

## Fundamental Concepts and Discussion of Plasma Physics

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### Abstract

Plasma physics is the state of matter, which consists of charged particles. Plasma is usually produced by heating a gas so that the electrons are separated from the atom or molecule from which it is made. Upper ionization can be performed using high power laser or microwave lighting. Plasma occurs naturally in stars and space. In physics, a plasma is an electrical conductor that has the same number of positively and negatively charged particles. What happens when atoms of a gas are ionized. It is sometimes called the fourth state of matter. Unlike rigid bodies, liquids and gases, negative ions are often carried by electrons. Every work has a reverse side. Positive charges are usually carried by atoms or molecules that do not have identical electrons. In some rare but curious cases, the missing electrons of one type of atom or molecule bond with another. As a result, positive and negative ions are present in the plasma. The most severe cases of this type occur when the dust is low. But as dust particles, they are added in a state known as plasma dust. The peculiarity of the state of the plasma is due to the value of the electrical and magnetic energy acting on the plasma. Affects all types of matter, except for gravitational attraction. Because the electromagnetic force can work over long distances. Therefore, the plasma acts as a fluid group. Although the particles rarely collide. Almost all visible objects in the Universe are in the plasma state. Most of them are found in sunlight and stars in this form. And the space between planets and stars, auroras, lightning and arcades are also plasma. Available with both plasma and fluorescent lamps. In addition to the rigid crystalline structure of the metal, among many other phenomena and objects, the Earth itself is immersed in a thin plasma. Called the solar wind and surrounded by a dense plasma called the ionosphere.

**Keywords:** Plasma Physics, gravitational attraction, electromagnetic force.

### Introduction

Plasma can be made in a laboratory by heating the gas to very high temperatures. This causes violent collisions between atoms and their molecules. Free electrons create the electrons and ions needed to be free. Similar processes occur in stars. Illumination is the absorption of sunlight, or photons, from starlight by the gas contained in it. Electrons are emitted because the sun and stars are constantly shining, and in this case almost all matter is ionized. And plasma is considered completely ionized. However, this is not the case. This is because the plasma can only be partially ionized. A fully ionized hydrogen plasma contains only electrons and protons. Hydrogen nuclei are the most fundamental plasma. Irving's plasma is one of four fundamental conditions. Langmeier's first systematic study in 1920 focused on gases, atoms or molecules orbiting one or more electrons. (or can attach additional electrons) and free electrons with the exception of the elusive dark matter and dark energy. Plasma is the most common form of ordinary matter in the universe. Most plasmas are related to stars. Our sun spreads throughout the environment. And it's probably very rare,

### Article Publication

Published Online: 31-Mar-2022

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TECHNO REVIEW Journal of Technology  
and Management

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and it might pass a cluster in space. Plasma can be artificially generated by heating a neutral gas or converting it into a strong electromagnetic field. The presence of freely charged particles conducts an electric current to the plasma. Although the individual particle dynamics and the visual motion of the plasma are controlled by a collective electromagnetic field, But the interaction of electromagnetic fields with plasma, which is very sensitive to external fields. It is used in many modern technological devices, such as plasma TVs, depending on the temperature and the density of many neutral particles. In this case it is called partial plasma. Examples of fluorescent signals and partially ionized flame plasma. Phase transition between other states The other three states are not well defined and depend on interpretation and context: a certain degree of ionization is enough to call an element "plasma", in another. Plasma is a question that cannot be accurately explained. regardless of the presence of charged particles.

### History of Plasma Physics

In the mid-nineteenth century, the Czech physiologist John the Evangelist Purkinje used the Greek word (meaning "form or shape") to denote the balance of fluid left in the blood after removal of all hematopoietic material. Half a century later, the American scientist Irving Langmer in 1922 proposed that electrons, ions and neutrons of ionized gases can be considered as physically entangled elements in a liquid medium. and they are called powered plasma. There is no "liquid medium" that injects electrons, ions and neutrons into the ionized gas. Since then, plasma researchers have had to convince friends and acquaintances that they do not study blood. During the 1920s and 1930s, many isolated researchers were inspired by specific practical problems. began to study what is known as plasma physics. This article focuses on understanding (i) the effect of ionospheric plasma on the long-range propagation of shortwave radio waves used for correction, switching and prestressing in semiconductor electronic devices; and (ii) gas vacuum tubes. In the 1940s, Hans Alfvén developed the theory of electromagnetism. (now called the Alfvén wave), and it is assumed that this wave is important in astronomical plasma. Research on magnetic thermonuclear energy using large-scale plasma physics began simultaneously in the United States, Britain and the then Soviet Union in the early 1900s. 15050 Because this work is a section of thermonuclear weapons research. Therefore, they are classified initially. But thanks to the efforts of each country, progress has been marginal. And it is unlikely that the military value of the coalition-controlled research. Thus, the three countries announced their efforts and began their cooperation in 1958. Many other countries are now involved in fusion research. 1. Progress in thermonuclear fusion slowed down in the 1960s. But by the end of that decade, the carefully evolving configuration of the Russian tokamak began producing plasma that was better than the unexpected results of two decades. It gets better and better, and by the end of the 20th century, it was possible to smelt the remains - even tokamaks. In the early 21st century, an international agreement was signed to build the International Thermonuclear Experimental Reactor (ITER), an economical tokamak designed to generate 500 megawatts of fusion power output. The merger netokamak also has mixed success. This is due to the magnetic confinement scheme used in many tokamaks, as opposed to the magnetic confinement-based attachment scheme. Also, schemes of passive brackets were developed for the explosion of pore holes of millimeter diameter in high-power lasers or high-power sources of thermonuclear fuel using direct energy pulses. The forces of extreme events corrode the surface of the pallet and act like rocket exhaust directed outward from the pallet. Radial strength is created using adiabatic plates. making it thick and hot with sufficient adiabatic compression. A state of ignition of the melt is achieved. Apart from collaborative efforts, plasma space is also equally important and widely studied. Plasma measurements in space around the Earth, such as auroras and the ionosphere. Arising at the end of the 19th century with the help of ground-based instruments, space plasma research became widespread when it became possible to establish the use of spacecraft to measure plasma in place of the Earth's magnetic field, the solar wind. And the magnetic fields of other planets. Of interest are the complex and impressive topological structures that take measurements from the earth and spacecraft, which sometimes dynamically explode in the solar corona . Radio Telescope Optical Telescope has very long baseline interferometry and recently detected many astronomical jets produced by Hubble and Spitzer spacecraft magnetic objects such as stars, active galactic cores

