

## Online tools for planetary sciences - Part II



**rocks**

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# Databases and Data Aggregators



We all need data, we all generate data.

- **Databases**

- Websites, CDS, on request
- Mostly static, single bibliographic reference
- Mixture of formats



# Databases and Data Aggregators

```
$ ls data/
CAPS      demen2006      lol20002023      sergeyev2021
aast      demen2009      lucas2017        shevchenko2022
akari     devogele2018   lucas2019        smss
astdys    ecaa           mahlke2021       splitzer
astorb    emery2011      mahlke2022       svo
atran     emery_brown2003  meteorites       tholen1984
beck2021  eschrig2021    micronegs        timeout_rjuno2024
birlan2007  formater2014   npc              usgs
blanco2023  gaffey1976     nebulae          verma2020B04
burkhardt2017  gals          nux3             vstsmovis
carry2016  gallardo2020   nu6              wang2017
carry_unpublished  gietzen2012   orca             yang_jewitt2007
classy     hat            perna2018        yang_jewitt2011
clowits2011  kaplan2020     popescu2011      zellner1905
dant       lant2017       relab
deloren2018  lant2018       smss4mc
```

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## Data Aggregators

- Collection of data **with processing**
- Dynamic, large number of bibliography references
- Uniform output



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$ ls data/
CAPS      demen2006      lol20002023      sergeyev2021
aast      demen2009      lucas2017        shevchenko2022
akari     devogele2018   lucas2019        smss
astdys    ecaa           mahlke2021       spitzer
astorb    emery2011      mahlke2022       svo
atran     emery_brown2003  mteuilles        thaler1984
becks2021 eschrig2021    micronegs        tinout_rapon2024
birlan2007 formaster2014   npc              usgs
blanco2023 gaffey1976     nebulae          verma2020B04
burkhardt2017 gals          nux3             vstsmovis
carry2016 gallardo2020    nu6              wong2017
carry_unpublished gietzen2012    orex             yang_jewitt2007
classy    hat            perna2018        yang_jewitt2011
clovis2011 kaplan2020     popescu2011      zellner1985
dmlt      lant2017       relab
delon2018 lant2018       smss4mc
```

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- Dynamic, large number of bibliography references
- Uniform output

Data aggregation takes effort but saves time and energy.



# Data Aggregators


NAME	OBJECTS	PARAMETERS	URL
ECOCCEL	Asteroids	Physical, Orbital	<a href="http://www.ecocel-database.com/">http://www.ecocel-database.com/</a>
JPL SBDB	Asteroids, Comets	Physical, Orbital	<a href="https://ssd.jpl.nasa.gov/tools/sbdb_lookup.html">https://ssd.jpl.nasa.gov/tools/sbdb_lookup.html</a>
Lowell	Asteroids	Physical, Orbital	<a href="https://asteroid.lowell.edu/astinfo/">https://asteroid.lowell.edu/astinfo/</a>
MP3C	Asteroids	Physical, Orbital	<a href="https://mp3c.oca.eu/">https://mp3c.oca.eu/</a>
NEOExchange	Near-Earth Objects	Orbital	<a href="https://neoexchange.lco.global/">https://neoexchange.lco.global/</a>
SiMDA	Asteroids, Comets	Size, Mass, Density	<a href="https://astro.kretlow.de/simda/">https://astro.kretlow.de/simda/</a>
SsODNet	Asteroids	Physical, Orbital	<a href="https://ssp.imcce.fr/forms/ssocard">https://ssp.imcce.fr/forms/ssocard</a>

# Demo

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The next slides show an outline of the demoed material.

# Demo


**Lowell Minor Planet Services**  
 Access to astorbDB and tools

[UpObjects](#)
[CribLists](#)
[AstEph](#)
[AstInfo](#)
[AstObs](#)
[AstFinder](#)
[QueryBuilder](#)
[Comets](#)
[astorb.dat](#)

## Asteroid Information

Use this tool to query available orbital and physical properties of asteroids.

