Python Software for Metis

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The 9th Metis Workshop - 24-26 Jan 2023

Outline

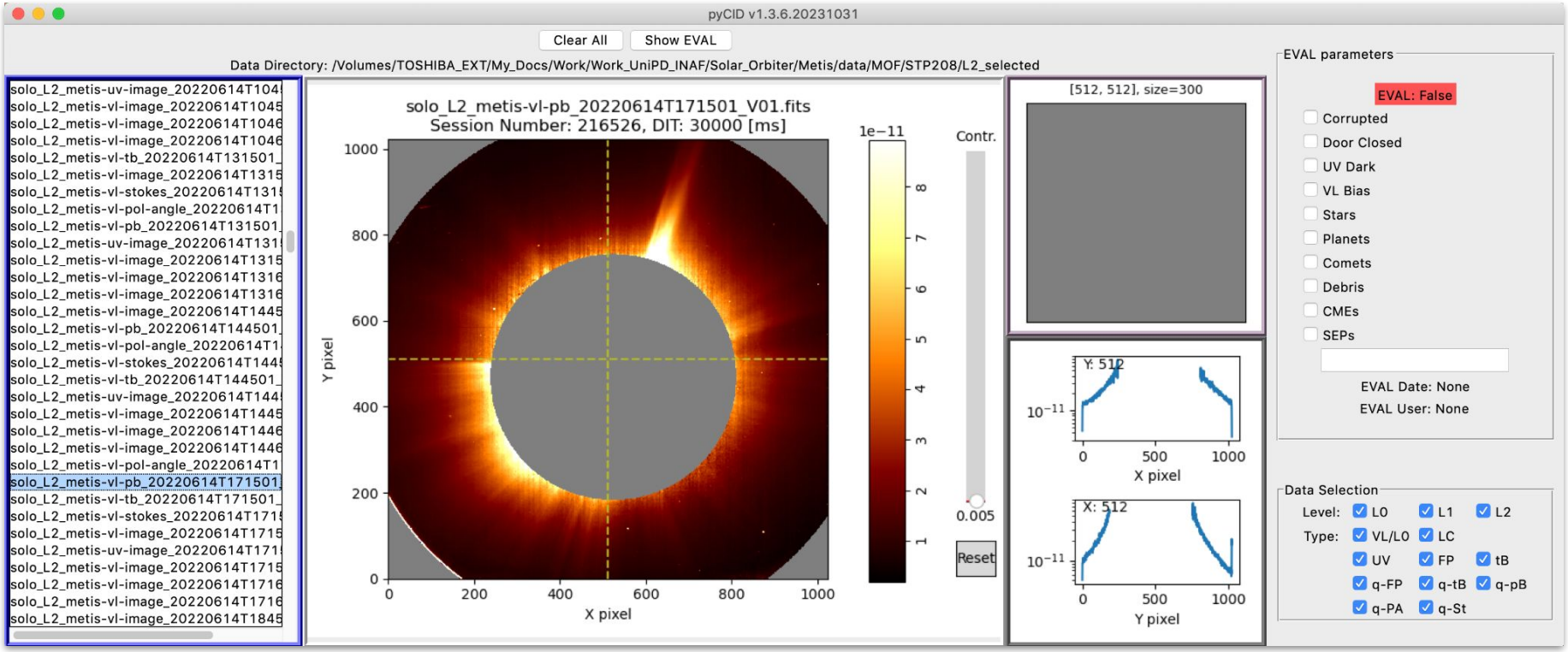
1. pyCID: Metis quick-look python tool
2. Metis scientific analysis with Python

pyCID

- pyCID is a quick-look GUI tool for visualization and validation of Metis data of different types (images, light curves) and levels (L0, L1 and L2)
- Inspired by more sophisticated IDL tool iCID (Coronal Image Display) ⇒ *see S. Giordano's talk*
- Available at Metis GitLab: https://www.ict.inaf.it/gitlab/metis/utilities/pycid

