"A magnificent description of electricity in space!"

—Donald E. Scott, author of ***The Electric Sky***

The Electric Universe

Wallace Thornhill
David Talbott

A new view of Earth, the Sun, and the heavens

The
Electric Universe

THUNDERBOLTS Project
Volume II

Mikamar Publishing
Portland, Oregon

The rare icon on the reverse side is from a global study
of tens of thousands of pictographs, described in
Volume I of the THUNDERBOLTS project,
***Thunderbolts of the Gods*.**
It was carved in rock at Kayenta, Arizona.
It is a definitive human recording of the cosmic thunderbolt
seen close to the Earth in its most lethal configuration.

Cover Image
HST image of the Cat's Eye Nebula (NGC 6543)
Hubble's Advanced Camera for Surveys (ACS) reveals the
full beauty of a bull's eye pattern of eleven or even more
concentric rings, or shells, around the central star.
The cellular, helical and filamentary structure is
characteristic of a plasma discharge.
Credit: R. Corradi (Isaac Newton Group of Telescopes,
Spain) and Z. Tsvetanov (NASA)

To the scientists of the future—

The Electric Universe

Wallace Thornhill and David Talbott

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In particular we wish to express our gratitude to Bruce Mainwaring, Gerald Simonson and Elizabeth Buntrock whose support has been indispensable to completion of both *The Electric Universe* and our earlier monograph *Thunderbolts of the Gods*.

Wallace Thornhill

Born and schooled in Melbourne, Australia, Wallace Thornhill completed a science degree at Melbourne University, majoring in physics and electronics. He began postgraduate studies with Prof. Victor Hopper's upper atmosphere research group. Before entering university he had been inspired by Immanuel Velikovsky through his controversial best-selling book *Worlds in Collision*. He experienced first-hand the indifference and sometime hostility toward a radical challenge to mainstream science. He realized there is no future for a young heretic in academia.

He worked for 11 years with IBM Australia. The later years were spent in the prestigious IBM Systems Development Institute in Canberra, working on the first computer graphics system in Australia. He was the technical support for the computing facilities in the Research Schools at the Australian National University (ANU), which gave him excellent access to libraries and scientists there. Remaining in Canberra, he then joined the Department of Foreign Affairs in the complex development of secure communications, message analysis and office automation. His spare time has been devoted to the continuing study of astronomy and physics and regularly attending seminars at the ANU Research School of Astronomy and Astrophysics and the Research School of Earth Sciences.

In 1974, he was invited to attend an international symposium in Hamilton, Ontario, dealing with the works of Velikovsky. It was there that he first met Velikovsky and an organizer of the conference, David Talbott. Several years later, in following Talbott's work, he was persuaded that the celestial dramas Talbott had proposed were plasma discharge phenomena. The two reconnected in 1994 and 1996 at international conferences in Portland, Oregon, and this began a partnership devoted to a new vision of the universe and of planetary history. The co-authored first full-color monograph *Thunderbolts of the Gods*, published in 2005, was followed by a 64-minute DVD *Thunderbolts*, featuring interviews with the two authors and other contributors.

He has for many years been an active member of the UK Society for Interdisciplinary Studies, and served on the society's committee. He has lectured in the USA and Europe on the electrical nature of the cosmos. The father of three daughters, all grown, he now lives with his wife Faye in Canberra, where he continues to pursue his life-long passion to identify the role of electricity in space.

David Talbott

Raised in Portland, Oregon, David Talbott has remained in the area all his life. A graduate of Portland State University, where he majored in education and political science, he returned briefly for graduate work in urban studies. His college observations on the failure of modern education led him to found two statewide organizations aimed at upgrading the quality of education at secondary and higher education levels. Both organizations were supported by leading corporations, the state bar, the medical association, organized labor, and major foundations in the region.

On reading Immanuel Velikovsky's *Worlds in Collision* in 1968, a sense of discovery soon took his life in new directions. From 1972 to 1975, he published a ten-issue journal *Immanuel Velikovsky Reconsidered*, provoking renewed international interest in the work of the pioneering theorist. A few years later, following a lead provided by Velikovsky himself, he completed a book he called 'a reconstruction of the ancient sky.' *The Saturn Myth* was published by Doubleday in 1980, and his original research provided a foundation for independent investigations by several other scholars and scientists in the years to follow. In 1987, he founded the publication, *Aeon: A Journal of Myth and Science*, which continues today, focusing heavily on subjects opened up by this work.

In December 1996 Wallace Thornhill visited him for a month and this meeting convinced him that the celestial formations he had labored to reconstruct from ancient testimony were, in fact, electrical in nature.

His decades-long work was the subject of the 1996 feature-length documentary *Remembering the End of the World*. He is co-author, with Thornhill, of *Thunderbolts of the Gods*. He and his wife Nancy have four children, all grown. They now live in Beaverton, Oregon.

TABLE OF CONTENTS

TABLE OF CONTENTS

Introduction

"The observations that are not explainable by current scientific theories are the most valuable, for they may propel the field forward in the next cycle of innovation, possibly to a paradigm shift."[1]

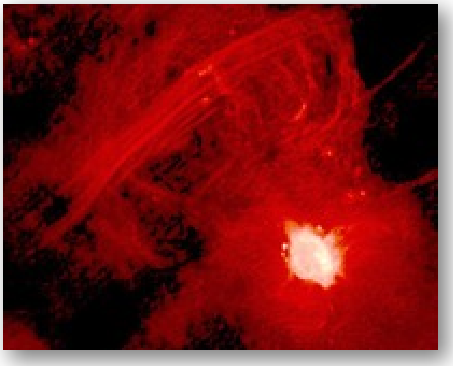
It has been said that the greatest obstacle to discovery is not ignorance but the illusion of knowledge. Too often the things we *think* we know obstruct the things we *need* to learn.

In the 20th century, the luminaries of theoretical science forged a picture of the universe that seemed somehow complete and inarguable. From subatomic physics to the life sciences, from planetary science to astronomy, astrophysics, and cosmology, the 'big picture' of the natural world left little room for doubt. Or so it seemed.

Today's popular cosmology stirs public imagination with weird and wonderful possibilities, all based on mathematics far beyond the interest or comprehension of most mortals. Working forward from a conjectured primordial state, the theorists would have us believe that they have solved the primary riddles of the cosmos - that they are on the verge of completing a 'theory of everything.'

We believe otherwise. Modern theory is not impregnable, and all is not well in the sciences. Space age engineers have indeed achieved unprecedented advances, and theoreticians have basked in the resultant glow of public attention. But in this environment a decades-old scientific myth froze into dogma that progressively excluded uncomfortable facts and counter-arguments. By the end of the 20th century, the illusion became 'reality' and the voices of critics—present in considerable numbers—were no longer heard.

It will be up to historians of science to show how this occurred. To make our case we need only consider discoveries readily accessible to working scientists and to all who have remained skeptical in the face of supposedly settled questions. As we intend to show, the fundamental mistake of standard cosmology is its dismissal of electricity in space.[2] Devotion to an electrically neutral, gravity-driven universe has turned cosmology into a playground for mathematicians. And this turn of events was possible only because today's cosmologists lack the training to see the most compelling message of the space age—*that we live in an electric universe*.



Today's cosmology asserts that all cosmic structure resulted from gravitational interactions following a primordial 'Big Bang.' On the contrary, here a Very Large Array (VLA) radio telescope image shows part of the electrical 'circuitry' feeding the core of our galaxy, the Milky Way.

No gravitational theorist ever suggested structures of this sort. In electrical terms the red filaments are the cosmic power transmission lines feeding the plasmoid at the center of the galaxy.

Credit: Farhad Yusef-Zadeh et al. (Northwestern), VLA, NRAO.

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[1] D. L. Jewett, "What's Wrong With Single Hypotheses? –It's time to eschew enthrallment in science," *The Scientist*, Volume 19, Issue 21, p. 10, Nov 7, 2005.

2 "It is pertinent to note, in this connection, that there are still many unsettled questions concerning the lightning storms that occur only a few miles above our heads in our own atmosphere." S. Chapman, *The Solar Wind*, Mackin & Neugebauer Eds., 1964, pp. xxiii-xxiv.

Cosmic Speculations

Only 'normal matter' can be directly detected with telescopes. Including matter and energy as separate elements in the same 'pie chart' highlights the breakdown of language in physics and descent into metaphysics. In the physical universe, mass is a *property* of matter. Einstein's famous $E=mc^2$ relates the *energy* stored in existing matter to its manifestation as *mass.* It tells us nothing about the *creation* of matter. Nor can it do so until we understand the real nature of matter.
Image Credit: NASA, WMAP

"The universe is made of stories, not of atoms."[3]

How did the universe begin? How does it work? Where is it headed?

For years, the scientific media have bombarded the public with intriguing answers to these big-picture questions. The themes are familiar even to the most casual observers of scientific commentary. Cosmologists speak confidently of the Big Bang that set the clock ticking and the universe on its course 13.7 billion years ago. This is a universe filled with black holes, dark matter, dark energy, and other incomprehensible objects and forces, all with one thing in common: they remain unseen and inaccessible under known laws of physics.

With each new discovery, the 'Big Bang' universe grows increasingly bizarre, inviting parodies that underscore the question many working scientists have hesitated to ask: *can anyone make real sense of this?*[4] The popular science fiction writer, Terry Pratchett, satirized the cosmological creation event: *"In the beginning there was nothing—which exploded."* When another science fiction writer, Douglas Adams, conjured an 'Infinite Improbability Drive,' the object of his wit was today's probabilistic quantum theory, which disconnects cause from effect. This theoretical approach has opened the door to every imaginable violation of physical laws, culminating in what many now claim to be the greatest scientific embarrassment of the twentieth century—'string theory.' When theories are described as 'beautiful,' one humorist asked "Where are the art critics of science?"

There is good reason for us to be skeptical. Cosmologists contend that their abstractions offer a secure foundation for understanding the origins, structure, and dynamics of the cosmos, as well as our place in it. But as we intend to illustrate with many examples, their conjectures failed to predict any of the milestone discoveries of the space age.[5]

Unyielding Faith in Gravity

"But hitherto I have not been able to discover the cause of those

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[3] Muriel Rukeyser, *The Speed of Darkness,* NY: Random House, 1968.

[4] "In spite of the fact that we call it the Big Bang theory, it tells us absolutely nothing about the Big Bang. It doesn't tell us what banged, why it banged, or what caused it to bang. It doesn't allow us to predict the conditions immediately after the bang."
Alan Guth in the BBC Horizon program, *Parallel Universes.*

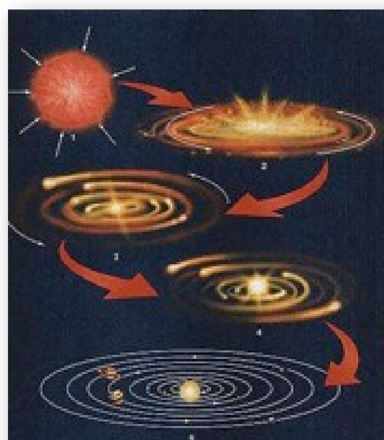
[5] "Big-bang cosmology refers to an epoch that cannot be reached by any form of astronomy, and, in more than two decades, it has not produced a single successful prediction." Fred Hoyle, *Home is where the Wind Blows,* 1994, p. 414.

properties of gravity from phenomena, and I frame no hypotheses."[6]

Cosmologists insist that the weakest force known to science—*gravity*—controls the universe. Early in the twentieth century, Einstein redefined Newtonian gravity by placing it in a metaphysical framework. He combined the three measurable physical dimensions of space with a mathematical 'dimension' that cannot be measured with a ruler: *time*.[7] The claimed success of Einstein's 'thought experiments' encouraged mathematicians to follow his lead, and they have dominated physics and cosmology ever since.[8]

It must be said that Einstein himself showed integrity by doubting his own work. But his followers have shown no such restraint. In their devotion to mathematical abstractions, cosmologists wrote themselves a blank check, with the freedom to invent anything necessary to save the theory when observations didn't fit.

