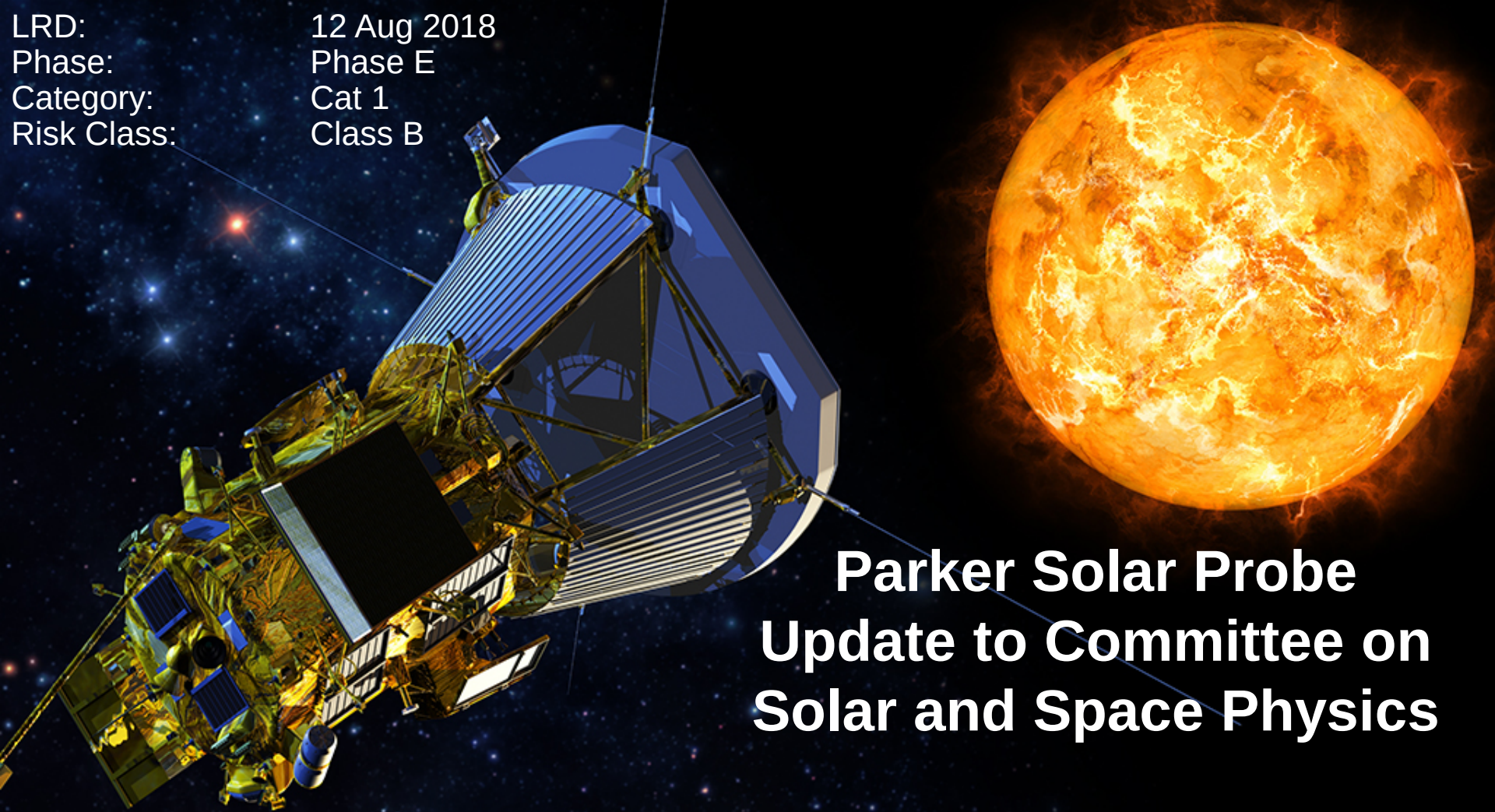
LRD: 12 Aug 2018
Phase: Phase E
Category: Cat 1
Risk Class: Class B



