

Clive Tickner B.A. BSC;
Diploma; theoretical physics; Stanford University
clivetickner@aol.com

Plasma Cosmology and the Structure in the Universe

Abstract

The Plasma Universe and Electric Universe models offer a revolutionary view of the cosmos, one where plasma and electromagnetism dominate cosmic processes rather than gravity alone. The work of the scientists catalogued below has opened up new avenues of exploration in astrophysics, challenging the dominant, but imperfect, Big Bang theory. These alternative models present a universe that is not only more dynamic and complex but also potentially older and infinite, governed by the known principles of plasma physics rather than speculative constructs. The experiences of these scientists, much like those of Galileo and Copernicus, reflect the difficulties faced by individuals who challenge dominant scientific paradigms.

Keywords

Kristian Birkeland (1867–1917), Hannes Alfvén (1908–1995), Halton Arp (1927–2013), Anthony L. Peratt (1940–), Eric J. Lerner (1947–), Donald E. Scott (1935– 2021) Guglielmo Marconi, Irving Langmuir (1881–1957) Bohdan Paczynski (1940 – 2007). Plasma, Standard cosmology, Ionisation, Background Interstellar and intergalactic space, Gravitational-only models, Magnetic fields, Stellar environments, Electric currents, the Big Bang, Earth's geomagnetic history, the Z-pinch, Galactic filaments, Interstellar molecular clouds, Synchrotron radiation, Recombination, Accretion disks, Nuclear fusion, Galactic rotation, Birkeland current, the Observable universe, Low-redshift galaxies, Doppler effect, Cosmic web, Laboratory plasma physics, Solar wind, Electric Sun, The Hertzsprung diagram, Star Formation, Aurora Borealis, Crookes tube, Tokamaks, Dark Matter and Dark Energy.

The Electric Universe

“The generation and persistence of cosmic magnetic fields necessarily imply sustained electrical currents, a requirement long established in plasma physics (Alfvén 1963; Parker 1979).”

Plasma does not prevent the formation of stars, suns, or galaxies. It explains how matter is organised, cooled, and concentrated enough for gravity to work at all.

In standard cosmology, gravity is asked to do everything from nothing. In plasma cosmology, gravity *finishes* the job of plasma physics.

Plasma cosmology asserts that electromagnetic forces are fundamental to the large-scale structure and dynamics of the universe and that their systematic exclusion from cosmological models represents a critical theoretical failure.

Observationally, the universe is overwhelmingly plasma. Ionisation of matter through stellar radiation, cosmic rays, and energetic particle interactions produces free electrons and ions, forming plasma—the dominant state of baryonic matter in cosmic environments. Estimates consistently indicate that approximately 99% of visible matter exists in this state.



A Plasma beginning.

Interstellar and intergalactic space, whilst sparse, is not empty.

Typical particle densities of order one particle per cubic centimetre are sufficient to sustain collective plasma behaviour due to the long-range nature of electromagnetic interactions. Plasma is characterised by its degree of ionisation, which may range from below 0.01% to complete ionisation.

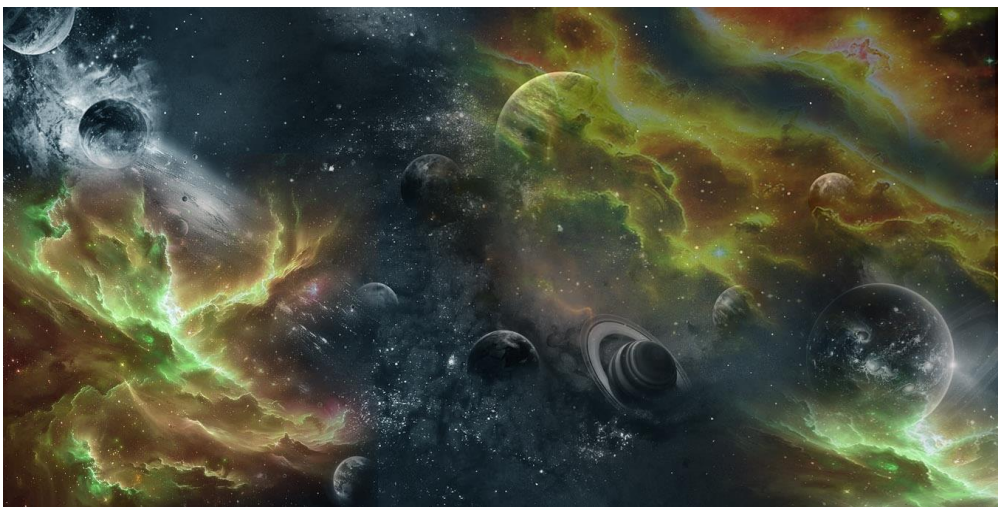
Crucially, plasma dynamics persist across this entire range, rendering the neutral-gas approximation fundamentally invalid for most cosmic environments.

Plasma does not behave as a gas and does not obey classical gas laws such as Boyle's law. Nevertheless, conventional astrophysics routinely models

ionised cosmic matter as *neutral gas*, thereby suppressing electric currents, charge separation, and self-organising electromagnetic structures.

This mis-characterisation obscures the presence of large-scale electrical currents, which necessarily generate magnetic fields. Time-varying magnetic fields, in turn, induce electric fields, producing coupled feedback systems intrinsic to plasma physics, but absent from gravitational-only models.

Magnetic fields are ubiquitous in astrophysical systems, from planetary and stellar environments to galactic and intergalactic scales. Their existence requires sustained electric currents. Despite this, standard cosmology—particularly the Big Bang framework—fails to incorporate current-driven plasma processes in any substantive way. As a result, magnetic phenomena are treated as secondary or emergent, rather than causal.



In plasma cosmology, gravity finishes the job of plasma physics.

This omission has tangible consequences. Earth's geomagnetic history alone records more than two hundred magnetic polarity reversals within the past 65 million years, with no coherent explanation derived from cosmological initial conditions. Similarly, filamentary structures observed at galactic and supergalactic scales mirror laboratory plasma formations, yet are interpreted gravitationally through increasingly abstract constructs.

Plasma cosmology, grounded in experimentally verified plasma physics, offers a physically consistent alternative framework. Its foundations were established by Kristian Birkeland, Irving Langmuir, and Hannes Alfvén, whose work demonstrated that cosmic plasma behaviour follows the same electrodynamic laws observed in the laboratory. Any cosmology that excludes these principles is, by definition, incomplete.

Firstly, it is necessary to understand that Plasma does not *replace* gravity; it *prepares the conditions under which gravity can act efficiently*.

Plasma processes, organises, concentrates, cools, and *hands over* matter to gravity.

Plasma is not a random soup. Electric currents flowing through plasma naturally 'self-pinch' via the zeta pinch (the Z-pinch). This is a laboratory-verified effect.

When a current flows, the associated magnetic field compresses the plasma inward whereby matter is *concentrated* along filaments. Density can increase by many orders of magnitude, with this filamentation being observed in laboratory plasma, in solar plasma, in galactic filaments and in interstellar molecular clouds.

Gravity acting alone struggles to produce such early structure at low densities, whereas plasma does it naturally.

One of gravity's biggest problems in structure formation is *cooling*. Hot gas resists collapse. However, Plasma provides *radiative losses* (synchrotron radiation, bremsstrahlung) with current-driven instabilities that shed energy efficiently, plus double-layers that accelerate particles- and radiate energy away. As plasma cools, recombination occurs (ions + electrons → neutral atoms), electromagnetic dominance weakens and matter transitions toward gas, then dust.

At this point, gravity finally takes over—but now acting on a *pre-assembled* mass.

Plasma does not need to be 100% ionised, as, even at <1% ionisation, charged particles dominate dynamics and neutral atoms are dragged along by collisions. As density increases, ionisation fraction drops and the plasma effects fade smoothly with ordinary hydrodynamics and gravity emerging.

There is *no phase discontinuity*—only a change of dominance.

