

Big Science in het Noorden

10-10-2023
Emilie Kernen

NIGHT VISION

MICROWAVE AMPLIFIERS

ADVANCED IMAGING

ULTIMATE DETECTION

NUCLEAR INSTRUMENTATION

PHOTONIS GROUP

LEADER IN DETECTION AND IMAGING

Photonis is specialized in innovation, development, production and sales of **high tech electro-optical detection and imaging solutions** used in defense, industrial, life science and scientific applications.

+85
YEARS
OF EXPERIENCE



1 500

EMPLOYEES



275 M€

TURNOVER
FORECASTED
FOR 2023



+100

PROVEN
TECHNOLOGY PATENTS



+50

COUNTRIES : 90%
OF EXPORT REVENUES

PHOTONIS GROUP HISTORY

ACROSS 3 COUNTRIES



1970

Delft
(Roden)



1942

Burle
(Lancaster)

1999

Purchase of
Galileo MCP
(Sturbridge)



1937

Philips
(Brive)

1998

Photonis



**PHOTONIS
Group**

2021



2022



2023



PHOTONIS GROUP

BECOMES

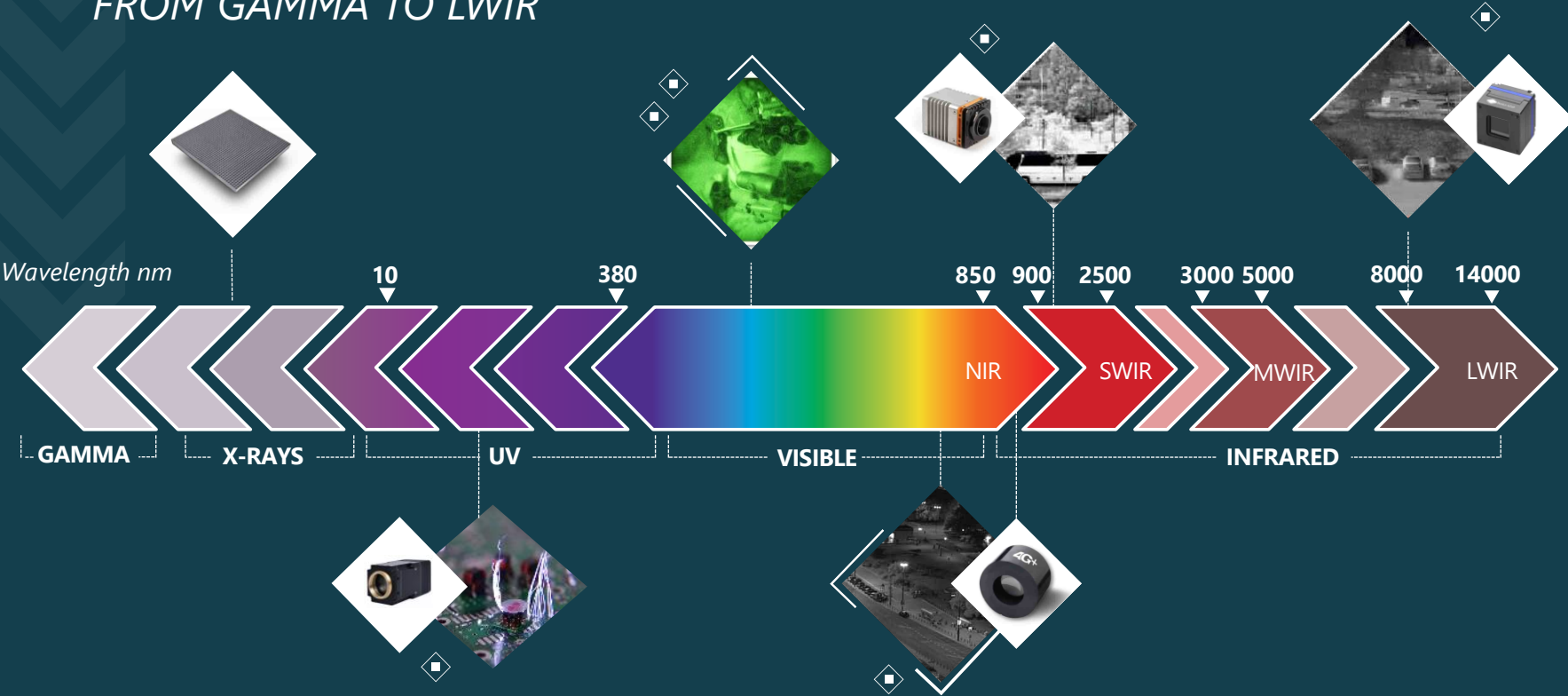
EXOSSENS

REVEAL THE INVISIBLE

28-09-2023

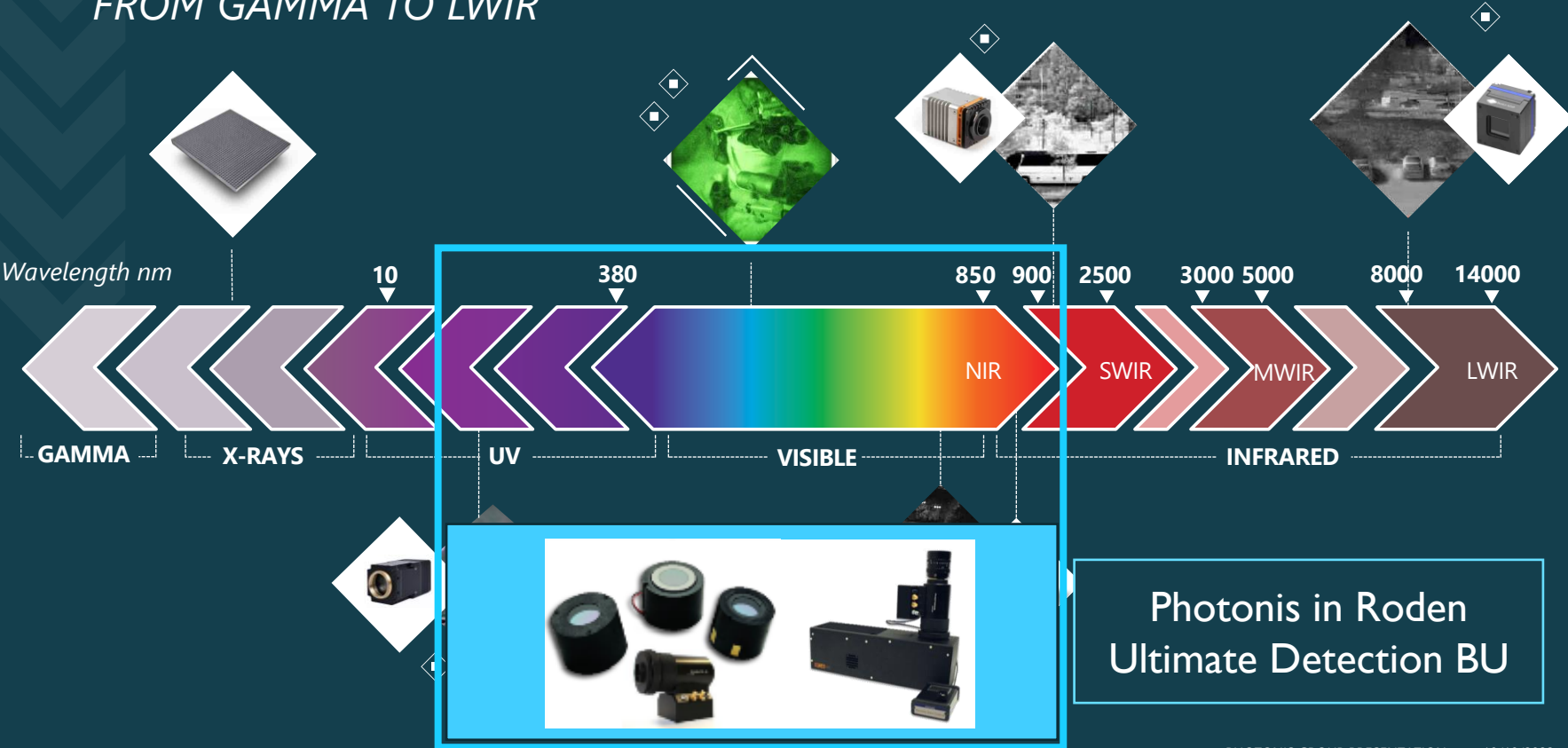
EXOSENS TECHNOLOGICAL PLAY FIELD

FROM GAMMA TO LWIR



EXOSENS TECHNOLOGICAL PLAY FIELD

FROM GAMMA TO LWIR



Photonis in Roden
Ultimate Detection BU



Ultimate Detection Roden, NL

[□]

[□]

[□]

Image Intensifier / Single photon detection



OUR VISION & MISSION

Be the Partner of Choice for *Image Intensified Technology* in the global OEM marketplace and the Technology Leader for high-end *Single Photon Detection & Imaging* solutions.

