

Bundesministerium
für Bildung
und Forschung



Panda Meeting Prag2023 Micro-Vertex-Detector Session

Update on available sensors for the MVD and connection to the ToASt

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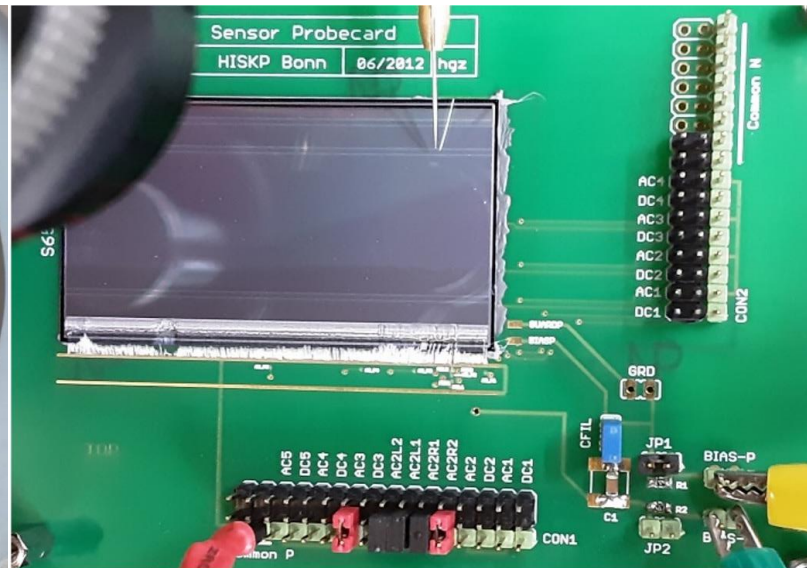
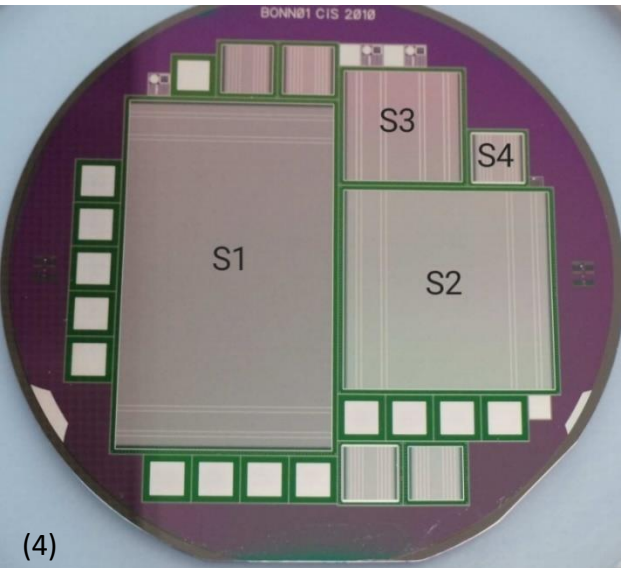
12.06.2023

- Double side silicon strip detectors
- High resolution ($\sim\mu\text{m}$)
- Radiation tolerance
- Test structures “diodes” on wafer for:
 - Irradiation tests
 - Series test for wafer properties
- Understanding of sensor properties for installation in the MVD

Specifications of strip detectors

(4)

General	
wafer material	FZ Si, 4", n/P
thickness	$285 \pm 10 \mu\text{m}$
resistivity	$2.3 \dots 5.0 \text{ k}\Omega \cdot \text{cm}$
n-side isolation	p-spray
guard rings	8
stereo angle	90°
passive rim	$860 \mu\text{m}$
S1	
n-side strips	896
p-side strips	512
pitch	$65 \mu\text{m}$
active area	$58.275 \times 33.315 \text{ mm}^2$
S2	
n-side strips	512
p-side strips	512
pitch	$65 \mu\text{m}$
active area	$33.315 \times 33.315 \text{ mm}^2$
S3	
n-side strips	384
p-side strips	384
pitch	$50 \mu\text{m}$
active area	$19.230 \times 19.230 \text{ mm}^2$
S4	
n-side strips	128
p-side strips	128
pitch	$65 \mu\text{m}$
active area	$8.355 \times 8.355 \text{ mm}^2$



