

Lab 3-Thin Moderate Gain Ultrafast Timing detectors

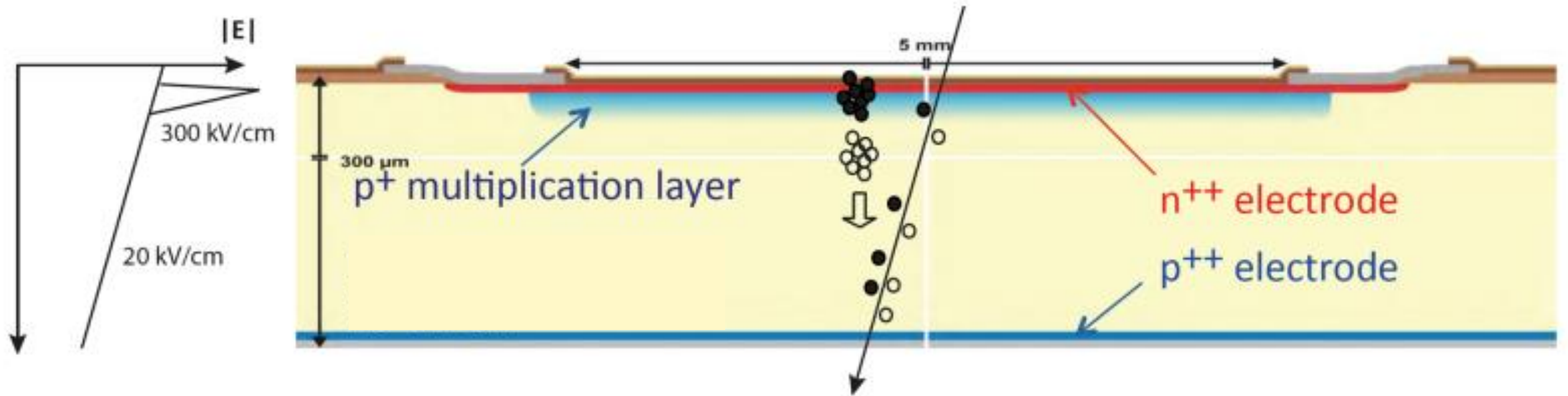
**Laser Transient Current Technique (TCT) to characterize Low Gain
Avalanche Detectors (LGAD) for Timing and Tracking applications**

Location: UAM, facultad ciencia, modulo 15, lab Microelectronica

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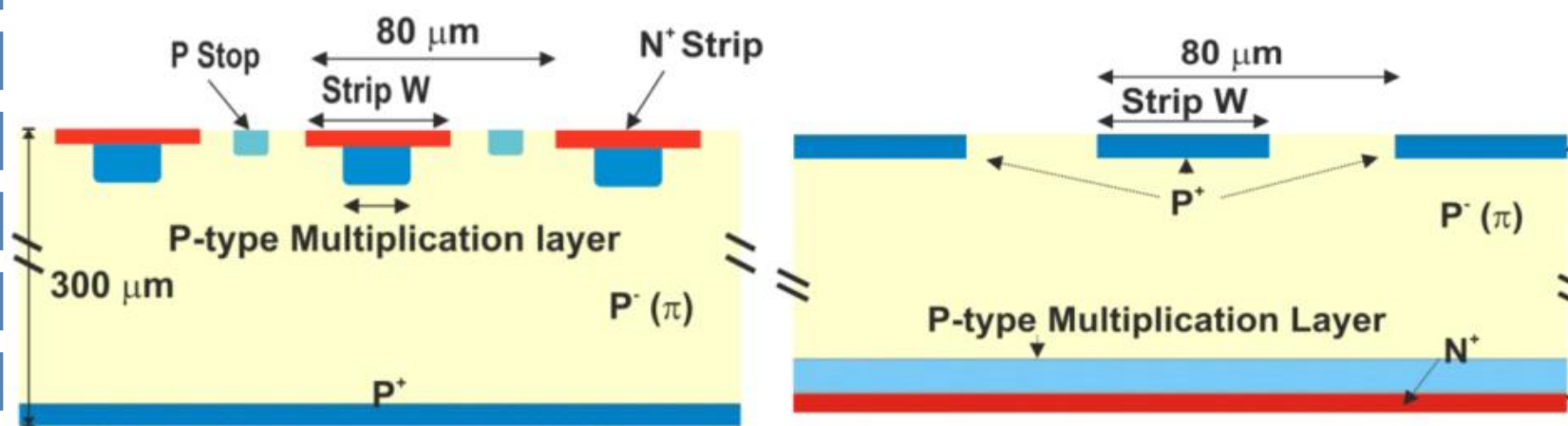
Low Gain Avalanche Detectors



