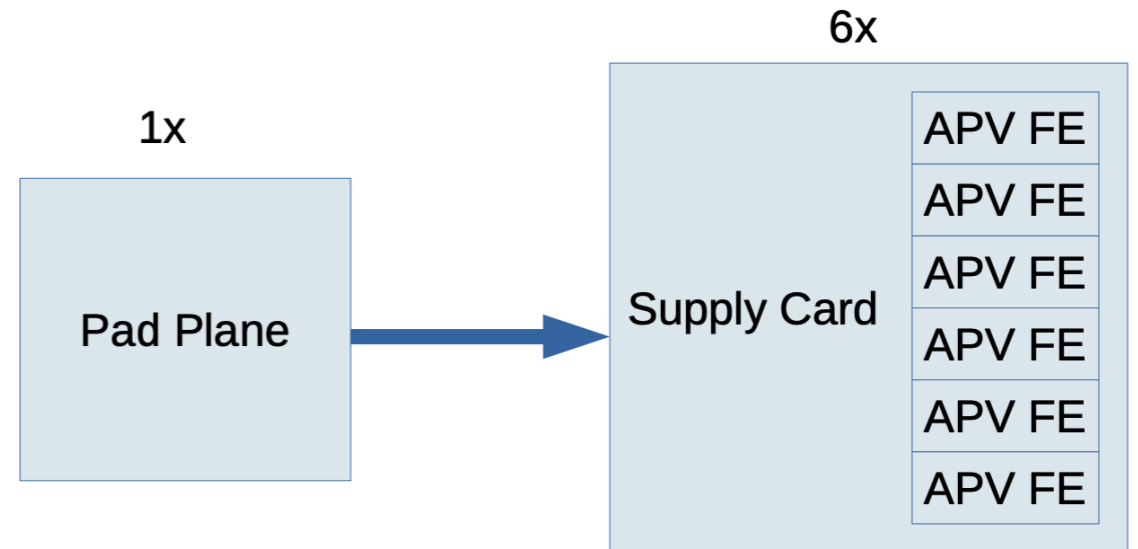
- One PCB for each foil (logic remains the same just distributed)
- Remote-controlled switch to activate/de-activate central area instead of central area power supply



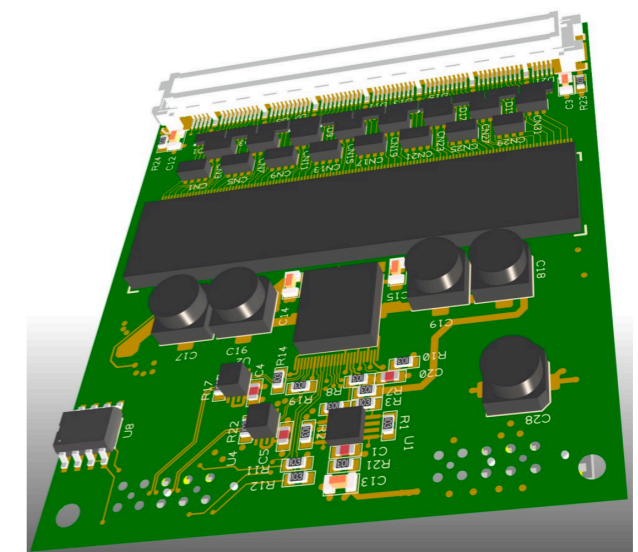
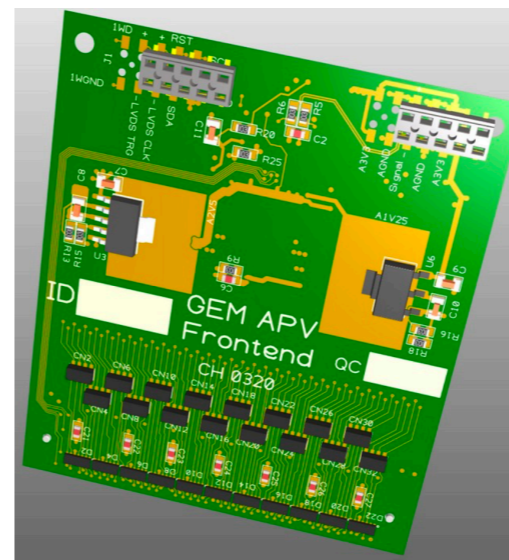
Status APV Frontend

