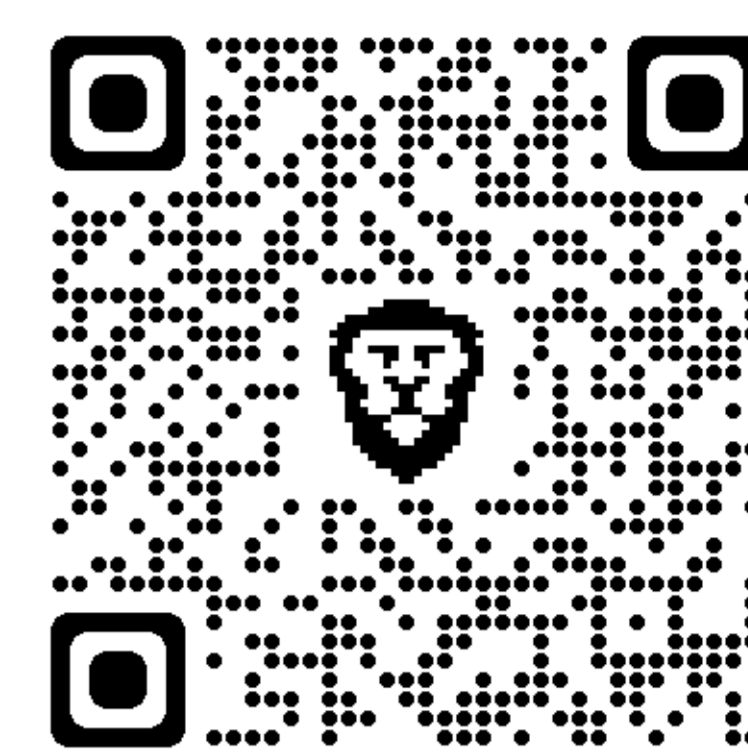# Speasy:
# Simplified Access to Plasma Physics Data
## Integration, Features, and Impact

# Alexis Jeandet[1], Nicolas Aunai[1], Vincent Génot[2], Benjamin Renard[3], Nicolas André[2], Myriam Bouchemit[2], and Christian Jacquey[2]

[1]Laboratory Of Plasma Physics, CNRS, Palaiseau CEDEX, France  [2]Institut de Recherche en Astrophysique et Planétologie, CNRS, CNES, UPS, Toulouse, France  [3]Akkodis, Toulouse, France

