Electronics

Christof Motzko
on behalf of the PANDA Luminosity Detector Group

Helmholtz-Institut Mainz
Johannes Gutenberg-Universität Mainz

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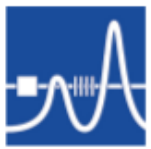
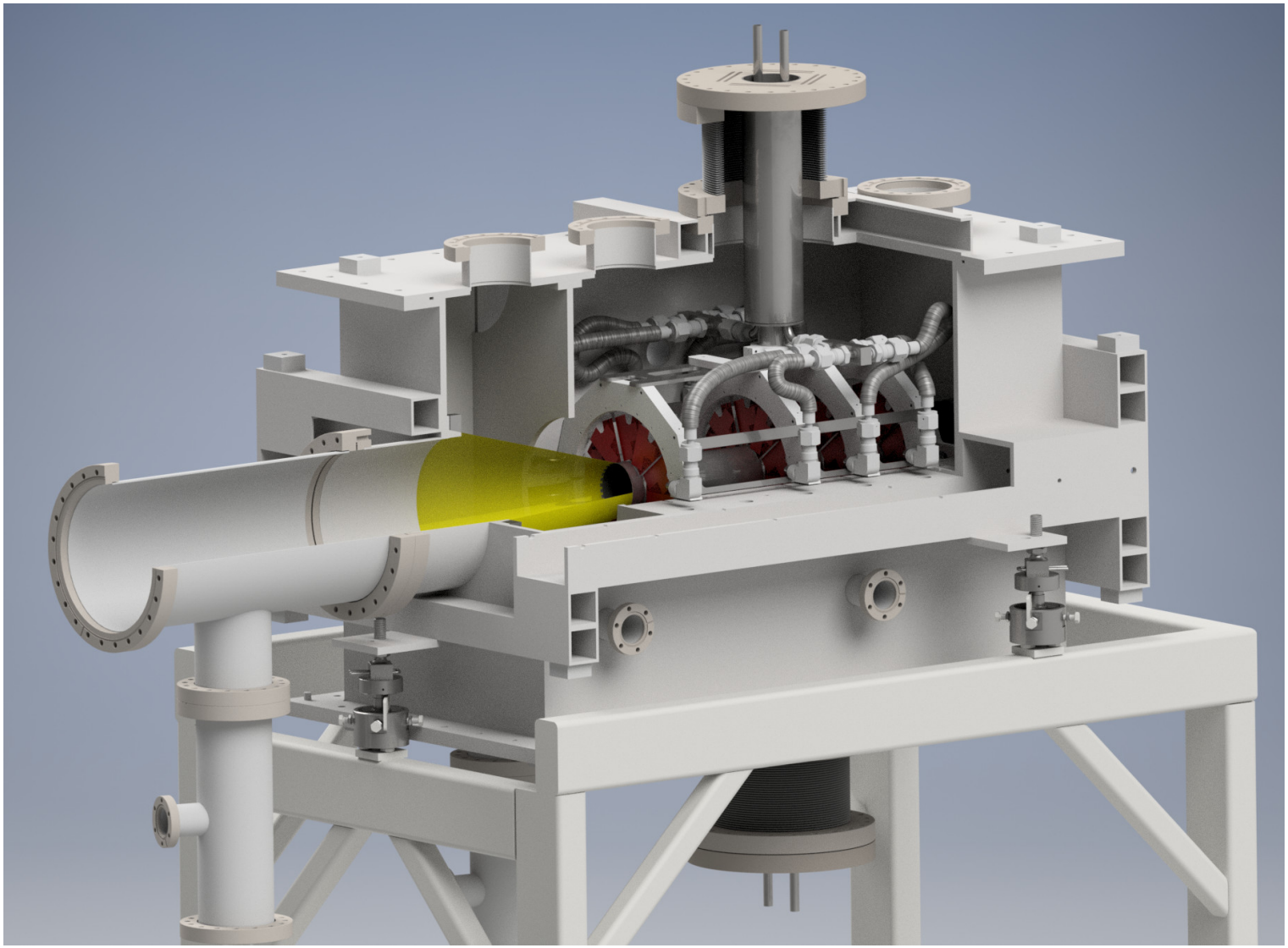


