Status of CNM RD50 LGAD Project

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RD50 Institutes Participating

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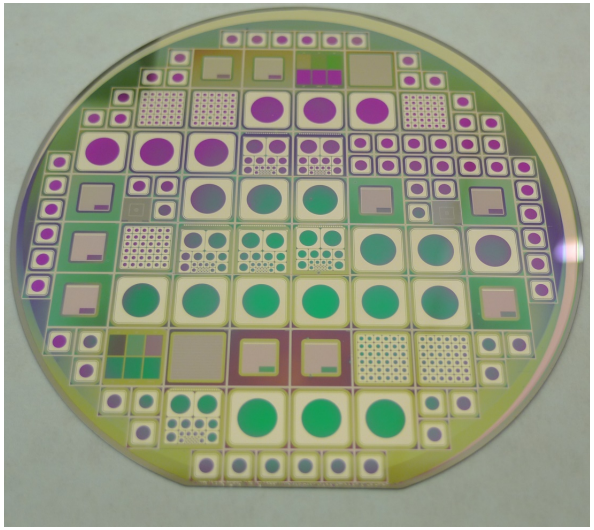
CNM Status

- **2 Runs** with **Boron** Multiplication Layer and **300 µm** Substrate: **Finished**
  - ✓ Run 7509
  - ✓ Run 7859
- **1 Run** with **Gallium** Multiplication Layer and **300 µm** Substrate: **Finished**
  - ✓ Run 7735
- **1 Run** with **Boron** Multiplication Layer and **200 µm** Substrate: **On Going**
  - ✓ Run 7782
- **New Run** with **Gallium** Multiplication Layer and **300 µm** Substrate: **Waiting**

- **Run** Basic Information:
  - ✓ Cnm761 Mask Set
  - ✓ Only Electron Collection
  - ✓ Improve Surface Isolation (P-Stop)
  - ✓ Different Terminations
  - ✓ Pad Detectors with Different Sizes
  - ✓ Strips and Pixel Detectors
  - ✓ LGAD for Timing Applications
  - ✓ Test Structures to measure the Multiplication Layer