Christian Honisch (honisch@hiskp.uni-bonn.de)

- One Detector:
 - 4x Supply card
 - ➔ Each 6x APV Front-End



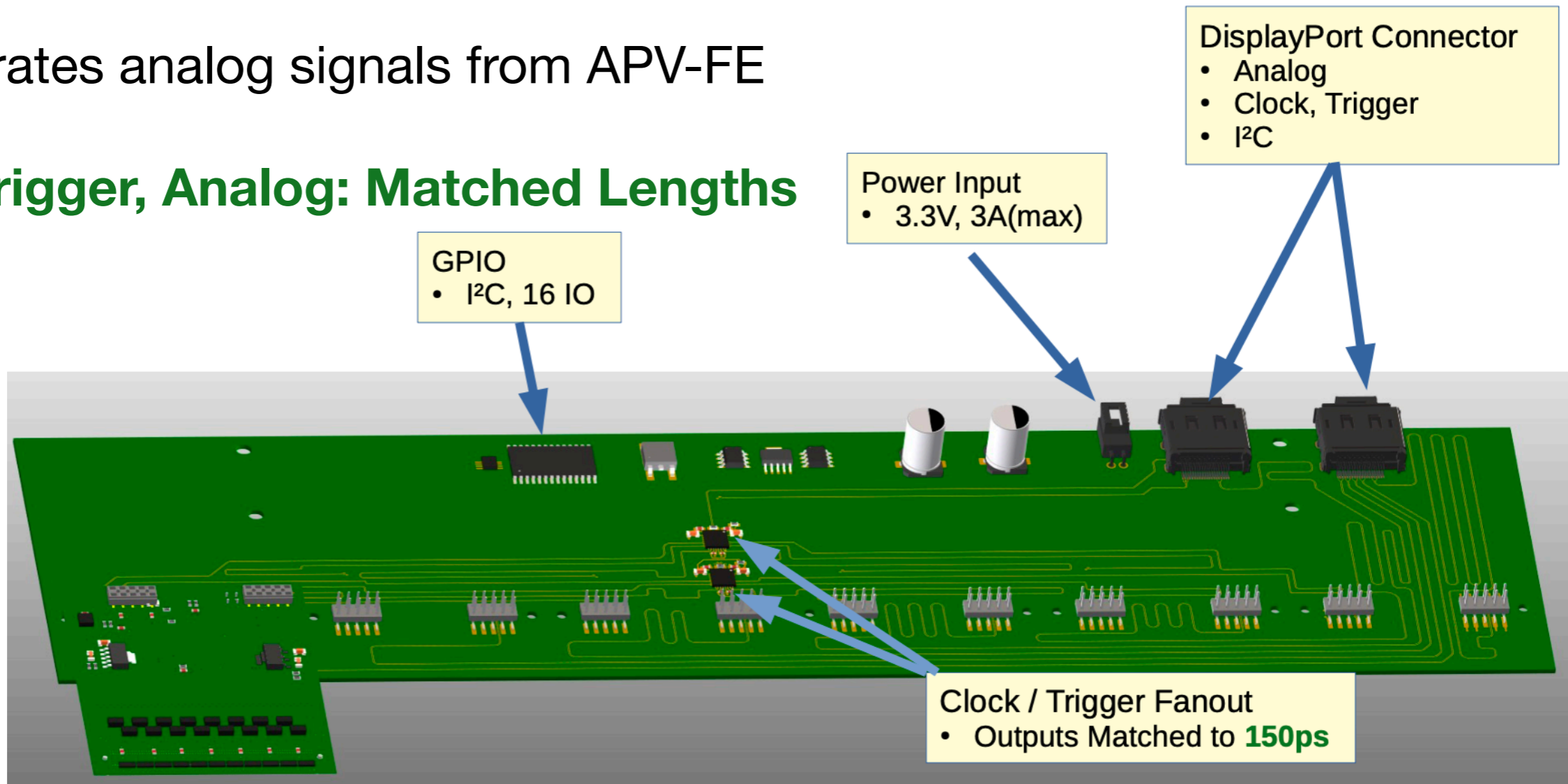
- PCB in production
- Improved input protection
- I²C temperature sensor
- I²C addresses: via detector connection



