# *CASSIS as a spectroscopy tool for VESPA*

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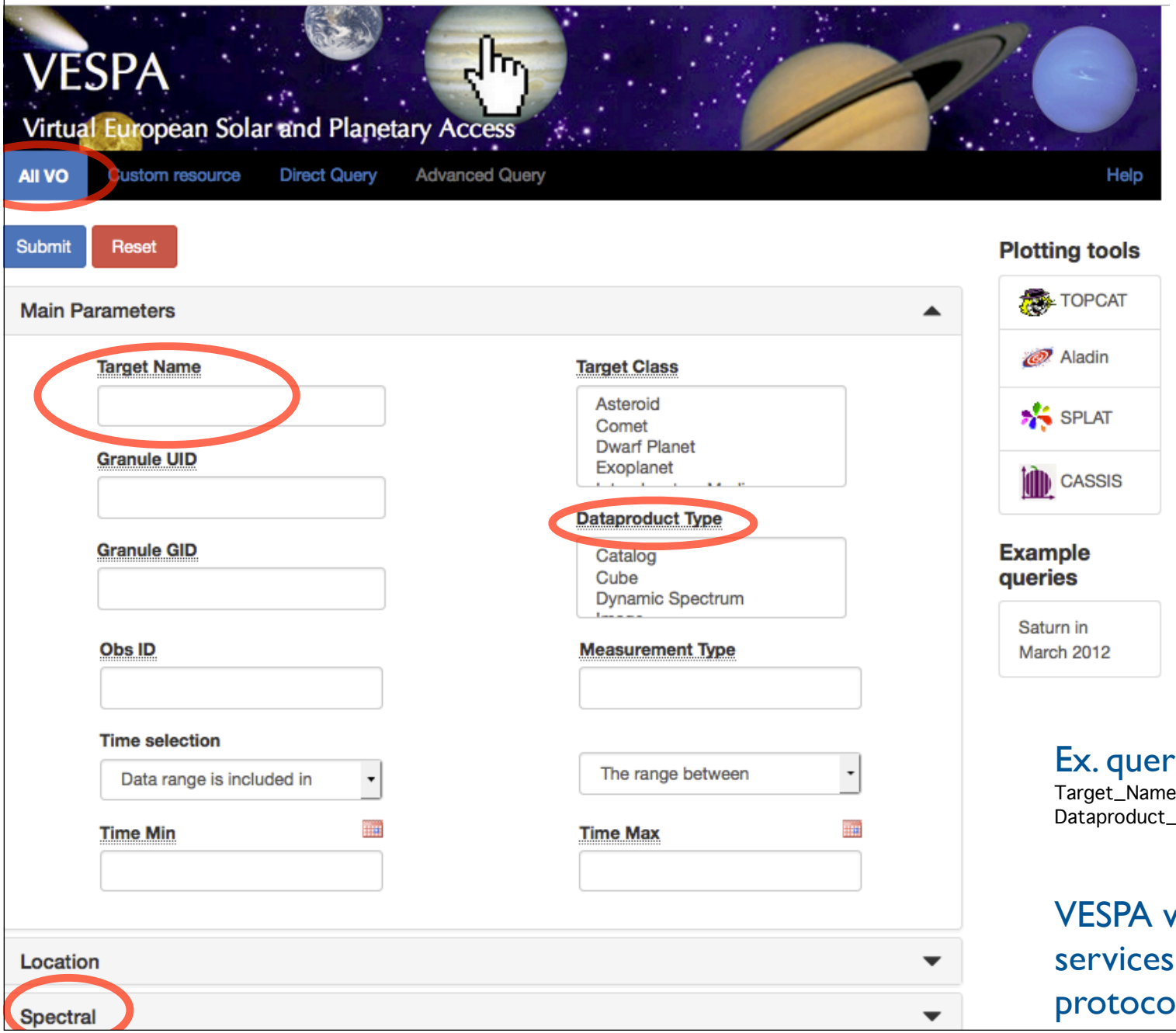
*v1.3, 11/9/2017*

# Go to VESPA portal

http://vespa.obspm.fr



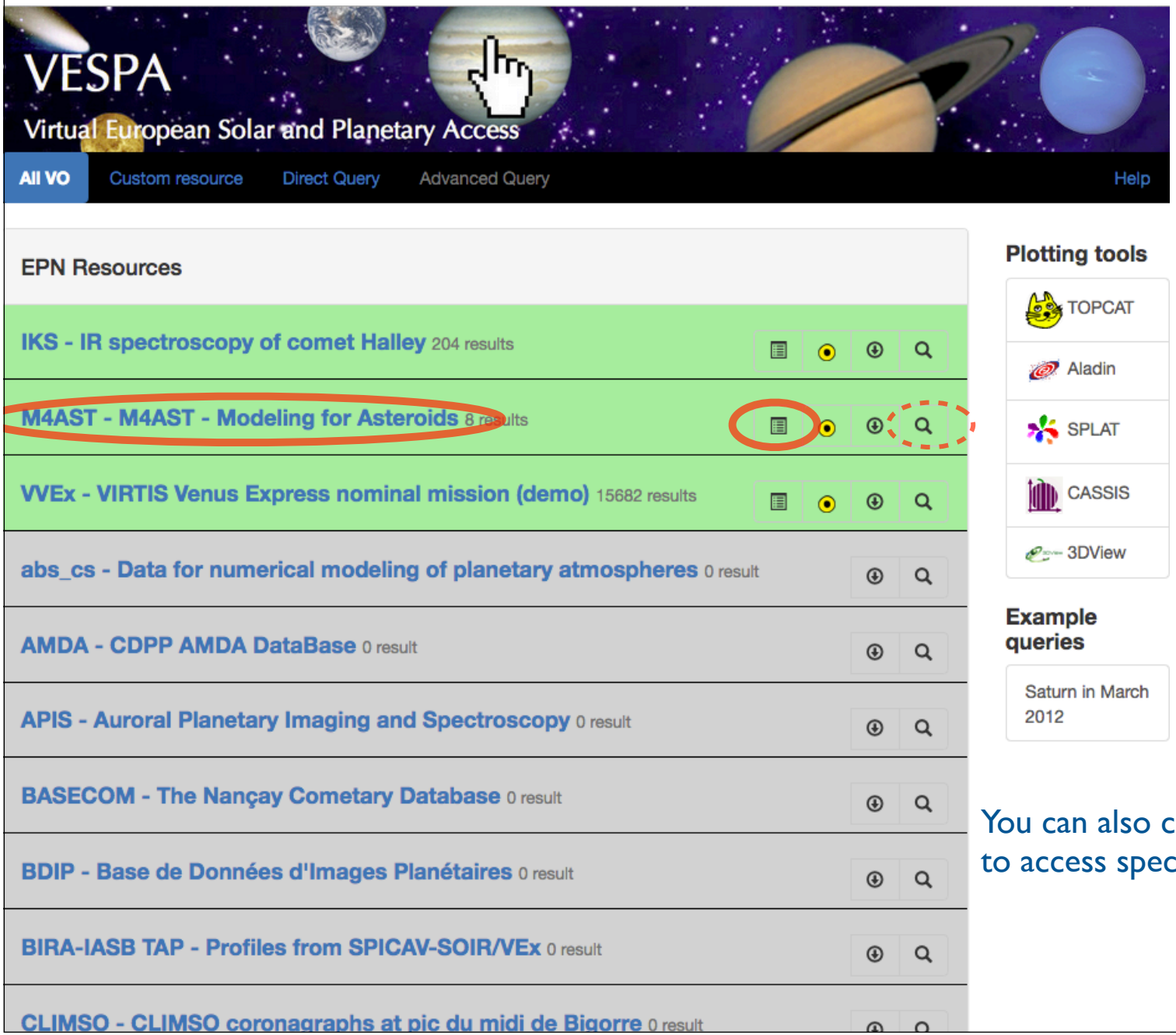

Click "Submit" to search public data services, or first enter query parameters

Ex. query parameters:
Target_Name = Jupiter or Ceres or Lutetia
Dataproduct_type = spectrum

VESPA will search all public data services which use the EPN-TAP protocol

# Service results

http://vespa.obspm.fr




On line M4ast, click the "Display results" icon to get result list from this service

You can also click "Advanced query form" to access specific parameters (local time…)

# Query results

Result is a list of files matching the query


Results in service M4AST

how 10 entries

Column visibility | Show all | Hide all

Select All in current page | Reset Selection

| granule_uid | dataproduct_type | target_name | time_min (d) | time_max (d) | access_url | granule_gid | obs_id |
|---|---|---|---|---|---|---|---|
| Zeissia_19920114_697_00_nativ | spectrum | Zeissia | 1992-01-14T00:00:00.000 | 1992-01-14T00:00:00.000 | http://cardamine.imc... | native | Zeissia_19920114_697_00_obs |
| Zeissia_19920114_697_00 | spectrum | Zeissia | 1992-01-14T00:00:00.000 | 1992-01-14T00:00:00.000 | http://voparis-srv-p... | formatted | Zeissia_19920114_697_00_obs |
| Zao_20001026_262_00_nativ | spectrum | Zao | 2000-10-26T00:00:00.000 | 2000-10-26T00:00:00.000 | http://cardamine.imc... | native | Zao_20001026_262_00_obs |
| Zao_20001026_262_00 | spectrum | Zao | 2000-10-26T00:00:00.000 | 2000-10-26T00:00:00.000 | http://voparis-srv-p... | formatted | Zao_20001026_262_00_obs |
| Wesson_19911028_697_00_nativ | spectrum | Wesson | 1991-10-28T00:00:00.000 | 1991-10-28T00:00:00.000 | http://cardamine.imc... | native | Wesson_19911028_697_00_obs |
| Wesson_19911028_697_00 | spectrum | Wesson | 1991-10-28T00:00:00.000 | 1991-10-28T00:00:00.000 | http://voparis-srv-p... | formatted | Wesson_19911028_697_00_obs |
| Viv_19911028_697_00_nativ | spectrum | Viv | 1991-10-28T00:00:00.000 | 1991-10-28T00:00:00.000 | http://cardamine.imc... | native | Viv_19911028_697_00_obs |
| Viv_19911028_697_00 | spectrum | Viv | 1991-10-28T00:00:00.000 | 1991-10-28T00:00:00.000 | http://voparis-srv-p... | formatted | Viv_19911028_697_00_obs |
| Vihuri_19911213_697_00_nativ | spectrum | Vihuri | 1991-12-13T00:00:00.000 | 1991-12-13T00:00:00.000 | http://cardamine.imc... | native | Vihuri_19911213_697_00_obs |
| Vihuri_19911213_697_00 | spectrum | Vihuri | 1991-12-13T00:00:00.000 | 1991-12-13T00:00:00.000 | http://voparis-srv-p... | formatted | Vihuri_19911213_697_00_obs |

