Poster Presentation

DERIVATION of the HUBBLE REDSHIFT

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by

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INTRODUCTION

In my talk at this conference, I deduced that the Universe is Static based on the Falsification of the Expanding Universe Model.

In this Poster, I derive the Hubble Redshift in a Static Universe.

The derivation of the Hubble Redshift is a difficult problem as evidenced by the failure of all attempts to derive the Hubble Redshift in a Static Universe over the past 65 years.

Why have these attempts failed?

One Possibility - a New Viewpoint on the Nature of the Universe is Required.

The New Viewpoint

Assume the Universe Consists only of Waves.

No New Physics is Involved - Only the Application of known Physical Principles to the New Viewpoint.

Assume the Waves are Linear - then all Interactions must be due to Changes in the Mass Density and Tension.

The Equilibrium State is determined by the Eigenvalues of the Wave Equation with Variable Parameters

$$\frac{\partial}{\partial x}[T(x)\frac{\partial A}{\partial x}] = \sigma(x)\frac{\partial^2 A}{\partial t^2}.$$

The System has Minimum Energy when all of the Wave Modes Constructively Interfere.

Then, the Elementary Particles are the Constructive Interference Peaks of the Wave System.

Proof that the Wave System Exists!

At this point in the argument, I wish to emphasize that the concept of an underlying wave system is not just a speculative idea. **Using group theory and well-founded physics, the existence of the wave system can be proved.**

A symmetry argument of Howard Giorgi, a particle physicist, is applicable.

Assume the Universe is an Infinite, Linear Physical System. Also, the Laws of Physics are Experimentally Known to be Space and Time Translation Invariant.

Let $x(t)$ represent the solution of the above system.

For time - translation invariance, if $x_0(t)$ is a solution at the present time, then

$$x_a(t) = x_o(t+a).$$

So, $x_a(t)$ is also a solution.

The simplest behavior for time - translation invariance is

$$y(t+a) = h(a)\,y(t).$$

where $h(a)$ is a constant.

This relation is allowed because we assumed the system is linear. This allows us to add solutions and multiply solutions by a constant, in the above case, $h(a)$.

The following equation also applies

$$y(t+a+b) = h(b)h(a)y(t).$$

It is easy to see then that the constant generalizes to

$$h(t) = \exp(-i\varpi t)$$

Similarly, for Space-Translation Invariance

$$y(x+d) = l(d)y(x)$$

and

$$l(x) = \exp(-ikx)$$

The Full Solution Consists of Left and Right Progressive Waves which Form the Standing Wave System, given by

$$\exp[-i(\varpi t \pm kx)].$$

This Result Proves an Underlying Wave System Exists.

However, you may ask why is the wave system not seen?

You have to realize that the wave system is a constructive interference system – an extreme case of wave motion.

Therefore, when you see Ordinary Matter, you see the Wave System in the form of Constructive Interference Peaks. These Peaks are the Mass Particles.

In fact, Space is comprised of regions of destructive interference between the wave modes.

DERIVATION of FORM of NEWTON's LAW of GRAVITATION

Assuming all Forces in the wave system are due to Parameter Variations, I derived a Force Law, given by

$$F = -sc^2 \frac{d\sigma}{dr} = -sc \frac{dI}{dr}$$

where s = particle size, σ = mass density and I = energy intensity.

The Force Law says a Force results from an Intensity Gradient.

Next, assume the Wave Intensity emitted by one particle produces an Intensity Gradient at a second particle.

Setting $I = I_0 / r^2$ and applying the force law,

$$F = -scdI / dr = scI_0 / r^3.$$

But, since the Result for the Gravitational Force varies as $1/r^3$, the Derivation is Obviously Incorrect.

Nevertheless, I assumed the force law is correct **and "Guessed" that the Intensity varies as** I_0 / r **.** This implies that waves Propagate Circularly rather than Isotropically. Then, applying the Force Law,

$$F = -scdI / dr = scI_0 / r^2.$$

This worked perfectly but, since this solution seemed physically improbable, I proved it mathematically.