Critical to this Mission:

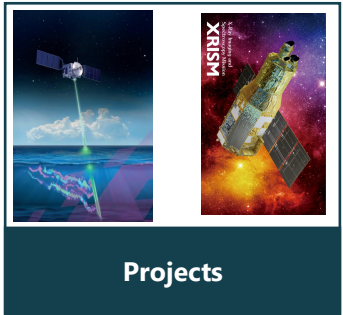
- Differentiated OEM approach from competition
- On-going R&D and product innovation

UD - IIT

Product Portfolio

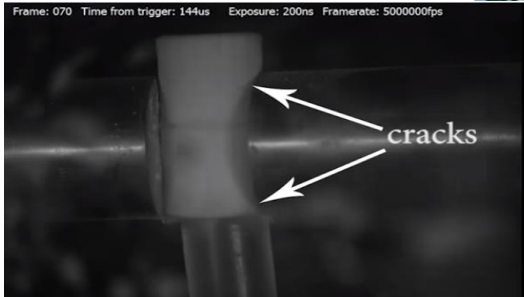
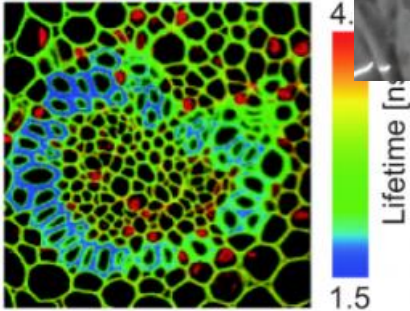
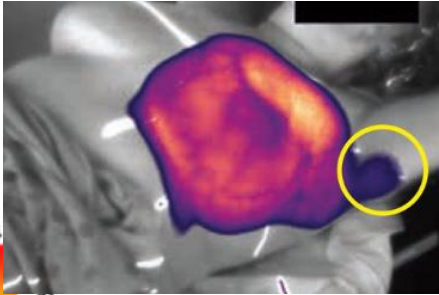
Market-leading providers of electro-optic technology used in the **detection** and **imaging** of **low light or single photon generated events.**

- Ultra High-Speed Imaging
- Scientific Imaging
- Time Gated Imaging
- Medical Imaging
- Corona Discharge Inspection
- Single Photon Imaging
- Single Photon detection



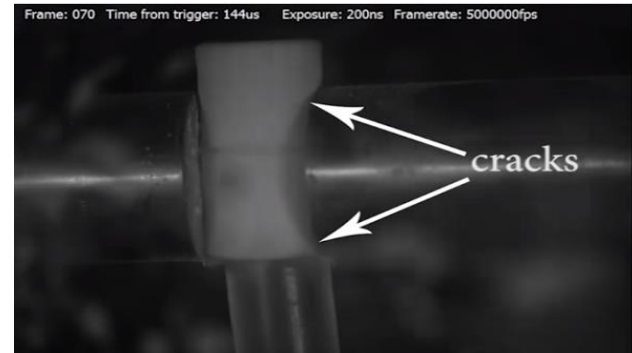
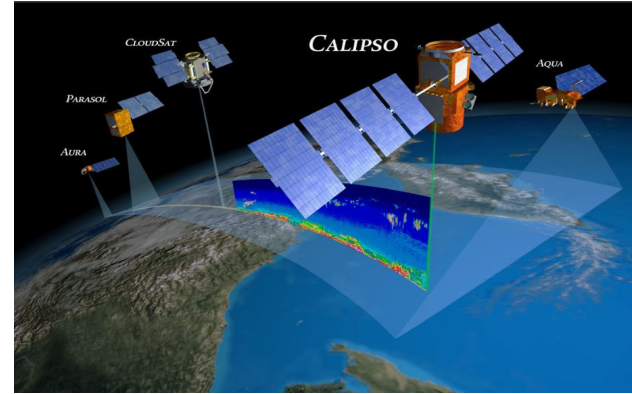
Enabled by Photonis IIT Technology

- ◆ Real-time radiation dose imaging
 - [▫] "See real-time video of the beam directly on the patient."
- ◆ Life Science / Single Photon
 - [▫] Timing: TTS=20 ps / Spatial resolution: 50 lpm
 - [▫] Limitation: Max rate < 1 MHz
- ◆ Power Line inspection
 - [▫] QE peak at 200-280nm typical 22%QE
 - [▫] Solar Blind: suppress visible response > 300nm
- ◆ Gated Intensified camera's
 - [▫] High Velocity Impact Imaging, high speck imaging
 - [▫] Fast gating : down to 2 ns or even 300ps

