03/07/2024

First ECFA-INFN Early Career Researchers Meeting

Experimental setup for the characterization of solid-state detectors optimized for radiation hardness

Fabio Davolio, Lucio Anderlini

in collaboration with UniTo and CNR-IOM (Perugia)

Ministero dell'Università e della Ricerca

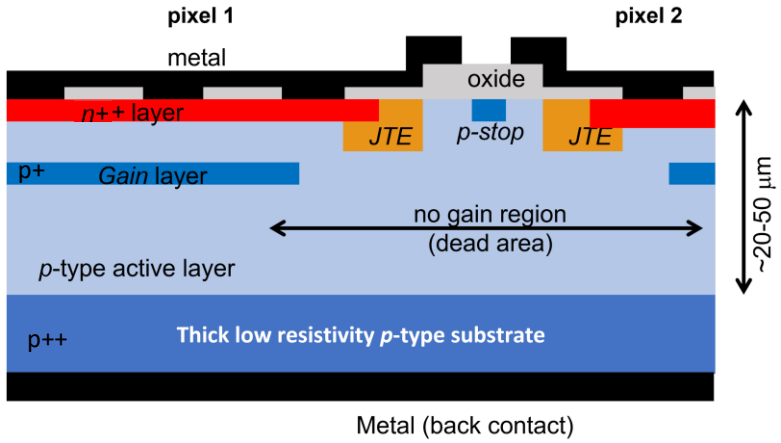
Bando PRIN 2022

INFN FIRENZE

Istituto Nazionale di Fisica Nucleare
Sezione di Firenze

Compensated LGADs

LGADs are silicon diodes with a p^+ doping layer near the cathode to start multiplication



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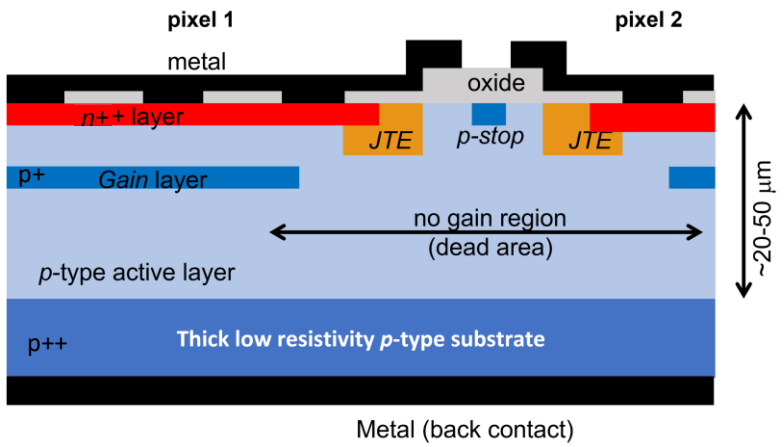
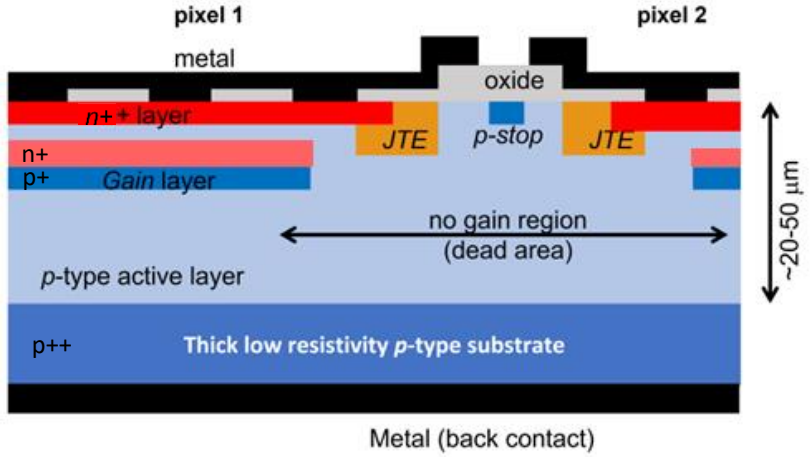


