

DEVELOPMENT OF A LIDAR RECEIVER UNIT

LIROC-PICOTDC Readout System

Salleh AHMAD, ⁽¹⁾ Tasneem SALEEM, ⁽¹⁾ Amar HADAR, ⁽¹⁾ Aymeric PANGLOSSE, ⁽²⁾ Florent PEREZ, ⁽¹⁾ Alex MATERNE, ⁽²⁾ and Julien FLEURY ⁽¹⁾

⁽¹⁾ Weeroc, Villebon-sur-Yvette, France

⁽²⁾ Service Opto-Électronique de Détection (DTN/TPI/OED), CNES, Toulouse, France

Abstract: LIDAR receivers require a large dynamic range to detect single photons and measure laser echoes. Weeroc has developed a readout system for LIDAR applications using a Silicon Photo-Multiplier (Si-PM) 8x8 array detector and a 64-channel ASIC called Liroc, combined with picoTDC [1] for high-resolution time measurement. The Liroc-picoTDC system can measure a wide photon flux dynamic range and provides improved time resolution compared to conventional TDC [2]. The system is now installed at CNES and is running well, acquiring Time over Threshold (ToT) and Time over Arrival (ToA) information of received photons.

1 - LiDAR system for space application

- LiDAR is Light Detection And Ranging is a method uses light in form of pulsed laser to measure distances to Earth, e.g. topography and atmospheric studies

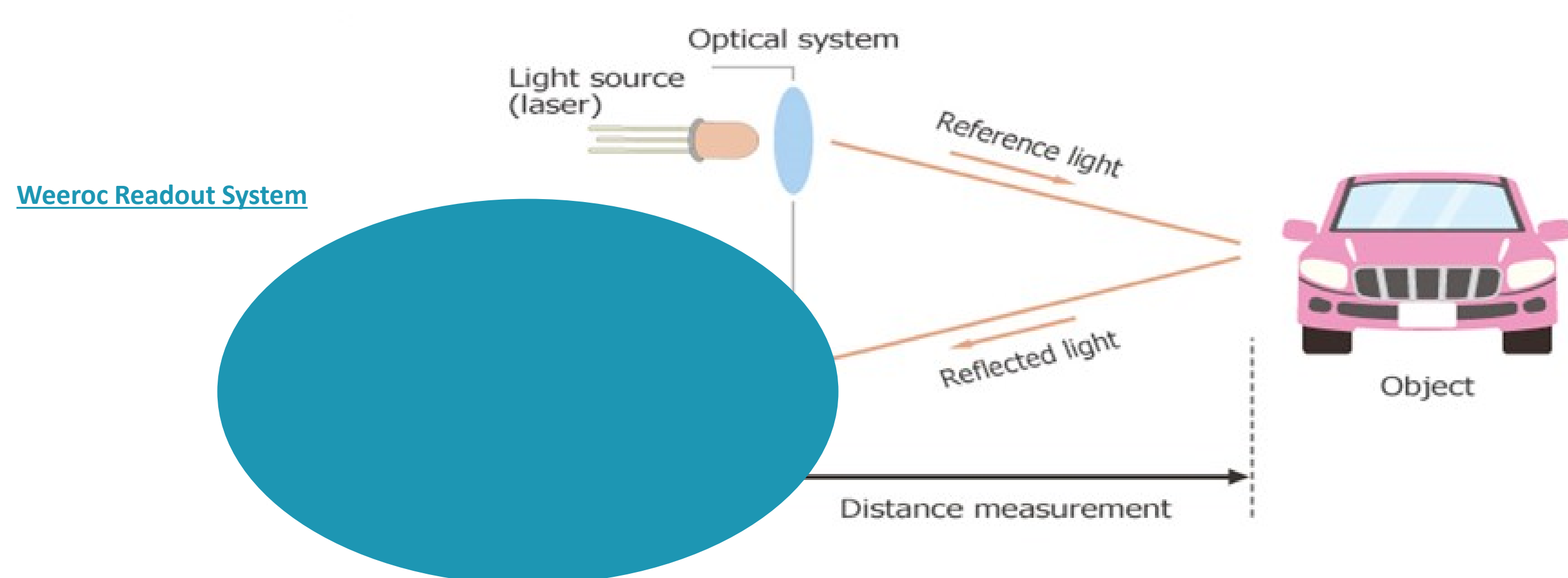


Fig. 1 : LiDAR System with Weeroc Readout System, based on the Liroc ASIC and picoTDC, process the SiPM signals