RD50 Samples Distribution

1. CNM Barcelona, G. Pellegrini, Giulio.Pellegrini@cnm-imb.csic.es
2. CERN, M. Moll, Michael.Moll@cern.ch
3. UC Santa Cruz, Hartmut Sadrozinki, hartmut@ucsc.edu
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5. IFCA Santander, Ivan Vila, ivan.vila@csic.es
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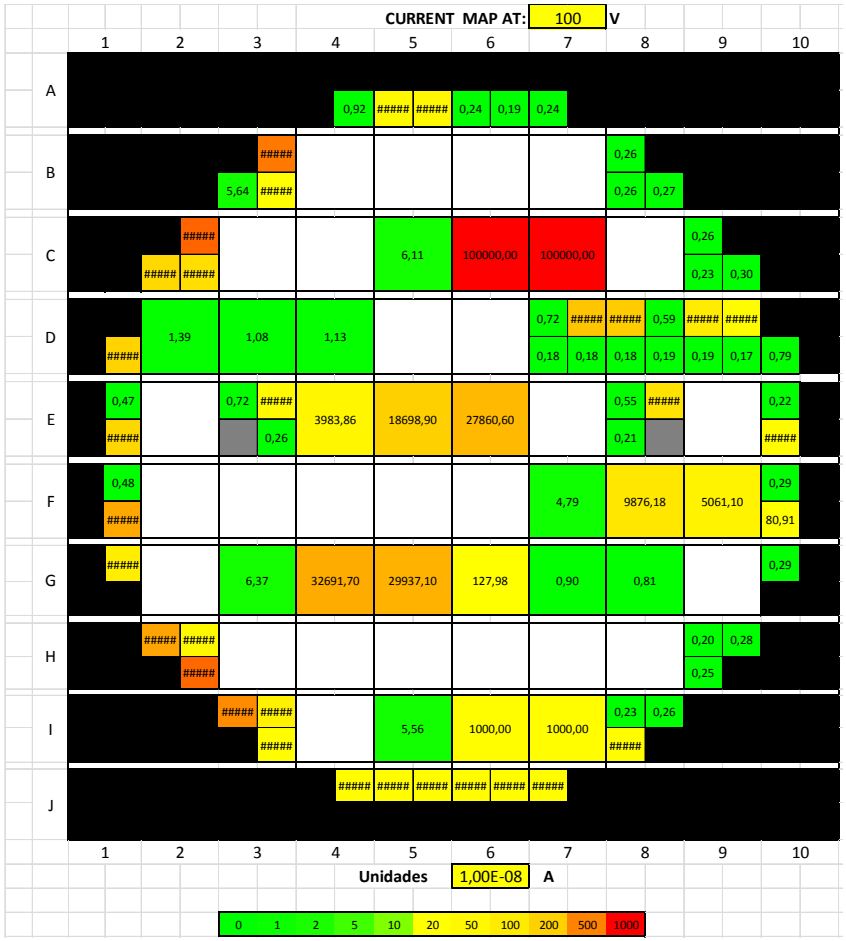
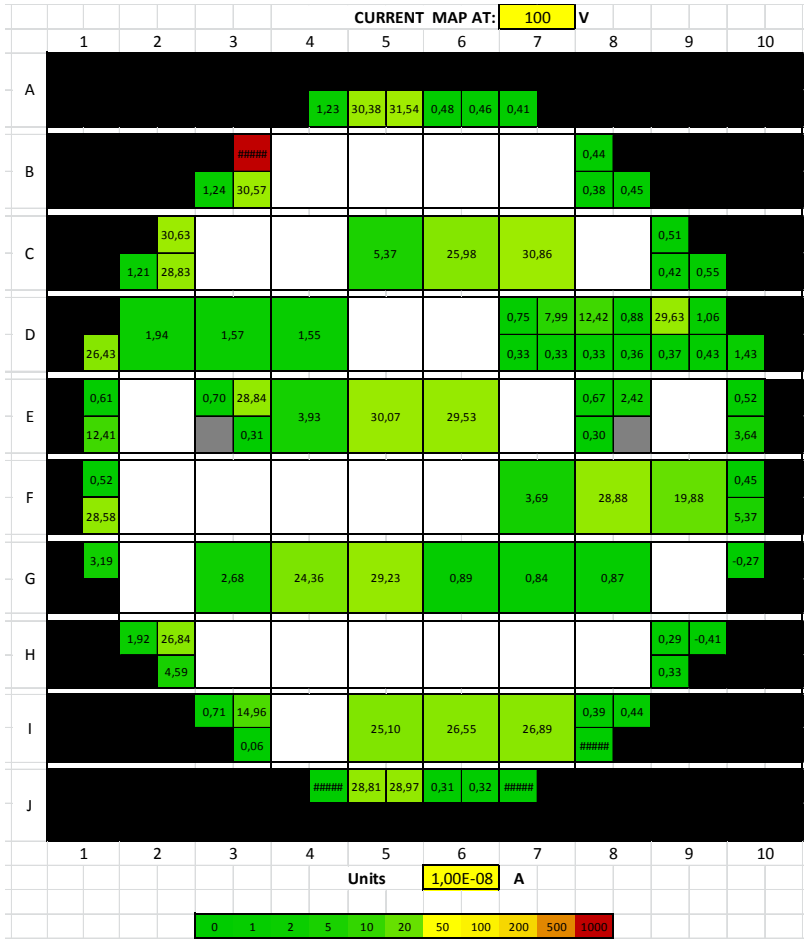
Boron Multiplication Layer. 300 µm Substrate

