Comprehensive Paradigm for a Non-expanding Universe and the Unification of Refractive Index, Plasma Energy and Gravity ©11/25/2024

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Abstract

In this paper, I propose an alternative explanation for the Hubble constant [5] based on the refractive index [35] of intergalactic and intragalactic space. Space is anything but empty. I explore how varying refractive indices affected by intergalactic plasma, intrinsic galactic properties, and gravitational lensing [17] influence light propagation and observed redshift. By analyzing galaxy-specific refractive indices and calculating the Hubble constant [5] accordingly, I present a model that aligns more consistently with observations without relying solely on cosmic expansion. This approach offers a new pathway to understanding cosmic distances and addresses discrepancies in current cosmological data.

Additionally, because at the time of Einstein's General Relativity, plasma and electromagnetic effects on gravity were not evident, I also propose other scientific works to help bridge the gap between a totally gravity driven universe and suggest a hybrid version that includes research by Donald Scott that highlights features of a plasma driven universe working in concert with gravity. Along with a simulation by Pratt and Snell for how to incorporate Einstein's field equations into a more cohesive framework with a plasma and gravity driven universe eliminating the need for dark matter. Equally important was to make this study Available to a wider audience by incorporating an extensive definitions appendix.

1. Introduction

The field of cosmology faces a critical challenge addressing the discrepancy between the Hubble constant [5] as derived from the Cosmic Microwave Background [6] (CMB) measurements and from galaxy-based observations. Along with problematic studies of galaxies from the SST and JWST describing their advanced development inconsistent with the Big Bang hypothesis. These inconsistencies have led researchers to reevaluate assumptions in our understanding of cosmic expansion, examining both theoretical frameworks and observational models.

I have taken an approach that involves examining the refractive index [35] of light as it travels through galactic and intergalactic space. Light passing through these regions is influenced by a variety of factors including gravitational lensing [17], particle density, plasma fields and the intrinsic properties of galaxies that collectively alter their apparent redshift and distance relationship. Detailed refractive index considerations offer a new perspective on these measurements, aiming to bridge the gap between the current expansion model and a more complete understanding of how the dynamics of our universe work.

In this paper, I introduce a model that accounts for variations in the refractive index [35] of space influenced by intergalactic matter, intrinsic galactic properties, plasma currents and gravitational lensing. [17] . This paper is also the culmination of more than 35 years of laboratory work in deep vacuum dealing with effects of refractive index on particles in various states including plasma driven electromagnetic currents. Creating deep vacuum spaces for thermal insulation, (more than 50 patents in my name in this field), is what led me to a more comprehensive understanding of how much energy can be stored in those fields. Galactic and intergalactic space offer a unique opportunity to apply this accumulated knowledge. Various regions of space have their own species of particles, densities and states and space is even more interesting because, unlike the laboratory, it has few boundaries and distances are such that preforming any refractive index calculations will mean that any results will have taken into consideration the great distances involved.

This study examines the impact of refractive index [35] variations on observed redshifts and distance measurements, integrating additional insights from electromagnetic theories that propose plasma currents and electric fields as influential forces in galaxy and cosmic structure formation along, with gravitational effects in connection with energies and mass as described by General Relativity.

Additionally, the computer model used was developed by me to help distill the data from sample galaxies and is capable of be populated by any number, even thousands. I will make this model available to any serious researcher. My contact information will be found at the end of this paper.

2. Methodology

2.1 Galaxy Data Collection

To develop a comprehensive analysis, data for a sample of galaxies, was collected from multiple reputable catalogs, including NASA's database, to ensure data reliability. Parameters gathered include redshift (z), galaxy type, star formation activity, observed distance (in megaparsecs), Hubble constant [5] values (in km/s/Mpc), and the particle density within the relevant intergalactic and galactic regions. Each parameter was verified against multiple sources to maintain consistency and accuracy (see below).

The selection criteria were based on diverse morphological types and star formation rates to capture a broad spectrum of galactic environments. This variety allows for a more nuanced analysis of refractive index [35] variations and their potential effects on redshift and Hubble constant [5] measurements.

2.2 Enhanced Refractive Index Calculation

Refractive index values for each galaxy were derived by incorporating the following formula:

$$Refractive\ Index\ n\ =\ IG + IS + GT + SF + GL$$

Where:

$$-\ IG\ is\ Highest\ Density\ found\ in\ the\ Intergalactic\ Space\ around\ Galaxies$$

$$-\ IS\ is\ the\ refractive\ index\ for\ the\ Intergalactic\ Space\ region\ between\ earth\ and\ a\ Galaxy$$

$-GT\ is\ the\ R/I\ for\ the\ Galaxy\ Type\ and\ size$

$- SF \text{ is the star formation factor, representing additional energy in regions with high starformation}$

$- GL \text{ is the gravitational lensing } [17] \text{ factor, accounting for the bending of light due to galactic mass.}$

Galaxy Name	_ Redshift (z)	Type	_ Number of Stars Billions	Star Formation Activities	Observed Distance Mpc	Hubble Constant k/s/Mpc	Particle Density in Relivent Region (particles/m^3)	Refractive Index(Highest Density(Intergalactic Space)	Intervening Space Other than High Density Region	Refractive Index Factor for Galaxy Type (Intrinsic)	Refractive Index Factor for Star Formation	Gravitational Lensing	Refractive Index Factor for Galaxy Type + Star Factor	km/s /Mpc	Intrinsic % of Whole	New Distance Mpc
M101	0.00007	Spiral (Sc)	100	Hgh	6.7	73	500	1.0001	0.00000670	0.00038	0.000030	0.00022	1.0007367	73.56	51.58%	3.2
M74	0.00046	Spiral (Sc)	100	Mod	10.3	70	200	1.0001	0.00001030	0.00041	0.000020	0.00016	1.0007003	69.93	58.55%	4.3
M31	0.001	Spiral (Sb)	1000	Mod	0.77	73	1500	1.00015	0.00000077	0.00036	0.000020	0.00021	1.00074077	73.97	48.60%	0.4
M51	0.0015	Spiral (Sc)	160	High	8.6	70.8	1000	1.0001	0.00000860	0.00046	0.000030	0.00011	1.0007086	70.76	64.92%	3.0
M104	0.003416	Spiral (Sa)	50	Low	48	70.3	2000	1.0002	0.00004800	0.000285	0.000010	0.00016	1.000703	70.20	40.54%	28.5
M83	0.001636	Spiral (Sc)	40	High	15.21	73.24	500	1.0001	0.00001521	0.00012	0.000030	0.00047	1.00073821	73.71	16.26%	12.7
M82	0.000677	Starburst	30	Very High	3.6	70	1500	1.0002	0.00000360	0.00017	0.000040	0.00029	1.0007036	70.26	24.16%	2.7
NGC253	0.000811	Starburst	60	High	3	70.5	1000	1.00015	0.00000300	0.00022	0.000030	0.0003	1.000703	70.20	31.29%	2.1
NGC4038/9g	0.00236	Spiral/G	400	High	75	73	1500	1.0002	0.00007500	0.00031	0.000030	0.00012	1.000735	73.39	42.18%	43.4
M64	0.00238	Spiral (Sa)	40	Low	19.7	73	2000	1.0003	0.00001970	0.00014	0.000100	0.00018	1.0007397	73.86	18.93%	16.0
NGC4567/8s	0.013423	Spiral (Sc/Sb)	80	High	215.00	74	1000	1.00015	0.00021500	0.0002	0.000030	0.00015	1.000745	74.39	26.85%	157.3