2 – Liroc-PicoTDC System Development

- The system is based on one of Weeroc latest ASICs, namely Liroc, combined with a PicoTDC.

Detector Read-out	SiPM, SiPM Arrays
Number of channels	64
Signal/HV polarity	Positive or Negative
Charge sensitivity	1/3 p.e or 50 fC
Maximum charge	100 p.e at gain 106 or 16 pC
Energy estimation	Time-over-Threshold
Best timing resolution demonstrated [2]	SPTR 90 ps FWHM
Package	BGA 20x20 mm (flip-chip low inductance technology)
Power consumption per channel	2.9 mW
Programmable features	Channel-wise HV & trigger threshold adjustment
Specificities	Pole-Zero Cancellation circuit

Tab. 1 : Liroc Features

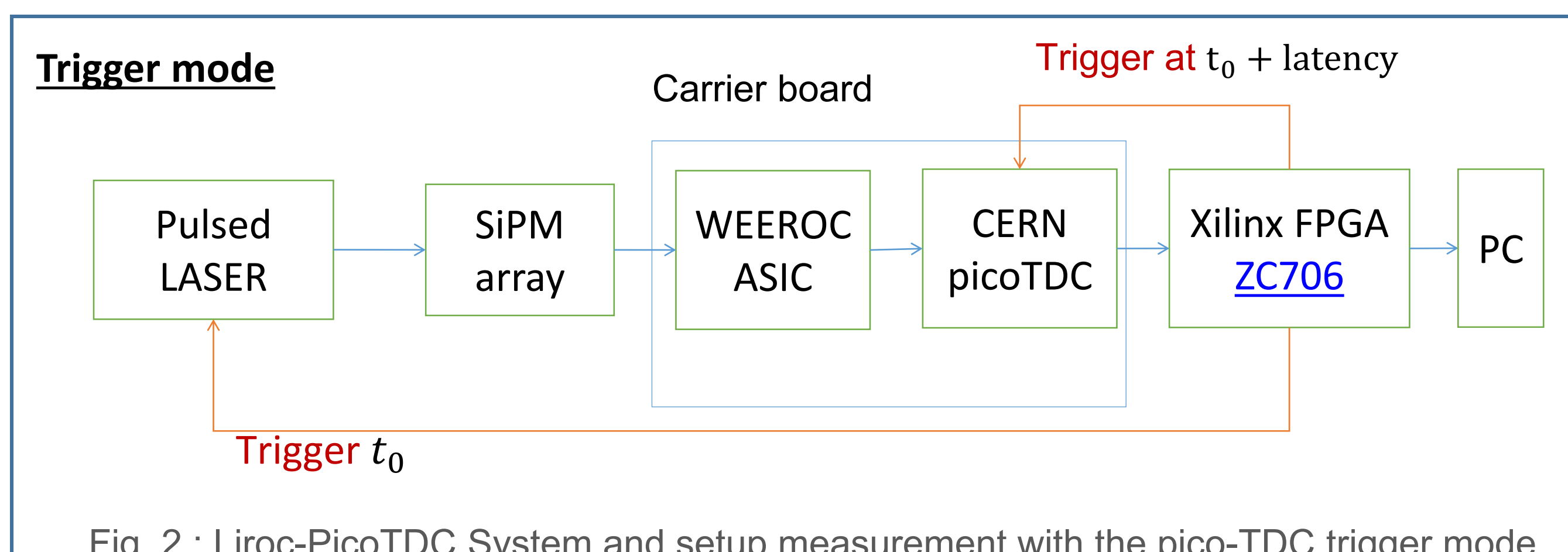


Fig. 2 : Liroc-PicoTDC System and setup measurement with the pico-TDC trigger mode

