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COSMOLOGY AND REDSHIFT IN COSMIC DUST TO THE PROCEEDINGS OF THE CONFERENCE "COSMOLOGY ON SMALL SCALES" 2020

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Abstract: Since Hubble, optical redshift measurements giving galaxy velocities higher than observed were accepted by assuming the presence of dark matter lowered the high velocities to levels consistent with Newtonian mechanics. In this way, dark matter was thought to exist in order to explain why the Milky Way rotated faster than observed. Similarly, optical redshift measurements of the M31 spiral galaxy showed high velocities at the dusty periphery that established flat rotation curves as the signature of dark matter. Recently, the Ghost galaxy absent obscuring dust was found to have a falling rotation curve. In this paper, dust redshift is shown to be the consequence of the Planck law that precludes atoms in dust less than a certain size from having the heat capacity to allow conservation of galaxy light by a change in temperature. For galaxy photons having wavelengths greater than the size of the dust, the absorption of a single galaxy photon produces heat that is absorbed in a thin penetration depth over the full dust surface, the penetration depth serving as the physical confinement for creating a photon from the energy of an absorbed galaxy photon, the redshift galaxy photon created having half-wavelength equal to the distance opposing penetration depths. Once created, the physical boundary vanishes and the redshift galaxy photon is free to travel to the Earth. Unlike Einstein's dust-free Universe where optical measurements do indeed measure actual galaxy velocities, velocities in the dusty Universe are highly overstated in estimates of Universe expansion. CMB radiation thought related to Universe expansion as a relic of the Big Bang is shown produced by blackbody radiation from asteroids in the Oort cloud of our Solar system, the asteroids heated by solar radiation from the Sun. Cosmology based on an expanding Universe from overstated redshift by dust and the CMB as a relic of the Big Bang is highly questionable.

Keywords: cosmology, dark matter, CMB, cosmic dust, redshift

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1. Introduction

Since the 1970's, dark matter is thought to exist because redshift measurements showed higher rotational velocities at the periphery of spiral galaxies than observed and expected from the falling curves of Newtonian mechanics. Andromeda M31 [1] and other low-redshift galaxies ($z<0.001$) were therefore characterized by flat rotation curves suggesting dark matter was present to lower the redshift velocities to observed levels. Dust concentration at the galaxy periphery was not considered, the consequence of which was that flat rotation curves became the signature of the existence of dark matter.

More recently, high-redshift ($0.6<z<2.6$) galaxies in the distant Universe were found [2] to have falling rotation curves suggesting the absence of dark matter. Similarly, the recently discovered DF2 galaxy was found [3] to have a falling rotation curve suggesting the absence of dark matter. DF2 is called the Ghost galaxy because it is transparent suggesting dark matter is not present in the absence of cosmic dust.

What this means is modern Cosmology faces a dilemma as galaxy velocities inferred from optical redshift measurements appear to be overstated compared to observation depending on the presence of cosmic dust. Perhaps, dark matter would not exist if redshift measurements could be corrected for the additional redshift in dust. But Cosmology has a related dilemma. The Cosmic Microwave Background (CMB) radiation redshift is not measured, but rather assumed based on Universe expansion. Nevertheless, the CMB at 160 GHz and blackbody temperature of 2.725 K is thought to be a relic of the Big Bang expansion. The related dilemma is temperatures near 2.725 K are found nearby in the Oort cloud of our Solar system.

2. Proposal

Dark matter only exists because velocities are inferred from highly overstated redshifts of galaxy light in micron-size dust, and

CMB radiation characterized by spottiness in WMAP and PLANCK surveys showing 2.725 K temperatures is produced from asteroid-size debris in the Oort cloud of our Solar system at about 10,000 AU.

Dark matter inferred from micron-size cosmic dust and the CMB from blackbody emission of asteroid-size debris in the Oort cloud find commonality in the Planck law limiting the size dependent heat capacity of the atom

3. Cosmic Dust Redshift

3.1. Blackbody Temperature

In 1969, Purcell questioned [4] the assumption of blackbody radiation from micron size dust because micron sized objects are unable to radiate microwaves and thus cannot be black. Later, Purcell thought [5] the absorption of galaxy light in dust produced a spike in temperature during IR emission.

Since Purcell, astronomers have assumed micron sized and even nanoscale < 100 nm dust absorbs galaxy light as a blackbody radiator, the assumption continuing to this day in the explanation [6] of IR spectra in the ISM. Regardless, the question remains:

How is heat conserved in nanoscale dust?

