Packing a PUNCH: Wide-Field Polarimetry of the Heliosphere

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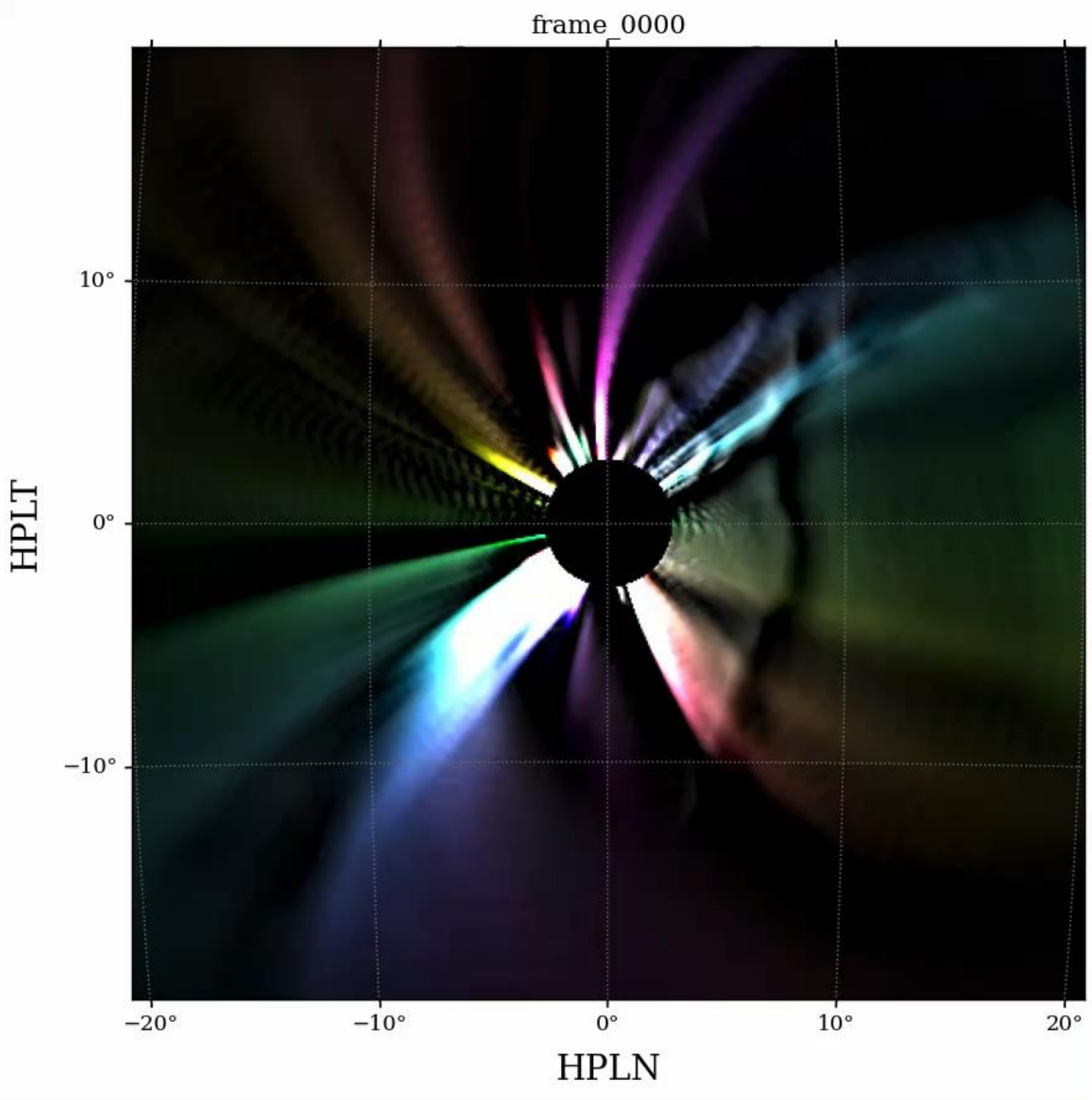
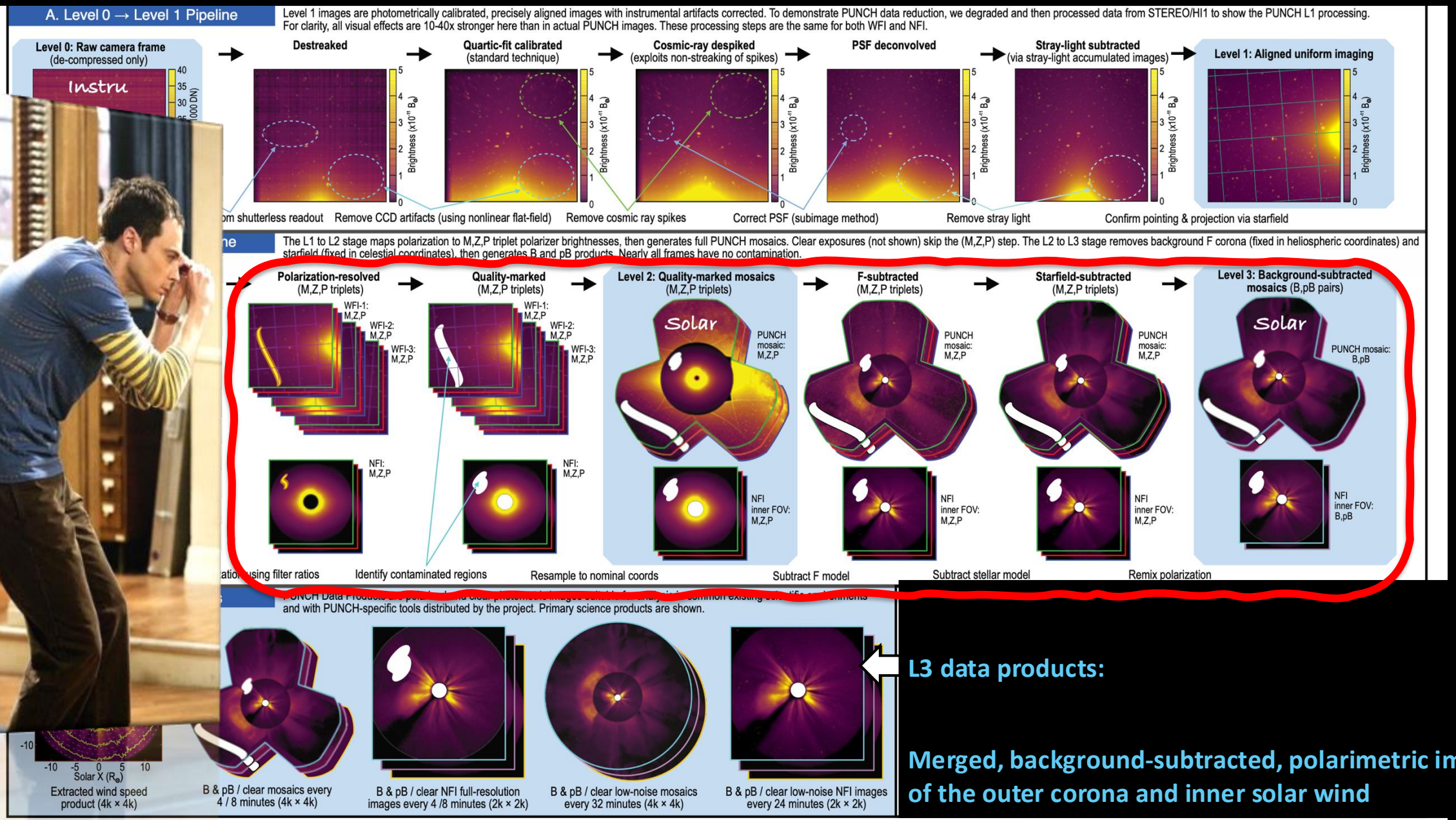

