THE JPL/NASA SOLAR PROBE MISSION

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ABSTRACT

The Solar Probe mission will be developed under the NASA Outer Planets Program using X-2000 system technology. The present design uses non-nuclear power systems, with the prime mission from 0.5 AU on the inbound pass, to a perihelion of 4 Rs, to 0.5 AU on the outbound pass. A full complement of both in situ and remote sensing instrumentation will be flown, including high resolution disk imaging. These high-technology lightweight instruments have been partially developed under a NASA NRA program and NASA PIDDP funding. The data rates will be greater than 100 kbps over the solar poles.

MISSION SUMMARY

Figure 1 shows the spacecraft trajectory near perihelion. The prime mission is from 0.5 AU (inbound) to 0.5 AU (outbound). Low cost cruise science is currently in the plan as well. Solar Probe first travels to Jupiter for a gravity assist to enter an orbit with a 4 Rs perihelion. The spacecraft will go from solar pole-to-pole in a trajectory that is orthogonal to the Sun-Earth line so that there is continuous radio contact. This orbit ensures that the mission will probe both the high-speed solar wind streams and also the equatorial low-speed streams.

Three types of power systems are used, Conventional solar arrays will power the spacecraft from launch to Jupiter and then in to 0.7 AU from the Sun. At this distance, these panels will be jettisoned and a transition will be made to a lightweight, high-efficiency, high-temperature solar array. This latter system will be used into ~0.2 AU, where a switch to batteries will be made. The high-temperature arrays will be stowed in the spacecraft umbra while the spacecraft is on battery power and will be redeployed on the outbound pass.

A helioseismology experiment is shown in the mission baseline (Figure 1). This is indicated at T ≈ -4 days, well before the north polar pass, The magnetograph/Doppler instrument will be used to study the circumpolar jets that were discovered by SOHO, as well as polar magnetic fields.

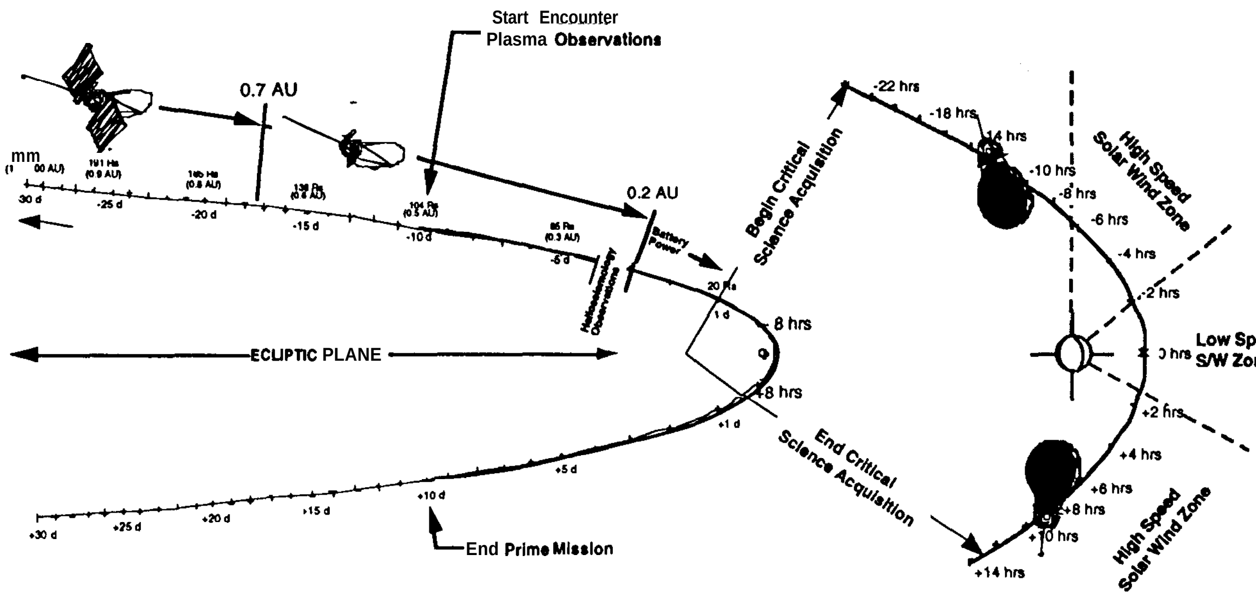

Figure 1: Solar *Probe trajectory and* activities *near perihelion (view from Earth).*