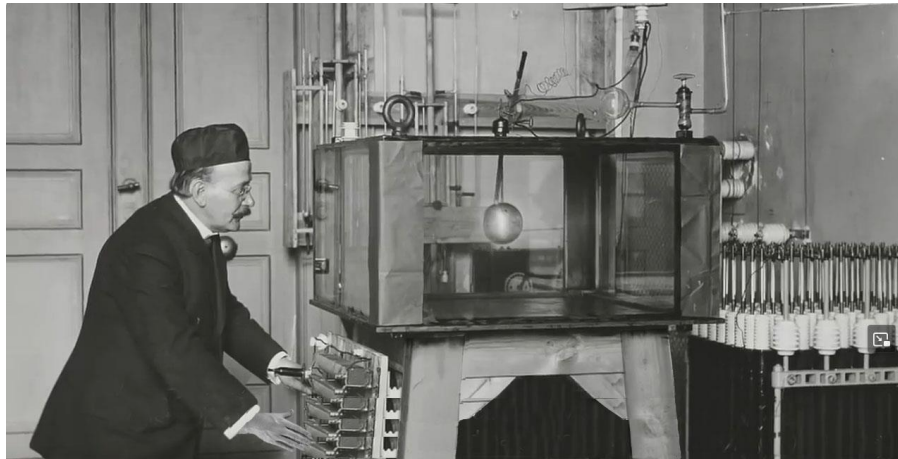
This is when stars form inside electrically structured environments; as in plasma cosmology, stars form at *current nodes*, pinch points, or filament intersections, where these locations naturally concentrate mass. Rotation, angular momentum, and accretion disks arise naturally from that current geometry, and once neutralised and dense, each object behaves gravitationally. Nuclear fusion will ignite (depending on model) the star where it becomes optically solid and electrically quiet at the surface.

Plasma processes explain a filamentary large-scale structure allowing galactic rotation- without the requirement of exotic matter. Jets, disks, and spiral arms become current phenomena. Gravity then stabilises the system, maintaining bound orbits and governing late-stage evolution.

The Plasma physicists

Kristian Birkeland (1867–1917) and the Origins of Plasma Cosmology

Kristian Birkeland, a Norwegian physicist, an early pioneer in plasma physics, was one of the first scientists to suggest that electric currents in space, (now known as Birkeland currents), were responsible for phenomena like the Aurora Borealis.

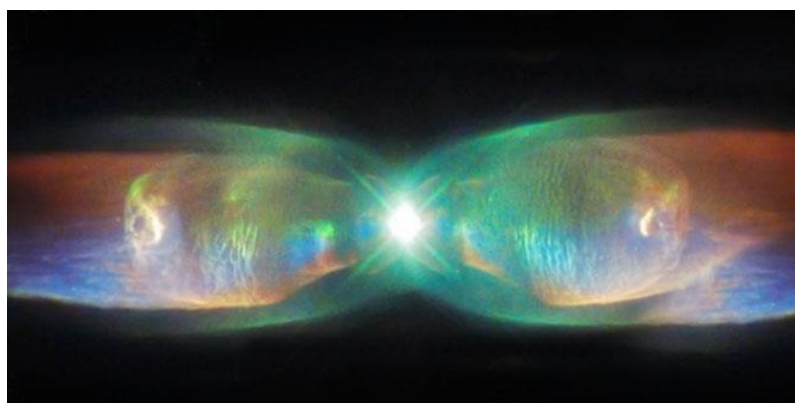


Photo; Kristian Birkeland

In the early 20th century, Birkeland's theory that electromagnetic forces play a significant role in space physics was met with scepticism. His peers largely rejected his hypothesis, favouring instead the ubiquitous gravity-centric explanations for most cosmic phenomena.

Birkeland's experiments, however, demonstrated that electric currents and magnetic fields could *shape* the plasma, a critical insight for understanding the universe. Birkeland currents are now understood to flow through space plasma, connecting stars, galaxies, and even galactic clusters.

These ideas laid the foundation for the larger Plasma Universe model, suggesting that electrical forces in space, plasma might be just as, if not more, significant than gravitational forces in the formation of cosmic structures.



Image; An example of a stellar 'pinch', a cosmic Birkeland current (NASA).

Birkeland's work was under-appreciated during his lifetime. His experiments and theories were considered unorthodox, and he struggled to secure funding for his research. He also faced personal struggles, including poor health and

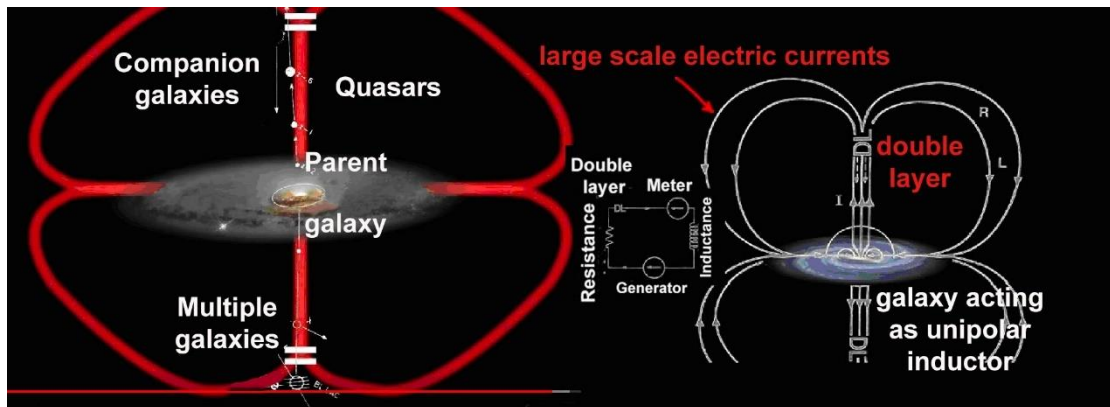
financial difficulties. By the time of his death in 1917, Birkeland's contributions were still not widely recognized, and it was only later that his ideas about electric currents in space were vindicated. Today, Birkeland is credited with pioneering work in space physics, but during his life, he did not receive the recognition he deserved.

Hannes Alfvén (1908–1995) and the Birth of Plasma Cosmology

Hannes Alfvén, a Swedish physicist, expanded upon Birkeland's work and formalized many aspects of plasma cosmology. In 1970, he won the Nobel Prize in Physics for his work in magnetohydrodynamics (MHD), which describes the behaviour of plasma in the presence of magnetic fields.

Alfvén was one of the first to propose that electromagnetic forces dominate the behaviour of plasma on cosmic scales, providing an alternative view of how galaxies and other large structures form.

He criticized the Big Bang model, arguing that it was an overly simplistic explanation of the universe's origins. He believed that the observable universe was much older than the estimated 13.8 billion years suggested by the Big Bang. According to him, the universe did not start with a singular event but is instead an ongoing, evolving system where plasma plays the leading role.



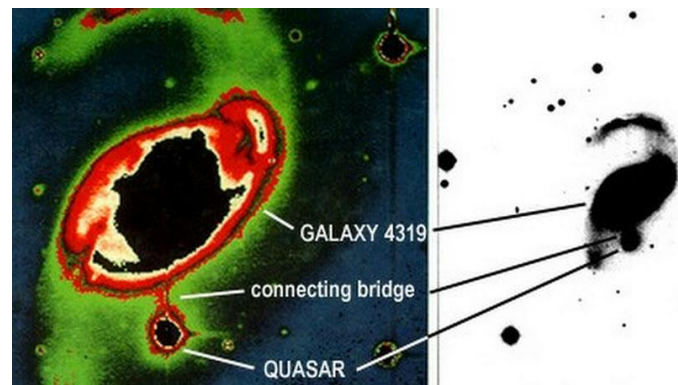
Diagram; Alfvén's Galactic circuit model

Alfvén argued that electromagnetic forces play a far more significant role in the universe than gravity alone and criticized the Big Bang theory as overly simplistic. Throughout his career, Alfvén was considered an outsider in the field of cosmology, thus also largely ignored by the mainstream scientific community.

Many of his colleagues and institutions dismissed his work on plasma physics and cosmic-scale electromagnetism as *irrelevant* to mainstream astrophysics. His emphasis on laboratory-tested principles of plasma physics clashed with the *highly theoretical* models that dominated cosmology, especially as those depended on *unobserved* phenomena like dark matter and dark energy. Despite his Nobel Prize, Alfvén remained on the fringes of the astrophysics community, and his ideas were not given serious consideration until after his death.

Halton Arp (1927–2013) and the Quasar Controversy

Halton Arp, an American astronomer, is perhaps one of the most famous examples of a modern scientist who was ostracized for challenging the Big Bang theory. Arp's work on quasars and redshift led him to question the standard interpretation that redshift is solely due to the expansion of the universe. He discovered anomalous cases where high-redshift quasars appeared to be physically connected to low-redshift galaxies, which contradicted the prevailing cosmological model. This contradiction implied that redshift could be caused by something other than the expansion of the universe, again challenging the Big Bang's foundational assumptions.



Image; One of Arp's galaxies with attendant Pulsar

He believed that in a plasma universe framework, quasars and galaxies are connected by vast currents of plasma, and redshift might be influenced by electromagnetic effects rather than just the Doppler effect of an expanding universe.

