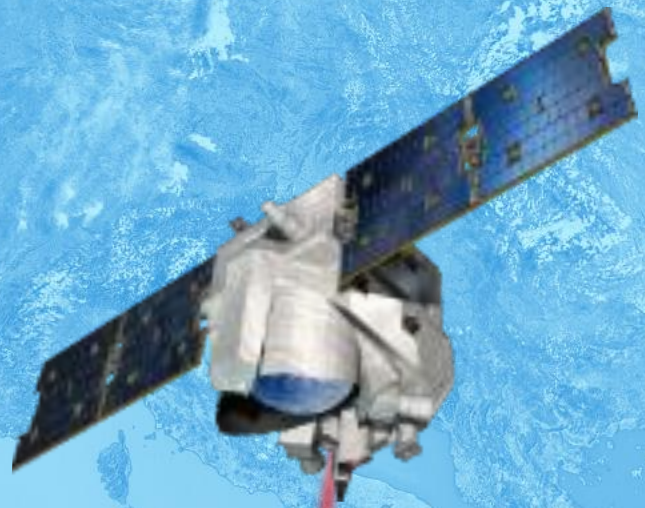
MERLIN

https://merlin-methane.space/



The Franco-German MERLIN mission: the first satellite lidar to quantify methane in the atmosphere

Diego Loyola (DLR)

On behalf of the MERLIN Mission PIs (P. Bousquet & A. Fix), the MERLIN Scientific Advisory Group (SAG), as well as the MERLIN teams at DLR, CNES, and Airbus D&S

With funding from the:

Federal Ministry of Research, Technology and Space

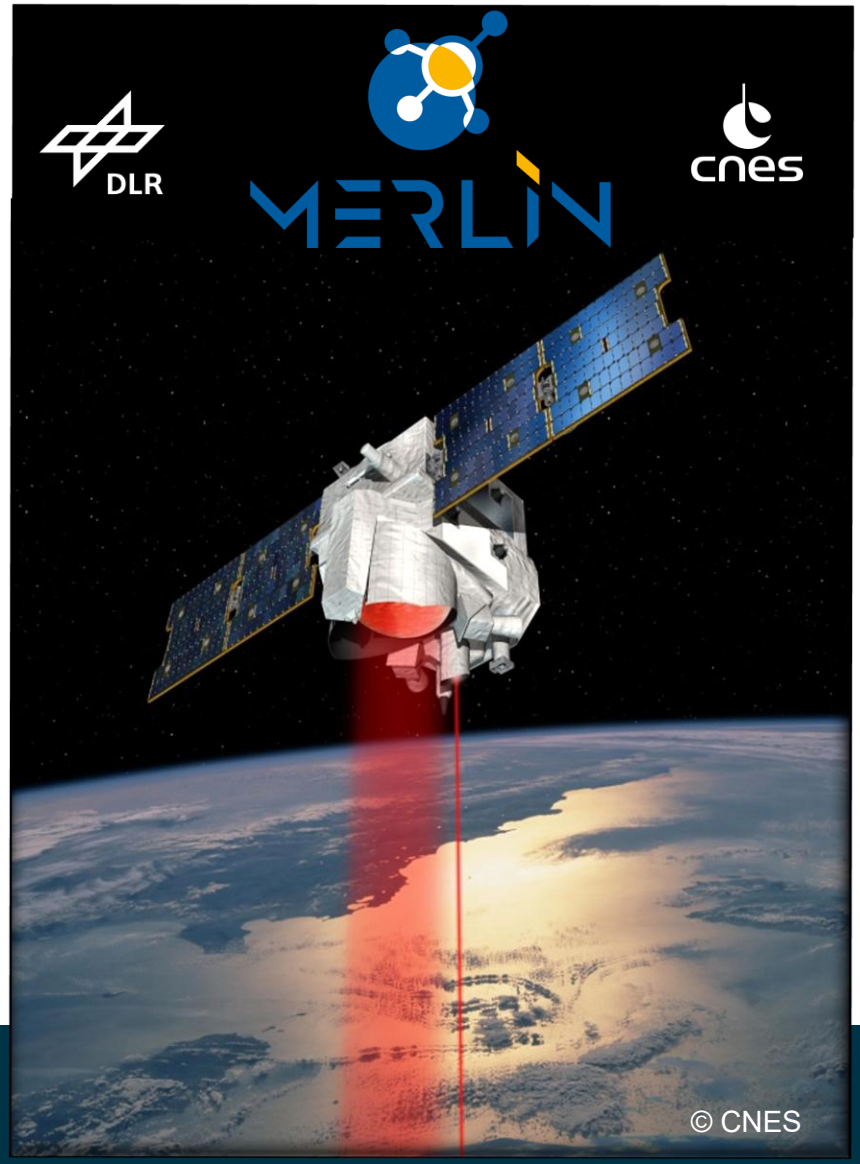
RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

