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CNM Centre Nacional de Microelectrònica IMB

CSIC Consejo Superior de Investigaciones Científicas

Characterization of new stripixel detectors

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Outline

- New detectors design
- Optimization of the design: simulation results
- Real prototypes
- Experimental results
- Conclusions

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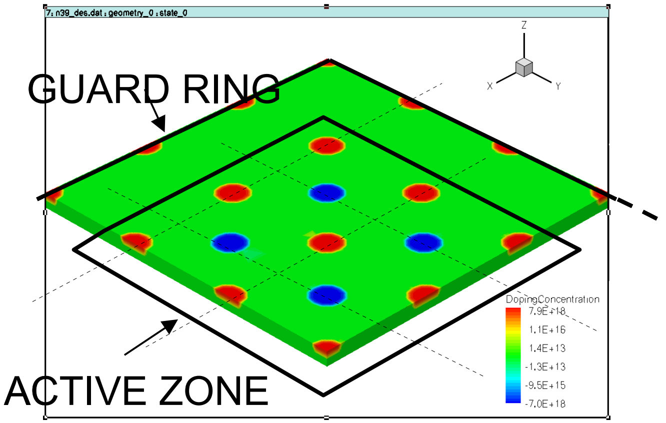
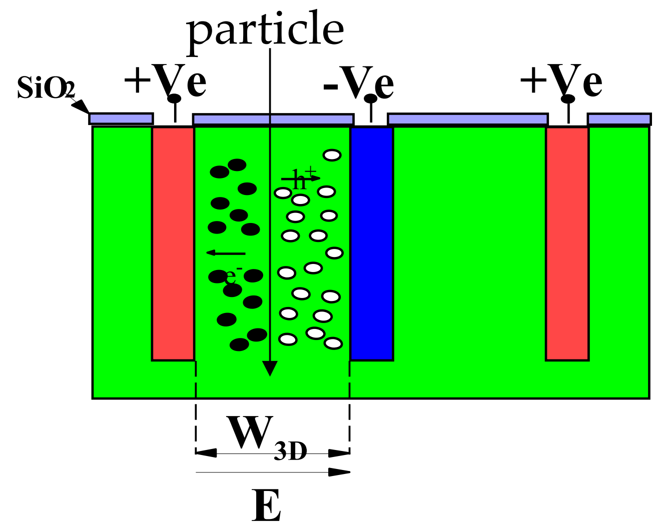
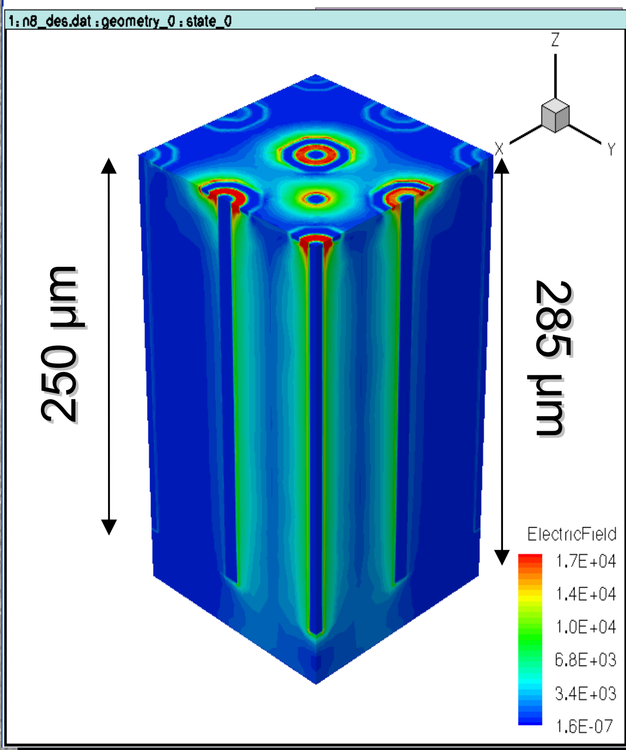
New design

