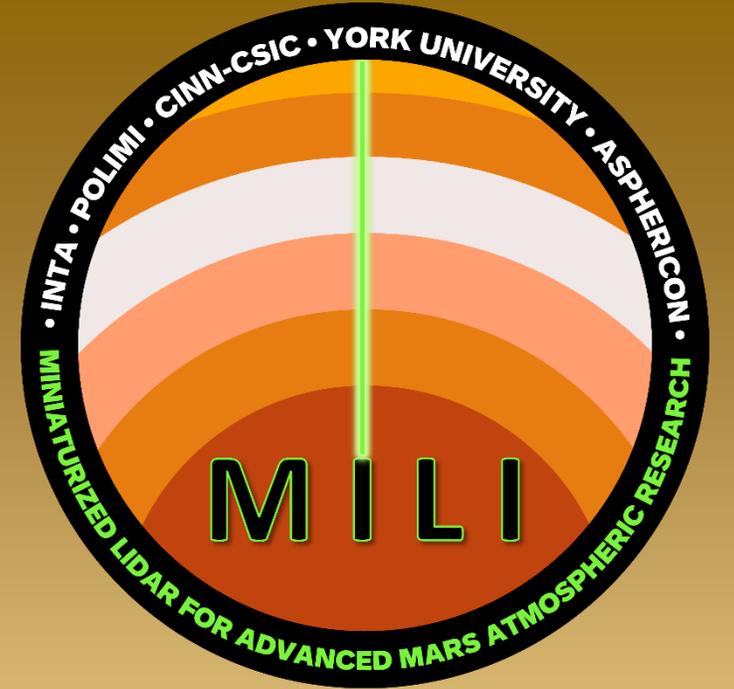


# MILI PROJECT

## TOWARDS NEXT GENERATION OF MINIATURIZED LIDARS FOR MARS ADVANCED ATMOSPHERIC RESEARCH



3rd international workshop on space-based lidar remote sensing  
techniques and emerging technologies



*Dr. Alberto Martín-Ortega*

*June 2023*

- ❖ WHY?
  - Understanding Mars Climate
  
- ❖ WHAT?
  - Miniaturized and Low Power Lidars
  
- ❖ HOW?
  - New Lidar Technologies

# UNDERSTANDING THE CLIMATE ON MARS

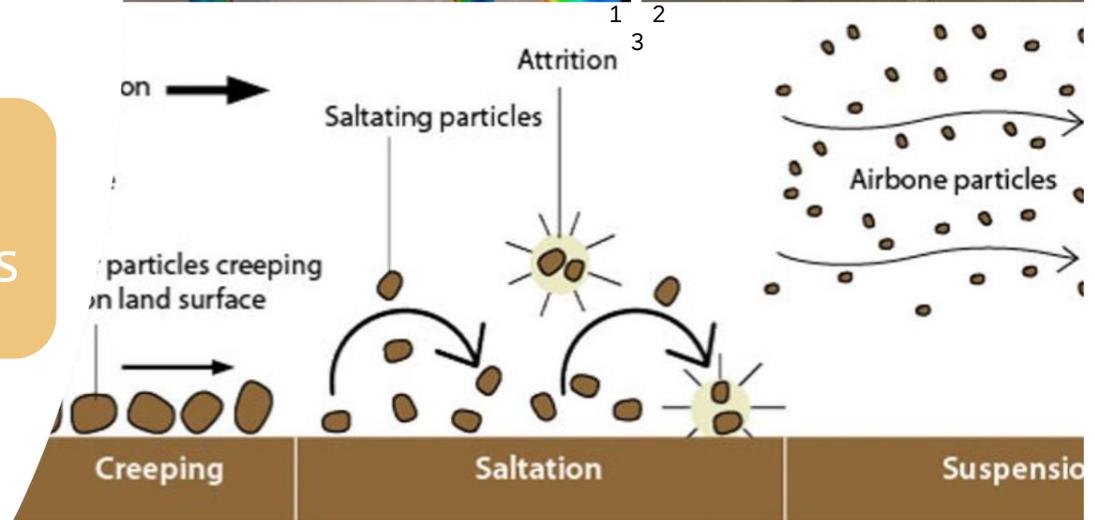
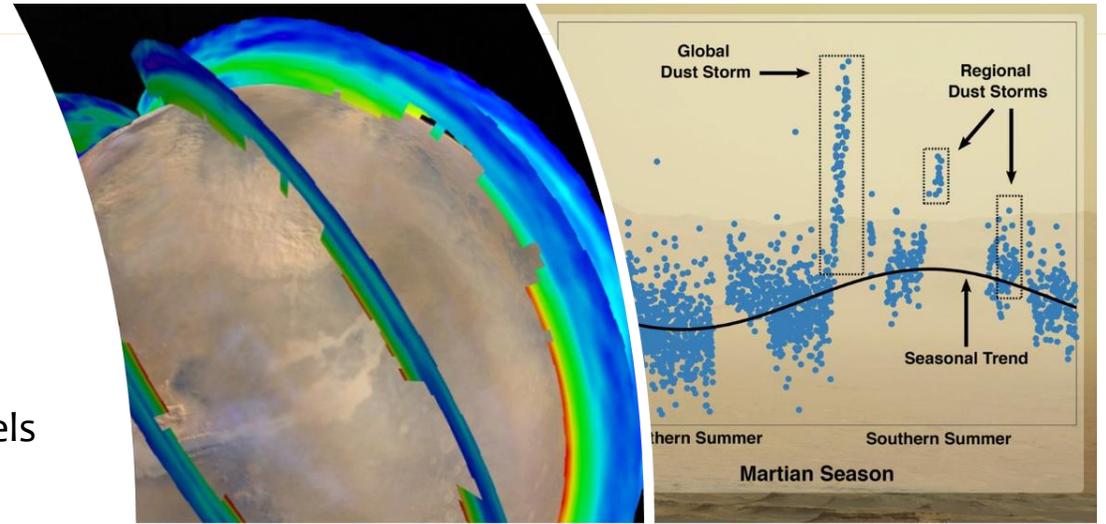
## Studying the Dust

