Microstrip stacked detectors

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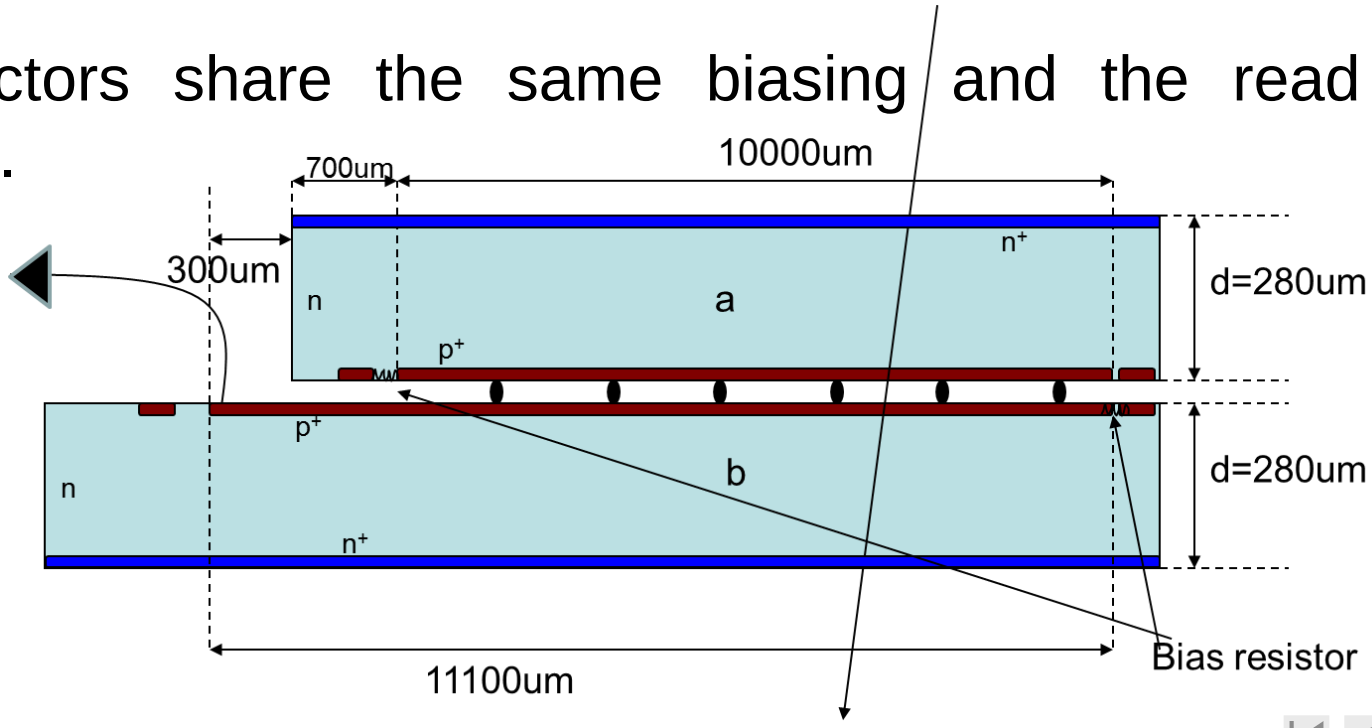
Outline

- Description of the geometry
- Motivations
- Radiation resistance studies
- Summary

