

MP<sup>3</sup>C

# MINOR PLANETS PHYSICAL PROPERTIES CATALOGUE

P. TANGA

LABORATOIRE LAGRANGE  
OBSERVATOIRE DE LA CÔTE D'AZUR



Observatoire  
de la CÔTE d'AZUR



# MP<sup>3</sup>C

- Service OV développé à partir de 2012 (<http://mp3c.oca.eu/>)
  - Initiative de M. Delbo' (CNRS/Lagrange) et P. Tanga (CNAP, OCA)
- Inter-operabilité avec des outils OV (TOPCAT etc.)
- Interface avec les services de l'IMCCE (Obs. de Paris): calcul d'éphémérides
- 17 bases de données gérées actuellement
- Déjà exploitable pour la science
- Labellisé en 2015



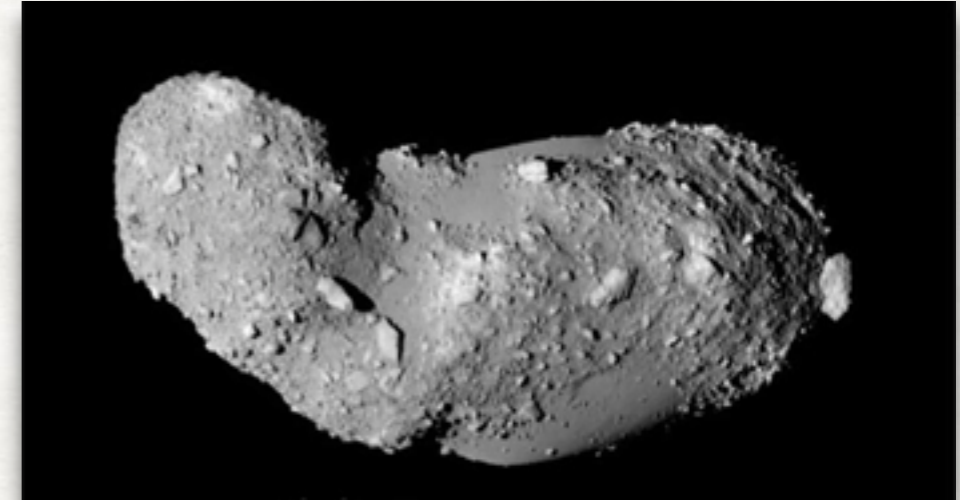
# MOTIVATIONS

- Science

- Grande variété de bases de données
- Difficulté d'une recherche systématique
- Impossibilité d'extraire les données de plusieurs bases au même temps
- Préparation aux grands relevés (Gaia, Pan-STARRS, LSST...)
- Intérêt pour les missions spatiales

- Observatoire Virtuel

- Lien avec d'autres services



Propriétés physiques:

- pôle de rotation
- période de rotation
- taille
- albedo
- type spectrale
- masse
- forme
- ...

# CONTEXTE: AUTRES SERVICES WEB

- Planetary Data System (NASA)
  - Small Bodies Data Ferret
- IMCCE – Observatoire de Paris
- ESA Space Situational Awareness



## Small Bodies Data Ferret

The Ferret is a tool that allows searchable access to all the Small Bodies Node asteroid, comet, and satellite data sets. Use the links below to access the data.

[Find Data By Target Name](#)  
[List All Datasets](#)

### Data Sets

Data sets are sorted based on the type of object that the data set contains. Some data sets may be listed under multiple categories if they contain objects of different types or if they contain objects that are dual natured.

