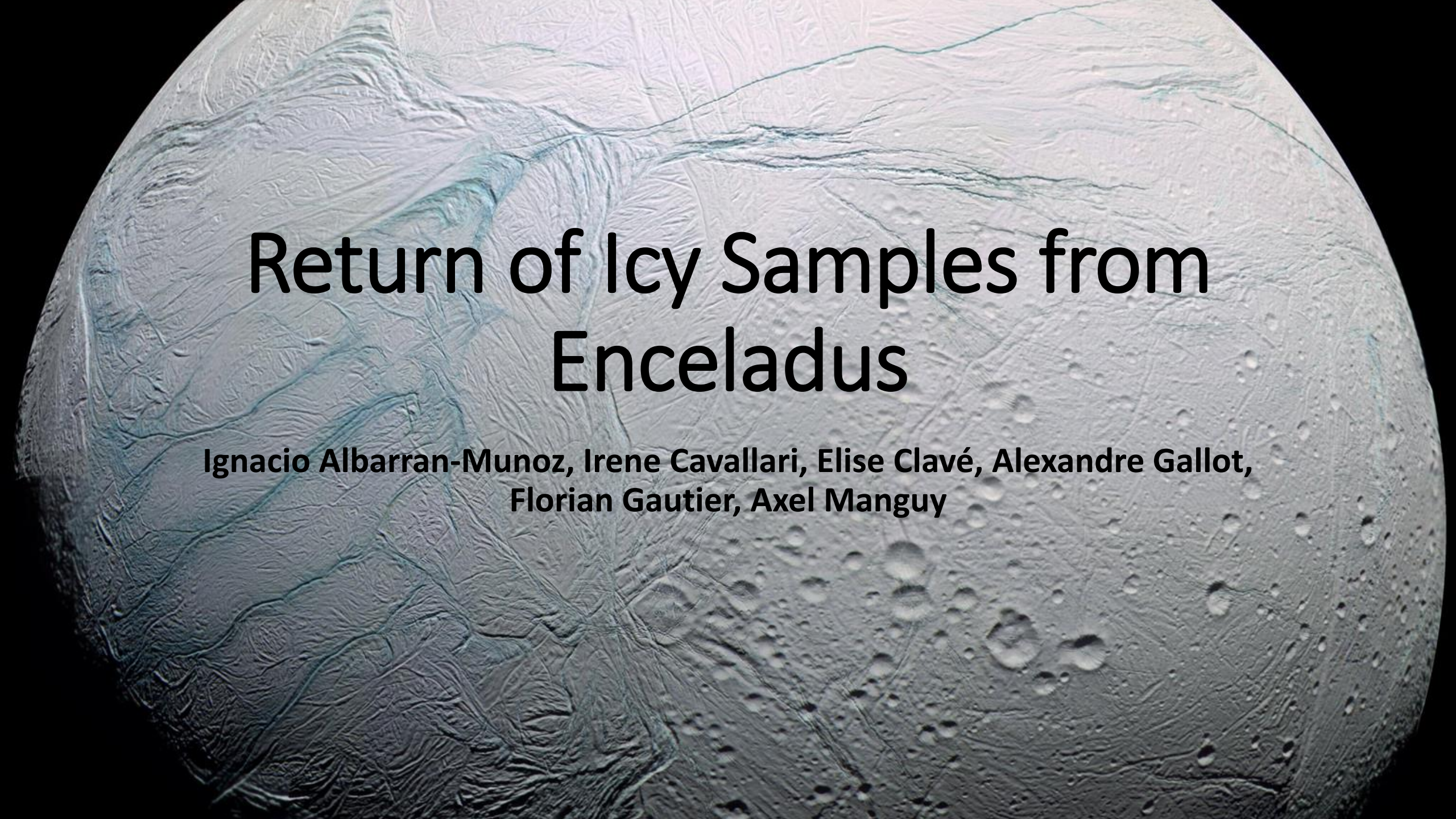


Return of Icy Samples from Enceladus

Ignacio Albarran-Munoz, Irene Cavallari, Elise Clavé, Alexandre Gallot, Florian Gautier, Axel Manguy

Cassini reveals Enceladus plumes

Credits NASA/JPL/Space Science Institute

Scientific goals

ORIGIN ?

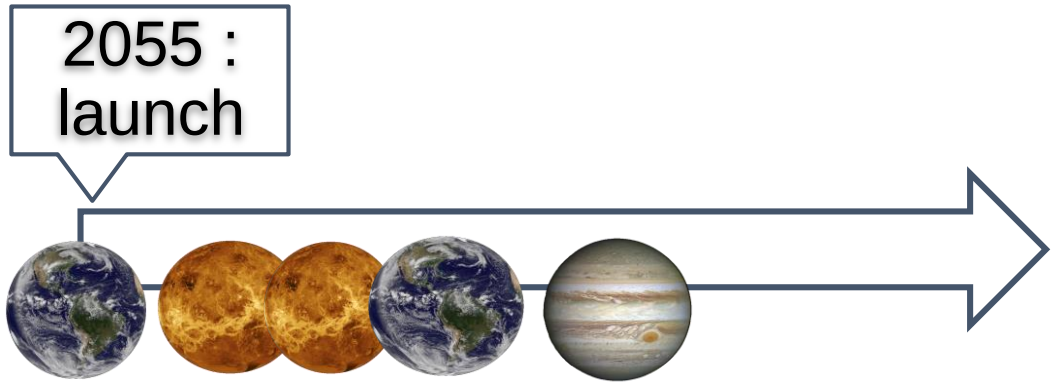
LIFE ?

