

# Capacitance measurements in AC-LGADs

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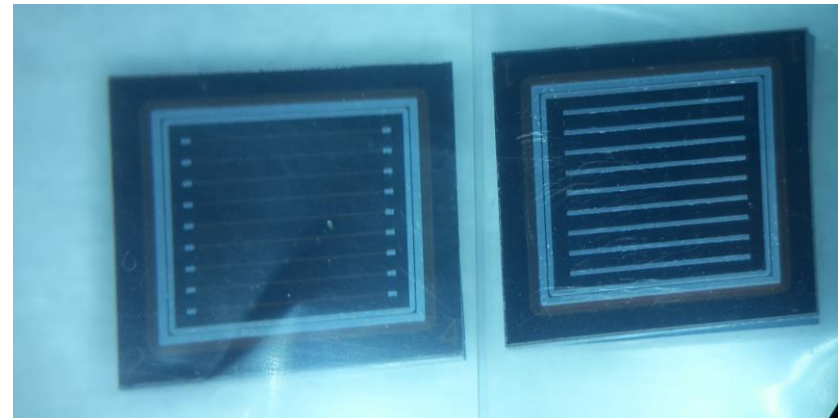
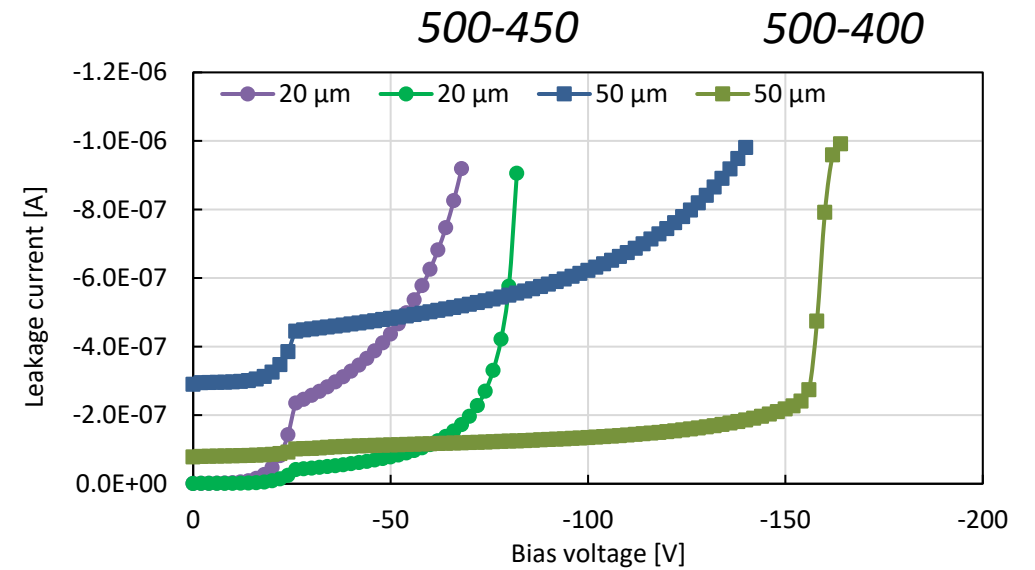
For the SCIPP team

May 16, 2023

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# 20 $\mu\text{m}$ and 50 $\mu\text{m}$ AC-LGADs

