

Polarimeter to Unify the Corona and Heliosphere



Science Operations Center
Development

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SOC Members



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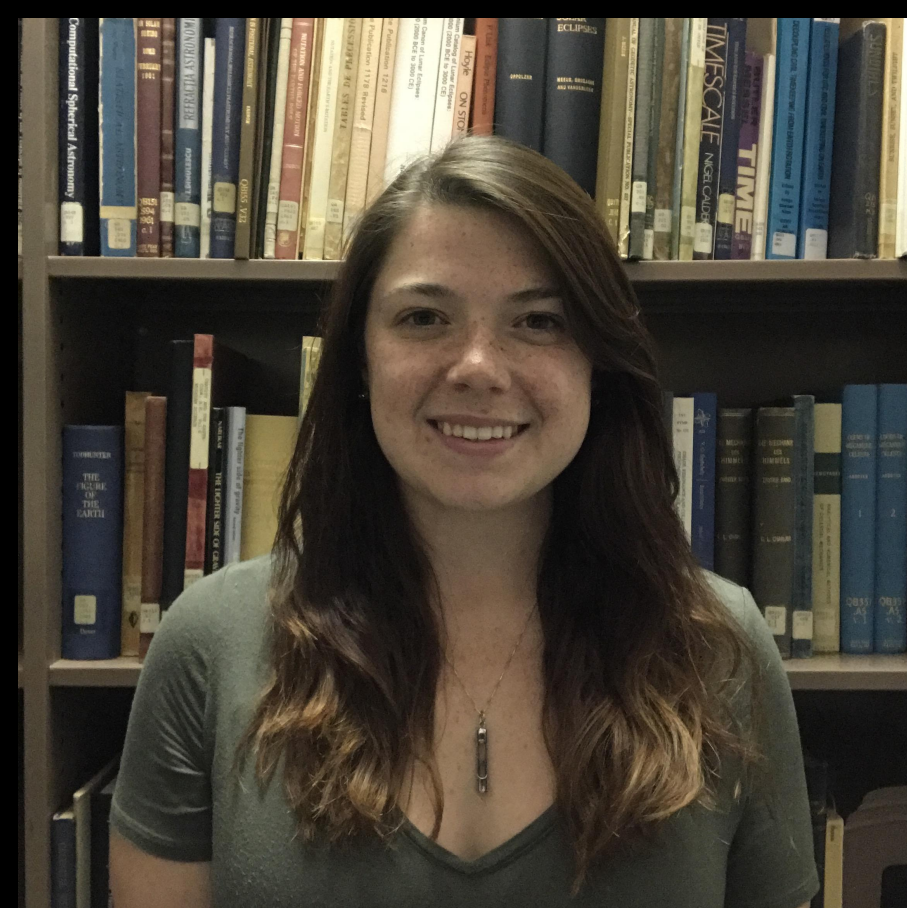
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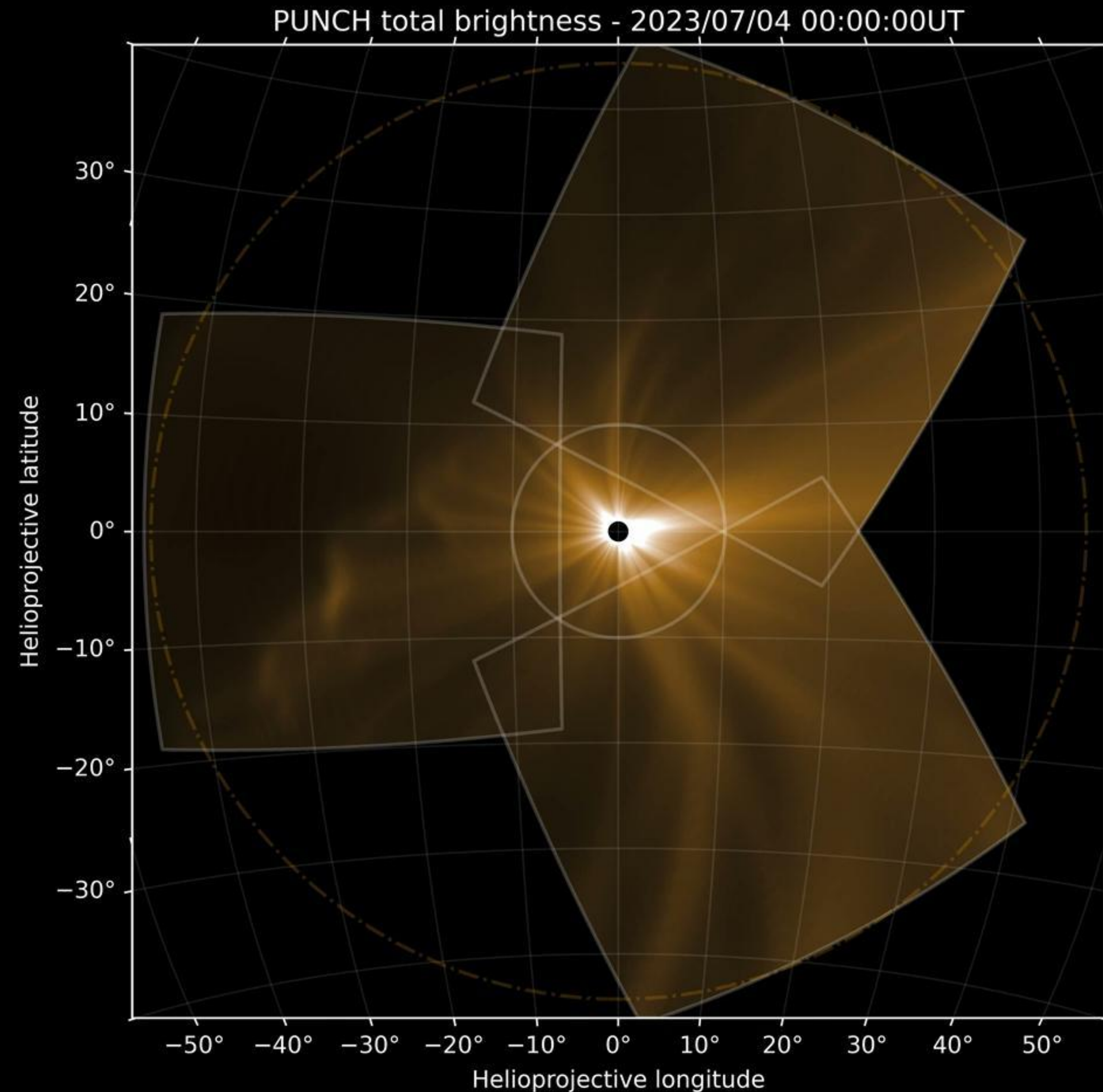


Matt West



Many Observations Make Combined Virtual Observatory

- PUNCH observes continuously at 4-min. cadence
- NFI covers 5.4–32 R_{\odot}
- WFI covers 20–180 R_{\odot}
3 separate segments
- PUNCH produces 3 full mosaics per orbit, from 6–180 R_{\odot}

