The Genuine Cosmic Rosetta

Robert V. Gentry and David W. Gentry
The Orion Foundation
P.O. Box 12067
Knoxville, TN 37912

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Abstract

Reexamination of general relativistic experimental results shows the universe is governed by Einstein's static-spacetime general relativity instead of Friedmann-Lemaitre expanding-spacetime general relativity. The absence of expansion redshifts in a static-spacetime universe suggests a reevaluation of the present cosmology is needed.

For many decades the Friedmann-Lemaitre spacetime expansion redshift hypothesis[1,2] has been accepted as the Rosetta of modern cosmology. It is believed to unlock the mysteries of the cosmos just as the archaeological Rosetta unlocked the mysteries of ancient Egypt. But are expansion redshifts *The Genuine Cosmic Rosetta*? Until now this has been the consensus because of their apparent, most impressive ability to uniquely explain how the twentieth century's two great astronomical and astrophysical discoveries—meaning of course the Hubble redshift relation and the 2.7K Cosmic Blackbody Radiation (CBR)—can be accounted for within the framework of a hot big bang universe. But this consensus is not universal. For example, Burbidge[3] and Arp[4] continue to note that while most astronomers and astrophysicists accept the hot big bang and attribute extragalactic redshifts to expansion effects, they continue to ignore the minority view that certain observations, such as anomalous quasar redshifts, imply the need for a different redshift interpretation, and perhaps a different universe model as well.

What is now almost certain to attract more attention to the Burbidge/Arp claim is the surprising, very recent discovery of a new redshift interpretation[5] of the Hubble relation and the 2.7K CBR based on a universe governed by Einstein's static-spacetime general relativity. This discovery shows for the first time that the expansion redshift hypothesis is not the only possible explanation of extragalactic redshifts. And in so doing it inevitably focuses attention on the question of how the universe is formatted, relativistically speaking: Is it governed by Friedmann-Lemaitre expanding spacetime general relativity, as has been generally assumed for many decades? Or does the new redshift discovery point instead to it being governed by Einstein static-spacetime general relativity? There are three solid reasons why this question should now be further investigated.

First, G. F. R. Ellis, one of the big bang's ablest advocates has: (i) gone so far as to suggest the big bang might not be correct, (ii) cautioned against the bandwagon effect in supporting it, (iii) emphasized the constant need to question and test its *foundations*, and (iv) even entertained the possibility of a paradigm shift away from it.[6] Is Ellis aware of something that has eluded everyone else? Not really. Rather, his forthright appraisal relates to the fact that the expanding spacetime paradigm stands alone among all the theories of modern physics in that, even after many decades, no way has yet been found to experimentally confirm the existence of the cosmic expansion factor, $\Re$, which is the essential parameter in Friedmann-Lemaitre expansion redshift equation, $z_{\mathrm{exp}} = \Re/\Re_e - 1$. Thus, despite the fact that expansion redshifts have been widely inferred to exist because of their apparently successful use in uniquely accounting for the Hubble redshift relation and the 2.7K CBR, we must recognize that inference is not the same as certainty obtained by direct experimentation. We should also recognize that the recent discovery of the new redshift interpretation,[5] which shows the uniqueness part of the inference argument has always been ill-founded, makes it more imperative than ever to further probe the expanding spacetime paradigm.

In doing this we almost immediately come face-to-face with a most interesting feature—namely, in defiance of long-established protocol for testing any and all modern scientific theories for consistency with known physical laws, we find wavelength expansion effects, which are the presumed cause of expansion redshifts, have been authoritatively defined to be exempt from obeying conservation of energy. For example, in 1981, 1989, 1990, and 1993, respectively, cosmologists Harrison,[7] Silk,[8] Alpher and Herman,[9] and Peebles[10], independently concurred that the in-flight photon energy loss which accompanies photon wavelength expansion represents nonconservation of energy. In 1993 Peebles stated the situation rather plainly:

> *"However, since the volume of the universe varies as $a(t)^3$, the net radiation energy in a closed universe decreases as $1/a(t)$ as the universe expands. Where does the lost energy go? ... The resolution of this apparent paradox is that while energy conservation is a good local concept, ...there is not a general global energy conservation law in general relativity theory".*[10]

This conclusion is based on Peebles' use of the expanding-spacetime paradigm. Even though such conclusions have long remained unchallenged, we are unable to find where the full implications of this and similar assertions[7−10] have ever been critically analyzed and reported in a text or journal. Indeed, we cannot even find where the answer to the most basic question about how much radiation energy is predicted to have been lost due to expansion effects has ever appeared in a journal publication. So we undertake to do this now, and the answer is quite large. Consider in particular the magnitude of the nonconservation-of-energy loss of CBR photons as in theory they were expansion-redshifted from 3000K at decoupling to the present 2.7K.

Assuming a nominal universe volume, V_{univ}, of 15 billion ly radius, the 2.7K CBR having about $\overline{n} = 410$ photons-cm^{-3} with average energy of about $\overline{\varepsilon}_{2.7} = 10^{-15}$ erg, and the 3000K radiation with $\overline{\varepsilon}_{3000} = 1.13 \times 10^{-12}$ erg, and an equal number of photons,[8] we compute the total CBR expansion energy loss as $E_{\rm exp} = \overline{n} \times (\overline{\varepsilon}_{3000} - \overline{\varepsilon}_{2.7}) \times V_{univ} = 5.5 \times 10^{75}$ erg. This is about three times the galactic mass of a universe composed of 10^{21} solar masses. For an initial fireball temperature of 3 million K, the total radiation energy loss would be three thousand times the mass of such a universe. Even more incredibly, since in theory photon conservation[8] extends back to a fireball temperature of 30 billion K, in this case the theorized nonconservation-of-energy loss projects to be thirty million times the mass of such a universe.

These gargantuan energy losses command our attention for there appear to be only two ways to interpret them, and both have significant cosmological implications. If expanding spacetime general relativity and expansion redshifts correctly describe the universe we inhabit, it would seem that our long-held concepts of energy conservation are drastically in error. On the other hand, if we hold to universal energy conservation, then it would seem our universe must be governed by Einstein's static-spacetime general relativity and Einstein redshifts, which are consistent with energy conservation. As this Letter now reports, even though the experimental data needed to distinguish these alternatives have existed for more than two decades, their cosmological implications have remained virtually unnoticed until now.

Testing the expanding-spacetime universe paradigm begins with listing its twofold basic assumption—namely, that general relativistic processes operate to expand wavelengths only while photons are in-flight. It is imperative to assume complete cessation of expansion effects during emission/absorption in order to insure agreement with the astronomical requirement of a fixed emission wavelength, λ_e. However, when we examine the many relativistic gravitational experiments performed over the last few decades we find that, while those results conflict with the expansion paradigm's basic assumptions, they are completely in accord with the predictions of the static-spacetime theory of general relativity as Einstein first proposed it in 1916.[11]

In that seminal paper he predicted that gravity should cause a perfect clock to go "*... more slowly if set up in the neighborhood of ponderable masses. From this it follows that the spectral lines of light reaching us from the surface of large stars must appear displaced towards the red end of the spectrum.*"[11]

In 1954 Brault's redshift measurement[12] of the sodium D line emanating from the sun's spectrum did succeed in confirming the *magnitude* of the gravitational redshift that Einstein had predicted. But this result did not settle the question of its *origin*. More specifically, was Einstein correct in postulating that different gravitational potentials at source and observer meant that clocks at these locations should run at intrinsically different rates, and hence that this was the origin of the gravitational redshift? Or did the measured redshift instead have its origin in photons experiencing an in-flight energy exchange with gravity as they moved in a changing gravitational potential in their transit from a star to the Earth?

