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A Brief Summary about Solar Activities and Geomagnetic Storms (Solar Cycle 24)

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Outline

- INTERESTING FACTS ABOUT OUR KIND STAR
- SPACE WEATHER AND GEOMAGNETIC STORMS
- ORIGIN OF GEOMAGNETIC STORMS
- THE EFFECTS OF SOLAR STORMS ON THE EARTH AND HUMAN
- SOLAR CYCLES AND THEIR ROLE IN GEOMAGNETIC STORMS
- REFERENCES

❖ Sun: Facts and Figure

Age: 4.6 Billion Years

Temperature: 5504 °C

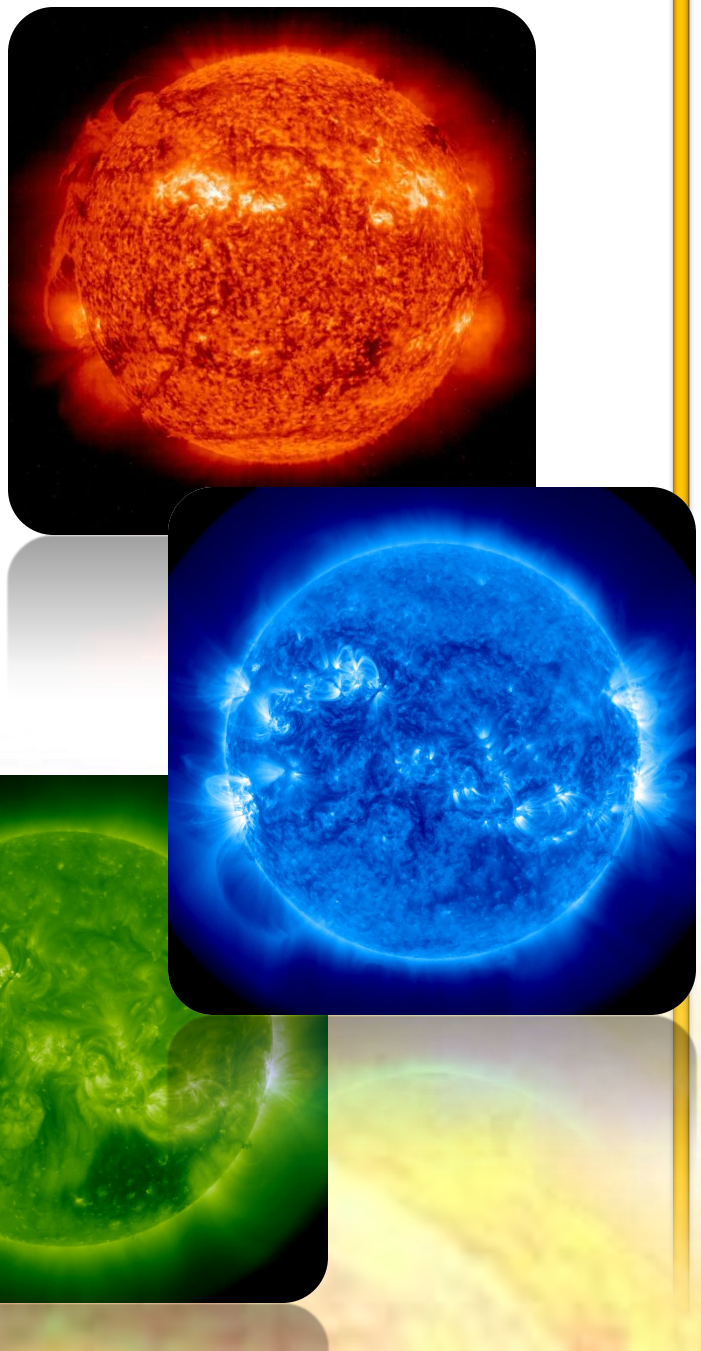
Mean Radius: 695,508 km (*109.2 x Earth*)

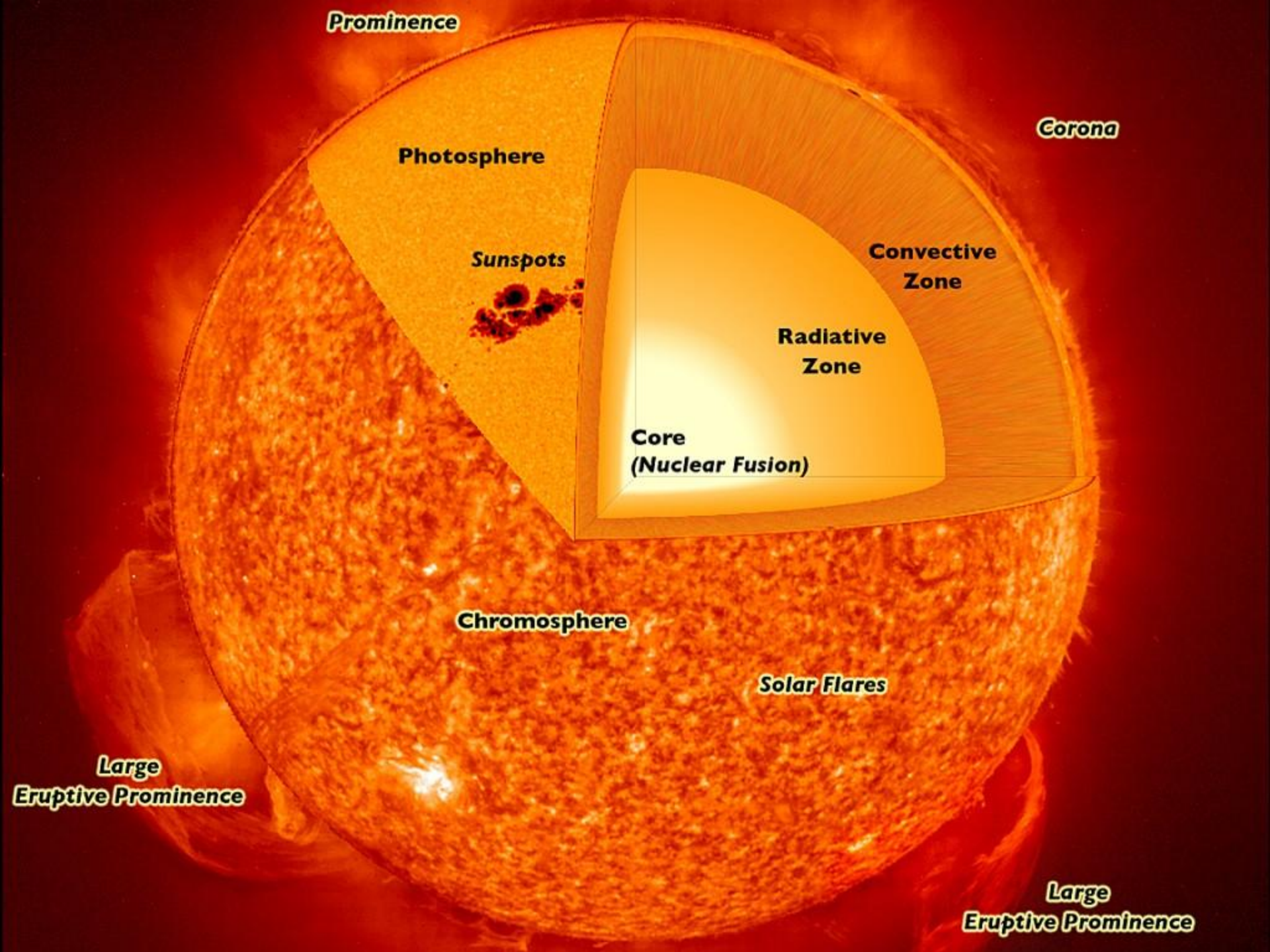
Mass: 1.989 x 10^{30} kg (*333,060.402 x Earth's*)

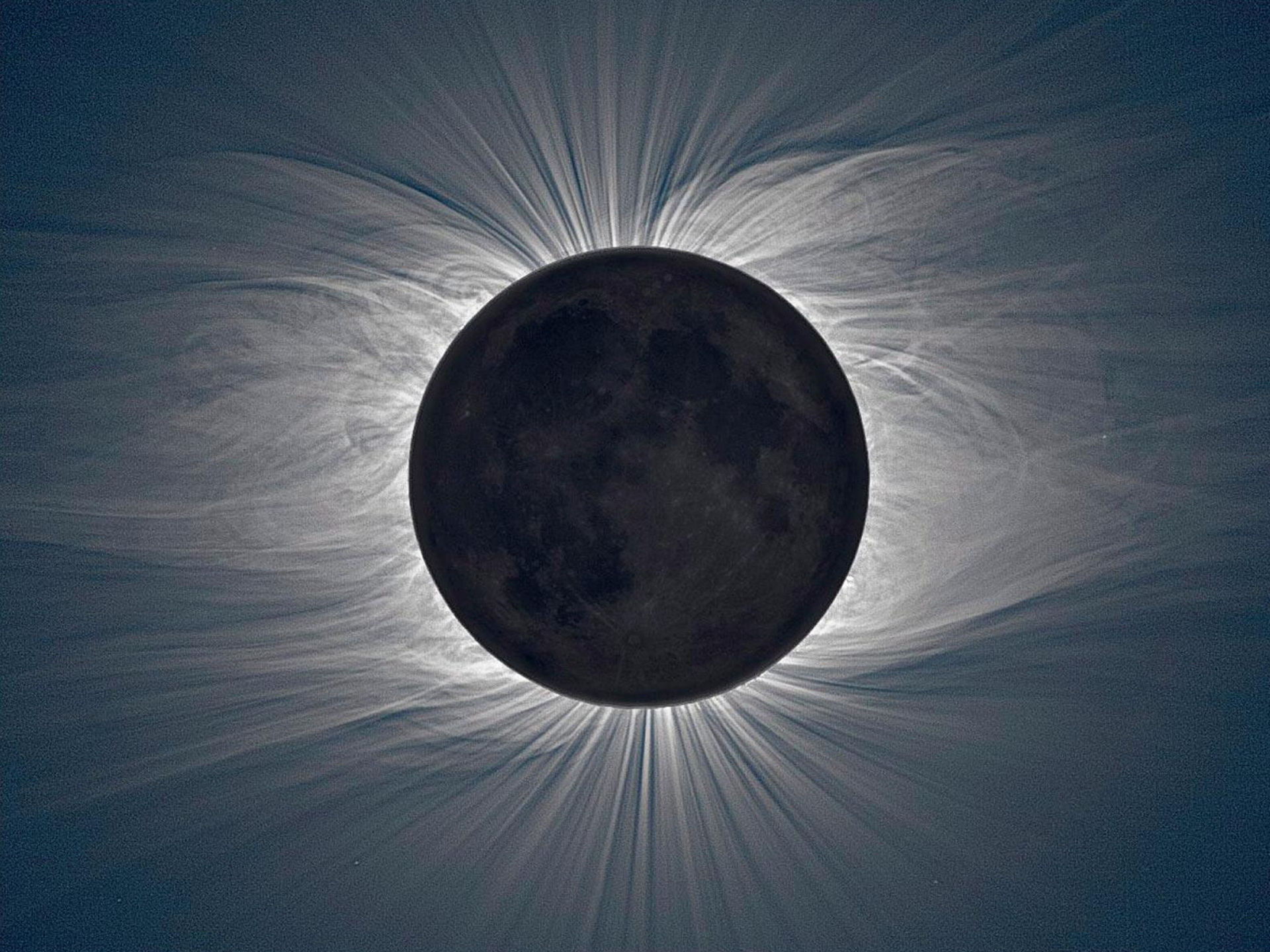
Surface Gravity: 274.0 m/s^2 **(***27.96 x Earth's)*

