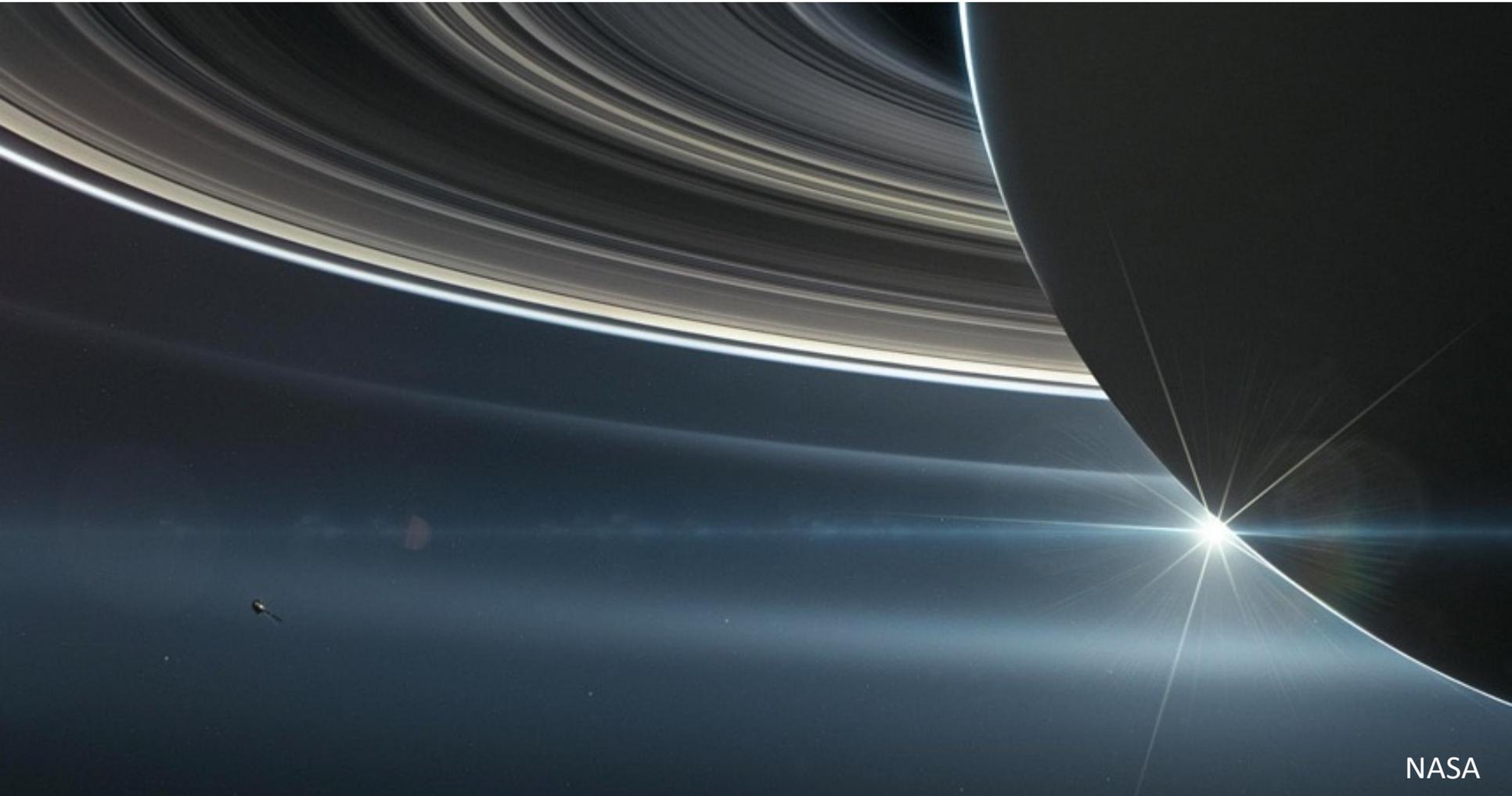


# Construction et précision des éphémérides des lunes de Saturne

Valéry Lainey  
[lainey@imcce.fr](mailto:lainey@imcce.fr)