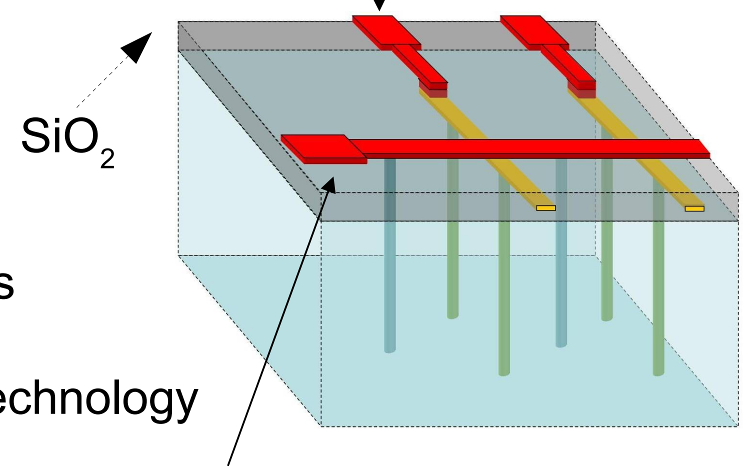




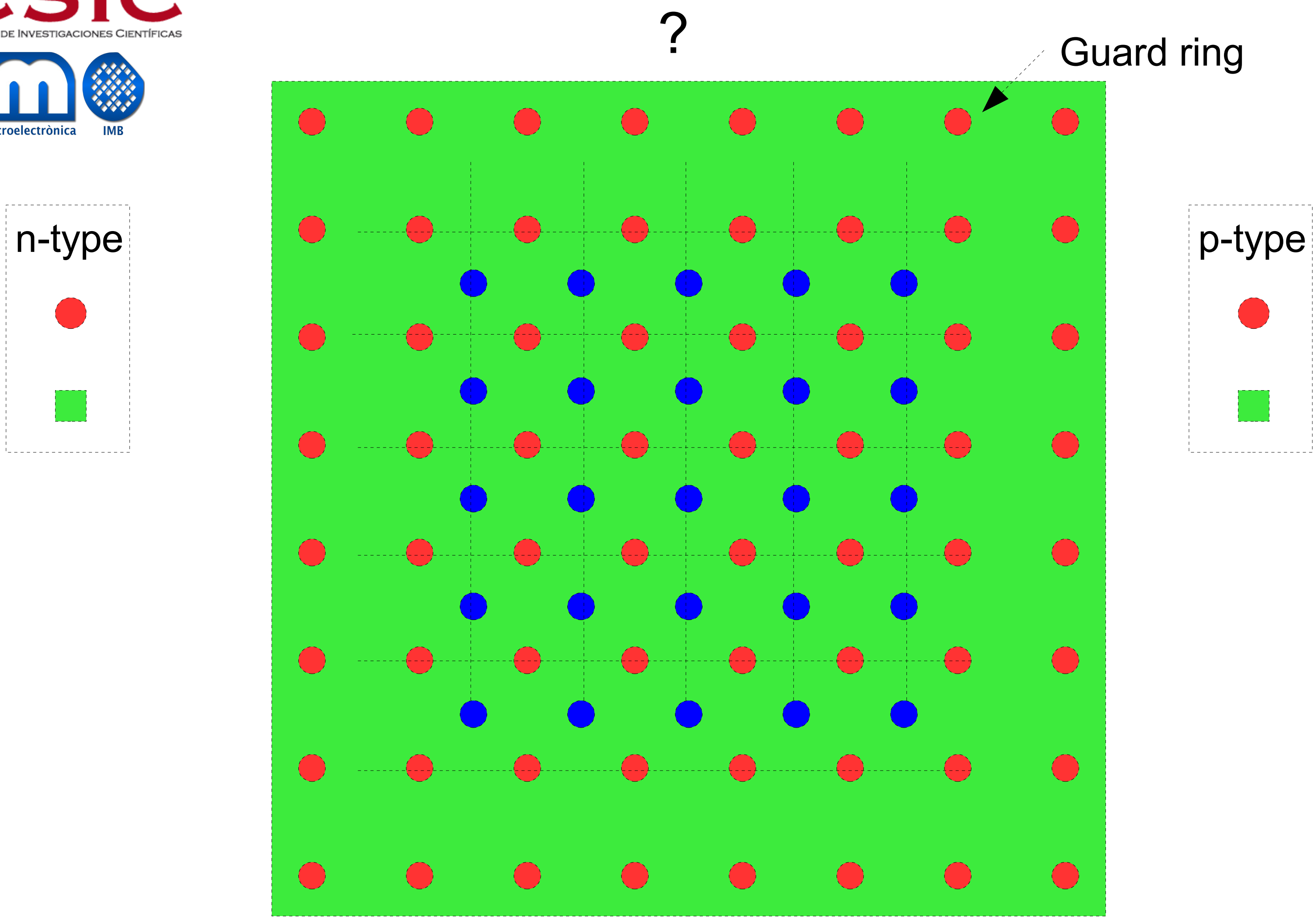


2D position sensitive 3D technology

- Single sided
- Double columns
- P-stop rings
- Double metal technology



Design optimization



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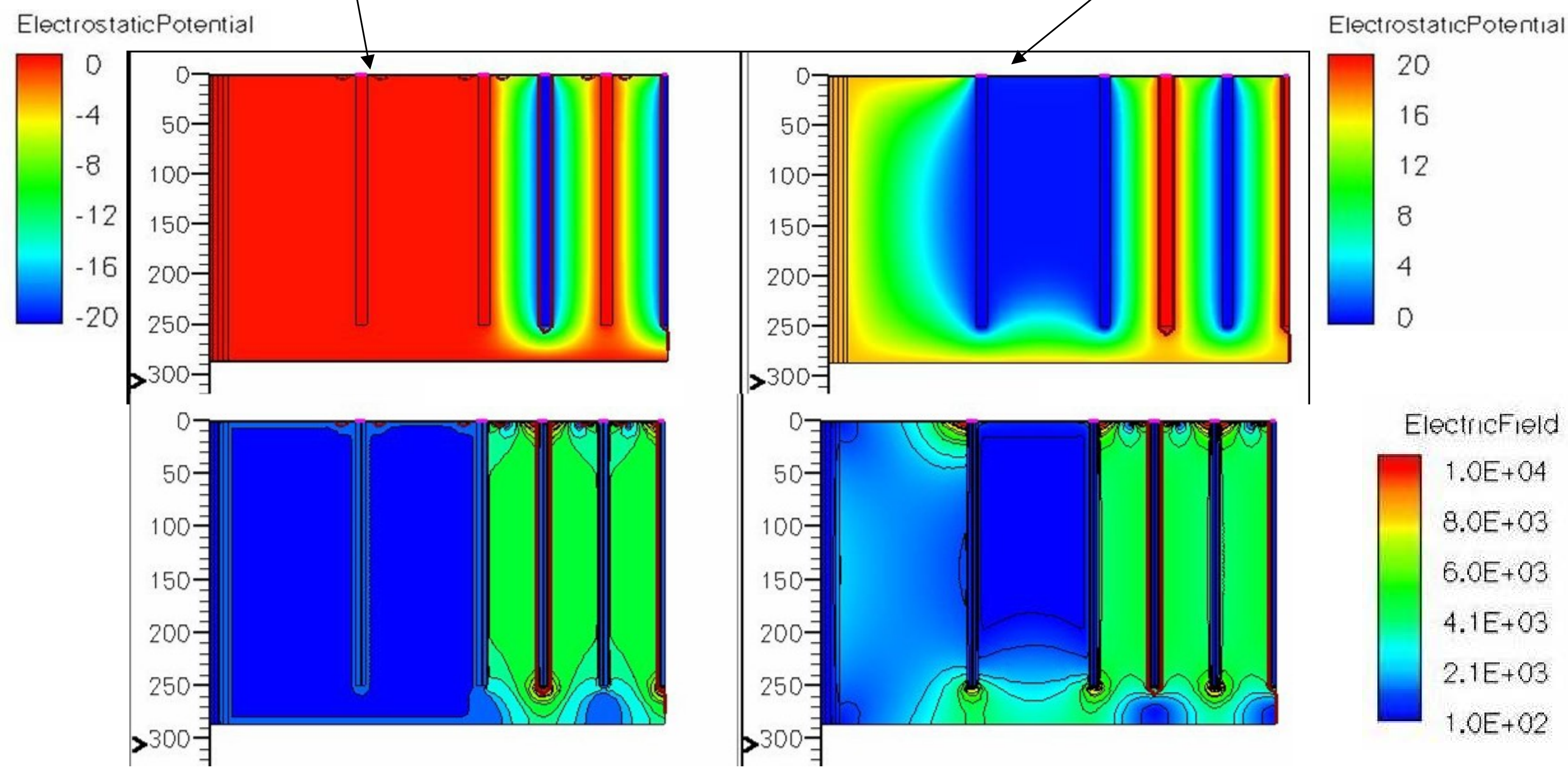
Simulation results:

