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Formation and Structure of Earth's Hidden Dark (Matter) Biospheres

Alfred, Jay[1]

[1]Independent Researcher - Plasma & Dark Astrobiology

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ABSTRACT

Recent studies of neutrino oscillations observed by the IceCube and Super-K detectors allows about 20 percent of Earth's total mass to comprise of dark matter. The author theorizes that a subcomponent of this dark matter could be self-interacting dark plasma with a weak dark electric charge, consistent with the growing consensus among leading physicists. Such properties would allow the formation of layered shell structures termed "dark plasmaspheres" that interpenetrate the ordinary matter Earth. These plasmaspheres, called "Dark Earths" by the author, could exhibit signature features of ordinary plasma, including concentric shells, filamentary currents, vortices, dark electric and magnetic fields. Furthermore, there is a compelling possibility that these Dark Earths could support well-defined dark plasma lifeforms. This paper discusses these possibilities, as well as suggests experiments to verify them.

Keywords: *Alternative Biology, Astrobiology, Biosphere, Complex Dark Plasma, Dark Biospheres, Dark (Matter) Biospheres, Dark Earths, Dark Electric Charge, Dark Electric Fields, Dark Electrons, Dark Electromagnetism, Dark Light, Dark Magnetic Fields, Dark Matter, Dark Matter Lifeforms, Dark Matter Planet, Dark Photons, Dark Plasma, Dark (Matter) Plasma, Dark Plasmasphere, Dark Protons, Eukarya-Plasma, Habitable Zones, Hidden Life Forms, Non-Baryonic Life, Parallel Dark Earth, Plasma and Dark Astrobiology, Plasma Lifeforms, Self-Interacting Dark Matter, Self-Interacting Dark Plasma, Shadow Biosphere.*

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CHAPTER ONE
INTRODUCTION

For a long time, scientists believed that dark matter existed mainly in a diffuse halo around galaxies, having minimal influence on our Solar System and Earth. However, new research challenges this view, suggesting that there could be a wide variety of dark matter particles and that some may have a weak electric charge.

Multiple research teams have found that dark matter could be accumulating within our Solar System, resulting in densities hundreds or even thousands of times higher than those observed in the broader galaxy. Recent studies have also presented substantial evidence that the dark matter density on Earth could be significantly higher than previous estimates. Observations of unusual spacecraft accelerations and the latest gravimetric measurements provide further support for a higher-than-expected dark matter density around our planet.

More crucially, advancements in mass measurement techniques using neutrino tomography have improved our understanding of the amount of dark matter in our vicinity. These new methods have shown discrepancies with older models that relied mainly on gravimetric measurements, either directly or indirectly. This hinted at the existence of a denser local dark matter halo.

If the dark matter particles in a halo around the Earth and in the core have a weak charge, this would slow down recombinations into atoms. The state of matter generally within the halo would then be plasma. The paper explores the consequences of this. It argues that this would be expected to result in complex, layered structures and the presence of signature features associated with plasma, such as concentric shells, filamentary currents, and vortices within the halo and core. To be more specific, it would from a self-organized structured dark *plasmasphere*. Theoretical models and indirect evidence are reviewed to examine these possibilities in some detail.

A particularly intriguing aspect of this research is the potential for these dark plasmaspheres to host exotic alternative biology and unique biophysical processes. Specifically, we consider how conditions in the dark plasmasphere might support the development of an ecology of plasma-based lifeforms and what this could mean for the search for life beyond the ordinary matter Earth.

To push this field of study forward, the paper suggests a series of experiments and methodologies to detect, map, and track local dark matter concentrations and dark matter lifeforms. This includes satellite-based gravity surveys, innovative neutrino-detection techniques, and approaches involving kinetic mixing and dark ionization processes. Each experimental strategy is discussed in terms of its feasibility and limitations, as well as its potential to shed light on dark matter's role on Earth.

By bringing together the latest findings from theory and experiments on dark matter in our local neighborhood, this paper aims to provide a thorough overview of dark matter's presence and broader implications on Earth. The insights gained could reshape our understanding of planetary science, space navigation, the history of our Solar System, and even the definition of life itself. Through this exploration, we aim to highlight the dynamic and evolving nature of dark matter research and to emphasize the importance of dark matter's so far understated role in the broader and deeper structure of the Earth and the evolution of life on it.

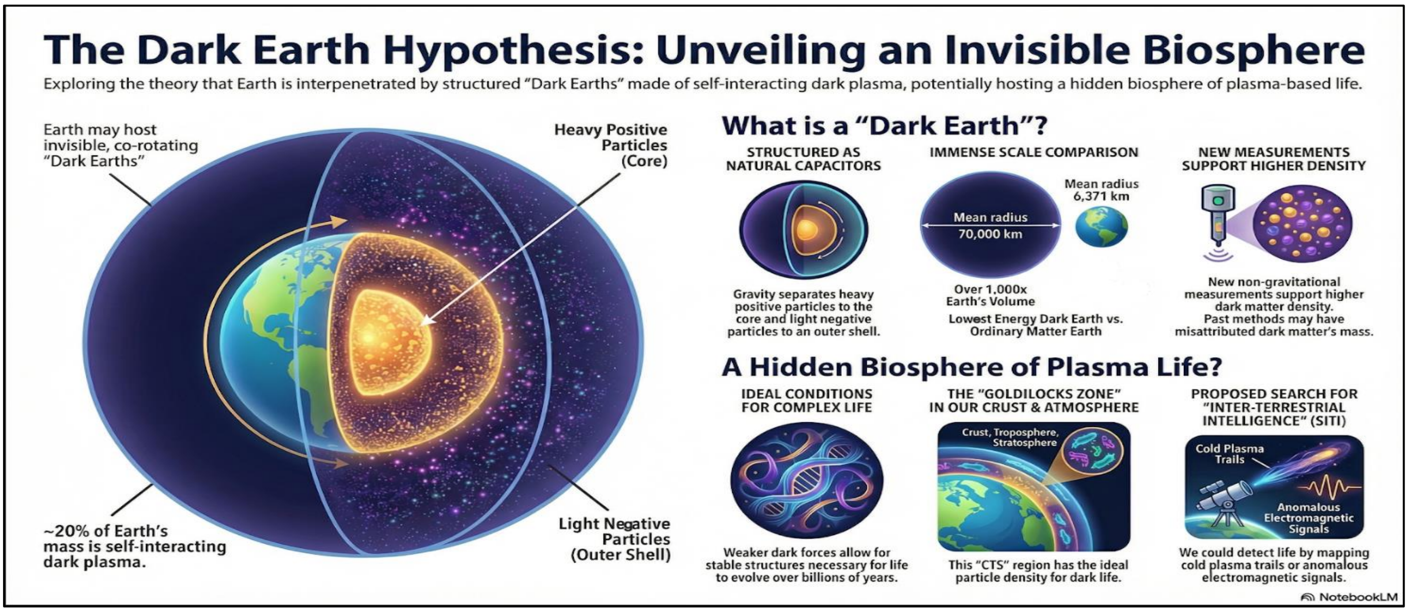

Fig 1 The Dark Earth Hypothesis: Unveiling an Invisible Biosphere

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A. Sources of Dark Matter in and Around Earth

➢ *Dark Matter Clouds, Rain, and Streams*

Jürg Diemand, a physicist at the University of California, Santa Cruz (US), and colleagues say that computations seem to indicate that small clouds of dark matter glide through Earth regularly [1]. The structures are shaped as flattened spheres or cigars with diameters of about 4,000 AU (The "AU" is the distance of the Earth from the Sun). It was estimated that about a million billion of them drift around our galaxy's dark matter halo. These clouds float through the planet every ten thousand years and remain for intervals of about fifty years. Other studies suggest that some clouds may persist in the Solar System for extended periods. According to Diemand, these clouds do not perturb Earth's orbit in any significant way. They can only nudge our planet to move away from its regular orbit by less than a millionth of a meter per second.

Dark matter is also present in passing ordinary matter clouds. The Local Interstellar Cloud, a neutral hydrogen cloud currently surrounding our solar system, is moving away from the Scorpius-Centaurus Association. This cloud enveloped the Sun about 100,000 years ago. The Sun will be immersed in it for another 10,000 to 20,000 years. Astrophysicists Leo Blitz and David Spergel suggest that interstellar clouds may harbor dark matter.

The Milky Way has been consuming the Sagittarius dwarf galaxy. During this process, not only ordinary matter from stars, but also dark matter, is stripped from the smaller galaxy. Astrophysicist Heidi Newberg of Rensselaer Polytechnic Institute, along with colleagues from the University of Michigan and the University of Utah, it may be possible to directly observe a dark-matter stream passing through Earth as a result of this interaction [2].

B. Dark Matter in the Sun and in Solar Winds

➢ *Accretion of Dark Matter within the Sun*

The local matter density near the Sun can be measured by analysing the velocities of visible stars above the galactic disk, which are influenced by the gravitational force that holds them together. It was found that these stars could account for only about half of the computed density. This suggests the presence of dark matter.

Based on the ordinary matter of the galaxy in the solar neighborhood, the Sun should only be moving at 160 km (99 mi) per second. However, it is actually moving at about 220 km (137 mi) per second, 60 km (37 mi) per second faster. This points to the gravitational influence of dark matter. The Sun makes up 99.9 percent of the mass of the Solar System. Hence, the Solar System, including Earth, is also moving sixty km (thirty-seven mi) per second *faster* because of dark matter in the galactic halo.

In 2001, University of Oxford researchers suggested the Sun contains a large amount of dark matter particles. Astrophysicists Ilidio Lopes and Joe Silk argued that passing dark matter particles would be captured by the gravitational fields of massive bodies like the Sun [3]. Italian researchers at the National Institute of Nuclear Physics in Pisa, led by Lorenzo Iorio, believe that the density of dark matter is most likely higher around the most massive bodies, such as black holes and stars. It then logically follows, say the researchers, that the Sun should also accumulate substantial amounts of dark matter as it rushes through the dark matter halo of our galaxy, the Milky Way [4].

As the mass of the Sun increases due to dark matter accretion, they believe the growing storehouse of dark matter in the Sun will alter the orbits of planets in the Solar System, including Earth's. The team estimated in 2010 that, if dark matter accretes onto the Sun at the same rate as in the past over the next 4.5 billion years, Earth's orbit will shrink to about half its current distance from the Sun. There is observational evidence for this shrinkage. Dark matter inside the Sun acts as an invisible Sun within the visible one.

More recently, physicists Subir Sarkar and Mads Frandsen of the University of Oxford came to the same conclusion: "the Sun has been whizzing around the galaxy for five billion years, sweeping up all the dark matter as it goes. It is estimated that the visible Sun contains about 2 percent to 5 percent of the mass of the Sun in the form of dark matter." [7] According to Sarkar and Frandsen, if we assume a 'matter-antimatter asymmetry,' i.e., a matter-dominated universe with little dark antimatter, *light* self-interacting dark matter particles in the Solar System captured by the Sun will not annihilate after gravitational capture. It would build up in the Sun and alter how heat moves within it in a way observable from Earth.

Self-interacting dark matter particles within the Sun would interact very weakly with ordinary matter (but relatively more strongly with each other) and thereby transport heat to the surface. The buildup of dark matter inside the Sun could solve a pressing problem in solar physics, called the "solar composition" problem. Similarly, but separately, physicist Stephen West of Royal Holloway Research Portal and his colleagues at the University of London used computer simulations to show that gravity would suck-up such *light* dark matter particles into the Sun's core, which would then carry off the heat from the core to the surface, decreasing the Sun's core temperature.

In the reverse case, another research team studied *heavy* dark matter particles in the Sun. Astroparticle physicist Aaron Vincent and his team at Spain's Institute of Space Sciences in Bellaterra used a model that also required a matter-antimatter asymmetry and

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self-interacting dark matter particles in the Solar System (just like Sarkar and Frandsen above). They suggested that these dark-matter particles could absorb energy in the hottest central part of the Sun's core, then move to a cooler part of the Sun, where they would deposit this energy. The changes in the Sun that this would bring about would explain the "solar abundance" problem, the researchers said. Vincent noted, "The main advantage of asymmetric dark matter is that a lot of it can accumulate in the Sun as it speeds through the dark-matter cloud that engulfs the Milky Way. If the dark matter were self-annihilating, the dark matter would disappear before transporting any sizable amount of heat from the Sun's core." [8]

These recent scientific research papers support the view that the Sun is indeed accumulating vast amounts of dark matter particles, generating what is effectively an invisible dark Sun growing inside the visible Sun. Furthermore, all the research experts involved assumed what the author proposed in his model: that the bulk of dark matter in the Solar System is asymmetric, no different from the ordinary matter sector, where substantial amounts of antimatter are absent at cosmic scales.

Also, all these theories require a currently undetected short-range attractive "fifth force" (similar to the strong nuclear force but much weaker) that would enable dark matter to interact with ordinary matter (to carry off the heat from the Sun's core through collisions with ordinary matter particles and other processes). The evidence for this fifth force is discussed in the Appendix 2 to this paper.

➢ *Production of Dark Matter within the Sun*

The Sun is theorized to produce some dark matter particles, such as axions. These particles would be exceptionally light and slow-moving. The CERN Axion Solar Telescope (CAST) is an experiment to search for these hypothetical particles produced by the Sun.

➢ *Ejection of Dark Matter from the Sun*

We know that, in addition to heat and light, the Sun constantly ejects a low-density plasma of charged electrons and protons, called the "solar wind." This omnidirectional wind emanates from the Sun at extremely high speeds, filling the entire Solar System with its contents. It is caused by the expansion of plasma from the Sun's corona (its outermost atmosphere), which is continually heated until it escapes the gravitational pull of the Sun. It then follows closely the Sun's magnetic field lines, which extend radially outward to the rest of the Solar System.

The composition of this solar wind has been generally analyzed to consist of only ordinary matter in the form of plasma. Suppose there is a significant dark matter accumulation in the Sun. In that case, we should expect self-interacting dark matter particles captured by the dark Sun from various sources to be ejected into its dark solar wind, driven by *dark* radiation and guided by *dark* magnetic fields. Trillions of self-interacting dark matter particles emanating from the Sun would be flooding this tiny Earth every second. This dark solar wind would emit axions, dark photons, dark protons, dark electrons, and other dark matter particles.

C. Dark Matter within Earth

➢ *Embryonic Dark Core*

Self-interacting dark matter would also have already been present during the formation of the Solar System, which was moving through the Randall-Reece dark disk of the galaxy. Ordinary and dark matter therefore worked together to form our Solar System. This embryonic dark matter could be locked inside both the Earth's and the Moon's cores (and all the other planets, moons, and even asteroids and comets, in the Solar System).

A 2023 research study states, "Although there are strong constraints on the amount of ambient DM [dark matter] captured by Earth, exotic scenarios like *the formation of Earth around a DM seed may still be viable*, similar to the formation of galaxies around DM cores" (Emphasis added).[19]

➢ *Accreted Dark Core*

Dark matter is generally assumed to pass through Earth. However, new research notes that when self-interacting dark matter particles lose energy as they interact with ordinary matter particles, they are captured and are accumulated on Earth. This occurs through weak interactions, as well as through the mediation of a conjectured fifth force (discussed in Appendix 2) that causes ordinary and self-interacting dark matter to be mutually attracted to each other.

It is important to note that the gravitational force on Earth is at a maximum near the boundary between the outer core and the mantle. Hence, a large amount of dark matter particles will get trapped in the mantle-core boundary if gravity alone were the attractive force. However, due to operation of the attractive fifth force, there are correlations in the number density between dark and ordinary matter particles. Hence, where ordinary matter is dense, dark matter will be dense. Conversely, where ordinary matter is tenuous, dark matter will be tenuous.

This means the mass density of dark matter would be highest within Earth's core (where the ordinary matter density is the highest) and much less in the atmosphere. This is in line with a particle-to-particle correlation between ordinary and dark matter

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particles. Dark matter could therefore be trapped in Earth's core and has been accumulating over 4.5 billion years. Physicist David Peat says the best calculations suggest that Earth's core could contain as much as 10 percent dark (or shadow) matter [10].

➢ *Dark Matter Density on Earth is Understated*

In a 2007 article, the author questioned: "Is this (dark matter) density understated? [76]" It was noted in the article that "The numerous sources of dark matter particles suggest that there could be a local excess of dark matter in our Solar System over and above the galactic background. However, since the orbits of the planets closely follow Newton's laws of gravity, the excess cannot be significant… However, Newton's laws of gravity require the mass of the Earth to be specified. This mass is computed from the gravitational acceleration measured at various locations on Earth. This assumes from the start that the acceleration is due to only ordinary matter. The contribution of any dark matter on Earth has been ignored." This is a concern shared by other researchers now, as discussed below.

➢ *Desktop Analysis*

In 2008, researchers Jinchao Xu and Jonathan Siegel from the University of Arizona estimated the density of dark matter around the Sun to be about 16,000 times higher than the current estimate of the galactic halo's dark matter density [12]. They estimated that the Solar System would have waded through 203 solar masses of dark matter as it orbited around the galaxy.

This is an enormous amount of dark matter that not only the Solar System, but Earth, was immersed in over 4.5 billion years, equivalent to the mass of more than two hundred Suns. As our Solar System orbits the galaxy at a speed of almost 220 km (137 mi) per second, it rushes through the dark matter particles in the galaxy.

As many as a thousand dark matter particles per day have passed through every kilogram of ordinary matter for over 4.5 billion years. Within the orbit of Neptune, 7.69×10^{19} kg of dark matter had become bound to the Solar System. (In comparison, the Earth's mass is approximately 5.97×10^{24} kg.) This is about a factor of 300 greater than the background mass of dark matter from the galactic halo. The dark matter density around Earth was therefore estimated to exceed the galactic halo density significantly. Within Earth's orbital radius it was estimated to be enhanced by more than four orders of magnitude over the local halo density, with a value of 3.3×10^{16} kg.

The researchers believe that the elevated levels of dark matter have significant implications for direct dark matter particle detection experiments and provide a potential explanation for spacecraft acceleration anomalies. They concluded, as follows: "Overall, *we find that dark matter in our Solar System is far more important than previously thought*. Due to gravitational three-body interactions between dark matter particles, the Sun, and the planets, a significant amount of dark matter winds up gravitationally bound to our Solar System… dark matter may [therefore] prove to be profoundly important in our Solar System for both its additional gravitational effects on planets and other orbiting bodies, as well as the motions of spacecraft." (Emphasis added). [12]

➢ *Anomalous Accelerations of Spacecraft*

In 2009, physicist Stephen Adler and his research team at the Institute of Advanced Studies in Princeton (NJ) conducted a study that found a correlation between changes in the velocities of space probes during Earth flybys and the presence of dark matter gravitationally bound to Earth. Their analysis proposed significantly elevated dark matter densities near Earth to explain these anomalies. *Adler concluded that the measured anomalies require dark matter concentrations many orders of magnitude higher than those computed for the galactic halo.* [14]

Adler theorized that as the density within the Solar System increased through gravitational capture of dark matter particles, even more particles would be captured, resulting in an accumulation cascade. Dark matter that accumulates within the Solar System over its history continues to accumulate via gravitational capture, analogous to a chain reaction. In Adler's model, as in the many models that are discussed in this paper, including the author's, a matter-antimatter asymmetry is assumed. Hence, there would be no annihilations, allowing rapid accumulation. The accumulation cascade caused by Earth-bound dark matter would theoretically result in a dark matter density that far exceeds the average density in the galaxy.

➢ *Refined Algorithms*

In 2012, astronomers at the University of Zurich used a standard mass-measuring technique to measure the density of dark matter on Earth and in the Solar System. However, *after careful study, they noted limitations in these types of methods and concluded that this method, along with previous approaches, had underestimated the density of dark matter.* The research team then refined their methodology to remove bias and applied a revised algorithm to observational data, using known positions and velocities of thousands of orange K dwarf stars in the vicinity of the Sun. Their findings suggested a high probability that dark matter is present in the vicinity of the Sun, with a 90 percent likelihood that its density exceeds all previous estimates.

Study leader Silvia Garbari stated this may be the first evidence of a dark matter disk in our galaxy, as predicted by recent theories and simulations. Or it could be that the dark matter halo of our galaxy is squashed, boosting the local dark matter density." In both cases, the dark density around Earth would increase [17].

➢ *Dark Disk*

The disk was proposed by Lisa Randall, a theoretical physicist at Harvard University, and her team. It will be referred to as the "Randall-Reece dark disk." The author had proposed that most of the dark matter in the disk, which is close to ordinary matter, would be self-interacting with a weak dark electric charge. The presence of a dark disk will further boost the expected density of self-interacting dark matter on Earth. While Earth wades through this dark disk, it would experience a cascade of dark matter accumulation.