howing 1 to 10 of 940 entries 1 row selected

Data Selection | Metadata Selection | All Data | All Metadata | Footprints

Plotting tools

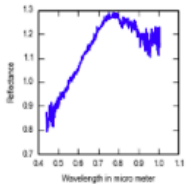
TOPCAT
Aladin
SPLAT
CASSIS
3DView

Example queries

Saturn in March 2012

Click "Show all" to see other parameters

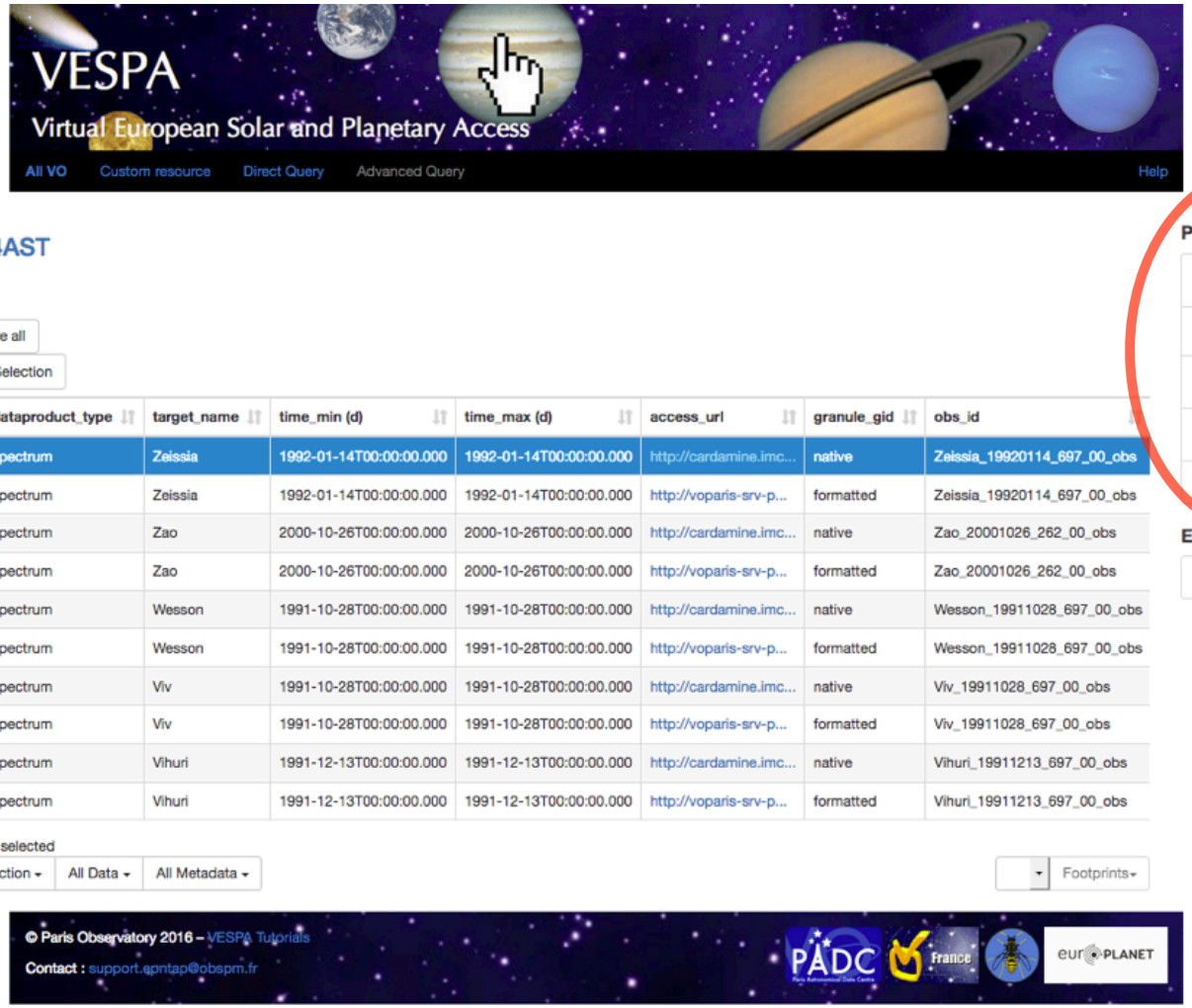
Hover the mouse over the table to see thumbnails

Click to select one or more lines & click "Data selection" / Download to retrieve data files
[ or click "All metadata" / Send table to send complete table to TOPCAT ]

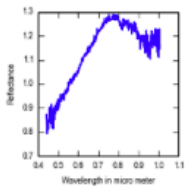
# Visualising results

Launch VO tools either from buttons or from your system




CASSIS is the tool of choice for spectra

TOPCAT is an all-purpose tool for tables



# CASSIS as a spectrum visualizer in VESPA

In service IKS, select iksfinal and iksfig7 spectra in VOtable format

Or use "granule_gid = corrected" in the query

VESPA Query Interface

VESPA user interface - VESP | D11.3 - Second VESPA increm | Spectral quantities in use for | VESPA Query Interface | ADQL Query | VESPA Query Interface

vespa.obspm.fr/planetary/data/display/?resource_id=ivo://vopdc.obspm/lesia/iks/epn&resource_type=epn&query_conditior

ay/VES/D11.2+-+First+VESPA+incremental+report

Les plus visités | Google | eBay | LESIA | Actualités | mail | Stick | wiki, etc | OVParis


## Results in service IKS

Show 10 entries

Column visibility | Show all | Hide all

Select All in current page | Reset Selection

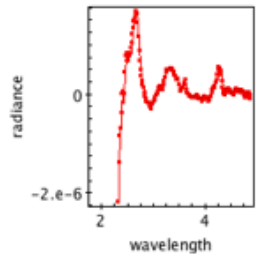
| granule_uid | dataproduct_type | target_name | time_min (d) | time_max (d) | access_url |
|---|---|---|---|---|---|
| iksfinalC | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://voparis-srv.o... |
| iksfinalA | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://pdssbn.astro.... |
| iksfig7C | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://voparis-srv.o... |
| iksfig7A | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://pdssbn.astro.... |
| iks193C | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://voparis-srv.o... |
| iks193A | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://pdssbn.astro.... |
| iks192C | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://voparis-srv.o... |
| iks192A | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://pdssbn.astro.... |
| iks191C | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://voparis-srv.o... |
| iks191A | spectrum | 1P | 1986-03-06T00:00:00.000 | 1986-03-06T00:00:00.000 | http://pdssbn.astro.... |

**Plotting tools**

- TOPCAT
- Aladin
- SPLAT
- CASSIS
- 3DView

**Example queries**

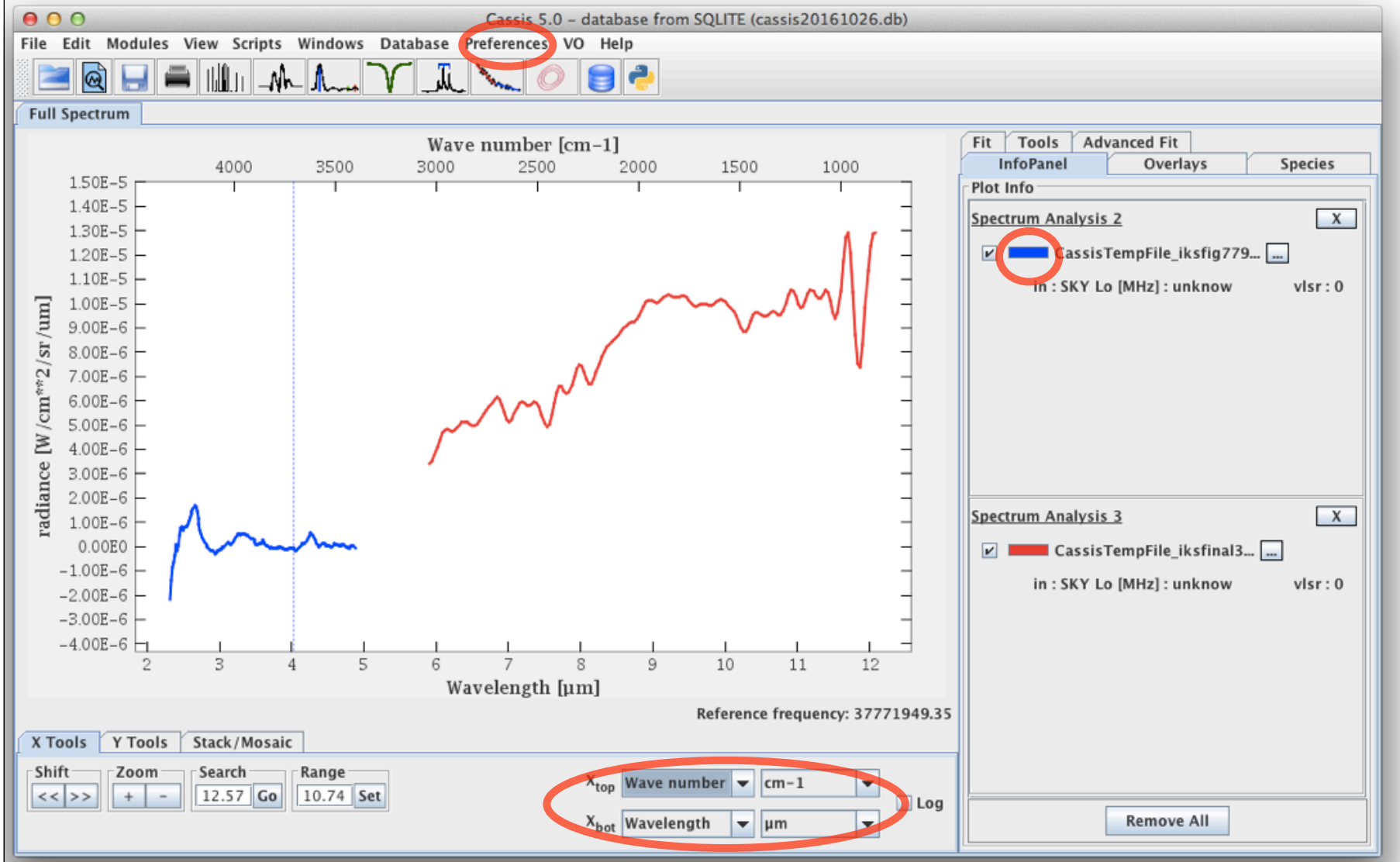
Saturn in March 2012




Click to select one or more lines & click "Data selection" / Send spectra to load data into CASSIS [ or / Send Table to load in TOPCAT ]