and black holes. But they are bigger. Since the 1960s, there has been considerable effort to use plasma for actuators in space. Plasma thrusters range from tiny ions to powerful dynamic magnetic thrusters to improve the orientation of spacecraft that can be used for interplanetary missions with the right energy source. Plasma machines are currently being used in many spacecraft and are being seriously considered for new and more ambitious spacecraft projects. In the late 1980s, a new form of plasma physics was applied - plasma processing - an important aspect of the creation of small integrated circuits used in modern electronic devices. This application is very important economically. In the 1990s, research on dust plasma began. Dust particles immersed in plasma can be electrically charged and act as extra charged particles. Because dust granules are larger than electrons or ions. And new physical behaviors are born that can be charged on many levels. Which is sometimes a continuation of what is happening in normal plasma. And sometimes all the new 1s and 1s were also studied with neutral plasma in the 1990s. They mimic the equations of incomplete fluid dynamics and create interesting analog computers to solve the problem of incomplete fluid dynamics. Both dust and neutral plasma can form bizarre and violent aggregates. Where plasma resembles a solid (such as forming a coa-crystal structure). In addition to the activities mentioned above, research on industrial plasma such as arc plasma torches continues. And laser plasma is typically about 40% US-made steel processed in large electric pressure furnaces. Which can melt more than 100 tons of scrap per minute. Plasma screens are used for flat screen TVs. And, of course, there are natural terrestrial plasmas, such as lightning.

### **The Melioration of Plasma Physics**

Modern ideas about plasma status have emerged recently. Beginning only in the early 1950s, history has spanned many areas. These three basic disciplines were integral in the early development of plasma physics, such as electrical conductivity and magnetohydrodynamics. (Which studies conductive fluids such as mercury) and kinetic theory. The interest in the phenomenon of electric discharge was demonstrated in the early 18th century, by three English physicists Michael Faraday in the 1830s and by Joseph John Thomson and John the Fool Edward Townsend in the late 19th century. In 1922 he and another American physicist, Louis Tonks, used the term to describe the area of discharge where a negatively charged electronic phase occurs. They call these plasma oscillations plasma oscillations. Their behavior refers to a jelly-like substance. However, it was not until 1955 that two other American physicists, David Bohm and David Pines, determined the mixed behavior of electrons in metals during the destruction. The general implementation of the plasma concept of the behavior of ionized gases is well appreciated. The mass behavior of charged particles in a magnetic field and the perception of conductive fluids are based on the study of magnetohydrodynamics. Founded in the early 1800s by Faraday and Andre Marie in Ampere, central France. New solar and geological phenomena were discovered until the 1930s. There are several fundamental problems with the interaction of ionized gases and magnetic fields. This contribution was shared with his subsequent studies on space plasma. Alfvén was awarded the Nobel Prize in Physics in 1970 for his introduction to the kinetic theory of plasma states. The theory states that plasma, as well as gas, consists of randomly moving particles. (Defined by the Austrian physicist Ludwig Edward Boltzmann) on the behavior of electrons in metals. During the 1930s and 1940s, many physicists and mathematicians took the theory of plasma kinetics to new heights. Since the early 1990s, plasma has attracted more and more attention. 15050 Space exploration development of electronic devices Growing understanding of the importance of magnetic fields in astronomical phenomena. and thermoregulation of nuclear reactors. (nuclear fusion) - all this is of such interest. due to the complexity of the phenomenon Many problems remain unresolved in studies of the physics of cosmic plasma. For example, a description of the solar wind should include Scottish physicist James Clark Maxwell's equations to describe the effects of gravity, temperature, and pressure. describe an electromagnetic field

### **Plasma Oscillations and Parameters**

Like a packet of light in the water that at rest goes up and down. The normal displacement of light electrons as a group of positive ions in the plasma causes electrical vibrations throughout the state. When the vehicle is stuck, energy is returned by gravity. In the plasma, the vibrations occur from electrical energy. These movements are plasma oscillations studied by Longmuir and Tonks because the floating effect refers to water waves. Plasma oscillations are related to the waveforms of electronic components in plasma longmers. Wavelength phenomena play an important role in plasma behavior.

The time required for oscillations is the most important transient parameter in the plasma. The main spatial parameter is the Debye length  $\lambda_D$ , which is the distance the average thermal electron travels in mean time  $\lambda_D/2\pi$ . A plasma can be determined as partially or fully ionized gas in terms of these parameters: cells of the same radius, and (3) the plasma is larger than the length of the Debye in each volume.

