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SOLAR PROBE PLUS: THE FIRST MISSION TO ENCOUNTER THE SUN

Abstract

Although more than a half century has passed since the first man-made satellite launched to space, the Sun, along with its near region, still remains unexplored due to technical challenges associated with the harsh environments and the difficulty to get close to the Sun. The closest approach that a spacecraft has made to the Sun is in the region of 0.29 AU (62.4 solar radii) by the Helios 2 spacecraft. According to the science community, to understand the nature of the Sun and its effects on Earth and on the solar system, data must be collected by a spacecraft inside the region of 10 solar radii (Rs). Solar Probe Plus (SPP), scheduled to launch in 2018, will go below 10 Rs and explore the near Sun region not once but 24 times in 7 years. The SPP mission concept was first formulated in 2007 during the “Solar Probe Lite” study by the Johns Hopkins University Applied Physics Laboratory (APL). In 2008, NASA directed APL to start to develop of the Solar Probe Plus mission aimed for launch in 2015. The initial development was focused on technology development and conceptual mission design, which concluded with a Mission Concept Review by the NASA SPP Standing Review Board in September 2009. An Announcement of Opportunity for SPP science investigations was released by NASA in January 2009; five investigations were selected in September 2010. The two-year Phase A study completed in December 2011. During the Phase A study, the launch date of the mission was revised to 2018 by NASA due to funding constraints. The mission is currently in Phase B, with the Preliminary Design Review scheduled in January 2014. The SPP mission and detailed implementation plan including the baseline alternative and backup mission are described in this paper. The baseline mission launches in July-August 2018 and encounters the Sun at 35 Rs three months after launch. On an unprecedented seven-Venus-gravity-assist trajectory, the closest approach distance from the Sun gradually reduces to below 10 Rs, including 24 different solar orbits, sampling the Sun’s near region about once every 3 months. With a small increase of the perihelion distance, an alternative mission allows for significant increase of spacecraft launch mass without compromising science. In addition, a backup mission is planned in case the primary launch date is scrubbed for unforeseen circumstances.