https://github.com/SciQLop/speasy

https://pypi.org/project/speasy/

Speasy is an open-source Python package that streamlines the discovery and retrieval of space physics data from remote servers. By providing a user-friendly API, Speasy removes the technical complexities involved in finding and downloading data from sources such as **CDAWeb**, **SSCWeb**, **CSA**, and **AMDA**, making it easier for researchers and students to focus on data analysis.
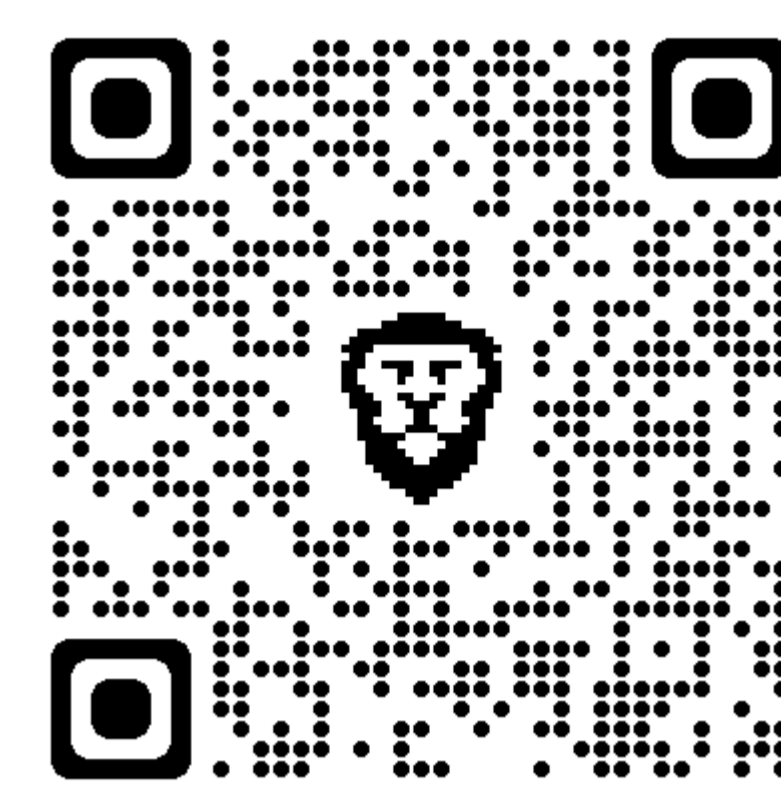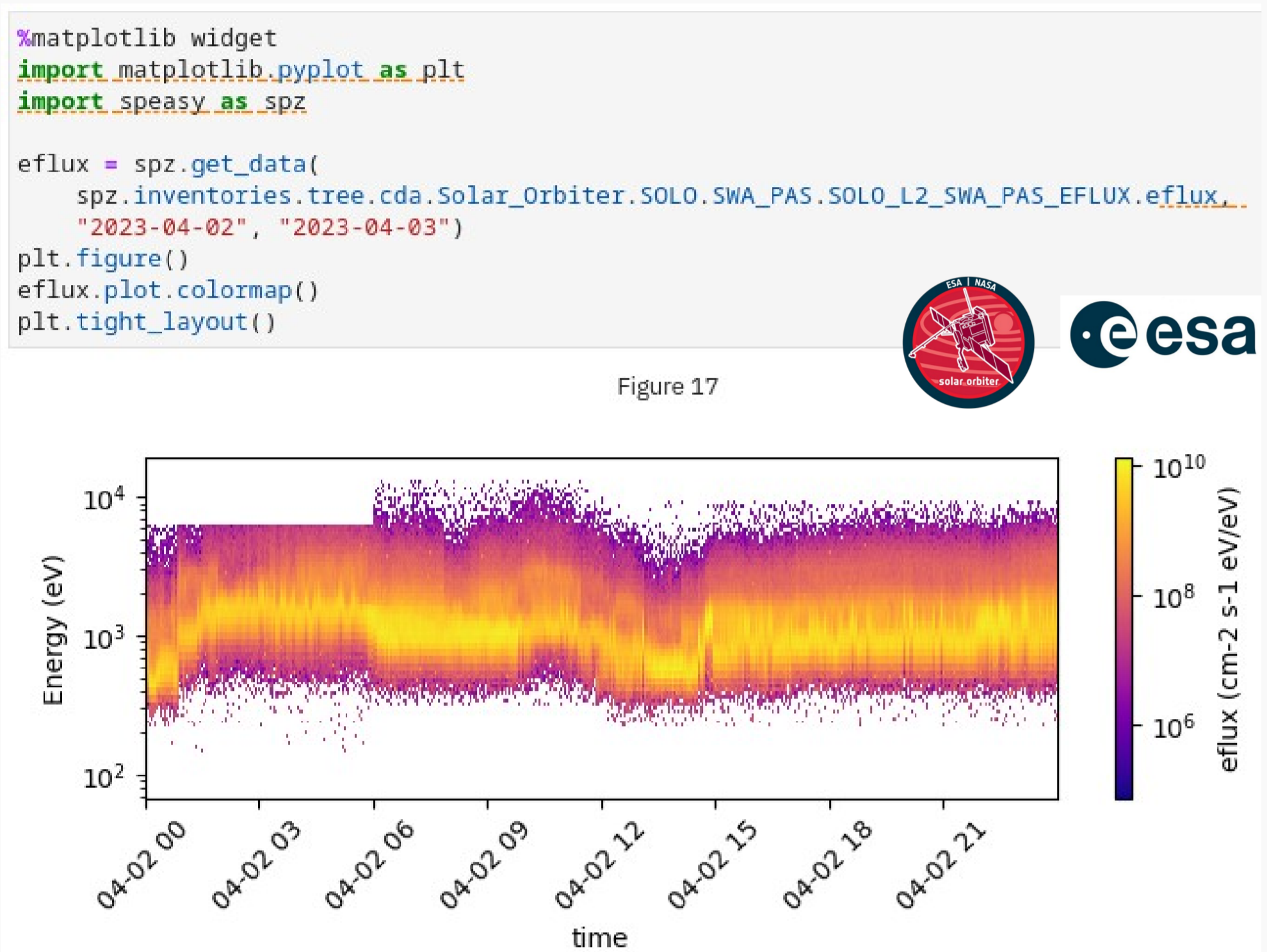
## Key features

### • Really simple and user friendly API

Speasy's simple **get_data(what, [when])** function allows you to retrieve any combination of data products and time ranges with a single command. This simplifies data access, eliminating the need to navigate complex server structures or learn multiple APIs.

```
%matplotlib widget
import matplotlib.pyplot as plt
import speasy as spz

eflux = spz.get_data(
    spz.inventories.tree.cda.Solar_Orbiter.SOLO.SWA_PAS.SOLO_L2_SWA_PAS_EFLUX.eflux,
    "2023-04-02", "2023-04-03")
plt.figure()
eflux.plot.colormap()
plt.tight_layout()
```

Figure 17

### • Efficient multi-layer caching mechanism

Speasy's multi-layer caching system, which stores data on disk and on a shared server, allows the package to quickly access previously requested data without having to make slow requests to remote servers like AMDA or CDAWeb. This saves time and reduces the load on the remote servers.