Luminosity Detector Overview

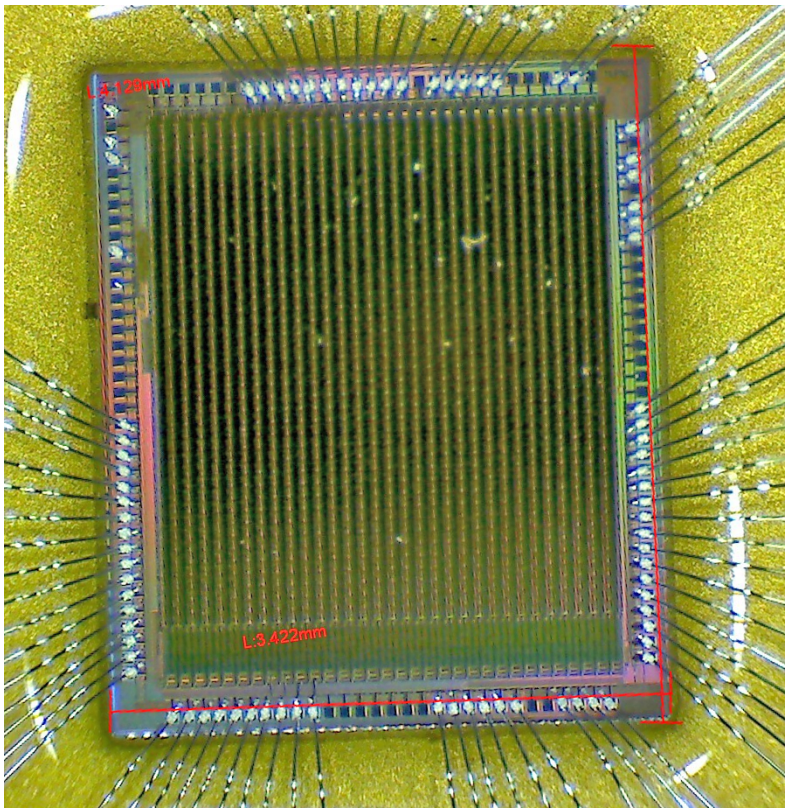


HV-MAPS

- High Volage Monolythic Active Pixel Sensor
- Under development (Mu3e group in Heidelberg)
- Standard CMOS production
- Digital part on chip
- High bias voltage increases S/N
- Pixel size: $80\,\mu\text{m} \times 80\,\mu\text{m}$
- Thikness: $\sim 50\,\mu\text{m}$

- Dimensions: $\sim 2 \times 2.3\,\text{cm}^2$
  Prototype: $1.08 \times 1.95\,\text{cm}^2$
- Expected power consumption $< 300\,\text{mW/cm}^2$

MuPix prototype $3 \times 4\,\text{mm}^2$



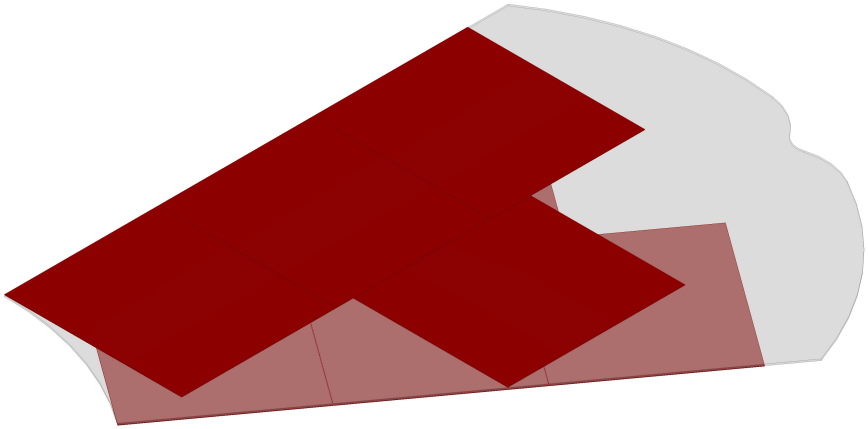
Arrangement of HV-MAPS

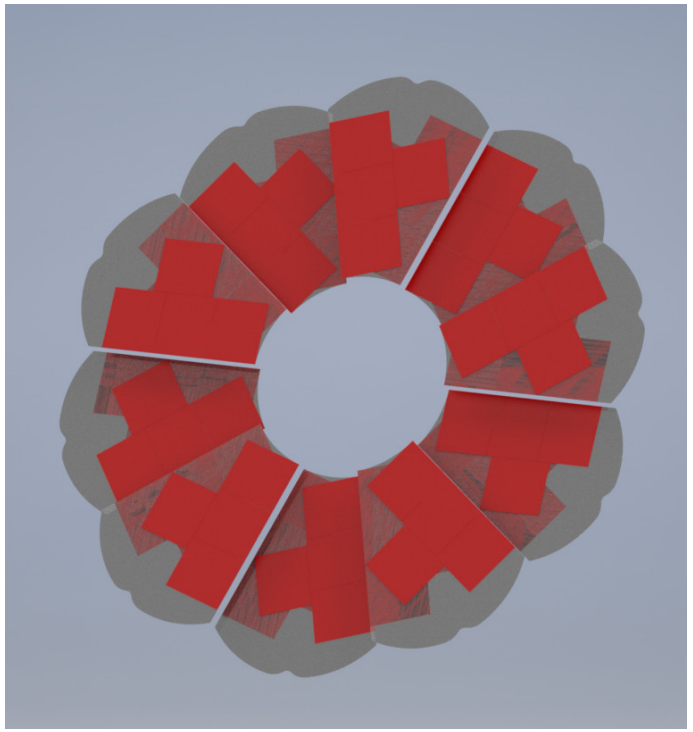
320 sensors (50 μm thick) glued on 40 CVD diamond wafers