- Run 7509, Wafer 2

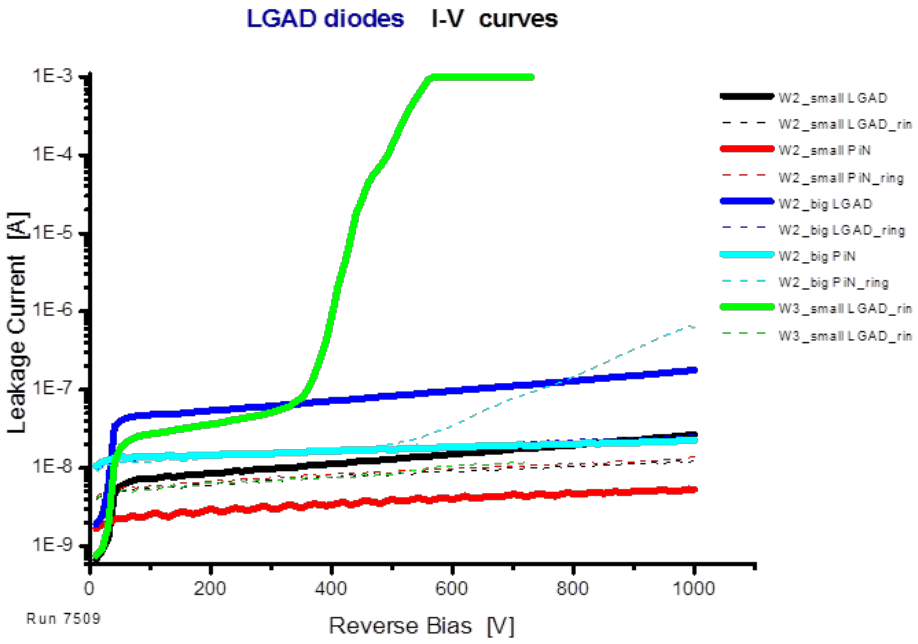


- Run 7859, Wafer 1

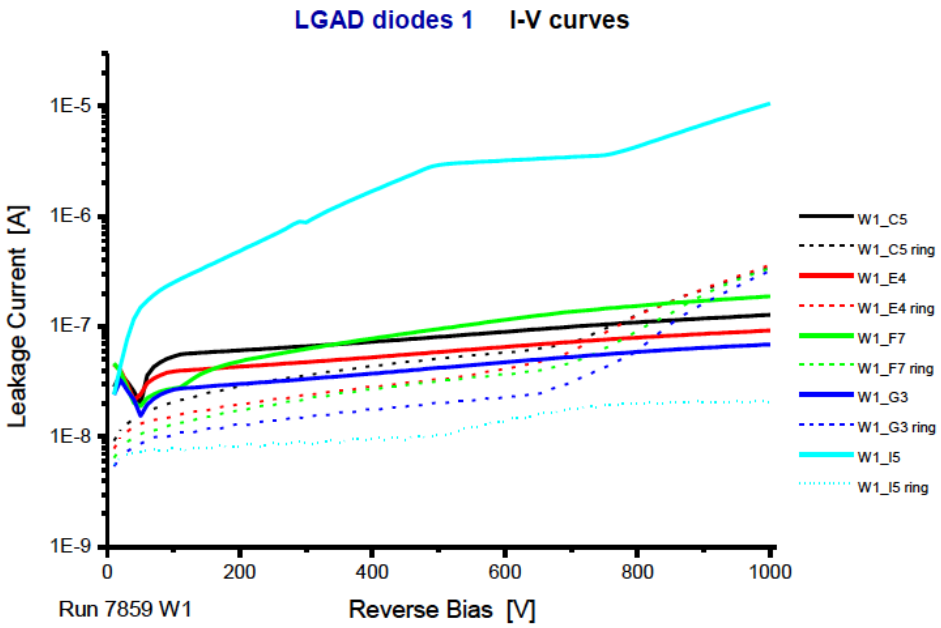


Boron Multiplication Layer. 300 µm Substrate. I(V)