Fluences $> 1 \cdot 10^{15}\ \mathrm{n_{eq}/cm^2}$
deactivate the gain layer

n^+ doping layer implanted
below the cathode



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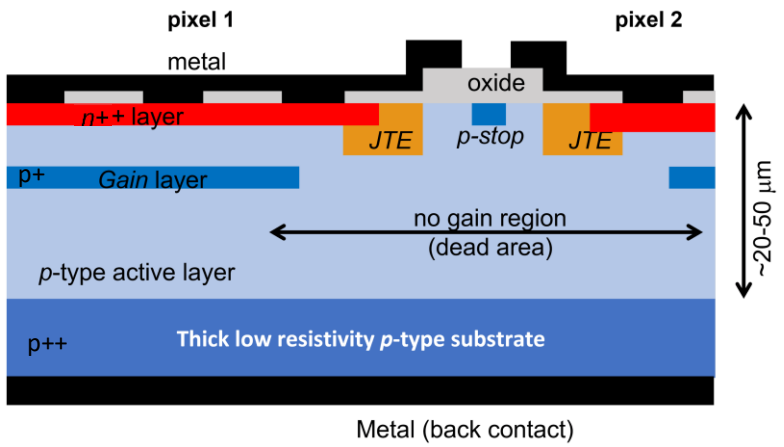

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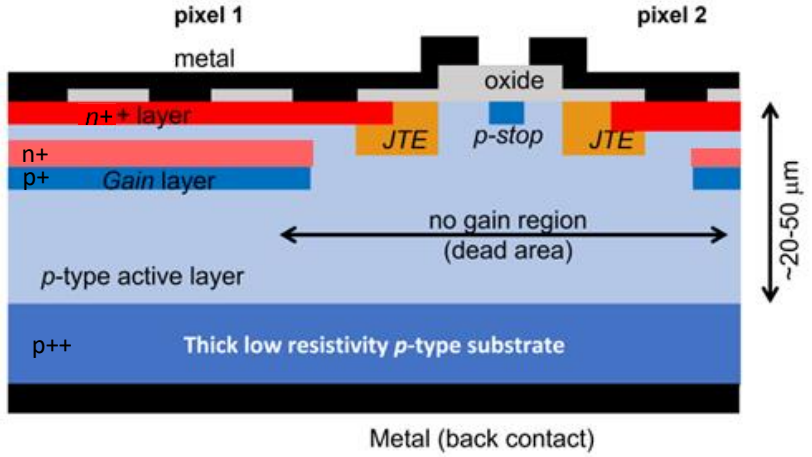
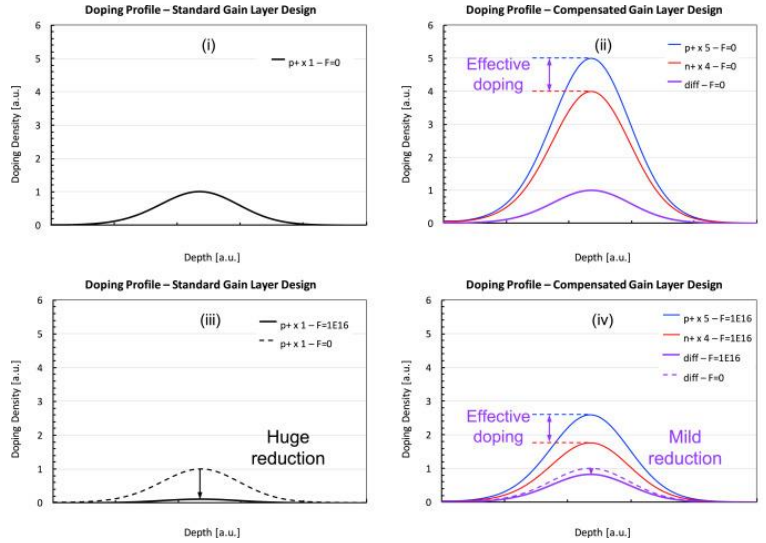


Local increase of electric field between the two implantations allows signal multiplication

Δ Concentration ~ constant ⟶ **Active gain up to fluences $\sim 10^{17} n_{eq}/cm^2$**



