



Universidad  
Industrial de  
Santander



GRUPO HALLEY DE ASTRONOMÍA Y  
CIENCIAS AEROSPAZIALES

# Astronomía Planetaria

## Clase 14 – Sistema Solar

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Escuela de Física

Grupo Halley de Astronomía y Ciencias Aeroespaciales

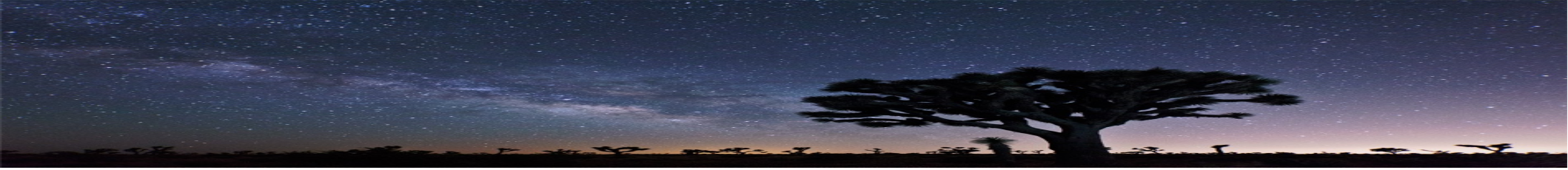
Universidad Industrial de Santander

Bucaramanga, II semestre de 2013



# Objetivos para hoy...

- Definir que es un sistema planetario.
- Describir los fenómenos asociados al Sol y su influencia en el clima espacial.



# ¿Qué es un sistema planetario?



# ¿Qué es un sistema planetario?

- Es una serie de planetas, y otros objetos, que por atracción gravitacional rotan alrededor de una, o varias estrellas.



# ¿y qué es la atracción gravitacional?

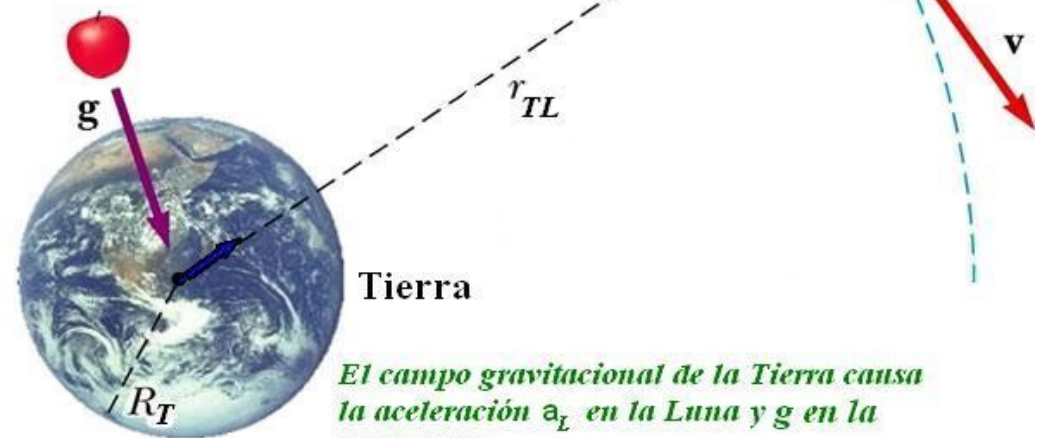


# ¿y qué es la atracción gravitacional?



Ley de Gravitación  
Universal de Newton

$$F_G = \frac{Gm_T m_L}{r_{TL}^2}$$



*El campo gravitacional de la Tierra causa la aceleración  $a_L$  en la Luna y  $g$  en la manzana.*

# ¿y qué es la atracción gravitacional?

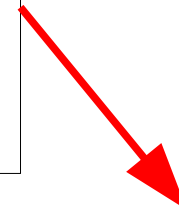


$$F = G \frac{m_1 m_2}{d^2}$$

# ¿y qué es la atracción gravitacional?



$$F = G \frac{m_1 m_2}{d^2}$$



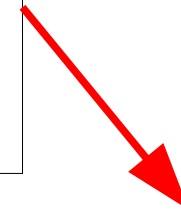
Leyes de Kleper



# ¿y qué es la atracción gravitacional?



$$F = G \frac{m_1 m_2}{d^2}$$



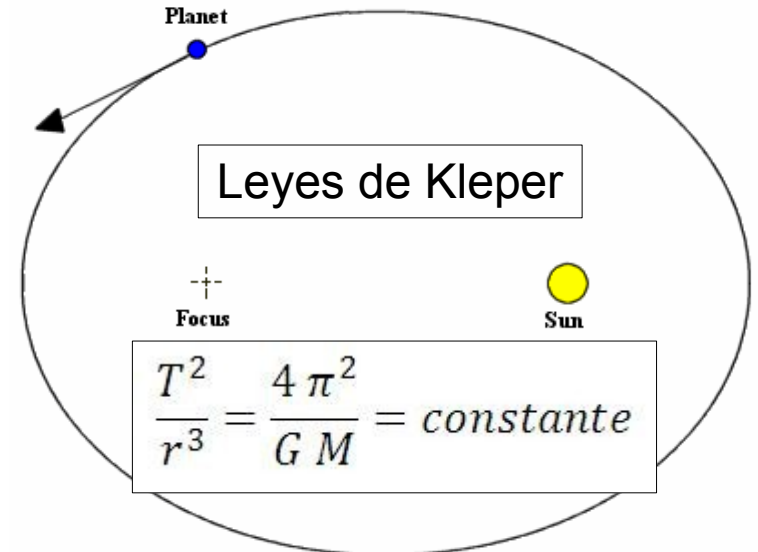
Leyes de Kleper

$$\frac{T^2}{r^3} = \frac{4 \pi^2}{G M} = \text{constante}$$

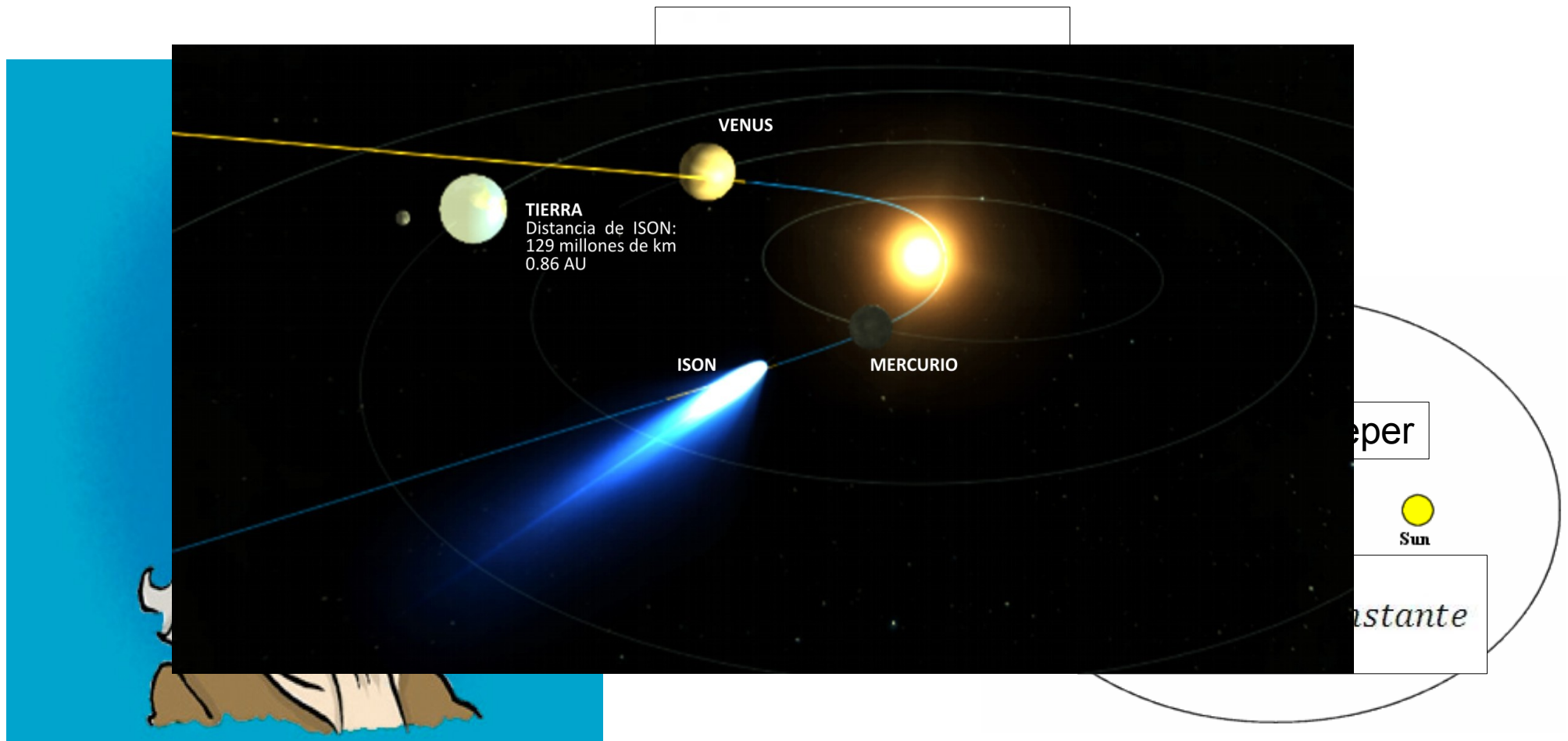
# ¿y qué es la atracción gravitacional?



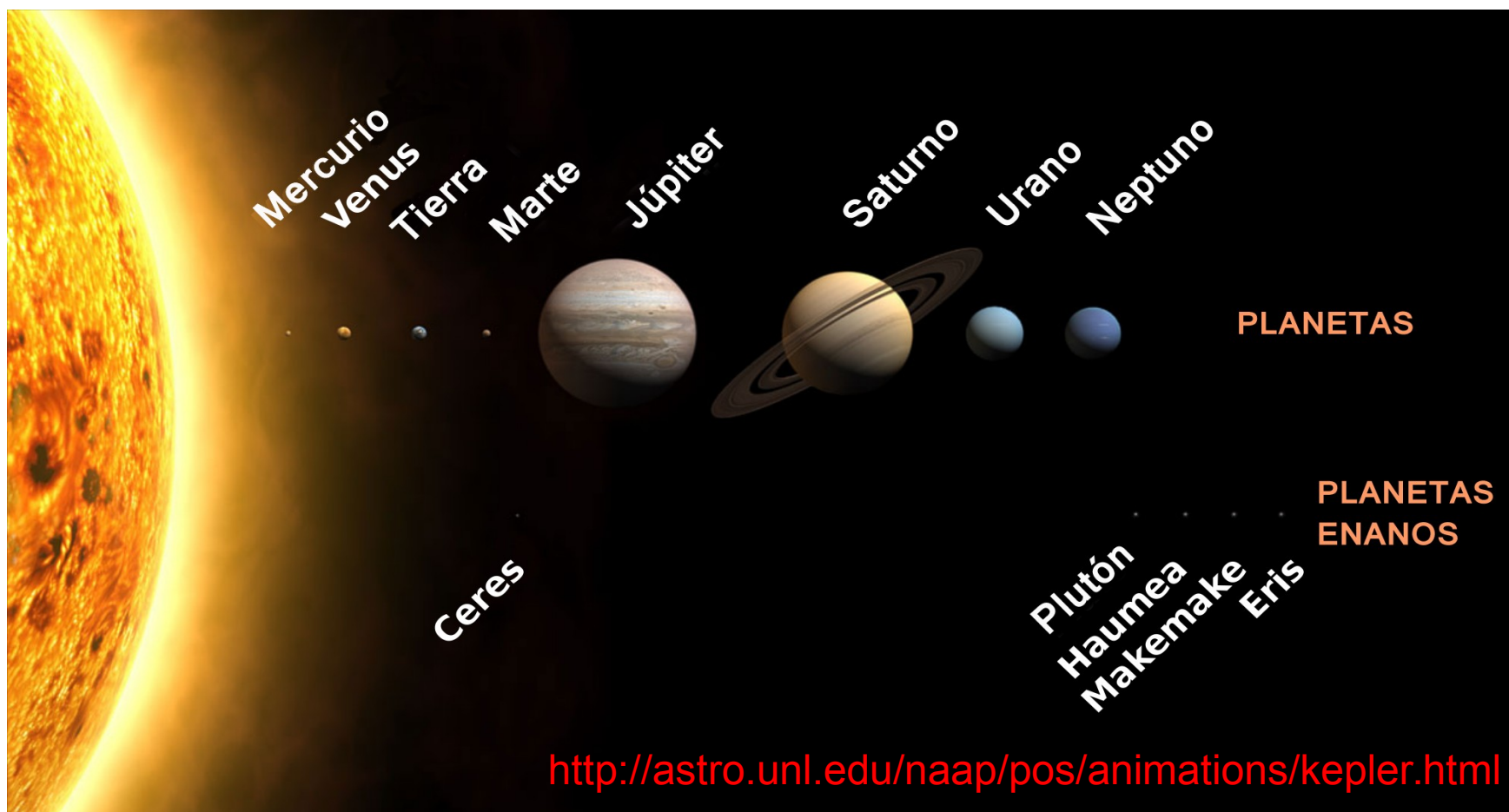
$$F = G \frac{m_1 m_2}{d^2}$$



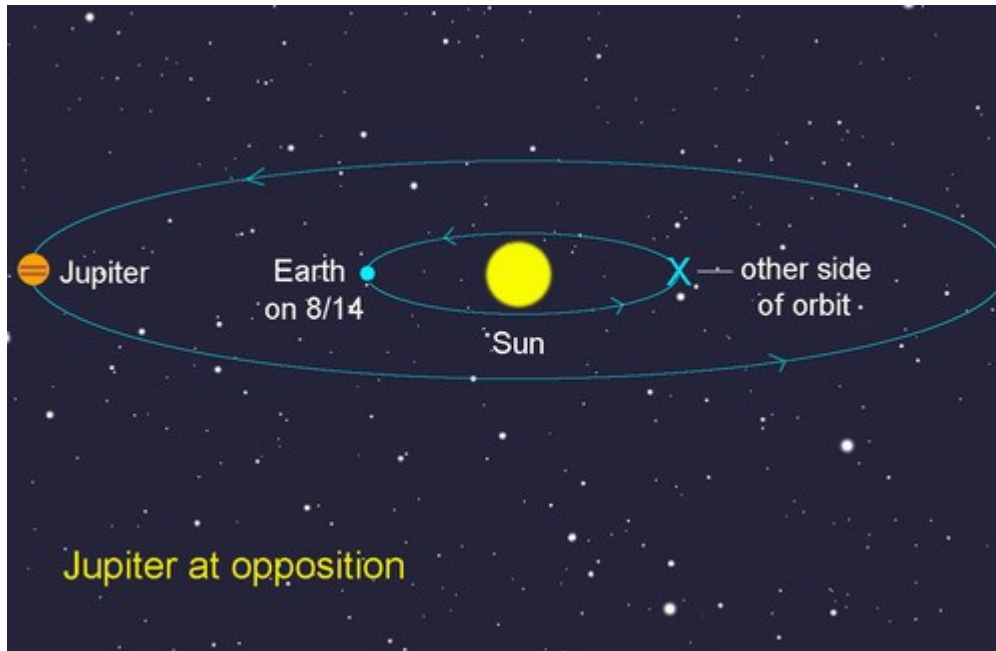
# ¿y qué es la atracción gravitacional?



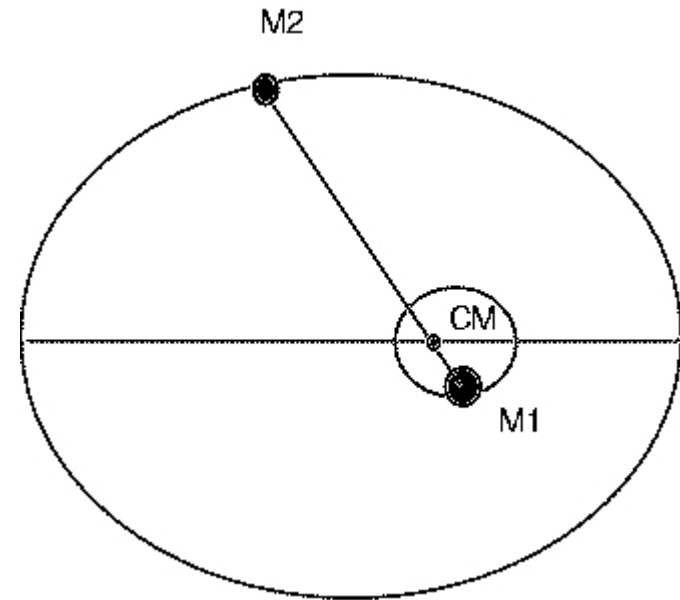
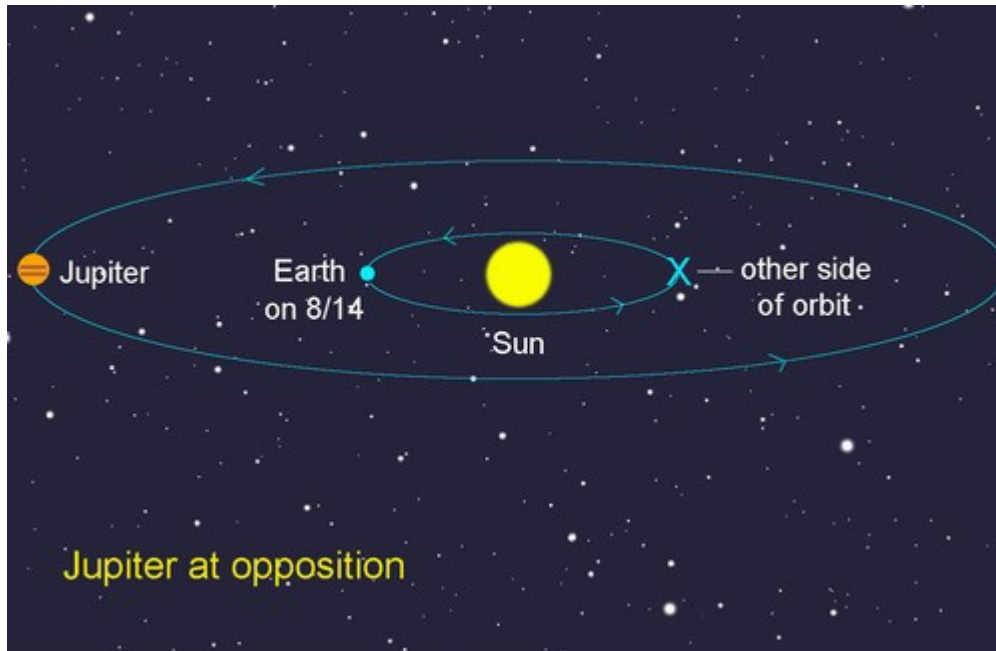
# Como un caso particular: el Sistema Solar



