Return of Icy Samples from Enceladus

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Cassini reveals Enceladus plumes
Scientific goals

ORIGIN ?

LIFE ?
- Habitability
- Stability of the environment
- Life

EVOLUTION ?
Interplanetary phase with gravity assists: 9 years

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

Horizon 2061 -- Return of Icy Samples for Enceladus -- September 2019 -- Elise Clavé
Optical communication

- Pointing accuracy
- Occultation issues
300 m² of Megaflex solar panels (NASA) 60% efficiency

or solar sail?
Interplanetary phase with gravity assists: 9 years

2055: launch

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

Orbit around Saturn and communication relay between the Lander and Earth

Moon tour To Enceladus: 4 years

Mission at the South Pole: 1 year

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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

1st system: collect samples falling on the lander

\[ V < 170 \text{ m/s} \]

position restrictions due to the distribution of the plumes?

40 cm² collecting plates
0.4 g collected each day
Two sample collectors in parallel

1st system: collect samples falling on the lander

Position restrictions due to the distribution of the plumes?

V < 170 m/s

2nd system: collect an ice core

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

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Two sample collectors in parallel

1st system: collect samples falling on the lander
→ position restrictions due to the distribution of the plumes?

40 cm² collecting plates
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V < 170 m/s

2nd system: 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
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Titan tour: < 1 an

Interplanetary phase with a direct transfer: 6 years

2080: Arrival of the samples on Earth

Planetary protection

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

Titan tour: $< 1$ an

Interplanetary phase with a direct transfer: 6 years

2080: Arrival of the samples on Earth

Total duration: 25 years
Total $\Delta V$: 5 km/s
Thanks for your attention!
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

**Moteur principal** (cryogénique LO₂/LH₂):

- $Isp = 464 \text{ s}$
- $T = 400 \text{ N}$, $m_{\text{moteur}} \approx 1,22 \text{ kg}$
- 2 moteurs pour chaque module

**SCAO** (hydrazine) :

- $Isp \approx 220 \text{ s}$
- $T = 1 \text{ N}$, $m_{\text{moteur}} \approx 0,33 \text{ kg}$
- 16 moteurs pour chaque module