

# **Automated Multi-Dataset Analysis (AMDA): An online database and analysis tool for heliospheric and planetary plasmas**

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DASH meeting, ESAC, 16 October 2024

# CDPP, the French national data centre for natural plasmas of the solar system

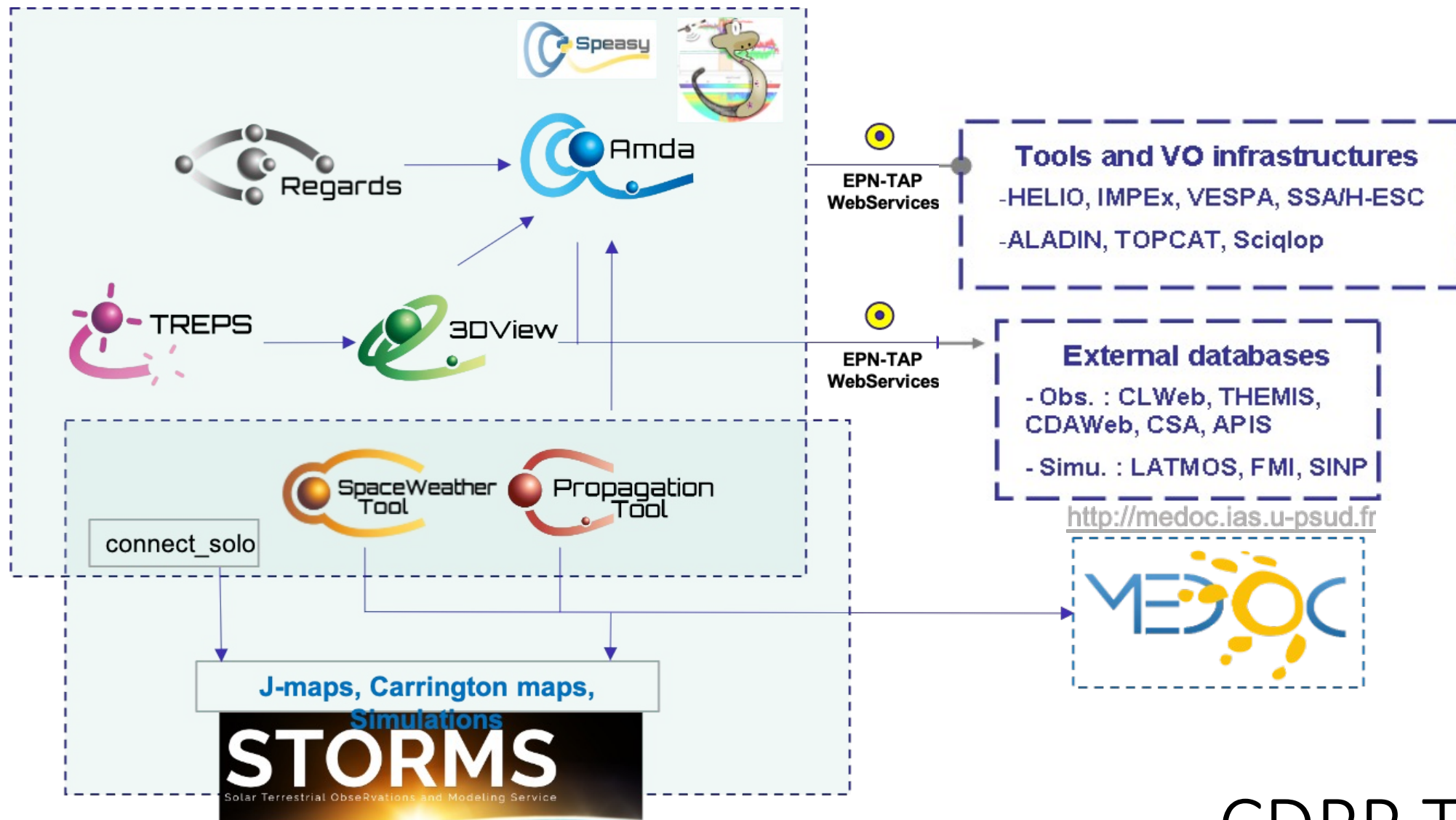
- <https://cdpp.eu>



- Created in 1998 jointly by [CNES](#) and [INSU](#), the CDPP assures the long term preservation of data obtained primarily from instruments built using French resources, and renders them readily accessible and exploitable by the international community.

# Objectives of CDPP

- **Data:** continue the long-term archiving activity of data obtained by experiments with French participation but also (i) make available recent data on which the community mobilizes and (ii) make them easily usable (extraction in standard formats )
- **Services:** develop attractive Value-Added Services that save users time and energy and promote an increase in the scientific return on data exploitation
- **Interoperability and Virtual Observatories (VO):** continued investment by the CDPP in the development of standards and in future VO projects.



CDPP Tools

<http://amda.cdpp.eu/>



- **A data analysis tool in your browser**
  - *physical parameters not files !*
- **Data are**
  - replicated from ESA/Cluster Science Archive, NASA/PDS
  - or accessed remotely : CDAWeb, simulation and model databases, ...
  - public or restricted to communities
  - can be exported in companion tools (SAMP)
  - or uploaded by the user
  - can be accessed via web-services (SOAP/REST)
- **Sessions are saved (so it's better to register !)**
  - register at [amda@irap.omp.eu](mailto:amda@irap.omp.eu)
  - Public access w/o registration also available

# AMDA reference paper

Automated Multi-Dataset Analysis (AMDA): An on-line database and analysis tool for heliospheric and planetary plasma data

*Vincent Génot, E. Budnik, C. Jacquy, M. Bouchemit, B. Renard, N. Dufourg, N. André et al.*

*Planetary and Space Science, Elsevier, 2021, 201, pp.105214.*

<https://doi.org/10.1016/j.pss.2021.105214>

# <http://amda.cdpp.eu/>



The screenshot shows a web browser window with the URL [amda.cdpp.eu](http://amda.cdpp.eu/). The browser's address bar and tabs are visible at the top. Below the browser window, a sidebar titled 'Workspace Explorer' is open, displaying a hierarchical tree structure of data and resources. The tree includes folders for 'Parameters', 'Derived Parameters', 'Time Tables', 'Catalogs', and 'My Files'. Two blue arrows point from a text box to the 'Parameters' and 'Time Tables' folders. The main content area of the browser shows a blue background with a white text box containing the text 'Data tree' and a list of items: '-Data (local and remote)', '-User and common event lists', and '-User data'. Below this, another text box says 'Access to analysis functionalities'. At the bottom of the browser window, a taskbar is visible with various icons, including a question mark, a pencil, a magnifying glass, a summation symbol, and a clock.

