

Polarimeter to Unify the Corona and Heliosphere



Approaching One Year of PUNCH Phase E

Craig DeForest



11-May-2026

PUNCH-7

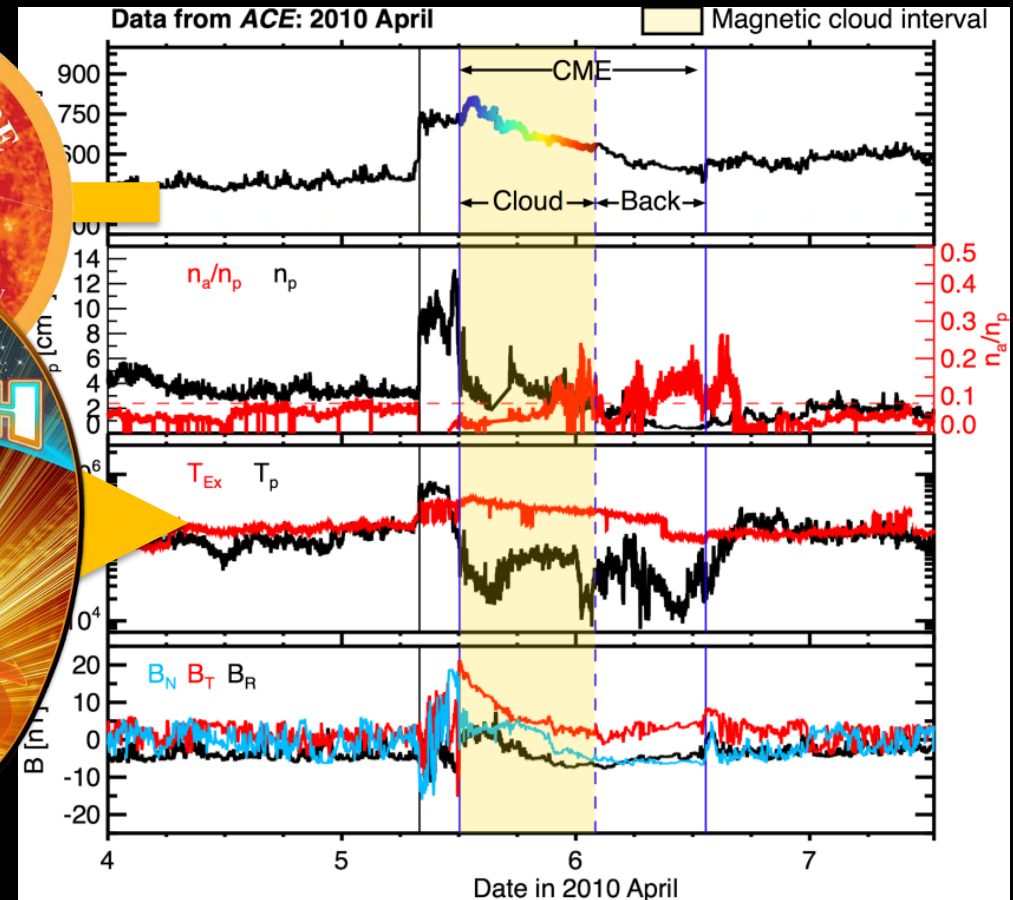
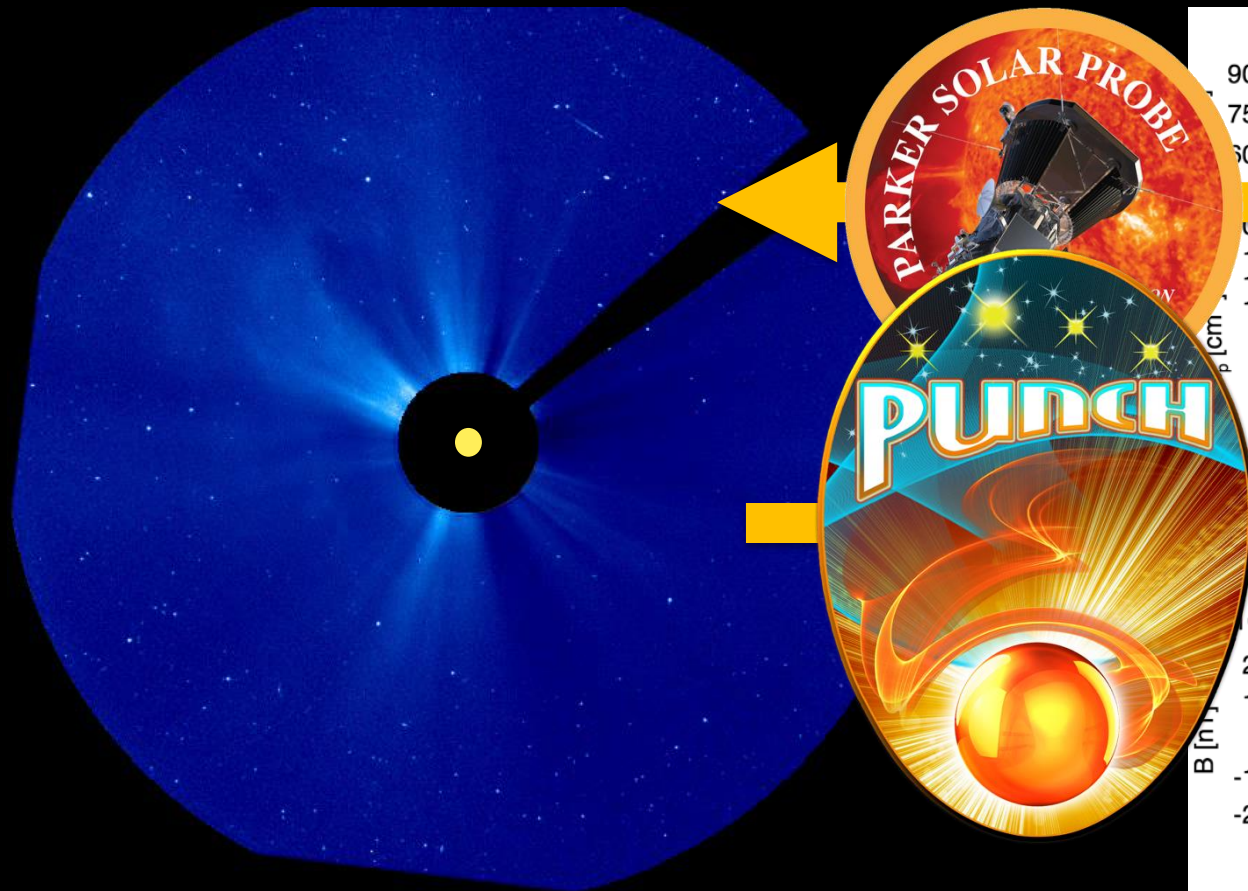
"One Year of PUNCH"



UNIFYING SOLAR PHYSICS & HELIOSPHERIC PHYSICS

Solar physics studies the Sun and corona, primarily through remote sensing and spectral analysis

Heliospheric physics studies the solar wind in interplanetary space, primarily through in-situ sampling

