Cosmic Dust as Dark Matter

T. V. Prevenslik

Abstract Redshift in cosmic dust above that given by Hubble redshift is shown to overstate galaxy velocities giving the impression dark matter is necessary to hold the galaxies together. But if Hubble redshift is corrected for cosmic dust, there is no need for dark matter as the galaxies would be 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 data showing supernovae brighter than expected based on the redshift/distance relation is corrected for the redshift in dust. Extensions of redshift corrections for cosmic dust to other historical astronomical observations are briefly discussed.

Keywords**—**alternative theories, cosmic dust redshift, Doppler Effect, quantum mechanics, quantum electrodynamics.

I. Introduction

In 1930, the Dutch astronomer Oort applied Newton's laws to the motion of galaxies and showed the Milky Way rotated faster than expected, an outcome that became known as the galaxy rotation problem. But in 1970, the rotation problem was resolved [1] for the M31 spiral galaxy assuming the presence of invisible mass which marked the beginning of the modern search for dark matter.

Scientist generally agree that dark matter is invisible having about 5-times the mass of ordinary matter. Until recently, dark-matter theory [2] 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. However, LUX researchers recently reported [3] no evidence of WIMPS suggesting dark matter may not exist.

II. Proposal

Cosmic dust comprising NPs of silicates having diameters < 500 nm permeate [4] the ISM. NPs stand for nanoparticles and ISM for interstellar medium. The proposal here is:

Cosmic dust NPs redshift galaxy light.

Light from a galaxy at wavelength λ may be increased $\Delta\lambda_V$ by the recession velocity V of the galaxy. However, a further wavelength increase $\Delta\lambda_D$ occurs [5] as the galaxy light is absorbed in the cosmic dust D surrounding the galaxy.

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Hence, the redshift Z of the galaxy emission at wavelength λ observed on Earth is,

$$Z = \Delta\lambda/\lambda = (\Delta\lambda_V + \Delta\lambda_D)/\lambda \quad (1)$$

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

$$Z = Z_V + Z_D \quad (2)$$

Unlike reddening where shorter wavelengths are not increased by scattering, cosmic dust redshift Z_D corresponds to an increase $\Delta\lambda_D$ in wavelength of galaxy light. Therefore, the galaxy velocity V computed by the Doppler Effect requires correction 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, $Z_V = Z - Z_D$ and c is the velocity of light.

III. Theory and Analysis

Today, the absorption of galaxy light by cosmic dust NPs is thought [6] to increase the dust temperature. Moreover, the subsequent thermal emission from cosmic dust is thought [7] to create the observed IR spectra. The conversion of galaxy light to a temperature increase in dust assumes heat transfer is governed by classical physics where the dust NP atoms have heat capacity. However, QM governs the nanoscale and not classical physics. QM stands for quantum mechanics.

A. QM Heat Capacity

By the Planck law [8] of QM, the heat capacity of NP atoms depends on temperature and EM confinement as illustrated at 2.7 and 300 K in Fig. 1.

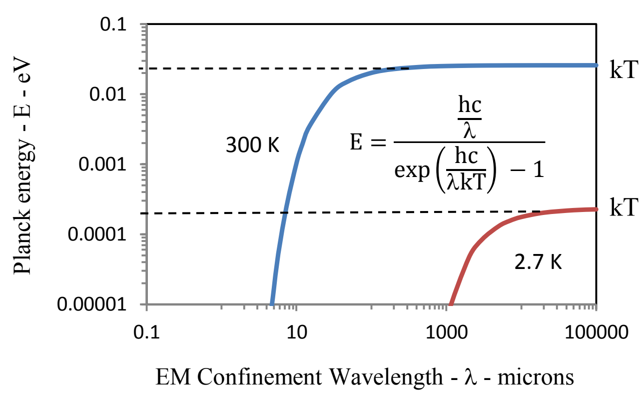

Fig. 1. QM Planck law – Thermal Energy of the Atom

In the inset, E is Planck energy, h Planck's constant, k Boltzmann's constant, λ EM confinement wavelength, and T absolute temperature.

Classical physics [9] allows the NP atoms to have heat capacity from the macro to the nanoscale, but QM requires the heat capacity to vanish at the nanoscale thereby precluding conservation of galaxy light absorbed in cosmic dust NPs by an increase in temperature. Fig. 1 shows the macroscale in classical physics (noted by dotted lines) at 300 and 2.7 K correspond to $\lambda > 20$ and 3000 microns, respectively.

