

# On Magnetic Fields

# Contents

- 1) Cosmos Magnetism**
- 2) Solar System Magnetism**
- 3) Planets Magnetism**
- 4) Sun – Earth magnetic fields**
- 5) Solar – Earth magnetic fields**
- 6) Earth's magnetic field**
- 7) Human Body magnetic field**

# **1) Cosmos Magnetism**

# ΚΟΣΜΟΣ κατά ...ΠΥΘΑΓΟΡΑ

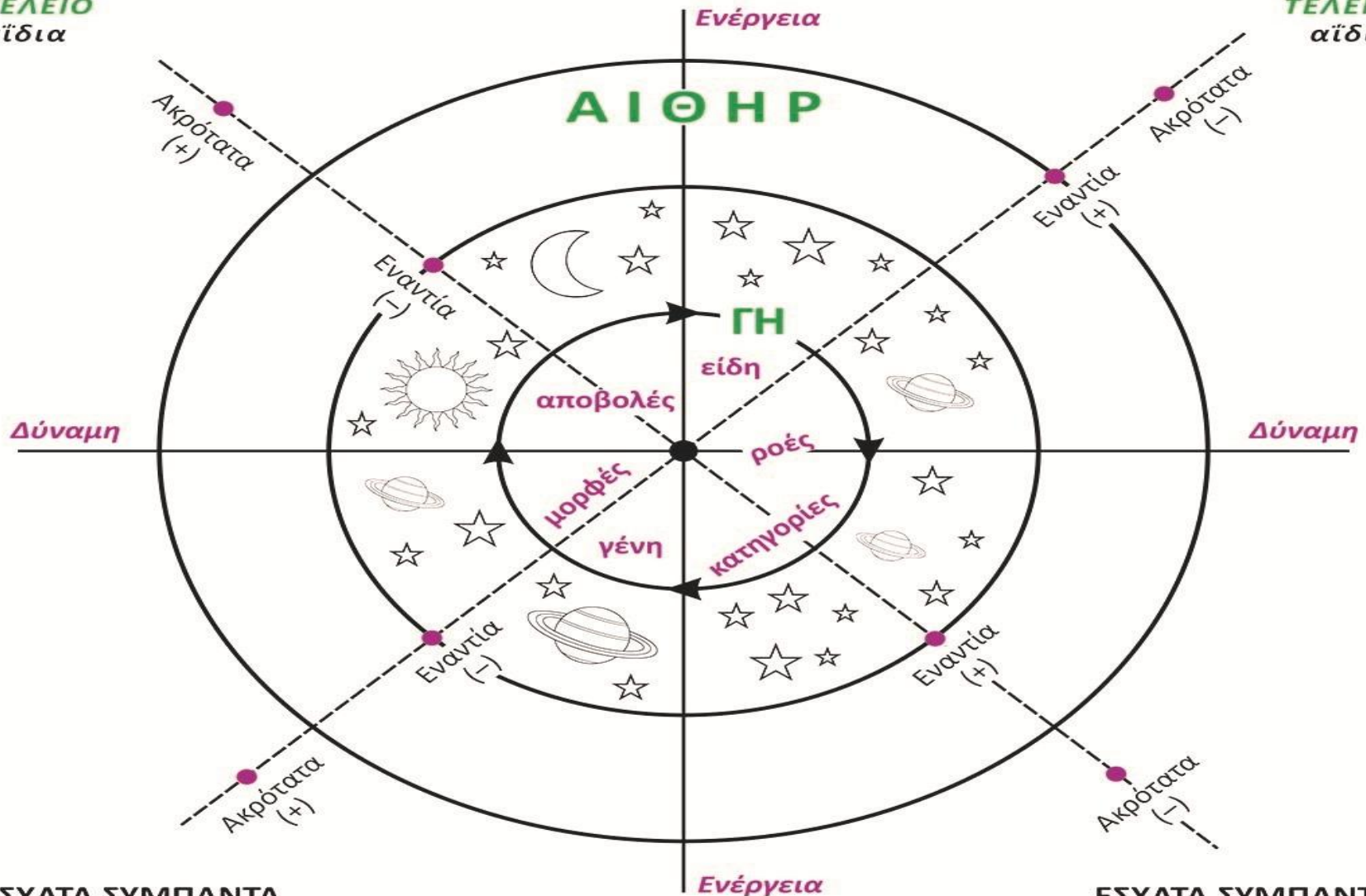
ΕΣΧΑΤΑ ΣΥΜΠΑΝΤΑ

ΤΕΛΕΙΟ  
αἶδια

ΑΚΙΝΗΤΟ ΚΙΝΟΥΝ

ΕΣΧΑΤΑ ΣΥΜΠΑΝΤΑ

ΤΕΛΕΙΟ  
αἶδια



ΕΣΧΑΤΑ ΣΥΜΠΑΝΤΑ

ΤΕΛΕΙΟ  
αἶδια

ΑΚΙΝΗΤΟ ΚΙΝΟΥΝ

ΕΣΧΑΤΑ ΣΥΜΠΑΝΤΑ

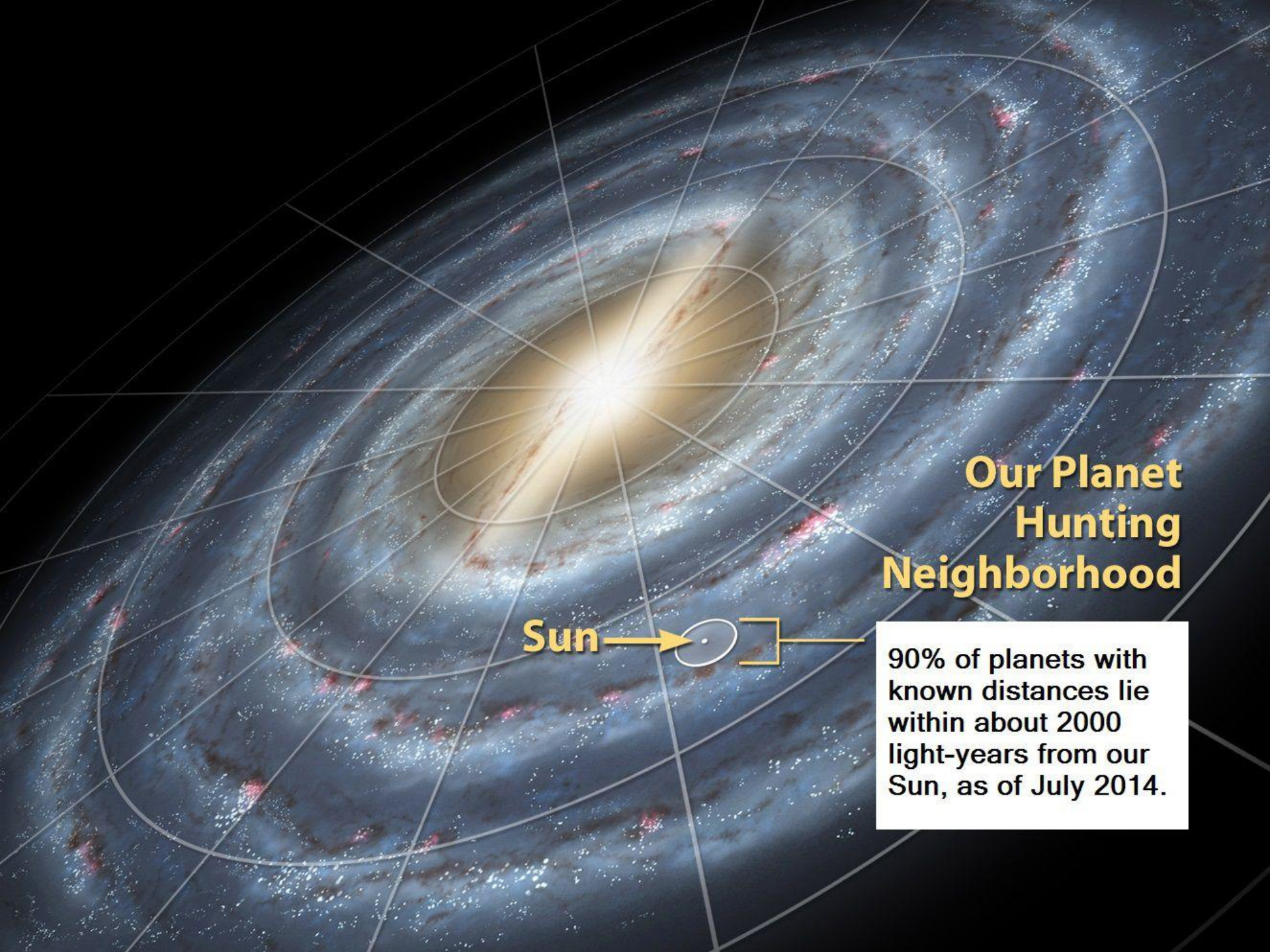
ΤΕΛΕΙΟ  
αἶδια

# The Milky Way Galaxy



# Milky Way Galaxy





## **Our Planet Hunting Neighborhood**

**Sun**



90% of planets with known distances lie within about 2000 light-years from our Sun, as of July 2014.

# The Milky Way

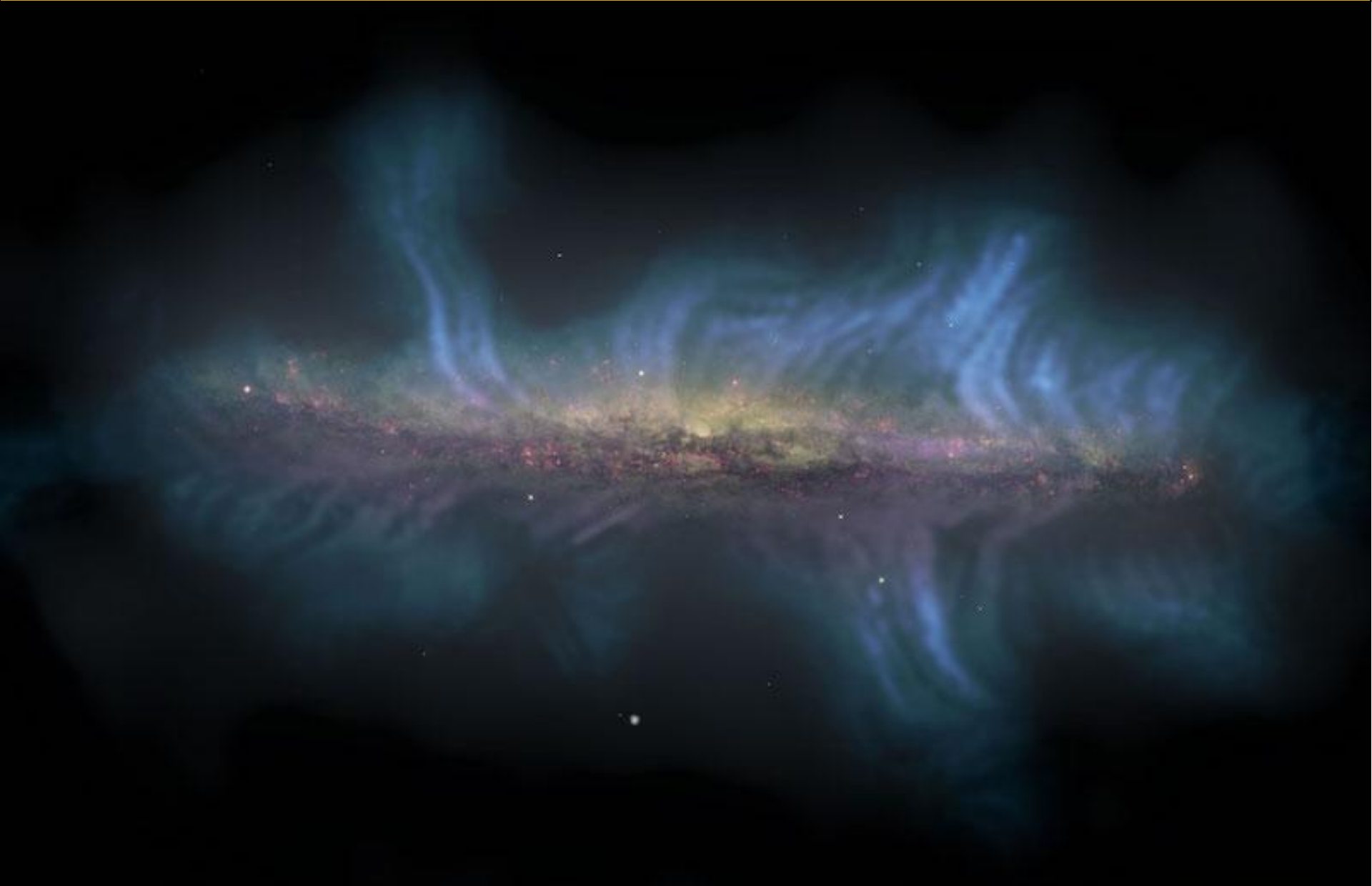
DIGITAL IMAGE OF THE MILKY WAY BY PIKAIA IMAGING (WWW.PIKAIA-IMAGING.CO.UK)



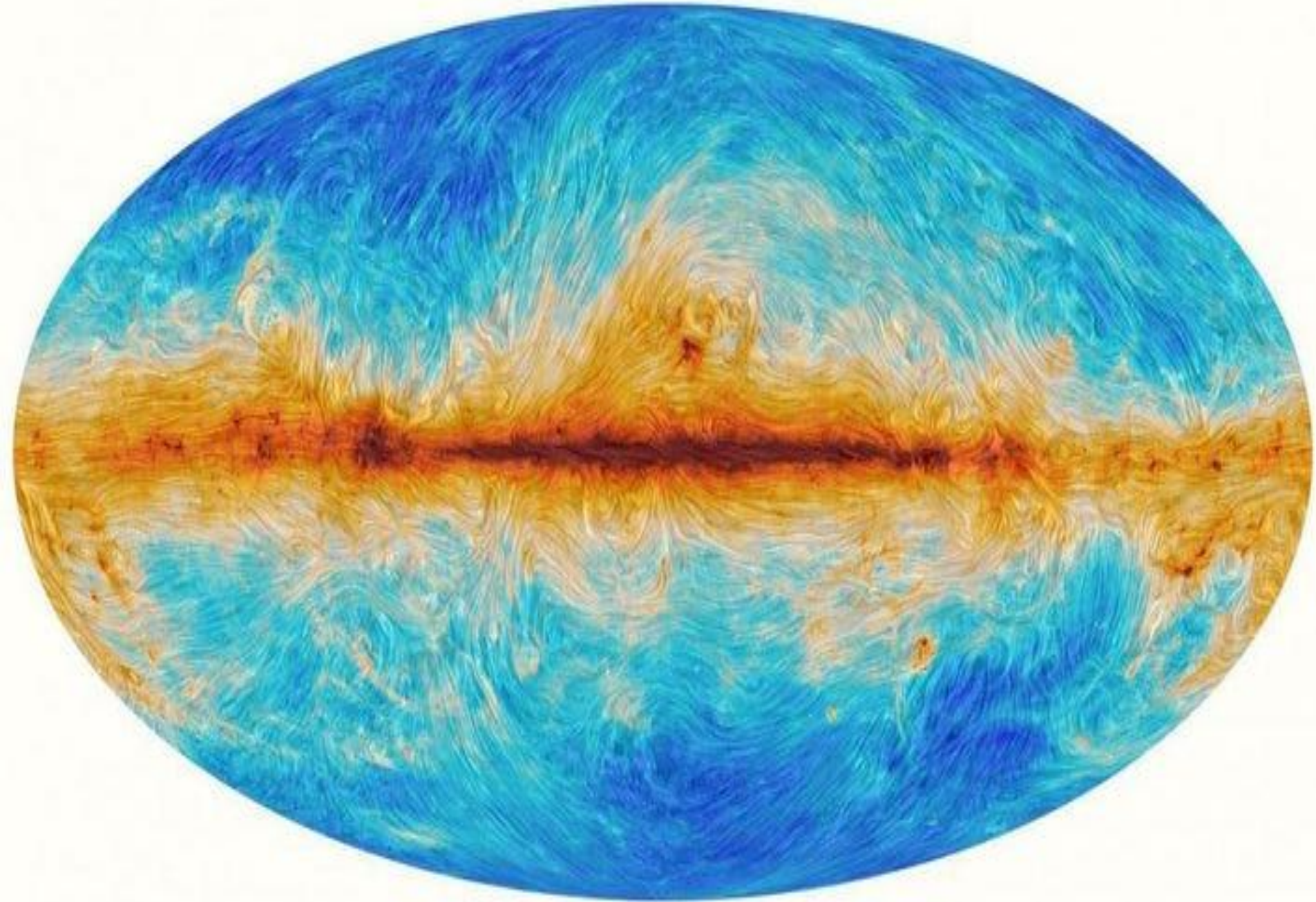
You are here.



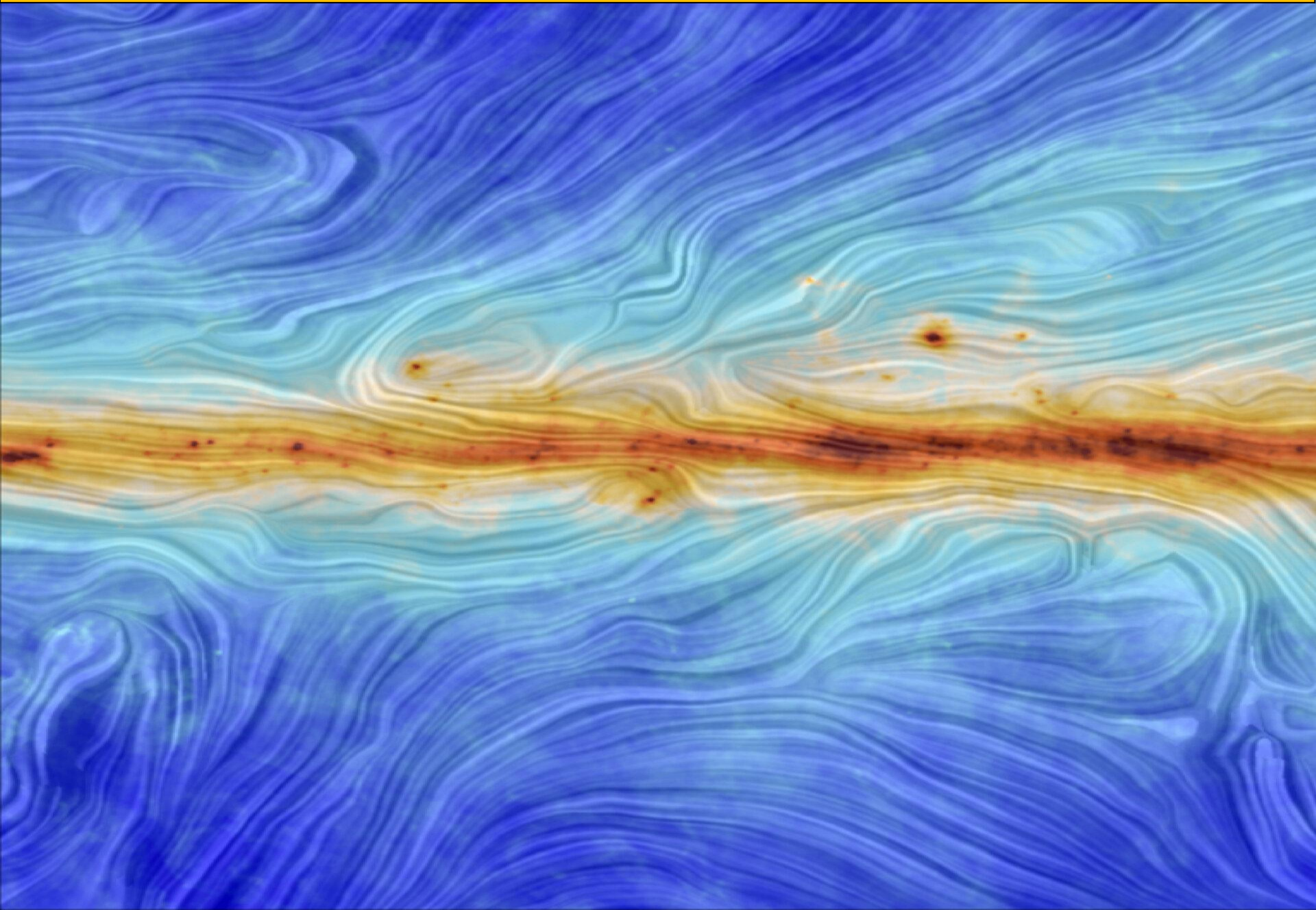
# The magnetic field along the **Galactic plane** ...



# The magnetic field at the ... **Cosmos**



# The magnetic field at the ... **Cosmos**

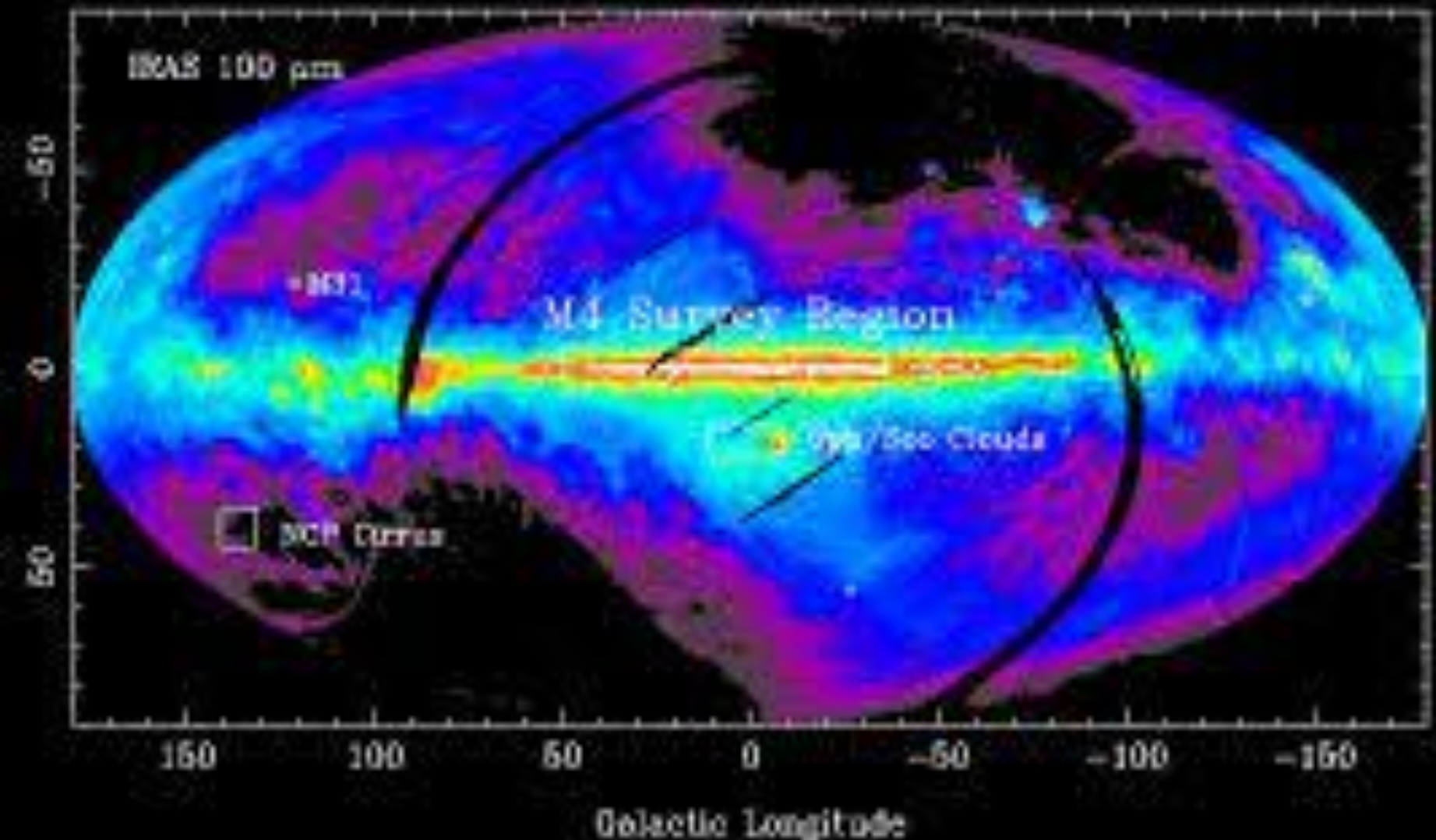


# The magnetic field at the ... **Cosmos**

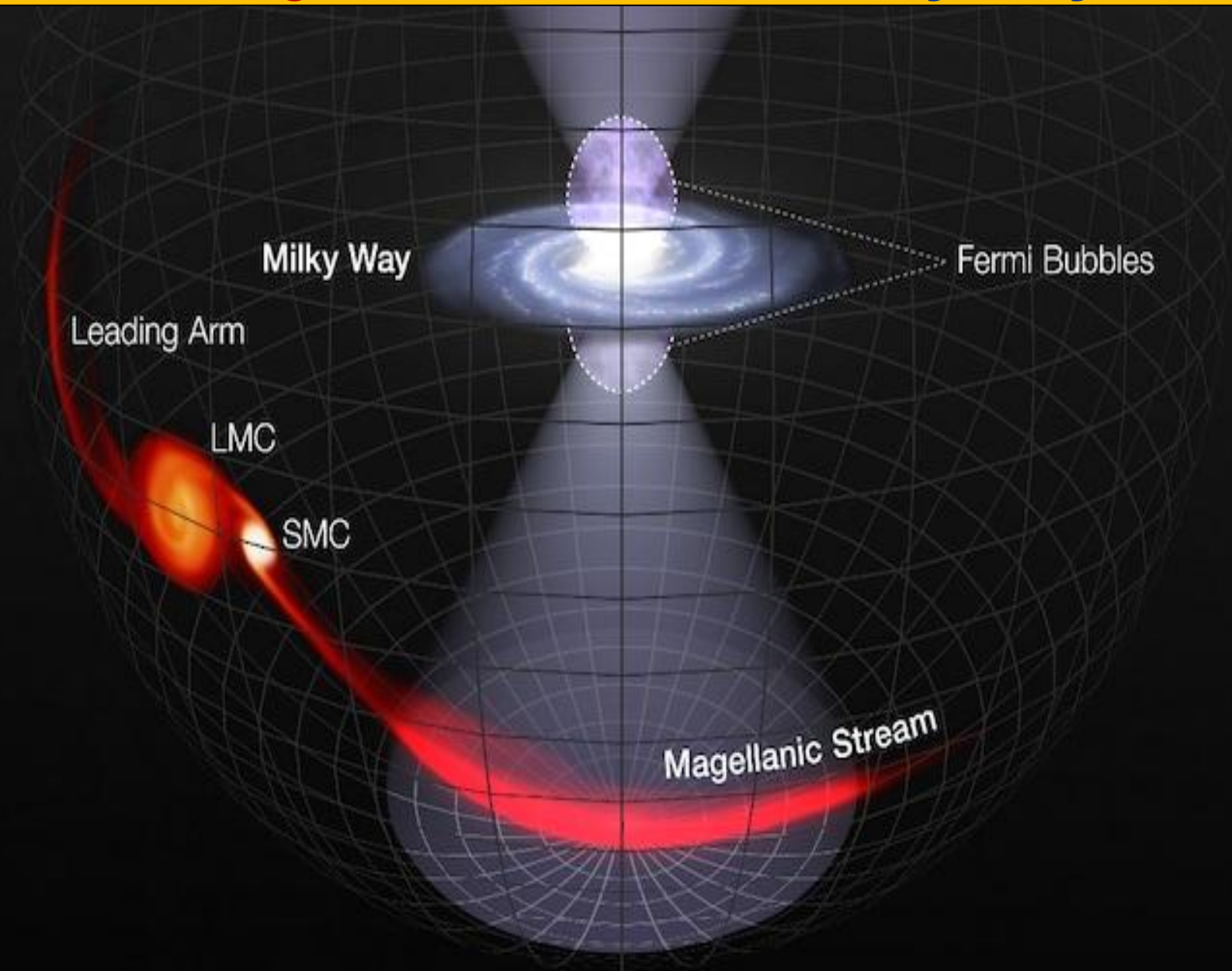


# The magnetic field of the Milky way ...

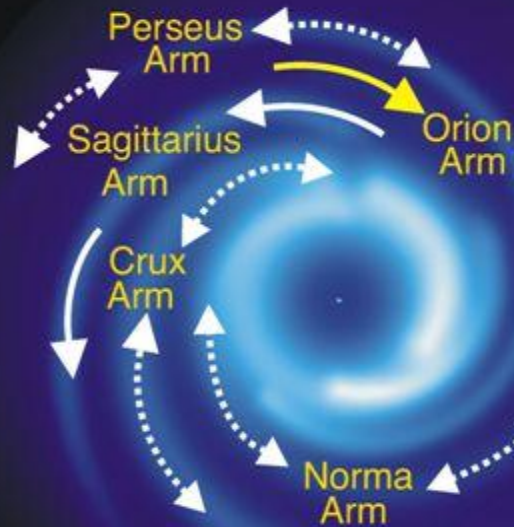
## M4: The Milky Way Magnetic Field Mapping Mission



# The magnetic field of the **Milky way** ...



## The Galactic Magnetic Field



- field is concentrated in disk
- follows the spiral arms
- local field is cw
- Sagittarius field is ccw
- additional reversals unclear
- **Determining the location of reversals may help understand the evolution of the field.**

# ΟΙ ΠΛΑΝΗΤΕΣ ΕΙΝΑΙ ΠΟΜΠΟΙ ... ΓΝΩΣΗΣ



**ΑΡΧΑΙΑ ΙΩΜΗ**

**Ο άνθρωπος είναι η βιβλιοθήκη του σύμπαντος και μεταφορέας των συμπαντικών πληροφοριών!**

UNIVERSE

SMALL BODIES

**‘Όποιος σκέπτεται σήμερα, σκέπτεται ελληνικά, έστω κι αν δεν το υποπτεύεται.» Jacqueline de Romilly**

## 2) Our Solar System magnetics

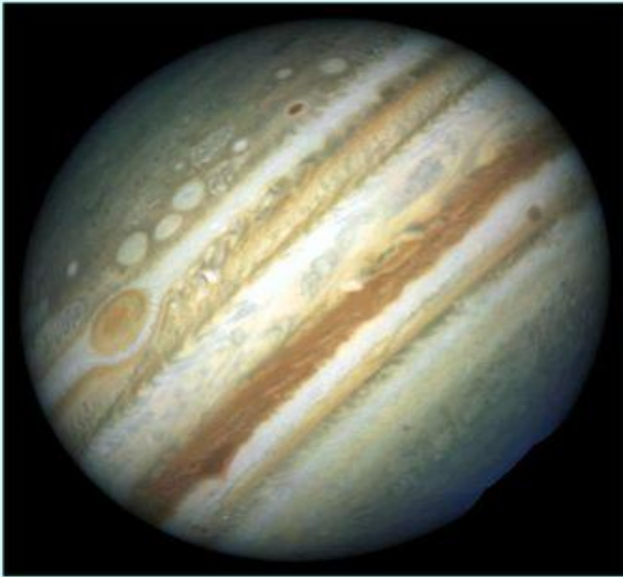
# The Jovian Planets

- Formation
- Internal Structure
- Appearance
- Weather---the Great Red Spot and bands of Jupiter
- Satellites---the Galilean Moons of Jupiter
- Rings



# The Giant – Jovian Planets

## The Giant Planets



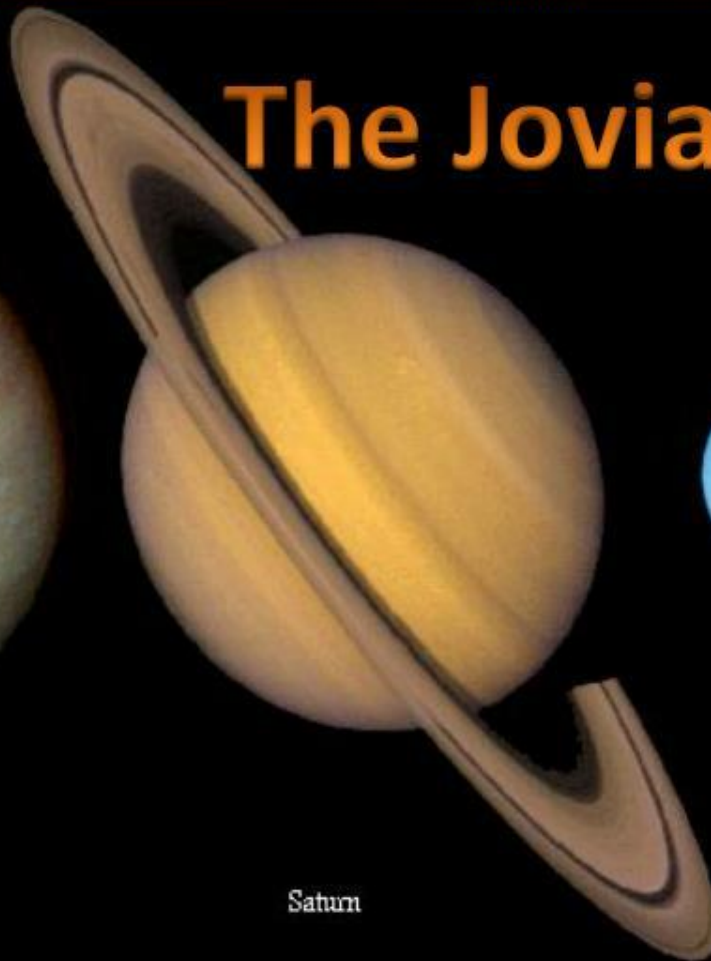
Uranus

© Copyright Calvin J. Hamilton

# The Jovian Planets



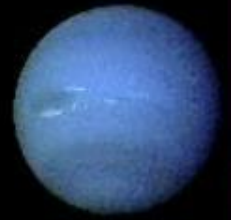
Jupiter



Saturn



Uranus



Neptune

Jacob Lambros



Chelsea Adams



Jynette Tigner



Alan Harris

# Two Types of Planets in our Solar System

*The Solar System*

*Terrestrial Planets*



Mercury



Venus



Earth



Mars



The Sun

*Jovian Planets*



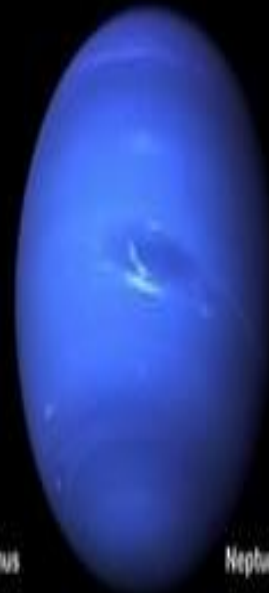
Jupiter



Saturn



Uranus



Neptune

# The Terrestrial Planets ...



**MARS**

**EARTH (DIA. = 12,756.2 KM)**

**VENUS**



**GANYMEDE**



**TITAN**



**MERCURY**



**CALLISTO**



**IO**



**MOON**



**EUROPA**



**TRITON**



**PLUTO**



**TITANIA**



**RHEA**



**OBERON**



**IAPETUS**



**CHARON**



**UMBRIEL**



**ARIEL**



**DIONE**



**TETHYS**



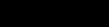
**ENCLADEUS**



**PROTEUS**



**MIRANDA**



**MIMAS**

(DIA. = 392 KM)

