RD50 project: Fabrication of 200um thick p and n- type pad detectors with enhanced multi-plication effect

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RD50 Institutes participating:

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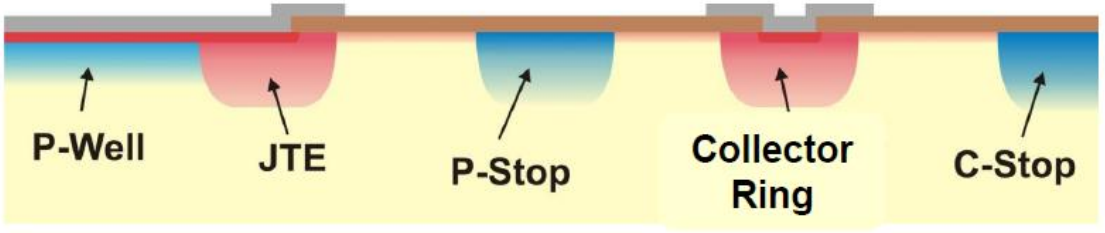
2. Liverpool University, Gianluigi Casse,
3. UC Santa Cruz, Hartmut Sadrozinki
4. IFCA Santander, Ivan Vila
5. University of Glasgow, Richard Bates,
6. INFN Florence, Mara Bruzzi
7. CERN, M. Moll
8. Jozef Stefan Institute , G. Kramberger,

What is new?

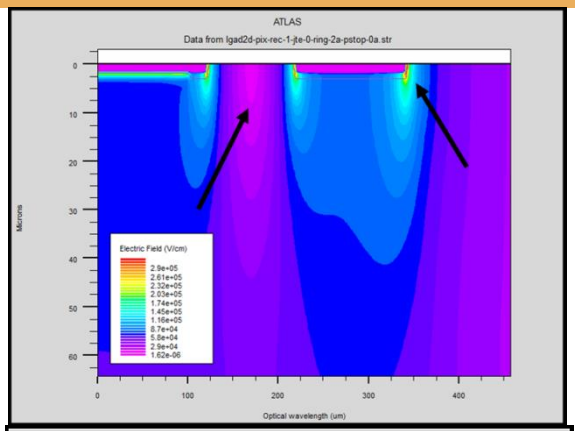
- New mask designed at CNM with many suggestions from all the groups.
- Thickness of the substrates: 200um.
- Only electron collection.
- Improve surface isolation (p-stop).
- Different terminations.
- Pads with different sizes + Strips and pixel detectors.
- Diodes for timing applications, TOTEM, AFP and PPS
- Different test structures to measure the multiplication layer.
- Try heavy dopants: Ga.