However, the NPs require EM confinement at nanoscale wavelengths to achieve vanishing QM heat capacity. Fig. 1 shows at 300 K, the heat capacity is reduced about 3 orders of magnitude at EM confinement at wavelengths $\lambda < 0.1$ micron, a comparable reduction in the ISM at 2.7 K requires $\lambda < 500$ microns. But cosmic dust does not appear to have any surface structure that might be construed as EM confinement suggesting the absorption of galaxy light in nanoscopic dust is itself the source of momentary EM confinement.

B. 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 heat 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 nanoscale, the EM confinement wavelength $\lambda < 0.1$ micron is also nanoscale and the heat capacity of the NP may be said to vanish as shown in Fig. 1.

Although Fig. 1 shows the heat capacity of the atom at 2.7 K decreases about 3 orders of magnitude at $\lambda < 500$ microns, the cosmic dust particles still have reasonably high S/V ratios making EM confinement still valid for dust particles larger than NPs. Regardless, size and not temperature is important as NPs at 2.7 K like those at 300 K also provide the high EM confinement necessary to conserve surface heat by creating EM radiation inside the NP.

C. Simplified QED and Conservation of Energy

The QED of light-matter interaction in NPs is usually thought to proceed by the complex relativistic QED theory [10] advanced by Feynman and others. However, the simplified QED proposed here 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, simplified QED conserves the heat of galaxy light absorbed by a NP by creating standing EM radiation having half wavelength $\lambda/2 = d$, where d is the diameter of the NP. The Planck energy E of the standing EM radiation is

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

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 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 QED redshifted galaxy light.

D. QED Redshift

Upon absorption, the EM energy of the galaxy light is redshift by QED depending on the properties of the NP. Redshift only occurs as the NP absorbs a single galaxy photon as the probability of successive absorptions of galaxy light by the same NP is extremely remote. In single photon absorption, blueshift with EM energy exceeding that of the galaxy photon cannot occur as the conservation of energy would be violated.

The QED redshift Z_D of the galaxy photon having wavelength λ is,

$$Z_D = (2nd - \lambda)/\lambda \tag{5}$$

and shown for Lyman alpha (Lyα) and hydrogen alpha (Hα) photons in Fig. 2.

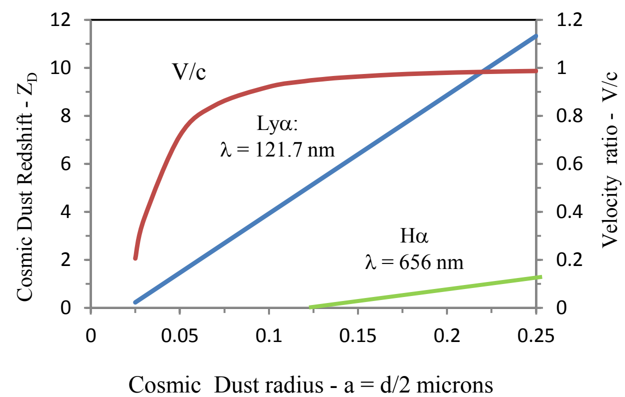

Fig. 2 Cosmic Dust Redshift of Lyα and Hα lines
Amorphous Silicate: n = 1.5

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 gslsxy. Hence, the cosmic dust redshift does not follow the basic premise of Hubble redshift that the Doppler Effect should be the same for both Lyα and Hα emissions. Because of this, cosmic dust provides the basis [5] for correcting measured redshift Z for cosmic dust Z_D to determine the Hubble or recession redshift $Z_V = Z - Z_D$.

E. Corrected Redshift

Hubble redshift by the Doppler Effect gives the same Z for ALL emission wavelengths from the galaxy. Indeed, historical data [11] 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, measured Z_{meas} may be corrected with the difference in redshifts Z of individual Lyα an Hα lines.

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

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.

IV. CONCLUSIONS

Today, cosmology is of great interest with regard to dark matter and Universe expansion, both relying on galaxy velocities computed by the Doppler Effect using the usual redshift measurements. Given that cosmic dust affects the redshift measurements, the following conclusions are made.

A. Dark Matter

The spiral galaxy M31 is thought [1] to have a flat velocity profile from the bulge to the edge while Newtonian mechanics suggests decreasing velocity with radius. By QED redshift, the rotation problem is resolved. The M31 spectra of galaxy light in an edge-on view gives nearly constant redshift along the galaxy radius because about the same amount of cosmic dust NPs are present along the line-of-sight between any radial location in the galaxy and the observer. Hence, the Doppler effect gives the observed flat velocity profile, but Newton's equations are valid if corrections in (6) are made for cosmic dust.

Prior to the WIMP search, the MOND theory [12] 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 [13] by kinematic measurements of redshifted galaxy positions. However, if the kinematics is based on actual galaxy positions excluding redshift, dark matter is shown [14] insignificant consistent with the corrections in (6) for QED redshift.