#### ASTEROID

- [24-Color Asteroid Survey \(EAR-A-DBP-3-RDR-24COLOR-V2.1\)](#)
- [2MASS Asteroid and Comet Survey V2.0 \(EAR-A-I0054/I0055-5-2MASS-V2.0\)](#)
- [52-Color Asteroid Survey \(EAR-A-RDR-3-52COLOR-V2.1\)](#)
- [Asteroid Absolute Magnitudes V12.0 \(EAR-A-5-DDR-ASTERMAG-V12.0\)](#)
- [Asteroid Albedos from Stellar Occultations V1.0 \(EAR-A-VARGBDET-5-OCCALB-V1.0\)](#)
- [Asteroid Dynamical Families V4.1 \(EAR-A-5-DDR-FAMILY-V4.1\)](#)
- [Asteroid Lightcurve Derived Data V13.0 \(EAR-A-5-DDR-DERIVED-](#)



esa

space situational awareness



European Space Agency

ESA

SSA

SST

SWE

NEO

01-Jul-2013

- NEO Home ▶
- Risk Page ▶
- Search for Objects** ▶
- Priority List ▶
- Close Approaches ▶
- Orbit Visualizer ▶
- Physical Properties ▶
- Comets ▶
- Discovery Statistics ▶
- Image Database ▶
- Fireball Database ▶
- Additional Information**
- Image Upload ▶
- Subscribe to Services ▶

Last update: 2013-07-01 00:07 UTC

### Search for Objects

Current number of known NEAs:

**9913**

Current number of known asteroids with good orbital information:

**484003**

Name/Designation

NEAs only

All Asteroids

Search

### Orbit properties

	Min	Max	Min Uncert.	Max
Semimajor Axis	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Eccentricity	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Inclination	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Ascending Node	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Arg. of Perihelion	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Mean Anomaly	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Epoch	<input type="text"/>	<input type="text"/>		
Perihelion	<input type="text"/>	<input type="text"/>		
Aphelion	<input type="text"/>	<input type="text"/>		

### Total number found: 12

- 1998DK36
- 2004JG6
- 2005TG45
- 2006WE4
- 2007EB26
- 2008EA32
- 2008UL90
- 2010XB11
- 2012VE46
- 2013JX28
- 163693 Atira
- 164294 2004XZ130

AU

AU



# AUTRES BASES DE DONNÉES

- Formes
  - DAMIT (Université de Prague)
  - Université de Poznan
- Courbes de lumière
  - Asteroid Photometric Catalog (Univ. Helsinki)
  - CdR, Obs. de Genève
- Astéroïdes binaires
  - Johnston archive
- Données dynamiques (orbites, familles...)
  - AstDYS (Univ. de Pise)
  - Minor Planet Center
- ...



The screenshot shows the DAMIT website. At the top, it says "DAMIT Database of Asteroid Models from Inversion Techniques - more about DAMIT". On the left is a navigation menu with sections: Project (Main page, About), Database (Search, Browse, Export, Description, References, Tumblers), and Download (Software). The main content area is titled "Project - Main page" and includes a "Statistics" box stating "The database contains 1592 models for 907 asteroids". Below this are links for "Models visualisation" and "Asteroids@home". A secondary navigation menu is also present at the bottom of the main content area.



The screenshot shows a page titled "Asteroids with Satellites" by Wm. Robert Johnston, last updated 6 March 2016. It features an image of an asteroid with a satellite. The "Contents" section lists several links: "List of binary asteroids/TNOs" (with links to specific data pages), "Tables of data on binary asteroids and other reports of asteroid/TNO companions (separate pages)", "General discussion", "Images and figures regarding binary asteroids/TNOs (separate pages)", and "Links - lists, databases, articles, etc." (including a link to ADS abstracts). Below this is a section titled "List of binary asteroids/TNOs - by class or by designation, with orbital class of object in parenthesis" and a link to list by date of announcement of detection. The page is divided into two columns: "by dynamical class" (listing near Earth objects like (1862) Apollo, (1850) Sisyphus, (3671) Dionysos, (5143) Heracles, (5381) Sekhmet, (5680) 1990 TR, (7080) Ishtar, (7880) 1990 LC, and (31345) 1998 PG) and "by designation" (listing (134340) Pluto, Charon, Nix, Hydra, Kerberos, and Styx; (22) Kalliope and Lissa; (41) Daphne and S/2006 (41) 1; (45) Eugenia, P66-Prince, and S/2004 (45) 1; and (87) Sylvia, Romulus, and Remus).