➢ *Satellite Evidence for a Dark Matter Halo Around Earth*

Data from multiple satellite navigation systems have provided compelling support for the existence of a dark matter halo interpenetrating the Earth. The data, gathered from several Global Positioning System (GPS) satellites, together with data from the Russian GLONASS and European Galileo constellations, suggests that Earth may have significantly more mass than previously estimated by conventional (mainly gravimetric) methods. These satellites orbit the Earth from approximately 5,000 km (about 3,000 miles) to 35,000 km (about 22,000 miles) above the Earth's surface. As such, they offer a unique vantage point for measuring Earth's gravitational influence. These satellites are well beyond the atmosphere, which ends at the Karman line, about 100 km (62 miles) from the surface.

In a 2014 study, Professor Ben Harris of Texas University reviewed the mass of Earth as sensed by each satellite system by analyzing the accelerations that these satellites experienced as they moved through their orbits. He found that the calculated mass of Earth, based on satellite data, exceeded the value established by the International Astronomical Union (IAU) [18]. Since the observed anomalous accelerations could not be due solely to ordinary matter in the space surrounding Earth, these findings provide strong evidence for a significant accumulation of dark matter forming a halo around our planet.

➢ *Seismic Waves*

Another method of measuring the mass of the Earth uses seismic waves. Seismic waves can tell us about the Earth's internal structure, but they do not directly measure the Earth's mass. By analyzing how seismic waves travel through different layers, Earth's internal composition and density can be estimated. It is to be noted, however, that to calculate the Earth's mass using seismic waves, scientists use not only seismic data, but also gravimetric measurements and the Earth's moment of inertia. (The moment of inertia is computed using the mass and the radius of the Earth.) Hence, even when using seismic waves to determine the mass of the Earth, gravitational accelerations are considered; therefore, the misattribution would still apply. Seismology alone cannot separate dark matter from baryonic matter — it relies on gravimetry to fix densities, and gravimetry itself is blind to composition.

Inaccuracies can arise if data from different methods are not adequately integrated or if assumptions about the Earth's internal structure are incorrect. The mass estimate would also not include the mass of the atmosphere or the magnetosphere. (The mass of the atmosphere is one-millionth of the mass of the Earth or 5.5 quadrillion tons.) Furthermore, the best model derived from seismic wave studies of the Earth's internal structure incorporates a 5 percent uncertainty in the mantle's density and significantly higher uncertainties in the core.

➢ *Self-Interacting Dark Plasma*

The author's dark plasma hypothesis theorizes that most of the dark matter around Earth and the Solar System in general, is composed of self-interacting dark plasma. This is discussed later in this paper.

Unlike collisionless cold dark matter, a self-interacting dark plasma could have pressure, viscosity, and even wave modes (dark acoustic waves). That means it could support internal oscillations. If dark matter were a self-interacting plasma coupled via X17 (discussed in Appendix 2), then it would no longer be invisible to seismic waves. It could act as a shadow medium that absorbs or modifies vibrations.

If dark plasma coexists with ordinary baryonic matter in Earth's interior, seismic waves might couple weakly to it. This will not be through elasticity, but through gravitational and mediator-induced drag. If dark plasma interacts via X17, then baryonic vibrations (like seismic waves) could experience frictional coupling to the dark plasma. Seismic waves might lose energy into the dark plasma, or their speed could be slightly altered depending on the local dark matter density.

There could be extra attenuation not matched by baryonic elasticity. Ordinary seismic waves would show unexplained attenuation or dispersion, not matched by the elasticity of the ordinary baryonic matter, if energy leaks into dark plasma modes. This would look like "extra damping" not explained by rock composition. This would be a new channel beyond gravity. In principle, therefore, we can separate dark matter from ordinary matter because dark plasma would have different interaction signatures.

Dark plasma contributes to total mass, but unlike collisionless dark matter, it could redistribute the matter dynamically (for example, forming currents or shells). This could produce subtle geographical and time dependent gravitational anomalies. There could be mass anomalies inconsistent with seismic density.

➢ *New Non-Gravimetric Methods*

All the above methods use gravimetric measurements. The density of dark matter in the Solar System and Earth will likely be revised upward when new measurement methods and tools are used in the future. Traditionally, the mass of the Earth is basically computed from Newton's law and measured gravitational accelerations around the planet. Highly sensitive gravimeters measure small changes in gravity across Earth's surface caused by differences in mass distribution. Most mass estimates assume these variations result only from ordinary matter. The contribution of any dark matter in or around Earth to its current mass has been ignored or overlooked.

Researchers in a 2023 study on Earth's interior composition using neutrino oscillations clarify, "Earth's mass has been measured very precisely through gravitational methods. *These measurements are sensitive to the sum of the DM [dark matter] and baryonic mass [normal matter] and hence would not be able to distinguish between the two*. Gravitational experiments do not distinguish between normal matter and DM." (Emphasis added.) [19]

In 2018, Earth's mass was measured using a new method called "neutrino tomography." This method uses only weak interactions, entirely independent of gravitational measurements. This was probably the first time that non-gravimetric measurements were used. Using the "IceCube" detector, the researchers determined the mass of the Earth and its core, its moment of inertia, and established that the core is denser than the mantle.

The detector tracked neutrinos arriving from multiple directions as they passed through different layers of Earth. Based on the number of neutrinos detected at each angle, researchers were able to calculate the densities of different parts of the Earth, which then allowed them to estimate Earth's total mass. The neutrinos sense both ordinary matter and dark matter inside the planet since both types interact with the weak force.

Recent advancements in neutrino detection have allowed scientists to investigate the possible presence of dark matter within Earth by analyzing neutrino oscillation probabilities. Deviations from the expected neutrino oscillation patterns can serve as indicators of dark matter embedded within the planet's interior. In particular, a 2023 study utilized a one-year data set collected by the IceCube detector to assess these probabilities.

According to the results of the study, the data does not rule out the possibility that less than 32 percent of the mass of the core or 24 percent of the mass of the entire Earth could be composed of dark matter, at the one sigma confidence level. These limits help refine our understanding of Earth's internal composition and the extent to which dark matter contributes to its overall mass. Atmospheric neutrino oscillations studies at the Super-K experiment does not rule out less than 21 percent of the mass of the entire Earth being in the form of dark matter at the one sigma level. [19]

The mass of dark matter in and around the whole planet may therefore be about 20 percent, and in the core about 30 percent. This is highly significant.

20 percent of the mass of the Earth (5.97×10^{24} kg) is 1.2×10^{24} kg. Based on this measurement, the average density of dark matter on Earth can be estimated. The density of the Earth is about 5,515 kg/m³. Twenty percent of this is 1,103 kg/m³. The density of dark matter on Earth could therefore be the same as the density of water. This is many orders of magnitude higher than any previous estimate discussed above.

➢ *Limitations of Neutrino Oscillation Probabilities Studies*

Over the past 20 years, the estimated dark matter density on Earth has continued to rise as our measurement methods grow more sophisticated. Even the latest neutrino oscillation studies (discussed above) may not capture all the dark matter on Earth. There are many theorized viable dark matter particles that do not interact with the weak force. For example, some dark matter may interact *only* via gravity, making it invisible to neutrino-based or direct detection methods.

Sterile neutrinos and axions evade weak interactions entirely or interact via other forces (e.g., axions via electromagnetic couplings). Some self-interacting dark matter (SIDM) models propose that dark matter interacts only with itself via a hidden sector, not with baryons. Neutrino-based detection methods may therefore miss entire classes of dark matter. If this is so, then the dark matter mass density limits stipulated by the IceCube and Super-K experiments may be too low and dark matter mass on Earth may still be understated. Furthermore, if some dark matter mimics baryonic weak couplings, it would be indistinguishable in oscillation data.

Additionally, the limits stipulated by the study are model dependent. Oscillation-based constraints rely on assumptions about the interaction cross-section, mass distribution, and flavor mixing. If dark matter interacts differently (for example, via a light mediator or not at all), the inferred density limits may be invalid.

To isolate dark matter, we need multi-modal constraints, for example, by combining neutrino data with gravitational anomalies, seismic profiles, and direct detection. Each probe alone would not be sufficient, but together they could reveal a hidden self-interacting dark plasma component.

➢ *Self-Interacting Dark Plasma*

If dark matter was in the form of self-interacting dark plasma, neutrinos would feel both the weak potential from ordinary baryons and an additional potential from self-interacting dark plasma via the X17 boson (discussed in Appendix 2). In this case, oscillation probabilities would deviate in ways distinguishable from baryonic-only models. Neutrino oscillation studies (such as INO-ICAL, IceCube, and Super-K) would be especially powerful, since they would be able to detect deviations consistent with a new mediator. From a broader perspective, this scenario would make Earth a laboratory for dark plasma physics, where seismic and neutrino data together could constrain the coupling strength of X17.

➢ *What about Newton's Laws?*

The numerous sources of dark matter particles, from the galaxy's halo, the Sun's solar wind, to the passing clouds of dark matter, suggest that there could be a local excess of dark matter in our Solar System significantly over and above the galactic background. We are inside the dark matter halo of the Milky Way, about 26,000 light-years from the galactic center, and (the author theorizes) within the Randall-Reece dark disk, which contains a higher density of self-interacting dark matter particles than the rest of the galactic halo. However, since the orbits of the planets comply very closely with Newton's universal law of gravitation, there is a general *assumption* that the dark matter content on Earth cannot be significant. This assumption is incorrect, and the reasons are explained below.

➢ *Thought Experiment*

One could imagine (hypothetically, as a thought-experiment), that if all the planets and the Sun were composed wholly of dark matter (and had the same mass currently ascribed to the Sun and the planets), they would still comply with Newton's gravitational laws with no significant anomalies in their rotational curves (assuming that the Solar System had only a very low-density halo of dark matter around it).

So, the absence of any significant anomalies (and deviation from Newton's laws) in the rotational curves of the planets in the Solar System does not necessarily rule out the possibility that there could be significant amounts of dark matter in the cores and/or halos in and around the individual planets and the Sun. Since the sources of dark matter are ever-present, we should expect the dark matter accreted within Earth to grow over billions of years (just like in the Sun).

➢ *Historical Mass Conflation*

It should be noted that dark matter may not only be evidenced by any additional mass computed, but also by the mass already estimated. The methods used to estimate the mass of Earth and other celestial bodies historically may have inadvertently combined the mass contributions from both dark and ordinary matter. When measuring the masses of the planets and the Sun, their calculations were based on observed gravitational effects and the application of Newton's laws. However, these measurements did not discriminate between dark and ordinary matter and ignored the presence and influence of relatively dense dark matter within these bodies.

Even if the Sun and the planets contained significant amounts of dark matter locked in their cores, they would still comply with Newton's laws. This is because the measured, or historically recorded, masses would already include the combined mass of both ordinary and dark matter. Any accelerations or gravitational influences caused by dark matter was misattributed to ordinary matter.

Consequently, there was an implicit assumption in traditional mass calculations that all gravitational effects arose purely from ordinary matter. This oversight meant that the potential contributions of dark matter to the total mass of the Sun and the planets were overlooked, leading to a conflation of the two in historical measurements. Number density correlations between ordinary and dark matter, through the operation of the attractive fifth force, will cause a very close correspondence between the two types of matter, increasing the chances of conflation.

If the mass of dark matter over the entire planet is approximately twenty percent of the mass of the Earth, dark matter will be subject to the gravitational influence of ordinary matter in the Solar System.

D. Self-Interacting Complex Dark (Matter) Plasma

➢ *Dark Plasma*

Physicists have found that a component of dark matter could be allowed to have a weak U(1) electric charge. It does not violate any known physics or conflict with any observations of dark matter and calculations show that it is able to produce the correct relic abundance of dark matter.

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In 2009, Carroll discussed the concept of U(1) dark electromagnetism. This is similar to ordinary electromagnetism but with a weaker charge [22, 23]. He explored the idea of dark photons, suggesting dark matter might interact via a new "dark force." Randall's 2016 book echoed this, stating that while restrictions exist, they do not rule out non-gravitational self-interactions in dark matter; instead, they only set limits on their strength and form [24].

In 2018, Julian Munoz, a postdoctoral fellow in the Department of Physics, and his collaborator, Avi Loeb of the Harvard-Smithsonian Center for Astrophysics (CfA), explored the possibility that charged dark matter particles have a weak electric charge. Loeb explained, "We're limiting the chance that dark matter particles have a minuscule electric charge, just one-millionth that of an electron, by looking at signals we can measure from the cosmic dawn. Only a small quantity of dark matter with a weak electrical charge could both account for the EDGES findings and align with other observations." [25]

If dark matter has an electric charge, it logically follows, as one of the options, that it could be plasma. The author has argued, in various books and articles, that the dark matter interpenetrating the Earth consists mainly of a self-interacting dark plasma, or more specifically dark (matter) plasma [49, 50, 51, 52, 53, 54, 61, 67, 68, 70, 77, 7, 83, 84]. This is due to several reasons.

Firstly, the strength of the dark electric charge is much weaker than in ordinary matter, as discussed above. This is estimated to be one-hundredth to one-millionth of the ordinary electric charge. Since binding energies scale with the fourth power of the electric charge, reducing the charge strength by a factor of 10^6 weakens binding energies by a factor of 10^{24}. Atoms would barely hold together - thermal fluctuations at even microkelvin temperatures, or quantum fluctuations would ionize them.

Hence, if the charge is weak, dark protons and electrons will be slow to recombine to form atoms. It will not be strong enough to bind charged particles into atomic structures as rapidly as in the ordinary matter sector. Furthermore, even exceptionally low temperatures will ionize atoms. (However, note that even if a million times weaker than the ordinary electric charge, it will still be 10^{30} times stronger than gravity.)

Secondly, there are almost five times as many neutral dark matter particles in dark sectors as charged particles (the reverse is true in the ordinary matter sector, where charged particles can outnumber neutrons by almost ten times). These neutral particles act as a buffer, insulating the charged particles from one another and further slowing or preventing any recombinations with atoms.

Thirdly, the density of dark matter particles is many orders of magnitude less than that of ordinary matter particles. Hence, the mean free path between particles will be longer. This slows any further recombinations of atoms.

Fourthly, it is conjectured by the author that the dark sectors have higher temperatures than the ordinary matter sector. Standard cosmology suggests that, under certain circumstances, dark sectors can be warmer than ordinary matter. After cosmic inflation, the universe goes through a reheating period. If the inflaton, which is responsible for driving inflation, has a stronger interaction with the dark sectors than with Standard Model particles, the dark sectors may begin with higher temperatures than the visible one. Since dark sectors are only weakly linked to the visible sector, the two do not reach thermal equilibrium. Consequently, the dark sectors would be able to retain distinct, potentially hotter temperatures for a long time.

The author conjectures that dark sectors may be hotter than ordinary matter, based on his Dark Plasma Hypothesis (first conceived in publication around 2005), which aligns with standard cosmology and eternal inflation theory. This theory posits bubble universes with varying physical constants, dimensions, and temperatures, originating from a very high-energy background. In our multiverse, each bubble universe experienced its own big bang; those existing before ours would be invisible to us and would be at higher energy or temperature levels as they cascade down energy levels from the high-energy background.

All these factors (among others discussed elsewhere) conspire to make non-atomic self-interacting dark plasma inevitable in the lower energy dark sectors. Many physicists, more recently, are gravitating to the view that a component of dark matter could be dark plasma. This has been discussed in more detail in the author’s paper entitled, "Self-Interacting Dark Plasma – A New Kind of Matter." [51]

In this context, dark plasma refers to a plasma composed of dark matter particles. It is not plasma composed of ordinary matter particles that are in the dark mode. It is also not a dark plasma of ordinary matter particles in the Sun, which is dark because it is cooler than the surrounding plasma. (Ordinary matter particles refer to particles included in the current standard model of particle physics.)

- *Complex Dark Plasma*

Complex (or dusty) plasma in space contains dust particles mixed in with electrons and positive ions. When this happens, the dust particles will attract and accumulate a large number of negative charges and become polarized, increasing their electrostatic potential. The net charge on a dust grain which would be attracting electrons in a haphazard way while losing some of them is not constant but fluctuates with the local plasma potential. Hence, new damping effects occur and give rise to several types of plasma waves. This non-linear behavior generates intricate structures, which exceed the complexity of solids and liquids.

The dark (matter) plasma envisaged in this paper is a complex plasma. The dark matter particles that could play a role similar to that of charged dust grains are theorized to be supersymmetric gauged and Fermionic Q-balls and I-balls. We would therefore expect Earth's dark plasmaspheres to exhibit signature features frequently found in complex plasma bodies in the laboratory and space plasma.

- *Gravity vs. Electromagnetism in a Weak-Charge Universe*

Even though the electric charge may be weakened in a dark sector by as much as a million times, it is still many orders of magnitude stronger than gravity at the particle level. Gravity is still feeble in direct interactions. However, its cumulative effect over large masses remains important. Ironically, because the charge is weak in the dark sector, the role of electromagnetism in a dark plasma sector may take on greater importance than in the ordinary matter sector. In fact, it would be as important as gravity in shaping the large-scale structure of the dark universe.

In our universe, strong charge coupling quickly neutralizes separations (ions recombine, dipoles collapse). Hence, no further work can be done. With weaker charge, though, recombination is sluggish and charge separations persist. This enables sustained currents, electric and magnetic fields, and large-scale plasma structures which do work, shaping the universe. With weaker charge, electromagnetism functions like a slow sculptor generating structures rather than an instant binder.

These structures can rival gravity in shaping cosmic architecture, with filaments, sheets, and plasma vortices interwoven with gravitational wells. Plasma would be the dominant state of matter in the dark plasma sector (just like in the ordinary matter sector), but its role in shaping the universe would be much more critical. In the lower energy dark plasma sectors, therefore, electromagnetism will become an equal partner with gravity.

Gravity would still be the universal attractor, pulling matter into large-scale clumps, which sets the stage for galaxies, stars, and cosmic scaffolding. However, electromagnetism will provide the local organization through long-lived charge separations and plasma dynamics. Together, they weave a universe where matter is not just clumped but intricately patterned.

- *Plasma Chemistry and Complexity*

With a weak charge, atoms cannot hold electrons tightly; molecules cannot form stable covalent bonds. The result would be no familiar chemistry of solids, liquids, or biomolecules. However, electromagnetism still rules structure but at vastly larger scales.

As discussed, the Dark Earth is a positively charged dark proton core surrounded by a dark diffuse electron shell – almost like a planetary-scale atom. These shells could overlap or interact with the shells of other plasma domains, with fluctuating net charges that create binding-like phenomena at cosmic scales. Instead of covalent bonds, there would be resonant plasma oscillations, magnetic linkages and potential differences which serve as the analog of "chemical bonds." This would be a kind of macro-quantum chemistry, where the building blocks are not microscopic atoms but plasma domains, and the "reactions" are large-scale reorganizations of charges and fields. Atoms may not bind tightly, but plasma filaments, sheets, and vortices can arise. Magnetic fields generated by currents would sculpt matter into intricate structures.

Complexity would arise through field-driven architectures rather than molecular bonds. This would be a new field of chemistry based on charge separations, plasma oscillations, and field interactions, rather than electron orbitals in molecules. Instead of chemistry-driven complexity, there will be plasma-driven complexity. Chemistry "as we know it" vanishes, and macro plasma chemistry emerges.

- *Dark Plasmaspheres or Dark Earths*

The dark matter from each dark sector (that interpenetrates the ordinary matter Earth) will be organized into near-spherical dark plasmaspheres through gravitational dynamics, aided by weak electromagnetic interactions. Each dark plasmasphere (within each dark sector) will be called a "Dark Earth." This could be cited as the "Dark Earth Hypothesis" – a corollary of the larger dark plasma hypothesis [49, 50, 52, 53, 54, 62, 64, 65, 66, 67, 68, 71, 72, 76, 83, 84]. Dark Earths would have characteristics in between a star (as it is composed of matter in a plasma state) and a planet (because of its smaller size and mass). It is therefore analogous to what we would call a "brown dwarf" in the ordinary matter sector.

They would have too little mass to generate nuclear fusion (through hydrogen burning). Unlike a brown dwarf, though, this "dark dwarf" will not be expected to undertake any deuterium or lithium fusion due to its extremely low density and higher rate of ionization. Hence, the analogy with a brown dwarf cannot be carried too far. The author proposes that a dark plasmasphere is a distinct theoretical astrophysical object.

Each Dark Earth is a dark matter planet, composed wholly of dark matter, corotating with the ordinary matter Earth. Unlike the ordinary matter Earth, which is in a broad sense a plasmasphere with a rocky core, its dark plasmaspheres would be highly ionized throughout their volume. These Dark Earths will form huge dark plasmaspheres, which can be described more generally as dark matter planets, and will interpenetrate the ordinary matter Earth. They are larger because of the lower density of dark matter particles and the weaker electric charge. This is in line with what would be expected of dark matter planets in theoretical models.

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Astrophysicists are now exploring detection techniques for planets composed wholly of dark matter in other star systems. These dark exoplanets are expected to be much larger than ordinary matter planets. Physicist Yang Bai, from the University of Wisconsin-Madison (USA), and his research colleagues are searching for planets that could harbor dark matter outside our Solar System [27].

