C-V measurements in AC-LGADs

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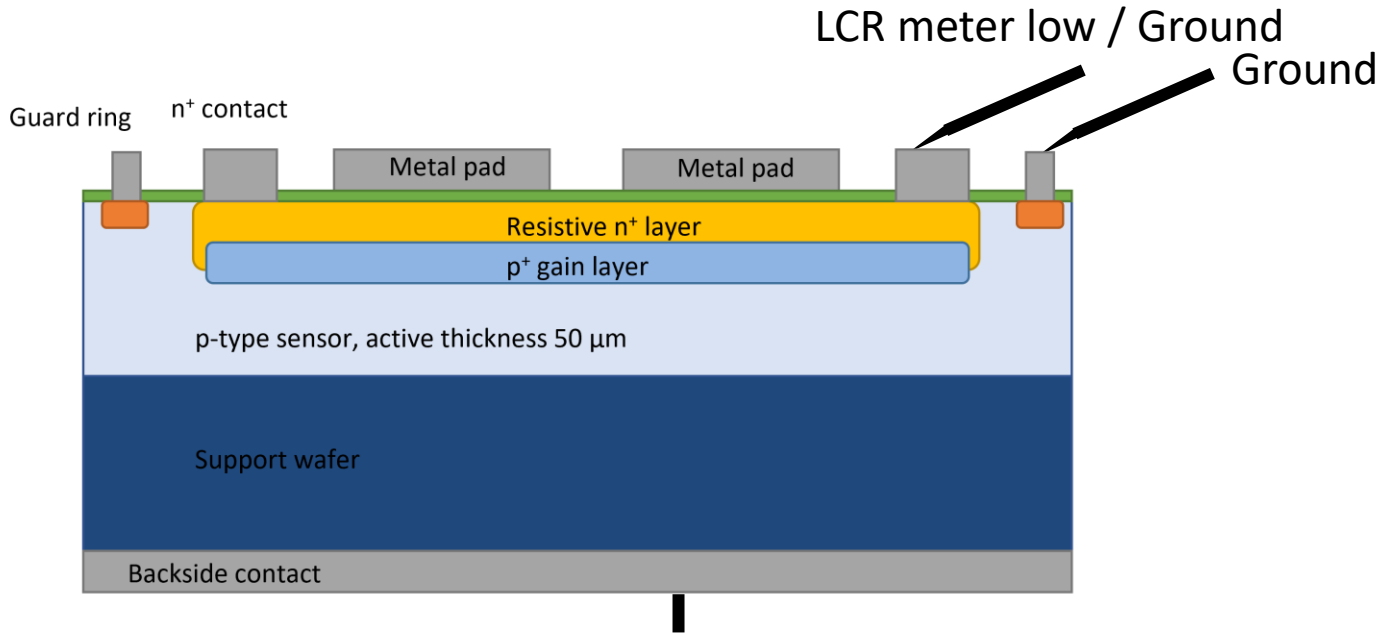
Standard C-V measurement

"Conventional" C-V measurement configuration: sensor backplane to front side electrode

- In AC-LGADs, there is one shared n^+ layer with the DC contact – capacitance measured over the full sensor area
- Depending on area: **pF to 10s of pF**