For questioning this key pillar of the Big Bang theory, Arp faced professional consequences. In the 1960s and 1970s, as he published more papers on this subject, he was increasingly marginalized by the astronomical community.

Eventually, he was denied access to key observatories, including the Palomar Observatory, effectively cutting him off from the resources he needed to continue his observational work.

Arp's inability to access telescopes was a severe professional blow, as observational data is the lifeblood of an astronomer's research. Despite this, he continued to publish and challenge the mainstream view throughout his life, though much of his work was overlooked or dismissed by the broader scientific community.

Anthony L. Peratt (1940–) and Cosmic Filaments

Anthony L. Peratt, a student of Hannes Alfvén and a plasma physicist himself, contributed significantly to the development of plasma cosmology through his work on "plasma instabilities" and cosmic-scale plasma interactions, which helped explain the formation of vast structures in the universe, such as the cosmic filaments that connect galaxy clusters

In a plasma universe, he confirmed that the large-scale structure of the universe, including the cosmic web of filaments, is indeed formed by Birkeland currents; the vast electrical currents flowing through space plasma. As with

the other physicists he agreed that these currents do exert electromagnetic forces that shape galaxies, stars, and other cosmic structures.



Image; cosmic web filaments and connecting structures, simulation.

Peratt's simulations showed that plasma filaments in space could evolve into the spiral shapes seen in galaxies *without* the need for dark matter or the Big Bang.

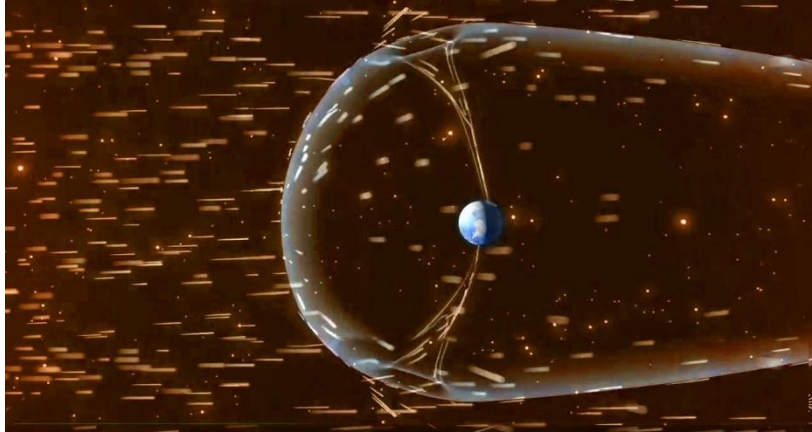
Despite the groundbreaking nature of his work, Peratt's ideas have not been widely accepted by the mainstream scientific community. Plasma cosmology remains a fringe theory in the field of cosmology, and Peratt, like Alfvén, has often been overlooked or ignored by the broader astrophysics community. His work, although supported by laboratory evidence, has struggled to gain traction in a field dominated by the Big Bang model and its associated theoretical constructs.

Eric J. Lerner (1947–) and the Critique of the Big Bang

Eric J. Lerner, a contemporary physicist and author of "The Big Bang Never Happened" (1991), has been a vocal critic of the Big Bang theory and a leading proponent of plasma cosmology. Lerner's work in challenging the foundations of the Big Bang model, similarly rejects the need for dark matter, dark energy, and cosmic inflation. His plasma cosmology model advocates a universe that has no beginning or end, but is also governed by the principles of plasma physics and electromagnetism.

Lerner's research shows that plasma's electromagnetic properties confirm the formation of galaxies, clusters, and large-scale structures without invoking anything from the Big Bang.

He suggests that plasma phenomena observed in laboratories, such as *Z-pinches* (electromagnetic constrictions that produce intense radiation), *can* account for the formation of stars and galaxies.



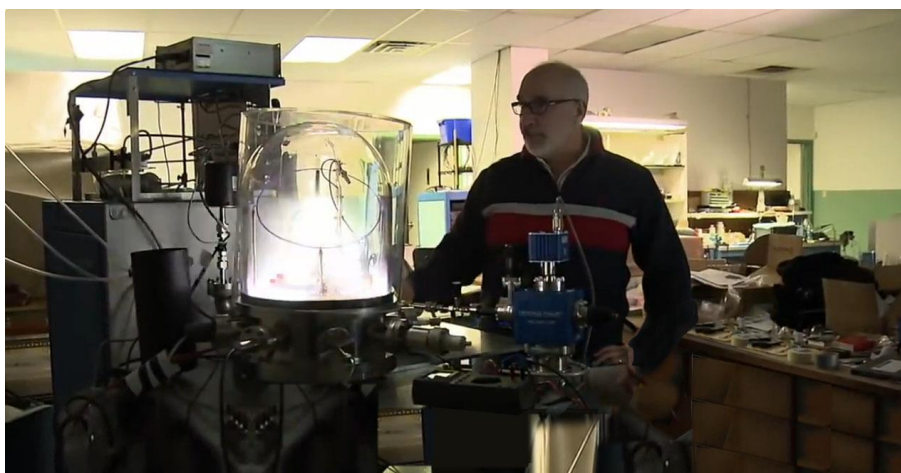
Image; Solar wind around Earth.

Lerner's work has been largely dismissed by the mainstream cosmology community, which remains strongly committed to the Big Bang model. His critiques of the Big Bang, as well as his promotion of plasma cosmology, have been met with scepticism and, in some cases, outright hostility. Despite the empirical grounding of his work in laboratory plasma physics, Lerner has found it difficult to gain support or recognition from mainstream scientific institutions. Like many before him, his willingness to challenge the dominant paradigm has left him on the margins of the field.

Donald E. Scott (1935–) and the Electric Sun

Donald E. Scott, an electrical engineer and proponent of the Electric Universe theory, extended plasma cosmology to the solar system with the Electric Sun hypothesis. This model posits that the Sun's behaviour is also largely governed by external electric currents flowing through the interstellar plasma, further challenging the mainstream model of nuclear fusion as the Sun's primary energy source.

Scott's work emphasizes the role of electric fields and plasma interactions in shaping not only stars but also planetary *systems*.



Image' SAFIRE electric sun model.

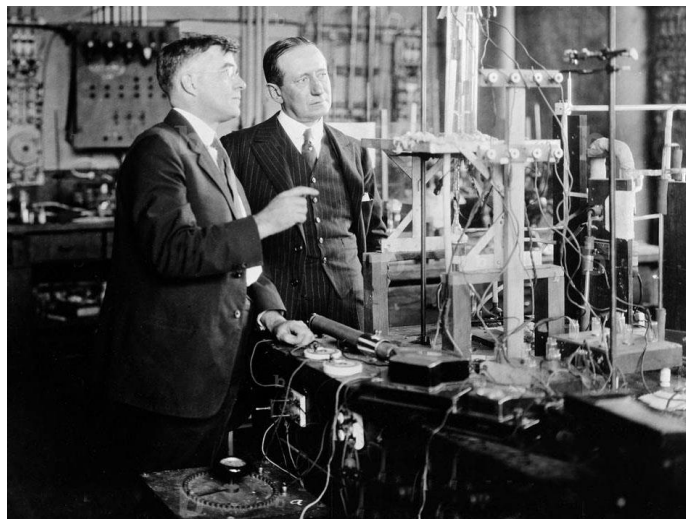
He too has faced significant resistance from the mainstream scientific community for his unconventional ideas, particularly his Electric Sun hypothesis. Scott's model suggests that the Sun's energy is not produced by internal nuclear fusion but by external electric currents flowing through interstellar plasma. This idea directly contradicts the standard solar model, which has been widely accepted for decades.

Scott's work has been largely ignored by mainstream astrophysicists, and his contributions to the Electric Universe theory have also been met with scepticism. Despite the empirical basis for his ideas in electrical engineering and plasma physics, Scott remains on the fringes of the scientific community. Like others in the Plasma Universe and Electric Universe schools of thought, Scott's work has not been embraced by the academic establishment, which remains committed to gravity-dominated cosmological models.

Irving Langmuir (1881–1957) and Plasma's Role in Space

Irving Langmuir, an American chemist and physicist who coined the term "plasma" in the 1920s, studied the electrical properties of ionized gases. His work laid the foundation for understanding how plasma behaves under different conditions, which became crucial in explaining the behaviour of interstellar and intergalactic matter.

Langmuir's research showed that plasma can sustain *long-range* electromagnetic interactions, making it the perfect candidate for modelling large-scale cosmic phenomena.