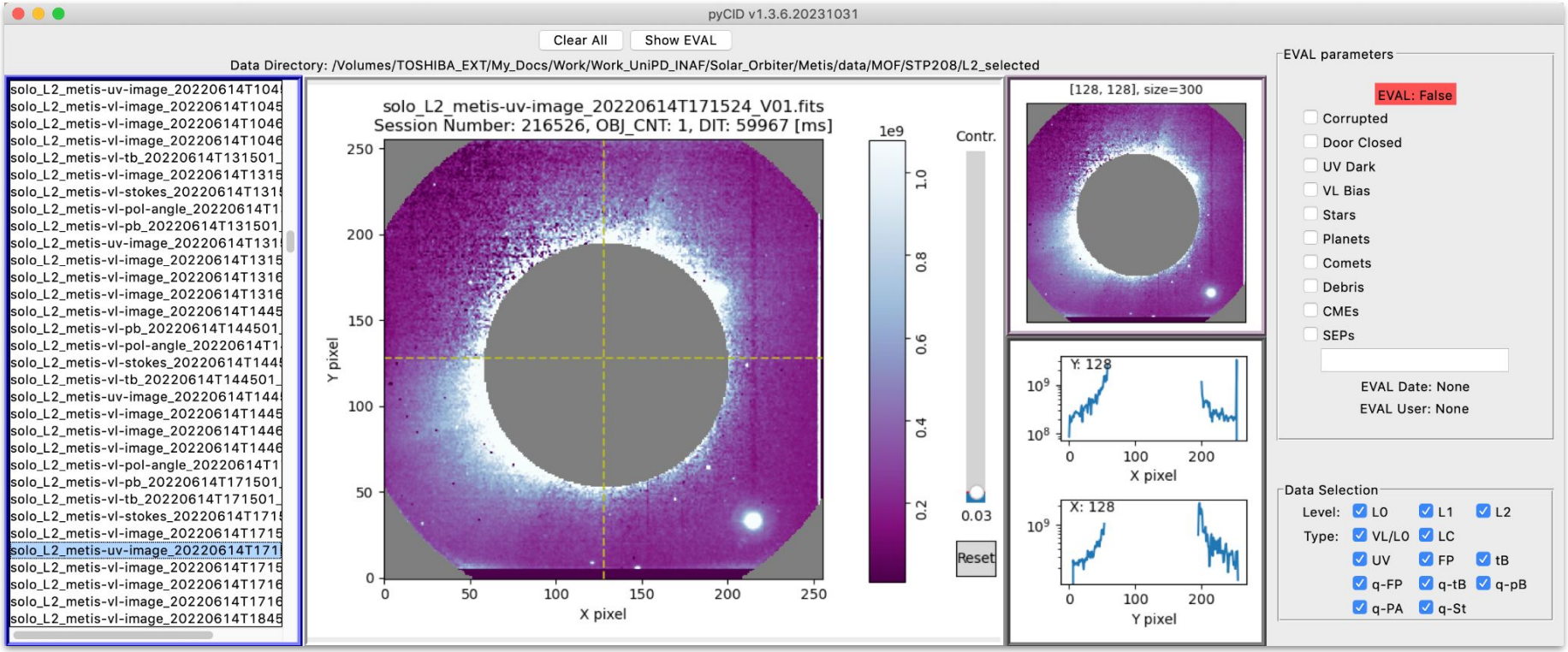
pyCID: main features

1. Quick data visualization (pB)



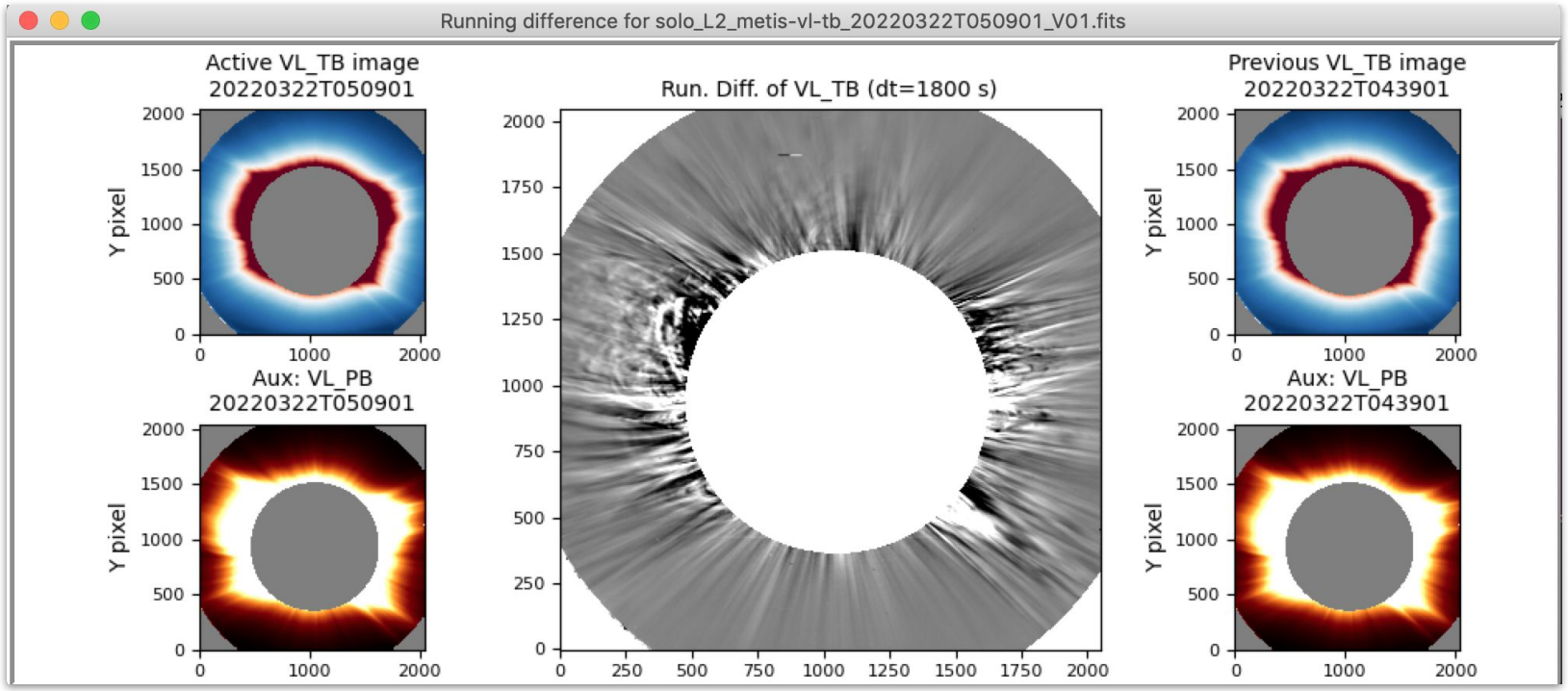
pyCID: main features

1. Quick data visualization (UV)



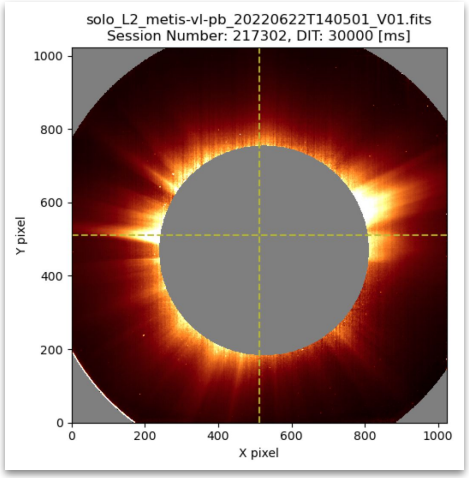
