observer. Therefore in 1924 de Broglie effectively explained the cosmological red shift in terms of photon mass."Big Bang" (a joke coined by Hoyle) is now known to be erroneous in many ways, and was the result of imposed and muddy pathology supplanting the clear science of de Broglie.

In 1924 de Broglie also introduced the concept of least (or "rest") angular frequency:

$$\hbar\omega_0 = mc^2 \qquad -(189)$$

and kinetic angular frequency ω_K. The latter can be defined in the non relativistic limit:

$$\hbar\omega = mc^2\left(1 - \frac{v_g^2}{c^2}\right)^{-1/2} \sim mc^2 + \frac{1}{2}mv_g^2 \qquad -(190)$$

so:

$$\hbar\omega_K \sim \frac{1}{2}mv_g^2. \qquad -(191)$$

Similarly, in the non relativistic limit:

$$\hbar\kappa \sim mv_g + \frac{1}{2}m\frac{v_g^3}{c^2}, \qquad -(192)$$

so the least wavenumber, κ_0, is:

$$\hbar\kappa_0 \sim mv_g \qquad -(193)$$

and the kinetic wavenumber is:

$$\hbar\kappa_K \sim \frac{1}{2}mv_g^3/c^2. \qquad -(194)$$

The total angular frequency in this limit is:

$$\omega = \omega_0 + \omega_K \qquad -(195)$$

and the total wavenumber is:

$$\kappa = \kappa_0 + \kappa_K \quad -(196)$$

The kinetic energy of the photon was defined by de Broglie by omitting the least (or "rest") frequency:

$$T = \hbar\omega_K \sim \frac{1}{2} m v_g^2 = \frac{p^2}{2m} \quad -(197)$$

where:

$$p = m v_g . \quad -(198)$$

Using Eqs. (189) and (193) it is found that:

$$v_p = \frac{c^2}{v_g} = \frac{\omega_0}{\kappa_0} \quad -(199)$$

and using Eqs. (191) and (194)

$$v_p = \frac{c^2}{v_g} = \frac{\omega_K}{\kappa_K} \quad -(200)$$

Therefore:

$$v_p = \frac{\omega}{\kappa} = \frac{\omega_0 + \omega_K}{\kappa_0 + \kappa_K} \quad -(201)$$

a possible solution of which is:

$$\frac{\omega_K}{\kappa_0} = v_p . \quad -(202)$$

Using Eqs. (193) and (191):

$$\frac{\omega_K}{\kappa_0} = \frac{1}{2} v_g \quad -(203)$$

so it is found that in these limits:

$$v_g = 2v_p. \quad (204)$$

The work of de Broglie has been extended in this chapter to give a simple derivation of the cosmological red shift due to the existence of photon mass, and conversely, the red shift is a cosmological proof of photon mass. In standard model texts, photon mass is rarely discussed, and the work of de Broglie is distorted and never cited properly. The current best estimate of photon mass is of the order of 10^{-52} kg. In UFT 150B and UFT 155 on www.aias.us the photon mass from light deflection was calculated as:

$$m = \frac{R_0}{c^2 a} E \quad (205)$$

using:

$$E = \hbar\omega. \quad (206)$$

This gave the result:

$$m = 3.35 \times 10^{-41} \text{ kg}. \quad (207)$$

Here R_0 is the distance of closest approach, taken to be the radius of the sun:

$$R_0 = 6.955 \times 10^8 \text{ m} \quad (208)$$

and a is a distance parameter computed to high accuracy:

$$a = 3.3765447822 \times 10^4 \text{ m} \quad (209)$$

In a more complete theory, given here, the photon in a light beam grazing the sun has a mean energy given by the Planck distribution {1 - 10}:

$$\langle E \rangle = \hbar\omega \left(\frac{e^{-\hbar\omega/(kT)}}{1 - e^{-\hbar\omega/(kT)}} \right) \quad (210)$$

where k is Boltzmann's constant and T the temperature of the photon. It is found that a photon mass of:

$$m = 9.74 \times 10^{-52} \text{ kg} \quad -(211)$$

is compatible with a temperature of 2,500 K. The temperature of the photosphere at the sun's surface is 5,778 K, while the temperature of the sun's corona is 1 - 3 million K. Using Eq. (176) it is found that:

$$v_g = 2.99757 \times 10^{8} \text{ ms}^{-1} \quad -(212)$$

which is less than the maximum speed of relativity theory:

$$c = 2.9979 \times 10^{8} \text{ ms}^{-1}. \quad -(213)$$

As discussed in Note 157(13) the mean energy < E > is related to the beam intensity I in joules per square metre by

$$I = 8\pi \left(\frac{f}{c}\right)^2 \langle E \rangle \quad -(214)$$

where f is the freqeuncy of the beam in hertz. The intensity can be expressed as:

$$I = 8\pi f^2 m \left(1 - \frac{v_g^2}{c^2}\right)^{-1/2} \quad -(215)$$

The total energy density of the light beam in joules per cubic metre is:

$$U = \frac{f}{c} I \quad -(216)$$

and its power density in watts per square metre (joules per second per square metre) is:

$$\Phi = cU = fI = 8\pi f^3 m \left(1 - \frac{v_g^2}{c^2}\right)^{-1/2} \quad -(217)$$

The power density is an easily measurable quantity, and implies finite photon mass through Eq. (217). In the standard model there is no photon mass, so there is no power density, an absurd result. The power density is related to the magnitude of the electric fiedl strength (**E**) and the magnetic flux density (**B**) of the beam by:

$$\underline{\Phi} = \epsilon_0 c E^2 = \frac{cB^2}{\mu_0} . \qquad -(218)$$

The units in S. I. are as follows:

$$\left.\begin{aligned} E &= \text{volt}\ m^{-1} = J C^{-1} m^{-1} \\ B &= \text{tesla} = J s C^{-1} m^{-2} \\ \epsilon_0 &= J^{-1} C^2 m^{-1} \\ \mu_0 &= J s^2 C^{-2} m^{-1} \end{aligned}\right\} \qquad -(219)$$

where ϵ_0 and μ_0 are respectively the vacuum permittivity and permeability defined by:

$$\epsilon_0 \mu_0 = 1/c^2 \qquad -(220)$$

so:

$$\underline{\Phi} = 8\pi f^3 m \left(1 - \frac{v_g^2}{c^2}\right)^{-1/2} = \epsilon_0 c E^2 = \frac{cB^2}{\mu_0} . \quad -(221)$$

4. 6 DIFFICULTIES WITH THE EINSTEIN THEORY OF LIGHT DEFLECTION DUE TO GRAVITATION.

The famous Einstein theory of light deflection due to gravitation is based on the idea of zero photon mass because in 1905 Einstein inferred such an idea from the basics of special relativity, he conjectured that a particle can travel at c if and only if its mass is identically zero, and assumed that photons travelled at c. Poincaré on the other hand realized that photons can travel at less than c if they have mass, and that c is the constant in the Lorentz transform. The Einsteinian calculation of light deflection due to gravitation was therefore based on the then new general relativity applied with a massless particle. In the influential UFT 150B on www.aias.us it was shown that Einstein's method contains several fundamental errors. However precisely measured, such data cannot put right these errors, and the Einstein theory is completely refuted experimentally in whirlpool galaxies, so that it cannot be used anywhere in cosmology.

The Einstein method is based on the gravitational metric:

$$ds^2 = c^2 d\tau^2 = c^2 dt^2 \left(1 - \frac{r_0}{r}\right) - dr^2 \left(1 - \frac{r_0}{r}\right)^{-1} - r^2 d\phi^2 \quad (222)$$

usually and incorrectly attributed to Schwarzschild. Here, cylindrical polar coordinates are used in the XY plane. In Eq. (220) r_0 is the so called Schwarzschild radius, the particle of mass m orbits the mass M, for example the sun. The infinitesimal of proper time is $d\tau$.

The lagrangian for this calculation is:

$$\mathcal{L} = \frac{m}{2}\left(\left(\frac{dt}{d\tau}\right)^2 \left(1 - \frac{r_0}{r}\right) - \left(1 - \frac{r_0}{r}\right)^{-1} \left(\frac{dr}{d\tau}\right)^2 - r^2 \left(\frac{d\phi}{d\tau}\right)^2\right) \quad (223)$$

and the total energy and momentum are given as the following constants of motion:

$$E = mc^2 \left(1 - \frac{r_0}{r}\right)\frac{dt}{d\tau}, \quad L = mr^2 \frac{d\phi}{d\tau}. \quad (224)$$

Since m << M the Schwarzschild radius is:

$$r_0 = \frac{2MG}{c^2} \quad (225)$$

Therefore the calculation assumes that the mass m is not zero. For light grazing the sun, this is the photon mass.