Around the middle of the twentieth century, astronomers were shocked to discover unimaginable concentrations of energy in deep space. Limited to gravitational models, they could only envision super-massive, super-compact objects below the limit of resolution. The laws of physics were suspended to allow for 'black holes.' On discovering galactic motions that directly contradicted gravitational models, physicists imagined vast regions of invisible 'dark matter.' Since no one could see it, they were free to place it wherever needed to preserve appearances. Then, when other dubious assumptions led them to think that the universe is expanding *ever faster*—the ultimate violation of gravitational dogma—'dark energy' was invented. It is an exotic energy neither witnessed nor understood, but supposedly dominating cosmic motions.[9]



Spinning cloud flattening into a disk and condensing into a star and planets. From: www.aerospaceweb.org/question/astronomy/q0247.shtml

As the 'queen of the sciences,' modern cosmology has imposed boundaries on all related disciplines, with disastrous consequences. How did the Sun and its planetary satellites arise? Theory *required* stars to accrete gravitationally from diffuse nebular clouds, lighting a nuclear furnace hidden in their cores.[10] From the residual disk of equatorial material, the theory says, planets and moons slowly congealed, together with a horde of lesser rocks moving around the Sun as meteors, asteroids, and comets.

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[6] I. Newton, the final paragraph of the *Philosophiae Naturalis Principia Mathematica*.

[7] D. E. Pressler, "By definition, time cannot be measured in a single line so the use of the term dimension is ambiguous... any conclusions drawn from a fallacious argument is meaningless." from a lecture at the *12th Relativity Meeting* at Chicago University, 2002.

[8] "For the non-specialists four-dimensional relativity theory, and the indeterminism of atom structure have always been mystic and difficult to understand." H. Alfvén, *Nobel Lecture*, December 11, 1970, pp. 315-6.

[9] We take up these cosmic quandaries in Chapter 1.

[10] In Chapter 3 we offer an electrical alternative to the thermonuclear model of the Sun.

From these assumptions, it was no great leap to write the history of our solar system. If gravity rules, the planets have surely moved on regular and predictable orbits for billions of years—a tranquil backdrop for the geologic and biologic evolution of Earth, punctuated only by random impacts from space.

By the force of 'reasoning from the top down,' the clockwork solar system also set firm limits on our understanding of human origins, the history of consciousness, and the rise of civilization. In the uneventful solar system of theory, the present became the guide to the past.[11] According to that way of thinking the sky above our early ancestors must have been virtually identical to what we observe today. A *speculation* thus deprived historians, archeologists, and anthropologists of a desperately needed incentive. It permitted them to ignore the universal testimony of early cultures that the sky once looked *vastly* different.[12] Scholars investigating the human past did not realize that this submission to the cosmologists' creed only added to the cost of misdirection in the sciences.

A New View of the Universe

Today a new breed of scientist is challenging modern cosmology at the level of its underpinnings. Sir Isaac Newton wrote to Robert Hooke in 1676, *"If I have seen further it is by standing on the shoulders of Giants."* This famous saying has become a cliché. But we must be careful whose shoulders we choose. Researchers standing on the shoulders of *unsung* twentieth century giants of science (including several Nobel Laureates) are investigating the *plasma* universe. They remind us that interplanetary, interstellar, and intergalactic space is *filled* with tenuous plasma, a medium that continually defies expectations.

Plasma is distinguished by the presence of charged particles, and the freely moving electrons in plasma are the primary carriers of *electric currents*. For today's innovators, electricity is the key to understanding the never-ending surprises of the space age. The patchwork of modern cosmology is unnecessary, these researchers tell us. They do not follow abstract reasoning from the top down. Their understanding arises from experiment and direct observation. They begin by comparing plasma behavior in the laboratory to patterns seen in space. And their insights have consistently succeeded in predicting the path of discovery where standard cosmology has failed.

Working with advanced computer simulations and the most powerful electrical discharges that can be produced on Earth, these investigators are now pointing the way to a new and revolutionary vision of the universe.

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[11] "..Newtonian physics is a guarantee against the occurrence of – just about anything disagreeable." D. Stove, *Anything Goes,* p.174.

[12] D. Talbott and W. Thornhill, *Thunderbolts of the Gods,* Mikamar Publishing, 2005.

Chapter 1 — Cosmic Quandaries

"The telltale sign of a unification in depth is a more complete understanding of elementary objects and a wider reach to other fields and objects of physics."[13]

A fundamental component is missing from modern theories of the cosmos. The missing component is electricity. It is a curious omission, considering that all matter is composed of electrically charged particles. We are dependent on electricity for locomotion, lighting, and heating. Electricity efficiently and conveniently powers our cities hundreds or thousands of kilometers from the energy source. Should it surprise us that Nature has a means to use electricity in a similar way and for the same purposes on a cosmic scale?

'Benjamin Franklin Drawing Electricity from the Sky,' painting by Benjamin West. Credit: Philadelphia Museum of Art

In a letter to Dr. Lining of Charles Town, South Carolina, addressed and dated Philadelphia, March 18, 1755, Benjamin Franklin reproduced the section of the Minutes he kept which described the steps in his arriving at the conclusion that lightning is but a glorified electric spark.

For well over a century, a few leading researchers have discerned that electrical phenomena abound in space as well as on Earth. However, electricity is missing from modern cosmology because the most influential astrophysicists have given virtually no attention to the great electrical theorists of the past 150 years. Most of today's astronomers and cosmologists believe that only one force —gravity—is capable of organizing matter throughout the universe.

Since gravity, operating in an electrically sterile universe, is amenable to mathematical modeling, it is no coincidence that all of the prominent names in cosmology shine most brightly as mathematicians. And who could deny that Newtonian science enjoyed impressive success when compared to the astrology and religious dogma it replaced? Newton's equations helped to guide 20th century spacecraft into Earth orbits, then to the Moon and to the planets. In fact, it was the practical applications of Newtonian mechanics that convinced astronomers that electric forces are confined to local events like lightning, and that the big picture is controlled by gravity alone.

But gravitational theory was formulated before Benjamin Franklin flew his kite and before James Maxwell developed his theory of electromagnetism. By the late 1800s, researchers experimenting with electricity had already begun to explain natural phenomena that had remained mysterious—auroras, zodiacal light, and even Saturn's rings. Some speculated about electrical behavior of the Sun. Science journals published letters on the electrical nature of comets. In various forms, the work begun by these researchers continues today, supported by the rapid growth of space technology, interplanetary exploration, and advanced plasma laboratory research. But the history of this research is one of the best-kept secrets of our time.

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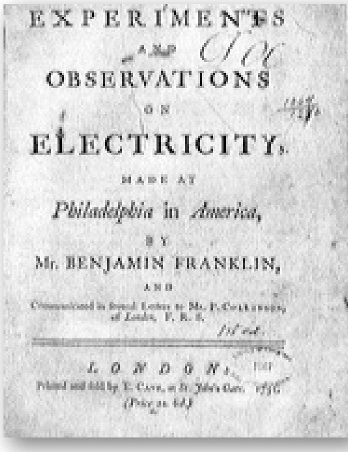
[13] E. Klein, M. Lachièze-Rey, *The Quest for Unity: The Adventure of Physics,* p. 94.



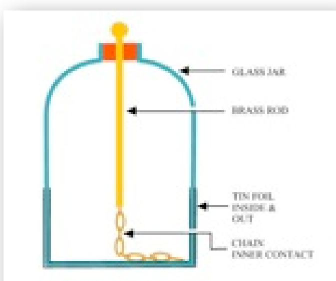
Statesman, author, and innovative printer, Benjamin Franklin was the first American to achieve an international scientific reputation. His book *Experiments and Observations on Electricity* was published in London in 1751.

Early electrical models of charged bodies in space, based on simple electrostatics, faced many problems. They lacked the benefit of later experimental research, including investigation of gas discharges and electrical circuits. So it is perhaps understandable that, early in the 20th century, opposition to electrical theories became entrenched. Space was thought to be a vacuum, a perfect insulator, making the flow of electric currents through this 'emptiness' impossible.

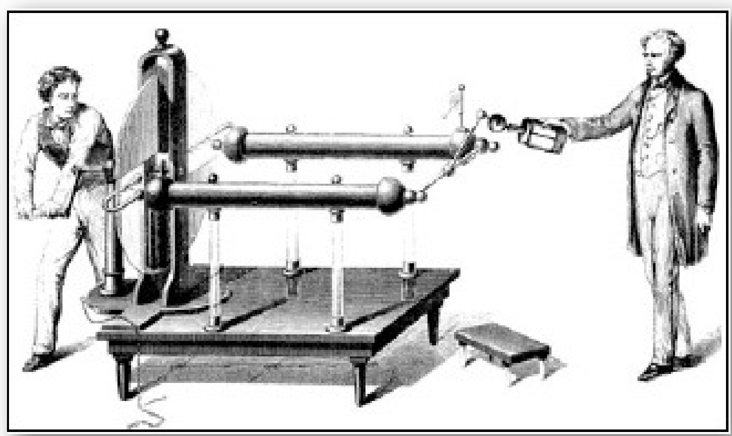
Astronomer Donald Menzel, Director of Harvard College observatory, expressed a common view when he wrote, in response to electrostatic ideas about the Sun, *"Indeed, the total number of electrons that could escape from the sun would be able to run a one cell flashlight for less than one minute."*[14]

The shame is that, in Menzel's time, it was already known that space is *not* empty. A percentage of atoms in space are positively charged due to the loss of one or more electrons. The resulting exceedingly thin medium, containing positive 'ions' and negative electrons, is *plasma*, sometimes called the 'fundamental state of matter' since it constitutes more than 99 percent of the visible universe. The electromagnetic behavior of plasma clearly distinguishes it from solids, liquids, and gases.[15]

But when faced with the newly discovered 'plasma universe,' astrophysicists turned their earlier argument on its head, now saying that plasma is a charge-neutral 'superconductor' and the extraordinary strength of the electric force guarantees that electrons will move at lightning-speed to short-circuit any electric differential. This claim



One of the early innovations of electrical researchers was the Leyden jar, a prototype of the 'capacitor' used to store static electricity. Its elementary components are two conductors separated by an insulator such as a glass bottle. The Ramsden generator (RIGHT) produced static electricity that could be stored in the Leyden jar.



[14] D. Menzel, *Flying Saucers* (Harvard University Press), 1953, p. 236.

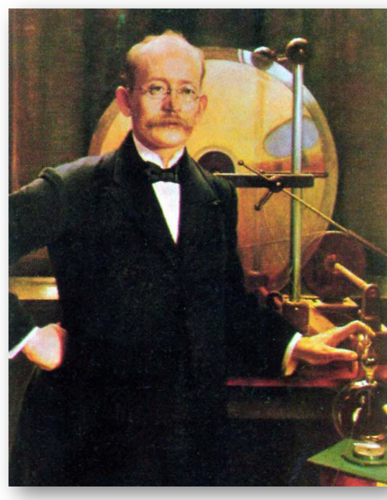
[15] See discussion of Hannes Alfvén, pp. 9ff. and Chapter 2.

enabled astrophysicists to continue treating plasma mechanically as a magnetizable gas without regard to the primary role of electric currents in space plasma. But the reversal left a gaping hole in standard theory. The universe revealed by radio telescopes is pervaded by magnetic fields and electromagnetic radiation—an inescapable fact confronting astronomers today. Magnetic fields are created by electric currents. And electric power is required to produce the radio signals. Magnetic fields in space are the cosmic *signature* of vast current streams throughout the universe.

