



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](mailto:craig.deforest@swri.org).



*The inner corona is highly structured*

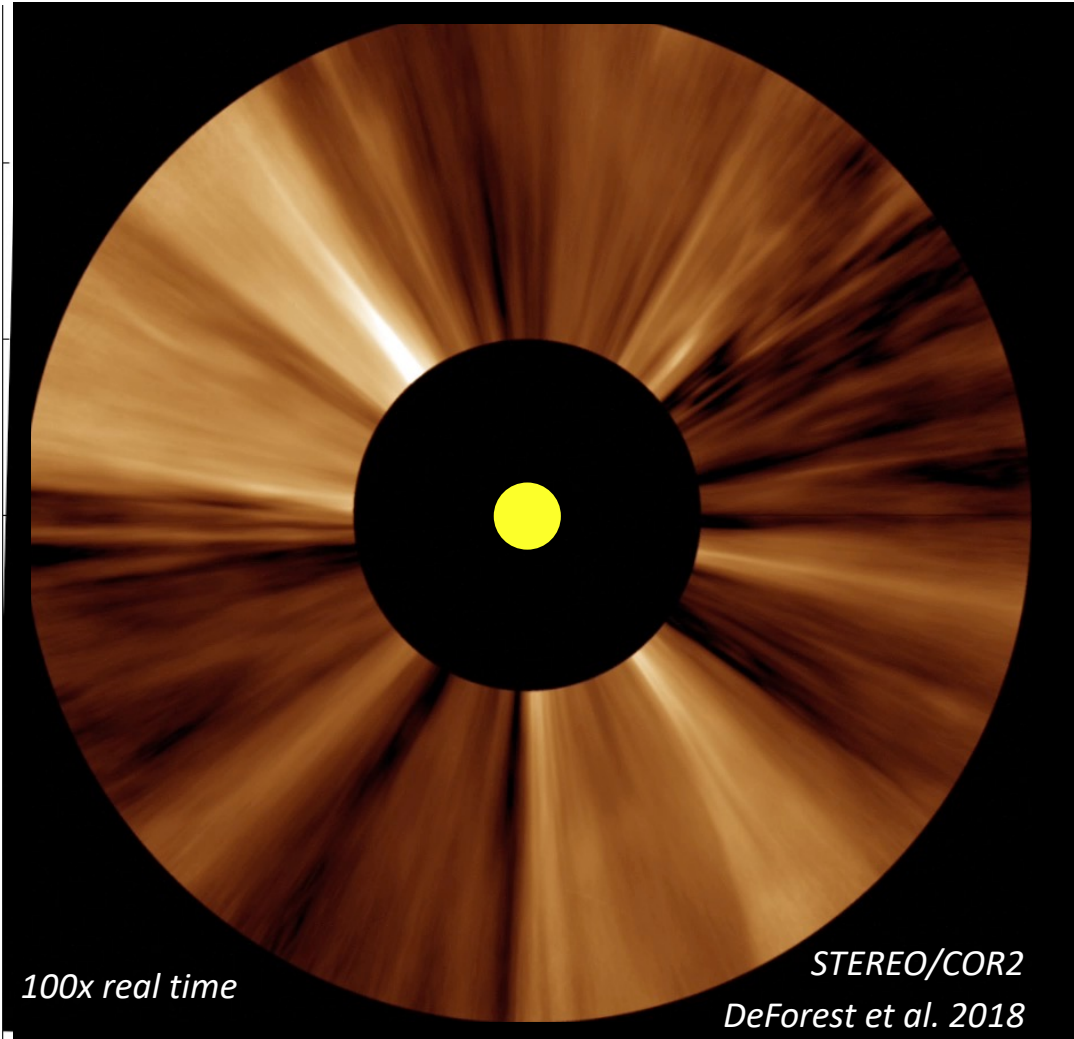


*M. Druckmuller, P. Aniol, S. Habbal (2017)*



# The outer corona is highly structured

(Radial-filtered visible light in the outer corona)



