



2024 ECLIPSE SCIENCE

AND NASA'S PUNCH MISSION

Craig DeForest





NASA's PUNCH Mission



What: Four small satellites will image the Sun's outer corona and the inner solar system ("heliosphere"), using an "artificial eclipse" in each instrument.

When: Spring 2025, from Vandenberg Space Force Base (California) on a Space-X Falcon 9 rocket.

Where: Polar orbit, 400 miles above the dawn/dusk line, for a continuous view of the Sun and heliosphere

Why: to understand how the Sun produces space weather and the solar wind.

How: PUNCH polarized movies of the corona measure the flow of solar wind and space weather – in 3D.

Who: PI is Craig DeForest, craig.deforest@swri.org.



The inner corona is highly structured

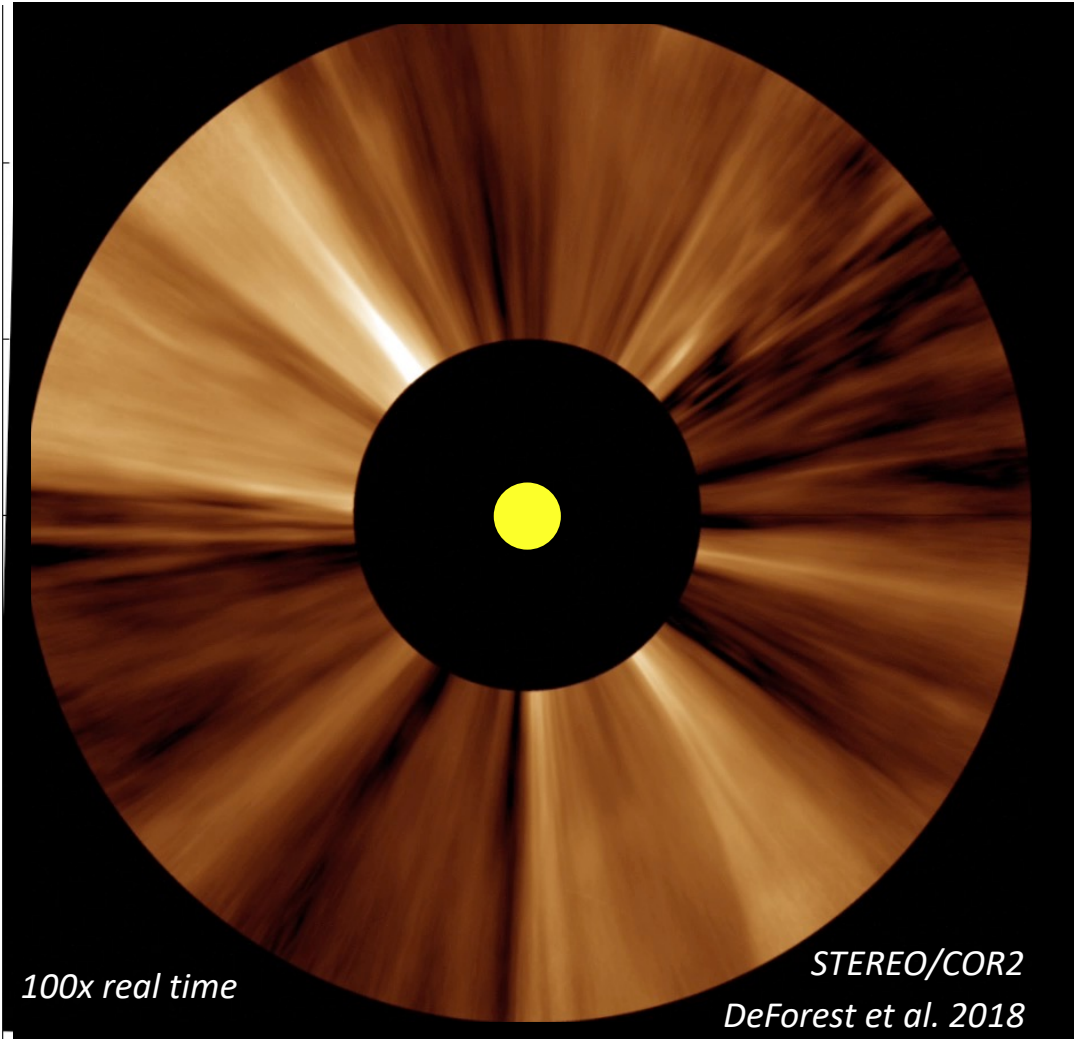


M. Druckmuller, P. Aniol, S. Habbal (2017)



The outer corona is highly structured

(Radial-filtered visible light in the outer corona)