## [HTTP://MP3C.OCA.EU/](http://mp3c.oca.eu/) AUJOURD'HUI:

- bases de données:
  - Minor Planet Center
  - Wide Infrared Survey Explorer
  - Planetary Data System (photometrie, IRAS, MSX, familles, stellar occultations)
  - Sloan Digital Sky Survey
  - Taxonomie (classeur MIT)
  - Diamètres et albedos AKARI
  - European Asteroid Research Node (EARN)
- Interface OV
  - avec TOPCAT
  - Services éphémérides IMCCE
- Retour positif de la part des utilisateurs



## Compositional study of asteroids in the Erigone collisional family using visible spectroscopy at the 10.4 m GTC

David Morate<sup>1,2</sup>, Julia de León<sup>1,2</sup>, Mário De Prá<sup>3</sup>, Javier Licandro<sup>1,2</sup>, Antonio Cabrera-Lavers<sup>1,4</sup>,  
Humberto Campins<sup>5</sup>, Noemí Pinilla-Alonso<sup>6</sup>, and Víctor Alf-Lagoa<sup>7</sup>

### 2. Observations and data reduction

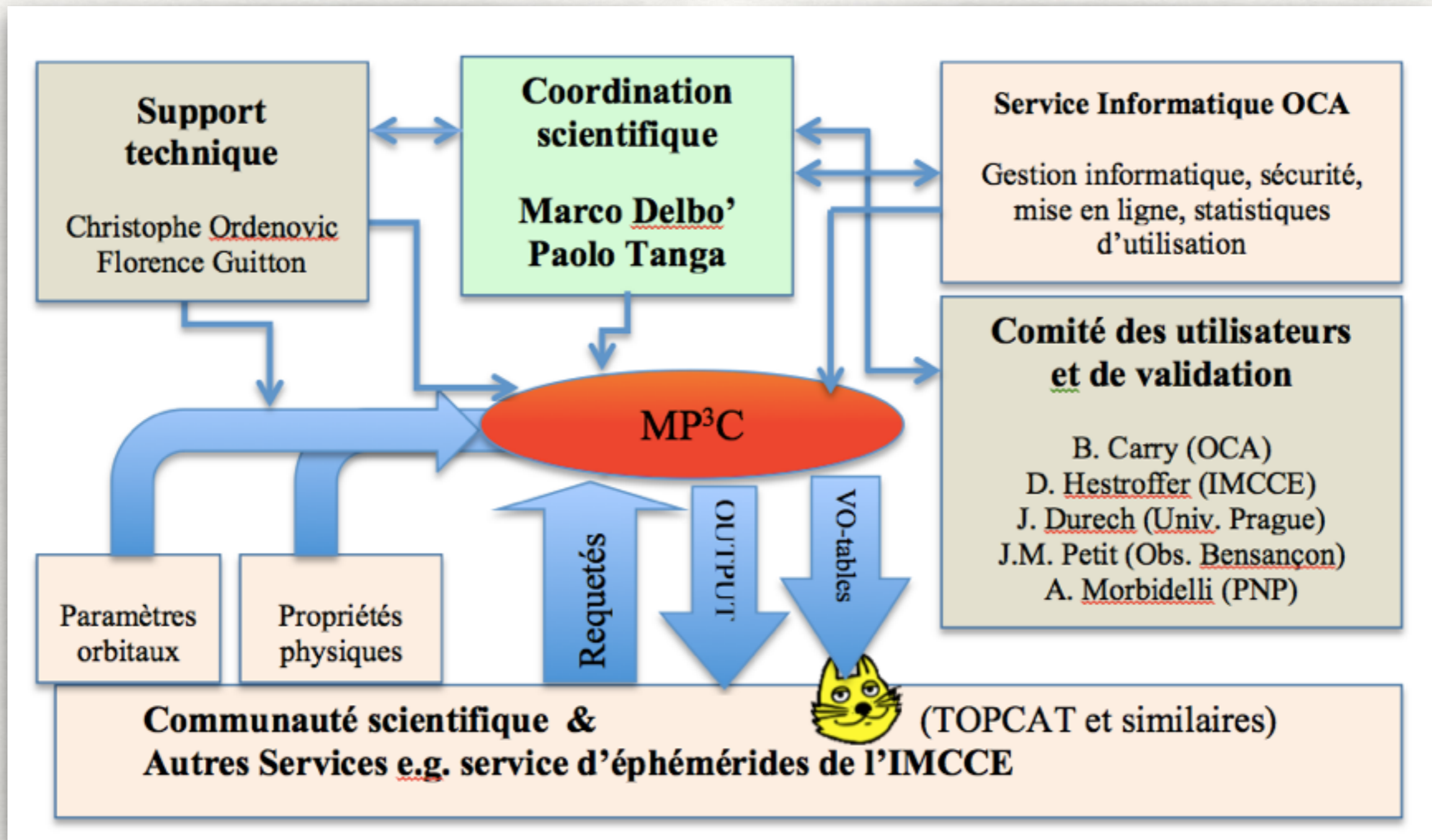
The sample of asteroids we observed in this study has been selected using the **Minor Planet Physical Properties Catalogue<sup>2</sup> (MP<sup>3</sup>C)**, which acknowledges the NASA Planetary Data System (PDS) as a data source. Orbital data of the asteroid families are extracted from a dataset containing asteroid dynamical families including both analytic and synthetic proper elements. These families were computed by David Nesvorný (Nesvorný 2012) using his code based on the hierarchical clustering method (HCM), as described in Zappala et al. (1990) and Zappala & Cellino (1994). The **MP<sup>3</sup>C** catalog also provides information on the absolute magnitude  $H$ , the diameter  $D$ , and the geometric albedo  $p_V$ . For the diameters and albedos we used the values provided by WISE (Wide-field Infrared Survey Explorer, Masiero et al. 2011). Family membership is based on values of the synthetic proper elements, that is, on the semimajor axis ( $a$ ), eccentricity ( $e$ ) and inclination ( $i$ ), and also on the absolute magnitude as a function of semimajor axis ( $a, H$ ). According to these parameters, the Erigone family contains a total of 1785 asteroids.

