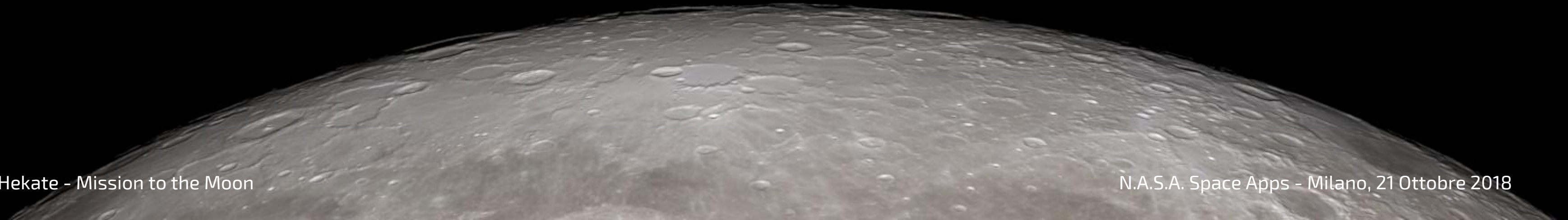
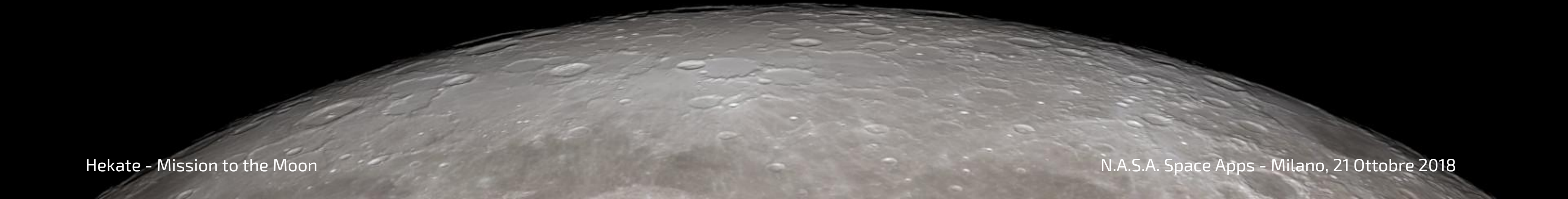
Hekate

Ad orbem per technicam



Hekate

First steps to the Moon



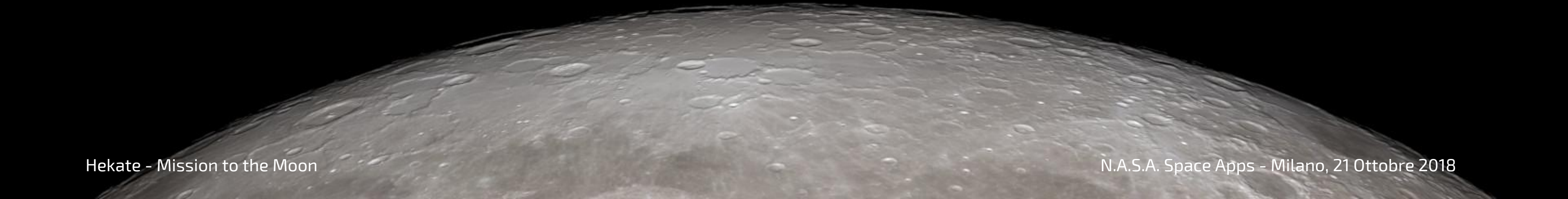
Purposes

The main aspect of this challenge is to inspect the moon in a proper and original way, focusing on the most recent discoveries.

The most relevant topics to investigate are:

- Research and Analysis of Lunar Water
- Analysis of Lunar Soil

Starting from these points we deepened the task and expanded it a bit beyond the standard request.