Another important transient parameter is the time between cell collisions. In any gas, the frequency of each collision is determined for all collisions of different types of particles, the total collision frequency for a given type. Weighted sum of each frequency There are two main types of collisions: flexible and resilient. in an elastic collision the total kinetic energy of all cells involved in the collision is equal before and after the event. in a static collision Part of the kinetic energy is transferred to the internal energy of the colliding particles. For example, an atom has the allowable (separate) energy of electrons and is considered a bond. during sarcasm the bound electron is excited, that is, the electron rises from a low state to a high energy state. However, this only happens when the kinetic energy is consumed and the kinetic energy exceeds the difference between the two energy states. if the power is enough the bound electrons are highly excited and become free electrons and the atoms become ionized. The minimum or limit value required for electron emission is called ionization energy. Passive collisions with cations can occur until all electrons are removed. Most electrons and photons collide with atoms and ions. electromagnetic radiation (The quantum of electromagnetic radiation) plays an important role in this constant friction. Ionization by photons is called photons.

Molecules have additional discrete energy states. Excited by the collision of particles or photons. The reaction takes place at sufficiently high energy. Atoms can be divided into atoms or atoms and ions. This includes the collision of electrons and photons with atoms, causing the atoms to ionize. ionized into atoms in general the speed of successive collisions is equal to the speed of chemical reactions. at high enough temperature Atoms are removed from all electrons and eventually become empty atomic nuclei. At temperatures of 1,000,000 K or higher, nuclear reactions can occur. This is another form of collision for a long time. When such reactions lead to the formation of large elements. This process is known as thermonuclear fusion mass transfer and gains momentum without loss.

All energy sources available on Earth today can be traced back to nuclear fusion in the Sun or from extinct stars in one way or another. in such energy sources Gravity controls and limits the stabilization process. The high temperatures required for fusion reactions occur in hydrogen or thermonuclear fusion. The bomb was successfully detonated by a nuclear bomb for the first time. Creating a Fractional Chain Reaction One of the greatest human challenges is building these high-temperature systems and exploiting the potential of nuclear fusion. This is the practical goal of plasma physics: to create nuclear fusion on Earth. The captive model invented by scientists. Detect and control hot plasma using magnetic inertia or explosions.

## **Basic of Plasma Physics**

### **Plasma formation**

In addition to solid state plasma, plasma plasma in such metal crystals does not normally occur normally on the Earth's surface. So, for laboratory testing and technical applications. Plasma must be created artificially. This is because the

ionization energy of alkaline atoms such as potassium, sodium and cesium are low. So, plasma can be made from them by heating directly at a temperature of about 3000 K. The degree of ionization is significant. Ionization is required when the temperature reaches about 10,000 K. Due to being accelerated by the electrical potential of the volts. Therefore, the temperature required for self-ionization ranges from 2.5 to 8 electron volts. This is because they are the normal amount of energy needed to remove electrons from an atom or molecule.

This is because all substances melt at temperatures below this level. Therefore, no endless vessel can withstand the external heat required to make plasma. So, one method that needs to be heated from the inside is to apply an electric field to the gas so that the free electrons are accelerated and scattered. This type of ohmic heating which will heat the plasma is like heating the free electrons coil of an electric furnace heating element. Due to small electrical losses from elastic collisions, electrons can be heated to much higher temperatures than other particles. Plasma formation requires a strong enough electric field, the exact value of which depends on the shape and pressure of the gas. The electric field can be set using an electrode or using a transformer where the electric field is induced by an AC electromagnetic field. Using a transformer method, a laboratory temperature of about 10,000,000 K, or 8 keV electron volts (keV), is achieved with an electron density of about  $10^{19}$  per cubic meter. Temperatures can be limited by the distribution of energy in the environment. Very high temperature but relatively low-density plasma is generated by individual ion and electron injection in the mirror system. (Plasma devices that use a fixed magnetic field system for capturing) Other methods have used higher back temperatures faster than sound waves to create so-called forward shocks; Lasers have also been used.

Natural plasma heating and ionization occur in the same way. The shock current in the plasma generated by lightning heats the atmosphere like the ohmic heating method described above. Solar plasma and star heat are generated internally and produced by the reaction of nuclear fusion. Solar corona is caused by the spread of waves from the earth's surface into the solar atmosphere. Plasma in the laboratory heats the plasma like shock wave heating. In the ionosphere, ionization does not occur as a result of heating the plasma. Rather, it is caused by the flow of energetic photons from the sun. The sun's ultraviolet and X-rays have enough energy to ionize atoms in the Earth's atmosphere. Some of that energy also heats the gas. This makes the upper atmosphere, known as the atmosphere, quite hot. These processes protect the Earth from energetic photons in the same way that the ozone layer protects life on Earth from low-energy ultraviolet rays. At a height of 300 km above the Earth's surface a typical temperature is 1200 K or about 0.1 eV, although the temperature is hotter than the Earth's surface. But this temperature is too low for self-ionization. The source of ionization ends when the sun sets with the ionosphere. And the lower part of the ionosphere returns to its extrinsic plasma state. In the case of auroras, plasma is generated in the atmosphere at night or during the day when the electron beam accelerates to hundreds or thousands of electron volts and hits the atmosphere.