- Characterizing Martian dust distributions
- Height profiles and concentration
- Dust lifting and transportation processes

## Improving the Models

- Temperature models
- Wind models

## Better predictions



<sup>1</sup> NASA/JPL-Caltech/MSSS

<sup>2</sup> University of Arizona/Shane Stone/NASA Goddard/Dan Gallagher

<sup>3</sup> <https://eschooltoday.com/>

# ON EARTH ANALOGUES



Polar-orbiting meteorological satellite

Polar-orbiting earth resources satellite

Geostationary meteorological satellite

High-altitude aircraft

International aircraft

Meteorological research aircraft

Baseline air pollution station

Radiosonde

Pilotless aircraft

Meteorological satellite ground station

Automated river-height and rain gauges

Automatic weather station

Wind profiler

Voluntary observing ship

Domestic aircraft

Meteorological observing station

Over-the-horizon radar

Drifting buoy



ON MARS

FUTURE

METEO

NETWORKS

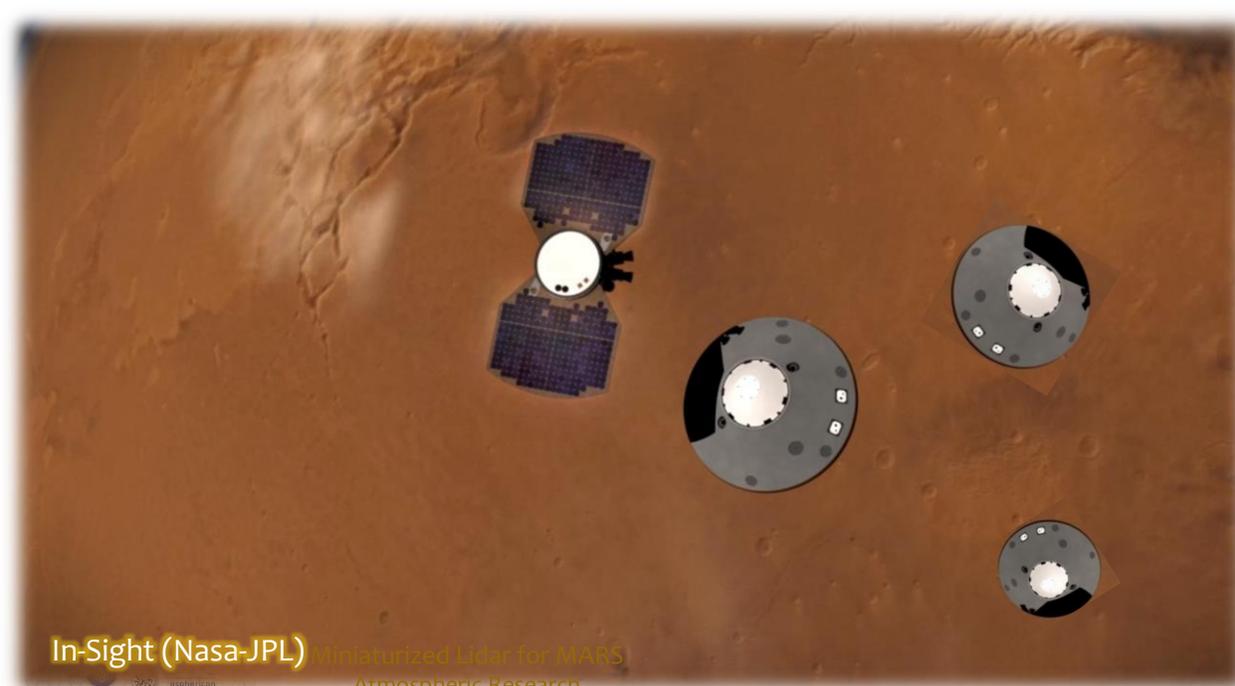
# FEASIBILITY OF METEOROLOGICAL NETWORKS

