SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (6)

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DESIGN OF THE CROSS-SCALE MULTI-SCALE PLASMA PHYSICS MISSION

Abstract

Cross-Scale is a candidate mission for ESA's Cosmic Vision program currently under consideration by the Agency. This paper presents the key results, drivers and challenges determined in the recent successful Astrium-led mission study to examine the couplings between plasma on different scales. The plasma state of matter exists in a huge variety of environments throughout the Universe - the solar wind, planetary magnetospheres, planetary nebulae and supernovae being a small sample. At different length and time scales of plasmas, different processes are dominant, and it is the interaction of these different scales – the cross-scale coupling – that needs to be understood. The large extension of these processes makes them inaccessible to laboratory studies. Hence the Earth's magnetosphere provides the easiest access to the study of these phenomena. The major challenge in analysing Earth magnetospheric data is the disentanglement of spatial and temporal variations in the various processes and understanding the interplay between the processes on larger and small scales. Cross-Scale builds on the advances from previous spacecraft missions like Cluster and pushes the frontiers of knowledge in terms of magnetospheric dynamics, energy processes and couplings across different spatial and temporal scales. The Astrium mission concept uses a modified LISA Pathfinder Propulsion Module to deliver 7 spacecraft to the operational orbit of 10 x 25 Earth Radii. This option enables the 7 spacecraft to be small satellites as they do not require bulky propulsion systems. Lunar resonances aid with the transfer to the operational orbit. The nominal mission lifetime is 5 years, including commissioning, the 2 year nominal mission and 2 year extended mission. Cross-Scale will employ 7 spacecraft, each with payload with strong heritage, which may fly with two or more highly complementary spacecraft from international partners. Together, they will form nested tetrahedra to separate spatial and temporal variations simultaneously on two of the three key scales for the first time. The Astrium Ltd team present the challenges in architecture, detailed design and AIV of the mission.