Query object by name / number ->

Number	Name	Primary Designation	Alternation Designation(s)	Dynamical Family
221	Eos	Eos	A882 BA	Eos

**Orbital + Physical Parameters**

Elements		Albedo/Diameter		Survey		# Obs.	# Bands	Technique	Ref.
Epoch	2823-12-22T00:00:00	Albedo	$\pm$	Diam. (km)	$\pm$				
Type	mbs,outer_belt	0.131	$\pm 0.005$	187.74	$\pm 1.51$	6	2	Mid IR photometry	<a href="#">🔗</a>
a	3.012	0.14	$\pm 0.01$	183.87	$\pm 3.6$	15	3	Infrared Astronomical Satellite (IRAS)	<a href="#">🔗</a>
e	0.182	0.182	$\pm 0.023$	91.197	$\pm 2.213$	68	4	Mid IR photometry	<a href="#">🔗</a>
i	10.898	0.166	$\pm 0.013$	95.469	$\pm 1.684$	24	2	Mid IR photometry	<a href="#">🔗</a>
M	216.969	0.14	$\pm 0.042$	94.925	$\pm 22.238$	32	2	Mid IR photometry	<a href="#">🔗</a>
Peri	192.558	0.151	$\pm 0.082$	87.123	$\pm 21.393$	31	2	Mid IR photometry	<a href="#">🔗</a>
Node	141.732								
H	7.788								

**Taxonomy**

Type	System	Survey	Technique	Ref.
S	Tholen_ECAS	Tholen (1989)	Visible photometry	<a href="#">🔗</a>
5	Barucci_Gmode	Barucci et al. (1987)	Visible photometry, Mid IR photometry	<a href="#">🔗</a>
K	Tedesco_Sparameter	Tedesco et al. (1989)	Visible photometry, Mid IR photometry	<a href="#">🔗</a>
K	Howell_Neural	Howell et al. (1994)	Visible photometry, Near IR spectroscopy	<a href="#">🔗</a>
K	Bus_SMASSII	SMASSII	Visible spectroscopy	<a href="#">🔗</a>
K	Bus-DeMao	DeMao et al. (2009)	Near IR spectroscopy	<a href="#">🔗</a>
K	Bus-DeMao	MITHNEOS	-	<a href="#">🔗</a>

**Orbit**

Arc	137.554
First Observed	1885-11-26
Last Observed	2823-06-18
# Apparitions	68
# Obs. Used	3971
Orbit Quality	6.95
T <sub>J</sub>	3.2141


**Colors**

16:08:10 UTC 09:08 MST 13:08 GMT-3 06:08 HST [astorb Citation](#) [Status](#) [Docs](#) [FAQ](#) [f](#) [t](#) [@](#) [v](#)

Bibliographic references -&gt;

<https://asteroid.lowell.edu/>

# Demo


**MP3C**
[Search](#)
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[Documentation](#)
[Citations](#)
[Contact](#)

Ceres

Eos

00221, 1882BA, 182B00A

^ Query object by name / number

All data for this body: [vot] <- Static URL to results in VOTable

MPC data

Name (number)	Eos (221)	$n_{obs}$	3325
Packed designation	00221	$n_{app}$	71
a	3.00997	Years observed	1885-2022
e	0.10228	rms	0.61
i / sin(i)	10.8932 / 0.18898		
q	2.70211		
Q	3.31784		
$\omega$	192.3274		
Node	141.7334		
m	85.1583		
n	0.1887		
Epoch	2459600.5		

Orbital + Physical Parameters

Best values

[raw, vot]

	Value	Standard error		Value	Standard error
Parent	Eos (221)		G	0.150	
$a_p$	3.013		H	7.800	
$e_p$	0.074		Mass	1.133e+18	3.650e+17
$\sin(i_p)$	0.172		D	100.15	0.878
			pV	0.147	0.0055

Family data

[raw, vot]


Parent	Parent name	Family ID	Family name	C <sub>J</sub>	Author	Reference	Method
221	Eos	606	Eos	-2.3700	Nesvorny	doi.org/10.26033/6cg5-pt13	HCM-2020-08-14

Bibliographic references

<https://mp3c.oca.eu/>



# Demo


**MP3C**

[Search](#)
[Plots](#)
[Documentation](#)
[Citations](#)
[Contact](#)

Ceres

## Plots

This form lets you plot 2- or 3-axis graphs (X, Y and optional marker color) from the MP3C data by selecting the axes. It allows for filtering of the data by several criteria.