Status APV Frontend

Christian Honisch (honisch@hiskp.uni-bonn.de)

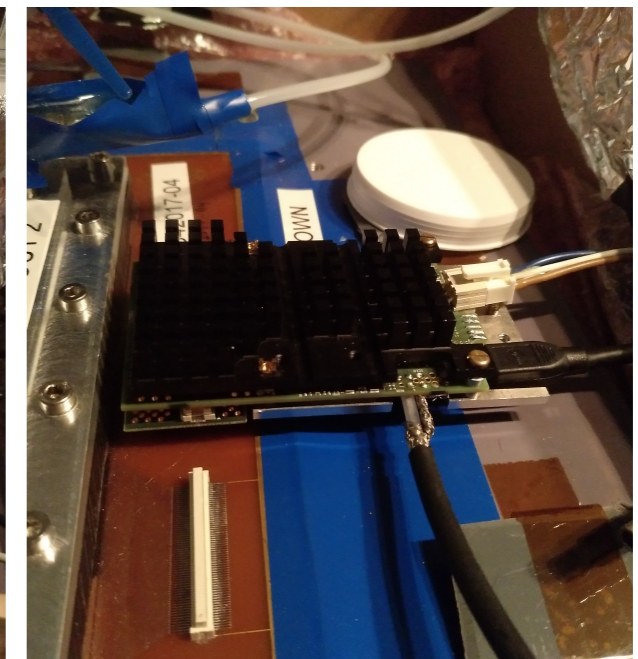
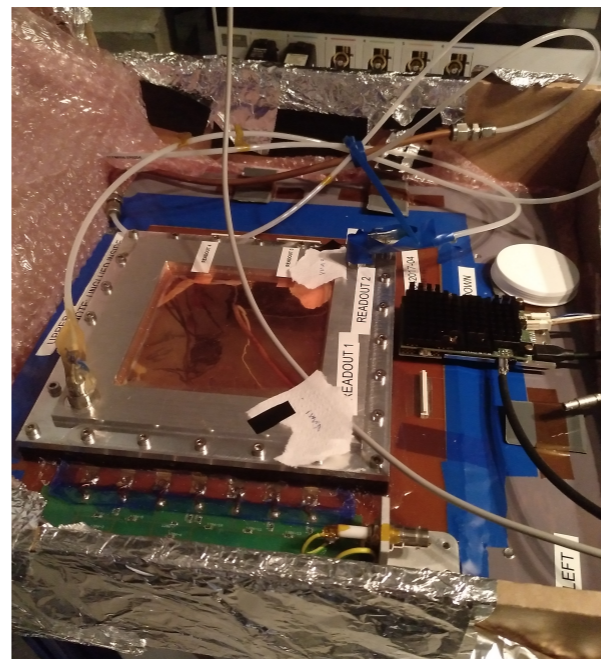
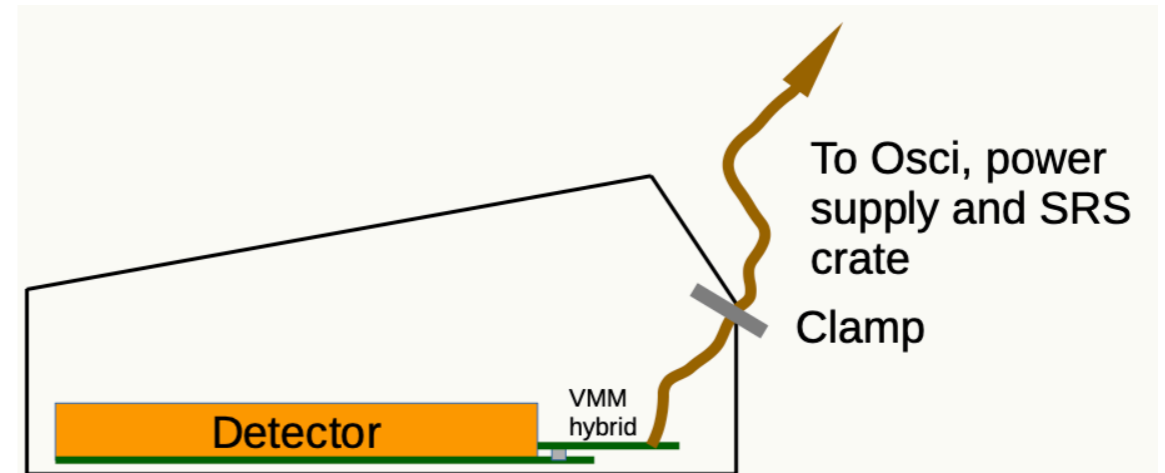
- Status: Work in progress
- Provides Power, Clock, Trigger to APV-FE
- Concentrates analog signals from APV-FE
- **Clock, Trigger, Analog: Matched Lengths**