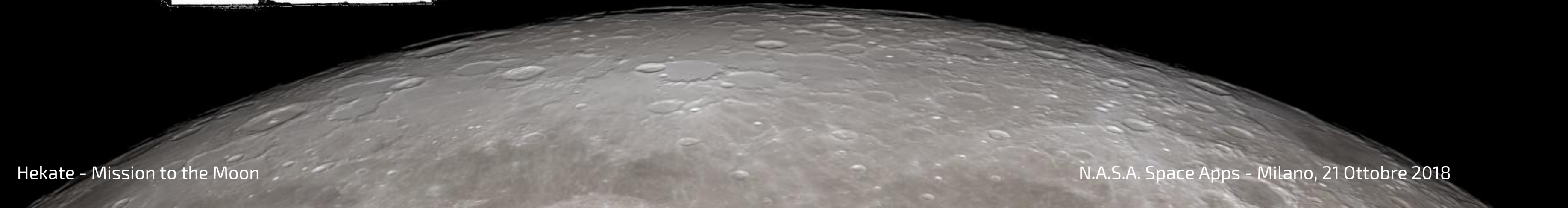


Hekate

We decided to call this mission after a Greek goddess because it is linked to the environment where the mission takes place:

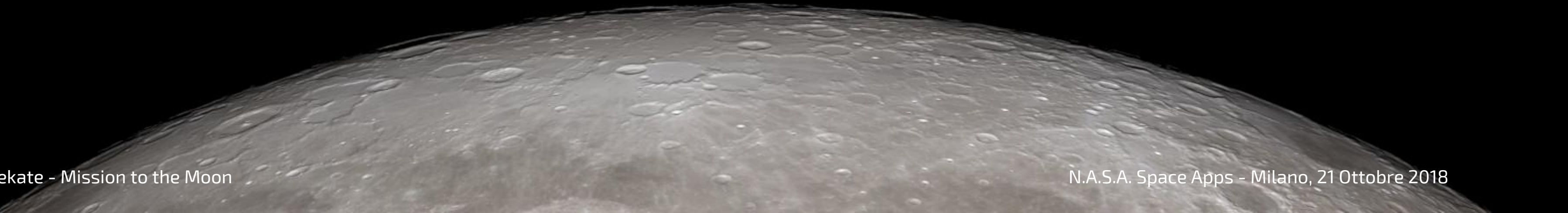
- she is the goddess of Moon
- she is the goddess of Darkness

The spot we are going to visit is an almost lightless place.

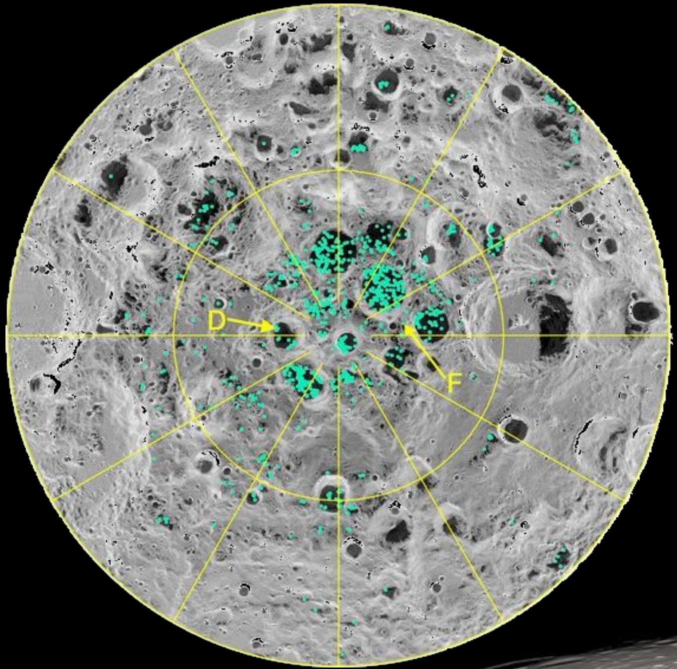


Hekate

Where and How



The Place



After having looked at a couple of places we decided to go for the south pole since:

- the soil should be older than on the rest of the Moon
- thanks to Chandrayaan-1 spacecraft we know there are spots of water

In particular we decided to set this mission to the Shoemaker Crater which:

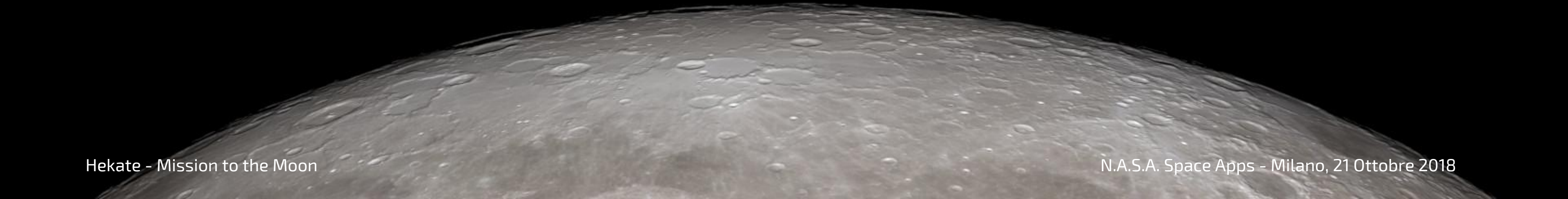
- is 8-9 km deep and with harsh environment (40 K)
- led us to stay in an area of 5 Km radius due to autonomy and guidance issues