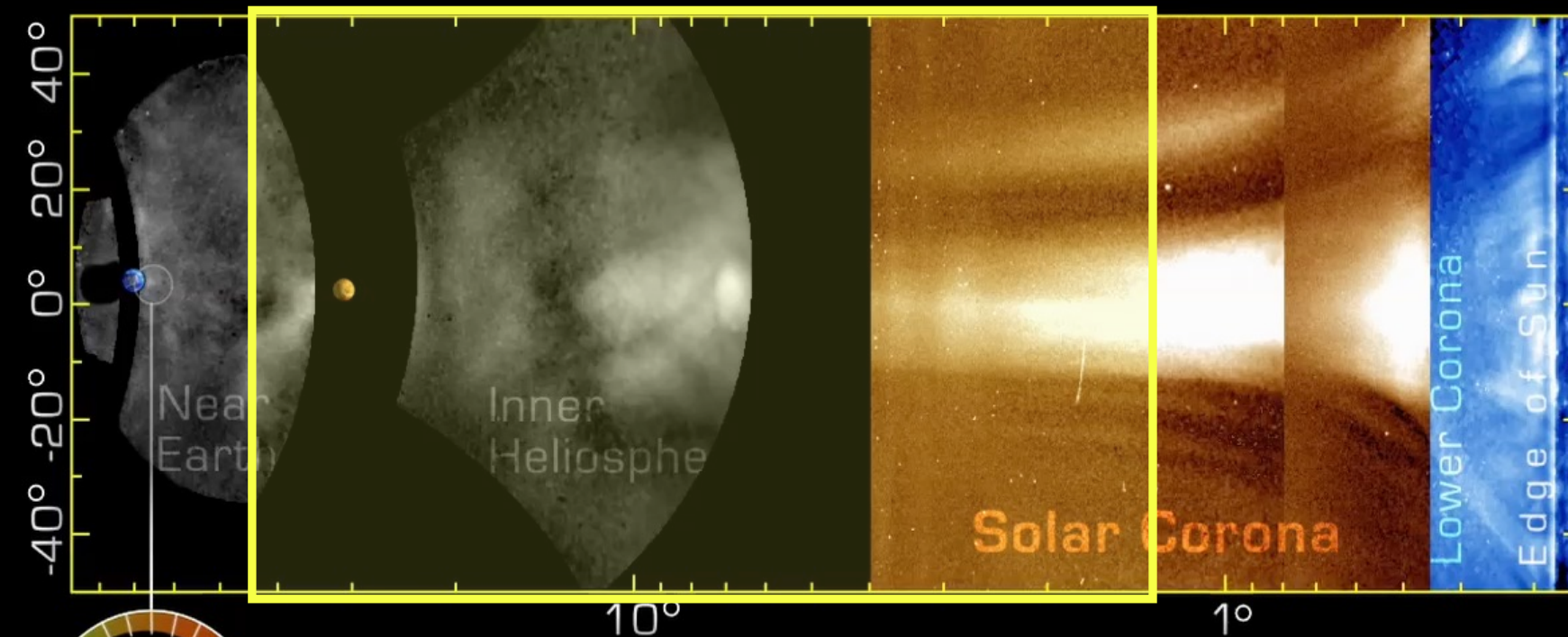
- Outer corona: too faint to see, even in an eclipse.
- Material constantly flows outward at 200-500 miles per second (300-700 km/sec)
- The outer reaches literally fill the solar system