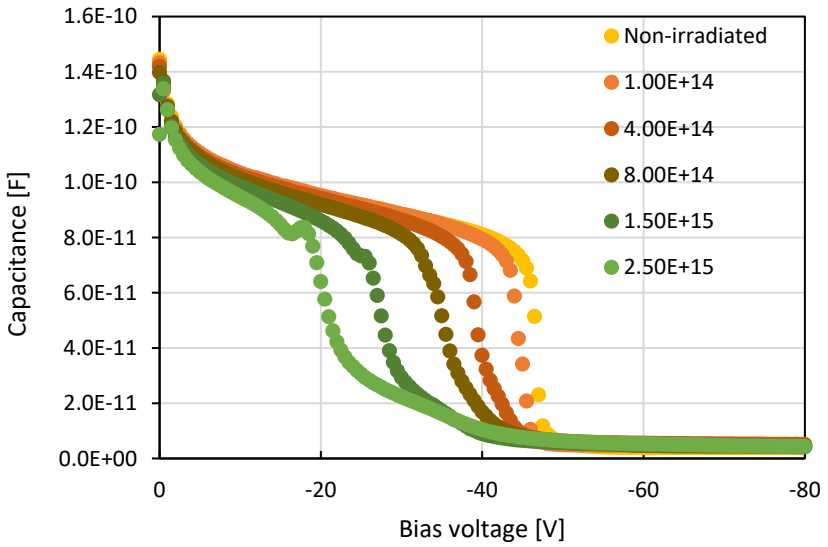


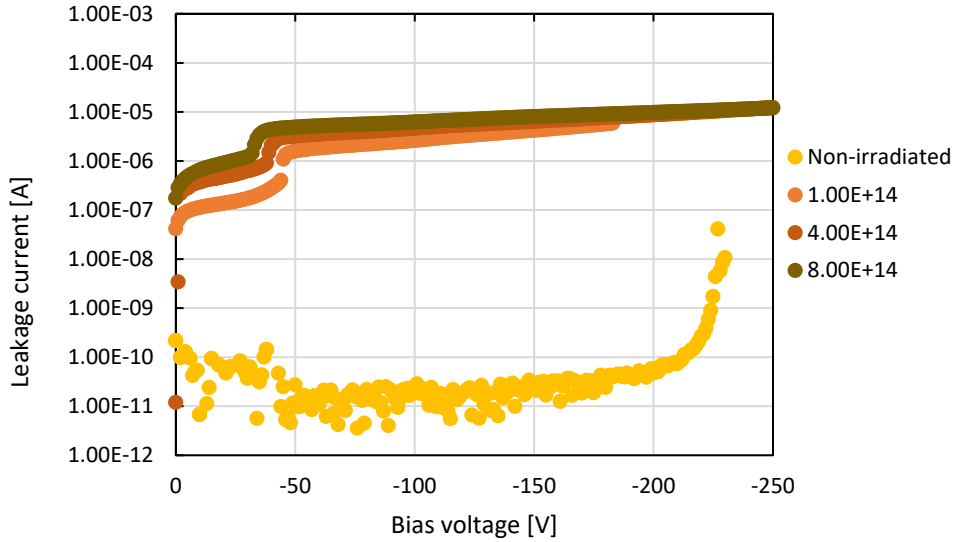
cf. M. Tornago, 35th RD50 Workshop 2019

Radiation damage

Irradiation has an impact on the bulk and on the gain layer, just like in other types of LGADs

- Bulk damage: increased leakage current and defect concentration – higher depletion voltage of the bulk volume
- Gain layer: “acceptor removal” – lower depletion voltage



