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Differences between general relativity and dynamical theory of gravitation in the resolution of radar sounding phenomenon to the order of C^{-5}

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Abstract

In a paper titled "Resolution of Radar Sounding Phenomena to the order of c^{-5}. According to General Theory of Relativity (GTR)" it was shown how the GTR resolved the radar sounding phenomena to the order of c^{-5} within the gravitational field established by the homogenous spherical massive sun. also in a paper titled "Resolution of Radar Sounding Phenomena to the order of c^{-5} according to Dynamical Theory of gravitation (DTR), it was shown how the DTG resolved the radar sounding phenomena to the order of c^{-5} within the gravitational field established by the homogeneous spherical massive sun. In this paper, the difference in the resolution of the radar sounding phenomena to the order of c^{-5} by the GTR and DTG shall be examined.

1.0 Introduction

In the year 1916 K. Schwarzchild provided one of the exact solutions to the Einstein's field equation of gravitation[1], called the Schwarzschild's centro-symmetric metric in the spherical polar coordinate system $(r,\theta,\phi,)$ as:

$$ds^2 = g_{00}(r)dt^2 + g_{11}(r)dr^2 - r^2(d\theta^2 + \sin^2\theta\, d\phi) \qquad (1.1)$$

where g_{00}, g_{11}, g_{22}, and g_{33} are metric tensors and chosen to be

$$g_{00} = (1+f)c^2 \qquad (1.2)$$

$$g_{11} = -(1+f)^{-1} \qquad (1.3)$$

$$g_{22} = -r^2 \qquad (1.4)$$

$$g_{33} = -r^2 \sin^2\theta \qquad (1.5)$$

Using the knowledge of the Christofel curvature[2], $f(r)$ in equation (1.2) and (1.3) has been calculated to be:

$$f(r) = -\frac{2GM}{c^2 r} \qquad (1.6)$$

where

M = mass of gravitating body
G = universal gravitational constant

c = speed of light in vacuo
r = radial coordinate distance

t = coordinate time
s = surface element

Indeed the Schwarzchild's centro symmetric metric in equation (1.1) has been applied to resolve the radar sounding phenomenon to the order of $(c^{-3})^1$ and extended to the order of $(c^{-5})^3$. Other physical observations that have been resolved are:

(i) Orbital perihelion precession [1]
(ii) Gravitational Deflection of starlight [1]
(iii) Gravitational red-shift [1] etc.

In resolving the radar sounding phenomena an observer fixed in space within the field of the homogenous spherical massive sun would need to send radar pulses in radial direction towards a small body compared to the massive sun (see figure 1).

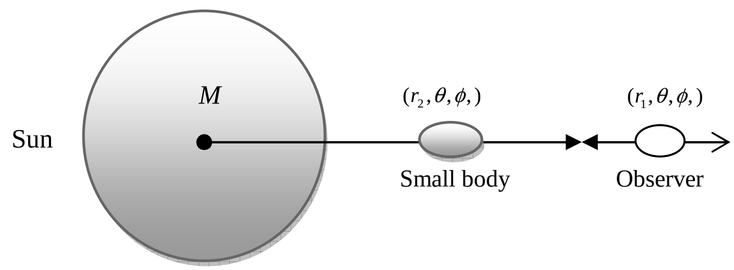

Figure 1.1: "*Radar Sounding Experiment*"

With the arrangement in figure 1.1 and applying equation (1.1), the GTR resolved the radar sounding phenomena to the order of c^{-5} within the gravitational field of the homogenous spherical massive sun as [3].

$$D\tau_0 = \frac{2GM}{C^3}\left\{l_n\left(\frac{r_1}{r_2}\right) - \left(\frac{r_1 - r_2}{r_1}\right)\right\} - \frac{2G^2M^2}{C^5 r_1}\left\{l_n\left(\frac{r_1}{r_2}\right) + \frac{1}{8}(r_1 - r_2)\right\} \qquad (1.7)$$

In the year 1991 the dynamical theory of gravitation (DTG) was published [5]. The fundamental principles and laws of the theory for radar or pulses (photons) are as follows:

A photon moving with an instantaneous frequency, v, possesses an instantaneous inertial energy, T, given by [4].

$$T = hv \qquad (1.8)$$

In all inertial references frames and times, h is the Planck's constant. It follows from equation (1.8) that a photon moving with an instantaneous frequency, v, possesses and instantaneous inertial mass m_i and passive mass m_p and active mass m_a given as in [4].

$$m_i = m_p = m_a = \frac{h\upsilon}{c^2} \qquad (1.9)$$

in all proper inertial reference frames and proper times. We c is the speed of light in vacuum, and also, if a photon moves with an instantaneous frequency v, and velocity $\underline{u}$ in a gravitational field having an instantaneous scalar potential, Φ_g, in such a way that the rate of change of its linear momentum is equal to the total external gravitational force acting on it [4], then

$$\frac{d}{dt}\left\{\frac{h\upsilon}{c^2}\underline{U}\right\} = -\frac{h\upsilon}{c^2}\underline{\nabla}\Phi_g \qquad (1.10)$$

in all proper inertial reference frames and proper times. $\underline{\nabla}$ is the del-operator is spherical coordinate system.

With the help of the Dynamical law of motion for photons in gravitational fields as in equation (1.10), the DTG has resolved satisfactorily the radar sounding phenomena to the order of $(c^{-3})^5$ and extended to the order of $(c^{-5})^{-6}$. Other physical observations that have been resolved are:

(i) Gravitational time dilation [7]
(ii) Gravitational length contraction [8].
(iii) Orbital prehelion precession

In resolving the radar sounding phenomena an observer fixed in space within the filed of homogeneous spherical massive sun would have to send pulses in radial direction towards a small body compared to the massive sun (see Figure 1.1). Applying equation (100) to the arrangement in Figure 1.1, DTG resolved the radar sounding phenomena to the order of c^{-5} within gravitational fields of the homogeneous spherical massive sun as

$$D\tau = \frac{2GM}{C^3}\left\{l_n\left(\frac{r_1}{r_2}\right) - \left(\frac{r_1-r_2}{r_1}\right)\right\} - \frac{2G^2M^2}{C^5 r_1}\left\{l_n\left(\frac{r_1-r_2}{r_1 r_2}\right) - \frac{1}{r_1}\left(\frac{r_1-r_2}{r_1 r_2}\right)\right\} \qquad (1.11)$$

2.0 Evaluation of radar time delays to the order of C^{-5} according to general relativity (GR) and dynamical theory of gravitational (DTG) in the solar system

Experimental tests considering Mercury and Venus in the solar system as small body and observer respectively and using the space crafts, mariner 6 and 7 yielded agreement between theoretical vale and experimental value to the uncertainty of 20 percent in 1968, 5 percent in 1971 and 3 percent in 1975 [1]. The above results were obtained based on the resolution of the radar sounding phenomena to the order of c^{-3}.

In order to compute the time delays suffered by the radar signals as resolved by the GRT and DTG to the order of c^{-5} we collect the various radial distances of the respective planets from the sun in the solar system and substitute in equation (1.7) and (1.11), then we have tables 1 and 2.

Table 2.1: Time delay experienced by radar signals according to GRT

S/N	**Planets → Planet**	$(r_1 - r_2)\times 10^9 m$	$\frac{1}{c^4}\left(\frac{1}{r_1} - \frac{1}{r_2}\right)$	$\ln\left(\frac{r_1}{r_2}\right)$	$r_1 - r_2 \frac{1}{8} r_1 \frac{r_1}{r_2}$	$D\tau_0(s)$
1	Earth → Mercury	92.10	0.024	25.273	0.262	25.04
2	Earth → Venus	42.00	0.007	8.734	0.041	8.70
3	Earth → Mars	78.00	0.004	11.123	0.027	11.10
4	Earth → Jupiter	682.00	0.011	43.700	3.742	39.97
5	Earth → Saturn	1280.00	0.013	59.863	9.621	50.26

6	Earth → Uranus	3020.00	0.013	78.340	29.707	48.65
7	Earth → Neptune	4350.00	0.013	90.285	49.145	41.14

$$\frac{2GM}{c^3} = \frac{2k}{c} \approx 8 \cdot 849 \times 10^{11}$$

$$\frac{2G^2M^2}{c^5} = \frac{2k}{c^2} \approx 176 \cdot 173 \times 10^{11}$$

s = seconds, m = meters.

