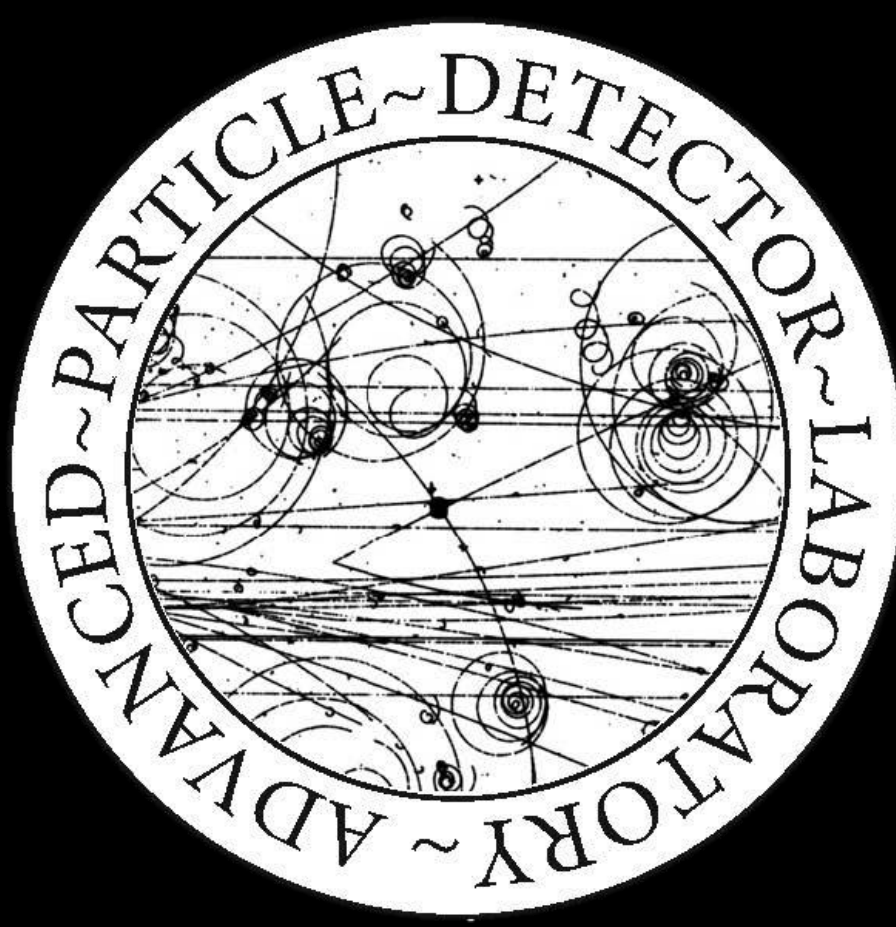




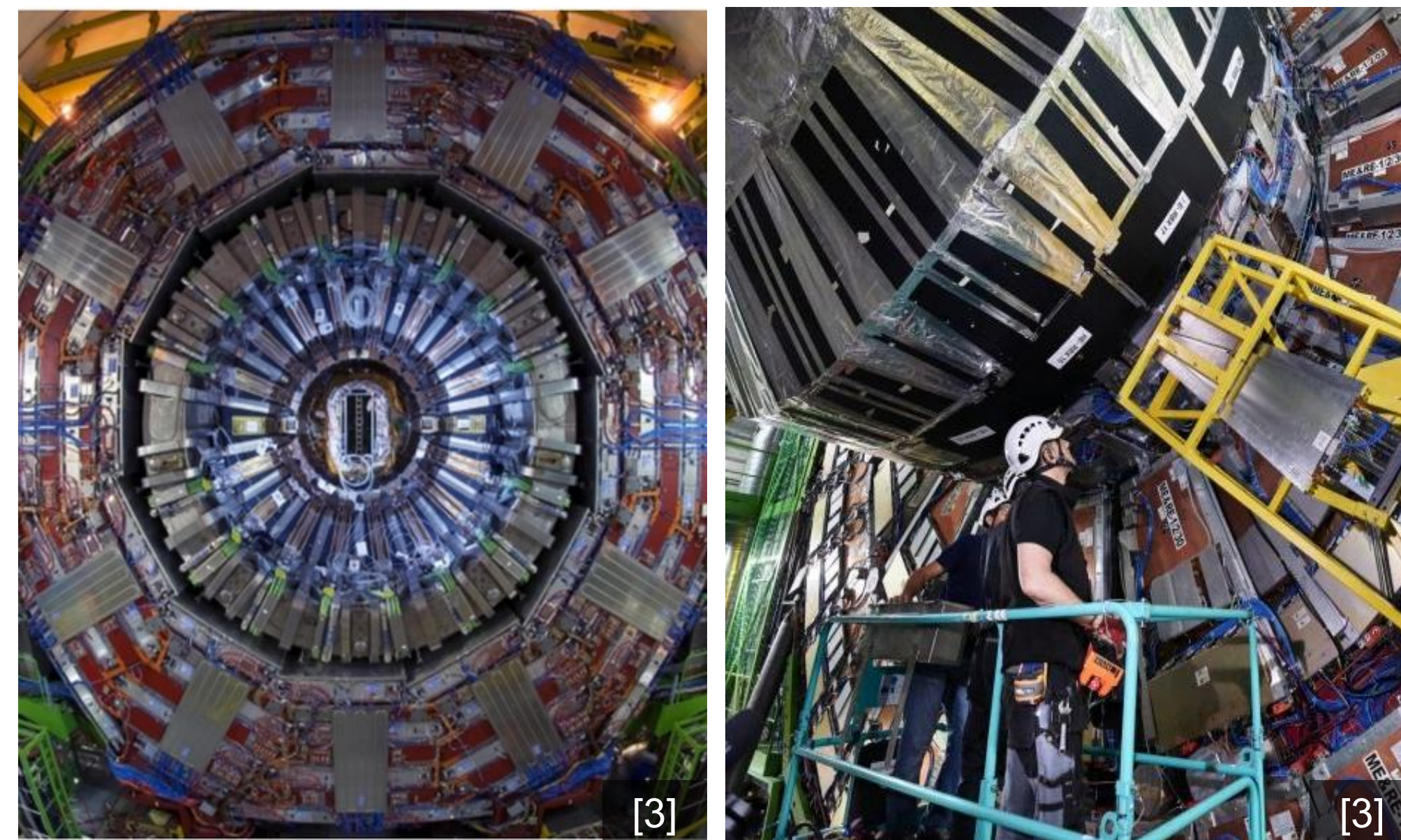
Characterization of AC Coupled Low-Gain Avalanche Diodes with Varying N-Resistive Layer Depth

Zen Leon-Guerrero, Miles Harris, Chris Madrid, Timo Peltola
Advanced Particle Detector Laboratory, HEP-Group
Texas Tech University Department of Physics and Astronomy