# The Terrestrial Planets ...

The Terrestrial Planets of Our Solar System



Mercury

Venus

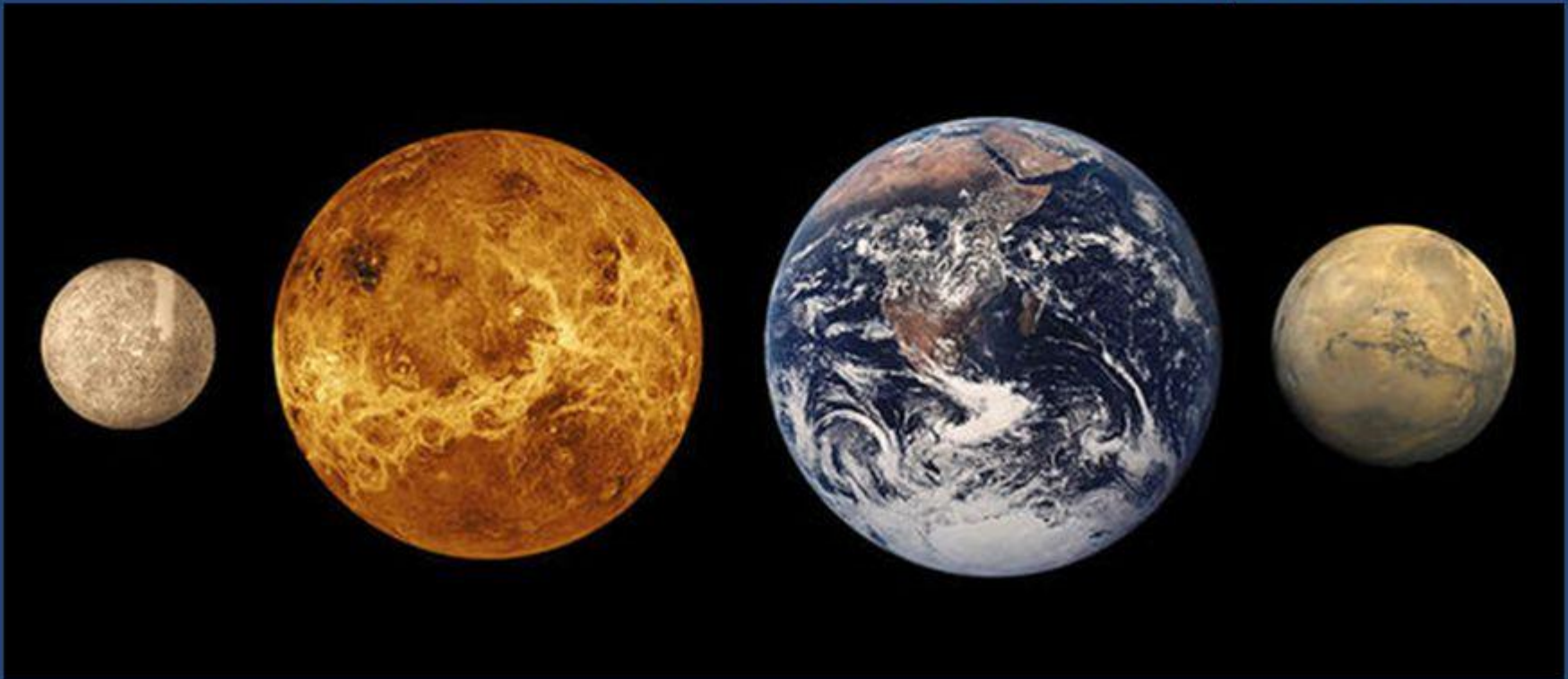
Earth

Mars

# The Terrestrial – Inner Planets ...

## INNER PLANETS

- Terrestrial, meaning Earth-like (*terra* = *earth*)
- Made up of rocks and metals
- Warmer and denser than the outer planets



# The Terrestrial – Inner Planets ...

## THE INNER PLANETS

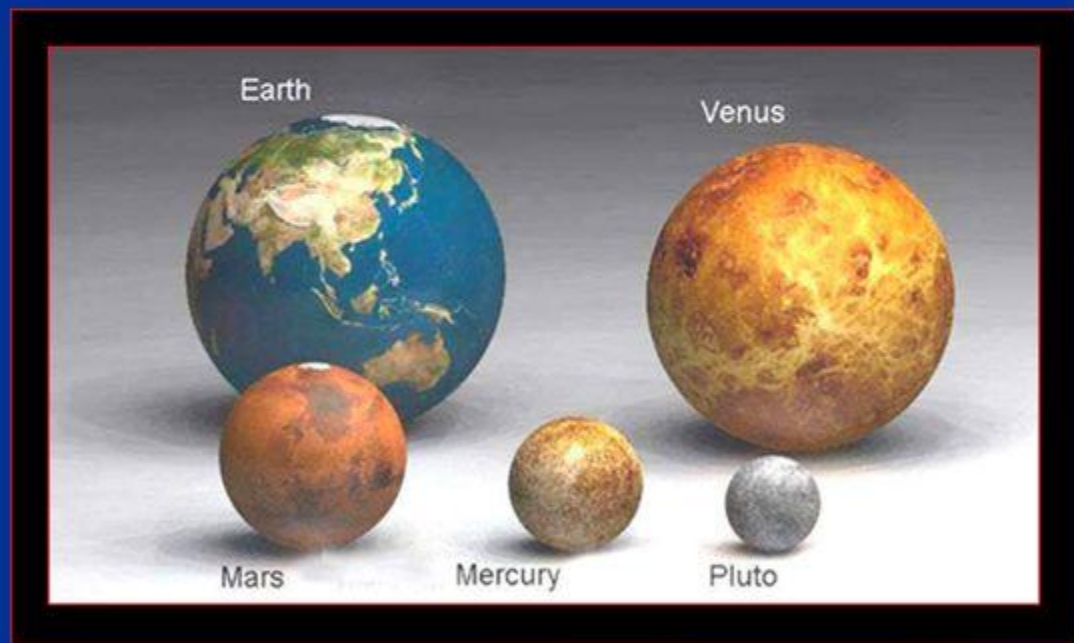
- Close to the sun
- Rocky surfaces
- Considered to be the “terrestrial” planets (meaning like earth)

MERCURY

VENUS

EARTH

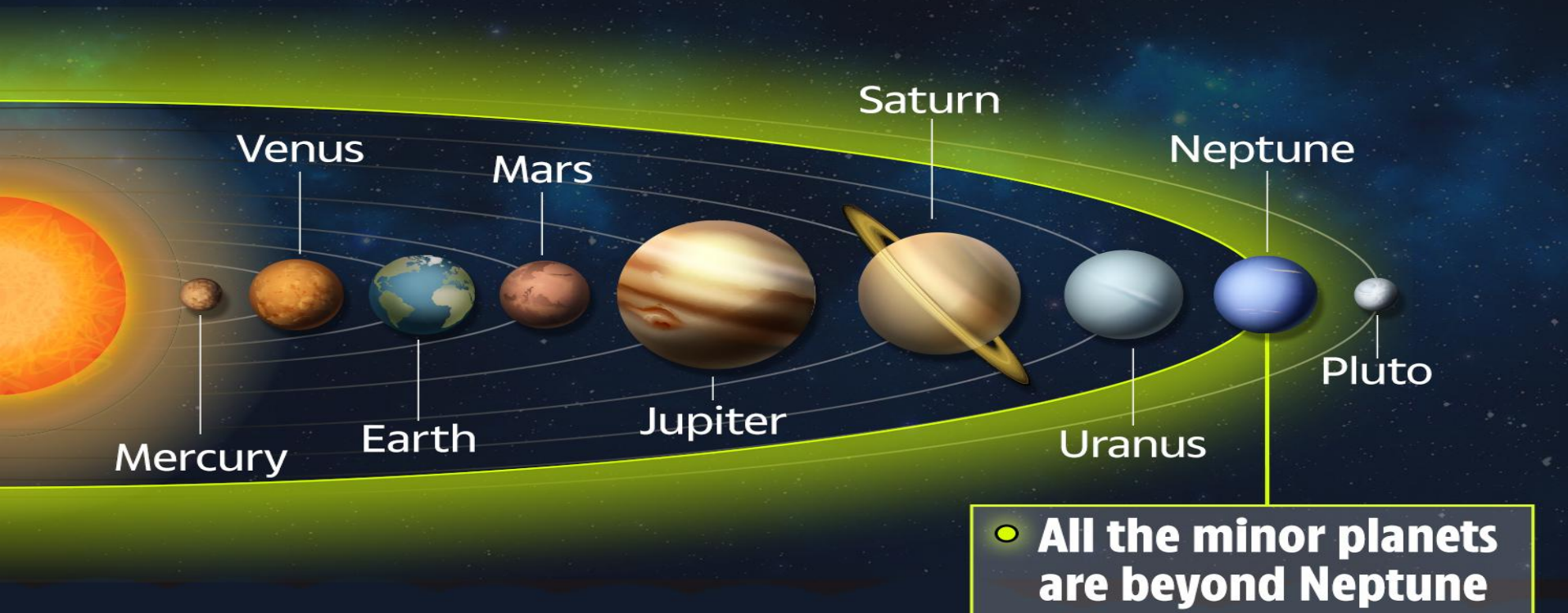
MARS



## More ... Planets ...

# OVER 100 MINOR PLANETS FOUND

- Scientists have found over 100 minor planets at the edge of our Solar System by re-analysing old data
- The data was collected with a camera used to survey dark matter

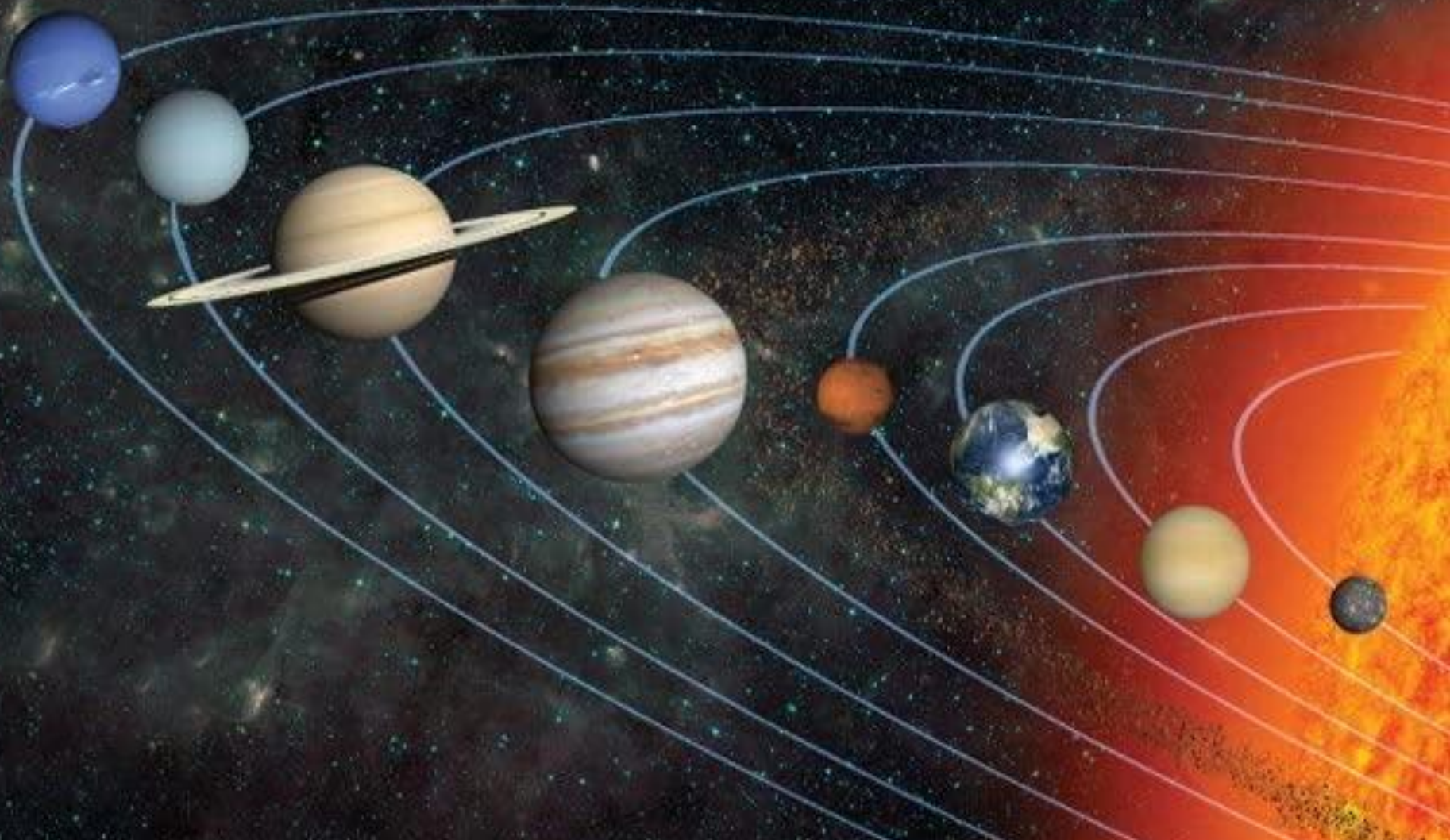


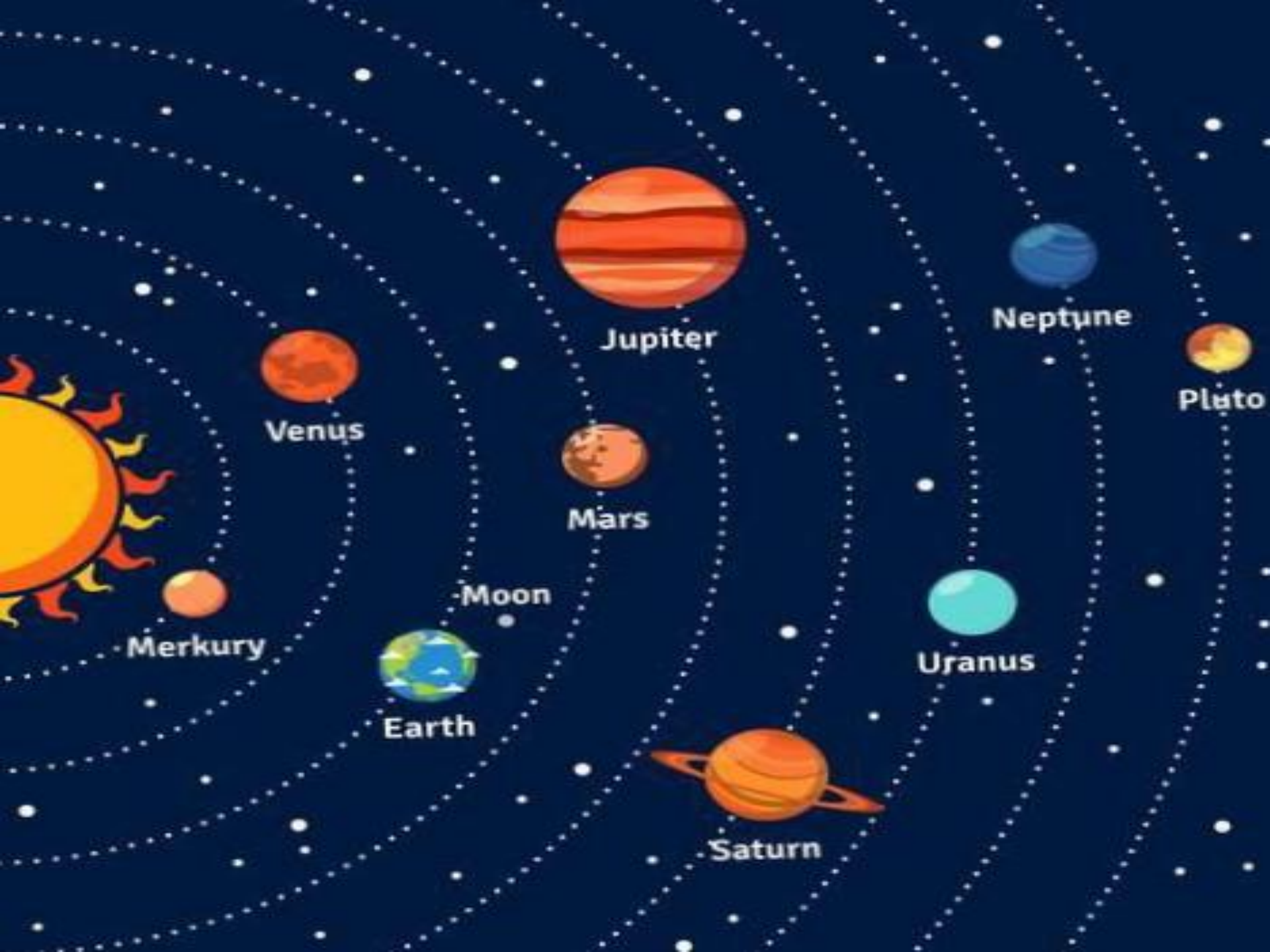
**Good Question!**

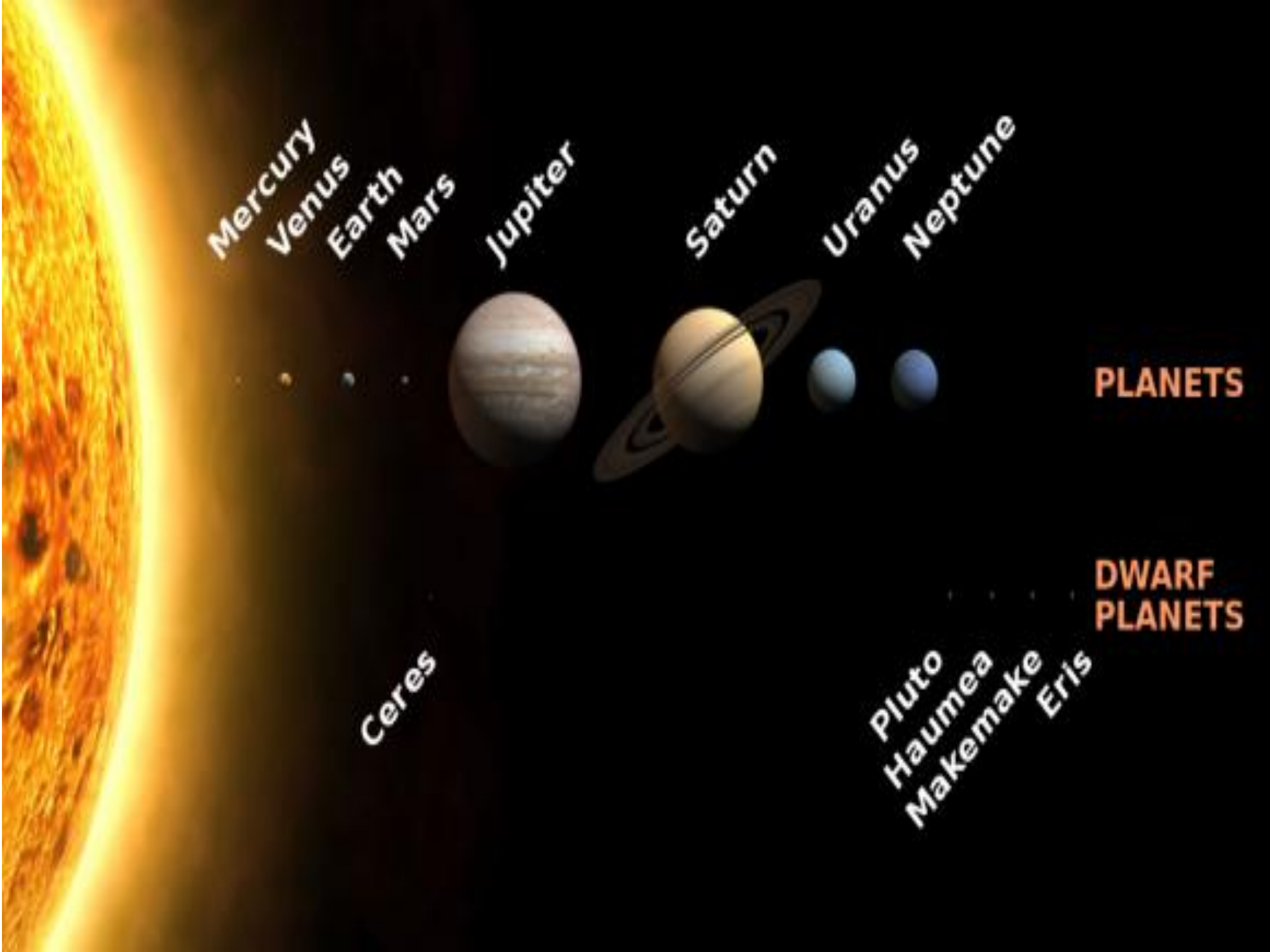
**How Many Planets Circle the Sun?**

AND OTHER QUESTIONS ABOUT . . .

***Our Solar System***







Mercury  
Venus  
Earth  
Mars

Jupiter

Saturn

Uranus  
Neptune

PLANETS

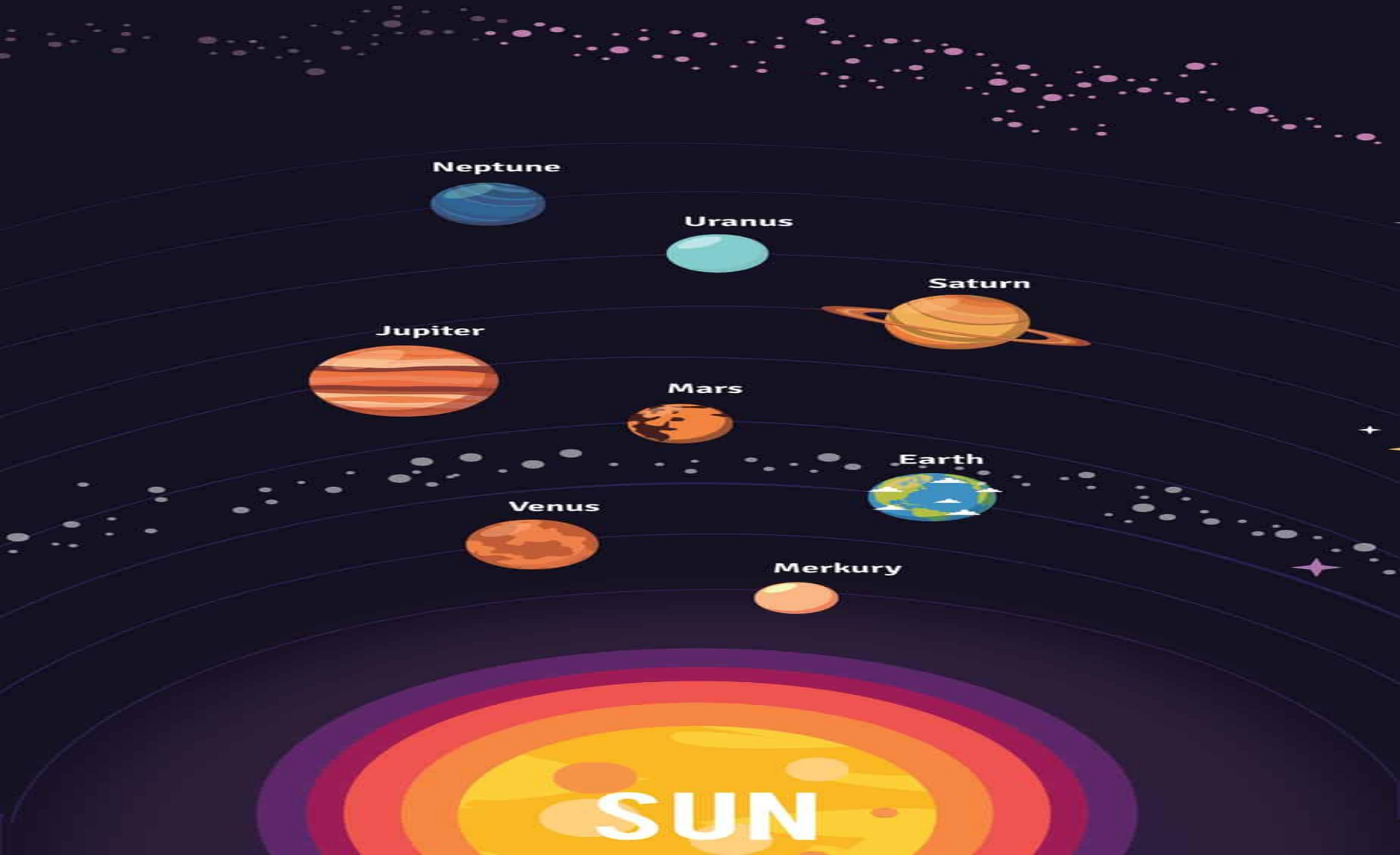
Ceres

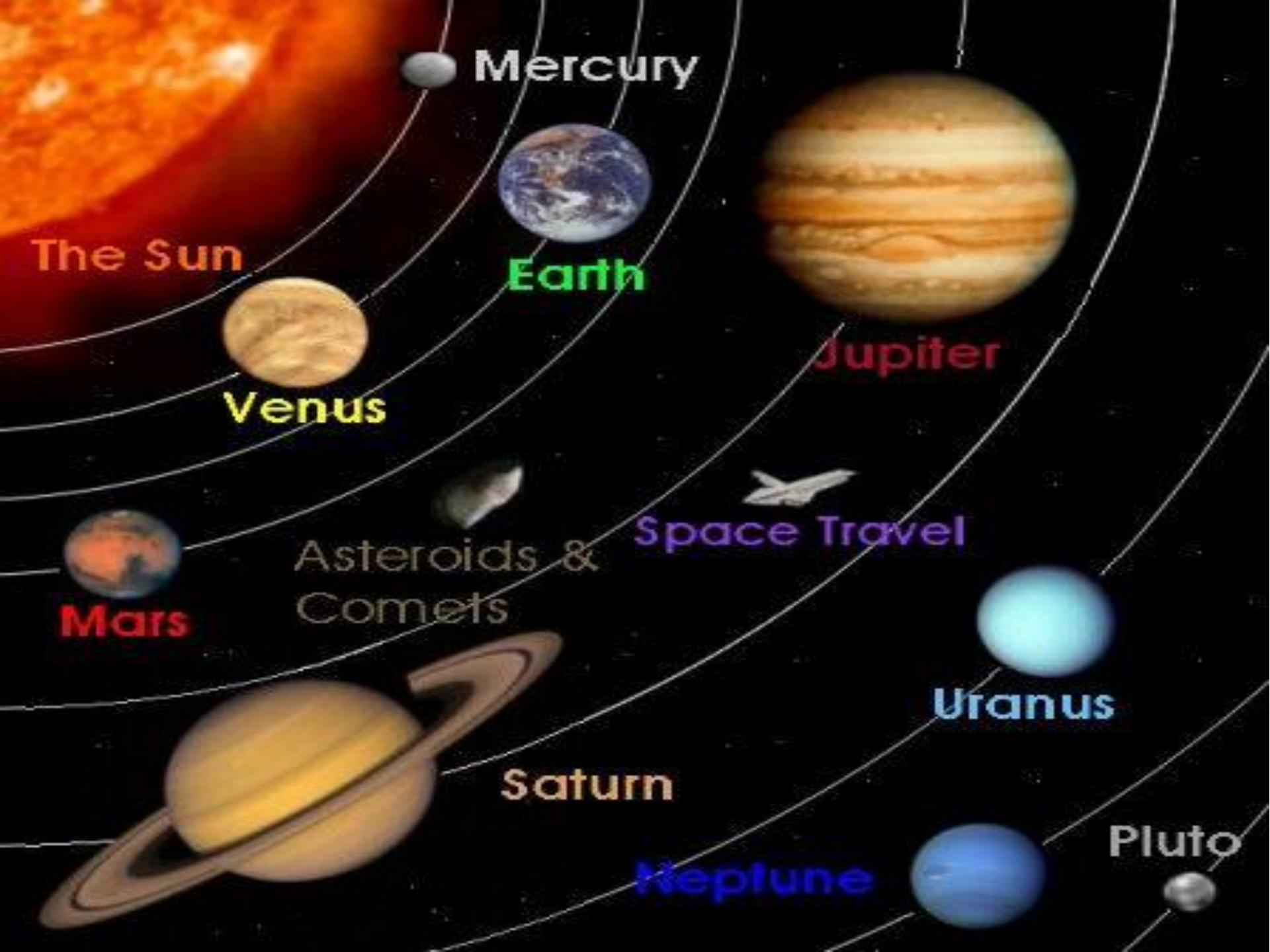
Pluto  
Haumea  
Makemake  
Eris

DWARF  
PLANETS

# HOW MANY PLANETS IN THE SOLAR SYSTEM?

There are eight planets revolving around one star (the Sun) in our Solar System. These are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune





The Sun

Mercury

Earth

Venus

Jupiter

Mars

Asteroids &  
Comets

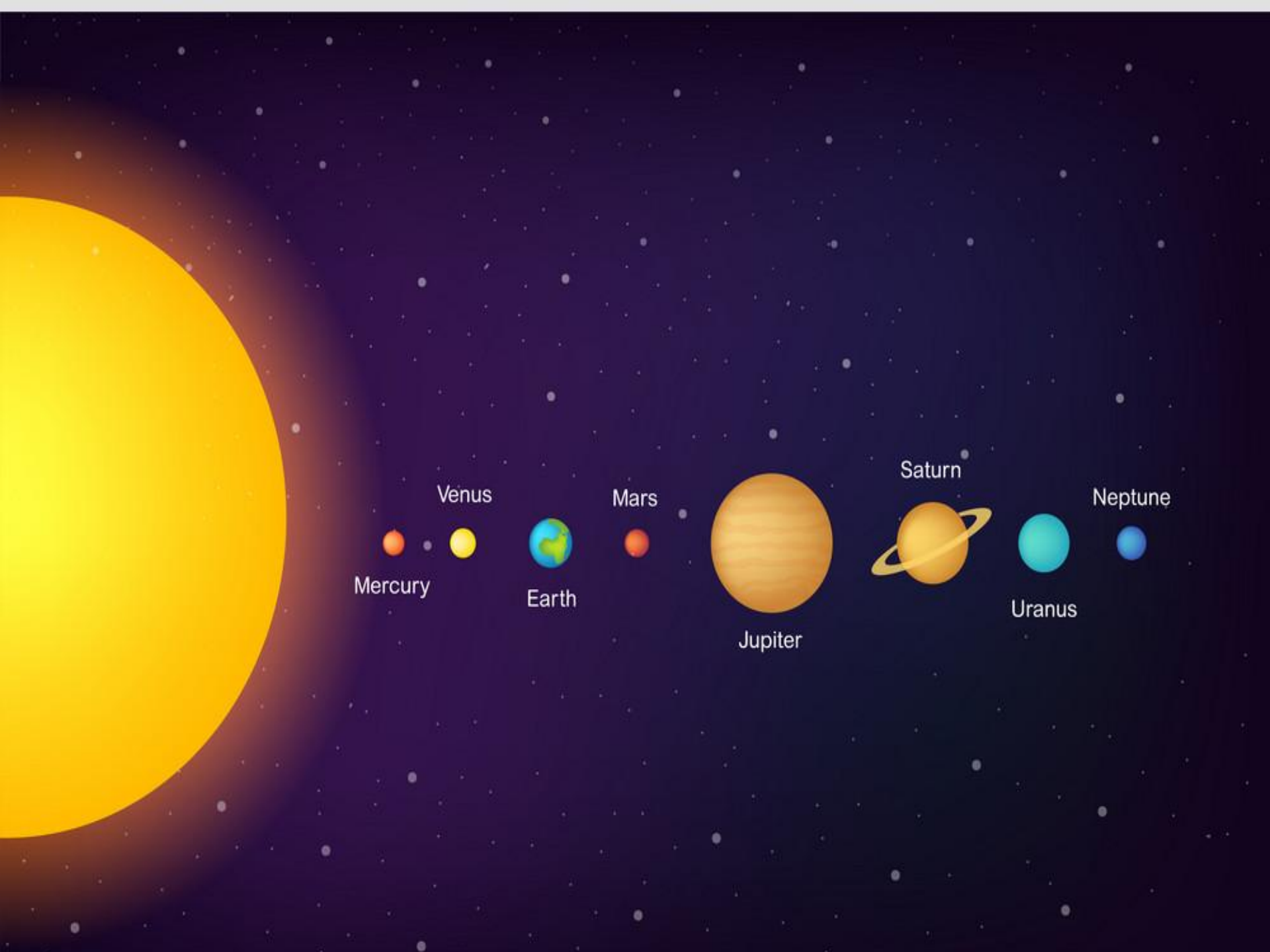
Space Travel

Uranus

Saturn

Neptune

Pluto



Mercury

Venus

Earth

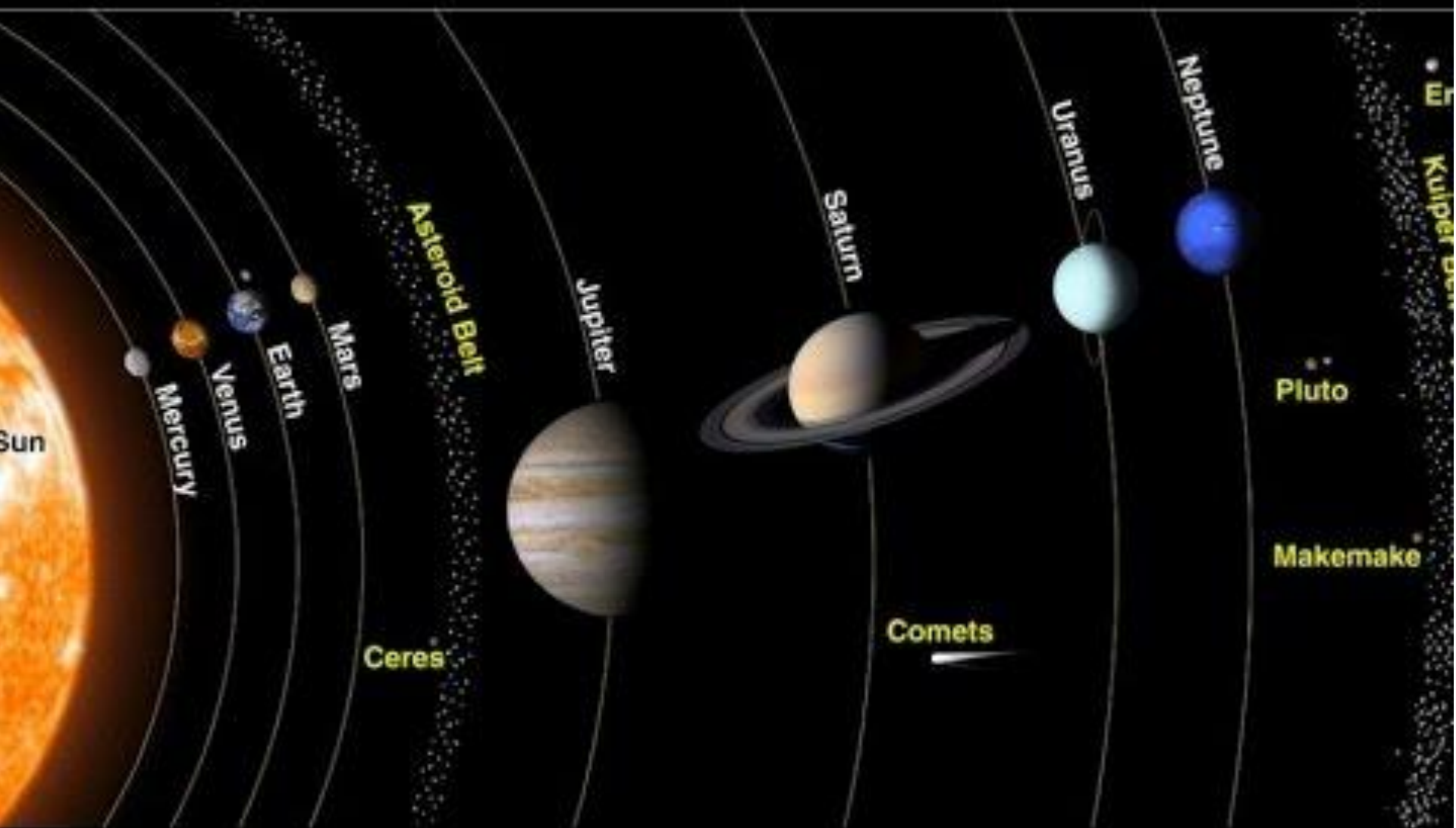
Mars

Jupiter

Saturn

Uranus

Neptune





# SOLAR SYSTEM

Solar system - planetary system that includes a central star of the Sun and all the natural space objects orbiting the Sun. It was formed by the gravitational compression of gas and dust cloud about 4.57 billion years ago.

