ESA ESDC heliophysics archives update

3rd IHDEA meeting, NASA/GSFC
16 October 2019

A. Masson, ESDC Heliophysics archives science Lead

Outline

1. Cluster Science Archive new features through science cases
2. Solar Orbiter Archive preview
3. SOHO archive at ESDC alignement with SOHO archive at Goddard
4. Proba-2 Jupyter Notebook
5. Ulysses archive ESDC/GSFC archives alignement and User group

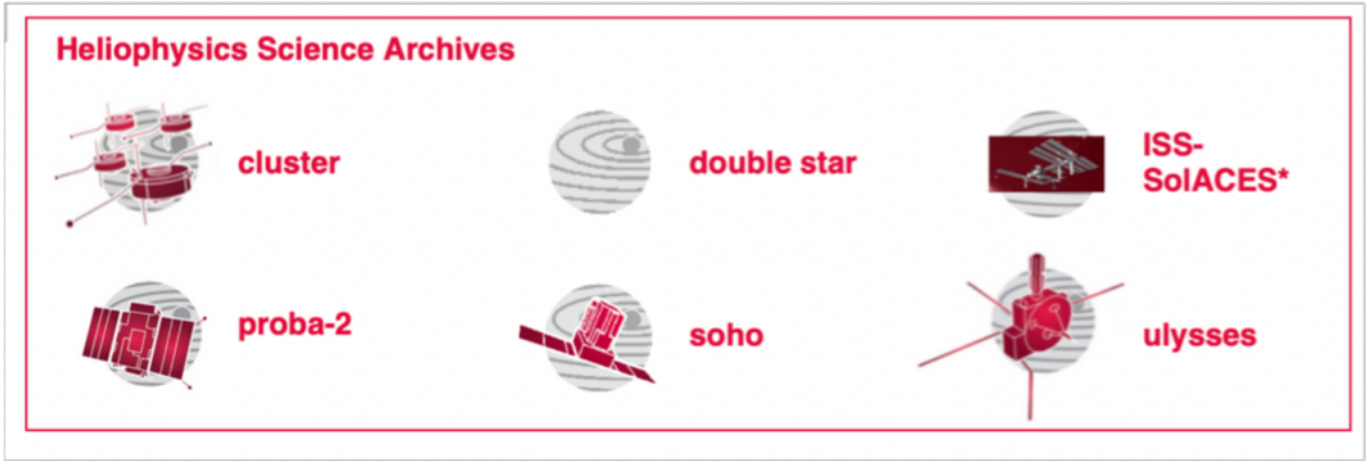
ESA ESDC heliophysics archives

Heliophysics archives team at ESAC SDC supports the following missions

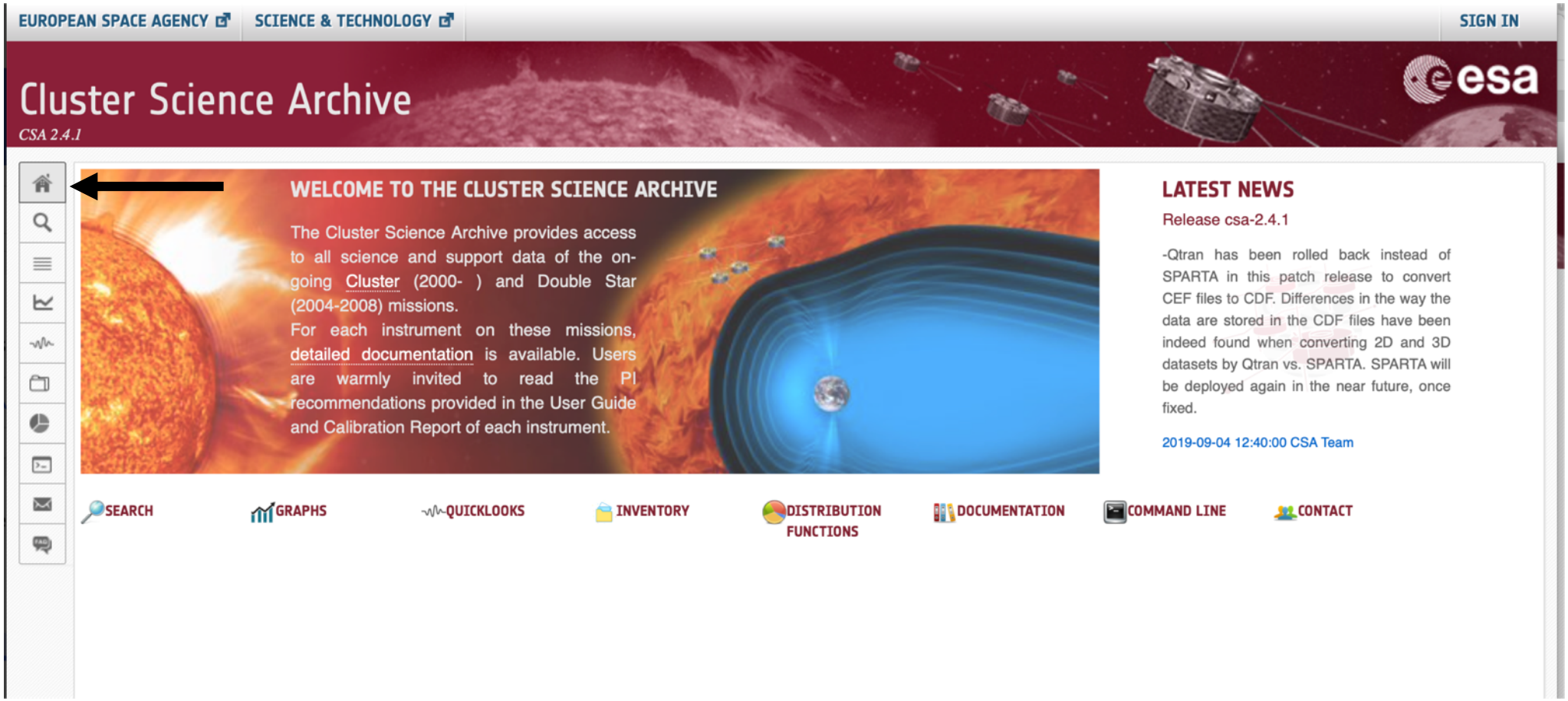
- Cluster (in operation)
- SOHO (in operation)
- Proba-2 (in operation)
- ISS-Solaces (legacy)
- Double Star (legacy)
- Ulysses (legacy)