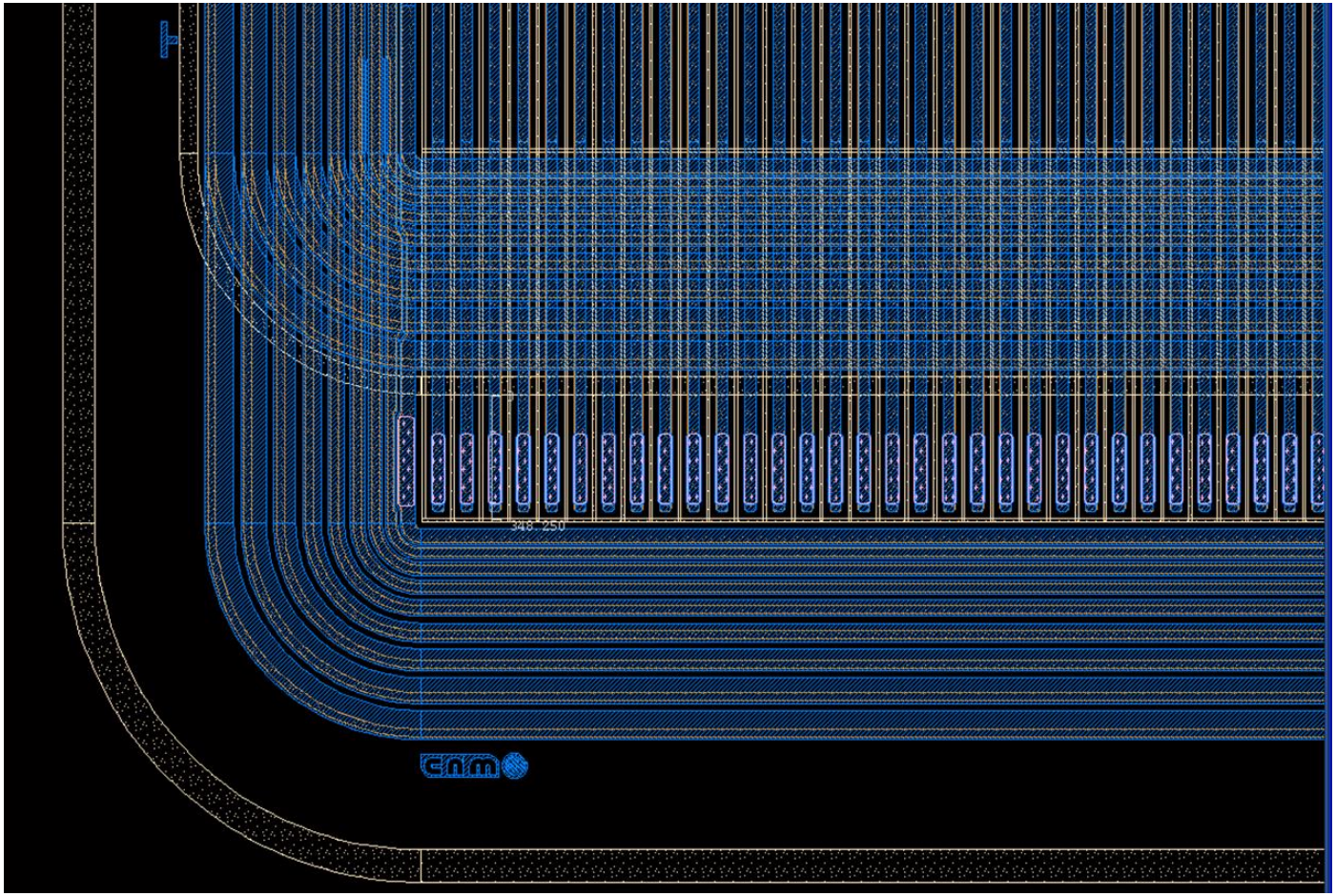
Description of the geometry

- Stack two microstrip silicon detectors by bump bonding technique.
- Doubling the thickness (or the signal), for instance, we can avoid the limitations of the fabrication process (for CNM max d=1.5mm).
- Both detectors share the same biasing and the read out electronics.