Speasy caches levels
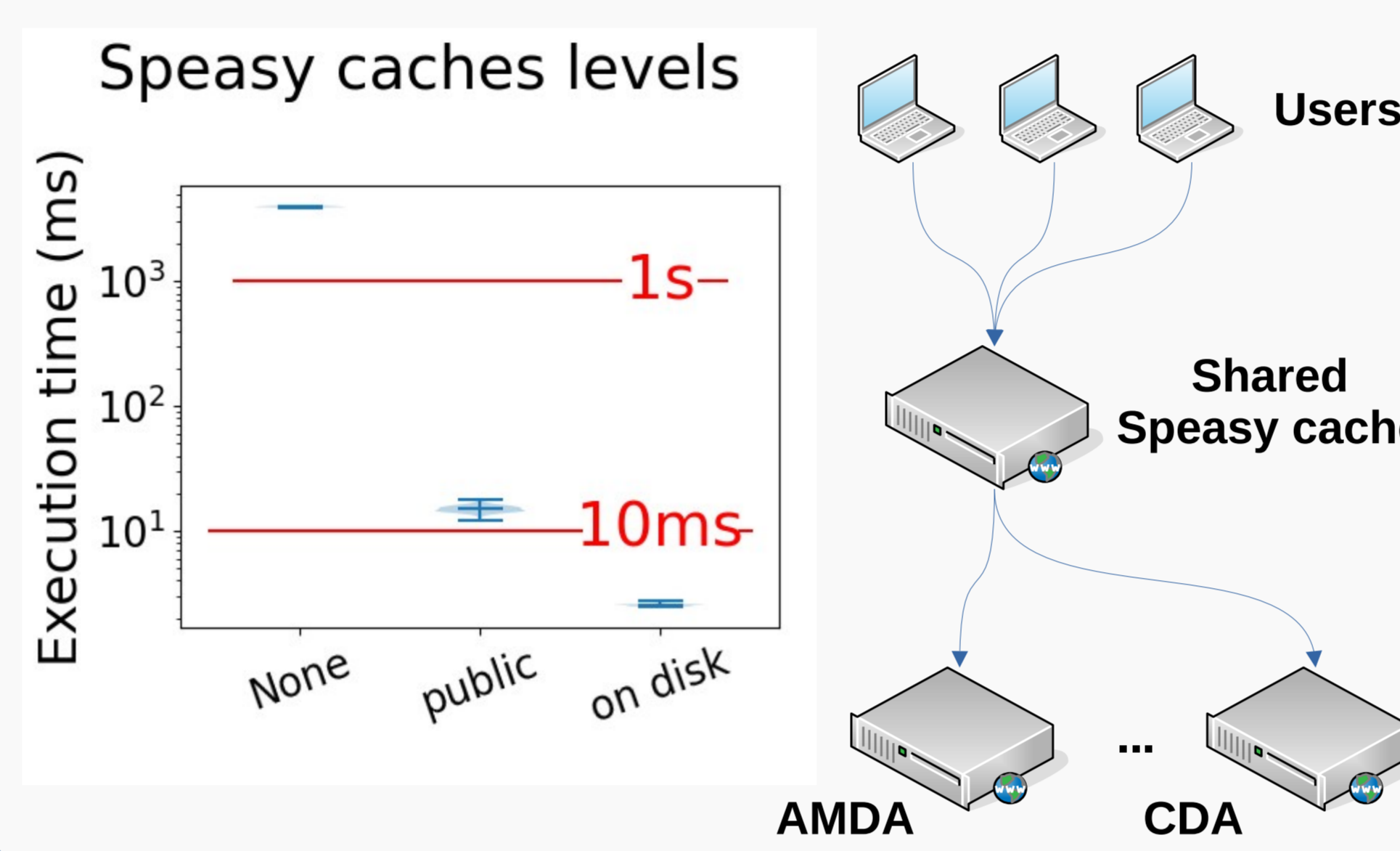
### • Dynamic remote servers inventory