frame_0000
10°
0°
−10°
HPLT
−20°
−10°
0°
10°
20°
HPLN

PUNCH DATA: routine images of the entire inner heliosphere

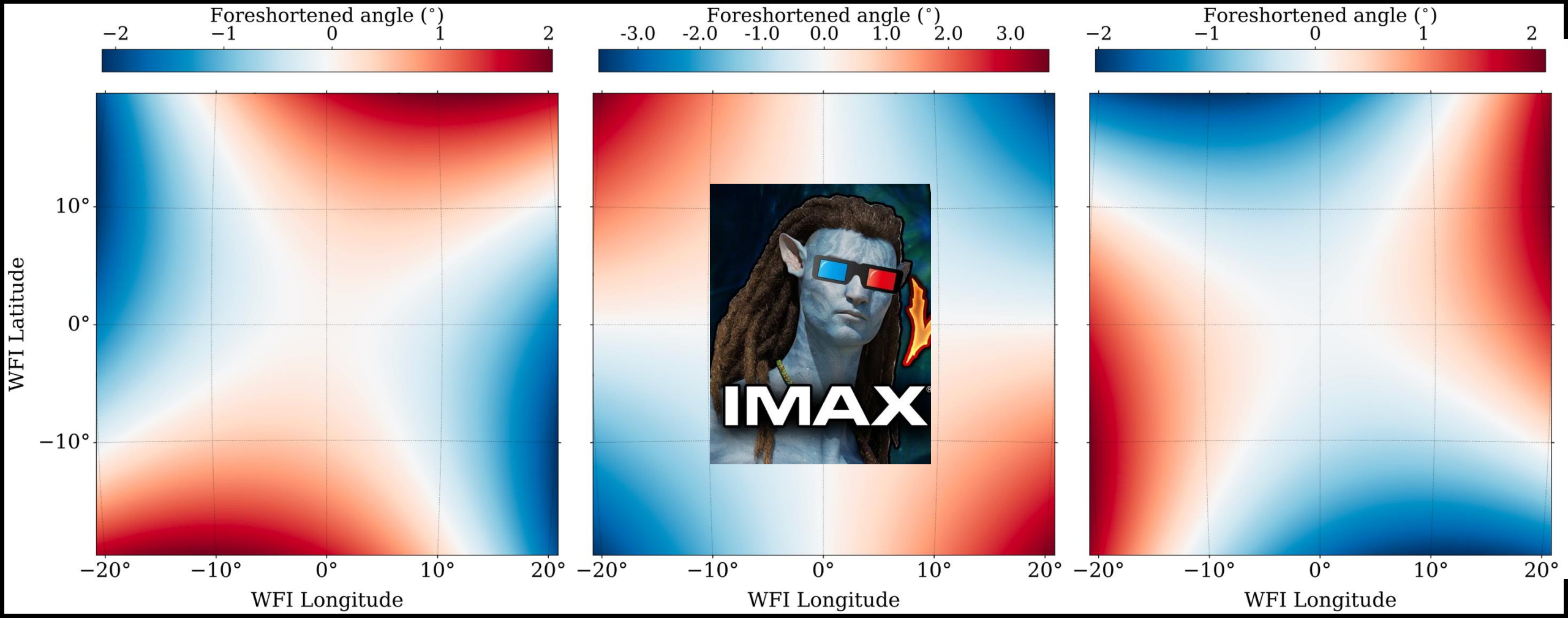


Original figures and layout from PUNCH CSR

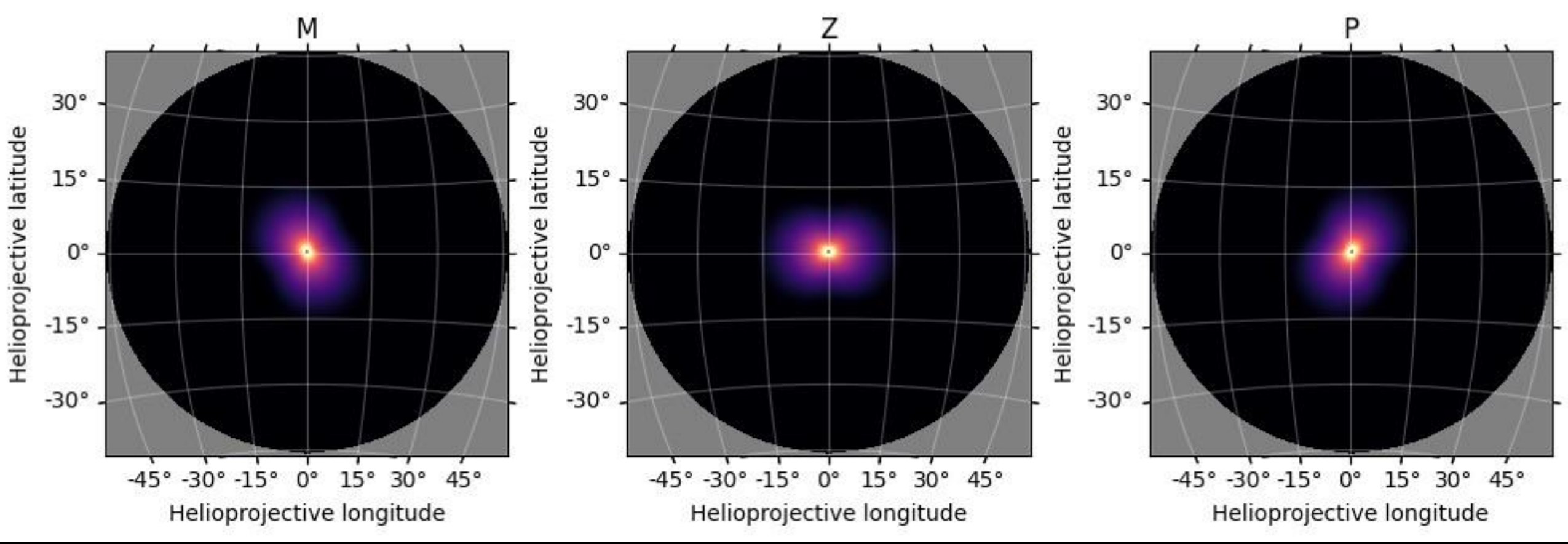
L3 data products:

Merged, background-subtracted, polarimetric images of the outer corona and inner solar wind

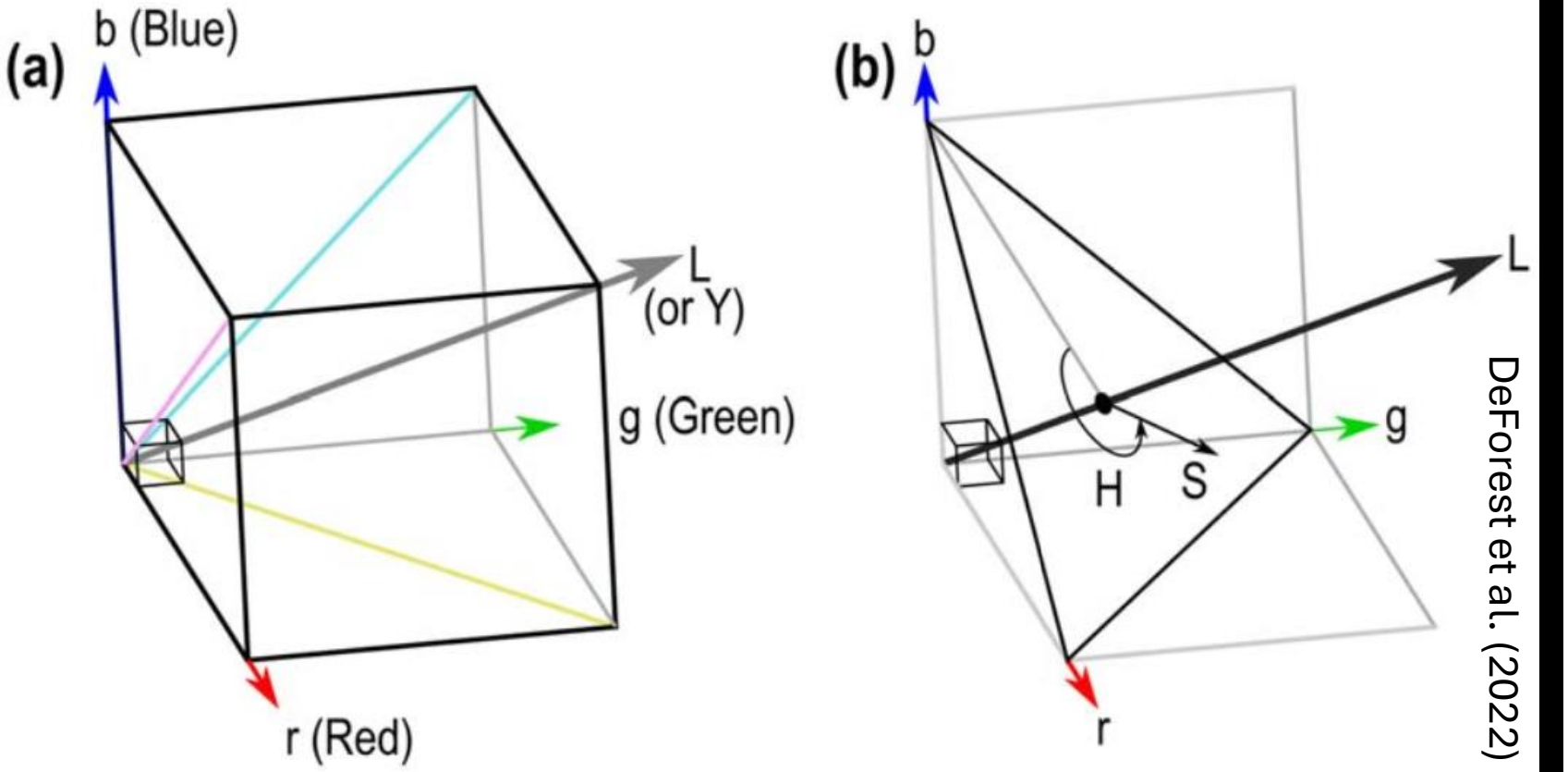
Resolving Polarization




Before We Start, We Got To Have
Some Ground Rules.


