



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 4, April 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

An Abridged Study on the Investigation and Application of Space Plasma

Pallavi Saikia

Former Assistant Professor, Department of Mathematics, Kokrajhar Government College &
Research Scholar, Bodoland University, India

ABSTRACT: The universe is completed of space plasma. Plasma is the word which is given to the fourth part or state of substance (solid, liquid, gas, plasma). Plasma is a gas, i.e., so hot that some or all its essential atoms are split up into electrons and ions, which can move independently to each other. Because they are made up of electrically charged particles, plasma may be intensely partial by electro-static and electro-magnetic fields and forces, which can be led to very difficult and fascinating performance. Plasmas are found through the Solar System and beyond in the solar corona and solar wind, in the magneto-spheres of the Earth and other planets, in extensions of comets, in the inter-stellar and space media and in the layer disks around black holes. There are similarly plasmas here on Earth, ranging from the inside of a nuclear fusion reactor to a candle glow. In the Space Plasma, we studied plasmas in the Earth's magnetosphere and the solar wind and plasma sphere, and what happens when they interact.

KEYWORDS: Space plasma; Charged particles; Nuclear fusion; Magnetosphere; Spacecraft mission

I. INTRODUCTION

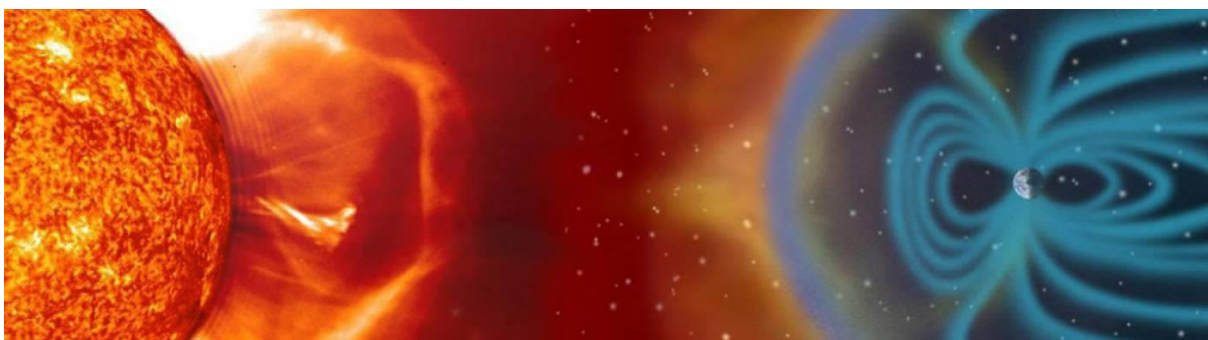
Phenomenon involved in the expansion of space plasma into a solar panel, wind, and planets. Availability of inexpensive or not expensive electrical power in quantity is the fundamental pre-requisite of technological advancement in every mainframe and payload system of space craft and nowadays, spacecraft manufactured world-wide are always for developing the technologies to maximize the efficiencies of power generators to meet the future power and necessity of energy [1,2]. In the space plasma analysis, the SPS is constructed in SPE which will be an interaction with its surrounding plasma analysis.

We will consider the many possible influences to the SPS on the SPE. And we will also consider the particularly focus on to the effect of low frequency electro-statics plasmas wave which is associated with the microwave emission.

In the analysis of application of space plasma is used in the solar wind, panel and planets or an array. One of the systems occupied by the power of the solar wind in the space that are called as solar space plasma power system (SSPS).

The universe is made of up of space plasma, the fourth state of matter.

The universe is made of up of space plasma. Plasma is the word given to the fourth state of matter (solid, liquid, gas, plasma). A plasma is a gas that is so hot that some or all its constituent atoms are split up into electrons and ions, which can move independently of each other. Because they are made up of electrically charged particles, plasmas can be strongly influenced by electrostatic and electromagnetic fields and forces, which can lead to very complex and interesting behaviour.

