



# ASTEROIDES: FASCÍNIO E PERIGO

**Motivação**

# ASTEROID DAY

30 JUNE

- Tecnologia para detecção de asteroides próximos
- Meta: 100 mil asteroides/ano.
- Dia para conscientização e esforço para prevenção de impactos.



**O que são?**



Nem cometa, nem planeta.



Nem cometa, nem planeta.



- Níquel, ferro, silicato, basalto, gelo...



Nem cometa, nem planeta.



- Níquel, ferro, silicato, basalto, gelo...
- Planetoides, planetas menores.

**Linha do tempo**



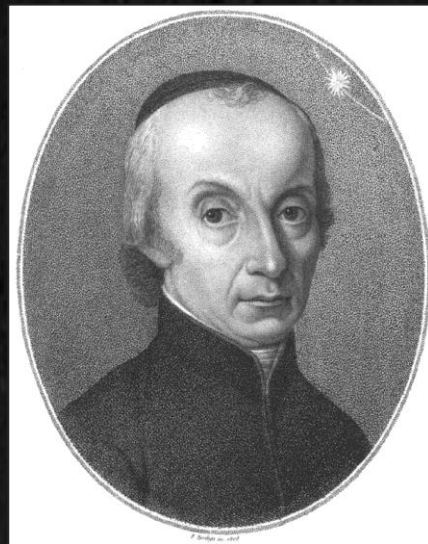
# 1 CERES: o primeiro (1801)



Ceres (Dawn/2015)

Lei de Titius-Bode:

0,4 0,7 1,0 1,6 2,8 5,2 10,0

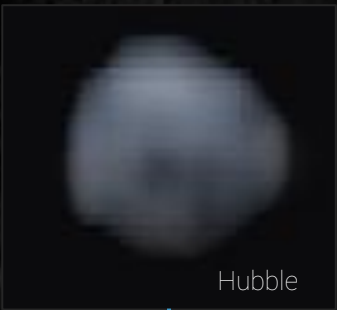


Giuseppe Piazzi



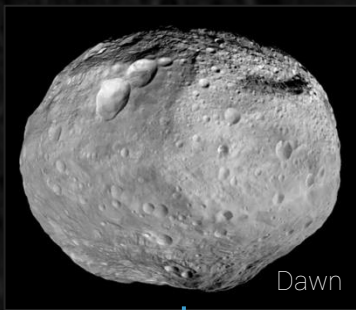
Carl Friedrich Gauss

2Pallas



Hubble

4Vesta



Dawn

6Hebe



VLT

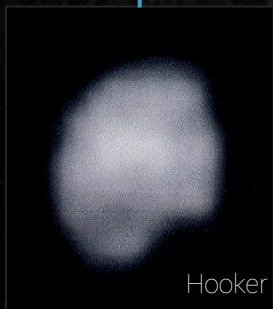
1804

1845

1802

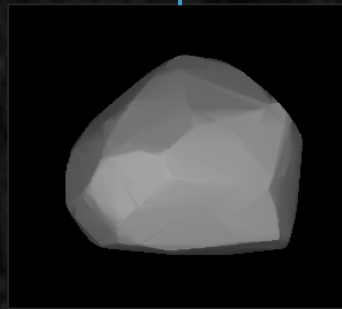
1807

1847



Hooker

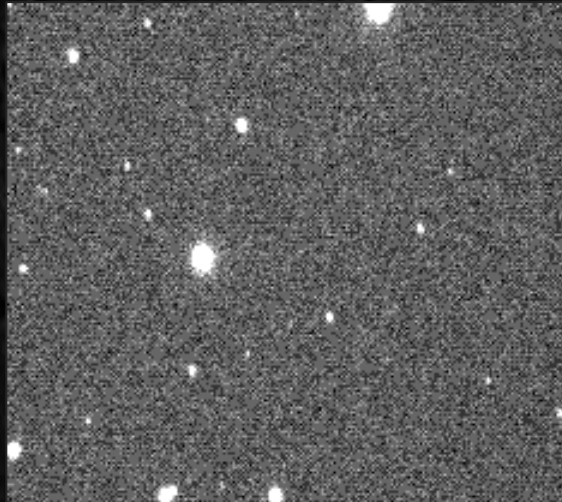
3Juno



5Astraea

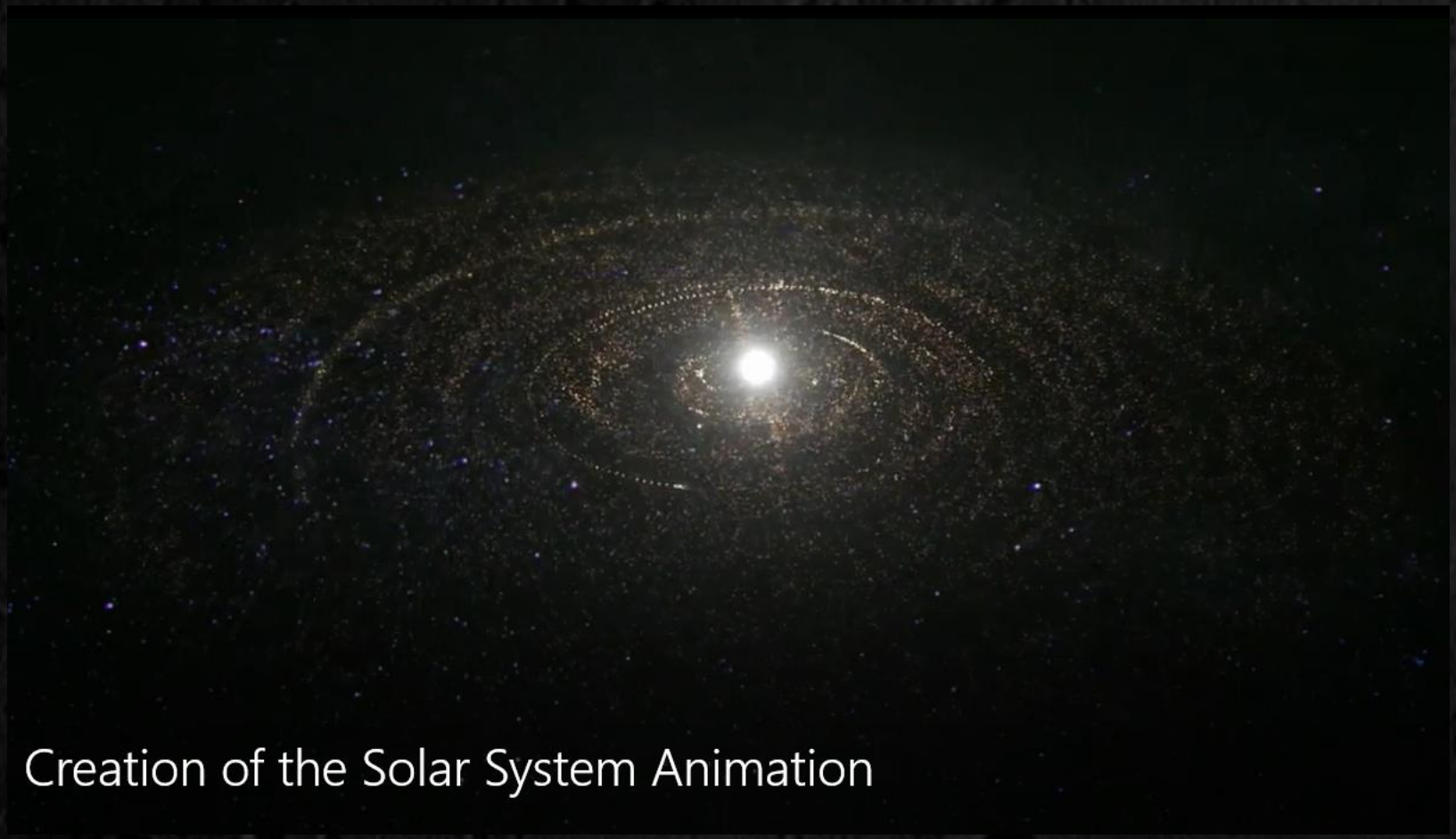
- Depois disso: 1 asteroide novo/ano.
- 1891: Max Wolf – 248 asteroides com astrofotografia.
- Hoje: 779.736 asteroides catalogados