Brainstorming

Single Rover mission

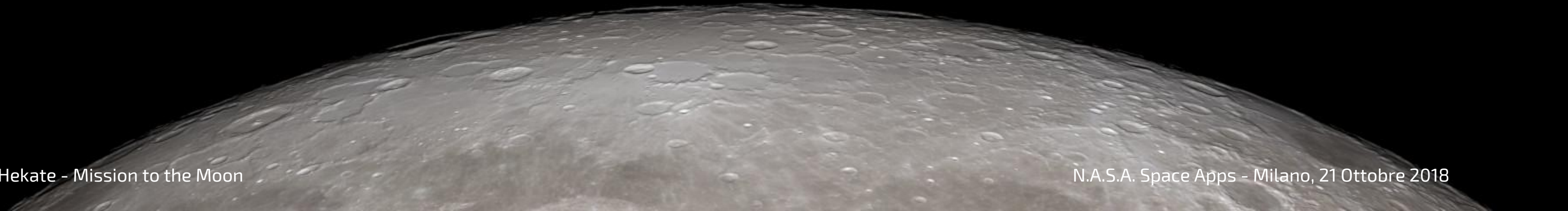
Multiple Mini-Rover mission

Drilling mission

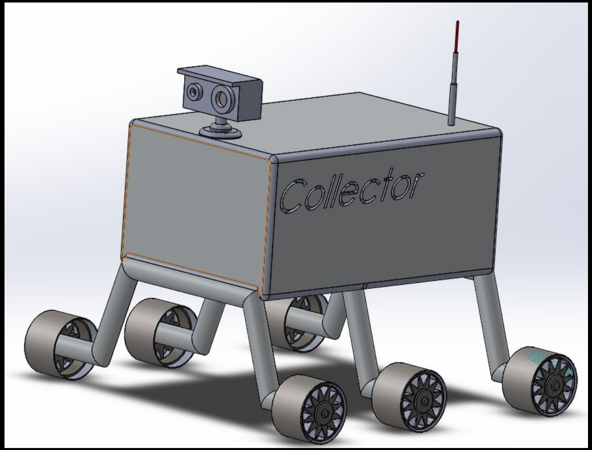


Mission Proposal

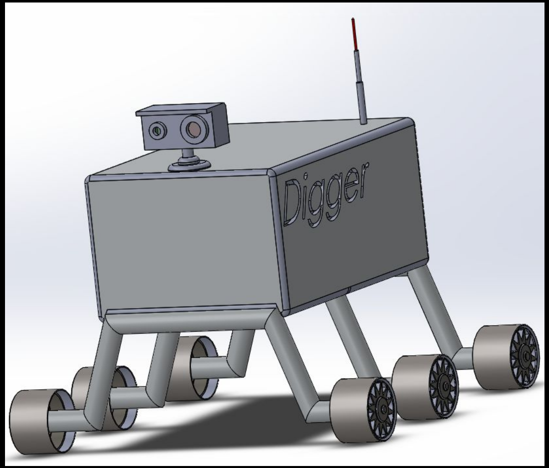
Structures



Main Rovers

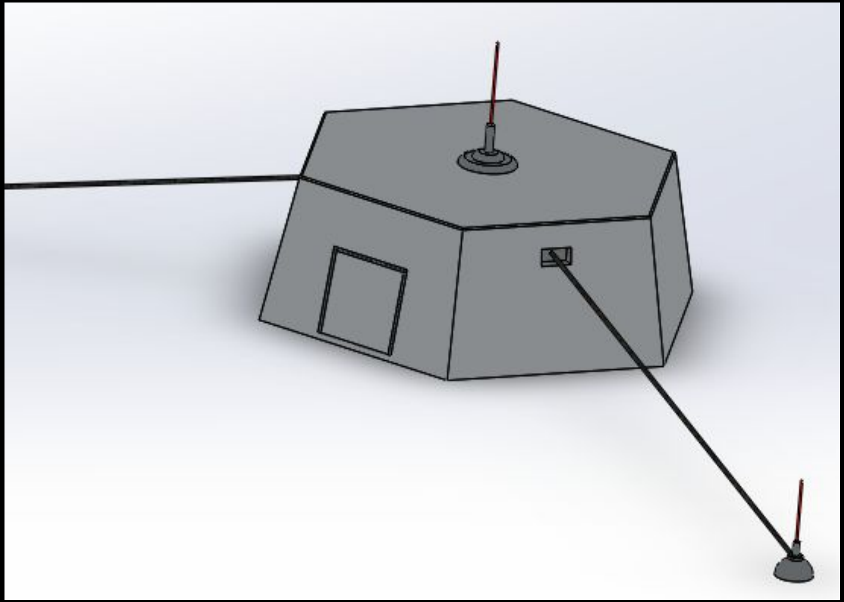


- 100 Kg
- Up to 0.18 km/h
- Collects samples and brings them back to the Hub



- 145 Kg
- Drill and sensors to collect samples up to 3-4 m and bringing them to the Hub

