

Medical Imaging Applications

May 18th 2026

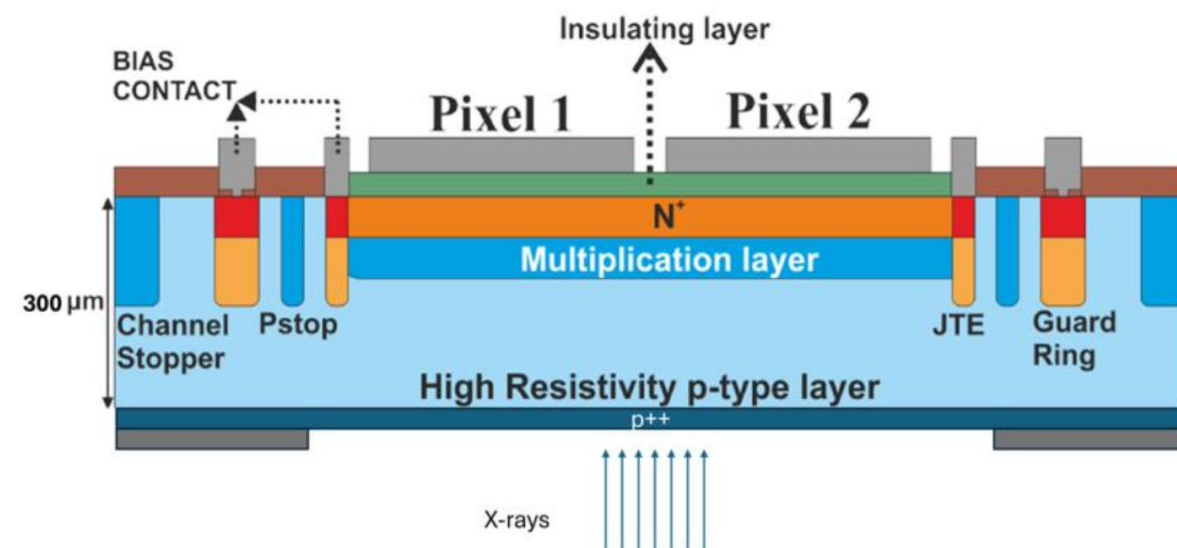
Gerard Ariño Estrada



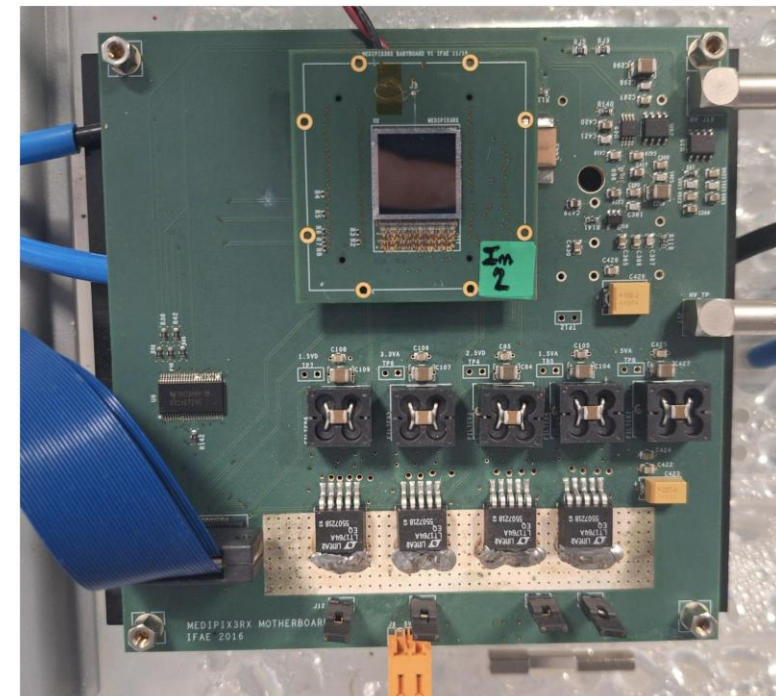
- X-ray detectors for transmission imaging
- ASIC design for medical imaging applications
- Gamma detectors for nuclear medicine

