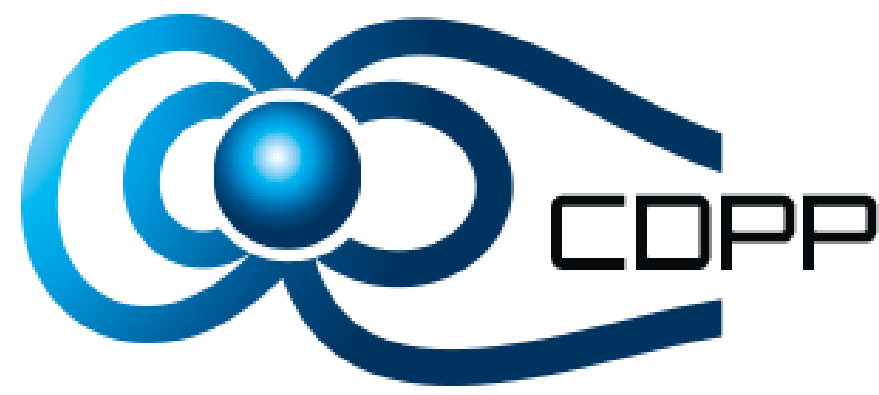


Analyzing planetary and heliophysics plasma data with AMDA: the ~~last~~ first 20 years



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We present **AMDA**, an online database and tool for analyzing plasma physics data. **AMDA** is developed and maintained by the French Plasma Physics Data Centre for **20 years** and gathered a community of hundreds of users. It gives access to a variety of space plasma datasets in the planetary and heliophysics domains acquired by dozens of missions, such as Cluster, MMS, Rosetta, Solar Orbiter, and in a close future, BepiColombo and Juice. The presentation offers a description of the architecture of **AMDA** including the interfacing with the Python library Speasy, describes its most recent functionalities notably statistical representation and catalogue management. Publications using **AMDA** are briefly analyzed with the help of ADS Explore.