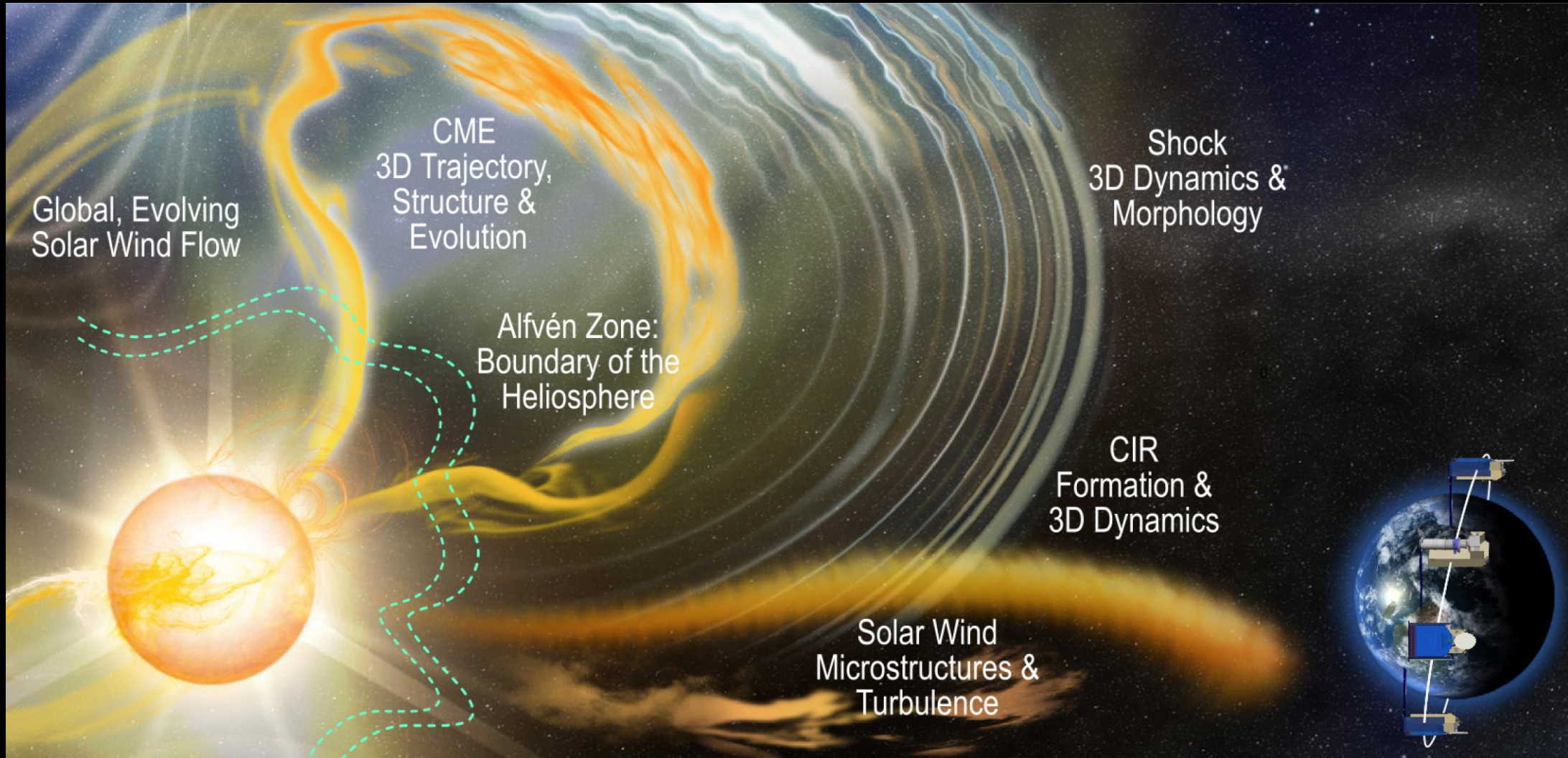




PUNCH science objectives



1. Understand how coronal structures become the *ambient solar wind*
2. Understand the dynamic evolution of *transient structures* in the young solar wind





Two instrument types; four spacecraft



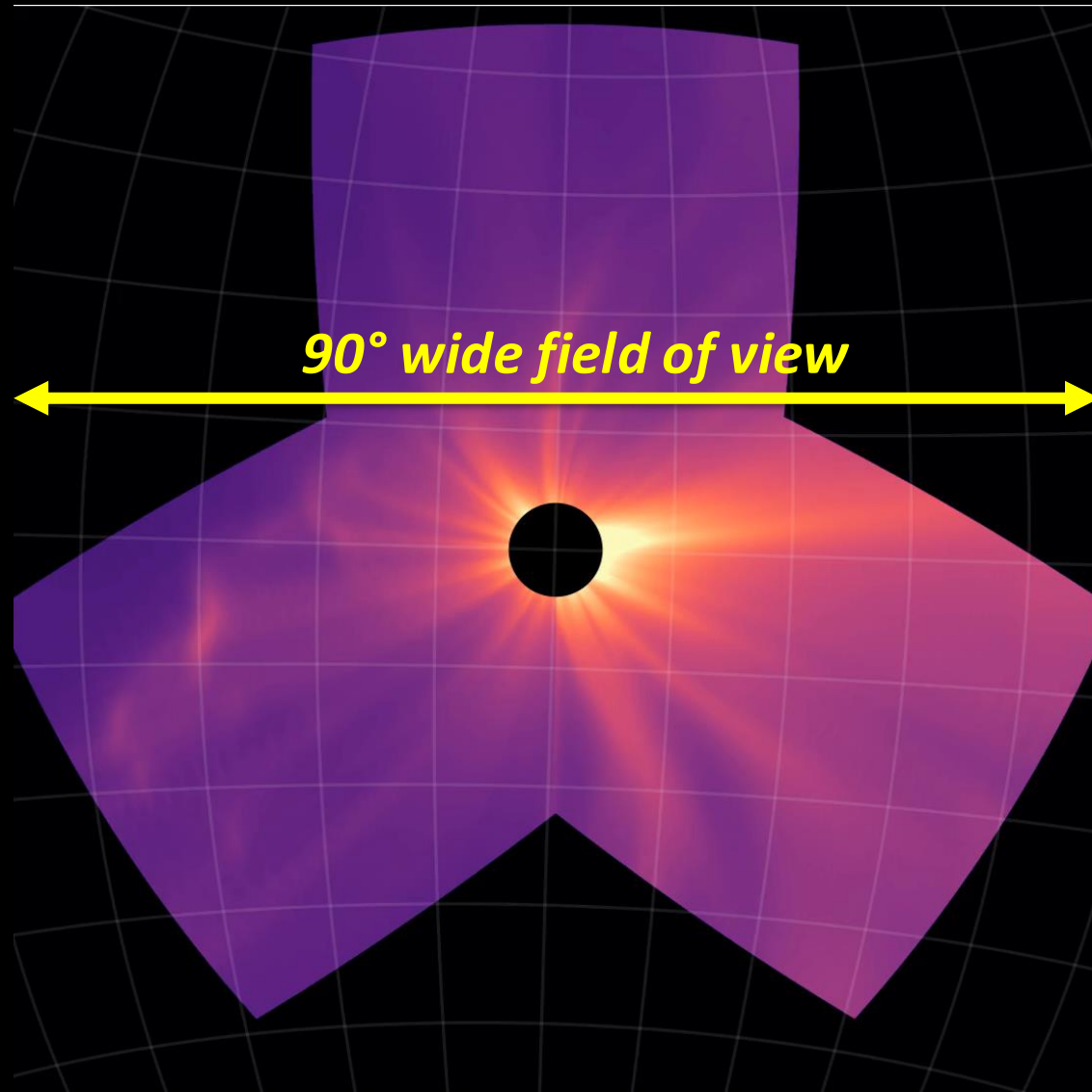
1x NFI: Compact Coronagraph design
Instrument: Naval Research Laboratory



3x WFI: Heliospheric Imager design
Instrument: SwRI



PUNCH MERGES IMAGES TO TRACK THE SOLAR WIND, SUN TO EARTH



- Exposures are synchronized and merged.
- Data are images from a single “virtual instrument”.
- PUNCH uses polarization to track space weather (e.g. CMEs) in 3D.

