Dark Matter only Exists because of Cosmic Dust

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Based on the Planck law of quantum mechanics, cosmic dust including neutral hydrogen atoms cannot conserve galaxy light by temperature fluctuations because their size requires heat capacities to vanish. With cosmic dust, conservation therefore proceeds by the re-emission of galaxy light redshifted beyond the Hubble redshift thereby overstating velocities to the extent that to hold galaxy clusters together dark matter is thought to exist. But if measured redshift is corrected for cosmic dust, dark matter need not exist as the galaxy clusters are held together by Newtonian mechanics. Because of the ubiquity of cosmic dust, all astronomical velocity measurements based on Hubble redshift are most likely overstated, e.g., the long-standing galaxy rotation problem may be resolved without the need for dark matter if the redshift measurements giving the higher than expected galaxy velocities are corrected for the redshift in cosmic dust. Moreover, an accelerating Universe expansion need not exist if the redshift showing supernovae brighter than expected is corrected for the redshift in the intervening cosmic dust. With regard to neutral hydrogen atoms, conservation of galaxy light thought to proceed by the thermal emission of the 21 cm hydrogen line is problematic as temperature fluctuations in hydrogen atoms are forbidden by quantum mechanics. Extensions of cosmic dust redshift corrections to historical astronomical observations are briefly discussed.

1. INTRODUCTION

Dark matter has a long history. In 1927, the Dutch astronomer Oort [1] applied Newton's laws to the motion of galaxies and showed the Milky Way rotated faster than expected suggesting dark matter was present to explain the flat rotation curves observed. In 1933, Zwicky found [2] the velocity dispersion of the Coma cluster of galaxies to be such that to keep the system together, the average mass density in the Coma system would have to be much higher than that deduced from observed visible matter. Similar to Hubble, early velocity measurements of galaxies were based on redshift [3] of optical emission wavelengths that continue to this day.

Since 1950, the computation of rotation curves became vogue after the radio astronomy discovery [4] of the 21 cm line of neutral hydrogen atoms. Unlike optical redshifts based on emission wavelengths, radio redshifts are determined from the frequencies of thermal emission.

In the 1970's, rotation curves based on both optical and radio redshifts were resolved [5] for the M31 spiral galaxy by assuming the presence of invisible mass thereby marking the beginning of the modern search for dark matter. Since then, a specific feature of these curves emerged: galaxy rotation curves tended to be flat instead of decreasing with radius consistent with Newtonian mechanics thereby suggesting a large amount of invisible dark matter pervaded the Universe.

Today, scientists generally agree that dark matter is invisible having about 5-times the mass of ordinary matter, but what it is and how it was formed has remained a mystery. Many dark matter dark matter theories are proposed. Until recently, dark-matter theory [6] rested on WIMPs thought created in the Big Bang. WIMP stands for Weakly Interacting Massive Particle. In LUX, the search for the WIMP was conducted in a large vessel containing liquid xenon. LUX stands for Large Underground Xenon collaboration. But LUX researchers recently reported [7] no evidence of WIMPS suggesting dark matter may not exist. The search for dark matter continues.

2. PROPOSAL

Cosmic dust generally comprises NPs of silicates having diameters < 500 nm that permeate the ISM. NPs stand for nanoparticles and ISM for interstellar medium. But the ISM is also filled with neutral hydrogen atoms. Both dust NPs and neutral hydrogen atoms affect optical and radio redshift measurements from which galaxy velocities are determined. In this paper, the light-matter interactions in deriving the optical and radio redshifts follow the Planck law of QM and not classical physics. QM stands for quantum mechanics.

QM affects the interpretation of optical and radio redshifts differently from that of classical physics. Upon the absorption of a galaxy photon, QM forbids temperatures fluctuations in both dust NPs and neutral hydrogen because their quantum size requires the heat capacities of constituent atoms to vanish.

What this means is both dust NPs and neutral hydrogen are required by QM to conserve galaxy photons by non-thermal mechanisms: (1) dust NPs by the optical re-emission of redshifted galaxy photons at a wavelength corresponding to the dimensions of the NP, and (2) the hydrogen atom by optical emission of the 21 cm hydrogen line. Both (1) and (2) processes require measurement by optical telescopes. In this regard, thermal radiation measured by radio telescopes is problematic as temperature fluctuations in dust NPs and hydrogen atoms are forbidden by QM.