Yet it seems that the myth of the 'short-circuited' universe lives on.[16] Scientists in more than a dozen fields continue to labor in the shadow of a mythic universe, believing that they can ignore electricity. It is only appropriate, therefore, that they be introduced to a different vantage point, one pioneered by some of the most insightful and accomplished scientists of the twentieth century.

Kristian Birkeland

The work of the early electrical theorists concentrated on laboratory experiments and systematic observation of natural phenomena, tracing back to the first investigations of Benjamin Franklin and his early counterparts in America and Europe.


Norwegian experimentalist
Kristian Birkeland

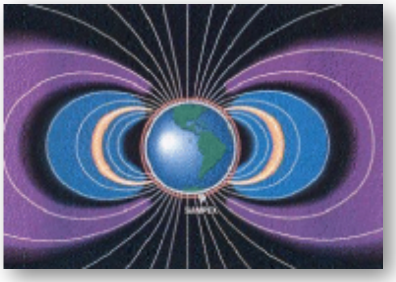
Much of the inspiration for today's advanced research came from the work of the Norwegian genius Kristian Birkeland, nominated for the Nobel Prize seven times. In 1889-90, Birkeland's Arctic expeditions took the first magnetic field measurements of Earth's polar regions. His findings suggested that charged particles originating from the Sun and guided by Earth's magnetic field produced the circumpolar rings of the auroras. Although mainstream theorists disputed this claim for decades, satellite measurements in the 1960s and '70s confirmed Birkeland's theory.

Birkeland was an experimentalist. He is renowned for his Terrella (little Earth) experiments in a near vacuum in which he generated electrical discharges to a magnetized metallic sphere representing the Sun or a planet. He was able to produce, in addition to scaled down auroral-type displays, analogs of planetary rings, weather features, sunspots, and other effects.[17]

In his experiments, Birkeland showed that electric currents flow preferentially along filaments shaped by current-induced magnetic fields. (Every electric current produces a magnetic field.) In this demonstration, he confirmed the observations of André Marie Ampère, who had noted that two parallel currents flowing in wires experience a

[16] We discuss the role of magnetic fields in space in Chapter 2.

[17] K. R. Birkeland, *The Norwegian Aurora Polaris Expedition, 1902-1903, Volume 1: On the Cause of Magnetic Storms and The Origin of Terrestrial Magnetism. 1908.*



The discovery of the two Van Allen Radiation Belts could be called the first surprise of the space age. But scientists might not have been surprised had they paid attention to the experiments of plasma scientist Kristian Birkeland.

We now know that the Earth is surrounded by a complex structure of magnetic fields and high-speed charged particles that include filamentary electric currents around the Earth. This structure has been named the 'magnetosphere' under the assumption that it forms the boundary between the Earth's and the Sun's plasma and magnetic fields.
Credit: NASA

long-range magnetic attractive force that brings them closer together. But as plasma filaments come together, they are free to rotate about each other. This generates a short-range repulsive magnetic force that holds the filaments apart so that they are insulated from each other and maintain their identity. The effect is that the filaments will form a twisted 'rope.' As they draw together, like a spinning ice skater bringing in her arms, they rotate faster and faster. Due to this dynamic, the paired current behavior is really an electrical 'whirlwind,' a plasma vortex (see pp. 34-5).

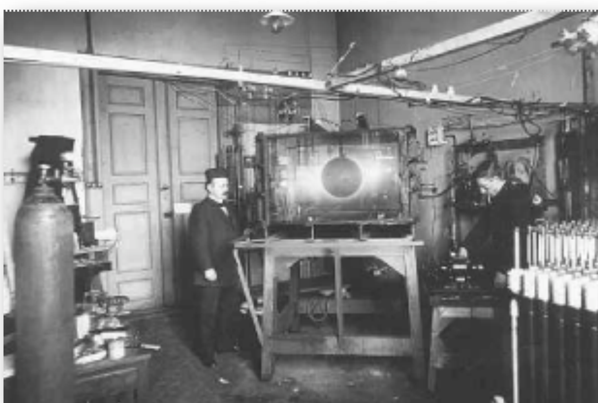
It was found that these twisted current pairs produce an alignment of current flow along the ambient magnetic field, providing the most efficient power transmission. The term 'Birkeland current,' referring to this natural configuration of current flow in plasma, first appeared in the scientific literature in 1969.

To put the electric force into perspective, it must be compared directly to the trivial force of gravity. The electric force is about a thousand trillion trillion trillion times more powerful. Another important fact to keep in mind is that the electromagnetic force acting between current filaments varies inversely with the *distance* between them. This is in contrast to gravity, which declines much more rapidly, with the *square of the distance*. For these reasons and many more, Birkeland currents provide a vastly more effective means than gravity for organizing widely dispersed dust and gas into stars and galaxies. These currents are also highly efficient at either imparting spin or removing spin from objects in space.

A studious observer of celestial phenomena, Birkeland believed that experimental knowledge of electric currents in plasma could pave the way to a unified cosmology, one *"in which solar systems and the formation of galactic systems are discussed perhaps more from electromagnetic points of view than from the theory of gravitation."*[18]

Birkeland was considered for the Nobel Prize but died while the committee was preparing his nomination. He is one of very few scientists to be honored on currency—his image and inventions appear on the Norwegian 200-kroner note.

Birkeland's work pointed the way for new generations of research on plasma's complex response to electric currents and magnetic fields. His successors include such plasma investigators as Nobel laureates Irving Langmuir and Hannes Alfvén.



Birkeland (LEFT) is shown operating his 'Terrella,' or 'little Earth.' The vacuum pump is being attended by an assistant to the right of the evacuated glass chamber. The magnetized sphere is enveloped by electrical glows that provided Birkeland with many insights into the electrical environment of the Earth, and auroras in particular.

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[18] "For the British scientists, as far as Birkeland could tell, their Earth stood in splendid isolation in empty space, impenetrable to outside cosmic forces other than that of gravity, which, after all, was British." *The Northern Lights*, Lucy Jago, Alfred and Knopf, NY, 2001 p. 82.

Langmuir was the first to use the word ‘plasma’ to describe this state of matter because of its life-like qualities, which reminded him of blood plasma (see information panel p. 12). He observed how plasma responded to charged objects by producing formations like cell walls —’Langmuir sheaths’—around the objects. Langmuir sheaths are often called ‘double layers’ (DLs) of opposite charge. Across the sheath there is a strong electric field, while on both sides of the double layer the electric field is much weaker.

The presence of double layers in plasma will tend to insulate a charged object from the surrounding plasma. This behavior, in particular, requires attention by those seeking to understand the nature of stars and the responses of planets and moons to their plasma environment. The insulating Langmuir sheath allows for the proximity of highly charged celestial bodies without the expected electrical exchange. In fact, though most cosmologists have never heard of them, plasma double layers may be the most important feature of plasma behavior.[19] Double layers can accelerate particles to cosmic-ray energies and can also account for rapid pulsing phenomena.[20]

The Norwegian Aurora Polaris Expedition, 1902-1903. In these volumes, Birkeland presaged the Earth’s magnetosphere, the solar wind and sputtering of matter from comets to form their stupendous tails.

Hannes Alfvén

The pioneers of plasma science knew that phenomena observed in the laboratory could be scaled up and applied to vast structures in space. And no one did more to advance experimental investigation of plasma than Hannes Alfvén. In 1948 Alfvén observed, *“Nearly everything we know about the celestial universe has come from applying principles we have learned in terrestrial physics…. Yet there is one great branch of physics that up to now has told us little or nothing about astronomy. That branch is electricity. It is rather astonishing that this phenomenon, which has been so exhaustively studied on the Earth, has been of so little help in the celestial sphere….”*[21]

Alfvén began his career as an electrical engineer and developed theoretical models for understanding plasma as a magnetic fluid. In 1970 he received the Nobel Prize for his fundamental discoveries in ‘magnetohydrodynamics,’ and he is acknowledged to be the founder of the study. Ironically, Alfvén’s early concept of magnetic fields ‘frozen-in’ to ‘superconducting’ plasma underpins the mainstream interpretation of magnetism in space. And it is this very concept that

Hannes Alfvén (1908-1995)

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[19] “Double layers in space should be classified as a new type of celestial object (one example is the double radio sources). It is tentatively suggested that X-ray and gamma ray bursts may be due to exploding double layers.” H. Alfvén, *Keynote Address, International Symposium on Double Layers in Astrophysics*, NASA Conference Publication 2469, 1987, pp. 1-32.

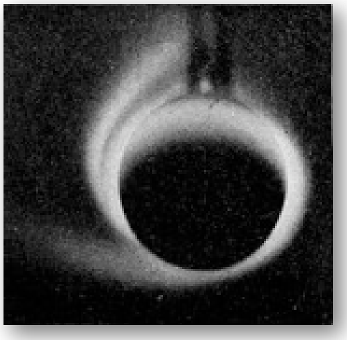
[20] A. Peratt, *Physics of the Plasma Universe,* p.194.

[21] H. Alfvén, *Electricity in Space,* First published in 1948 in *The New Astronomy,* Chapter 2, Section III, p. 74.

has enabled astrophysicists to ignore the electric currents necessary to generate and maintain cosmic magnetic fields.

The critical turn in this story, the part never told within the astrophysics community, is that Alfvén came to realize he had been mistaken. In his acceptance speech for the Nobel Prize, he pleaded with scientists to ignore his earlier work. Magnetic fields, he said, are only one component of plasma science. The electric currents that generate magnetic fields must not be overlooked, and attempts to model space plasma in the absence of electric currents and circuits will set astronomy and astrophysics on a course toward crisis.

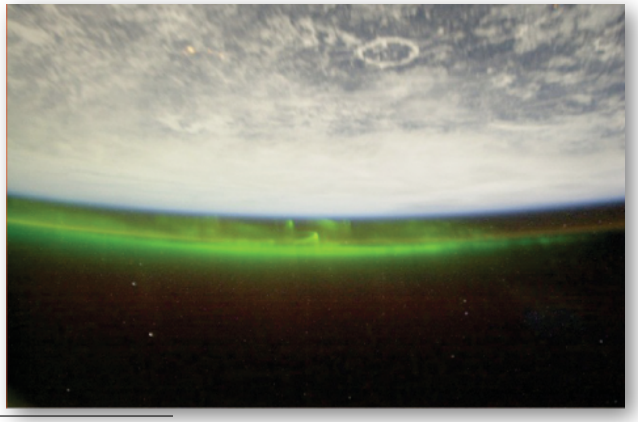
Alfvén stressed that plasma behavior is too *"complicated and awkward"* for the tastes of mathematical theorists. It is a field *"not at all suited for mathematically elegant theories,"* and it requires strict attention to plasma behavior in the laboratory: *"The plasma universe became the playground of theoreticians who have never seen plasma in a laboratory. Many of them still believe in formulae which we know from laboratory experiments to be wrong. The astrophysical correspondence to the thermonuclear crisis has not yet come."*[22]



ABOVE: Kristian Birkeland's magnetized Terrella, simulating a spiral nebula.