The selection criterion was quite simple. The Erigone collisional family is a primitive one according to the information we currently have: from the list of 1785 members of the family, 1015 have no albedo information, but from the remaining 770 objects, 692 have geometric albedo values  $p_V < 0.1$ . In addition, 156 objects have SDSS color-based taxonomies, the majority of

<sup>2</sup> <http://mp3c.oca.eu/MP3C/>



# MP3C: GOUVERNANCE ET INTERACTIONS







# MP<sup>3</sup>C : Minor Planet Physical Properties Catalogue



by M. Delbo' and P. Tanga

Laboratoire Lagrange UMR7293, Université de Nice Sophia-Antipolis, CNRS, Observatoire de la Côte d'Azur

implemented by:

J. Gerakis - Observatoire de la Côte d'Azur

[click here to access the service](#)

The aim of this database is to offer a user-friendly interface for exploring large databases of Minor Planets properties. Our ambition is to collect in a single place data of major interest that were scattered among several different databases, with a particular accent on physical properties. The output of our tool is multi-format and can also be exported toward Virtual Observatory utilities such as TOPCAT for subsequent exploitation.

## Sources

We acknowledge the use of the following data sources :

- [IAU Minor Planet Center](#) (photometric, orbital and miscellaneous data)
- [NASA Wide Infrared Survey Explorer](#) (diameter and albedo data)
- [NASA Planetary Data System](#) (object family, proper element and lightcurve data, IRAS and MSX)