- Habitability
- Stability of the environment
- Life

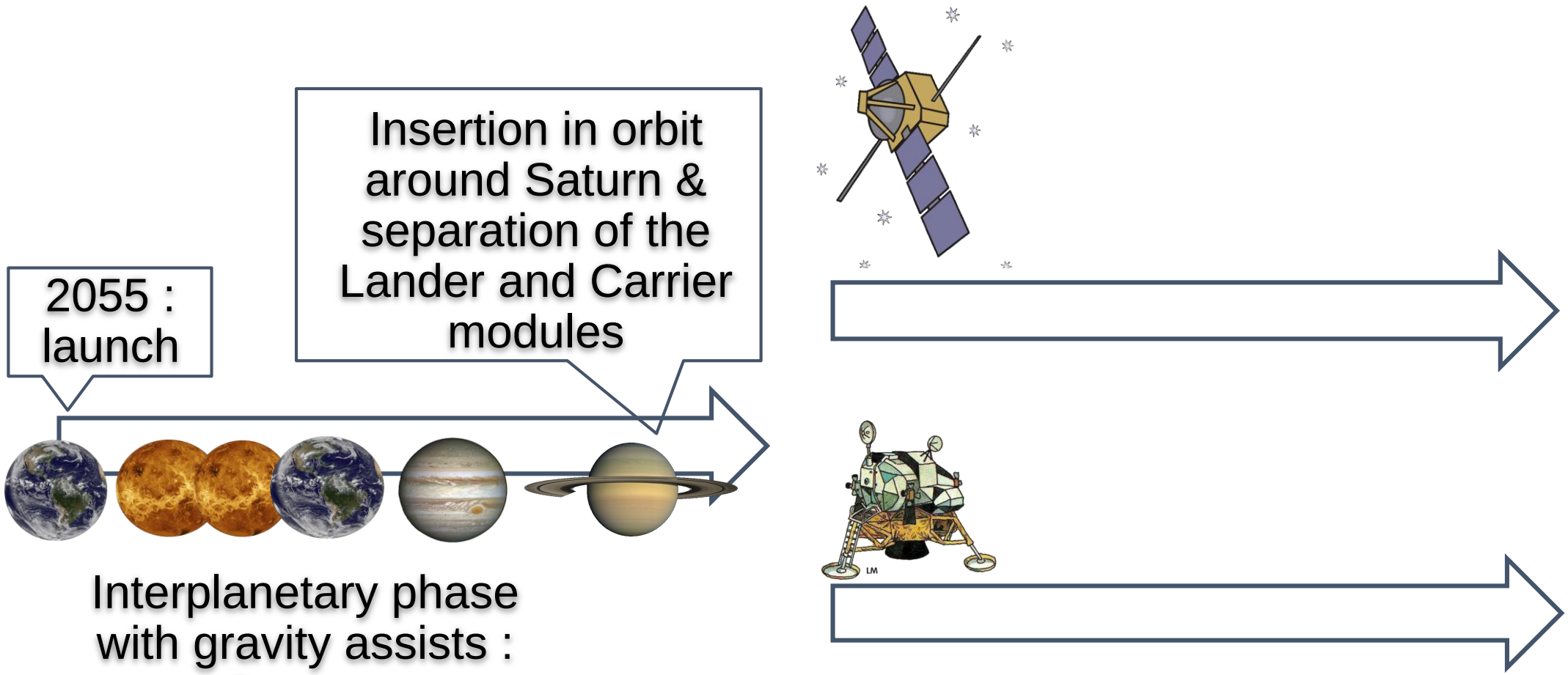
EVOLUTION ?

