



LEO SPACE PHOTONICS

# New generation space photonics for high data rate intra and inter-satellite optical communications

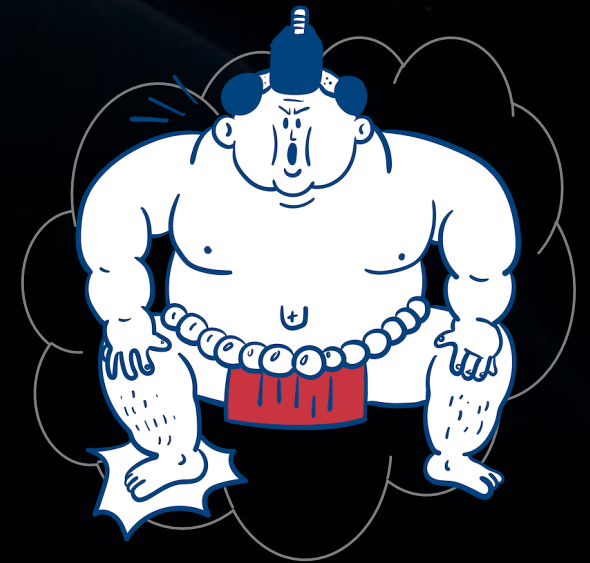
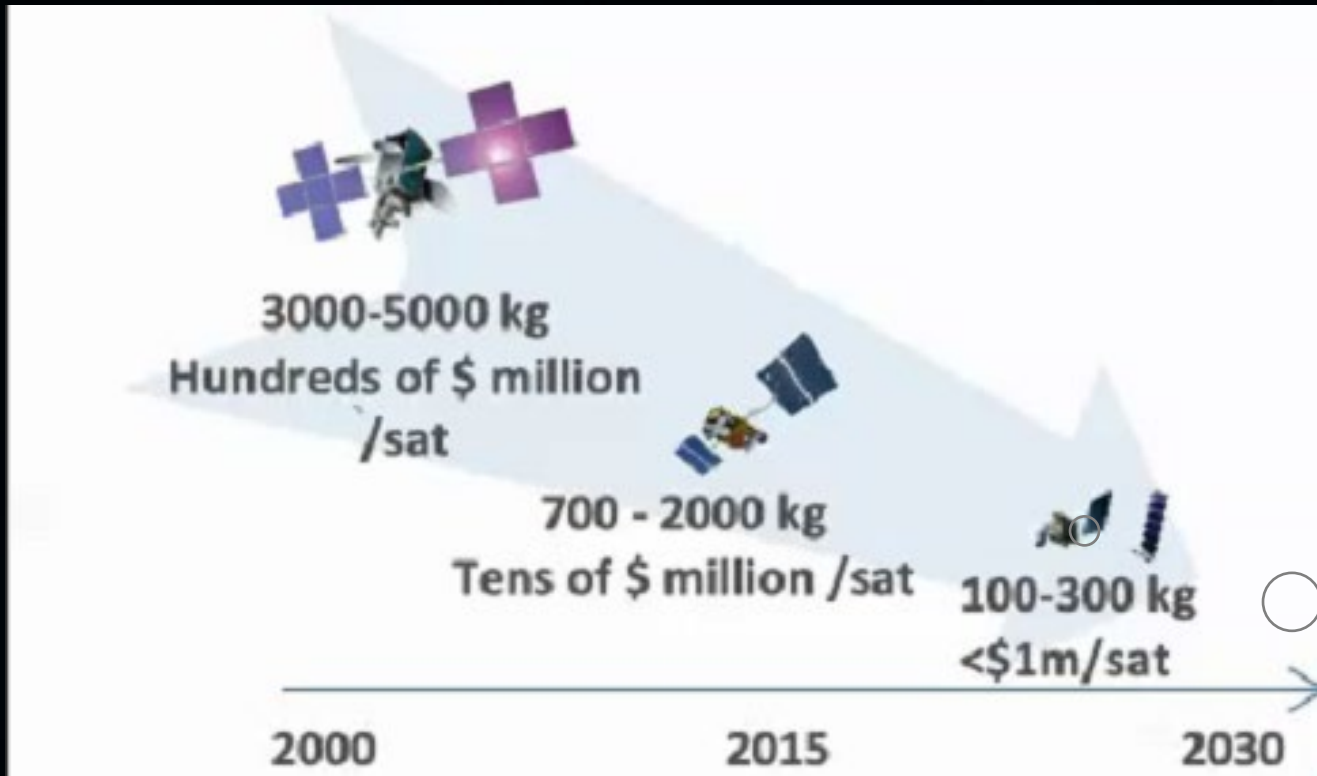
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# OUTLINE

