50µm thin LGAD detectors

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1. LGAD STRUCTURE

- ✓ Proposed by CNM <u>*G.Pellegrini et al NIMA 765 (2014) 12*</u>
- ✓ First batch on 285µm thick High Resistivity p-type wafers (2014)
- ✓ Active area: 3.3x3.3 mm²; 8.3x8.3 mm²
- ✓ Pads, strips and 6x6 arrays
- ✓ Guard Ring



1. LGAD STRUCTURE

 Enhancement of the electric field to start the impact ionization of electrons after the depletion of the multiplication layer



Time (ns)



2. 50μm thin LGAD detector on SOI wafers

- ✓ First batch on 50µm SOI wafers (2016)
- Active area: 1.3x1.3 mm²; 2.3x2.3 mm²
- ✓ HGTD (2x2, 4x4, 6x6 array), CT-PPS structure



2.1 Structure Simulation

- ✓ Synopsis TCAD Sentaurus
- ✓ Optimization of the distances between pads for HGTD and CT-PPS structures
- Optimization minimum distance between the active area and the edge



Electrical performance non irradiated 2.2



2.3 CCE Measurement



G. Kramberger et al. "Radiation damage studies in LGAD detectors from recent CNM and FBK runs", 29th RD50, CERN,



2.4

Beam test performance

- J. Lange et al. JINST 12 (2017) P05003 AFP beam test in June/July and September 2016 \checkmark
- H6B beam line of the CERN-SPS North Area with 120 GeV pions \checkmark
- SiPM/LGAD trigger \checkmark A. Apresyan et al Beam test studies of the uniformity of 50 m low gain submitted to NIMA
- Similar results to UCSC/Fermilab at FNAL, and UCSC/Torino \checkmark

N. Cartiglia et al. NIMA 850 (2017) 83-88





3. 50 μm thin LGAD on Si-Si wafers

- 1 less mask and process step
- ✓ JTE in all structures
- ✓ Active area: 1x1 mm², 1.3x.1.3 mm², 2x2 mm²
- ✓ HGTD (2x2, 3x3, and 8x8 arrays), CT-PPS, Single pads, HGTD for Altiroc, 2x1 arrays, and AC LGAD







3.1 Electrical performance of non irradiated detectors

\checkmark CNM lab, Room temperature, N₂ flow







3.2 CCE measurement of non irradiated detectors

- ✓ UCSC lab
- ✓ ⁹⁰Sr source
- ✓ UCSC single channel board
- ✓ Climate chamber T=20C
- ✓ Dry Oxygen
- ✓ Trigger: LGAD HPK 50D







4. Future work

6" Technology

Radiation Hardness







4.1 50 μm thin LGAD on Si-Si wafers with Gallium multiplication layer

- ✓ Process optimized for 6"
- ✓ Last implantation (Finish: February)
- ✓ Irradiation campaign to study the Gallium removal





4.2 35 μm thin LGAD on Si-Si wafers with Carbon

- ✓ Process in 6"
- ✓ Mask design
- ✓ Carbon spray





4.3 AC LGAD detectors

- ✓ Process in 4"
- ✓ Simulation of the process
- ✓ Optimization of the Nplus and multiplication layer





4.3 AC LGAD detectors







Thank you for your attention