In the (near) future

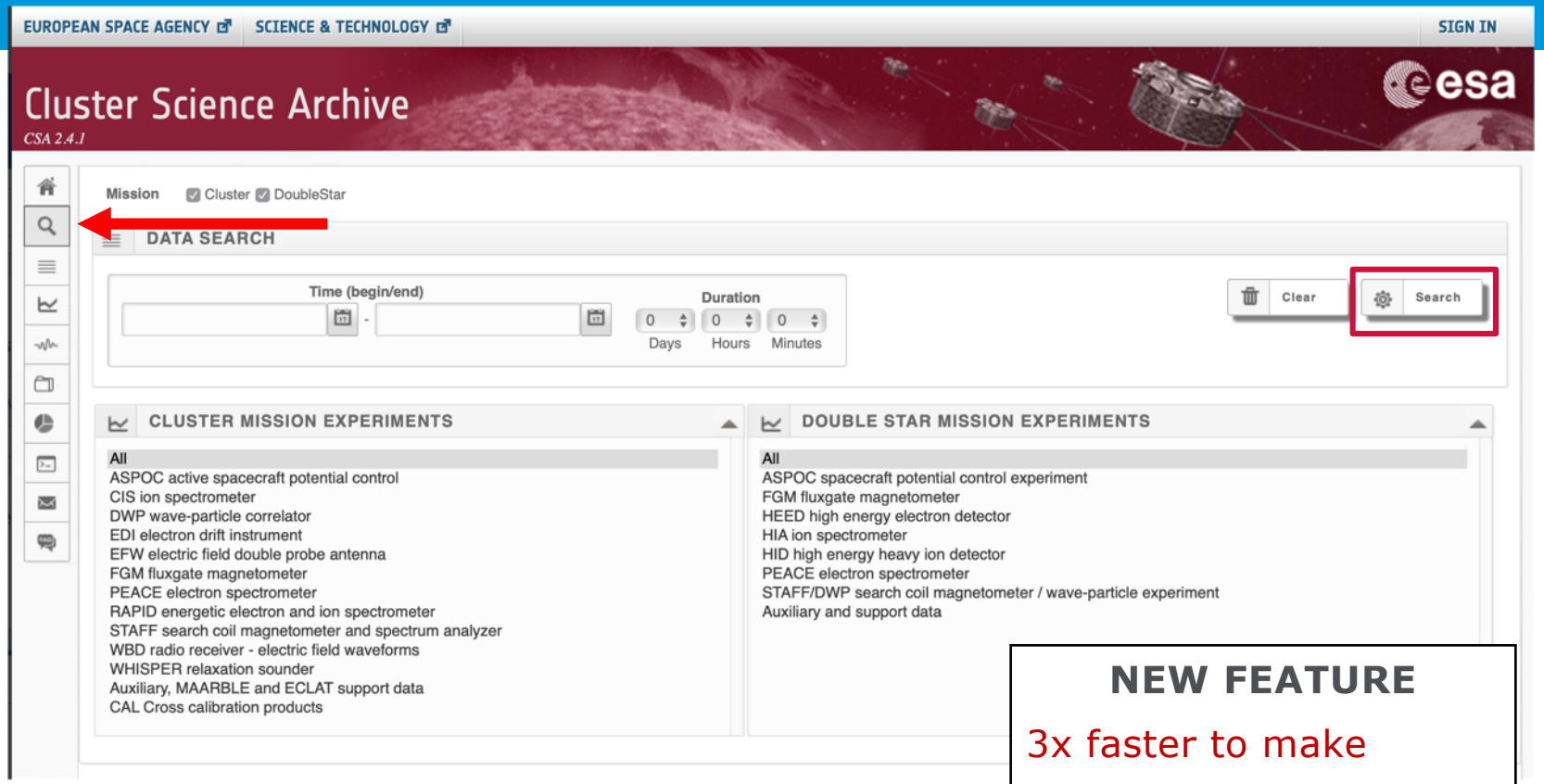
- Solar Orbiter
- SMILE
- PROBA-3



CSA Web GUI: https://csa.esac.esa.int/



Basic dataset search



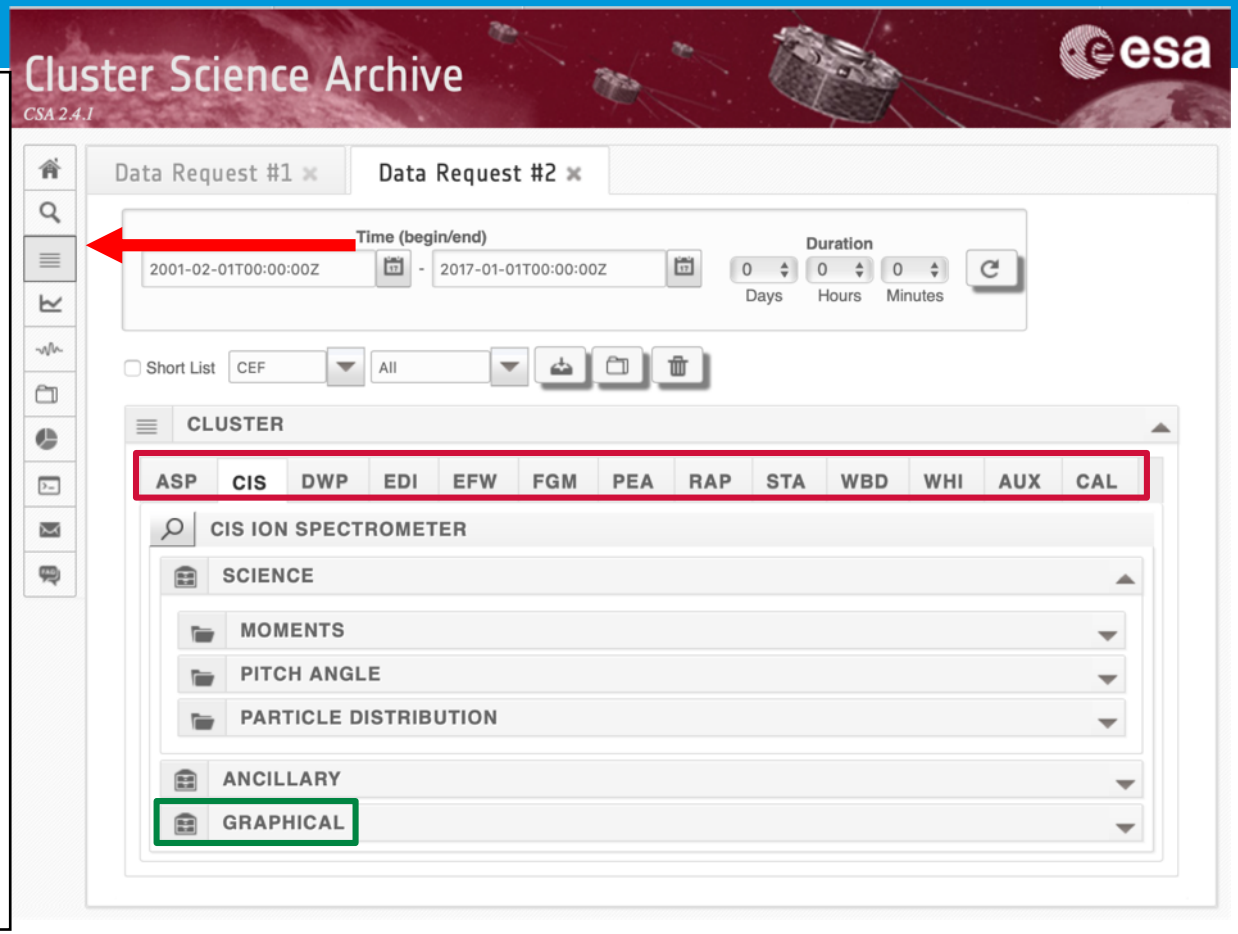
NEW FEATURE

3x faster to make inventory queries

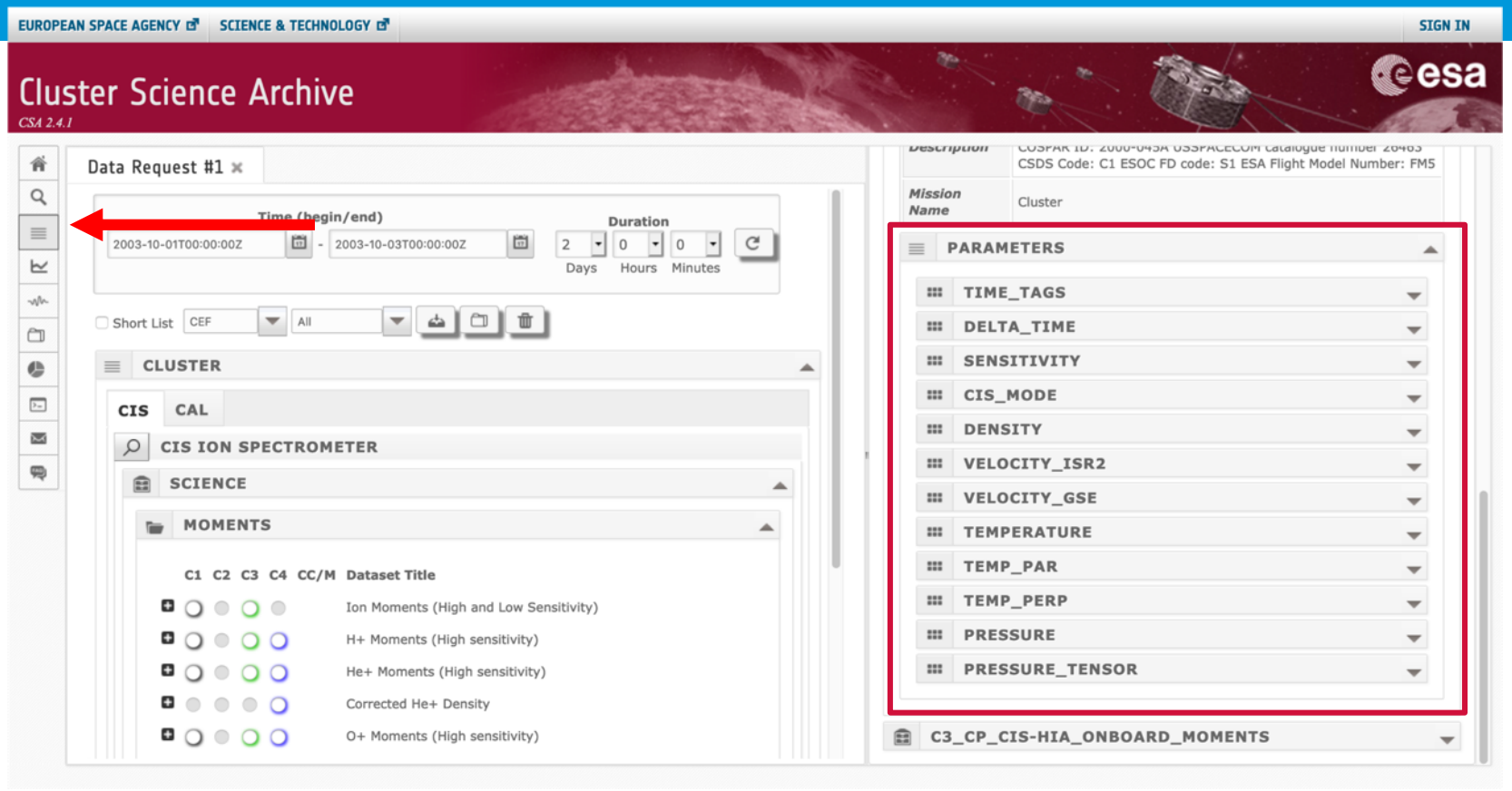
Results + new features

NEW FEATURES

- Experiments in tabs
- New ordering and grouping of datasets



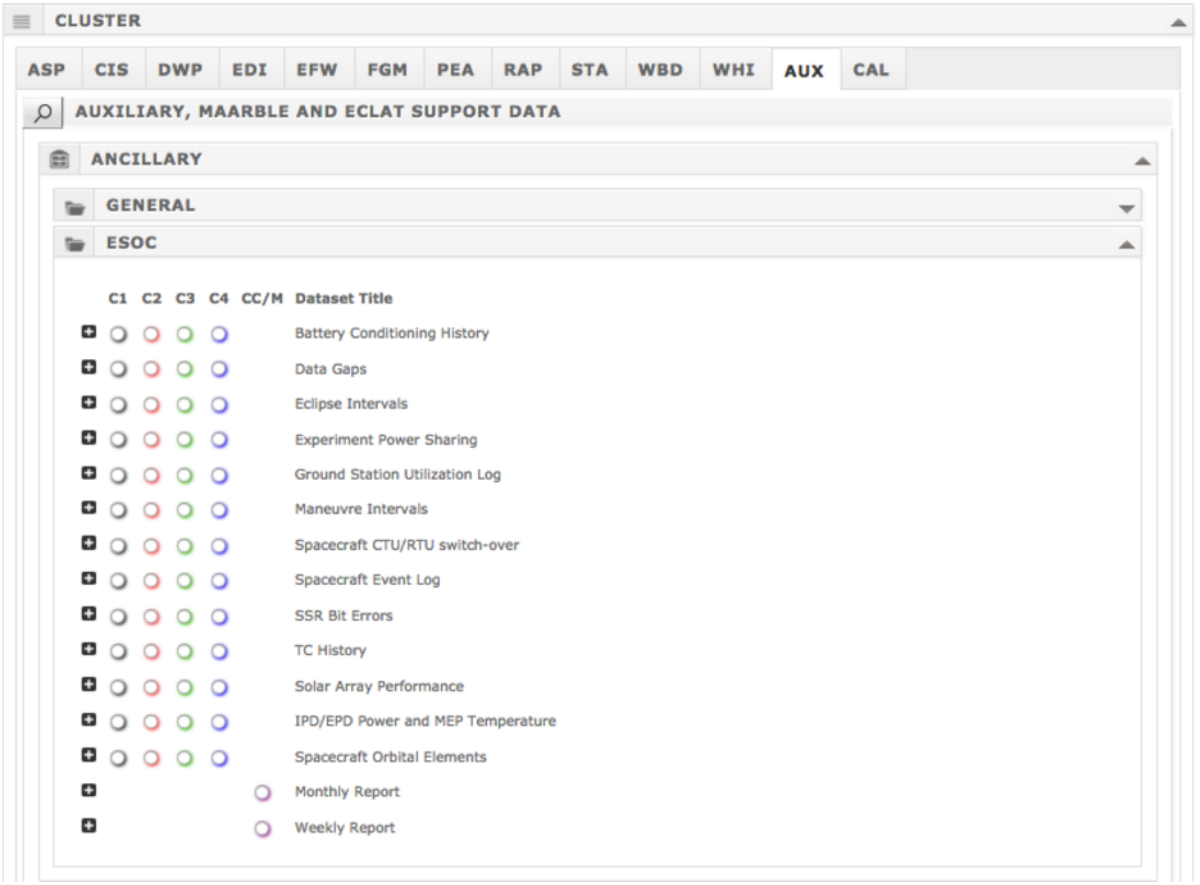
Metadata: parameters display

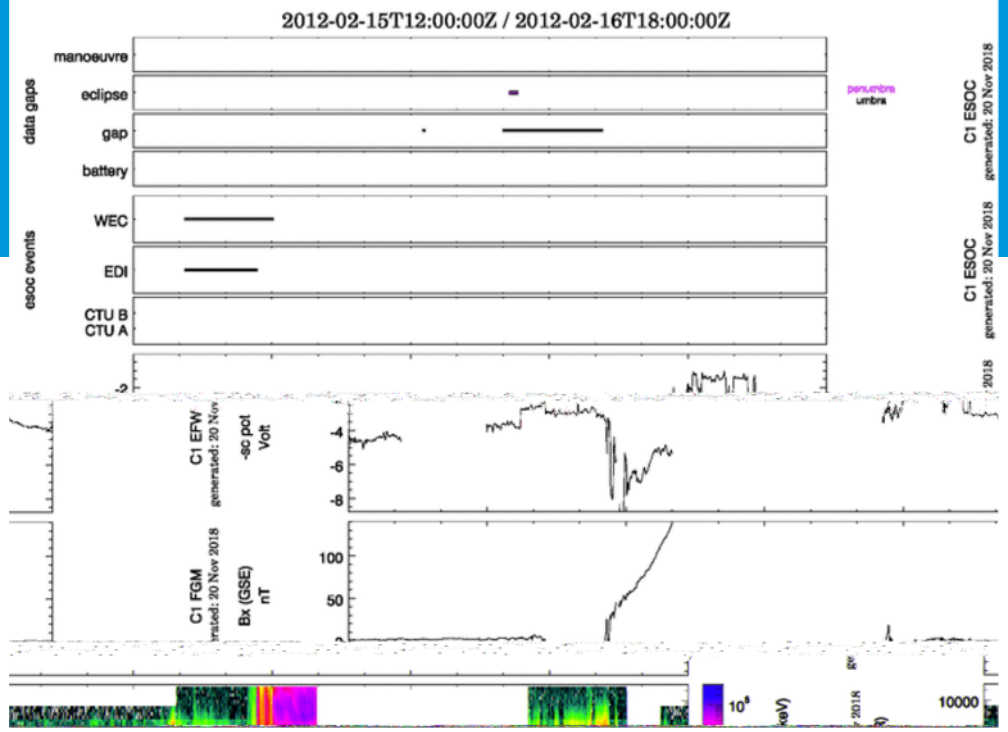


Results + new features

NEW FEATURES

- ESOC products (AUX)