Examples of Segmented LGADs + many more

LGAD (N on P Microstrips)

iLGAD (P on P Microstrips)



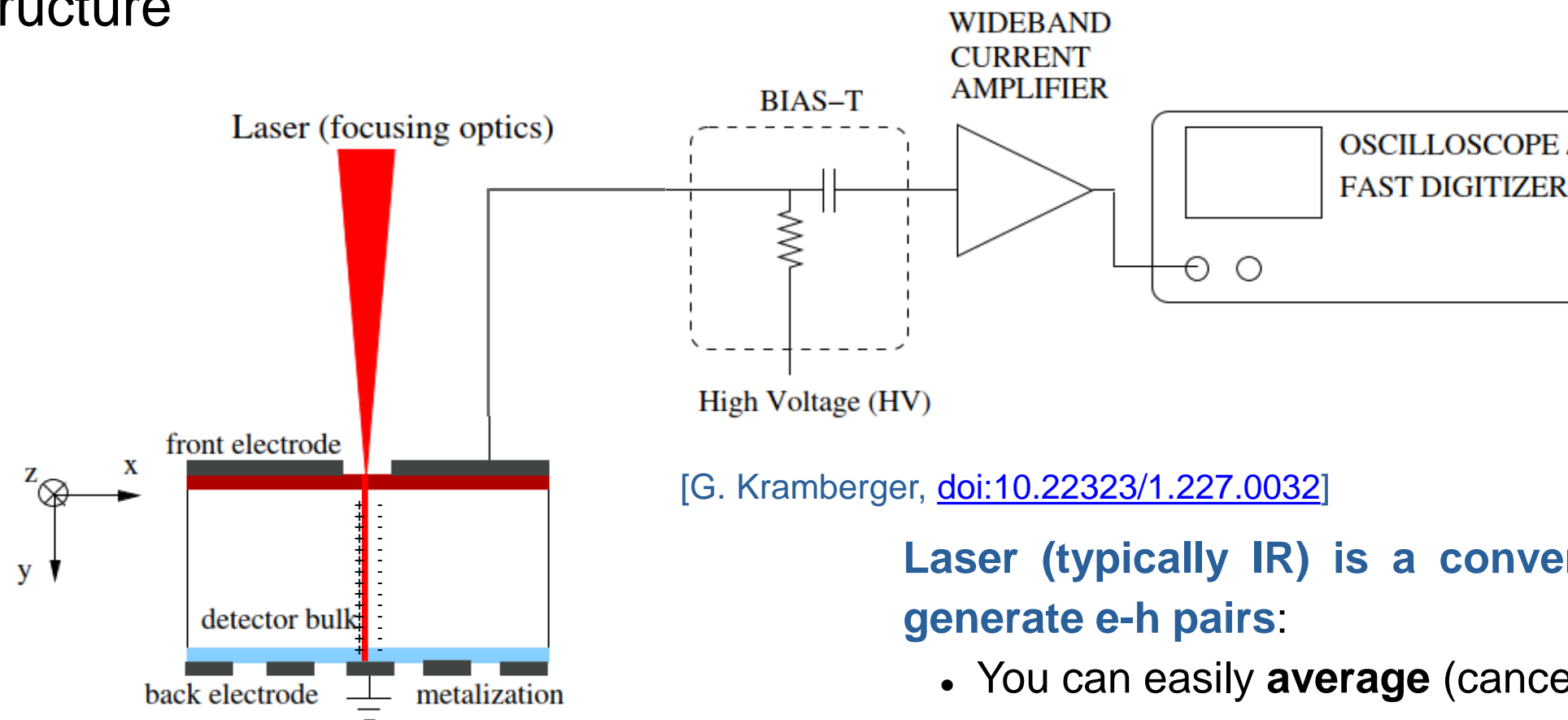
[G. Pellegrini, [doi:10.1016/j.nima.2014.06.008](https://doi.org/10.1016/j.nima.2014.06.008)]