- 4 planes with 10 modules
- Full azimuthal range

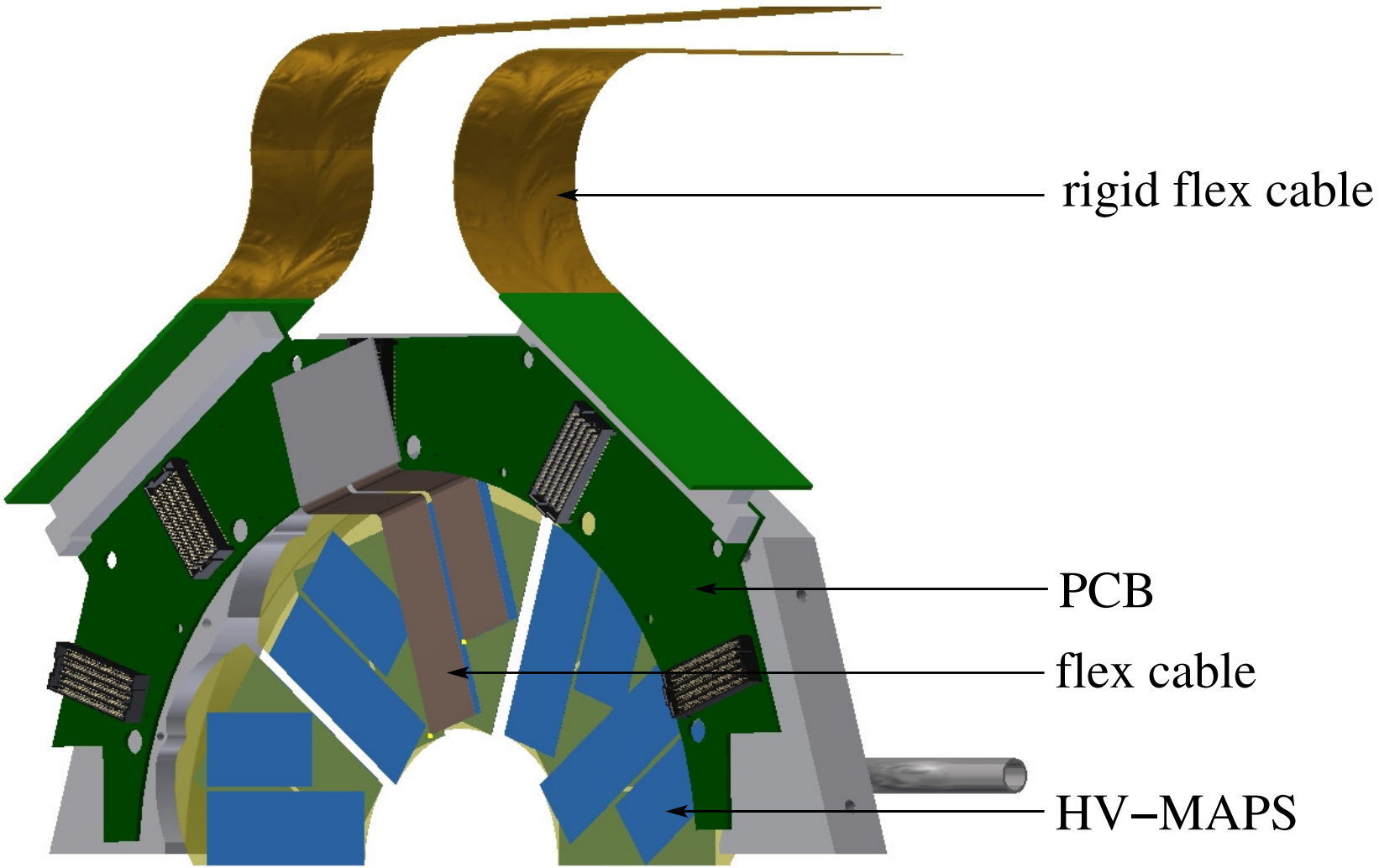
Advantages of CVD diamond:

- very high thermal conductivity
- very hard material
  $\Rightarrow$ very thin supply structure (200 μm)