Parker Solar Probe Update to Committee on Solar and Space Physics

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Solar Probe Plus

A NASA Mission to Touch the Sun

NASA

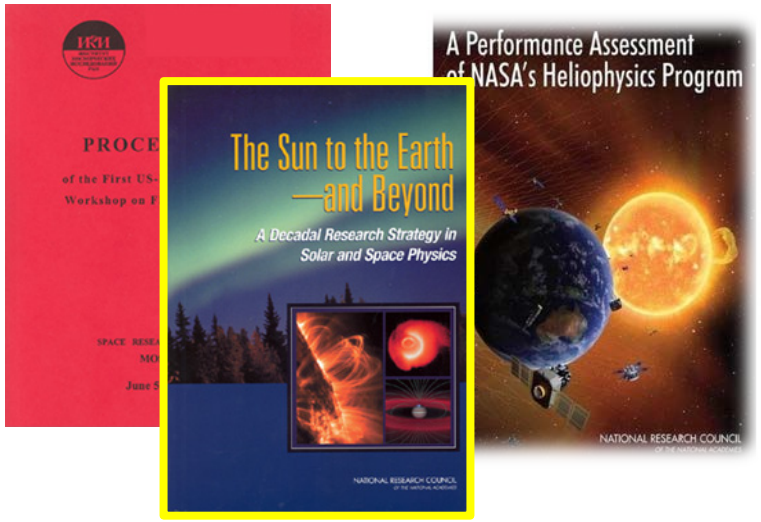
APL JOHNS HOPKINS APPLIED PHYSICS LABORATORY

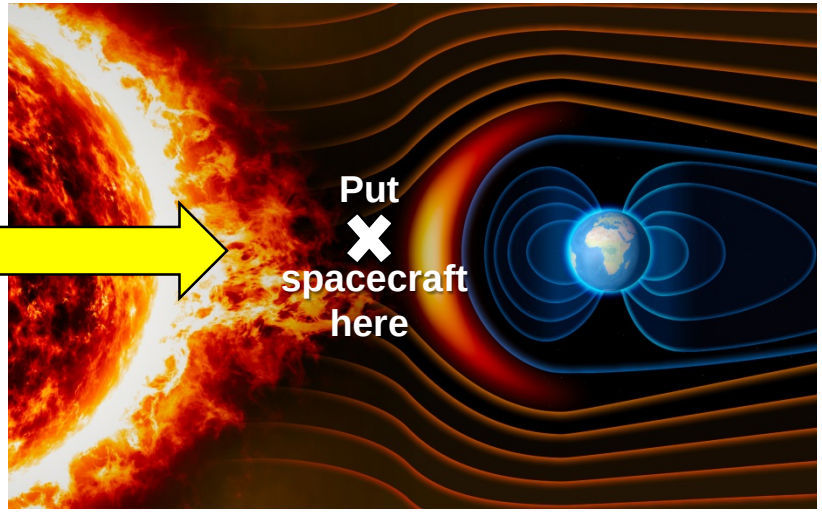
Agenda

- **Overall Status**
- **Instrumentation Performance**
  - **Science summary provided by Arik Posner**
- **Mission Design Performance**
- **Science Data Volume collected and recovered**
- **Select Subsystem Performance**
- **Consumable Status**
- **Programmatic Status**

The Vision: Touching the Sun

- **Sending a spacecraft close to the Sun has been a priority since 1958**
  - **The concept for a "Solar Probe" dates back to "Simpson's Committee" of the Space Science Board (National Academy of Sciences, 24 October 1958)**





- **Parker Solar Probe has three 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.**