Alfvén reiterated the point many times: the theoretical assumptions of cosmologists today *"are developed with the most sophisticated mathematical methods,"* and it is *"only the plasma itself which does not understand how beautiful the theories are and absolutely refuses to obey them."*[22]

Plasma in space is electrically 'quasi neutral.' However, its temperature, density and chemical composition vary from place to place. At the boundaries between plasma of different characteristics a 'cell wall' or 'double layer' (DL) is formed, across which a voltage is generated. Plasma cells moving relative to one another induce electric currents in each other. Now, at the largest scale that we can observe,



RIGHT: Like a high-tension wire, our Earth produces hums and crackles as it responds to surges of power in the electric currents of space. Perhaps the most obvious sparks are the auroras, as seen in this picture taken from the International Space Station in April 2003. Credit: Don Pettit, ISS Expedition 6, NASA

[22] H. Alfvén, "Plasma physics, space research and the origin of the solar system," *Nobel Lecture*, December 11, 1970, pp. 308-9. See nobelprize.org/nobel_prizes/physics/laureates/1970/alfven-lecture.pdf

we see superclusters of galaxies—composed primarily of plasma—moving relative to each other. Therefore, every plasma cell at smaller scales is embedded in externally generated fields and will develop filamentary currents that form circuits within. The power in those circuits is dissipated by objects like rotating spiral galaxies and the stars within galaxies.

Nevertheless, in their discussion of plasma phenomena, astrophysicists continue to refer to plasma as a gas, and their descriptions of celestial events draw upon the language of wind and water, an invitation to scientific confusion: plasma discharge follows different rules from those governing the behavior of either gases or liquids.

Astrophysicists are not trained in electrodynamics, circuit theory, or plasma discharge phenomena. Such things would render their gravitational models obsolete and require practical experiments outside the areas of their expertise. They continue to rely on gas and magnetized-fluid physics that is mathematically well-mannered. They seem not to consider that our insulated home at the bottom of an atmosphere on a small rocky planet presents an illusion of electrical neutrality. In truth, our Earth is part of a *complex* electric universe.

Hannes Alfvén, in 1970, receiving the Nobel Prize from the king of Sweden.

As a rule, astrophysicists will not attend conferences having anything to do with electric discharge in plasma. They have little or no interest in the application of electrical phenomena to unsolved enigmas in space. Published findings, including the work of the leading authorities on plasma cosmology—a discipline recognized by the Institute of Electrical and Electronics Engineers (IEEE)—receive little acceptance or acknowledgment in mainstream astronomy and astrophysics journals.

This theoretical division can be resolved only by a fundamental reassessment of popular theory, starting with doctrines that dominated the sciences at the end of the twentieth century.

The Big Bang and the 'Expanding' Universe

No definitive assessment of Big Bang cosmology could be achieved in the limited space of this monograph. But, if accepted theories are mistaken when they exclude electric currents in space, it is likely that many effects of the mistake will be obvious to investigators well trained in the behavior of electrical phenomena.

Pioneers of Plasma Cosmology

Kristian Birkeland (1867-1917)

Irving Langmuir (1881-1957)

Hannes Alfvén (1908-1995)

More than 100 years ago, Norwegian physicist Kristian Birkeland proposed an electrical explanation of the auroras, based on direct experimental evidence. He designed a magnetized sphere suspended in a vacuum to experimentally model the electrical behavior of the Earth. He called this experiment a 'Terrella,' Latin for 'little earth.' He found that the magnetic field of the Terrella guided charged particles to its magnetic poles, producing rings of light that appeared to mimic Earth's auroras.

Birkeland proposed that auroras are caused by charged particles ejected from the Sun and guided to the Earth's polar regions by the geomagnetic field. The hypothesis was disputed for many years. Confirmation of Birkeland's aurora theory finally came from observations made above the ionosphere by satellites, beginning in 1963. The first map of 'Birkeland currents' in the Earth's polar region was developed in 1974 from satellite-borne magnetic field observations. Today, Birkeland's description of current flow in plasma is essential to the understanding of space plasma.

The work of Irving Langmuir left its mark on many sciences. He was largely responsible for the perfection of Edison's incandescent light bulb. His sonar system for detecting submarines was a vital tool of the allies in World War II, and his understanding of oil films on water or glass surfaces led to dramatic improvements in optics and a Nobel Prize in 1932.

In 1927, Langmuir's studies of electrical discharge phenomena led him to use the term plasma to describe ionized gases and their lifelike responses to electricity. His observation of the cellular 'sheath' that forms around charged objects in a plasma laid a foundation for a new understanding of the 'magnetospheres' of planets and stars. Today, 'Langmuir probes' in spacecraft continue to expand our understanding of plasma in space.

Virtually all of modern plasma physics is indebted to Hannes Alfvén for his insights into the role of electric and magnetic fields in plasma. But there is an irony to Alfvén's contributions. In his earliest papers, he spoke of magnetic fields being 'frozen' into plasma, a notion to which astrophysicists were readily attracted, and today the concept underpins most mainstream ideas about magnetic fields in space. Alfvén, however, later dissociated himself from his own pioneering contribution. Instead of isolated magnetic regions enduring forever, he came to see electric currents through the rarefied plasma of space as the source of localized magnetic fields. Based on these observations he and his colleagues proposed a far-reaching alternative cosmology to the Big Bang.

In 1970 Alfvén received the Nobel prize for his *"fundamental discoveries in magnetohydrodynamics."* He used the occasion of his acceptance speech to beg scientists to ignore his earlier work. He considered the failure of physicists to produce controlled fusion, after 30 years' of expensive attempts, to be a result of the tenacity with which they hold on to his mistaken early speculation.

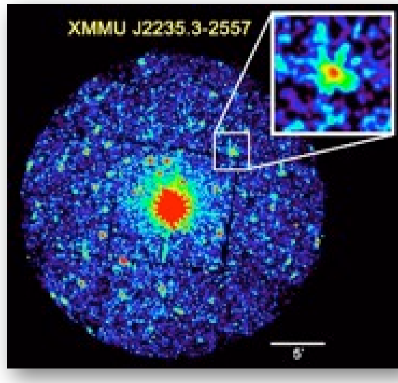
INFORMATION PANEL

The Big Bang hypothesis rests on two unconfirmed and precarious assumptions, one about the implications of the light waves received from remote objects in space, the other concerning the role of gravity in the macrocosm. Cosmologists assume—

(1) that the redshifts of objects in deep space indicate primarily that the objects are receding, and

(2) that gravity alone, the weakest force in the universe, determines the structure and behavior of matter on the cosmic scale.

These two assumptions have encouraged theorists to ignore the role of electricity in the plasma universe.



Combining observations by the Very Large Telescope and the XMM-Newton X-ray observatory, astronomers discovered (white inset) a massive cluster of galaxies—"the most distant, very massive structure in the Universe known so far." According to the announcement by the European Southern Observatory, "The discovery of such a complex and mature structure so early in the history of the Universe is highly surprising." To state the point more accurately, astronomers had long believed such 'early' structure to be impossible. But is this cluster really as distant, massive, and 'early' as astronomers' theoretical assumptions imply?
Credit: ESA, XMM-Newton, Mullis et al.

First assumption: that redshift implies distance.

Sixty years ago Edwin Hubble discovered the velocity-distance relation, based on redshift of remote stars and galaxies (the stretching of their light toward red on the light spectrum). This discovery laid the foundations for modern cosmology. But Hubble remained cautious. Using the known intrinsic brightness of galaxies as one scale of distance and redshift as another, Hubble found that *"one scale does lead to trouble. It is the scale ...which assumes that the universe is expanding."*[23] Five years later, Hubble reiterated the concern— *"It seems likely that redshift may not be due to an expanding Universe, and much of the speculations on the structure of the universe may require re-examination."*[24]

However a consensus was soon established which assumed that the redshift could only be due to the 'Doppler effect'—the objects must be moving away from the observer, stretching out the light waves emanating from them. This enabled astronomers, based on the degree of redshift, to calculate velocities of recession and implied distances from Earth. The calculations could only mean that the universe is expanding. And since this expansion could not have been going on forever, it must have had a starting point. In their confidence, cosmologists give us a *date* for the Big Bang (13.7 billion years ago).

But for decades now, astronomer Halton Arp, the leading authority on peculiar galaxies, has been warning cosmologists that their underlying assumption cannot be correct. He claims that objects of widely varying redshift are physically connected to each other. Even quasars, which astronomers (based on redshift) place at the outermost reaches of the universe, reveal 'impossible' bridges and 'preposterous' statistical clustering near active galaxies in our own cosmic neighborhood.

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[23] E. Hubble, "The Problem of the Expanding Universe," *American Scientist*, Vol. 30, No. 2, April 1942, pp. 108-9.

[24] E. Hubble, "The 200-Inch Telescope and Some Problems It May Solve," *Publications of the Astronomical Society of the Pacific*, 1947, pp. 153-67.

Astronomer Halton (Chip) Arp
Photo: W. Thornhill

(See image on p.17, showing a quasar in *front* of a nearby galaxy.)

Astronomers responded to Arp's critical observations by depriving him of his telescope time, and he was forced to leave the United States to carry on his groundbreaking work at the Max Planck Institute in Germany. As noted by Geoffrey Burbidge, *"Arp was the subject of one of the most clear cut and successful attempts in modern times to block research which it was felt, correctly, would be revolutionary in its impact if it were accepted."*[25]

Having adopted the Big Bang, the scientific media regularly publish a story of 'success.' When the COBE satellite measured the cosmic microwave background radiation (CMBR) at 2.7 Kelvin, proponents of the Big Bang immediately announced that the measurement 'confirmed' their theory. Principal investigator of the COBE team, Dr. John Mather: *"The Big Bang Theory comes out a winner."* John Huchra, a professor of astronomy at Harvard University: *"The discovery of the 2.7 degree background was the clincher for the current cosmological model, the hot Big Bang."* And astrophysicist Michael Turner: *"The significance of this cannot be overstated. They have found the Holy Grail of cosmology."*

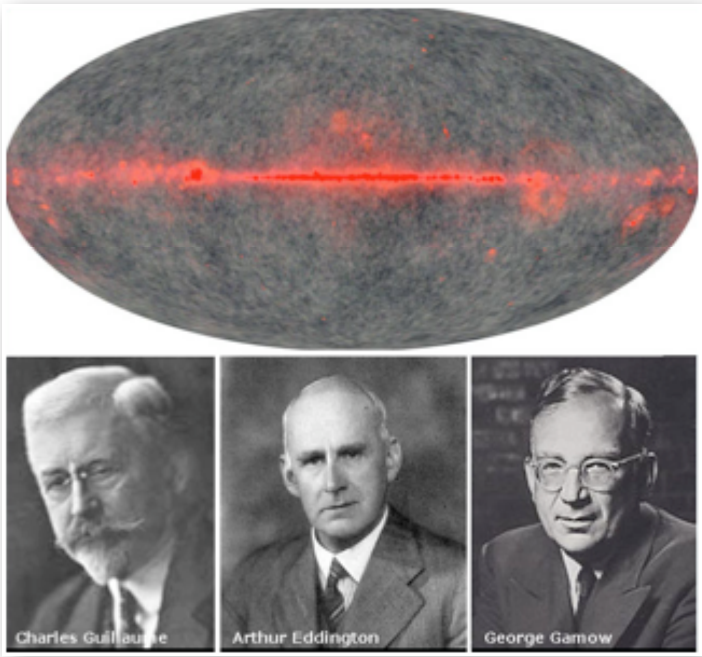
Did the measurement of the CMBR actually confirm a prediction of the Big Bang hypothesis? The truth is that predictions by other theorists, who did not base their estimates on the Big Bang, were a great deal closer. The first astronomer to collect observations from which the temperature of space could be calculated was Andrew McKellar. In 1941 he announced a temperature of 2.3K from radiative excitation of certain molecules. But World War II occupied everyone's attention and his paper was ignored. In 1954, Finlay-Freundlich predicted 1.9K to 6K based on 'tired light' assumptions. Tigran Shmaonov estimated 3K in 1955. In 1896, Charles Edouard Guillaume predicted a temperature of 5.6K from heating by starlight. Arthur Eddington refined the calculations in 1926 and predicted a temperature of 3K. Eric Regener predicted 2.8K in 1933.

