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A Dimensionless Equation Linking the Maximum and Minimum Values for Mass (or Energy) and Time (or Length)

By Andre P. Steynberg

Abstract- The James Webb telescope can detect photons in the infrared wavelength from cosmic events with a known intensity and emission frequency. The redshift data from such measurements for photons from the early universe can be used to determine the dimensions of a finite spacetime manifold. Such measurements would differ from predictions using the assumption that space and time are infinite. If these measurements confirm that the spacetime manifold is finite, then there exists a dimensionless ratio between the maximum and minimum dimensions for space and time. Furthermore, the Schwarzschild equation can be used to calculate the total mass of the Universe to determine a dimensionless ratio for the maximum and minimum mass values. The resulting equation derivation is a tribute to the work of Albert Einstein, Alexander Friedmann, Karl Schwarzschild, and Max Planck. The derived dimensionless relationship is $M_u/m_P = t_m/\pi t_P = \ell_m/\pi\ell_P$.

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I. Introduction

Alexander Friedmann worked out a solution to Einstein's field equations which applies to the entire Universe. A specific solution to the Friedmann equation applies to a finite, symmetrical Universe. For this solution, the entire mass of the Universe, M_u, can be related to the maximum radius of the Universe, R_m, by a version of the Schwarzschild equation, $R_m = 2GM_u/c^2$. Where c is the speed of light and G is the universal gravitational constant.

If the spacetime manifold has a constant finite structure, the maximum space dimension radius is reached when space ceases to expand. When expansion ceases, the Schwarzschild equation is then a solution to the Friedmann equation. A single parameter model has been proposed to predict photon redshift as a function of time, consistent with curved spacetime[1]. So, this theory for the structure of spacetime is falsifiable according to the scientific method. Data from the James Webb telescope, which can detect photons in the infrared wavelength range, is the type of equipment required to test this hypothesis.

Max Planck, a German physicist, is best known as the originator of the quantum theory of energy for which he was awarded the Nobel Prize in 1918. Today, the standard model of particle physics describes the smallest entities which exist. Although these entities are referred to as particles, it is better to think of them as packets of energy.

So, at both ends of the scale, from small to large, there is a finite metric. Nothing real is infinite. Everything with mass consists of finite packets of energy in a finite spacetime manifold.

Author: e-mail: ap.steynberg@gmail.com

In particle physics and physical cosmology, Planck units are a set of units of measurement defined exclusively in terms of four universal physical constants, in such a manner that these physical constants take on the numerical value of 1 when expressed in terms of these units.

Originally proposed in 1899 by Max Planck, these units are a system of natural units because the origin of their definition comes only from properties of nature.
The four universal constants used to define the Planck units are:

- The speed of light in a vacuum, c
- The gravitational constant, G
- The reduced Planck constant, ħ (Originally h was used which differs from ħ by a factor of $(2\pi)^{½}$.)
- The Boltzmann constant, kB (which is used to give natural units for temperature)

The mass of a packet of energy with a wavelength equal to the Planck length is:

$$m_P = (\hbar c/G)^{½}.$$

The Planck length, denoted ℓ_P, is a unit of length defined as:

$$\ell_P = (\hbar G/c^3)^{½}$$

Planck time $t_P$is the time required for light to travel 1 Planck length in a vacuum,

$$t_P = (\hbar G/c^5)^{½} = Gm_P/c^3.$$

II. Equation Derivation

At $t = t_m$, when the space dimensions reach their maximum size, the time dimension and the space dimension are equal. (The referenced publication uses the symbol T for t_m). This assumes that the spacetime structure is symmetrical so that the curvature of the time dimension is the same as the curvature of the space dimensions. Applying some simple spherical geometry to this structure, $2\pi R_m = 4ct_m$ so that $R_m = 2ct_m/\pi$. When substituting t_m for R_m in the Schwarzschild equation, the result is $t_m = \pi GM_u/c^3$.

Dividing the maximum time, t_m, by Planck time, t_p, while the other side of the above equation is also divided by t_P using the relation $t_P = Gm_P/c^3$(which is obtained from the definitions of t_P and m_P, the Planck mass) gives the result:

$$t_m/t_P = \pi M_u/m_P$$

This can be rearranged to $M_u/m_P = t_m/\pi t_P = \ell_m/\pi\ell_P$

The length metric denoted by ℓ_m is the maximum possible distance that a photon can be separated from its source mass, and, like t_m, it is a quarter of the circumference of the spacetime manifold.

Note that $M_u/m_P = E_u/E_p$ where E_u is the total energy in the Universe contained in entities with mass and E_p is the Planck energy.

Any fundamental entity with mass has an associated Schwarzschild radius. This means that analogous equations apply if the mass of the Universe, M_u, is replaced by the mass of a black hole or any of the mass-containing fundamental entities in the standard model of particle physics. So, these fundamental entities are spherical packets of energy (in four dimensions)in a spacetime manifold. The distortion of spacetime by mass orthogonal to the manifold is observed as gravity. Therefore, gravity is the

additive result from the summation of the distortions from the individual contributions by all the fundamental mass-containing entities.

III. Conclusion

If observations from the James Webb telescope do validate the single parameter model proposed to predict photon redshift as a function of time, then it can be concluded that there is a simple dimensionless representation relating mass (or energy) to time (or length) at the maximum possible scale. This relationship is derived using the definitions for the Planck units which are used to describe entities at the smallest possible scale. Nature would then be consistent for all entities with mass at any scale.

Notes

References Références Referencias

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