In retrospect, classical physics that allows the atoms in quantum sized dust NPs and neutral hydrogen to have the heat capacity to fluctuate in temperature has led astronomy to a notion of redshift supportive of an expanding Universe. Another cosmology might have evolved for redshift based on QM.

The proposal here is dark matter is not a physical property of the Universe that can be discovered by experiment and only exists because optical redshifts are not corrected for cosmic dust. Radio redshifts of the 21 cm hydrogen line are simply problematic .

3. THEORY AND ANALYSIS

3.1. Optical Redshift

3.1.1. Background

Light from a galaxy at wavelength λ may be optically redshift by the increment $\Delta\lambda_V$ by the recession velocity V of the galaxy. However, a further wavelength increment $\Delta\lambda_D$ occurs [8] as the galaxy light is absorbed in the cosmic dust D surrounding the galaxy. Hence, the redshift Z_{meas} of the galaxy emission at wavelength λ measured on Earth is,

$$Z_{meas} = \frac{\Delta\lambda}{\lambda} = \frac{(\Delta\lambda_V + \Delta\lambda_D)}{\lambda} \quad (1)$$

In terms of the Hubble or recession redshift $Z_V = \Delta\lambda_V/\lambda$ and cosmic dust $Z_D = \Delta\lambda_D/\lambda$,

$$Z_{meas} = Z_V + Z_D \quad (2)$$

Unlike reddening where shorter wavelengths are not increased by scattering, cosmic dust redshift Z_D corresponds to a physical increase $\Delta\lambda_D$ in the wavelength of galaxy light. Therefore, the galaxy velocity V is computed by correcting for the redshift Z_D of cosmic dust,

$$\frac{V}{c} = \frac{[(Z_V + 1)^2 - 1]}{[(Z_V + 1)^2 + 1]} \quad (3)$$

where, $Z_V = Z_{meas} - Z_D$ and c is the velocity of light.

Today, the absorption of galaxy light by cosmic dust NPs is thought [9] to increase the dust temperature. Moreover, subsequent thermal emission from cosmic dust is thought [10] to create the observed IR spectra.

The conversion of galaxy light to a temperature increase in dust NPs assumes heat transfer is governed by classical physics where the constituent dust atoms have heat capacity. To date, the assumption of classical physics for dust NPs has not only misdirected IR spectra, but also cosmology by supporting an expanding Universe which by QM is problematic because of cosmic dust..

3.1.2. Heat Capacity

By the QM Planck law, the NP heat capacity [11] of constituent atoms at temperatures of 300 and 2.7 K depends on the EM confinement wavelength λ as illustrated in Figure 1.

Classical physics (noted by dotted lines) allows NP atoms irrespective of EM confinement to always have kT heat capacity. QM differs by only allowing kT heat capacity at 300 and 2.7 K for λ > 100 and 3000 microns, while otherwise requiring kT heat capacity to decrease and vanish at λ < 1 micron.

In the ISM, NPs in the size range < 0.5 microns [12] therefore have vanishing heat capacity thereby precluding conservation of galaxy light by fluctuations in temperature.

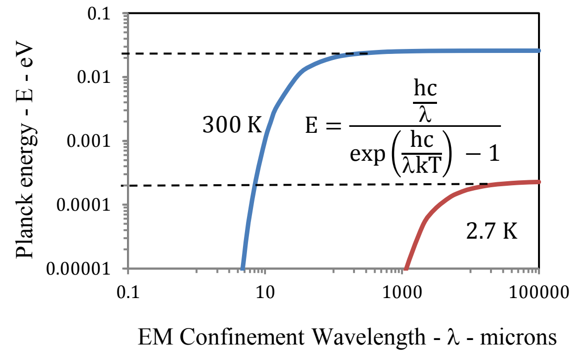

Figure 1: QM Planck law – Thermal Energy of the Atom In the inset, E is Planck energy, h Planck's constant, k Boltzmann's constant, λ EM confinement wavelength, and T absolute temperature

However, the NPs require EM confinement at submicron wavelengths to achieve vanishing QM heat capacity. But cosmic dust is not observed to have any surface structure that might be construed as EM confinement suggesting the absorption of galaxy light in submicron dust NPs is itself the source of momentary EM confinement

3.1.3. EM Confinement

Indeed, EM confinement of atoms in cosmic dust does not require any surface treatment, but is a natural consequence of the high S/V ratio of NPs. S/V stands for surface-to-volume. Upon absorption of galaxy light, almost all of the photon energy is therefore spontaneously deposited in the NP surface. What this means is the NP atoms are momentarily placed under EM confinement. Since the NPs are submicron, the EM confinement is also submicron and the heat capacity of the NP vanishes.