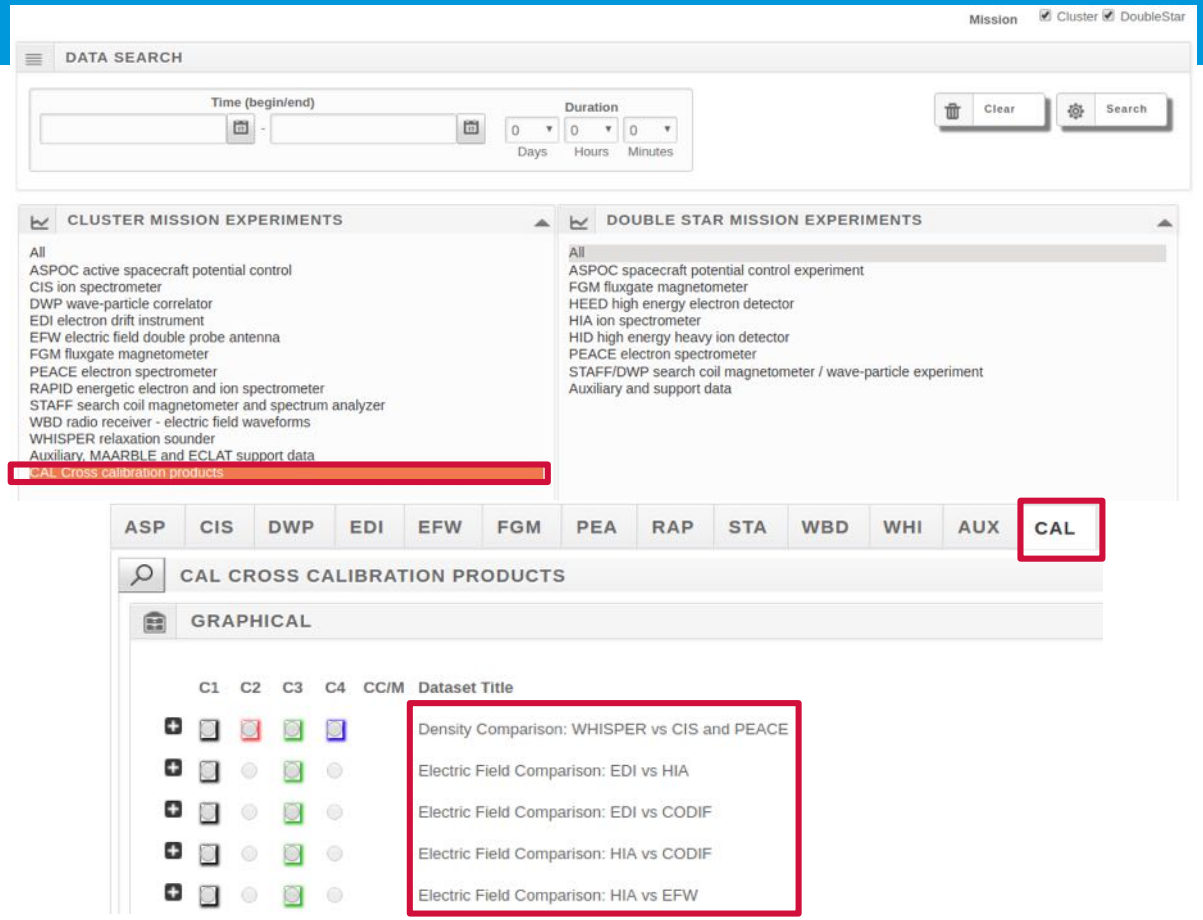


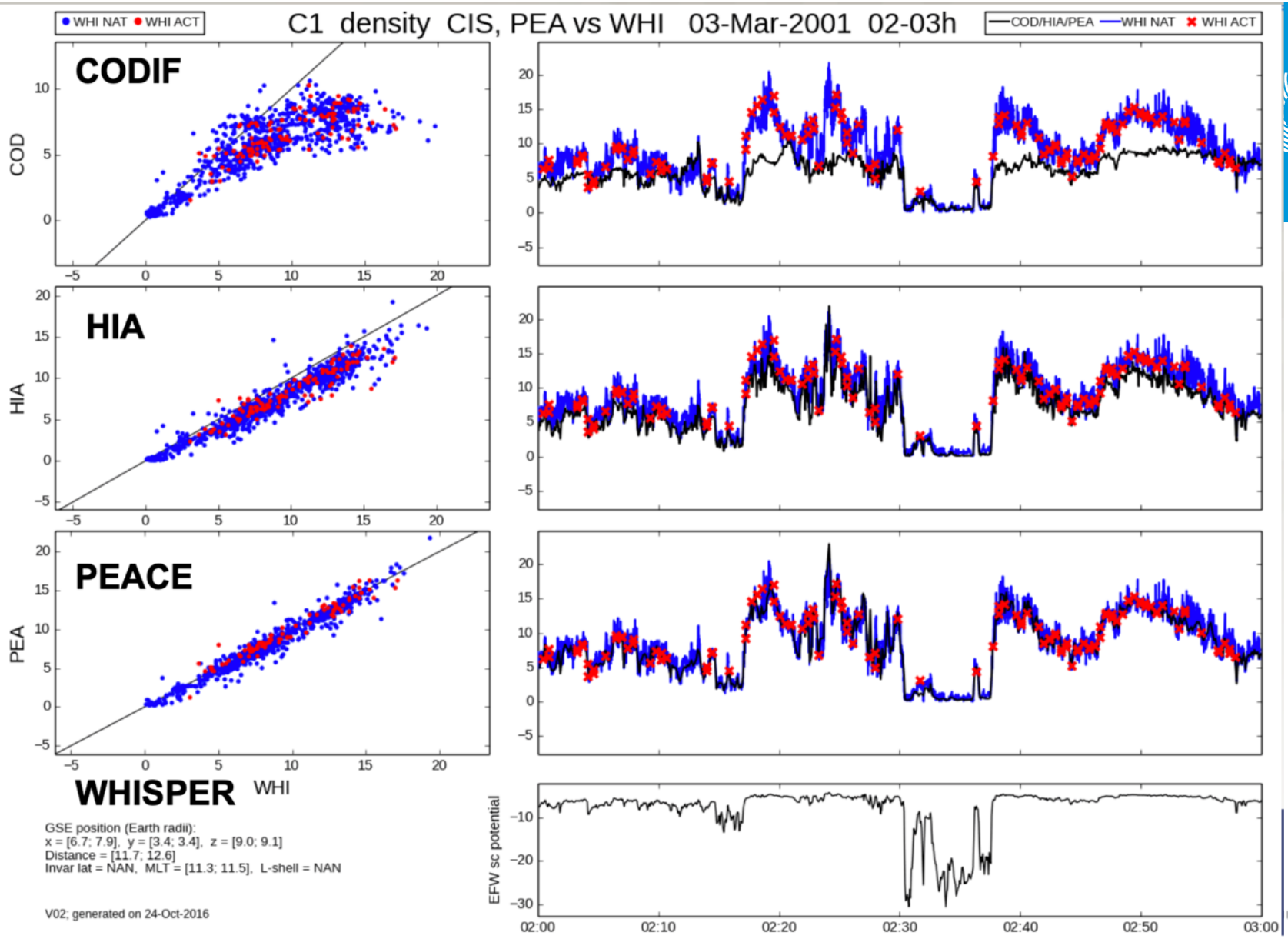

2012-02-15T12:00:00Z / 2012-02-16T18:00:00Z
data gaps
manoeuvre
eclipse
gap
battery
esoc events
WEC
EDI
CTU B
CTU A
penumbra
umbra
C1 ESOC
generated: 20 Nov 2018
C1 EFW
-sc pot
Volt
-4
-6
-8
C1 FGM
Bx (GSE)
nT
100
50
10000

Search and Results – Cross calibration

NEW FEATURES

- Cross calibration plots
- Gathered in the CAL "experiment"





esa

ropean Space Agency

Science case on FTEs by Cluster and Double Star

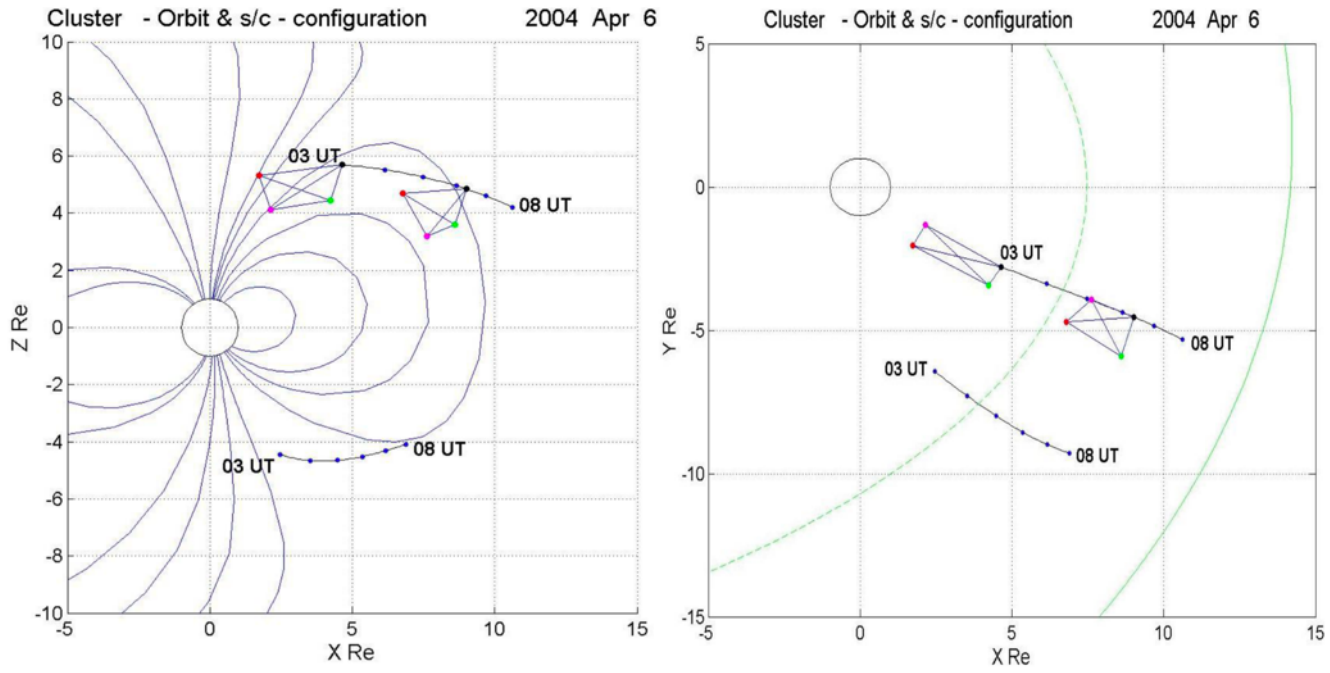
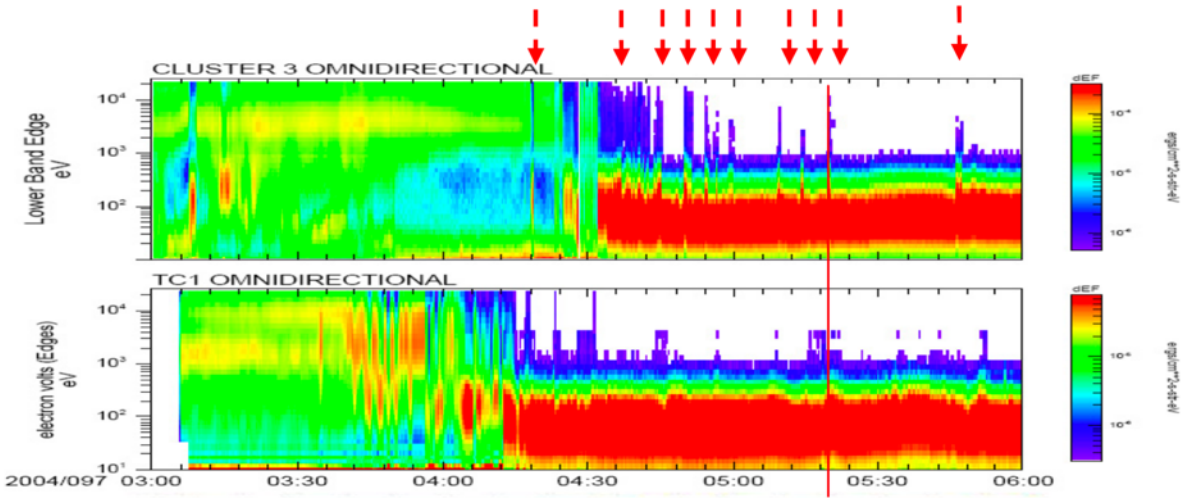


Fig. 1. Cluster s/c1 and Double Star TC-1 tracks in GSM coordinates for the interval 03:00 to 08:00 UT on 6 April 2004. The Cluster orbit also shows two spacecraft configurations (scaled up by a factor x50). Each orbit has hour markers. Model field lines are shown for the projection into the X,Z plane and cuts through the bow shock and magnetopause are shown for the X,Y plane. For the X,Z plane field lines are drawn from the Tsyganenko '89 model for guidance.