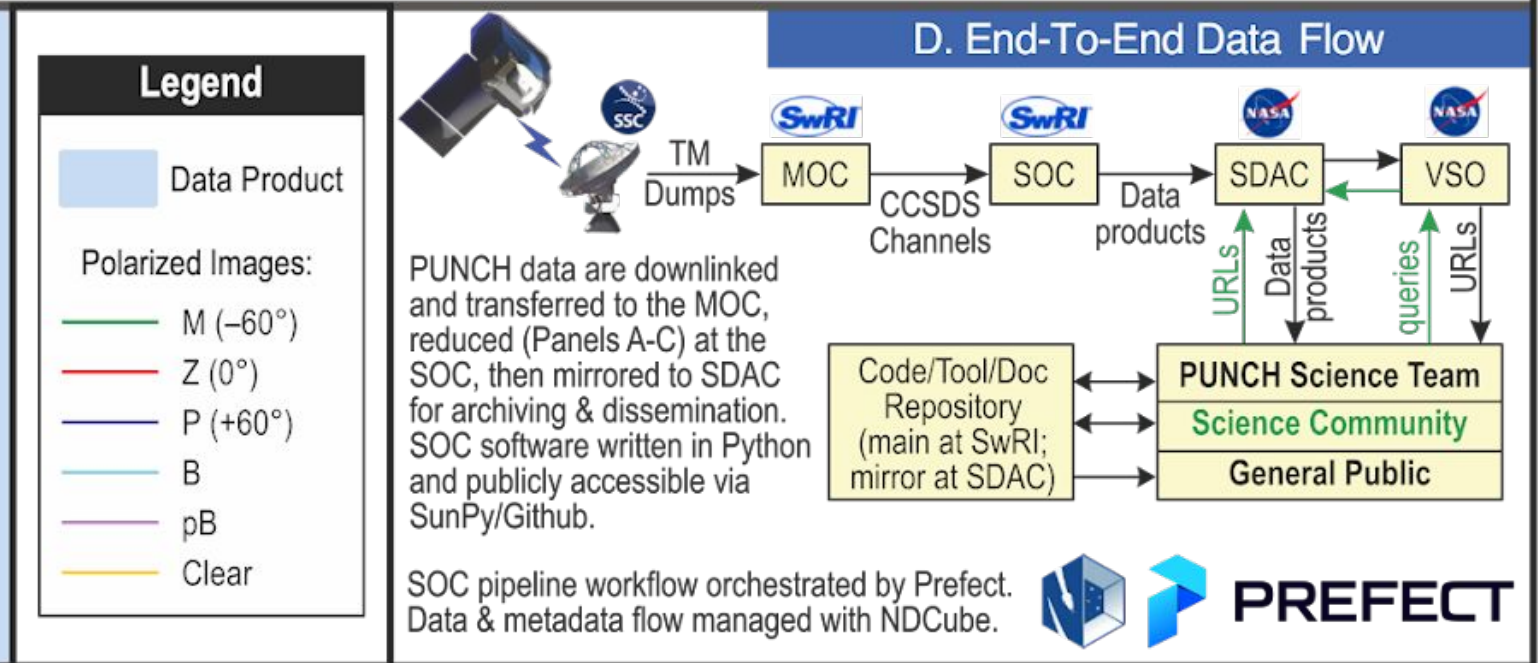
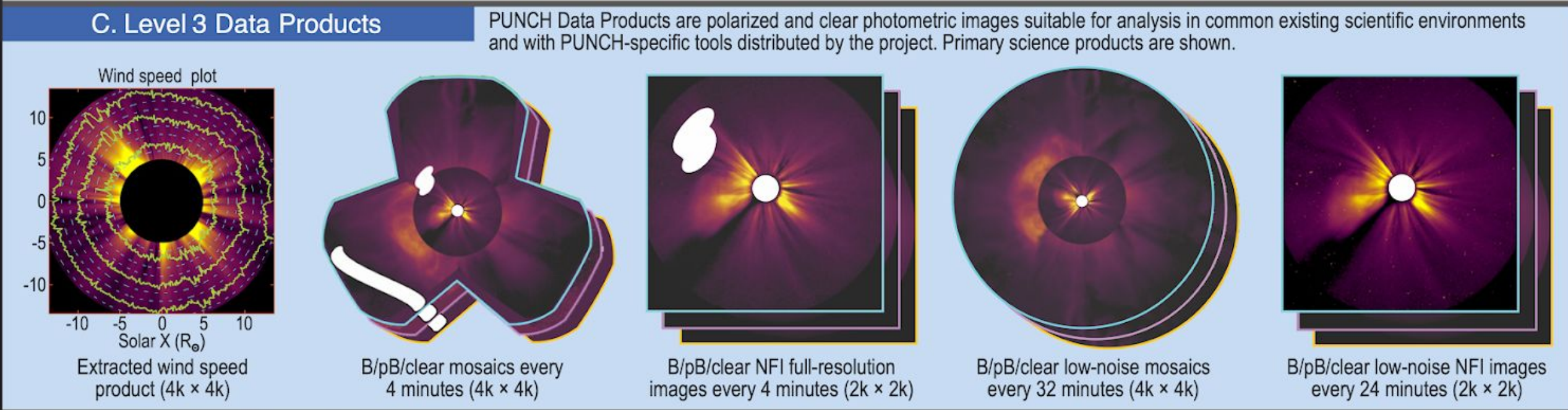
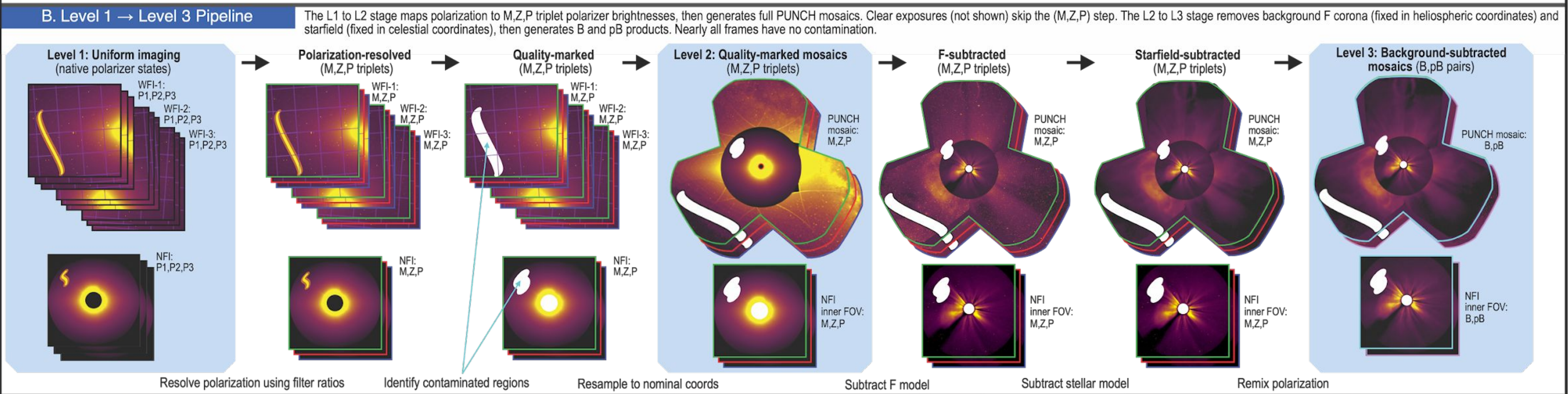
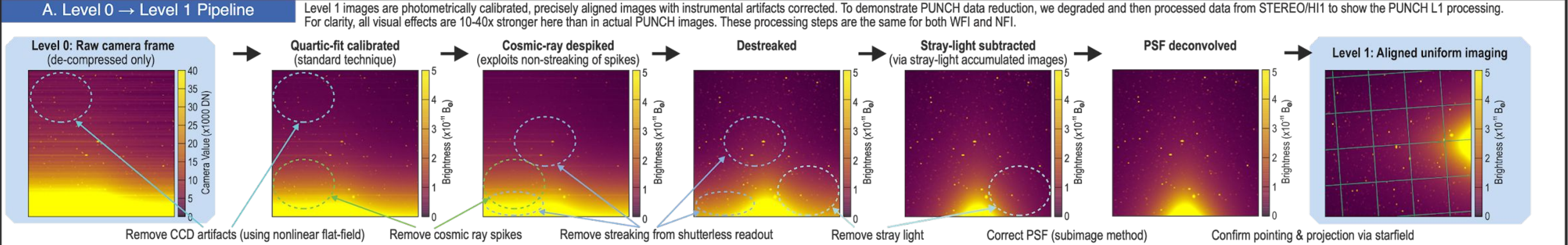




Level 1
Levels 2 & 3
L3 Products

PUNCH Science Data Pipeline and Products

For effective data analysis by the PUNCH team and the broader community, PUNCH produces (A-C) and disseminates (D) calibrated, simple-to-use data products and analysis tools.



Original figures and layout from PUNCH CSR



What are the Data Products?

