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

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THE CHALLENGES OF INTEGRATING THE PARKER SOLAR PROBE OBSERVATORY

Abstract

The Parker Solar Probe (PSP) explores the inner region of the Sun's heliosphere in great detail through in-situ and remote sensing observations of the magnetic field, plasma, and accelerated particles. PSP travels much closer to the Sun – 9.5 solar radii (RS) from solar center – than any other spacecraft to repeatedly obtain in-situ and remotely sensed coronal magnetic field and plasma observations in the region of the Sun that generates the solar wind and ultimately creates space weather. Due to the high energy requirements of its mission and the relatively low mass allocated to the spacecraft, PSP has been a very challenging spacecraft to integrate. This low mass requirement results in a relatively compact and complicated spacecraft. The PSP spacecraft is the proverbial "10 lbs of potatoes (electronics) fit into a 5 lb sack" (or structure). The spacecraft has four moveable panels that allow access to its interior. Due to the compact size of the spacecraft, it is desirable to integrate the spacecraft working from the interior to the exterior. Once the interior components are integrated, the panels are closed and then the exterior components are added. However, this assembly sequence dictates that the components are delivered in a sequential order. This was not the case for PSP. One of the very first components integrated was the Redundant Electronics Module (REM) to allow for systems testing. The flight unit was delayed by 6 months and the Engineering model REM was substituted to allow integration and testing to continue. Much later in the integration flow, the REM required removal to repair a faulty relay. Further complicating the integration effort was the Solar Array Cooling System (SACS). The SACS provides cooling to PSP's fluid-cooled solar arrays. The SACS was assembled as an integral part of the spacecraft structure's Top Deck. This meant that a "dummy" top deck was needed to substitute during the early months of integration and midway through the schedule this "dummy" top deck was replaced by the flight top deck, fully-integrated SACS. This was an extremely risky operation but was successful due to careful planning and preparation. The paragraphs above are just a few of the many examples of the serious challenges overcome by the PSP team during the two-year-long integration process. The intent of this paper is to describe those challenges, highlight the successes and provide lessons learned from the PSP team to benefit future complicated spacecraft.