WP7 - 2nd Annual Meeting Introdution

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4/4/2017

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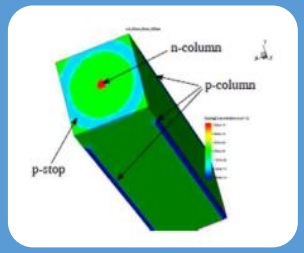
Outline

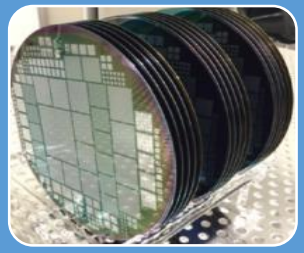
- Review of Milestones & deliverables.
- Common sensor production at CNM and FBK.
- Goals for the meeting.

Overview: Tasks



Device Simulation

- Layout optimization.
- Radiation damage modeling
- Optimization signal multiplication structures.



Sensor manufacturing

- Development & improvement of manufacturing processes for planar, 3D and LGAD devices.
- MPWR for thinned 3D and slim/active edge planar.

Detector performance assessment

- Hybrid thin planar & 3D pixels for HL-LHC environment.
- Very small size and thin pixel sensors for CLIC.
- Low Gain Avalanche Detectors for timing and tracking

Deliverables

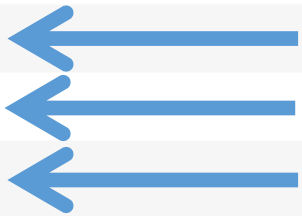
Deliverables

Del. no.	Deliverable name	WP no.	Planned delivery date	Actual delivery date	Status	Comments
D7.1	Simulation of 3D pixel sensor cells	7	M18	04/11/2016	Achieved	Report
D7.2	Simulation active edge sensors	7	M18	04/11/2016	Achieved	Report
D7.3	LGAD simulation	7	M18	04/11/2016	Achieved	Report
D7.4	TCAD model radiation damage	7	M46			
D7.5	Wafer Layout MPW run	7	M30			
D7.6	Initial pixel characterisation	7	M24			
D7.7	Final pixel characterisation	7	M46			
D7.8	LGAD characterisation	7	M46			

Milestones

Milestones

Mil. no.	Milestone name	WP no.	Planned delivery date	Actual delivery date	Status	Comments
MS29	Validation and release of TCAD simulation	7	M16	02/09/2016	Achieved	Report
MS49	Workshop on 3D-planar	7	M24			
MS50	LGAD thickness technological choice	7	M24			
MS51	LGAD Workshop on the characterisation results of the available LGAD sensors	7	M24			
MS81	Test beam campaign for 3D and planar sensors	7	M36			
MS87	MPW runs completion	7	M42			
MS98	Validation radiation damage model with data comparison	7	M46			



Publications

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AIDA-2020 **20** records found Search took 1.01 seconds.