- Run 7509, Wafer 2

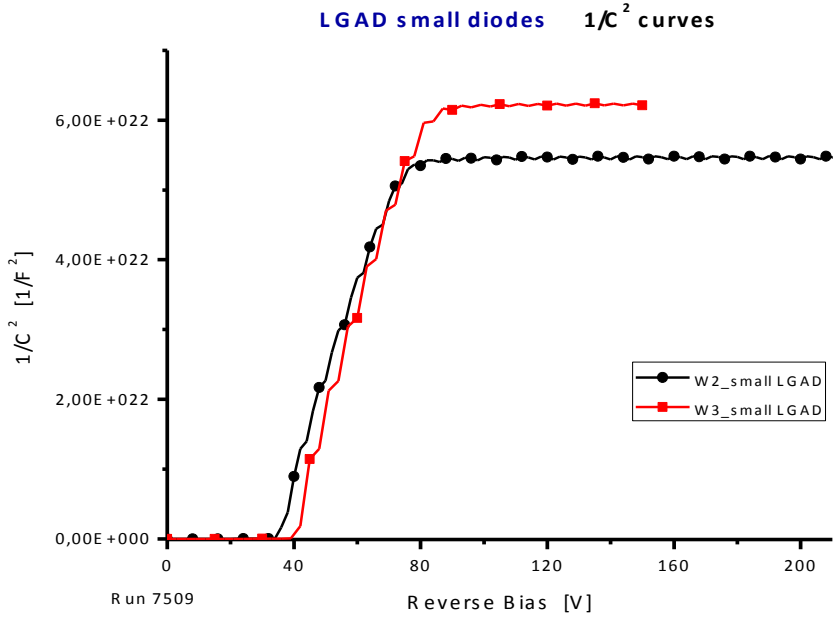


- Run 7859, Wafer 1

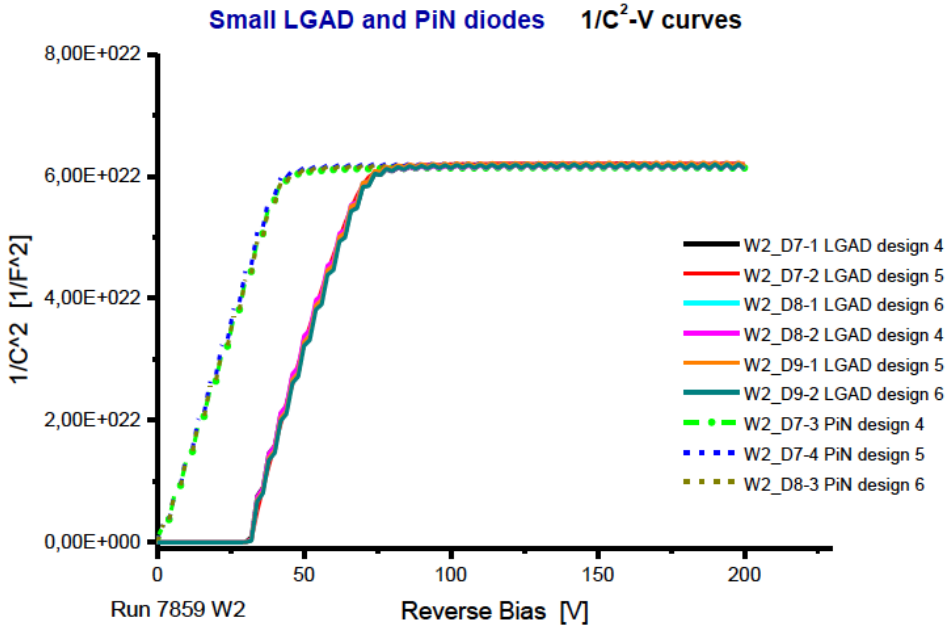


Boron Multiplication Layer. 300 µm Substrate. C(V). 1/C²

- Run 7509, Wafer 2

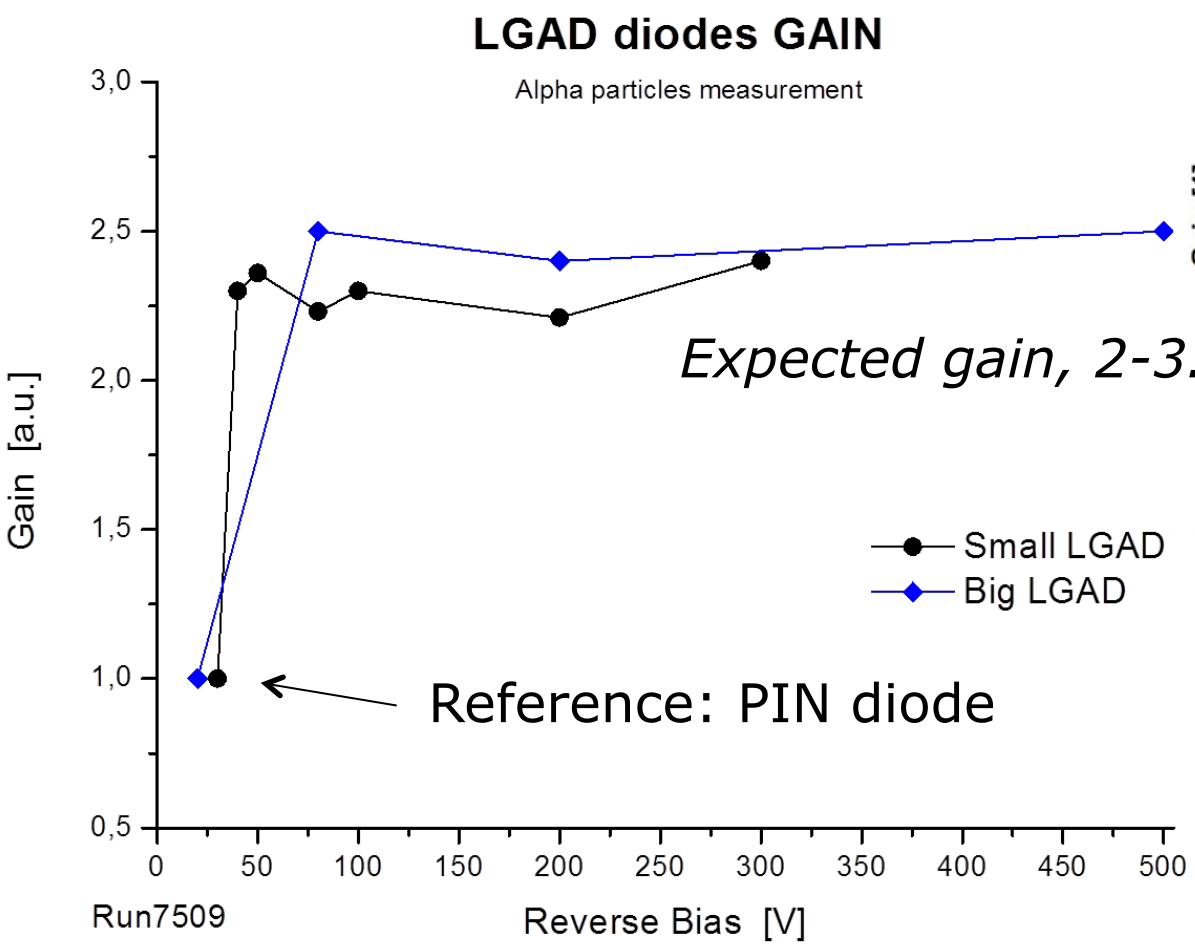