DLR

MERLIN

MERLIN
(MEthane Remote sensing LIdar missioN)

- Joint French-German mission (DLR and CNES)
- First methane lidar in space
- Satellite launch planned for early 2030
- Independent of solar illumination (Laser!)
- Significantly less affected by clouds and aerosols than passive sensors.



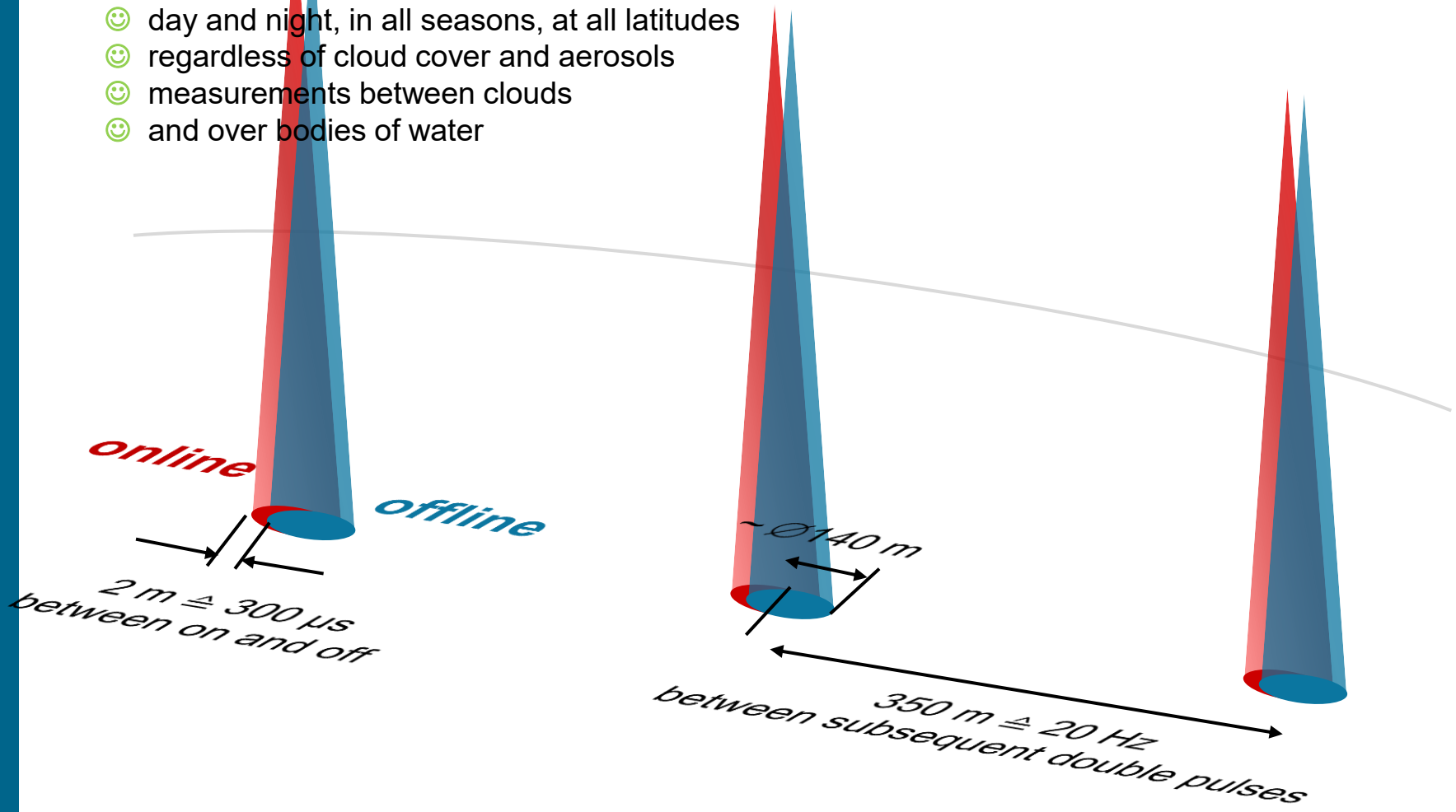
- Designed to quantify global methane fluxes