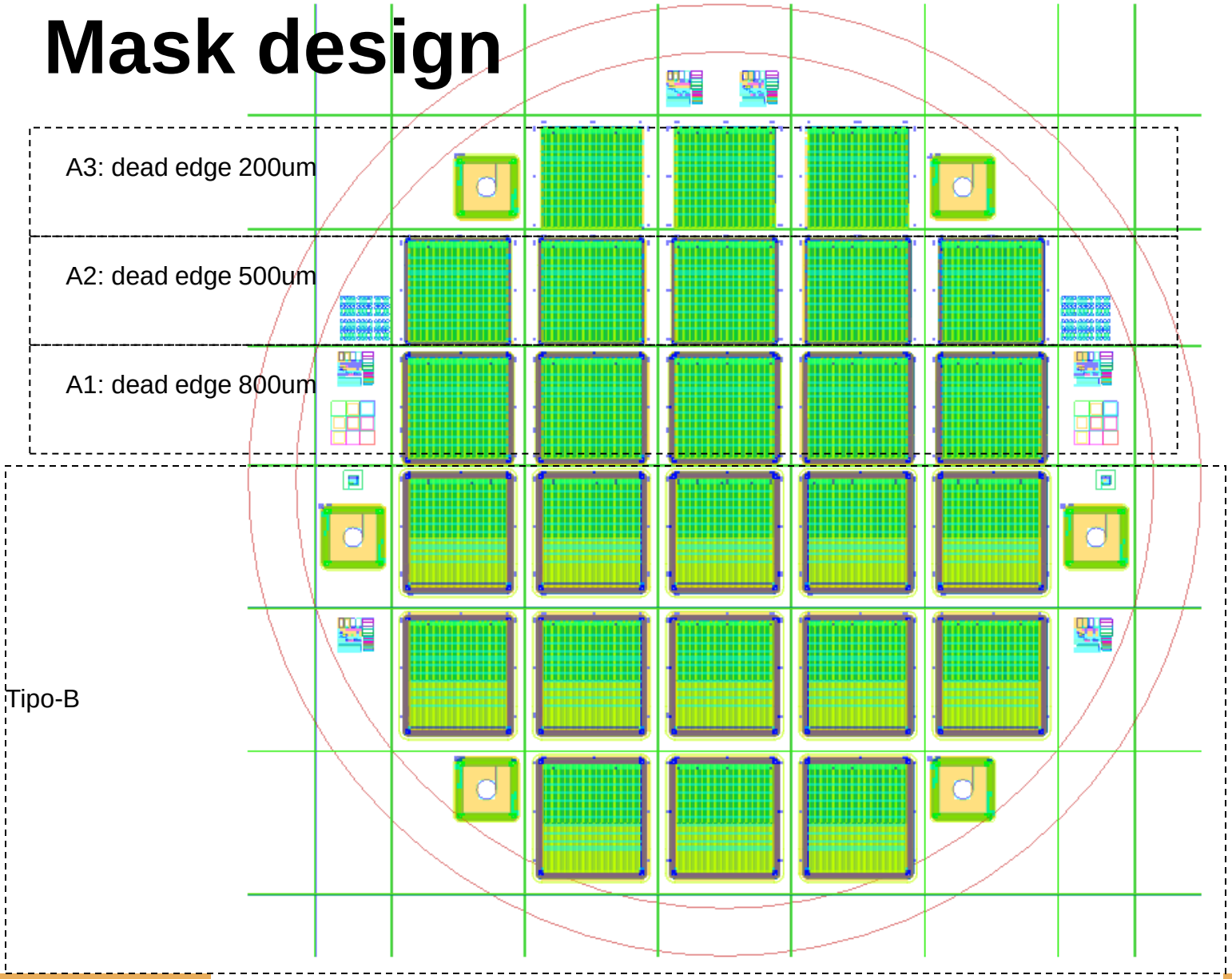
$$d \propto \sqrt{V}$$

Mask design



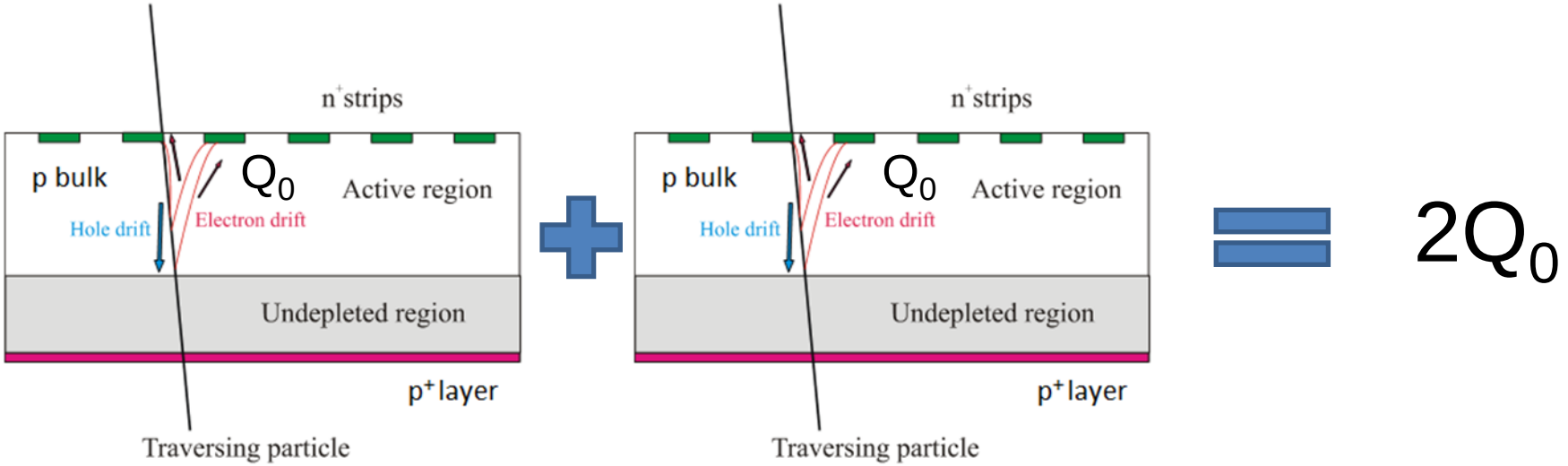
80um pitch
N-p technology
P-stop isolation
1x1 cm^2

Mask design


A3: dead edge 200um
A2: dead edge 500um
A1: dead edge 800um
Tipo-B
Top detector
Bottom detector

