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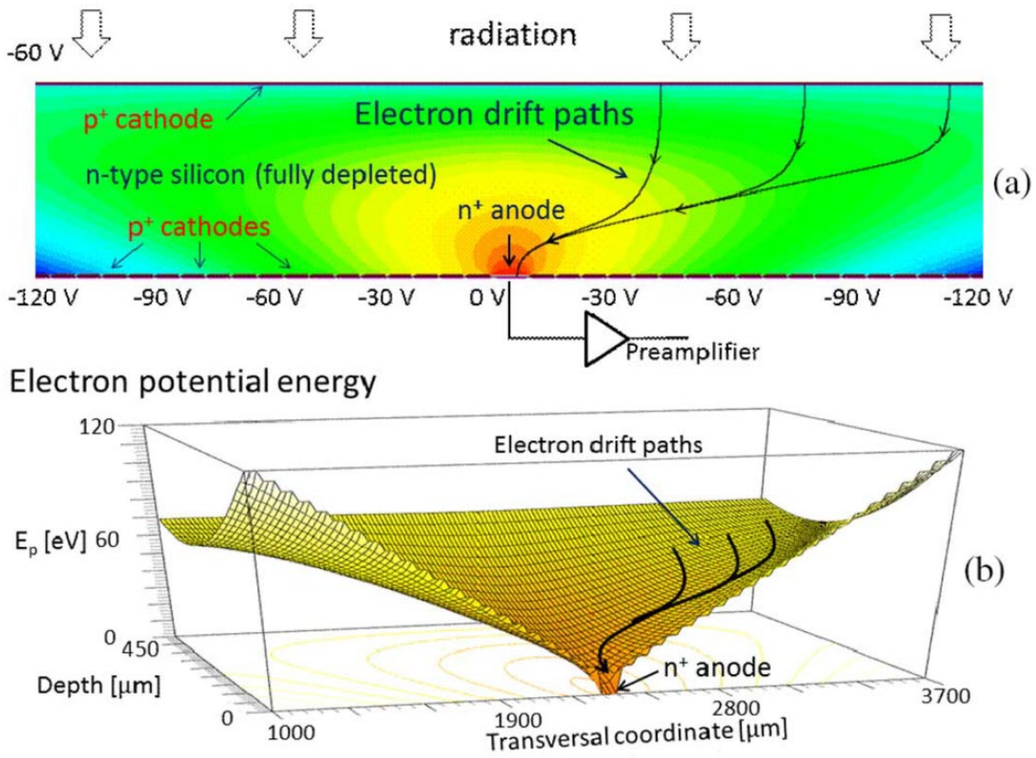
Silicon drift detectors for X-ray timing, imaging and spectroscopy

E. Del Monte[1], F. Ceraudo[1], G. Della Casa[1], G. Dilillo[1], Y. Evangelista[1], M. Feroci[1], G. Lombardi[1], A. Nuti[1], M. Rapisarda[1], R. Campana[2], M. Fiorini[3], V. Bonvicini[4], D. Cirrincione[4], A. Rachevski[4], I. Rashevskaya[5], A. Vacchi[4], G. Zampa[4], N. Zampa[4], M. Centis Vignali[6], E. Demenev[6], F. Ficorella[6], G. Pepponi[6], A. Picciotto[6], A. Samusenko[6], N. Zorzi[6], G. Bertuccio[7], F. Mele[7], M. Grassi[8], P. Malcovati[8]

[1]INAF IAPS (Roma), [2]INAF OAS (Bologna), [3]INAF IASF-Milano, [4]INFN sez. di Trieste, [5]TIFPA (Trento), [6]Fondazione Bruno Kessler (Trento), [7]Politecnico di Milano, [8]Università di Pavia