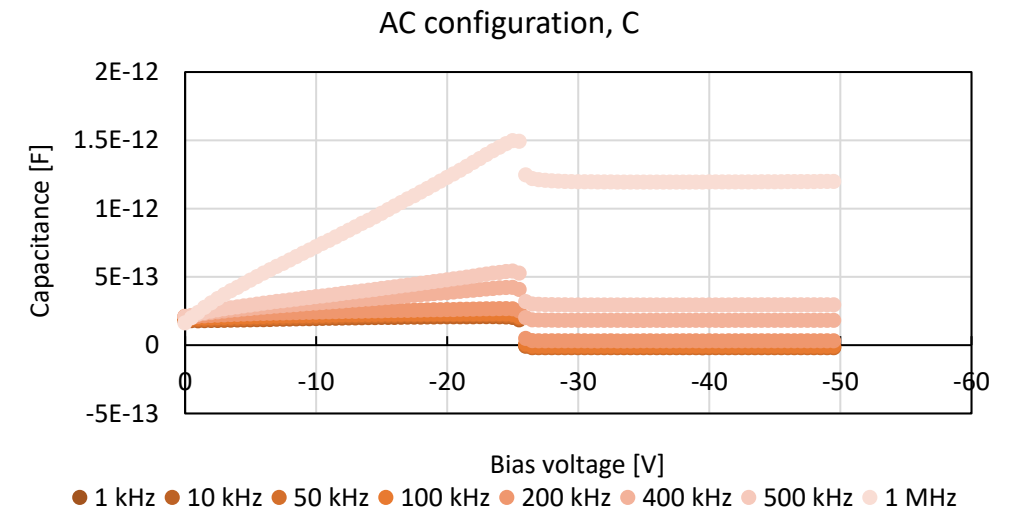
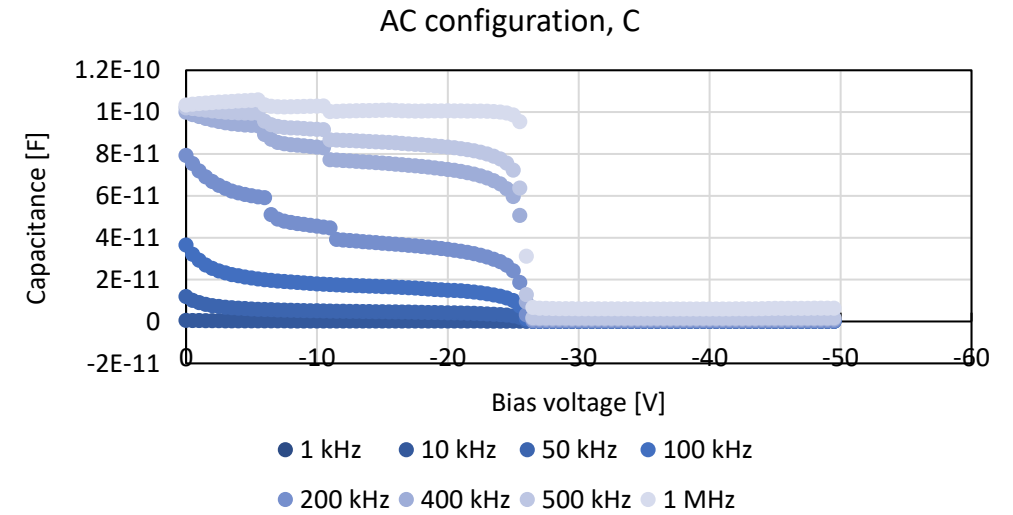
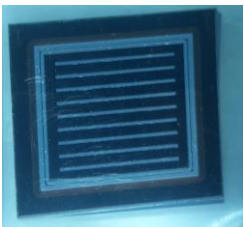
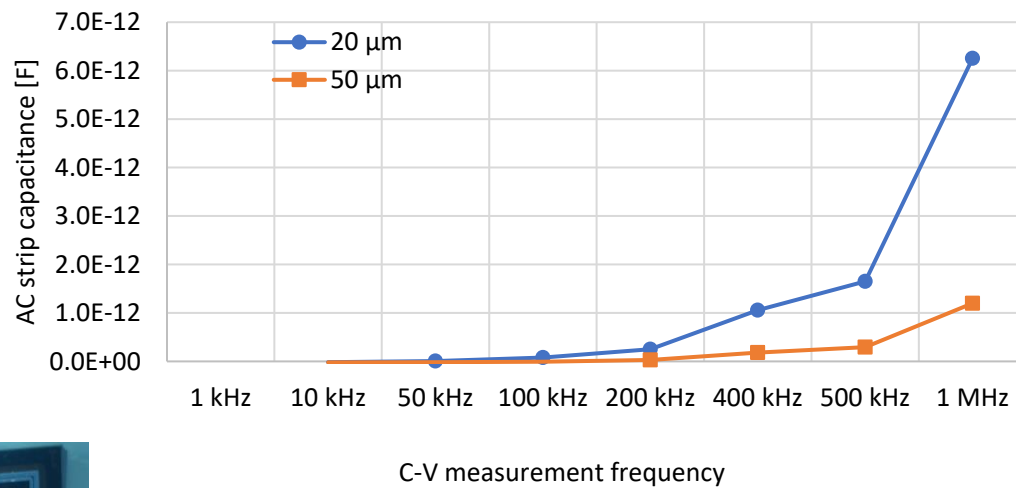
- Strips with 500  $\mu\text{m}$  width and 100 / 50  $\mu\text{m}$  metal width (500-400, 500-450)
- 0.5 cm length
- On 20  $\mu\text{m}$  and 50  $\mu\text{m}$  wafers