NASA

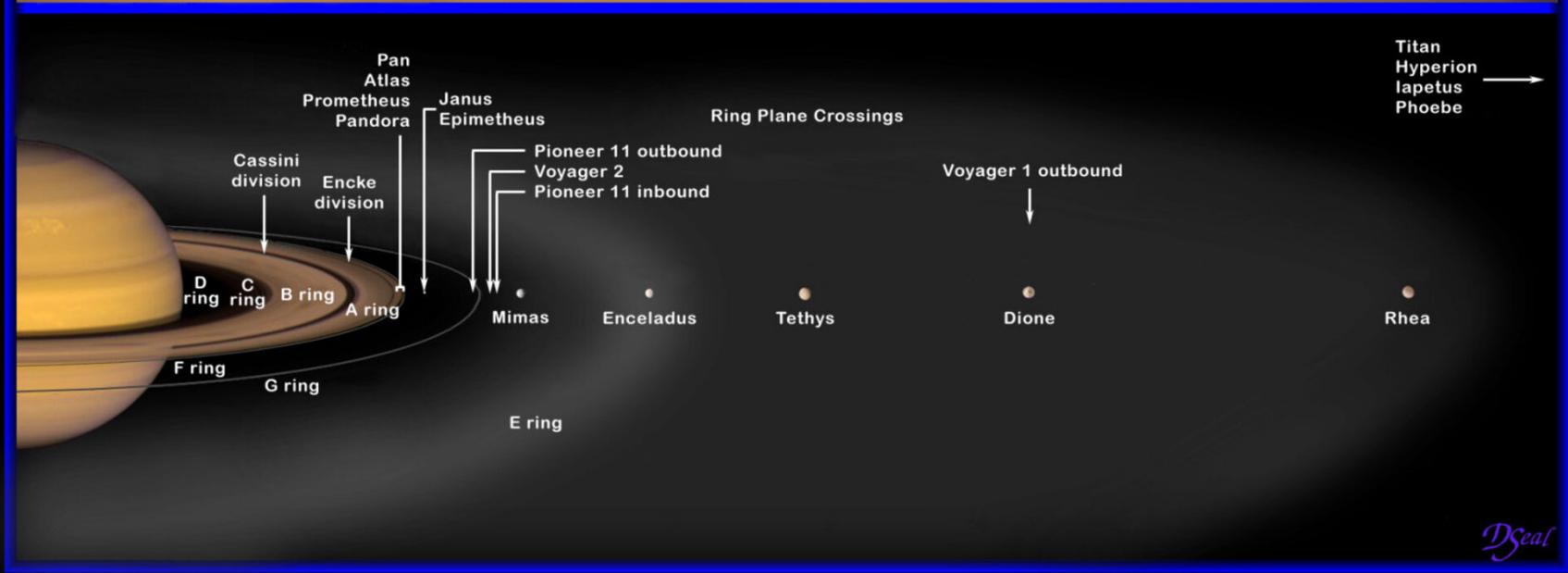
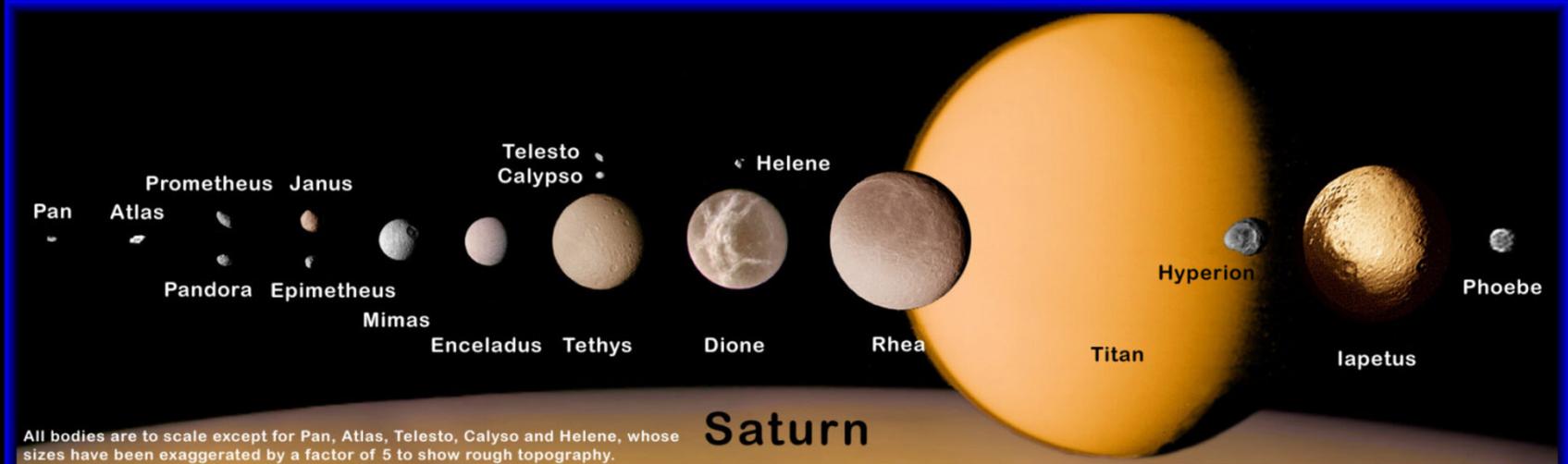


**Campagne PheSat 2024-2026**



# Principales lunas de Saturne...

## Saturn's Satellites and Ring Structure



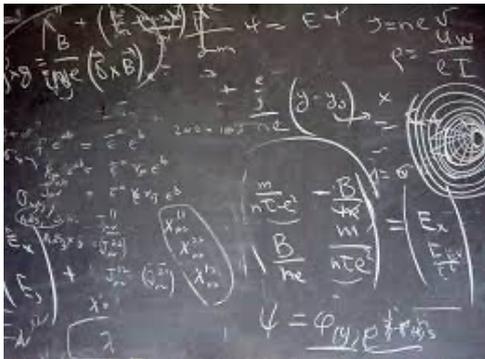
# Problématique

Observations



?

Théorie (ou modèle)



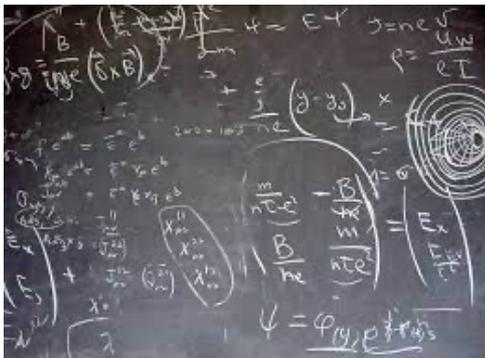
# Problématique

Observations



?

Théorie (ou modèle)



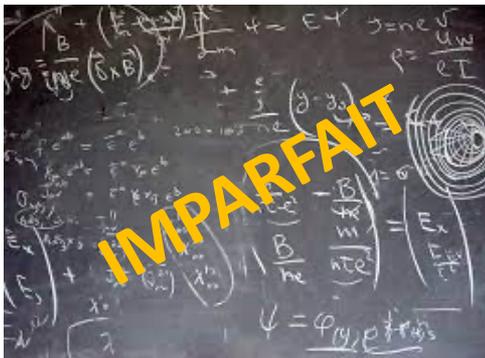
# Problématique

Observations



?

