



# GOES-R Solar UltraViolet Imager Extended Coronal Imaging

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# Agenda

- Background
- Overview of the Campaign
- Preliminary Analysis Results
- Recommendation

# Geostationary Operational Environmental Satellite (GOES-R)

Launched:

GOES-R: November 19, 2016

GOES-S: March 1, 2018

Nadir-pointed instruments:

Advance Baseline Imager (ABI)

Geostationary Lightning Mapper (GLM)

Sun-pointed instruments:

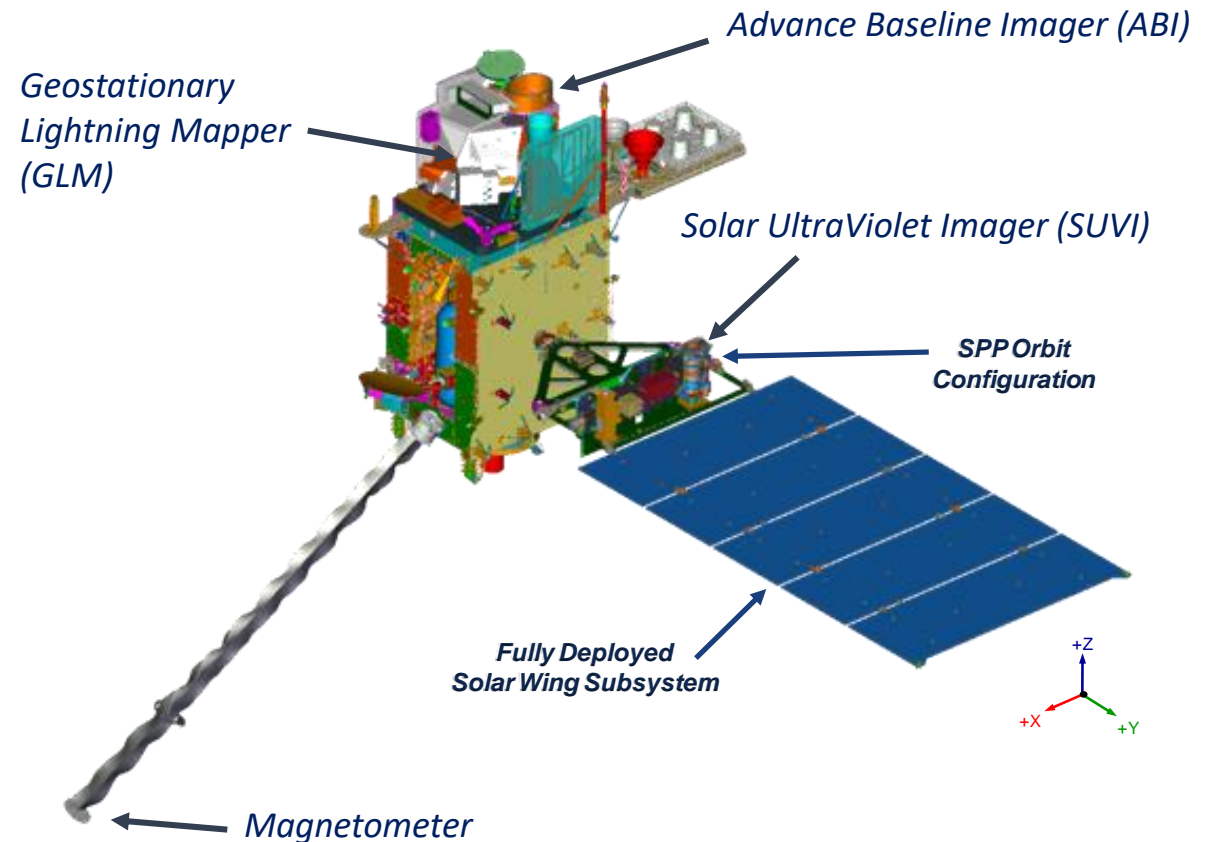
EUVS and X-ray Irradiance Suite (EXIS)

Solar UltraViolet Imager (SUVI)

Bus-mounted instruments:

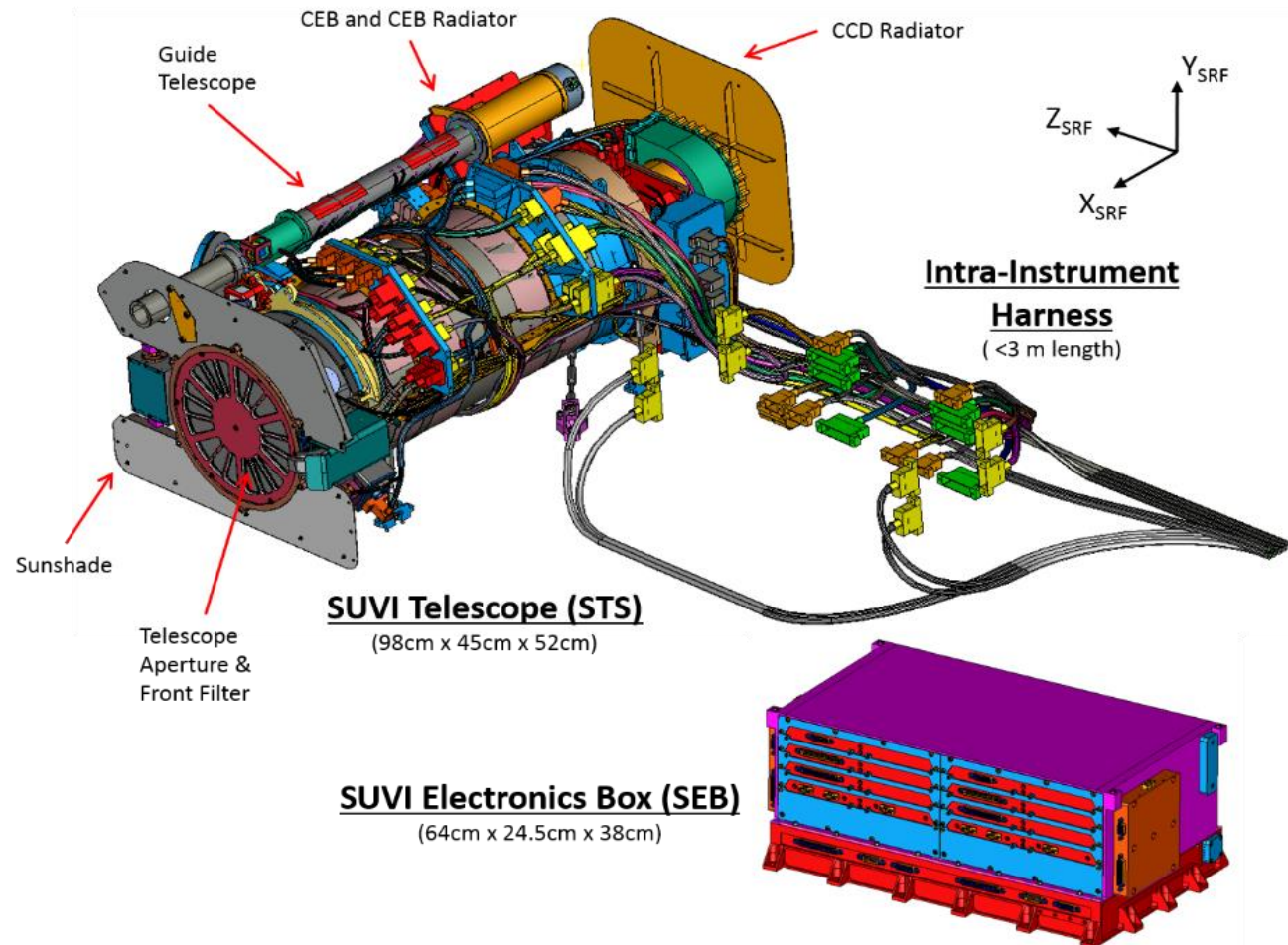
Space Environment In-Situ Suite (SEISS)

Magnetometer



# Solar UltraViolet Imager (SUVI)

- Generalized Cassegrain Telescope
- Multilayer coated primary and secondary mirrors
- Six channels:
  - 9.4nm, 13.1 nm, 17.1nm, 19.5nm, 28.4nm, 30.4nm
- Entrance and analysis filters for bandpass & OOB rejection
- 53 arcmin x 53 arcmin CCD
- Guide Telescope (GT) provides Sun-pointing information
- Spacecraft controls gimbals with the GT data







# Motivation

## Observation:

- SUVI image shows significant corona
  - ❖ Largest among solar imagers
- No UV coronagraphs

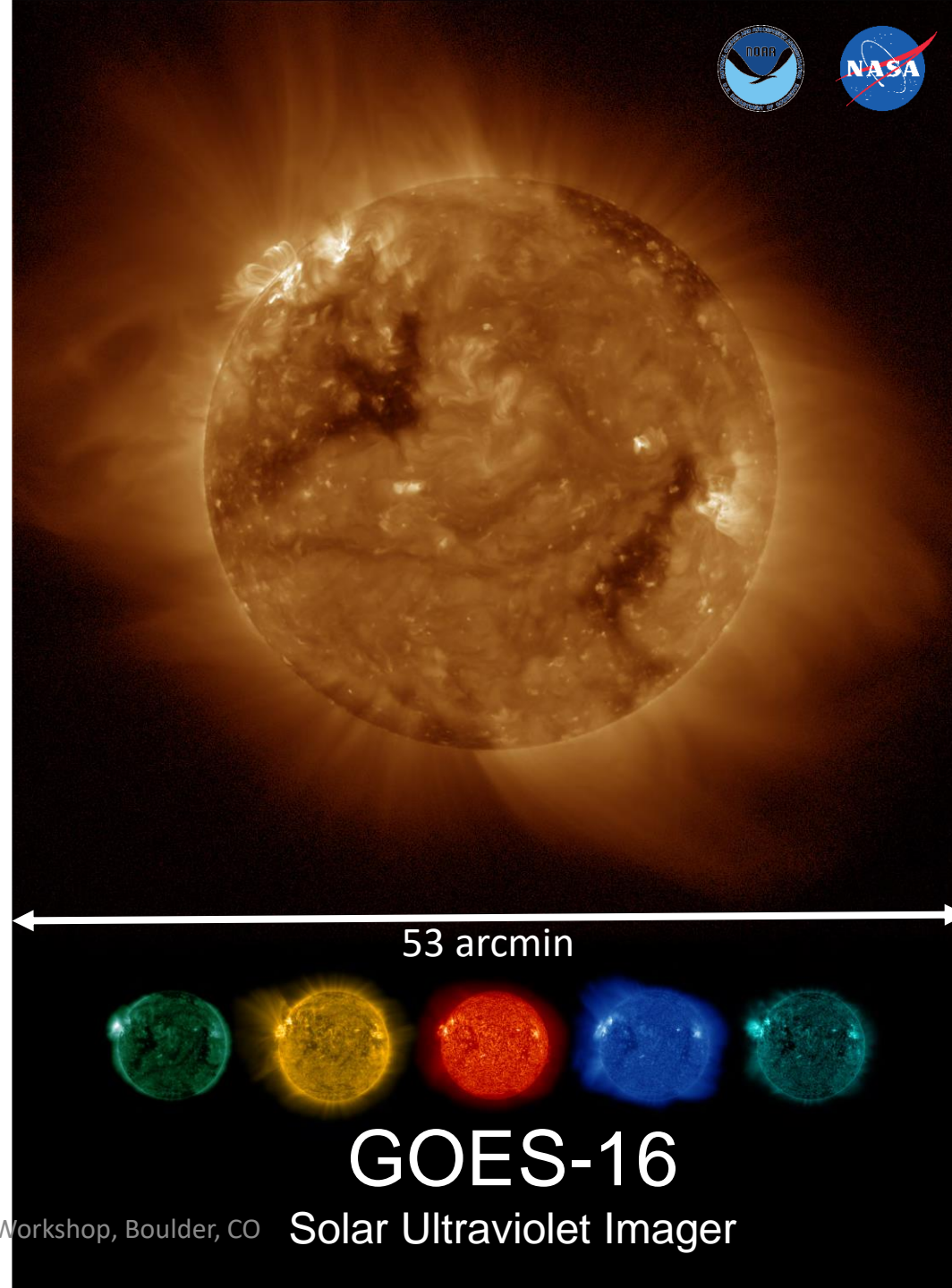
## Action:

- Image EUV corona up to a few solar radii
- Explore CME detection capability

## Implementation:

- Off-point SUVI Line-of-Sight away from the Sun

53 arcmin



53 arcmin

GOES-16

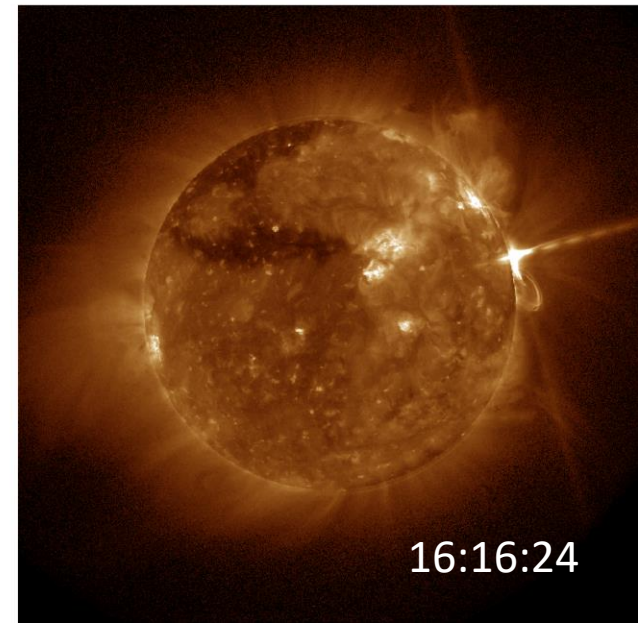
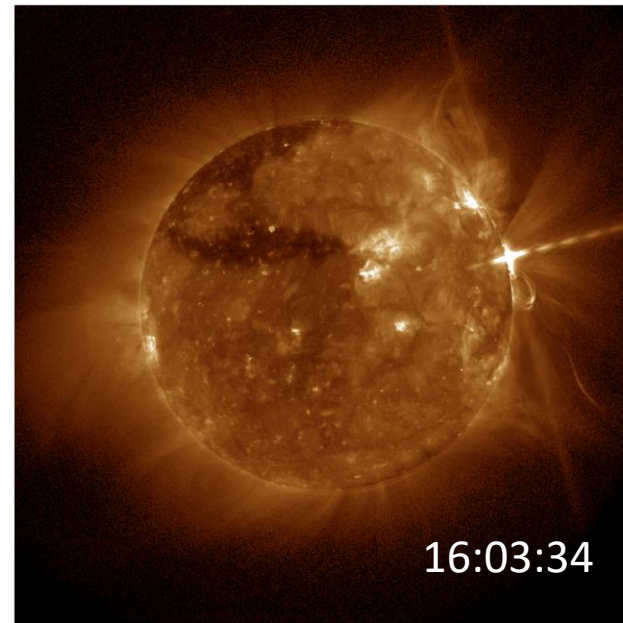
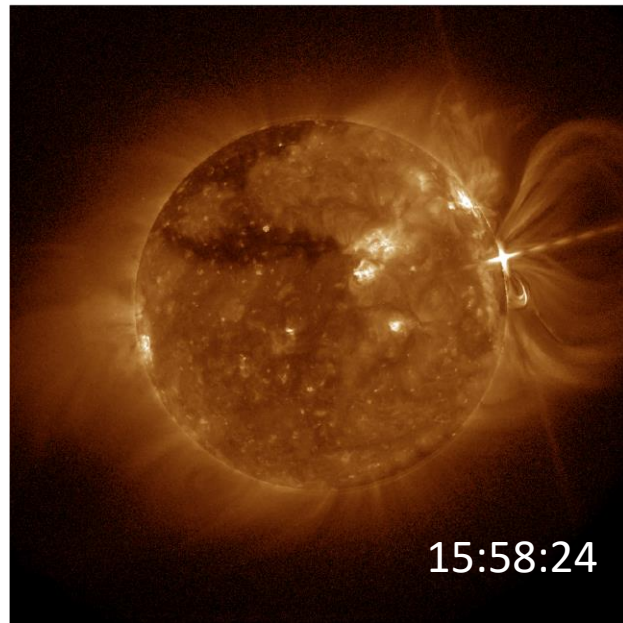
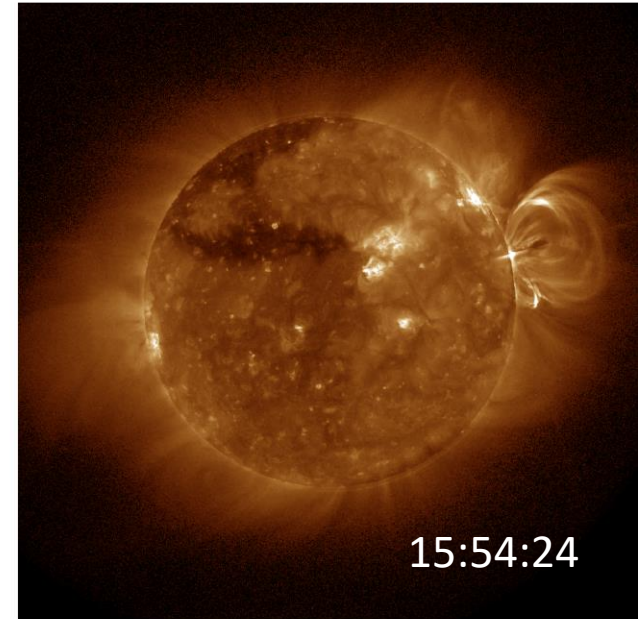
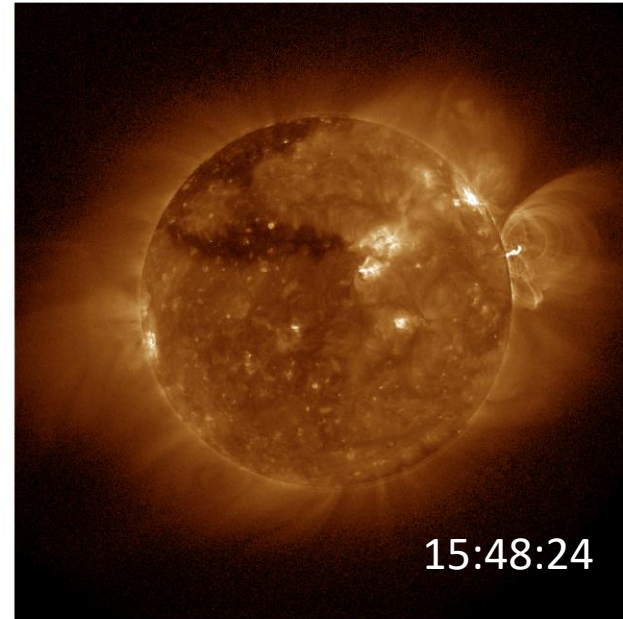
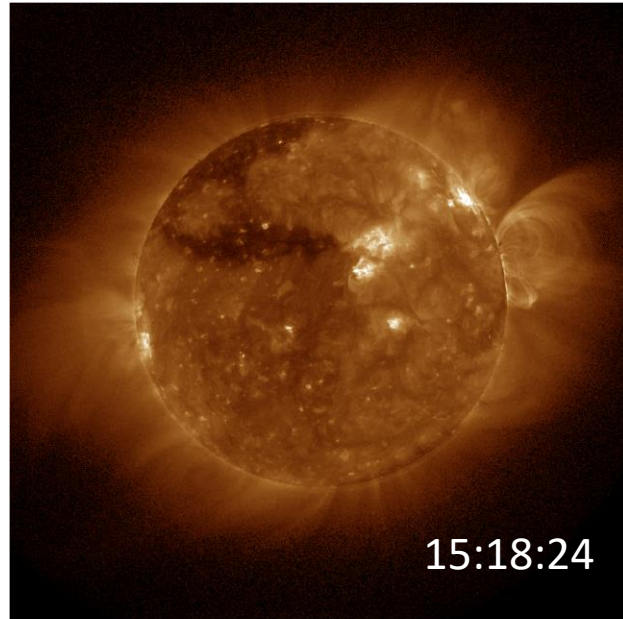
Solar Ultraviolet Imager



# Caught on camera: X8.2 flare

19.5 nm

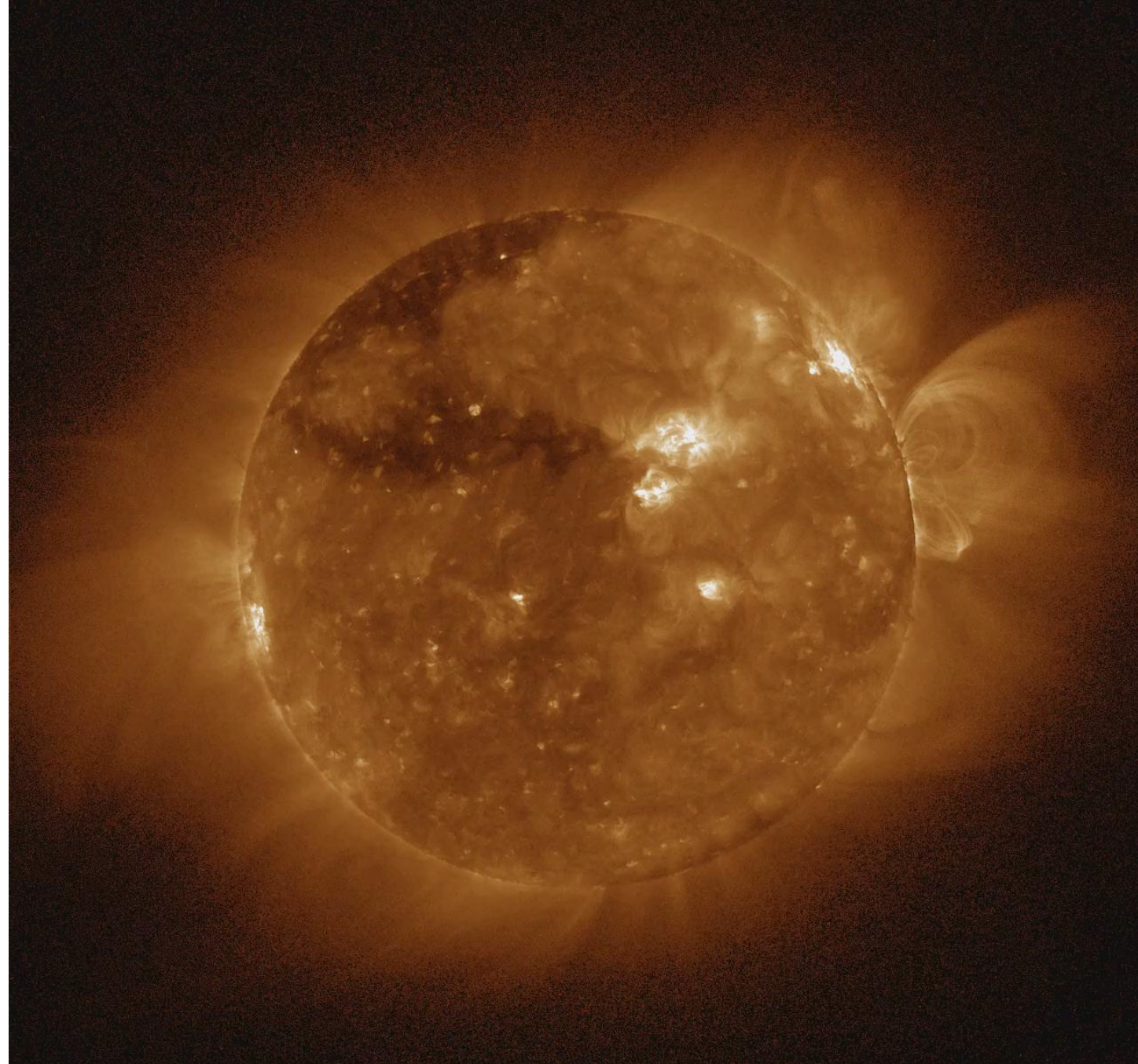
2017 September 10\*



\* Seaton, et al, The Astrophysical Journal Letters, 852:L9 (7pp), 2018 January 1

