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LIGO Experiments Cannot Detect Gravitational Waves by Using Laser Michelson Interferometers

—Light's Wavelength and Speed Change Simultaneously When Gravitational Waves Exist Which Make the Detections of Gravitational Waves Impossible for LIGO Experiments

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Abstract

It is proved strictly based on general relativity that two important factors are neglected in LIGO experiments by using Michelson interferometers so that fatal mistakes were caused. One is that the gravitational wave changes the wavelength of light. Another is that light's speed is not a constant when gravitational waves exist. According to general relativity, gravitational wave affects spatial distance, so it also affects the wavelength of light synchronously. By considering this fact, the phase differences of lasers were invariable when gravitational waves passed through Michelson interferometers. In addition, when gravitational waves exist, the spatial part of metric changes but the time part of metric is unchanged. In this way, light's speed is not a constant. When the calculation method of time difference is used in LIGO experiments, the phase shift of interference fringes is still zero. So the design principle of LIGO experiment is wrong. It was impossible for LIGO to detect gravitational wave by using Michelson interferometers. Because light's speed is not a constant, the signals of LIGO experiments become mismatching. It means that these signals are noises actually, caused by occasional reasons, no gravitational waves are detected really. In fact, in the history of physics, Michelson and Morley tried to find the absolute motion of the earth by using Michelson interferometers but failed at last. The basic principle of LIGO experiment is the same as that of Michelson-Morley experiment in which the phases of lights were invariable. Only zero result can be obtained, so LIGO experiments are destined failed to find gravitational waves.

Keywords

Gravitational Wave, LIGO Experiment, General Relativity, Special Relativity, Michelson Interferometer, Michelson-Morley Experiment, GW150914, WG151226

1. Introduction

February 11, 2016, LIGO (Laser Interference Gravitational-Waves Observatory) announced to detect gravitational waves events GW150914 [1]. Four months later, they announced to detect another two gravitational events WG151226 and LVT151012 [2]. In LIGO experiments, Michelson laser interferometers were used. Based on general relativity, we proved strictly that by using Michelson interferometers, LIGO cannot detect gravitational waves. The basic principle of LIOGO experiment is wrong. The so-called detections of gravitational waves and the observations of binary black hole mergers are impossible.

The design principle of LIGO experiments is as follows. According to general relativity, gravitational waves stretch and compress space to change the lengths of interferometer's arms. When two lights travelling along two arms which are displaced vertically meet together, the shapes of interference fringes will change. Based on this phase shifts, gravitational waves can be observed.

There are two methods to calculate the phase shift of interference fringes in classical optics. One is to calculate the phase difference of two lights and another is to calculate the time difference of two lights when they arrive at the screen. In LIGO experiments, two of them were used. But the calculations are based on a precondition, *i.e.*, light's speed is a constant.

As well-known, light's phase is related to its wavelength. The stretch and squeeze of space also cause the change of light's wavelength and affect phases. However, LOGO experiment neglected the effect of gravitational wave on the wavelength of light. If the effects of gravitational wave on light's wavelength and interferometer arm's lengths are considered simultaneously, light's phases are unchanged in Michelson interferometers. So it is impossible for LIGO experiments to detect gravitational waves.

On the other hand, light's speed was considered as a constant in LIGO experiments. It is proved strictly based on general relativity that when gravitational waves exist, light's speed is not a constant again. If light's speed is less than its speed in vacuum when it travels along one arm of interferometer, its speed will be great than its speed in vacuum when it travels along another arm, *i.e.*, so-called superluminal motion occurs. In this way, no time differences exist when two lights meet together in Michelson interferometer. Therefore, according to the second method of calculation, LIGO experiments did not detect gravitational waves too.

The other principle problems existing in LIGO experiments are briefly discussed in this paper. The conclusion is that LIGO experiments do not detect gravitational waves and no binary black hole mergers are observed. The signals occurred in LIGO experiments could only be noises caused by some occasional reasons.