- Run 7859, Wafer 2

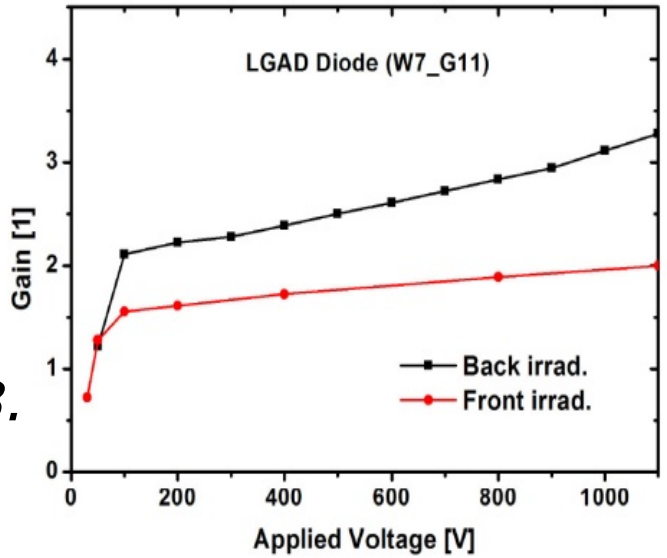


Boron Multiplication Layer. 300 µm Substrate. Alfa

- Run 7509, Wafer 2. Top Illumination

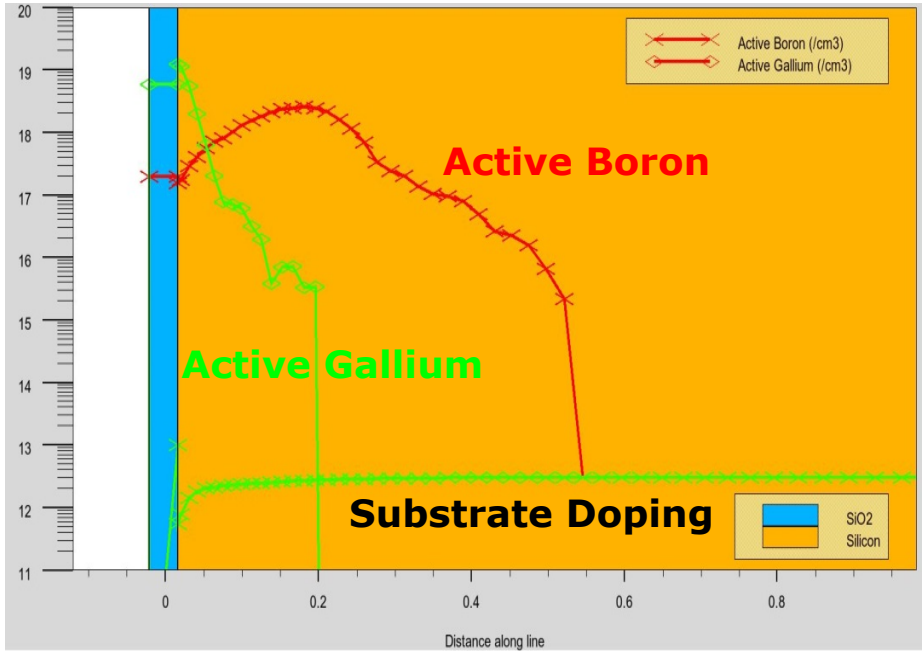


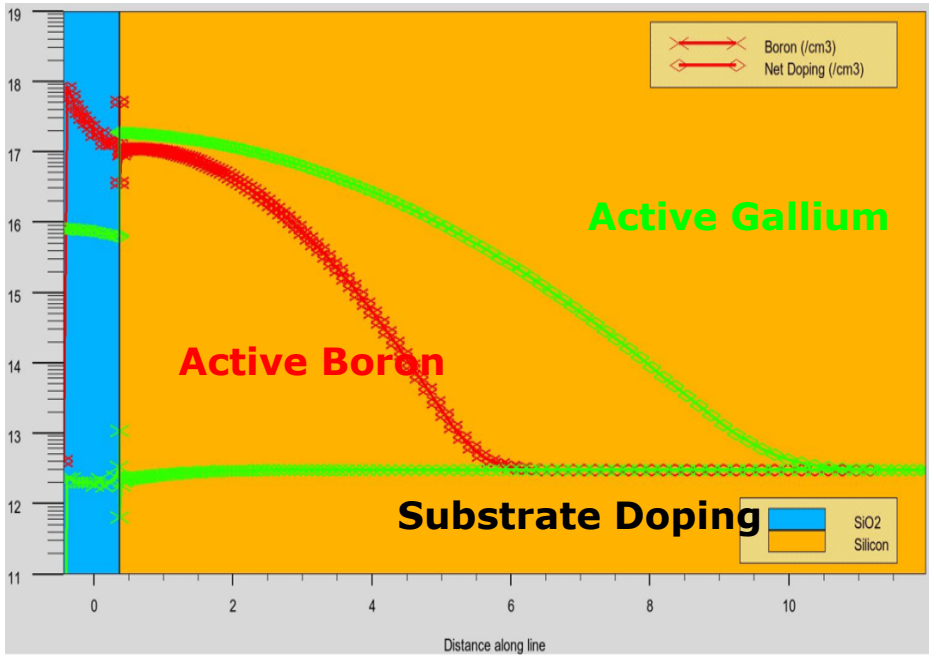
Old Run