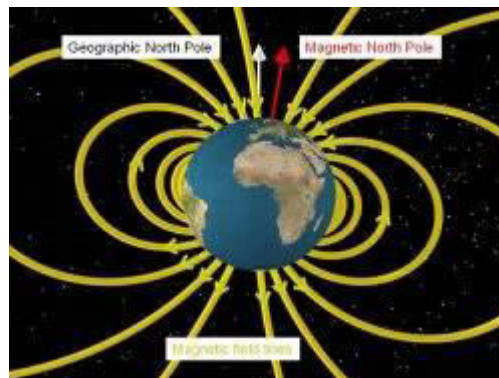




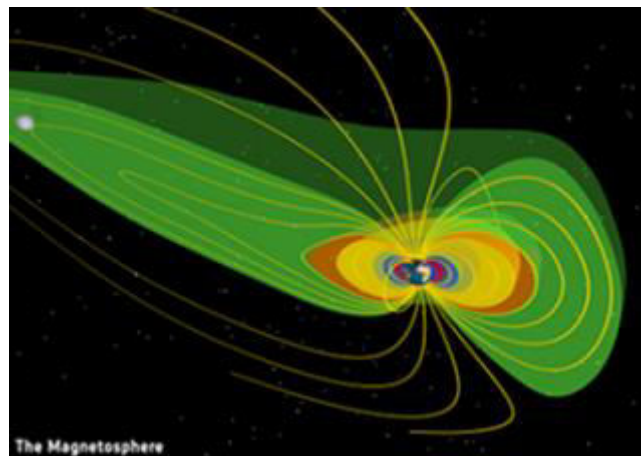
Plasmas are found throughout the Solar System and beyond: in the solar corona and solar wind, in the magnetospheres of the Earth and other planets, in tails of comets, in the inter-stellar and inter-galactic media and in the accretion disks around black holes. There are also plasmas here on Earth, ranging from the inside of a nuclear fusion reactor to a candle flame.

This paper studies on the Space Plasma Physics where plasmas in the Earth's magnetosphere and the solar wind, and what happens when they interact are done.

The Magnetosphere

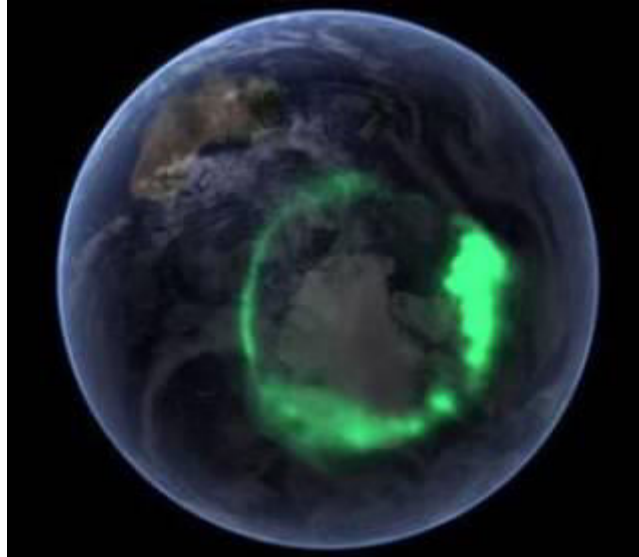


The Earth has a magnetic field that is generated by electric currents flowing in its liquid outer core. It can be detected using a simple magnetic compass - from the UK a compass points North if someone hold it horizontally and into the ground if you hold it vertically. If someone urges to do this experiment at lots of points on the Earth's surface, it is possible to find out that the Earth's magnetic field look like that of a bar magnet - a magnetic dipole.



The Earth's magnetic field extends far into space, where it meets the interplanetary magnetic field, which is carried throughout the solar system by the solar wind, a gusty stream of plasma that flows through the solar system at typical speeds of 450km/s. The solar wind is diverted around the Earth's magnetic field, which compresses the Earth's magnetic field on the side facing the sun and stretches into a long tail on the side pointing away from the Sun. The region of space containing the Earth's magnetic field is called the magnetosphere

II. THE EARTH'S MAGNETOSPHERE AND THE AURORA



It is because we have a magnetosphere that our planet has the spectacular aurora borealis and australis - the northern and southern lights that can often be seen at night near the arctic and antarctic circles. The aurora are caused by electrons from the magnetosphere being accelerated along the Earth's magnetic field into the upper atmosphere, where they collide with atmospheric particles at altitudes between 100 and 200km. The brightest colour of aurora, green is caused by electrons hitting oxygen atoms in the atmosphere.