# CASSIS as a visualizer

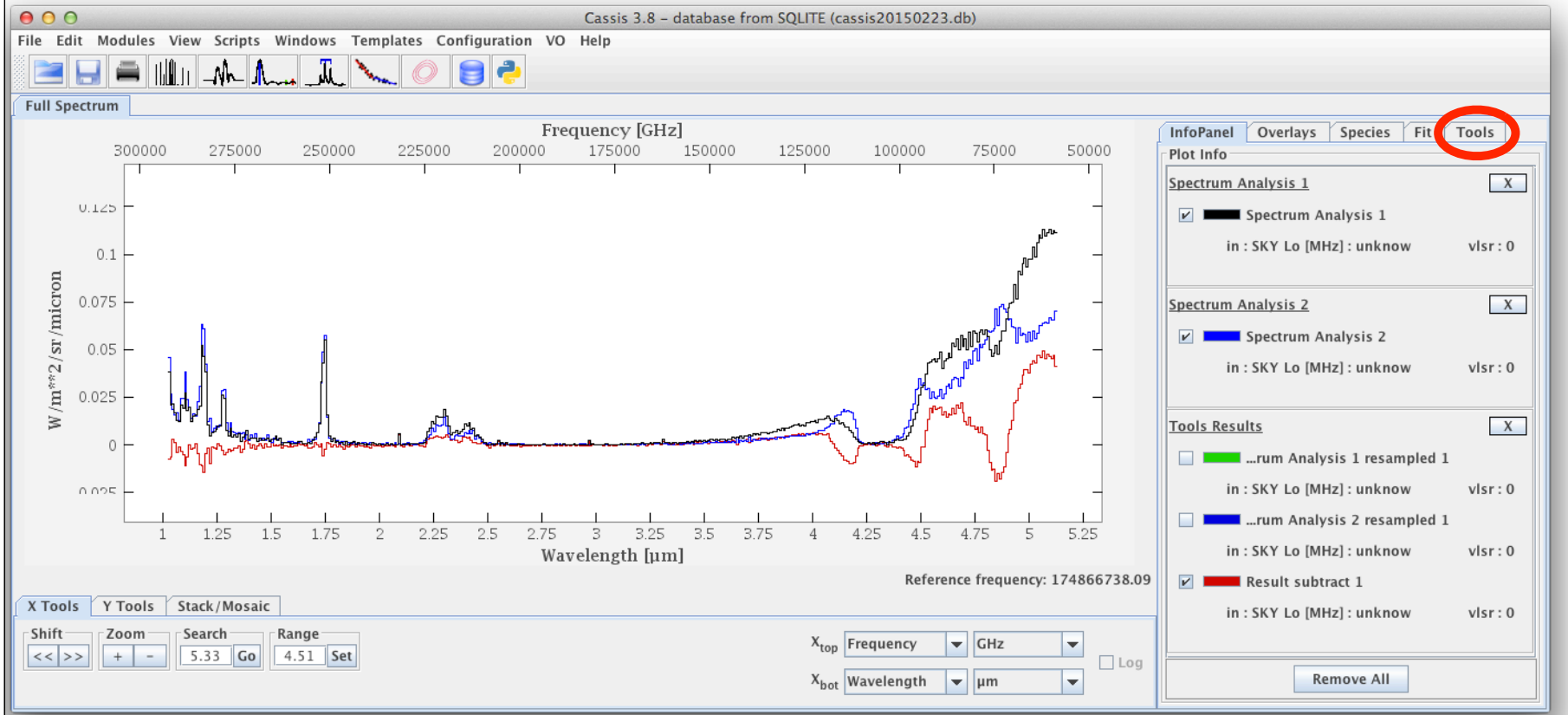
CASSIS receives spectra from search interface, can overplot selections




In Preferences > General set "Force direct opening" to True (this will bypass dialogues)
Adjust color and line style in the panel under the color box
Change units and navigate with lower panel buttons

# Visualization and arithmetics in CASSIS

CASSIS can overplot a selection of spectra and manipulate them



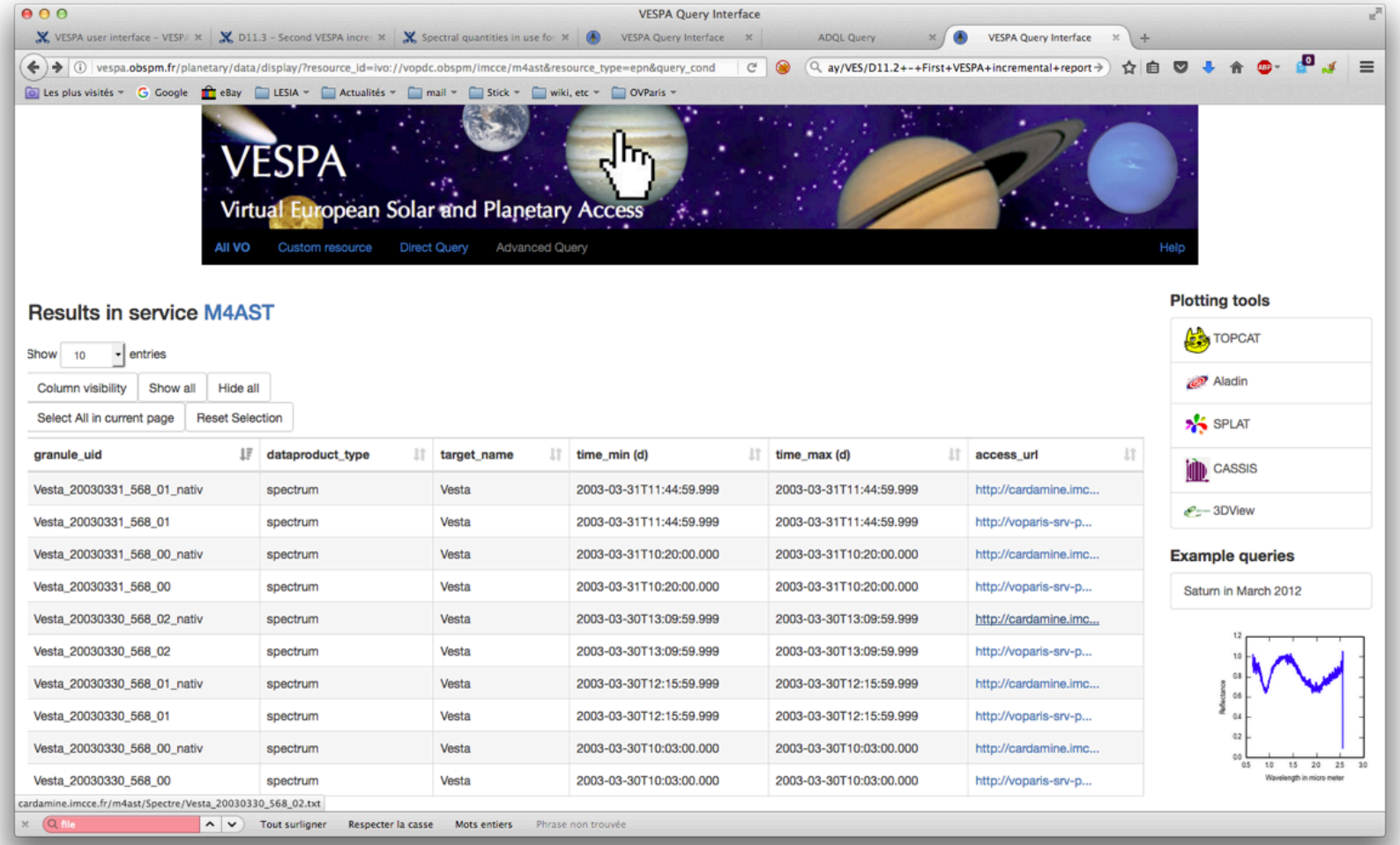

Press "shift" to see level at mouse location
Left click or "Comm"-drag to set plotting region
"Alt"-drag to select a region (used in "Fit" tab)
"Alt"-click to set markers (& remove them in InfoPanel)
Mouse-wheel to zoom in/out

Click the "Tools" tab to combine spectra
Spectra are resampled to a common wvl vector on the fly
The "Species" tab accesses line databases (most of them related to the ISM)
Also includes LTE and RADEX modeling

# Spectral comparisons from different services

## In VESPA, ask for spectra of asteroid Vesta and look in M4ast result page:

Use "target_name = vesta" & "granule_gid = formatted" in the query




Select prefered results visually from thumbnails

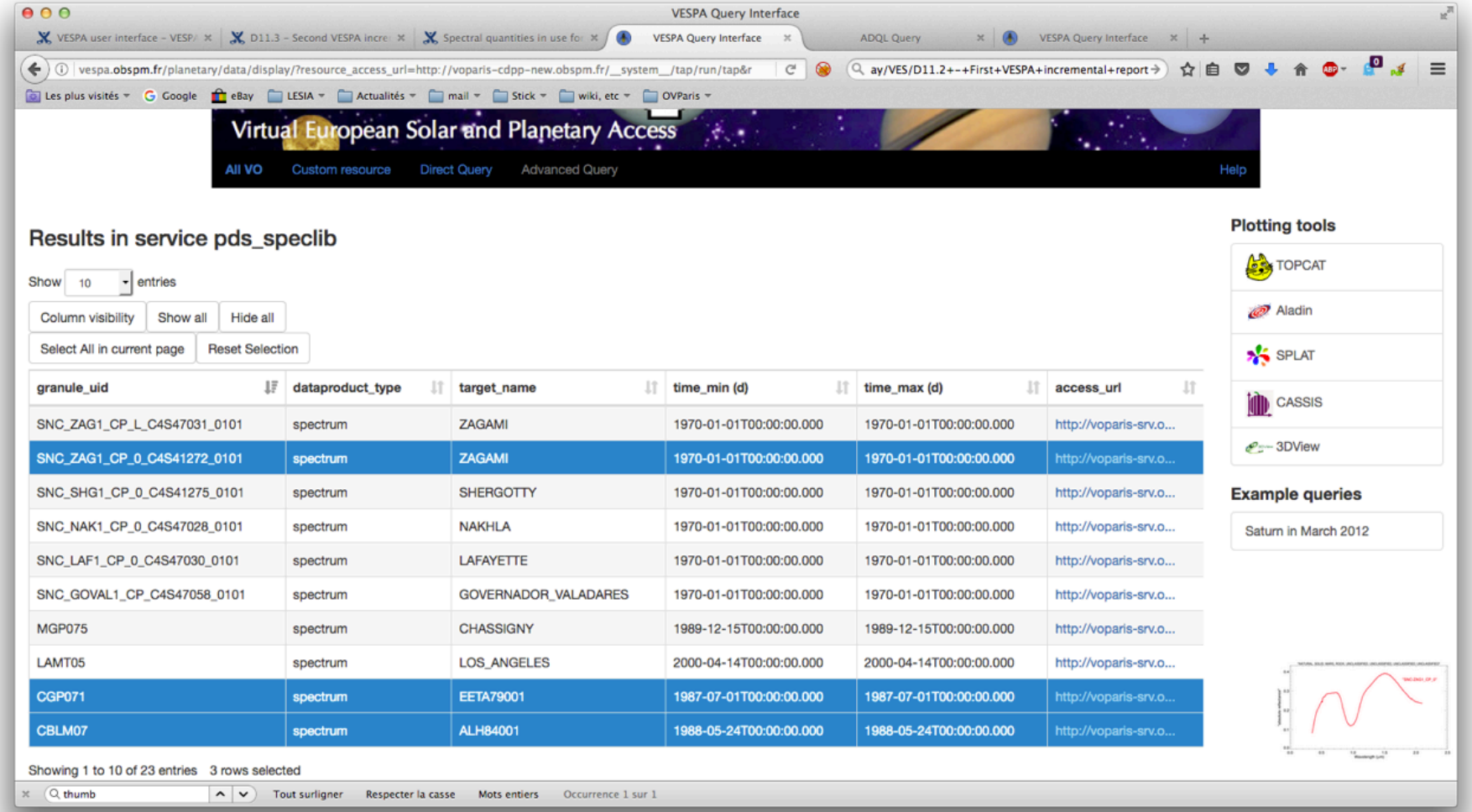
Pick-up VOtable versions (if not already selected in the query)

