

Parker Solar Probe
A NASA Mission to Touch the Sun



**Parker Solar Probe
and IRIS**

Nour E. Raouafi

IRIS-9, MPS Göttingen June 25-29, 2018



IRIS-9, Göttingen, 25-29 June 2018

Invited Talk

6. Science together with future facilities

The Parker Solar Probe (PSP) and IRIS

Nour-Eddine Raouafi¹

¹ *The Johns Hopkins University Applied Physics Laboratory, Laurel, USA*

tbd.

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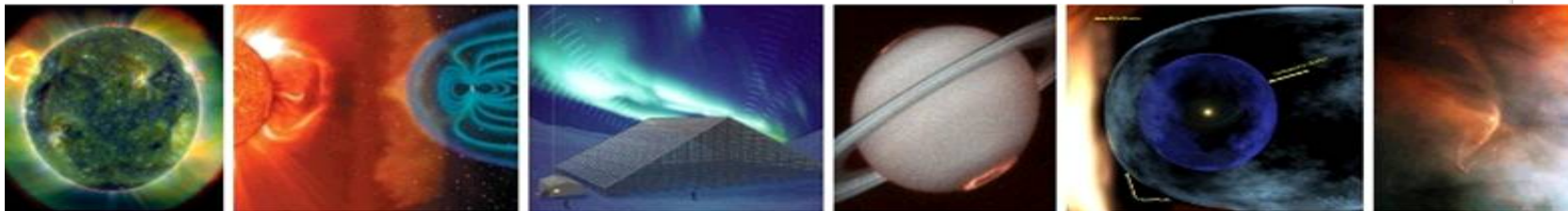
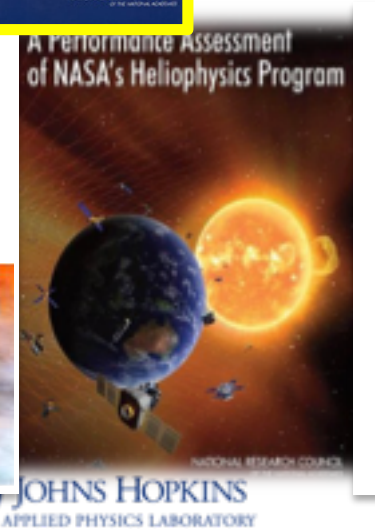
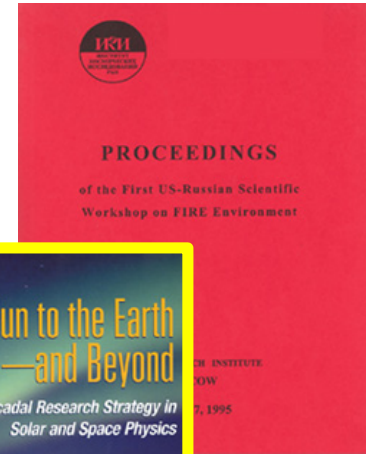
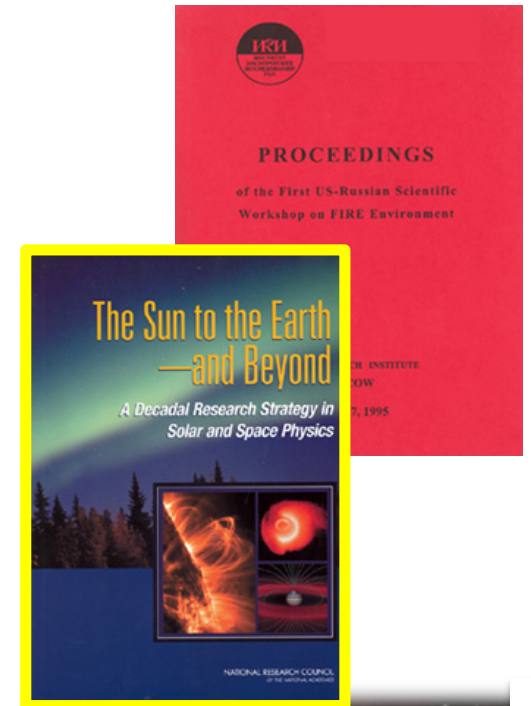


Parker Solar Probe

60 years in the Making



- 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



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Parker Solar Probe and IRIS



JOHNS HOPKINS
APPLIED PHYSICS LABORATORY

Touching a Star

A Monumental Stride for Humanity



Parker Solar Probe

Parker, meet Parker



University of Chicago
PSP Renaming Ceremony
May 31, 2017

Eugene Parker
NASA's Distinguished
Public Service Medal



IRIS-9, MPS Göttingen, June 25-29, 2018



Parker Solar Probe and IRIS

The True Nature of the Solar Corona

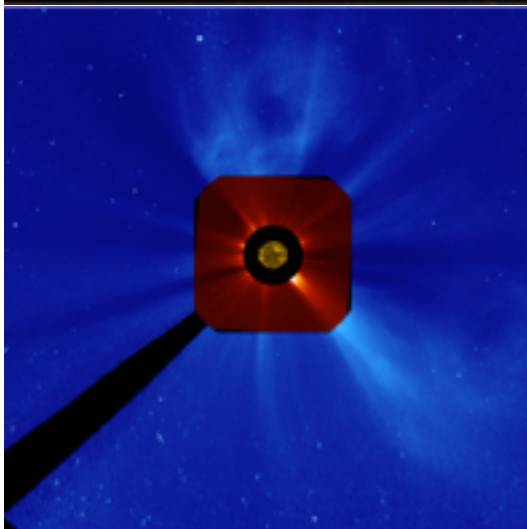
Parker Solar Probe Science



How the corona is heated?



