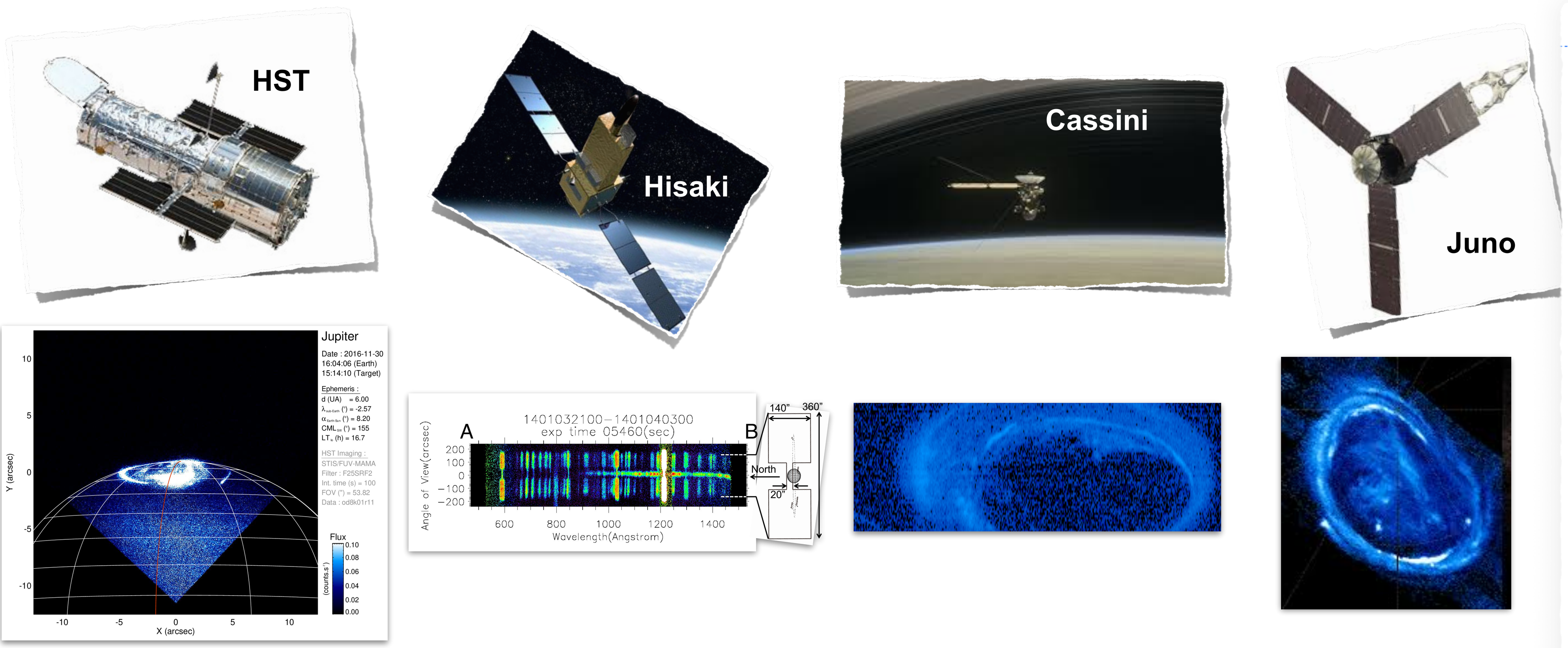
The Auroral Planetary Imaging and Spectroscopy (APIS) service : a facilitated access to UV observations of solar system planets

L. Lamy[1,2], F. Henry[2], R. Prangé[2], S. Aicardi[3], C. Pit[1], J. Waters[2,1], B. Benmahi[1], P. Le Sidaner[3], B. Cecconi[2], L. Jorda[1], D. Vibert[1]

[1]LAM, Aix-Marseille Université, Pythéas, CNES, France. [2]LIRA, Observatoire de Paris/PSL, CNRS, France. [3]PADC, DIO, Observatoire de Paris/PSL, France.