INTRODUCTION

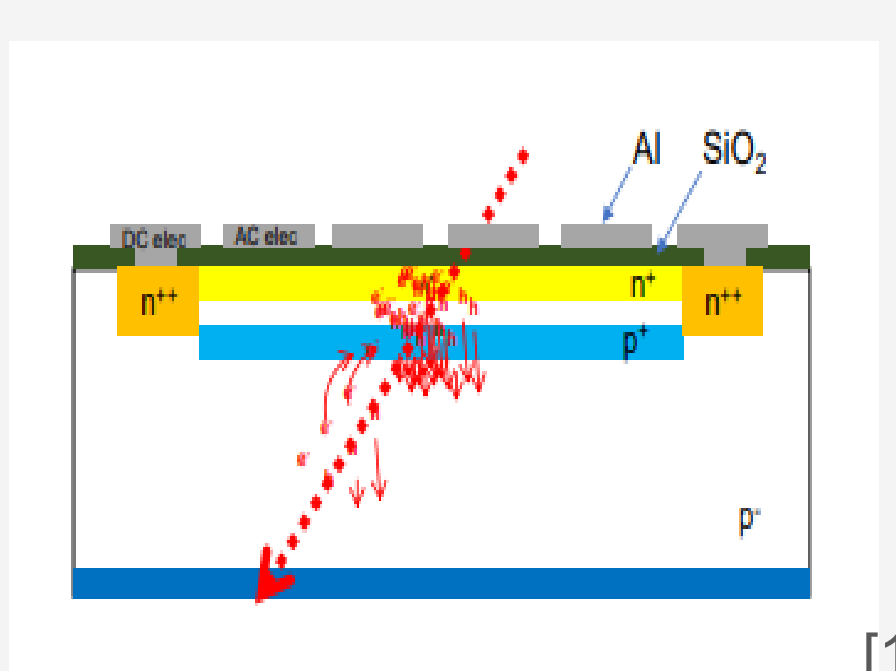
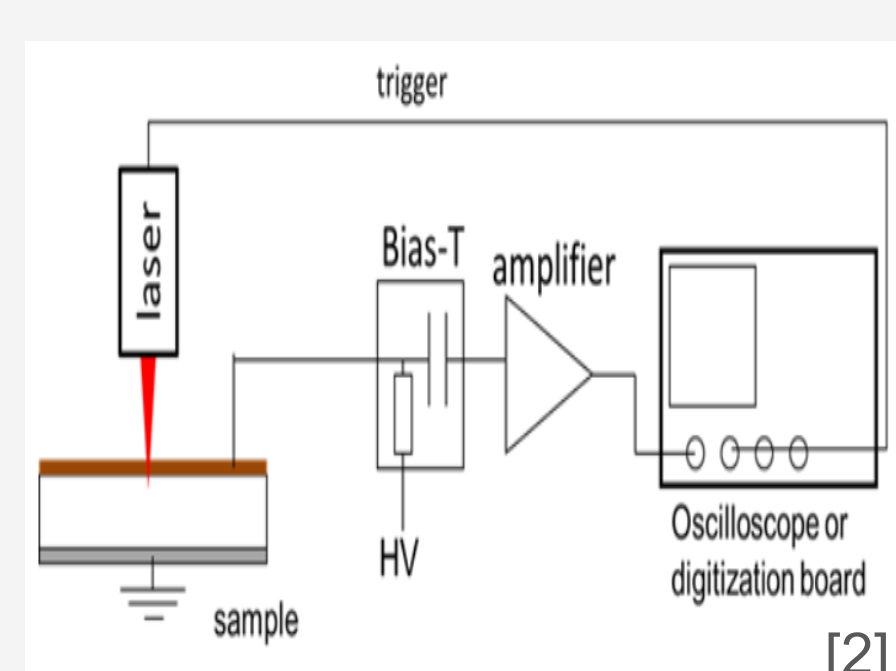
- The upgrade of the CMS detector at the LHC requires precise particle detectors for tracking and profiling
- Solid-state detectors are a promising candidate technology; however, their properties must be characterized
- We have established a study into AC Coupled Low-Gain Avalanche Diodes with varying n-resistive layers



