IAF SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (Part 1) (4A)

Author: Mrs. Pamini ANNAT
Centre National d'Etudes Spatiales (CNES), France

Mr. Clément Beal
Centre National d'Etudes Spatiales (CNES), France
Mr. Jean Jaubert
Centre National d'Etudes Spatiales (CNES), France
Mr. Sébastien Goulet
CS-SI, France
Mrs. Julie Vernière
Centre National d'Etudes Spatiales (CNES), France
Mr. Romain Pinède
Centre National d'Etudes Spatiales (CNES), France
Mr. Aurélien Felin
Centre National d'Etudes Spatiales (CNES), France
Dr. Aurélie Moussi
Centre National d'Etudes Spatiales (CNES), France

HERA CUBESATS TRAJECTORY DESIGN AND MISSION PLANNING CONCEPT FOR DIDYMOS BINARY ASTEROID CHARACTERIZATION

Abstract

In the frame of AIDA (Asteroid Impact Deflection Assessment), an international collaboration for Planetary Defense, the DART and Hera spacecraft will target the binary asteroid system Didymos-Dimorphos. The scientific objectives of the two missions are to assess the deflection of an asteroid, perform close observations for asteroid characterization, and demonstrate technologies for future missions. The first NASA mission, DART has impacted Dimorphos in September 2022. The second one, Hera, is an ESA spacecraft carrying two European cubesats (Juventas and Milani) to be launched in October 2024. The Didymos system will be reached in December 2026 to characterize the DART crater and the binary asteroid physics (gravity field, internal structure, dynamical properties, global mapping, dust cloud caused by the impact). Hera will have a two-year Cruise phase, under ESA/ESOC operations lead. When arriving close to the binary asteroid, Hera mothercraft will first characterize the asteroids in terms of dynamics, shape and gravity models, before the release of the two cubesats Milani and Juventas. The French Space Agency, CNES, was granted responsibility for close-proximity flight dynamics and mission planning operations of these two CubeSats around the binary asteroid. This responsibility begins from the ejection of the mothercraft and extends up to the fulfillment of the scientific objectives of the different CubeSats' payloads. These operations will be held in Toulouse at the FOCSE (French Operation Center for Science and Exploration), which is part of the CMOC (Cubesat Mission Operation Center, ESEC, Belgium) with direct exchanges with the HMOC (Hera Mission Operation Center, ESOC, Germany). The asteroid close proximity observation will consist in a series of phases, for both cubesats, with ejection and separation, far range, close range, landing and disposal phases. Taking into account the mission payloads, navigation and safety constraints for each phase implies specific trajectories and dedicated maneuvers strategies. For instance, ASPECT (hyperspectral imager), Milani main payload, aims to map both asteroids and

image DART crater with specific resolutions and phase angles. For JuRa (low frequency radar), Juventas main payload, the mission constraints lead to the choice of SSTOs (Sun Stabilized Terminator Orbit) at different altitudes, with a station-keeping strategy in a low gravity environment. This paper will therefore present the trajectory design by focusing on one of the different observation phases in compliance with the preliminary Mission Planning Concept elaborated to fulfill mission programming and flight dynamics constraints, in partnership with Hera ground segment European stakeholders and Payloads teams.