pyCID: main features

2. Running difference

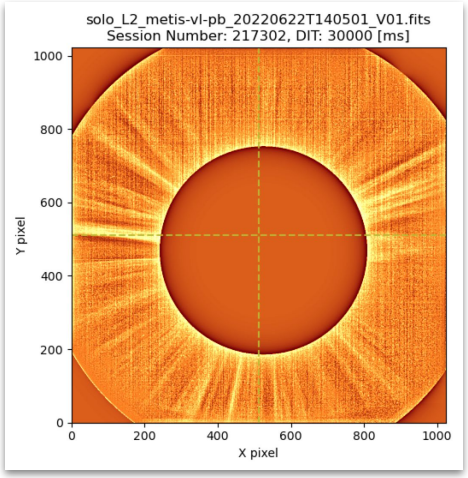


pyCID: main features

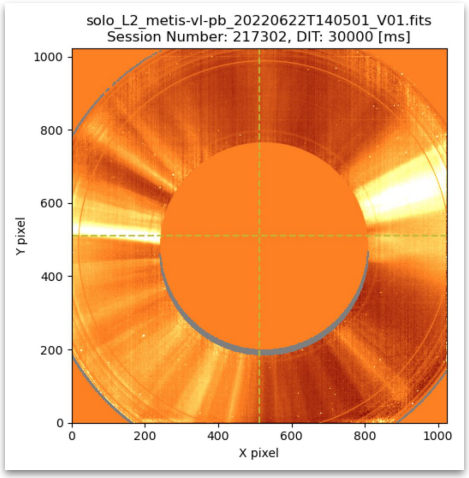
3. Image enhancement
   - MGN and NRGF filters from SunPy affiliated package “sunkit-image”