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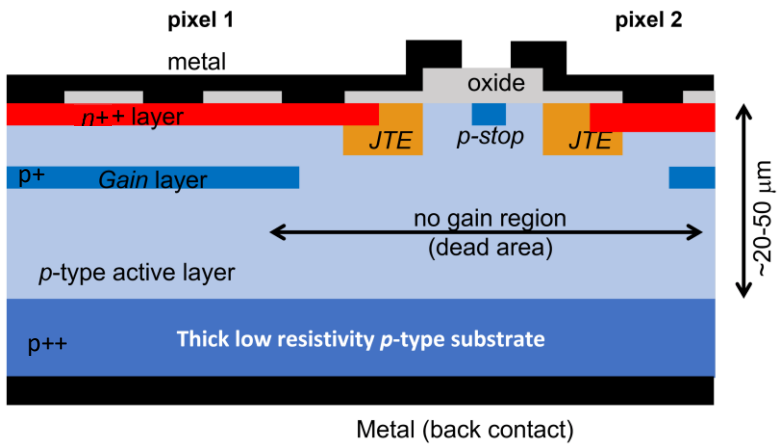

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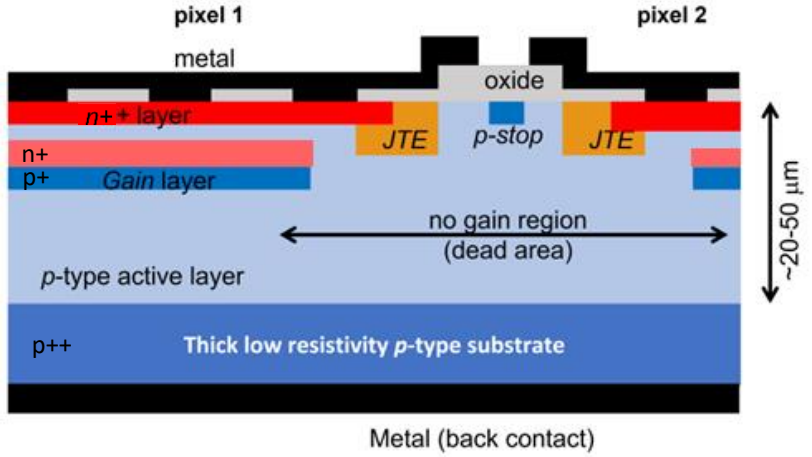

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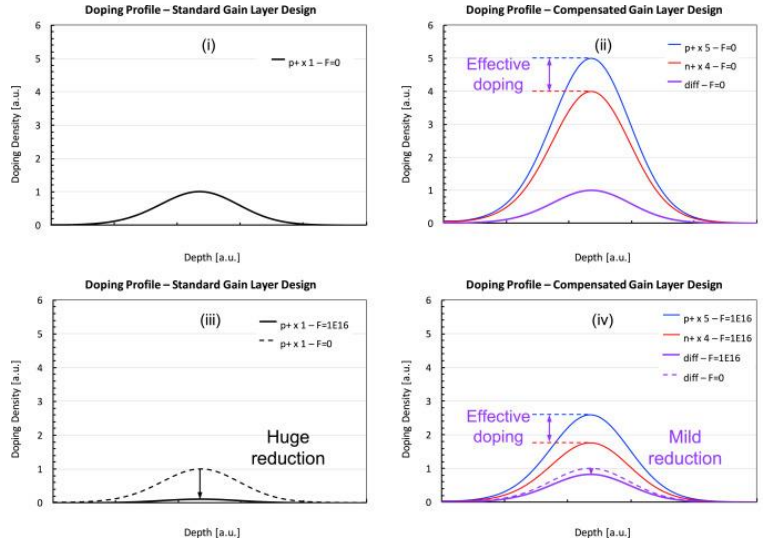


At the relevant doping densities ($\sim 10^{16}\ /\mathrm{cm^3}$): acceptor removal coefficient is well known
donor removal coefficient is being studied