Workspace Explorer

resources operati

Filter: None SortBy: Name Target

- Parameters
  - AMDA DataBase
  - Remote DataBases : Observations
  - Remote DataBases : Simulations
  - My DataBase
- Derived Parameters
- Time Tables
  - My Time Tables
  - Shared Time Tables
- Catalogs
  - My Catalogs
  - Shared Catalogs
- My Files

Log

Data tree

- Data (local and remote)
- User and common event lists
- User data

Access to analysis functionalities

10:28 P

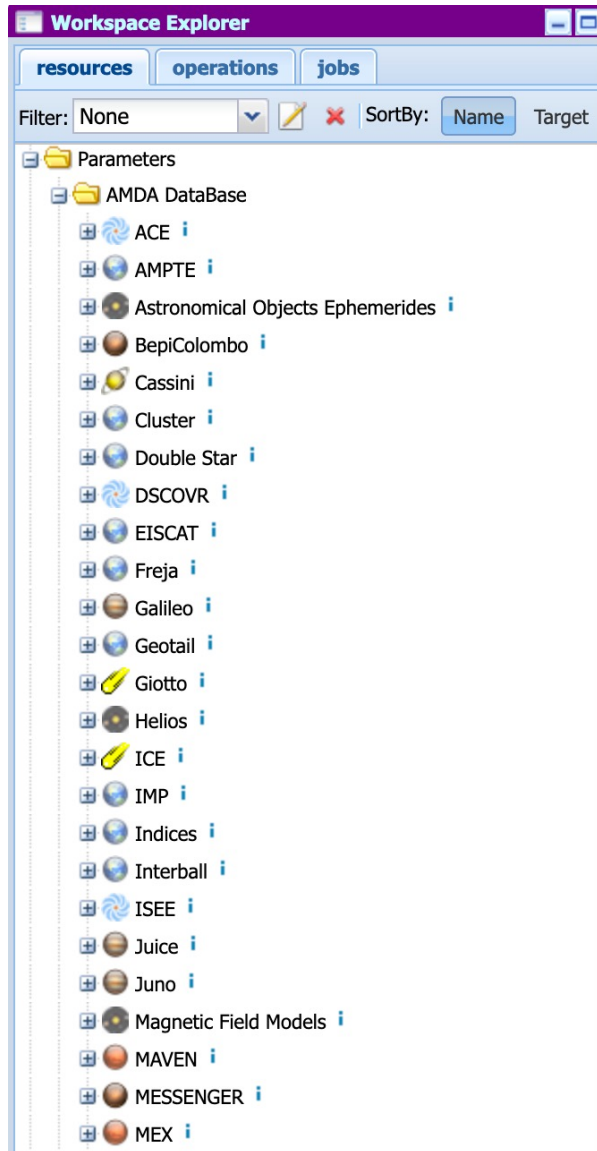
# AMDA Database

- More than 80 missions (heliosphere, magnetosphere, planets, comets, ...) and 800 datasets (electromagnetic fields, plasmas, particles, waves, ...)
- **AMDA** has been integrated in the **Space Weather Service Network** of the European Space Agency.
- **AMDA** data can also be accessed through our **HAPI server**.
- **AMDA** data can also be accessed through our **python tool Speasy**.
- **AMDA** data can also be accessed through **EPN-TAP**.



# Datasets available in the online tool CDPP/AMDA

Space missions  
data



Heliosphere

Planets

Comets

Earth

# SPASE Data Model

AMDA XML resource manager

File SPASE Parameters Styles Help

Mission Instrument NumericalData Person

Table configuration

Add column :

#	
25	IMP 8
75	IRM
29	ISEE
30	ISEE 1
31	ISEE 2
26	Indices
28	Interball
27	Interball Tail
32	JASON3
33	JUICE
34	Juno
37	MAVEN
38	MESSENGER
39	MEX
40	MGS
41	MMS
42	MMS1
44	MMS2
45	MMS3
46	MMS4
43	MMS_1234

Mission editing form

File Edit Errors

Spase

Attributes

Version : 2.4.0

Observatory

**Observatory**

ResourceID : spase://CNES/Observatory/CDPP-AMDA/MMS1

ResourceHeader :

**ResourceHeader**

ResourceName : MMS1

AlternateName : Magnetospheric Multiscale Mission #1

ReleaseDate : 2019-03-01 20 05 54

Description :

Contact :

**Contact**

PersonID : spase://SMWG/Person/Thomas.E.Moore

Role : ProjectScientist

Add : Role StartDate StopDate Note

Add : AlternateName DOI RevisionHistory ExpirationDate Acknowledgement PublicationInfo Funding Contact InformationU

ObservatoryGroupID : spase://CNES/Observatory/CDPP-AMDA/MMS

Location :

**Location**

Region : Earth.Magnetosphere

Add : Region CoordinateSystemName Latitude Longitude Elevation

OperatingSpan :