Original pB image



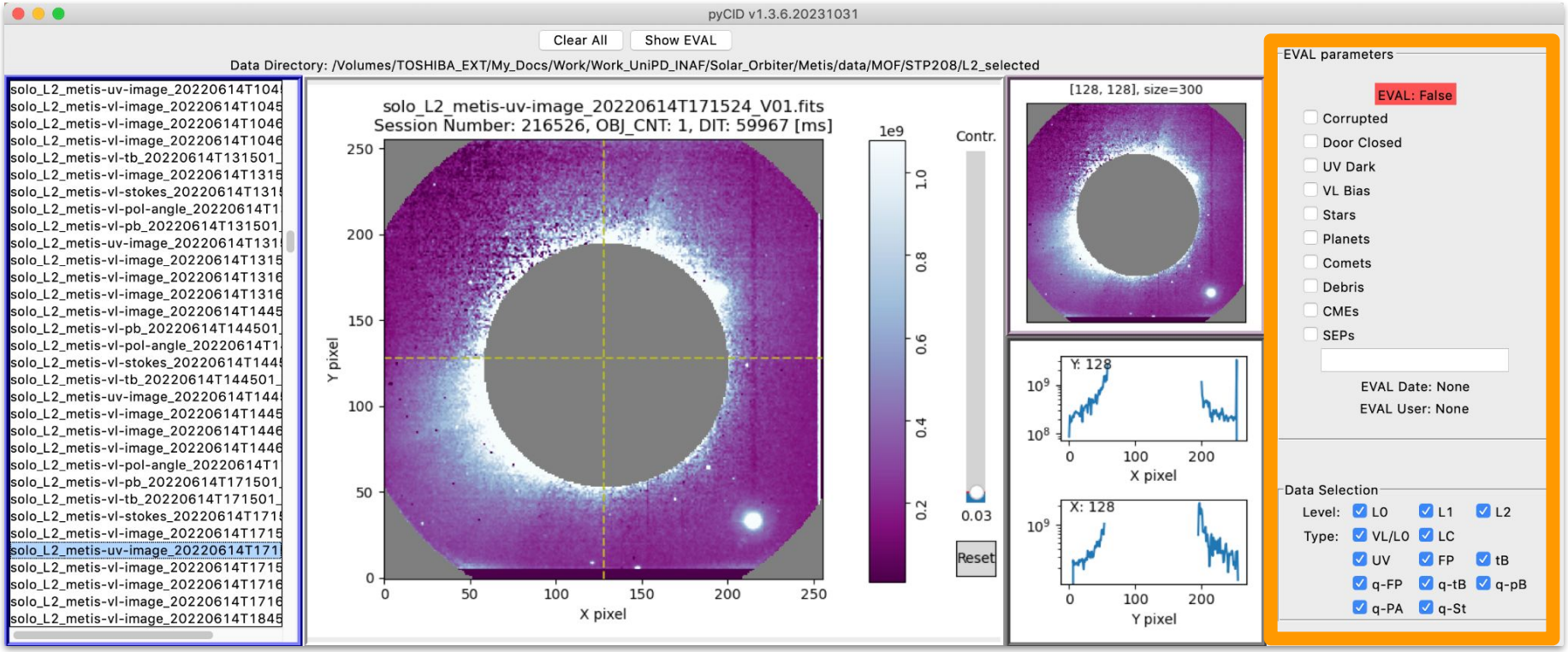
pB with MGN



pB with NRGF

pyCID: data validation

4. Data validation



pyCID: data validation

4. Data validation ➔ release_global.csv (published at the Metis web-page)

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Instrument Team

Data

- Metis data description
- Observation summary
- Metis data access
- Publication policy