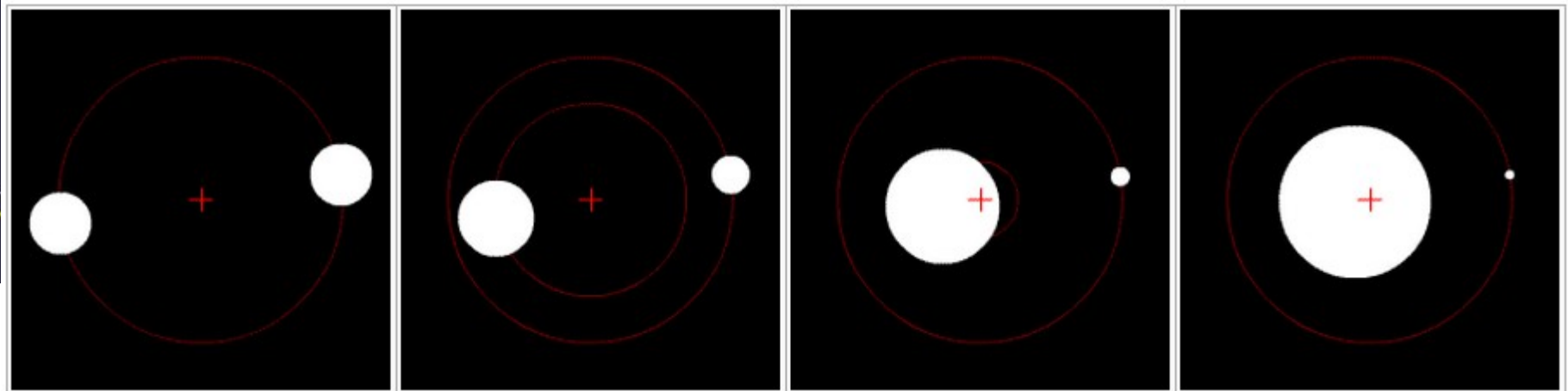
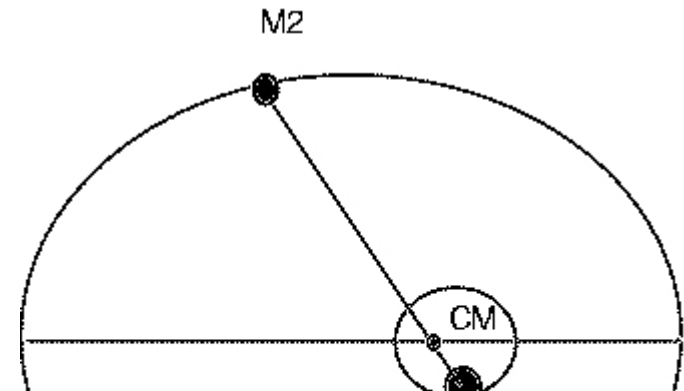
# Baricentro del Sistema Solar



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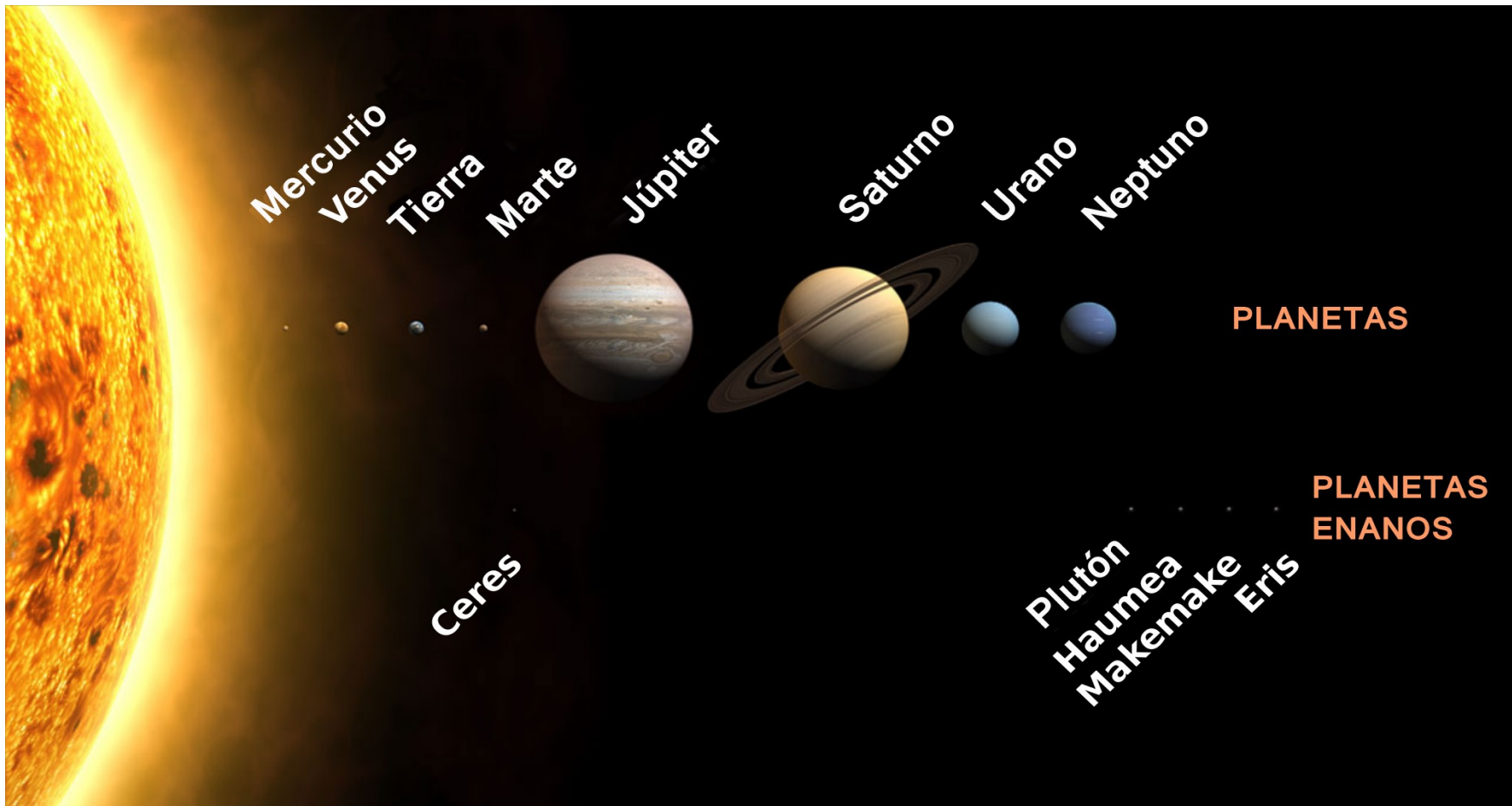


# Baricentro del Sistema Solar



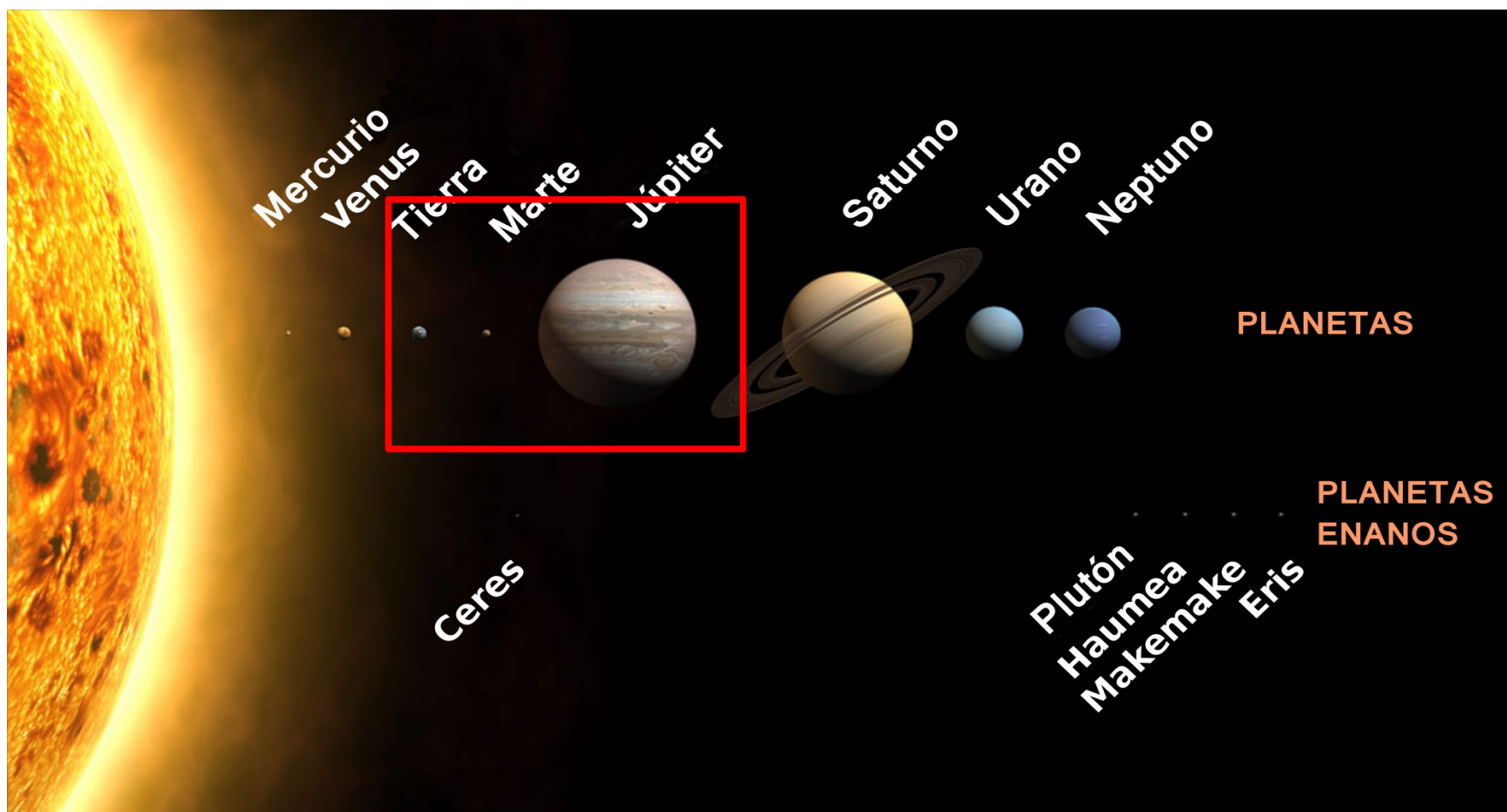
[http://en.wikipedia.org/wiki/Barycentric\\_coordinates\\_\(astronomy\)](http://en.wikipedia.org/wiki/Barycentric_coordinates_(astronomy))

# Como un caso particular: el Sistema Solar

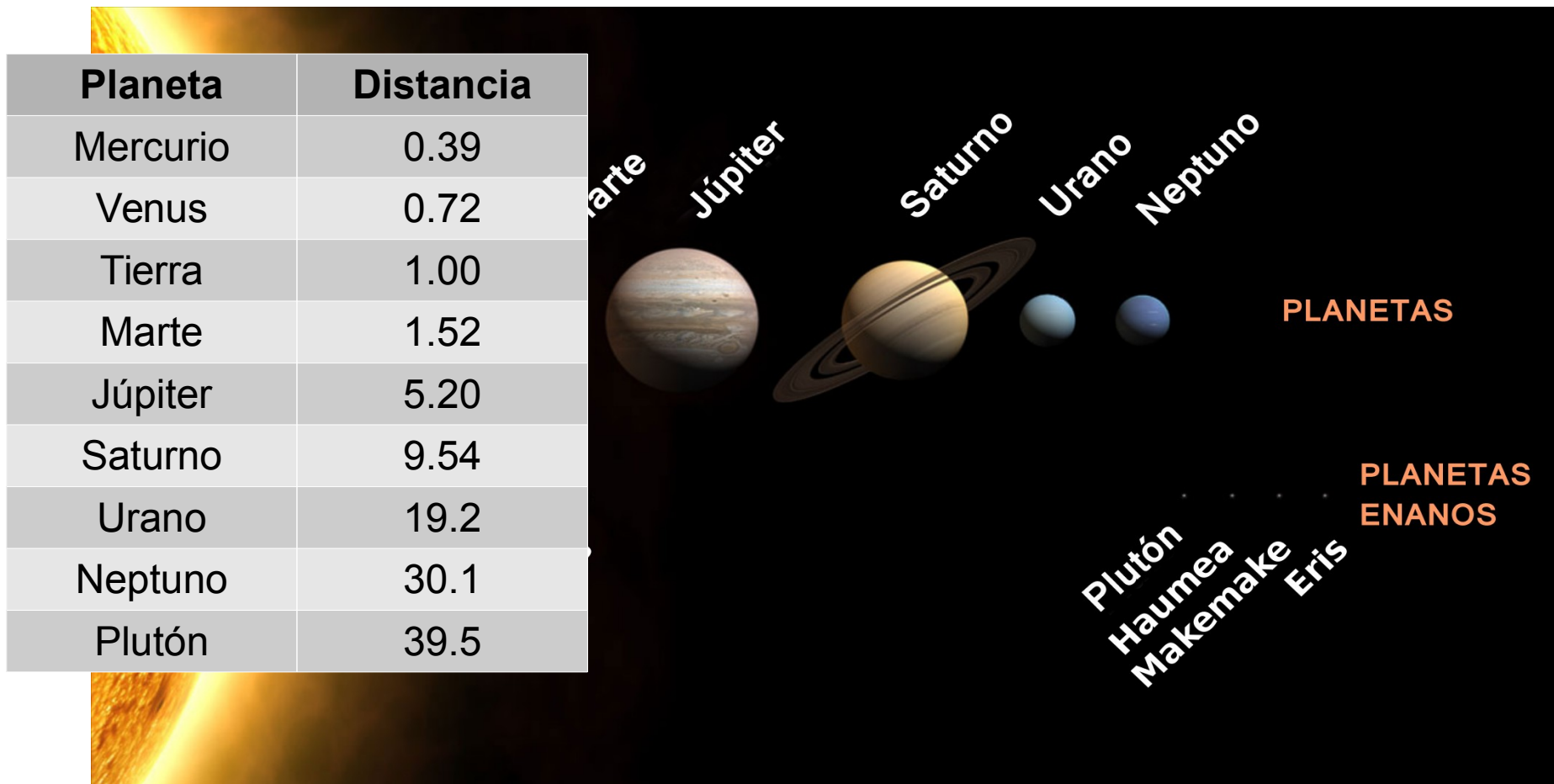




# Como un caso particular: el Sistema Solar



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Astronomía planetaria, clase 14. S. Solar

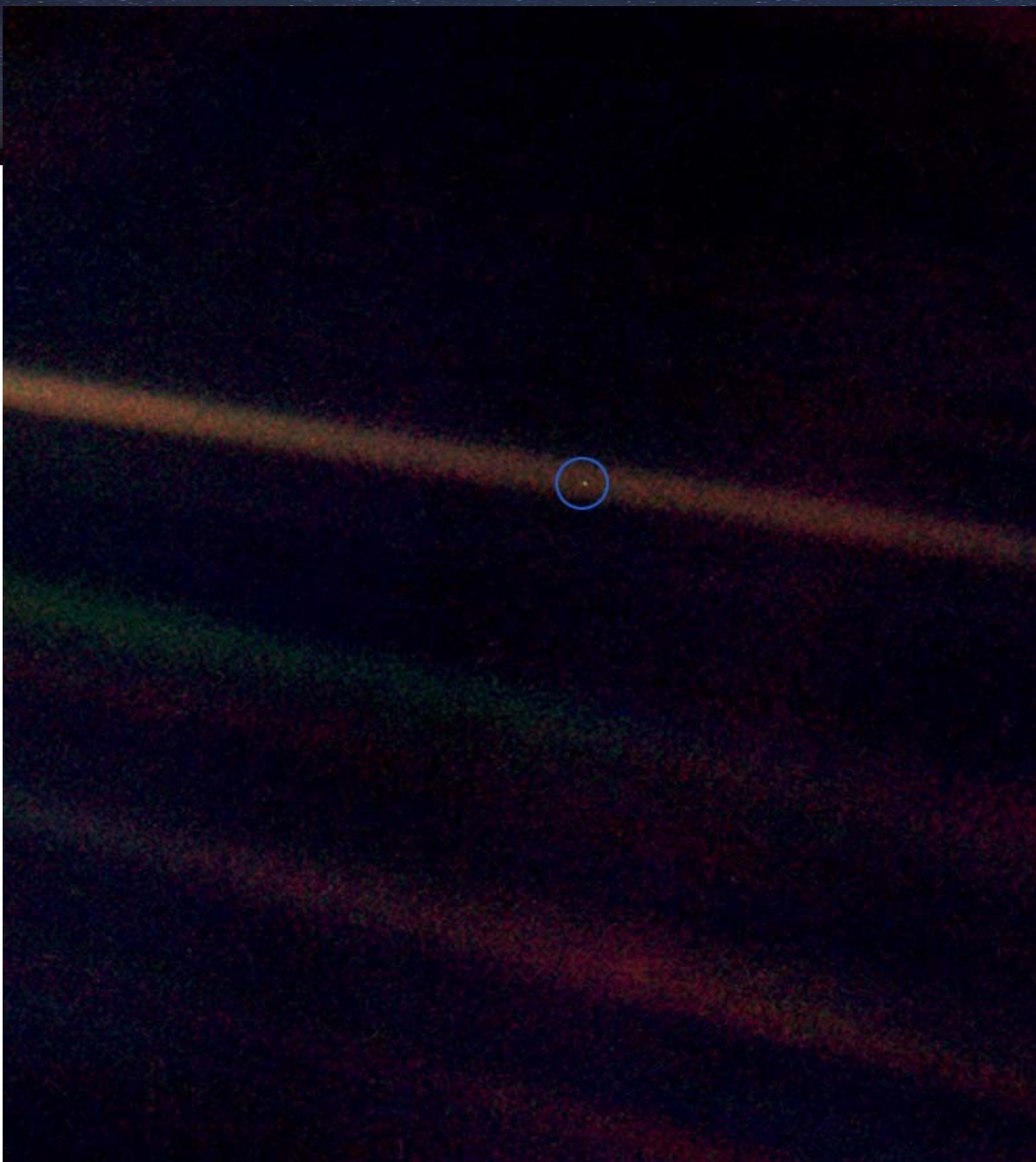
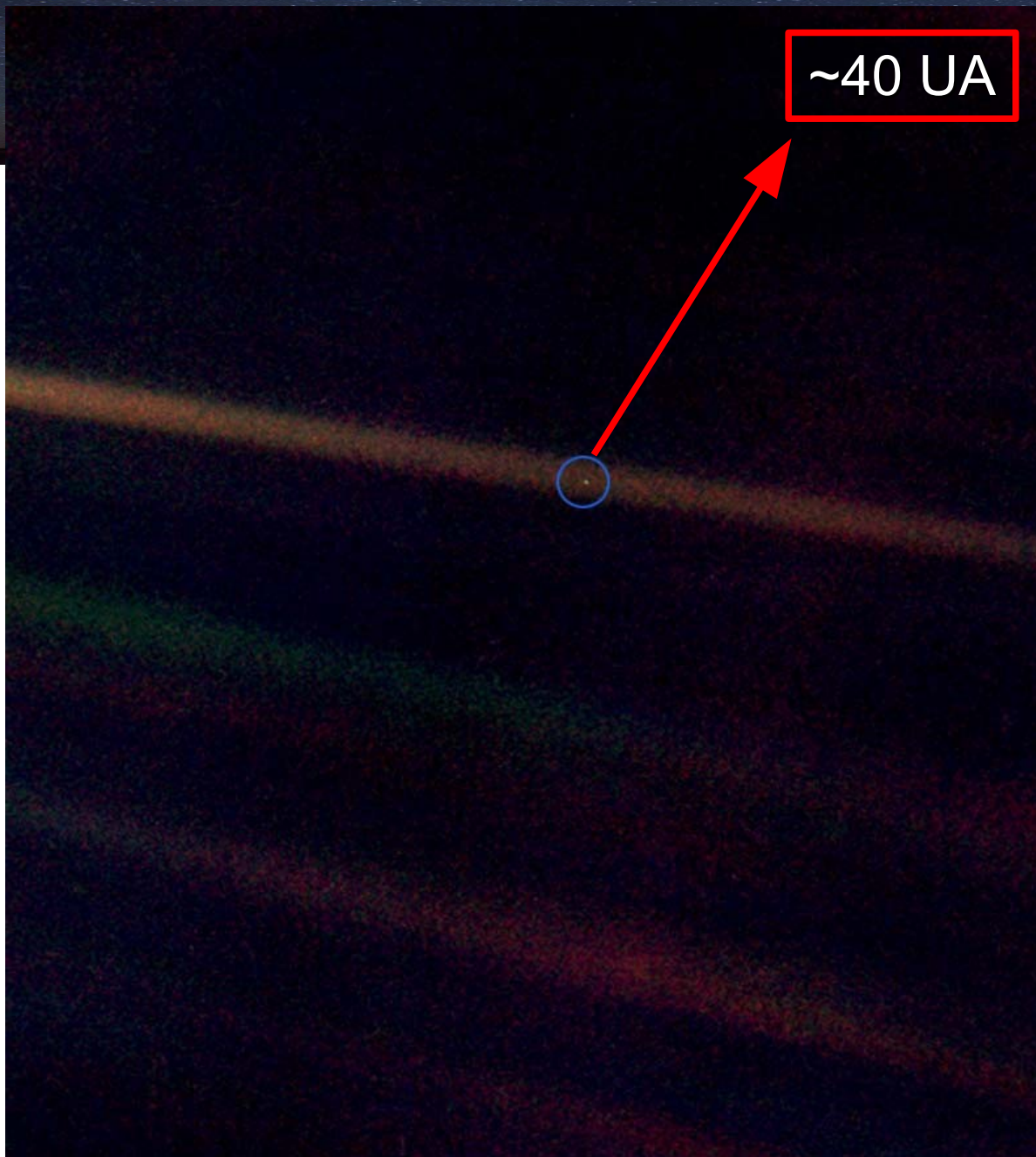


Image Landsat  
Image © 2014 DigitalGlobe

Tour Guide

Imagery Date: 4/9/2013 6°54'40.01" N 73°01'03.83" W elev 1401 m eye alt 50.29 km

Astronomía planetaria, clase 14. S. Solar



~40 UA



~40 UA



The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that in glory and triumph they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner. How frequent their misunderstandings, how eager they are to kill one another, how fervent their . Our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity – in all this vastness – there is no hint that help will come from elsewhere to save us from ourselves.