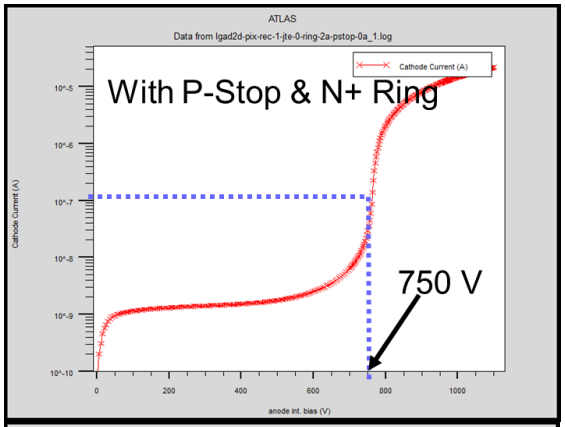
RD50 LGAD New Run. Mask Design

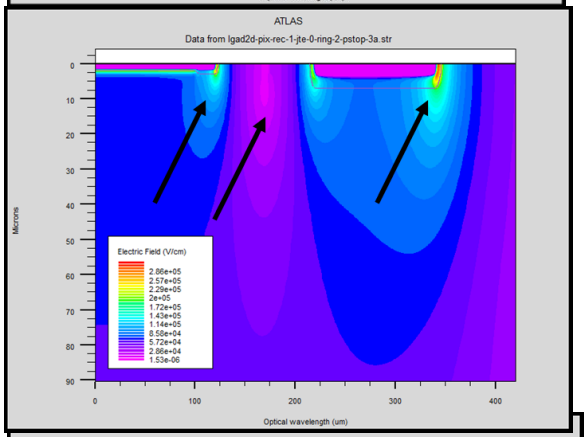
- Pad Detectors with Multiplication
  - ✓ Multiplication Area
    - ❖ **8 x 8** mm
    - ❖ **3 x 3** mm

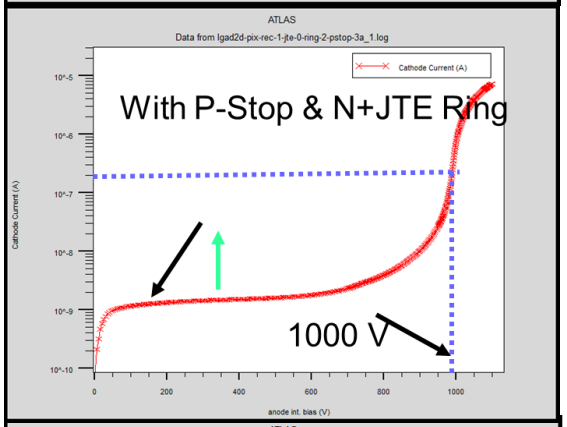


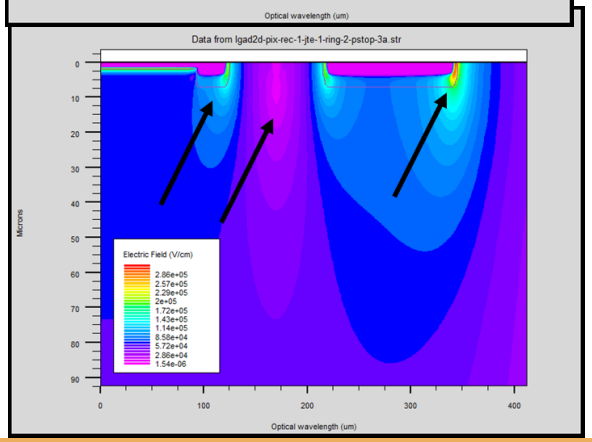
  - ➢ Termination: * P-Stop + N-Guard Ring
    * P-Stop + N-Guard Ring with JTE
    * JTE + P-Stop + N-Guard Ring with JTE
- Pixel Detectors
  - ✓ **1 x 1** mm (6x6 Matrix)
- PIN Diodes (for reference)
  - ✓ **8 x 8** mm
  - ✓ **3 x 3** mm
  - ✓ **1 x 1** mm (6x6 Ma*trix)*
  - ➢ Top & Bottom circular windows in the metal layer.

