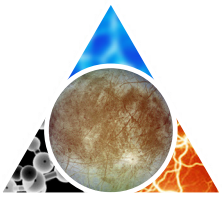
Europa Clipper

National Aeronautics and Space Administration

Europa Clipper is a mission concept currently in formulation for consideration as a future NASA flight project. The Europa Clipper study is a joint project of the Jet Propulsion Laboratory, California Institute of Technology, and the Applied Physics Laboratory, Johns Hopkins University. The mission would explore Europa and chart the three factors that could lead to life:



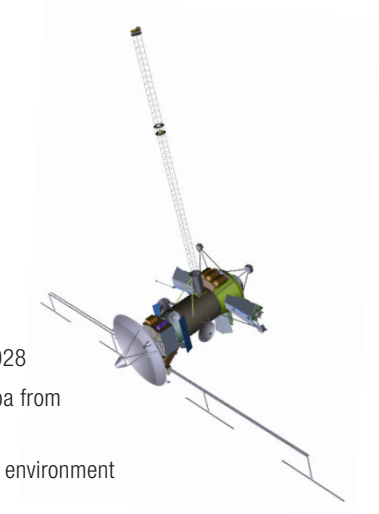
Water Characteristics of Europa's ice shell and its ocean, and their interaction.

Chemistry Composition of Europa and its ocean.

Energy Chemical gradients that can drive the metabolism of life.

Science Goal

The Europa Clipper's science goal is to explore Europa to investigate its habitability. This goal coincides with the NRC Planetary Science Decadal Survey: "The first step in understanding the potential of the outer solar system as an abode for life is a Europa mission."



Baseline Mission Overview

- Launch on Atlas V 551, November 2021
- Venus–Earth–Earth gravity-assist trajectory
- Jupiter orbit insertion, April 2028
- 45 low-altitude flybys of Europa from Jupiter orbit over 3.5 years
- Minimal time in high-radiation environment
- Simple, repetitive operations
- 34-m Deep Space Network coverage
- 1.44 Tb anticipated science data return

Objectives

Science

Ocean and ice shell — Characterize the ice shell and any subsurface water (including their heterogeneity), the nature of surface–ice–ocean exchange, and the properties of the ocean.

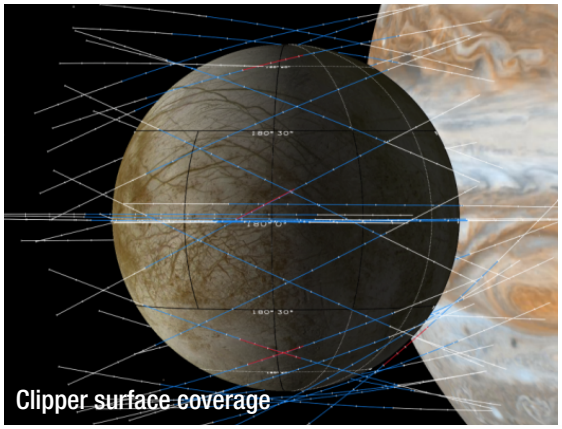
Composition — Understand the habitability of Europa's ocean through study of composition and chemistry.

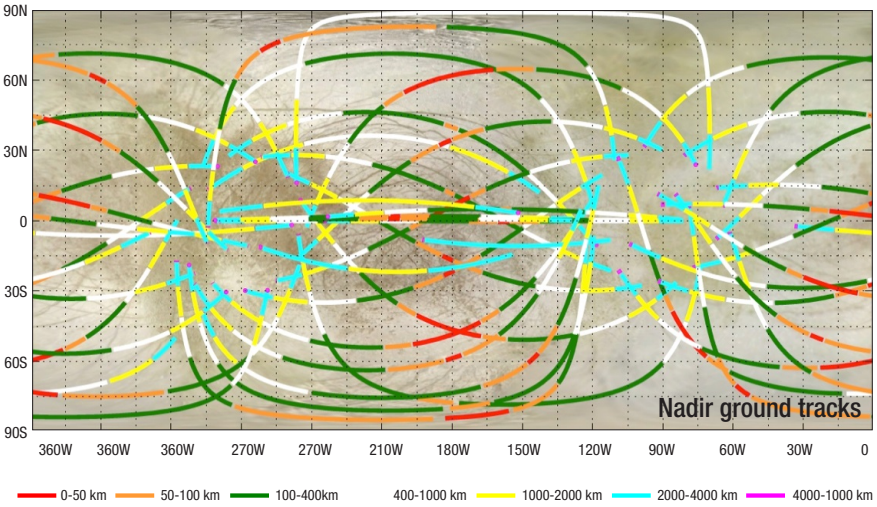
Geology — Understand the formation of surface features, including sites of recent or current activity, and characterize high-science-interest localities.