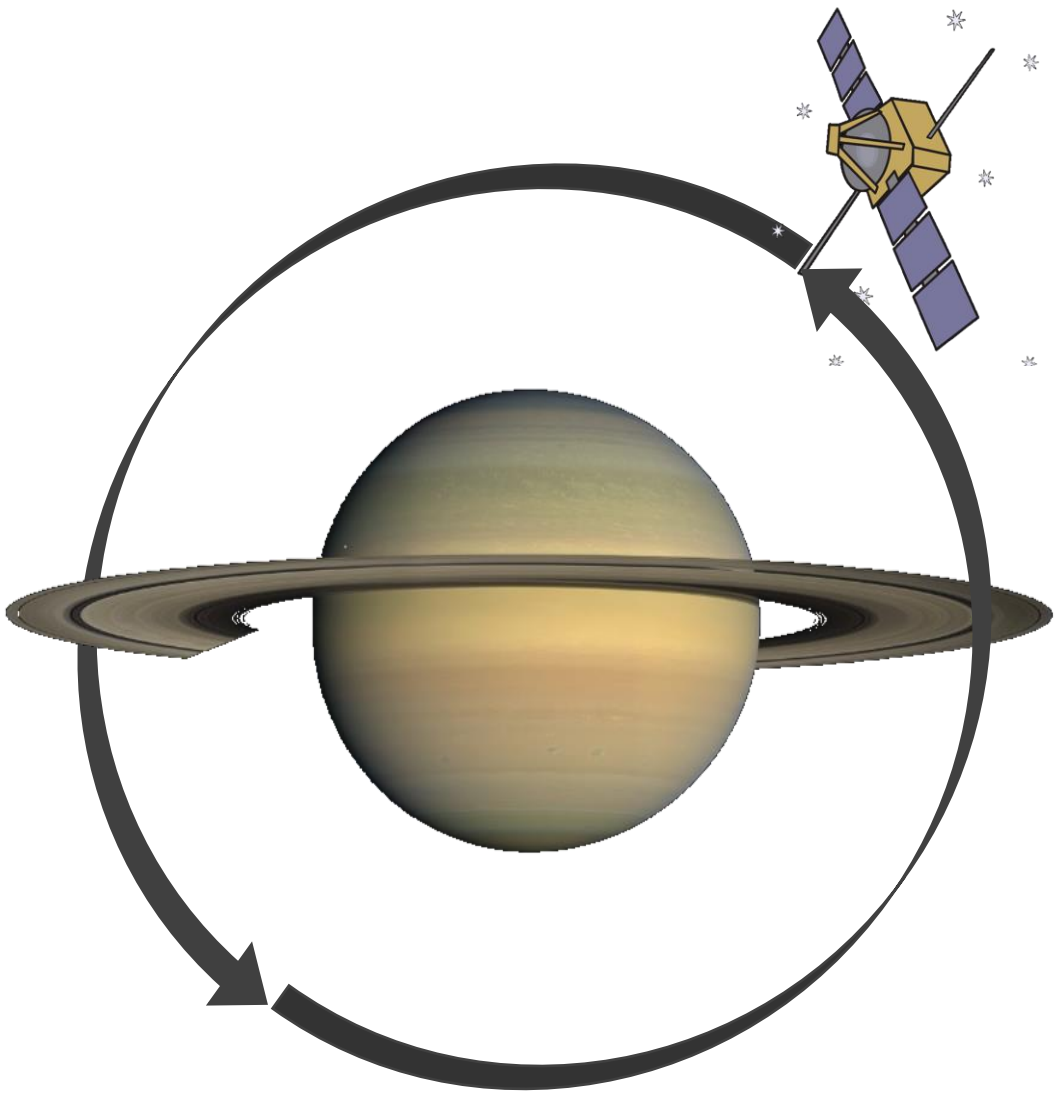

2055 :
launch

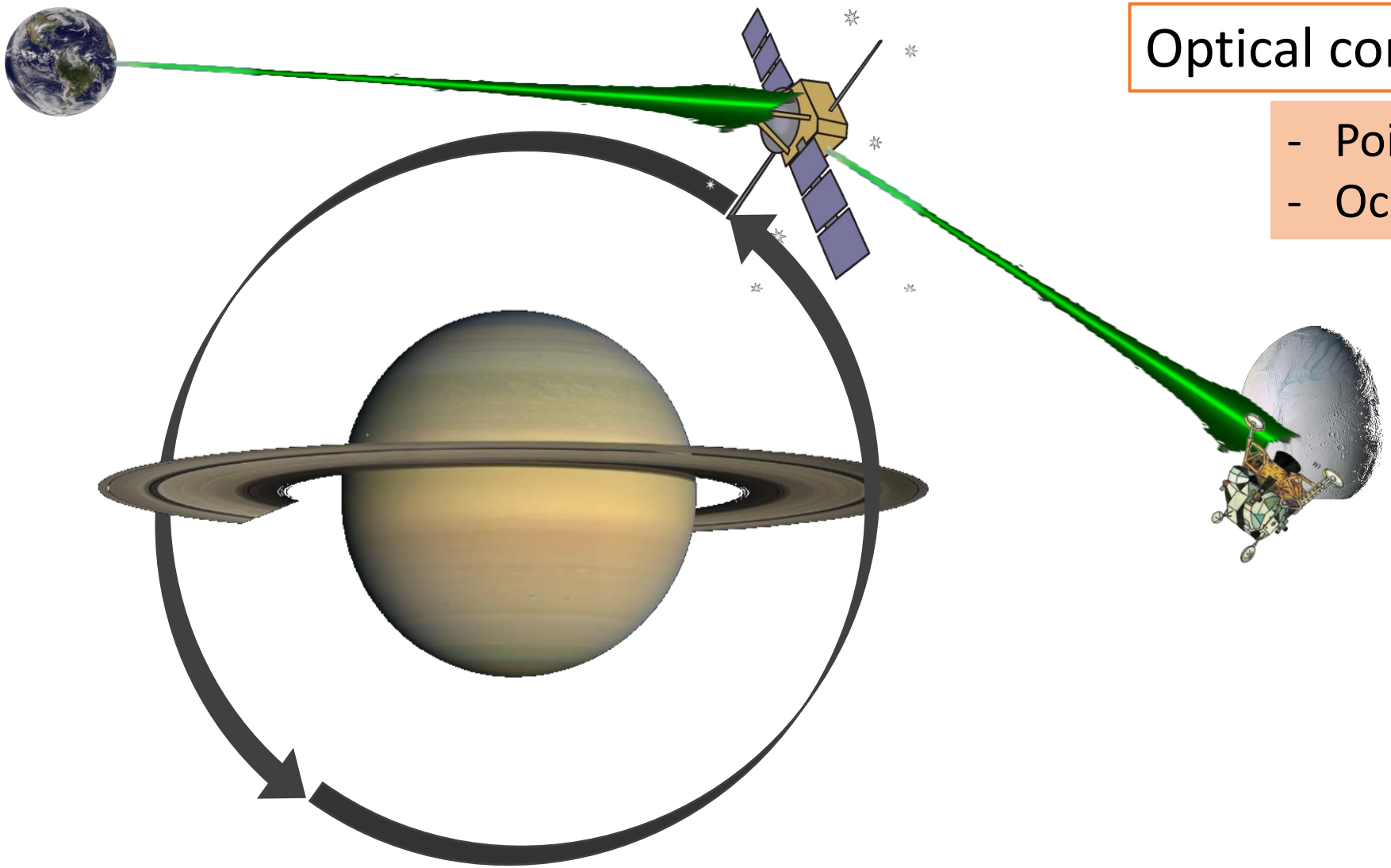
Cryogenic propulsion



Interplanetary phase
with gravity assists :
9 years

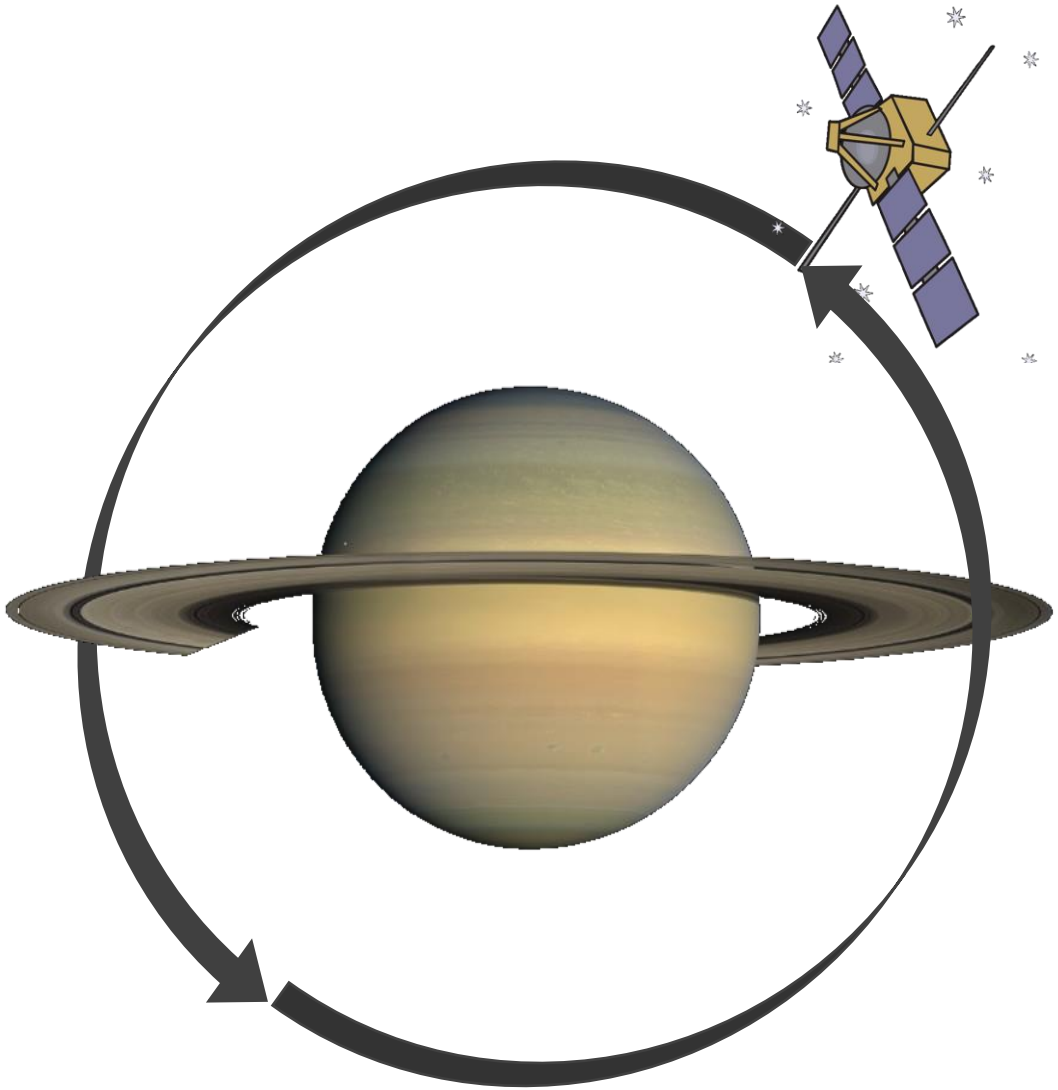

2055 : launch
Insertion in orbit around Saturn & separation of the Lander and Carrier modules
Interplanetary phase with gravity assists : 9 years
LM