2. Light's Phase Difference Is Invariable in LIGO Experiments

According to general relativity, under the condition of weak field, the metric tensor is

$$g_{\mu\nu}(x) = \eta_{\mu\nu} + h_{\eta\nu}(x) \tag{1}$$

Here $\eta_{\mu\nu}$ is the metric of flat space-time and $h_{\mu\nu}(x)$ is a small quantity. Substitute (1) in the Einstein's equation of gravitational field, it can be proved that the modal of gravitational radiation is quadrupole moment. In a small region, we may assume $h_{\eta\nu}(x) = h_{\eta\nu}(t)$. When gravitational wave propagates along the *x*-axis, the intensity of gravitational field is $h_{11}(t)$. While it propagates along the *y*-axis, the intensity is $h_{22}(t)$. It can be proved to have relation $h_{11}(t) = -h_{22}(t)$ [3].

On the other hand, according to general relativity, we have $ds^2 = 0$ for light's motion. Suppose that gravitational wave propagates along the *z*-axis, when lights propagate along the *x*-axis and the *y*-axis individually, we have [4]

$$ds^2 = c^2dt^2 - \left[1 + h_{11}(t)\right]dx^2 = 0 \tag{2}$$

$$ds^2 = c^2dt^2 - \left[1 + h_{22}(t)\right]dy^2 = 0 \tag{3}$$

It is obvious that time is flat but space is curved according (2) and (3). The propagation forms of light are changed when gravitational waves exist. Due to $|h_{11}| \ll 1$, $|h_{22}| \ll 1$ and $h_{11}(t) = -h_{22}(t)$, we have

$$dx = \frac{c}{\sqrt{1 + h_{11}}}dt = c\left(1 - \frac{1}{2}h_{11}(t)\right)dt \tag{4}$$

$$dy = \frac{c}{\sqrt{1 + h_{22}}}dt = c\left(1 + \frac{1}{2}h_{11}(t)\right)dt \tag{5}$$

LIGO experiments used Michelson interferometers to detect gravitational waves. The principle of Michelson interferometer is shown in **Figure 1**. Light is emitted from the source S and split into two beams by beam splitter O. Light 1 passes through O, arrives at reflector M_1 and is reflected by M_1 and O, then arrived at *E*. Light 2 is reflected by

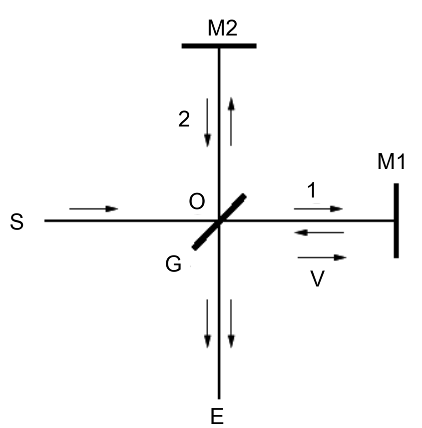

Figure 1. The principle of Michelson interferometers.

O, arrives at M_2 and is reflected, then arrived at E too. Two lights overlay and form interference fringes which can be observed by observer at E.

In order to reveal the problems of LIGO experiments clearly, we discuss the simplest situation. Suppose that the length of interferometer's arm is L_0 and let $h_{11}(t) = h =$ constant. The time interval is $t_2 - t_1 = 2\tau$ when the light moves a round-trip along the arm. The integral of (4) and (5) are

$$x = 2L_0\left(1 - h/2\right), \quad y = 2L_0\left(1 + h/2\right) \tag{6}$$

Here $L_0 = c\tau$. So the optical path difference is $\Delta L = y - x = 2L_0 h$ for lights move along two interferometer's arms. Suppose that the electric fields of lasers are

$$E_x = E_0 \cos\left(\omega t - kx\right), \quad E_y = E_0 \cos\left(\omega t - ky\right) \tag{7}$$

Here, $k = 2\pi/\lambda$, $\omega = 2\pi\nu$ and $\nu\lambda = c$. According to classical optics, by adding two amplitudes together directly and taking square, we obtain light's intensity which is unrelated to time

$$E^2 = \left(E_x + E_y\right)^2 = 2E_0^2\left(1 + \cos\Delta\delta\right) \tag{8}$$

The difference of phases is

$$\Delta\delta = k\left(y - x\right) = \frac{2\pi}{\lambda}\left(y - x\right) \tag{9}$$

If there is no gravitational wave, we have $y = x = 2L_0$ and get $\Delta\delta = 0$. If there is a gravitational wave which passes through the interferometers, according to the current theory, the difference of phases is

$$\Delta\delta = \frac{2\pi}{\lambda}\left(y - x\right) = \frac{4\pi L_0 h}{\lambda} \neq 0 \tag{10}$$

Therefore, gravitational waves would cause the phase changes of interference fringes. By observing the change, gravitational waves would be detected.

