

Parker Solar Probe Update and Lessons Learned for NAS Space Studies Board

November 5, 2020

Andrew Driesman

Johns Hopkins University
Applied Physics Laboratory



Agenda

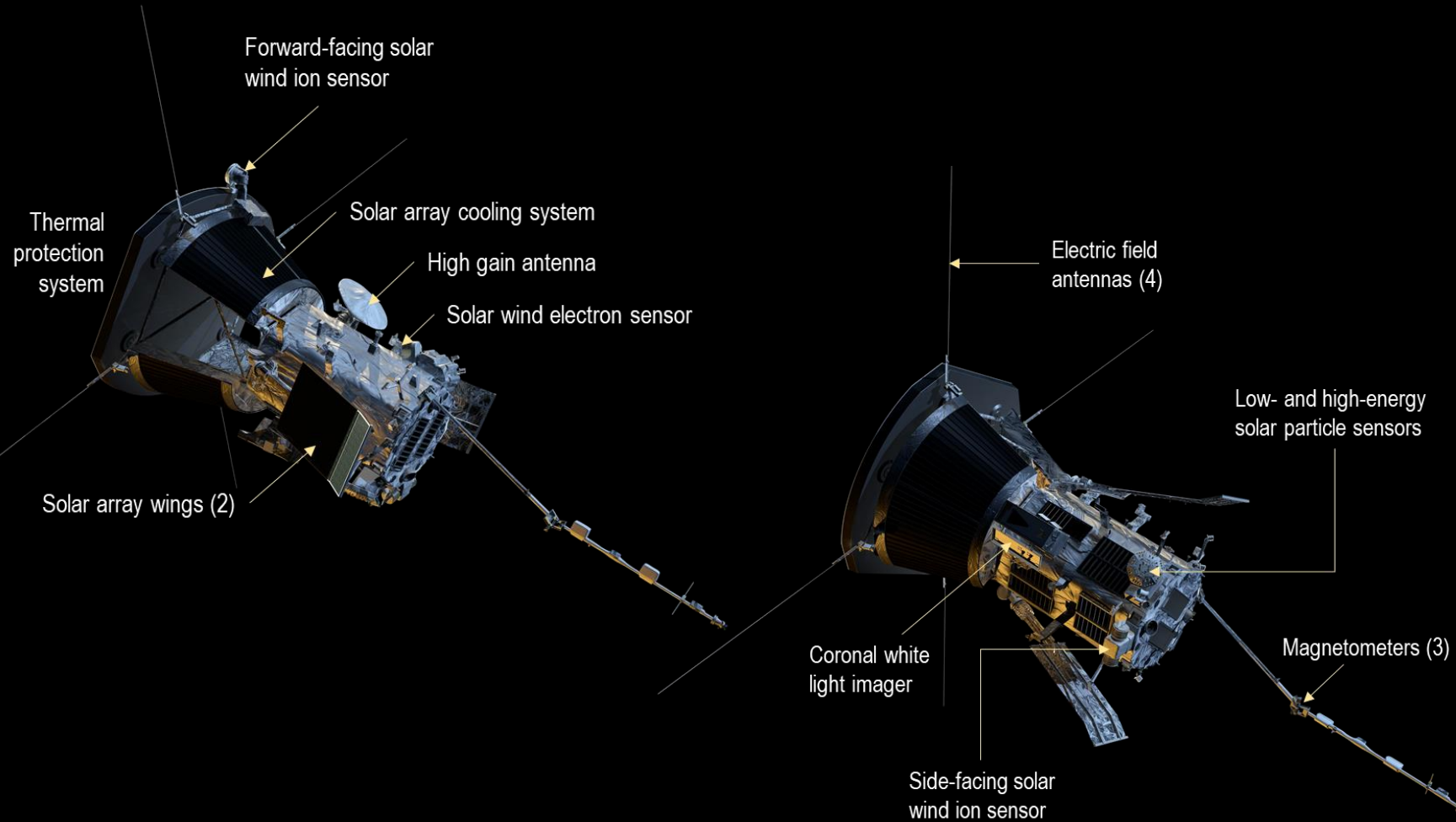
- Parker Solar Probe: an Historical Perspective
- Mission and System Overview and Status
- Science Discovery Highlights
- Enabling Lessons Learned and Lessons Learned the “Hard Way”
- Summary
- Discussion