M
Z
P
Helioprojective latitude
Helioprojective longitude
30°
15°
0°
-15°
-30°
-45°
-30°
-15°
0°
15°
30°
45°

Polarimetry ↔ Colorimetry



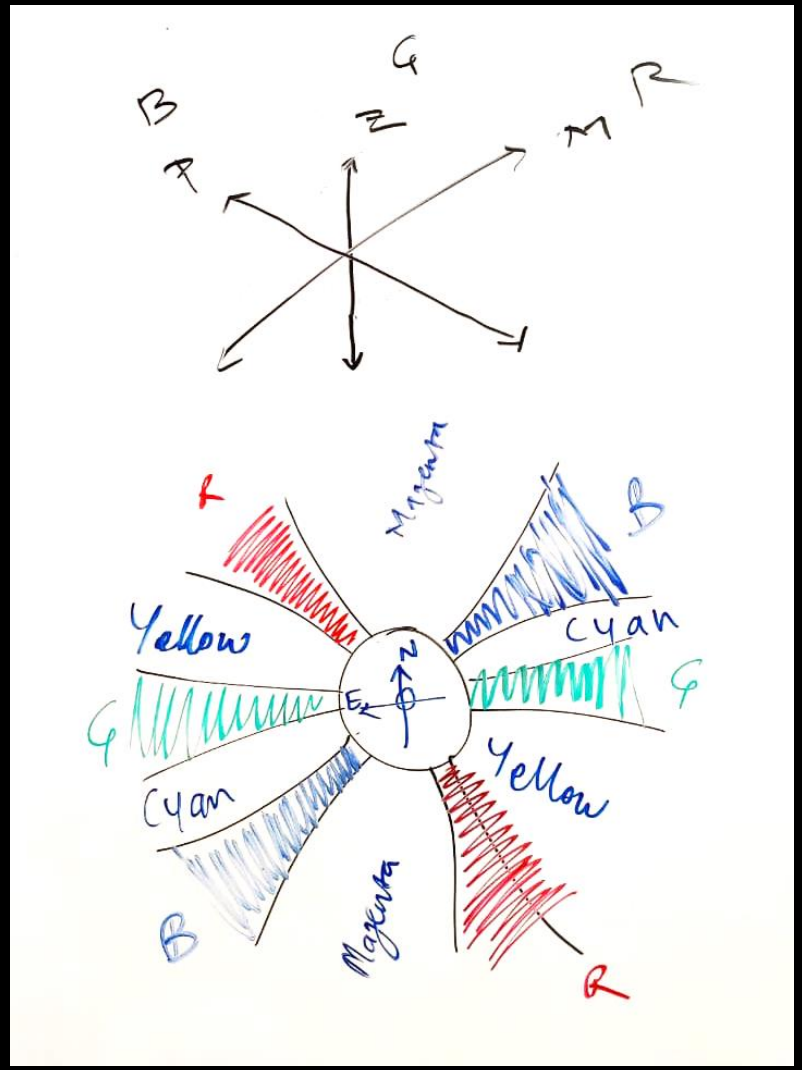
DeForest et al. (2022)

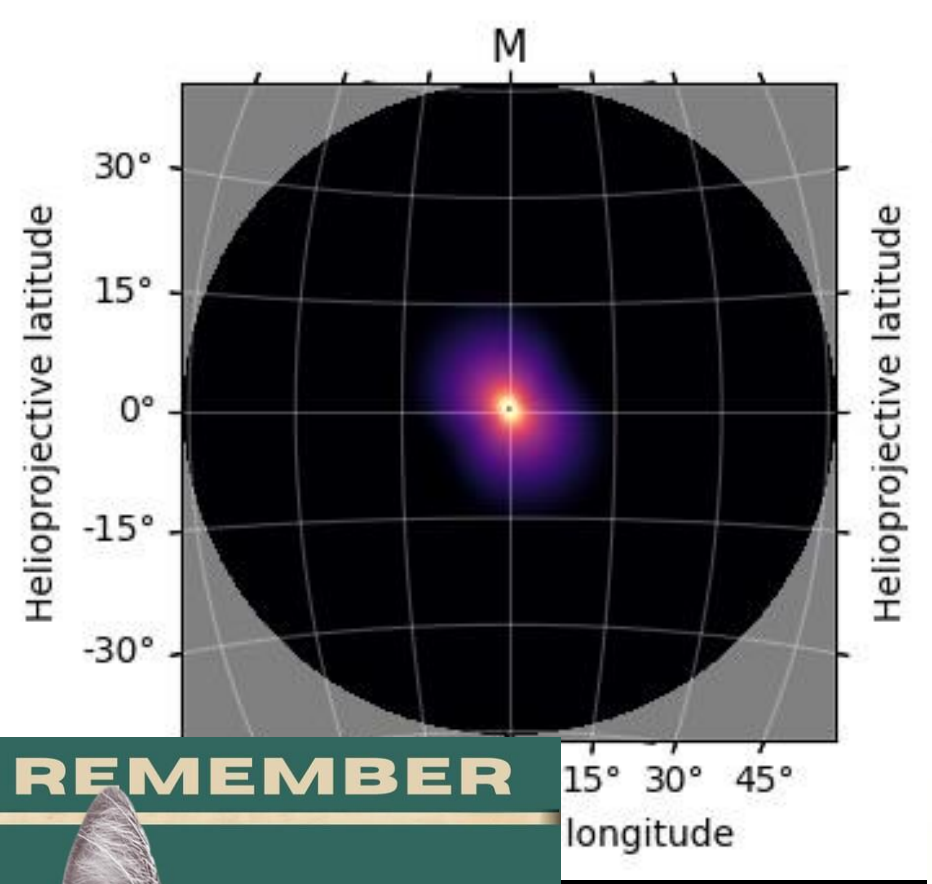
$I_M = g$, $I_Z = b$, $I_P = r$:

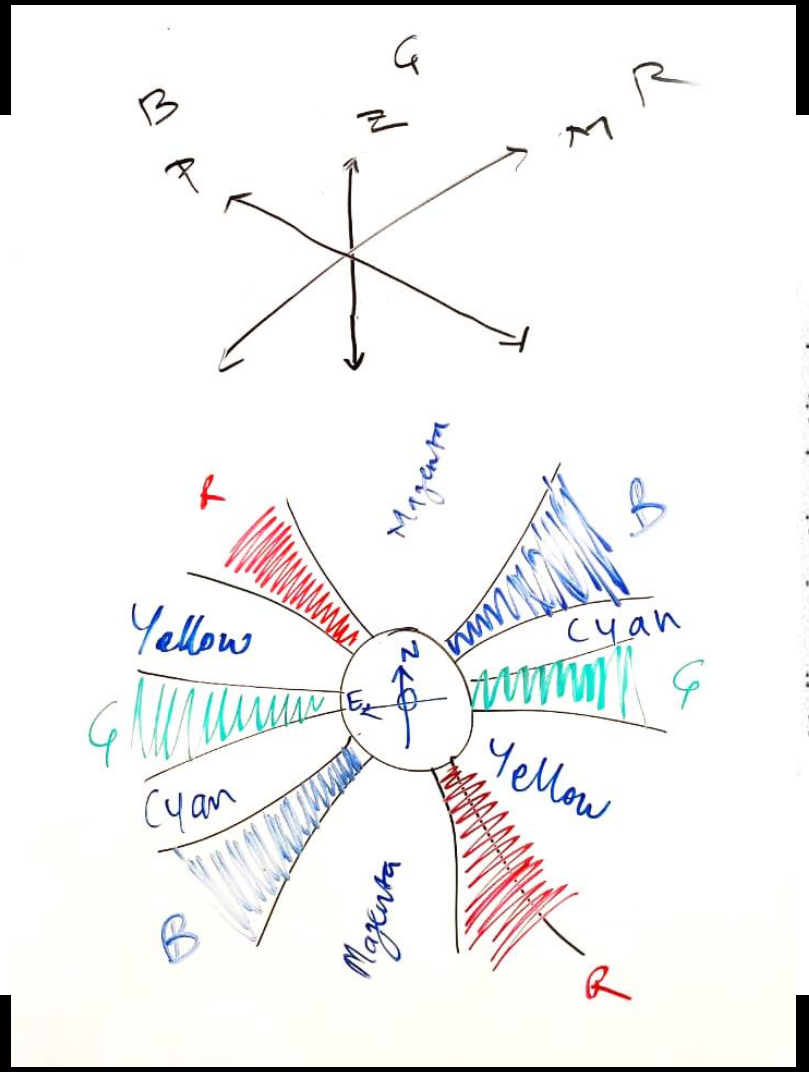
M, Z, P

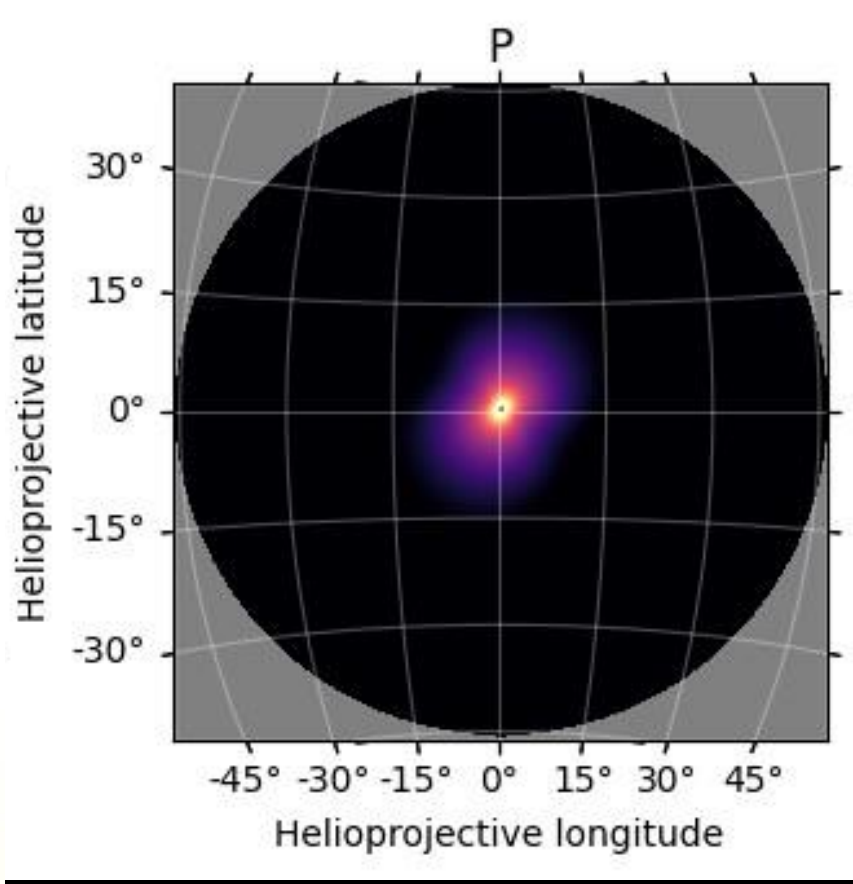
$I = L$, $\beta = H/2$, $p = S$:

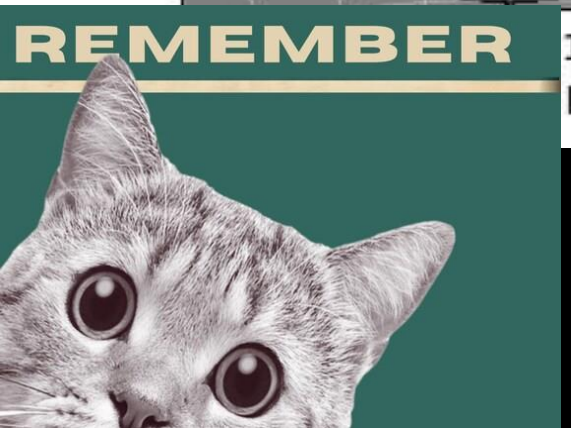
I, β, p



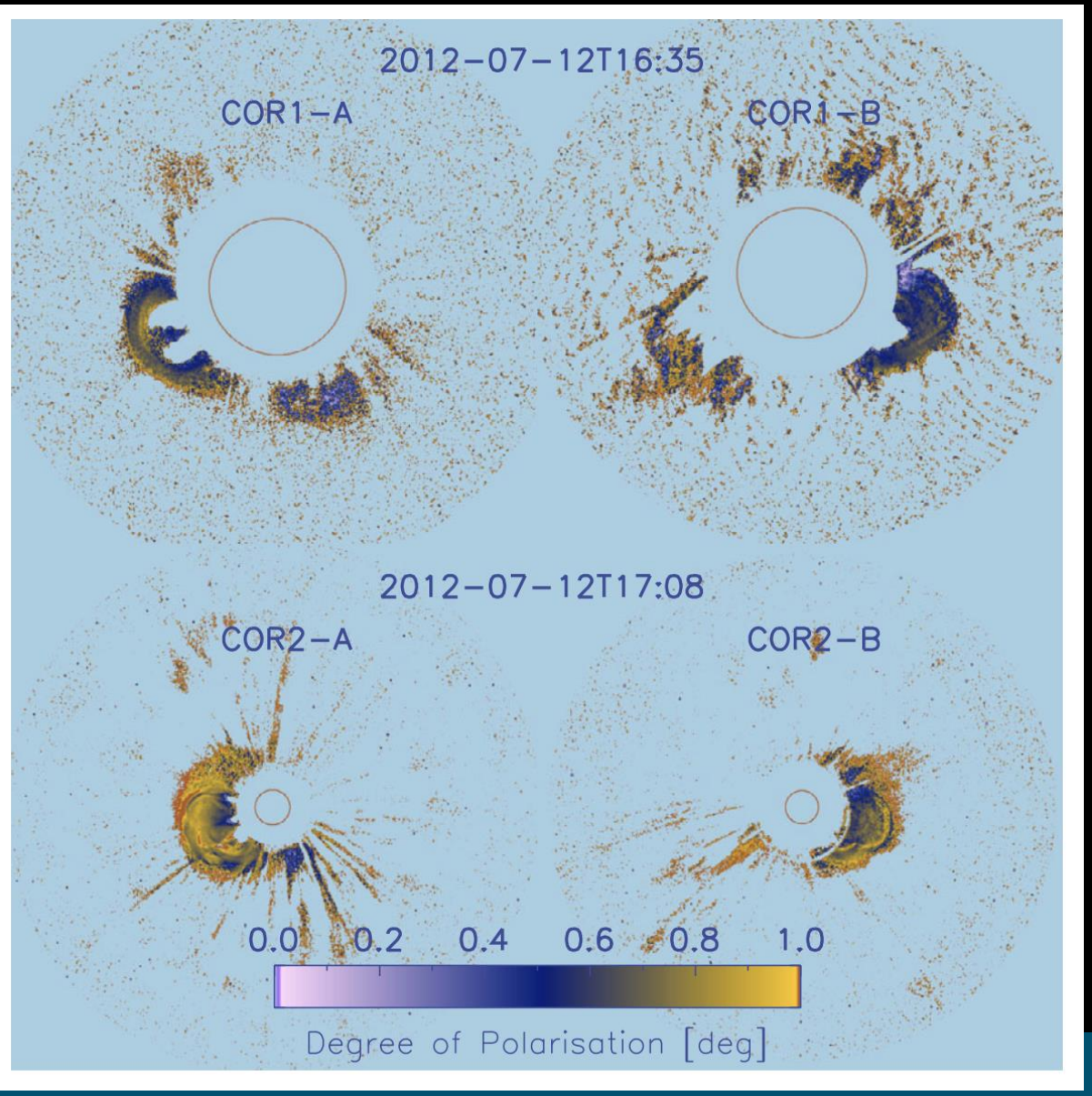

M
Helioprojective latitude
30°
15°
0°
-15°
-30°
15° 30° 45°
longitude

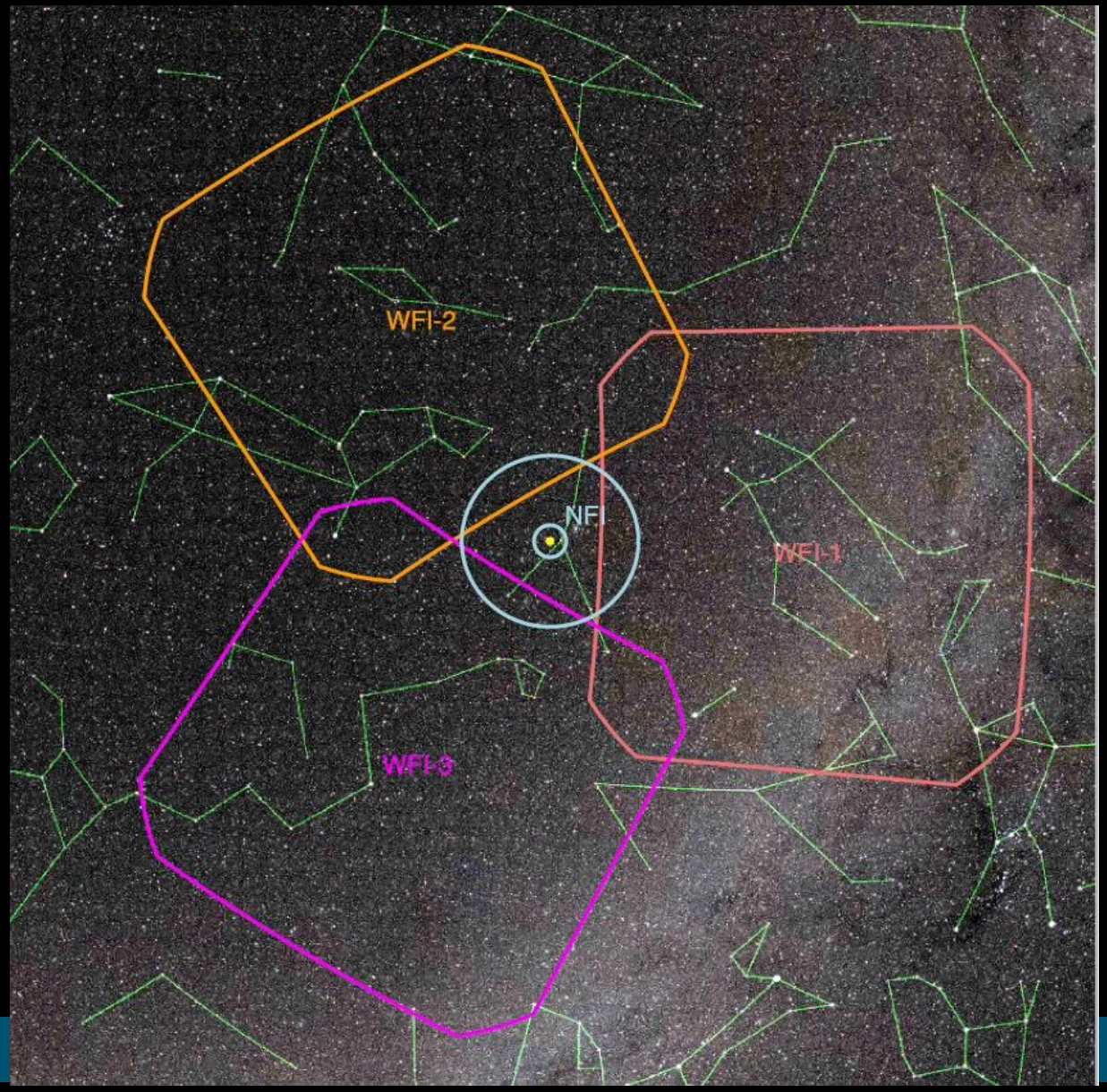

B
G
R
Magenta
Yellow
Cyan
Yellow
Cyan
Magenta
N
E


P
Helioprojective latitude
30°
15°
0°
-15°
-30°
-45° -30° -15° 0° 15° 30° 45°
Helioprojective longitude


REMEMBER

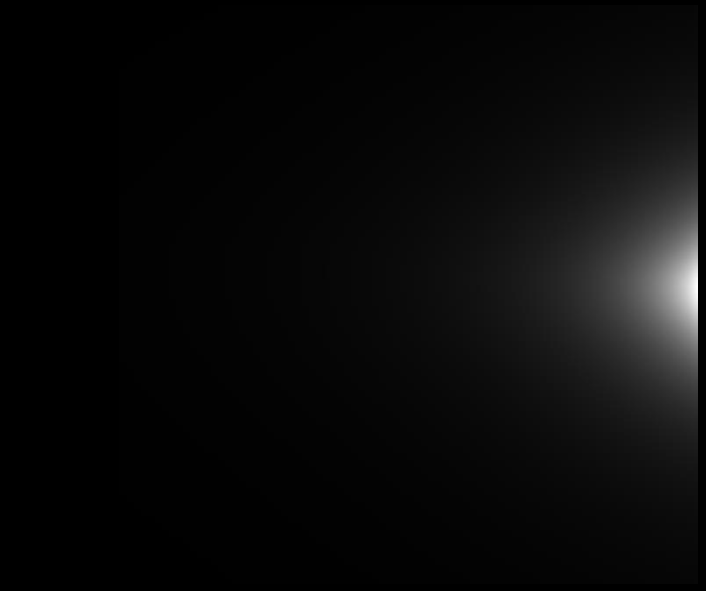
Resolving Polarization

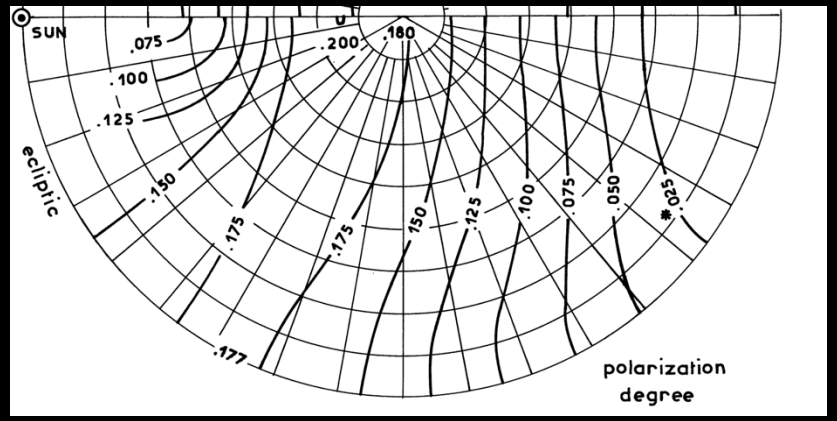


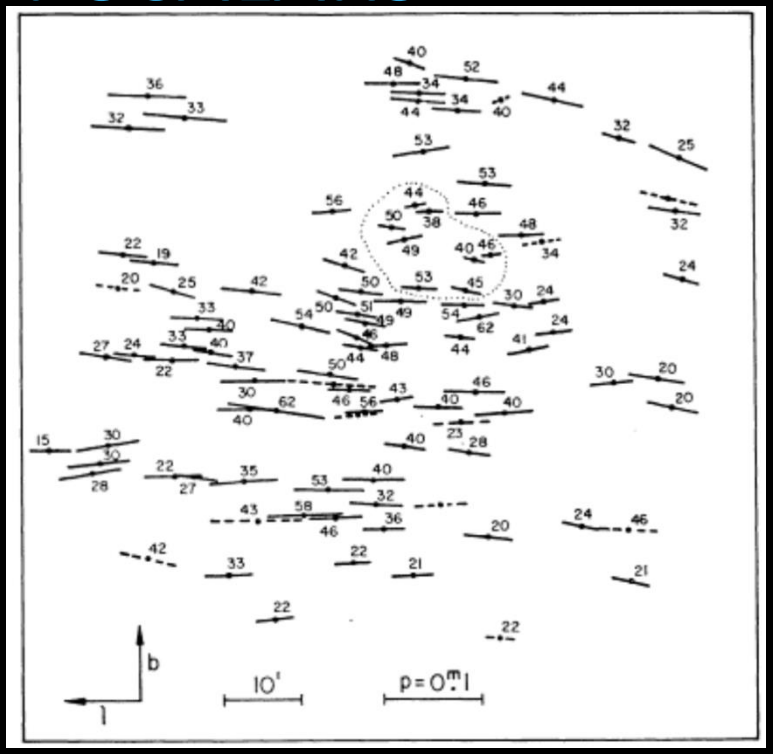


(Mierla et al. 2022)

POLARIZED BACKGROUNDS: VECTORS, NOT SCALARS







Instrumental scattering is likely polarized

The F corona is up to 20% polarized. (Figure: Dumont & Sánchez 1976)

The starfield itself is up to 5% polarized. (Figure: Serkowski 1973)

