Cosmological Redshifts criticized

Sjaak Uitterdijk

Abstract - One of the missions of the James Webb telescope is to learn more about the origin and expansion of the universe by means of redshift measurements in the spectra of stars far away from Earth. This article shows that such a mission is doomed to fail.

1 Introduction

Redshifts of spectra in received light from stars far away from Earth should tell humanity more about the origin and the alleged expansion of the universe. At least that is the generally accepted idea. In order to investigate this idea closer, a simple mathematical model has been made of an imaginary expanding universe. Based on this model, the redshift of an arbitrary frequency emitted by an imaginary star has been analyzed theoretically.

2 Modelling of the universe

2.1 Definitions and assumptions

Universe: all matter in cosmos
Cosmos: imaginary universe, being without matter

Assumptions

1. The universe was born from a Big Bang.

2. The Big Bang created an expanding amount of matter.

3. This matter is homogeneously distributed inside a sphere.

4. The matter's current distance from the coordinates (0,0,0) of the Big Bang is a result of the various initial accelerations with which it has moved away from this origin.

5. The acceleration of all matter will decrease over time represented by the same exponential function, but with different initial values.

6. One day the expansion of the universe will stop and all matter will come together again, eventually resulting in the next Big Bang.

For more detailed considerations see chapter XXXVI in reference [1].

2.2 Mathematical model of the universe based on the assumptions

The following mathematical expressions can now be posited for respectively: acceleration, velocity and distance of matter in the universe, all relative to the origin (0,0,0) of the Big Bang and to be read as 3-dimensional vectors:

$$a(t) = -a_i \cdot e^{-t/\tau}$$

$v(t) = v_i + \int_0^t a(t)dt = v_i + a_i\tau \cdot e^{-t/\tau} - a_i\tau$ Assuming $v_i = a_i\tau$ $v(t) = a_i\tau \cdot e^{-t/\tau}$

$r(t) = r_i + \int_0^t v(t)dt = r_i - a_i\tau^2 \cdot e^{-t/\tau} + a_i\tau^2$ $r(0) = 0$, so $r_i = 0$ $r(t) = a_i\tau^2 \cdot (1 - e^{-t/\tau})$

The following variables will be considered, related to the source (s) to be observed and to the receiver (r), used to observe:

$a_s(t) = -a_s \cdot e^{-t/\tau}$ $\quad$ $a_r(t) = -a_r \cdot e^{-t/\tau}$

$v_s(t) = a_s\tau \cdot e^{-t/\tau}$ $\quad$ $v_r(t) = a_r\tau \cdot e^{-t/\tau}$

$r_s(t) = a_s\tau^2 \cdot (1 - e^{-t/\tau})$ $\quad$ $r_r(t) = a_r\tau^2 \cdot (1 - e^{-t/\tau})$

Adding the assumption that the distance of the source to the origin is greater than the distance of the receiver to the origin, it follows that $a_s > a_r$, so $v_s(t) > v_r(t)$.

Because the origin is unknown only velocities and distances of matter relative to other matter can be measured. In other terms: absolute values of velocity and distance are unknown.

3 Requirements and restrictions regarding redshift measurements.

Observing $v_s(t)$ by means of shifts in the spectrum of the emitted light, requires by definition that the original spectrum of the source is known. More specifically: if f_s would be the only frequency emitted by the source and f_r is the observed frequency, than the so-called Doppler shift is $f_r - f_s = f_s \cdot v_{sr}/c$, with v_{sr} the velocity of the source relative to the receiver. N.B. v_{sr} is negative in the situation under consideration. See chapter VI in ref. [1] for the physical and mathematical background of this outcome.

Given the fact that v_{sr} has to be measured in order to decide about the expanding of the universe, *relative to the position of the receiver*, f_s thus has to be known.

Another important restriction is the following. All 6 mentioned variables as function of time are in reality 3-dimensional vectors. So is also the vector representing the orientation of the receiver, aimed at the source to be investigated! Hubble's very simple redshift-distance law suggests that he only considered a 1-dimensional configuration. Such a configuration only occurs if all relevant vectors would be in line. That is a most unlikely situation. So the measurements carried out up to now, leading to an alleged v_{sr}, have to be interpreted as the difference of the projections of $v_r(t)$ and $v_s(t)$ on the vector $r_r(t) - r_s(t)$. But all these vectors are unknown, so the results of such measurements have to be considered as useless.