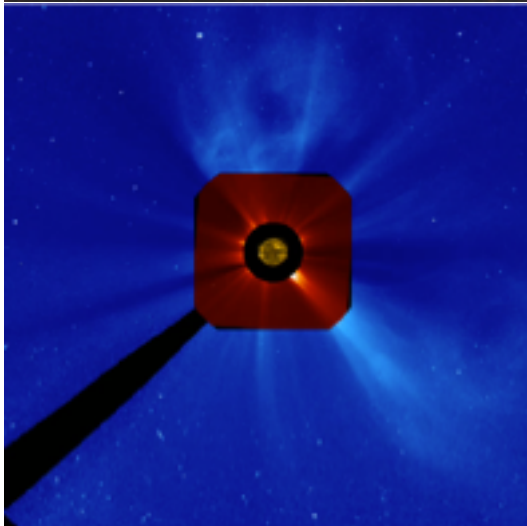
How the solar wind is accelerated?



How solar energetic particles are produced and their distributions evolve?

The True Nature of the Solar Corona

Parker Solar Probe Science



PSP Science Objectives:

- 1. Trace the flow of energy that heats the solar corona and accelerates the solar wind.**
 - 1a. How is energy from the lower solar atmosphere transferred to, and dissipated in, the corona and solar wind?
 - 1b. What processes shape the non-equilibrium velocity distributions observed throughout the heliosphere?
 - 1c. How do the processes in the corona affect the properties of the solar wind in the heliosphere?
- 2. Determine the structure and dynamics of the plasma and magnetic fields at the sources of the solar wind.**
 - 2a. How does the magnetic field in the solar wind source regions connect to the photosphere and the heliosphere?
 - 2b. Are the sources of the solar wind steady or intermittent?
 - 2c. How do the observed structures in the corona evolve into the solar wind?
- 3. Explore mechanisms that accelerate and transport energetic particles.**
 - 3a. What are the roles of shocks, reconnection, waves, and turbulence in the acceleration of energetic particles?
 - 3b. What are the source populations and physical conditions necessary for energetic particle acceleration?
 - 3c. How are energetic particles transported in the corona and heliosphere?

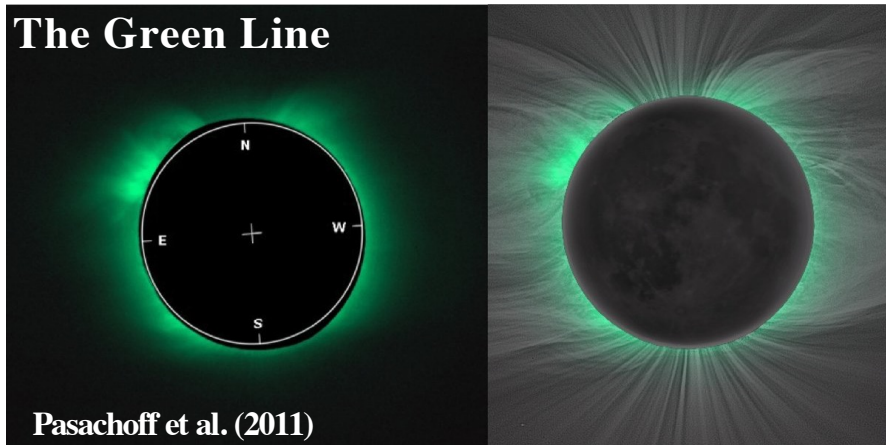
From the Green Line Mystery (1869)

To the Coronal Heating Problem (1939-1941)

To ??? (2020's)



The Green Line



Pasachoff et al. (2011)

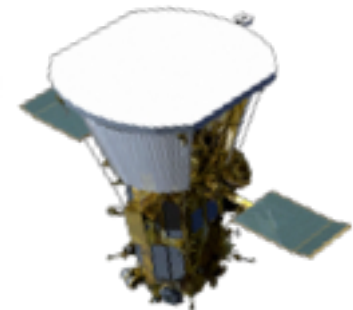
A mystery that lasted for more than seven decades (1869-1941)



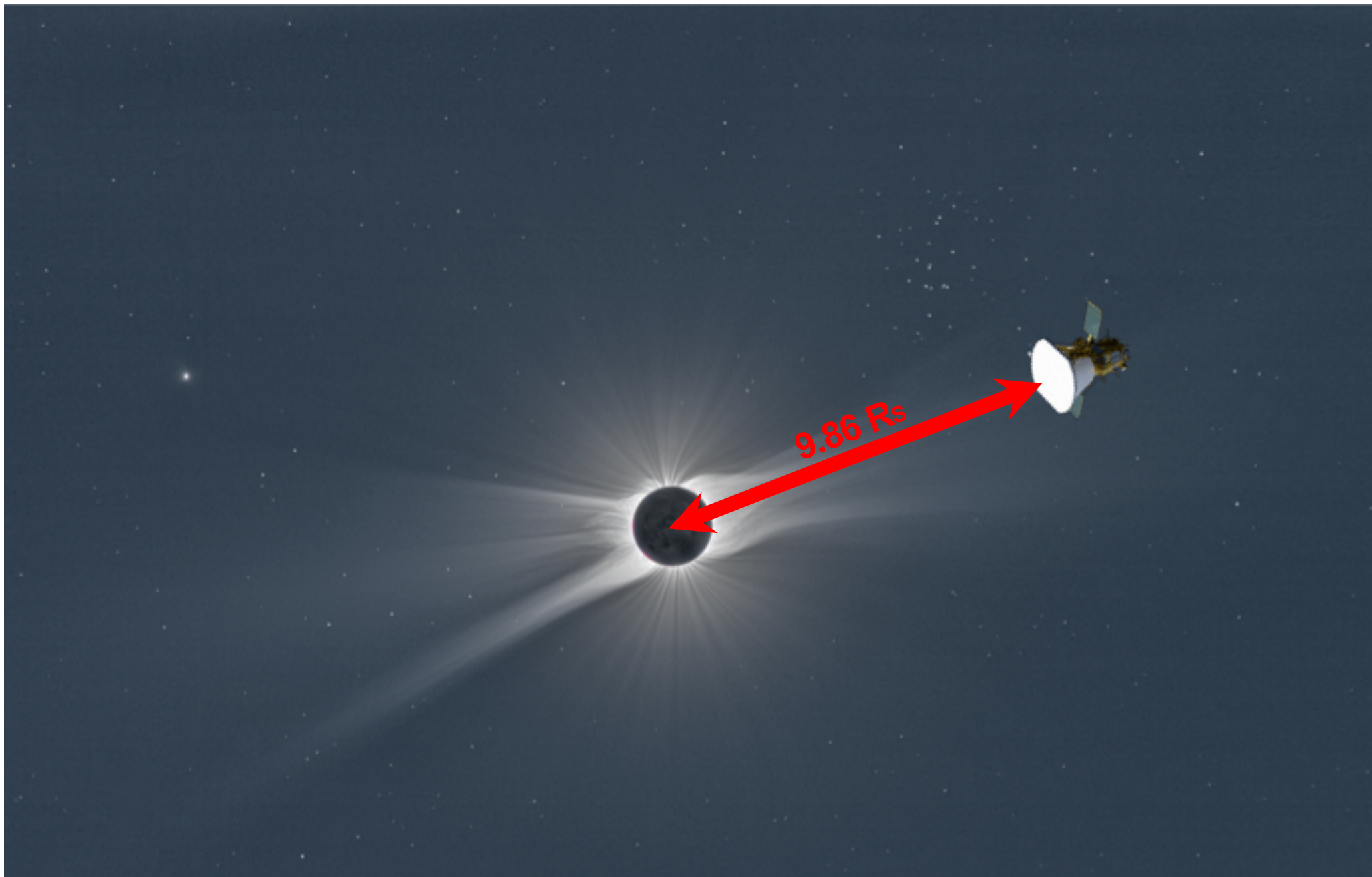
Edlén 1939-1941
Mystery solved
It is Fe¹³⁺