# 20 $\mu\text{m}$ and 50 $\mu\text{m}$ AC-LGADs, AC strip capacitance

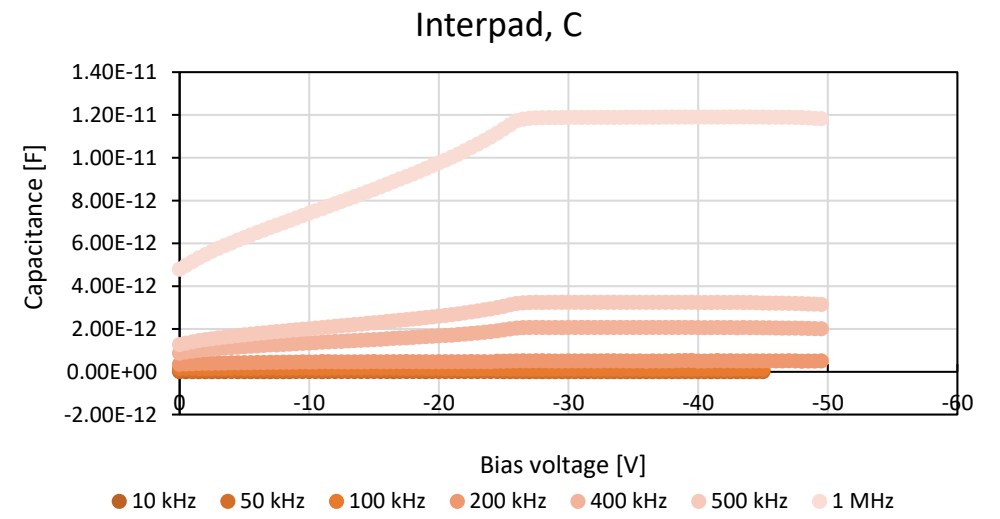
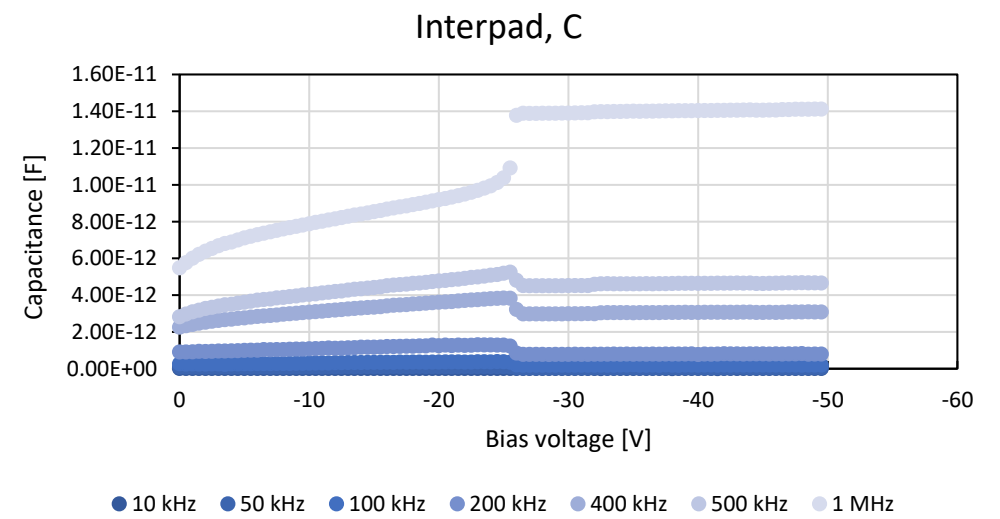
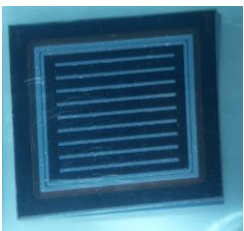
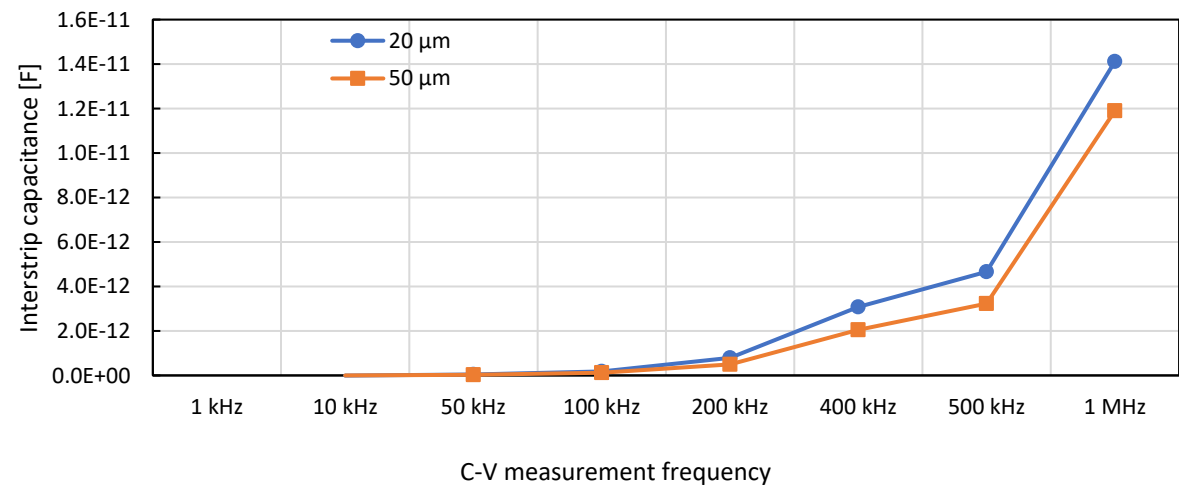
- W3051: 50  $\mu\text{m}$
- W3075: 20  $\mu\text{m}$
- 500-400 = 100  $\mu\text{m}$  metal