April 04, 2019



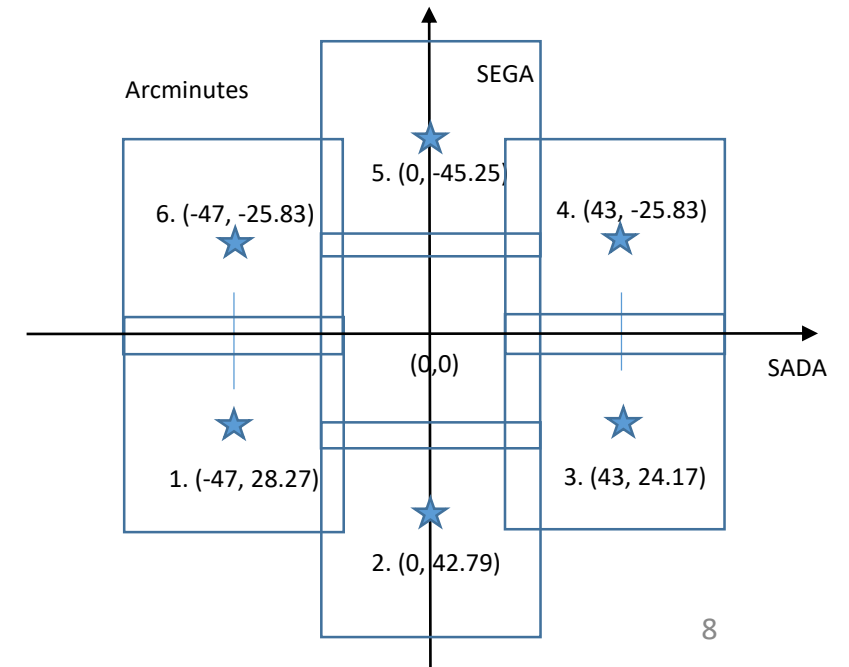
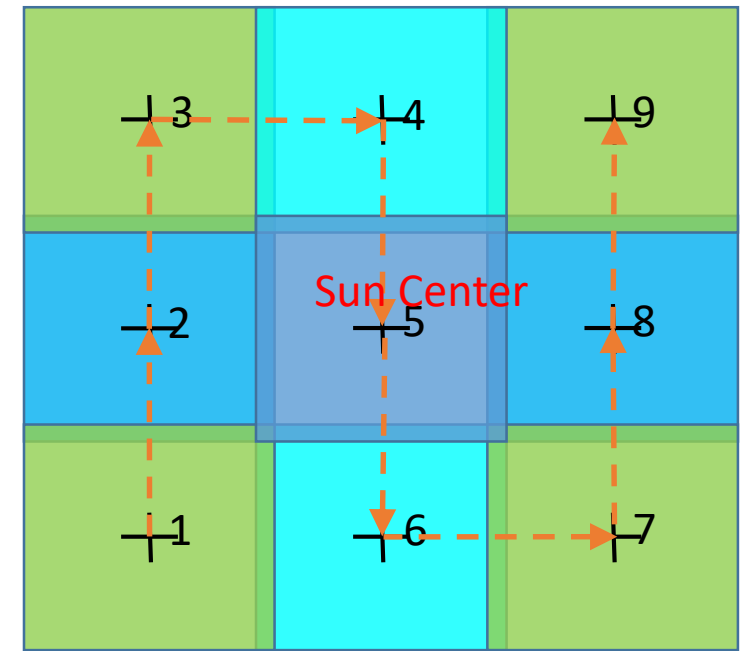


April 04, 2019

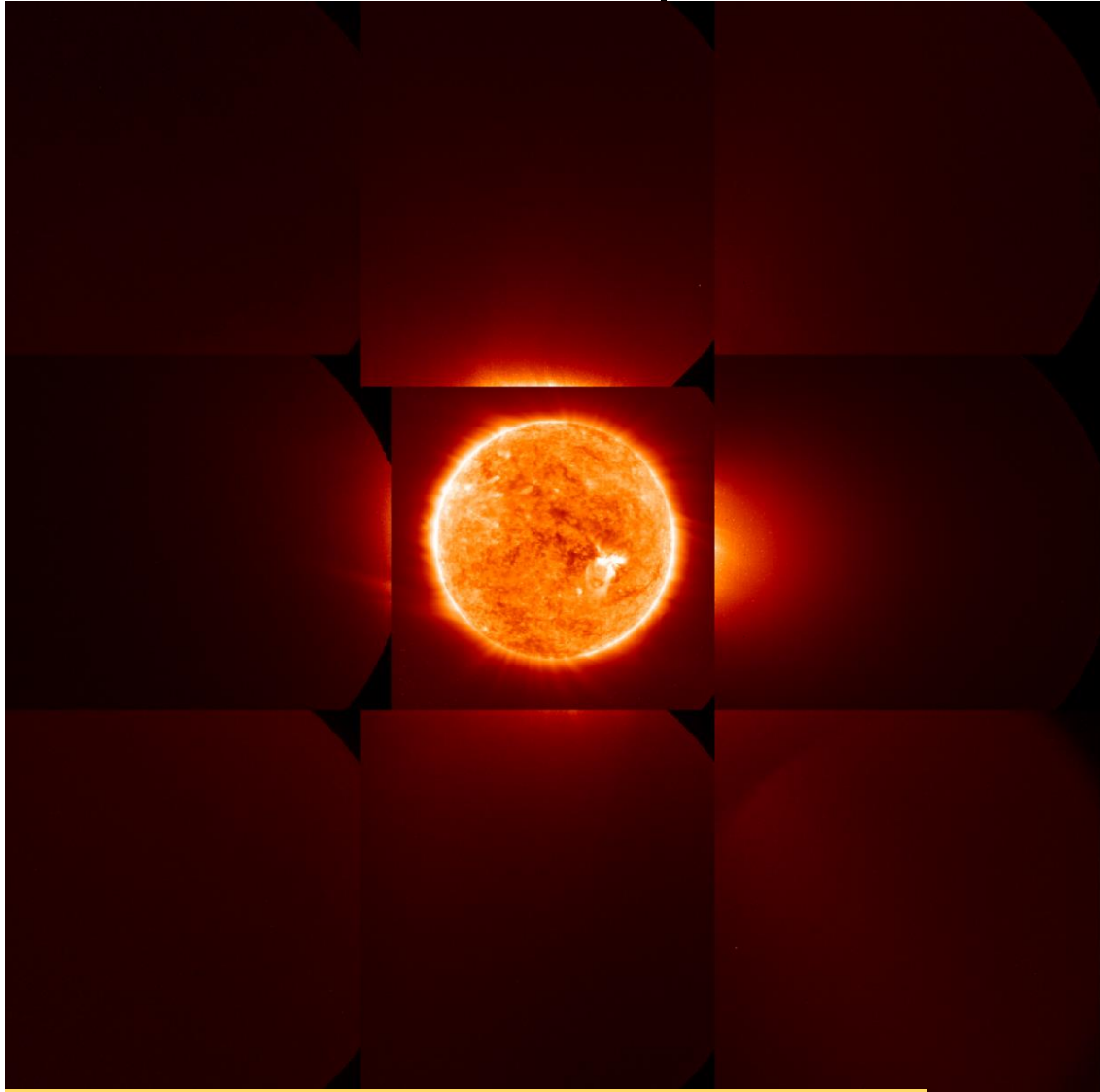
GOES-16/SUVI 195 Å 2017-09-10 15:01:14

# First Investigation

- On GOES-16, February 12-13, 2018
- Two patterns, in two wavelengths
  - 17.1 nm, 19.5 nm
  - 9-panel: 17.1nm in forward, 19.5nm in reverse
  - 7-panel: Both images at each offset
  - 4 arcmin overlap
  - Glass images
  - 25 – 200 secs exposures
  - One execution per each pattern
  - ~ 2 hours execution for each
  - Created composite images