Photo; Irving Langmuir with Guglielmo Marconi

While his work earned him the Nobel Prize in Chemistry in 1932, Langmuir's later ideas about plasma's role in space were largely ignored during his lifetime. This suggestion that plasma could sustain long-range electromagnetic interactions was not immediately appreciated by the broader scientific community, which was focused primarily on gravitational explanations for cosmic phenomena.

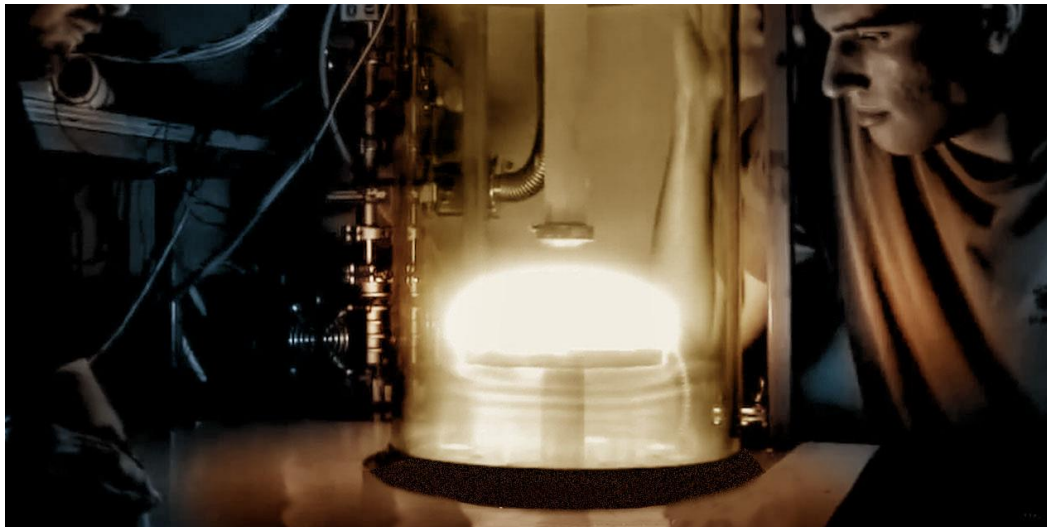
Langmuir's contributions to plasma physics laid the foundation for later developments in plasma cosmology, but during his lifetime, his ideas about the role of plasma in space were met with indifference or scepticism. Today, Langmuir is recognized as a key figure in the study of plasma, but much like Alfvén and Birkeland, his work did not gain the full appreciation it deserved during his career.

Their experiments

1. Alfvén Waves (1942)

Experiment:

Alfvén proposed the existence of magnetohydrodynamic (MHD) waves in a plasma, which later became known as Alfvén waves. These are low-frequency oscillations of ions in a magnetized plasma, where the magnetic field lines act as the restoring force.



Image; Laboratory plasma experiments

Results: The concept of Alfvén waves was experimentally confirmed in laboratory plasmas and in observations of space plasmas, such as in the Earth's magnetosphere. This discovery was crucial because it demonstrated that magnetic fields could propagate through plasmas and that these waves could transport energy and information across vast distances.

Significance: Alfvén waves are now a fundamental concept in plasma physics, used to explain phenomena in both laboratory and astrophysical plasmas, including solar wind and the dynamics of the Earth's magnetosphere.

2. Pinch Effect (1943)

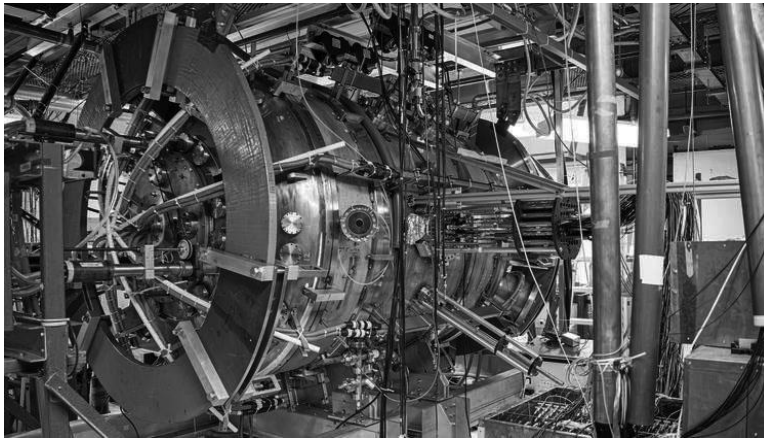
Experiment: Alfvén investigated the "pinch effect," where a plasma column can be compressed by its own magnetic field, leading to instabilities and to a pinch. This was studied in the context of controlled nuclear fusion and in understanding astrophysical jets and other plasma structures.

Results: This pinch was a critical insight into understanding both plasma confinement in fusion research and natural astrophysical processes.

Significance: The pinch effect is also vital in the design of Tokamaks and other plasma confinement devices used in fusion research, as well as in explaining naturally occurring plasma structures in space.

3. Magnetic Reconnection Experiment:

Although not directly associated with a specific experiment by Alfvén, his theories influenced the study of magnetic reconnection, a process where magnetic field lines in a plasma break and reconnect, releasing vast amounts of energy.



Photo; Princeton Plasma Physics Laboratory. 1995

Results: Laboratory experiments and space observations (such as in the solar corona and Earth's magneto-tail) confirmed the occurrence of magnetic reconnection. This process is now understood to be responsible for phenomena such as solar flares and magnetic storms.

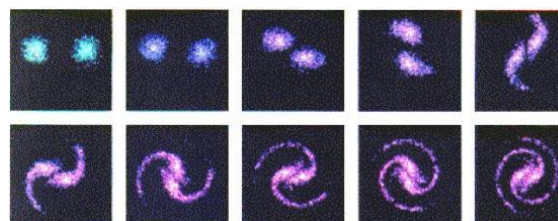
Significance: Magnetic reconnection is a fundamental process in both laboratory plasmas and astrophysics, influencing our understanding of solar and space *weather*, as well as energy release in various cosmic environments.

4. Anthony Peratt; computer simulations

Experiment:

Peratt, a student of Alfvén, conducted extensive computer simulations of plasma behaviour in astrophysical contexts. His work on the dynamics of

galaxy formation and large-scale structures in the universe suggested that plasma processes could play a more significant role than gravity alone.



Image; Supercomputer simulation of spiral galaxy formation by Anthony Peratt, based on charged particle interactions

Results: Peratt's simulations showed that plasma filaments could form structures similar to those observed in galaxies and galaxy clusters, offering an alternative perspective to the gravitational collapse models.

Significance: Peratt's work is a cornerstone of the Plasma Universe theory, providing a framework that challenges conventional gravitational models of cosmology by emphasizing the importance of plasma and electromagnetic forces.

5. Bohdan Paczynski and Donald Scott

Experiment: These researchers focused on the electrical currents in space plasmas and their role in cosmic structures. Paczynski worked on understanding the role of electric currents in the formation of cosmic jets and other plasma phenomena.



Inter-American Observatory in Chile. Credit: CTIO/NOIRLab/NSF/AURA

Results: The experiments and observations supported the idea that cosmic plasmas could be shaped by electrical currents, not just gravitational forces.

Significance: Their contributions have provided additional evidence supporting the Plasma Universe concept, which sees the universe as being primarily influenced by plasma and electromagnetic forces rather than gravity alone.

The Hertzsprung-Russell (H-R) diagram

The Hertzsprung-Russell (H-R) diagram is a fundamental tool in astrophysics that plots stars based on their luminosity (brightness) against their surface temperature (colour). This diagram provides a visual representation of the different stages in the life cycle of stars and helps astronomers understand stellar evolution.

However, whilst the traditional H-R diagram is well-established based on gravity-dominated processes, the concept of plasma physics involves a re-interpretation of stellar evolution, thus altering the positions and evolutionary paths of stars on the diagram.

Order on the conventional Hertzsprung-Russell Diagram

Colour (Temperature): X-axis:

The horizontal axis of the H-R diagram represents the surface temperature of stars, typically decreasing from left to right. The colour of a star is directly related to its temperature:

Blue stars (far left) are the hottest, with temperatures above 30,000 K.

White stars are somewhat cooler, around 10,000 K.

Yellow stars (like the Sun) have temperatures around 5,000-6,000 K.

Red stars (far right) are the coolest, with temperatures below 3,500 K.

Brightness (Luminosity): Y-axis:

The vertical axis represents the luminosity of stars, typically in units relative to the Sun. Stars *higher* on the diagram are brighter and more luminous.

Stars *lower* on the diagram are dimmer and less luminous.