## ❖ Low Mass Budget

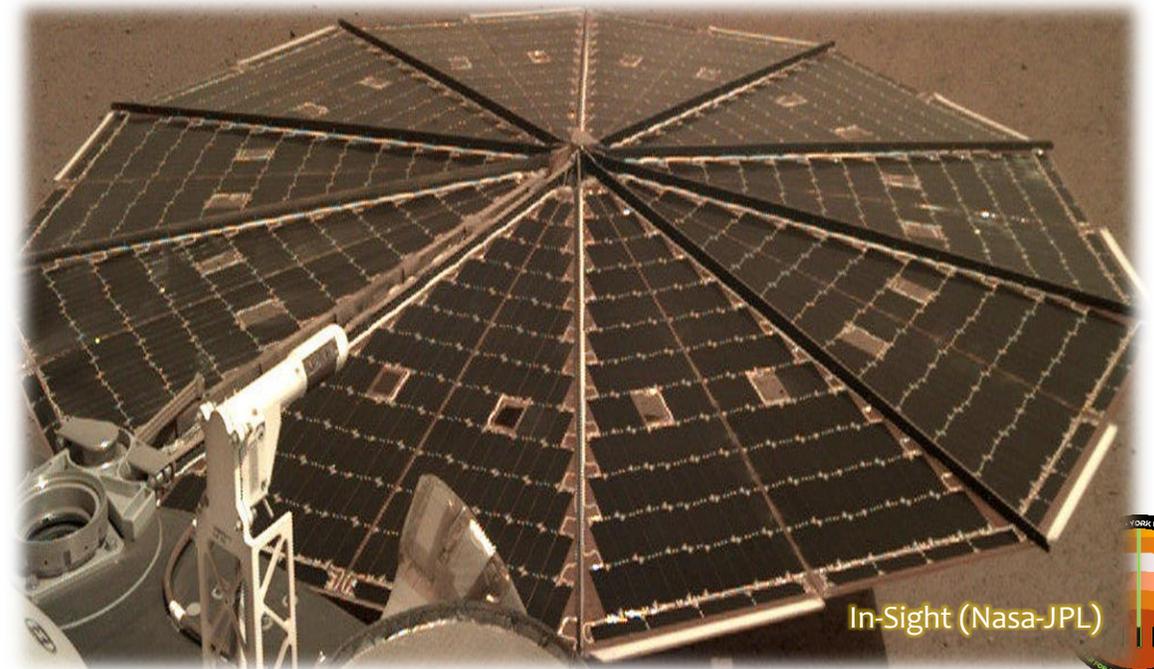
- Multiple meteorological stations in one launch
- Simple landing system

