Energy-redshift challenge to the velocity-distance interpretation of cosmological redshift

Douglas K Robinson
Solid State Dynamics Ltd

Corresponding Author: doug.robinson@btinternet.com

Abstract

An alternative interpretation of cosmological redshifts derived from the Planck energy-wavelength equation is presented, that in contrast to the velocity-distance interpretation in the 'Standard' Lambda-Cold Dark matter (Λ-CDM) model, permits credible explanations of 'anomalous' observations without recourse to indeterminate physics such as Dark Energy or Dark Matter. Beyond 'local' groups of galaxies which have what are described as 'peculiar' motions attributed to genuine Doppler shifts that includes blue as well redshifts, sources with increasing age and distance are found to comprise only of redshifted spectra. Should such cosmological redshifts be considered a consequence of a vanishingly small loss of energy that becomes evident only after millions of years in transit, less exotic and more credible alternative explanations emerge for the Hubble tension, the increasing rate of expansion, and anomalous rotation curves of galaxies.
Challenging the claim that the Cosmic Microwave Background is relic radiation of a single primordial event 13.8 billion years ago are the conclusions of a 2005 study by Ibison [4], that found the thermalization of starlight would be inevitable in a Steady-State-Cosmology.
From the alternative energy-redshift approach in a steady-state, homogenous, isotropic and stochastic Universe of indeterminate age, the ratio of the emitted energy of L*y*-*a* UV photons to the energy of sources observed at redshifts at z =11.0 according to $E(z) = E(\text{rest})/(1+z)$ = 8.3%. That such is comparable with the change in the Hubble constant H_0 early to late universe ~ 8.3%, may prove to be a model distinguishing factor in favour of a Steady State Cosmological model.

The premise for change

In 1937, Edwin Hubble presented his Rhodes Memorial lecture "The Observational Approach to Cosmology" at Oxford University England [1], and pertinent to this essay, was his assessment of the strengths and weaknesses of two radically different cosmologies that are largely dependent on how the redshifted spectra of extragalactic sources are interpreted. Although the constant named after Hubble is firmly embedded in the Λ-CDM cosmological model, it is clear from his lecture at Oxford, that he had serious reservations on the presumptions relied upon to account for what he considered was a "dubious" world,—the expanding universe of relativistic cosmology.
In expressing his concerns on the interpretation of redshifts as velocity shifts, he said; "If redshifts are not primarily velocity shifts, the picture is simple and plausible…There is no evidence of expansion, no restriction of the time scale, no spatial curvature, and no limitation of spatial dimensions." Concluding this lecture, Hubble added the following, "We seem to face, as once before in the days of Copernicus, a choice between a small finite universe, and a universe indefinitely large plus a new principle of nature."

Problematic early assumptions?

The reservations expressed by Edwin Hubble on the expanding Universe hypothesis, added to the ~5σ tension between values of the Hubble constant *Ho* early and late Universe, suggests a review of the assumptions that led to the 'Standard' Λ-CDM model is now warranted, since the acknowledged 'crisis' may well have emerged or evolved from a consensus of opinions held by members in the astrophysics community almost a century ago. Arguably one of the most significant early paradigm defining examples, concerns the observation of surprisingly high redshifts that were perceived to increase linearly with distance according to the Doppler interpretation. Since this implied untenable superluminal velocities of recession, avoiding direct conflict with the speed of light constant 'c', required an extraordinary revision of the expanding Universe theory,— The presumption that the fabric of space itself between galaxies must be expanding, which subsequently became a strongly held view by the overwhelming majority, and a characteristic feature of successive cosmological models.

Undoubtably, the vast scale of the universe imposes great difficulties in substantiating model dependent assumptions, thus until technological advances are able to resolve those unknowns, progress at best, must be considered tentative, and the consensus of opinions should be objectively biased towards a model with the highest degree of compatibility between theory and observations consistent with an absolute minimum number of presumptions and notional free parameters.

Energy conservation and entropy.

One of the main objections to what have been termed “tired light” theories in cosmology, is that energy loss regardless of how small, is contrary to the conservation of energy law, and an explanation for such energy loss has yet to survive peer review. Questionable here however, is the presumption that the conservation of energy law is valid for *all* eternity.