1. OISL            Optical intra-satellite link
2. OISL            Optical inter-satellite link

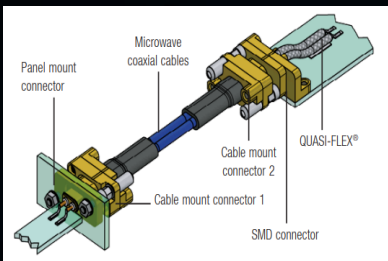


# Wireline Vs Optical

- FD 4m 400G link based on space grade wireline 3.125 Gb/s data lanes
- Cable assembly: 17 grams/meter & 2.5 mm Ø & 1.55 dB/m @ 5 GHz (ESCC 3409/001 iss.4)



Electrical



ESCC3409/001

	Electrical	Optical	% decrease
<b>Cables required</b>	512	4	99.2
<b>Cable mass (kg)</b>	34.8	0.16	99.5
<b>Cable volume (cm<sup>3</sup>)</b>	10.000	113	98.8
<b>Connector mass (kg)</b>	1.44	0.06	95.8
<b>Transceiver mass (kg)</b>	-	0.07	-
<b>Total mass (kg)</b>	36.24	0.29	99.2

Optical



Space heritage

The OTRx is the critical element of space-grade on-board optical interconnects



# SIPhoDiAS

Photonic-Enabled VHTS

[www.space-siphodias.eu](http://www.space-siphodias.eu)