1. **First Production of New Thin 3D Sensors for HL-LHC at FBK** / Sultan, D.M.S. (U. Trento (main) ; TIFPA-INFN, Trento) ; Dalla Betta, Gian-Franco (U. Trento (main) ; TIFPA-INFN, Trento) ; Mendicino, Roberto (U. Trento (main) ; TIFPA-INFN, Trento) ; Boscardin, Maurizio (Fond. Bruno Kessler, Trento ; TIFPA-INFN, Trento) ; Ronchin, Sabina (Fond. Bruno Kessler, Trento ; TIFPA-INFN, Trento) ; Zorzi, Nicola (Fond. Bruno Kessler, Trento ; TIFPA-INFN, Trento)
   Owing to their intrinsic (geometry dependent) radiation hardness, 3D pixel sensors are promising candidates for the innermost tracking layers of the forthcoming experiment upgrades at the Phase 2 High-Luminosity LHC (HL-LHC). To this purpose, extreme radiation hardness up to the expected maximum fluence of 2e16 neq.cm-2 must come along with several technological improvements in a new generation of 3D pixels, i.e., increased pixel granularity (50x50 or 25x100 um2 cell size), thinner active region (~100 um), narrower columnar electrodes (~5 um diameter) with reduced inter-electrode spacing (~30 um), and very slim edges (~100 um). [...]
   arXiv:1612.00638.- 2017 - 8 p. - Published in : *J. Instrum.* 12 (2017) C01022 **Preprint:** PDF;
   In : 18th International Workshop on Radiation Imaging Detectors, Barcelona, Spain, 03 - 07 Jul 2016, pp.C01022
   Detailed record - Similar records
2. **Technology developments and first measurements on inverse Low Gain Avalanche Detector (iLGAD) for high energy physics applications** / Carulla, M. (IMB-CNM (CSIC)) ; Fernández-García, M. ;IFCA (CSIC-UC) ; Fernández-Martínez, P.; IMB-CNM (CSIC) ; Flores, D.; IMB-CNM (CSIC) ; González, J. (IFCA (CSIC-UC)) ; Hidalgo, S. (IMB-CNM (CSIC)) ; Jaramillo, R. (IFCA(CSIC-UC)) ; Merlos, A. (IMB-CNM (CSIC-UC)) ; Palomo, F.R.

Common sensor productions

At least three common productions foreseen in WP7, one for each technology

- Processing of MPWR for 3D and planar pixel sensors on thinned substrates, compatible with the RD53 chip

- Common submission of LGAD sensors
  - Prototyping of LGAD sensors on thin substrates.

Deliverable	Responsible Group	Month due
D7.5 Wafer Layout MPW	CSIC	M30 (OCT 2017)

Milestone	Responsible Group	Month due
MS87 MPW runs completion	CSIC	M42 (OCT 2018)

3D production at FBK about to start.
Active edge production at FBK second half 2017, trench technology to be defined with test wafers or test batches beforehand

3D production at CNM already started..
LGAD production at CNM to be decided during this meeting.

Goals of this meeting

- **Converge on the technology and the devices to be included in the LGAD Common Run**
- **Continue the discussion on the active planar common Run, not to be closed today.**
- **Define the devices and groups to participate on the coming WP7 Test beam at SPS (baseline to continue the activities of the last year test-beam)**