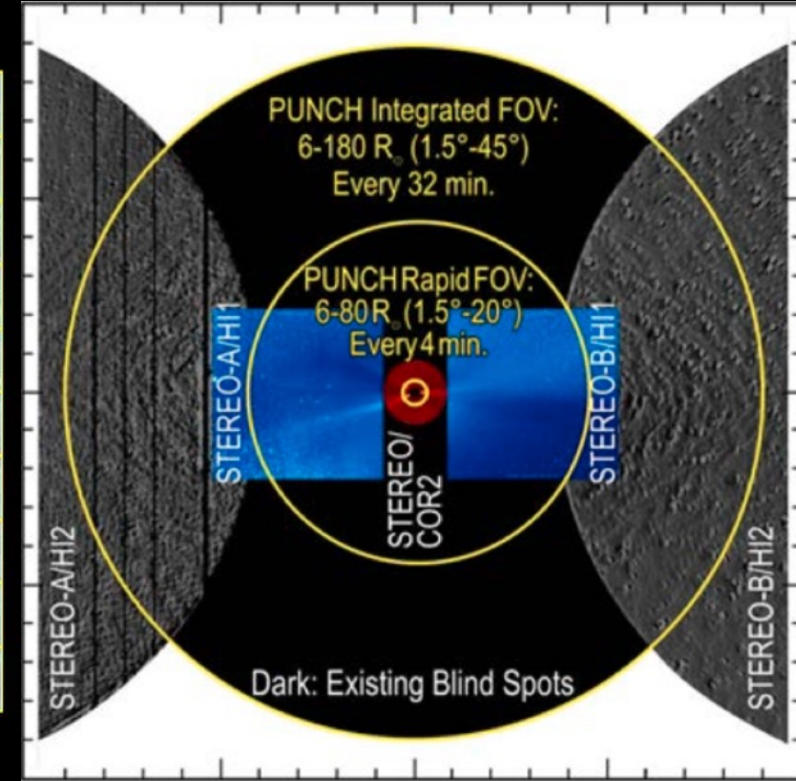
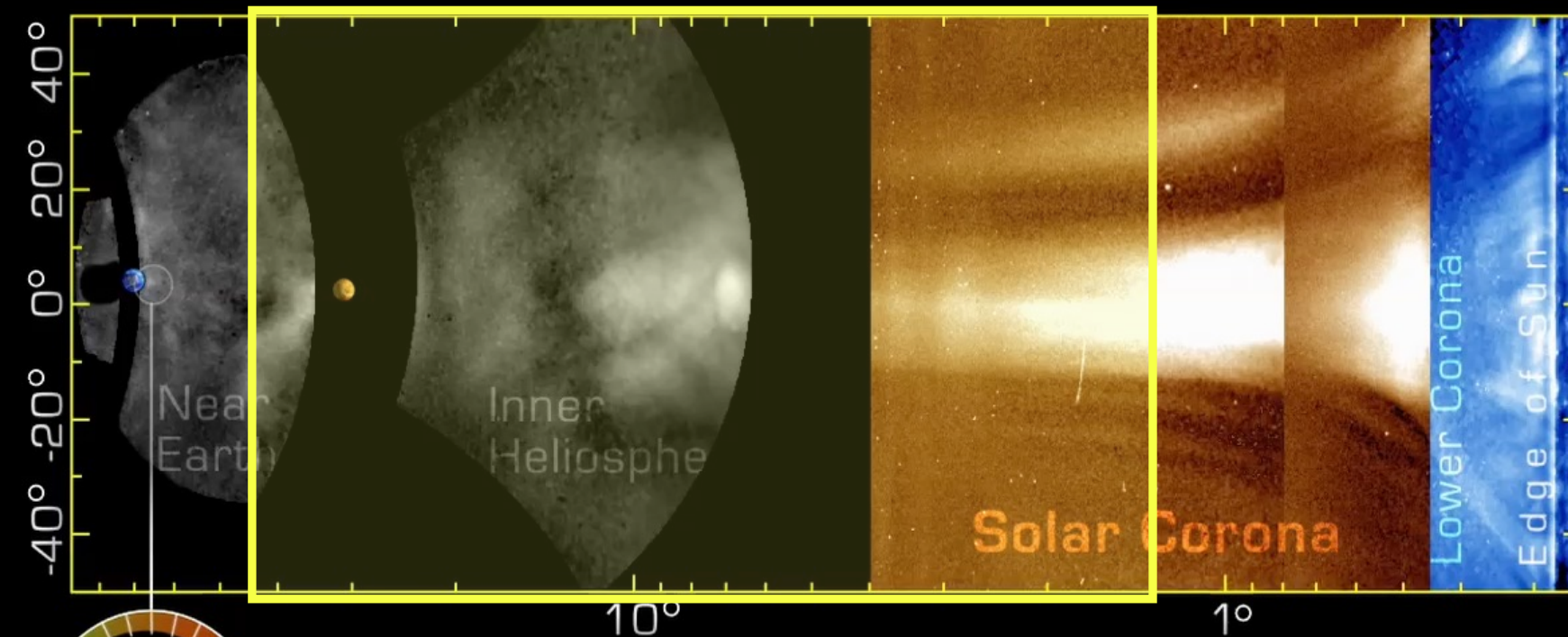
- Outer corona: too faint to see, even in an eclipse.
- Material constantly flows outward at 200-500 miles per second (300-700 km/sec)
- The outer reaches literally fill the solar system