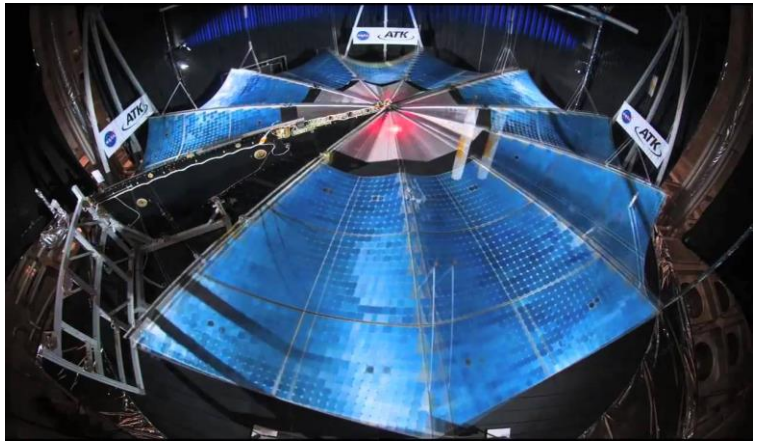


Optical communication

- Pointing accuracy
- Occulation issues



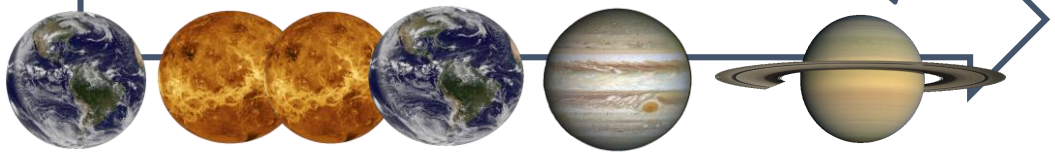
300 m² of Megaflex solar pannels (NASA)
60% efficiency



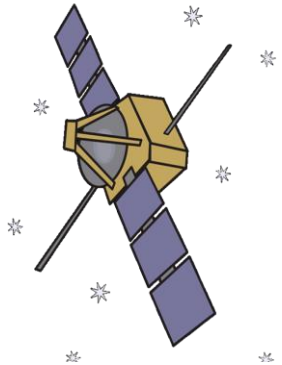
or solar sail ?

2055 : launch

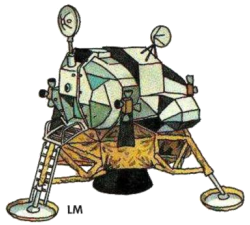
Insertion in orbit around Saturn & separation of the Lander and Carrier modules



