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The Callisto Desent Probe

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Abstract

The Callisto Descent Probe (CDP) is a small spacecraft to be part of the Jupiter Ganymede Orbiter (JGO) of the Europa-Jupiter System Mission (EJSM) of ESA and NASA. CDP shall be deployed during a dayside Callisto flyby of JGO. With the help of a de-orbit engine, the CDP's orbit will be adjusted to intersect the surface of Callisto. Scientific data will be recorded during the decent to the surface. The impact of CDP on the surface will end the science phase of CDP, with the exception of a survival capsule that accommodates a radio beacon. The radio beacon shall survive operational and continue to transmit a radio signal from the surface for extended time periods.

The scientific objective of CDP is to provide measurements during the descent phase, thus close to Callisto's surface that will enhance the total scientific return of the Callisto science investigation of EJSM. The areas of investigation of CDP instruments are the composition of neutrals and ions in the atmosphere, visible light imaging, magnetic field investigations, and radio science.

Scientific Instrumentation

Neutral Gas Mass Spectrometer (NMS): to measure the atmospheric neutral gas composition. Much more sensitive mass spectroscopic measurements will be performed during decent than during flyby because the atmospheric density increases dramatically closer to the surface. Moreover, since the atmosphere is in direct contact with the surface it thus provides information of the surface composition.

Ion Mass Spectrometer (IMS): to measure the composition of low-energy ions arriving mainly from Callisto. These ions result from sputtering of ions from the surface from Callisto by energetic particles from Jupiters magnetosphere, and thus also provide information about Callisto's surface composition.

Wide Angle Camera (WAC): for surface imaging in visible light at high cadence to contribute to the characterization of the surface. In particular, WAC it will provide close up images of Callisto's surface at spatial resolutions much better than can be achieved from the JGO spacecraft (up to 0.25 m/px).

Magnetometer (MAG): will measure the altitude profile of the induced magnetic field variations generated due to varying Jovian magnetic field induced in Callisto's interior. The actual altitude profile allows drawing conclusions on the strength and structure of the induced field, thus providing information about the inducing layers such as a possible subsurface ocean.

Radio system: allows the reconstruction of the probe's state-vector (coordinates and their time derivatives) by means of VLBI and Doppler measurements. The radio beacon in the survival capsule will contribute to research in celestial mechanics, planetary dynamics, seismology, and geodesy.

CDP Spacecraft

The CDP will be a small spacecraft travelling as passenger of the JGO spacecraft to its final destination Callisto. CDP weight is about 50 kg total mass including the separation mechanism. Release of CDP from the JGO spacecraft and its spin-up will be accomplished with a spring separation system. CDP has a de-orbit engine to change its trajectory to a collision trajectory with Callisto. CDP will also have small thrusters for spin adjustment and stabilisation, as well as attitude control.