- **X-ray detectors for transmission imaging**
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- **GOAL:** Detect soft x-rays ($E < 1$ keV) with LGAD + Timepix4
- **Coordinated project**
 - **IMB-CNM:** developing novel small-pitch ($55 \mu\text{m}$) LGAD silicon sensors
 - **IFAE:** providing DAQ and expertise for Timepix4, detector integration and characterization
- **IPs FPN2020:** M.Chmeissani and M.Cavalli-Sforza (IFAE), E.Cabruja (CNM)
- **IPs FPN2024:** S.Terzo and M.Chmeissani (IFAE), E. Cabruja and P. Fernandez (CNM)



Low Gain Avalanche Detector (LGAD)
concept pioneered at IMB-CNM

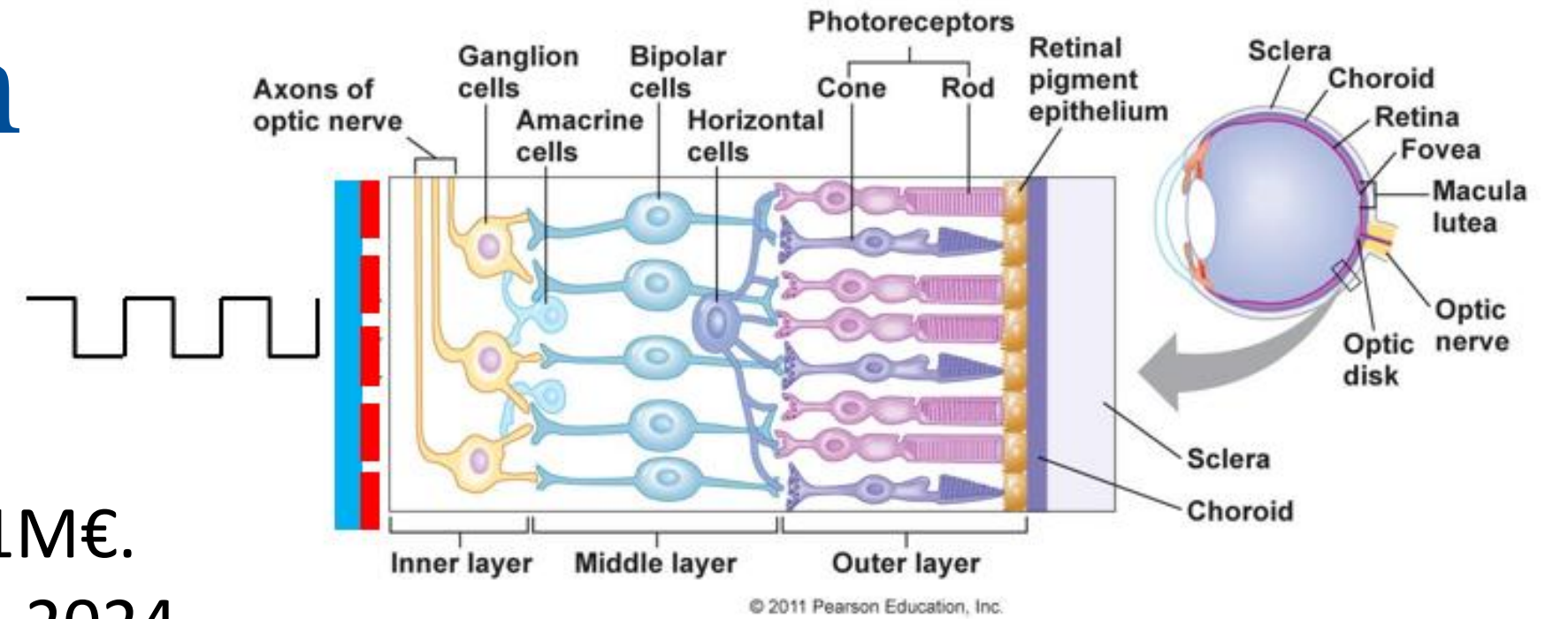


First LGAD prototypes still using Medipix3
chips characterised at IFAE, but not up to
specs (FPN2020). New promising sensors
expected next year (FPN2024)