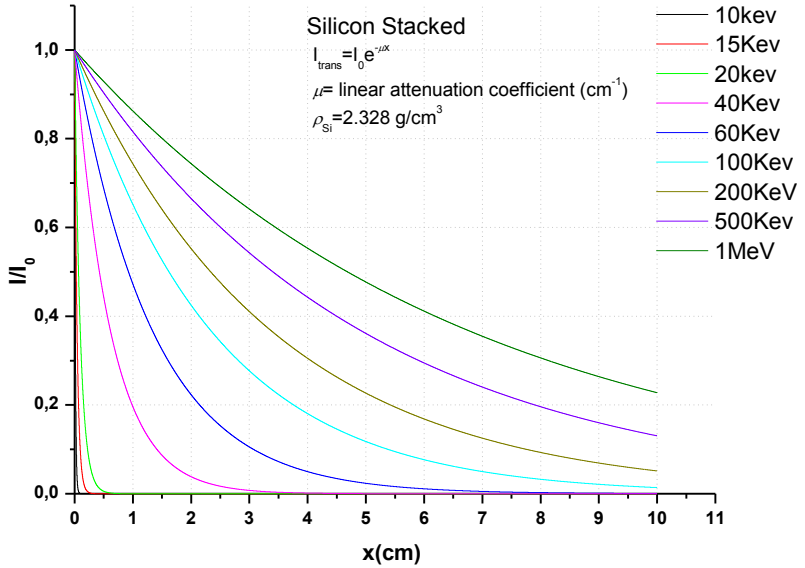
Motivation 1

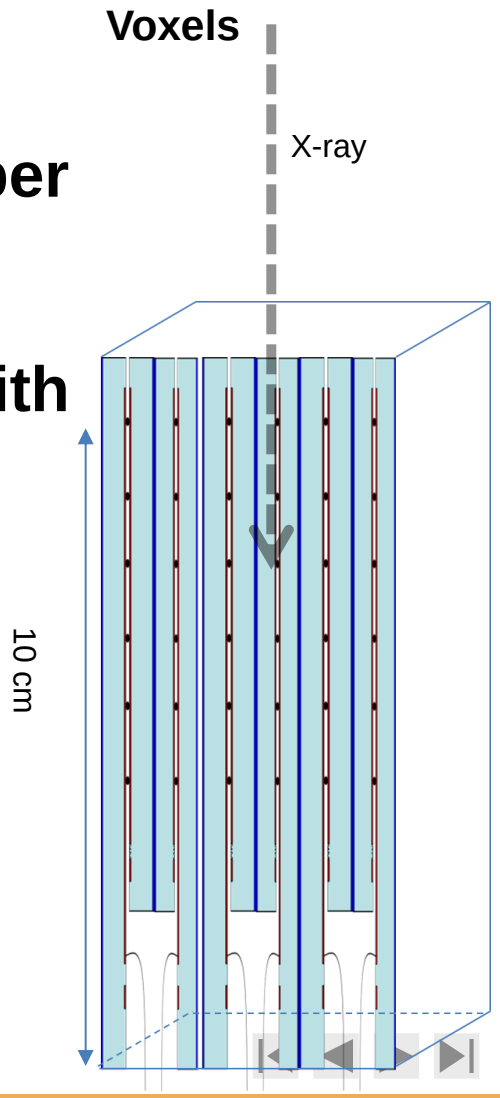
- Increase radiation hardness of silicon strip detectors.
- Increasing the thickness of an irradiated detectors will only deteriorate the S/N ratio.
- By stacking 2 detectors together we can double the collected charge.