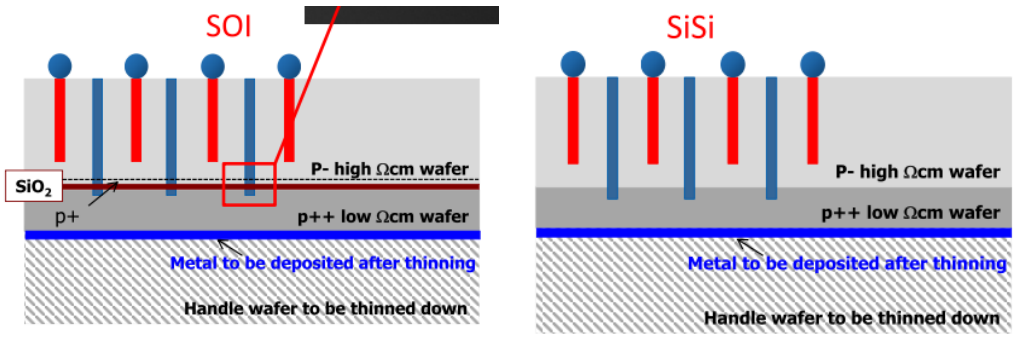
Agenda

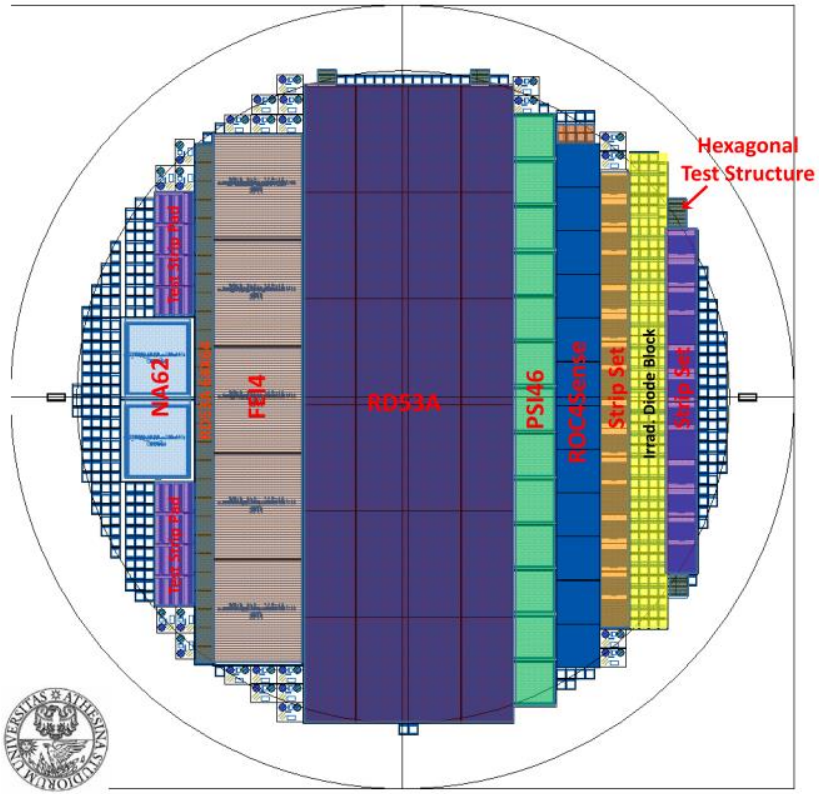
	Introduction — *Anna Macchiolo et al.* *Salle des séminaires- 1222-RC-08, LPNHE* — 14:30 - 14:40	
	Discussion on common LGAD production — *Nicolo Cartiglia* *Salle des séminaires- 1222-RC-08, LPNHE* — 14:40 - 15:00	
15:00	**3D pixel sensors in Trento: update on activities and plans** — *Gian Franco Dalla Betta et al.* *Salle des séminaires- 1222-RC-08, LPNHE* — 15:00 - 15:20	
	Development of a radiation model for TCAD simulations — *Arianna Morozzi* *Salle des séminaires- 1222-RC-08, LPNHE* — 15:20 - 15:40	
	Update on small-pitch active-edge planar sensor studies for the CLIC vertex detector — *Dominik Dannheim* *Salle des séminaires- 1222-RC-08, LPNHE* — 15:40 - 16:00	
16:00	**Update on activites in Manchester** — *Cinzia Da Via* *Salle des séminaires- 1222-RC-08, LPNHE* — 16:00 - 16:20	
	Coffee break *Amphi Charpak* — 16:20 - 16:30	
	Update on activities at MPP — *Anna Macchiolo* *Salle des séminaires- 1222-RC-08, LPNHE* — 16:30 - 16:50	
	3D and Planar Pixel Sensors Results and Plans in Florence — *Marco Meschini* *Salle des séminaires- 1222-RC-08, LPNHE* — 16:50 - 17:10	
17:00	**Status of Lgad technology for timing applications** — *Giulio Pellegrini* *Salle des séminaires- 1222-RC-08, LPNHE* — 17:10 - 17:30	
	Update on activities at Santander — *Ivan Vila Alvarez* *Salle des séminaires- 1222-RC-08, LPNHE* — 17:30 - 17:50	
	Common discussion on WP7 planar active edge production — *Maurizio Boscardin* *Salle des séminaires- 1222-RC-08, LPNHE* — 17:50 - 18:00	
18:00		

THANK YOU!