## ❖ Low Power Budget

- Powered by solar panels
- Day and Night operations

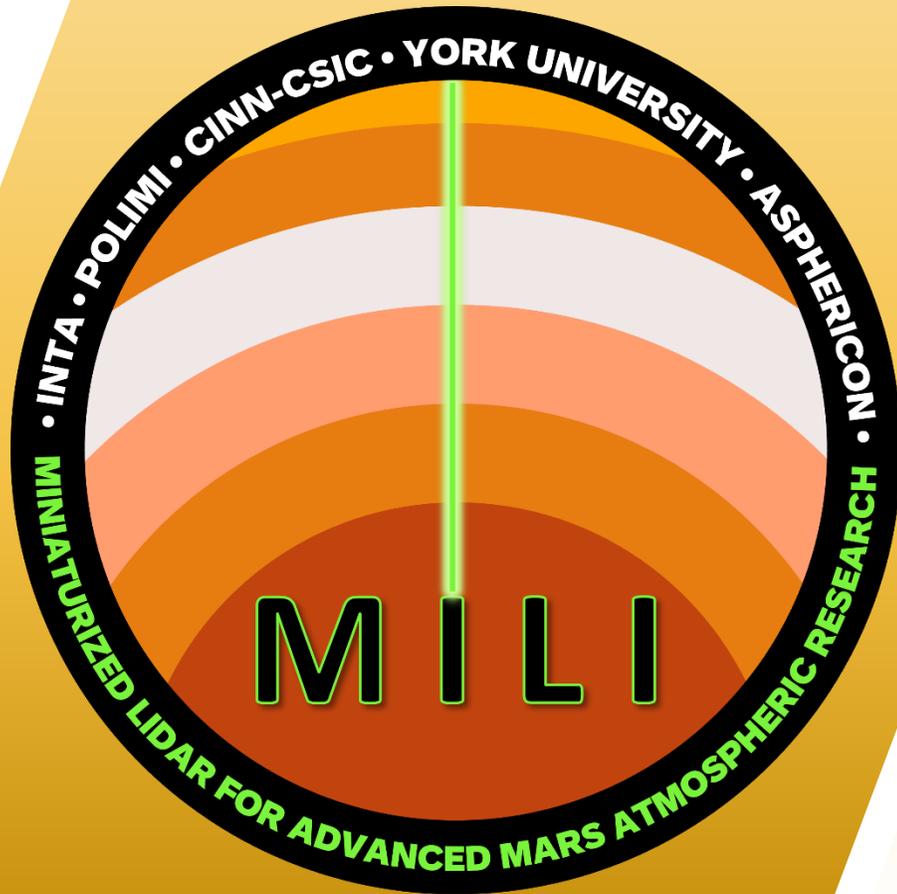


In-Sight (Nasa-JPL) Instrumentized Lander for MARS  
Atmospheric Research



In-Sight (Nasa-JPL)





## Miniaturized LIDAR for Mars Advanced Atmospheric Research



Funded by  
the European Union



## OBJ1:

To mature the required technologies to enable development of a *miniaturized and low power* space born LIDAR

### TECH-1

Controlled Coefficient of Thermal Expansion structures.

### TECH-2

Use of Miniaturized Laser Modules as the main laser for the emitter.

### TECH-3

Use of new Si-PMs for the receiver.

### TECH-4

Complex Form Optics based solutions.

OBJ2:

To build an Earth model of an atmospheric LIDAR

## KEY FEATURE 1

Total mass  
**< 6 kg**

## KEY FEATURE 2

Maximum operational  
power consumption  
**< 15 W**

## KEY FEATURE 3

Two wavelengths plus  
depolarization ratio  
 **$2\beta+1\delta$**

## KEY FEATURE 4

TRL4 with a clear path  
towards TRL6



- System engineering and integration
- Optical design
- Electronics/Optoelectronics/Software
- Science



- Thermol-Mechanical design & manufacturing



- Co-Science
- Instrument-level Verification & Characteriz.



- Structural materials (controlled CTE)