METHODOLOGY

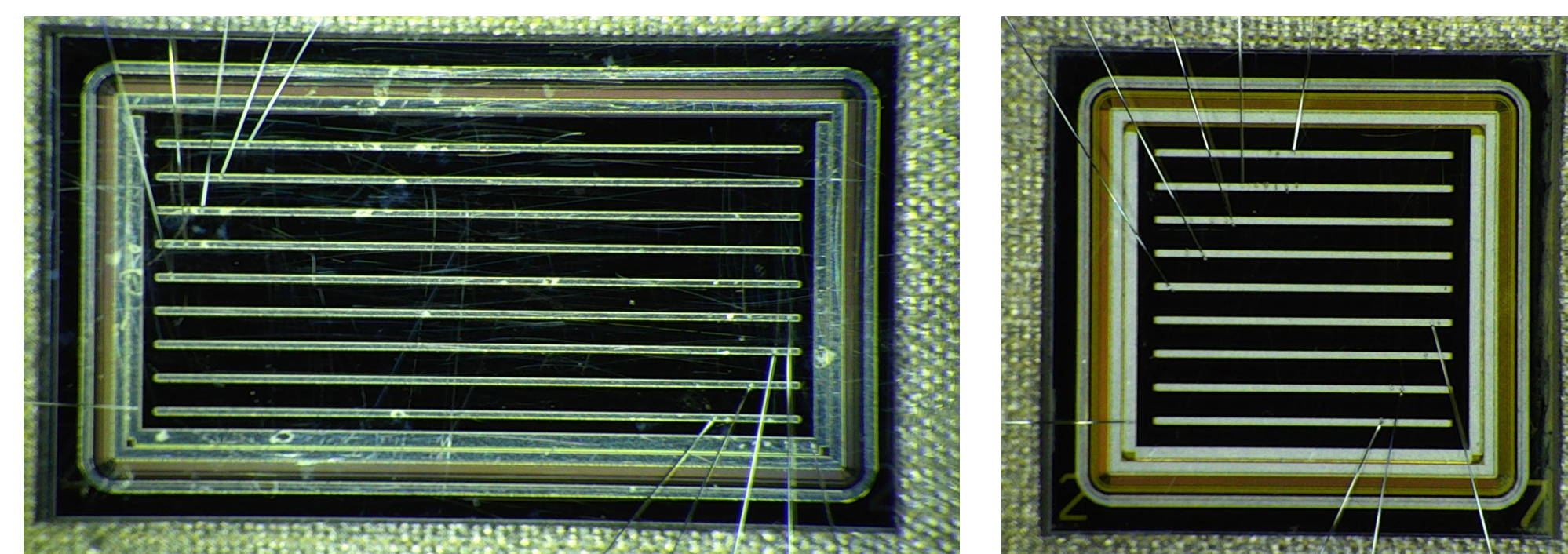
- Transient Current Technique uses the signal generated by motion of free charge carriers
- Carriers are excited through use of IR laser, signal is readout on Oscilloscope
- Our measurement apparatus allows for precise movement of laser across LGAD sample
- Fermilab multi-channel readout board allows for readout of at most sixteen channels simultaneously