Signal Routing



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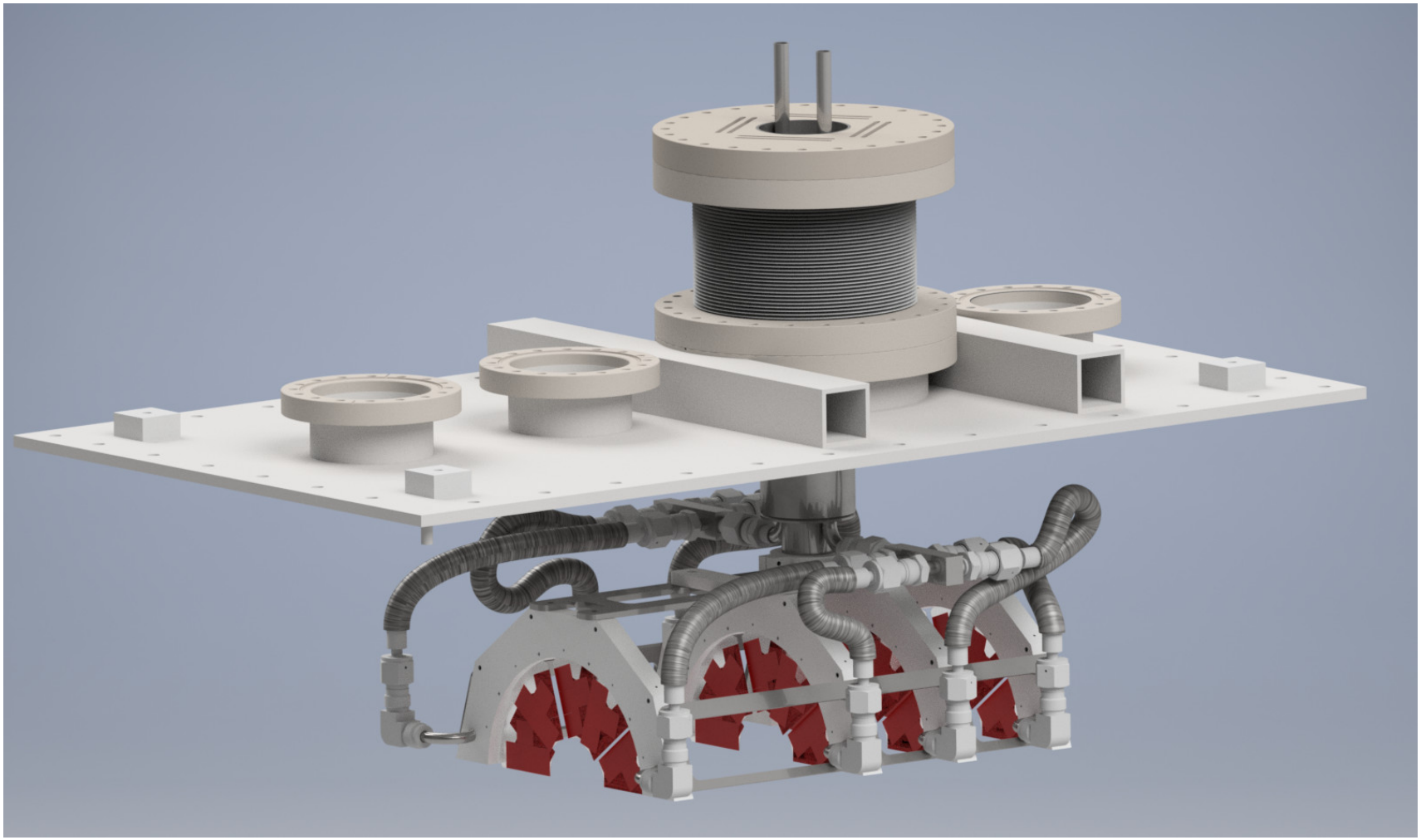