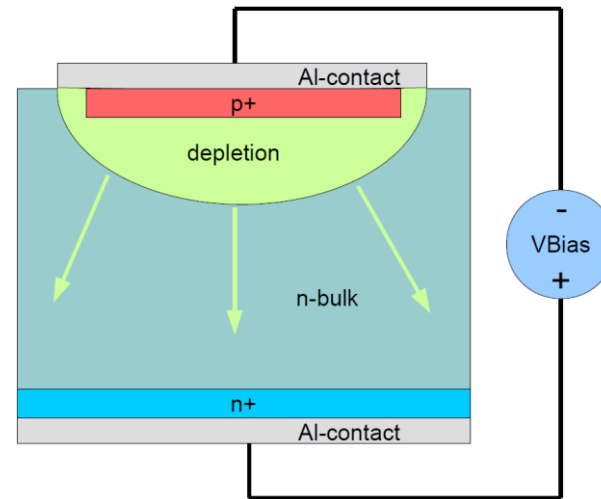
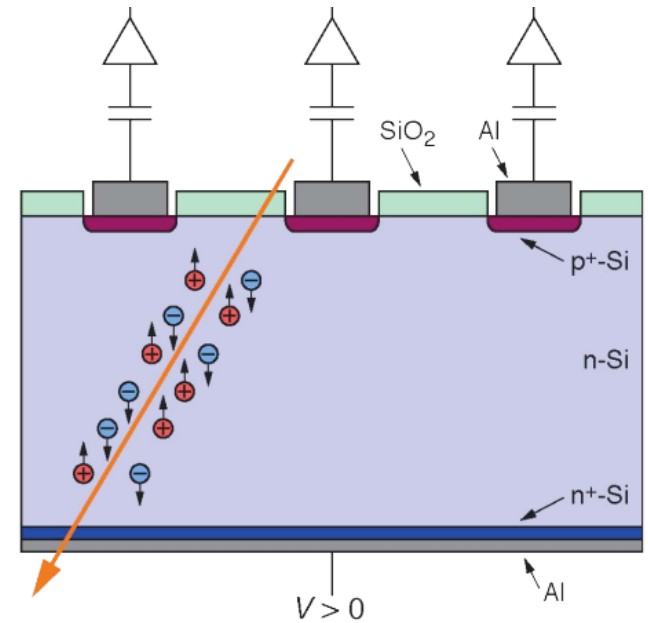
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Double-sided silicon strip detectors