**Operating Span**

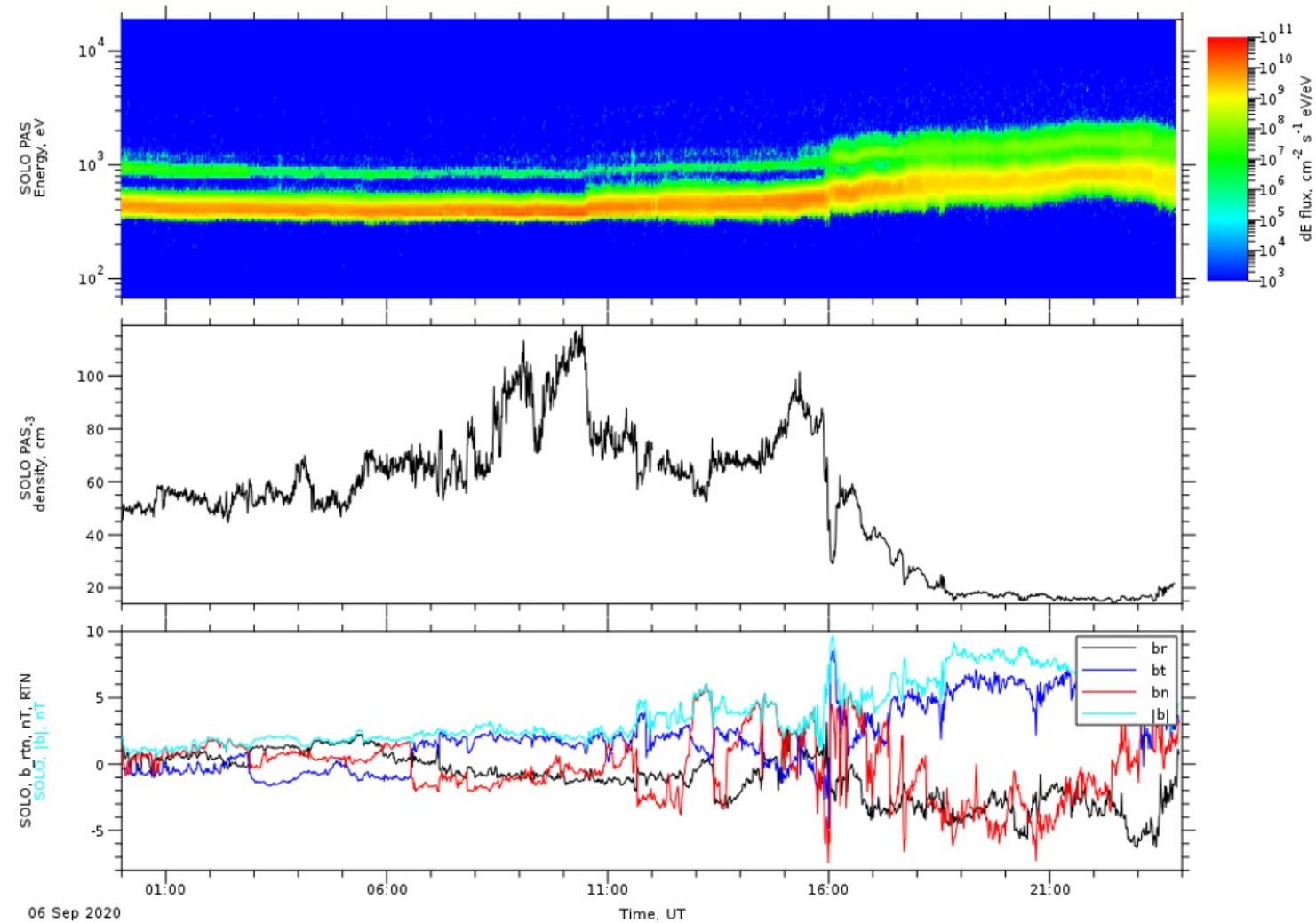
StartDate : 2015-09-01 00 00 00

Add : StopDate Note

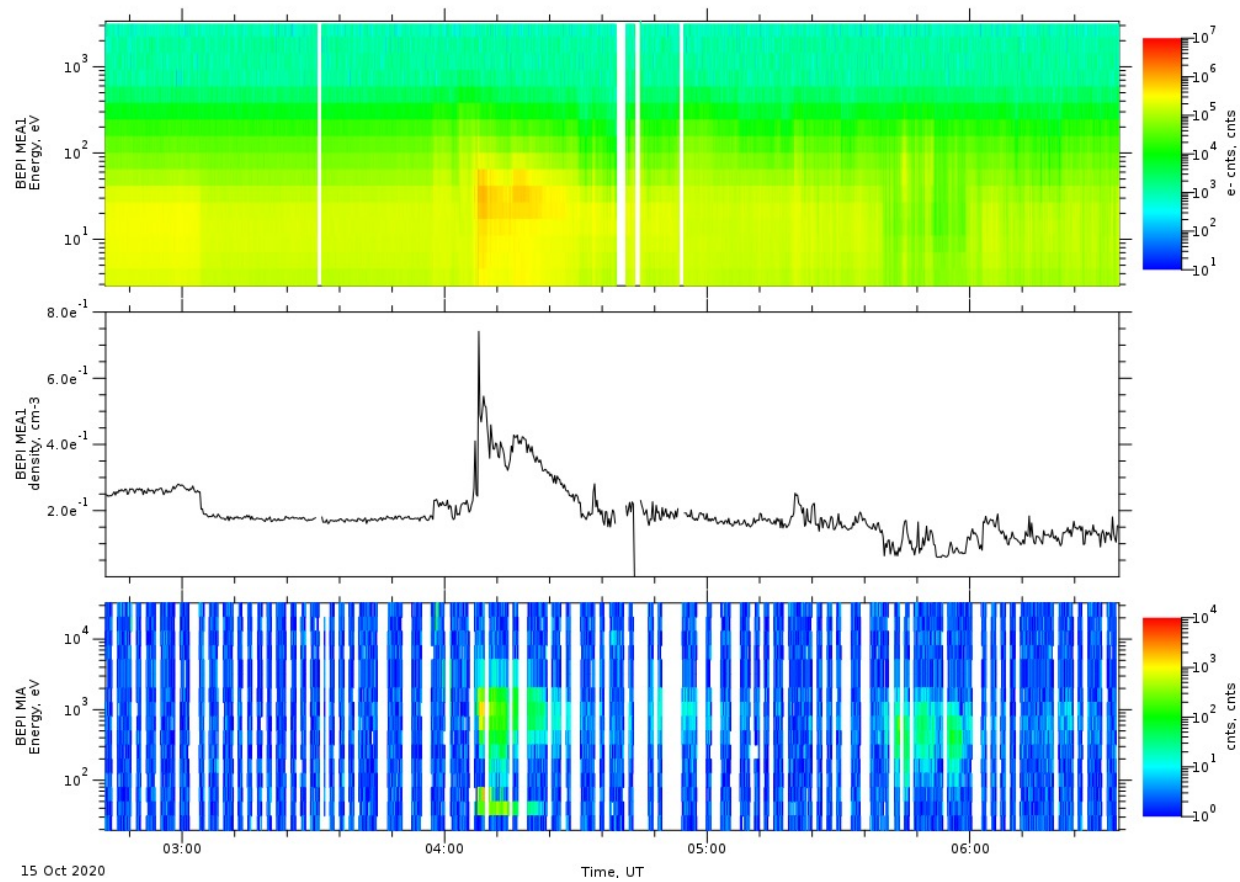
Add : ObservatoryGroupID OperatingSpan Extension

