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-electrodynamics 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 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.