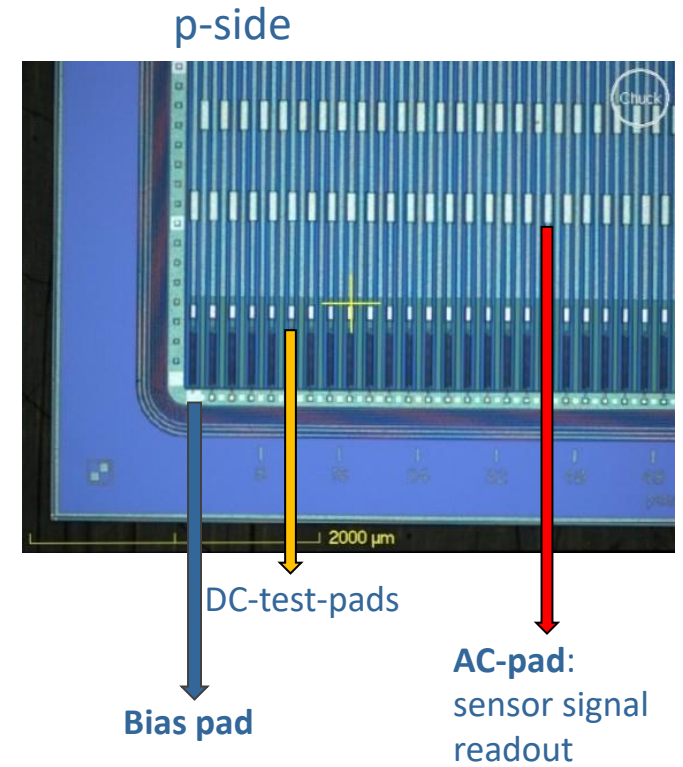
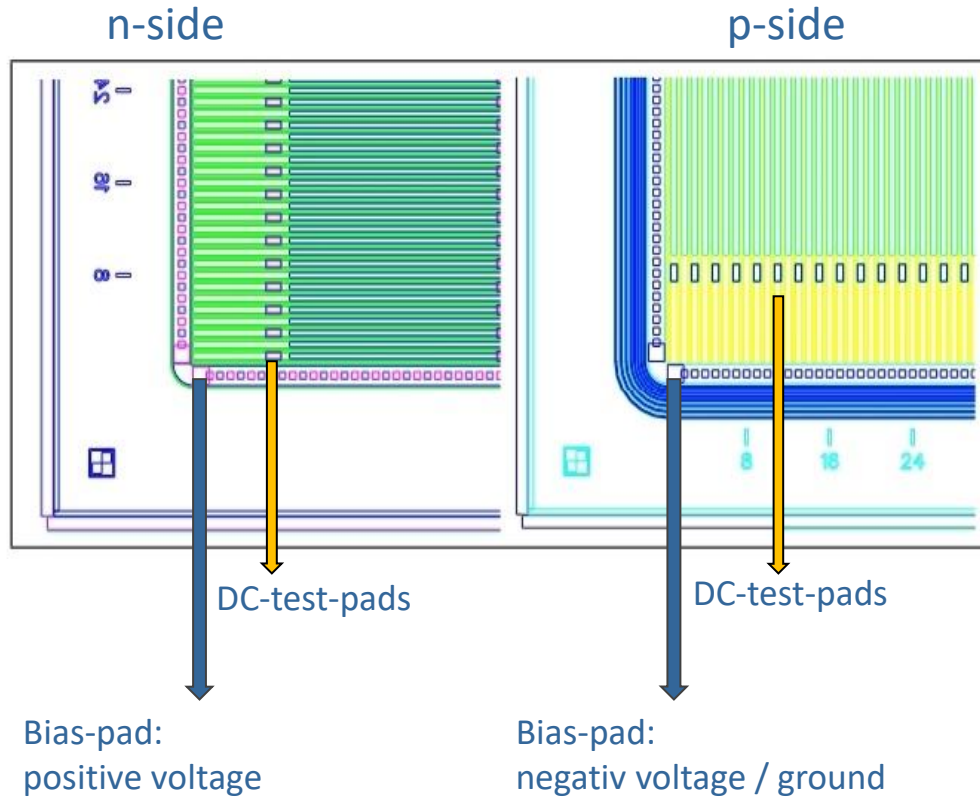
- Doped silicon semiconductor
- Pn-junction
- Reverse bias-voltage regime
- ➔ Depletion => no free space charge carriers
- Impinging minimum ionizing particles (MIP)
- ➔ Charge generation
- Small current pulses at readout electrodes

Working / limitation parameters

- Dark current < 10 μA
- Initial depletion voltage $\approx 100\text{ V}$
- Breakdown voltage > 200 V
- Identification of the depletion plateau



Connection Panda Si-Strip-Sensors



Connection to ToAst-Pads:

- N-side **bias-pad** to **HV+**
- P-side **bias-pad** to **AGND**
- **AC-pads** to **ToAst channels**