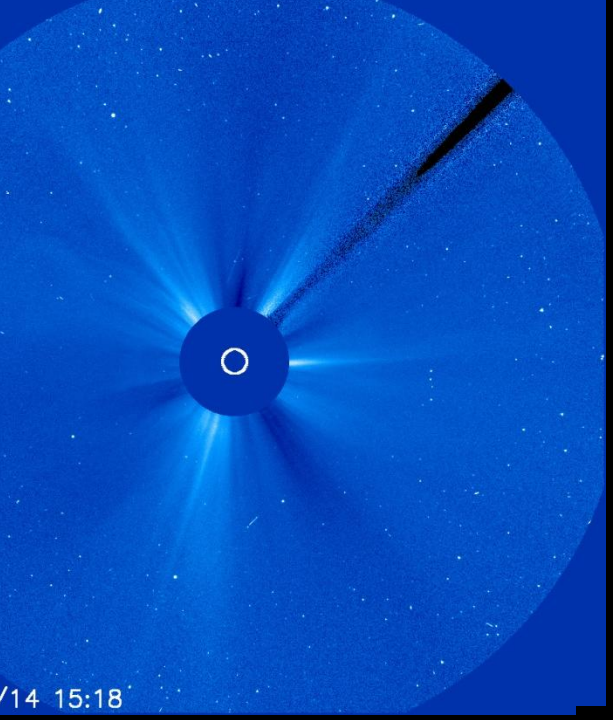
Mean Distance to Earth: 149.60 million km

Composition: 92.1% Hydrogen, 7.8% Helium




Prominence
Corona
Photosphere
Sunspots
Convective Zone
Radiative Zone
Core
(Nuclear Fusion)
Chromosphere
Solar Flares
Large Eruptive Prominence
Large Eruptive Prominence

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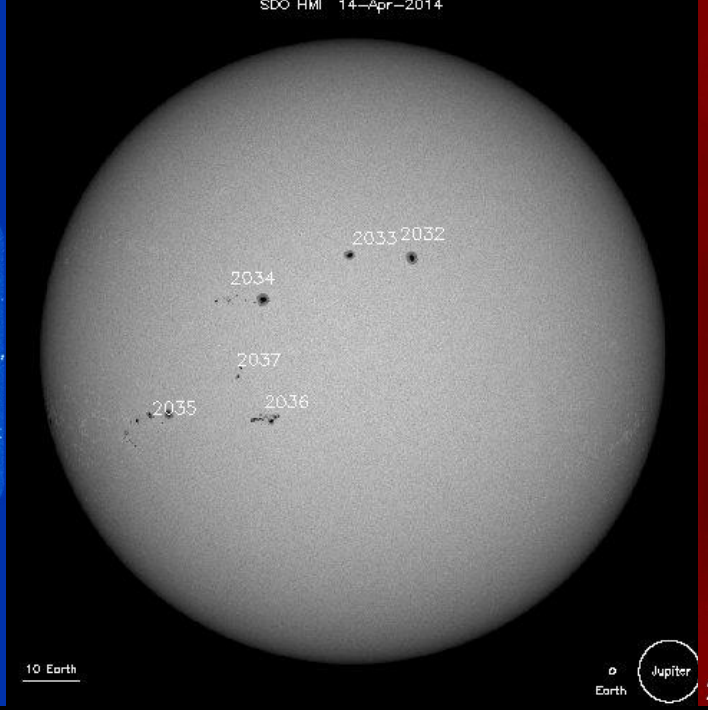
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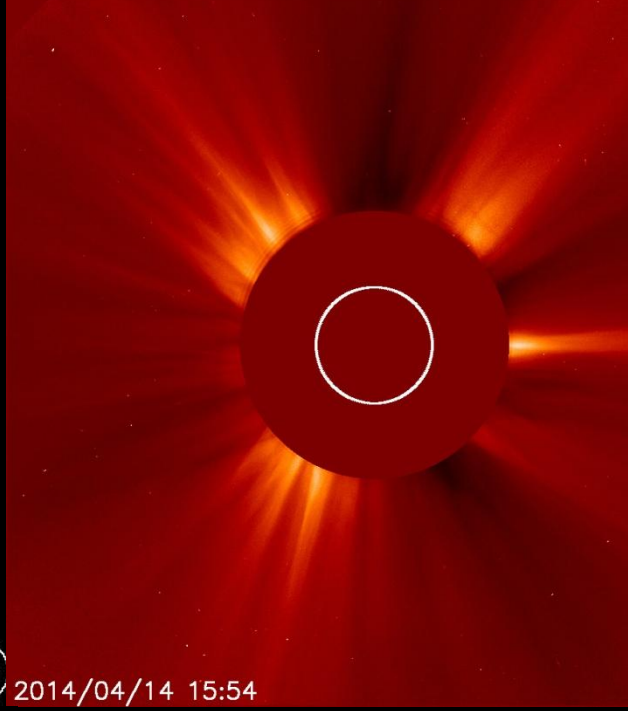
10 Earth
Earth
Jupiter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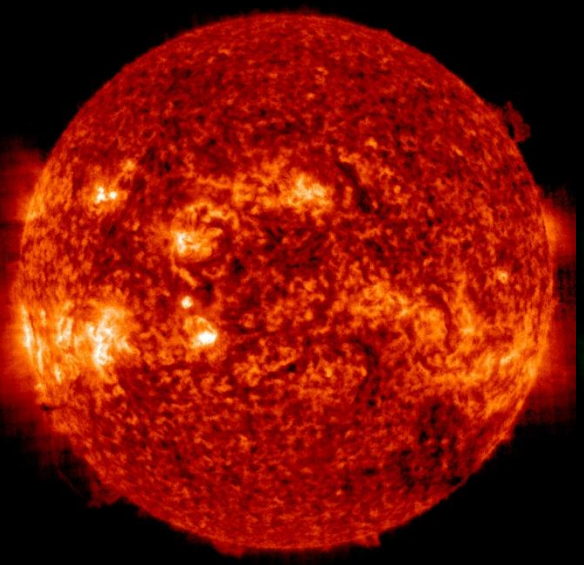
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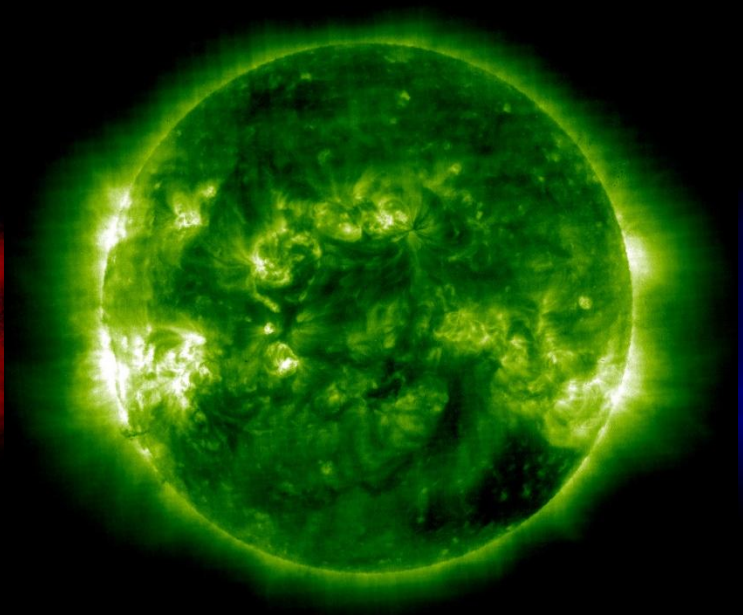
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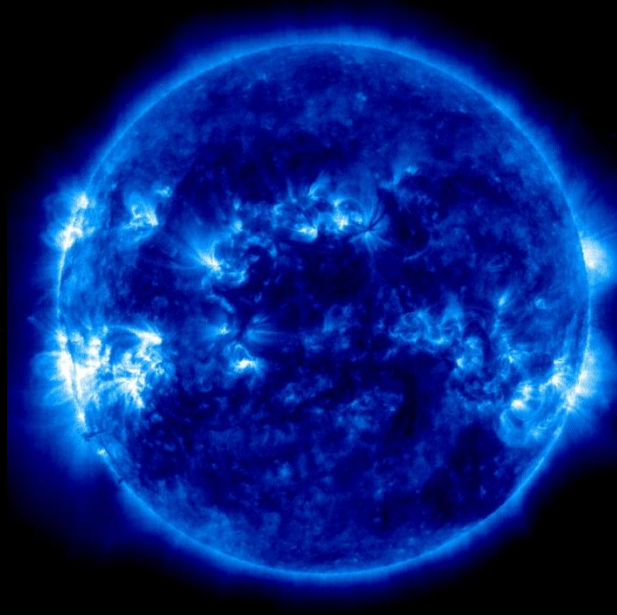
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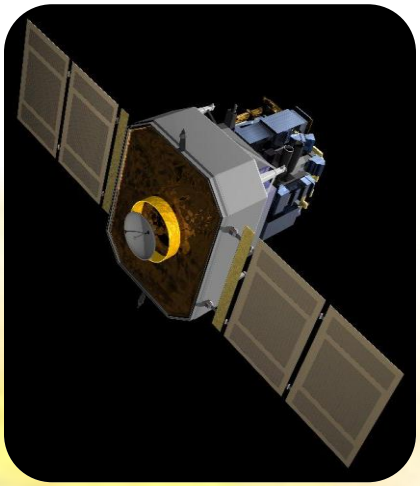
❖Space crafts

We must use from a few spacecraft to fine the sources of these events.