Data products are described by level and product code:

L0_PM1: Level 0, Polarized Minus WFI-1

Full list of codes available in the punchbowl documentation (as shown on right)

The screenshot shows the 'punchbowl' website documentation page for 'Data Product Codes'. The page includes a navigation menu with 'Data' selected, a search bar, and a sidebar with 'Section Navigation' containing links for 'Accessing PUNCH Data', 'PUNCH data structure', 'Data Product Codes' (highlighted), and 'Metadata Description'. The main content area features the title 'Data Product Codes' and a paragraph explaining that PUNCH data products are organized into levels from Level 0 (raw camera data) to Level 3 (calibrated science data), with unique identifying product codes. Below this is a table titled 'Data Product Codes' with columns for Level, Code, and Description.

Level	Code	Description
0	PM1, PM2, PM3, PM4, PZ1, PZ2, PZ3, PZ4, PP1, PP2, PP3, PP4, CR1, CR2, CR3, CR4	Science images in the standard polarization (PM, PZ, PP) and clear (CR) states
0	PX1, PX2, PX3, PX4	Science images in a nonstandard polarization state
0	ST	STEAM data packet (CSV format)
1	PM1, PM2, PM3, PM4, PZ1, PZ2, PZ3, PZ4, PP1, PP2, PP3, PP4, CR1, CR2, CR3, CR4	Science images in the standard polarization (PM, PZ, PP) and clear (CR) states (photometrically calibrated)



What are the Data Products?

Level 0: Almost straight from the satellite, no calibrations applied

Level 1: Photometrically calibrated

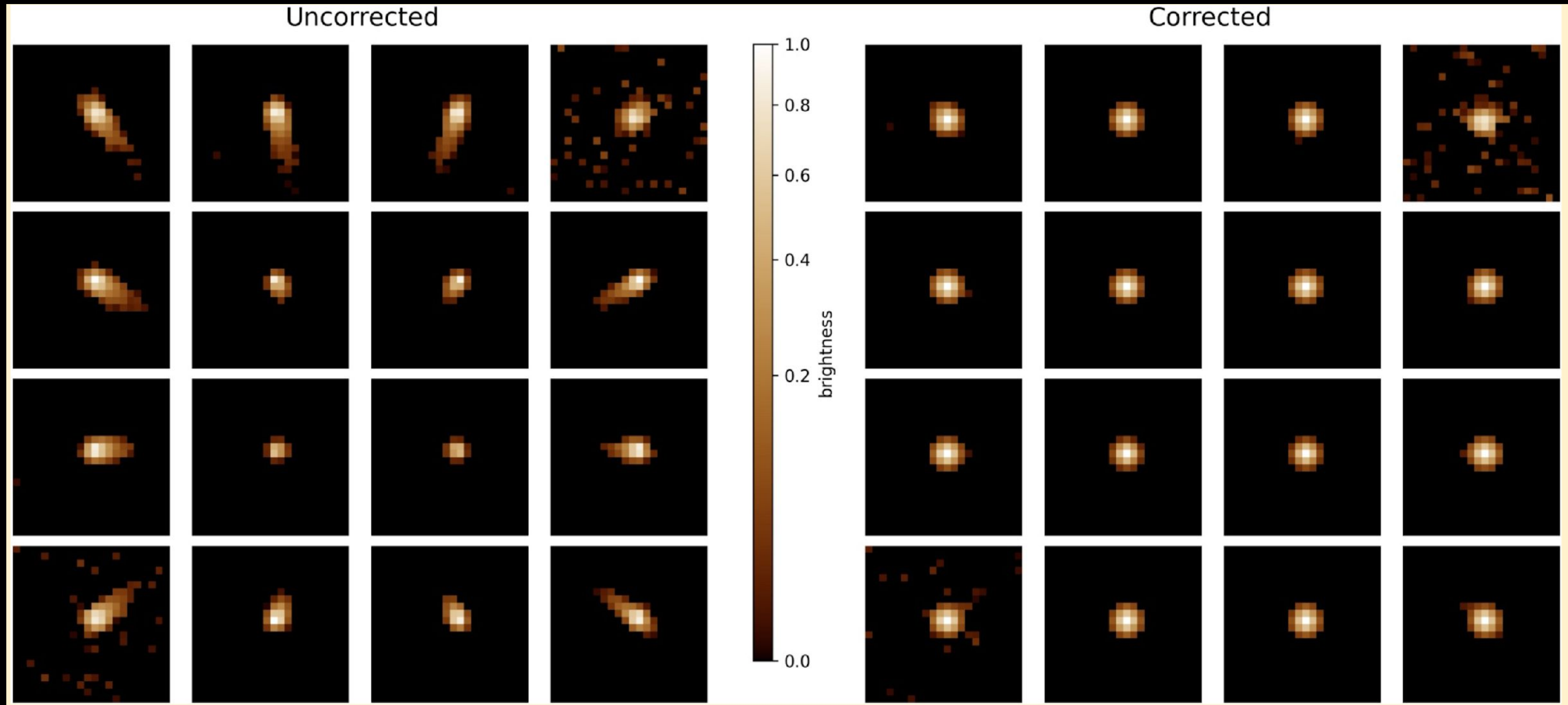
Level 2: Trefoils with polarization resolved

Level 3: Highly calibrated images (stars and F-corona removed) including wind speed maps and low noise mosaics

Level Q: QuickPUNCH products (much like level 2 but with a different resolution and FOV)