- Optics manufacturing & verification

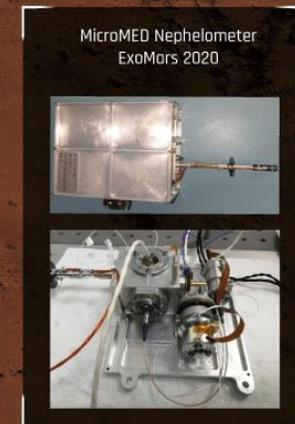


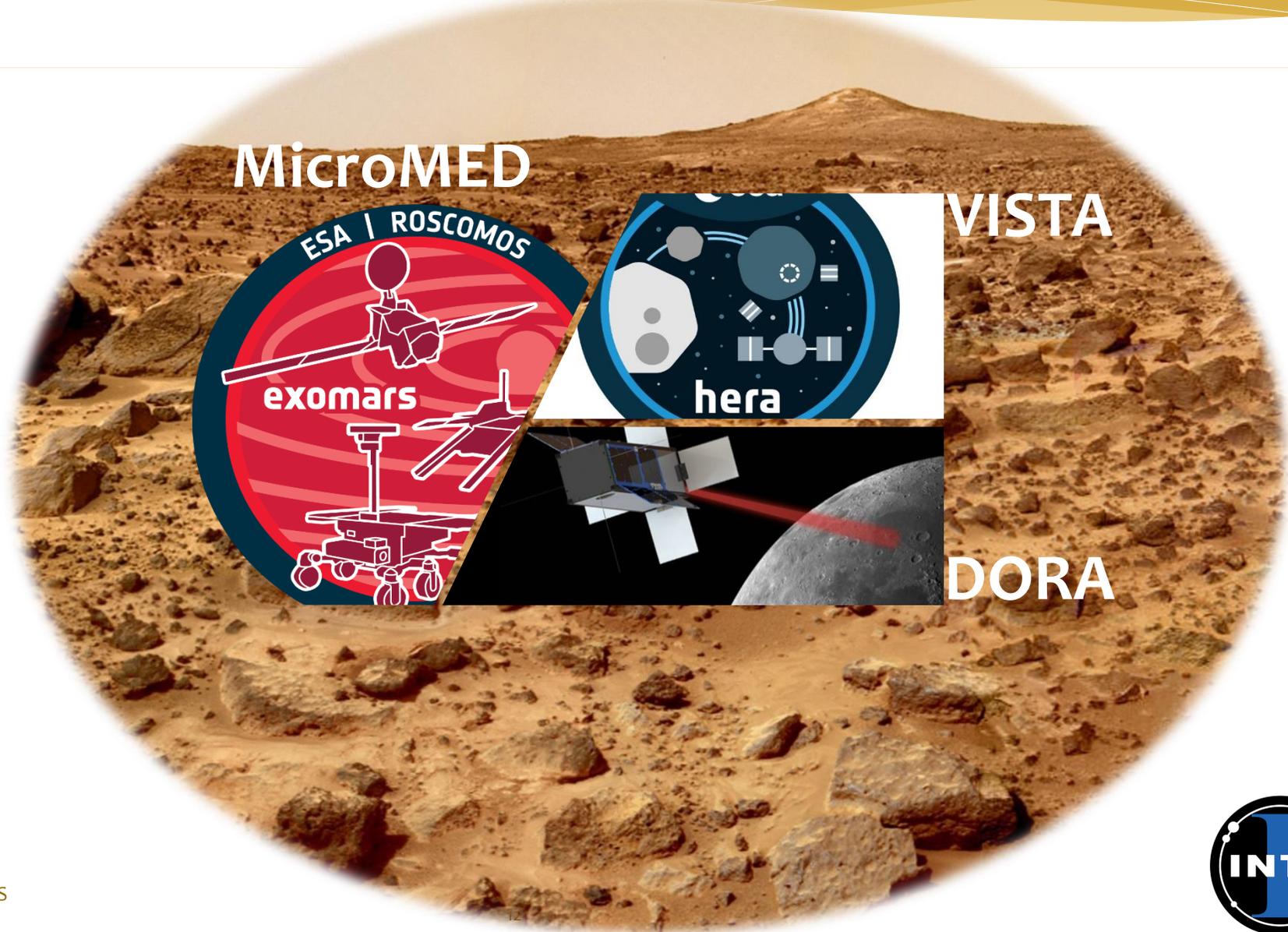


## Compact Sensors for in-situ Mars exploration



Área de Ingeniería de Sensores Espaciales  