Science case on FTEs by Cluster and Double Star



Science case on FTEs by Cluster and Double Star

Cluster Science Archive

Cluster 2.1.1

KEY GRAPHICAL PRODUCTS

Time granularity ○ 1 day ○ 6 hours ○ 1 hour ◉ On demand

Clear « Plot »

Time (begin/end)

2004-04-06T03:00:00Z - 2004-04-06T06:00:00Z

Duration

0 Days | 3 Hours | 0 Minutes

Cluster | **DoubleStar**

ASPOC | AUX | FGM | HIA | **PEACE** | STAFF

D1	D2	All	Product Name
○	○	○	DENSITY (ELECTRONS) -- On Demand only
◉	○	○	ENERGY SPECTROGRAM (OMNI-DIRECTIONAL) - ELECTRONS -- On Demand only
○	○	○	ENERGY SPECTROGRAM (PARALLEL) - ELECTRONS -- On Demand only
○	○	○	ENERGY SPECTROGRAM (ANTI-PARALLEL) - ELECTRONS -- On Demand only
○	○	○	ENERGY SPECTROGRAM (PERPENDICULAR) - ELECTRONS -- On Demand only
○	○	○	PITCH-ANGLE DISTRIBUTION (5-200 EV) - ELECTRONS -- On Demand only
○	○	○	PITCH-ANGLE DISTRIBUTION (500-1500 EV) - ELECTRONS -- On Demand only
○	○	○	PITCH-ANGLE DISTRIBUTION (5-10 keV) - ELECTRONS --

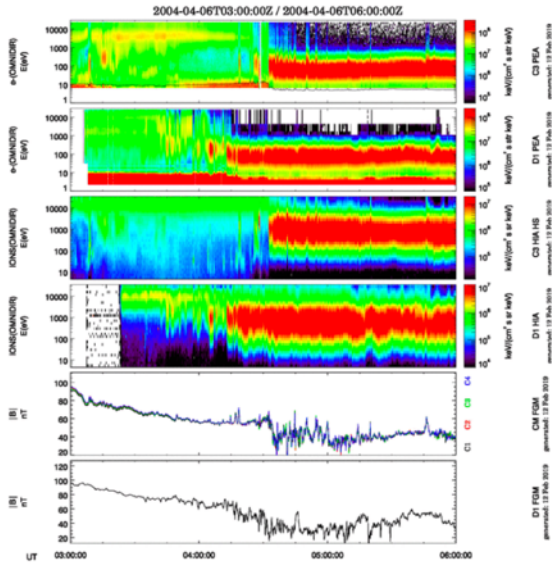
SELECTED PLOTS

- **PEACE *C3***: ENERGY SPECTROGRAM (OMNI-DIRECTIONAL) - ELECTRONS
- **PEACE *D1***: ENERGY SPECTROGRAM (OMNI-DIRECTIONAL) - ELECTRONS
- **CIS *C3***: ENERGY SPECTROGRAM (OMNI-DIR) - IONS (HIGH SENSITIVITY)
- **HIA *D1***: ENERGY SPECTROGRAM (OMNI-DIR)
- **FGM *CM***: MAGNETIC FIELD - TOTAL FIELD
- **FGM *D1***: MAGNETIC FIELD - TOTAL FIELD

PLOTS

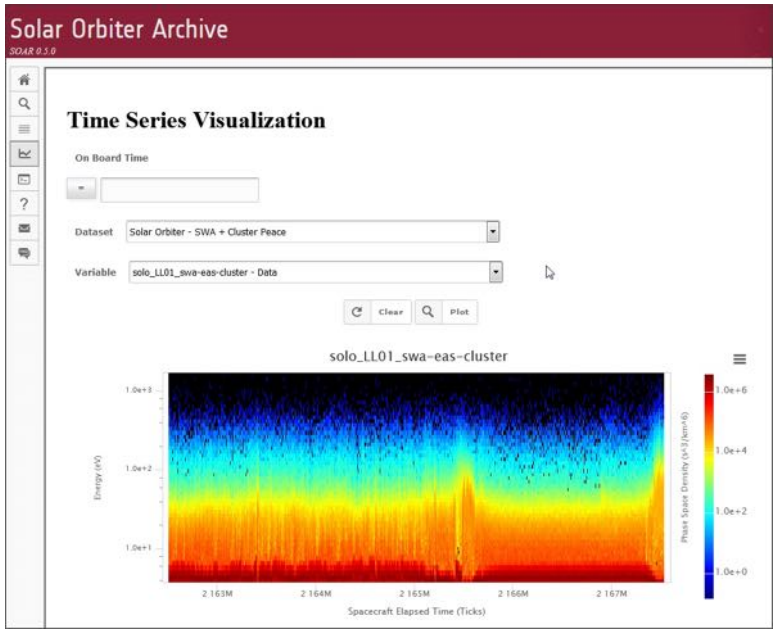
PS | CEF

CL_CG_ONDMD__20040406030000_20040406060000_V20190212232551_00.gif

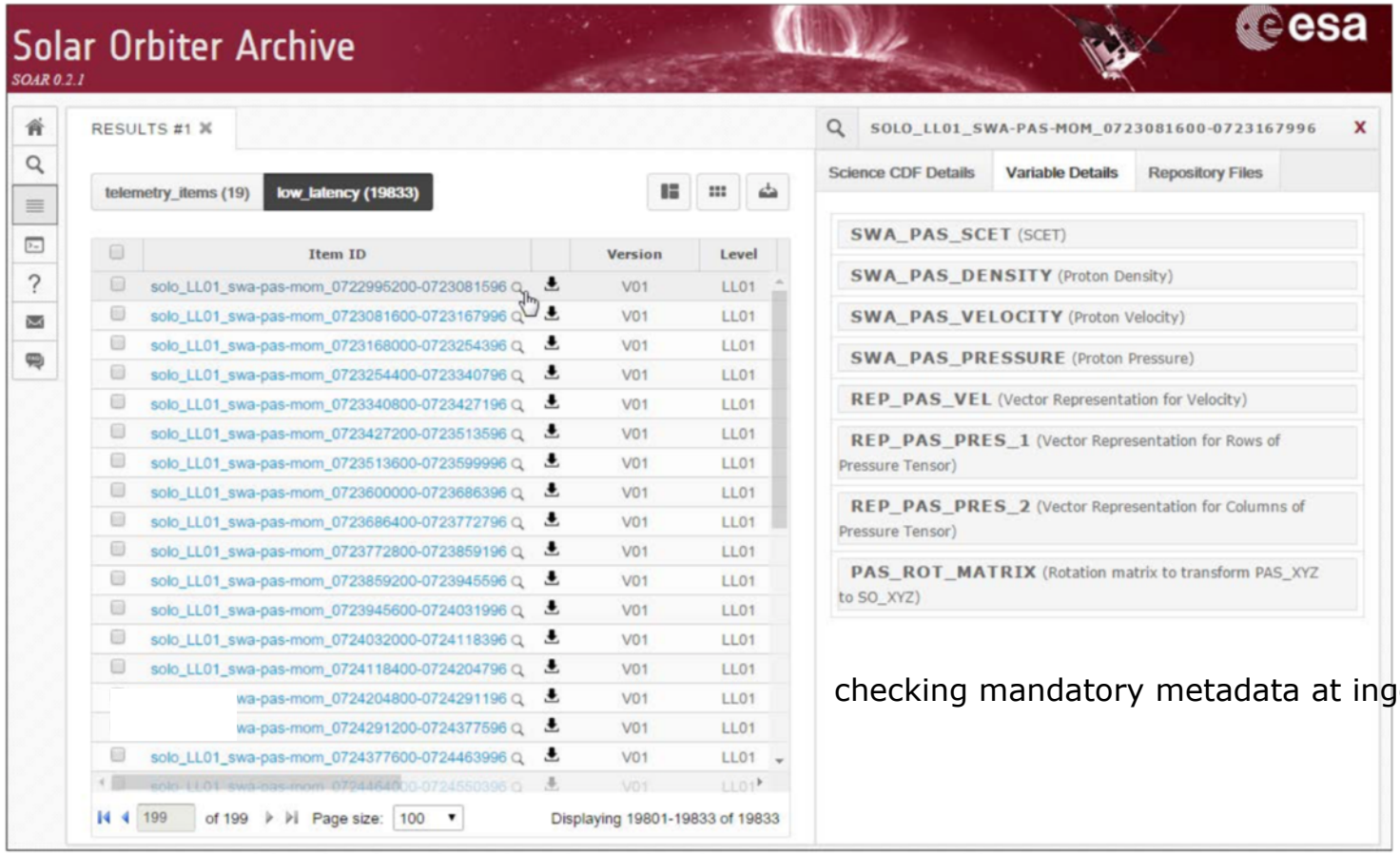


Solar Orbiter ARchive (SOAR)

- SOAR is ready to ingest Solar Orbiter files and planning files (test with SOC: ok)
- Handles proprietary periods at file level
- On-going implementation on plotting with Highcharts Time Series data and spectrograms
- Ready for launch!



Solar Orbiter ARchive



checking mandatory metadata at ingestion time

Figure 4: CDF variables displayed, and in the order they appear in CDF file

SOAR can already interact with external data analysis applications via IVOA SAMP protocol

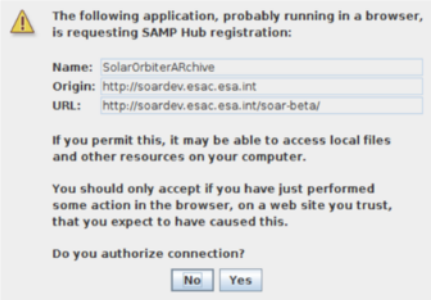


Figure 5: If it is the first time, SOAR is registered in the SMAP hub in this session, user must to authorize the connection.

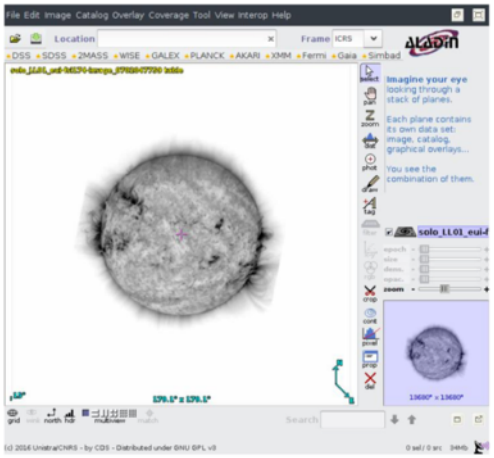


Figure 6: Example of FITS file (from EUI) sent to Aladin via SAMP

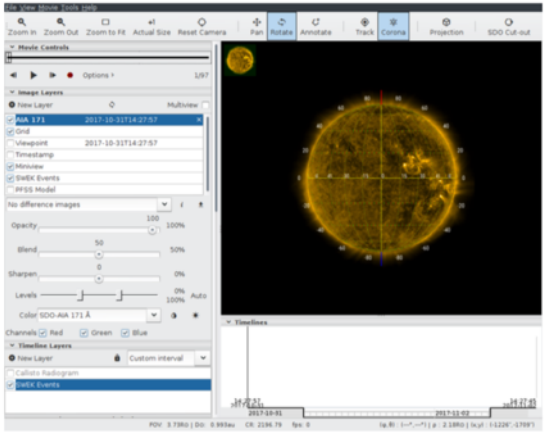


Figure 7: Example of FITS file (EUI) sent to JHelioviewer

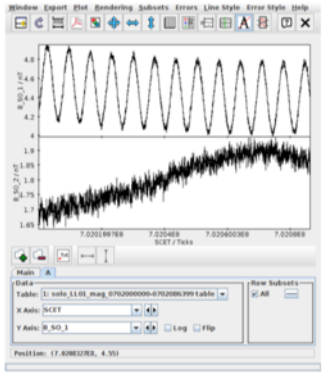


Figure 8: Example of CDF file (MAG) sent to Topcat

Alignement of the GSFC/ESA SOHO archives

SOHO GUI at NASA definitely shut down end 2018 for security reasons (backend is up of course, i.e. data are Goddard are available through IDL, Python, VSO etc...)