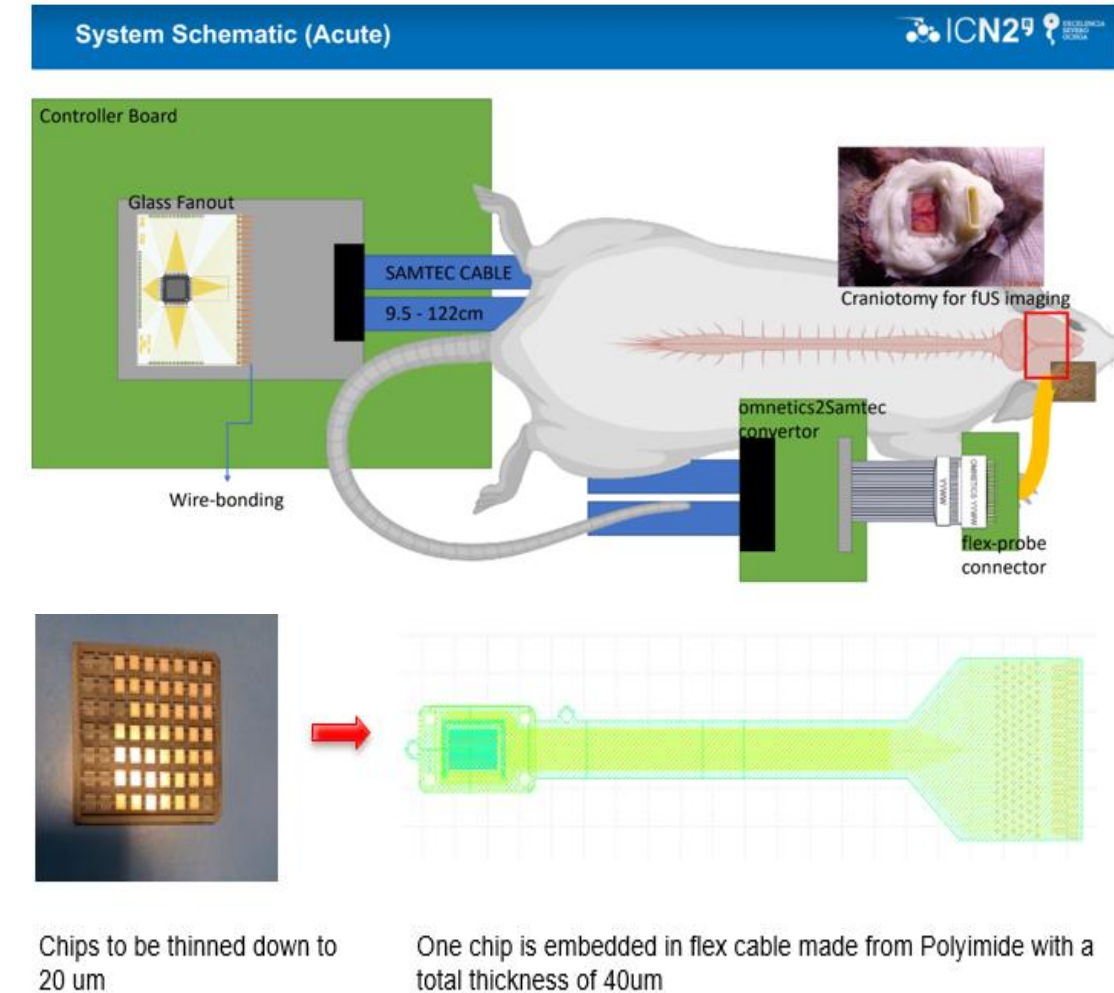
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Retinal Implant i-Vision

- Funded by La Caixa Health Programme. Total fund 1M€. IFAE share is 250k€. Started 01-09-2019, ends 31-09-2024.
- IFAE + ICFO + ICN2, Hospital Barraquer (Barcelona) and Institut de la Vision (Paris) form a consortium to develop Epi-retinal implant
- IFAE role is to develop high density electrodes ASIC to stimulate and to read the retinal ganglion cells.
- IFAE designed an ASIC with **1260** electrodes
- Developed the hardware, firmware, and the Graphic User Interface (GUI) to characterize the ASIC