Space Sensors Engineering Area





**MicromED**

**VISTA**

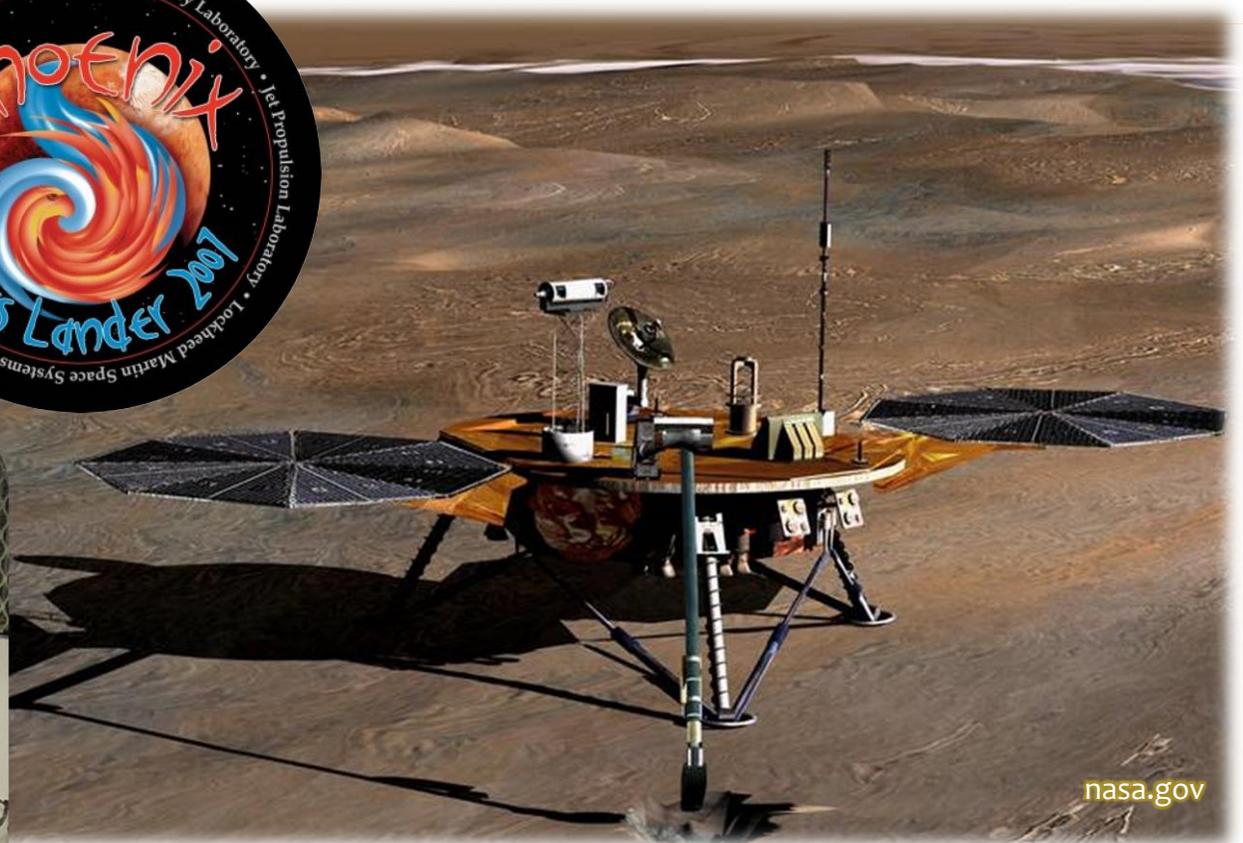
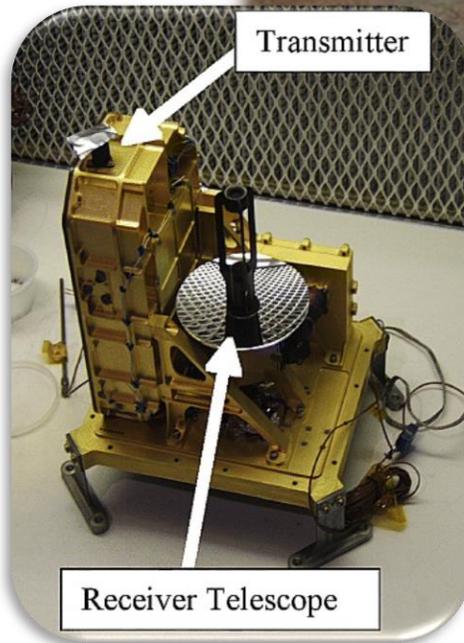
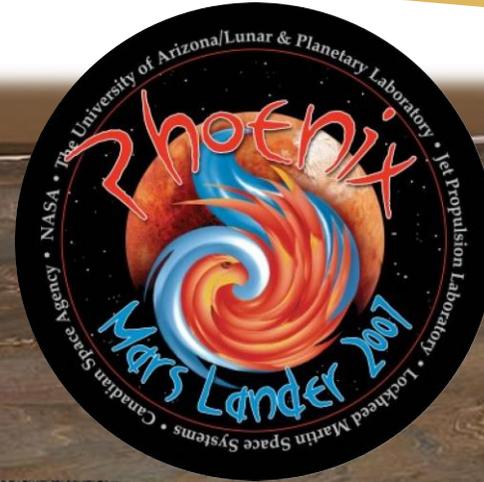
**exomars**