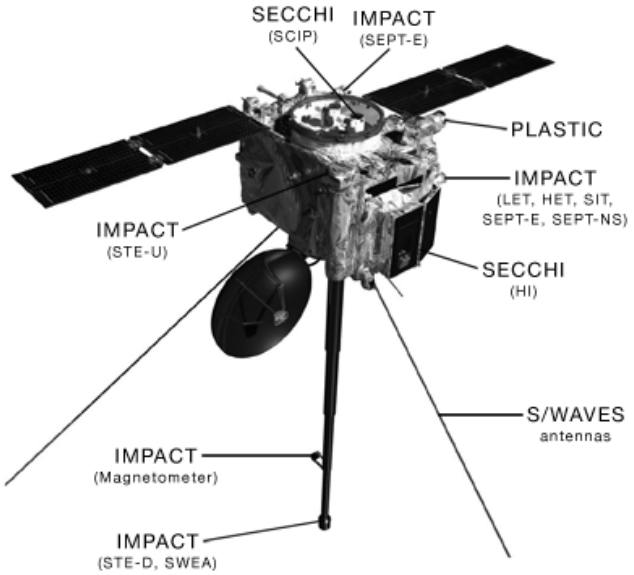
- SOHO

SOHO, the Solar & Heliospheric Observatory, is a project of international collaboration between ESA and NASA to study the Sun from its deep core to the outer corona and the solar wind SOHO was launched on December 2, 1995.



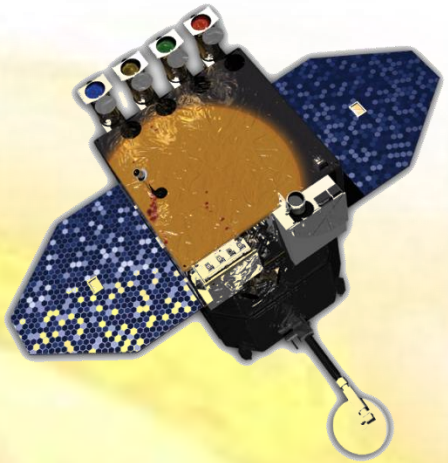
- STEREO

STEREO (Solar TErrestrial RElations Observatory) is the third mission in NASA's Solar Terrestrial Probes program (STP). This two-year mission will employ two nearly identical space-based observatories - one ahead of Earth in its orbit, the other trailing behind - to provide the first-ever stereoscopic measurements to study the Sun and the nature of its coronal mass ejections, or CMEs.

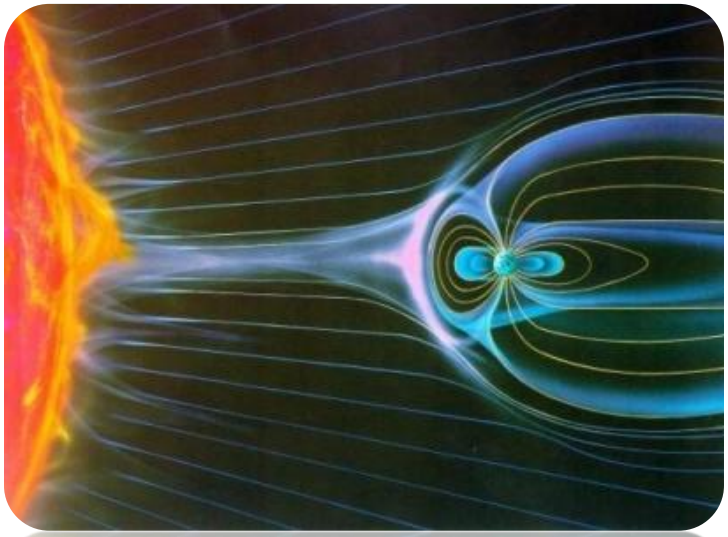


- SDO

The Solar Dynamics Observatory, a program designed to understand the causes of solar variability and its impacts on Earth. SDO is designed to help us understand the Sun's influence on Earth and Near-Earth space by studying the solar atmosphere on small scales of space and time and in many wavelengths simultaneously .



What Is the Space Weather?



The term "space weather" was coined not long ago to describe the dynamic conditions in the Earth's outer space environment, in the same way that "weather" and "climate" refer to conditions in Earth's lower atmosphere. Space weather includes any and all conditions and events on the sun, in the solar wind, in near-Earth space and in our upper atmosphere that can affect space-borne and ground-based technological systems and through these, human life and endeavor. Heliophysics is the science of space weather.

❖ Solar Wind

Speed: 300 km/s to 2000 km/s

Temperature: Slow wind (450 km/s): $1.4 – 1.6 \times 10^6$
Fast wind (750 km/s): 8×10^5 K

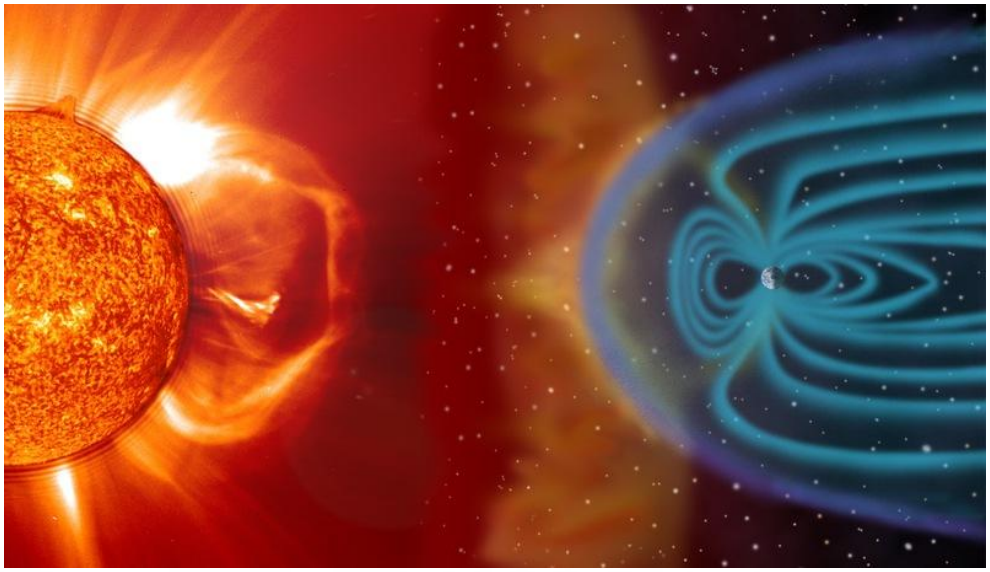
Mass: 1×10^9 kilograms per second. This is equivalent to losing a mass equal to the Earth every 150 million years.

Source: Solar Corona

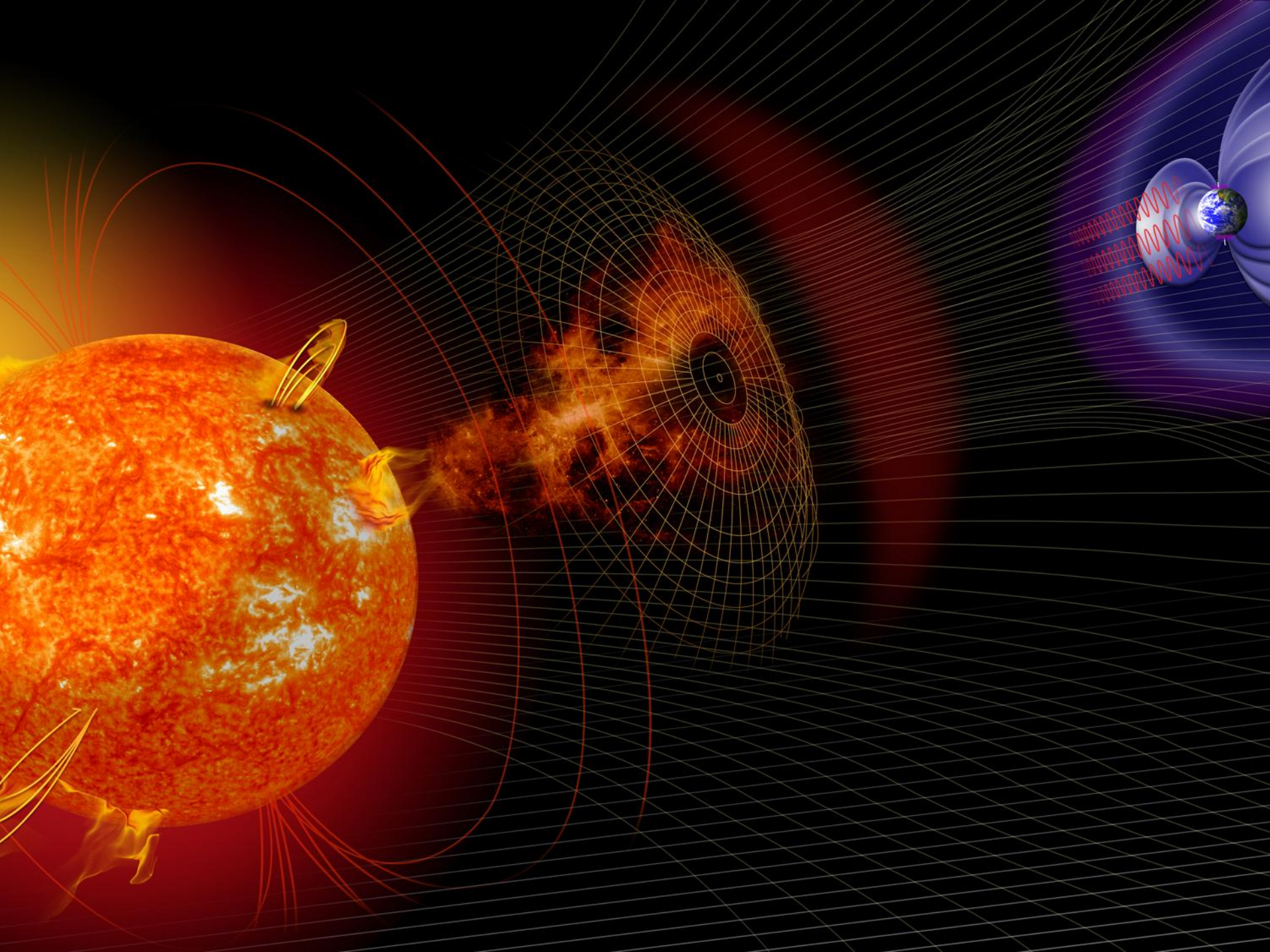
Effects on the Earth: Magnetospheric and Atmospheric diseases.