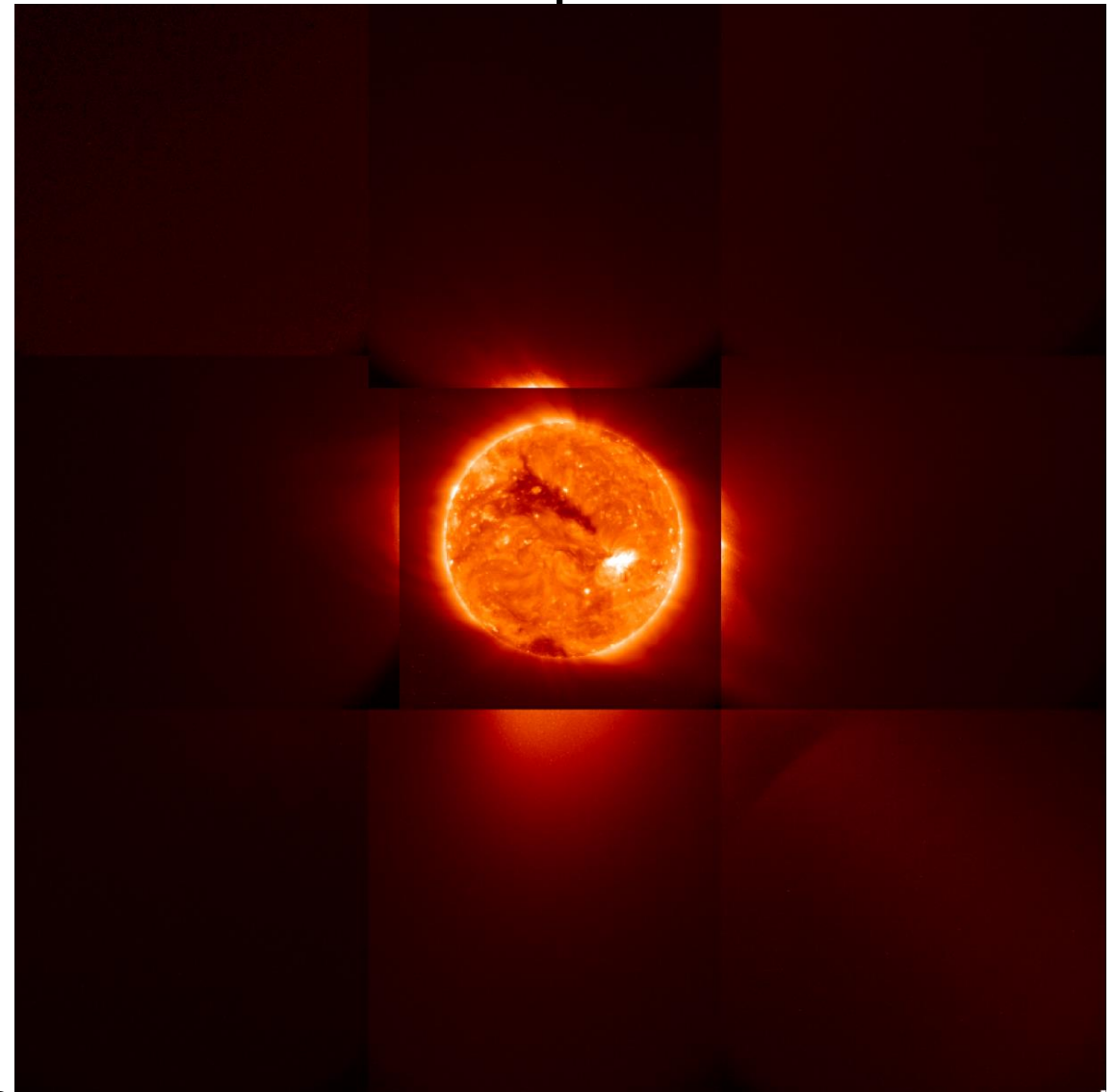
# 17.1 nm composite



GOES-16 Preliminary, Non-Operational Data

April 04, 2019

# 19.5 nm composite



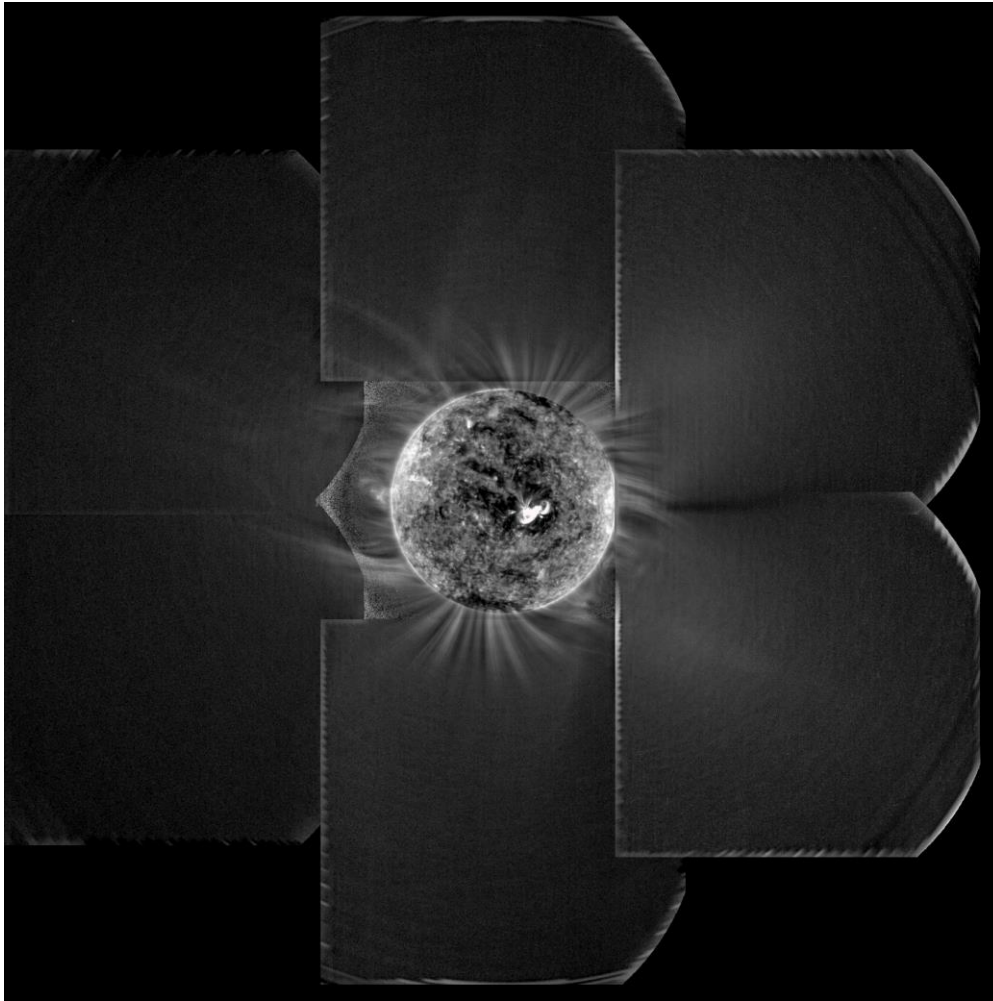
$4.7 * R_{\text{sun}}$

Space Weather Workshop, Boulder, CO

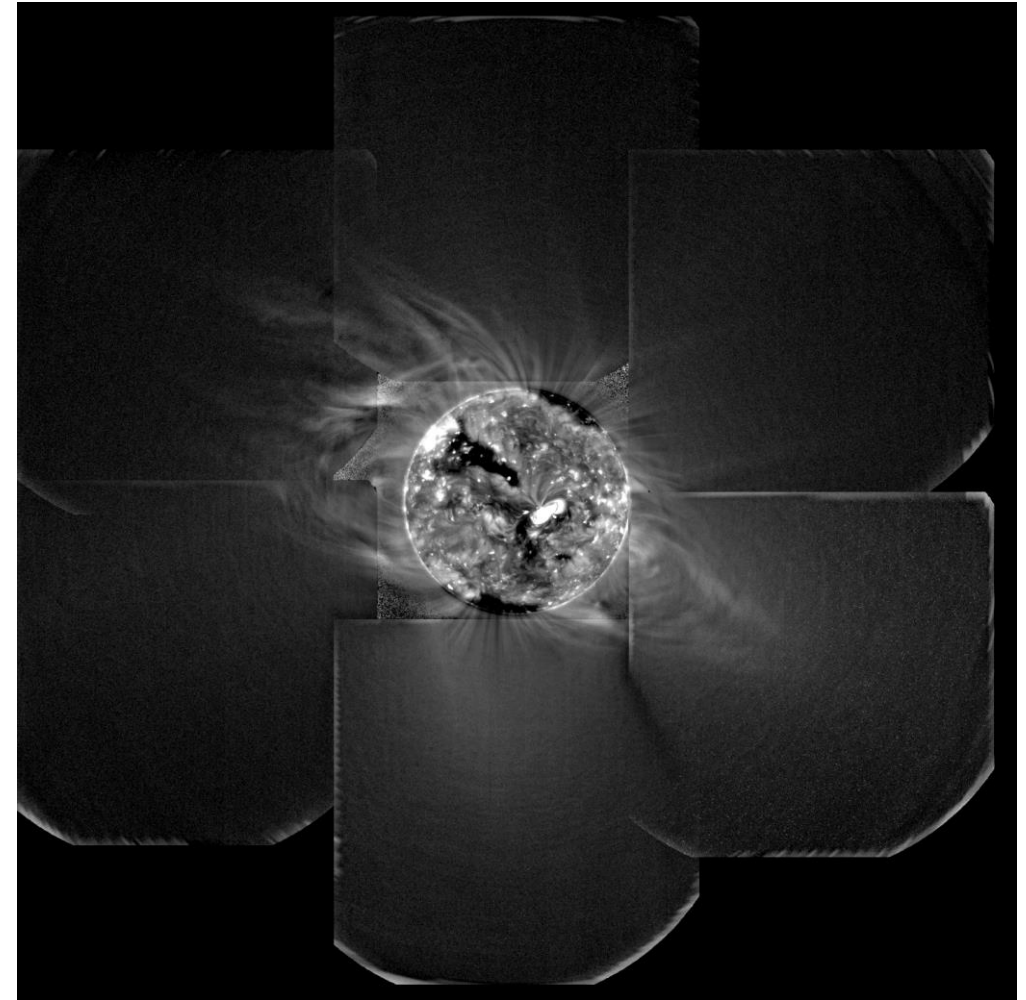
February 12-13, 2018



17.1 nm



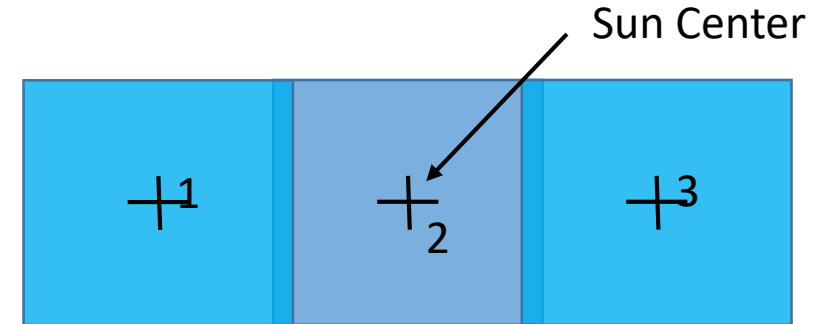
19.5 nm



**Demonstrated: EUV Corona exists to a few solar radii, even for quiet Sun**

# GOES-17, June 4-7, 2018

- 3-panel option
- Exposure duration reduced w/on-chip binning
- Overlap, accounting for pointing errors, reduced to 2 arcmin
- 72 hour execution
- Precursor to an operational concept



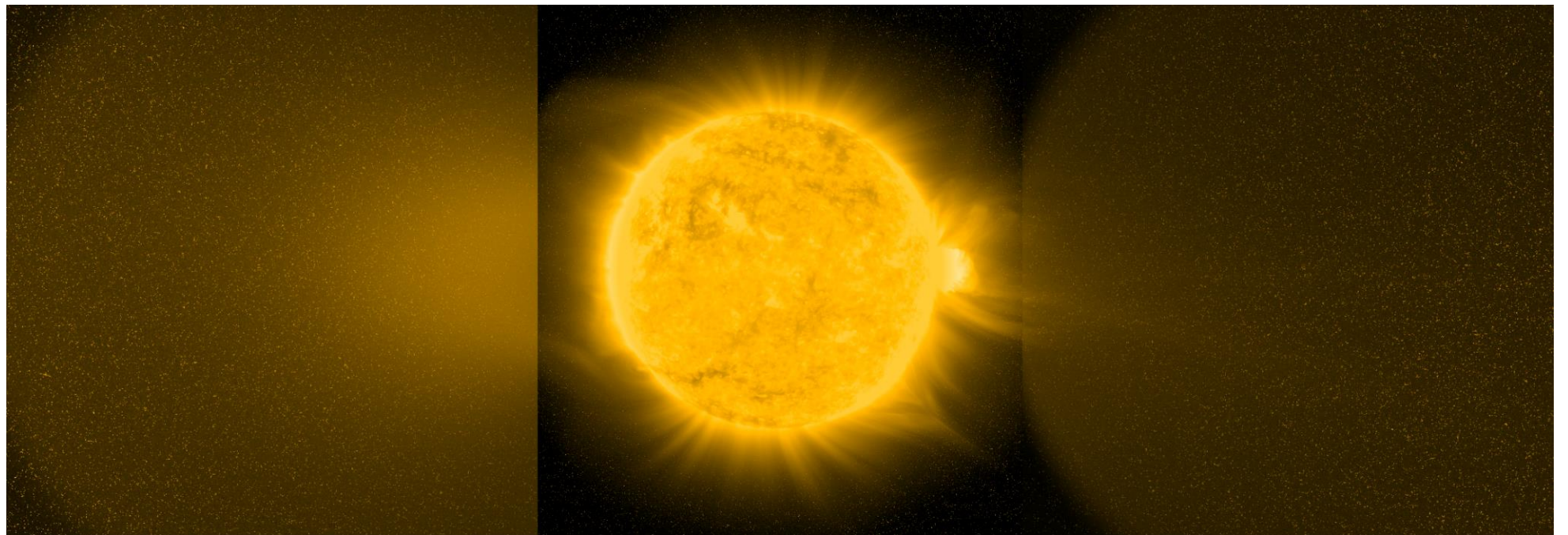
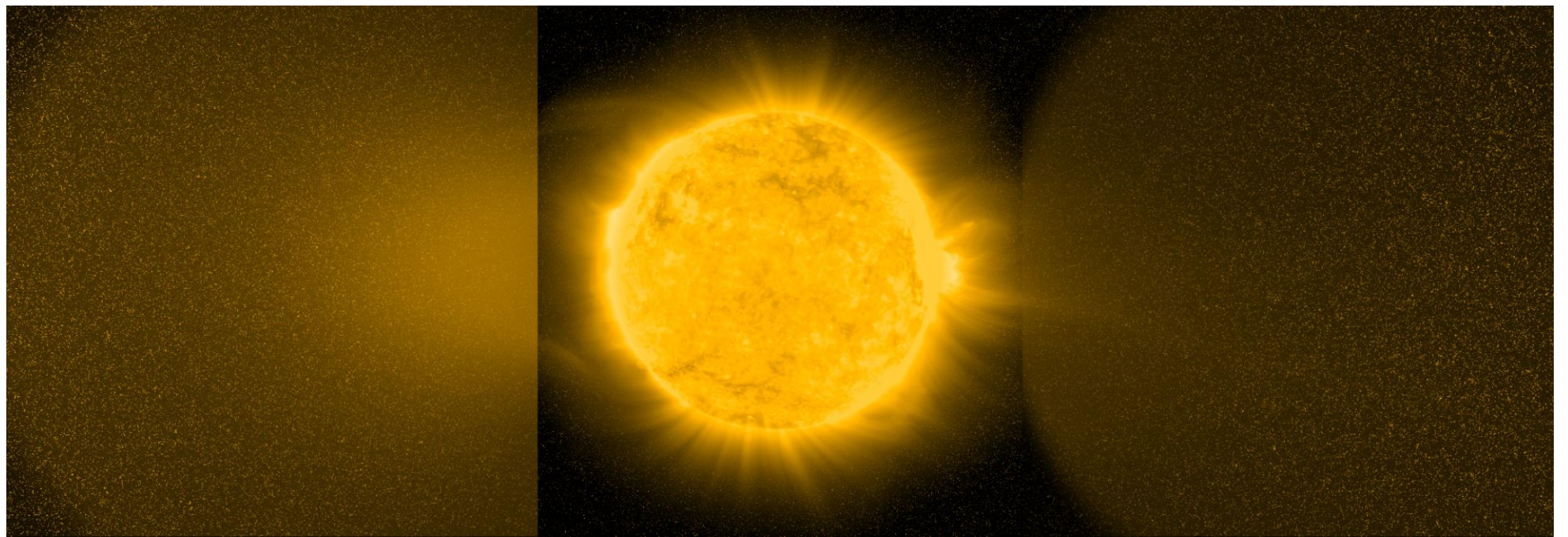