Fixed in Instrument frame

Fixed in solar frame

Fixed in celestial frame

PUNCH
Polarimetry

1

Generate Polarized Stray Light Model in Instrument Frame

2

Transform Polarization to Solar Frame and Generate Polarized F-corona background

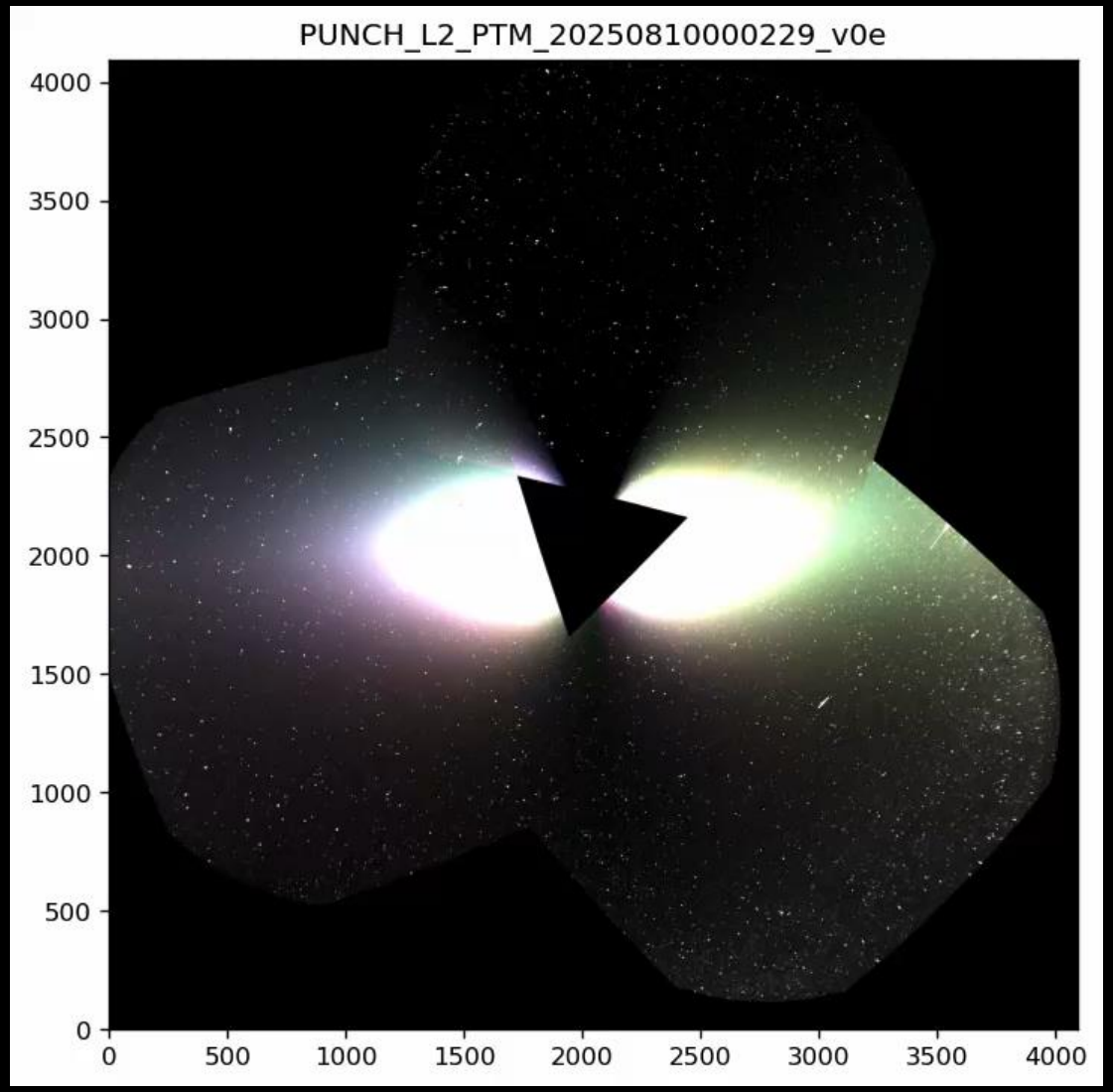
3

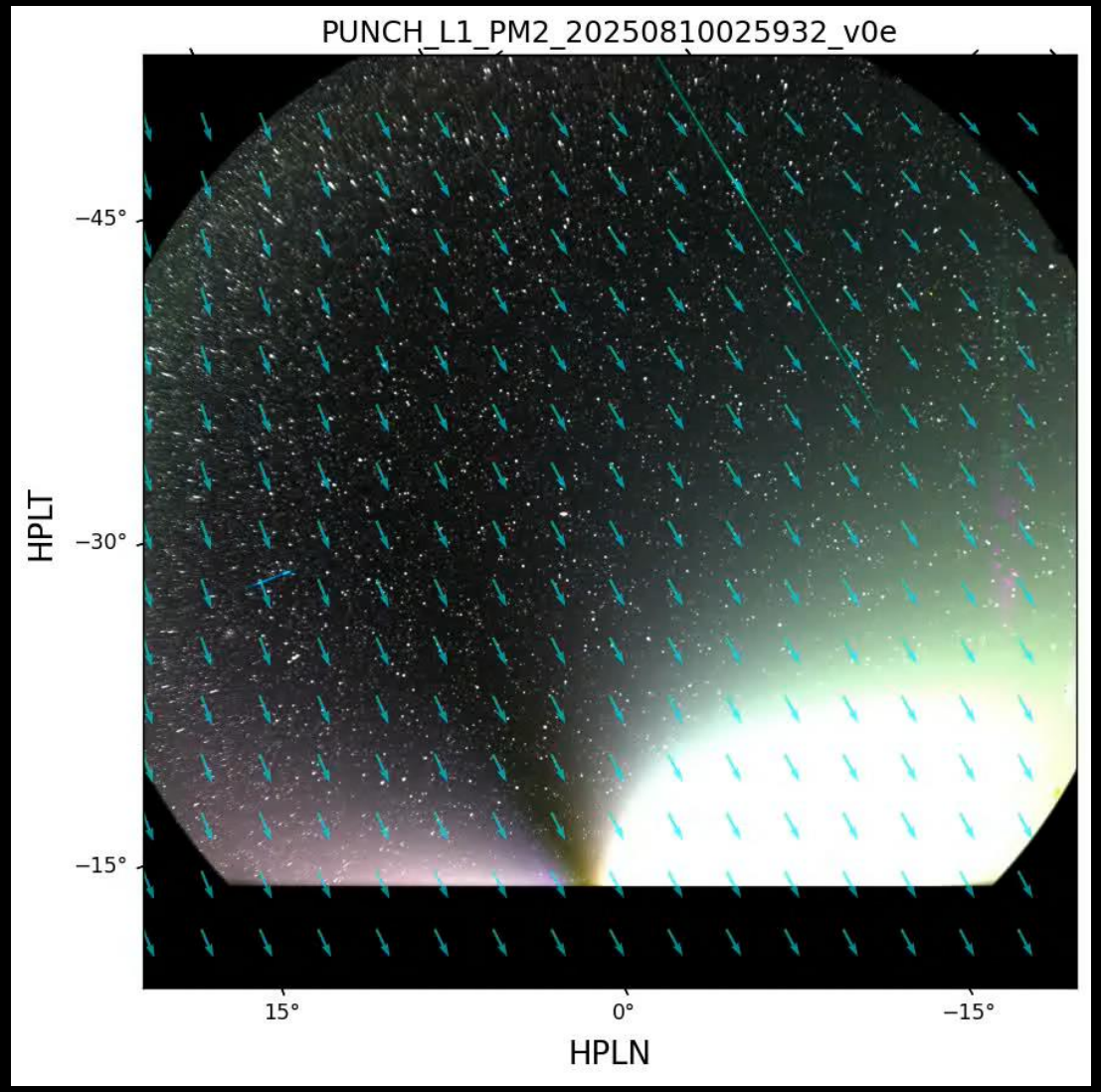
Remove F-corona. Transform Polarization to Celestial Frame and Remove Starfield background

4

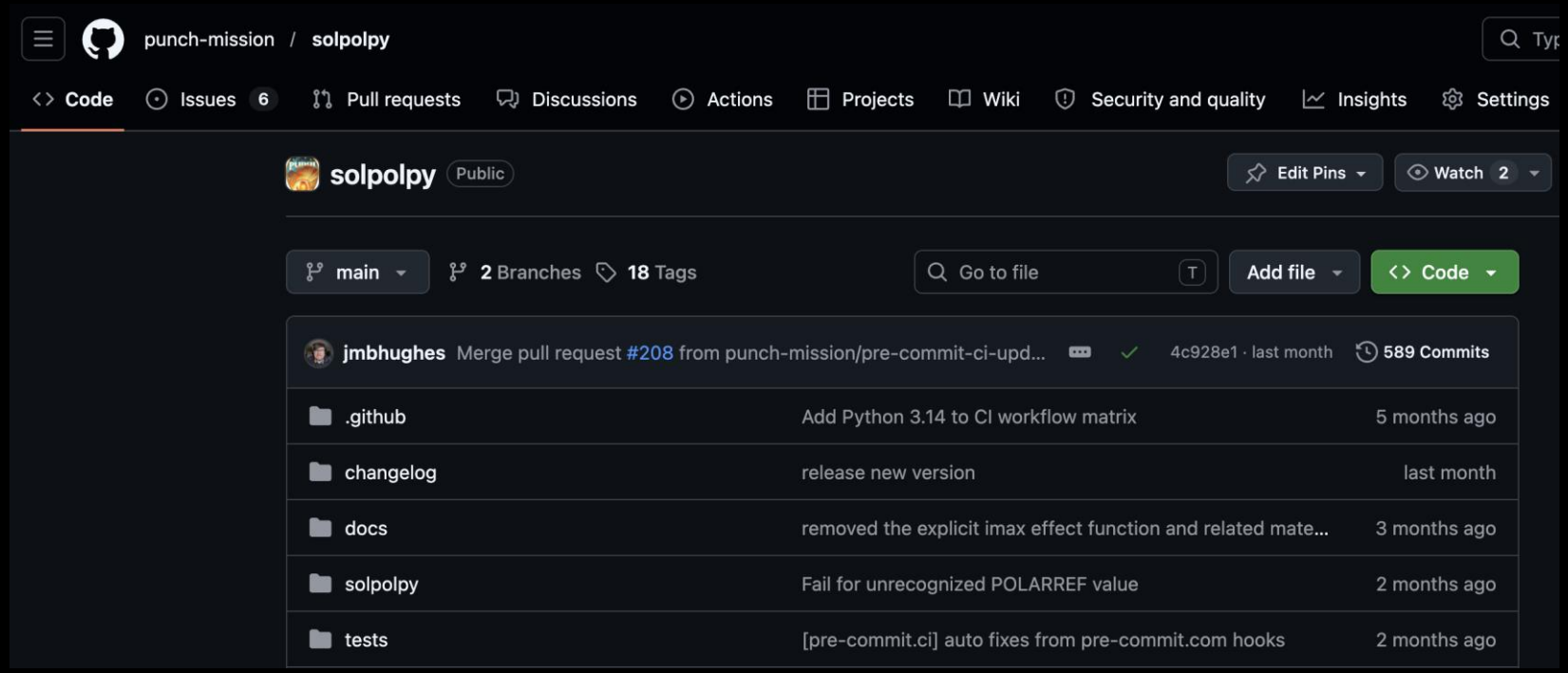
Transform Polarization Back to Solar Frame and Disseminate L3 Polarized data