& send as spectra

# Spectral comparisons from different services

## In VESPA, ask for spectra of SNC meteorites and look in pds_speclib result page:

Use "granule_gid=natural_meteorite_rock" in the query

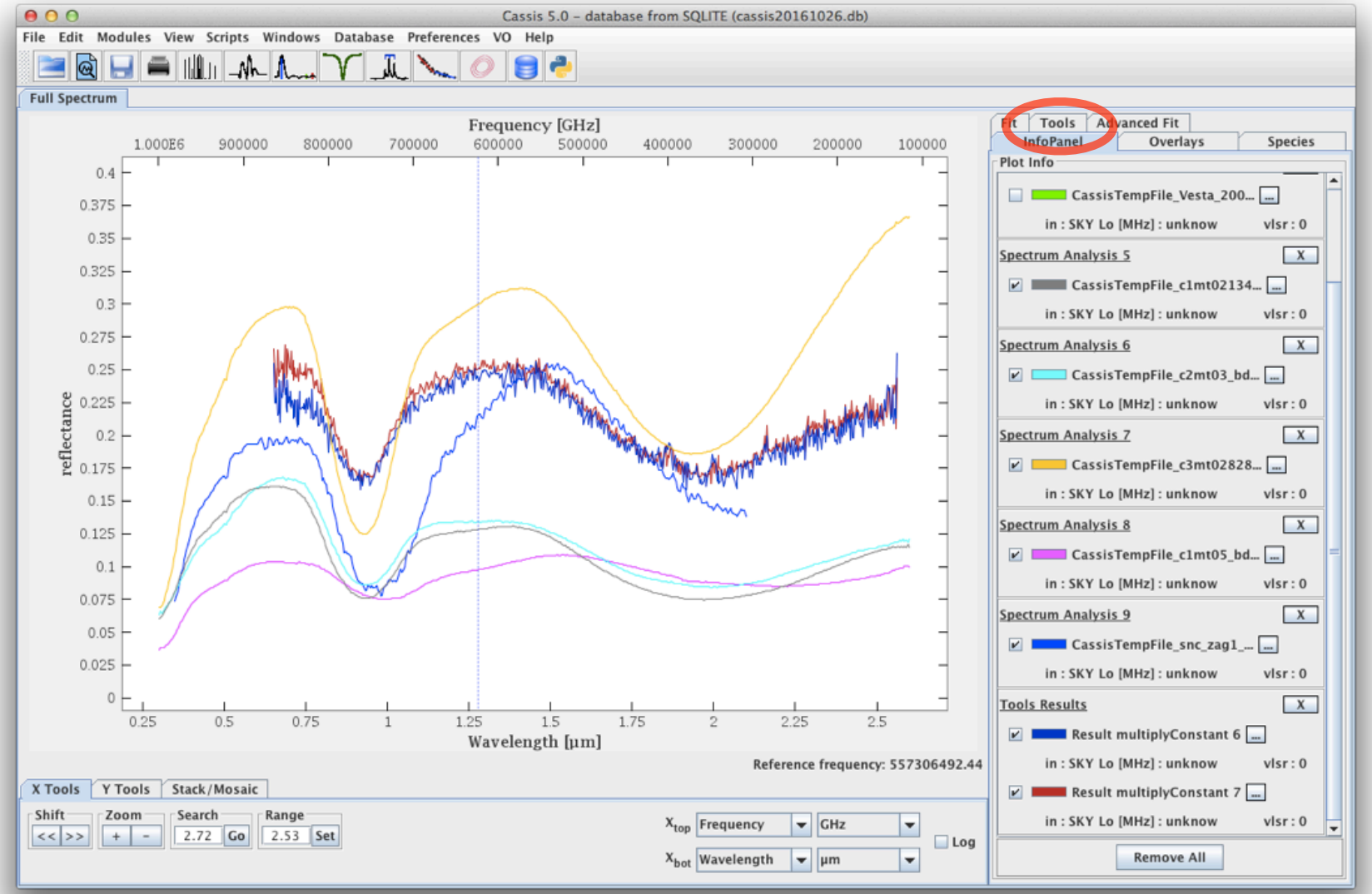



## Select prefered results visually from thumbnails & send as spectra

# Spectral comparisons from different services

## All spectra will plot immediately in the same window

Spectral axis units will be converted if needed

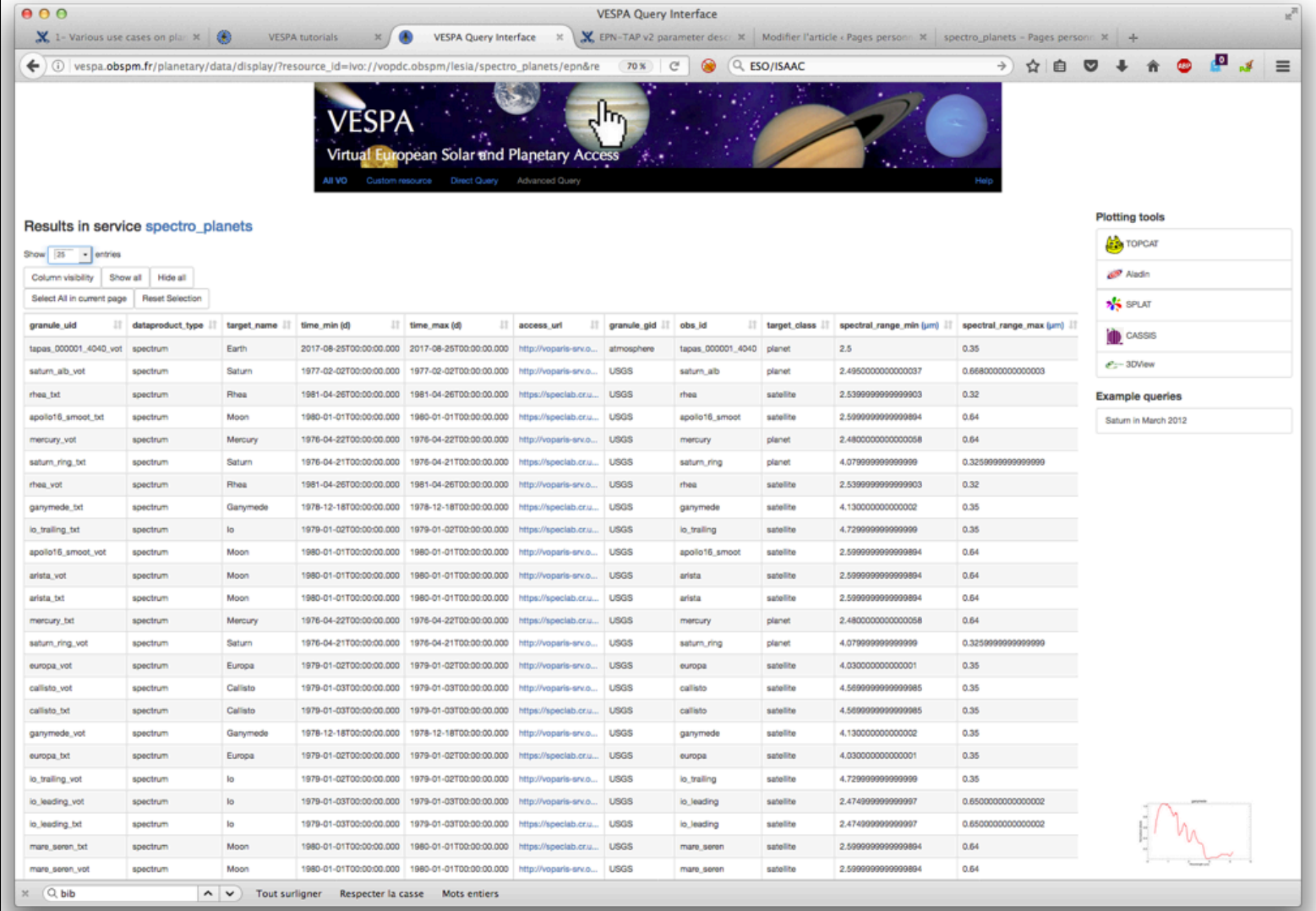



## Use Tools tab to scale flux axis (multiply M4ast spectra by 0.25)

Scaling is required, as Vesta spectra are provided as normalized I/F, and SNC spectra as reflectance factor