# 20 $\mu\text{m}$ and 50 $\mu\text{m}$ AC-LGADs, interstrip

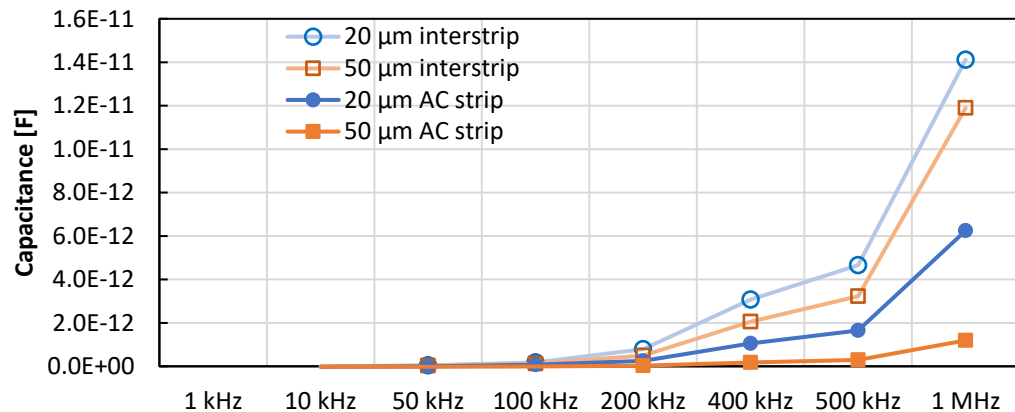
- W3051: 50  $\mu\text{m}$
- W3075: 20  $\mu\text{m}$
- 500-400 = 100  $\mu\text{m}$  metal