17.1nm

20180604\_131458

GOES-17 Preliminary,  
Non-Operational  
Data

20180605\_230203

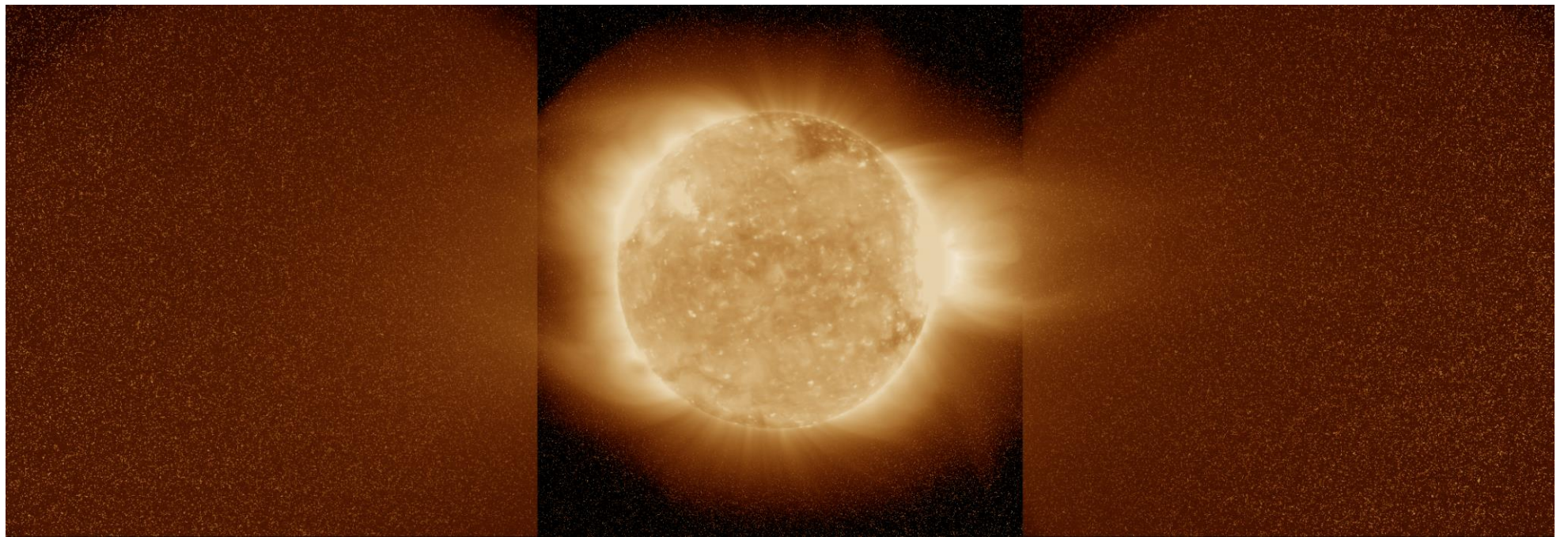




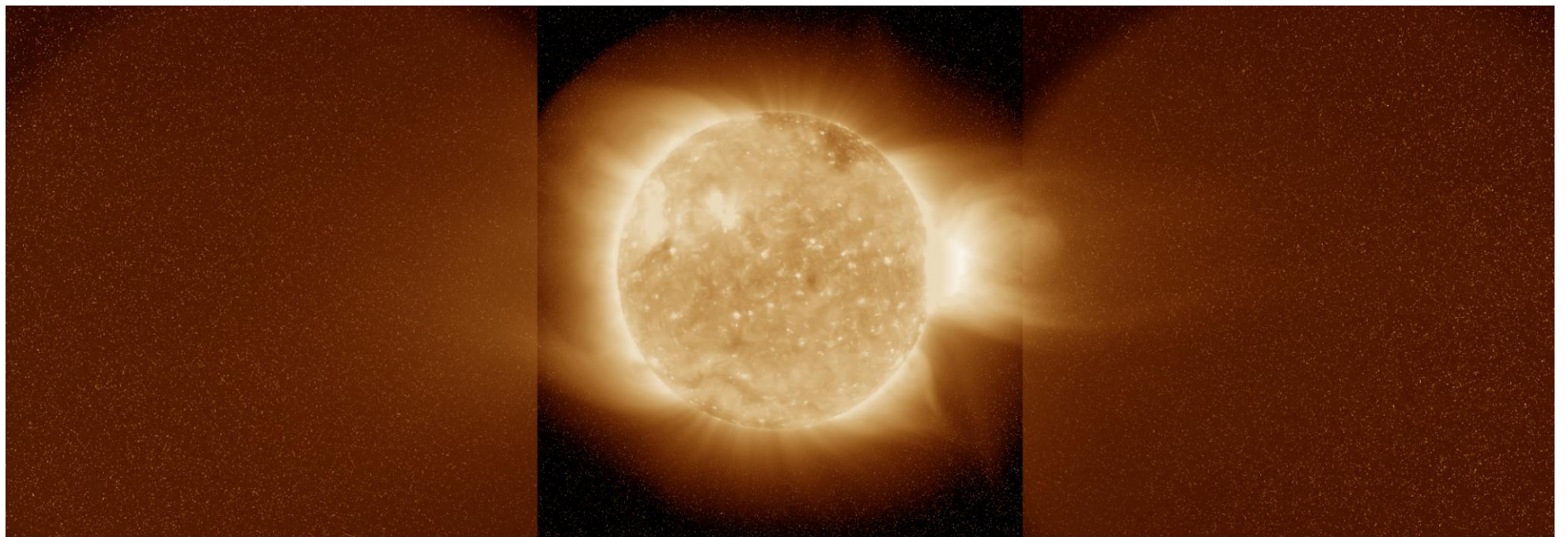
19.5nm

20180604\_131523

GOES-17 Preliminary,  
Non-Operational  
Data



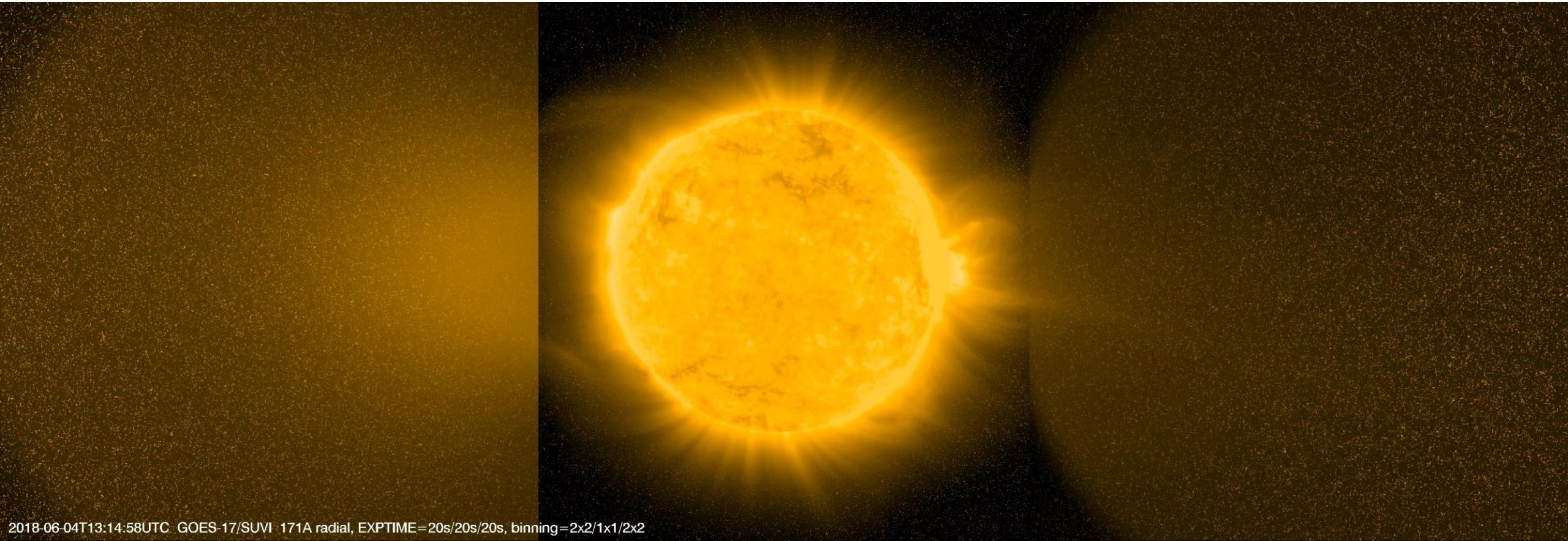
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17.1 nm

GOES-17 Preliminary, Non-Operational Data

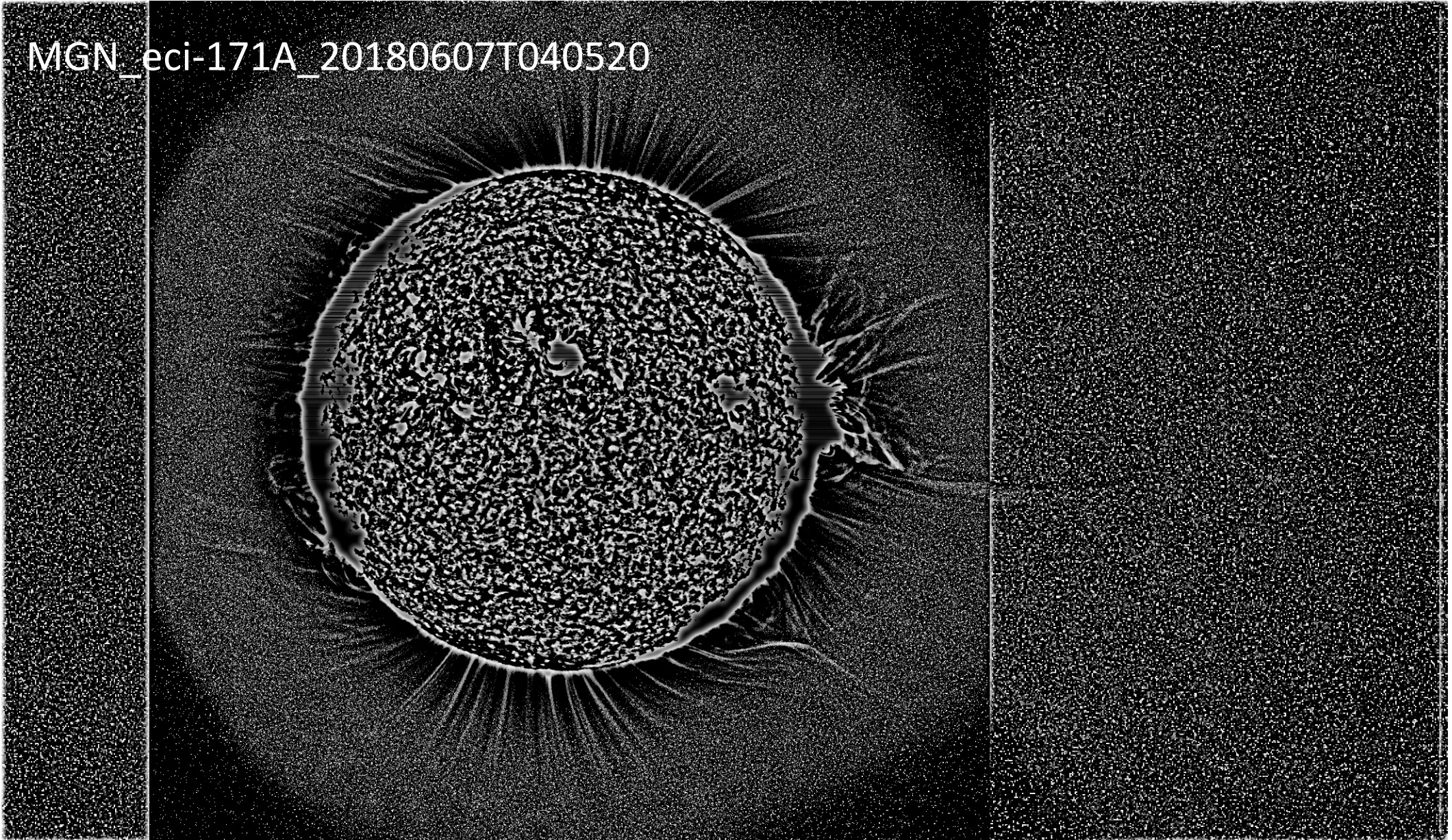


2018-06-04T13:14:58UTC GOES-17/SUVI 171A radial, EXPTIME=20s/20s/20s, binning=2x2/1x1/2x2

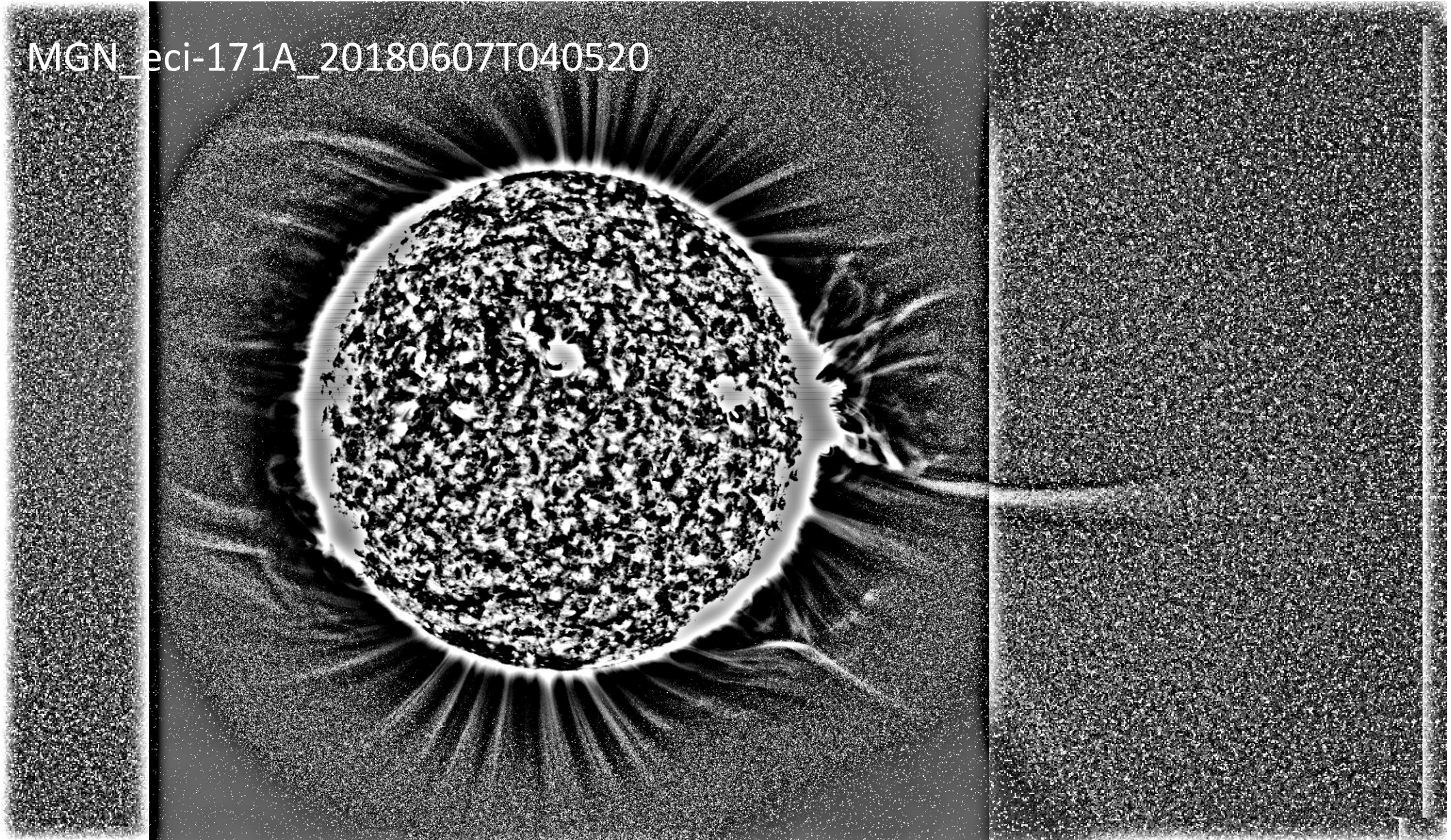
The authors gratefully acknowledge the support provided by the Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, USA, team



