Physical Reality and Cosmology

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We show that the real Universe as we know it requires no more than four variables to describe it. These consist of three space dimensions x, y and z, to describe location. The continued existence of a particle requires an internal circulation velocity at right angles to a direction of translation which may be imposed upon it. This fact requires the existence of the fourth variable, time.
The analysis indicates that photons deflected in a gravitational field lose energy to the field. This effect accounts for the redshifts in the spectra of distant stars without the assumption of an expanding universe.

1. The Length Element

In the world of the straight line, the squared element of length is

$$ds^2 = dx^2 \tag{1.1}$$

In the world of the flat surface, we have

$$ds^2 = dx^2 + dy^2 \tag{1.2}$$

where it can be assumed that x and y are at right angles to each other. In the world of three dimensional space we have

$$ds^2 = dx^2 + dy^2 + dz^2 \tag{1.3}$$

where the coordinates x, y, and z are mutually at right angles. If we write

$$ds^2 = dx^2 + dy^2 + dz^2 + dw^2 \tag{1.4}$$

in terms of geometry, there is no place for w to be at right angles to x, y, and z simultaneously, but equation (1.4) is still valid in the assumption that w is independent of x, y, and z. Then we can state that the elements x, y, z, and w form an orthoganal system.

2. Physical Reality

The variables applying to the real universe are concerned with location and duration. The location of a point with respect to a reference frame is determined by assigning values to x, y, and z.

The symbol t represents time or duration, but the w appearing in (1.4) must have the units of length to correspond to those describing location. Then we write

$$w = jCt \tag{2.1}$$

where $j = \sqrt{-1}$ is the imaginary symbol and C is an arbitrary constant of proportionality. Then (1.4) reduces to

$$ds^2 = dx^2 + dy^2 + dz^2 - C^2dt^2 \tag{2.2}$$

where the imaginary symbol does not appear. When (2.2) is divided by the squared time element we have

$$\left(\frac{ds}{dt}\right)^2 = \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2 - C^2 \tag{2.3}$$

Since we are concerned with reality, we observe that the left member of the equation describes a squared real velocity. Since this cannot be negative, we find

$$V^2 = \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2 - C^2 \tag{2.4}$$

where the velocity combination forming the right member of the equation is greater than zero. Then we write

$$\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 + \left(\frac{dz}{dt}\right)^2 = C_o^2 \tag{2.5}$$

This requires

$$V_2 = C_o^2 - C^2 \tag{2.6}$$

where C_o represents the uncontracted velocity of light. In terms of energy, we have

$$MC_o^2 = MC^2 + MV^2 \tag{2.7}$$

It follows that the symbol C represents a reduced velocity of light resulting from the kinetic nature of the system.

3. Gravitation

The velocity of free fall from rest at infinity under action of a gravitational field is given by

$$V^2 = \frac{2GM}{R} \tag{3.1}$$

where G is the universal gravitational constant, M is the mass of the object generating the field, and R is any general radius vector. When (3.1) is used in (2.6), the index of refraction of any gravitational space is found to be

$$\eta = \frac{C_o}{C} = \frac{1}{\sqrt{1 - 2GM/RC_o^2}} \tag{3.2}$$

A photon interacting with the gradient of the sun has to do work against the gradient in order to escape. The work done in reaching the point of closest approach is

$$\tfrac{1}{2} M_p V^2 = \frac{GMM_p}{R_o} \tag{3.3}$$

where M_p is the photon mass and M is the mass of the sun. This will account for one-half the total bending of the path of travel of the photon past the sun. On the second half, the deflection continues in the same sense. The total energy loss in the photon is then

$$M_p V^2 = \frac{2GMM_p}{R_o} \tag{3.4}$$

Then we see that a photon deflected by a gravitational field loses energy to the field. The ratio of energy loss to the original energy is given by

$$\frac{M_p V^2}{M_p C_o^2} = \frac{2GM}{R_o C_o^2} \tag{3.5}$$

By the use of Planck's energy form and equation (3.2), we find

$$\frac{\Delta f}{f_o} = 1 - \frac{1}{\eta^2} = \frac{2GM}{R_o C_o^2} \tag{3.6}$$

where the value of R_o is that applying to the point of closest approach.

4. Errors in Concept

Any mechanism which will deflect a photon from a straight line path must result in an energy loss. The Compton interaction between photons and electrons can be used as one example. The original error can be traced to the idea that a photon past the sun follows a straight line path through a curved space. Such a concept takes no account of the energy loss occasioned by the deflection.

The analysis has a bearing on the theory of the expanding universe. There is no need to invoke the Doppler effect to account for the redshift. Random deflections tend to preserve a general straight line path of travel over long distances. Every gravitational interaction along the path results in an energy loss which is cumulative with distance. This confirms the concept of "tired light", with the added bonus of providing a mechanism. All gravitational matter, whether it be of molecular size or a major star will have its effect.

The cumulative effect with distance can be written

$$\frac{\Delta f}{f_o} = \frac{2G}{C_o^2} \sum_i \frac{M_i}{R_i} \tag{4.1}$$

where the maximum path of travel is the diameter of the universe. If we define the radius of the universe as that distance in which the change in frequency is equal to the original frequency, we have

$$\frac{f_o}{f_o} = 1 = \frac{GM}{C_o^2 R} \tag{4.2}$$

where M is the mass of the universe and R is the corresponding radius. This may be written

$$\frac{GM}{R} = C_o^2 \tag{4.3}$$

This final form is recognized as the Mach Limit.

By the use of (3.1) in (2.7), the gravitational energy law is

$$MC_o^2 = MC^2 + \frac{2GM^2}{R} \tag{4.4}$$

For any given mass system, the left member of the equation is constant. The value of C in the right member is dependent upon the magnitude of the final term. It follows that the concept of a constant velocity of light is in error.

There is an implication contained in the energy law which is worthy of note. Since in a given system, the total energy must be conserved, the energy lost from the photon by deflection in a field must be accounted for. Then we have an answer to the nature of the radiation detected by Penzias and Wilson (1965) without the necessity of assuming that it had its origin in the "Big Bang." (Henry, 1980)

References

Henry, Paul S., 1980. *Science*, **207**, 939.

Penzias, A.A. and Wilson, R. W., 1965. *Astrophys. Journal*, **142**, 420.