

Hadron-2030 Kickoff Meeting

Developments towards the PHILM sensor

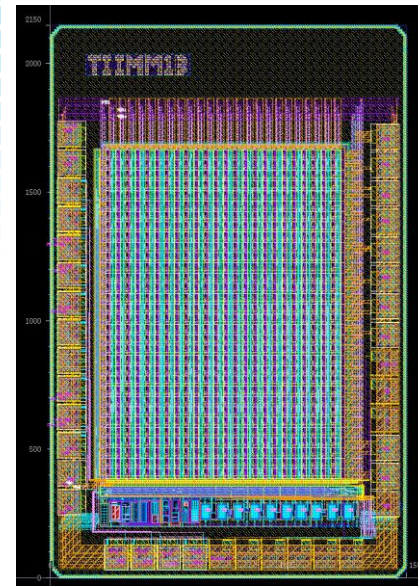
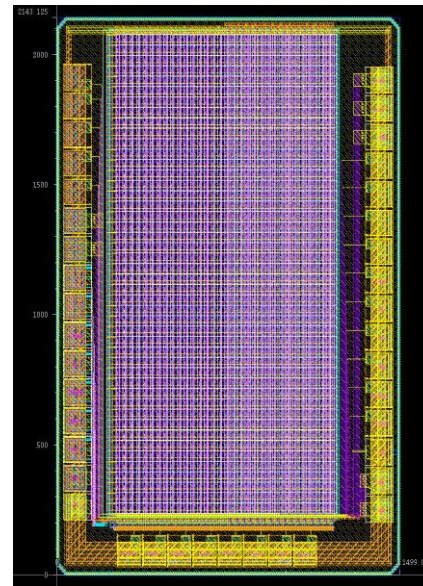
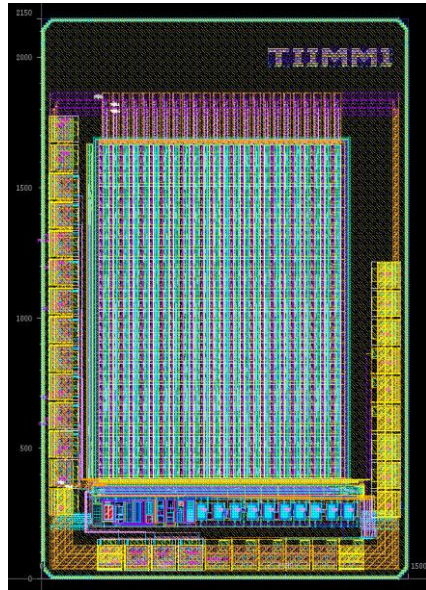
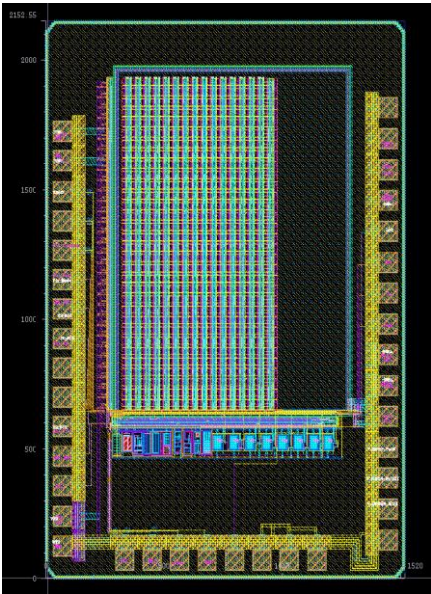
[19/05/2026](#)

Maciek Kachel

TIIMM SENSOR FAMILY

CMOS Monolithic Active Pixel Sensor design in TowerJazz 180 nm process
For position and energy measurements

- First submission: preliminary prototype (TIIMM0) submitted in March 2020.
- Second submission: TIIMM0/TIIMM1/TIIMM1A/TIIMM1B prototypes received in August 2022



7 sensing layer variants

Thickness	Process	
25 μm Epi High Res.	Standar	1. Non-uniform N- layer 2. Uniform N- layer + Extra Deep
50 μm Epi High Res.		1. Non-uniform N- layer 2. Uniform N- layer + Extra Deep P
100 μm Epi High Res.		1. Non-uniform N- layer 2. Uniform N- layer + Extra Deep P