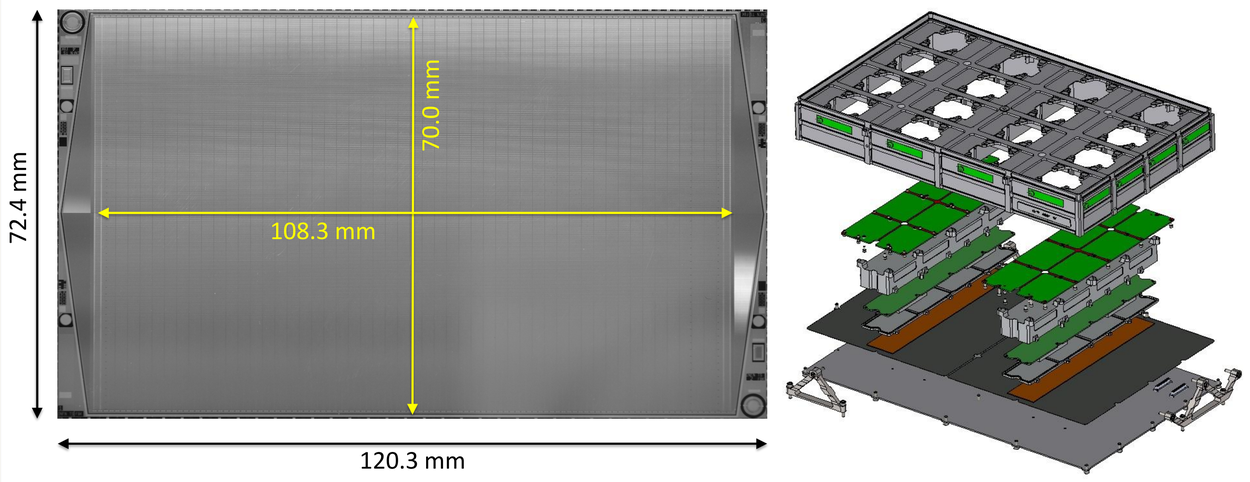
contacts: ettore.delmonte@inaf.it, marco.feroci@iaps.inaf.it, yuri.evangelista@inaf.it

Working principle



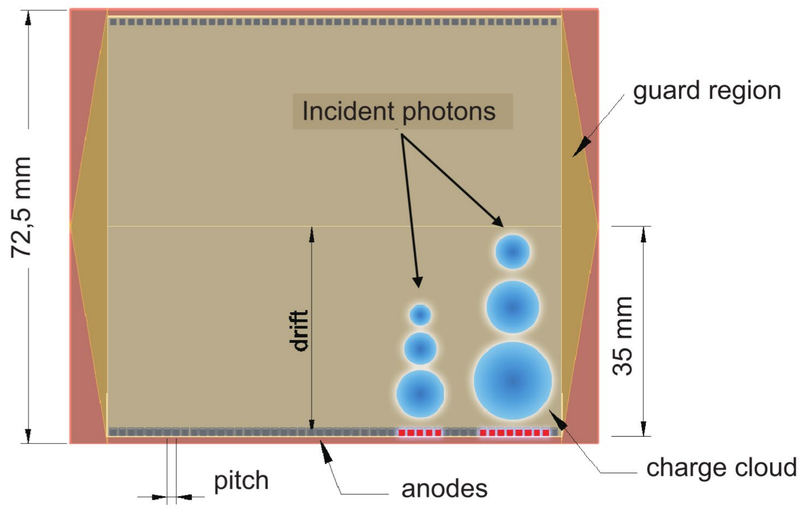
- Silicon Drift Detectors (SDDs) were initially developed for particle physics experiments. We adapted them as detectors for X-ray spectroscopy and timing (G. Zampa et al., NIM A, **633**, 15-21, 2011)
- By applying an electric field, the charge cloud produced by the interaction of a photon "drifts" through the detector bulk toward a set of readout anodes
- With this technique we can produce detectors with ~tens of cm^2 sensitive area and ~tens of fF capacitance → very low electronic noise.