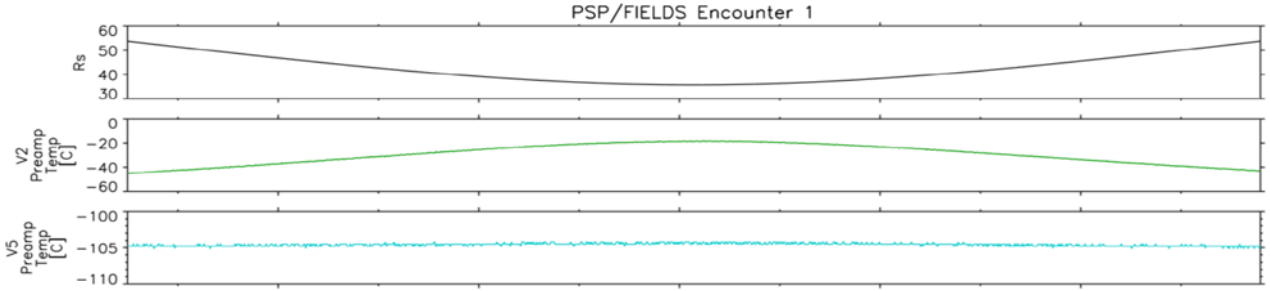
Parker Solar Probe Summary

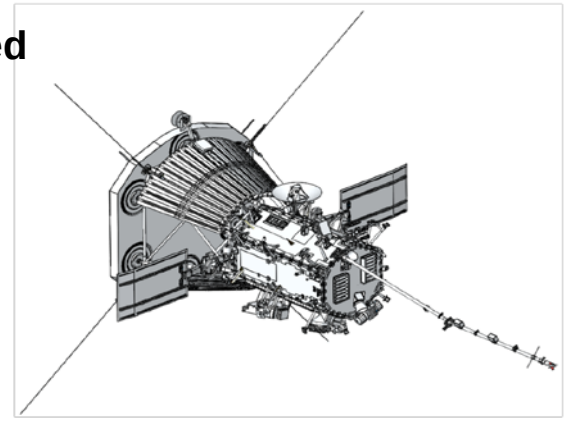
	DEC	JAN	FEB	COMMENTS
Cost	G	G	G	Phase E budget matches requirements. Slight under-run due to mostly nominal performance
Schedule	G	G	G	Encounter 2 preparations are underway
Science	G	G	G	No significant Issues. Release of margin in the system has allowed us to increase expected data return. Expect data return from Orbits 1 and 2 approximately twice the pre-launch plan.
Spacecraft	G	G	G	Preparations for Encounter #2 are under-way. Pre-encounter Ka-Band passes completed as planned. Team is noting higher than expected temperature on fan-beam antenna 1. Issue is understood. Antenna being tested on gnd to higher temperatures.
Instruments	G	G	G	All instruments are nominal. ISOIS not fully commissioned yet due to lack of solar activity.
Ground System	G	G	G	No significant ground system issues.
Overall Project	G	G	G	All systems are nominal as spacecraft enters Solar Encounter #2.

	DEC	JAN	FEB	COMMENTS
Instruments				
FIELDS	G	G	G	Preparations on-going for Encounter #2.
SWEAP	G	G	G	Preparations on-going for Encounter #2. SWEAP has completed diagnostic testing regarding unexpected resets. Data is being analyzed.
ISOIS	G	G	G	Preparations on-going for Encounter #2. Due to low solar activity, ISOIS is not yet fully commissioned. Hoping to see sufficient events in the data files to be downlinked in April. CONOPs changed to keep ISOIS on – evaluated on an orbit by orbit basis.
WISPR	G	G	G	Preparations on-going for Encounter #2.
Overall Insts	G	G	G	All instrument performance is nominal.

Instrumentation Performance (1)

- **FIELDS – measures electric and magnetic fields**
  - **E and B-field instruments performance is nominal**
    - **Thermal performance of sun-lit antennas is as-expected**
  - **Electronics and operations performing nominally**



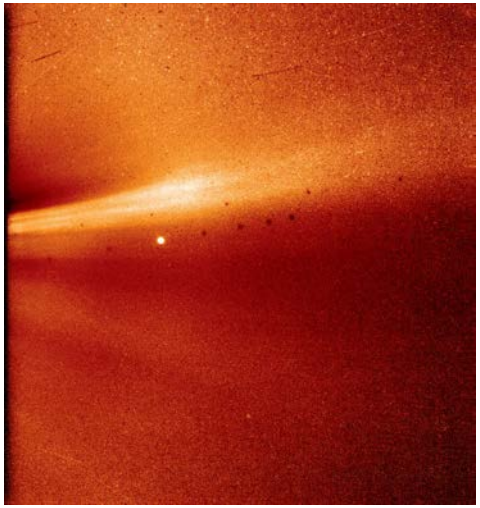


- **SWEAP (Solar Wind Electrons Alphas and Protons) – measures the constituents of the solar wind**
  - **SPC, SPAN A Ion and Electron and SPAN-B Electron performance are nominal**
    - **Thermal performance of sun-lit SPC is better than expected, potentially relieving late mission constraints on operations.**
  - **Electronics and operations performing nominally**

Instrumentation Performance (2)

- **ISOIS (Integrated Science Investigation of the Sun) – measures energetic electrons, protons and ions.**
  - **EPI-Hi and EPI-Lo instruments are performing nominally**
  - **Lack of solar activity has delayed fully commissioning the suite**
    - **Remaining data from encounter #1 to be downlinked in April**
  - **Electronics and operations performance is nominal**

