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MISSION DESIGNS FOR SOLAR PROBE PLUS ENABLING LAUNCH EVERY YEAR FROM 2015  
THROUGH 2018

**Abstract**

After an in-depth trajectory study and mission design trades, a trajectory design utilizing seven Venus gravity assists (V7GA) was selected among the various different trajectory options as the baseline for the Solar Probe Plus (SPP) mission. The design introduced a new mission concept with significant advantages in both science and mission implementation over the old solar probe concept. Through multiple Venus gravity assists, SPP will spiral in along gradually reduced orbits towards the Sun, getting as close as 8.5 solar radii from the Sun's surface. In situ measurements will be conducted during 24 frequent solar encounters at 3 to 4 encounters per year for more than 6 years.

The original study targeted a launch in 2015 for SPP, and accordingly the baseline V7GA trajectory was developed for launch in May 2015. For mission planning, however, a single launch date is not enough because unforeseeable circumstances—such as funding shortages and development schedule delays—could force a change to the launch date. The next launch opportunity for the V7GA trajectory after 2015 is January 2017, but due to an extremely high launch C3 requirement, this launch date with the V7GA trajectory is not viable. The next viable launch opportunity after 2015 is August 2018, but that would call for a delay of over 3 years should the 2015 launch date be missed. Thus, viable launch dates between 2015 and 2018 are urgently needed to minimize possible negative impacts on the SPP program.

A method of solving the launch window problem is described that uses different trajectory designs to create new windows of launch within the desired time period. Two viable launch dates in 2016 and 2017 are made possible for SPP through the development of two new trajectory designs. The 2016 launch is made possible by a new V8GA trajectory that utilizes eight Venus gravity assists, and the 2017 launch is made possible by a new EV7GA trajectory that uses one Earth and seven Venus gravity assists. Together, the baseline V7GA trajectory and the two new trajectory designs, V8GA and EV7GA, create greater flexibility in launch dates, allowing SPP to launch in any year from 2015 through 2018.