# Spectral comparisons of different quantities

In VESPA, ask for spectra of planets and look in spectro_planets result page:




| granule_uid | dataproduct_type | target_name | time_min (d) | time_max (d) | access_url | granule_gid | obs_id | target_class | spectral_range_min (µm) | spectral_range_max (µm) |
|---|---|---|---|---|---|---|---|---|---|---|
| tapas_000001_4040_vot | spectrum | Earth | 2017-08-25T00:00:00.000 | 2017-08-25T00:00:00.000 | http://voparis-srv.o... | atmosphere | tapas_000001_4040 | planet | 2.5 | 0.35 |
| saturn_alb_vot | spectrum | Saturn | 1977-02-02T00:00:00.000 | 1977-02-02T00:00:00.000 | http://voparis-srv.o... | USGS | saturn_alb | planet | 2.4950000000000037 | 0.6680000000000003 |
| rhea_txt | spectrum | Rhea | 1981-04-26T00:00:00.000 | 1981-04-26T00:00:00.000 | https://speclab.cr.u... | USGS | rhea | satellite | 2.5399999999999903 | 0.32 |
| apollo16_smoot_txt | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | https://speclab.cr.u... | USGS | apollo16_smoot | satellite | 2.5999999999999894 | 0.64 |
| mercury_vot | spectrum | Mercury | 1976-04-22T00:00:00.000 | 1976-04-22T00:00:00.000 | http://voparis-srv.o... | USGS | mercury | planet | 2.4800000000000058 | 0.64 |
| saturn_ring_txt | spectrum | Saturn | 1976-04-21T00:00:00.000 | 1976-04-21T00:00:00.000 | https://speclab.cr.u... | USGS | saturn_ring | planet | 4.079999999999999 | 0.3259999999999999 |
| rhea_vot | spectrum | Rhea | 1981-04-26T00:00:00.000 | 1981-04-26T00:00:00.000 | http://voparis-srv.o... | USGS | rhea | satellite | 2.5399999999999903 | 0.32 |
| ganymede_txt | spectrum | Ganymede | 1978-12-18T00:00:00.000 | 1978-12-18T00:00:00.000 | https://speclab.cr.u... | USGS | ganymede | satellite | 4.130000000000002 | 0.35 |
| io_trailing_txt | spectrum | Io | 1979-01-02T00:00:00.000 | 1979-01-02T00:00:00.000 | https://speclab.cr.u... | USGS | io_trailing | satellite | 4.729999999999999 | 0.35 |
| apollo16_smoot_vot | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | http://voparis-srv.o... | USGS | apollo16_smoot | satellite | 2.5999999999999894 | 0.64 |
| arista_vot | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | http://voparis-srv.o... | USGS | arista | satellite | 2.5999999999999894 | 0.64 |
| arista_txt | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | https://speclab.cr.u... | USGS | arista | satellite | 2.5999999999999894 | 0.64 |
| mercury_txt | spectrum | Mercury | 1976-04-22T00:00:00.000 | 1976-04-22T00:00:00.000 | https://speclab.cr.u... | USGS | mercury | planet | 2.4800000000000058 | 0.64 |
| saturn_ring_vot | spectrum | Saturn | 1976-04-21T00:00:00.000 | 1976-04-21T00:00:00.000 | http://voparis-srv.o... | USGS | saturn_ring | planet | 4.079999999999999 | 0.3259999999999999 |
| europa_vot | spectrum | Europa | 1979-01-02T00:00:00.000 | 1979-01-02T00:00:00.000 | http://voparis-srv.o... | USGS | europa | satellite | 4.030000000000001 | 0.35 |
| callisto_vot | spectrum | Callisto | 1979-01-03T00:00:00.000 | 1979-01-03T00:00:00.000 | http://voparis-srv.o... | USGS | callisto | satellite | 4.5699999999999985 | 0.35 |
| callisto_txt | spectrum | Callisto | 1979-01-03T00:00:00.000 | 1979-01-03T00:00:00.000 | https://speclab.cr.u... | USGS | callisto | satellite | 4.5699999999999985 | 0.35 |
| ganymede_vot | spectrum | Ganymede | 1978-12-18T00:00:00.000 | 1978-12-18T00:00:00.000 | http://voparis-srv.o... | USGS | ganymede | satellite | 4.130000000000002 | 0.35 |
| europa_txt | spectrum | Europa | 1979-01-02T00:00:00.000 | 1979-01-02T00:00:00.000 | https://speclab.cr.u... | USGS | europa | satellite | 4.030000000000001 | 0.35 |
| io_trailing_vot | spectrum | Io | 1979-01-02T00:00:00.000 | 1979-01-02T00:00:00.000 | http://voparis-srv.o... | USGS | io_trailing | satellite | 4.729999999999999 | 0.35 |
| io_leading_vot | spectrum | Io | 1979-01-03T00:00:00.000 | 1979-01-03T00:00:00.000 | http://voparis-srv.o... | USGS | io_leading | satellite | 2.4749999999999997 | 0.6500000000000002 |
| io_leading_txt | spectrum | Io | 1979-01-03T00:00:00.000 | 1979-01-03T00:00:00.000 | https://speclab.cr.u... | USGS | io_leading | satellite | 2.4749999999999997 | 0.6500000000000002 |
| mare_seren_txt | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | https://speclab.cr.u... | USGS | mare_seren | satellite | 2.5999999999999894 | 0.64 |
| mare_seren_vot | spectrum | Moon | 1980-01-01T00:00:00.000 | 1980-01-01T00:00:00.000 | http://voparis-srv.o... | USGS | mare_seren | satellite | 2.5999999999999894 | 0.64 |

Select Jupiter spectra from IRTF and ESO - they are provided in different quantities

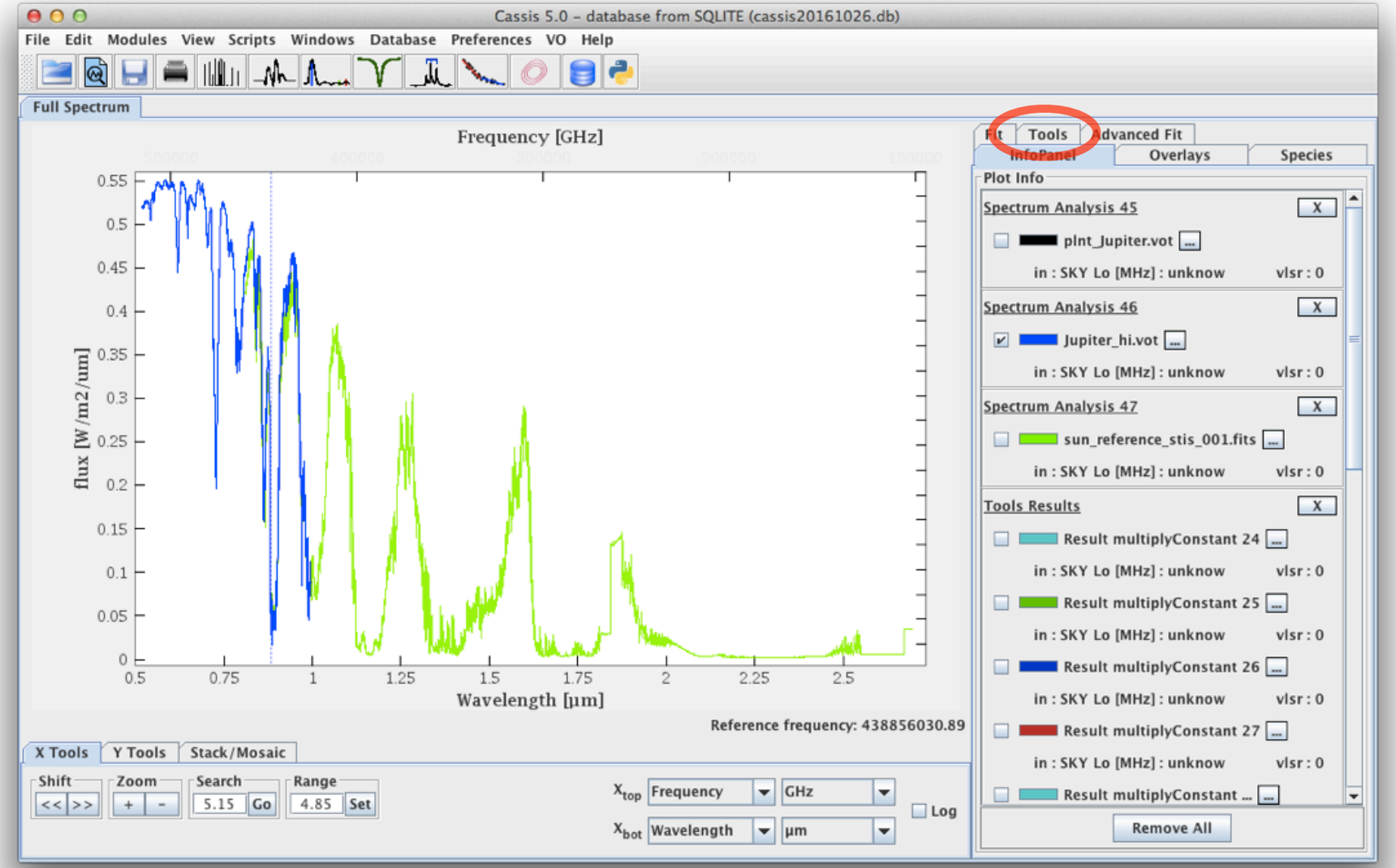
Also select the Colina et al 1996 solar spectrum, send to CASSIS

(pick up only VOtable formats)

# Spectral comparisons of different quantities

## Spectral arithmetics is performed after resampling to a commun wvl vector

In tools tab divide radiance by solar spectrum and mulitply by adequate coefficient