References:

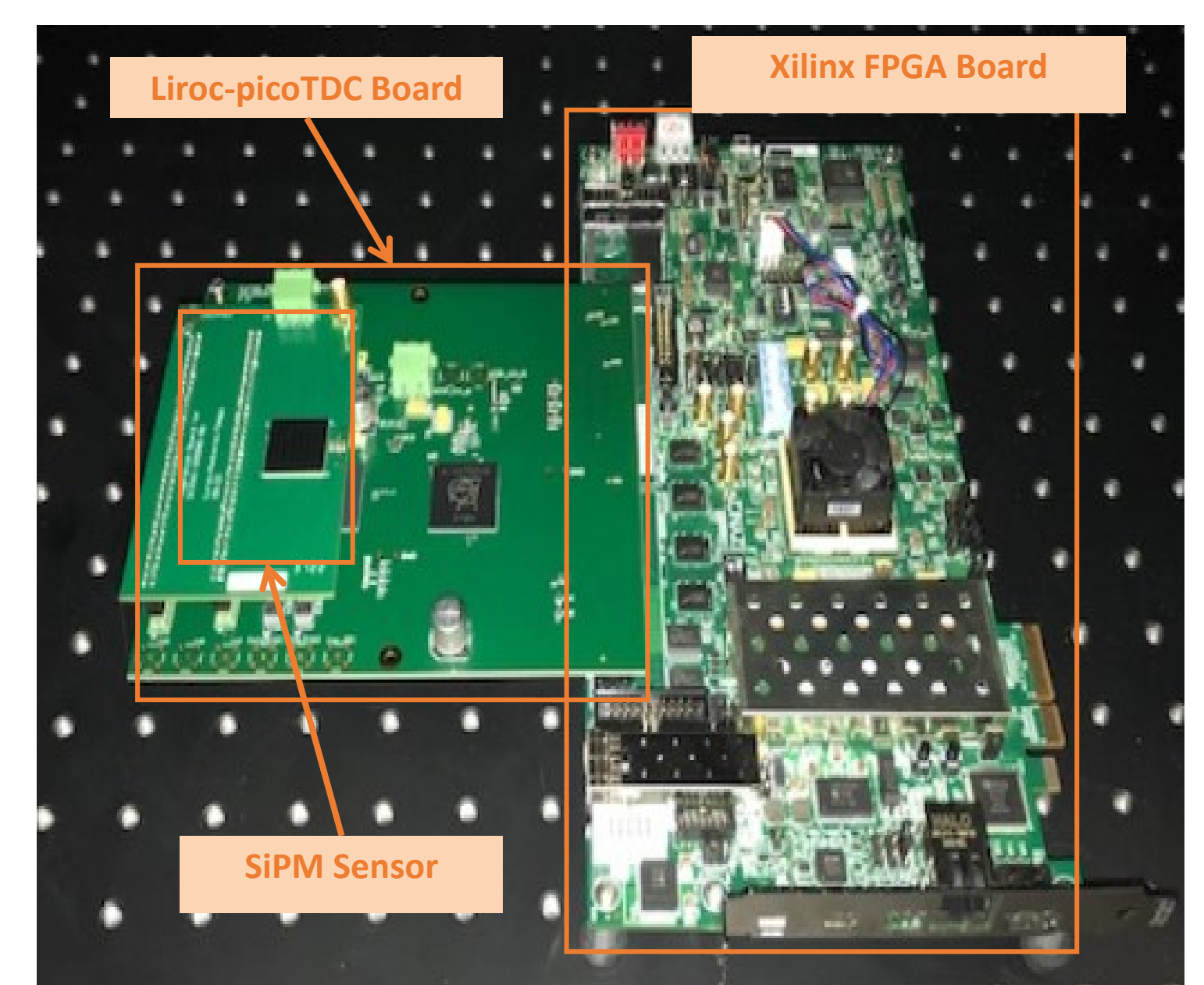
- [1] Samuele A. et al, JINST. 2023, 18, (P07012).
[2] Saleem T. et al, JINST. 2023, 18, (P10005).



