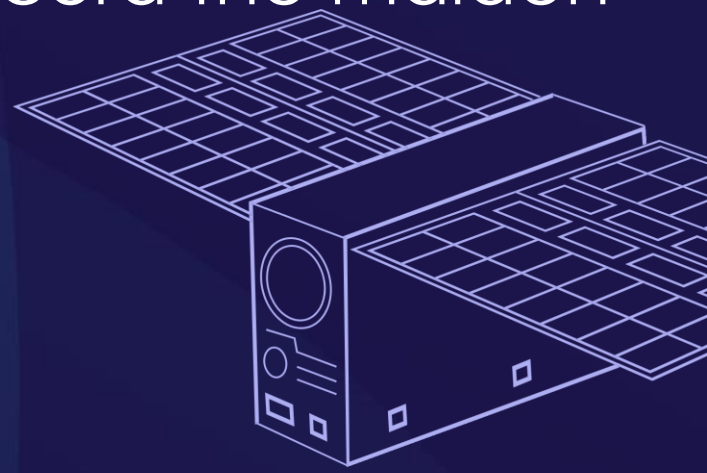
Main author: Simone Simonetti
Co-author and presenter: Biagio Cotugno

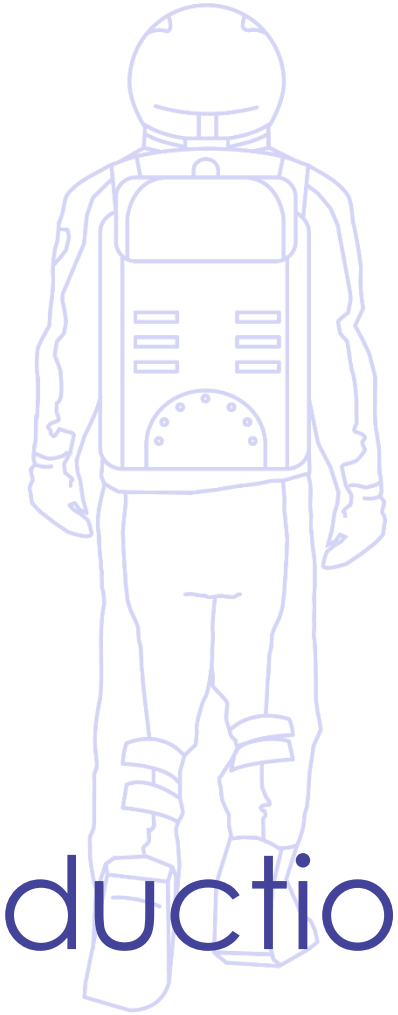
Agenzia Spaziale Italiana

argotec

ArgoMoon

Italian CubeSat technology to record the maiden flight of SLS towards the Moon





ARGOTEC Introduction

ARGOTEC
Units and Locations

Payloads

SmallSat

Avionics

Training, Ops. and Services

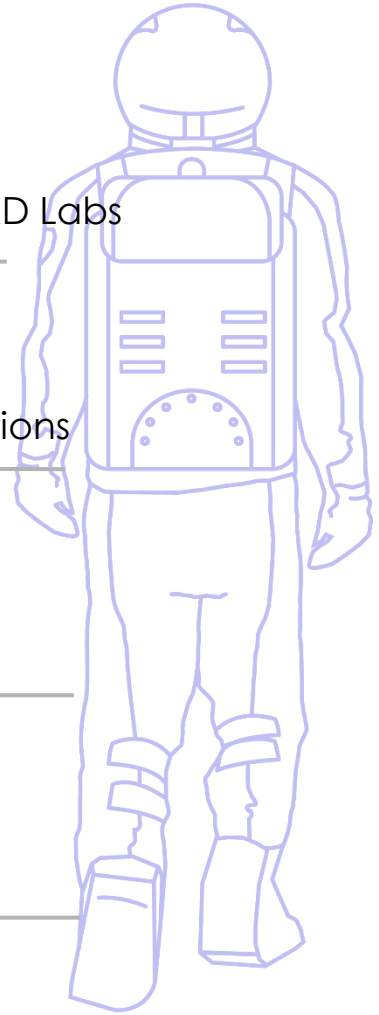
R&D

Turin (IT)
Headquarter – Engineering & R&D Labs

Cologne (DE)
EAC – Training, Services and Operations

Noordwijk (NL)
ESTEC – Technical Support

Riverdale, MD (US)