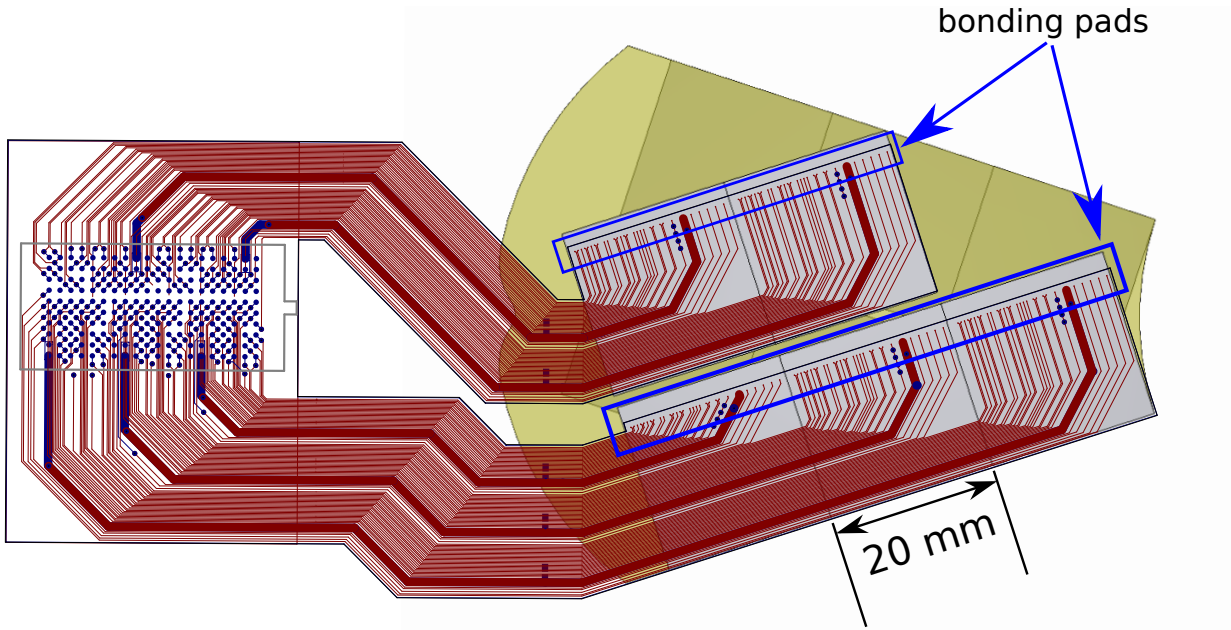
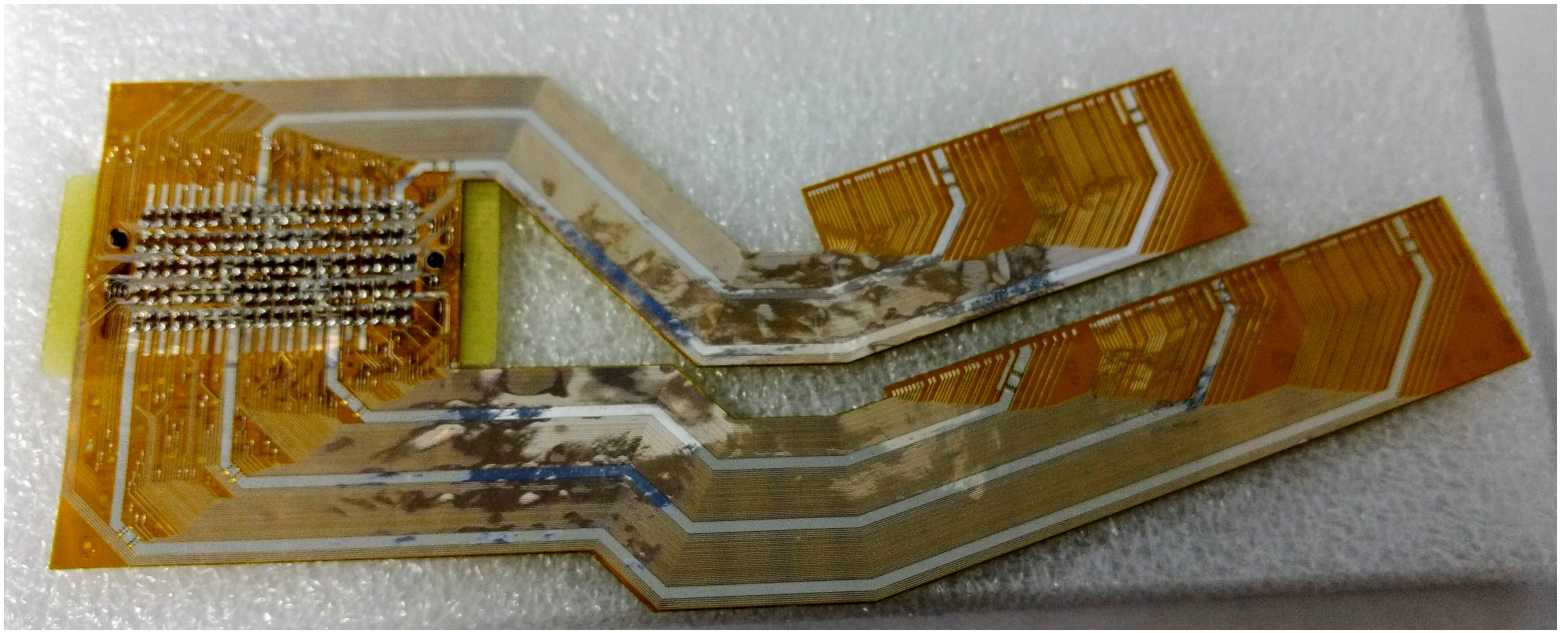


