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Unique Results and Lessons Learned from the TSS Missions

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Abstract

The Tethered Satellite System (TSS) Program was a binational collaboration between NASA and the Italian space agency, ASI. NASA developed the Shuttle-based deployer and the 20 km long conducting tether. ASI developed a satellite especially designed for tethered deployment. Science Investigations were funded by both agencies.

The TSS program resulted in two Space Shuttle missions, the TSS-1 mission carried on STS 46 in 1993; and a reflight mission, TSS-1R, carried on STS 75 in 1996. The goal of these missions was to elucidate the electrodynamics of a long, conducting tether moving in earth orbit through the geomagnetic field and ionospheric plasma. The TSS carried seven coordinated hardware investigations that provided *in situ* measurements of the effects of tether electrodynamics on the tether system and on its environmental ionospheric plasma. The physical, *in situ* measurements were supported by two ground-based electromagnetic wave investigations that were designed to observe TSS-induced perturbations at the bottom of magnetic field lines crossed by TSS; by two theoretical investigations of tether dynamics; and by a theoretical investigation of tether plasma-electrodynamic interactions.

The first objective of this presentation is to highlight technical findings enabled by the TSS missions, which were significant. TSS achieved a number of “firsts” and produced unique scientific data that proved the ability of electrodynamic tether systems to produce electrical power for spacecraft operations; and have fundamentally expanded our general understanding of spacecraft-space plasma interactions. The second objective is to address the technical issues suffered by TSS that eliminated the opportunity to perform of a number of planned experiments designed to address specific aspects of the physics of electrodynamic tethers in space. Some of these issues and the subsequent lessons learned have a broad range of application that extends beyond the specifics of space tethers to space missions in general.

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