Gallium Implantation. Silvaco TCAD Simulation

- **Simulation** of other p-layer doping ions: **Gallium**

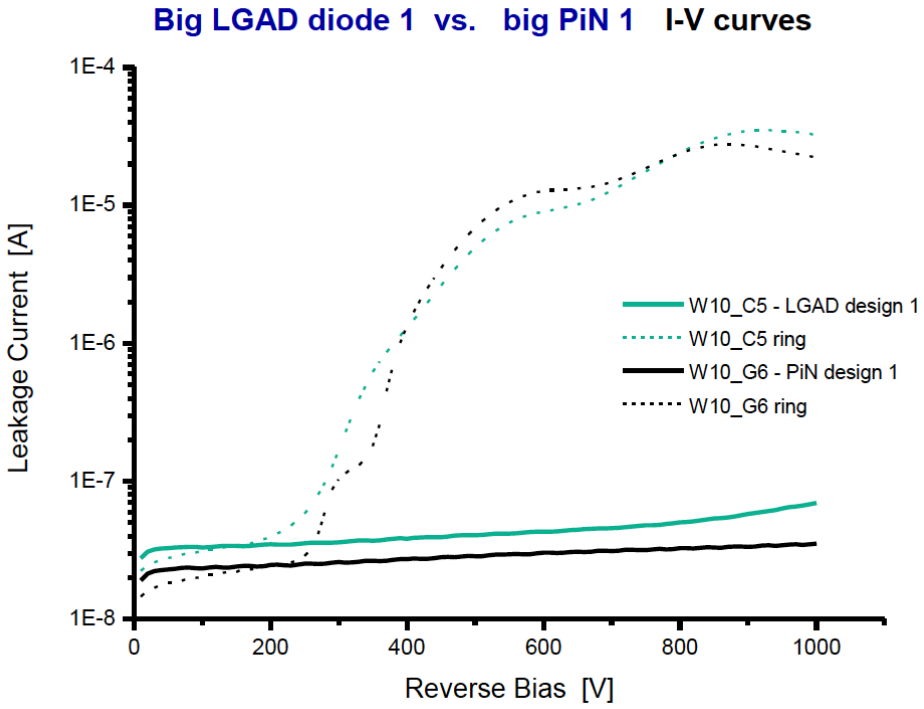


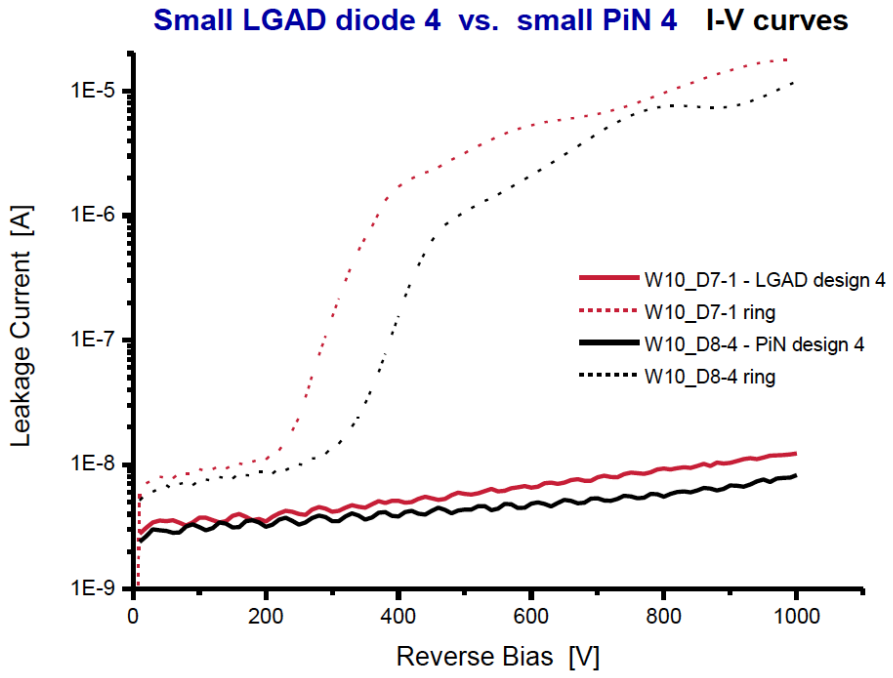


- **Gallium** has **lower** penetration than **Boron**, but **higher** diffusion (with annealing)
- Simulation predicts that **Gallium Implantation** (Dose=1.3e13, Energy=60) through **35 nm SiO2** is enough to obtain a similar doping profile than Boron Implantation

Gallium Implantation. Electrical Characterization. I(V)