In fact, the proponents of the Big Bang had made the *worst* predictions. Robert Dicke, whose microwave radiometer made possible a rough estimate of background radiation in 1964 (3.5 degrees K), had predicted 20K in 1946. Later he revised the predictions to 45K.

No name is more closely associated with the Big Bang than that of astrophysicist George Gamow, who in 1961 gave an estimated background temperature of 50K. To place the competing estimates in perspective, one must keep in mind that the 'temperature' in space is the square root of a square root of energy density. So as a measure of the background energy of the universe, Gamow's estimate of 50K was *12,000 times* too high.

What actually occurred is that, as *technology* moved toward more

[25] F. Hoyle, G. Burbidge, J. V. Narlikar, *A Different Approach to Cosmology,* p. 134.



Top: The Wilkinson Microwave Anisotropy Probe (WMAP) map of cosmic microwave background temperatures. Red indicates warmer, and grey indicates cooler areas. The cosmic microwave background fluctuations are extremely faint (one part in 100,000) compared to the 2.73 Kelvin average temperature of the radiation field.
Credit: WMAP Science Team, NASA

The discovery of the cosmic microwave background radiation (CMBR) is often claimed to have 'confirmed' the Big Bang. But the truth is quite the opposite. Predictions by Charles Guillaume, Arthur Eddington and others were not based on the Big Bang, and they were much closer than those by proponents of Big Bang cosmology such as George Gamow.

precise measurements, Big Bang proponents simply changed their theory to match discoveries. Nothing ever discovered 'confirmed' the Big Bang. Clearly, the CMBR is not uniquely a requirement of Big Bang cosmology. In fact, the astronomer Fred Hoyle said, *"A man who falls asleep on the top of a mountain and who awakes in a fog does not think he is looking at the origin of the Universe. He thinks he is in a fog."* [26] It is certainly a peculiar assumption that CMBR has anything to do with the origin of the universe. In 2006, the shadows expected to be cast by the distant CMBR were not found.[27] As Hoyle makes clear, it is more sensible to assume that CMBR is locally generated microwave radiation—a 'fog.' The recent WMAP data seems to confirm it when matched against radio signals from local neutral hydrogen (HI) filaments.[28] The CMBR is simply the 'hum' of the galactic power lines in the vicinity of our solar system.

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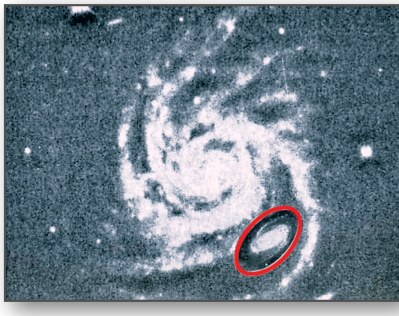
[26] Cited in H. C. Arp, G. Burbidge, F. Hoyle, J. V. Narlikar, N. C. Wickramasinghe, "The Extragalactic Universe: an alternative view," *Nature* Volume 346, pp. 807-812, 1990.

[27] Lieu, Mittaz and Shuang-Nan Zhang, "The Sunyaev-Zel'dovich effect in a sample of 31 clusters: A comparison between the X-ray predicted and WMAP observed decrement," *Astrophysical Journal,* Sept. 1, 2006, Vol. 648, No. 1, p. 176

[28] "do those [WMAP] signals truly reveal the fingerprints of processes that took place shortly after the universe was born? Upon closer inspection, certain features in the WMAP maps look hauntingly familiar to those who have spent their careers studying the HI structure and radio emission from the Milky Way galaxy." G. Verschuur, "High Galactic Latitude Interstellar Neutral Hydrogen Structure and Associated High Frequency Continuum Emission," *IEEE Transactions on Plasma Science,* August 2007.



This image superimposes two galaxies at their relative sizes if the redshift/distance assumption is correct. The high-redshift spiral galaxy NGC 309 appears to dwarf the lower redshift galaxy M81. But M81 is amongst the *largest* nearby spiral galaxies. Do spiral galaxies get bigger the farther they are from Earth? Critics suggest that the 'super-sized' spiral is a distortion due to the false assumption that redshift gives a measure of distance.
Credit: Halton Arp, *Seeing Red*

A Return to Common Sense

The present state of Big Bang cosmology highlights an urgent need for a return to common sense in the face of unreality in the sciences. Direct observations and experiment must take precedence over thought experiments and purely mathematical adventures. It is too easy to introduce new theoretical assumptions after each discovery to explain away uncomfortable data.

When things become oddly coincidental or improbable, that is a good reason to reconsider theoretical assumptions, no matter how far-reaching the implications. This was, of course, the point made by Arp. *"The evidence that many objects previously believed to be at great distances are actually much closer confronts us with the most drastic possible revision of current concepts,"* he wrote.[29]

If the redshift/distance assumption is incorrect, certain signs of this should be obvious, showing up as a greatly distorted picture of size, energy, and distribution of redshifted objects. When astronomers see a strongly redshifted galaxy they envision it as occupying the outer edges of the universe. But what if the redshift is largely due to an intrinsic quality of the object, something *other* than recessional velocity? Imagine what that would do to the calculated *size* of the object, for example. If it has erroneously been placed at the farthest reaches of space, then astronomers will assume it is *much larger* than it actually is, creating an artificial distortion. The picture on the upper left highlights the uncomfortable consequence. It juxtaposes two galaxies at the relative sizes they would be if they were at their accepted redshift distances. The low-redshift galaxy M81 (inset) is one of the *largest* nearby spiral galaxies. The higher redshift NGC 309 (large image), an otherwise normal-appearing spiral galaxy, has been distorted so much by assuming that it is at its 'redshift distance' that it appears to swallow M81 in one of its arms. Is it reasonable to assume that galaxies of the same type will be considerably larger if they are farther away? Or is the theoretical assumption that makes them larger incorrect?

Arp 220 is the brightest of the 'Ultra Luminous Infra Red Galaxies,' (ULIRGs). It is number 220 in Arp's Catalogue of Peculiar Galaxies, To be as far away as astronomers assume, based on redshift, it must be the brightest object in the heavens.
Credit: R. Thompson (U. Arizona) et al., NICMOS, HST, NASA

And what of the *luminosity* of strongly redshifted objects? If astronomers are placing objects much too far away, then these objects must be 'super-luminous' to appear as bright as they do in our sky. So today astronomers speak of 'ultra-luminous' objects (UL's). But is their 'brightness' a fact, or an *artifact* created by a doubtful theoretical assumption? (See the 'Ultra Luminous Infra Red Galaxy' or ULIRG, left.)

Gamma-ray bursts (GRBs) are supposed to be the most luminous events known in the universe since the Big Bang. But how energetic is

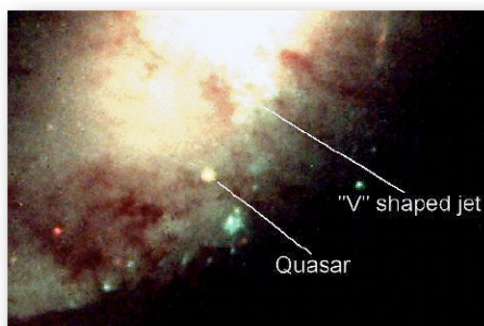
[29] H. Arp, *Catalogue of Discordant Redshift Associations*, p. 46. (Montreal: Apeiron, 2003)

a GRB? The estimated energy levels depend on the calculated distances. While the gamma rays are produced for only a few seconds, many GRBs can be identified by their afterglow in X-ray, visible light, and radio waves. When astronomers assume that redshift equates to distance, many GRBs suddenly become exceedingly far away, ancient, and inconceivably energetic—more powerful than anything previously considered possible. Nothing closer to us in distance could compare to it. Consequently, we are told that GRBs in the early universe were much stronger than more recent gamma ray bursts.

The arrow in this Hubble Space Telescope image points to a ULX, or Ultra Luminous X-ray object in front of the galaxy NGC 7319. It is now known to be a quasar, showing up where quasars, based on redshift assumptions, were never supposed to be. In relative terms, it is in our own neighborhood, not at the outer boundaries of the visible universe. Credit: NASA, and S. Gallagher (Penn State University)

But are highly redshifted objects really so far away that new categories are necessary to describe them? Pictured on the right is the galaxy NGC 7319, as captured in a Hubble Telescope image of Stephan's Quintet, a visual assembly of five galaxies. NGC 7319 is a 'Seyfert 2,' which means it is shrouded with heavy dust clouds that obscure most of the bright, active nucleus that defines a normal Seyfert galaxy. This galaxy has a very low redshift of 0.0225. But a small object close to the core of the galaxy (denoted by an arrow) is an ULX—an 'Ultra Luminous X-ray object.' Prior to the Hubble image Arp had concluded that this light source was a *quasar*, an object that could not, on standard assumptions, lie in *front* of the dense galactic cloud.

When Arp observed the spectrum of the object it did indeed reveal itself as a profoundly redshifted quasar. Arp writes, *"Nothing could convey the excitement of sitting in the Keck 10 meter control room and seeing that beautiful z = 2.11 [high redshift] spectrum unfold on the screen."*[30]



The galaxy, NGC 7319 has a redshift of 0.0225. The quasar shown has a redshift of 2.114. Hence, on cosmologists' standard ruler, the quasar should be *much* more remote than NGC 7319—not *in front* of it. Credit: Jane C. Charlton (Penn State) et al., HST, ESA, NASA.

The subsequent Hubble image, highlighting the relationship of the quasar to the dense galactic cloud, thus brought attention to something Arp had long been saying, even as astronomers ignored him. The tiny white spot is a quasar either silhouetted in front of the opaque plasma clouds or embedded in the topmost layers of the dust. The redshift of the quasar is 2.114, compared to the background galaxy's redshift of 0.0225. Since the discovery of this badly misplaced quasar, one might have expected a great controversy to erupt among cosmologist. Yet the scientific media have virtually ignored it.

In the close-up of NGC 7319 (right) a jet extends from the core of the galaxy toward the quasar, a phenomenon anticipated by Arp's theory of quasar ejection from parent galaxies (see diagram on p. 19). Based on patterns he had observed over decades, Arp concluded that most, if not all, ULXs will turn out to be nearby quasars in the process

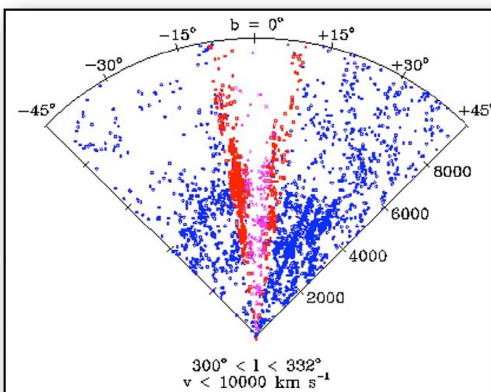
[30] H. Arp, private communication. See arxiv.org/pdf/astro-ph/0409215

Astronomer, Geoffrey Burbidge.
Credit: Armagh Observatory

of being ejected from active galaxies.

A few astronomers investigated Arp's work. Geoffrey Burbidge designed a test of Arp's conclusions concerning ULXs. He looked at 24 quasars that are unusually close to active galaxies. If he pretended that he didn't know that they were quasars (that is, he pretended that he didn't know they had a high redshift), then all 24 of them met the criteria of 'standard' ULXs in neighboring galaxies. What astronomers considered impossible is apparently business as usual in the cosmos, according to Burbidge's findings.