Argotec Inc – US brench



ARGOTEC
Facilities

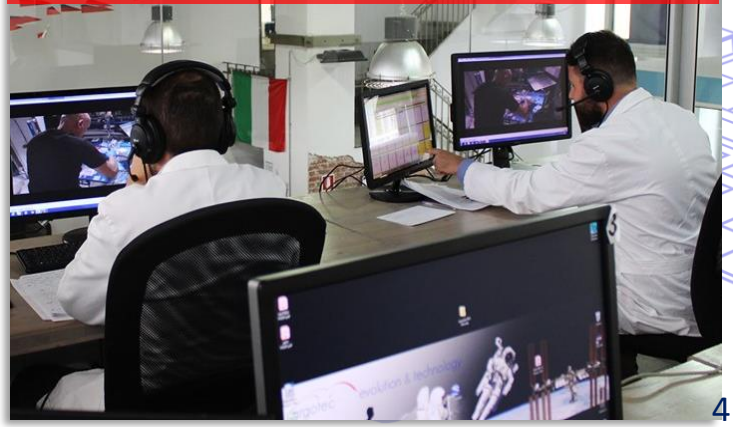
Electronic Lab

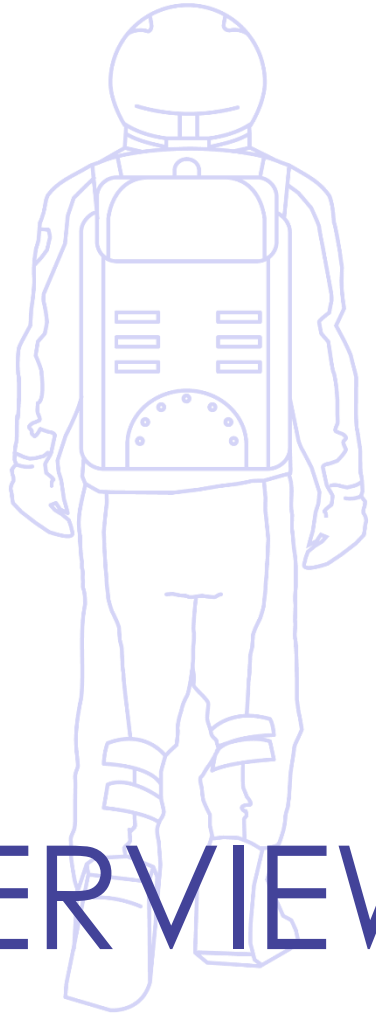

MultiLab


Prototype Lab


Thermal Lab


Clean Room ISO 5

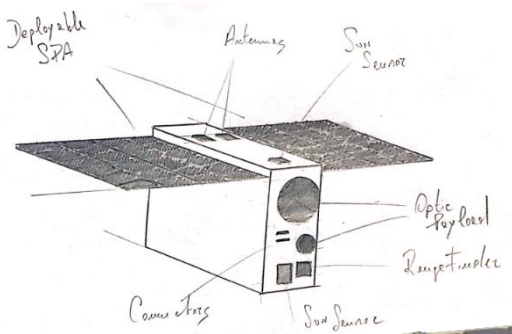

Mission Control Centre


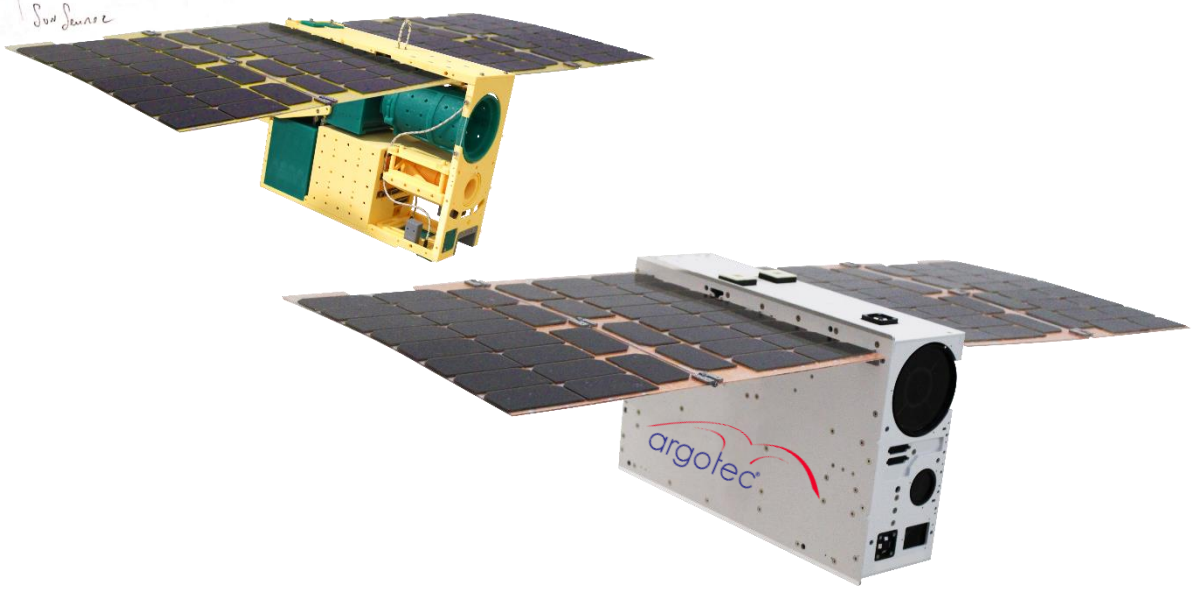


PLATFORM OVERVIEW

PLATFORM OVERVIEW

Concept All-in-house



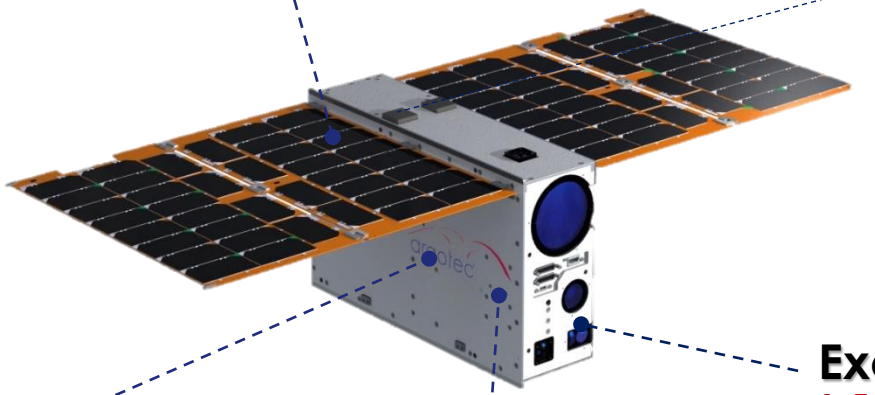


PLATFORM OVERVIEW

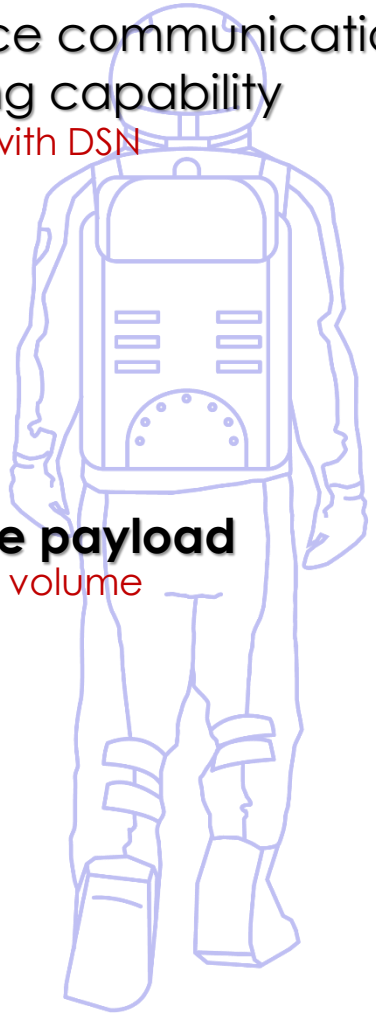
HAWK 6 - Deep Space Platform

Advanced maneuvering & attitude control
High performance thruster with integrated RCS