I showed that Circularly Propagating Wave Modes satisfied an eigenvalue solution in three dimensions**, provided that the mass density and tension also vary as** $1/r$ **.**

This is the Key Change in Current Physics required to derive the Hubble Redshift Effect.

For completeness, the Mathematical Derivation of the Circularly Propagating Modes is presented next.

Derivation of Circularly Propagating Modes

I thought that the $1/r$ guess might have something to do with the solution of the wave equation in three-dimensions.

So, I retraced the steps in solving the three-dimensional wave equation. I didn't know what I was looking for but, I reasoned, **Whatever it is should be Simple if the Solution Always Applies.**

Separating the variables in a spherical coordinate system,

$$\Psi = R(r)\Theta(\theta)\Phi(\phi)T(t).$$

Only the radial equation $R(r)$ is needed, given by

$$\frac{d^2R(r)}{dr^2} + \frac{2}{r}\frac{dR(r)}{dr} + [k^2 - \frac{l(l+1)}{r^2}]R(r) = 0$$

where

$$k^2 = \omega^2 / c^2.$$

The standard method of solving the radial equation is to separate $R(r)$ into two functions

$$R(r)=\frac{1}{\sqrt{r}}B(r).$$

where $B(r)$ is the Bessels equation of half-integral order , given by

$$\frac{d^2B(r)}{dr^2}+\frac{1}{r}\frac{dB(r)}{dr}+[1-\frac{(l+1/2)^2}{r^2}]B(r)=0.$$

Since we require constructive interference in the wave system and only the $l=0$ solution is periodic, the general solution of $B(r)$ is restricted to

$$B(r)=\frac{A}{\sqrt{r}}\sin kr+\frac{C}{\sqrt{r}}\cos kr.$$

Next, the second term on the right must be eliminated since it is infinite at $r=0$. Then, the solution of $R(r)$ is

$$R(r)=\frac{1}{\sqrt{r}}B(r)=\frac{1}{\sqrt{r}}\frac{A}{\sqrt{r}}\sin kr=\frac{A}{r}\sin kr.$$

However, this is simply the usual spherical solution where the intensity is the square of the amplitude

$$R^2(r)\sim 1/r^2.$$

But, then I realized this solution was implicitly derived assuming Constant Parameters.

Therefore, to fit the problem, the Parameters were assumed proportional to $1/r$**.**

Then, the modified $B^*(r)$ is simply

$$B^*(r) = \frac{1}{\sqrt[4]{T\sigma}} B(r) = \frac{1}{\sqrt[4]{T_o \sigma_o / r^2}} B(r) \approx \sqrt{r} B(r).$$

Finally, the Unique Eigenmode of $R^*(r)$ with Variable Parameters is

$$R^*(r) = \frac{A}{\sqrt{r}} B^*(r) = \frac{A}{\sqrt{r}} \sqrt{r} B(r) = B(r).$$

Therefore, the solution is

$$R^*(r) = \frac{A}{\sqrt{r}} \sin kr$$

and the Intensity is given by

$$R^{*2}(r) \sim 1/r.$$

This Solution represents a **Periodic Circularly Propagating Wave as Required**.

HUBBLE RED-SHIFT

The Hubble Redshift is essentially derived by Newtonian Gravitational Theory **as Modified by the Circular Propagation of Wave Modes.**

First, the Newtonian Gravitational Theory will be used.

Consider the gravitational attraction of a mass m to a thin spherical shell surrounding the particle with a constant mass density. For the inverse square law, the net attractive force on the particle is

$$F = 0$$

since the attraction by opposite sides of the shell cancel exactly.

On the other hand, if the particle is outside a thin spherical shell, the particle is attracted towards the center of the shell by a force

$$F = -GM_S m / r^2 = -4\pi G \sigma_S m$$

where σ_S is the surface mass density.