The equation of motion is obtained from Eq. (222) by multiplying both sides by $1 - \frac{r_0}{r}$ to give:

$$m\left(\frac{dr}{d\tau}\right)^2 = \frac{E^2}{mc^2} - \left(1 - \frac{r_0}{r}\right)\left(mc^2 + \frac{L^2}{mr^2}\right) \quad (226)$$

The infinitesimal of proper time is eliminated as follows:

$$\frac{dr}{d\tau} = \frac{d\phi}{d\tau}\frac{dr}{d\phi} = \left(\frac{L^2}{mr^2}\right)\frac{dr}{d\phi} \quad -(227)$$

to give the orbital equation:

$$\left(\frac{dr}{d\phi}\right)^2 = r^4\left(\frac{1}{b^2} - \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right) \quad -(228)$$

where the two constant lengths a and b are defined by:

$$a = \frac{L}{mc}, \quad b = \frac{cL}{E}. \quad -(229)$$

The solution of Eq. (228) is:

$$\phi = \int \frac{1}{r^2}\left(\frac{1}{b^2} - \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right)^{-1/2} dr \quad -(230)$$

and the light deflection due to gravitation is:

$$\Delta\phi = 2\int_{R_0}^{\infty} \frac{1}{r^2}\left(\frac{1}{b^2} - \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right)\right)^{-1/2} dr - \pi \quad -(231)$$

where R_0 is the distance of closest approach, essentially the radius of the sun. Using:

$$u = 1/r, \quad du = -\frac{1}{r^2}\,dr \quad -(232)$$

the integral may be rewritten as:

$$\Delta\phi = 2\int_{0}^{1/R_0} \left(\frac{1}{b^2} - \left(1 - r_0 u\right)\left(\frac{1}{a^2} + u^2\right)\right)^{-1/2} du - \pi \quad -(233)$$

If we are to accept the gravitational metric for the sake of argument its correct use must be to assume an identically non zero photon mass and to integrate Eq. (233), producing an equation for the experimentally observed deflection $\Delta\phi$ in terms of m, a and b.

However, because of his conjecture of zero photon mass, Einstein used the null geodesic condition:

$$ds^2 = 0 \qquad -(234)$$

which means that m is identically zero. This assumption means that:

$$a = \infty . \qquad -(235)$$

However, the angular momentum is L is a constant of motion, so Eq. (235) means:

$$m = 0, \quad \frac{d\phi}{d\tau} = \infty \qquad -(236)$$

which in the obsolete physics of the standard model was known as the ultrarelativistic limit. In this Einsteinian light deflection theory Eq. (223) is defined to be pure kinetic in nature , but at the same time the theory sets up an effective potential:

$$V(r) = \frac{1}{2} mc^2 \left(-\frac{r_0}{r} + \frac{a^2}{r^2} - \frac{r_0 a^2}{r^3} \right) \qquad -(237)$$

and also assumes circular orbits:

$$\frac{dr}{d\tau} = 0 . \qquad -(238)$$

However, this assumption means that:

$$\frac{1}{b^2} = \left(1 - \frac{r_0}{r}\right)\left(\frac{1}{a^2} + \frac{1}{r^2}\right) \qquad -(239)$$

and the denominator of Eq. (230) becomes zero and the integral becomes infinite. In order to circumvent this difficulty Einstein assumed:

$$\frac{r_0}{r} \rightarrow 0 \qquad -(240)$$

which must mean:

$$r \rightarrow \infty \quad -(241)$$

and

$$m \rightarrow 0, \quad a \rightarrow \infty. \quad -(242)$$

The effective potential was therefore defined as:

$$V(r) \xrightarrow[m\rightarrow 0,\, a\rightarrow\infty,\, r\rightarrow\infty]{} mc^2\left(\frac{a}{r}\right)^2\left(1-\frac{r_0}{r}\right) \quad -(243)$$

which is mathematically indeterminate. Einstein also assumed:

$$mc^2 \longrightarrow 0 \quad -(244)$$

so the equation of motion (229) becomes:

$$\frac{E^2}{2mc^2} = \frac{L^2}{mr^2}\left(\frac{1}{2} - \frac{MG}{c^2 r}\right). \quad -(245)$$