[Example query](#)
Fast and versatile 2D plots + histograms

### Filter rules

**Names list (optional):**

**Numbers list (optional):**

**Parents (families) list (optional):**


Include "0" to match bodies not in any family.

**Parent names list (optional):**


Include "None" to match bodies not in any family.

### Constraints on quantities (optional):

0	≤	D	≤	10	Clear
	≤	---	≤		Clear
	≤	---	≤		Clear
	≤	---	≤		Clear
	≤	---	≤		Clear

[More](#)

### Axes


**X axis:**

**Y axis:**

**Color axis (optional):**

<https://mp3c.oca.eu/xyz-plot/>


# Demo

 Formulaires de calcul d'éphémérides

## SsoCard

This form allows to display the best estimates of the dynamical and physical properties of the small bodies of the solar system, namely *ssoCard*, compiled by the SsODNet service.

[DOCUMENTATION](#)

 Solar system objects : Eos (Asteroid) ^

Asteroids and dwarf planets

Eos (Asteroid) <- Query objects by name / number

✓ Désignation officielle du corps

SEARCH

Orbital + physical parameters, references, static URL to JSON format

(221) Eos

Type: Asteroid  
Class: MB>Outer  
Parent body: Sun  
Dynamical system: Sun

COPY LINK

EXPORT

Dynamical parameters ^

<https://ssp.imcce.fr/forms/ssocard>

# Demo

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[Orbits & Ephemerides](#)
[Planets](#)
[Planetary Satellites](#)
[Small Bodies](#)
[Tools](#)
[Extras](#)

[Home](#) / [Tools](#) / Small-Body Database Lookup

## 67P/Churyumov-Gerasimenko

Classification: Jupiter-family Comet [NEO]   
 SPKID: 1000012   
 Related Links: [Ephemeris](#)

[Orbit Viewer](#) [\[show\]](#)

[Orbit Parameters](#) [\[hide\]](#)

Select Orbit:

### Osculating Orbital Elements

Epoch 2457305.5 (2015-Oct-10.0) TDB  
 Reference: [\[J2000\]](#) (heliocentric IAU76/J2000 ecliptic)

Element	Value	Uncertainty (1-sigma)	Units
<b>e</b>	0.6409081297452731	2.7466E-8	
<b>a</b>	3.462249488233078	1.5491E-7	au
<b>q</b>	1.243265644018067	9.8838E-8	au
<b>i</b>	7.040295031286642	2.7143E-6	deg
<b>node</b>	50.13557349079007	2.2796E-5	deg
<b>peri</b>	12.79825003360463	2.3023E-5	deg
<b>M</b>	8.859927433499202	2.7804E-6	deg
<b>tp</b>	2457247.588657805554	1.7755E-5	TDB
	2015-Aug-13.08865781		
<b>period</b>	2353.076065970291	.00015792	d
	6.442371159398469	4.3236e-7	y
<b>n</b>	0.1529912293130881	1.0268E-8	deg/d
<b>Q</b>	5.68123332448069	2.5419E-7	au

### Miscellaneous Details

<b>solution date</b>	2023-May-04 10:48:55
<b># obs. used (total)</b>	8608
<b>data-arc span</b>	5442 days (14.90 years)
<b>first obs. used</b>	2008-06-01
<b>last obs. used</b>	2023-04-26
<b>planetary ephem.</b>	DE441
<b>SB-pert. ephem.</b>	SB441-N16
<b>condition code</b>	0
<b>norm. resid. RMS</b>	.55098
<b>source</b>	JPL
<b>producer</b>	Davide Farnocchia
<b>Earth MOID</b>	.256932 au
<b>Jupiter MOID</b>	.0837763 au
<b>T_jup</b>	2.746

### Model Parameters

Parameter	Value	Uncertainty (1-sigma)	Units
<b>A1</b>	1.042492137165642E-9	1.321E-11	au/d^2
<b>A2</b>	-6.739448129852418E-11	2.918E-12	au/d^2
<b>A3</b>	2.957443603656012E-10	1.147E-11	au/d^2
<b>DT</b>	45.6855341067259	1.18	d

### Physical Parameters [\[hide\]](#)

Parameter	Value	Units	Sigma	Reference	Notes
<b>[M1] comet total magnitude</b>	12.9		0.8	K213/5	2 parameter fit from 3526 observations, ...