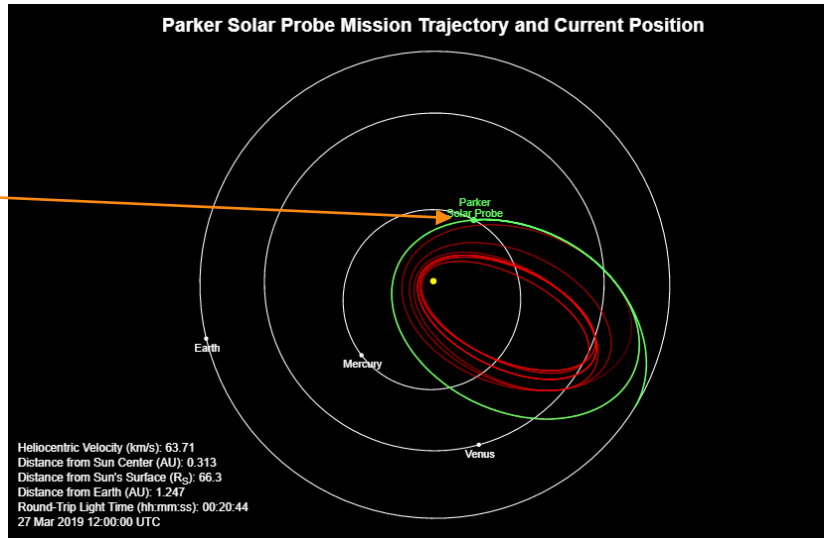
- **WISPR (Wide-field Imager for Solar PRobe) - Two white light imagers that image the corona**
  - **Both WISPR cameras are performing nominally**
  - **Electronics and operations are also performing nominally**



Mission Design Performance

- **Significant Mission Design Events**
  - 12 Aug 2018 – Launch
  - 19-20 Aug 2018 – TCM #1
  - 3 Oct 2018 – Venus Fly-By 1
  - 6 Nov 2018 – Perihelion #1
  - 9 Dec 2018 – TCM #6
  - 20 Jan 2019 – Aphelion #2
- **Excellent performance associated with all events.**

Parker was here on 27 Mar 19

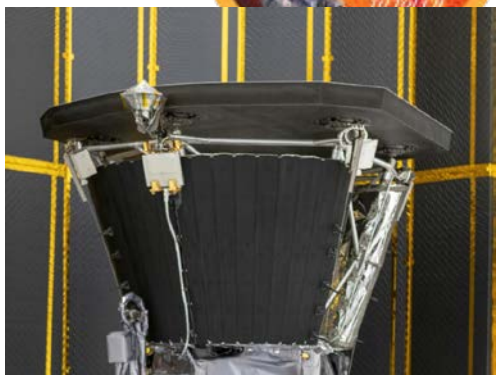


Science Data Volume

	Pre-Launch Plan	Current Plan	Unit
Collected during Encounter #1	107	107	Gbits
Collected during Encounter #2	107	340	Gbits
Total Volume	214	447	Gbits
"Downlink by" Date	15 May 2019	238 Gb by 15 May, rest by 15 Aug 2019	

- **Why increased performance?**
  - **~2 db of RF margin was released which resulted in higher Ka-Band data rates to the ground.**
  - **More aggressive use of CFDP (CCSDS File Delivery Protocol).**

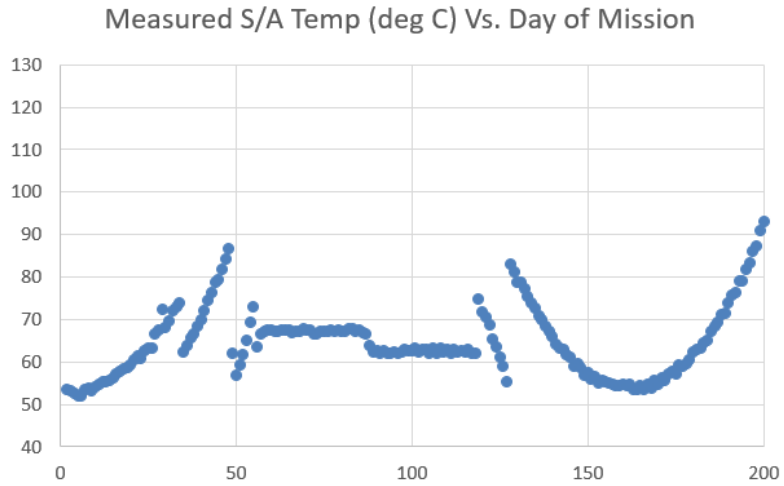
Thermal and Solar Array Cooling System (SACS) Performance

