The Gravitation Dependence of the Speed of the Light
and the Pioneer 10&11 Acceleration Anomaly Explanation

(Rapid Communications <RC>)

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Abstract

In the article the "ether" is considered to be the "warped space-time of the Universe" itself. Unambiguous results for the presence of anisotropy of the speed of light are obtained up to now.

The approach in this paper is that fairness requires that experiments have to be related to the reference system, associated with the space itself, where the Earth moves and warps the space around. The results:

- Constant speed of light in time-spatial domains with equal gravitational potential.
- Explanation of the anomaly in the acceleration of Pioneer 10 and 11 at escaping from the Sun's gravity with "acceleration of the speed of the electromagnetic radiation" emanated from the spacecrafts.

Keywords: general relativity, speed of the light test, Pioneer 10 and Pioneer 11 acceleration anomaly.

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The results of the "one-way" measurements of the speed of light [1] show, that if we connect the coordinate system with the Earth's surface, we get light speed anisotropy results. However, the light is propagated in the space. That's why, it is correct to associate reference coordinate system with the space itself, where the Earth moves, and warps the space around. In this reference coordinate system the light passes different paths depending on the direction.

Let us examine "**One-Way**" light speed determination, the case "Eastward Transmission"[1], where the speed of the light was claimed to be equal to (c-V). In this case, the transmitter, the receiver and the travelling path (trajectory of the light) are in a domain with the same gravitational potential.

Let's assume the same designations as in the One-Way Light Speed Determination [1], where the transmission and reception stations are moving eastward at the speed **V** of the Earth's surface at the same latitude. Then, the light passes a path in the space (from the moment of transmission t_I to the moment of receiving t_F, from the point $X_A(t_I)$ to the $X_B(t_F)$). This path is equal to the distance between the two stations **D** plus the distance **Δ** that the station **B** has passed during the time interval $(t_F–t_I)$ at the speed **V**:

Fig. 1
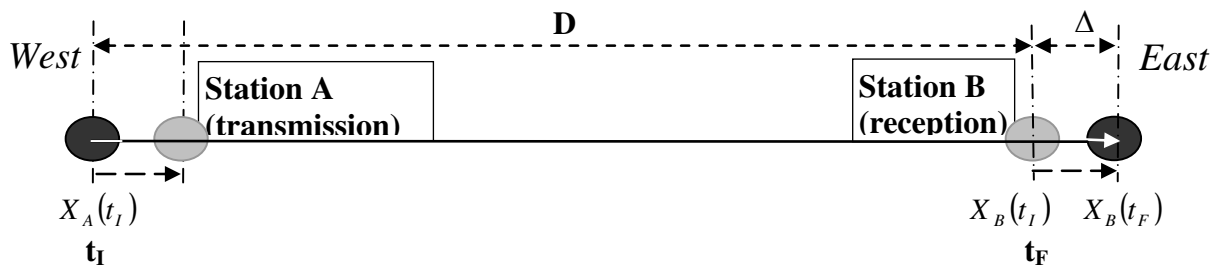
$$(t_F - t_I) = \frac{Path}{c} = \frac{D + \Delta}{c} = \frac{D + V*(t_F - t_I)}{c} \qquad (1)$$
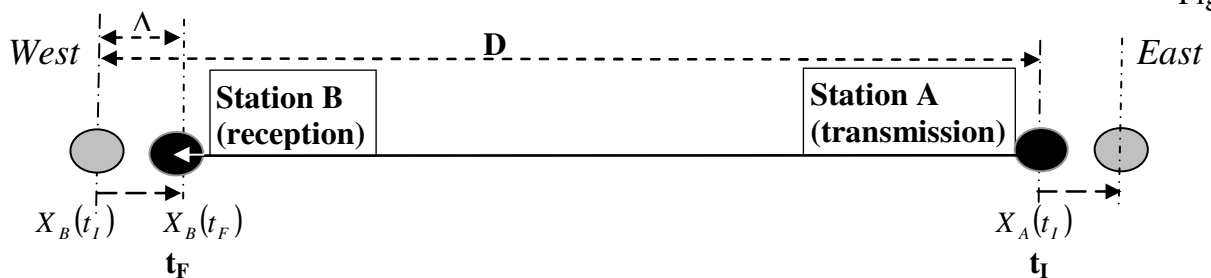
As a result we get the same expression:

$$(t_F - t_I) = \frac{D}{c - V} \qquad (2)$$

But the interpretation of (2) is: "if the light has travelled the path **D** during the time interval $(t_F–t_I)$, then its speed would be **(c-V)**". However, the real path is **(D+Δ)**, and in the space where the light is propagated, the speed of light occurs to be constant.

Let us examine the case "Westward Transmission" [1]:

Fig. 2

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In this case we apply the same approach:

$$\left(t_F - t_I\right) = \frac{Path}{c} = \frac{D - \Delta}{c} = \frac{D - V*\left(t_F - t_I\right)}{c} \tag{3}$$

$$\left(t_F - t_I\right) = \frac{D}{c + V} \tag{4}$$

The interpretation of (4) is not that the speed of the light is equal to (c+V), but: "if the light has travelled the path **D** during the time interval (**t$_F$–t$_I$**), then its speed would be **(c+V)**". However, the real path of the light is (**D-Δ**) and in the space where it is propagated (the domain with the constant gravitational potential) the speed of the light is constant.