The standard ruler for measuring galactic distances produces distortion of every type that would be expected if the Doppler interpretation of redshift is not reliable. For example, it artificially stretches clusters of galaxies into narrow lines radiating away from the Earth, as if we are the center of the universe. That is because the visible clusters include bodies with quite different redshifts, so astronomers are required by their theoretical assumptions to place them on a line extending out from the observer. Of course, to the extent that the redshift is intrinsic to the respective galaxies, then no distortion will occur.



The chart above, representing a 90 degree slice of the sky, shows the effect of redshift on a 'map' based on the Doppler interpretation of redshift. Galactic clusters are stretched into the 'fingers of god' pointed at the earth from every direction. The galaxies in red are those of the Virgo Cluster. (See optical image on the opposite page.) The 'fingers' involve velocities and distances that preclude explanations based on peculiar motions within the cluster.
Credit: AAO newsletter, Aug 1996

Arp's interpretation of this redshift anomaly is well illustrated by the 90 degree chart of the sky, on the left. By closely examining peculiar galaxies and galactic clusters, he came to realize that the core galaxies of clusters are typically very bright and shifted toward blue on the light spectrum, whereas the galaxies toward the periphery of the cluster are progressively less bright and shifted toward red. This, he concluded, was due to the ejection of smaller, higher redshift galaxies from larger and brighter parent galaxies exhibiting lower redshift. In the case of the 'great-grandparents' closer to the core of the cluster, the shift is toward blue. From this deduction, based on direct observation, Arp anticipated precisely what is shown on the 'galactic map' on the left. The map artificially projects the edges of the Virgo cluster up to *450 million light years* outward from the observer on Earth, all due to the redshift assumption. The inner portion of the 'V' created from this distortion is empty—simply because these older, larger, and brighter galaxies are blue shifted and thus misplaced (by the erroneous Doppler interpretation of redshift) to the *base* of the 'V.' For this predictable distortion Big Bang cosmology has no explanation.

Distortions such as those noted here have led to a complex chain of rationalizations. Seeing the *'fingers of God'* pointing at the Earth astronomers suggested that this effect was due to peculiar motions within large clusters of galaxies. But this would require preposterous velocities internal to a cluster, with no force available to hold the cluster together across the equally implausible distances implied.

Appeals to invisible 'dark matter' will not save the standard interpretation of redshift either. The gravitational models preclude the *two* redshifted 'fingers' of the Virgo cluster map. In gravitational terms, relative motions away from Earth will be balanced by relative motions toward Earth. Even if we accept the implausible distances and velocities necessary to produce such pronounced radial distortions, there should be two fingers at two different 'distances,' one red and the other blue. And there should not be an 'empty V' in the chart.

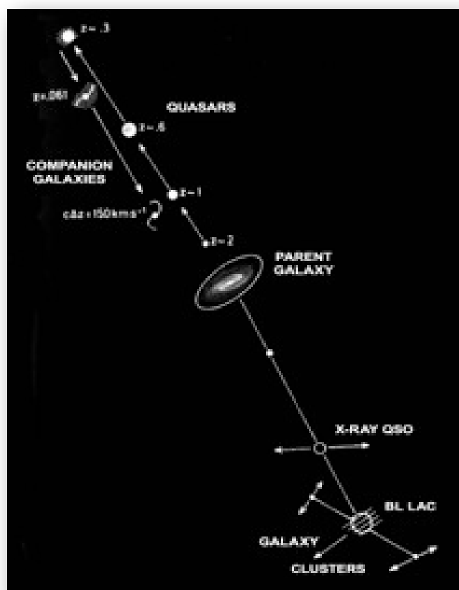
In the universe envisioned by Arp, multiple objects of different redshifts are part of coherent interacting systems. In fact, over several decades now, he has pointed to hundreds of instances in which bodies are interacting physically and energetically in contradiction of redshift assumptions. They obviously do not stand billions of light years away from each other.

One example is the barred spiral galaxy NGC 1313 on the right. It is seen in the southern sky near the Large Magellanic Cloud. Though it is surrounded visually by smaller and fainter bodies, they are all redshifted to the extent that, on the astronomers' assumption, they could not be dynamically connected to NGC 1313. The first problem is that this form of galaxy, according to mainstream thinking, *requires* interactions. Indeed a companion must pass *through* the galaxy.

Visually, there are over 100 galaxies within a degree of NGC 1313. The only consideration that prevents them from being possible neighbors of NGC 1313 is the usual assumption that a small and faint appearance means a great distance away.

One characteristic of quasars is their strong X-ray emission, and within the bounds of NGC 1313 two objects have already been identified as ultra-luminous X-ray (ULX) sources. Because ULXs appear to be within *nearby* host galaxies, they cannot be identified as quasars under standard theory: the high redshifts of quasars require that they be great distances away. A number of ULXs have been examined closely and have turned out to be quasars—which then have been dismissed as 'background objects' seen through 'holes' in the foreground galaxy. But if Arp is correct, and a growing number of astronomers have concluded that he is, it is likely that most ULXs will turn out to be quasars that have been generated recently by the very galaxy to which they are visually linked.

NGC 1313, a barred spiral galaxy in the southern sky near the Large Magellanic Cloud, displays at least two ultra-luminous X-ray (ULX) objects. If they are quasars, as Halton Arp suspects, they will spell more trouble for the Big Bang.
Credit: Henri Boffin (ESO), FORS1, 8.2-meter VLT, ESO



Arp's empirical model of galaxy interactions. It shows how galaxies are born from an active parent galaxy. The model has almost biological overtones and allows the genealogy of nearby galaxies to be reconstructed.
From H. Arp, *Seeing Red,* p. 239

From Speculation to Ideology

There is a lesson for us in the hardening of the mainstream perspective on redshift. Recent history suggests that, given time, theories tend to harden into 'facts,' even in the face of mounting contradictions. Astronomer Carl Sagan's *Cosmos* was published a quarter-century ago. At that time, some questions were still permitted. On the issue of redshift, Sagan wrote: *"There is nevertheless a nagging suspicion among some astronomers, that all may not be right with the deduction, from the redshift of galaxies via the Doppler effect, that the universe is expanding. The astronomer Halton Arp has found enigmatic and disturbing cases where a galaxy and a quasar, or a pair of galaxies, that are in apparent physical association have very different redshifts...."*[31]

Sagan's acknowledgment here shows a candor almost never found in standard treatments of astronomy for the general public today. *"If Arp is right,"* he wrote, *"the exotic mechanisms proposed to explain the energy source of distant quasars—supernova chain reactions, super massive black holes and the like—would prove unnecessary. Quasars need not then be very distant. But some other exotic mechanism will be required to explain the redshift. In either case, something very strange is going on in the depths of space."*

At the time of Sagan's *Cosmos*, evidence contradicting the Doppler interpretation of redshift could be discussed in popular presentations. The paradox is that the intervening years have seen an avalanche of evidence against Big Bang assumptions, even as public relations announcements have 'confirmed' them and NASA refuses to fund *any* project questioning the Big Bang.[32]

Recent images of the clustered galaxies of Stephan's Quintet suggest interactions that cannot not be taking place under mainstream assumptions. One of the galaxies NGC 7320, (lower left) has a tail that can be traced to a high redshift galaxy to the left (out of frame). NGC 7319 has a redshift (indicative velocity) of 6700 km/s, similar to the other 3 members to the right; NGC 7320 has a redshift of 800 km/s and it is the largest "dominant" member of the group, thus fitting the general pattern that the dominant members have the lowest redshift. (NGC 7319 is the galaxy in front of which appears the quasar noted on page 17.)
Credit: NASA/JPL/Max-Planck Institute/P. Appleton (SSC/Caltech)

[31] C. Sagan, *COSMOS*, p. 255.

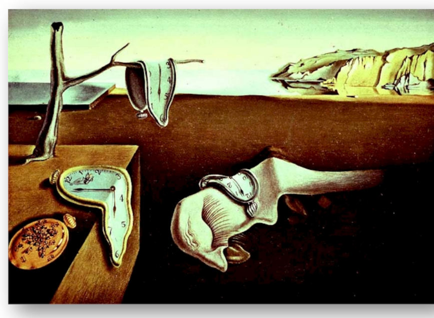
[32] See astronomer Tom Van Flandern's "Top 30 Problems with the Big Bang," metaresearch.org/cosmology/BB-top-30.asp

Second assumption: that gravity is sovereign

Metaphysics and Obscurantism

For our purposes here we shall leave aside the metaphysical nuances of the Big Bang, other than to note the profound confusion engendered by terminology that has crept into popular usage. When proponents of the Big Bang universe use the word 'dimension' in reference to more than the three spatial dimensions, they imply that a ruler can also be used to measure the extra dimensions. To speak of a weird cloth called the 'fabric of space-time,' or of 'four-dimensional warped space,' is no more helpful than references to 'parallel universes,' 'time travel,' or 'string theory.' Unfortunately, the notion of extra dimensions has become increasingly popular in science, science fiction and new-age literature and given a false impression of substance.

It is noteworthy that Einstein inspired the surrealist artist, Salvador Dali. But when mathematicians introduce Daliesque rulers and clocks to physics, they are throwing away the underpinning of modern science—*measurement*.



Salvador Dali's The Persistence of Memory

While we are not averse to exploring possible bridges between physics and metaphysics, cosmologists have grown careless in their use of language, as when they use the words 'mass' and 'matter' interchangeably. We can define matter in terms of its constituent subatomic particles. But what is the essential *nature* of matter that determines the *mass* of an object?

The answer eludes philosophers and theorists.[33] Even in standard textbooks, authors seeking to explain Einstein's famous equation, $E=mc^2$, fall victim to confusion. The 'm' in the equation refers to mass, which is not matter but a *property* of matter measured by inertial and gravitational effects. Yet within a paragraph or two the word 'matter' will have crept in, as if mass and matter are synonymous. The textbook then cites the equation as the foundation for the Big Bang as 'first cause'—the event that gave birth to *matter* from raw primordial *energy*.

While natural philosophers still puzzle over the relationship of matter and mass, astrophysicists just assume that one kilogram of matter on Earth will exhibit the same mass, or gravitational effect, anywhere in the universe. It is implied by the common phrase, 'Newton's *universal constant* of gravitation, written: G.' But any suggestion that we know 'G' to be a '*universal constant*' is deceptive, since we also know that a subatomic particle's apparent mass, and therefore gravity, can change in response to electromagnetic forces.

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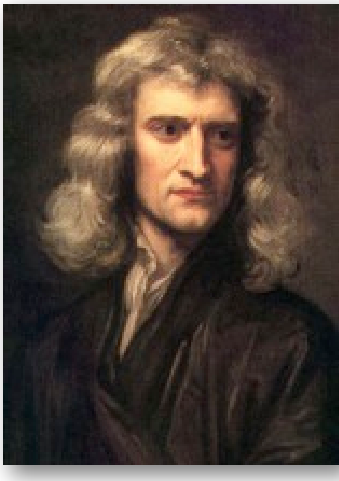
[33] "One has to admit that in spite of the concerted efforts of physicists and philosophers, mathematicians and logicians, no final clarification of the concept of mass has been reached." M. Jammer, *Concepts of Mass in Classical and Modern Physics,* p, 224.