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- 1891: Max Wolf – 248 asteroides com astrofotografia.
- Hoje: 779.736 asteroides catalogados



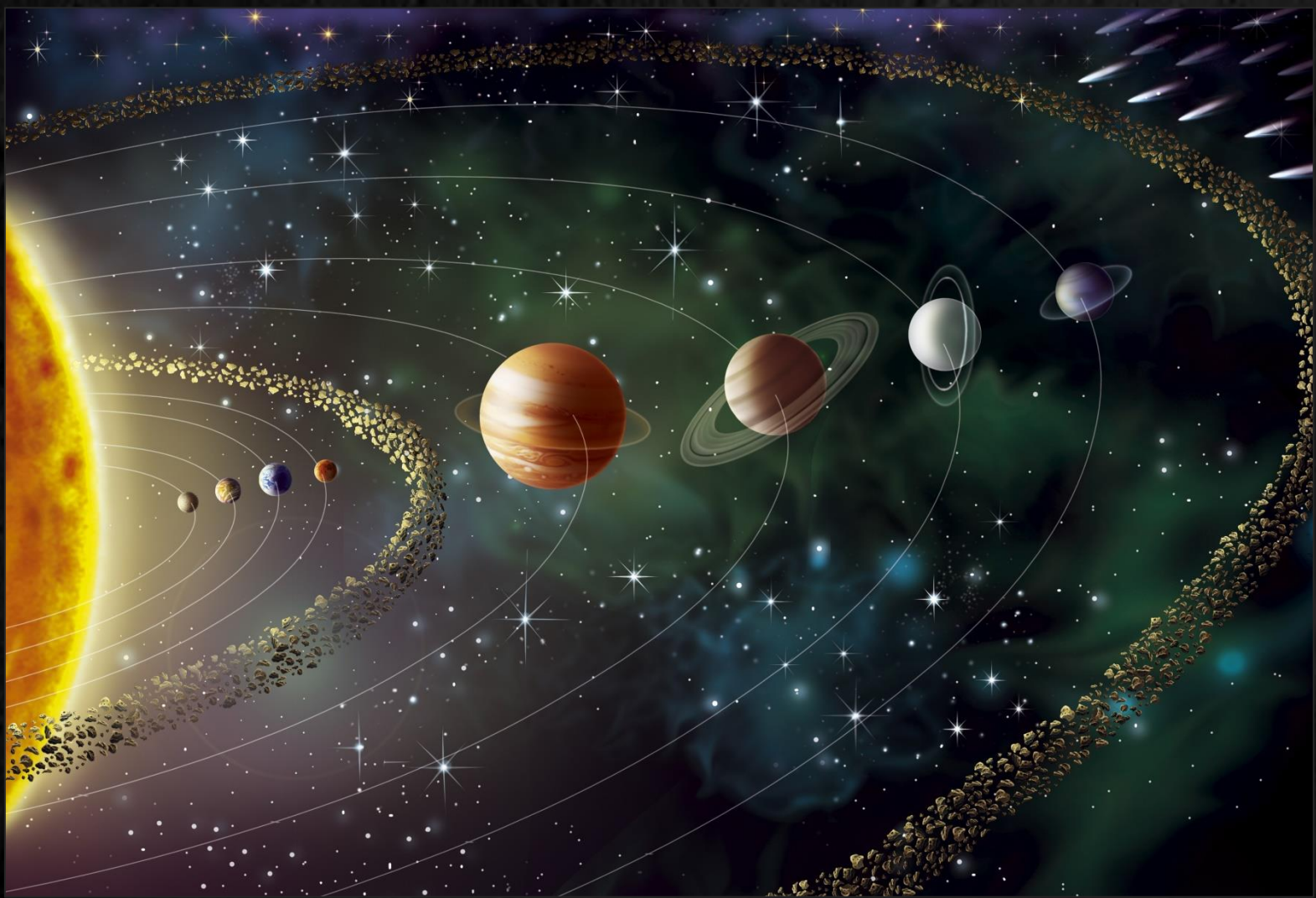
Asteroide Juno  
Créditos: Andreas H. Wolf