However, the calculation above has serious defects. At first, according to general relativity strictly, the formulas (1) and (2) are only suitable for two particles in vacuum without the existence of electromagnetic interaction. In LIGO experiments, two mirrors are hanged in interferometers using fiber material. Interferometers are fixed on the steal tubers which are fixed on the surface of the earth. Whole system is controlled by electromagnetic interaction. As we known, the intensity of electromagnetic interaction is 10^{40} times greater than gravitational interaction. Therefore, gravitational waves cannot overcome electromagnetic forces to change the length of interferometer's aims or make two mirrors vibration by overcoming the stain forces acted on fiber material. This is just the reason why J. Weber's gravitational wave experiments failed. This is the critical defect of LIGO experiments. We have discussed this problem in Document [5], so we do not discuss it any more here.

Second, the major point in this paper is to emphasize that the effect of gravitational wave on the wavelength of light has not been considered in LIGO experiments. In fact, if gravitational wave causes the change of spatial distance, it also causes the change of light's wavelength. Both are synchronous. According to (6), when gravitational waves exist, the wavelengths of lights should become

$$\lambda_x = \lambda(1-h/2),\ \lambda_y = \lambda(1+h/2) \tag{11}$$

when two lights meet together, the difference of phases should be

$$\Delta\delta = 2\pi\left(\frac{y}{\lambda_y}-\frac{x}{\lambda_x}\right) = 2\pi\left(\frac{2L_0}{\lambda}-\frac{2L_0}{\lambda}\right) = 0 \tag{12}$$

Therefore, interference fringes are unchanged. That is to say, it is impossible to detect gravitational waves by using Michelson interferometers. If $h_{11}(t) \neq \text{constant}$, we write it as

$$h_{11}(t) = h\sin(\Omega t+\theta_0) \tag{13}$$

Here, Ω is the frequency of gravitational wave. Substitute (13) in (5) and (6), the integrals become

$$\begin{aligned} x &= 2c\tau - \frac{ch}{2}\int_0^{2\tau}\sin(\Omega t+\theta_0)\,\mathrm{d}t \\ &= L_0 - \frac{ch}{2\Omega}\left[\cos(2\Omega\tau+\theta_0)-\cos\theta_0\right] = L_0(1-A/2) \end{aligned} \tag{14}$$

$$\begin{aligned} y &= 2c\tau + \frac{ch}{2}\int_0^{2\tau}\sin(\Omega t+\theta_0)\,\mathrm{d}t \\ &= L_0 + \frac{ch}{2\Omega}\left[\cos(2\Omega\tau+\theta_0)-\cos\theta_0\right] = L_0(1+A/2) \end{aligned} \tag{15}$$

Here

$$A = \frac{ch}{\Omega L_0}\left[\cos(2\Omega\tau+\theta_0)-\cos\theta_0\right] \tag{16}$$

The result is the same with (6) by substituting A for h.

In LIGO experiments, by assuming that gravitational wave's speed is light's speed in vacuum, the frequency of gravitational wave is $\nu = 30 \sim 300\ \text{Hz}$ and the wavelength is $\lambda = c/\nu = 3\times10^6\ \text{m}$. The length of interferometer's arm is $L_0 = 4\times10^3\ \text{m}$, so we have $\lambda \gg L_0$. In the extent of interferometer size, the wavelength of gravitational wave can be considered as a fixed value. The formula (11) is still suitable by substituting A for h. So, even though (13) was used to describe gravitational waves, LIGO experiments could not detect gravitational waves too.