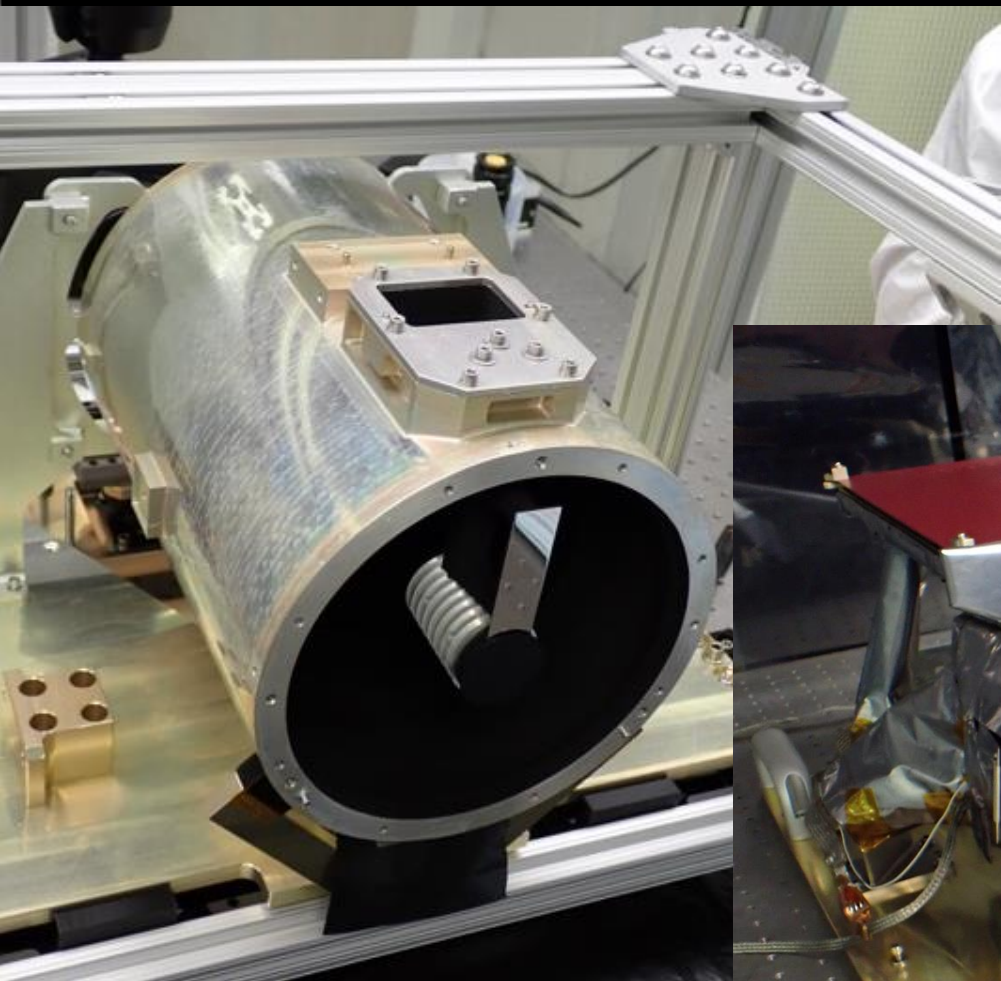




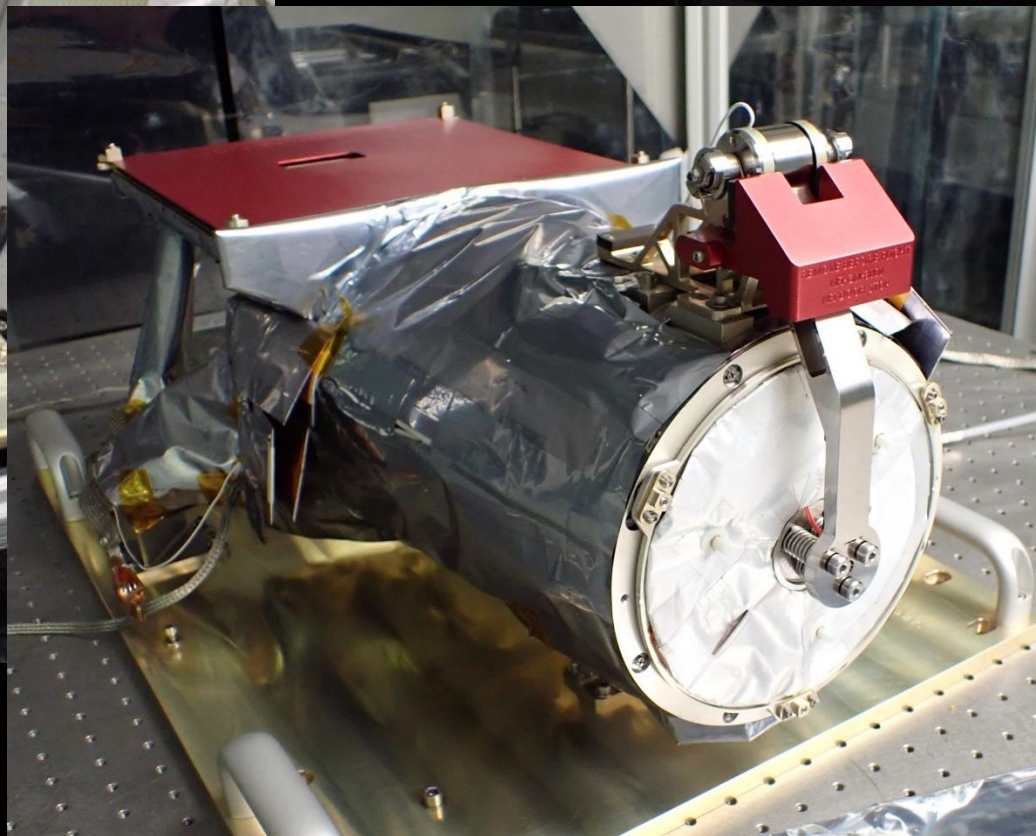
NFI Under Construction at NRL



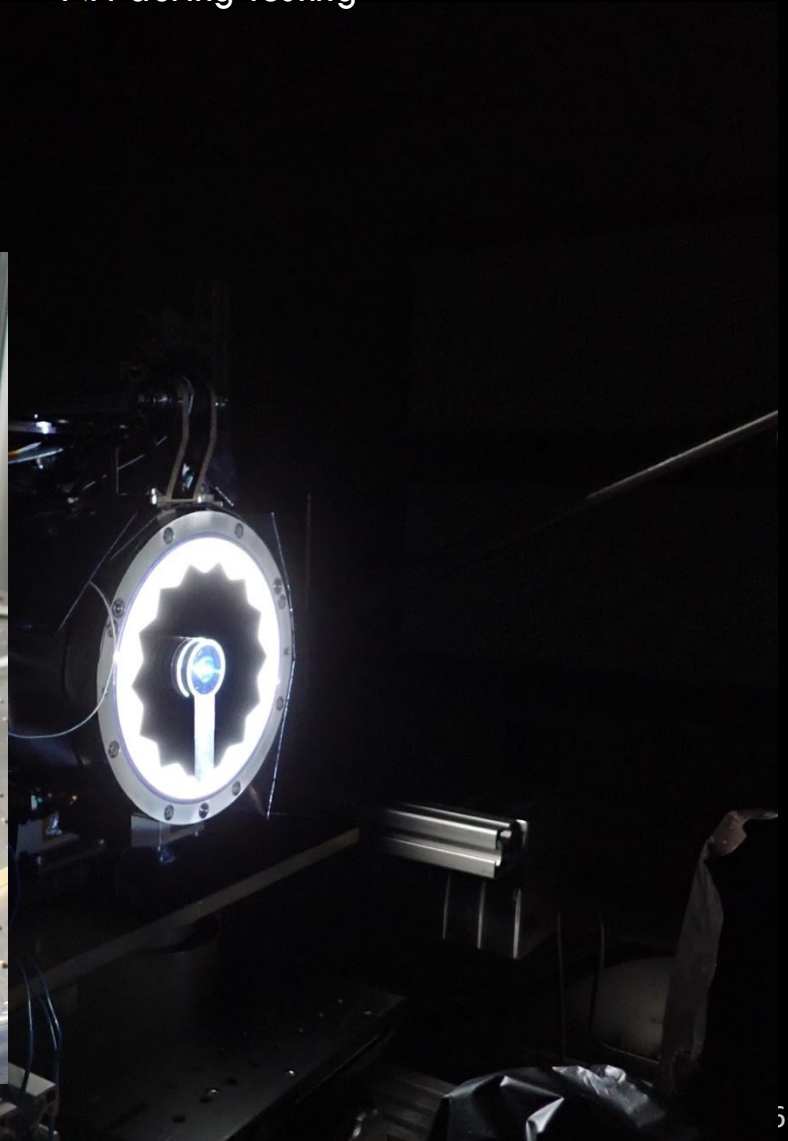
NFI during integration



NFI pre-ship



NFI during testing



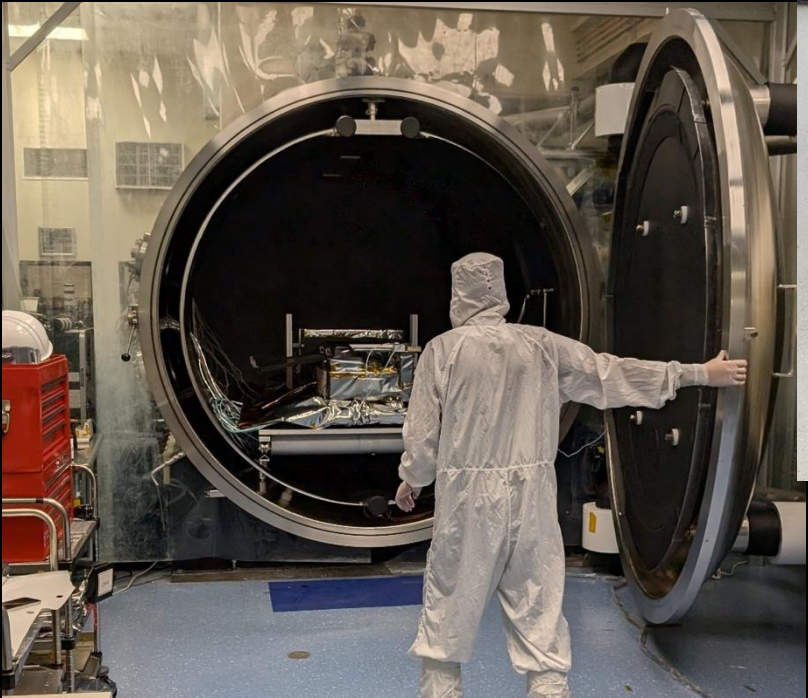


WFI under construction at SwRI





PUNCH Observatories at SwRI





PUNCH Observatories at VSFB



Late February 2025

WFI
(2 of 3
visible)



Early March 2025



March 9 2025



PUNCH Observatories over Africa



March 11, 2025



Spacecraft & instrument status

- Spacecraft are working as designed!
- Ground passes:
 - WFIs: 1-2 passes per day (long-term average); mostly X-band
 - NFI: 6-7 passes per day (long-term average); all S-band
- Pointing, flight software, power, storage, thrusters – all working fine
- Science campaign: continuous since late May 2025
- All four cameras remain operational!
- WFIs are working as designed!
- NFI remains in good focus
 - subject to terrestrial stray light that is believed correctable



