The Hubble constant as a measurement of entropy.

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Abstract

In our last paper [14], we established topological definitions for astrophysical spin, DM and DE using Einstein's field equations. We demonstrated the necessity for a scale-invariant definition for the cosmological constant, and the Hubble constant. Using the topological limits of completeness developed by Bill Thurston on a 3-sphere [8], we established equivalencies between our value for the Hubble constant and the basic building blocks for the standard model of physics at quantum and relative scales [12, 13, 14]. In this paper, we extend our discussion, of a scale-invariant Hubble constant, by creating equivalencies at both macro and micro scales using nothing but the established relationships between the fundamental constants. We introduce an equivalency between the cosmological constant, the Hubble constant and the Boltzmann value for the entropy of the Universe. We discuss how a topological, and scale invariant, definition of the Hubble constant can be used to establish the entropy value for the universe and may explain the redshift for all observations that are currently interpreted as accelerated due to "Dark Energy".

Introduction

Since the discovery that all objects in the universe are moving away from each other, at an accelerated redshift, the "Dark Energy" paradigm has established a firm grip on astrophysical theory and measurement. Currently, DE has no clear definition despite decades of theoretical activity. In this discussion, we will return to establishment of DE, in the late 1990's, and discuss the discovery of the acceleration of Universe. We then demonstrate a topological equivalency between redshifted measurements of acceleration and entropy, as defined by the Boltzmann equation. In (Section 1.0), we quickly review some of the topological equivalencies we established using Einstein's field equations. We discuss the scale-invariant nature of the Hubble constant and demonstrate macro and micro-state equivalencies to a topological definition. (Section 1.1) discusses the Boltzmann equation for entropy. We demonstrate how relative macro boundaries limit the actions of quantum micro-states and establish an equivalency between redshift, entropy and measurements of the Hubble constant. In (Section 1.2), we review the history of measurements of the Hubble constant and demonstrate the advantage of a scale-invariant and log-natural Hubble constant to resolve the current "tension" between current measurements. In our concluding remarks, we simply compare the concept of "Dark Energy" to a scale-invariant, topological, Hubble constant driven by an equivalency to Boltzmann's equation for entropy.

1.0 A topological value for the Hubble, and Cosmological, constants.

In our last paper [14], we established equivalencies to astrophysical spin, DM and DE using a topological definition of the Hubble constant and Ricci flow in Einstein's field equations. We demonstrated topological equivalencies to many of the fundamental building blocks of the standard model of Physics, at relative and quantum scales, allowing us to make to following statement:

$$H_0 = \Lambda = \frac{2\pi i^2}{c^2} = \frac{GM}{c^2} = \frac{|\psi(x,t) = \hat{H}|\psi}{c^2}$$

Our topological equivalencies, from Schwarzschild to Schrodinger, are based on the concept of geometric completeness, established by Bill Thurston [8][10]. Limits for Geometric completeness establish the real boundaries for measurements at quantum and relative scales. Because all Lorentz-invariant measurements share a common limit of the speed-of-light, they are complete in the Hyperbolic plane of GR. Quantum measurements are only bound to a statistical definition, of geometric completeness, in the Euclidean plane [8,12]:

$$\frac{2\pi i^2}{c^2} = \frac{topological\ boundaries\ in\ the\ Euclidean\ plane}{measurements\ limited\ by\ the\ speed\ of\ light} = \frac{completeness\ in\ the\ Euclidean\ plane}{completeness\ in\ the\ hyperbolic, GR, plane}$$

In this discussion, we will add two more, rather surprising, equivalencies to our topological, and scale-invariant definition of the Hubble constant. The first will establish a baseline measurement for an equivalency to mass using the two most accurate measurements in Physics. The other, we will discuss in the next section. At the smallest of measurable scales, the ratio of the rest mass of the electron to the fine structure constant is remarkably close to our value for the Hubble, and Cosmological, constants:

$$H_0 = \Lambda = \frac{2\pi i^2}{c^2} = 69.9098 i^2$$

$$\frac{m_e}{\alpha} \approx m_e \times 137 = .510998950 \times 137 = 70.00685615$$

From the largest to the smallest of scales, a topological equivalency sets the macro and micro scales for the next part of our discussion, the Boltzmann equation for entropy and an equivalency to a scale-invariant, Hubble constant.