3. Light's Speed Is Not a Constant When Gravitational Waves Exist

Based on (4) and (5), we can obtain an important conclusion, *i.e.*, light's speed is not a constant again when gravitational waves exist

$$\begin{aligned} V_x &= \frac{\mathrm{d}x}{\mathrm{d}t} = \frac{c}{\sqrt{1+h_{11}}} \approx c\left(1-\frac{1}{2}h_{11}\right) \neq c \\ V_y &= \frac{\mathrm{d}y}{\mathrm{d}t} = \frac{c}{\sqrt{1+h_{22}}} = c\left(1+\frac{1}{2}h_{11}\right) \neq c \end{aligned} \tag{17}$$

This result also causes a great effect on LIGO experiments. The current theory always considers light's speed to be a constant in gravitational fields. According to Reference [4], (17) means that the spatial refractive index becomes $1+h_{kk}/2$ from 1 due to the existence of gravitational waves. In this medium space, light's speed is changed. More interesting is that if $h_{11}>0$, we have $V_x<c$ and $V_y>c$. That is to say, V_y exceeds light's speed in vacuum. How do we explain this result? No one consider this problem at present.

Reference [4] also indicates that "For Gaussian beam, the interval of space-time is not equal to zero. In the laser detectors of gravitational waves, Gaussian beams are used. Do these lights exist in curved space-time?" [4]. According to strict calculation, when gravitational waves exist, the propagation speed of Gaussian beam is

$$V_c = c\left|1-\frac{2}{(k\omega_0)^2+(2z/\omega_0)^2}\right| < c \tag{18}$$

Here, ω_0^2 is the spot size of Gaussian beam, k is the absolute value of wave's vector and z is the coordinate of light beam. These results will cause great influence on the waveform match in LIGO experiment. The original matching signals would become mismatching when comparing them with the templates of waveforms. The conclusion to detect gravitational waves should be reconsidered.

In fact, LIGO team also admits that gravitational wave changes light's wavelength. In the LIGO's FAQ page (https://www.ligo.caltech.edu/page/faq) we can see the following question:

"*If a gravitational wave stretches the distance between the LIGO mirrors, doesn't it also stretch the wavelength of the laser light?*"

The answer of LIGO team is:

"*A gravitational wave does stretch and squeeze the wavelength of the light in the arms. But the interference pattern doesn't come about because of the difference between the length of the arm and the wavelength of the light. Instead it's caused by the different arrival time of the light wave's "crests and troughs" from one arm with the arrival time of the light that traveled in the other arm. To get how this works, it is also important to know that gravitational waves do NOT change the speed of light.*

The answer is very confusing, showing that they aware of the problem but try to escape from it. Then they say

"*But the interference pattern doesn't come about because of the difference between the length of the arm and the* wavelength *of the light.*"

The sentence makes no sense. In the above explanation, we see that

"*Instead it's caused by the different arrival time of the light wave's 'crests and troughs' from one arm with the arrival time of the light that traveled in the other* *arm. To get how this works, it is also important to know that gravitational waves do NOT change the speed of light.*"

In this sentence, LIGO emphases that gravitational waves do not change light's speed. This is the foundation of LIGO experiments. Because this conclusion does not hold, LIGO's explanation is untenable.

It is a confused problem for many physicists whether or not light's speed is a constant in gravitational field. To measurement speed, we first need to have unit ruler and unit clock. According to general relativity, gravitational field cause space-time curved. In the gravitational field, we have too definitions for ruler and clock, *i.e.*, coordinate ruler and coordinate clock, as well as standard ruler and standard clock (or proper ruler and clock). Coordinate ruler and coordinate clock are fixed at a certain point of gravitational field. They vary with the strength of gravitational field. Standard ruler and standard clock are fixed on the local reference frame which falls free in gravitational field. In local reference frame, gravitational force is canceled, so standard ruler and standard clock are unchanged.

It has been proved that if the metric tensor g_{0i} which is related to time is not equal to zero, *i.e.*, $g_{0i} \neq 0$, no matter what ruler and clock are used, light's speed is not a constant. If $g_{0i} = 0$, by using coordinate ruler and coordinate clock, light's speed is not a constant. Using standard ruler and standard clock, light's speed becomes a constant. But in this case, the observer is also located at the reference frame which falls free in gravitational field [3].

