Aurora

A natural light display observed in high latitude skies during magnetospheric substorms and magnetic storms. The aurora is formed due to emissions of photons occurring during the collisions of energetic charged particles originate from the magnetosphere and the solar wind, with atoms and molecules of the Earth's upper atmosphere.. The variable colors of the aurora depend on the kind of atoms/molecules (nitrogen, oxygen) and on the energy of the impacting charged particles.

Bow shock

As the solar wind reaches the terrestrial magnetosphere a shock is produced at the point where the solar wind pressure balances the pressure of the terrestrial magnetosphere. This shock allows the solar wind to get slowed, heated and deflected around the Earth. It has a curved shape, symmetrical about the sun-earth line. The position of the most sunward part of the bow shock is at about 14 R_E radii (1 R_E= 6371 km) from the center of the Earth. The exact position of the bow shock depends on the solar wind dynamic pressure.

Chromosphere

It is a relatively thin layer of the Sun's atmosphere, with roughly 2,000 km width at a temperature of about 10,000 K, lying above the photosphere and below the corona. Chromosphere contributes to the spectrum of the Sun with characteristic emission lines. Characteristic features observed in the chromosphere are the **filaments** which are plums of gas rising through the chromosphere, the **prominences**, which are filaments viewed from the side, and the **spicules** which are dynamic jets moving upwards from the photosphere.

Corona

Corona is the extended outer atmosphere of the Sun**,** located above the photoshere It is characterized by low densities and high temperatures (> 10^6K) and can be observed with a coronagraph or during a total solar eclipse.

CME (Coronal Mass Ejection)

A massive burst of charged particles and magnetic fields of solar origin, released from the sun's upper atmosphere (solar corona) into interplanetary space. CMEs can travel 3 times faster than the solar wind. They typically reach the Earth a few days, after they have left the sun, and they play an important role to the prediction of space weather.

Geomagnetic indices

Geomagnetic indices are used to measure the variations of the geomagnetic field, and thus the intensity of geomagnetic disturbances. Kp and SYM-H indices are related to magnetic storm activity. AL and AU indices, describe magnetospheric substorm disturbances.

Geomagnetically Induced Currents (GICs)

During magnetospheric disturbances (such as magnetic storms) electric currents flowing in the magnetosphere and ionosphere experience large variations, which also affect the Earth's magnetic field. These variations induce currents on the ground (GICs) which can cause problems on human activity on the surface of the Earth, such as increased corrosion of pipelines and damages of high-voltage power transformers.

Heliosphere
The cavity inside which the solar wind is extended.

Heliopause
The boundary between the heliosphere and the interstellar medium. The boundary where the outgoing solar wind meets the incoming plasma of the local interstellar medium. It is located at least at 120 astronomical units away (i.e. One Astronomical unit (AU) is the mean distance between the Sun and the Earth. 1AU= 149.6×10^{6} km).

IMF (Interplanetary Magnetic Field)
The solar magnetic field carried by the solar wind among the Earth and the other planets of our solar system.

Ionosphere
Ionosphere is the uppermost layer of the Earth’s atmosphere, extending from about 80 km above the surface to about 600 km.. It includes part of the mesosphere, the thermosphere and part of the exosphere. It is characterized by low density and pressure and significant ionization of the atoms. The free electron density of the ionosphere is correlated to the solar activity and influences the propagation of radio waves on Earth.

Kelvin temperature scale
An absolute temperature scale, where no negative temperatures can exist. At 0 K all thermal motion of matter would be at a standstill. 0 K corresponds to -273.15°C.

Magnetosphere
The region around a planet, whose processes are dominated by the planet's magnetic field.
The Earth’s magnetic field would ideally had the shape of a dipole magnetic field, if it was not disturbed by the solar wind and the interplanetary magnetic field.

Magnetopause
The magnetopause is a boundary to the Earth’s magnetic field, that separates the plasma of primarily terrestrial origin, from the solar-wind plasma. Chapman and Ferraro (1931) were the first who proposed the existence of a boundary to the Earth's magnetic field. The first spacecraft that provided the first measurements across the magnetopause was Explorer 10 that was launched in 1961.

Magnetosheath
It is the region between the magnetopause and the bow shock of a planet's magnetosphere.
The Earth's magnetosheath typically occupies the region of space approximately 10 Earth radii on the sun-facing side of the planet, extending significantly farther out on the downwind side due to the pressure of the solar wind. The exact location and width of the magnetosheath does depend on

variables such as solar activity. Within the magnetosheath, the magnetic field is turbulent, distorted and weaker than the magnetospheric field.

Magnetotail

The region of the magnetosphere extending at the nightside (the anti-sunward direction). It appears long and stretched, created by the interaction of the solar wind with the Earth's magnetosphere. It ranges from about 8 Earth radii nightwards, extending far beyond our planet. It has been observed out to 220 Earth radii. The magnetotail is a region of great importance, because it acts as a reservoir of plasma and energy. Energy and plasma are released from the magnetotail to the inner magnetosphere, during magnetically disturbed periods (magnetospheric substorms). The existence of the geomagnetic tail was first established in the early 1960s by spacecraft observations

Magnetospheric activity

The variations in the Earth's magnetic field, due to interactions of the magnetosphere with the solar wind, are characterized as magnetospheric activity. The major types of magnetospheric activity are magnetic storm and magnetospheric substorms.