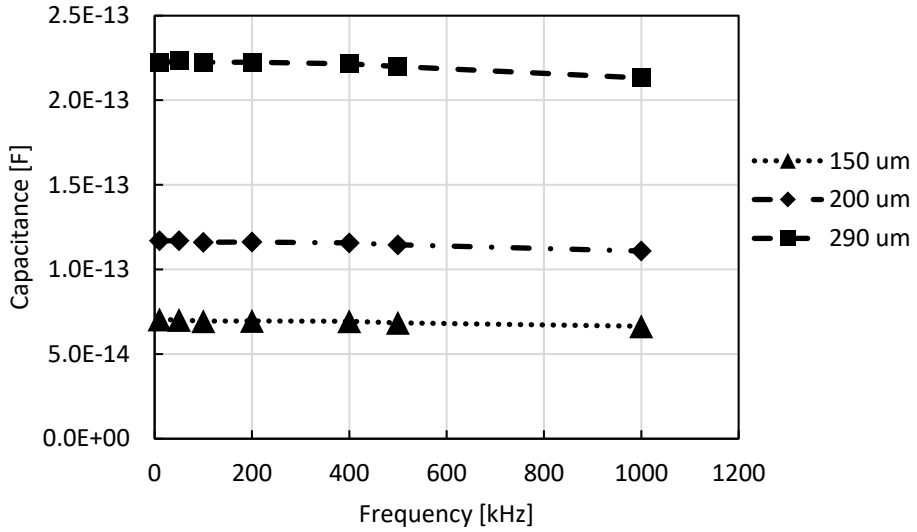


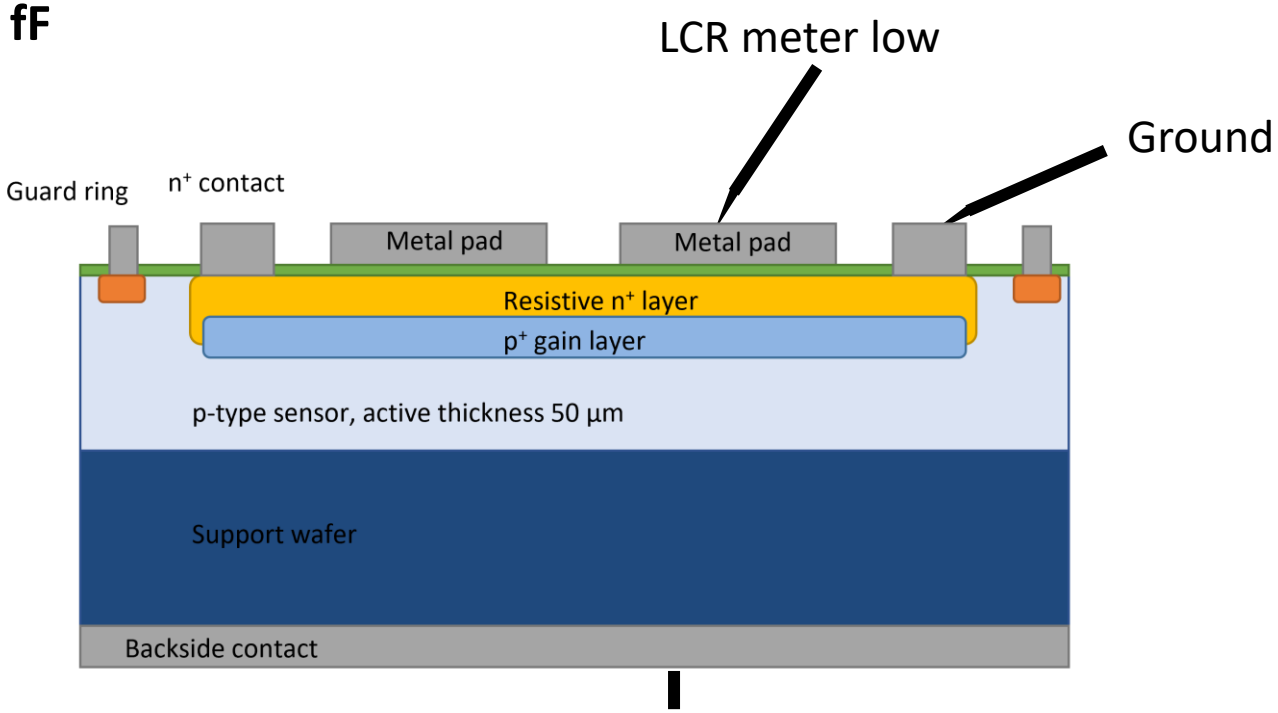
➢ Radiation levels of $\mathcal{O}(10^{14}\ \mathrm{cm}^{-2})$ as predicted for ePIC should not have a significant impact on sensor performance, but increase in leakage current needs to be considered

AC capacitance

Specific to AC-LGADs: measurement from backplane to individual AC metal pad

- Pad size affects the final capacitance values, since capacitance is directly proportional to the area
- Values after full depletion are relatively small compared to “regular” CV measurements: **for 150 µm pads, < 100 fF**