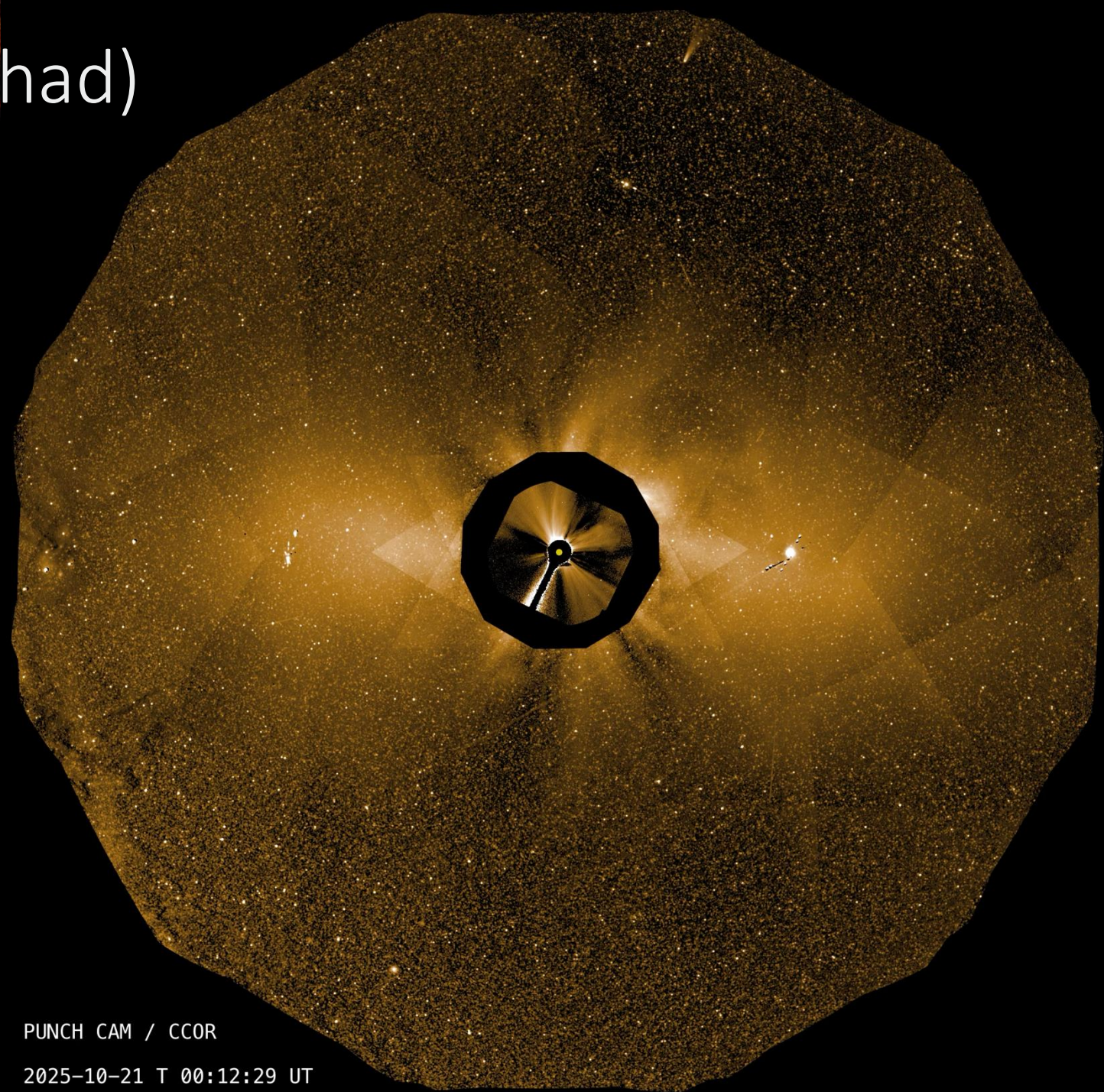
Ground system status

- MOC:
 - Working as designed
 - Many passes are lights-out
 - Tracking & nav solution: have been challenging but now working well
 - Recent events:
 - LED linearity tests
 - WFI crop mask update
- SOC:
 - 11 iterations of the data processing to date (now at "v0k")
 - 12th ("v0l") coming shortly; v1 expected mid-to-late June
 - Many more steps than planned (see Marcus' talk)
 - New computer in procurement now (for v1 reprocessing)



V0j data (what we had)

- Beginning of 2026
- This movie: CCOR in inner field
- Solar wind streams visible to $\sim 100 R_s$
- CMEs visible to 45° from Sun
- No polarization



PUNCH CAM / CCOR

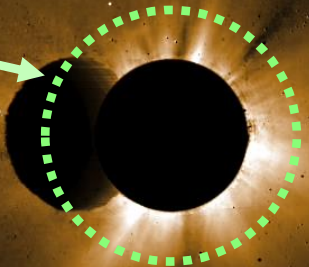
2025-10-21 T 00:12:29 UT



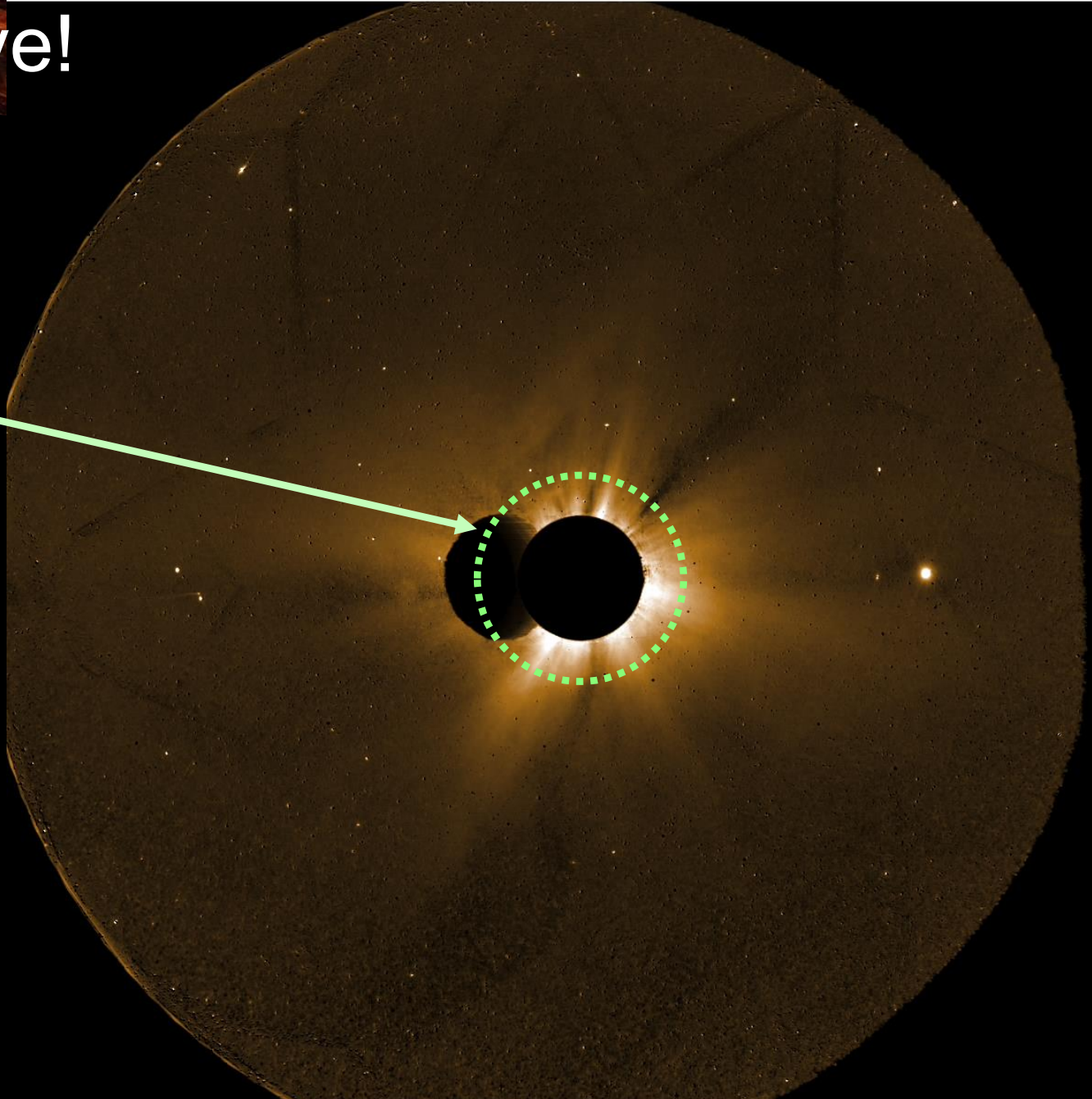
v0k data: what we have!