Automated Multi-Dataset Analysis
In-situ database and analysis tool

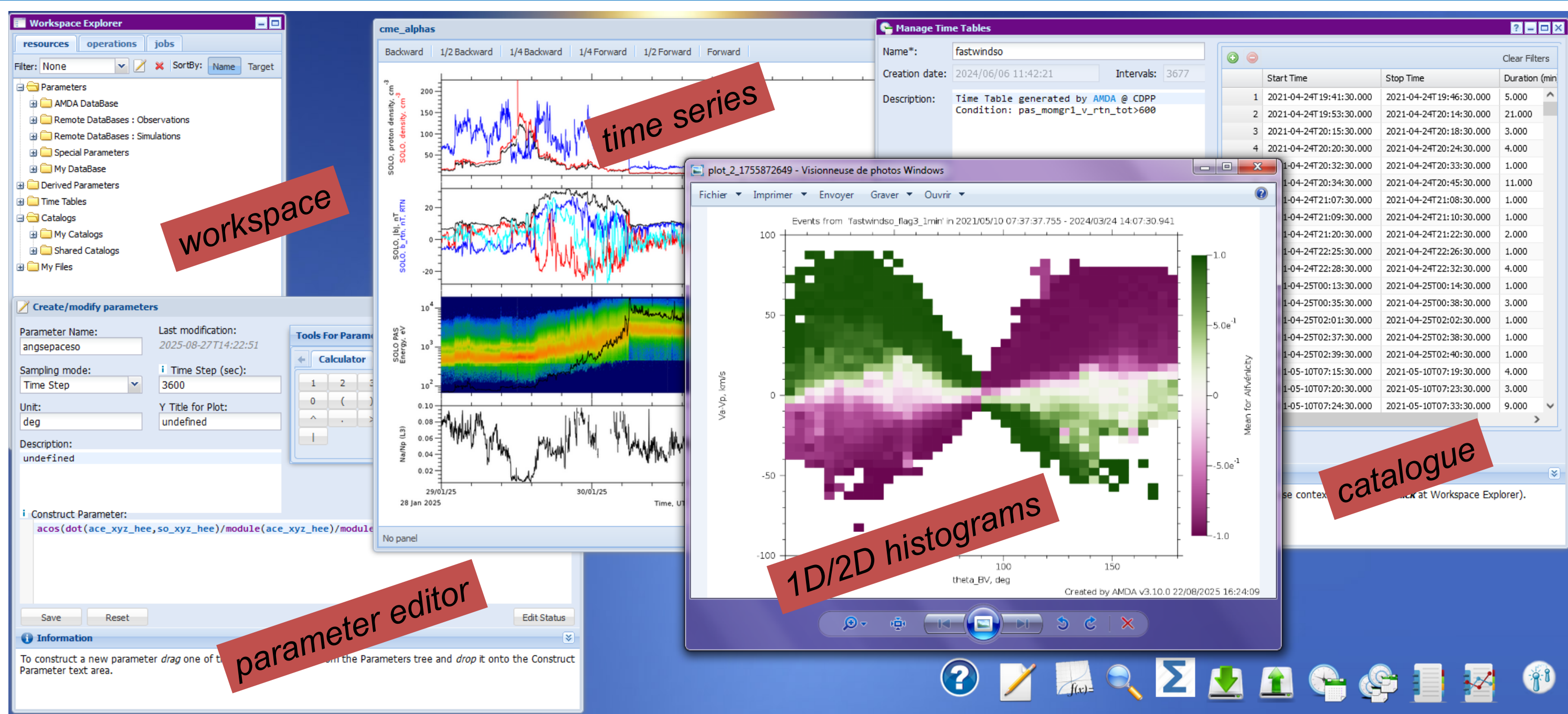
<https://amda.cdpp.eu>

Register at amda@irap.omp.eu

Reference paper:

Automated Multi-Dataset Analysis (AMDA): An on-line database and analysis tool for heliospheric and planetary plasma data.
V. Génot, E. Budnik, C. Jacquey, M. Bouchemit, B. Renard, N. Dufourg, N. André et al., *Planetary and Space Science*, 2021.
<https://doi.org/10.1016/j.pss.2021.105214>

AMDA functionalities



Parameter Editor

Compute new parameters by editing a mathematical expression combining existing parameters. Heterogeneous time bases are handled by AMDA transparently to the user (by interpolating/averaging data).

Remote Data Access

The user can browse through the parameters of the distant databases, like CDAWeb, select the desired ones and save them in his/her own external data tree. Any data centers whose data are described by the SPASE datamodel may be reachable by AMDA.

Data Mining

Automatically detect time intervals when a particular condition applied on given parameters is fulfilled. Result can be saved as a TimeTable in the user workspace.

TimeTable Edition

TimeTables produced by visual inspection or conditional search may be edited, modified and saved. TimeTables may be also imported/exported in ASCII, VOTable or HPEvent formats.

Plotting Data

The user can edit a figure combining any available parameters with the desired options. From the window presenting the resulting plot, it is possible to zoom in/out (with the mouse) or move the interval backward/forward in time. The user can save a figure in format PNG, PDF, PS or SVG.

Data Download

All AMDA parameters can be downloaded in different formats (plain ASCII, CDF, VOTable) and with a chosen resolution. Time series may optionally be joined on a common time basis before exporting.

Statistics

Apply a statistical function (mean, max, min, median, standard deviation, skewness, kurtosis) on a chosen parameter on all the intervals of a TimeTable to produce a catalog.

Catalog Edition

Catalogs produced by a statistical process may be edited, modified and saved. Catalogs may be also imported/exported in ASCII, VOTable or HPEvent formats.

In-situ database

More than 80 missions and 800 datasets

Fully described in the SPASE data model

ACE: MFI, SWEPAM
DSCOVER: MAG, Faraday Cup
ISEE: FGM, FVA
OMNI
WIND: MFI, SWE, 3DP
STEREO: HET, LET, MAG, PLASTIC, SEPT, SIT, SWEA

Venus-Express: ELS, IMA, MAG
PVO: MAG

MMS: EDP, FGM, FPI, HPCA
HelioSwarm: planned trajectories
THEMIS: ESA, FGM
ARTEMIS: ESA, FGM
Cluster: CODIF, HIA, EFW, FGM, PEACE, STAFF, WHISPER
Geotail: CPI, EFD, EPIC, LEP, MGF
Double Star: FGM, HIA
AMPTE: CCE, IRM, & UKS
EISCAT: ESR 32M, ESR 42M, UHF, VHF
JASON3: AMBRE
Swarm: GNSS, EFI/LP, ASM/VFM, EFI/TII
Indices: DST, AE, AL, SME, SML, ...
Freja: ESP, MFE
IMP-8: MAG, MIT
Interball Tail: Corall, DOK2, MIF-M
Polar: HYDRA, MFE

Rosetta: AUX, IES, LAP, MAG, MIP, ROSINA
Giotto: IMS, JPA, MAG, RPA
ICE: MAG

Helios: AUX, E1, E3, MAG
Pioneer 10&11: CPI, CRT, GTT, MAG
Astronomical Objects Ephemerides
Planets Properties
Magnetic Field Models: T96, Morschhauser, Cain, JRM09, JRM33
Solar Wind Propagation Models
Ulysses: FGM, SWICS, SWOOPS, URAP
Voyager 1&2: CRS, LECP, MAG, PLS, PWS