Parker Solar Probe's History

- First proposed in 1958
- Concept studies for 5 decades (1958-2007) – “Solar Probe”
- Re-designed in 2007 – “Solar Probe Plus” – became flight project
- Mission development for 10 years (2008-2018)
 - Pre-Phase A: Jul 2008 – Nov 2009
 - Phase A: Dec 2009 – Jan 2012
 - Phase B: Feb 2012 – Mar 2014
 - Phase C: Mar 2014 – Jun 2016
 - Phase D: Jun 2016 – Sep 2018
 - Launch Aug 12, 2018, 3:31a
- “Solar Probe Plus” ➤ “Parker Solar Probe” in 2017

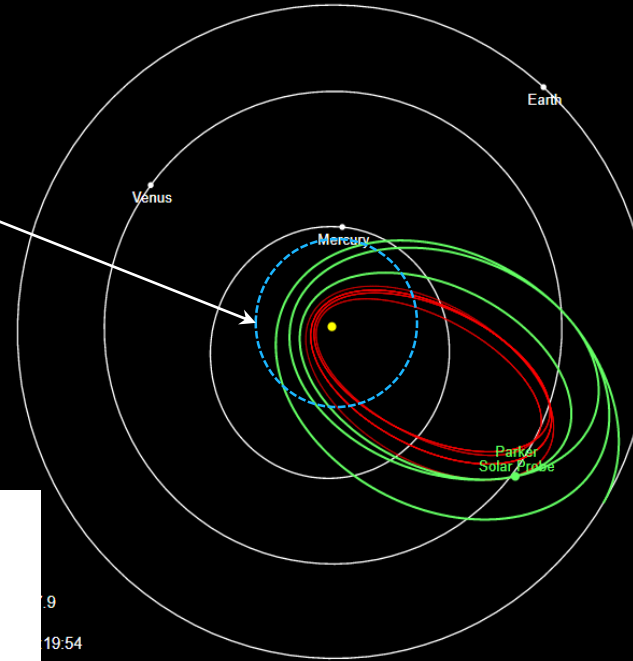


Flight System and Payload

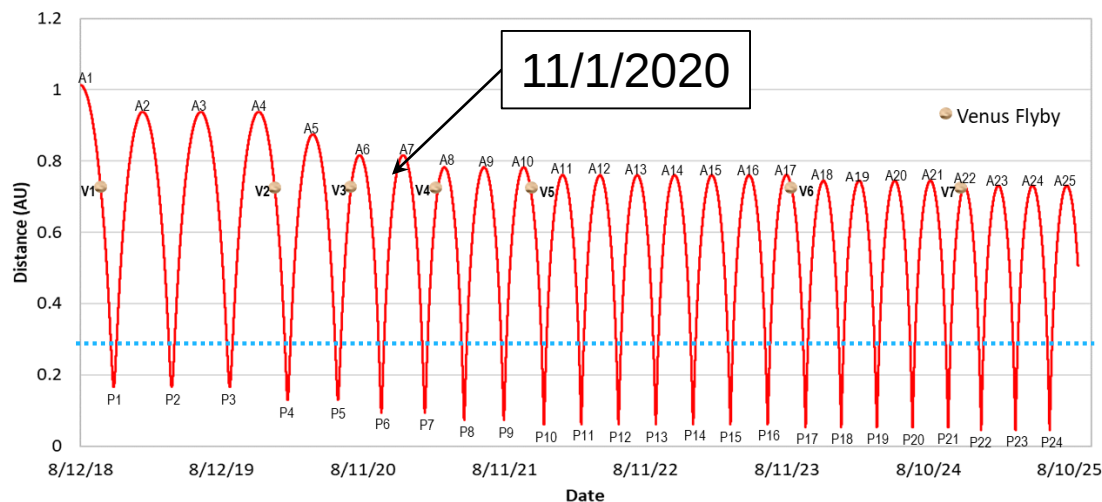


Status and Environment

Helios-B, 0.29 AU, 1976



- Unknown and unexplored region of the solar system
- Highly dynamic
- Hyper-velocity dust
- Unforgiving
- Poor/No communications
- Short cruise