Image Landsat  
Image © 2014 DigitalGlobe

Google earth

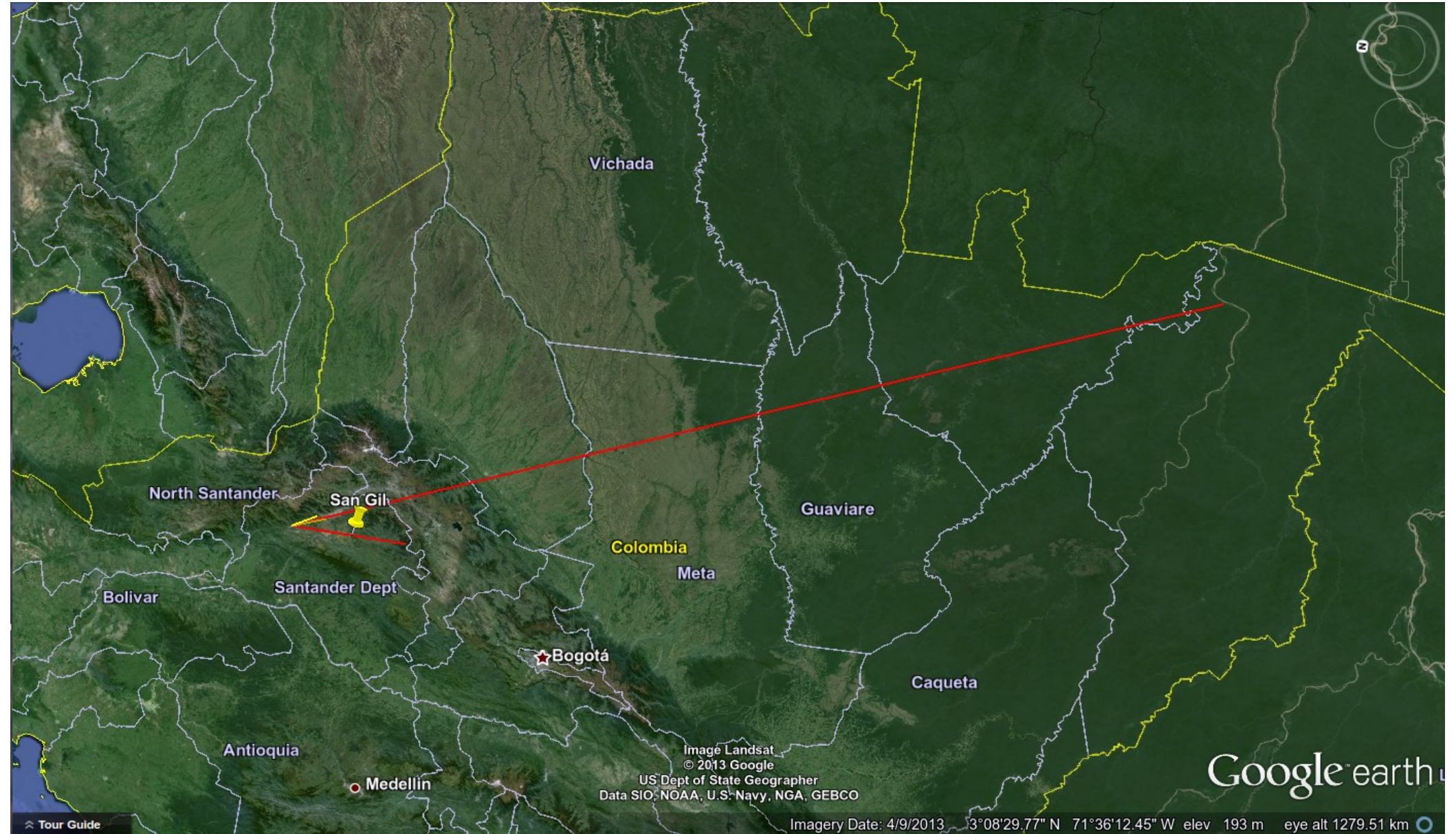
Tour Guide

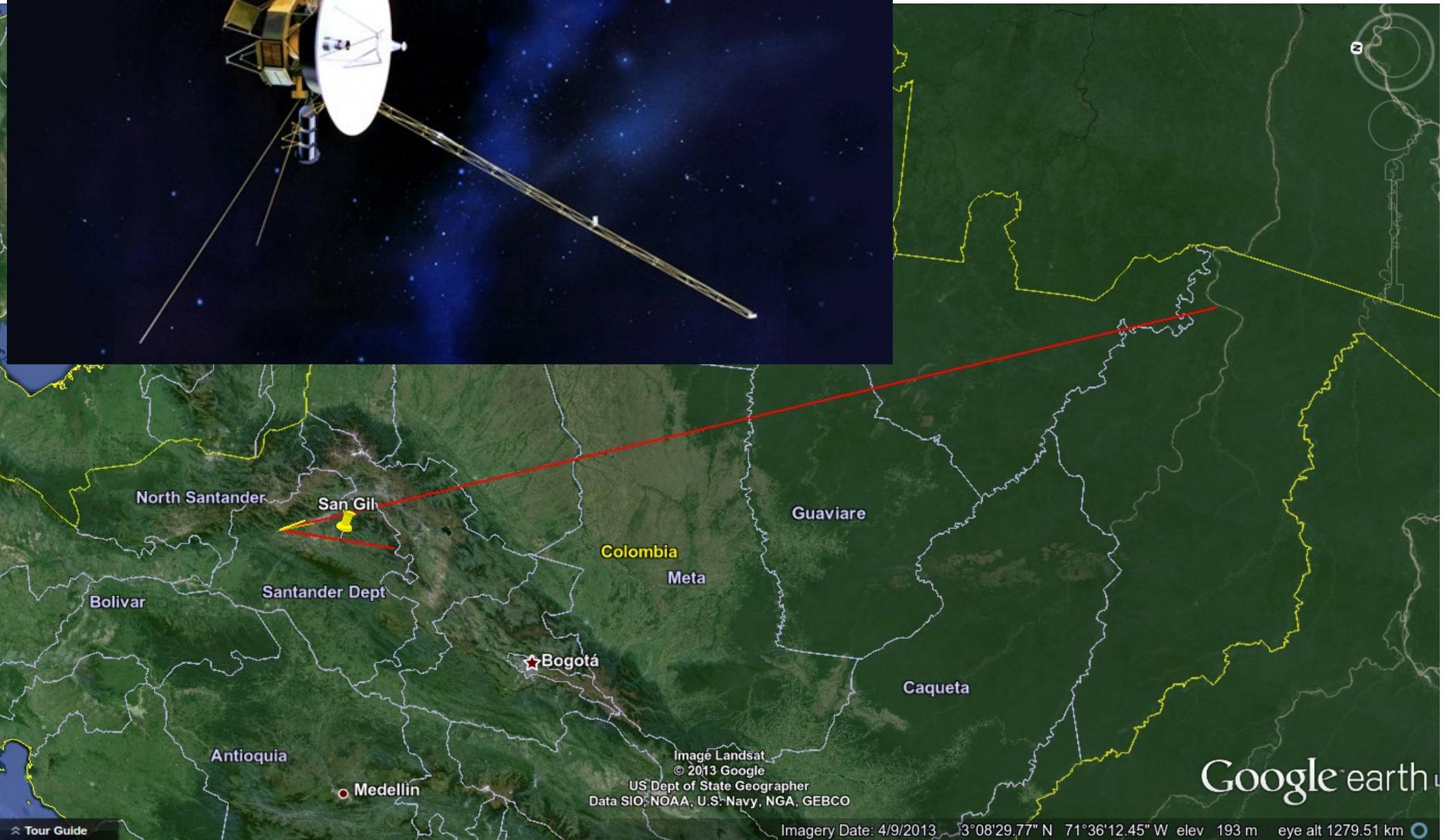
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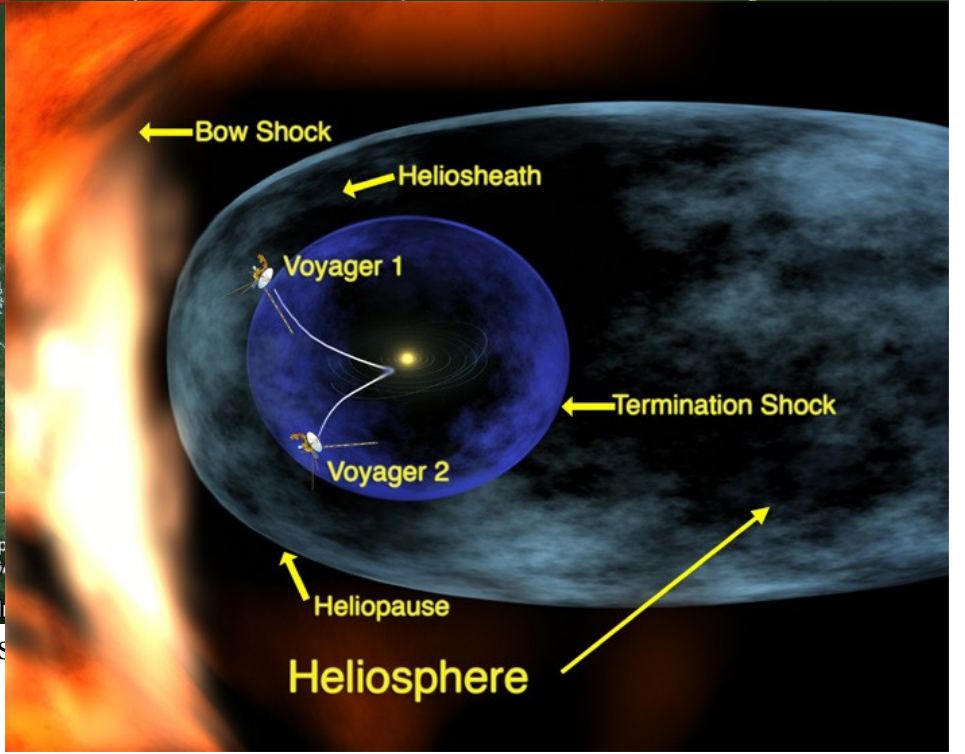
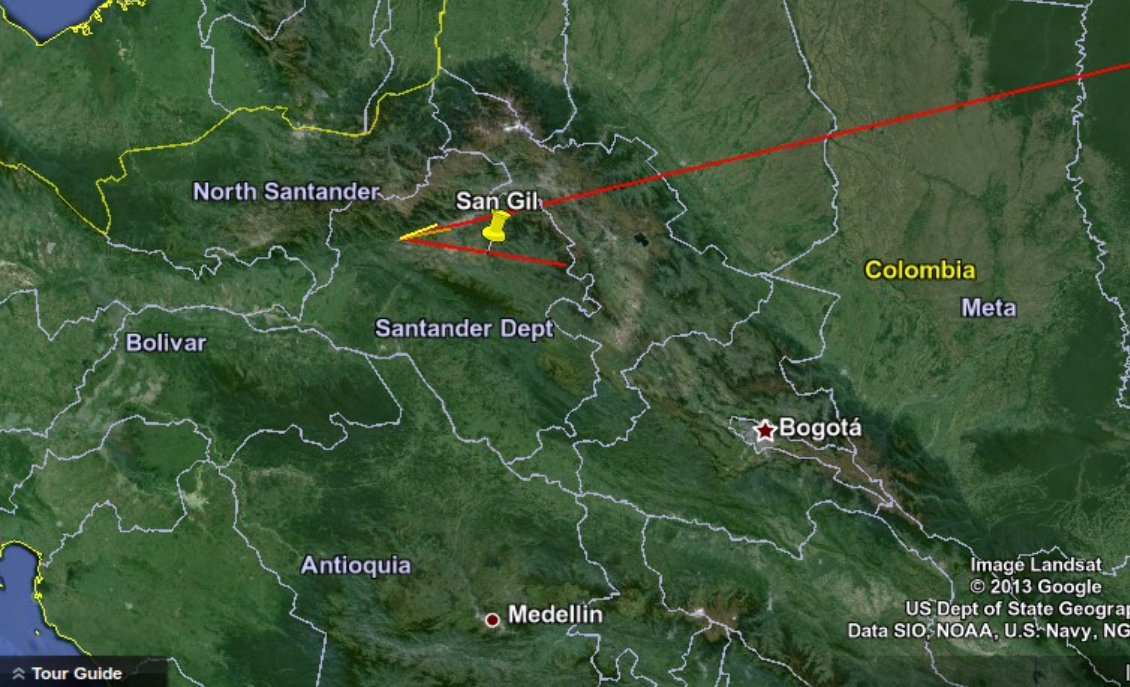
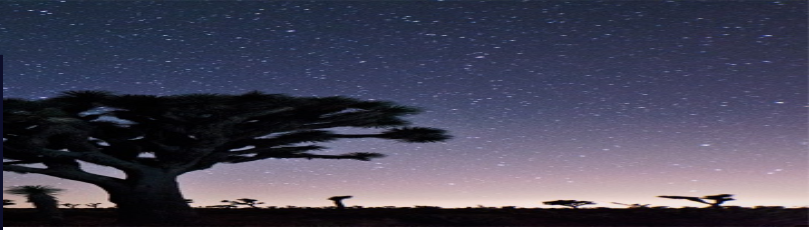
~40 11A

The Earth is a very small speck in the vastness of the universe. The blood spilled by all those who have lived on this planet, if they could be gathered together, they could become the moisture of a single drop in the ocean. The endless cruelties visited by the scarcely distinguishable inhabitants of some other corner of this globe, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds, our boasted civilization, our posturings, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity – in all this vastness – there is no hint that help will come from elsewhere to save us from ourselves.

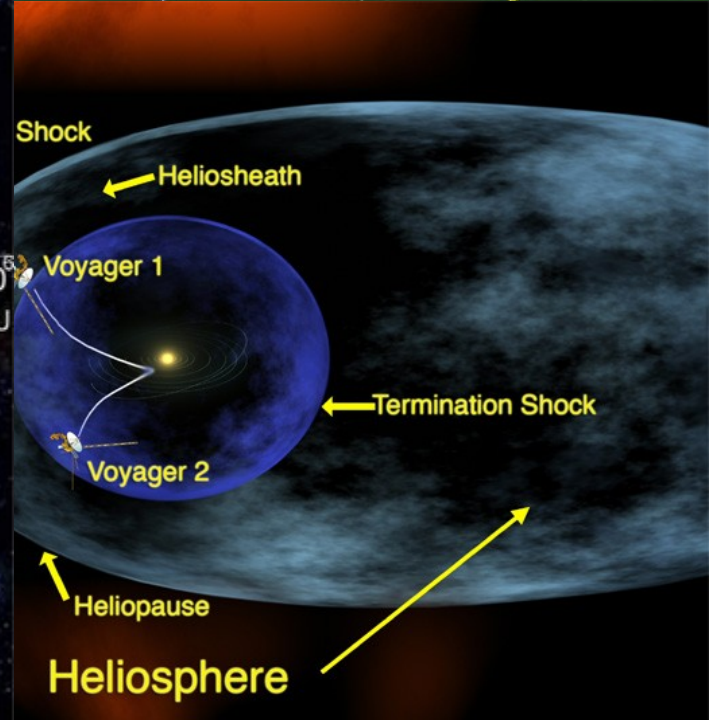
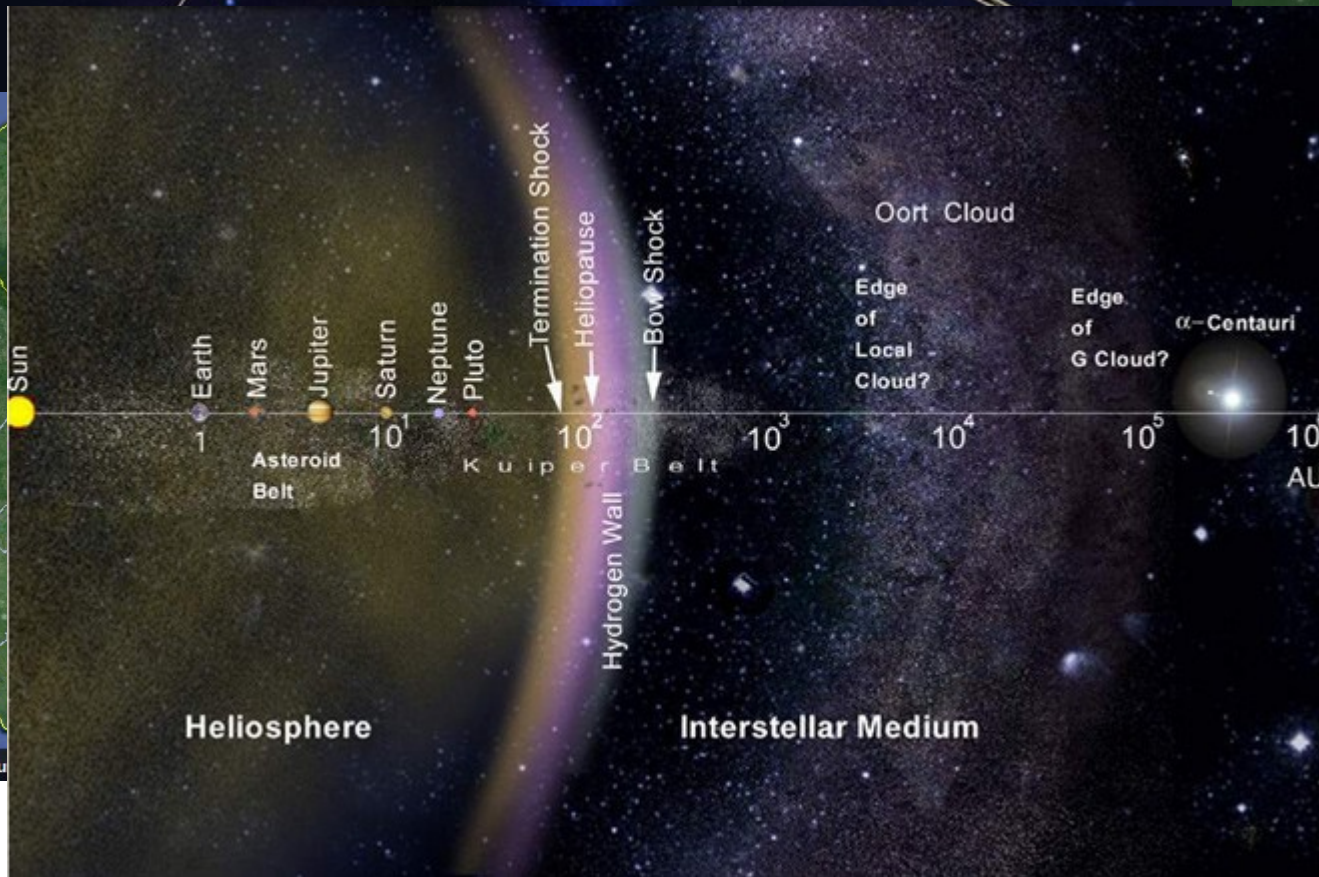
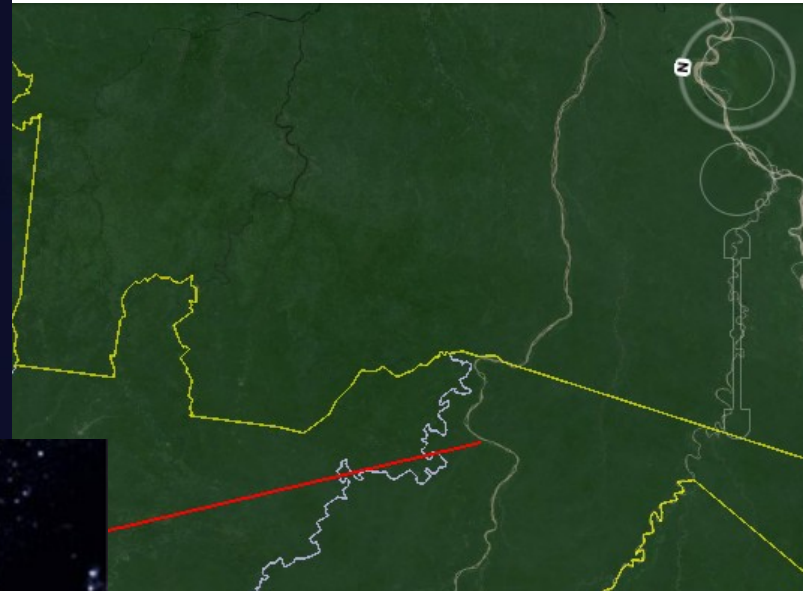
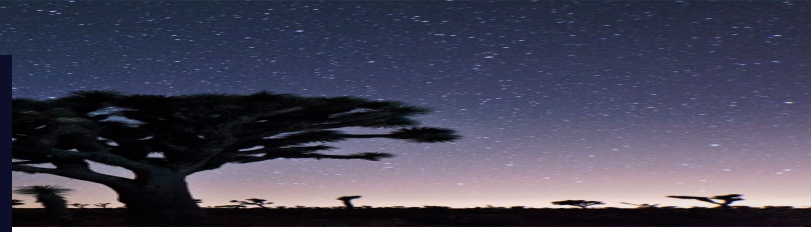