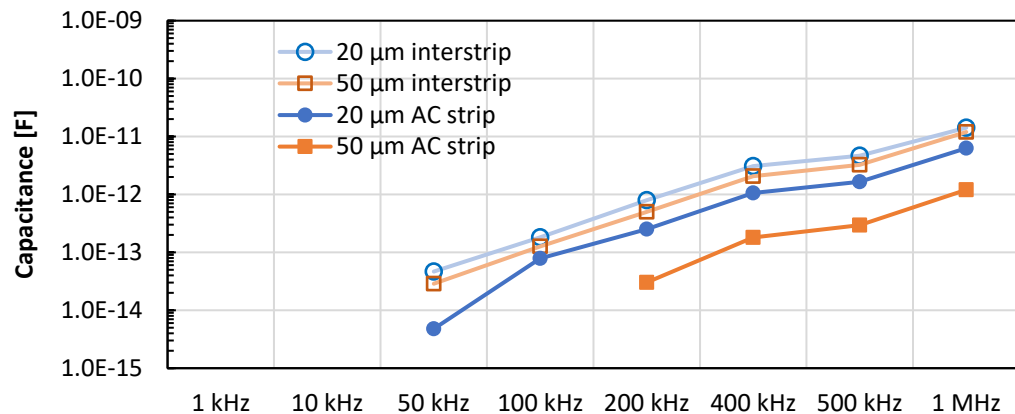


# 20 $\mu\text{m}$ and 50 $\mu\text{m}$ AC-LGADs, comparison

500-400 = 100  $\mu\text{m}$  metal, 20 and 50  $\mu\text{m}$

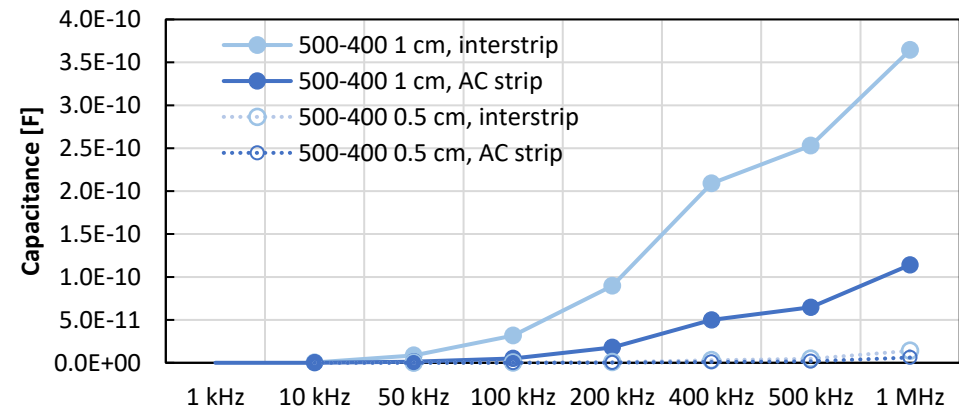


C-V measurement frequency

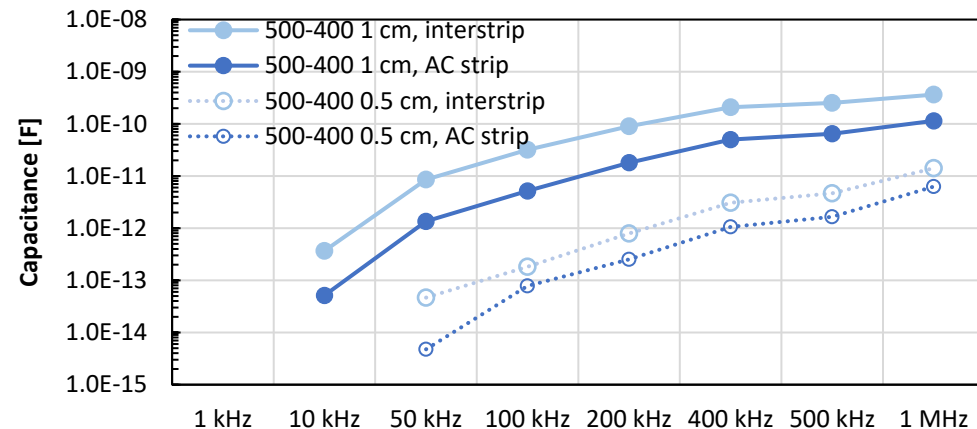


C-V measurement frequency

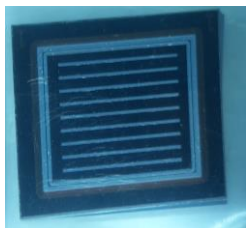
500-400 = 100  $\mu\text{m}$  metal, 0.5 and 1 cm, 20  $\mu\text{m}$



C-V measurement frequency



C-V measurement frequency





## 20 $\mu\text{m}$ and 50 $\mu\text{m}$ AC-LGADs

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- All new wafers (3072, 3075, 3051) exhibit very frequency-dependent AC and interstrip capacitance, W1 did not
  - Retake thorough measurements on 'new' W1 samples
- For 0.5 and 1 cm lengths, AC and interpad capacitance seem to scale similarly as for the multipitch geometries (even though cross-comparing here W3075 and 3072)
- Small measured capacitances for W3051 and 3075 500-400, plus variation over frequency – hard to quantify the (visible!) impact of substrate thickness