MGN\_eci-171A\_20180607T040520



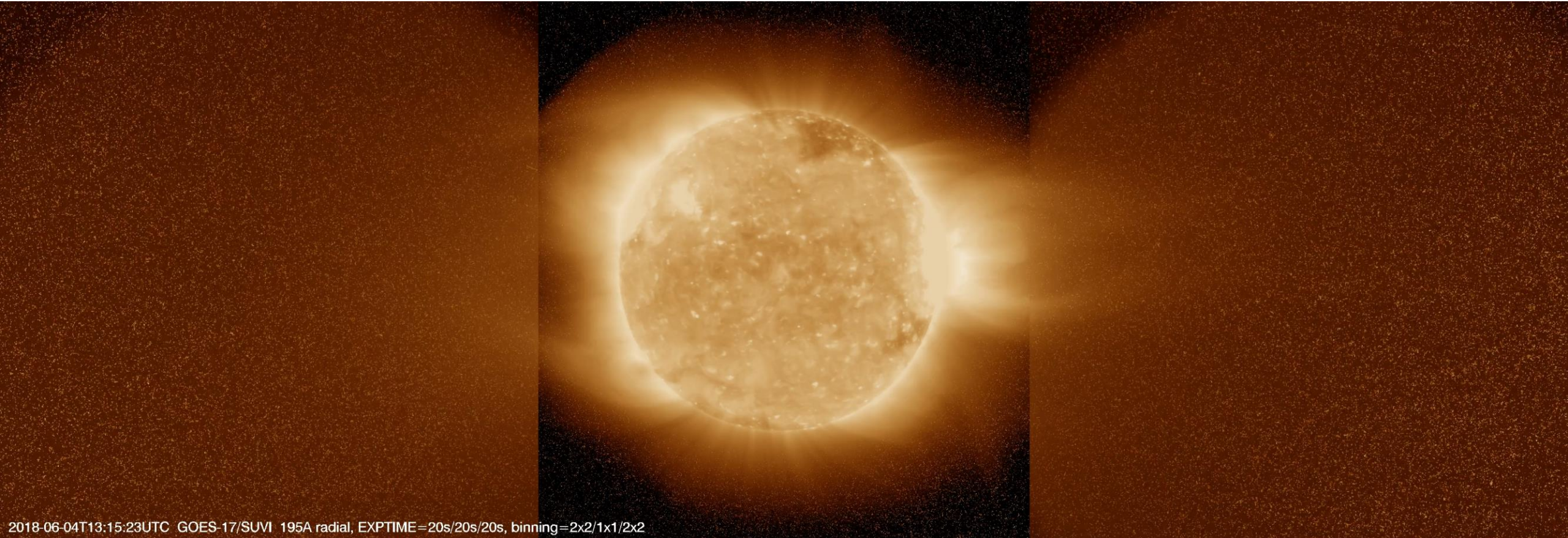
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19.5 nm

GOES-17 Preliminary, Non-Operational Data

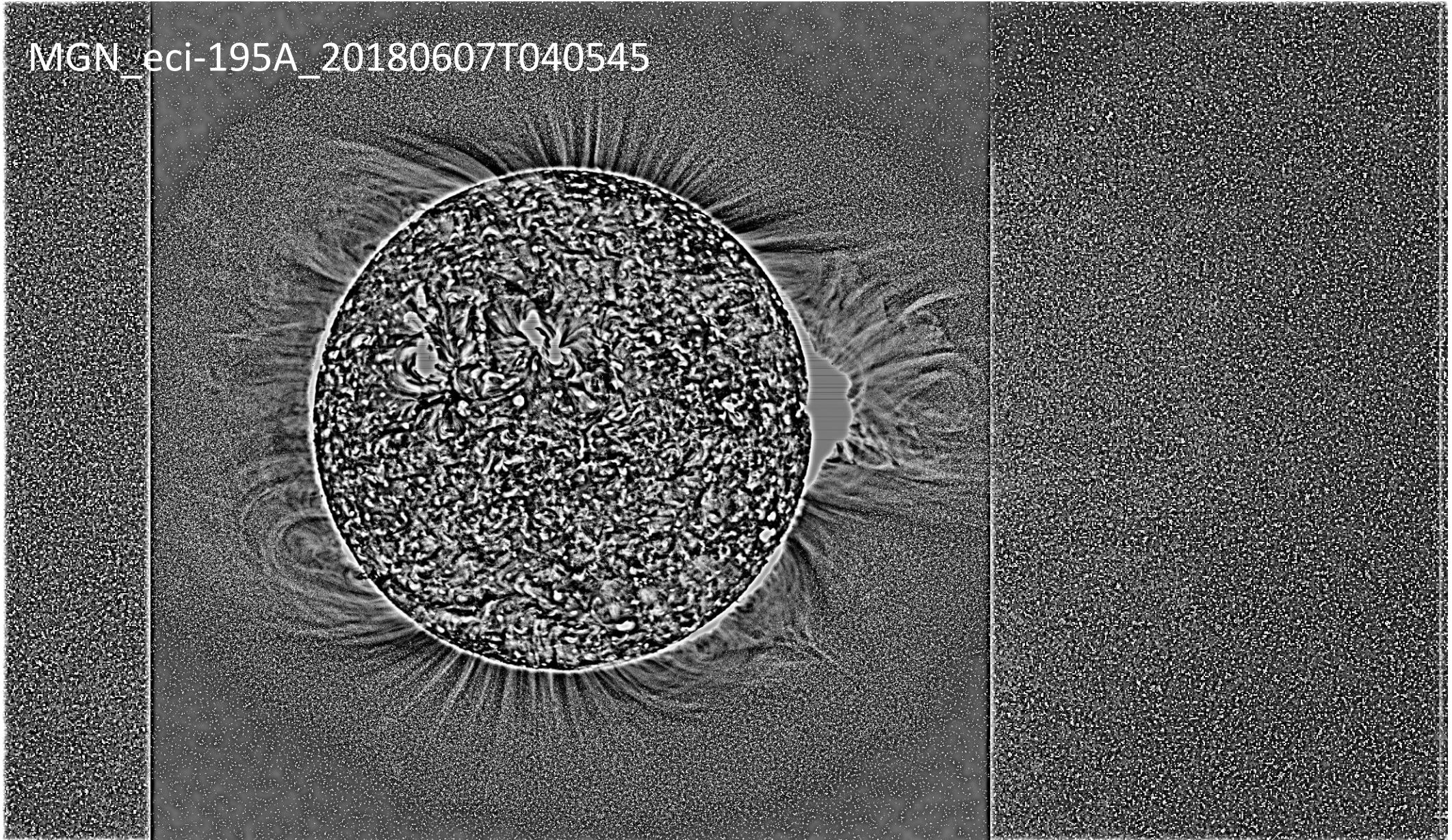


2018-06-04T13:15:23UTC GOES-17/SUVI 195A radial, EXPTIME=20s/20s/20s, binning=2x2/1x1/2x2

The authors gratefully acknowledge the support provided by the Lockheed Martin Solar and Astrophysics Laboratory, Palo Alto, USA, team

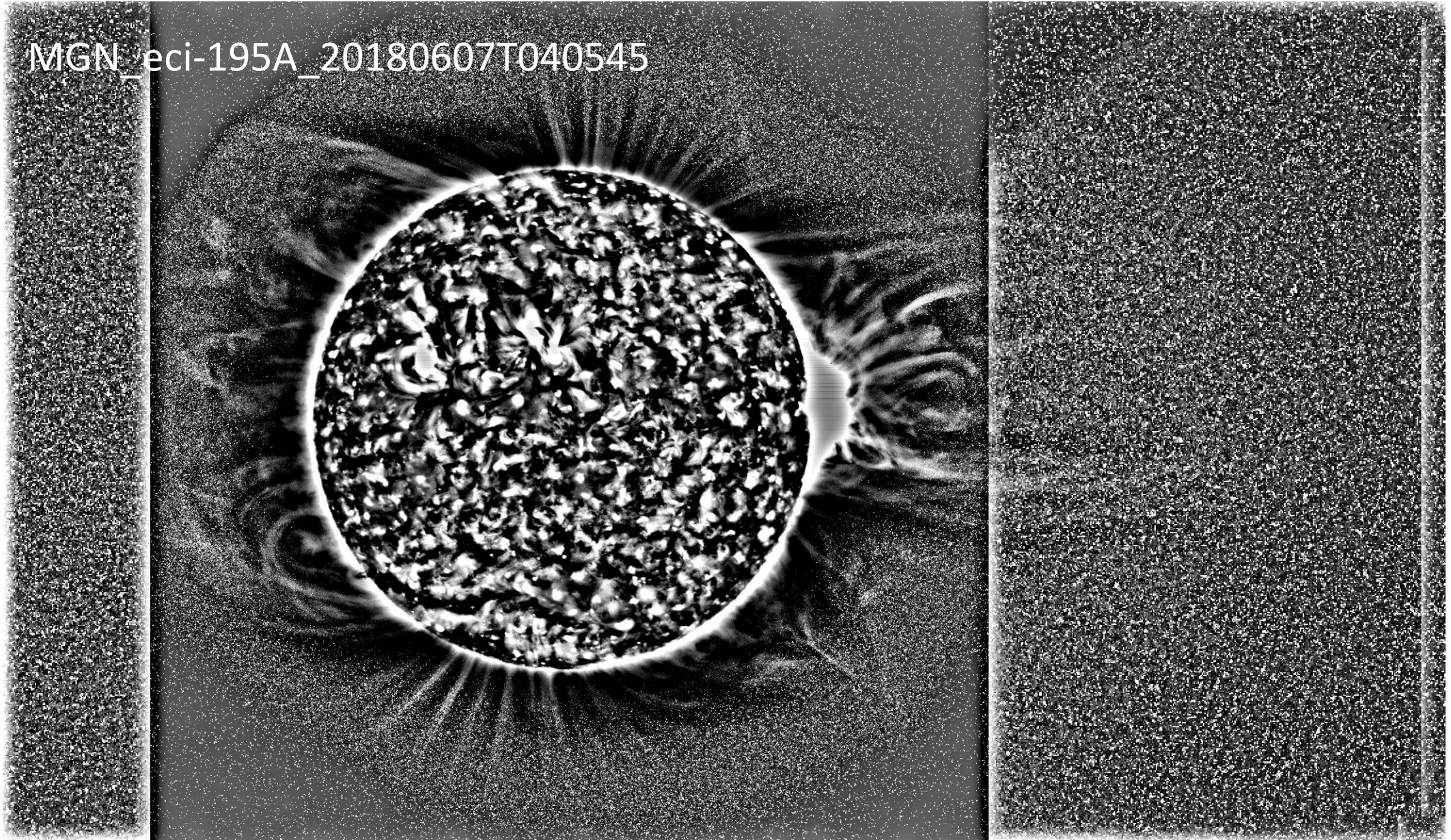


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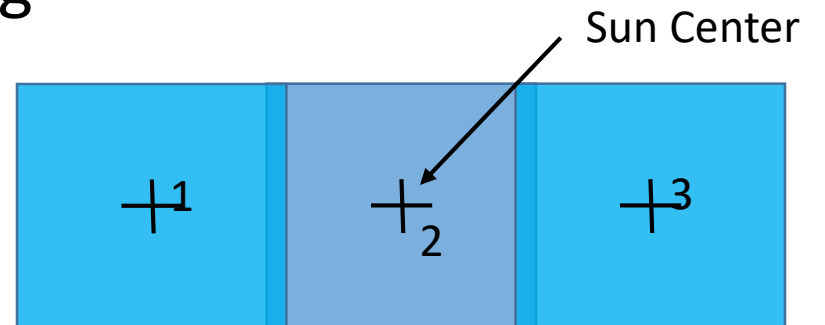