ABSTRACT

Remote Ultraviolet (UV) auroral observations of the outer planets provide highly valuable constraints on the auroral processes at work and the underlying coupling between the solar wind, the magnetosphere, the ionosphere and the moons. APIS stands for *Auroral Planetary Imaging and Spectroscopy*[1]. This french CNRS national observation service has been available online at https://apis.obspm.fr since 2012, and aims at **facilitating** the use of **complex** UV planetary auroral observations. APIS provides an open and interactive access to high level data, dealing with UV observations from various UV observatories (HST[1], Hisaki[2], Cassini[3], Juno[4]), through a dedicated search interface and standard VO tools. APIS is additionnally interfaced with other VO services of the community such as VESPA, CDPP/AMDA, CDPP/ 3dView and CDPP/PropTool. Recently, we extended the HST database to observations of Jupiter in support to Juno, developed high level products for the Cassini/UVIS dataset and worked on a prototype of Juno/UVS observations of Jupiter.



THE HUBBLE DATABASE

The core of the APIS database now reaches >13000 public auroral observations of Mars, Jupiter, Saturn, Uranus, Neptune and their satellites acquired over 1997-2025 with the STIS and ACS Far-UV spectro-imagers. For each individual observation (either imaging or spectroscopy), we compute high level data products, namely levels 2 and 3, including processed data, physical units, maps in physical reference frames[1].

We continuously ingest to the APIS database the most recent public HST observations, such as the STIS measurements of Jupiter's aurorae acquired in support to Juno. Whenever STIS images are acquired in the time-tag mode, we additionally sequence these into short exposures. The spacecraft magnetic footpath and the expected satellite auroral footprints are displayed on the derived polar projections to facilitate the identification of time intervals during which in situ measurements were simultaneously obtained (Figure 1).

Recently, we also started working on (1) improving the limb-fitting of Jupiter with ML techniques and (2) specific STIS long-slit slewing spectroscopy observations of Jupiter and Saturn to develop higher level data products (level 3+) separating measurements of H-Lyα and H_2 bands aurorae, together with measurements of the Color Ratio and H-Lyα/H_2 Brightness Ratio which respectively probe the energy of high- and low-energy auroral electrons (Figure 2).