What new phenomena are we going to discover



Discovery of the coronal heating problem



PSP will travel to within 4% (below 10 R_s) Sun-Earth distance – well within the portion visible during an eclipse

Parker Solar Probe

Launch & Mission Design Overview



Launch Window

- Jul. 31 – Aug. 19, 2018
(LRD Aug. 4, 2018)

Trajectory Design

- 24 Orbits
- 7 Venus GA flybys

Mission Lifetime

- 6 years, 11 months

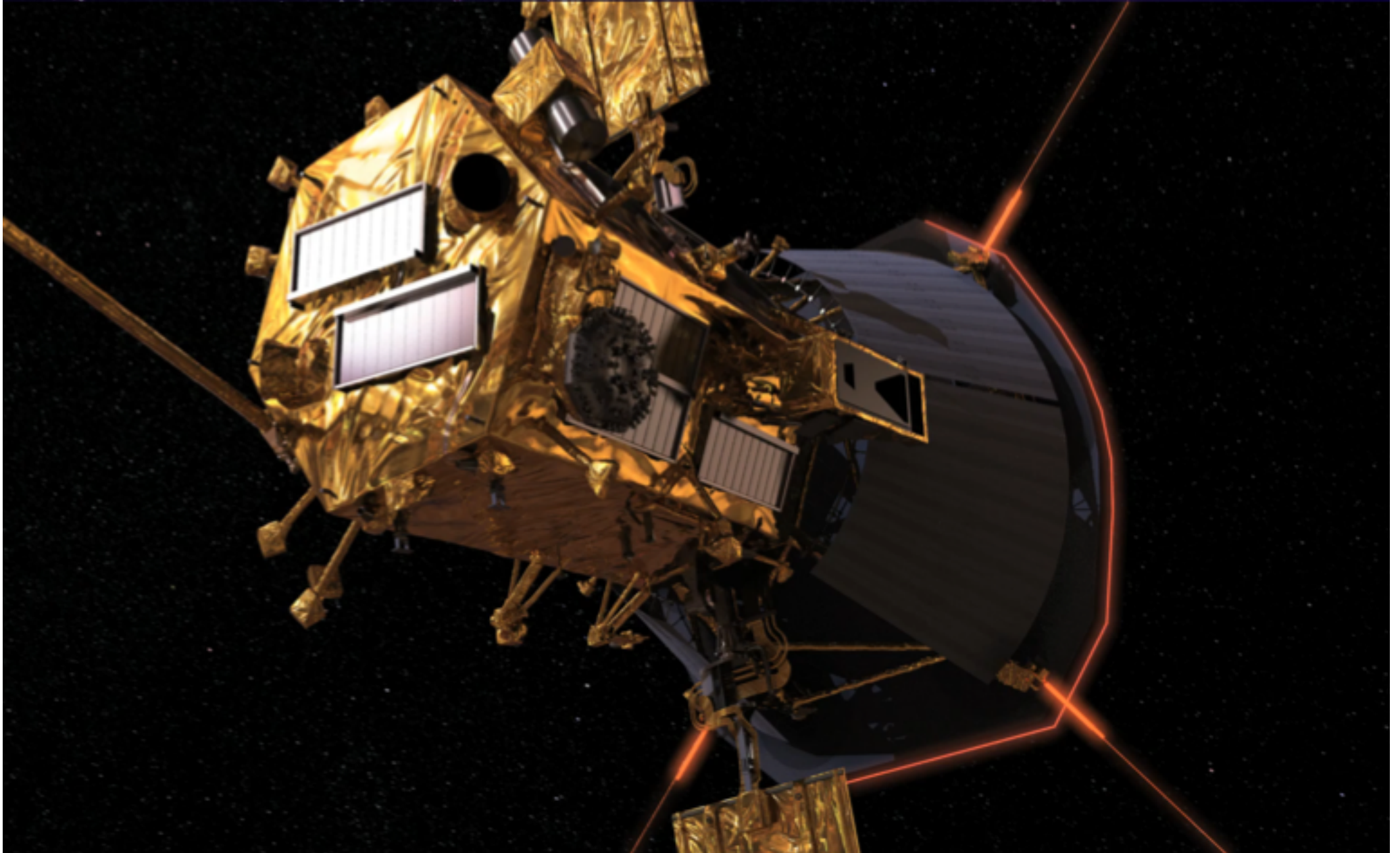
First Orbit

- Perihelion $35 R_{\odot}$
- L0+30 days: S/C commissioning
- L30+25 days: payload commissioning
- Oct. 26 – Nov. 7: first encounter
- Dec. 3-8: first data downlink