In LIGO experiments, observers located at a gravitational field caused by gravitational wave, rather than falling free in gravitational field, so what they used were coordinate ruler and coordinate clock. Therefore, light's speed in LIGO experiments are not a constant. In fact, according to (2), the time part of metric is flat and the spatial part is curved, so the speed $V_x = \mathrm{d}x/\mathrm{d}t$ is not a constant certainly.

According to this definition, by using coordinate ruler and coordinate clock, light's speeds in gravitational fields are generally less its speed in vacuum. For example, light's speed is $V_r = \mathrm{d}r/\mathrm{d}t = c(1-\alpha/r) < c$ in the gravitational field of spherical symmetry according to Schwarzschild metric and $V_r = c\sqrt{1-kr^2}/R < 1$ at present moment with $R = 1$ in the gravitational field of cosmology according to the R-W metric. But in the early period time of cosmos with $R < 1$, light's speed is great than its speed in vacuum. So it is not strange that light's speed may be greater than its speed in vacuum at a certain direction if gravitational waves exist.

4. Phases Shifts Cannot Be Obtained by the Calculation Method of Time Difference in LIGO Experiments

In classical optics, the difference of time is also used to calculate the change of interference fringes. However, it has a precondition, *i.e.*, light's speed is a constant. LIGO experiments used time differences to calculate the changes of interference images [6]. Due to the fact that light's speed is not a constant when gravitational waves exist, we prove that it is impossible to use time difference to calculate the change of interference fringes.

Thought the lengths of interferometer's arms change, the speed of light also changes synchronously, so that the time that light travels along the arms is unchanged too.

Because light's frequency is $\omega = 2\pi\nu = 2\pi c/\lambda$, when gravitational wave exists, if light's speed is unchanged but the wavelength changes, the frequency ω will change. In this case, (7) should be written as

$$E_x = E_0 \cos\left(\omega_x t - k_x x\right),\ E_y = E_0 \cos\left(\omega_y t - k_y y\right) \tag{19}$$

when two lights are superposed, we cannot get (8). The result is related to time and becomes very complex. If light's speed is not a constant, according to (6) and (11), we have

$$\omega_x = 2\pi\nu_x = \frac{2\pi V_x}{\lambda_x} = \frac{2\pi c}{\lambda} = \omega,\ \omega_y = 2\pi\nu_y = \frac{2\pi V_y}{\lambda_y} = \frac{2\pi c}{\lambda} = \omega \tag{20}$$

In this case, light's frequency is invariable and the formula (8) is still tenable. So, when gravitational waves exist, we should think that light moves in medium. Light's frequency is unchanged but its speed and wavelength change. Only in this way, we can reach consistency in physics and logic. In fact, (20) is well-found in classical physics. As mentioned in [7], in a static medium, wave's speed changes but frequency does not change, so wavelength also changes.

We know from (7) that light's phase is determined by both factors ωt and kx. Here $kx = 2\pi x/\lambda$ is an invariable quantity according to discussion above. Because of $\omega = 2\pi\nu = 2\pi/T$ and T is the period of light which changes with t synchronously. We always have $\omega' = 2\pi\nu' = 2\pi t'/T' = 2\pi t/T = \omega$. Because gravitational waves do not affect time t, the phase ωt of light is also unchanged in LIGO experiments.

5. The Problems Existing in the Third Method to Calculate Phase Shifts of Light

There is a more complex method to calculate the phase shift of light for LIGO experiments by considering interaction between gravitational field and electromagnetic field, or by solving the Maxwell's equations in a curved space caused by gravitational wave [8]. This method also has many problems. We discuss them briefly below.