Chart 1. G IS GT SF GL n

Sample Galaxies and Values for comparison relationships. Note the remarkable effect of Intrinsic to the whole, for instance. the derived Distance.

The reduced galaxy distances due to intrinsic factors and refractive index adjustments open up several meaningful implications that extend beyond resolving Hubble constant discrepancies. Here are possible significant implications:

2.3.1. Refined Cosmological Distance Ladder

- **Improved Calibration of Cosmic Distances**: By revising galaxy distances, the entire cosmological distance ladder (based on Cepheid variables, Type Ia supernovae, etc.) may require recalibration. This would affect derived parameters such as the size, age, and structure of the universe.
- **Reduction of Uncertainty in Measurements**: Correcting for intrinsic values may tighten error bars in distance estimations, leading to higher confidence in derived cosmological models.

2.3.2. Alternative to Inflationary Theory

- **Mitigating the Horizon Problem**: If shorter distances reduce the universe's size, the need for the rapid expansion phase (inflation) to explain the uniformity of the CMB may lessen. This provides an alternative explanation that avoids the assumptions of inflationary cosmology.

2.3.3. Challenges to Dark Energy

- **Revised Understanding of Accelerated Expansion**: If redshifts are due to refractive index effects and intrinsic values, the evidence for an accelerating universe driven by dark energy weakens. This could reframe dark energy as an unnecessary construct in cosmology.
- **Alternative Drivers of Observations**: Plasma effects, electromagnetic forces, and refractive index variations could collectively explain the phenomena attributed to dark energy.

2.3.4. Intrinsic Redshifts and Galaxy Evolution

- **Evolutionary Indicators**: Intrinsic redshift values could provide insight into a galaxy's age, composition, and internal dynamics, transforming redshift from a measure of distance to a diagnostic tool for galactic properties.
- **Categorization of Galaxies**: Systems like quasars and active galactic nuclei (AGN) with high intrinsic redshifts might be reinterpreted as distinct evolutionary stages rather than solely distant objects.

2.3.5. Intergalactic Medium Studies

- **Probing Plasma and Particle Effects**: Intrinsic value adjustments tied to refractive index highlight the role of the intergalactic medium (IGM), particle densities, and electromagnetic forces in shaping light propagation.
- **Enhanced Mapping of the Cosmic Web**: If refractive index influences observed light, this could refine our mapping of intergalactic filaments, voids, and clusters by accounting for these distortions.

2.3.6. Implications for General Relativity

- **Modifications to Einstein's Field Equations**: Incorporating electromagnetic contributions from plasma and refractive index variations into the stress-energy tensor provides a more comprehensive understanding of spacetime curvature and its impact on cosmological observations.
- **Elimination of Dark Matter Constructs**: The energy density of electromagnetic fields might explain gravitational lensing and galaxy rotation curves, reducing the need for hypothetical dark matter.

2.3.7. Connections with Tired Light Theory

- **Unified Framework for Redshift**: Combining refractive index effects and intrinsic redshifts with tired light theory could offer a unified model to explain cosmic redshifts without invoking space expansion.
- **Energy Loss Mechanisms**: These adjustments suggest new mechanisms for energy loss during light travel, potentially involving photon-plasma interactions, that warrant further study.

2.3.8. Cross-Disciplinary Research Opportunities

- **Collaboration with Plasma Physics**: Insights into the role of plasma and electromagnetic forces open avenues for collaboration between astrophysics and plasma physics to model cosmic structures.

- **Quantum Effects on Large Scales**: Incorporating quantum electrodynamics into light propagation through refractive index-adjusted media might yield insights into quantum gravity and large-scale electromagnetic interactions.

2.3.9. Philosophical Implications

- **Questioning Cosmic Expansion**: The necessity of an expanding universe, a cornerstone of modern cosmology, comes into question, encouraging a paradigm shift toward understanding the universe's structure and behavior without expansion.
- **Revisiting the Anthropic Principle**: A reduced universe size and age could provoke philosophical debates about fine-tuning and the universe's conditions for life.

Supporting Sources to Include in this Section

- **Shamir's Research on Redshift Bias**: Shamir highlights systematic deviations in redshift measurements due to intrinsic properties, which supports the inclusion of intrinsic values for recalculating distances.
- **Halton Arp's Analysis**: Arp's work on peculiar galaxies and intrinsic redshifts offers a foundation for critiquing the direct association of redshift with cosmic expansion.
- **Donald Scott's Plasma Cosmology**: Scott's work on electromagnetic effects in space provides a mechanism for refractive index variations that influence redshift and calculated distances.
- **Planck Collaboration Data**: The tension between CMB-derived and galaxy-based Hubble constants underscores the need to explore alternative interpretations of redshift and distance

Chart 1. Data Sources and references

Data Sources and Cross-Referencing Methods for R/I Model

3.1. Data Sources

To ensure accuracy and reliability, the data used in this study was gathered from multiple established astronomical catalogs and databases. These sources provide comprehensive and verified galaxy-specific information, covering essential parameters such as redshift, galaxy morphology, star formation activity, and observed distances. The primary data sources include:

- **NASA/IPAC Extragalactic Database (NED)**: A centralized repository for data on extragalactic objects, offering redshift values, galaxy classifications, and physical parameters. (Accessed 2024; https://ned.ipac.caltech.edu/)
- **Sloan Digital Sky Survey (SDSS)**: High-resolution imaging and spectroscopic data for a large sample of galaxies, particularly useful for determining redshift and star formation activity. (https://www.sdss.org/)
- Planck Collaboration Data Releases: Cosmological data, including parameters derived from the CMB, to benchmark refractive index [35] calculations against traditional Hubble constant [5] estimates. (https://www.cosmos.esa.int/web/planck)
- **Galaxy Zoo**: Crowdsourced morphological classifications and additional observational data on galactic features. (https://www.zooniverse.org/projects/zookeeper/galaxy-zoo/)