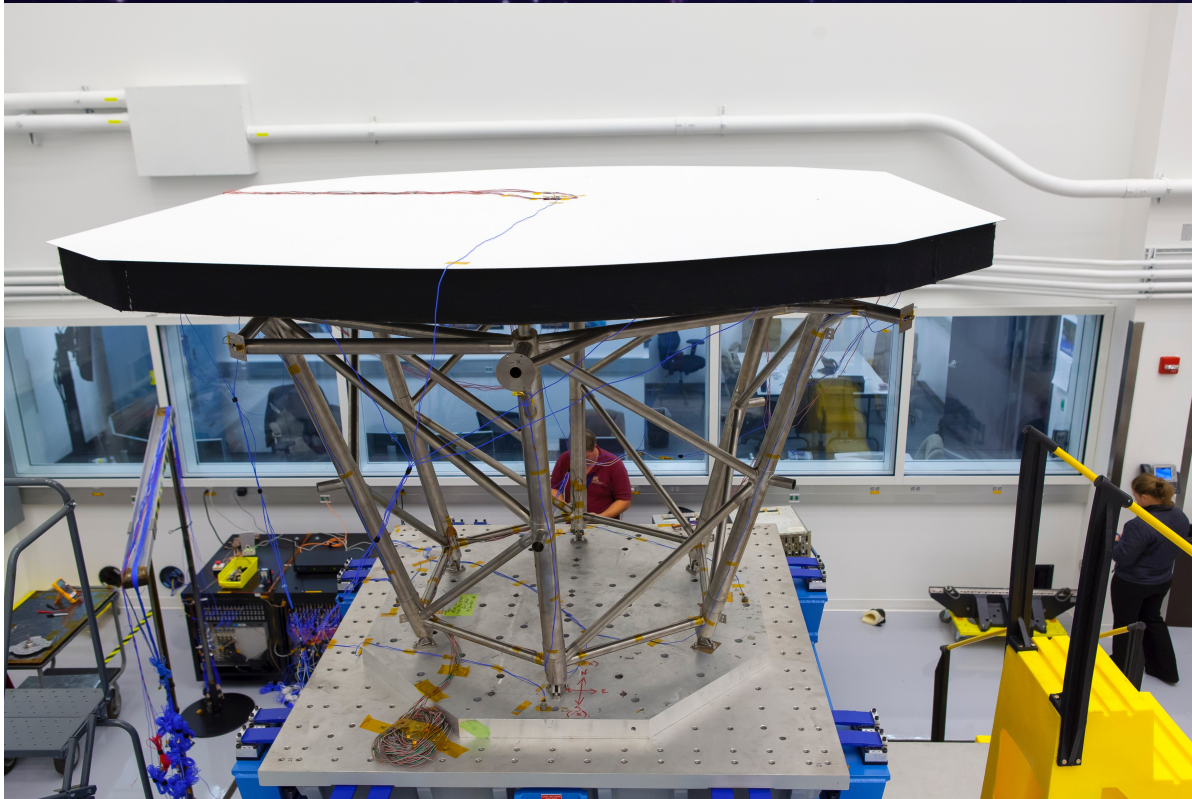
The Parker Solar Probe

A Mission of Extremes



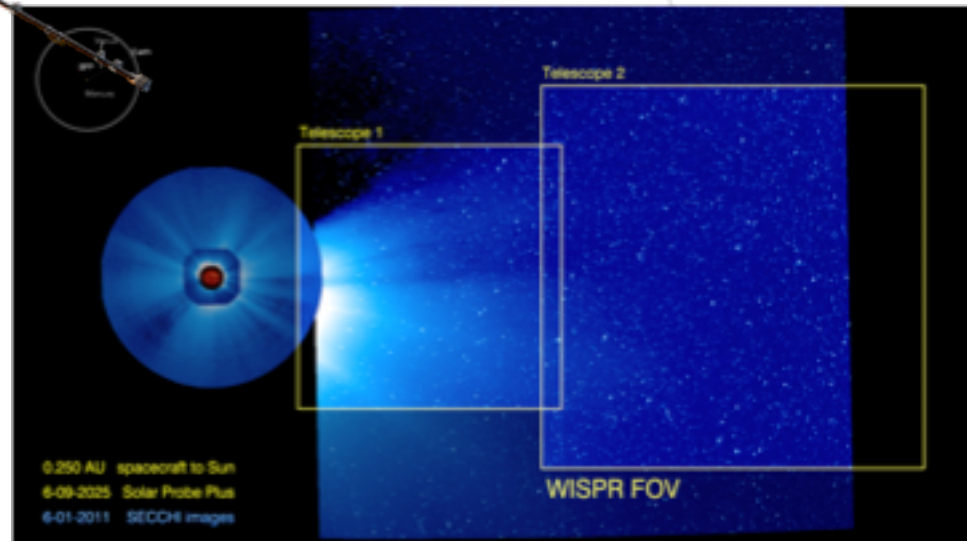
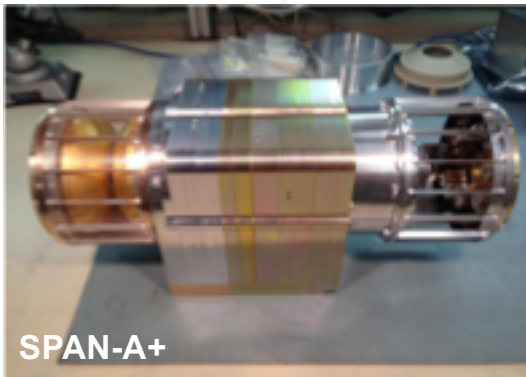
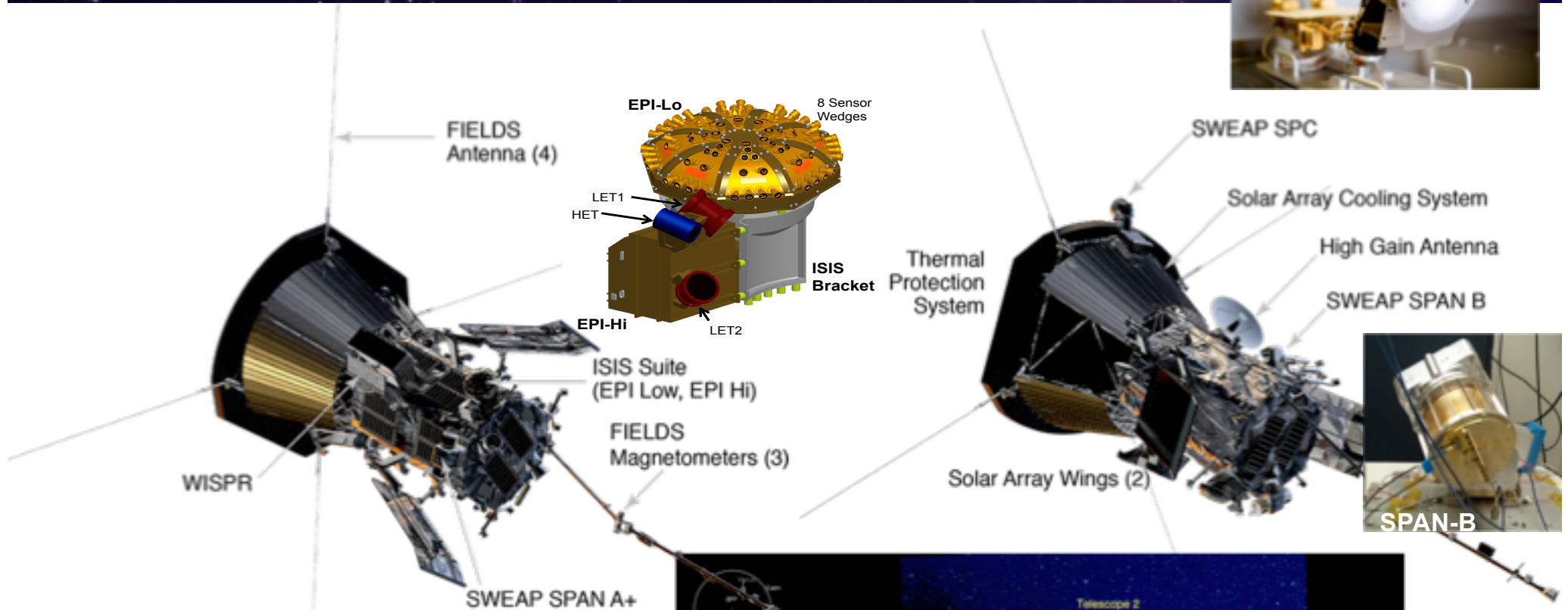
Parker Solar Probe

Thermal Protection System Assembly



- **4.5-inch-thick (11.43-centimeter-thick) carbon-composite shield**
- **At closest approach, the front the heat shield will be at 2500°F (1,400°C), but the payload will be near room temperature**
- **Water-cooled radiators**