If one considers the statistically reliable half-lives of radioactive substances that are routinely exploited in radiometric dating to determine the age of ancient materials, and that the statistical probability of a decay event is unaffected by external conditions such as temperature, pressure, electric fields, magnetic fields, the chemical environment, solar radiation or gravity, then by Occam’s principle of parsimony, such events may indeed be considered evidence of non-conserved energy, particularly when that energy loss is evident only after millions of years in transit. Indeed one may justifiably consider the phenomenon to be one of the last stages in natures tendency towards maximum entropy, in one of the few environments that man could not realistically replicate in a laboratory on Earth, the vast vacuum of intergalactic space.

Given that the half-life of uranium-238 is about 4.5 billion years, uranium-235, 700 million years, and uranium-234, 25,000 years, if one considers that such decay events are just as statistically certain as the ticks of an extremely long period clock marking the passage of time, then the contention that a systematic infinitesimal decline in the energy of starlight from non-local extragalactic sources is a major cause of cosmological redshifts, is not unreasonable, and certainly no less tenable than Dark Energy or Dark Matter hypothesised to sustain the ‘Standard’ Lambda-CDM cosmological model.

The Cosmic Microwave Background (CMB)

Long considered evidence for the Λ-CDM cosmological model, the CMB is assumed to be relic radiation that originated from a single cataclysmic event that occurred about 13.8 billion years ago. However, decades before Penzias and Wilson accidentally discovered this microwave background in 1965, a study by Andrew Mackellar in 1941 [2], determined the temperature of interstellar space to be a maximum effective temperature of 2.7 Kelvin from excitation levels of the cyanogen molecule in space. This and further early predictions were recounted comprehensively in an essay by Assis and Neves in their 1995 paper:”The History of the 2.7 K Temperature Prior to Penzias and Wilson.” [3].
Significant also, is a later study by Michael Ibison in 2005 on the “Thermalization of Starlight in the Steady-State Cosmology” [4], where the characteristic black body spectrum was found to be inevitable in a steady-state-cosmology once it falls below the plasma frequency of the intergalactic plasma ~ 450 Gyr after emission for typical optical frequencies. Notable also, is the study by Conselice et al in “The Evolution of Galaxy Number Density at $Z< 8$ and its implications” [5] where they concluded that a large population of faint distant galaxies must exist, but have yet to be detected, and that these galaxies are likely responsible for the optical and near infrared background.
The existence of, and conclusions in those studies, suggest that the relic radiation interpretation of the CMB is not as compelling evidence as claimed for the ‘Standard’ expanding Universe Big Bang cosmological model.

Nonlinear Energy-Redshift relationship

From Planck’s $E=hf$ and equivalent $E=hc/\lambda$, there is an analogous nonlinear energy-redshift curve:-
$z = h(\nu_0-\nu)/\nu = (E_0 - E)/E = (E_0/E)-1$ leading to
$(z + 1) = E_0/E$ hence $E(z) = E_0/(z + 1)$ which is plotted in Fig.1 from z = 0 to z = 10.0

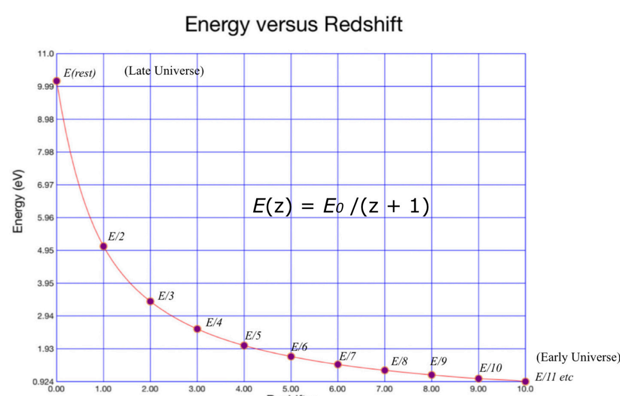

Fig.1

From the plot, the change in the energy ratio of Ly-*a* UV photons at redshift z =11.0, (0.85 eV) to the emitted energy (10.16 eV)

<u>*E(observed)/E(rest)*</u>
(0.85 eV / 10.196 eV) = 0.083 or <u>8.3%</u>

Finding a corresponding difference in values of the Hubble flow H_0 early to late Universe:-
<u>[(67.4 (km/s)/Mpc) - (73.5(kms)Mpc)]</u>
[73.5(km/s)/Mpc]. also at = 0.083 or <u>8.3%</u> is contended to be more than a coincidence.