Level 0 \rightarrow 1: Point-Spread Function Regularization



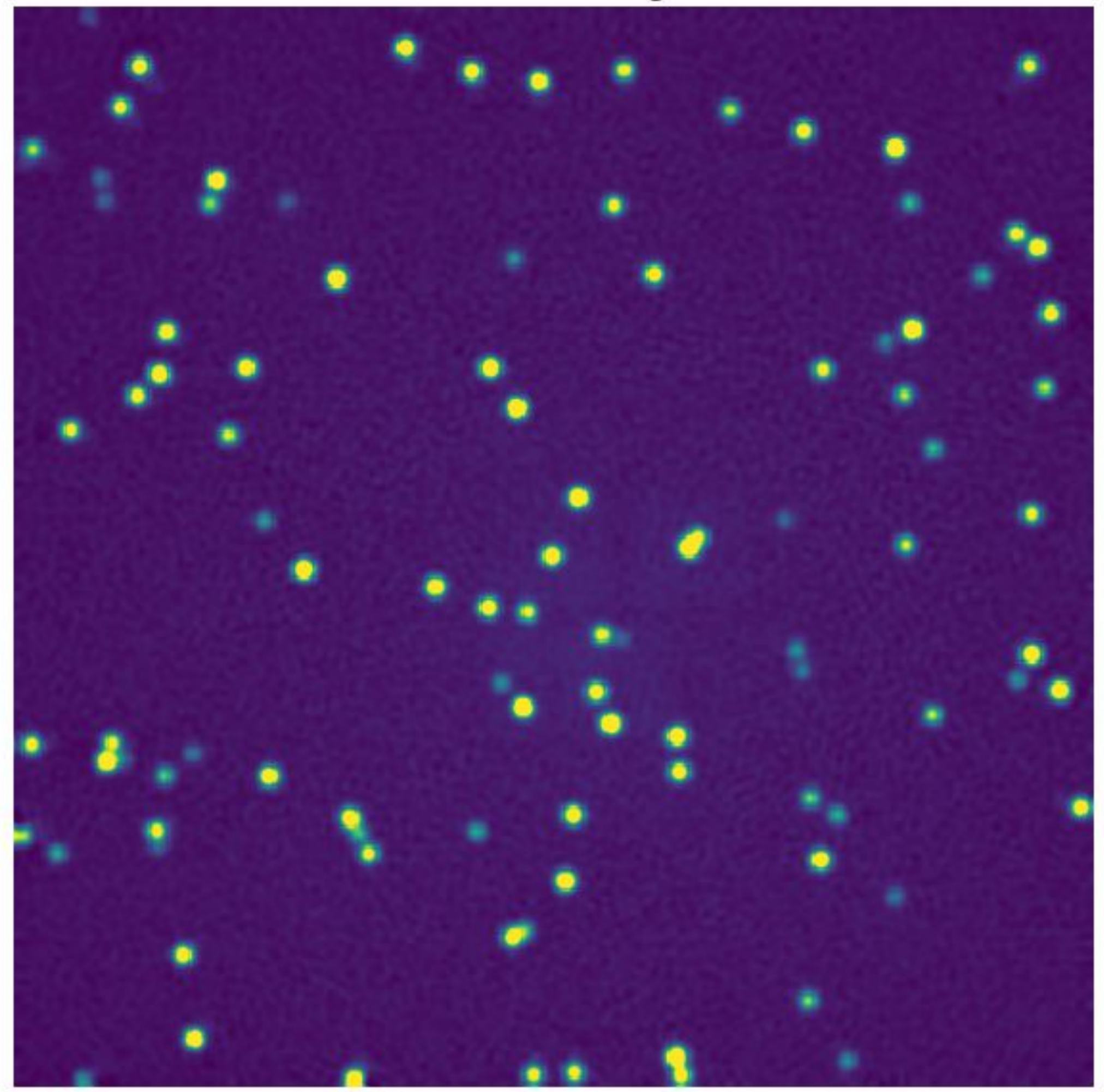
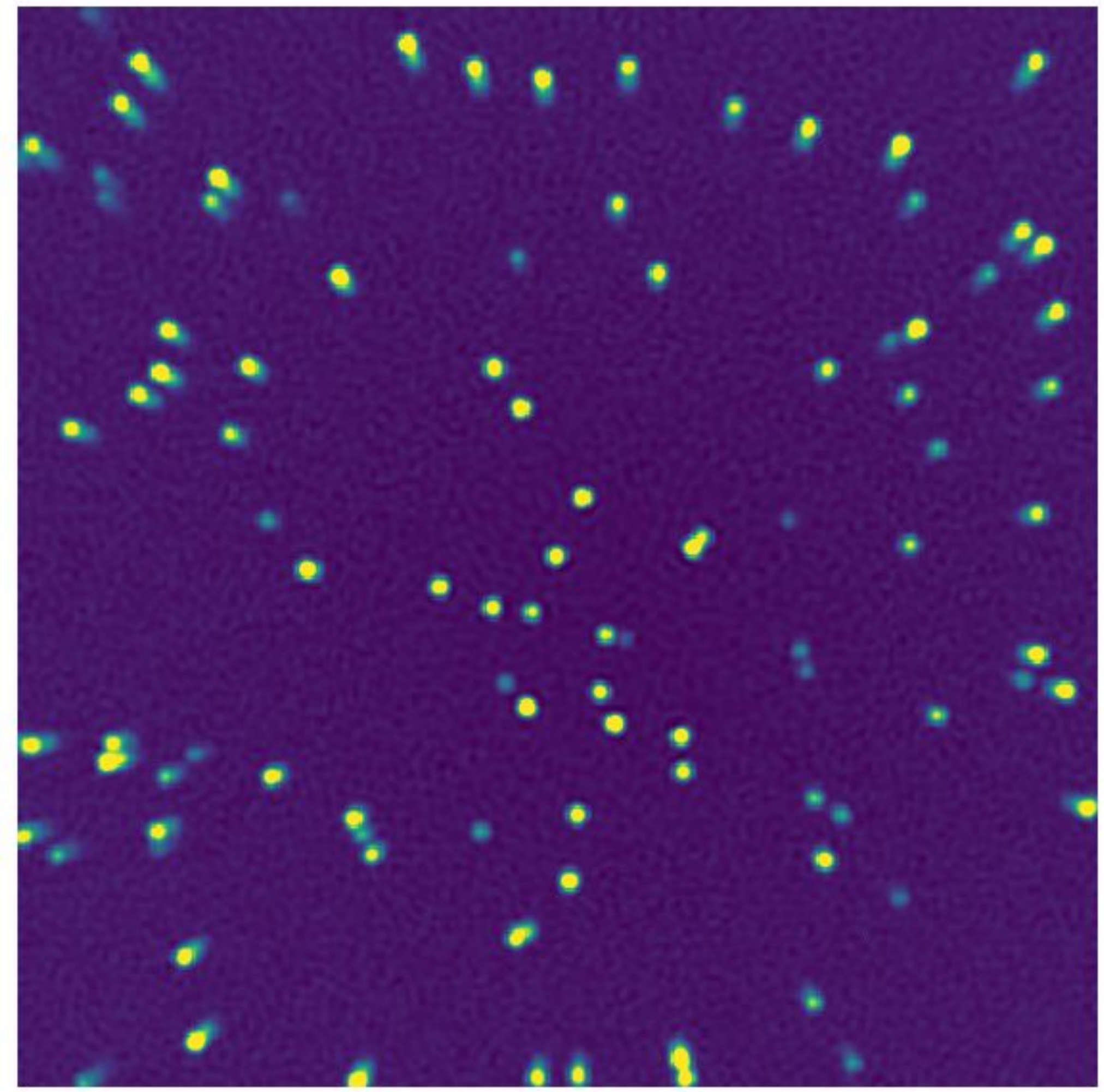
Careful treatment of the PSF is necessary
create seamless mosaics.



Level 0 \rightarrow 1: Point-Spread Function Regularization

Observation

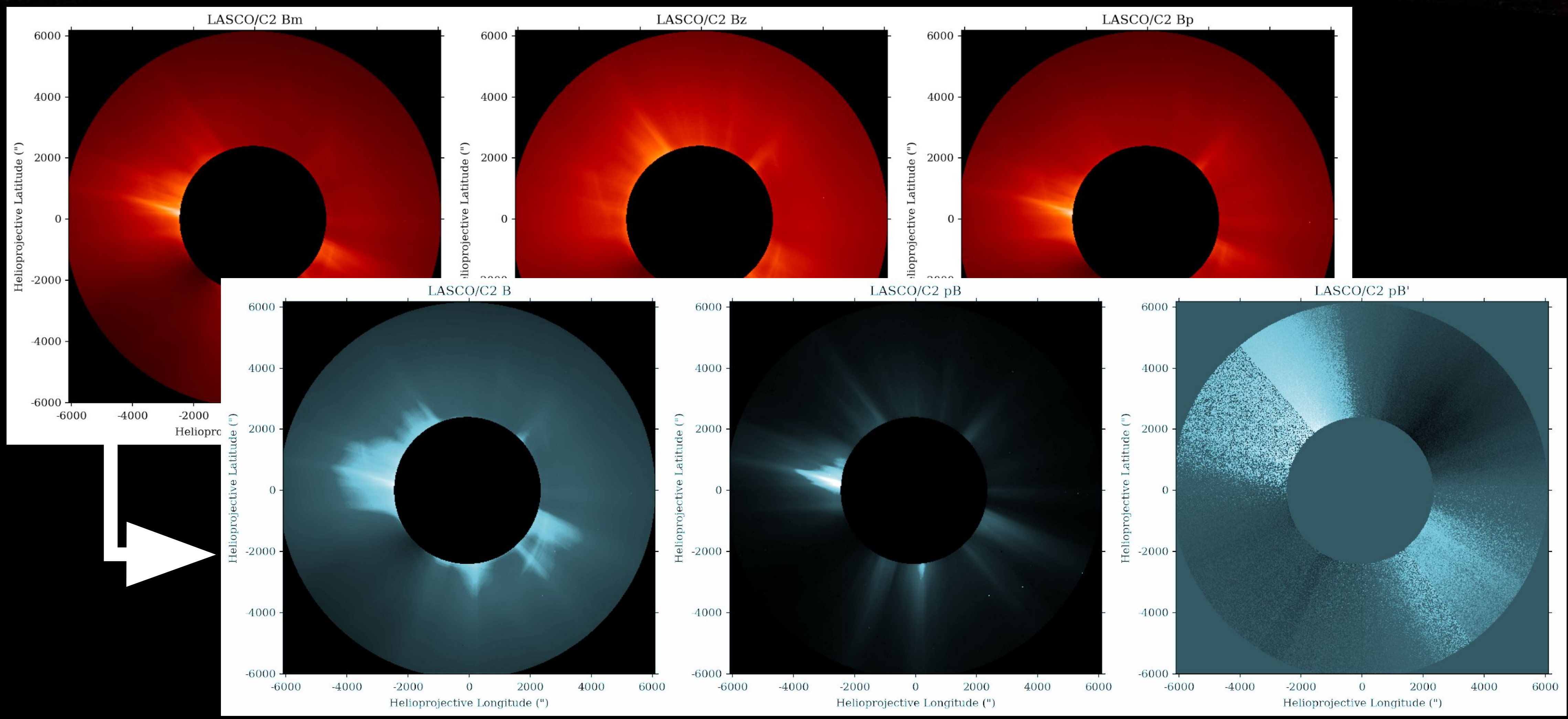
Corrected image



And we can do it!