Status VMM Measurements

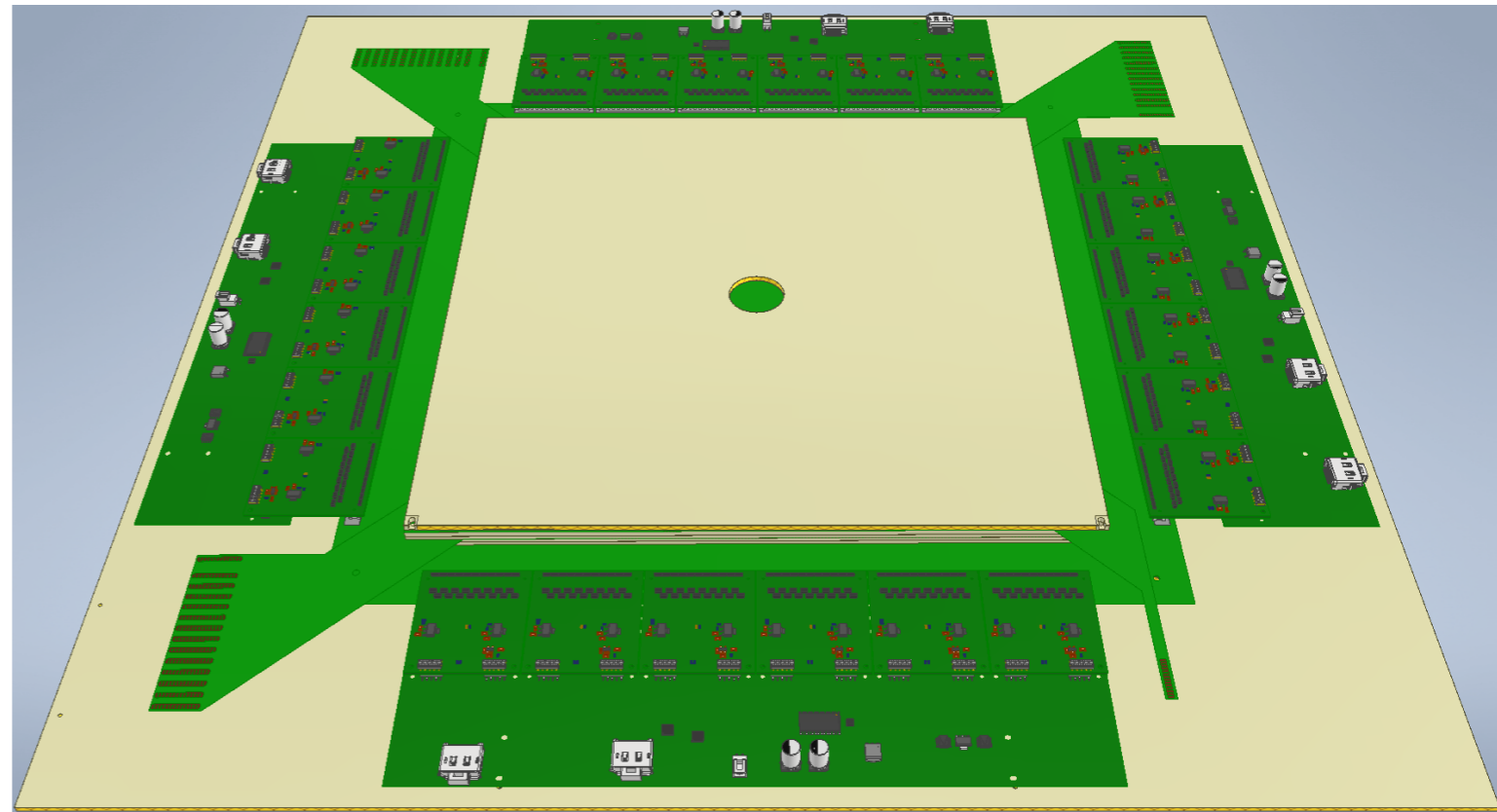
Michael Lupberger (michael.lupberger@cern.ch) - Emorfili Terzimpasoglou (eterzimp@physics.auth.gr)