More exotically, there is still no compelling evidence [15] that PBHs provide 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 [16] is required to resolve the redshift wavelength $\Delta\lambda$ which may only be a fraction of a nanometer. Therefore, PBHs need critical review for QED redshift.

B. Accelerating 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 of an expanding Universe that today is thought [17, 18] to explain a Universe with an accelerating expansion

In 2001, the most distant Type Ia SN having a redshift of $Z = 1.7$ was found [17] brighter than expected and interpreted that it was closer to us than indicated by the redshift/distance relationship. SN stands for Supernovae. Later 10 more distant SN were all found brighter than expected. Since dust can only make SN dimmer, but never brighter, the brighter SN explained [18] 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 assumes $Z = Z_V$ and not $Z = Z_V + Z_D$. If redshift Z is not corrected for dust Z_D, the brightness $B(Z_V)$ is greater than at $B(Z_V+Z_D)$ consistent with [17] that the SN appears is closer to us than expected from the distance based on the relationship with redshift.

However, if the redshift Z is corrected for QED 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 QED redshift.

V. EXTENSIONS

A. Sunyev-Zel'dovich Effect

The SZE is thought [9] to blueshift CMB radiation upon interacting with collapsing galaxy clusters. SZE stands for Sunyaev-Zel'dovich Effect and CMB for Cosmic Microwave Background. Since Z_{meas} is thought proportional to both the SZE and galaxy mass M, the SZE should be proportional to Z_{meas}. Contrarily, the SZE is found [19] to be independent of Z_{meas}. By QED redshift, Z_{meas} does not originate within the collapsing galaxy clusters, but rather from cosmic dust NPs in the line-of-sight of the galaxy cluster to the Earth. QED redshift in cosmic dust therefore does not depend on the SZE consistent with observations.

B. SN Light Curve Decay

Studies of time dilation in SN light curves [20] showed that at low Z it takes 20 days to decay while at $Z = 1$ it takes 40 days . By QED redshift in dust, Z_{meas} is proportional to the number of NPs 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 takes a longer time to decay than for smaller M at low Z. But this has nothing to do 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.

C. Tolman Test

In 1930, Tolman proposed correlating the brightness B of galaxies with redshift Z as a test to determine whether the Universe is expanding. But Tolman did not consider [9] the redshift in the intervening cosmic dust, i.e., $Z = Z_V + Z_D$. Nevertheless, the Tolman test was interpreted [21] as the reality of Universe expansion. Recently, the brightness B of aging SN spectra was shown [19] to drop inversely with $(1 + Z)$, but is only valid assuming $Z_D = 0$, i.e., $Z = Z_V > 0$.

Indeed, QED redshift Z_D may occur even if the galaxy is not receding, i.e., $Z_V = 0$. If so, the Tolman test is meaningless as there is no Universe expansion. From (5) and assuming only QED redshift by dust alone, the brightness Bo at the observer is, $Bo = hc/2nd$ while at the galaxy $B = hc/\lambda$. Hence, the wavelength of galaxy light redshift by cosmic dust is $2nd = (1+Z_D)\lambda$ and $Bo = hc/(1 + Z_D)\lambda = B/(1 + Z_D)$. Hence, QED redshift is consistent with the observed reduction in the brightness B of the SN spectra by $(1+Z_D)$ even though the galaxy is not receding.

D. *Exoplanets and Cosmic Dust*

Planets orbiting the distant star HR8799 are thought [22] 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 QED redshift to the near IR. From (5), methane having QED redshift wavelength 2nd > 1650 nm is observed 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.

E. *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 [9] 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 because QM denies dust atoms the heat capacity to increase in temperature. Instead, visible galaxy starlight upon absorption in cosmic dust can only be QED redshift 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 experimentally 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.

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Thomas V Prevenslik is a retired American living in Hong Kong and Berlin. Because classical physics does not work at the nanoscale, he developed the theory of QED radiation based on QM. QED is a simple form of the complex light-matter interaction advanced by Feynman and others. By simplified QED, heat cannot be conserved in NPs by temperature changes because the heat capacity of the atom vanishes by QM. Instead, heat is conserved by creating standing EM radiation inside the NP. The EM confinement necessary to create the standing radiation is the consequence of the high surface-to-volume ratio of NPs that requires absorbed heat to be deposited in the NP surface – the surface heat itself providing momentary EM confinement. Once the surface heat providing the EM confinement is depleted in creating the standing EM radiation, the EM radiation is free to be emitted into the surroundings. QED radiation is applicable to a wide range of nanoscale heat transfer applications, and the instant topic of redshift of galaxy light in cosmic dust..