FIGURE 1

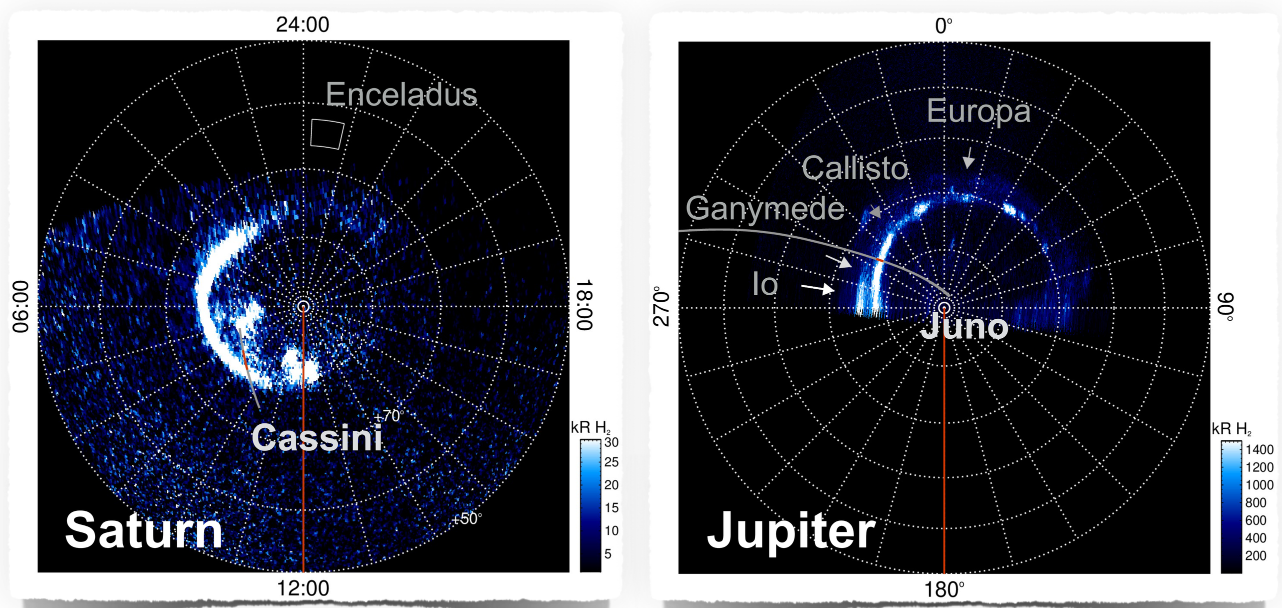


Figure 1 : Polar projections of HST images of Saturn and Jupiter taken when the footpath of Cassini/Juno S/C crossed the auroral regions. Such images have been used to provide the auroral context of Cassini and Juno in situ measurements.