But the NPs in the ISM need not be submicron as the heat capacity of the atom at 2.7 K decreases about 3 orders of magnitude at λ < 1 microns, and therefore cosmic dust NPs > 1 micron also have reasonably high S/V ratios making EM confinement still valid. Regardless, size and not temperature is important as NPs > 1 micron also provide the sufficient EM confinement of constituent atoms necessary to conserve surface heat for creating non-thermal EM radiation.

3.1.4. Simple QED

The QED of light-matter interaction in NPs is usually thought to proceed by the complex relativistic theory [13] advanced by Feynman and others. However, the simple QED proposed [14] to conserve the heat from absorbed galaxy light under EM confinement is far simpler and can be readily understood. Briefly stated:

Under the QM restriction that the heat capacity of the atom under high EM confinement vanishes, simple QED conserves the heat of galaxy light absorbed in a NP surface by spontaneously creating standing EM radiation inside the NP having half wavelength λ/2 = d, where d is the NP diameter.

The Planck energy E of the standing EM radiation is,

$$E = \frac{h\left(\frac{c}{n}\right)}{\lambda} = \frac{hc}{2nd} \quad (4)$$

where, the velocity of light c is corrected for the slower speed in the solid state by the refractive index n of the NP.

Once the EM confinement formed [14] as the galaxy light deposited in the NP surface is depleted in creating the standing EM radiation, the EM confinement vanishes allowing the standing EM radiation to escape the NP and travel to Earth as cosmic dust Z_D redshifted galaxy light.

3.1.5. Cosmic Dust Redshift

Upon absorption, the EM energy of the galaxy photon is redshift by simple QED depending [14] on the properties of the NP. Redshift only occurs as the NP absorbs a single galaxy photon because the probability of successive absorptions of galaxy photons by the same NP is extremely unlikely. In single photon absorption, only redshift occurs as blueshift with EM energy exceeding that of the galaxy photon is forbidden by the conservation of energy. The cosmic dust redshift Z_D of the galaxy photon having wavelength λ is,

$$Z_D = \frac{(2nd - \lambda)}{\lambda} \quad (5)$$

The redshift Z_D for Lyman alpha (Lyα) and hydrogen alpha (Hα) photons is depicted in Figure 2.

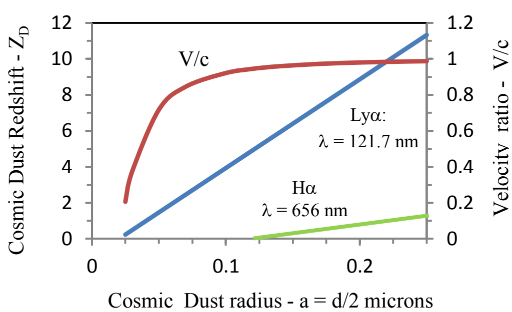

Figure 2: Cosmic Dust Redshift of Lyα and Hα lines for Amorphous Silicate n = 1.5

Of importance, the Lyα and Hα redshifts in (5) depend on the NP radius a = d/2 and refractive index n even if the emissions are from the same galaxy. Hence, the cosmic dust redshift does not follow the basic premise of Hubble redshift that the Doppler Effect is the same for both Lyα and Hα emissions from the same galaxy.

Because of this, cosmic dust was proposed [8] as the basis for correcting measured redshift Z_{meas} for cosmic dust Z_D to determine valid Hubble recession redshift Z_V.

3.1.6. Corrected Redshift

Hubble redshift by the Doppler Effect gives the same Z for ALL emission wavelengths from the galaxy. Indeed, historical data [15] supports the Hubble redshift at low Z < 0.05, but excludes the Lyα and Hα lines that give the largest difference in redshift from cosmic dust. Therefore, to assess the validity of Hubble redshift, Z_{meas} may be corrected with the difference in redshifts Z of individual Lyα and Hα lines.

$$Z = Z_{meas} - (Z_{Ly\alpha} - Z_{H\alpha}) \quad (6)$$

If $Z_{Ly\alpha} = Z_{H\alpha}$, $Z = Z_{meas}$ and the galaxy velocities given by the Doppler Effect are valid. Otherwise, cosmic dust invalidates the galaxy velocities.