  - In AC strip capacitance, difference larger than x 2.5
  - In interpad, difference smaller and almost constant
- For comparison: interstrip capacitances in conventional strip DC-LGAD and trench-isolated LGAD on the order of 0.4-0.8 pF
- Next: testing of 20 and 50  $\mu\text{m}$  AC-LGADs samples by laser



# ASICs

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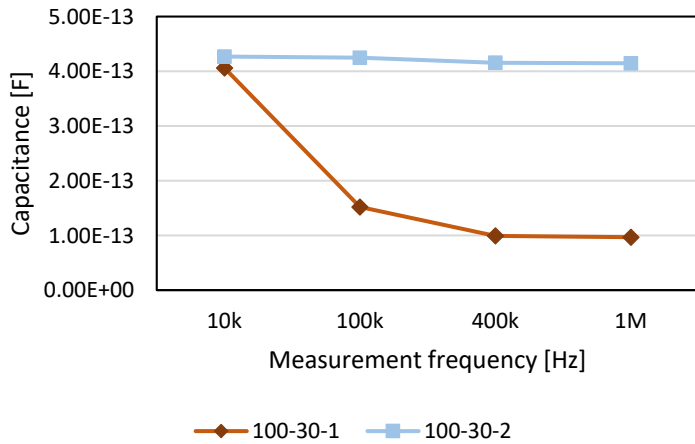
- Nalu HPSoC 4-ch prototype, new version: small modification to front-end TIA done (lowering input impedance to increase gain), tapeout expected in 1-2 months
- Anadyne ASROC: chip is ready, waiting for delivery. Test board in fabrication
- INFN FAST: now testing digital part of FAST-2, waiting for FAST-3 availability
- eRD112 funds to SCIPP for 2023 were just received – what kind of progress report is expected by July, if any?
- eRD109: have not heard or received anything?
- Jefferson Lab special funding for waveform digitizing ASIC: Nalu has received their share, SCIPP still arranging

