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

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SOLAR PROBE PLUS MISSION DEFINITION

Abstract

Solar Probe Plus will be the first mission to touch the Sun – to fly into the solar corona to study how the corona is heated and the solar wind is accelerated. Solving these two fundamental mysteries has been a top-priority science goal for over five decades. Thanks to an innovative design, emerging technology developments and completion of a successful Phase A, answers to these critical questions will soon be achieved. The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, is designing and building the Solar Probe Plus mission and managing the project for NASA's Living with a Star Program. The SPP science objectives are: 1) Trace the flow of energy that heats and accelerates the solar corona and solar wind. 2) Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind. 3) Explore mechanisms that accelerate and transport energetic particles. Science investigations led by the University of California, Berkeley, the Smithsonian Astrophysical Observatory, the US Naval Research Laboratory, and the Southwest Research Institute will make the groundbreaking in situ and remote sensing measurements needed to achieve the science objectives. 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. A 0.6m diameter high gain antenna operates at Ka-band for science data downlink. This allows the recovery of an average of 122 Gbit of data per orbit, including spacecraft housekeeping and margin, to be downlinked for the 24 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 spacecraft 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. This paper discusses the mission concept at the beginning of Phase B, the science investigations, and mission concept of operations. We will also present the status of technology development efforts and plans for the remainder of Phase B.