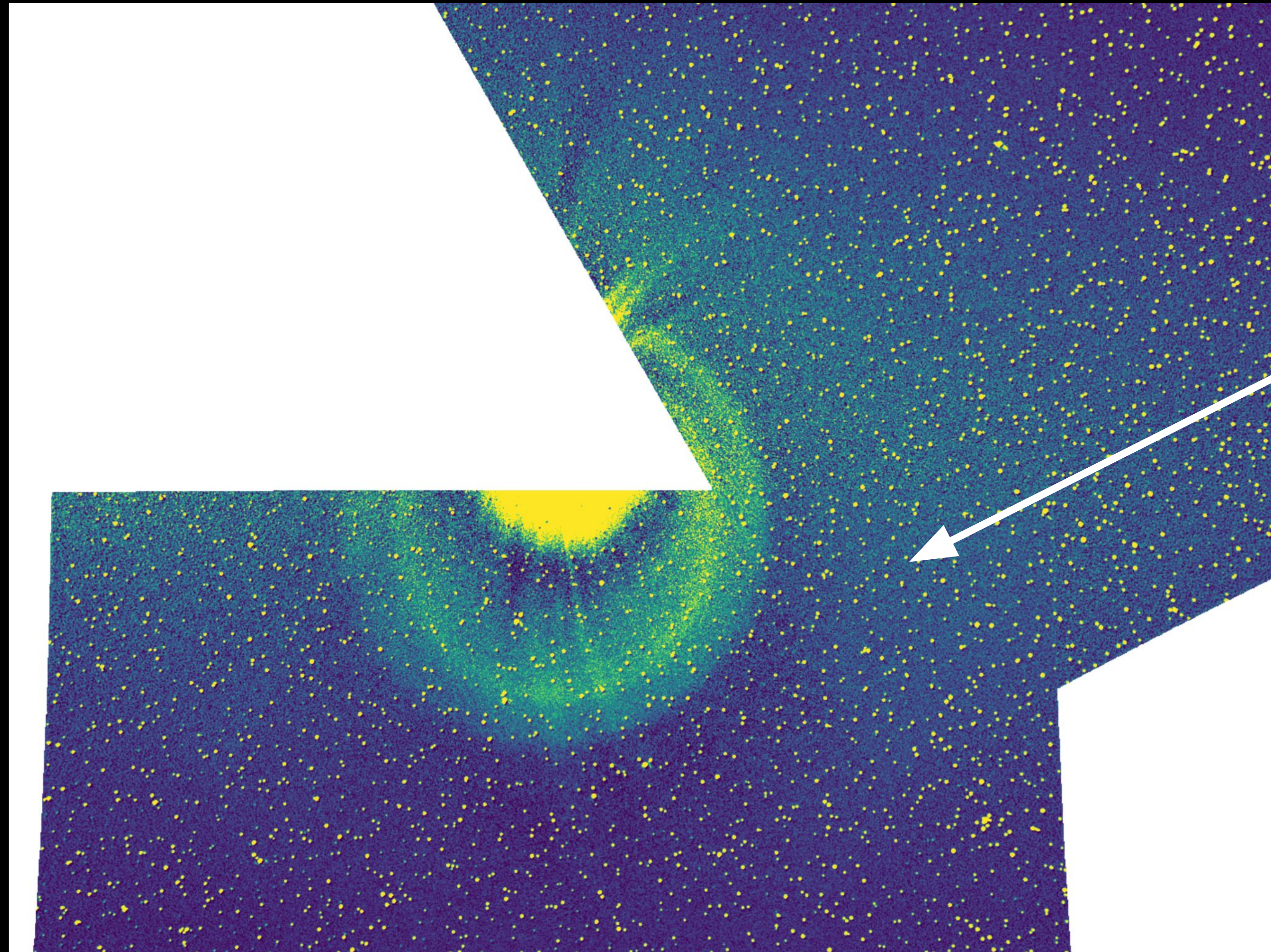
Level 1 \rightarrow 2: Polarization resolution via *solpolpy*



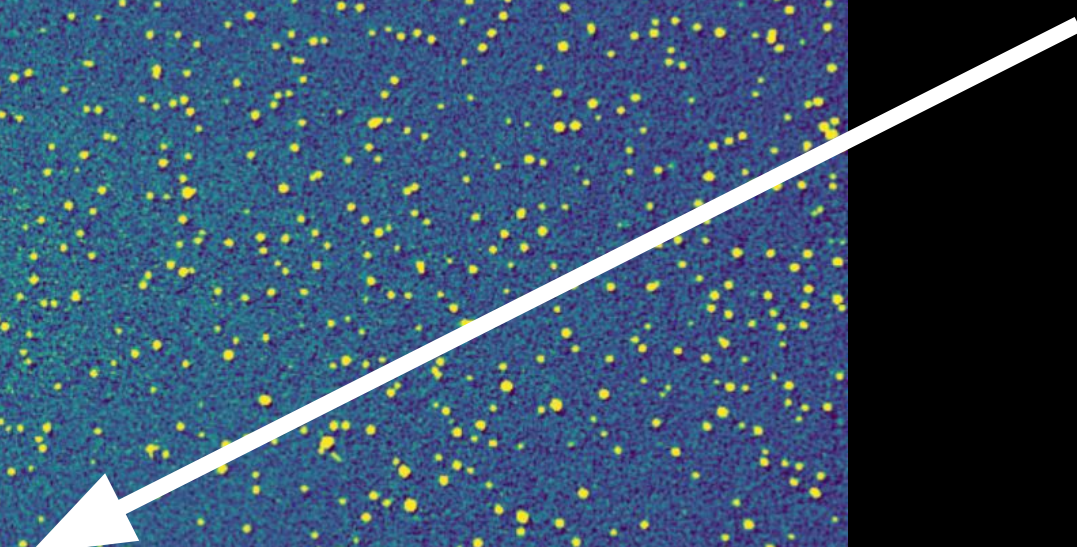
9 *solpolpy* converts from arbitrary polarization measurements to common bases.



Level 1 → 2: Mosaic Building



No artifacts!