T-CAD Sentaurus simulations

Cut defects model: e^-, h neutral traps.

Active area better defined with n-type bulk and guard ring!

n-type bulk, n-type guard ring VS p-type bulk, p-type guard ring



Thanks to Marie Ruat for collaborating in the simulation study

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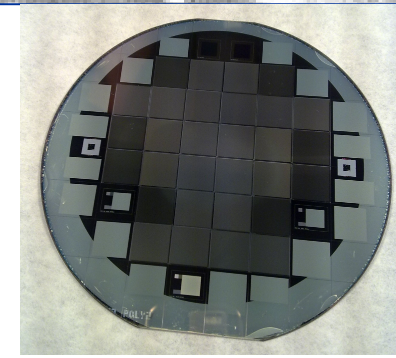
Real prototypes

Produced at the IMB-CNM, CSIC clean room facilities in Barcelona (ES)



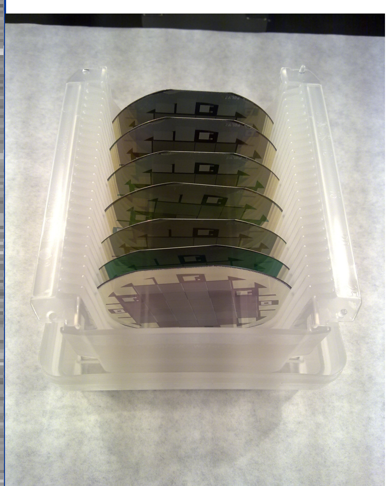
6 wafers 285 μm thick, 1 wafer SOI 20 μm thick.

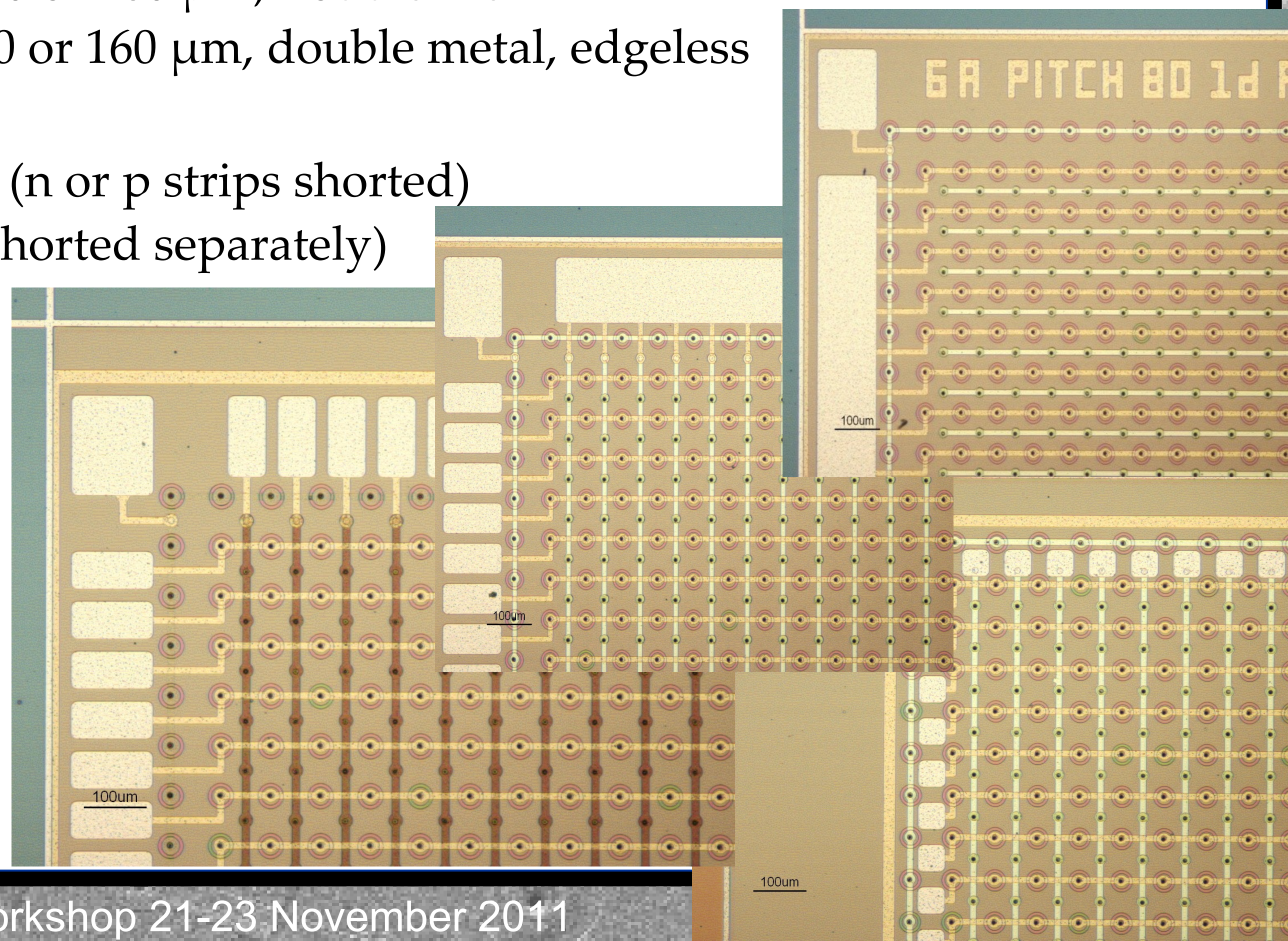
Detector structures:

- pitch 80 or 160 μm, double metal
- pitch 80 or 160 μm, double metal, edgeless

Test structures:

- 1D microstrip detectors (n or p strips shorted)
- Diodes (n and p strips shorted separately)





Electrical characterization

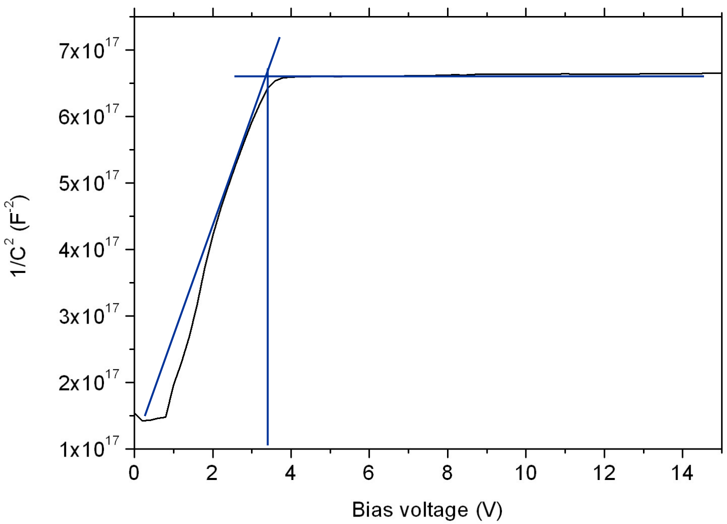
Depletion voltage < 4V < breakdown voltage

T=20ºC, f=10kHz

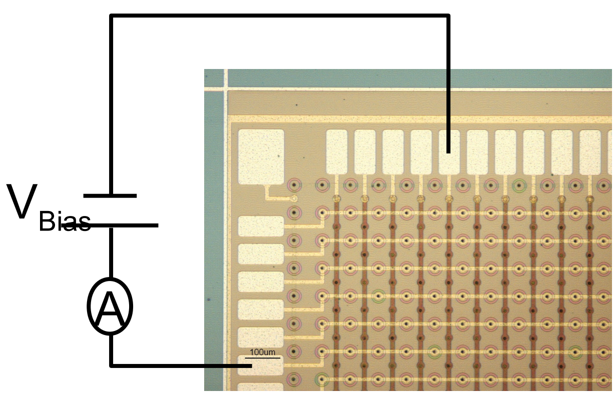
C_{bulk} ~ 8 pF

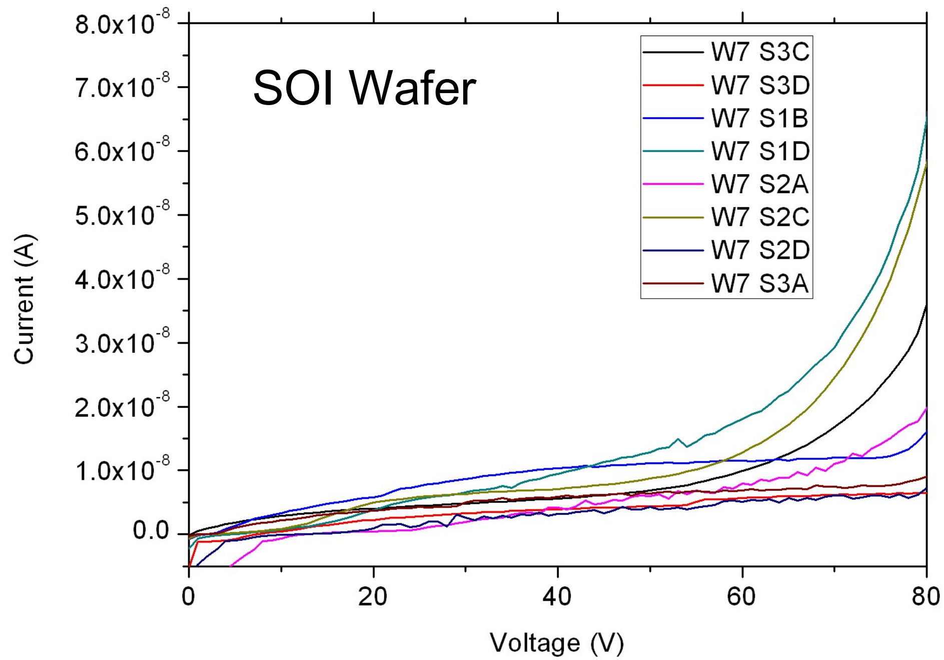
$I_{leakage}$ ~ few nA (columns 20 µm deep)

10^2 nA (columns 250 µm deep)