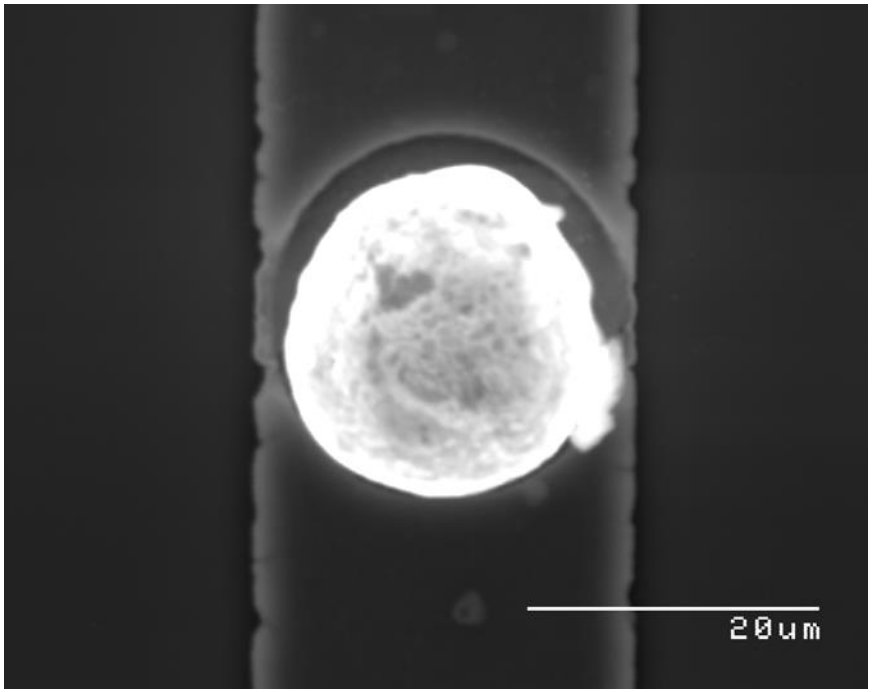
Motivation 2

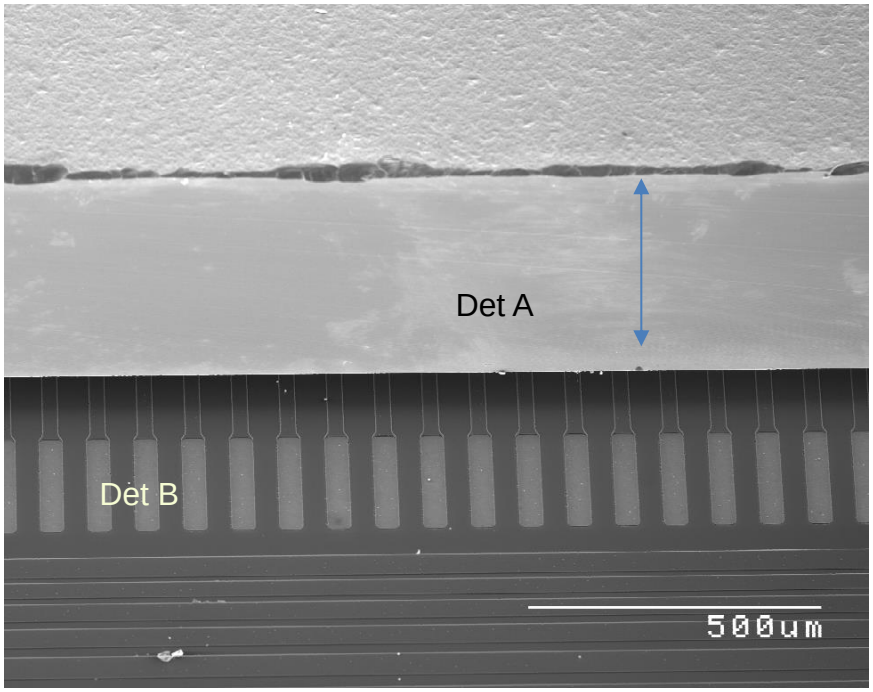
- **Medical application.**
- **Large area detectors 10x10cm^2.**
- **Increase the thickness of the absorber material.**
- **Edge on illumination.**
- **3D position reconstruction possible with resistive electrodes.**