1.1 The Boltzmann equation for entropy and the Hubble constant.

Boltzmann's equation for the entropy of a closed system is one of the most important equations in the history of physics [1,2]. It establishes the probabilities associated with the second law of thermodynamics applied to the relationship between microstates and macro boundaries:

$$S = k \ln(W)$$

Where (S) is the entropy of the system, (k) is the Boltzmann constant and $\ln(W)$ represents the natural log of the number of possible microstates limited by macro probabilities. In this paper, it is our intention to demonstrate an equivalency between the Boltzmann value for the entropy of the universe (S), and measurements of the Hubble constant currently associated with the acceleration of the Universe. Our scale invariant value for the Hubble constant establishes both quantum and relative boundaries for all microstates limited by macro probabilities:

$$\mathrm{S} = k \ln(W) = Entropy\ of\ the\ universe\ = \frac{all\ possible\ quantum\ microstates}{relative\ macro\ probabilities} = \frac{2\pi i^2}{c^2}$$

All quantum micro-states in the universe are held to the boundary of the speed of light and Lorentz invariance. When we substitute Avogadro's number (N_A) as the value for W, the result is the Universal gas constant:

$$\mathrm{R} = k \ln(N_A) = 8.3144626\ J/Kmol$$

This brings us to our other, rather surprising, equivalence to the Hubble constant. Because the Hubble constant is a value for vectored momentum it is always a squared value. By squaring both sides of the equation, we can state:

$R^2 = [k \ln(N_A)]^2 = [8.3144626]^2 = 69.130$ J/Kmol

The value of the Universal gas constant establishes the proportionality between energy, temperature and scale. Its value in Joules allows us to equate to the work done by an accelerating mass. The second law of Thermodynamics tells us that the entropy of any closed system will increase with time and distance. Our equivalency to the Boltzmann equation allows us to treat the Hubble and Cosmological constants as log-natural measurements of entropy, *instead of acceleration*. A topological and scale invariant definition of the Hubble constant, as a measurement of entropy, resolves many of the difficulties presented by the acceleration/deceleration paradigm. The equivalency between acceleration and entropy, as defined by the Boltzmann equations, leads to a log-natural, and scale invariant definition of the Hubble constant. In our next section, we will discuss the early development of the "Dark Energy" paradigm in the late 1990's and how the equivalency between redshift and acceleration became adopted as the model for the expansion of the universe. We will discuss current measurements of the acceleration of the Universe and how a log-natural definition of the Hubble constant is clearly indicated by, *converging*, measurements.

1.2 An improbable discovery.

In the late 1990's, two teams, the High-Z Supernova Search Team and The Supernova Cosmology Project, were in a competition to decide the *deceleration* rate of the Universe. In a moment that turned cosmology on its head, both teams discovered that, instead of *decelerating*, the Universe was *accelerating* [5,7]. Because each team had made this discovery independently of the other, the results were accepted almost immediately by the astrophysical community. By the time Michael Turner, from The University of Chicago, had coined the term "Dark Energy" in 1998 [9], the association of the Hubble constant with a measurement of acceleration was complete. In the decades since that discovery, the acceleration of the Universe has become an accepted fact that has spawned an entire industry of publication surrounding the mystery of "Dark Energy" and yet, no answer has been found that can explain this measurement.

Currently, there is "tension" between different measurements of the Hubble constant. A scale-invariant and log-natural Hubble constant could explain the difference between these converging measurements. Measurements, of the Hubble constant, calibrated using the Laws of Thermodynamics, at both micro and macro scales, are logarithmic to our topological value. This can be demonstrated using the measurements of TRGB and JAGB stars done by the Chicago Carnagie Hubble Program (CCHP), [4]. The CCHP team uses measurements of TRGB and JAGB stars to establish a calibration for Type1a Supernova. Their measurements use thermodynamic micro-states, Helium flash and Carbon burning, bounded by the macro boundary of gravity [4]. Because SN1a Supernova distance measurements are calibrated using the Laws of Thermodynamics, The CCHP team's measurement, of the Hubble constant, is logarithmically closest to the topographic value we have established using the Boltzmann equations at the smallest scales:

$$H_0 = 70.039 \ \pm 1.22\ (stat) \pm 1.33\ (sys)\ Freedman, Madore\ (2024)$$

$$\frac{m_e}{\alpha} \approx m_e \times 137 = .510998950 \times 137 = 70.00685615$$

The most accurate temperature measurements of the Hubble constant are offered by the Planck Collaboration measurement of micro-temperature fluctuations in the Cosmic Microwave Background. The Planck Collaboration estimates of the Hubble constant [6], are an exact match to our scale invariant value when they are scaled to the (EE+low E) power spectra:

$H_0(EE + lowE) = 69.9 \pm 2.7$ $Planck\ Collaboration$ (2018)