Solar Orbiter: EPD, MAG, PAS, RPW, EAS
Parker Solar Probe: MAG, SWEAP, ISOIS
Solar Irradiance: FERMI (LAT), TIMED (SEE)
Bepi Colombo: MEA, MIA, ENA, MSA, MGF
MESSENGER: MAG, FIPS, EPS
Mariner 10: MAG, PLS

MAVEN: EUV, LPW, MAG, NGIMS, SEP, STATIC, SWEA, SWIA
Mars-Express: ELS, IMA, MARSIS
MGS: ER, MAG, Proxy
Phobos-2: ASPERA, MAG

JUNO: FGM, JADE, JEDI, WAVES
JUICE: CREMA, PEP, RPWI
Galileo: EPD, MAG, PLS, PWS

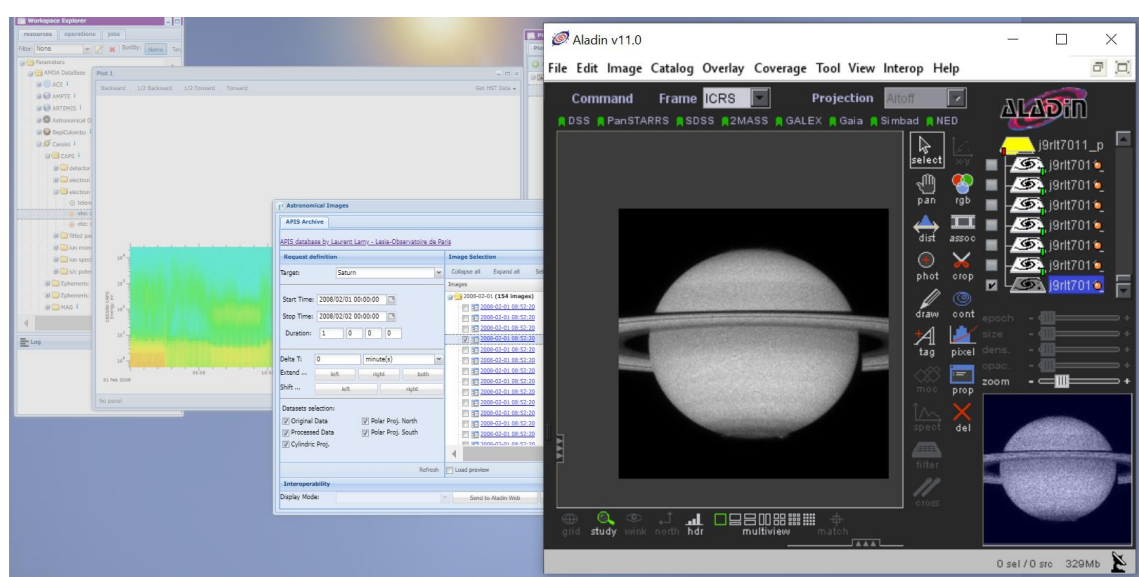
Cassini: CAPS, MAG, MIMI-LEMMS, RPWS



Interoperability

IVOA standards & protocols

Thanks to the AMDA EPN-TAP server, you can query AMDA data from the VESPA portal: <http://vespa.obspm.fr>
User can also query APIS service (<https://apis.obspm.fr/>) directly from AMDA to retrieve UV spectro-imaging auroral observations, and open FITS image in Aladin tool with the SAMP protocol.