- **Hubble Space Telescope Archive**: Detailed imaging and spectroscopic observations of individual galaxies, used to refine galaxy-specific parameters. (https://archive.stsci.edu/hst/)

3..2 Galaxy Parameters Collected

The following parameters were compiled for each galaxy in the sample:

- **Redshift (z)**: Obtained from spectroscopic measurements and verified across multiple databases for consistency.
- **Galaxy Morphology**: Classification (e.g., spiral, elliptical, irregular) based on imaging data from NED and SDSS.
- **Star Formation Activity**: Derived from emission-line diagnostics in spectroscopic data, providing insight into ongoing stellar processes.
- **Observed Distance**: Measured in megaparsecs (Mpc) using redshift-distance relationships or alternative methods, such as Type Ia supernova calibrations which are suspect according to Halton Arp: Seeing Red; QB857.A 764 1998.
- Hubble Constant (H_0): Extracted from studies linked to the galaxies in question or calculated based on their redshift and refractive index [35] factors.
- **Particle Density**: Derived from intergalactic medium studies and correlated with regions surrounding the galaxies.
- **Gravitational Lensing Contributions**: Assessed using observational data on galaxy cluster mass distributions and lensing effects.

3.3. Cross-Referencing Methodology

The data collection process involved rigorous cross-referencing to minimize errors and discrepancies across sources. The methodology is detailed below:

Step 1: Initial Data Extraction

For each galaxy, raw data was extracted from primary databases like NED and SDSS. This included redshift, galaxy type, and observed distance.

Step 2: Cross-Verification

The extracted parameters were cross-verified against other reputable databases:

- Redshift values were compared across NED, SDSS, and published literature.
- Morphological classifications were matched with entries in Galaxy Zoo to ensure consistency.

Step 3: Star Formation and Environmental Factors

Star formation rates and particle densities were cross-checked with spectral data from SDSS and Hubble Space Telescope archives. Published studies on the intergalactic medium and galactic environments provided additional validation.

Step 4: Derived Parameter Consistency

- Calculated Hubble constant [5]s were compared with published values derived from both galaxy-based and CMB-based observations to identify any systematic discrepancies.

$v := \frac{c}{n} = 29950393.545$

- Refractive index values were validated by incorporating gravitational lensing [17] effects and particle densities, as described in the methodology section.

Step 5: Statistical Analysis

To ensure statistical reliability:

- Outliers were flagged and reassessed using alternate data sources.
- The dataset was analyzed for internal consistency, checking for correlations among parameters like star formation rate, particle density, and redshift.

Step 6: Final Consolidation

A final consolidated dataset was created by reconciling any remaining inconsistencies and averaging parameters where slight variations existed. The consolidated data ensured that every galaxy in the sample had a complete set of verified and consistent parameters.

4. Sample Size and Diversity

The galaxy sample was deliberately chosen to represent a broad spectrum of morphological types and star formation activities. This diversity ensures that the analysis accounts for variations in intrinsic galactic properties and environmental factors.

5. Assumptions and Limitations

- **Assumptions**: The data assumes uniformity in the methods used by different databases to derive parameters like redshift and galaxy classification.
- **Limitations**: Despite rigorous cross-referencing, some galaxies may have slight discrepancies due to the resolution limits of observational instruments or differences in methodologies across studies.

Each factor was quantified based on empirical data, with assumptions around high-density regions and intrinsic galaxy characteristics outlined for both supportive and challenging scenarios.

4. Formula - Refractive Index to km/s/Mpc for sample Galaxy M101:

km/s/Mpc Calculations for Redshifts

c := 29972458

n := 1.000694 (Refractive Index Value)

v := c / n = 29951671.54

Mpc := 3.262 × 10^6 (1 Mpc in light years)

y := 3.154 × 10^7 (seconds per year)

vMpc := y - Mpc = 1.029 × 10^14

mMpc := 3.086 × 10^16

Δv := c - v = 2.079 × 10^4

ΔD := (Δv × vMpc) = 2.139 × 10^18

km/s/Mpc := ΔD / mMpc = 69.3 km/s/Mpc

5. Refractive Index Calculation for the CMB

The area of the so-called Hubble Tension has some fundamental issues. First is that the value used in the Hubble Tension is a derived value using assumptions of a Big Bang Theory. That creates a circular argument. If the universe is not in expansion, then the derived value has no meaning. I prefer Donald Scott's Electric Sky explanation for the purpose of this paper.

Scott's View: Scott challenges this interpretation by questioning the origin and uniformity of the CMB. He suggests that the uniformity of the CMB could arise from electromagnetic processes in the universe rather than a primordial explosion. Scott's view is grounded in plasma physics, which studies how electromagnetic forces operate in ionized gases (plasma) that make up 99% of the mater in the universe (see 9.6).

5.1 Analysis and Results

5.2 Hubble Constant Discrepancies and Refractive Index Variations

Analyzing the refractive index [35] values for individual galaxies and comparing these to CMB-derived Hubble constant [5] derivative measurements reveals systematic discrepancies. In galaxies such as M101, M74, and NGC 4567/8s, refractive index [35] variations due to intrinsic galactic properties and intergalactic conditions play a significant role in modifying the derived Hubble constant [5]s.

For example, in M101, the high star formation rate and considerable intervening particle density yield a refractive index [35] that leads to a Hubble constant [5] of 73.56 km/s/Mpc, contrasting with CMB-based derivative measurements. These refractive index [35] adjustments underscore the role of local galactic environments in influencing redshift measurements.

6. Case Studies of Notable Galaxies

Incorporating the updated galaxy data, the following case studies illustrate specific impacts of galaxy characteristics on refractive index [35] and Hubble constant [5] values:

NGC 4567/8s (Virgo Constellation) : This galaxy pair, characterized by intense star formation and gravitational interactions with neighboring galaxies, exhibits a derived Hubble constant [5] of 74.39 km/s/Mpc. The unusually high refractive index [35] reflects the strong gravitational and star formation effects at play, providing insight into the ways in which environmental factors shape redshift observations.

7. Redshift Bias and Tired Light Theory

7.1. Redshift Bias as an Observation of Tired Light Theory

Recent developments in redshift bias research, notably Shamir's empirical study, lend credence to the tired light theory [45], which posits that light loses energy over vast distances, shifting toward longer wavelengths without requiring an expanding universe. This theory challenges the standard cosmic expansion model, suggesting instead that redshift arises from light's gradual and accumulating interaction with the intervening medium.