Deep Space communication and ranging capability
Compatible with DSN



Exchangeable payload
1.5 U of available volume

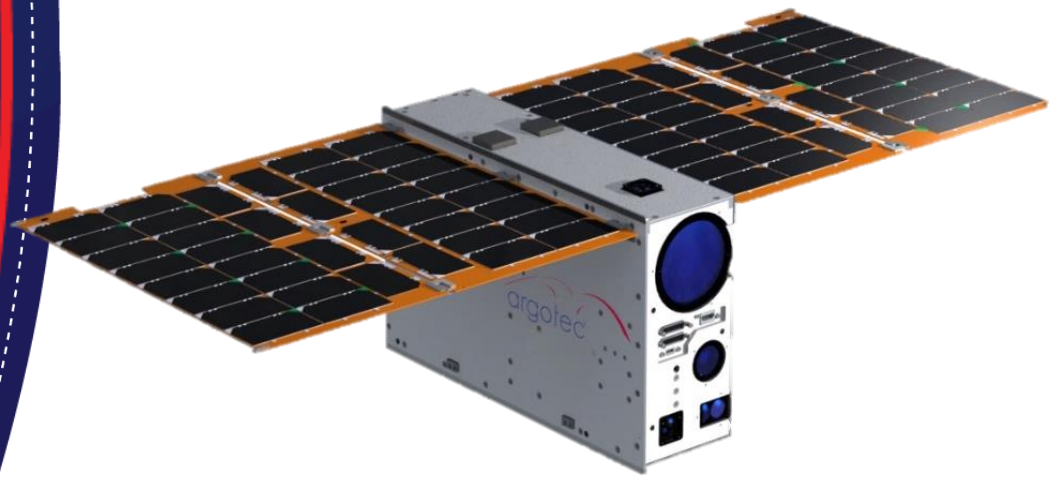


Tailored on mission needs
Customized EPS and OBC with highly reliable space rated components