Backup

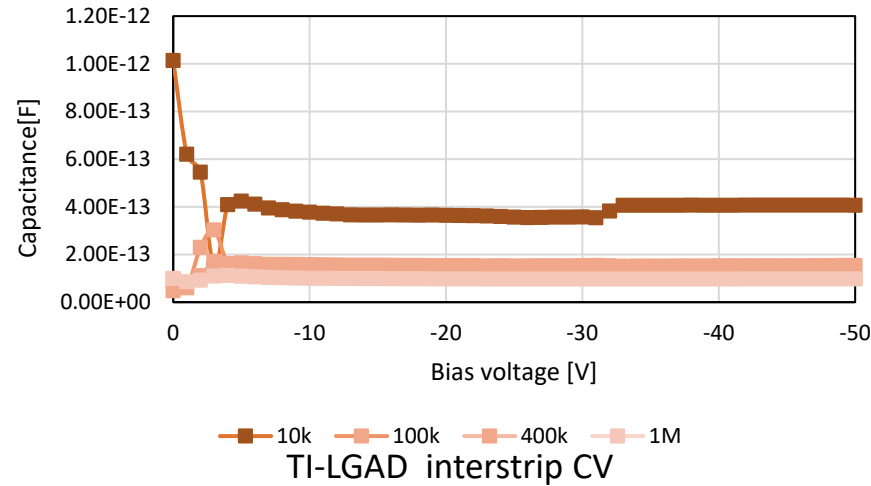


# TI-LGAD interstrip capacitance

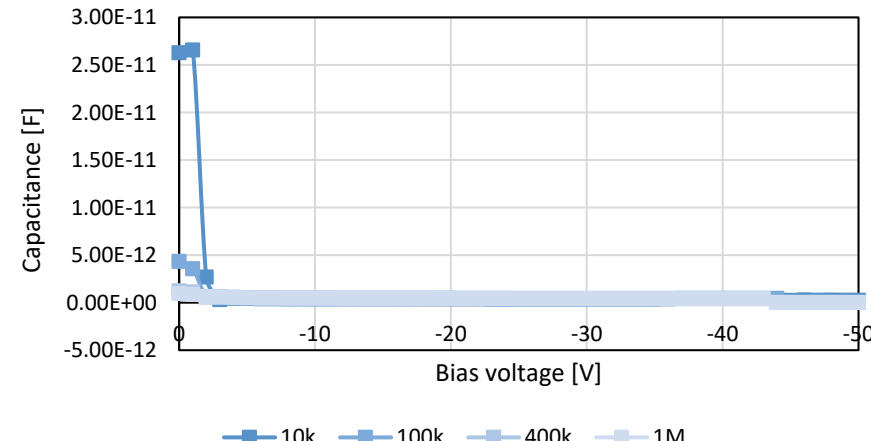
TI-LGAD interstrip capacitance (-40V)