3.2. Radio Redshift

3.2.1. Background

The W-F effect [16] couples the spin temperature of neutral hydrogen to the Lyα excitation of the 21 cm line of hydrogen at 1420 MHz. W-F stands for Wouthuysen-Field. Most hydrogen in the Universe is in the ground state where the electron spins are parallel with higher energy than antiparallel spins, the relative occupation of the spin levels given by the spin temperature T_s.

The W-H effect assumes neutral hydrogen by absorbing and re-emitting Lyα photons may enter either of the two spin states. Since the spin state energy difference is very small, the hydrogen can wait on average a few million years before undergoing the 21 cm emission. Even so, the large amount of hydrogen gas in the Universe suggests hydrogen atoms are always emitting 21 cm radiation to allow detection with radio telescopes.

3.2.2. Spin and Kinetic Temperatures

Radio telescopes measure the 21 cm recession velocity of hydrogen based on the thermal power P received per unit bandwidth by, $P = k\,T_k$, where T_k is the kinetic temperature. But the spin temperature T_s is only a descriptor of the electronic spin state. Only the kinetic temperature T_k is a true thermodynamic temperature. The W-F effect is thought to provide the link between the spin temperature T_s produced under Lyα absorption with the kinetic temperature T_k of the hydrogen atom. But like cosmic dust NPs, the Planck law of QM precludes thermal fluctuations of kinetic temperature T_k because the heat capacity of hydrogen atoms vanishes.

What this means is the W-F effect that couples the kinetic temperature T_k to the spin temperature T_s is forbidden by QM. The 21 cm hydrogen line emission is therefore optical and related to the spin temperature T_s but has nothing to do with the kinetic temperature T_k and thermal power P radiated from the neutral hydrogen atom.

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3.2.3. Thermal Noise

Galaxy velocities inferred from the thermal power P measured by the radio telescope that depend on the kinetic temperature T_k of the hydrogen are questionable because of thermal noise. Signal to noise ratios of radio telescope power P may be < 1 suggesting noise is being interpreted as 21 cm radiation. What this means is radio measurements of 21 cm radiation may have nothing to do with galaxy velocities, or the existence of dark matter inferred [4, 5] from the flat rotation curves of the M31 galaxy. Non-thermal 21 cm emission is suggested, but optical measurements are difficult and radio telescopes only measure the power P of thermal radiation.

3.2.4. Conclusions

QM by the Planck law questions the W-F effect in describing the excitation of the spin temperature T_s of the hydrogen atom by the kinetic temperature T_k. In fact, the 21 cm hydrogen lines can only have a non-thermal origin and cannot be measured by radio telescopes. Indeed, radio redshift measurements based on thermal power P emitted by neutral hydrogen have no physical meaning as the atom is forbidden by QM to conserve the Lyα photon by temperature because of its vanishing heat capacity.

Radio telescopes measuring the thermal power P thought emitted by the 21 cm hydrogen line are most likely measuring thermal noise. Only galaxy redshifts measured by optical telescopes and corrected for cosmic dust provide credible galaxy velocities.

4. DISCUSSION

Today, cosmology is of great interest with regard to dark matter and Universe expansion, both relying on galaxy velocities computed by the Doppler Effect. The following discussions are made based on assessments of optical redshifts. Radio redshifts are excluded.

4.1. Dark Matter

The spiral galaxy M31 is thought [5] to have a flat velocity profile from the bulge to the edge while Newtonian mechanics suggests decreasing velocity with radius. But cosmic dust redshift Z_D resolves the dilemma. The M31 spectra of galaxy light in an edge-on view gives a nearly constant redshift Z_D along the galaxy radius because the galaxy illuminates about the same amount of cosmic dust NPs along the line-of-sight between the galaxy and the Earth based observer.

If the amount of cosmic dust in front of the galaxy is negligible, the velocity profile would appear Newtonian and not flat. But this is not expected as the Doppler velocities inferred from optical redshift Z_D are expected to dwarf recession Z_V redshifts, $Z_D >> Z_D$ giving the flat velocity profile. Regardless, Newton's equations are valid if corrections in (6) are made for cosmic dust.

Prior to the WIMP search, the MOND theory [17] based on spatially dependent gravitation force – laws was considered the leading explanation of dark matter. MOND stands for Modified Newtonian Dynamics. For spiral galaxies, MOND does reproduce the galaxy rotation curves. But for elliptical galaxies, galaxy groups, galaxy clusters, and larger-scale structures, MOND does not fit observations.