Speasy dynamically builds an inventory of accessible remote servers, providing users with a comprehensive list of available products. Runtime Python completion allows users to easily navigate and discover products on remote servers without having to read extensive documentation or write complex queries. This simplifies the discovery process and reduces the time required to find the relevant data, making Speasy an efficient and user-friendly tool.
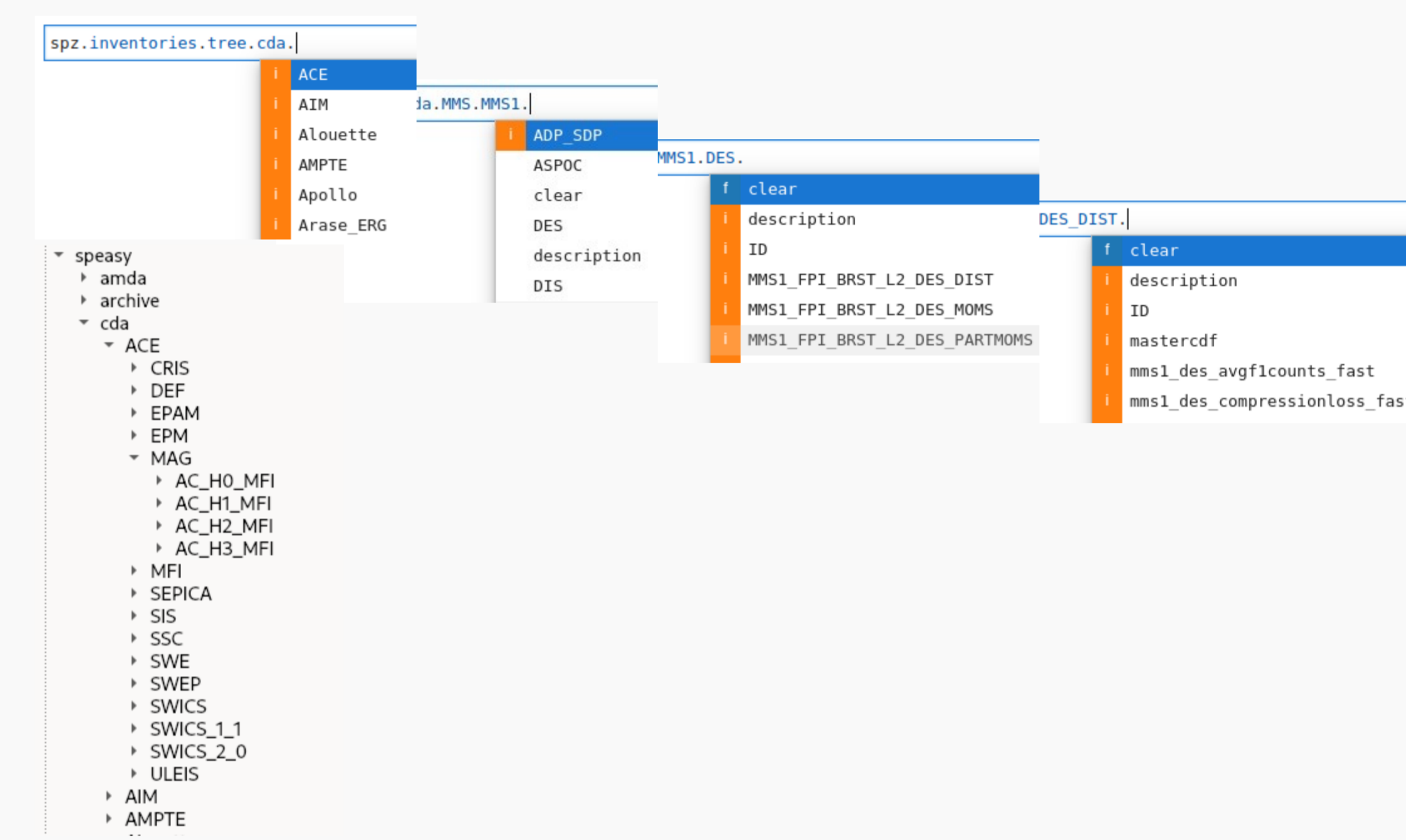
## The Significance of CDF ISTP(INTERNATIONAL SOLAR TERRESTRIAL PHYSICS) guidelines in Speasy

ISTP standards enable Speasy to seamlessly integrate heterogeneous space physics data, streamlining data management and eliminating the need for customized data handling procedures, resulting in a more efficient and cohesive approach to space data analysis.