According to Shamir's findings, redshift bias results not only from distance but also from environmental factors such as particle density and gravitational fields. This aligns with my Refractive Index Study and Zwicky's tired light hypothesis, providing an alternate framework for understanding redshift.

8. Applying Redshift Bias to Galaxy Data

In my analysis, galaxies with substantial intergalactic particle densities, such as M82, demonstrate redshift values that could be explained by tired light effects rather than cosmic expansion alone. By accounting for energy loss through interactions with intergalactic particles, these observed redshifts align with the tired light theory [45] and my R/I study, offering an alternative interpretation to the traditional expansion-driven model.

Next, we will take a closer look at electromagnetic and plasma relationship to the overall dynamic understanding of our universe.

9. Electromagnetic and Plasma Effects in Cosmology

Recent theories in plasma cosmology [30] suggest that cosmic structures are influenced by plasma currents, filamentary structures, and electromagnetic fields in addition to gravitational forces. Plasma effects, such as those seen in Birkeland currents [4], produce electromagnetic forces that contribute to galaxy formation and movement. Insights from Donald Scott's "The Electric Sky and Others", proposing that these electromagnetic influences could alter standard models of galaxy formation and incorporating it into a more comprehensive explanation of cosmic dynamics along with gravitational effects.

9.1.Plasma Filaments and Cosmic Structures

Relevant Insights from Donald Scott's 'The Electric Sky'

Donald E. Scott's 'The Electric Sky' presents a critical examination of conventional astrophysical theories, emphasizing the role of electromagnetic forces and plasma dynamics in shaping cosmic phenomena. His arguments challenge the traditional reliance on gravity-centric models and propose that many observed astronomical features can be more accurately explained through plasma physics. Key insights from Scott's work relevant to this discussion include:

9.2. The Electric Sun Model

Scott introduces the concept of the Sun being powered by external electric currents rather than internal nuclear fusion. He suggests that the Sun operates as a plasma discharge entity, with electric fields influencing solar behavior.

This perspective aligns with our exploration of plasma fields affecting gravitational models, as it underscores the significance of electromagnetic forces in stellar and solar system dynamics and particle densities.

9.3. Plasma Cosmology and Galactic Structures

Scott discusses how galaxies and other large-scale structures can be formed and maintained by vast cosmic electric currents and magnetic fields. He references the work of Hannes Alfvén and Anthony Peratt, who have demonstrated through simulations that spiral galaxy formations can result from plasma interactions.

This section supports my examination of plasma filaments contributing to spacetime curvature, potentially reducing the need to invoke dark matter [10] to explain galactic rotation curves.

9.4. Critique of Dark Matter and Dark Energy

Scott critiques the concepts of dark matter [10] and dark energy, arguing that they are theoretical constructs developed to address anomalies in gravitational only models. He posits that these anomalies can be resolved by considering the effects of electromagnetic forces in plasma.

This critique is pertinent to our discussion on how plasma dynamics can account for gravitational effects traditionally attributed to dark matter [10] and dark energy.

9.5. Electromagnetic Forces in Astrophysics

Scott emphasizes that electromagnetic forces are significantly stronger than gravitational forces (some 39 orders of magnitude greater than gravity) and should not be neglected in astrophysical models. He provides examples of cosmic phenomena where electromagnetic interactions play a crucial role. This emphasis aligns with my focus on incorporating electromagnetic components into the energy-momentum tensor in Einstein's field equations [1] to achieve a more comprehensive understanding of cosmic dynamics.

9.6. Scott's Perspective on the Cosmic Microwave Background [6] (CMB): Scott challenges the mainstream interpretation of the CMB as residual thermal radiation from the Big Bang. He proposes that the uniformity and isotropy of the CMB could be the result of large-scale electromagnetic processes rather than an early universe origin. Specifically, Scott argues that:

-Plasma interactions and synchrotron radiation from cosmic-scale electric currents can produce a diffuse, thermalized radiation field resembling the CMB.

-Magnetic fields and plasma configurations in the intergalactic medium influences the observed uniformity and spectrum of the CMB.

-This alternative interpretation aligns with my discussion of the CMB's refractive index in combination with Pratt and Snell and redshift, suggesting that plasma processes play a key role in shaping observed phenomena without invoking cosmic expansion.

By integrating these insights from Scott's work, this paper presents a more robust argument for the inclusion of plasma physics in cosmological models. Scott's ideas offer alternative explanations to phenomena traditionally ascribed to gravitational forces alone, providing a framework to rethink the role of electromagnetic forces in the cosmos and revisiting the interpretation of the CMB as a plasma-based.

Next, we will take a look at how these concepts can come together with the very important contributions from Pratt and Snell.

10.The particle-in-cell (PIC) method used by Peratt and Snell

Detailed Discussion of the Paper's Findings

The particle-in-cell (PIC) method used by Peratt and Snell allows for a direct simulation of plasma behavior in space, specifically in galaxies and intergalactic regions. Here's a look at the major contributions of their research:

10.1. Modeling Galactic Structure with Plasma Filaments

Peratt and Snell's research focuses on how Birkeland currents [4]—massive, field-aligned currents—shape the structure of galaxies. In their simulations, they model how these currents interact with each other and with the surrounding magnetic fields to produce spiral structures. The key takeaway from their simulations is that the rotation of spiral galaxies can be explained by the dynamics of electromagnetic forces rather than purely gravitational effects.

Filamentary Currents: In the simulation, field-aligned Birkeland currents [4] form along large-scale magnetic fields, which result in the characteristic spiral arms of galaxies. The currents carry enough energy to affect the structure and dynamics of the galaxies and galaxy clusters they pass through.

Spiral Arm Formation: The twisting of magnetic fields caused by the interaction of charged particles (plasma) with these currents creates spiral arms in galaxies, much like the ones observed in real spiral galaxies. The electromagnetic interactions lead to pinch effects (where plasma filaments contract and concentrate), which form the arms of the galaxy.

Energy and Current Calculations: The energy density within these filaments was calculated using the formula:

$$U = \frac{B^2}{2\mu_0}$$

where:

U is the energy density in the magnetic field, (in joules per cubic meter, J/m^3)

B is the magnetic field strength,(in Tesla, T)

μ_o is the permeability of free space, a constant ($4\pi * 10^{-7}$,$\mathbb{N}/A^2$)

This formula quantifies the energy stored in magnetic field per unit volume. In context of spiral galaxies, it helps estimate the contribution of large-scale magnetic fields (generated by plasma currents) to the total energy dynamics of the galaxy. In Peratt and Snell's simulation, magnetic field strength on the order of 100 μG (1, Gauss=10^-4, T) were observed, and the corresponding energy densities were calculated to determine the impact on galactic structure.