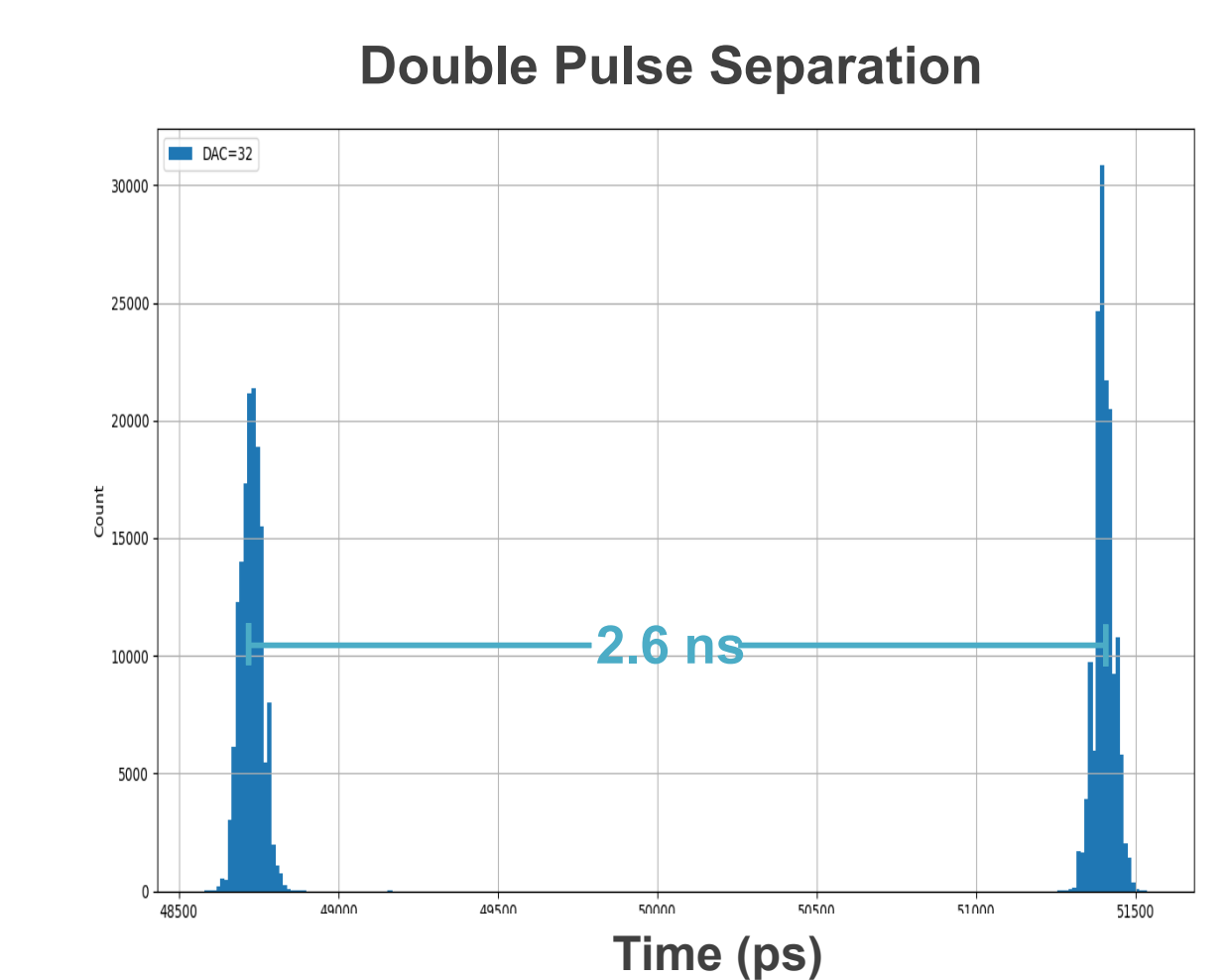
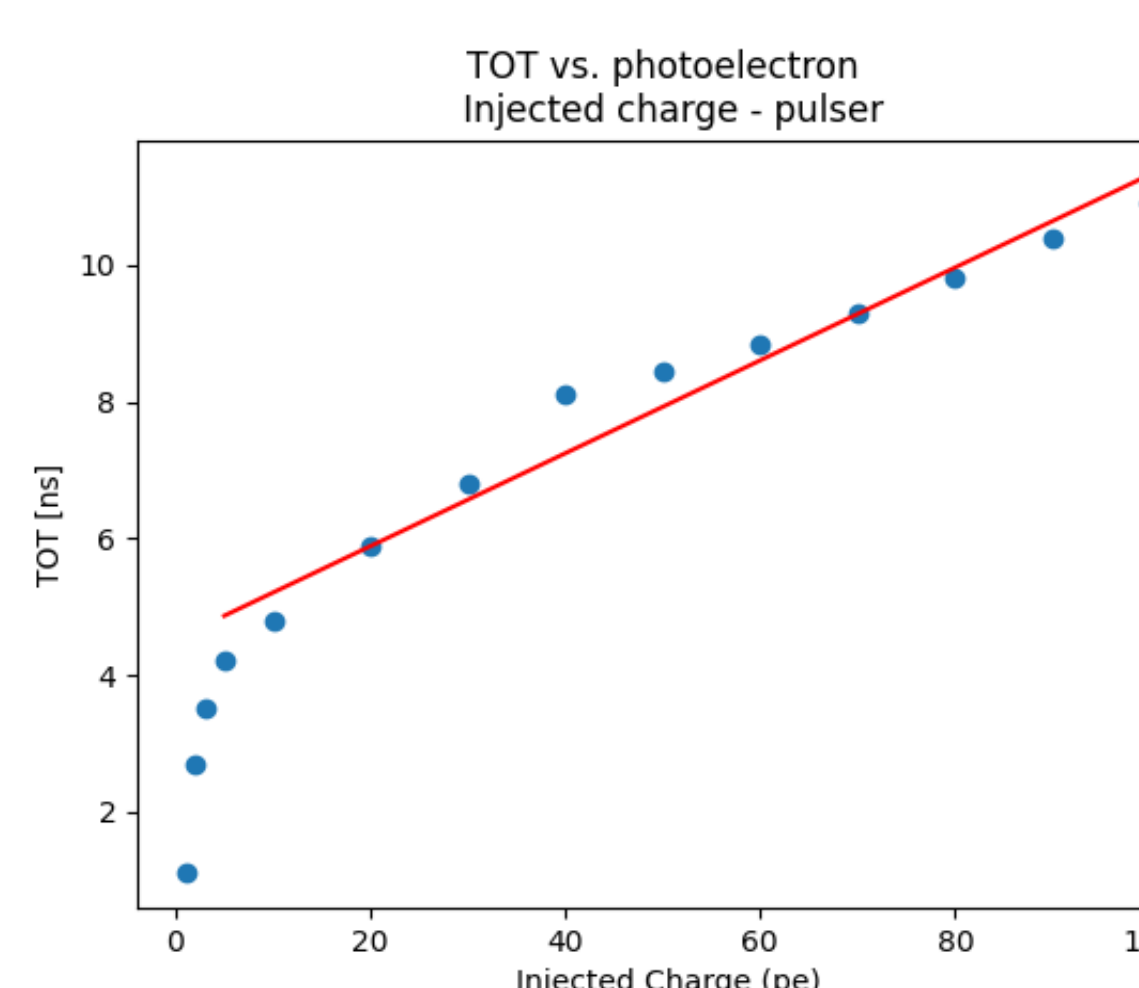
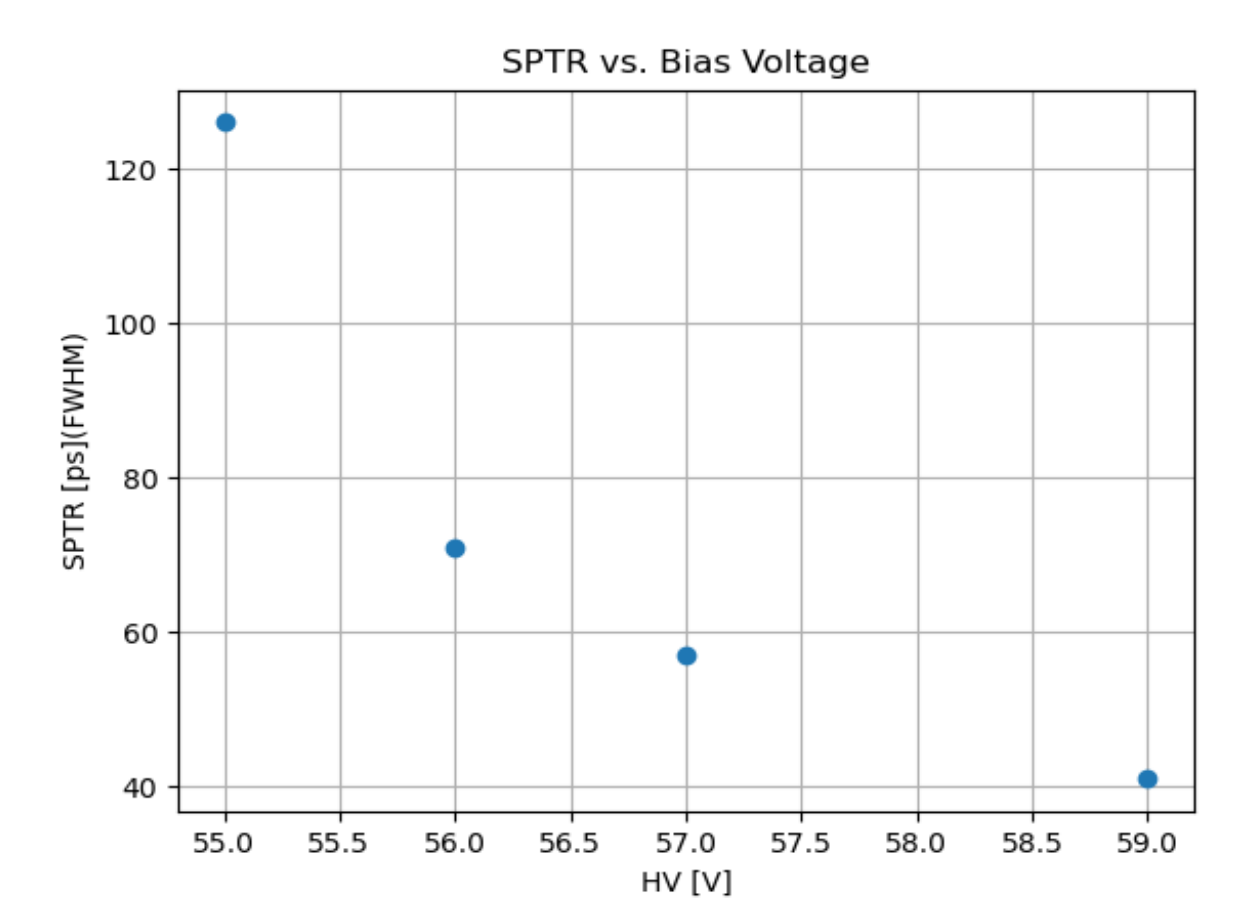
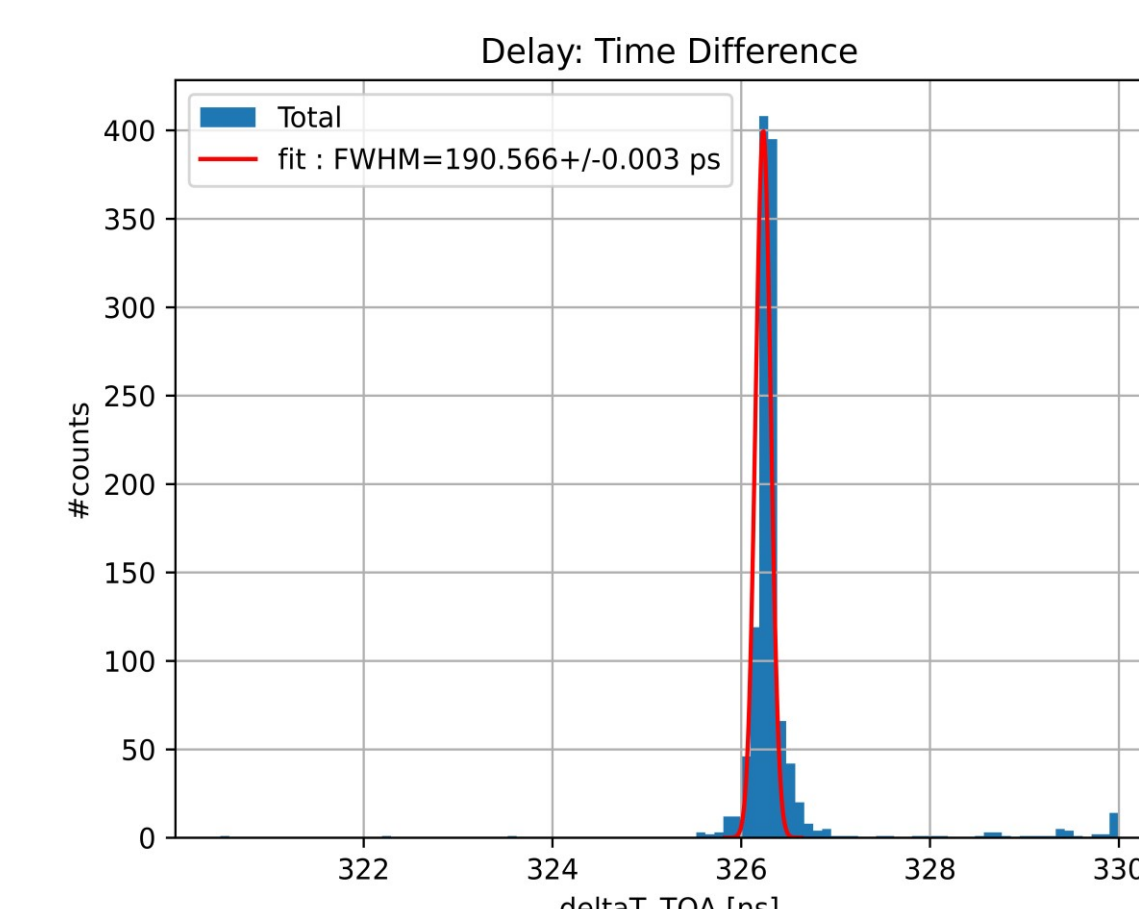
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3 – Results: System Performance

- In-house mezzanine board containing Liroc and PicoTDC chips (readout front-end)
- Commercial Xilinx ZC706 evaluation board (backend of the system)



- DAQ firmware, software, and GUI (based on QT) were developed internally.



4 – Summary

- Combining Liroc ASIC with picoTDC results in a promising SiPM-based multichannel readout system.
- The system is capable of acquiring & achieving:
 - Time over Threshold information: **energy spectrum reconstruction, linearity up to 100 pe**
 - Time of Arrival information: achievement of optimal timing resolution (**SPTR**) of **58 ps**
 - Double pulse separation of **< 3 ns**

Acknowledgment: This project has received funding from CNES under Action de R&T program (contract n°R-S22/OT-0002-116).