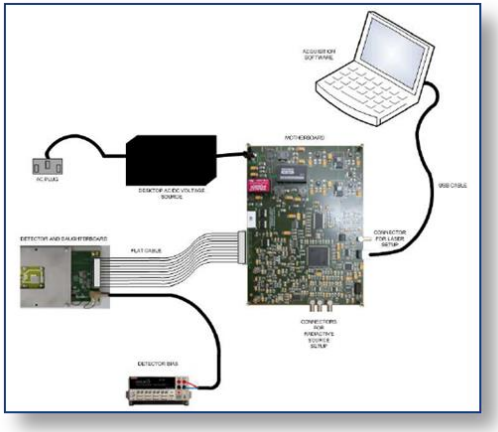
Final detector





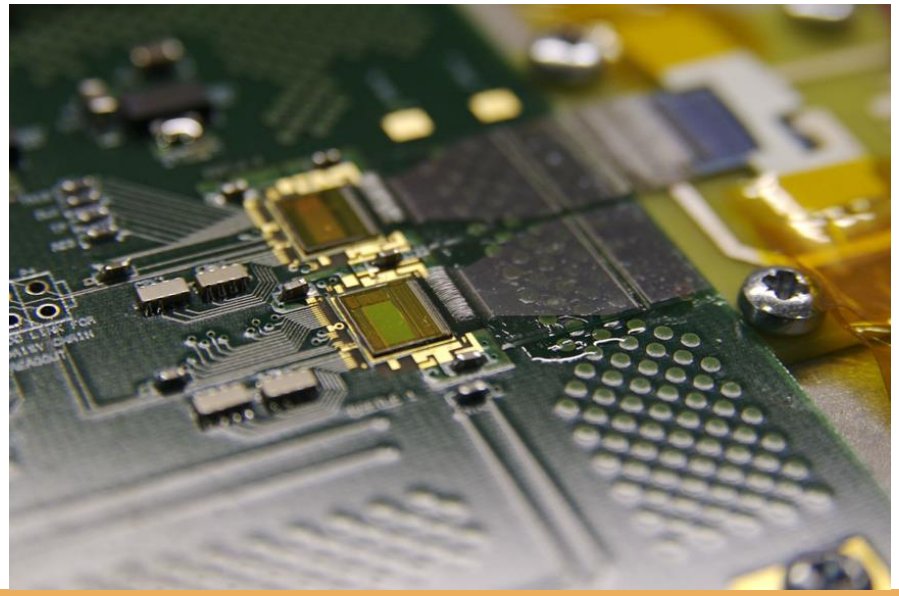
Alibava System

- β-source: Sr-90 → MIPs; External trigger



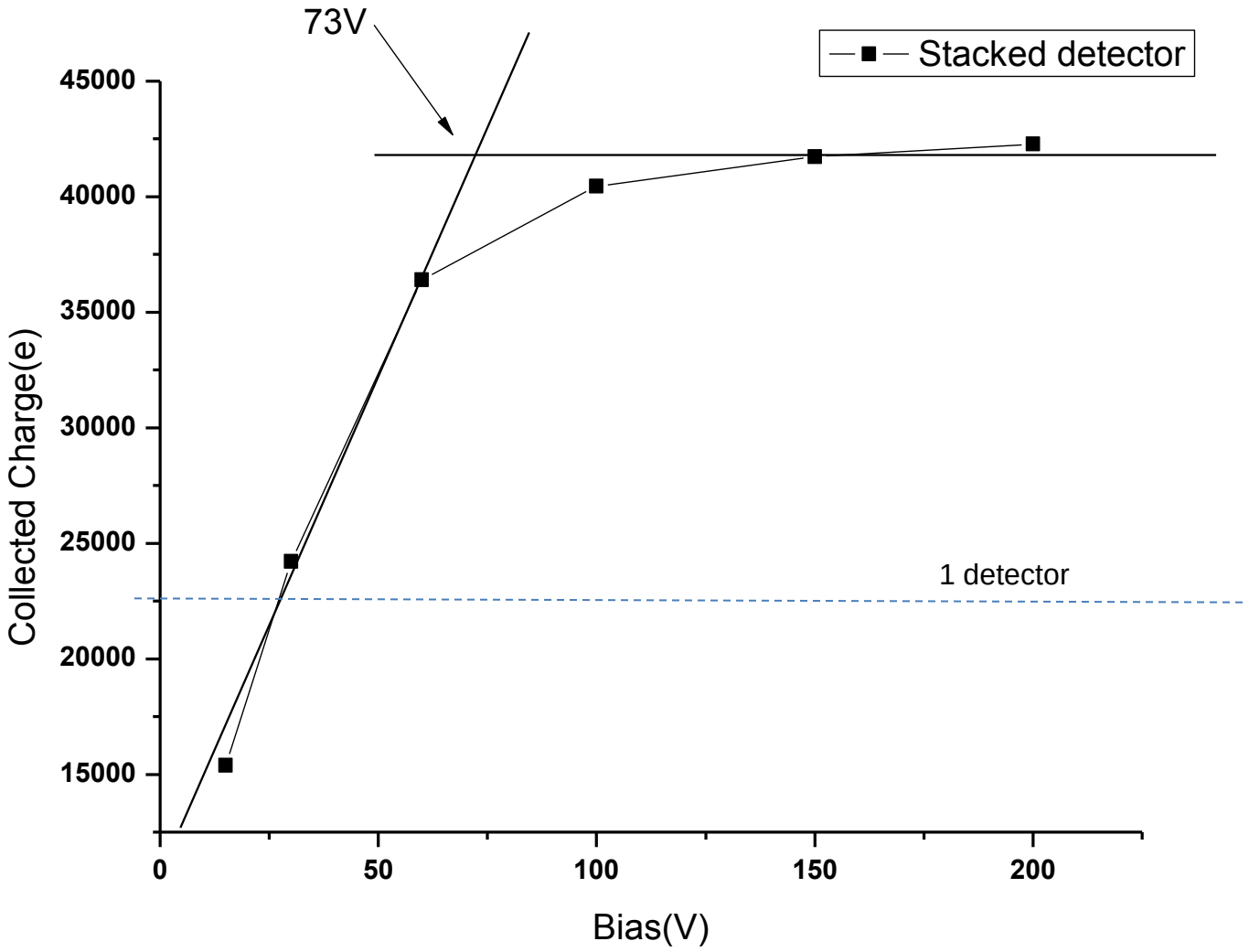
Two Beetle readout chips in parallel mode.

- 256 input channels.
- Analogue front-end with 25 ns of peaking time.
- Analogue multiplexed readout of each chip.
- Output dynamic range ~ ±110000 electrons.