- **I(V)**: On Wafer

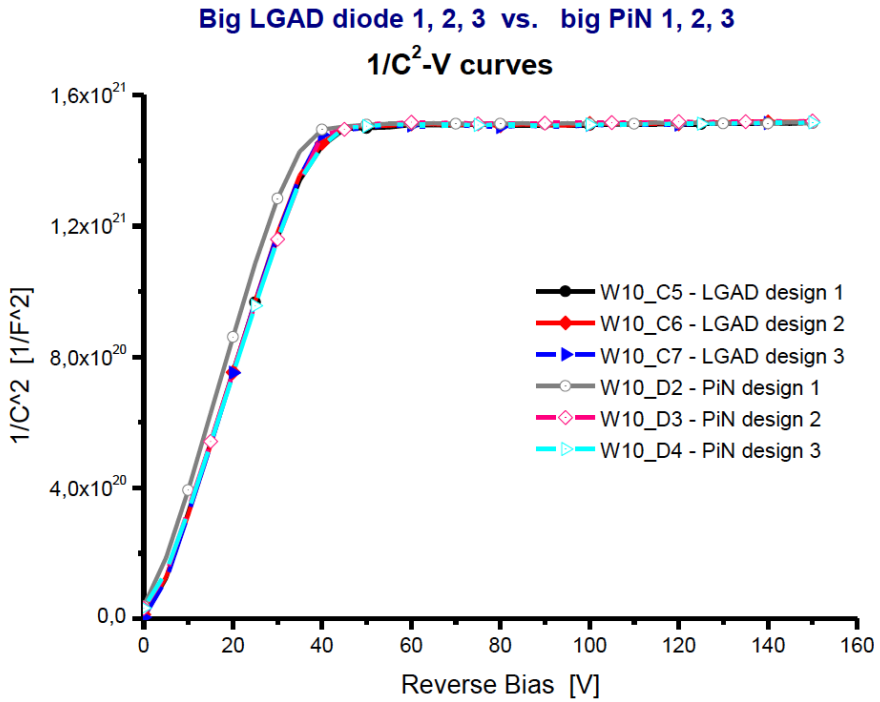


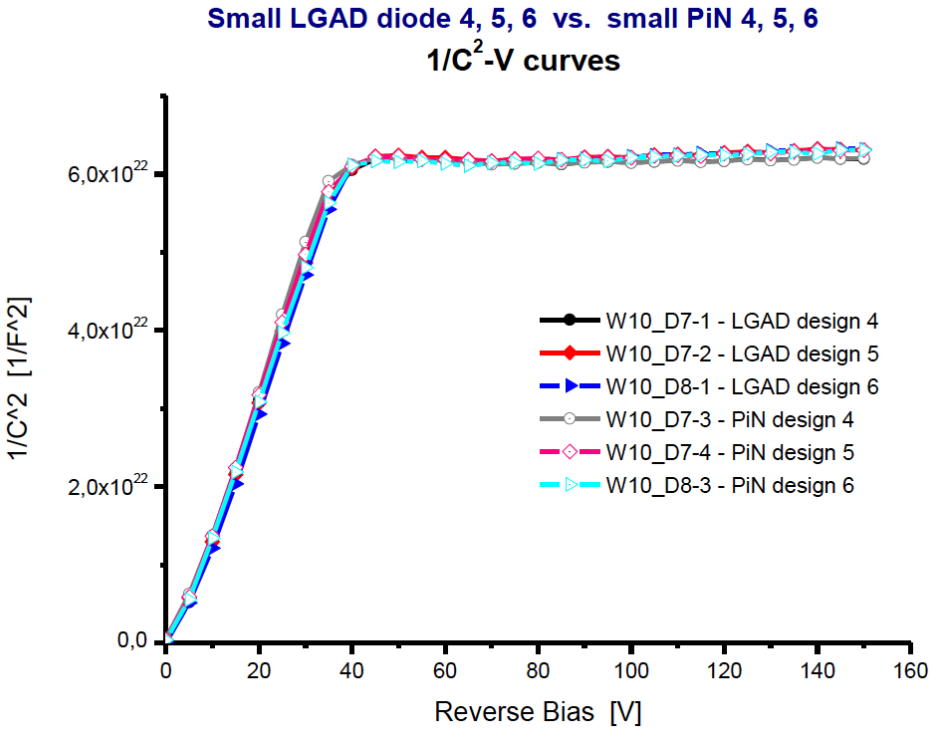


- LGAD devices with **Gallium Multiplication Layer** have similar I(V) characteristics than PiN Detectors

Gallium Implantation. Electrical Characterization. C(V). 1/C²

- C(V): On Wafer

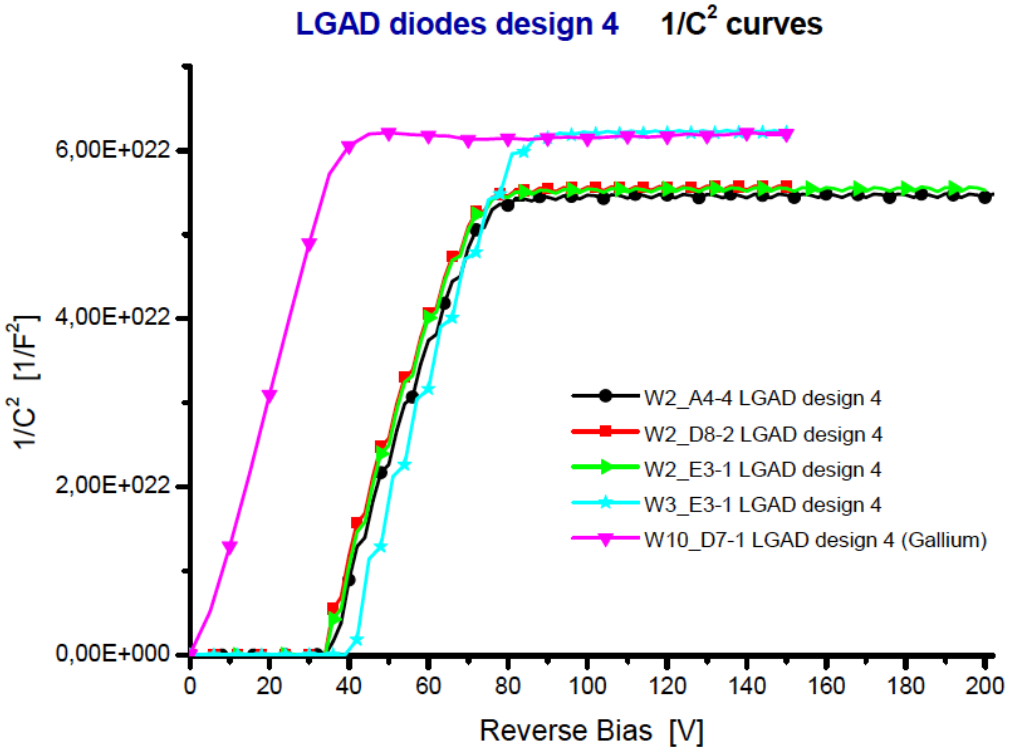




- LGAD devices with **Gallium Multiplication Layer** have similar C(V) characteristics than PiN Detectors. We do not observe the multiplication layer depletion

Boron Implantation. Electrical Characterization

- **C(V)**: On Wafer



- LGAD devices with **Boron Multiplication Layer** : We observe the multiplication layer depletion @ 35 Volts

Conclusion

- **Silvaco** do **not simulate correctly** the **gallium** implantation process
- We need to **spend more time** to tune the **simulator** to reproduce **real results**
- We have a **hard work to do**

Thank you for your attention !!!!