Théorie (ou modèle)

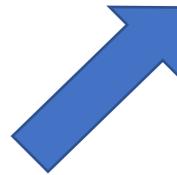
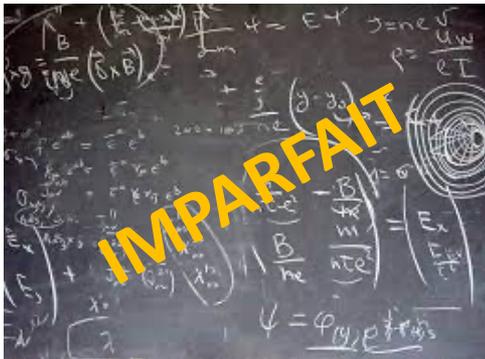


# Problématique

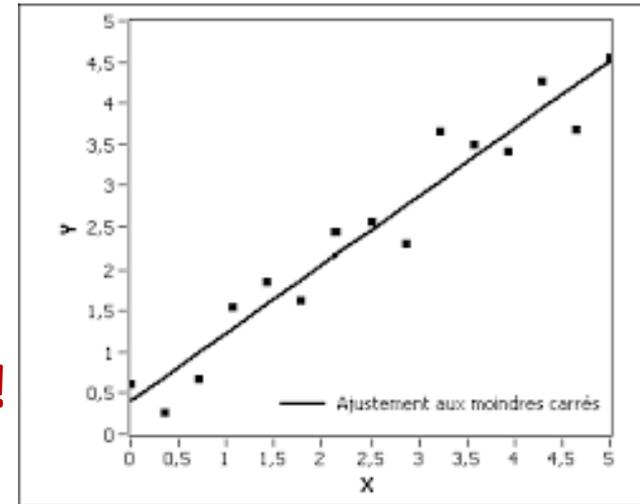
Observations



Théorie (ou modèle)

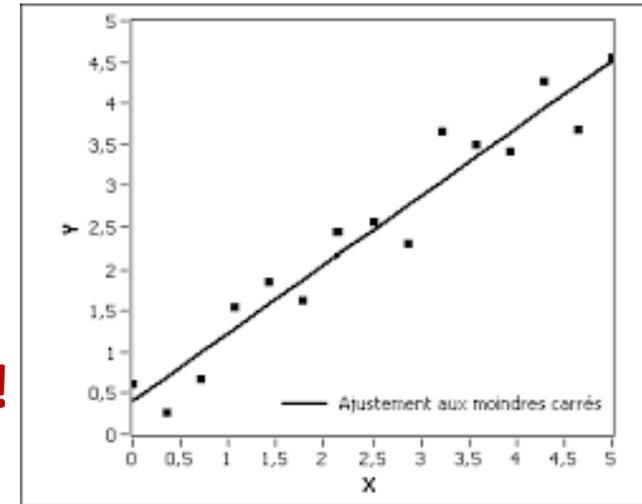


Ajustement  
**ESSENTIEL!**



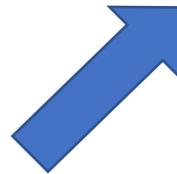
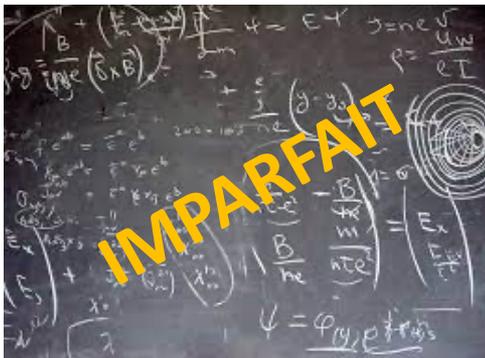
# Problématique

Observations



Ajustement  
**ESSENTIEL!**

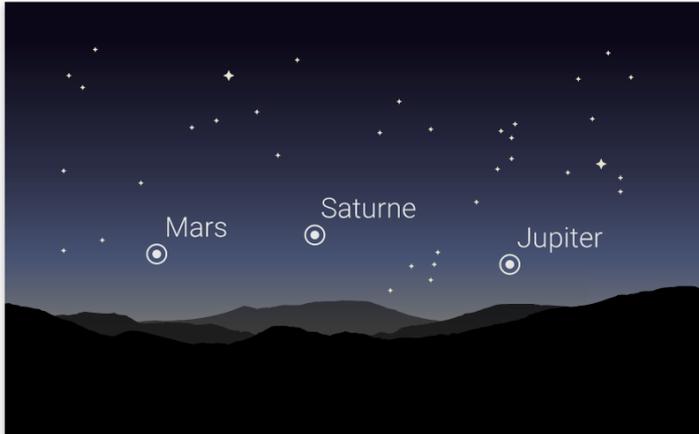
Théorie (ou modèle)



Solution ajustée

→ éphéméride!!!