Optimized for **Deep space Radiation**
High protection structure

PLATFORM OVERVIEW

HAWK 6 - Deep Space Platform



6U

+

SUBSYSTEMS OF BIGGER SATELLITES

+

MINIATURIZED ADCS, PS, STR, EPS AND OBC

+

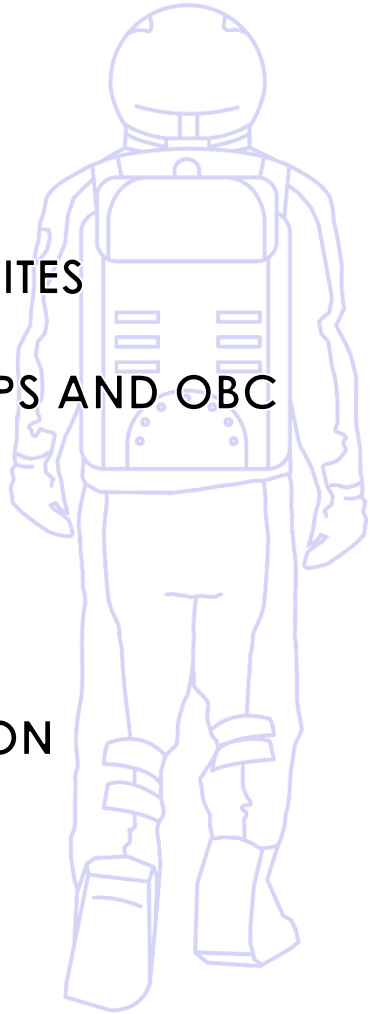
IN HOUSE EPS

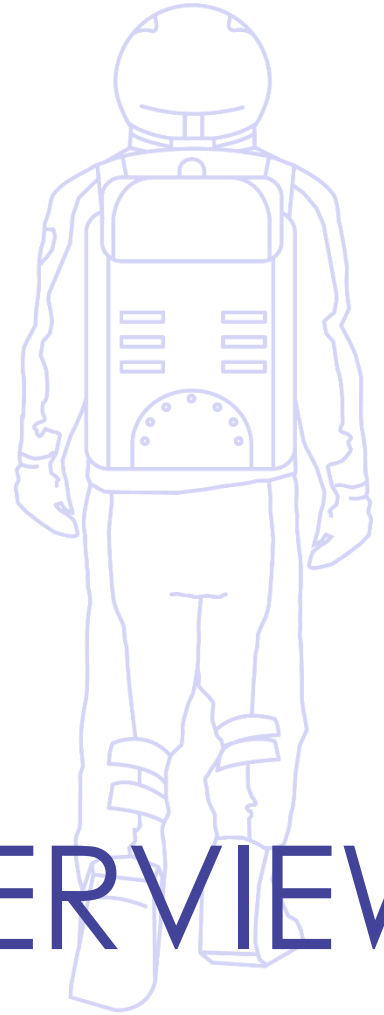
+

IN HOUSE OBC

+

IN HOUSE SATELLITE INTEGRATION





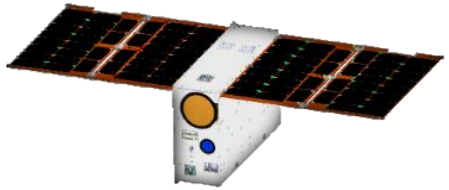
ARGOMOON OVERVIEW

ARGOMOON OVERVIEW

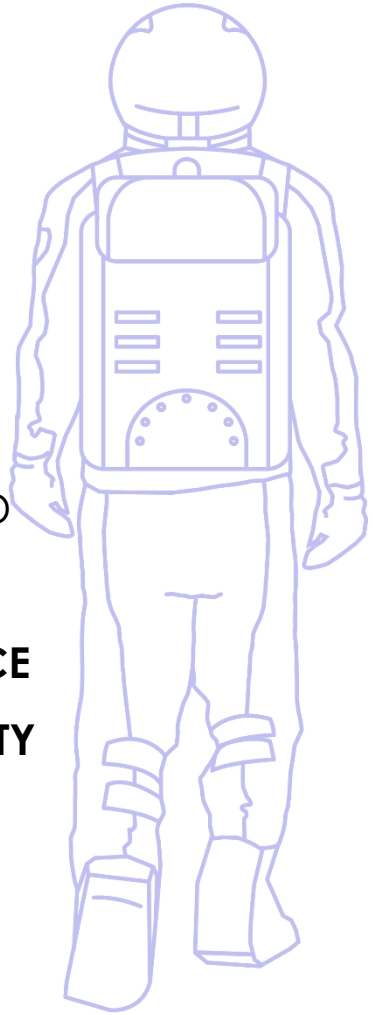
Artemis-1 Mission - SLS

ORBIT: 10,000 – 450,000 KM

LIFETIME: 6 MONTHS



SLS ARTEMIS-1 MISSION



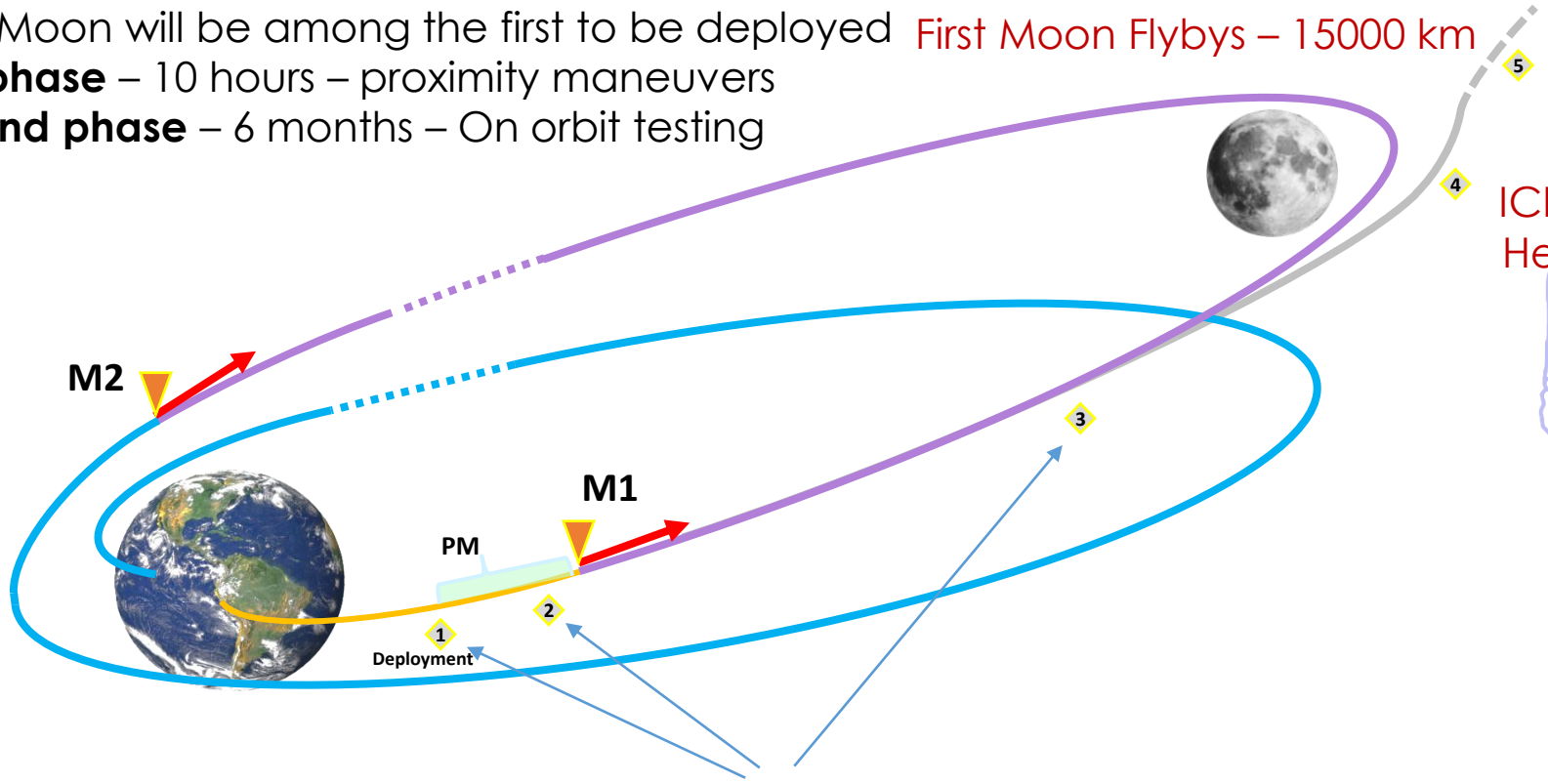
MISSION OBJECTIVES

- PROVIDE **AUTONOMOUS NAVIGATION** AND **POINTING** BASED ON DETAILED PHOTOGRAPHY
- VALIDATE **NEW NANOSATELLITE TECHNOLOGIES** IN **DEEP SPACE**
- DEMONSTRATE HIGH HARDWARE **RELIABILITY** AND **OPERABILITY**
- PROVIDE **HISTORICALLY SIGNIFICANT PHOTOGRAPHY** OF **ARTEMIS-1 MISSION**
- PROVIDE **DETAILED IMAGERY** OF **ICPS**, **MOON** AND **EARTH**

ARGOMOON OVERVIEW

Mission Overview

ArgoMoon will be among the first to be deployed
First phase – 10 hours – proximity maneuvers
Second phase – 6 months – On orbit testing

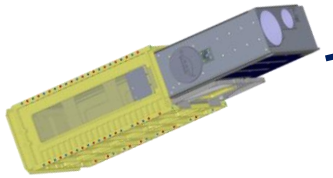


PM Proximity flight maneuvers
M1 Lunar Fly by Maneuver
M2 Final Maneuver for reentry trajectory