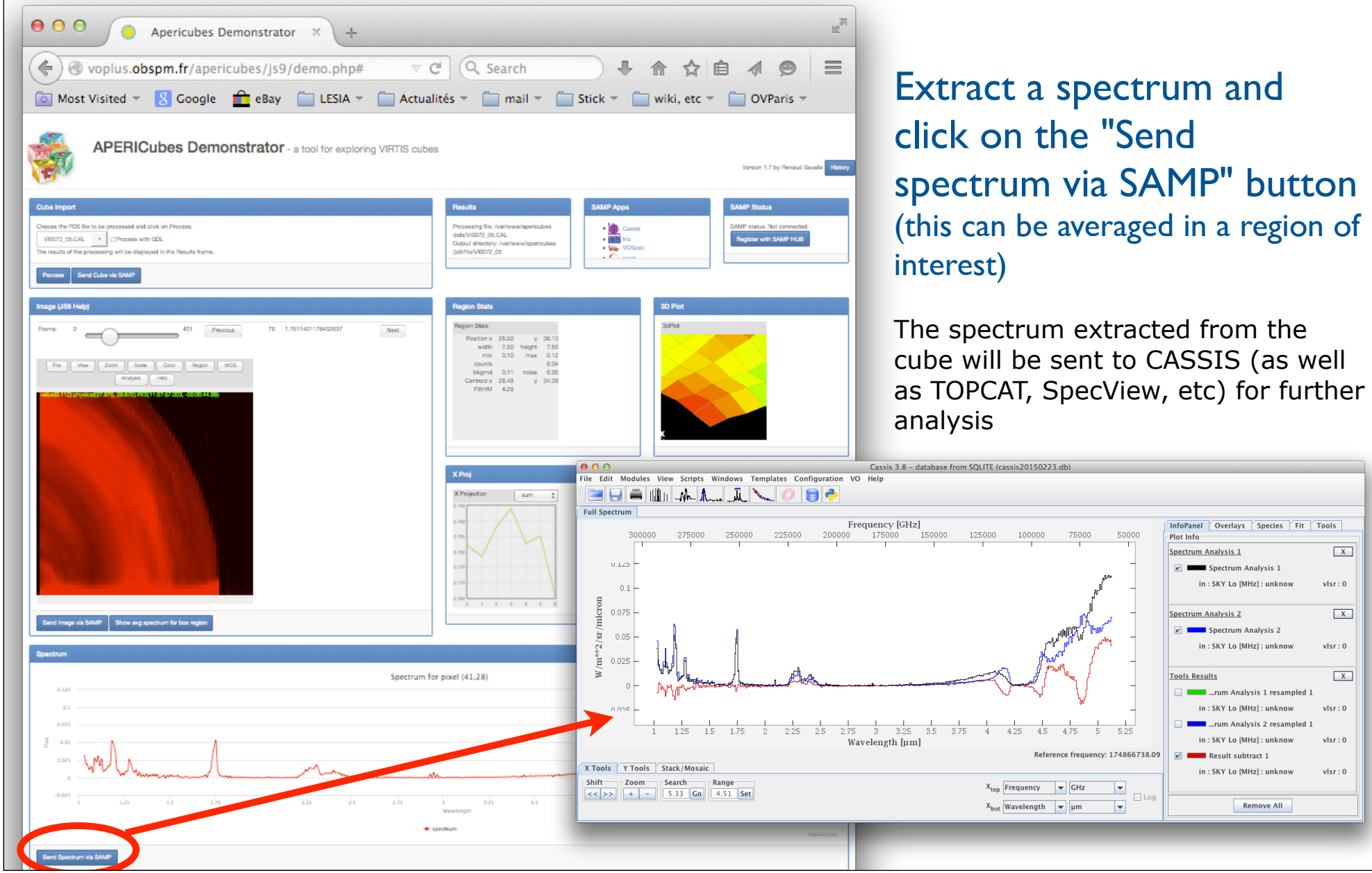



Comparison of IRTF (flux) and ESO (reflectance) spectra of Jupiter from service spectro_planets
IRTF spectrum is divided by Colina et al solar spectrum and scaled

# Analyzing spectral cubes with APERICubes & CASSIS

## APERICubes is a PDS spectral cube viewer for the VIRTIS instrument

see Tuto_TopCat_VEx for details - http://voplus.obspm.fr/apericubes/js9/demo.php




## Extract a spectrum and click on the "Send spectrum via SAMP" button

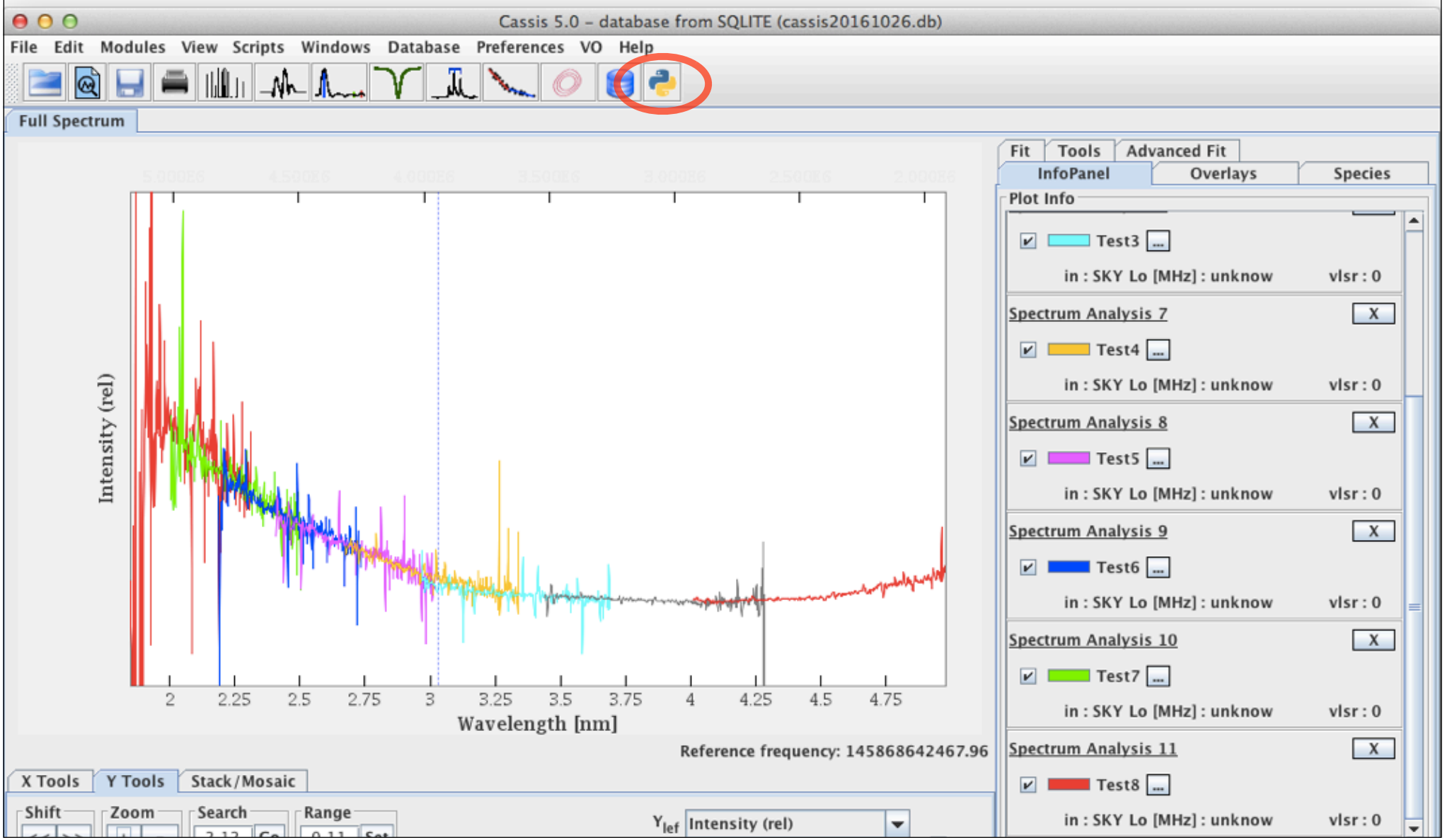
(this can be averaged in a region of interest)

The spectrum extracted from the cube will be sent to CASSIS (as well as TOPCAT, SpecView, etc) for further analysis

# Special uses in CASSIS

## With adequate script CASSIS can plot spectral segments independently

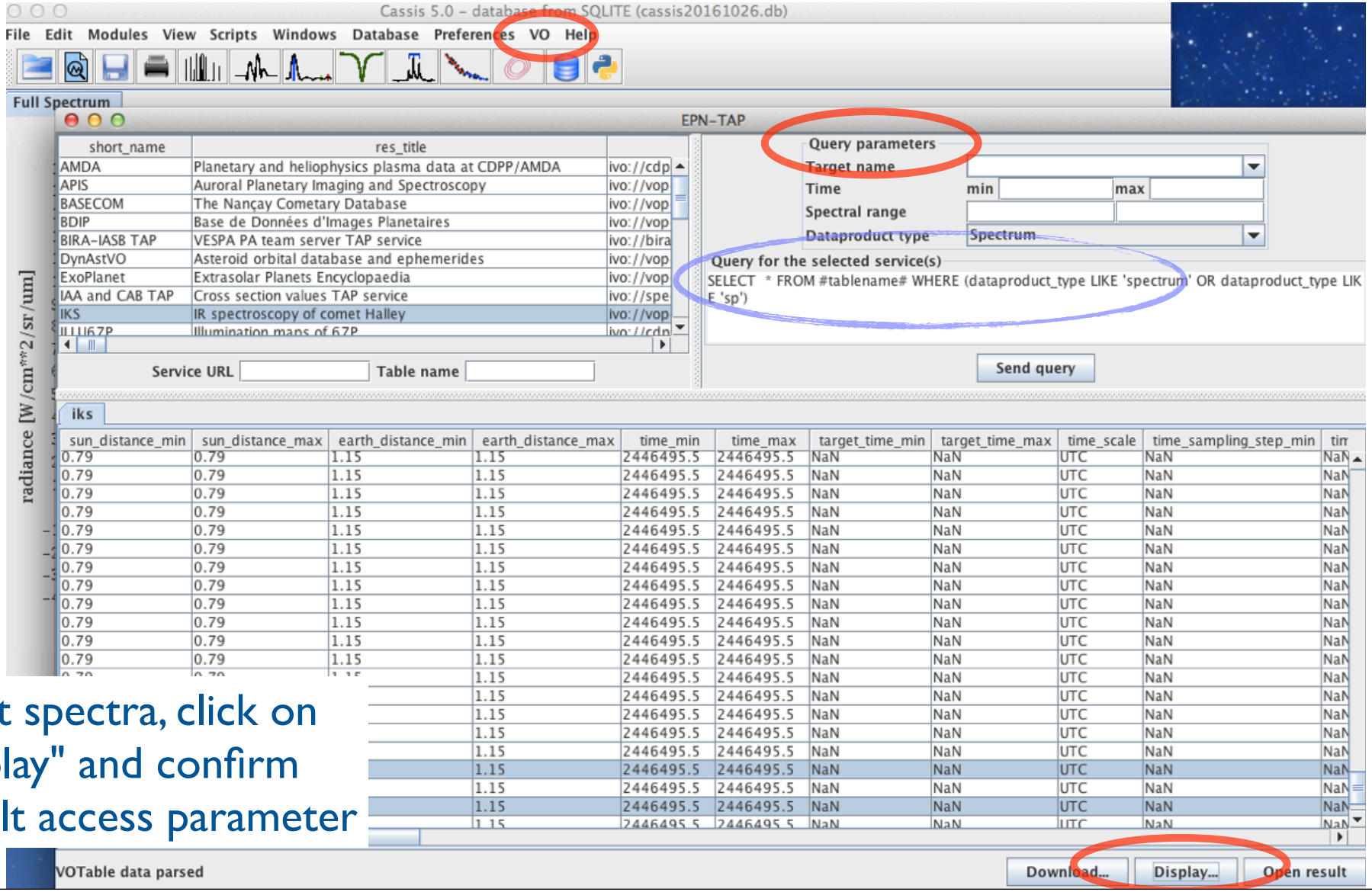
In this case, 8 overlapping spectral orders from VIRTIS-H/Rosetta in the same file
(the default is to merge overlaping regions)



