

ALCOR: a SiPM readout chip for the ePIC-dRICH detector at the EIC

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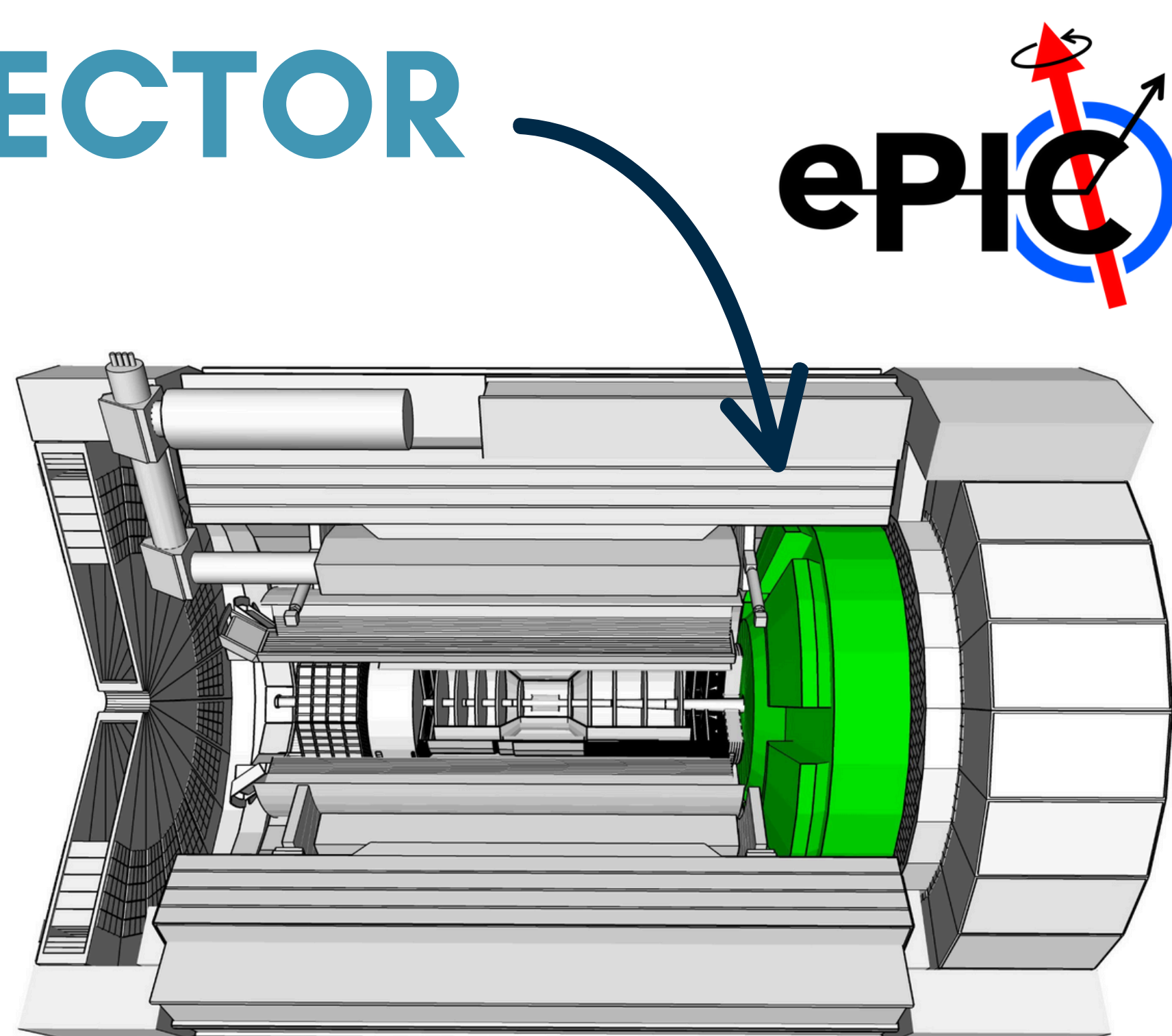
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on behalf of the ePIC-dRICH Collaboration

ePIC dRICH DETECTOR

The dual-radiator RICH detector is a compact and cost-effective solution for **broad momentum coverage at forward rapidity**.