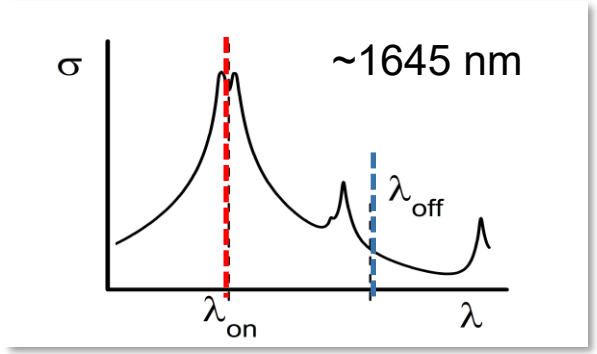
https://merlin-methane.space/

How does MERLIN actually work?
IPDA: Integrated Path differential absorption

Advantages

- ☺ simple radiative transfer
- ☺ day and night, in all seasons, at all latitudes
- ☺ regardless of cloud cover and aerosols
- ☺ measurements between clouds
- ☺ and over bodies of water





Prime product XCH4:
column-integrated dry-air mixing ratio of CH_4

differential atmospheric optical depth

$$XCH4 = \frac{DAOD}{\int_{p_{lidar}}^{p_{surf}} WF(p)dp}$$

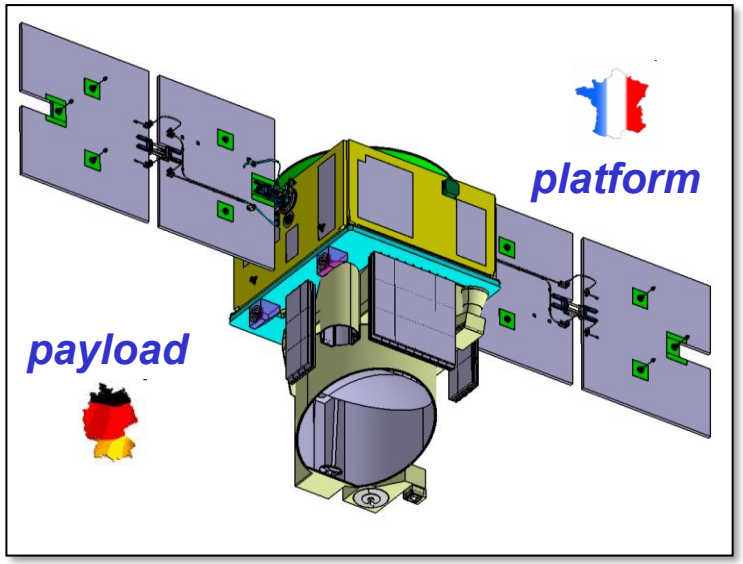
weighting function

MERLIN

Atmospheric Methane Lidar Mission

DLR

Orbit altitude	506 km
Mass (Satellite)	400 kg
Mass (Instrument)	119 kg
Payload power	~ 150 W
Payload volume	~ 900×700×800 mm^3



Level-0: raw data
Level-1a: vertically resolved, pulse energy corrected lidar data
Level-2: XCH4
Level-3: global XCH4 maps
Level-4: methane fluxes (inverse modelling)