In this calculation, two arms of interferometers are located at the *x*-axis and the *y*-axis. If there is no gravitational wave, the vibration direction of electric field is along the *y*-axis for the light propagating along the *x*-axis (electromagnetic wave is transverse wave), we have

$$E_y^{(0)} = E_0\left[\mathrm{e}^{i(kx-\omega t)} - \mathrm{e}^{-i(kx-\omega t-2ka)}\right] = -F_{02}^{(0)} \tag{21}$$

Here, a is the coordinate of reflect mirror, $F_{ik}^{(0)}$ is electromagnetic tensor. The form of magnetic field is the same, so we do not write it out here. When the light propagates along the *y*-axis, the vibration of electric field is along the direction of *x*-axis with

$$E_x^{(0)} = E_0\left[\mathrm{e}^{i(ky-\omega t)} + \mathrm{e}^{-i(ky-\omega t-2ka)}\right] = -F_{01}^{(0)} \tag{22}$$

Meanwhile, gravitational wave propagates along the *z*-axis with

$$h_{11} = -h_{22} = -A\cos\left(k_g z - \omega_g t\right) \tag{23}$$

when gravitational wave exists, electromagnetic tensors become

$$F_{\mu\nu} = F_{\mu\nu}^{(0)} + F_{\mu\nu}^{(1)} \tag{24}$$

Here, $F_{\mu\nu}^{(1)}$ is a small quantity of electromagnetic field induced by gravitational field. Substitute (24) in the equation of electromagnetic field in curved space-time, the equation $F_{\mu\nu}^{(1)}$ satisfied is [9]:

$$F_{\mu\nu,\rho}^{(1)}\eta^{\rho\nu} = h_{\mu}^{\nu,\rho}F_{\nu\rho,\rho}^{(0)} + h^{\nu\rho}F_{\mu\nu,\rho}^{(0)} + O\left(h^2\right) \tag{25}$$

$$F_{\mu\nu,\rho}^{(1)} = F_{\nu\rho,\mu}^{(1)} + F_{\rho\mu,\nu}^{(1)} = 0 \tag{26}$$

By solving (25) and (26), the concrete form of $F_{\mu\nu}^{(1)}$ can be obtained and the phase shifts caused by gravitational waves can be determined. The phase shifts along two arms are [8]

$$\delta\varphi_x = \frac{A}{2}\frac{\omega}{\omega_g}\sin\omega_g\tau, \quad \delta\varphi_y = -\frac{A}{2}\frac{\omega}{\omega_g}\sin\omega_g\tau \tag{27}$$

The total phase shift between two arms is $\delta\varphi = \delta\varphi_x - \delta\varphi_y$. However, by careful analysis, we find following problems in this calculation.

1) This method is also based on the precondition that light's speed is unchanged. As proved above, this is impossible.

2) Because the phases of lights are not affected by gravitational waves, the forms of (21) and (22) are invariable when gravitational waves exist. We have $F_{\mu\nu}^{(1)} = 0$ in (24), no phase shifts of lights can be obtained by this calculating method.

3) According to (21) and (22), the vibration directions of two lights propagating along the *x*-axis and the *y*-axis are vertical, so they cannot interfere to each other. How did gravitational waves make the shifts of interference fringes? This is another basic problem for this calculation method.

In addition, the phase differences $\delta\varphi_x$ and $\delta\varphi_x$ caused by gravitational waves cannot be obtained independently and simultaneously by solving Equations (25) and (26). The author of the paper admitted that "we solve these equations in a special orientation which does not correspond to an actual interferometer arm" [9]. So the paper introduced "a fictitious system which is composed of an electromagnetic wave propagating along the *z* axis, …is perturbed by a gravitational wave moves along the *y*-axis." It means that the calculation did not consider the light propagating along another arm of interferometers.

After simplified calculation, a coordinate transformation was used to transform the result to original problem. For the light propagating along the *x*-axis, the coordinate transformations are $t' = t$, $x' = y$, $y' = z$ and $z' = x$ (The coordinate reference frame rotates 90 degrees around the *x*-axis, then rotates 90 degrees around the *z*-axis again along the clockwise directions.) For the light propagating along the *y*-axis, the coordinate transformations are $t' = t$, $x' = x$, $y' = z$ and $z' = -y$ (The coordinate reference frame rotates 90 degrees around the *x*-axis along the anticlockwise direction.).

In this way, two problems are caused.

