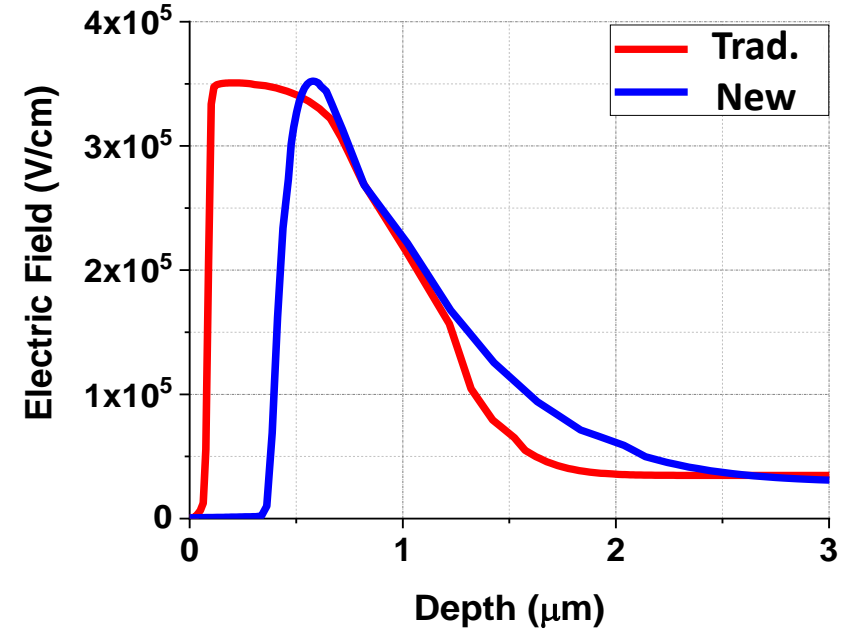
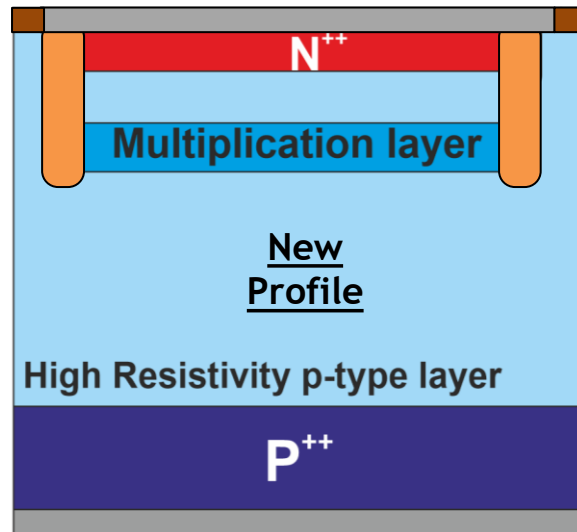
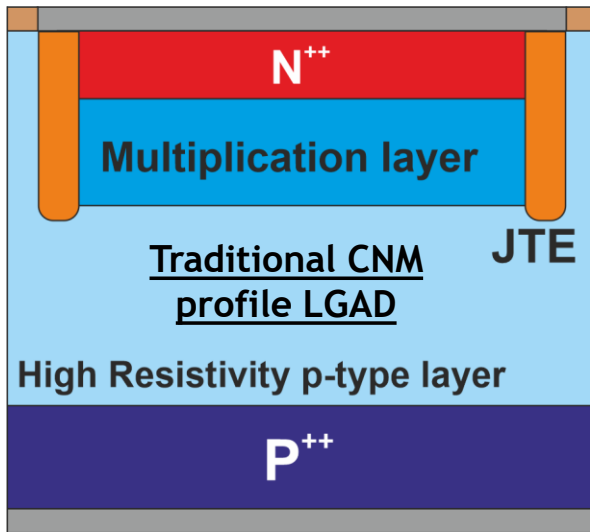


Technology stabilization and yield optimization in IMB-CNM LGADs

P. Fernández-Martínez, on behalf of the project collaboration

- This project aims at **improving the yield of large area pixelated LGAD, through a more stable technological process**
 - This includes an optimized doping profile and uniform response across a large area (>2x2 cm²) pixelated sensor.*



- Traditional CNM profile: N⁺⁺ and Multiplication layers are **overlapped**, and the **electric field peaks at the PN junction**
- New LGAD process, N⁺⁺ and Multiplication layers are **physically separated**, and the **electric field is nearly flat within this gap**

List of already interested institutions

Country	Collaborating Institution	Town	Institution Code	Contact
Spain	IMB-CNM, CSIC	Barcelona	CNM	Pablo Fernández Martínez*
Spain	IFCA, CSIC	Santander	IFCA	Iván Vila Álvarez
Spain	CNA	Sevilla	CNA	M ^a Carmen Jiménez Ramos
Spain	ITA	Zaragoza	ITA	Fernando Arteche
Spain	IFAE	Barcelona	IFAE	Stefano Terzo

Potential links to other WG:

- WG3 for damage characterization (before and after irradiation)
- WG4 for optimization of the technological TCAD simulations
- WG5 for characterization with test beams and other sources
- WG7 for hybridization

*Activity is already partially supported by Spanish National funding:
-PID2023-148418NB-C42 and PDC2023-145925-C32*

Warmly open to add collaborators!!