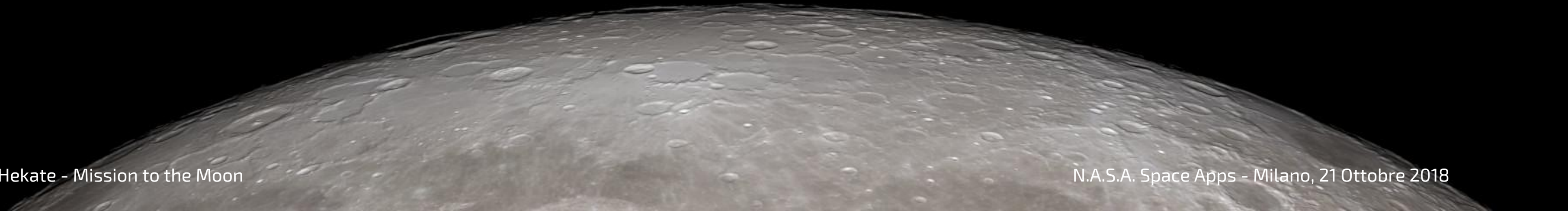
Fixed Station



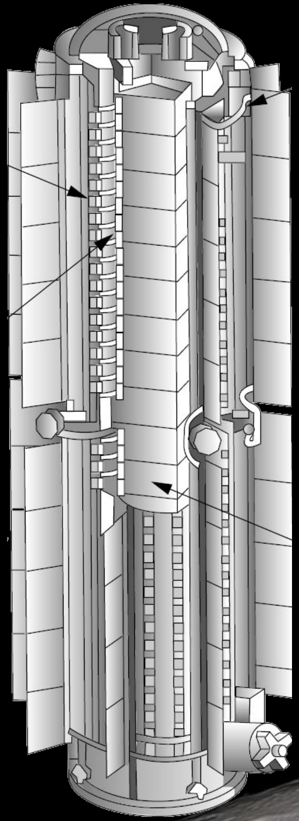
- Central Hub which is responsible for:
  - Samples analysis and experiments
  - Power supply and rovers recharging
  - Communication with the orbiter
- Sentinels that provide high quality close range operations thanks to transponders

Mission Proposal

Power Systems



RTG Supply



As is often done in this cases using RTG is convenient because:

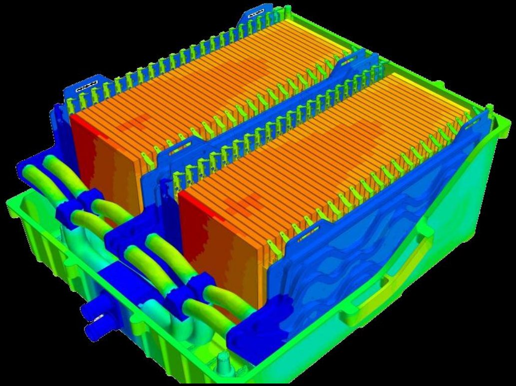
- can heat up the ambient and the systems
- can provide long term, autonomous energy

We did the computations on required energy based on Spirit (and Opportunity) rovers consumptions with a resulting:

- 560 Wh per day

Power issues and solutions

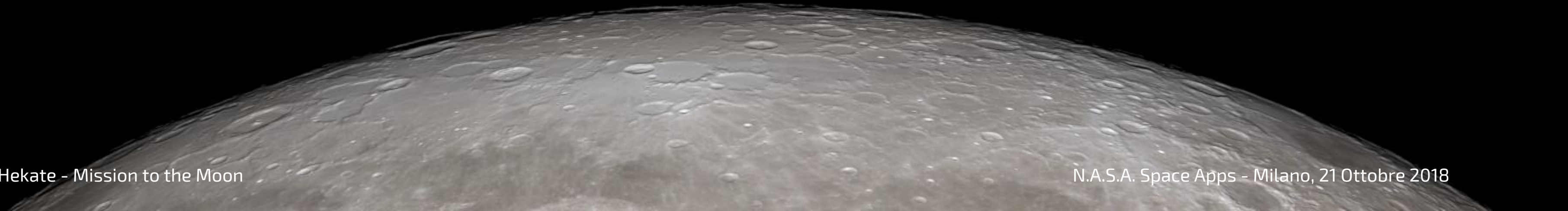
Kapton Space Blanket to optimize heat transfer and grant systems working temperatures