**hera**

**DORA**



# YORK U



nasa.gov

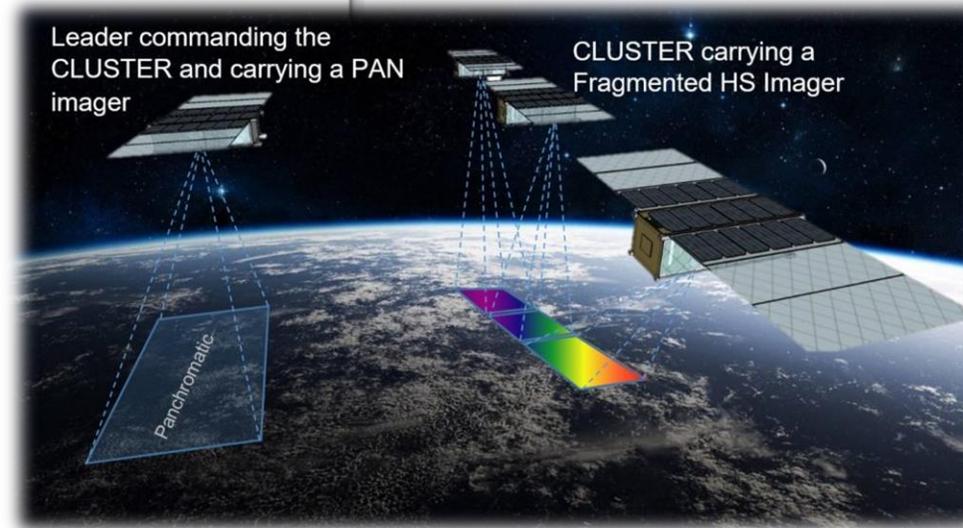


Miniaturized Lidar for MARS  
Atmospheric Research





## sentinel-4



Miniaturized Lidar for MARS  
Atmospheric Research



# cinn

Nanomaterials & Nanotechnology  
Research Center



## IP NANOKER SP6 MIRRORS



Zerodur  
By  
Schott

Glassceramic



SiC  
By  
Astrium

SiC gas pressure sintered



CeSiC  
By  
ECM

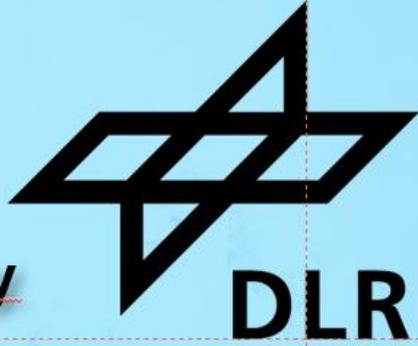
Composite of SiC reinforced  
with C-C



Miniaturized Lidar for MARS  
Atmospheric Research