<b>[K1] comet total magnitude slope</b>	7.5			K213/5	autocomd 3.0e
<b>diameter</b>	3.4	km	0.1	Sierks et al., Science 34...	
<b>GM</b>	662.2e-9	km^3/s^2	0.2e-9	Patzold et al., Nature 53...	

[https://ssd.jpl.nasa.gov/tools/sbdb\\_lookup.html](https://ssd.jpl.nasa.gov/tools/sbdb_lookup.html)

# Data Aggregators

## And the meteorites?

- Meteoritical Bulletin <https://www.lpi.usra.edu/meteor/>
  - Name, classification, fall/find
  - Meteorite Name Checking Utility <https://www.lpi.usra.edu/meteor/metbullcheck.php>
- Antarctic Meteorite Classification Database <https://curator.jsc.nasa.gov/antmet/>
  - Has an API :-)
  - Only records antarctic meteorites :-)

# Data Aggregators

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Need for a meteorite database + API!

# The N-Body Problem

## Graphical User Interfaces do not scale

- Many bodies → Many clicks
- Repeated queries to update data
- Bibliography management

→ Data aggregators need programmatic APIs

## Different degrees of simplification

- Static URLs pointing to text files
- Common service such as the *Table Access Protocol*
- Secondary client such as python packages

```
$ ls data/
CAPS      demo2006      lolzeau2023      sergayev2021
aars      demo2009      lucas2017        shavchenko2022
akari     devogele2018  lucas2019        smass
astdyn    eca3          mahlke2021       spitzer
astorb    emery2011     mahlke2022       svo
atran     emery_brown2003  meteorites       tholen1984
beck2021  eschrig2021   micronega        timeout_runo2024
bislap2007  formasier2014  nsc              usps
bishop2021  gaffey1976    newwise          vernazza2014
burkhardt2017  gala          nls3             vistanovis
carry2016  gallardo2020  nup              wong1937
carry_unpublished  gietzen2012  orex             yano_jewitt2007
classy     hst           perna2018        yano_jewitt2011
clovis2011  kaplan2020    popescu2011      zellner1985
datt       lant2017      rel30
deleon2010  lant201X      sdss4mc
```

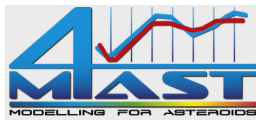


# Tutorial

[20min] Tutorial notebook on data access

- Basic: Programmatic data access with `astroquery` and `rocks`
- Advanced: Analysis of catalogue data with `rocks`
- Expert: Building our own `meteorite`-classification lookup tool

# Spectra Access



# cLassy

- **Spectra are complex data products**
  - Wavelength, Reflectance, Irradiance, ...
  - Instrument Metadata
  - Sample Metadata
- **Spectra Databases for Ast./Comets/Met.**
  - PDS, CDS, RELAB
  - SMASS, MITHNEOS
- **Spectra Aggregators for Asteroids and Meteorites**
  - SSHADE, M4AST, cLassy
  - Processing required
  - Few updates



# Demo

The next slides show an outline of the demoed material.