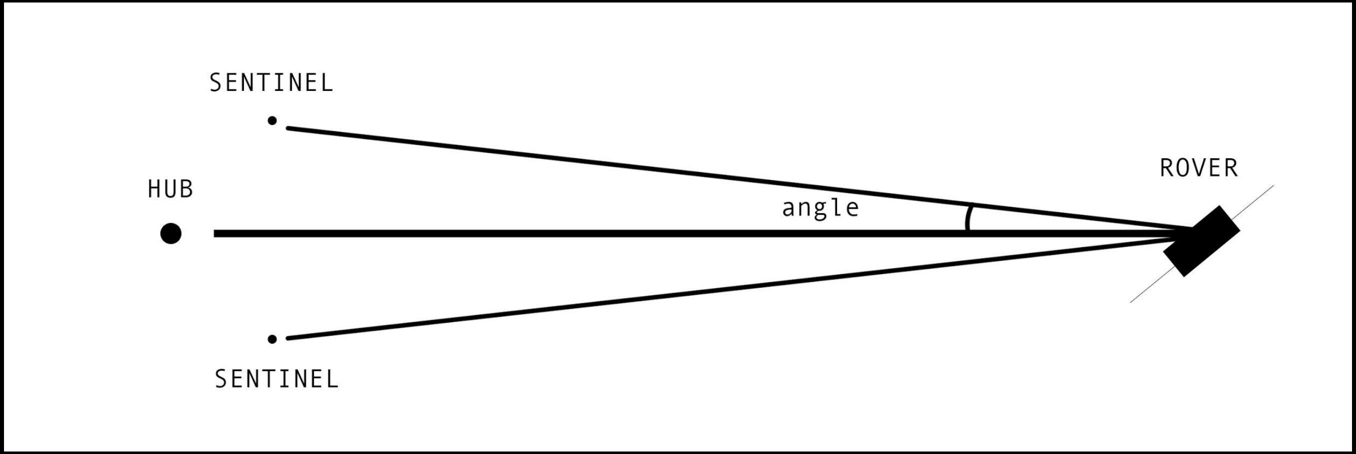
Li-ion battery pack to grant rovers power for 3 up to 5 operating days

Mission Proposal

Positioning



Location Problem

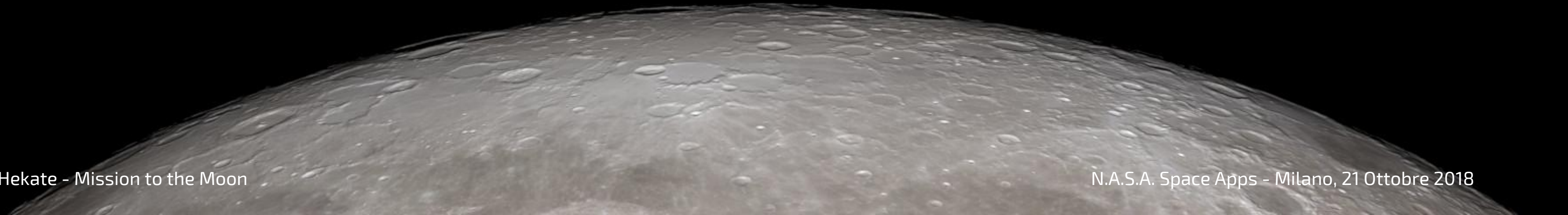


We are used to be able to track our position in almost every moment, but on the moon is not like that since there's no GPS system. Therefore we tried to find a solution so our rovers could navigate the surroundings.