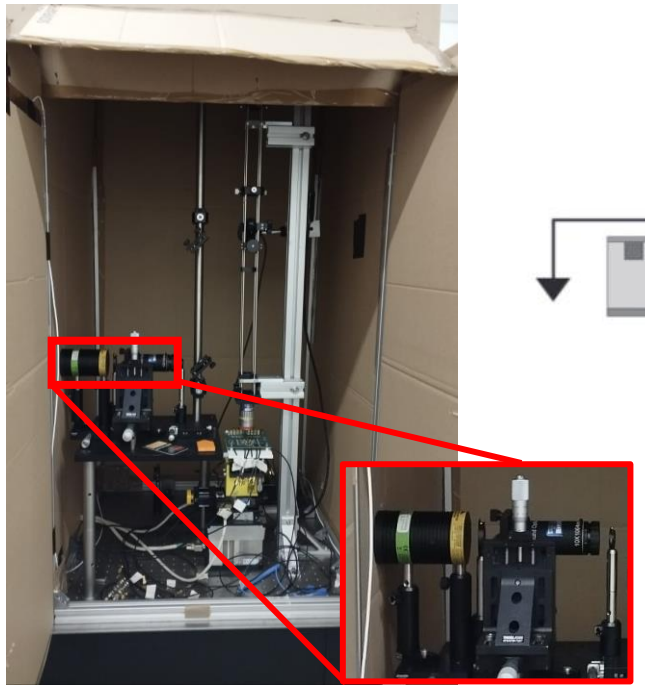
In Florence: Transient Current Technique

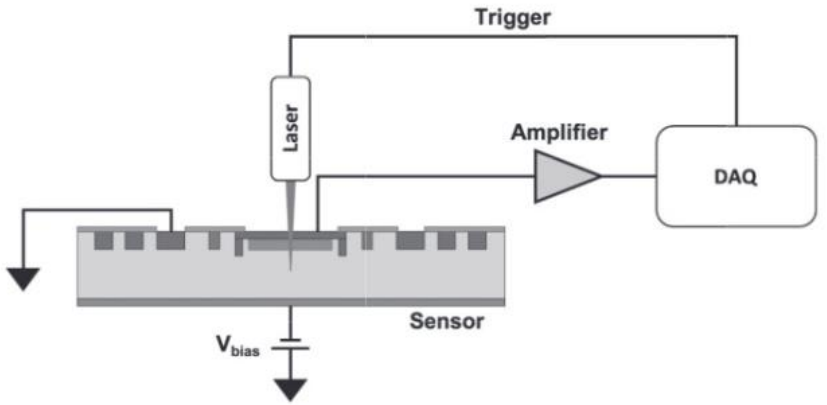
TCT (Transient Current Technique)

Focused laser pulses generate *e-h* pairs, which iduce a current signal on the read-out electrode, which is stored in an oscilloscope

Measurements:

- **Charge collection efficiency**
- **Sensor gain**
- **Inter-pad width**
- **Temporal resolution**





Wavelength: 1080 nm
Pulse freq.: 5 MHz
Pulse duration: 50 ps
Avg. power: 4 mW

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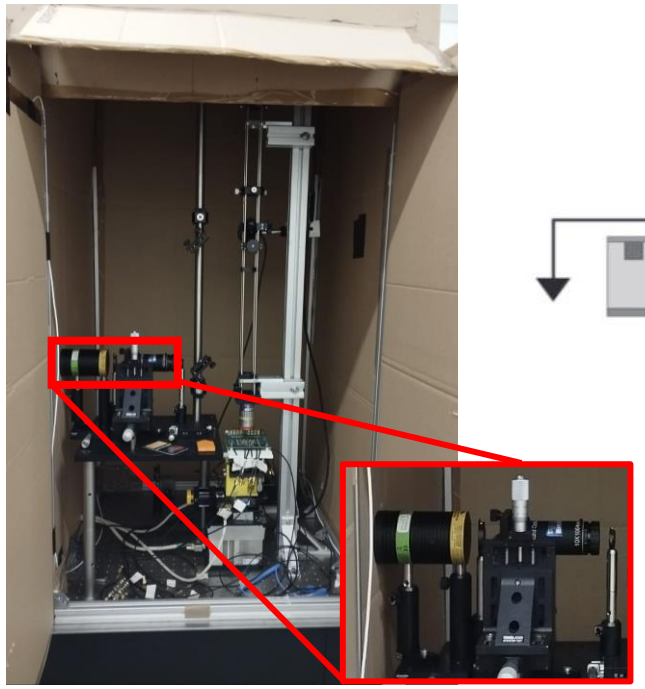