Surface-TCT



LGADs

- LGADs are n-in-p semiconductor detectors with an additional gain layer
- The gain layer induces avalanche multiplication of charge carriers
- AC-LGADs have a continuous gain layer across entire active area to eliminate dead zones between electrodes
- Two n-resistive layer depths tested: “deep” (1cm_42) and “deeper” (5mm_27)

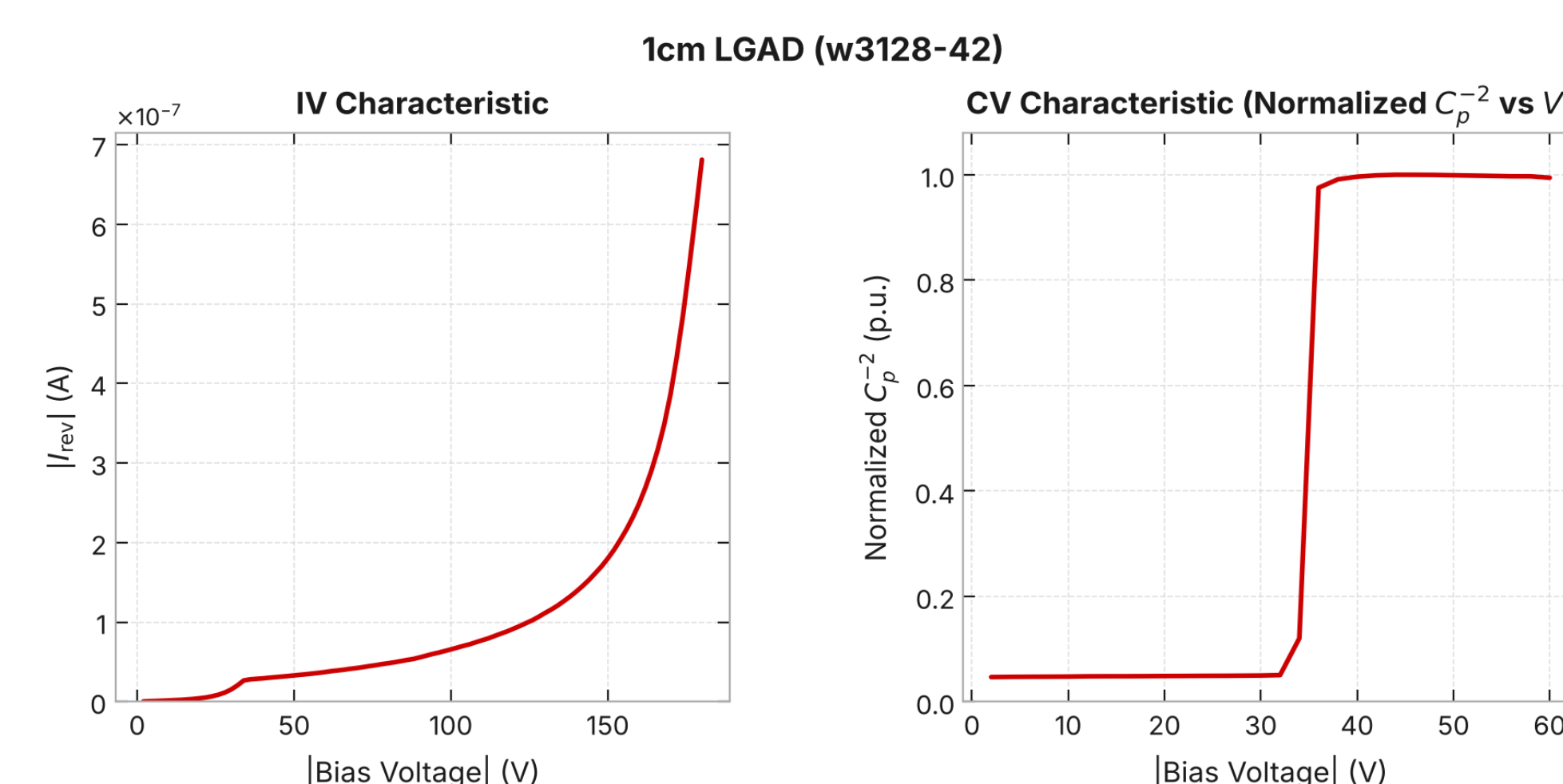
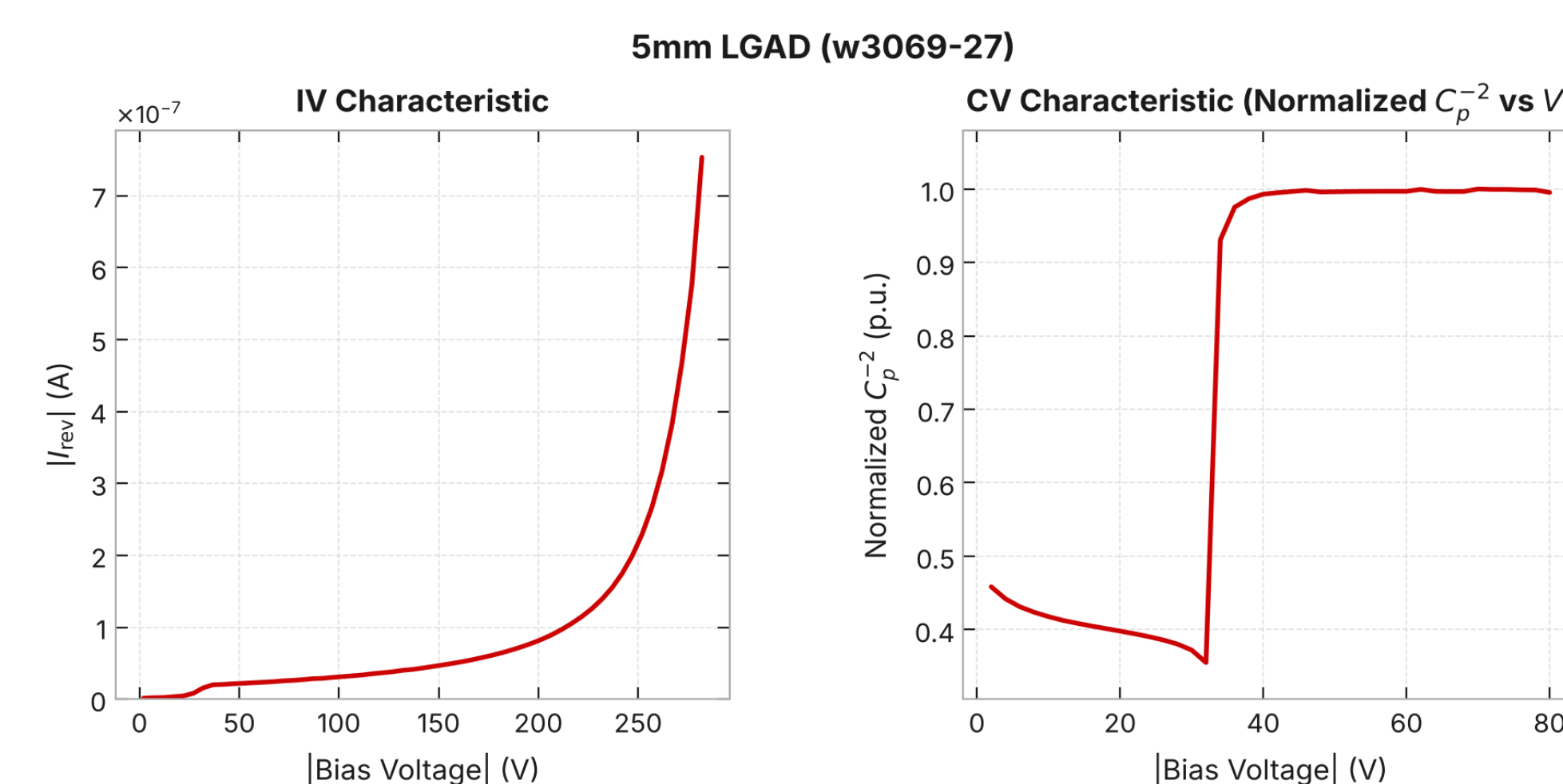


