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

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SOLAR PROBE PLUS, A HISTORIC MISSION TO THE SUN

Abstract

Solar Probe Plus (SPP) will be the first mission to fly into the low solar corona, revealing how the corona is heated and the solar wind is accelerated, solving two fundamental mysteries that have been top-priority science goals for decades. Thanks to an innovative design, emerging technology developments and a significant risk reducing engineering development program these critical goals will soon be achieved. The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, is designing and building the Solar Probe Plus system and managing the project for NASA's Living with a Star Program. The SPP science objectives are: 1) Determine the structure and dynamics of the magnetic fields at the sources of the fast and slow solar wind. 2) Trace the flow of energy that heats the corona and accelerates the solar wind. 3) Determine what mechanisms accelerate and transport energetic particles. 4) Explore dusty plasma phenomena in the near-sun environment and their influence on the solar wind and energetic particle formation. SPP will launch no later than 2018, performing 24 orbits over a 7 year duration. The mission design utilizes seven Venus gravity assists to gradually reduce perihelion (Rp) from 35 solar radii (Rs) in the first orbit to ¡10 Rs for the final three orbits. The SPP orbit consists of two primary orbit phases, a science phase (0.25AU to perihelion) and a cruise/data downlink phase (0.25AU to aphelion). A 0.6m diameter high gain antenna operates at Ka-band for science data downlink. This allows 128Gbit of data to be downlinked for each of the final three solar encounters (Rp ¡ 10Rs), thereby meeting mission requirements. SPP also provides 128Gbit/orbit for most of the earlier 21 orbits. The SPP spacecraft is 610kg wet at launch, 3m in height and 2.3m in diameter at the thermal protection system (TPS). At 9.5Rs, the solar intensity is 512 times that at 1AU. SPP is packaged behind the Carbon-Carbon TPS to protect it from this extreme solar environment and allow it to operate at standard space thermal environments while the TPS experiences temperatures of 1400degC on its sun-facing surface. SPP utilizes actively cooled solar arrays for power generation maintaining the solar cells within required temperature limits. SPP has successfully completed MCR and is currently in Phase A. NASA has released an AO for the SPP science instruments and anticipates instrument selection by September 2010. This paper will further describe the SPP mission.