# M4AST

**Home**

Home Start Analysis Database Login

**M4AST (Modelling for Asteroids)** is a free on-line tool for modeling reflectance visible and near-ir spectra of atmosphereless bodies.

The [old](#) version of M4AST is available [here](#).

M4AST allows to analyse visible and near-infrared spectra of planetary surfaces. There are two ways of using it:

- 1) analyse a spectrum from the database;
- 2) upload your own spectrum (anonymous file submission).

M4AST offers several routines for spectral analysis:

- plotting the data;
- merging spectra;
- taxonomy comparison;
- comparison with laboratory spectra (RELAB database);
- mineralogical modelling.

Acknowledge M4AST tool by citing:

*M4AST - A Tool for Asteroid Modelling*, American Astronomical Society, DPS meeting #48, id.325.17  
Bibliographic code [here](#).

*Modeling of asteroid spectra - M4AST*, Astronomy and Astrophysics, Volume 544.  
Bibliographic code [here](#).

<https://spectre.imcce.fr/m4ast/index.php/index/home>

# classy

## classy

[GitHub](#) · [ReadTheDocs](#)

In Short

1. Upload your spectra
2. Add literature spectra
3. Classify spectra
4. Export classifications

Development of `classy` and the web interface are on-going.

Last update: 2024-01-09

## classy

Welcome to the web interface of `classy`, a tool for the analysis of asteroid reflectance spectra. This interface provides basic functionality. For the full feature set, you can have a look at the `python` package [here](#).

This interface allows to visualise, classify, and export reflectance spectra and their metadata. You can provide your own data, use literature data, or a combination of the two. To get started, just keep scrolling.

### Optional: Upload Your Spectra

Upload CSV files

### Optional: Add literature spectra

Here you can select spectra from the literature to include in your analysis. Write a query and select the spectra to add by marking it in the `select` column.

Query and select from 66572 Spectra

### Classify

Classify

Either upload your spectra or select literature spectra to continue.

← Manage app

<https://classy.streamlit.app/>

# RELAB

## PDS Geosciences Node Spectral Library

Home Search Cart Contribute Data Help

NASA Planetary Data System  
**GEOSCIENCES**  
Washington University in St. Louis

### Search Filters

[Reset All](#)

**Spectral Database**

☒ RELAB 21,379

RELAB Note: Purity or composition of samples sent by users to the NASA RELAB facility are not independently verified by the RELAB spectroscopy facility.

☐ XAS Synthesized Glasses 130

**Keyword Search**

**Chemical Composition**

**Specimen Type**

**Specimen Origin**

**Material State**

**Material Type**

**Material Sub Type**

**Specimen Size**

**Mineral Type**

**Rock Type**

**Measurement Type**

**Reflectance Measurement Range**

### Result List - Filters Applied

Specimens: 13,708/11,733 Measurements: 21,379/21,509

[RELAB](#)

[Add All Results to Cart](#) [Remove All Results to Cart](#)

Legend: Chemistry Thin Section Sample

Page 1 of 235, Items 1 to 90 of 11708

Specimen	Specimen Name	Specimen Description	Measurements
AA-A1S-001	Ammonium anrite (4.001)	Synthesis and characterization of K-free NH4-anrite (Astrobiology)	2
AA-A1S-002	Ammonium anrite (4.002)	Synthesis and characterization of K-free NH4-anrite (Astrobiology)	2
AA-A1S-003	Ammonium anrite (4.004)	Synthesis and characterization of K-free NH4-anrite (Astrobiology)	2
AA-A1S-004	Ni-bearing ammonium anrite (4.005)	Synthesis and characterization of K-free NH4-anrite (Astrobiology)	2
AB-DTB-003	Pathfinder Airbag (Kevlar)	Mars Pathfinder airbag material: Kevlar. About eight layers over one another.	1
AB-EAC-001	Albiteite- ALB101 0 - 45 $\mu$ m	From Minerals Unlimited	3
AB-EAC-001-E	Albiteite- ALB101E	From Minerals Unlimited	1
AC-PCP-001	Basalt- BaG1 0 - 70 $\mu$ m	A fresh unaltered basalt, with some phenocrysts of olivine, pyroxene and plagioclase	6
AC-PCP-002	Basalt- BaG2 70 - 250 $\mu$ m	A fresh unaltered basalt, with some phenocrysts of olivine, pyroxene and plagioclase	1

### Quick View

Compare measurement plots from search results

Expand specimens and click the measurement thumbnails to view plots in the quick view graph. Click the thumbnail a second time to remove it from the quick view.