According to the researchers, dark matter exoplanets would have different properties from ordinary matter exoplanets in ways that defy our current understanding of planet formation. For example, they say, "You might get an exoplanet …*so low-density that its existence is impossible to explain.*" Very low-density, radiation-like planets will not significantly perturb the orbits of other planets and will be exceedingly difficult to detect gravitationally. Dark Earths are low-density radiation-like dark matter planets gravitationally coupled to the ordinary matter Earth.

➢ *Formation of Dark Earths*

It is theorized that self-interacting dark matter, with a weak dark electric charge, can contract and cool into much smaller macroscopic objects from much larger dark matter halos that have themselves contracted due to gravity within the cosmic web of dark matter. These form dark planets. The genesis of Earth's dark matter planets (i.e., the Dark Earths) would then probably be a top-down process. (This is just the opposite of the bottom-up process that occurs for ordinary matter planets, which form due to the strong electric charge within smaller pieces of matter that come together to form larger pieces.)

The Dark Earths would be expected to be *large* plasmaspheres – consistent with the current theory of dark matter planets. The smallest Dark Earth is as large as Jupiter, as discussed at the end of this paper. The author believes that both the dark and ordinary matter components of the Solar System evolved within an enormous dark matter halo of more than 4 light-years (the extent of the Solar System), within the cosmic dark web. The halo's content would have mostly dissipated over 4.5 billion years of Earth's history due to tidal forces from nearby astrophysical objects that cannibalized it after pulling it apart. However, the dark plasmaspheres that cooled and broke off from the halo remained. Ordinary matter on Earth was formed within the lowest-energy dark halo, or Dark Earth.

Subsequently, the ordinary matter on Earth also attracted dark matter from various sources (as discussed above) through gravitational interactions, weak interactions and a conjectured fifth force (discussed in Appendix 2). This dark matter has accreted over Earth's history and continues to accrete. This will increase the mass of the Earth and nudge its orbit around the Sun by extremely tiny amounts over millions of years. The actual impact is not straightforward to calculate and would fluctuate as the Sun and other astrophysical bodies in the Solar System are themselves accreting dark matter within their bodies in a variety of ways and rates.

➢ *Nature of Dark Earths*

These dark plasmaspheres or Dark Earths are similar in structure and dynamics to the ordinary matter magnetosphere (which can be broadly considered a generalized magnetized plasmasphere). They have dark plasma sheaths enveloping them and have the same stretched ovoid shape. They have polarized regions (such as the Van Allen radiation belts) containing concentrations of oppositely charged particles. They will also include a global dark magnetic field. Just like Jupiter's gas envelope, these dark plasmaspheres do not have a hard surface.

Each higher-energy and more tenuous Dark Earth would have a larger volume as the particles become more energetic and the electric charge weakens further, resulting in larger interparticle distances. Additionally, the mass and size of the dark matter particles progressively decrease. Hence, the mass of each succeeding larger plasmasphere will fall.

➢ *Size and Shape Shifting*

Each Dark Earth can be imagined as a vast ball of low-density plasma, extending farther from the visible Earth than the last, while interpenetrating one another where they come into physical proximity. Like our visible oceans, these invisible halos of dark plasma can be imagined as plasma oceans subject to tides due to gravitational interactions within the Earth-Moon-and-Sun system. Furthermore, as dark matter particles are captured by Earth's gravity or lost due to the gravitational influences of nearby bodies, the density, size, and shape of the dark plasma bubbles around the visible Earth (and the Moon) undergo constant changes.

The shape and size of the Dark Earths would therefore be constantly size-shifting and shape-shifting like a dancing candle flame. (This is similar to the ordinary matter Earth's magnetosphere and plasmasphere, or even the atmosphere.) They would receive dark radiation from their corresponding Dark Suns and be buffeted by dark solar winds and other dark matter winds emanating from the galaxy. The dark geomagnetic field, which is embedded in the dark plasmasphere, moves with it, changing its size and shape in tandem, just like the ordinary matter in Earth's magnetosphere. (The factors that give rise to the field are discussed below.)

➢ *Differential Rotation*

Just like the Sun (which is a rotating ball of plasma), Dark Earths (also rotating balls of plasma) would experience differential rotation, with the rate of rotation in the equatorial region much higher than at the poles. This will generate a Coriolis force (as in the ordinary matter Earth) that may give rise to plasma vortices within the dark plasmaspheres. The length of day and night will therefore vary in various parts of the dark planets (just like on the ordinary matter Earth).

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The rotational Dark Earths is expected to be slower than the ordinary matter, mainly due to the huge volumes. Hence, a day in a Dark Earth would exceed twenty-four hours currently. Recent studies of the dark matter halo around our galaxy show that it is mildly counter-rotating. Hence, we cannot rule out the possibility that, at some latitudes in the Dark Earths, certain regions could in fact be counter-rotating. (This counter-rotation property suggests that they are driven by Birkeland currents.) Furthermore, the interior of the Dark Earth may rotate at a different rate from the external surface.

➢ *Diffused Ambient Light*

Being composed of plasma, which spontaneously emits dark photons (i.e., dark radiation), these Dark Earths will be filled with an ever-present diffused dark light, day or night. The plasmasphere interacts with the ambient dark light (whether internally generated, from the Dark Sun and other dark objects), resulting in different appearances to an observer. If its internal composite plasma frequency is higher than the ambient dark light, it will shine like a metal ball; if it is lower, it will become transparent and disappear; and if it is the same, it will be a black ball that will disappear against the darkness of space. (This is based on fundamental plasma dynamics.)

Plasma frequency is directly correlated to its density. Hence, when the density keeps changing due to space weather and gravitational interactions, the plasma frequency will change in tandem. Since plasma frequency changes the degree of visibility and opacity, the fluctuations would cause Dark Earths to oscillate in brightness, alternating between being visible and invisible. This results in a shimmering or scintillating appearance for observers outside the dark planet who can see the dark radiation.

➢ *Filamentary Currents and Vortices*

We would expect self-interacting dark plasma to display signature features as observed in the laboratory. Hence, Earth's dark plasmasphere is theorized to contain a grid of dark filamentary currents. Filaments are high-density regions in the plasmasphere. When density increases, the collision rate between ordinary matter particles and dark matter particles rises. This generates cold (non-thermal) plasma via the dark ionization process [49, 50, 58, 60, 67, 68].

The dark filamentary currents would then generate streams of weak cold plasma in the ordinary matter sector – not only on the surface of the Earth but also in the atmosphere and the crust (as the dark plasmasphere interpenetrates the ordinary matter Earth). The author has theorized that filamentary currents serve as dark electromagnetic highways under the dark plasma hypothesis.

In places where these currents intersect and pinch, vortices will be formed. If dense nodes, arising from the intersections of the filamentary currents, are located in these sites, the collision rates of ordinary and dark matter particles will rise. This will initiate the dark ionization process, which generates cold plasma. These sites could therefore contain higher amounts of cold plasma than isolated filaments.

Cold plasma has healing properties. For example, beams of ordinary cold plasma today kill bacteria, decontaminating food. Cold plasma is also used in medicine to promote human skin wound healing and can effectively treat various wounds. It would also be able to influence the body's bioelectric field and inherent electric and magnetic fields to heal. This may constitute a biosignature of dark plasma lifeforms.

➢ *Dark Plasmaspheres are Ubiquitous in the Universe*

In 2008, Xu and Siegel computed dark matter densities for all the planets in the Solar System, including Earth. Hence, all these planets may have dark matter plasmaspheres or Dark Earth-like planets co-rotating with them. The Sun and the Moon also have their dark plasmaspheres. – Dark Suns and Dark Moons.

Many ordinary matter exoplanets also host dark matter planets that corotate with the ordinary matter component. Besides these "hybrid" planets, there are also purely dark matter planets, without or very little ordinary matter components. Numerous dark galaxies, composed predominantly of dark matter with minimal ordinary matter, have been identified through gravitational lensing techniques.

In June 2015 and thereafter, Jin Koda's team at Stony Brook University in New York confirmed 901 dark galaxies in the Coma cluster. Of these, 332 were as large as the Milky Way. After further analysis, the team concluded that the Coma cluster could harbor more than a thousand dark galaxies of all sizes – the same number as the visible galaxies. In August 2015, three more dark galaxies in the Virgo cluster were detected by Christopher Mihos of Case Western Reserve University in Cleveland and his colleagues. [28]

In June 2016, van der Burg and his collaborators found another batch of dark galaxies, using the telescope at Mauna Kea in Hawaii. Observing eight clusters, which were less than one billion light-years away, researchers found almost 800 more *ultra-diffuse* dark galaxies. "As we go to bigger telescopes, we find more and more," said astrophysicist Michael Beasley at Spain's Instituto de Astrofisica de Canarias in Santa Cruz de Tenerife. "We don't know how many there are," he says, "but we know there are a lot of them." [31]

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He theorizes that there could be even more dark galaxies than the two trillion bright ones in the universe. Hence, dark plasmaspheres would outnumber ordinary matter planets. Dark plasmaspheres or Dark Earth-like planets are therefore not unique. We should not therefore be surprised that Earth also hosts dark plasmaspheres.

We expect a generically similar configuration and shape for them.

E. DM Mass Density on Earth

➢ *In Earth's Core*

A 2023 analysis of a one-year data set from the IceCube detector does not rule out the presence of less than 32 percent of the mass of the core being composed of dark matter at the one-sigma level. Overall, most of the dark matter around Earth is expected to be below the crust.

➢ *Surface of the Earth*

In 2023, Rebecca Leane, a theoretical astroparticle physicist with the SLAC Theory Group and Stanford KIPAC in California, USA, and her colleagues have shown that it is possible to have a high concentration of neutral dark matter particles on the surface of the Earth [32]. This was realized after they included many more variables into their model, including thermal and concentration diffusion, gravity, and capture accumulation, for neutral dark matter in local thermal equilibrium with ordinary matter.

(We assume that the lowest energy neutral (or pseudo-neutral) dark matter particles would have cooled down and reached thermal equilibrium, as their cross-section of interaction would be much greater than for tiny negatively-charged dark matter particles that would have a much higher temperature. The researchers assume, effectively, asymmetric dark matter – which is also assumed in the author's dark plasma hypothesis.)

The researchers concluded that dark matter may sit on the surface of a celestial object, which can be significantly displaced from the core. The number density of neutral dark matter particles at the surface of these objects would exceed the galactic dark matter halo density by more than ten to fifteen orders of magnitude. We can therefore expect a high concentration of neutral dark matter particles on the surface of the ordinary matter Earth.

➢ *Around the Earth*

In 2009, Adler noted that if the combined mass of Earth and the Moon exceeded their individual masses, it would indicate that the difference could be attributed to a halo of dark matter between them. Adler reviewed studies that measured the Earth-Moon distance using lasers reflected off Apollo lunar mirrors and LAGEOS satellites. If Earth exerts an unusually stronger pull on the Moon, which lies roughly 384 thousand km (238 thousand mi) out, than on the LAGEOS Earth satellites, which is about 12 thousand (7 thousand mi) away from the Earth's surface, this could be attributed to the effects of a dark matter halo between the Moon and the artificial satellites in medium Earth orbit. [14]

Based on this method, Adler estimated in 2009 that about twenty-four trillion metric tons (or 2.39 x 10^{16} kg) of dark matter lie between the Moon and Earth. "Such a dark matter halo might explain the anomalies seen in the orbits of the Pioneer, Galileo, Cassini, Rosetta, and NEAR mission spacecraft," he adds. Adler also estimated that the dark matter density peaked at about 70 thousand km (44 thousand mi) from the center of the Earth. This would form a spherical shell (or cloud) of dark matter particles around the ordinary matter Earth. (This distance will be dubbed the "Adler line," in contrast to the Karman line, which marks the end of the ordinary matter Earth's atmosphere, about 100 km from the surface.)

This cloud would lie between the Earth and Moon and significantly above the LAGEOS Earth satellites. Only the gravitational effects of this cloud will be pervasive in the ordinary matter sector, although there could be sporadic weak interactions. The density of this cloud, as determined by Adler's investigation using the "LAGEOS method," is considered relatively high. However, relative to the entire Earth, it is lower in density than the core or the Earth's surface, as discussed below, which uses different, more current methods of detection and analysis.

➢ *Summary*

The core of the Earth would contain predominantly large positively-charged dark matter particles. The surface of the Earth would be composed of predominantly large neutral particles. Around the Earth, the dark matter would consist predominantly of tiny negatively-charged dark matter particles.

➢ *DM Charge Density Distribution in Dark Earths*

Dark Earths will consist mainly of neutral (or pseudo-neutral) particles, as they are the dominant component in the universe. Dark matter makes up 85 percent of all matter in the universe. A sub-component of this would be made of self-interacting dark matter particles (which are assumed to be weakly charged). This has been estimated by Lisa Randall, theoretical physicist at Harvard University, to make up about 15 percent of all matter.

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The difference of 70 percent will then be made up of neutral (or pseudo-neutral) particles. (Pseudo-neutral particles are particles that have such a weak charge that appear neutral in a low density environment.) This means there will be almost five times the number of neutral dark matter particles as charged dark matter particles in the dark sectors. This composition is the reverse of the ordinary matter universe, in which the number of charged particles can be almost ten times that of neutrons.

Since the electric charge of ordinary matter particles may be a hundred to a million times stronger than that of dark matter particles, natural charge separation in the ordinary matter universe would be less common on large scales. However, because dark universes or sectors have more neutral particles and a weaker electric charge, charge separations happen more easily and widely in dark sectors and are sustained longer. This means, ironically or paradoxically, that the electromagnetic force may actually play a much larger role in determining the architecture of the large-scale structure of the dark universes or sectors, compared to in the ordinary matter universe or sector.

The dark neutral particles may have different behaviors from the weakly charged particles. However, they may be influenced by weak electrostatic forces acting on them indirectly through the interparticle viscosity. In this way, even if a low percentage of a soup of particles is composed of charged particles, the whole soup may behave like plasma. (In many laboratory and astrophysical contexts, about only one percent ionization in a collection of ordinary matter particles may be enough for them to exhibit plasma behavior. For example, the ionosphere of Earth is only a tiny fraction ionized, yet it behaves like plasma and supports radio wave propagation. Glow discharges in neon signs or plasma TVs operate at low ionization fractions but still exhibit plasma properties. However, note that these are non-thermal ionization scenarios. Self-interacting dark plasma is produced through non-thermal ionization scenarios.)

Together with the charged particles, the neutral particles would constitute a colloidal fluid-like medium. A colloid is a mixture with tiny insoluble particles evenly suspended in another substance. In this case, there are two species of charged particles (i.e., positive and negative) suspended throughout a soup of polarized neutral particles, and subject to gravity.

➢ *Charge Separation in Dark Plasmaspheres*

Researcher G. Tellez conducted experiments on a two-component plasma of heavy and light charged particles in a colloidal fluid *subject to a gravitational field*. In these experiments, he observed that heavy particles sunk to the bottom of the container and the light particles floated above. According to Tellez, if the container was high enough, he observed an excess of the light-charged particles forming a *cloud* floating above [33]. Numerical computations of the model confirmed that the heavy, charged particles accumulated at the bottom of the container while the light particles floated at the top. This is possibly due to gravitational stratification. The driving force in this type of stratification is gravity, which distributes adjacent volumes of particles by their density, acting through buoyancy and weight.

Quasi-neutrality is preserved in plasma because the number density of protons and electrons is almost equal. Given that the proton is nearly two thousand times more massive than the electron, equal numbers of protons and electrons within a given volume will produce a higher mass density for protons and a lower mass density for electrons. Gravitational stratification will therefore force the protons down, while the electrons will be pulled towards the protons as they fall, forming a cloud above the protons. Since the heavy and light particles are oppositely charged, the concentration of each type of particle in each region will effectively act as an electrode.

H. Thomas and his colleagues replicated the dynamics of the Tellez experiment. [32] An ensemble of particles was placed between two electrodes and exposed to a laser beam. Under these conditions, the particles exhibited a remarkable tendency to self-organize. They arranged themselves into a highly ordered crystal-like array of particles, forming up to eighteen distinct planes that were parallel to the electrodes. Each plane appeared as a flat disk-shaped *cloud* floating above the electrode.

This stratification or charge separation demonstrated the natural emergence of layered arrangements in multi-component plasmas subjected to external fields and illumination, which was observable with the naked eye.

The dynamics occurring in the above two sets of experiments is analogous to the dynamics of the well-known *Pannekoek-Rosseland Field* mechanism of charge separation and resulting electric field generation. This was first recognized in 1922-24. Pannekoek was studying the Sun's heliosphere. He noted that because the masses of protons and electrons were significantly different in the heliosphere they would give rise to charge separation and stratification. The tiny higher energy electrons would be able to escape the heliosphere, while the massive protons remained. To maintain quasi-neutrality in the presence of gravitational forces, electric fields would then be generated.

Similarly, when the electrons in the cold plasma of the ionosphere are exposed to ultraviolet light from the Sun, they can gain enough energy to escape the Earth altogether. This creates a net positively-charged region. When negative electric charges are attracted to this positively-charged region, a negatively, charged region develops. With this stratification, an electric field develops between the two regions. This is called the Pannekoek-Rosseland E-field.

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The gravitational stratification of plasma can separate the light hot electrons from the heavy cold protons (or ions), generating *gravity-induced weak electric fields*. This happens in the solar atmosphere, the solar winds, and in planetary ionospheres – including the Earth's. It also occurs in Earth's dark plasmaspheres or Dark Earths.

➢ *Dark Pannekoek-Rosseland Electric Fields*

Gravitational stratification within a non-thermal (or cold) plasma will occur more readily in a dark plasmasphere (and be more pronounced or extreme) because of the weak dark electric charge, the abundance of neutral (or pseudo-neutral) particles, low particle density, and the different temperatures and sizes of the particles, among other factors. This allows for long-lived charge separation. The collection of charged and neutral (or pseudo-neutral) particles forms a colloidal fluid-like medium.

In a Dark Earth, thermal stratification reinforces gravitational stratification. The cause of this thermal stratification is inherent in the cold (or non-thermal) dark plasma. At the galactic center, gravitational and the hypothetical fifth force bring dark protons and dark electrons together. Since the protons have a much higher mass, their cross-sections would be much larger. This results in a higher collision rate among dark protons, cooling them off faster. The dark electrons, however, would have fewer collisions. This results in their higher temperature.

Within the Dark Earth, we would expect the warm dark electrons to have a lower density and the cold dark protons to have a higher density. Gravitational stratification then separates the heavier, colder dark protons, with higher mass density, from the lighter, warmer dark electrons, with lower mass density. The heavy, positively charged (and relatively cold), more massive dark protons will sink to the core of the Earth and accumulate as a (relatively) dense non-neutral plasma. This region will be called the "E+ region." The mass density of dark matter will be highest within this region (due to the more massive positively charged particles being confined in a smaller region, i.e., the core).

The more energetic, tiny and light negatively charged (relatively warm and more energetic) dark electrons, however, will hover in the atmosphere as a spherical shell (or cloud) around the Dark Earth. This evidences a charge stratification, analogous to what happens in the ionosphere in the ordinary matter Earth. It will accumulate as a non-neutral, low-density spherical shell or (non-neutral) plasma cloud, which we will call the "E-region." This stratification of charges will generate a dark Pannekoek-Rosseland E-field. Overall, the Dark Earth will be electrically neutral (i.e., quasi-neutral) due to the Pannekoek-Rosseland field effects and double layers. We would therefore expect a similar outcome, as recorded in the experiments discussed immediately above.

The neutral (or pseudo-neutral) particles will dominate on the surface of the ordinary matter Earth, between the two "electrodes," where the least number of charged particles are located. Since they are heavier and colder than electrons (similar to protons), many of them will also settle at the core due to gravitational stratification, thereby shielding or screening the dark protons from dark electrons. Additionally, the space occupied by the abundant neutral particles, between the dark electrons and dark protons, increases their separation, further weakening the modest electric field that these two species of particles generated.

The table below shows the concentrations of different particle species in the experiment conducted by G. Tellez (discussed above) on the left, and the expected equivalent concentrations in the Dark Earths on the right.

Table 1 General Distribution of Dark Matter Particles in Dark Earths

Tellez Experiment	**Dark Earths**
Heavy particles at the bottom.	Heavy, low-energy, positively-charged dark matter particles in the core, where the density of ordinary matter is highest. This will be called the E+ (or E plus) region.
Light particles in a cloud, floating at some altitude.	Light, high-energy, negatively-charged dark matter particles form a spherical plasma shell (or cloud) of dark matter particles around the Earth. This will be called the E- (or E minus) region.
Weakly ionized or polarized fluid or gas in the colloidal medium.	Neutral particles that buffer the above two charged regions are mixed in with much smaller numbers of charged particles. Due to viscosity, electrostatic forces act indirectly on neutral particles, causing them to behave as a weakly polarized fluid collectively. This will be called the E0 region.

The configuration of a positive electrode at the core of the Dark Earth, a negative electrode around the Dark Earth, and neutral particles separating them (like a dielectric, i.e., an electrical insulator that an applied electric field can polarize) produces a typical capacitor configuration. A capacitor stores electrical energy. This suggests that Dark Earths are planetary-scale capacitors which are able to store electrical energy.