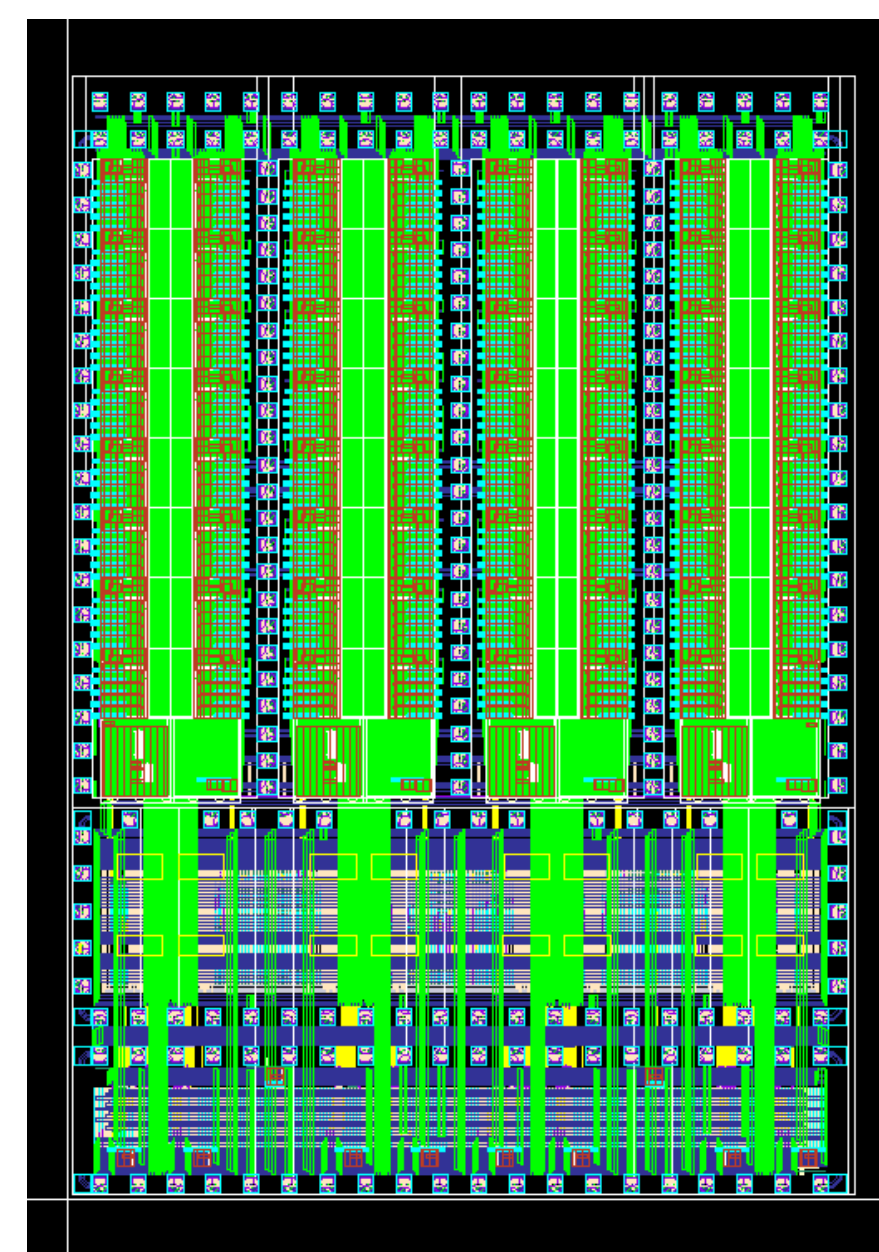
The photodetector is made of approximately **3 m² of SiPM sensors** for a total of more than **300 k readout channels**