# CASSIS as a VO search tool

## Select EPN-TAP under the VO menu to access VESPA-compliant data services

The ADQL query is filled automatically from exposed parameter fields, but can be edited manually
You can select several services (Comm-click) in the left list to query them together
An SSA client is also available for more general astronomy services (SSA protocol)

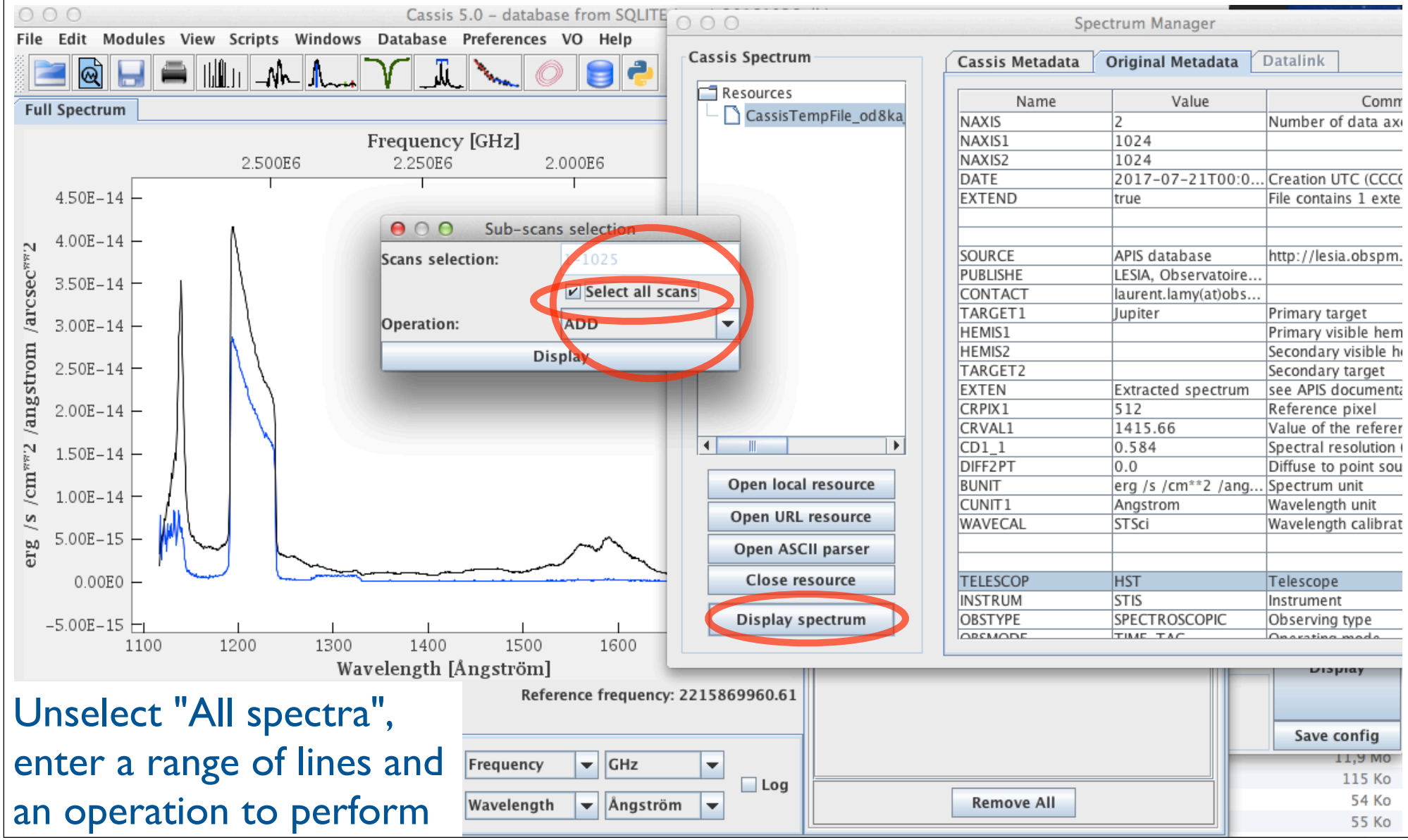



Select spectra, click on "Display" and confirm default access parameter

# CASSIS and spectral series

From the VESPA interface go to APIS service, select a *_proc file in fits format, send via SAMP to CASSIS — a sub-scan selector will open

Those contain series of spectra acquired in sequence ("2D spectra") at various locations on a planet