- [Sloan Digital Sky Survey](#) (spectroscopic data)
- [MIT Small Mainbelt Asteroid Spectroscopic Survey](#) (classifiers)
- [Data ARchives and Transmission System \(DARTS\)](#) (AKARI diameter and albedo data)
- [European Asteroid Research Node \(EARN Data\)](#)



### Search by Identification

**Designation Number**

Standard, long, or packed (e.g : 105333, D9837, J99D08B...)

**Full Name**

Common name or temporary (e.g : "Pallas", "1995 SY25")

### Search by Physical Parameters

**Absolute Magnitude H**

min :  max :

**Phase Parameter G**

min :  max :

**Albedo pV**

min :  max :

**Diameter (km)**

min :  max :

**Spectral Slope**

min :  max :

**Spectral Color (I-Z)**

min :  max :

**Rotation Period (hour)**

min :  max :

**Classification**

Tholen   SMASS II

### Search by Orbital Parameters

**Inclination**

min :  max :

**Orbital Eccentricity**

min :  max :

**Semimajor Axis (AU)**

min :  max :

### Search by Proper Elements

**Method**

Analytic  Synthetic

**Proper Inclination**

min :  max :

**Proper Eccentricity**

min :  max :

**Proper Semimajor Axis**

min :  max :

**Family**

192692

192692



## Result Display Options

### MPC data

- Full Name
- Photometric Parameters
- Orbital Elements
- R.M.S residual
- Other details

### WISE data

- Size
- Albedo
- Wx

### SDSS data

- Color
- Classification

### PDS data

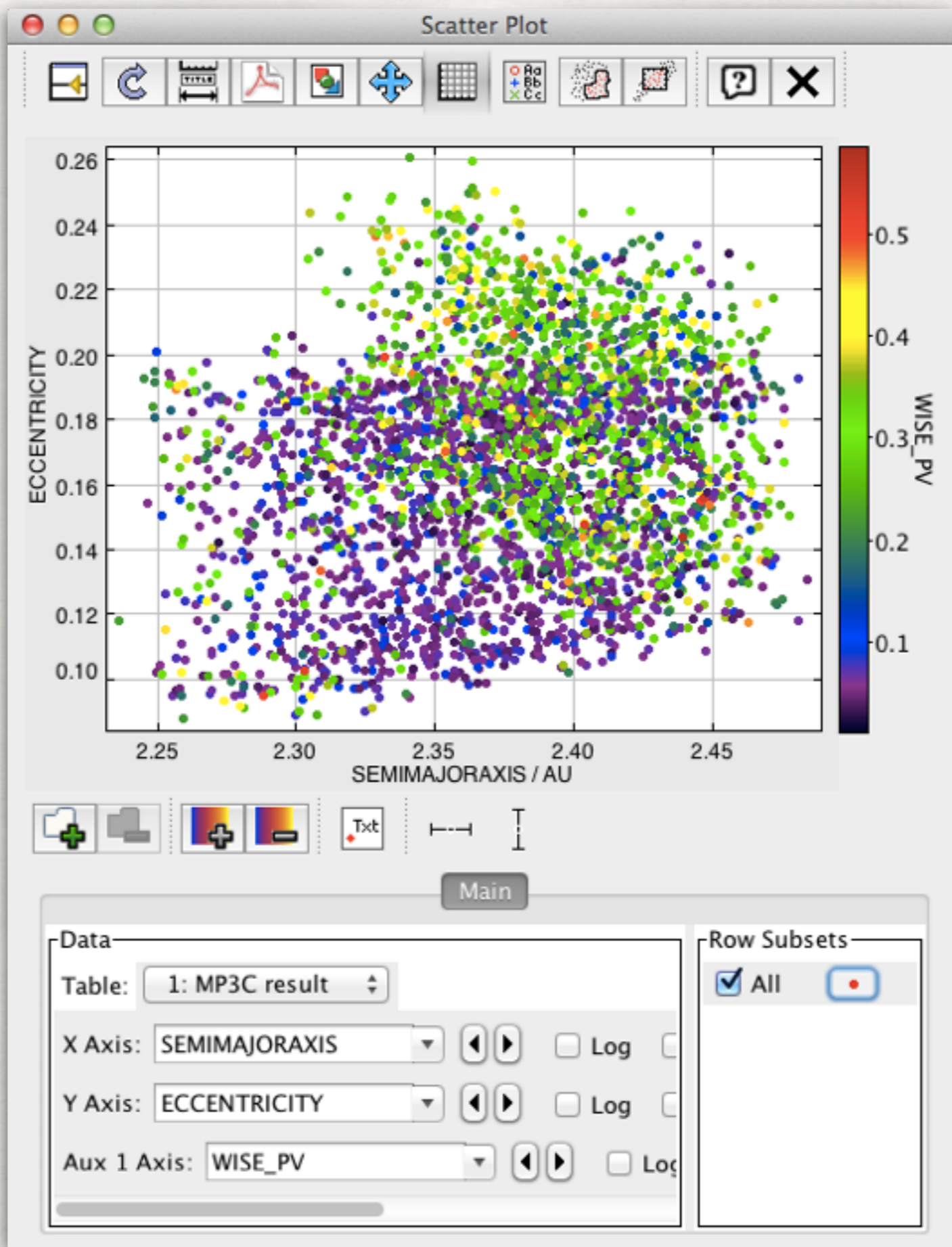
- Rotation and Light Curve
- Proper elements
- Families