Submit Cancel

# Solar Orbiter (Solar wind)

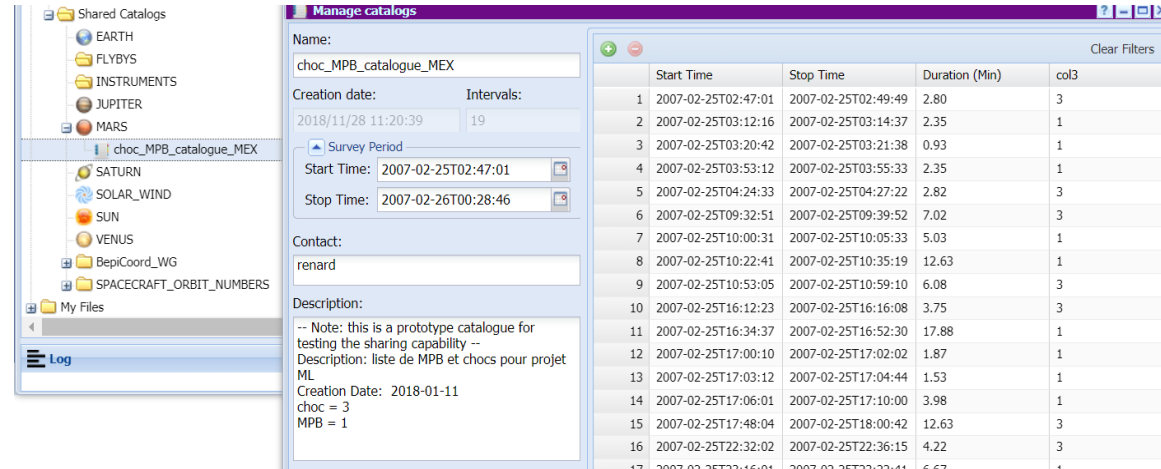


# BepiColombo (Venus flyby)

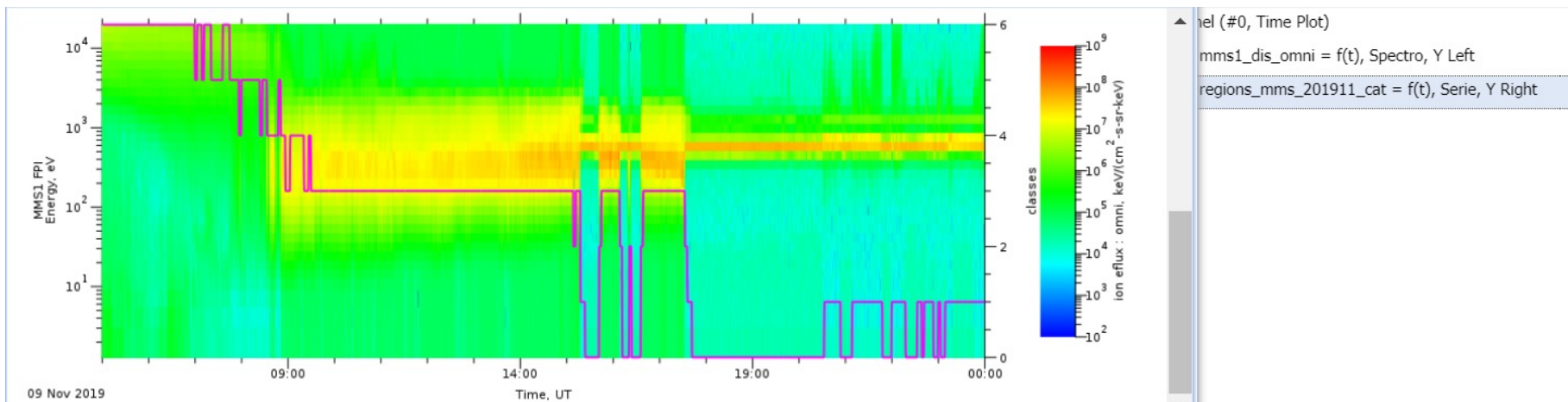


- BepiColombo
  - Ephemeris
  - MEA1
  - MEA2
  - MIA
  - MPO-MAG
- Cassini
  - CAPS
  - Ephemeris: Cassini
  - Ephemeris: Saturn Moons : special
  - MAG
  - MIMI-LEMMS
  - RPWS
- JUICE
  - Analytical Models
  - Ephemeris
- Juno
  - Analytical Models
  - Ephemeris
  - FGM
  - JADE
  - JEDI
  - WAVES