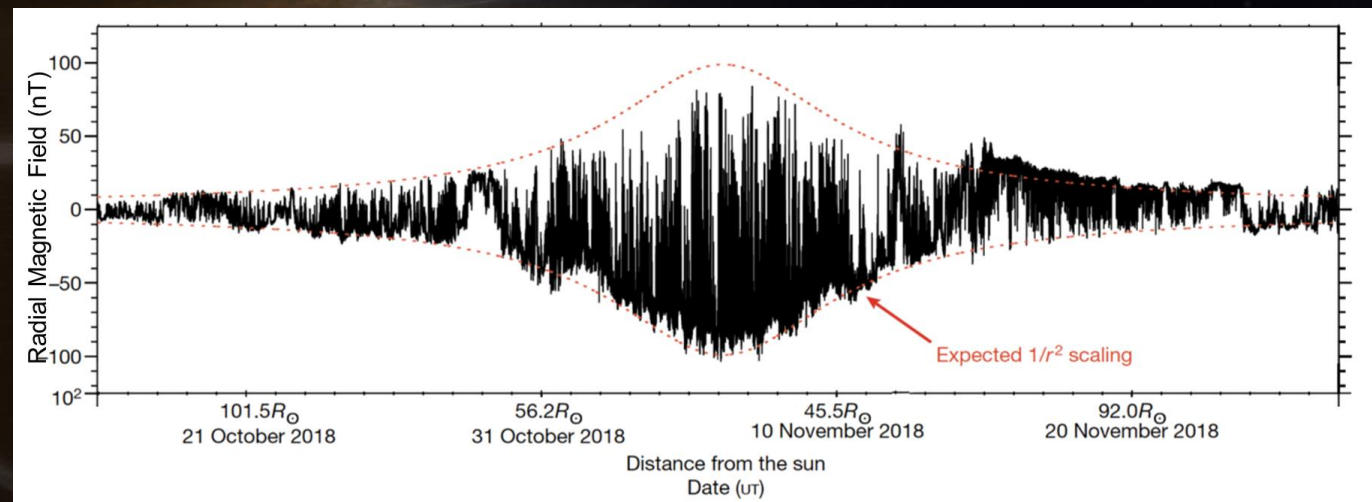


The spacecraft is healthy and fully operational!

Switchbacks: Energy Source for the Corona Heating

Bale et al., Nature (2019); Kasper et al., Nature (2019)

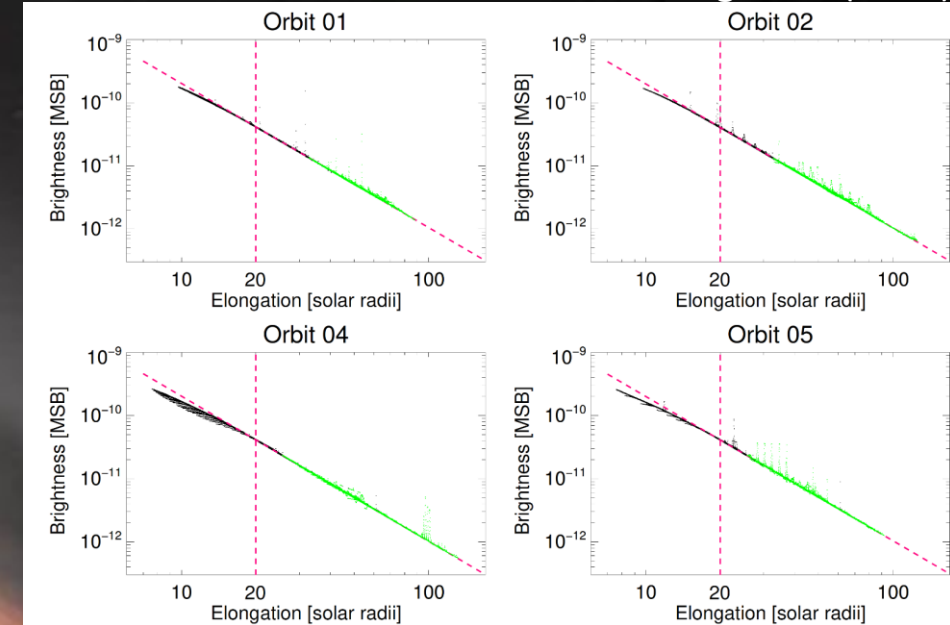
- Origin: are switchbacks convected structures or local manifestation?
- Plasma behavior: disentangle signatures of Solar processes and properties of Alfvénic motion
- When and where do they form?
- Source of coronal heating?
- Do switchbacks contribute dynamically to SW acceleration?