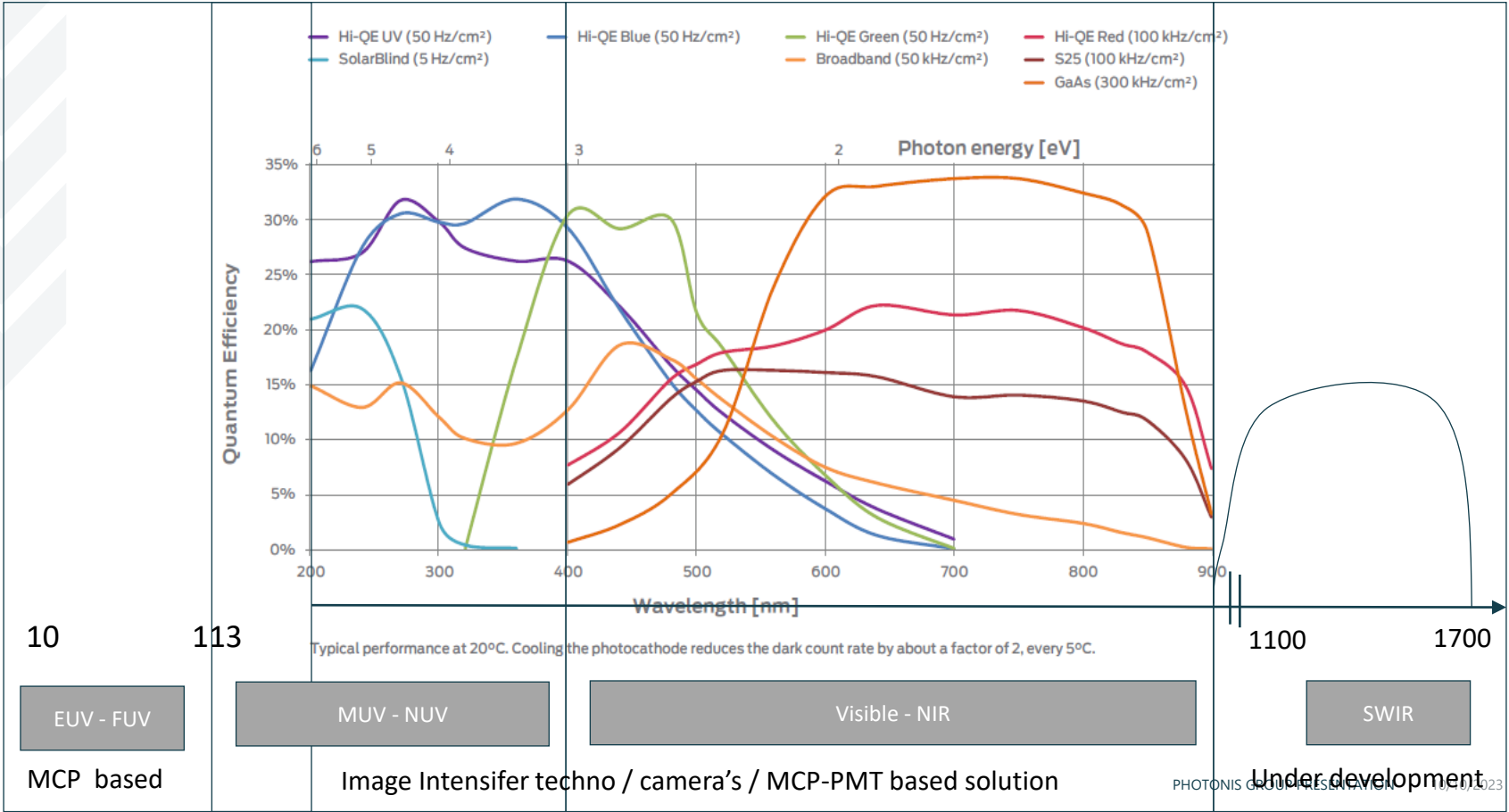


Enabled by Photonis IIT Technology

- ◆ Earth Care program
 - [▫] Atmospheric LIDAR - CNES
 - [▫] Bathymetry LIDAR - NASA
- ◆ Space environmental qualification
- ◆ Gated Intensified camera's
 - [▫] High Velocity Impact Imaging
 - [▫] High Speed Imaging
- ◆ Fast gating : down to 2 ns or even 300ps