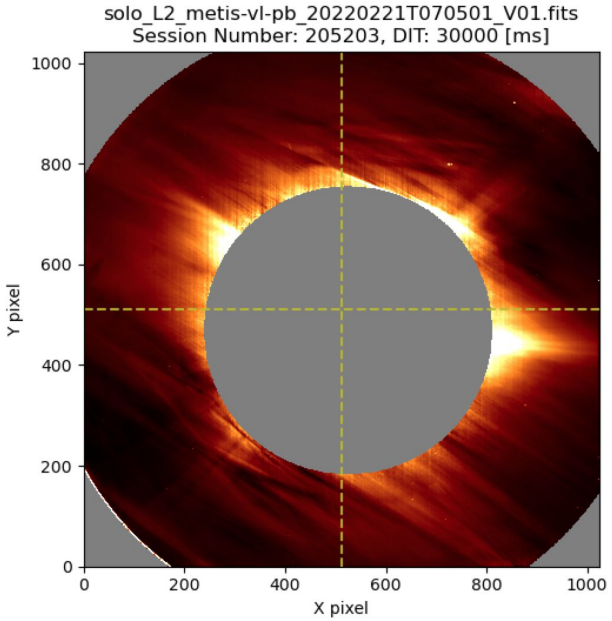
STP193

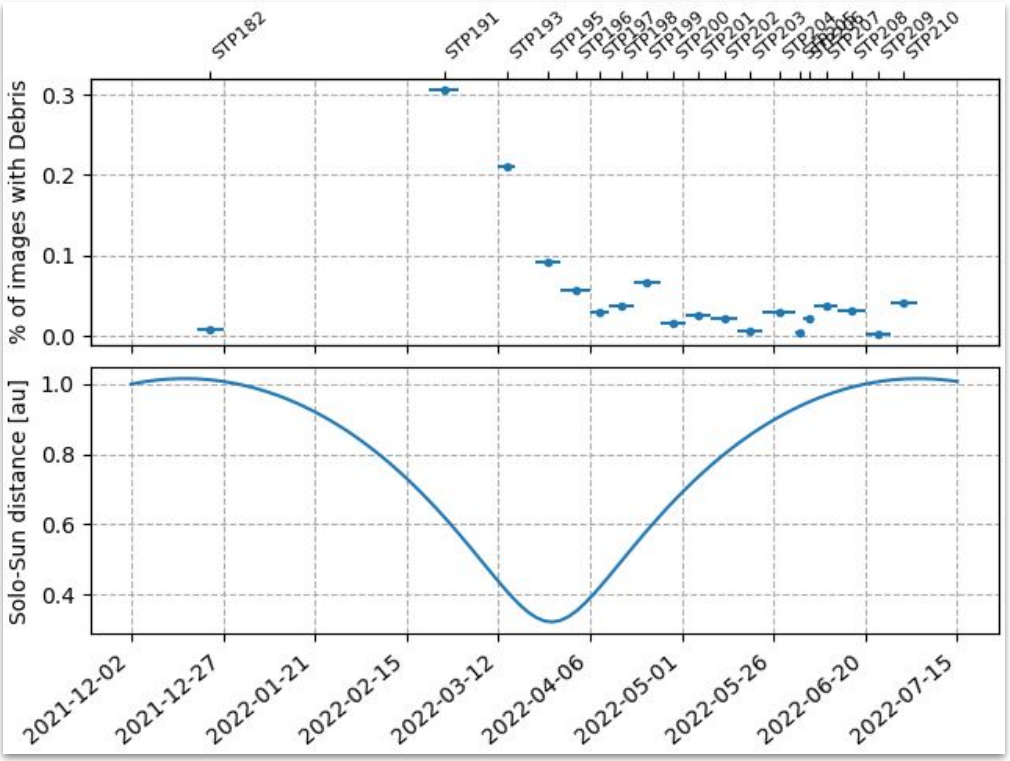
Download detailed report

Start	Stop	Observing program	Description	Solar Orbiter Observing Plan (SOOP)	VL/bin DIT/NDIT/CAD	UV/bin DIT/NDIT2/CAD
13/03/2022 06:04:00	13/03/2022 12:34:16	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
13/03/2022 13:04:00	13/03/2022 13:26:01	LOW LATENCY	Quick look data		pB/4x4 30s/10/1220s	
13/03/2022 14:04:00	13/03/2022 17:00:00	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
13/03/2022 17:05:00	14/03/2022 00:00:00	METIS_VL_POL	Polarimeter characterization		pB/1x1 15s/5/310s	
14/03/2022 02:04:00	14/03/2022 12:34:16	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
14/03/2022 13:04:00	14/03/2022 13:26:01	LOW LATENCY	Quick look data		pB/4x4 30s/10/1220s	
14/03/2022 14:04:00	14/03/2022 16:55:00	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
14/03/2022 16:55:00	15/03/2022 06:00:00	METIS_VL_ALI	Alignment characterization		FP/2x2 5s/None/None pB/2x2 15s/2/124s tB/2x2 20s/2/40s	
15/03/2022 06:04:00	15/03/2022 12:34:16	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
15/03/2022 13:04:00	15/03/2022 13:26:01	LOW LATENCY	Quick look data		pB/4x4 30s/10/1220s	
15/03/2022 14:04:00	16/03/2022 00:34:16	METIS_GENERIC	Global corona configuration measurements		pB/2x2 30s/14/1800s	
					FP/None 15s/None/None	

pyCID: data validation

4.1. Debris in Metis/VL images





pyCID: conclusions

- Development is ongoing
- Any feedback or contribution is welcome

Metis scientific analysis with Python

Metis scientific analysis with Python

sunpy

- We are developing Python tools for the scientific application of the Metis data
- Presented at the 8th Solar Orbiter Workshop in Belfast (Sep 2022)
- Jupyther notebooks and the corresponding routines are publicly available at https://github.com/SolarOrbiterWorkshop/solo8_tutorials