TIIMM0 (second submission)
Chip area: 2.2 mm * 1.5 mm
Matrix: 32 (rows) * 16 (col)
Pixel pitch: 40 μm × 40 μm

TIIMM1 sensor
Chip area: 2.2 mm * 1.5 mm
Matrix: 32 (rows) * 24 (col)
Pixel pitch: 41.2 μm × 40 μm

TIIMM1A sensor
Chip area: 2.2 mm * 1.5 mm
Matrix: 46 (rows) * 32 (col)

TIIMM1B sensor
Chip area: 2.2 mm * 1.5 mm
Matrix: 32 (rows) * 24 (col)
Pixel pitch: 41.2 μm × 40 μm

Corrected from the first submission

New front-end

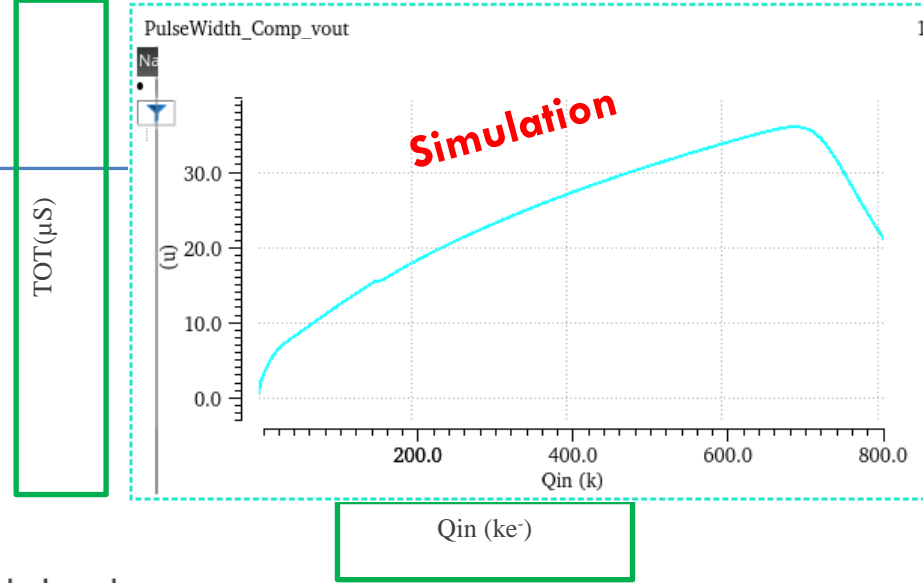
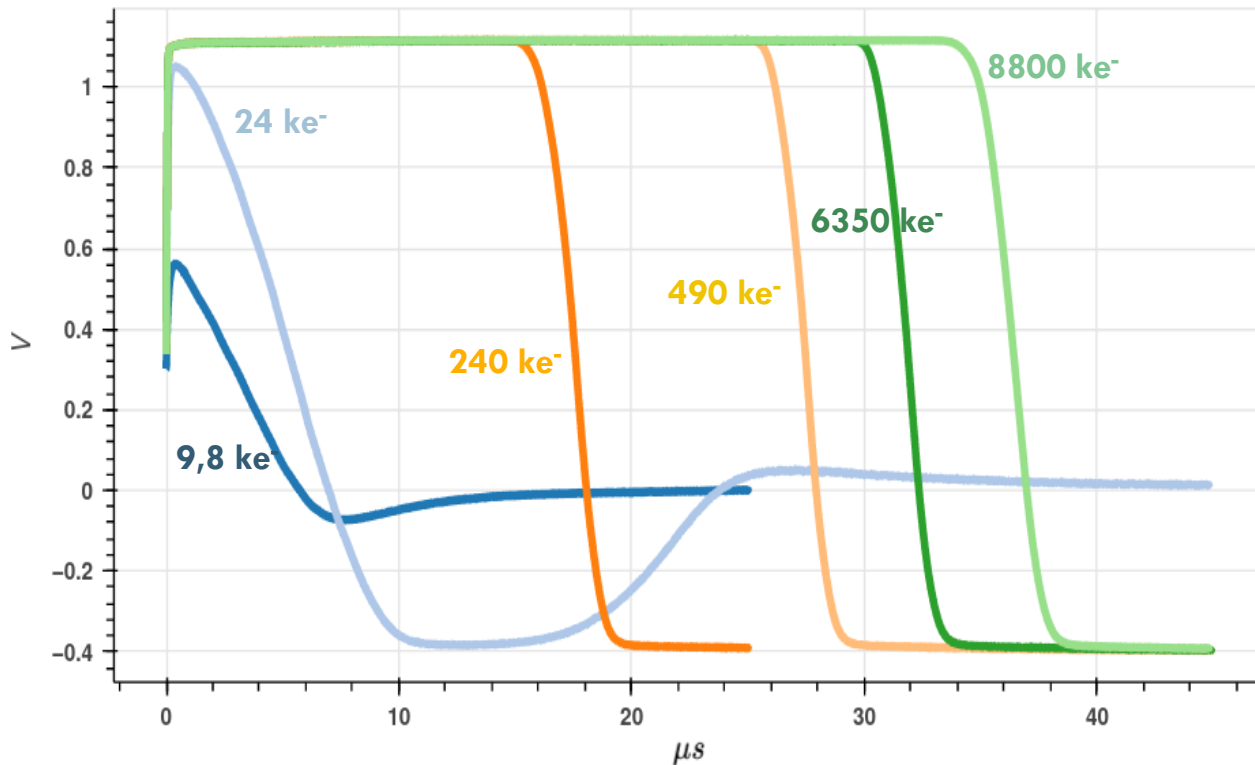
New front end
Analog part study only