- *Irradiation campaigns*
- *Test beam characterization*
- *Timing/Spatial resolution studies*
- *Damage studies (before and after irradiation)*
- *Large array characterization techniques*
- *Technological TCAD simulations...*

G1: Stabilize standard CNM LGAD technology to achieve a reliable production of pixelated LGADs

G2: Obtain a deep *insight* on the impact of technological choices on the LGAD performance

G3: Supply LGADs sensors to experiments and laboratories, not necessarily in the LHC or even HEP scope (also explore technology transfer to new industrial manufacturers, e.g. innoFab)



Work package 1: Stabilization of the LGAD technology

- **Task 1:** Sensor manufacturing at IMB-CNM (3 successive runs)
- **Task 2:** Optimization of the fabrication steps (close revision of all the critical processes)
- **Task 3:** Optimization of the technological TCAD simulation -> **connection with WG4**
- **Task 4:** Revision of the design/layout (optimization of the termination structures and passivation strategies)
- **Task 5:** Investigation of small pixel array

Work package 2: Electrical and sensing performance -> **connection with WG5**

- **Task 1:** Characterization of the sensors in the laboratory (before and after irradiation)
- **Task 2:** Development of a multichannel probe system able to characterize large arrays
- **Task 3:** Characterization of the sensors in tests beams (spatial and timing resolution)

Work package 3: Evaluation of the impact of manufacturing strategies -> **connection with WG3**

(deep implants, short thermal budgets, etc.)

- **Task 1:** Evaluation of lattice damage on pristine samples
- **Task 2:** Evaluation of damage on irradiated samples
- **Task 3:** Proposal of mitigation strategies

Work package 4: Irradiations

- **Task 1:** Organization of irradiations (3 runs)

Work package 5: Hybridization -> **connection with WG7**

- **Task 1:** Organization hybridization

Deliverables

- D1: Production of 1st run (pad structures) → M12 **WP1**
- D2: Production of 2nd run. (pad and arrays) → M24 **WP1**
- D3: Development of a multichannel probe system for large arrays → M18 **WP2**
- D4: Production of 3rd run. Pad ad arrays → M36 **WP1**

Milestones

- M1: Report on technological modifications and their impact → M12 **WP1**
- M2: Characterization of the 1st run before and after irradiation and in test beams → M18 **WP1/WP2/WP4**
- M3: Report on the optimization of TCAD simulations → M18 **WP1**
- M4: Define mask layout for runs 2 and 3 (pad + arrays) → M14 **WP1**
- M5: Report on the impact of manufacturing strategies on sensor performance → M20 **WP3/WP4**
- M6: Characterization of the 2nd run before and after irradiation → M30 **WP2/WP4**
- M7: Hybridization of devices from 2nd run → M36 **WP5**
- M8: Characterization of the 3rd run before and after irradiation and in test beams → M42 **WP2/WP4**
- M9: Hybridization of devices from 3rd run → M48 **WP5**

Prototype run already produced (2025):

- N+ Arsenic contact (looking for the shallowest region)
- 3 different Boron doses for the deep multiplication region implant (low, medium, high)
- Wafers with and without carbon implant
- Higher control of all the technological processes (oxide thickness, quality of deposited layers, etc.)