Reconnaissance

Landing site safety — Assess the distribution of surface hazards.

Landing site science value — Assess the composition of surface materials with respect to geologic context, potential for geologic activity, and the proximity of near-surface water.





For more information, contact Europa Clipper Pre-project Formulation, 818-393-5164.

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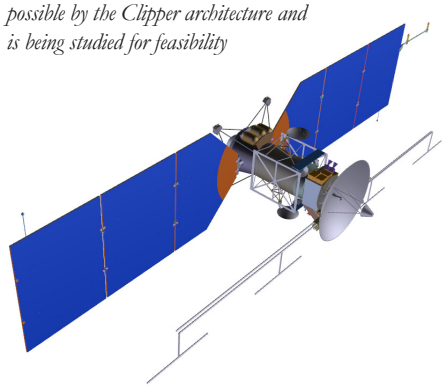
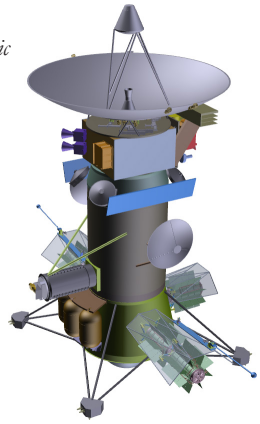
Spacecraft

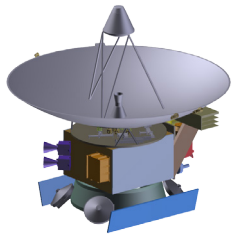
Solar power is an attractive option made possible by the Clipper architecture and is being studied for feasibility



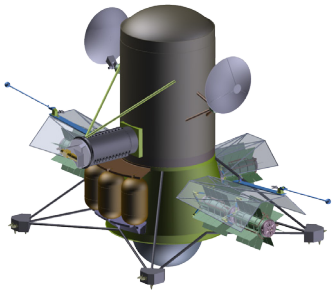
Multi-Mission Radioisotope Thermoelectric Generator (MMRTG) configuration



Avionics



Propulsion Subassemblies



Radiation Shielding

- Radiation-sensitive electronics are housed in an avionics vault designed to shield contents to 150 krad (Si) end-of mission dose.
- Radiation-sensitive external components are shielded independently.
- Enables use of 300 krad (radiation design margin x 2) parts commonly qualified for Earth geosynchronous applications without additional shielding.

Modular Flight System

- 3582 kg wet mass*; 2072 kg dry mass*
- Model payload: Up to 104 kg
- Five MMRTGs (baseline), or two solar arrays provide 391 W during primary mission; battery for peak power modes
- 3-m, fixed high-gain antenna transmitting at a data rate of ~134 kbps to Deep Space Network 34-m at Ka-band frequencies
- Two-way Doppler with X-band capability;
- Acquires 32 Gb of science data per flyby
- Bi-propellant propulsion system providing 1645 m/s Δ-v
- Fully redundant avionics architecture
- 54 kg of payload shielding
- 11-year mission lifetime
- Class III Planetary Protection compliant

* Configuration dependent: MMRTG numbers shown

Model Payload

Instruments	Instrument Characteristics
Ocean and Ice Shell	
Gravity Science (RS)	X-band via telecom subsystem; two-way Doppler uplink and downlink
Magnetometer (Mag)	Three-axis magnetic field components at 8 vectors/s, sensitivity 0.1 nT
Langmuir Probe (LP)	Double 5-cm-diameter spheres mounted on 1-m-long booms
Ice-Penetrating Radar (IPR)	Shallow-mode 60 MHz and deep-mode 9 MHz with 10 MHz and 1 MHz bandwidths, vertical depths of 3 km and 30 km
Composition	
Short-Wavelength Imaging Spectrometer (SWIRS)	850 nm to 5.0 µm, 10 nm spectral resolution below 2500 nm and 20 nm from 2500 to 5000 nm; pushbroom with along-track scan mirror; 300 m/pixel resolution from 2000 km
Neutral Mass Spectrometer (NMS)	1–150 Daltons; mass resolution 200; FOV 50° cone half-angle
Geology	
Topographic Imager (TI)	Stereo imaging; panchromatic pushbroom; IFOV 250 µrad; 25-m/pixel resolution from 100 km; FOV 58°
Landing Site Reconnaissance	
Reconnaissance Camera (RC)	Panchromatic pushbroom; IFOV 10 µrad; 0.5 m resolution; FOV 5.28°
Thermal Imager (TI)	Pushbroom; IFOV 2.5 mrad; 250 m/pixel resolution from 100-km range; 2 spectral bands: 8–35 µm and 35–100 µm; FOV 3°

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www.nasa.gov

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