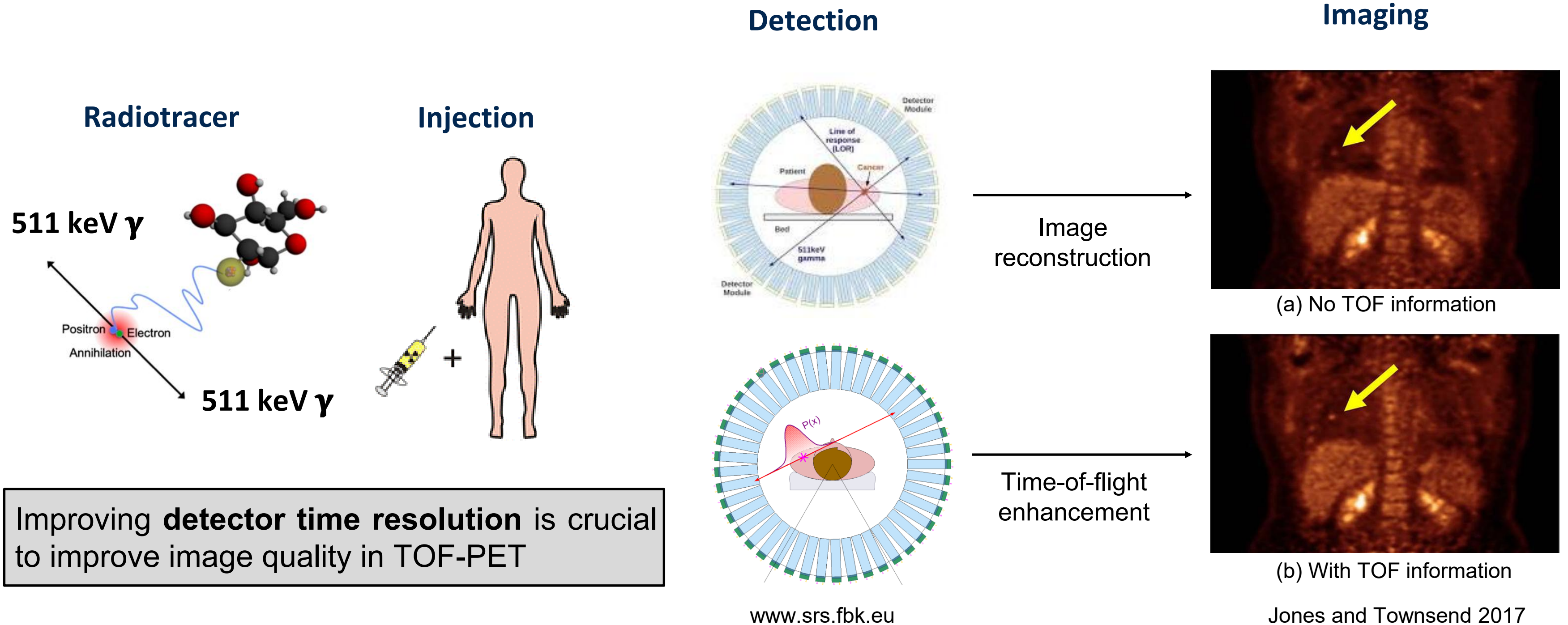


The retina chip will be used to stimulate/monitor rat's brain



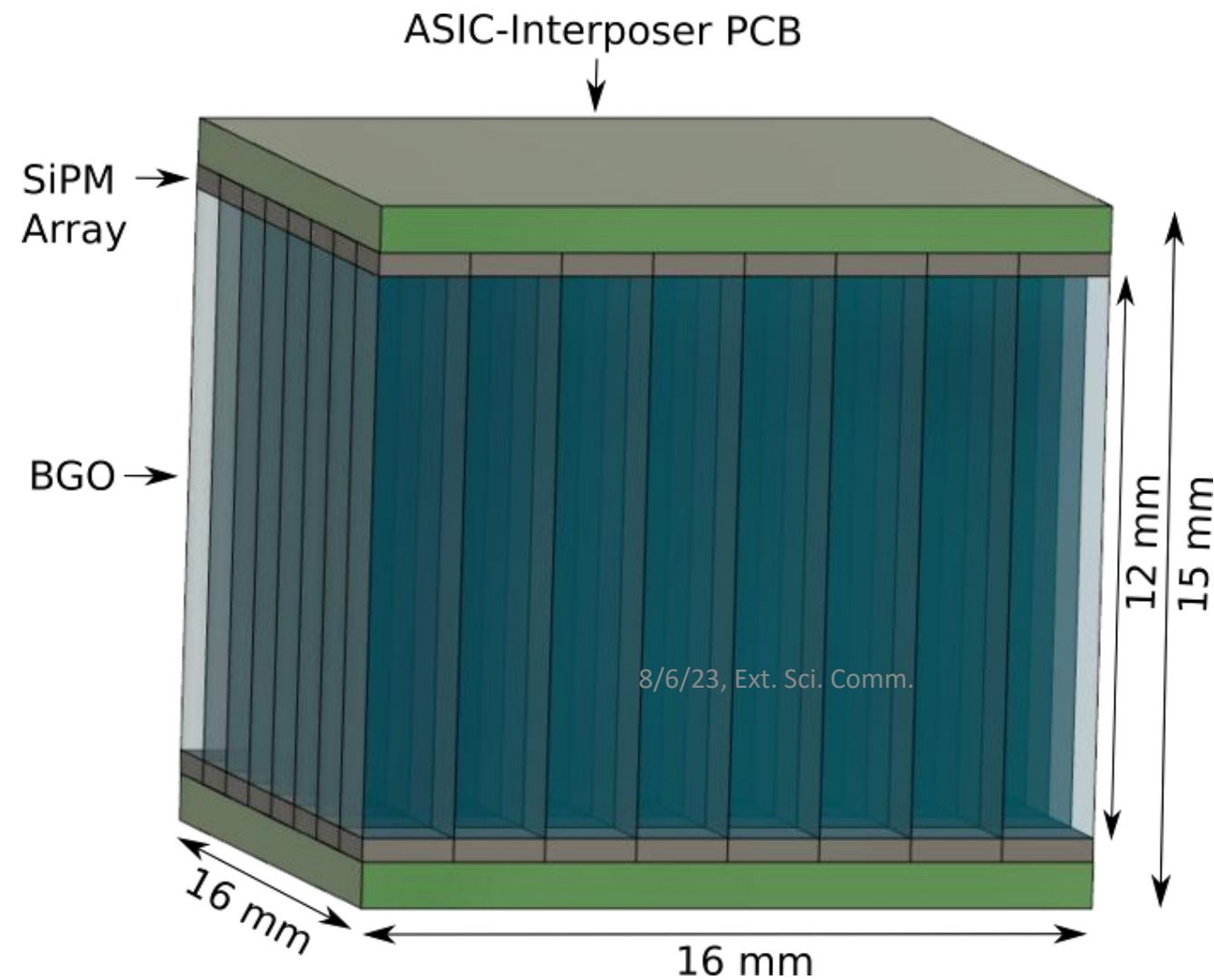
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Time-of-flight Positron Emission Tomography (TOF-PET)



Improving **detector time resolution** is crucial to improve image quality in TOF-PET