One observation that potentially could distinguish a finite 13.8 billion years old Universe from an unbounded homogeneous isotropic steady-state universe of indeterminate age, would be the number of sources of ancient starlight, that from any observation point in the Universe, would be expected to increase exponentially with time and distance. The only constraint to an exponential increase in the number of sources that theoretically could be infinite in an unbounded Universe, would be a relentless decline in the energy of starlight according to the energy-redshift expression, $E(z) = E_0 / (z + 1)$, quantitatively accounts for the removal of photons from the visible region of the electromagnetic spectrum, through the far-infrared and terahertz gap into the microwave region, where the characteristic peak in the cosmic microwave background marks the transition from the visible to the optically dark radio region of the spectrum.

Evidence that supports the contention of an unbounded Universe, emerged from a recent NSF funded study by T.R. Lauer et al. "New Horizons Observations of the Cosmic Optical Background", which found that existing deep galaxy surveys are "systematically missing about half of the actual galaxies". [6]
With the commissioning of the James Webb Space Telescope (JWST) in 2022, there is the real prospect of large mature clusters of galaxies being observed much further back in space and time, than those evident in the Hubble space telescope Ultra Deep Field Survey. This expectation arises from a 2016 study by Conselice et al, in "The Evolution of Galaxy Number Density at $z < 8$ and its implications" [5], where the number of Galaxies >10 million solar masses is shown via a lower limit, to be a factor of ten, higher than would be seen in an all sky Hubble Ultra Deep Field survey and from results that also reveals that " the CMB light in the optical and near-infrared likely arise from these unobserved faint galaxies." And more recently, July 2022 the report by R.P. Naidu et al on "Two Remarkably Luminous Galaxy Candidates at $z \approx 11 - 13$ Revealed by JWST".[10]

Relevant to the determination of ancient redshifts in this essay, is a paper by Wisotzki et al for Nature 2018, which found that "Nearly 100% of the sky is covered by Lyman-α emission around high redshift galaxies."[9]
This finding is important in a new determination of the redshift of the Cosmic Microwave Background from the accurate measurements of the thermal black body spectrum at a temperature of 2.72548 ± 0.00057 K, which corresponds with 1.168 meV THz photons, that according to $E(z) = E0 / (z + 1)$, rearranged as $z = (E_0/Ez)-1$ (where E_0 = 10.16 eV and $E(z)$ = 1.168 meV), suggests that the peak CMB field has a redshift z = 8,697 a value almost eight times greater that currently believed.
Estimating the age of the sources of radiation directly from redshifts through the $E(z) = E0 / (z + 1)$ equation is theoretically possible, but is complicated by the nonlinear nature of the Energy-Wavelength relation which also would be subject to an independently calibrated Energy-Redshift data point, other than at the origin of that curve.

[1]. E.Hubble: The observational approach to cosmology
http://ned.ipac.caltech.edu/level5/Sept04/Hubble/paper.pdf

[2]. A.McKellar: Evidence for the molecular origin of some hitherto unidentified Interstellar lines
https://iopscience.iop.org/article/10.1086/125159/pdf

[3]. Assis and Neves: History of the 2.7 K Temperature Prior to Penzias and Wilson.
http://redshift.vif.com/JournalFiles/Pre2001/V02NO3PDF/V02N3ASS.PDF

[4]. M. Ibison 2005, "Thermalization of Starlight in the Steady-State Cosmology.
https://arxiv.org/pdf/0910.3004.pdf

[5]. Conselice et al: The evolution of Galaxy Number Density at Z <8 and its Implications
https://arxiv.org/pdf/1607.03909.pdf

[6]. T.R Lauer et al: New Horizons Observations of the Cosmic Optical Background
https://arxiv.org/pdf/2011.03052.pdf

[9]. Wisotzki.2018: Nearly 100% of the sky is covered by Lyman-α emission around high redshift galaxies
https://arxiv.org/pdf/1810.00843.pdf

[10]. R.P.Naidu et al "Two Remarkably Luminous Galaxy Candidates at z ≈ 11 − 13 Revealed by JWST"
https://arxiv.org/pdf/2207.09434.pdf [astro-ph.GA