# CONCURRENT ENGINEERING STUDY

hosted by



DLR

K/O presentations &  
Domain Status

Set-up of working  
environment

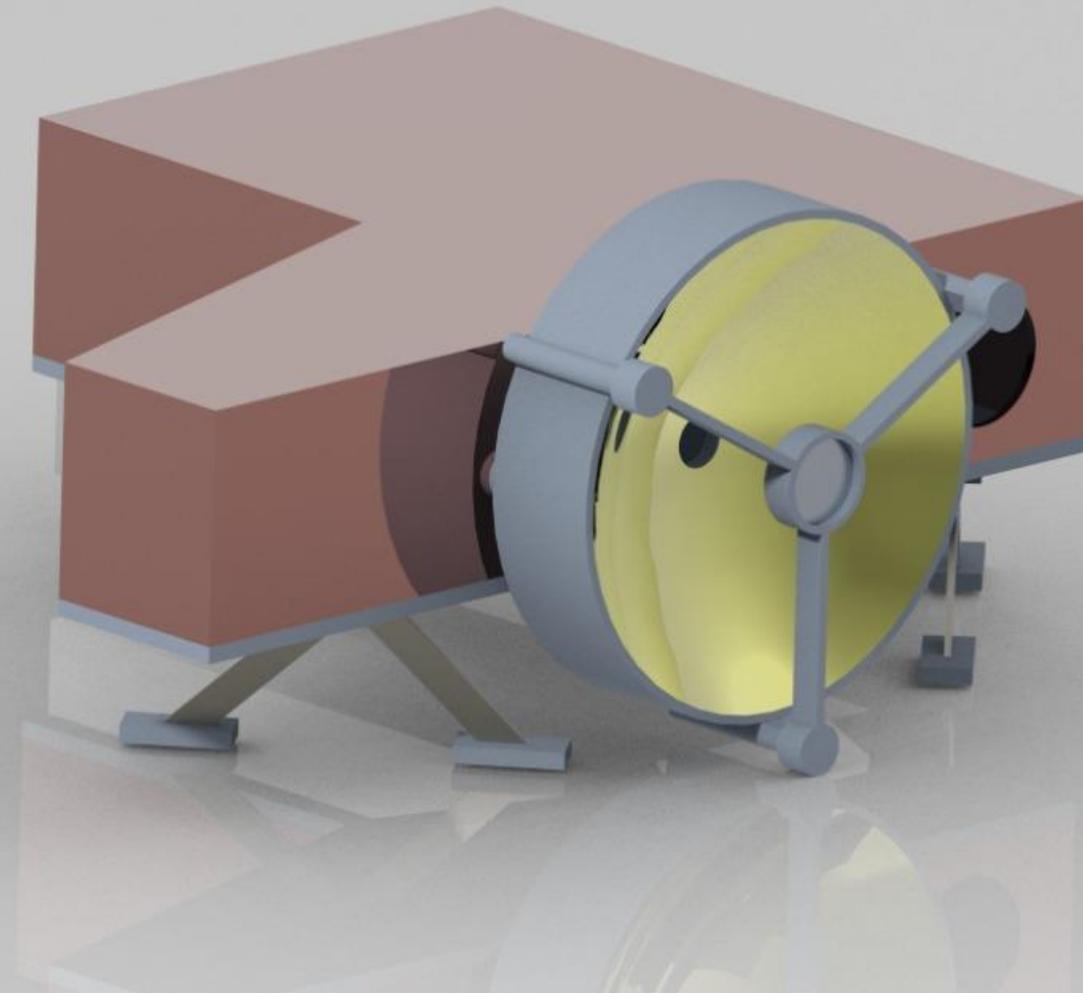
Responsibilities

Identification of major  
discussions

Clarification of  
interdependencies

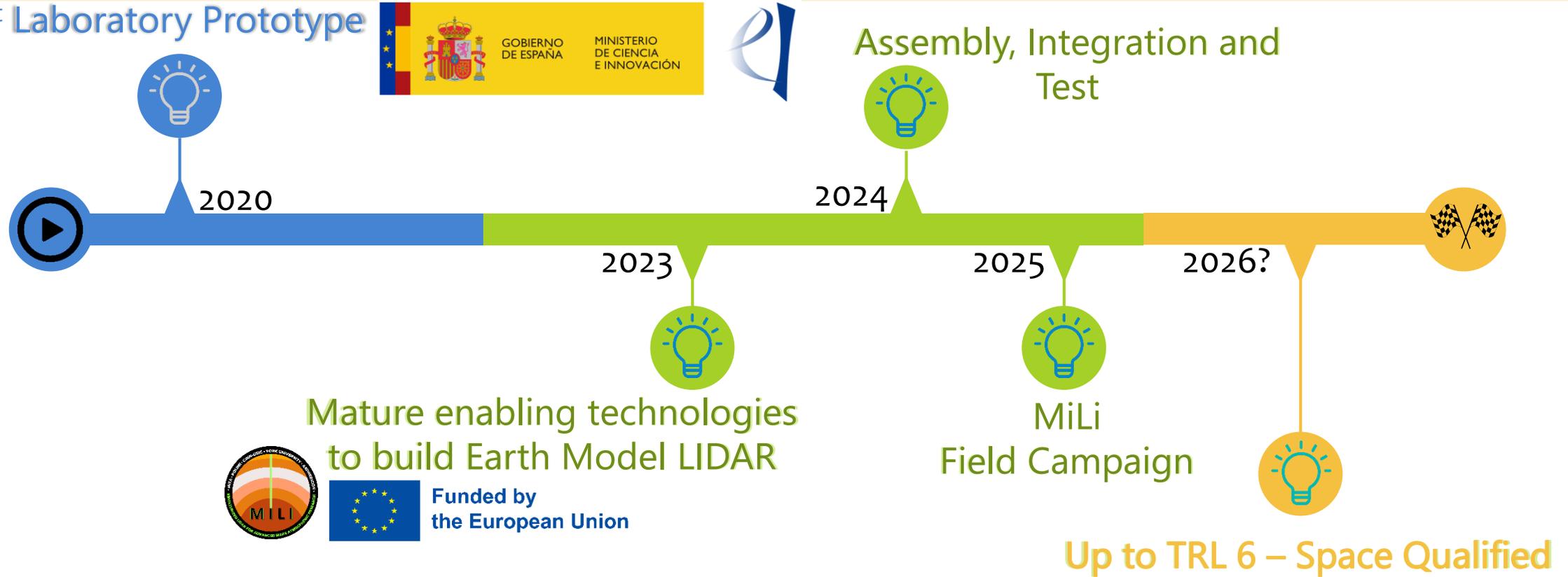


# Actual configuration with horizontal mechanical interface (Layout A)



# PAST, PRESENT & FUTURE OF MILI

## LIDAR Initial Concepts to 1<sup>st</sup> Laboratory Prototype



# THANKS!

Dr. Alberto Martín-Ortega  
[amarric@inta.es](mailto:amarric@inta.es)