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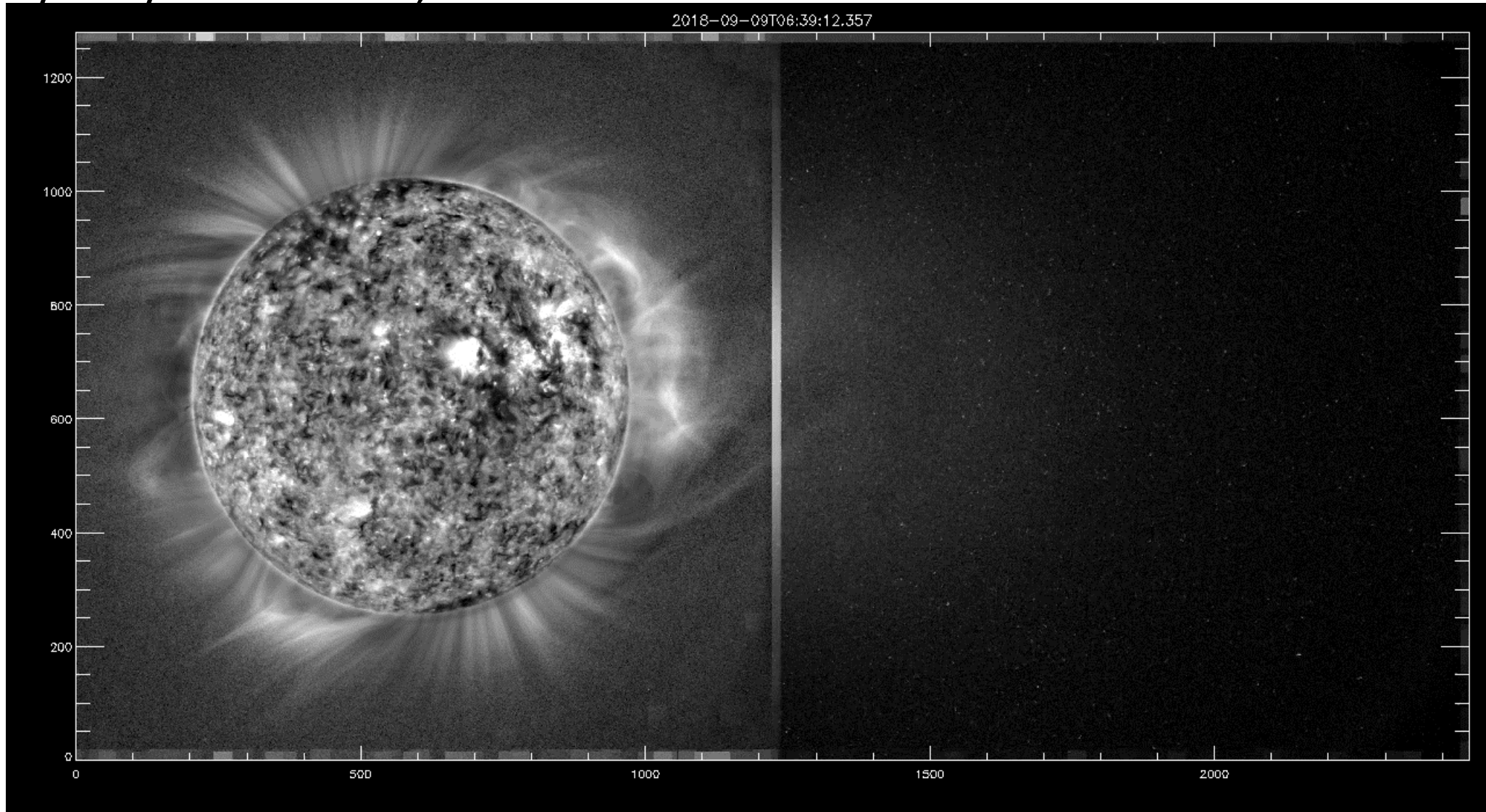


# GOES-17, August 7 – September 13, 2018

- 3-panel options
- Exposure duration reduced w/on-chip binning
- Added 30.4nm
- ~5 week execution
- Objective: tracing CME from onset