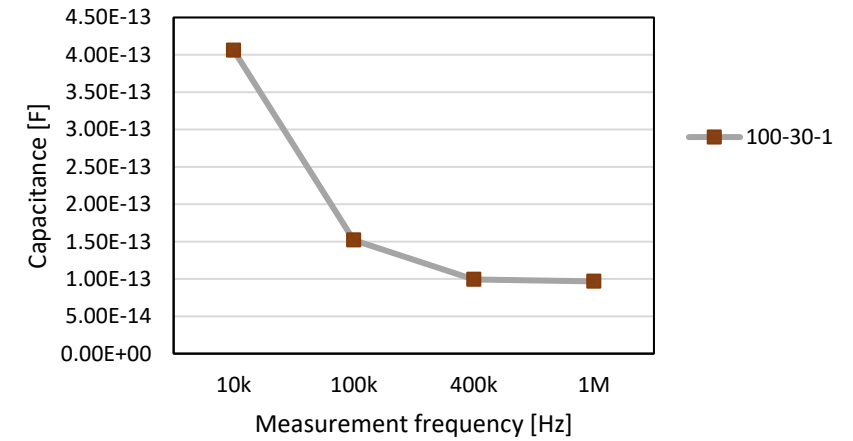
TI-LGAD interstrip CV



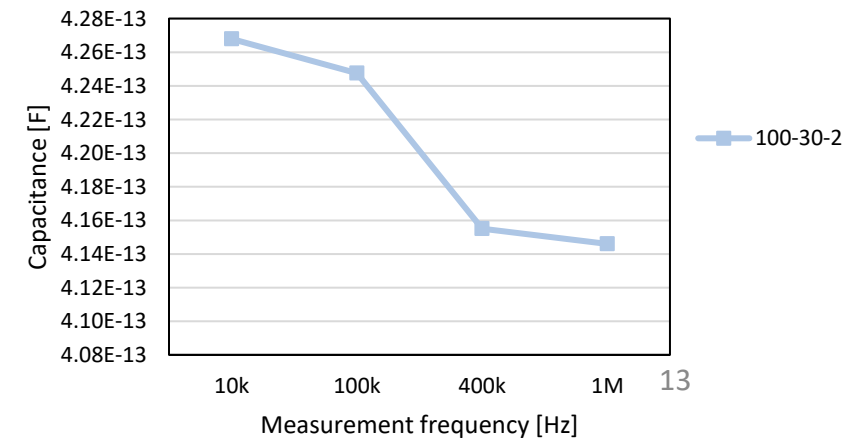
TI-LGAD interstrip CV



TI-LGAD interstrip capacitance (-40V)



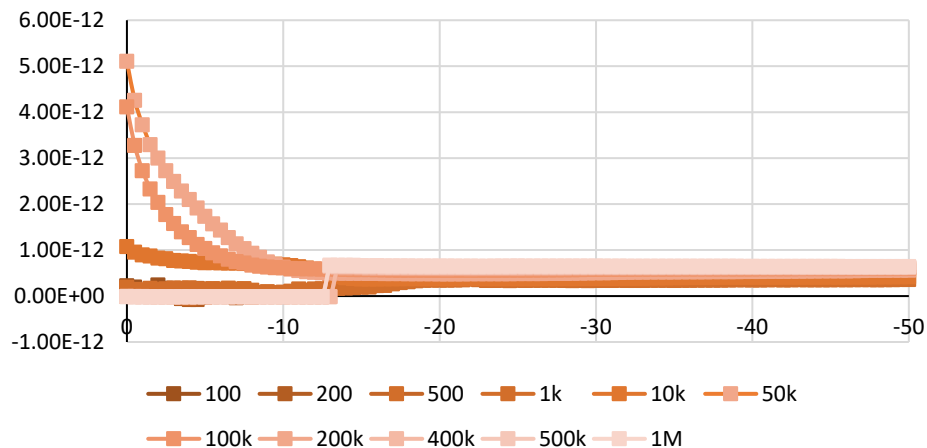
TI-LGAD interstrip capacitance (-40V)



# DC-LGAD interstrip capacitance

- Measured on sample 4
- Some frequency dependency, but not large – appears inverse to freq.dep. of strip capacitance
- Freq. below 1 kHz not measurable

HADES sample 4 interstrip CV



HADES sample 4 interstrip capacitance (-49V)