### Other data (albedo and diameter)

- AKARI
- IRAS
- MSX







# Virtual Observatory Interoperability

## Export your result

- General result    Satellites only    Occultations only    General + satellites    General + occultations  
 ASCII File    CVS File    VOTable

## Send your result to other VO softwares

Click 'register' to search and connect to an active VO hub (on your local machine)

**Registered:** No

### Registered Clients

## IMCCE Miriade

Check targets with the Miriade tool

All    Selected

Ephemeris    Visibility

Epoch

How many dates?

How many cuts?

Increment

Location  (IAU location codes)

*(the following options matters only for ephemeris computation)*

Type of coordinates :  Spherical    Rectangular    Local    Hour Angle    Dedicated to observation    Dedicated to AO

Type of ephemeris :  Astrometric J2000    Apparent of date    Mean of date    Mean J2000

Reference plane :  Equator    Ecliptic

Ephemeris time scale :  UTC    TT

Planetary theory :  INPOP    DE405



Target	Date	RA "h:m:s"	DEC "d:m:s"	Distance AU	Mv	Phase deg	Elongation deg	dRAcosDEC arcsec/s	dDEC arcsec/s	dist_dot km/s
Eunomia	2013-07-02T10:48:54.00	11 26 40.45295	-08 40 48.4077	3.205034873	11.13	18.45	75.58	0.941E-02	-0.223E-02	23.5525714
Eunomia	2013-07-02T11:48:54.00	11 26 42.73371	-08 40 56.4344	3.205601863	11.13	18.45	75.55	0.938E-02	-0.223E-02	23.5729744
Eunomia	2013-07-02T12:48:54.00	11 26 45.00708	-08 41 4.4626	3.206169600	11.13	18.44	75.53	0.935E-02	-0.223E-02	23.6142633
Eunomia	2013-07-02T13:48:54.00	11 26 47.27428	-08 41 12.4877	3.206738553	11.13	18.44	75.50	0.933E-02	-0.223E-02	23.6733830
Eunomia	2013-07-02T14:48:54.00	11 26 49.53705	-08 41 20.5059	3.207309101	11.13	18.44	75.47	0.931E-02	-0.223E-02	23.7460575