The configuration of particles in a Dark Earth is similar to that of certain ionized regions in ordinary matter on Earth. For example, the Pannekoek-Rosseland E-field in the ordinary matter Earth develops between the positively charged ionosphere and the negatively charged region above the ionosphere. Similarly, a *dark* Pannekoek-Rosseland electric field develops between positively

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charged particles in the E+ region, within the core of Dark Earth, and the negatively charged particles in the E- spherical shell (or cloud) that surrounds it.

➢ *Charge Stratification is More Prevalent in Dark Earths*

The charge stratification that occurs in a tenuous ionized Dark Earth does not generally happen in astrophysical objects in the ordinary matter sector. For example, it does not occur inside stars (in a significant way) due to hydrogen fusion and the higher particle density (which increases the rate of particle collisions). Nor does it occur in brown dwarfs due to deuterium and lithium fusion, as well as their higher density (which increases the rate of particle collisions).

It also does not occur in the core of the ordinary matter Earth. Above the surface of the ordinary matter Earth, the lower and middle atmosphere is slightly ionized. Above this are the ionized regions of the ionosphere and plasmasphere. However, in the rocky core of the ordinary matter Earth, the light particles (electrons) are largely firmly bound, through the strong electromagnetic force, to the heavy particles (protons) within atoms, notwithstanding some radioactivity that would cause some ionization.

In contrast, in a dark plasmasphere, the particles are freer to move because the binding force between oppositely charged particles is weaker due to the weaker dark electric charge, making them more susceptible to gravitational and thermodynamic forces. Charge stratification can therefore be maintained for extended periods in Dark Earths.

➢ *Dark Magnetic Fields*

Following the formation of the dark Pannekoek-Rosseland electric field between the E+ region, within the core of Dark Earth, and the negatively charged particles in the E- spherical shell (or cloud) that surrounds it, a weak vertical current will develop between the two regions (according to fundamental electrodynamics). This will in turn generate a weak dipole magnetic field. This is similar to what happens in the ordinary matter Earth, with observed vertical currents of up to one thousand amperes, between the Earth's surface and the ionosphere.

However, in the Dark Earths, the electrodes are farther apart, i.e., beyond the ionosphere and below the Earth's surface (around the core), and are not blocked by a rocky core. The weak global magnetic fields that develop will serve as seed fields for a dynamo mechanism.

The dynamo mechanism is driven by the rotation of the dark plasmasphere and by convectional flows of plasma that are generated by the thermal gradient between the cold core of positive particles and the hot cloud of negative particles. Charged particles follow the magnetic field lines, forming dark Birkeland currents. The dark geomagnetic field that has developed rotates with the Dark Earth, constantly changing its size and shape (just like the ordinary matter Earth's magnetosphere).

➢ *Nested Concentric Shells and Cells*

As discussed in the experiment by H. Thomas, particles in the plasma spontaneously arranged themselves into parallel *planes*, between the electrodes. Subsequent experiments showed that the particles in a plasma crystal organized themselves into ordered *concentric shells*, to a total ball diameter of several millimeters. These orderly Coulomb balls, consisting of aligned, nested concentric shells of dust particles, were able to survive for prolonged periods.

This does not only happen on small scales. It is well-known that deep observations of many elliptical galaxies show concentric shells. If this happens on both small and large scales, it is reasonable to expect that dark matter planets, like Dark Earths, would also exhibit plasma-crystalline properties and concentric shells. This is based on known plasma dynamics related to the formation of double layers or plasma sheaths.

Electrical plasma is able to self-organize and spontaneously arrange itself in such a way that it electrically isolates one section from another, depending on the physical and electrical properties of each region. Through this mechanism, different parts of the plasma can develop distinct characteristics—such as density, temperature, and charge—while maintaining overall system stability.

This self-organization is achieved by forming internal isolating walls, such as double layers or nested shells, that function as boundaries between regions with different properties. These boundaries minimize direct electrical interaction between the separated regions, allowing each section to retain its own set of characteristics. As a result, the plasma is able to sustain complex internal organization over extended periods, preserving the isolation of its various parts while still functioning as a unified whole.

For example, suppose the voltage difference between the electrodes becomes large enough in a plasma. In that case, a thin double layer will form somewhere in the middle of the tube (to preserve quasi-neutrality). The plasma on one side of the double-layer (the side toward the anode) will have approximately the same voltage as the anode. On the opposite of the double-layer, towards the cathode, the plasma will have essentially have the same voltage as the cathode. The two sides of the plasma are then electrically isolated from each other by the double-layer. Only weak electrostatic forces are felt by particles on either side of the double-layer due to charges on the other side of the double-layer.

The strongest electric fields in the plasma will be found within the thin double-layer. The strength of the electric field inside each succeeding double-layer would become weaker towards the middle of the body, i.e., between the regions that represent the electrodes. A double-layer that forms in a sphere, with one electrode in the core, and the other a shell around it, would be in the form of a spherical shell in the middle (between the electrodes). A series of double layers would form concentric shells that separate plasma with different properties, i.e., with different densities, temperatures, and plasma frequencies.

The number of shells will depend on the voltage potential of the electrodes – the higher the potential, the greater the number of shells. Since the voltage potential can change over time, the number of shells would also vary. The concentric shells in between the positive and negative regions are quasi-neutral due to the action of the double layers, as well as the predominance of neutral (or pseudo-neutral) particles. The double layers act as dielectrics (as in a capacitor) that insulate to prevent current flow while allowing charge polarization within the double layer, which enables the storage of electrical charge.

The double layers, separating the concentric shells, follow the contours of the magnetic field lines. It is the magnetic field lines that provide the skeleton to give these shells their shape. Birkeland currents are aligned with these magnetic field lines. The double layers will accelerate charged particles in the Birkeland current. The magnetic field induces a rotation in the nested concentric shells. This has been observed in experiments by Hirakjyoti Sarma and colleagues from Tezpur University in India.

Where adjacent plasmas within the concentric shells have different properties, additional double layers will form to separate them structurally into smaller granules within the shells. This structure of plasma can be clearly seen in the granulation of the Sun. These granules would have slightly different plasma frequencies, densities, and temperatures.

The Dark Earths are expected to organize into concentric shells and exhibit other signature features associated with plasma bodies, which are frequently observed in laboratory and space plasmas. These would include filamentary currents, plasma vortices, and plasmoids.

➢ *Dark Moons*

The Moon is also surrounded by many sources of dark matter, just like the Earth. Hence, we would expect the Moon to gravitationally capture dark matter from these sources, adding to the embryonic dark matter seed already present when the Moon formed. Hence, the Moon, like the Earth, would host dark matter halos (i.e., “Dark Moons”). Similar to the configuration in the Earth, there will be a high concentration of positively charged particles in the Moon’s core – the M+ (or M plus) region. Surrounding the Moon there will be a high concentration of negatively charged dark matter particles in a cloud or shell - the M- (or M minus) region. These will serve as the electrodes in the Dark Moon.

In between these electrodes, on the surface of the Moon, there will be an abundance of neutral (or pseudo-neutral) particles. Similar to the Earth, the ordinary matter Moon will be co-rotating with its Dark Moons. All the Earths and Moons will gravitate toward the centre of mass of the Earth-Moon system. They will mutually gravitationally interact with each other, causing tidal forces within each body – both ordinary and dark. There will be a much weaker dark vertical electric field and dipole magnetic field, which developed in similar fashion as in the Dark Earths, in the Dark Moons.

➢ *DM Charge Density Between the Earth and Moon*

Moving out from the Earth’s core, charge density forms a wave - alternating from positive to neutral, and then to negative, then neutral again. The charge density, moving out from the Moon’s core, mirrors this pattern.

There would be a high positive charge density of dark matter in Earth’s core, the E+ (or E plus) region, decreasing gradually as it reaches the surface of the Earth, where it is dominated by neutral (or pseudo-neutral) particles, with equal numbers of positively and negatively charged particles. The Earth's surface would have a high quasi-neutral charge density. As we move towards the Adler line (about seventy thousand km (44 thousand mi) from Earth’s center), the negative charge density will rise to a peak. This will be the E- (or E minus) region. (This region is beyond Earth’s atmosphere by thousands of kilometers.)

As we approach the Moon, there will be a rise in negative charge density at about 12 thousand km (7,456 mi) from the center of the Moon. (This is a rough first estimate which takes the Adler line, 70 thousand km (44 thousand mi) from Earth and dividing by six (the difference between the strength of Earth’s and the Moon’s gravity) and rounding up.) This is the M- (or M minus) region. The quasi-neutral charge density then increases as we approach the Moon’s surface. From there on, the positive charge density rises to a peak in the Moon's core, the M+ (or M plus) region.

In between the E- (or E minus) region of the Earth and M- (or M minus) region of the Moon, there will be dark very low density collisionless plasma comprising of neutral (or pseudo-neutral) dark matter particles, mixed in with a smaller pool of an equal number of dark electrons and dark protons (and other dark matter particles). This region, between the Earth and Moon, will therefore have a high quasi-neutral charge density.

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At perigee, when the Moon is closest to Earth, a tenuous dark bridge would form from the lowest-energy Dark Earth to the lowest-energy Dark Moon.

F. Dark Plasma Biospheres

➢ *Dark Matter Lifeforms*

Many leading scientists are now hinting or raising the possibility of dark matter lifeforms. In 2008, theoretical physicist, Sean Carroll, from Caltech said, "So, we can imagine much more than a single species of dark matter; what if you had two different types of stable particles that carried dark charge? Then we would be able to make dark atoms and could start writing papers on dark chemistry. You know that *dark biology* is not far behind" (emphasis added). [22]

So, Carroll and his colleagues believe that the concept of "dark biology" may become increasingly significant, suggesting the possible existence of life forms constituted by dark matter. He and his colleagues had also theorized that dark matter could be present in the form of dark plasma. Both conjectures were also first put forward by the author in 2005. A paper entitled *Creation of Minimal Plasma Cell Systems by Self-Organization in Earth's Dark Biosphere Leading to the Evolution of Dark Plasma Life-Forms* was published in 2009 formalizing the concepts.

In 2016, theoretical physicist Lisa Randall of Harvard University remarked, "If one variety of dark matter can clump together, it could form a range of previously unimagined dark structures. It could aggregate into dark stars orbited by dark planets composed of dark atoms. In a particularly speculative scenario, *this new type of dark matter might even permit the existence of dark life*" (emphasis added). [24]

If the hidden dark (matter) biospheres are dark plasmaspheres, it follows logically that the hidden lifeforms that evolve in this habitat would most likely be dark plasma lifeforms.

➢ *Dark Plasma Lifeforms and Dark Astrobiology*

Astrobiology is the scientific study of the possible origin, distribution, evolution, and future of life in the universe, including that on Earth, using a combination of methods from biology, chemistry, and astronomy. The author introduced a new branch of astrobiology called *plasma and dark astrobiology.*

This is a branch of astrobiology that proposes the existence of plasma-based life-forms, both in the ordinary and dark sectors. It uses an inter-disciplinary approach, incorporating mainly biology, dark matter and plasma physics. It studies the biology and biophysics of these plasma life-forms, as well as their ecosystems and habitable zones within hypothesized hidden dark biospheres, called "Dark Earths."

These veritable dark matter planets, which corotate with the ordinary matter Earth, are theorized to be able to support and harbor complex non-baryonic life in the form of dark plasma life-forms, as well as less complex ordinary plasma life-forms in ionized regions in the ordinary matter sector. (A series of papers, articles and books by the author over the past twenty years that support this hypothesis (called the "dark plasma hypothesis," are referenced below.)

In this paper, "plasma lifeforms" refers to a proposed new phylogenetic domain, called "eukarya-plasma," distinct from eukarya-carbon [56]. The term covers single-celled eukaryotic organisms, not specific species, and excludes discussion of individual evolutionary adaptations. Notably, dark plasma lifeforms are theorized to be made of self-interacting dark plasma.

Plasma physicist Mituo Uehara and colleagues argued in a 2000 *American Journal of Physics* paper [41] that plasma physics should play a role in biological research, noting its relevance to understanding the electrical properties of cell membranes through concepts such as charge neutrality, Debye length, and double layers.

To explore the evolution of plasma-based life, we can examine experiments with ordinary matter plasma that have produced short-lived plasma cells resembling primitive organisms such as viruses and bacteria. These findings may offer insights into how both ordinary and dark-sector plasma life-forms could emerge through Darwinian evolution over millions of years.

➢ *Ordinary Plasma "Life-Forms" Model*

In 2003, physicists Lozneanu and Sanduloviciu from the Plasma Physics Department at the University of Alexandru Ioan Cuza (UAIC) in Romania, reported that they were able to generate (ordinary matter) plasma spheres or cells in the laboratory, subject to gravity, which display the behavior of simple lifeforms. [42]

They reported that when they applied a high voltage to the electrodes in argon gas, an arc discharge flew across the gap like a miniature lightning strike. When this happened, the neutral gas was converted to a non-thermal (or cold) plasma at the points where the discharge struck. This electric spark generated a high concentration of ions and electrons which resulted in the production of a

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cold (non-thermal) plasma to accumulate at the positively charged electrode (i.e., the anode). Spheres, with double layers spontaneously grew.

The energy of the induced spark determined the size and lifespan of the spheres. After growing to a certain size, these spheres appeared as stable (static), self-confined, luminous, nearly spherical gaseous bodies attached to the anode. Their sizes ranged from a few micrometers up to three centimeters in diameter. The sphere detached itself to become a free-floating and independent body after reaching a threshold value of the electrode's potential. In this state, it can replicate by splitting into two (analogous to splitting biological cells undergoing mitosis). They grew in size, as if they were ingesting neutral argon atoms and splitting them into ions and electrons to refill their boundary layers.

The sphere's sheath provided an enclosed internal environment that shielded it from the external environment, just like a biological cell's membrane. The sheath was able to sustain and control processes, including energy management and matter exchange. This is reminiscent of the membranes of biochemical cells, with ion channels that exchange energy and matter with the surrounding environment. The researchers described a rhythmic and pulsating "inhalation" of the nucleus in the cell that resembled the breathing process of living systems during metabolic processes in biological cells.

Furthermore, the cells communicated with other plasma cells, exchanging, as it were, information. This was achieved by the emission or reception of electromagnetic waves a resonant frequency, making other nearby cells vibrate at a specific frequency. This would confer upon the plasma spheres or cells a capacity that might be characterised as "telepathic," were it not understood that electromagnetic waves are responsible for this phenomenon.

In 2024, R. Joseph from the Astrobiology Research Centre in California (USA), and his colleagues from other distinguished institutions reported, "The 'plasmas' observed in the thermosphere engage in behaviors similar to simple multicellular organisms; a phenomenon also observed among plasmas generated experimentally [45]. As theorized by the author much earlier [54, 56, 60, 83, 84] plasma lifeforms do have structures that resemble unicellular organisms. "Simple multicellular organisms" is a near-approximation.

Based on the above and other similar experiments or observations, there is a possibility that ordinary plasma could be considered a quasi-neutral prebiotic soup of charged particles, that, under the right conditions, could give rise to proto plasma lifeforms (or what behaves as lifeforms as we know it).

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CHAPTER TWO
ABIOGENETIC PROPERTIES OF DARK EARTHS

A. Stability

- *Crystalline Structure*

Earth's ordinary matter is sufficiently stable to harbor mainly complex carbon-based life-forms. The coupling or anchoring of the Dark Earths to the highly dense ordinary matter Earth provides stability to the Dark Earths – unlike nearby ordinary plasma clouds that could drift away or be torn apart by tidal forces and be cannibalized. The stability provides the necessary evolutionary timescale.

The profound plasma crystalline properties of the Dark Earths gives them structural integrity. Furthermore, the Dark Earths are not uniform; they are layered. The spontaneous formation of nested concentric shells and double layers (as discussed earlier) provides the foundational organization.

- *Ecological Niches*

These double layers are not arbitrary boundaries. They form wherever adjacent plasmas in the dark plasmasphere have different properties. They separate plasma regions with vastly different densities, temperatures, and charge potentials. Additional double layers within the concentric shells separate them into smaller sub-regions within the shells. This self-organization, driven by thermodynamics and electrodynamics, creates specific confined honeycomb structures that can function as individual ecological niches. It is inherently self-replicating and self-confining. Different cells would have slightly different plasma frequencies, densities, and temperatures.

- *Plasma Cells*

Hannes Alfvén, Nobel laureate in physics (1970), highlighted the similarity between double-layers in electrical plasma and cell membranes. In 1986, he noted that both function as protective barriers between their respective plasmas and the environment [46].

At small scales, double layers act as permeable cell membranes. However, if a particle’s kinetic energy exceeds the potential drop across the double layer, it can cross through. In other words, they are selective barriers rather than absolute insulators. In this way, there is selectivity in permeability – similar to that of biological cell membranes.

Furthermore, in a plasma, there is no need for actual contact to carry out processes, as fluctuating electric and magnetic fields abound. In fact, the very definition of a plasma is that most of its interactions would be via electric and magnetic field fluctuations. If most of their interactions were collisions with other particles, it would no longer be a plasma and would become a gas.

The local insulating properties of the double layers are precisely what allow information and structural integrity to persist over evolutionary timescales. The weak charge enables complex computation without chaotic dissipation. But the question of gross energy supply, the metabolic fuel for the entire biosphere, is solved globally, not locally. This is the gravity-induced charge stratification caused by the Pannekoek-Rosseland mechanism.

- *Weak Charge*

The weak electric charge in dark plasma suppresses instabilities and allows for sustained charge separation, which is crucial for biological organization and evolution. This stability enables the development of complex plasma life over billions of years, potentially outnumbering carbon-based life. Phenomena like plasma turbulence, filamentation, and kink instabilities depend on strong field interactions. Weakening the electric force could allow more linear or laminar behavior.

Hence, dark matter planets in the form of dark plasmaspheres would be larger, in line with current theory. Fusion reactions would be suppressed. Ionized gases will be present, but less chaotic than in the ordinary sector. The particles in the plasma would still interact through fluctuating electric and magnetic fields, but without the wild dance of high-speed instabilities and eruptions we see in solar flares or fusion labs.

Instead of turbulence, ionized particles would settle into concentric shells and filamentary current grids, including helical structures. Stable clouds of low-energy plasma would form star-like objects with diffused light. These structures would not radiate wildly but would shimmer. The stability provides the necessary evolutionary timescale for large and diverse populations of plasma lifeforms to fill the ecological niches in the dark plasmasphere. These unique attributes are generally not found in ordinary plasma bodies.

Lozneanu and Sanduloviciu showed that minimal ordinary plasma cells could be formed in a laboratory, but their structure degraded quickly, and they were only analogous to the most primitive ephemeral life forms, like viruses or bacteria. Those experiments showed the limit of ordinary plasma self-organization. In contrast, the prolonged stable environment of a Dark Earth, however, would allow the dark versions of these types of simple laboratory plasma cell systems to evolve into extraordinarily complex dark plasma life forms, potentially creating a biosphere that vastly outnumbers carbon-based lifeforms due to the vastness of the dark biospheres.

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➢ *Charge Separation and Steep Gradients*

For complex plasma lifeforms to evolve, electric charge separation would need to be sustained longer. Charge separation is vital for life and supports many biological and chemical systems and processes. It is especially relevant in the origin and sustainability of life.

The biochemical substrates of life are mainly made up of neutral atoms and molecules, with areas containing non-neutral charge carriers that are separated by hydrodynamic forces. However, this is not possible in ordinary plasma on a wide scale as oppositely-charged particles quickly recombine to form neutral atoms on the surface of the Earth.

This is in contrast with *dark* plasma in the Dark Earths. With its weaker electric charge, preponderance of neutral particles that act as buffers and low density, charge separation does not only occur but can be sustained for extended periods. Charge separation provides the steep gradient to trigger self-organization and life processes that maintain a dynamic equilibrium.

On the macroscopic scale, there is charge separation in the Dark Earth, due to the separation of the E+ region in the core and the E- region around it. On a microscopic scale, double-layers form in plasma. Double-layers are layers where positive and negative charges are separated to generate electric fields which can accelerate particles that enter the region. These charge separations provide steep gradients at both the macroscopic and microscopic levels, priming and pushing Dark Earths to biological self-organization. This augurs well for the evolution and development of lifeforms in Dark Earths.

These Dark Earths could harbor life. The weaker dark electric charge will enable charge separation to be sustained longer. Charge separation is essential for the development of lifeforms. The weaker charge will also suppress plasma instabilities, which is conducive to life.

Ordinary plasmas usually resist charge separation, making complex bioplasma activities needed for intelligent plasma life unlikely, except in rare or unique settings alongside atomic-based life. Substantial electric charges trigger plasma instabilities, which are harmful to life. On the other hand, dark plasma, with its weaker electric charge and predominance of neutral (or pseudo-neutral) particles, will be able to sustain charge separation for the evolution of complex plasma life-forms.