The ESDC/GSFC alignement upgrade aims at

- Making sure all SOHO files stored at GSFC are at ESAC/SSA*
- Double check both archives are in sync
- Improving the metadata display and content to ease the life of scientists
- Re-ingest all data with the improved metadata

*Apart from MDI

Alignement of the GSFC/ESA SOHO archives

IMPORT

- Making sure all SOHO files stored at GSFC are at ESAC/SSA: 9/12
- Double check both archives are in sync with GSFC: all in sync

INGEST (opens each file, read CDF/FITS keywords, rejects if not compliant)

- Re-ingest all data with the improved metadata
    - 2/12 fully done (SUMER, CELIAS)
    - 1 on-going, 1.7 million files (LASCO)
    - 4 now providing mission long files (VIRGO, GOLF, COSTEP, CELIAS)

- This month the import/ingestion module speed increased by a factor 11 (multi-threads)

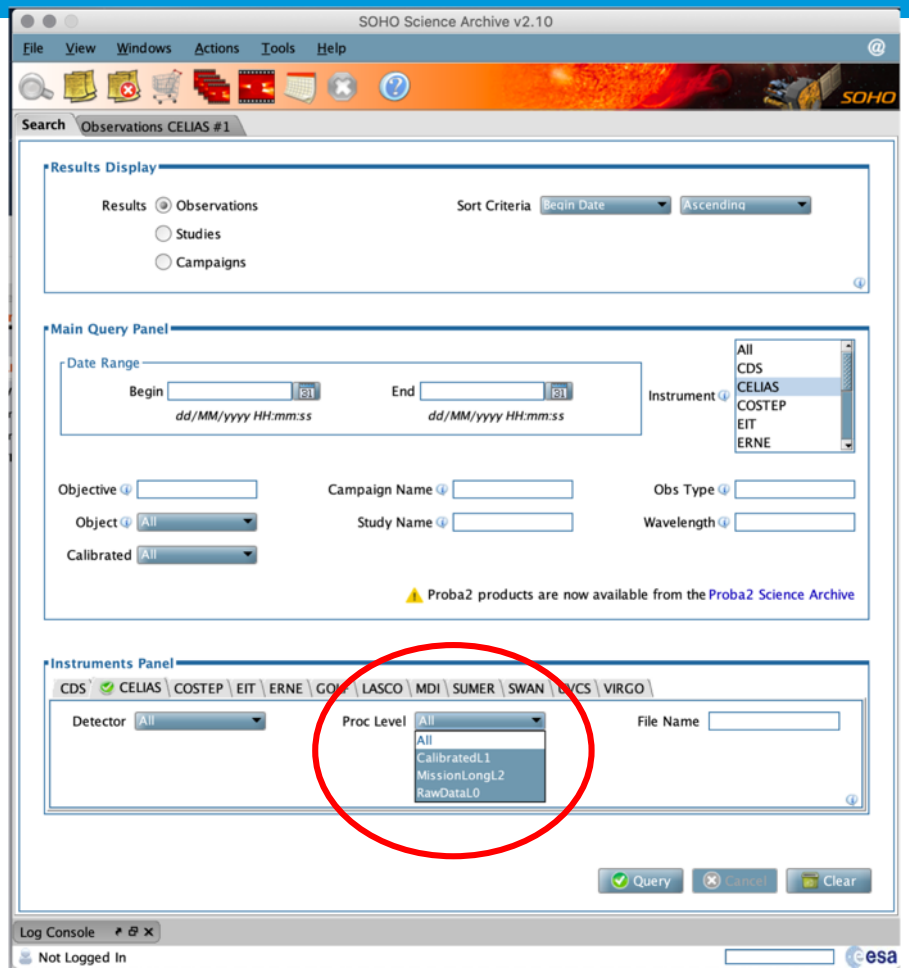
SOHO archive ESDC/GSFC alignment

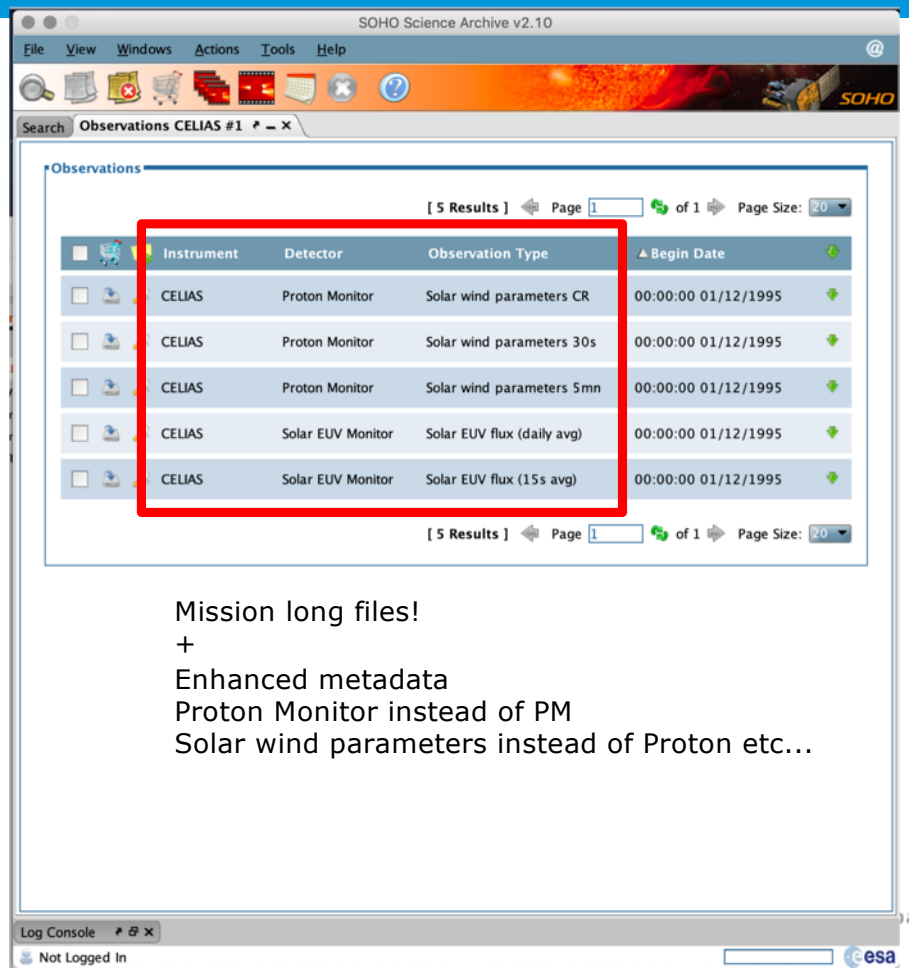
Integration of mission long files

Ingestion module updated to take into account these new type of files

- CELIAS Proton Monitor 30sec data [215M]
- CELIAS Proton Monitor 5min data [32M]
- CELIAS Proton Monitor Carrington Rotation data [8.4M]
- CELIAS SEM 15sec Averaged data [511M]
- CELIAS SEM Daily Averaged data [436K]
- COSTEP EPHIN L3 I3i 10min (By Year) [41M]
- COSTEP EPHIN L3 I3i 1440min (By Year) [4.5M]
- COSTEP EPHIN L3 I3i 1min (By Year) [185M]
- COSTEP EPHIN L3 I3i 30min (By Year) [21M]
- COSTEP EPHIN L3 I3i 5min (By Year) [62M]
- COSTEP EPHIN L3 I3i 60min (By Year) [25M]
- GOLF 22-year MEAN [132M]
- GOLF 22-year PM1 [132M]
- GOLF 22-year PM2 [132M]
- VIRGO SPM Blue [93M]
- VIRGO SPM Green [93M]
- VIRGO SPM Red [93M]
- VIRGO TSI Daily [129K]
- VIRGO TSI Hourly [3.0M]

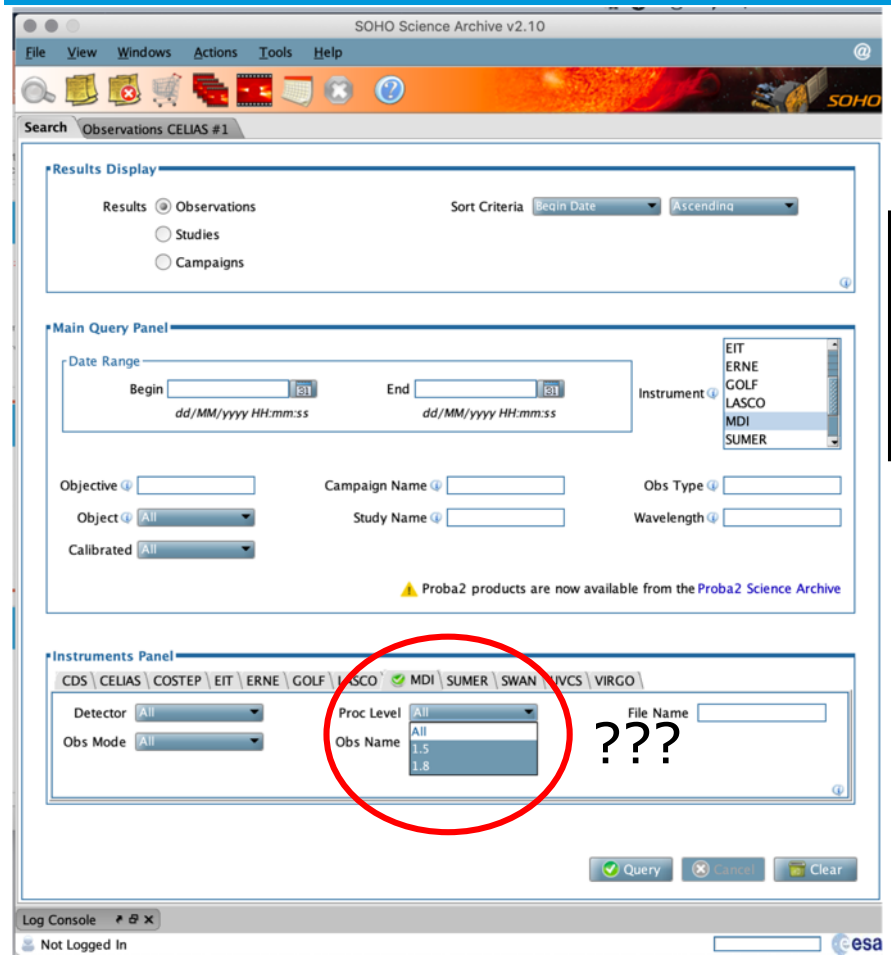
SOHO archive upgrade





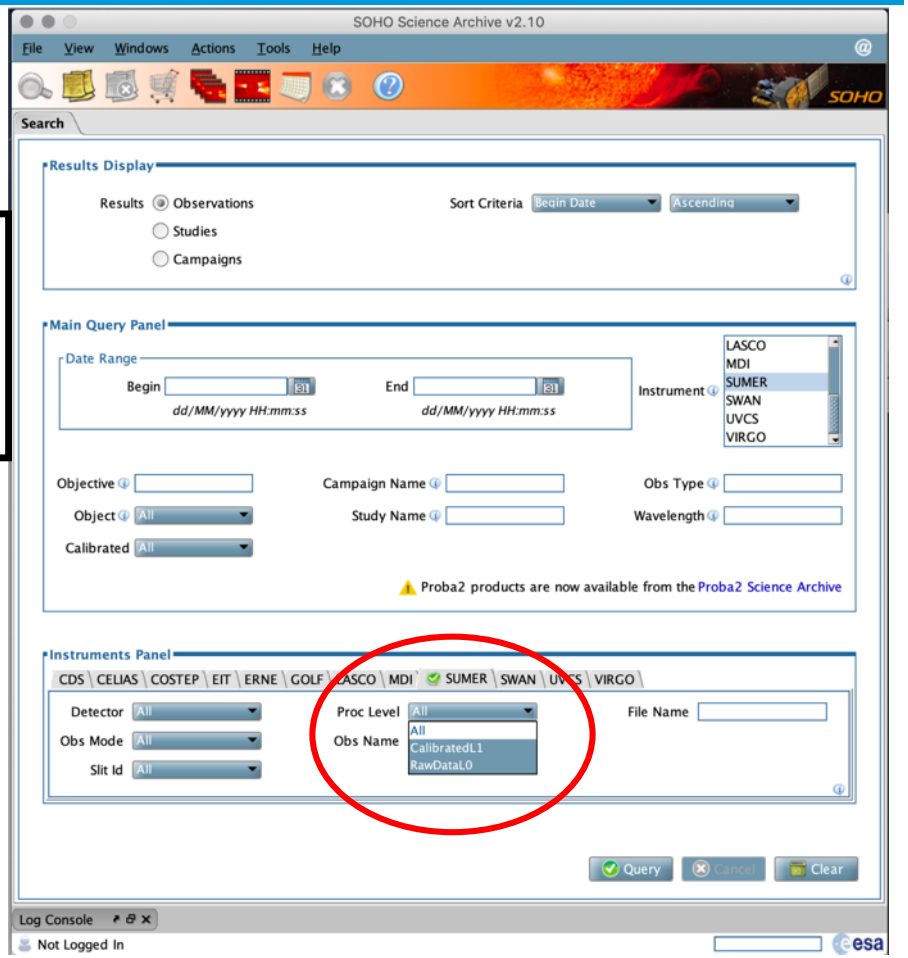
Mission long files!
+
Enhanced metadata
Proton Monitor instead of PM
Solar wind parameters instead of Proton etc...