Main Sequence:

Most stars, including the Sun, are found along a diagonal band called the Main Sequence.

Stars on the Main Sequence are in a stable phase, fusing hydrogen into helium in their cores.

As you move up the Main Sequence (from bottom right to top left), stars become hotter, bluer, and more luminous.

Giants and Super-giants:

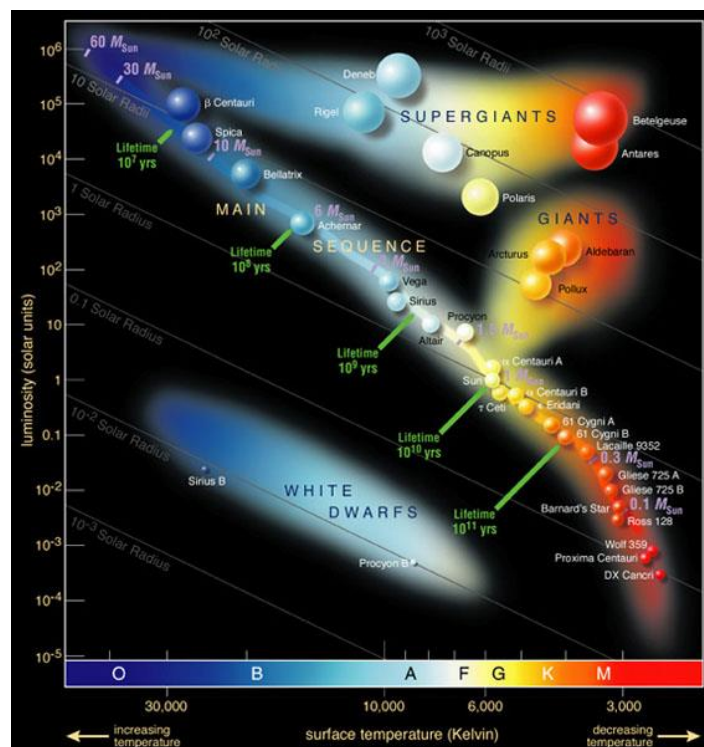
Above the Main Sequence, in the upper right portion of the diagram, are the giants and super-giants. These stars are cool but very bright because they are large.

They have evolved off the Main Sequence and are in later stages of stellar evolution, typically fusing heavier elements.

White Dwarfs:

In the lower left of the diagram are white dwarfs. These stars are hot but not very luminous because they are small.

White dwarfs represent the final evolutionary stage of stars like the Sun.



The Hertzsprung diagram. Credits:ESO

H-R Diagram with Plasma Physics

When plasma physics is considered in the formation and evolution of stars, certain aspects of the H-R diagram are interpreted differently:

Colour and Temperature:

Plasma physics emphasizes the role of *electromagnetic* forces, which would affect the temperature distribution within a star.

Z-pinch processes in plasma lead to different heating patterns, causing variations in surface temperature *not* accounted for by gravity alone.

Brightness (Luminosity):

Electromagnetic forces within plasma must alter the energy distribution in a star, leading to stars that are either *more or less* luminous than expected when based on gravity alone.

The efficiency of energy transport through plasma will lead to stars being brighter or dimmer *depending* on how plasma currents affect the internal dynamics.

Main Sequence:

The concept of Z-pinch and other plasma processes clearly influence the stability of stars on the Main Sequence. For example, stars will evolve *off* the Main Sequence *differently* as electromagnetic forces must play a significant role in their life cycles.

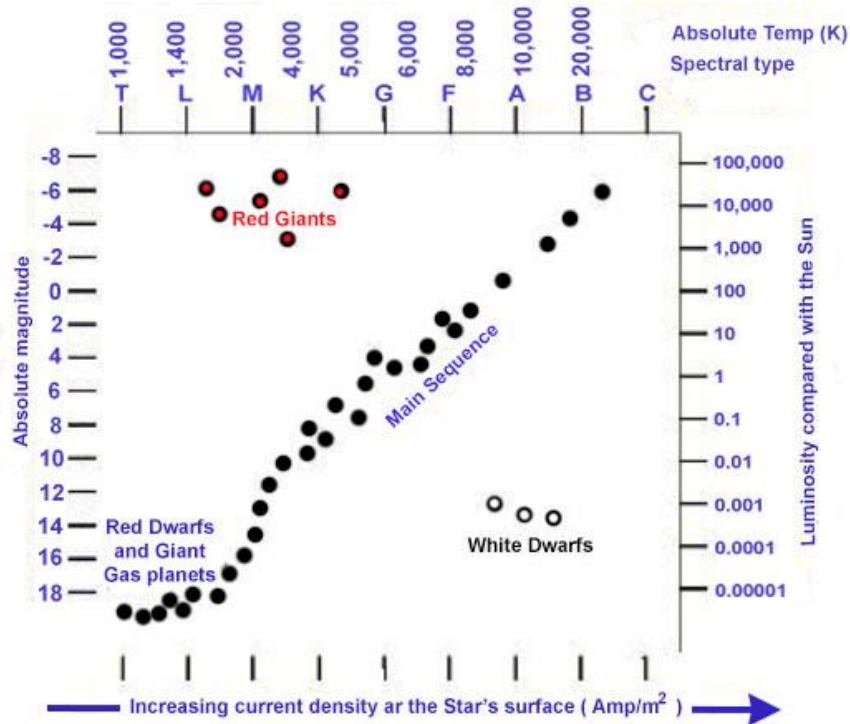
Stars formed through plasma processes cannot follow the traditional path from the Main Sequence to giants or white dwarfs.

Giants, Super-giants, and White Dwarfs:

The plasma universe insists upon alternative pathways for stellar evolution, where stars evolve into giants or super-giants under the influence of plasma dynamics rather than purely gravitational collapse.

White dwarfs, in a plasma context, will have different properties when their formation and cooling are influenced by electromagnetic interactions.

A sketch of the way Donald E Scott and other plasma engineers suggest the Hertzsprung-Russell diagram should be properly plotted, with both the electric current density and surface temperature (as well as maximum velocity) increasing from left to right is shown below.



Image; The Alternative H.R. Diagram

Traditional views explained by Plasma physics

Star Formation and Evolution:

In the standard model, stars are formed from the gravitational collapse of gas clouds, and their evolution is driven by nuclear fusion processes. Their position on the H-R diagram is determined by their mass, age, and composition.

Plasma Universe View:

The Plasma Universe model suggests that electromagnetic forces, rather than just gravity, play a significant role in star formation and evolution. Proponents argue that stars might be powered by external electric currents (Birkeland currents) rather than solely by internal nuclear fusion. This could affect interpretations of a star's position on the H-R diagram, suggesting that some stars might be younger or older than they appear according to traditional models, depending on the plasma conditions.

Distance Measurements:

Distances to stars are typically measured using methods such as parallax, standard candles, or redshift-based techniques.

Plasma Universe View: Plasma theorists argue that redshift is not solely due to the expansion of the universe but must be influenced by plasma effects, leading to different interpretations of distances. If distances to stars are reinterpreted, this could change their luminosity values and thus their placement on the H-R diagram. For example, if a star is closer than traditionally thought, it would appear less luminous.

Colour and Temperature:

The colour and temperature of stars are determined by their surface temperature, with hotter stars appearing *bluer* and cooler stars appearing *redder*.

Plasma Universe View: Plasma interactions in a *star's atmosphere* could alter its apparent colour or temperature. Electromagnetic forces in the cosmos are definitely more significant than currently assumed, inevitably leading to different spectral signatures, affecting how stars are classified on the H-R diagram.

Ages of Stars:

The age of a star is *inferred* from its position on the H-R diagram, with main sequence stars being younger and those off the main sequence (like red giants or white dwarfs) being older.

Plasma Universe View: If stars are powered or influenced by external electrical currents, their evolution will not follow the traditional nuclear fusion timeline. This means that stars thought to be old (based on their position on the H-R diagram) might actually be younger, or vice versa, depending on the plasma conditions in their environment.

Although the H-R diagram remains a critical tool in standard astrophysics, the Plasma Universe theory challenges many of the assumptions behind the traditional interpretations of star properties, crucially leading to different conclusions about star distances, colours, and ages.

'Mysteries' in Standard Cosmology solved by Plasma Universe Theory

Plasma physics, offers explanations for several cosmological phenomena that are considered challenging or "mysterious" within the framework of standard cosmology. It is not unusual for scientists to be perplexed about some detail in a cosmological discovery. Dubious invisible and intangible suggestions prevail as 'Patches', they are invented, with no provable evidence, in order to explain away these dilemmas.