As a result, ordinary plasma life-forms are not common throughout the universe made of ordinary matter; when they do exist, they tend to be primitive. These basic forms may have served as models for the development of carbon-based life. In other words, complex plasma life did not develop from ordinary plasma forms—instead, those forms evolved into carbon-based organisms in our universe.

Gravity acts on the mass, forcing the heavier dark protons to sink to the core to the E+ region. Since the dark plasma is weakly charged, this gravitational stratification creates an electrical potential difference, forcing the lighter dark electrons to build a massive spherical cathode shell. The E-region is theorized to exist at the 70,000 km marked by the Adler line. The result is a self-powered planetary-scale device, a massive natural capacitor that could store electrical energy.

The E+ core could function as the anode, and the distant E-shell a cathode, and the vast region filled with the neutral particles acts as a buffer, which acts as a dielectric insulator between them. There would be weak and gentle counter-streaming proton and electron currents in the Dark Earth between the core and the shell. (Counter-streaming electron and proton currents are observed in astrophysical plasmas, like the solar wind and coronal mass ejections.)

The set-up of Dark Earth with its two electrodes, one in the core (composed of heavy positively charged particles), and the second in the shell (composed of light negatively charged particles), is similar to the experiment that Lozneanu conducted (as discussed above). If the voltage gradient between the two electrodes is high enough, under certain conditions, there could be weak discharge currents that would spark the formation of “Lozneanu spheres” around the “electrodes.”

These dark plasma spheres, or plasma cells, would be able to survive and grow in the dark plasmasphere for extended periods (compared to in a laboratory in the ordinary matter sector). They could possibly replicate and communicate (like the spheres in the experiment) and ultimately evolve (over billions of years) into complex plasma lifeforms.

This gravity-driven configuration provides an immense stable electrical potential across vast distances. A power source that runs on planetary-scale thermodynamics and gravity. The double layers provide local organization and information processing, while the giant capacitor offers the deep, long-lived energy gradient necessary to drive the entire biosphere over billions of years. This configuration is optimized as a conceptual planetary capacitor.

Dark plasma life-forms would have a head start, compared to ordinary matter life-forms on Earth, as they would not need to wait for the Earth’s crust to cool down to evolve and proliferate. They are likely to outnumber ordinary plasma-based and carbon-based life-forms by many thousand folds on Earth and in the Solar System. These Dark Earths contain layers that overlap with the surface of the normal Earth, where carbon-based life exists.

➢ *Summary*

The stability and the ability of these Dark Earths to sustain charge separation and suppress plasma instabilities make them not just possible but fundamentally ideal for the development and evolution of dark plasma lifeforms. Despite the low mass and density, a thin halo of dark plasma, interpenetrating the Earth's atmosphere and crust, would therefore be sufficient to support a plethora of low-mass, highly energetic, ultra-light radiation-like plasma-based dark matter lifeforms, existing between matter and radiation. Despite its low-density, the dark plasma contains particles with electric and magnetic fields that form complex structures and long-range correlations within the intervening apparently empty space.

➢ *Habitats*

Table 2 Attributes of Dark Earth vs. Ordinary Matter Earth

	Lowest Energy Dark Earth	**Ordinary Matter Earth**
Volume	1.44 x 10^{30} cm^3	1.08 x 10^{27} cm^3
Mean Radius	70,000 km	6,371 km

There is no hard boundary to the lowest-energy dark plasmasphere. The Adler line at 70,000km (44 thousand mi) is taken as an approximate border. The relationship between the lowest-energy Dark Earth and the visible, rocky Earth may then be very similar to that between Jupiter's gas envelope, which is about 71 thousand km (44 thousand mi) in radius, and its small fuzzy-rocky core (which, based on late-2008 computations, is about the same radius as the mean radius of the visible Earth of about 6,400km (4,000 mi).

Hence, this Dark Earth would be able to fit more than one thousand visible ordinary matter Earths inside itself. Its' diameter would be at least eleven times the Earth's diameter (i.e., 70 thousand km divided by 6,400 km). Dark plasmaspheres do not have a fixed shape or size (very much like the ordinary matter Earth's magnetosphere). Hence, the actual ratio of the diameters would vary and the number of Earths it would be able to contain would also vary at various times.

The human biosphere on Earth is coincident with only a very thin layer of the dark plasmasphere. The volume of Earth inhabited by humans is only about 0.03 percent. (The land area of Earth is less than a third of its surface. Most of this area is largely uninhabitable including the deserts, extremely cold regions and high altitude mountainous regions.) The smallest Dark Earth is about a thousand times larger than Earth. Hence, the human biosphere coincides with only about 0.00003 percent of the volume of the smallest Dark Earth. (This is derived by taking the volume of Earth occupied by humans (i.e., 0.03 percent), divided by one thousand). Even if trillions of plasma life-forms existed, the dark biosphere would still have a low population density in most areas, with the outermost regions being especially empty.

The habitability of the dark plasmasphere in different regions varies. There are constraints such as density and temperature, as well as overall net charge of the region which may make it challenging for complex macroscopic lifeforms to survive. The density of the dark plasma in a habitable regions needs to be sufficient to allow for these types of life-forms to evolve and interact. However, it should not be too dense. Hence, high dark matter density regions, such as in the core of the Earth, or even most of the mantle, may not be suitable. The temperature should not be too hot as it will invite instabilities. There should be an abundance of neutral dark matter particles with equal numbers of positively and negatively charged particles, to ensure stability, quasi-neutrality, and the ability to sustain charge separation.

The highest density of neutral dark matter particles coincides with the ordinary matter Earth's crust, troposphere, and stratosphere, or the "CTS" region. It is conjectured that most dark plasma life-forms would inhabit this region – the Goldilocks zone. The CTS region has a thickness of *about 100 km (62 mi) - about 50 km (31 mi) above the surface of the crust and 50 km (31 mi) below.* The highest density of higher density dark plasma life-forms (DPLF) is believed to be here.

➢ *Plasma Frequency and Quantum Coherence in the Dark Biosphere*

Plasma frequency is the rate at which charged particles (usually electrons) in a plasma oscillate when they are disturbed from their equilibrium positions. It is a fundamental property of plasmas and determines how quickly electrons respond to electric fields. It is directly related to the number density of charged particles and the strength of their electric charge. It is inversely related to the mass of the particle.

With a weaker dark electric charge, the plasma frequency in dark plasmaspheres would be generally lower. Lower plasma frequency means that the charged particles respond more gently and less intensely to electric fields. Furthermore, the density of particles in the dark plasmaspheres are significantly lower with interparticle distances much larger. These factors result in a much weaker coupling between elementary particles and the environment than in the ordinary matter sector.

Physicists Itamar Allali and Mark Hertzberg of Tufts University explain in their 2020 paper, "…dark matter may have the unique possibility of exhibiting naturally prolonged macroscopic quantum properties due to its weak coupling to its environment." [47] In ordinary matter, the electric charge couples strongly to the environment. This means charged particles interact constantly and strongly with photons, phonons, then other excitations. Such interactions cause decoherence, collapsing quantum superpositions into classical states very quickly.

However, lower plasma frequency oscillations in dark biospheres reduce noise and favor quantum coherence. In a low-noise plasma environment, quantum coherence can be sustained longer. Furthermore, the mass of the particles in the dark biospheres are expected to be lower. If this is the case, the de Broglie wavelengths would be longer (due to lower mass), making the environment more quantum-like.

The Bohr radius is a fundamental physical constant that represents the most probable distance between the nucleus and the electron in a hydrogen atom in its ground state. It is inversely related to the electric charge. Hence, with a weaker charge, the Bohr radius expands. If the electric charge weakens by a million times, this will have a huge effect on the Bohr radius.

It will expand way beyond the nanoscale where quantum effects dominate in the ordinary matter sector. The gaps between quantum states then collapse. Quantum transitions, tunneling, and superpositions become easier to access at low energies, so quantum behavior will not be confined to microscopic systems but can occur in macroscopic ones. The "quantum scale" will balloon to meters or kilometers.

With a weaker charge, particles will not generally bind strongly into atomic structures or even bind at all. Instead of atoms and molecules, there will be plasma filaments, sheets, vortices, waves and other collective electromagnetic modes that would dominate. These collective excitations are inherently quantum (like phonons or plasmons), and with weaker charge, their coherence length could stretch to macroscopic scales. Magnetic fields generated by currents (sustained by widespread charge separation) would sculpt matter into intricate, filamentary architectures. Chemistry-driven complexity in the ordinary matter sector would be replaced by electromagnetic plasma-driven complexity in dark biospheres.

It is important to note that these effects would take place incrementally over the different dark biospheres, from low energy ones to much higher energy dark biospheres. It is the higher energy dark biospheres that will see the full panoply of quantum effects at macroscopic scales. The lowest energy Dark Earth that we are focusing on in this paper would display the features described above and in the next section only to a partial extent.

The lower-energy dark biospheres (including the lowest energy Dark Earth) may have a weaker electric charge, but it would not be a million times weaker. (The range is between one hundred and one million times weaker.) Hence, it will not have the full-blown effects that will be discussed below, and will still retain its semi-classical character, although it would be more “quantum-like” than the ordinary matter sector. As we proceed to higher energies, the dark biospheres would show increasing quantum weirdness at macroscopic scales.

In the higher energy dark biospheres everyday objects would exhibit quantum superposition and tunneling. These properties would be biologically relevant, because decoherence times are long enough to influence life processes. Its biology would be quantum-native, not classical with quantum exceptions. Lifeforms would exploit this quantum phenomena to adapt to the environment and evolution would favor those who exploit quantum phenomena.

This opens the door for biosphere-wide quantum correlations. In a low-density dark biosphere, quantum correlations could allow for nonlocal information sharing. Cognitive processing might be distributed nonlocally. It might not be confined to individual brains but distributed across the biosphere.

The biosphere itself could function as a quantum network, with coherence sustained across large scales and where entangled states encode collective “thought.” Intelligent lifeforms would share a quantum cognitive field. A high energy dark biosphere could then plausibly function as a macroscopic quantum computer, with lifeforms interconnected by quantum correlations rather than classical signals.

➢ *Debye Length and Scaling in the Dark Biosphere*

Debye length is the distance over which electric fields are screened out or shielded in plasma. It is directly related to temperature and inversely related to the electric charge. Hence, when the electric charge is weaker and temperature rises in a dark sector, the Debye length becomes larger. Hence, electrostatic fields extend farther before being screened, and charges “feel” each other over larger distances.

This would enable dark bioelectric fields to couple across larger scales. Communication and coherence could extend beyond the local granule or shell and potentially across ecosystems, or the planetary-scale plasmaspheres. The biospheres would also be much larger since this gentle plasma can maintain stability over greater distances, allowing for the formation of larger, more tenuous, and stable biospheres. These large biospheres would support long-range electrostatic coherence. Intelligent dark plasma lifeforms in these biospheres would sense a remarkably high level of interconnectedness.

The scale of the biosphere expands because fields and lifeforms grow larger because of the weaker charge and higher temperature (and consequently, the larger Debye length. However, another factor would also need to be considered. This is the temperature gradient in the plasmasphere, with the cold, more massive protons in the core and the hotter, tiny electrons in a cloud or shell around the Earth.

Due to this temperature gradient, the Debye length will vary, being smaller at the center of the dark biosphere and larger in its outer shell. Consequently, lifeforms will vary in size - with smaller denser and colder lifeforms closer to the ordinary matter Earth's core, and larger less dense and warmer lifeforms in the atmosphere. There would be macro-organisms and extended ecosystems, possibly planetary-scale "superorganisms" the farther the distance from the center. These plasma lifeforms will grow much larger than carbon-based lifeforms because the forces that would otherwise break up or destabilize them are weaker.

➢ *Ecology of Dark Plasma Lifeforms (DPLF)*

As discussed earlier, the lowest energy dark plasmasphere bears the same size relationship with the rocky Earth as Jupiter's gas envelope with its rocky core. This is consistent with the current understanding in the scientific community of the scale of dark matter exoplanets.

While there would be smaller dark plasma lifeforms on the colder surface of the ordinary matter Earth, following the temperature gradient, there would generally be much larger oblate and prolate ovoid and near-spheroid plasma lifeforms, much larger than whales, cruising through the dark plasma ocean that are coincident with our atmosphere (mostly in the troposphere and stratosphere). In the thermosphere, where the population density in the corresponding location in the dark plasma biosphere would be much less, the size may reach even larger dimensions. This is analogous to what Carl Sagan imagined in the gas envelope of Jupiter.

Sagan and Edwin Salpeter, in their 1976 paper, speculated that balloon-like organisms might thrive in Jupiter's atmosphere, drawing inspiration from ocean ecosystems on Earth, where diverse species inhabit various depths. According to their hypothesis, Jupiter could host "floaters"—huge, self-heating gas bags that rely on sunlight and ambient molecules for sustenance and drift by expelling helium. Alongside these, there could be "hunters," squid-shaped beings using gas jets for movement, with their size potentially reaching several kilometers across. Science fiction writer Arthur C. Clarke also envisioned similar life forms inhabiting Jupiter's skies.

Just like Jupiter's (ordinary matter) gas envelope, the Dark Earth's vast dark plasma halo would not have any hard surface. Dark plasma life-forms would generally drift and move through a vast plasma ocean or atmosphere, surrounded by diffused light from photon emissions and dark radiation. Without surfaces to walk on, they would float, swim, or swiftly zip around rapidly using a variety of mechanical and electromagnetic methods [55].

Occasionally, however, they will be abruptly stopped by electrical fences (i.e., the current-carrying double layers around plasma cells or shells). If their energy levels are too low, they would not be able to penetrate these fences around the cells or shells that confine plasma (and plasma life-forms) with different densities, temperatures, and other properties.

➢ *Experiments and Testing*

The dark plasma lifeforms from shadow biospheres in Dark Earths may sometimes manifest in the ordinary matter sector using specific processes, as discussed below. When they do this, various belief systems may identify and culturally embellish them in multiple ways. These could include characterizations, or rather mischaracterizations, such as UAPs/UFOs, Marian apparitions, ghosts, jinns, apparitions of saints, and other spiritual figures. This would be one category of investigations, described as "inbound" interventions.

The other category of investigations could include "outbound" investigations, i.e., monitoring and mapping of populations, or clustering of intelligent dark plasma lifeforms in the lowest-energy Dark Earth by tracing their biosignatures and technosignatures. There could also be investigations of geological structures in the Dark Earths through the use of dark ionization, kinetic mixing, and other processes.

➢ *SITI (Search for Inter-Terrestrial Intelligence)*

This paper proposes that NASA (National Aeronautics and Space Administration) launch a new initiative called "SITI (Search for Inter-Terrestrial Intelligence)." It also outlines potential research strategies and communication methods for interacting with these inter-terrestrial intelligences.

The SITI (Search for Inter-Terrestrial Intelligence) project will adopt a range of detection strategies to identify dark plasma lifeforms that may coexist with us on or near Earth. These strategies are designed to expand the scope of current search methodologies and foster interdisciplinary collaboration.

This will establish a comprehensive framework for identifying and communicating with the intelligent plasma life forms that may coexist with us on our planet. This approach offers a novel pathway to uncover forms of non-human intelligence that may have

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gone unnoticed by science. Should dark plasma life exist within the Dark Earths, such entities may be "hiding in plain sight," remaining undetected except through rare, subtle, or non-standard interactions. Some experiments aimed at detecting dark matter on Earth might inadvertently and unintentionally probe these dark (matter) biospheres. By leveraging SETI’s skills in signal detection alongside the advanced sensitivity of dark matter experiments, we could improve our chances of finding these alternative forms of life.

Several experiments and strategies for detecting these intelligent dark plasma life forms have already been proposed by the author, particularly for identifying them as alien entities. These concepts are detailed in the authors’ paper, “Could Unidentified Aerial Phenomena (UAP) Be from Earth’s Dark (Matter) Biosphere? The ‘Inter-Terrestrial Aliens’ Hypothesis (ITH),” published in 2025 [49]. Readers are encouraged to consult this publication for further insights on how to detect such lifeforms. This paper provides selected highlights and extensions from those existing strategies. Broadly, these are some of the initiatives that are proposed to be undertaken under project SITI to detect, study and interact with both inbound and outbound intelligent plasma lifeforms:

- *Expanding the Scope of Signal Detection*

SITI broadens SETI’s investigative efforts to encompass not only traditional extraterrestrial signals but also local, non-ordinary signals originating from within or near the Earth. This expanded focus allows for the possibility of detecting unique phenomena that may not conform to known astrophysical or technological sources.

- *Protocols for Anomalous Signals*

A key component of SITI’s strategy is the development of protocols specifically tuned to recognize “anomalous” signals from Dark Earths. These are signals that do not fit established patterns and may be weak, transient, or non-standard in nature. Examples include bursts, modulations, or unusual “dark” electromagnetic phenomena, which could be indicative of unknown forms of intelligence or communications emanating from Dark Earths.

- *Regional Mapping of Cold Plasma Trails*

SITI is committed to identifying regions where anomalies tend to cluster. These will be near underlying dark filamentary currents and vortices, which are theorized to generate cold plasma. Once such areas are mapped using aircraft and satellites, communication efforts can be directed at them using channels that leverage on dark ionization and kinetic mixing, as detailed in subsequent sections. This targeted approach increases the likelihood of meaningful detection and interaction.

- *Collaborations with Dark Matter Experiments*

Intensive collaboration with teams engaged in dark matter experiments forms another cornerstone of the SITI methodology. These teams can work together to design new protocols to detect potential signals from intelligent dark matter lifeforms. Additionally, they will jointly analyze data that may originate from sources on Earth or near-Earth environments.

- *Collaborations with NASA*

Project SITI will collaborate with NASA engineers to identify, measure, and study unusual changes in the velocity or trajectory of spacecraft and satellites orbiting the Earth and Moon. Such anomalies could signal interactions with these dark plasma biospheres.

➢ *Using Dark Ionization Processes*

The author theorizes that Earth's dark plasmasphere contains a network of dark, filament-like currents. These are higher density regions within the dark plasmasphere. As density rises, collisions between ordinary matter and dark matter particles become more frequent, creating cold (non-thermal) plasma through the dark ionization process. These dark filamentary currents may then produce streams of weak cold plasma, not only on the ordinary matter Earth's surface but also its atmosphere and in its crust.

Detection by SITI could reveal a detailed map of these underlying filamentary currents in the dark plasmasphere. The Earth's surface environment is only mildly ionized. If the primary dark filamentary currents form secondary filamentary cold plasma trails on the ordinary matter Earth, there would be localized increases in ionization along those filaments.

Using relevant scientific visualization instruments, specific test locations in the CTS region (as discussed above) could be scanned by aircraft and satellites to produce maps of streams of slightly more ionized air on the Earth's surface. If the analysis of the pattern of these streams resembles persistent filamentary currents, these would be the projected imprints from Dark Earth.

In places where these currents intersect and pinch, vortices will be formed. These primary vortices in the Dark Earth will generate secondary wells of cold plasma in the ordinary matter Earth through the dark ionization process. These wells would contain higher amounts of cold plasma than even the filaments.

Cold plasma has healing properties. For example, beams of ordinary cold plasma today kill bacteria, decontaminating food. Cold plasma is also used in medicine to promote human skin wound healing and can effectively treat various wounds. It would also be able to influence the body’s bioelectric field and inherent electric and magnetic fields to heal. The wells of cold plasma would be

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centers where rates of healing and feelings of well-being would be higher. A historical analysis and mapping of sites that have this characteristic could provide leads to trace the cold plasma trails and wells, as discussed above.

Besides cold plasma, other physical phenomena generated by the dark ionization process could be mapped. These relate to anomalous heat, light, electricity, electromagnetic waves (including infrared and microwaves), electric and magnetic fields generated by the underlying dark filamentary currents. Microwaves along the cold plasma trails can heat biological tissues. When these microwaves warm soft tissue in the head, they generate thermoelastic acoustic pressure waves. These waves travel through bone conduction to the inner ear, resulting in buzzing and other sounds that are perceived internally. Only the person affected would hear it, others who are even nearby would not hear it. This would be an additional symptom that can be noted when tracking these cold plasma trails.

SITI therefore proposes using magnetic sensors, infrared cameras and frequency analyzers to detect subtle electromagnetic signatures, and anomalous heat and light, along the cold plasma trails and wells. These sites are where dark matter density is highest. This increases the probability of measurable dark ionization events. The persistence of these trails and sites acts as a persistent signature of the hidden dark biosphere.

➢ *Using Kinetic Mixing Processes*

Dark matter particles, such as axions and dark photons convert to ordinary photons under strong or resonant magnetic fields. If the conversions occur in plasma, it will be enhanced if the plasma frequency matches the dark photon mass. (The oscillation between ordinary and dark photons is analogous to neutrino oscillations which are observed on a regular basis. When neutrinos travel through space, they can oscillate between distinct types or flavors of neutrinos – electron, muon and tau.)