ALCOR-64

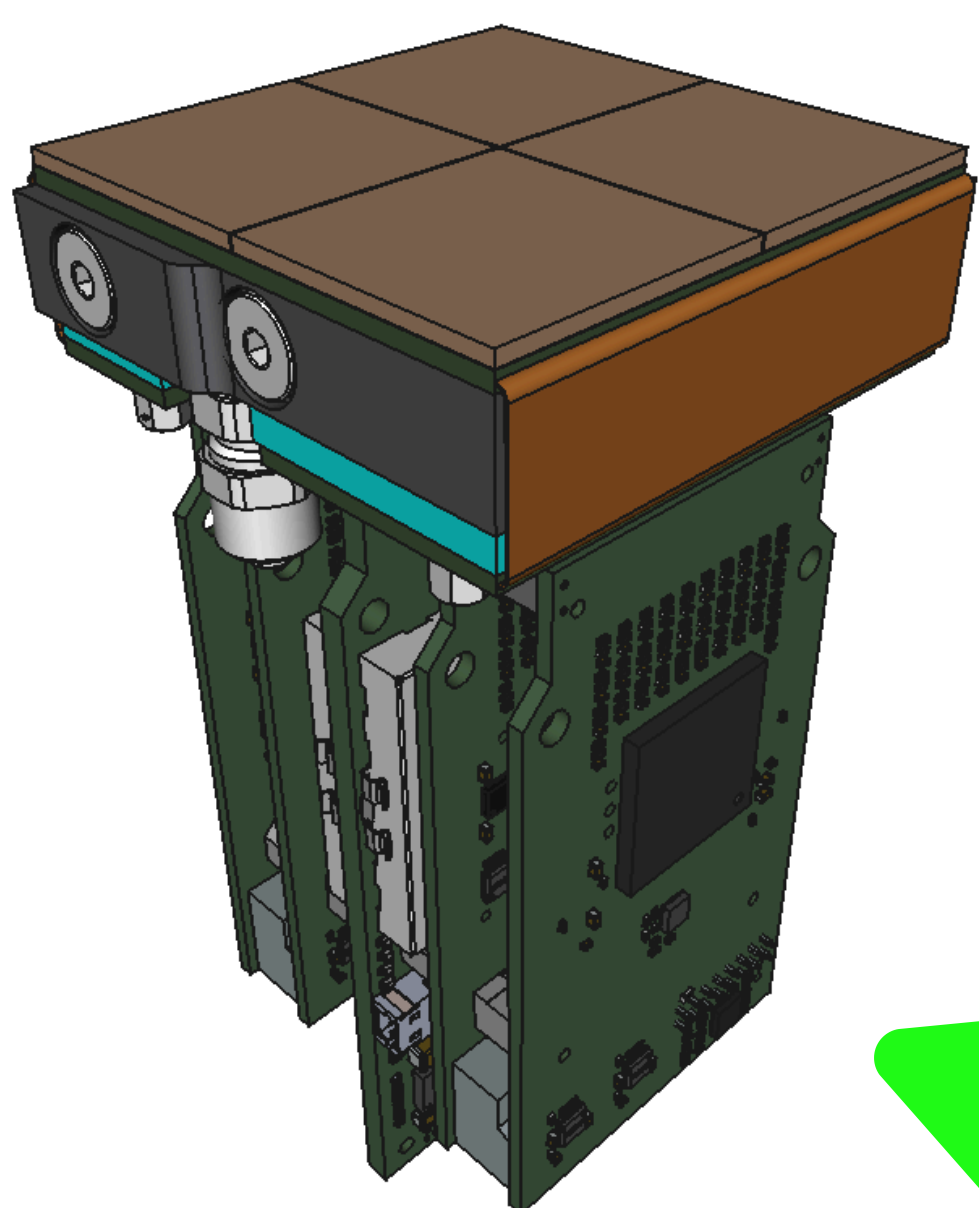
Is a 64-pixel matrix mixed-signal ASIC designed in 0.11 μm CMOS technology for **single-photon time tagging**, featuring

- on-chip signal amplification
- time-over-threshold
- trigger-less readout
- fully digital output
- 12 mW/channel consumption