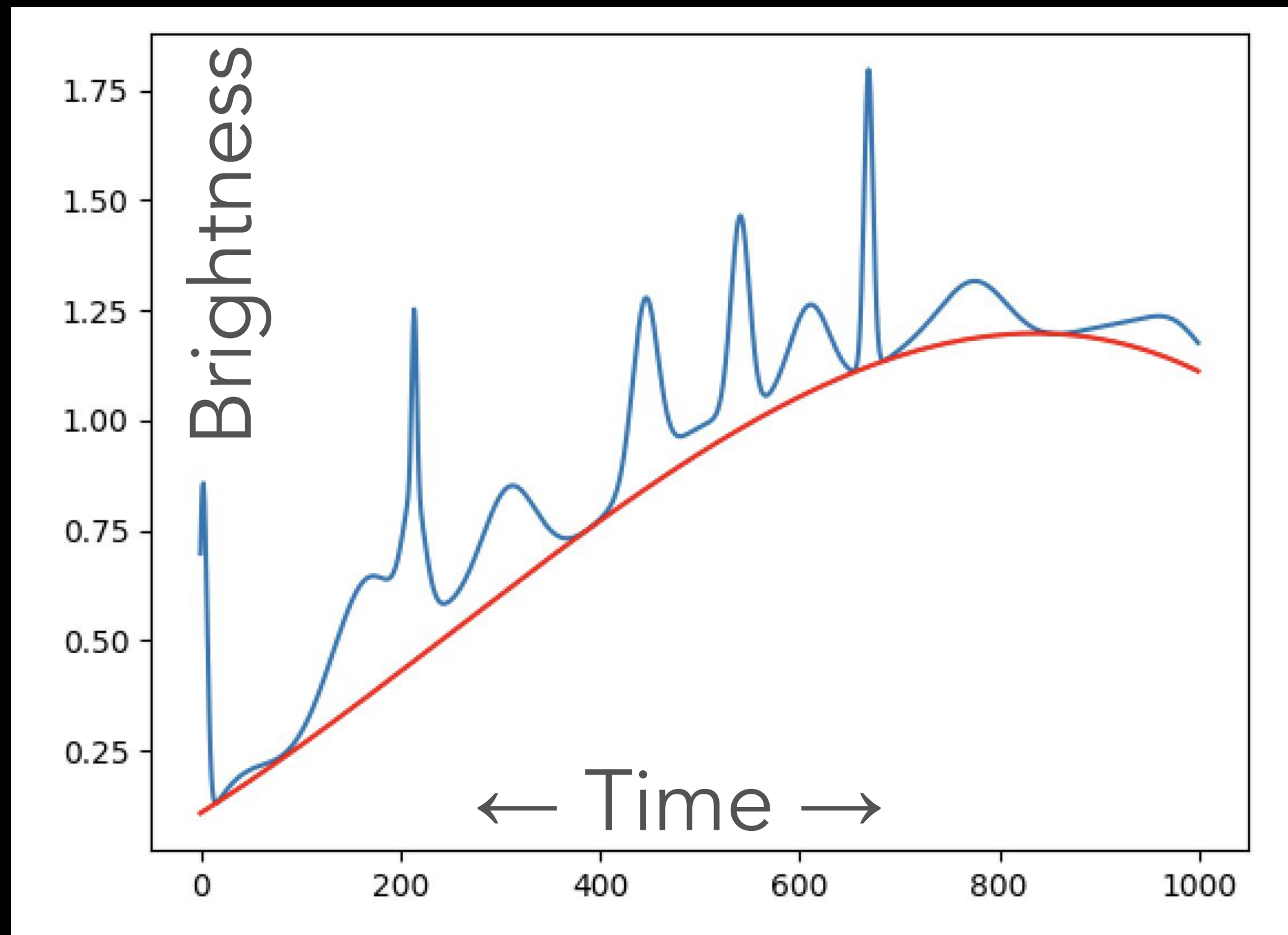


Successful Level 0 → Level 1 processing enables seamless mosaics

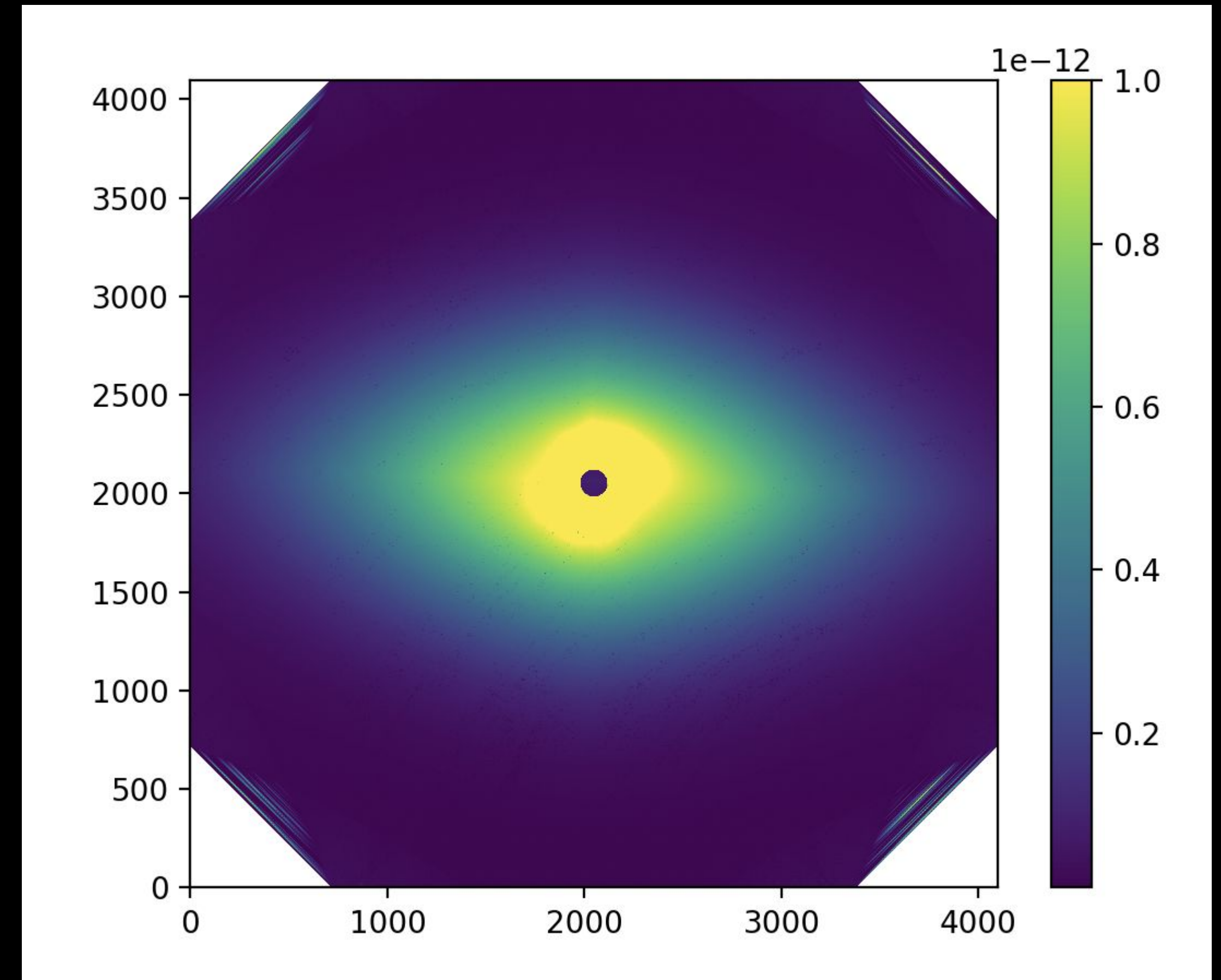


Level 2 → Level 3: F-corona Modeling

Blue: Pixel brightness over time
Red: Derived F-corona model



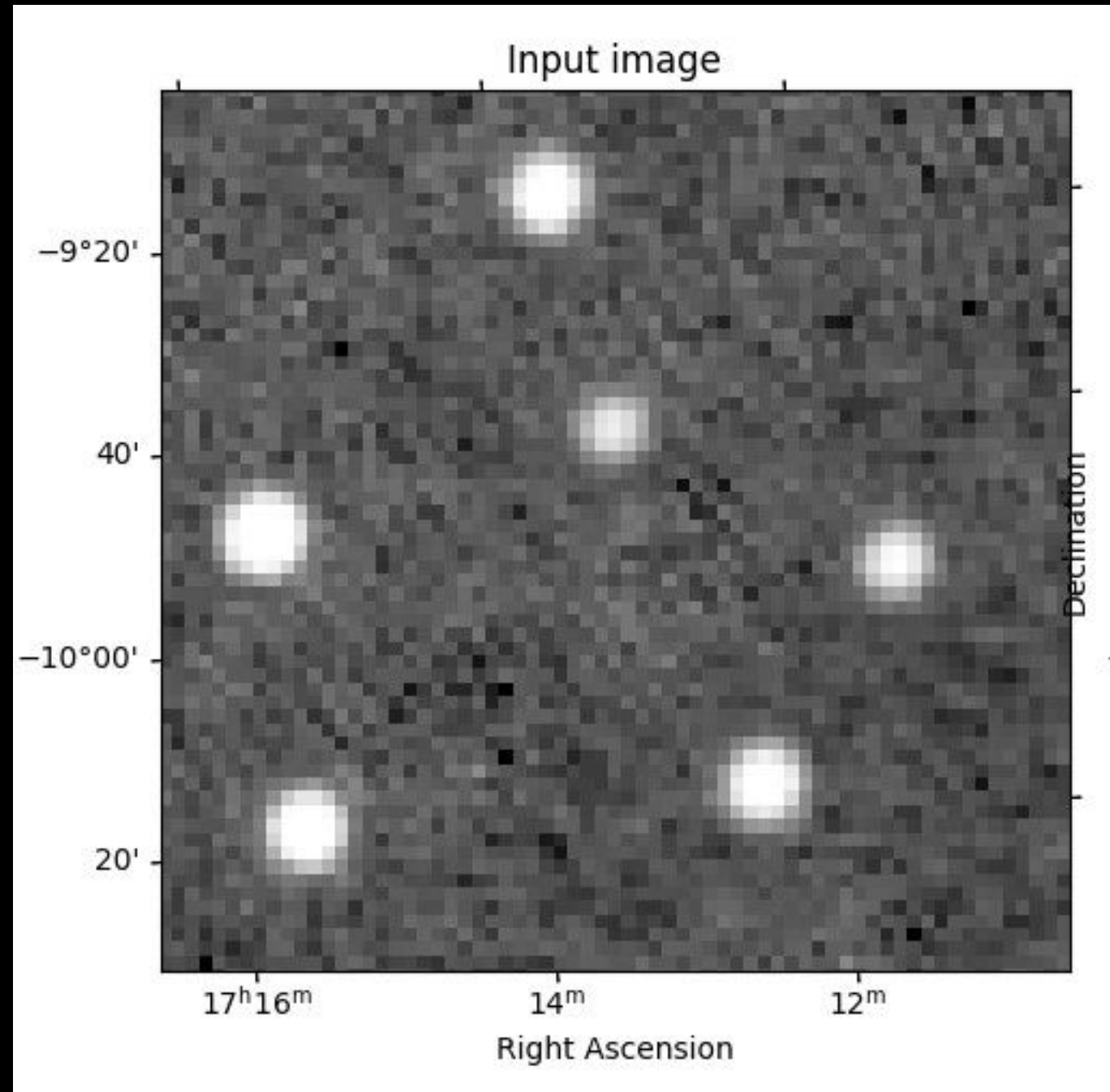
F corona model



For every pixel, we fit a time-series to estimate the F-corona model at a given time.