Mercury  
Venus  
Earth  
Mars

Asteroid Belt

Jupiter

Saturn

Uranus

Neptune

Kuiper Belt

Comet

Comet

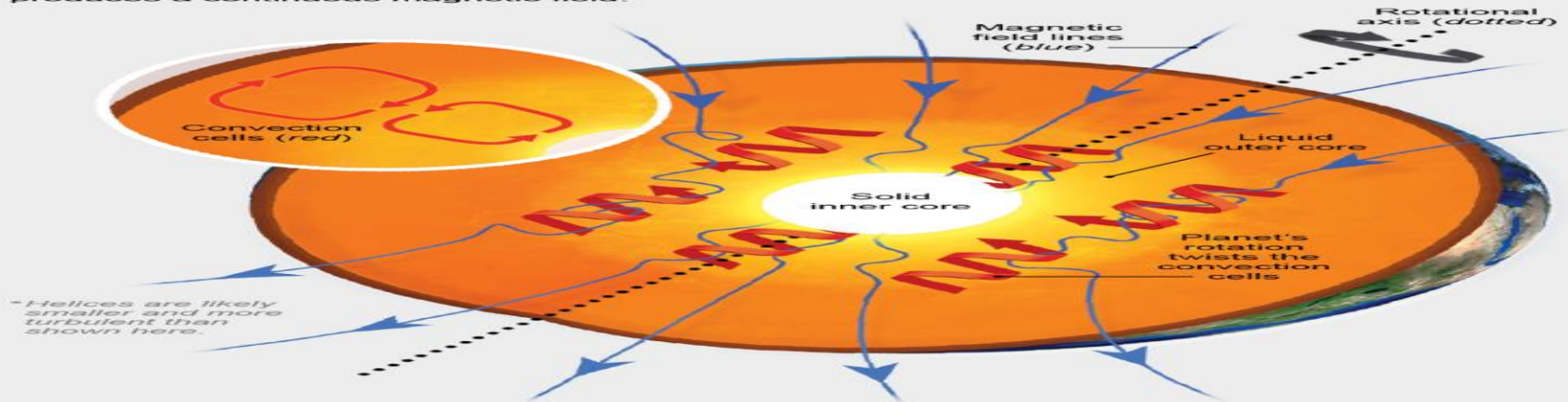
THE MASS OF THE SUN TAKES A **99.86%**  
WEIGHT OF THE SOLAR SYSTEM

### **3) Magnetics of the Planets**

# The magnetic field of the ... planets

## Dynamo Basics

Dynamos form inside planets when moving electric charges give rise to magnetic fields. Earth's magnetic field, for instance, originates in its outer core, which is mostly made of molten iron. This iron, a metal, is essentially a river of electrically charged particles. These particles churn and flow because of convection—the tendency of denser material to sink and hotter, less dense stuff to rise—as well as our planet's rotation. The result is a constantly moving electric current, which produces a continuous magnetic field.



## Planets with Magnetic Fields

Each planet's magnetic field arises from its own unique composition and rotational properties. Venus and Mars seem to lack enough convection in their interiors to produce fields.

### Mercury

The smallest of the planets also has the weakest magnetic field. Its internal dynamo is counteracted by the solar wind of particles streaming off the sun.



### Earth

Our planet's magnetic north pole happens to point toward its geographic south pole, as do Mercury's and Uranus's.



### Jupiter

The solar system's strongest magnetic field is much more intense and complex than Earth's because of the gas giant's rapid rotation and larger metallic interior.



### Saturn

Saturn's magnetic field is weaker than Jupiter's and symmetric around its axis of rotation, possibly because of helium rain that dampens convection in the atmosphere.



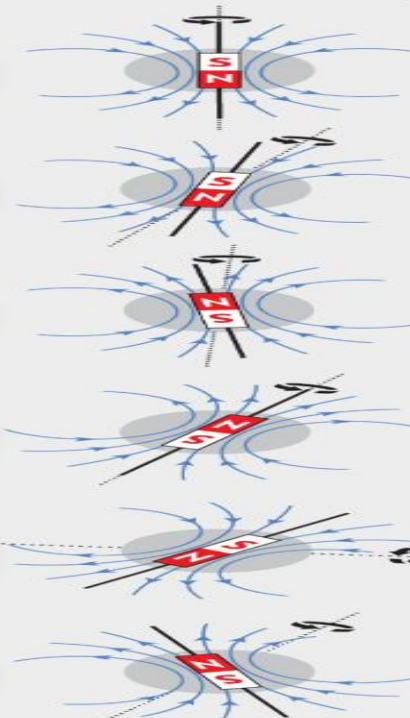
### Uranus

The magnetic field here is tilted 60 degrees from the planet's rotational axis, causing the field's strength and orientation to fluctuate as Uranus spins.



### Neptune

The farthest planet's magnetic axis is also misaligned from its rotational axis, giving it a lopsided shape that interacts with the solar wind in unbalanced ways.



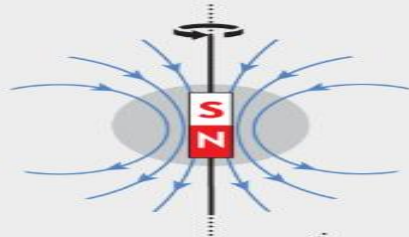
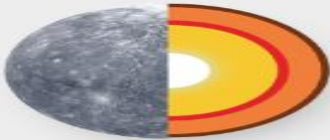
- Solid iron
- Liquid iron
- Iron sulfide
- Silicate mantle
- Silicate crust
- Liquid metallic hydrogen and helium
- Liquid hydrogen
- Water, methane, and ammonia
- Hydrogen and helium

**Planets with Magnetic Fields**

Each planet's magnetic field arises from its own unique composition and rotational properties. Venus and Mars seem to lack enough convection in their interiors to produce fields.

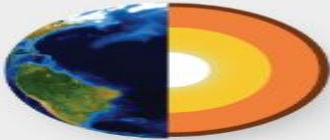
**Mercury**

The smallest of the planets also has the weakest magnetic field. Its internal dynamo is counteracted by the solar wind of particles streaming off the sun.



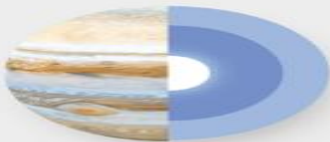
**Earth**

Our planet's magnetic north pole happens to point toward its geographic south pole, as do Mercury's and Uranus's.



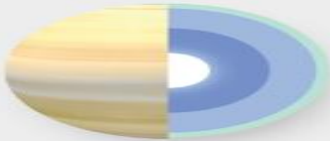
**Jupiter**

The solar system's strongest magnetic field is much more intense and complex than Earth's because of the gas giant's rapid rotation and larger metallic interior.



**Saturn**

Saturn's magnetic field is weaker than Jupiter's and symmetric around its axis of rotation, possibly because of helium rain that dampens convection in the atmosphere.



**Uranus**

The magnetic field here is tilted 60 degrees from the planet's rotational axis, causing the field's strength and orientation to fluctuate as Uranus spins.



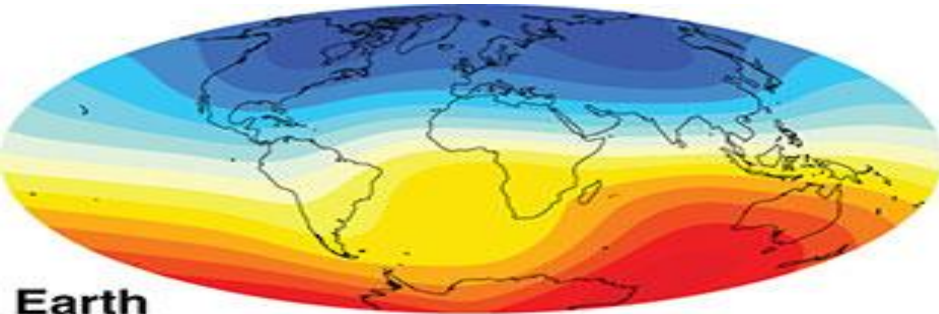
**Neptune**

The farthest planet's magnetic axis is also misaligned from its rotational axis, giving it a lopsided shape that interacts with the solar wind in unbalanced ways.

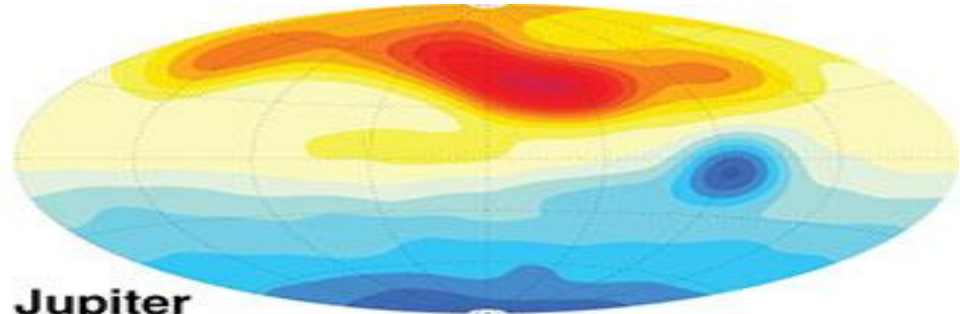


- Solid iron
- Liquid iron
- Iron sulfide
- Silicate mantle
- Silicate crust
- Liquid metallic hydrogen and helium
- Liquid hydrogen
- Water, methane, and ammonia
- Hydrogen and helium

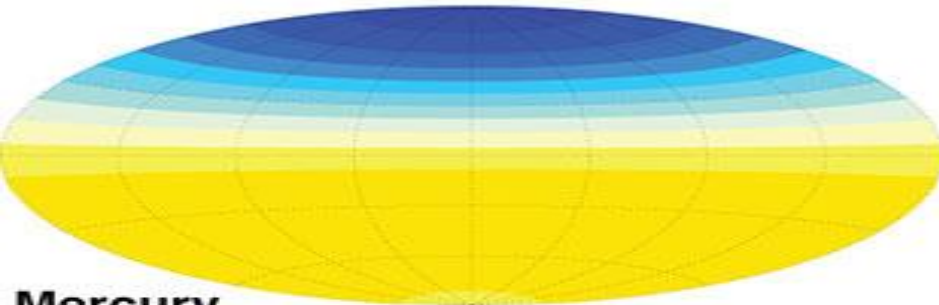
# The magnetic field of ... various planets



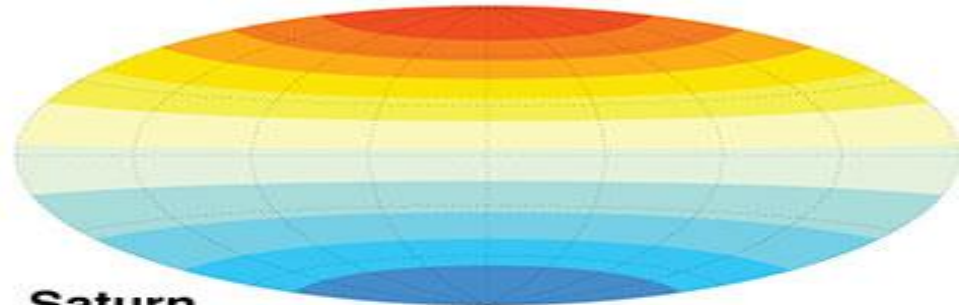
**Earth**



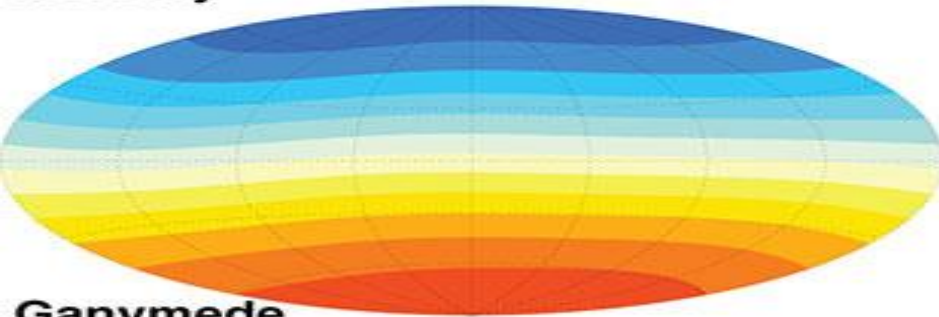
**Jupiter**



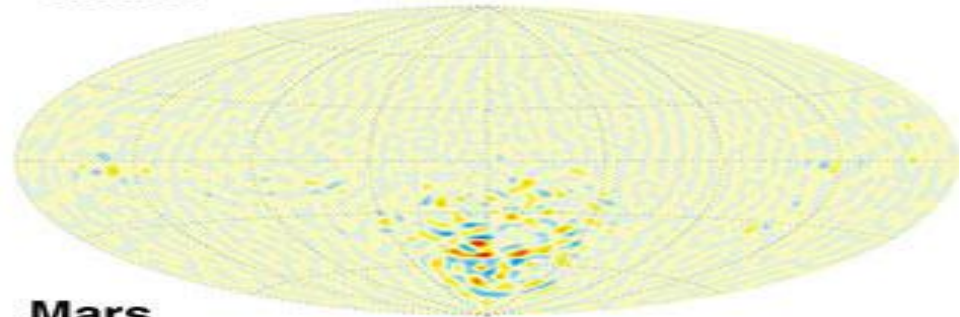
**Mercury**



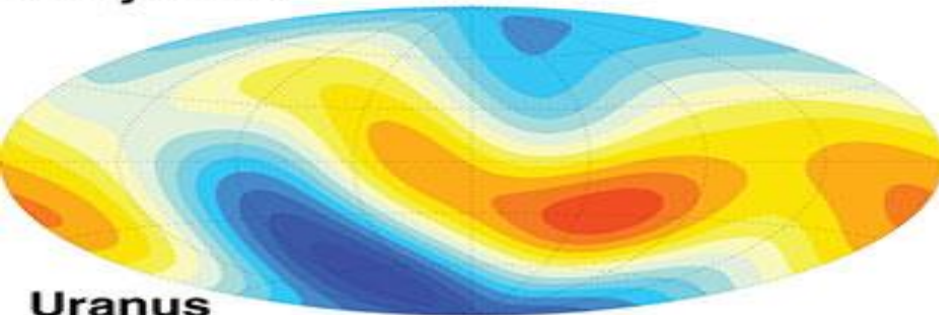
**Saturn**



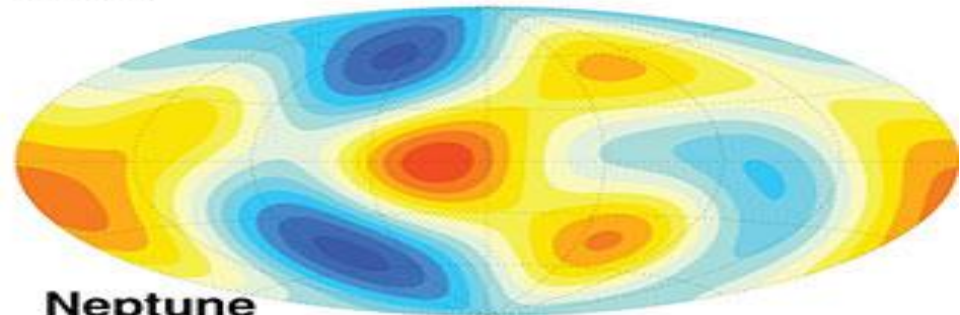
**Ganymede**



**Mars**



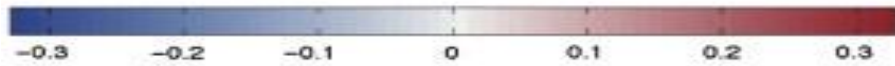
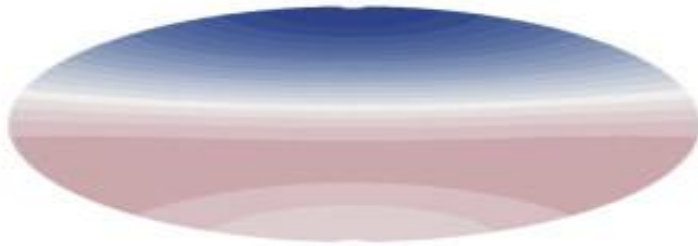
**Uranus**



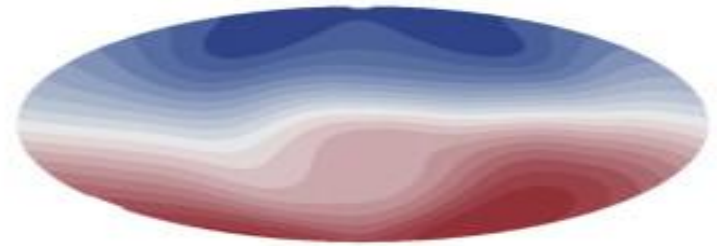
**Neptune**

# The magnetic field of ... various planets

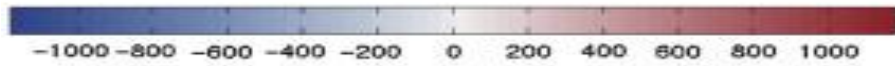
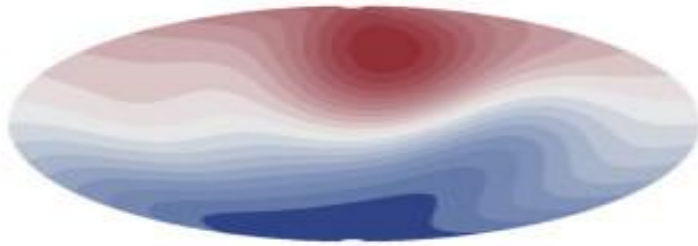
Mercury



Earth



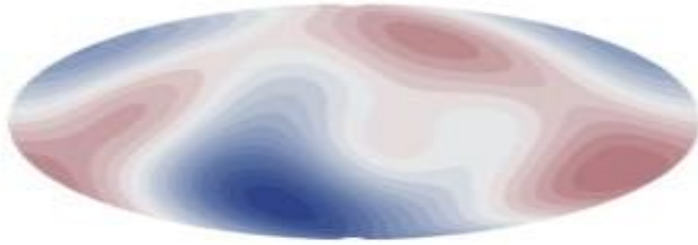
Jupiter



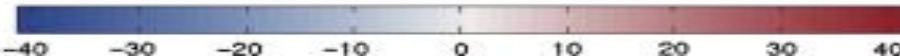
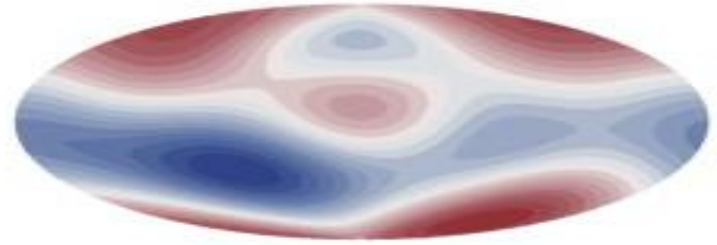
Saturn



Uranus

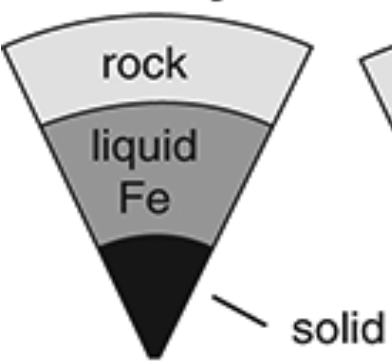


Neptune

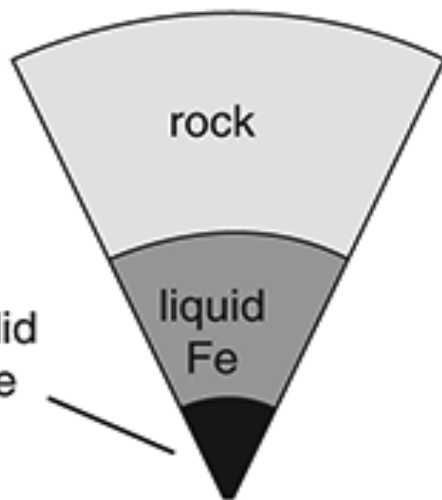


# The underlying composition of ... **various planets**

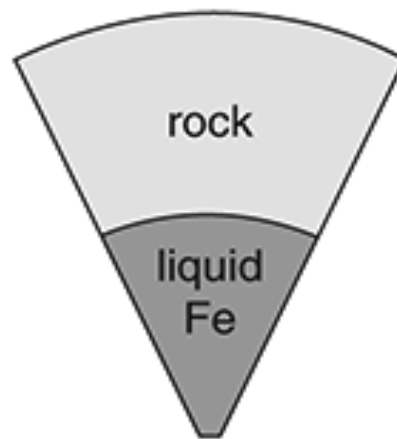
**Mercury**



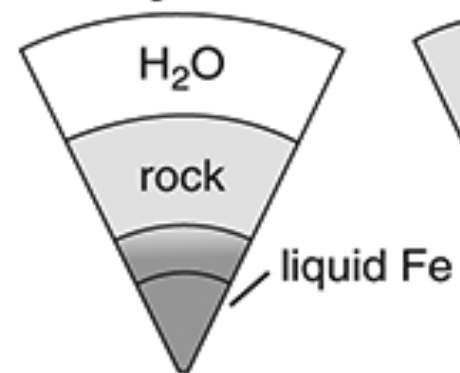
**Earth**



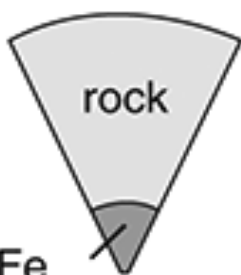
**Venus/Mars**



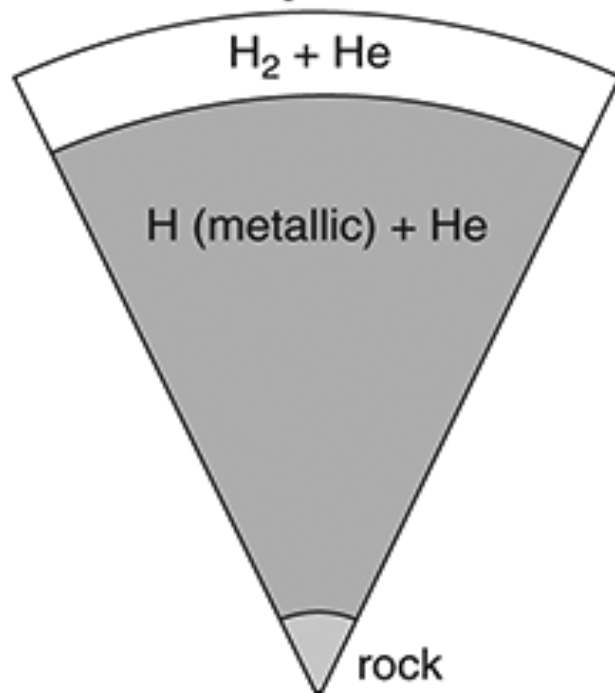
**Ganymede**



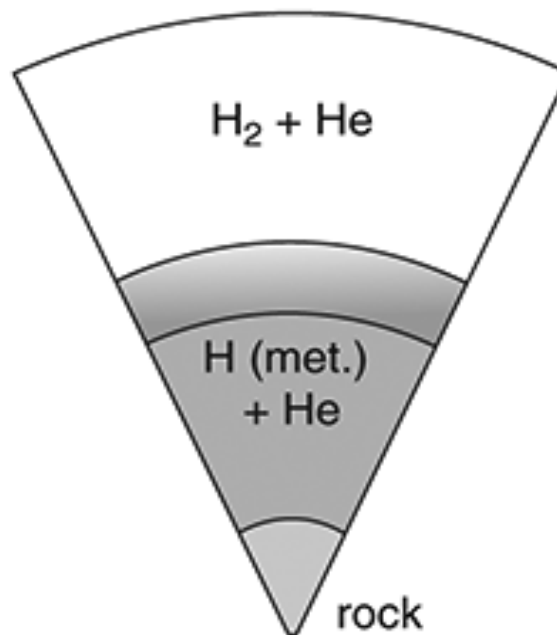
**Moon**



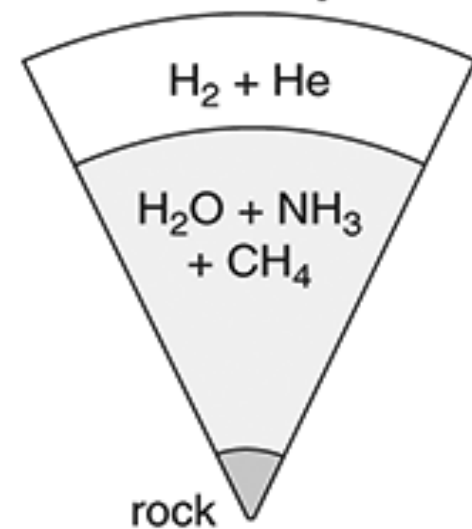
**Jupiter**



**Saturn**



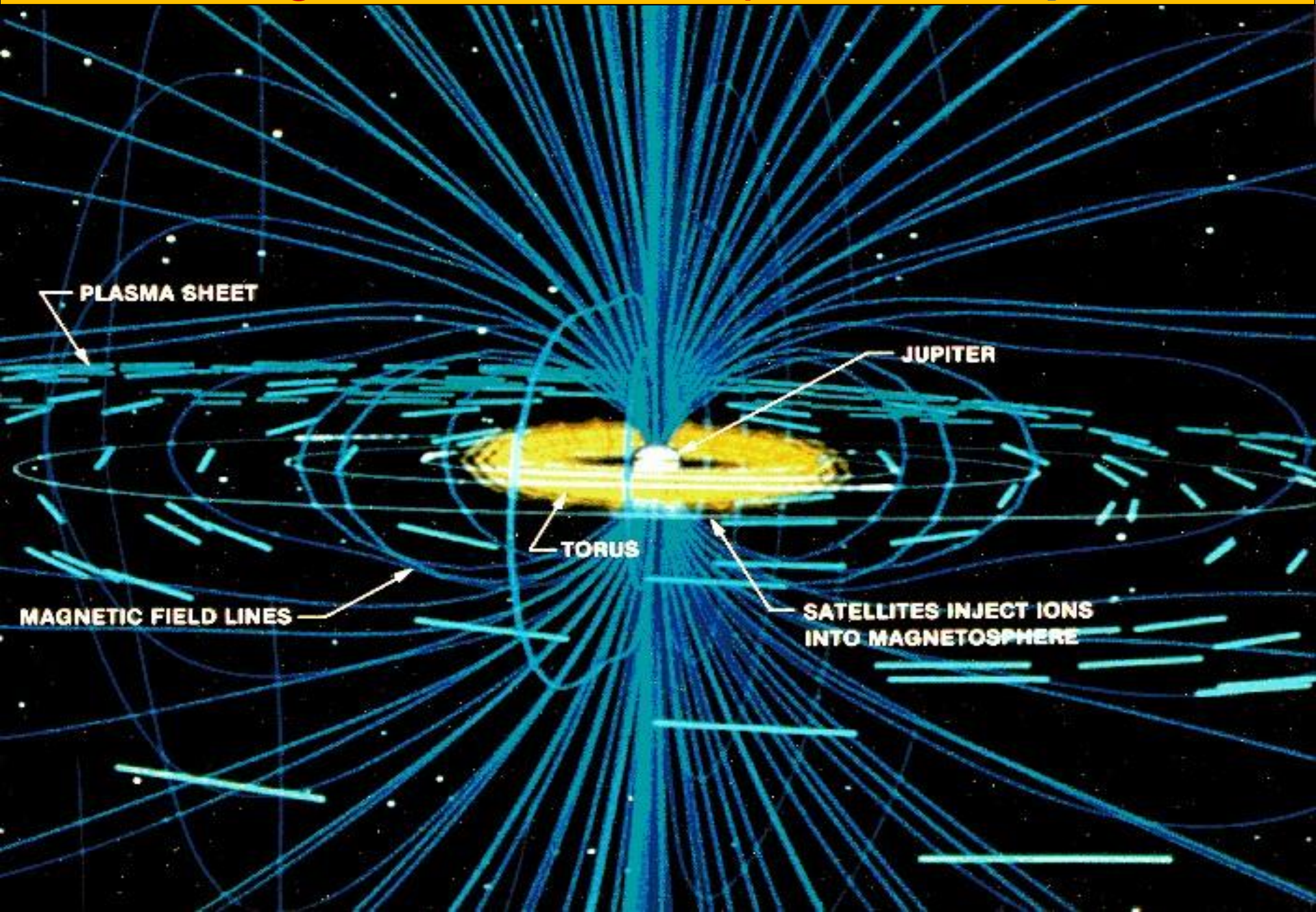
**Uranus/Neptune**



# The magnetic field of ... **various planets**

- ❑ *Since 1973 space missions carrying vector magnetometers have shown that most, but not all, **solar system planets have a global magnetic field of internal origin.***
- ❑ **They have also revealed a surprising diversity in terms of field strength and morphology.**
- ❑ **Earth has a dipole magnetic field.** *(moderately tilted relative to the planet's spin axis).*
- ❑ **Jupiter has a dipole magnetic field too.**
- ❑ **Uranus and Neptune are multipole-dominated.**
- ❑ **Saturn and Mercury** are highly symmetric relative to the rotation axis.
- ❑ **Planetary magnetism** *originates from a dynamo process, which requires a fluid and electrically conducting region in the interior with sufficiently rapid and complex flow.*