1) When a light propagates along one arm, the interaction between gravitational wave and electromagnetic field is different from that when two lights propagate along two arms, or the formulas (25) and (26) are different in two situations. So this simplified method cannot represent real experiment processes.

2) After coordinate transformation, the electric field of light originally propagating along the x-axis becomes [8]

$$E_x'^{(0)} = E_0 \left[\mathrm{e}^{i(kz'-\omega t')} - \mathrm{e}^{-i(kz'+\omega t'-2ka)} \right] \tag{28}$$

The electric field of light originally propagating along the z-axis becomes

$$E_x'^{(0)} = E_0 \mathrm{e}^{2ika} \left[\mathrm{e}^{i(kz'-\omega t')} - \mathrm{e}^{-i(kz'+\omega t'-2ka')} \right] \tag{29}$$

The gravitational waves become

$$h_{11} = -h_{33} = -A\cos\left(k_g y' - \omega_g t'\right) \tag{30}$$

It is obvious that though the vibration directions of two lights become the same so that the interference fringes can be created, two lights move along the same directions. The process is inconsistent with real experiments of Michelson interferometers. That is to say, it is hard for this calculating method to reach consistence.

In fact, the result of this calculation contracts with the calculation in this paper. The method of this paper is standard one with clear image and definite significance in physics. If the results are different from it by using other methods, we should consider whether or not other methods are correct.

It is obvious that there are so many foundational problems in theory of LIGO experiments. It is meaningless to declare the detection of gravitational waves. Even thought the experiments are moved to space in future, it is still impossible to detect gravitational wave if Michelson interferometers are used.

6. Comparison between LIGO Experiment and Michelson-Morley Experiment

The principle of detecting gravitational wave by using Michelson interferometers was first proposed by M. E. Gertenshtein and V. I. Pustoit in early 1960s [8] and G. E. Moss, etc. in 1970s [9]. However, before Einstein put forward special relativity, A. A. Michelson and E.W. Money spent decades to conduct experiments by using Michelson interferometer, trying to find the absolute movement of the earth but failed at last. This result led to the birth of Einstein's special relativity. The explanation of special relativity for this zero result is based on the length contraction of interferometer. When one arm which moved in speed V contracted, another arm which was at rest was unchanged. The speed of light was considered invariable in the process so that no any shift of interference fringes was observed.

It is obvious the principle of LIGO experiment is the same as that in Michelson experiments. Because Michelson's experiments could not find the changes of interference fringes, it is destined for LIGO experiments impossible to find gravitational waves [10].

We discuss this problem in detail. Suppose that the interferometer's arm is located along the *y*-axis and the arm along the *x* axis moves in speed V. For an observer who is at rest with the *y*-axis, the length contraction and time delay of the arm along the *x*-axis are

$$x' = x\sqrt{1-V^2/c^2}, \quad t' = t\Big/\sqrt{1-V^2/c^2} \tag{31}$$

Suppose that the period is T' and the frequency is ν' for a light moving along the *x*-axis, we have $\nu'T' = 1$, $\omega' = 2\pi\nu' = 2\pi/T'$, as well as $T' = T\Big/\sqrt{1-V^2/c^2}$ (period is also time). So we have

$$\omega't' = \frac{2\pi t'}{T'} = \frac{2\pi t}{T} = \omega t, \quad k'x' = \frac{2\pi x'}{\lambda'} = \frac{2\pi x}{\lambda} = kx \tag{32}$$

It means that in the rotation processes of Michelson interferometers, the phase $\omega t - kx$ of light is unchanged. In this way, the absolute movement of the earth cannot be observed. The key is that light's speed is unchanged, frequency and wavelength change simultaneously in the processes. But in LIGO experiment, as shown in (2), (3) and (17), due to the fact that the time part of metric is flat but space is curved, light's speed and wavelength had to change when gravitational waves exist. This is just the difference between LIGO experiments and Michelson experiments. But the phases of lights are invariable in both experiments. We can only obtain zero results, so LIGO experiments are destined failed to find gravitational waves.