3.2. Heat transfer at the nanoscale

Research in nanoscale heat transfer [7] has advanced over the past decades, and a large number of interesting phenomena have been reported. But despite the advances in nanotechnology, classical physics is still assumed at the nanoscale with differences with experiment treated as challenges to understanding the mechanism of thermal transport.

In this regard, researchers have not appreciated the significant difference between classical physics and the Planck law of quantum mechanics (QM) with regard to the heat capacity of the atom without which nanoscale heat transfer cannot proceed. Of importance, the Planck law denies atoms in nanostructures the heat capacity to increase in temperature upon the absorption of heat - a difficult notion to accept because of our training in classical physics. The Planck law at 300 K is shown in Fig. 1.

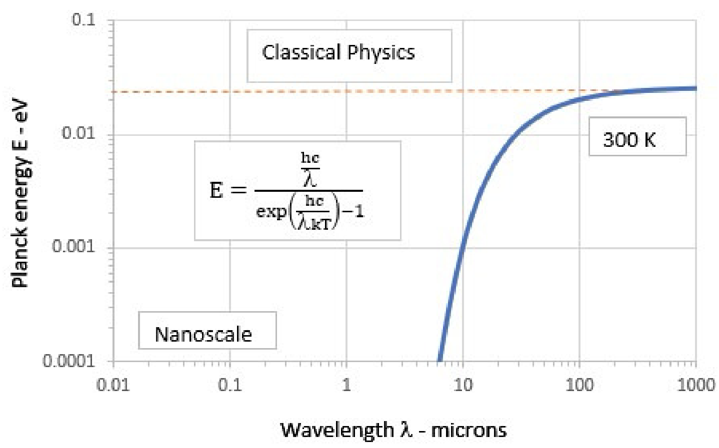

Figure 1: Planck law at 300 K: E is Planck energy, h Planck's constant, c light speed, k Boltzmann's constant, T temperature, and λ the EM confinement wavelength

In classical physics, the kT heat capacity of the atom is constant for all EM confinement wavelengths allowing temperature to exist in nanostructures evidenced by many papers in the literature.

QM differs significantly from classical physics. At 300 K, the classical kT heat capacity is restricted to $\lambda >$ 200 microns. For $\lambda <$ 200 microns, kT decreases rapidly and at the nanoscale for $\lambda <$ 0.10 microns (100 nm), the heat capacity of the atom may be said to vanish.

Heat transfer without changes in temperature preclude the Fourier law of heat conduction commonly used in nanoscale heat transfer. Similarly, the Stefan Boltzmann law for radiation heat transfer is not applicable to nanostructures. Although valid at the macroscale, the Fourier law and Stefan Boltzmann equation are invalid at the nanoscale.

Molecular Dynamics (MD) simulations [8] based on classical physics thought to provide an understanding of the atomic response to thermal disturbances assume atoms have temperature. Although MD using periodic boundary conditions (PBC) is valid for simulating the atomic response in the interior of macroscopic bodies consistent with classical physics, MD absent PBC applied to discrete nanostructures is not valid.

Researchers need both new theory and computational procedures to be developed to understand nanoscale heat transfer.

3.3. Simple QED

Simple QED is a method [9] of nanoscale heat transfer that conserves heat with EM radiation instead of temperature. QED stands for quantum electrodynamics, a complex theory based on virtual photons advanced by Feynman and others.

In contrast, simple QED is a far simpler theory based on the Planck law that requires the heat capacity of the atoms in nanostructures to vanish allowing conservation to proceed by the creation of real photons as EM waves standing across the nanostructure. Like electron quantum states with EM waves standing across electron orbits, simple QED states are size dependent based on the dimension of the nanostructure over which the EM waves stand.

The Planck energy E of the simple QED state assumes the time τ for light to travel 1 cycle across and back dimension d of the nanostructure at light speed c corrected for the refractive index n of the particle is, $\tau = 2d/(c/n)$. Hence, the Planck energy E of simple QED radiation,

$$E = h/\tau = hc/2nd$$

having wavelength λ,

$$\lambda = 2nd$$

3.4. Redshift in Cosmic dust

The redshift in cosmic dust went unnoticed for almost a century because the light-matter interaction of galaxy light was assumed to follow classical physics allowing the heat capacity of the atoms in nanoscopic dust particles to conserve the galaxy photon by an increase in temperature. By the Planck law, conservation of the galaxy photon is therefore only possible by a non-thermal mechanism proposed here to be the morphing of the EM energy of the absorbed galaxy photon into that of a redshift photon within the EM constraints in the dimension of the dust particle.