Cherenkov Light mOduLE for TOF-PET: CHLOE-PET



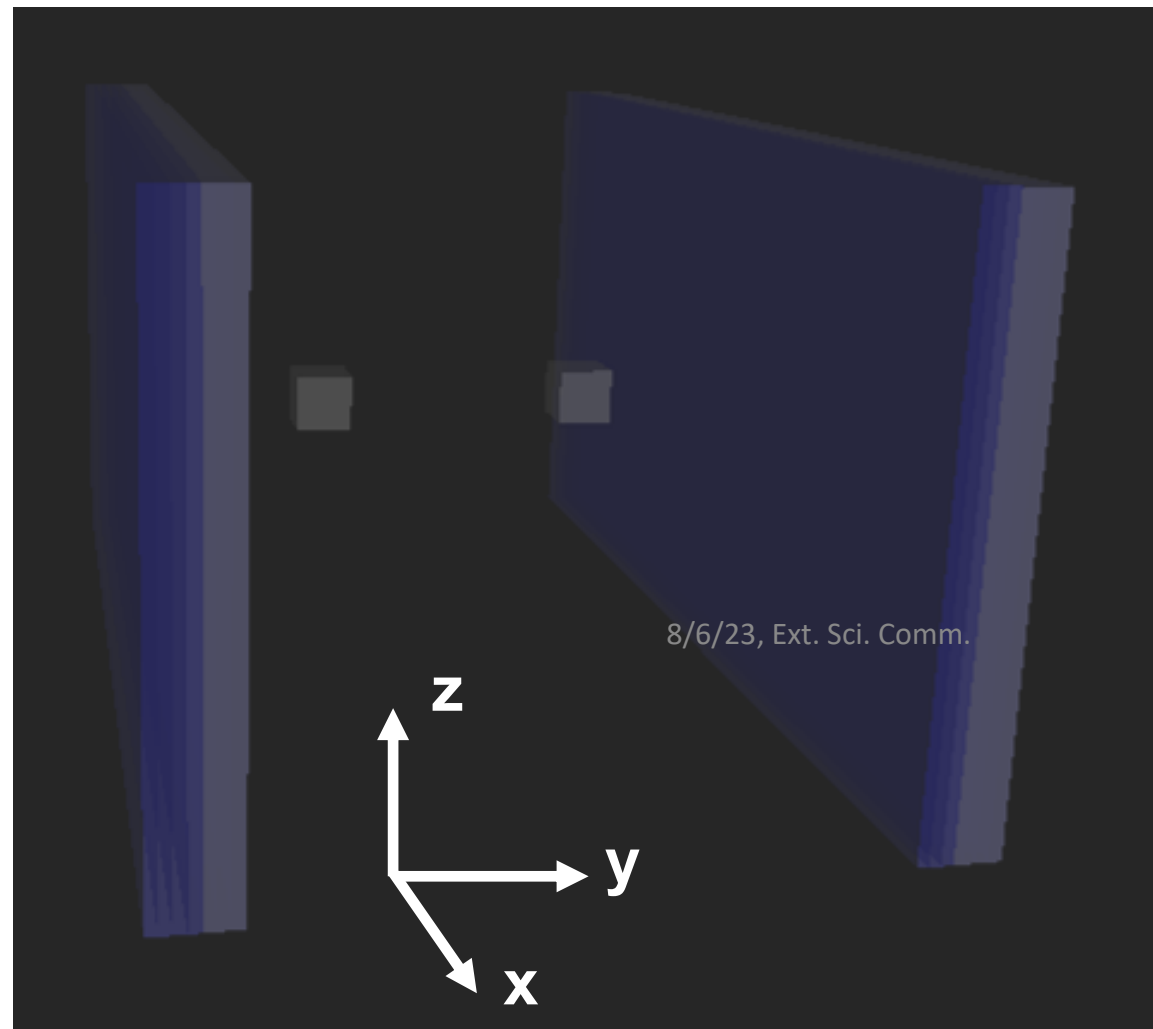
- Effective voxels of $2 \times 2 \times 2 \text{ mm}^3$
- **5x material cost reduction** compared to commercial systems
- Lack of intrinsic radiation background (unlike state-of-the-art systems)

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Beyond Ring-Shaped TOF-PET Scanners