# Catalogues



- shared catalogs
- Time formats for ASCII exports





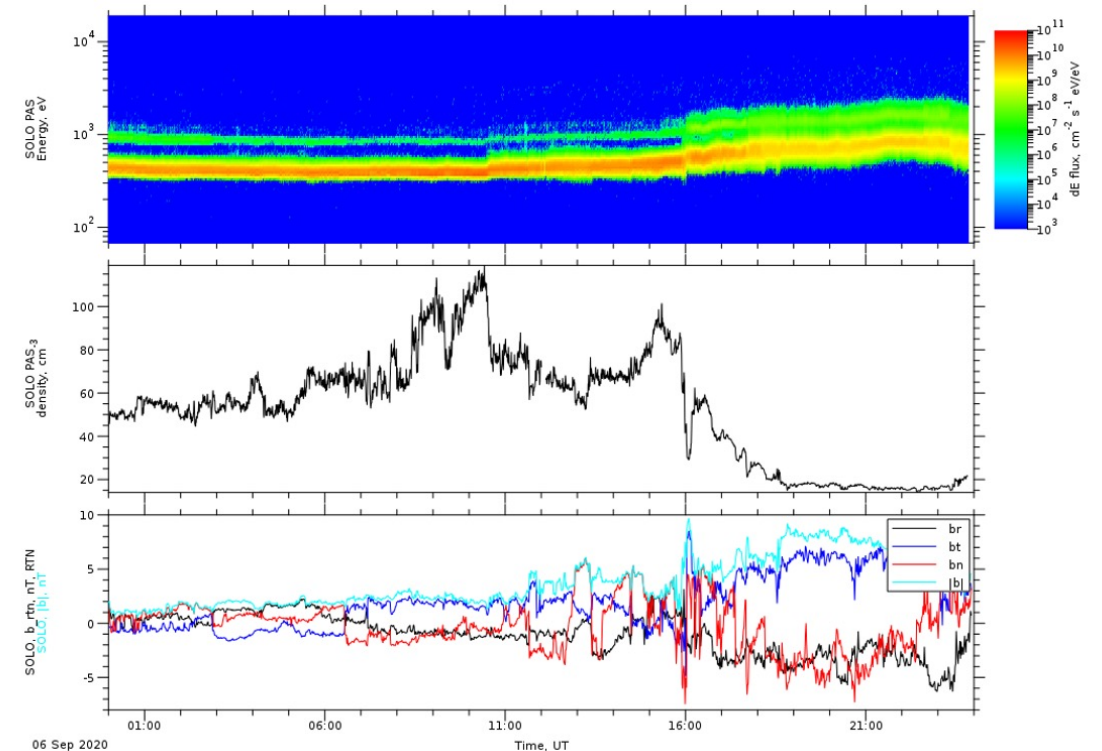
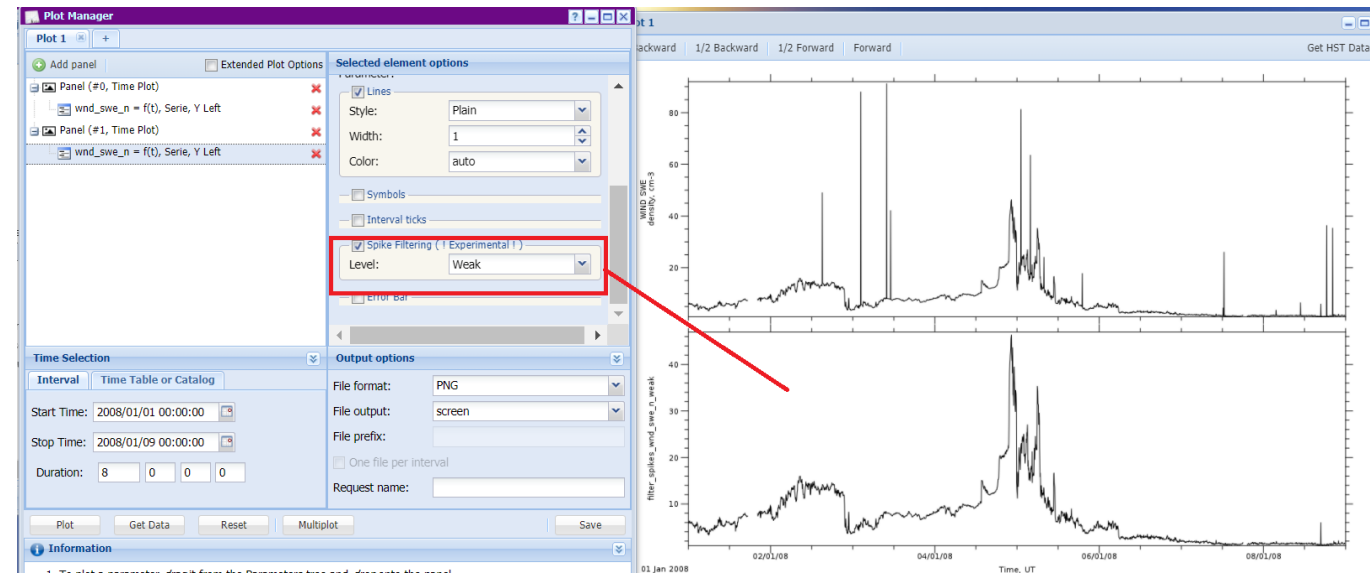
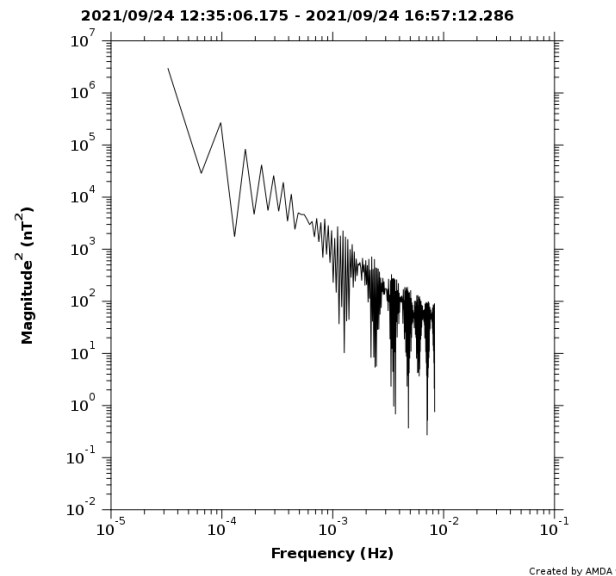
# New functionalities