Only 1 p-type strip and 1 n-type strip have been biased and read



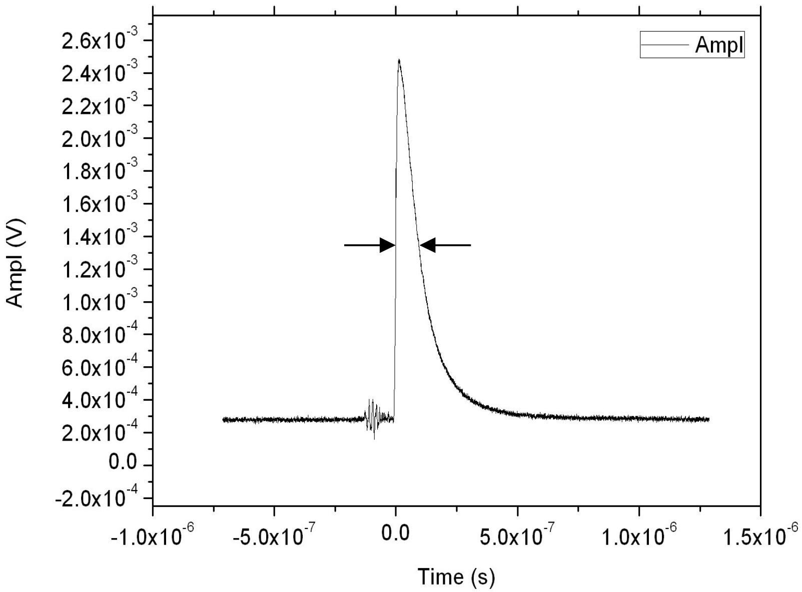


TCT measurements: setup

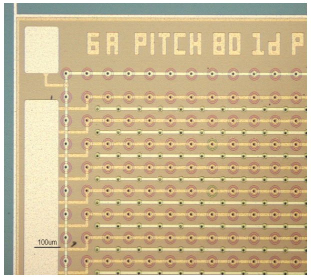
Carried out in the BNL (NY,USA) laboratories

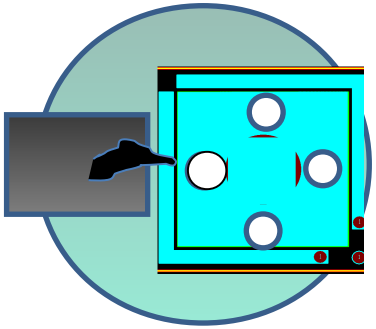
Laser setup	Wavelength λ (nm)	Intensity (V)	Width (ns)	Period (μs)	Penetration depth (μm)
1st	1060	10	10	20	whole bulk
2nd	830	10	10	20	14
3rd	660	10	10	20	4

FWHM (Average Drift Time) = f(1/Ē)

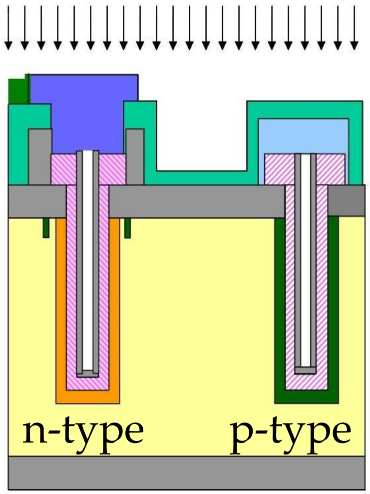


Parallel strips

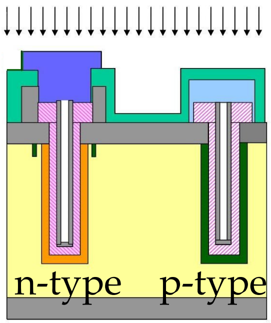




Laser beam (spot = 1mm)