Interestingly, the presence of dark matter has been inferred [18] by kinematic measurements of redshifted galaxy positions. However, if the kinematics is based on actual galaxy positions excluding redshift, dark matter is shown [19] insignificant consistent with the corrections in (6) for redshift by cosmic dust.

More exotically, there is no compelling evidence [20] that PBHs produce dark matter. PBH stands for primordial black holes. To determine the mass of a PBH, the velocity of orbiting stars again rely on redshift measurements. However, the star velocities may be only a few hundred km/s that by the Doppler Effect correspond to $Z < 0.005$. Therefore, high precision spectroscopy [21] is required to resolve the redshift wavelength $\Delta\lambda$ which may only be a fraction of a nanometer. Therefore, PBHs need critical review for cosmic dust redshift.

4.2. Accelerated Universe Expansion

Since Hubble's discovery of galaxy redshift, an expanding Universe has dominated astronomy. However, by correcting for the redshift in cosmic dust, Hubble might have allowed astronomy to proceed on the basis of Newtonian mechanics instead of Einstein's general relativity. Nevertheless, astronomy still follows Hubble's redshift in explaining how the Universe is currently undergoing an accelerated expansion.

In 2001, the most distant Type Ia SN was found [22] brighter than expected for a distance corresponding to its redshift $Z = 1.7$. SN stands for Supernovae. Later 10 more distant SN were all found brighter than expected and interpreted as being closer to us than indicated by the redshift/distance relationship. Since dust can only make SN dimmer, but never brighter, the brighter SNs were explained [23] by accelerated Universe expansion.

It is correct that cosmic dust can never make the SN brighter, but incorrect to conclude dust does not redshift SN light. From (2), the redshift/distance relationship usually assumes $Z_{meas} = Z_V$ and not $Z_{meas} = Z_V + Z_D$. If redshift Z_{meas} is not corrected for dust Z_D, the brightness B (Z_V) is greater than at B ($Z_V + Z_D$) consistent with [22] that the SN appears closer to us than expected from the distance based on the relationship with redshift.

However, if the redshift Z_{meas} is corrected for cosmic dust redshift Z_D, the brightness B ($Z_V + Z_D$) is the same as expected B (Z_V) from the redshift/distance relationship. What this means is the accelerating Universe is not physical, but rather an anomaly of redshift in cosmic dust.

5. EXTENSIONS

5.1. Sunyaev-Zel'dovitch Effect

The SZE is thought to blueshift CMB radiation upon interacting with collapsing galaxy clusters. SZE stands for Sunyaev-Zel'dovich Effect. Both measured redshift Z_{meas} and the SZE are usually thought proportional to the galaxy cluster mass M, so the SZE should be proportional to Z_{meas}. Contrarily, the SZE is found [23] to be independent of Z_{meas}. But $Z_{meas} = Z_V + Z_D$ includes cosmic dust redshift Z_D. Since $Z_D >> Z_V$, and since Z_D does not originate within the collapsing galaxy clusters, but rather in the in the line-of-sight of the galaxy cluster to the Earth, it is likely Z_{meas} does not depend on the SZE consistent with observations.

5.2. Supernovae Light Curve Decay

Studies of time dilation in SN light curves [24] showed that at low Z it takes 20 days to decay while at Z = 1 it takes 40 days. Cosmic dust redshift, Z_D is proportional to the number of dust NPs surrounding the SN that in turn is proportional to the mass M of the SN. Hence, Z_{meas} should be proportional to M, i.e., the SN at Z = 1 having larger M taking a longer time to decay than for smaller M at low Z.

But this has nothing to do with time dilation, rather the fact the NPs causing the redshift are simply cooling at a rate proportional the mass of the SN. What this means is time dilation based on redshift observed in SN light curves requires review for cosmic dust to avoid interpreting thermal cooling of SN as Universe expansion.

5.3. Tolman Test

In 1930, Tolman proposed correlating the brightness B of galaxies with redshift Z_V as a test to determine whether the Universe is expanding. But Tolman did not consider the redshift Z_D of the intervening cosmic dust. In fact, Tolman is only valid if $Z_D = 0$, i.e., $Z_{meas} = Z_V$. Since cosmic dust redshift Z_D exist even if the galaxy is not receding $Z_V = 0$, Tolman fails as there is no Universe expansion. Nevertheless, the Tolman test was interpreted [25] as the reality of Universe expansion.