Connection of HV-MAPS



- Characteristics:
  - Trace material: aluminum
  - Trace width: $> 100\,\mu$m
  - Trace thickness: 14 µm
  - Cable thickness: $\approx 60\,\mu$m
  - Pads for wire bonding
- Advantage of aluminum: Short radiation length
  $\rightarrow$ Average $X/X_0 = 0.32\,\%$
- Disadvantage of aluminum: High electrical resistance
  $\rightarrow$ voltage drop
  $\rightarrow$ high power dissipation

Connection of HV-MAPS



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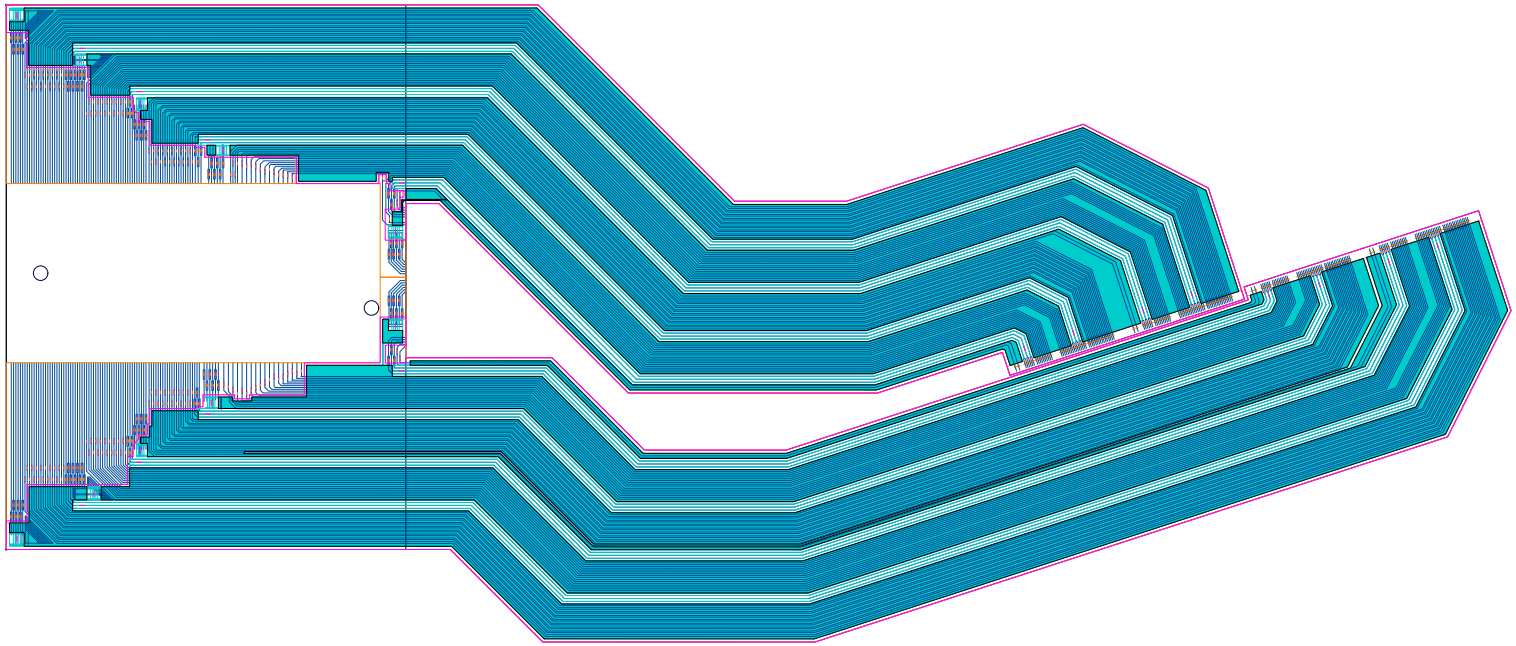
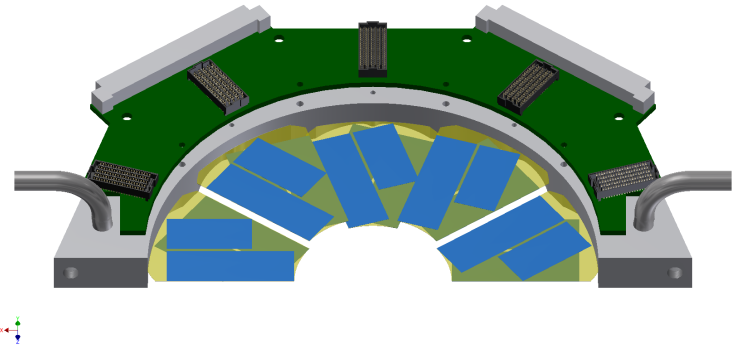
Flex Cable for Prototype Sensor



Changes:

- Trace width: $> 80\,\mu$m
- Cable thickness: $\approx 100\,\mu$m
- Pads for TAB bonding
- Switch of bottom and top layer
- Cable consist of 3 parts

Supply Board



- PCB on both sides of the half plane
- Power dissipating components attached to the surface
- Radiation tests with electronic parts were made at COSY