In the ISM, only the interaction of a single galaxy photon with the dust particle is assumed as multiple collisions at the same time are unlikely. However, once the redshift galaxy photon is emitted, a second galaxy photon may repeat the process and increment the redshift. The interaction of the galaxy photon creating a redshifted photon in the dust particle is illustrated in Fig. 2.

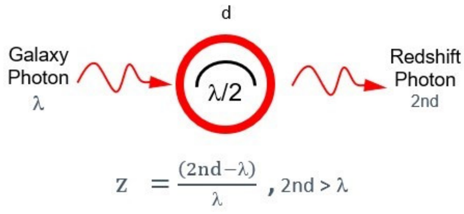

Figure 2: Redshift of Galaxy photon in Cosmic dust particle

The galaxy photon having wavelength λ is absorbed in a dust particle having diameter d and refractive index n. By simple QED, the redshift photon has wavelength $\lambda = 2$nd. For dust redshift z > 0, 2nd $> \lambda$, but if not, there is no redshift and the redshift z $= 0$. In single galaxy photon interaction, the conservation of energy precludes the creation of a blueshifted photon for 2nd $< \lambda$.

The overstated galaxy velocity V induced by dust redshift z depends on the approximate diameter d of the dust. For refractive index n $= 1.4$, the redshift z for the Lyα and Hα photons interacting with cosmic dust in terms of the dust diameter d is shown in Fig. 3.

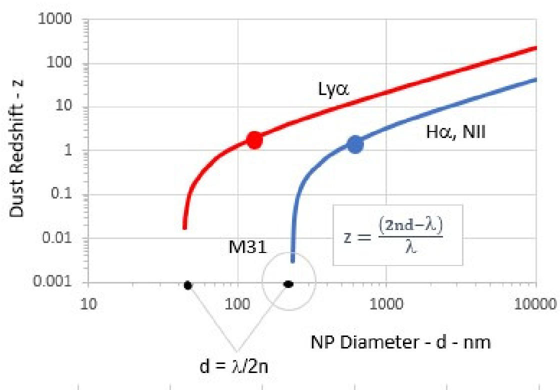

Figure 3: Redshift of Lyα and Hα photons in cosmic dust

Both Lyα and Hα show high z for large dust diameters, but this is contrary to the requirement the dust particle d $< \lambda$ allowing the galaxy photon to be absorbed in a penetration depth δ over the full surface of the dust particle. Hence, the wavelengthλ of the galaxy photon upper bounds diameter d of the dust particle. For Lyα and

Hα, the diameter is upper bound at d = 121.7 and 656 nm noted by colored dots. Similarly, the lower bound dust diameter is given by the diameter at zero redshift, d = λ/2n. For n = 1.4, the lower bound dust diameters for Lyα and Hα are 43 and 235 nm. If dust of this size absorbs the galaxy photon, the redshift z of the galaxy is overstated. The Hα line is close to the M31 nitrogen NII photon and shows the 235 nm dust produces a redshift z error in the range z < 0.01.

In order to verify the validity of galaxy velocity inferred from redshift, z measurements [10] of both Hα and Lyα, or any other 2 lines is required. If both z measurements are the same, the velocity of the galaxy is valid. But if not, the inferred galaxy velocity is not valid. The problem is only one line is usually measured.

3.5. Redshift in Andromeda M31

Since the 1970's, dark matter was thought to exist because the rotational velocities V found [1] in Andromeda M31 and other low-redshift galaxies z < 0.001 were characterized by flat rotation curves having higher peripheral velocities than expected from the falling curves given by Newtonian mechanics. Redshifts were made with the nitrogen NII line having λ = 658.3 nm gave rotational velocities of about 30 km/s, the velocities higher than expected suggesting dark matter was present to keep the galaxy from flying apart. In addition to flat rotation velocity curves, the line intensity decreased at the outer periphery. In this way, the flat rotation curve became known as the signature of the existence of dark matter.