The author has theorized that filamentary currents serve as dark electromagnetic highways under the dark plasma hypothesis [55, 83, 84]. Hence, there would be a clustering of dark plasma lifeforms along these filamentary currents, which would be evidenced by cold plasma trails in the ordinary matter sector.

The biosignatures found along these trails would include metabolic fingerprints such as low-energy dark radiation from excretory processes of these dark plasma lifeforms that would convert to low-energy ordinary radiation in the ordinary matter sector. If these life forms are proliferating in the billions or trillions, the aggregate metabolic-waste signature should be detectable via spectroscopy or sensitive radiometers along the cold plasma trails.

If there is “high traffic” along these highways, it may be possible to eavesdrop on communications between these lifeforms. Dark radio waves would convert to very weak ordinary radio waves that could be received in the ordinary matter sector. Tests could include listening for these unnatural radio signals. The objective is to see if there are patterns in the “communications” that have the hallmarks of a language. The tell-tale signs may include persistent ordinary cold plasma filaments behaving like information channels. If these underlying dark currents are being used as transportation and communication channels by these lifeforms, they would constitute a technosignature.

Low-energy ordinary radiation from these underlying filamentary currents in the dark biosphere may correlate with geomagnetic phenomena and magnetic anomalies on the surface of the ordinary matter Earth, as these environments function as catalysts to manifest and sustain this radiation. If these streams of cold plasma flow through high-intensity geomagnetic spots in the ordinary matter Earth, dark photons (and axions) could, in theory, convert into ordinary photons under the right conditions. This could manifest infrared radiation and microwaves (as we assume this would be generally a weak and low-energy phenomenon).

➢ *Density Requirements for Visibility*

If 20 percent of the mass of the Earth is dark matter (as discussed earlier), the ambient density in the dark plasmasphere would be about 1 g/cm3 (the same as water). However, we expect most of the dark matter to be within the Earth's periphery or below its crust. The density would fall significantly as we moved up from the surface of the Earth. However, dark matter lifeforms, being self-organized biological systems, would have much higher densities than the ambient density. (For example, the density of the human body is much higher than that of the air in which it is immersed.)

If we assume the operation of the fifth force (see Appendix 2 for current evidence on this force) through the mediation of the X-17 boson, then ordinary and dark matter scattering would be mediated by the X-17 boson, in addition to weak interactions mediated by the Z^o boson. This would allow larger cross sections at low energies without conflicting with existing weak-interaction limits. With both X-17 and Z^o bosons mediating, visible ionization would need a dark matter object to have the following density: 10^{-8} to 10^{-4} g per cm³ for naked-eye visibility at 10 cm. The requirement drops sharply with stronger coupling, a shorter viewing distance, a larger interaction volume, or a higher photon yield per ionization.

Any fast motion or rotation of the dark matter object or lifeform will help by increasing the collision rate and potentially enlarging or collimating any active emission region, but isotropic visibility at kilometer ranges still demands extreme densities unless an additional operation by the fifth force is also considered. This involves the fifth force attracting a veneer of ordinary matter

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particles around the dark matter object or lifeform. This would significantly increase visibility by increasing interaction volume and cross-sections, and also the density of the dark matter object or lifeform.

Even if the object or lifeform had a density of 0.1 g/cm³ or 0.5 g/cm³, a thin veneer or shell of ordinary matter (gas, aerosols, dust) can help to extend momentary visibility from meters into tens to hundreds of meters. That boosts total photon production, potentially extending visible range. Collisions, however, may quench further development of the veneer, cutting down photon yield.

A CCD camera uses a charge-coupled device sensor to convert light into electronic signals. Leaving a CCD camera open for hours or days also significantly improves detectability of objects that were initially invisible. Integration increases the number of collected photons linearly with exposure time, so even faint, diffuse ionization can rise above the noise if the background is controlled and the source is stable.

However, note that if the dark object is moving or rotating, the surface brightness on the sensor can smear. Strong background or occasional bright events can saturate pixels in extended frames. However, stacking sub-exposures can avoid these issues. To increase visibility at longer distances, prioritize a larger aperture, faster optics, strong filtering, low dark current, and stacking sub-exposures.

B. Interaction Zones and Times

➢ *CTS Region*

As discussed above, the highest density of relatively high-density dark plasma lifeforms is in the lowest-energy, most accessible Dark Earth. More specifically, it would be in the regions in the dark plasmasphere that coincide with the upper crust of the ordinary matter Earth, its troposphere, and the lower part of its stratosphere, i.e., the CTS region [54]. This would be where most inter-sector interactions occur.

➢ *Seasonal Modulation of Dark Matter Interactions in the CTS Region*

Interactions with plasma lifeforms from Earth's lowest-energy, most accessible Dark Earth, specifically in the CTS region, are subject to seasonal fluctuations due to orbital dynamics. These interactions tend to reach their peak around the middle of the calendar year, a pattern attributable to annual modulations in the density of dark matter surrounding Earth. This phenomenon occurs as Earth moves through clouds of dark matter particles while orbiting the galaxy's center.

➢ *Orbital Dynamics and Seasonal Modulations*

Each year, millions of weakly interacting dark matter particles rain down on Earth. Scientific research indicates that the quantity of these particles varies throughout the year, influenced by Earth's motion relative to the Solar System. A vast cloud of dark matter envelops the galaxy itself, and as the Solar System travels through this cloud, Earth simultaneously orbits the Sun. The combination of these motions creates a seasonal variation in the amount of dark matter particles that interact with Earth.

The direction of Earth's movement shifts throughout the year. In December, Earth travels against the direction of the Solar System's motion around the galactic center. Conversely, in June, Earth moves in the same direction as the Solar System. This change leads to a seasonal "rain" of dark matter particles, reminiscent of the monsoon rains that sweep through central Asia every year.

The analogy of a cyclist riding into or with the wind helps illustrate this effect: a rider becomes wetter when moving into the wind than when driving with it. Similarly, dark matter detectors are expected to record higher numbers of dark matter particles in June than in December. Extensive experimental records from DAMA-LIBRA, a leading dark matter detector, support this prediction. The results from DAMA-LIBRA provide 9.5-sigma evidence for an annual modulation. It is at the (1−6) keV energy range, which strongly suggests that the observed modulation has a dark matter origin.

The density of the dark matter in the plasmaspheres of Dark Earths is therefore not constant. The above discussions suggest that when the density increases within the dark plasmasphere due to seasonal modulations, the collision rate between ordinary matter and dark matter particles will rise, initiating and sustaining more dark ionization events. Hence, there may be more of these events near high-density locations, specifically the dark filamentary structures and vortices in the CTS region. Testing these structures during the peak period across different latitudes would yield the best results for identifying where ordinary ephemeral cold plasma trails and wells occur.

Dark matter lifeforms also have much higher density than the ambient density of dark matter in the dark plasmaspheres. Hence, a seasonal influx of dark matter particles may see them manifesting more often in the ordinary matter sector, though momentarily each time. The probability of sighting the ordinary cold plasma envelopes of dark plasma lifeforms inhabiting Earth's lowest energy dark biosphere would therefore increase during the peak periods. These sightings, not surprisingly, may have been culturally embellished as ghosts, Marian apparitions, or UAPs/UFOs. To verify seasonal patterns of interaction with Earth's dark matter biosphere, a meta-analysis of current data on the frequency of ghost and UAP/UFO sightings could be conducted (as discussed below).

The peaks and troughs in the frequency should be analyzed to identify correlations with the seasonal variations in the density of dark matter particles, as inferred from the annual density modulations observed by DAMA-LIBRA. If verified, this will be a powerful indicator that a dark biosphere interpenetrates our environment.

➢ *Chinese Ghost Festival Correlate with Modulation*

The author noted in 2005 that there appears to be a broad correlation between the timing of the annual modulation and a well-known ancient festival celebrated by the Chinese called the "Hungry Ghosts month" around August each year. They believe that souls are freed in this month to roam the Earth. This belief probably arose from observations that there were more ghost sightings around this month. The annual modulation, or seasonal variations, in the volume of dark matter passing through and being captured by the Earth each year suggests that the ancient Chinese festival may have a deeper scientific significance.

Dismissing folklore is premature, as many myths have led to significant scientific discoveries. For instance, ancient Norse stories about crystals aiding navigation were validated when scientists discovered that Iceland spar could indicate the sun's position. Additionally, Asian flood myths correspond with geological evidence of major river valley floods. Hawaiian traditions concerning the goddess Pele recorded eruption dates that align with geological findings, while tales of sea monsters have been linked to the discovery of giant squids.

Myths often preserve accurate memories of natural events that science has since validated. Traditions like the Ghost Festival may have preserved observations of unusual phenomena, such as lights, apparitions, and psychological states. This may coincide with environmental cycles, whether geomagnetic, atmospheric, or even exotic, like dark matter flux. Let us consider the idea that ghosts could be lifeforms associated with dark matter from the nearest (lowest-energy) dark plasmasphere. DAMA's signal suggests that a seasonal variation in dark matter flux might bring them into visibility by accelerating the initiation of the dark ionization process, as well as sustaining it.

Notably, DAMA's peak occurs in June, while the Ghost Festival is celebrated in August, specifically during the seventh lunar month of the Chinese lunar calendar. This timing may be offset because Earth's orbital dynamics can alter the local maxima in flux, depending on factors like latitude, detector sensitivity, or environmental conditions. The changes in latitude occur due to the tilt of Earth's axis, as it faces the dark matter rain head-on and then gradually turns away while maintaining its orbit around the Sun.

➢ *UAP (or UFO) Sightings Correlate with Modulation*

The author's dark plasma hypothesis views many UAP (or formerly known as UFOs) sightings as the sighting of the cold plasma envelopes and veneers of dark plasma lifeforms in the ordinary matter sector. [49, 50].

The charts below was produced by Massimo Teodorani, former researcher at the Istituto Nazionale di Astrofisica (INAF) (the Italian National Institute for Astrophysics) and now an independent researcher. It contains a set of reports from the US states of New York (2,057 data points) and Connecticut (543 data points) and the Canadian province of Ontario (969 data points), organized by month and number of sightings. [48]

The months with the highest occurrence of UAP-UFO sightings are the summer months. The winter months have the lowest occurrence of UAP-UFO sightings. The single month with the highest number of sightings in all three locations occur in August – the same month as the Chinese ghost month. This correlates with the annual modulation of dark matter density, observed by DAMA-Libra.

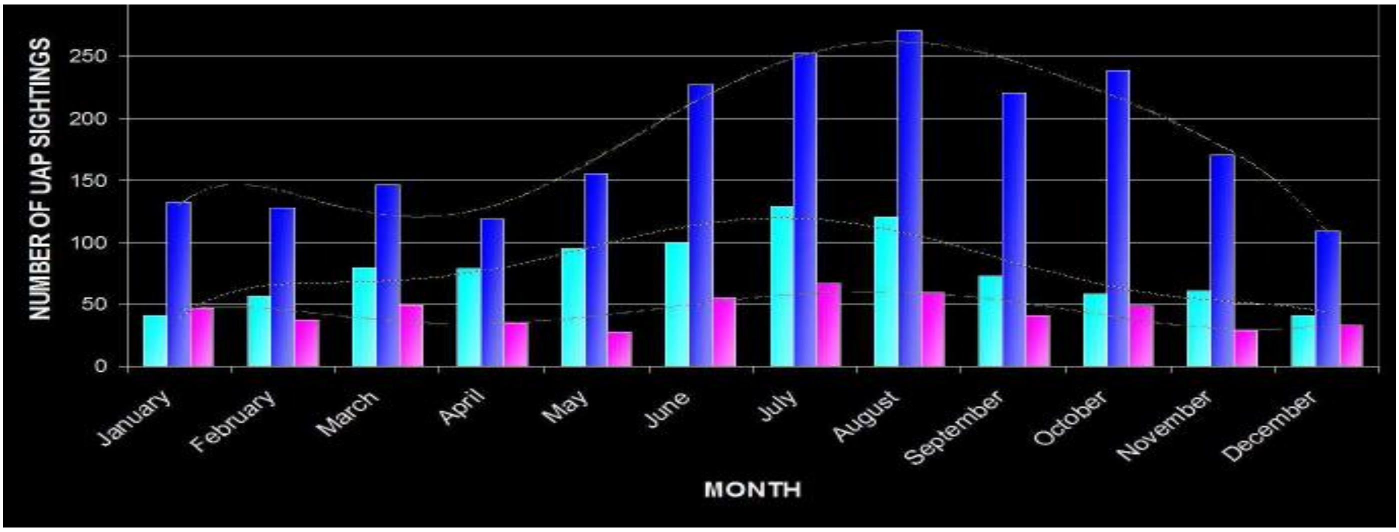

Chart 1: Highest Number of Sightings in August (Credit: Massimo Teodorani)

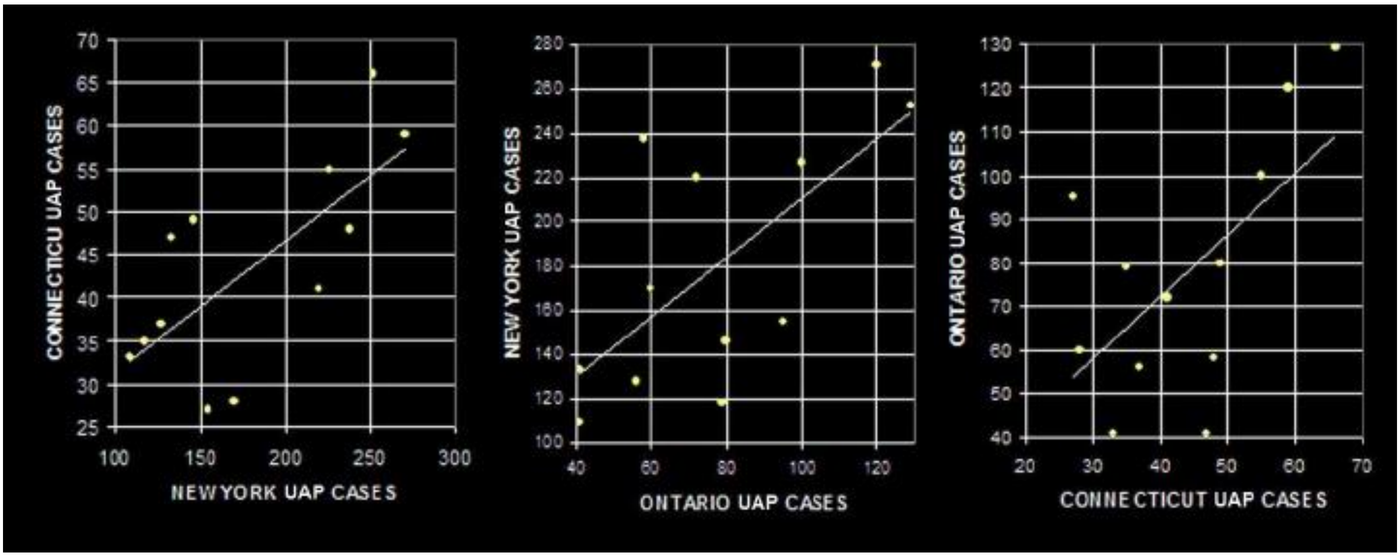

Chart 2: All 3 Locations Correlate with Highest Number of Sightings in August (Credit: Massimo Teodorani)

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CHAPTER THREE
LIMITATIONS OF SITI

➢ *An Ambitious Project like SITI Faces Several Challenges.*

- Novel Methods and Evolving Models: Dark plasma biospheres remain theoretical and are not widely accepted, meaning detection relies on evolving models and negative findings may be inconclusive. Researchers should therefore regularly consult with theorists to update methodologies and instrumentation as new data emerges.

- Distinguishing Signals from Background: One of the most significant challenges in detecting dark plasma lifeforms and biospheres is the need to distinguish their faint, rare signals from the ever-present background noise. The genuine dark matter biosphere signatures must therefore be carefully separated from ordinary sources to avoid misinterpretation and false positives. Achieving this level of discrimination demands the use of highly sensitive instruments and sophisticated data analysis techniques. To address the inherent ambiguity in signal interpretation, researchers should utilize advanced statistical methods, data analytics, and meta-analyses.

- Misinterpretations: Misinterpretation is possible because numerous predicted biosphere effects, such as anomalous accelerations and electromagnetic signals, may have alternative explanations. There exists a risk of attributing ordinary phenomena to dark matter biospheres without sufficient evidence. To mitigate this, rigorous controls and repeatable experiments are imperative. This issue can be addressed through collaboration with established dark matter projects and space missions' experts. Such partnerships facilitate the sharing and joint analysis of data for potential signals from dark plasma biospheres, including anomalous spacecraft accelerations or unexplained neutrino oscillations.

- Seasonal and Spatial Variability: Dark matter density and interactions near Earth change with the seasons and location due to orbital motion within the galaxy. Detection needs precise timing and targeted locations, making experiments more complex. Efforts should therefore be focused on optimal regions and times. The CTS region (Crust, Troposphere, Stratosphere) should be prioritized as the ideal target area for dark plasma lifeforms. Observations should be scheduled during predicted peaks in dark matter influx to Earth, such as June to August.

- Instrument Sensitivity and Limitations: Detecting faint signals such as low-energy infrared or radio emissions demands highly sensitive devices like magnetometers, radiometers, spectrometers, and ionization scanners. Current technology may not be sufficient, so development of new instruments is crucial for identifying subtle signals from dark plasma biospheres.

- Interdisciplinary Data Integration: Detection methods also include analyzing cultural and historical data, such as ghost sightings and UAP reports, for correlations with dark matter phenomena. Combining these varied sources with physical measurements is complex and requires robust statistical controls. Collaborative efforts will unite experts in physics, astrobiology, signal processing, and space engineering for rigorous experiment design and reliable data analysis.

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CHAPTER FOUR
CONCLUSION

This research thoroughly investigates the existence and implications of nested dark matter biospheres located both within and around Earth. It combines strong theoretical frameworks with empirical evidence to conduct its analysis.

➢ *Dark (Matter) Biospheres*

Earth's own dark biosphere, the theorized "Dark Earths," are immense, structured plasmaspheres interpenetrating and co-rotating with the ordinary Earth. They are powered by planetary-scale mechanisms like the Pannekoek-Rosseland effect, creating massive natural capacitors and persistent energy gradients. These provide the energy needed for biological processes and support the formation of nested shells and granules, filamentary currents, and vortices.

The dynamic interplay between planetary physics and biological evolution within a stable, dark matter-rich environment highlights the likelihood of a wealth of life forms hidden in the universe, waiting to be discovered through their interactions with ordinary matter. The unique structural characteristics and stability of these biospheres, combined with billions of years of evolutionary opportunity, make the emergence of complex plasma life forms not only conceivable but highly probable.

These dark matter biospheres are theorized to host plasma-based lifeforms that are a new phylogenetic domain, distinct from carbon-based life. By exploring these types of life forms, this paper provides a comprehensive foundation for understanding the incredible complexity and richness of life that could potentially exist outside the traditional carbon-based model we are familiar with. This challenges the traditional view that life must be carbon-based and opens the possibility for complex, stable, and evolving life in environments previously considered inhospitable.

➢ *Integration of Human Knowledge*

As the investigation into these nested dark matter biospheres advances, it becomes increasingly clear that the relationship between planetary phenomena, such as annual modulation in dark matter density, and cultural traditions, like the timing of the Chinese Ghost Festival, may provide unexpected clues to the presence of plasma-based life forms on Earth.

The striking correlation between periods of heightened UAP sightings and peaks in dark matter flux, as observed by researchers, suggests that interactions between ordinary and dark plasma could be more common than previously imagined. Recognizing these patterns lends further credibility to the dark plasma hypothesis and underscores the need for innovative methodologies that integrate astrophysical data with anthropological records.

Integrating cultural insights with scientific evidence enriches our understanding of the universe's hidden biospheres. Such an integrative approach not only sharpens our strategies in the search for extraterrestrial life but also deepens our appreciation for the profound connections between human traditions and the scientific quest to comprehend our planetary environment.

If dark plasma lifeforms exist, they may occasionally interact with ordinary matter, producing observable phenomena such as cold plasma trails, anomalous electromagnetic signals, or even cultural manifestations. This suggests new experimental approaches for detection, such as mapping cold plasma trails, searching for kinetic mixing signals, and correlating sightings with seasonal dark matter flux.

➢ *Dark Astrobiology*

By broadening the scope of astrobiology to include hidden dark matter biospheres and the possibility of plasma-based life forms, this research opens new and exciting pathways for the ongoing scientific search for life, both here on Earth and beyond. The existence of dark matter biospheres would revolutionize astrobiology, planetary science, and our understanding of the universe. It would require interdisciplinary research, merging physics, biology, and anthropology, and fundamentally alter our conception of life, habitability, and our place in the cosmos.

The idea that there may be billions, if not trillions, of dark matter exoplanets housing similar biospheres dramatically enhances the significance of this field, termed "plasma and dark astrobiology" by the author of this paper. It will necessitate interdisciplinary approaches that merge insights from physics, biology, and cultural studies.