### **Methods of describing plasma phenomena**

Plasma reactions can be explained at different levels. If the contract repeatedly falls, you should consider the movement of the particles. In the sweetest plasmas, magnetism only works on particles as they move. The force is to the right of both the field and the motion of the particle. In the magnetic field (B), the charge moves linearly. The center of the circle is called the midpoint. Parts can also have something that resembles a magnet quickly. Thus, it draws a circle in the yellow magnetic field. If an electric field (E) is applied based on a magnetic field, the directional velocity varies with velocity, the magnitude of which corresponds to the magnitude of the electric field in the magnetic field (E / B). On the right is the electric and magnetic field section. The body is located in such a field in the cycloidal direction. The point follows it behind the rim, although the circumference of the "wheel" and the effect of rotation for different objects are different. Instead, the navigator moves at the same E / B speed, regardless of charge and particle size. If the electricity changes over time, the problem becomes more complicated. However, if the AC zone

falls at the same time as the cyclotron (i.e. the reverse circuit), the driving distance is still absent. particles are also forced to move in increasing orbits. This phenomenon is known as cyclotron resonance and is based on cyclotron activation.

The movement of particles around the center of motion creates a circle that forms a magnetic field, unlike a magnetic field. Therefore, the charge occurs not only in magnetic fields. However, the magnetic field of a moving object depends on whether it is a positive or negative charge. and the direction of movement of this particle If the movement of the object is fast at random. the magnetic field exceeds each external area used. Therefore, the magnetic field between charges is more complex than physical.

At a higher level of detail than the Boltzmann-type Kinetic alphabet used, which describes the behavior of these particles in relation to low-frequency sound. in fact, the velocity of the particles is quite small. and the values used relate to the same velocity, volumetric and electric fields on each magnet. They show safety of measure, stamina and energy in one voice. and a set of measurements for each particle type.

### **Determination of plasma variables**

The major changes that occur in plasma studies are density, temperature, electricity, and magnetic fields. Stable calculations (charges) and magnetic sensors in laboratories and in space to help determine the magnitude of change, called analysis. The ion concentration and ion temperature of ions of different substances can be detected by electrostatic precipitation. Small search engines and other magnetic fields determine the value of the magnetic field. From Maxwell's electric meter you can find the current concentration in the charger as well as the application of the electricity generated. Aircraft have provided such tests for almost all space systems in the world. He showed scientists plasma objects like lightning in Jupiter. 1 In the early 1990's, the sound of Saturn and its orbits sent signals from a number of planes landing at the plasma terminal inside the solar system, Heliopos.

In the laboratory, the extraction, diffusion and excitation of neutral ion radiation at high energy helps to detect the temperature and concentration of electrons. In short, meditation, meditation, absorption, expansion, and electromagnetic interference are also pathways. Set a variable. This method can also be used to measure remote plasma instruments on Earth using incomparable radar transmission systems. This system is driven by waves and radio waves from the small waste and the electronic gas of the incoming air. Due to the Doppler effect - the return signal falls slightly from the transmission signal and the plasma speed can be determined in the same way as the police detect a speeding vehicle. The best radar times in the geospace range from 50 to 1000 MHz (MHz) depending on the temperature, density, electric field and ion type, but high plasma density and plasma frequency, microwave ovens and lasers are required.

In addition to the above methods, much can be learned from the plasma radiation produced and extracted. In fact, it is the only way to detect cosmic plasma outside the atmosphere. Different technologies cover all types of CW and detect non-thermal sources such as pulse-producing synchrotron radiation.

### **Waves in plasmas**

The most common waves are floating waves that cross the surface of lakes and oceans and off the coast of the earth. Some are common, though not necessarily considered a wave. But chaos in the atmosphere gives rise to so-called weather. Wave phenomena are very important for plasma behavior. Indeed, one of the three criteria for plasma existence is that the frequency of particle collisions is less than the frequency of plasma oscillations. This means that

the aggregate response of a gas plasma launcher is the same or more dependent on the effects of electric and magnetic fields than a normal collision. Because waves can propagate. Therefore, the ball field can work far away from its origin.

The medium supports the propagation of sound waves (sound) which are associated with changes in pressure, temperature and velocity. Electromagnetic waves can propagate even in vacuum. But it's basically slowed down by the interaction of electric fields in waves with charged particles that bind gas molecules or molecules. Although this is important for a complete description of electromagnetic waves, in plasma, however, cells interact with electromagnetic fields (eg electromagnetic waves) as well as pressure or velocity fields (eg sound waves), and electric fields are generated for electromagnetic interference. together The result is called ionic sound waves. It is one of several types of waves found in plasma. short conversation The following will focus on the default vibration mode as the frequency increases.