SOHO graphical user interface (GUI) at ESAC update (2019)



Processing Level

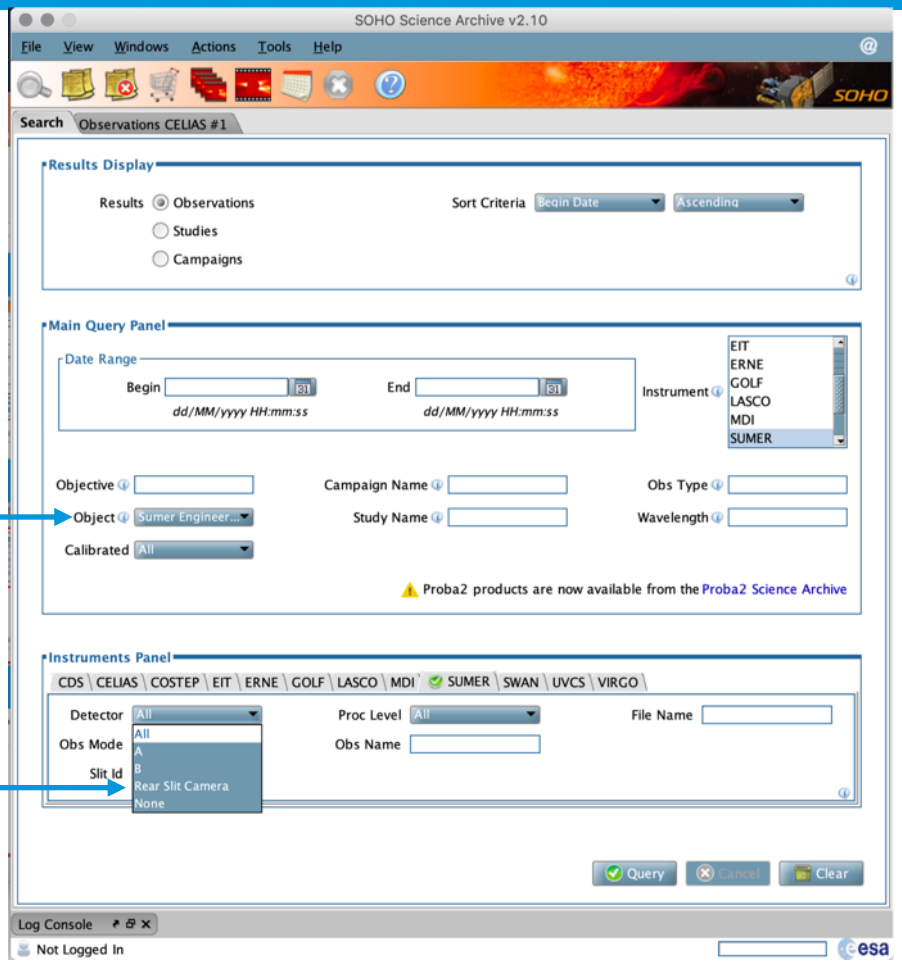
Mission Long
Calibrated
Raw



Working with B. Fleck and PI teams

New science objects delivered clarified with PI team: FF, OS, NN

Instead of RSC, less acronyms



Soho Science Archive

Pages
Blog

PAGE TREE
- Applicable Items
- Reference Items
- Coordination Meetings
- Milestone Meetings
- Reports
- Doc Deliverables
- Sw Deliverables
- Knowledge Base
  - Data Repository
  - Data Transfer SW
  - Import/Ingest Maintenance
  - Import/Ingest Status
  - Link Images To Observations
  - Documents
  - SSA Startup
  - Usage Statistics
  - Ingest Testing
  - SSA Time Animator
  - **Goddard-SSA synchronisatio**
- Releases

TITLE TREE

Space tools

Goddard-SSA synchronisation

Created by Monica Fernandez, last modified on 08 Oct, 2019

On 2019 it has been decided to perform the whole re-ingestion of all SSA products to get a complete synchronisation between Goddard and SSA.

The table below contains the status of this alignment.

Instrument	Total number of files	Re-ingestion status	Software update	Download progress	Ingestion done
16 **mission long files** (Celias, Costep, Golf, Virgo)	16	Done	4.5 days	N/A	03 Jun 2019
SUMER	13.716	Done	2	2 hours	04 Jun 2019
3 **Virgo mission long files** (SPM BLUE/GREEN/RED) + Celias re-ingestion	8				31 Jul 2019
LASCO	1.773.296	Ingesting in SSA	3 (Coronal Images) + 2.5		
CDS	552.143				
CELIAS	114.950				14 Aug 2019

LASCO

Imported Date	Files	Status	Ingested
2010-01-01 --> 2011-01-01	956114 (missing 48)	Done (except 48 files)	Ingesting...
2011-01-01 → 2013-0101	736	Done.	Done.
2013-01-01 → 2014-01-01	109582	Done.	Done.
2014-01-01 → 2015-01-01	32763	Done.	Done.
2015-01-01 → 2016-01-01	188895	Done.	Done.
2016->2017	98240	Done	Done.
2017->2019	93.074	Done.	Done.
2019_01_01->2019_05_01	192.298	Done.	Done.
2019_05_01 → 2019_07_01	101594	Done.	Done.

CELIAS

Imported date	Files	Download progress	ingested
2010->2014	41.914	Done.	Done.

New version expected by the end of 2019

TBD

To be redelivered

CDS	552.143				
CELIAS	114.950				14 Aug 2019

Imported date	Files	Download progress	ingested
2010->2014	41.914	Done.	Done.
2014->2017	47.713	Done.	Done.
2017->2019_07_10	25.323	Done.	Done.

COSTEP 44.765

Imported date	Files	Download progress	Ingested
18 Jul 2019	44.765	Done. Missing 7 files.	

EIT 534.093

Id range	Files	Download progress	Ingested
1 → 450.000	80.046	Done.	
450000->550000	100.001	Done (missing one).	
550000->650000	100.001	Done.	
650000->800000	149.917	Done.	
800.000->6.370.775	104.132	Done.	

ERNE 36.743

Imported date	Files	Download progress	Ingested
All mission until 16 Jul 2019	37.049	Done.	

GOLF 7.870

Imported date	Files	Download progress	Ingested
All mission until 15 Jul 2019	7.870	Done (missing 163)	

MDI	96.401				
SWAN	12.184				

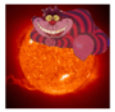
Imported date	Files	Download progress	Ingested
18 Jul 2019	12.183	Done.	

UVCS	156.609				
VIRGO	35.033				

Imported date	Files	Download progress	Ingested
All mission until 16 Jul 2019	35.033	Done.	

VSO Time / Instrument Search Form

Version 1.4



All from Provider	All from Source	Instrument	Date Range
HANET (unavailable)	BBSO	BBSO	2000.07.05 →
	KANZ	KANZ	2001.02.07 →
	OACT	OACT	2002.02.26 →
	OBSPM	OBSPM	2004.10.22 →
	YNAO	YNAO	2000.11.27 →
HAO	MLSO	K-Cor	2013.09.30 →
		chp	1996.04.20 – 2013.08.02
		dpm	1994.02.20 – 2010.02.23
		mk4	1998.10.01 – 2013.07.20
	SMM	cp	1980.03.02 – 1989.11.18
JSOC	SDO	AIA	2010.05.12 →
		HMI	2010.03.29 →
KIS (unavailable)	ChroTel	ChroTel	2012.04.01 →
KSO	KSO	KHPI	2008.06.07 →
LASP	SDO	EVE	2010.04.30 →
LMSAL	IRIS	IRIS	2013.07.16 →
	TRACE	TRACE	1996.01.19 – 2010.06.22
LSSP	RHESSI	RHESSI	2002.02.12 →
MSFC	CLASP2	SJ	2019.04.11 – 2019.04.11
		SP1	2019.04.11 – 2019.04.11
		SP2	2019.04.11 – 2019.04.11
	Hi-C	Hi-C	2012.07.11 – 2012.07.11
	Hi-C21	Hi-C21	2018.05.29 – 2018.05.29
MSU	YOHKOH	BCS	1991.09.01 – 2001.12.14
		HXT	1991.09.03 – 2001.12.14