**Como se formaram?**



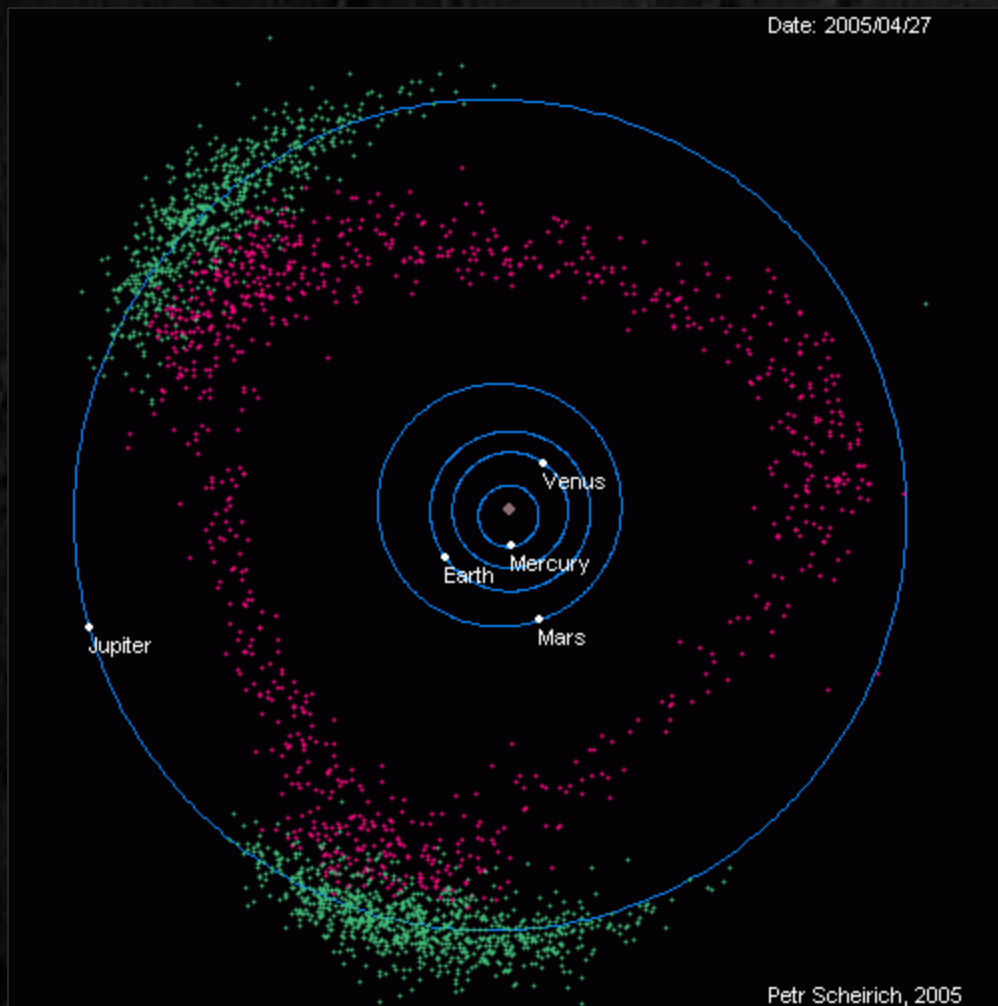
Creation of the Solar System Animation

**Onde vivem?**





Date: 2005/04/27



Petr Scheirich, 2005

# Tamanho e massa



Ceres



Pallas



Juno



Vesta



Astraea



Hebe



Iris



Flora



Metis



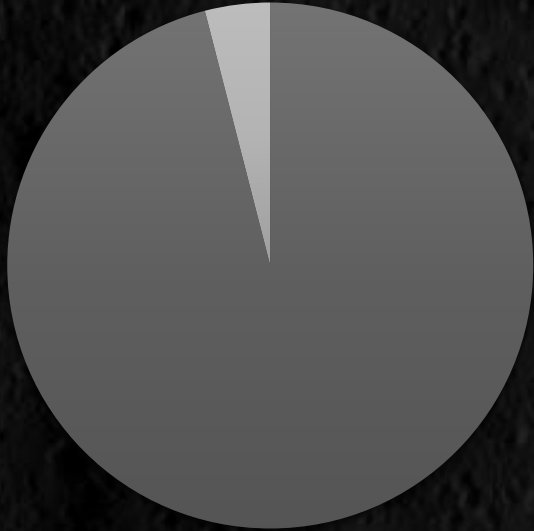
Hygiea

1000 km



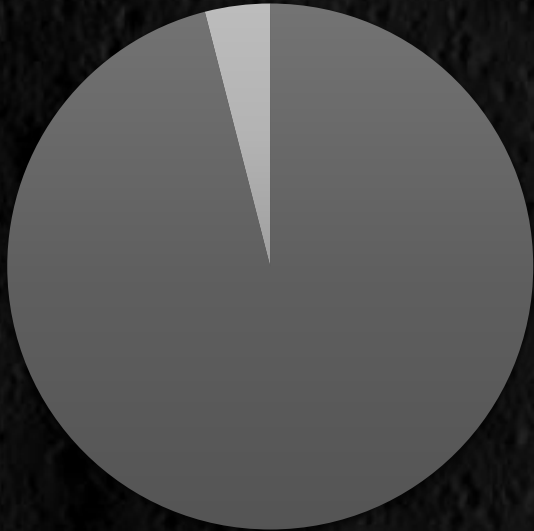
Cinturão de asteroides:  $3 \times 10^{21}$  kg

Cinturão de asteroides:  $3 \times 10^{21}$  kg



4% da massa da Lua

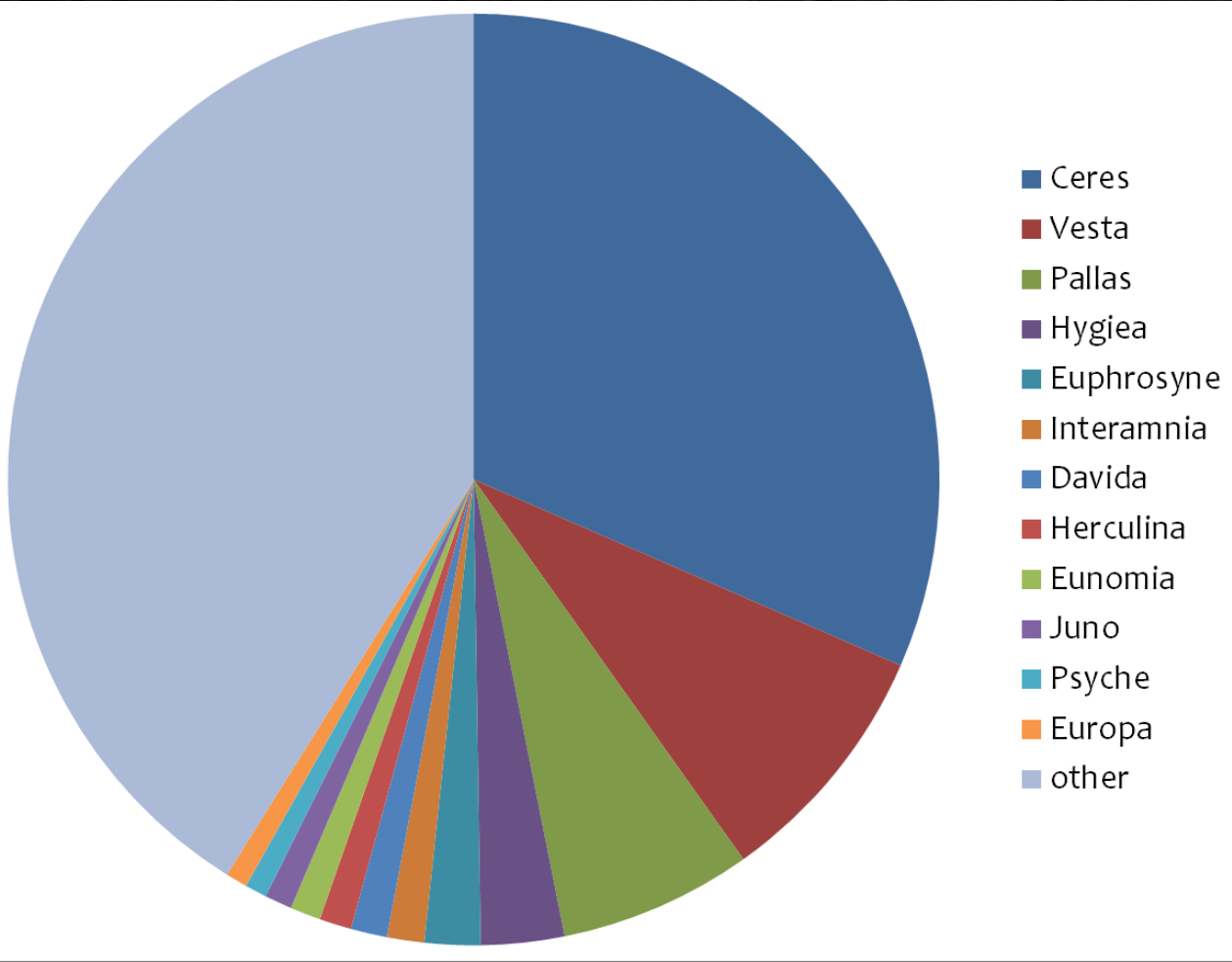
Cinturão de asteróides:  $3 \times 10^{21}$  kg



4% da massa da Lua



10 quatrilhões de An-225 Mriya



# **Asteroides legais**



# 90 Antiope

## O asteroide binário

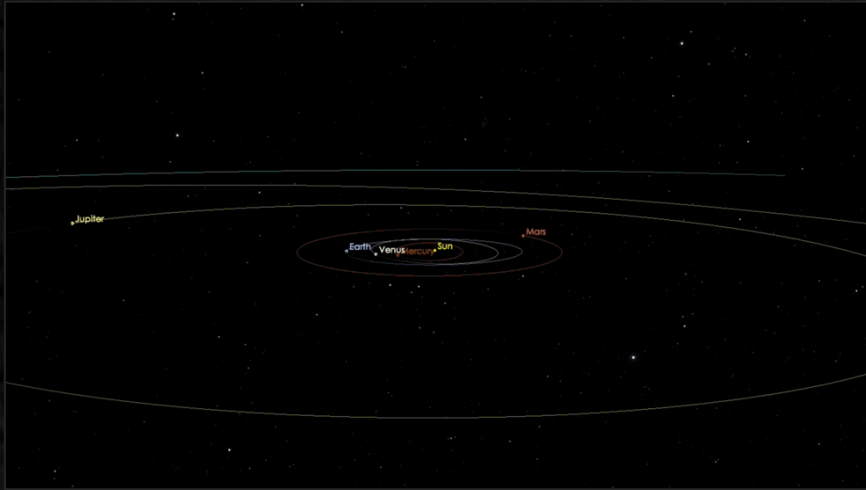


Descoberta: 1866

Sistema binário: 2000

# 1 I/'Oumuamua

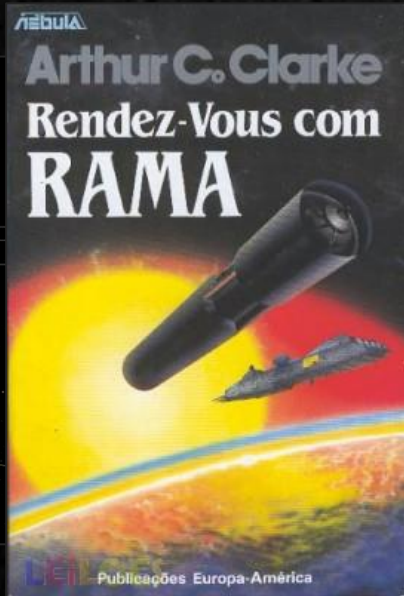
“O primeiro mensageiro de longe”



Descoberta: 2017

# 1 I/'Oumuamua

“O primeiro mensageiro de longe”