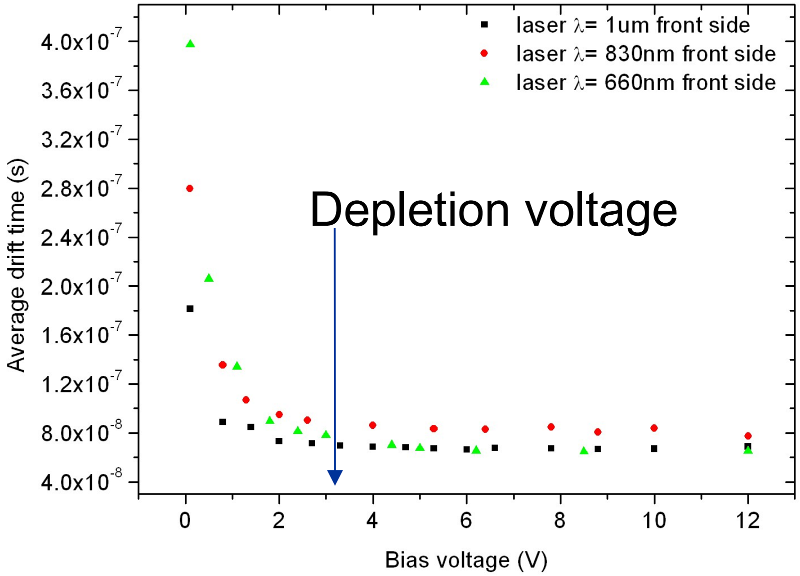
TCT measurements



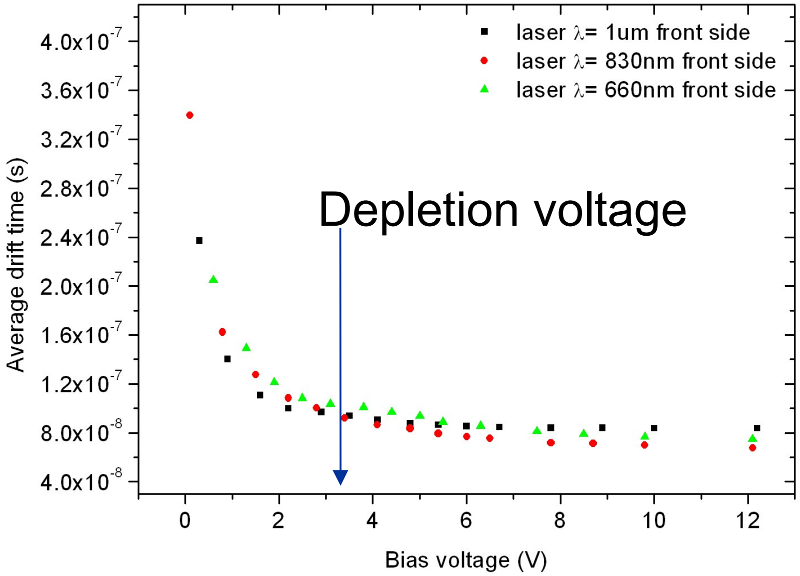
Laser illuminating the front side

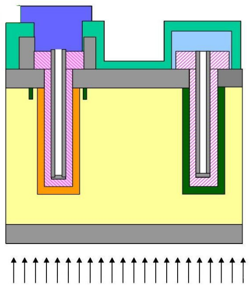
Signal read from both the electrodes

Signal read from the n-type electrodes



Signal read from the p-type electrodes





Illuminating the backside with both the lasers of shorter wavelengths (660 nm and 800 nm) any signal is read.

→ The last 14 μm never deplete

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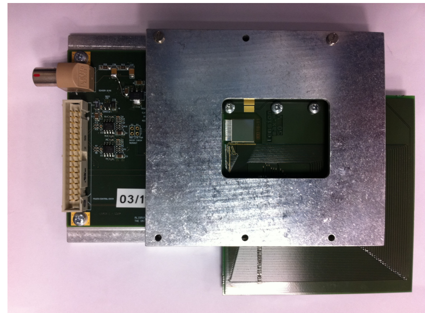
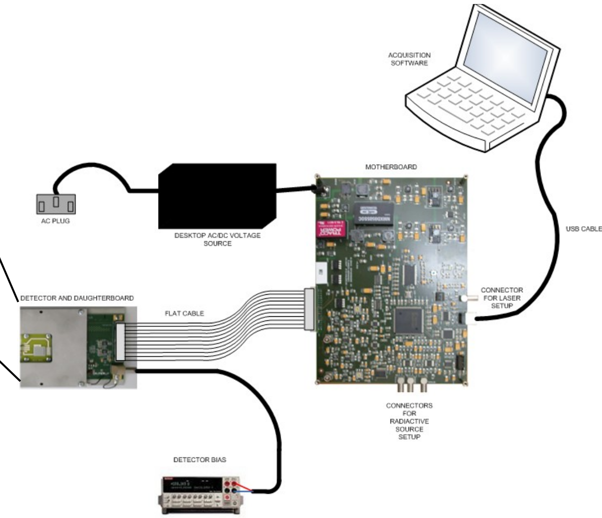
Laser characterization: setup

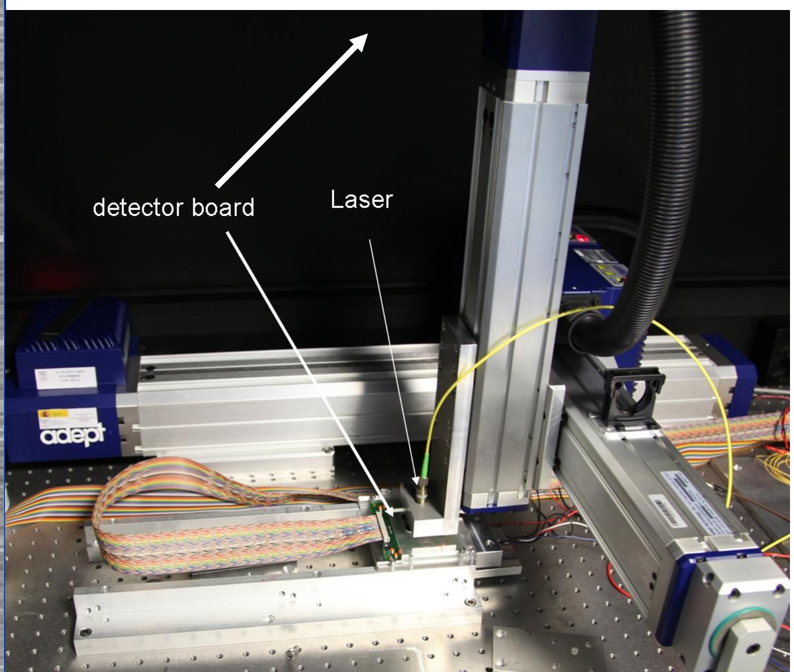
Carried out in the IFCA (Santander, Spain) clean room



ALIBAVA SYSTEMS



Special detector board to connect n-type strips to one beetle chip and p-type strips to the other.



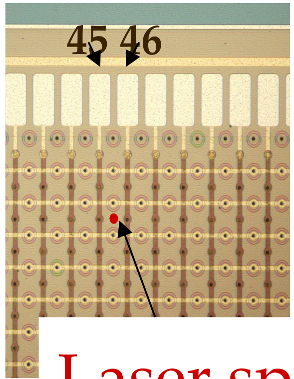
Pulsed DFB laser λ=1060nm

- Gaussian beam spot width ≈ 15 μm

3D axis stage with displacement accuracy ≈ 10 μm

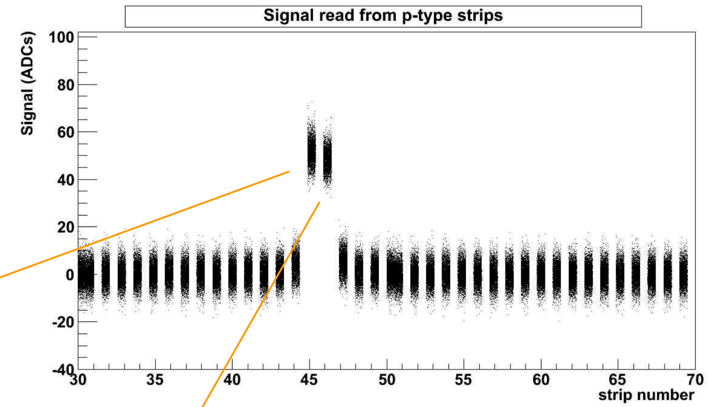
Thanks to the IFCA group for the measurements