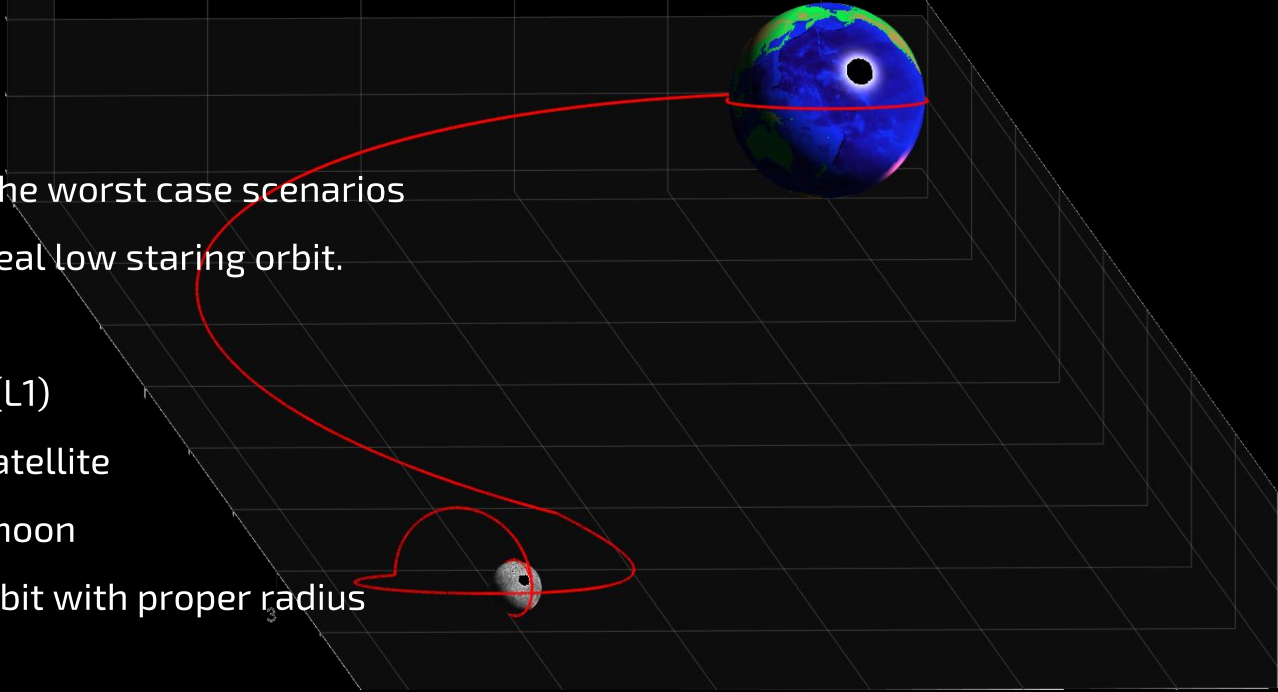
We adopted transponders coupled with inertial navigation.

Mission Proposal

Arrival and Landing



Orbit Path

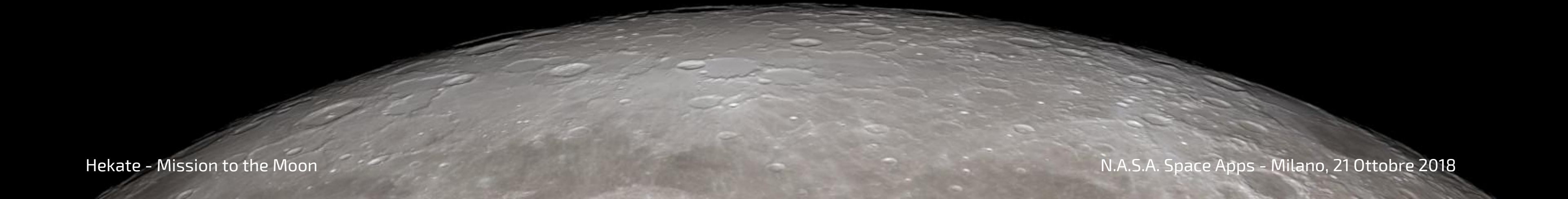


We decided to compute one of the worst case scenarios with high planar change and a real low staring orbit.

This is how we decided to:

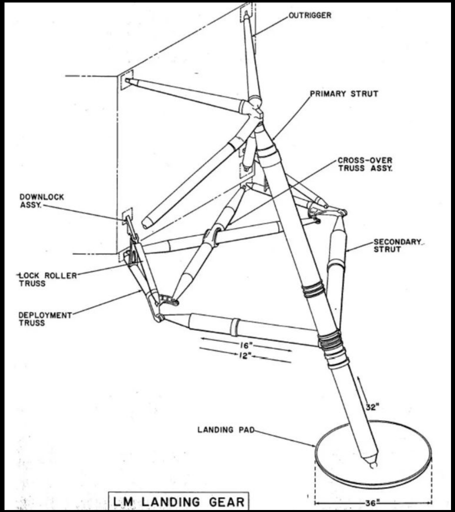
- reach the Lagrange point (L1)
- let the moon attract the satellite
- get into orbit around the moon
- change plane to a polar orbit with proper radius
- circularize