### • More data
ISTP guidelines provide a standardized data format, making it easier to add new data sources without having to write custom code.
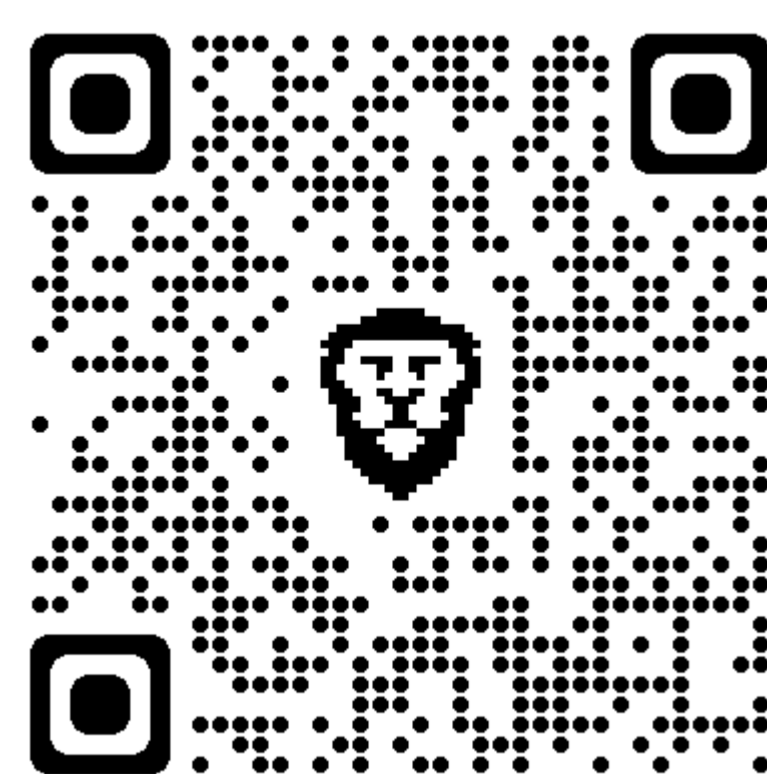
### • Less Code
ISTP guidelines help to reduce code duplication, making the Speasy codebase more maintainable and less prone to bugs.