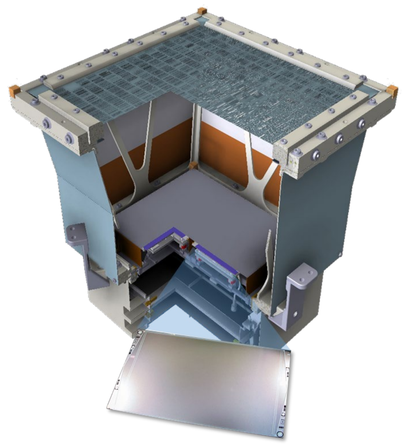
Large Area Detector (LAD)



- Large-area Silicon Drift Detectors are one of the key enabling technologies of the LAD
- The LAD is devoted to X-ray spectral-timing studies in the 2 – 10 keV energy band and has been studied in the context of the LOFT, eXTP and STROBE-X space missions (M. Feroci et al., Procs. SPIE, **10699**, id. 106991C, 2018)
- This instrument is composed of a set of identical and independent Modules, each one including SDDs, X-ray collimators, optical filters, FEE, BEE and PSU.
- The design of the LAD is now mature and has reached a Technology Readiness Level of 5.

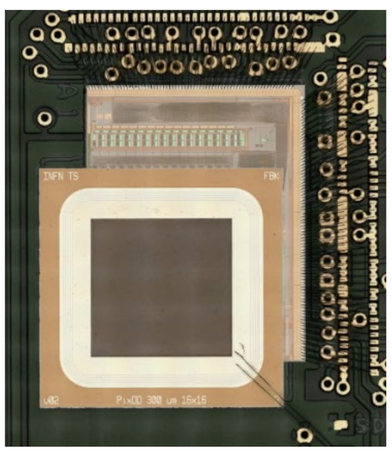
Wide Field Monitor (WFM)

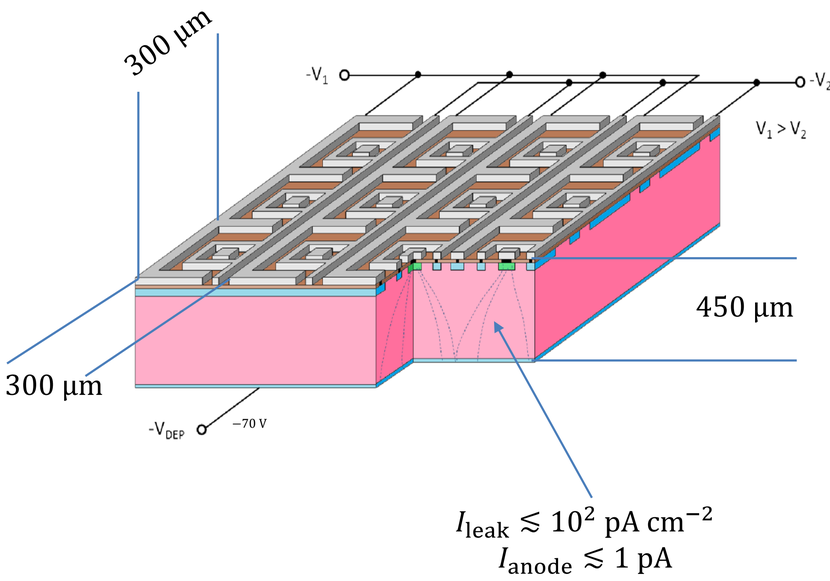




- By reconstructing the width of the charge cloud generated by the X-ray photon and expanded during drift, we can locate the position of the interaction with a resolution of ~25 μm (anode direction) × ~5.5 mm (drift direction)
- By coupling the SDDs to a coded mask at ~20 cm distance, we obtain an X-ray monitor sensitive in the 2 – 50 keV range, with a field of view of ~1 sr and a point-source location accuracy of ~1 arcmin
- We are studying two possible configurations for this monitor: aboard a satellite (WFM) or on the surface of the Moon (LEM-X, see poster by Alessio Nuti).

Pixelated silicon Drift Detector (PixDD)





- PixDD is an SDD-based system for spectral-timing studies and can be coupled to (large-FoV) non-imaging optics:
  - Lobster-eye optics
  - Low-resolution optics (concentrators)
- At the current stage, PixDD is composed of 16 × 16 square pixels of 300 μm side each and is sensitive in the 0.5 – 15 keV energy band (Ceraudo et al., Procs. SPIE 12191, 1219116, 2022)
- The development of a prototype of PixDD has been funded by ASI under the "Progetto premiale Advanced Detectors for x-ray Astronomy Missions (ADAM)".