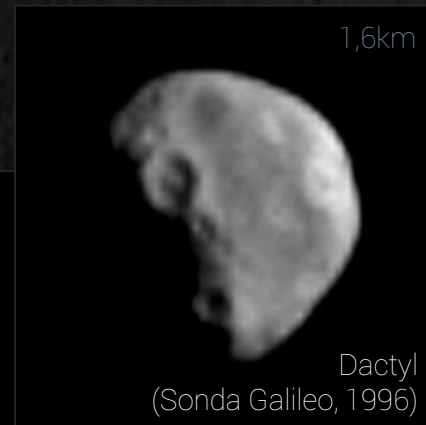
Descoberta: 2017

# 243 Ida

O primeiro com satélite natural



Ida: 1884  
Dactyl: 1993



# 87 Sylvia

O primeiro com dois satélites naturais

Sylvia: 1866  
Romulus: 2001  
Remus: 2004

Remus  
7km  
Romulus  
18km

300km

Densidade:  $1,2\text{g/cm}^3$

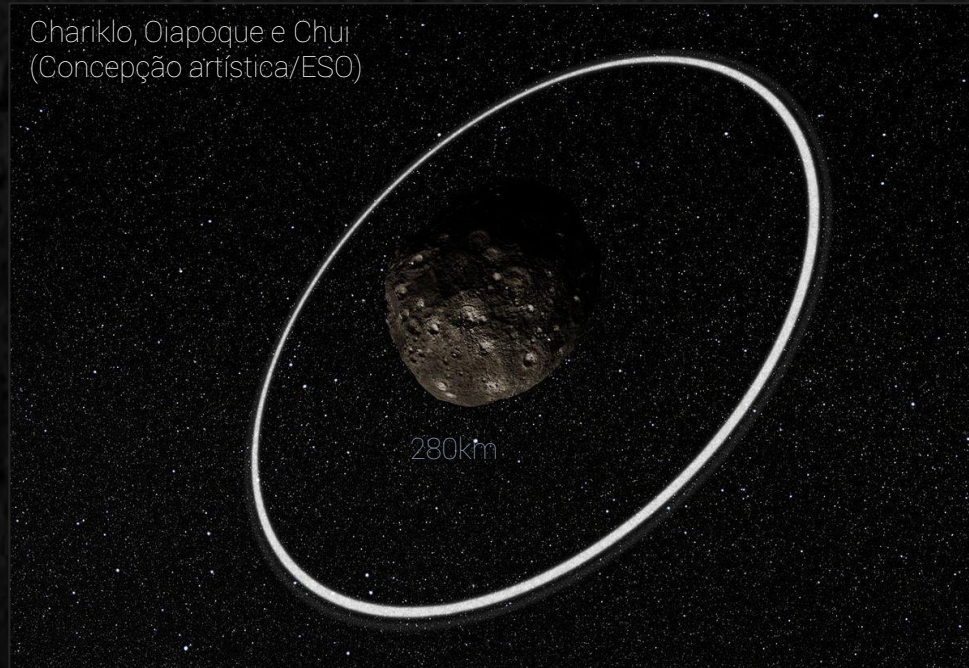
Sylvia e suas luas  
(Franck Marchis, 2004)

# 10199 Chariklo

## O asteroide com anéis

Chariklo: 1997

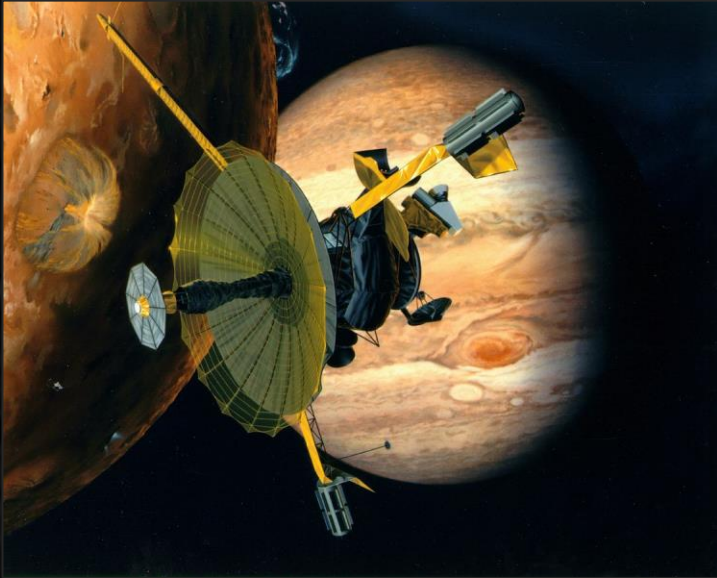
Anéis: 2014



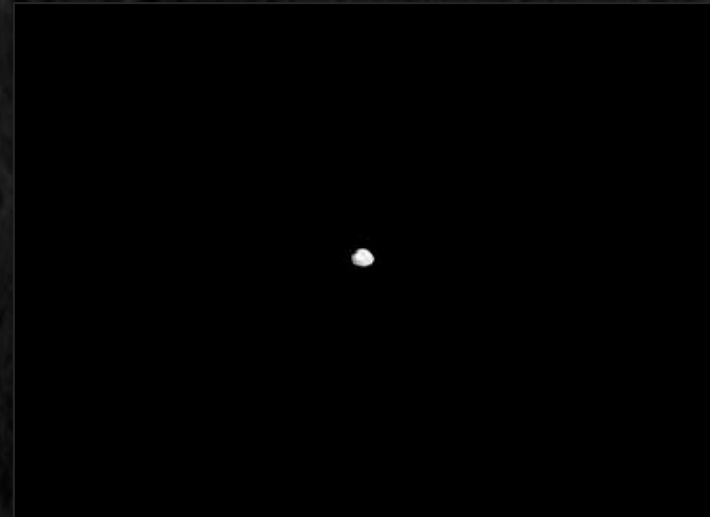
**Exploração**

# Galileo

(NASA/1989-2003)



1991  
Flyby Gaspra

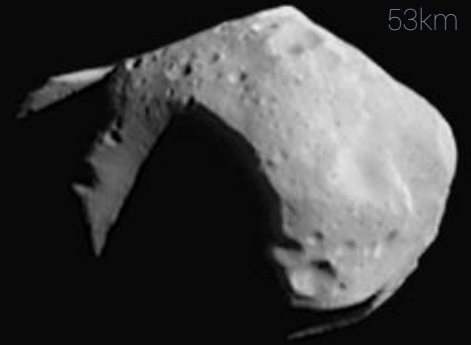


1993  
Flyby Ida



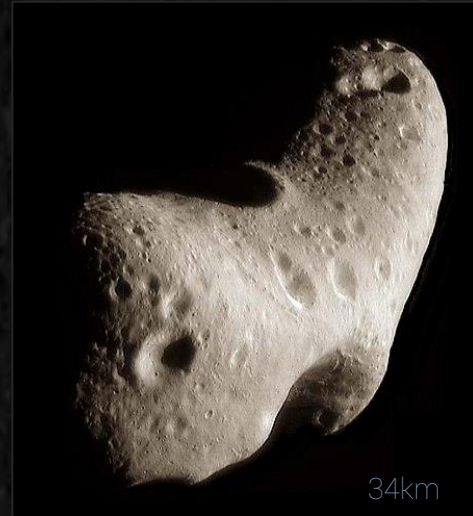
# NEAR Shoemaker

(NASA/1996-2001)