position: Plasma, Proton flows, magnetic fields

Geomagnetic Storms!!!

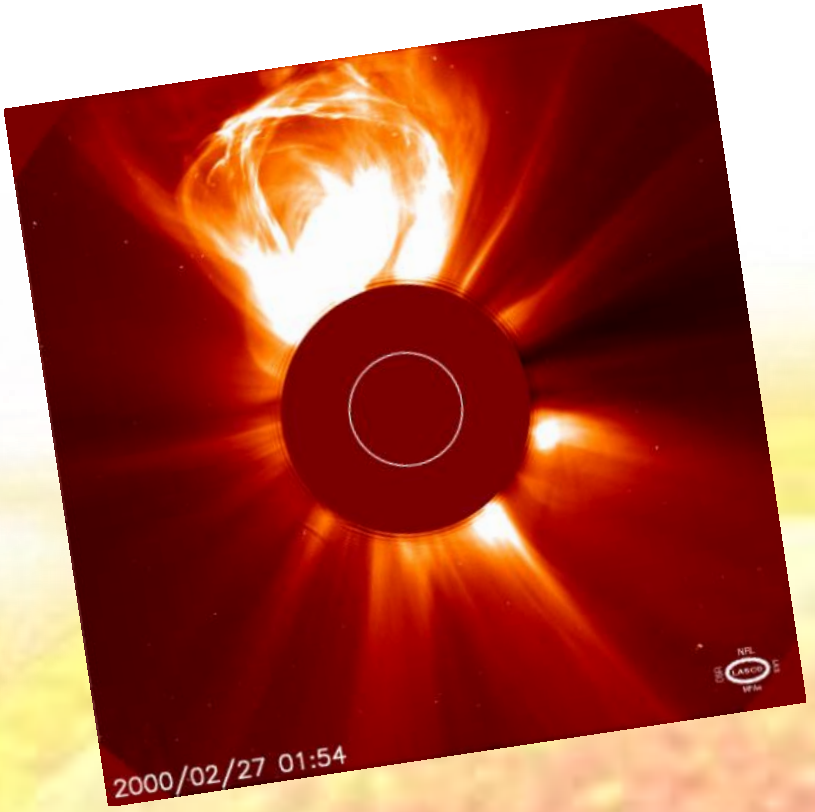


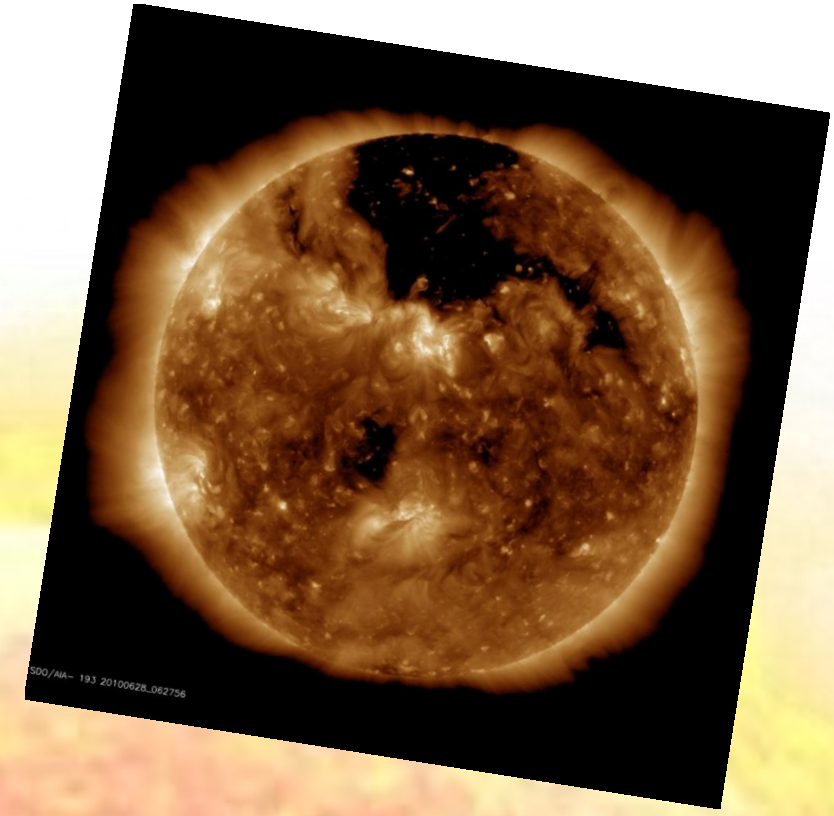
A geomagnetic storm is a temporary disturbance of the Earth's magnetosphere caused by a solar wind shock wave and/or cloud of magnetic field which interacts with the Earth's magnetic field. The increase in the solar wind pressure initially compresses the magnetosphere and the solar wind's magnetic field interacts with the Earth's magnetic field and transfers an increased energy into the magnetosphere. Both interactions cause an increase in movement of plasma through the magnetosphere (driven by increased electric fields inside the magnetosphere) and an increase in electric current in the magnetosphere and ionosphere.