New front-end enhanced

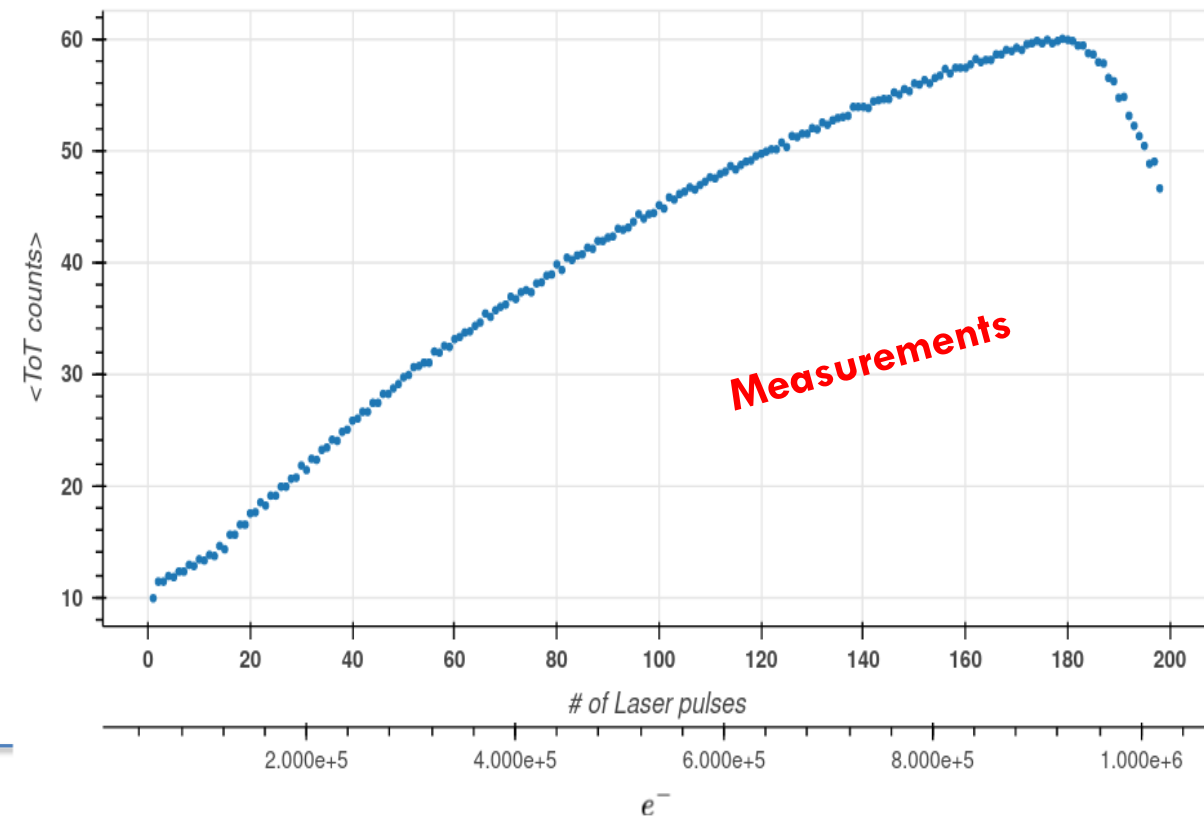
TIIMM1B –Laser tests

Energy loss measurement (TOT)