Key feature : Spectrum coverage



10

113

EUV - FUV

MUV - NUV

Visible - NIR

SWIR

MCP based

Image Intensifier techno / camera's / MCP-PMT based solution

PHOTONIS GROUP PRESENTATION 2023 Under development

Key features : Timing

Fast : Intensified gated camera's

- Fast gating : 2 ns - 300ps



Faster : Single Photon Detectors

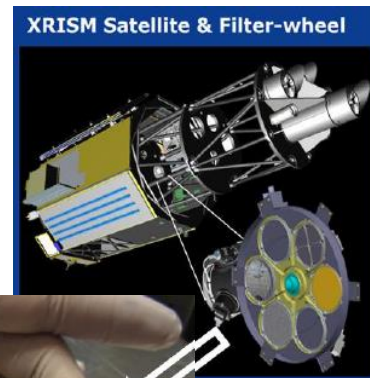
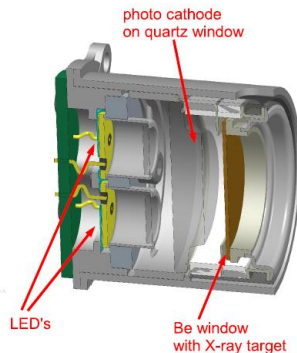
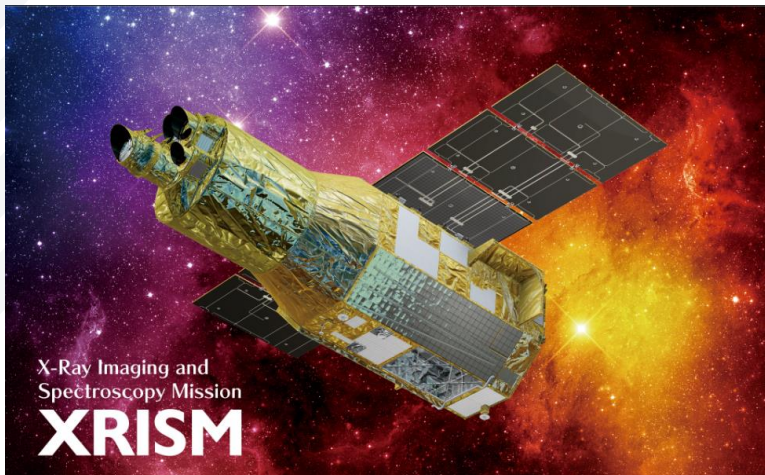
- <10ps TTS – 100ps rise time – 250ps FWHM
- >2GHz detection rate

Fastest: Streak cameras

- < 1ps time resolution

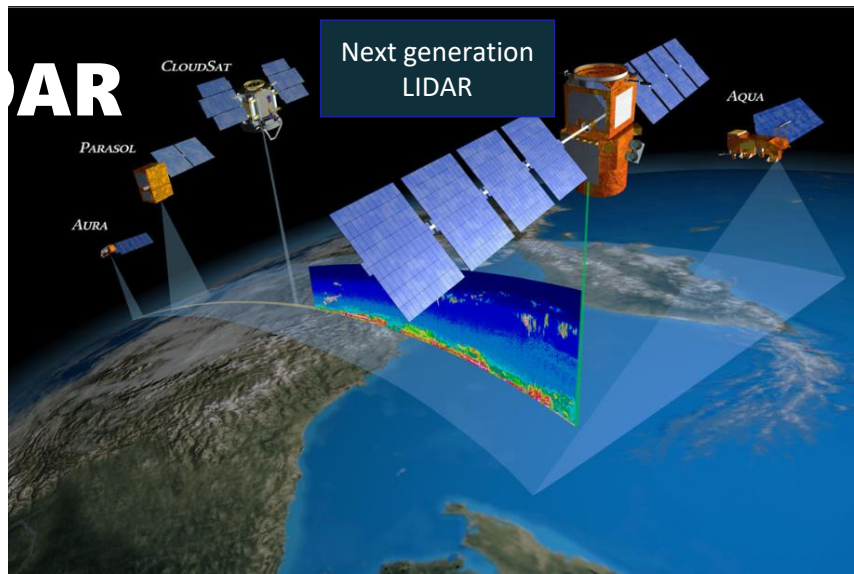
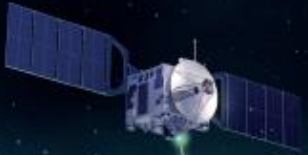
Modulated soft X-ray source