Expected radiation dose: < 0.1 kGy

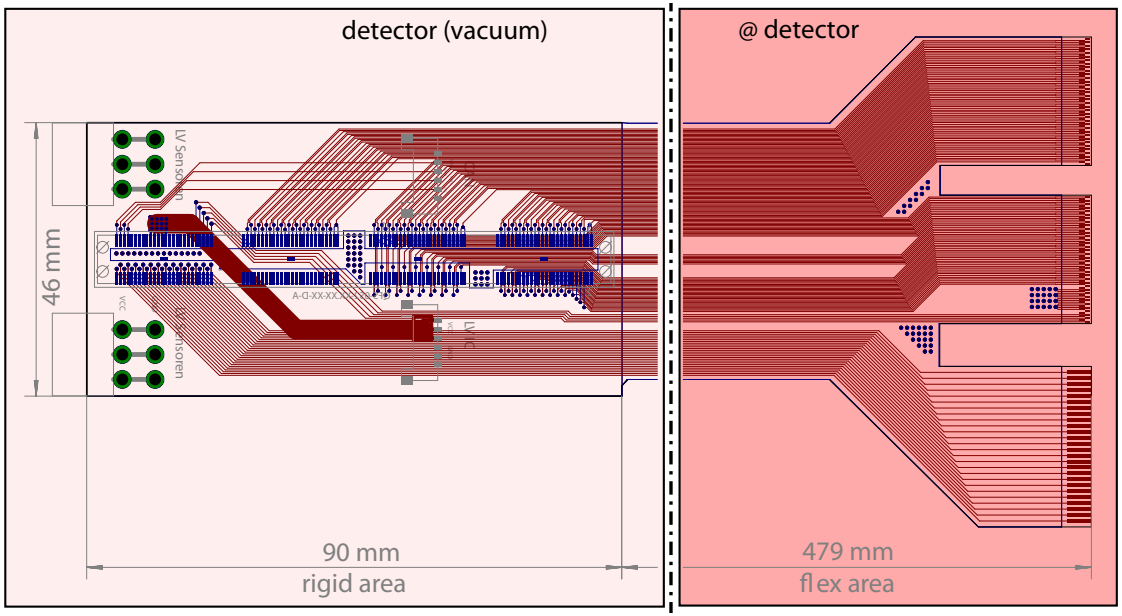
5 kGy, 30 MeV protons

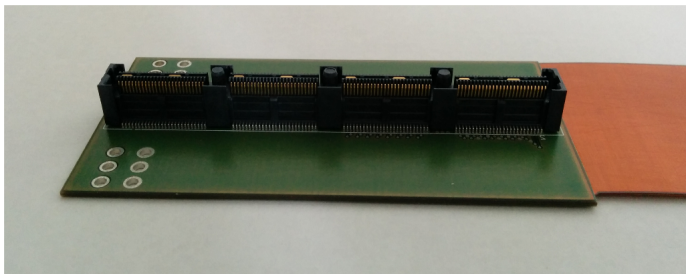
type	part number	# irradiated	# broken
LDO regulator	MCP1727	9	0
	ADM7172	9	9
LVDS repeater	DS25BR100	8	0
clock driver	ADCLK846	8	0

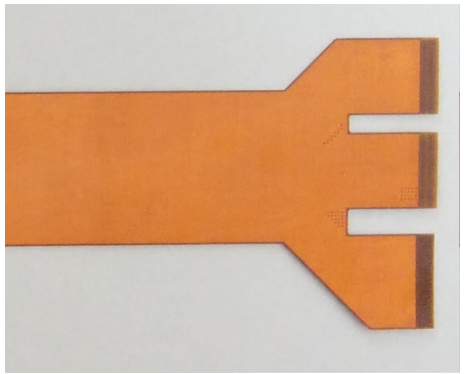
1.5 kGy, 2.9 GeV protons

type	part number	# irradiated	# broken
LDO regulator	MCP1727	10	0
	ADP1740	15	8
LVDS repeater	DS25BR440	4	2
clock driver	MAX9153	6	0
microcontroller	AT90CAN128	3	0