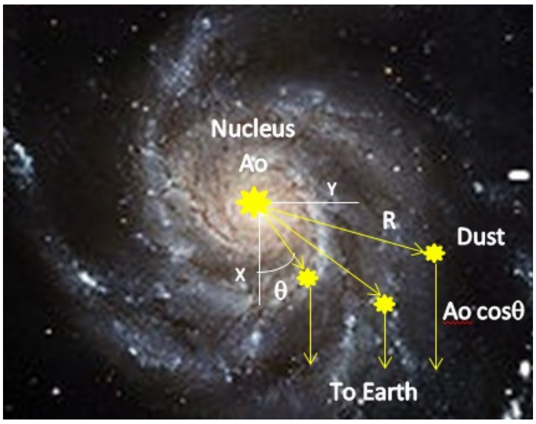

Figure 4: Cosmic dust redshifting Galaxy light to Earth

The cosmic dust particles in Fig.4 are shown located relative to the galaxy nucleus with x-axis oriented in the direction of the observer on Earth by radius R and angular position Θ coordinates. The distance y from the galaxy nucleus to the dust particles is y = R sinΘ.

Ultraviolet radiation from stars within the nucleus assumed to produce an intensity Ao of ionized NII nitrogen at λ = 658.3 nm moving spherically outward shown by arrows until absorption by a dust particle. The velocity V of the rotation curve is determined from the redshift z of NII in dust which is nearly uniform across the galaxy giving a flat rotation curve. Consistent with the M31 report [1] of decreased line intensity at the galaxy periphery, the NII line intensity decreases with distance y = R cosΘ from the nucleus and vanishes as Θ approaches 90 degrees.

3.6. Summary

Modern Cosmology faces a dilemma as galaxy velocities inferred from optical redshift measurements are overstated compared to observation suggesting dark matter only exists to reduce velocities to observed levels consistent with Newtonian mechanics. The validity of galaxy velocities requires agreement of redshift measurements of at least 2 different spectral lines.

4. CMB radiation from the Oort cloud

Although not directly related to redshift in cosmic dust, the CMB is related to the expansion of the Universe that has been supported by overstated galaxy velocities in cosmic dust. Indeed, the CMB thought to be the relic of the Big Bang expansion and located at the outer limits of the Universe may also be considered overstated as cold temperatures of 2.725 K are found in the nearby Oort cloud of our Solar system.

4.1. Solar Blackbody Radiation

The CMB evolved from models [11] of the Big Bang by Gamow beginning in 1948. Only later in 1965 did Penzias and Wilson [12] discover the microwave radiation coming from space. Dicke [13] and others came to the conclusion that the Big Bang left behind residual radiation which would still be present in the Universe as black body EM radiation with a temperature of about 10 K.

However, Universe expansion is not required as cold temperatures are a natural consequence of our Solar System. Beyond the Planetary System, the Oort Cloud at 10,000 AU is naturally cold.

In 1950, the Oort Cloud was inferred [14] by showing the orbits of different comets were permanent members of the Solar System and not random bodies. Unlike the disk-like Planetary System in the ecliptic of the Sun, the Oort cloud is spherical allowing emission of EM radiation to be uniform in all directions as observed on the Earth.

Indeed, the CMB radiation in all directions observed by Penzias and Wilson was more likely the microwave emission from debris at 10 K in the Oort cloud upon heating by the Sun. Taking Ts = 5800 K, Rs = $693\text{x}10^6$ m, and D = 10,000 AU, 1 AU = $150\text{x}10^9$ m, the temperature of the Earth and Oort cloud debris is 279 and 2.79 K as illustrated in Fig. 5.

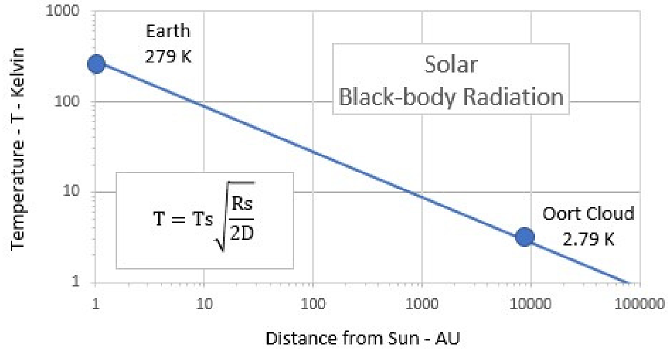

Figure 5: Blackbody temperatures of Earth and Oort Cloud: Ts and Rs are the Sun temperature and radius, D is the distance from the Sun, and AU is astronomical units

It is noteworthy, the equilibrium 2.79 K temperature of the Oort boundary depends only on the radius Rs and temperature Ts of the Sun, and the distance D to the cold spot in the Oort cloud. In blackbody radiation, the radius of the debris is of no consequence in the temperature of the debris.