53km

1997  
Flyby Mathilde



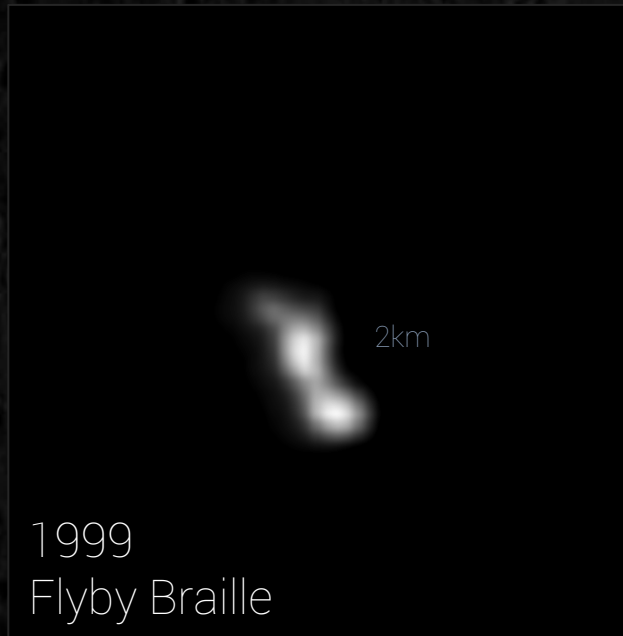
34km

1998-2001  
Flyby, órbita e pouso em Eros



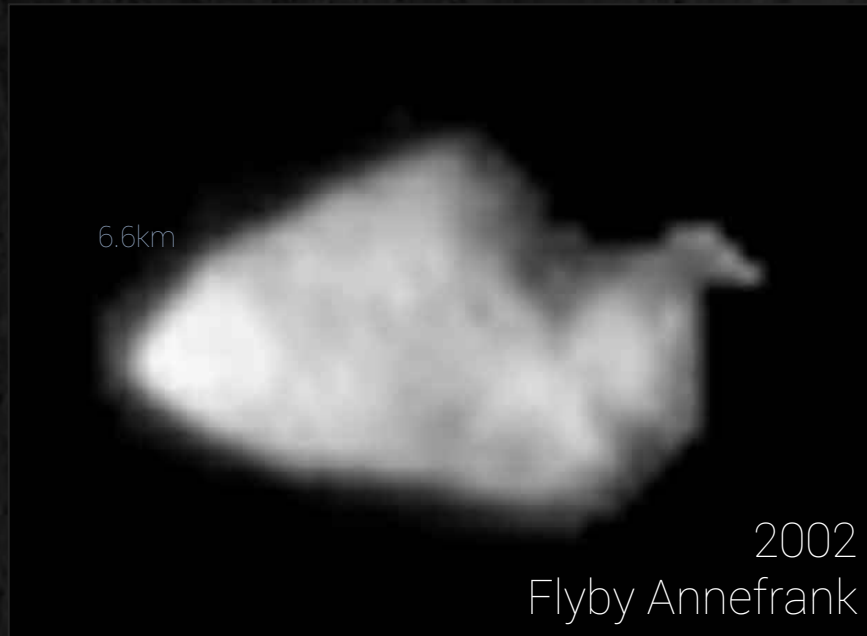
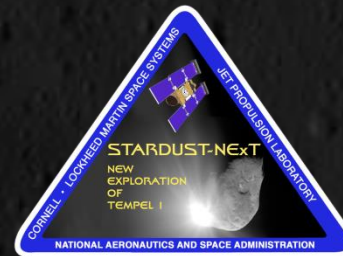
# Deep Space 1

(NASA/1998-2001)



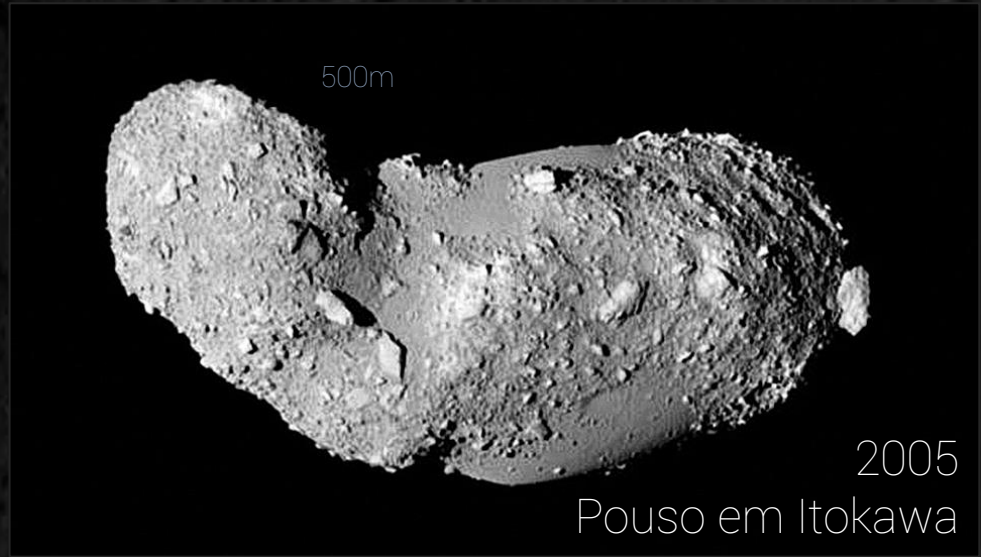
# Stardust

(NASA/1999-2011)



# Hayabusa

(JAXA/2003-2010)

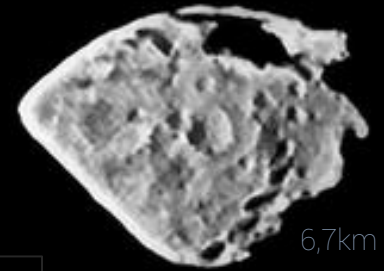


# Rosetta

(ESA/2004-2016)



2008  
Flyby Steins



6,7km

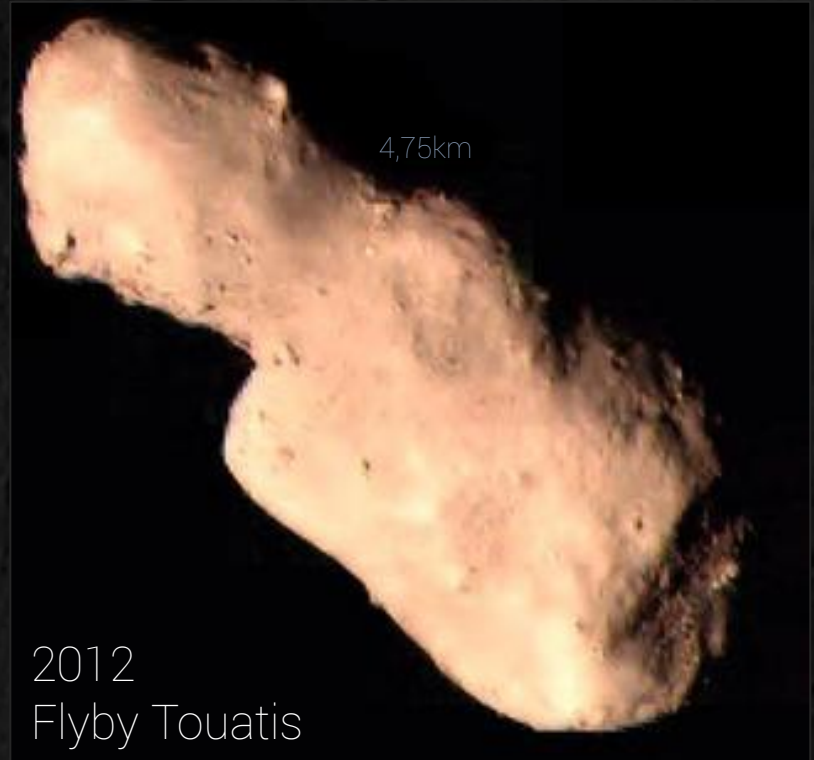
121km



2010  
Flyby Lutetia

# Chang'e-2

(CNSA/2010-?)



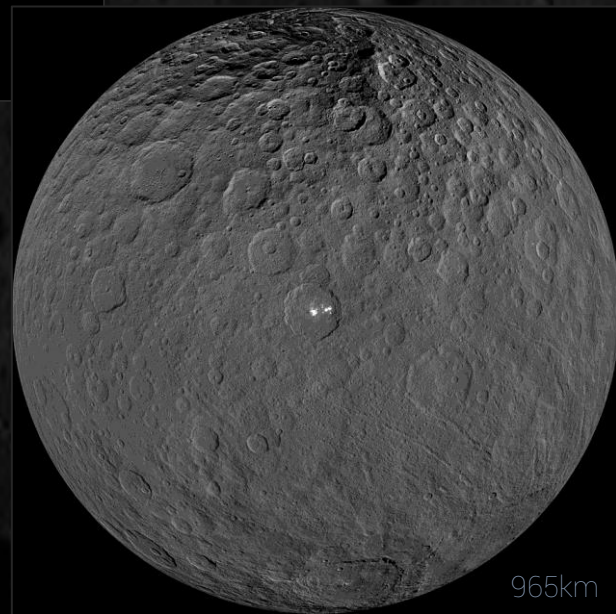
# Dawn

(NASA/2007-?)