Continuing with the strictly Newtonian Gravitational theory, for a solid sphere with radius a and a constant mass density of σ_V, the attraction of a particle **within the sphere** and at a distance r from the center of the sphere is

$$F = -4/3\pi G\sigma_V mr.$$

In the Newtonian case, **the Force is Proportional to the Distance** r. The Hubble Redshift Effect does not result from this Newtonian force.

These equations are well known in Newtonian Theory.

However, for the Circular Propagation of Wave Modes, **a Modified Newtonian Gravitational Theory is used.**

The mass, M_S, within a single circulararly propagating mode is $\pi\sigma_S r^2$ and there are N $(\approx 10^{41})$ circularly propagating modes. The previous Newtonian gravitational equation becomes

$$F = -NGM_S m/r^2 = -\pi NG\sigma_S m.$$

Now, the Force is a Constant. Note: the Net Force from Mass Shells Surrounding the Particle is Zero.

Especially Note: This equation does not apply at small distances such as bore holes in the Earth. The Reason is

Simple: All the mass particles in the Earth interact with the test particle because of the **Large Number of Circularly Propagating Modes.** Then, the force on the test particle is given by the strictly Newtonian gravitational theory.

However, over cosmological distances, the circular wave modes Fan - Out and the test particle does not interact with all of the mass particles in three - dimensional space. **Then, the Modified Newtonian Theory applies and the Gravitational Force on the Test Particle is Constant.**

Action of a Constant Force on a Photon

The Force on a test particle involves only constants. **These Constants are determined by the Equilibrium State of the Universe.**

Consistent values of the constants are:

$N \approx 1.7*10^{38}$ circularly propagating modes
$R_0 \approx 1.4*10^{28}$ cm (calculated from c/H_0 for $H_0 = 60$)
$\sigma_S = 1.67*10^{-24}*6.9*10^{41}/(\pi(1.4*10^{28})^2) = 1.8*10^{-39}$
(Assumes $\approx 6.9*10^{41}$ protons per mode)
$m = 1.67*10^{-24}$ g
$G = 6.67*10^{-8}$ (gravitational constant)

Then, the Force is given approximately by

$$F = -N\pi G\sigma_S m \approx -1.1*10^{-31} \text{ dynes.}$$

You can see immediately from the above equation that the energy required to remove the proton from the "Local Universe" if $R_0 \approx 1.4*10^{28}$ cm is $\approx 1.5*10^{-3}$ ergs. This is very close to the mass energy of a proton.

However, it is more useful to set $m = E/c^2$. Then, using the same values for the constants, we find

$$F = dE/dr \approx -7.1*10^{-29} E = -E/R_0$$

where $R_0 \approx 1.4*10^{28}$ cm. R_0 is an important scale factor of the Universe.

Re-Arranging the above equation,

$$dE/E = -dr/R_0,$$

and integrating, we have

$$E/E_0 = \exp(-r/R_0)$$

Next, from the definition of the Hubble Redshift,

$$z = (\lambda - \lambda_0)/\lambda_0,$$

where λ_0 and λ are respectively the initial and the observed wavelengths, we obtain

$$f / f_0 = E / E_0 = 1/(1+z).$$

Consequently, $r / R_0 = \ln(1+z)$.

Then, since $\ln(1+z)$ is approximated by $z = v / c$ where v is the velocity of recession or expansion, we have

$$v = cr / R_0 = H_0 r.$$

This is the Famous Hubble Redshift Law.

Note: The Hubble Redshift Derivation also Applies to Mass Particles. Thus, moving (very slowly) a mass particle a distance r requires an energy input.

Also, the kinetic energy of a mass particle is reduced proportional to the distance the mass particle moves.

Finally, the Hubble Redshift Effect Accounts Quantitatively for the Anomalous Acceleration Towards the Sun of the Pioneer 10 and 11 Spacecraft.