*Current preliminary data: total brightness
(Processing version 0k)*

NFI Field of View



- Total brightness measures approximate line-of-sight density
- Stars suppressed by 20x-100x compared to v0j data



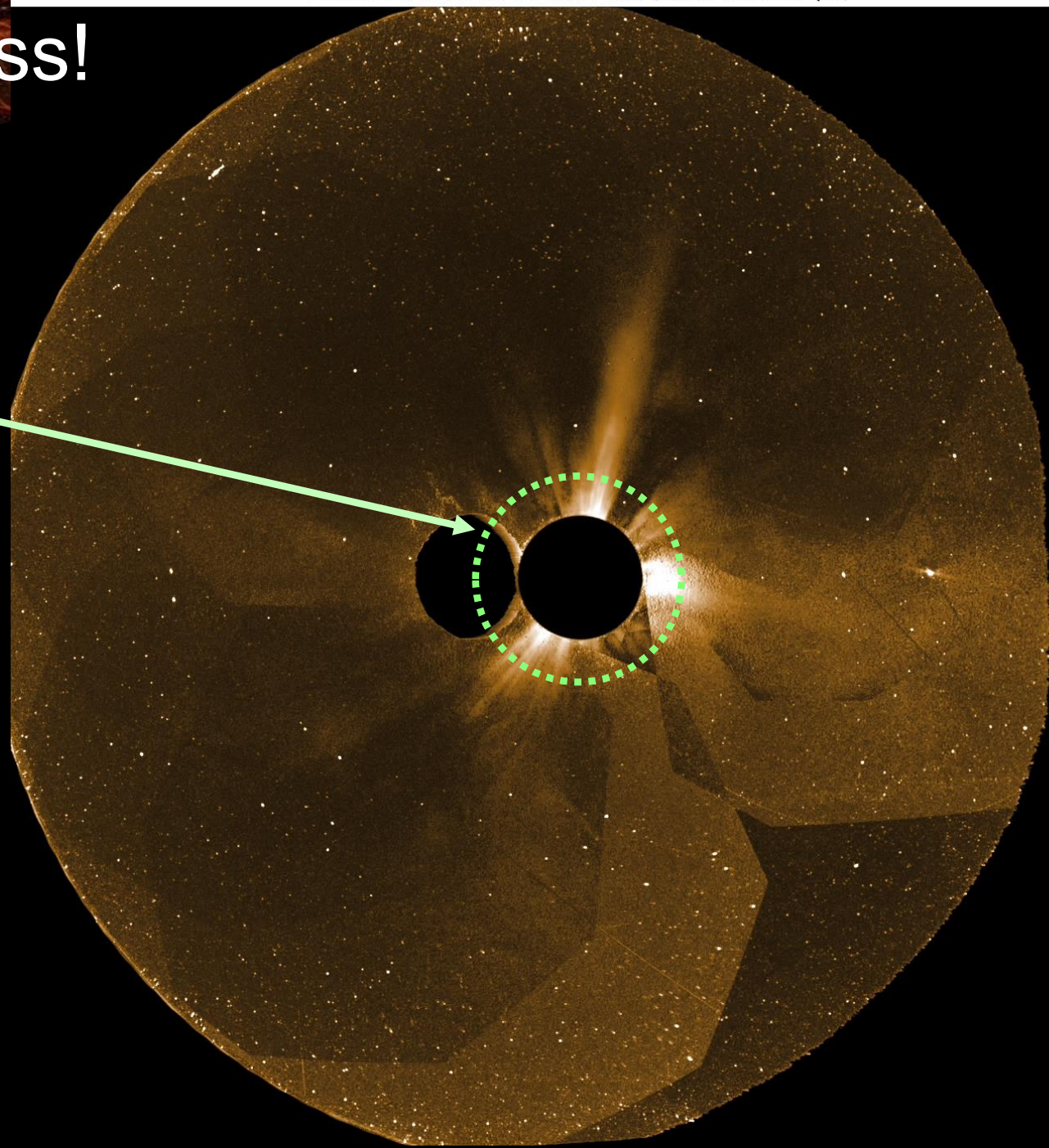


v0k polarized brightness!

PRELIMINARY DATA: *polarized brightness*
(Processing version 0k; calculated °pB)

NFI Field of View

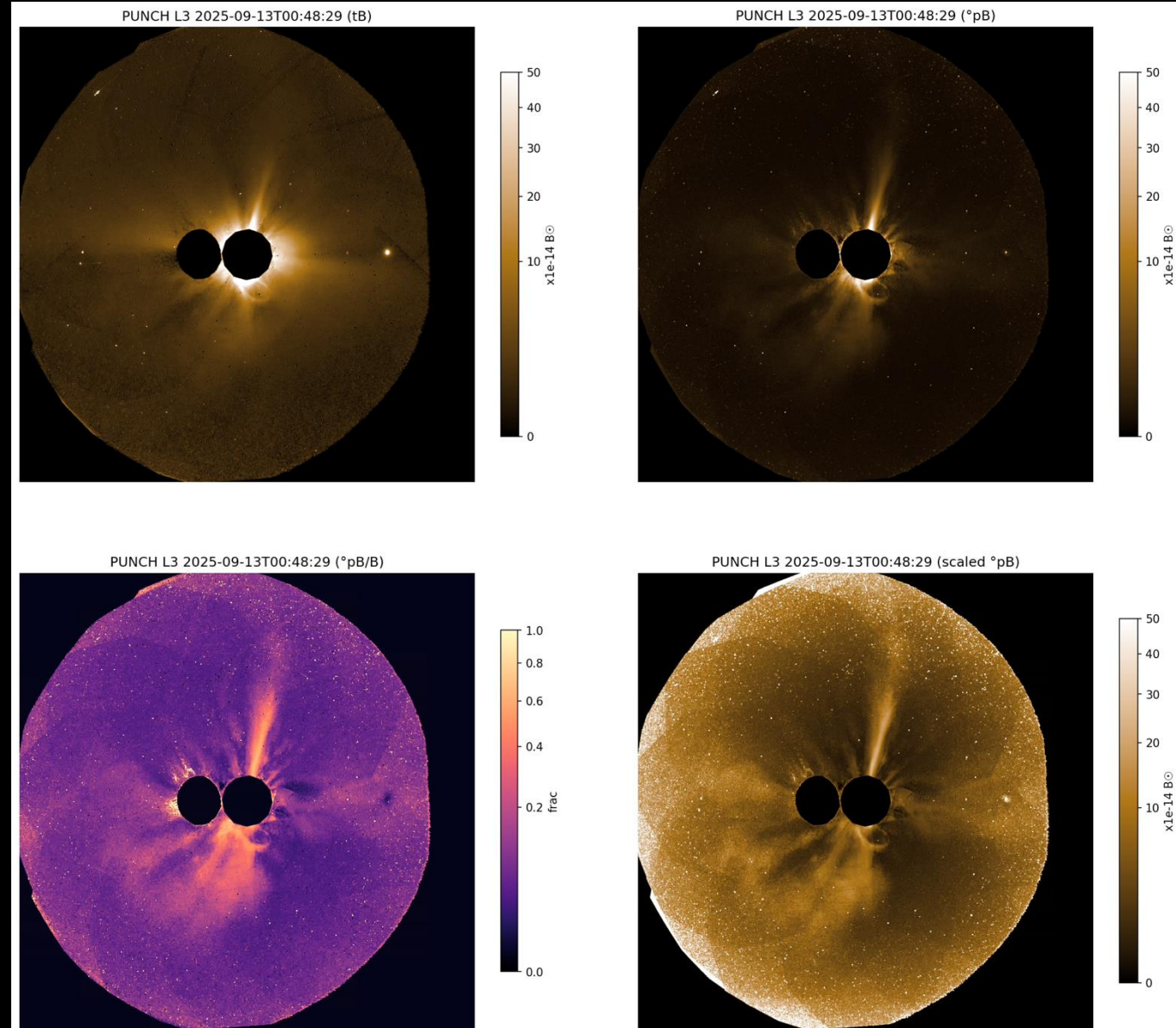
- Polarized brightness measures density near the “plane of the sky”.
- Feature contrast is higher than in tB
- v0k: shaking out pB measurement