Interplanetary phase with gravity assists : 9 years

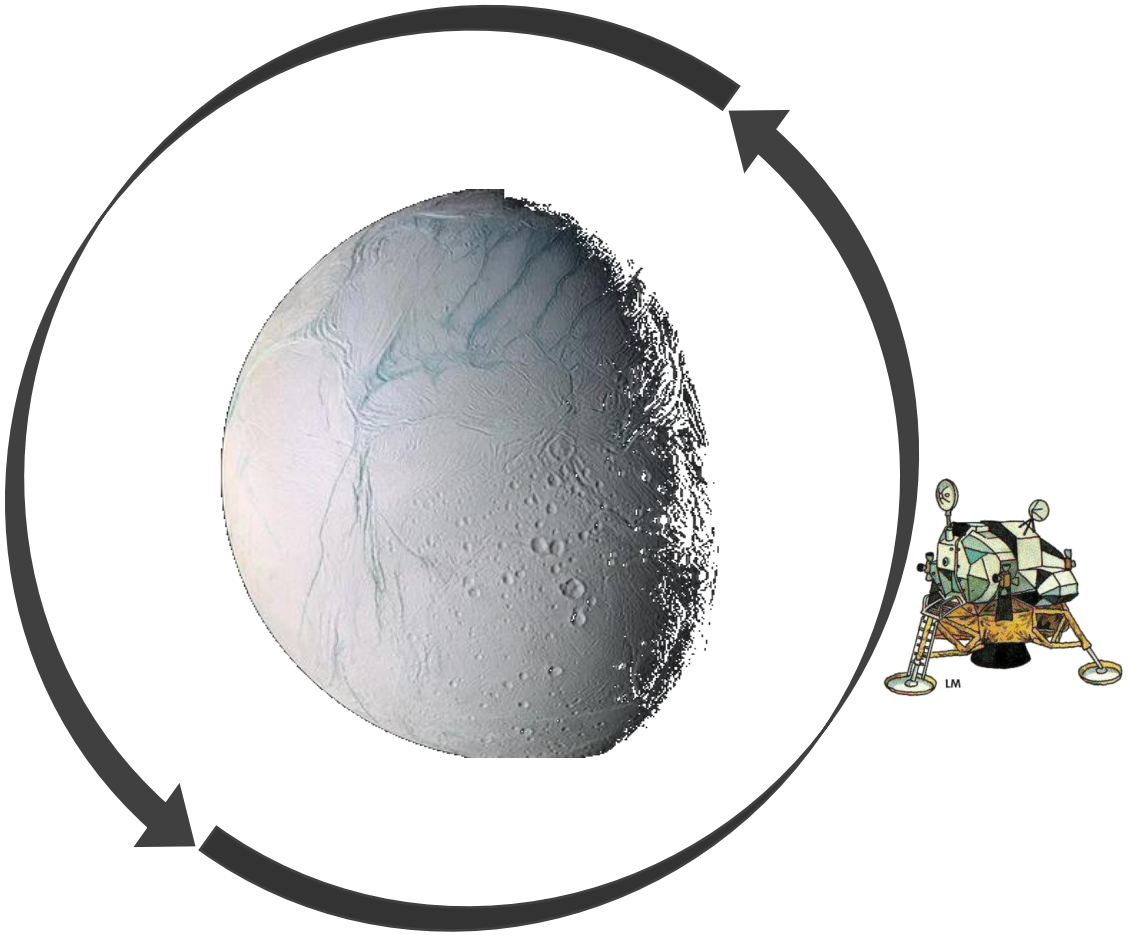


Orbit around Saturn and communication relay between the Lander and Earth



Moon tour To Enceladus: 4 years

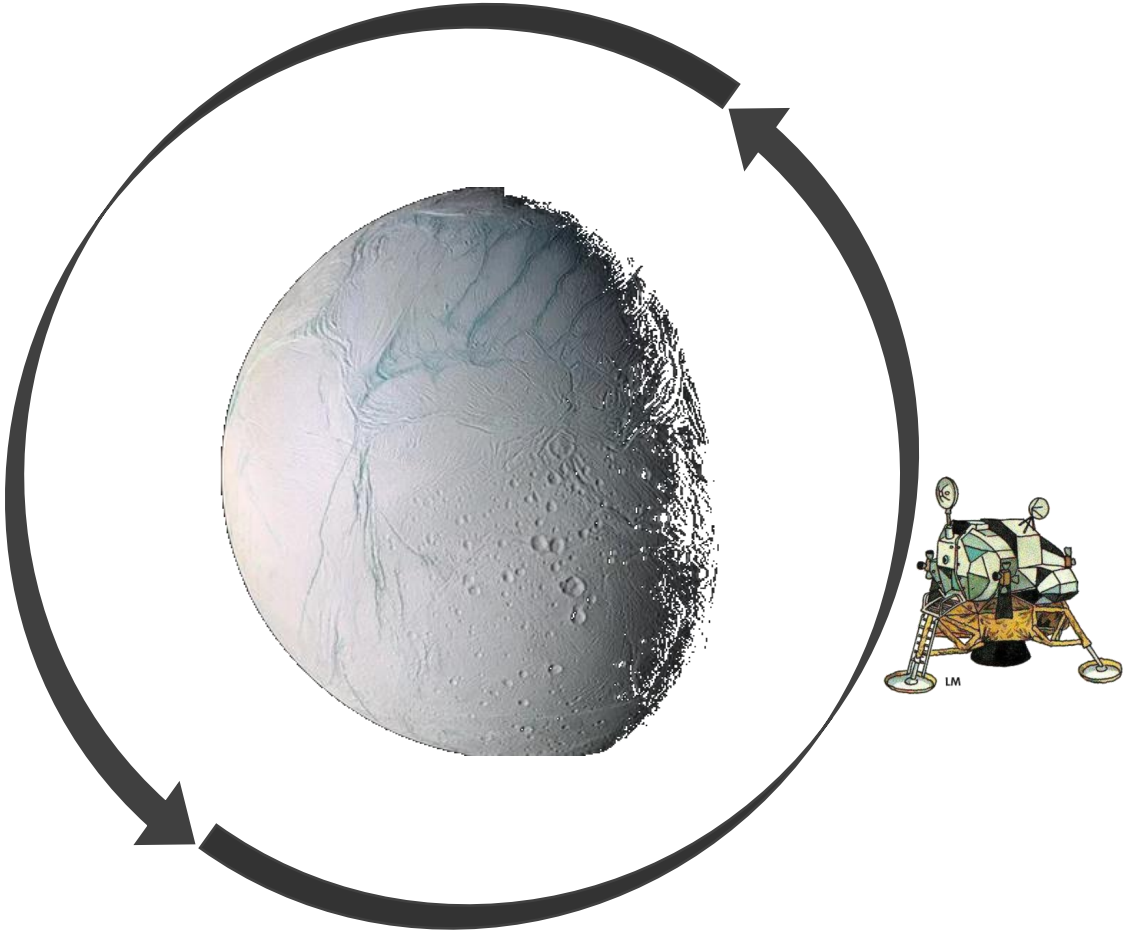
Mission at the South Pole: 1 year



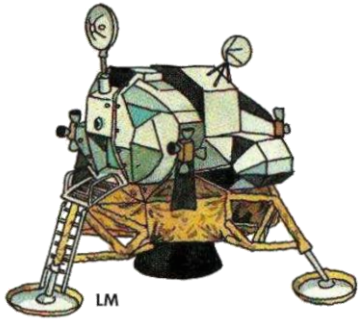
Artificial Intelligence to:

- Select landing site
- Select samples
- Trajectory control
- Resilience

- Computational capability
- Reliability



Advanced Stirling radioisotope generator



Landing on icy surface

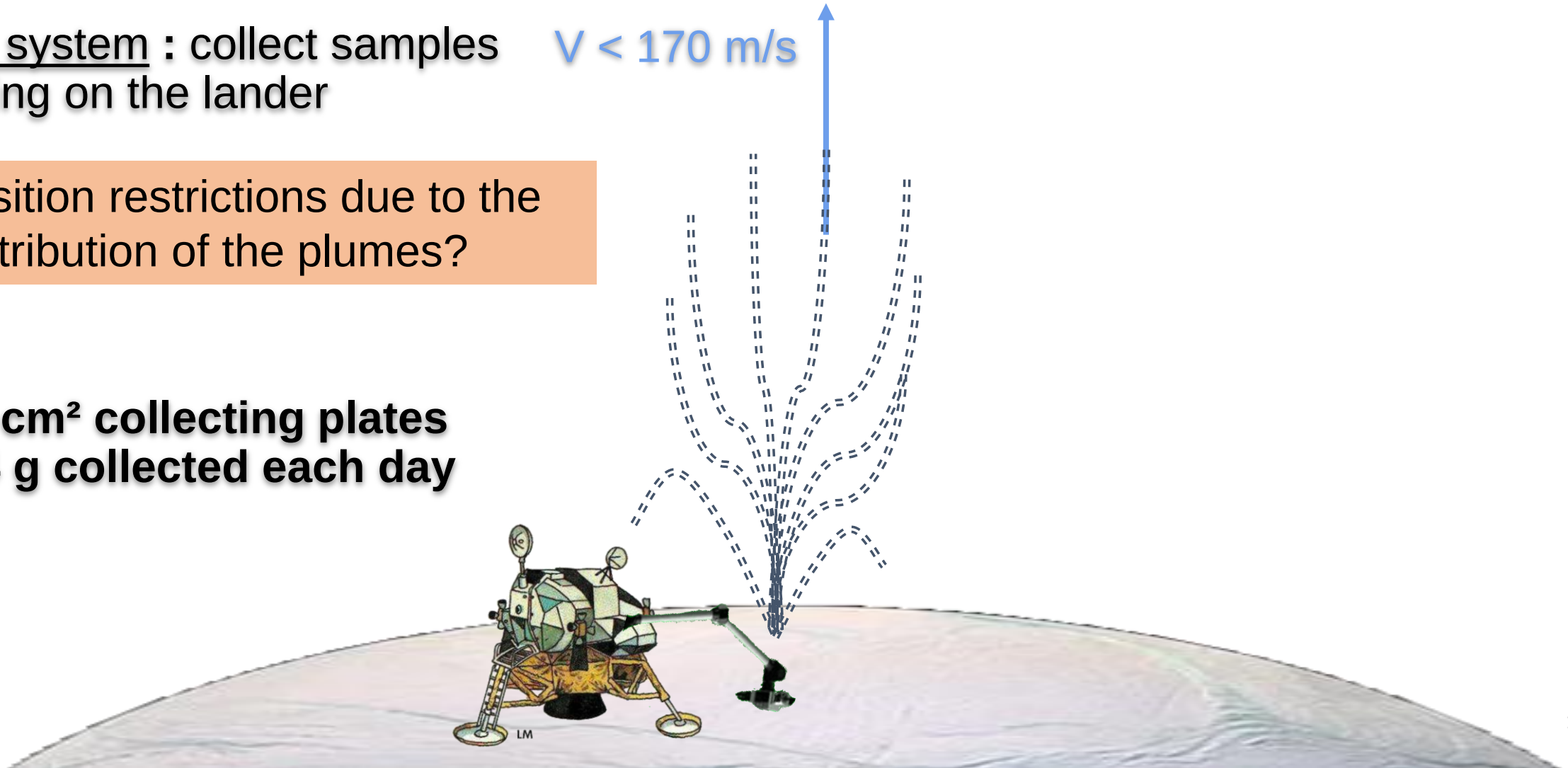
- Descent
- Temperature

Two sample collectors in parallel

<u>1st system</u> **:** collect samples falling on the lander

position restrictions due to the distribution of the plumes?

40 cm² collecting plates
0,4 g collected each day



Two sample collectors in parallel

<u>1st system</u> **:** collect samples falling on the lander

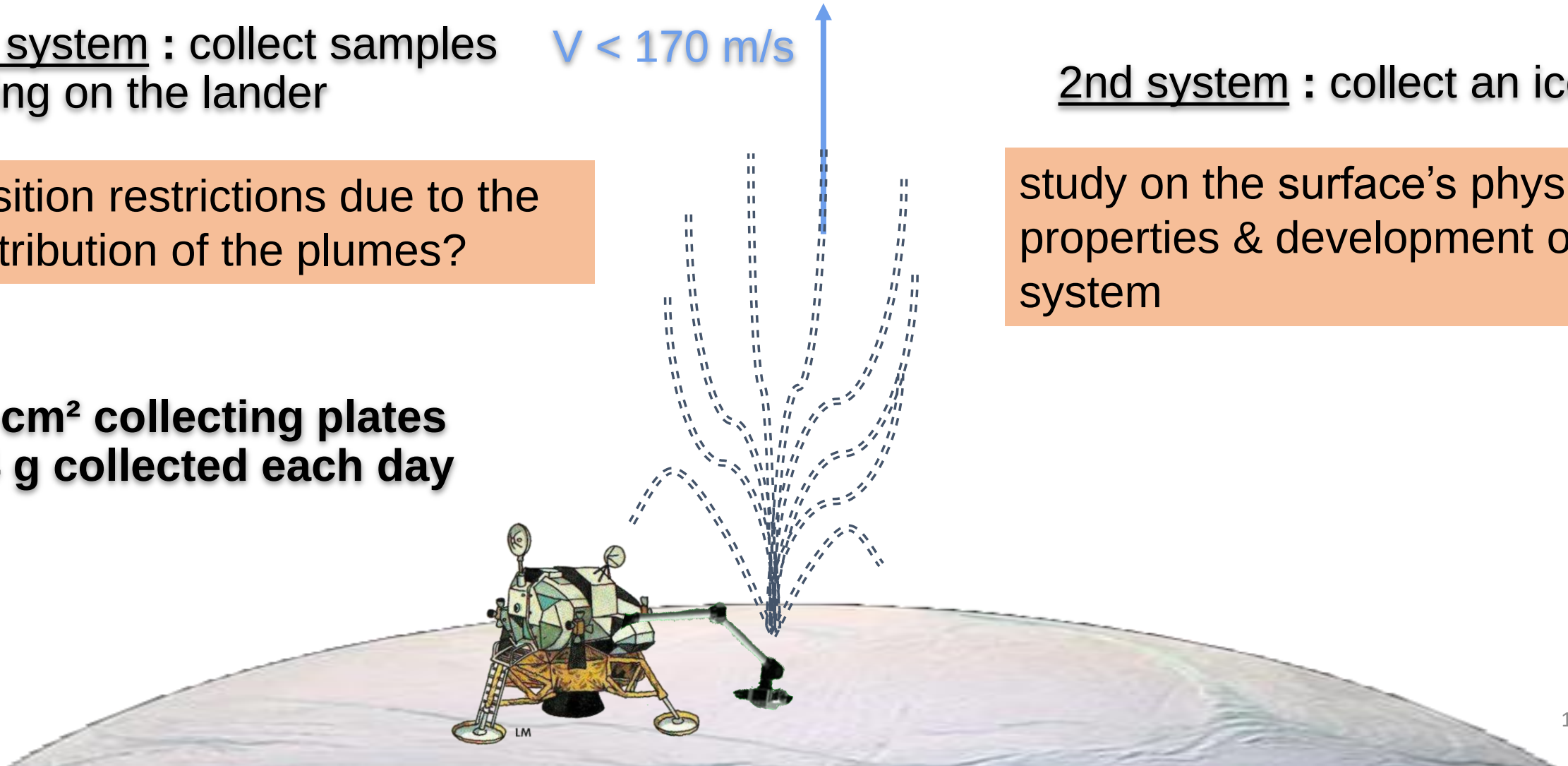
V < 170 m/s

<u>2nd system</u> **:** collect an ice core

position restrictions due to the distribution of the plumes?