### **Low-frequency waves**

At low frequencies, alpha waves require a magnetic field. In fact, in addition to ionic sound waves, any wave requires a background magnetic field. Numerous low to low frequency plasma plasmas form a spiral through the natural magnetic fields of the plasma. and in plasma in the laboratory Magnetic fields are often used to limit magnetic fields. Therefore, this condition is often encountered and there can be all sorts of waves. Alfvén waves are similar to waves that appear on a stretched guitar string. In this case, the rope is the line of intensity of the magnetic field. When there is a slight magnetic field interference The field is slightly bent. and the interference propagates to the magnetic field. due to the changing magnetic field, an electric field is formed. Electromagnetic waves are slower and lower in frequency than all known electromagnetic waves. For example, the solar wind leaves the Sun faster than alfvén or sound waves. This means that when the solar wind strikes the lines of the magnetic field away from Earth, the shock wave "says" that there is a barrier to the incoming plasma. This is similar to shock waves involving supersonic planes. The shockwave moves toward the Sun at the same speed. but in the opposite direction to the solar wind It seems to stand out all over the world. because the cells have almost no friction. Such collision-free shock waves are of interest to cosmic plasma physicists. This showed that similar shock waves appear in supernovae and other celestial plasmas. The hot solar wind is approaching the Earth, and the slow shock waves communicate with the Earth's atmosphere through nuclear waves that propagate along the energy lines of the magnetic field. The turbulent surface of the Sun emits large waves of alpha amplitude. It is believed that it contributed to the heating of the crown by 1,000,000,000. Such waves can also cause fluctuations in the solar wind. and when they were scattered all over the world, they imagined magnetic storms and auroras that disrupted communications and electrical networks on Earth. Two main types of wave motion can occur: longitudinal, sound waves, or sound ions. The particles vibrate parallel to the direction of propagation and are similar to surface water waves. where the vibrational wave of the particle is perpendicular to the direction of propagation. The speed corresponding to this expression is equal to the wavelength ( $\lambda$ ) and the frequency ( $\omega$ ) at the output, ie  $u = \frac{\lambda \omega}{2\pi}$  the alpha wave moves with the shear wave, and the speed depends on the density of the particles and the strength of the magnetic field. Velocity is the density of the magnetic flux divided by the square root of the mass density ( $\rho$ ) equal to ( $\mu_0$ ) the permeability of space ( $\mu_0$ ), ie  $B / \sqrt{\rho \mu_0}$  Ionic sound waves propagate parallel to the magnetic field at a speed equal to the average thermal velocity of the longitudinal wave and ions Different types of longitudinal magnetic waves The so-called magnetic waves can occur.

### **Higher frequency waves**

In these waves, the plasma is active as a whole. And the speed does not depend on the frequency of the waves. The individual behavior of ions and electrons leads to changes in the speed of the wave depending on the direction and frequency. These are called fast and slow alfvén waves. Which travels at a frequency-dependent speed where the frequency is still high. These two waves electron waves (called electron cyclone waves and cyclotron waves,

respectively) resonate (create synchronization) of electrons and cyclotrons at the respective resonance frequencies. In addition to this resonance, transverse reproduction does not occur at all until a higher frequency is reached, which is comparable to the plasma frequency.

At the frequencies between ions and electrons, there is a wave mode known as whistling. The name comes from the study of plasma waves produced by lightning. When early researchers connected an antenna to an audio amplifier to listen to natural radio waves, they heard a strange whistle as electrical signals from lightning in one hemisphere moved along the Earth's magnetic field. The journey has been so long that many waves (which have a higher frequency) come first, resulting in a hissing sound. These natural waves are used to observe space around the earth before the spacecraft is ready for use. Frequency-dependent motion of a wave is called wave propagation due to different frequencies spread over a distance.

Ionic sound waves also propagate at high frequencies. And similar resonance of electronic oscillations in plasma, arising at frequencies determined by electrostatic oscillations of ions. Outside of this frequency, sound waves do not propagate parallel to the magnetic field, so the frequency reaches a plasma frequency, which is higher than that of electro-acoustic waves. The wavelength of this wave is critical at critical frequencies ( $\omega_p$ ), the behavior of electrons at this frequency is Langmuir and the plasma oscillation of tonks, even without particle collisions. Waves shorter than the goddness length are also very wet, i.e., their amplitude decreases rapidly over time. This phenomenon, known as landau dampness, occurs because the waves of some electrons have the same speed. As they move on the waves they will accelerate like surfers on the waves. And does not transfer energy from the waves and interrupts the waves in the process.

### **Regulation of Magnetic fields**

Magnetic fields are used to hold high-density and high-temperature plasma. This is because the farm puts pressure and strain on the plasma. Equilibrium is created when the plasma maintains the pressure at all points and the pressure of the pressure particle motion. A well-known example is the pinch effect seen on specially designed devices. If an external current is conducted in a cylindrical plasma and flows parallel to the plasma core. Magnetic energy acts internally and compresses or compresses the plasma. Achieve equilibrium at a temperature proportional to the square of the electric current. These results show that any temperature current can be created high enough. Heat is generated by the flow and contraction of water. However, in practice, because the plasma does not have an infinite length, a severe loss of energy occurs at the end of the cylinder and develops significant instability in its simplified form. Preventing such instability is one of the main tasks of the Plasma Physics Laboratory and the mission of controlling the nuclear fusion reaction.

A useful method of describing the magnetic binding of plasma is the captive time ( $\tau_c$ ), or the average time at which charged particles disperse from the plasma. This time will depend on each type of configuration. Different types of instability can occur in plasma. This results in severe plasma erosion and reduced incarceration time. The most important thing is magnetohydrodynamic instability. Although equilibrium may exist, however, it may not be consistent with the minimum potential energy, so plasma requires a state with a low energy potential. Just like a ball stops in the mountains. (Represents equilibrium) Rolls down during violation. The state of low plasma energy resembles a ball at the bottom of a valley. In the search for low-energy conditions, turbulence will occur, resulting in proliferation, increased electrical resistance, and large heat loss. However, a completely stable system is almost impossible. But extensive progress has been made in creating measures that address critical instability. Temperatures around 10,000,000 K with a density of 10<sup>19</sup> particles per cubic meter and retention time up to 1/50 second.

## Application and Analysis

The most important practical applications of future plasma are the use of a heat source to convert water into vapor, the main way to generate energy, especially in the power generation sector. It is powered by a turbine generator. This heat source is based on the combustion of fossil fuels such as coal, oil and natural gas. And decomposition in nuclear reactors. A possible heat source could be a deuterium-tritium-soluble plasma reactor. The fusion of atoms between these hydrogen isotopes releases large amounts of energy into the kinetic energy of the products of the collision reaction. (Nuclei of neutrons and hydrogen and helium atoms) by absorbing these products through the environment. It can be a powerful source of heat. Obtaining useful energy from power plants used for plasma radiation and cell damage. As well as converting heat into electricity relatively inefficiently. MA Plasma temperature is approximately 100,000,000 K and requires production with a particle density of approximately 10<sup>20</sup> particles per cubic meter, e.g. For a density of 10<sup>20</sup> particles per cubic meter. Check-out time is one minute. However, this number has not made much progress.