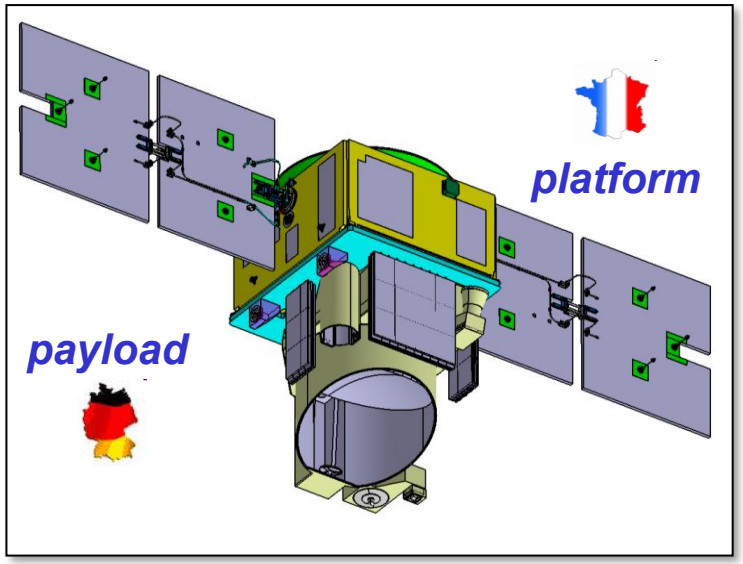
Execution:	• **French Space Agency (CNES)** • **German Space Agency (DLR)**
Industrial Prime Contractors:	• **S/C Bus: Airbus D&S (F)** • **Payload: Airbus D&S (D)**
Scientific PIs:	• **A. Fix (DLR)** • **P. Bousquet (LSCE/CNRS)**

	Threshold	Breakthrough	Target
XCH4 statistical error	**36 ppb**	**18 ppb**	**8 ppb**
XCH4 systematic error	**3 ppb**	**2ppb**	**1 ppb**
Resolution	**horizontal: 50 km, vertical: total column**		

MERLIN

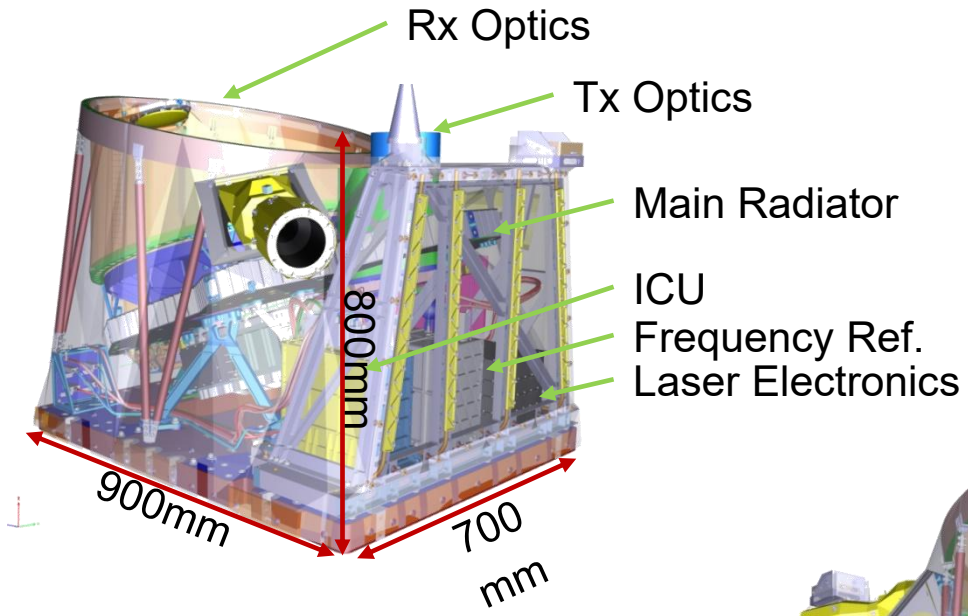
Atmospheric Methane Lidar Mission

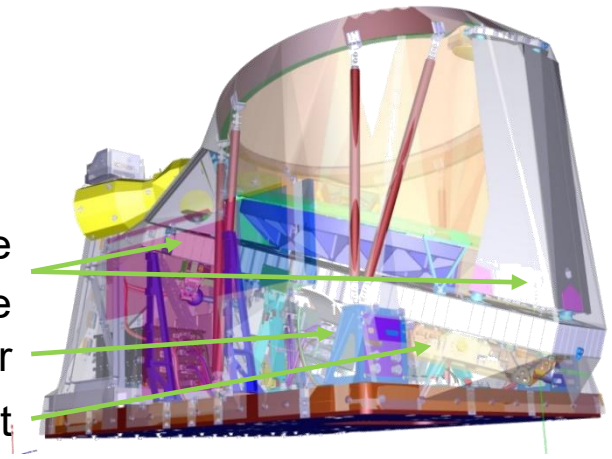
DLR



Orbit altitude	506 km
Mass (Satellite)	400 kg
Mass (Instrument)	119 kg
Payload power	~ 150 W
Payload volume	~ 900×700×800 mm^3