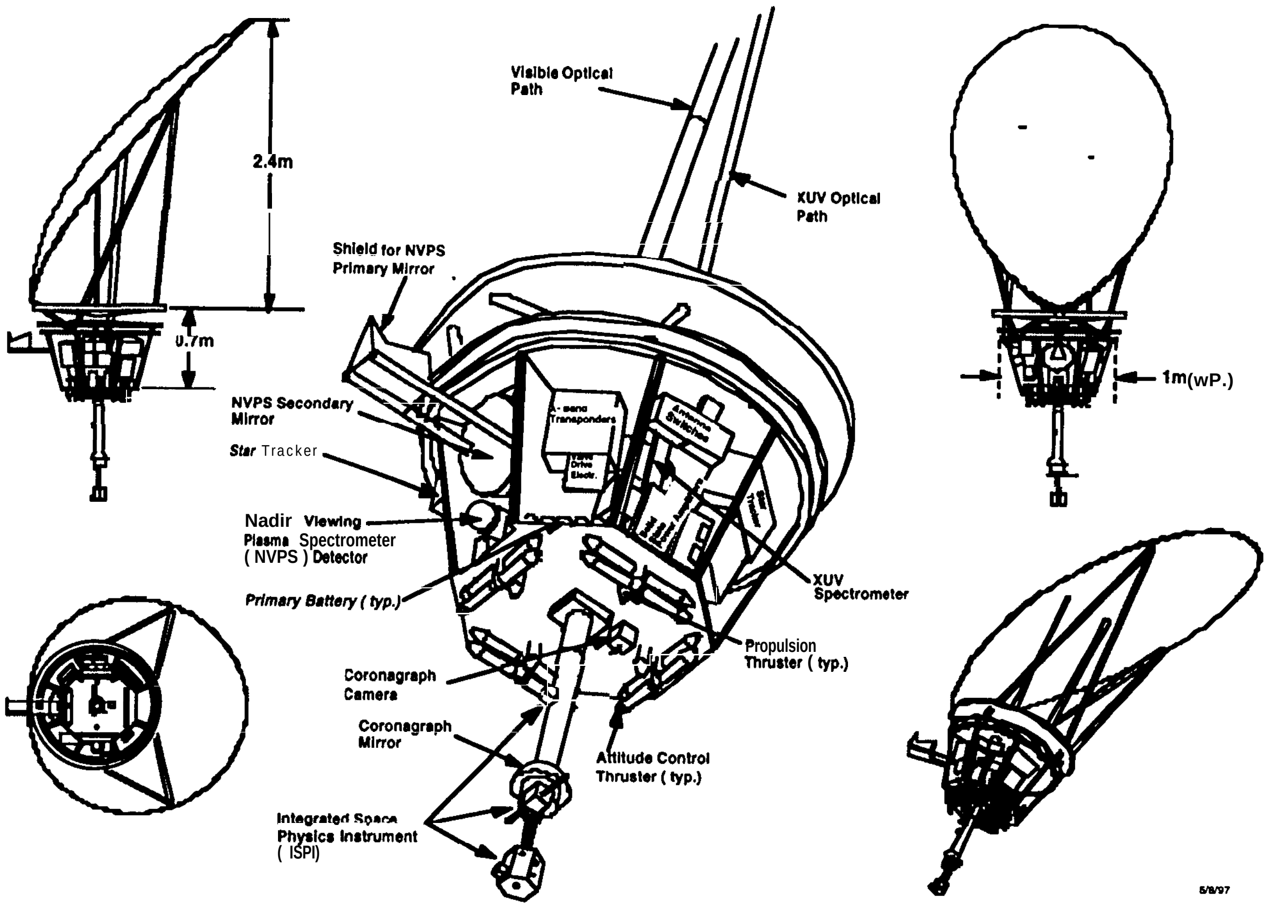

Figure 2: Solar Probe baseline configuration.

Table 1: Solar Probe Instruments

Instrument	Tot Mass (kg)	Pk Power (W)	Data Rate (kbps)
2 Triaxial Magnetometers	0.3	0.4	1.2
Plasma Wave Sensor	0.5	0.4	9.6
8 Plasma Particle Detectors	0.8	1.5	20
2 Neutral Particle Detectors	0.3	0.4	0.8
EUV Imager	2.0	0.8	30
2 Energetic Particle Detectors	0.4	0.5	4
Ion/e^- Plasma Instrument	3.1	3.4	14
Visible Magnetograph/ X-ray imager	1.8	1.5	30
All-sky and High Resolution Coronagraph	2.4	2.0	2
DPU	2.0	3.5-6.5	-
Boom Cables	1.0	0.2	-
Total	14.6	14.6- 17.6	111.6

Figure 2 and Table 1 give the spacecraft configuration and the instrument payload, respectively. Note that for the latter, a high-technology integrated instrument package (with many sensors) is envisioned. This configuration reduces mass and power and also allows correlative high time resolution measurements to be made, The plasma, plasma wave and magnetometer sensors will resolve polar plume/interplume structures (with simultaneous coronagraph context viewing) to 1.5 km resolution to determine when coronal hole solar wind acceleration is taking place. At the equator, the same set of in situ sensors will resolve magnetic and plasma structures to 3.0 km in the helmet streamer belt. It should be noted that the Solar Probe perihelion of4 R_S will be sunward of the predicted location of the sonic point.

The strawman payload contains a high resolution EUV imager with 75 km resolution over the poles, the highest resolution ever taken of the Sun. A magnetograph/Doppler imager will also have the same spatial resolution. An all-sky coronagraph will take tomographic images of the structures through which Solar Probe flies, as well as the near-solar coronal features related to plasma heating and acceleration.

SCIENCE OBJECTIVES

The purpose of the Solar Probe mission is to: 1) understand the plasma processes that heat the corona and accelerate the fast and slow solar winds, 2) determine the dynamics of interior convection and small scale magnetism in the polar regions, and **3)** measure the high-latitude solar magnetic fields on the solar surface and determine (with the in situ measurements) how they project outwards into the solar system.

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