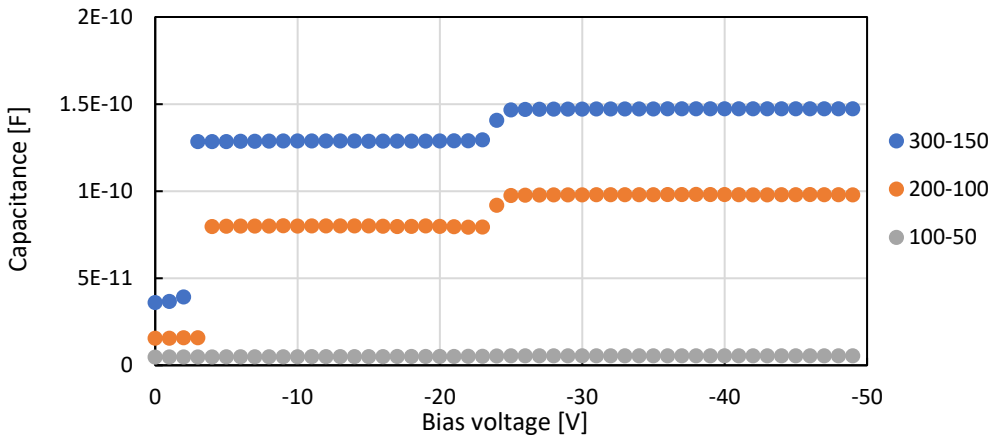


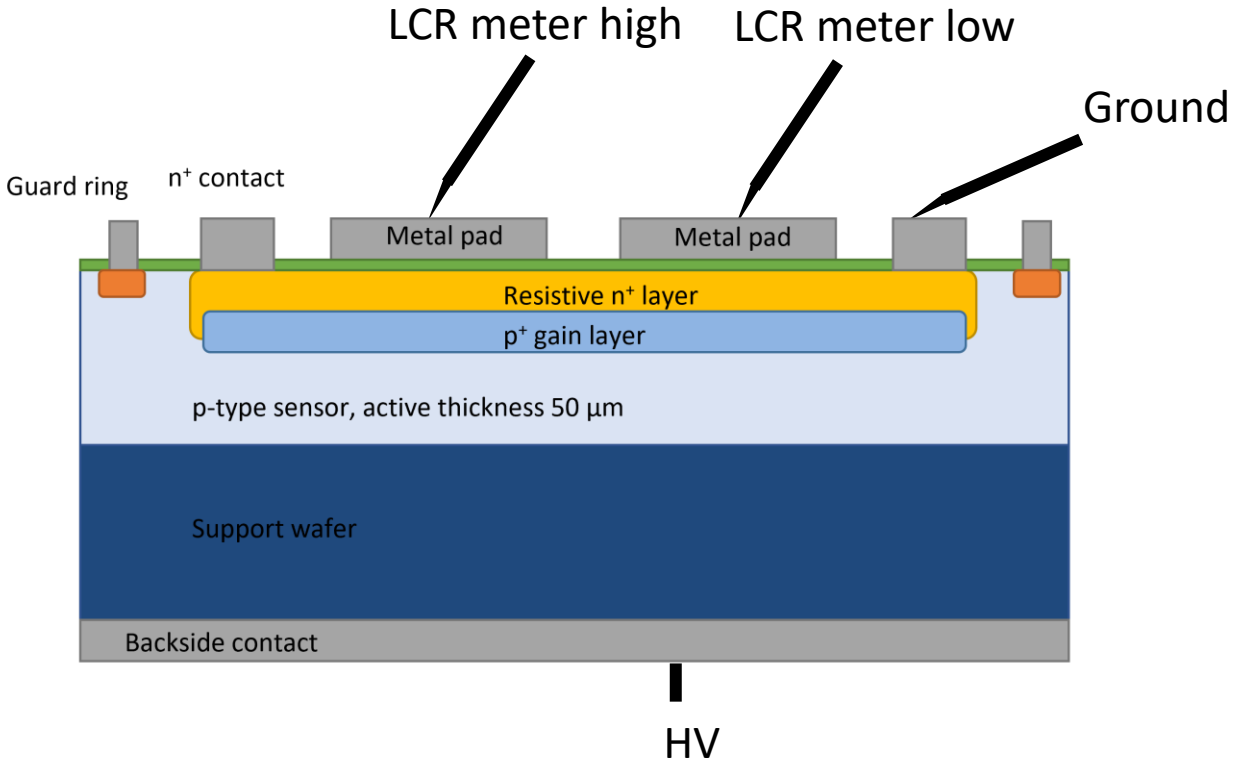
cf. M. Tornago, 35th RD50 Workshop 2019

Interpad capacitance

Interpad capacitance: between two AC metal pads, sensor biasing from backplane as usual, grounding to the n+ DC contact