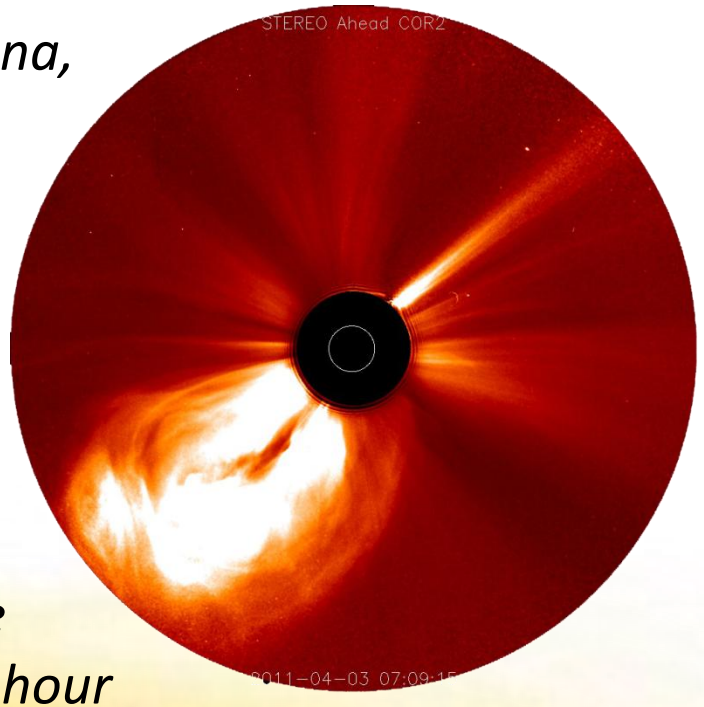
❖ Sources of the Storms

1. CORONAL MASS EJECTION (CME)
2. CORONAL HOLES (CH)

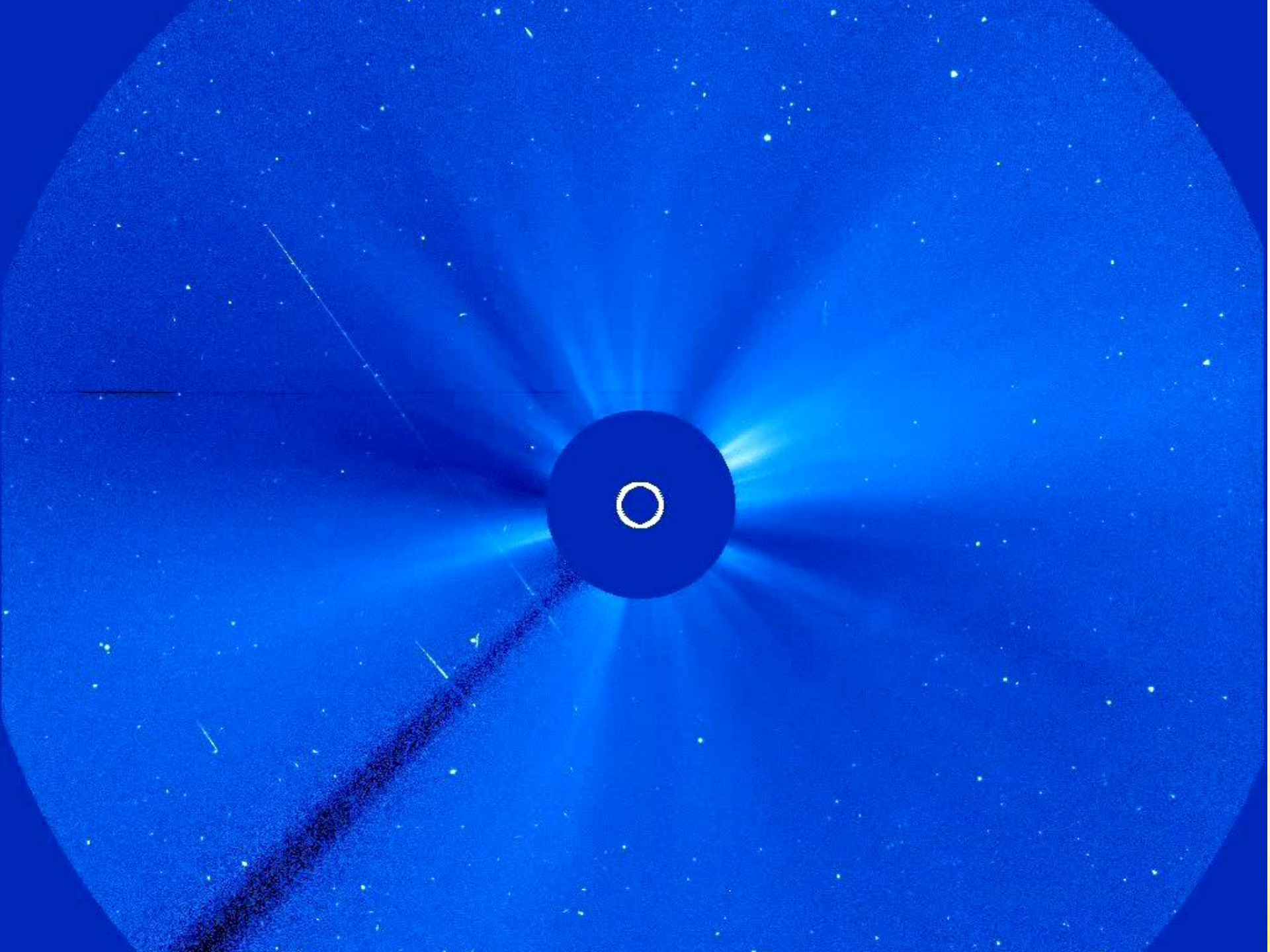


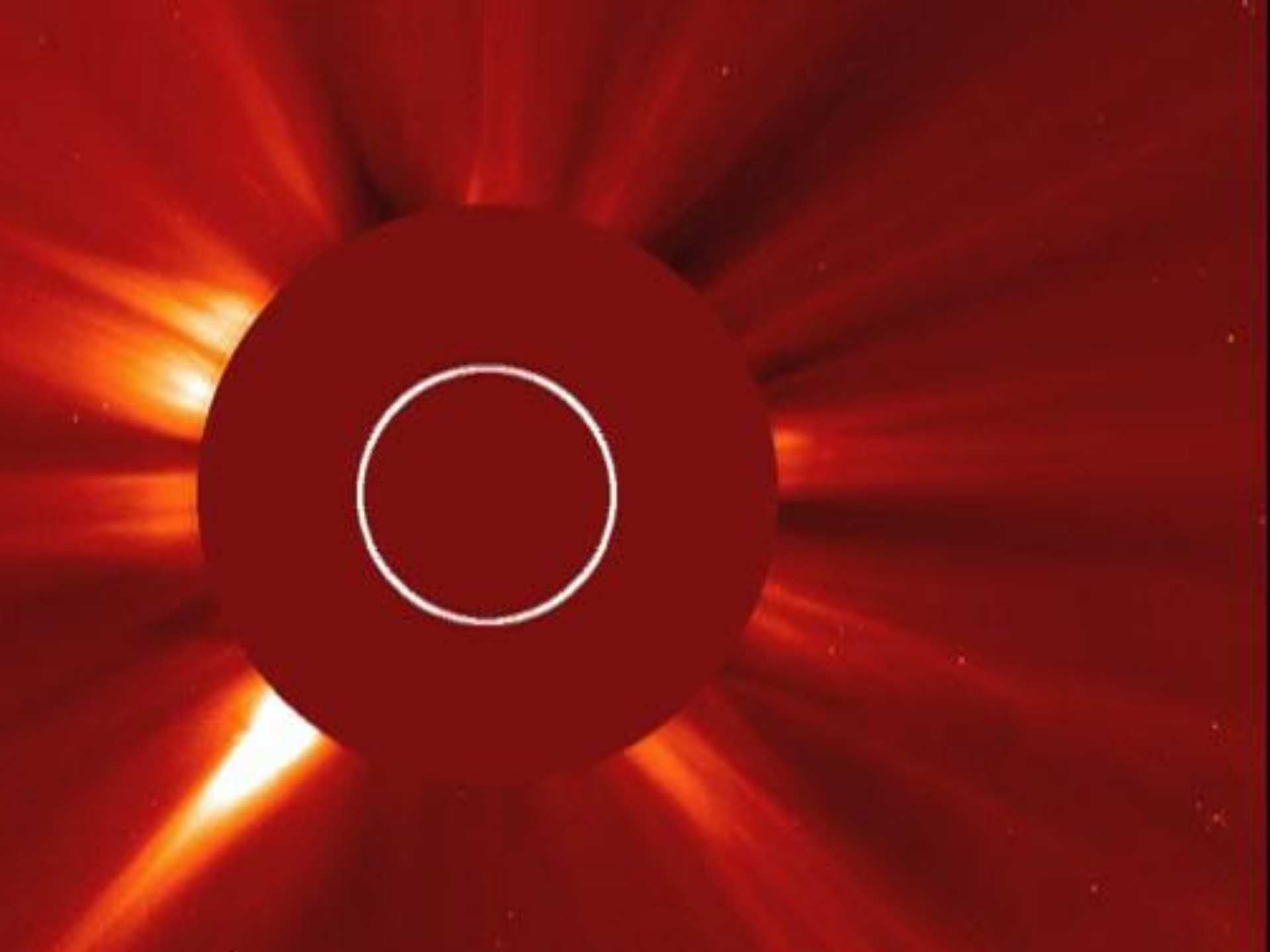


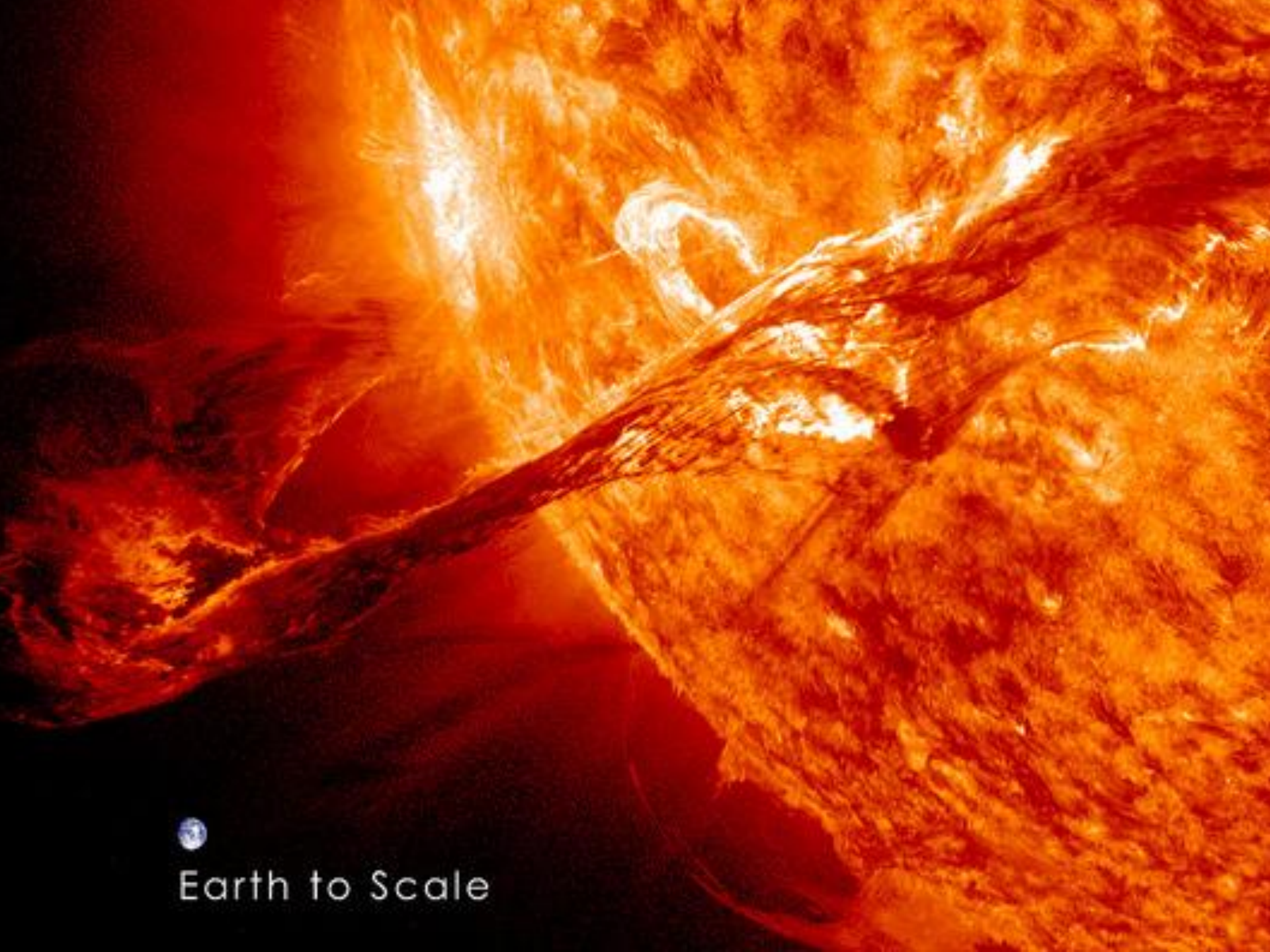
❖ Coronal Mass Ejection (CME)



The outer solar atmosphere, the corona, is structured by strong magnetic fields. Where these fields are closed, often above sunspot groups, the confined solar atmosphere can suddenly and violently release bubbles of gas and magnetic fields called coronal mass ejections. A large CME can contain a billion tons of matter that can be accelerated to several million miles per hour in a spectacular explosion. Solar material streams out through the interplanetary medium, impacting any planet or spacecraft in its path. CMEs are sometimes associated with flares but can occur independently.