**Current Plot**

Wavelength (nm)

Reflectance

AA-A1S-001

Move cursor over spectrum to display values

Download Graph Download Measurements

X Min: X Max: Update Graph Reset

Y Min: Y Max: Clear Graph Contents

Display as Wavenumber

<https://sites.brown.edu/relab/relab-spectral-database/>

# SSHADE

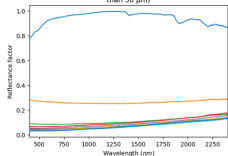
[Help](#) [Log in / Register](#)

## Solid Spectroscopy Hosting Architecture of Databases and Expertise

[Search spectra](#)[Search band lists](#)[Search bands](#)[Search publications](#)**Latest spectra dataset**1 / 5 [←](#) [→](#)

**EXPERIMENT\_CF\_20200813\_000** : VIS-NIR reflectance spectra of binary mixtures of silicon dioxide (SiO<sub>2</sub>) particles (0.5 - 10 μm) and Juniper charcoal particles (less than 50 μm) | BYPASS database 2023-12-07

VIS-NIR reflectance spectra of binary mixtures of silicon dioxide (SiO<sub>2</sub>) particles (0.5 - 10 μm) and Juniper charcoal particles (less than 50 μm)

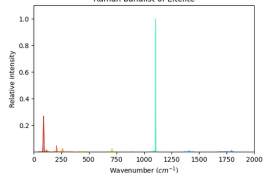


— VIS-NIR reflectance spectrum of pure silicon dioxide (SiO<sub>2</sub>, 0.5 - 10 μm)  
— VIS-NIR reflectance spectrum of a binary mixture of silicon dioxide and Juniper charcoal (10 wt.%)  
— VIS-NIR reflectance spectrum of a binary mixture of silicon dioxide and Juniper charcoal (20 wt.%)

**Latest bandlists dataset**1 / 5 [←](#) [→](#)

**BANDLIST\_RAMAN\_Eitelite** : Raman bandlist of Eitelite 2023-12-27

Raman bandlist of Eitelite



<https://www.sshade.eu>

## SSHADÉ

Window TAP Registry Edit Interop Help

Select Service Use Service Resume Job Running Jobs

Metadata

Find:

☒ Name ☐ Descrip ☐ Or

Service	Schema	Table	Columns	Keys	Hints
DSUG TAP [7]	home	granule_id	char(4)		Internal table row index, which must be unique within the table. Can be alphanumeric.
		granule_gid	char(4)		Common to granules of same type (e.g. same map projection, or geometry data products). Can be alphanumeric.
		obj_id	char(4)		Associates granules derived from the same data (e.g. various representations/processing levels). Can be alphanumeric, may be the ID of an...
		dataproduct_type	char(4)		The high-level categorization of the data product, from a controlled vocabulary (e.g., im for image, sp for spectrum). Multiple terms may be us...