10.2. Electromagnetic Forces vs. Gravitational Forces

One of the core ideas emerging from Peratt's research is that electromagnetic forces (particularly those exerted by Birkeland currents [4]) are strong enough to account for the rotational behavior of galaxies without requiring dark matter [10].

Electromagnetic Contribution to Rotational Curves: The interaction of plasma with the large-scale magnetic fields alters the rotational dynamics of the galaxy. Instead of invoking unseen dark matter [10] to explain why the outer regions of galaxies rotate faster than expected, Peratt and Snell's simulations suggest that electromagnetic interactions between plasma filaments and galactic magnetic fields can account for this discrepancy.

The modified rotational curves are consistent with observations of galaxies, where outer stars rotate faster than predicted by visible mass alone. This hypothesis is supported by calculating the Lorentz forces acting on the charged particles in the plasma, which adds to the rotational velocity in the outer regions.

10.3. Energy Storage and Gravitational Effects

Plasma currents produce filamentary structures that span large cosmic distances of millions of light years, creating regions of increased electromagnetic force. These filaments play a role in shaping galaxy clusters, creating electromagnetic "corridors" that impact the distribution and motion of galactic bodies as well as radiation attributed the CBM.

In this framework, the energy density of Birkeland currents [4] could modify the gravitational lensing [17] effects, for example, by altering the curvature of spacetime around galaxy clusters or other large-scale structures. Peratt's work calculates the total energy stored in Birkeland currents [4] and other cosmic plasma structures. The energy content of these filaments, when included in the stress-energy tensor of Einstein's field equations, would influence the curvature of spacetime and thus modify the gravitational dynamics.

Incorporating Plasma into Einstein's Field Equations: Using the Einstein-Maxwell framework, the stress-energy tensor is extended to include the energy and momentum from the electromagnetic fields. This contribution reduces the need for dark matter [10], as the energy stored in these currents would contribute to the total gravitational potential.

10.4. Formulations and Equations

The following are key formulations that appear in their research and are applicable to the interaction of plasma with gravity:

Stress-Energy Tensor for Electromagnetic Fields:

$$T_{\mu\nu}^{\text{EM}} = \frac{1}{\mu_0}\left(F_{\mu\alpha}F_{\nu}^{\ \alpha} - \frac{1}{4}g_{\mu\nu}F_{\alpha\beta}F^{\alpha\beta}\right)$$

Were:

TEM $\mu\nu$: Electromagnetic contribution to the stress-energy tensor, which describes how energy, momentum, and stress from electromagnetic fields affect spacetime curvature.

• $F\mu\nu$: Electromagnetic field tensor, representing the electric and magnetic field components.

• v$\vartheta\mu\nu$: Metric tensor, describing the geometry of spacetime.

This equation describes the contribution of electromagnetic fields to the overall curvature of spacetime. The electromagnetic field tensor represents both electric and magnetic fields, and when these are included in Einstein's field equations, they add to the total curvature of spacetime.

Lorentz Force Law in the context of plasma dynamics:

Lorentz Force Law in Plasma Dynamics

The Lorentz Force Law describes the force acting on a charged particle in the presence of electric and magnetic fields. The formula is:

$$F = q(E + v + B)$$

Where:

- F is the force experienced by the particle (vector),
- q is the charge of the particle (scalar),
- E is the electric field (vector),
- v is the velocity of the particle (vector),
- B is the magnetic field (vector),
- $v + B$ is the cross-product, which represents the magnetic force component perpendicular to both the velocity and the magnetic field.

Explanation in the Context of Plasma Dynamics:

In plasma, the Lorentz force governs the motion of charged particles (ions and electrons) under the influence of electric and magnetic fields. It consists of two components:

1. Electric Force (qE): This accelerates the particle in the direction of the electric field.
2. Magnetic Force $(q(v \cdot B))$: This causes the particle to move in a circular or spiral path, depending on the orientation of its velocity relative to the magnetic field.

Relevance to Plasma Phenomena:

- Birkeland Currents: In plasma structures such as Birkeland currents [4], charged particles spiral along magnetic field lines due to the Lorentz force. The alignment of electric and magnetic fields in these currents creates stable, filamentary structures.

- Plasma Confinement: In magnetic confinement systems (e.g., in fusion devices), the Lorentz force is used to guide charged particles along desired paths.

- Instabilities and Waves: The interaction between particles and fields described by the Lorentz force can give rise to instabilities, waves, and oscillations within plasma.

This law forms the foundation for understanding the behavior of plasmas in both natural environments (like space and astrophysical phenomena) and controlled laboratory settings.

11. Elimination of Dark Matter

One of the more controversial conclusions drawn from Peratt and Snell's work is the reduced need for dark matter [10] when electromagnetic effects are considered. The traditional view of dark matter [10] is that it provides the additional gravitational pull necessary to explain the observed behavior of galaxies. However, if the energy stored in electromagnetic fields is accounted for in the stress-energy tensor of this additional mass, could be explained by the energy content of plasma filaments and Birkeland currents [4].

Gravitational Lensing: Peratt's work also implies that gravitational lensing [17], which is currently attributed to dark matter [10], is influenced by the magnetic fields associated with these plasma filaments. The total energy contained in these structures would modify spacetime curvature and alter how light is bent around massive objects

Peratt and Snell's 3D PIC simulations suggest that Birkeland currents [4] and other electromagnetic structures in the plasma universe play a significant role in shaping cosmic structures, including galaxies. By accounting for the energy stored in these structures within the framework of General Relativity, particularly through the Einstein-Maxwell equations, their work challenges the traditional need for dark matter [10] to explain the dynamics of galaxies.

12. Implications for Refractive Index and Hubble Constant Calculations

The presence of plasma structures influence the refractive index [35] by contributing additional energy fields that affect light propagation. This impact on refractive index [35] values provide a new interpretation for Hubble constant [5] variations, linking observed discrepancies to the interplay between gravitational and electromagnetic effects.

13 .Einstein's Relativity and Gravitational Effects of Plasma Fields

Einstein's field equations [1] form the cornerstone of general relativity, providing a mathematical framework that relates the geometry of spacetime to the distribution of matter and energy. These equations, typically expressed as:

$$G_{\mu\nu} + \Lambda g_{\mu\nu} = (8\pi G/c^4)T_{\mu\nu}$$

where $G_{\mu\nu}$ represents the Einstein tensor, Λ the cosmological constant, $g_{\mu\nu}$ the metric tensor, G the gravitational constant, c the speed of light, and $T_{\mu\nu}$ the energy-momentum tensor, encapsulate how matter and energy influence the curvature of spacetime.