Rigid Flex Cable





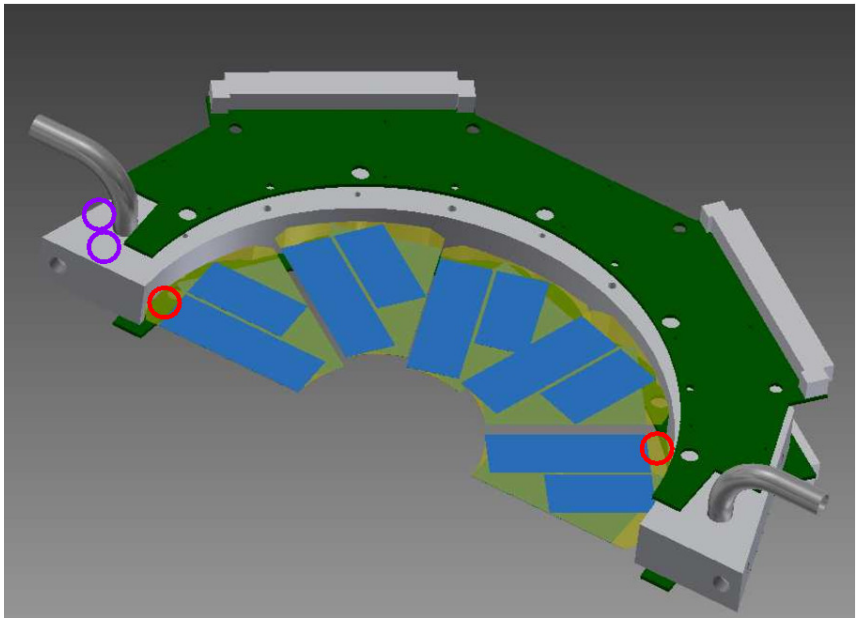


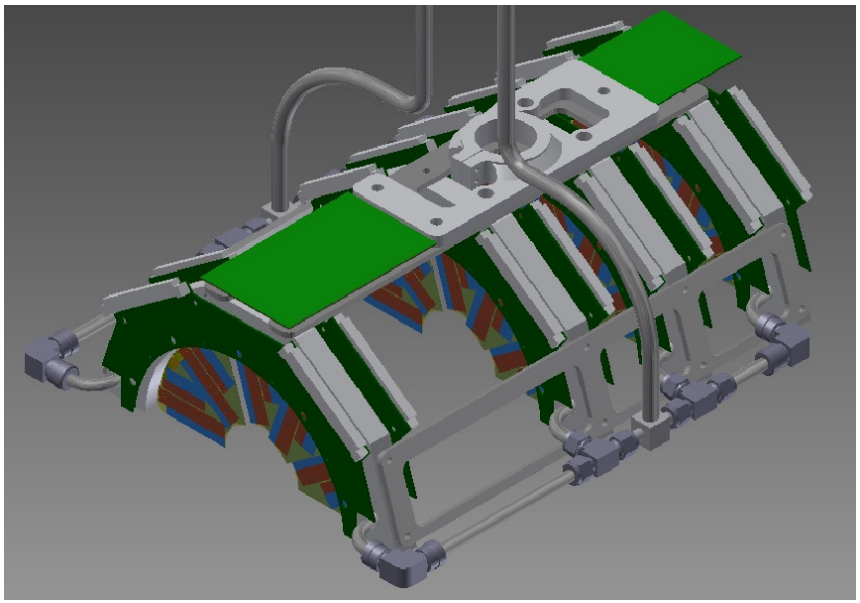
- Dimensions:
  $83\,\text{mm} \times 569\,\text{mm}$
- FFC connector outside of the box
- Three layers for flex area:
  - 40 differential pairs (signal, clock, ...)
  - High voltage
  - $\approx 500\,\mu\text{m}$ thick
- Rigid area:
  - Connector for LV
  - High density, high power connector to half plane

Temperature sensors

- Temperature measurement inside of the detector necessary
- 88 temperature sensors (PT100) foreseen:
  - 40 temperature sensors (on the diamonds) for monitoring
  - 48 temperature sensors (on the halfplanes and PCB) for overheating protection

  $\rightarrow$ 352 wires
- Maybe NTC Thermistors on the HV-MAPS
- Patch panel to combine single wires to a FPC





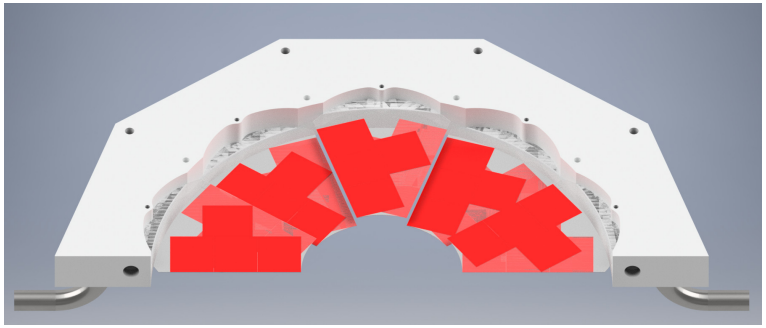
Voltage

Low voltage

- HV-MAPS need 1.8 V (< 1.6 A)
- Voltage drop on flex cable up to 0.2 V $\rightarrow$ LDO regulator with sense pin necessary
- Use of MCP1727
  - Regulation: < 330 mV
  - $I_{Out} < 1.5$ A
  - Dimensions: 3 mm $\times$ 3 mm
- Power supply: Wiener PL506 with MEH-02/07
  - Up to 115 A per channel
  - Master-Slave mode for paralleling of channels
  - Noise and ripple (datasheet): < 10 mV
- Use of a current bar in the detector to split the LV to the PCBs

High Voltage

- HV-MAPS need high voltage (> 60 V)
- Combine 5 sensors with one HV channel
- Power supply: ISEG EHS F205p-F
  - U < 500 V
  - 16 channels per module



Conclusion

- New design of flex cables in work
- Estimated voltage drop for the LV up to 0.2 V
  $\rightarrow$ Use of LDO regulator with sense pin
- Radiation test of electronic components are done
- Use of flex cables glued in feedthroughs

To Do

Test of the flex cables
Glueing test of the rigid flex cables
Design and test of the half plane pcb