On Resolve instrument is the Soft X-ray micro-calorimeter Spectrometer flying on XRISM since 07.09.23



- Follow up : Athena (>2030)
 - Characterisation internship
- Spin-off Development
Fast-timing intense X-ray source

Satellite based LIDAR



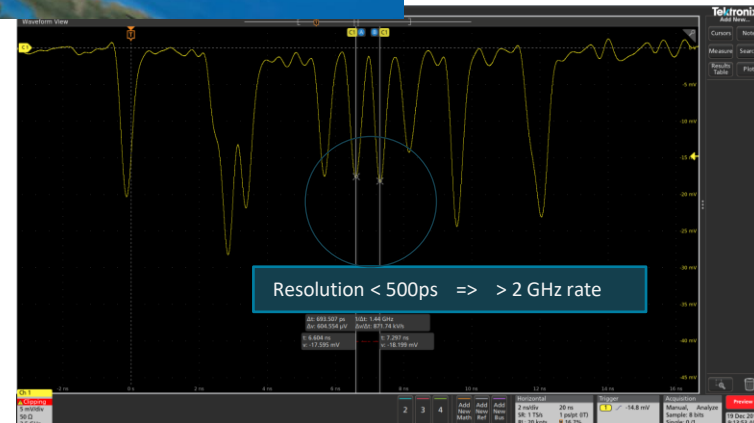
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Reveal the invisible



Single photon
detector

- Earth Care program
- Atmospheric LIDAR - CNES
- Bathymetry LIDAR - NASA

- 355nm + 532 nm laser
- High time resolution
- High dynamic range



Tuesday October 4th 2022

ICSO 2022

Lifetime and Radiation tests results on Hi-QE Blue MCP-PMTs for spaceborne UV LIDAR receivers

**Alex MATERNE^a, Olivier GILARD^a, Marine RUFFENACH^a, Frédéric BOURCIER^a
Olivier SAINT PE^b, Xavier DURAND^b, Dmitry ORLOV^c, Emilie KERNEN^c,
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Lifetime and Radiation tests results on Hi-QE Blue MCP-PMTs for spaceborne UV LIDAR receivers

CONCLUSION

- Novel design of Hi-QE Blue MCP-PMT Hi Linearity and Long Life with stability of quantum efficiency up to 20 C of charge generation at the photocathode.
- Proton radiation proved no significant changes for LEO missions over more than 10 years equivalent fluences.
- Results improve TRL of the MCP-PMT technology and consolidates the position of Photonis MCP-PMTs for future space LIDAR missions.

ACKNOWLEDGEMENTS

The authors thank the MESCAL project teams V. Cipolla, R. Schmisser, P.J. Hebert from CNES, M. Schillinger, B. Corselle from Airbus Defence and Space and C. Hostetler from NASA, for inputs provided and fruitful discussions on operating conditions.



Tuesday October 4th – Session 4b

ICSO 2022

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Results

- [] Great multi-party collaboration
- [] Publications by Photonis
- [] Publication by CNES
- [] Improved Commercial product
- [] Technological platform : longlife time / Specific QE / high linearity

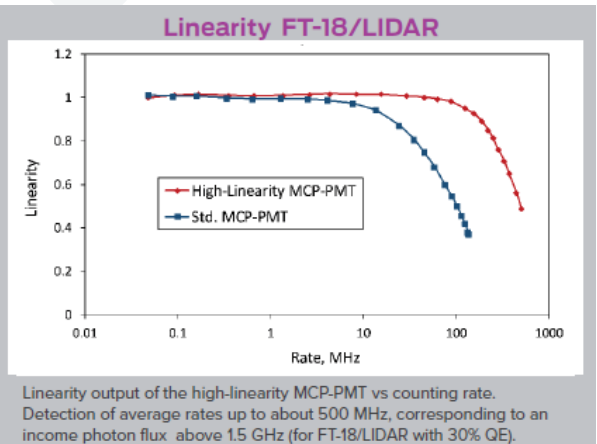
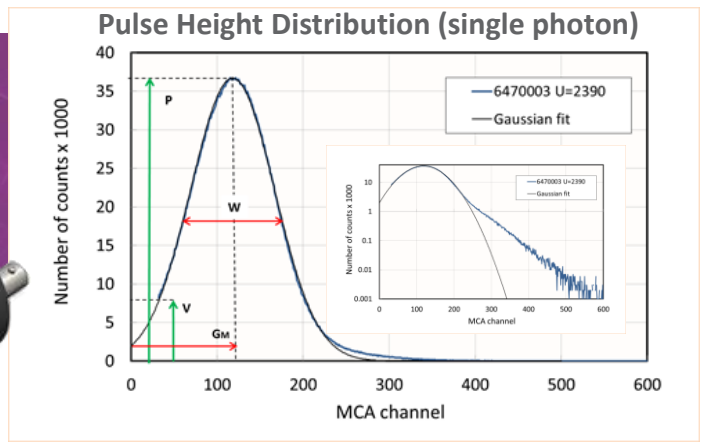
Fast Timing - MCP-PMT