Pioneers of Gravitational Theory

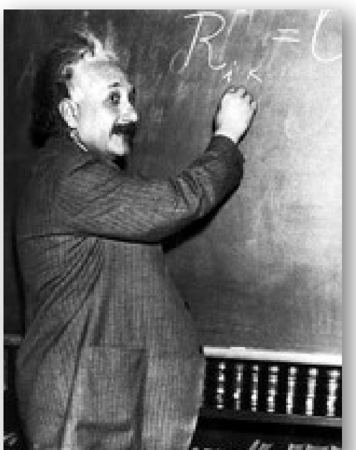


Isaac Newton (1642-1727)

Sir Isaac Newton was probably the most influential scientific figure of the past millennium. His theory of 'universal gravitation,' which first occurred to him at age 23, provided a theoretical underpinning for the Copernican revolution, in which the Earth was no longer the center of the universe, but revolved around the Sun. Newton discerned an 'attractive' force between all physical objects—a force directly proportional to the mass of the objects and operating everywhere in the universe. The force declines with the square of distance, allowing mathematical accuracy in statements of one celestial body's movement in relation to another.

Based on these findings, Newton envisioned the heavens moving with clock-like precision, all things obeying universal laws.

In the mid nineteenth century, James Clerk Maxwell prepared the way for modern adaptations of gravitational theory. He opened the door for Einstein's special theory of relativity, though Einstein appeared to do away with Maxwell's 'æther,' leaving unanswered the question of how an electromagnetic wave can be sustained in empty space. Einstein's special theory placed a speed limit on gravity of 'c,' the speed of light. However, Newton had shown that gravity must act instantaneously to maintain the stability of planetary orbits. A speed of light delay would produce a torque, moving the Earth far from the Sun in a few thousand years!



Albert Einstein (1879-1955)

But in the twentieth century, Einstein emerged as the giant of modern gravitational physics. Sometimes regarded as an equal of Newton, he went on to produce a pseudo-geometric theory of gravity called the 'General Theory of Relativity.' Although highly successful, the theory cleverly skirted the issue of why inertial mass is equivalent to gravitational mass. It proposed a metaphysical notion of empty space 'warped' by the presence of matter. Gravity became an abstract mathematical property of space in an extra dimension.

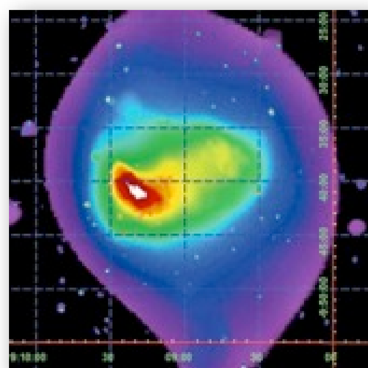
Einstein then spent much of his later life searching for a way to reconcile gravity and electromagnetism—without success. That is not surprising. As a theoretical mathematician he had no knowledge of the plasma universe and took no account of the electrical nature of matter. So, despite his apparently prodigious accomplishments, his work also helped to inspire an unhealthy trend in physics, wherein a mathematical skeleton is dressed with whatever flesh the mind can imagine. In the extreme, this tendency promotes highly selective perception, as new observations are forced to fit theoretical expectations, giving rise to imaginary black holes, dark matter, dark energy, and other uniquely modern fictions.

What is the real nature of gravity? Does the electric force play a role in celestial dynamics? If such questions are to find answers, the electrical basis of the natural world must not be ignored.

INFORMATION PANEL

The unannounced truth in all of this is that gravity itself remains mysterious, while Einstein's solution, though enchanting, would exclude something that is clearly occurring. Newton recognized that gravity acts *instantaneously*, while Einstein's 'speed limit' for information (the speed of light) says otherwise. But without the instantaneous connection between massive objects, the solar system, the Milky Way, and all other galaxies would be incoherent and chaotic. In fact, the *observed* behavior of gravity does not involve time: there is no relativistic delay in its effects. The Sun 'knows' where Jupiter is right now, despite the 43 minutes delay in light traveling from the Sun to Jupiter. Light waves, in contrast to the force of gravity, travel exceedingly 'slowly' on a cosmic scale.

Arp is well placed to comment on the obscurantism engendered by the way theoretical physics is done today. The general approach follows Einstein's 'thought experiment' in which a model is constructed to see if it works. If it doesn't, the model is usually elaborated so that *"the adjustable parameters are endless and one never hears the crucial words: 'It just won't work, we have to go back and reconsider our fundamental assumptions.' The practical problem can be appreciated by glancing at any professional journal. One finds an enormous proliferation of articles dealing with minor aspects of models in which the science may be correct but the assumptions are often wrong."*[34] While such habits are not the focus of this monograph, it should be obvious that undisciplined 'thought experiments,' sloppy use of language, and uncritical application of mathematic models will lead to whimsical and untestable descriptions of nature. With complete seriousness, today's popular science now entertains everything from 'dents in the space-time fabric' to 'magnetospheric eternally collapsing objects,' all under the pretense that such language adds to our understanding of the natural world.



The image above maps the X-ray brightness of more than a thousand galaxies in the galaxy cluster Abell 754. White indicates the brightest and densest parts, and purple the dimmest.
To explain the energetic core of the cluster, the astrophysicists' toolkit is limited to imagined 'collisions'—in this case, a 'gigantic collision between two clusters of galaxies' involving trillions of stars. In the electric interpretation, the galaxies are not smashing together, but presenting a coherent picture of plasma interactions..
Credit: *ESA/ XMM-Newton/ Patrick Henry et al.*

The Mystery of Cosmic Structure

Even in its early formulations, Big Bang cosmology required tenuous reasoning to explain galactic concentrations of matter in a universe that, from the beginning, was supposed to be inflating at a speed that precludes concentrations of anything. Alfvén himself posed this issue years ago: *"I have never thought that you could obtain the extremely clumpy, heterogeneous universe we have today, strongly affected by plasma processes, from the smooth, homogeneous one of the Big Bang, dominated by gravitation."*[35]

The contradiction has only grown as high-powered telescopes revealed dynamic exchanges between galaxies in a supposedly

[34] H. Arp, *Seeing Red,* pp. 257-8.

[35] A. L. Peratt, "Dean of the Plasma Dissidents," *The World & I*, May 1988, pp. 190-197. See public.lanl.gov/alp/plasma/people/alfven.html.

The Crab Nebula as viewed by the Very Large Telescope (VLT). The inset superimposes two images: an X-ray photograph of the Crab Nebula's intensely energetic core, taken by the Chandra X-ray Observatory; and a Hubble Space Telescope image of the same region. The internal 'motor' with surrounding toruses and axial jets mimics the behavior of high energy plasma discharge in the laboratory. Credit: (top): FORS Team, 8.2-meter VLT, ESO; (inset): NASA/CXC/ASU/J. Hester et al; Optical Image (inset): NASA/HST/ASU/J

expanding universe, whose expansion is claimed to be *accelerating*. Equally peculiar is the response of astronomers as they looked more closely at galactic interactions. They could only imagine celestial bodies colliding under the influence of gravity. 'Colliding galaxies,' originally discounted by the assumptions of the Big Bang, have now become a stock answer wherever galaxies are observed to be dynamically interacting—a condition observed with increasing frequency. (See Abell 754 on p. 23, said to be a 'collision' of two giant clusters—including more than a thousand galaxies.)

Today the issues go far beyond the billions of galactic concentrations of matter. Remarkable formations, unknown when the Big Bang hypothesis first came into prominence, now confront us from every corner of the visible universe: galaxies strung along gigantic filaments; prodigious galactic jets (lower left); enigmatic supernova remnants like the pulsating Crab nebula (upper left); and exquisitely organized structures now visible in X-ray, radio, and other electromagnetic frequencies—all catching astronomers by surprise, and all mocking the theoretical underpinning—the gravity-driven universe.

Invisible Genies Rescue Gravitational Models

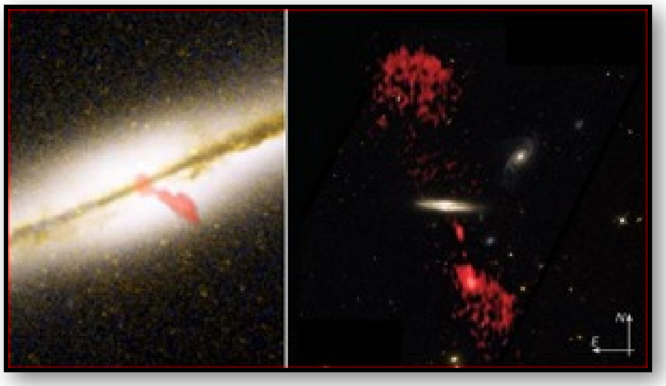
Astrophysicists faced a growing dilemma posed by the internal motions of galaxies. Gravity is severely deficient: the rapidly moving outer stars in galaxies should be flying apart.

To answer the challenge of galaxies behaving badly, astrophysicists proposed the existence of an unknown *invisible* form of matter that obeys gravity while not responding to electromagnetic radiation. They simply placed this 'dark matter' wherever needed to save their models.

Galaxy M87, exhibiting an energetic jet spanning thousands of light years. The glow is caused by synchrotron radiation, from extremely energetic electrons spiraling along magnetic field lines. The jet was first detected in 1956 by Geoffrey Burbidge, confirming predictions by plasma scientists Hannes Alfvén and Nicolai Herlofson in 1950, and Josif Shklovskii in 1953.
Credit: NASA/ESA

Later, however, on observing the behavior of certain supernovae (called 'type 1a'), cosmologists were forced to the uncomfortable conclusion that the universe is not just expanding but expanding at an *accelerating* rate—the one thing most obviously forbidden within a gravity-dominated universe. In fact, the cosmologists' shock was due entirely to the unjustified assumption noted earlier (the redshift/distance relationships) and to baseless conjectures about supernovae. Their response was to invent *another* invisible influence on matter. They chose 'dark energy,' a concept devoid of physicality and akin to 'gravity that *repels*.' With this freedom to invent abstractions, cosmologists have given us a remarkable picture of the heavens, one in which the familiar (visible) forms of matter make up less than 5 percent of the imagined universe. (See chart on page 2.)

From the inception of Big Bang cosmology, surprises and contradictions have been relentless. Long before the dark matter and dark energy craze, astrophysicists had found that galactic cores exhibit far more concentrated energetic activity than could be achieved by



Two views of Galaxy 0313-192, both involving radio images from the Very Large Array superimposed on images recorded by the Hubble Space Telescope. Astronomers were perplexed when they found that a 'radio galaxy' revealed a structure that such radio sources were never supposed to have: it is a spiral galaxy, But more significantly, the radio signals (in red) confirm that the galaxy is embedded in electric circuits and electric discharge activity that dwarf the galaxy itself. The X-rays make clear that hidden macrocosmic currents drive the visible activity of the galaxy, as Hannes Alfvén predicted many years before the discovery of double radio sources.

Credit: NASA, NRAO, AUI/NSF/ACS/WFC, W. Keel (University of Alabama), M. Ledlow (Gemini Observatory), F. Owen (NRAO) and AUI/NSF

normal objects operating gravitationally. In order to circumvent this problem they effectively 'divided by zero' by using the near zero force of gravity to power the supposed object responsible for the outbursts. The theoretical result was, not surprisingly, a virtually infinite concentration of mass called a 'black hole.' Black holes, the theorists said, produce the detected energies by *"consuming everything around them."*

Even Arthur Eddington, who produced the gravitational model of stars that inspired Subrahmanyan Chandrasekhar (originator of the black hole idea), could not swallow this extension of physics beyond all testable hypotheses. *"A reductio ad absurdum,"* he called it. *"I think there should be a law of nature to prevent a star from behaving in this absurd way."*[36]

The black hole model only led to more contradictions. New telescopes soon revealed material erupting explosively from galactic cores, defying a theory that had proclaimed, *"nothing, not even light, can escape black holes."* So the theorists invoked an accretion disk and magnetic field (magically present, but disconnected from causative electric currents) that *somehow* produced a narrowly confined jet across *millions of light years*. (See the galaxy M87, opposite.)