USE L3 PAM & PTM PRODUCTS WHEREVER POSSIBLE

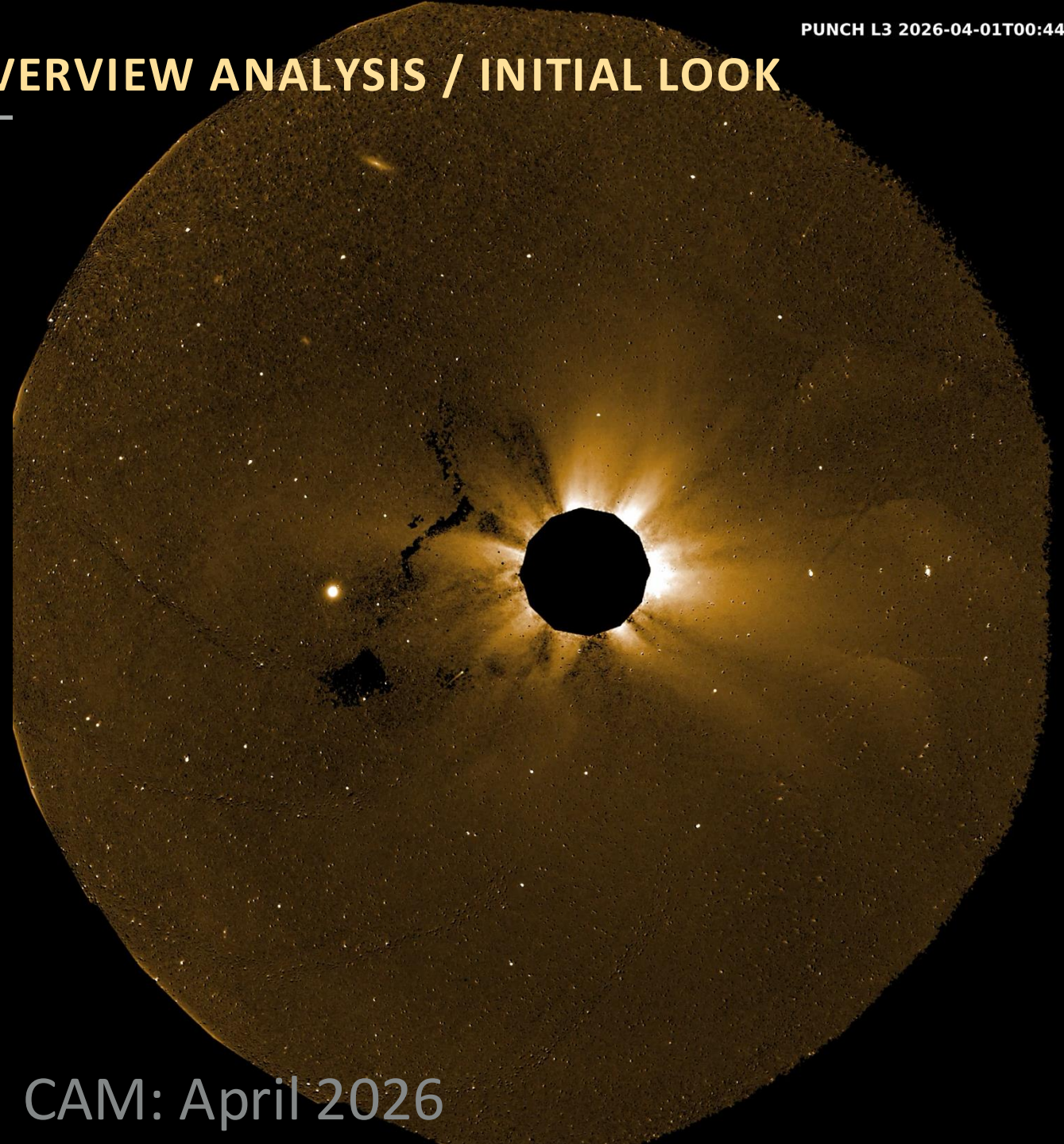
- PAM: Polarized Avg. Mosaic: 32 min. cadence
 - 3 x 4096 x 4096: tB, pB, pB'
 - v0k: calculate $^{\circ}\text{pB} = \text{sqrt}((\text{pB})^2 + (\text{pB}')^2)$
 - tB is lower noise than CAM.

- PTM: Polarized Trefoil Mosaic: 4 min. cadence



USE L3 CAM/CTM PRODUCTS FOR OVERVIEW ANALYSIS / INITIAL LOOK

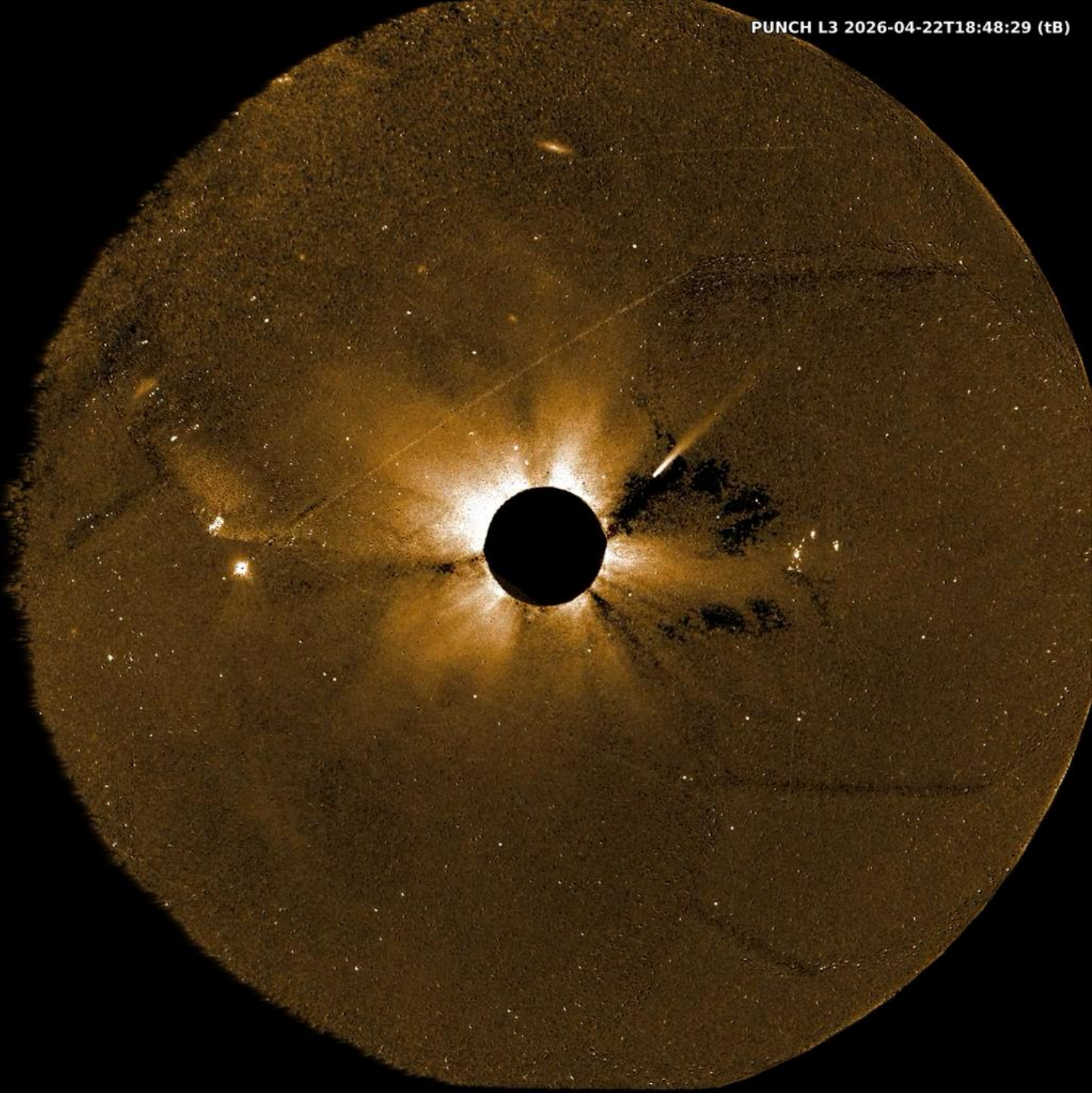
- CAM: Clear Avg. Mosaic: 32 min. cadence
 - 4096 x 4096 tB
 - 2.5x higher noise than PAM tB
 - Smaller files
 - Often processed faster
- CTM: Clear Trefoil Mosaic: 8 min. cadence
 - Intended for validating tB
 - Useful for quicklook