GATE simulation



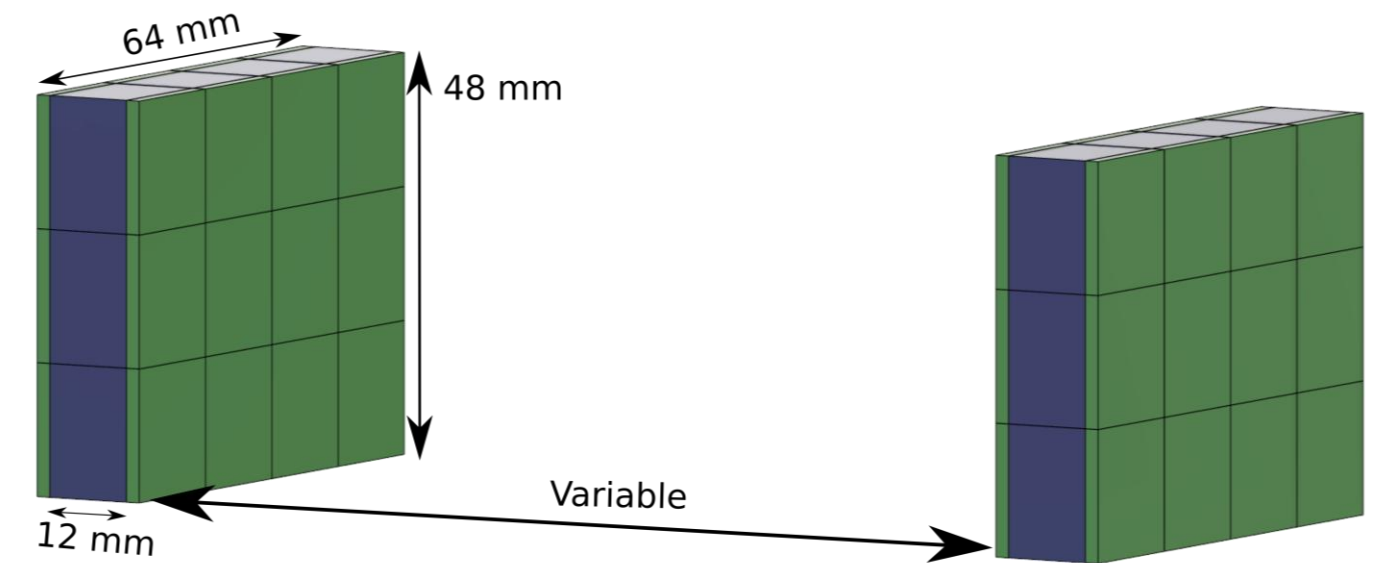
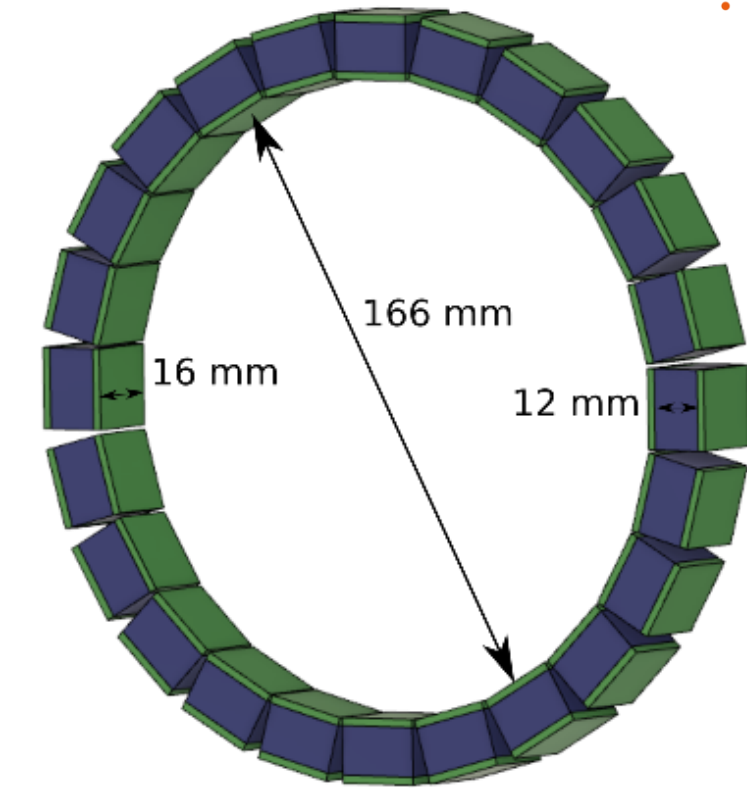
State-of-the-art detectors