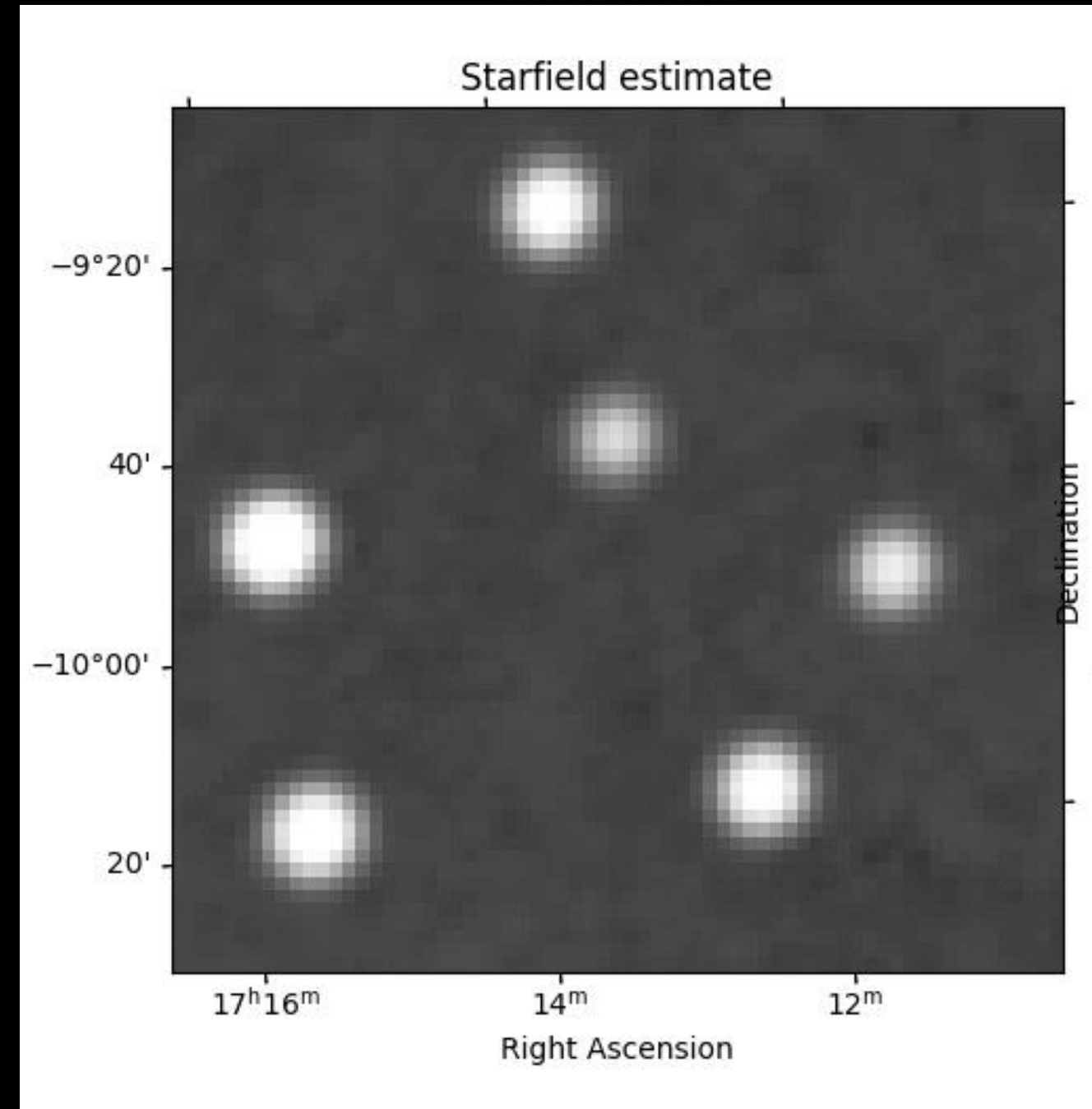


Level 2 \rightarrow Level 3 Starfield Subtraction



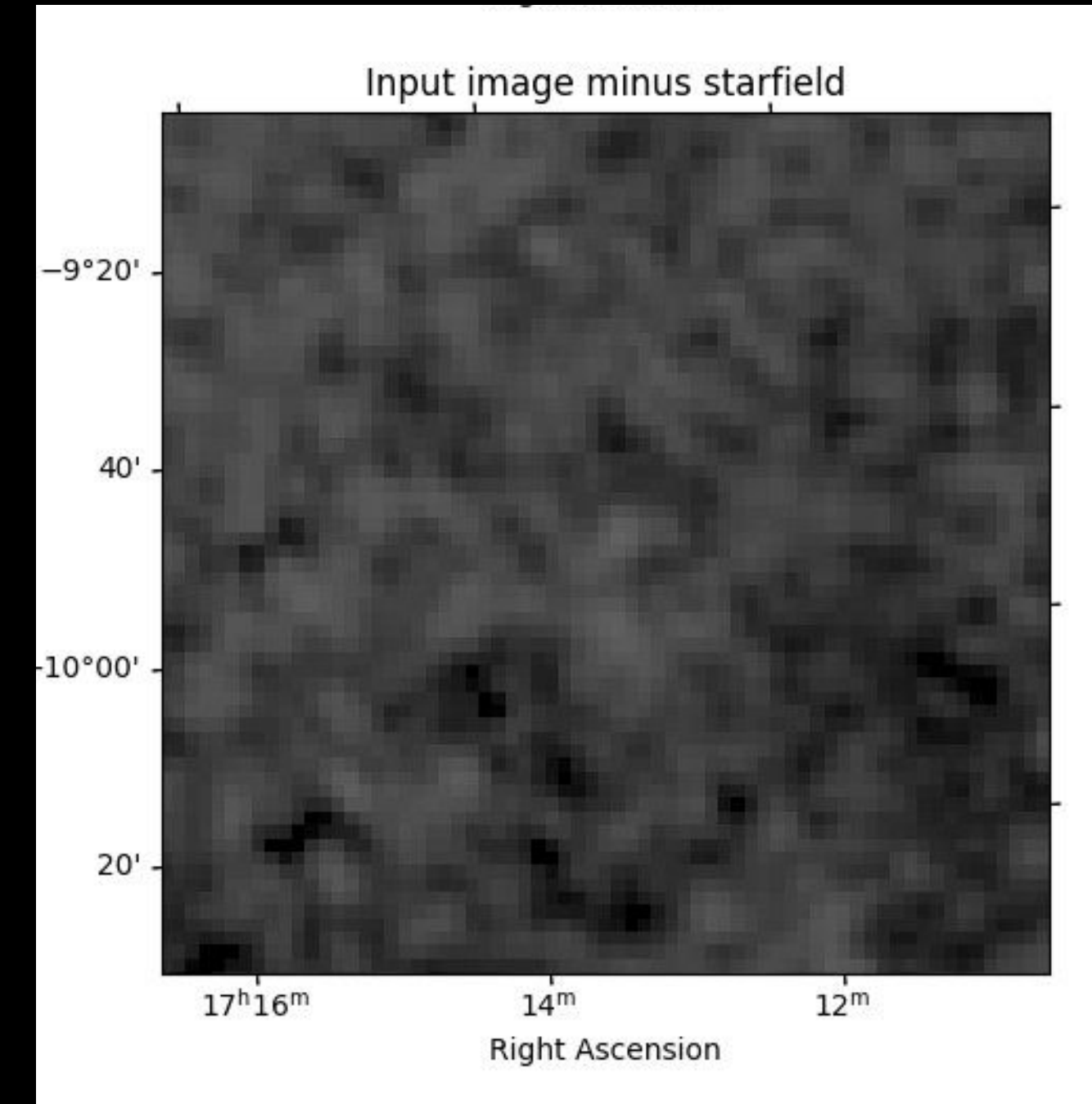
Level 2(ish) Image

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Starfield Model

=



Level 3 Image

We routinely build starfield models from PUNCH observations.
Stay tuned to hear from Sam Van Kooten.



How to get data

Data will be available through the SDAC without any embargo.

Level 0 and 1 products are available the fastest.

Level 2 wait until all satellites have responded.

Level 3 require building the F-corona and starfield models and thus take a couple weeks.

VSO Time / Instrument Search Form
Version 1.2

All from Provider	All from	Source	Instrument	Date Range
<input type="checkbox"/> ESA	<input type="checkbox"/> PROBA2		<input type="checkbox"/> LYRA	2010.03.09 →
			<input type="checkbox"/> SWAP	2010.03.09 →
	<input type="checkbox"/> SOAR		<input type="checkbox"/> EUVI	2020.05.12 →
<input type="checkbox"/> HAO	<input type="checkbox"/> MLSO		<input type="checkbox"/> K-Cor	2013.09.30 →
			<input type="checkbox"/> chr	1996.04.20 - 2013.08.02
			<input type="checkbox"/> dpm	1994.02.20 - 2010.02.23
			<input type="checkbox"/> mk4	1998.10.01 - 2013.07.20
			<input type="checkbox"/> cp	1980.03.02 - 1989.11.18
<input type="checkbox"/> HSOS	<input type="checkbox"/> SMM		<input type="checkbox"/> SUTRI	2022.09.05 - 2022.12.05
<input type="checkbox"/> INAF-OACT	<input type="checkbox"/> SATech-01		<input type="checkbox"/> BE::Continuum	2012.01.02 →
	<input type="checkbox"/> OACT		<input type="checkbox"/> BE::Halpna	2012.01.02 →
			<input type="checkbox"/> Cook_Refractor	2009.01.02 →
<input type="checkbox"/> JSOC	<input type="checkbox"/> SDQ		<input type="checkbox"/> AIA	2010.05.12 →
			<input type="checkbox"/> HMI	2010.03.29 →
<input type="checkbox"/> KIS (unavailable)	<input type="checkbox"/> ChroTel		<input type="checkbox"/> ChroTel	2012.04.01 →
<input type="checkbox"/> KSO	<input type="checkbox"/> KSO		<input type="checkbox"/> CAII	2010.07.31 →
			<input type="checkbox"/> SHORTWAVE::LOBE:07	2007.11.06 - 2007.11.06
			<input type="checkbox"/> SHORTWAVE::SLIT:06	2006.04.12 - 2006.04.12
			<input type="checkbox"/> SHORTWAVE::SLIT:07	2007.11.06 - 2007.11.06
	<input type="checkbox"/> FOXS1		<input type="checkbox"/> FOXS1	2012.11.02 - 2012.11.02
	<input type="checkbox"/> FOXS2		<input type="checkbox"/> FOXS2	2014.12.11 - 2014.12.11
	<input type="checkbox"/> FOXS3		<input type="checkbox"/> FOXS3	2018.09.07 - 2018.09.07
	<input type="checkbox"/> Hinode		<input type="checkbox"/> PHOENIX	2018.09.07 - 2018.09.07
			<input type="checkbox"/> EIS	2006.10.23 →
			<input type="checkbox"/> SOT	2006.10.23 →
	<input type="checkbox"/> PUNCH-1		<input type="checkbox"/> WFI-1	2024.01.01 →
	<input type="checkbox"/> PUNCH-2		<input type="checkbox"/> WFI-2	2024.01.01 →
	<input type="checkbox"/> PUNCH-3		<input type="checkbox"/> WFI-3	2024.01.01 →