Start: 2019 Sep 19 / 01 : 00

End: 2019 Sep 19 / 04 : 59

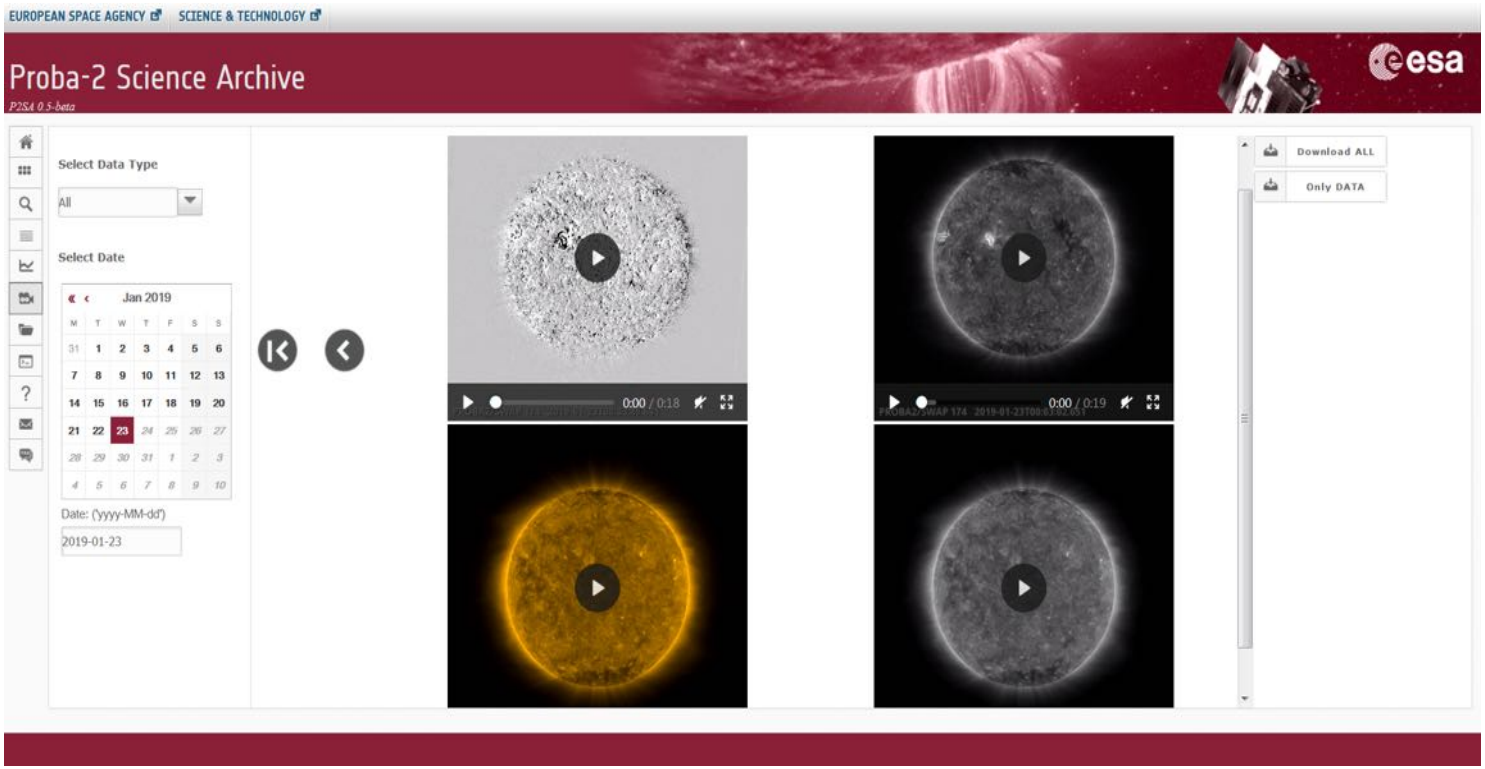
All Month All Day

Search Clear

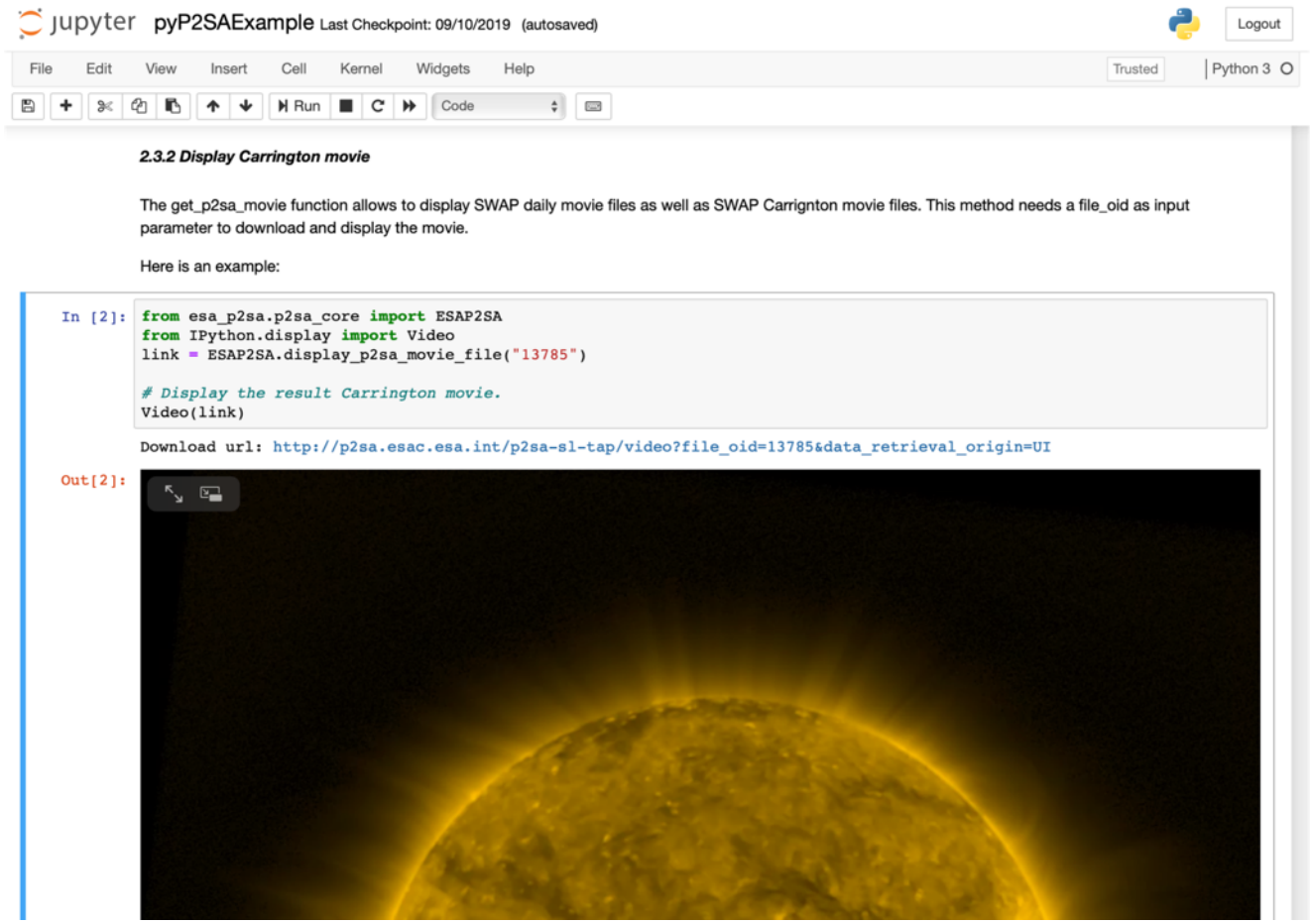
Let’s work together to bring ESDC solar archives within the VSO!

Proba-2: new stand-alone archive released early 2019

Video Gallery containing SWAP up-to-date daily and Carrington rotation movies



P2SA Jupyter Notebook



Ulysses archives alignement

Main work achieved in 2019

- Critical upgrade of hardware
- Critical upgrade of software
- Update of Ulysses FTP server with 2018 3D data generated at UCLA
- Some 3D data at ESA were not yet on Goddard a few months ago
- All experiments have been reviewed by an external group of European experts: a number of upgrades needed have been found

To be implemented ASAP most likely next year

Heliophysics Archives user group

Topics	Names
Helioseismology	Markus Roth (KIS, Germany)
Solar Atmosphere	Louise Harra (ETH, Switzerland)
Solar and interplanetary transients	A. Veronig (Graz, Austria)
Heliophysics particles	Nina Dresing (Univ. of Kiel, Germany)
Heliophysics fields	Christopher Chen (Imperial College, UK)
Heliophysics Archive expert	Vincent Genot (IRAP, Toulouse)
PS Representative	Matt Taylor

Scope of this working group

- Review individual archives to identify shortcomings or missing functionality
    - to improve the content and usage of individual archives

- **Overarching heliophysics multi-missions archive**

  Advise on the main functionalities (based on science cases)

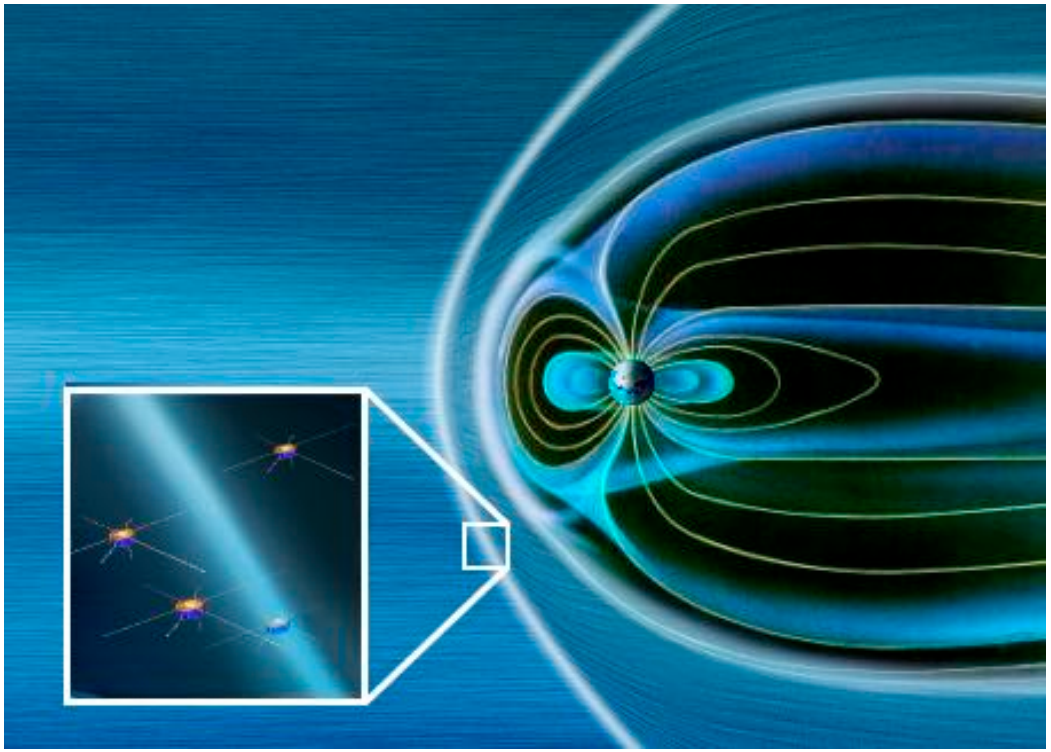
- Link to PSA or even astro archives

  Advise on the main functionalities (based on science cases)

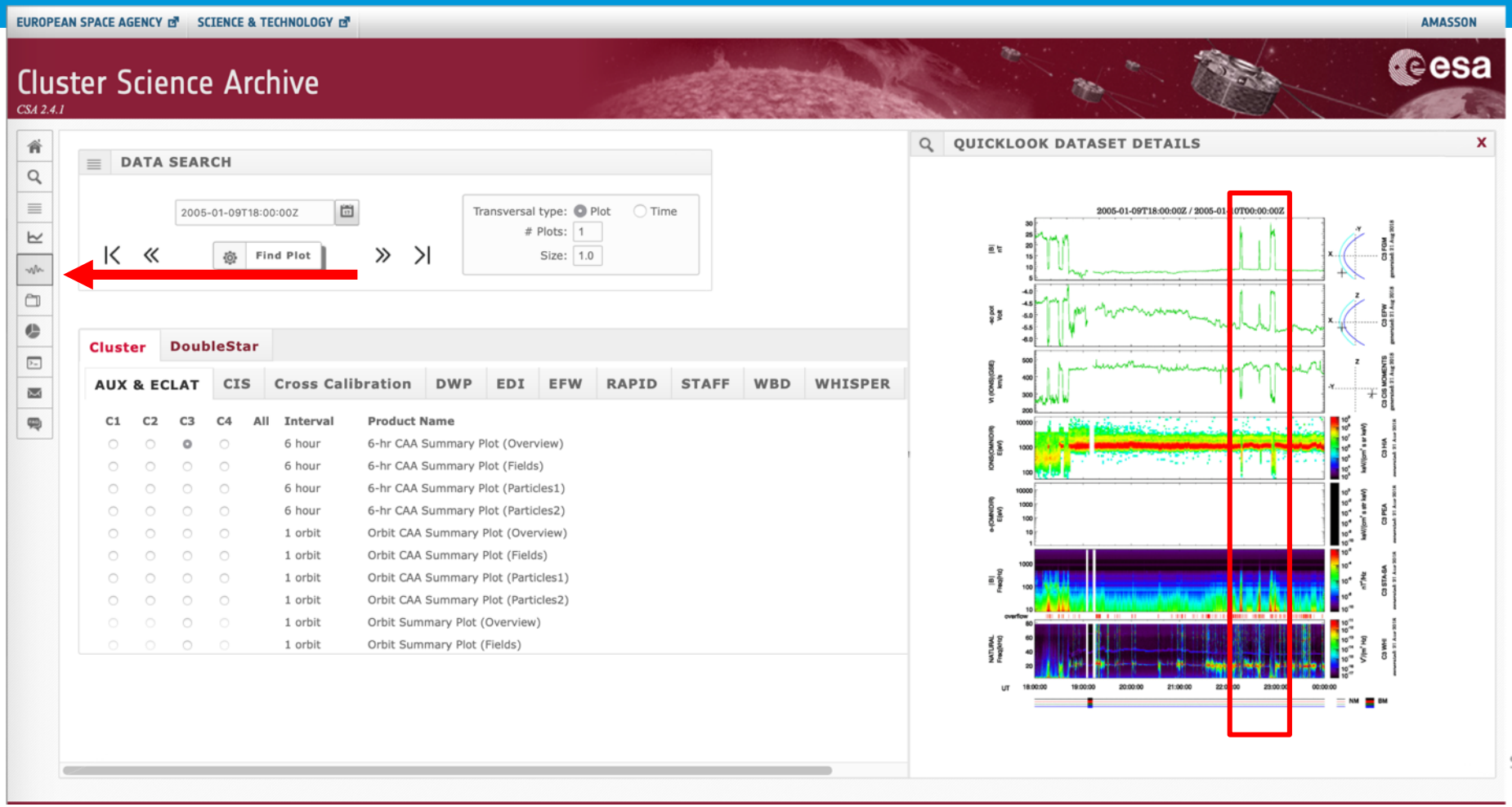
Conclusion

1. Cluster Science Archive new features through science cases
2. Solar Orbiter Archive preview
3. SOHO archive at ESDC alignement with SOHO archive at Goddard
4. Proba-2 Jupyter Notebook
5. Ulysses archive ESDC/GSFC archives alignement and User group

1. Cluster science archive
Science case on shock physics



83 quicklook plots (orbit long, 6h, PI plots)



Space Agency

Pre-generated plots (1h, 6h, 1day)

Cluster Science Archive

CSA 2.4.1

KEY GRAPHICAL PRODUCTS

Time granularity: 1 day | 6 hours | 1 hour | On demand

Time (begin/end): 2005-01-09T22:00:00Z - 2005-01-09T23:00:00Z

Duration: 0 Days, 1 Hours, 0 Minutes

Clear | Plot

Cluster | DoubleStar

ASPOC | AUX | CIS | DWP | EDI | EFW | FGM | PEACE | RAPID | STAFF | WBD | WHISPER

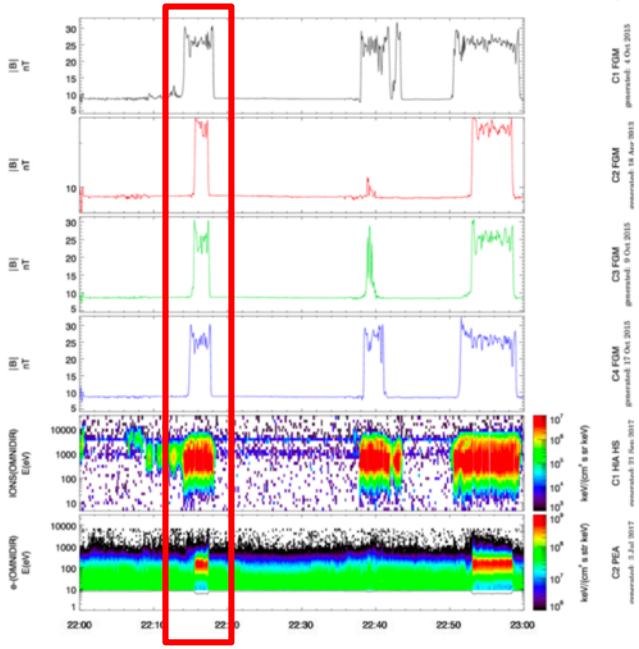
C1	C2	C3	C4	All	Product Name
○	○	○	○		MAGNETIC FIELD - X COMPONENT IN GSE
○	○	○	○		MAGNETIC FIELD - Y COMPONENT IN GSE
○	○	○	○		MAGNETIC FIELD - Z COMPONENT IN GSE
●	●	●	●		MAGNETIC FIELD - TOTAL FIELD
○	○	○	○		MAGNETIC FIELD - AZIMUTHAL COMPONENT IN GSE
○	○	○	○		MAGNETIC FIELD - POLAR COMPONENT IN GSE
○	○	○	○		CAVEATS -- On Demand only