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Project lead – IC design

## ALTER

Module AIT



IC design & foundry



System specs/test

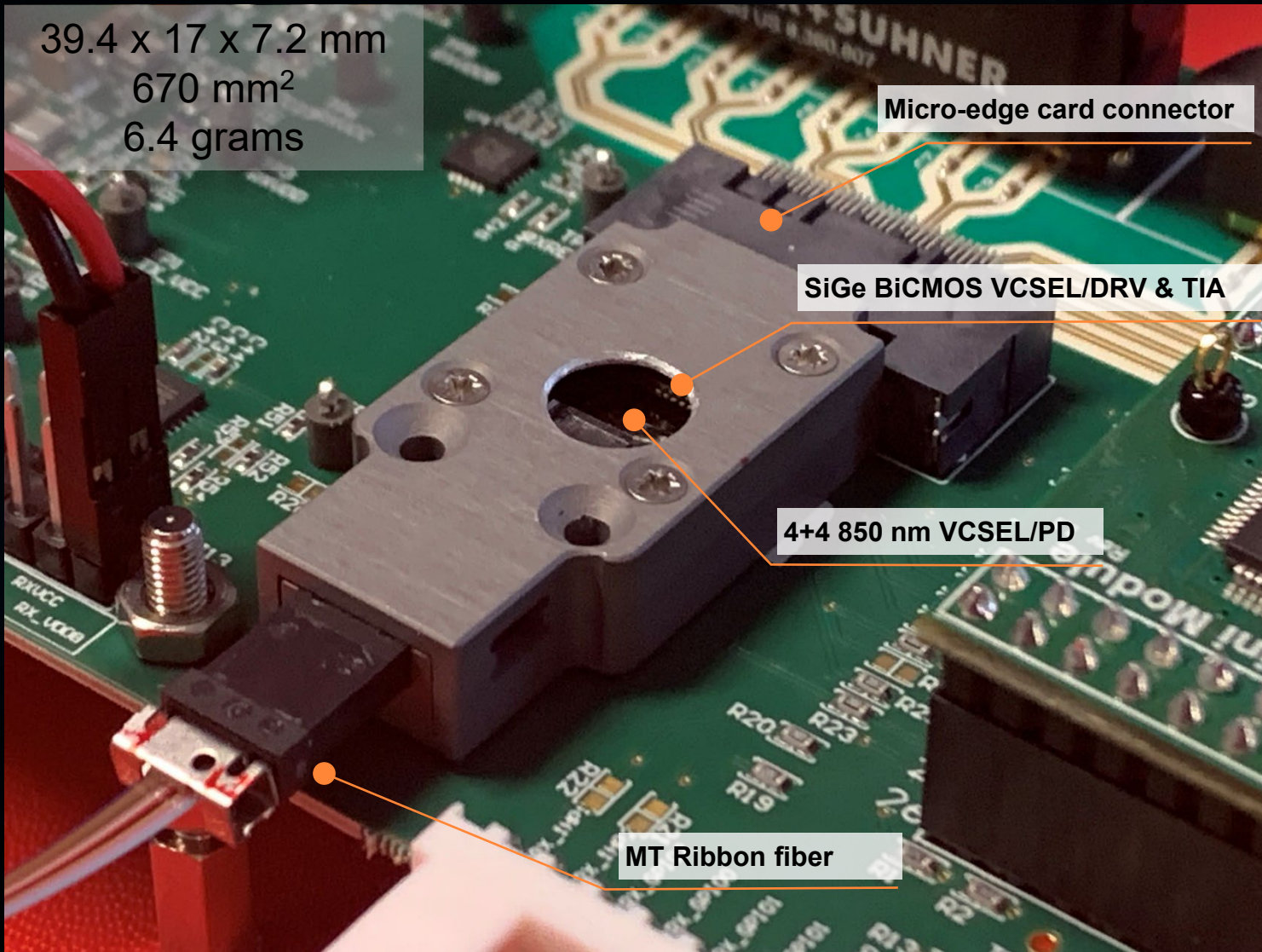
Ruggedized Mid-board optics VCSEL OTRx

- RH electronics
- All-flip-chip assembly
- No soldering / interposer



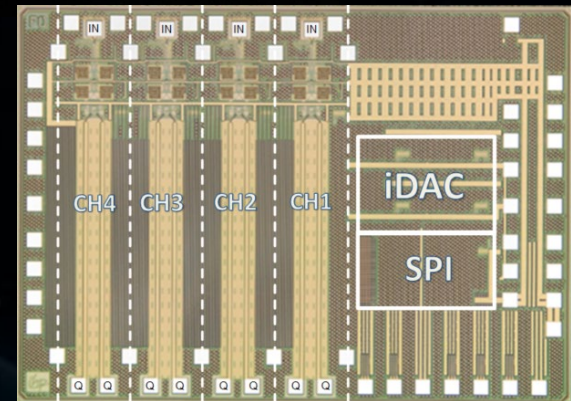
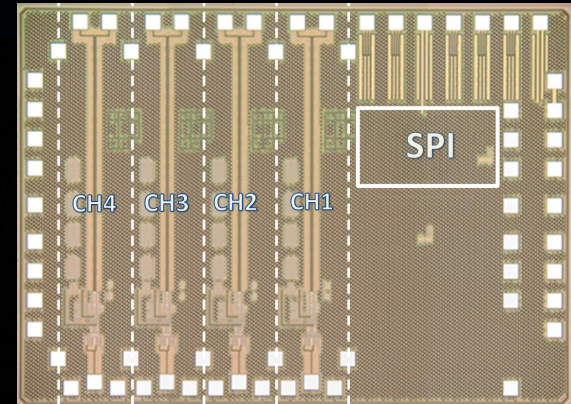
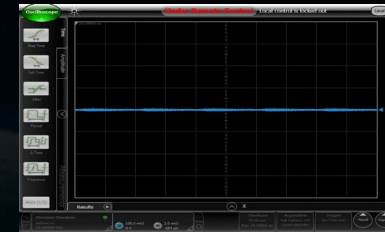
# MBO-TRX MODULE & IC