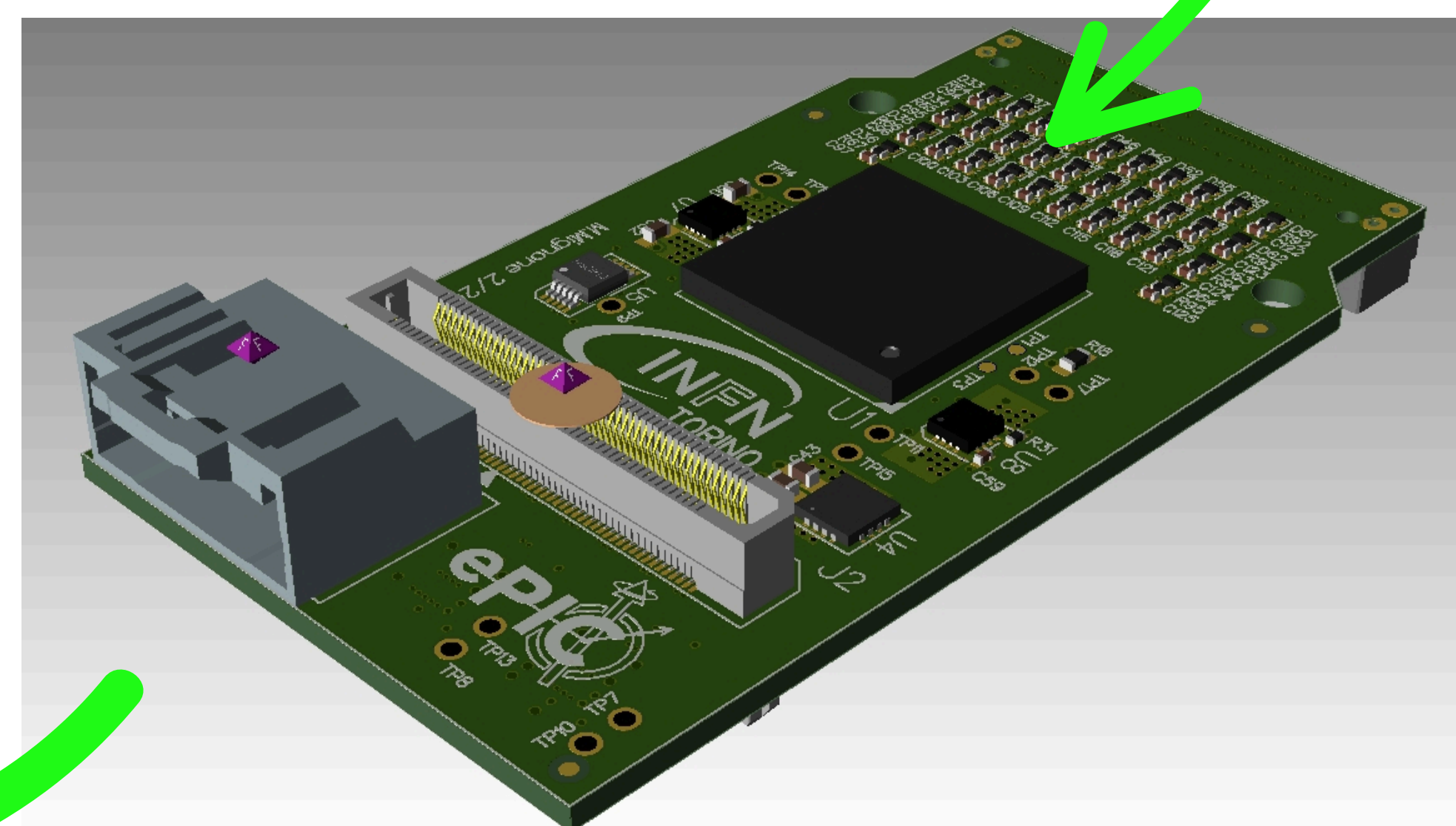
PHOTODETECTOR UNIT

Designed to host and readout 4x 64-channel SiPM arrays for a total of **256 channels**. Provides **cooling** to the sensors and routing of the signals towards the electronics bay, composed of four ALCOR-64-based **front-end electronics** cards and one FPGA-based **readout board** with connections towards LV and DAQ.



FRONT-END BOARD

ALCOR-64 chips are encapsulated into 256-ball 17x17mm² 1mm-pitch BGA packages and mounted onto **almost 5000 front-end electronics boards** for dRICH.