1cm LGAD

5mm LGAD

Capacitance- & Current-Voltage (CV/IV) Characterization

- CV/IV curves used to find each sensor's breakdown voltage and optimal bias voltage
- Readout scans run at 170 V (1cm_42) and 260 V (5mm_27)

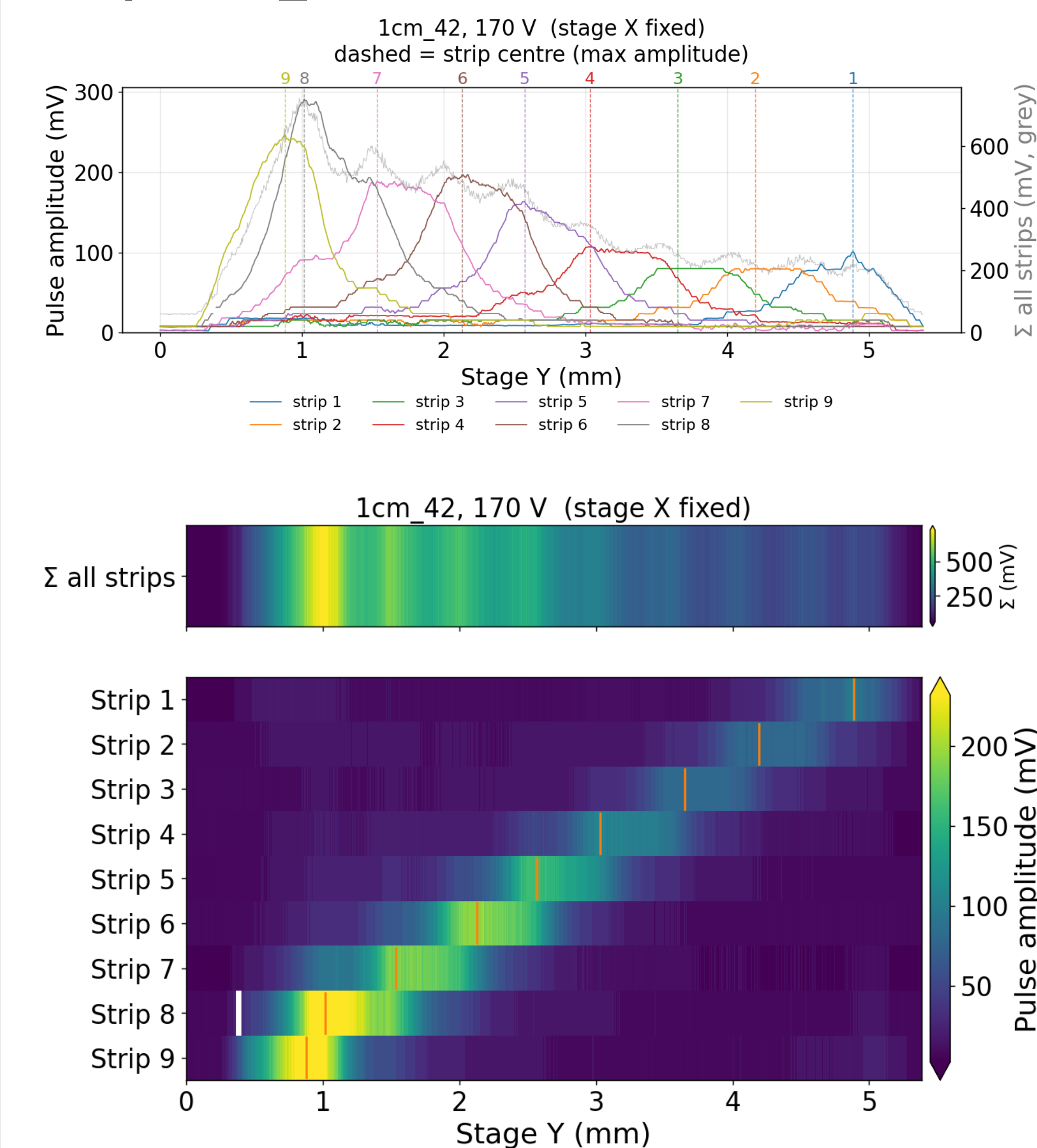


CV/IV curves for 5mm and 1cm LGAD

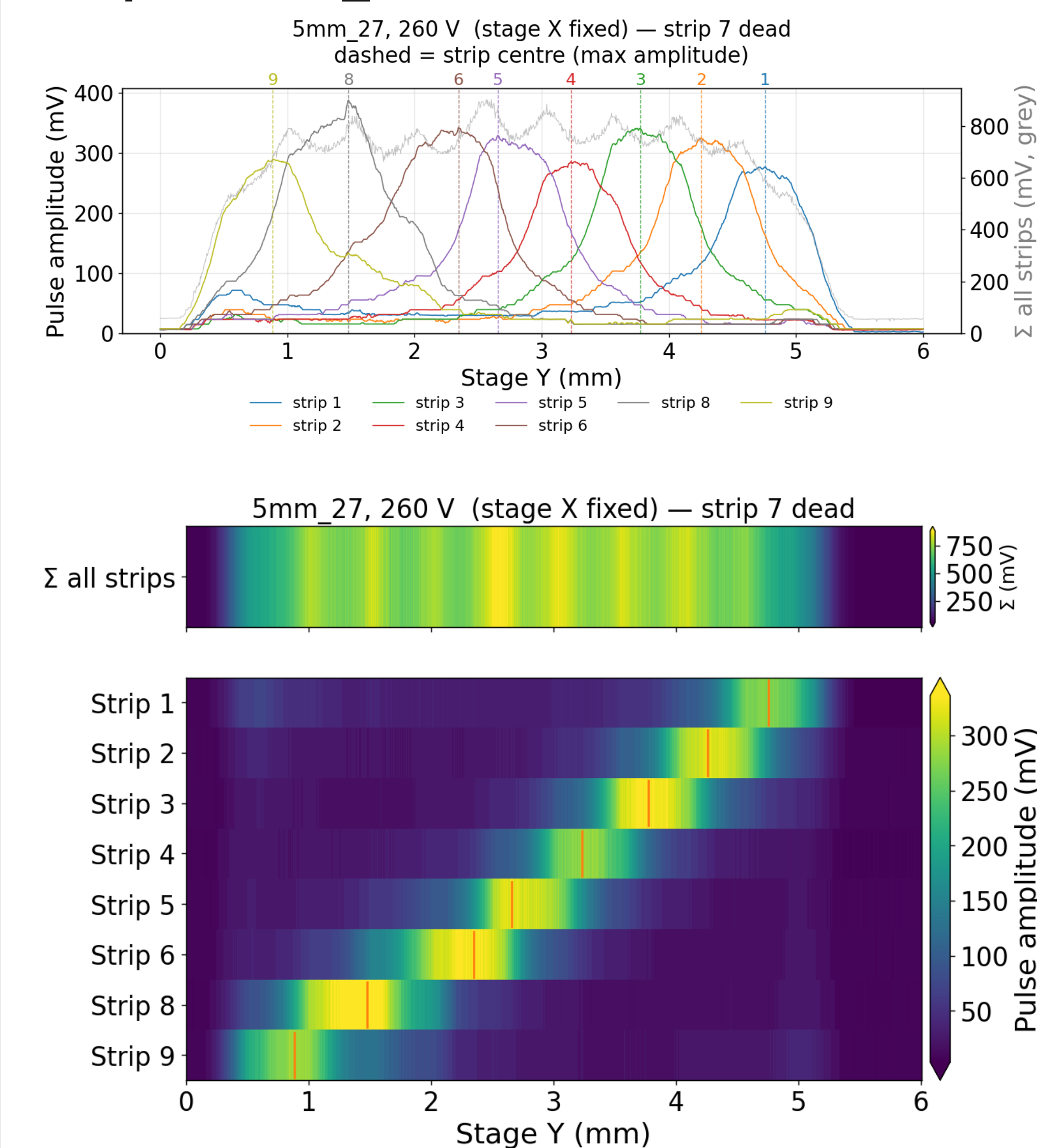
LGAD STRIP READOUT

- Laser scanned across the strips in Y with stage X fixed, each strip's pulse amplitude peaks at its centre (dashed lines)