Execution:	• **French Space Agency (CNES)** • **German Space Agency (DLR)**
Industrial Prime Contractors:	• **S/C Bus: Airbus D&S (F)** • **Payload: Airbus D&S (D)**
Scientific PIs:	• **A. Fix (DLR)** • **P. Bousquet (LSCE/CNRS)**





Current status of satellite development

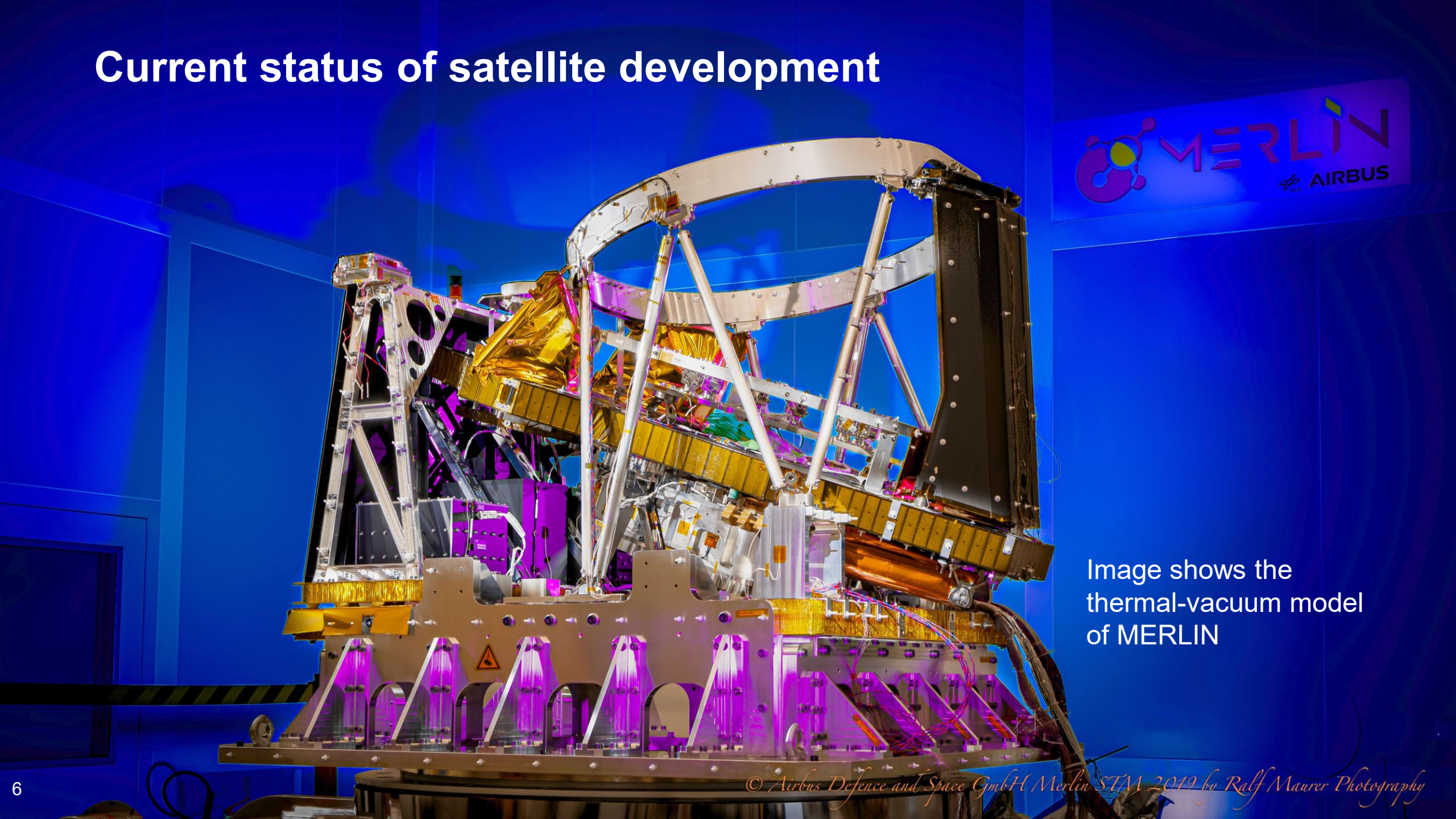
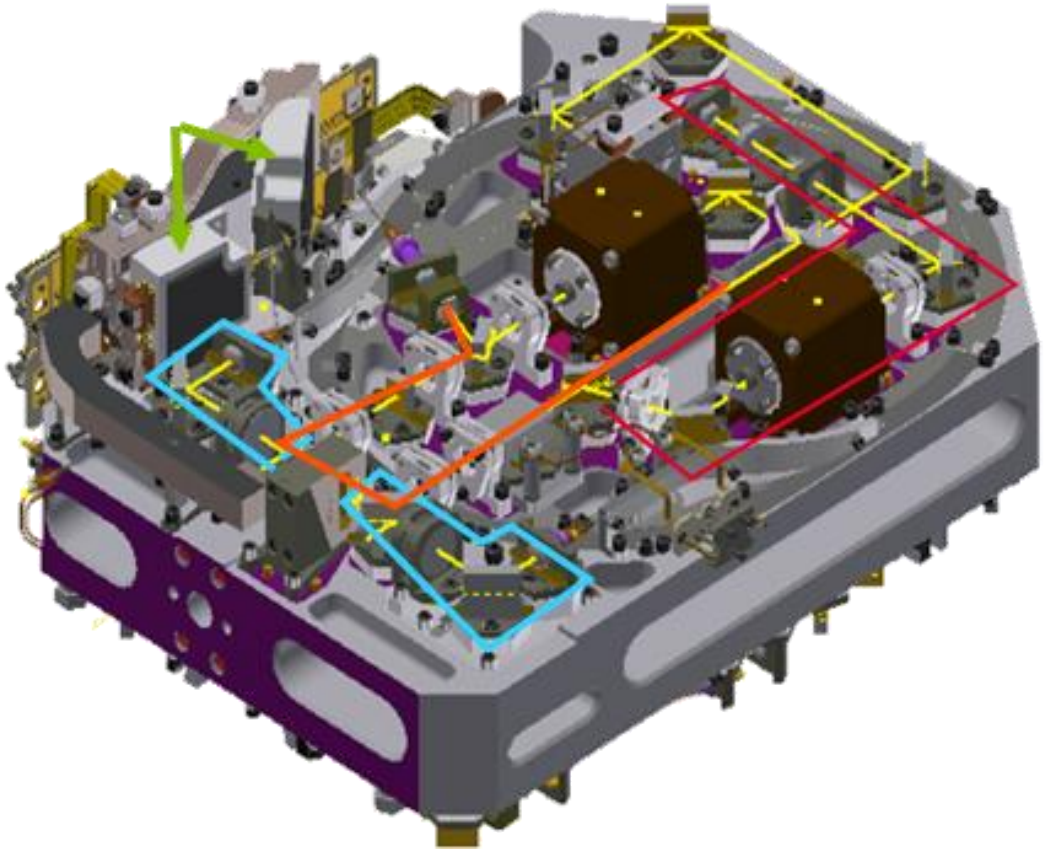
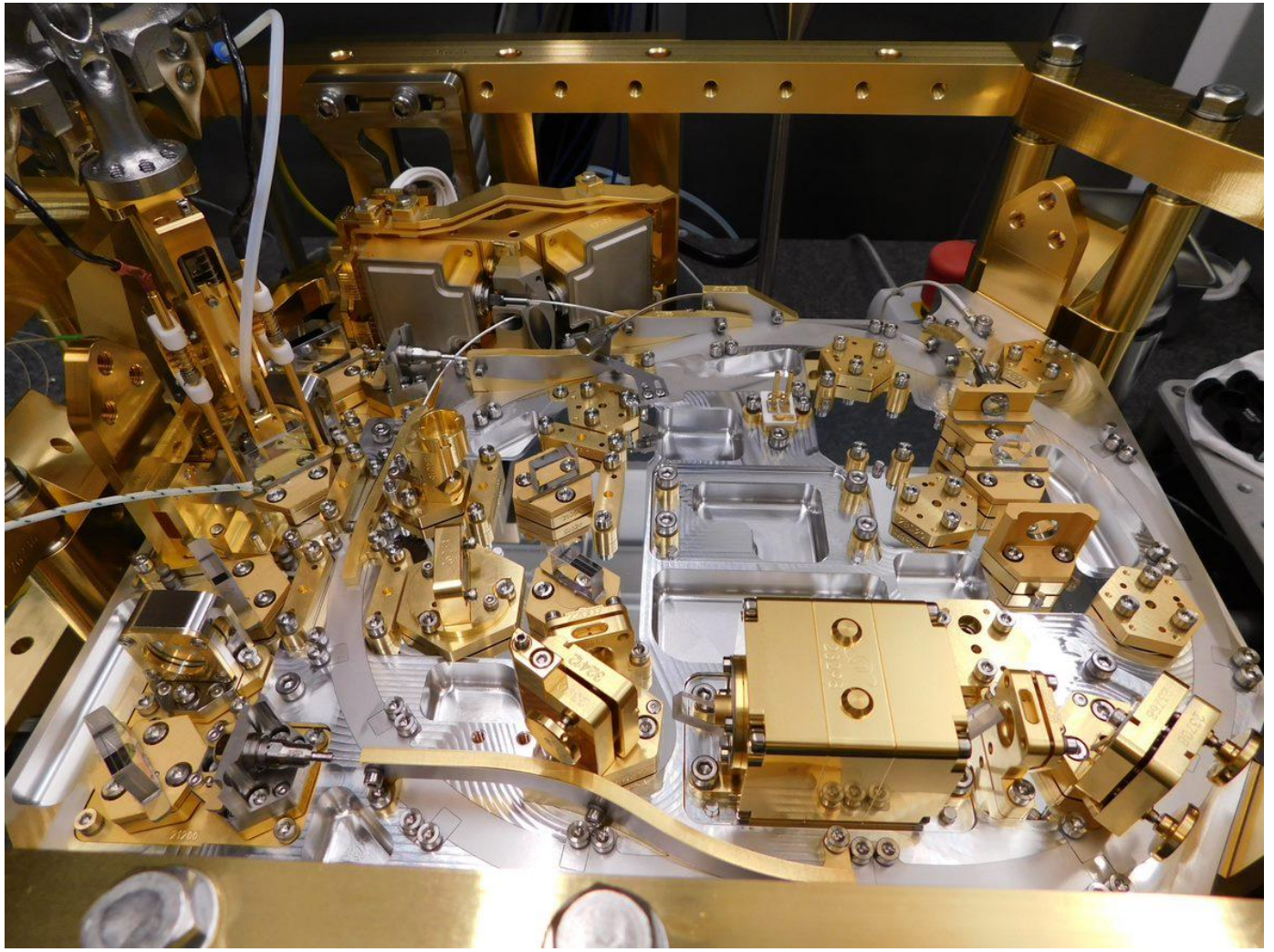