Different CubeSat deployment point

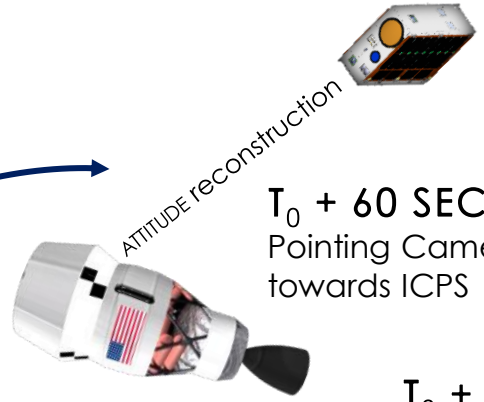
ARGOMOON OVERVIEW

Artemis-1 Mission - SLS

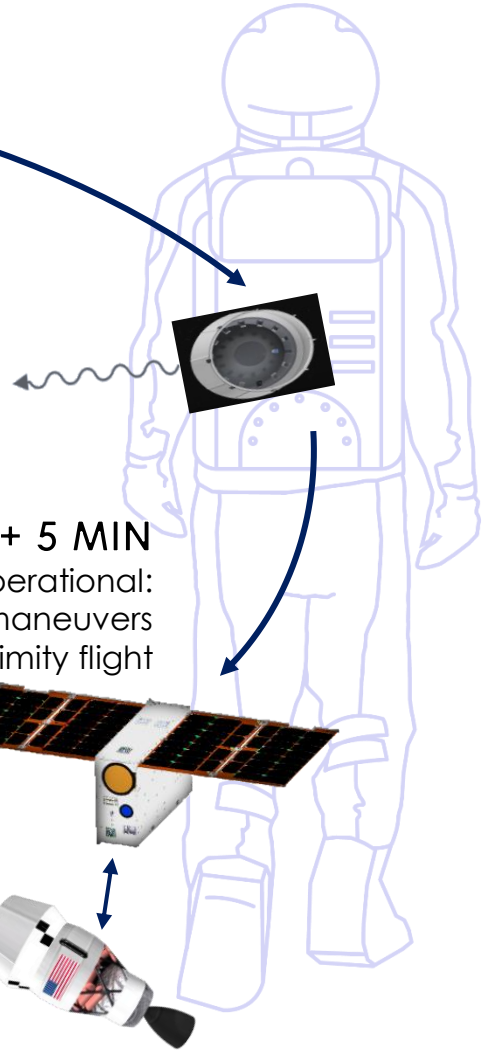


ORION DETACHMENT FROM ICPS
Put in a Translunar Trajectory

T_0 = DEMPLOYMENT
Closure of the separation switches: **power to the system**



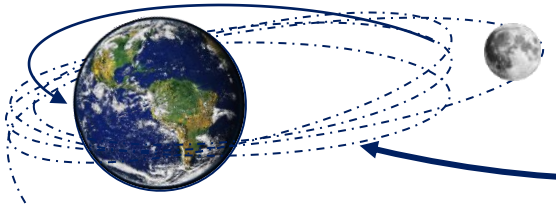
T_0 + 60 SEC
Pointing Cameras towards ICPS



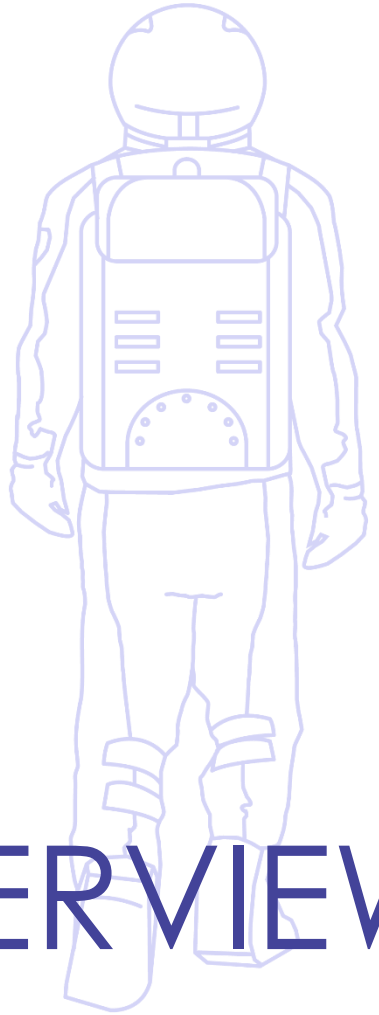
T_0 + 1 MIN
ICPS Targeted:
Tracking Mode

T_0 + 5 MIN
PS operational:
Relative dynamic maneuvers
100m-500m proximity flight

T_0 + 8 HOUR
Geocentric orbit
Pictures of Earth and the Moon and validation of on-board technology



T_0 + 6 MONTHS
Heliocentric disposal

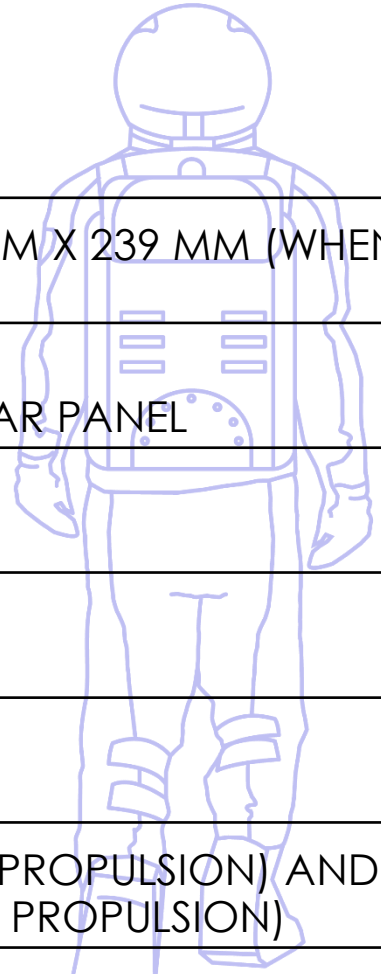


SUBSYSTEMS OVERVIEW

SUBSYSTEMS OVERVIEW

Platform Overview

MASS	14 KG
VOLUME	6U - 911.5 MM 366 MM X 239 MM (WHEN DEPLOYED)
GENERATED POWER	80 W THROUGH SOLAR PANEL
STORAGE MEMORY	16 GB
DOWNLINK BAND	X-BAND
DOWNLINK DATA RATE	256 KPBS
PROPULSION	LMP103LT (PRIMARY PROPULSION) AND R134A (SECONDARY PROPULSION)
PAYLOADS	40° FIELD OF VIEW CAMERA, 2.5° FIELD OF VIEW CAMERA, RANGEFINDER