Number of MCPs: 2 (chevron)
 Dimensions: 18mm (from 8-18 mm UCD)
 Gain: $>10^5$
 Magnetic resistance: 3 T

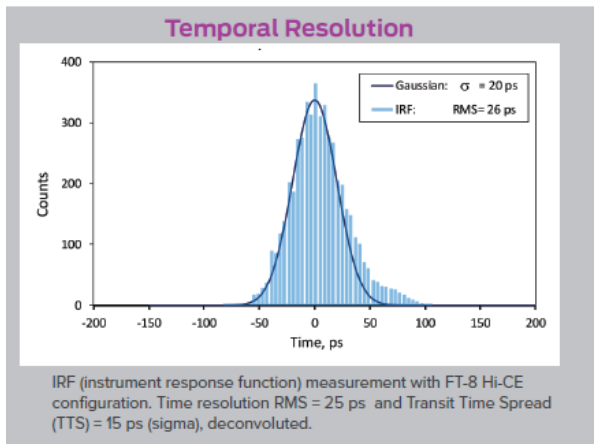
QE peak (Hi-QE series) $> 30\%$
 Dark rate: down to 30 cts/cm²
 PHD: single photon resolved
 CE $> 90\%$

- Excellent timing
- Hi-QE photocathode technology
- Great PHD characteristics
- Hi-CE MCP technology
- High linearity MCP
- Fast gating

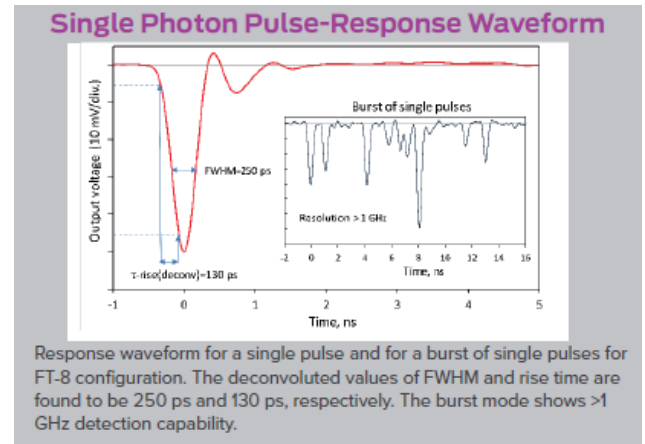
FT-8 : fastest
 TTS : ~ 10 ps sigma / 15ps RMS
 Detection capability > 1 GHz
 FT-18 : high dynamic range
 Max. photon rate ~ 500 MHz



Linearity output of the high-linearity MCP-PMT vs counting rate. Detection of average rates up to about 500 MHz, corresponding to an income photon flux above 1.5 GHz (for FT-18/LIDAR with 30% QE).



IRF (instrument response function) measurement with FT-8 Hi-CE configuration. Time resolution RMS = 25 ps and Transit Time Spread (TTS) = 15 ps (sigma), deconvoluted.



Response waveform for a single pulse and for a burst of single pulses for FT-8 configuration. The deconvoluted values of FWHM and rise time are found to be 250 ps and 130 ps, respectively. The burst mode shows > 1 GHz detection capability.