Image shows the thermal-vacuum model of MERLIN

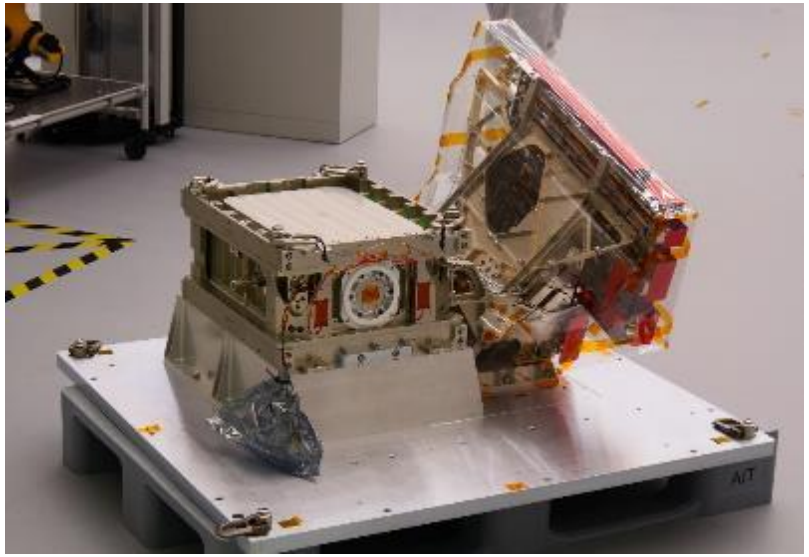
One of the most challenging sub-modules is the Laser Optomechanical Assembly (LASO)