## Spike filtering

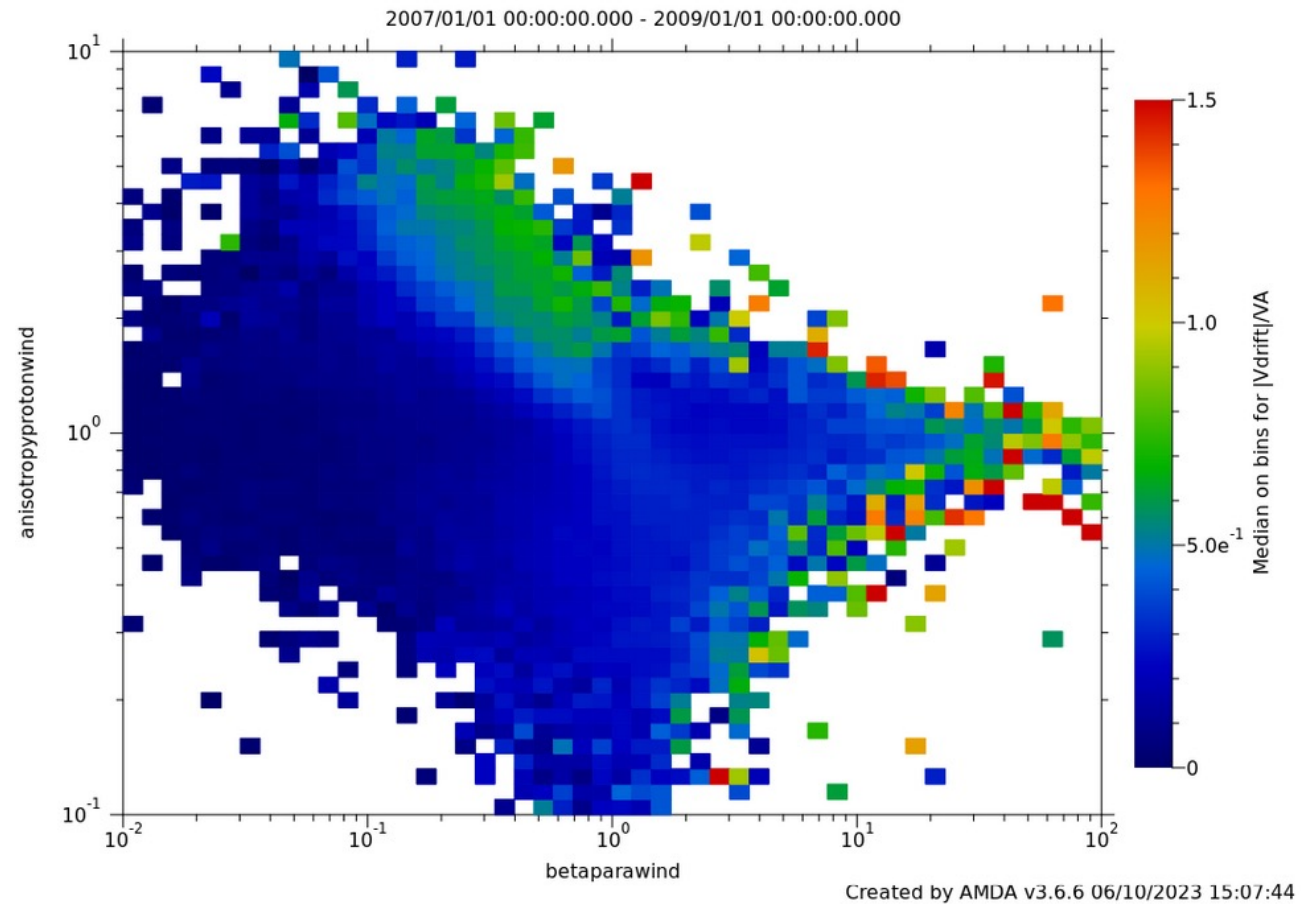
The user can remove spike in time-series data.

## FFT

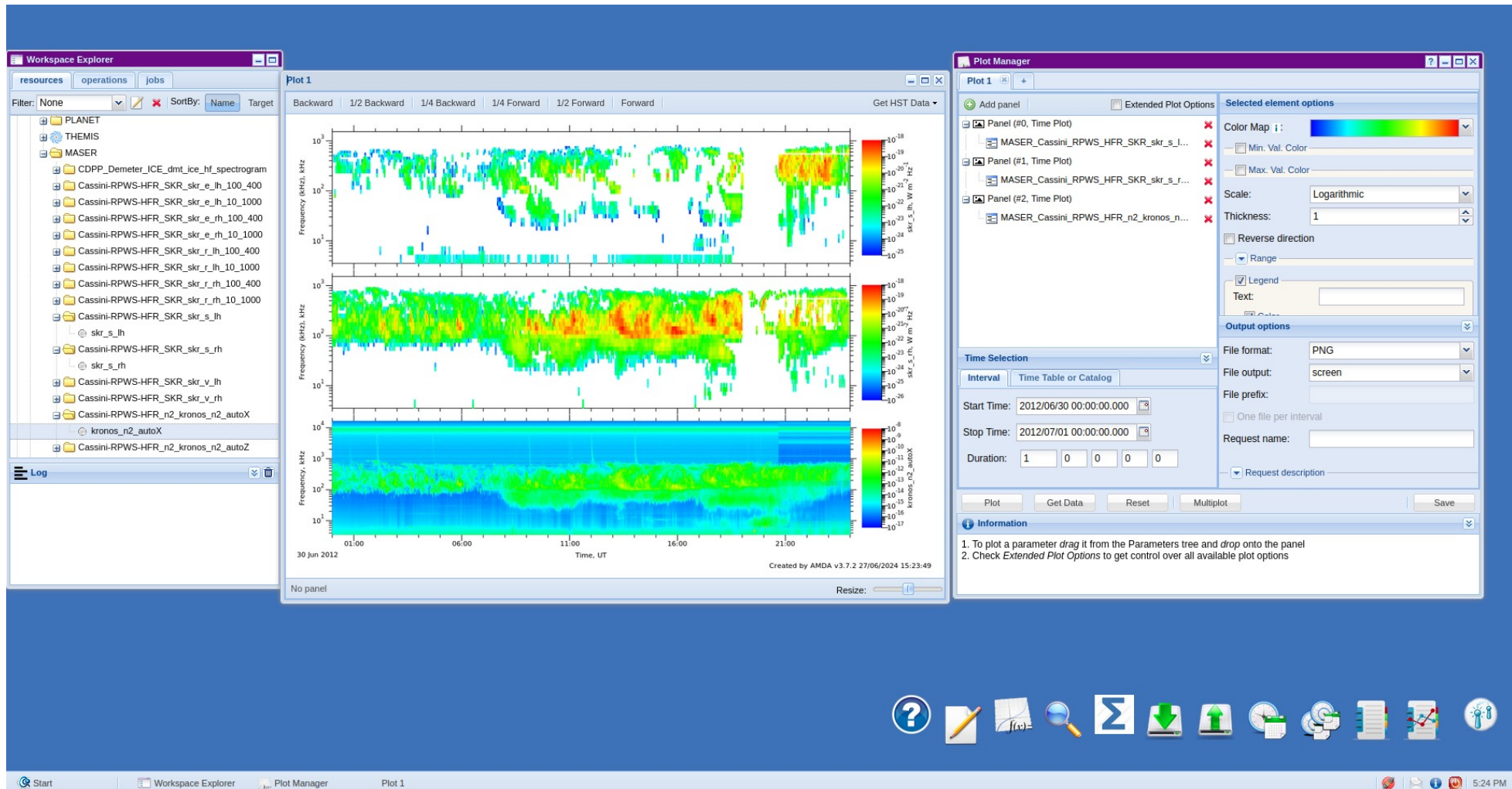
The user can perform FFT on selected time windows.