In general, there are two main methods to eliminate or minimize final damage from synthetic plasma: toroidal plasma production and magnetic glass consumption (see nuclear fusion) by bending the cylinder in a circular motion until it closes on its own. And requires a constant special magnetic field. The largest element is the circular field parallel to the plasma nucleus. It is necessary to control some turbulent plasma processes with 1.7 million watts approximately 2 seconds after the magnetic field is injected into the titanium plasma to keep the system stable. This is the first time that it has succeeded in producing controlled molten energy in such a limited environment.

In addition to generating electricity, the fusion reactor also disinfects seawater. Two-thirds of the earth's surface is uninhabited. The surface is half dry. Irrigation of the area is economically viable as both furnaces and giant smelters are used to evaporate large volumes of seawater. Another possibility of generating electricity is the removal of the thermal vapor mechanical energy chain. Recommendations based on dynamics According to Faraday's law if a plasma extends in a magnetic field an electromotive force is generated perpendicular to both the direction of the plasma flow and the magnetic field. This dynamo effect is to control the current in the external circuit connected to the plasma electrode. Therefore, electricity is generated without the need for rotary steam-powered devices. This process is called magnetohydrodynamic power generation (MHD) and has been proposed as a method of extracting electricity from multiple fission reactors. This type of generator drives the aurora because the Earth's magnetic field lines convert electricity from the MHD generator to solar wind.

This is in stark contrast to the dynamo effect known as the motor effect. It can be used to accelerate plasma, for example, when exposed to a magnetic field in the form of a plasma cascade. You get the voltage proportional to the square of the magnetic field. Cars using this technology are proposed to launch the spacecraft. Their advantage is that they can reach high exhaust speeds. This reduces the amount of fuel transport.

Practical applications of plasma are light radiation that occurs between two electrodes at a pressure of one thousandth of the atmosphere. This type of illumination is responsible for light coming from other light sources, for example fluorescent lamps and fluorescent lamps, which are supplied by the emitted plasma. Plasma ionization levels are generally low. But the density of 10<sup>16</sup> to 10<sup>18</sup> electrons per cubic meter can reach 100,000 K electrons. There is a potential difference between the two electrodes. There is no plasma in this region. But this is the area between it and the anode (i.e. the positive electrode). Other applications for light radiation include electronic switching devices. This and similar plasmas produced by radio frequency methods can be used to supply ions to particle accelerators and as generators of laser beams. As the current from the transmitted light increases, it reaches a level where the energy produced at the cathode allows all conducting electrons directly from the cathode surface. In this case, a large cathode

potential difference is not lost due to the gas between the electrodes. And the plasma column will shrink. This new state of electrical discharge is known as arc. Will operate at a higher plasma density and wider pressure than light output. This pressure is used as a light source for ringing. To change the alternating current in the electronic exchanger and the pressure between the electrode and the gas injection concentrated in high temperature chemistry, a high-density plasma mixture known as a plasma jet is created. There are many uses in the chemical and metal industries.

## Natural plasmas

### Extraterrestrial forms

It is estimated that the universe evolved from a violent explosion about 13.8 billion years ago. And is composed entirely of fully ionized hydrogen plasma fireballs. Regardless of the truth, there are some things in the universe today that are not in the plasma state. Observable stars consist of plasma. As well as interstellar and interplanetary media. As well as the outer atmosphere most of the scientific knowledge of the universe comes from the study of electromagnetic radiation emitted and propagated by plasma. And from space exploration in the solar system since the 1960s.

In stars, plasma is gravitationally bound. And much of the energy released is expressed in the fusion reaction of stars. Heat is transferred from the inside to the outside by radiation to the outer layer. Where transport near hot stars is more important, hydrogen is almost completely ionized by the stars' ultraviolet radiation. The region is known as the H II region. However, most of the interstellar medium exists in the form of a neutral hydrogen cloud. This is called the HI region because the heavy atoms in the clouds are ionized by ultraviolet radiation. Thus, they are considered plasma. Although their ionization level can be a fraction of 10,000, dust and other cosmic rays form stellar matter. The latter consists of a completely high-energy atomic nucleus without electrons. Interaction with background plasma waves can result in the expansion of nearby isotropic cosmic velocities.

This plasma has a magnetic field across the universe. The magnetic field in the interstellar space is approximately  $5 \times 10^{-6}$  Gauss (magnetic field strength unit), and in the interplanetary space  $5 \times 10^{-5}$  Gauss, while in interplanetary space it can be only  $10^{-9}$  Gauss. These values suggest that the surface area of the Earth is about  $5 \times 10^{-1}$ , much smaller than Gauss, although these fields are smaller. But these fields are huge considering their size, for example, in interstellar phenomena laboratory simulations.  $10^{15}$  Gauss needs a field, so this field plays an important role in almost all astronomical phenomena. In the sun, the average surface area is 1 to 2 G, but there are magnetic disturbances like sunspots. It produces fields ranging from 10 to 1000 G. Many of them have magnetic fields.  $10^{-3}$  Gauss's field strength is related to a variety of extragalactic nebulae. Including synchrotron radiation measurements.