Metis scientific analysis with Python

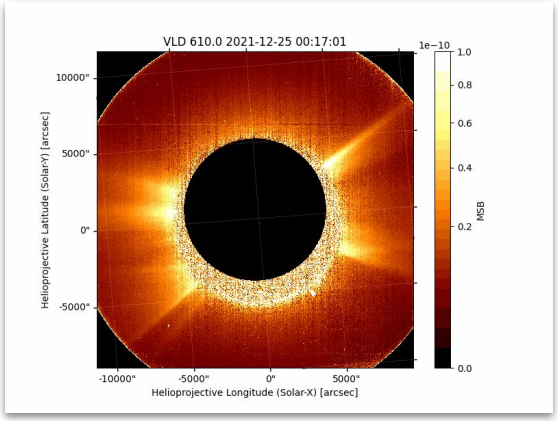
sunpy

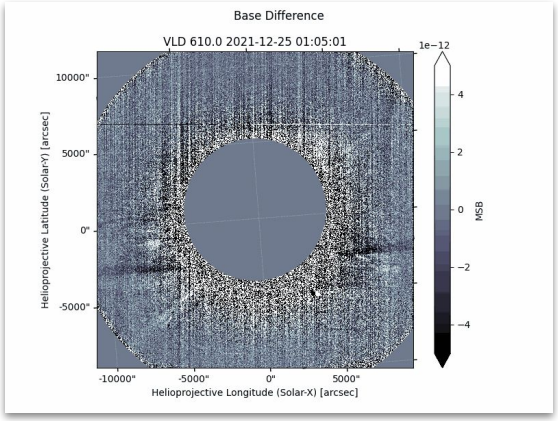
1. Visualization of Metis VL and UV data by means of general tools of `matplotlib` and `sunpy`

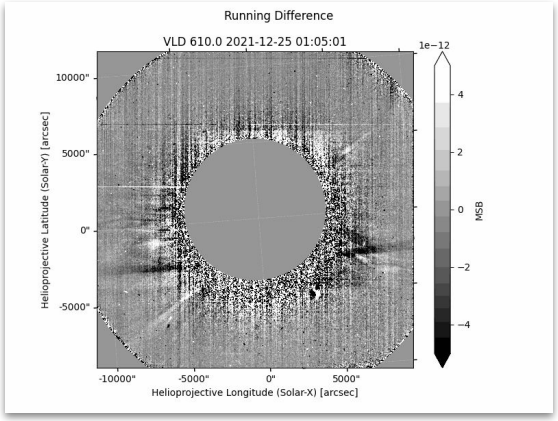
- Important aspects of Metis data to be aware of:
  - masking the Metis field of view
  - visualizing simultaneous VL and UV images of the solar corona
  - using Quality and Error matrices of an image
- Define sunpy map with the Metis image
- Apply image enhancement filters
- Identify stars/planets