PUNCH Polarimetry





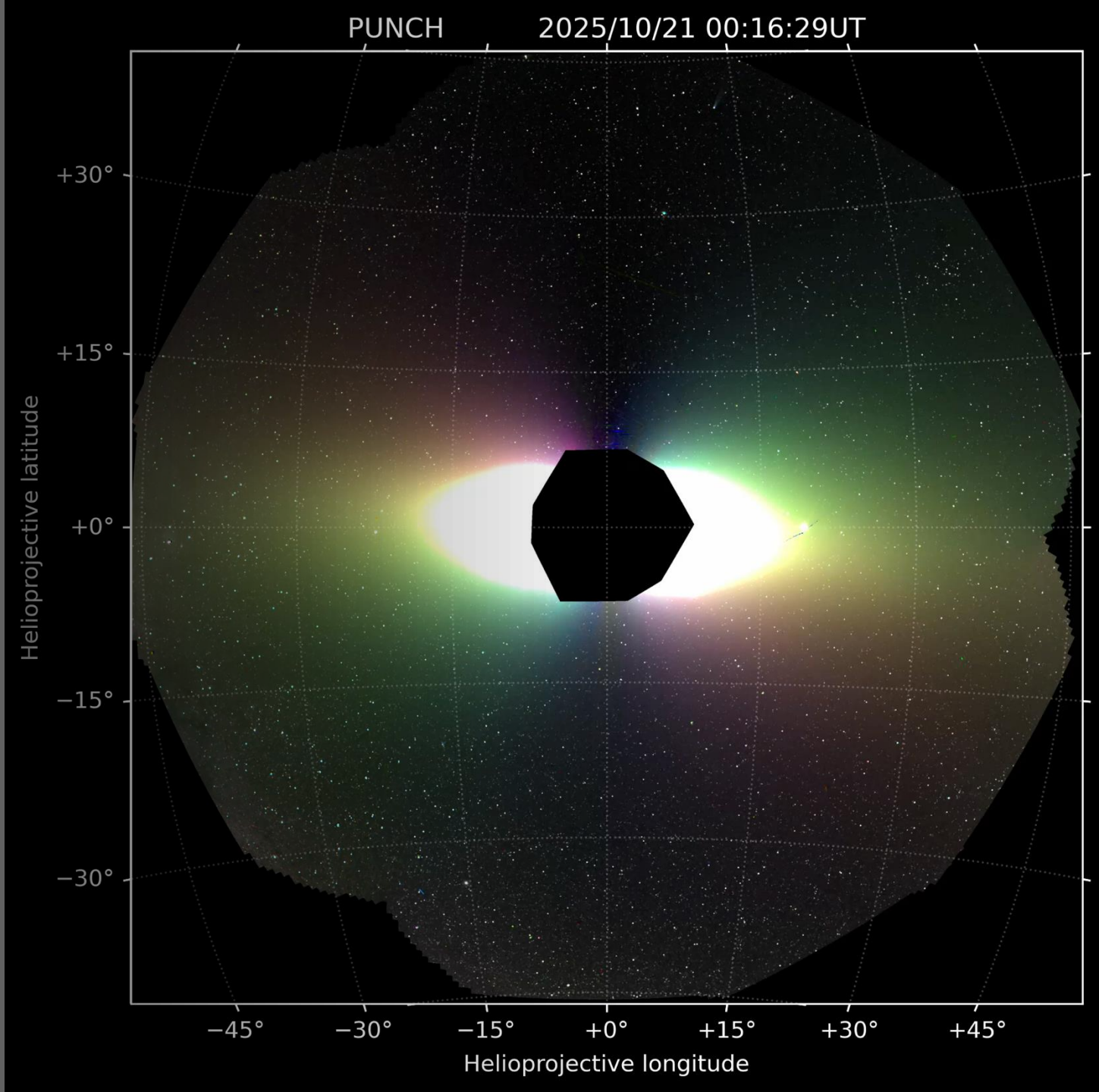
PUNCH Polarimetry



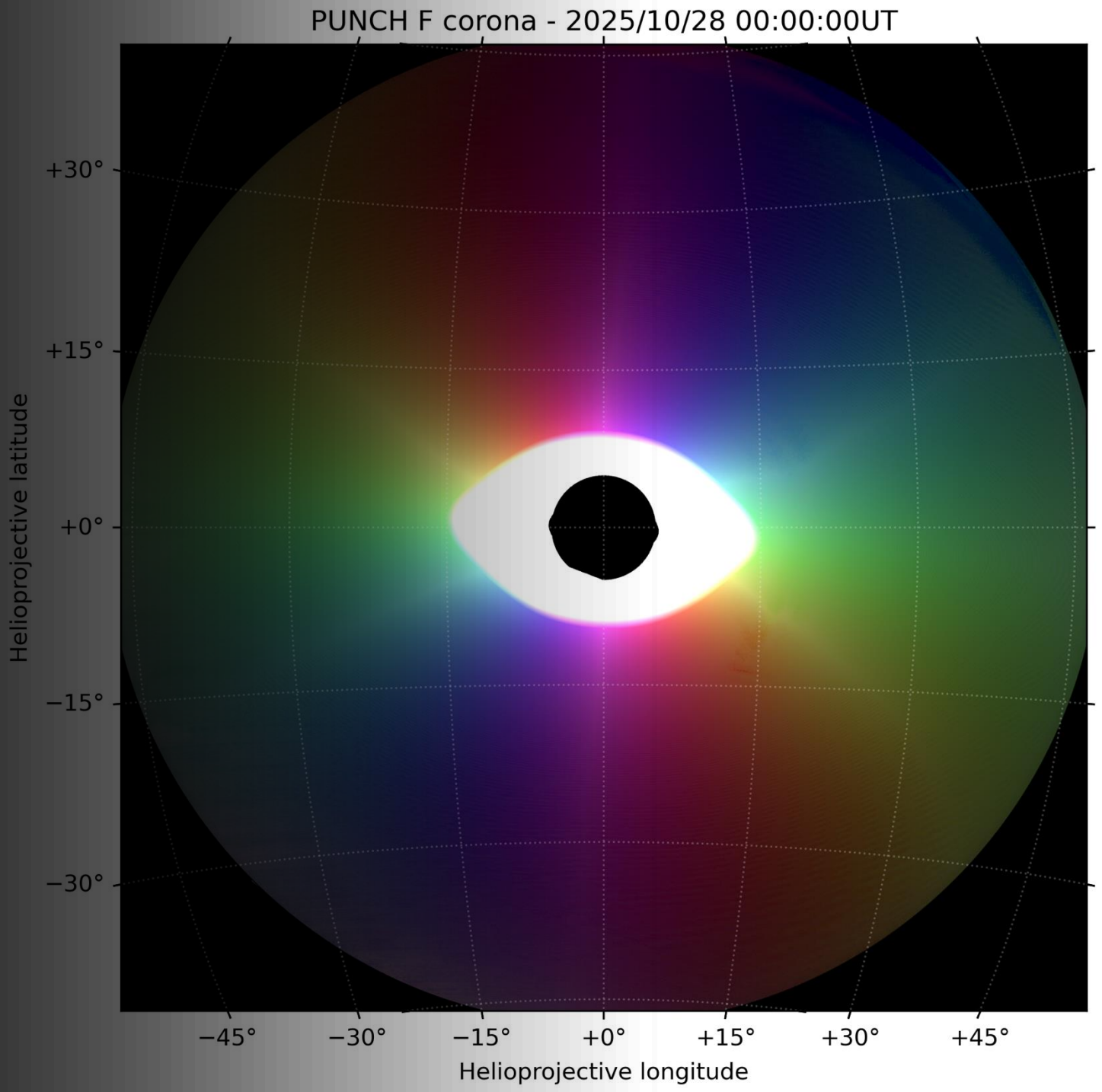
SCAN ME

Based on DeForest et al. (2022)