# The magnetic field of the planet ...**Jupiter**...

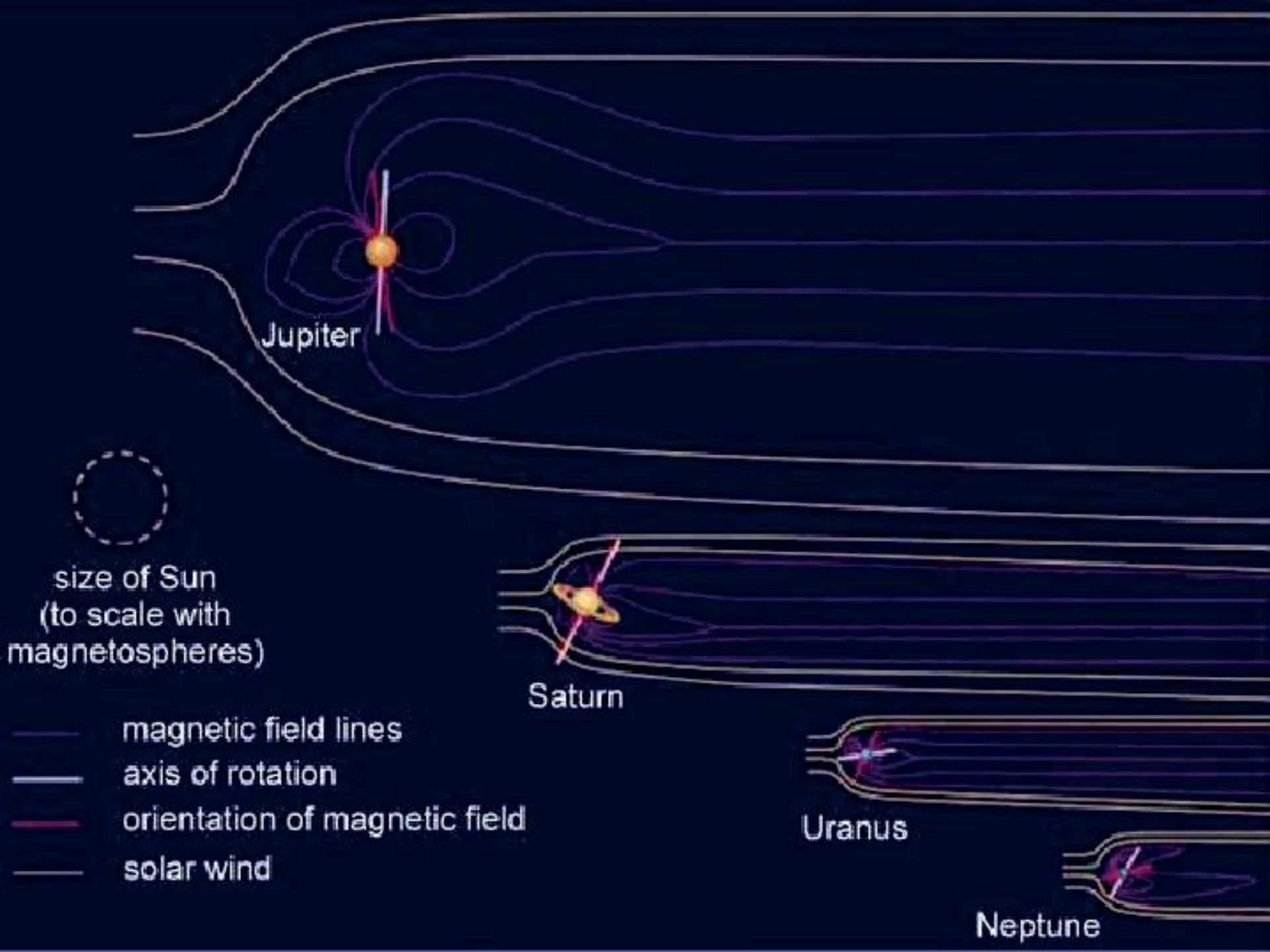


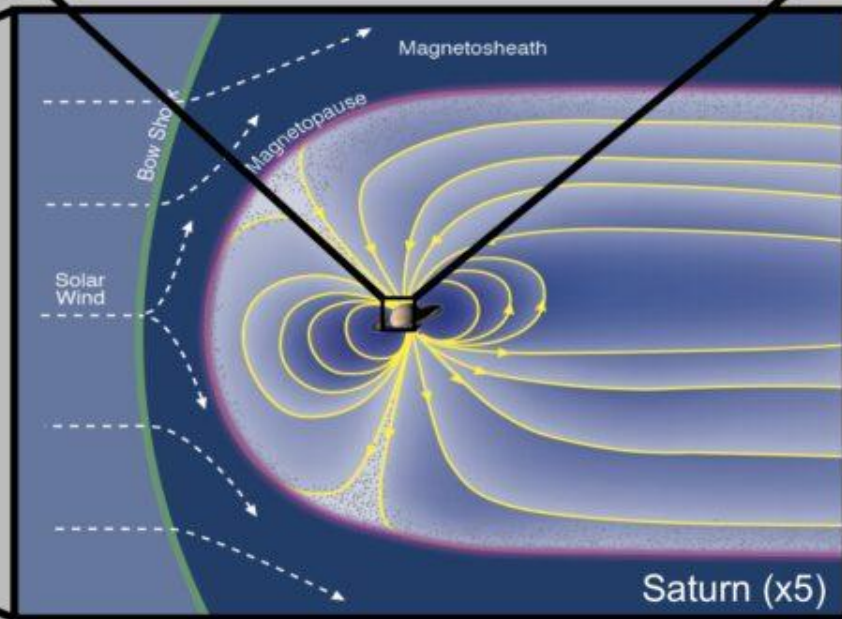
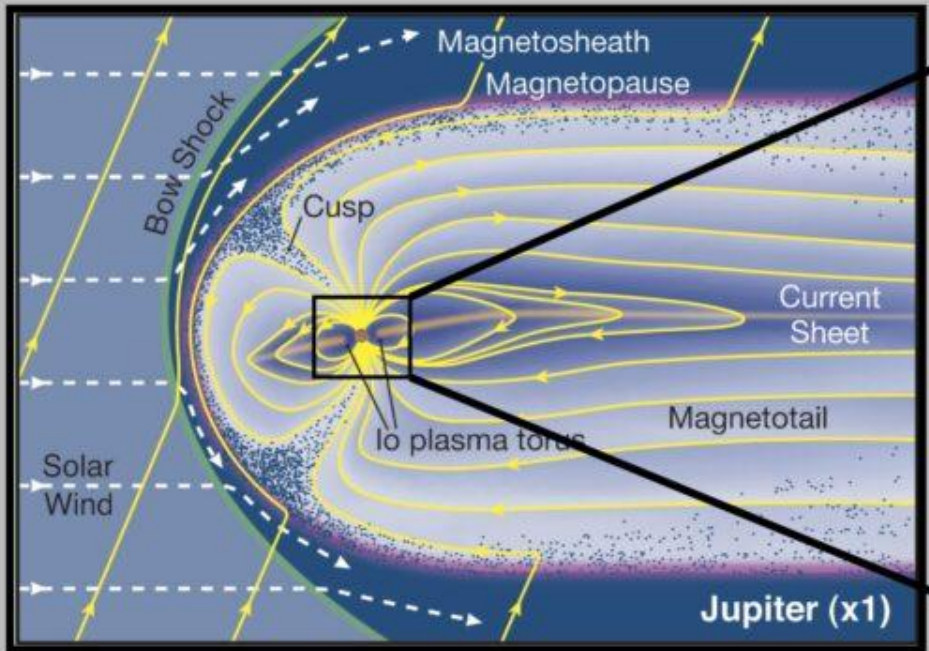
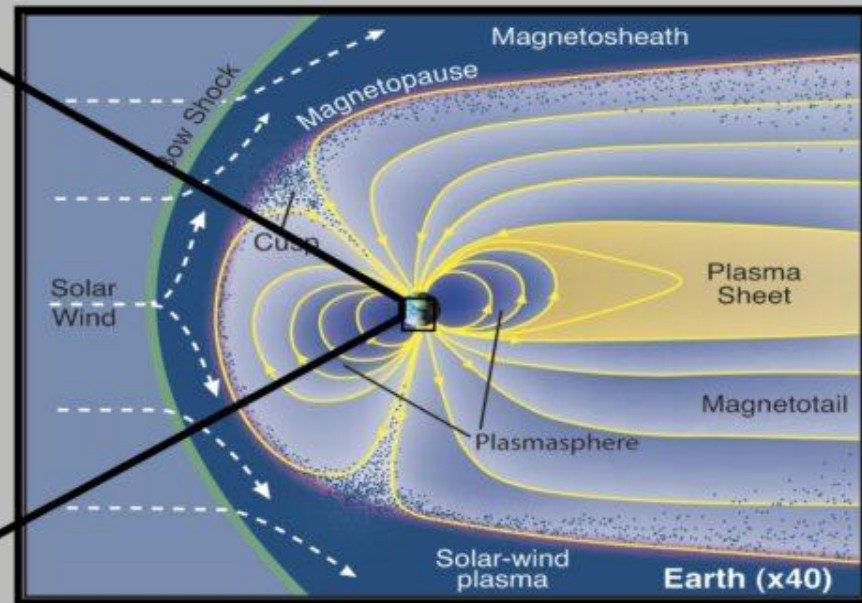
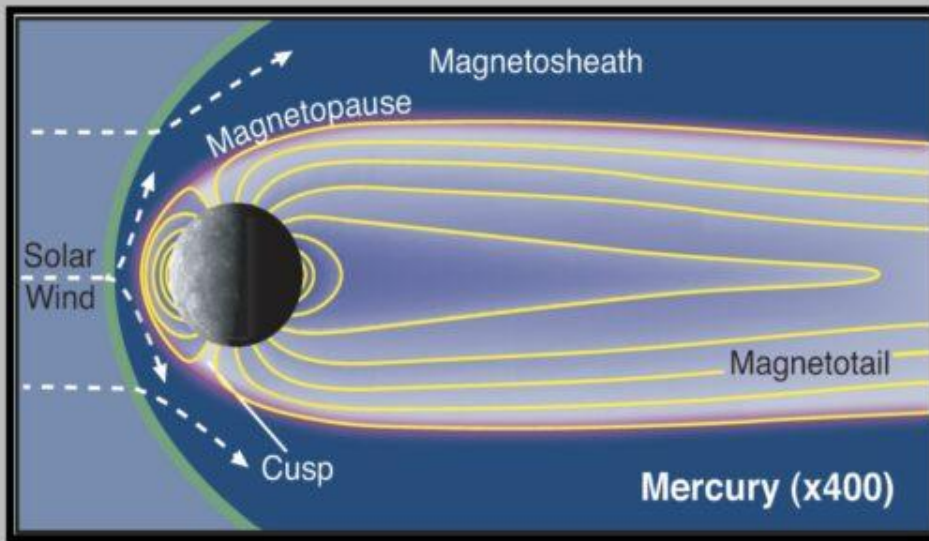
# The magnetic fields are of interest for three reasons

1. they provide ground truth for **dynamo theory**.
2. the magnetic field controls how the planet interacts with its space environment, for example, the solar wind, and
3. the existence or nonexistence and the properties of the field enable us to draw inferences on the constitution, dynamics, and thermal evolution of the planet's interior.

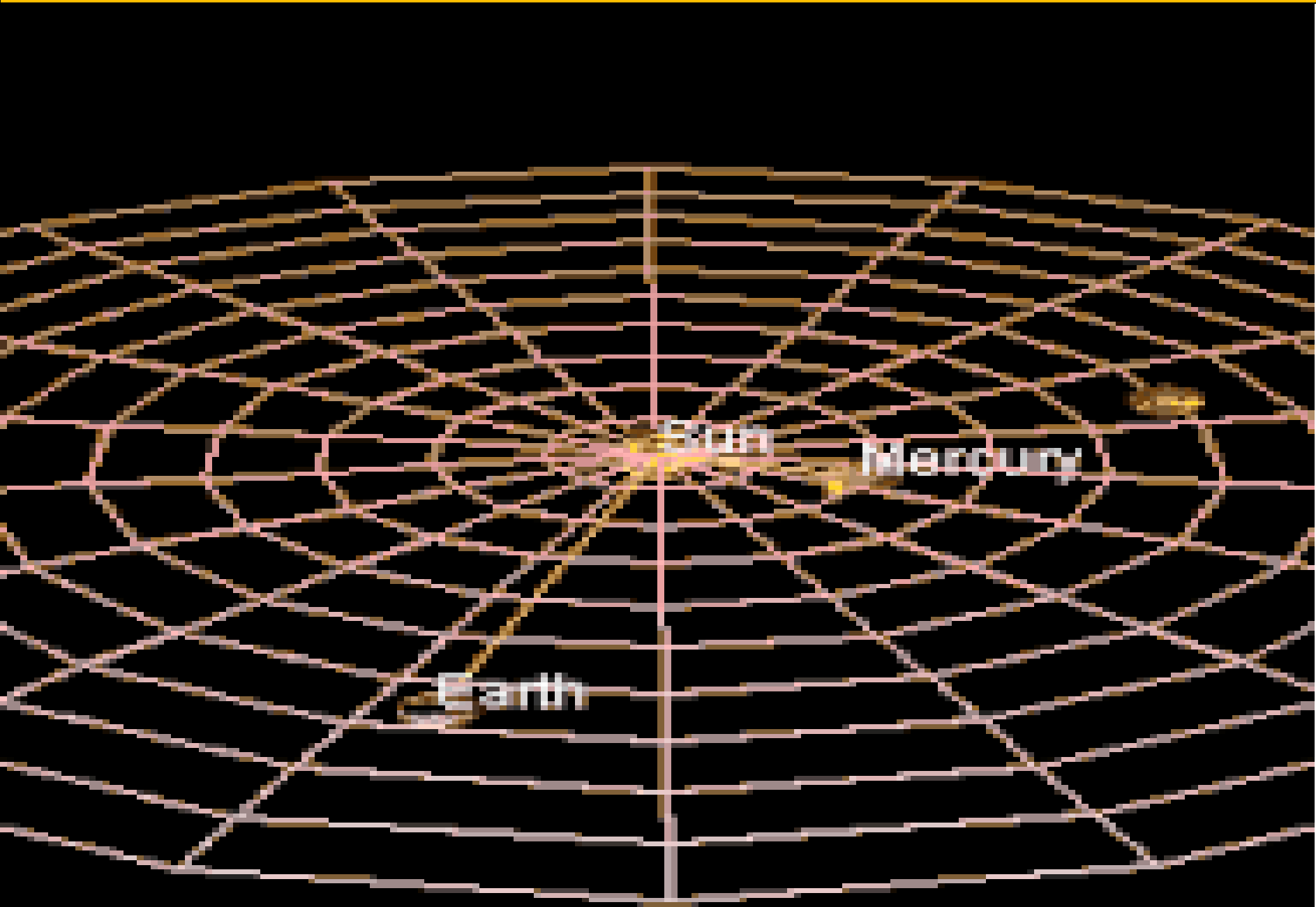
## More ...

- ❑ Numerical simulations of the geodynamo, in which convective flow in a rapidly rotating spherical shell representing the outer liquid iron core of the Earth leads to induction of electric currents, have successfully reproduced many observed properties of the geomagnetic field.
- ❑ They have also provided guidelines on the factors controlling magnetic field strength and morphology.
- ❑ For numerical reasons the simulations must employ viscosities far greater than those inside planets and it is debatable whether they capture the correct physics of planetary dynamo processes.
- ❑ Nonetheless, such models have been adapted to test concepts for explaining magnetic field properties of other planets.
- ❑ For example, they show that a stable stratified conducting layer above the dynamo region is a plausible cause for the strongly axisymmetric magnetic fields of Mercury or Saturn.



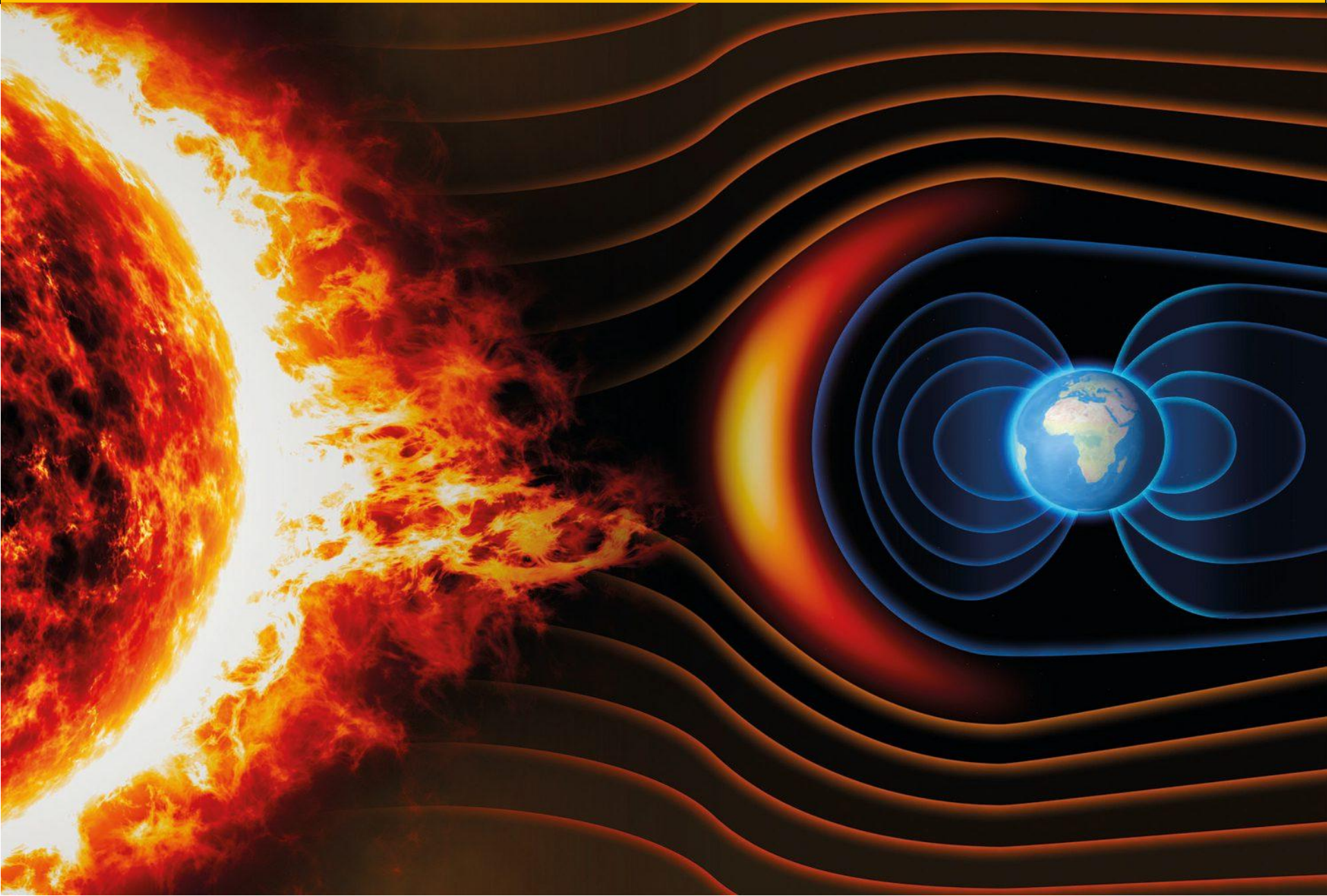


# Animation of Mercury's and Earth's revolution around the Sun

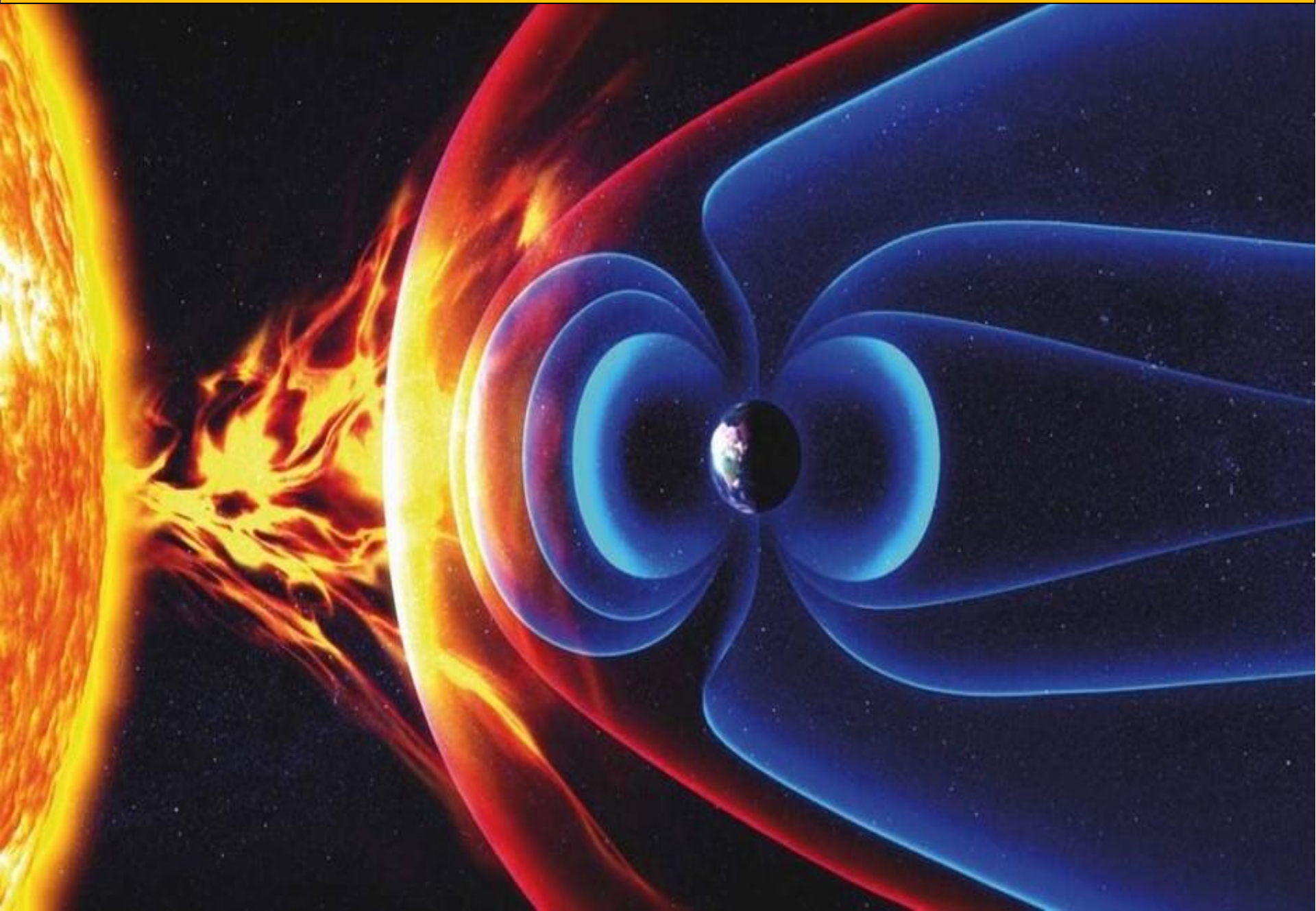


## 4) Sun - Earth magnetic fields

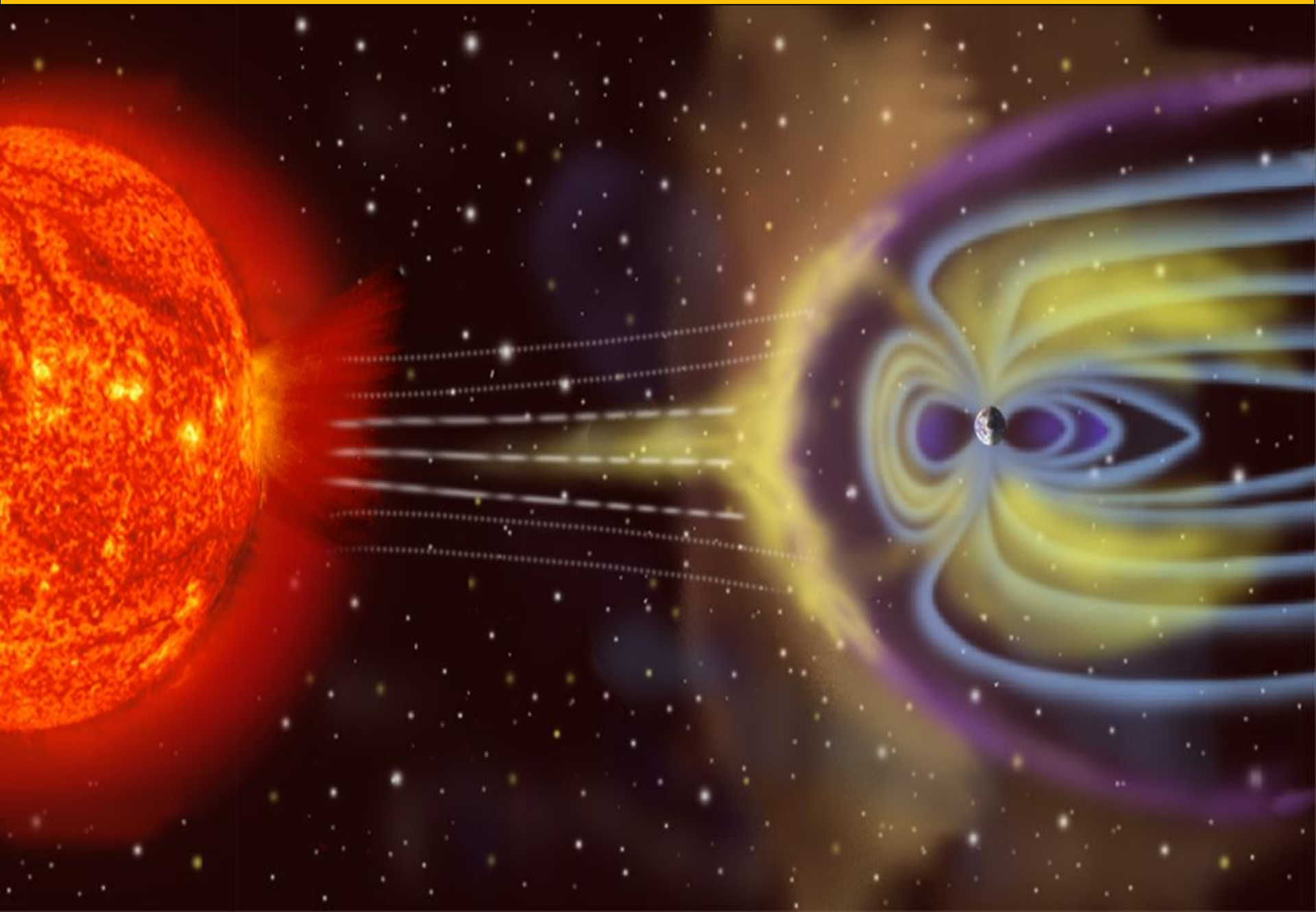
# Sun & Earth ...

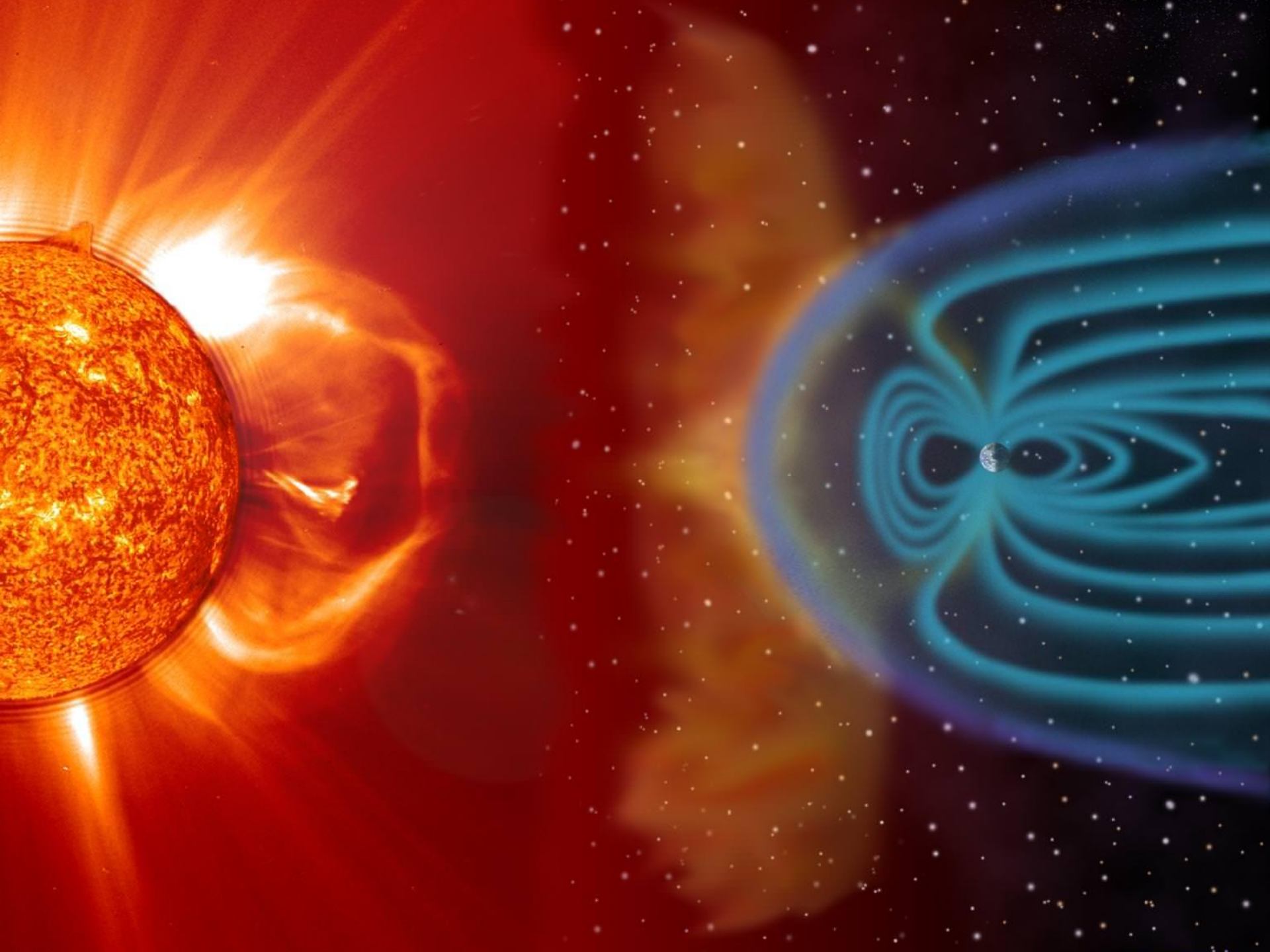


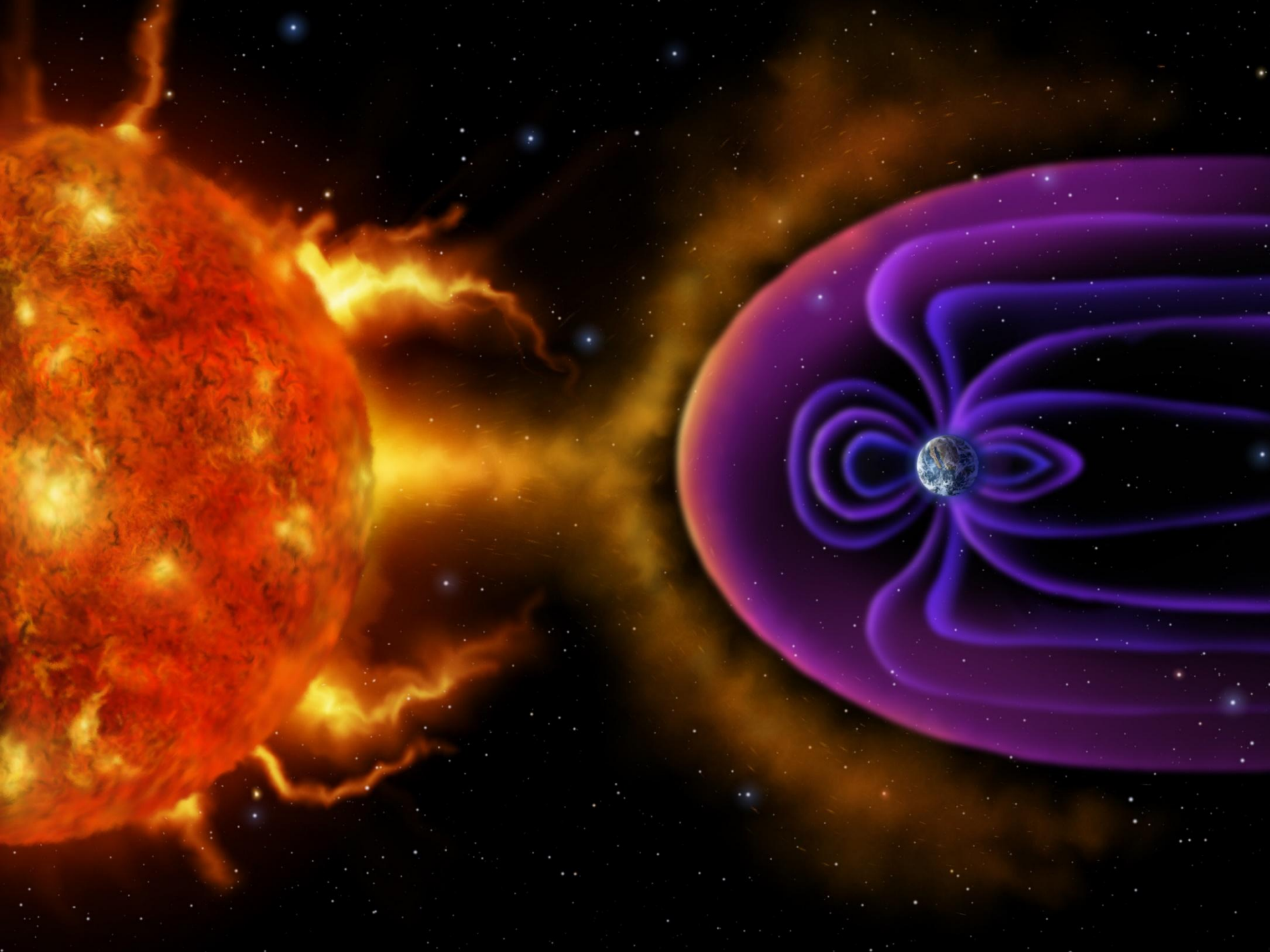
# Sun & Earth ...