4.2. Temperature Measurement

The Oort cloud having a temperature exactly at 2.79 K at 10,000 AU may appear unrealistic. Today, the CMB temperature is measured as T $= 2.725 \pm 0.00057$ K. Instrument error aside, there is a range of possible temperatures about 2.725 K as shown in Fig. 6.

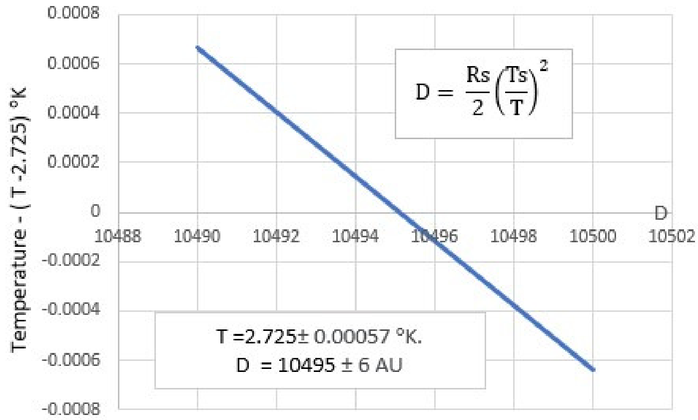

Figure 6: Blackbody temperature of Oort cloud at 2.725 K spread over 12 AU

The CMB having a peak frequency of 160 GHz with a debris temperature of 2.725 K is observed to be spread over 12 AU near 10,495 AU which is more realistic than an exact 2.725 K temperature. But the 12 AU band may be restrictive. Indeed, the 50-500 GHz spectra of the CMB suggest the full frequency range is that of the debris throughout the full Oort cloud.

4.3. Debris size by the Planck law

The Oort cloud as the source of CMB radiation requires the debris temperature 2.725 K be measured. Similar to Purcell's argument that micron-sized dust cannot radiate microwave radiation, consider the Planck law to answer the question what debris size in the Oort cloud can emit microwaves at 2.725 K. The Planck law at temperatures of 300, 100, and 2.725 K is shown in Fig. 7.

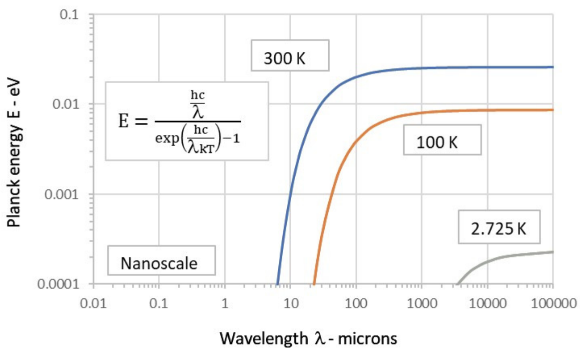

Figure 7: Planck law at Temperature 300, 100, and 2.725 K

Contrary to Purcell and others, the Planck law for all temperatures < 300 K precludes EM radiation at wavelength $\lambda < 3$ microns from having the kT heat capacity to conserve heat by a change in temperature. By simple QED, the respective particle diameter $d < \lambda/2n$d. For $n = 1.5$, $d < \lambda/3$, e.g., at 300 K, $d < 1$ micron.

In the Oort cloud at 2.725 K, the debris size descriptor is the minimum wavelength λ required for debris to be in the classical range. In Fig. 7, the classical range at 2.725 K occurs for $\lambda > 20{,}000$ microns. Hence, the debris having diameter $d > \lambda/3 = 7$ m , which includes larger asteroids, but certainly not cosmic dust. The 160 GHz microwave measurements suggest the Oort cloud has a large number of asteroids > 7 m that emit black body radiation at 2.725 K temperature. Indeed, 8 billion asteroids > 5 km are reported [15] in the Oort cloud, all of which emit blackbody radiation at 2.725 K - the Oort cloud having more asteroids than the Asteroid belt.

4.4. Summary

In 1965, Penzias and Wilson were most likely measuring the microwave emission at 10 K from asteroids in the Oort cloud at about 10,000 AU from the Sun. Any microwave emission from the CMB at the outer limits of the Universe would necessarily be dwarfed by nearby Oort cloud emission at 10,000 AU. Today, the CMB temperature is measured to be 2.725 K, but spottiness observed in WMAP and PLANCK suggest the microwaves are emitted from individual asteroids distributed over about a 12 AU radial band, but more likely from the billions of > 5 km asteroids estimated in the full Oort cloud. More study is required in the correlation of WMAP and Planck spottiness and the distribution of asteroids throughout the Oort cloud.