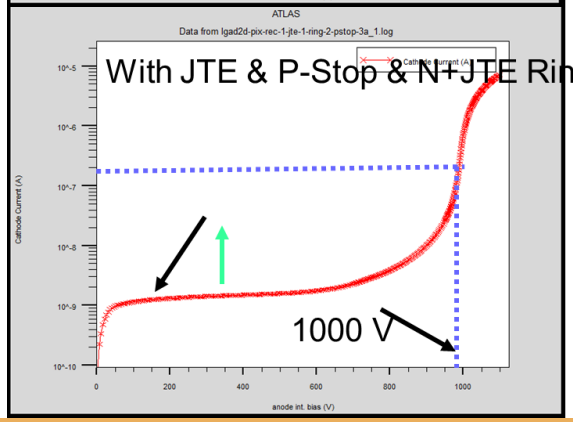








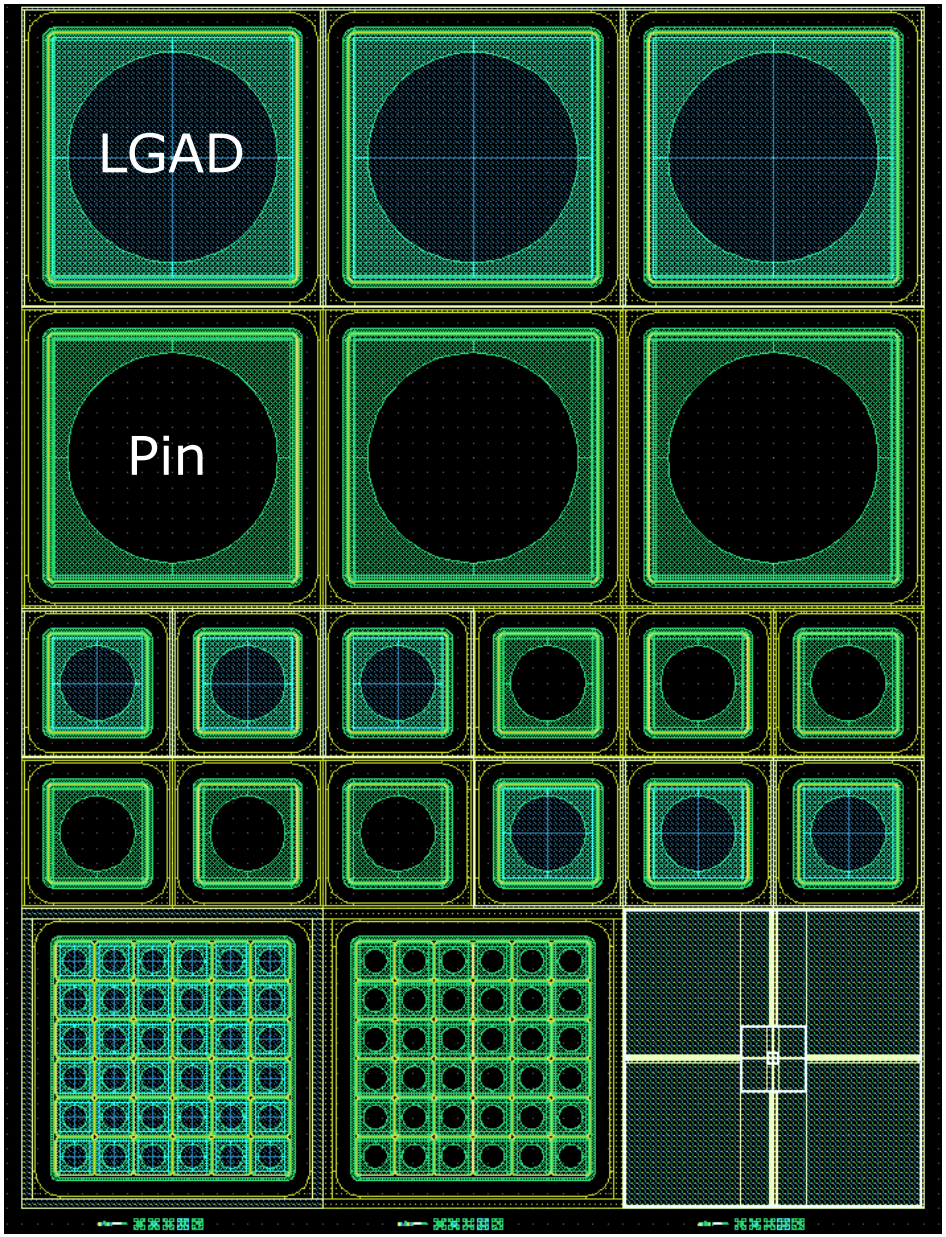


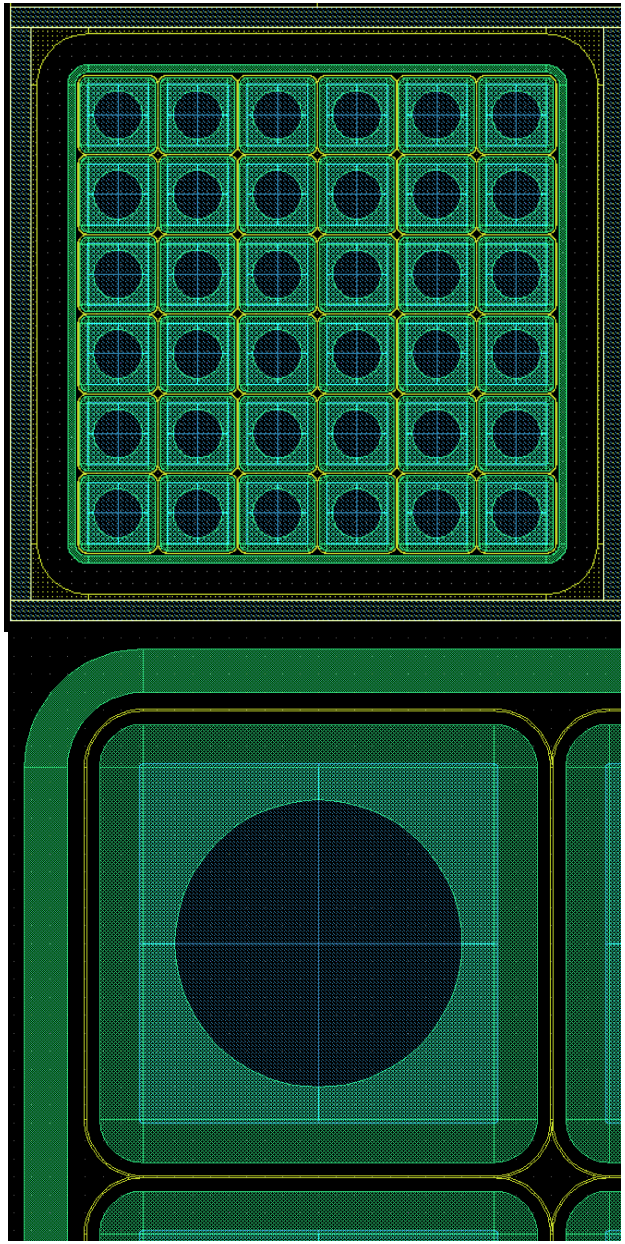


Simplest process

Segmented detectors

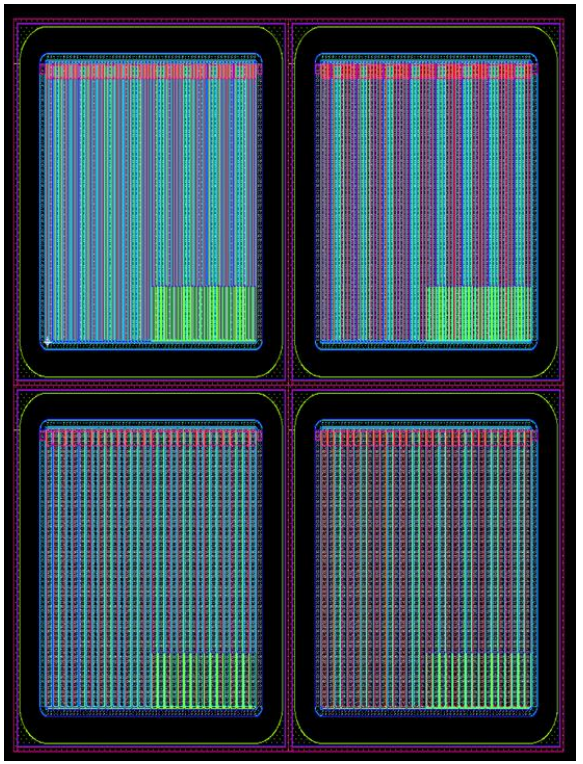