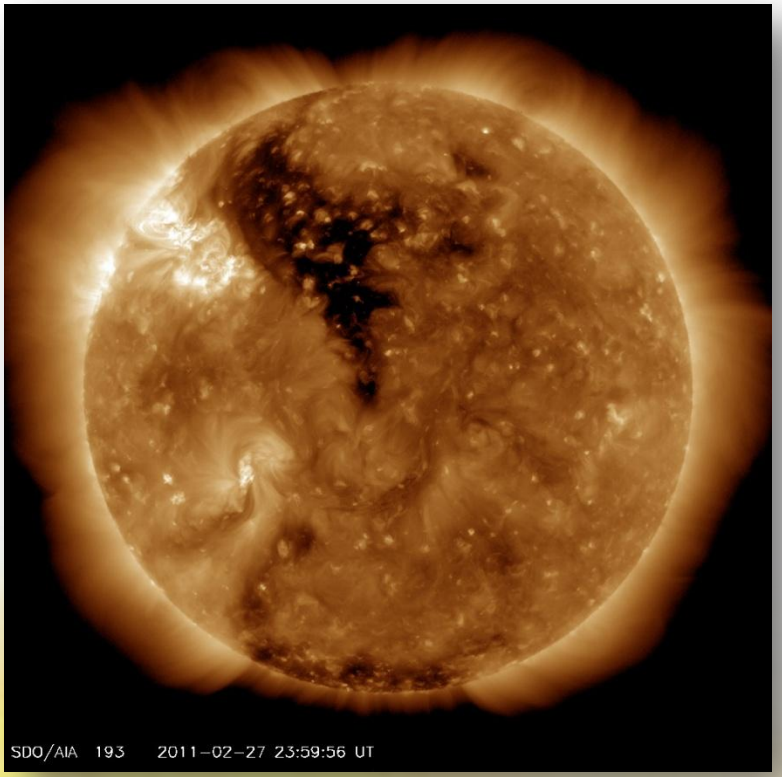


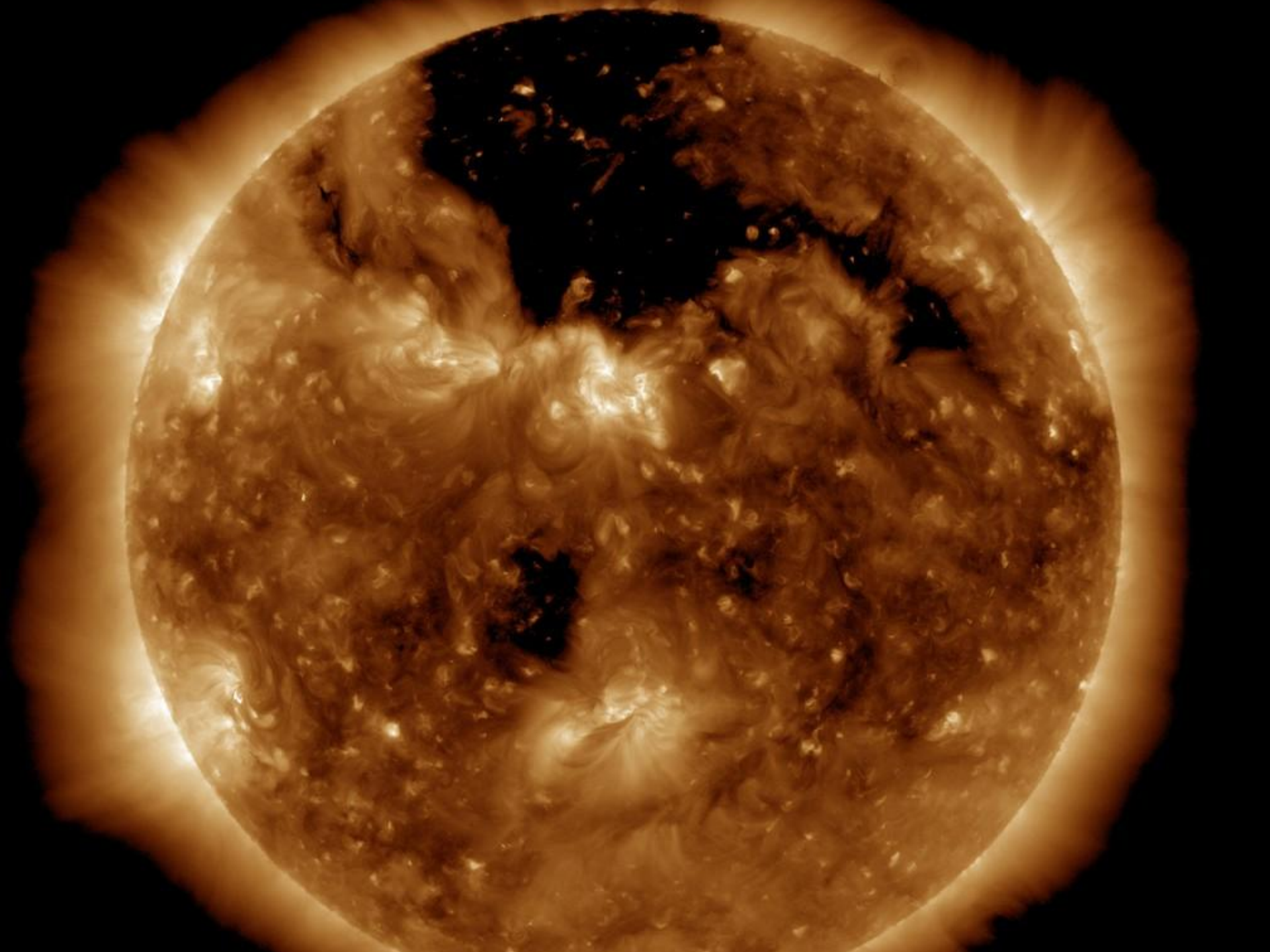



Earth to Scale

❖ Coronal Holes (CH)

Coronal holes are variable solar features that can last for weeks to months. They are large, dark areas (representing regions of lower coronal density) when the sun is viewed in EUV or x-ray wavelengths, sometimes as large as a quarter of the sun's surface. These holes are rooted in large cells of unipolar magnetic fields on the sun's surface; their field lines extend far out into the solar system. These open field lines allow a continuous outflow of high-speed solar wind. Coronal holes tend to be most numerous in the years following solar maximum.

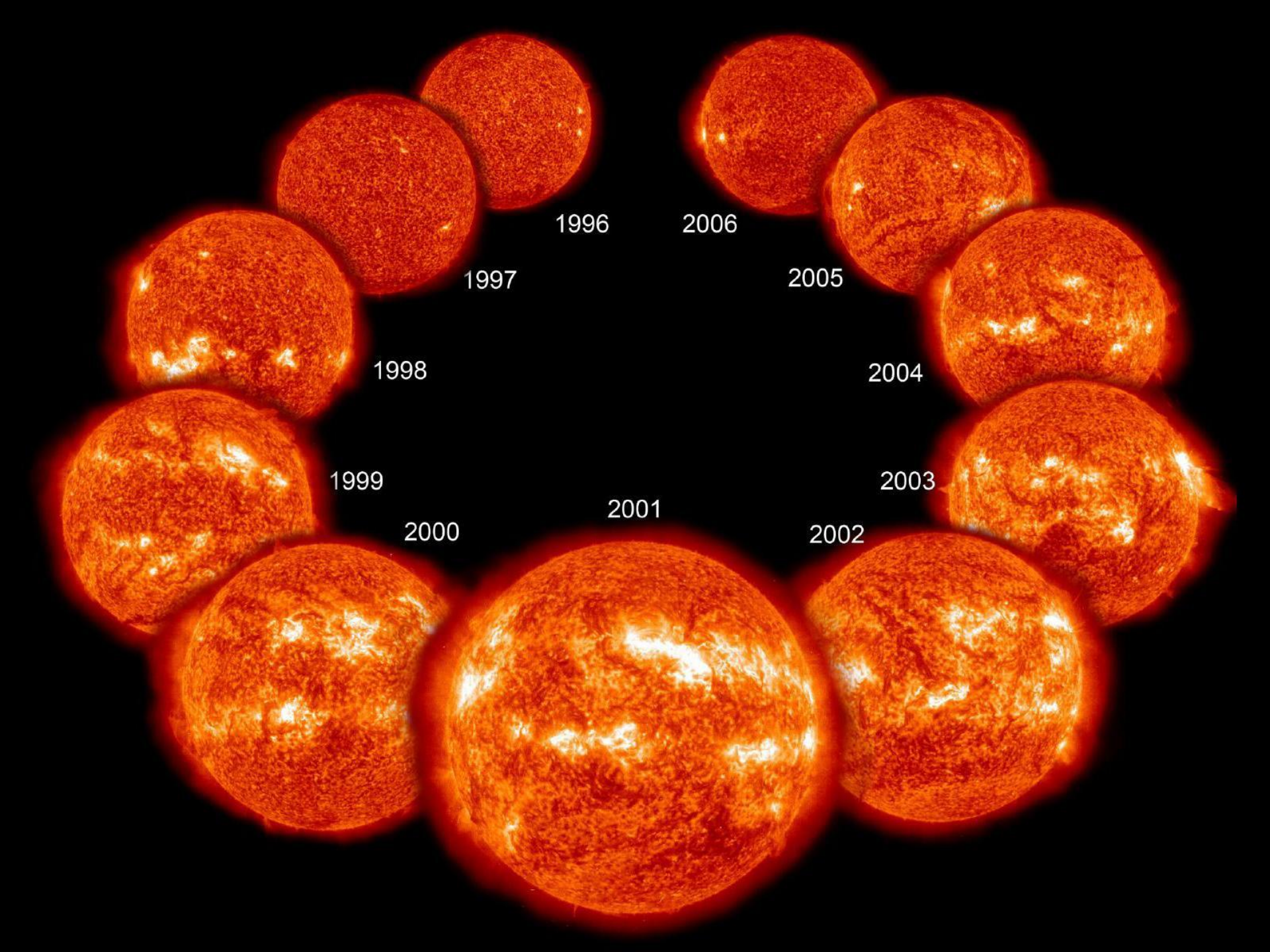




❖ Solar Cycles

The solar cycle is the periodic change in the Sun's activity (including changes in the levels of solar radiation and ejection of solar material) and appearance (visible in changes in the number of sunspots, flares, and other visible manifestations). Solar cycles have an average duration of about 11 years. They have been observed (by changes in the sun's appearance and by changes seen on Earth, such as auroras) for hundreds of years. Solar variation causes changes in space weather, weather, and climate on Earth. It causes a periodic change in the amount of irradiation from the Sun that is experienced on Earth.

