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DESTINY+: TRAJECTORY DESIGN AND OPERATIONAL PLANNING FOR DEEP SPACE
EXPLORATION

Abstract

JAXA/ISAS is currently developing DESTINY+, a deep space exploration spacecraft with the aim of launching in 2024. DESTINY+ will be deployed into a highly elliptical orbit around Earth by an Epsilon S rocket, before using low-thrust ion engines to gradually raise its altitude in a spiral trajectory. The spacecraft will then perform multiple lunar swing-bys before embarking on a journey to explore the asteroid Phaethon, the parent body of the Geminid meteor shower. The trajectory of Phaethon is unique, with a high inclination and elliptical orbit, presenting a significant challenge for the mission. To overcome this, DESTINY+ will perform a flyby observation of the asteroid, gathering valuable scientific data. Following this observation, the spacecraft will return to Earth using swing-bys, before embarking on further exploration of other asteroids. This presentation provides an overview of the overall trajectory plan of DESTINY+ and emphasizes the importance of trajectory design and operational planning during the spiral ascent phase. To escape the radiation belt during the first half of the ascent, the ion engine will be fired in the tangential direction. However, slight errors in thrust and direction may cause deviations from the planned trajectory, potentially leading to the loss of the spacecraft from ground-based observation. If this occurs, search operations and orbit determination will be conducted to ensure that DESTINY+ can continue its spiral ascent.