Is There a Dust-free Zone Around the Sun?

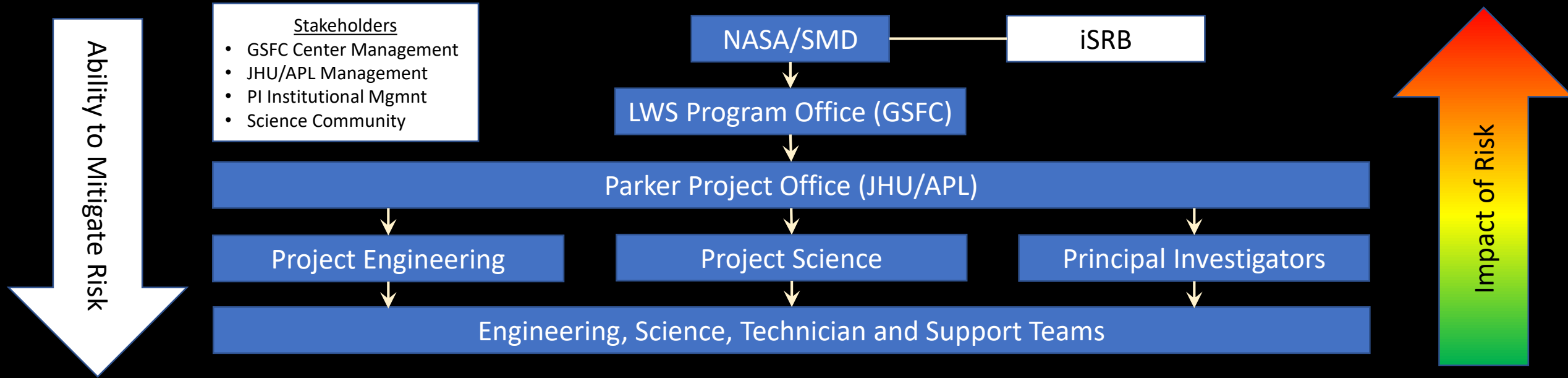
(Predicted by H. N. Russell, 1929)

Stenborg et al. (2020)