4 Hubble's redshift-distance law

The variables in Hubble's law are defined as follows: z is the measured redshift, c the velocity of light, L the distance source-receiver and H_0 a constant, valid at this moment. "This moment" has to be read in relation to billions of years. Formally L is described as "distance of extragalactic nebulae", so implicitly assuming that $r_s(t) >> r_r(t)$. Because we do see from Earth in whatever direction stars such an assumption is most likely correct.

Expressing the shift in terms of wavelength instead of frequency ($\Delta_f = f_s \cdot v_{sr}/c$) leads to:

$$\Delta_\lambda = \lambda_r - \lambda_s = c/f_r - c/f_s = c/(f_s(1+v_{sr}/c)) - c/f_s$$

For $v_{sr} << c$ the shift in wavelength can be approximated well by: $\Delta_\lambda = -v_{sr}/f_s = -\lambda_s \cdot v_{sr}/c$.

Ignoring all the above mentioned restrictions, so concentrating on a 1-dimensional situation, the relative velocity v_{sr} can, given the assumptions, be expressed by: $v_{sr} = v_s(t) - v_r(t) = \Delta_a \cdot \tau \cdot e^{-t/\tau}$, resulting in: $\Delta_\lambda = -\lambda_s \cdot \Delta_a \cdot \tau \cdot e^{-t/\tau}/c$.

Aiming for an expression in terms of Hubble's redshift-distance law, with $z = \Delta_\lambda$, $L = r_{sr}$ and H_0 a yet to find "constant valid at this moment", leads to:

$r_{sr} = r_s(t) - r_r(t) = \Delta_a \cdot \tau^2 \cdot (1 - e^{-t/\tau}) = \Delta_a \cdot \tau^2 - \Delta_a \cdot \tau^2 \cdot e^{-t/\tau} = \Delta_a \cdot \tau^2 - \tau \cdot v_{sr}$, so $v_{sr} = \Delta_a \cdot \tau - r_{sr}/\tau$

Applying this to Δ_λ results in $\Delta_\lambda = -\lambda_s/c \cdot (\Delta_a \cdot \tau - r_{sr}/\tau)$, leading to:

$$r_{sr}(t) = \Delta_\lambda(t) c\tau/\lambda_s + \Delta_a \cdot \tau^2$$

Leaving out the constant part $\Delta_a \cdot \tau^2$: $r_{sr}(t) = \Delta_\lambda(t) c\tau/\lambda_s$

Or: $\Delta_\lambda(t) \cdot c = \lambda_s/\tau \cdot r_{sr}(t)$

In terms of Hubble's variables: $z(t) \cdot c = H(t_0) \cdot L(t)$

with $H(t_0) = H_0 = \lambda_s/\tau$ a *permanent* constant instead of a constant at "this moment", as presented in reference [2]:

> ".....the Hubble term H(t) is everywhere a constant in homogeneous and isotropic space at a common instant of time; a zero subscript denotes the present time, $H_0=H(t_0)$; and L is the distance to a galaxy of redshift z."

5 The velocity-distance law

Copied from [2], chapter 3:

"Unlike the Hubble law, the origin of the velocity-distance law remains obscure."
The shown relevant equations are $V = H(t)L$ and $V = dL/dt$.

Given the assumptions defined above $dL/dt = dr_{sr}(t)/dt = \Delta_a \tau \cdot e^{-t/\tau}$,
so $V(t) = \Delta_a \cdot \tau \cdot e^{-t/\tau} = H(t)L = H(t) r_{sr}(t)$

As a result $H(t) = V(t)/r_{sr}(t) = \Delta_a \tau \cdot e^{-t/\tau} / \Delta_a \cdot \tau^2 \cdot (1 - e^{-t/\tau}) = e^{-t/\tau}/\tau(1 - e^{-t/\tau})$.

This result shows that H(t) is a function that solely depends on the chosen mathematical model of the universe and thus has nothing to do with redshift measurements.

In this expression t as well as τ are unknown. Even if t would have the alleged value of roughly 10 billion years, the value of τ still can be, for example, 1 or 100 billions of years. The value of this H(t) and of $H(t_0)$ in Hubble's law (λ_s/τ) thus is completely unknown.

Conclusions

One of the missions of the James Webb telescope is to learn more about the origin and expansion of the universe. But a simple theoretical analysis proves that such a mission is doomed to fail, due to too many completely unknown variables.

References

[1] https://vixra.org/abs/2107.0027

[2] https://adsabs.harvard.edu/full/1993ApJ...403...28H