### • More features
By reducing the need for custom code, ISTP guidelines free up engineers to focus on developing new features and improving the performance and scalability of Speasy.
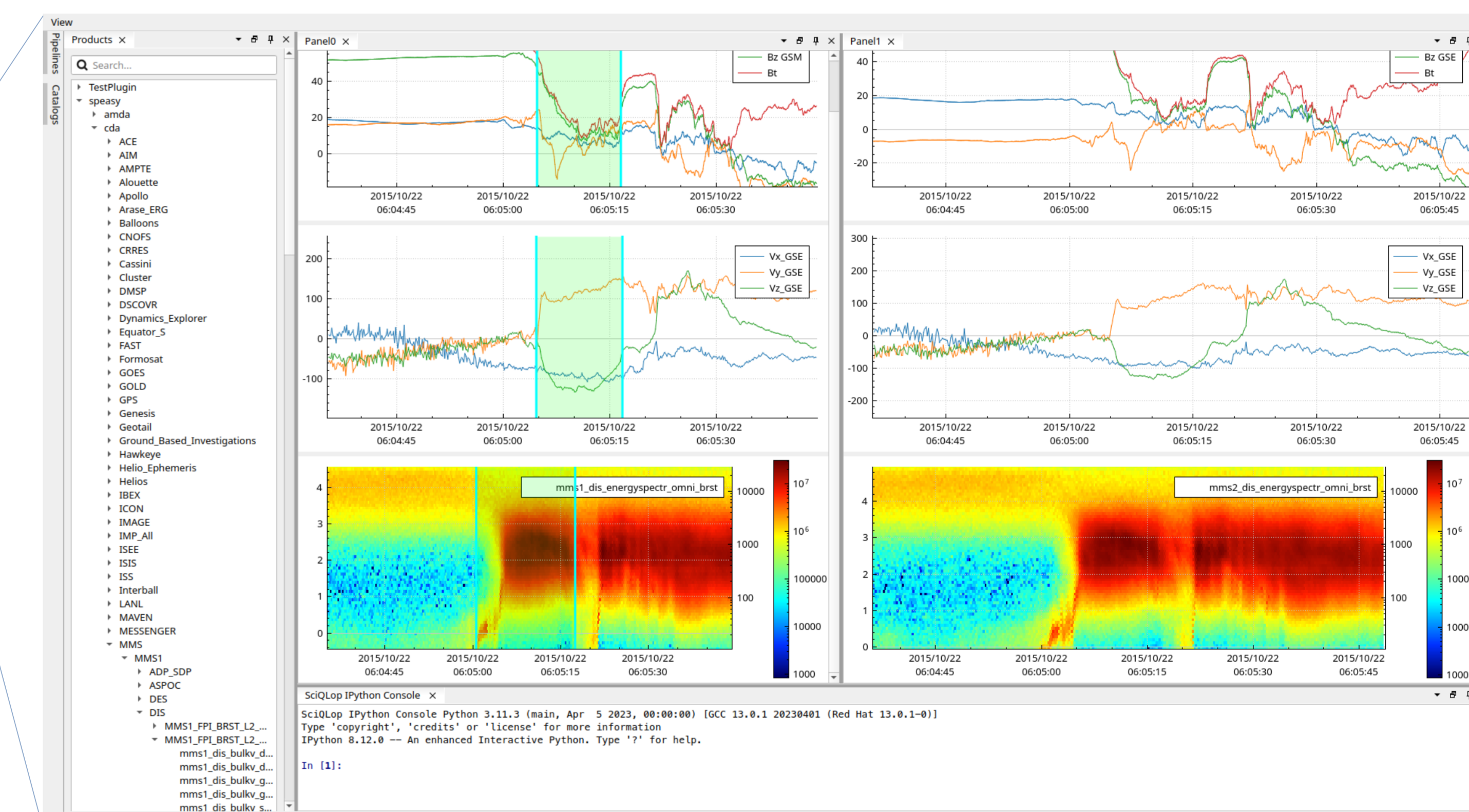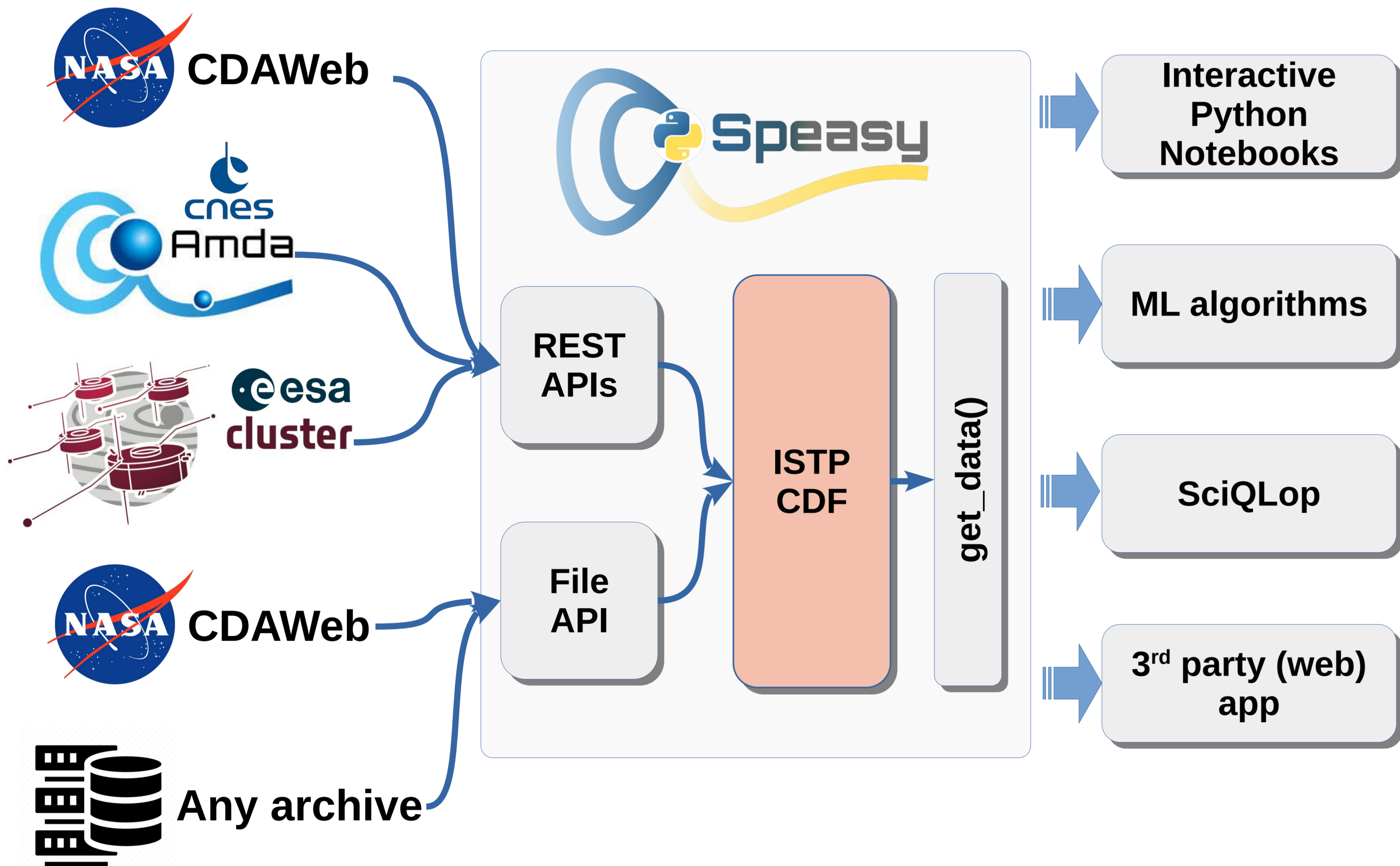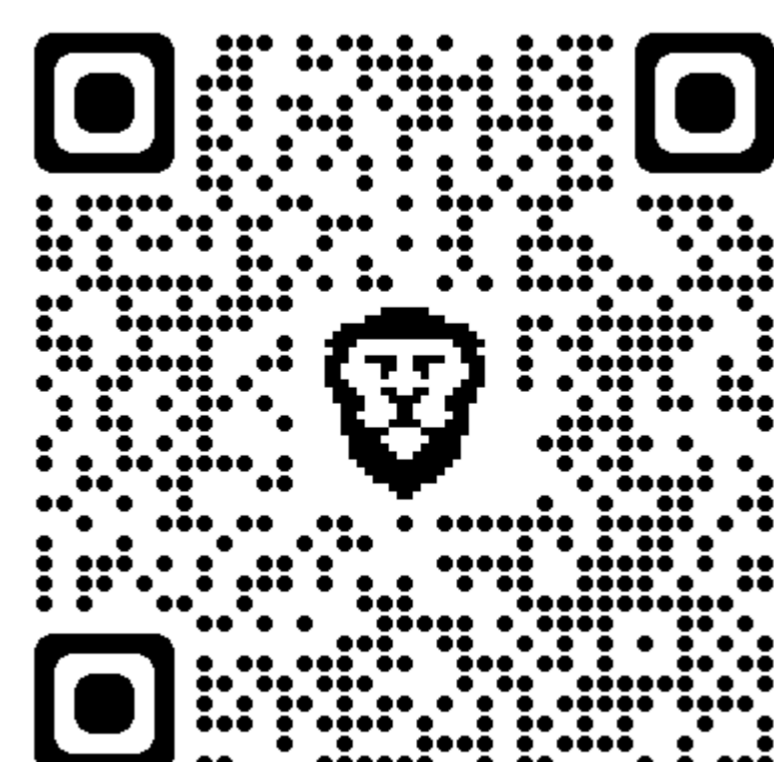
## Scientific publications using Speasy