Models that Work

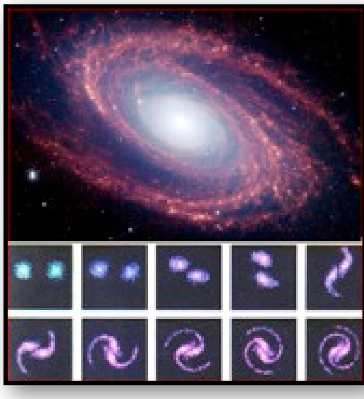
When big picture theories *"link speculation to speculation in order to prove speculation,"*[37] the outcome is inevitable. A growing chasm will arise between theoretical expectations and new discoveries. Surely the present chasm was well anticipated by Fred Hoyle, one of the twentieth century's most distinguished and controversial astronomers.

Astronomer Fred Hoyle, 1972

Photo courtesy California Institute of Technology Archives

[36] Meeting of the Royal Astronomical Society, Friday, 1935 January 11, *The Observatory* 58 (February 1935), pp. 33–41.

[37] "Big-Bang cosmology, the uncertain chain that links speculation to speculation in order to prove speculation." *Let it Bang, Chronicles of Modern Cosmology* - D.S.L. Soares, unpublished.

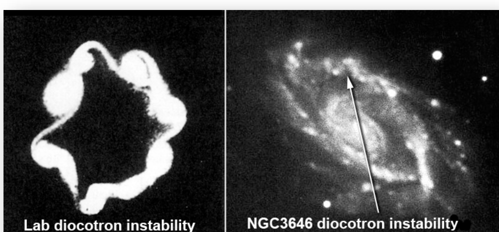


Laboratory experiments, together with advanced simulation capabilities, have shown that electric forces can efficiently organize spiral galaxies, without resorting to the wild card of gravity-only cosmology— the black hole. The image of the spiral galaxy above was taken by the Spitzer Telescope. The lower image is a sequence from a computer simulation illustrating how electric currents alone, through the 'pinch effect,' can generate the observed structure and motions of a spiral galaxy.
Credit: NASA/JPL-Caltech/S. Willner (Harvard-Smithsonian Center for Astrophysics).
Simulations from A. L. Peratt, *Physics of the Plasma Universe,*, p. 120.

"Big-bang cosmology refers to an epoch that cannot be reached by any form of astronomy, and, in more than two decades, it has not produced a single successful prediction," he wrote in 1994.[38]

As the gap widened, the theories grew increasingly complex and obscure until only the theorists themselves could claim to understand them. In the present circumstance the best response of critical thinkers is to look closely at those discoveries that were not anticipated by the theory. If a new perspective becomes necessary, it is most often the patterns of *surprises* that suggest an alternative vantage point, one from which the patterns would be *expected*.

Laboring far from the spotlight of media attention, plasma cosmologists did indeed anticipate the major discoveries of the space age. As early as 1937 Alfvén proposed that our galaxy contains a large-scale magnetic field and that charged particles move in spiral orbits within it, owing to forces exerted by the field. Through experimentation over many decades, Alfvén and others demonstrated the complex behavior of plasma discharges, and now plasma physicists can trace the evolution of observed galactic forms from basic electromagnetic principles. This last point has been demonstrated most persuasively by plasma scientist Anthony Peratt, a close colleague of Alfvén. Peratt's supercomputer simulations and experiments have shown that the interaction between cosmic Birkeland filaments—with no dark matter, no black holes, and no role for gravity at all—naturally produces an accumulation of matter at the currents' intersection, leading to galactic structure and rotational motions that accurately match observations (upper left).[39] As further confirmation at a level of detail, a well-known plasma instability, known as the 'diocotron' instability, can be seen in the spiral arms of some galaxies (left).



ABOVE LEFT: an image of a laboratory 'diocotron' instability in a 58-micro-ampere beam of electrons. The enormous scalability of plasma phenomena is evident in the same type of instability in the arms of a galaxy (RIGHT).
Credit: LEFT: H. Davis. RIGHT: H. F. Webster.

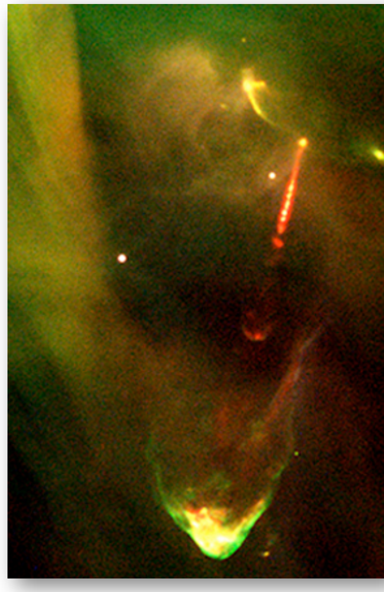
Cosmic magnetic fields confirm that the fundamental state of space plasma is *electrically dynamic*. It is known that plasma cells moving with respect to each other generate electric currents in each other, but cosmologists seem unaware of this. Moreover, electric currents so abundantly evident over cosmic distances are sufficient to organize galaxies and to power their stars. A star is a barely-visible speck of dust when seen against the volume of plasma *between* stars; and a galaxy is an insignificant piece of fluff in relationship to *intergalactic* space. We do not know the ultimate source of the stupendous electrical energy manifest in the visible universe, but its effects can be seen at every scale.

With firsthand experience of electrical phenomena, plasma cosmologists can offer concrete and testable models addressing the

[38] F. Hoyle, *Home is where the wind blows*, p. 414.

[39] A. L. Peratt, *Physics of the Plasma Universe,* Springer-Verlag, 1991.

puzzles and contradictions of popular theories. They know that the magnetic fields in deep space trace macrocosmic electric currents like a cosmic wiring diagram. And they understand that plasma phenomena are scalable up to intergalactic dimensions: under similar conditions, what occurs in the laboratory can be seen in space. As plasma cosmologists have noted, the universe exhibits *fractal* patterns: the patterns repeat at different scales from small to large. The scalability of plasma phenomena thus means that a fractal universe is a *prediction* of plasma cosmology while it is *inimical* to the Big Bang model.[40]



This spectacular Hubble image is of a Herbig Haro object, HH-34 in Orion. It features a pencil-thin jet issuing from its pole, with bright 'bullets' shot out at intervals. Astrophysicists can only speculate that the jet and string of 'bullets' from the young star somehow result from 'rebound' when gas from a disk surrounding the star momentarily collapses onto the star. The stream down the left is called the 'waterfall'—highlighting the fluid/mechanical analogy.
While such objects lack plausible explanations in Newtonian physics, such axial jets are a well-known feature of plasma guns, where the electromagnetic energy stored in a plasma toroid suddenly switches to produce an energetic polar jet. The electric current flowing along the jet can maintain the integrity of the thin beam over many light-years. In a non-electrical environment such hot gases would quickly disperse in space. The 'bullets' are coherent 'plasmoids.'
Credit: FORS Team, 8.2-meter VLT, ESO

Contrasting Two Models

Experiments have shown that electric currents in space typically flow in sheets and narrow filaments, while cells form around regions of differing plasma character. Today's higher resolution instruments now permit us to observe the ubiquitous filamentation and cellular structures of space plasma, a decisive pointer to cosmic electricity (see the cover image of the Cat's Eye nebula and p. 35). *Neutral gas in a vacuum will not organize itself into cells and filaments*.

But as we noted earlier, when faced with the unexpected presence of magnetic fields in space, astrophysicists continued to think in terms of neutral superconducting plasma. They found refuge in Alfvén's original concept of 'magnetohydrodynamics,' describing the effects of a magnetic field trapped in plasma but without reference to the electric currents required to create and sustain the magnetic field. That is why they are unprepared to deal with *electric discharge* in plasma, which does not follow the rules of magnetohydrodynamics. And no one seemed to know that Alfvén had disowned his earlier assumptions.

As a result, the mechanical language of wind and water pervades popular discussion of astronomy today. Rather than plasma discharge effects, astrophysicists see expanding superheated gas, gas flowing in rivers, rains of charged particles, shock fronts, eddy currents, windsocks, and 'nozzles' creating rivers of 'hot gas' *light-years* in length and the jet of the galaxy M87 (page 24). To those trained in the behavior of electrified plasma, the crisis in cosmology is all too obvious.

Plasma cosmologists can explain why galactic cores, so astonishing to astronomers, exhibit such stupendous, focussed energy. Birkeland currents can generate numerous other 'anomalous' structures, including polar jets (right), double radio sources, and the 'synchrotron'

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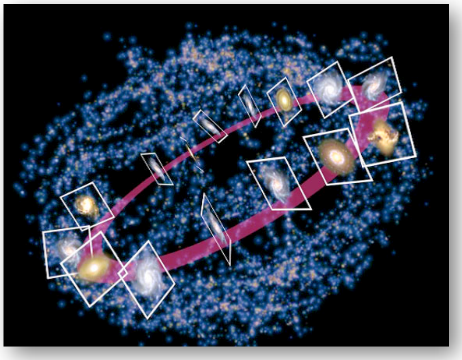
[40] A fractal distribution implies areas empty of matter—voids between galaxies and clusters—will appear at ever larger scales. Plasma cosmology, unlike the Big Bang, has unlimited time to form these structures. See A. Gefter, "Don't mention the F word," *New Scientist,* 10 March 2007, pp.30-33. "Einstein's equations would be thrown out first, followed by the Big Bang and expansion of the universe."



It has recently been found that spiral galaxies located on the shells of the largest cosmic 'voids' have rotation axes that lie preferentially on the 'void' surface. Plasma cosmology predicts this arrangement because spiral galaxies will be born with their rotation axes aligned with the current filaments and sheets that surround the 'voids.'
Credit: I. Trujillo, C. Carretero, S. G. Patiri.

radiation associated with such phenomena. Indeed, Winston Bostik produced such behavior in the laboratory years before the counterparts were discovered in space.[41]

A good test of contrasting approaches is provided by galactic *synchrotron* radiation, a 'non-thermal' form of electromagnetic radiation from particles accelerated in an electromagnetic field rather than by collisions with other particles (such as will occur in an electrically neutral but high-temperature flare or explosion). Synchrotron radiation is emitted by charged particles accelerated to *near light speed* along spiraling paths following the ambient magnetic field. High-energy plasma discharges always produce synchrotron radiation.

Since galactic emissions of synchrotron radiation are a fact, their effect has been to shine the harshest light on the failure of purely gravitational models. Considering the particle velocities required for synchrotron radiation over vast distances, even a mythic black hole could not do the job. So theorists have taken another speculative leap, calling upon a '*super-massive* black hole' equivalent to the mass of billions of suns, accelerating charged particles along magnetic field lines by the force of *gravity*—a flight of imagination that gives new meaning to the phrase 'doing things the hard way.'

Were they to have considered the ordinary electric potential necessary to create and sustain the observed radiation, the answer would have been all too obvious. Electric fields accelerate charged particles most efficiently; in the presence of electric fields charged particles ignore gravity. Neither black holes, nor super-massive black holes are required in an electric universe. Nature doesn't do things the hard way.

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[41] W.H. Bostick, "Experimental Study of Plasmoids," *Electromagnetic Phenomena in Cosmical Physics,* IAU Symposium No. 6, Stockholm, 1956 (Cambridge University Press), 87.
Physical Review 104:292, (1956).
Physical Review 106:404, (1957).
"Plasmoids," *Scientific American,* Oct. 1957, 81.
"Simulation of Astrophysical Processes in the Laboratory," *Nature*, 197:214 (Jan. 26, 1957).
Reviews of Modern Physics, 30:1090 (1980).