Metis scientific analysis with Python

2. Calculation and visualization of the running and base difference maps using a sequence of `sunpy` maps

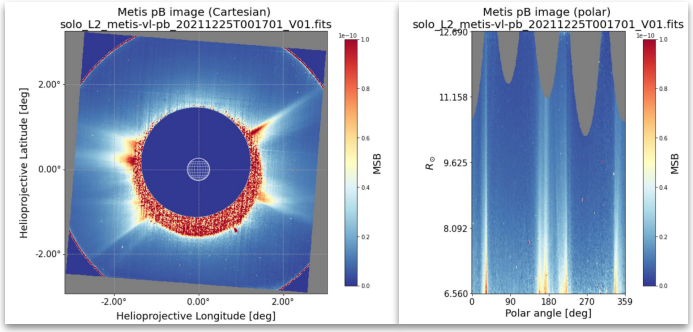


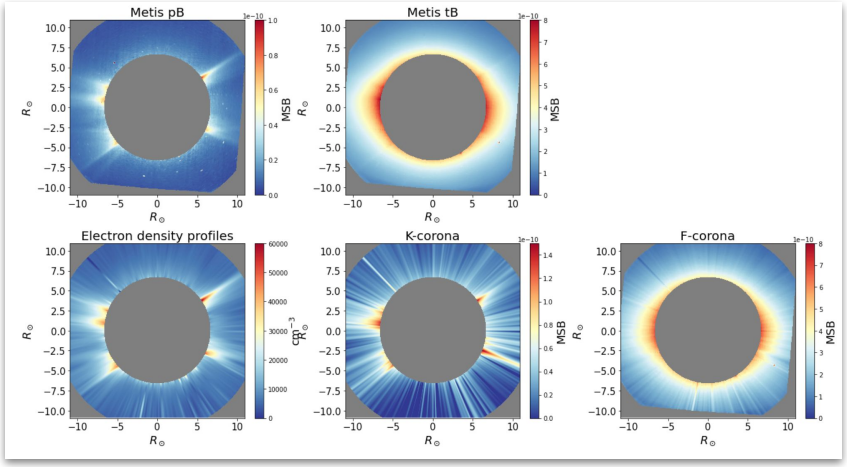




Metis scientific analysis with Python

3. Calculation of the electron density profiles and K/F corona maps using
   - Conversion of images from Cartesian to polar coordinates
   - Calculation of electron density radial profiles and K-corona model by means of the inversion method (Hayes et al. 2001)
     - *implementation of Van De Hulst (1950) method is in progress…*
   - Determination of the F-corona model as a difference of the total brightness image and K-corona model

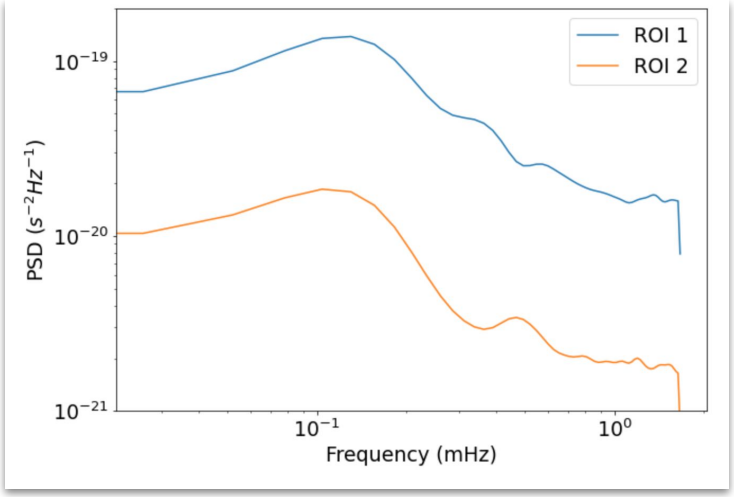


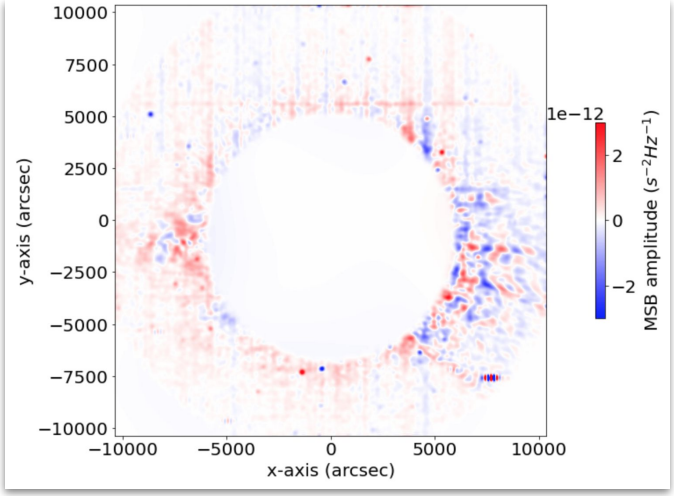


Metis scientific analysis with Python

4. Studying fluctuations and oscillations in a sequence of Metis images

- Studying the power spectral density in different regions of Metis FoV
- Examining the temporal-spatial coherent oscillations of the coronal structures by means of performing the k-Omega filtering





Metis scientific analysis with Python: conclusions

- Development is ongoing
- With an aim of integration of the Metis-related routines with sunpy package
- Any feedback or contribution is welcome