# Problématique



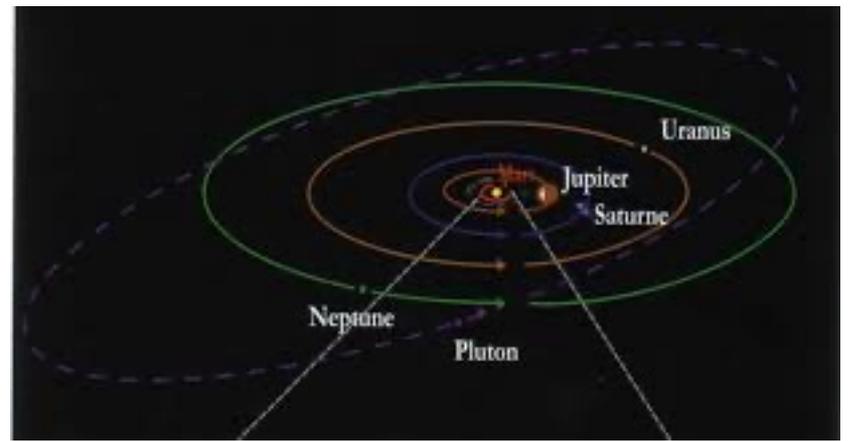
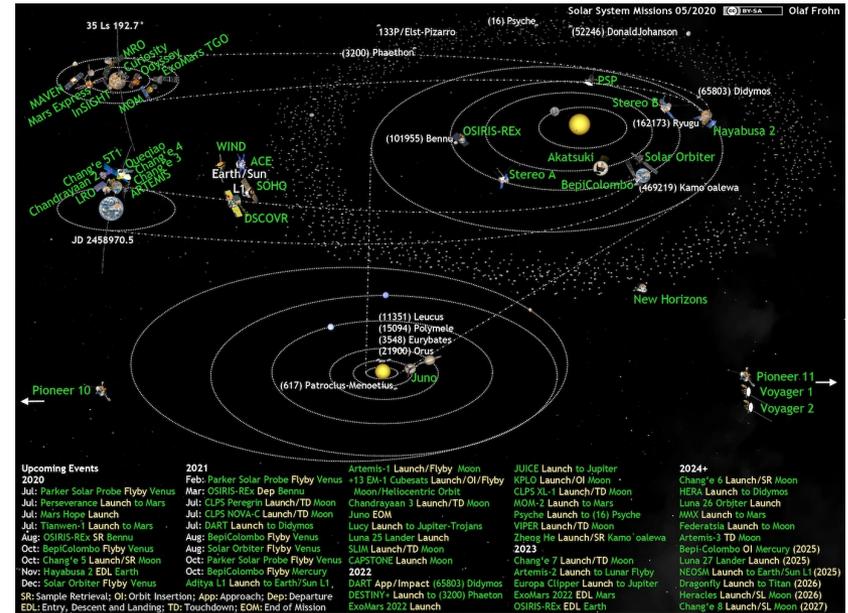
ÉPHÉMÉRIDES

## Observation des planètes

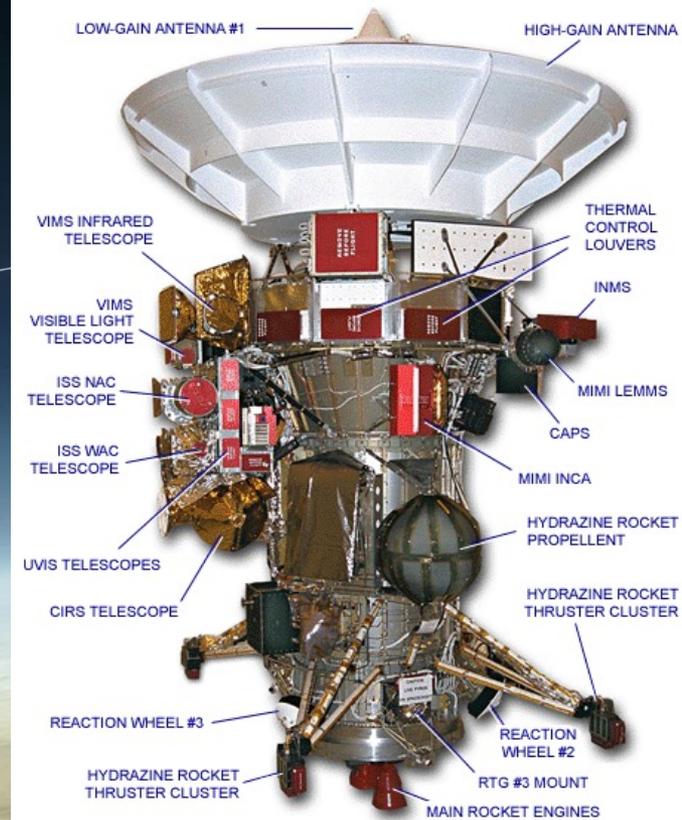
Calcul des éphémérides utiles à l'observation du Soleil et des corps du Système solaire depuis la Terre.

[www.imcce.fr](http://www.imcce.fr)

Il n'existe pas d'éphéméride précise sans ajustement!



# Éphémérides des lunes de Saturne: La mission Cassini



## Deux instruments essentiels: ISS et HGA

- Des millions de points de données radio-science
- 443 215 images ISS

# Éphémérides des lunes de Saturne: La mission Cassini



Perform a text search like "mars crater" or "cassini rings", or a more advanced search like "TARGET\_NAME:enceladus"

Search

### Show results for

(click to remove filter)

Share 

remove all

(x) ATLAS\_MISSION\_NAME:cassini

(x) ATLAS\_INSTRUMENT\_NAME:iss

▶ Mission

▶ Spacecraft

▼ Instrument

iss (443216)

iss nac (318358)

iss wac (124713)

▶ Target

▶ Product Type

▶ Lighting Geometry

▶ Filters

▶ Lat/Lon Bounding Box

▶ Time Constraints

▶ Orbital Mission Constraints

▶ Landed Mission Constraints

▶ PDS Archive Constraints

▶ Advanced Constraints

Results: 24 ▾

Page:

< 1 2 ... 10 11 12 ... 18467 18468 > displaying 241 to 264 of 443216

 Thumbnail View

 List View

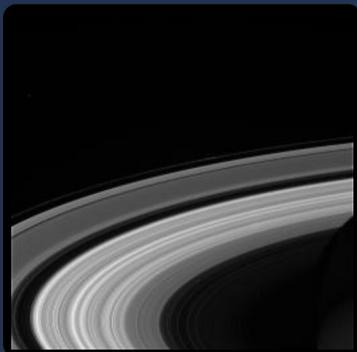
Add field to sort by: START\_TIME

Clear

Hide Missing Browse

Select All Images:  On Page

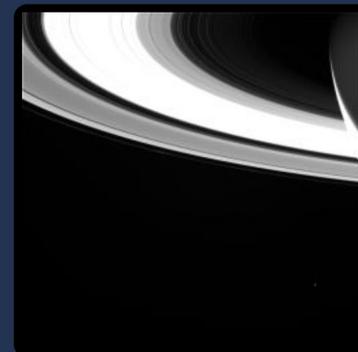
In Query



W1884009801\_1



W1884009746\_2

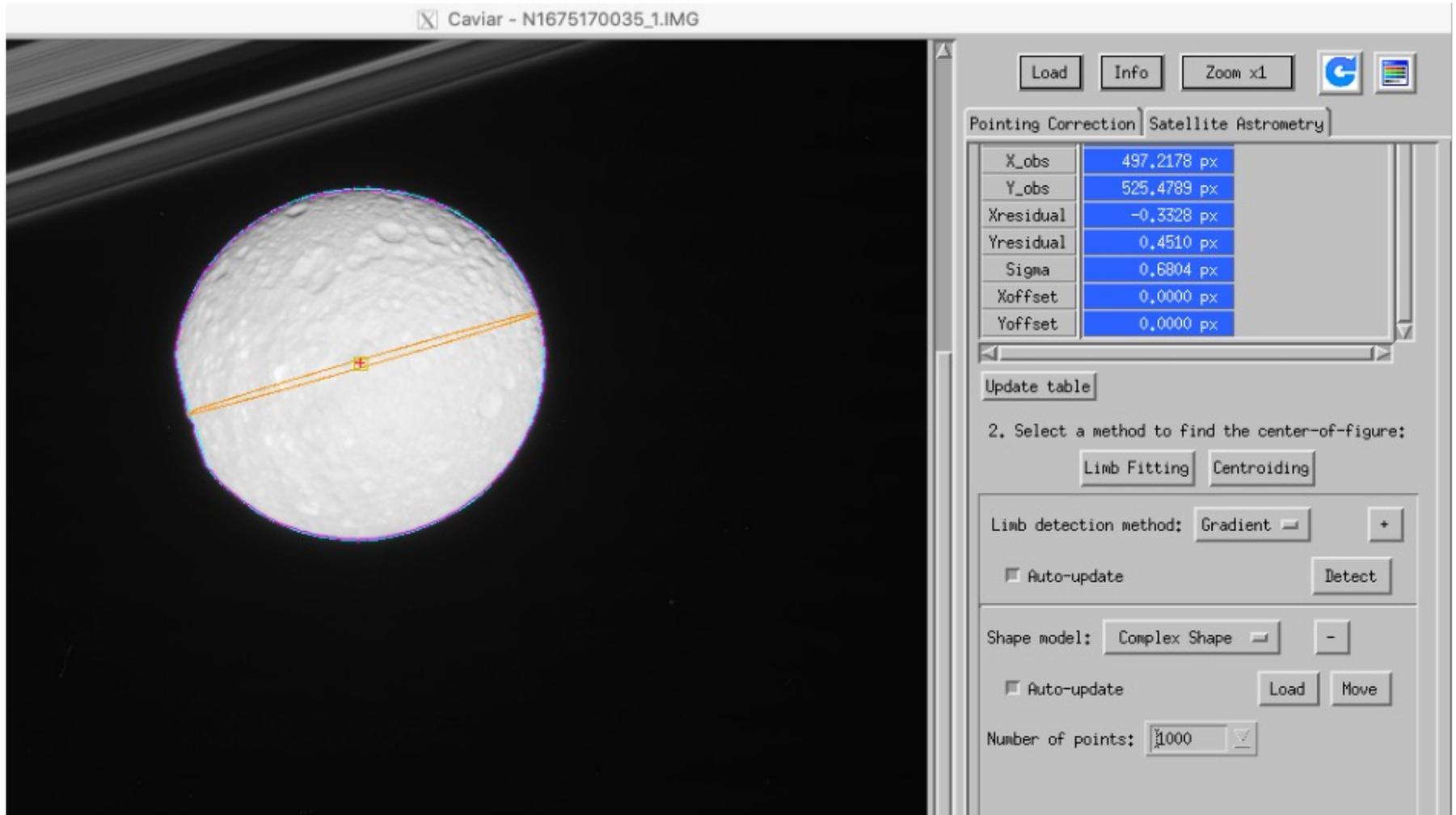


W1884009526\_1



# Éphémérides des lunes de Saturne: La mission Cassini

Caviar - N1675170035\_1.IMG



Pointing Correction		Satellite Astrometry	
X_obs	497.2178 px		
Y_obs	525.4789 px		
X_residual	-0.3328 px		
Y_residual	0.4510 px		
Sigma	0.6804 px		
X_offset	0.0000 px		
Y_offset	0.0000 px		

Update table

2. Select a method to find the center-of-figure:

Limb detection method:

Auto-update

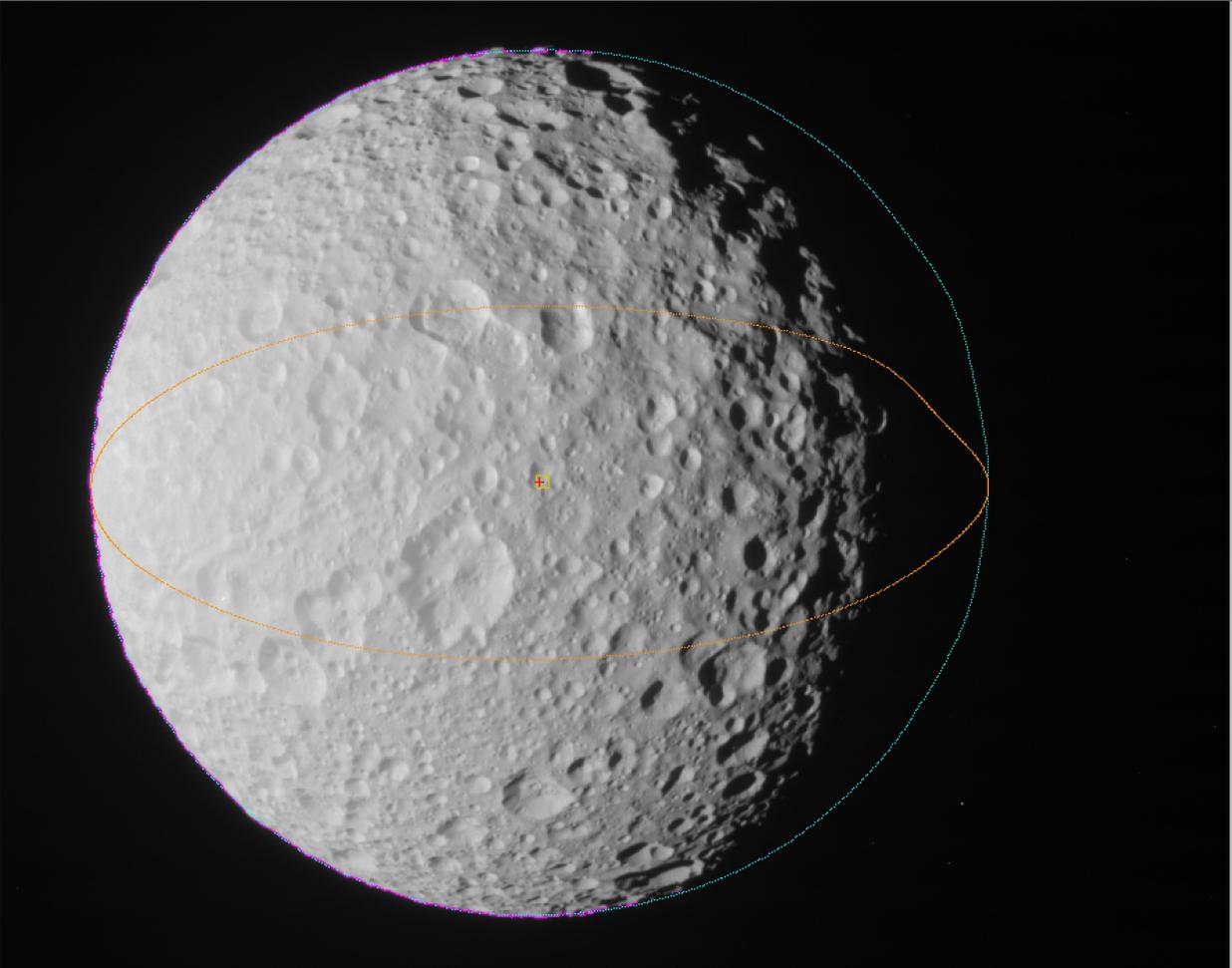
Shape model:

Auto-update

Number of points:

# Éphémérides des lunes de Saturne: La mission Cassini

Caviar - N1501638743\_1.IMG



Load Info Zoom x1

Pointing Correction Satellite Astrometry

1. Select satellite to be measured:

Name	MIMAS
ID	601
RA_calc	171.4915078 deg
DEC_calc	28.1025933 deg
X_calc	527.9830 px
Y_calc	496.4381 px
Resolution	0.61 km/px
Method	LIMB-FIT
RA_obs	171.4927008 deg
DEC_obs	28.1023294 deg
X_obs	525.0041 px
Y_obs	497.4930 px
Xresidual	-2.9789 px
Yresidual	1.0548 px
Sigma	0.8117 px
Xoffset	0.0000 px
Yoffset	0.0000 px

Update table

2. Select a method to find the center-of-figure:

Limb Fitting Centroiding

Limb detection method: Gradient +

Auto-update Detect

Shape model: Complex Shape -

Auto-update Load Move

Number of points: 1000

# Éphémérides des lunes de Saturne: La mission Cassini

Caviar - N1607518963\_1.IMG



Load Info Zoom x1

Pointing Correction Satellite Astrometry

1. Select satellite to be measured:

Name	TETHYS
ID	603
RA_calc	231.9856385 deg
DEC_calc	-57.4505194 deg
X_calc	541.2066 px
Y_calc	195.3819 px
Resolution	1.52 km/px
Method	LIMB-FIT
RA_obs	231.9862791 deg
DEC_obs	-57.4517790 deg
X_obs	544.1042 px
Y_obs	197.8725 px
Xresidual	2.8976 px
Yresidual	2.4907 px
Sigma	0.7932 px
Xoffset	0.0000 px
Yoffset	0.0000 px