3D Common production @ FBK

- Single-sided process
- "Thin" active layer (130 μm): SiSi or SOI
- Ohmic columns depth > active layer
- Junction columns depth < active layer
- Column diameter ~ 5 um
- Holes partially filled with poly
- Very slim edge (100 μm)



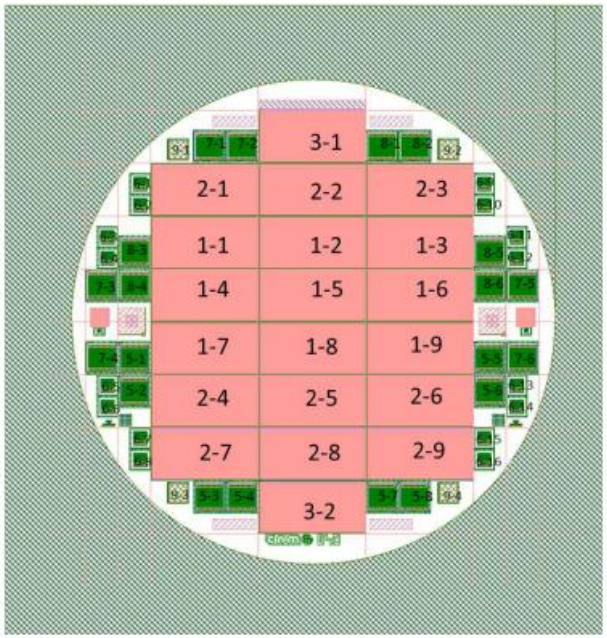


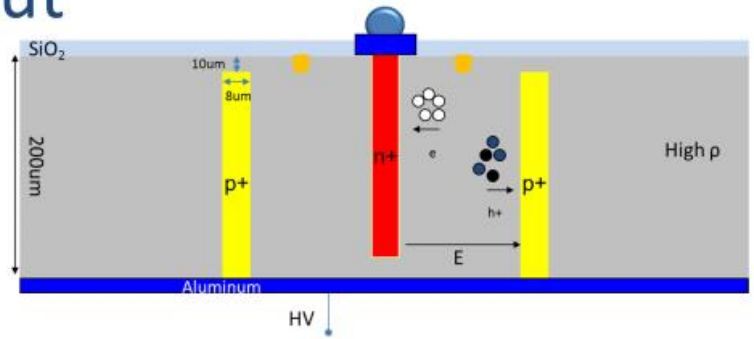
3D Common Production @ CNM

- Ready to start this week.

Run XXXX: mask layout

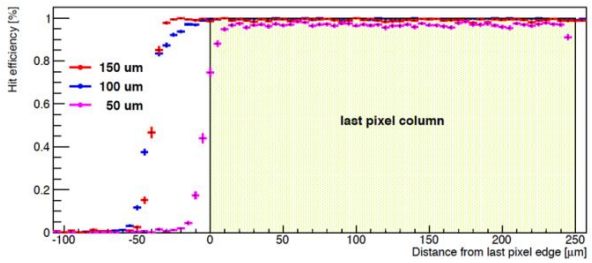
Mask: CNM840

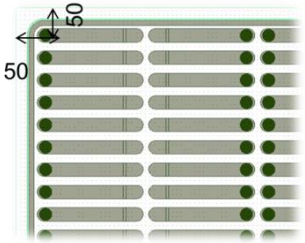


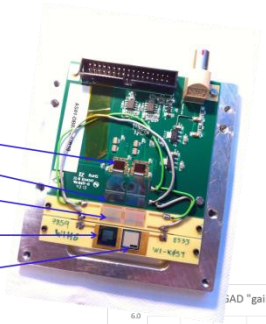


- 9 RD53 50x50um^2 (1-x)
- 9 RD53 25x100um^2 2E (2-x)
- 2 RD53 25x100um^2 1E (3-x)
- 9 Diodes 50x50um^2 (5-x)
- 16 Diodes (small) 50x50um^2 (6-x)
- 6 Diodes 25x50um (7-x)
- 6 Diodes 25x100um^2 (8-x)
- 4 MOS (9-x)