[G. Pellegrini, [doi:10.1016/j.nima.2016.05.066](https://doi.org/10.1016/j.nima.2016.05.066)]

- Charged particles already produce large signals (mip: ~ 80 ehp/ μm) \rightarrow Very large gain is not required
- Lower gain \rightarrow Lower mult. noise
- Easier segmentation (lower electric field involved)
- Lower power consumption after irradiation
- **Fast timing information**

Transient Current Technique

TCT exploits the signal induced in electrodes by the motion of non-equilibrium free carriers (e-h pairs) in a semiconductor structure to study the properties of the structure



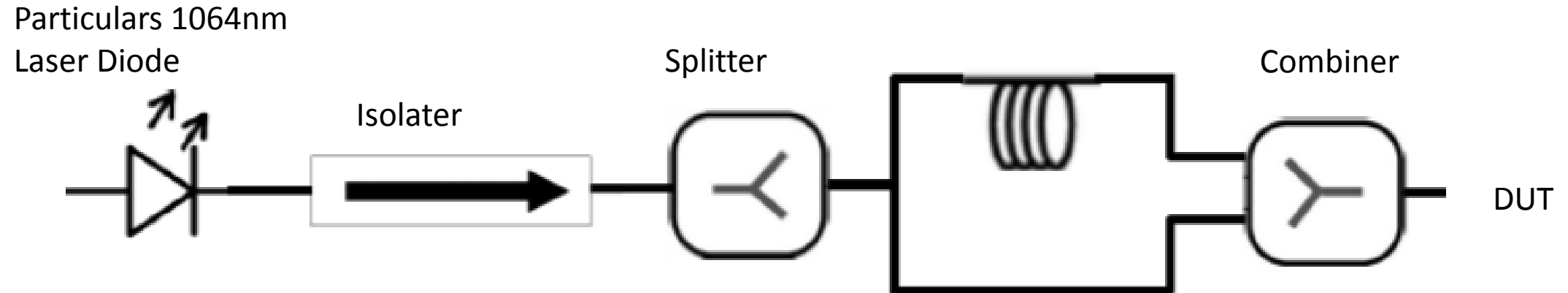
[G. Kramberger, [doi:10.22323/1.227.0032](https://doi.org/10.22323/1.227.0032)]

Laser (typically IR) is a convenient method to generate e-h pairs:

- You can easily **average** (cancelling noise)
- **Triggering** (exactly known time of your pulse)
- Generation depth can be tuned with wavelength
- Controllable beam position
- **But! You have to open metallization!!!**

Timing measurements using a TCT

TCT can also be used for **timing measurements**



- Laser light is split by the 50:50 beam splitter
- Half of light travels along the delay line (11.4 m long fiber) ,=50 ns delay
- Light is combined and two signals are seen by the DUT with a delay of 50ns.
- Copy of the pulse (#2) used as time reference – $\Delta t = t_1 - t_2$
- Time resolution measured by taking the sigma of the histogram of the time difference.

In this lab:

1) First part: TCT and LGAD basics

- How it works, how to analyse the data and understand the results

2) Second Part: Focus

- How to set the focus and run the analysis

3) Third Part: Scan

- Run and Analyse a Voltage and Line Scan

4) Fourth Part: Timing

- Run and Analyse (external data) a timing analysis