5. Conclusions

In the 1970's, the M31 galaxy rotational velocities of 30 km/s reported from measurements of NII ($z = 0.001$) including decreasing line intensity are not valid because of in cosmic dust. A flat velocity curve occurs because the velocity is inferred from the same redshift of the NII photon in every dust particle in the galaxy having diameter near $\lambda/2n = 235$ nm. The intensity of the NII line depends on the angular location of the dust particle in the direction of the galaxy nucleus to the Earth. At the outer galaxy periphery, the angle approaches 90 degrees and the direction of the redshifed galaxy photon is away from the Earth causing the NII line intensity to be lower than near the galaxy center.

The literature shows the CMB radiation was proposed [16] to originate in the cold temperatures in the 'Oort Soup' of debris consistent with the findings in this paper. However, a disparaging rebuke [17] of the Oort cloud as the source of CMB radiation argued blackbody radiation is required to come from something that is "optically thick" to that radiation, i.e., it should have a surface around the Sun that had somehow come into perfect thermal equilibrium at 2.7K. But then we would be unable to see the stars in the Universe. This is nonsense as there is space between the asteroids to allow light from the Universe to reach the Earth.

The validity of galaxy velocities inferred from overstated redshift in dust may be assured by requiring the same redshift measurements from 2 spectral lines.

More study is required to verify the spottiness in WMAP and PLANCK correlates with the distribution of asteroids in the Oort cloud.

References

[1] Rubin, V. and Ford, W.: Rotation of the Andromeda Nebula from a Spectroscopic Survey of Emission Regions. Astrophys. J., **159** (1970), 379.

[2] Genzel, R., et al. : Strongly Baryon-Dominated Disk Galaxies at the Peak of Galaxy Formation Ten Billion Years Ago. Nature., **543** (2017), 397–401.

[3] van Dokkum, P., et al.: A galaxy lacking dark matter. Nature., **555** (2018), 629.

[4] Purcell, E. M.: On the absorption and emission of light by interstellar grains. Astrophys. J., **158** (1969), 443–440.

[5] Purcell, E. M.: Temperature fluctuations in very small interstellar grains. Astrophys. J., **206** (1976), 685–690.

[6] Li, A. and Draine, B. T.: Infrared emission from interstellar dust. Ii. The diffuse interstellar medium. Astrophys. J., **554** (2001), 778–802.

[7] Cahill, D. G., et al.: Nanoscale thermal transport. II. Appl. Phys., **93** (2003), 793-818.

[8] Poulikakos, D., Arcidiacono, S., Muruyama S.: Molecular Dynamics simulation in nanoscale Heat Transfer: a review. Microscale Thermophysical Eng., anoscale thermal transport. II. Appl. Phys., **7** (2003), 793-818.

[9] Prevenslik, T.: Simple QED Applications., https://www.nanoqed.org. 2012-2020.

[10] Prevenslik, T. V.: Cosmic Dust and Cosmology. Publications of the Korean Astronomical Society, http://dx.doi.org/10.5303/PKAS.2015.00.0.1

[11] Gamow, G.: The Origin of Elements and the Separation of Galaxies. Phys. Rev., **74** (1948), 505-506.

[12] Penzias, A. A, and Wilson, R. W.: A Measurement of Excess Antenna Temperature at 4080 Mc/s. Astrophys. J., **142** (1948), 419-421.

[13] Dicke, R. H., Peebles, P. J. E., Roll, P. G., Wilkinson, D. T.: Cosmic Black-Body Radiation. Astrophs. J., **142** (1965), 414-419.

[14] Oort, J. H.: The structure of the cloud of comets surrounding the Solar System and a hypothesis concerning its origin. Bulletin of the Astronomical Institutes of the Netherlands, **11** (1950), 91-110.

[15] Andrew Shannon, A., Jackson, A. P., Veras. D., and Wyatt, M.: Eight billion asteroids in the Oort cloud. Mon. Not. R. Astron. Soc, **446** (2015), 2059–2064

[16] Noel D.: The Oort Soup as the real origin of Cosmic Microwave Background Radiation. http://aoi.com.au/OortSoup/index.htm

[17] Scientific evidence against CMB originating from "Oort Soup"? Stack Exchange,Astronomy https://meta.stackexchange.com/