While standard cosmology models like the Lambda Cold Dark Matter hypothesis have been successful in explaining a wide range of cosmic phenomena, plasma physics offers many alternative explanations for these ambiguities by emphasizing the role of electromagnetic forces in space.

1. Galaxy Formation and Structure

In the Lambda Cold Dark Matter model, galaxies form primarily through the gravitational collapse of dark matter halos, followed by the accumulation of baryonic matter. However, the model struggles to fully explain the observed distribution of galaxies, their rotation curves, and the intricate filamentary structure observed in the cosmic web.

Plasma Physics Explanation: Plasma cosmologists argue that electromagnetic forces, specifically those within vast cosmic plasmas, can naturally lead to the formation of filamentary structures and influence galaxy rotation without invoking dark matter. In this view, galaxy formation is driven by electric currents in plasma, which can explain the coherent filamentary structures and the observed behaviours of galaxies more naturally than gravity alone.

2. Galactic Rotation Curves

The flat rotation curves of galaxies—where stars in the outer regions of galaxies rotate at speeds similar to those near the centre—are traditionally explained by postulating the presence of *dark matter*. However, the precise nature of dark matter remains elusive.

Plasma Physics Explanation: Plasma cosmologists suggest that the magnetic fields generated by electric currents within the plasma can influence the rotation curves of galaxies, negating the need for dark matter. This model proposes that the observed rotation curves are the result of electromagnetic forces rather than the gravitational influence of unseen matter.

3. Large-Scale Structure of the Universe

The Λ CDM model predicts a certain distribution and structure for the large-scale arrangement of galaxies and galaxy clusters. However, the observed “cosmic web,” with its intricate filaments and voids, presents challenges to this model, particularly in explaining how such structures formed so uniformly across vast scales.

Plasma Physics Explanation: Plasma cosmology proposes that these large-scale structures are the result of the dynamics of plasma filaments, shaped by electromagnetic forces. According to this view, plasma naturally forms filamentary structures, which can span *vast distances* and are responsible for the large-scale organization of matter in the universe.

4. Cosmic Microwave Background (CMB)

The CMB is considered a remnant of the Big Bang and is often cited as strong evidence for the standard cosmological model. However, certain anomalies, such as the “axis of evil” (an unexpected alignment of temperature fluctuations) and the uniformity problem, pose challenges.

Plasma Physics Explanation: Some plasma physicists argue that the CMB could be a result of electromagnetic phenomena in plasma, rather than a remnant of the Big Bang. They suggest that the CMB’s uniformity and fluctuations might be explained by processes occurring within cosmic plasmas rather than as an afterglow of a hot, dense origin event.

5. Quasar Redshifts

Quasars exhibit very high redshifts, which are typically interpreted as indicators of great distance, meaning that these objects are billions of light-years away and were formed in the early universe. However, some observed associations between quasars and nearby galaxies *challenge* this interpretation.

Plasma Physics Explanation: Plasma cosmologists, particularly those influenced by the work of Halton Arp, suggest that the redshifts of quasars may not be purely due to the expansion of the universe (Doppler shift) but could involve intrinsic redshift components related to plasma processes. This interpretation could mean that quasars are not as distant as traditionally thought and that their redshifts could be influenced by local plasma environments.

6. Cosmic Rays and High-Energy Phenomena

The origin and acceleration mechanisms of ultra-high-energy cosmic rays are not fully understood in the standard model.

Plasma Physics Explanation: Plasma physics provides mechanisms, such as electric fields generated by double-layers in cosmic plasmas, that could accelerate particles to the high energies observed in cosmic rays. This explanation *does not require* the involvement of exotic astrophysical objects like *dark matter* halos but instead relies on known plasma processes.

7. Birkeland Currents and Auroras

The presence of large-scale, coherent magnetic fields in the universe and the exact mechanism for auroras in planetary atmospheres, remain areas of active research.

Plasma Physics Explanation: Plasma physics explains these phenomena through the existence of Birkeland currents—large-scale electric currents that flow along magnetic field lines in space. These currents can create magnetic fields and are responsible for phenomena like auroras, providing a direct link between plasma processes and observable cosmic events.

8. The creation of craters on moons and planets.

The idea that all craters on moons and planets are caused by meteor impacts is widely accepted in planetary science, even although one would expect that not all the craters would be circular. Impacts from sidelong strikes, and other indirect hits would cause elongated troughs rather than the ubiquitous rounded shapes which are difficult to explain with simple impact models.

Plasma Physics Explanation

Plasma physics, however, offers a more likely answer to crater formation. In space, plasma is abundant, particularly in the form of the solar wind, which is a stream of charged particles emitted by the Sun.

When plasma interacts with a planetary body, electric discharges can occur. These discharges are akin to massive lightning strikes which can excavate material from the surface, potentially creating craters.

Electric Discharge Machining would create craters that are circular or oval, as the electric discharge spreads out symmetrically from the point of contact.

Plasma interactions could also explain why some craters are surrounded by rays or other surface features that are difficult to reconcile with the physics of impact ejecta.

Electric currents interacting with the surface could cause melting, vaporization, or even the deposition of material, which might account for some of the complex patterns observed around certain craters.

9. Replacing the Big Bang with Plasma Cosmology

The Plasma Universe and Electric Universe models challenge the Big Bang's fundamental assumptions. Instead of an expanding universe that began with a singular event, the plasma cosmology suggests a more complex, self-sustaining universe driven by the interactions of plasma and electromagnetic forces.

As we have seen, advocates argue that the Big Bang theory relies on unproven concepts like *dark matter* and *dark energy*, which merely act as 'patches' inserted to allow an uncertain idea to have any credence, while plasma cosmology draws from established principles of plasma physics and electromagnetism observed both in laboratories and in space.

Moreover, the Plasma Universe suggests that many phenomena attributed to the Big Bang, such as cosmic background radiation and redshift, can be better explained through plasma interactions without the need for an initial singularity. For instance, cosmic background radiation is more probably the result of thermal emissions from plasma filaments, rather than the afterglow of a primordial explosion.

Conclusion

The Plasma Universe and Electric Universe models offer a revolutionary view of the cosmos, one where plasma and electromagnetism dominate cosmic processes rather than gravity alone. The work of the scientists catalogued above has opened up new avenues of exploration in astrophysics, challenging the dominant, but imperfect, Big Bang theory. These alternative models present a universe that is not only more dynamic and complex but also potentially older and infinite, governed by the known principles of plasma physics rather than speculative constructs.

The experiences of these scientists, much like those of Galileo and Copernicus, reflect the difficulties faced by individuals who challenge dominant scientific paradigms. Galileo was condemned by the Catholic Church and forced to recant his support for heliocentrism, while Copernicus' work was met with scepticism during his life and only accepted posthumously.

Similarly, the scientists involved in plasma cosmology and the Electric Universe theory have faced professional marginalization, denial of resources, and scepticism from their peers for challenging the Big Bang and other gravity-based cosmological models. Despite these challenges, their work continues to

inspire alternative views of the cosmos, suggesting that scientific progress often involves overcoming entrenched ideas and the resistance that accompanies them.

The Priests are still refusing to look through Galileo's telescope.

NOTES

Where we experience Plasma today

Plasma is a versatile state of matter that plays a crucial role in many natural and man-made phenomena. From the stunning displays of auroras and lightning to practical applications like fluorescent lighting and plasma cutting, plasma's unique properties make it essential in a wide range of contexts.

Plasma consists of a hot, ionized gas with equal numbers of positive ions and free electrons. Here are examples of plasma use that we encounter both in nature and in everyday life:

1. Aurora Borealis (Northern Lights)

The aurora borealis is a natural light display predominantly seen in high-latitude regions around the Arctic and Antarctic. It occurs when charged particles from the *solar wind* interact with the Earth's magnetosphere.

These natural light shows are caused by magnetic storms that have been triggered by solar activity, such as solar flares (explosions on the Sun) or coronal mass ejections (ejected gas bubbles). Energetic charged particles from these events are carried from the Sun by the solar wind.