- Noise measurements in progress
- With the VMM the signal is given to a monitoring output after a charge sensitive amplifier and shaper
- Find and cancel out interfering signals

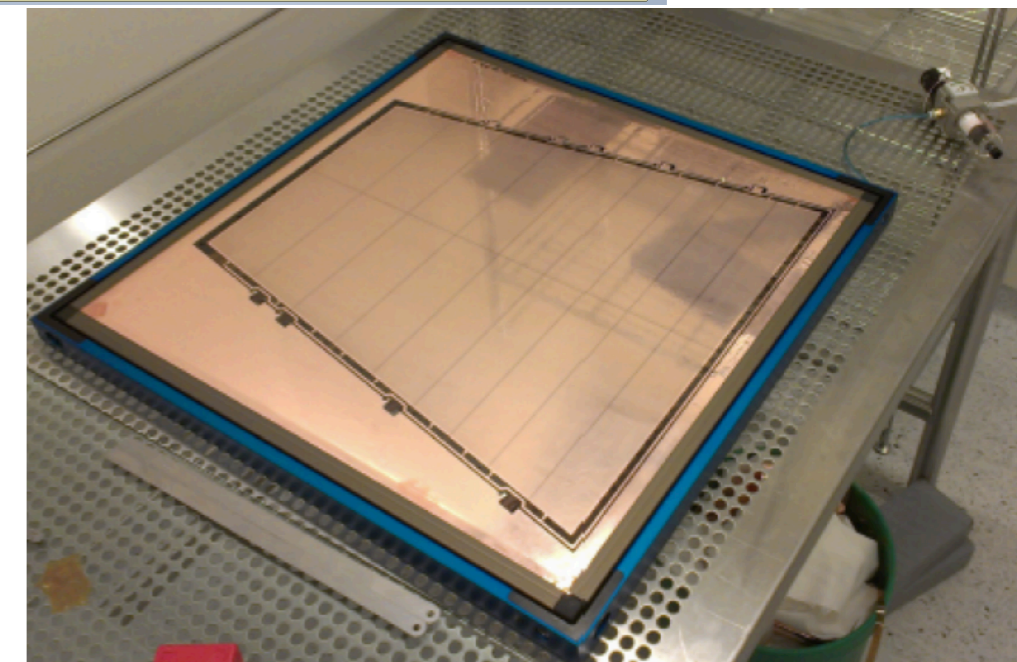
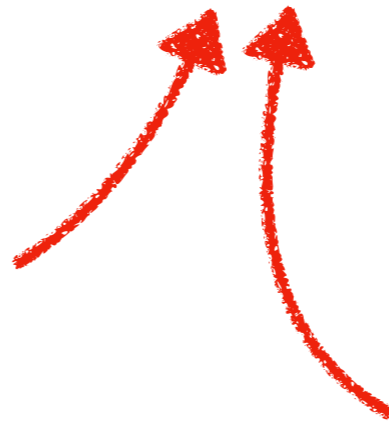
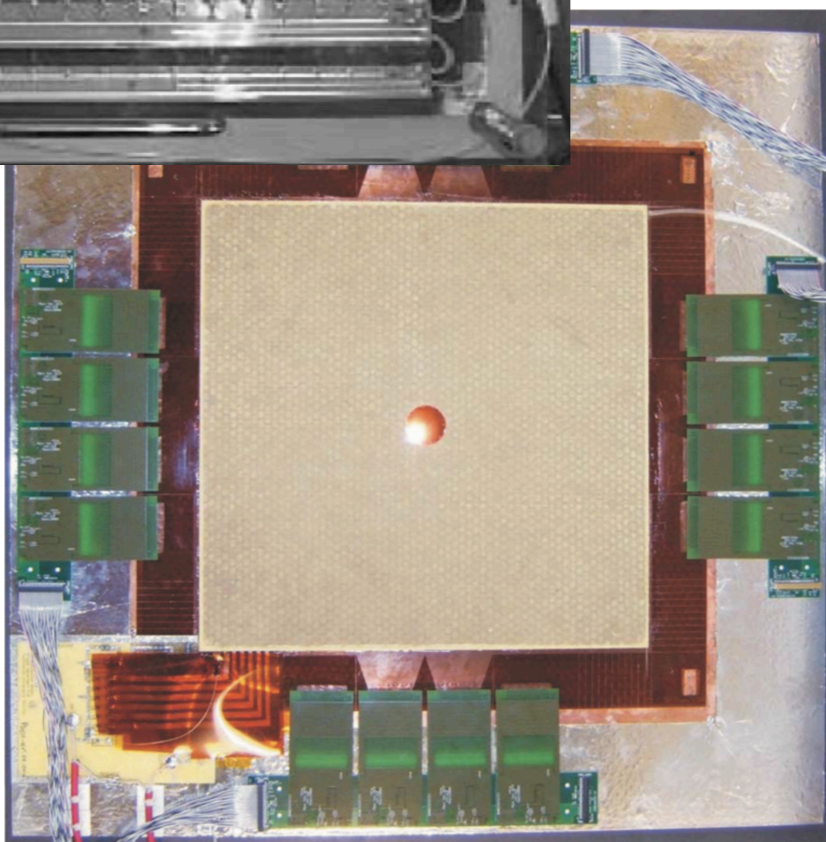