### Solar-terrestrial forms

#### Regions of the Sun

The visible region of the sun is the region of the luminosity. The radiation is similar to the continuous blackbody radiation from the chromosphere which is observed by emitting linear radiation from atoms and ions, above 5800 K in the photosphere. Outside the corona chromosome, it expands into the perpetual solar wind, which passes through the planetary system, filling the stellar medium. The crown is clearly visible as the moon obscures its bright light. During periods of maximum abundance of sunspots, sunspot activity decreases and decreases over about 11 years of the cycle. In the mid-1600s and early 1700s, sunspots but disappeared in the mid-1600s and early 1700s. At least the time known by Monder, this time coincided with the small ice age of Europe. There is a lot of speculation about the potential impact of sunspots on the climate. Periodic changes such as sunspots have been observed in the tree rings and sediments of the lake. If this is true, then these effects are significant because they indicate the fragility of the Earth's climate.

In 1958, the American astronomer Eugene Parker showed that there is a solution to the equation describing the plasma flow in the Sun's gravitational field: the gas becomes supersonic and separates from the Sun's gravity. The solution is similar to the description of the nozzle of a rocket in that the compression of its flow is similar to the effect of gravity. Parker predicts that the solar atmosphere will behave as predicted by the solar wind. Instead of following another solar wind solution. Studies of interplanetary satellites in the 1960s confirmed the accuracy of the solution.

### **Interaction of the solar wind and the magnetosphere**

Collisionless plasma of the solar wind it consists mainly of electrons and protons, and there is a direct flow of matter during supersonic and supersonic motion. Wind is an extension of the Sun's magnetic field. It freezes in highly conductive liquids. The average wind speed on the Earth's surface is 400 kilometers per second, and when it hits the planet's magnetic field, it will touch the front. The applied pressure compresses the field towards the sun and extends into the night. Therefore, the Earth's magnetic field is surrounded by cavities known as magnetic fields. This channel extends 10 Earth radii near the Sun and 1000 Earth radii at night.

The plasma region moves by teleportation from the solar air within this very large magnetic field. The plasma flows parallel to the solar air at the edge of this space and back into the inner world. As a result, the system acts as a backup magnetohydrodynamic generator. Both generators generate about 10,000 volts of electrical power and magnetic field potential through the aurora ellipsoids. The second is the region of the Earth where concentrated electrons and ions accumulate in the planet's atmosphere. This creates an amazing light show. Even if the sun doesn't shine, these cell currents are strong enough to act as a new source of plasma. Aurora Oval is a good conductor. A large stream flowed through it. These currents are typically in the 1,000,000 amp range due to differences that can occur in the system.

Plasma is very hot (1-10 million Kelvin) and very small (1-10 particles per cubic centimeter) in a magnetic field. Cells are heated by many interesting plasma effects. The most doubtful was the process of dispersal of the aurora. Particle accelerator, possibly a model of a space accelerator. It is located on the earth's radius above the Aurora ellipse and is associated with the most important magnetic field lines. Strong with a possible difference of orders of three to six kilovolts. This may be due to the fact that the electric field is parallel to the magnetic field lines and offset from the ground. Ball filaments of magnetic fields often act as precise conductors. Therefore, such fields are difficult to describe. Awa refers to spherical magnetic field lines. If the Earth's dipole field is not deflected It will cross the equator within a radius of 6-10 Earth's.

Close to Earth Within a radius of 4 Earth, the planet controls the system from the solar wind. Plasma revolves around the Earth in this region. In addition to the atmosphere, the System also acts as a magnetohydrodynamic generator. The plasma atmosphere and the rotation of the ionosphere create an electric field that rotates the internal magnetic field around the Earth's axis. because this area is in contact with the world In the ionosphere, the Sun produces a large amount of plasma. Therefore, the inner region is filled with dense cold plasma, forming plasma spheres. On planets like Jupiter, which have a stronger magnetic field than Earth and a higher rotational speed, control of the planet goes beyond the surface.

### **The ionosphere and upper atmosphere**

The plasma at an altitude of less than 2000 km is called the ionosphere. Thousands of rocket probes have helped to create maps of this atmospheric vertical structure. And multiple satellites provide latitude and longitude information. The ionosphere was discovered during radio travel "on the horizon" in the early 1900s if radio waves were near or below the plasma frequency. Radio waves cannot propagate in the plasma of the ionosphere. So there is no jumping in space but instead of reflecting or perceiving at night, the absorption is low. This is because the minimal plasma at

an altitude of 100 km has the highest absorption. The ionosphere acts as a powerful reflector. This involves reflecting waves through planets such as the Earth's surface and waveguide. The great communication revolution began with wireless communication. The development of a satellite system that uses radio waves to transmit sound continues to this day. In this case, the wave frequency must be greater than the peak plasma frequency of the ionosphere so that the waves do not reflect from the ground.

The main ion in the upper atmosphere is nuclear oxygen. Although atomic oxygen and nitric oxide are abundant at depths less than 200 km, the meteorite contains large amounts of metal atoms such as iron, silicon and magnesium. It is ionized by sunlight and lasts for a long time, creating enormous ion clouds that cause radio stations to disappear and disappear overnight.

### **The lower atmosphere and surface of the Earth**

summer Ordinary clouds are formed on the basis of terrestrial plasma in the polar mesosphere. These clouds have a height of 85 kilometers and are the highest in the world. and appear only when darkness enters the world. Therefore, such clouds are called lightless clouds. It is thought to be composed of charged ice and dust crystals formed at 120 K in the coldest part of the atmosphere. and other space systems Night clouds gradually grew in the 20th century and may become a pioneer of global change.