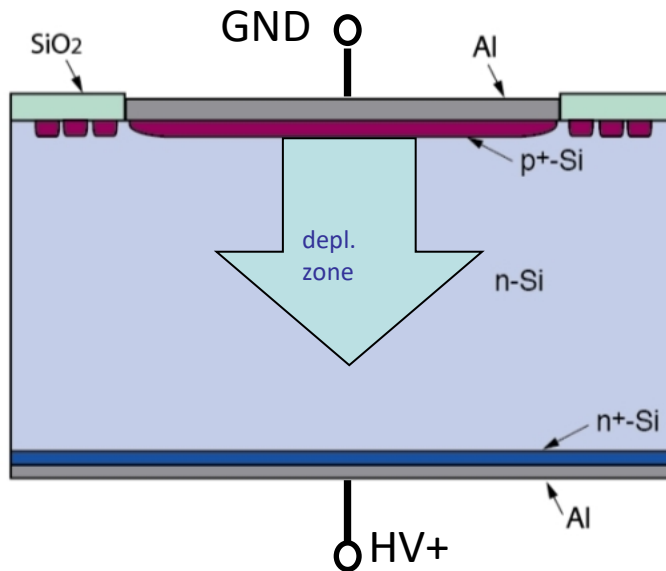
Single-side connection

Depletion Zone

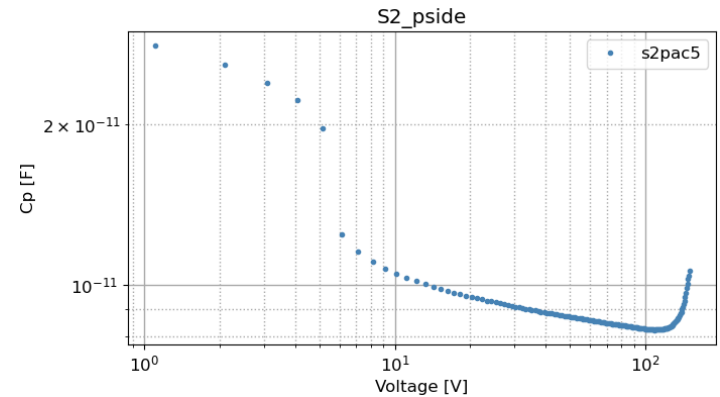
- Reverse Bias
- Free space charge
- Exceeds between p- and n-layer with voltage

Connection for testing

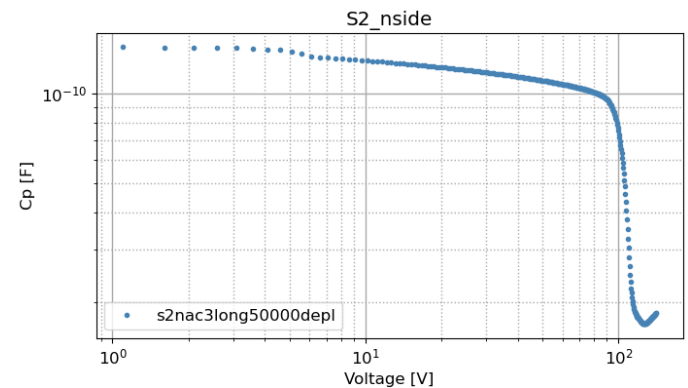
- Possibly damaged (production, assembling,...) strips could damage the readout electronics
- P-side for partly depletion at lower voltages
- Smaller voltage for safer execution



p-side connection



n-side connection



CiS Measurements

Every Sensor is checked for:

- Depletion voltage
- Leakage current
- Strip testing

Giessen Measurements

Test structures for every Sensor is checked for:

- Depletion voltage
- Leakage current
- Breakdown compliance

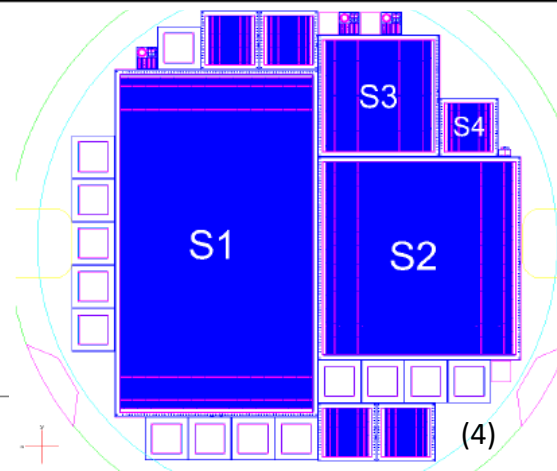
Test structures and sensors are checked for:

- Radiation hardness
- Polysilicon resistors

Accepted DATA@Giessen/ fully functional SENSORS@Giessen				
File	LOT	S1	S2	comment
2019-01.29_Daten_Uni_Gi	381921, 381922		25	25 plus dummies
Bonn01_Overview_UniGi	341772,341773,34		82	85 plus dummies
Bonn-02Lieferung1	410536, 410537		19	12
Bonn-02Lieferung2	410535,410536,4		22	0
Bonn-02-Lieferung 3b	413017,413018,4		44	0 plus 16 sensors with slight overlap
Total			192	122
Needed			184	64

Total Sensors

- **253 S1** and **145 S2** sensors at giessen
- **MVD** can be equipped with fully functional sensors
- **150 additional available** double sided silicon strip sensors at giessen



[4. Technical Design Report for the: PANDA
Micro Vertex Detector \(2012\)](#)