Recently, the brightness B of aging SN spectra was shown [26] to drop inversely with (1 + Z). Assuming only redshift Z_D by dust alone, the brightness Bo at the observer is, Bo = hc / 2nd while at the galaxy B = hc / λ. Hence, the wavelength λ of galaxy light redshift by cosmic dust is $2nd = (1 + Z_D)\ \lambda \rightarrow Bo = hc / (1 + Z_D)\ \lambda = B / (1 + Z_D)$ and cosmic dust redshift Z_D is consistent with the drop in brightness B of the SN spectra by $(1 + Z_D)$ even though the galaxy is not receding.

5.4. Exoplanets

Planets orbiting the distant star HR8799 are thought [27] to support the theory that exoplanets surround other stars in the Universe consistent with the planets that orbit our Sun. IR spectroscopic measurements of the suspected planets in the wavelength range from 995-1769 nm showed the presence of ammonia 1450-1550 nm, acetylene 1500-1550 nm, methane greater than 1650 nm, and carbon dioxide 1560-1630 nm, all observed in the atmospheres of the planets in our solar system. Unlike the distinct IR spectra observed on Earth, however, the exoplanet spectra are broadband with superposed small features identifying the IR lines of molecular gases.

Stars like HR8799 emit high intensity UV radiation that can be absorbed in the dust of surrounding debris haloes, but there is no mechanism known to convert UV radiation, say Lyα, to near IR radiation upon absorption in the dust of debris haloes. However, UV can be redshift by cosmic dust to the near IR. From (5), methane having cosmic dust redshift Z_D wavelength 2nd > 1650 nm could be mistaken for Lyα radiation at Z > 12.6 and d > 550 nm. Broadband near IR spectra around suspected lines of exoplanet gases may be explained by variations in the diameters d of NPs in the cosmic dust debris.

5.5. Olbers Paradox

In 1823, Olbers made the paradoxical observation that the night sky is dark, but in a static infinite Universe the night sky should be bright. Indeed, Olbers paradox is often argued in supporting the Big Bang theory in an expanding finite Universe. Olbers argued in an infinite Universe the observer would see a nearby galaxy in one region of the sky and other more distant galaxies. Although the nearby galaxy would appear brighter, there would be more distant galaxies in the sky. Therefore, both the light from the nearby region and the total light from the distant region would be the same. Hence, the night sky should be bright if the Universe is infinite, but since the night sky is dark, Olbers concluded the Universe is finite.

But in a finite Universe, darkness requires absorption of starlight that by classical physics increases temperatures resulting in a bright night sky which is not observed. Hence, Olbers paradox requires the Big Bang to expand the finite Universe, the increased volume compensating for starlight heating to maintain the CMB at 2.7 K.

For cosmic dust, QM differs. In a static and infinite Universe, a bright night sky from starlight heated cosmic dust may be dismissed [14] because QM denies dust atoms the heat capacity to increase in temperature. Instead, visible galaxy starlight upon absorption in cosmic dust may only be cosmic dust redshift Z_D to the IR, the IR visually appearing to the observer on Earth as a dark night sky and not bright. Unlike cosmic dust, starlight heats macroscopic matter, but the infinite mass in the static and infinite Universe precludes any measurable temperature increase, a fact supported by the thermal stability of the CMB.

Olbers paradox is resolved. Either static and infinite or finite and expanding Universes are possible, but the Universe is more likely static and infinite because the finite and expanding Universe requires the speculative Big Bang to maintain the CMB temperature at precisely 2.7 K.

6. CONCLUSIONS

The Buchalter Cosmology Prize was conceived on the premise that there are still fundamental gaps in our understanding of cosmology and that currently-accepted paradigms such as dark matter and Universe expansion are incomplete and perhaps even incorrect descriptions of our Universe.

The instant paper is presented in the manner of the Buchalter Prize not because it is ground breaking theoretical, observational, or experimental work in cosmology, but rather based on deductions from the well-known, but the long-forgotten Planck law of QM formulated over a century ago. Nevertheless, my paper challenges current cosmology on dark matter and Universe expansion from first principles hopefully spurring the formulation of a simpler cosmology that explains current observations while advancing our understanding of QM and classical physics. By credibly refuting current cosmological theories for dark matter and Universe expansion, perhaps cosmology will return to Einstein's once upon a time static and dynamic Universe.

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