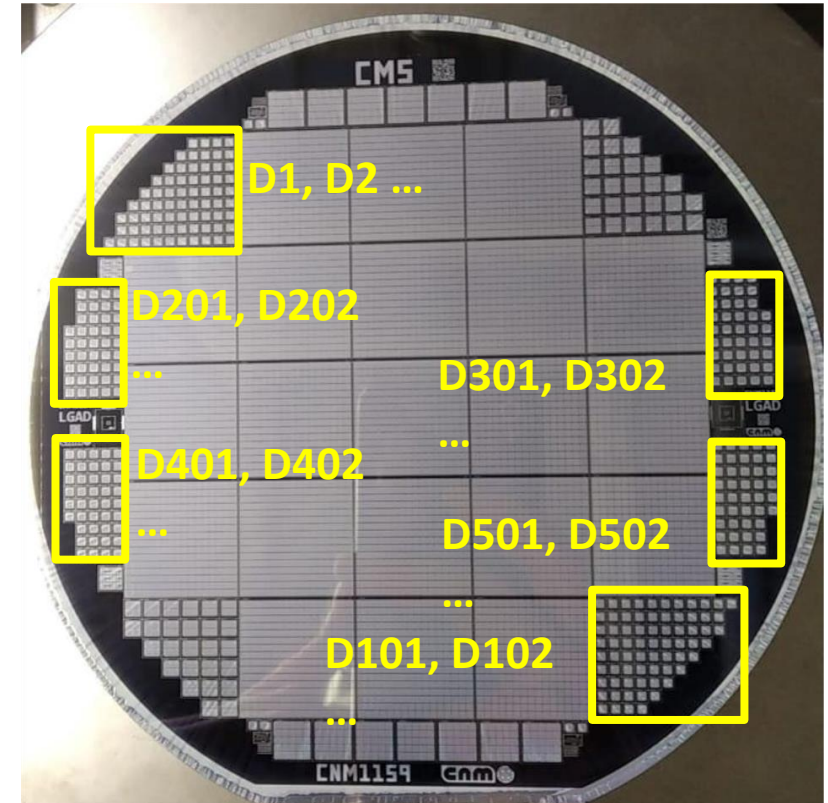
Samples have been irradiated:

- Fluences (3 samples each): 0.8, 1.5 and 2.5e15 n_{eq}/cm²
- Objective: evaluate acceptor removal coef.

MIP measurements:

- Samples doesn't have window for laser illumination
- Objective: evaluation of gain and timing

Single-pad label arrangement

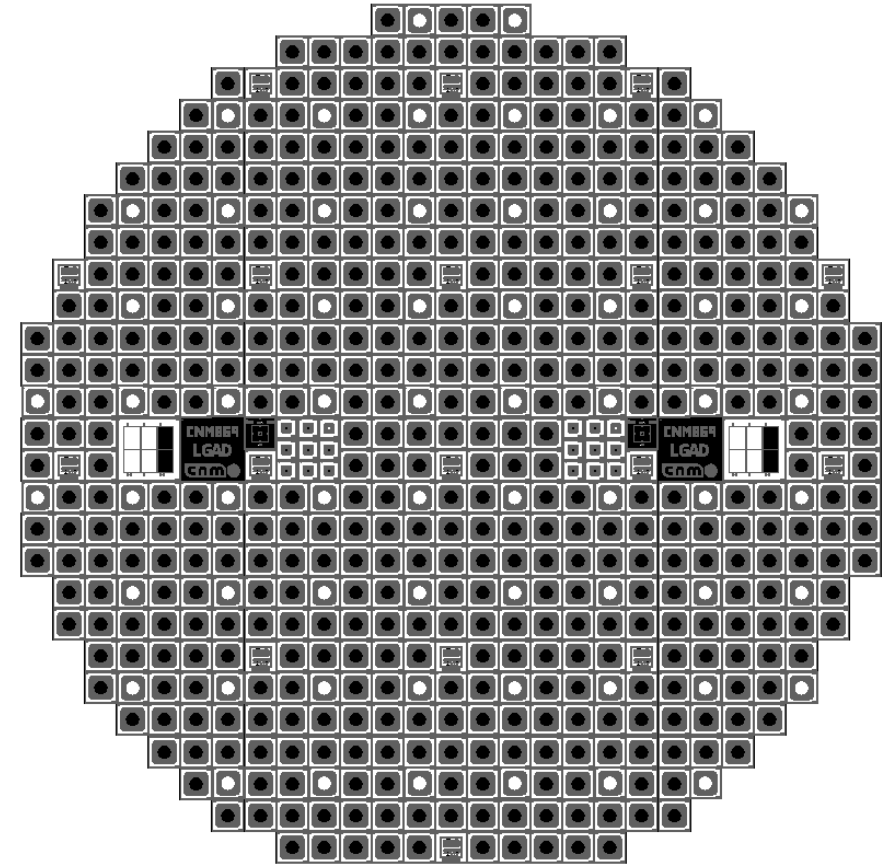


Check

- J. Villegas talk: [Wednesday at 9:00](#)
- F. Dougados talk: [Wednesday at 9:54](#)
- J. Villegas et al, [doi: 10.3390/s25175571](https://doi.org/10.3390/s25175571)

New run (1st):

- Only pad devices (6" wafer with, LGADs, PiNs and window on the metallization)
- Revision of the final thermal steps to anneal implantation damage



Objectives for this DRD3 collaboration meeting

- Conversation with potential collaborations to integrate them in the project and refine specific tasks and workflows, if needed
- Preparation of a cds document (before end of the year)
- Ask for WG2 discussion and approval
- Presentation to CB in the next DRD3 meeting

Thank You!



Acknowledgements

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