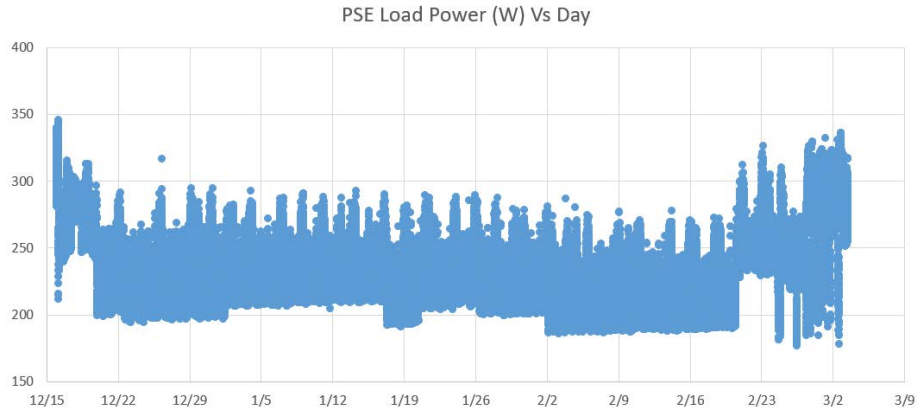


- **Umbra Attitude, <0.7 AU, TPS Sun pointing**
  - **Solar Array Cooling System**
    - **SACS performance was nominal through encounter #1**
    - **SACS dissipating ~3,000 Watts**
    - **Performance matching predictions**
  - **Thermal System**
    - **All components well within their operating temperatures, performance matching predictions**
  - **TPS performance nominal. Load is ~38 Suns (~240 KW) vs ~470 Suns (~3 MW) at closest approach**
- **Aphelion Variable Attitude, >0.7 AU, <0.79 AU, can expose –x side of spacecraft to Sun**
  - **Solar Array Cooling System – performance nominal, matching predictions.**
  - **Thermal System**
    - **Due to secondary effects, Fan-Beam Antenna #1, Digital Sun Sensor #1 and Span-B seeing higher than expected temperatures.**
    - **Geometry repeats in March 2020**
    - **Like units for FB#1 and DSS#1 will be tested to higher temps.**
    - **Impacts to SPAN-B are still being evaluated**

Power System Performance

Component	Status	Comments
EPS Overall	Green	Power margin remains high early in mission
Solar Array	Green	S/A power margin is presently high. Assessing degradation vs predictions.
Power System Electronics (PSE)	Green	PSE efficiency and power consumption are as expected
Battery	Green	Battery performance is nominal





On Board Consumables

- **Two primary consumables are: Propellant and Solar Array performance.**
  - **Due to high irradiance environment, the PSP Array degrades due to UV darkening of adhesives. System was designed to accommodate this.**
- **Propellant**
  - **82.0 Kg of usable propellant was loaded prior to launch**
  - **As of 22 March 2019, remaining propellant is 78.1 Kg**
  - **Remaining propellant usage is dependent on future TCM and momentum management performance**
  - **Expectations are there will be propellant remaining for a significant extended mission**
- **Solar Array Performance**
  - **PSP flies in a high irradiance environment never encountered.**
    - **Trending of array performance is critical**
  - **After one encounter, S/A power is degrading at a rate similar to pre-launch predictions using pre-launch estimated temperatures**
  - **Initial indications are that there will be sufficient power (380 Watts) available beyond the primary mission.**

Programmatic Status

- **Parker is continuing to operate within budget and has exceeded the scheduled plan (wrt to data performance)**
- **Staffing remains stable at all key institutions**
- **Parker completed its second Pre-Encounter Assessment Review with no significant findings.**
- **Significant Upcoming Events (UTC):**
  - **5 April 2019: Perihelion #2 @~35 Rs**
  - **13 May 2019: TCM #7 Opportunity**
  - **18 Jun 2019: Aphelion #3, start Orbit #3**
  - **1 Sep 2019: Perihelion #3 @~35 Rs**
  - **26 Dec 2019: Venus Fly-By #2**
  - **29 Jan 2020: Perihelion #4 @~28 Rs**
- **All is “green” for the next solar encounter**

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http://parkersolarprobe.jhuapl.edu