Parker Solar Probe Payload



Parker Solar Probe

Resources



All Open Access

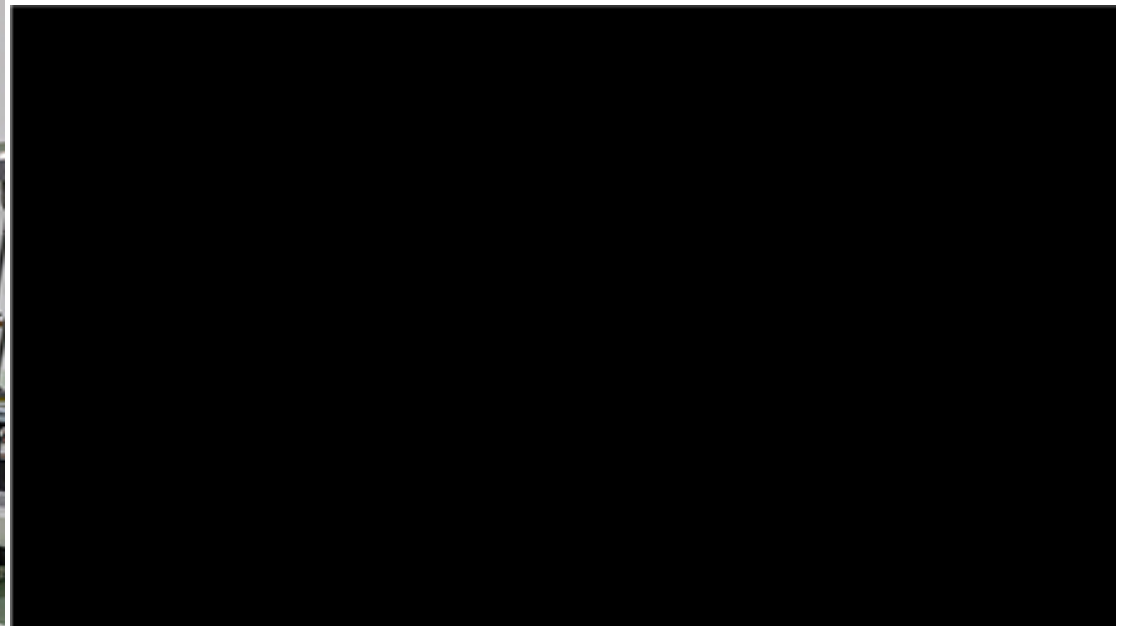
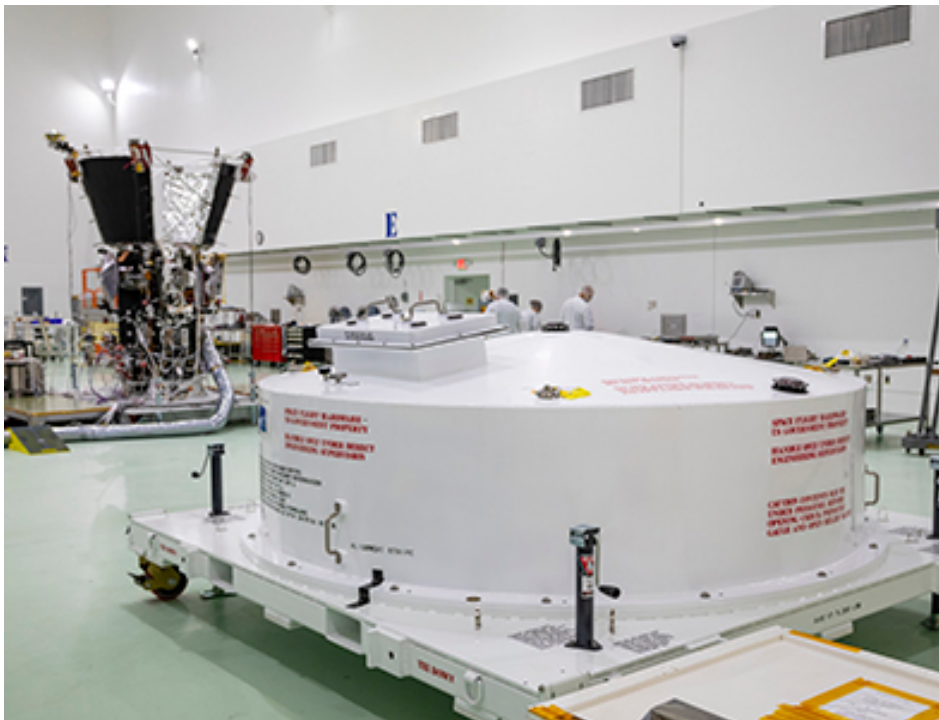
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In preparation: new series of papers about instrument calibration, upgrades, operation, etc.



Parker Solar Probe

Finishing Touches Before Launch



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Parker Solar Probe and IRIS

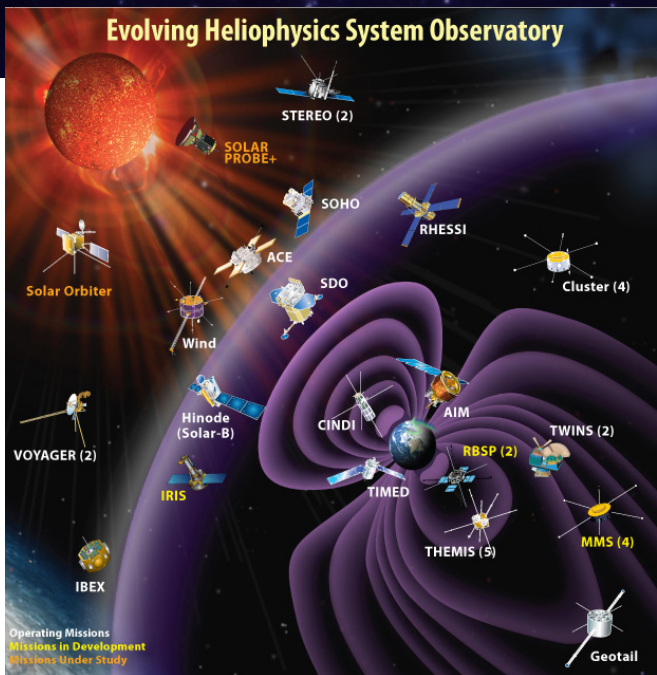


2020s

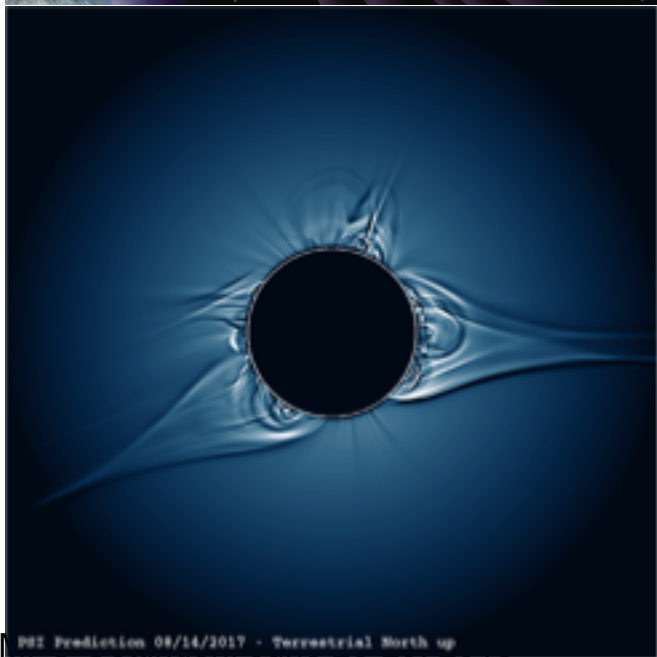
Golden Age of Solar and Heliospheric Research