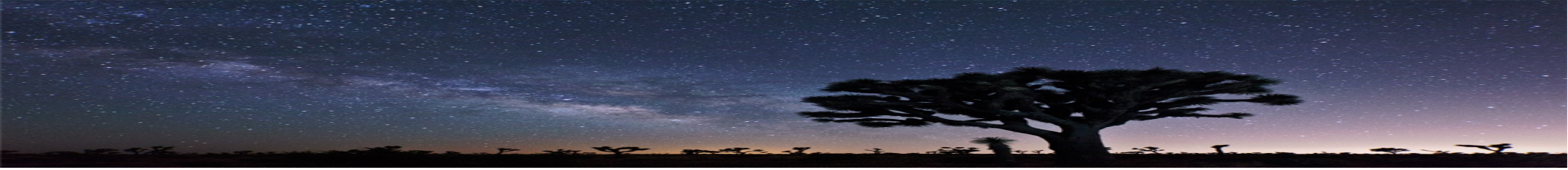






Astronomía planetaria, clas

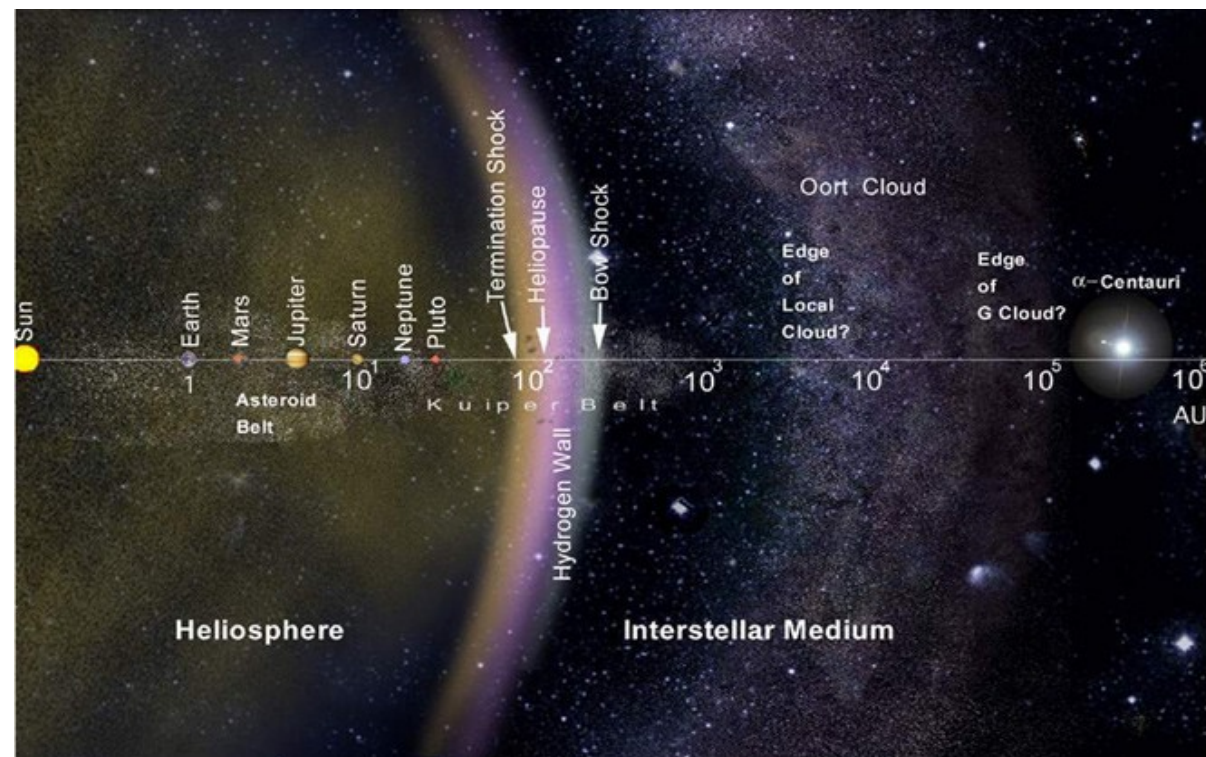




# ¿Y cuál es el límite del Sistema Solar?

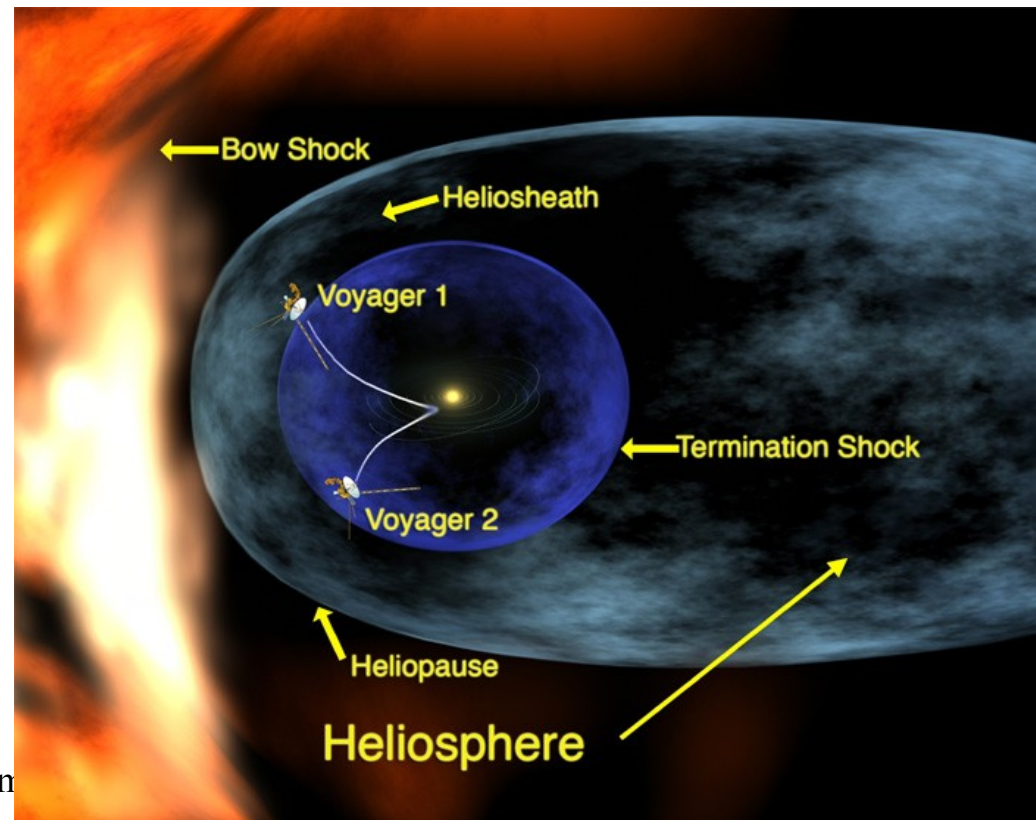
# ¿Y cuál es el límite del Sistema Solar?

- En términos gravitacionales: el límite exterior de la nube de Oort (~100000 UA).



# ¿Y cuál es el límite del Sistema Solar?

- Para la física Solar: la Heliopausa (~100 UA)





# El Sol como nuestra estrella principal





# El Sol como nuestra estrella principal



- Determina la dinámica del nuestro sistema planetario.
- Marca los bordes los límites del Sistema Solar.
- Produce la energía que requerimos para vivir.

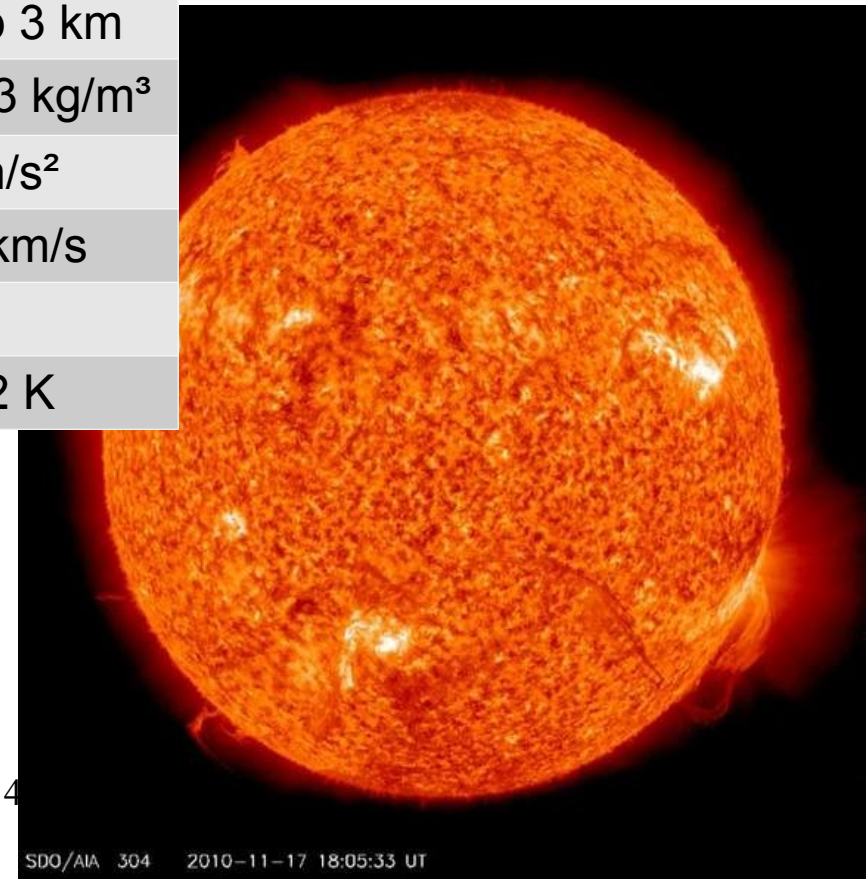


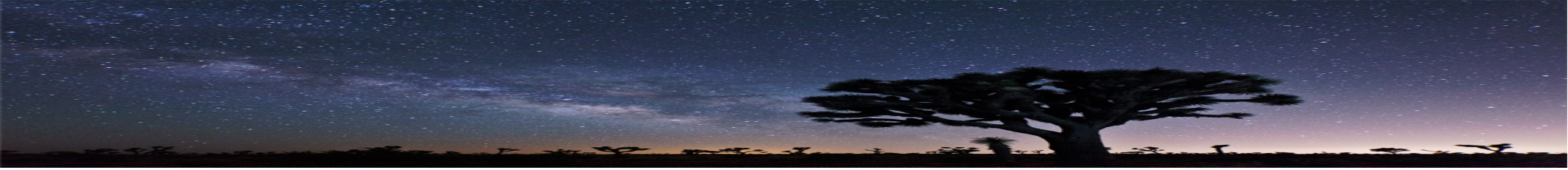
# ¿Qué sabemos del Sol?



# Características generales

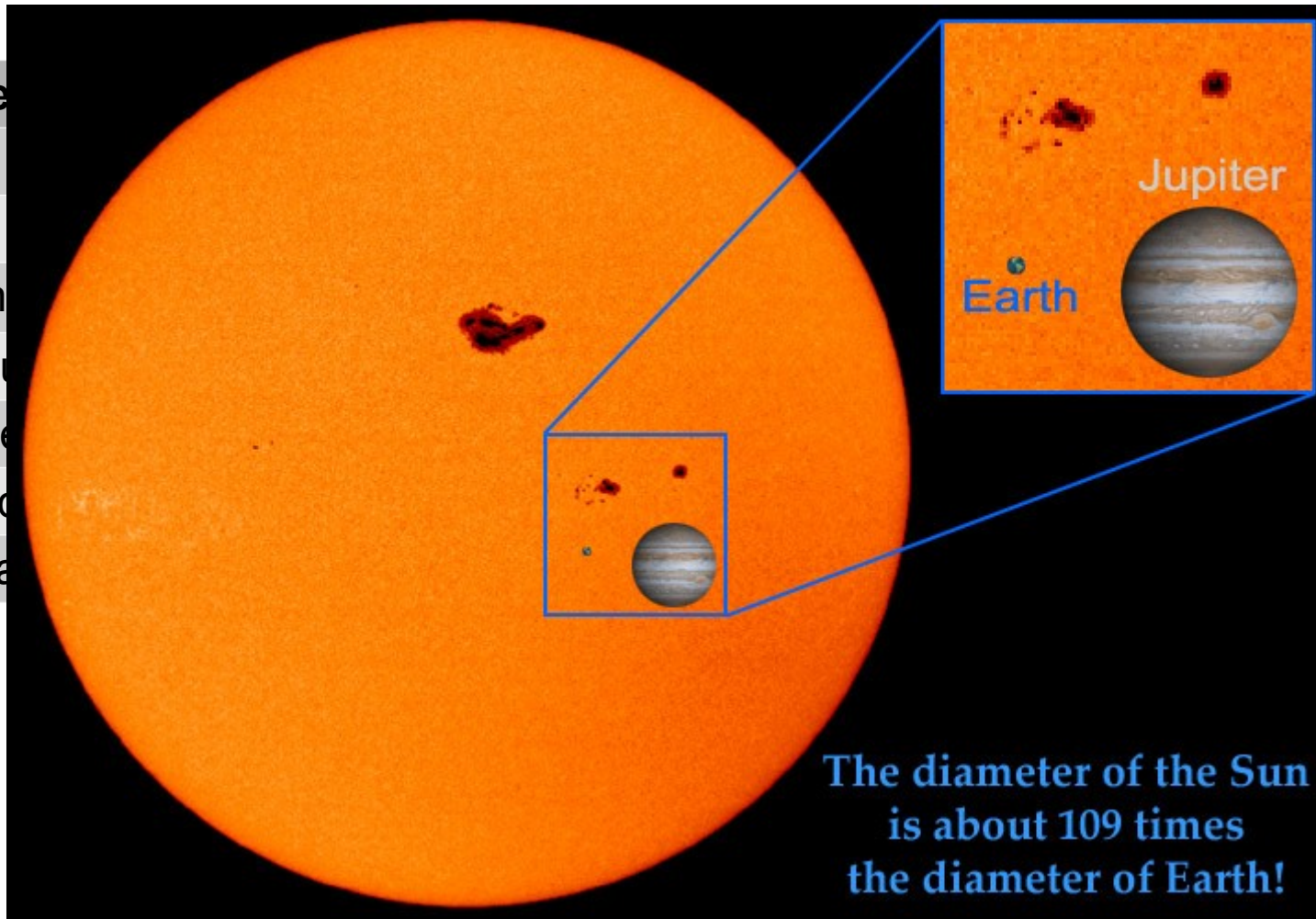
Propiedad	Sol	Tierra
Masa	1,99 exp 30 kg	5,97 exp 24 kg
Radio	6,96 exp 5 km	6,37 exp 3 km
Densidad media	1,41 exp 3 kg/m <sup>3</sup>	5,52 exp 3 kg/m <sup>3</sup>
Gravedad superficial	2.74 exp 2 m/s <sup>2</sup>	9,8 m/s <sup>2</sup>
Velocidad de escape	6,18 exp 2 km/s	11,19 km/s
Luminosidad	3.86 exp 26 W	--
Temperatura efectiva	5770 K	287,2 K



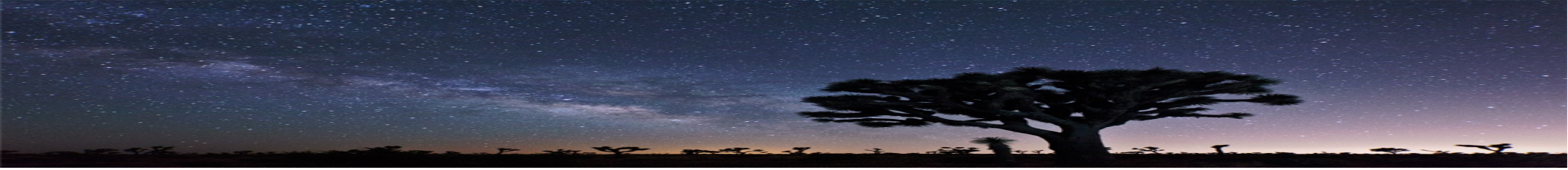


# Características generales

Propie
Masa
Radio
Densidad m
Gravedad s
Velocidad de
Luminosidad
Temperatura



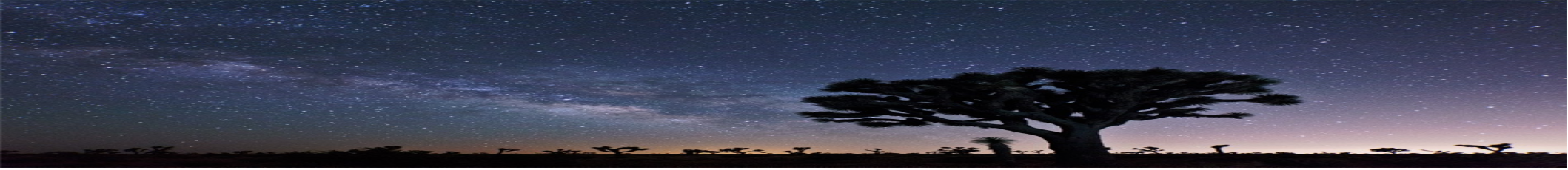
The diameter of the Sun is about 109 times the diameter of Earth!