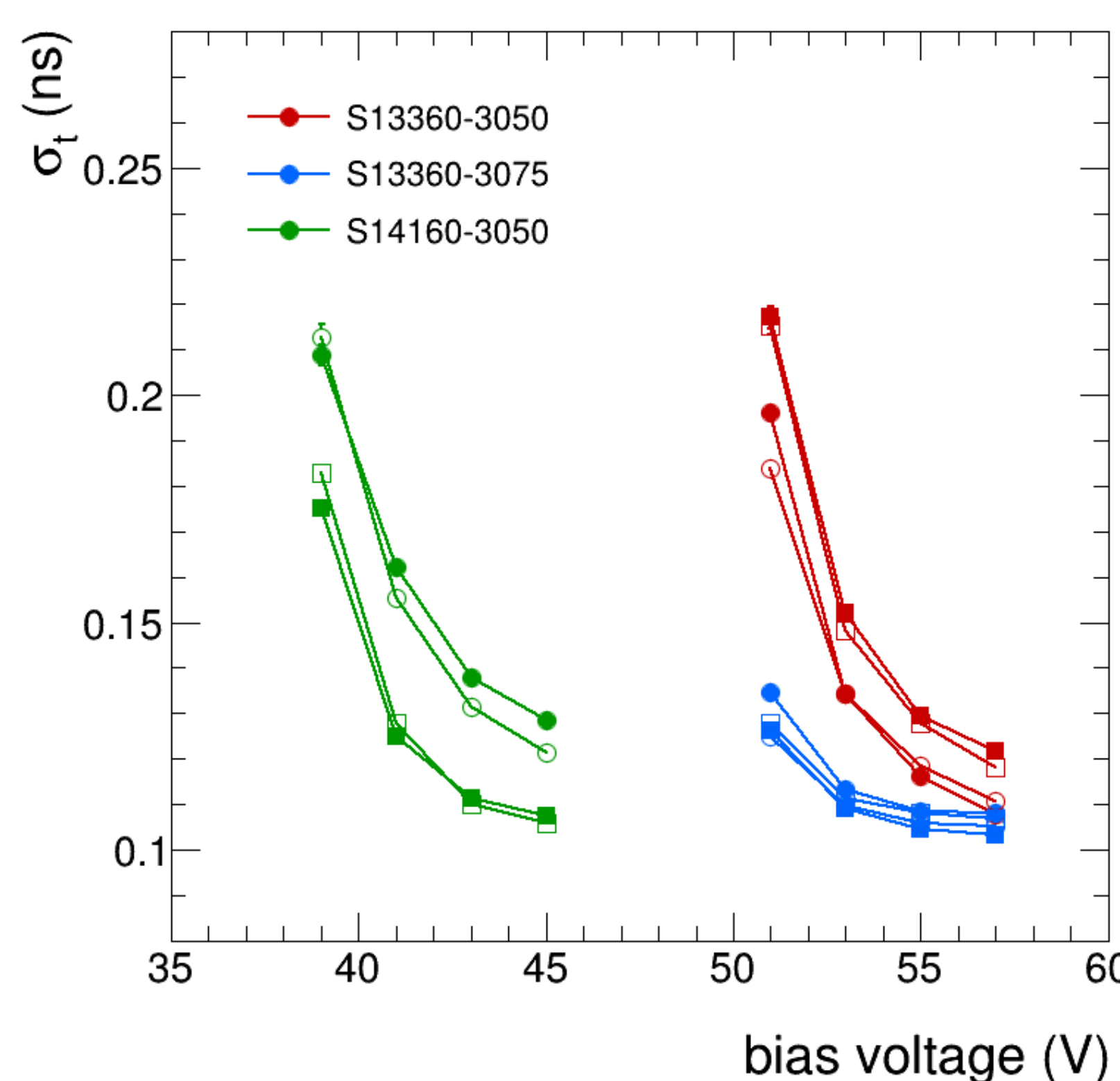


TIMING PERFORMANCE

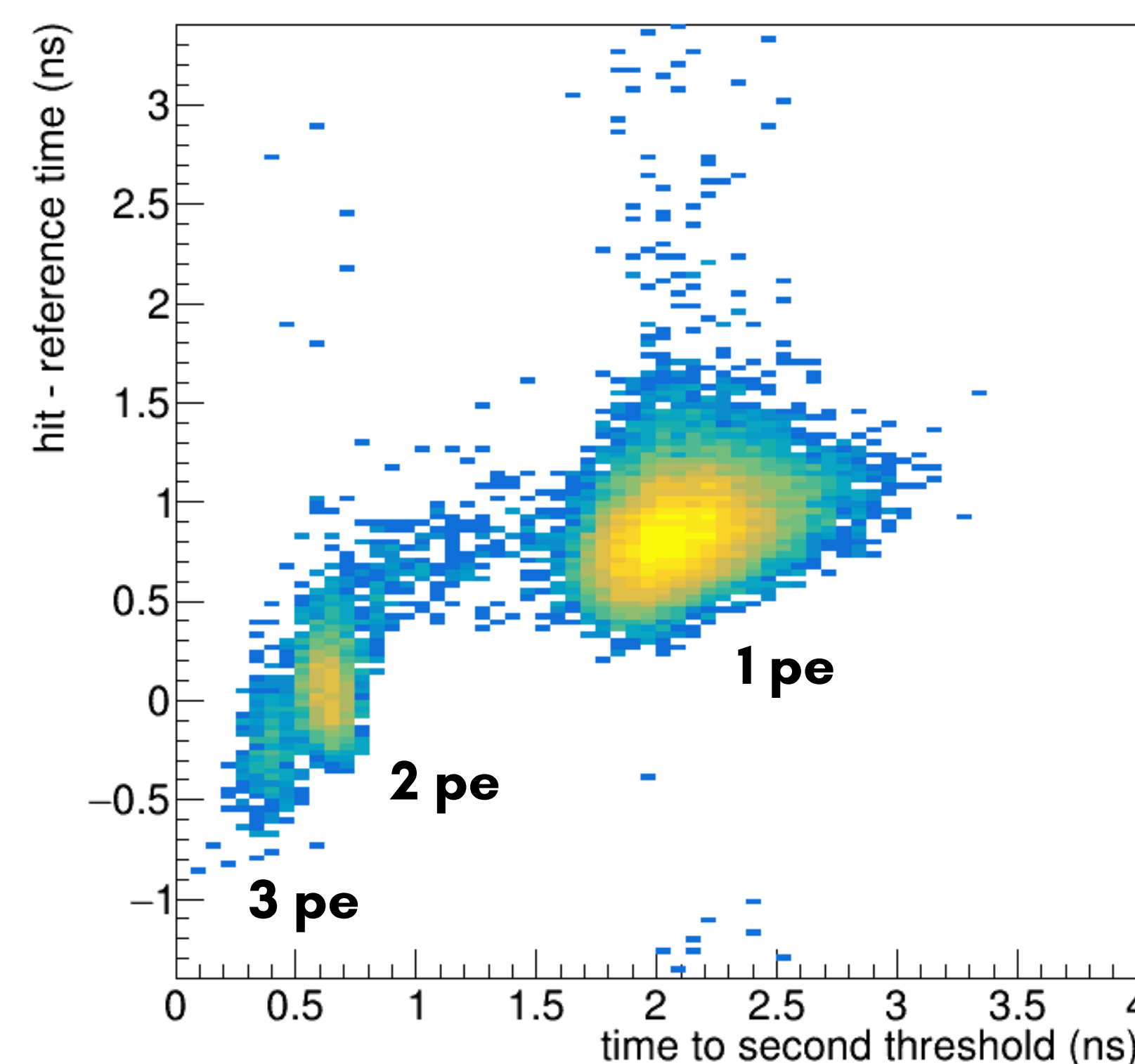
Measurements performed with single-photon laser events in the laboratory show that the overall **time resolution is comfortably below 150 ps RMS**, even for low bias voltages. Better time resolution is achieved with large-SPAD SiPM sensors, given their larger signals and faster slew-rate.