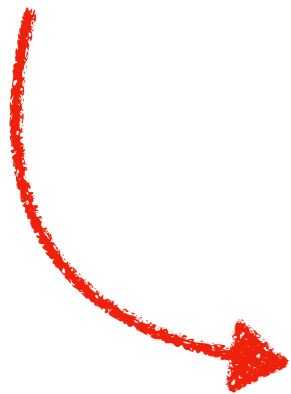
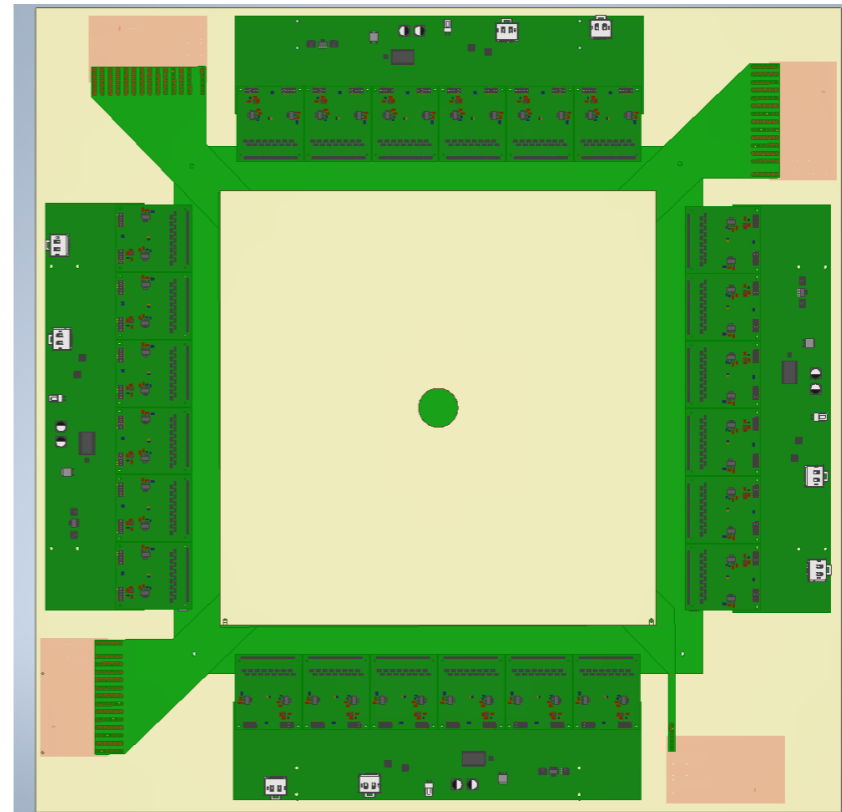
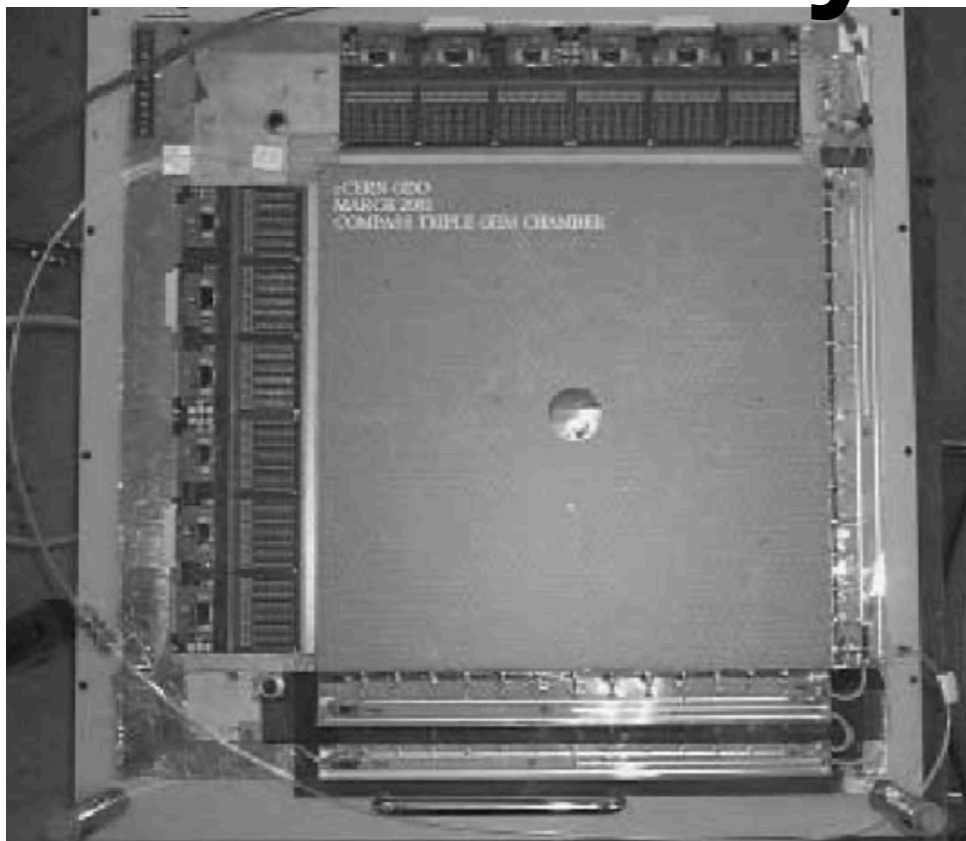


Progress

- Backward compatible (30.7 cm x 30.7 cm active area)
- No spacer grids
- Solution for surface bending
- Modular design (APV & VMM exchangeable)
- Potentially eco. material use
- Additional copper etching
- Avoid gas blocking due to rims
- For time being HV distribution via resistor chain
- Helpful knowledge from previous production & ALICE upgrade



Thanks - stay healthy & tuned



ALICE IROC GEM foil in stretching frame