# 1D/2D Histograms



# Connexion AMDA-MASER (radio data)

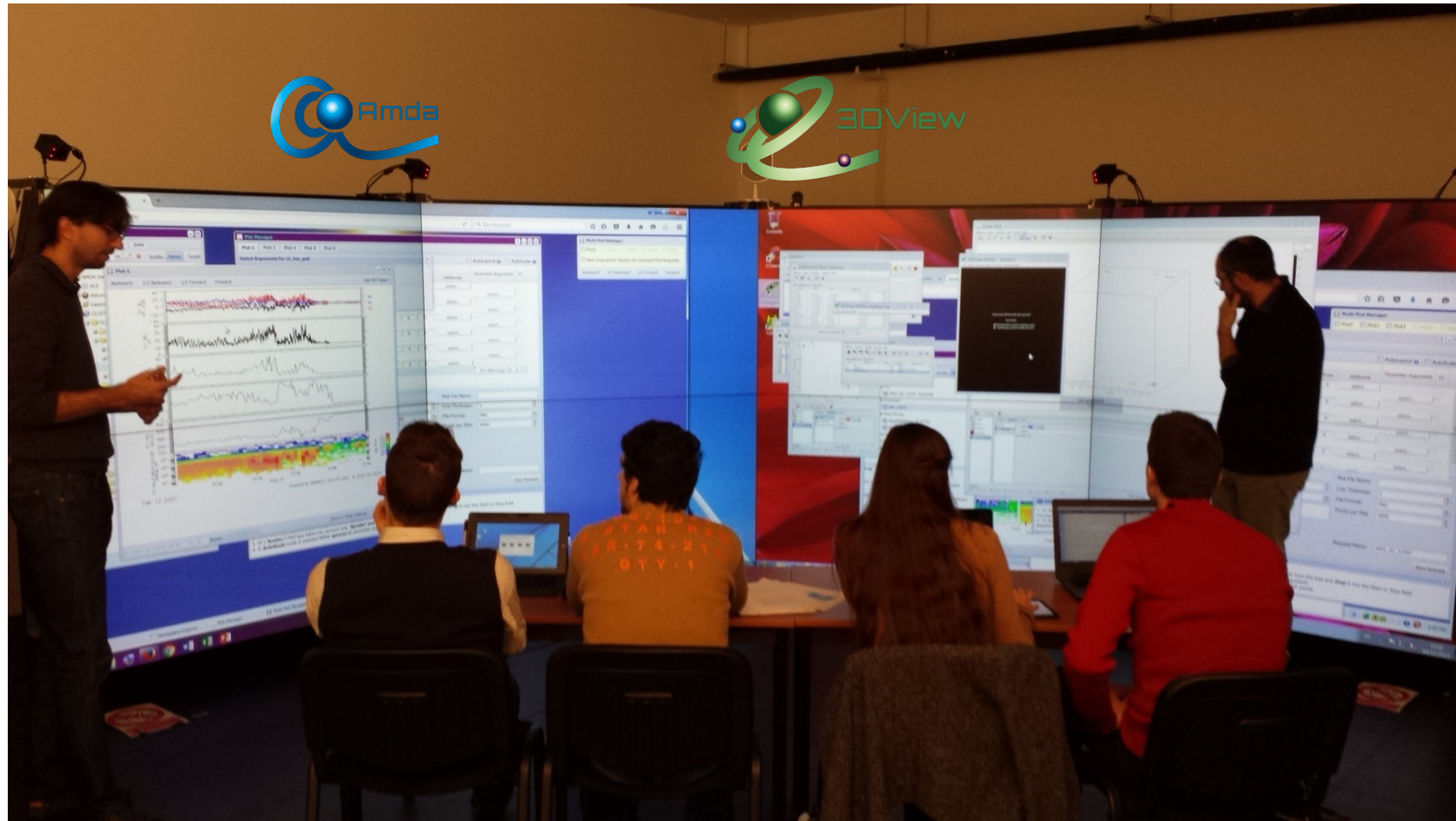




# Hands-on sessions for students

Tools for education in space sciences

- At the Masters Degree level, in summer schools, ...