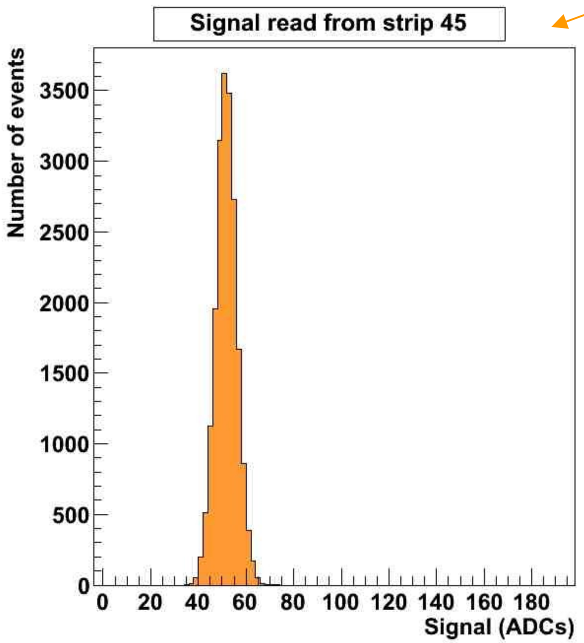
Laser characterization

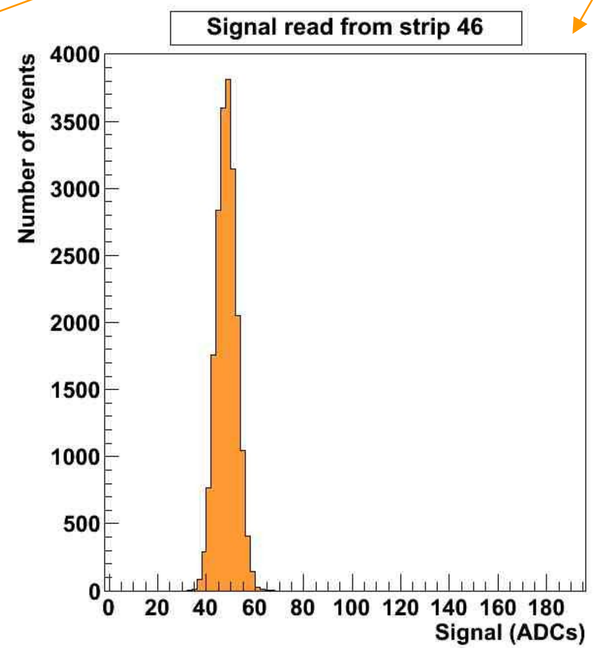


Laser spot

Laser spot centred in a pixel







Average noise ~ 2,5 ADCs

S/N~20

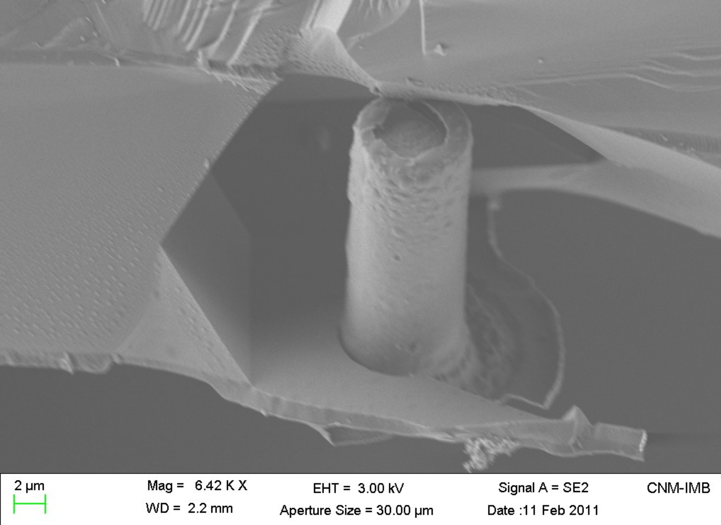
Laser signal > MIP!!!

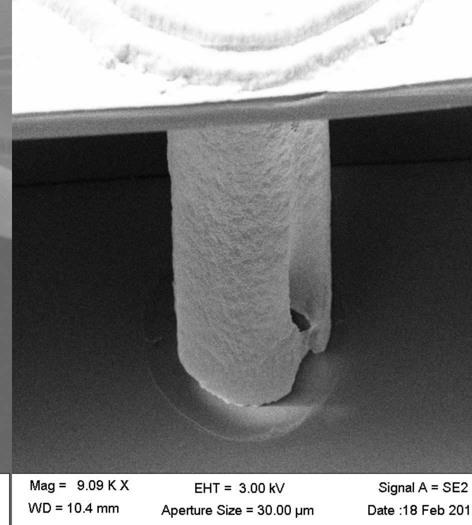
No calibration!