Dark matter biospheres imply that life could be far more diverse and widespread than previously imagined, existing in stable, structured environments powered by unique physical mechanisms. Their detection would transform science and philosophy, opening new frontiers in the search for life and the study of planetary environments.

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APPENDIX 1: GLOSSARY OF KEY TERMS

Term	Definition
Adler line	The distance of approximately 70,000 km from the center of the Earth where the density of a theorized spherical shell of dark matter particles peaks.
Complex (or dusty) plasma	A plasma that contains charged dust particles mixed with electrons and positive ions. The dust particles can accumulate a large negative charge, leading to new types of plasma waves and the formation of intricate structures.
CTS region	The region encompassing Earth's **C**rust, **T**roposphere, and **S**tratosphere, extending about 50 km above and 50 km below the surface. It is hypothesized to be the "Goldilocks zone" for dark plasma lifeforms.
Dark Earths	Theoretical, near-spherical dark matter planets, composed of self-interacting dark plasma, which interpenetrate and co-rotate with the ordinary matter Earth. They are characterized by layered or nested concentric shells, filamentary currents, and dark electromagnetic fields.
Dark Ionization	A process where collisions between dark matter and ordinary matter particles generate cold (non-thermal) plasma in the ordinary matter sector.
Dark Pannekoek-Rosseland Electric Fields	A gravity-induced electric field within a Dark Earth, generated by the large-scale separation of heavy, positively charged dark protons (which sink to the core) and light, negatively charged dark electrons (which form a cloud around the planet).
Dark Plasma	A plasma composed of dark matter particles that possess a weak dark electric charge, allowing them to interact through dark electromagnetism.
Dark Plasma Lifeforms (DPLF)	A proposed phylogenetic domain of life ("eukarya-plasma") composed of self-interacting dark plasma. These lifeforms are theorized to have evolved within the stable, structured environment of Dark Earths.
Dark Plasmasphere	A more general term for a "Dark Earth," describing it as a large, structured sphere of self-interacting dark plasma organized through gravitational and weak electromagnetic interactions.
Debye Length	Debye length is the distance over which electric fields are screened out or shielded in plasma. It is directly related to temperature and inversely related to the electric charge.
Double-layer	An electrical isolating wall that can form in a plasma, separating sections with different properties (for example, density, temperature, voltage). In a Dark Earth, a series of double-layers forms the nested concentric shells.
Eukarya-Plasma	This is a proposed new phylogenetic domain of life, distinct from eukarya-carbon. The term covers complex single-celled eukaryotic dark plasma lifeforms that are theorized to be composed of self-interacting dark plasma.
E+ region	The region within the core of a Dark Earth where heavy, positively charged dark matter particles (dark protons) accumulate due to gravitational stratification, forming a dense non-neutral plasma.
E- region	The region forming a non-neutral, low-density spherical shell or cloud around a Dark Earth where light, negatively charged dark matter particles (dark electrons) accumulate.
E0 region	The region that has the highest density of neutral particles that buffer the above two charged regions and are mixed in with much smaller numbers of charged particles. Due to viscosity, electrostatic forces act indirectly on neutral particles, causing them to behave as a weakly polarized fluid collectively.
Fifth force	A conjectured new, short-range attractive fundamental force, potentially mediated by the X17 boson, which allows dark matter and ordinary matter to interact beyond gravity and the weak force.
Kinetic Mixing	A process through which dark photons or axions can convert into ordinary photons (for example, infrared radiation, microwaves, radio waves), particularly in the presence of strong or resonant magnetic fields. This provides a potential channel for detecting dark sector activity.

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Mass Conflation	The historical error in which the mass contribution of dark matter was misattributed to ordinary matter because gravitational measurement methods cannot distinguish between the two.
Neutrino Tomography	This is a non-gravimetric method of measuring a planet's mass and internal density by observing how neutrino oscillations are affected as they pass through different layers of matter.
Plasma Frequency	Plasma frequency is the rate at which charged particles (usually electrons) in a plasma oscillate when they are disturbed from their equilibrium positions. It is a fundamental property of plasmas and determines how quickly electrons respond to electric fields. It is directly related to the number density of charged particles and the strength of their electric charge. It is inversely related to the mass of the particle.
Plasma and Dark Astrobiology, Dark Astrobiology	This is a branch of astrobiology, pioneered by Jay Alfred, which proposes the existence of plasma-based life-forms, both in the ordinary and dark sectors. It uses an inter-disciplinary approach, incorporating mainly biology, dark matter and plasma physics. It studies the biology and biophysics of these plasma life-forms, as well as their ecosystems and habitable zones within hypothesized hidden dark biospheres, called “Dark Earths.
Self-interacting dark matter	A type of dark matter whose particles can interact with each other through forces other than gravity, such as a weak "dark electromagnetism."
SITI (Search for Inter-Terrestrial Intelligence)	A proposed initiative to search for dark plasma lifeforms existing in hidden biospheres on or around Earth by expanding SETI's scope to include local, anomalous signals and non-standard detection methods.
X17 boson	A hypothetical new particle, with a mass of about 17 MeV, theorized to be the carrier (boson) of the new "fifth force," potentially linking the visible world with the dark matter sector.

APPENDIX 2: A NEW YUKAWA-TYPE FUNDAMENTAL FORCE

There is both astrophysical evidence and experimental data that suggest the existence of a new short-range attractive fifth force that could mediate between ordinary and dark matter particles. It is attractive to neutrons and electrons over the range of a single atom.

➢ *Astrophysical Evidence*

Many astrophysicists propose that an as-yet-unidentified force must exist that allows dark matter to interact with ordinary matter beyond the influence of gravity and the weak nuclear force. Among those searching for answers is Antonio Boveia, a physics professor at Ohio State University in Columbus, who investigates dark matter and other novel particles and forces through the ATLAS experiment at the Large Hadron Collider in Geneva, Switzerland.

Boveia contends that, in addition to gravity, there should be additional channels for interaction between ordinary and dark matter, specifically through dark bosons. Bosons are particles responsible for carrying fundamental forces. In his 2018 theory, Boveia emphasized the necessity of a communication mechanism between the visible and dark universes: “There must be a means for the visible universe and the dark universe to communicate with each other…A force requires a force carrier or boson. The electromagnetic force is carried by the photon, the weak nuclear force by so-called vector bosons… Interactions between dark matter and normal matter should be no different: They could happen by exchanging dark bosons.” Based on this reasoning, Boveia hypothesized the existence of a dark vector boson, a new force-carrying particle that could facilitate interactions between dark matter and normal matter, analogous to the known exchanges in fundamental forces.

In a 2020 article published in Astronomy & Astrophysics Letters, researchers from the Instituto de Astrofísica de Canarias (IAC)/University of La Laguna (ULL) and the National University of the North-West of the Province of Buenos Aires (Junín, Argentina) demonstrated that dark matter within galaxies follows a "maximum entropy" distribution. Achieving this state would require dark matter to undergo collisions with itself, similar to how gas molecules interact, in order to establish an equilibrium where density, pressure, and temperature are interconnected. This equilibrium implies that dark matter particles have exchanged energy either among themselves or with ordinary matter.

Despite this finding, scientists remain uncertain about the process by which dark matter attained this equilibrium. Ignacio Trujillo, an IAC researcher, notes, "The fact that equilibrium has been established so rapidly, relative to the age of the Universe, might point to some form of interaction between dark matter and normal matter beyond gravity." He adds, "The precise nature of this mechanism still needs further investigation."

In 2015–2016, scientists fired protons at lithium-7 atoms, causing them to form an unstable isomer of beryllium-8 briefly. During the decay process, the unstable beryllium nucleus disintegrated and emitted pairs of electrons and their antimatter counterparts, known as positrons. An unexpected observation emerged: these electron-positron pairs appeared more frequently at a particular angle than theoretical predictions anticipated. This anomaly in the emission pattern suggested the possible existence of a previously unidentified particle. This could be potentially a lightweight boson, with a mass of about 17 MeV, which may have formed momentarily during the decay event. Follow-up experiments in 2019 to 2025 observed similar anomalies in helium-4 and carbon-12 nuclear transitions, reinforcing the possible detection of a force-mediating particle with a mass near 17 MeV.

Jonathan Feng, a physics and astronomy professor at UC Irvine, and his team spent years building on research started by Hungarian scientists. After the Hungarians’ 2016 discovery, Feng’s group published a theory to explain their findings. In the meantime, nuclear physicists worldwide tried to find flaws in the Hungarian results but found none. According to Feng, many respected experts double-checked the numbers and equipment calibration, but everything seemed correct. The only explanation left for X17 was the presence of an unknown “fifth force.”

Feng and colleagues theorized in 2016 that X17 is a vector boson responsible for a new fundamental force. This particle interacts weakly with protons but more strongly with neutrons and electrons, thereby bypassing limitations set by other experiments and making sense of the observed anomalies. Its influence spans about ten femtometers—comparable to nuclear forces at atomic scales.

Because X17 barely interacts with ordinary matter and may also connect to dark sector particles, it could be a link between dark matter and what we can see. As Feng noted, X17 might bridge our visible world with dark matter. Furthermore, data from the Hungarian team’s 2019 experiment showed there was only a one-in-a-trillion chance that their results were caused by something other than X17 and this new fifth force.

➢ *Implications of Collisions*

Many dark matter experiments rely on collisions between dark matter and ordinary matter particles to cause nuclear recoils that would confirm the existence of the dark matter particles. These are usually WIMP-based dark matter models that rely on the weak force. This assumes that dark matter particles (such as neutralinos and sterile neutrinos) interact with atomic nuclei via the weak force's Z^0 boson exchange. This is a neutral current interaction: no charge is transferred, but momentum is. The result is a nuclear recoil—a tiny "kick" to the nucleus, which can produce ionization. These are not "collisions" in the classical sense, but quantum scattering events with extremely low cross-sections ($\sim 10^{-46}$ cm^2 or smaller).

Suppose X17 exists and interacts with both dark matter and neutrons. In that case, it may mediate a Yukawa-type attractive force between dark and ordinary matter, potentially increasing local clustering or scattering cross-sections and permitting non-weak interactions in detection experiments. This would establish an additional portal between the visible and dark sectors, supplementing the weak force, to facilitate the dark ionization process as previously described. Such an attractive force could enhance the efficiency of the dark ionization process.

While these interactions remain infrequent in laboratory settings due to the very low ambient dark matter density, plasma lifeforms that contract their volume before the dark ionization process can reach densities many orders of magnitude greater than those observed in laboratory environments. The collision rates between ordinary and dark matter particles in a dark matter lifeform would therefore be much higher than in a laboratory.

➢ *Implications on Coupling with Ordinary Matter*

The fifth force enables dense ordinary matter to attract layers of various dark matter particles, forming shapes that mirror those of ordinary objects. Conversely, dark plasma bodies can draw in ordinary matter particles at close range. The X17 boson, which mediates this force, acts as a short-range "plasma glue," binding dark plasma to baryonic structures without electromagnetic interaction.

Dark plasma bodies in Dark Earths are much less dense than ordinary matter, so any ordinary matter that gathers around them forms a very thin layer. This thin veneer may briefly make the dark plasma lifeform visible by reflecting light. It can also produce sensations of touch on contact, generate faint sounds when hitting hard surfaces, and cast dim shadows.

On a larger scale, the fifth force leads to density correlations between ordinary and self-interacting dark matter, reinforcing the layers formed by Pannekoek-Rosseland field effects in the dark plasmasphere. Areas of higher ordinary matter density attract more dark matter, while lower-density regions attract less, resulting in density correlations between both forms of matter on Earth.

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APPENDIX 3: PROJECT SITI

A Research Proposal for the Search for Inter-Terrestrial Intelligence within Earth's Theorized Dark (Matter) Biospheres

A. *Introduction: A Paradigm Shift in the Search for Non-Human Intelligence*

Modern science is defined by two grand challenges that shape our cosmic perspective: understanding the fundamental nature of dark matter and discovering the extent of life in the universe. These two clouds n the horizons of science has historically been treated as separate, parallel inquiries. Project SITI (or Search for Inter-Terrestrial Intelligence) proposes a revolutionary approach that unifies these two lines of investigation into one – the existence of parallel dark biospheres hosting intelligent non-human life.

Our central thesis is grounded in compelling theoretical models derived from recent advances in particle physics and dark matter research that suggest the existence of vast, hidden biospheres composed of self-interacting dark matter, gravitationally bound to and co-rotating with the ordinary matter Earth. These "Dark Earths" are theorized to possess the necessary conditions—stability, a persistent energy source, and complex internal structure—to support the evolution of life. This life would not be baryonic or carbon-based but would exist in a stable, non-atomic plasma state, entirely invisible to our conventional senses and most of our current scientific instruments.

Our vision positions SITI not as an alternative to the Search for Extra-Terrestrial Intelligence (SETI), but as its necessary and logical expansion. For decades, we have looked outward, scanning distant stars for signs of life. SITI proposes that we must also look inward—to probe a parallel sector of reality that interpenetrates our own, hidden from us not by distance but by its fundamental nature. We propose to expand the astrobiological paradigm, looking for life not just "out there," but also "right here," concealed within a dark biosphere we are only now developing the means to perceive. To achieve this, we must first establish the robust scientific theory underpinning this entire endeavor.

The purpose of this proposal is to secure the necessary funding for a novel; multi-phased research initiative designed to detect and characterize these potential lifeforms—referred to herein as Dark Plasma Lifeforms (DPLFs)—within these theorized Dark Biospheres. By developing and deploying new detection methodologies, Project SITI aims to test a hypothesis that, if confirmed, would represent one of the most profound discoveries in human history.

B. *Scientific Rationale: The Dark Biospheres Hypothesis*

A research program of this magnitude requires a robust theoretical framework grounded in compelling recent evidence. The SITI project is built upon a synthesis of findings from neutrino physics, satellite dynamics, and dark matter theory, which collectively build the scientific case for a vast, structured, and ultimately habitable dark matter environment co-rotating with Earth. This section outlines the logical progression from the confirmed presence of abundant local dark matter to the theoretical plausibility of an intelligent biosphere thriving within it. This Dark Biospheres Hypothesis, or more specifically the Dark Earths Hypothesis, does not contradict known physics but rather extends it, offering a new lens through which to interpret anomalous data and explore the nature of one of the universe's greatest mysteries: dark matter.

The following sections establish the robust scientific rationale that underpins this ambitious endeavor, presenting a testable model with clear, predictable signatures. Our objective is to detect and characterize the biological and technological signatures of non-baryonic, plasma-based lifeforms theorized to exist within a structured dark plasmasphere co-located with our own planet. This endeavor is not based on speculation but on a growing body of evidence suggesting that a significant fraction of Earth’s mass is dark matter, and that this matter possesses properties conducive to the formation of complex, stable, and habitable structures.Our approach is grounded in the novel detection methodologies derived directly from the dark plasma hypothesis, leveraging predicted interactions between the dark and ordinary matter sectors.

➢ *Re-Evaluating Dark Matter Density and Composition on Earth*

The long-held view of dark matter as a diffuse, non-interactive halo distributed thinly throughout the galaxy is being systematically challenged by new evidence. Recent data strongly indicates that dark matter density around and within Earth is many orders of magnitude higher than previously assumed.

Pioneering measurements using neutrino tomography have provided the first non-gravitational constraints on Earth's dark matter content. Unlike gravitational methods, which cannot distinguish between ordinary and dark matter, neutrino-based measurements are sensitive to the weak force interactions of both. Analyses from leading experiments establish critical upper limits:

- IceCube Detector (2023 Analysis): A 2023 analysis of IceCube data rules out the possibility that dark matter comprises more than 32 percent of Earth's core mass or 24 percent of its total mass at the one sigma level.

- Super-K Experiment: Similarly, atmospheric neutrino oscillation studies from the Super-K experiment independently rule out a dark matter contribution of more than 21 percent of Earth's total mass.

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While these are constraints, they permit a dark matter component up to a fifth of our planet's mass—equivalent to 1.2 x 10^{24} kg—implying an average density comparable to that of water. This paradigm-shifting conclusion is further supported by a convergence of evidence from multiple, independent lines of inquiry:

- Anomalous Spacecraft Acceleration: In a 2009 study, physicist Stephen Adler and his team found a distinct correlation between anomalous velocity changes during spacecraft Earth-flybys and the presence of a dense, gravitationally-bound dark matter halo. The observed accelerations require dark matter concentrations orders of magnitude higher than the galactic average.
- Satellite Navigation Data: A 2014 study led by Professor Ben Harris analyzed acceleration data from GPS, GLONASS, and Galileo satellite constellations. The findings revealed that Earth's mass, as sensed by these satellites, significantly exceeds the value established by the International Astronomical Union (IAU), providing strong evidence for a massive dark matter halo interpenetrating our planet.
- Historical Mass Conflation: Gravitational measurements have historically been our primary tool for weighing the Earth. However, these methods are blind to the composition of mass. As researchers now clarify, these experiments measure the sum of ordinary and dark matter. The gravitational effects of a significant dark matter component have therefore been unknowingly misattributed to ordinary matter, effectively hiding its true abundance in plain sight.This radical revision is made plausible by two core concepts. The first is "mass conflation." Historical gravimetric measurements, which form the basis of Earth's accepted mass value, are incapable of distinguishing between baryonic (ordinary) matter and dark matter. Secondly, the mediation of a conjectured "fifth force," which would enable a close particle-to-particle correlation between dark and ordinary matter. This force would explain why dark matter density is highest where ordinary matter is densest—such as in Earth's core—and why the mass conflation would be so seamless as to remain undetected until now.

➢ *The Nature of Self-Interacting Dark Plasma*

The growing consensus among physicists is that a subcomponent of dark matter is self-interacting, possessing a weak "dark electric charge," estimated to be between one-hundredth and one-millionth that of an ordinary electron. While incredibly weak, this force would still be dominant; even a charge one-millionth that of an electron would render dark electromagnetism 10^{30} times stronger than gravity, enabling complex, non-gravitational interactions. estimated to be between one-hundredth and one-millionth that of an electron. This would result in a sustained self-interacting dark plasma state. Three primary factors are theorized to conspire to keep this matter in a persistent plasma state:

- Weak Dark Electric Charge: The significantly weaker dark electromagnetic force slows the rate at which oppositely charged dark particles can recombine to form neutral "dark atoms."
- High Ratio of Neutral to Charged Particles: The dark sector is theorized to have a neutral-to-charged particle ratio of nearly 5:1, with these neutral particles acting as a buffer that further inhibits recombination.
- Low Particle Density: The overall density of the dark plasma is many orders of magnitude lower than that of ordinary matter, increasing the mean free path between particles and making recombination events less frequent.

➢ *Formation and Structure of "Dark Earths"*

The Dark Earths Hypothesis posits that the relatively dense (compared to galactic halo density) concentration of this type of dark matter around Earth exists not as inert particles, but as a dynamic, self-interacting dark plasma.

This property allows for the formation of vast "Dark Earths"—dark plasmaspheres that interpenetrate and co-rotate with our ordinary matter planet. These are not homogenous clouds but are theorized to possess a a highly organized internal structure, analogous to plasma crystals observed in laboratory settings, and internal architecture analogous to astrophysical plasmas. This inherent, self-organizing capacity, relating to well-studied plasma dynamics in laboratory and space plasma, provides the structural foundation for a potential biosphere. These organized structures include the following:

- Dark Global Magnetic Field: The differential rotation and convection of charged dark plasma particles within the Dark Earth are predicted to generate a global dark magnetic field which provides the skeletal structure for the concentric shells and filamentary currents.
- Nested Concentric Shells: These are formed by "double layers" around the skeletal structure that was generated by the global magnetic field, with thin boundaries that electrically isolate regions of plasma with different densities, temperatures, and potentials. These shells provide the foundational structure for confined, stable environments. Within the shells, smaller sub-regions enclosed by double-layers form where plasma with different densities, temperatures, and potentials exist. These provide additional sub-structure that reinforces the structural integrity of the plasmasphere.
- Filamentary Currents and Vortices: The dark plasmasphere is theorized to be permeated by a grid of dark filamentary currents around the global magnetic field, which function as electromagnetic highways. Where these currents intersect and pinch, stable vortices are formed, creating nodes or plasmoids containing high density dark plasma and high intensity magnetic fields.

The scale of these Dark Earths is immense. The lowest-energy and most accessible Dark Earth is estimated to have a mean radius of approximately 70,000 km, more than ten times the approximately 6,400 km radius of the ordinary Earth—a boundary referred to as the "Adler line." This gives it a volume capable of containing over one thousand ordinary Earths. Its larger volume can be explained by the lower density of dark matter particles around Earth and the weaker electric charge of these particles. This larger scale is consistent with current scientific theory on the scale of dark matter exoplanets which are also expected to be much larger than ordinary matter planets.

➢ *The Conditions for a Habitable Dark Biosphere*

The unique properties of the theorized dark plasma create an environment that is not just habitable but potentially ideal for the evolution of complex life, in stark contrast to the chaotic nature of ordinary plasma.