570km

2011-2012  
Órbita em Vesta



2015-?  
Órbita em Ceres

965km

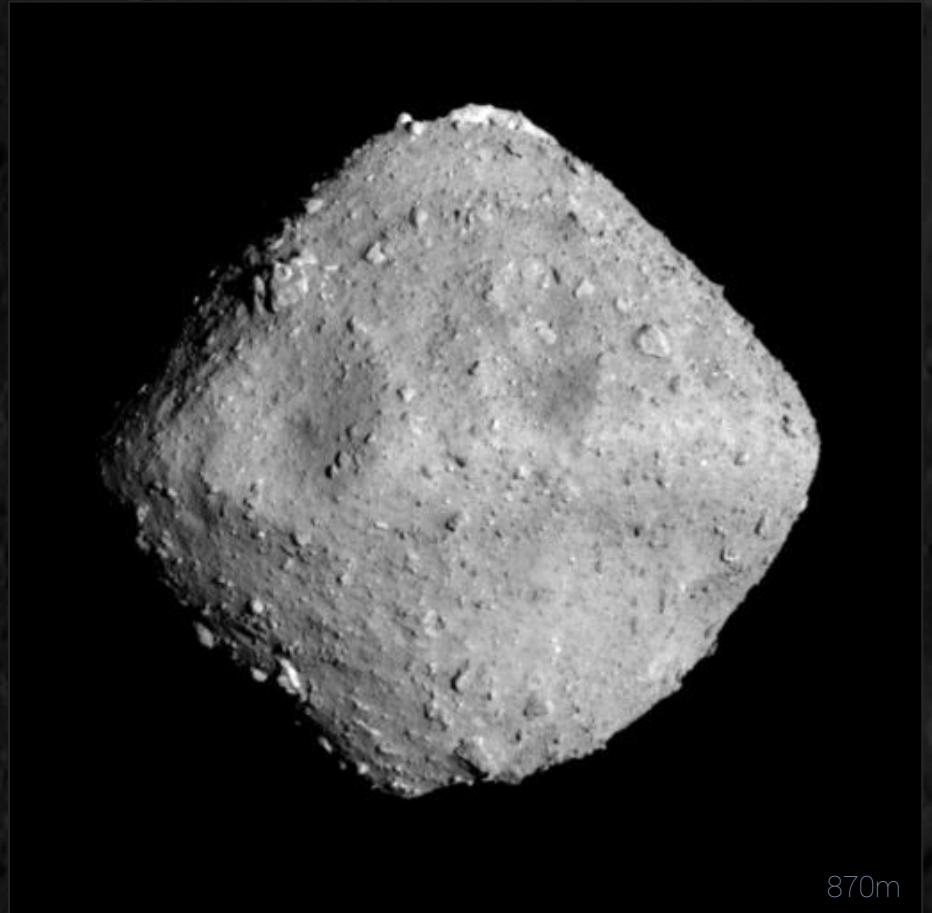
# Hayabusa 2

(JAXA/2014-?)

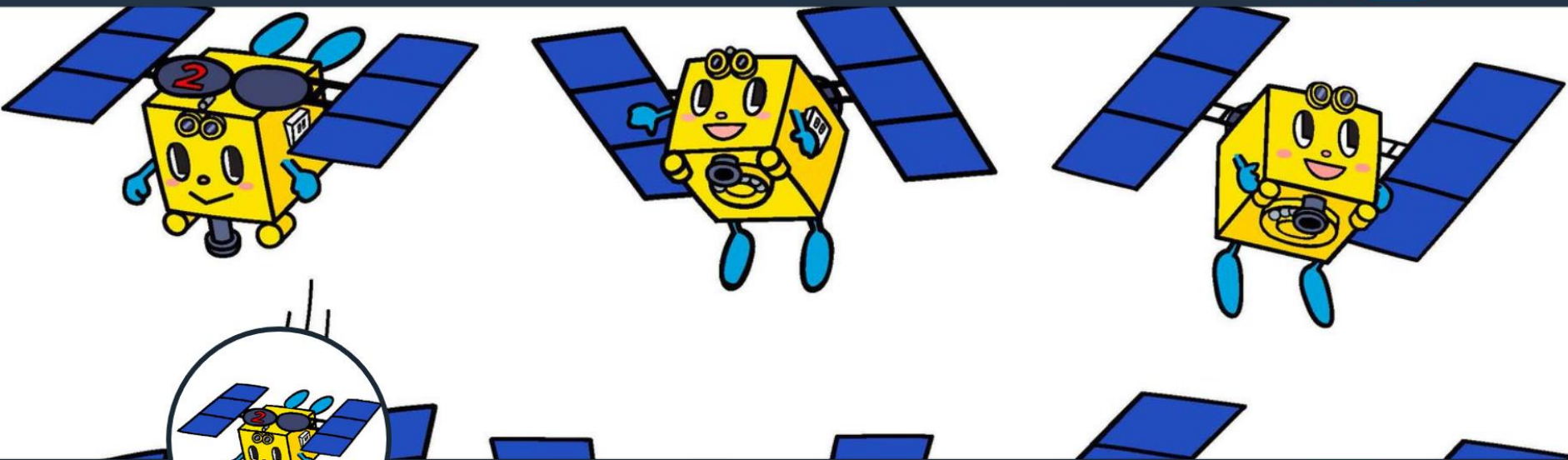


28/06/2018

Aproximando-se de Ryugu



870m



Tweets  
257

Following  
12

Followers  
11.2K

Likes  
125

Following

**haya2kun**

@haya2kun

『はやッー君』は小惑星探査機「はやぶさ2 @haya2\_jaxa」のマスコットキャラクターです。はやッー君と一緒に太陽系の旅を楽しみましょう。

Tweets

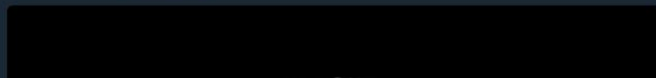
Tweets & replies

Media



**haya2kun** @haya2kun · Jun 28

Rise and shine @MASCOT2018 ! It's a new day and we have arrived at #Ryugu! Take a look... #hayabusa2



Who to follow · Refresh · View all



小惑星探査機「はやぶさ2... ×

Follow



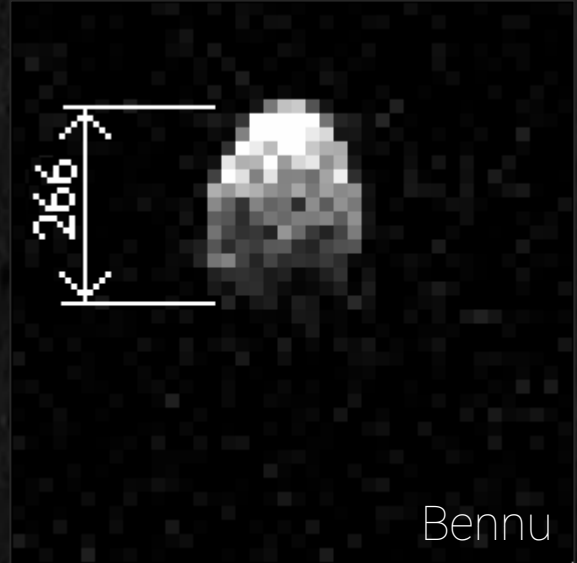
国立天文台 @prcnaoj ×

Follow



# OSIRIS-Rex

(NASA/2016-?)



**Momento de tensão**

2007: "Asteróide Pallas poderá se chocar com a Terra"



2007: "Asteróide Pallas poderá se chocar com a Terra"

CHEGOU O CITROËN C4 PALLAS. JÁ VEM COM EMOÇÃO DE SÉRIE.