We had a total spent dV of about 14 km/s



Landing system

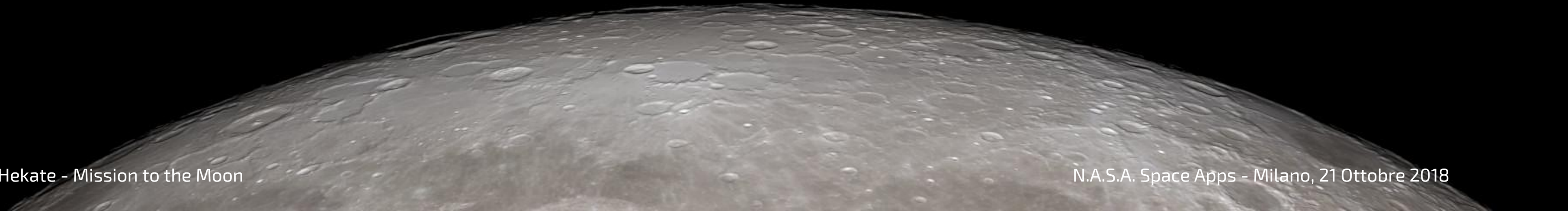
Retro-thrusters for soft landing of the fixed station with packed rovers inside of it



Landing gear to avoid soil discontinuity to produce irreversible damage to the equipment

Mission Proposal

Research

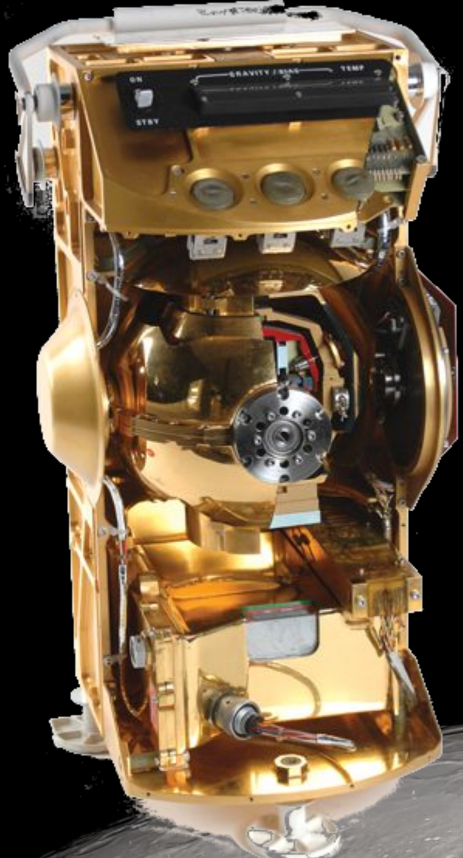


Rovers

Each Rover has this sensors and equipments:

- NavCam
- Lights
- Computation Motherboard
- Antennas and Receivers for communication with the Hub and the Sentinels

Hub



In the Hub a lot of equipment for experiments is present, such as:

- Cold Cathode Ion Gauge (CCGE)
- Heat Flow (HFE)
- Lunar Ejecta and Meteorites (LEAM)
- Lunar Surface Gravimeter (LSG)
- Lunar Surface Magnetometer (LSM)
- Solar Wind Spectrometer (SWS)

Together with the equipment for soil analysis:

- Chemical Camera (ChemCam)
- Sample Analysis (SAM)
- Microscopic Imager (MI)
- Mössabauer Spectrometer (MB)
- Chemistry & Mineralogy X-Ray (CheMin)

Thanks for your attention!

Agistri Marzio

Bella Salvatore Andrea

Barberi Spirito Daniele

De la Hera Ignacio