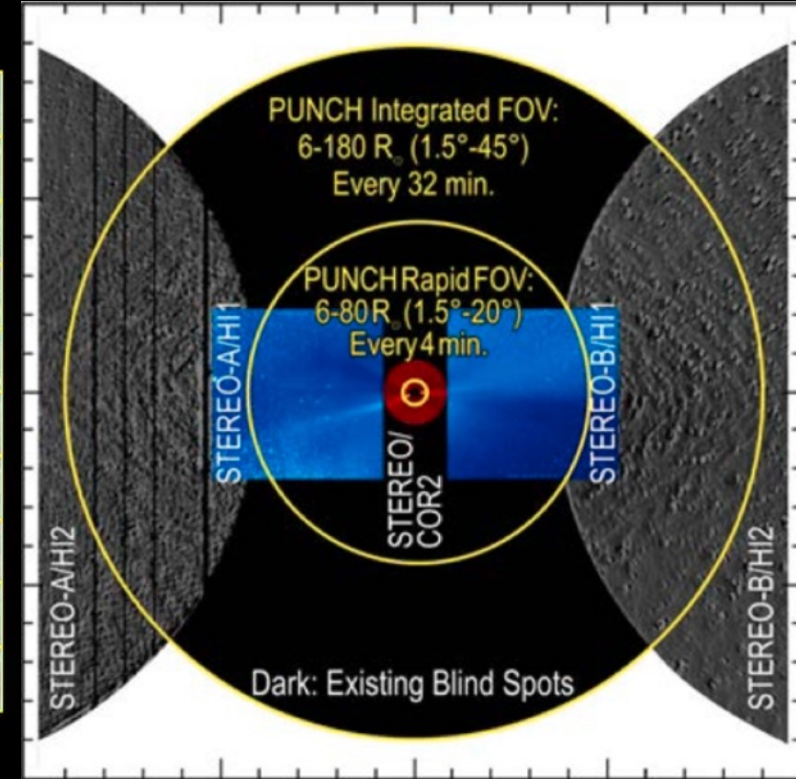
Solar events cross the interplanetary void