Images from space have shown us that the aurora form ovals centred around Earth's magnetic poles. The radius of these ovals get larger and the aurora move to lower latitudes when the Earth's magnetosphere is strongly affected by the solar wind or engulfed by a coronal mass ejection, a massive explosion of solar plasma and magnetic field that travels through the solar system, often at speeds much faster than the normal solar wind.

Background

Solar wind or panels are the sole source for the power generation for the most of the spacecraft mission. It is not unexpected that the spacecraft manufacturing attempt to works the solar wind and panels for the generation of higher current for met the increasing the demand or at higher level of voltage to the cut-down on losses. In the presence of SPE in the most useful for an orbit, namely that is geostationary orbit and PSSO (polar sun synchronization orbit) and threat posed by this environment to space-craft solar wind, panels, planets, and an array were recognized [3].

After in 1990s an ISRO was contemplating its first 70V solar wind or solar array for space craft that is GSAT-4 which configure to the demand and that a part of the solar wind or panels which drives the power at 70 volts. And an ISRO was also contemplating its first high power ranging imaging spacecraft (RISAT) in the polar SSO operating on a 70Volt. But it was the period when a space of in an orbit failure of solar array or panel due to arcing reports was happening.

The solar panel space plasma project started in 2002. There are some kinds of goal of the SPIX which as follows: -

1. To developing the fundamental of basic understanding of a space plasma and an arcing in SPE.
2. An attempt to develop the models of charging and an arcing.
3. To build an experimental facility for an arcing simulation to validate the models.
4. Making a database for an arcing simulation for thresholds and its rates on the different-different variety of solar panel configuration.

There are two type of space plasma interaction example which are:

1. SPIXFP
2. SPIXARC

SPIXFP

The SPIXFP (Spacecraft Plasma Interaction Experiment Floating Potential finder) code was deliberate to estimation the floating potentials of the various material used in the solar array when located in a plasma environment [4]. Any material located in a charging environment becomes charged to a steady state voltage, characteristic of the material and the plasma environment, known as the floating potential. When the floating potential is reached, the net current flow into (and out of) the material is zero.

SPIXARC

The SPIXFP model takes into account the various elements of current during the plasma charging process, which includes the following:

- Flux due to ambient electrons and ion
- Plasma (electron and ion) impact induced secondary electrons

The SPIXARC (Spacecraft Plasma Interaction Experiment ARcing estimation) code was deliberate to independently solve the differential equations suggested through SCILAB procedures [5]. In this methodology, the electrical equivalent circuit in terms of L, C, R and current and voltage sources signifies the arcing simulation.

There are some reasons behind it which is as follows:

1. To develop and understand of underlying space plasma physics of charging and arcing phenomenon for both IPR & ISRO teams and
2. Non-availability of NASA's charging codes to an ISRO in 1990s.

Nowadays, the improvement of spacecraft and an increasing payload of launching have increased their costs. In the search for means of prolonging an effective lifetime of new spacecraft has been pursued [6,7].

For instance, launching the small space devices that is micro or Nano-sat to LEO are being preferred for reasons of costs and efficiency but in that region (200-800Km Altitude), ruin of assured space craft materials of ultra-violet radiation become relevant issues [8].

The Earth's Plasma Sphere

The Earth's plasma sphere is an inner part of the magnetosphere. It is located just outside the upper ionosphere located in Earth's atmosphere.

It is a region of dense, cold plasma that surrounds the Earth. Although plasma is found throughout the magnetosphere, the plasma sphere usually contains the coldest plasma [9] (Figure 1).