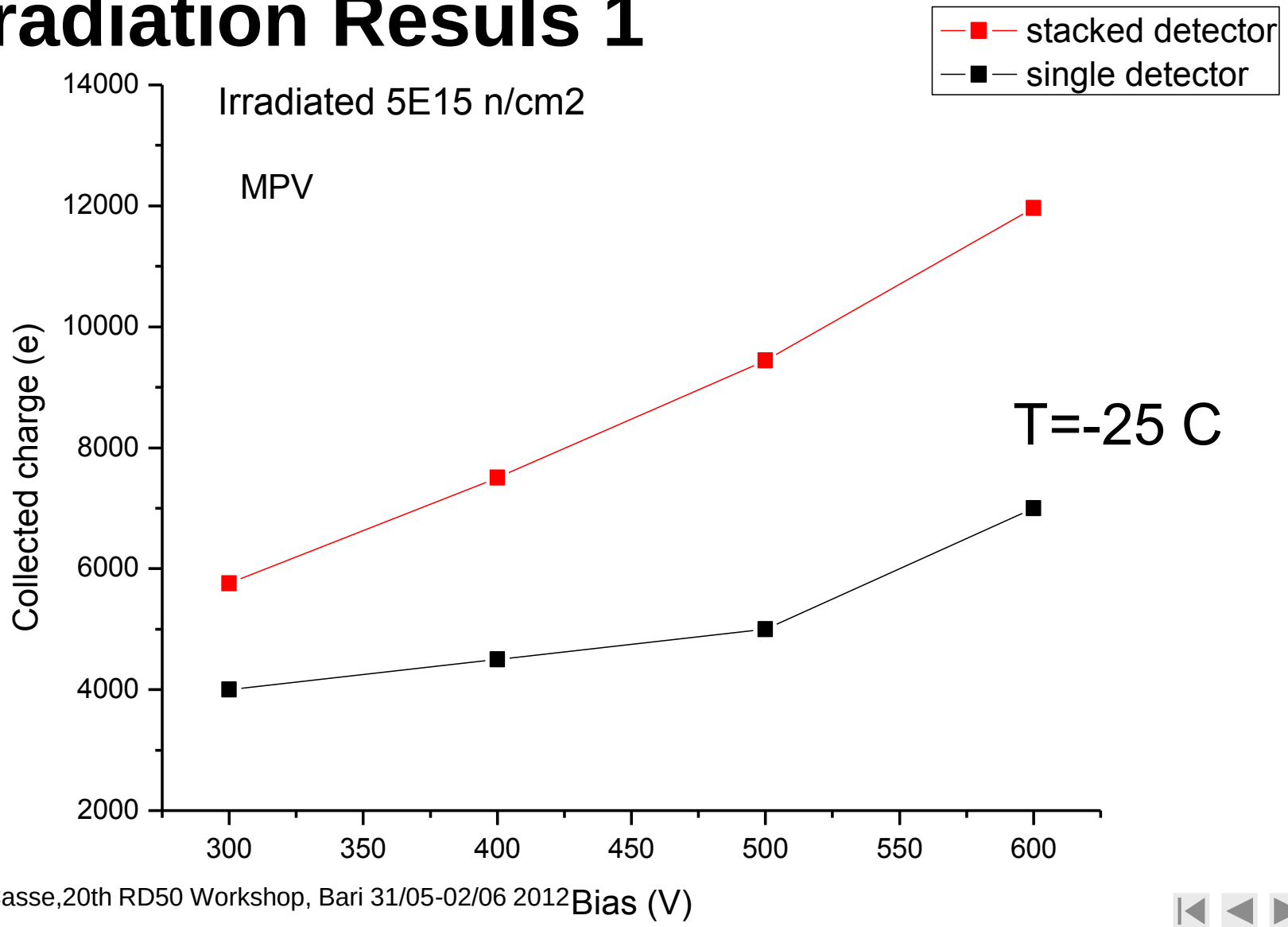


Al ibava systems

Charge collection studies

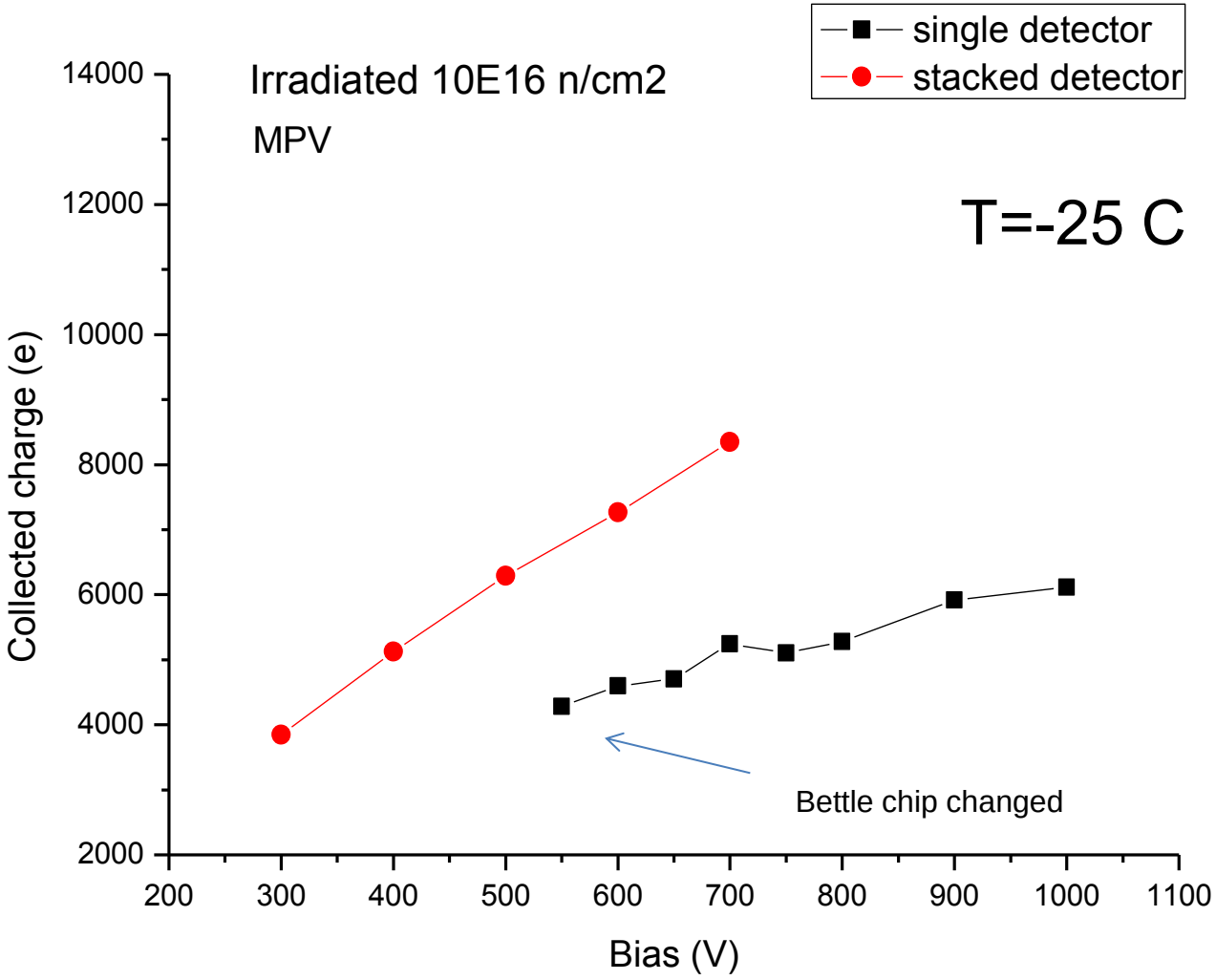


Irradiation Resuls 1

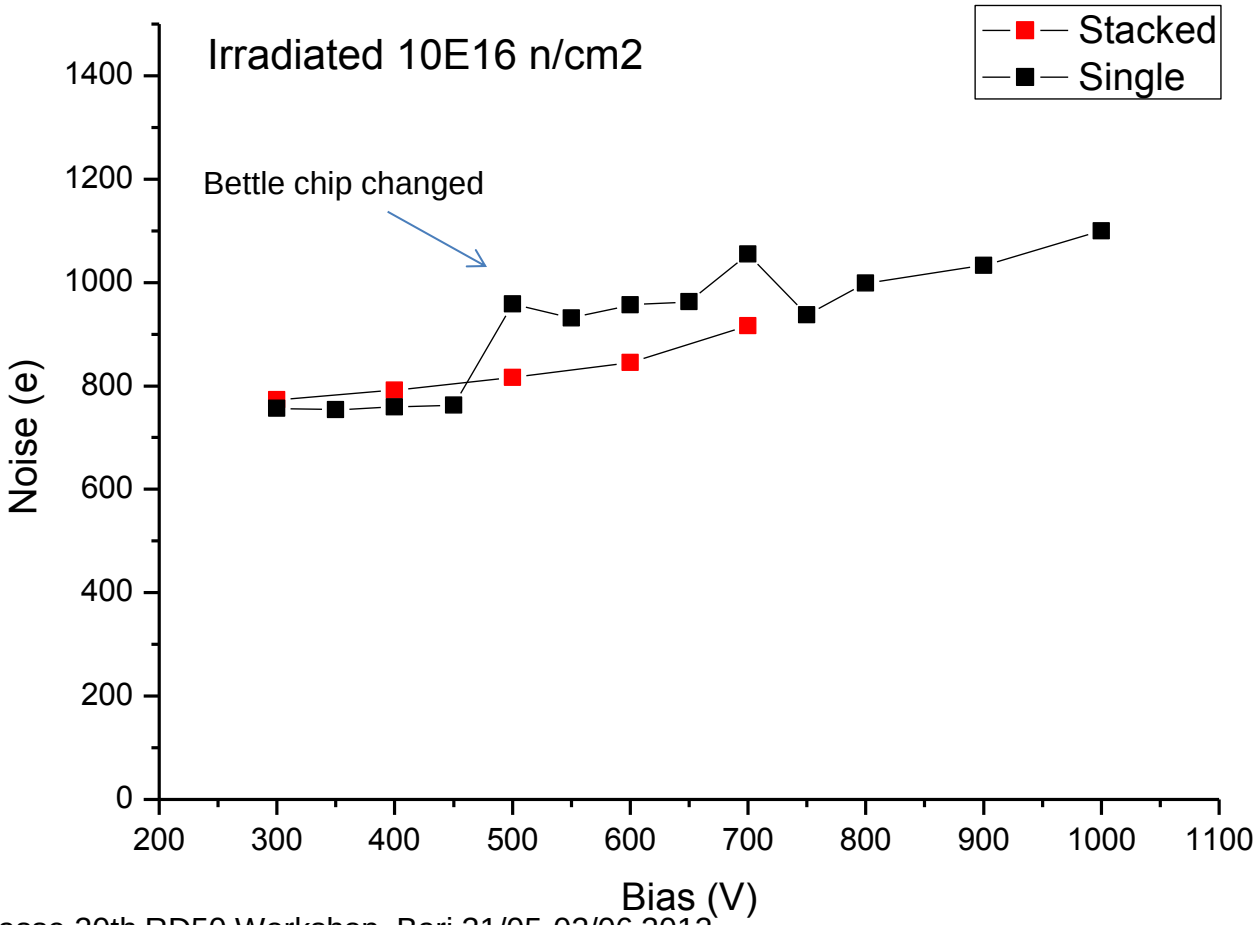


Ref: G. Casse,20th RD50 Workshop, Bari 31/05-02/06 2012

Irradiation results



Noise considerations



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Conclusions

- Stacked microstrip detectors can be fabricated using standard process and flip chip.
- Stacked detectors are a simple option to increase the S/N ratio of irradiated microstrip detectors.
- Other applications could benefit from this technology, for example for detecting high energy X-rays in astronomy or medical applications.