FIGURE 2

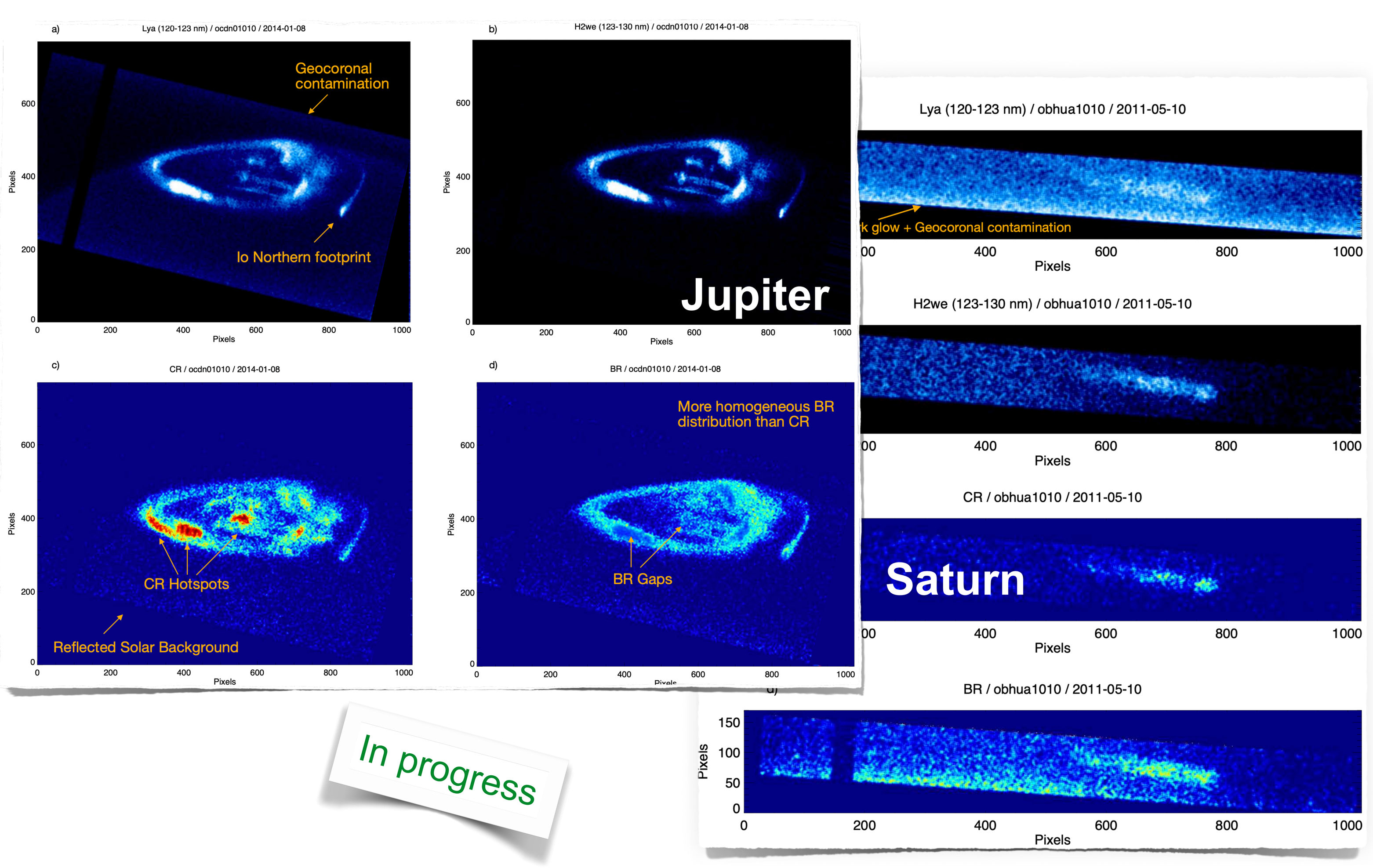


Figure 2 : Reconstructed map of (left) Jupiter's and (right) Saturn's aurorae from STIS long slit slewing spectroscopy. The 4 panels display the brightness, of H-Lyα, H_2, the Color Ratio and the H-Lyα/H_2 Brightness Ratio.

CASSINI/UVIS OBSERVATIONS OF SATURN

The Cassini/UVIS spectro-imager observed the UV aurorae of Saturn from 2004 to 2017 with a long slit together with FUV and EUV channels. As a first step, the FUV data were calibrated, sequenced in individual UVIS slewing of Saturn's auroral regions and provided as fits files which can be browsed online (level 2 data products, see Figure 3).

We are currently working on the finalization of higher level data products[2,3] (level 3) : for EUV data, we will build up polar projections of H_2 bands emissions while, for FUV data, we will construct polar maps of H-Lyα and H_2 bands aurorae and of the Color Ratio and H-Lyα/H_2 Brightness Ratios (insert in Figure 3).