Best configuration for diodes


LGAD
Pin

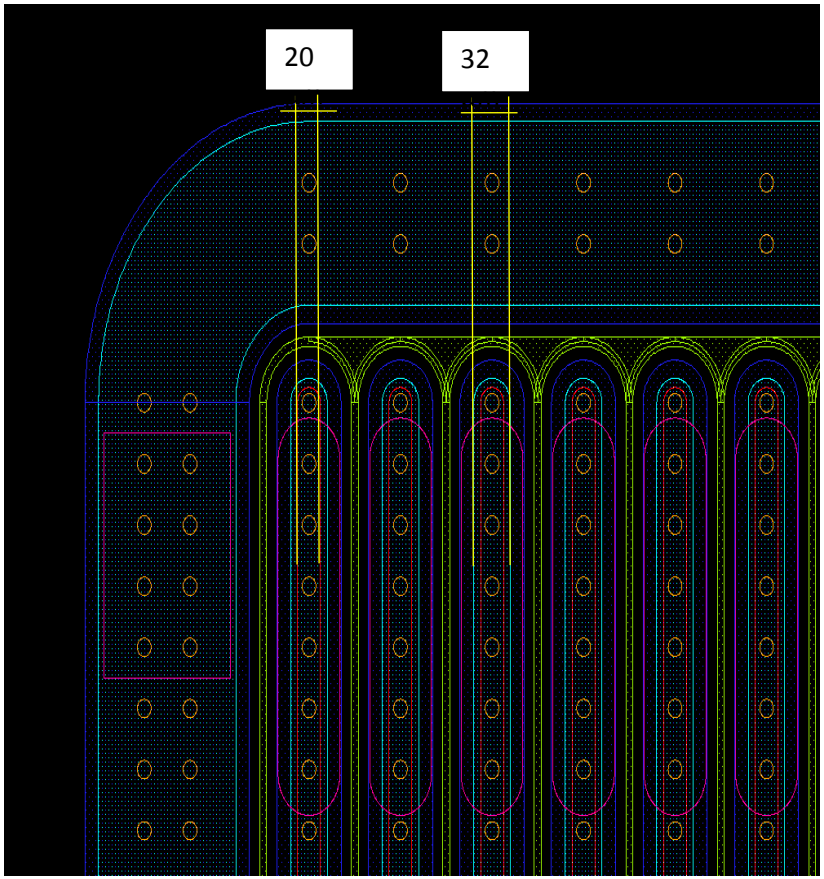


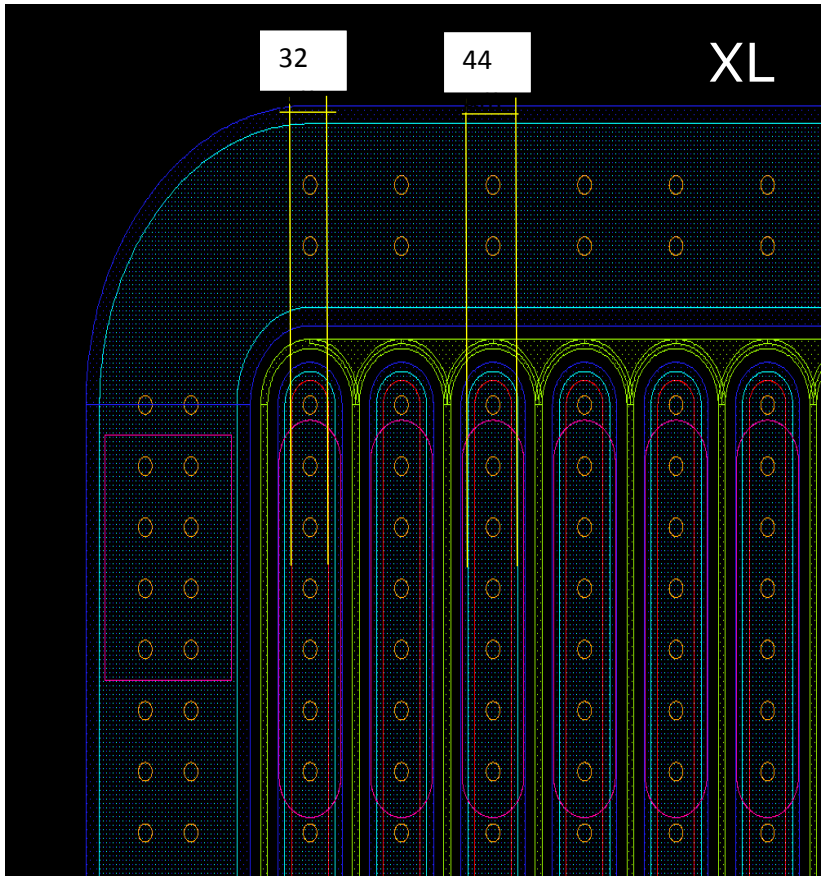
RD50 LGAD New Run. Mask Design

- **Strip Detectors with Multiplication**
  - 80 µm pitch
  - 160 µm pitch
  - ✓ **DC Strips (standard width)**
  - ✓ **Spaghetti DC Strips**
  - ✓ **XL DC Strips (extended implantation)**
  - ✓ **PIN Strips**
    - 80 µm pitch, 50 % Standard, 50 % Spaghetti
    - 160 µm pitch, 50 % Standard, 50 % Spaghetti
- **Test Structures**
  - ✓ **SIMS** LAL Group Structures
  - ✓ **INFN** Group Structures
  - ✓ **Electrical and Technological** CNM Structures
- **FEI4 Matrix (?)**
  - ✓ **8 x 8** mm Active Area