Time-walk correction using the **slew-rate mode** capabilities of ALCOR provides a very good response, allowing us to clearly **distinguish between after-pulses** (slow-rise time, large ToT) **and cross-talk** (fast rise-time, large ToT).

laser time resolution measurements

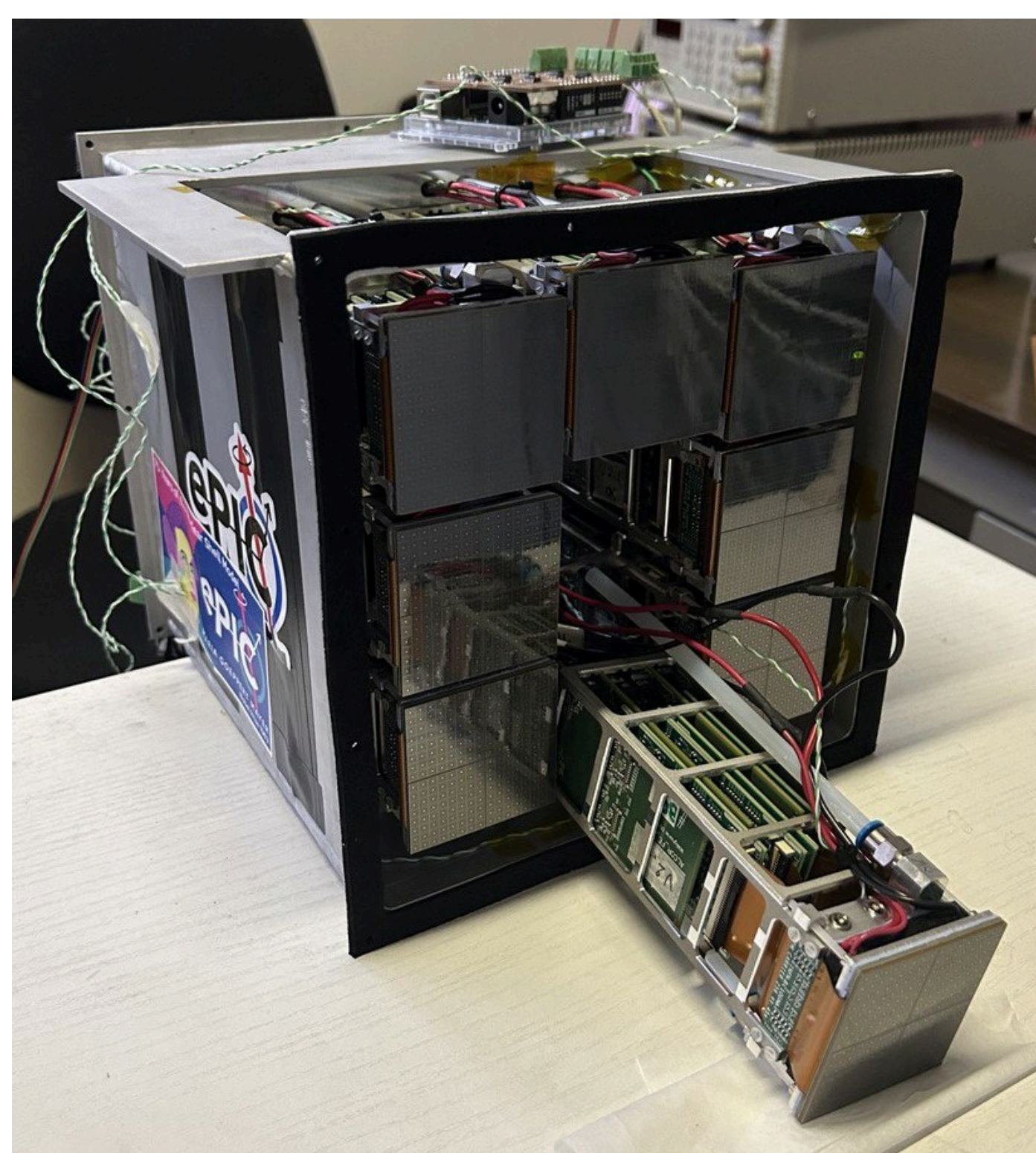


time-walk correction vs. slew-rate