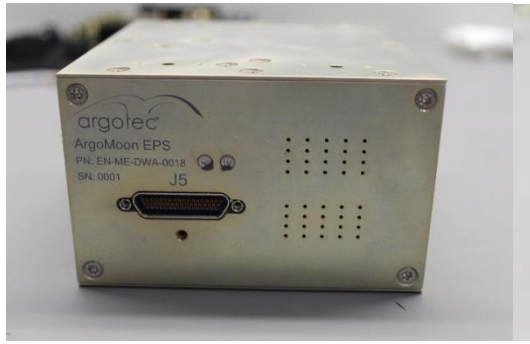


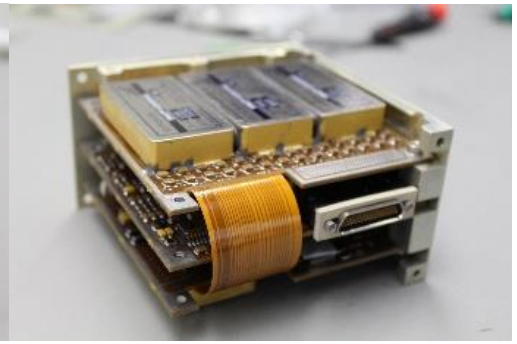
SUBSYSTEMS OVERVIEW

EPS and OBC&DH – In-House

30 KRAD RAD-HARD

- 0.6 U - 0.8 KG
- VOLTAGE 15V÷50V
- OUT_PWR UP TO 80W (3.3V, 5V, 12V BUS)
- LCL CIRCUITS FOR SEL MITIGATION
- MPPT BASED ON COTS

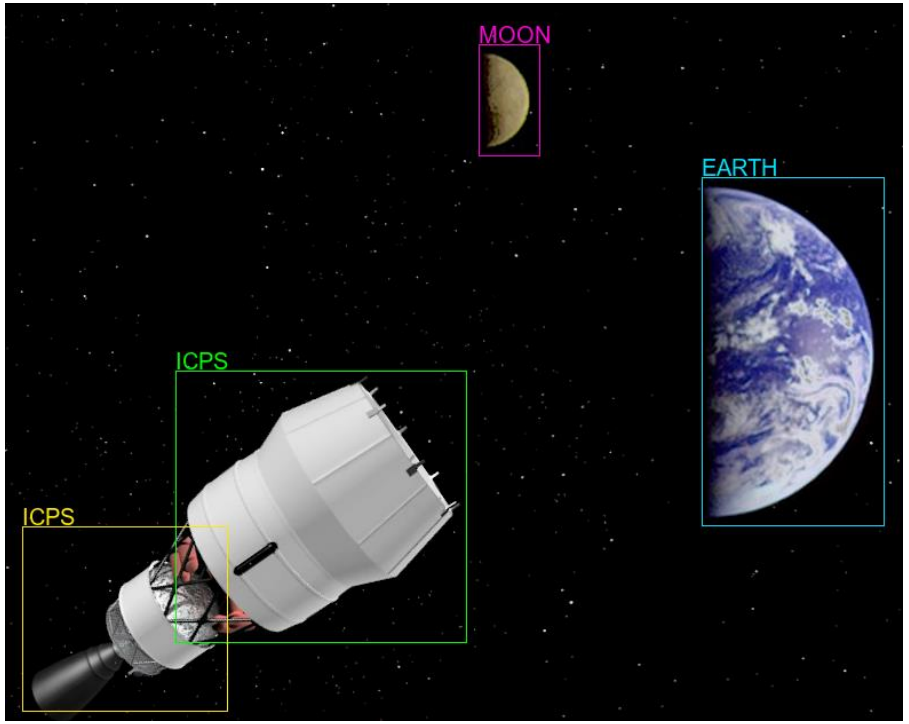




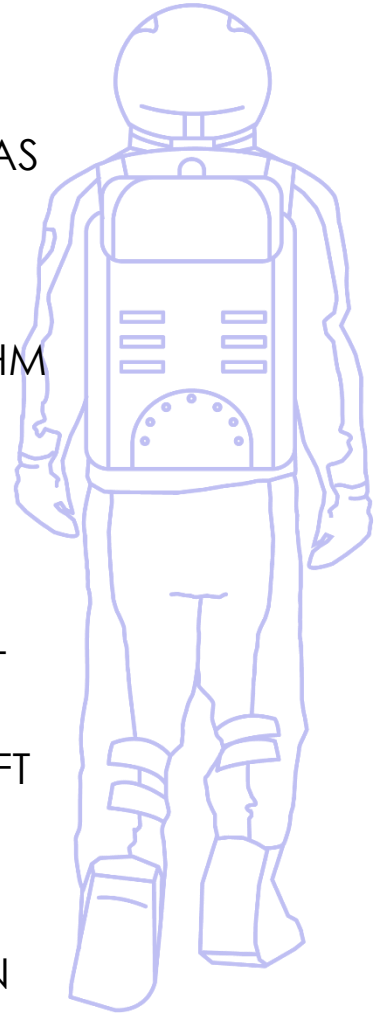
- 0.5U - 0.6 KG
- DUAL-CORE SPARC V8 CPU
- 20 MBIT EEPROM EDAC
- 16 GB NAND FLASH (+1000 PHOTOS)
- INTEGRATED FPGA