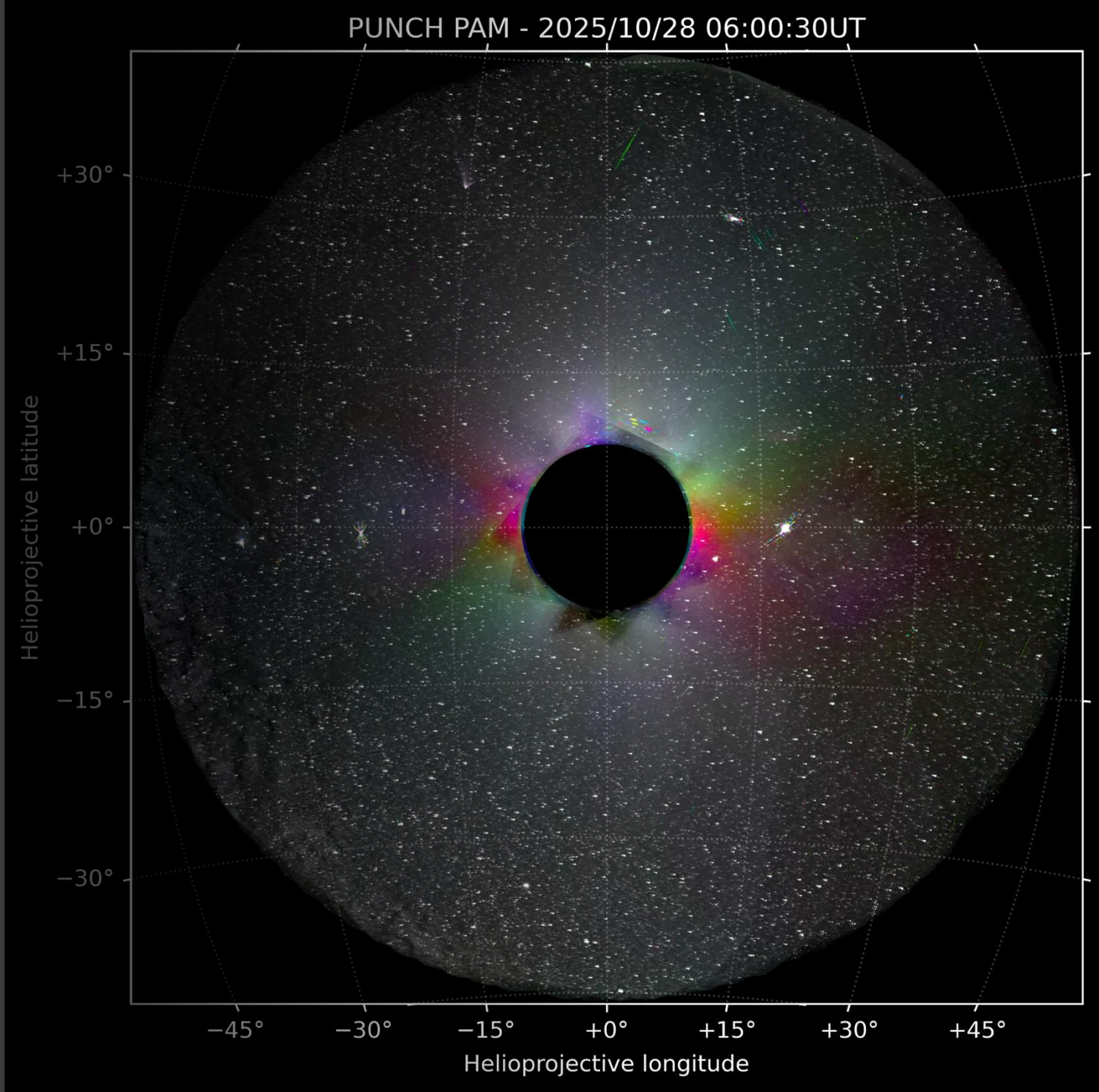
PUNCH Polarimetry



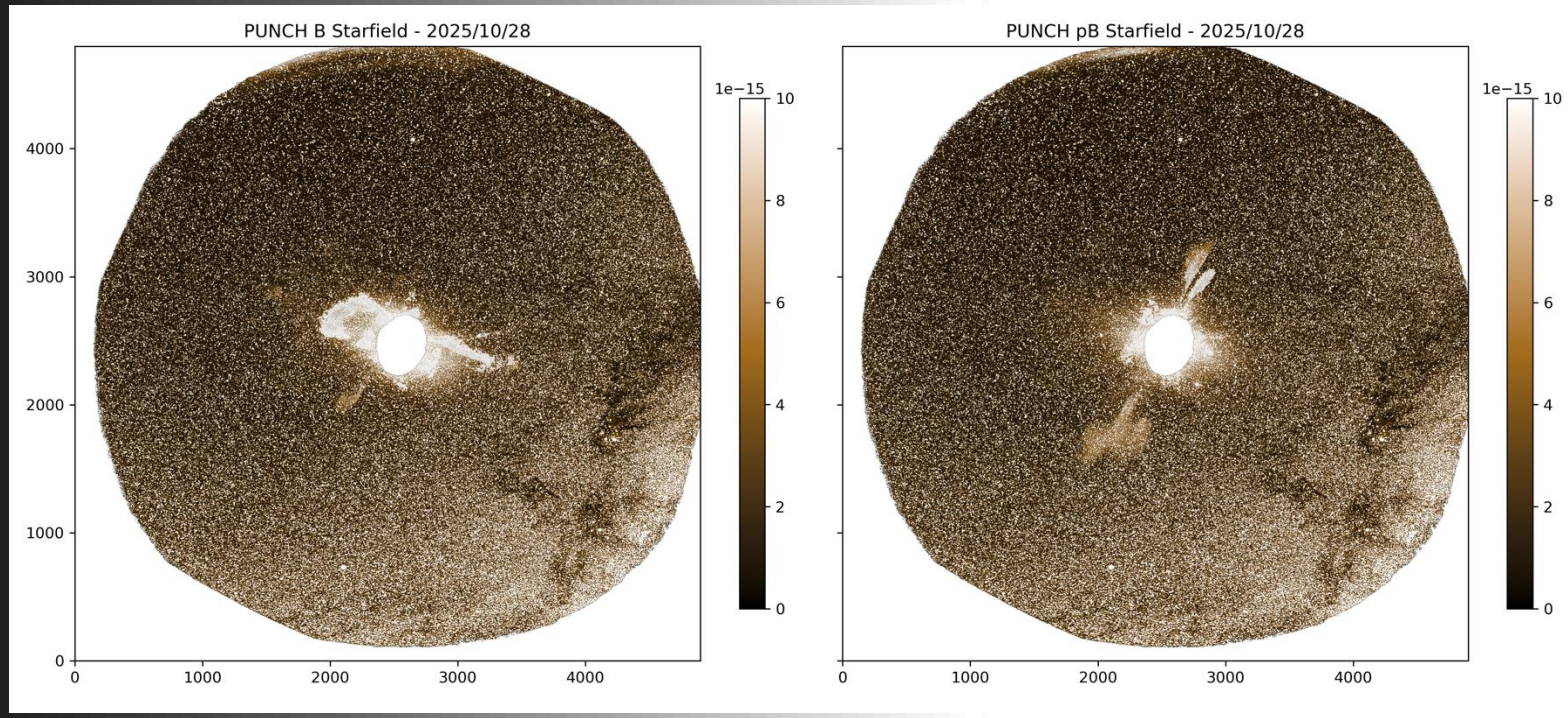
PUNCH Polarimetry



PUNCH Polarimetry

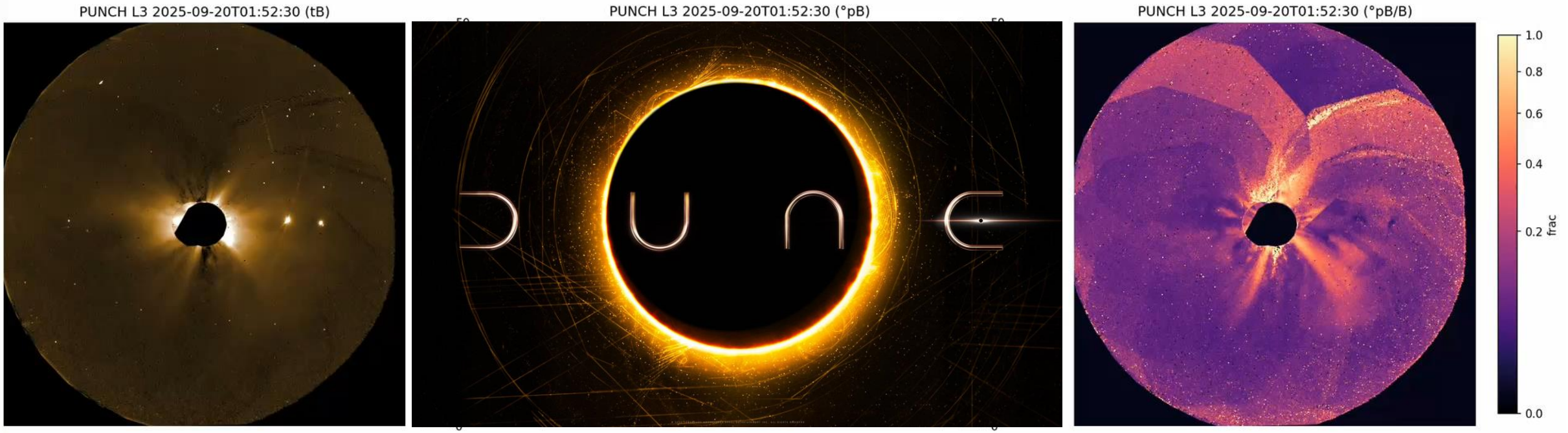


PUNCH Polarimetry



PUNCH Polarimetry

(DeForest et al.)



Summary

- With wide field of view comes wider challenges.
- Backgrounds at various reference frames has to be removed to reveal the heliospheric polarization.
- Level 3 polarized data products are corrected for non-relevant polarized signals.