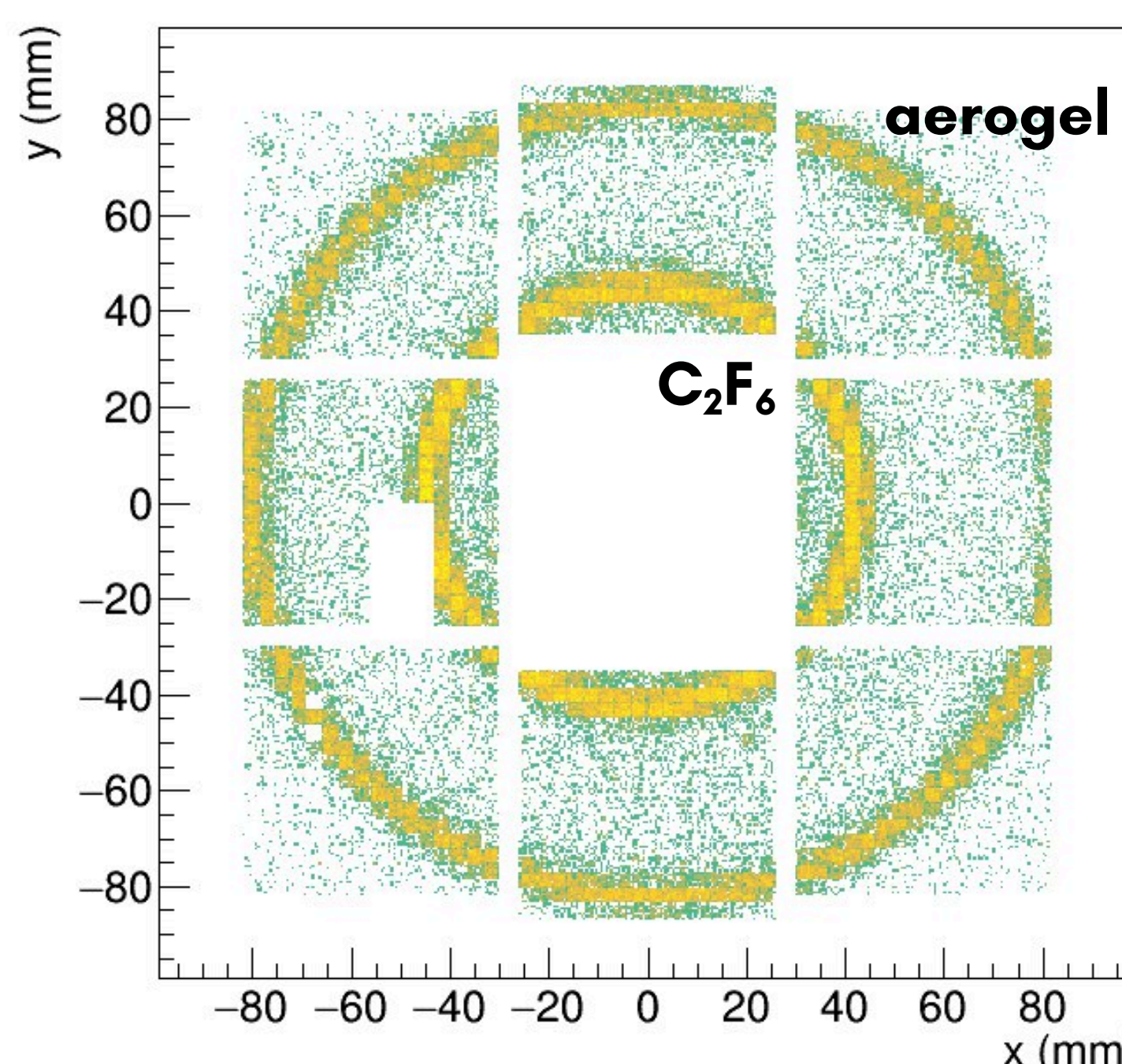


BEAM TESTS

Two recent **successful beam tests** in 2023 and 2024 at CERN-PS with the dRICH detector prototype equipped with **more than 2k SiPM sensors** and **ALCOR readout** confirmed the capabilities for ring-imaging and particle-identification.



accumulated events detector hit map



reconstructed radii vs. beam momentum