A graph of $(r_1 - r_2)$ in meters versus the time day ($D\tau_0$) in seconds of the radar signals plotted from Table 2.1 shows direct proportionality between the earth and inner planets but behaves differently with the outer planets.

Table 2.2: Time delay experienced by radar signals according to DTG.

S/N	Planets → Planet	$(r_1 - r_2) \times 10^9 m$	$\frac{r_1 - r_2}{r_1}$	$\ln\left(\frac{r_1}{r_2}\right)$	$\frac{r_1 - r_2}{r_1 r_2}$	$D\tau(s)$
1	Earth → Mercury	92.10	24.038	12.424	1.245	37.684
2	Earth → Venus	42.00	10.962	4.293	0.304	15.553
3	Earth → Mars	78.00	20.358	5.468	0.268	26.089
4	Earth → Jupiter	682.00	178.002	21.480	0.686	200.155
5	Earth → Saturn	1280.00	334.080	29.472	0.701	364.195
6	Earth → Uranus	3020.00	788.220	38.511	0.824	827.540
7	Earth → Neptune	4350.00	1135.350	44.383	0.757	1180.480

$$\frac{2GM}{c^3} = \frac{2k}{c} \approx 39 \cdot 15 \times 10^{22}$$

$$\frac{2G^2M^2}{c^5} = \frac{2k}{c^2} \approx 117 \cdot 449 \times 10^{30}$$

s = seconds, m = meters.

A graph of $(r_1 - r_2)$ in meters versus the time delay ($D\tau$) in seconds of the radar signals shown in figure 2.1 and shows direct proportionality between the earth all the planets (both inner and outer).

It may be interesting comparing the total time delays experience by the radar signals as they travel within the gravitational field of the homogenous spherical massive sun according to GRT and DTG (See table 2.3).

Table 2.3: Time delays of radar signals according to GRT and DTG.

S/n	Planets → Planet	$(r_1 - r_2) \times 10^9 m$	$D\tau_0(s)$	$D\tau(s)$

1	Earth $\to$ Mercury	92.10	25.04	37.68
2	Earth $\to$ Venus	42.00	8.70	15.55
3	Earth $\to$ Mars	78.00	11.10	26.09
4	Earth $\to$ Jupiter	682.00	39.97	200.16
5	Earth $\to$ Saturn	1280.00	50.26	364.20
6	Earth $\to$ Uranus	3020.00	48.65	827.54
7	Earth $\to$ Neptune	4350.00	41.14	1180.48

The graphs of total distance travelled $(r_1 - r_2) \times 10^9 m$ versus the total time delays, $D\tau_0$(s) and $D\tau$(s) are presented in Figure 2.1