Update table

2. Select a method to find the center-of-figure:

Limb Fitting Centroiding

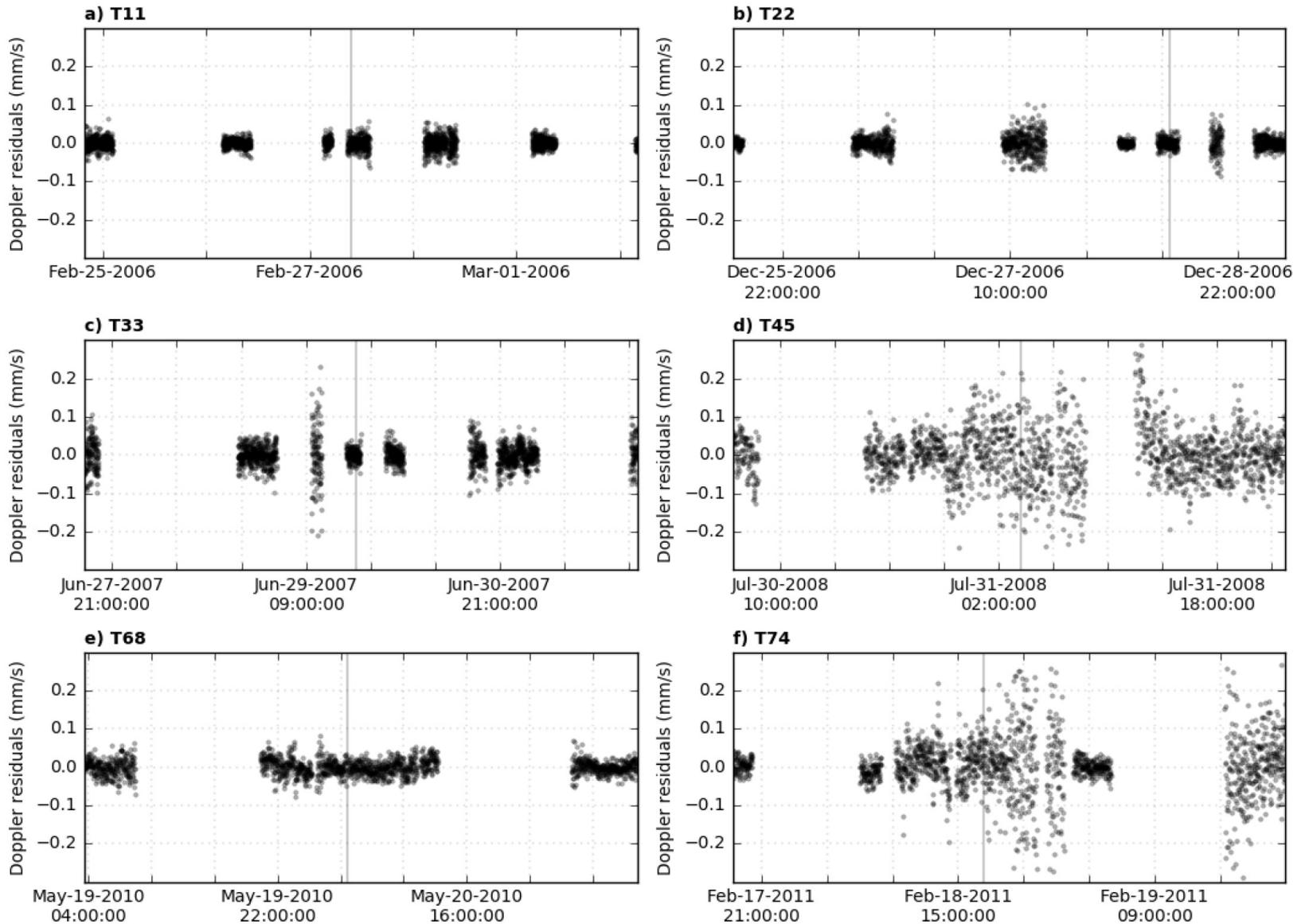
Limb detection method: Gradient +

Auto-update

Detect

Shape model: Complex Shape -

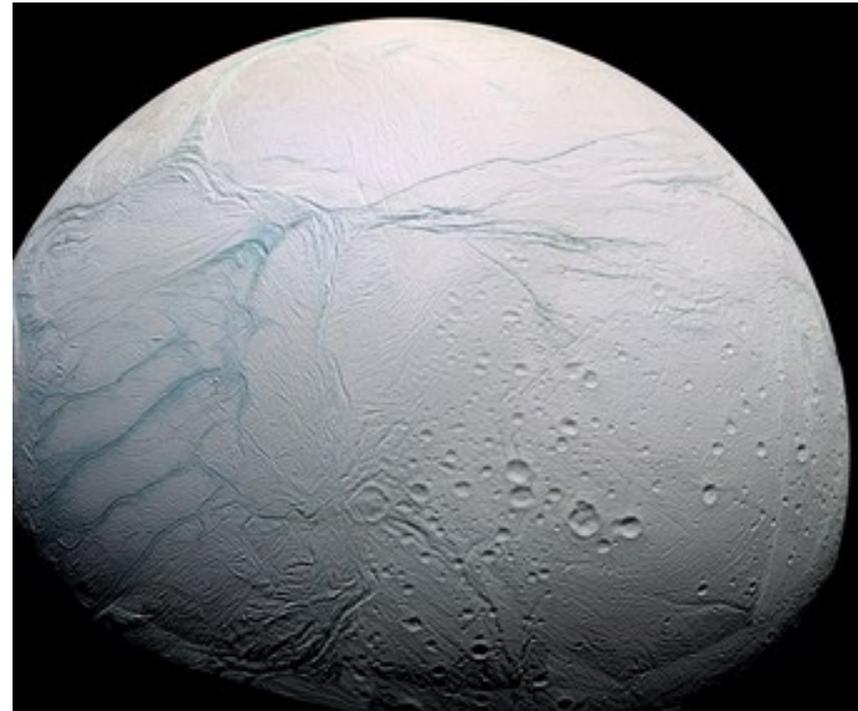
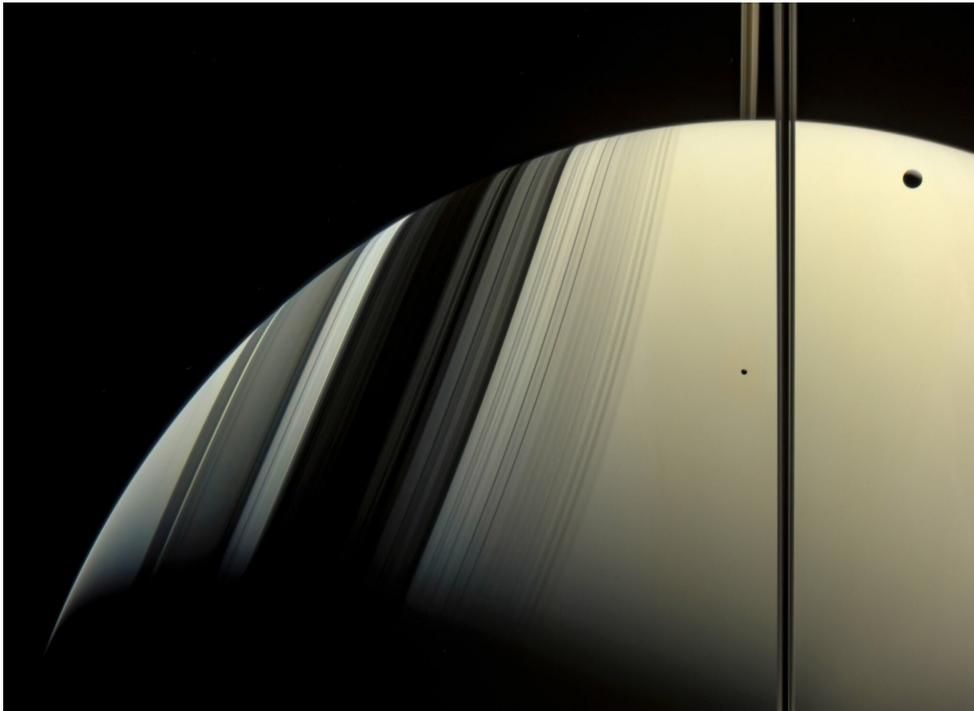