SUBSYSTEMS OVERVIEW

Optical Payload – Imaging System

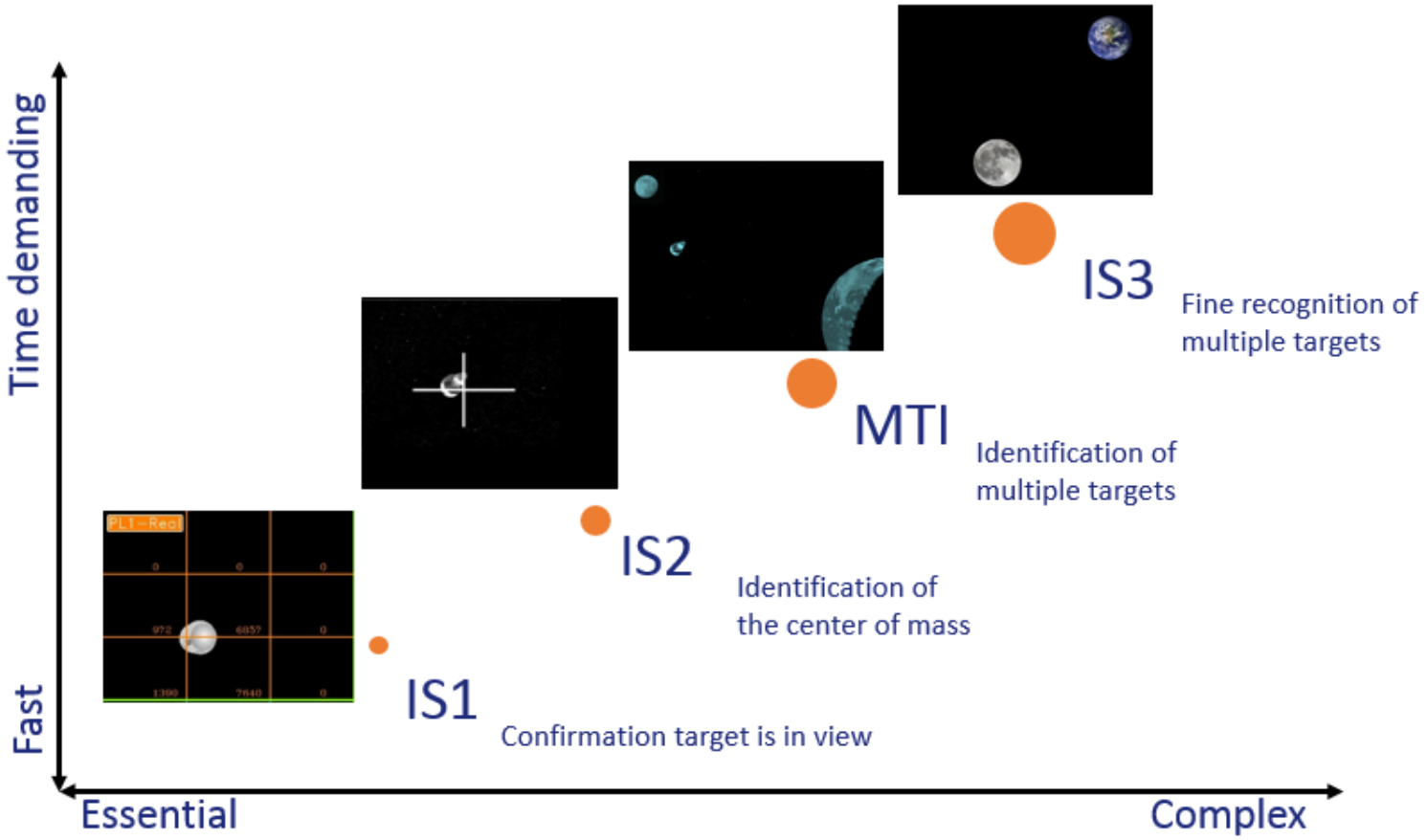


1.5 U – 1.2 KG
+
NARROW AND WIDE F.O.V. CAMERAS
+
1 PX/CM RESOLUTION FROM 1 KM
+
INTEGRATED AUTOFOCUS ALGORITHM
+
DOUBLE CAMERA SYSTEM
+
BACKGROUND NOISE FILTER
+
FAST IDENTIFICATION OF THE TARGET
+
ADCS POINTING OF THE SPACECRAFT
+
MULTIPLE TARGET IDENTIFICATION
+
FINE TRACKING FOR PHOTO SESSION