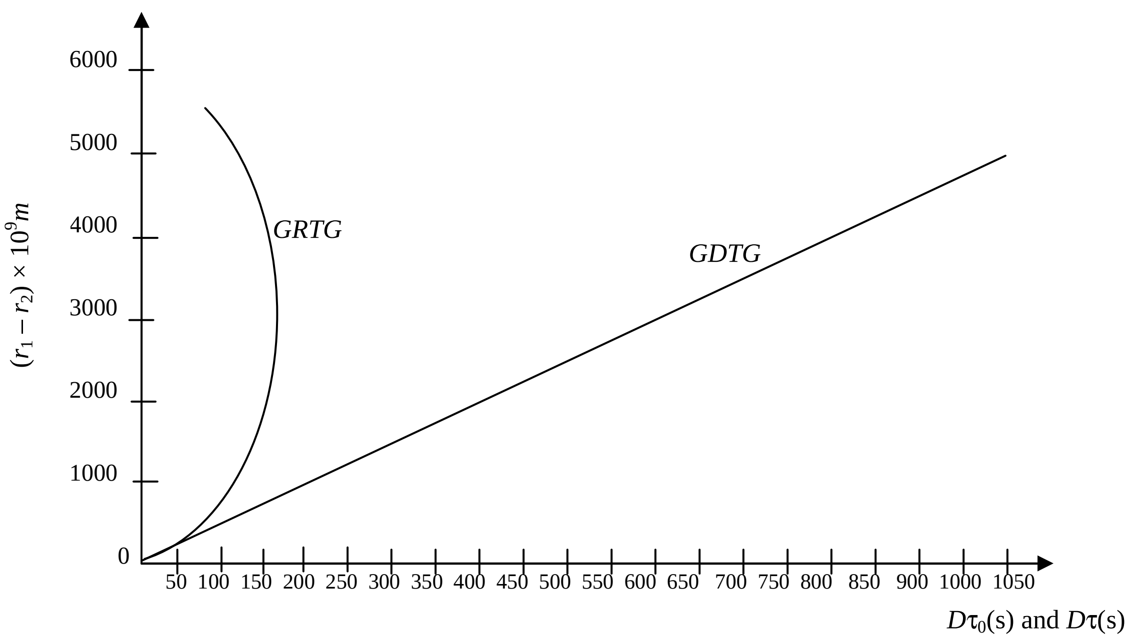

Figure 2.1: Comparism of Time Delays According to GRT and DTG

3.0 Summary and conclusion

In this paper we have examined the resolution of the radar sounding phenomena to the order of c^{-5} according to:

(i) **The general relativity theory (GRT)**

Here the time delay ($D\tau_0$) by the radar pulses is given as in equation (1.7) and table 1 gives the numerical values for computing the theoretical time day of the radar signals from one planet to another.

(ii) **The dynamic theory of gravitation (DTG)**

Here the time delay ($D\tau$) is given by equation (1.11) and table 2.2 gives the numerical values for computing the theoretical time delay of the radar signals from one planets to another.

Examining equation (1.7) and (1.11), it shows that there is no difference in the resolution of the radar sounding phenomena to the order of c^{-3} by both theories (GRT) and DTG) (see figure 2.1). However to the order of c^{-5}, there is a remarkable difference between them in the resolution of the radar sounding phenomena.

According to GRT the distance ($r_1 - r_2$) versus time delay($D\tau_0$) graph in figure 2.1 shows direct proportionality between earth and the inner planets which is in accordance with natural expectation but the proportionality does not held between earth and the outer planets. What is responsible for this type of unexpected situation? Could it be that the position at which the outer planets are situated relative to the earth curves towards the earth as suggested by GRT that gravitation is a phenomena of curving of space and not a force concept.

According to DTG the distance ($r_1 - r_2$) versus time delay($D\tau_0$) graph also in figure 2.1 shows direct proportionality between earth and the planets. This is in accordance with natural expectation because DTG suggest that gravitation is a force concept and not curving of space as put forward by GRT.

References

[1] J.D. Nightingale (1979): General Relativity Longman, London, pp2-30

[2] H. A. Atwater (1974): Introduction to General Relativity, Butter Wroths, London, pp31-42

[3] Y. Y. Jabil and S. X. K. Howusu (2002): A Dynamical Theory of Radar Sounding Zuma Journal of Pure & Applied Science 4 (2).

[4] S.X.K. Howusu (2005): General Mechanics of a Photon in the Gravitational Field of a Stationary Homogenous Spherical Bodies – Aperion (Montreal), 31(1) 10-31.

[5] S.X.K. Howusu (1991): On the Gravitational of Moving Bodies, Physics Essays (Ottawa(4(1) 81 – 93.

[6] S. X. K. Howusu (2000): A Dynamical Theory of Radar Gravitational Length Contribution (submitted to Galilean Electro dynamics in Nov. 2000).

[7] S. X. K. Howusu (2000): A Dynamical Theory of Gravitational Time Daliation (submitted to Galilean Elecrro dynamics in Nov. 2002).

[8] S. X. K. Howusu (1996): Cosmological Red shift: Experimental Detection of Gravitational Radiation. Aperion (Montreal) 3(1): 10 – 13.