It is one component of solar variation, the other being aperiodic fluctuations.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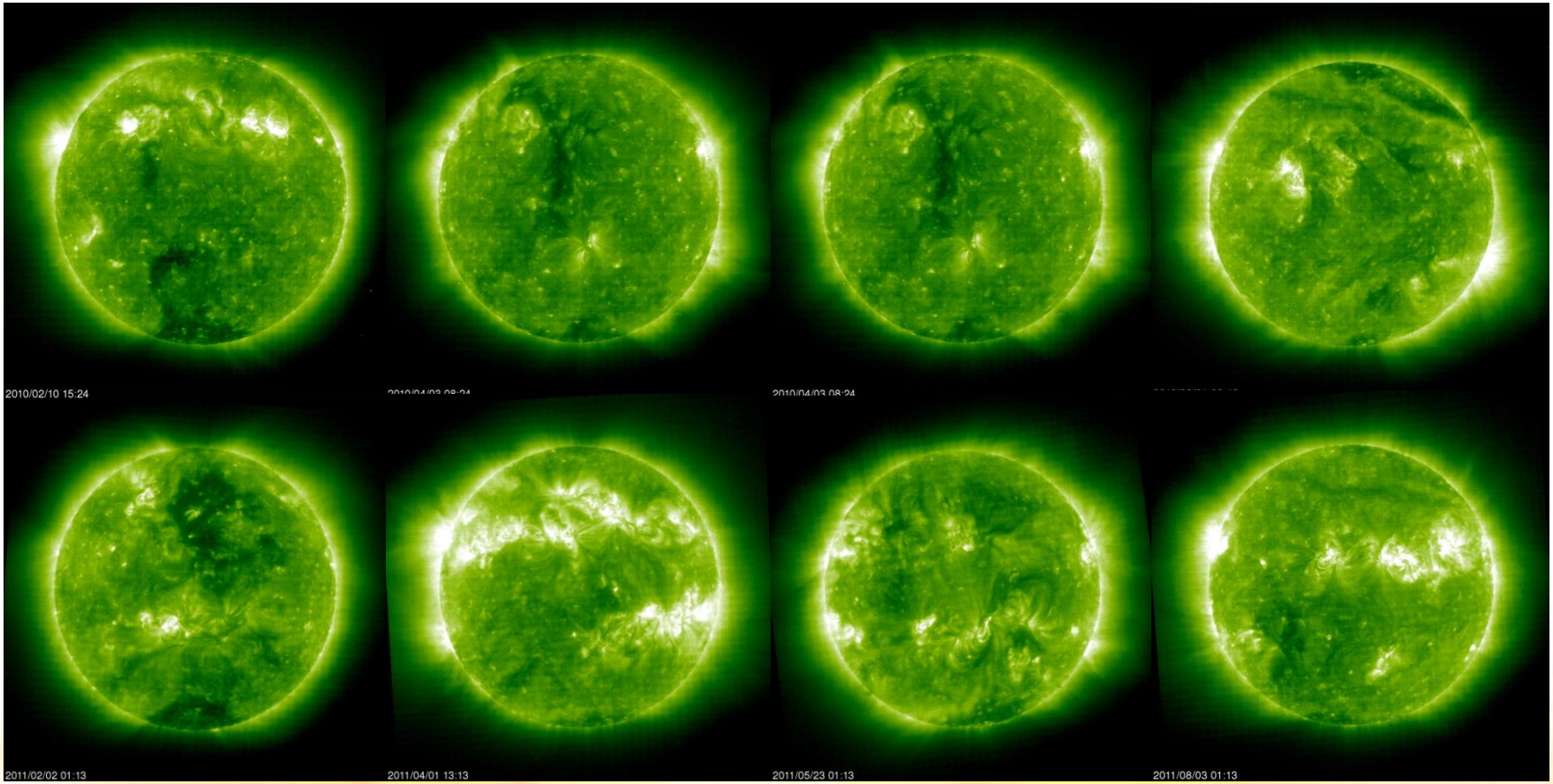
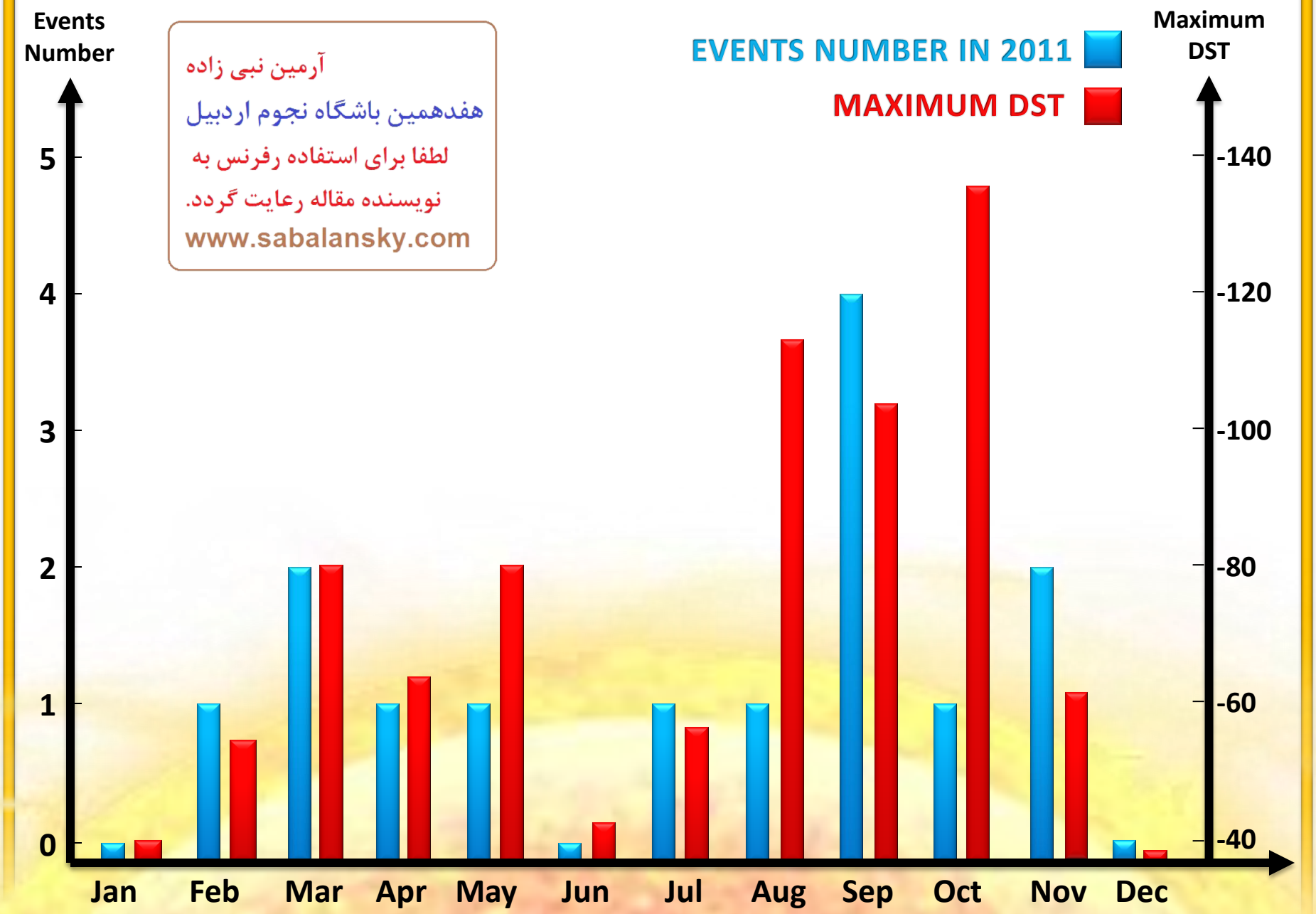
EIT PICTURES OF 2010



EIT PICTURES OF 2011


Events Number
Maximum DST
EVENTS NUMBER IN 2011
MAXIMUM DST
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❖ The effects of solar storms on the earth and human