The laser has a footprint roughly the size of a laptop.

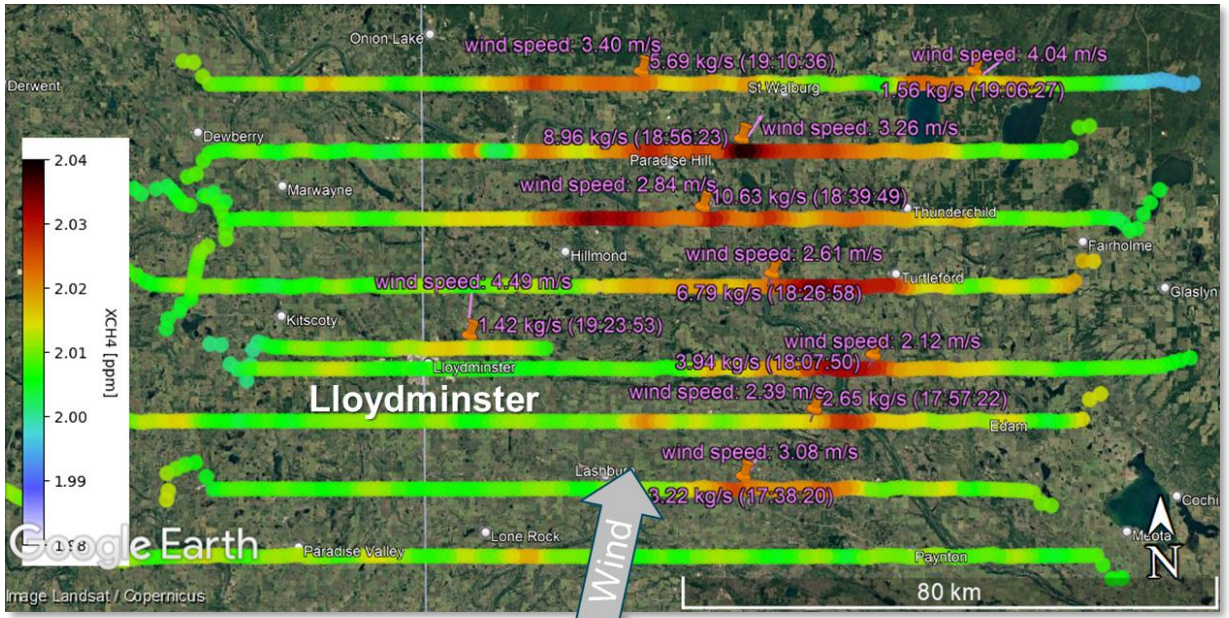
The primary telescope mirror has been fitted and the payload core is under integration



Next milestone:
‘Wedding’ of LASO (Laser Optomechanical Assembly) and Laser Housing (LASH)

DLR operates a MERLIN airborne demonstrator (CHARM-F) onboard the research aircraft HALO and ATR42

Amediek et al., Appl. Opt. 2017
Wolff et al. AMT, 2021



Pre-lauch campaigns

CoMet 1.0
HALO: Europe (2018)

MAGIC 2021
ATR42: Scandinavia (2021)

CoMet 2.0 Arctic
HALO: Canada (2022)

AB2CD
ATR42: France, Spain (2025)

CoMet 3.0 Tropics
HALO Brazil (August 2026)

MAGIC Tropics
ATR42: Brazil (2028)

If your are interested in validation and pre-launch campaigns, please contact us!

Thank you very much for your attention!

https://merlin-methane.space/