study on the surface's physical properties & development of the system

40 cm² collecting plates
0,4 g collected each day



Two sample collectors in parallel

<u>1st system</u> **:** collect samples falling on the lander

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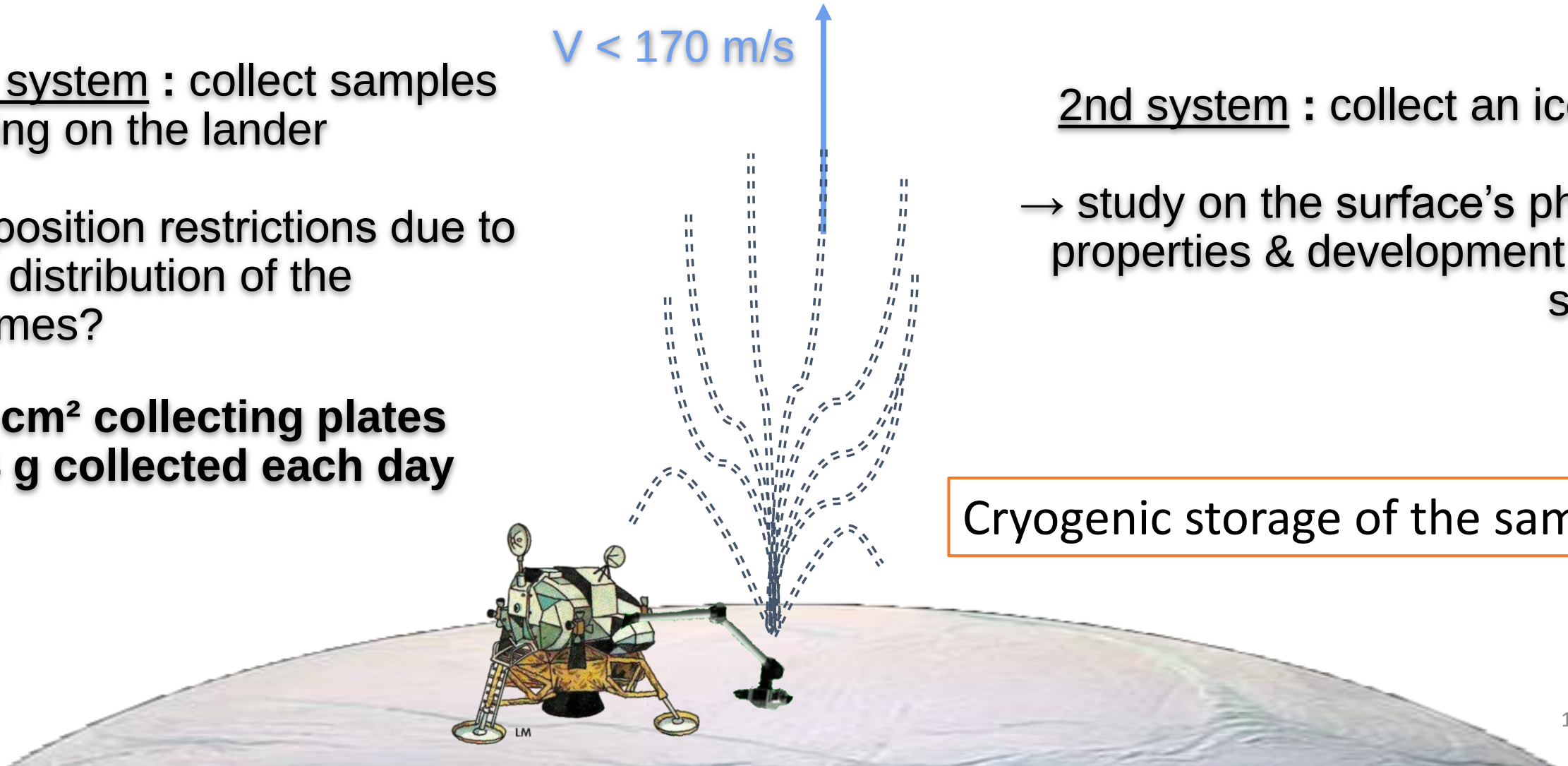
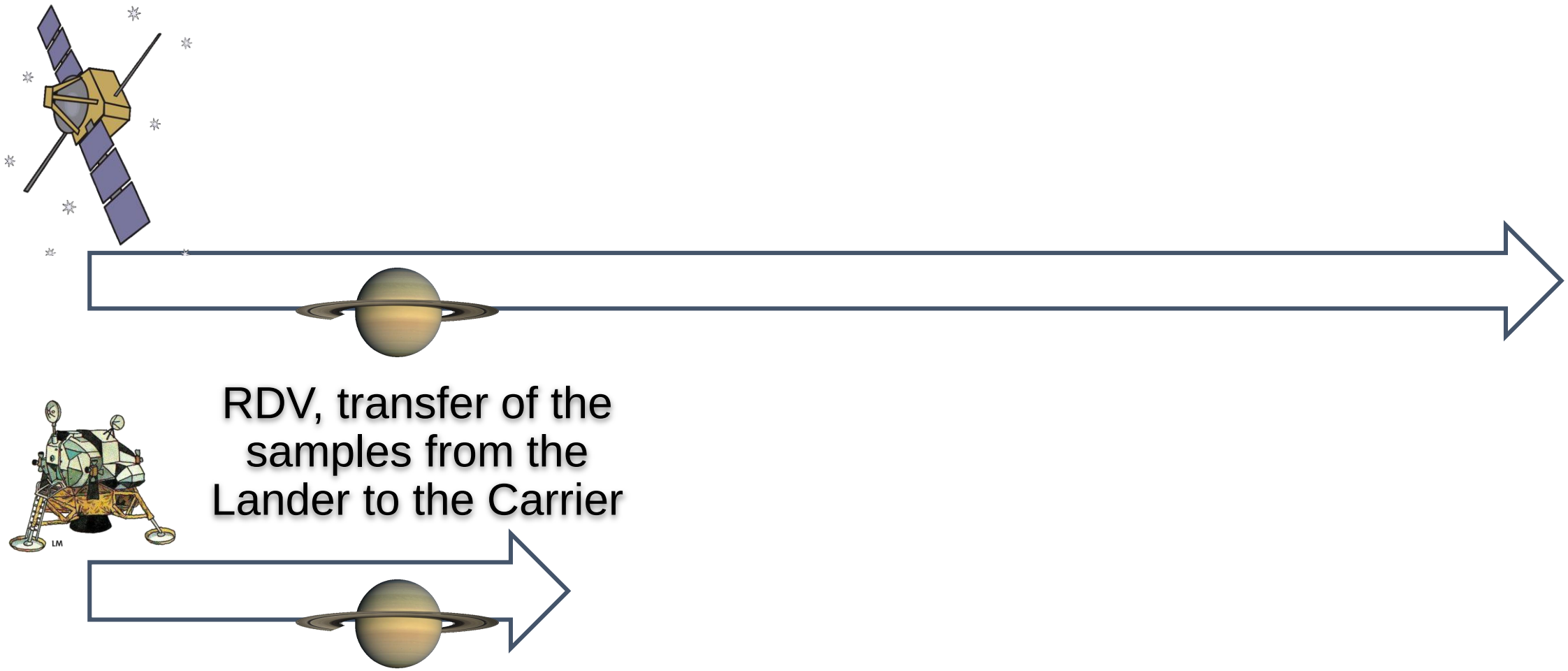
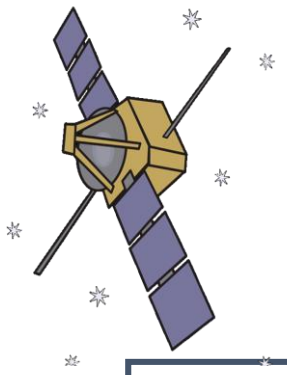


