OCCATOR-mission

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Introduction: Ceres, a mysterious dwarf planet that, despite the Dawn-mission still harbors a lot of secrets. The OCCATOR-mission is designed to start where the Dawn-mission ended in order to answer questions raised by the Dawn-mission. The abbreviation OCCATOR sums up the objectives of the mission; Observation of Ceres Components and Analysis of seismic and Tidal processes, Origin in the solar system and Roots of life.

Objectives: The primary objectives of the mission are to identify the interior and composition of Ceres, as analog for the building blocks of the early solar system. Furthermore, we will determine the presence and composition of subsurface liquids and look for the possibilities of life on Ceres. Additionally, the formation of the carbonates, salts and ammoniated phyllosilicates and the ongoing geological activities regarding ice deposits from the surface will contribute to our knowledge of the origin of the dwarf planet. Secondary objectives are improvements of the lander and instruments for Ceres surface conditions.

Mission Design: In order to accomplish the objectives, an orbiter with lander and two mini-rovers will be sent to Ceres. The mission will take two years to develop and six years for testing. The orbiter will need four years to travel to Ceres, two years for arriving at Mars for the gravity assist and another two years to arrive at Ceres. The orbiter will carry the lander and mini-rovers, which decouple from the orbiter once it is into orbit with Ceres. Orbiter instrumentation consists out of a Gamma Ray Spectrometer (GRS), Microwave Instrument Ceres Orbiter (MICO), Visible and Infrared Thermal Imaging Spectrometer (VIRTIS), Framing Camera (FC) and Communication Disk (COD). With these instruments the orbiter will help land the lander, communicate with the lander, rovers and Earth, make high-resolution images of Ceres surface, perform elemental mapping of the surface and analyze outgassing rates and subsurface temperatures. In order to analyze the soil and rocks on Ceres, explore the possibilities of life and get more insight into Ceres' interior, the lander will contain the following instruments: Surface Stereo Imager (SSI), Robotic Arm (RA) and Camera (RAC), Thermal and Evolved Gas Analyzer (TEGA), Ceres Lander Imaging Technology (C-LIT), Seismic Experiment for Interior Structure (SEIS) and Heat Flow and Physical Properties Probe (HP^3). Two mini-rovers, produced by Stellar Space Industries® will be attached to the lander and will each be equipped with the same instruments. The main function of the rovers is to measure the composition of the different lithologies that can be found on the surface of Ceres. Therefore an Additive System of Photographic Exposure (APXS) and Observational Camera (OC) will be attached on both rovers. [1-3]

With the Dawn mission two bright spots were located within the Occator crater (19.8 °N, 239.3 °E); the central Carelia Facula spot and east of this, the smaller Vinalia Faculae spot. Geological features suggest recent geological activity [4], the composition of the bright spots most likely consists of Mg-sulphates, carbonates and phyllosilicates [5]. These spots may be the result of cryovolcanism [6] or post-impact hydrothermal activity [7]. Because of all these findings, the proposed landing place for the lander will be a smooth surface near Vinalia Faculae, limiting the distance for the rovers to reach the bright spots.

Costs: The approximate calculation for the total costs for the rocket launch, rocket, orbiter, lander, rovers and instruments comes to $990.000.000. There are possibilities for participation in the project by the space industry. For instance the Falcon-9 rocket (SpaceX®) used for launch and the mini-rovers developed by Stellar Space Industries®.

References:

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[7] Bowling, T. J., et al., (2016), *Lunar and Planetary Science Conference, 47*.