**3**

**CITROËN**  
IMAGINAÇÃO EM TUDO

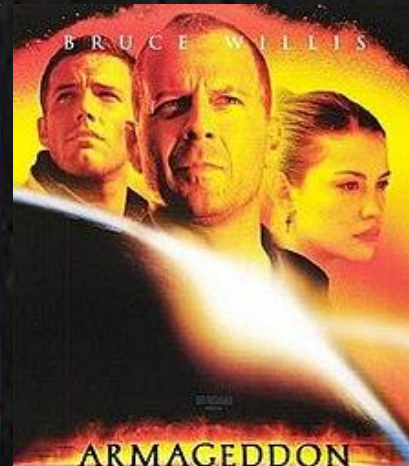
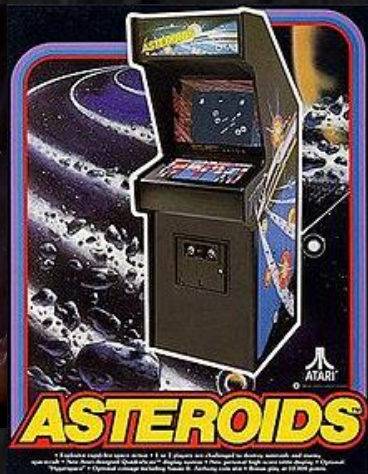
0800 811 8088 • www.citroen.com.br

The advertisement features a man in a dark shirt and jeans standing on a cobblestone walkway next to a silver Citroën C4 Pallas sedan. The background shows the Manhattan skyline and the Manhattan Bridge. The text 'CHEGOU O CITROËN C4 PALLAS. JÁ VEM COM EMOÇÃO DE SÉRIE.' is positioned above the car. In the bottom left corner, there is a red box with the number '3' and three small inset images. The Citroën logo and slogan 'IMAGINAÇÃO EM TUDO' are in the bottom right, along with the contact number '0800 811 8088' and website 'www.citroen.com.br'.

# Asteroides na ficção

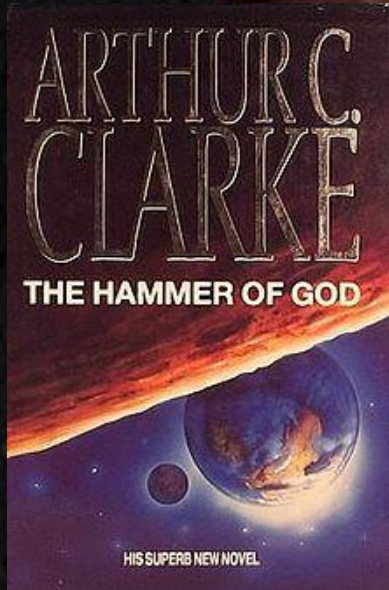


# THE DIG

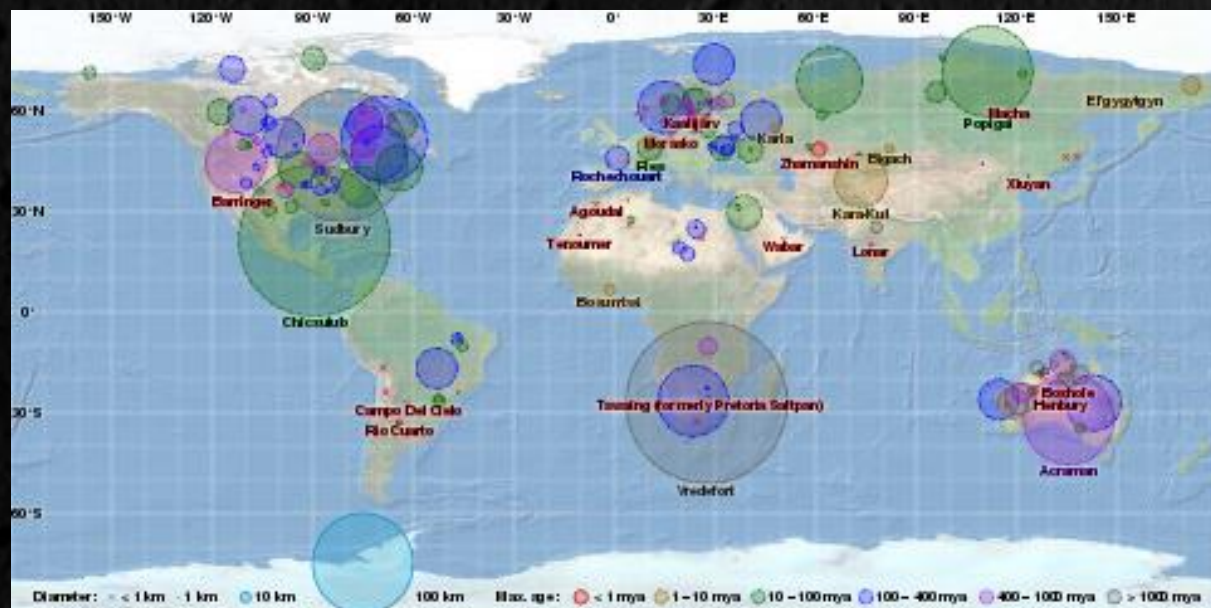


## Marooned Off Vesta

Isaac Asimov



**Pode cair um na Terra?**





# Cratera de Barringer

Local: Arizona/USA

Diâmetro: 1,2 km

Profundidade: 170 m

Borda: 45 m

Idade: 50 mil anos

Meteoroide: 50 m

Energia: 50 megaton  
(17 x WWII)