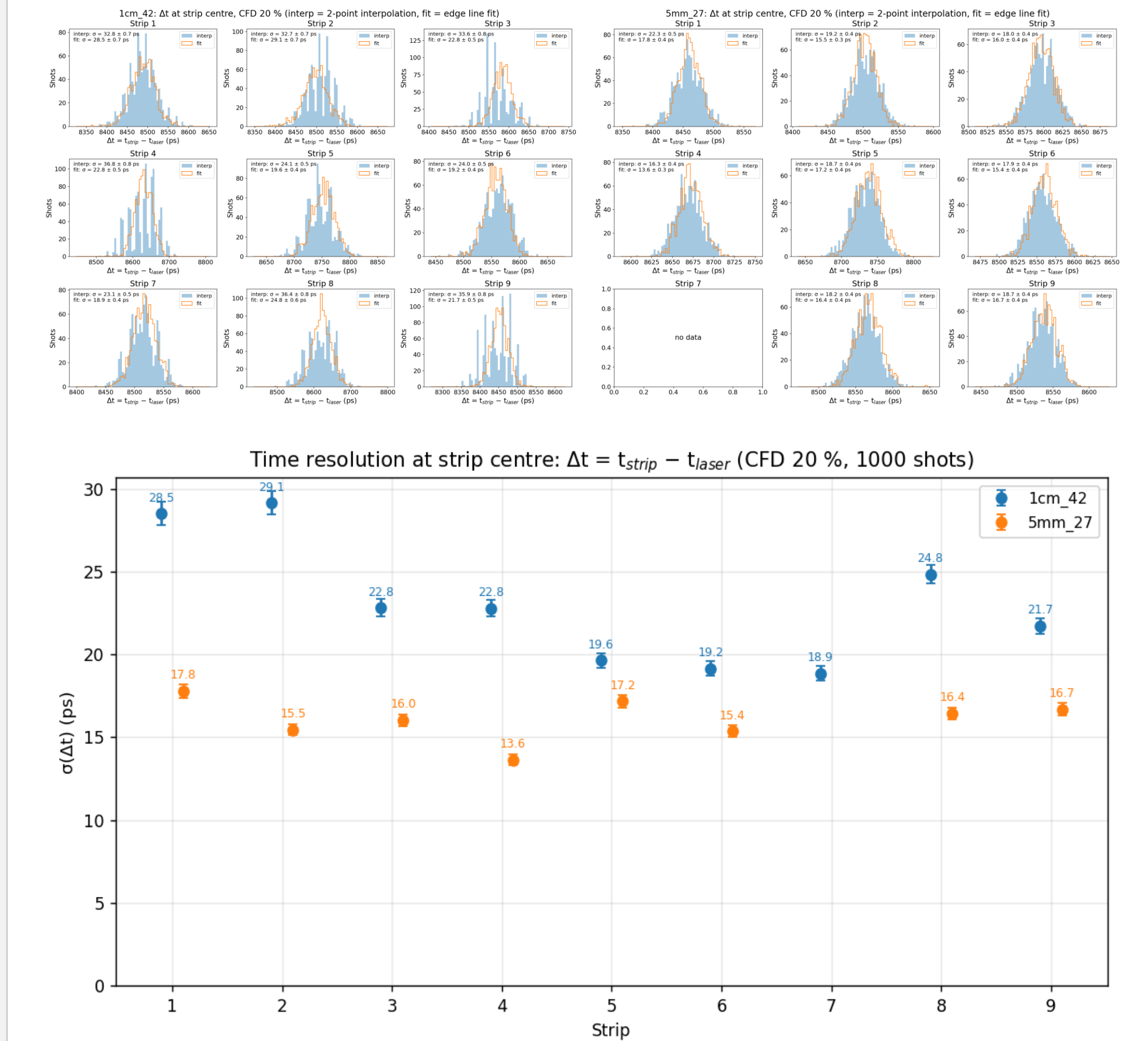
Deep: 1cm_42, 170 V



Deeper: 5mm_27, 260 V



TIME RESOLUTION



CONCLUSION

- The deeper n-resistive layer (5mm_27) performed better than the deep layer (1cm_42):
 - More uniform amplitude across strips
 - Better time resolution on every working strip
- Next:
 - Prepare and measure a standard process LGAD for comparison
 - Extract position resolution
 - Measure across the entirety of each LGAD

REFERENCES

- [1] F. Zareef, "Gain degradation study after neutron and proton irradiations in Low Gain Avalanche Diodes," presented at the 42nd RD50 Workshop on Radiation Hard Semiconductor Devices for Very High Luminosity Colliders, Montenegro, Jun. 20–23, 2023.
- [2] G. Kramberger, "Advanced TCT Setups," presented at the 23rd Vertex Workshop, Lake Macha, Czech Republic, Sep. 15–19, 2014.
- [3] CERN, "Enhancing the Muon in Compact Muon Solenoid | CMS Experiment." Accessed: Sep. 26, 2025. [Online]. Available: <https://cmsexperiment.web.cern.ch/news/enhancing-muon-compact-muon-solenoid>