Subion-Scale Turbulence Driven by Magnetic Reconnection

D. Manzini, F. Sahraoui, and F. Califano
Phys. Rev. Lett. 130, 205201 – Published 19 May 2023

Global Three-Dimensional Draping of Magnetic Field Lines in Earth's Magnetosheath From In-Situ Spacecraft Measurements

B. Michotte de Welle, N. Aunai, G. Nguyen, B. Lavraud, V. Génot, A. Jeandet, R. Smets
First published: 08 December 2022

The Helicity Sign of Flux Transfer Event Flux Ropes and Its Relationship to the Guide Field and Hall Physics in Magnetic Reconnection at the Magnetopause

S. Dahani, R. Kieokaew, V. Génot, B. Lavraud, Y. Chen, B. Michotte de Welle, N. Aunai, G. Tóth, P. A. Cassak, N. Fargette, R. C. Fear, A. Marchaudon, D. Gershman, B. Giles, R. Torbert, J. Burch
First published: 26 October 2022

## Speasy users survey results

Which web services did or you plan to use?
16 responses

AMDA — 15 (93.8%)
CDAWeb — 10 (62.5%)
CSA — 3 (18.8%)
SSCWeb — 2 (12.5%)
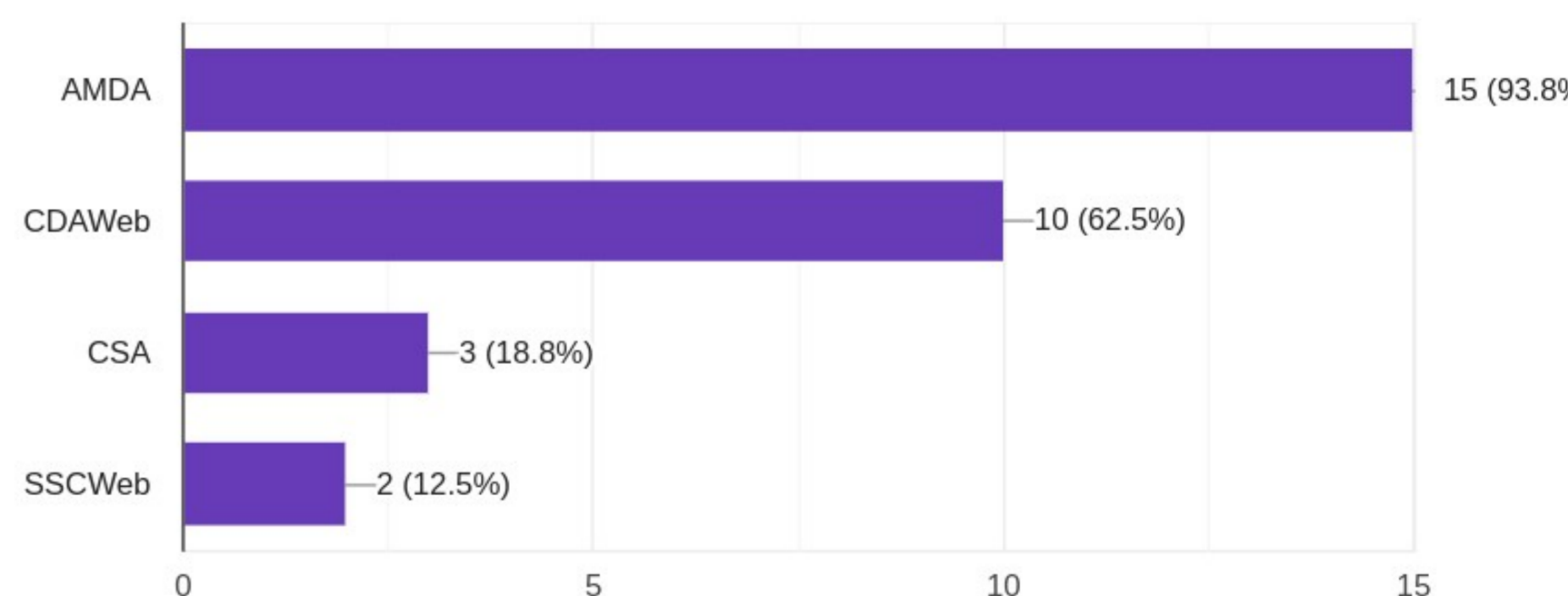
Do you appreciate the ability to access many servers from the same tool/function?
16 responses