# Tunguska

Local: Sibéria/RUS

Diâmetro: 40 km

Idade: 30/06/1908

Meteoroide: 60 m

Energia: 1000xHiroshima



# Chicxulub

Local: Yucatán/MEX

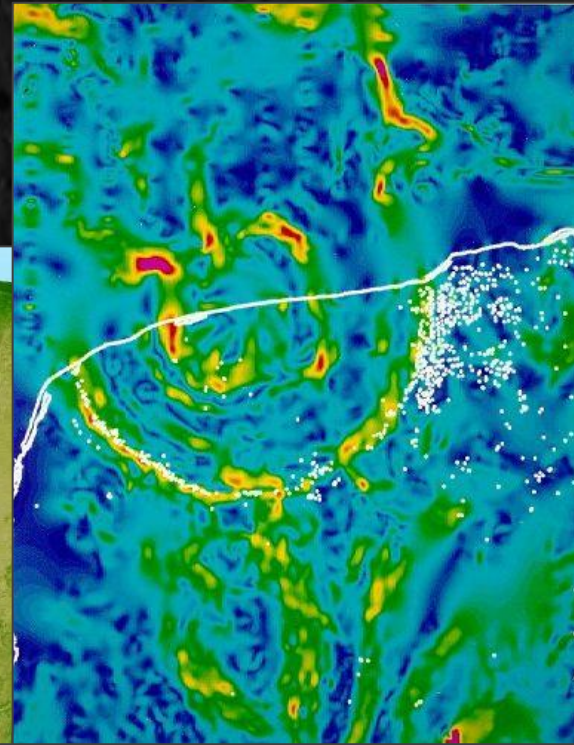
Diâmetro: 180 km

Profundidade: 1 km

Idade: 65 milhões de anos

Meteoroide: 10 km

Energia: 8bi x Hiroshima



# Chicxulub

Local: Yucatán/MEX

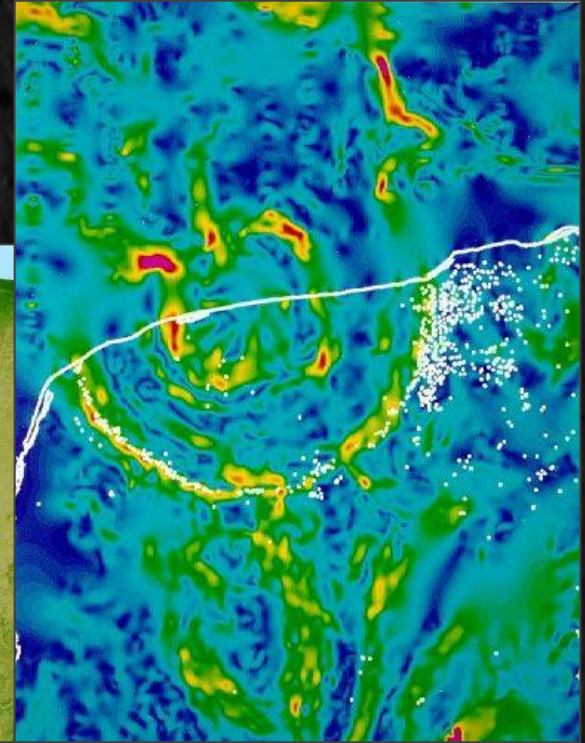
Diâmetro: 180 km

Profundidade: 1 km

Idade: 65 milhões de anos

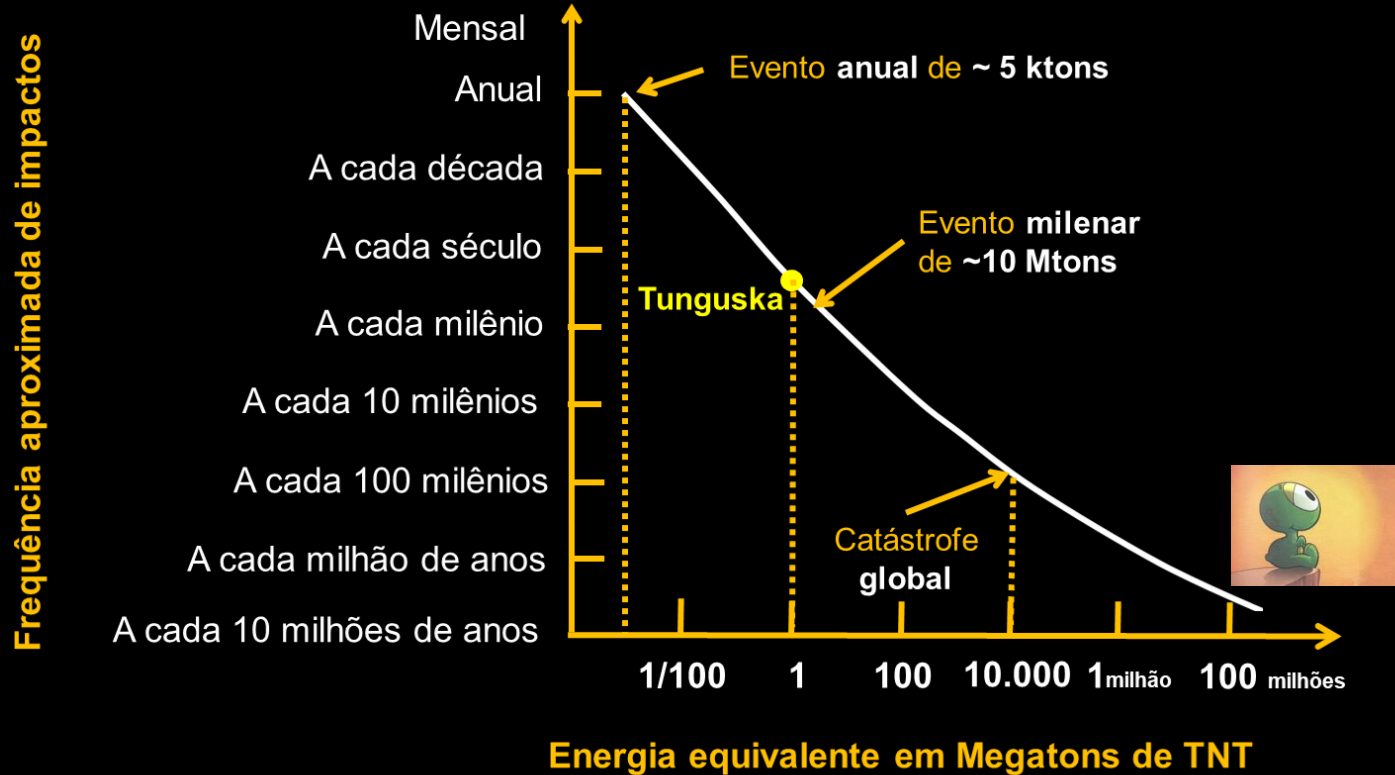
Meteoroide: 10 km

Energia: 8bi x Hiroshima



sula

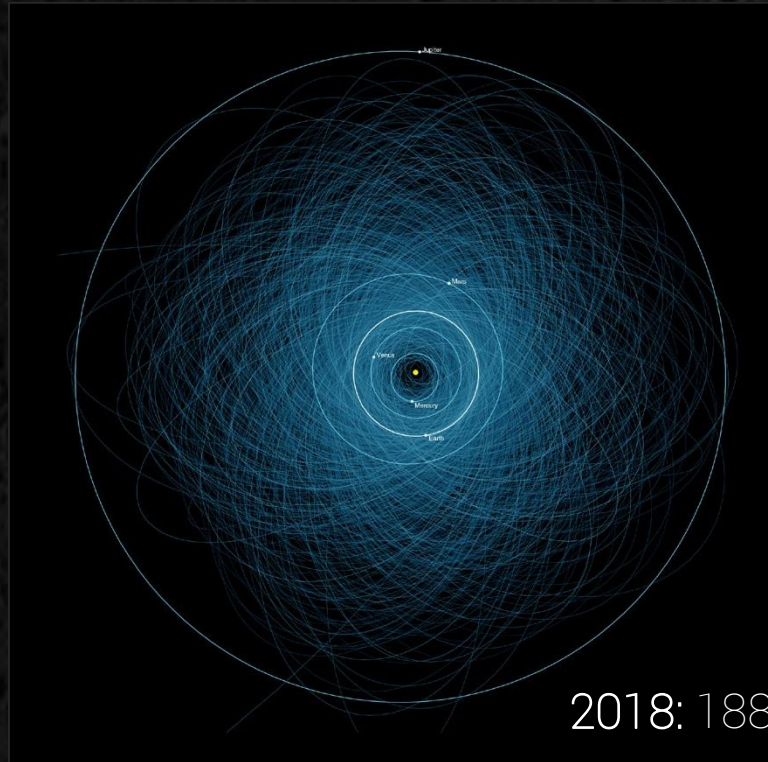
# frequência de impactos (estim.)

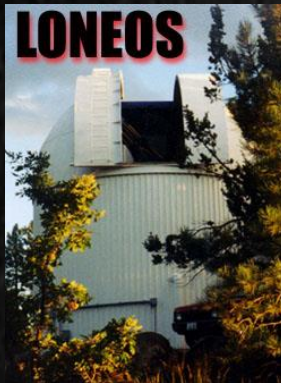


**E agora?**

# Objeto Potencialmente Perigoso (PHO)

19,5 Lua-Terra  
Magnitude absoluta: 22 ou menos





Sentinel Mission



The Spaceguard Central Node

*Nec cum fiducia inveniendi*



*Nec sine spe*



UA SCIENCE

**LUNAR & PLANETARY  
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SPACEWATCH®

A.D.A.S.  
Asiago - DLR Asteroid Survey



The International Astronomical Union  
**Minor Planet Center**



atlas





## NATIONAL NEAR-EARTH OBJECT PREPAREDNESS STRATEGY AND ACTION PLAN

*A Report by the*  
INTERAGENCY WORKING GROUP FOR DETECTING AND MITIGATING  
THE IMPACT OF EARTH-BOUND NEAR-EARTH OBJECTS

*of the*  
NATIONAL SCIENCE & TECHNOLOGY COUNCIL

JUNE 2018

- Melhorar a descoberta e acompanhamento de PHOs.
- Melhorar a simulação de impactos.
- Tecnologias para desvio e destruição de PHOs.
- Aumentar as colaborações internacionais.
- Rotina de procedimentos de emergência.

## Referências

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[https://www.youtube.com/watch?v=\\_lORzs90Ril](https://www.youtube.com/watch?v=_lORzs90Ril)

Formação do Sistema Solar: <https://www.youtube.com/watch?v=8Rg9v3J0liU>

Objetos Próximos da Terra: <https://www.youtube.com/watch?v=0Z3nzKcBfeI>

Asteroides na ficção: [https://en.wikipedia.org/wiki/Asteroids\\_in\\_fiction](https://en.wikipedia.org/wiki/Asteroids_in_fiction)

Google Maps das crateras de impacto: <http://impact.scaredycatfilms.com/>

# ASTEROIDS

...are nature's way of asking:



“How’s that space  
program coming along?”