FIGURE 3

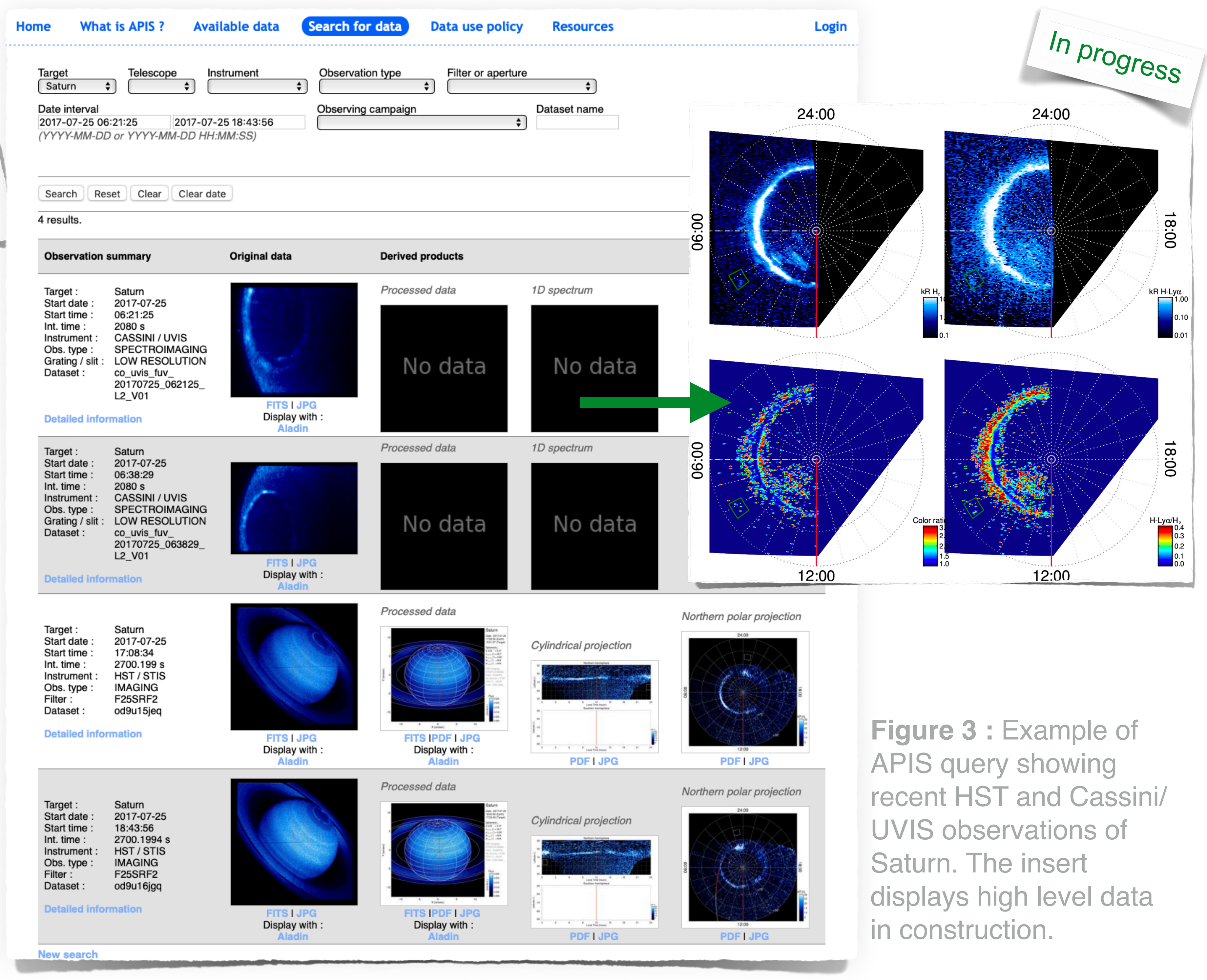


Figure 3 : Example of APIS query showing recent HST and Cassini/ UVIS observations of Saturn. The insert displays high level data in construction.

JUNO/UVS OBSERVATIONS OF JUPITER

Such as for Cassini/UVIS at Saturn, we aim at constructing a processed set of Juno/UVS observations of Jupiter with a prototype database in construction[4]. An example of data products is displayed in Figure 4.