Target	Date	RA "h:m:s"	DEC "d:m:s"	Distance AU	Mv	Phase deg	Elongation deg	dRAcosDEC arcsec/s	dDEC arcsec/s	dist_dot km/s
Massalia	2013-07-02T10:48:54.00	01 43 11.01942	+10 57 23.5682	2.511686382	11.39	23.72	72.65	0.139E-01	0.525E-02	-22.5312588
Massalia	2013-07-02T11:48:54.00	01 43 14.42244	+10 57 42.4751	2.511144526	11.39	23.72	72.68	0.139E-01	0.525E-02	-22.5066851
Massalia	2013-07-02T12:48:54.00	01 43 17.83636	+10 58 1.3688	2.510602997	11.39	23.72	72.70	0.140E-01	0.525E-02	-22.5042897
Massalia	2013-07-02T13:48:54.00	01 43 21.26135	+10 58 20.2579	2.510061254	11.39	23.73	72.73	0.140E-01	0.525E-02	-22.5244077
Massalia	2013-07-02T14:48:54.00	01 43 24.69679	+10 58 39.1510	2.509518767	11.39	23.73	72.75	0.141E-01	0.525E-02	-22.5658342

Target	Date	RA "h:m:s"	DEC "d:m:s"	Distance AU	Mv	Phase deg	Elongation deg	dRAcosDEC arcsec/s	dDEC arcsec/s	dist_dot km/s
Amphitrite	2013-07-02T10:48:54.00	11 40 0.77398	-00 05 53.3363	2.765954244	11.19	21.43	74.93	0.109E-01	-0.524E-02	22.3550874
Amphitrite	2013-07-02T11:48:54.00	11 40 3.38390	-00 06 12.1957	2.766492368	11.19	21.43	74.90	0.109E-01	-0.524E-02	22.3712279
Amphitrite	2013-07-02T12:48:54.00	11 40 5.98501	-00 06 31.0612	2.767031144	11.19	21.42	74.88	0.108E-01	-0.524E-02	22.4089925
Amphitrite	2013-07-02T13:48:54.00	11 40 8.57856	-00 06 49.9329	2.767571062	11.19	21.42	74.85	0.108E-01	-0.524E-02	22.4655975
Amphitrite	2013-07-02T14:48:54.00	11 40 11.16644	-00 07 8.8106	2.768112530	11.19	21.42	74.82	0.108E-01	-0.524E-02	22.5369700

# MP<sup>3</sup>C: PERSPECTIVES

- **Développements:**
  - Nouvelles modalités d'accès aux données
  - Intégration avec le *Gaia Archive* (ESAC)
  - Nouveau services en interface avec IMCCE (calcul de cartes de température des surfaces astéroïdales, prédictions d'occultations stellaires, etc.)



# UN PORTAIL GENERAL POUR LES PETITS CORPS


- Vers le développement d'un "pole thématique"
- Un portail unique pour les petits corps
  - ...Pour répondre à un besoin de la communauté:
    - éphémérides
    - propriétés physiques
    - propriétés dynamiques
- Premier prototype (fonctionnant) : B. Carry (OCA/IMCCE), J. Berthier (IMCCE)

- Dashboard
- Academic
- Astronomer
- Developer
- Services



Welcome onboard the french portal dedicated to celestial mechanics, physics, and dynamics of solar system objects. Astronomer, teacher, observer, developer, astronomy fan, this Web site is yours, to compute ephemerides, to discover the solar system, to analyse and share your data, in short, to dig for the missing keys to the knowledge of the solar system.

[Read less](#)

 Developed and maintained by J. Berthier, P. Descamps, J. Normand and F. Vachier of the ACME team of the Institut de mécanique céleste et de calcul des éphémérides (Observatoire de Paris / CNRS), and B. Carry and P. Tanga of the TOP team of the Lagrange laboratory (Observatoire de la Côte d'Azur).



 Developed thanks to the efforts of the international astronomical community through the International Virtual Observatory alliance (IVOA), which led to the construction of the Virtual Observatory. We are thankful for the technical and human assistance brought by the Action Spécifique OV-France, the European Virtual Observatory (EURO-VO) project, and the Paris Astronomical Data Centre.