PUNCH FOV



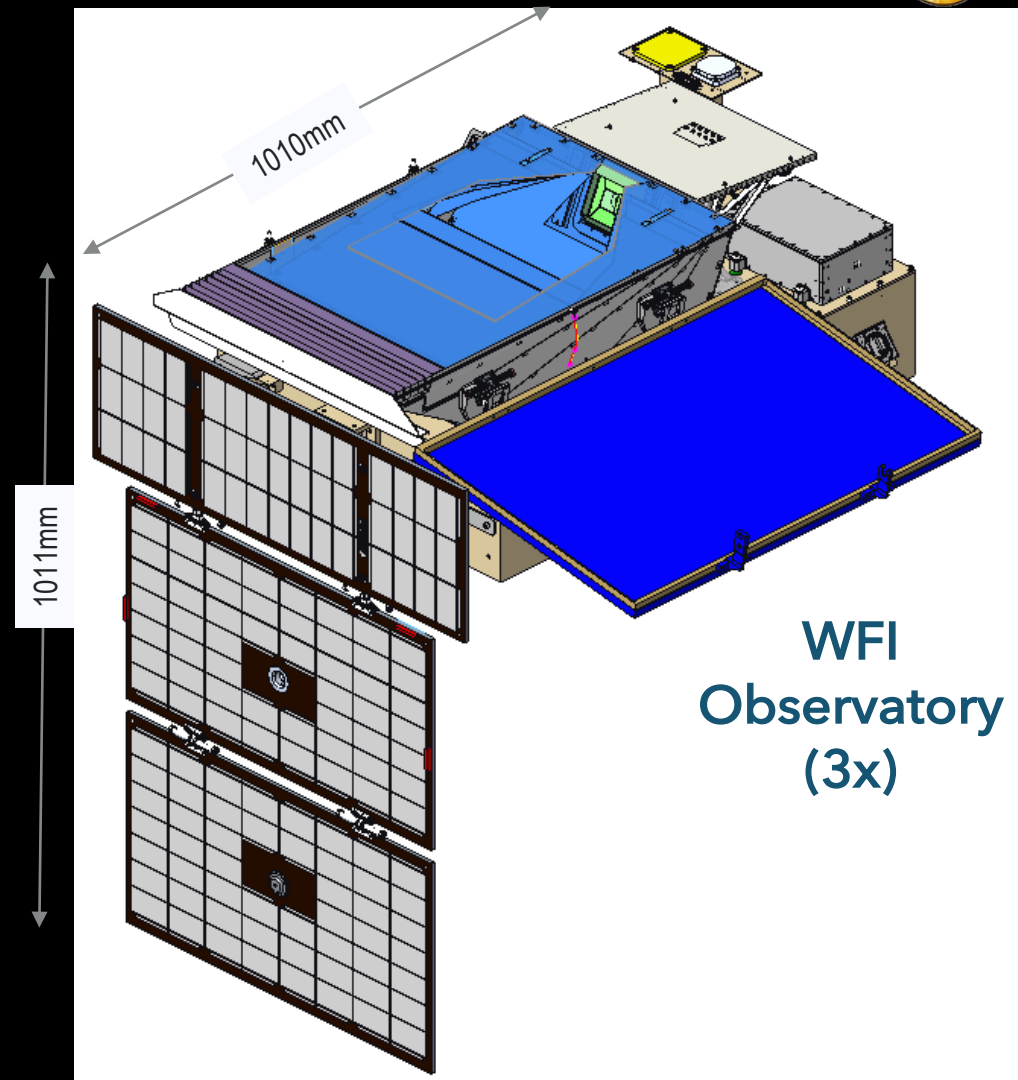
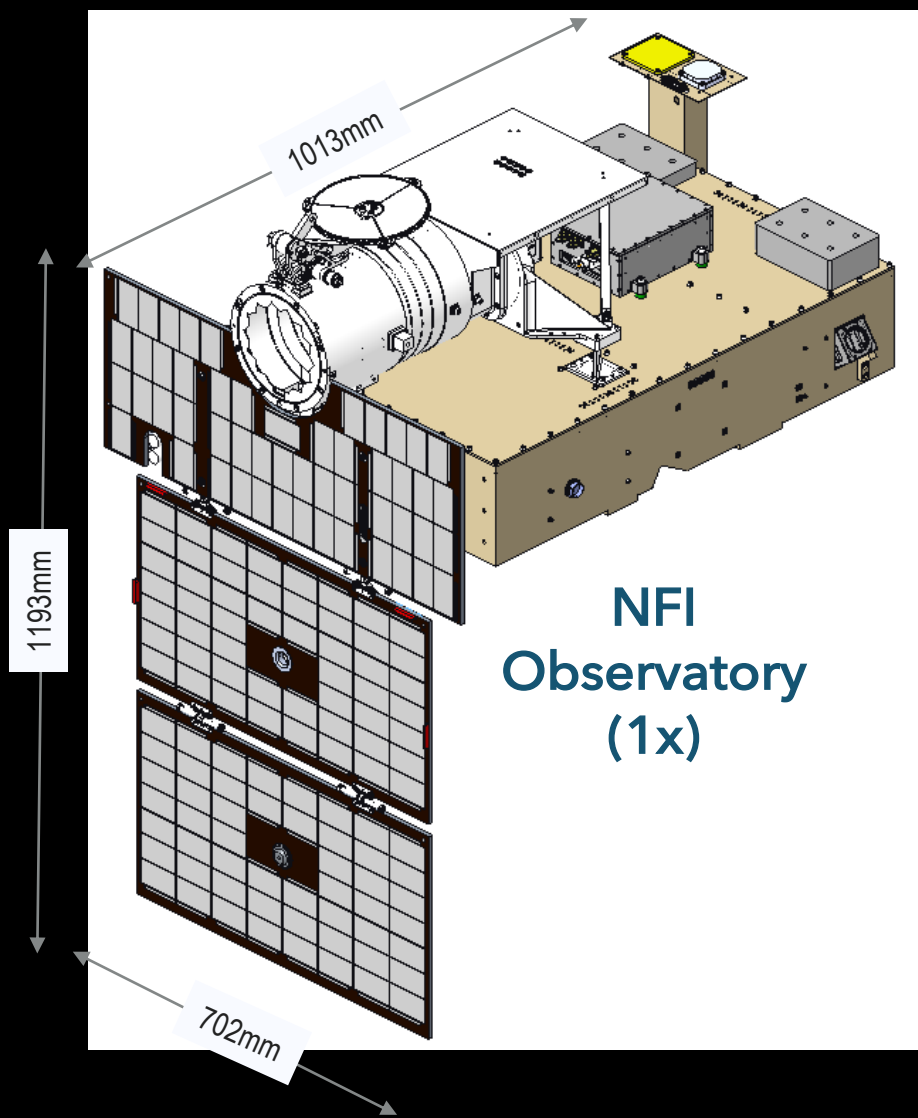
STEREO-A: 12/11/08 12:40:00 AM



PUNCH FOV: 1.5° to 45° from the Sun, full circle; polarized images every 4 minutes