Space



Theory



IRIS-9, HMI Prediction 08/14/2017 - Terrestrial North up

DKIST



VLA



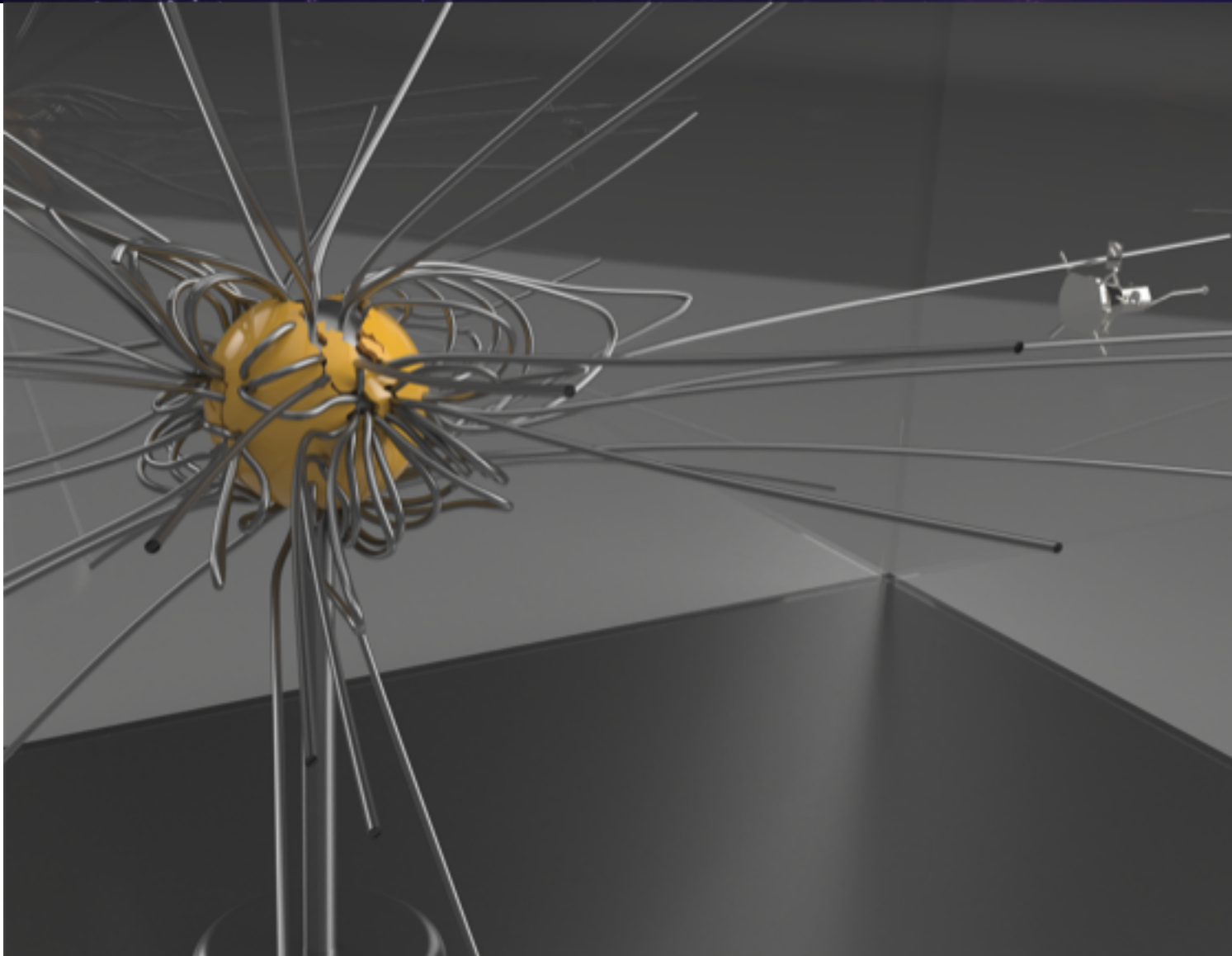
Ground

Parker Solar Probe and IRIS



JOHNS HOPKINS APPLIED PHYSICS LABORATORY

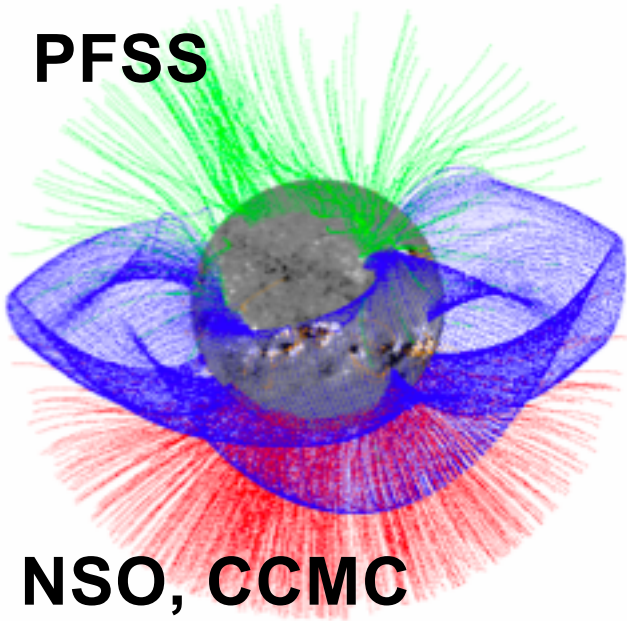
PSP Magnetic Footpoint



What We Need to Support PSP?