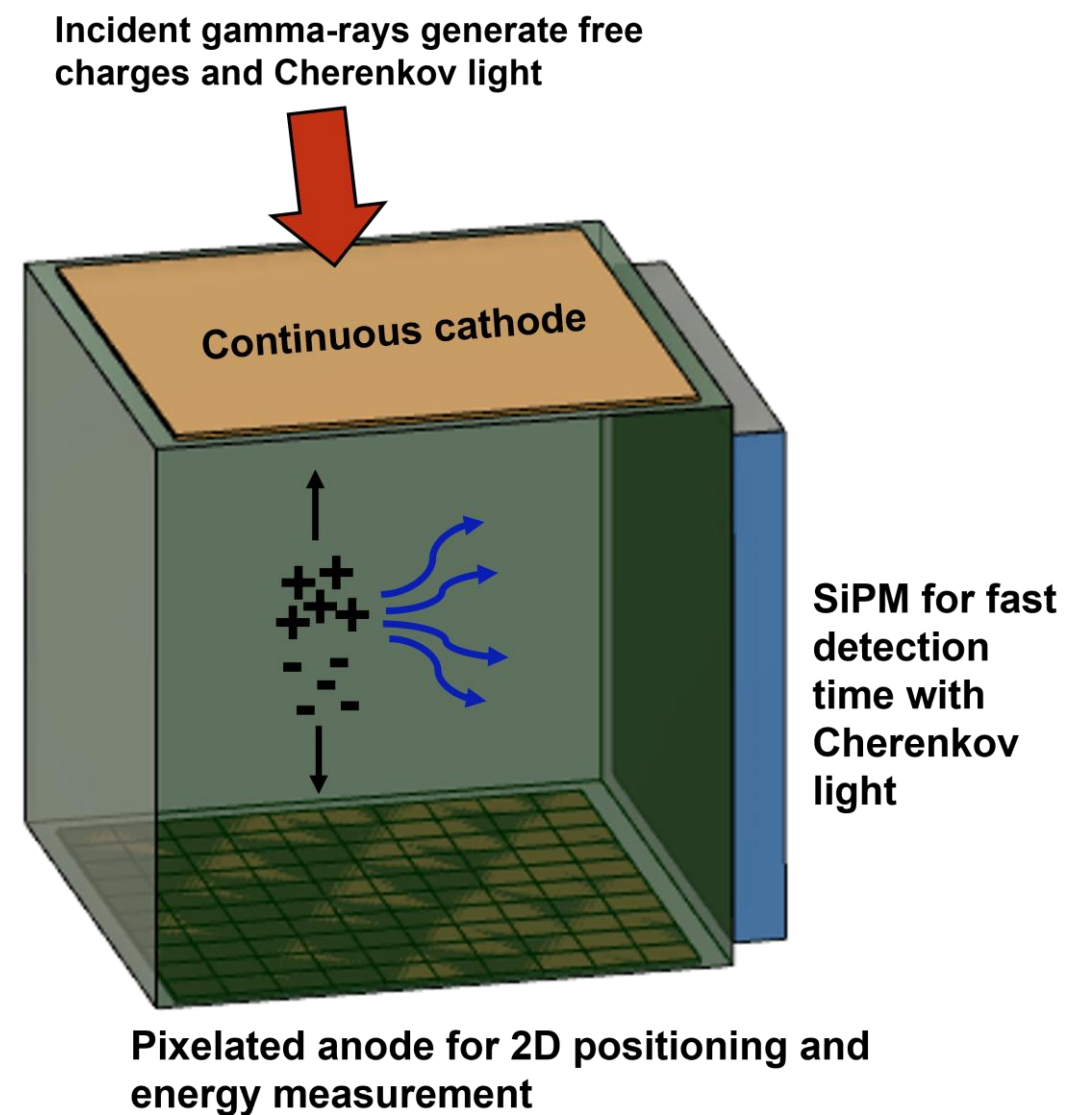
CHLOE-PET



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Voxelized Emission Tomography Scanner with Augmented Time, spatial, and Energy resolution (VERSATILE)



- TOF-PET and SPECT
- Semiconductor technology & Cherenkov readout
- Effective **voxels of $1 \times 1 \times 1 \text{ mm}^3$** (VIP-PIX ASIC)
- Coincidence time resolution **$\sim 300\text{-}400 \text{ ps}$**
- Wide dynamic range (0.1-1 MeV) and energy resolution