

# Soft X-ray photon counting with an n-type Low Gain Avalanche Detector



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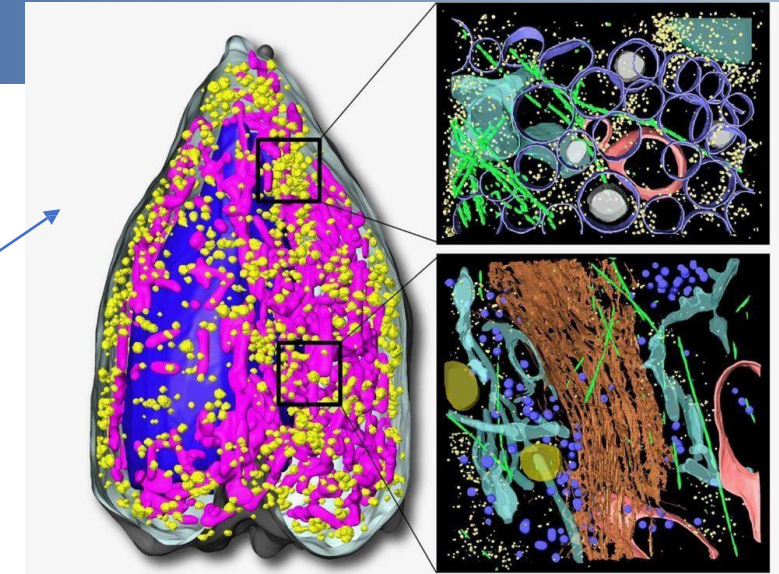
**Salvador Hidalgo**

**Main idea:** Soft X-rays from 282-533 eV highly penetrate water but are highly absorbed by carbon structures.

↓ ... by harvesting this property

Soft X-ray imaging in the "water window" range:

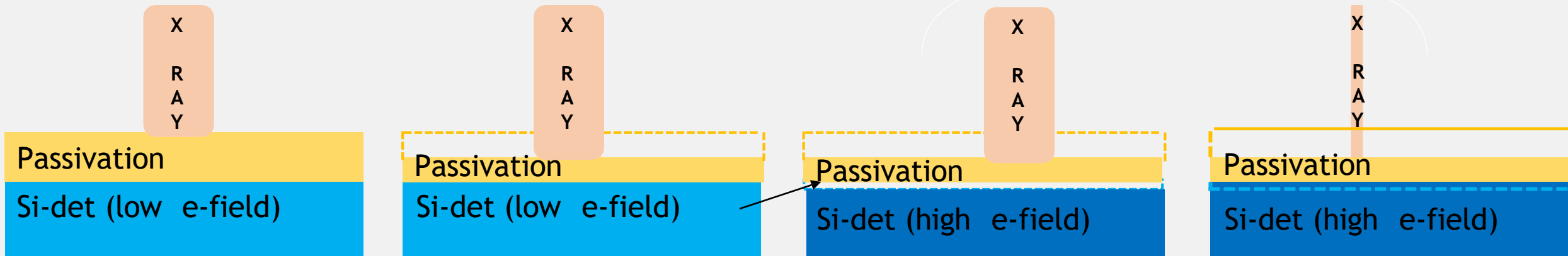
- High resolution imaging of biological samples, cells and tissues