FIGURE 4

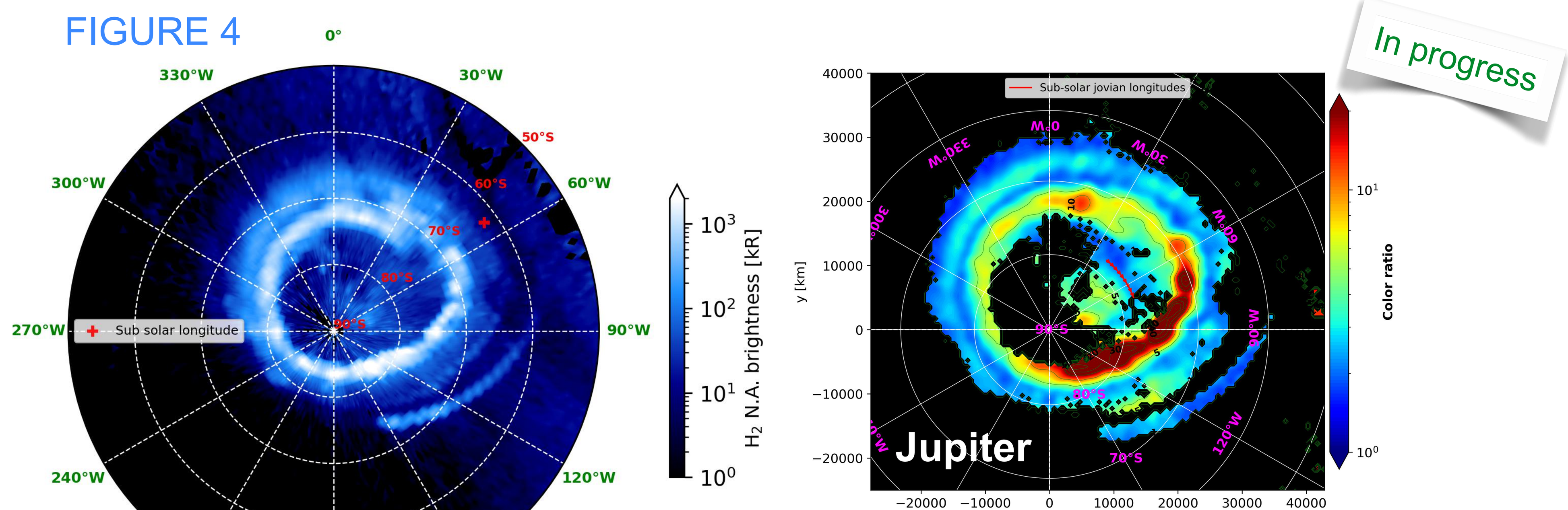


Figure 4 : Example of Juno/UVS observations of Jupiter's aurorae (Perijove 32, South) stacked into a single polar projection displayed in (left) H_2 brightness and (right) Color Ratio.

A SERVICE INSERTED INTO THE VIRTUAL OBSERVATORY (VO)

APIS databases are referenced by doi and compliant with the EPN-TAP standard. The service is interfaced with VO portals (VESPA) and VO tools at CDPP (AMDA[5], PropTool, 3Dview), as illustrated in Figure 5. The data retrieved on the search interface can also be browsed interactively on the search interface with Aladin (datacubes) and Cassis/Specview (spectra) thanks to the SAMP protocol.

FIGURE 4

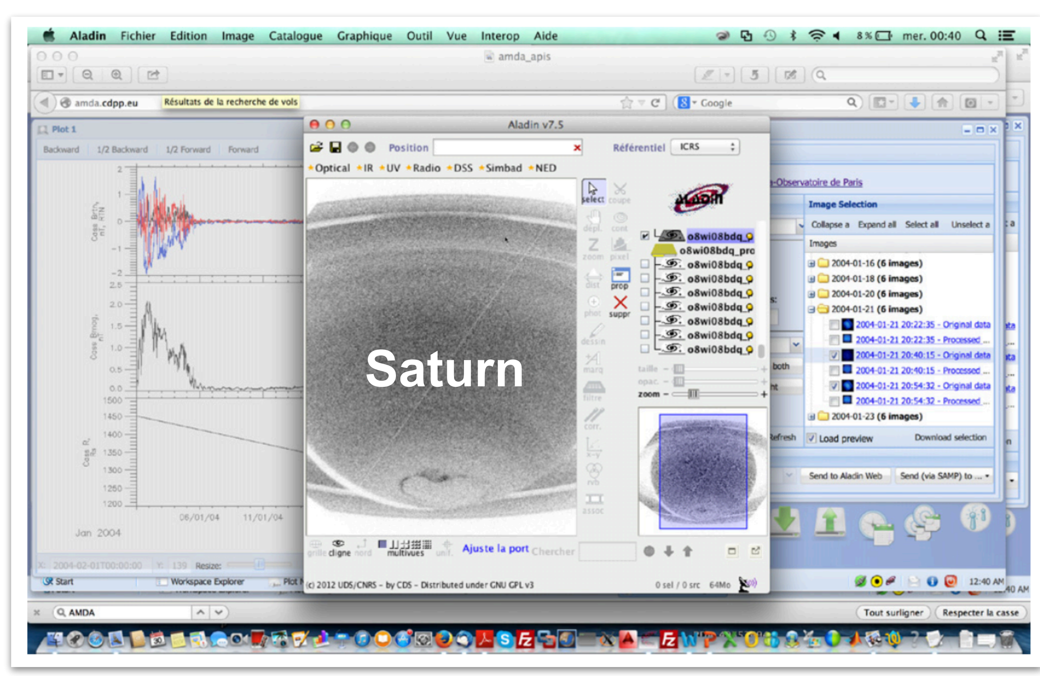


Figure 4 : Joint use of AMDA and APIS services to study the magnetosphere of Saturn[5].

REFERENCES

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