The magnetic field also contains high energy particles. with a radius of about 1.5 and 3.5 from the center of the Earth. Both regions have high energy cells. These regions are named after the Van Allen radiation bands discovered by the American scientist James van Allen using radiation detectors on early spacecraft. Charged particles in the belt are captured by a system of mirrors under the action of the Earth's bipolar magnetic field.

Plasma remains in the earth's atmosphere for a very short time. In a flash state, oxygen-nitrogen plasma heats up to about 20,000 K, ionizing 20 percent at laboratory pressure. Although the course is a few centimeters and takes less time. But that special power is gone. Lightning in the middle, on the ground and in the clouds sounded four songs in a row. Somewhere in the world lightning strikes. This is about 200,000 volts from lightning on the negative surface of the ionosphere. If lightning stops somewhere, the world will flow for at least an hour. The ball lightning incident confirmed the existence of a bright, floating and stable ball several centimeters in diameter. What happens when there is strong electrical activity in the atmosphere? These balls emit a lot of energy when they touch an object. The ball could be plasma lightning. But so far, explanations are not enough for them.

Plasma physics and the birth of the Universe is much more than a vast ocean of plasma. This is in stark contrast to the fact that the only plasma on the Earth's surface exists naturally. In addition to lightning in ordinary matter, Plasma is free electrons responsible for the electrical conductivity of metals. The ion is added to the mesh node. Therefore, the behavior of plasma in a metal is limited by plasma oscillations and electron cyclotron waves. (called helicon waves), in which the electronic components act separately from the ions. Carrier electrons and positive holes The latter acts on the element as a positive charge limited by free mass. with proper preparation, the number of electrons and holes is almost the same. General observation of plasma behaviour.

### **Magnetic fields**

The importance of magnetic fields has been confirmed by astronomical events. These fields are believed to have been created by homemade dynamos. Although the exact details are not fully understood. But in the case of the world, the rotation of the liquid core differentially leads to an external dipole magnetic field. (Shown as the North and South Poles) Fluid is produced by the storm's turbulence. Thermal conduction and Coriolis energy (an external force along

the entire rotation system, including celestial objects) generate a dipole field from these loops. Over time, geologists sometimes reduce the Earth's field. Then change direction, the north pole becomes the south pole, and the cosmic rays, on the contrary, easily reach the surface of the earth. And increased levels of genetic mutations affect lifestyle.

It is believed that similar processes of magnetic field formation occur both on the Sun and in the Milky Way galaxy. The magnetic field in the sphere of the Sun can be seen along the line of the ball. It seems to destroy the surface of the sun. The loop is open because sunspots are prominent entry and exit points. Although the Earth's external magnetic field is similar to a dipole, it is further modified by currents in the ionosphere and by magnetic fields. In the outer atmosphere, lunar and solar waves pass through the terrestrial fields. This creates a dynamo-like current that changes the default field. The current system in these oval ears causes significant fluctuations in the magnetic field. The intensity of these currents is measured by the intensity of the solar wind. It induces or creates a magnetic field along with other currents. These currents create the essence of magnetic storms.

## Conclusions

Most of the materials around us are solid, liquid and gas. The nature of alcohol is the same in most parts of the world. It is to the Sun and to our other stars, with the middle earth. Plasma is used in the lightning stage. computer chip manufacturing Electricity generated by the thermal atomic connection of planes and other potential futures. Nuclear fusion is one of the best ways to have a stable life or a long-term source. Thermal fuel is very weak and light all over the world. The operation of the synthetic plant is safe and there is no risk of radioactive waste for a long time. Understanding this reaction to electrical activity in Scientists is a big challenge for scientists and trainers. The contribution of magnetic compound research to plasma science is significant. In addition, it is a machine for the development of modern physics. Fusion benefits from the advancement of ethical science. Perhaps the most important area for future research will be to learn how to “manipulate” high-air acids in a new environment. They need to know more about transport and plan effective management practices. This also means that the search for a stable balance in the upper region of the upper beta has been achieved beyond the current beta region. In particular, with high  $\beta_p$  values (depletion of pits in the chamber), it is necessary to learn how to control the electrical signal of the plasma. including temperature, density and current density. at high tide we have to learn to control the tension. the key in the current state of the signal. The Tokamak project needs management to improve the melting point of the ivory. it matters. This is especially true if you do not control the plasma, or it may become more complicated and very expensive. Maybe the notion of a prison is better than a rock invention. This is especially true if local reactors are needed for technical reasons. However, in recent years, funding constraints have failed to create a detailed draft of the coastal project. However, in the case of Stellar, the problem of electricity and radiation (helium emission) in all detectors must be solved in the scientific field. This is once again being questioned by the scientific community. The solution is to analyze the concept in detail. this has been combined with successful research in large-scale code and plasma point physics. This study should combine plasma science, atomic physics, and atomic science. Finally, the next tokamak comes in a thermometric type, burns D-T fuel and emits multi-generation carbon particles with a capacity of 3.5 MeV. A gateway to the study of plasma signals associated with alpha particles. including stability and mobility. Development of new diagnostic equipment may be required to test the flame plasma field. However, many opportunities for research have disappeared in the past. In some cases, due to financial constraints, and in some cases due to differences in key themes of partnership initiatives. Perhaps the biggest problem for the associated magnet research fund is the level of funding for these weak projects over the past decade. This is a very difficult choice between large firms to manage better. and increasing research on remote devices. Research and development with the help of the U.S. Department of Health and Human Services Office of Fusion Energy (OFE) mission will continue to focus on these topics.

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