SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

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MISSION AND SYSTEM DESIGN FOR A LANDER MISSION TO PROBE SUBGLACIAL WATER ON SATURN'S MOON ENCELADUS FOR LIFE

Abstract

The project Enceladus Explorer (EnEx) aims to design a mission to the Saturnian icy moon Enceladus, as well as to develop an operable drilling technique to penetrate the icy surface of the moon using the IceMole, a novel maneuverable subsurface ice melting probe for clean sampling and in-situ analysis of ice and subglacial liquids. The presumed reservoirs of liquid water under Enceladus' thick ice crust would make a prime target in the search for extraterrestrial life and would be more easily accessible near one of the plumes of water vapor on the moon's south pole. The general mission concept therefore, is to land EnEx at a safe distance from an active plume. The IceMole would then be deployed, melting its way through the ice crust to a water-bearing crevasse at a depth of up to 200 m to perform an in situ examination for the presence of microorganisms. The project is sponsored by the German Aerospace Center (DLR) and developed by a university consortium led by FH Aachen. In this context the Institute for Space Technology and Space Applications (ISTA) of the Bundeswehr University Munich is responsible for the overall mission and system design of the EnEx spacecraft. The driving requirement for EnEx is the high energy demand by the IceMole to melt through the cold Enceladan ices. This requirement is met by a nuclear reactor providing 5 kW of electrical power. The nuclear reactor and the IceMole are placed on a pallet lander platform. An orbiter element is also foreseen, with the main function to act as a communications relay between the lander and Earth. A reconnaissance instrument suite to assess landing site scientific interest and safety is included. After launch, the combined spacecraft perform the

transfer to Enceladus using the on-board nuclear reactor to power electric thrusters. Once in Enceladus orbit the various reconnaissance instruments sense the candidate landing sites within a Tiger Stripe valley on the south polar terrain. After a landing site is identified, the lander separates from the orbiter and performs an autonomously guided, pinpoint landing. Once landed, the IceMole is deployed and starts melting through the ice, while navigating around hazards and towards a target subglacial water pocket. Initial estimations of the mission's cost, mass budget, and duration are given, as well as recommendations on the further development of enabling technologies.