	<input type="checkbox"/> PUNCH-4		<input type="checkbox"/> NEI:0	2024.01.01 →
	<input type="checkbox"/> PUNCH-MOSAIC		<input type="checkbox"/> Polar_BpB	2024.01.01 →
			<input type="checkbox"/> Polar_MZP	2024.01.01 →
			<input type="checkbox"/> Unpolarized	2024.01.01 →
	<input type="checkbox"/> SDQ		<input type="checkbox"/> AIA	2012.05.11 →
	<input type="checkbox"/> SQ		<input type="checkbox"/> EUVI	2020.05.12 →
			<input type="checkbox"/> Metis	2021.12.03 →
			<input type="checkbox"/> SPICE	2020.11.17 →
			<input type="checkbox"/> SoloHI	2021.12.27 →
	<input type="checkbox"/> SQHQ[Finalized Data Bundles]		<input type="checkbox"/> CDS	1996.01.19 →



Join Us!

<https://github.com/punch-mission>



SCAN ME

GitHub repository page for **punch-mission**.

PUNCH Mission
a NASA mission to study the solar wind

31 followers | United States of America | <https://punch.space.swri.edu/> | punch_soc@swri.org

readme.md

PUNCH Mission

punch_fig_lowres.mp4

0:00 / 0:35

PUNCH is a NASA Small Explorer (SMEX) mission to better understand how the mass and energy of the Sun's corona become the solar wind that fills the solar system. Four suitcase-sized satellites will work together to produce images of the entire inner solar system around the clock. The movie above is an example of what one of the PUNCH Level 3 Products will look like.



Have a Discussion

<https://github.com/punch-mission>

The screenshot shows the GitHub profile for 'punch-mission'. At the top, there is a navigation bar with a search box and several utility icons. Below this is a horizontal menu with tabs for 'Overview', 'Repositories', 'Discussions', 'Projects', 'Packages', 'Teams', 'People', 'Insights', and 'Settings'. The 'Discussions' tab is highlighted with an orange circle. The main content area shows the profile header for 'PUNCH Mission', including a profile picture, a bio 'a NASA mission to study the solar wind', and an 'Unfollow' button. Below the header, there is a section for a 'readme.md' file, which displays the title 'PUNCH Mission'. To the right of the README, there is a 'View as: Public' dropdown menu and a note stating 'You are viewing the README and pinned repositories as a public user.' with a link to 'Get started with tasks that most successful'.

Each repository has a discussion (and issues) tab.

Feel free to open a discussion anywhere.

We'll respond.



Summary

- Data will be available through the Virtual Solar Observatory via the Solar Data Analysis Center
 - Retrieve with SunPy's search interface
 - Data will also be available in NASA HelioCloud

Related presentations:

- Chris Lowder: PUNCH Data—A Guided Tour
- Sam Van Kooten: Photometric starfield subtraction from PUNCH images
- Raphael Attie: Tracking Solar Wind Evolution with PUNCH Flow Maps

Polarimeter to Unify the Corona and Heliosphere



SCAN ME

We want to work with you!

github.com/punch-mission

punch_soc@swri.org