<u>2nd system</u> **:** collect an ice core

→ study on the surface's physical properties & development of the system

Cryogenic storage of the samples

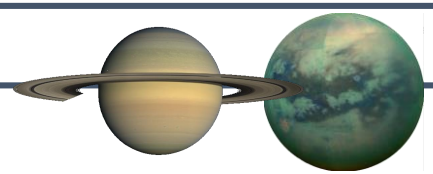

RDV, transfer of the samples from the Lander to the Carrier
LM

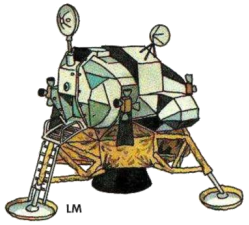


Titan tour :
< 1 an

Interplanetary phase
with a direct transfer:
6 years

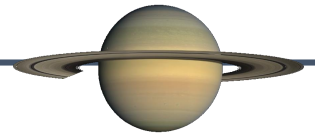
2080 : Arrival
of the
samples on
Earth

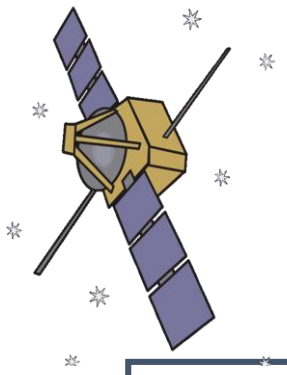




RDV, transfer of the
samples from the
Lander to the Carrier

Planetary protection





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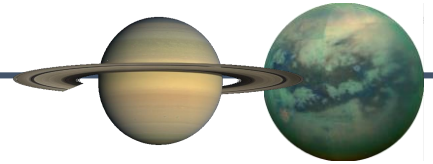

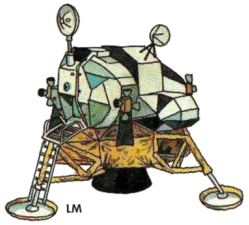

RDV, transfer of the
samples from the
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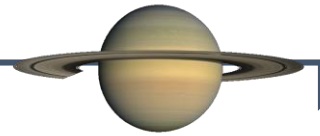
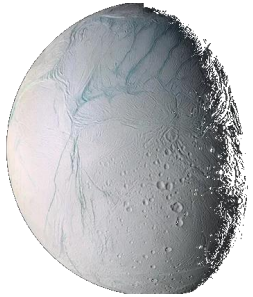


Total duration: 25 years

Total ΔV : 5 km/s

Thanks for your attention !

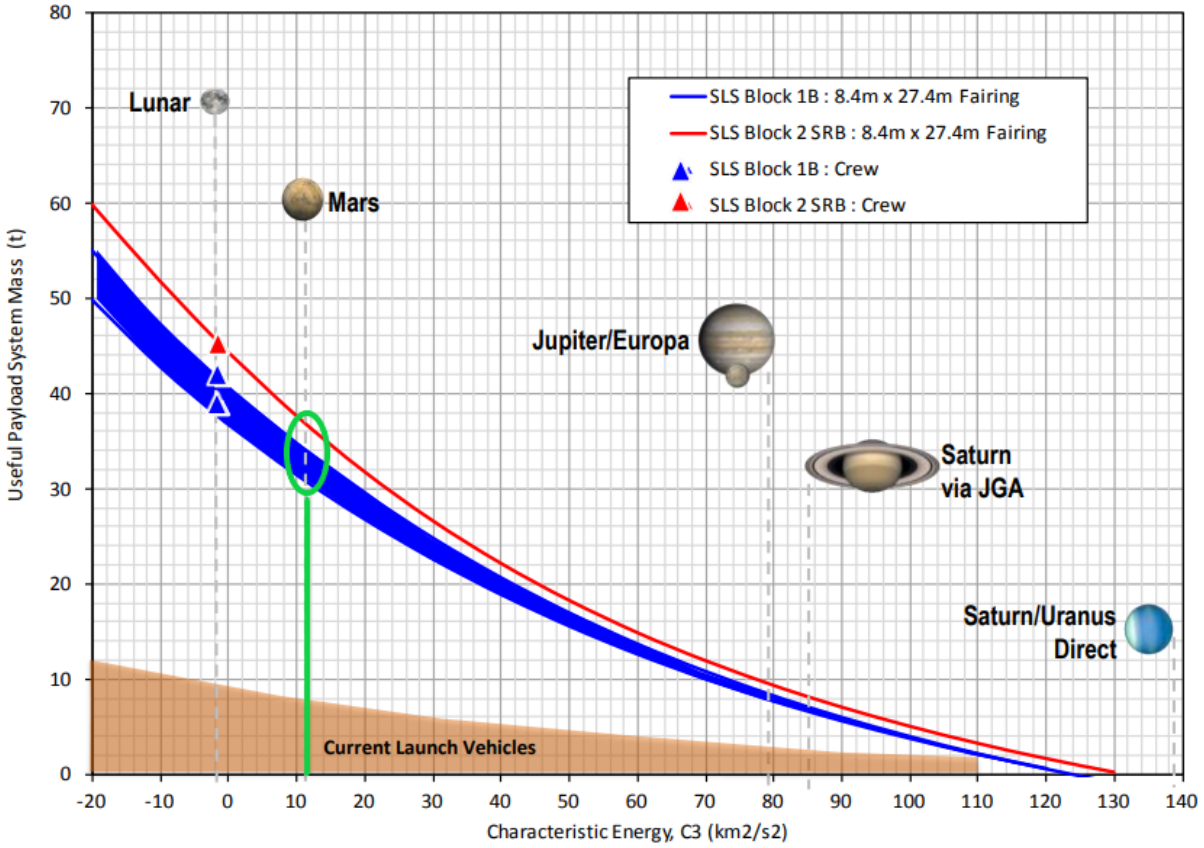


Lanceur

Étude de différents lanceurs (NASA SLS, Ariane6, Falcon Heavy)

C3~10,24 km²/s²

Choix SLS → 30 - 38 tonnes de masse initiale



Creech, S. (2017), A new capability for discovery, NASA

Propulsion chimique

<u>Moteur principal</u> (cryogénique LO_2/LH_2):

Isp = 464 s

T = 400 N, m_{moteur}~ 1,22 kg

2 moteurs pour chaque module

<u>SCAO</u> (hydrazine) :

Isp ~ 220 s

T = 1 N, m_{moteur}~ 0,33 kg

16 moteurs pour chaque module