CAM: April 2026

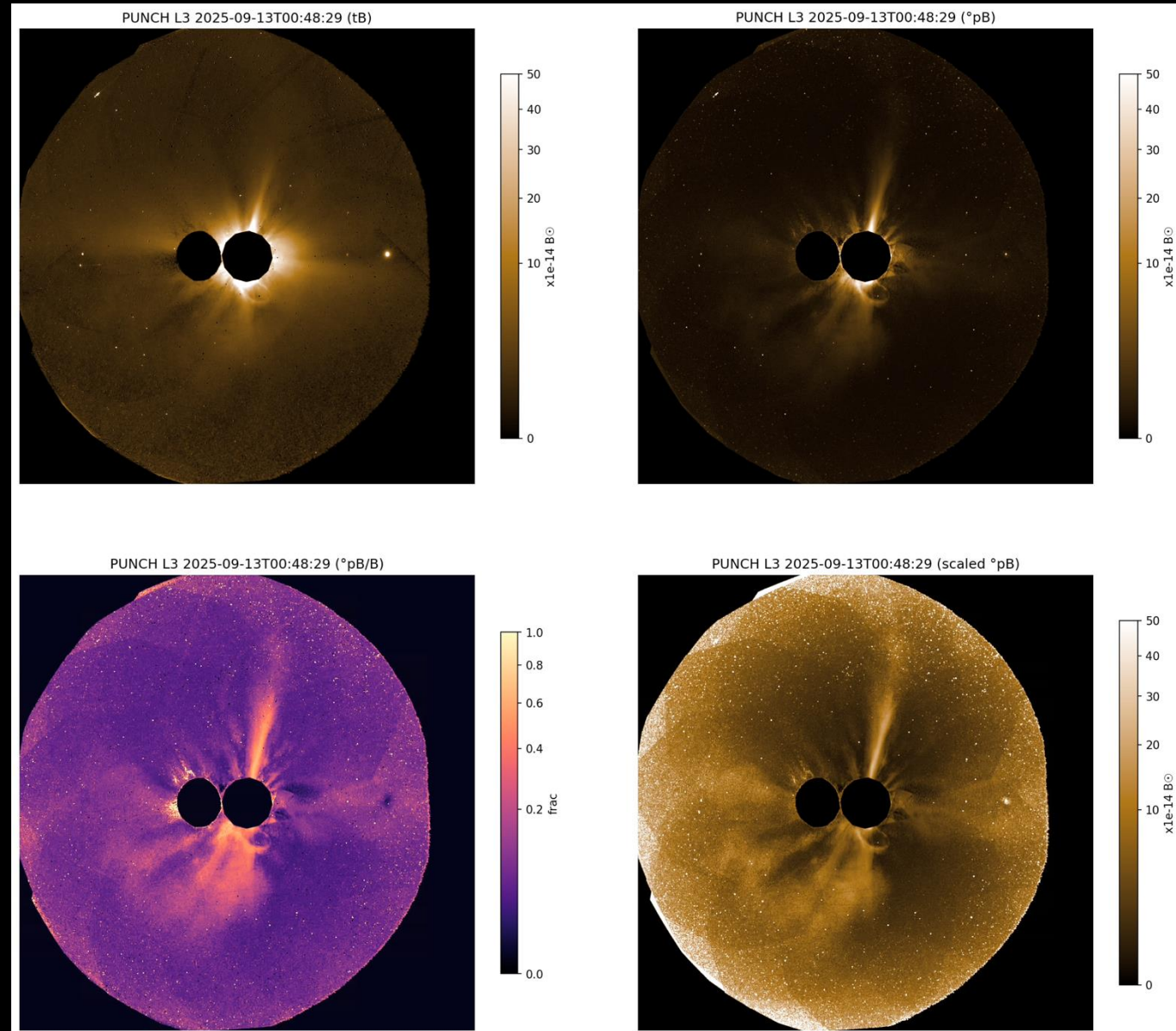
USE L3 CAM/CTM PRODUCTS FOR OV

- CAM: Clear Avg. Mosaic: 32 min. cadence
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COMING SOON:

- v0l: many improvements (see Marcus' talk)
- NFI! (See Joe Plowman's poster)
- HelioViewer integration (sort of works now; will keep improving)
- Daily QuickLook movies
- Calendar tool
- QuickPUNCH

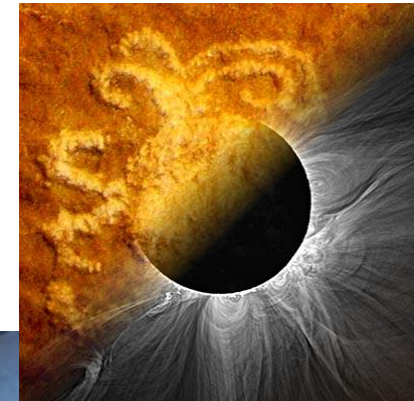
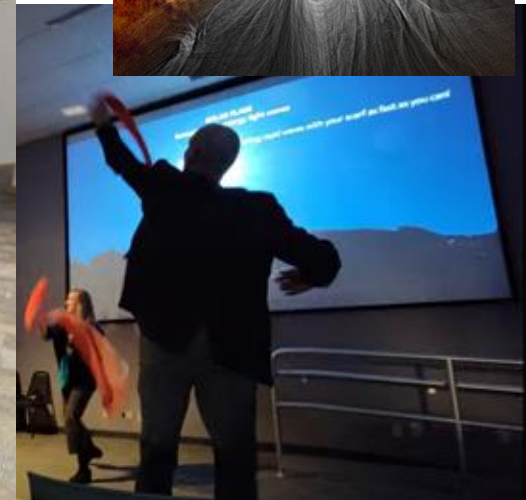




PUNCH Outreach: Lighting up Kids (and adults) Everywhere



- Built around “ancient and modern sunwatching”
- Building the next generation of heliophysicists & scientists
- Novel pedagogy and aids to improve STEM engagement
- Tested, vetted, and optimized methods
- Has directly affected over 250,000 children
- **Regional design, national impact**





Summing up:

- The mission is healthy!
- Data are usable for science now
- Data are about to get much, much better
- Thanks to everyone who got us here!