# Solar events cross the interplanetary void



## PUNCH FOV

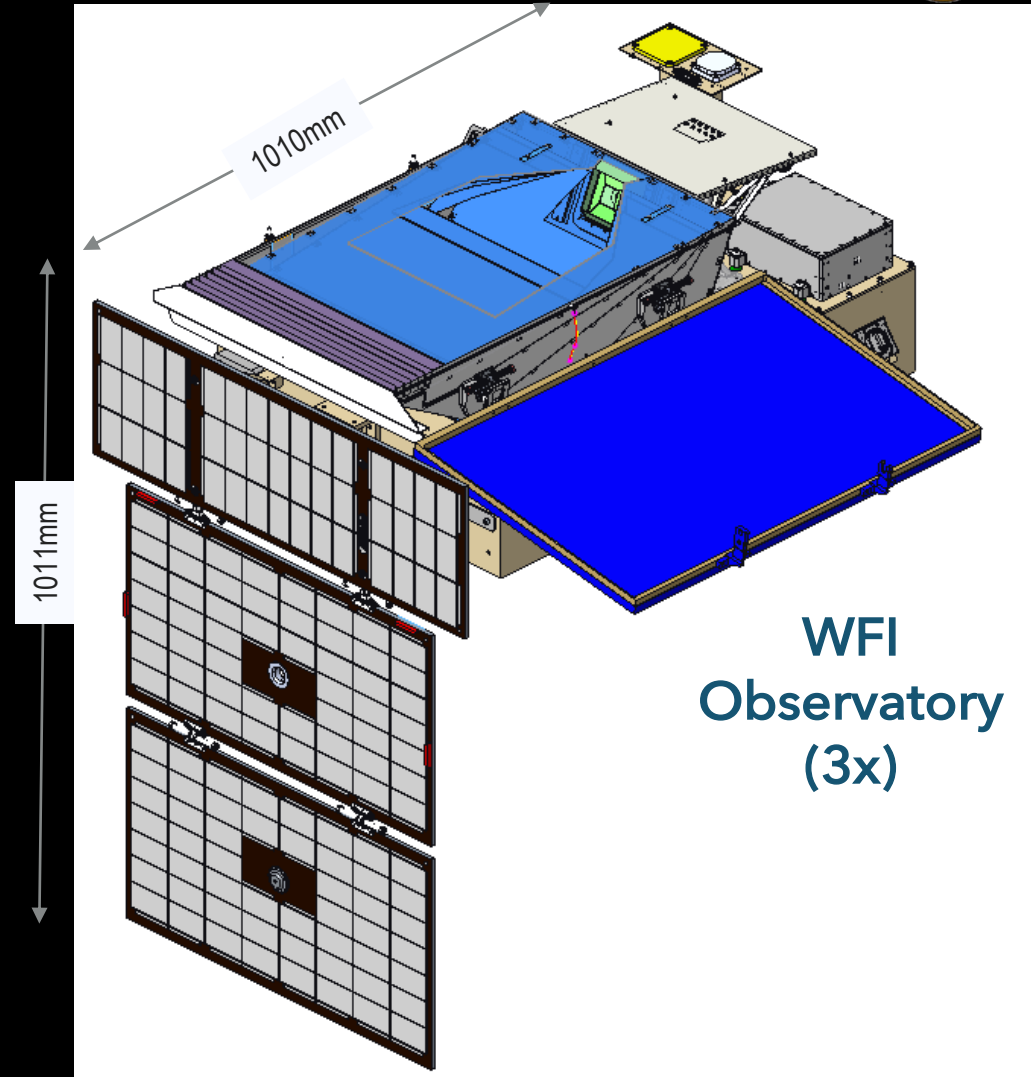
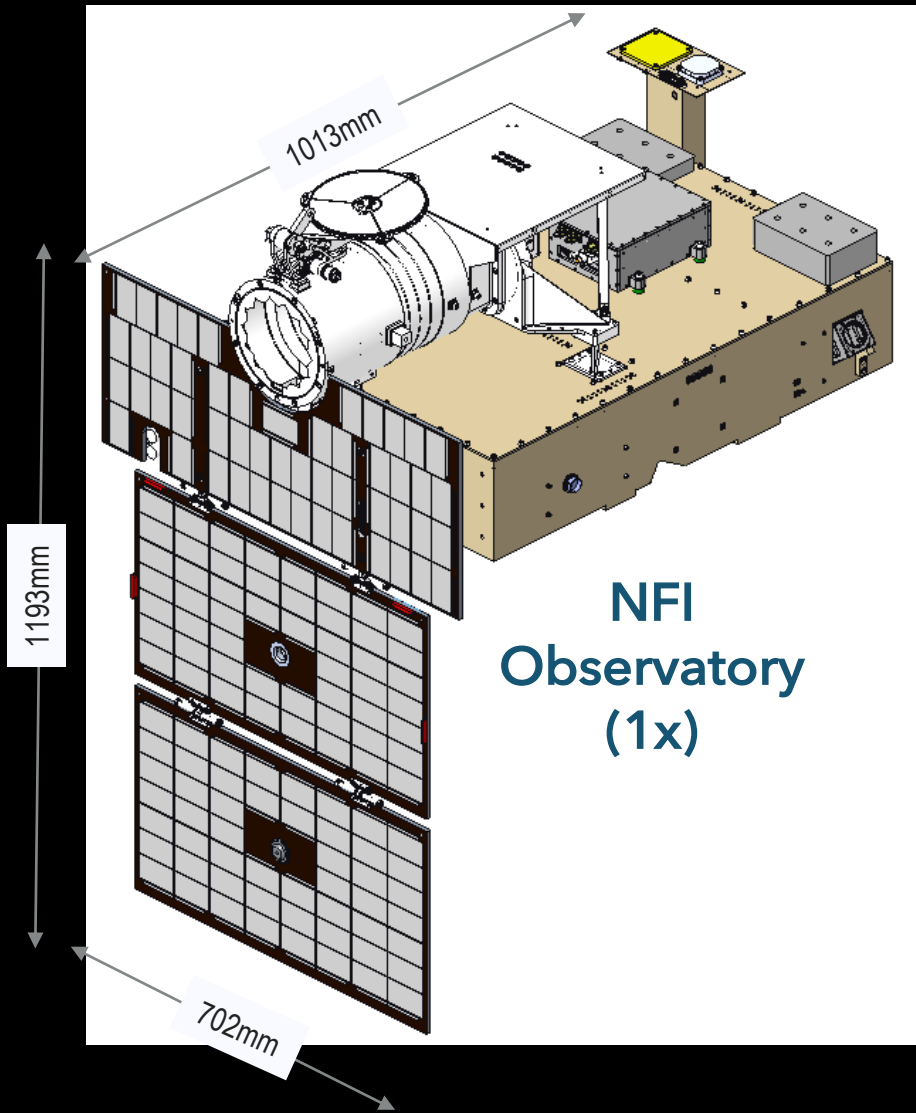