Charge Sensitive Amplifier output voltage (oscilloscope)



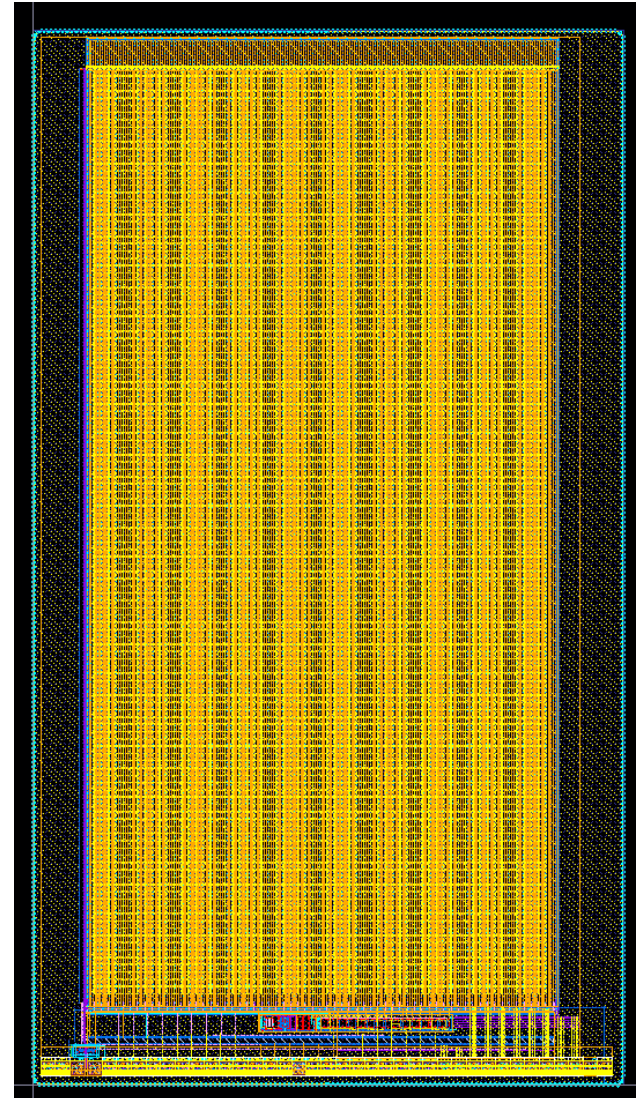
TIIMM1B ToT under Laser beam



Range of measured charges on single pixel: $\sim [500e^- , 900Ke^-]$

IMPACT sensor

- Analog front end => TIIMM1B
 - Linearity up to $\sim 800 \text{ ke}^-$
- Digital => TOT measurement:
 - 12-bit per pixel (\uparrow from 6-bits in TIIMM)
 - Single hit/Accumulation counting
- Design for Test:
 - Pixel pulsing (analog/digital)
 - Pixel masking
- Matrix:
 - 128x64 pixels of $50 \times 50 \mu\text{m}^2$
 - Active area = $6.4 \times 3.2 \text{ mm}^2$ (**16x** from TIIMM)
- 8 digital outputs @ 50MHz => 4k frame rate



Foreseen delivery July 2026

Planning

- Now: Readout system development at IPHC (=> MK)
- From mid August 2026 – first tests of the IMPACT sensor
 - Fe55/Sr90 sources => laser => Cyrce (protons up to 26 MeV)
- From October 2026 - Measurement campaign (PhD student(s))
- Beam tests?
- Mid 2027 - PHILM sensor specifications, based on :
 - Measurements results of IMPACT
 - Partners requirements
- Design of the PHILM sensor