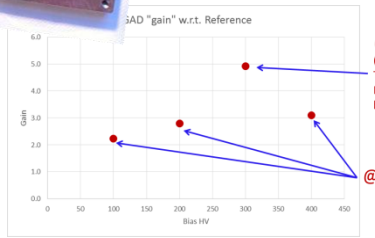
Results Snapshot



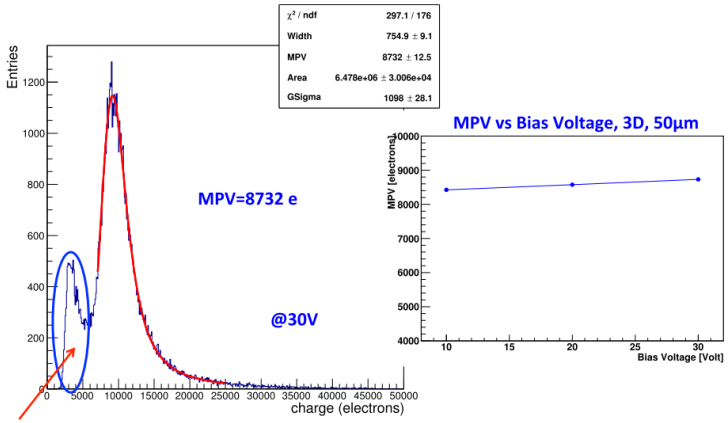




Inverse-LGAD @ Wp7 TB Gain vs V_{bias}

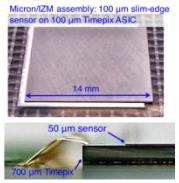


3D Pixels with 50x50µm² pitch

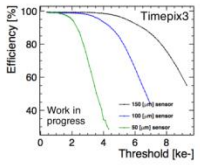


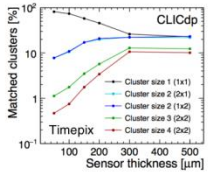
Charge shared by non connected adjacent pixels. This charge will not be there when reading out every single small pitch pixel

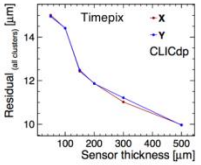
December 2016 Test Beam Setup at Fermilab



- Test beam studies on sensor assemblies with different thickness (Micron, Advacam) using Timepix(3) readout ASICs, 55 µm pitch
- Thinnest assembly: 100 µm sensor on 100 µm Timepix ASIC
- Study performance of thin planar sensors
  - High detection efficiency even for 50 µm thin sensor under normal operating conditions
  - Resolution limited by cluster size in thin sensors







Progress report: 2016 TB @ SPS

- First WP7 Test Beam @ CERN-SPS from July 27th through August 3 + one additional week parasitically with Atlas ITK
- The use of the ATLAS tracker/vertex test beam infrastructure (motor stages, cooling box, etc) was capital (and support from A. Macchiolo team support)
- Telescope: **ACONITE (AIDA telescope)**
- Devices:
  - 50x50 mm^2 3D pixel strips: non-irradiated (CNM)
  - 25x100 mm^2 3D pixel strips: non-irradiated (CNM)
  - 25x100 mm^2 3D pixel strips: $7x10^{15}$ n_{eq}/cm^2 protons (CNM)
  - I-LGAD (p-in-p strip LGADs) (CNM)
  - Thinned planar pixel detectors (50um, 100um & 150um) slim/active edges from Advacam (FE-I4 footprint), fresh and irradiated (10^{15} n_{eq} cm^{-2})
  - THIN n-in-p pixel sensors 130µm and 100µm active thickness (PSI46dig footprint), fresh and proton irradiated (8.3E15 p/cm2)