Image; Aurora Borealis

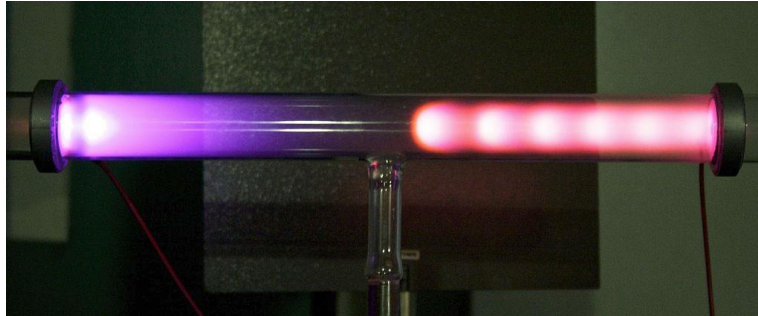
Plasma explanation:

When these particles seep through Earth's magnetosphere, they cause substorms. Then fast-moving particles slam into our thin, high atmosphere, where the atmosphere is in a plasma state, colliding with Earth's oxygen and nitrogen particles. As these air particles shed the energy they picked up from the collision, each atom starts to glow in a different colour.

2. Fluorescent Lighting

Fluorescent lamps are common in homes, offices, and public spaces. They produce light by passing an electric current through a gas, usually mercury vapour, contained within a tube.

Plasma explanation: Inside the fluorescent tube, the electric current ionizes the gas, creating a plasma. This plasma emits ultraviolet light when the excited mercury atoms return to their ground state. The ultraviolet light then excites the phosphor coating on the inside of the tube, which in turn emits visible light.

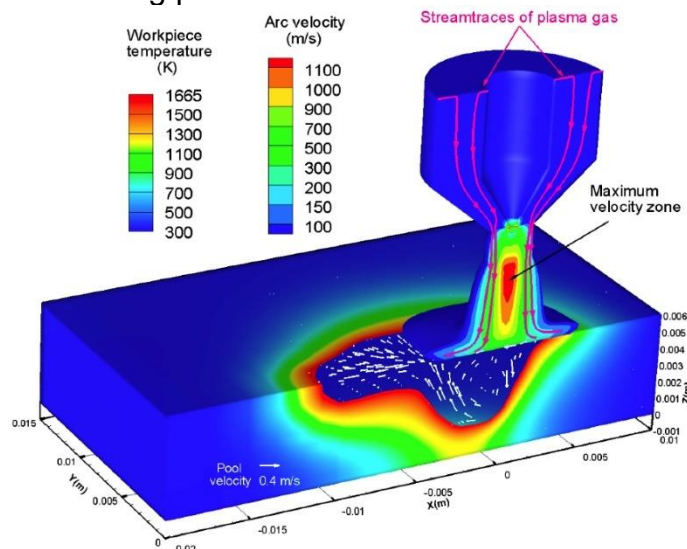


Image; A classic glow discharge in a Crookes tube;
Credit; Plasma-universe.com

3. Arc Welding

Arc welding is a process used to join metals by generating an electric arc between an electrode and the base material. The intense heat of the arc melts the metals at the welding point, allowing them to fuse together.

Plasma explanation: The electric arc in welding is a form of plasma. The high current passing through the air or gas between the electrode and the workpiece ionizes the air, creating a plasma arc. This plasma is extremely hot, reaching temperatures of up to 10,000°C (18,000°F), which melts the metal and enables the welding process.



Image; Arc welding. Credit MDPI

4. Lightning

Lightning is a natural electrostatic discharge during a thunderstorm. It occurs when there is a build-up of electrical charge in the clouds, leading to a sudden release of electricity.

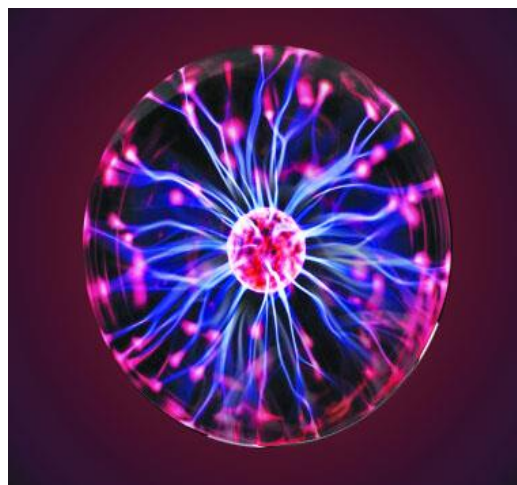
Plasma explanation: During a lightning strike, the air in the path of the discharge becomes ionized, turning into a plasma. This plasma channel allows the electrical energy to travel from the cloud to the ground (or between clouds), producing the bright flash and thunder associated with lightning.



5. Neon Signs

Neon signs are often used for advertising and decorative purposes. They produce light by passing an electric current through a gas, typically neon, contained within a glass tube.

Plasma explanation: When the electric current passes through the neon gas, it ionizes the gas, creating a plasma. The plasma emits light as the neon atoms return to their ground state, producing the characteristic bright red-orange glow. Different gases or coatings can produce other colours.

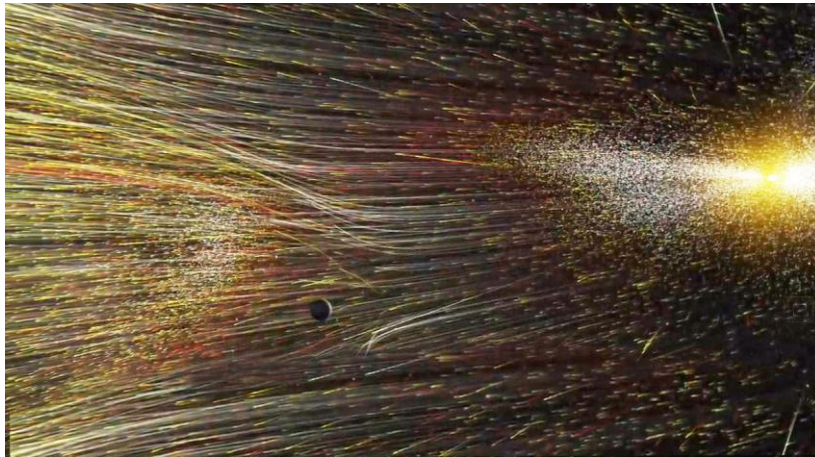


Image; Plasma ball

6. Solar Wind

The solar wind is a stream of charged particles (plasma) released from the upper atmosphere of the Sun. It permeates the solar system and interacts with planetary magnetospheres and atmospheres.

Plasma explanation: The solar wind is composed of plasma, primarily electrons and protons, that escape the Sun's gravitational field. This plasma can interact with the Earth's magnetosphere, contributing to phenomena like the aurora borealis and affecting space weather.

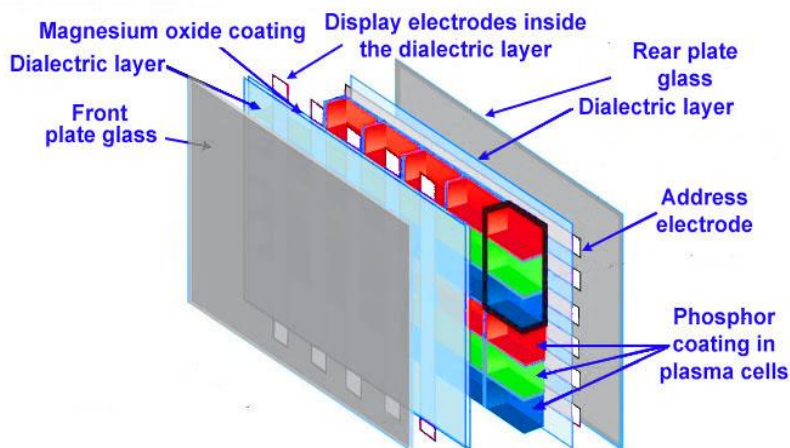


Image; Solar wind. (Image credit: NASA)

7. Plasma TV Screens

Plasma televisions were popular before the advent of LED and OLED screens. They produced images by illuminating small cells containing electrically charged ionized gases.

Plasma explanation: In a plasma TV, each pixel is a tiny cell filled with gas (typically xenon and neon). When an electric current passes through the cell, it ionizes the gas, creating a plasma that emits ultraviolet light. This light excites phosphors that emit visible light, producing the image on the screen.

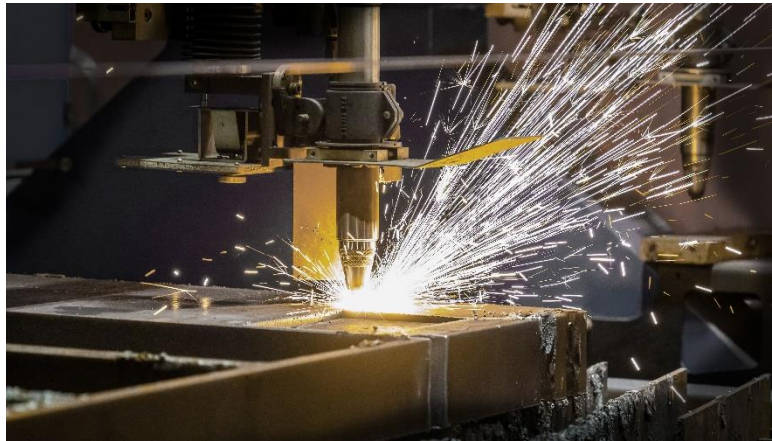


Image; Plasma television.