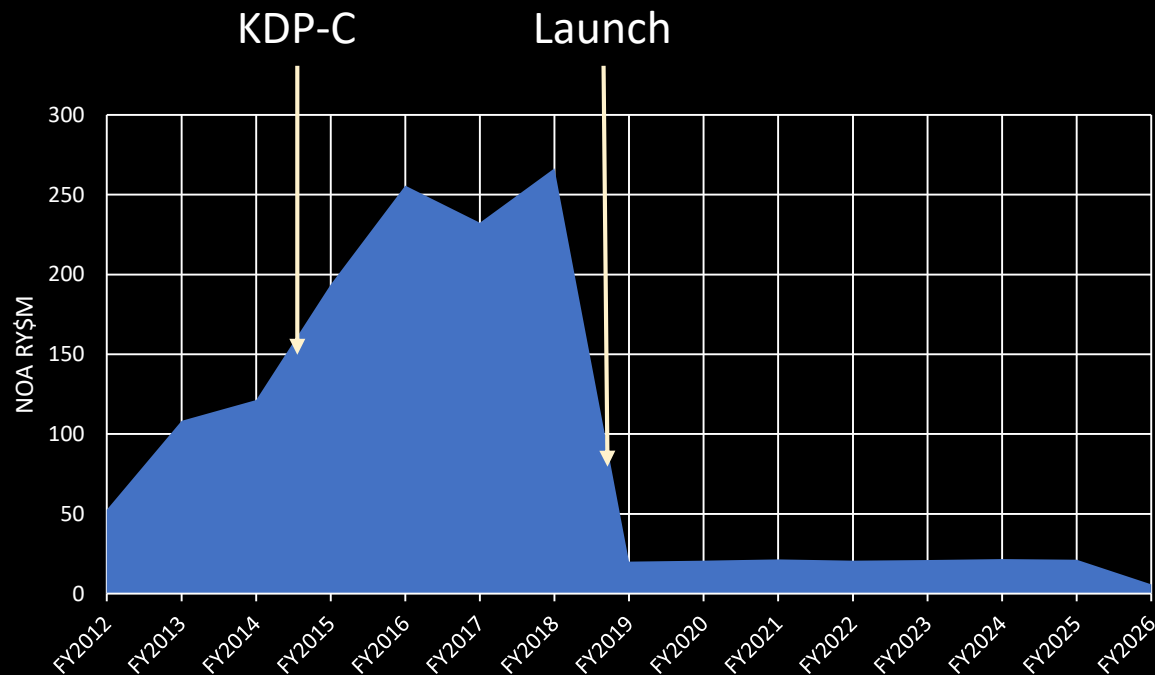
LL #1 – One team with Mission Success as a Single Objective

Everyone understood and played their part



- The impact of risk on NASA Management is opposed to their ability to mitigate risk
- Developing trust and communication is paramount
- Emphasize the importance of cross-institution team building

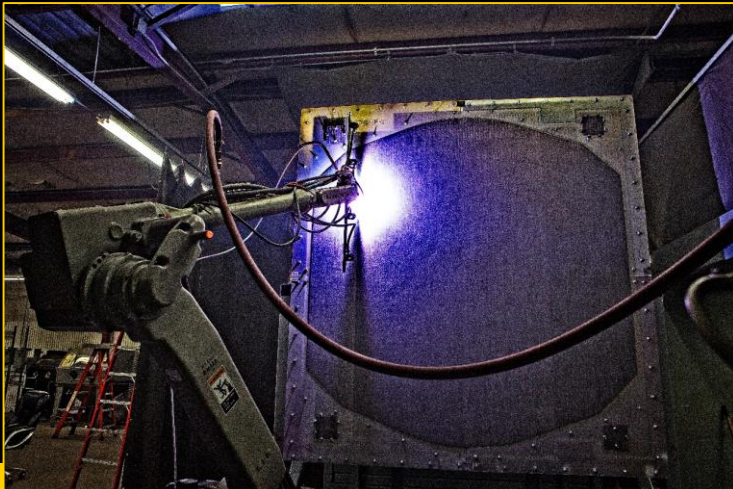
LL #2 – the funding profile set at KDP-C was nearly ideal



- The confirmation budget (base, reserves and UFE) for PSP was almost ideal
 - Huge push up for NASA
- The Project never slowed work due to funding concerns
- Focus was on schedule performance not cost performance
 - Cost will follow schedule