Let's make further calculation. The speed that the earth moves around the sun is $V = 3\times10^4$ m/s. The length of Michelson interferometer's arm is $L = 10$ m. According to special relativity, the Lorentz contraction of one arm in Michelson experiments is

$$\Delta L = L\left(1-\sqrt{1-V^2/c^2}\right) = L\times V^2\Big/\left(2c^2\right) = 5\times10^{-8}\ \text{m} \tag{33}$$

In LIGO experiment, the length change of arm is about 10^{-18} m, about one 20 billionth times smaller than that in Michelson experiment. Suppose that the shift of interference fringes can be observed in Michelson experiments. According to classical mechanics, the number of fringe shifts is about 0.2. Suppose that IGO experiments can detect the shift of interference fringes caused by gravitational waves, the number of fringe shifts is only one 100 billionth of Michelson experiment. How could LIGO experiments separate such small shifts from strong background noises of environment (including temperature influence) and identified that they were really the effect of gravitational waves?

In fact, LIGO's interferometers are fixed on two huge steel tubes with length 4000 m. The steel tubes are fixed on the surface of the earth under wind and rain. It is impossible to put so huge interferometers in a constant temperature rooms. The tubes are displaced vertically and 4000 m is not an ignorable length. The differences of temperatures exist and change with time frequently. Suppose that at a certain moment, the temperature of one tube changes 0.001 degree in one second. This is a conservative estimation. We calculate its influence on LIGO's experiment.

The expansion coefficient of common steel tube is 1.2×10^{-5} m/degree. When temperature changes 0.001 degree, the change of tube length is $1.2 \times 10^{-5} \times 0.001 \times 4000 \approx 5 \times 10^{-5}$ m in one second. The action time of gravitational wave is 1 second. In this time, the length change of tube caused by gravitational wave is 10^{-18} m. The length change of tube caused by gravitational wave only is 2×10^{-12} times less than that caused by the change of temperature.

What is this concept? It means that LIGO used a ruler of 10 Km to measure the radius of an atom. The length changes caused by temperature completely cover up the length changes caused by gravitational waves. No any reaction can be found when a signal of gravitational wave hit the interferometers of LIGO. LIGO's instrument cannot separate the effect of gravitational waves from temperature's effect. The SNR (signal to noise ratio) of 13 and 24 declaimed by LIGO is only an imaginary value in theory, having nothing to do with practical measurements.

7. Conclusions

In this paper, based on general relativity, we strictly prove that the LIGO experiments neglect two factors. One is the effects of gravitational waves on the wavelengths of light. Another is that light's speed is not a constant when gravitational waves exist. If these factors are considered, no phase shifts or interference fringe's changes can be observed in LIGO experiments by using Michelson interferometers.

In fact, in the laser detectors of gravitational waves, Gaussian beams are commonly used. The propagation speed of Gaussian beam is not a constant too. So the match of signals becomes a big problem without considering these factors in LIGO experiments.

In addition, in Reference [5], X. Mei and P. Yu pointed out that no source of gravitational wave burst was found in LIGO experiments. The so-called detections of gravitational waves were only a kind of computer simulation and image matching. LIGO experiments had not verified general relativity. The argument of LIGO team to verify the Einstein's prediction of gravitational wave was a vicious circle and invalid in logic. The method of numerical relativity to calculate the binary black hole mergers was incredible because too many approximations were involved.

In Reference [11], P. Ulianov indicated that the signals appeared in LIGO experiments may be caused by the changes of frequency in the US power grid. The analysis shows that one of noise sources in LIGO's detectors (32.5 Hz noise source) is connected to the 60 Hz power grid and at GW150914 event. This noise source presents an unusual level change. Besides that, the 32.5 Hz noise waveform is very similar to the gravitational waveform, found in GW150914 event. As LIGO system only monitored the power grid voltage levels without monitoring the 60 Hz frequency changes, this kind of changes over US power grid (that can affect both LIGO's detectors in a same time windows) was not perceived by the LIGO team.

Based on the arguments above, we can conclude that it is impossible for LIGO to detect gravitational waves. What they found may be some noises by some occasional reasons. So called finding of gravitational waves is actually a game of computer simulations and image matching, though it is a very huge and accurate game.

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