1: 0 (0%)  2: 0 (0%)  3: 2 (12.5%)  4: 4 (25%)  5: 10 (62.5%)
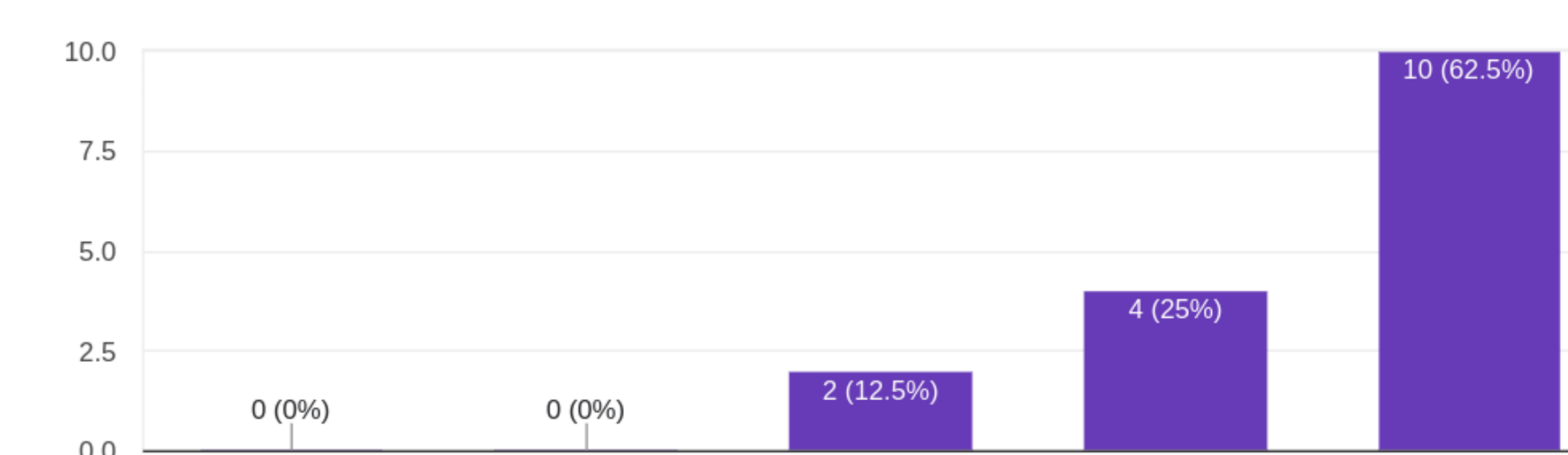
Which Spacecrafts/Missions did you or do you plan to use?

## Conclusion: Empowering Space Data Access and Analysis

Speasy simplifies access to space plasma data by adhering to standards, integrating diverse web services, and optimizing data retrieval. This enables researchers to explore the space plasma environment efficiently, with real-world applications attesting to its effectiveness.

Speasy's support for ISTP standards ensures data consistency and reliability, while its integration of diverse web services expands the scientific data landscape. Speasy's features, such as dynamic inventory creation, multi-level caching, and efficient data retrieval, streamline data access and accelerate analysis.

In practical use cases, Speasy has empowered researchers to overcome data access hurdles and shift their focus to data analysis. Speasy is a valuable tool for the space plasma physics community, supporting ongoing exploration and discoveries in the field.