Theoretically, we can equate our scale-invariant Hubble constant to Planck definitions of the matter density of the Universe, by equating to the Ricci metric scalar. If you recall, from our last paper, we used the inverse of the Hubble constant to represent the actions of the Ricci scalar, and the Hubble constant was used as the Cosmological constant:

$$g_{\mu v} = Einstein\ metric\ tensor = \frac{c^2}{2\pi i^2} = \frac{1}{\Lambda} i^2 = .143061 i^2$$

$$\Omega_m h^2 = Matter\ density\ of\ the\ Universe\ accelerated\ by\ the\ Planck\ constant\ = 0.14314\ (Planck\ 2018)$$

$$H_0 = \frac{1}{\Omega_m h^2} = \frac{1}{g_{\mu v}} = \Lambda = \frac{2\pi i^2}{c^2} = \frac{GM}{c^2} = \frac{\left|\psi(x,t) = \hat{H}\right|\psi}{c^2} = \frac{m_e}{\alpha} = R^2 = k \ln(W) = S$$

This statement reflects the basic relationship between the Hubble constant, the Cosmological constant and the entropy of the Universe, *at all scales of Lorentz invariance*. When we add it to our list, of topological equivalencies, the argument for a scale invariant, and Log-natural, Hubble constant becomes very compelling.

1.3 A simple question

In our last two papers, we have equated a topological, and scale invariant, definition of the Hubble constant to Einstein's field equations and the Boltzmann equation for entropy. We now ask the simple question: What is more probable; redshift caused by an imaginary force that we know nothing about, is unmeasurable, and is accelerating all the matter in the Universe, or an overall redshift established by topological equivalencies to Einstein's field equations and the Boltzmann equation for entropy using a scale invariant, and Log-natural, measurement of the Hubble constant?

References:

(Note from author: references are listed alphabetically except for me. I don't belong in any other way but last on this list)

(1) ***Boltzmann, L***. *"Über die Mechanische Bedeutung des Zweiten Hauptsatzes der Wärmetheorie". Wiener Berichte.* ***53****: 195–220 (1866).*

(2) ***Boltzmann, L*** *Vorlesungen über Gastheorie, vol. I. J.A. Barth, Leipzig:; Ludwig Boltzmann (1898). Vorlesungen über Gastheorie, J.A. Barth, Leipzig. (1896).*

(3) ***Einstein, Albert*** *"Relativity –The special and the General Theory " Random House, 15th edition (1961) Translation by Robert W. Lawson*

[4] ***Freedman, Madore "****Status Report on the Chicago-Carnegie Hubble Program (CCHP): Three Independent Astrophysical Determinations of the Hubble Constant Using the James Webb Space Telescope" arXiv: 2408.06153v1 [astro-ph. CO] 12 Aug 2024*

(5) ***Perlmutter, S. et al.****, " Measurements of Ω and Λ from 42 High-Redshift Supernovae"Astrophys. J.* **517**, 565 (1999

[6] ***The Planck Collaboration*** *"Planck 2018 results. VI. Cosmological parameters " arXiv: 1807.06209v4 [astro-ph.CO] 9 Aug 2021*

(7) ***Riess , A. et al.****, " OBSERVATIONAL EVIDENCE FROM SUPERNOVAE FOR AN ACCELERATING UNIVERSE AND A COSMOLOGICAL CONSTANT" Astronom. J.* **116**, 1009 (1998)

(8) ***Thurston, William*** *"The geometry and topology of three-manifolds" American Mathematical Society (2022). Our use of Bill Thurston's images has been for distribution to the scientific community. All other uses are protected by the AMS copyrights and prohibited.*

(9) ***Turner, M****." Dark Matter and Dark Energy in the Universe" (1998),* https://arxiv.org/abs/astro-ph/9811454

[10] ***Blackwood, CJ*** *"The Geometric Theorem of Completeness." Mtdi.org (Feb, 2021)*

[11] ***Blackwood, CJ*** *"Measuring the Universe Pt. I- Dark Matter, Dark Energy, and The Big Flip." Mtdi.org (Jun, 2022)*

[12] ***Blackwood, CJ*** *"Measuring the Universe Pt. II-Establishing the Topological Boundaries for Gravity, Dark Energy and Dark Matter in the early universe." Mtdi.org (Dec, 2023)*

[13] ***Blackwood, CJ*** *"Galaxies as probabilities"." Mtdi.org (Dec, 2024)*

[14] ***Blackwood, CJ*** *"Establishing topological definitions for astrophysical spin, DM and DE, using Einstein's field equations." Mtdi.org (Oct, 2025)*