39.4 x 17 x 7.2 mm  
670 mm<sup>2</sup>  
6.4 grams



Quad ch. VCSEL  
DRV IC

2.6 mm<sup>2</sup>

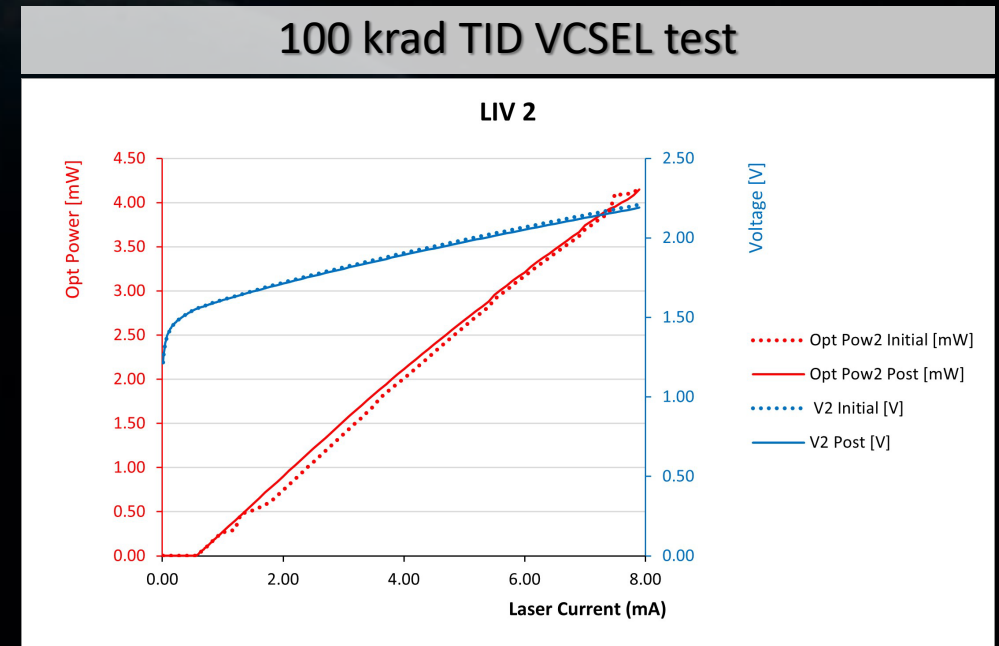
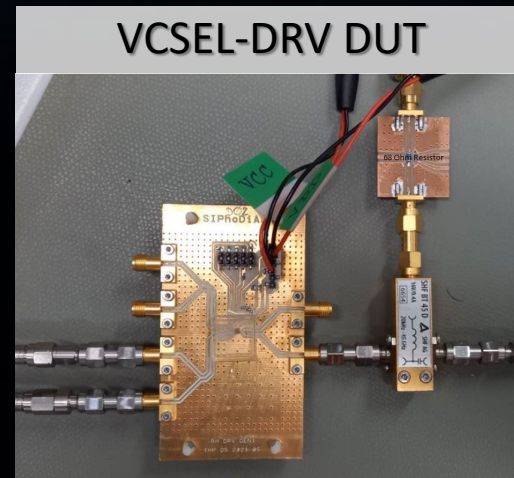
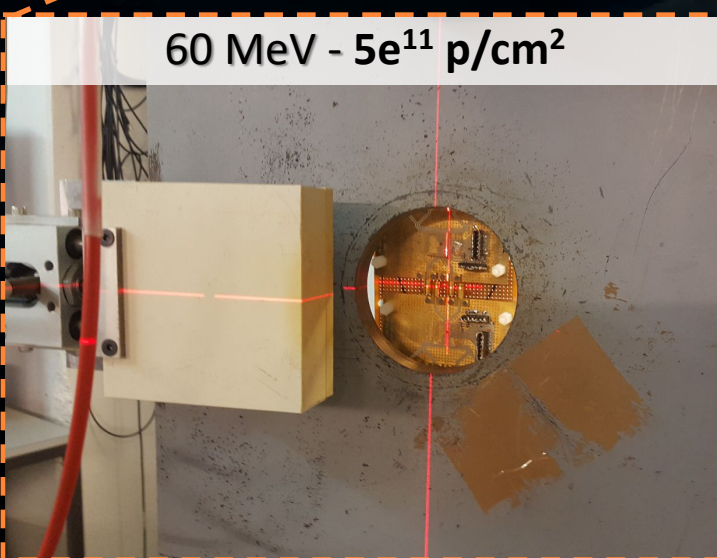
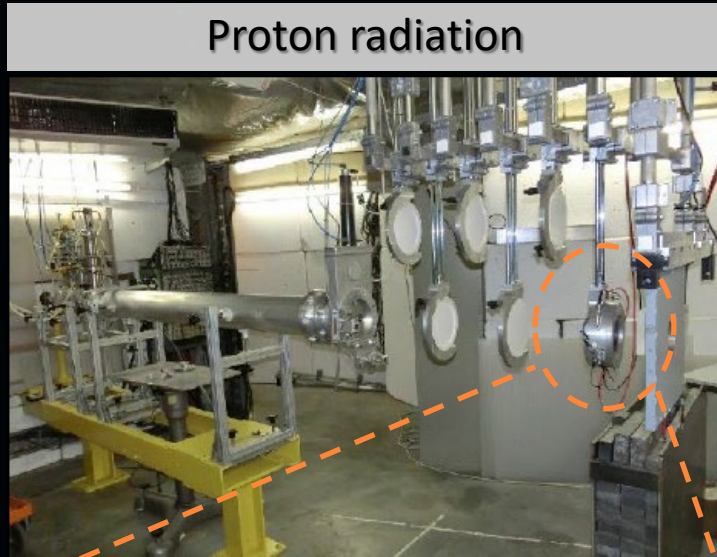