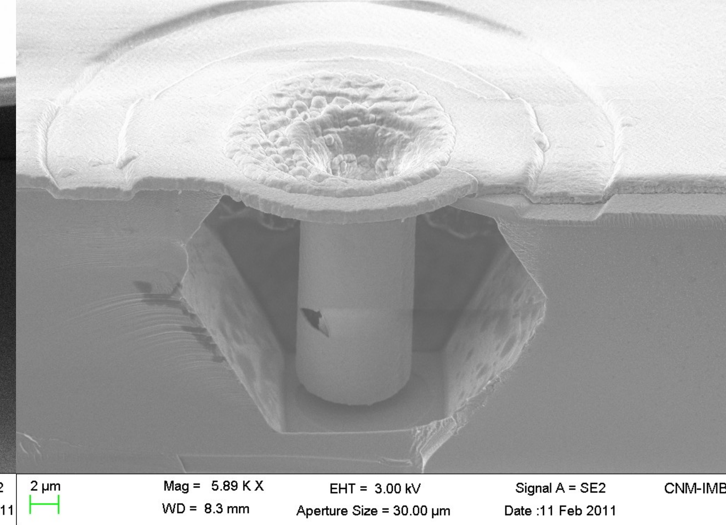
Conclusions

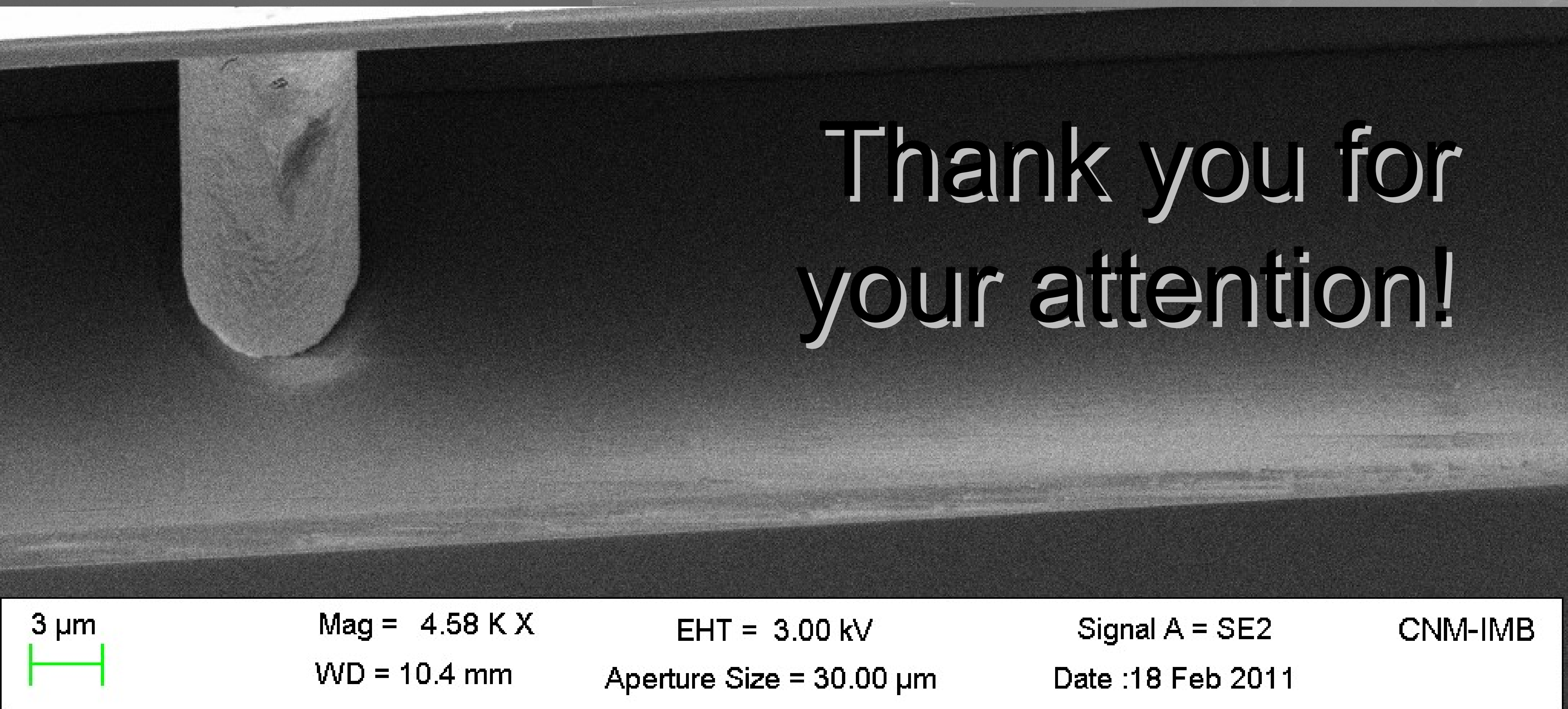
New 2D position-sensitive stripixel detectors have been manufactured using dual column electrodes and double metal layer technology in a true single-sided processing.

- 2D and 3D simulations have been used to optimize the design.
- Electrical characterization shows the lateral depletion voltage $< 4V <$ breakdown voltage.
- TCT measurements demonstrate both the n-type and p-type strips can be read.
- A preliminary laser measurement shows the good response of the devices.
- A full laser characterization and CCE measurements are in process using the ALIBAVA readout system.


2 µm
Mag = 6.42 K X
WD = 2.2 mm
EHT = 3.00 kV
Aperture Size = 30.00 µm
Signal A = SE2
Date :11 Feb 2011
CNM-IMB


Mag = 9.09 K X
WD = 10.4 mm
EHT = 3.00 kV
Aperture Size = 30.00 µm
Signal A = SE2
Date :18 Feb 2011


2 µm
Mag = 5.89 K X
WD = 8.3 mm
EHT = 3.00 kV
Aperture Size = 30.00 µm
Signal A = SE2
Date :11 Feb 2011
CNM-IMB


Thank you for your attention!
3 µm
Mag = 4.58 K X
WD = 10.4 mm
EHT = 3.00 kV
Aperture Size = 30.00 µm
Signal A = SE2
Date :18 Feb 2011
CNM-IMB