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

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MISSION AND SYSTEM TRADES FOR ESA'S TURBULENCE HEATING OBSERVER (THOR) SCIENCE MISSION

Abstract

Due to the characteristics of Earth's magnetic field, there are several accessible regions of turbulent magnetized plasma. Hot plasma is considered as a main origin of electromagnetic radiation and its measurement is fundamental for our knowledge of the Universe. Hence, the direct investigation of the turbulent energy dissipation and plasma energization is key for a better understanding of plasma physics and the underlying physical mechanisms, which is still very limited. In order to answer the connected scientific questions, ESA selected the proposed Turbulence Heating Observer (THOR) as a candidate for the 4th ESA medium-class science mission within the Cosmic Vision 2015-2025 programme. The THOR mission is currently undergoing the definition phase with a launch date planned for 2026, and an envisaged nominal operational lifetime of 3.5 years. The desired time in the regions of interest (i.e. within Earth's magnetosheath, bowshock, foreshock and pristine solar wind environment) and the related highly-elliptical orbits as well as the scientific payload impose stringent requirements on the mission architecture and system design, which are carefully traded very early in the project. These trades include amongst others the orbit injection approach, the transfer scenarios to access the relevant science orbits with apogees of up to 70 Earth radii, and the interlinked system aspects, such as appendage dynamics, radiation and electromagnetic shielding. The ten different payloads, including magnetometers, particle analyzers and electric field instruments, are accommodated on a spin-stabilized spacecraft which is equipped with two approximately 6 meter rigid and four 50 meter wire booms, carrying some of the instruments. This particular configuration is mainly needed due to the required measurement accuracy, radiation and electromagnetic compatibility (EMC) issues, and closely interdependent with the THOR maneuver strategy, spacecraft modes as well as component placement and shielding. This paper describes the driving requirements and the results of all major mission- and system-trades performed by OHB System and its consortium, including a discussion on the Ariane 6.2 and Soyuz launch vehicle capabilities and how they affect and create subsequent options and trades. The presented work furthermore contains a summary of the baseline mission and system architecture and concludes with an outlook of the on-going analysis required to make this interesting mission a reality.