PLOTS

PS | PNG

09 January 2005

CSA_CG_PREGEN_1HOUR_amasson_20191015_183147__20050109220000.png



On-demand plotting

Cluster Science Archive

CSA 2.4.1

KEY GRAPHICAL PRODUCTS

Time granularity ○ 1 day ○ 6 hours ○ 1 hour ● On demand

Time (begin/end) 2005-01-09T22:13:00Z - 2005-01-09T22:17:00Z

Duration 0 Days 0 Hours 4 Minutes

Clear « Plot »

Cluster | **DoubleStar**

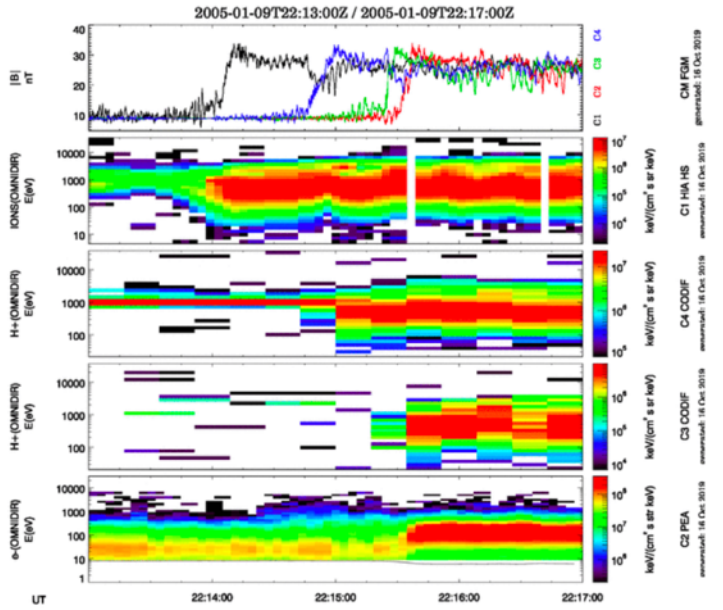
ASPOC | AUX | CIS | DWP | EDI | EFW | **FGM** | PEACE | RAPID | STAFF | WBD | WHISPER

C1	C2	C3	C4	All	Product Name
○	○	○	○	○	MAGNETIC FIELD - X COMPONENT IN GSE
○	○	○	○	○	MAGNETIC FIELD - Y COMPONENT IN GSE
○	○	○	○	○	MAGNETIC FIELD - Z COMPONENT IN GSE
○	○	○	○	●	MAGNETIC FIELD - TOTAL FIELD
○	○	○	○	○	MAGNETIC FIELD - AZIMUTHAL COMPONENT IN GSE
○	○	○	○	○	MAGNETIC FIELD - POLAR COMPONENT IN GSE
○	○	○	○	○	CAVEATS -- On Demand only
○	○	○	○	○	DATA GAPS -- On Demand only
○	○	○	○	○	VALIDATION GAPS -- On Demand only

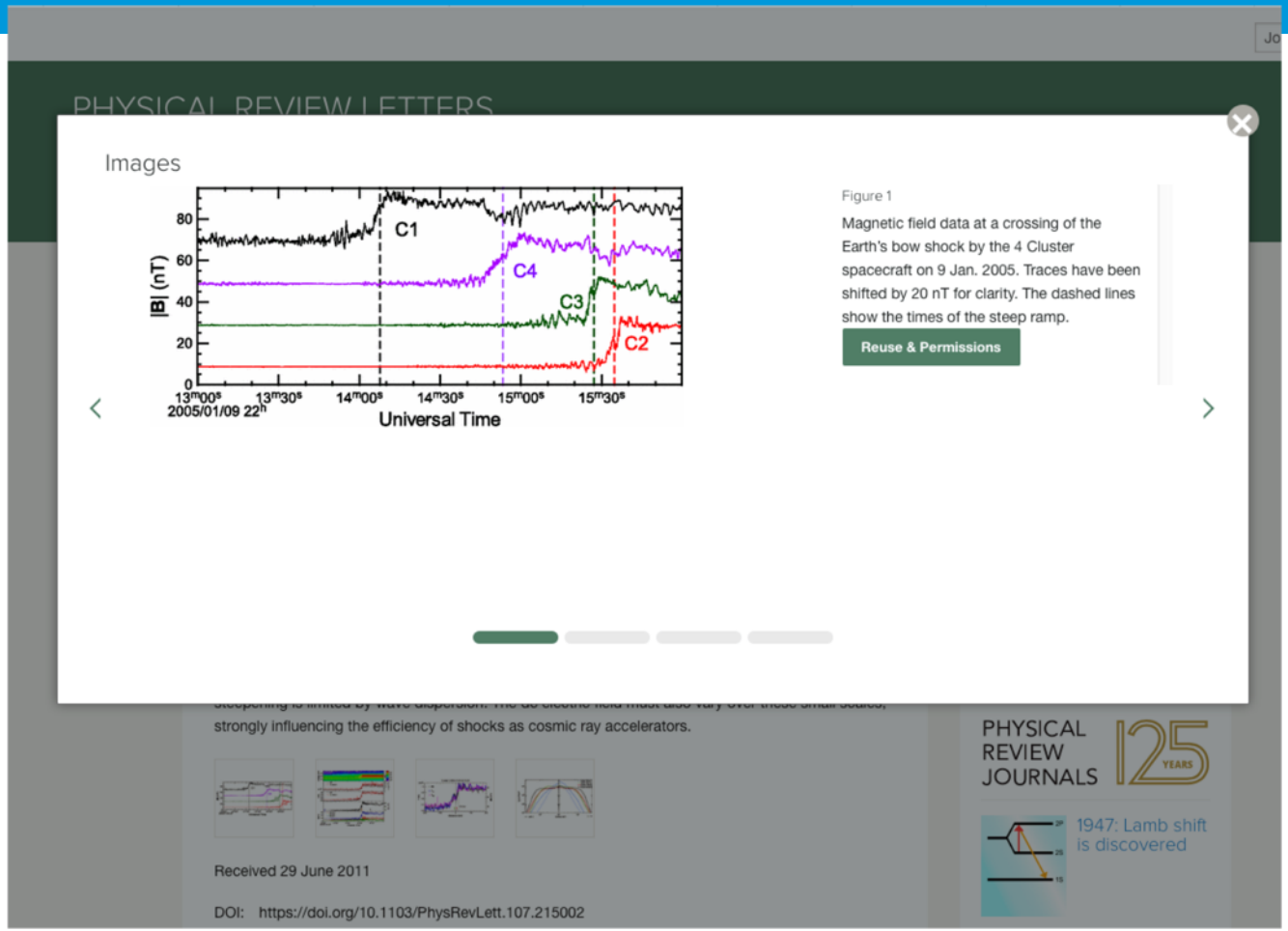
PLOTS

PS | CEF

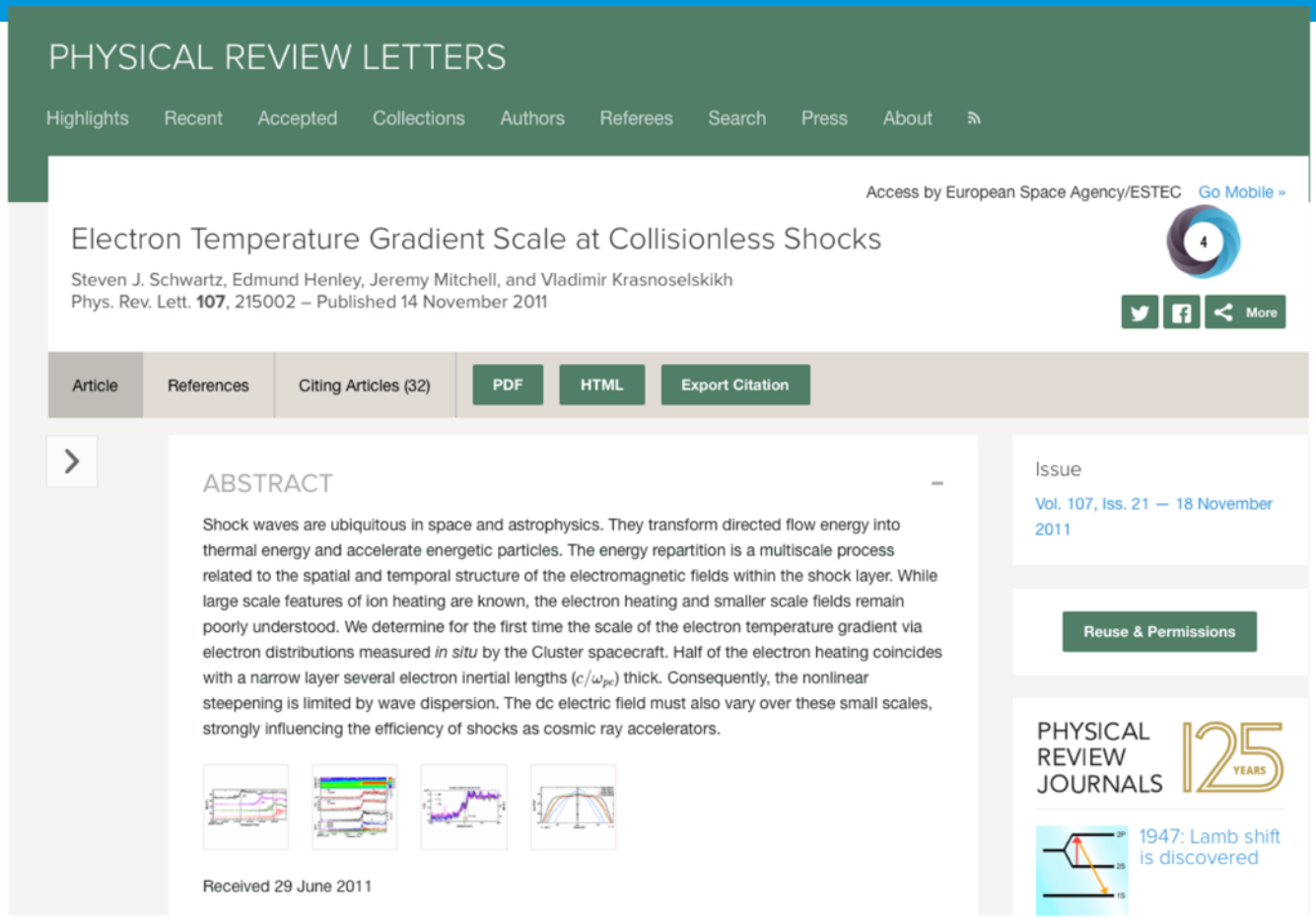
CL_CG_ONDMD__20050109221300_20050109221700_V20191016003015_00.gif



1. Cluster science archive
Science case on shock physics



1. Cluster science archive
Science case on shock physics



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Electron Temperature Gradient Scale at Collisionless Shocks

Steven J. Schwartz, Edmund Henley, Jeremy Mitchell, and Vladimir Krasnoselskikh
Phys. Rev. Lett. **107**, 215002 – Published 14 November 2011

Article References Citing Articles (32) PDF HTML Export Citation

ABSTRACT

Shock waves are ubiquitous in space and astrophysics. They transform directed flow energy into thermal energy and accelerate energetic particles. The energy repartition is a multiscale process related to the spatial and temporal structure of the electromagnetic fields within the shock layer. While large scale features of ion heating are known, the electron heating and smaller scale fields remain poorly understood. We determine for the first time the scale of the electron temperature gradient via electron distributions measured *in situ* by the Cluster spacecraft. Half of the electron heating coincides with a narrow layer several electron inertial lengths (c/ω_{pe}) thick. Consequently, the nonlinear steepening is limited by wave dispersion. The dc electric field must also vary over these small scales, strongly influencing the efficiency of shocks as cosmic ray accelerators.

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1947: Lamb shift is discovered

Distribution functions

Cluster Science Archive
CSA 2.4.1

DATA SEARCH

Time (begin/end)
2009-12-30T16:00:00Z - 2009-12-30T16:01:00Z

Duration
0 Hours 1 Minutes

DISTRIBUTION PANELS

CIS | PEACE | RAPID

C1	C2	C3	C4	Product Name
○	○	○	○	ANGLE-ANGLE DISTRIBUTION (HEEA)
○	○	○	○	ANGLE-ANGLE DISTRIBUTION (LEEA)
○	○	○	○	PITCH_ANGLE/ENERGY PLOT
○	○	○	○	SAUVAUD PLOT
○	○	◉	○	WHEEL PLOT
○	○	○	○	WHEEL PLOT (FULL)

PLOTS

C3_CG_PEA_PITCH_SPIN_DEFlux_CAA_WHEEL__20091230160000_20091230160100_20191009073756_00.png