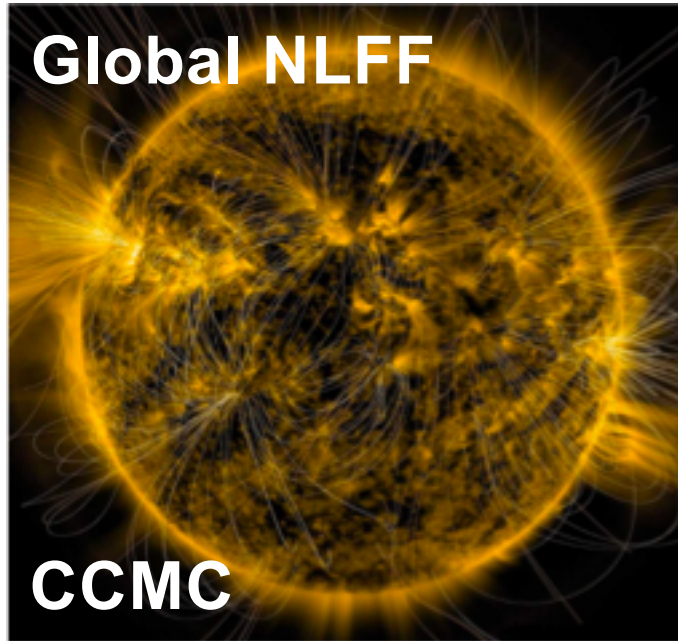


PFSS



NSO, CCMC

Global NLFF



CCMC

MHD



PSI, Michigan, ...

PSI Prediction 08/14/2017 - Terrestrial North up

- If you have a model, can you help?
- If you have ideas (wishes) of PSP/ground- or spacebased observatories



Let us know

Nour.Raouafi@jhuapl.edu



Parker Solar Probe

Humanity's First Visit to a Star



See You at the Launch on August 4th

Thank You

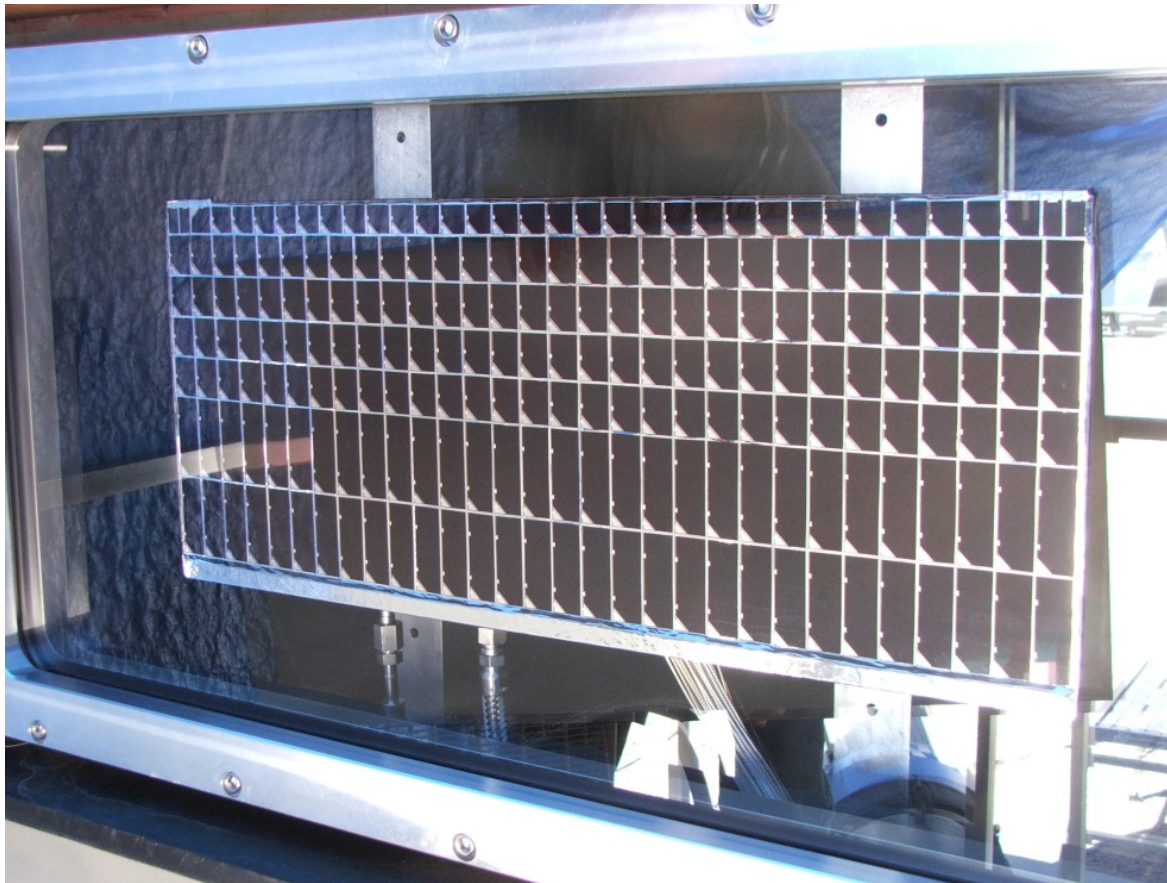




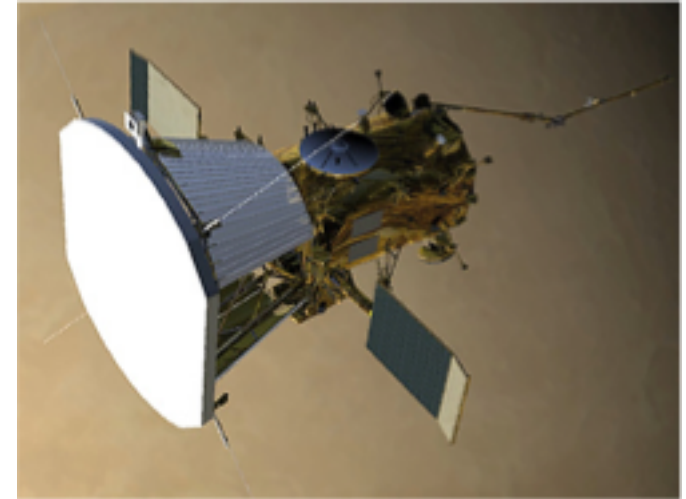
Solar Array Development



Solar Array is unique: liquid cooled, operates under extreme solar flux.



Full Sized Solar Array in HelioStat Vacuum Chamber



HelioStat



**Launch is the goal
Determination is what will get us there.**

What We Need to Support PSP?