 Completed thanks to many years of fruitful collaborations with worldwide observatories, astronomers and planetary science teams: J.-M. Petit and P. Rousselot (SPACE team, UTINAM institute, Besançon, France), J. Durech (Astronomical institute, Charles University, Prague, Czech Republic), ... TBC ...



 Funded by the Ministère de l'Éducation Nationale et de la Recherche Scientifique through the Bureau des longitudes and the Observatoire de Paris, and the Institut National des Sciences de l'Univers (INSU) of the Centre National de la Recherche Scientifique (CNRS).





# CELESTIAL MECHANICS & SOLAR SYSTEM

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THE FRENCH PORTAL OF  
**CELESTIAL MECHANICS & SOLAR SYSTEM**

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## Academic

**TIME KNOWLEDGE**

- Julian day
- French legal time
- Public holidays
- Day of the week
- Seasons
- Calendars
- Easter date
- Religious celebrations

**CELESTIAL EVENTS**

- Moon phases
- Lunar eclipses
- Solar eclipses
- Helical rising of Sirius

**SOLAR SYSTEM**

- Tour in the solar system
- Destination Lutetia (2010)
- Mars opposition
- Sub-solar latitude of Triton

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## Astronomer

**WEB FORMS**

Run our softwares interactively.

- Ephemerides** Compute ephemerides
- SsODNet** Name resolver
- SkyBoT** Cone-search, resolver, class
- VISION** Visibility for observing nights
  - RTS** Rise, set & transit
  - MP°C** Physical properties
  - TNOs** Outer solar system

**TOOLS**

Run our softwares on your desktop.

- Clients** Enhance your desktop
- Plugins** Extend your applications
- GLU files** Customize your Aladin

**SCIENCE CORNER**

Learn the science behind the portal.

- Genoide** Orbital elements of asteroidal satellites
- M4AST** Modeling for asteroids
- References** Inescapable papers
- Bibliography** Cite our work



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[Read more](#)

  
**ACADEMIC**

  
**ASTRONOMER**

  
**DEVELOPER**

  
**SERVICES**

## Developer

### API

Connect our softwares by using **REST** APIs.

- SsODNet** Name resolver, physical and dynamical data, information system

### WEBSERVICES

Connect our softwares by using **Web services**.

- SsODNet** Name resolver, physical and dynamical data, information system
- Miriade** Ephemerides, rise-set-transit, visibility
- SkyBoT** Identify Sso
- Skybot3D** Solar system explorer

### DOCUMENTATION

Get help for learning what and how to do.

- Getting started** Tutorial for new users
- Release notes** Overview of last changes
- FAQ** Questions and answers

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[Read more](#)



ACADEMIC



ASTRONOMER



DEVELOPER



SERVICES

## Services

<p><b>SsODNET</b></p> <p>Launch</p> <p>Name resolver, information system dedicated to solar system objects.</p> <p><a href="#">Read More</a></p>	<p><b>MIRIADE</b></p> <p>Launch</p> <p>Ephemerides of solar system objects, rise, set and transit, visibility for observing night.</p> <p><a href="#">Read More</a></p>	<p><b>SkyBoT</b></p> <p>Launch</p> <p>Seek and identify solar system objects into astronomical images.</p> <p><a href="#">Read More</a></p>
<p><b>GENOIDE</b></p> <p>Launch</p> <p>Dynamic solutions, orbital elements of satellites of asteroids.</p> <p><a href="#">Read More</a></p>	<p><b>MP1C</b></p> <p>Launch</p> <p>Explore large databases of Minor Planets properties.</p> <p><a href="#">Read More</a></p>	<p><b>M4AST</b></p> <p>Launch</p> <p>On-line modelling of visible and near-ir spectra of atmosphere-less bodies.</p> <p><a href="#">Read More</a></p>
<p><b>VESPA</b></p>	<p><b>TNOob</b></p>	<p><b>BPOb</b></p>