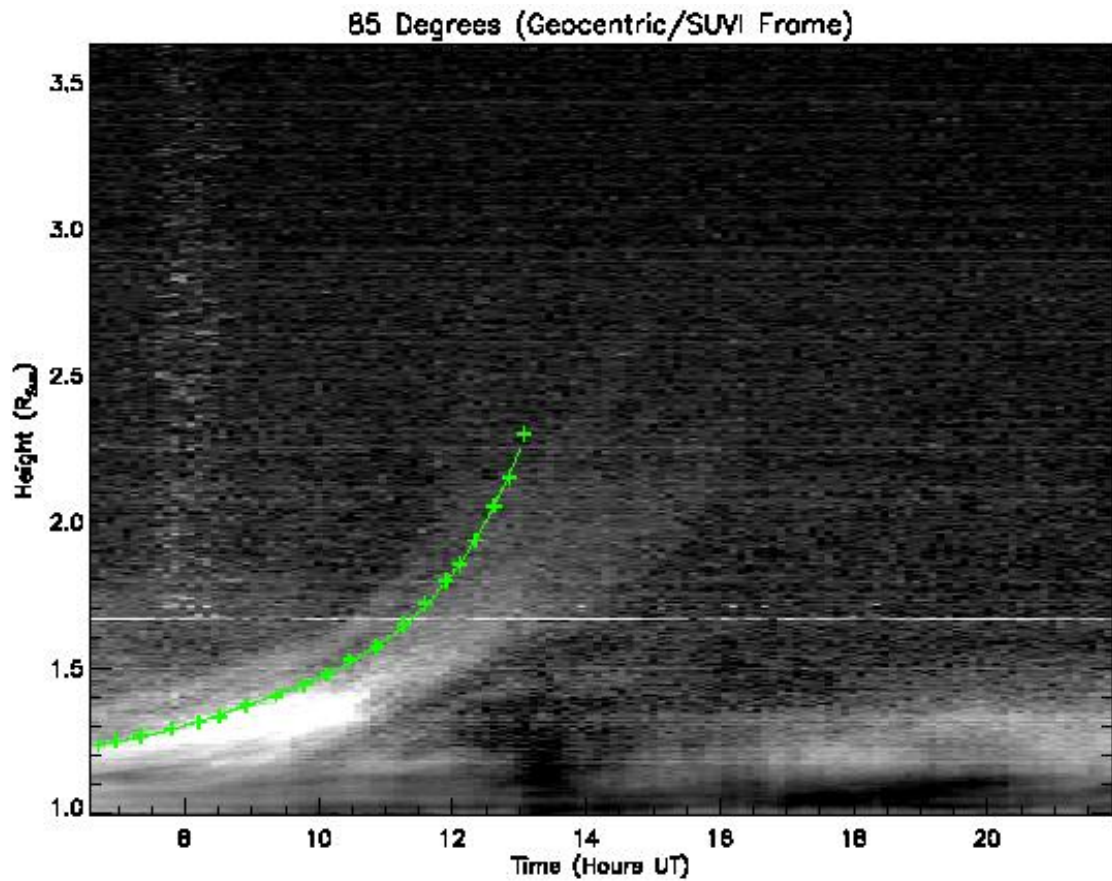


# 09/09/18 CME, 17.1 nm

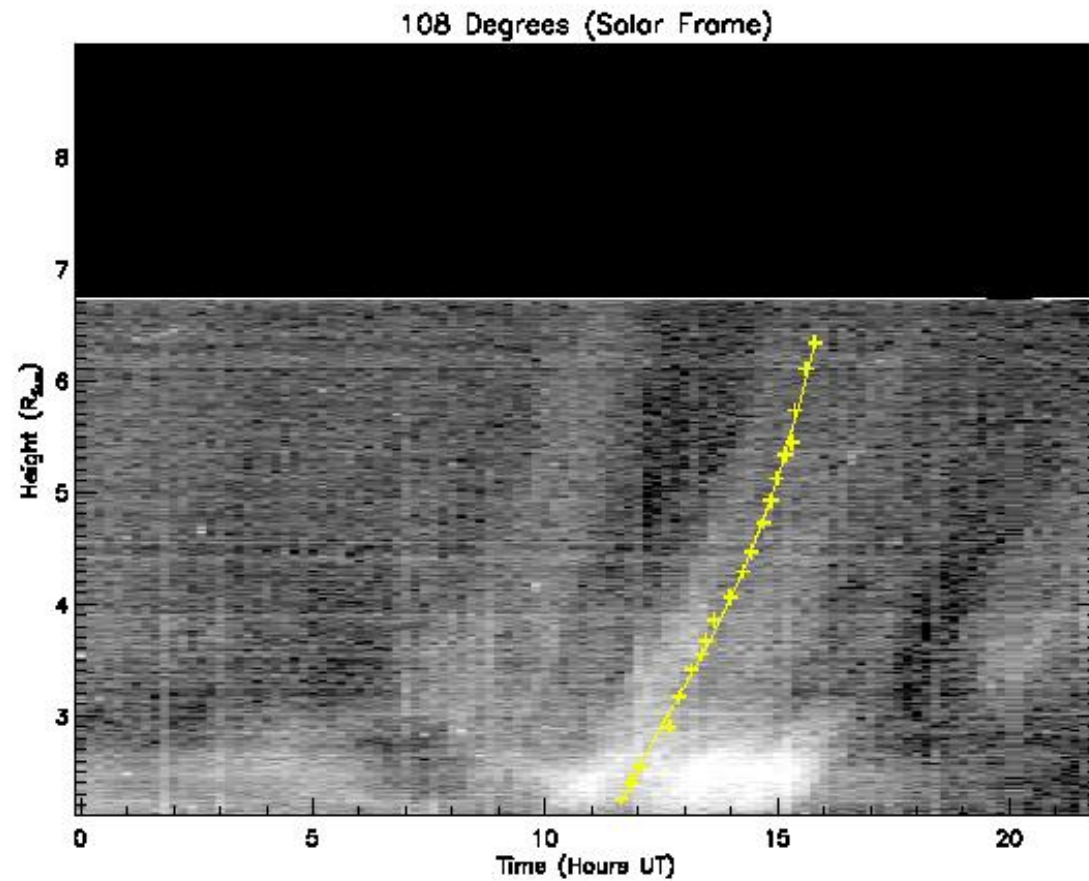




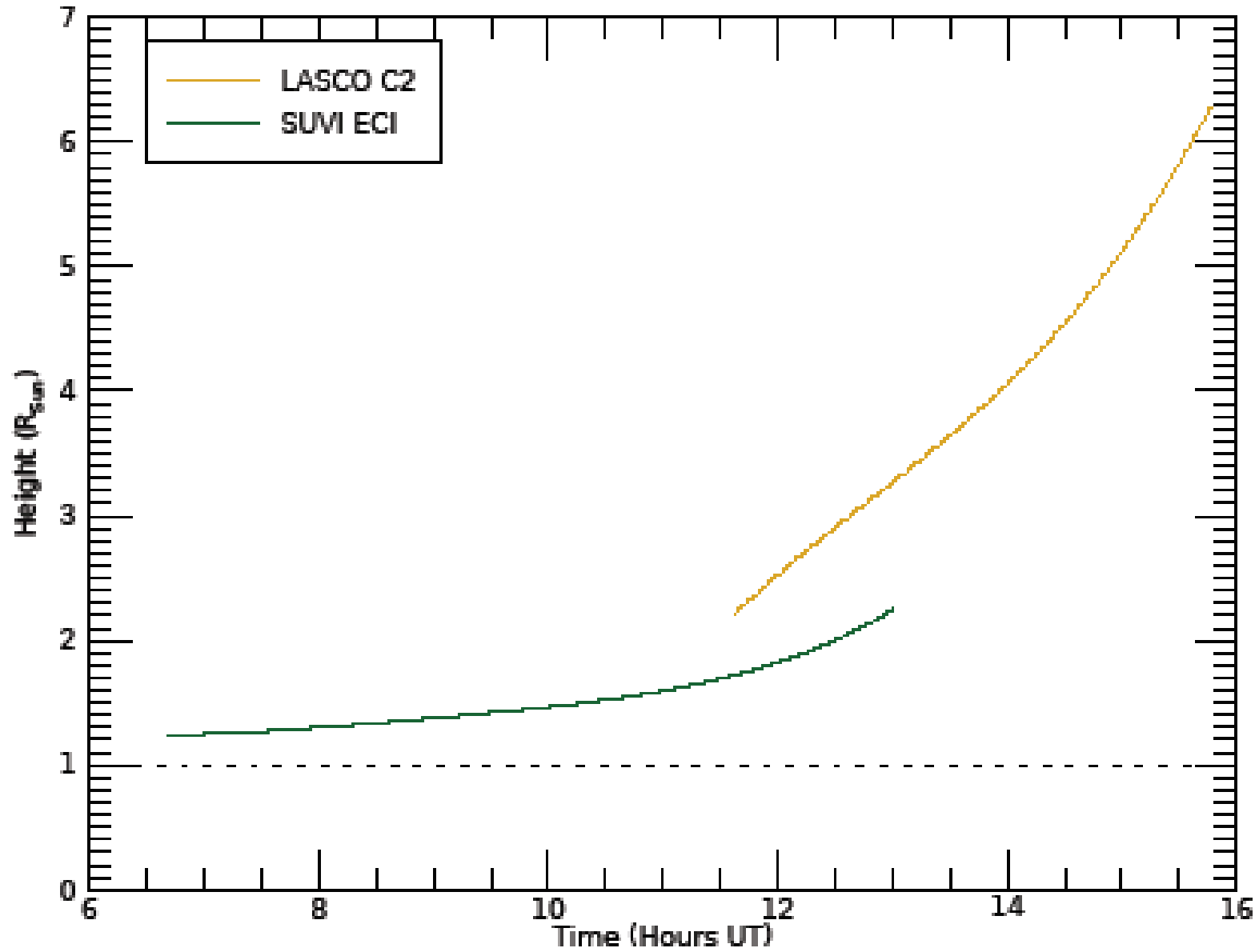
# SUVI



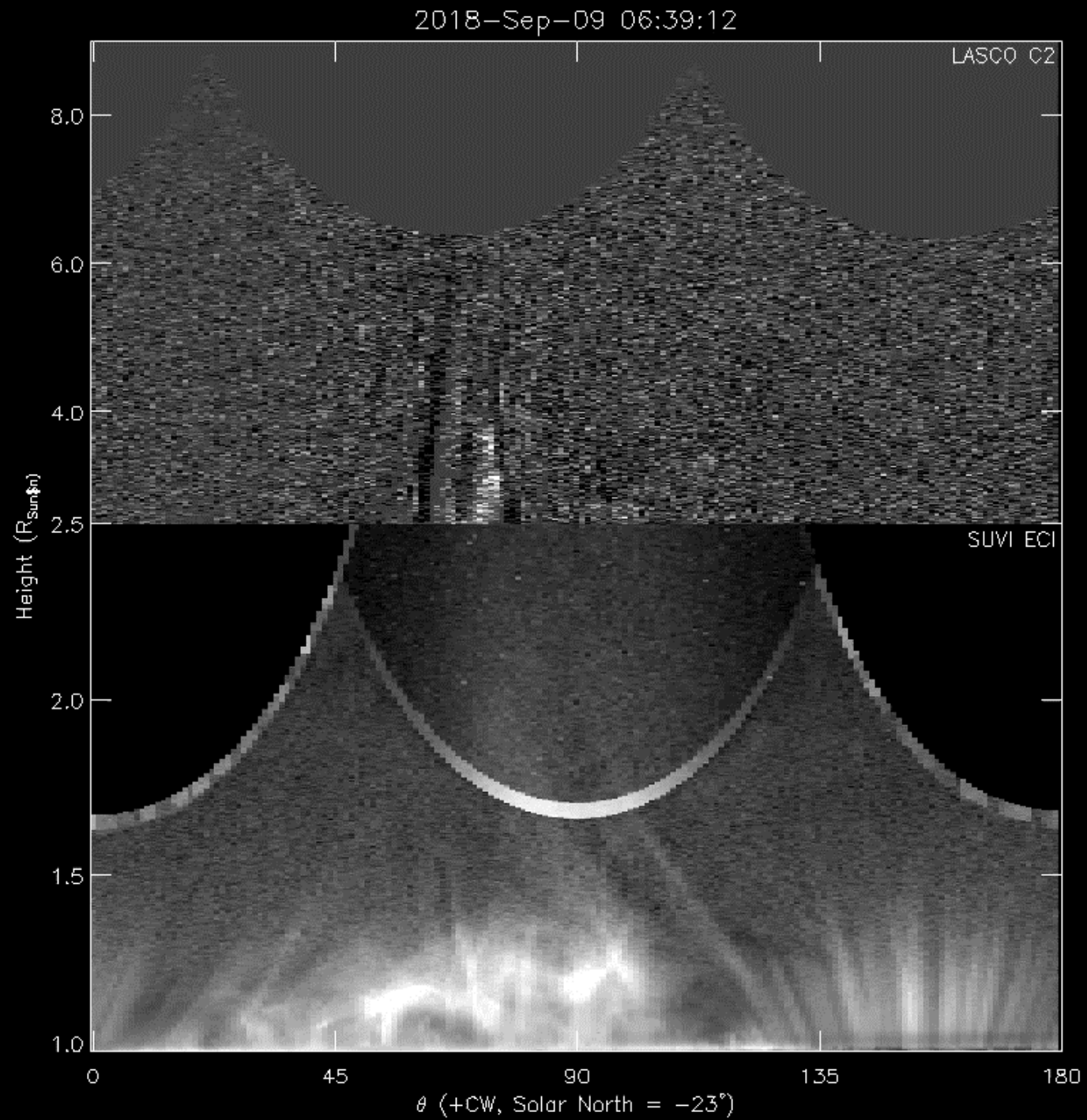
# LASCO



# 2019 Sep 9 Eruption



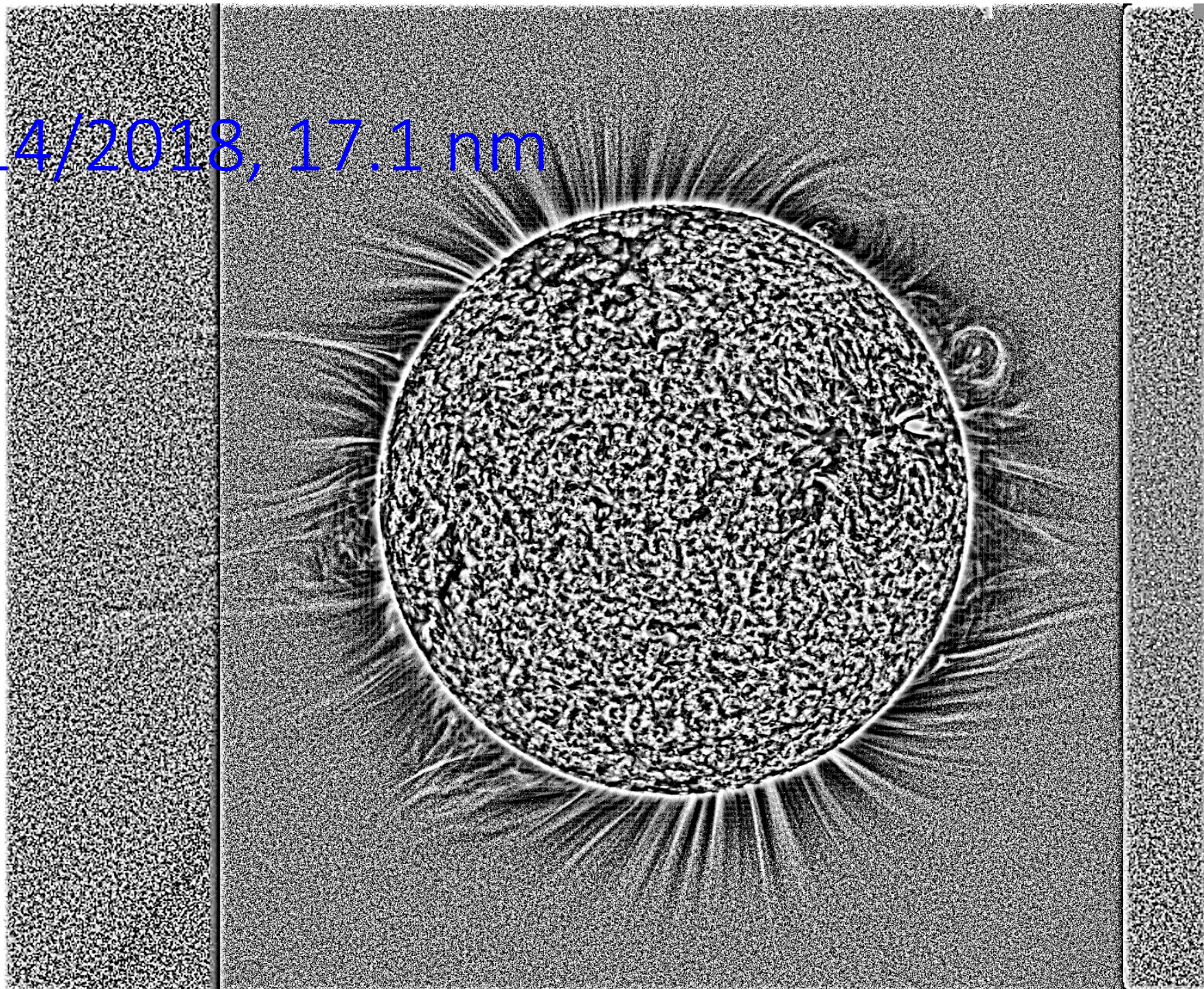
# SUVI – LASCO connection



April 04, 2019

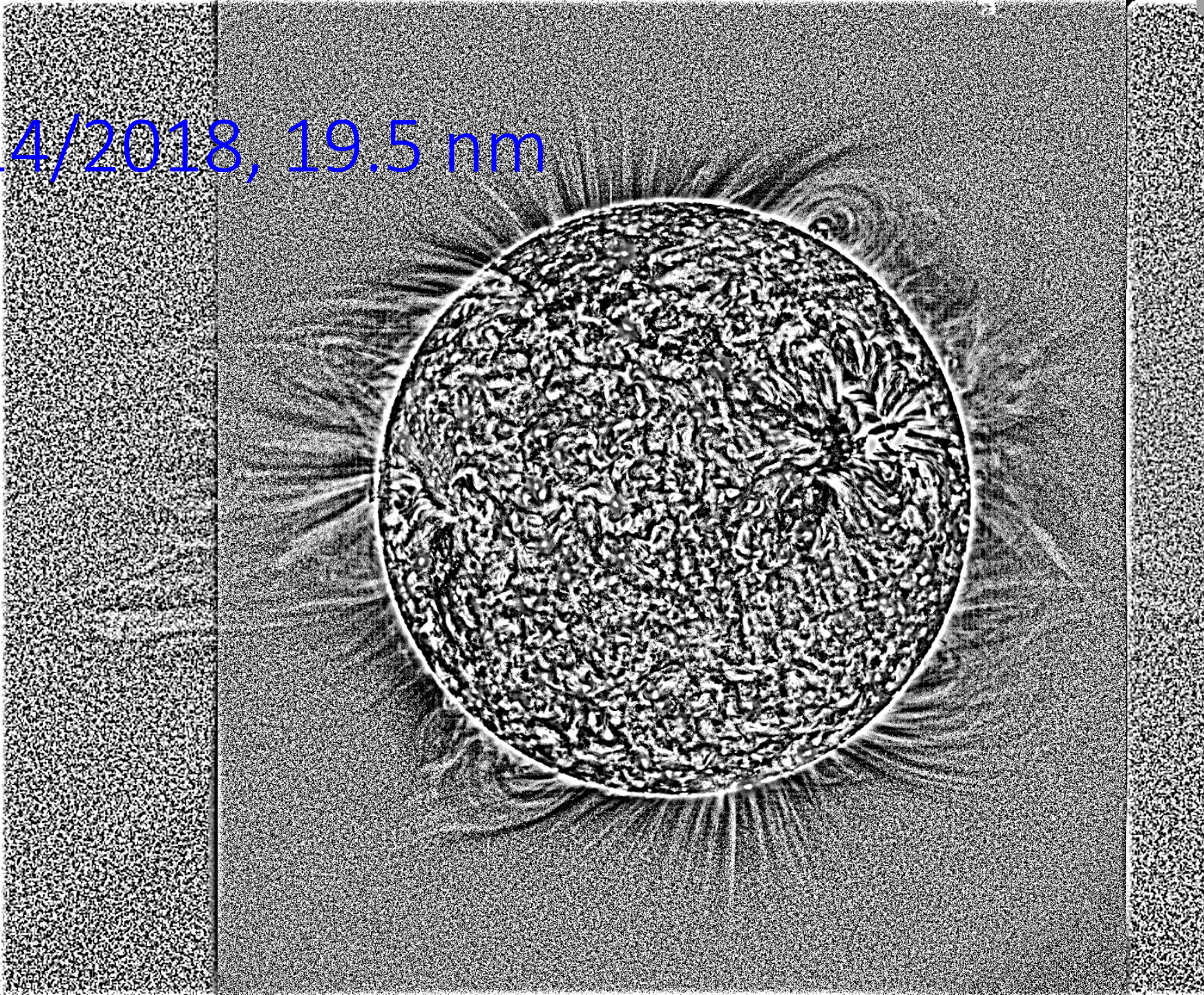


08/14/2018, 17.1 nm





08/14/2018, 19.5 nm





# Near-Term

- Pursuing a plan to execute ECI for a few months in 2019
- NCEI developing ECI products

# Recommendation for Long-Term

- A Wide FOV (6-8\* $R_{\text{sun}}$  across) EUV Imager!
- There will be a GOES-East and a GOES-West
- One of the SUVI's can operate in an ECI "mode"
  - Can provide data to support COSIE and SunCET missions
- GOES-U, scheduled for launch in 2024 will have a white light Coronagraph (CCOR)
  - Imaging area: 3.7-17\* $R_{\text{sun}}$
  - SUVI on the same platform will observe the Sun nominally
- SUVI from the "other" GOES satellite function in the ECI mode

**A Great Opportunity for GOES-R instruments to observe Solar corona from the solar limb to the outer edge of the FOV of CCOR**