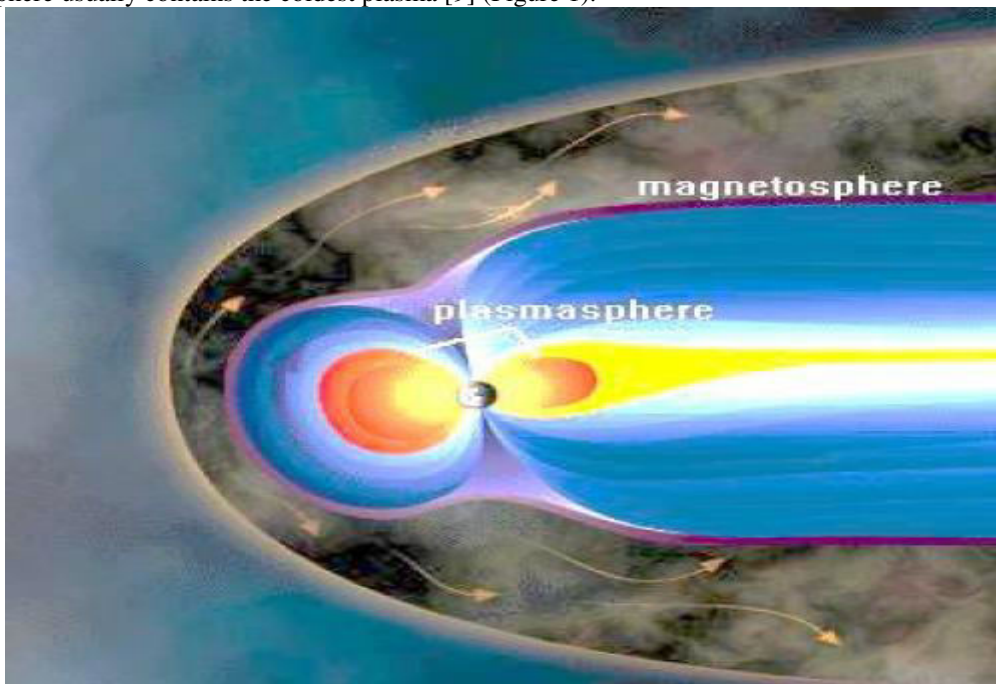


Figure 1. Earth's plasma sphere.

Figure 1: Earth's plasma sphere.



Space Plasma Effects in Different Plasma Environments

Plasma effect in environment is shown in Table 1.

| Different Environment | Surface density | Plasma density | Ion temp | ElectronTemp | Surface field |
|-----------------------|------------------------------------|----------------------------|----------------------------|-------------------------------|-----------------------------------|
| Solar wind | - | 2-20 | 0.001-0.3 | 0.01-0.2 | 2e-5 to 1e-6 |
| Earth | 1.3 | 3e+3 to 3e+6 in Ionosphere | - | - | 0.3 in Magnetosphere |
| Moon | Trace Na, K (sodium and potassium) | - | 0.02-0.3 in Ionosphere | Photo-electrons in Ionosphere | Less than 1e-4 in Magnetosphere |
| Mars | 1.8e-2 | 1e+3 to 1e+5 in Ionosphere | 2e-5 to 2e-4 in Ionosphere | 2e-4 to 8e-4 in Ionosphere | Less than 1.6e-2 in Magnetosphere |

Table 1: Plasma effect in environment.

III. CONCLUSION

This paper deals with the development of a new method of an analysis and application of space plasmas property of an electromagnetic radiation sources in the near earth and solar wind, planet, panel, and array plasma [10].

This method is based on the theory of resonant responses of receiving antennas in plasma. In recent years, many efforts to improve the integration of the front-end electronics of space plasmas instrument have emerged, and these instruments are designed to the study of ionized environment of earth and solar wind interactions with planets.

REFERENCES

1. Cole RK, et al. Operation of Solar Cell Arrays in Dilute Streaming Plasma. 1969.
2. www.spennis.oma.be
3. Mengu C. Arcing on High Voltage Solar Arrays in Low Earth Orbit: Theory and Computer Particle Simulation. 1992.
4. Bhoomi KM, et al. Development of Circuit Model for Arcing on Solar Panels, Journal of Physics: Conference Series. 2010;208.
5. Mengu C. ISO – 11221 Space systems - Space Solar Panels – Spacecraft charging induced electrostatic discharge test methods. 2010.
6. Gupta SB, et al. Development of an ESD detection and Characterization facility for space like LEO and GEO environment, ISDEIV. 2014;713-716.
7. Ferguson DC and Hillard GB. Low Earth Orbit Spacecraft Charging Design Guidelines. 2003.
8. NASA-STD-4005. Low Earth Orbit Spacecraft Charging Design Standard.
9. ECSS-E20-06, Space Engineering – Spacecraft Charging: 2008.
10. Purvis CK, et al. Design Guidelines for ‘Assessing and Controlling Spacecraft Charging effects. 1984.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 **6381 907 438** **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details