## Detector requirements: High sensitivity, Gain & Low noise

... especially challenging is low fluence (single photon) detection

... Surface electric field is often very low, leading to recombination

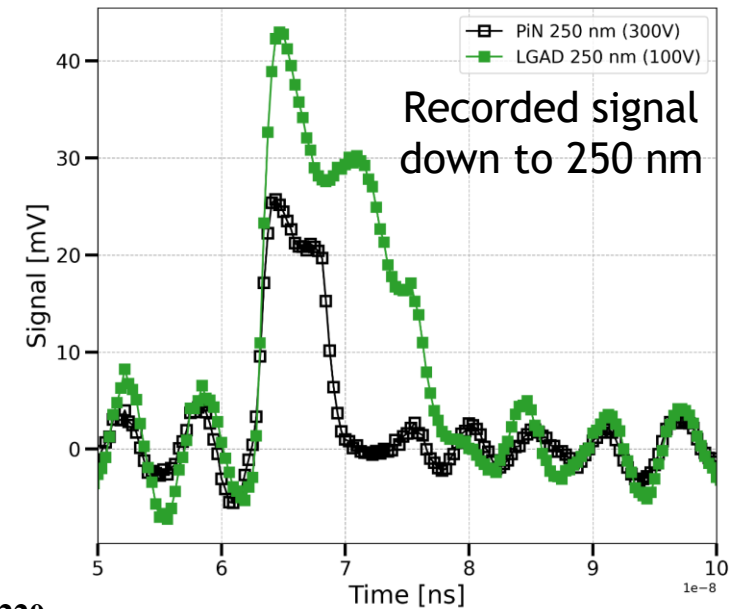
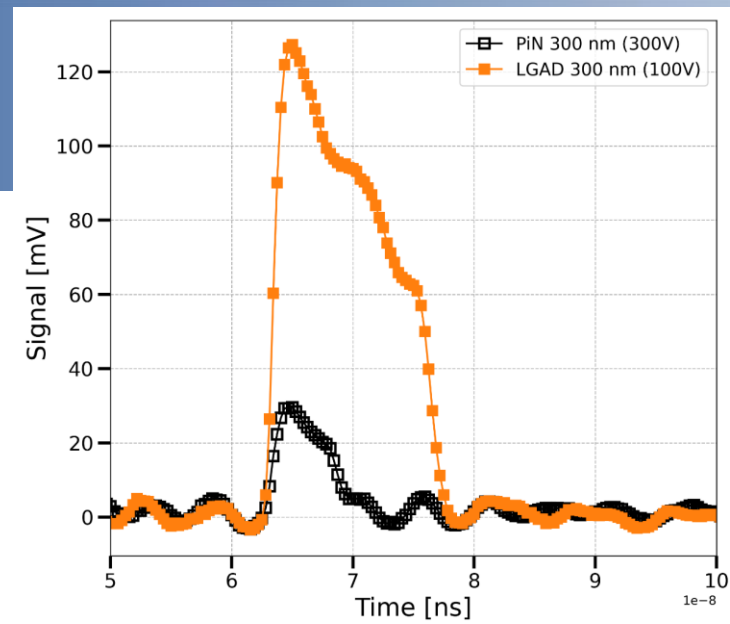
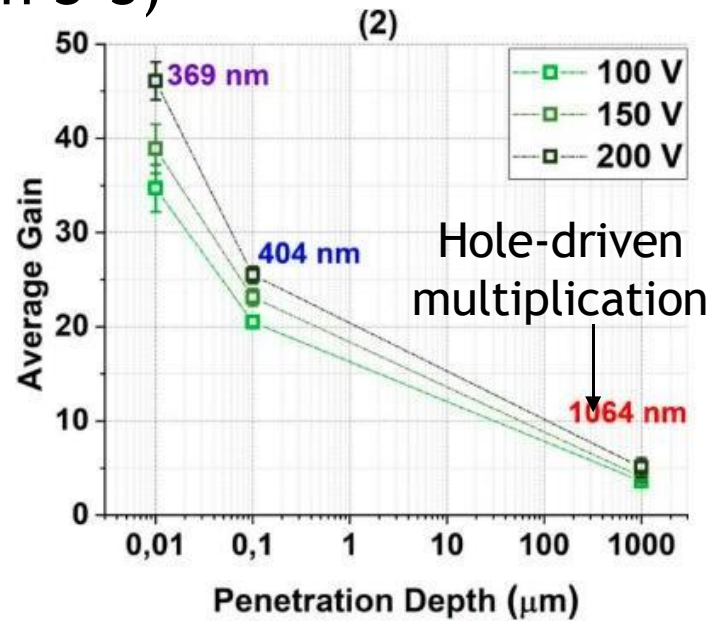
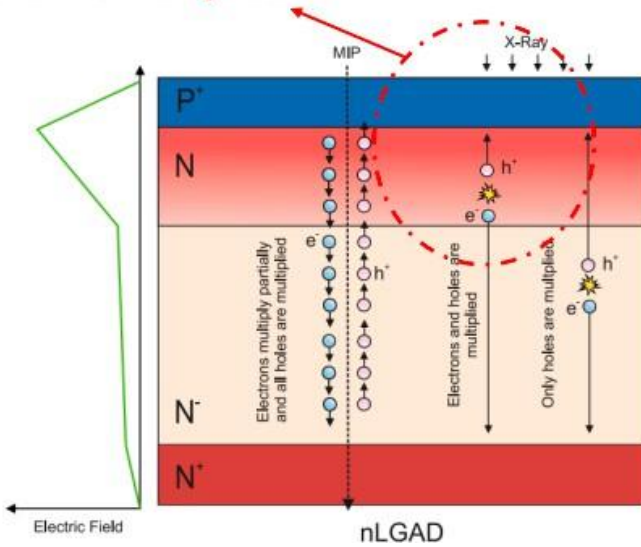


... Passivation thickness needs to be optimized

## n-type Low Gain Avalanche Tehnology

- Shallow-penetrating radiation specific application
- Standard nLGAD design was proven to have good performance (high gain) in the **blue and near UV range**, and **deep UV range** (lower gain 3-5)

### Electron-driven multiplication



1 Khalid, W. et al., *First results for the pLGAD sensor for low-penetrating particles*, *Nucl. Instrum. Methods Phys. Res. A* **1040**, 167220 (2022). <https://doi.org/10.1016/j.nima.2022.167220>

2 Villegas, J., et al. (2025). nLGAD gain response to low-penetrating particles. *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment*, 1072, 170208. <https://doi.org/10.1016/j.nima.2025.170208>

Patent: Pellegrini, G. et al., *Low-penetrating particles low-gain avalanche detector*, [European patent EP 3 971 997 B1](https://patents.google.com/patent/EP3971997B1)

Results implied that surface optimization was necessary