Even the 1965 Pound-Snider experiments[13] did not settle this question. True, these observers did find a $\Delta\nu/\nu = -\Delta\varphi/c^2 = gh/c^2$ fractional frequency difference between ^{57}Fe gammas emitted at the top and received at the bottom of a tower of height, h, and this result did more precisely confirm the *magnitude* of the Einstein redshift. But it did not settle its *origin*, for they could not tell whether the redshift resulted from in-flight wavelength change as the photon passed through a gravitational gradient, or whether it was due instead to differences in gravity affecting the relative frequency at the point of emission. They did suggest, however, this issue could be decided by comparing coherent light sources operating at different potentials.[13]

That is, if atomic clocks separated by a height h were found to run at the same rate, this would prove that local gravity does not affect relative emission frequencies, and hence that relativistic redshifts do result from photons experiencing an in-flight energy exchange with gravity. If this had been the experimental outcome, then the predictions of the expanding-spacetime paradigm, with its expansion redshifts, would have been fully confirmed.

But as is now well-known, atomic clock experiments have repeatedly shown that a clock on a mountain top does run faster than its sea level counterpart by a fractional amount $\Delta\nu/\nu = -\Delta\varphi/c^2 = gh/c^2$, the same shift found by Pound and Snider. Although not generally recognized as such until now, this result proved long ago that the Einstein redshift is due to local gravity operating to affect relative emission frequencies as seen by an observer in a different gravitational potential. Moreover, the basic principle of local gravity affecting relative emission frequencies is further confirmed many thousands of times every hour in the continuing operation of GPS atomic clocks. Synchronization of those clocks utilizes the Einstein static-spacetime paradigm with its predicted effect of gravity on emission frequency to calculate how much faster satellite clocks will be expected to operate once they are in orbit. Thus, prior to launch, satellite clocks are preset to run about 38,400 ns/d slower than the base master clock to compensate for their faster rate in orbit.[14]

Another remarkable confirmation of gravity's effect on emission frequencies comes from Taylor's comparison of atomic clock time with pulsar timing data.[15] To synchronize both data sets he found it necessary to account for the change of local atomic clock time due to the monthly variation in the sun's gravitational potential at Earth. In Taylor's own words, *"Here is direct proof, based on a clock some 15,000 light years from the solar system, that clocks on Earth run more slowly when the moon is full—because at this time of the month we are deeper in the gravitational potential of the sun!"*[15]

Thus Einstein's 1916 predictions about both the origin and the magnitude of the gravitational redshift have been confirmed by a variety of general relativistic experiments, so as to obtain the following conclusions: (1) there is only one gravitational redshift between two points at different potentials, and it is given by $\Delta\nu/\nu = -\Delta\lambda/\lambda = -\Delta\varphi/c^2$, and (2) this redshift does not originate with photons exchanging energy with gravity during transit through a potential gradient, but instead originates in precisely the way that Einstein stated it in 1916, and again in 1952—namely, *"An atom absorbs or emits light of a frequency which is dependent on the potential of the gravitational field in which it is situated."*[16]

The foregoing results contradict the basic assumptions of a universe governed by Friedmann-Lemaitre expanding-spacetime general relativity, showing instead that the universe we inhabit is one governed by Einstein's static-spacetime general relativity. In doing this they focus added attention on the recent discovery of *a New Redshift Interpretation*[5] (NRI)—which shows for the first time that an expanding universe characterized by Hubble-relation galactic recession and the 2.7K CBR can be explained within the framework of a universe governed by static-spacetime general relativity. The credibility of the NRI is enhanced by its apparent ability to also account for:[5] (i) the 2.7K CBR's spatial isotropy, (ii) the predicted variation of redshift, z, with CBR temperature, (iii) the observed monotonic decline in galactic angular size with increasingly higher redshifts, and (iv) possibly the sparsity of high redshift quasars for $z > 4$.