# Éphémérides des lunes de Saturne: La mission Cassini



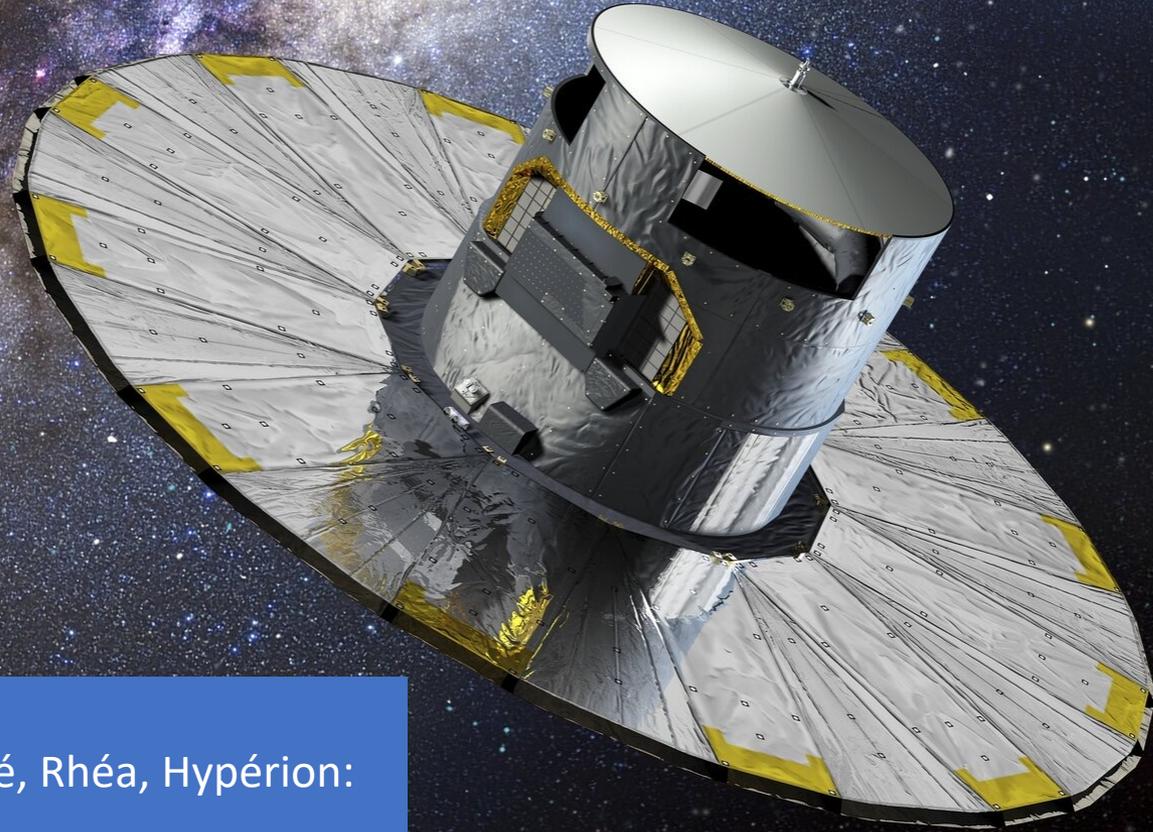
## Précision des éphémérides

Lunes principales (sauf Titan): 10 km (2 mas à l'opposition)

Titan: quelques kilomètres (1 mas à l'opposition)



# Éphémérides des lunes de Saturne: La mission Gaia



2014.5 - 2025

Encelade, Téthys, Dioné, Rhéa, Hypérion:

Précision = quelques mas