# Sun & Earth ...

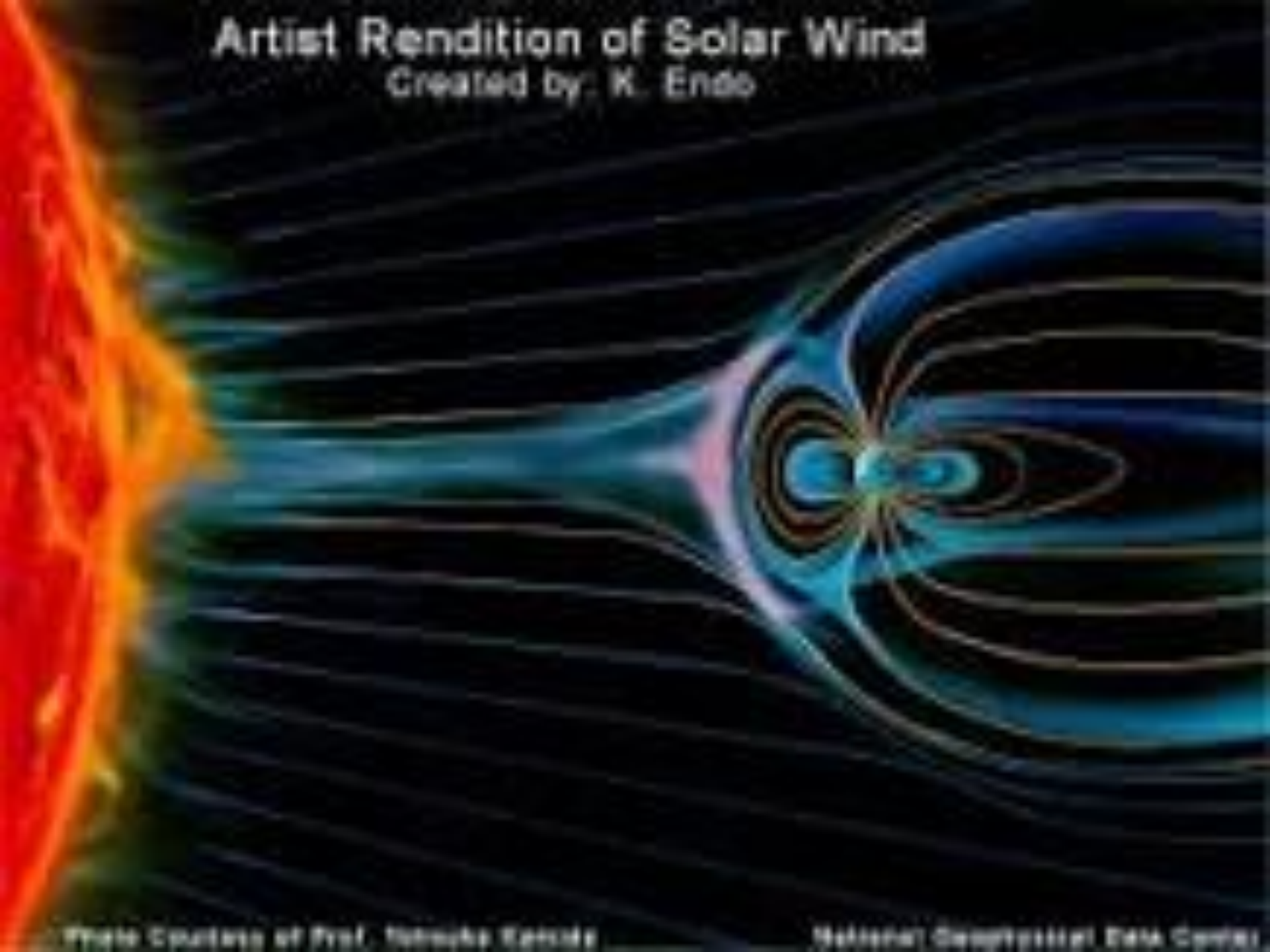


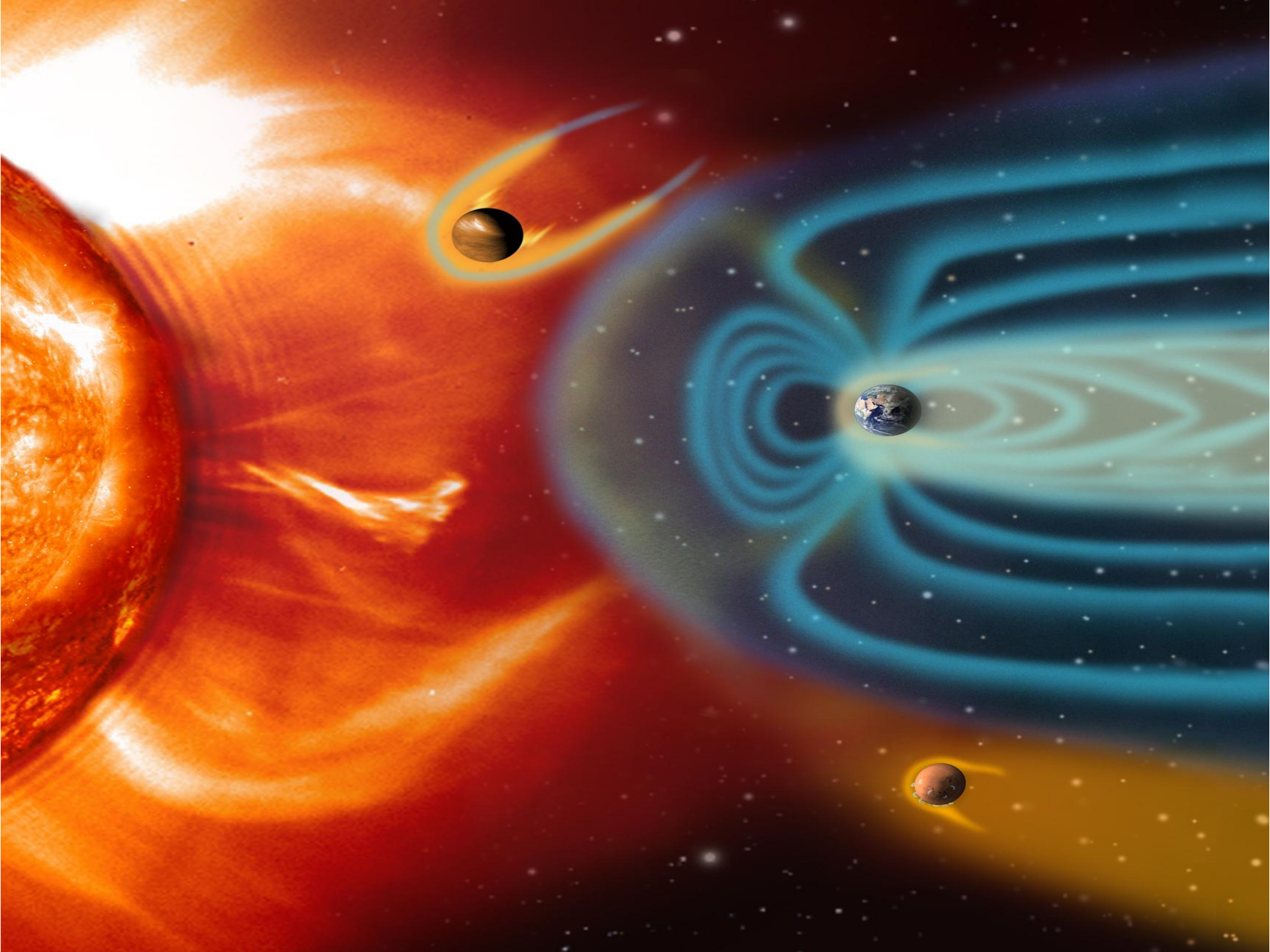


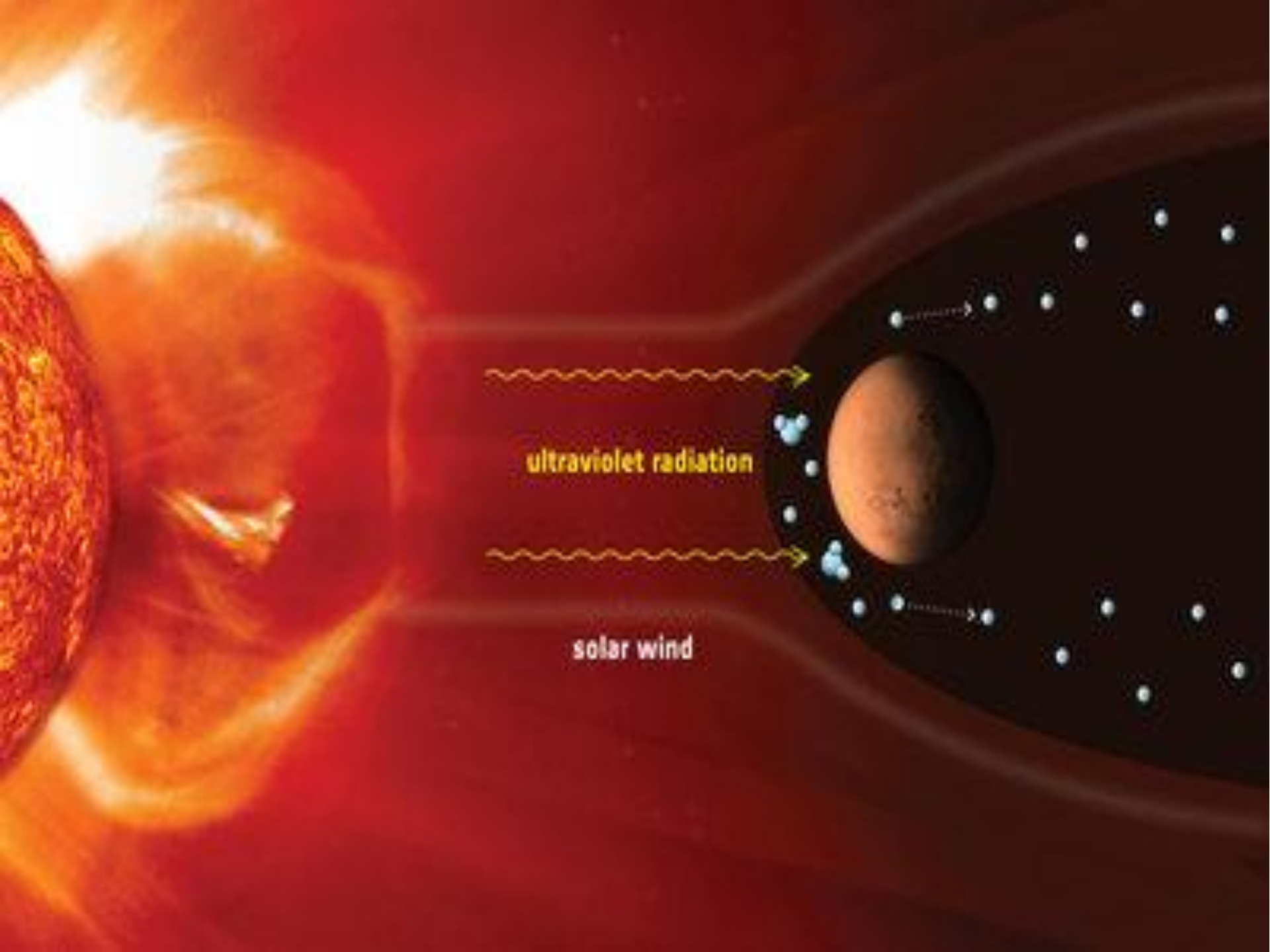


# Artist Rendition of Solar Wind

Created by: K. Endo







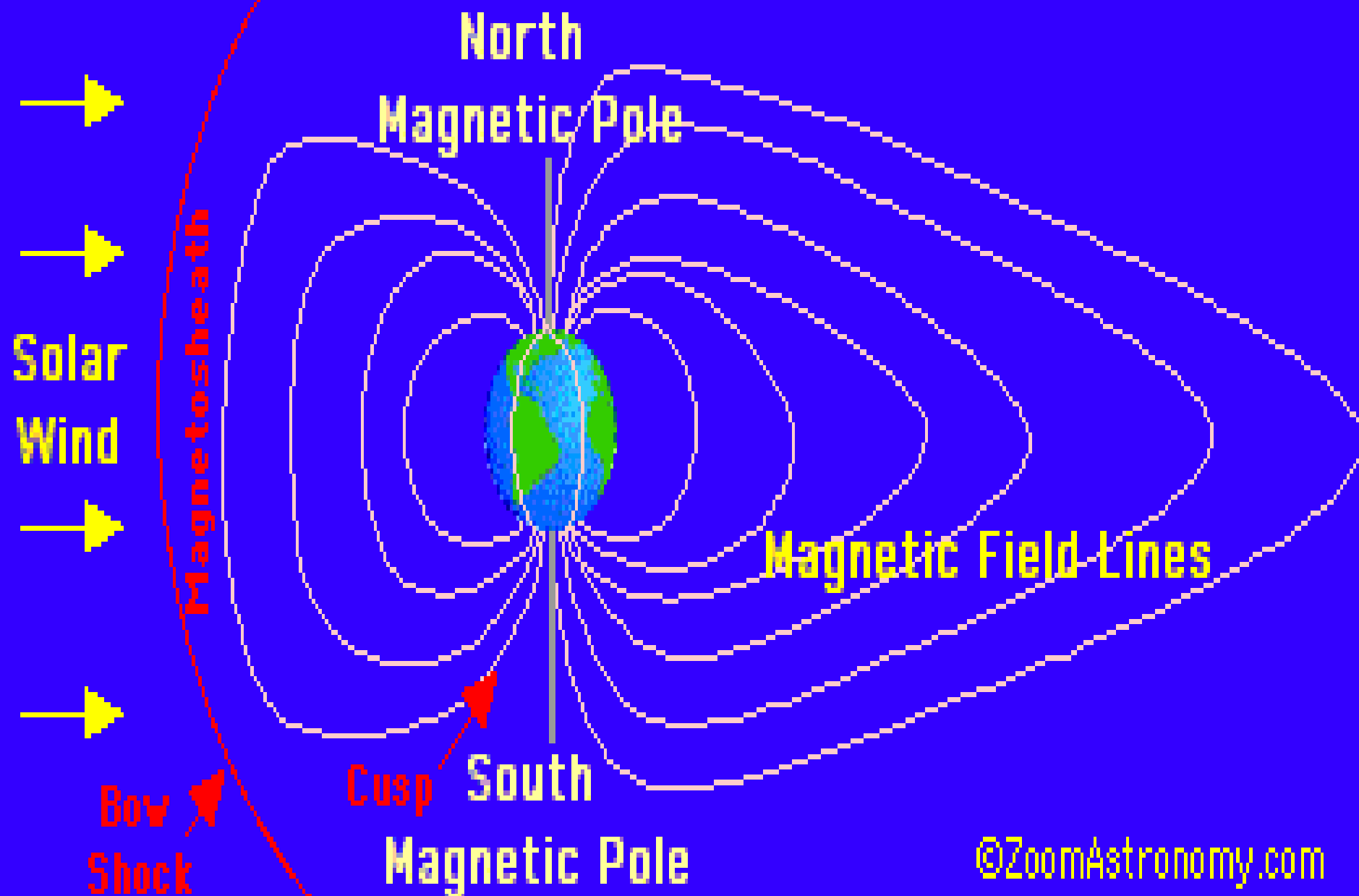
ultraviolet radiation

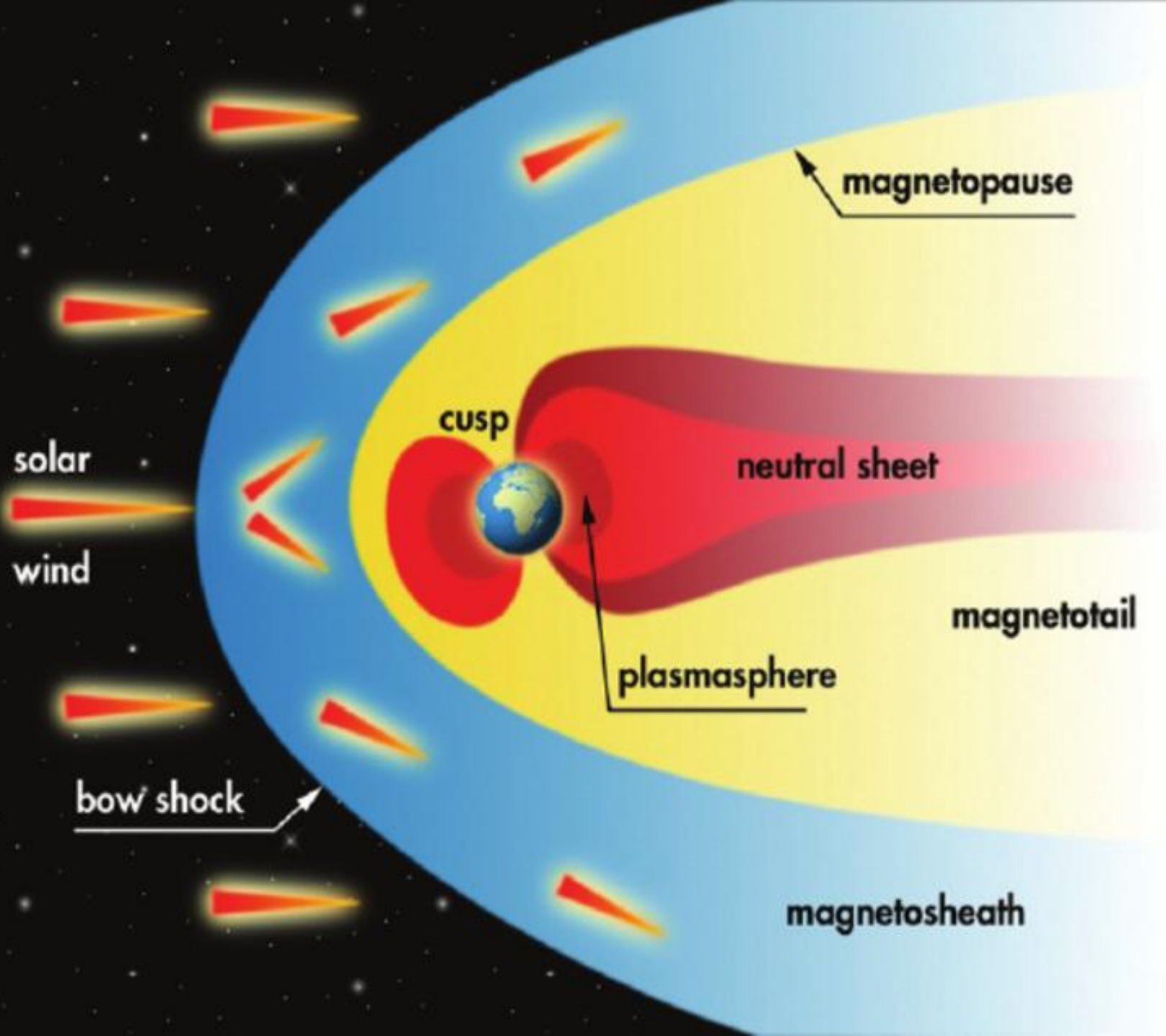
solar wind

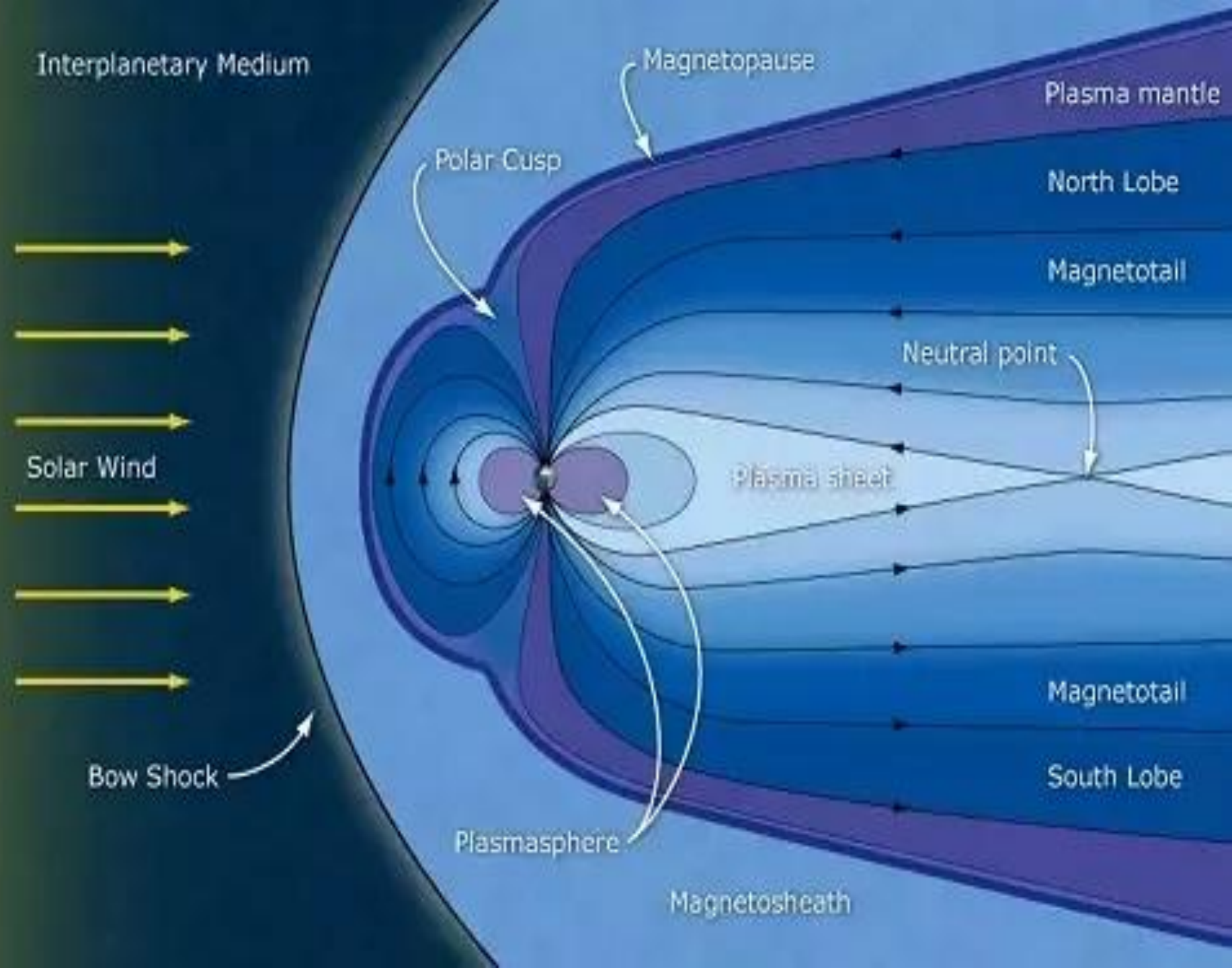
## 5) Solar - Earth magnetic fields

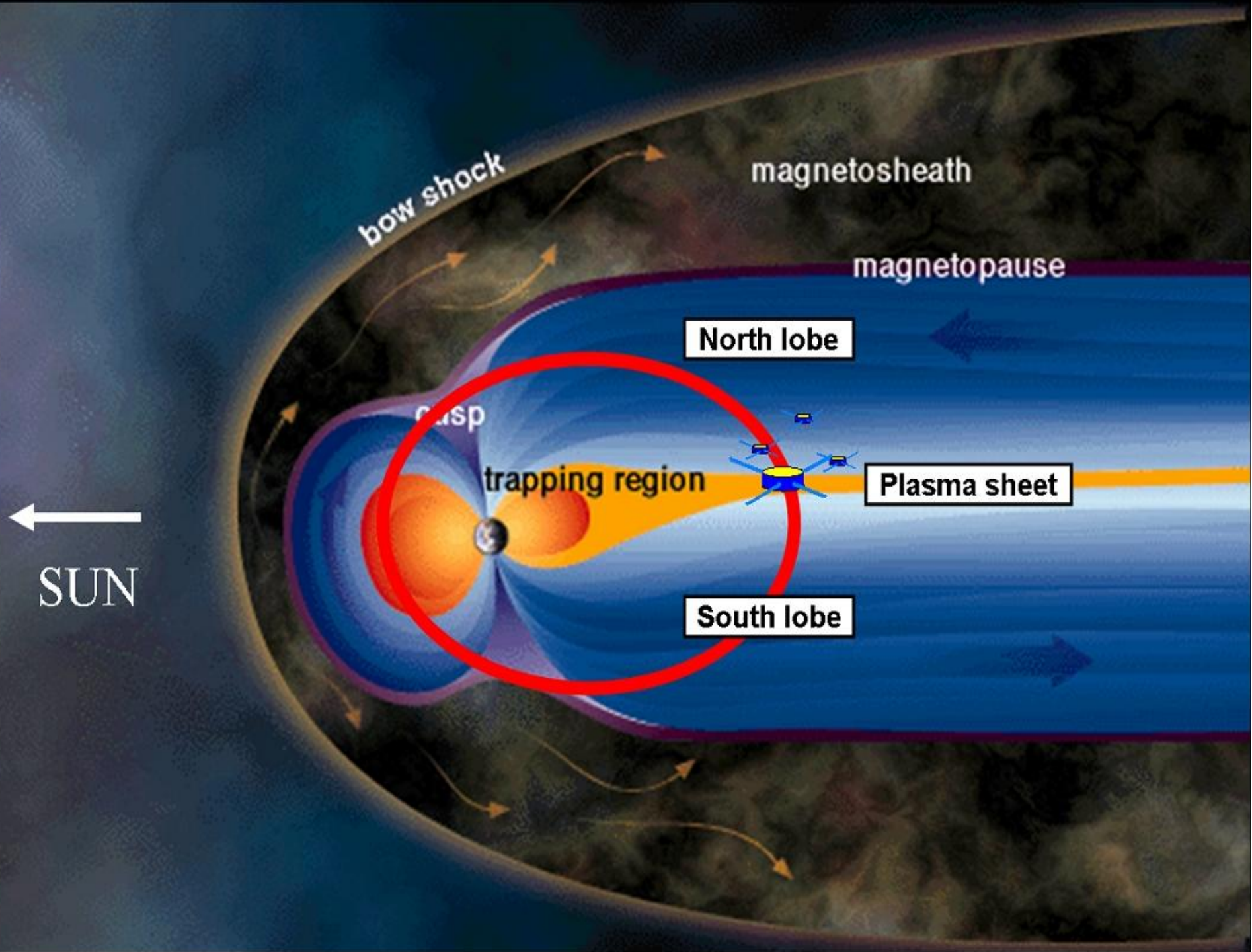


# The Earth's Magnetosphere



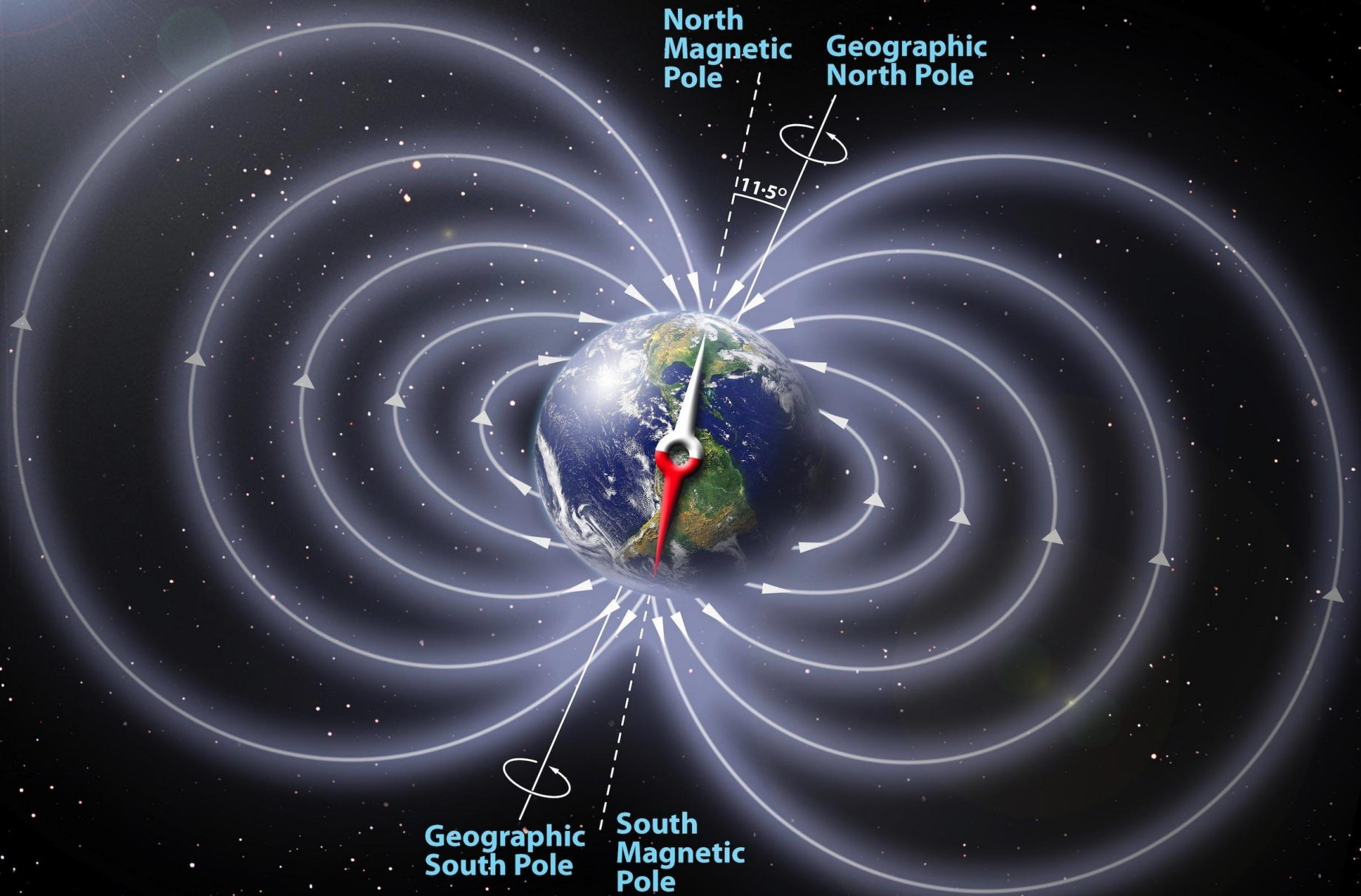


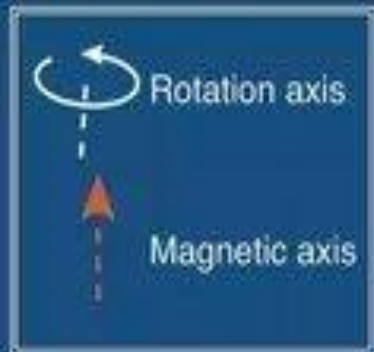




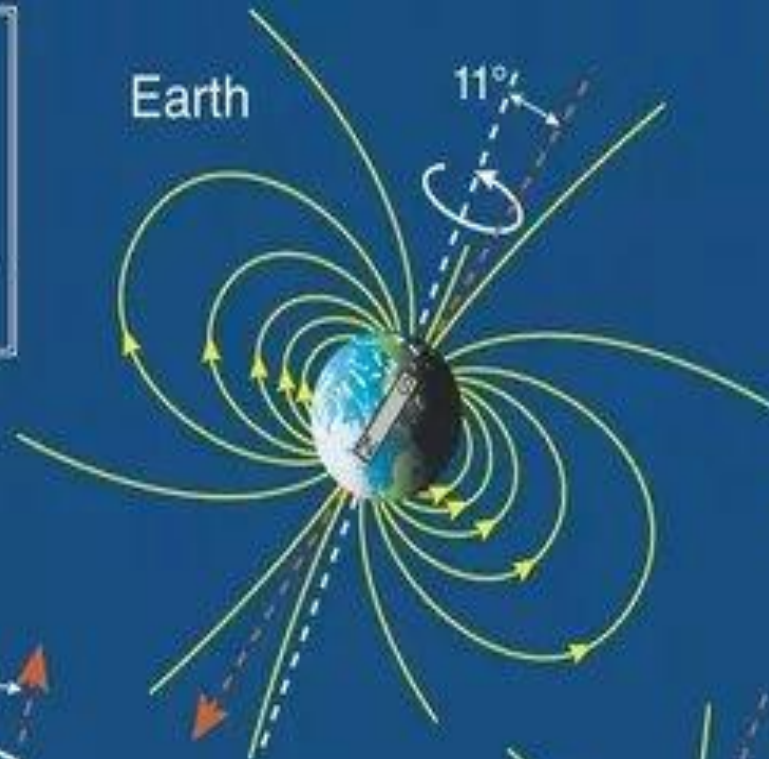
## 6) Earth's magnetic field

# The Earth's Magnetic Field

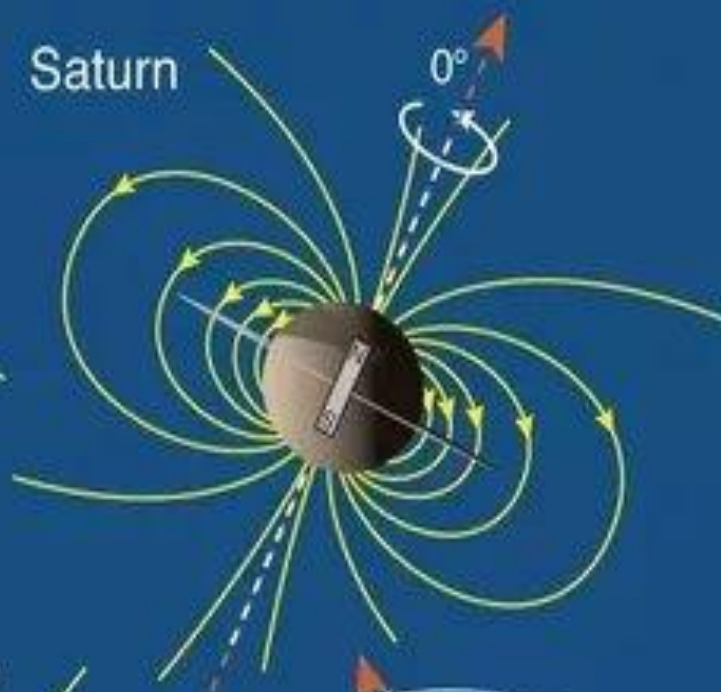




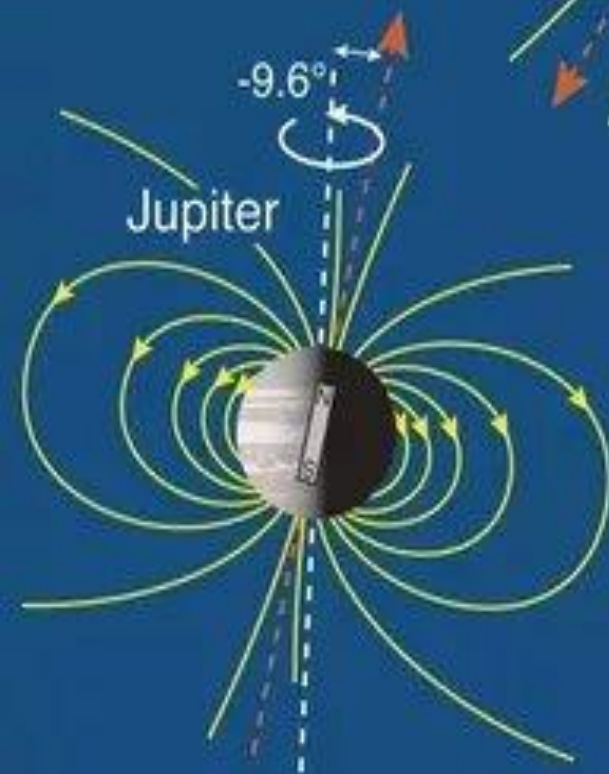
Earth



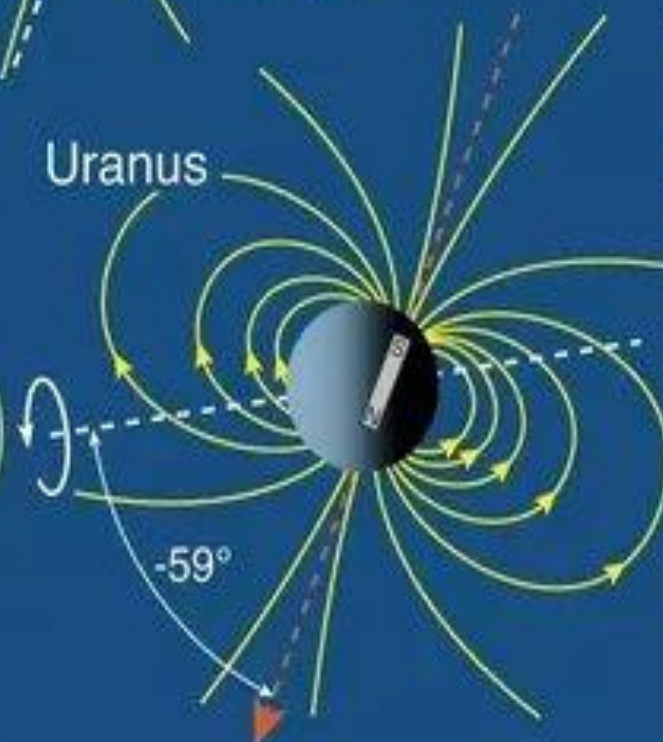
Saturn



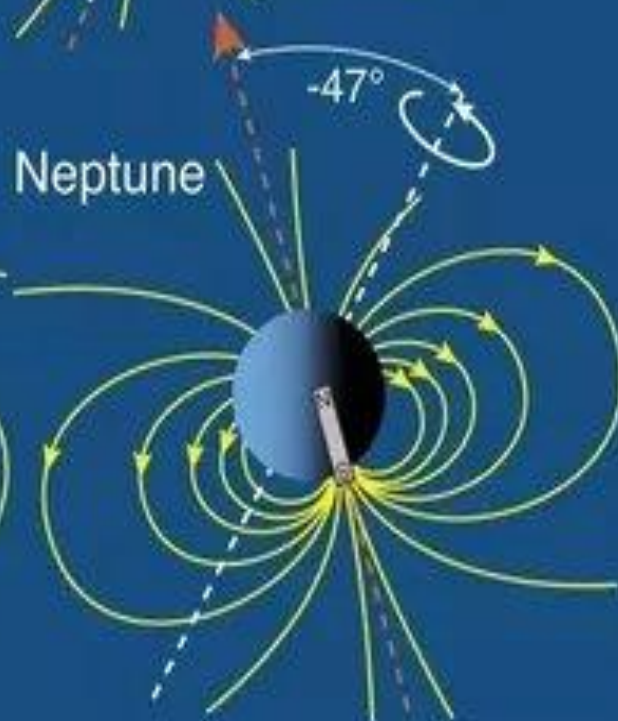
Jupiter

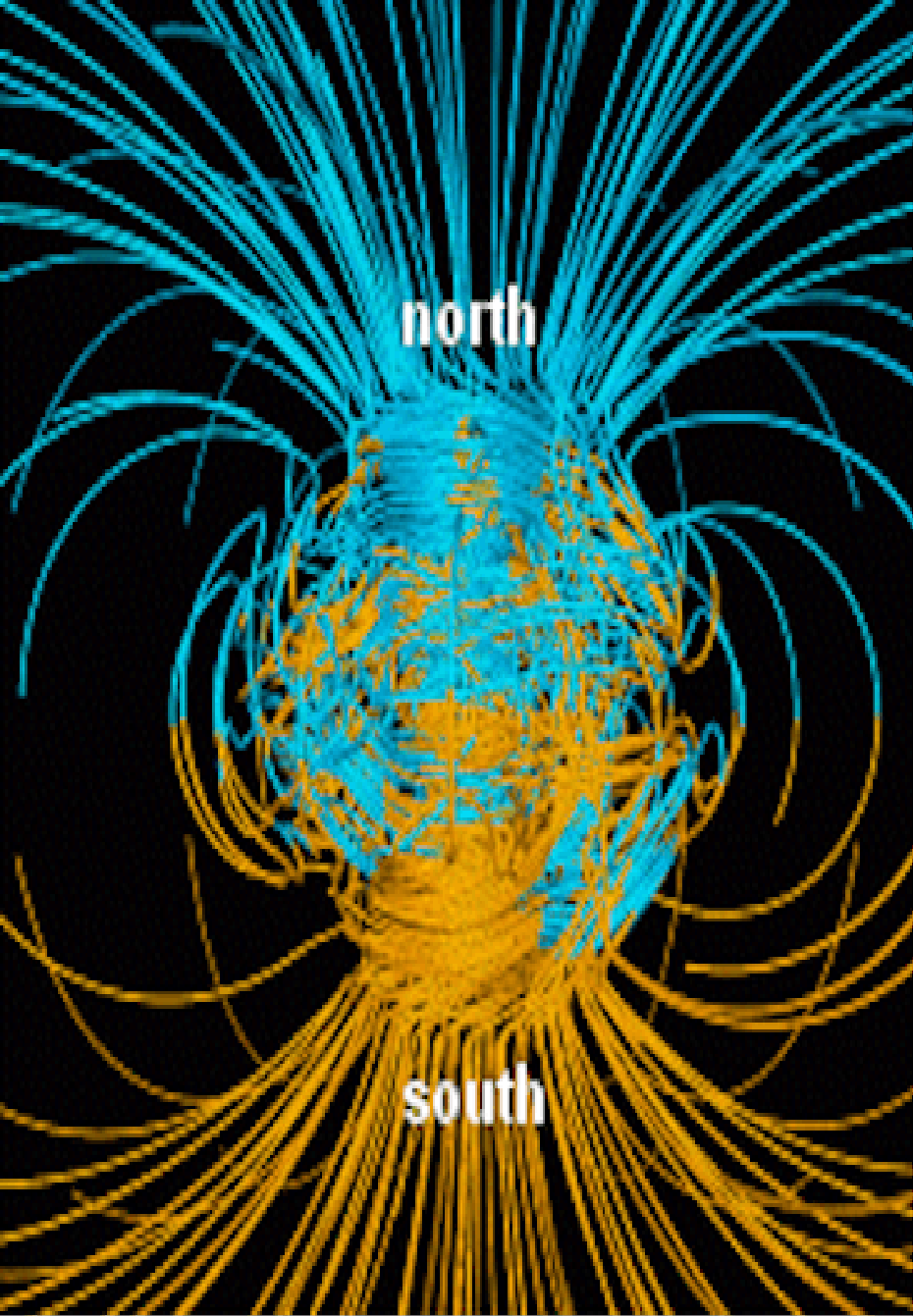


Uranus

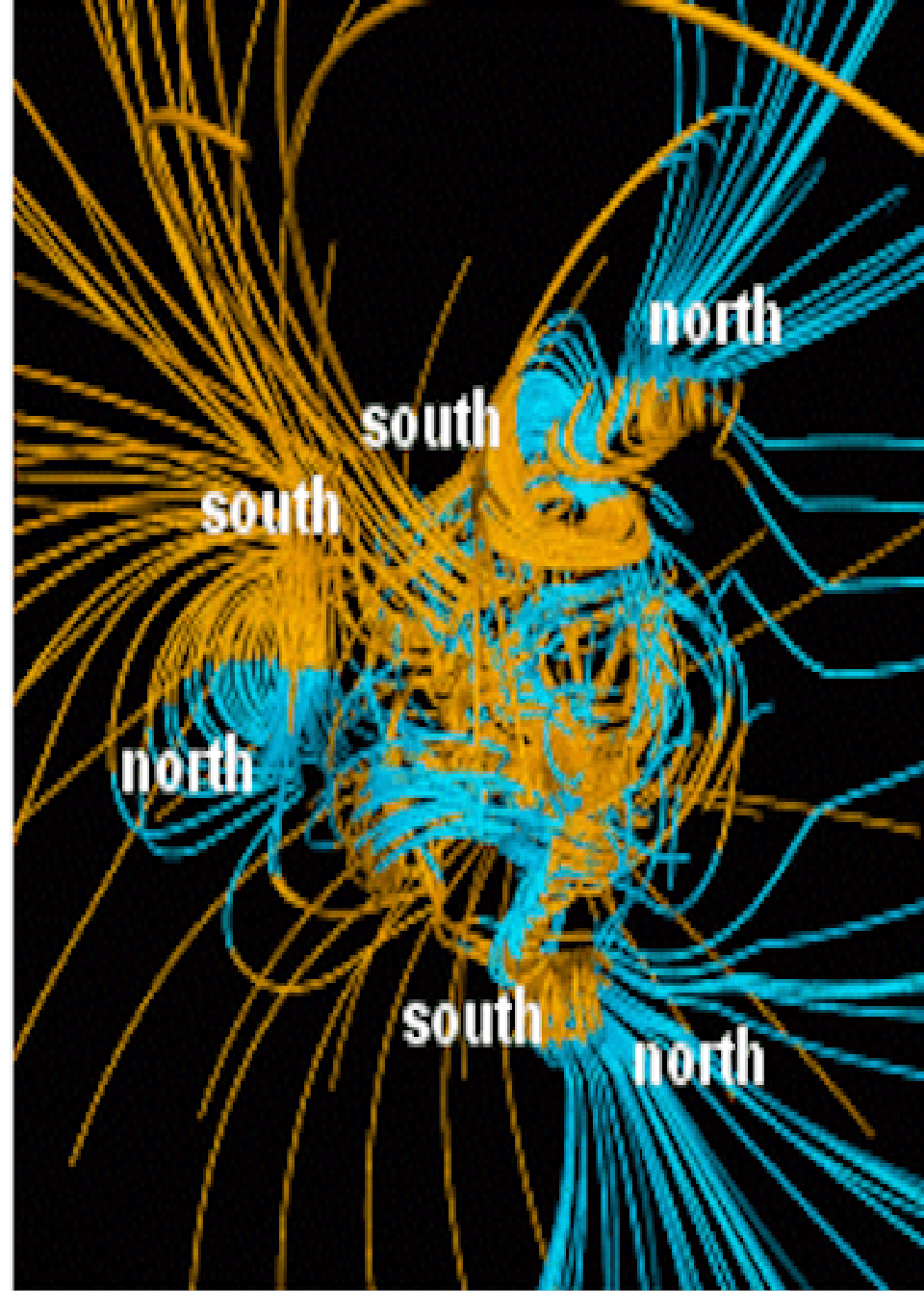


Neptune



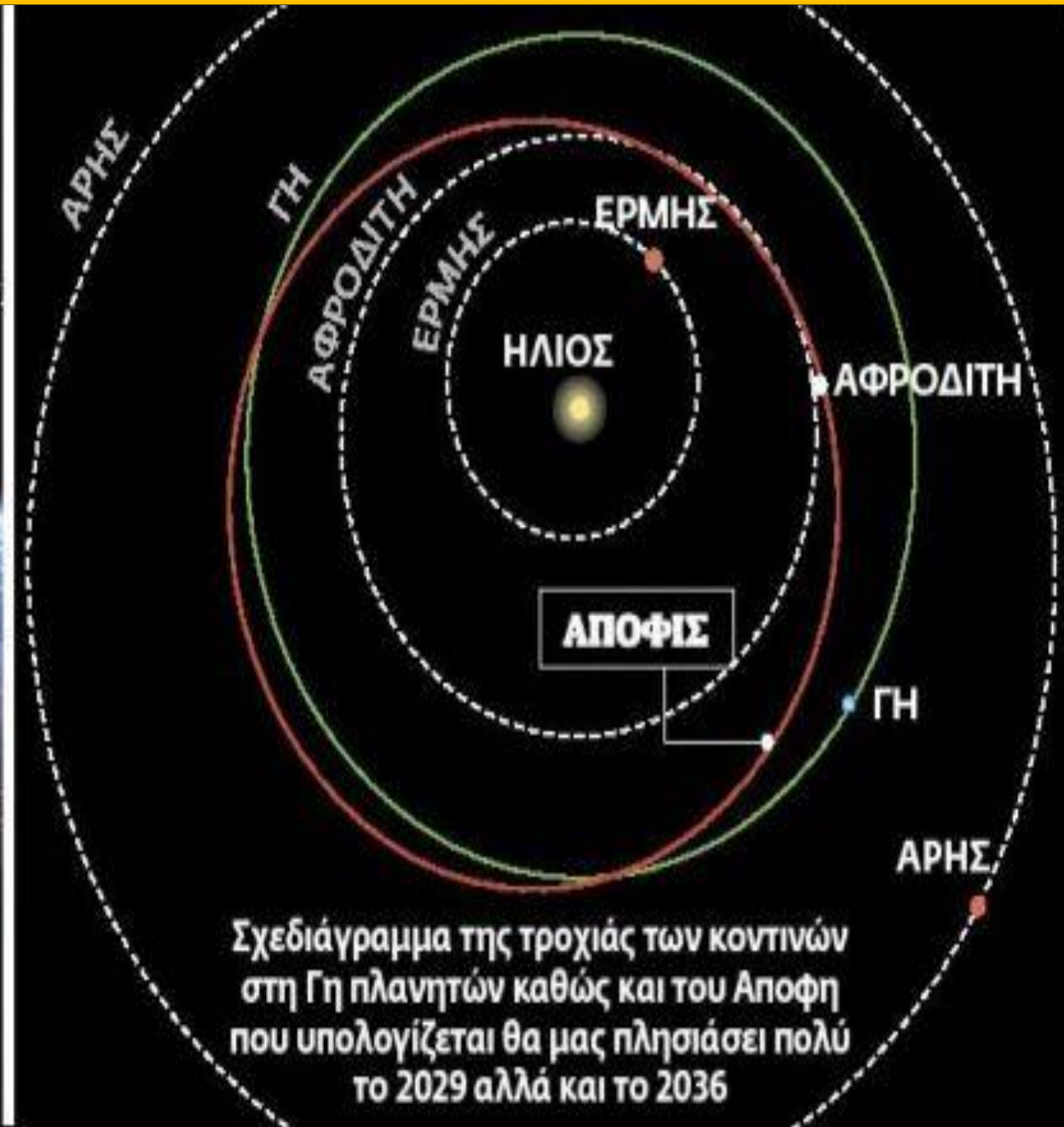


between reversals