# Estructura Solar

- Neutrinos
- Espectrometría





# ¿Cómo lo podemos estudiar?

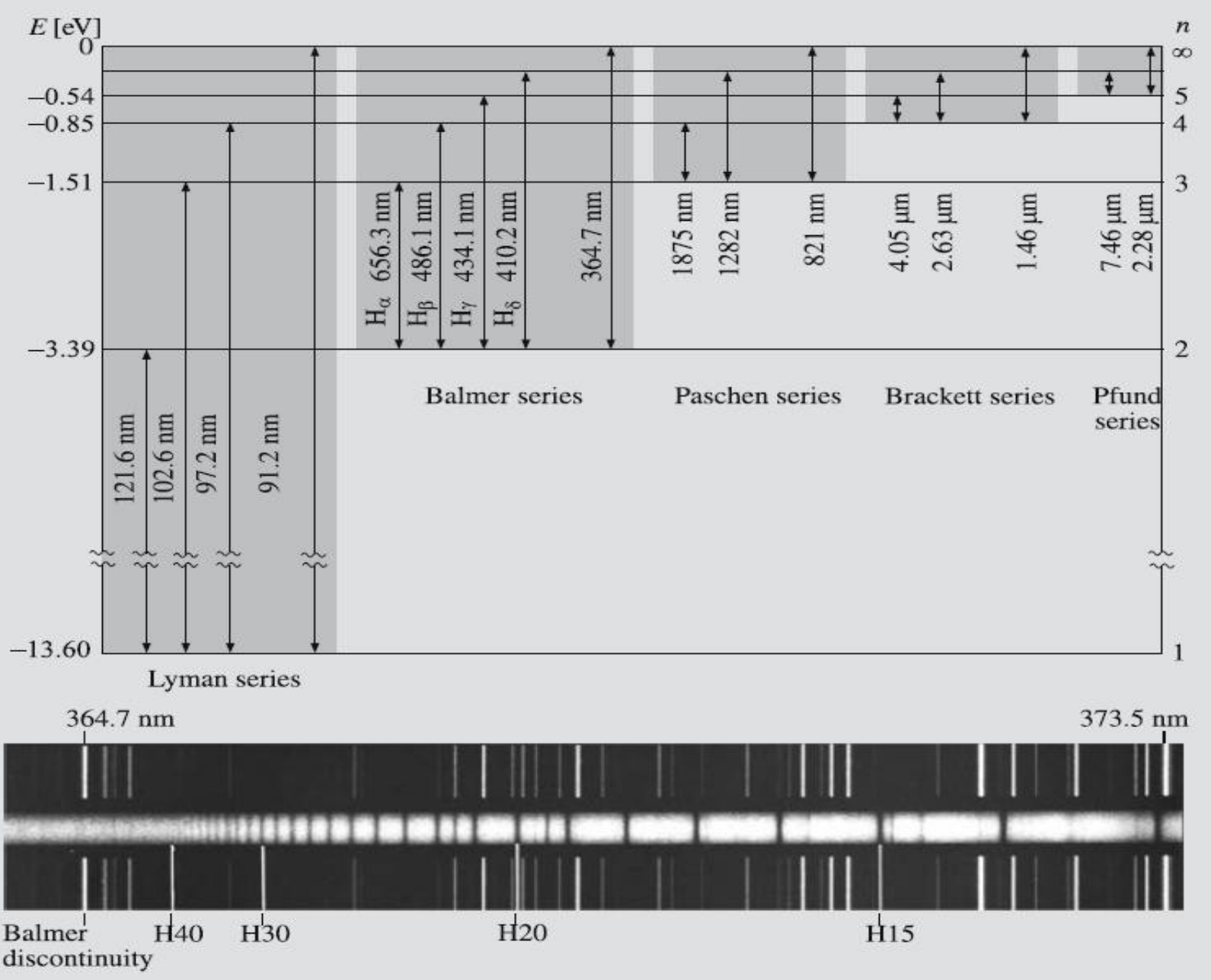
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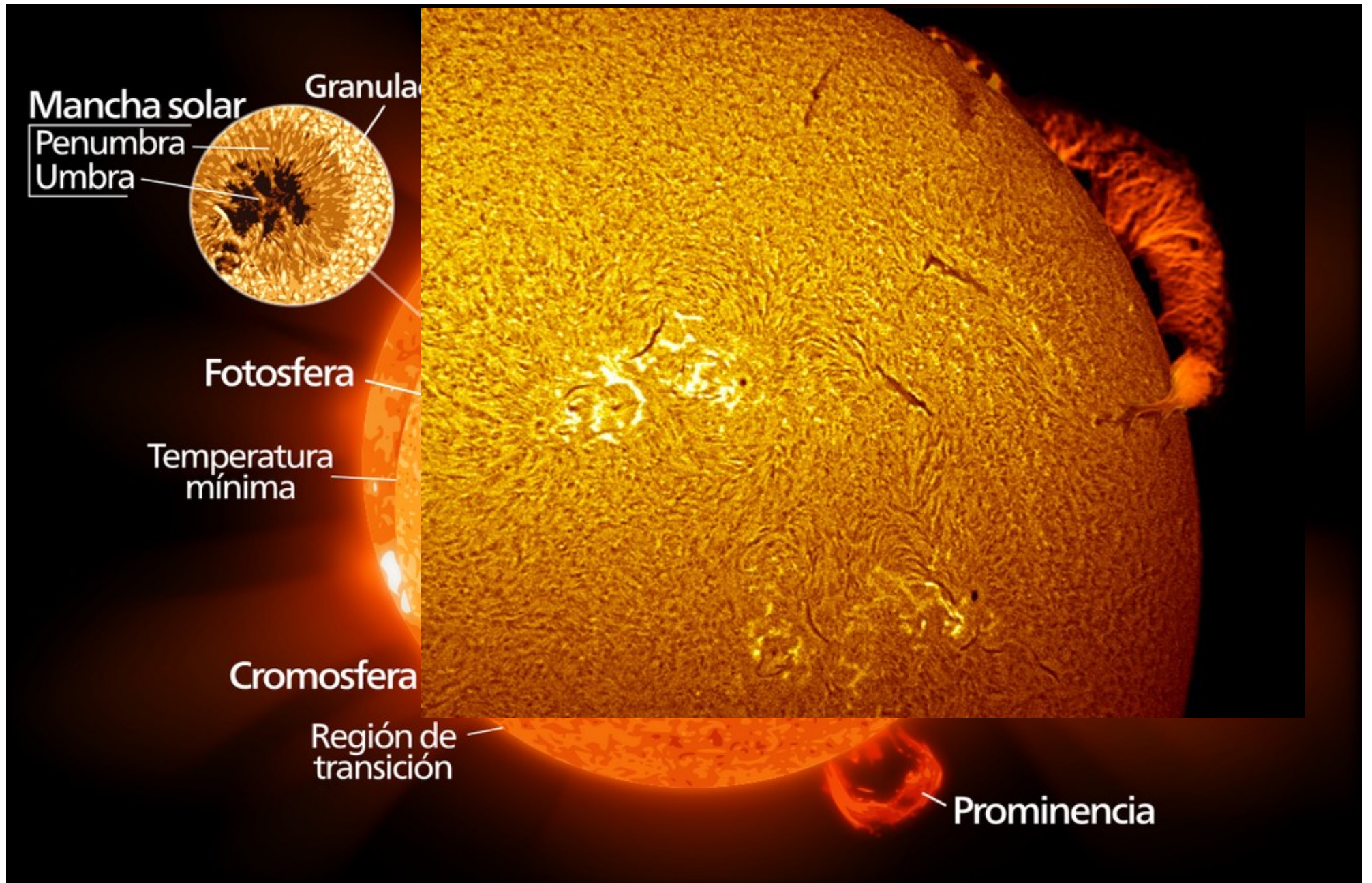


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d. As

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Mancha solar

Granular

Penumbra

Umbra

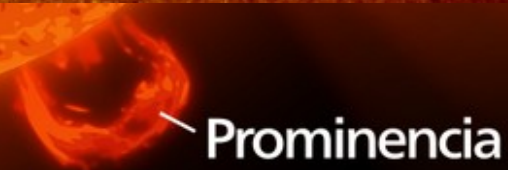
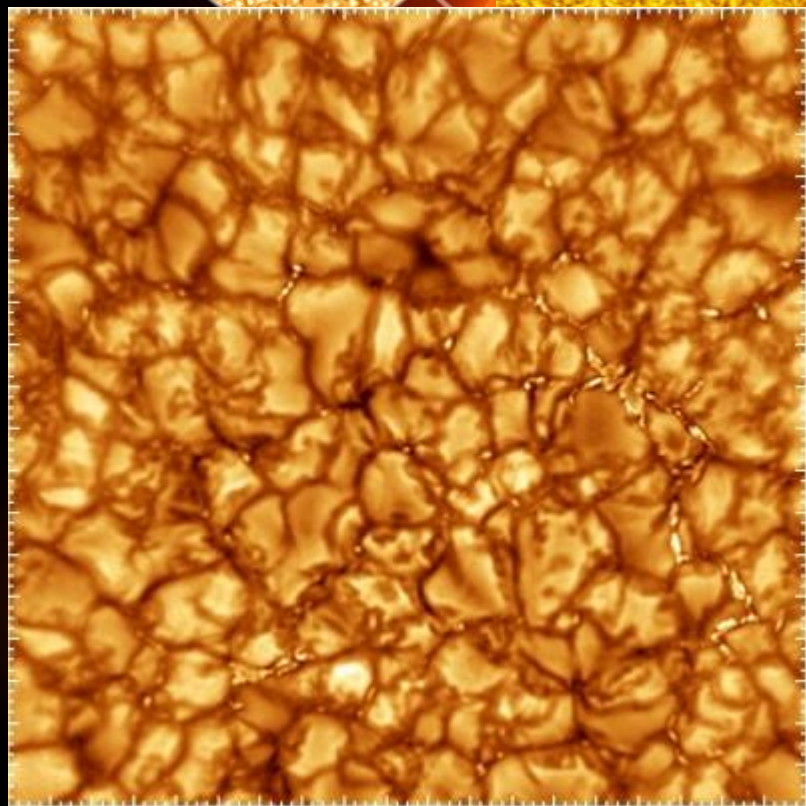
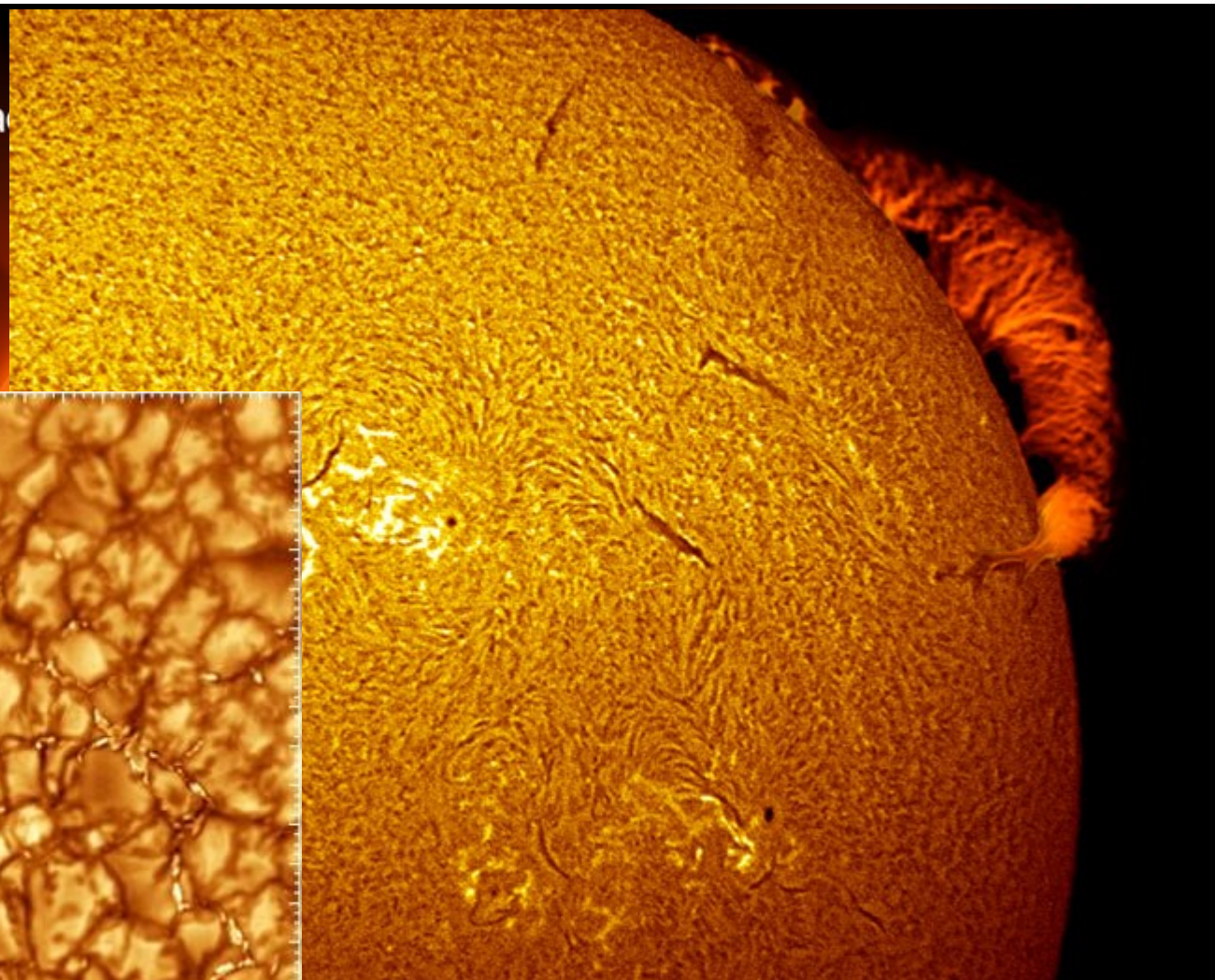
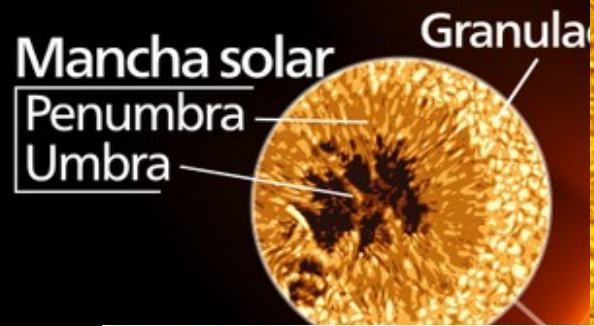
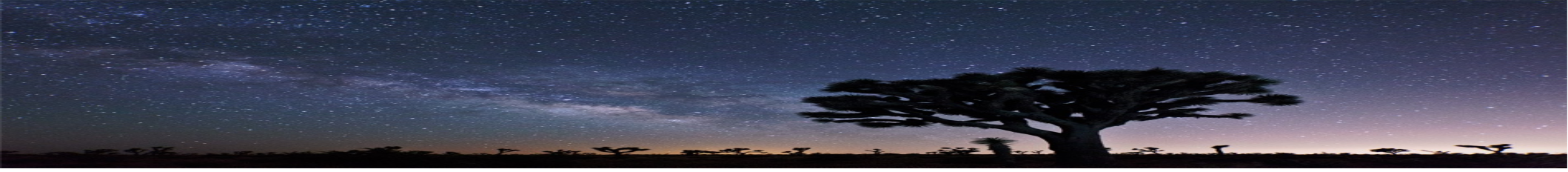
Fotosfera

Temperatura mínima

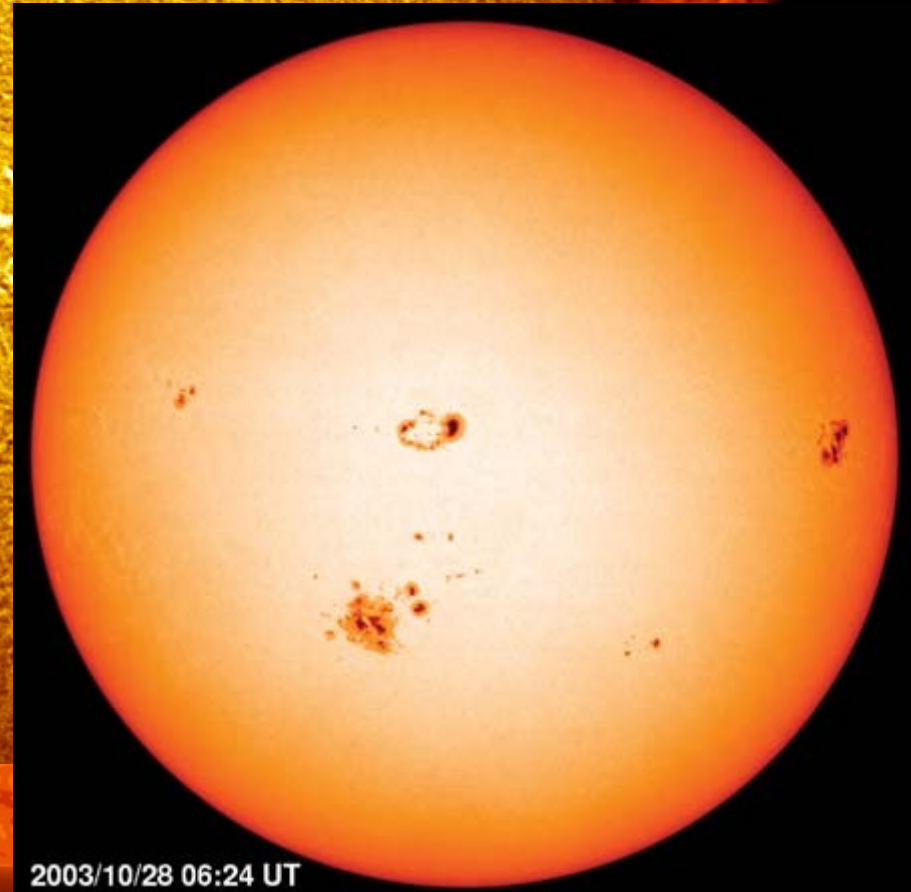
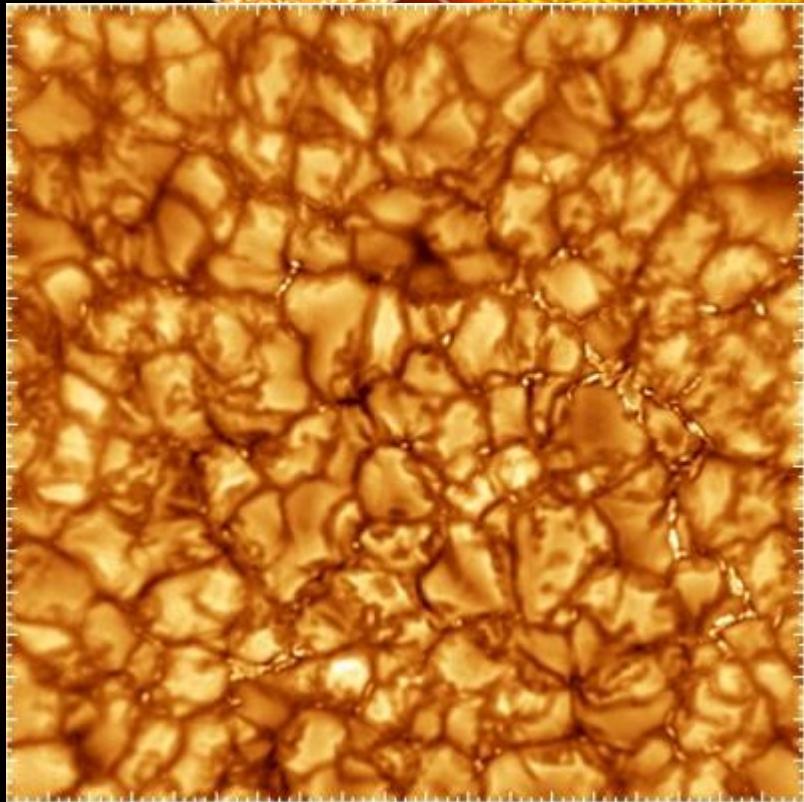
Cromosfera