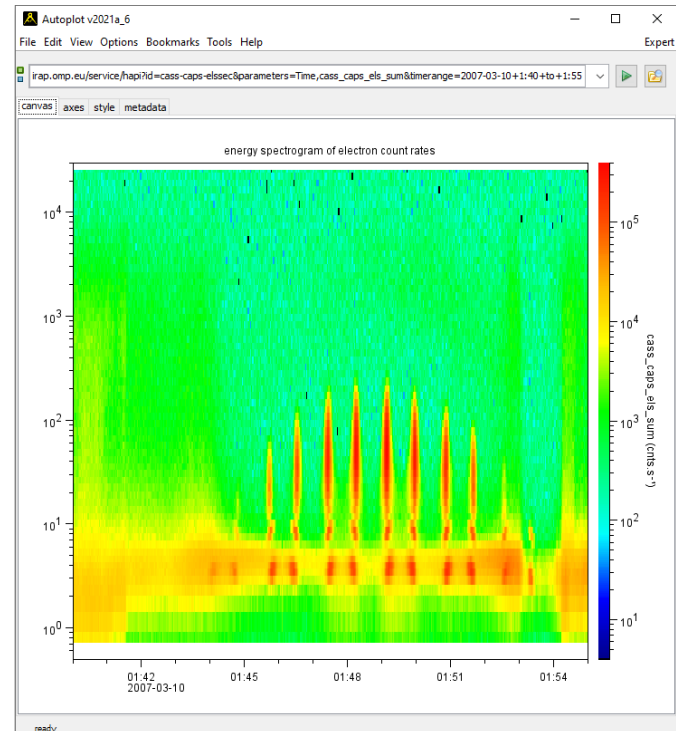
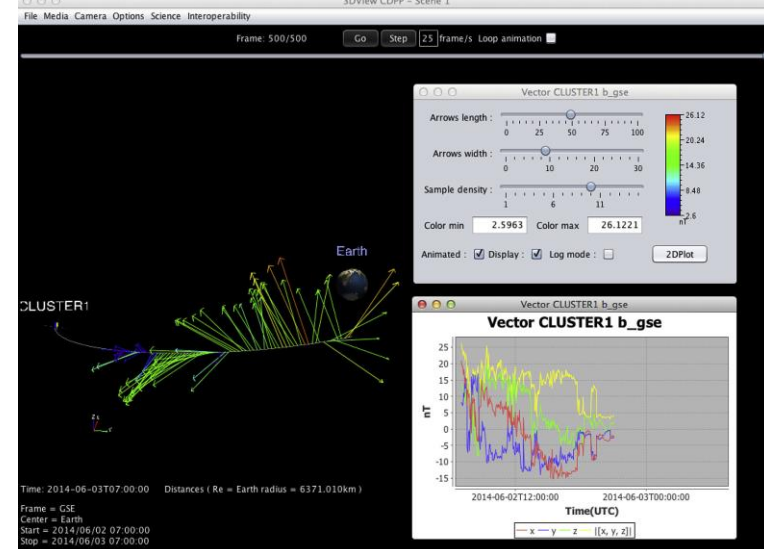


AMDA REST WebService

AMDA WebService gives the possibility to access AMDA data (time series, TimeTables & Catalogs): <http://amda.irap.omp.eu/help/apidoc/>
For example, AMDA WebService is used by CDPP/3DView tool (<http://3dview.irap.omp.eu/>) to access observational data.

Access AMDA data through our HAPI server

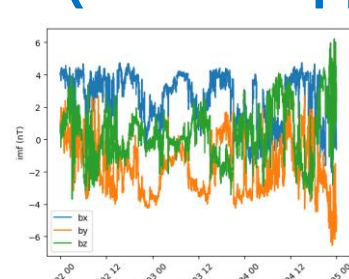
HAPI is an API, metadata, and data streaming format specification for time-series data. AMDA data can be easily retrieved with [a simple URL](#), and dataset description [with this URL](#) too. For example, thanks to this server, you have a direct access to AMDA data from Autoplot (<http://autoplot.org/>).



Python API

Access AMDA data in Python with Speasy module (Julia wrapper available)

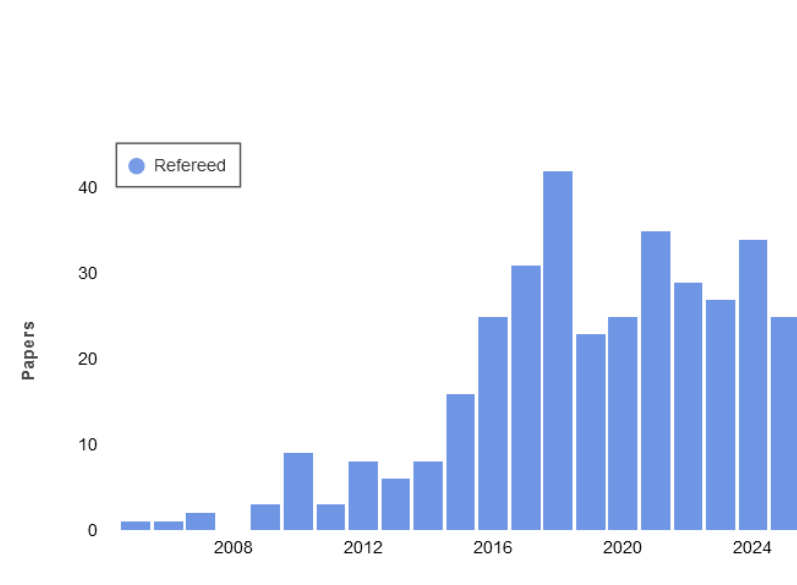
```
import speasy as spz  
amda_tree = spz.inventories.data_tree.amda  
ace_mag = spz.get_data(amda_tree.Parameters.ACE.MFI.ace_inf_all.inf, "2016-6-2", "2016-6-5")  
ace_mag.plot()
```



See F89-EPSC-DPS2025-1422 Jeandet et al.: SciQlop & Speasy: Open-Source Tools for Unified Planetary and Heliospheric Data Analysis

Impact

More than 300 refereed papers using AMDA in 20 years !



Analysis provided by astrophysics data system