during a reversal

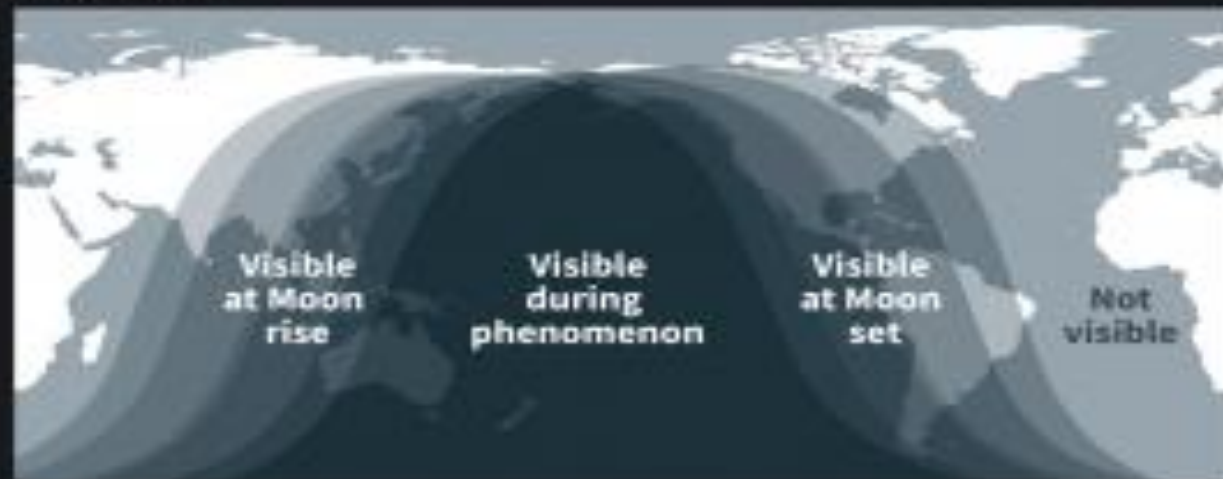
# ΜΙΑ ΕΚΡΗΞΗ ΤΩΡΑ ... ΑΛΛΑ Η ΔΟΝΗΣΕΙΣ ΦΤΑΝΟΥΝ ΣΕ ΕΜΑΣ ΜΕΤΑ ΑΠΟ ΧΡΟΝΙΑ



## Lunar eclipse

15-minute total eclipse on May 26

### Visibility



### How it happens

Sunlight filtered through the Earth's atmosphere makes the Moon appear red



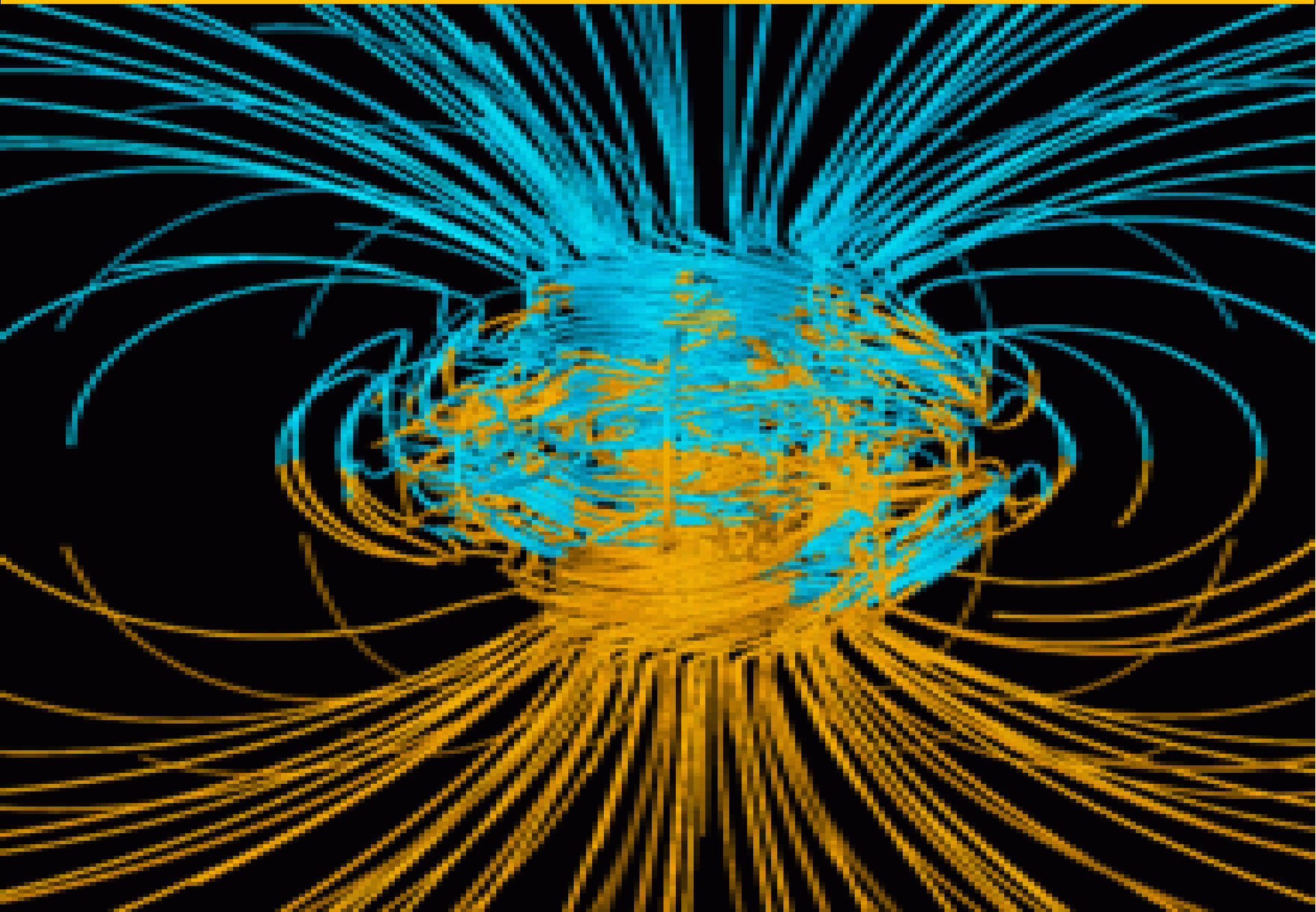
### Stages of eclipse

Times in GMT

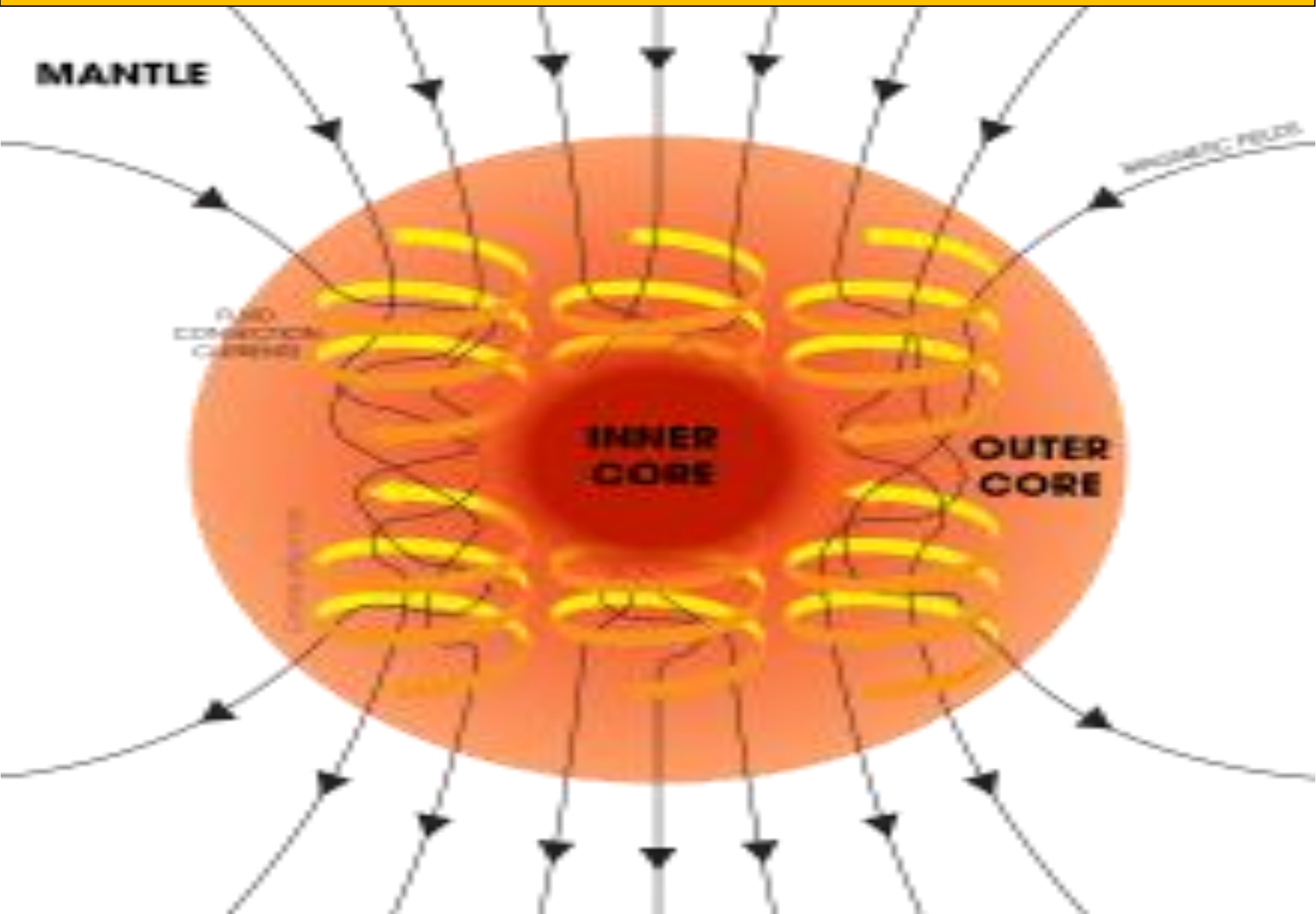
- 0945 ① partial phase begins
- 1111 ② total eclipse starts
- 1126 ③ total eclipse ends
- 1252 ④ partial phase ends



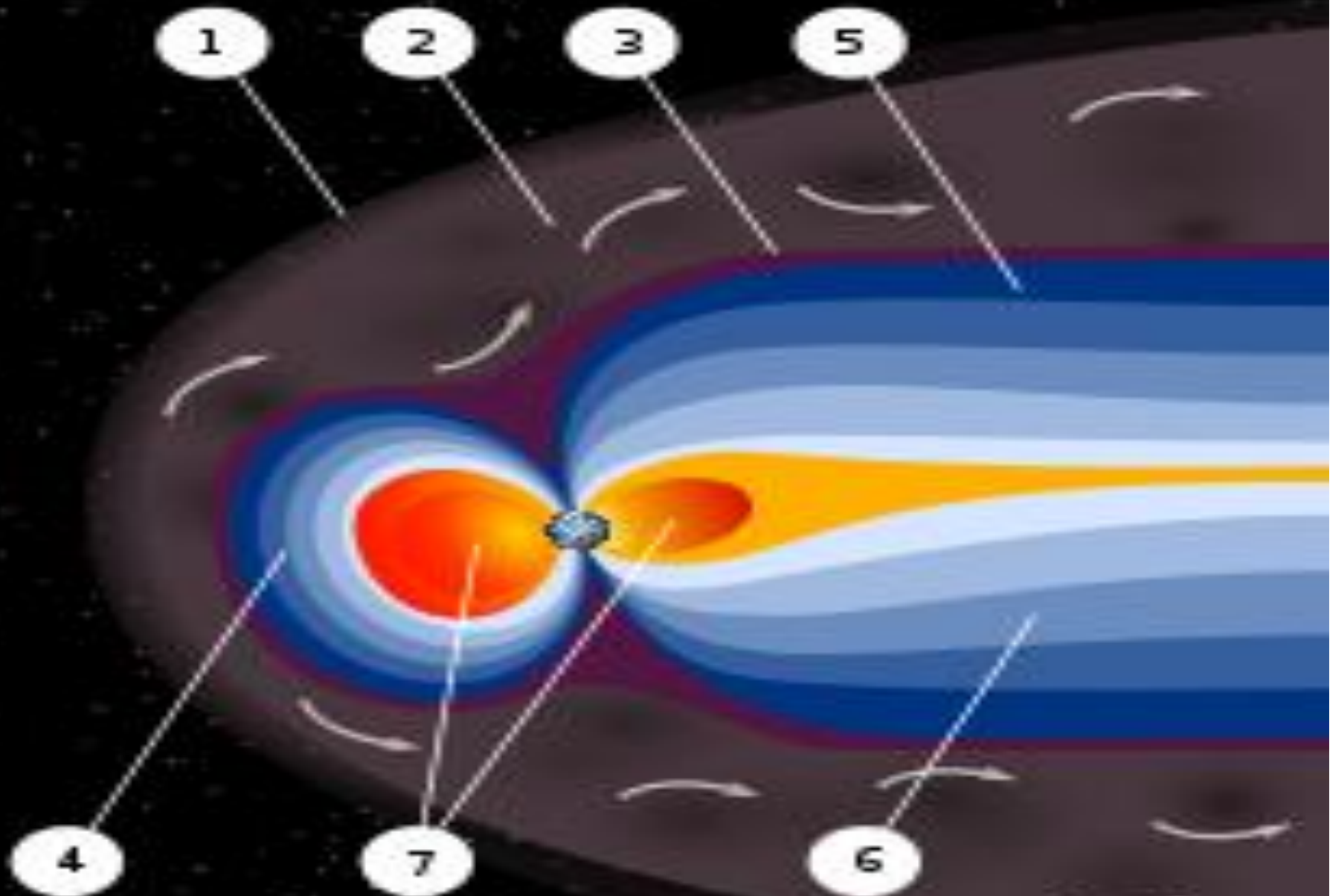
# ΠΕΡΙΠΛΟΚΗ ΑΠΕΙΚΟΝΙΣΗ ΜΑΓΝΗΤΙΚΩΝ ΡΟΩΝ ΓΗΣ



# ΕΣΩΤΕΡΙΚΑ: Η ΓΗ ΕΙΝΑΙ ΕΝΑΣ ... ΜΑΓΝΗΤΗΣ

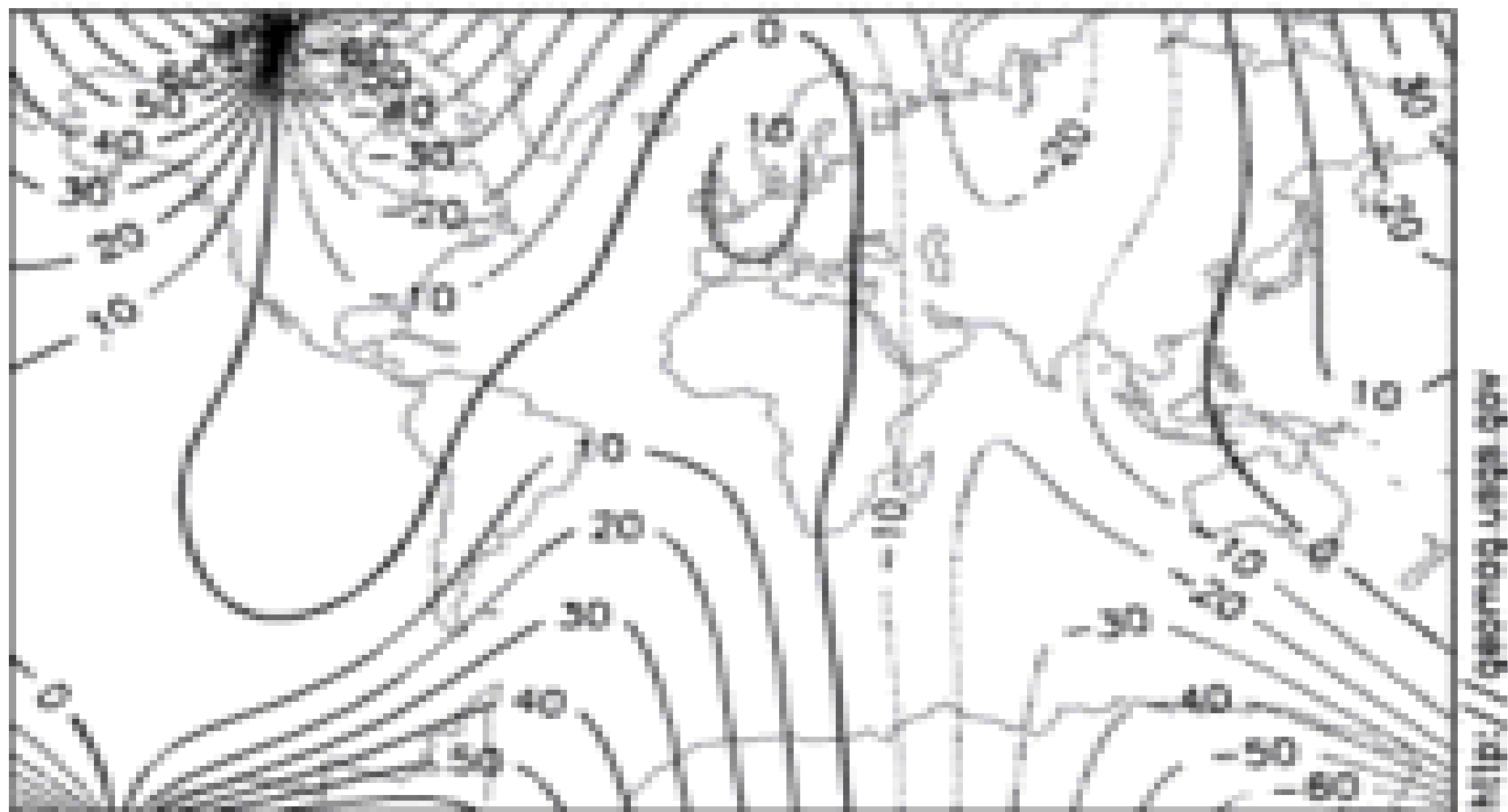


# ΕΞΩΤΕΡΙΚΑ: Η ΓΗ ΕΙΝΑΙ ΕΝΑΣ ... ΜΑΓΝΗΤΗΣ



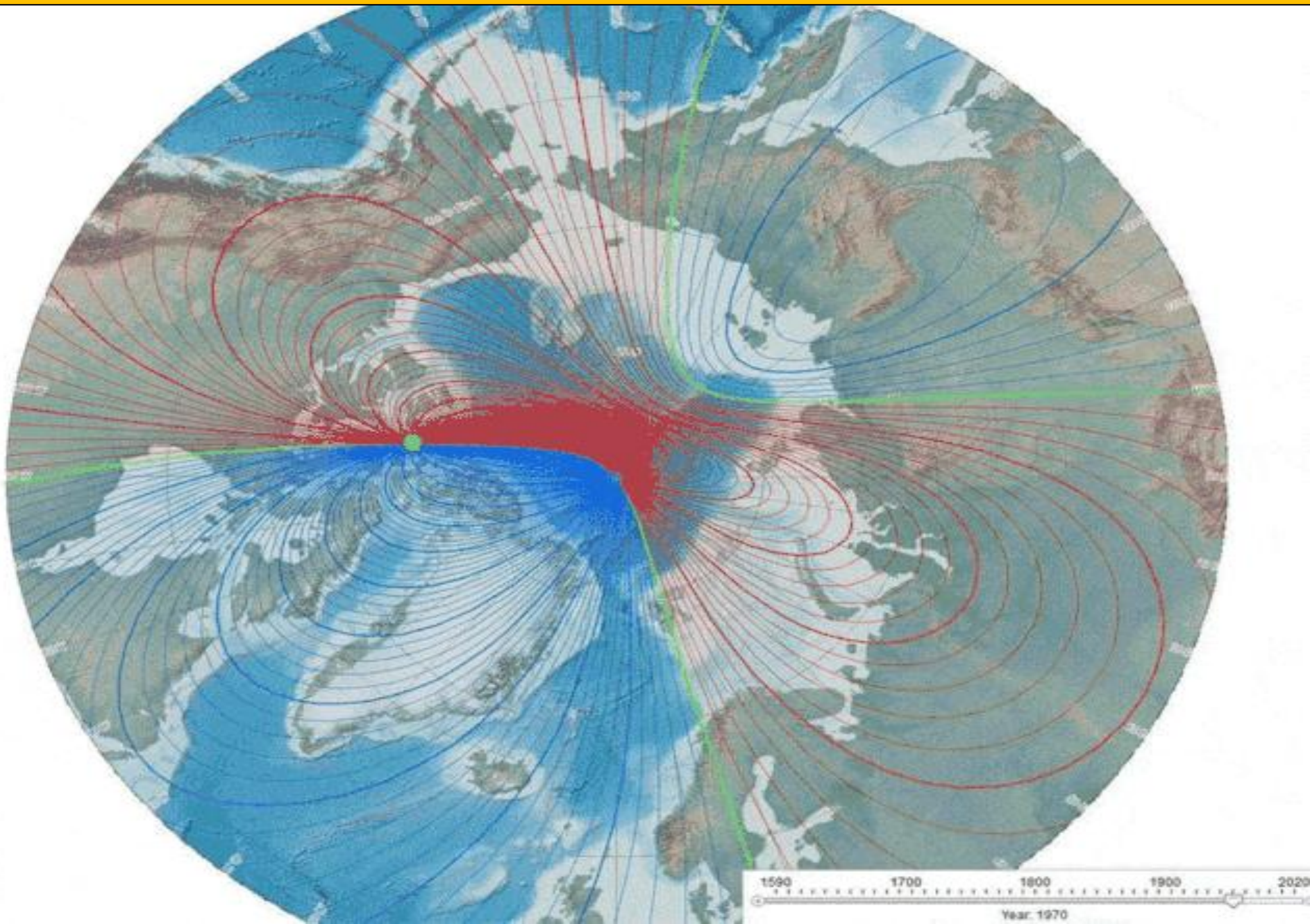
# ΟΙ ΜΑΓΝΗΤΙΚΕΣ ΡΟΕΣ ... ΜΕΤΑΤΟΠΙΖΟΝΤΑΙ ΣΥΝΕΧΩΣ

1590  
Declination (degrees east)

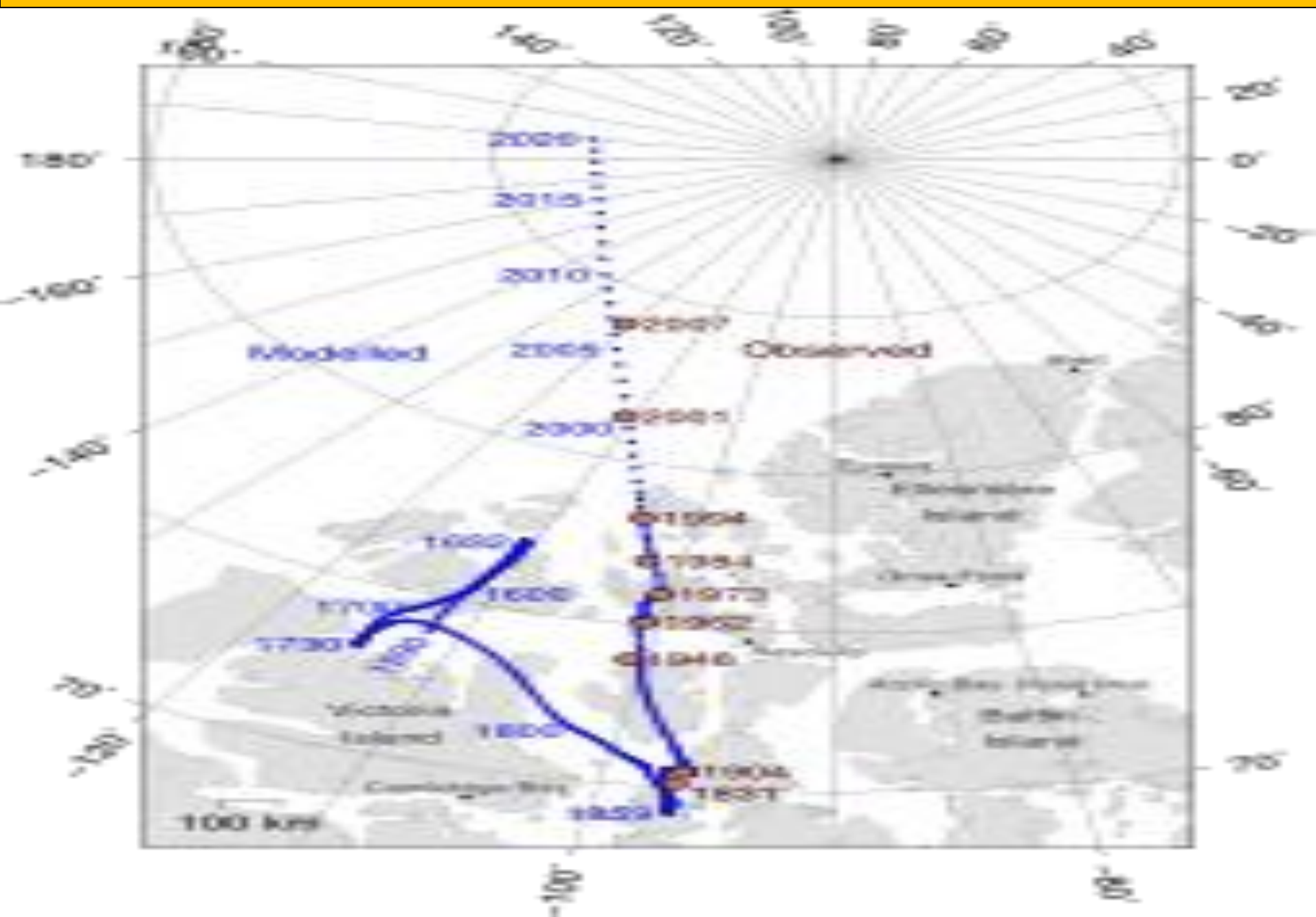


Model by A. Jackson, A. R. T. Jonkers, M. R. Walker,  
Phil. Trans. R. Soc. London A (2000), 358, 957-990.