STEREO-A: 12/11/08 12:40:00 AM

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



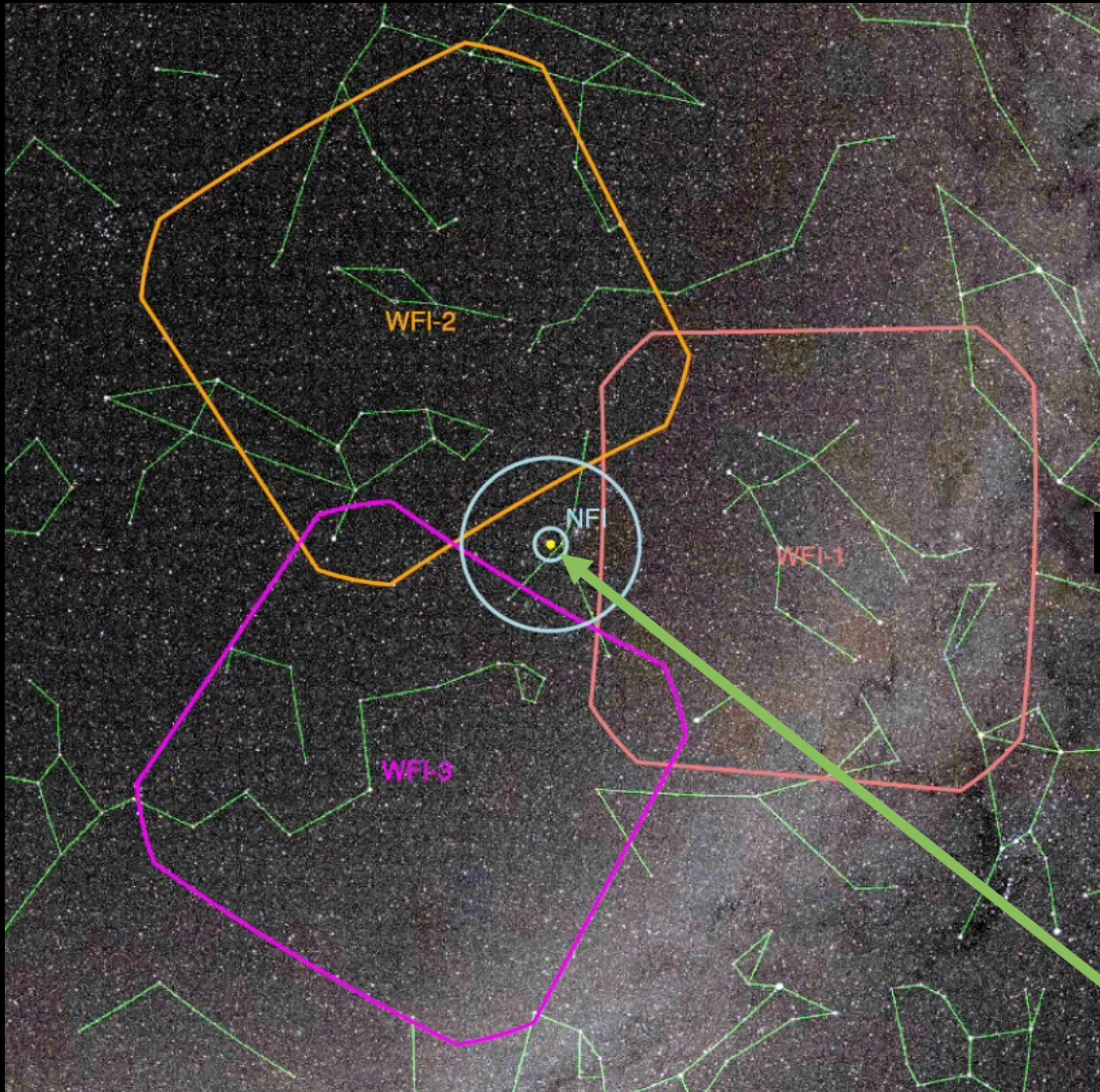
# Four PUNCH spacecraft work together



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.