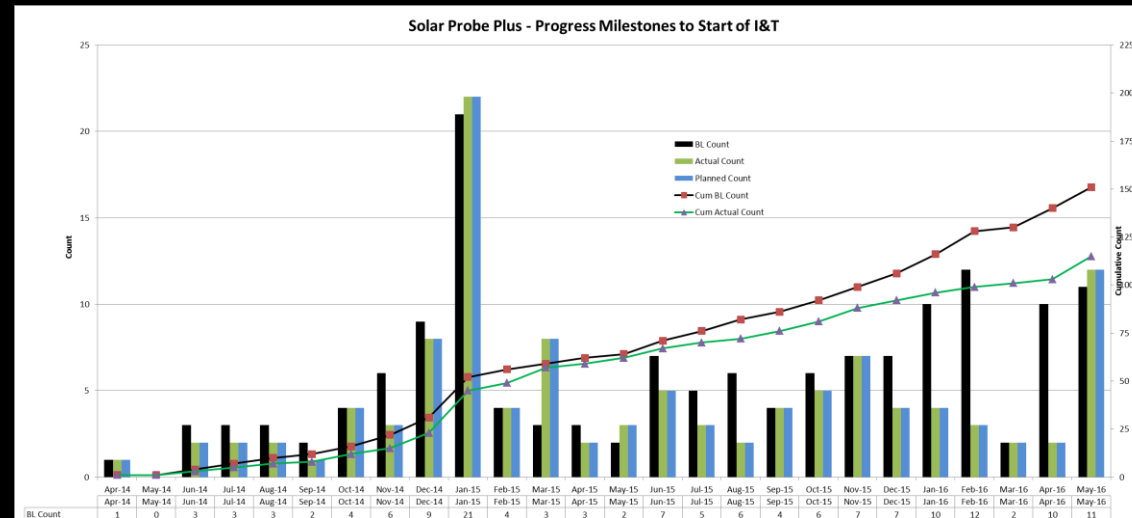
LL #3: Parker benefited from significant technology investment during Pre-Phase A, Phase A and B

- Approximately \$80 RY\$M was invested in Pre-Phase A and Phase A to develop technology along with the system
- Developing technologies by themselves is insufficient to reduce risk across the system
 - The spacecraft was matured along with the technologies
- When necessary - science performance was traded for technology stability



LL #4: Early milestones are just as important as the later milestones

- Be a hard critic of the quality of the progress being made and make the hard calls early
- The Project team learned this lesson, the hard way, just in time
 - Started double shifts two years prior to launch
- Net result: On time launch at a cost well below Agency Budget.



LL #5: Complexity and Institutional/Team Experience with Complexity is a Knife that cuts both ways

- Parker, in hindsight, was significantly more complex than originally thought
 - Outside team's experience base
- Positive impacts:
 - Allowed for innovative solutions with minimum overhead
 - Forced institutional growth
- Negatives impacts:
 - Lack of complexity sensitive processes and organizational structures led to surprises and impacted schedule
- Managing complexity is paramount