He used:

$$r = R_0 \quad -(246)$$

in this equation, thus finding an expression for b_0:

$$\frac{1}{b_0^2} = \frac{1}{R_0^2} - \frac{r_0}{R_0^3}. \quad -(247)$$

Finally he used Eq. (247) in Eq. (233) with:

$$a^2 \rightarrow \infty \quad -(248)$$

to obtain the integral:

$$\Delta\phi = 2\int_0^{1/R_0}\left(\frac{R_0 - r_0}{R_0^3} - u^2 + r_0 u^3\right)^{-1/2} du \; - \pi \quad -(249)$$

It was claimed by Einstein that this integral is:

$$\Delta\phi = \frac{4MG}{c^2 R_0} \quad -(250)$$

but this is doubtful for reasons described in UFT 150B, whose calculations were all carried out with computer algebra. The experimental result for light grazing the sun is given for example by NASA Cassini as

$$\Delta\phi = 1.75'' = 8.484 \times 10^{-6} \text{ rad}, \quad -(251)$$

but eq. (250) depends on the assumption of data such as:

$$R_0 = 6.955 \times 10^8 \text{ m}, \; M = 1.9891 \times 10^{30} \text{ kg}$$

$$G = 6.67428 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-2}. \quad -(252)$$

In fact only MG is known with precision experimentally, not M and G individually. The radius R_0 is subject to considerable uncertainty. If we accept the dubious gravitational metric for the sake of argument, the experimental data must be evaluated from Eq. (231) with finite photon mass, and independent methods used to evaluate a and b.

Einstein's formula (249) for light deflection depends on the radius parameters R_0 and r_0. R_0 represents the radius of the sun (6.955×10^8 metres) while the so called Schwarszchild radius r_0 is 2,954 metres. So:

$$r_0 << R_0 \quad -(253)$$

which implies from Eq. (247) that:

$$b_0 \sim R_0. \quad -(254)$$

This gives the integral:

$$\Delta \phi = 2 \int_0^{1/R_0} \left(\frac{R_0 - r_0}{R_0^3} - u^2 + r_0 u^3 \right) du - \pi \quad -(255)$$

which has no analytical solution. Its numerical integration is also difficult, even with contemporary methods. The square root in the integral has zero crossings, leading to infinite values of the integrand and as discussed in Section 3 of UFT 150B there is a discrepancy between the experimental data, Einstein's claim and the numerical evaluation of the integral.

The correct method of evaluating the light defelction is obviously to use a finite mass m in Eq. (231). In a first rough approximation, UFT 150B used:

$$E = \hbar \omega \quad -(256)$$

for one photon. More accurately a Planck distribution can be used. However Eq. (256) gives:

$$a = \frac{\hbar \omega}{m c^2} b. \quad -(257)$$

The parameter b is a constant of motion, and is determined by the need for zero deflection when the mass M of the sun is absent. This gives:

$$\Delta \phi = 2 \int_0^{1/R_0} \left(\frac{1}{b^2} - u^2 \right)^{-1/2} du - \pi = 0 \quad -(258)$$

and as described in UFT 150B this gives a photon mass of:

$$m = 3.35 \times 10^{-41} \text{ kg} \quad -(259)$$

which again a lot heavier than the estimates in the standard literature.

So in summary of these sections, the B(3) field implies a finite photon mass which can be estimated by Compton scattering and by light deflection due to gravitation. The photon mass is not zero, but an accurate estimate of its value needs refined calculations. These are simple first attempts only. There are multiple problems with the claim that light deflection by the sun is twice the Newtonian value, because the latter is itself heuristic, and because Einstein's methods are dubious, as described in UFT 150B and UFT 155. The entire Einstein method is refuted by its neglect of torsion, as explained in great detail in the two hundred and sixty UFT papers available to date.