- **Magnetospheric Disturbances**

Polar Auroras

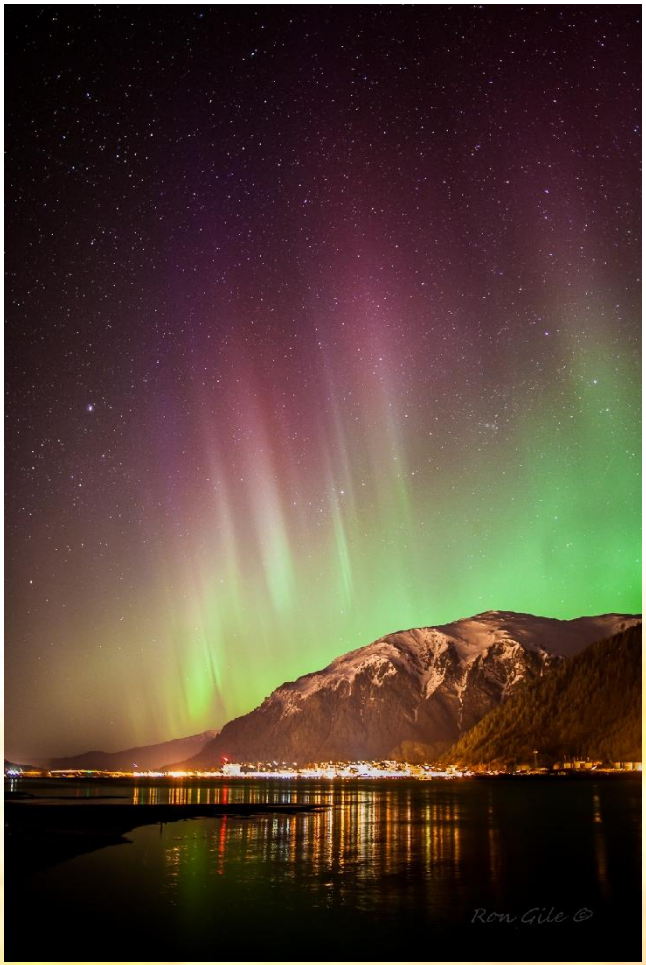
- **Ionospheric Disturbances**

Radio Communications

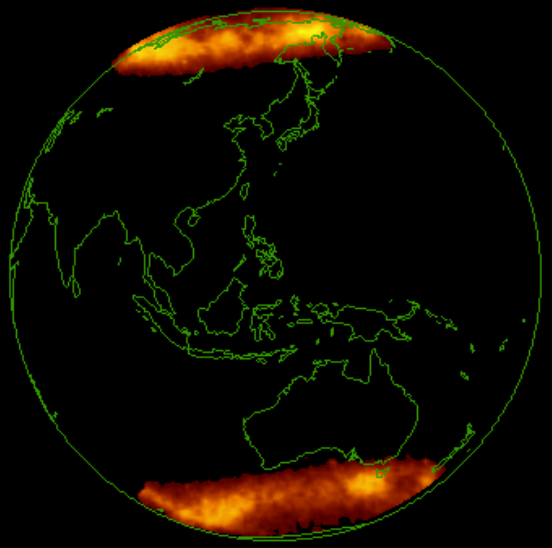
- **Biological Disturbances**

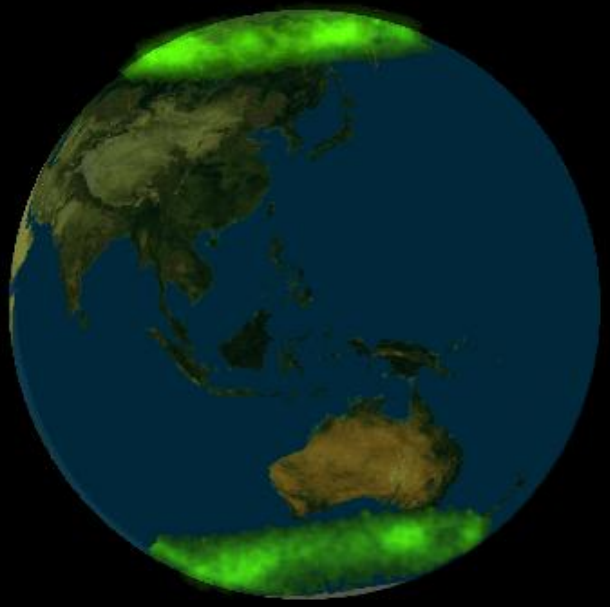
Human’s Body

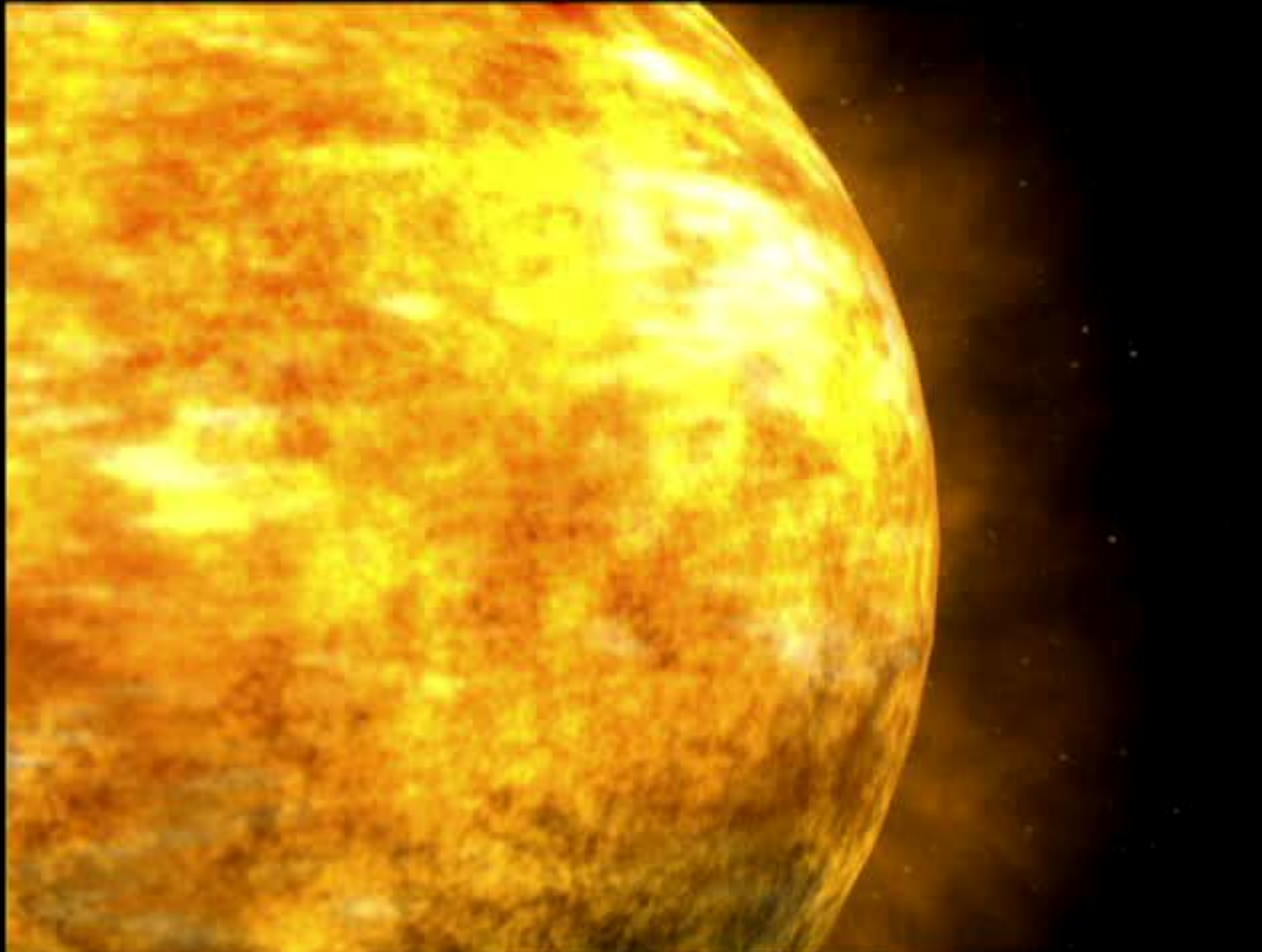
❖ Polar Auroras



An aurora (plural: auroras or aurorae;[1] from the Latin word aurora, "sunrise" or the Roman goddess of dawn) is a natural light display in the sky particularly in the high latitude (Arctic and Antarctic) regions, caused by the collision of energetic charged particles with atoms in the high altitude atmosphere (thermosphere). The charged particles originate in the magnetosphere and solar wind and, on Earth, are directed by the Earth's magnetic field into the atmosphere. Most auroras occur in a band known as the auroral zone,[2][3] which is typically 3° to 6° wide in latitude and observed at 10° to 20° from the geomagnetic poles at all local times (or longitudes). The solar wind is directed into the atmosphere by the Earth's magnetosphere. A geomagnetic storm expands the auroral zone to lower latitudes.



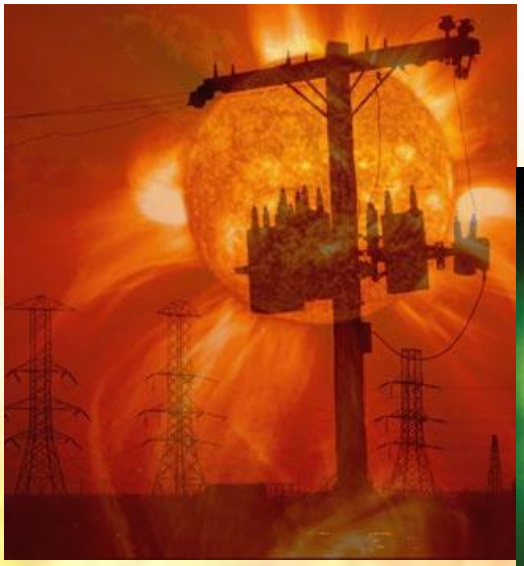


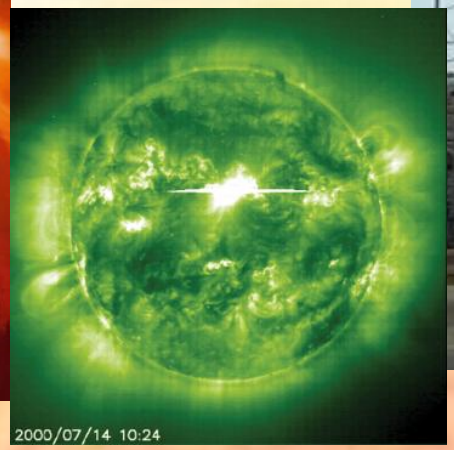


❖ Radio Communications

Solar storm of 1859: Carrington Event

The solar storm of 1859, also known as the Carrington Event, was a powerful geomagnetic solar storm in 1859 during solar cycle 10. A solar flare or coronal mass ejection hit Earth's magnetosphere and induced the largest known solar storm, which was observed and recorded by Richard C. Carrington.





❖ Biological Diseases

- Brain Diseases

Neural Disturbances

- Heart Diseases

Heart Attacks

- Skin Diseases

Skin Concerns

Remember That:

- Use Sunglasses in Sunny Days

- Use Anti Sunlight Cream

- Check the Websites of Space Agencies for More information

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2. M. Stixand " The Sun "; Springer, (1991), 430-440
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