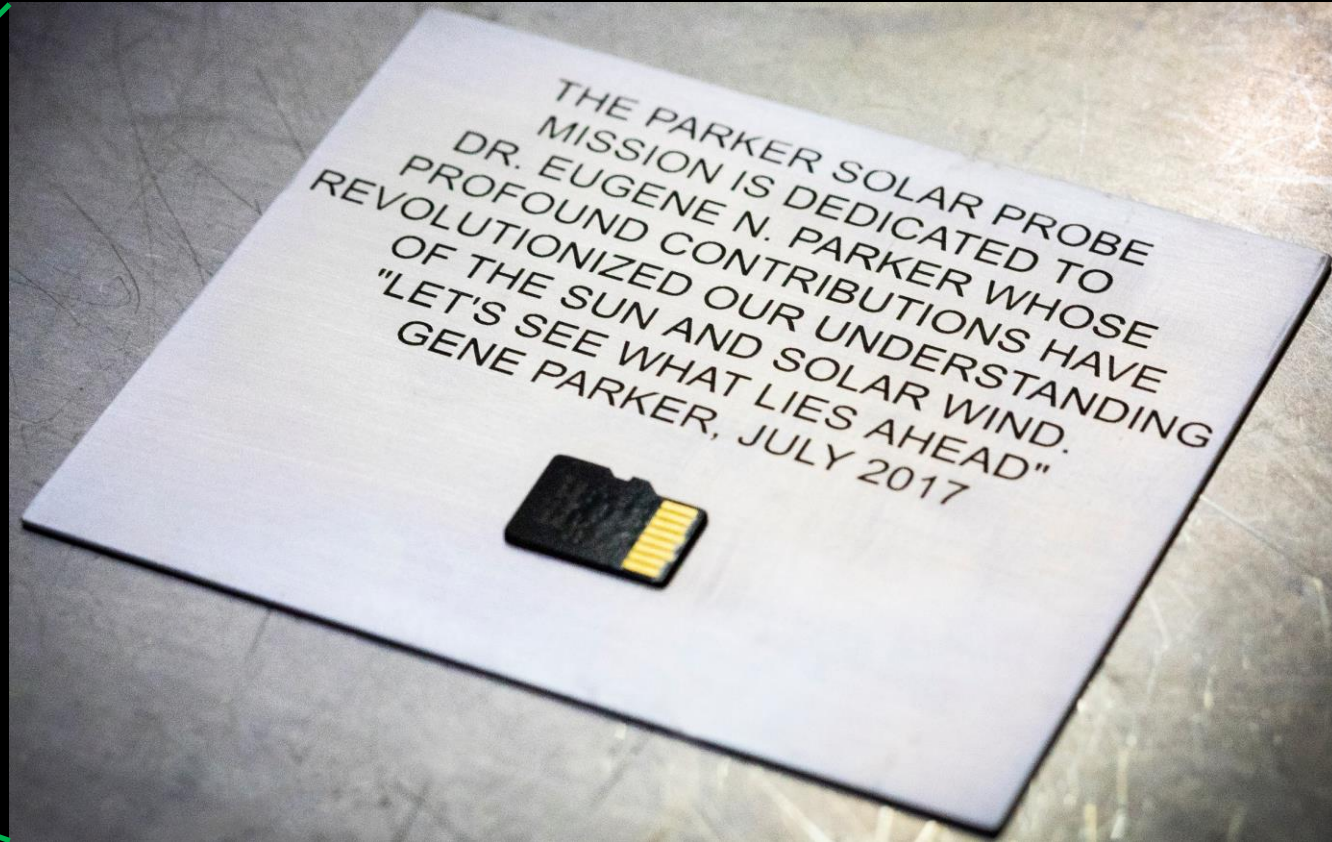
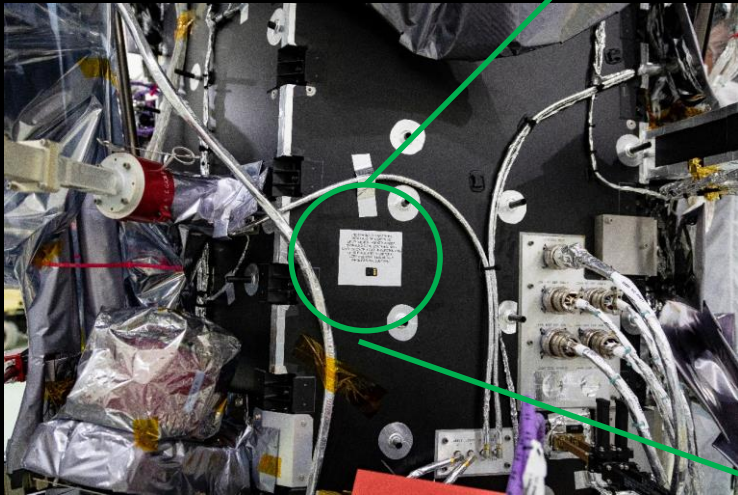


Summary

- Parker Solar Probe is realizing the vision established 60+ years ago
- The spacecraft is fully operational
- The mission has recovered ~3x more data than originally planned
 - This should continue...
- Every orbit is yielding new discoveries and insights

**Daring, high technology missions of exploration
CAN BE successfully done within established cost
and schedule commitments**

Discussion





PARKER SOLAR PROBE

— THE FIRST MISSION TO TOUCH THE SUN —