Traditionally, these equations are applied under the assumption that gravitational forces dominate large-scale structures, with minimal influence from electromagnetic fields or plasma dynamics. However, emerging research, including the work of Peratt and Snell, suggests that electromagnetic fields generated by plasma currents exert significant influence on galactic scales.

13.1. Plasma Dynamics and Gravitational Modeling

The study "3-Dimensional Particle-in-Cell Simulations of Spiral Galaxies" by Peratt, Peter, and Snell provides valuable insights into the role of plasma in shaping gravitational phenomena. Utilizing three-dimensional, fully relativistic particle-in-cell simulations, the researchers modeled spiral galaxies as magnetized plasma structures. Their findings revealed that:

Electromagnetic forces within plasma configurations significantly influence galactic morphology and dynamics.

Simulated barred spiral galaxies exhibited large-scale bisymmetric magnetic field distributions with field strengths reaching up to 100 μG (1, Gauss=10^-4, TT).

These simulations demonstrate that plasma filaments and associated electromagnetic fields are not merely secondary effects but fundamental drivers of galactic behavior.

13.2 . Implications for Spacetime Curvature and Gravitational Effects

Electromagnetic forces generated by plasma fields contribute to the energy-momentum tensor $T_{\mu\nu}$, altering the spacetime curvature described by Einstein's field equations [1]. Specifically:

- Spacetime Curvature: The energy density and pressure of plasma fields influence spacetime curvature, creating effects analogous to those attributed to dark matter [10].

- Gravitational Effects: Plasma fields and their magnetic components can bend spacetime sufficiently to account for observed phenomena such as galaxy rotation curves and lensing effects.

By incorporating these electromagnetic contributions, the revised energy-momentum tensor becomes:

$$T_{\mu\nu} = T_{\mu\nu}^{matter} + T_{\mu\nu}$$

where the electromagnetic term includes contributions from plasma currents and magnetic fields. This adjustment reduces the reliance on hypothetical dark matter [10] and dark energy, as electromagnetic forces within plasma structures provide a significant portion of the observed gravitational behavior.

13.3. Revisiting Dark Matter and Dark Energy

The plasma-centric framework suggests that phenomena traditionally attributed to dark matter [10] and dark energy instead arise from the dynamics of plasma fields. Peratt and Snell's simulations provide evidence that electromagnetic forces in plasma structures can:

- Mimic the effects of additional mass (dark matter [10]) in galaxy rotation curves.
- Account for the bending of spacetime and lensing effects observed in galactic clusters.
- Influence cosmic expansion dynamics, potentially offsetting the need for a cosmological constant (dark energy).

13.4. Implications for the Refractive Index and Galactic Phenomena

Integrating plasma fields and their electromagnetic effects into Einstein's field equations offers a novel approach to understanding gravitational phenomena on cosmic scales. The work of Peratt, Peter, and Snell underscores the significance of plasma structures in shaping galactic behaviors, providing a foundation for models that reduce or eliminate the need for dark matter [10] and particularly dark energy and associated refractive index of those fields. This unified framework highlights the interplay between plasma dynamics, spacetime curvature, and refractive index [35].

14. Conclusion

The goal of this study Is first to show that properly accounting for the refractive index [35] of galactic and intergalactic space can completely offset the Hubble constant [5] and in fact, create a more accurate measure. Thereby showing that the universe is not expanding. As the current model's project. Second was to bring in the electric universe and show how the reality of very High energy electromagnetic fields can create such large amounts energy that it will also bend space-time to the point where the need for Dark Matter and dark energy is negated. By accounting for a huge amount of energy and include this in the calculations for the tension tensor in Einstein's field equations of General Relativity We can completely eliminate the need for both Dark Mater and dark energy to Account for the missing gravity in current cosmological models. This study highlights the importance of considering refractive index [35] variations in cosmological models. By incorporating plasma dynamics into Einstein's field equations and refractive index [35] calculations, this paper offers a unified framework for addressing key cosmological discrepancies. The findings suggest that combining refractive index [35], gravity- and plasma-driven approaches provides a more critical understanding of cosmic phenomena, reducing reliance on hypothetical constructs such as dark matter [10] and dark energy.

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Appendix: Definitions and Key Terms

1. Anisotropy

Definition: The property of being directionally dependent, as opposed to isotropic uniformity.

Context: Anisotropies in the CMB and other cosmic phenomena are discussed in terms of their potential origins in plasma dynamics.

Relevance: Identifying anisotropies helps refine the models presented in this paper by highlighting deviations from uniformity.

2. Anthropic Principle

Definition: The philosophical concept that the universe's fundamental constants are fine-tuned to allow for the existence of life.

Context: This principle is discussed in the context of refractive index [35] variations and cosmic evolution.

Relevance: The anthropic principle provides a philosophical perspective on cosmological models.

3. Big Bang Hypothesis

Definition: The prevailing cosmological model that describes the universe as expanding from a hot, dense initial state.

Context: This paper challenges the Big Bang hypothesis by proposing plasma and refractive index [35]-based alternatives.

Relevance: Rethinking the Big Bang model has implications for understanding cosmic origins.

4. Birkeland Currents

Definition: Large-scale electric currents flowing along magnetic field lines in plasma, named after Norwegian scientist Kristian Birkeland.

Context: Birkeland currents [4] are used in this paper to explain galaxy formation and electromagnetic contributions to spacetime curvature.

Relevance: These currents offer an alternative explanation to gravitational-only models for cosmic structures and dynamics.

5. Cosmic Expansion

Definition: The theory that the universe is expanding, as evidenced by the redshift of light from distant galaxies.

Context: This paper challenges the expansion paradigm by proposing refractive index [35] variations as an alternative explanation for redshift.

Relevance: Reassessing cosmic expansion impacts our understanding of the universe's age, structure, and ultimate fate.

6. Cosmic Microwave Background [6] (CMB)

Definition: A faint radiation detected throughout the universe, believed to be a remnant of the Big Bang.

Context: The paper examines alternative explanations for the CMB's origin, linking it to plasma processes rather than a primordial explosion.

Relevance: The CMB serves as critical evidence in cosmological models, and its reinterpretation impacts theories of the universe's age and structure.

7. Cosmic Web

Definition: The large-scale structure of the universe, consisting of galaxies, filaments, and voids interconnected by dark matter [10] and baryonic matter.

Context: This paper considers the role of plasma filaments in shaping the cosmic web.