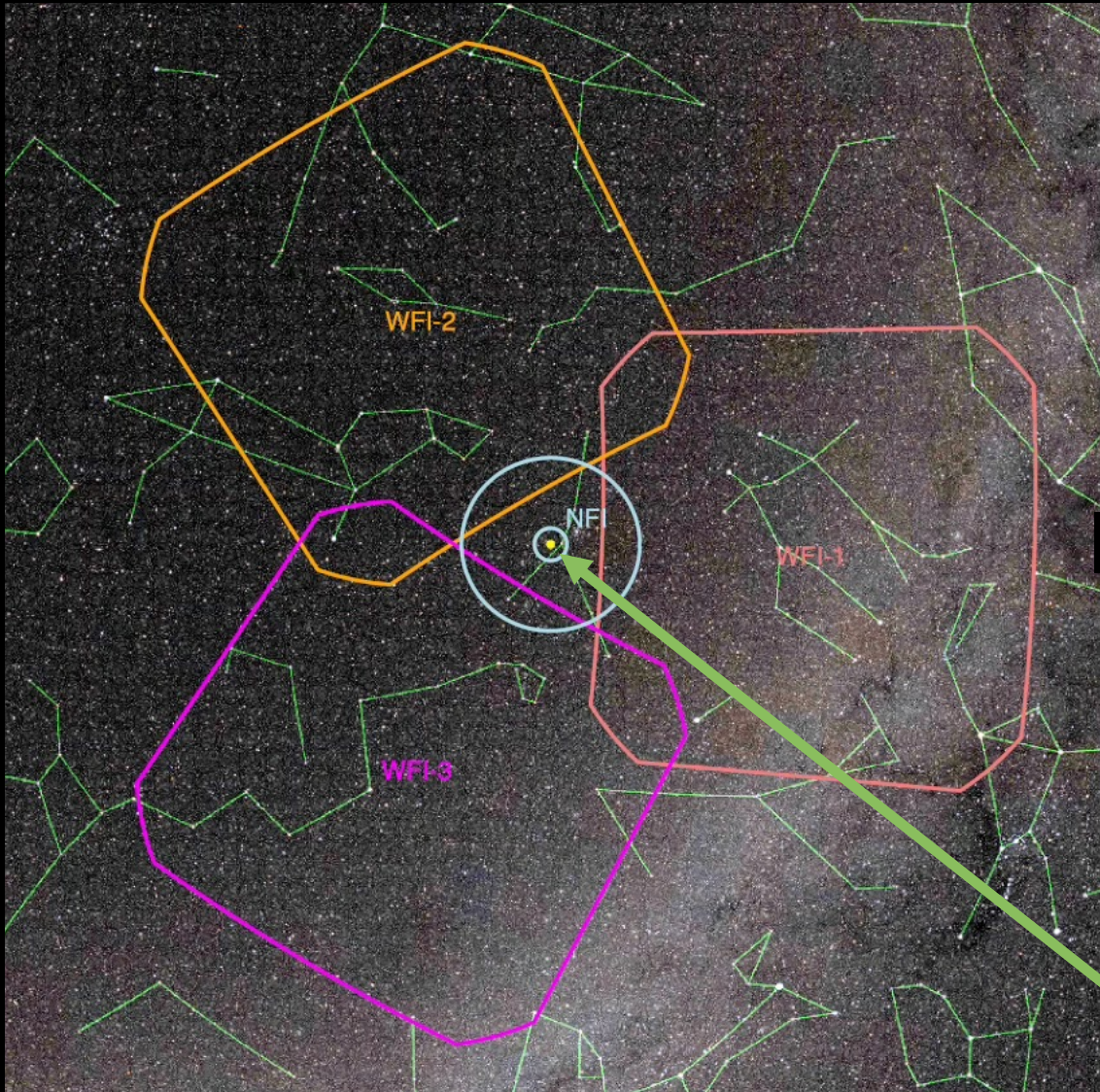
Four PUNCH spacecraft work together



Each PUNCH spacecraft carries one primary instrument; the spacecraft are interchangeable.

HOW DOES PUNCH WORK?

PUNCH MERGES IMAGES TO CREATE A SINGLE LARGE FOV



- Entire constellation is synchronized to ~1 sec.
- Exposures are combined on the ground.
- Seamless image merging: developed for PUNCH; demonstrated by CATE

Sun



M. Druckmuller, P. Aniol, S. Habbal (2017)



*Eclipse of
August 21, 2017
Salem, OR*

*Photo:
Dr. Emil Kepko*

PUNCH Total Field of View

*PUNCH/WFI-1
Field of View*

*PUNCH/WFI-2
Field of View*

PUNCH Rapid Field of View

*PUNCH NFI
Field of Vlew*

*PUNCH/WFI-3
Field of View*

- PUNCH will image the corona and surrounding solar wind with visible light, every four minutes ... for 2-10 years.
- PUNCH field of view is huge – 90° across.
- PUNCH launches in 2025.
- PUNCH-CATE synergy:
 - citizen science helps develop PUNCH
 - CATE science is relevant to PUNCH
- PUNCH Outreach Program is actively supporting eclipse events.