Región de transición

Prominencia



Prominencia



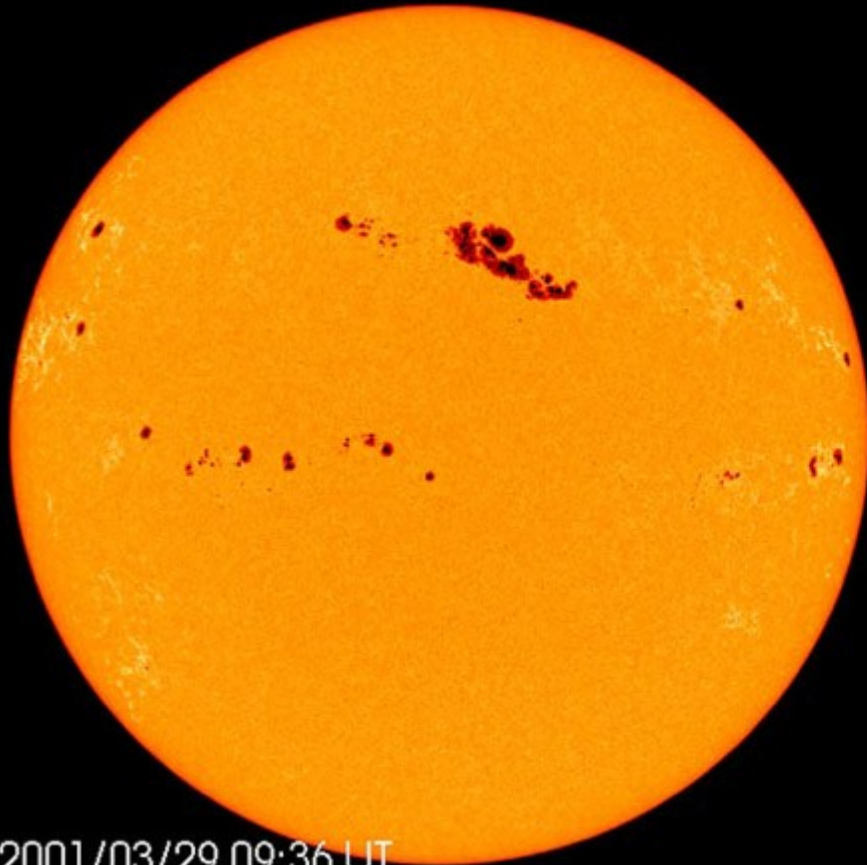
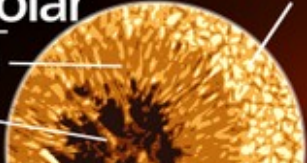
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PROHIBIDA



Mancha solar  
Penumbra  
Umbra

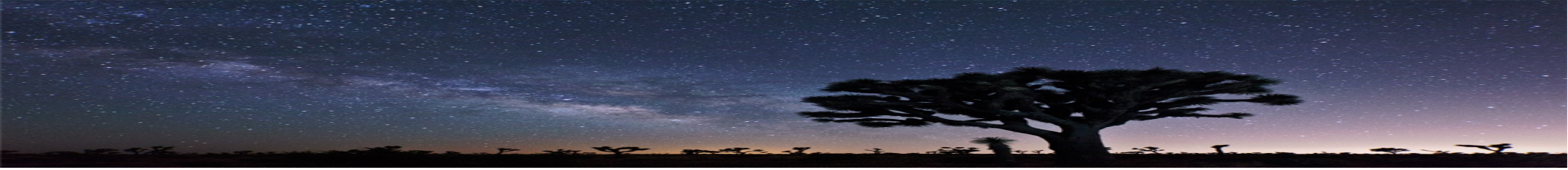
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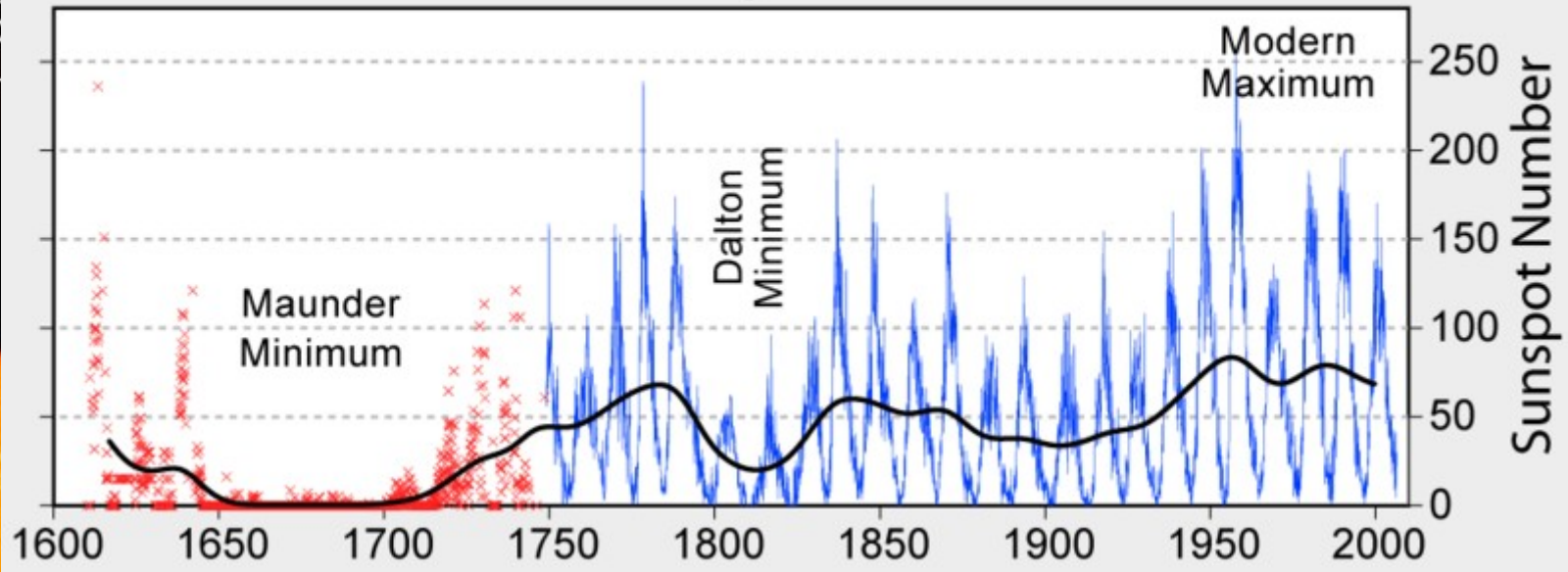


2009/03/25 11:40



Manche  
Penumb  
Umbra

## 400 Years of Sunspot Observations



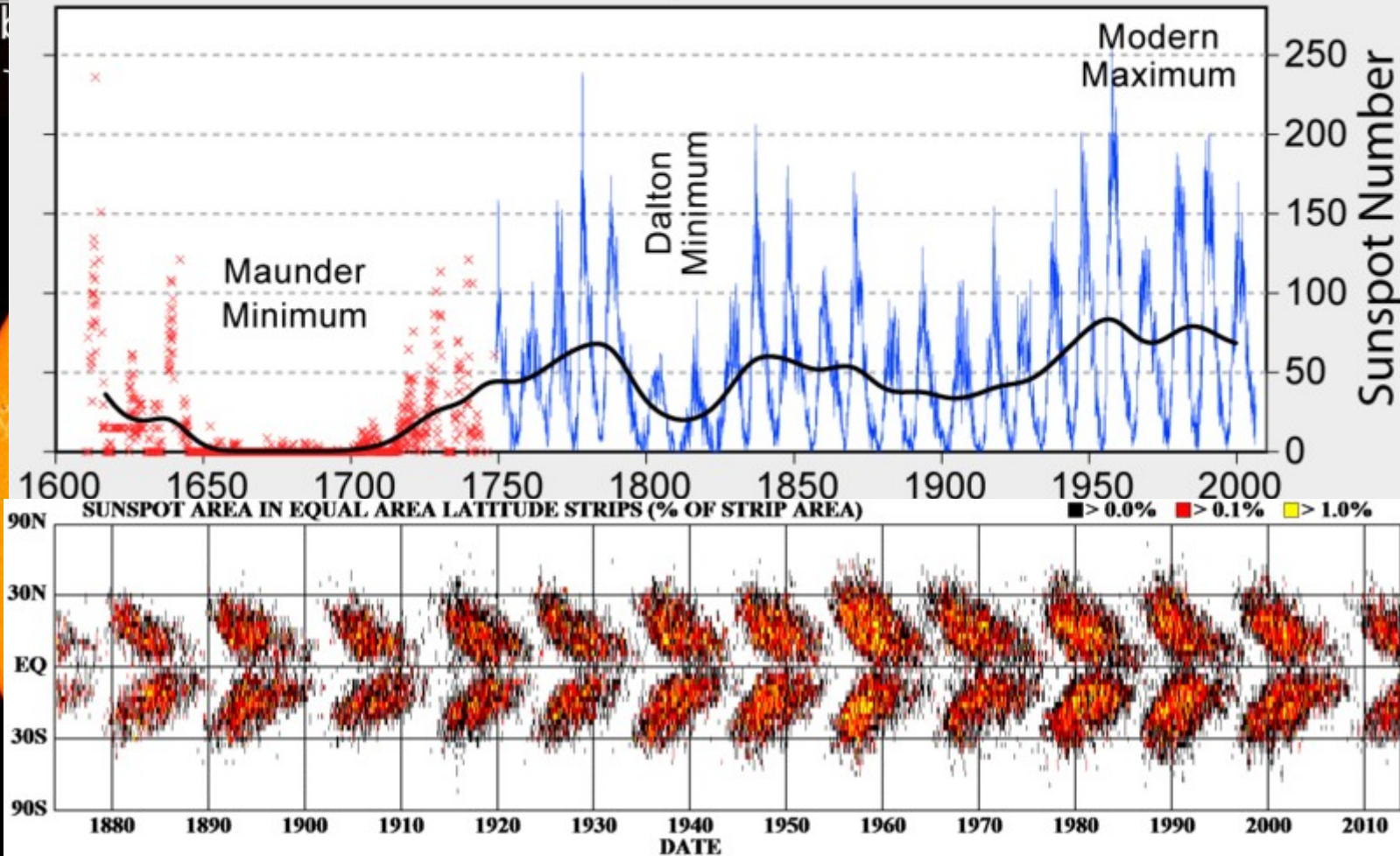
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2009/03/25 11:40



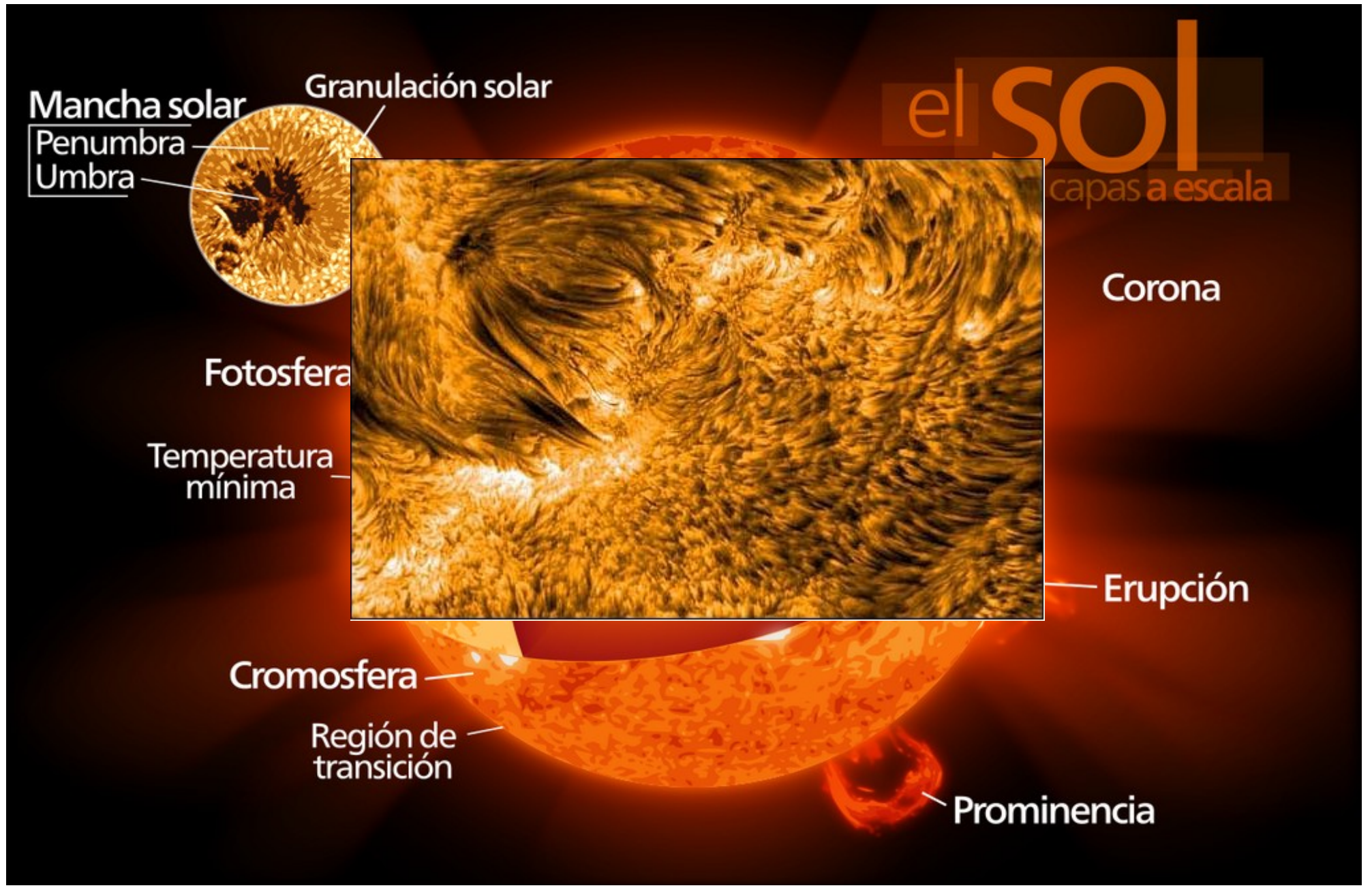
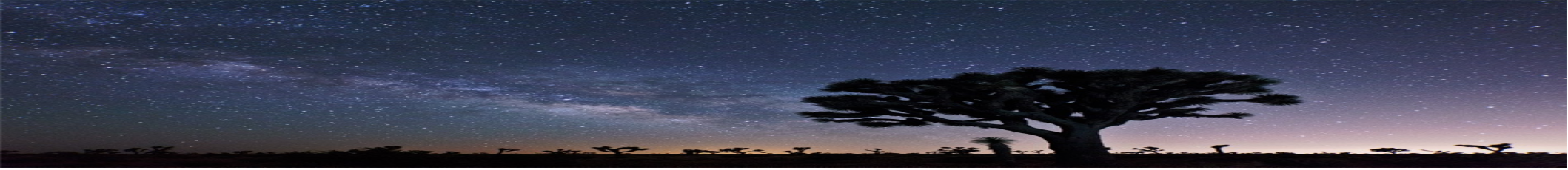
Mancha  
Penumbra  
Umbra

# 400 Years of Sunspot Observations



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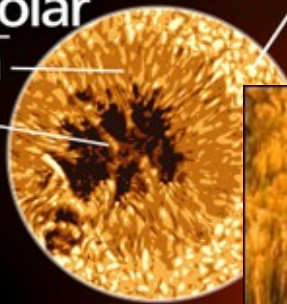
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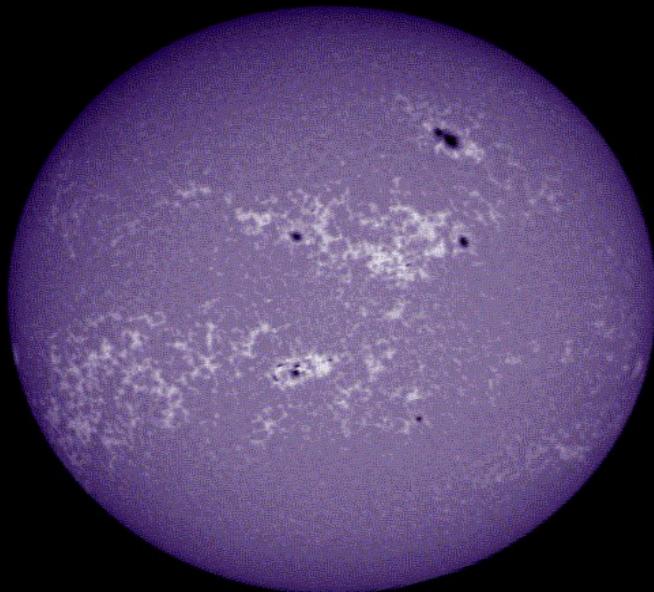
Mancha solar  
Penumbra  
Umbra

Granulación solar



Fotosfera

Ca II 3934 Å  
BBSO



# el sol

capas a escala

Corona

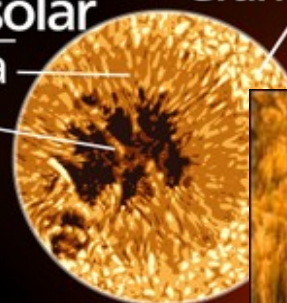
Erupción

Prominencia

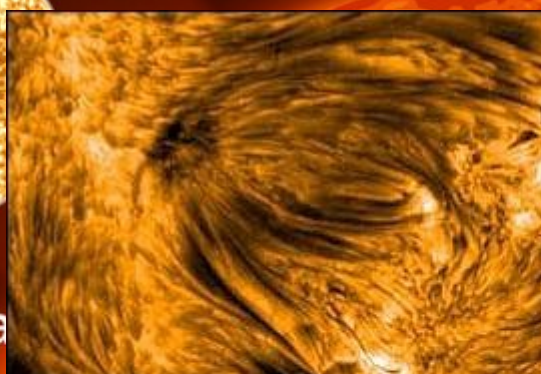




Mancha solar  
Penumbra  
Umbra

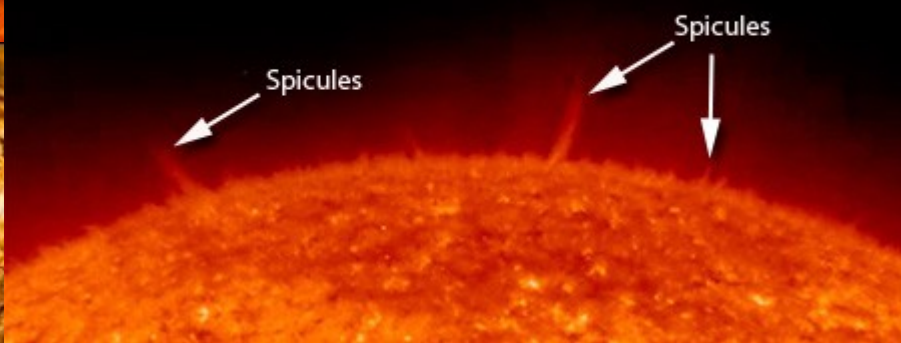


Granulación solar

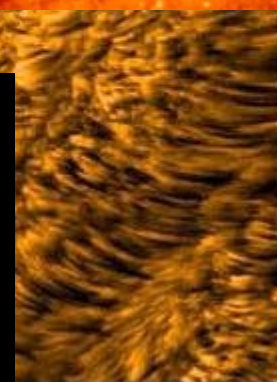
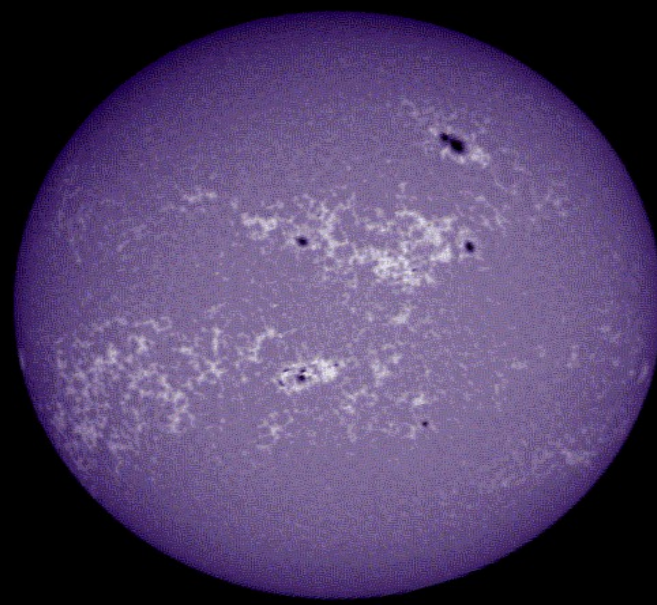