Thus this Letter concludes that Einstein's static-spacetime general relativity is indeed *The Genuine Cosmic Rosetta.* Its apparent success in interpreting the aforementioned observations implies it now needs to be further tested against an increasing array of other astrophysical phenomena. Indeed, in the relatively short time that has elapsed since the NRI's publication, new results have appeared which seem to provide one of the strongest observational tests of its validity. We refer to most recent reports of astronomical observations strongly suggesting the existence of a repulsive force in the outermost reaches of the universe.[17,18] An important question which may soon attract wide attention is whether these observations may reasonably be interpreted to be a remarkable confirmation of the NRI's prediction that ours is a universe dominated by a repulsive force due to vacuum gravity.[5]

In another paper we show how the NRI and a static-spacetime universe lead to new possibilities for quasar redshifts.[19] The latter may be of considerable interest to researchers such Burbidge and Arp, who have long contended that certain quasars provide strong evidence of intrinsic redshifts. Also, while we acknowledge the concerns and results of Burbidge,[3] Arp,[4] Ellis,[6,20] and Ellis *et al.*,[21] as providing motivation for pursuing the investigation of this most interesting topic, we do not imply that these researchers have been participants in it.

Where the results of this Letter may attract the most interest is with the majority of astronomers and astrophysicists who have long believed the creation of the universe can be traced to a big bang singularity, for the results presented herein challenge the very existence of the big bang's essential ingredient of spacetime expansion. These results are presented in the spirit of free scientific inquiry with the expectation that more details about these matters will emerge as all their ramifications are openly and freely pursued.

References

[1] A. Friedmann, *Z. Phys.* **10** (1922) 377.

[2] G. Lemaitre, *Annales Société Scientifique Bruxelles* **A47** (1927) 49.

[3] G. Burbidge, *Ap. & Space Science* **244** (1996) 169.

[4] H. Arp, *Ap. & Space Science* **244** (1996) 1.

[5] R. V. Gentry, *Mod. Phys. Lett. A* **12** (1997) 2919; also available at http://www.wspc.com.sg/ .

[6] G. F. R. Ellis, "Innovation, resistance and change: the transition to the expanding universe," in *Modern Cosmology in Retrospect* (Cambridge Univ. Press, 1990), pp. 97–113.

[7] E. R. Harrison, *Cosmology: Science of the Universe* (Cambridge Univ. Press, 1981), pp. 275–276.

[8] J. Silk, *The Big Bang* (W. H. Freeman & Co., 1989), pp. 423–425.

[9] R. A. Alpher and R. Herman, "Early work on big bang cosmology and the CBR," in *Modern Cosmology in Retrospect* (Cambridge Univ. Press, 1990), pp. 151–152.

[10] P. J. E. Peebles, *Principles of Physical Cosmology* (Princeton Univ. Press, 1993), pp. 96–99; 138–139.

[11] A. Einstein, *Ann. der Physik* **49** (1916) 769. English reprint in *The Principle of Relativity* (Dover Publications), pp. 160–164.

[12] J. W. Brault, Abstract, "Gravitational Redshift of Solar Lines," in *Bull. Amer. Phys. Soc.* **8** (1963) 28.

[13] R. V. Pound and J. L. Snider, *Phys. Rev. B* **140** (1965) 788.

[14] N. Ashby and J. J. Spilker, Jr. in *The Global Positioning System: Theory and Applications., Vol. 1* (American Institute of Aeronautics and Astronautics, Inc., 1995), Chapter 18.

[15] J. H. Taylor, "Astronomical and Space Experiments To Test Relativity," in *General Relativity and Gravitation* (Cambridge Univ. Press, 1987), p. 214.

[16] A. Einstein, *Relativity: The Special and General Theory* (Crown Trade Paperbacks, New York, 1961), p. 130.

[17] S. Perlmutter *et al.*, LBNL preprint 41801 (1998); see also www-supernova.lbl.gov .

[18] A.G. Riess *et al.*, astro-ph/9805201.

[19] R. V. Gentry, in preparation.

[20] G. F. R. Ellis, *Ann. Rev. Ast. Ap.* **22** (1984) 157.

[21] G. F. R. Ellis, R. Maartens, and S. D. Nel, *Mon. Not. Roy. Ast. Soc.* **184** (1978) 439.