Relevance: Understanding the cosmic web provides context for large-scale cosmological models.

8. Cosmological Constant (Λ)

Definition: A term introduced by Einstein to represent a constant energy density filling space, later associated with dark energy.

Context: This paper reexamines Λ in the context of plasma and electromagnetic contributions to spacetime curvature.

Relevance: Understanding Λ is essential for reconciling observations with general relativity.

9. Dark Energy

Definition: A theoretical force believed to drive the accelerated expansion of the universe.

Context: The paper questions the need for dark energy by introducing plasma-based mechanisms to explain observed cosmic dynamics.

Relevance: Understanding dark energy is critical for addressing discrepancies in current cosmological models.

10. Dark Matter

Definition: A hypothetical form of matter that does not emit, absorb, or reflect light, making it invisible, but is inferred from gravitational effects on visible matter.

Context: This paper explores whether plasma dynamics and electromagnetic fields could account for phenomena attributed to dark matter [10].

Relevance: Dark matter is a cornerstone of modern cosmology, and reevaluating its necessity impacts theories about the universe's structure.

11. Electromagnetic Spectrum

Definition: The range of all types of electromagnetic radiation, from radio waves to gamma rays.

Context: This paper discusses how the refractive index [35] affects the propagation of electromagnetic waves across intergalactic space.

Relevance: The electromagnetic spectrum underpins observational astronomy and is crucial for interpreting redshift and refractive index [35] variations.

12. Einstein-Maxwell Equations

Definition: A set of equations combining Einstein's field equations of general relativity with Maxwell's equations of electromagnetism.

Context: This paper extends Einstein-Maxwell equations to include plasma dynamics and their contributions to the stress-energy tensor.

Relevance: Integrating these equations provides a unified framework for understanding the interplay between electromagnetic fields and spacetime curvature.

13. Einstein's Field Equations

Definition: A set of ten interrelated differential equations in general relativity that describe how matter and energy influence the curvature of spacetime.

Context: The paper modifies Einstein's equations to include the contributions of plasma fields and refractive index [35] variations.

Relevance: These equations form the foundation of modern gravitational theory and are pivotal to the paper's hybrid cosmological framework.

14. Energy Density

Definition: The amount of energy stored per unit volume in a physical system, such as a magnetic field or plasma.

Context: The paper calculates energy density in plasma filaments to evaluate their contribution to the curvature of spacetime.

Relevance: Understanding energy density is essential for incorporating plasma effects into Einstein's field equations.

15. Energy-Momentum Tensor (T_{mn})

Definition: A tensor in general relativity that represents the density and flux of energy and momentum in spacetime.

Context: This paper extends the energy-momentum tensor to include contributions from electromagnetic fields in plasma.

Relevance: Modifying the tensor alters the predictions of Einstein's field equations, challenging conventional interpretations of cosmic phenomena.

16. Gravitational Constant (G)

Definition: A fundamental constant in physics (6.674×10^{-11} N·m²/kg²) that quantifies the strength of gravity.

Context: The gravitational constant appears in Einstein's equations and is used in conjunction with refractive index [35] calculations in this paper.

Relevance: It is a foundational parameter for describing gravitational interactions on cosmic scales.

17. Gravitational Lensing

Definition: The bending of light around massive objects due to spacetime curvature, predicted by general relativity.

Context: This paper examines how refractive index [35] variations influence gravitational lensing [17] effects.

Relevance: Gravitational lensing is a key observational tool for studying dark matter [10], galaxy formation, and cosmic distances.

18. Hannes Alfvén

Definition: A Swedish physicist and Nobel laureate who pioneered the field of plasma physics.

Context: The paper references Alfvén's work on magnetohydrodynamics and plasma interactions.

Relevance: Alfvén's theories underpin much of the plasma-based cosmology discussed in this paper.

19. Hubble Deep Field

Definition: A long-exposure image taken by the Hubble Space Telescope, revealing thousands of distant galaxies.

Context: The paper uses data from the Hubble Deep Field to analyze galaxy-specific refractive index [35] values.

Relevance: This dataset provides a rich source of information for cosmological studies.

20. Hubble Flow

Definition: The movement of galaxies due to the overall expansion of the universe, as described by the Hubble law.

Context: The paper reevaluates Hubble flow by considering refractive index [35] and non-expansion models.

Relevance: Understanding Hubble flow is vital for interpreting large-scale cosmic motion.

21. Intrinsic Redshift

Definition: A redshift that arises from a property of the object itself, rather than the Doppler effect or cosmological expansion.

Context: This paper considers intrinsic redshift as a key factor in galaxy-specific refractive index [35] variations.

Relevance: Intrinsic redshift challenges conventional interpretations of distance and velocity in cosmological observations.

22. Isotropy

Definition: The property of being uniform in all directions.

Context: The isotropy of the CMB is a key feature discussed in the paper, with alternative explanations involving plasma and electromagnetic processes.

Relevance: Challenging the assumption of isotropy impacts the interpretation of the universe's structure and origins.

23. Lorentz Force

Definition: The force experienced by a charged particle moving through electric and magnetic fields, expressed as $F = q(E + v \times B)$.

Context: The Lorentz force is used in this paper to describe how plasma currents influence galactic rotation and structure.

Relevance: This force underpins the electromagnetic interactions discussed in the plasma-driven cosmological model.

24. Magnetohydrodynamics (MHD)

Definition: The study of the dynamics of electrically conducting fluids, such as plasmas, in the presence of magnetic fields.

Context: The paper uses MHD principles to model galaxy dynamics and plasma interactions.

Relevance: MHD is fundamental to understanding the behavior of astrophysical plasmas.

25. Magnetic Field Strength (B)

Definition: A measure of the magnetic force in a region, typically expressed in Tesla (T).

Context: The strength of magnetic fields in plasma currents is critical to determining their impact on galactic dynamics and spacetime curvature.

Relevance: Magnetic field strength contributes to the equations and simulations presented in this paper, linking plasma dynamics with observable phenomena.

26. Metric Tensor (g_{mn})

Definition: A mathematical object in general relativity that describes the curvature of spacetime.

Context: The paper modifies the metric tensor to include electromagnetic effects from plasma fields.

Relevance: The metric tensor is central to understanding how energy and mass influence spacetime.

27. Permeability of Free Space (μ_0)

Definition: A physical constant ($4\pi \times 10^{-7}$ N/A²) that characterizes the ability of a vacuum to support magnetic fields.

Context: μ_0 is used in the paper's equations for calculating energy densities in magnetic fields associated with plasma filaments.

Relevance: It is essential for quantifying the role of electromagnetic fields in cosmic structures.