8. Plasma Cutters

Plasma cutters are used to cut through electrically conductive materials like steel, aluminium, and copper by using a jet of hot plasma.

Plasma explanation: A plasma cutter generates a plasma jet by sending an electric arc through a gas (usually compressed air). The gas is ionized and reaches extremely high temperatures, forming a plasma. This plasma is capable of melting and cutting through the metal, providing precise and efficient cuts.

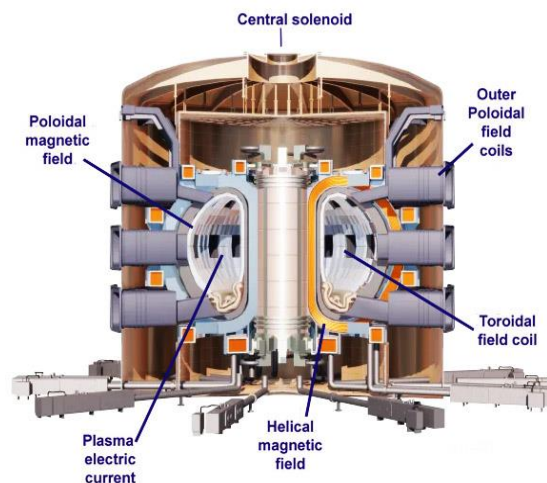


Plasma cutting

9. Fusion Reactors (Tokamaks)

Fusion reactors, such as Tokamaks, are experimental devices designed to replicate the fusion processes of the Sun, aiming to produce clean and virtually limitless energy.

Plasma explanation: In a tokamak, hydrogen isotopes are heated to extremely high temperatures, creating a plasma. Magnetic fields are used to confine this plasma in a toroidal (doughnut-shaped) chamber. The goal is to sustain the plasma long enough for fusion to occur, releasing energy.



Image; A Tokomak confining [plasma](#) using magnetic fields.

Key Concepts of the Plasma Universe:

Birth of the Universe

The Plasma Universe theory is an alternative cosmological model that emphasizes the role of plasma and electromagnetic forces in the formation and evolution of the universe. Unlike the more widely accepted Big Bang theory, which posits that the universe began as a singularity that expanded over time, the Plasma Universe model suggests that electromagnetic forces in plasma play a significant role in shaping cosmic structures.

In the Plasma Universe model, the universe didn't necessarily start with a singular event like the Big Bang. Instead, it might have always existed in some form, undergoing cycles of change driven by plasma dynamics. Plasma, a highly conductive state of matter consisting of free electrons and ions, does, in fact, permeate all of space and is influenced by electric and magnetic fields.

This model suggests that the large-scale structures we see in the universe today, such as galaxies and clusters of galaxies, are primarily the result of interactions *within* this plasma, rather than being driven by gravity alone.

In the Plasma Universe theory, the formation of stars, planets, and other celestial bodies is also governed by plasma physics. According to this view, interstellar space is filled with plasma, and stars form within these plasma clouds through a process called 'Z-pinch' or 'Bennett pinch'. This occurs when currents within a plasma cloud cause the cloud to *compress* under the influence of its own magnetic field. The compression can become strong enough to cause the material to condense into stars.

Plasma as the Dominant Form of Matter:

In the Plasma Universe, it's proposed that over 99% of the visible universe is composed of plasma, which is an ionized gas of free electrons and ions. Plasma is highly conductive and interacts with electromagnetic fields.

Electromagnetic Forces vs. Gravity:

While mainstream cosmology attributes the large-scale structure of the universe mostly to gravitational forces, the Plasma Universe model places a significant emphasis on *electromagnetic* forces. In this view, electric currents and magnetic fields in space are seen as more influential than gravity in shaping cosmic structures like galaxies and galaxy clusters.

Filamentary Structures:

Plasma physics predicts the formation of long, filamentary structures, which are *often seen* in space. These are attributed to the behaviour of plasmas, which tend to form such structures due to the "Birkeland currents," named after Kristian Birkeland, a Norwegian physicist who pioneered the study of these cosmic electrical currents.

Electric Stars:

In the Plasma Universe model, stars and galaxies are not just governed by nuclear fusion and gravitational collapse, but also by electric currents. Proponents of the theory argue that electrical energy flowing through plasma could *power* stars and drive their evolution.

Critique of Dark Matter and Dark Energy:

Plasma cosmology also challenges the need for dark matter and dark energy, which are key components of the standard model. Instead, electromagnetic forces in plasma are proposed to explain phenomena that are usually attributed to these unseen entities.

In mainstream cosmology, *Edwin Hubble's interpretation* is based on the observation of the redshift of light from distant galaxies, which led to the understanding that the universe is expanding. This interpretation is fundamental to the Big Bang Theory and how we currently explain the distances of stars and galaxies. (examined in chapter 14).

The redshift is interpreted as a Doppler effect, where the wavelength of light from objects moving away from us gets stretched, shifting it toward the red end of the spectrum.

Physics asserts that Hubble's law has established that galaxies farther away from us are *moving faster*, suggesting that the universe is expanding. This expansion model also correlates with the *colours* of stars, as stars' light gets redder as they move farther away, with blue light associated with stars that are relatively closer or hotter. However, Plasma Cosmology provides an alternative explanation:

Redshift as an Intrinsic Property:

Proponents of Plasma Cosmology suggest that redshift is *not necessarily* due to the expansion of the universe, but could be an *intrinsic property* of light as it interacts with interstellar or intergalactic plasma. This is referred to as the "tired light" hypothesis. According to this, photons *lose energy* through their interaction with plasma over vast distances, leading to a redshift *without* needing an expanding universe.

Colour and Electric Stars:

Plasma cosmology also provides a different take on the *colours* of stars. Instead of solely attributing a star's colour to its temperature (as in the standard model), it posits that a star's colour could be influenced by its *electric environment*. Plasma sheath effects, or the way plasma interacts with electric currents, could alter a star's appearance, leading to variations in its observed colour.

Distances of Stars:

In the Plasma Universe model, the redshift would *not* be a reliable measure of distance, as it is in the Big Bang cosmology. If redshift is caused by the interaction of light with plasma, rather than the Doppler effect from an expanding universe, the interpretation of how far away stars and galaxies are would change fundamentally. The distances to galaxies and stars might be *much smaller* than Hubble's law suggests.

Key Differences from the Hubble Interpretation:

Expansion of the Universe:

The standard interpretation (Hubble) views the redshift as a sign of cosmic expansion, while the Plasma Universe interprets redshift as possibly due to energy loss (tired light) through plasma interactions.

Role of Plasma:

Mainstream cosmology recognizes the importance of plasma but doesn't give it a primary role in shaping the large-scale structure of the universe. Plasma Cosmology, on the other hand, makes it *central*, particularly emphasizing the role of electromagnetic forces in the cosmos.

Cosmic Distance Measurements:

Hubble's law and redshift-distance relationships form the backbone of measuring cosmic distances in standard cosmology. Plasma cosmology questions the reliability of using redshift for these measurements, proposing a different mechanism that could challenge conventional views on how far stars and galaxies are from us.

Colour and Temperature:

The colour and temperature of stars are determined by their surface temperature, with hotter stars appearing *bluer* and cooler stars appearing *redder*.

Plasma Universe View:

Plasma interactions in a *star's atmosphere* could alter its apparent colour or temperature. Electromagnetic forces in the cosmos are definitely more significant than currently assumed, inevitably leading to different spectral signatures, affecting how stars are classified on the H-R diagram.

Ages of Stars:

The age of a star is *inferred* from its position on the H-R diagram, with main sequence stars being younger and those off the main sequence (like red giants or white dwarfs) being older.

Plasma Universe View: If stars are powered or influenced by external electrical currents, their evolution will not follow the traditional nuclear fusion timeline. This means that stars thought to be old (based on their position on the H-R diagram) might actually be younger, or vice versa, depending on the plasma conditions in their environment.

Although the H-R diagram remains a critical tool in standard astrophysics, the Plasma Universe theory challenges many of the assumptions behind the traditional interpretations of star properties, crucially leading to different conclusions about star distances, colours, and ages.

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