Or in the two cases the light travels different paths during different time intervals (**t$_F$–t$_I$**), at a constant speed of light.

The interferometer used in „Michelson-Morley" experiment:

- the light source, detector, "SSM" (Semi-silvered mirror) and the mirrors are horizontally located:

Fig. 3
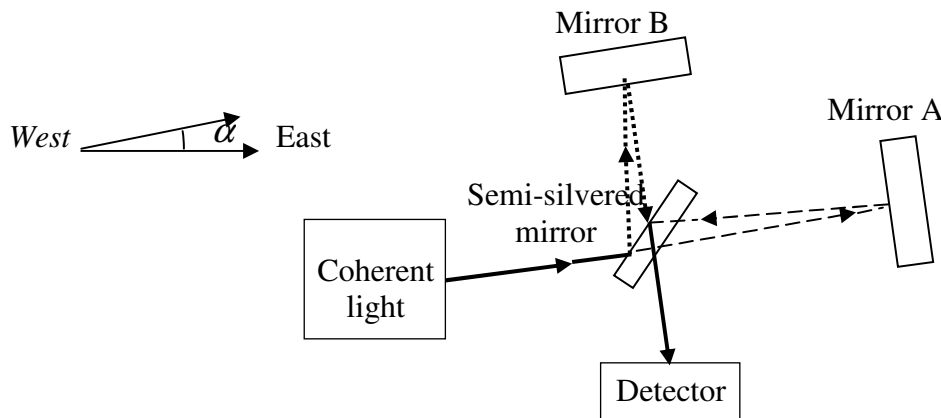
- The SSM, mirror A and mirror B are in the general case at the different latitudes (L$_{SSM}$, L$_A$ and L$_B$) with the corresponding speed of the Earth's surface (V$_{SSM}$, V$_A$ and V$_B$).

If the distances between (SSM-Mirror A) and (SSM-Mirror B) are **D**, the "Two-way path" between (SSM-Mirror A) and (SSM-Mirror B) will depend on Δ, which will be different (V$_{SSM}$, V$_A$ and V$_B$ are different) and this difference will change as the angle α changes. This difference is too small to detect, but in case of "Multiple-way path", obtained by the Mill's Interferometer [2], the difference grows repeatedly.

In all of the above mentioned cases, the objects of the sets of the experiments are **at the same gravitational potential**. The potentials of these objects in relation to the Sun and their potentials to the global location of the Solar system in the Galaxy can be ignored, because the gravitation to the Earth is dominant.

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According to the article by Albert Einstein "*On the Influence of Gravitation on the Propagation of Light*" [3], the speed of light is different in its passage through the time-spatial domain with different gravitational potential:

„If we call the *speed of light* at the origin of co-ordinates c_0, then the *speed of light c* at a place with the gravitation potential Φ will be given by the relation:

$$c = c_0\left(1 + \frac{\Phi}{c^2}\right)$$

The *principle of the constancy of the speed of light* holds good according to this theory in a different form from the one that usually underlies the ordinary theory of relativity." [3]

This approach also gives an explanation to the **Pioneer 10 and 11 Acceleration Anomaly.** The total gravitational potential of certain small spatial domain in the Universe corresponds to the GULW (Global Universe Level of Warping), or to the expansion of the space-time in this domain. The speed of light accelerates in correspondence of GULW of the spatial domain in the Universe which the light passes. Or in any time-spatial domain, GULW depends on $(GL_P+GL_S+GL_G)$, where GL_P is this level depending on the gravitational potential related to the nearest planet; GL_S is this level depending on the gravitational potential related to the Sun; and GL_G is this level depending on the gravitational potential related to the current location of the Solar system in the Galaxy.

The Explanation of the Pioneer 10 and 11 Acceleration Anomaly:

The observed anomaly of the acceleration of the spaceships Pioneer 10 and Pioneer 11 is because of the fact that the **transmitted electromagnetic radiation is with the much higher** speed (and increasing) when the spaceships escape from the Sun gravity. Furthermore, **the part of the whole trajectory** of the electromagnetic waves from the spaceship to the Earth in which the speed of light is much higher than the speed of light at the Earth surface **is increasing too**.

This is actually also a test of Einstein's conclusion in his article "*On the Influence of Gravitation on the Propagation of Light*" [3]**.** The concept of changing speed of light is developed in the article "The Postulate "Invariance of the Speed of Light" [4], which is in a peer review process in the International Journal "Physics Essays" since January 18th, 2011. This article concerns not only the necessity of changing the meaning of some units such as "light-year", the necessity of new universal hierarchical structure of the SI System, the necessity of introducing the **"Uncertainty principle of the macro-world",** but it also gives a solution of problems such as "the accelerated expansion of the Universe", as well as the explanation of the dark matter and the dark energy in the Universe, which have been under research for a long time. A planned continuation of this paper is a proposal for an experiment that proves the change of the speed of light at the changing gravitational potential!

Reference list

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4) G.V. Sharlanov: *The Postulate"Invariance of the Speed of Light",* submitted to Physics Essays (2011).

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