28. Photon

Definition: A quantum of electromagnetic radiation, representing the basic unit of light.

Context: Photons are the primary particles affected by refractive index [35] variations and plasma interactions as they traverse space.

Relevance: Their behavior underlies the calculations and models presented in the paper, including redshift and refractive index [35] adjustments.

29. Photon-Particle Interaction

Definition: The interaction between photons and particles in intergalactic space, affecting light propagation and redshift.

Context: This phenomenon is modeled as a factor influencing the refractive index [35] in this paper.

Relevance: Photon-particle interactions help explain variations in light speed across different cosmic regions.

30. Plasma Cosmology

Definition: A theoretical framework that emphasizes the role of plasma and electromagnetic forces in shaping cosmic structures.

Context: This paper incorporates plasma cosmology [30] principles to explain galactic dynamics and spacetime curvature without invoking dark matter [10] or dark energy.

Relevance: Plasma cosmology offers alternative explanations for many phenomena traditionally attributed to gravitational forces alone.

31. Plasma Filaments

Definition: Thread-like structures of plasma that often form along magnetic field lines and carry electric currents.

Context: Plasma filaments are modeled in the paper as key drivers of galaxy rotation and structure.

Relevance: Understanding these filaments helps explain phenomena traditionally attributed to dark matter [10].

32. Plasma Instabilities

Definition: Disturbances in plasma that lead to irregularities in its motion or structure, such as filamentation or turbulence.

Context: The paper considers these instabilities as drivers of large-scale cosmic structures.

Relevance: Understanding plasma instabilities aids in modeling galaxy formation and evolution.

33. Planck Length

Definition: The smallest measurable length in the universe, approximately 1.616×10^{-35} meters.

Context: The paper explores how fundamental constants like the Planck length relate to cosmic phenomena.

Relevance: Understanding the Planck length helps connect quantum mechanics with cosmology.

34. Planck Scale

Definition: The scale at which quantum gravitational effects become significant, characterized by extremely small length (Planck length) and high energy.

Context: While not explicitly calculated in this paper, the Planck scale represents the theoretical limits of current physical models.

Relevance: Understanding the Planck scale provides a conceptual boundary for the interplay of gravity, plasma, and electromagnetic forces.

35. Refractive Index

Definition: A dimensionless number that describes how light propagates through a medium.

Context: Used in this paper to explain variations in light speed in galactic and intergalactic space.

Relevance: Refractive index variations impact the calculation of cosmic distances and the interpretation of redshift.

36. Refractive Index Factor

Definition: A dimensionless number that represents the combined effects of various factors (e.g., particle density, gravitational lensing [17]) on the refractive index [35].

Context: This paper defines specific refractive index [35] factors for intergalactic and galactic regions.

Relevance: These factors provide a framework for reconciling observational discrepancies in the Hubble constant [5].

37. Redshift

Definition: The shift of light toward longer wavelengths (the red end of the spectrum) as it moves away from an observer.

Context: In this paper, redshift is analyzed in terms of refractive index [35] variations, challenging its traditional interpretation as evidence for an expanding universe.

Relevance: Redshift is central to cosmological measurements, including the calculation of distances and the interpretation of the Hubble constant [5].

38. Redshift Bias

Definition: A systematic deviation in redshift measurements caused by environmental factors or observational techniques.

Context: This paper explores how intrinsic galactic properties and intergalactic conditions influence redshift bias, challenging traditional interpretations.

Relevance: Understanding redshift bias is essential for accurately determining cosmological parameters and resolving the Hubble tension.

39. Singularity

Definition: A point in spacetime where density becomes infinite, such as at the center of a black hole or the start of the Big Bang.

Context: The paper challenges the inevitability of singularities by introducing alternative models for spacetime curvature influenced by plasma and refractive index [35].

Relevance: Understanding singularities is crucial for exploring the universe's origin and ultimate fate.

40. Spacetime Curvature

Definition: The warping of spacetime caused by mass, energy, or pressure, as described in general relativity.

Context: This paper investigates how plasma fields and refractive index [35] variations affect spacetime curvature.

Relevance: Understanding spacetime curvature is critical for modeling gravitational lensing [17], galaxy dynamics, and cosmic expansion.

41. Speed of Light (c)

Definition: The maximum speed at which all energy, matter, and information in the universe can travel in a vacuum, approximately 299,792 kilometers per second.

Context: The paper recalculates the speed of light as it is reduced by the refractive index [35] of space.

Relevance: Adjusting c has profound implications for Einstein's field equations and the derived age of the universe.

42. Star Formation Rate (SFR)

Definition: The rate at which a galaxy forms new stars, usually measured in solar masses per year.

Context: This paper considers SFR as a factor in the refractive index [35], particularly in regions with active star formation.

Relevance: SFR affects the energy output of galaxies, influencing their redshift and observed Hubble constant [5].

43. Stress-Energy Tensor

Definition: A mathematical object in general relativity that encapsulates the density, flux, and stresses of energy and momentum in spacetime.

Context: This paper extends the stress-energy tensor to include contributions from plasma fields and electromagnetic forces.

Relevance: Modifying the tensor allows for a more comprehensive understanding of gravitational and electromagnetic interactions.

44. Synchrotron Radiation

Definition: Electromagnetic radiation emitted when charged particles accelerate in curved magnetic fields.

Context: This paper suggests that synchrotron radiation from plasma filaments may contribute to observed cosmic phenomena like the CMB.

Relevance: Synchrotron radiation offers alternative interpretations for observed emissions, challenging Big Bang-based explanations.

45. Tired Light Theory

Definition: A hypothesis that suggests light loses energy as it travels through space, causing a redshift without requiring an expanding universe.

Context: The paper examines this theory as an alternative explanation for observed redshift patterns.

Relevance: Tired light theory provides a non-expansion-based mechanism for interpreting cosmic redshift.

46. Vacuum Permeability (μ_0)

Definition: A physical constant that describes the ability of the vacuum to support magnetic fields, approximately $4\pi \times 10^{-7}$ N/A^2.

Context: This constant appears in calculations of magnetic energy density in the context of plasma filaments.

Relevance: Accurate values of μ_0 are critical for modeling electromagnetic interactions in plasma-dominated environments.

47. Zwicky's Tired Light Theory

Definition: A hypothesis that redshift is caused by light losing energy as it travels through space, rather than by cosmic expansion.

Context: This paper incorporates Zwicky's theory to support alternative interpretations of redshift and the Hubble constant [5].

Relevance: Revisiting tired light theory [45] offers a pathway to resolving discrepancies in modern cosmological data.

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