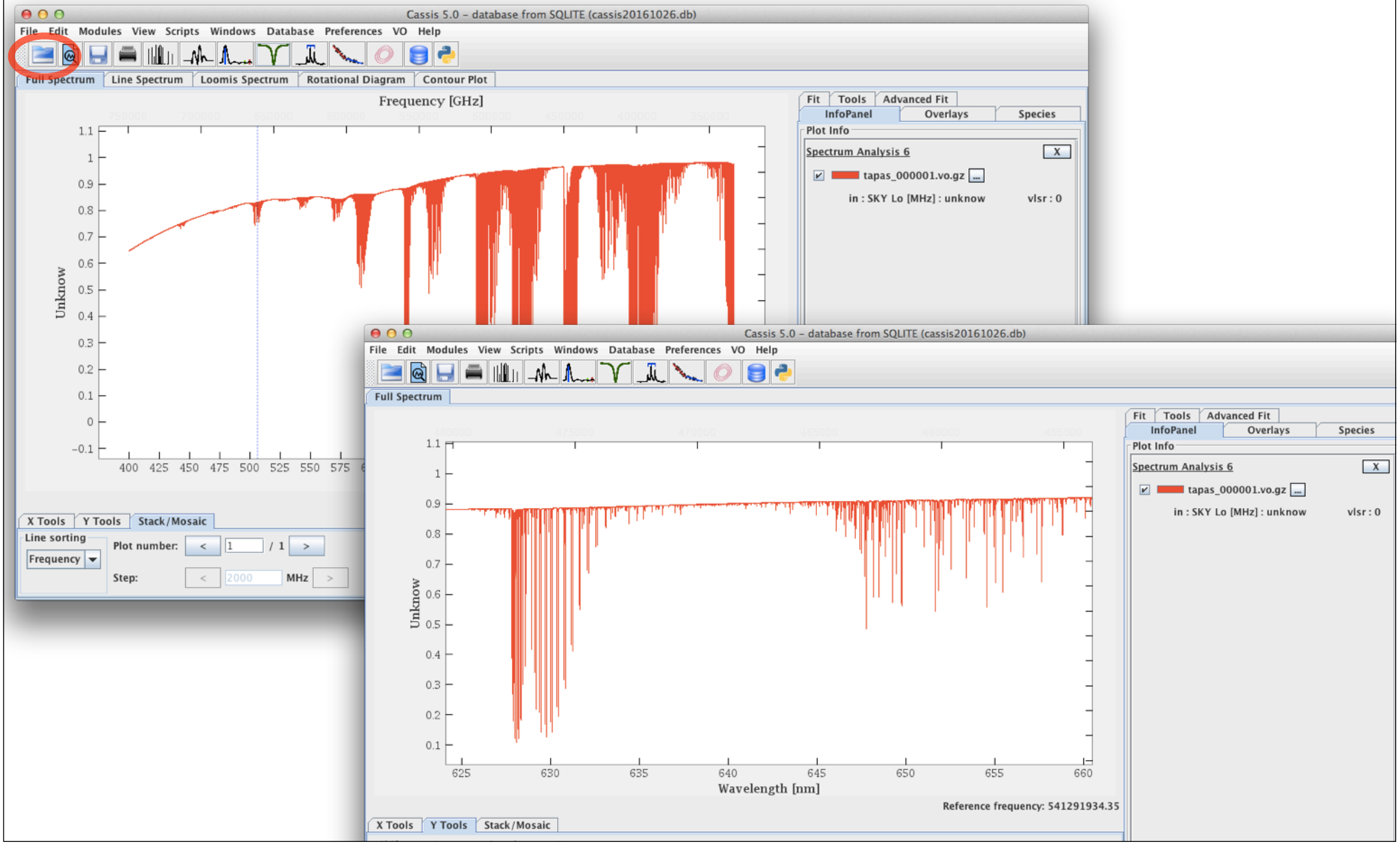



Unselect "All spectra", enter a range of lines and an operation to perform

# Use with external (not VO) services

## Get a simulated Earth atmosphere transmission spectrum from TAPAS

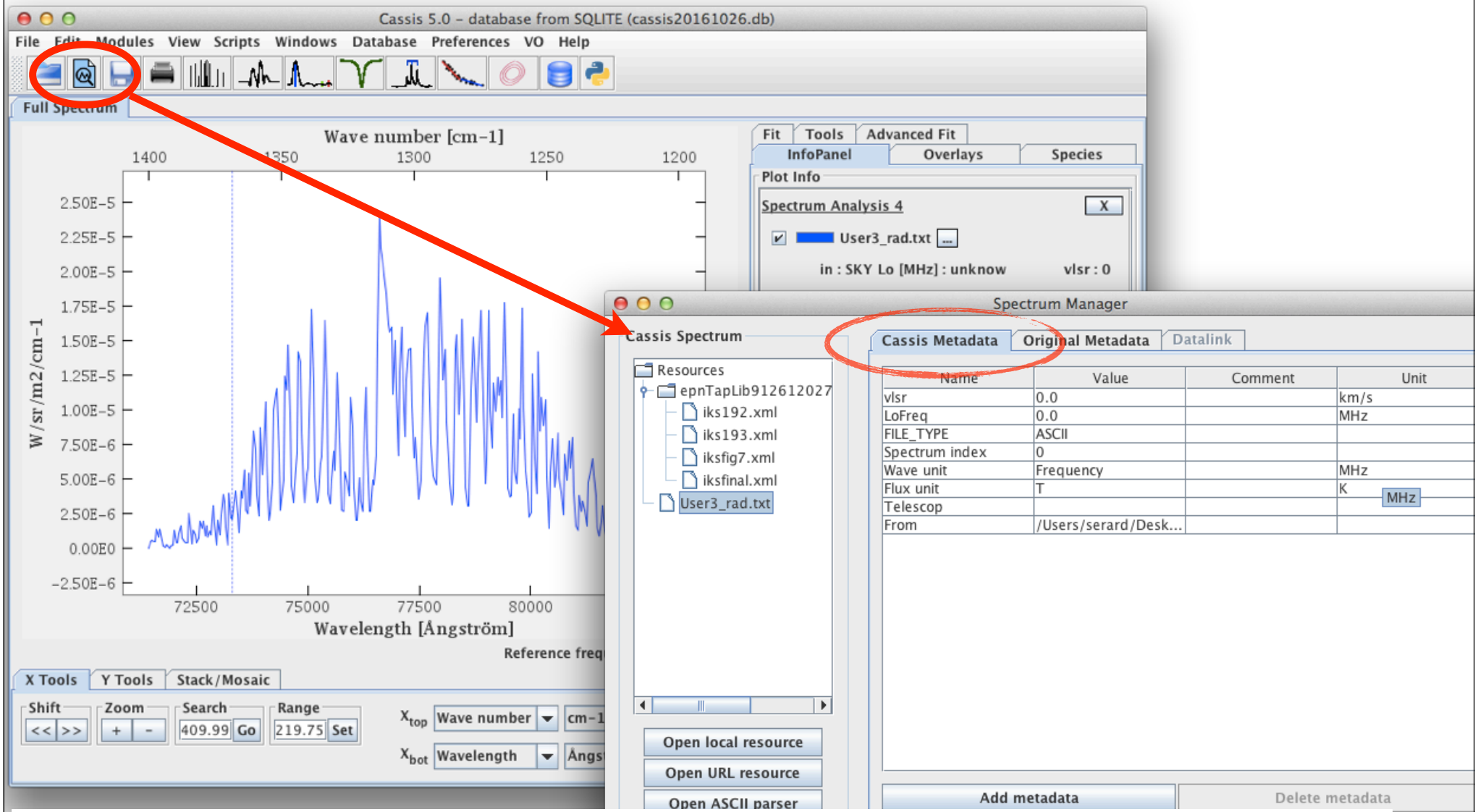
http://www.pole-ether.fr/tapas/ (requires registration) - ask for a VOTable output, open it in CASSIS



# Use with external (not VO) services

## Get a Titan atmosphere spectrum from Planetary Spectrum Generator

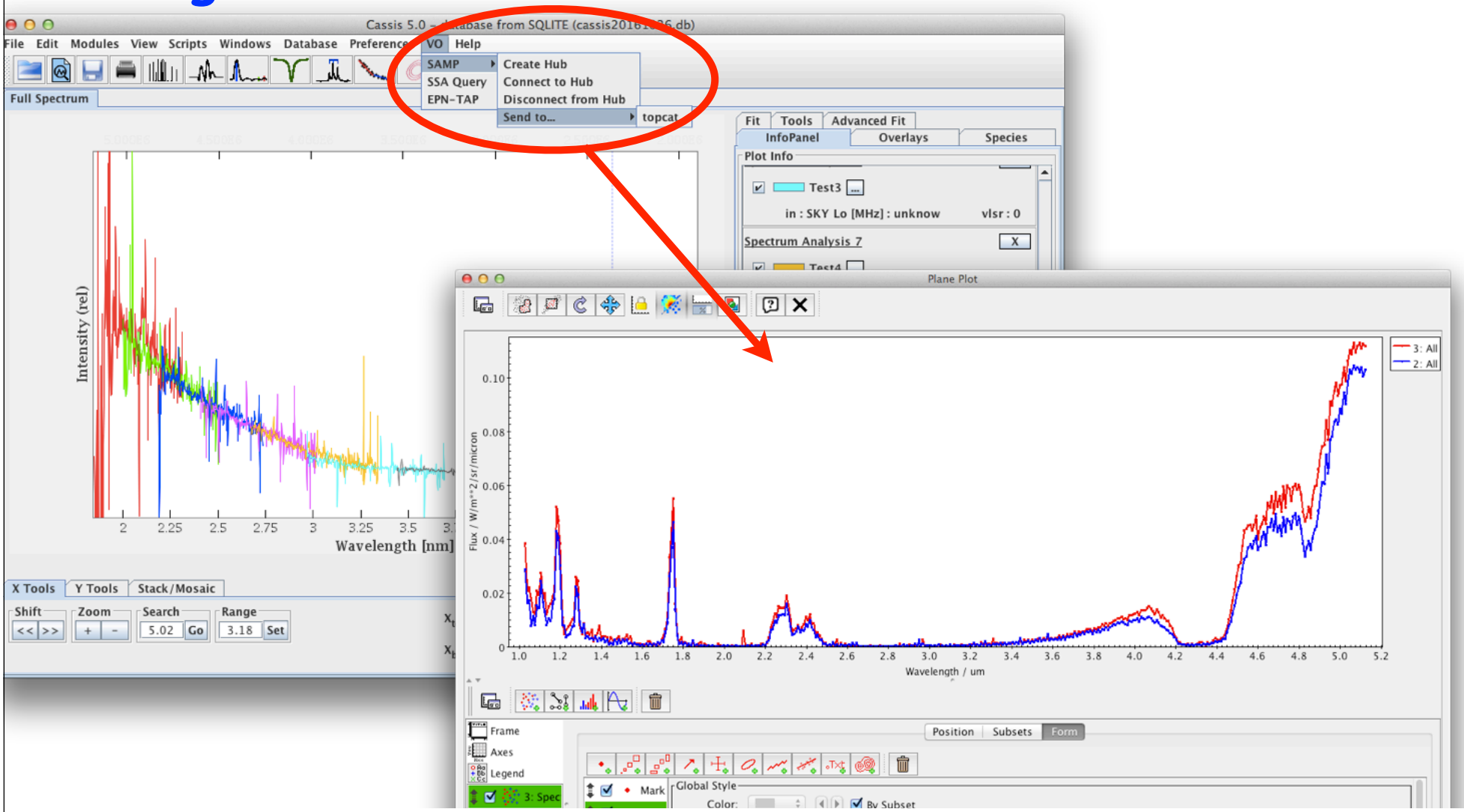
https://ssed.gsfc.nasa.gov/psg/ (requires manual configuration) and retrieve the standard ascii output




## Enter correct quantities and units in CASSIS metadata panel

Click SpectrumManager and go to CASSIS metadata tab, fix wave & flux unit lines as provided in the file

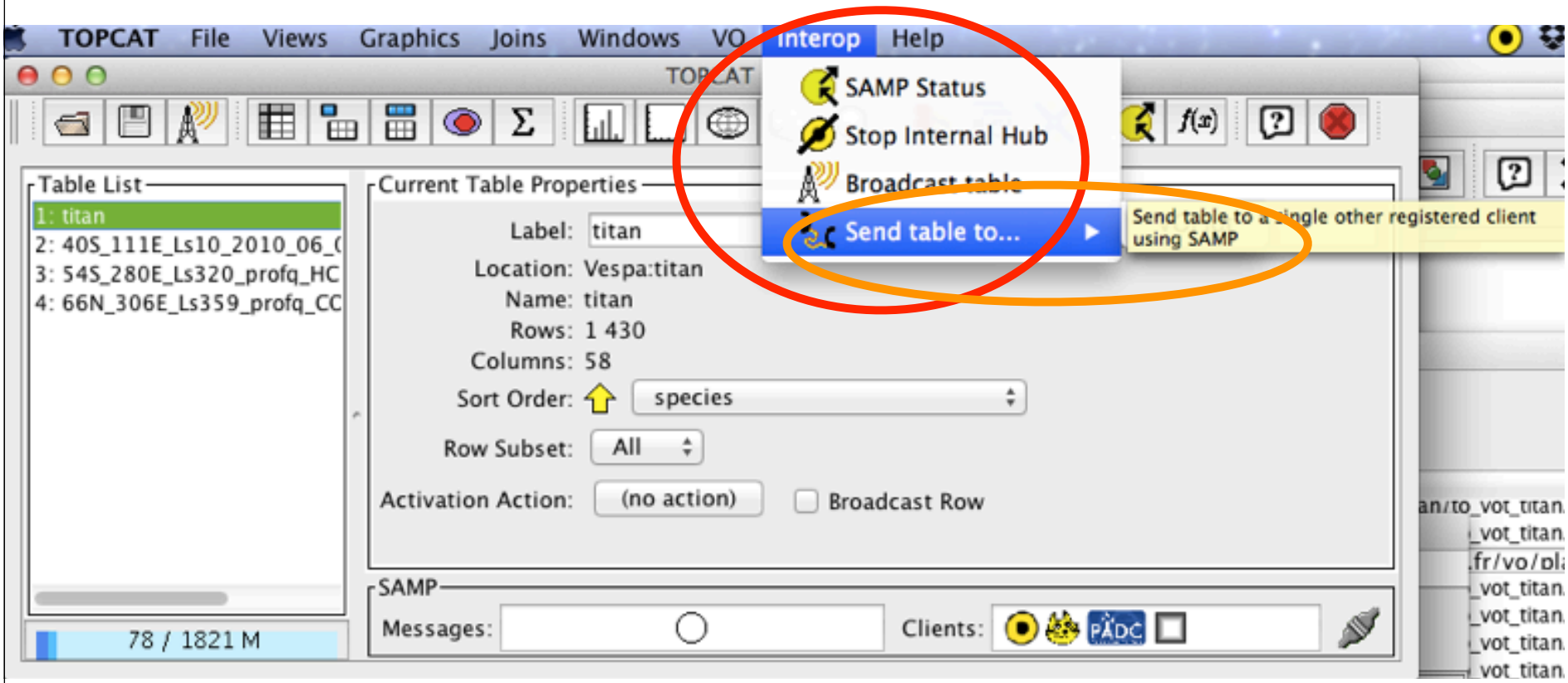
# Sending data from CASSIS




With TOPCAT (or SPLAT-VO, VOspec, SpecView, etc) activated, select SAMP > Send to… > topcat in VO menu

In TOPCAT, click on PlanePlot (units may be converted in the process)

# Sending data from TOPCAT




Use menu item Interop > Send table to.… in TOPCAT

A table is transmitted to other VO ploting tools

Will open in CASSIS if format is adequate (2 columns with known units)

Going through TOPCAT may help ingesting spectral data that do not enter CASSIS easily

# Other relevant tutorials

Tuto_Spectro
EPN-TAP spectroscopy data services in VESPA,
use with various spectral tools

Tuto_TopCat_VEx
Imaging spectroscopy from Venus-Express,
CASSIS interaction with APERICubes

QGIS_plugin
https://github.com/epn-vespa/tutorials/blob/master/vo_qgis_plugin/vo-qgis-plugin.md
Imaging spectroscopy of Mars from CRISM,
sending spectra from TAPhandle or QGIS to CASSIS

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