LGAD/AC-LGADs BNL update

EIC Roman Pots Meeting (eRD24)

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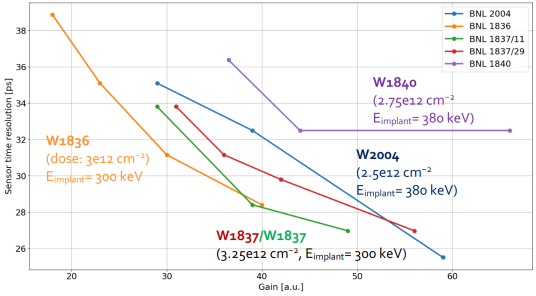
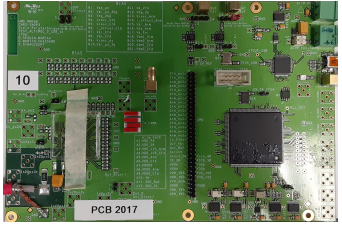
LGADs and AC-LGADs

Timing performances

- **Time resolution of BNL produced LGAD** sensors measured in β coincidences using HPK 1.2 LGAD as trigger
- Pre-irradiation sensors with high gain can reach $\sigma_t \simeq$ **26 ps**
- AC-LGAD strip tested at FNAL with 120 GeV protons, leading to **similar timing performances** compared to standard LGADs with same gain



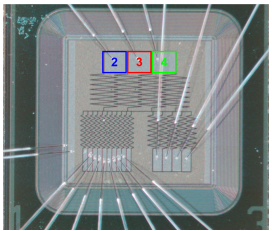


AC-LGADs on ALTIROC

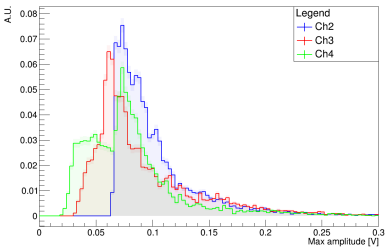
- AC-LGAD being wire-bonded to ALTIROC PCB V0 as we speak with ALTIROC 0 ASIC to perform **digital scan** and electrical testing
- ALTIROC 1V2 and ALTIROC PCB V2B already available at BNL for wirebonding soon afterwards

New Geometries - Zig-Zag AC-LGAD

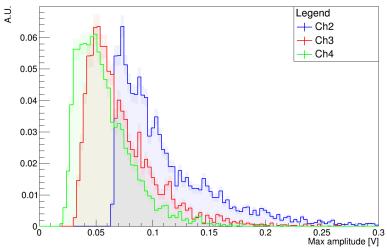
- Characterisation of **Zig-Zag AC-LGAD strip** in interactions with β from ^{90}Sr
- Study of **Signal Sharing** between strips by applying software selection based on signal amplitude and distance from trigger (ex: $A_2 > A_3 > A_4$)
- Results to be compared with **Transient Current Technique** (IR and Red laser) and at **proton test-beams**



No selection



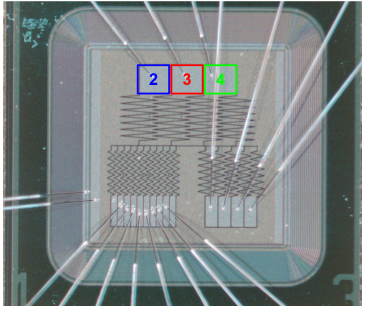
Software selection

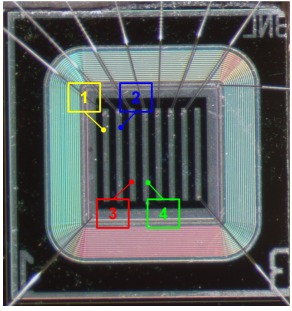


Test-Beams

Three FNAL test-beams scheduled in the neat future:

- **ANL@FNAL** (20 January 2021): Timing Studies of LGADs (High- and Medium-gain LGADs) and characterization of space resolution of Zig-Zag strip AC-LGAD (3 channels) using protons
- **CMS@FNAL (Silicon Telescope)** (late February 2021): Spatial resolution of AC-LGAD strips/pixels with different topologies and n^+ resistivities (x2 factor)





Test-Beams

EIC@FNAL (Silicon Telescope) (3 - 30 March 2021): Characterization of new AC-LGAD production. Final strategy tuned according to results of previous test-beams

Time Resolution studies:

- 1× BNL/UCSC timing board, mounting 1 strip/pixel AC-LGAD with high gain (50-60)

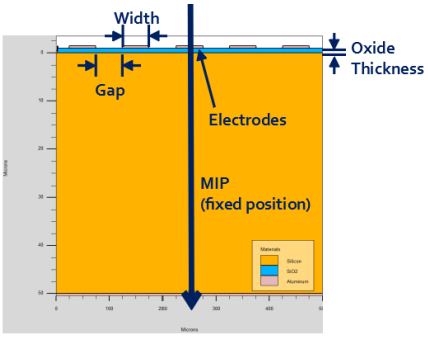
Signal sharing/Space resolution studies:

- 1× FNAL 16 channels board with diverse Zig-Zag AC-LGADs (W2006). Three topologies available on single board (1×3, 1×4, 1×10). Up to 7 channels available in parallel for measurement. Space resolution of available telescope 10-15 μm. Characterization of charge sharing compared to β results @BNL
- 2× FNAL 16 channels board mounting AC-LGADs with different geometries (pitch, gap size) and n^+ resistivities

New Geometries

Thin AC-LGADs

- BNL AC-LGADs are 50μm thick: working on a new wafer with 20 - 30 μm thickness
- Lower Landau noise for (theoretically) **better timing resolution**
- Currently in production



Geometry optimization in TCAD

- Performed TCAD simulation to study **signal dependence on strip geometry**
- Study of signal amplitudes from MIP vs inter-strip gap for hit and adjacent strip, for several implantation doses of resistive (n+) sheet
- Currently working on 2D simulations (strips); Next step: 3D simulations (pixels)

Summary of LGAD activities January - March 2021

- Participation at **three test-beams @ FNAL** to study **time and space resolution** of LGAD and AC-LGAD prototypes fabricated @ BNL, with different resistivity, pitch, gap size, configuration (pixel, strip, zig-zag)
- Comparison of **TCT scans** using red laser and IR for zig-zag configurations to results in test-beams
- Continue characterization of new productions using β from ^{90}Sr to compare timing and charge collection results with test-beams