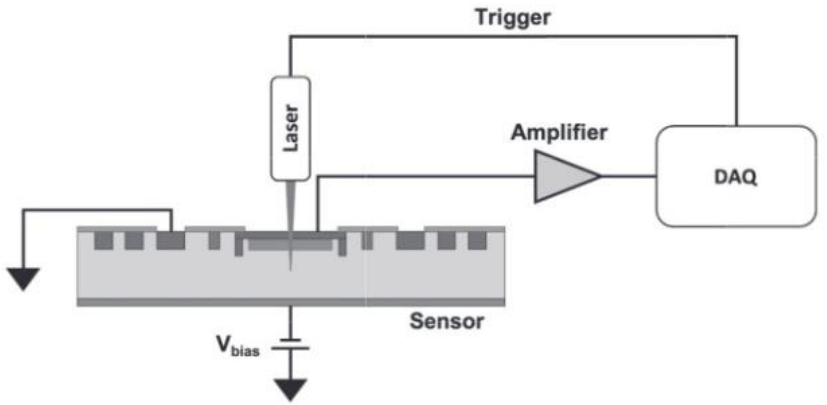

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Next steps

Design solutions for low-T measurements (-20°C) in order to study irradiated sensor

Automation of the measurement

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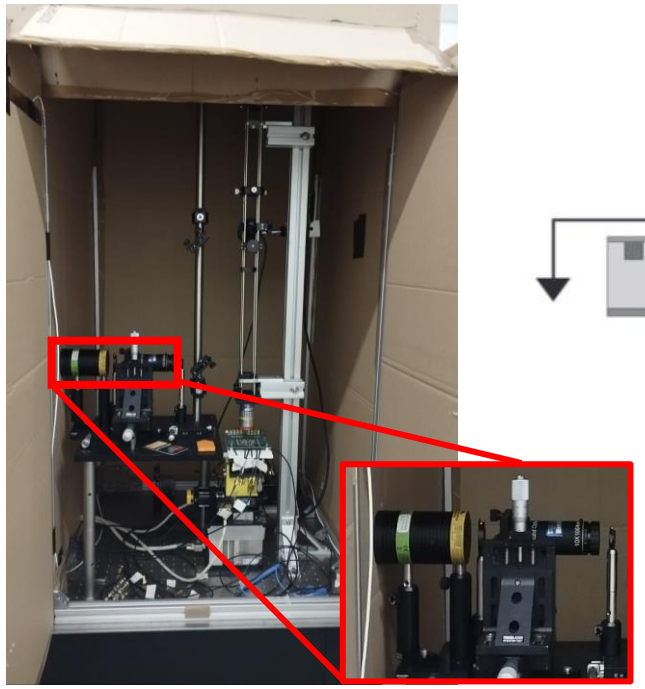

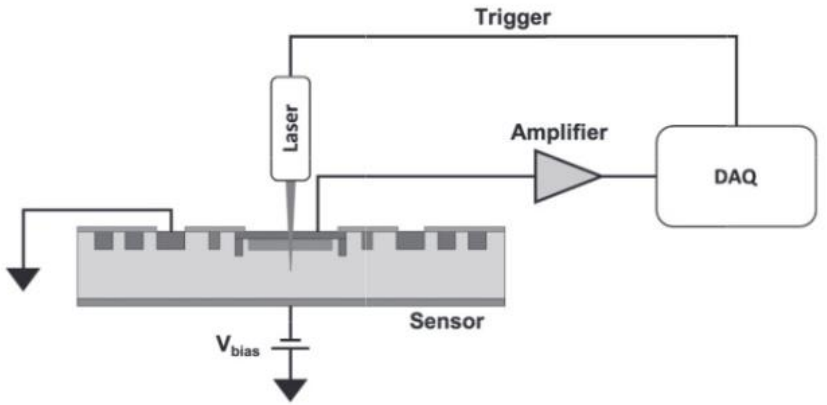

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