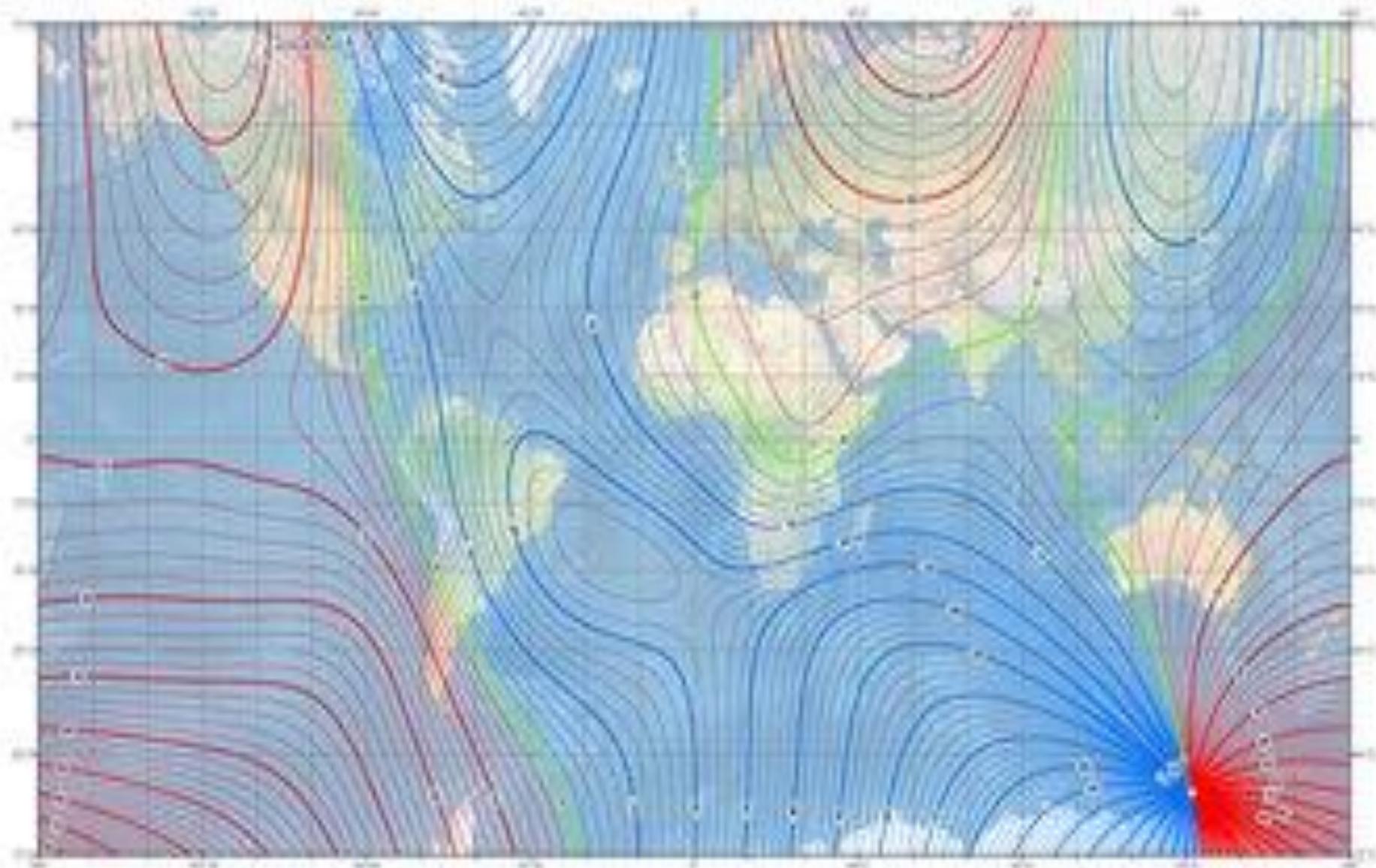
# ΟΙ ΜΑΓΝΗΤΙΚΕΣ ΡΟΕΣ ... ΜΕΤΑΤΟΠΙΖΟΝΤΑΙ ΣΥΝΕΧΩΣ



# Ο ΒΟΡΕΙΟΣ ΠΟΛΟΣ ... ΜΕΤΑΤΟΠΙΖΕΤΑΙ ΣΥΝΕΧΩΣ

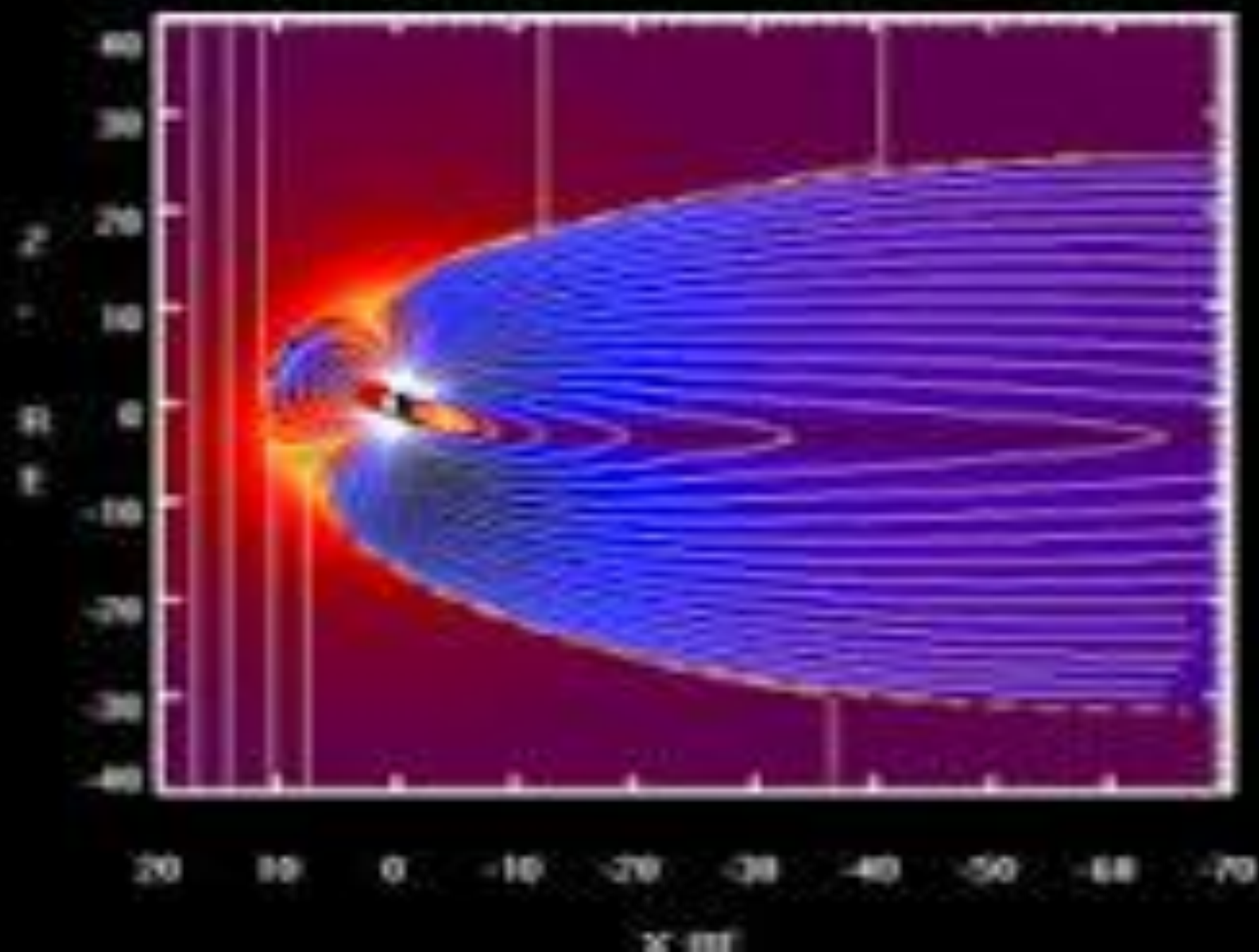


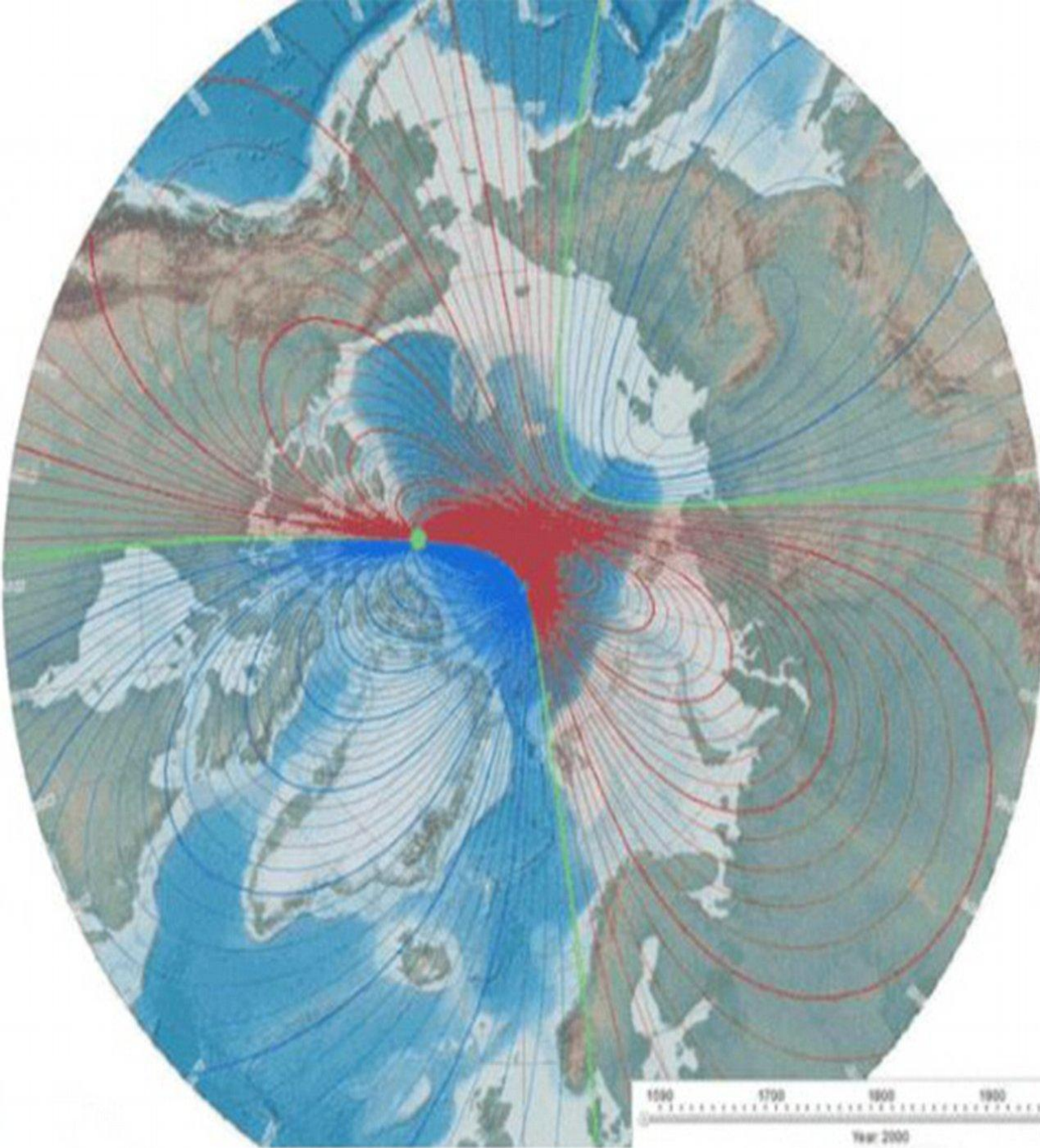
US/UK World Magnetic Model - Epoch 2015.0  
Main Field Declination (D)



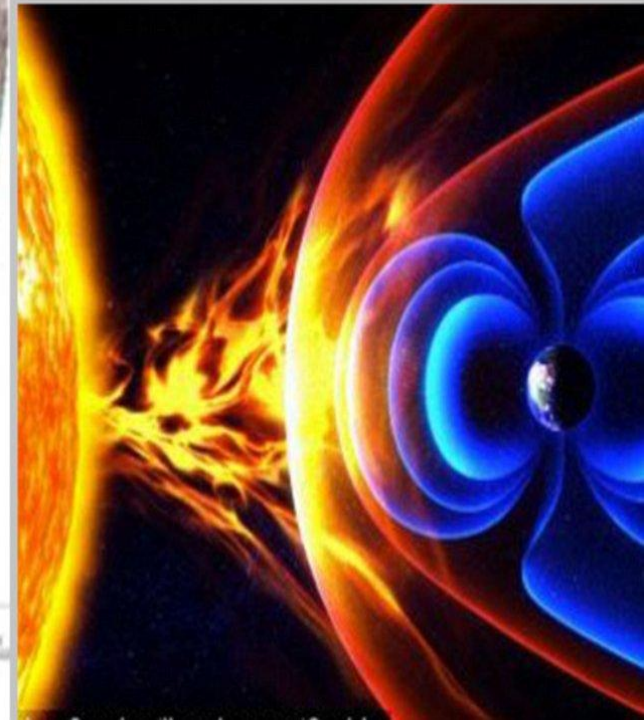
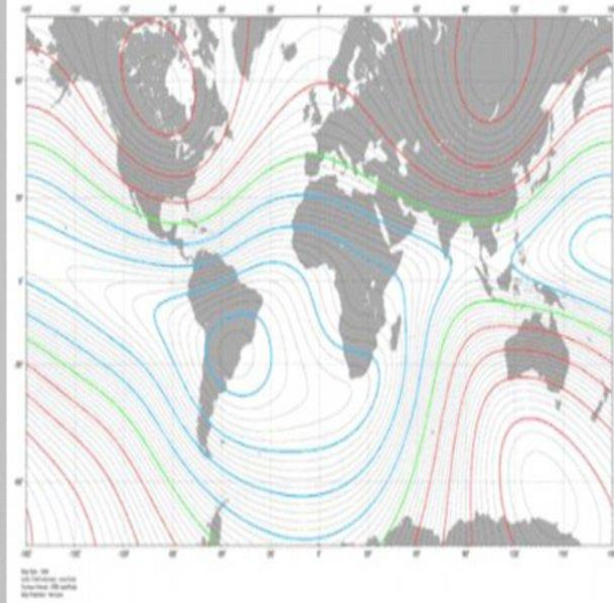
Map 1000-100000000  
Latitude: 100000000  
Longitude: 100000000  
Declination: 100000000  
100000000

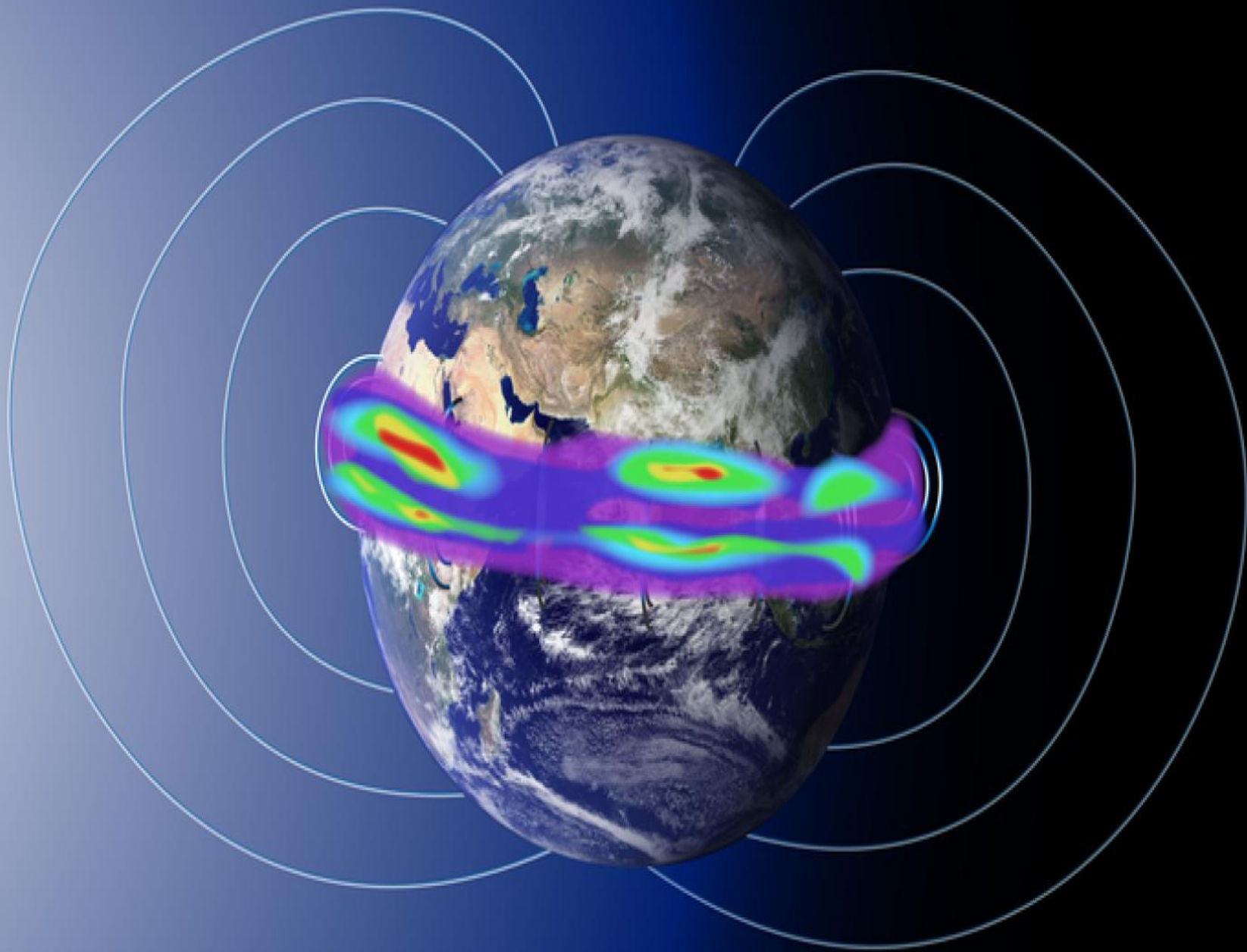
Map 1000-100000000  
Latitude: 100000000  
Longitude: 100000000  
Declination: 100000000  
100000000





International Geomagnetic Reference Field Model -- Epoch 1980  
Main Field Total Intensity (F)

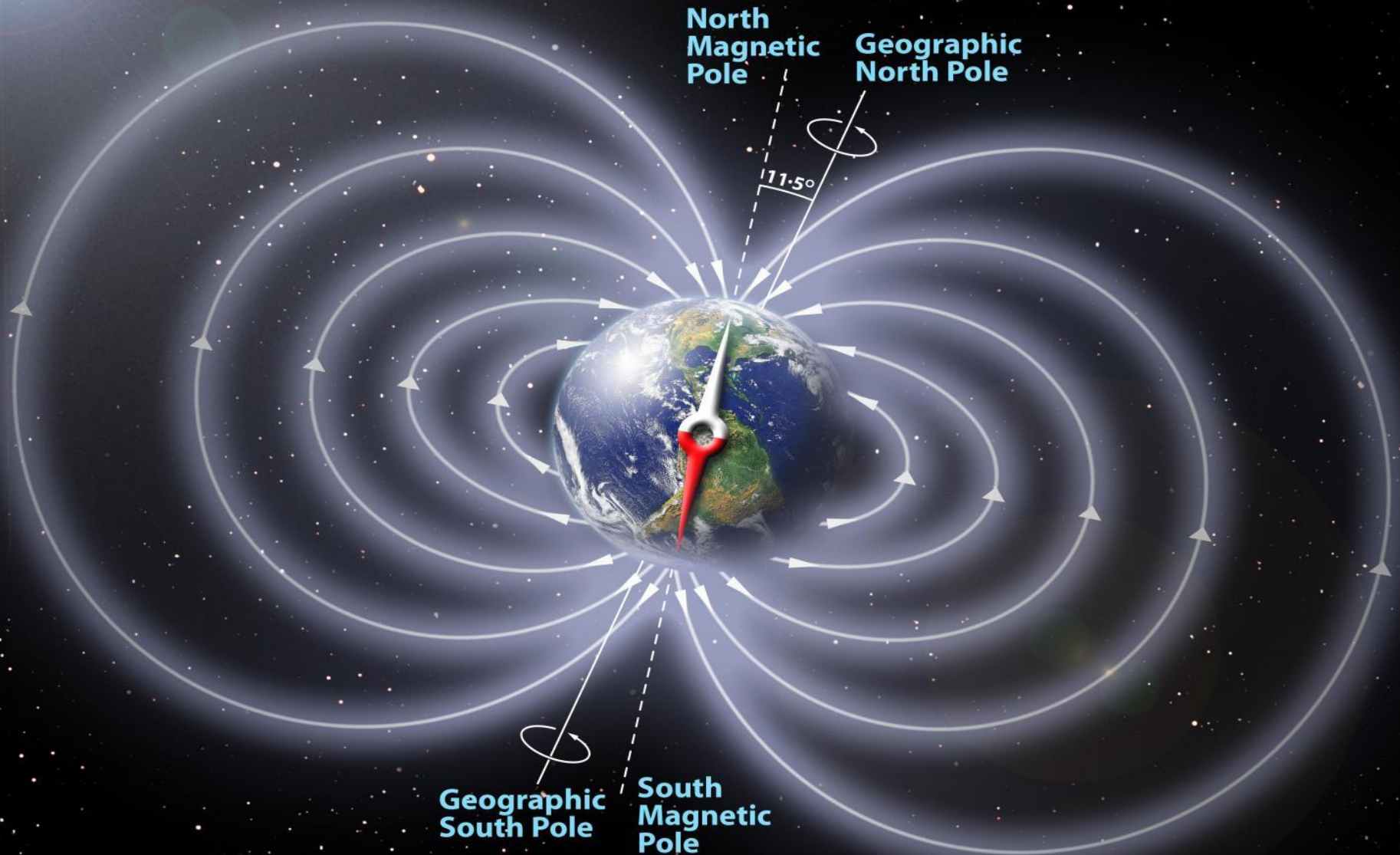




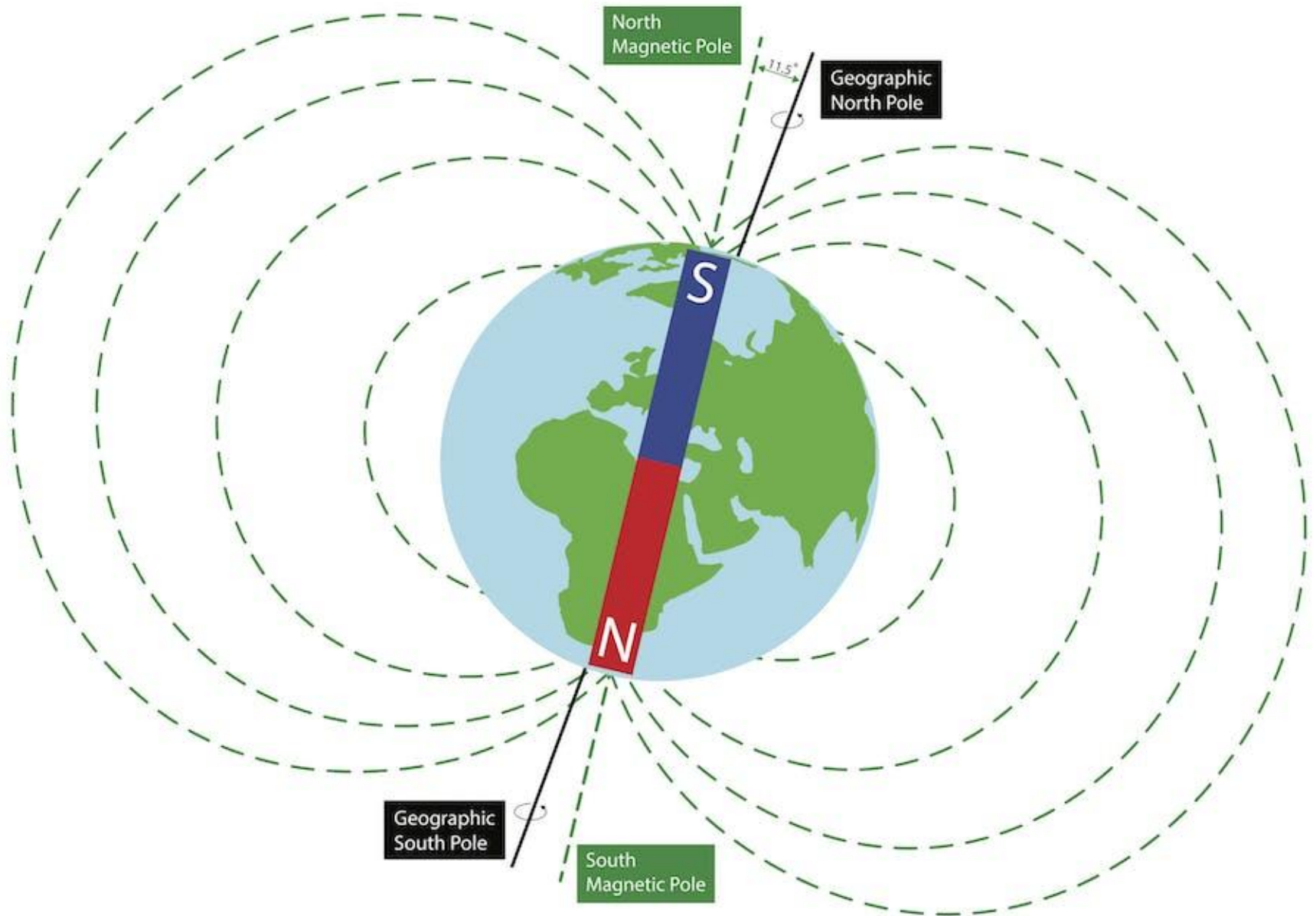
## **7) Human Body magnetic field**

# ... Mother Earth ...

## The Earth's Magnetic Field



# The Earth's Magnetic Field



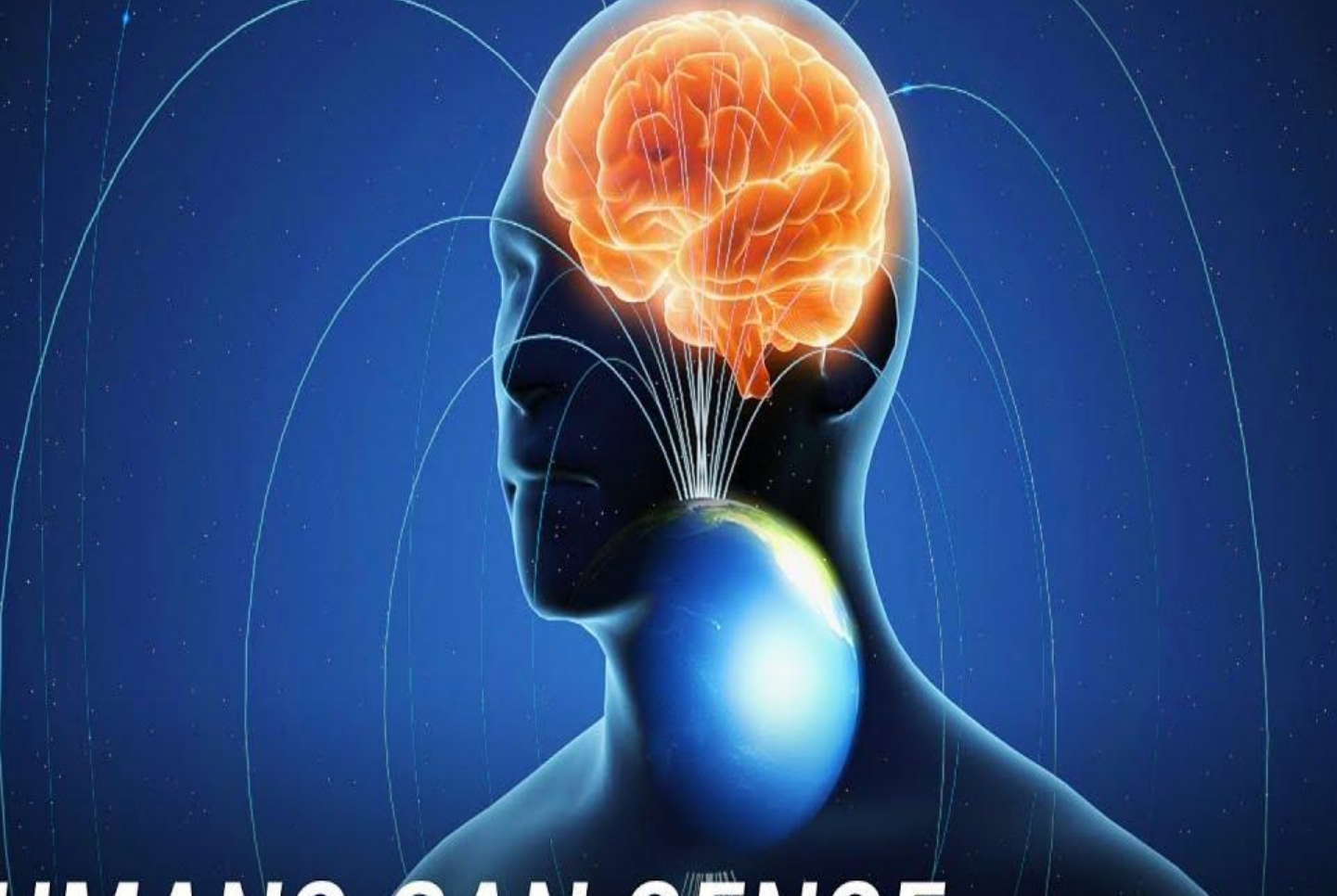
... affects ... the Human Body ...

# Did You Know?



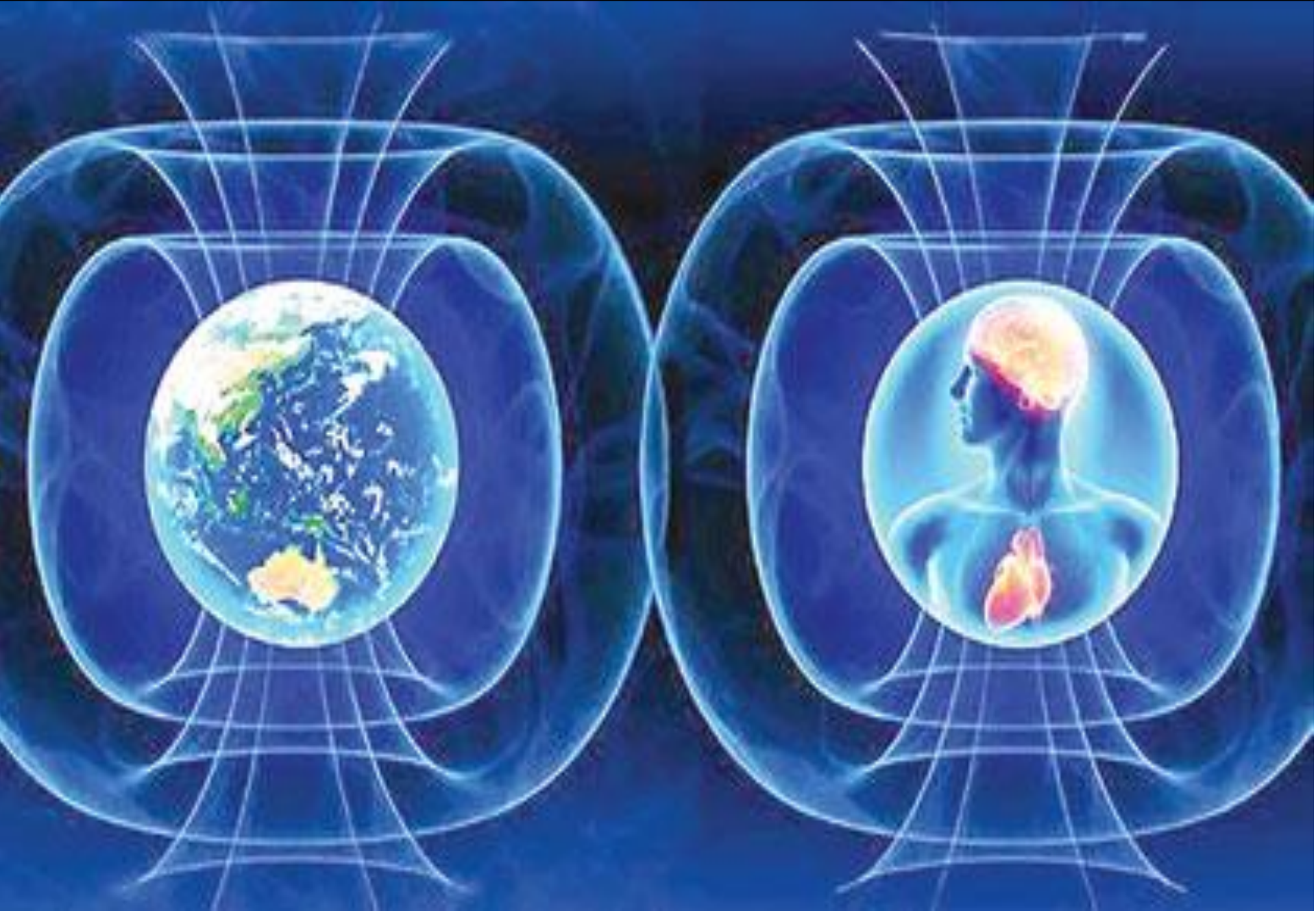
The earth's magnetic resonances vibrate at the same frequency as our heart rhythms and brain waves.

**... and Humans can sense ... Earth's Magnetics ...**



***HUMANS CAN SENSE  
EARTH'S MAGNETIC FIELD***

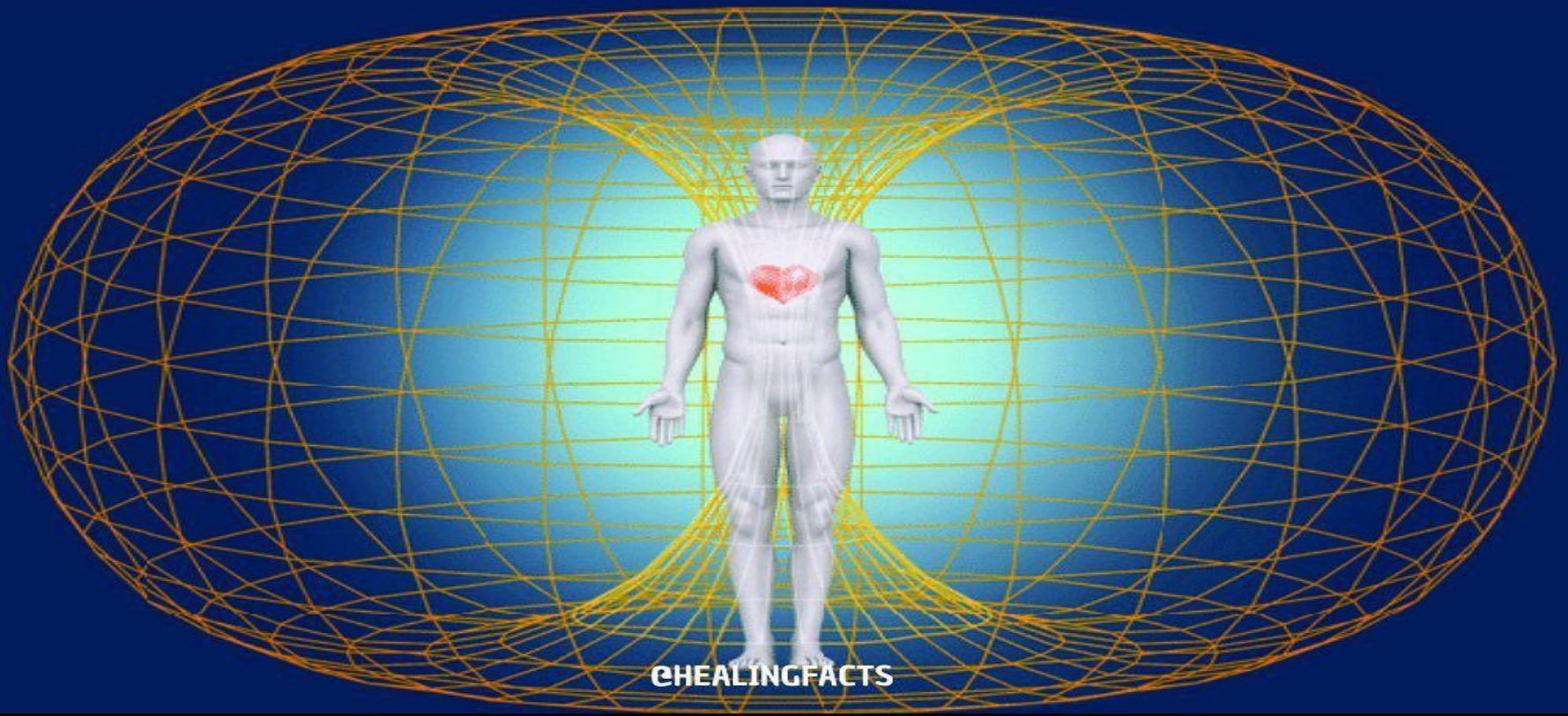
**... so, there is a constant sensor-communication ...**



... the human platform is at the physical heart ...