- IHP Rad-hard 130nm SiGe BiCMOS
  - Single 3.3V power supply
  - Rad-hard Vref circuit
  - Rad-Hard SPI IP
- Programmable 4-channel O/P
  - VCSEL DRV: 70 mW/ch
  - TIA: 108 mW/ch
  - < 10 mW / Gb/s



# RADIATION TESTING

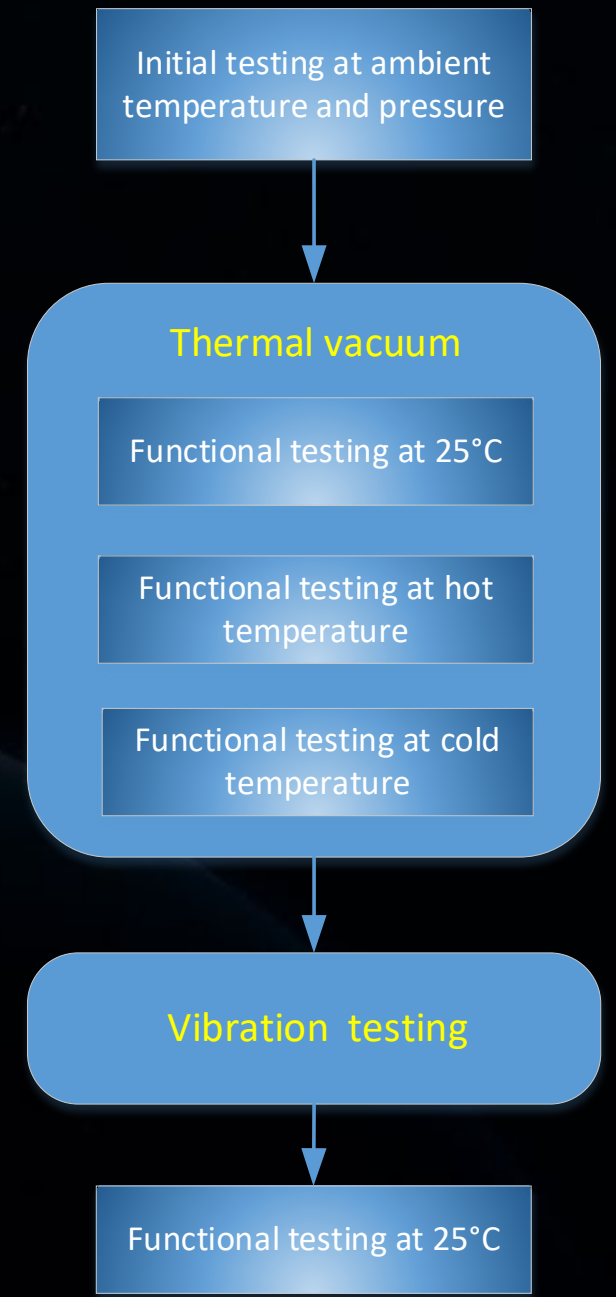
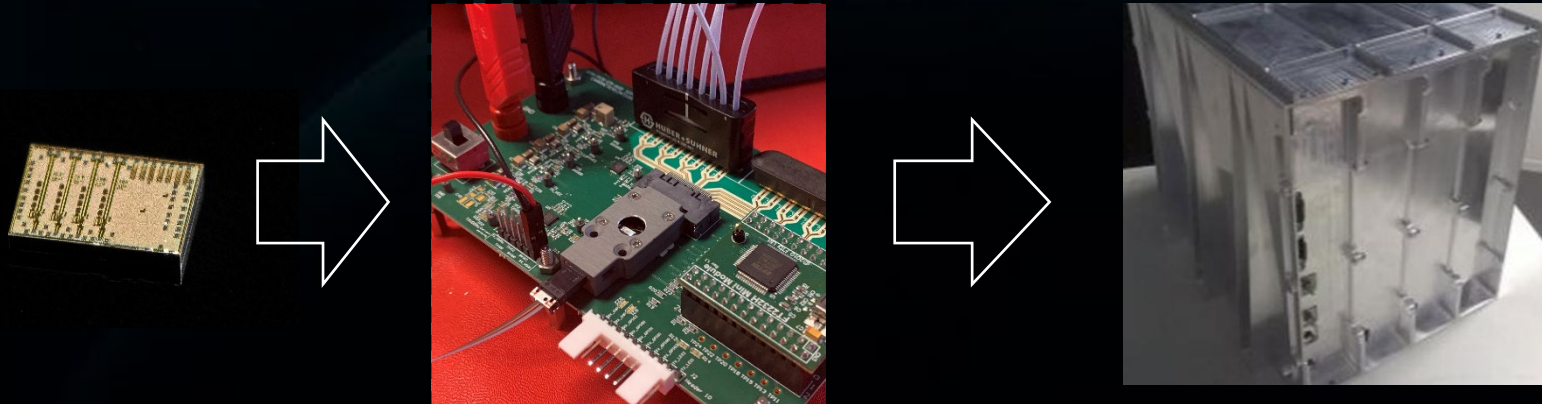
- LIF (Light Ion Irradiation Facility) line of the **CYCLONE** Accelerator in **UCL** (Université Catholique de Louvain).
- DD test with a flux of  $1e^8$  p/cm<sup>2</sup>-s until a total accumulated fluence of  $5e^{11}$  p/cm<sup>2</sup> with a beam energy of **60 MeV**.
- No degradation in current consumption/supply of ICs
- No degradation of VCSEL emitted optical power



CONFIDENTIAL

# NEXT STEPS

- VCSEL driver and TIA chipset v2 in fab – Available Q4 2022
- Gamma & heavy ion test
- MIL-spec module-level reliability testing
- System-level evaluation testing as per ECSS-E-ST-10-03C Rev.1
  - TVAC
  - Random vibration



# Thank you for your attention

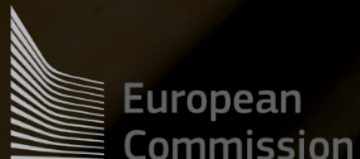


## Acknowledgment



LEO SPACE PHOTONICS

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Horizon 2020  
European Union funding  
for Research & Innovation