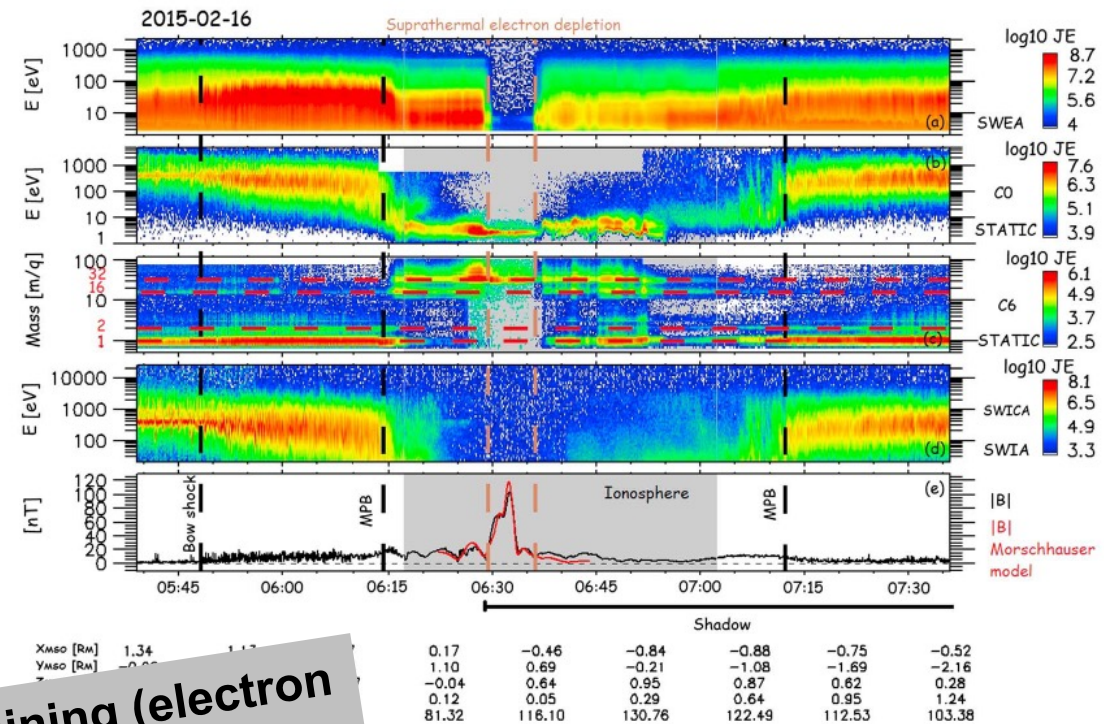


# Use of the PDS/MAVEN data from AMDA

Altitude dependence of nightside Martian suprathermal electron depletions as revealed by MAVEN observations, *M. Steckiewicz et al., GRL, 2015*

- MAVEN observes on almost each periapsis in the nightside ionosphere suprathermal electron depletions
- Observed depletions are populated by 6 eV electrons resulting from absorption by CO<sub>2</sub> and by 3 eV O<sub>2</sub>
- The geographical distribution of nightside suprathermal electron depletions

AMDA was used for data mining (electron depletion) and selection of events



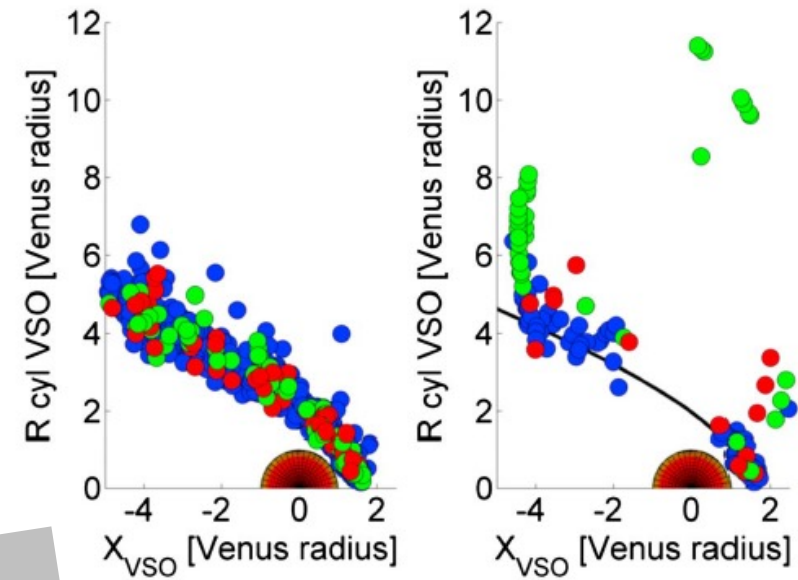
MAVEN observations in its plasma environment observed above a crustal magnetic field anomaly during February 2015. (a) SWEA energy-time spectrogram of omnidirectional electron energy flux, (b) STATIC energy-time spectrogram of omnidirectional ion energy flux (C0 mode), (c) STATIC mass-time spectrogram of omnidirectional ion energy flux (C6 mode), (d) SWIA energy-time spectrogram of omnidirectional ion energy flux (SWICA mode), and (e) magnetic field intensity (measured by MAG in black and calculated from the model of Morschhauser et al. [2014] in red) versus time. The grey shading highlights the ionosphere. The shadow corresponds to solar zenith angle (SZA) larger than 100°.

# Use of Venus Express multi-datasets from AMDA

Space weather effects on the bow shock, the magnetic barrier, and the ion composition boundary at Venus, *Vech et al., JGR, 2015*

- Statistical study of the ICME-Venus interaction
- Analysis of solar wind and magnetic barrier conditions during ICME passages
- Decreased altitude of the nightside ionosphere during ICME passages

**AMDA was used to search extreme events in long time series (9 years)**



Locations of the bow shock crossing for all the 42 investigated events. The green marks show the bow shock crossings (including the multiple bow shock crossings as well) on the day when the ICME arrived at Venus, the red dots represent the bow shock location during the following day, and the rest of the days are marked with blue dots. (left) Thirty-six cases when the interaction between the magnetic cloud and the induced magnetosphere was not observed and (right) six cases when the signature of the passing magnetic cloud was detected.