N.O.M.A.D

Novel Orbital Mission for Asteroid Determination

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1. Mission Purpose

N.O.M.A.D will consist of a one-way probe with autonomous landing and composition analysis of the asteroid 16-Psyche. This asteroid is of interest as it is disputed among planetary scientists to be an ancient planetary core. Further investigation of this asteroid has not been pursued despite the potential for knowledge on planetary formation in our solar system.

Upon landing the probe will extract samples and analyze the composition as well as photograph the surface and transmit the data back to Earth where it will be extensively studied by planetary scientists.

2. Mission Objectives

1) Arrive to Psyche Safely
2) Using a gravity assist from Mars.
3) Approximately 3.5 years away from Earth.
4) Orbit around Psyche before landing.
5) During orbit, photographs will be captured of the asteroid.
6) Land on Psyche and collect samples.
7) Analyze samples and data

3. Mission Configuration

Launch - Parking Orbit - Mars Fly-by - Arrival & Landing

4. Spacelift Trajectory

Launch - Outgoing Transfer orbit to Mars - Mars Fly-by including Blackout communication as Dark side of planet - Arrival into orbit at Psyche

5. Mission Timeline

2023: Manufacturing Construction and assembly of the spacecraft and its autonomous systems.
2024: Launch - Communication of payload is complete and is ready to be launched.
2024-2028: Transit - Twenty-three-month long journey to Psyche begins, which includes a Mars flyby.
2028-2029: Orbital Scan & Landing - Orbital scan of 16 Psyche and land on the surface.

6. Systems Overview

Communications, Antenna, Solar Panels, Top Cover with Motors, Goldized Kapton Plated Frame with Payload, ADC Thrusters, Propellant Tanks, Main Engines, Landing Gear

7. Systems Engineering

Power Systems

Power System shall provide nominal power of 433 W to all loads for the duration of the mission.

Thermal Systems

Thermal System analysis for 16 Psyche surrounding temperatures of 25°C and 125°C.

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8. Autonomous Systems

Payload

The spacecraft subsystems will enable scientists to understand the geochemical composition of Psyche, much like the asteroid 21 Lutetia above. Through examination of the asteroid's composition, we will understand more about other asteroids, our earth, and our solar system.

Onboard Data Handling

MMRTG Source

ADC Thrusters

Bipropellant

ADCS Systems

Requirements:

- Bipropellant thrusters that land autonomously. N.O.M.A.D chooses best suitable landing site based on the format point and minims that landing site to autonomously land at.
- Functional Polyformaldehyde is then used for landing where the ADAMS System controls the landing attitude of the spacecraft and its components.

The attitude determination and control subsystems will perform accurate maneuvers determined by the landing guidance system. The system needs to converge within 10 seconds with an accuracy of within 1° of the desired attitude. This system will use multiple sensors to determine the attitude of the lander using IMU, a coarse sun sensor, and star tracker. An LQR controller is utilized to determine the thrust needed in each axis for the lander to achieve the correct orientation. The correct orientation is achieved using the 1.2 Ares JD RocketDyne thrusters. All 1.2 work in tandem to make the correct attitude maneuvers to keep the lander stable throughout its descent and landing.

9. Communication Systems

Requirements:

- For antennas, we will be using the Deep Space Network, including Goldstone, Madrid, and Canberra. We will need an input of power no less than 52 dBW. We will need the following hardware: 5-band Transponder, mixer, filters, amplifiers, and antennas. We believe a high-gain parabolic reflector dish works best for our mission profile and objectives. Using a dish with diameter of 1-2m would meet our goal of 354 Mbps in the 5 band for the orbiter's connection to Earth.

- A 30 cm dish on the lander will still achieve an 18-4 dB gain and be able to communicate with the orbiter 7 km up. Will need to use 5/15 MHz as the received frequency will be over 6 GHz. The ideal data rate we want to generate is at least 5.5 megabits per second and no less than 4 megabits per second.

10. Propulsions Systems

Requirements:

- Propulsive system shall include MMRTG for landing + extra 150 kg of propellant needed. 250 Kg of propellant needed

- Bipropellant thrusters for a 10 deg/s attitude maneuver.

- 12 Aerojet Rocketdyne MR-103-J Attitude Thrusters

Contact