Fotosfera

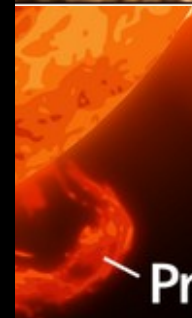
Credit: ESA/NASA



Ca II 3934 Å  
BBSO



Erupción

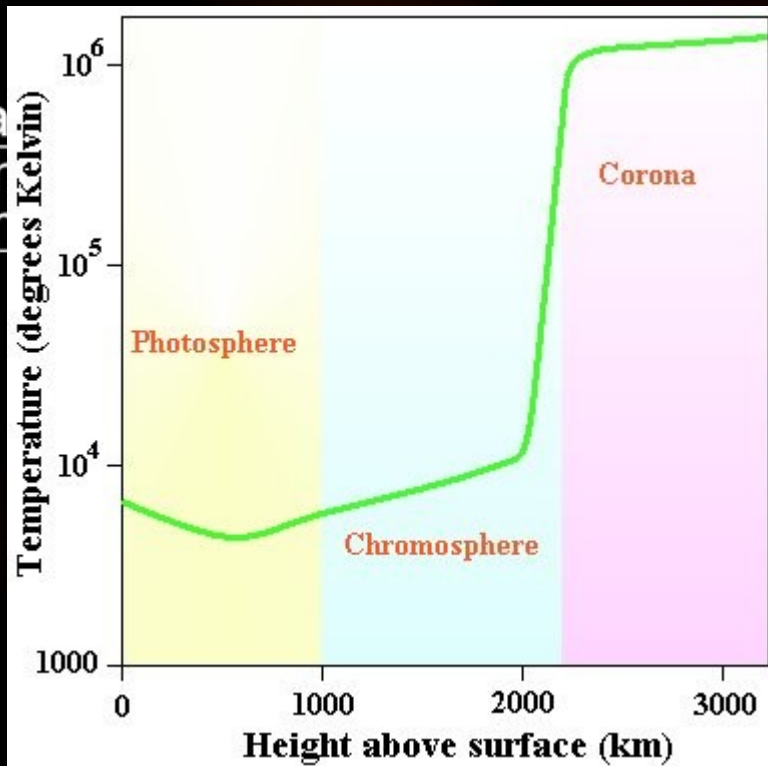


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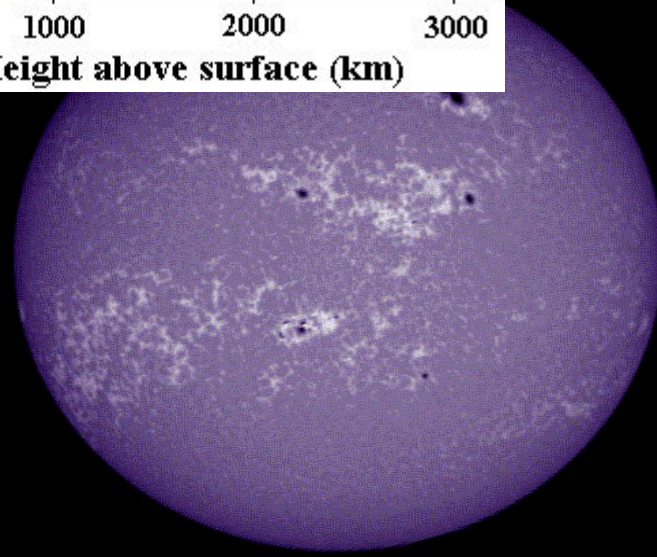
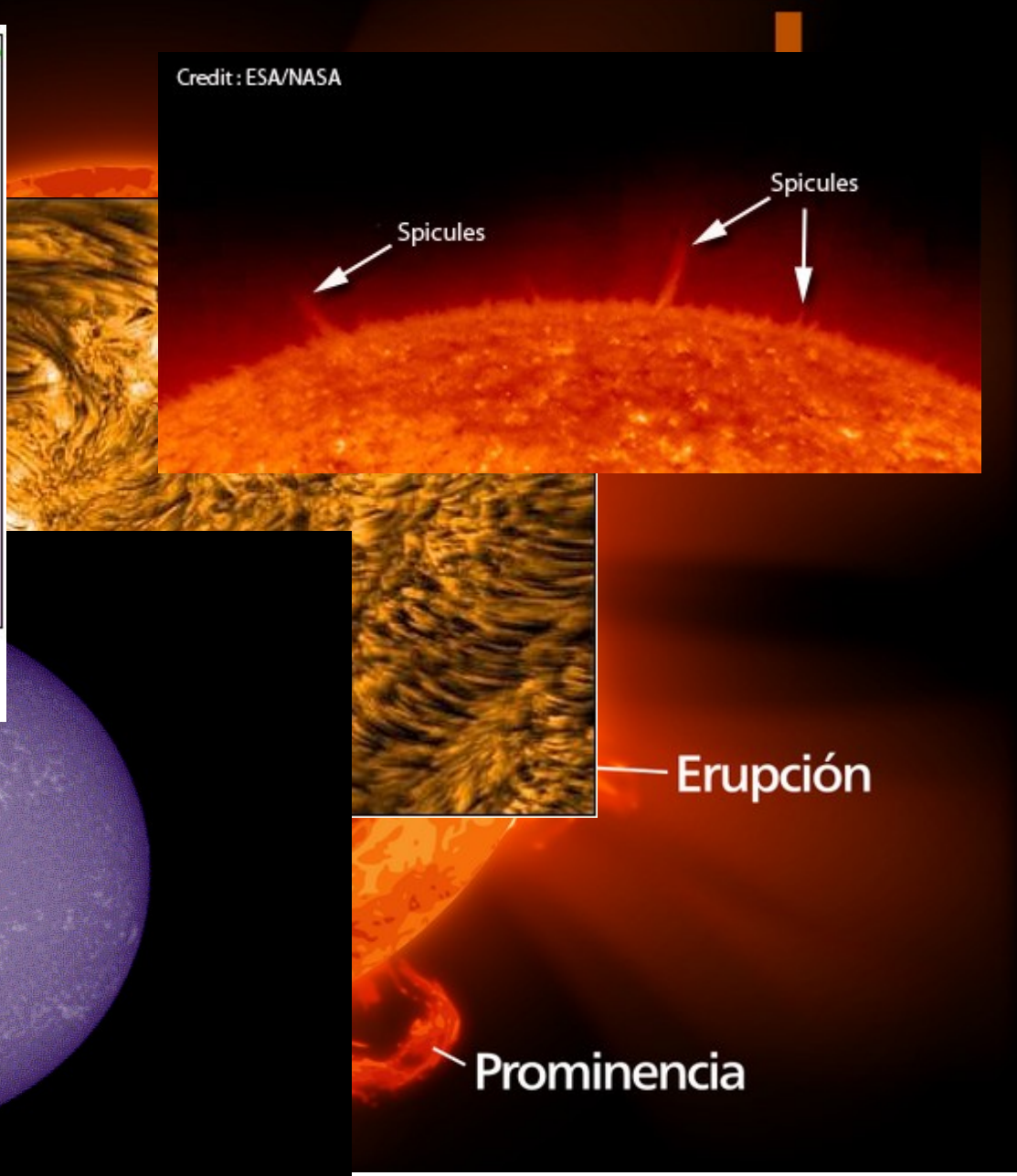
1991 May 13



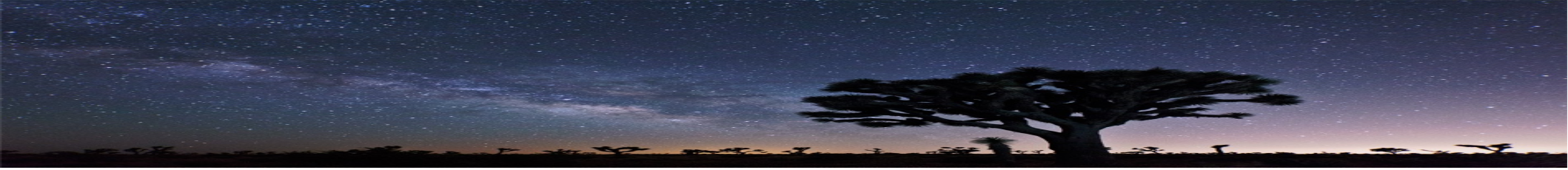
Ma  
Per  
Um



Credit : ESA/NASA



1991 May 13



# el sol

capas a escala



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Cromosfera  
Región de transición

zona radiativa  
zona convectiva  
nucleo

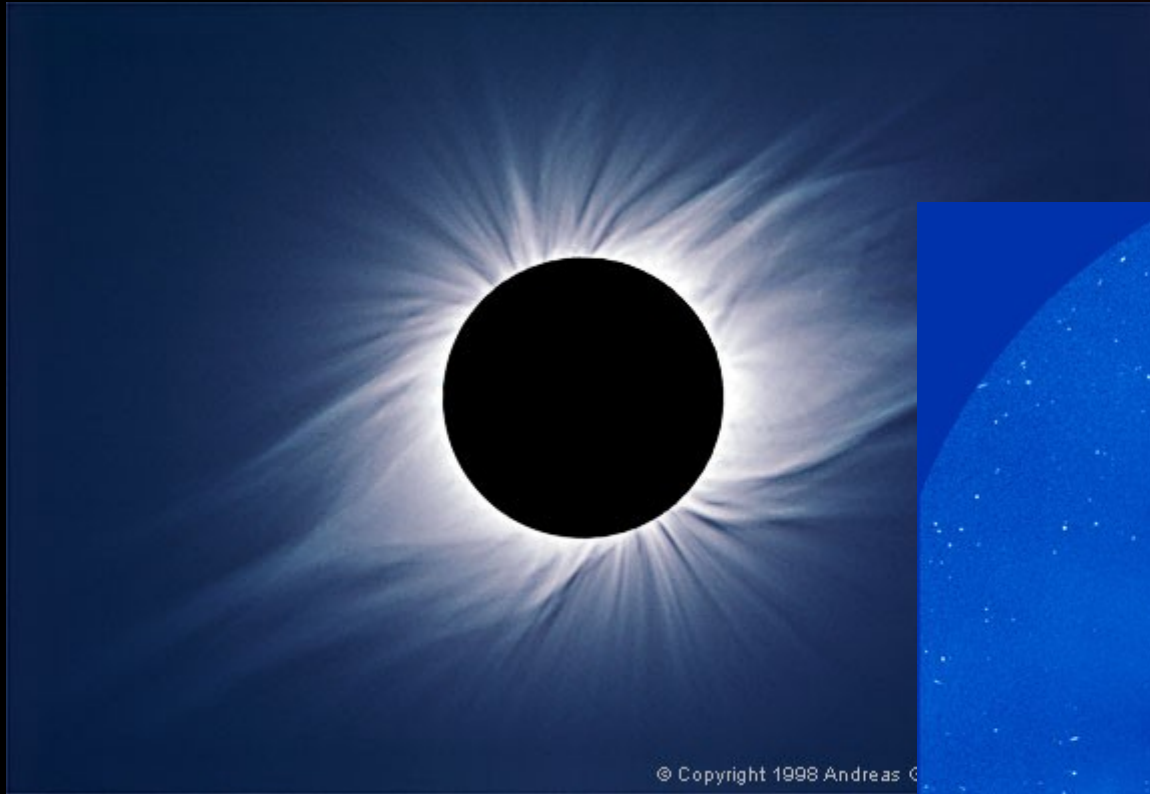
Corona

Erupción

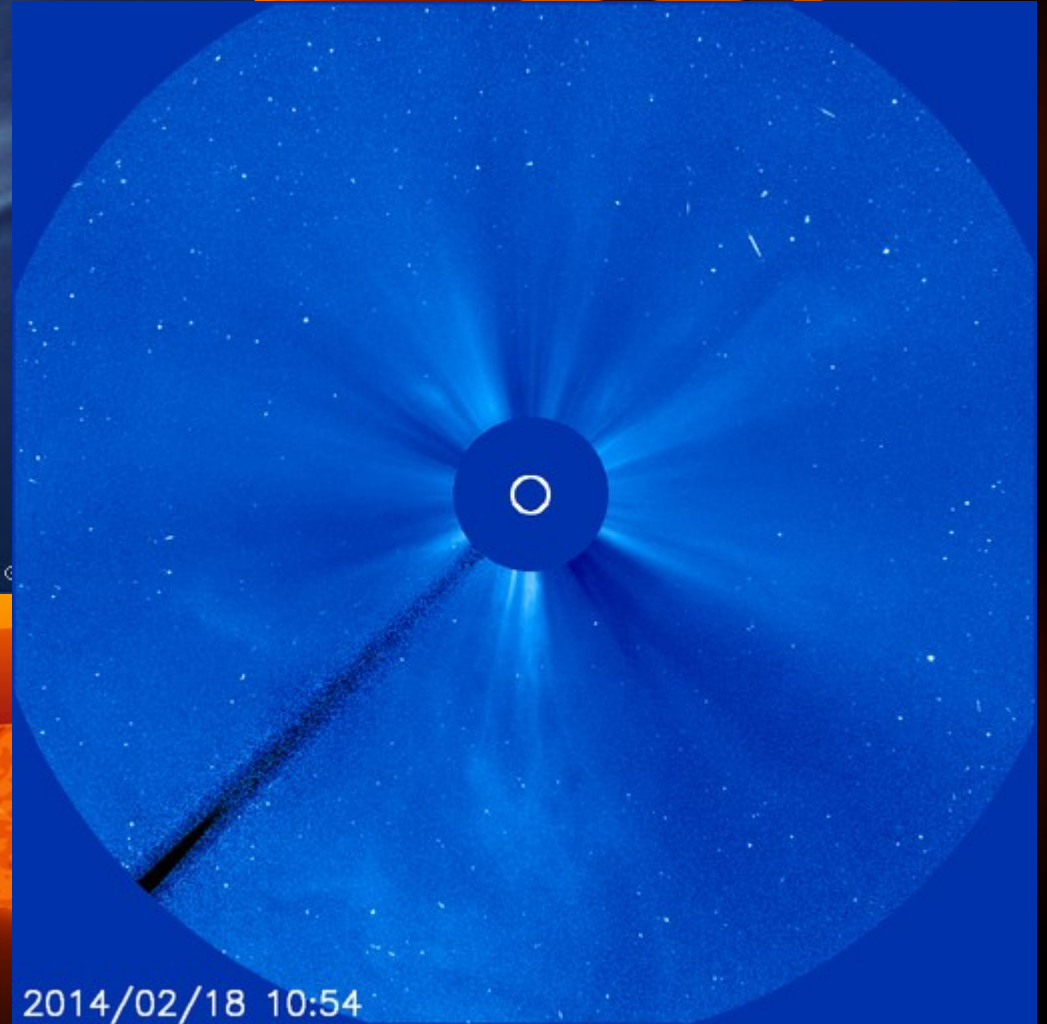
Prominencia



# el sol



© Copyright 1998 Andreas C



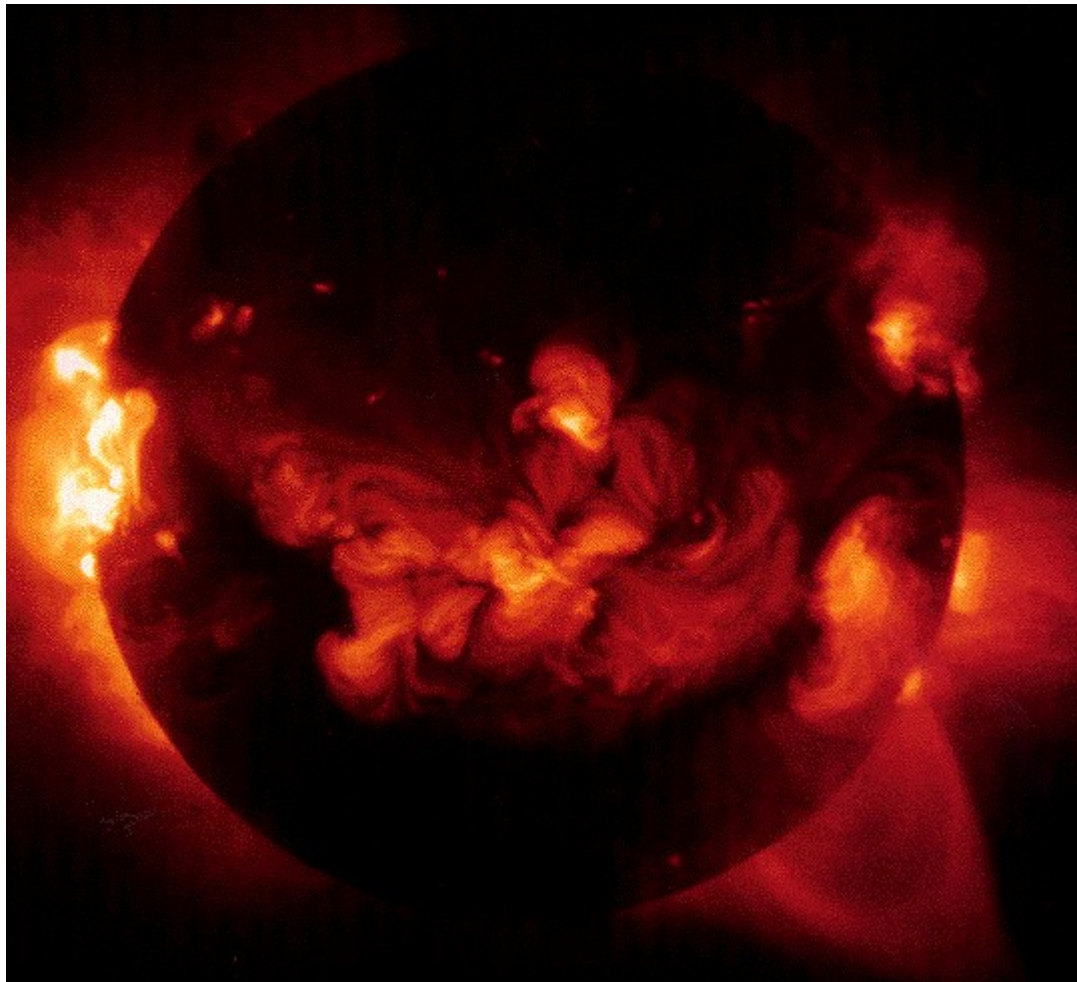
Cromosfera

Región de transición

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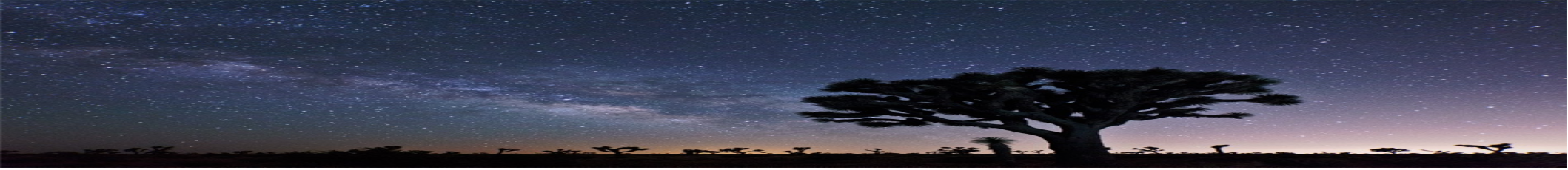
# Llamaradas solares