SUBSYSTEMS OVERVIEW

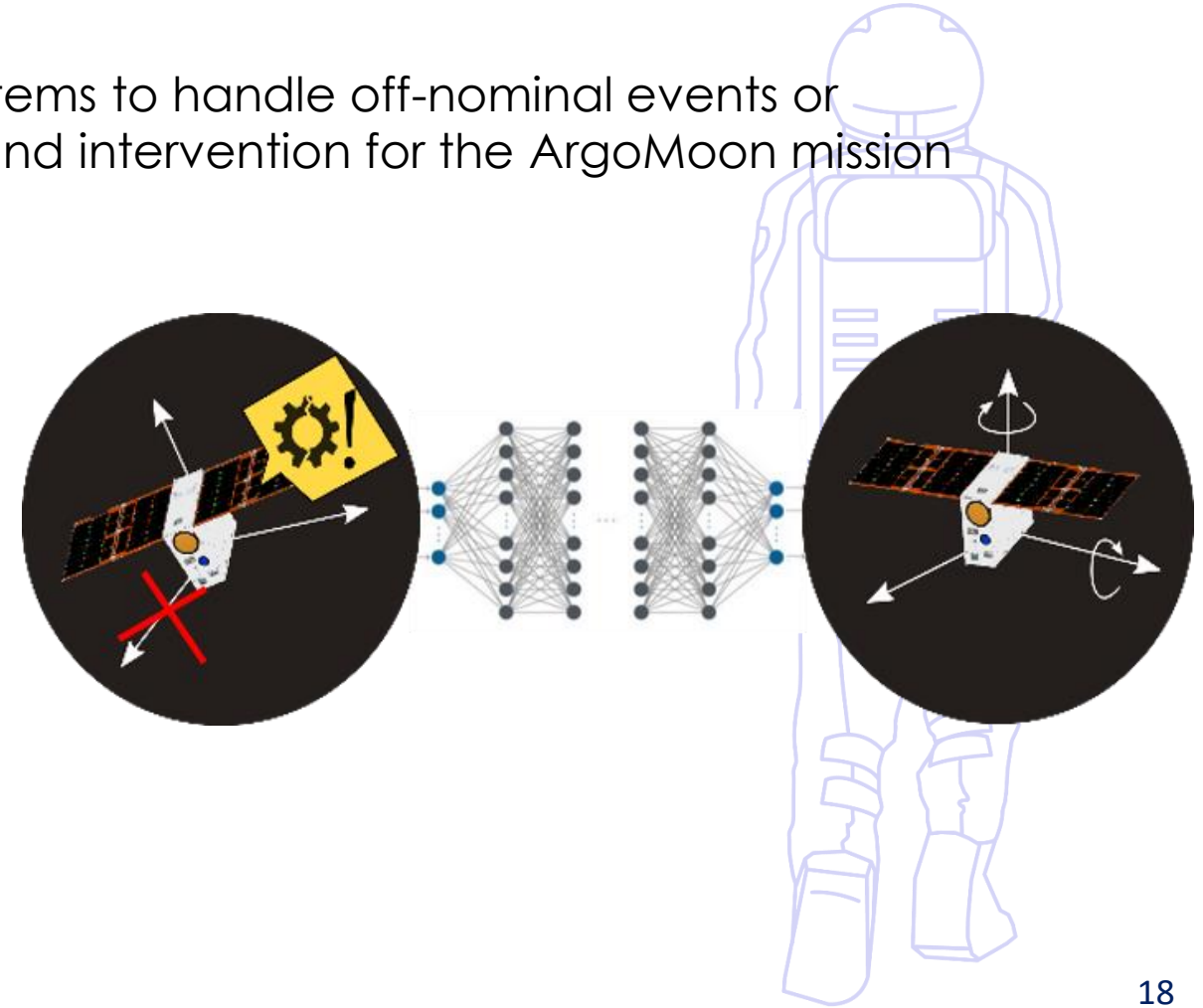
Autonomous Tracking and Pointing – In-House

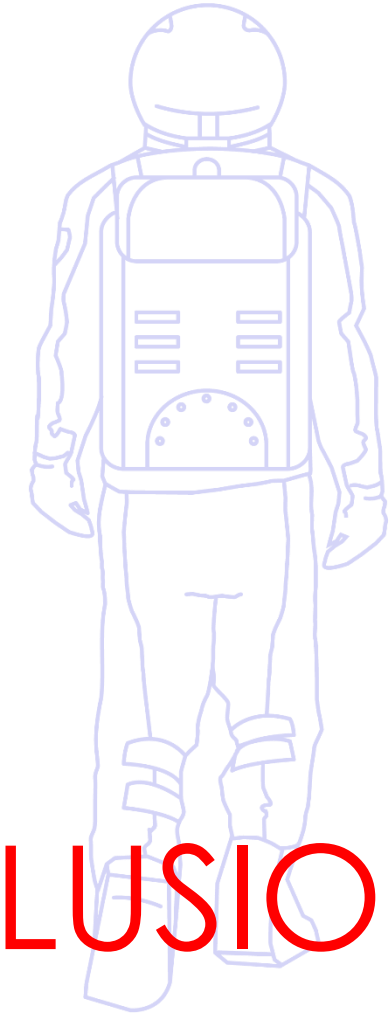


SUBSYSTEMS OVERVIEW
REACT

Argotec is developing an AI subsystems to handle off-nominal events or execute complex task without ground intervention for the ArgoMoon mission

- An adaptive attitude control system for increased nanosatellite autonomy
- Able to detect and react to reaction wheels failures
- The system uses on Deep Reinforcement Learning to train light and fast controllers based on neural networks



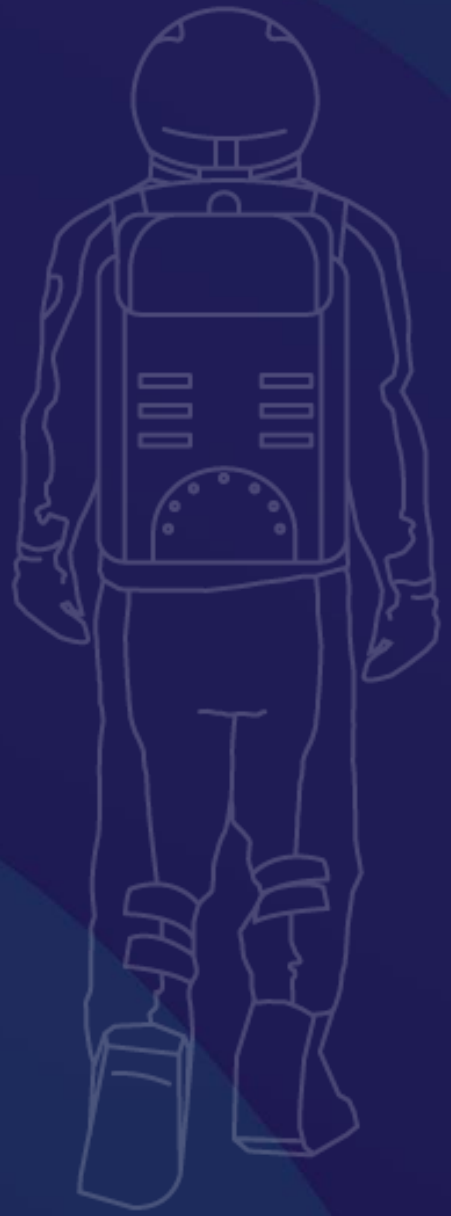


CONCLUSION

CONCLUSION

ArgoMoon on Artemis-1 Mission- SLS

- Only European NanoSat on-board SLS
- Collaboration with Italian Space Agency
- Historic pictures of the first mission of SLS
- High resolution pictures of Earth and Moon
- Autonomous Navigation for tracking and pointing
- Rad-hard in-house avionics technology
- High data storage capacity



THANK YOU!

www.argotecgroup.com