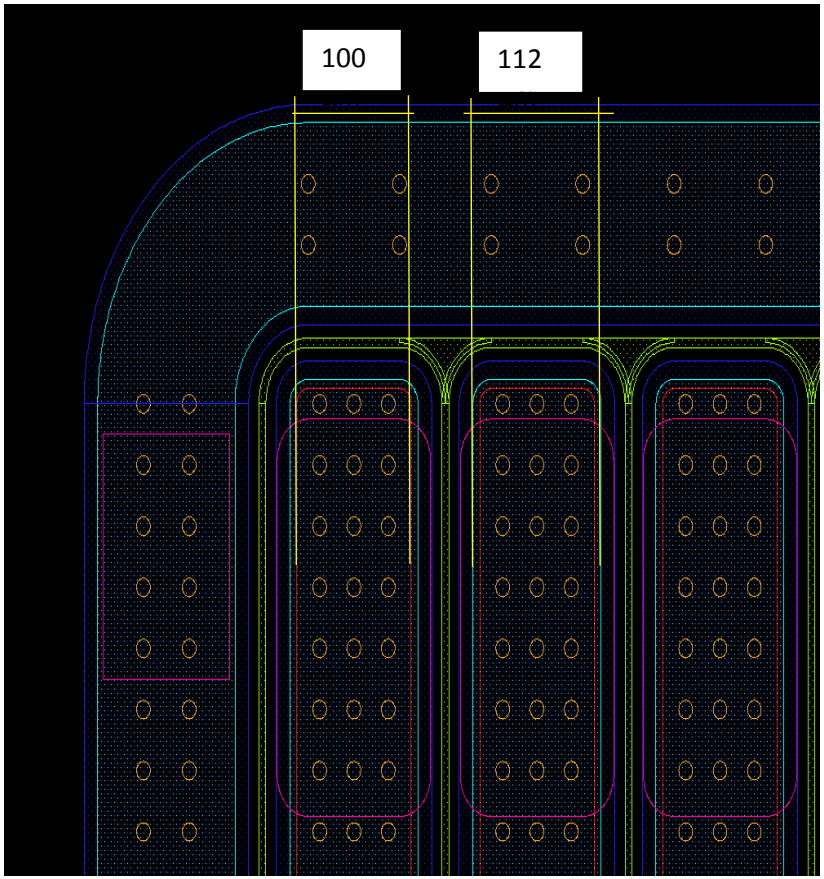


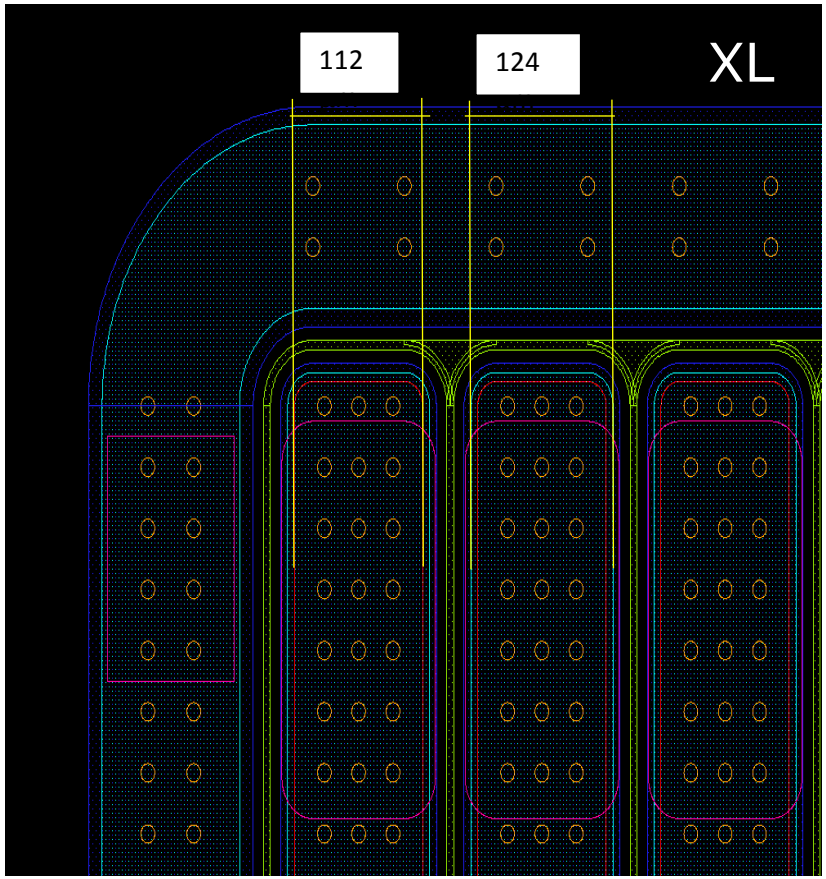
80um pitch strips





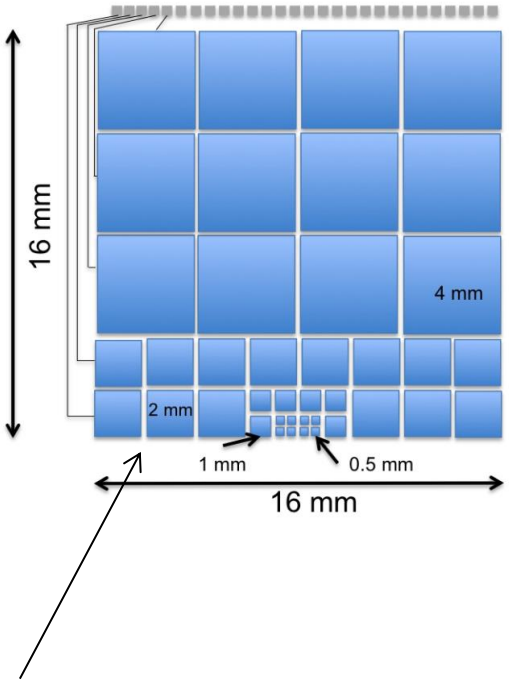
160um pitch strips





Ultra Fast Silicon Detectors

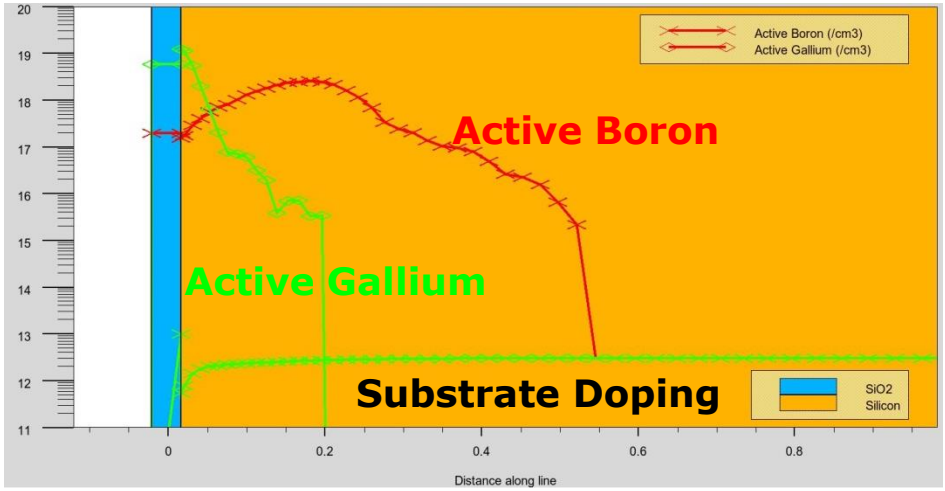
- Experiments interested CMS-TOTEM-ATLAS.
- Time resolution required 10ps.
- Designed proposed by Nicoló Cartiglia.
- In this mask, the UFSD detectors will be 1cm^2. This is just to prove their functionality.
- Final detectors will be larger and may be thinner.



Slim edge
Close to beam side

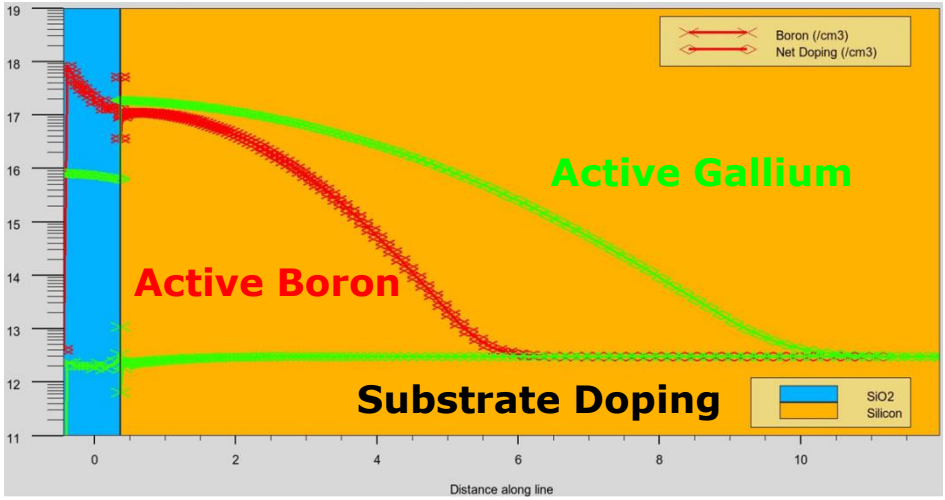
See Nicolo´s Talk.

Heavy Dopants: Ga



After implantation

Why multiplication decrease with irradiation?
Try to use heavy dopants for the multiplication layer to reduce the initial acceptor removal effect.
See Gregor´s talk.



After diffusion

- Similar Diffusion coefficients
- Different Solid Solubility (one order of magnitude lower in the case of Gallium)

Conclusion and future work

- New mask design ready, we will buy it next week.
- Fabrication should start in July.
- Run due by end of October.
- Preliminary IV and CV will be done at CNM. Then the detectors will be diced and distributed between the participating institutes.