First, the weak dark electric charge is a critical stabilizing factor. It suppresses the violent plasma instabilities (for example, turbulence, filamentation) that are characteristic of ordinary plasma and would be detrimental to the formation of large, stable, information-bearing structures necessary for life. The weak charge also allows charge separation to be sustained in a plasma. Charge separation is essential for biological processes – analogous to the biochemical processes that take place in cells.

Second, the Dark Earths possess a planetary-scale, persistent energy source, driven by the Pannekoek-Rosseland mechanism. This is a gravity-driven process that creates a self-powering, planetary-scale capacitor. Gravity naturally stratifies the dark plasma by mass: the heavier, positively charged dark protons (the "E+ region") sink towards and accumulate within Earth's ordinary core, acting as an anode in an electrolytic cell. In contrast, the much lighter, negatively charged dark electrons (the "E- region") form a vast, spherical shell at the 70,000 km Adler line, acting as a cathode. The vast region between them, filled with neutral particles, serves as a dielectric insulator. This immense separation of charge creates a massive, stable natural capacitor, establishing a persistent electrical potential gradient across the entire system.

Third, the combination of these factors—structural stability, self-organizing complexity, and a continuous, planetary-scale energy gradient—provides the necessary and sufficient conditions for life to emerge. Over billions of years, simple, self-replicating plasma cell systems could evolve into highly complex and potentially intelligent organisms within this vast, protected dark biosphere.

This stability is not inherent in ordinary plasma, which makes up more than 99 percent of the ordinary matter universe. The basic constraints are tabulated below and compared with dark (matter) plasma.

Feature	Ordinary Plasma	Dark (Matter) Plasma (in Dark Earths)
Charge Strength	Strong	Weak
Plasma Stability	Prone to instabilities, which are harmful to life.	Instabilities are suppressed, allowing for stable, long-lived structures.
Charge Separation	Difficult to sustain; recombination is rapid.	Sustained for long periods due to weak charge and abundant neutral particles.
Potential for Life	Unlikely to support complex life; forms are primitive and ephemeral.	Highly probable to support complex, evolving lifeforms over geological timescales.

The energy source for this biosphere is provided by a planetary-scale physical mechanism. The Pannekoek-Rosseland mechanism, driven by gravity, creates a fundamental charge separation within the Dark Earth. Gravitational stratification causes the heavier, positively charged dark protons to sink and accumulate in the core (the E+ region), while the lighter, negatively charged dark electrons form a vast, diffuse shell far from the planet (the E- region). This configuration establishes a stable, planetary-scale capacitor, creating a continuous energy gradient that can power biological processes across the entire biosphere over geological timescales.

This theoretical framework establishes not only the presence of a vast dark matter component on Earth but also its capacity to self-organize into a stable, energy-rich environment. It does more than suggest a possibility - it provides a concrete, falsifiable model with predictable signatures, demanding the experimental validation we now propose. We now turn to the specific methodologies.

C. The SITI Initiative: Research Objectives and Methodology

Having established the robust scientific rationale for a habitable dark biosphere, this proposal now details the concrete, phased experimental strategy for the SITI initiative. Our methodology is an active investigation grounded in detecting the predictable physical interactions between the dark biosphere and our ordinary matter sector. By targeting the unique physical signatures of these interactions, we can move from theoretical possibility to empirical verification.

➢ *Program Objectives*

To move this hypothesis from theory to empirical science, the SITI program will pursue three primary, falsifiable objectives:

- Objective 1 - GEOLOGICAL: To experimentally verify the existence of theorized non-baryonic dark plasma structures (filamentary currents, vortices) within the near-Earth environment by mapping their predicted physical imprints in the ordinary matter sector.

- Objective 2 – BIOLOGICAL-TECHNOLOGICAL: To search for and analyze anomalous low-energy electromagnetic signals, specifically in the infrared, microwave, and radio spectra, to detect and analyze any biological and/or technological signatures that would establish empirical evidence for intelligent, non-baryonic lifeforms within the lowest energy Dark Earth.

- Objective 3 – SEASONAL VARIATIONS: To correlate the frequency and intensity of detected anomalies with known dark matter phenomena, particularly the annual signal modulation, and with specific geographic and geomagnetic locations on Earth to establish a causal link.

SITI fundamentally expands upon traditional SETI by shifting the search paradigm. Instead of scanning for distant, powerful signals from extrasolar sources, we will focus on identifying local, anomalous signals that do not conform to known astrophysical phenomena or conventional human technology. This approach allows us to probe for a form of intelligence that may be "hiding in plain sight," detectable only through its subtle physical imprint on our own environment.

➢ *Phase 1: Mapping the Dark Biosphere's Imprint via Dark Ionization*

Our initial phase focuses on mapping the foundational structure of the dark biosphere. This will be achieved by detecting a key interaction process known as dark ionization. The theory posits that as the high-density, filamentary dark matter currents of the Dark Earth pass through our world, their collisions with ordinary matter atoms generate detectable trails of weak, cold (non-thermal) plasma in our atmosphere and crust.

The primary activity for Phase 1 is to deploy a distributed network of magnetic sensors, frequency analyzers, and other advanced scientific visualization instruments in targeted geographical regions. The goal of this network is to produce a dynamic, three-dimensional map of these persistent cold plasma streams. This approach is strategically sound because these plasma trails are direct imprints of the underlying dark matter structures. By mapping these filamentary "highways" and their vortical "nodes," we can reveal the architecture of the dark biosphere and, most importantly, identify the high-probability locations where dark plasma lifeforms are most likely to cluster.

Our plan is to systematically scan the primary theorized habitable zone—the Crust-Troposphere-Stratosphere ("CTS") region, defined as the volume extending 50 km above and below Earth's surface. This region is the prime target because it is where the density of neutral dark matter particles is theorized to be highest, creating the ideal conditions for sustained charge separation while suppressing plasma instabilities.

➢ *Phase 2: Detecting Biosignatures and Technosignatures via Kinetic Mixing*

Phase 2 will conduct a targeted search for signals of life along the cold plasma trails identified in Phase 1. This search will leverage the theorized phenomenon of "kinetic mixing," where dark photons or axions are predicted to convert into ordinary photons (infrared, microwaves, radio waves). This conversion is predicted to be most efficient at the interface between the dark and ordinary sectors, particularly in the presence of strong or resonant magnetic fields. This indicates that high intensity geomagnetic hotspots should be targeted. We will search for two distinct types of signatures:

- Metabolic Biosignatures: All life produces waste. For dark plasma lifeforms, this would include waste energy in the form of low energy dark radiation. Through kinetic mixing, this is expected to manifest as low-energy ordinary photons. Hence, they would be in the infrared and microwave bands, and the low end of the visual spectrum. Using sensitive radiometers and spectroscopic analysis, we will scan the cold plasma trails identified in Phase 1 for anomalous and persistent sources of waste infrared and microwave radiation. A distributed, aggregated heat signature of a large, concentrated population of plasma lifeforms, along filamentary currents and vortical nodes (particularly those residing in geomagnetic hotspots), that cannot be attributed to known sources would provide compelling evidence for the metabolic activity of a large population of lifeforms.

As a secondary, more speculative biosignature, we will also investigate reports of anomalous therapeutic or biostatic effects on local terrestrial biology. Given that cold plasma is known to have medical applications, such as promoting wound healing, observing these effects in proximity to the mapped plasma trails could provide another layer of evidence for dark biological activity.We will use sensitive radiometers and spectrometers to search for persistent, localized infrared or microwave emissions that are inconsistent with any known natural or artificial sources. Such emissions could be interpreted as the aggregate metabolic waste heat from large populations of DPLFs.

- Communication Technosignatures: The filamentary currents are theorized to serve as electromagnetic highways and communication channels. We will adapt established radio astronomy protocols for near-Earth scanning to "eavesdrop" on these mapped filaments. The objective is to search for unnatural, patterned, or complex modulated ordinary radio signals emanating

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from these channels which were converted from dark radio signals used by the intelligent dark plasma lifeforms. The detection of persistent, information-rich signals would constitute a powerful technosignature, indicating intelligent communication.We will employ advanced frequency analyzers, adapting existing SETI protocols, to monitor for structured, non-natural radio signals originating from the mapped plasma filaments and vortical nodes (particularly those residing in geomagnetic hotspots). The discovery of patterned or modulated signals would be a profound indicator of intelligent communication along these dark filament "highways."

➤ *Phase 3: Data Analysis and Seasonal Correlation*

The final phase will involve a rigorous analysis of all data collected in Phases 1 and 2, searching for complex patterns indicative of an intelligent origin. A crucial component of this phase will be to test for a correlation between the frequency and intensity of all detected anomalies and the well-documented annual dark matter modulation pattern.

This modulation, confirmed with high statistical significance by the DAMA-LIBRA experiment, shows a peak in dark matter interactions around June of each year. A positive correlation between our detected signals and this seasonal peak would provide powerful, independent evidence linking the observed phenomena directly to a dark matter origin, thereby validating the central premise of the Dark Earths Hypothesis.

This phased approach provides a logical and systematic pathway from habitat identification to the potential discovery of non-human intelligence, leveraging the specific instrumentation and methodologies detailed in the following section.

➤ *Strategic Experimental Design*

Our experimental design incorporates two key strategic elements to maximize the probability of a successful detection:

- LOCATION - Targeting the CTS Habitable Zone: Our primary search area will be the CTS (Crust, Troposphere, Stratosphere) region. The hypothesis predicts that this is the "Goldilocks zone." It is conjectured to be the habitat with the highest concentration of dark plasma lifeforms, making it the most promising location for detecting the signatures described above.

- TIMING - Leveraging Seasonal Modulation: The DAMA-LIBRA experiment has produced 9.5-sigma evidence for an annual modulation in dark matter interactions, with a predictable peak in flux around June. This occurs as Earth's orbital motion moves in the same direction as the Solar System's path through the galactic dark matter halo. SITI's most intensive observation campaigns will be timed to coincide with this predicted peak. By focusing our efforts when the local dark matter density is at its maximum, we significantly increase the probability of detecting dark ionization and kinetic mixing events.

This phased, targeted, and strategically timed methodology provides a clear and actionable path toward discovery.

D. Methodology and Instrumentation

The success of the SITI program depends on a synergistic methodology that combines existing, high-sensitivity instrumentation with novel analytical protocols and a robust framework for interdisciplinary collaboration. We will not be building entirely new observatories from scratch but will instead repurpose and refocus existing technologies to search for the specific, low-energy signatures predicted by the Dark Earths Hypothesis. The primary requirements and implementation details are summarized below:

Requirement	Implementation Detail
High-Sensitivity Magnetometers	Deploy arrays of magnetometers in the CTS region to map localized disturbances in Earth's magnetic field that correlate with hypothesized dark plasma structures.
Broad-Spectrum Radiometers & Spectrometers	Utilize sensitive radiometers to detect faint infrared and microwave emissions (metabolic signatures) along identified cold plasma trails.
Radio Frequency Analyzers	Adapt SETI signal analysis protocols to scan for patterned or modulated radio signals (technosignatures) originating from the mapped filamentary currents.
Atmospheric Ionization Scanners	Employ scientific visualization instruments to produce high-resolution maps of cold plasma ionization trails in the atmosphere and on the surface.
Collaboration with Dark Matter Experiments	Establish a formal partnership with experimental teams (for example, those operating detectors like IceCube) to share data and develop protocols for identifying potential intelligent signals within their datasets.

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Collaboration with NASA Satellite Operations	Create procedures with NASA engineers to systematically monitor and analyze anomalous accelerations or trajectory deviations in orbiting spacecraft, which could indicate interaction with dense dark plasma regions.

This integrated approach, leveraging expertise from plasma physics, astrobiology, signal processing, and space engineering, provides a feasible and cost-effective pathway to executing the SITI research program and rigorously testing its core hypotheses.We will now turn to the profound scientific impact a positive detection would have.

E. Limitations

An ambitious and potentially revolutionary research project like this would naturally have many challenges and limitations. These are discussed below.

- Novel Methods and Evolving Models: The existence, properties, and behavior of dark plasma biospheres are still theoretical and not universally accepted. This means that detection strategies are based on models that may need revision as new data emerges, and negative results may not conclusively rule out their existence. *Response*: Researchers will need to review results with theoretical specialists to continuously update the theoretical framework and recalibrate current methodology and instrumentation.
- Distinguishing Signals from Background: The hypothesized dark plasma lifeforms and biospheres interact with ordinary matter via extremely weak forces (such as the conjectured "fifth force" or kinetic mixing). This means that signals or physical effects are faint, rare, and easily lost in background noise. Many proposed detection methods (e.g., mapping cold plasma trails, searching for anomalous electromagnetic signals) must distinguish genuine dark matter biosphere signatures from natural or artificial background phenomena. This requires highly sensitive instruments and sophisticated data analysis to avoid false positives. *Response*: To address the challenge of signal ambiguity, researchers should employ sophisticated statistical methods, advanced data analytics and meta-analyses.
- Misinterpretation: There is a potential for misinterpretation because many predicted biosphere effects (e.g., anomalous accelerations, electromagnetic signals) could have alternative explanations. There would therefore be a risk of misattributing ordinary phenomena to dark matter biospheres. *Response*: This can be addressed by having rigorous controls and replication by other teams to avoid such errors. There should also be collaboration with existing dark matter projects' and space missions' experts to sift through and analyze the data using multiple diverse perspectives.
- Seasonal and Spatial Variability: The density and interaction rate of dark matter around Earth varies seasonally and spatially due to orbital dynamics and the planet's movement through the galactic dark matter halo. This means detection efforts must be carefully timed and geographically targeted, complicating experimental design and interpretation. *Response*: To address this, detection efforts should be focused on the most promising regions and times. Consequently, the CTS region (Crust, Troposphere, Stratosphere) would be targeted as the "Goldilocks zone" for dark plasma lifeforms. Observational campaigns of cold plasma trails and wells will be timed to coincide with predicted peaks in dark matter influx (e.g., around June to August).
- Instrument Sensitivity and Limitations: Detecting faint signals (e.g., low-energy infrared, microwave, or radio emissions) requires innovative instrumentation. These would include magnetometers, radiometers, spectrometers, and ionization scanners with extremely high sensitivity and low noise. Even then, the signals may be below the threshold of current technology. *Response*: To address this, we will need to develop novel, highly sensitive instrumentation. Researchers will deploy and refine advanced tools such as high-sensitivity magnetometers, broad-spectrum radiometers, spectrometers, and atmospheric ionization scanners. These instruments are designed to detect the faint, non-standard signals (e.g., cold plasma trails, low-energy electromagnetic emissions) predicted by the author's model and other similar models.
- Interdisciplinary Data Integration: Some detection strategies involve meta-analysis of cultural, anecdotal, and historical data (e.g., ghost sightings, UAP/UFO reports) to look for correlations with predicted dark matter phenomena. Integrating such diverse data sources with physical measurements is methodologically challenging and requires careful statistical controls. *Response*: To address this, we will need to leverage on interdisciplinary collaboration. Teams should integrate expertise from plasma physics, astrobiology, signal processing, and space engineering. This interdisciplinary approach allows for the design of experiments and data analysis protocols that can distinguish genuine dark matter biosphere signatures from background noise and conventional phenomena.
- Conclusion: Detecting dark matter biospheres is an extraordinary scientific challenge due to their invisible, weakly interacting nature, the faintness and variability of predicted signals, and the need for highly sensitive, interdisciplinary approaches. Overcoming these challenges will require advances in both theory and technology, as well as careful experimental design and data analysis. Researchers are addressing the challenges of detecting dark matter biospheres through a combination of innovative instrumentation, interdisciplinary collaboration, strategic targeting of experiments, partnerships with major physics and space missions, and advanced data analysis. This multi-pronged approach is designed to maximize the chances of detecting the subtle, rare, and non-standard signatures that would indicate the presence of a hidden biosphere.

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F. Project Significance and Potential Impact

The successful detection of inter-terrestrial intelligence by the SITI project would represent one of the most significant paradigm shifts in the history of science. It would not be a singular discovery but a catalyst that fundamentally alters our understanding of our planet, our place in the cosmos, and the very definition of life. The impact of this research would reverberate across multiple scientific domains, opening entirely new fields of inquiry. The successful execution of Project SITI promises transformative results, regardless of whether it ultimately confirms the existence of intelligent dark plasma lifeforms. The project's impact extends far beyond a simple "yes" or "no" answer, with profound implications for astrobiology, fundamental (dark matter and particle) physics, and human philosophy. The very act of conducting this search will open new frontiers of scientific inquiry. The project's significance can be understood through its potential to transform key areas of science:

- A Revolution in Astrobiology: SITI's success would definitively prove that life is not limited to carbon-based chemistry and aqueous environments. It would establish that vast, complex biospheres can evolve from fundamentally different physical principles. The discovery that habitable zones can exist interpenetrating our own world, not just on distant exoplanets, would transform the search for life from a purely astronomical endeavor into an inter-sector physical science, with profound implications for planetary habitability models. A positive detection would fundamentally redefine the search for life. It would establish a new, accessible "inter-terrestrial" domain for study and prove that life can exist in a non-baryonic, plasma-based state. This would expand our understanding of what "life" is and where it might be found.
- A New Window into Dark Matter and Going Beyond the Standard Model of Particle Physics: The project offers a novel, indirect method to study the properties and structure of dark matter. Mapping the filamentary grid and its interactions with ordinary matter would provide unprecedented data on dark matter's self-interaction, the nature of a potential "dark electromagnetism," and its fine-grained distribution within our solar system. Even a constrained null result would provide an invaluable contribution. The methodologies developed to search for kinetic mixing and dark ionization would place rigorous new limits on dark matter self-interaction and kinetic mixing phenomena, thereby advancing particle physics beyond the Standard Model. The characterization of intelligent, self-organizing dark matter structures would provide the first direct, observational proof of self-interacting dark matter, resolving one of the greatest mysteries in modern cosmology. The interactions detected by SITI would create a unique natural laboratory to study the properties of dark matter, dark electromagnetism, and a theorized "fifth force" that may mediate interactions between the dark and ordinary sectors, potentially validating the existence of particles like the X17 boson.
- Transforming Planetary Science and Space Navigation: The confirmation of a dense, structured, and dynamic dark matter halo co-rotating with Earth would have immediate practical implications. It could provide a definitive explanation for the anomalous accelerations observed in spacecraft flybys and refine our gravitational models of the Earth-Moon system. A comprehensive understanding of this "dark plasmasphere" would be essential for improving the precision of satellite navigation systems and ensuring the safety of future space missions.
- Profound Philosophical Implications: The discovery of a vast, intelligent biosphere co-inhabiting our planet would represent one of the most significant moments in human history. It would compel a complete re-evaluation of humanity's place in the universe, the nature of consciousness, and our most basic assumptions about reality itself. A discovery of this magnitude would transcend science and reshape human culture, religion and philosophy. Confirming that we share our world with a hidden, intelligent civilization would compel us to reconsider our most fundamental assumptions about reality and consciousness.

The Project SITI initiative represents an opportunity to pioneer this monumental next step in human discovery. It represents a bold, calculated, and essential next step in humanity's quest to understand the universe. It is a high-impact initiative grounded in a testable framework that has emerged from the forefront of modern physics. To not look for something that theory suggests could be right here, co-existing with us, would be a failure of scientific imagination and curiosity. By confirming the existence of an inter-terrestrial biosphere, we would not only redefine our place on this planet but also establish the genesis of a new field—dark exobiology—and unlock the search for life within the billions, if not trillions, of dark matter exoplanets that may populate our galaxy, and other hybrid and purely dark galaxies. We have searched the heavens for decades; it is time now to look for life beyond the 15 percent of ordinary matter in the universe and search the 85 percent composed of dark matter.

G. Conclusion

This proposal has laid out a comprehensive, evidence-based case for a pioneering new scientific endeavor: the Search for Inter-Terrestrial Intelligence (SITI). We have followed a rigorous chain of scientific logic, demonstrating that this initiative is not speculative but is instead the next logical step in both dark matter physics and astrobiology.

The logic is clear and compelling: a convergence of empirical evidence from neutrino tomography, satellite dynamics, and theoretical physics that points to a massive, structured dark matter presence on and around Earth. The known properties of self-interacting dark plasma suggest that this structure provides a stable, energy-rich environment fundamentally conducive to the evolution of complex life. Finally, the SITI methodology provides a concrete, phased, and scientifically-grounded plan for detecting the biological and technological signatures of this hidden biosphere through its predictable physical interactions with our world.

SITI represents a unique and timely opportunity. While we have spent decades looking to the stars, one of humanity's oldest questions—"Are we alone?"—may find its answer not in the vast emptiness of space, but in the unseen reality that surrounds us

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every day. We invite you to partner with us in leading a discovery that would reshape the course of human knowledge and redefine our place in the universe.

H. Foundational References

The entire theoretical basis for this proposal, including the Dark Earths Hypothesis, the nature of self-interacting dark plasma, and the proposed detection methodologies, is derived exclusively from the research and publications of Jay Alfred, as detailed in the comprehensive source document "Formation and Structure of Earth's Hidden Dark (Matter) Biospheres" (2025).