Parker Solar Probe
A NASA Mission to Touch the Sun

Parker Solar Probe is on its way…!

Angelos Vourlidas
WISPR Project Scientist
• The concept for a “Solar Probe” dates back to “Simpson’s Committee” of the Space Science Board (National Academy of Sciences, 24 October 1958)
• This has been of top priority in multiple Roadmaps and Decadal Surveys
• Technological challenges made it possible only now
PSP Mission: Launch and Mission Overview

Launch
- Dates: Aug. 12, 2018
- Max. Launch C3: 154 km/s²
- Delta IV-Heavy w/ Upper Stage

Trajectory Design
- 24 Orbits
- 7 Venus gravity assist flybys

Mission duration:
- 6 years, 11 months

Final Solar Orbits
- Closest approach: 9.86 Rs
- Speed: ~720,000 km/hr (~200 km/sec)
- Orbit period: 88 days (sci ops 10 days)

Upcoming Activities
- L30 + 25 days: Commissioning
- Oct 26 – Nov 7: Encounter #1 (35.7 Rs)
- Dec 3 – 8: First Science Data Downlink
### PSP Science Objectives

#### Overarching Science Objective
- To determine the structure and dynamics of the Sun’s coronal magnetic field, understand how the solar corona and wind are heated and accelerated, and determine what mechanisms accelerate and transport energetic particles.

#### Detailed Science Objectives
- Trace the flow of energy that heats and accelerates the solar corona and solar wind.
- Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind.
- Explore mechanisms that accelerate and transport energetic particles.
Launch 8/12/2018

1st Perihelion at 35.7 Rs 11/1/2018

1st Perihelion at 9.86 Rs 12/19/2024

Sun

Mercury

Venus

Earth

Parker Solar Probe
FIELDS will measure electric and magnetic fields and waves, Poynting flux, absolute plasma density and density fluctuations, electron temperature, spacecraft floating potential, and radio emissions.

Solar Wind Electron Alphas & Protons (SWEAP)
PI: Justin Kasper (Univ. Michigan/SAO)

SWEAP will count the most abundant particles in the solar wind -- electrons, protons and helium ions -- and measure their velocity distributions (velocity, density, & temperature).


30th IAU Assembly – Vienna, Austria
Parker Solar Probe
IS☉IS will measure energetic electrons, protons and heavy ions that are accelerated to high energies (10s of keV to 100 MeV) in the Sun's atmosphere and inner heliosphere, and correlates them with solar wind and coronal structures.

WISPR will image of the solar wind, shocks and other structures as they approach and pass the spacecraft. This investigation complements the other instruments on the spacecraft providing direct measurements by imaging the plasma the other instruments sample.

PSP corotation periods are key to untangling connection to corona
Inner Heliosphere Network (2021+)

PSP/So are VERY Different than Current Solar Missions:

- Encounter
- Long Latency
- Variable Viewpoints
- Emphasis on in-situ meas.

- PSP Corotation (~2 days/orbit)
- SO Near-Corotation

Solar Orbiter, PSP, STEREO-A & Earth orbits in 2021-2023
Synergies with Ground- & L1-Based Observatories

The Role of Ground-Based Network

- **Monitoring**
  - 24/7 observations of solar conditions (transient activity, coronal hole evolution, etc.)

- **Forecasting**
  - Using the monitoring data to create forecast of the conditions on the Sun and inner heliosphere.

- **Modeling**
  - Useful for certain kinds of modeling. Will play a central role in realizing the PSP-GBN objectives.

- **Mission Planning**
  - GBN can provide ‘situational awareness’ for solar/heliospheric conditions that would be useful for the PSP science operations.

PSP-GBN White Paper
[https://sppgway.jhuapl.edu/sites/default/files/Pubs/SPP-GBN-WhitePaper-v5.0.pdf](https://sppgway.jhuapl.edu/sites/default/files/Pubs/SPP-GBN-WhitePaper-v5.0.pdf)
**RECAP**

- PSP is a very **different** mission than past solar physics missions
  - Observations: Encounter not synoptic
  - Data: Long latency not real time
  - Methodology: in-situ measurements not imaging
  - Viewpoint: actively changing not constant

- Emphasis on **quiescent** structures, kinetic scales, 3D structure
  - CMEs, shocks and SEPs may be few but extremely valuable

- Strong synergies with **off-limb** observations (e.g. coronagraphs, off-limb spectrometers, etc.)

- Synergies with **disk/low** atmosphere measurements (e.g., disk imagers and spectrometers, magnetographs, etc.)
The Parker Solar Probe
A Mission of Extremes
Parker Solar Probe: Resources

All Open Access


In preparation: new series of papers about instrument calibration, upgrades, operation, etc.
Visualizing the PSP and SO Orbits

- Necessary for science planning
- Tools available:
  - IDL routines (sorbet.pro, vizzer.pro). Contact: A. Vourlidas
  - YouTube playlist of PSP/SP movies by N. Savani: https://www.youtube.com/watch?v=oaCgWEbN1vk&list=PLZo7abHVYqFc03NeSOv6tcK5014Ree0Q-
CME Rate Estimates

Estimate of CME occurrence rates during prime phase (4/2021 - 9/2025):

- Minimum ~on 01/2019; current slope is sharper than C23 slope.
- Therefore, 2021-23 is rise to max. Maximum ~ 2023-2025.

Using 2010-14 as guide…

- **119 CMEs** >1000 Km/s, >20 deg width.
- SoloHI nominal Duty Cycle (~18%, 30/165). SoloHI FOV: Coverage 40/360 (~11%)*.

- Expect to see at least **2-3 CMEs** w/ potential shock signs.
- *Expect to cross ~20 CMEs < 0.4 AU for in-situ measurements (assuming 2007-2017 stats)*

* WISPR duty cycle (12.5% 11/88 days)*
At closest approach, the front heat shield will be at 1,400°C (2,500°F), but the payload will be near room temperature.
PSP Vehicle: Ram-Facing View

FIELDS PI
Stuart Bale (UC, Berkeley)

IS⊙IS PI
David McComas
(Southwest Research Inst.)

WISPR PI
Russ Howard
(Naval Research Lab)