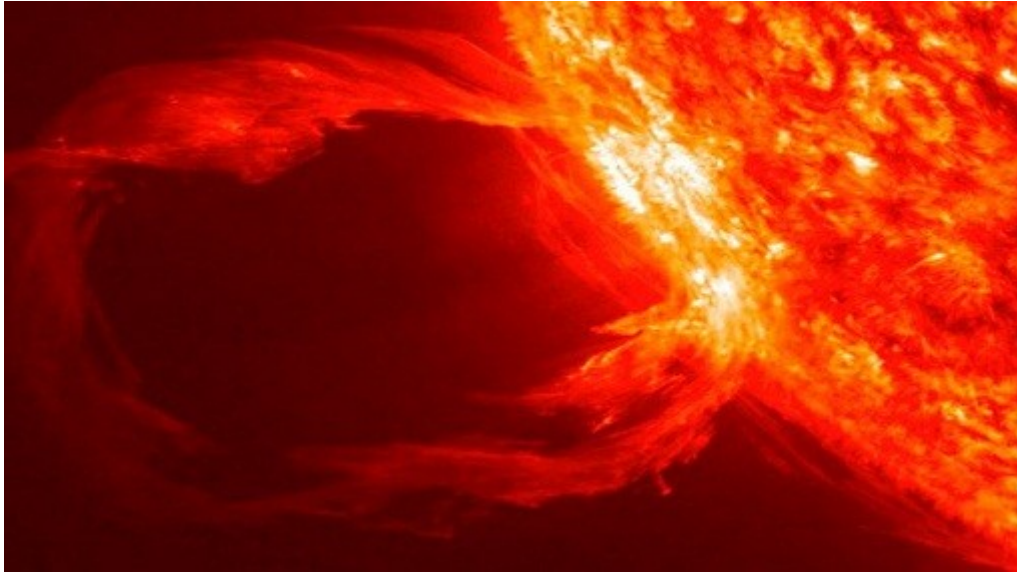


# Llamaradas solares





# Llamaradas solares





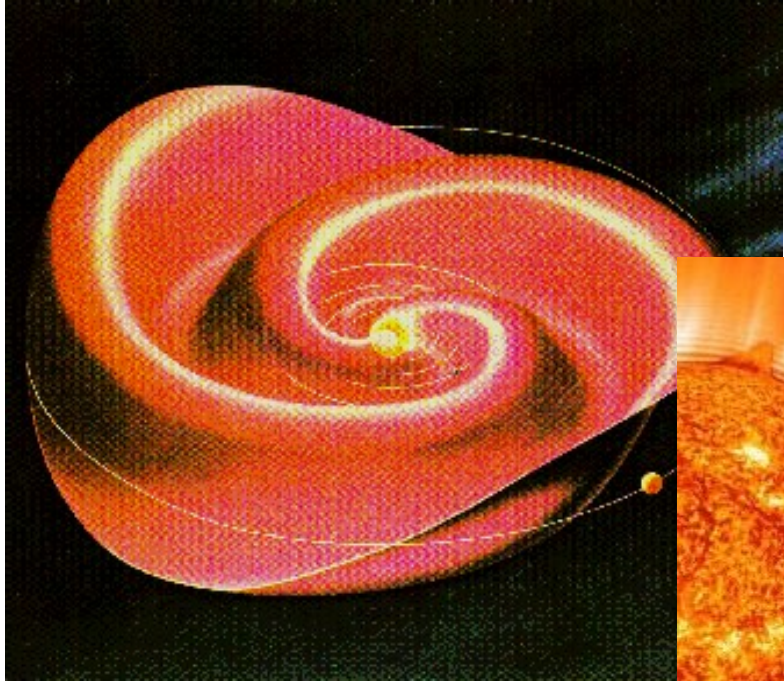
# Clima espacial



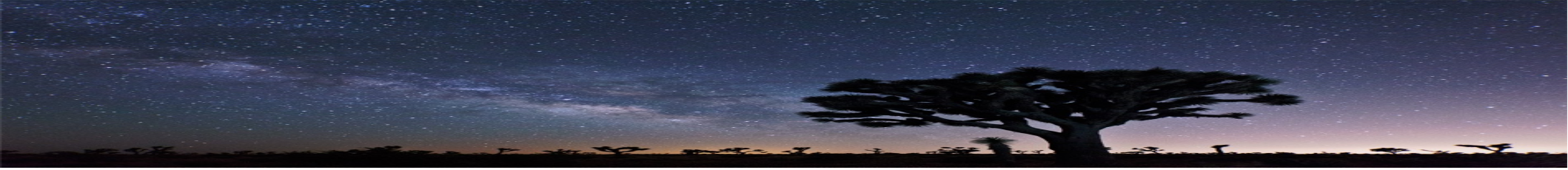
# Clima espacial



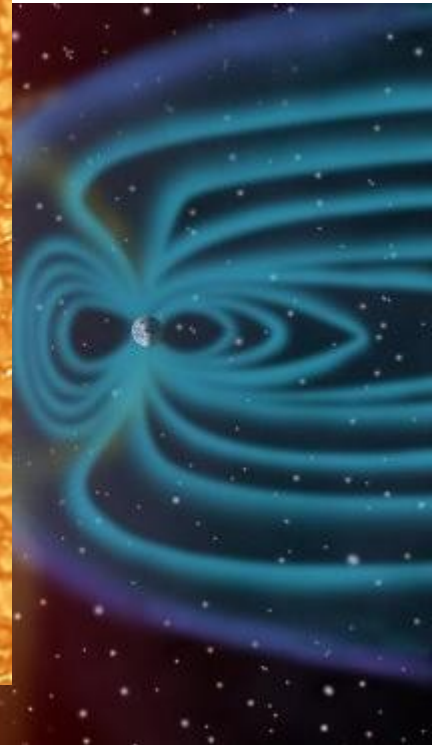
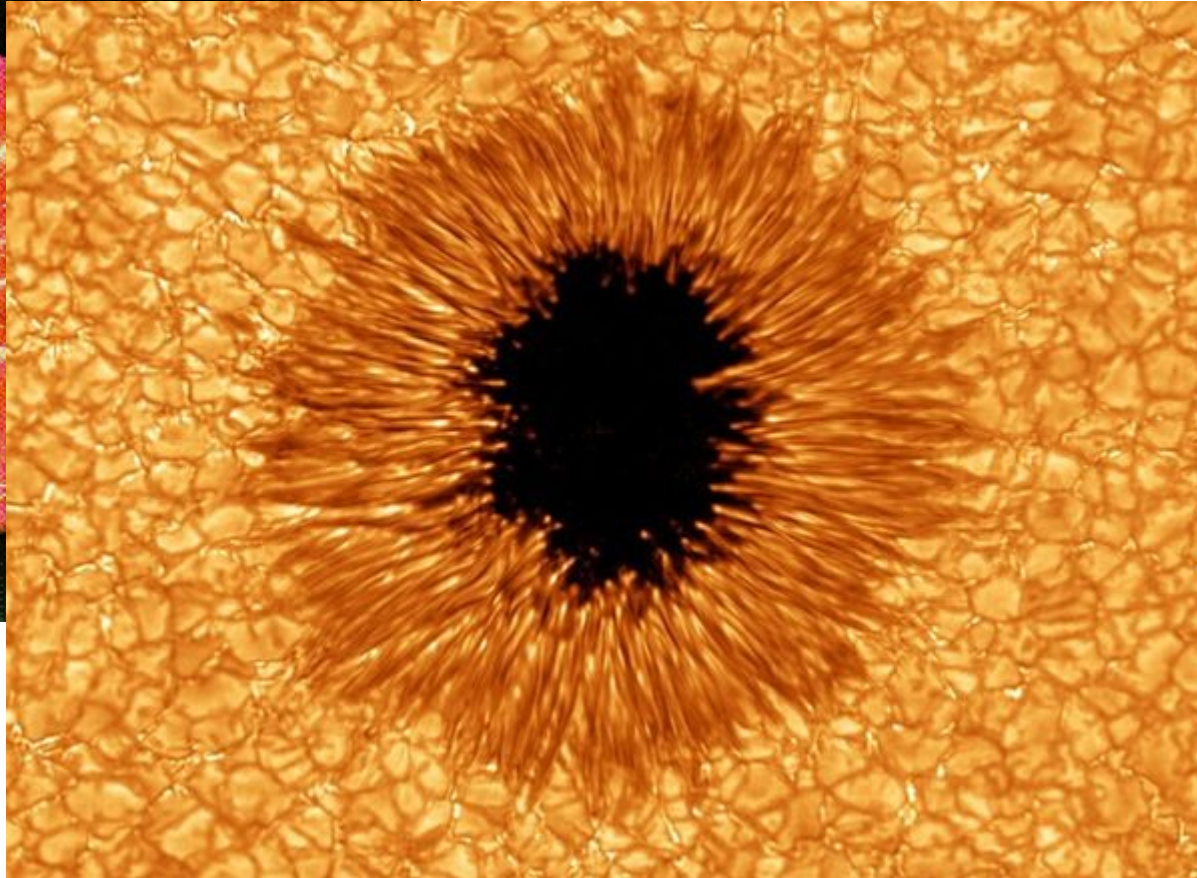
# Clima espacial



Astronomía planetaria, clase 14. S. Solar



# Clima espacial



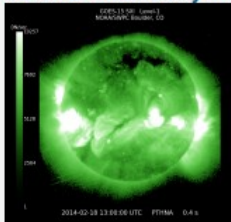
# Clima espacial

## NOAA / Space Weather Prediction Center

### Space Weather Now

2014 Feb 18 13:07 UTC (Feb 18 06:07 MST)

#### Latest GOES Solar X-ray Image



#### NOAA Scales Activity

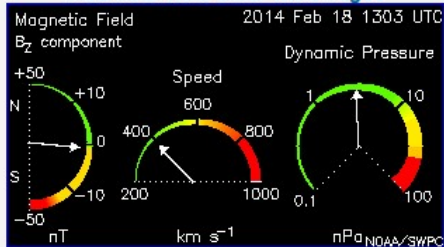
Range 1 (minor) to 5 (extreme)

NOAA Scale	Past 24 hrs	Current
Geomagnetic Storms	none	none
Solar Radiation Storms	none	none
Radio Blackouts	none	none

#### Alerts

Latest Alert: Feb 17 0548 UTC ALERT: Type II Radio Emission

#### ACE Real-Time Solar Wind Pages



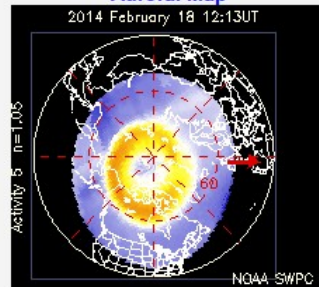
Average over last 15 minutes



#### Space Weather User Groups

- Navigation
- Radio
- Electric Power
- Satellite Operators
- Aurora
- News Media

#### Auroral Map



#### Solar Cycle Progression



#### Related pages

Today's Space Weather  
SW for Aviation Service Providers

<http://www.swpc.noaa.gov/SWN/index.html>  
e 14. S. Solar

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Alerts / Warnings, Space Weather Now, Today's Space Wx, Data and Products, About Us, Email Products,

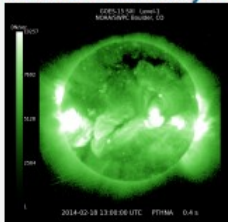
# Clima espacial

## NOAA / Space Weather Prediction Center

### Space Weather Now

2014 Feb 18 13:07 UTC (Feb 18 06:07 MST)

#### Latest GOES Solar X-ray Image

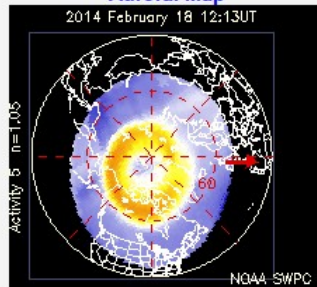


#### NOAA Scales Activity

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NOAA Scale	Past 24 hrs	Current
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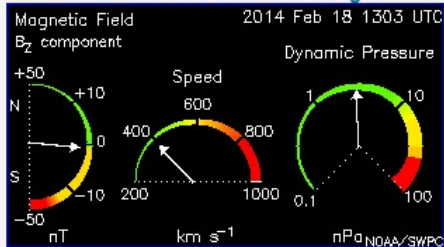
#### Auroral Map



#### Alerts

Latest Alert: Feb 17 0548 UTC ALERT: Type II Radio Emission

#### ACE Real-Time Solar Wind Pages



Average over last 15 minutes



#### Space Weather User Groups

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- Aurora
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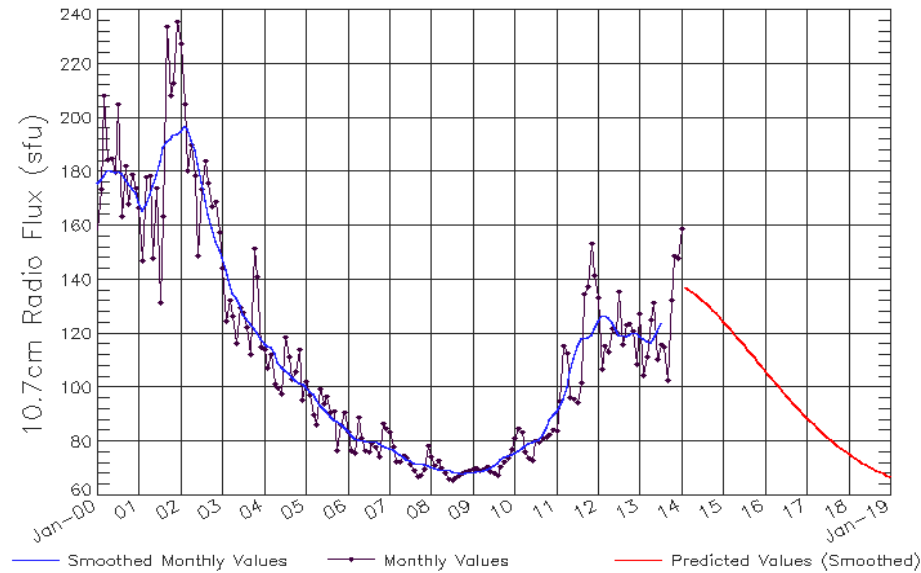
#### Solar Cycle Progression



#### Related pages

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[SW for Aviation Service Providers](#)

ISES Solar Cycle F10.7cm Radio Flux Progression  
Observed data through Jan 2014



Updated 2014 Feb 3

NOAA/SWPC Boulder, CO USA

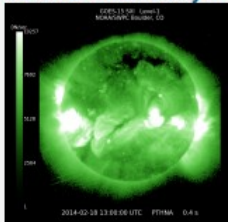
# Clima espacial

## NOAA / Space Weather Prediction Center

### Space Weather Now

2014 Feb 18 13:07 UTC (Feb 18 06:07 MST)

#### Latest GOES Solar X-ray Image



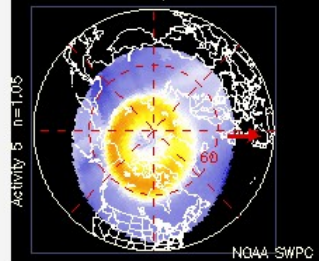
#### NOAA Scales Activity

Range 1 (minor) to 5 (extreme)

NOAA Scale	Past 24 hrs	Current
Geomagnetic Storms	none	none
Solar Radiation Storms	none	none
Radio Blackouts	none	none

#### Auroral Map

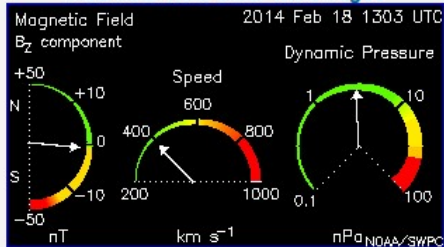
2014 February 18 12:13UT



#### Alerts

Latest Alert: Feb 17 0548 UTC ALERT: Type II Radio Emission

#### ACE Real-Time Solar Wind Pages



Average over last 15 minutes



#### Space Weather User Groups

- Navigation
- Radio
- Electric Power
- Satellite Operators
- Aurora
- News Media

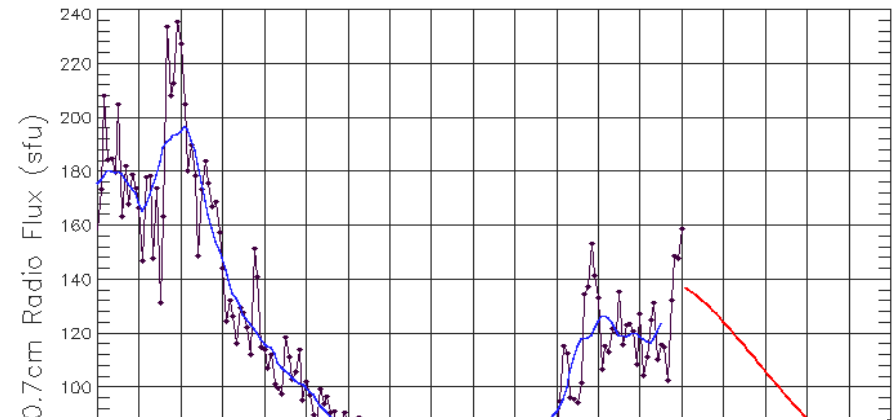
#### Solar Cycle Progression



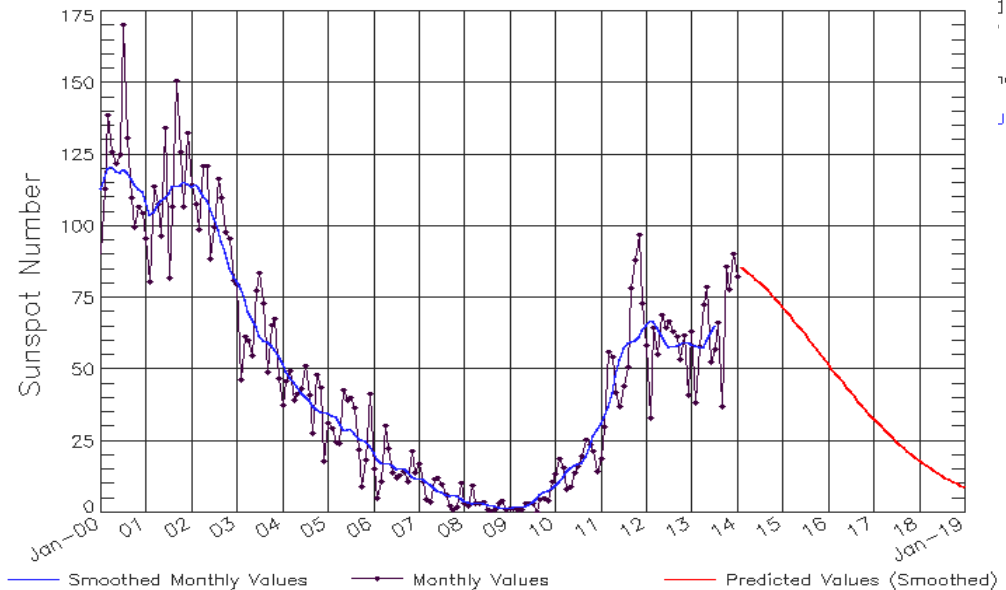
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[SW for Aviation Service Providers](#)

ISES Solar Cycle F10.7cm Radio Flux Progression  
Observed data through Jan 2014



ISES Solar Cycle Sunspot Number Progression  
Observed data through Jan 2014



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