Magnetic storm

Magnetic storms have been characterised as episodes of extraordinary fluctuations in the Earth's magnetic field. They last for a few days and they cause a global reduction of the magnitude of the horizontal component of the geomagnetic field. This reduction is caused by the enhancement of the trapped magnetospheric particle population. Alexander von Humboldt was the first to adopt the name magnetic storm for this phenomenon in the early 19^{th} century.

Magnetospheric substorm

Magnetospheric substorms represent the most frequent type of magnetospheric activity, during which energy is transported from the solar wind to the Earth's magnetosphere and ionosphere. Magnetospheric substorms typically last for a few hours. During a substorm quiet auroral arcs suddenly explode into brilliance at the polar regions.

Magnetometer

Magnetometers are instruments measuring magnetic fields. They are widely used for measuring the Earth's magnetic field and detect its variations. There are ground-based magnetometers, measuring the variations of the geomagnetic field on the Earth's surface, and spacecraft magnetometers set on spacecraft and satellites, measuring the magnetic fields in the Earth's magnetosphere and in solar wind. The first spacecraft magnetometer was placed on the Sputnik 3 spacecraft in 1958.

Magnetotail

The region of the magnetosphere containing field lines stretched away from the Sun. It starts about 8 Earth radii (R_E) nightward of the Earth and has been observed to distances of at least 22 R_E. The magnetotail region varies depending on magnetospheric disturbances.

Photosphere

The photosphere is the visible surface of the Sun**.** Dynamic phenomena of the sun's photosphere are the sunspots and solar flares.

Plasma

Plasma is often called the "Fourth State of Matter," the other three being solid, liquid and gas. A plasma is a distinct state of matter containing a significant number of electrically charged particles, a number sufficient to affect its electrical properties and behavior. In addition to being important in many aspects of our daily lives, plasmas are estimated to constitute more than 99 % of the visible universe.

Plasmasphere

Consists of cold and dense plasma population that originate in the topside ionosphere (H^+, He^+, O^+, O^{++}, D^-, N^+, N^{++} and other minor ion species). It builds up in the equatorial region of the magnetosphere.

Plasmaspheric wind

Cold plasma population that originates in the plasmasphere.

Ring current

Electrons and positive ions drift around the Earth's equatorial plane in opposite directions, creating an electric current, called ring current. The ring current flows perpendicular to the geomagnetic field at altitudes between 10,000 and 60,000 km. It's field weakens the Earth's geomagnetic field as observed. Changes in this current are responsible for global decreases in the Earth's surface magnetic field, known as geomagnetic storms**.**

Sun

The closest star to our planet and the center of our solar system. Its age is about 4.6 billion years. It generates its energy by nuclear fusion of hydrogen nuclei into helium.

Sunspots

Sunspots are features on the Sun's surface (photosphere), caused by intense magnetic activity. They appear as dark spots because of their reduced temperature compared to surrounding regions on the sun's surface. Most of the times they appear as pairs with each sunspot having the opposite magnetic pole than the other.

Solar flares

Solar flares are phenomena of the Sun's photosphere that occur when magnetic energy that has built up in the solar atmosphere is suddenly released. Radiation is emitted across virtually the entire electromagnetic spectrum, from radio waves at the long wavelength end, through optical emission to x-rays and gamma rays at the short wavelength end**.** Solar flares are usually followed by coronal mass ejections (CMEs) which propagate in the interplanetary medium

Solar wind

The solar wind is the expanding solar corona. It is magnetized plasma of charged particles of solar origin (i.e. H^+, $4He^{++}$, e^-), streaming continuously from the solar corona into the volume of space which includes the planets of the solar system, known as the Heliosphere. The solar wind parameters such as velocity, density, temperature etc. are highly variable. Typical values of the above parameters are: velocity: 400-800 km/sec, density: 5 particles/cm^3, temperature: 100.000 K.

Solar cycle

A periodicity of 11 years that characterizes the intensity of the solar phenomena, such as the sunspots, solar flares and coronal mass ejections (CMEs).

Space weather

The term space weather refers to conditions on the Sun and in the solar wind, Earth's magnetosphere, ionosphere, and thermosphere that can influence the performance, efficiency, and reliability of space- and ground-based infrastructure and can endanger unprotected humans in space conditions or above the Earth's poles. Magnetic storms and magnetospheric substorms are of the major magnetospheric disturbances related to space weather. The energization of the Van Allen radiation belts is also associated with space weather.

Van Allen Belts (or Radiation Belts)

Regions in the Earth's magnetic field of trapped energetic charged particles. They were discovered by James Van Allen. The mission Explorer 1, first detected them in 1958. Nowadays space scientists state that there are at least two toroidal layers of energetic particle populations around our planet, consisting the van Allen Belts. As the charged particles contained in the Van Allen belts remain trapped along field lines of the Earth, they drift and spiral around the Earth's magnetic field lines. When approaching the converging field lines near the poles, they are reflected back towards the opposite pole. The inner radiation belt is located between about 1.1 - 3.3 R_E near the equatorial plane, containing primarily protons with energies exceeding 10 MeV. Its flux maximum is at about 2 R_E. This population varies with 11-year solar cycle. The outer radiation belt is located between 3 - 9 R_E, with a maximum around 4 R_E. It contains mainly electrons with energies up to 10 MeV arising from solar wind electron injection and acceleration during geomagnetic storms.