- Depletion visible, frequency dependence before depletion – capacitance component through the bulk
- A factor in the observed higher signal sharing for longer strips



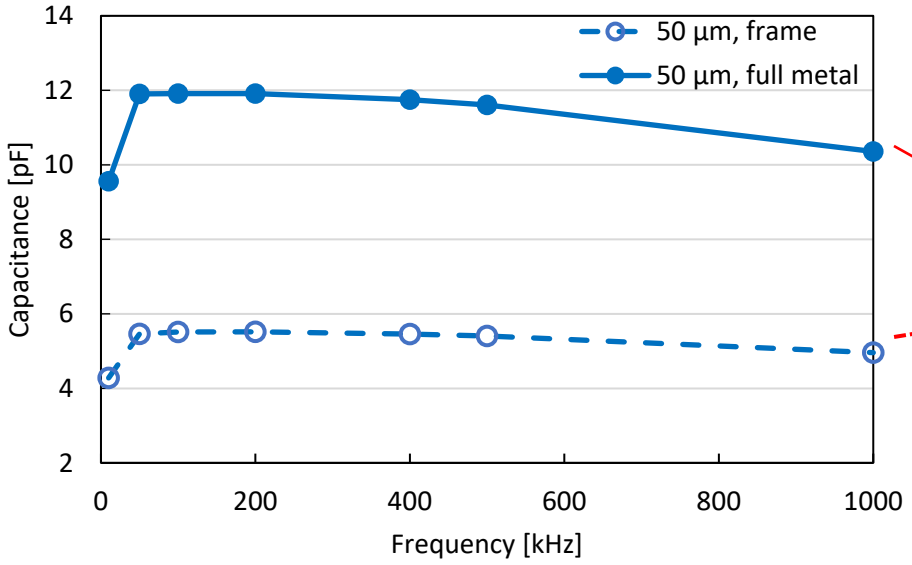


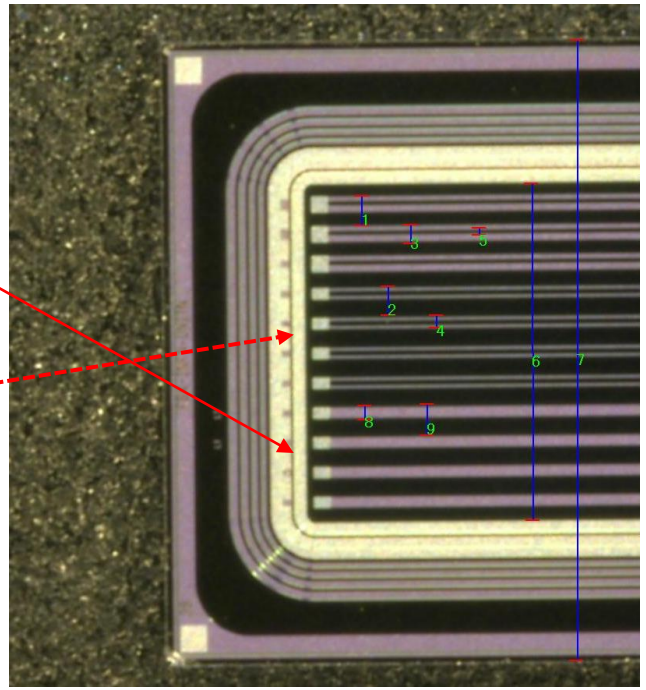
cf. M. Tornago, 35th RD50 Workshop 2019

Reducing input capacitance by reducing metal?

E.g. cutting out the metal on strips, leaving a “frame” instead of a fully metallized strip, in FBK RSD2*

- Direct impact on electrode capacitance





M. Mandurrino et al, 39th RD50 Workshop, November 2021 (https://indico.cern.ch/event/1074989/contributions/4602006/)