		target_name	char(4)		Standard IAU name of target (from a list related to target class), case sensitive
		target_class	char(4)		Type of target, from a controlled vocabulary
		time_min	double	d	Acquisition start time (in J2000 as UTC at time of reposition)
		time_max	double	d	Acquisition stop time (in J2000 as UTC at time of reposition)
		time_sampling_step_min	double	s	Sampling time for measurements of dynamical phenomena, lower limit
		time_sampling_step_max	double	s	Sampling time for measurements of dynamical phenomena, upper limit
		time_exp_min	double	s	Integration time of the measurement, lower limit
		time_exp_max	double	s	Integration time of the measurement, upper limit
		spectral_range_min	double	Hz	Spectral range (frequency), lower limit
		spectral_range_max	double	Hz	Spectral range (frequency), upper limit
		spectral_sampling_step_min	double	Hz	Spectral sampling step, lower limit
		spectral_sampling_step_max	double	Hz	Spectral sampling step, upper limit
		spectral_resolution_min	double		Spectral resolution, lower limit
		spectral_resolution_max	double		Spectral resolution, upper limit
		c1_min	double	deg	Longitude on body, lower limit
		c1_max	double	deg	Longitude on body, upper limit
		c2_min	double	deg	Latitude on body, lower limit
		c2_max	double	deg	Latitude on body, upper limit
		c3_min	double	km	Altitude from reference surface, lower limit
		c3_max	double	km	Altitude from reference surface, upper limit
		s_region	char(4)		Obscure-like footprint, valid for celestial, spherical, or body-fixed frames
		c1_resol_min	double	deg	Resolution in the first coordinate, lower limit
		c1_resol_max	double	deg	Resolution in the first coordinate, upper limit
		c2_resol_min	double	deg	Resolution in the second coordinate, lower limit
		c2_resol_max	double	deg	Resolution in the second coordinate, upper limit
		c3_resol_min	double	km	Resolution in the third coordinate, lower limit
		c3_resol_max	double	km	Resolution in the third coordinate, upper limit
		spatial_frame_type	char(4)		Flavor of coordinate system, defines the nature of coordinates. From a controlled vocabulary, where 'none' means undefined.

Service Capabilities

Query Language: ADQL-2.0 Max Rows: 20000 (default) Uploads: 20MB

ADQL Text

Mode: Synchronous

1

SELECT \* FROM sshade\_spectra\_apn\_core

Examples

Info ID

TOPCAT → TAP Query → “SSHADÉ”

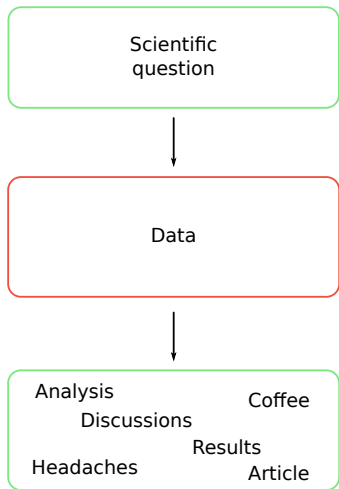
# Tutorial

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[20min] Tutorial notebook on spectra access with SSHADE and TAP

- Basic: Access of SSHADE database using TAP
- Advanced: Creating an astroquery module for SSHADE

## Re: A typical research project



### Repetitive (and tedious) tasks!

- **Planning and conduction of observations**
  - Observations already exist?
  - Target/sample available? visible?
- **Gathering ancillary data for the analysis**
  - Complementary information diameter, fall/find, ...
  - Context for research another population
- **Repetitive low-level analysis**
  - Spectral classification
  - Cross-matches & merges



## Online resources in a nutshell

- A suite of pages, libraries, and services
  - **Providers:** data archives, catalogs, online codes
  - **Clients:** GUI, CLI, analysis tools
  - Check IVOA: <http://ivoa.net/astronomers/applications.html>

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- It is **not** a one size fits all
- Resources are made **by us**, and **for us**
  - Powerful libraries and tools
  - Good practice to release data/codes Consider CDS at the very least
  - Contribute to open-source projects: `astroquery`, `sbpy`, `rocks`, ...