➤ Multi Anode MCP-PMT

- [] 61 anodes
- [] Hi-QE Green with QE > 25% @532nm
- [] High Linearity and Long Life time MCP technology
- [] Cross-talk reduction
- [] Space grade potting
- [] Environmental : shock, vibration, temperature



◆ Results

- [] Happy Scientist team at NASA and great collaboration
- [] Publications by Photonis
- [] Too specific product design to become a commercial product as such
- [] NASA switched to the **single anode design => TRL6 for space**

GSI, Darmstad

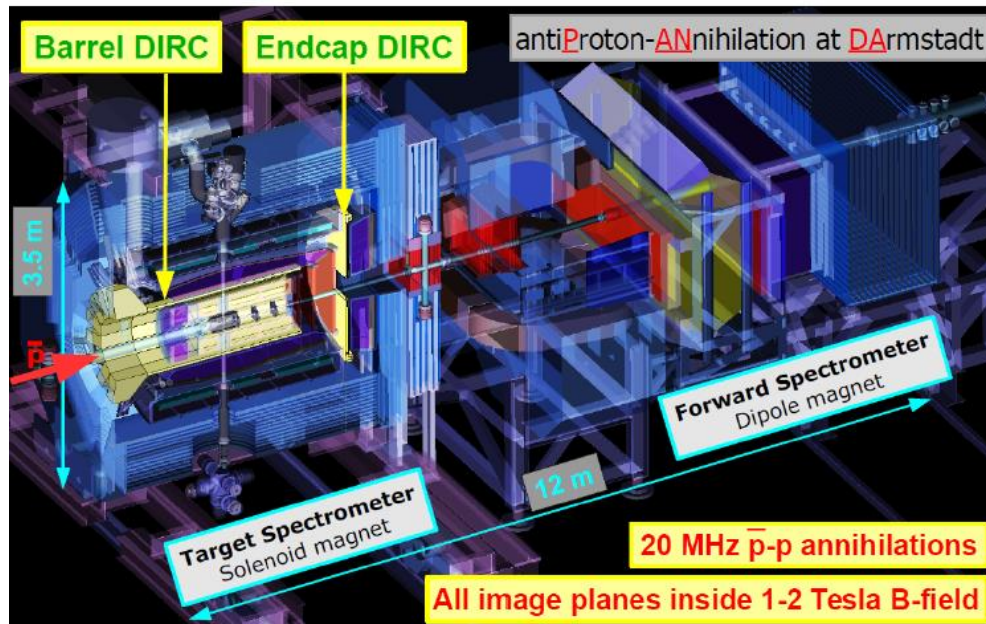
Panda DIRC detector

Cherenkov radiation detection

- ◆ Photonis Planacon chosen end of 2020
- ◆ 155 planacons under manufacturing
- ◆ Coverage 3'300cm²

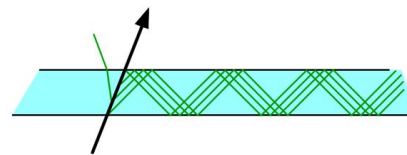
The biggest MCP-PMT application in the world

- 1 MHz/cm² counting rate
- Excellent time resolution <50 psPeak (σ) (<120 ps RMS)
- 1 Tesla compatible
- > 5C/cm² Lifetime



◆ Results

- [] Manufacturing in progress
- [] Technological platform
- [] Remains for this project only
- No further commercialization of this model



Internal reflection of Cherenkov light inside a DIRC quartz bar.



Summary on “Projects”

By definition:

- ◆ Projects typically boost “Technology” development!

Commercial Spin-Off:

- ◆ Results in a commercial product (recurring revenue potential)
- ◆ Creates new or deepens existing technology platform(s) / competences
- ◆ Generates publications / patents

Conditions for Success:

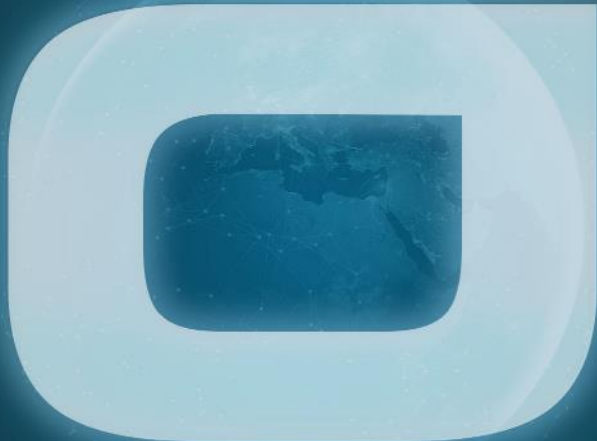
- ◆ Business Case: make a clear ROI estimation at the start
- ◆ Balance investing in R&D for the project and R&D for recurring business
- ◆ Alignment on mutual Goals

Risks:

- ◆ The project/ development becomes too specific => need re-investment to broaden



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