Empathy is centered at the Heart.

The heart beat produces the human body's largest electromagnetic field.

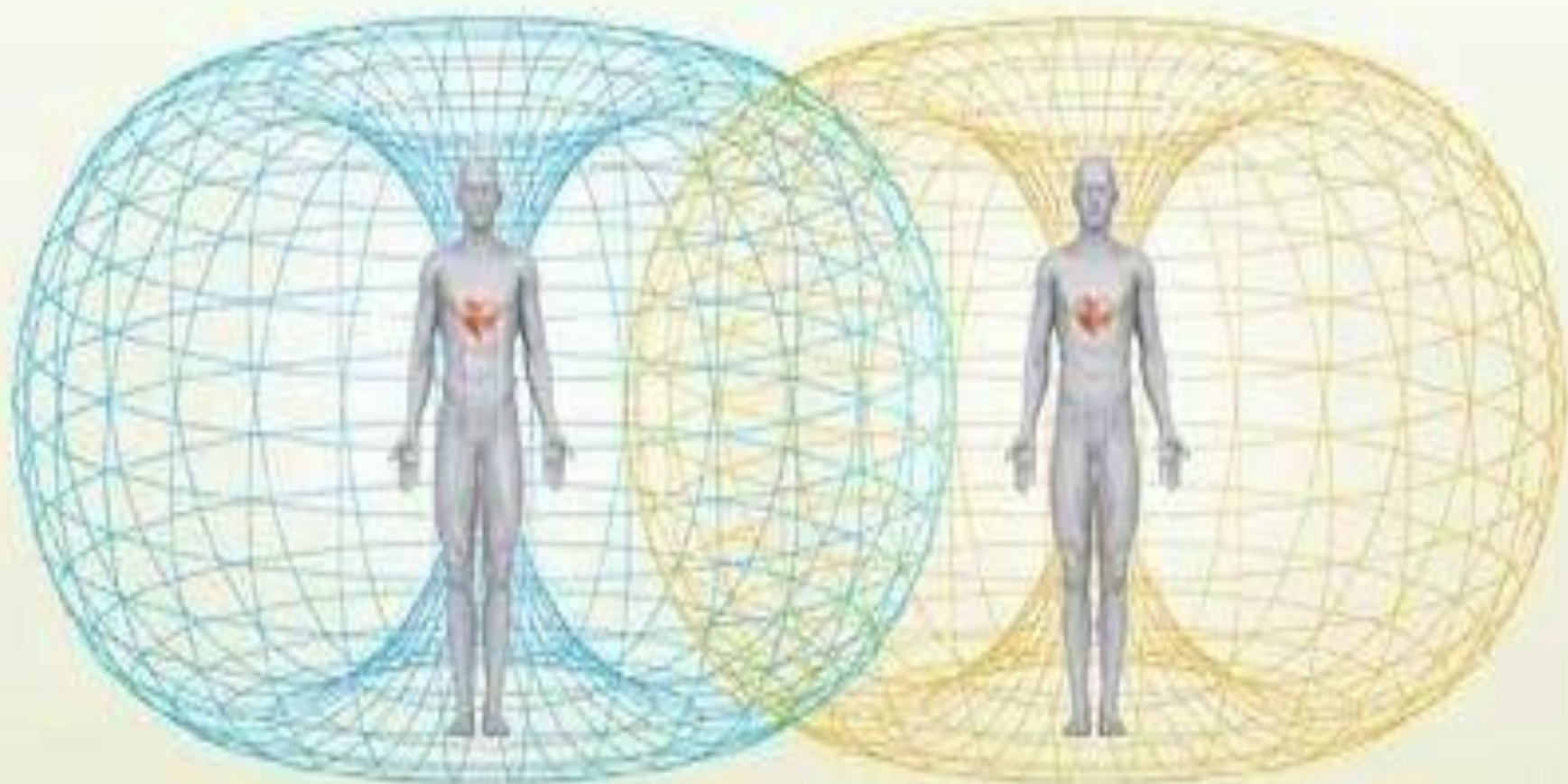


EMPathy allows our heart to feel the electromagnetic pulse (EMP) of others.

# Electromagnetic Field of the Heart

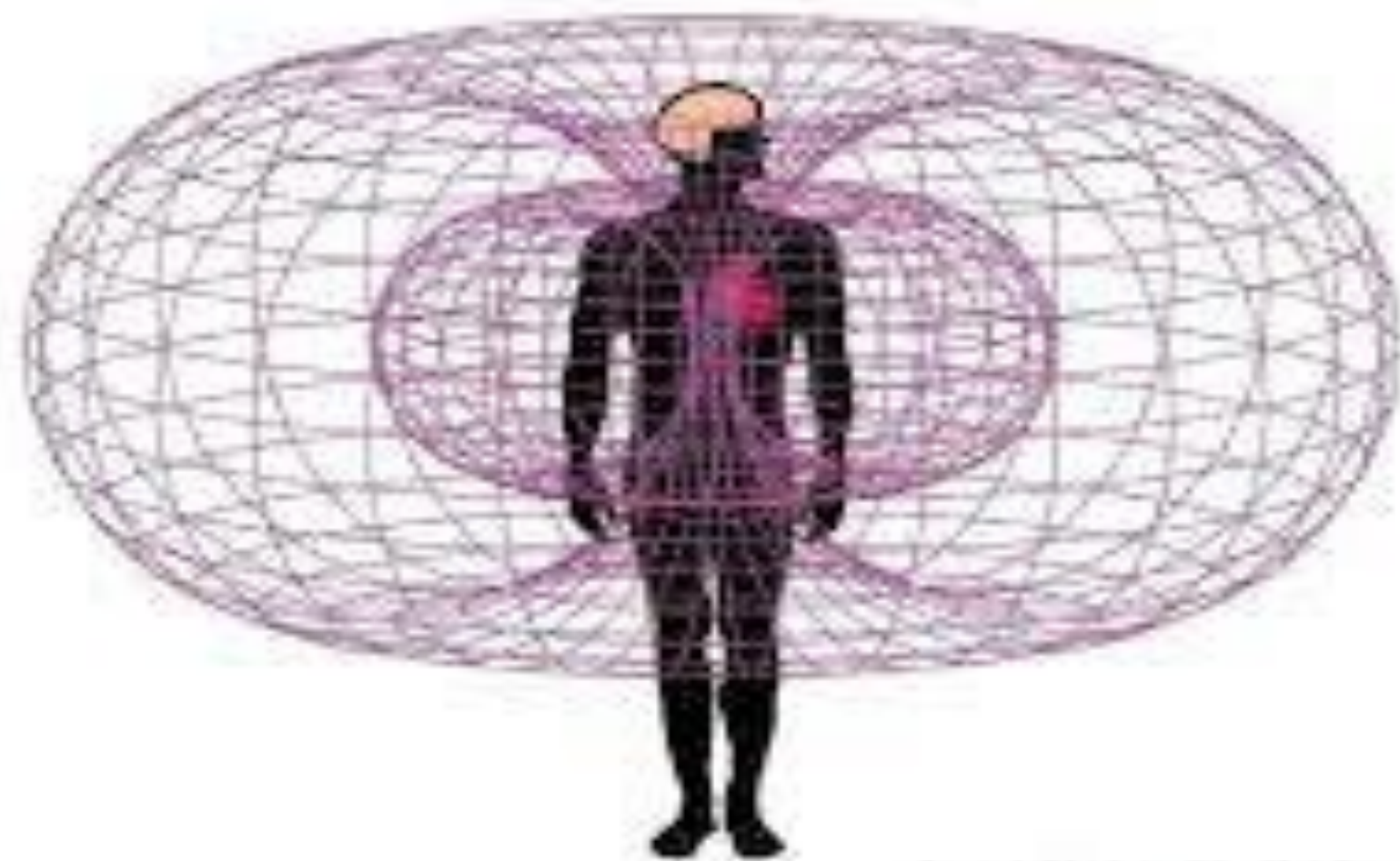
---

Our thoughts and emotions affect the heart's magnetic field, which energetically affects those in our environment whether or not we are conscious of it.



# The Heart is more powerful than the Brain

The Heart is about 100,000 times stronger electrically & up to 5,000 times stronger magnetically than the brain.





The electromagnetic field of the human heart has the most influence over all our other functions



Your heart generates  
an electromagnetic field  
that reaches several feet outside  
of your physical body.

*People can feel you.*

(The Mind Journal)

... books on this ... like ...

# **The Energetic Heart**

## Bioelectromagnetic Interactions Within and Between People



Rollin McCraty, Ph.D.  
HeartMath Research Center  
Institute of HeartMath

... this is why, Love is more powerful than Fear ...

# Quantum DNA Evolution

The Wave of LOVE (WAVE X)

LOVE

Fear



... but it is not only the heart ...

# Our Body Needs Magnetic Energy!

**Each cell** has a positive & a negative field in the DNA.

**Cell division** is a process responsible for keeping the body healthy & rejuvenated.

**The force** which activates the formation and division of cells is magnetic energy.

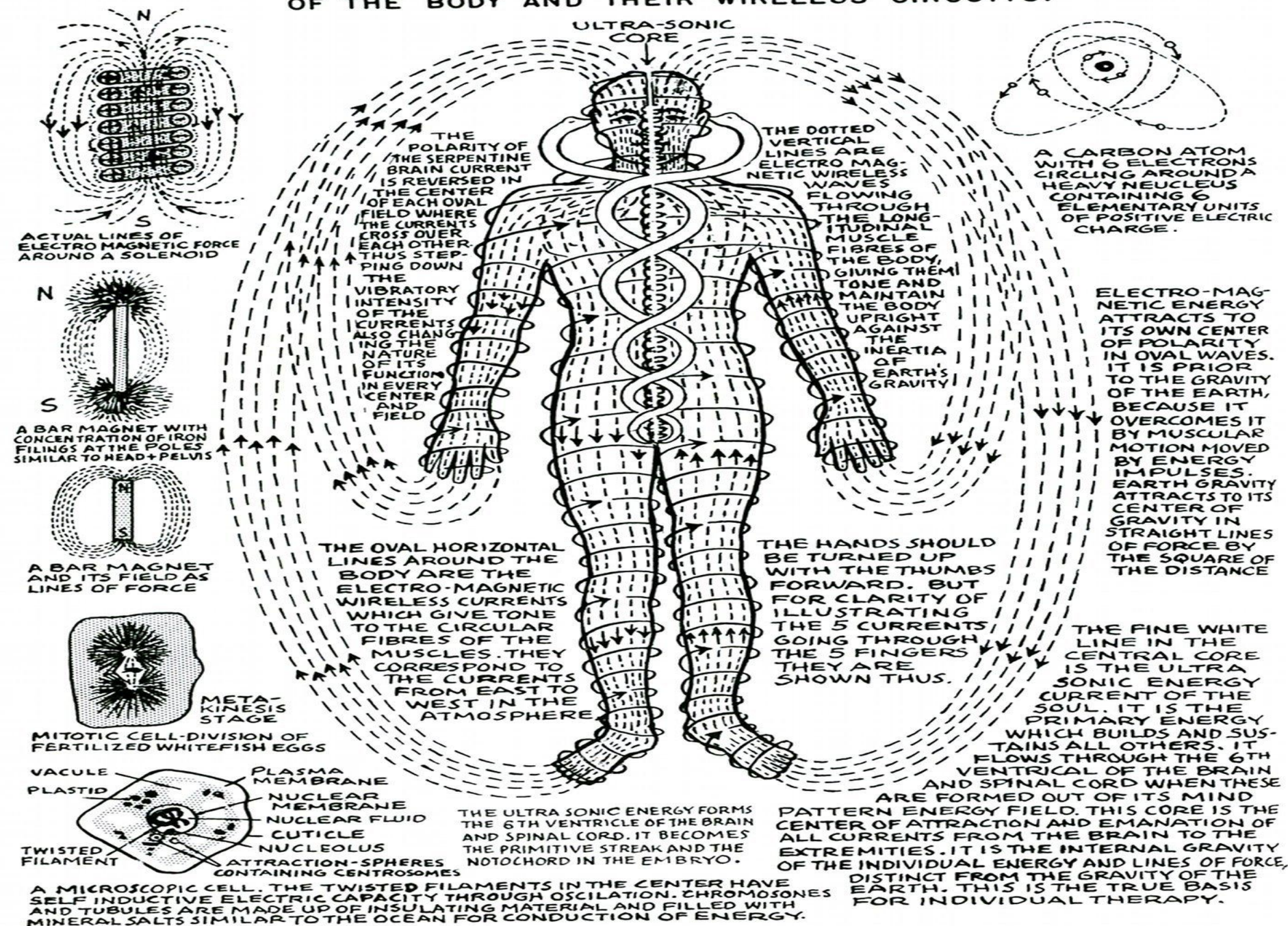


**The proper function and interaction of all organs and systems in the body depend on the constant presence of adequate magnetic energy.**

**Magnetism is essential** for the body's electromagnetic activity and plays a major role in health

# CHART NO. 3

## COMPOSITE PICTURE OF THE PATTERN FORCES OF THE BODY AND THEIR WIRELESS CIRCUITS.



... the body is recharging when at sleep ...

# What is the best direction To Sleep In?

In India, people have generally been told never to sleep with their head towards the North. What's the logic behind this? Because of the magnetic pull of the planet and the iron in our blood, sleeping in certain directions causes unnecessary pressure on the brain which may lead to disturbed sleep and health issues.

**Northern Hemisphere**  
Sleeping with your head towards...

**East is best**



**North-east is okay**



**South, if you must**



**North: No**



**West is alright**



... so is very important to align it with the **earth's magnetic fields** ...



west(yes)



East(yes)



South(yes)



North(no)



# ... the Ancients teach us ... Sleeping Directions ...

North - Avoid



East - Good

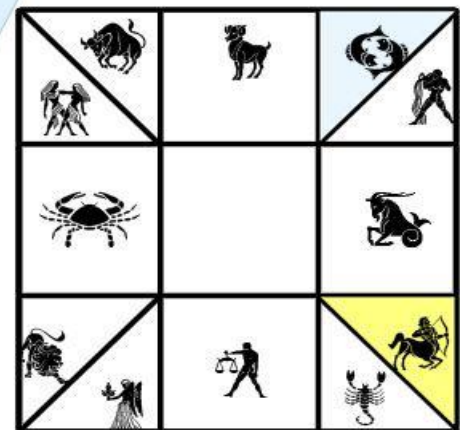
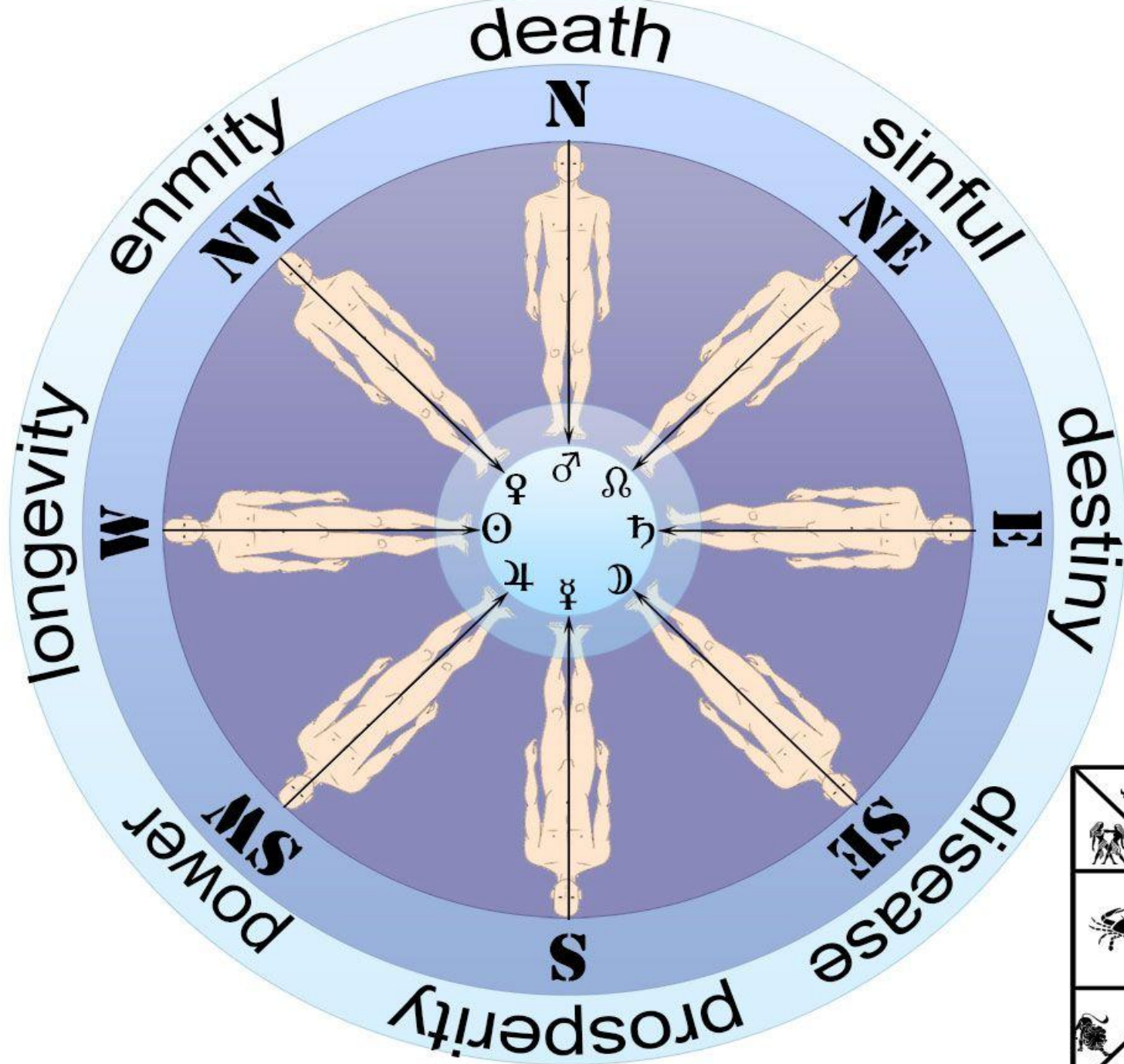


West - Neutral

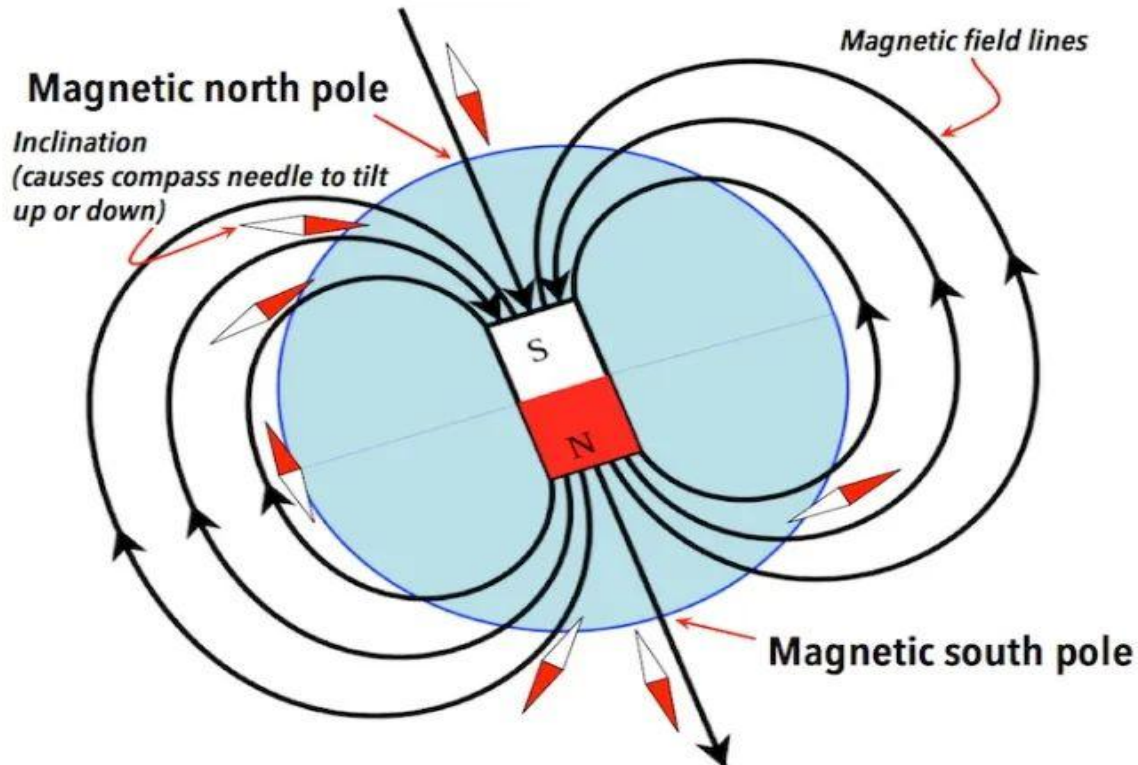


South - Good





# WHY IS IT FORBIDDEN TO SLEEP HEADING NORTH?



**In Hinduism, Vastu-kala, It is forbidden to sleep heading north because the Earth's Magnetic Field flows from South to North, if we sleep heading north the iron in our blood will accumulate in our upper part of the body mainly our Brain as Magnetic field of earth gets align with the magnetic field of our body and magnetism attracts Iron, Accumulated Iron in our brain can result in many health issues like Headache and Sleepiness.**

# **Why you should not sleep with head towards the north?**

[www.vastuconsultant.com](http://www.vastuconsultant.com)



Scientists hypothesize that humans possess an internal compass similar to the Earth's magnetic field. The metallic inner core creates a magnetic field on each rotation. According to the magnetic field theory, if you sleep facing north, the two north poles (if your head is pointed north) will repel each other, resulting in bad dreams and sleeplessness.

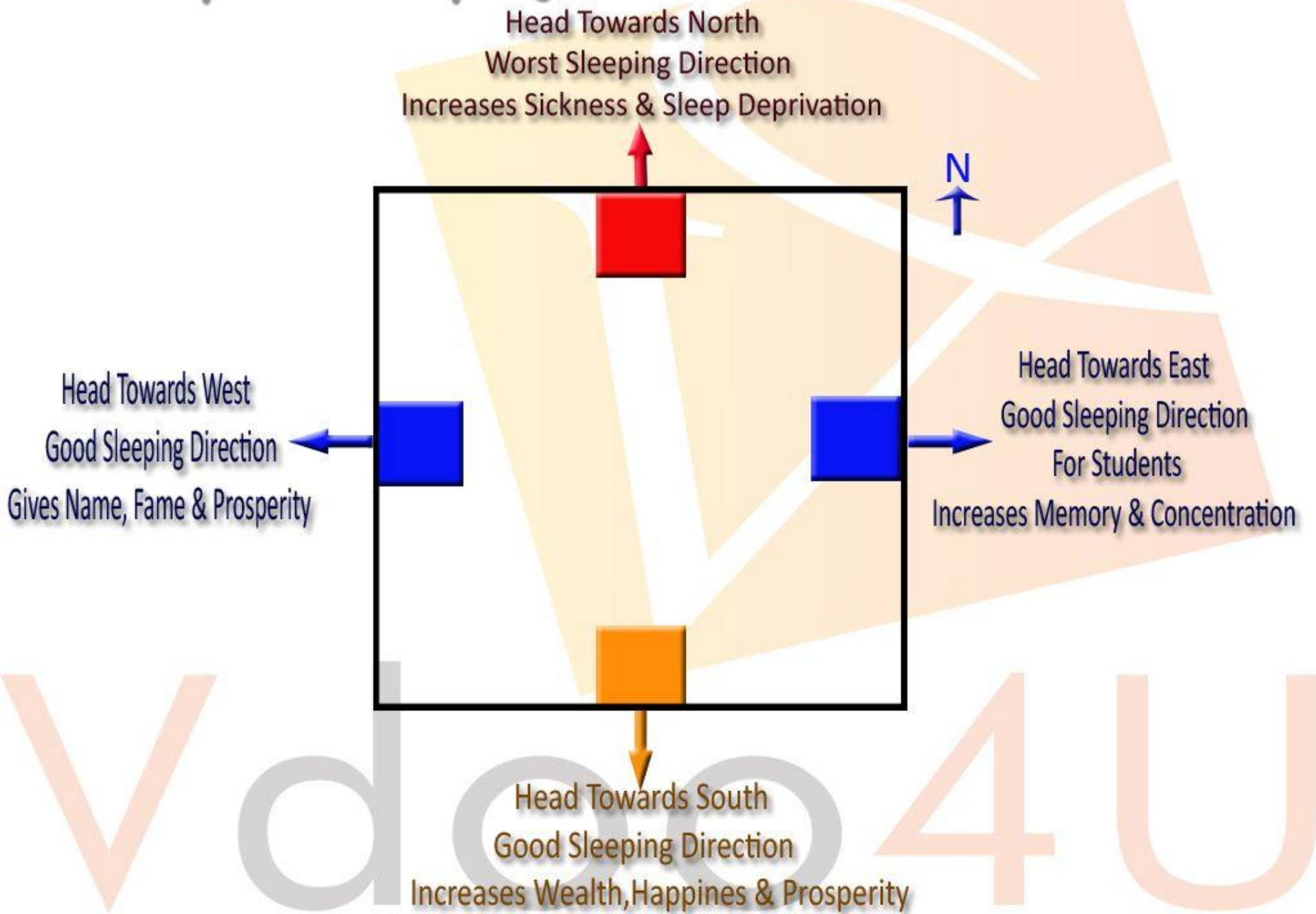
[www.vastuconsultant.com](http://www.vastuconsultant.com)

# Sleeping Positions

Why North is not the best direction



# Vastu tips for sleeping directions and their influence



## Northern Hemisphere

|            |      |            |
|------------|------|------------|
| North-east | East | South-east |
| North      |      | South      |
| North-west | West | South-west |

## Southern Hemisphere

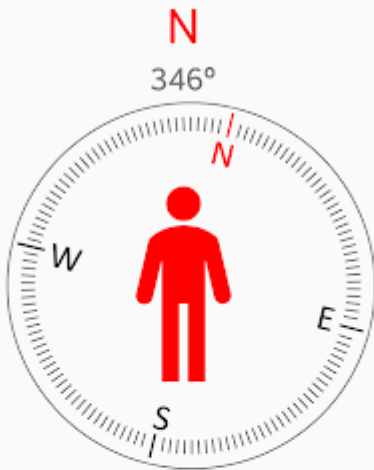
|            |      |            |
|------------|------|------------|
| North-east | East | South-east |
| North      |      | South      |
| North-west | West | South-west |

 - Ideal directions

 - Avoid this direction

... **1 NO** – **2 OK** ...

### Sleeping Direction



Sleeping with your Head in North direction is **NOT RECOMENDED** as per Vaastu .Only Dead bodies head is kept towards North Direction if one sleeps in this direction then he/she remains sleep Deprived and faces major sickness

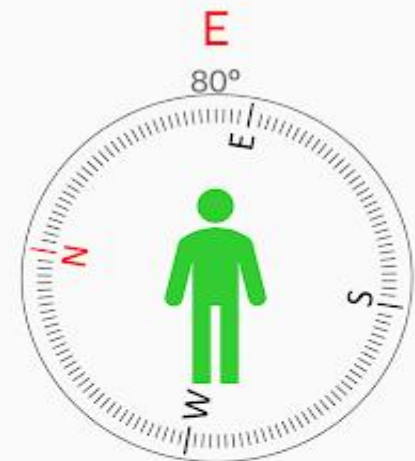
### Vastu Sleeping Compass

South



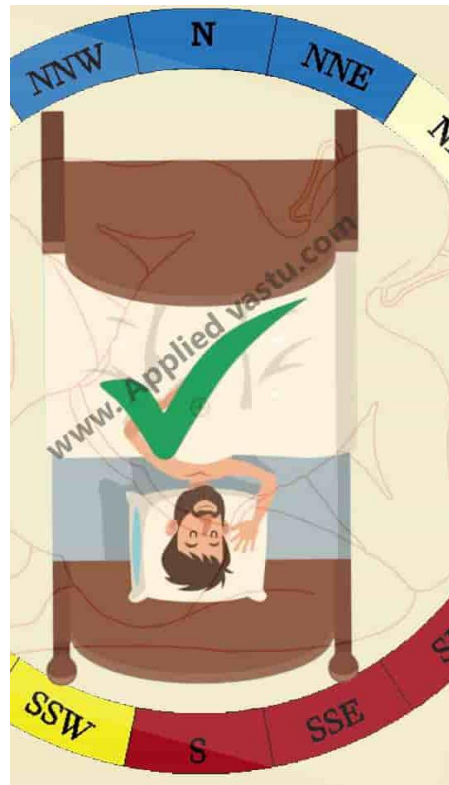
As per sleeping direction Vastu, this is the **BEST DIRECTION** to keep head. Sleeping with head towards South direction increases wealth, happiness and prosperity. Also the quality of sleep is best when sleeping in this position.

### Sleeping Direction



Sleeping with head in East direction increases memory , concentration , health and inclination towards Spirituality. Students are suggested to sleep in this position

... **1 NO** – **2 OK** – **1 ?** ...



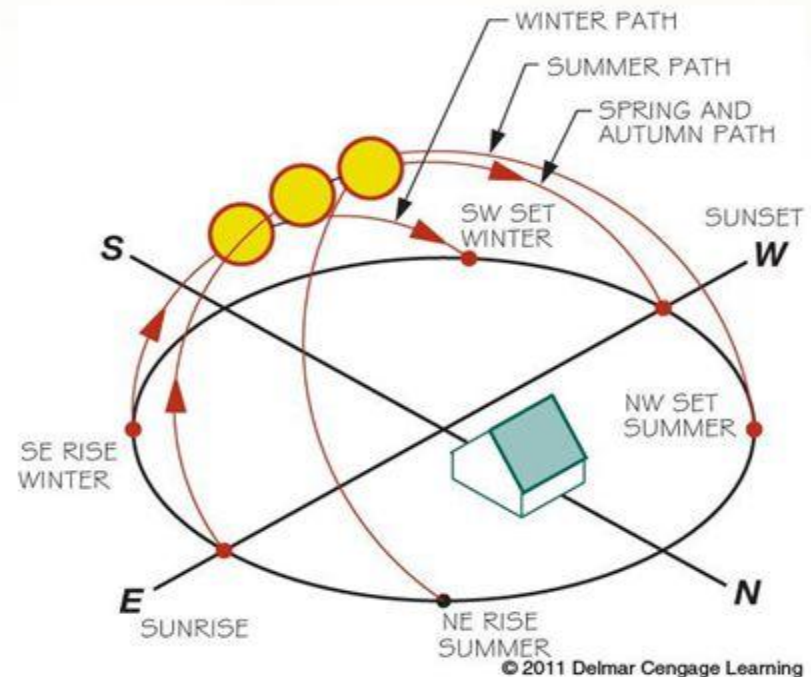
... even your House should be aligned ...

# Architectural Drafting & Design

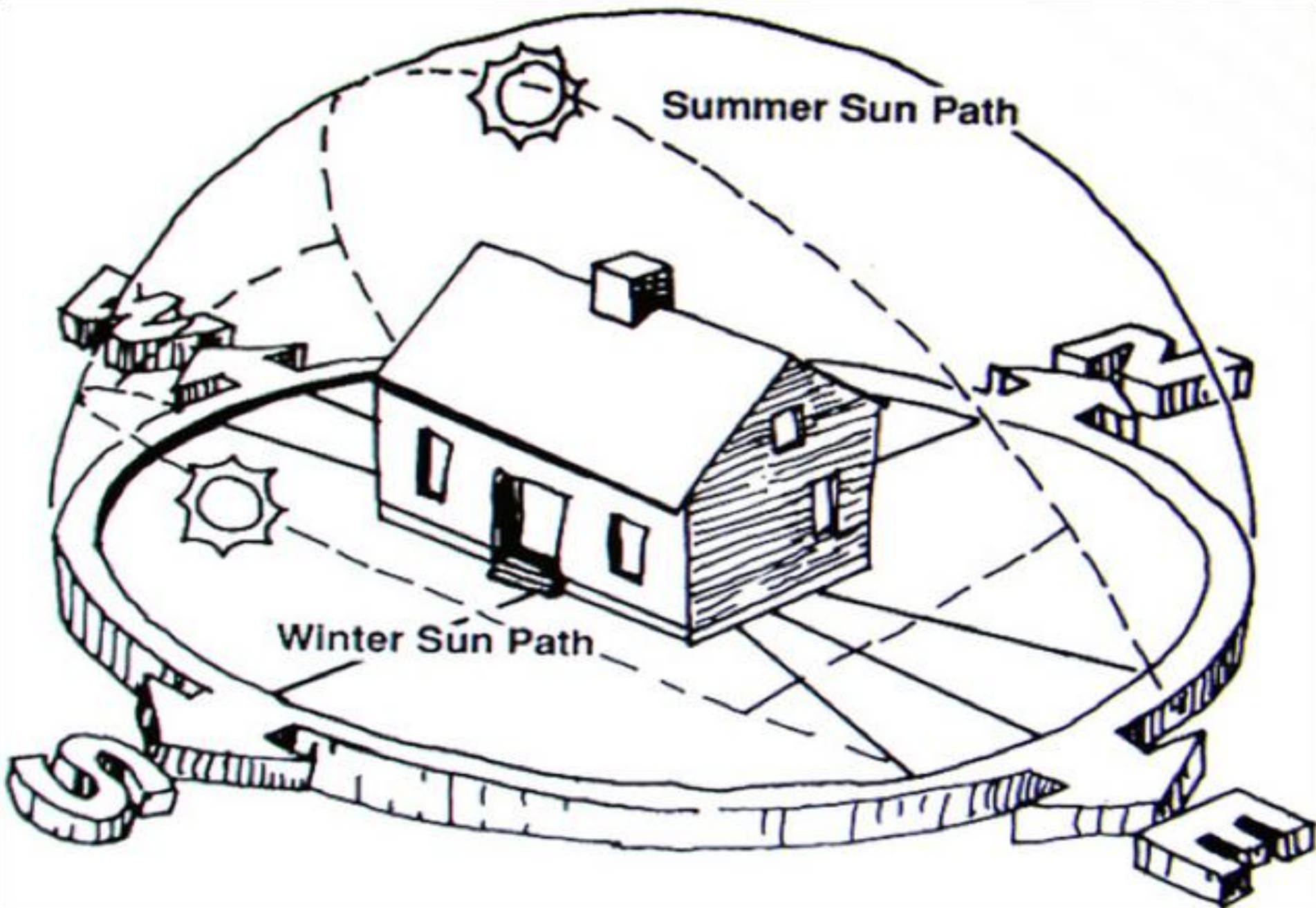
6th  
Edition

## Solar Orientation

- Sites with a solar orientation allow for excellent sun exposure
  - South slope
  - Southern exposure



... even your House should be aligned ...



# Thank You

This presentation/document was prepared and synthesized by Nick Demos. The information contained herein derives from various sources, mostly online sources, and publicly available books and data on the internet, etc. This presentation has been supplied on condition that anyone who consults it is understood to recognise that the copyright rests with its author and that no quotation from this presentation and no information derived from it may be published and used without the prior written consent of the author. This document was prepared by Nick Demos.

©2022 Nick Demos | ALL RIGHTS RESERVED